IMPORTANT

WARNING/CAUTION/NOTE

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

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

CAUTION:
Indicates a potential hazard that could result in vehicle damage.

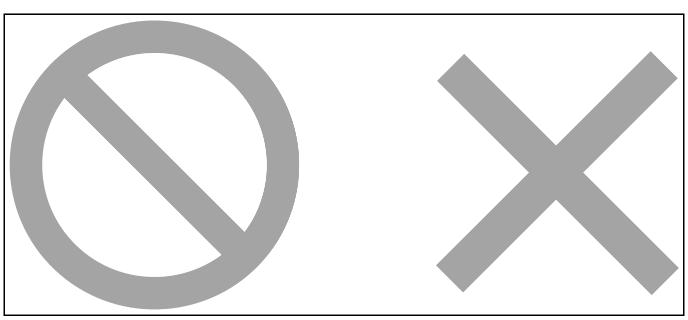
NOTE:
Indicates special information to make maintenance easier or instructions clearer.

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

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

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

The circle with a slash or a cross on illustllation in this manual means "Do not do this" or "Do not let this happen".



Foreword

This SUPPLEMENTARY SERVICE MANUAL is a supplement to RB413 SERVICE MANUAL. It has been prepared exclusively for the following applicable model.

Applicable model: RB410/RB413 of and after the vehicle identification number below.

※ TSM MMA93S00 280001 ※
※ TSM MMA33S00 280001 ※
※ TSM MMB33S00 280001 ※
※ TSM MMA33S40 280001 ※

If describes only different service information of the above applicable model as compared with RB413 SERVICE MANUAL. Therefore, whenever servicing the above applicable model, consult this supplement first. And for any section, item or description not found in this supplement, refer to the related service manual below.

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

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

RELATED MANUAL:

Manual Name	Manual No.
RB413 SERVICE MANUAL	99500-83E00-01E
Wagon R+ (RB413) SUPPLEMENTARY SERVICE MANUAL	99501-83E00-01E
RB310 SERVICE MANUAL	99500-83E10-01E
Wagon R+ (RB310/RB413) SUPPLEMENTARY SERVICE MANUAL	99501-83E10-01E
Wagon R+ (RB310/RB413) SUPPLEMENTARY SERVICE MANUAL	99501-83E20-01E
RB310/413 WIRING DIAGRAM MANUAL	99512-83E30-669

SUZUKI MOTOR CORPORATION

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NOTE:

For the screen toned sections in the above table, refer to the same section of Service Manual mentioned in FOREWORD of this manual.

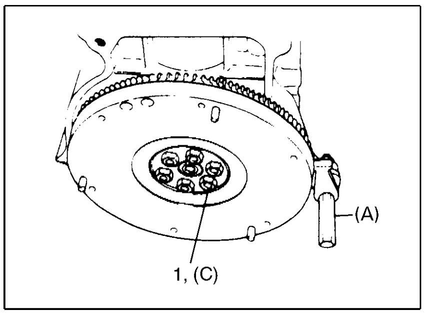
SECTION 0A

GENERAL INFORMATION

CONTENTS

How to Use This Manual

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



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

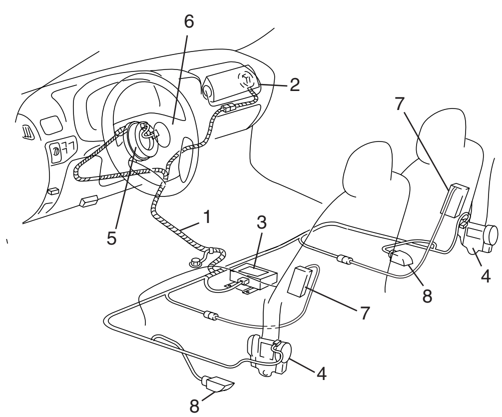
Special Tool
(A) : 09924-17810

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

4) A number of abbreviations and symbols are used in the text. For their full explanations, refer to “Abbreviations and Symbols May Be Used In This Manual” in this section.
5) The SI, metric and foot-pound systems are used as units in this manual.
6) “Diagnosis” are included in each section as necessary.
7) At the end of each section, there are descriptions of “Special Tool”, “Required Service Material” and “Tightening Torque Specification” that should be used for the servicing work described in that section.

Precautions

Precaution for Vehicles Equipped with a Supplemental Restraint (Air Bag) System



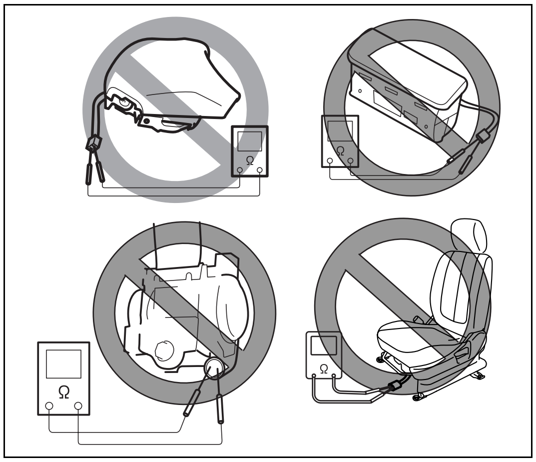
WARNING:

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

1. Air bag wire harness (in instrument panel harness)	5. Contact coil
2. Passenger air bag (inflator) module (if equipped)	6. Driver air bag (inflator) module
3. SDM	7. Side air bag (inflator) module (if equipped)
4. Seat belt pretensioner	8. Side sensor (if equipped)

Diagnosis

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



WARNING:

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

Servicing and handling

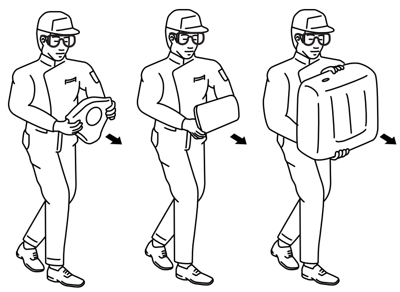
WARNING:

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

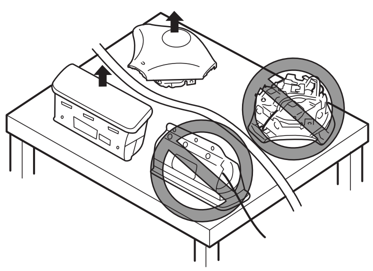
Driver, Passenger and side Air Bag (Inflator) Modules

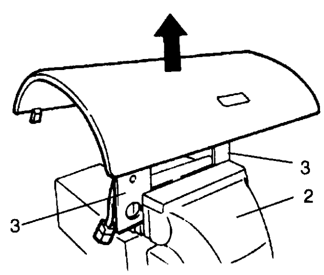
- **For handling and storage of a live air bag (inflator) module, select a place where the ambient temperature below 65 °C (150 °F), without high humidity and away from electric noise.**
- **When carrying a live air bag (inflator) module, make sure the bag opening is pointed away from you. In case of an accidental deployment, the bag will then deploy with minimal chance of injury. Never carry the air bag (inflator) module by the wires or connector on the underside of the module. When placing a live air bag (inflator) module on a bench or other surface, always face the bag up, away from the surface. As the live passenger air bag (inflator) module must be placed with its bag (trim cover) facing up, place it on the workbench with a slit (1) or use the workbench vise (2) to hold it securely at its lower mounting bracket (3). The front seat back with the live air bag (inflator) module must be placed with its frontal seat cover facing up. It is also prohibited to place anything on top of the trim cover and stack air bag (inflator) modules. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Otherwise, personal injury may result.**
- **Never dispose of live (undeployed) air bag (inflator) modules (driver, passenger and side). If disposal is necessary, be sure to deploy them according to deployment procedures described in Section 10B before disposal.**
- **The air bag (inflator) module immediately after deployment is very hot. Wait for at least half an hour to cool it off before proceeding the work.**
- **After an air bag (inflator) module has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and by-products of the chemical reaction. As with many service procedures, gloves and safety glasses should be worn.**

[A]

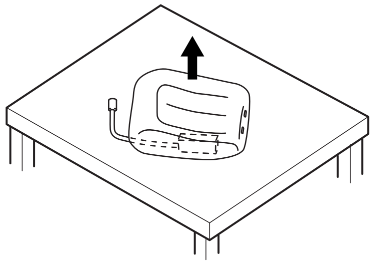


[B]





[C]



[A]:	Always carry air bag (inflator) module with trim cover (air bag opening) away from body.
[B]:	Always place air bag (inflator) module on workbench with trim cover (air bag opening) up, away from loose objects.
[C]:	Always place with its frontal seat cover facing up, away from loose objects.

WARNING:

SDM

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

WARNING:

Driver and Passenger Seat Belt Pretensioners (If equipped)

- **For handling and storage of a live seat belt pretensioner, select a place where the ambient temperature below 65°C (150°F), without high humidity and away from electric noise.**
- **Never carry seat belt pretensioner by wire or connector of pretensioner. When placing a live seat belt pretensioner on the workbench or some place like that, never put something on seat belt pretensioner. Otherwise, personal injury may result.**
- **Never dispose of live (inactivated) seat belt pretensioners (drive and passenger). If disposal is necessary, be sure to activate them according to activation procedures described in Section 10B before disposal.**
- **The seat belt pretensioner immediately after activation is very hot. Wait for at least half an hour to cool it off before proceeding the work.**
- **With many service procedures, gloves and safety glasses should be worn to prevent any possible irritation of the skin or eyes.**

- **Even when the accident was light enough not to cause air bags to activate, be sure to inspect system parts and other related parts according to instructions under "Repair and Inspection Required After an Accident" in Section 10B.**
- **When servicing parts other than air bag system, if shocks may be applied to air bag system component parts, remove those parts beforehand.**
- **When handling the air bag (inflator) modules (driver, passenger and side), seat belt pretensioners (driver and passenger), side sensors or SDM, be careful not to drop it or apply an impact to it. If an excessive impact was applied, never attempt disassembly or repair but replace it with a new one.**
- **When grease, cleaning agent, oil, water, etc. has got onto air bag (inflator) modules (driver, passenger and side) or seat belt pretensioners (drive and passenger), wipe off immediately with a dry cloth.**
- **Air bag wire harness is included in floor and instrument panel wire harnesses. Air bag wire harness branched off from floor and instrument panel wire harnesses can be identified easily as it is covered with a yellow protection tube and it has yellow connectors. Be very careful when handling it.**
- **When an open in air bag wire harness, damaged wire harness, connector or terminal is found, replace wire harness, connectors and terminals as an assembly.**
- **Do not apply power to the air bag system unless all components are connected or a diagnostic chart requests it, as this will set a diagnostic trouble code.**
- **Never use air bag system component parts from another vehicle.**
- **When using electric welding, be sure to disconnect all air bag (inflator) module connectors and pretensioner connectors from air bag wire harness respectively.**
- **Never expose air bag system component parts directly to hot air (drying or baking the vehicle after painting) or flames.**

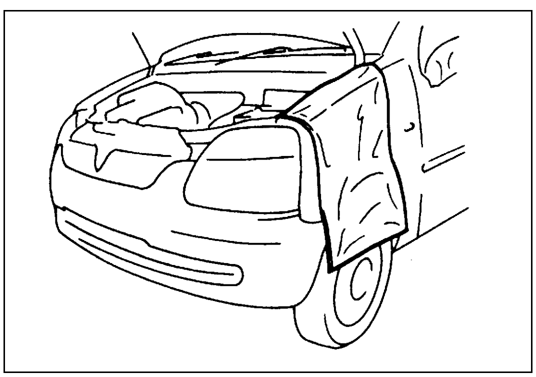
- **WARNING / CAUTION labels are attached on each part of air bag system components. Be sure to follow the instructions.**
- **After vehicle is completely repaired, perform "Air Bag Diagnostic System Check" in Section 10B.**

General Precautions

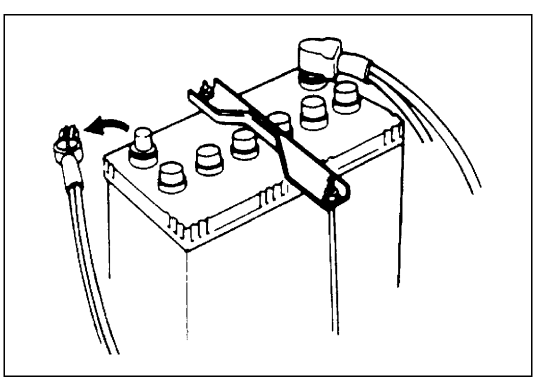
The WARNING and CAUTION below describe some general precautions that you should observe when servicing a vehicle. These general precautions apply to many of the service procedures described in this manual, and they will not necessarily be repeated with each procedure to which they apply.

WARNING:

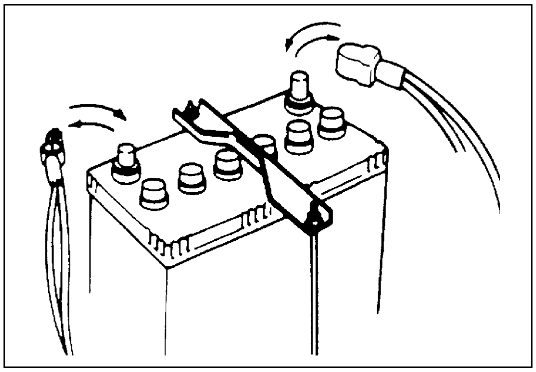
- **Whenever raising a vehicle for service, be sure to follow the instructions under "Vehicle Lifting Points" in this section.**
- **When it is necessary to do service work with the engine running, make sure that the parking brake is set fully and the transmission is in Neutral (for manual transmission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



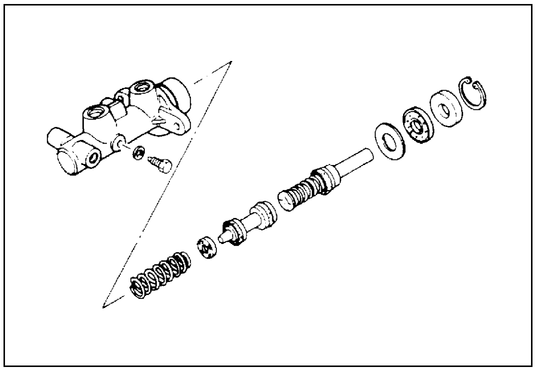
- **Before starting any service work, cover fenders, seats and any other parts that are likely to get scratched or stained during servicing. Also, be aware that what you wear (e.g, buttons) may cause damage to the vehicle's finish.**



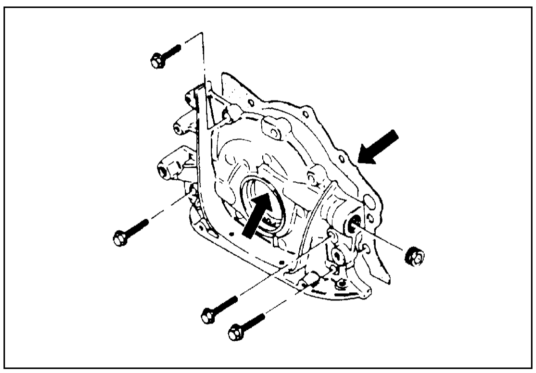
- **When performing service to electrical parts that does not require use of battery power, disconnect the negative cable of the battery.**
- **When disconnecting the battery negative cable, record displayed contents of clock and audio system before disconnecting and reset them as before after connecting.**



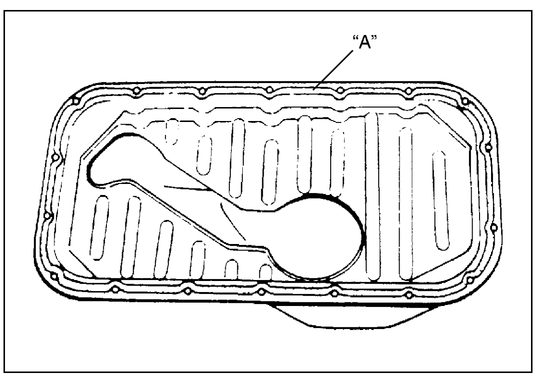
- When removing the battery, be sure to disconnect the negative cable first and then the positive cable. When reconnecting the battery, connect the positive cable first and then the negative cable, and replace the terminal cover.



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

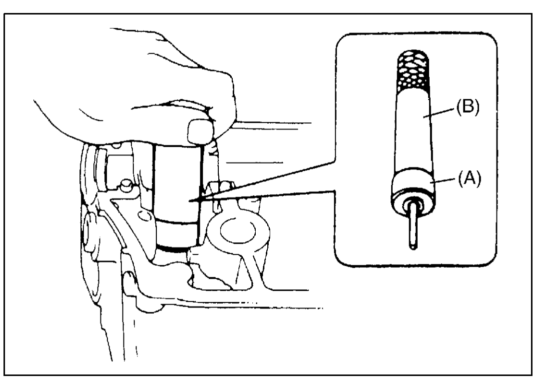


- Whenever you use oil seals, gaskets, packing, O-rings, locking washers, split pins, self-locking nuts, and certain other parts as specified, be sure to use new ones. Also, before installing new gaskets, packing, etc., be sure to remove any residual material from the mating surfaces.



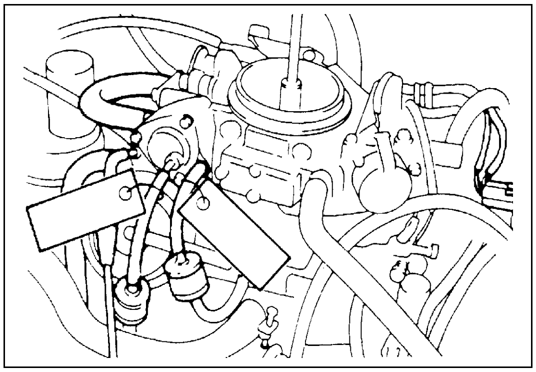
- Make sure that all parts used in reassembly are perfectly clean.
  When use of a certain type of lubricant, bond or sealant is specified, be sure to use the specified type.

"A": Sealant 99000-31250

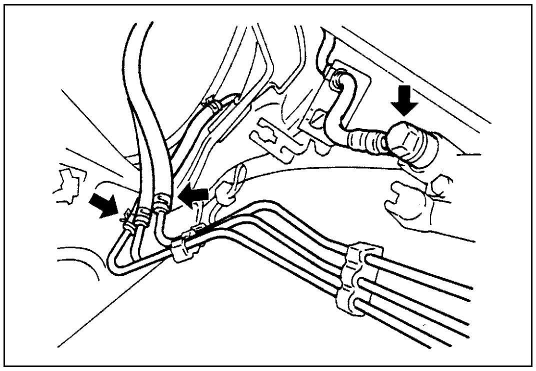


- Be sure to use special tools when instructed.

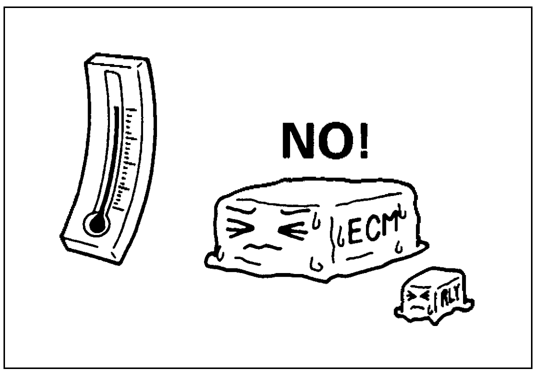
Special tool
(A): 09917-98221
(B): 09916-58210



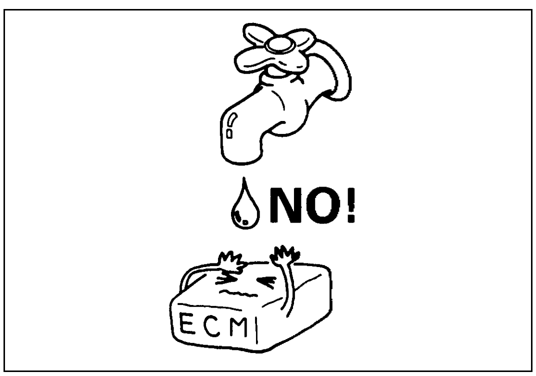
- **When disconnecting vacuum hoses, attach a tag describing the correct installation positions so that the hoses can be reinstalled correctly.**



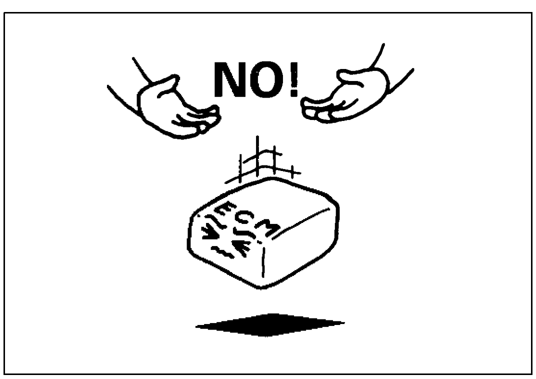
- **After servicing fuel, oil, coolant, vacuum, exhaust or brake systems, check all lines related to the system for leaks.**
- **For vehicles equipped with fuel injection systems, never disconnect the fuel line between the fuel pump and injector without first releasing the fuel pressure, or fuel can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



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

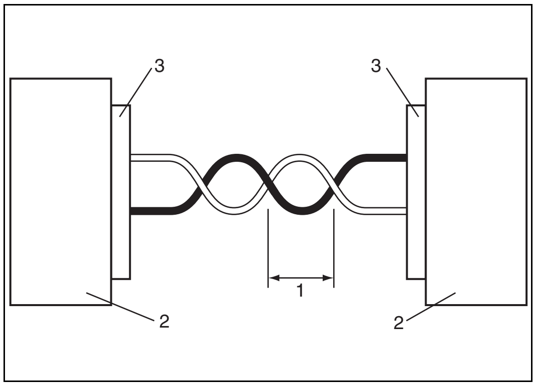


- **Use care not to expose connectors and electrical parts to water which will be a cause of a trouble.**



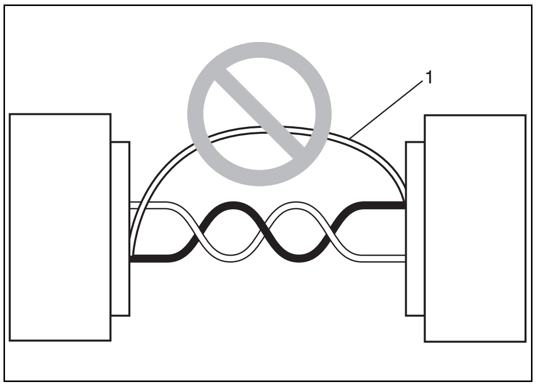
- **Always be careful not to handle electrical parts (computer, relay, etc.) in a rough manner or drop them.**

Precaution for CAN Communication System



- The loose (1) in the wire harnesses twist of the CAN lines except around the connector (3) should be within 100 mm (3.9 in.) Refer to the wiring diagram for the CAN line discrimination. Excessive loosed lines may be influenced by the electric noise.

2. Controller



- Do not connect terminals of the CAN line using a bypass wire (1). Otherwise, the CAN line may be influenced by the electric noise.

Precaution for Wheel (with Tire) Removal

Each wheel of this vehicle is installed using wheel bolts. When removing any of these wheels, never remove all wheel bolts at the same time. Leave at least 1 bolt for each wheel as it is to prevent wheel from dropping. When removing this remaining 1 bolt, hold wheel and tire so as not to allow them to come off.

Precautions for Catalytic Converter

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

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

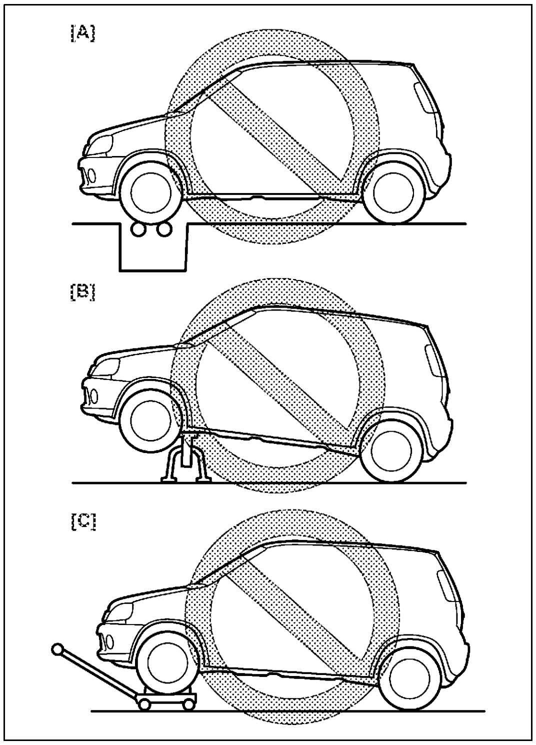
Precaution for Installing Mobile Communication Equipment

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

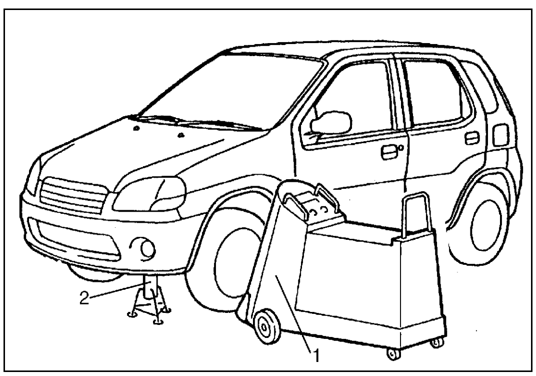
- **Keep the antenna as far away as possible from the vehicle's electronic control unit.**
- **Keep the antenna feeder more than 20 cm (7.9 in) away from electronic control unit and its wire harnesses.**
- **Do not run the antenna feeder parallel with other wire harnesses.**
- **Confirm that the antenna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

Precaution in Servicing Full-Time 4WD Vehicle

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

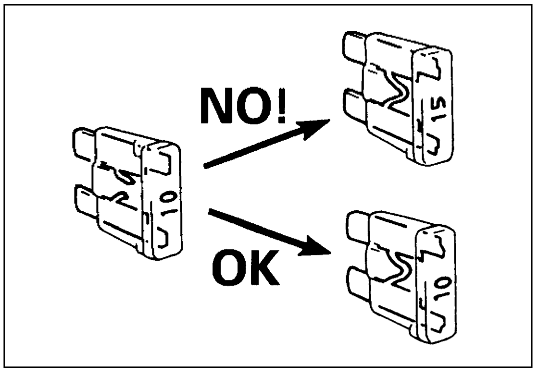


- **Never perform any of the following types of service work.**
  [A]: Testing with 2-wheel chassis dynamometer, speedometer tester or brake tester.
  [B]: Driving front wheels, which are jacked up.
  [C]: Towing under the condition where either front or rear wheels can not rotate.
- **When testing with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

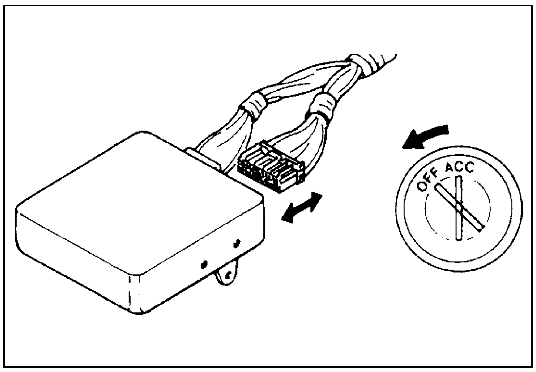


- **When using On-vehicle type wheel balancing equipment (1), be sure to jack up all four wheels, off the ground completely and support vehicle with safety stands (2).**
  Be careful of the other wheels, which will rotate at the same time.
- **This vehicle should be towed under one of the following conditions:**
  - **With all wheels on a flatbed truck.**
  - **With front or rear wheels lifted and a dolly under the other wheels.**

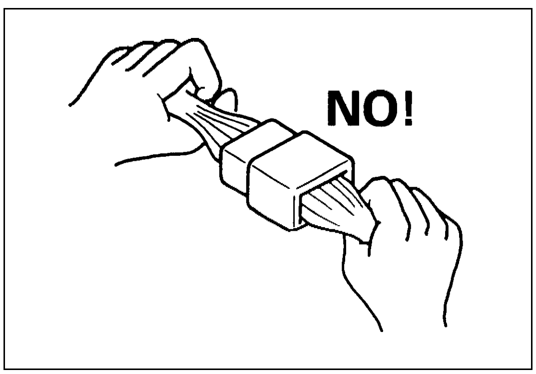
Precautions for Electrical Circuit Service



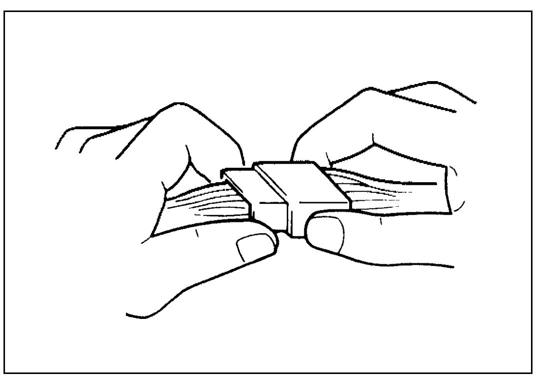
- **When replacing a fuse, make sure to use a fuse of the specified capacity. Use of a fuse with a larger capacity will cause a damage to the electrical parts and a fire.**



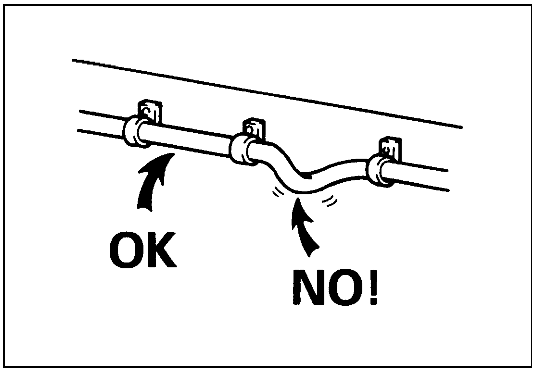
- **When disconnecting and connecting coupler, make sure to turn ignition switch OFF, or electronic parts may get damaged.**



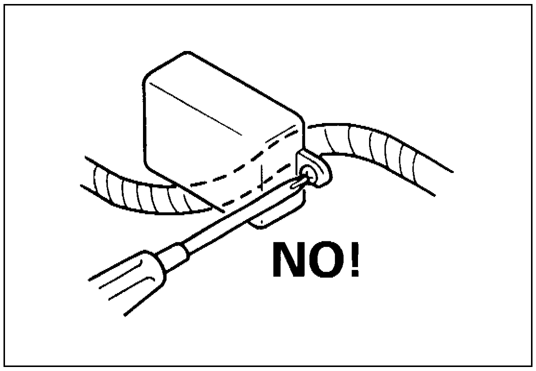
- **When disconnecting connectors, never pull the wiring harness. Unlock the connector lock first and then pull them apart by holding connectors themselves.**



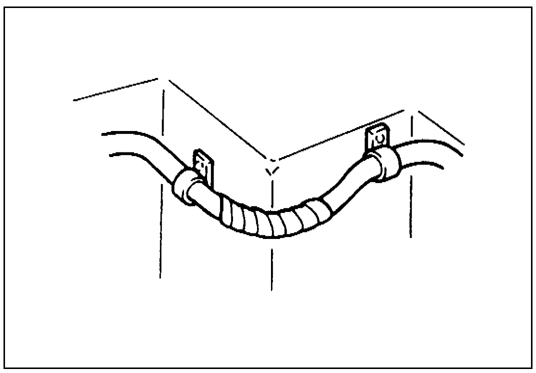
- **When connecting connectors, also hold connectors and put them together until they lock securely (a click is heard).**



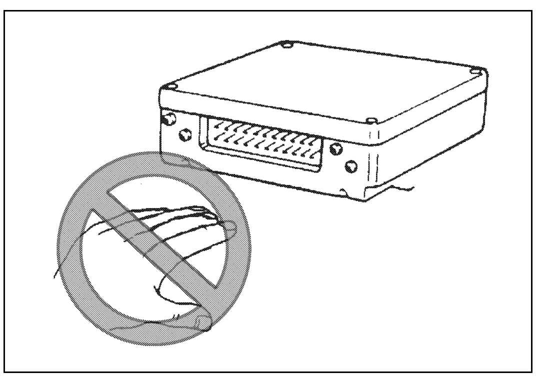
- When installing the wiring harness, fix it with clamps so that no slack is left.



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



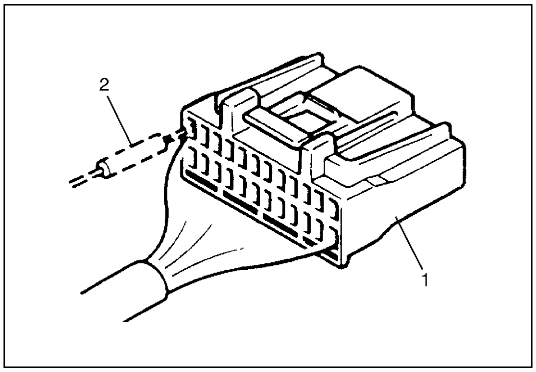
- To avoid damage to the harness, protect its part which may contact against a part forming a sharp angle by winding tape or the like around it.



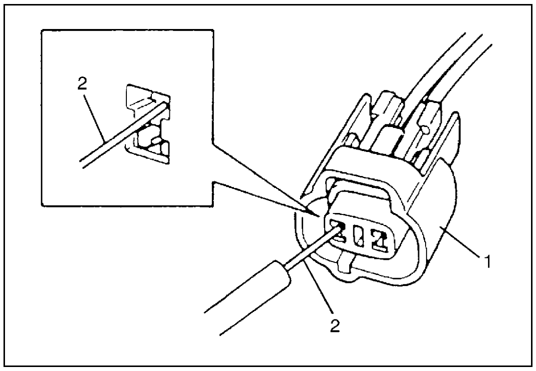
- Be careful not to touch the electrical terminals of parts which use microcomputers (e.g. electronic control unit like as ECM, PCM, P/S controller, etc.). The static electricity from your body can damage these parts.
- Never connect any tester (voltmeter, ohmmeter, or whatever) to electronic control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

- Never connect an ohmmeter to electronic control unit with its coupler connected to it. Attempt to do it may cause damage to electronic control unit and sensors.

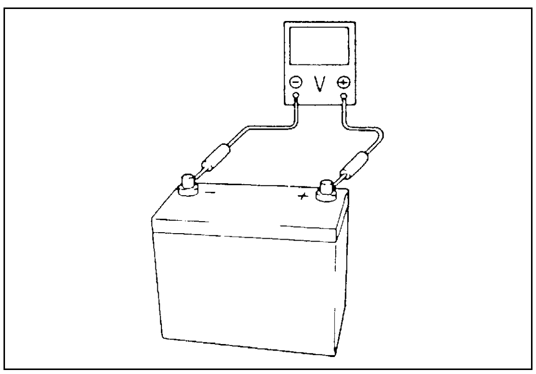
- Be sure to use a specified voltmeter/ohmmeter. Otherwise, accurate measurements may not be obtained or personal injury may result. If not specified, use a voltmeter with high impedance (MΩ / V minimum) or a digital type voltmeter.



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



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



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

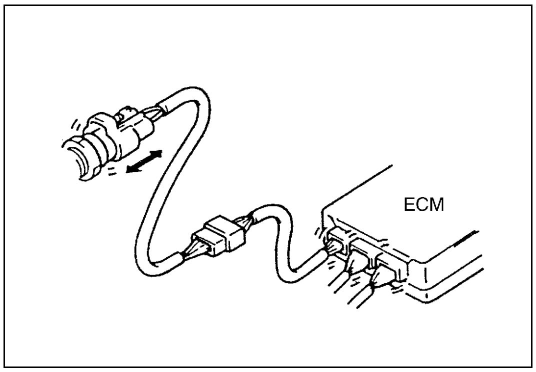
Electrical Circuit Inspection Procedure

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

Open circuit check

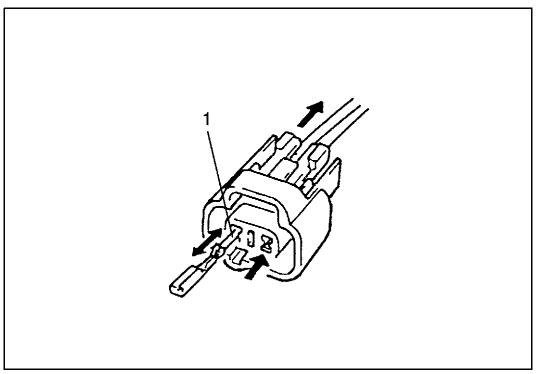
Possible causes for the open circuit are as follows. As the cause is in the connector or terminal in many cases, they need to be checked particularly carefully.

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



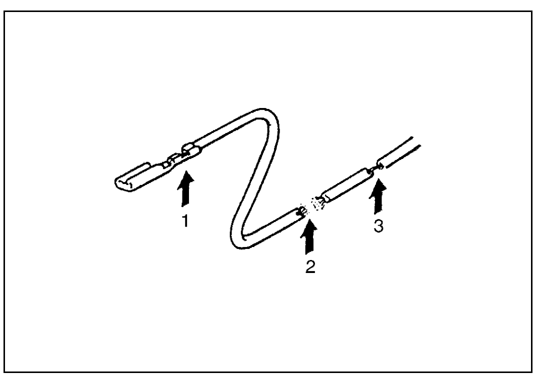
When checking system circuits including an electronic control unit such as ECM, TCM, ABS control module, etc., it is important to perform careful check, starting with items which are easier to check.

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



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

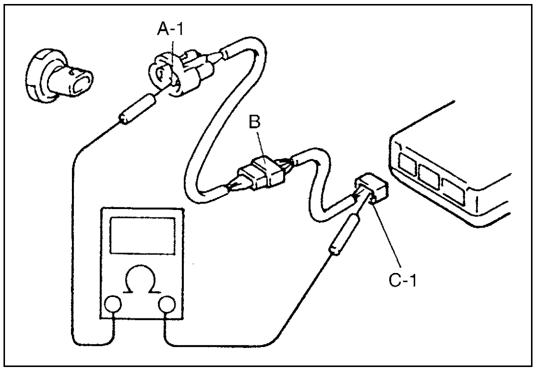
1. Check contact tension by inserting and removing just for once.



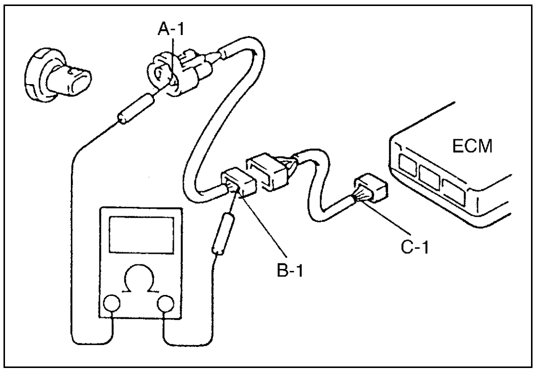
4) Using continuity check or voltage check the following procedure, check the wire harness for open circuit and poor connection with its terminals. Locate abnormality, if any.

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

Continuity check



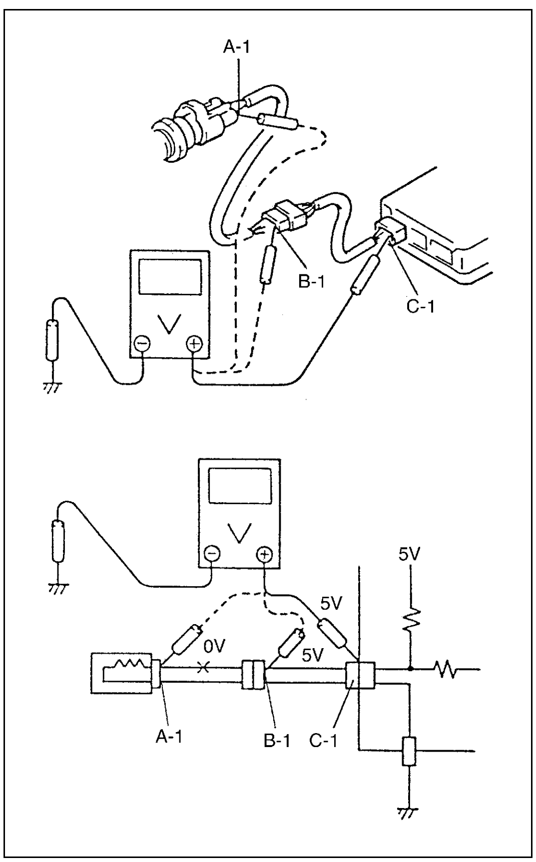
1) Measure resistance between connector terminals at both ends of the circuit being checked (between A-1 and C-1 in the figure). If no continuity is indicated (infinity or over limit), that means that the circuit is open between terminals A-1 and C-1.



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

Voltage check

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



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

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

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

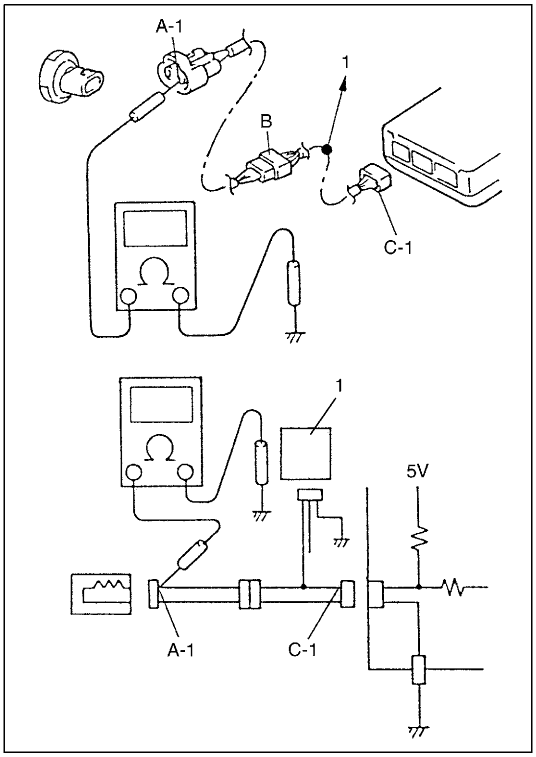
Voltage between
C-1 and body ground: Approx. 5 V
B-1 and body ground: Approx. 5 V
A-1 and body ground: Approx. 3 V

Short circuit check (wire harness to ground)

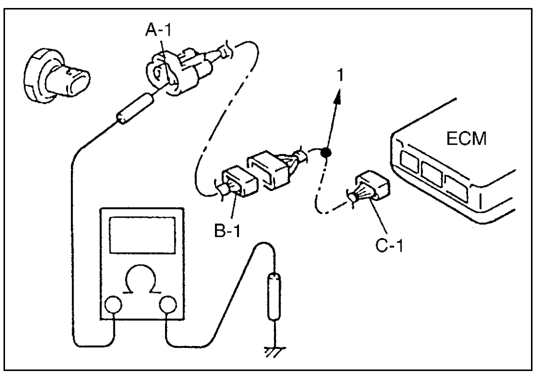
1) Disconnect negative (–) cable at battery.
2) Disconnect connectors at both ends of the circuit to be checked.

NOTE:

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



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

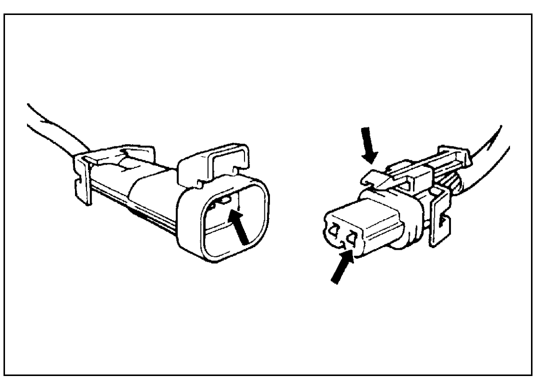


4) Disconnect the connector included in circuit (connector B) and measure resistance between A-1 and body ground.
   If continuity is indicated, it means that the circuit is shorted to the ground between terminals A-1 and B-1.

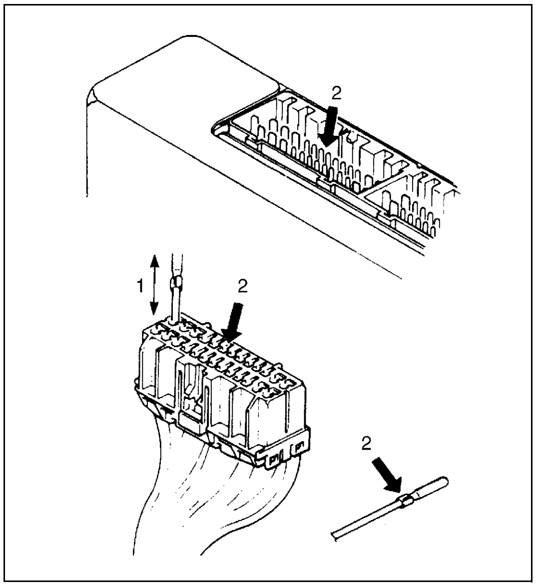
1. To other parts

Intermittent and Poor Connection

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

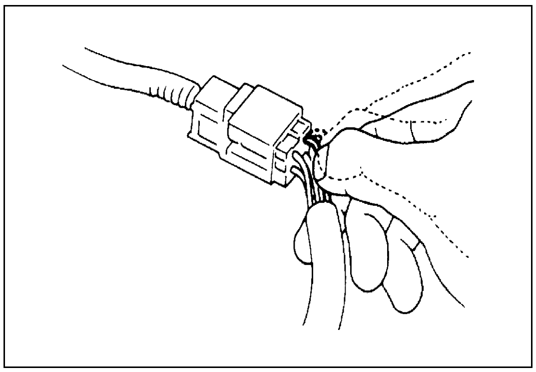


- Poor mating of connector halves, or terminals not fully seated in the connector body (backed out).
- Dirt or corrosion on the terminals. The terminals must be clean and free of any foreign material which could impede proper terminal contact. However, cleaning the terminal with a sand paper or the like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

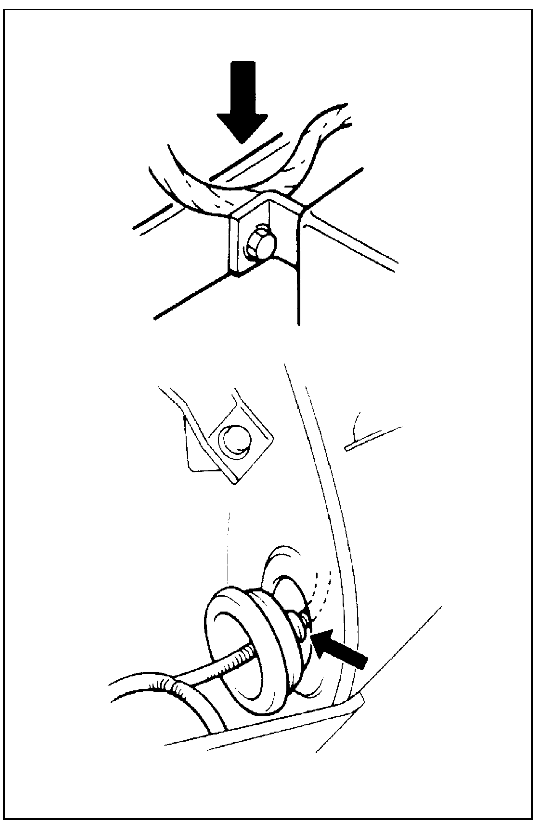


- Improperly formed or damaged terminals.
  Check each connector terminal in problem circuits carefully to ensure good contact tension by using the corresponding mating terminal.
  If contact tension is not enough, reform it to increase contact tension or replace.

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



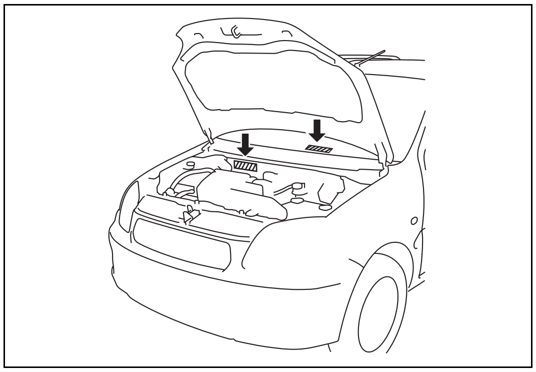
- Poor terminal-to-wire connection.
  Check each wire harness in problem circuits for poor connection by shaking it by hand lightly. If any abnormal condition is found, repair or replace.



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

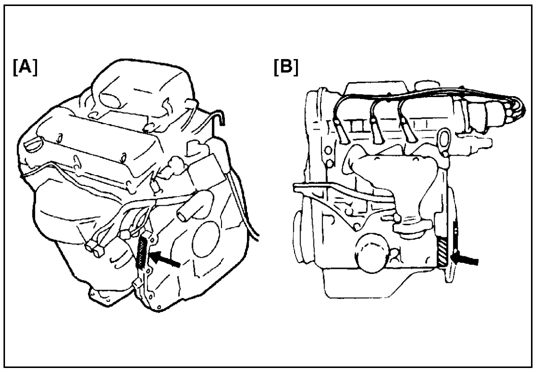
Identification Information

Vehicle Identification Number



The number is punched on front dash panel in engine room and it is also on the left side of instrument panel depending on the vehicle specification.

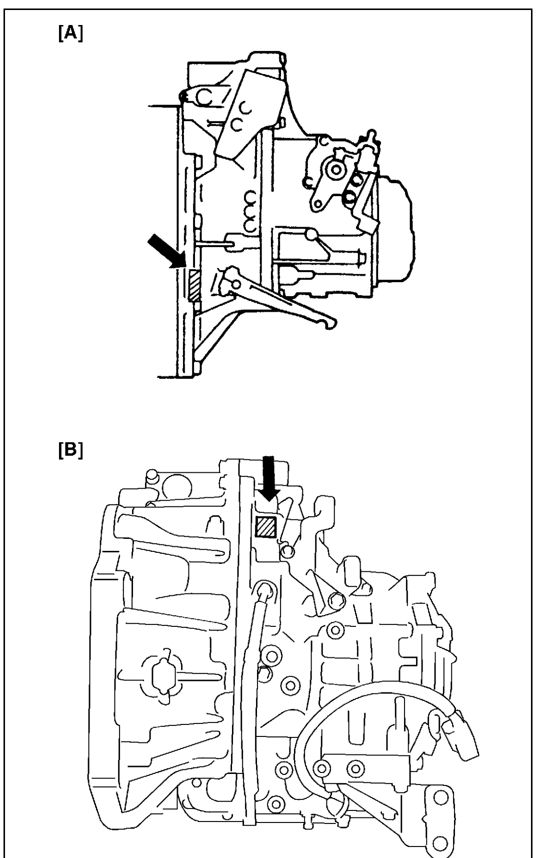
Engine Identification Number



The number is punched on cylinder block.

1.	M13 engine
2.	G10 engine

Transmission Identification Number

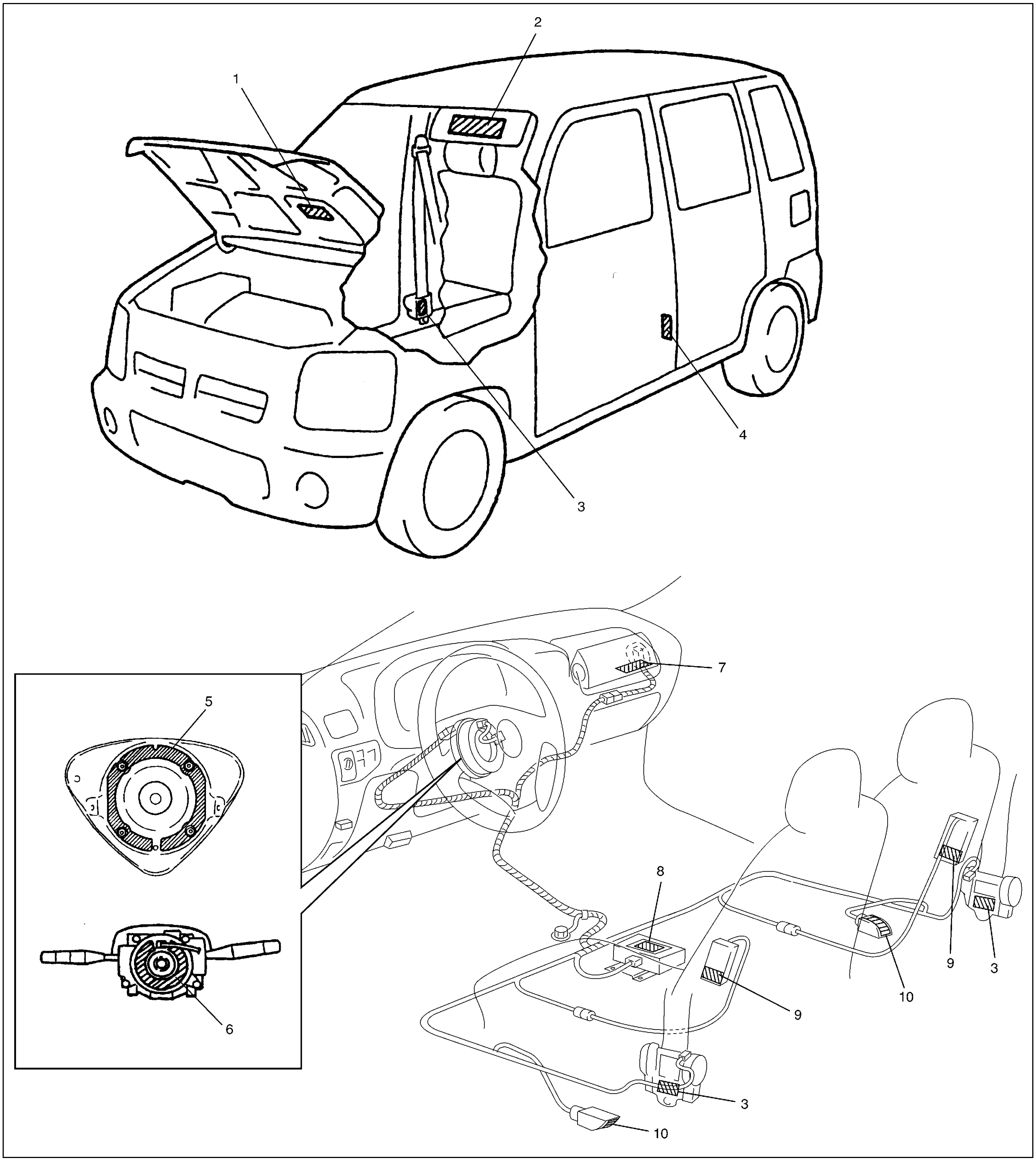


The number is located on the transmission case.

[A]:	M/T for G10 engine
[B]:	A/T for M13 engine

Warning, Caution and Information Labels

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



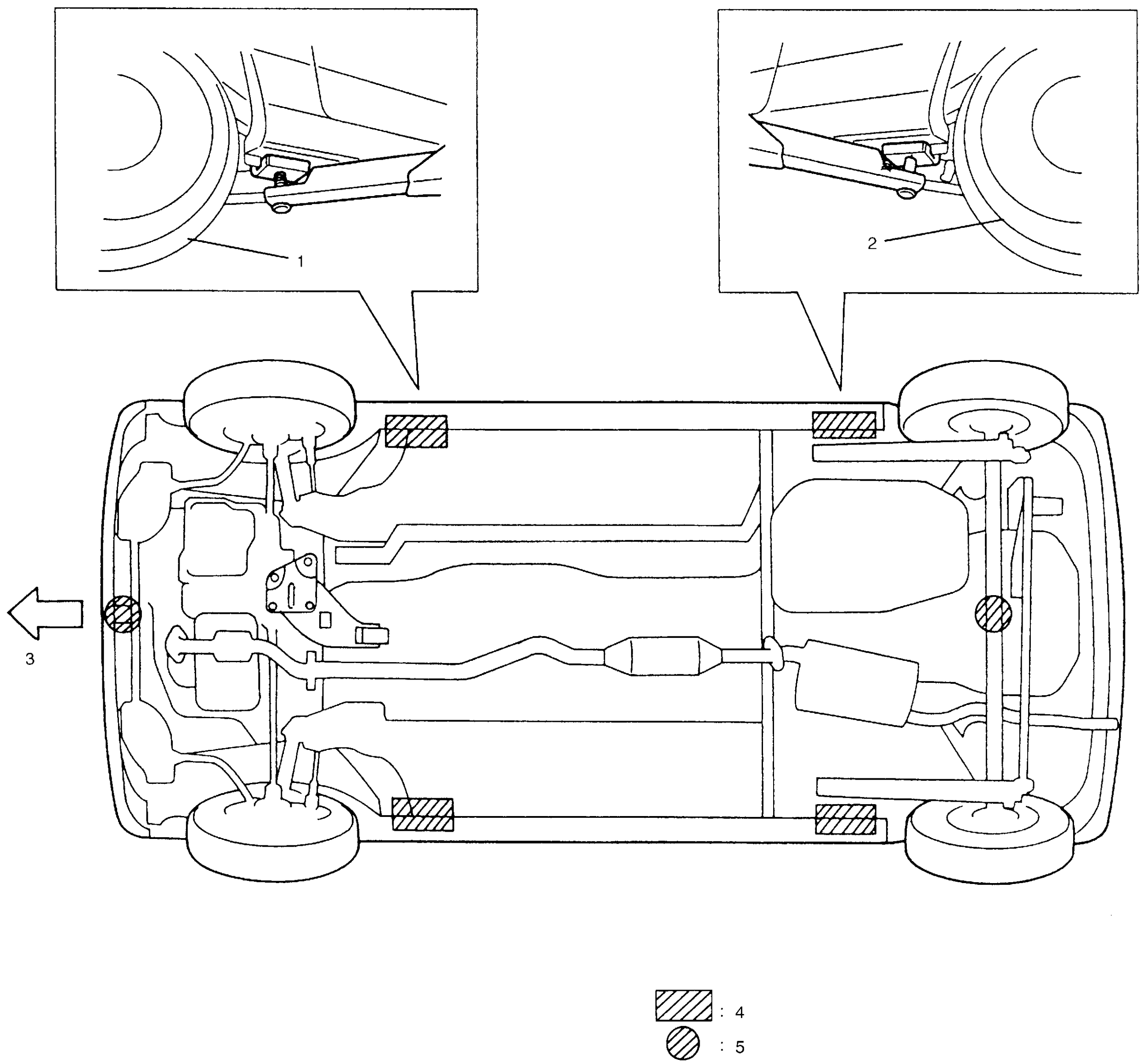
1. Air bag caution label on back side of engine hood	6. Air bag caution label on combination switch and contact coil assembly
2. Air bag caution label on sun visor (for vehicle with air bag system)	7. Air bag caution label on passenger air bag (inflator) module
3. Pretensioner label on seat belt retractor	8. Air bag caution label on SDM
4. Tire information placard	9. Air bag caution label on side air bag (inflator) module
5. Air bag caution label on driver air bag (inflator) module	10. Side sensor caution label

Vehicle Lifting Points

WARNING:

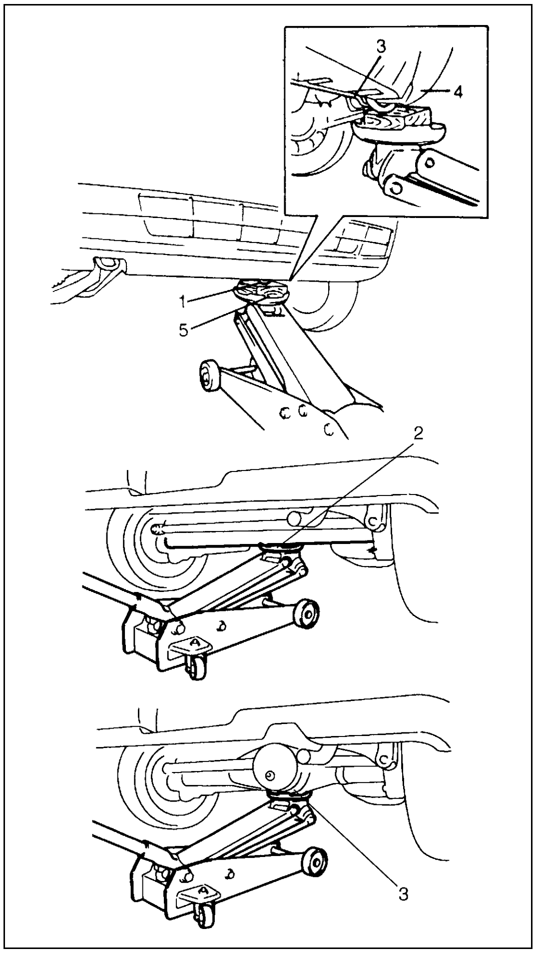
- **Before applying hoist to underbody, always take vehicle balance throughout service into consideration. Vehicle balance on hoist may change depending on what part to be removed.**
- **Before lifting up the vehicle, check to be sure that end of hoist arm is not in contact with brake pipe, fuel pipe,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

When using frame contact hoist



1. Front left tire	4. Support position for frame contact hoist and safety stand
2. Rear left tire	5. Floor jack position
3. Vehicle front	

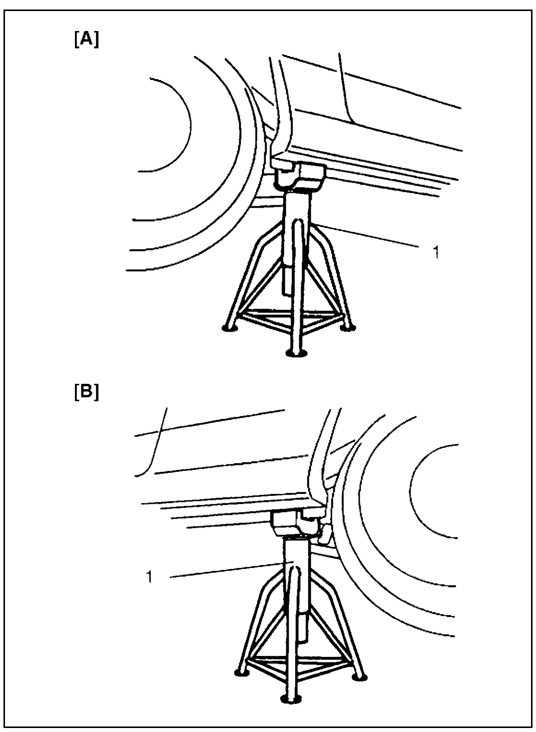
When using floor jack



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

> **CAUTION:**
> **Never apply jack against suspension parts (i.e., stabilizer (3), etc.), front bumper (4) or vehicle floor, or it may get deformed.**

When lifting front vehicle end with floor jack, be sure to put the wooden block (5) on the jack against front jacking bracket (1).
When lifting rear vehicle end with floor jack, be sure to put the jack against the center portion of rear axle (2) (2WD vehicle) or rear axle housing (6) (4WD vehicle).



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

[A]:	Front
[B]:	Rear

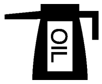
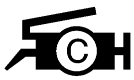
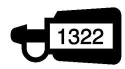
Abbreviations and Symbols May be Used in This Manual

Abbreviations

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

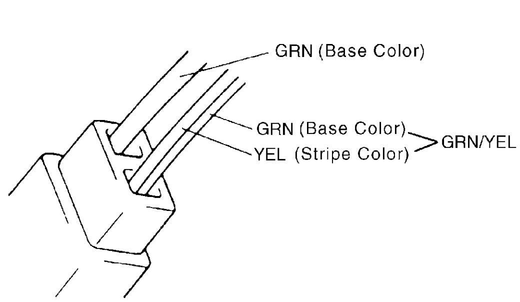
P	PSP Switch	Power Steering Pressure Switch (P/S Pressure Switch)
	PCM	Powertrain Control Module
	PCV	Positive Crankcase Ventilation
R	RH	Right Hand
S	SAE	Society of Automotive Engineers
	SDM	Sensing and Diagnostic Module (Air bag controller, Air bag control module)
	SFI	Sequential Multiport Fuel Injection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

Symbols

SYMBOL	DEFINITION	SYMBOL	DEFINITION
	Tightening torque		Apply SEALANT 1216B 99000-31230
	Apply oil (engine, transmission, transfer, differential)		Apply SILICONE SEALANT 99000-31120
	Apply fluid (brake, power steering or automatic transmission fluid)		Apply SEALING COMPOUND 366E 99000-31090
	Apply GREASE A 99000-25010		
	Apply GREASE C 99000-25030		Apply THREAD LOCK 1322 99000-32110
	Apply GREASE E 99000-25050		Apply THREAD LOCK 1333B 99000-32020
	Apply GREASE H 99000-25120		Apply THREAD LOCK 1342 99000-32050
	Apply GREASE I 99000-25210		
	Apply SEALANT 1215 99000-31110		Do not reuse
	Apply SEALANT 1207F 99000-31250		Note on reassembly

Wire Color Symbols

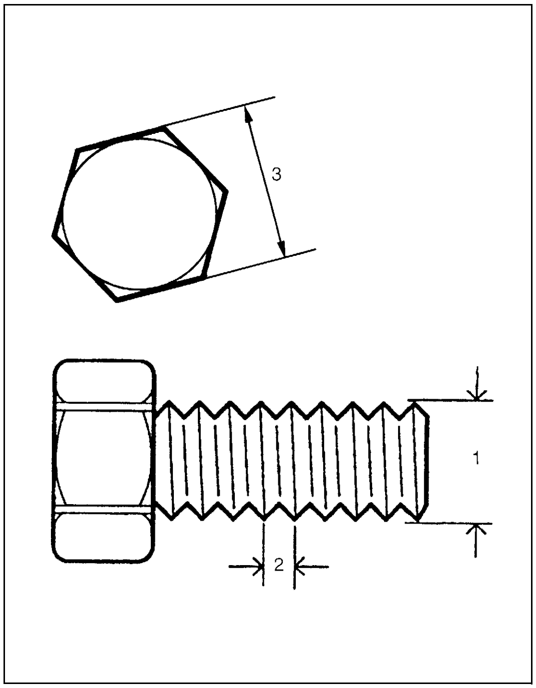
Symbol		Wire Color	Symbol		Wire Color
B	BLK	Black	O, Or	ORN	Orange
Bl	BLU	Blue	R	RED	Red
Br	BRN	Brown	W	WHT	White
G	GRN	Green	Y	YEL	Yellow
Gr	GRY	Gray	P	PNK	Pink
Lbl	LT BLU	Light blue	V	PPL	Violet
Lg	LT GRN	Light green			



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

Fastener Information

Metric Fasteners Information



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

> **CAUTION:**
> **Even when the nominal diameter (1) of thread is the same, the thread pitch (2) or the width across flats (3) may vary between ISO and JIS. Refer to JIS-TO-ISO Main Fasteners Comparison Table below for the difference.**
> **Installing a mismatched bolt or nut will cause damage to the thread.**
> **Before installing, check the thread pitch for correct matching and then tighten it by hand temporarily. If it is tight, recheck the thread pitch.**

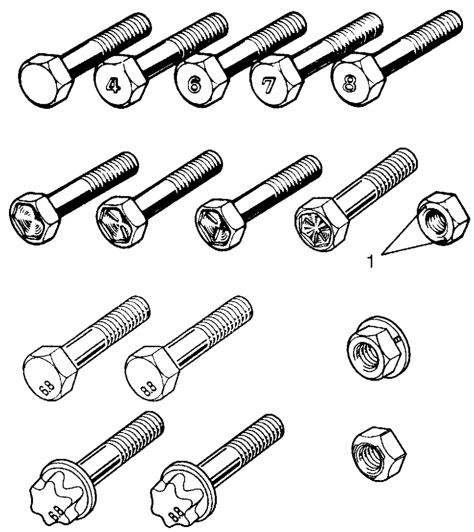
JIS-TO-ISO Main Fasteners Comparison Table

Standard \ Nominal diameter		M6	M8	M10	M12	M14
JIS	Thread pitch	1.0	1.25	1.25	1.25	1.5
	Width across flats	10	12	14	17	19
ISO	Thread pitch	1.0	1.25	1.5	1.5	1.5
	Width across flats	10	13	16	18	21

Fastener Strength Identification

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

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



1. Nut strength identification

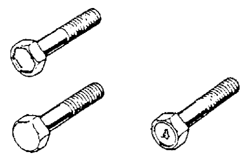
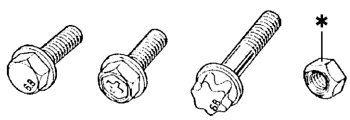
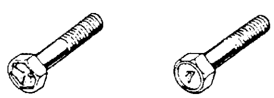
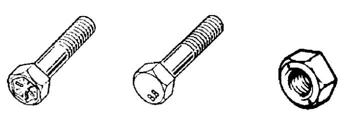
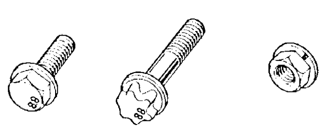
Standard Tightening Torque

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

NOTE:

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

Tightening torque chart:

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

*: Self-lock nut

SECTION 0B

MAINTENANCE AND LUBRICATION

WARNING:

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

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

CONTENTS

Maintenance Schedule

Maintenance Schedule Under Normal Driving Conditions

NOTE:

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

Interval		Km (x 1,000)	15	30	45	60	75	90
		Miles (x 1,000)	9	18	27	36	45	54
		Months	12	24	36	48	60	72
ENGINE								
Drive belt			–	–	I	–	–	R
Camshaft timing belt (G10 engine)			Replace every 100,000 km (60,000 miles)					
Valve lash (clearance) (M13 engine)			–	I	–	I	–	I
Engine oil and oil filter		When SG, SH, SJ, or SL grade oil is used.	R	R	R	R	R	R
Engine coolant			–	R	–	R	–	R
Exhaust system			–	I	–	I	–	I
IGNITION SYSTEM								
✱Spark plugs	When unleaded fuel is used	M13 engine — Iridium plug	Replace every 105,000 km (63,000 miles) or 84 months					
		G10 engine	–	–	R	–	–	R
	When leaded fuel is used, refer to “Maintenance Recommended Under Severe Driving Cond-tion” in this section.							
Distributor cap and rotor (G10 engine)			–	–	I	–	–	I
FUEL SYSTEM								
Air cleaner filter		Paved-road	I	I	R	I	I	R
		Dusty conditions	Refer to “Maintenance Recommended Under Severe Driving Conditions” in this section.					
Fuel lines and connections			–	I	–	I	–	I
Fuel tank			–	–	I	–	–	I
EMISSION CONTROL SYSTEM								
✱PCV valve			–	–	–	–	–	I
✱Fuel evaporative emission control system			–	–	–	–	–	I

NOTE:

- **“R”: Replace or change**
- **“I”: Inspect and correct, replace or lubricate if necessary**
- **For Sweden, items with ✱ (asterisk) should be performed by odometer reading only.**
- **For spark plugs, replace every 50,000 km if the local law requires.**
- **Iridium spark plug: IFR6J11 (NGK)**
- **For camshaft timing belt (G10 engine), it may be replaced every 90,000 km (54,000 miles) according to customer’s maintenance convenience.**

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

NOTE:

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

Maintenance Recommended Under Severe Driving Conditions

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

Severe condition code:

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

<table>
<tr><th>Severe Condition Code</th><th colspan="2">Maintenance</th><th>Maintenance Operation</th><th>Maintenance Interval</th></tr>
<tr><td rowspan="2">– B C D – – – –</td><td rowspan="2" colspan="2">Drive belt</td><td>I</td><td>Every 15,000 km (9,000 miles) or 12 months</td></tr>
<tr><td>R</td><td>Every 45,000 km (27,000 miles) or 36 months</td></tr>
<tr><td>A – C D E F – H</td><td colspan="2">Engine oil and oil filter</td><td>R</td><td>Every 5,000 km (3,000 miles) or 4 months</td></tr>
<tr><td rowspan="2">– – C – – – – –</td><td rowspan="2" colspan="2">Air cleaner filter ∗1</td><td>I</td><td>Every 2,500 km (1,500 miles)</td></tr>
<tr><td>R</td><td>Every 30,000 km (18,000 miles) or 24 months</td></tr>
<tr><td rowspan="2">A B C – E F – H</td><td rowspan="2">Spark plugs</td><td>Iridium spark plug of M13 engine</td><td>R</td><td>Every 30,000 km (18,000 miles) or 24 months</td></tr>
<tr><td>G10 engine</td><td>R</td><td>Every 10,000 km (6,000 miles) or 8 months</td></tr>
<tr><td>– B C D – – – H</td><td colspan="2">Wheel bearings</td><td>I</td><td>Every 15,000 km (9,000 miles) or 12 months</td></tr>
<tr><td>– B – D E – – H</td><td colspan="2">Drive shafts and propeller shafts (4WD)</td><td>I</td><td>Every 15,000 km (9,000 miles) or 12 months</td></tr>
<tr><td rowspan="2">– B – – E – – H</td><td rowspan="2" colspan="2">Manual transmission oil, transfer oil (4WD) and differential oil (4WD)</td><td rowspan="2">R</td><td>First time only: 15,000 km (9,000 miles) or 12 months</td></tr>
<tr><td>Second time and after: Every 30,000 km (18,000 miles) or 24 months reckoning from 0 km (0 miles) or 0 month</td></tr>
<tr><td rowspan="2">– – CD – – – –</td><td rowspan="2" colspan="2">Ventilator air filter ∗2 (if equipped)</td><td>I</td><td>Every 15,000 km (9,000 miles) or 12 months</td></tr>
<tr><td>R</td><td>Every 45,000 km (27,000 miles) or 36 months</td></tr>
<tr><td>– B – – E – – H</td><td colspan="2">Automatic transmission fluid</td><td>R</td><td>Every 30,000 km (18,000 miles) or 24 months</td></tr>
</table>

NOTE:

- **"I": Inspect and correct or replace if necessary**
- **"R": Replace or change**
- **∗1: Inspect more frequently if the vehicle is used under dusty conditions.**
- **∗2: Clean or replace more frequently if the air from the ventilator decreases.**

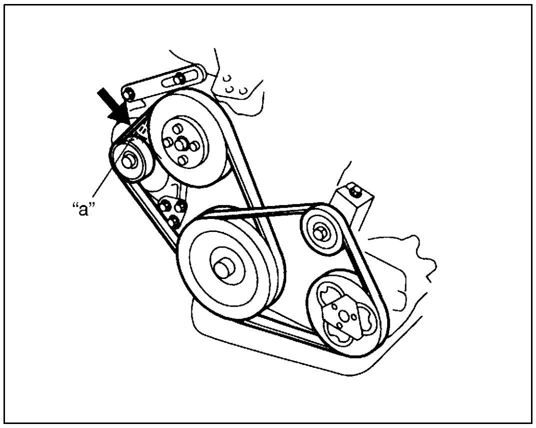
Maintenance Service

Drive Belt Inspection (M13 Engine)

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

Water pump and generator drive belt inspection

1) Disconnect negative (–) cable at battery.



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

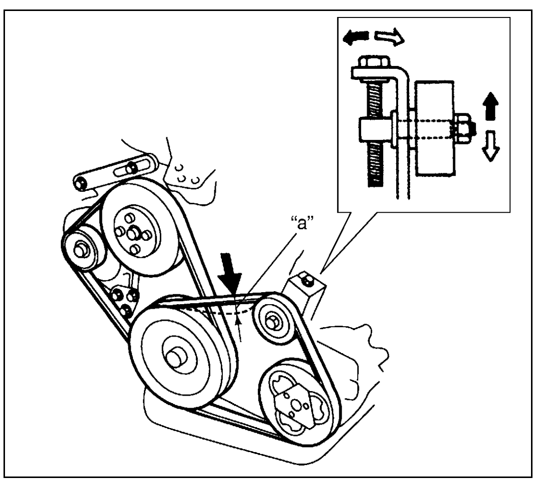
   Water pump and generator belt tension
   "a": 4.5 – 5.5 mm (0.18 – 0.22 in.) deflection under 100 N (10 kg, 22 lb) pressure

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

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

A/C Compressor drive belt (if equipped) inspection

1) Disconnect negative (–) cable at battery.



2) Inspect belt for cracks, cuts, deformation, wear and cleanliness. If any defect exists, replace.
   Check belt for tension.
   If belt tension is out of specification, adjust it referring to "A/C Compressor Driver Belt (M13 engine model)" in Section 1B.

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

3) Connect negative (–) cable to battery.

Drive Belt Replacement (M13 Engine)

Water pump and generator drive belt replacement

Replace belt with new one referring to "Water Pump/Generator Drive Belt Removal and Installation" in Section 6B2.

A/C Compressor drive belt (if equipped) replacement

Replace belt with new one referring to "A/C Compressor Drive Belt (M13 engine model)" in Section 1B.

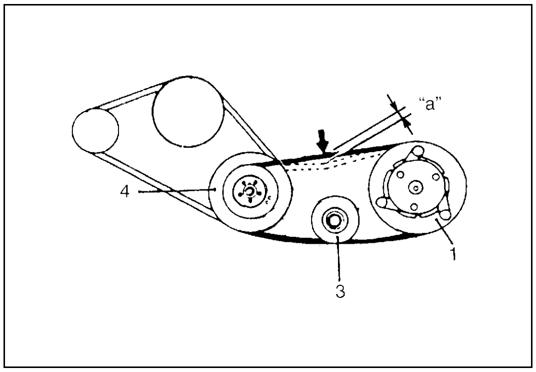
Drive Belt Inspection (G10 Engine)

WARNING:
Disconnect negative cable at battery before checking and replacing belt.

A/C compressor drive belt inspection (If equipped)

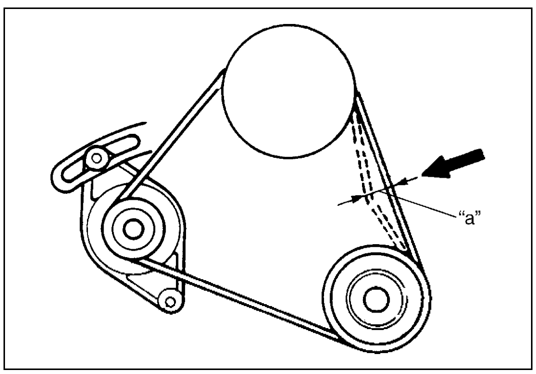
1) Hoist vehicle and remove engine under cover of right side from vehicle body.
2) Inspect belt for wear, deterioration and tension.
   Replace or adjust, if necessary.

A/C compressor drive belt tension "a":
7 – 9 mm (0.28 – 0.35 in.) deflection under 100 N, 10 kg or 22 lb pressure



1.	A/C compressor pulley
2.	Blank
3.	Tension pulley
4.	Crankshaft pulley

Water pump belt inspection



1) Inspect belt for cracks, cuts, deformation, wear and cleanliness.
   Replace, if necessary.
2) Check pump belt for tension and adjust it as necessary.

Water pump belt tension "a":
7 – 9 mm (0.27 – 0.35 in.) deflection under 100 N, 10 kg or 22 lb pressure

Drive Belt Replacement (G10 Engine)

A/C compressor drive belt replacement

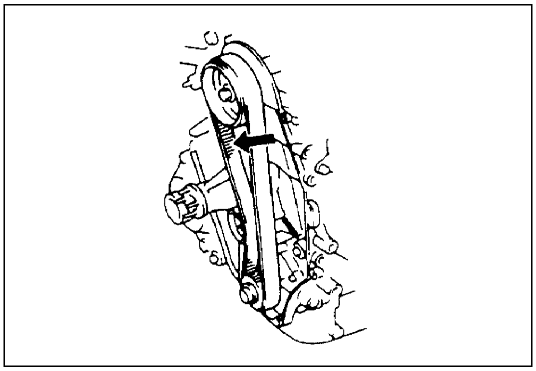
1) Disconnect negative cable from battery.
2) Remove engine under cover of right side.
3) Loosen belt tension and replace belt with new one.
4) Adjust belt tension to specification.
5) Install engine under cover and connect negative cable to battery.

Water pump belt replacement

Replace belt with a new one. Refer to Section 6B for replacement procedure of pump belt.

NOTE:
When replacing belt with a new one, adjust belt tension to 6 – 7 mm (0.24 – 0.27 in.).

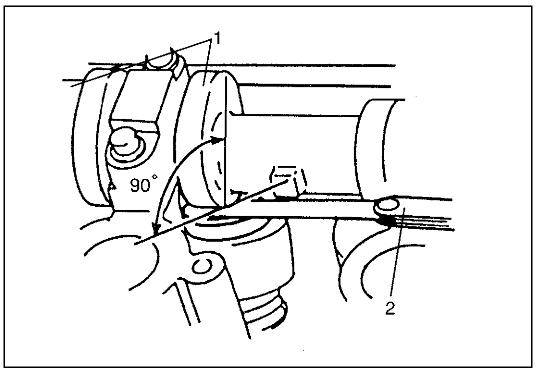
Camshaft Timing Belt Replacement (G10 Engine)



Replace belt with new one. Refer to Section 6A for replacement procedure.

CAUTION:
- **Do not bend or twist timing belt.**
- **Do not allow timing belt to come into contact with oil, water, etc.**

Valve Lash (Clearance) Inspection (M13 Engine)



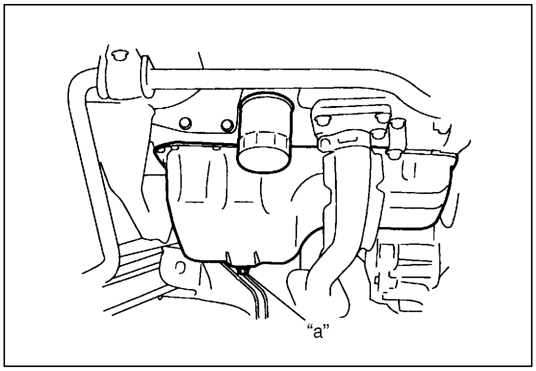
1) Inspect intake and exhaust valve lash and adjust as necessary.
   Refer to “Valve Lash (Clearance) Inspection” in Section 6A2 for valve lash inspection and adjustment procedure.

1.	Camshaft
2.	Thickness gauge

Engine Oil and Oil Filter Replacement

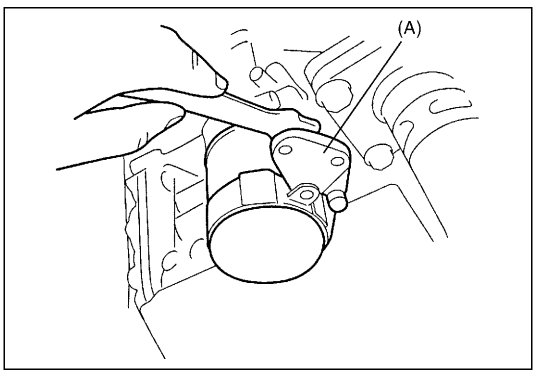
WARNING:
- **New and used engine oil can be hazardous. Be sure to read “WARNING” in General Precaution in Section 0A and observe what in written there.**
- **Step 1) – 7) outlined below must be performed with ENGINE NOT RUNNING. For step 8), be sure to have adequate ventilation while engine is running.**

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



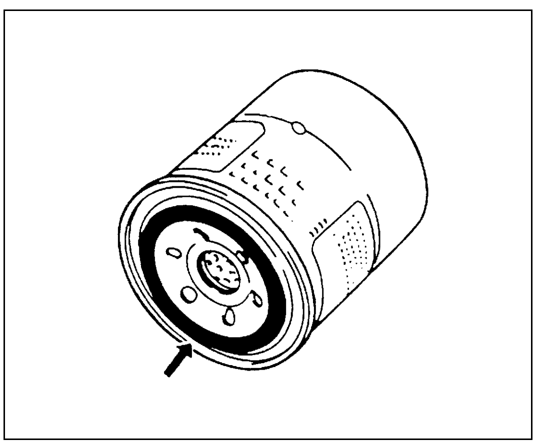
1) Drain engine oil by removing drain plug.
2) After draining oil, wipe drain plug clean. Reinstall drain plug, and tighten it securely as specified below.

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



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

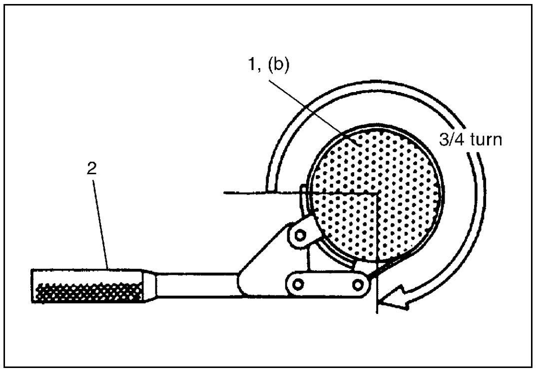
Special tool
(A): 09915-47330



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

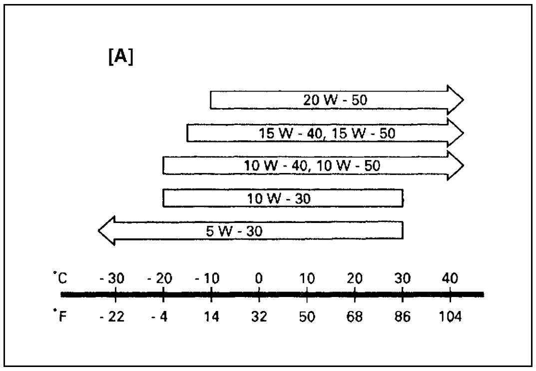
4) Screw new filter on oil filter stand by hand until the filter O-ring contacts the mounting surface.

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



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

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



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

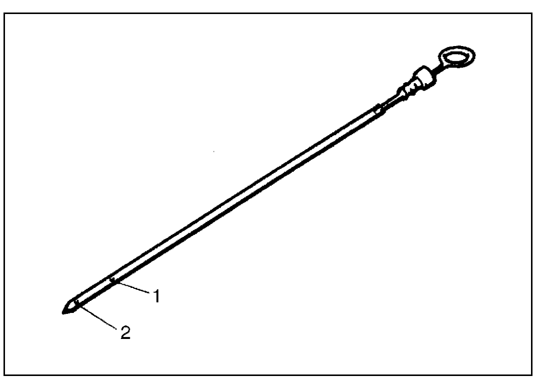
Engine oil specification

	M13 Engine	G10 Engine
Oil pan capacity	About 3.6 liters (7.6/6.3 US/Imp pt.)	A bout 3.1 liters (6.5/5.5 US/Imp pt.)
Oil filter capacity	About 0.2 liter (0.4/0.3 US/Imp pt.)	
Others	About 0.3 liter (0.6/0.5 US/Imp pt.)	
Total	About 4.1 liters (8.7/7.2 US/Imp pt.)	A bout 3.6 liters (7.5/6.3 US/Imp pt.)

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

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

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



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

Engine Coolant Replacement

WARNING:

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

CAUTION:

When changing engine coolant, use mixture of 50% specified water and 50% ANTIFREEZE / ANTICORROSION COOLANT for the purpose of corrosion protection and lubrication.

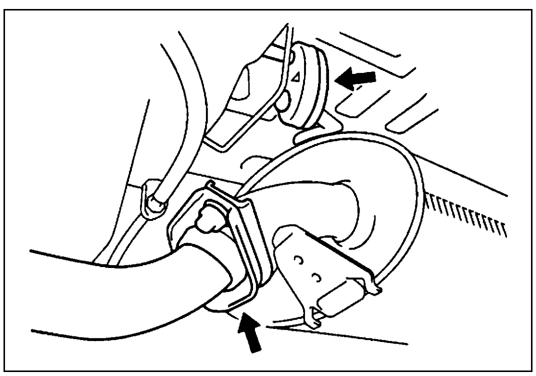
Change engine coolant with new one referring to “Cooling System Flush and Refill” in Section 6B or 6B2.

Exhaust System Inspection

WARNING:

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

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

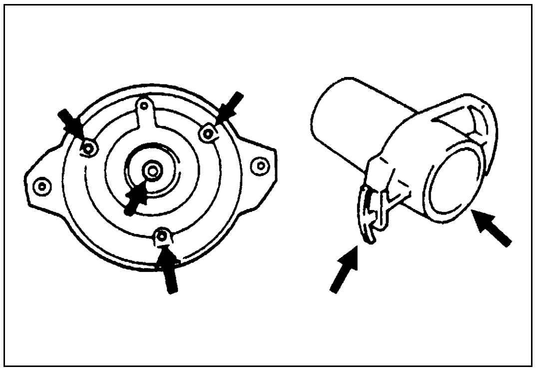


- Check rubber mountings for damage, deterioration, and out of position.
- Check exhaust system for leakage, loose connections, dents and damages.
  If bolts or nuts are loose, tighten them to specification.
- Check nearby body areas for damaged, missing, or mispositioned parts, open seams, holes, loose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

Spark Plugs Replacement

Replace spark plugs with new ones referring to “Spark Plugs Removal and Installation” in Section 6F or 6F2.

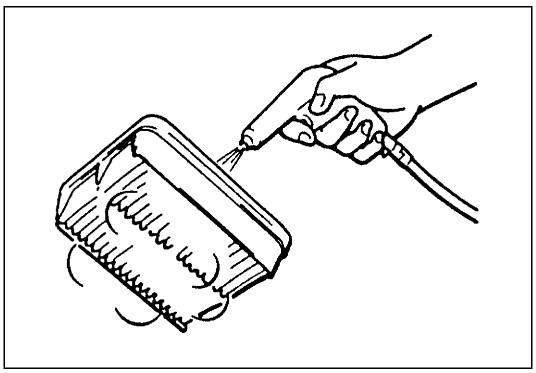
Distributor Cap and Rotor Inspection (G10 Engine)



- Check distributor cap and rubber caps for cracks.
- Clean dusty and stained parts using a dry, soft cloth.
- Check center electrode and terminals for wear.
- Check rotor for cracks and its electrode for wear.
  Repair or replace any component which is found to be in malcondition.

Air Cleaner Filter Inspection

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

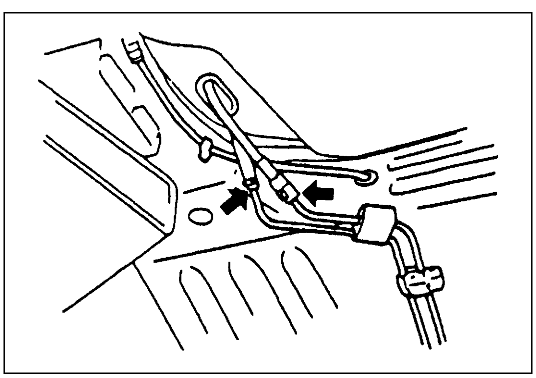


3) Check that filter is not excessively dirty, damaged or oily, clean filter with compressed air from air outlet side of filter.
4) Install air cleaner filter and clamp upper case securely.

Air Cleaner Filter Replacement

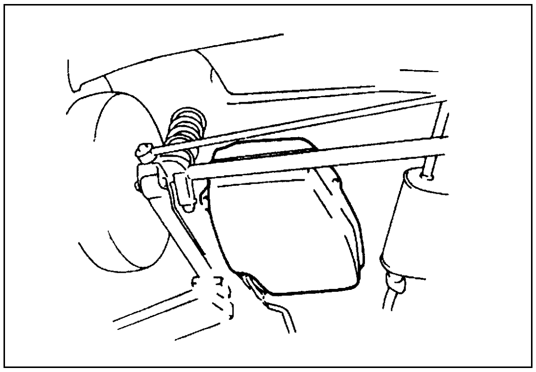
Replace air cleaner filter with new one according to steps 1), 2) and 4) of inspection procedure.

Fuel Lines and Connections Inspection



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

Fuel Tank Inspection

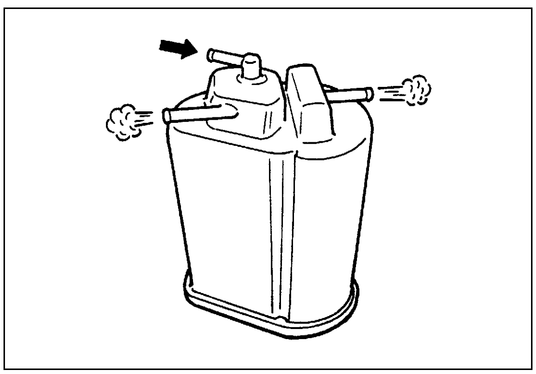


Check fuel tank damage, cracks, fuel leakage, corrosion and tank bolts looseness.
If a problem is found, repair or replace.

PCV Valve Inspection

Check crankcase ventilation hose and PCV hose for leaks, cracks or clog, and PCV valve for stick or clog. Refer to “PCV valve” under “PCV System Inspection” of Section 6E1 or 6E2 for PCV valve checking procedure.

Fuel Evaporative Emission Control System Inspection

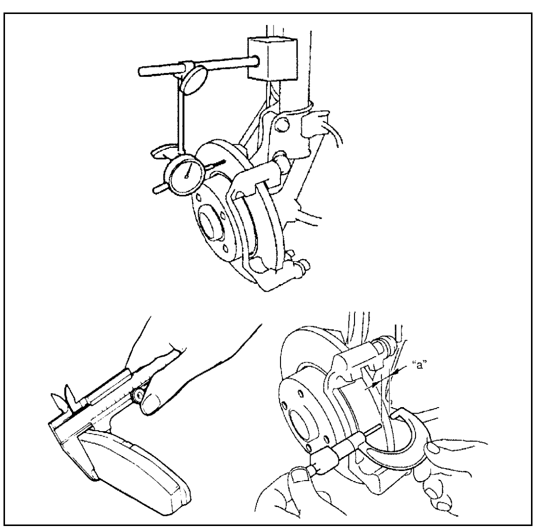


1) Visually inspect hoses for cracks, damage, or excessive bends. Inspect all clamps for damage and proper position.
2) Check EVAP canister for operation and clog, referring to “EVAP Canister” under “EVAP Control System Inspection” in Section 6E1 or 6E2.

If a malfunction is found, repair or replace.

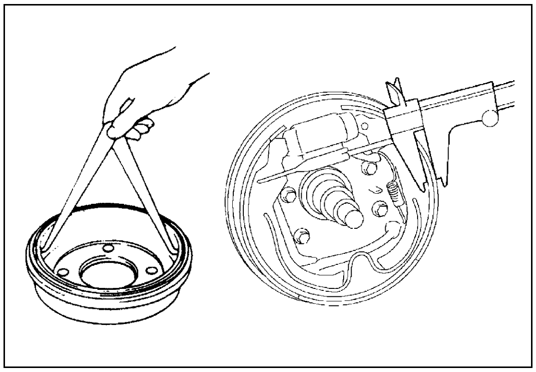
Brake Discs and Pads (Front) Inspection

1) Remove wheel and caliper but don’t disconnect brake hose from caliper.



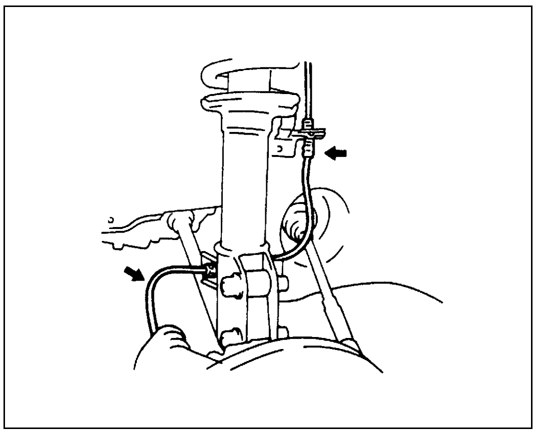
2) Check front disc brake pads and discs for excessive wear, damage and deflection. Replace parts as necessary. For details, refer to “Front Disc Brake Pad Inspection” and “Front Brake Disc Inspection” in Section 5B.
   Be sure to torque caliper pin bolts to specification.

Brake Drums and Shoes (Rear) Inspection



1) Remove wheel and brake drum.
2) Check rear brake drums and brake linings for excessive wear and damage, while wheels and drums are removed. At the same time, check wheel cylinders for leaks. Replace these parts as necessary.

Brake Hoses and Pipes Inspection



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

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

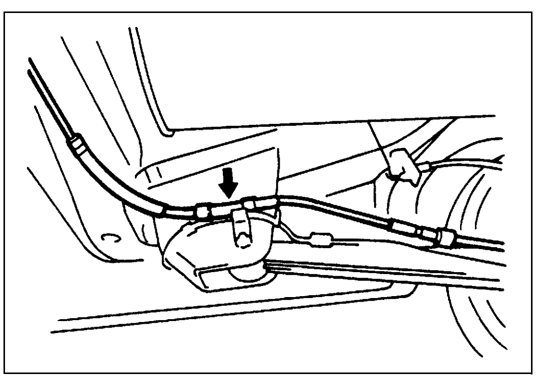
Repair or replace any of these parts as necessary.

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

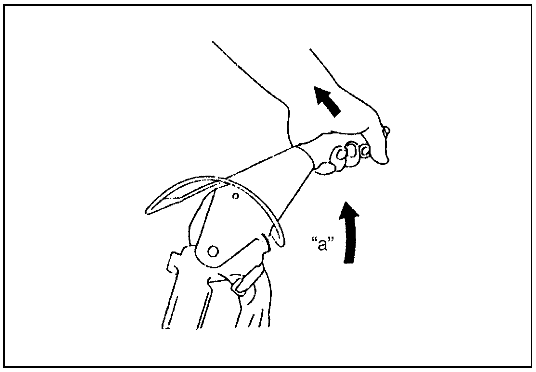
Brake Fluid Replacement

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

Brake Lever and Cable Inspection



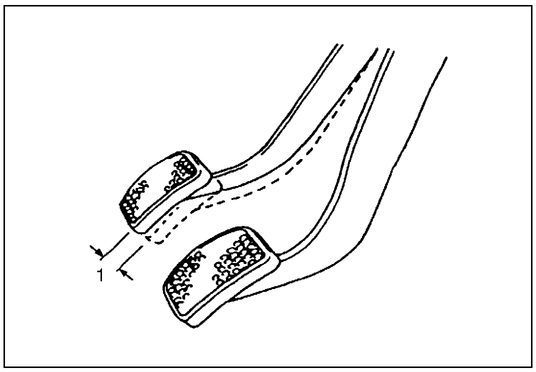
1) Inspect brake cable for damage and smooth movement.
Replace cable if it is in deteriorated condition.



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

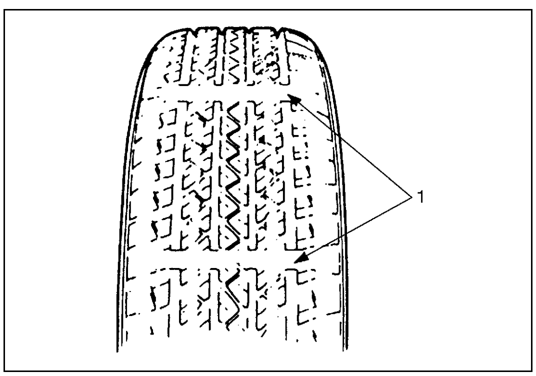
Parking brake lever stroke
"a": 4 – 9 notches (with 20 kg (44 lbs) of pull pressure)

Clutch Inspection



Check clutch pedal for height and free travel (1) referring to "Clutch Pedal Height Check" and "Clutch Pedal Free Travel Check" in Section 7C. Adjust or correct if necessary.

Tires Inspection



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

1. Wear indicator

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

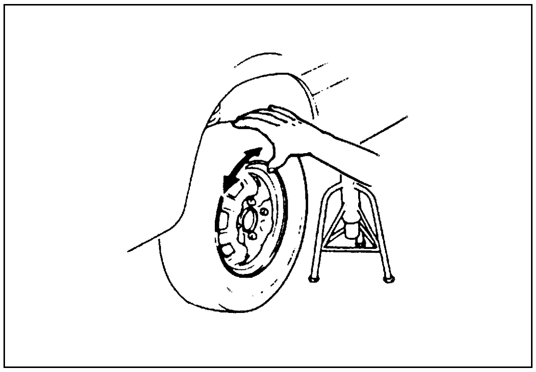
NOTE:
- **Tire inflation pressure should be checked when tires are cool.**
- **Specified tire inflation pressure should be found on tire placard or in owner's manual which came with the vehicle.**

3) Rotate tires.
   For details, refer to "Tire Rotation" in Section 3F.

Wheel Discs Inspection

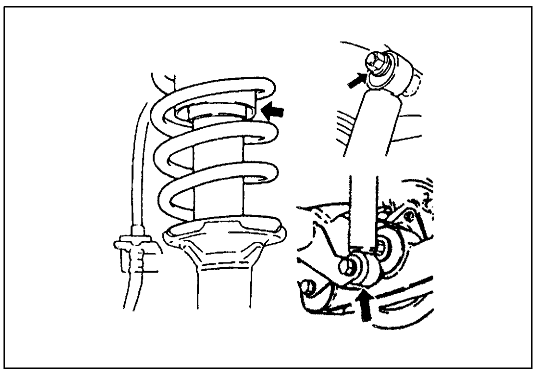
Inspect each wheel disc for dents, distortion and cracks. A disc in badly damaged condition must be replaced.

Wheel Bearing Inspection

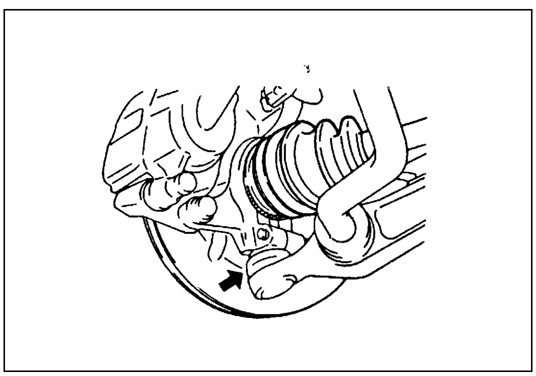


1) Check front wheel bearing for wear, damage, abnormal noise or rattles. For details, refer to “Wheel Disc, Nut and Bearing Check” in Section 3D.
2) Check rear wheel bearing for wear, damage, abnormal noise or rattles. For details, refer to “Wheel Disc, Nut and Bearing Check” in Section 3E.

Suspension System Inspection

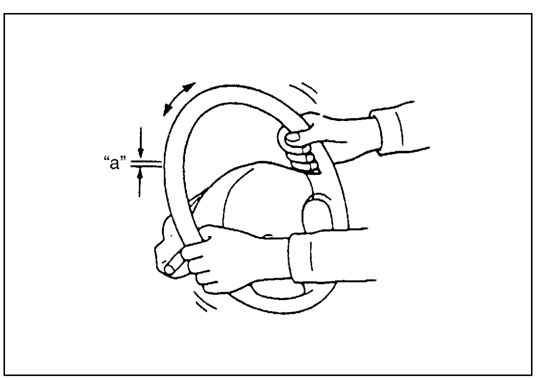


- Inspect front struts & rear shock absorbers for evidence of oil leakage, dents or any other damage on sleeves; and inspect anchor ends for deterioration.
  Replace defective parts, if any.
- Check front and rear suspension systems for damaged, loose or missing parts; also for parts showing signs of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



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

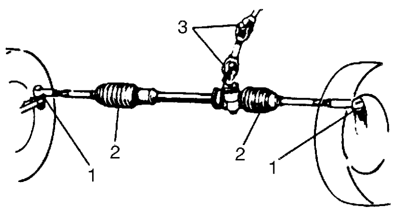
Steering System Inspection



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

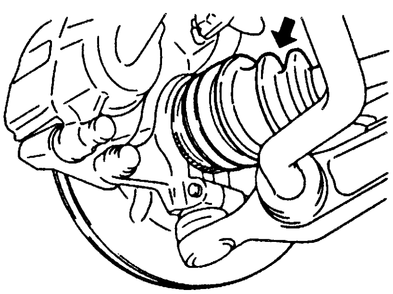
Steering wheel play
“a”: 0 – 30 mm (0 – 1.1 in.)

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



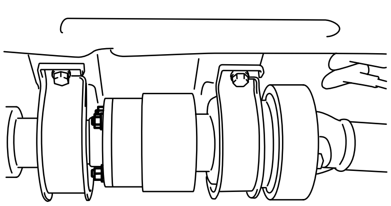
3) Check steering linkage for looseness and damage. Repair or replace defective parts, if any.
4) Check boots (1) and (2) of steering linkage and steering gear case for damage (leak, detachment, tear, etc.). If damage is found, replace defective boot with new one.
   If any dent is found on steering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

Drive Shaft (Axle) Boots Inspection



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

Propeller Shafts (4WD) Inspection



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

Manual Transmission Oil Inspection

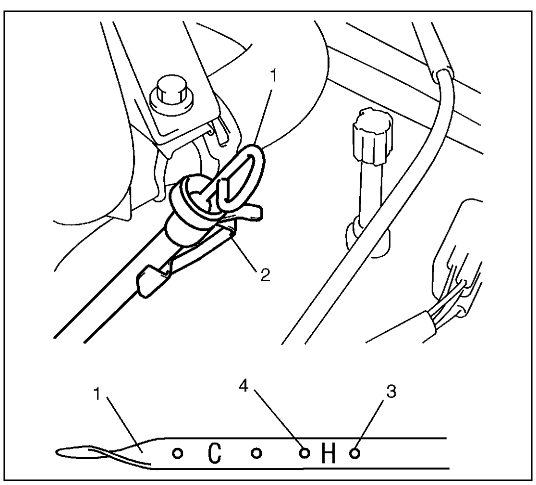
1) Inspect transmission case for evidence of oil leakage.
   Repair leaky point if any.
2) Make sure that vehicle is placed level for oil level check.
3) Remove oil filler/level plug (1) of transmission.
4) Check oil level.
   Oil level can be checked roughly by means of filler/level plug hole. That is, if oil flows out of level plug hole or if oil level is found up to hole when level plug is removed, oil is properly filled.
   If oil is found insufficient, pour specified oil up to level hole.
   For specified oil, refer to "Manual Transaxle Oil Change" in Section 7A or 7A2.
5) Apply sealant to filler/level plug and tighten it to specified torque.

Manual Transmission Oil Replacement

1) Place the vehicle level and drain oil by removing drain plug (2).
2) Apply sealant to drain plug after cleaning it and tighten drain plug to specified torque.
3) Pour specified oil up to level hole.
4) Tighten filler plug to specified torque.
   For recommended oil, its amount and tightening torque data, refer to "Manual Transaxle Oil Change" in Section 7A or 7A2.

Automatic Transmission Fluid Level Inspection

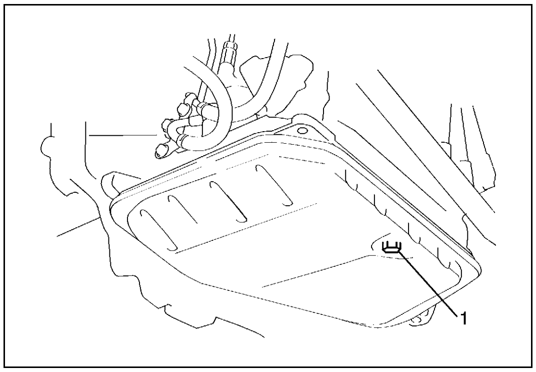
1) Inspect transmission case for evidence of fluid leakage.
   Repair leaky point, if any.
2) Make sure that vehicle is placed level for fluid level check.



3) Pull out dipstick and check fluid level.
   For fluid level checking procedure, refer to "Fluid Level Check at Normal Operating (Hot) Temperature (Hot Check)" in Section 7B and be sure to perform it under specified conditions. If fluid level is low, replenish specified fluid.

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

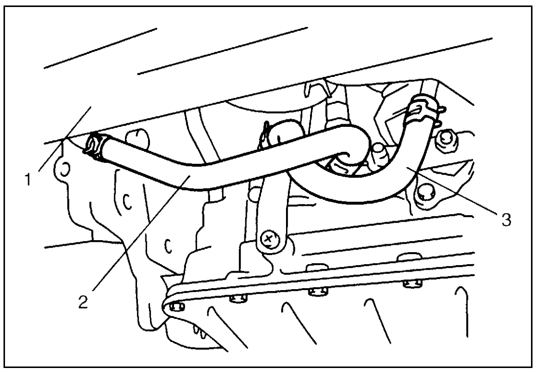
Automatic Transmission Fluid Replacement



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

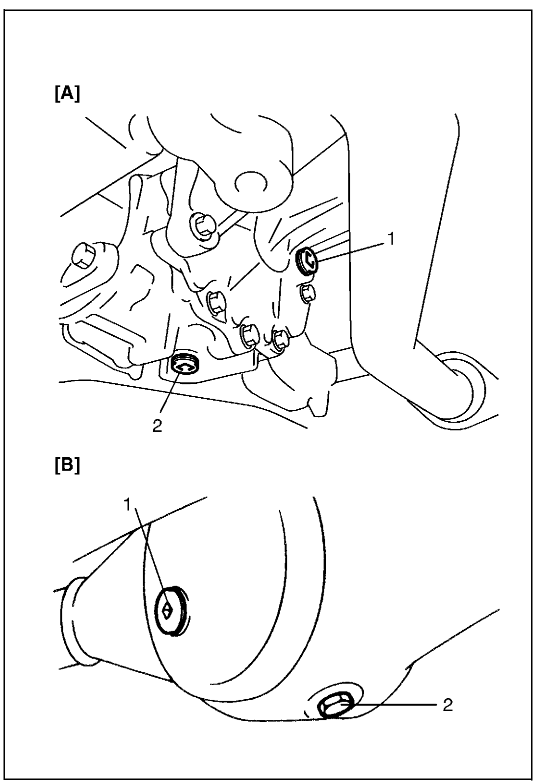
1.	Drain plug

Automatic Transmission Fluid Cooler Hose Inspection



Check automatic transaxle fluid cooler hose for fluid leakage, cracks, damage and deterioration.
Replace hose and/or clamp if any faulty condition is found.

Transfer Oil (4WD) and Rear Differential Oil (4WD) Inspection



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

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

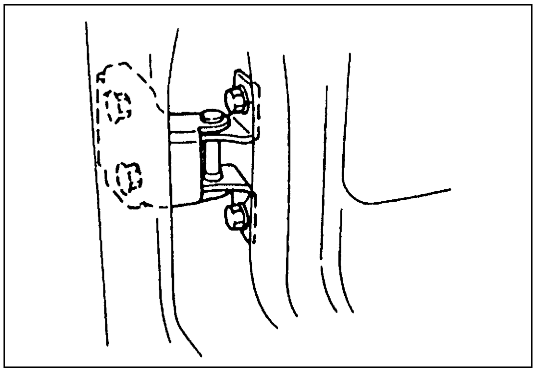
4) Tighten level plug to specified torque referring to “Transfer Oil Change” in Section 7D or “Rear Differential Oil Change” in Section 7F.

Transfer Oil (4WD) and Rear Differential Oil (4WD) Replacement

Change transfer oil and differential oil with new specified oil referring to "Transfer Oil Change" in Section 7D or "Rear Differential Oil Change" in Section 7F.

All Latches, Hinges and Locks Inspection

Doors



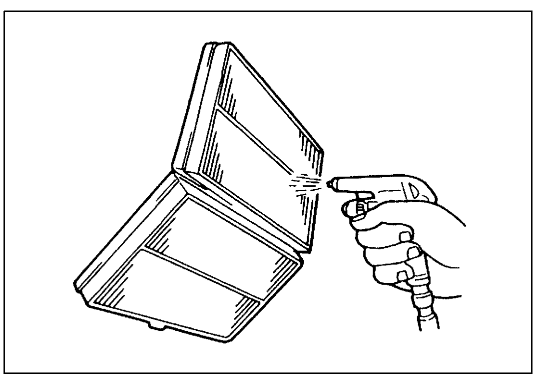
Check that each door of front, rear and back doors opens and closes smoothly and locks securely when closed.
If any malfunction is found, lubricate hinge and latch or repair door lock system.

Engine hood

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

Ventilator Air Filter (If Equipped)

Inspection



1) Remove air filter from air inlet box or cooling unit by removing filter cover located on bottom of case.
2) Check filter for dirt. Replace excessively dirty filter.
3) Blow off dust by compressed air from air outlet side of filter.
4) Install filter to air inlet box or cooling unit.

Replacement

Replace ventilator air filter with new one.

Final Inspection

WARNING:

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

SEATS

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

SEAT BELT

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

BATTERY ELECTROLYTE LEVEL CHECK

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

ACCELERATOR PEDAL OPERATION

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

ENGINE START

Check engine start for readiness.

WARNING:

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

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

EXHAUST SYSTEM CHECK

Check for leakage, cracks or loose supports.

CLUTCH (FOR MANUAL TRANSMISSION)

Check for the following.

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

GEARSHIFT OR SELECT LEVER (TRANSMISSION)

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

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

PARKING BRAKE
Check that lever has proper travel.

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

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

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

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

BODY, WHEELS AND POWER TRANSMITTING SYSTEM
Check that body, wheels and power transmitting system are free from abnormal noise and abnormal vibration or any other abnormal condition.

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

LIGHTS
Check that all lights operate properly.

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

Recommended Fluids and Lubricants

Engine oil	SG, SH, SJ or SL grade (Refer to “Engine Oil and Oil Filter Replacement” in this section for engine oil viscosity.)
Engine coolant (Ethylene glycol base coolant)	“Antifreeze / Anticorrosion coolant”
Brake fluid	DOT 4 or SAE J1704
Manual transmission oil	Refer to “Manual transaxle Oil Change” in Section 7A or 7A2.
Automatic transmission fluid	An equivalent of DEXRON®-III
Transfer oil (4WD)	Refer to “Transfer Oil Change” in Section 7D.
Differential oil (4WD)	Refer to “Rear Differential Oil Change” in Section 7F.
Door hinges	Engine oil or water resistance chassis grease
Hood latch assembly	Engine oil or water resistance chassis grease
Key lock cylinder	Spray lubricant

SECTION 1B

AIR CONDITIONING (OPTIONAL)

WARNING:

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

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

CAUTION:

The air conditioning system of this vehicle uses refrigerant HFC-134a (R-134a).
None of refrigerant, compressor oil and component parts is interchangeable between two types of A/C: one using refrigerant CFC-12 (R-12) and the other using refrigerant HFC-134a (R-134a).
Be sure to check which refrigerant is used before any service work including inspection and maintenance. For identification between these two types, refer to the description in page 1B-2.
When replenishing or changing refrigerant and compressor oil and when replacing parts, make sure that the material or the part to be used is appropriate to the A/C installed in the vehicle being serviced.
Use of incorrect one will result in leakage of refrigerant, damage in parts or other faulty condition.

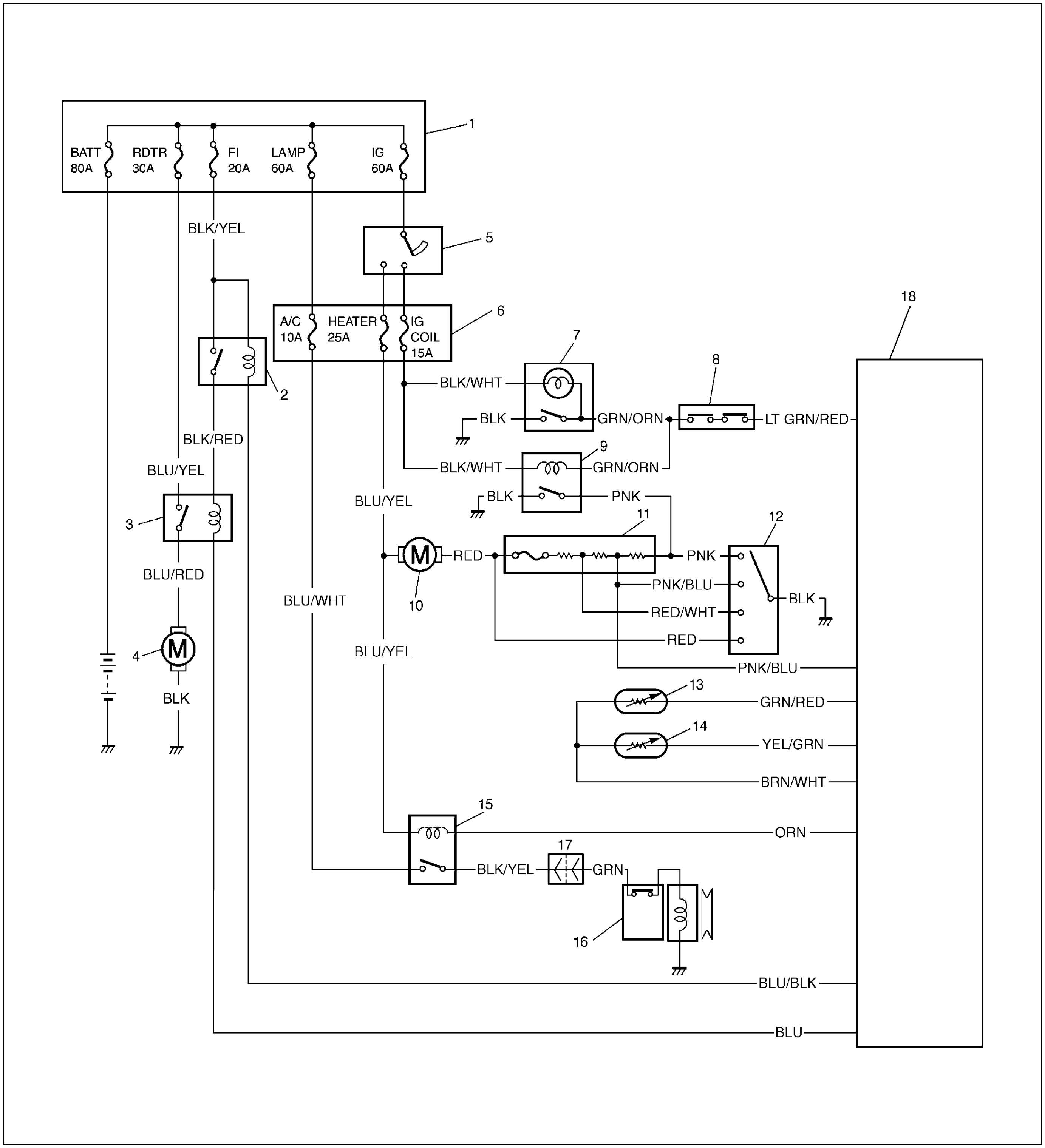
NOTE:

For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.

CONTENTS

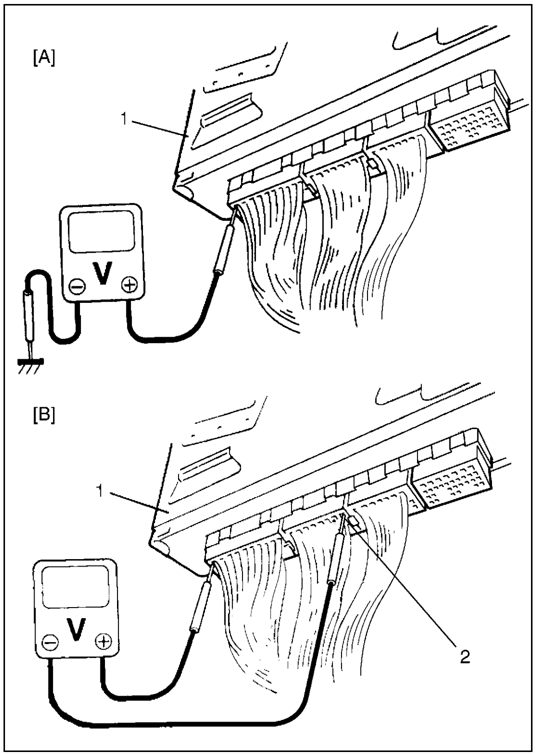
Diagnosis

Wiring Circuit (M13 Engine Model)



1.	Main fuse box	7.	A/C switch	13.	A/C evaporator thermistor
2.	Main relay	8.	Dual pressure switch	14.	ECT sensor
3.	Radiator (and condenser) cooling fan motor relay	9.	Blower fan motor relay	15.	Compressor relay
4.	Radiator (and condenser) cooling fan motor	10.	Blower fan motor	16.	Compressor
5.	Ignition switch	11.	Blower fan motor resistor	17.	Connector
6.	Circuit fuse box	12.	Blower fan switch	18.	ECM

A/C System Inspection of ECM and Its circuits (M13 Engine Model)



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

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

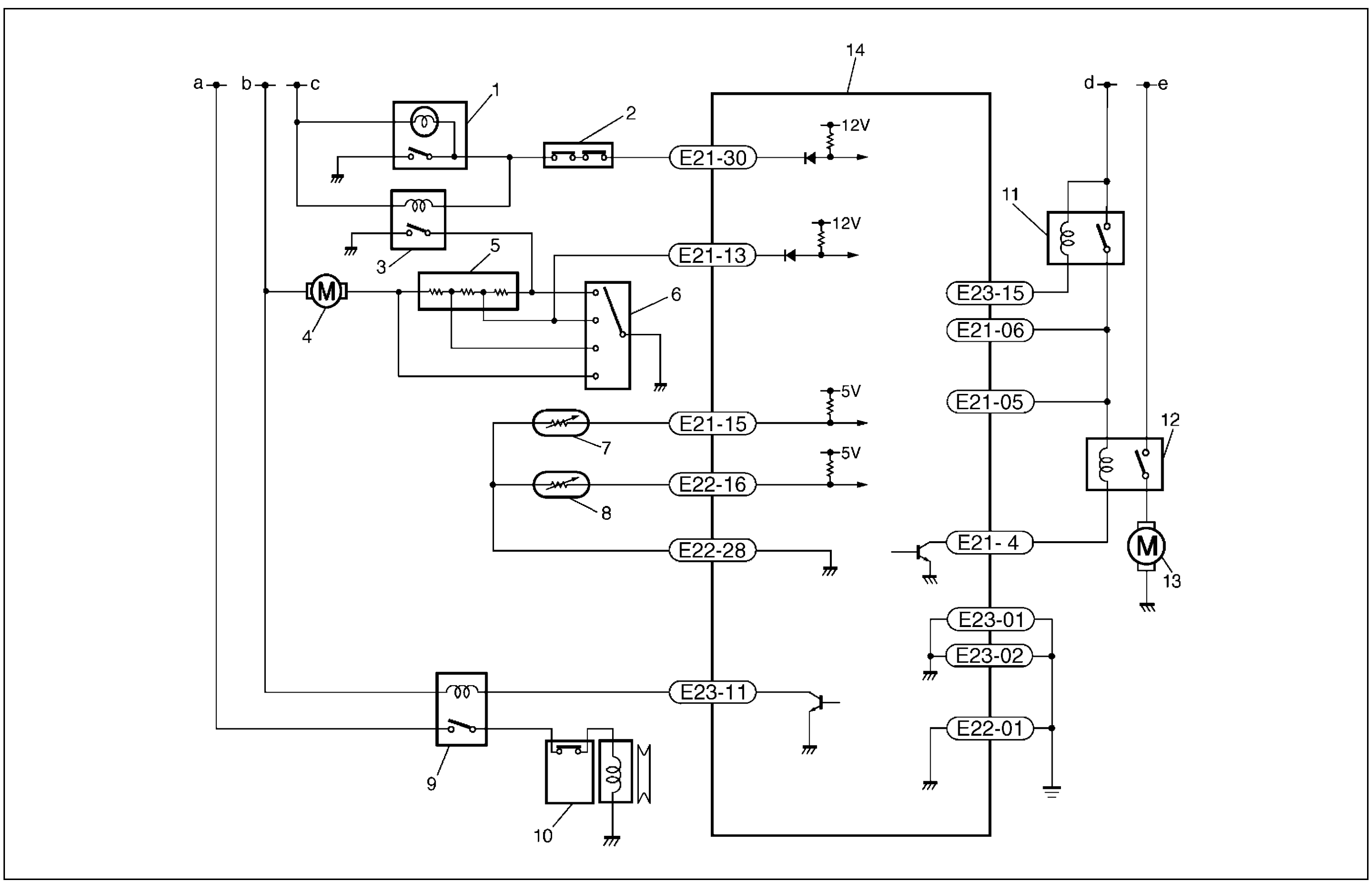
Inspection

1) Remove ECM (1) from vehicle.
2) Connect ECM (1) couplers to ECM.

[A]:	Fig. A
[B]:	Fig. B
2.	E22-01

3) Check voltage at each terminal of couplers connected. Refer to next page and "Inspection of ECM and Its Circuits" in Section 6–2.

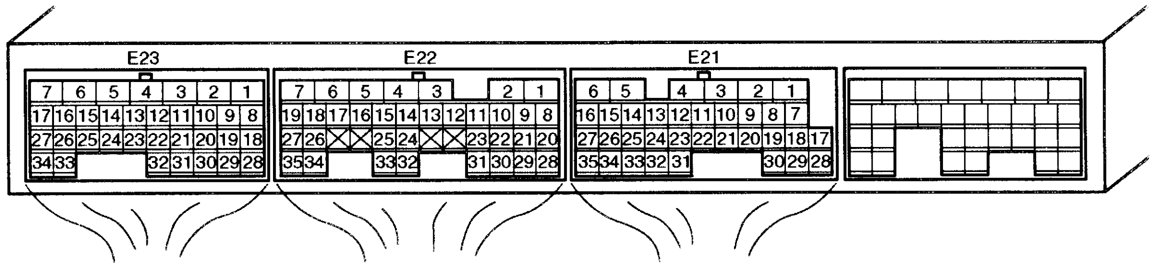
NOTE:
As each terminal voltage is affected by the battery voltage, confirm that it is 11 V or more when ignition switch is ON.



a. To "A/C" fuse (10A) in circuit fuse box	1. A/C switch	6. Blower fan switch	11. Main relay

b. To "HEATER" fuse (25A) in circuit fuse box	2. Dual pressure switch	7. A/C evaporator thermistor	12. Radiator (and condenser) cooling fan motor relay
c. To "IG COIL" fuse (15A) in circuit fuse box	3. Blower fan motor relay	8. ECT sensor	13. Radiator (and condenser) cooling fan motor
d. To "FI" fuse (20A) in main fuse box	4. Blower fan motor	9. Compressor relay	14. ECM
e. To "RDTR" fuse (30A) in main fuse box	5. Blower fan motor resistor	10. Compressor	

Terminal Arrangement of ECM Coupler (viewed from Harness Side)



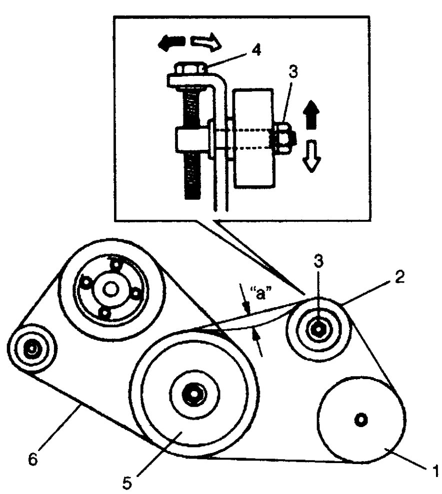
ECM Voltage Values Table for Relation of A/C Control (M13 Engine Model)

Terminal	Wire	Circuit	Measurement ground	Normal value	Condition
E22-01	BLK	Main ground for ECM	Ground to body (Fig A)	–0.3 – 0.3 V	Ignition switch ON
E21-05	BLK/RED	Power supply for engine control	Ground to engine (Fig B)	10 – 14 V	Ignition switch ON
E23-01	BLK/YEL	ECM ground for power circuit	Ground to body (Fig A)	–0.3 – 0.3 V	Ignition switch ON
E21-06	BLK/RED	Power supply for engine control	Ground to engine (Fig B)	10 – 14 V	Ignition switch ON
E21-4	BLU	Radiator (condenser) cooling fan relay output	Ground to engine (Fig B)	0 – 1 V	A/C switch ON or engine coolant temp. sensor more than 96 ºC (205 ºF) with engine running
				10 – 14 V	Except the above-mentioned with engine running
E23-15	BLU/BLK	Main relay	Ground to engine (Fig B)	0 – 1 V	Ignition switch ON
				10 – 14 V	Ignition switch OFF
E23-11	ORN	Compressor magnet clutch relay output	Ground to engine (Fig B)	0 – 1 V	A/C switch ON with engine running
				10 – 14 V	Except the above-mentioned with engine running
E23-02	BLK/YEL	ECM ground for power circuit	Ground to body (Fig A)	–0.3 – 0.3 V	Ignition switch ON
E21-15	GRN/RED	Evaporator thermistor temp. input	Ground to engine (Fig B)	2.0 – 2.3 V (1800 – 2200 Ω)	Evaporator thermistor temp. at Approx. 25 ºC (77 ºF) with ignition switch ON
				3.5 – 3.6 V (6300 – 7000 Ω)	Evaporator thermistor temp. at Approx. 0 ºC (32 ºF) with ignition switch ON

Terminal	Wire	Circuit	Measurement ground	Normal value	Condition
E21-30	LT GRN/ RED	A/C switch input	Ground to engine (Fig B)	0 – 1 V	A/C switch ON with ignition switch ON
				10 – 14 V	A/C switch OFF with ignition switch ON
E22-16	YEL/ GRN	Engine coolant temperature sensor input	Ground to engine (Fig B)	0.71 – 0.76 V (290 – 320 Ω)	Engine coolant temperature at Approx. 80 ºC (176 ºF) with ignition ON
				0.35 – 0.37 V (136 – 144 Ω)	Engine coolant temperature at Approx. 110 ºC (230 ºF) with ignition ON
E22-28	BRN/ WHT	Sensor ground	Ground to body (Fig A)	–0.3 – 0.3 V	Ignition switch ON
E21-13	PNK/ BLU	Blower fan speed input	Ground to engine (Fig B)	0 – 2 V	Blower switch 2nd, 3rd or 4th position with ignition switch ON
				3 – 5 V	• Blower switch 1st position with ignition switch ON • A/C switch ON and blower switch off with ignition ON
				10 – 14 V	Blower switch OFF position with ignition switch ON

Compressor Drive Belt (M13 Engine Model)

Inspection



- Check compressor drive belt (6) for wear and cracks, and replace as required.
- Check compressor drive belt (6) tension by measuring how much it deflects when pushed at intermediate point between compressor pulley (1) and tension pulley (2) with about 100 N (10 kg, 22 lbs) force after crankshaft pulley 1 rotating. If belt tension is without specification, adjust belt tension referring to below procedures.

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

Adjustment

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

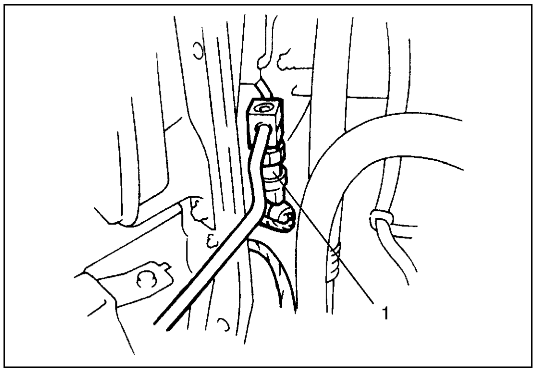
Replacement

1) Loosen tension pulley nut (3).
2) Loosen belt tension by loosen tension pulley adjusting bolt (4).
3) Remove compressor drive belt (6).

4) Install new compressor drive belt.
5) Adjust belt tension referring to above procedure.

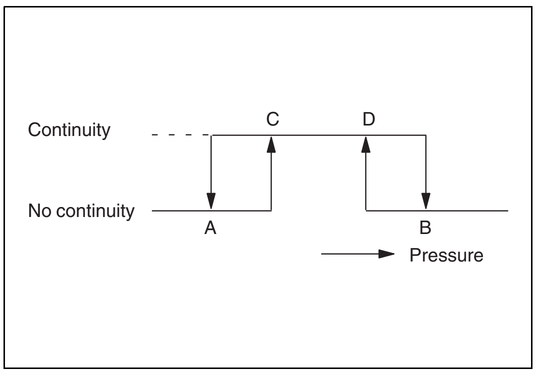
On-Vehicle Service

Dual Pressure Switch



Inspection

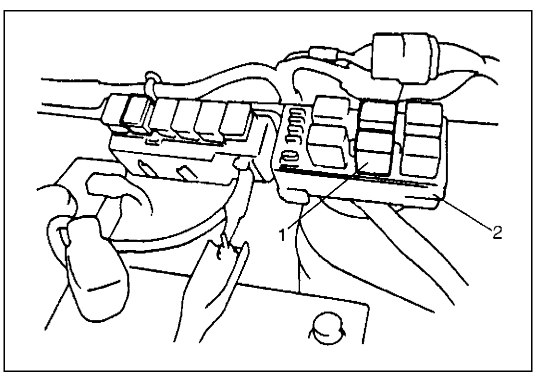
1) Check dual pressure switch (1) for continuity at normal temperature (approx. 25 °C (77 °F)) when A/C system has a proper charge of refrigerant and when A/C system (compressor) is under operation. In each of these cases, switch should show proper continuity.



2) Check switch for continuity at specified pressure as shown.

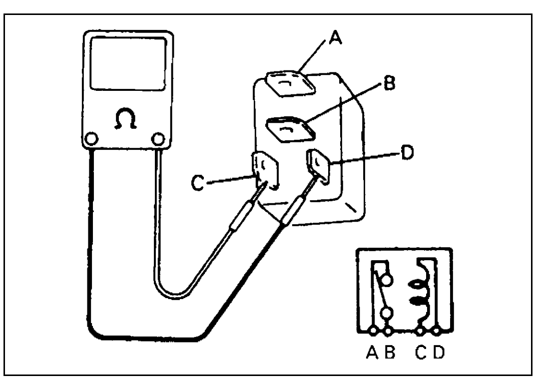
A: Approx 200 KPa (2.0 kg/cm^2)
B: Approx 3200 KPa (32 kg/cm^2)
C: Approx 260 KPa (2.6 kg/cm^2)
D: Approx 2600 KPa (26 kg/cm^2)

A/C Compressor Relay



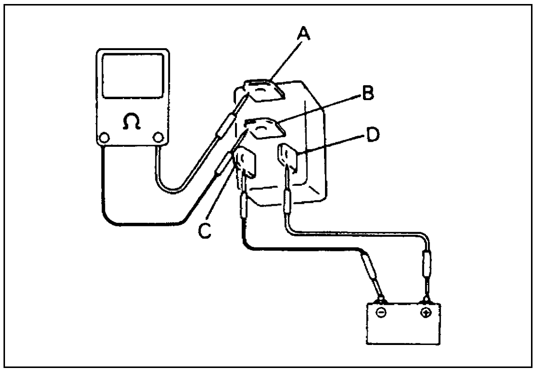
Inspection

1) Disconnect negative cable at battery.
2) Remove A/C compressor relay (1) from relay box (2).



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	Approx. 170 Ω

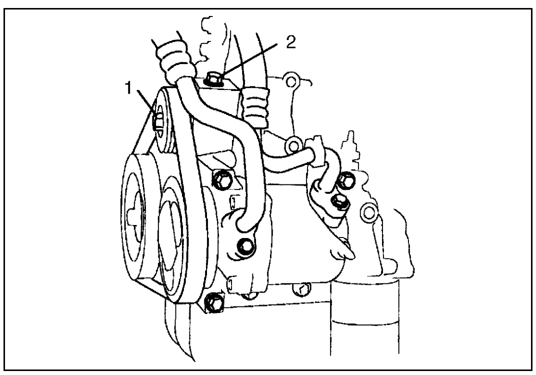


4) Check that there is continuity between terminals “A” and “B” when battery is connected to terminals “C” and “D”. If found defective, replace.

Compressor (M13 Engine Model)

Removal

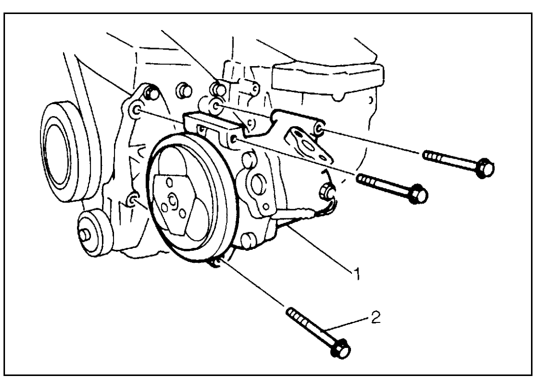
1) Run engine at idle speed with air conditioning ON for 10 minutes. After that, stop the engine.
2) Disconnect negative (–) cable at battery.
3) Recover refrigerant from refrigeration system by using recovery and recycling equipment.
4) Remove front bumper.
5) Remove engine front cover.
6) Disconnect magnet clutch lead wire and disengage lead wire clamp.



7) Remove compressor drive belt by loosening tension pulley bolt (1) and adjust bolt (2).
8) Disconnect suction and discharge hoses from compressor.

NOTE:

Cap open fittings immediately to keep moisture out of system.



9) Remove compressor with magnet clutch assembly (1) from its mount by loosening mounting bolts (2).
10) Drain oil from compressor, and measure its amount.

SECTION 3A

FRONT WHEEL ALIGNMENT

WARNING:

Do not removal all of the wheel bolts at once, because all the wheels of this vehicle are mounted by the wheel bolts.
Leave a bolt at least not to drop the wheel.
Support the wheel and/or tire and then remove the bolt(s) left with the wheel.

NOTE:

For descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.

CONTENTS

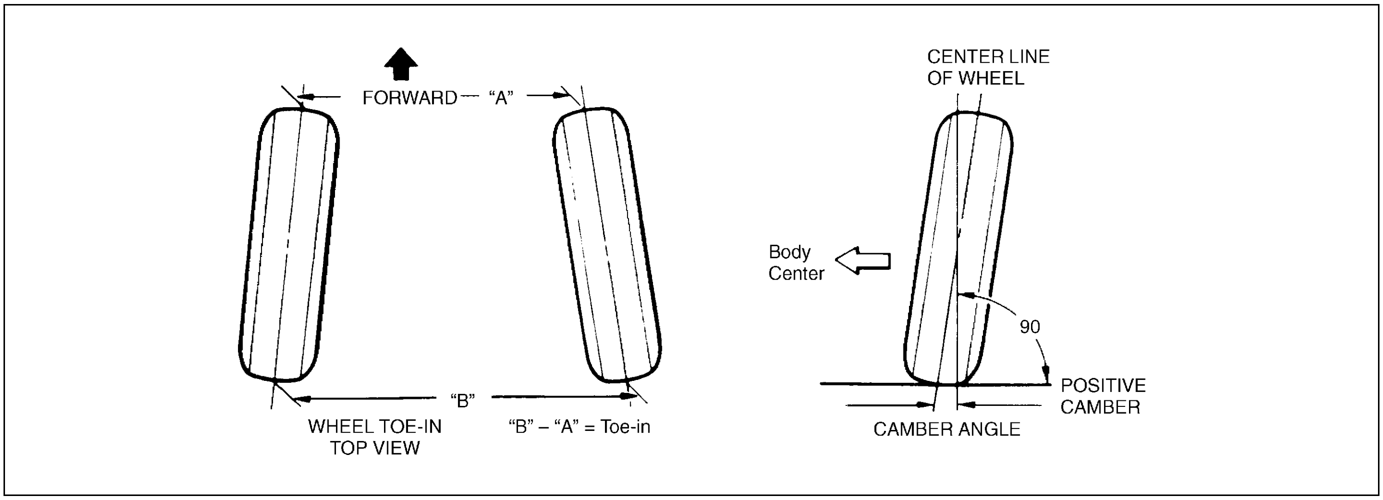
General Description

Front Wheel Alignment Specifications

Item		Front Wheel
Toe (total)		0 ± 1 mm
Camber		–0 ° 20’ ± 1 °
Caster		3 ° 40’ ± 1 °
Side Slip Limit mm/m		0 – IN 3 mm/m
Steering Angle (Turning angle)	Inside	35 ° ± 3 °
	Outside (Reference)	31 ° ± 3 °

NOTE:

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



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

SECTION 3B

MANUAL RACK AND PINION

WARNING:

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

- **Service on and around the air bag system components or wiring must be performed only by an autho-rized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “Gener-al Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precau-tions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**
- **Do not removal all of the wheel bolts at once, because all the wheels of this vehicle are mounted by the wheel bolts.**
  Leave a bolt at least not to drop the wheel.
  Support the wheel and/or tire and then remove the bolt(s) left with the wheel.

NOTE:

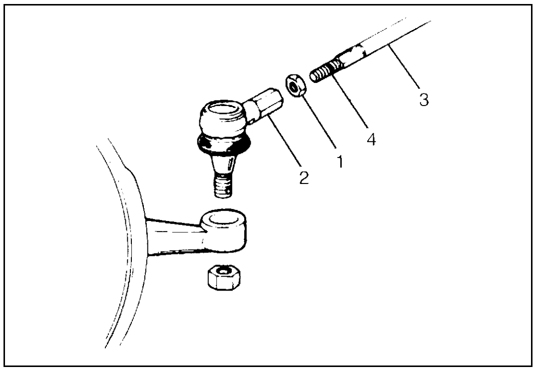
- **All steering gear fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/ or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.**
- **For discriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.**

CONTENTS

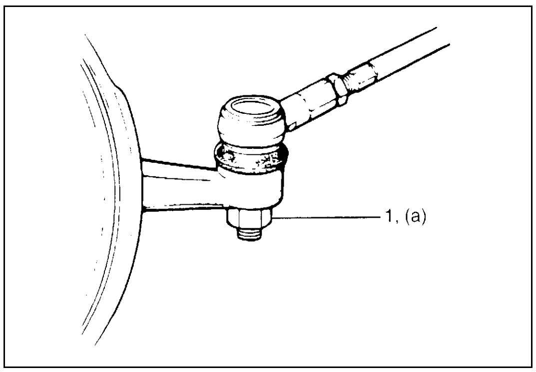
On-Vehicle Service

Tie Rod End

Installation



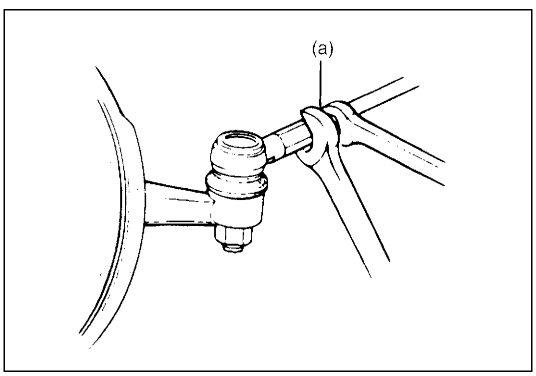
1) Install tie rod end lock nut (1) and tie rod end (2) to tie rod (3). Align lock nut with mark (4) on tie rod thread.



2) Connect tie rod end to knuckle. Tighten new tie rod end nut (1) to specified torque.

Tightening torque
Tie rod end nut (a): 40 N·m (4.0 kg-m, 29.0 lb-ft)

3) Inspect for proper toe (Refer to “Front Wheel Alignment”).



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

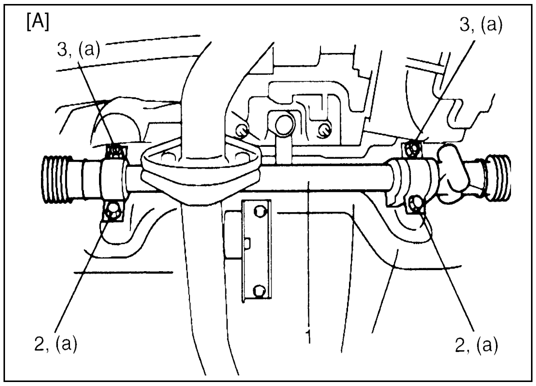
Tightening torque
Tie rod end lock nut (a): 45 N·m (4.5 kg-m, 32.5 lb-ft)

5) Tighten wheel to specified torque and lower hoist.

Tightening torque
Wheel bolt: 95 N·m (9.5 kg-m, 69.0 lb-ft)

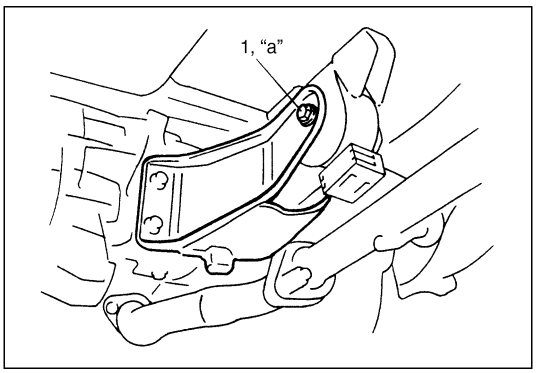
Manual Rack and Pinion Assembly (Steering Gear Case)

Installation



1) Apply grease to inside of pinion packing and install pinion packing onto pinion. Mount steering gear case (1) to body and tighten gear case mount bolts (2) and nuts (3) to specified torque.

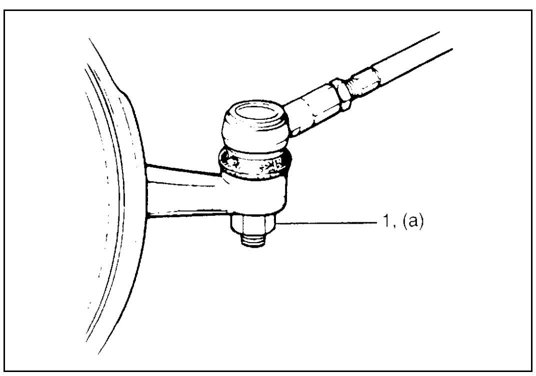
   Tightening torque
   Steering gear case mounting bolt and nut (a): 25 N·m (2.5 kg-m, 18.0 lb-ft)



2) Install engine rear mounting bolt (1). Tighten bolts to specified torque.

   Tightening torque
   Engine rear mounting bolt (a): 55 N·m (5.5 kg-m, 40 lb-ft)

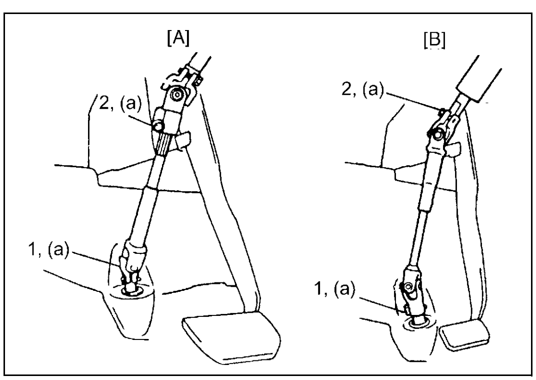
3) Remove transmission jack.



4) Install tie rod ends to knuckles (right & left). Tighten each new tie rod end nut (1) to specified torque.

   Tightening torque
   Tie rod end nut (a): 40 N·m (4.0 kg-m, 29.0 lb-ft)

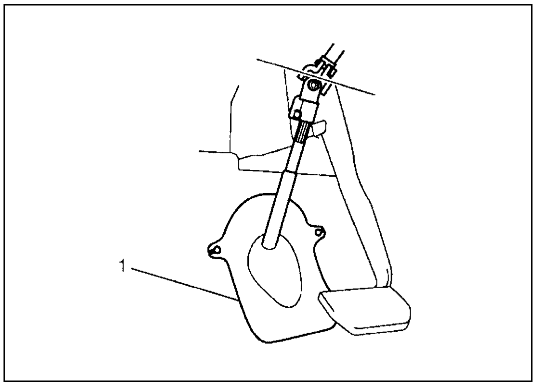
5) Be sure that steering wheel and brake discs (right & left) are all straight-ahead position and then insert steering lower joint into steering pinion shaft.



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

   Tightening torque
   Steering shaft joint bolt (a): 28 N·m (2.8 kg-m, 20.5 lb-ft)

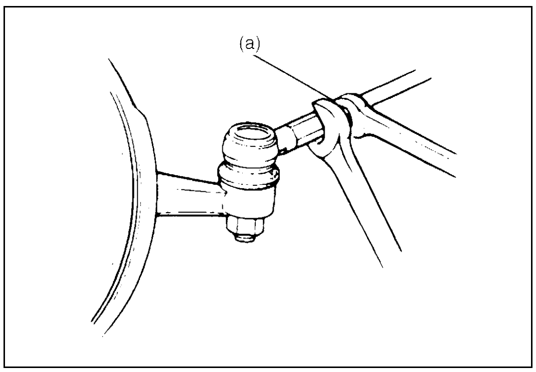
[A]:	Power steering
[B]:	Manual steering



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

Tightening torque
Wheel bolt: 95 N·m (9.5 kg-m, 69.0 lb-ft)

10) Lower hoist.
11) Check toe setting. Adjust as required (refer to “Front Wheel Alignment” in Section 3A).



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

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

Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Engine rear mounting bolt	55	5.5	40.0
Steering gear case mounting bolt and nut	25	2.5	18.0
Steering shaft joint bolt	28	2.8	20.5
Tie rod end lock nut	45	4.5	32.5
Tie rod end nut	40	4.0	29.0
Wheel bolt	95	9.5	69.0

SECTION 3B1

ELECTRICAL POWER STEERING (EPS) SYSTEM (IF EQUIPPED)

WARNING:

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

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

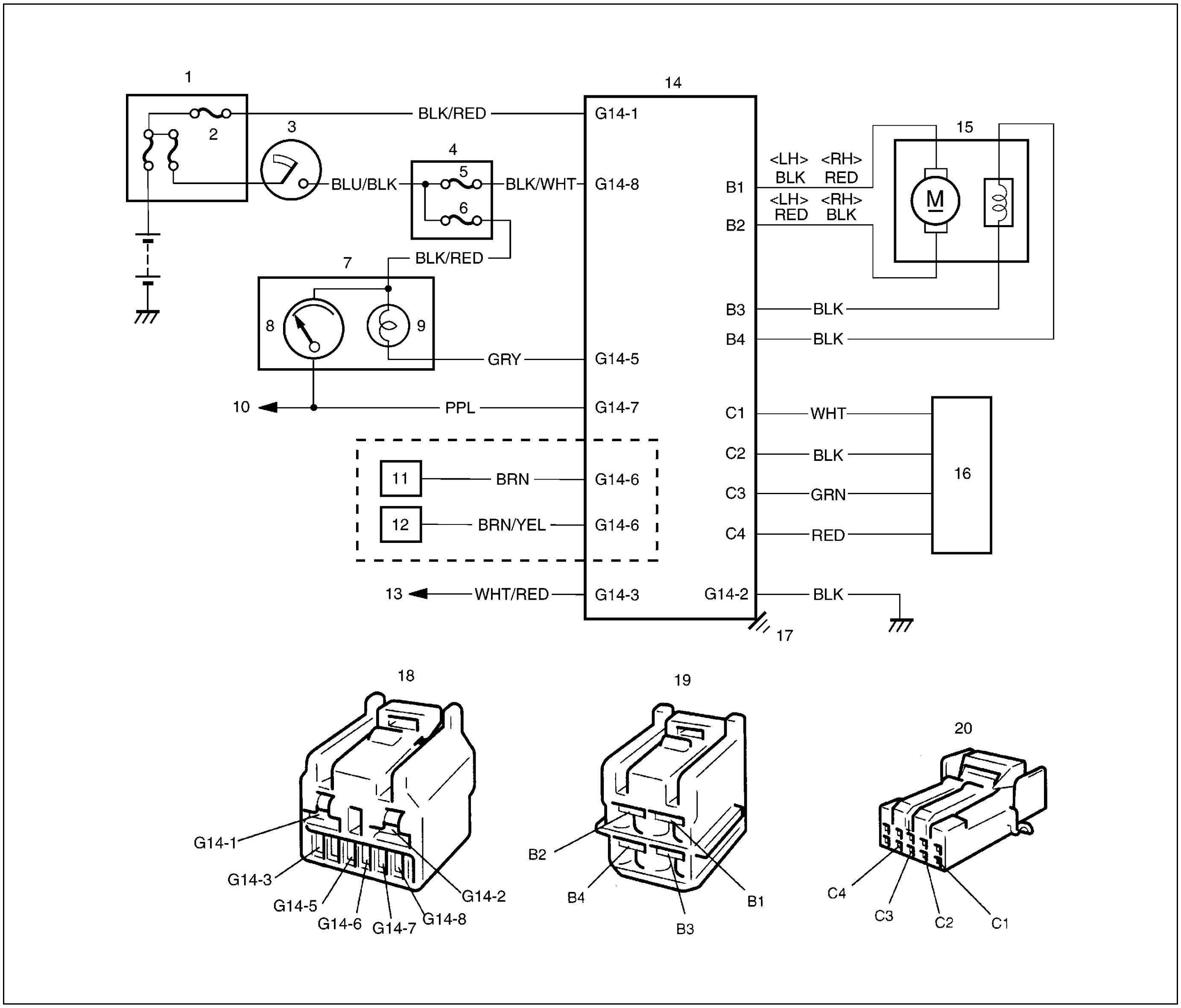
NOTE:

For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.

CONTENTS

General Description

Wiring Diagram



1. Main fuse box	8. Speedometer	15. Motor assembly (with clutch incorporated)
2. “EPS” fuse (30 A)	9. “EPS” warning lamp	16. Torque sensor
3. Ignition switch	10. To vehicle speed sensor (VSS) for G10 engine model, To ECM/PCM for M13 engine model	17. P/S control module body ground
4. Circuit fuse box	11. Noise suppressor for G10 engine model	18. Connector “G14”
5. “IG COIL” fuse (15A)	12. ECM/PCM	19. Connector “B”
6. “METER” fuse (10A)	13. To data link connector (DLC)	20. Connector “C”
7. Combination meter	14. P/S control module	

Diagnosis

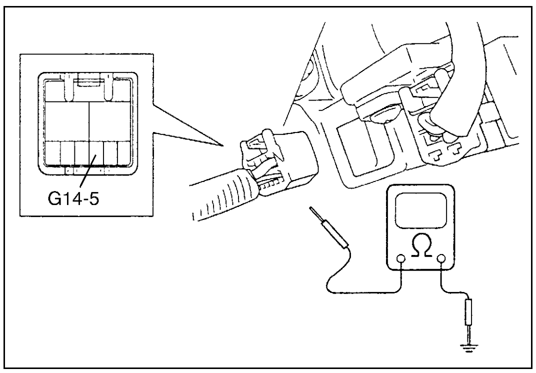
"EPS" Warning Lamp Circuit Check Flow Table for M13 Engine Model

CAUTION:
Be sure to perform "System Check Flow Table" before starting diagnosis according to flow table.

Step	Action	Yes	No
1	1) Make sure that battery voltage is about 11 V or higher. 2) Note "EPS" warning lamp as ignition switch is turned to ON position. Does "EPS" warning lamp come ON when ignition switch is turned to ON position?	Go to Step 2.	Proceed to "Table-A "EPS" Warning Lamp Does Not Light".
2	Check that "EPS" warning lamp lights for 2 sec. and then goes OFF.	"EPS" warning lamp is in good condition.	Check for any DTC referring to "Diagnostic Trouble Code (DTC) Check" in Section 6-1 for G10 engine model or in Section 6-2 for M13 engine model. If there is any, troubleshoot the problem(s). If not, proceed to "Table-B "EPS" Warning Lamp Remains ON".

Table-B "EPS" Warning Lamp Remains ON

Step	Action	Yes	No
1	Was "System Check Flow Table" performed?	Go to Step 2.	Go to "System Check Flow Table" in this section.
2	1) With ignition switch OFF, disconnect 8 pin ("A") connector from P/S control module. 2) Measure resistance between "G14-5" terminal of "A" connector and body ground. Is resistance 1 Ω or less?	Go to step 3.	Substitute a known-good P/S control module and recheck.
3	1) Disconnect "G25" connector from Combination meter. 2) Turn ignition switch to ON position. 3) Check voltage between "G25-9" and body ground. Is it 10 – 14 V?	Replace bulb in combination meter, and then recheck.	Repair short to ground in "G14-5" wire circuit.



[A]: Fig. for Step 2

SECTION 3D

FRONT SUSPENSION

WARNING:

Do not removal all of the wheel bolts at once, because all the wheels of this vehicle are mounted by the wheel bolts.
Leave a bolt at least not to drop the wheel.
Support the wheel and/or tire and then remove the bolt(s) left with the wheel.

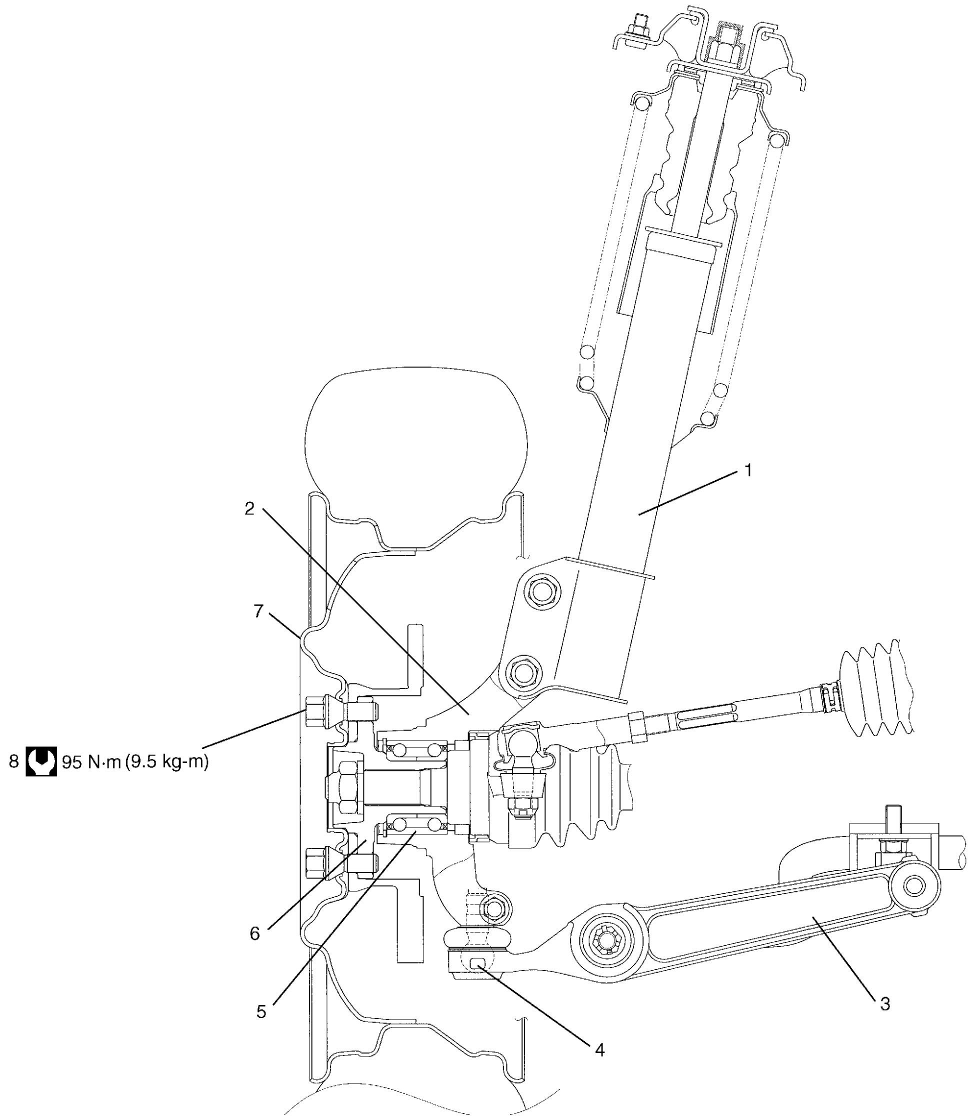
NOTE:

- **All front suspension fasteners are an important attaching part in that it could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.**
- **Never attempt to heat, quench or straighten any front suspension part. Replace it with a new part or damage to the part may result.**
- **For descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.**

CONTENTS

General Description

The front suspension is the strut type independent suspension. The upper end of a strut is anchored to the vehicle body by a strut support. The strut and strut support are isolated by a rubber mount. A strut bearing is also installed a little lower to the rubber mount.
The lower end of the strut is connected to the upper end of a steering knuckle and lower end of knuckle is attached to the stud of a ball joint which is incorporated in a unit with a suspension control arm. And connected to this steering knuckle is the tie-rod end.
Thus, movement of the steering wheel is transmitted to the tie-rod end and then to the knuckle, eventually causing the wheel-and-tire to move. In this operation, with the movement of the knuckle, the strut also rotates by means of the strut bearing and lower ball joint.

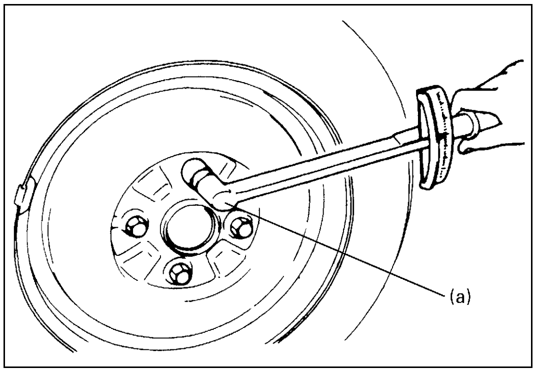


1. Strut assembly	3. Suspension control arm	5. Wheel bearing	7. Wheel	Tightening torque
2. Steering knuckle	4. Ball stud	6. Front wheel hub	8. Wheel bolt	

Diagnosis

Wheel Disc, Bolt & Bearing Check

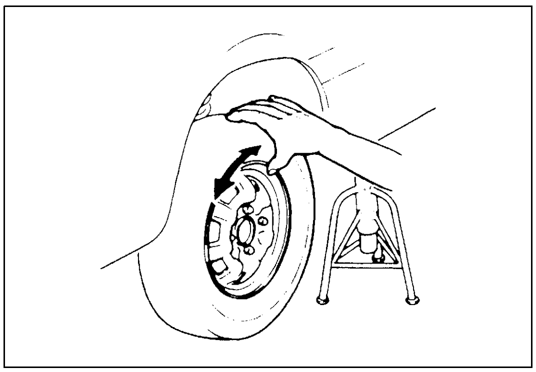
1) Inspect each wheel disc for dents, distortion and cracks. A disc in badly damaged condition must be replaced.



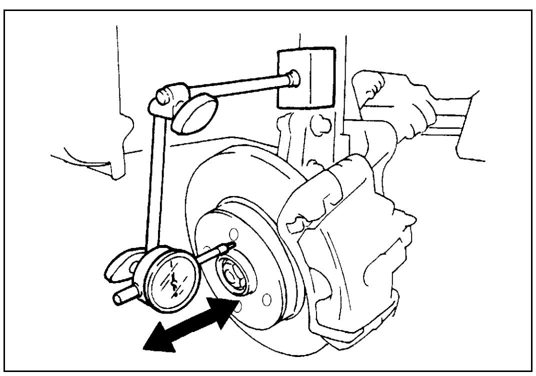
2) Check wheel bolts for tightness and retighten them to specification as necessary.

Tightening torque

Wheel bolt (a): 95 N·m (9.5 kg-m, 69.0 lb-ft)



3) By rotating wheel actually, check wheel bearing for noise and smooth rotation. If defective, replace bearing.



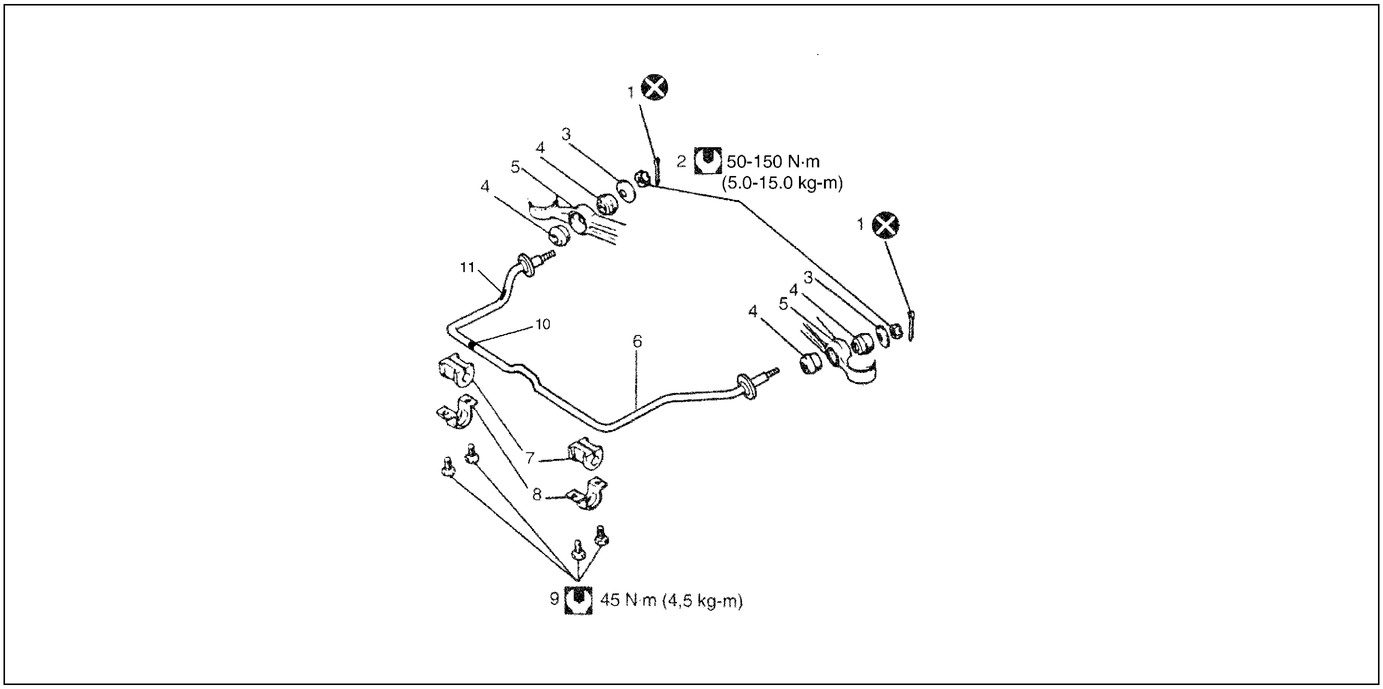
4) Check wheel bearing for wear. When measuring thrust play,
   a) Remove wheel.
   b) Fix brake disc tightening wheel bolts.
   c) Set a dial gauge.
   d) Check wheel bearing for thrust play.
      When measurement exceeds limit, replace bearing.

Thrust play limit “a”: 0.1 mm (0.004 in.)

On-Vehicle Service

Stabilizer Bar and/or Bushings

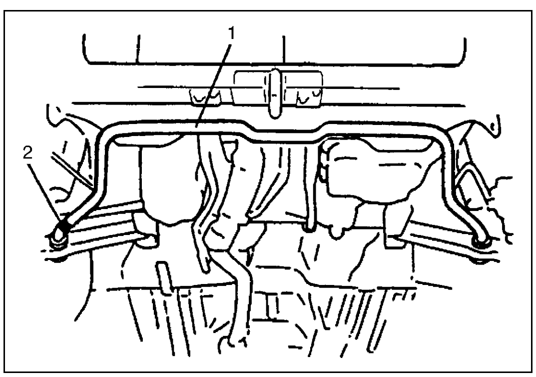
Components



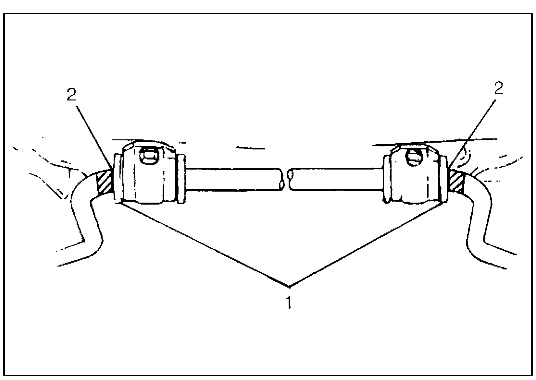
1. Split pin	4. Stabilizer bar bushing	7. Mount bushing	10. Paint mark	Tightening torque
2. Castle nut	5. Suspension control arm	8. Mount bush bracket	11. Paint mark (RH side)	Do not reuse.
3. Stabilizer bar washer	6. Stabilizer bar	9. Mount bracket bolt		

Installation

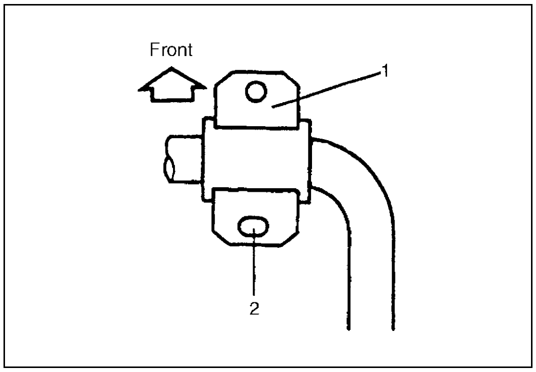
For installation, reverse removal procedure, observing the following instructions.



- Install stabilizer bar (1) so that paint mark (2) on it comes to the right side of vehicle.

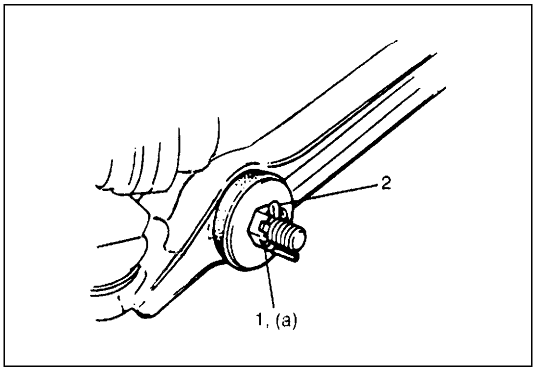


- Align the outside edge (1) of mount bushing with the inside edge (2) of paint as shown in figure.



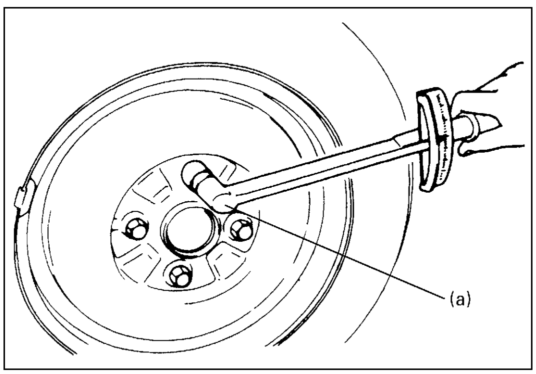
- Install mounting bracket (1) so that its oblong hole side (2) comes to the rear.
- Tighten stabilizer bar bracket bolts to specified torque.

Tightening torque
Stabilizer bar bracket bolt: 45 N·m (4.5 kg-m, 32.5 lb-ft)



- After tightening castle nut (1) to specified torque, install new split pin (2) as shown.

Tightening torque
Castle nut
(a): 50 – 150 N·m (5.0 – 15.0 kg-m, 36.5 – 108.5 lb-ft)



- Install wheels and tighten wheel bolts to specified torque.

Tightening torque
Wheel bolt (a): 95 N·m (9.5 kg-m, 69.0 lb-ft)

Strut Assembly

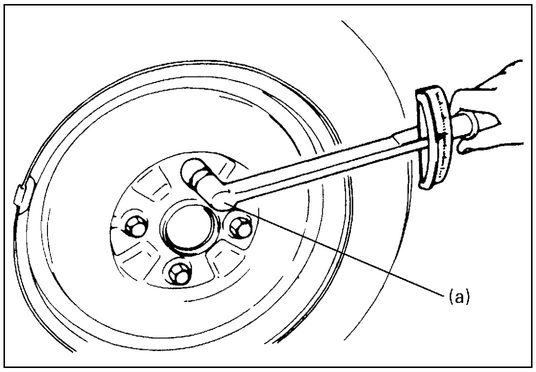
Installation

- Install strut assembly by reversing removal procedure.

CAUTION:
- **Don’t twist brake hose when installing it.**
- **Install E-ring as far as it fits to bracket.**

- Torque all fasteners to specification.

Tightening torque
Strut support nut: 23 N·m (2.3 kg-m, 17.0 lb-ft)
Strut bracket bolt: 115 N·m (11.5 kg-m, 83.5 lb-ft)



- Install wheel and tighten wheel bolts to specified torque.

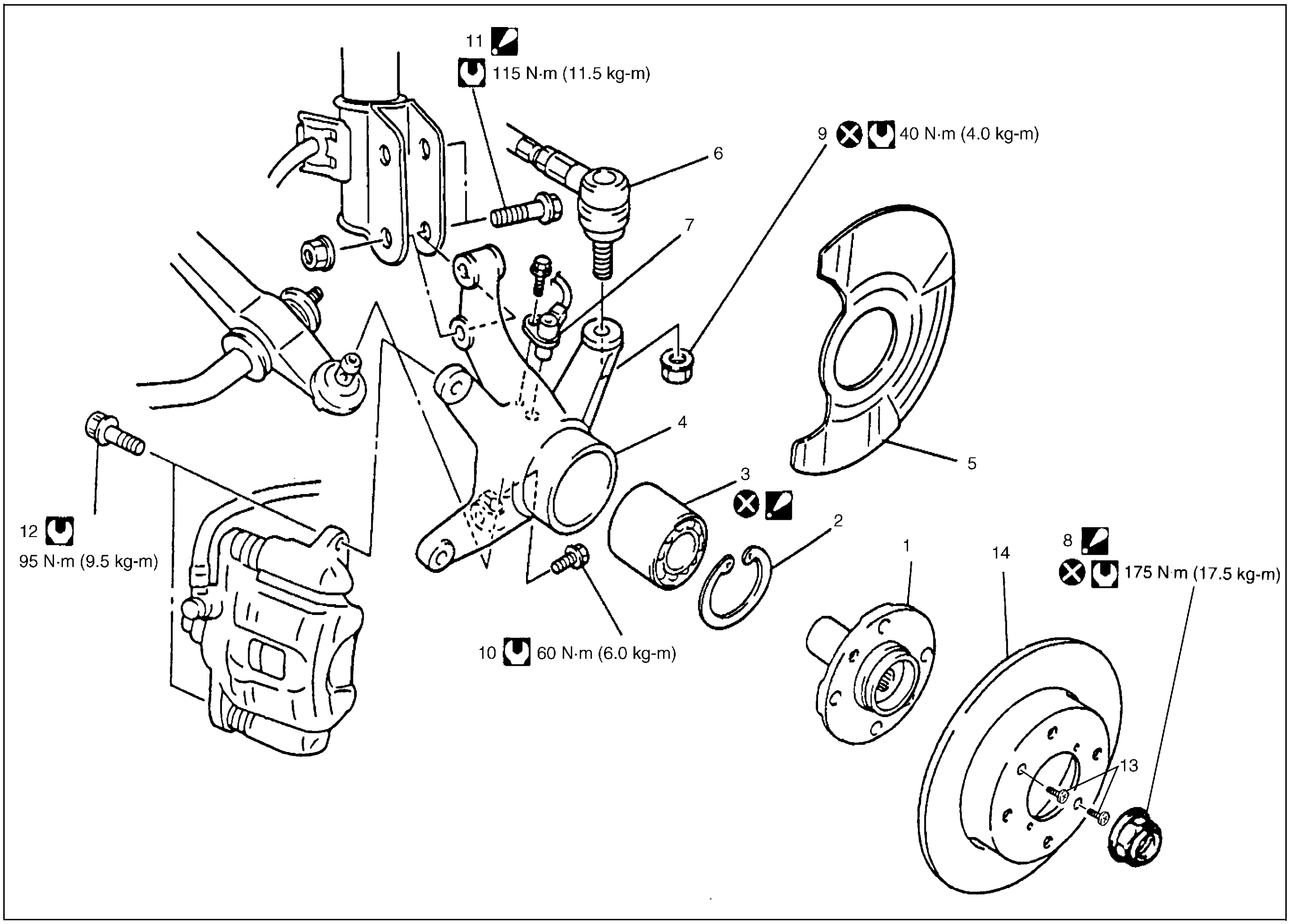
Tightening torque

Wheel bolt (a) 95 N·m (9.5 kg-m, 69.0 lb-ft)

- Confirm front end (wheel) alignment, referring to Section 3A.

Steering Knuckle / Bearing

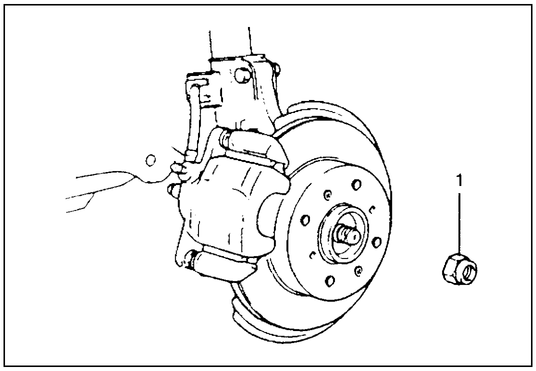
Components



	1. Wheel hub		5. Dust cover		9. Tie-rod end nut		13. Brake disk screw		
	2. Circlip		6. Tie-rod end		10. Control arm ball stud bolt		14. Brake disc		
◪	3. Wheel bearing: Face grooved rubber seal side to wheel hub.		7. Wheel speed sensor (if equipped)	◪	11. Strut bracket bolt: Insert from the direction as shown.	⊔	Tightening torque		
	4. Steering knuckle	◪	8. Drive shaft nut: Calk, after tightening.		12. Brake caliper carrier bolt	⊗	Do not reuse.		

Removal

1) Hoist vehicle and remove wheel.

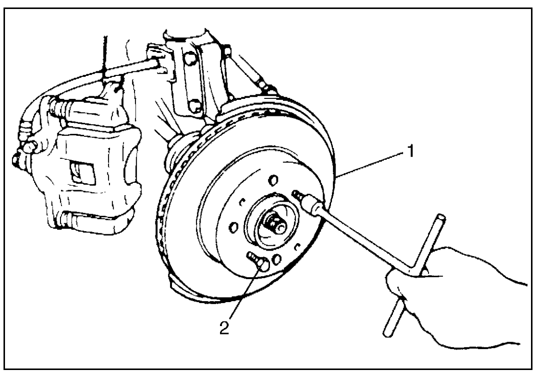


2) Uncaulk drive shaft nut (1).
3) Depress foot brake pedal and hold it there. Remove drive shaft nut.
4) Remove caliper carrier bolts.
5) Remove caliper with carrier.

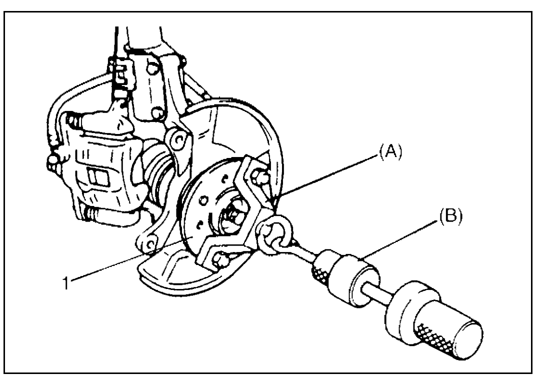
NOTE:

Hang removed caliper with a wire hook of the like so as to prevent brake hose from bending and twisting excessively or being pulled.
Don't operate brake pedal with pads removed.

6) Remove brake disk screws.

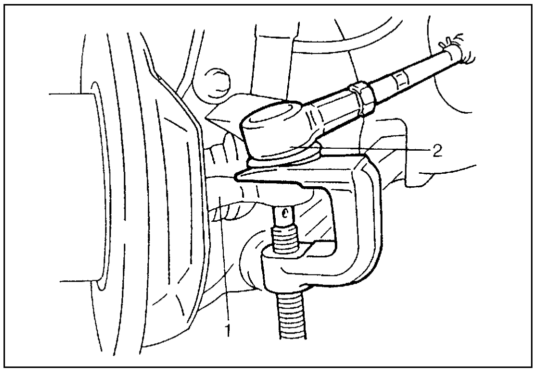


7) Pull brake disc (1) off by using two 8 mm bolts (2).



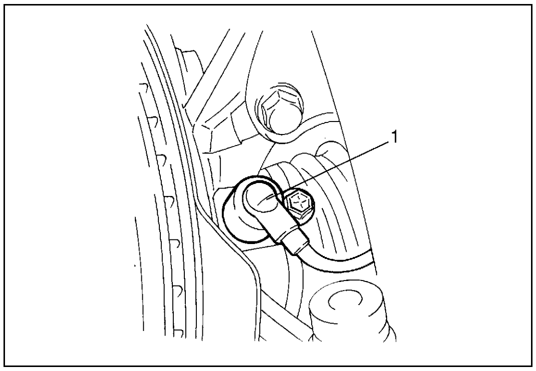
8) Pull out wheel hub (1) with special tools.

Special tool
(A): 09943-17912
(B): 09942-15511

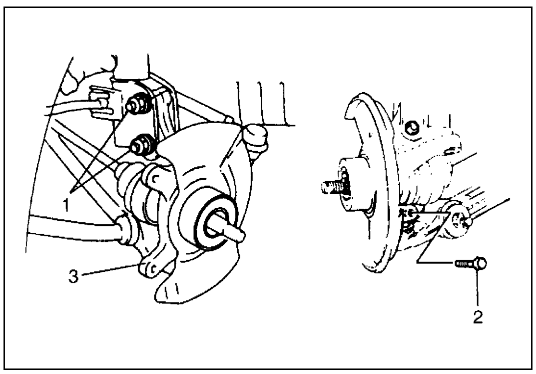


9) Remove tie-rod end nut and disconnect tie-rod end (2) from knuckle (1) with puller.

> **CAUTION:**
> - **Never reuse tie-rod end nut.**
> - **Reused nut will not be locked securely.**

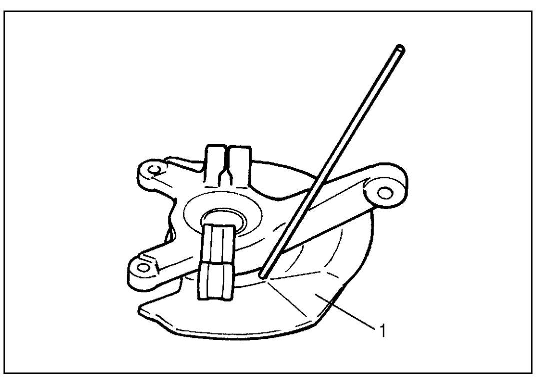


10) Remove wheel speed sensor (1) from knuckle (if equipped).

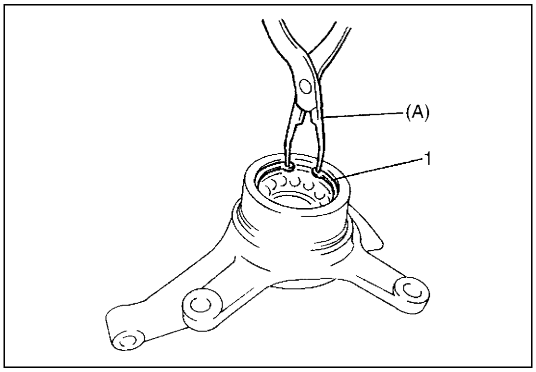


11) Remove strut bracket bolts (1) from strut bracket and then control arm ball stud bolt (2).
12) Remove knuckle (3).

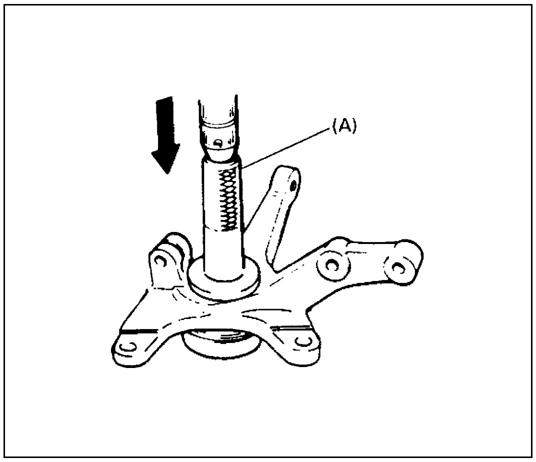
Disassembly



1) Uncaulk and remove dust cover (1).



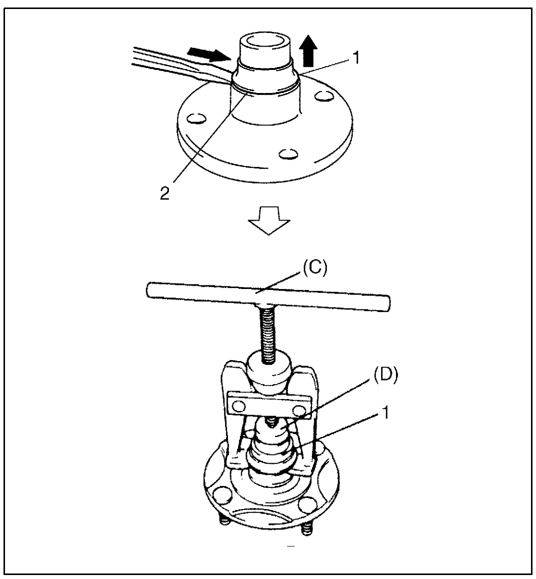
2) Remove circlip (1).
Special tool
(A): 09900-06108



3) Remove wheel bearing using special tool and hydraulic press.

Special tool
(A): 09913-75810 (for gasoline engine model)
(A): 09913-85210 (for diesel engine model)

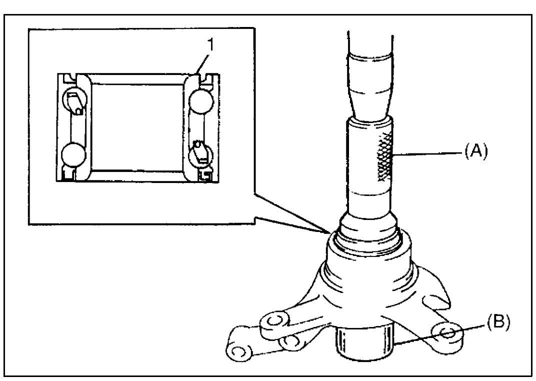
CAUTION:
- **Never reuse wheel bearing.**
- **When replacing bearing, inner races or outer race, be sure to replace them with new ones as a set.**



4) Remove wheel bearing outside inner race (1) as shown by hammering lightly at 3 locations around it so as not to cause damage to seating part (2) of wheel hub.

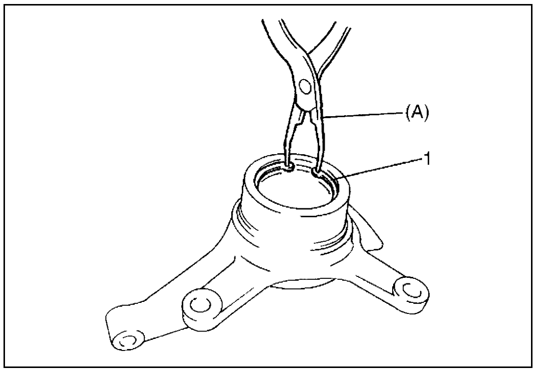
Special tool
(C): 09913-61110
(D): 09925-88210

Assembly



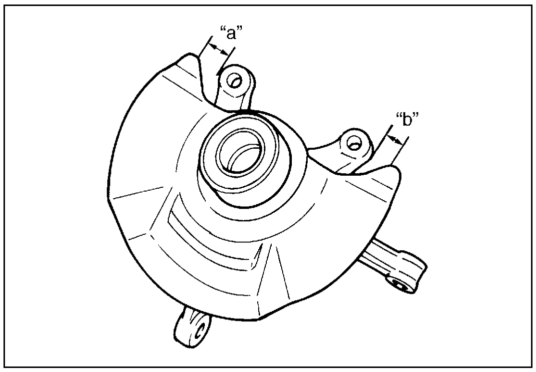
1) Face grooved rubber seal side (1) of new wheel bearing upward as shown and press-fit new wheel bearing into knuckle using special tools.

Special tool
(A): 09913-75520 (for gasoline engine model)
(A): 09913-75510 (for diesel engine model)
(B): 09951-18210



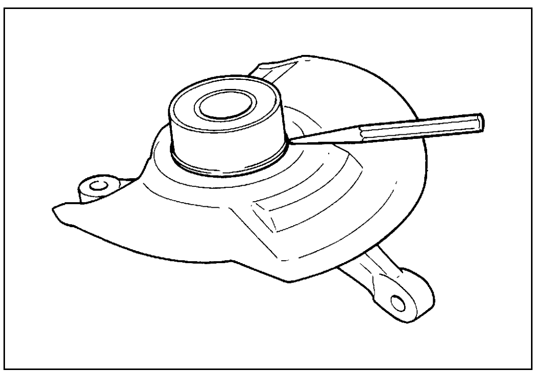
2) Install circlip (1).

Special tool
(A): 09900-06108



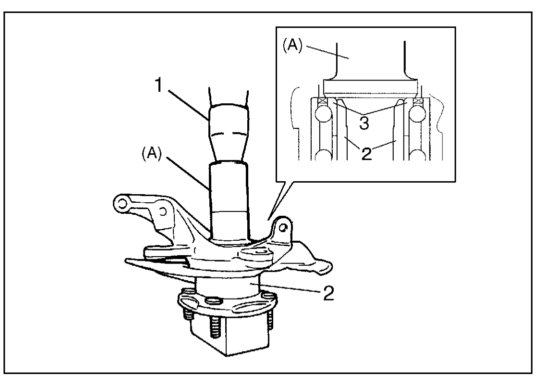
3) Drive in dust cover (1) so that dimensions "a" and "b" become equal as shown.

CAUTION:
When drive in dust cover, be careful not to deform it.



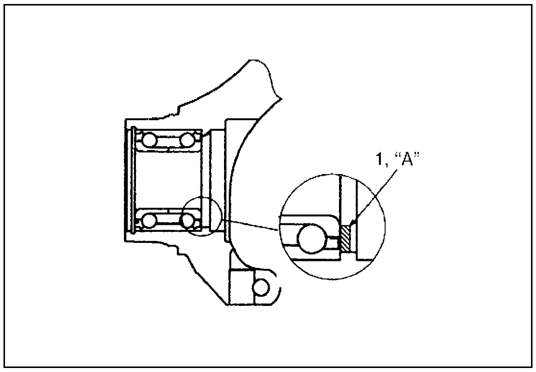
4) Caulk with a punch.

Installation



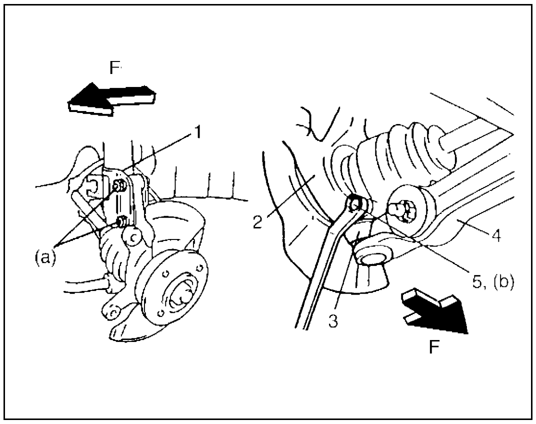
1) Using special tools and hydraulic press (1), drive wheel hub (2) into wheel bearing (3) as shown.

Special tool
(A): 09913-75810



- Apply grease lightly to contact part (1) of wheel bearing and drive shaft.

"A": Grease 99000-25050



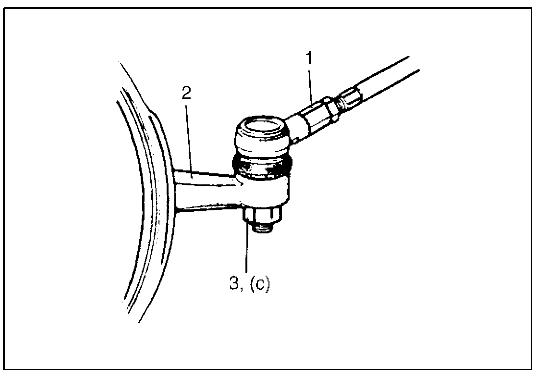
2) Install knuckle (2) to ball stud (3) on suspension control arm (4) and strut bracket (1). Installing direction of each bolt is as shown.
   Align knuckle bolt hole with ball stud groove and install control arm ball stud bolt (5). Tighten each bolt and nuts to specified torque.

Tightening torque

Strut bracket bolt (a): 115 N·m (11.5 kg-m, 83.5 lb-ft)

Control arm ball stud bolt (b): 60 N·m (6.0 kg-m, 43.5 lb-ft)

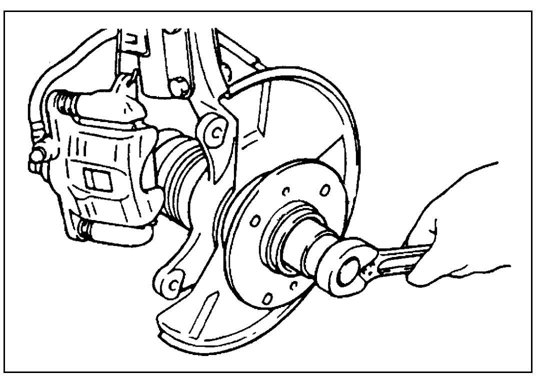
F. Forward



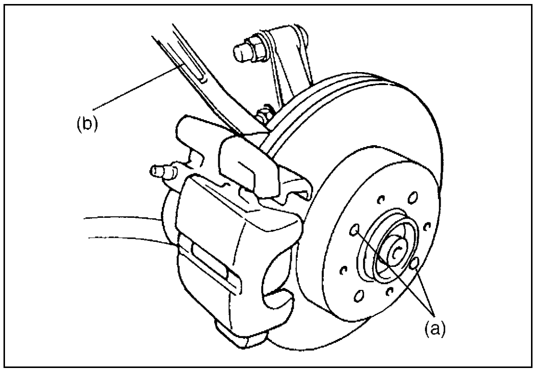
3) Install wheel speed sensor (if equipped).
4) Connect tie-rod end (1) to knuckle (2) and install new tie-rod end nut.
   Tighten tie-rod end nut (3) to specified torque.

Tightening torque

Tie-rod end nut (c): 40 N·m (4.0 kg-m, 29.0 lb-ft)



5) Tighten new drive shaft nut temporarily.

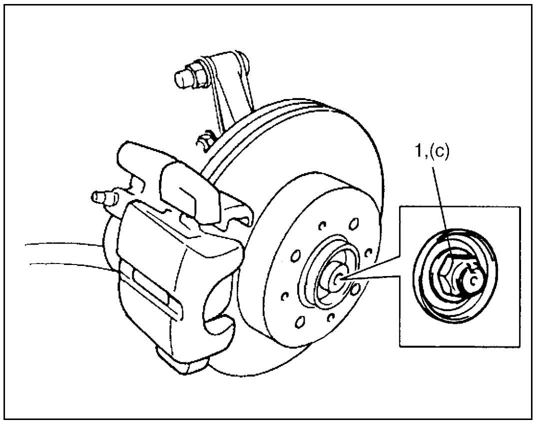


6) Install brake disc.
7) Tighten brake disc screws.

Tightening torque
Brake disc screw (a): 9 Nm (0.9 kg-m, 6.5 lb-ft)

8) Install brake caliper/caliper carrier.
9) Tighten caliper carrier bolts to specified torque.

Tightening torque
Brake caliper carrier bolt (b): 95 N·m (9.5 kg-m, 69.0 lb-ft)



10) Depress foot brake pedal and hold it there.
Tighten new drive shaft nut (1) to specified torque.

Tightening torque
Drive shaft nut (c): 175 N·m (17.5 kg-m, 127.0 lb-ft)

11) Calk drive shaft nut as shown.

CAUTION:
Be careful while caulking nut so that no crack will occur in caulked part of nut. Cracked nut must be replaced with new one.

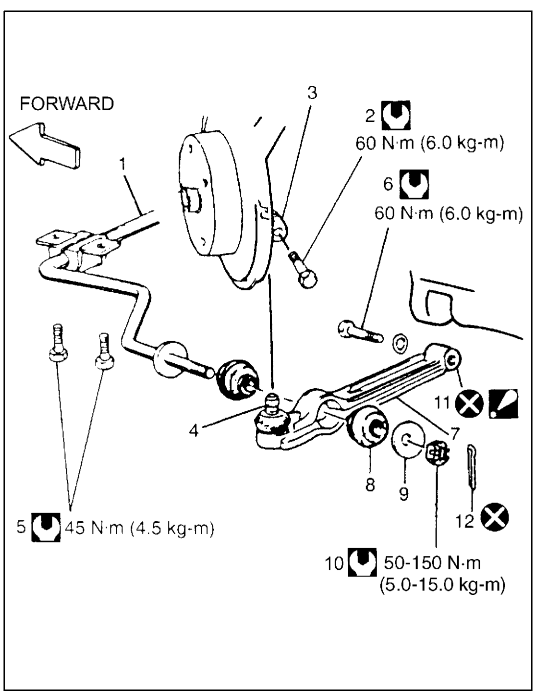
12) Install wheel and tighten wheel bolts to specified torque.

Tightening torque
Wheel bolt: 95 N·m (9.5 kg-m, 69.0 lb-ft)

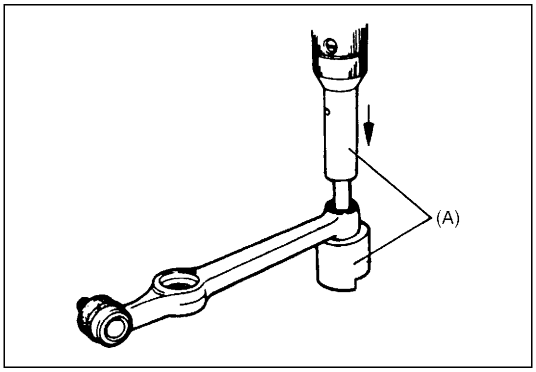
Suspension Control Arm / Bushing

Removal

1) Hoist vehicle and remove wheel referring to “Wheel Removal” in Section 3F.
2) Remove split pin (12), stabilizer bar nut (10), washer (9) and bushing (8).
3) Remove stabilizer bar mount bracket (right & left) bolts (5).
4) Remove ball stud bolt (2).
5) Remove suspension Control arm mounting bolt (6) and washer.
6) Remove suspension control arm (7).



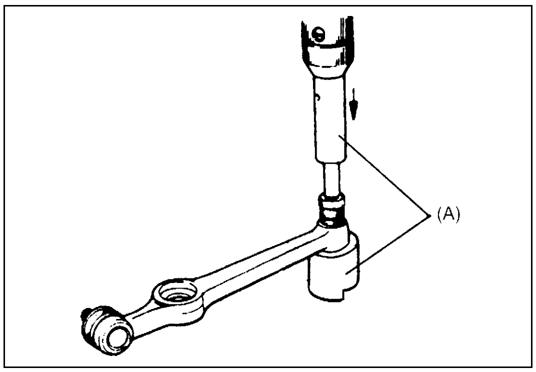
1. Stabilizer bar	8. Stabilizer bar bushing
2. Control arm ball stud bolt	9. Washer
3. Knuckle	10. Stabilizer bar nut
4. Ball stud	11. Suspension control arm bushing: Before installing, apply soap water.
5. Stabilizer bar bracket bolt	12. Split pin
6. Control arm mounting bolt	Tightening torque
7. Suspension control arm	Do not reuse.



7) Remove bushing.
   Place suspension control arm onto flat surface side of special tool and push out bushing with special tool and oil hydraulic press as shown.

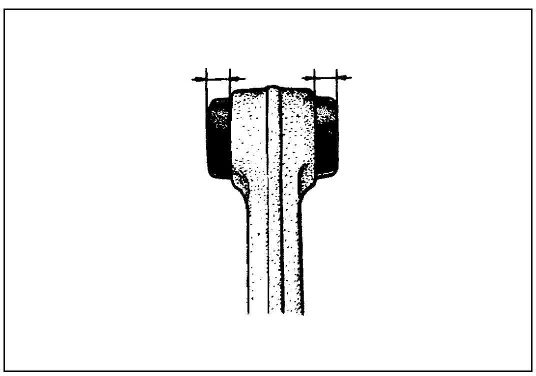
Special tool
(A): 09943-77910

Installation

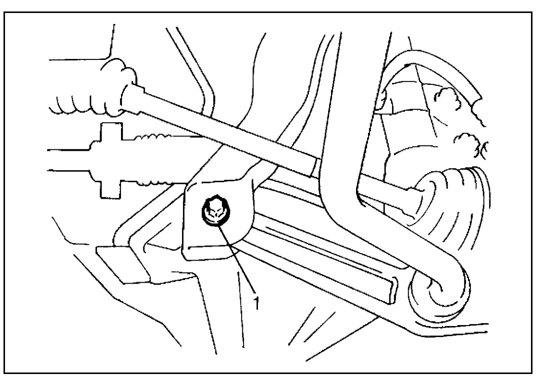


1) Place suspension control arm onto flat surface side of special tool and install new bushing with special tool and oil hydraulic press as shown.

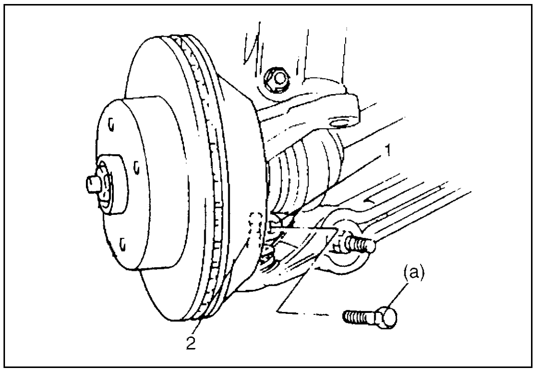
Special tool
(A): 09943-77910



NOTE:
- **Before installing bushing, apply soap water on its circumference to facilitate installation.**
- **When installed, bush should be equal on the right and left of arm as shown.**

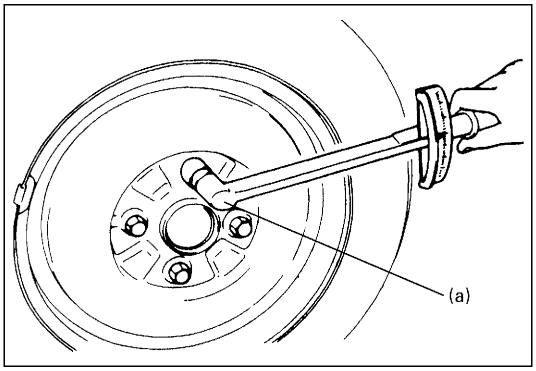


2) Install suspension control arm to vehicle body and tighten suspension Control arm mounting bolt (1) and washer temporarily.



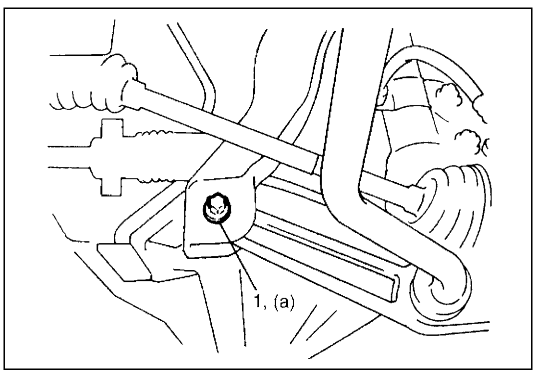
3) Install ball stud (2) to knuckle (1). Align ball stud groove with knuckle bolt hole as shown.
   Then install ball stud bolt from the direction as shown. Tighten control arm ball stud bolt to specified torque.

Tightening torque
Control arm ball stud bolt
(a): 60 N·m (6.0 kg-m, 43.5 lb-ft)



4) Install wheel and tighten wheel bolts to specified torque.

Tightening torque
Wheel bolt (a): 95 N·m (9.5 kg-m, 69.0 lb-ft)



5) Lower hoist and vehicle in non-loaded condition, tighten control arm mounting bolt (1) to specified torque.

Tightening torque
Control arm mounting bolt (a): 60 N·m (6.0 kg-m, 43.5 lb-ft)

- Install stabilizer bar, referring to “Stabilizer Bar Installation” in this section.

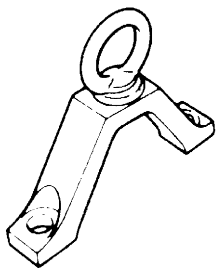
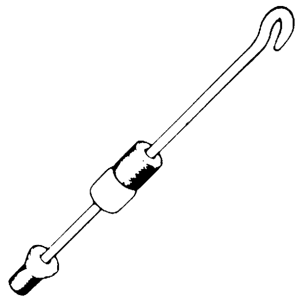
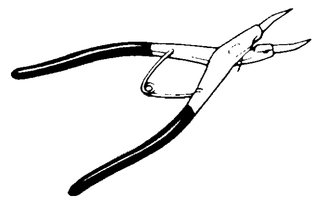
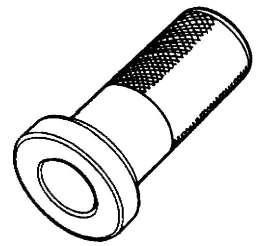
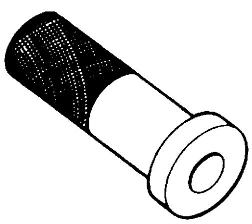
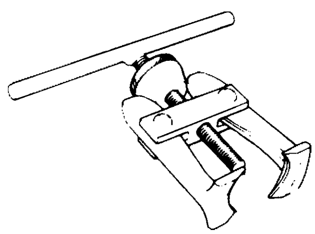
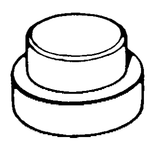
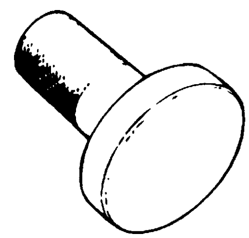
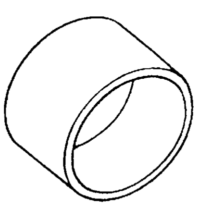
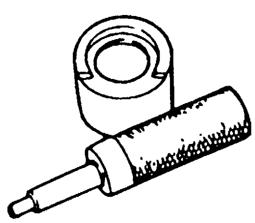
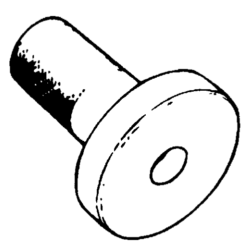
Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Brake caliper carrier bolt	95	9.5	69.0
Brake disk screw	9	0.9	6.5
Castle nut	50 – 150	5.0 – 15.0	36.5 – 108.5
Control arm ball stud bolt	60	6.0	43.5
Control arm mounting bolt	60	6.0	43.5
Drive shaft nut	175	17.5	127.0
Stabilizer bar bracket bolt	45	4.5	32.5
Strut bracket bolt	115	11.5	83.5
Strut support nut	23	2.3	17.0
Tie-rod end nut	40	4.0	29.0
Wheel bolt	95	9.5	69.0

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium Grease (Should be applicable for –40 C° – 130 °C or –40 °F – 266 °F)	SUZUKI SUPER GREASE (E) (99000-25050)	• Wheel bearing

Special Tool

 09943-17912 Front wheel hub remover	 09942-15511 Sliding hammer	 09900-06108 Snap ring pliers (closing type)	 09913-75810 Bearing installer (for gasoline engine model)
 09913-85210 (for diesel engine model)	 09913-61110 Bearing puller	 09925-88210 Bearing puller attachment	 09913-75510 Bearing installer (for diesel engine model)
 09951-18210 Remover booster body oil No.2	 09943-77910 Suspension lower arm bush remover	 09913-75520 Bearing installer (for gasoline engine model)	

SECTION 3E

REAR SUSPENSION

WARNING:

Do not removal all of the wheel bolts at once, because all the wheels of this vehicle are mounted by the wheel bolts.
Leave a bolt at least not to drop the wheel.
Support the wheel and/or tire and then remove the bolt(s) left with the wheel.

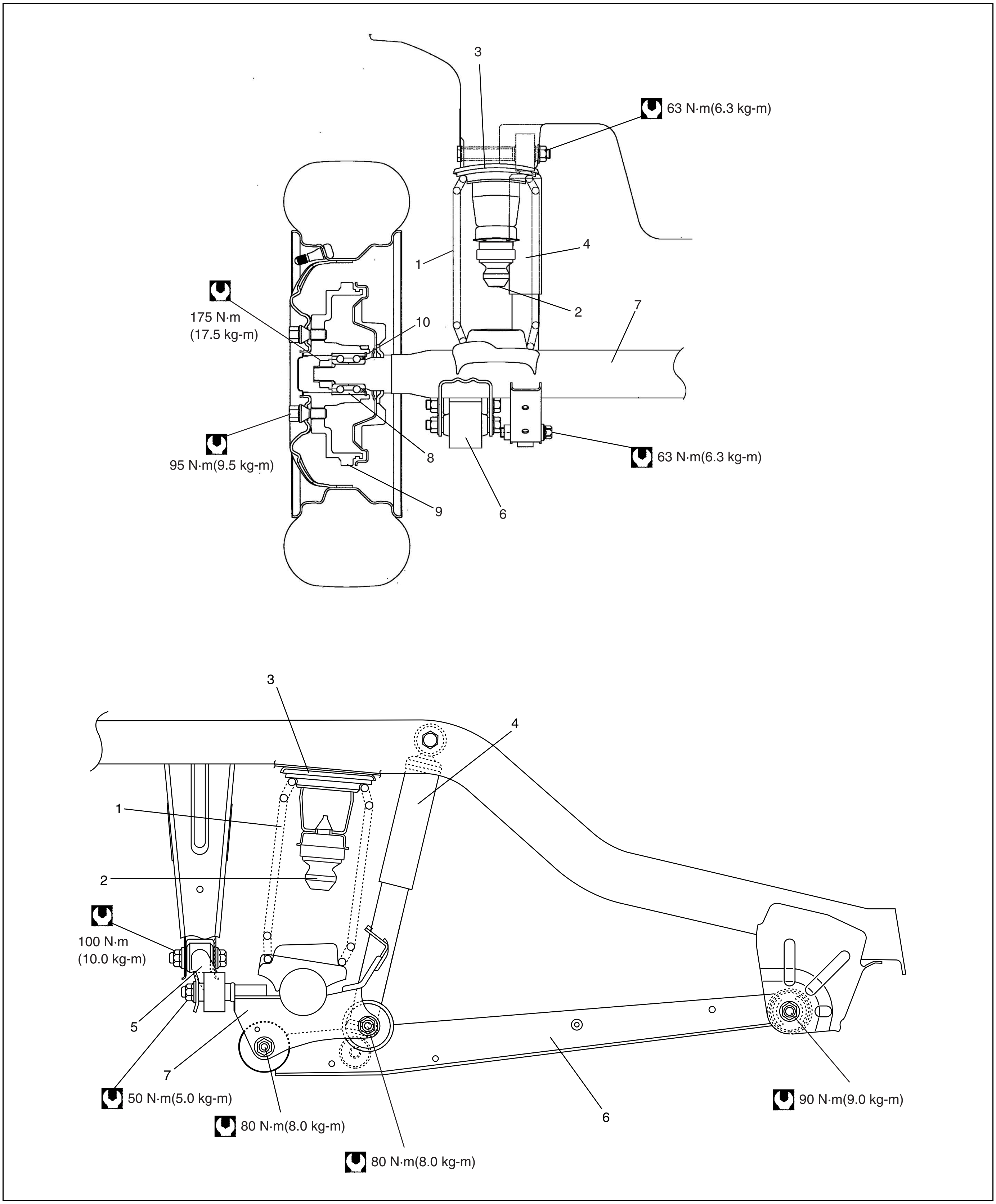
NOTE:

- **All suspension fasteners are an important attaching part in that it could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.**
- **Never attempt to heat, quench or straighten any suspension part. Replace it with a new part, or damage to the part may result.**
- **For descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.**

CONTENTS

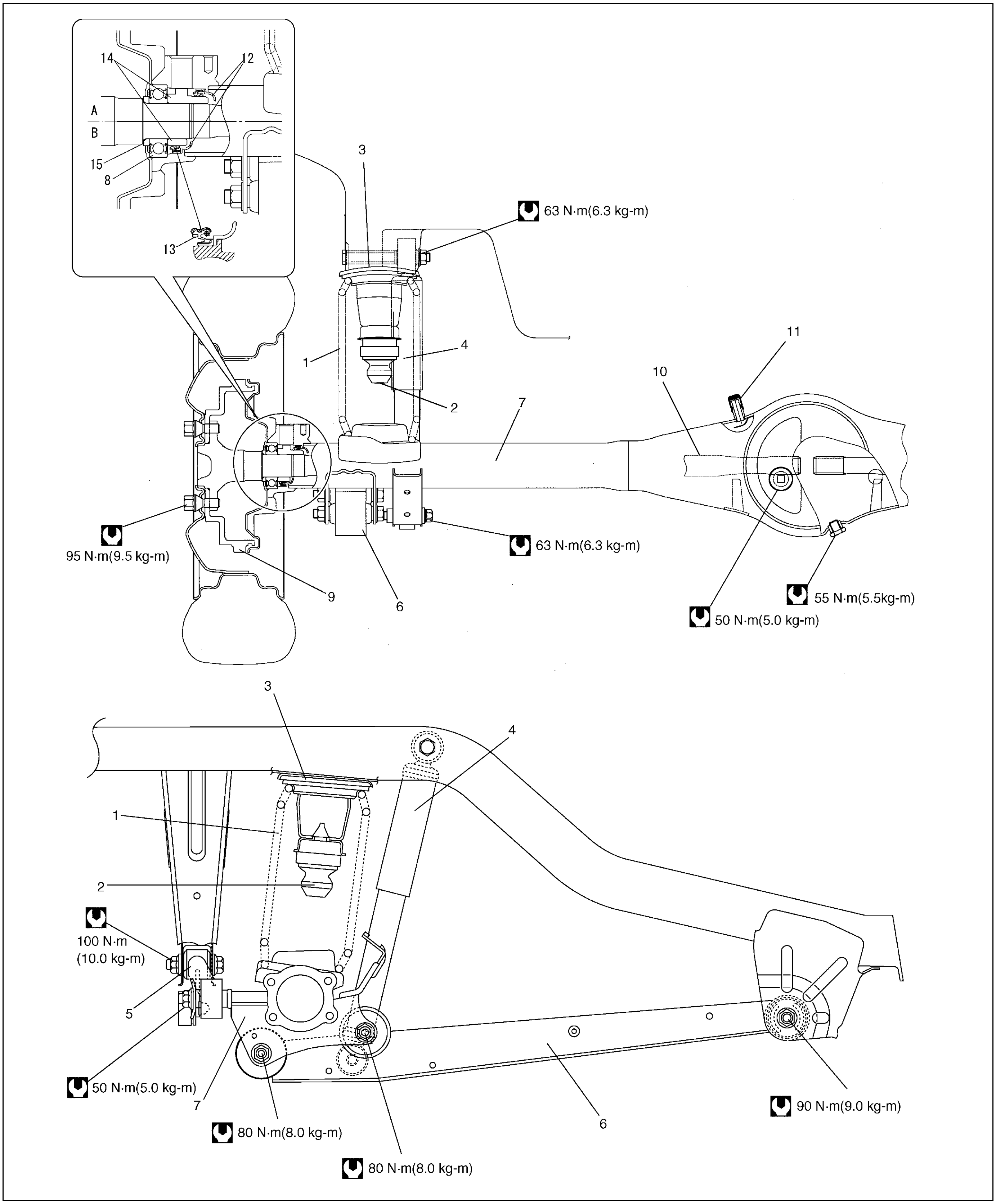
General Description

2WD model



1. Rear coil spring	4. Rear shock absorber	7. Rear axle	10. Circlip
2. Rear bump stopper	5. Lateral rod	8. Wheel bearing	Tightening torque
3. Rear spring upper seat	6. Trailing arm	9. Brake drum	

4WD model

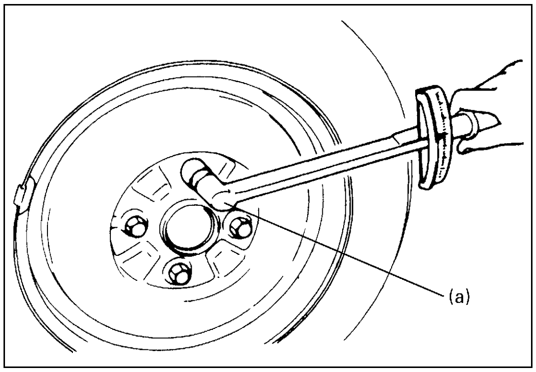


A: With ABS	4. Rear shock absorber	9. Brake drum	14. Wheel bearing retainer ring or rear wheel sensor ring (if equipped with ABS)
B: Without ABS	5. Lateral rod	10. Rear axle shaft	15. Spacer
1. Rear coil spring	6. Trailing arm	11. Breather cap	Tightening torque
2. Rear bump stopper	7. Rear axle housing	12. Oil seal protector	
3. Rear spring upper seat	8. Wheel bearing	13. Oil seal	

Diagnosis

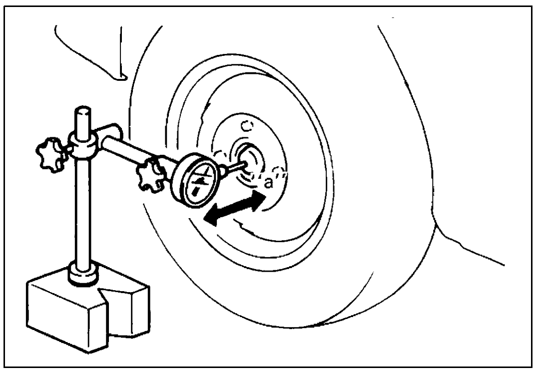
Wheel Disc, Bolt and Bearing Check

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



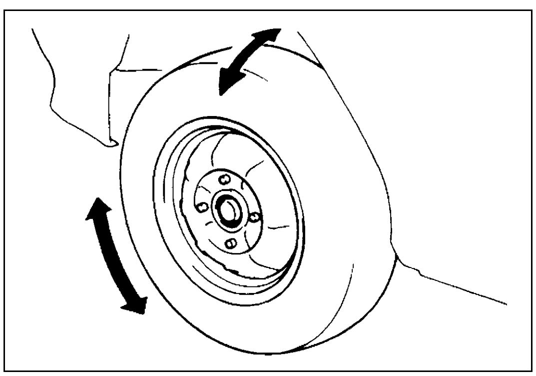
- Check wheel bolts for tightness and, as necessary, retighten to specification.

Tightening torque
Wheel bolt (a): 95 N·m (9.5 kg-m, 69.0 lb-ft)



- Check wheel bearings for wear. When measuring thrust play, apply a dial gauge to spindle cap center.
  When measurement exceeds limit, replace bearing.

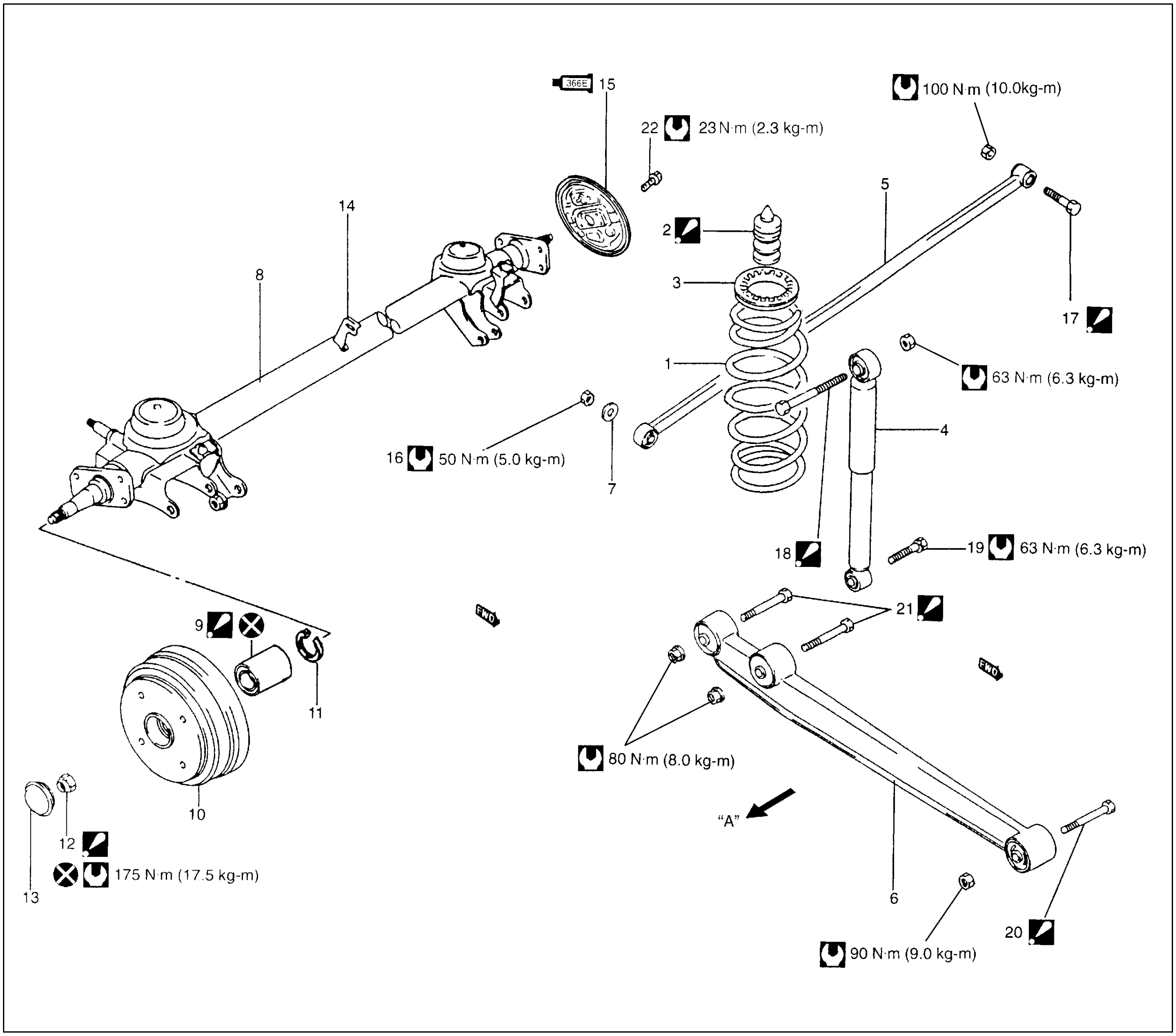
Thrust play limit “a”: 0.1 mm (0.004 in.)



- By rotating wheel actually, check wheel bearing for noise and smooth rotation. If it is defective, replace bearing.

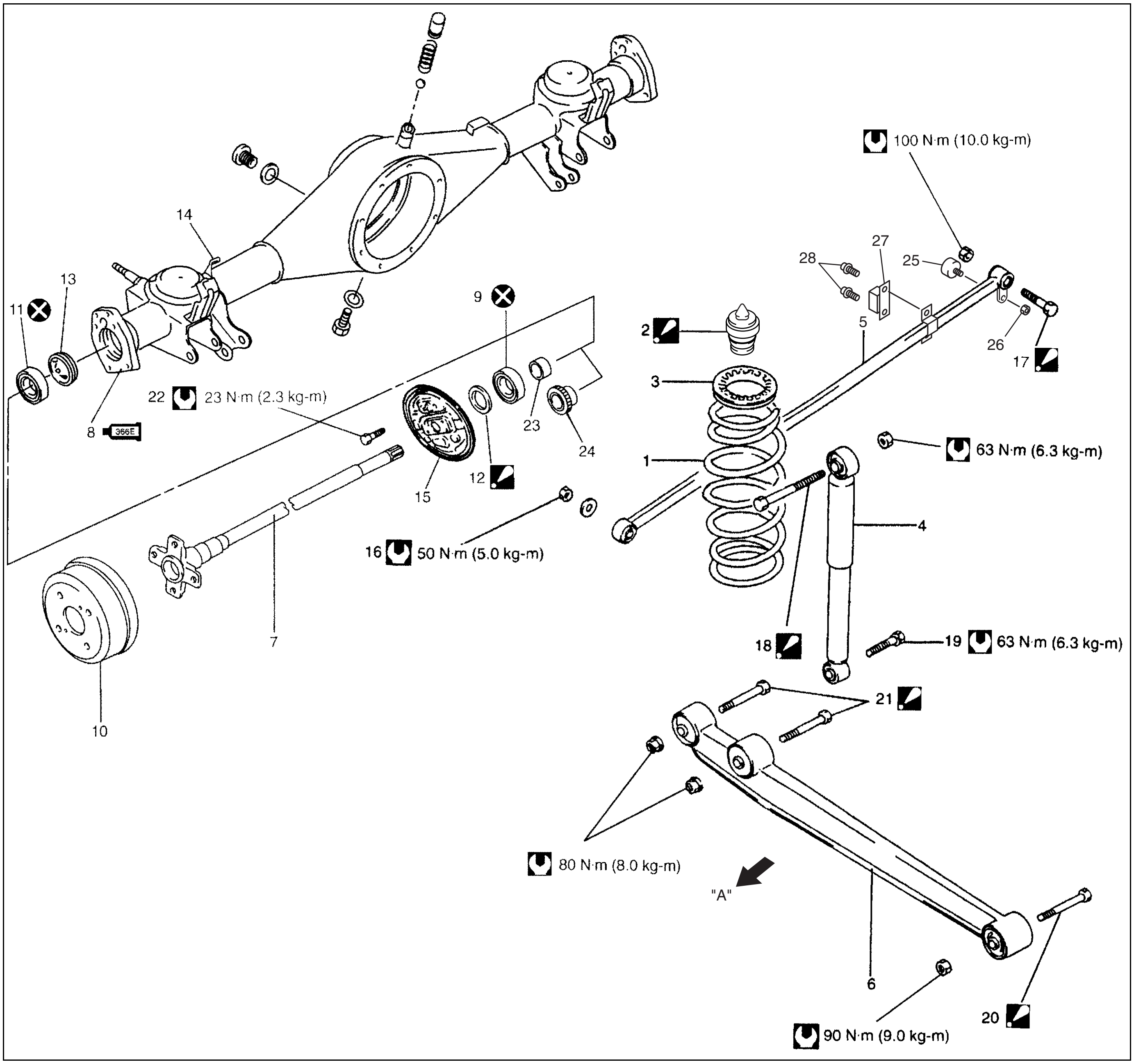
On-Vehicle Service

2WD model



"A": Body outside	7. Lateral rod outer washer	14. LSPV bracket (only vehicle with LSPV)	21. Trailing arm rear bolt: Insert from vehicle inside.
1. Rear coil spring	8. Rear axle	15. Brake back plate: Apply water tight sealant 99000-31090 to joint of plate and axle.	22. Brake back plate bolt
2. Rear bump stopper: Apply soap water, when installing.	9. Bearing: Seal side of bearing comes brake back plate side.	16. Lateral rod axle side nut	Tightening torque
3. Rear spring upper seat	10. Brake drum	17. Lateral rod body side bolt: Insert from the direction as shown.	Do not reuse.
4. Rear shock absorber	11. Circlip	18. Shock absorber upper bolt: Insert from vehicle out-side.	
5. Lateral rod	12. Spindle nut: Caulk, after tightening.	19. Shock absorber lower bolt	
6. Trailing arm	13. Spindle cap	20. Trailing arm front bolt: Insert from vehicle inside.	

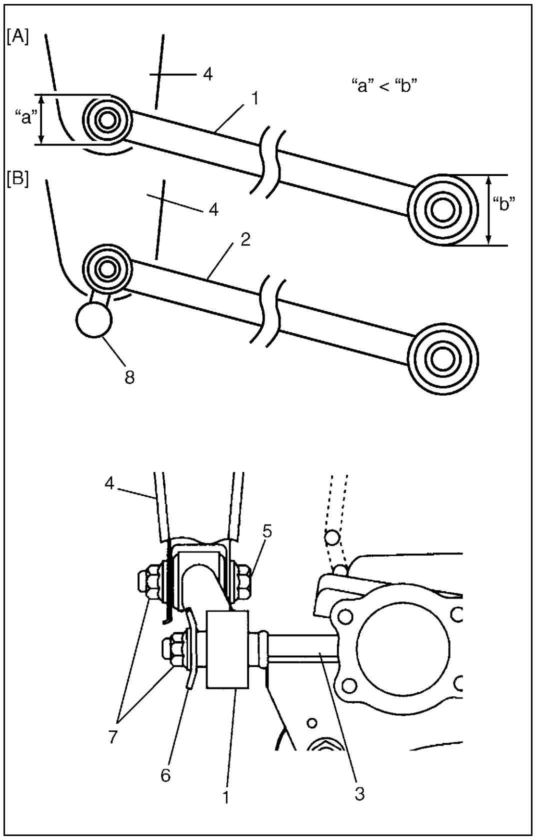
4WD model



“A”:	Body outside		11. Oil seal		22. Brake back plate bolt
	1. Rear coil spring		12. Spacer: The tapered side of spacer inner diameter directed toward outside (brake drum side).		23. Bearing retainer ring (without ABS)
	2. Rear bump stopper: Apply soap water, when installing.		13. Oil seal protector		24. Bearing retainer ring (with ABS)
	3. Rear spring upper seat		14. LSPV bracket (only vehicle with LSPV)		25. Lateral rod dumper
	4. Rear shock absorber		15. Brake back plate		26. Lateral rod dumper nut
	5. Lateral rod		16. Lateral rod axle housing side nut		27. Lateral rod dumper
	6. Trailing arm		17. Lateral rod body side bolt: Insert from the direction as shown.		28. Lateral rod dumper bolt
	7. Rear axle shaft		18. Shock absorber upper bolt: Insert from vehicle outside.		Tightening torque
366E	8. Rear axle housing: Apply water tight sealant 99000-31090 to joint of plate and axle housing.		19. Shock absorber lower bolt		Do not reuse.
	9. Bearing		20. Trailing arm front bolt: Insert from vehicle inside.		
	10. Brake drum		21. Trailing arm rear bolt: Insert from vehicle inside.		

Lateral Rod

Installation

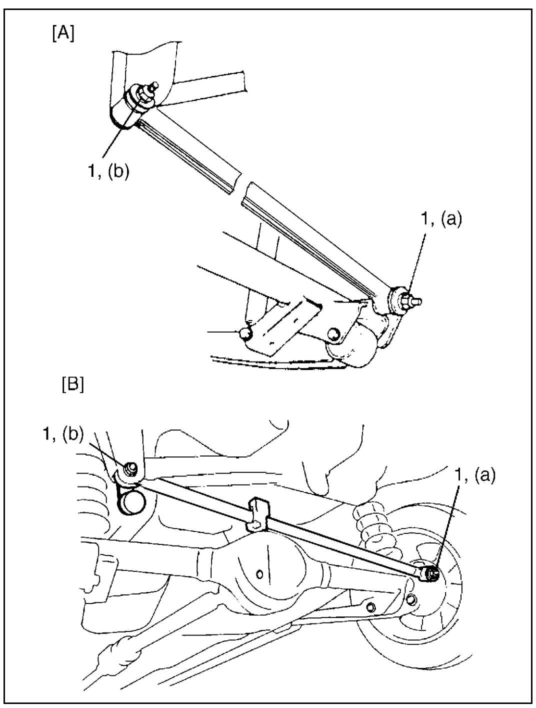


1) Install lateral rod (1) or (2) to rear axle (or axle housing) (3) and vehicle body (4) referring to figure for proper installing direction of bolt (5) and washer (6).
   Tighten nuts (7) temporarily at this step.

NOTE:

- **When installing Rod (1) for 2WD, identify rod end by smaller diameter "a" and install that end to vehicle body side.**
- **When installing rod (2) for 4WD, identify rod end by damper (8) and install that end to vehicle body side. Also make sure that both dampers are directed rearward of vehicle.**

[A]:	2WD model
[B]:	4WD model



2) Lower hoist.
3) Tighten lateral rod nuts (1) to specified torque. It is the most desirable to have vehicle off hoist and in non-loaded condition when tightening them.

Tightening torque

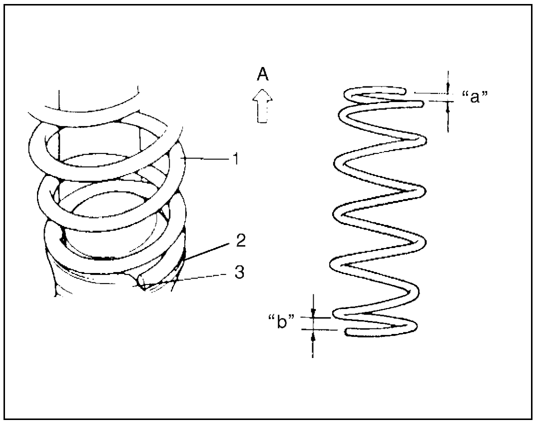
Lateral rod nut (axle side) (a): 50 N·m (5.0 kg-m, 36.5 lb-ft)

Lateral rod nut (body side) (b): 100 N·m (10.0 kg-m, 72.5 lb-ft)

[A]:	2WD model
[B]:	4WD model

Coil Spring

Installation

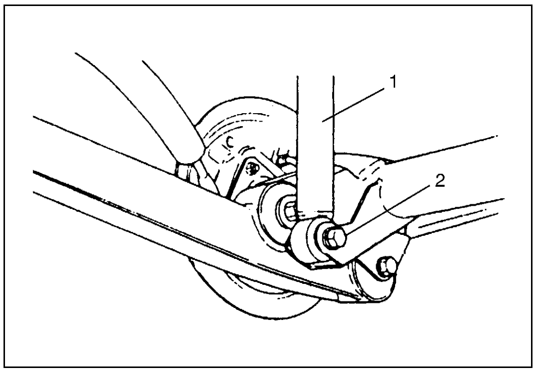


1) Install coil springs (1) (right & left) on spring seat (2) of rear axle as shown in figure and then raise rear axle.

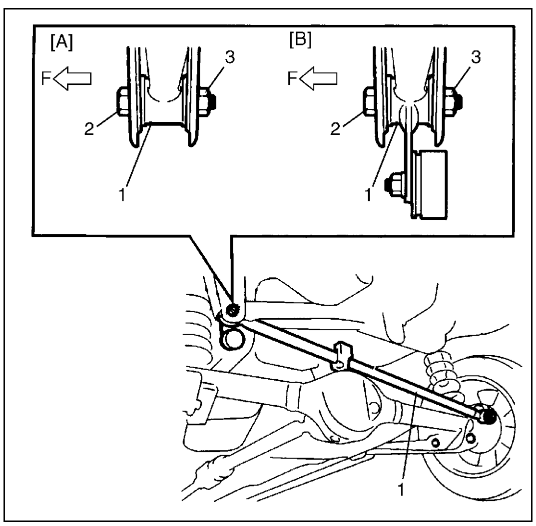
NOTE:

When seating coil spring (1), mate spring end with stepped part (3) of rear axle spring seat as shown.

A.	Upper side
"a":	Small
"b":	Large



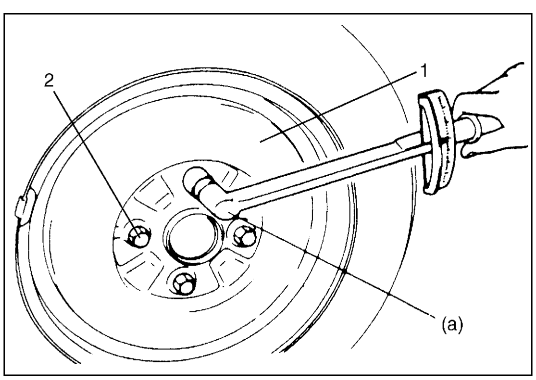
2) Install shock absorber (1) lower side to rear axle (or axle housing).
   Tighten shock absorber lower bolt (2) temporarily by hand at this step.



3) Install lateral rod (1) to vehicle body, referring to the figure for proper installing direction of bolt (2).
   Tighten nut (3) temporarily by hand at this step.
4) Remove floor jack from rear axle (or axle housing).

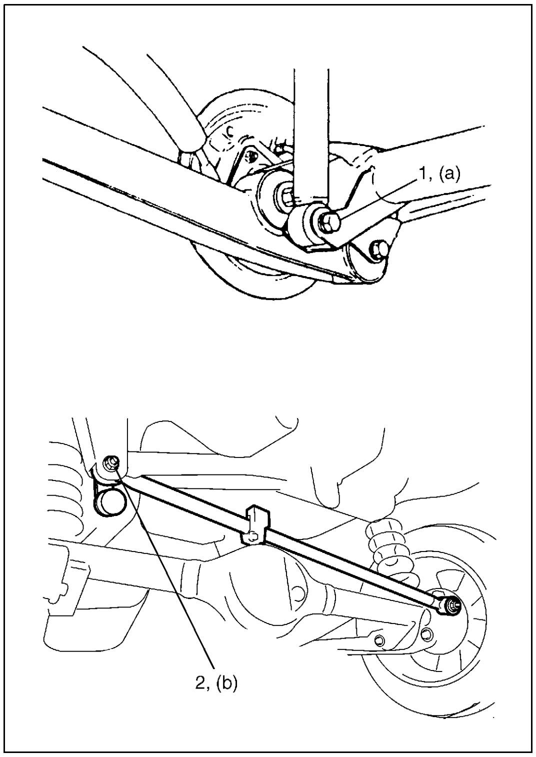
[A]:	2WD model
[B]:	4WD model
F:	Forward

5) Install brake flexible hose E-ring.
6) Install LSPV spring to rear axle. Tighten LSPV adjust nut temporarily at this step (if equipped with LSPV).



7) Install wheel (1) and tighten wheel bolts (2) to specified torque.

Tightening torque
Wheel bolt (a): 95 N·m (9.5 kg-m, 69.0 lb-ft)



8) Lower hoist and vehicle in non-loaded condition, tighten absorber lower bolt (1) and lateral rod body side nut (2) to specified torque.

Tightening torque
Rear shock absorber lower bolt
(a): 63 N·m (6.3 kg-m, 45.5 lb-ft)
Lateral rod nut (body side)
(b): 100 N·m (10.0 kg-m, 72.5 lb-ft)

9) If equipped with LSPV, check and adjust LSPV spring referring to “LSPV (Load Sensing Proportioning Valve) Inspection and Adjustment” in Section 5A and “Brake Fluid Pressure Test (if equipped with LSPV)” in Section 5.

Bump Stopper

Installation

1) Install bumper stopper.

NOTE:

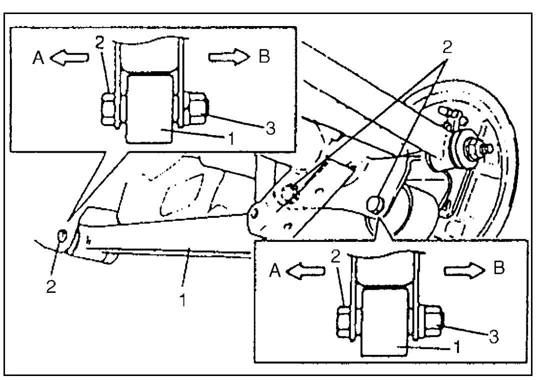
Before installing bump stopper apply soap water on it.

2) Install wheel and tighten wheel bolts to specified torque.

Tightening torque
Wheel bolt: 95 N·m (9.5 kg-m, 69.0 lb-ft)

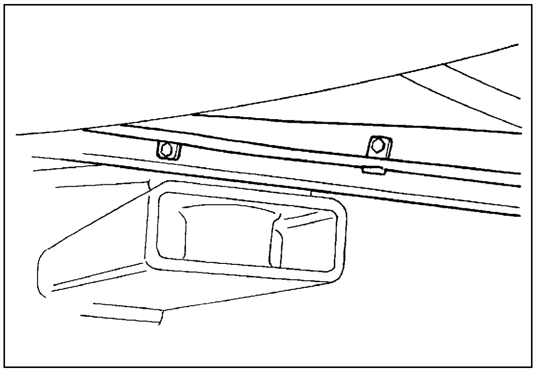
Trailing Arm

Installation

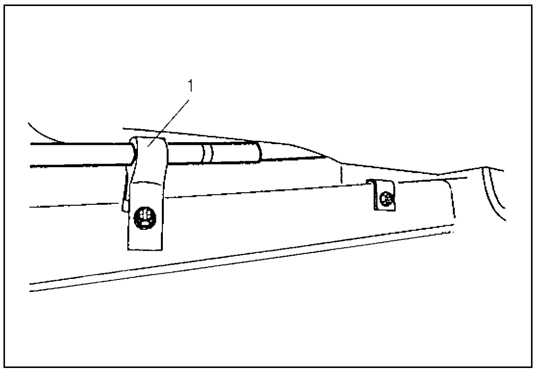


1) Install trailing arm (1) to vehicle body and rear axle, referring to figure for proper installing direction of bolts (2) and then tighten nuts (3) temporarily by hand.

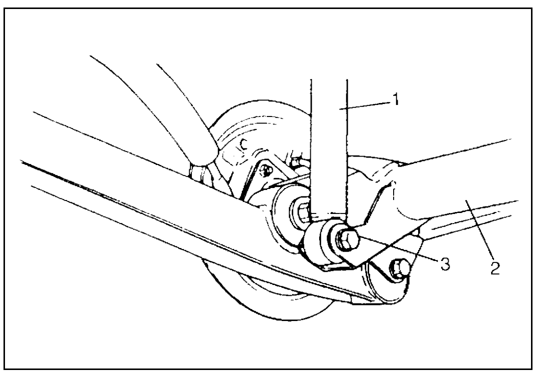
A.	Vehicle center side
B.	Vehicle outside



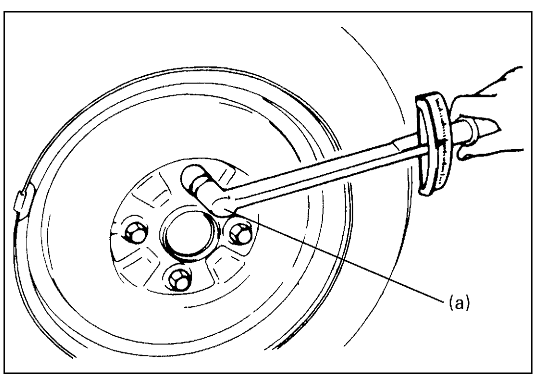
2) Install wheel speed sensor lead wire clamp, if equipped.



3) Install parking brake cable clamp (1).

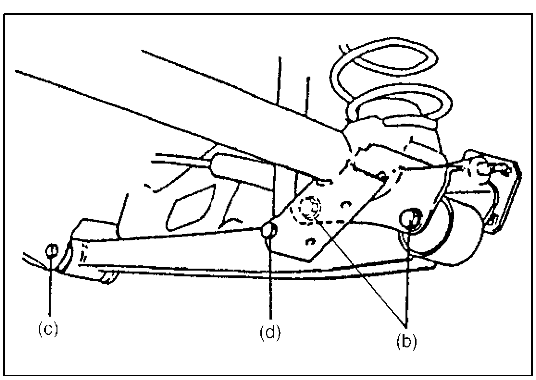


4) Install shock absorber (1) to rear axle (2).
5) Tighten shock absorber lower bolt (3) temporarily by hand.
6) Remove floor jack from rear axle.



7) Install wheel and tighten wheel bolts to specified torque.

Tightening torque
Wheel bolt (a): 95 N·m (9.5 kg-m, 69.0 lb-ft)



8) Lower hoist and vehicle in non loaded condition, tighten trailing arm front and rear nuts and shock absorber lower bolt to specified torque.

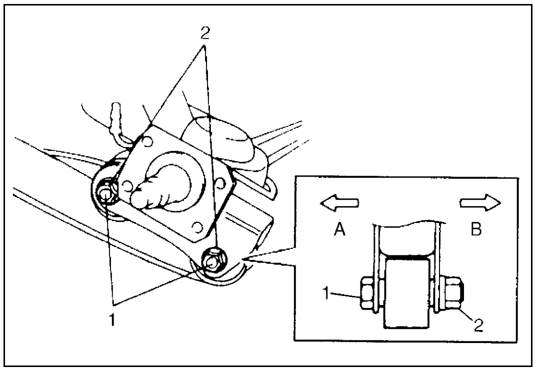
Tightening torque
Trailing arm rear nut (b): 80 N·m (8.0 kg-m, 58.0 lb-ft)
Trailing arm front nut (c): 90 N·m (9.0 kg-m, 65.0 lb-ft)
Shock absorber lower bolt (d): 63 N·m (6.3 kg-m, 45.5 lb-ft)

Rear Axle (for 2WD Model)

Installation

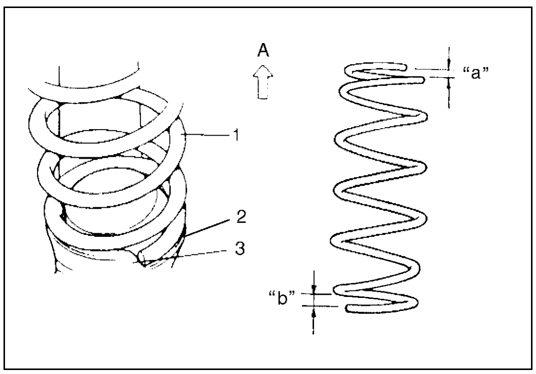
Install removed parts in reverse order of removal, noting the following points.

1) Place rear axle on floor jack. Then install lateral rod to rear axle and tighten nut temporarily by hand.



2) Install trailing arm rear bolts (1) (right & left) in proper direction as shown in figure. Then tighten nuts (2) temporarily by hand.

A.	Vehicle center side
B.	Vehicle outside

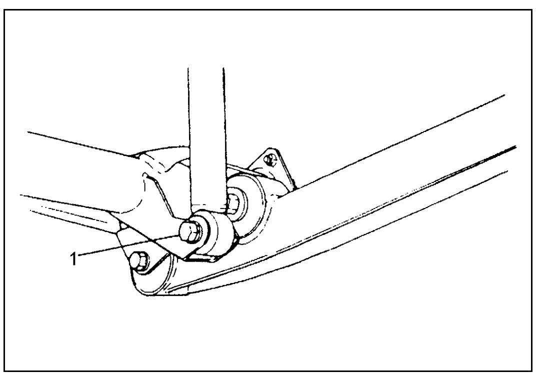


3) Install coil springs (1) (right & left) on spring seat (2) of rear axle as shown in figure and then raise rear axle.

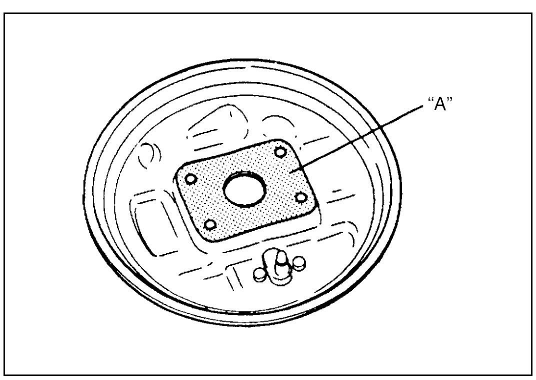
NOTE:

When seating coil spring (1), mate spring end with stepped part (3) of rear axle spring seat as shown.

A.	Upper side
"a":	Small
"b":	Large

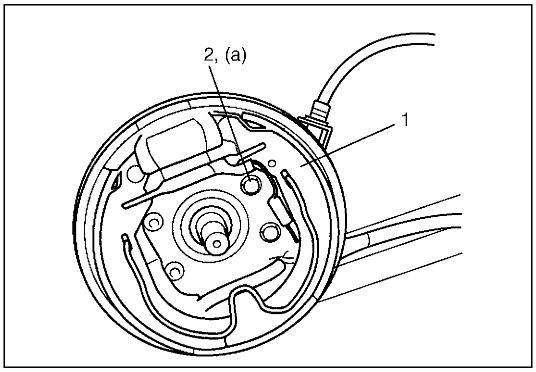


4) Tighten shock absorber lower bolts (1) (right & left) temporarily by hand.
5) Remove floor jack from rear axle.



6) Clean mating surface of rear axle (right & left) with brake back plate and apply water tight sealant as shown in figure.

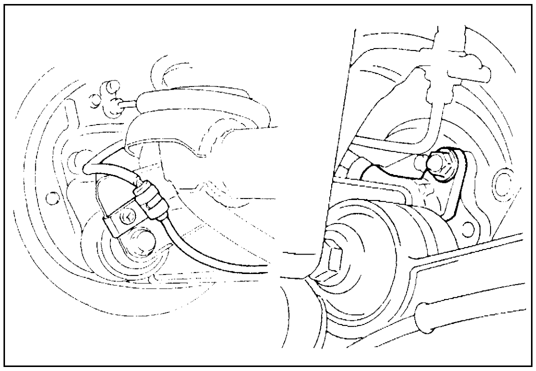
"A": Sealant 99000-31090



7) Install brake back plates (1) and tighten back plate bolts (2) to specified torque.

Tightening torque

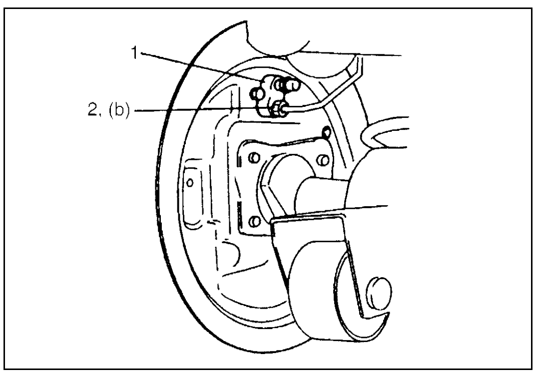
Brake back plate bolt (a): 23 N·m (2.3kg-m, 16.5 lb-ft)



8) Connect wheel speed sensor and lead wire clamps (right & left) (if equipped).

CAUTION:

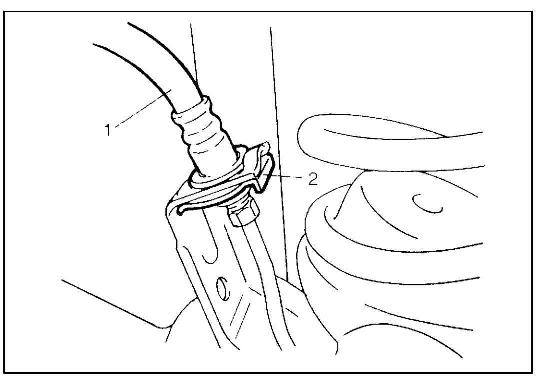
Since there are two holes on each side of rear axle, be sure to install wheel speed sensor at the position as shown in the figure.



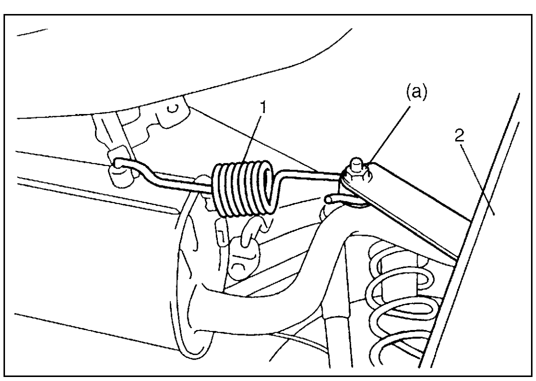
9) Connect brake pipes to wheel cylinders (1) (right & left) and tighten brake pipe flare nuts (2) to specified torque.

Tightening torque

Brake pipe flare nut (b): 16 N·m (1.6 kg-m, 11.5 lb-ft)



10) Connect brake flexible hoses (1) (right & left) to bracket on rear axle and secure it with E-rings (2) (right & left).

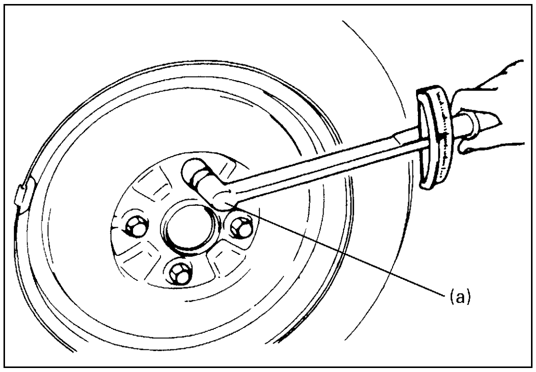


11) Install LSPV spring (1) to rear axle (2) (if equipped with LSPV).

Tightening torque

LSPV bolt (a): 26 N·m (2.6 kg-m, 19.0 lb-ft)

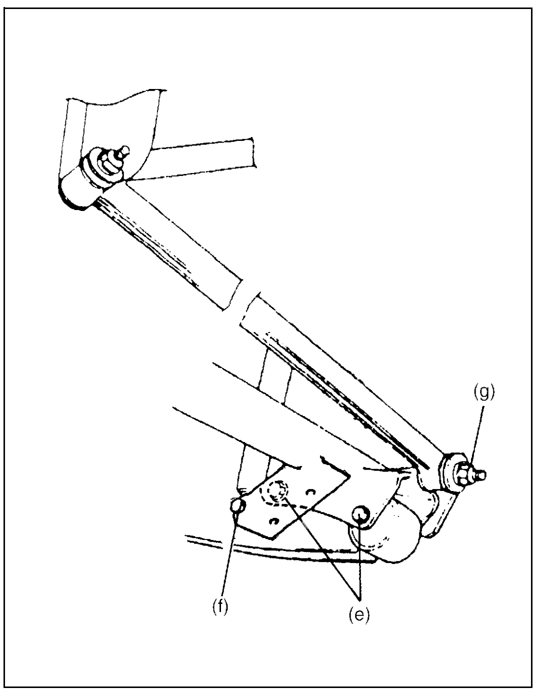
12) Install brake drums (right & left). For details, refer to steps 3) to 8) of "Brake Drum Installation" in Section 5C.
13) Fill reservoir with brake fluid and bleed brake system. (For bleeding operation, refer to Section 5.)



14) Install wheel and tighten wheel bolts to specified torque.

Tightening torque
Wheel bolt (a): 95 N·m (9.5 kg-m, 69.0 lb-ft)

15) Upon completion of all jobs, depress brake pedal with about 300 N (30 kg, 66 lbs) load three to five times so as to obtain proper drum-to-shoe clearance. Adjust parking brake cable. (For adjustment, refer to Section 5.)
16) Install console box.
17) Lower hoist and bounce vehicle up and down several times to stabilize suspension.



18) Tighten right and left trailing arm rear nuts, shock absorber lower bolts and lateral rod rear axle side nut to specified torque.

NOTE:
When tightening these nuts and bolts, be sure that vehicle is off hoist and in non loaded condition.

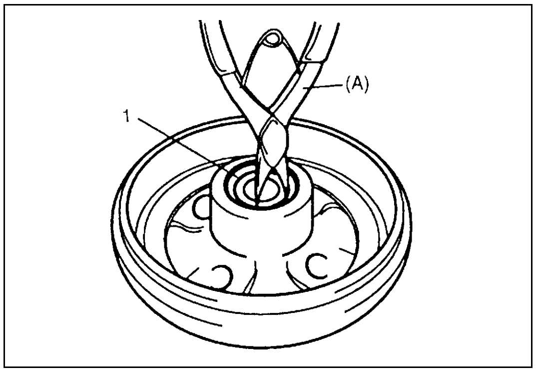
Tightening torque
Trailing arm rear nut
(e): 80 N·m (8.0 kg-m, 58.0 lb-ft)
Shock absorber lower bolt (f): 63 N·m (6.3 kg-m, 45.5 lb-ft)
Lateral rod nut (axle side) (g): 50 N·m (5.0 kg-m, 36.5 lb-ft)

19) Check to ensure that brake drum is free from dragging and proper braking is obtained.
20) Perform brake test (foot brake and parking brake).

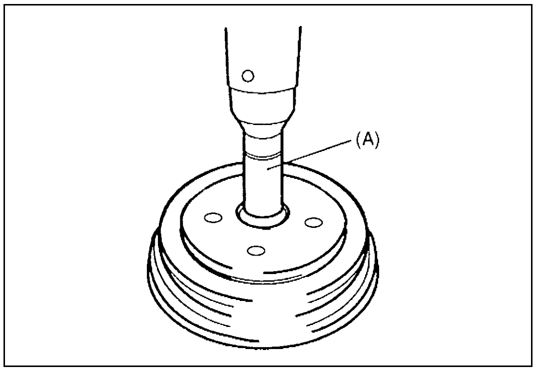
Wheel Bearing (for 2WD Model)

Removal

1) Remove rear brake drum, referring to "Rear Brake Drum Removal" in Section 5C.



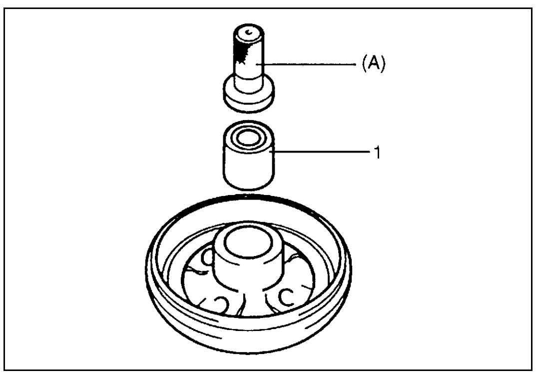
2) Remove circlip (1).
Special tool
(A): 09900-06108



3) Remove wheel bearing by using special tool and hydraulic press.
Special tool
(A): 09913-76010

CAUTION:
- **Never reuse wheel bearing.**
- **Reused bearing should have excessive play.**

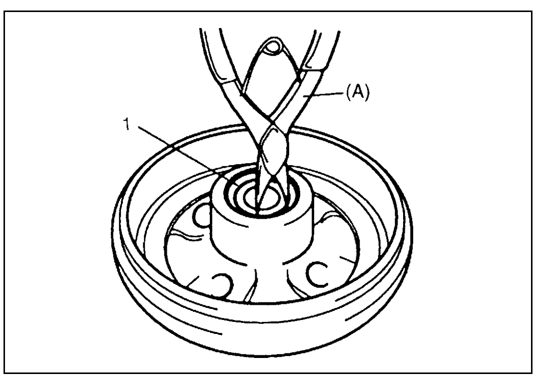
Installation



1) Install new wheel bearing (1) by using special tool and hydraulic press.

NOTE:
Seal side of bearing comes brake back plate side.

Special tool
(A): 09913-75810



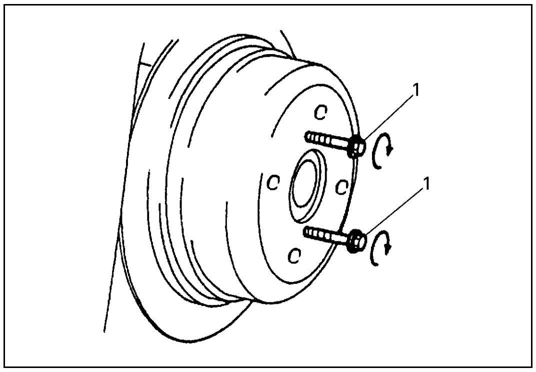
2) Install circlip (1).
Special tool
(A): 09900-06108

3) Install brake drum and wheel, referring to "Brake Drum" Installation in Section 5C.

Rear Axle Shaft and Wheel Bearing (for 4WD Model)

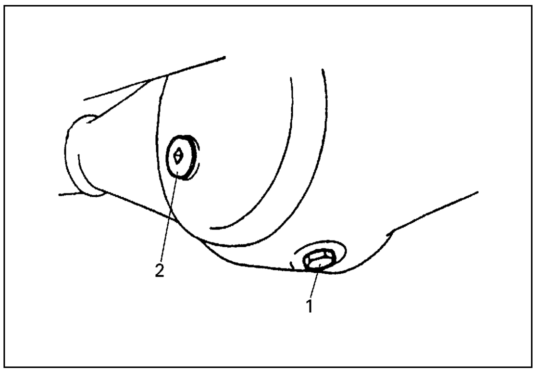
Removal

1) Hoist vehicle and remove rear wheels.



2) Remove brake drum screw and rear brake drum by using 8 mm bolts. For details referring to Section 5C.

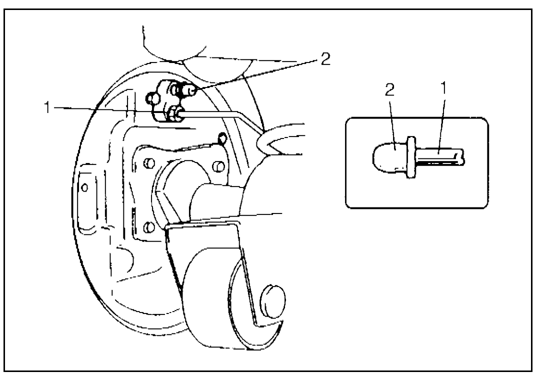
1. 8 mm bolt



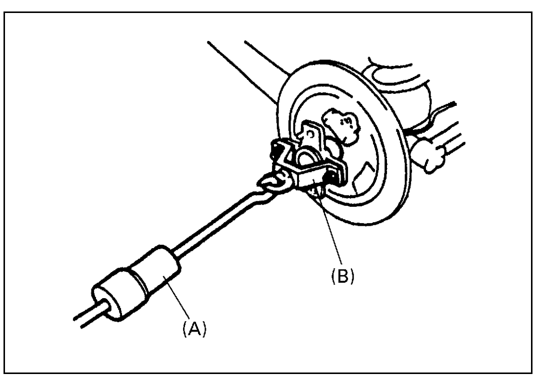
3) Drain gear oil from rear axle housing by loosening drain plug (1).

2. Filler and level plug

4) Remove brake shoe referring to “Brake Shoe” in Section 5C.
5) Remove parking brake cable from brake back plate.

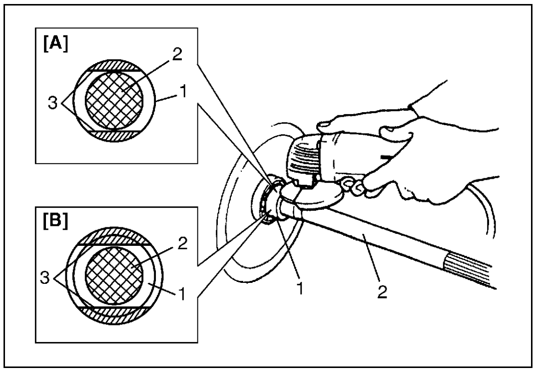


6) Disconnect brake pipe (1) from wheel cylinder and put wheel cylinder bleeder plug cap (2) onto pipe to prevent fluid from spilling.
7) Remove wheel speed sensor from axle housing (if equipped with ABS).
8) Remove brake back plate bolts from axle housing.



9) Using special tools indicated, draw out axle shaft with brake back plate.

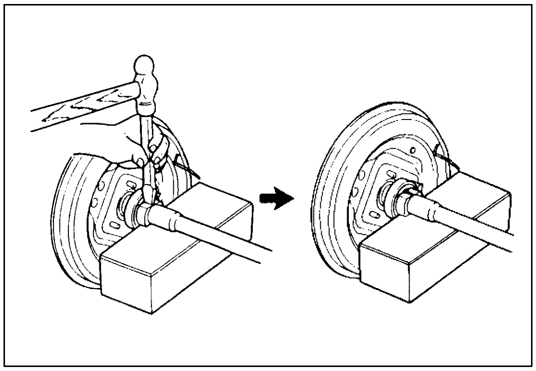
Special tool
(A): 09942-15511
(B): 09943-17912



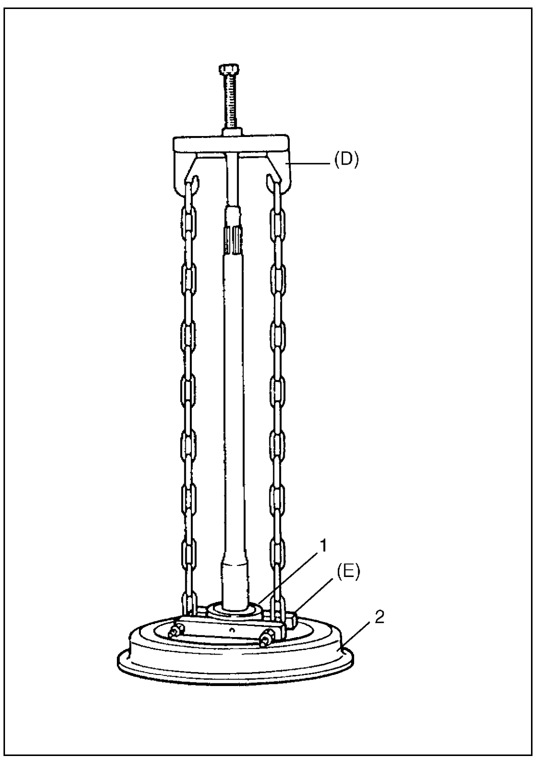
10) In order to remove the retainer ring (1) from the axle shaft (2), grind (3) with a grinder two parts of the bearing retainer ring as illustrated till it becomes thin.

CAUTION:
Be careful not to go so far as to grind the shaft.

[A]:	Without ABS
[B]:	With ABS



11) Break with a chisel the thin ground retainer ring, and it can be removed.

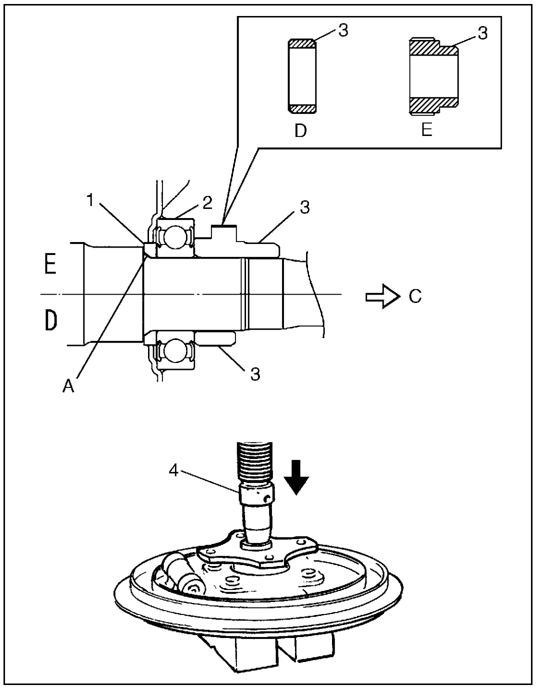


12) Using special tools, remove bearing (1) from shaft and then remove brake back plate (2).

Special tool
(D): 09927-18411
(E): 09921-57810

Installation

Install removed parts in reverse order of removal, noting the following points.

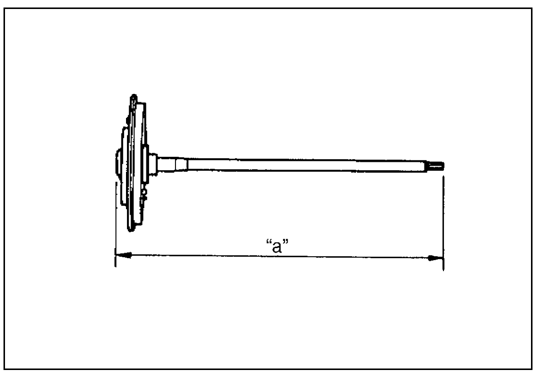


1) Install wheel bearing spacer (1) with the tapered side of its inner diameter directed toward outside, or brake drum side.
2) Press in a new bearing (2) and retainer ring (3) in order by using an hydraulic press (4).

NOTE:

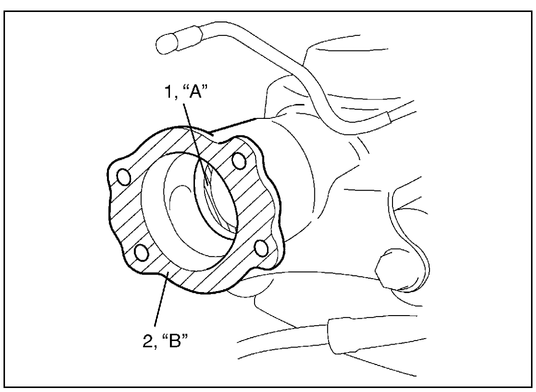
Use care not to cause any damage to outside of retainer ring.

A :	Tapered side
B :	Blank
C :	Differential side
D :	Without ABS
E :	With ABS



3) Inspect axle shaft length.

Rear axle shaft length "a"
Right side: 657.5 mm (25.9 in.)
Left side: 785.5 mm (30.9 in.)



4) Apply grease to axle shaft oil seal (1) lip as shown.

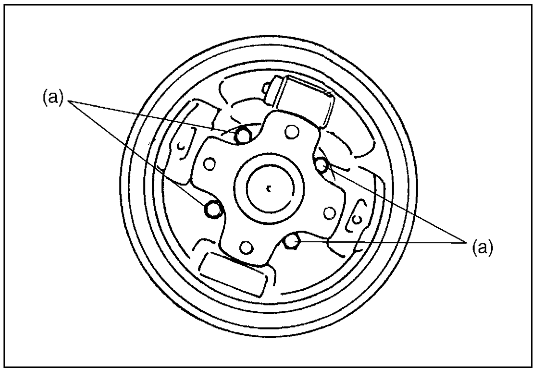
"A": Grease 99000-25010

5) Apply sealant to mating surface (2) of axle housing and brake back plate.

NOTE:

Make sure to remove old sealant before applying it anew.

"B": Sealant 99000-31090

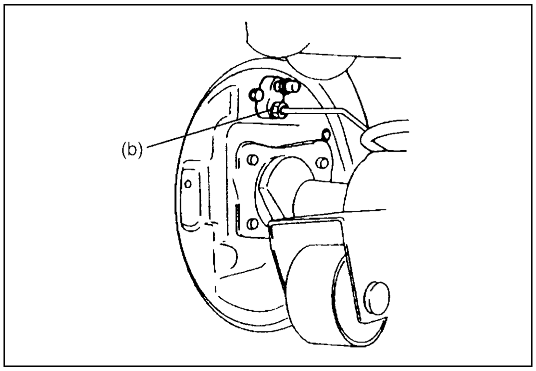


6) Install rear axle shaft to rear axle housing and tighten brake back plate bolts to specified torque.

NOTE:

When installing rear axle shaft, be careful not to cause damage to oil seal lip in axle housing.

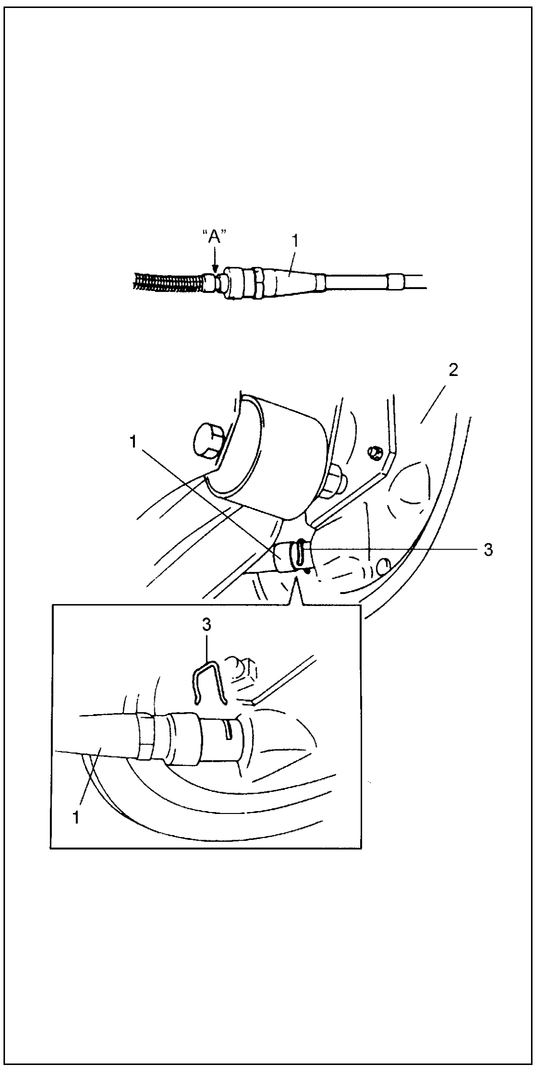
Tightening torque
Brake back plate bolt (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)



7) Connect brake pipe to wheel cylinder and tighten brake pipe flare nut to specified torque.

Tightening torque
Brake pipe flare nut (b): 16 N·m (1.6 kg-m, 11.5 lb-ft)

8) Tighten oil drain plug to specified torque and refill rear axle (differential) housing with new specified gear oil and tighten oil filler plug to specified torque. Refer to Section 7F for tightening torque data and refill.



9) Apply watertight sealant where plate and cable contact, and run parking brake cable (1) through brake back plate (2) and secure it with clip (3).

"A": Sealant 99000-31090

CAUTION:

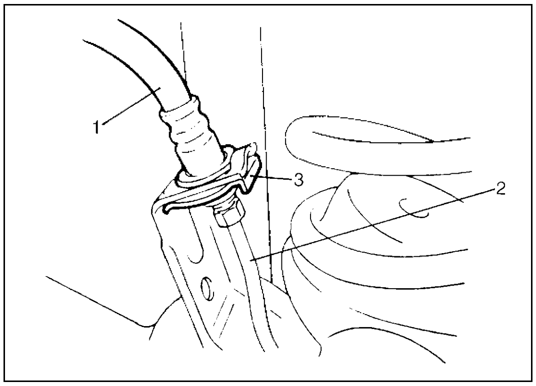
Check to ensure that clip is in good condition before installing it. If deformed or broken, replace.

10) Connect parking brake cable (1) to parking brake shoe lever. Install brake shoes referring to "Brake Shoe Installation" in Section 5C.
11) Install wheel speed sensor (if equipped with ABS).
12) Install brake drum (right & left) after marking sure that inside of brake drum and brake shoes are free from dirt and oil. Then tighten brake drum screw.
13) Fill reservoir with brake fluid and bleed brake system. (For bleeding operation, refer to "Bleeding Brakes" in Section 5.)
14) Install wheel and tighten wheel bolts to specified torque.
15) Upon completion of all jobs, pull parking brake lever with about 200 N (20 kg, 44 lbs) load three to five times so as to obtain proper drum-to-shoe clearance.
    Adjust parking brake cable (for adjustment, refer to "Parking Brake" in Section 5).
16) Check to ensure that brake drum is free from dragging and proper braking is obtained.
17) Perform brake test (foot brake and parking brake).
    (For brake test, see Section 5.)
18) Check each installed part for oil leakage.

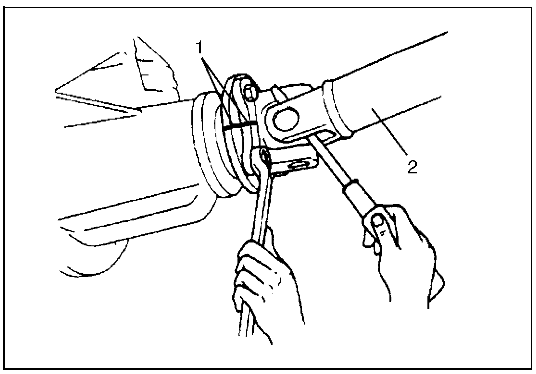
Rear Axle Housing (for 4WD Model)

Removal

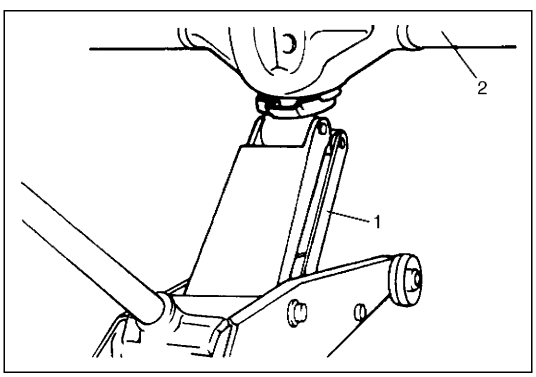
1) Hoist vehicle and remove rear wheels referring to “Wheel Removal and Installation” in Section 3F.
2) Remove rear axle shafts (right & left) referring to Steps 2) – 9) of “Rear Axle Shaft and Wheel Bearing (for 4WD Model)” in this section.



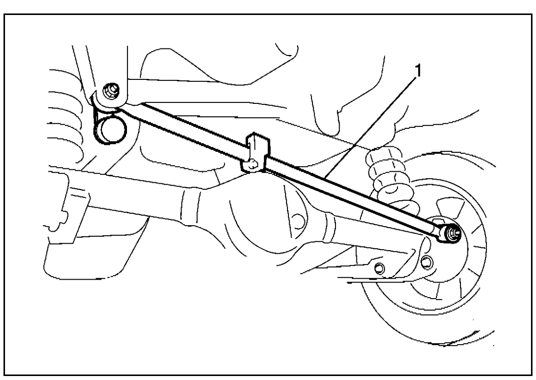
3) Disconnect brake pipes (2) (right & left) from flexible hoses (1) and remove E-rings (3).
4) Remove brake pipes from wheel cylinders (right & left).
5) Remove wheel speed sensors (right & left) and release clamps from axle housing (if equipped with ABS).
6) Remove LSPV adjust nut and detach spring end from rear axle housing (if equipped with LSPV).



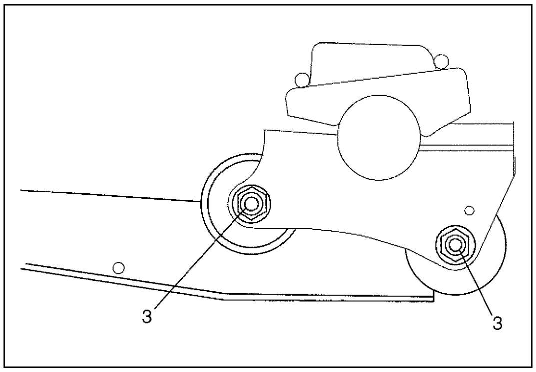
7) Before removing propeller shaft, give match marks (1) on joint flange and propeller shaft (2) as shown.
8) Remove propeller shaft.



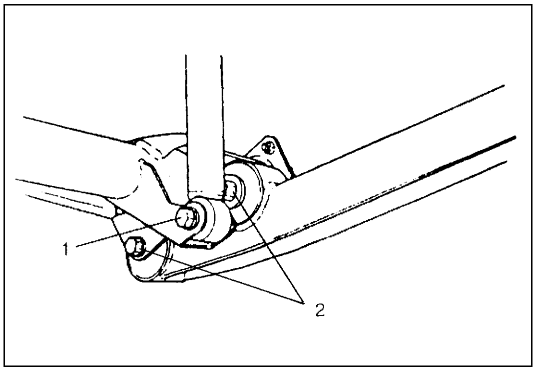
9) For jobs hereafter, support rear axle housing by using floor jack (1) under axle housing (2) and remove differential carrier assembly.



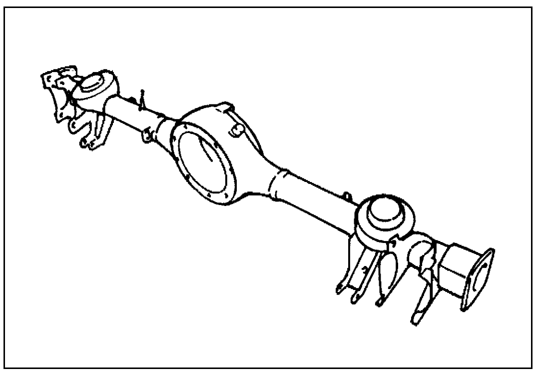
10) Remove lateral rod (1).



11) Loosen trailing arm rear mounting nuts (3) (right & left) from axle housing, but don't remove bolts.



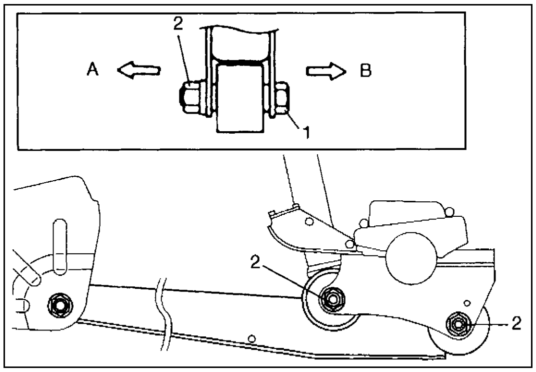
12) Remove shock absorber lower mounting bolts (1).
13) Lower floor jack until tension of suspension coil spring becomes a little loose and remove trailing arm rear mounting bolts (2) (right & left).
14) Lower rear axle housing gradually and remove coil springs.



15) Remove axle housing.

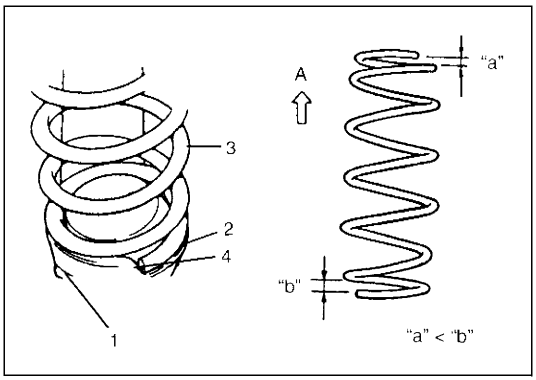
Installation

Install removed parts in reverse order of removal, noting the following.



1) Place rear axle housing on floor jack. Then install rear trailing arm bolts (1) (right & left) in proper direction as shown. Then tighten nuts (2) temporarily by hand.

A :	Vehicle out side
B :	Vehicle center side

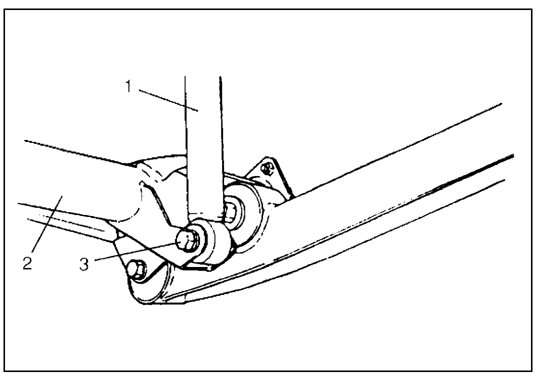


2) Install coil springs (3) (right & left) on spring seat (2) of axle housing (1) and raise axle housing.

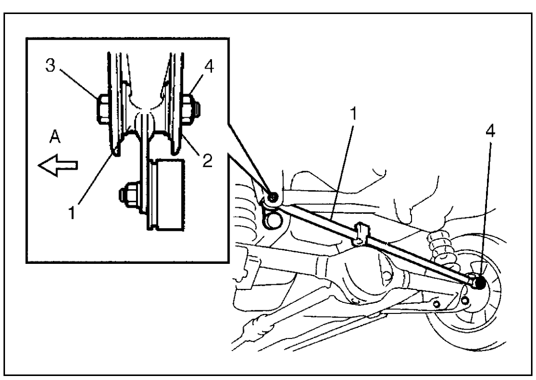
NOTE:

When seating coil spring (3), mate spring end with stepped part (4) of rear axle spring seat as shown.

A.	Upper side
"A":	Small
"b":	Large

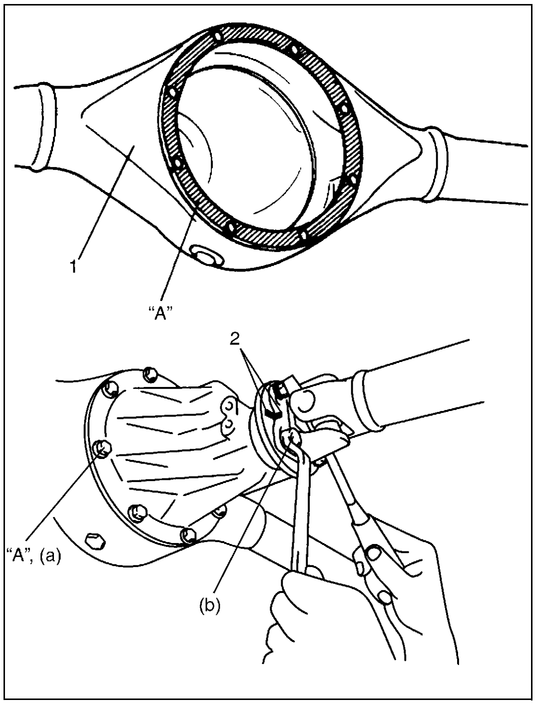


3) Install shock absorber (1) (right & left) to axle housing (2) and install bolts in proper direction as shown. Then tighten bolts (3) (right & left) temporarily by hand.



4) Install lateral rod (1) and bolt (3) in proper direction as shown. Then tighten nuts (4) temporarily by hand.

2.	Vehicle body
A :	Forward



5) Clean mating surfaces of axle housing (1) and differential carrier and apply sealant to housing side.

"A": Sealant 99000-31110

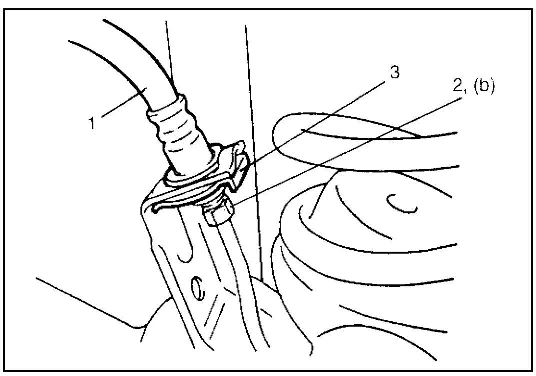
6) Install differential carrier assembly to axle housing and tighten carrier bolts to specified torque.

Tightening torque
Rear differential carrier bolt
(a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

7) Install propeller shaft to joint flange aligning match marks (2) and tighten flange bolts to specified torque.

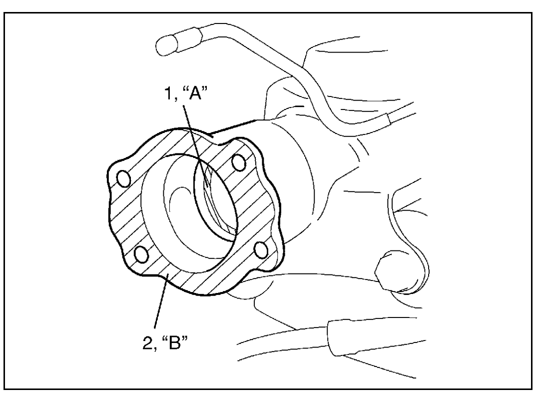
Tightening torque
Differential flange bolt (b): 23 N·m (2.3 kg-m, 17.0 lb-ft)

8) Install LSPV spring to rear axle.
   Tighten LSPV adjust nut temporarily at this step. (if equipped with LSPV).
9) Install wheel speed sensor and clamp wire securely (right & left) (if equipped with ABS).
10) Remove floor jack from axle housing.



11) Connect brake flexible hoses (1) (right & left) to bracket on rear axle and secure it with E-rings (3) (right & left).
12) Connect brake pipes to brake flexible hoses (1) and tighten brake pipe flare nuts (2) to specified torque.

Tightening torque
Brake pipe flare nut (b): 16 N·m (1.6 kg-m, 11.5 lb-ft)

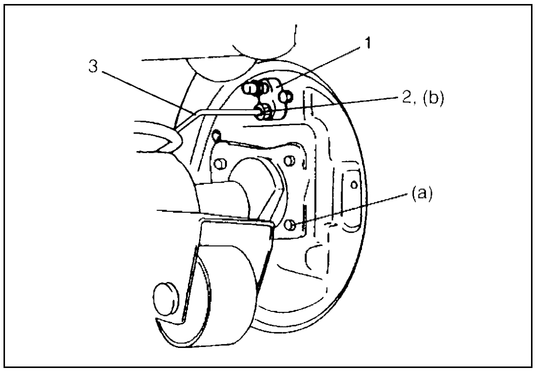


13) Apply grease to axle shaft oil seals (1) lip (right & left).

"A": Grease 99000-25010

14) Clean mating surfaces (2) (right & left) of axle housing and brake back plate and apply water tight sealant as shown in figure.

"B": Sealant 99000-31090

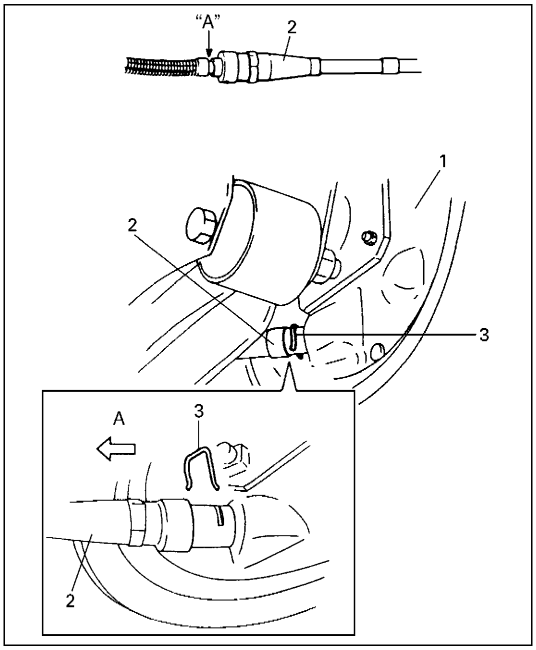


15) Install rear axle shaft (right & left) to rear axle housing.
16) Tighten brake back plate bolts to specified torque.

Tighteningtorque
Brake back plate bolt (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

17) Connect brake pipes (3) to wheel cylinders (1) (right & left) and tighten brake pipe flare nuts (2) to specified torque.

Tightening torque
Brake pipe flare nut (b): 16 N·m (1.6 kg-m, 11.5 lb-ft)



18) Apply water tight sealant where brake back plate (1) and parking brake cable contact.
Connect parking brake cable (2) to brake back plate (right & left) and secure it with clip (3).

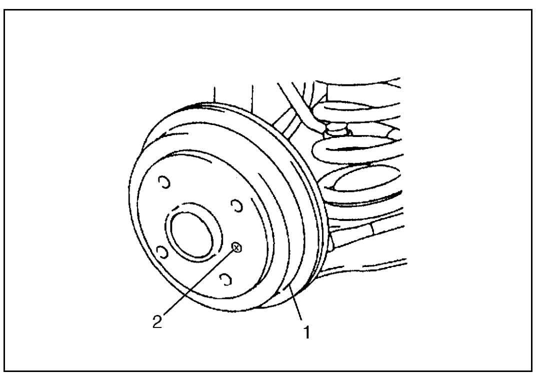
"A": Sealant 99000-31090

NOTE:

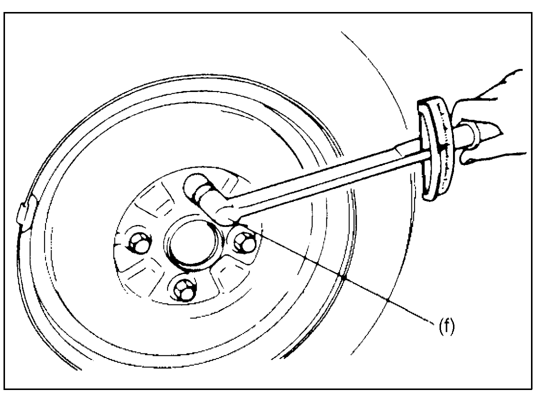
Check to ensure that clip is in good condition before installing it. If deformed or broken, replace.

19) Install brake shoes (right & left) referring to "Brake Shoe" in Section 5C.

A: Forward



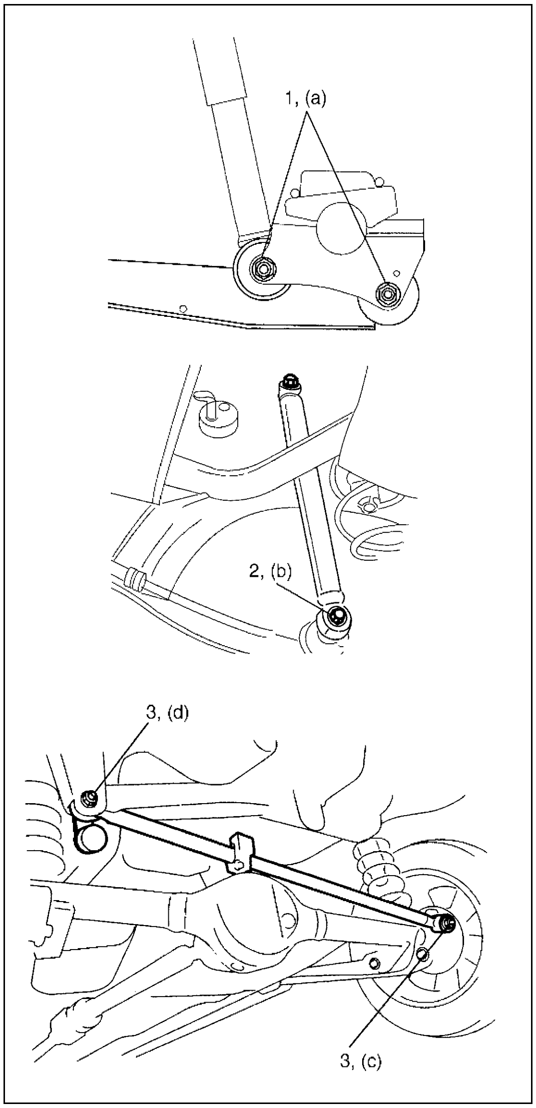
20) Install brake drums (1) (right & left) after making sure that inside of brake drum and brake shoes are free from dirt and oil. Then tighten brake drum screw (2).
21) Fill reservoir with brake fluid and bleed brake system. (For bleeding operation, refer to Section 5.)
22) Refill differential gear housing with new specified gear oil. Refer to Section 7F.



23) Install wheels and tighten wheel bolts to specified torque.

Tightening torque
Wheel bolt (f): 95 N·m (9.5 kg-m, 69.0 lb-ft)

24) Upon completion of all jobs, pull parking brake lever with about 200 N (20 kg, 44 lbs) load three to five times so as to obtain proper drum-to-shoe clearance.
Adjust parking brake cable referring to "Parking Brake" in Section 5.
25) Lower hoist.



26) Tighten right and left trailing arm nuts (1) and shock absorber lower bolts (2) to specified torque.
Tighten lateral rod nuts (3) to specified torque.

NOTE:

When tightening these bolts and nuts, be sure that vehicle is off hoist and in non loaded condition.

Tightening torque
Trailing arm rear nut
(a): 80 N·m (8.0 kg-m, 58.0 lb-ft)
Rear shock absorber lower bolt
(b): 63 N·m (6.3 kg-m, 45.5 lb-ft)
Lateral rod nut (axle side)
(c): 50 N·m (5.0 kg-m, 36.5 lb-ft)
Lateral rod nut (body side)
(d): 100 N·m (10.0 kg-m, 72.5 lb-ft)
Trailing arm front nut
(e): 90 N·m (9.0 kg-m, 65.0 lb-ft)

27) Check to ensure that brake drum is free from dragging and proper braking is obtained.
28) Perform brake test (foot brake and parking brake).
29) If equipped with LSPV, check and adjust LSPV spring referring to “LSPV Inspection and Adjustment” in Section 5A and perform “Fluid Pressure Test” in Section 5.
30) Check each installed part for oil leakage.

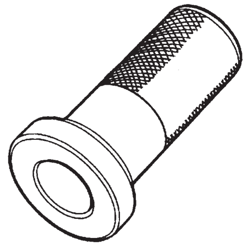
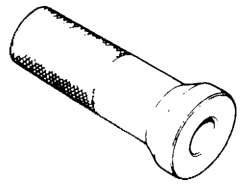
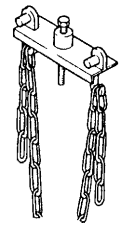
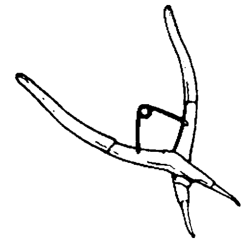
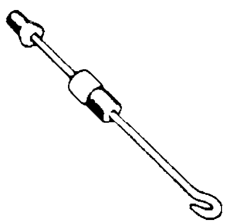
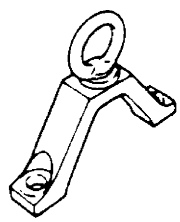
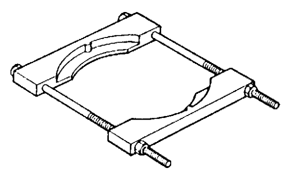
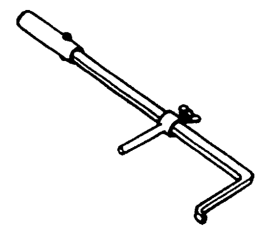
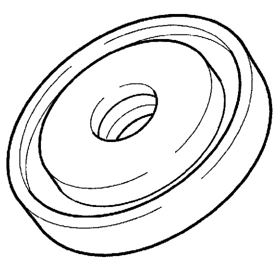
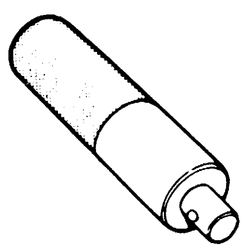
Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Brake back plate bolt	23	2.3	17.0
Brake pipe flare nut	16	1.6	11.5
Differential flange bolt	23	2.3	17.0
Lateral rod nut (axle side)	50	5.0	36.5
Lateral rod nut (body side)	100	10.0	72.5
LSPV bolt	26	2.6	19.0
Rear differential carrier bolt (4WD model)	23	2.3	17.0
Rear shock absorber lower bolt	63	6.3	45.5
Shock absorber lower bolt	63	6.3	45.5
Trailing arm front nut	90	9.0	65.0
Trailing arm rear nut	80	8.0	58.0
Wheel bolt	95	9.5	69.0

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE (A) (99000-25010)···(for 4WD Model)	• Axle shaft oil seal
Sealant	SUZUKI BOND NO. 1215 (99000-31110)···(for 4WD Model)	• Joint seam of differential carrier and axle housing • Differential carrier bolt
Gear oil	For gear oil information, refer to Section 7F. (for 4WD Model)	• Differential gear (Rear axle housing)
Water tight sealant	SUZUKI SEALING COMPOUND 366E (99000-31090)	• Joint seam of axle housing and brake back plate
Brake fluid	Indicated on reservoir cap or described in owner’s manual of vehicle.	• To fill master cylinder reservoir • To clean and apply to inner parts of caliper and wheel cylinder when they are disassembled.

Special Tool

 09913-75810 Bearing installer (for 2WD Model)	 09913-76010 Rear wheel bearing installer (for 2WD Model)	 09927-18411 Universal puller (for 4WD Model)	 09900-06108 Snap ring pliers (for 2WD Model)
 09942-15511 Sliding hammer	 09943-17912 Brake drum remover	 09921-57810 Bearing remover (for 4WD Model)	 09913-50121 Oil seal remover (for 4WD Model)
 09944-67010 Oil seal installer (for 4WD Model)	 09924-74510 Installer attachment (for 4WD Model)		

SECTION 3F

WHEELS AND TIRES

NOTE:

- **All wheel fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts.**
  There is to be no welding as it may result in extensive damage and weakening of the metal.
- **For descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.**

CONTENTS

General Description

Tires

This vehicle is equipped with the following tire.

Tire specification

165/60R14 75T ········ Gasoline engine model

165/60R14 79T ····························· Diesel engine model

The tire is of tubeless type. The tire is designed to operate satisfactorily with loads up to the full rated load capacity when inflated to the recommended inflation pressures.

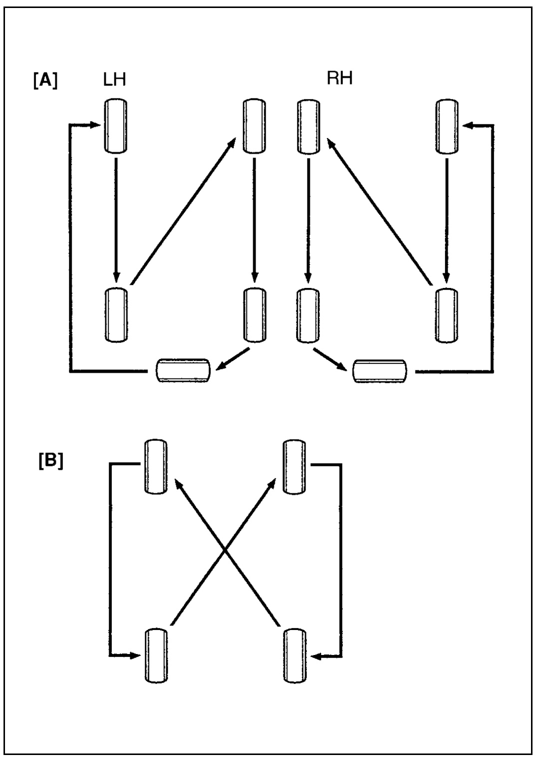
Correct tire pressures and driving habits have an important influence on tire life. Heavy cornering, excessively rapid acceleration, and unnecessary sharp braking increase tire wear.

Maintenance And Minor Adjustments

Wheel Maintenance

Wheel repairs that use welding, heating, or peening are not approved. All damaged wheels should be replaced.

Tire Rotation



To equalize wear, rotate tires according to left figure. Radial tires should be rotated periodically. Set tire pressure.

NOTE:

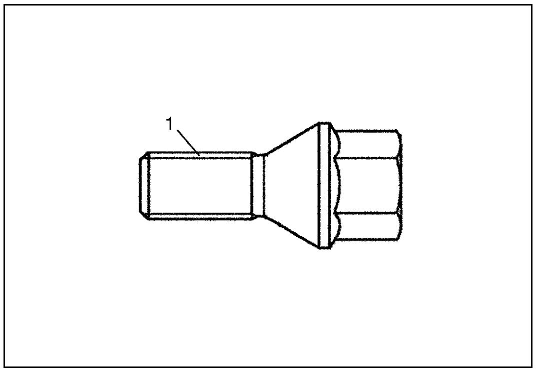
Due to their design, radial tires tend to wear faster in the shoulder area, particularly in front positions. This makes regular rotation especially necessary.

[A]:	5-tire rotation NOTE: Applicable to vehicles equipped with 5 tires including spare tire all of which are identical in size
[B]:	4-tire rotation
LH:	Left-hand steering vehicle
RH:	Right-hand steering vehicle

On-Vehicle Service

Service Operations

Wheel Bolts



All models use metric lug wheel bolts.

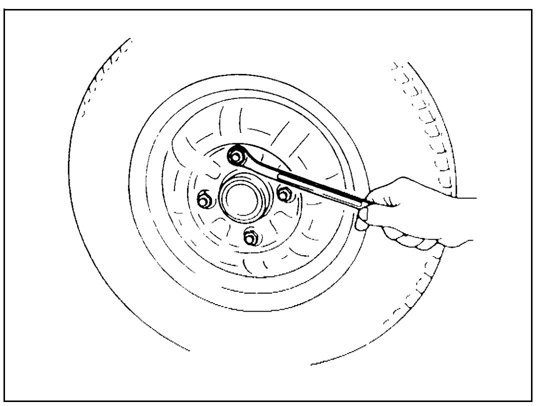
Metric lug bolt size
(1): M12 x 1.5

Wheel

Removal

WARNING:

Do not removal all of the wheel bolts at once, because all the wheels of this vehicle are mounted by the wheel bolts.
Leave a bolt at least not to drop the wheel.
Support the wheel and/or tire and then remove the bolt(s) left with the wheel.



1) Loosen wheel bolts by approximately 180 ° (half a rotation).
2) Hoist vehicle.
3) Make sure that the Vehicle will not fall off by trying to more vehicle body in both ways.
4) Remove wheel bolts except one.
5) Support the wheel and/or tire not to drop the wheel and then remove the bolt left with the wheel.

CAUTION:

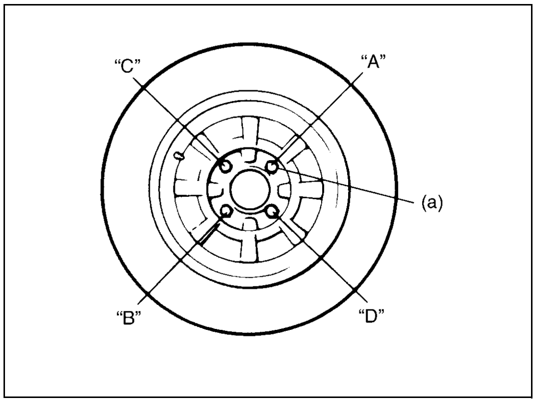
Never use heat to loosen tight wheel because application of heat to wheel can shorten life of wheel and damage wheel bearings.

Installation

For installation, reverse removal procedure, noting the flowing. Wheel bolts must be tightened in sequence and to proper torque to avoid bending wheel or brake disc, left figure.

NOTE:

Before installing wheels, remove any build-up of corrosion on wheel mounting surface and brake disc mounting surface by scraping and wire brushing. Installing wheels without good metal-to-metal contact at mounting surfaces can cause wheel bolts to loosen, which can later allow a wheel to come off while vehicle is moving.



Tightening order
"A" – "B" – "C" – "D":

Tightening torque
Wheel bolt (a): 95 N·m (9.5 kg-m, 69.0 lb-ft)

Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Wheel bolt	95	9.5	69.0

SECTION 4A

FRONT DRIVE SHAFT (G10/M13 ENGINES)

CONTENTS

4A

General Description

A constant velocity double offset joint (DOJ) and tripod joint are used on the differential side of drive shaft as the following table.
A constant velocity ball joint (fixed type) is used on the wheel side of both right and left drive shaft assemblies.
The drive shaft can slide through the tripod joint or DOJ in the extension/contraction direction.

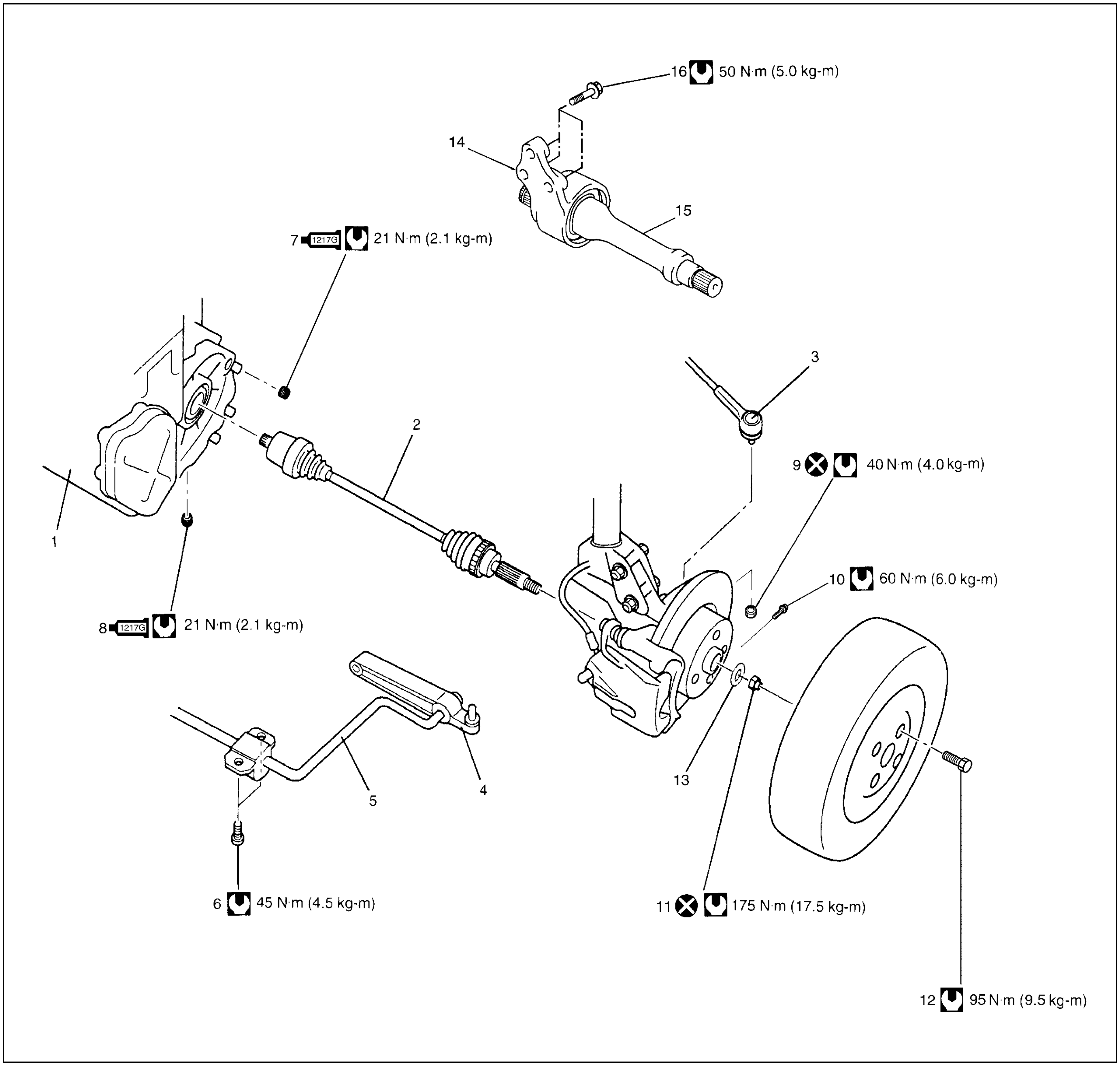
Type			Differential side joint	Wheel side joint
M13 engine	2WD	–	DOJ	Constant velocity ball joint (Fixed type)
	4WD	Right side	Tripod joint	
		Left side	DOJ	
G10 engine	2WD	Right side	Tripod joint	
		Left side	DOJ	

Diagnosis

Condition	Possible Cause	Correction
Abnormal noise	• Worn or breakage of the drive shaft joint • Worn or breakage center bearing	Replace. Replace.

On-Vehicle Service

Front Drive Shaft Assembly Construction

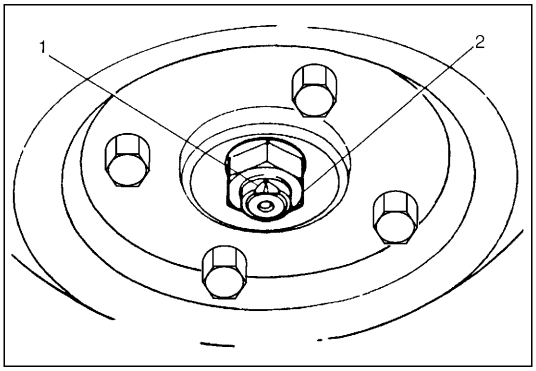


1. Transaxle	1217G	7. Oil filler/level plug : Apply sealant 99000-31260 to plug thread	13. Drive shaft washer
2. Drive shaft assembly	1217G	8. Oil drain plug : Apply sealant 99000-31260 to plug thread	14. Center bearing support
3. Tie-rod end		9. Tie-rod end nut	15. Center shaft
4. Suspension control arm		10. Ball stud bolt	16. Center bearing support bolts
5. Stabilizer		11. Drive shaft nut	Do not reuse.
6. Stabilizer mount bracket bolt		12. Wheel bolt	Tightening torque

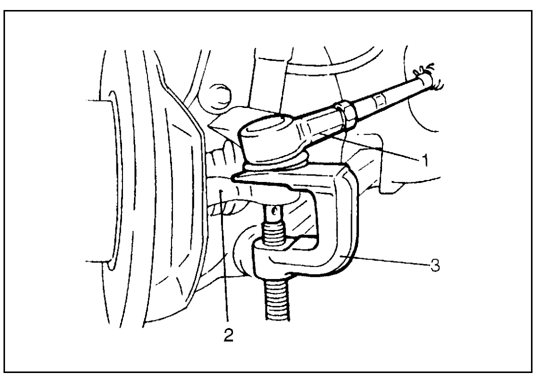
Front Drive Shaft Assembly Removal and Installation

Removal

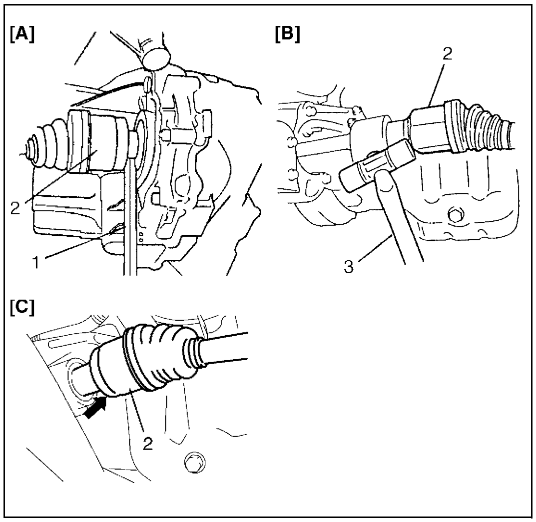
CAUTION:
To prevent the breakage of boots, be careful not to damage the boots when removing drive shaft assembly.



1) Undo caulking (1) and remove drive shaft nut (2).
2) Loosen wheel bolts.
3) Hoist vehicle.
4) Remove wheel.
5) Drain transaxle oil as follows.
   - For M/T model with G10 engine
     Refer to “Oil Change” in Section 7A of the Service Manual mentioned in the FOREWORD of this manual.
   - For M/T model with M13 engine
     Refer to “Transaxle Oil Change” in Section 7A2.
   - For A/T model
     Refer to “Fluid Change” in Section 7B1.
6) Drain transfer oil referring to “Oil Change” in Section 7D of the Service Manual mentioned in the FOREWORD of this manual, if equipped.
7) Remove tie-rod end nut.



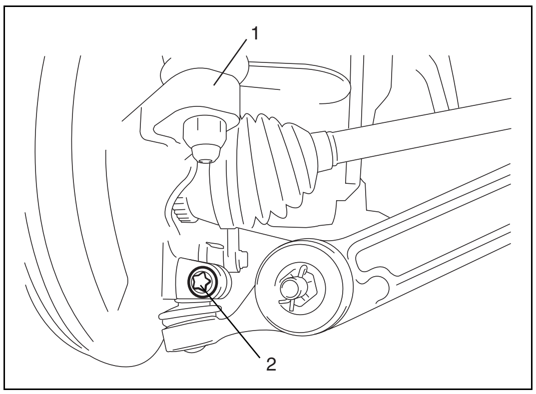
8) Disconnect tie-rod end (1) from steering knuckle (2) by using puller (3).



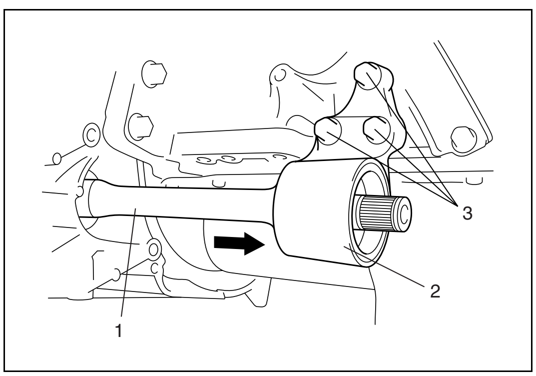
9) Pull out drive shaft joint (2) as follows.
   - For left side of all model and right side of G10 engine model
     Using tire lever (1), pull out drive shaft joint (2) so as to release snap ring fitting of joint spline at differential side.
   - For right side of 2WD model with M13 engine
     Using plastic hammer (3), drive out drive shaft joint (2) so as to release snap ring fitting of joint spline at center shaft.
   - For right side of 4WD model with M13 engine
     Using plastic hammer, drive out drive shaft joint (2) so as to release snap ring fitting of joint spline at transfer side.

[A]:	Left side of all model and right side of G10 engine model
[B]:	Right side of 2WD model with M13 engine
[C]:	Right side of 4WD model with M13 engine

10) Remove two stabilizer mount brackets from vehicle body.



11) Disconnect front suspension control arm ball joint stud from steering knuckle (1) by pushing down stabilizer bar after removing ball joint bolt (2).
12) Remove drive shaft assembly.



13) For vehicle with center shaft, remove center bearing support bolts (3) and remove center bearing support (2) with center shaft (1) from differential side gear.

Installation

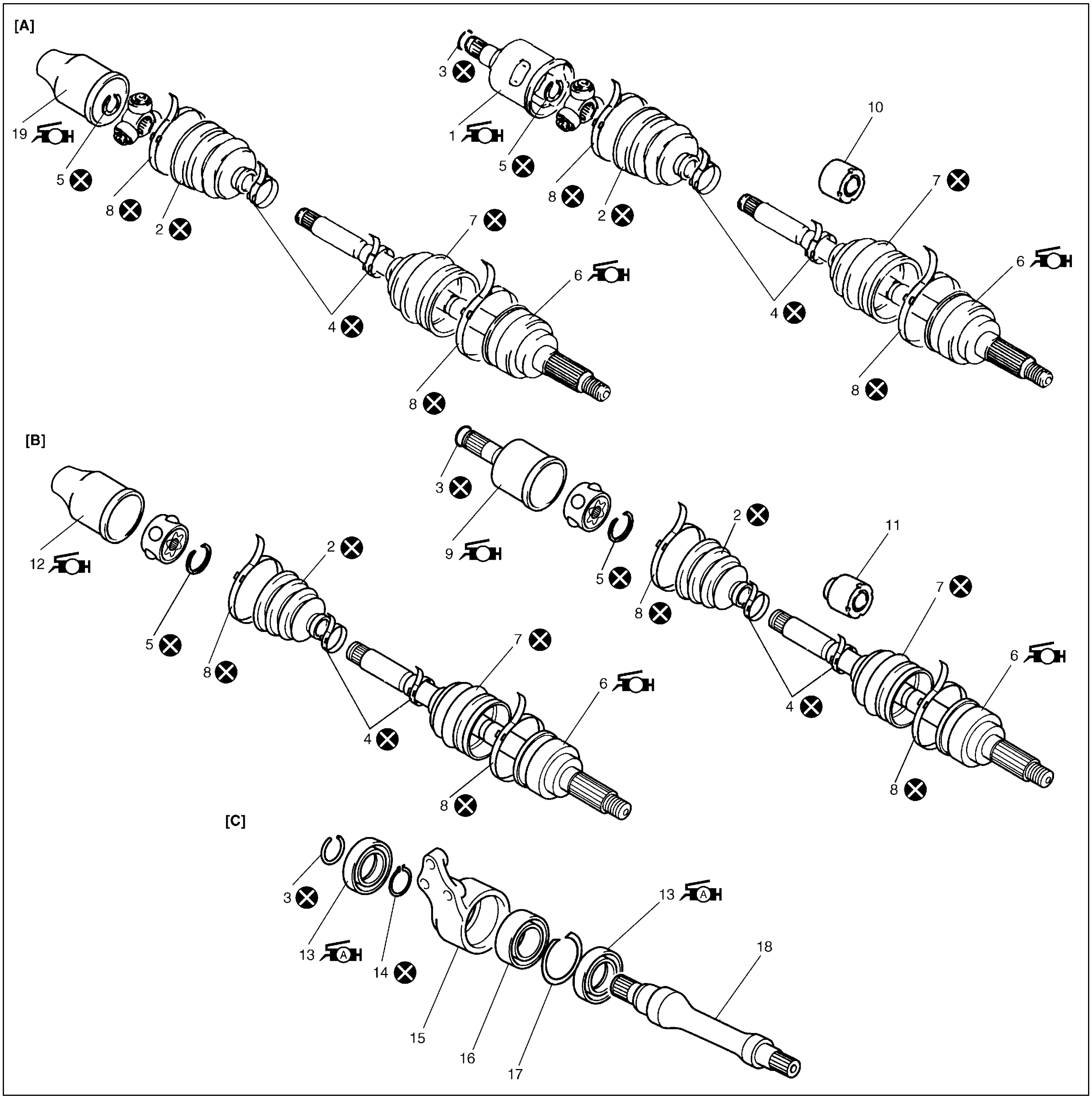
CAUTION:
- **Be careful not to damage oil seals and boots when installing drive shafts.**
- **Do not hit joint boot with hammer. Inserting joint only by hands is allowed.**
- **Make sure that differential side joint is inserted fully and its snap ring is seated as it was.**

Reverse removal procedure for installation noting the following.
- Install wheel side joint to steering knuckle first, and then differential side joint to transaxle.
- Tighten each bolt and nut to the specified torque referring to "Front Drive Shaft Assembly Construction" in this section.
- Fill transaxle oil as follows.
  - For M/T model with G10 engine
    Refer to "Oil Change" in Section 7A of the Service Manual mentioned in the FOREWORD of this manual.
  - For M/T model with M13 engine
    Refer to "Transaxle Oil Change" in Section 7A2.
  - For A/T model
    Refer to "Fluid Change" in Section 7B1.
- Fill transfer oil referring to "Oil Change" in Section 7D of the Service Manual mentioned in the FOREWORD of this manual.
- Check toe setting and adjust referring to "Toe Setting" and "Toe Adjustment" in Section 3A.

Front Drive Shaft Assembly Inspection

- Check boots for breakage or deterioration.
- Check wheel side joint for rattle or smoothness.
- Check differential side joint for smoothness.
  If any abnormality is found, replace.

Front Drive Shaft Components

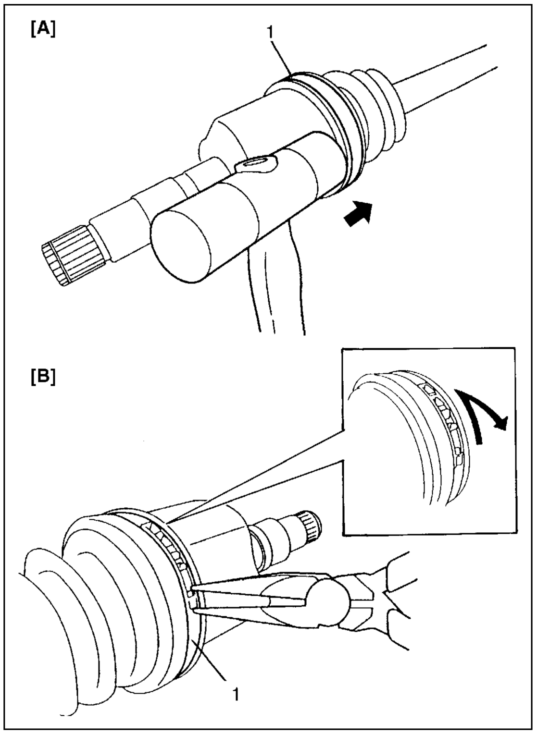


[A]: Tripod joint type	6. Wheel side joint (Constant velocity ball joint) : Apply Black grease included in spare part to joint.	14. Circlip
[B]: DOJ type	7. Boot (Wheel side)	15. Center bearing support
[C]: Center shaft for 2WD model with M13 engine	8. Boot band (Large)	16. Center bearing
1. Differential side joint (Right side of 4WD model with M13 engine) : Apply Black grease included in spare part to joint.	9. Differential side joint (LH of all models) : Apply Black grease included in spare part to joint.	17. Circlip
2. Boot (Differential, transfer or center shaft side)	10. Damper (Right side of G10 engine)	18. Center shaft
3. Circlip	11. Damper (Other than right side of G10 engine)	19. Center shaft side joint (Right side of 2WD model with M13 engine) : Apply Dark brown grease included in spare part to joint.
4. Boot band (Small)	12. Center shaft side joint (Right side of 2WD model with M13 engine)	Tightening torque
5. Snap ring	13. Oil seal : Apply grease 99000-25010 to oil seal lip.	Do not reuse.

Front Drive Shaft Disassembly and Assembly

Disassembly

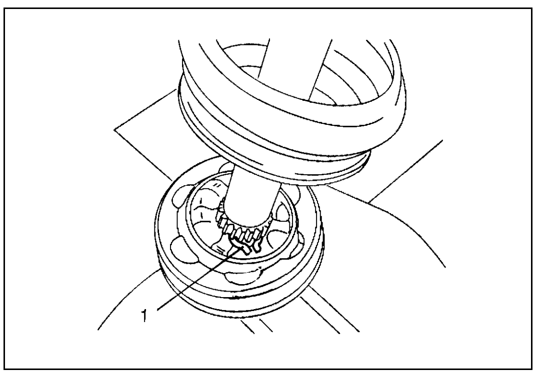
For DOJ type



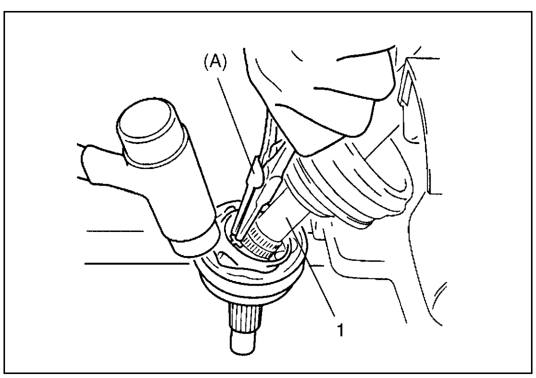
CAUTION:
Disassembly of wheel side joint is not allowed. If any abnormality is found, replace it as assembly.

1) Remove differential side boot big band (1) as follows.
   - For boot big band without joint
     Remove boot big band by tapping boot and band with plastic hammer. If it is hard to remove boot big band, cut it using a nipper or a iron saw with care not to damage DOJ housing.
   - For boot big band with joint
     Draw hooks of boot big band together and remove band.

[A]:	For boot big band without joint
[B]:	For boot big band with joint

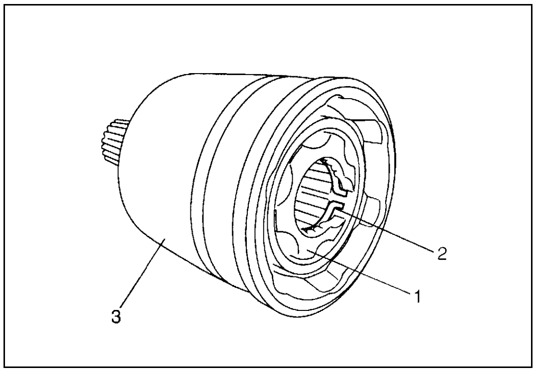


2) Remove DOJ from shaft as follows.
   a) Fold over boot and remove old grease so that retaining ring (1) is accessible.



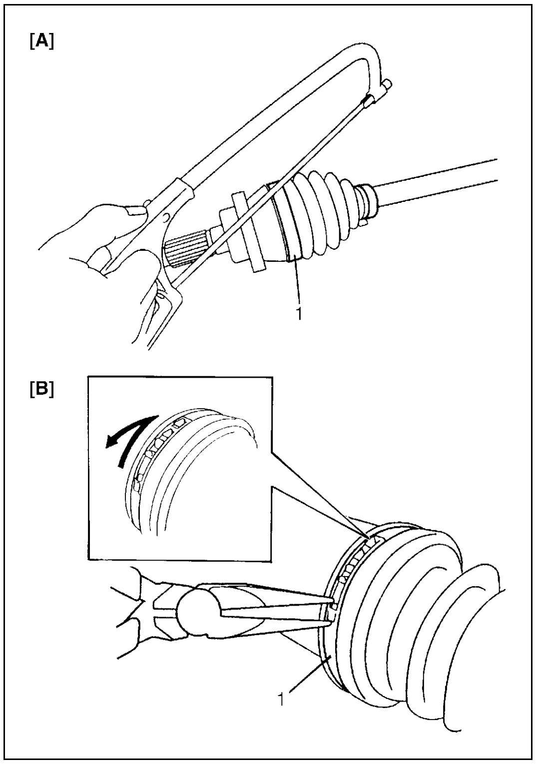
   b) Clamp drive shaft in soft jawed vise, and then open retaining ring using special tool and tap DOJ of drive shaft (1) using plastic hammer until retaining ring no longer engages in groove of shaft.

   Special tool
   (A): 09900-06107



c) Remove cage (1) with retaining ring (2) from housing (3) if necessary.

3) Remove differential side boot small band, and then pull out differential side boot from shaft.
4) Pull out damper through shaft.

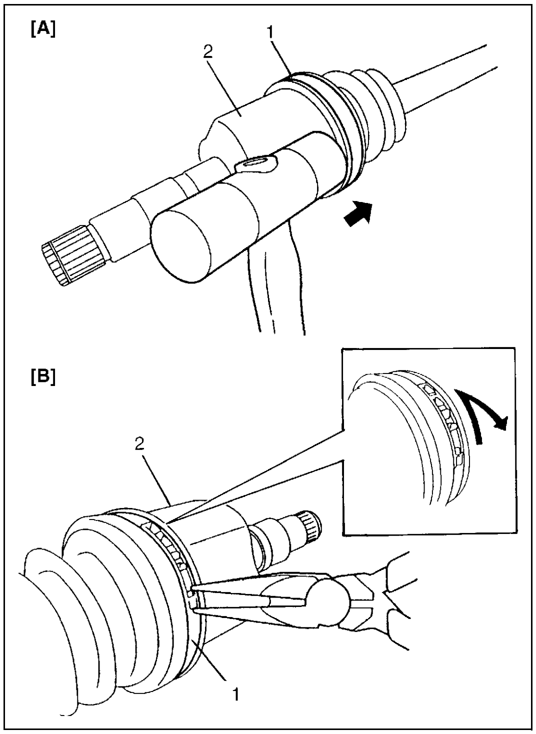


5) Remove wheel side boot big band (1) as follows.
   - For boot big band without joint
     Cut boot big band using a iron saw or a nipper with care not to damage wheel side joint housing.
   - For boot big band with joint
     Draw hooks of boot big band together and remove band.
6) Remove wheel side small band, and then pull out wheel side boot from shaft.

[A]:	For boot big band without joint
[B]:	For boot big band with joint

For tripod joint type

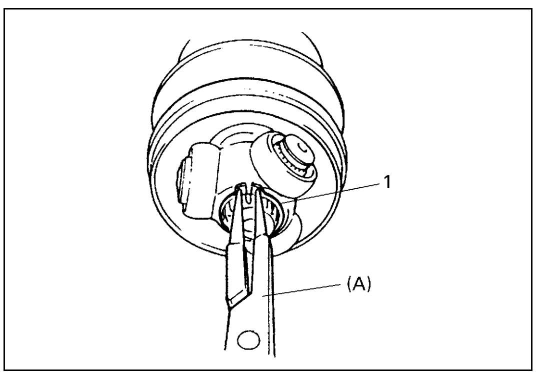
CAUTION:
- **Disassembly of wheel side joint is not allowed. If noise or damage exists in it, replace it as assembly.**
- **Do not disassemble tripod joint spider. If any malcondition is found in it, replace it as differential side joint assembly.**



1) Remove differential side boot big band (1) as follows.
   - For boot big band without joint
     Remove boot big band by tapping boot and band with plastic hammer.
     If it is hard to remove boot big band, cut it using a nipper or a iron saw with care not to damage tripod joint housing.
   - For boot big band with joint
     Draw hooks of boot big band together and remove band.

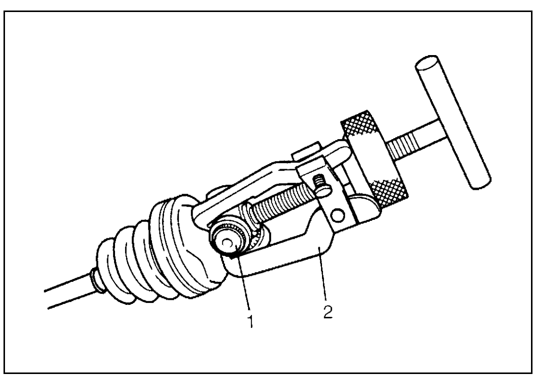
[A]:	For boot big band without joint
[B]:	For boot big band with joint

2) Take out tripod joint housing (2).



3) Wipe off grease from shaft and take off snap ring (1) by using special tool.

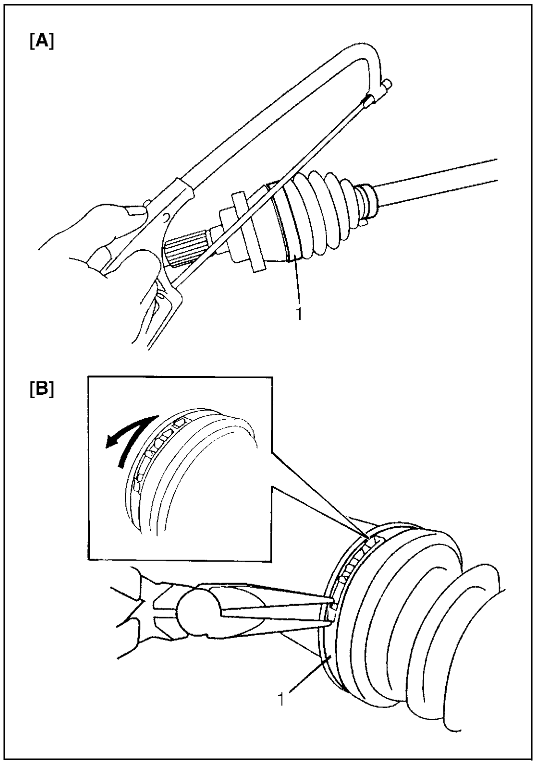
Special tool
(A): 09900-06107



4) Remove spider (1) by using 3 arms puller (2).

CAUTION:
To prevent needle bearing of joint from being degreased, do not wash it if it is to be reused.

5) Remove differential side boot small band, then pull out differential side boot from shaft.
6) Pull out damper through shaft, if equipped.

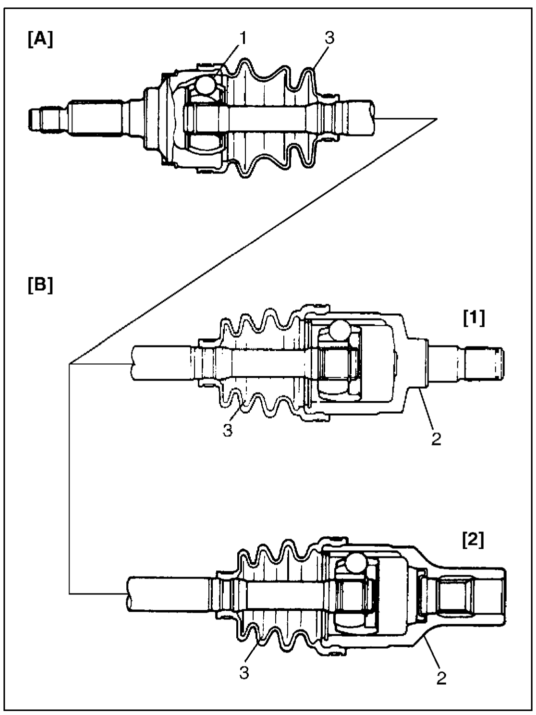


7) Remove wheel side boot big band (1) as follows.
   - For boot big band without joint
     Cut boot big band using a iron saw or a nipper with care not to damage wheel side joint housing.
   - For boot big band with joint
     Draw hooks of boot big band together and remove band.

[A]:	For boot big band without joint
[B]:	For boot big band with joint

8) Remove wheel side small band, then pull out wheel side boot from shaft.

Assembly
For DOJ type



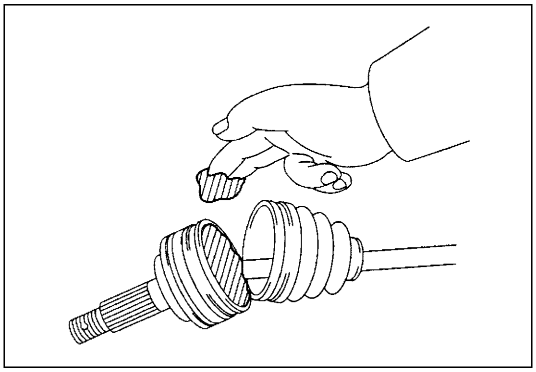
CAUTION:
- **Do not wash boots in degrease, such as gasoline or kerosene, etc. Washing in degrease causes deterioration of boots.**
- **To ensure full performance of joint as designed, be sure to distinguish two types of grease in spare part and apply the specified amount of grease to each joint.**

Judging from abnormality noted before disassembly and what is found though visual check of each component after disassembly, prepare replacement parts and start assembly, and make sure that wheel side joint (1) and differential side joint (2) are washed thoroughly and air dried, and boots (3) are cleaned with cloth if they are to be reused.

[A]:	For wheel side joint
[B]:	For differential side joint
[1]:	For left side shaft
[2]:	For right side shaft

1) Wash disassembled parts (except boots), and then dry parts completely by blowing air.
2) Clean boots with cloth.

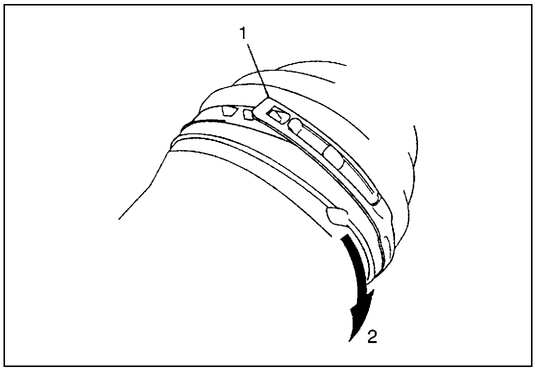
NOTE:
Do not wash boot in degreaser, such as gasoline or kerosene, etc. Washing in degreaser causes deterioration of boot.



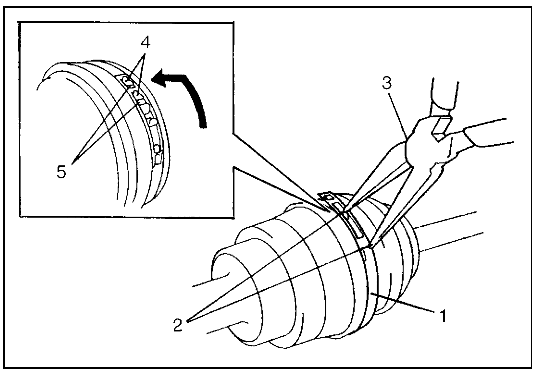
3) Install new wheel side boot on shaft temporarily.
4) Apply grease in the supplied parts to the inside of joint housing.

Grease color: Black
Grease amount: Approx. 70 g (2.5 oz)

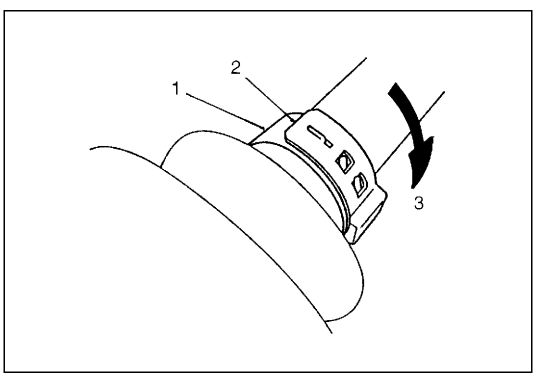
5) Fit wheel side boot onto grooves of housing and shaft.



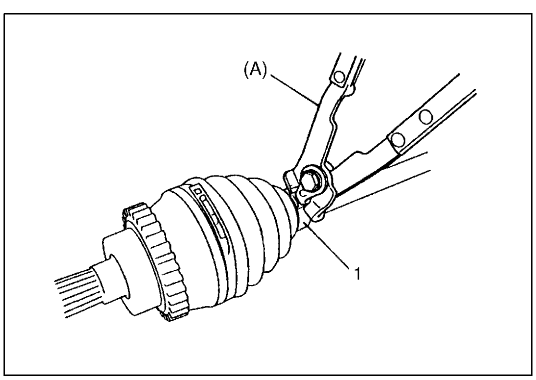
6) Place new wheel side boot big band onto boot putting band outer end (1) against forward rotation (2) as shown in figure.



7) Fasten wheel side boot big band (1) by drawing hooks (2) with plier (3) and engage hooks (4) in slot and window (5).

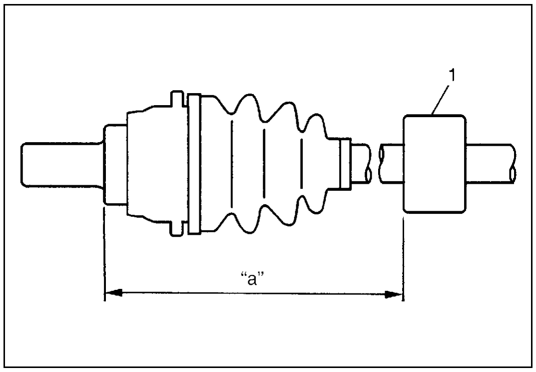


8) Place new wheel side boot small band (1) onto boot putting band outer end (2) against forward rotation (3) as shown in figure.



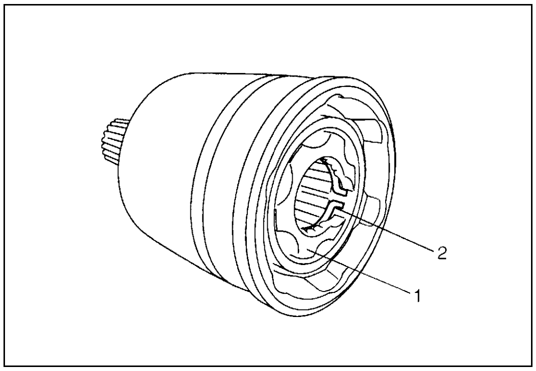
9) Confirm that wheel side boot is not stretched or contracted, and then fasten boot small band (1) securely using special tool.

Special tool
(A): 09943-55010

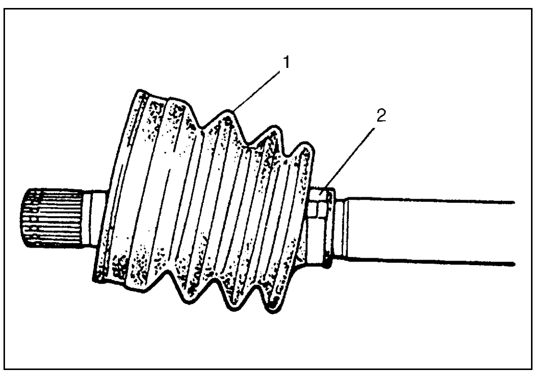


10) Install damper (1) on left side drive shaft according to dimension specified below.

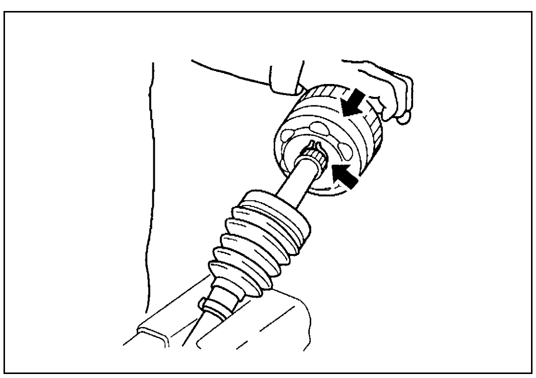
Damper installation position
For M/T model with M13 engine
"a": 134 – 140 mm (5.28 – 5.51 in.)
For A/T model with M13 engine
"a": 157 – 163 mm (6.18 – 6.42 in.)



11) Install retaining ring (2) to cage (1).



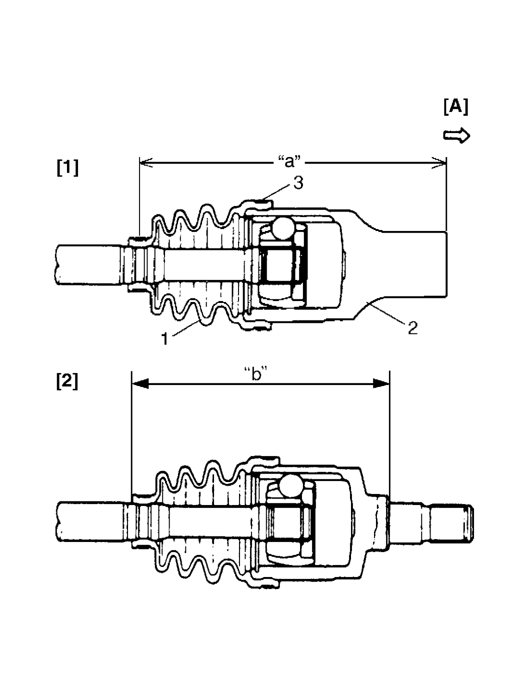
12) Set new differential side small band (2) and differential side boot (1) on shaft temporarily.



13) Apply grease in the supplied parts to DOJ and inside of housing.

Grease color: Black
Grease amount: Approx. 60 g (2.1 oz)

14) Place DOJ onto spline of drive shaft and drive onto drive shaft by using plastic hammer until retaining ring engages.



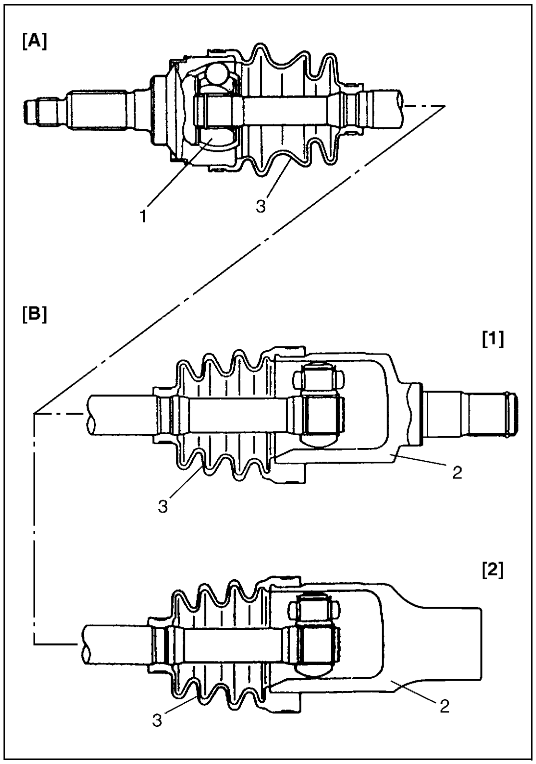
15) Install boot on joint housing.
   - For right side
     When fixing boot (1) to joint housing (2) with differential side boot big band (3), adjust so that measurements become as indicated below.
   - For left side
     Fit boot to grooves of shaft and housing and adjust length "b" to specification below.
     Insert screwdriver into boot and allow air to enter boot so that air pressure in boot becomes the same as atmospheric pressure.

Length
"a": 181.4 mm (7.26 in.)
"b": 147.1 mm (5.88 in.)

[A]:	For differential side
[1]:	For right side
[2]:	For left side

CAUTION:
- **To prevent any problem caused by washing solution, do not wash joint boots. Degreasing of those parts with cloth in allowed.**
- **Do not squeeze or distort boot when fastening it with bands.**
  Distorted boot caused by squeezing air may reduce its durability.

16) Install and fasten new big and small bands at the position of step 15) referring to steps 6) to 9).



For Tripod Joint Type

CAUTION:

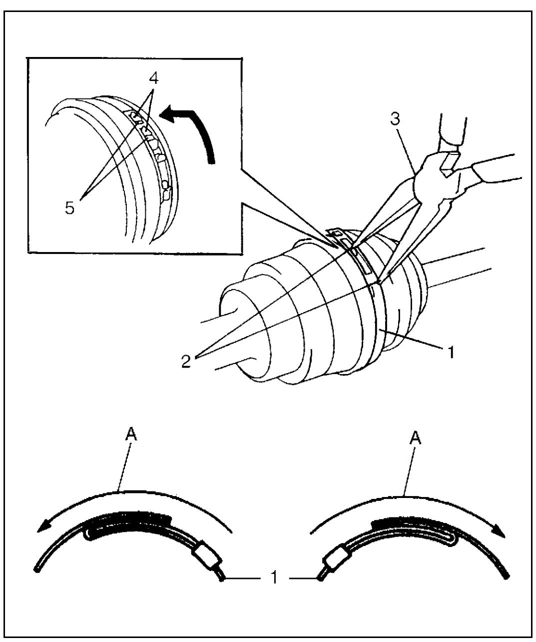
- **Do not wash boots in degrease, such as gasoline or kerosene, etc. Washing in degrease causes deterioration of boots.**
- **To ensure full performance of joint as designed, be sure to distinguish two types of grease in spare part and apply the specified amount of grease to each joint.**

Judging from abnormality noted before disassembly and what is found through visual check of component parts after disassembly, prepare replacing parts and proceed to reassembly.
Make sure that wheel side joint (1) and differential side joint housing (2) are washed thoroughly and air dried, and boots (3) are cleaned with cloth if they are to be reused.

[A]:	For wheel side
[B]:	For differential side
[1]:	For 2WD model
[2]:	For 4WD model

1) Wash disassembled parts (except boots). After washing, dry parts completely by blowing air.
2) Clean boots with cloth.
3) Apply grease in the supplied parts to the inside of joint housing.

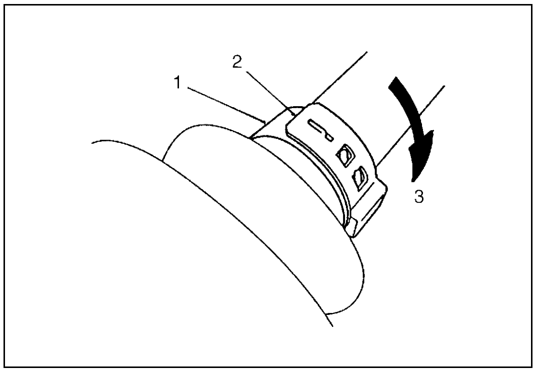
Grease color
For 2WD model: Dark brown
For 4WD model: Black
Grease amount: Approx. 70 g (2.5 oz)



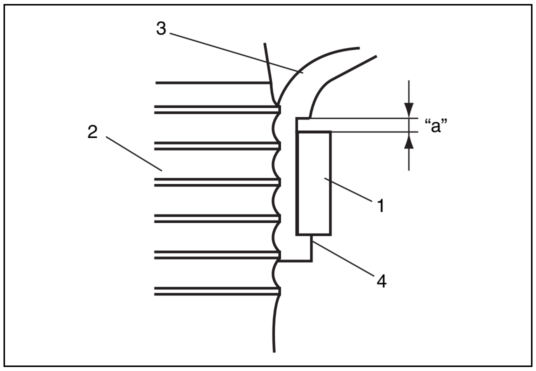
4) Install wheel side boot on shaft, fill up boot inside with grease and then fasten boot big band (1) by drawing hooks (2) with plier (3) and engage hooks (4) in slot and window (5).

CAUTION:

- **Bend each boot band against forward rotation (A).**
- **Do not squeeze or distort boot when fastening it with bands.**
  Distorted boot caused by squeezing air may reduce its durability.

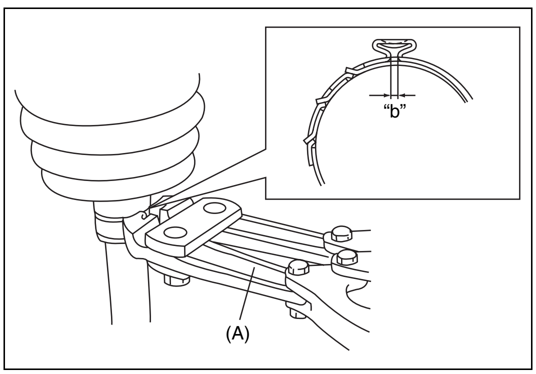


5) Place new wheel side boot small band (1) onto boot putting band outer end (2) against forward rotation (3) as shown in figure.



6) Install wheel side boot small band (1), putting its lower edge against projected end (4) of boot (3) so that clearance "a" is provided as shown in figure.

2. Shaft

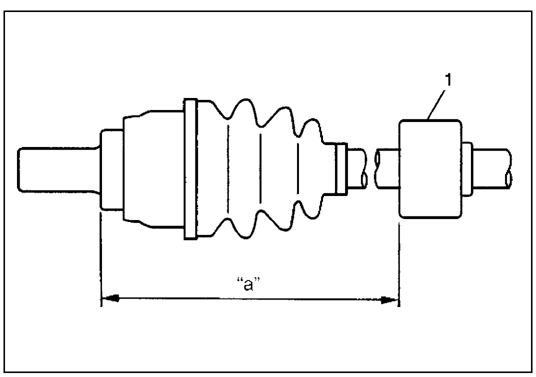


7) Fasten small band by using special tool.

NOTE:

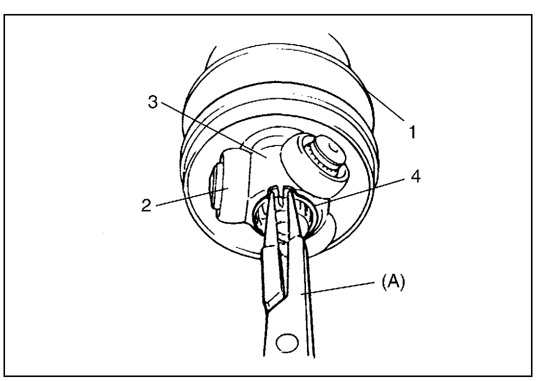
- **Small band must not come out of its installation section.**
- **Be sure to caulk small band securely until complete contact "b" is obtained.**

Special tool
(A): 09943-57010



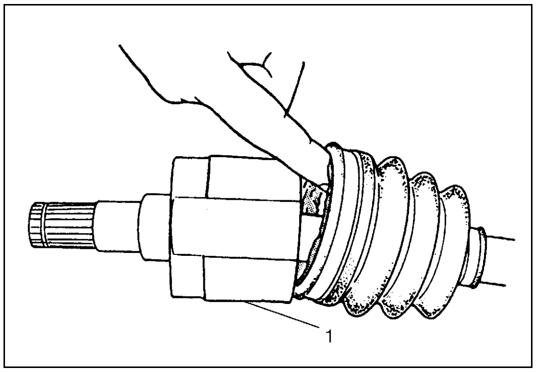
8) Install damper (1) on right side drive shaft according to dimension specified below, if equipped.

Damper installing position
"a": 347 – 353 mm (13.66 – 13.90 in.)



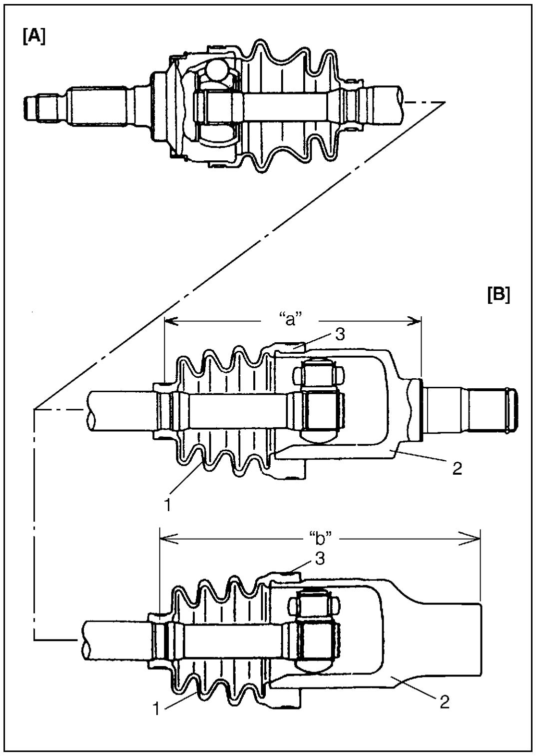
9) Set new differential side small band and differential side boot (1) on shaft temporarily.
   Apply grease to tripod joint (2). Use specified grease in tube included in spare parts.
10) Install tripod joint spider (3) on shaft, facing its chamfered spline inward (wheel side), then fasten it with snap ring (4).

Special tool
(A): 09900-06107



11) Apply grease to inside of joint housing (1), then install housing, joint it with boot and fit boot to joint housing.
    After fitting boot, insert screwdriver into boot on joint housing side and allow air to enter boot so that air pressure in boot becomes the same as atmospheric pressure.

Grease color
For 2WD model: Dark brown
For 4WD model: Black
Grease amount: Approx. 95 g (3.3 oz)



12) When fixing boot (1) to joint housing (2) with differential side big band (3), adjust so that measured dimensions become as indicated below.

Length
"a": 152.7 mm (6.11 in.) for right side of G10 engine model
"b": 188.2 mm (7.53 in.) for right side of 4WD with M13 engine model

CAUTION:
To prevent any problem caused by washing solution, do not wash joint boots and tripod joint except its housing. Degreasing of those parts with cloth is allowed.

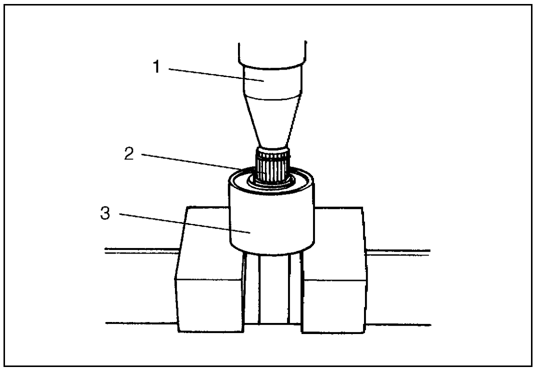
[A]:	For wheel side
[B]:	For differential side

Front Drive Shaft Inspection

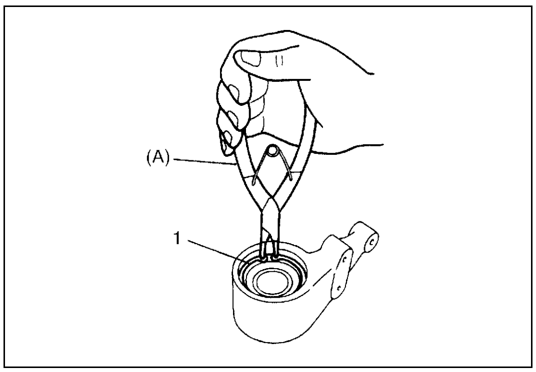
- Check shaft and joint for damage, wear or bend.
  Replace them as necessary.
- Check retaining ring and snap ring for breakage or deformation.
  Replace as necessary.

Center Shaft and Center Bearing Support Disassembly and Assembly (2WD Model with M13 Engine)

Disassembly



1) For M/T model, go to the next step. For A/T model, remove wheel side oil seal and circlip from center bearing support bracket (3).
2) Using hydraulic press (1), draw out center shaft (2) from center shaft support bearing.
3) Remove oil seals from center bearing support bracket (3).

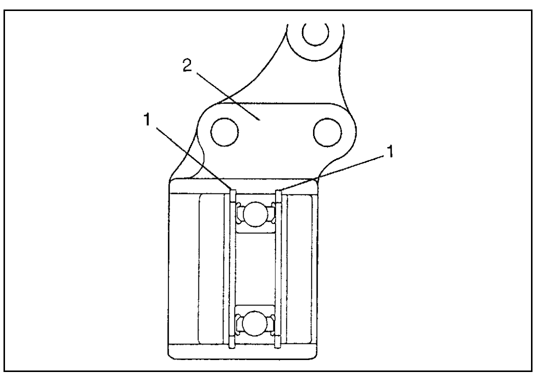


4) Remove bearing support circlip(s) (1) by using special tool.

Special tool
(A): 09900-06108

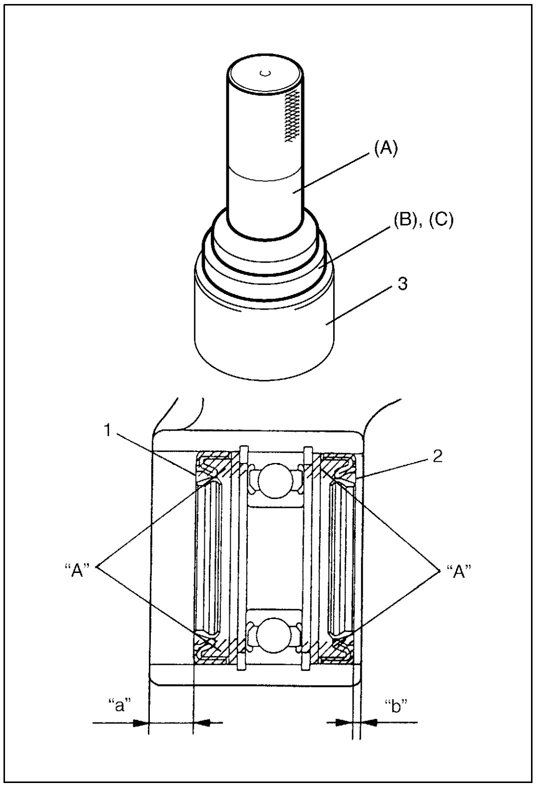
5) Remove center shaft support bearing from center bearing support bracket.

Assembly



Install center shaft by reversing removal procedure and noting following points

- When installing circlips (1), make sure that it fits in circlip groove in center bearing support bracket (2) securely as shown.



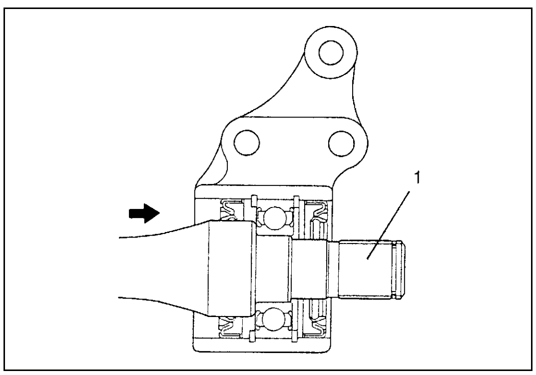
- When installing left oil seal (1) and right oil seal (2) to center bearing support bracket (3) by using special tools, use care so that the oil seals installed in proper direction and position as shown figure.

Special tool
(A): 09913-76010 (For A/T model)
(B): 09951-46010 (For A/T model)
(C): 09944-66020 (For A/T model)
09925-15410 (For M/T model)

Distance
For M/T model
"a": 8 – 9 mm (0.31 – 0.35 in.)
"b": 2 – 3 mm (0.08 – 0.12 in.)
For A/T model
"a": 0 mm (0 in.)
"b": 0 mm (0 in.)

- Be sure to apply grease to oil seal lip and bearing side space indicated in figure.

"A": Grease 99000-25010



- Press-fit center shaft (1) from transaxle side.

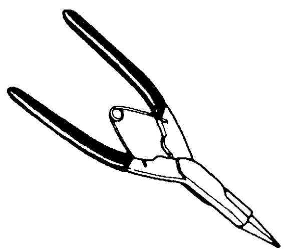
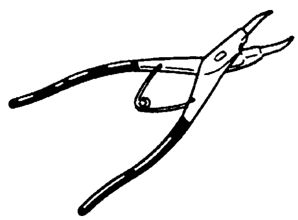
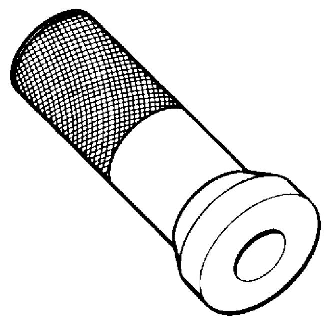
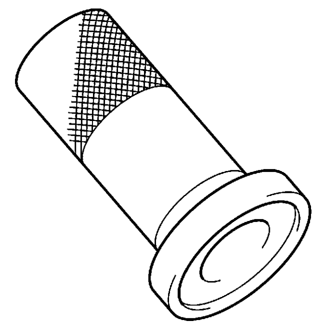
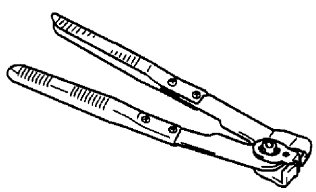
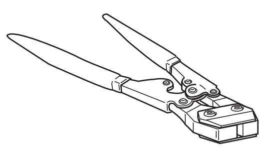
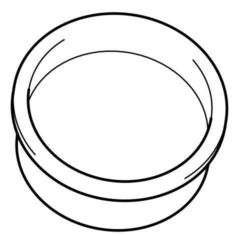
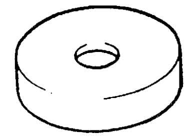
Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Transfer oil filler/level and drain plugs	21	2.1	15.5
Transmission oil filler/level and drain plugs	23	2.3	17.0
Ball stud bolt	60	6.0	43.5
Tie rod end nut	40	4.0	29.0
Drive shaft nut	175	17.5	127.0
Wheel bolt	95	9.5	69.0
Stabilizer mount bracket bolt	45	4.5	33.0
Center bearing support bolt	50	5.0	37.0

RequirPed Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Oil seal lip
Sealant	SUZUKI BOND NO. 1217G (99000-31260)	• Oil drain and filler/level plugs for manual transmission

Special Tools

 09900-06107 Snap ring plier (Open type)	 09900-06108 Snap ring plier (Close type)	 09913-76010 Differential bearing race inst	 09925-15410 Oil seal installer
 09943-55010 Boot clamp plier	 09943-57010 Band compressor	 09944-66020 Installer bearing	 09951-46010 Installer drive shaft oil seal

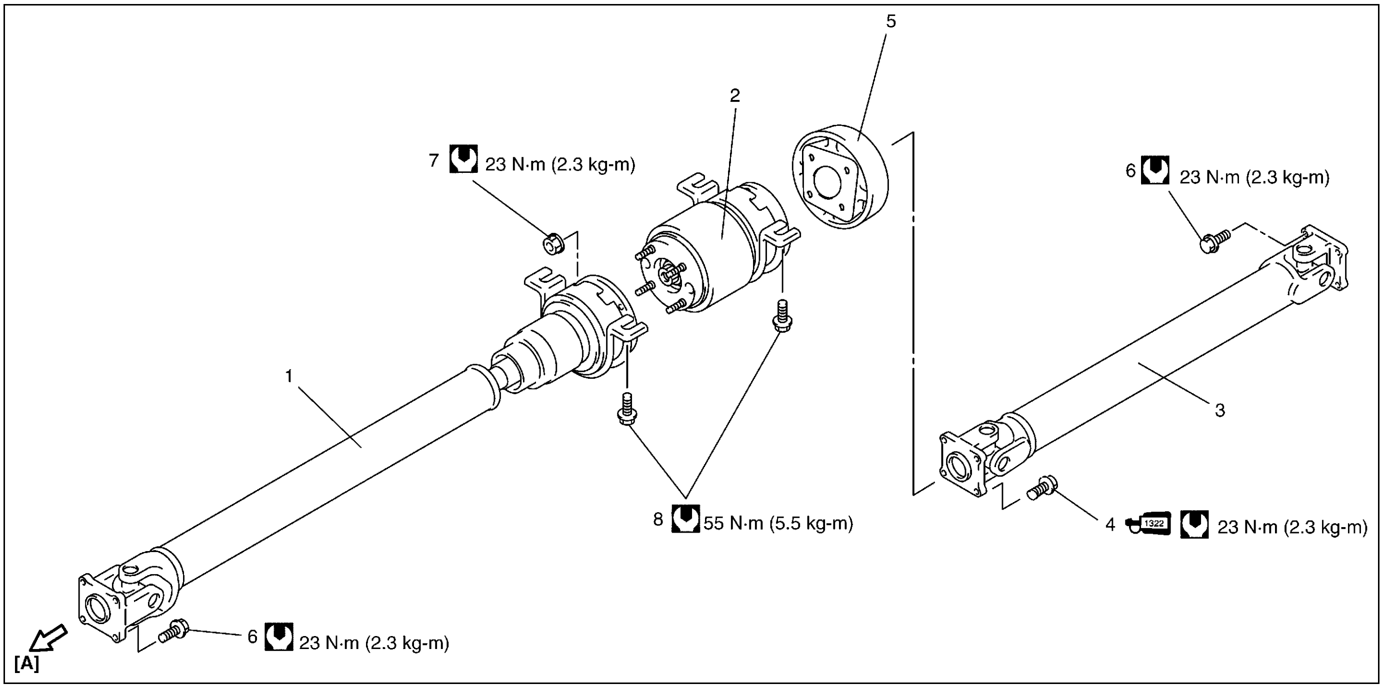
SECTION 4B

PROPELLER SHAFTS

NOTE:
For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

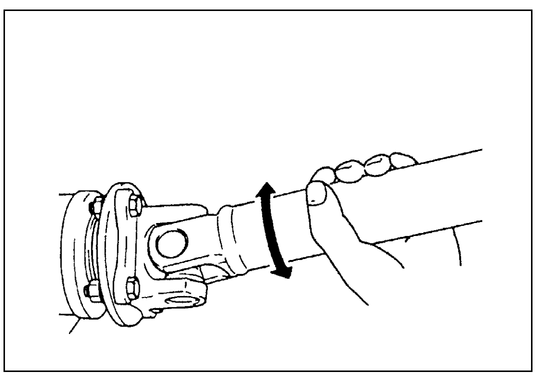
CONTENTS

On-Vehicle Service

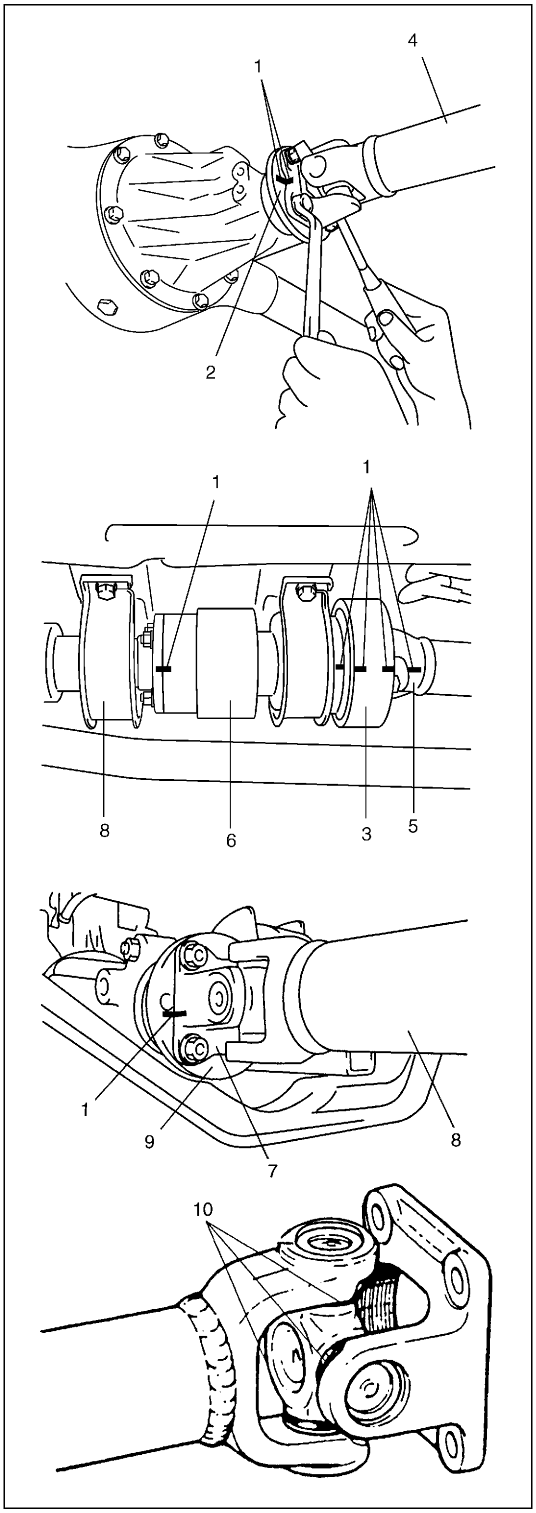


[A]:	Forward.	1322	4. Propeller shaft No.2 bolt : Apply thread lock 99000-32110 to thread.	8.	Center support bolt
1.	Propeller shaft No.1 with center support		5. Dynamic damper		Tightening torque
2.	Viscous coupling with center support		6. Propeller shaft bolt		
3.	Propeller shaft No.2		7. Viscous coupling nut		

ON-VEHICLE INSPECTION



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

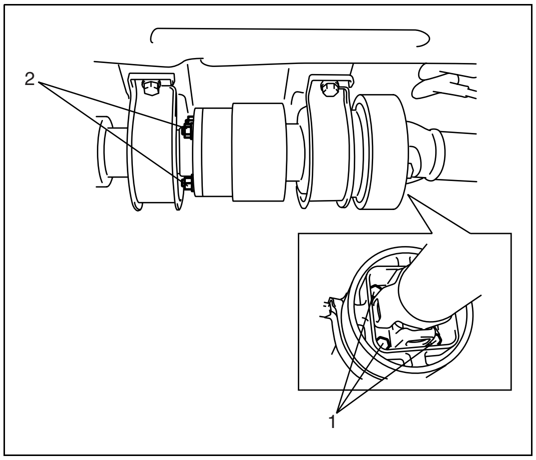


REMOVAL

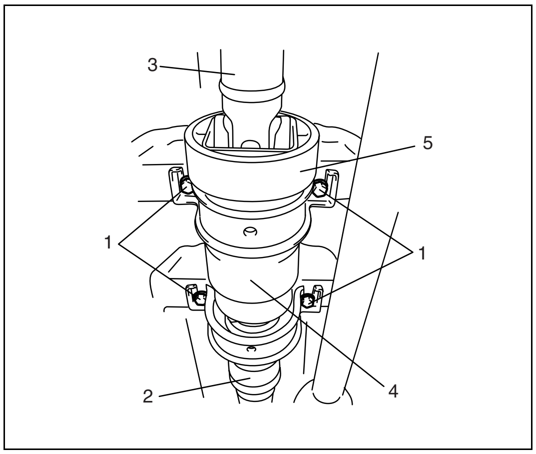
1) Hoist vehicle.
2) Before removing propeller shafts, give match marks (1) on propeller shaft No.2 (4) and companion flange (2) of rear differential as shown. Also give match marks (1) on propeller shaft No.2 yoke (5), dynamic damper (3), viscous coupling with center support (6), yoke (7) of propeller shaft No.1 with center support (8) and transfer output flange (9).

> **CAUTION:**
> **Don't damage joint seal (10) to prevent lubrication defect of joint.**

3) Loosen propeller shaft bolts at front and rear end, and separate propeller shafts from transfer and rear differential.



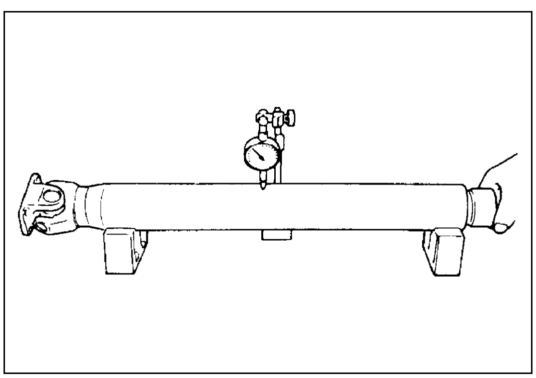
4) If disassembling propeller shaft assembly is necessary, loosen propeller shaft No.2 bolts (1) and viscous coupling nuts (2) to facilitate subsequent disassembling, but keeping each connection provisionally.



5) Loosen center support bolts (1), then remove propeller shaft No.1 with center support (2), propeller shaft No.2 (3), dynamic damper (5) and viscous coupling with center support (4) all together.

6) Disconnect propeller shaft No.1 with center support and propeller shaft No.2 from viscous coupling with center support

INSPECTION



- Inspect propeller shaft and flange yoke for damage.
- Inspect propeller shaft for runout.
  If damage is found or shaft runout exceeds its limit, replace.

Propeller shaft runout
Limit: 0.7 mm (0.028 in.)

INSTALLATION

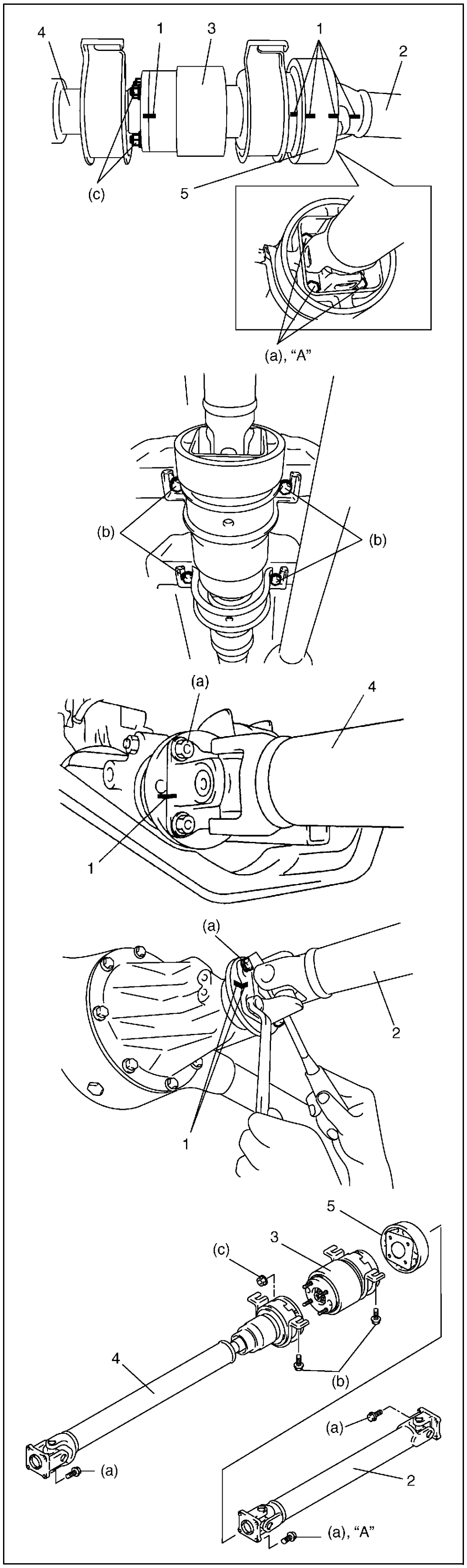
Reverse removal procedure to install propeller shafts noting the following points.

- When installing propeller shafts, dynamic damper and viscous coupling with center support, align the match marks (1).
  Otherwise, vibration may occur during driving.
- Apply thread lock cement to thread of propeller shaft No.2 bolts.

“A”: Cement 99000-32110

- Use following specification to torque bolts.

Tightening torque
Propeller shaft bolt (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)
Center support bolt (b): 55 N·m (5.5 kg-m, 40.0 lb-ft)
Viscous coupling nut (c): 23 N·m (2.3 kg-m, 17.0 lb-ft)



2.	Propeller shaft No.2
3.	Viscous coupling with center support
4.	Propeller shaft No.1 with center support
5.	Dynamic damper

Tightening Torque Specification

Fastening portion	Tightening torque		
	N•m	kg-m	lb-ft
Propeller shaft bolt	23	2.3	17.0
Propeller shaft No.2 bolt	23	2.3	17.0
Center support bolt	55	5.5	40.0
Viscous coupling nut	23	2.3	17.0

SECTION 5

BRAKES

WARNING:

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

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**
- **Do not removal all of the wheel bolts at once, because all the wheels of this vehicle are mounted by the wheel bolts.**
  Leave a bolt at least not to drop the wheel.
  Support the wheel and/or tire and then remove the bolt(s) left with the wheel.

NOTE:

- **When inspecting and servicing vehicle equipped with ABS, be sure to refer to section 5E1 first.**
- **All brake fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.**
- **For descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.**

CONTENTS

General Description

When the foot brake pedal is depressed, hydraulic pressure is developed in the master cylinder to actuate pistons (two in front and four in rear).

The master cylinder is a tandem master cylinder. Brake pipes are connected to the master cylinder and they make two independent circuits. One connects front right & rear left brakes and the other connects front left & rear right brakes.

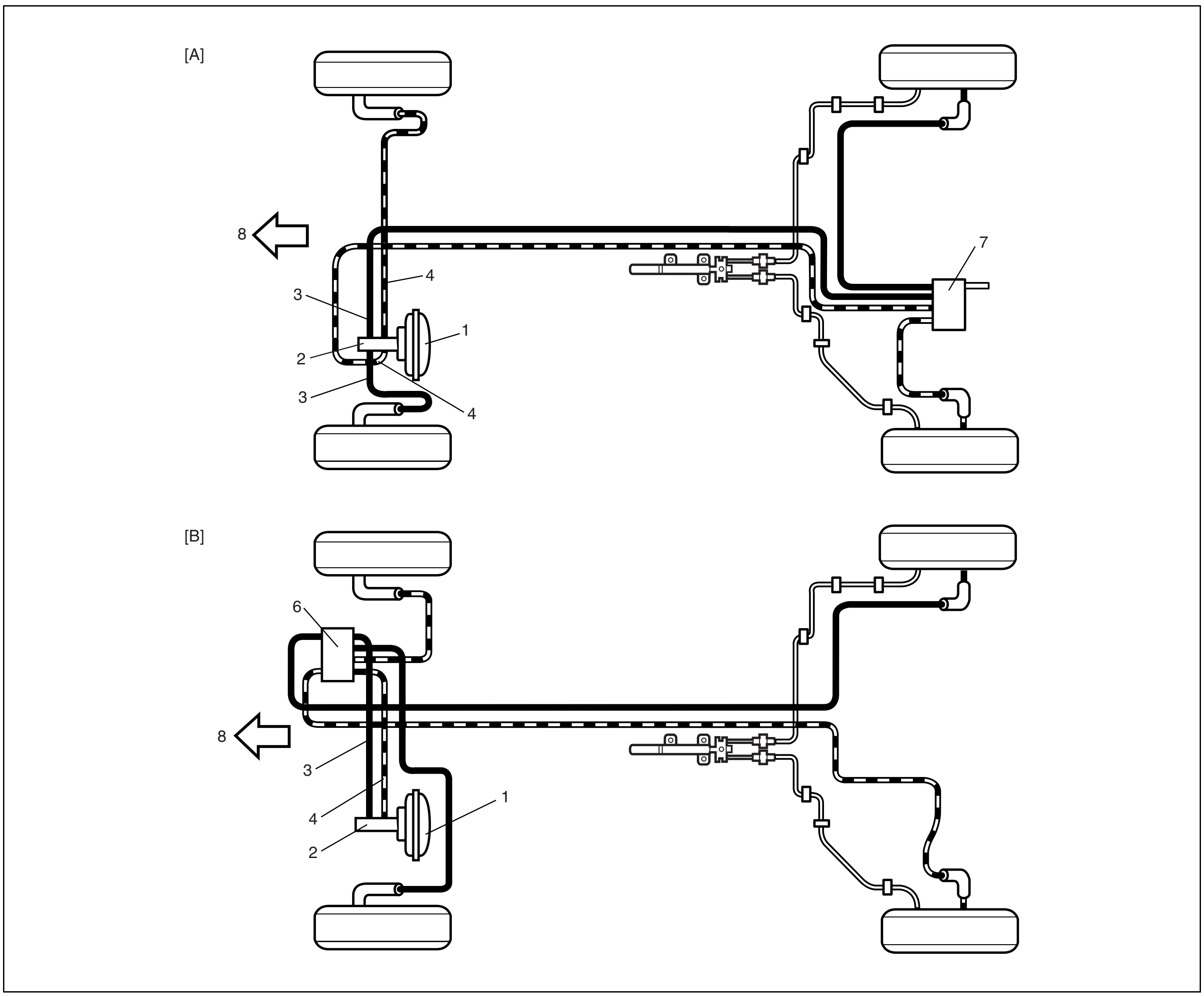
The load sensing proportioning valve (LSPV) is included in these circuits between the master cylinder and the rear brake for the vehicle without ABS.

In this brake system, the disc brake type is used for the front wheel brake and a drum brake type (leading / trailing shoes) for the rear brake.

The parking brake system is mechanical. It applies brake force to only rear wheels by means of the cable and mechanical linkage system. The same brake shoes are used for both parking and foot brakes.

NOTE:

The figures shows left-hand steering vehicle.
The figure for right-hand steering vehicle should be symmetrical.



[A]: For vehicle without ABS	3. Secondary side	7. LSPV (Load Sensing Proportioning Valve)
[B]: For vehicle with ABS	4. Primary side	8. Forward
1. Brake booster	5. Blank	
2. Master cylinder	6. ABS hydraulic unit / control module assembly	

Check and Adjustment

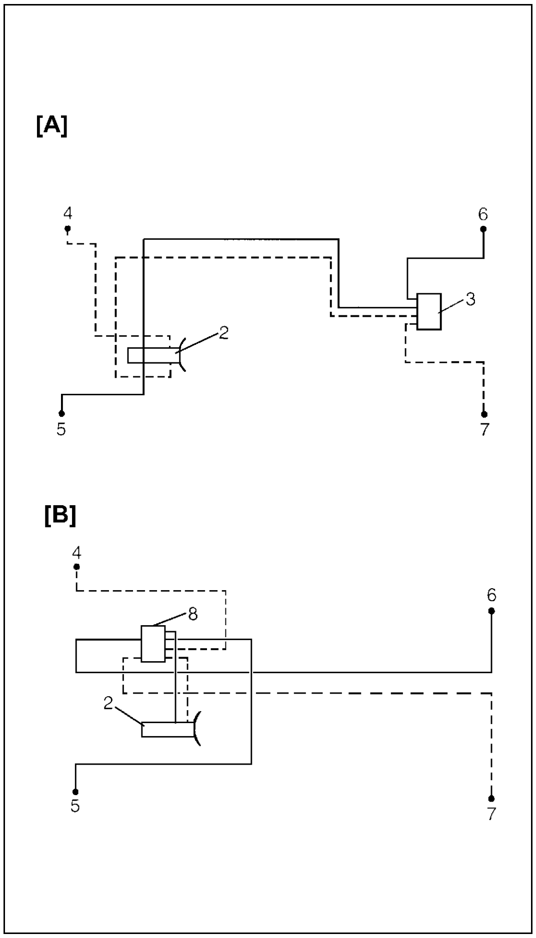
Bleeding Brakes

CAUTION:

Brake fluid is extremely damaging to paint. If fluid should accidentally touch painted surface, immediately wipe fluid from paint and clean painted surface.

NOTE:

For vehicle equipped with ABS, make sure that ignition switch is turned off.



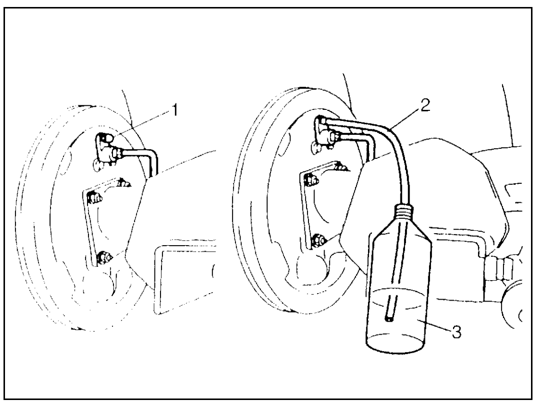
Bleeding operation is necessary to remove air whenever it entered hydraulic brake system.
Hydraulic lines of brake system are based on the diagonal split system. When a brake pipe or hose was disconnected at the wheel, bleeding operation must be performed at both ends of the line of the removed pipe or hose. When any joint part of the master cylinder or other joint part between the master cylinder and each brake (wheel) was removed, the hydraulic brake system must be bled at all 4 wheel brakes.

NOTE:

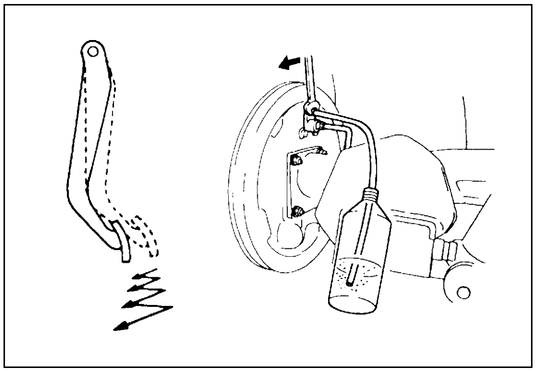
Perform bleeding operation starting with wheel cylinder farthest from master cylinder and then at front caliper of the same brake line. Do the same on the other brake line.

[A]:	Without ABS
[B]:	With ABS
1.	Blank
2.	Master cylinder
3.	LSPV
4.	Right brake caliper
5.	Left brake caliper
6.	Right wheel cylinder
7.	Left wheel cylinder
8.	ABS hydraulic unit
●:	Air bleeding point

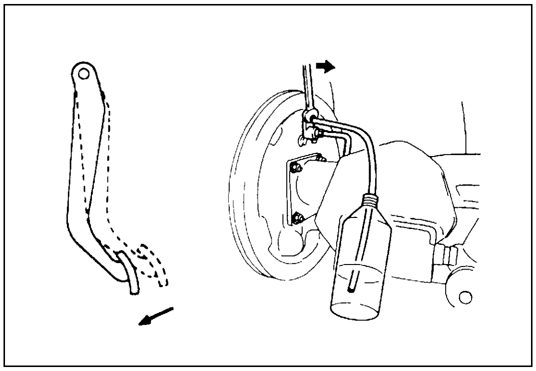
1) Fill master cylinder reservoir with brake fluid and keep at least one-half full of fluid during bleeding operation.



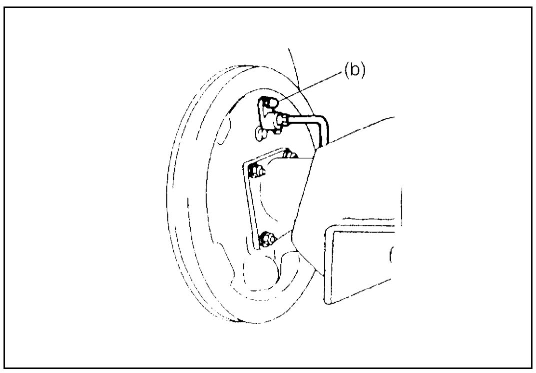
2) Remove bleeder plug cap (1).
   Attach a vinyl tube (2) to bleeder plug of wheel cylinder, and insert the other end into container (3).



3) Depress brake pedal several times, and then while holding it depressed, loosen bleeder plug about one-third to one half turn.



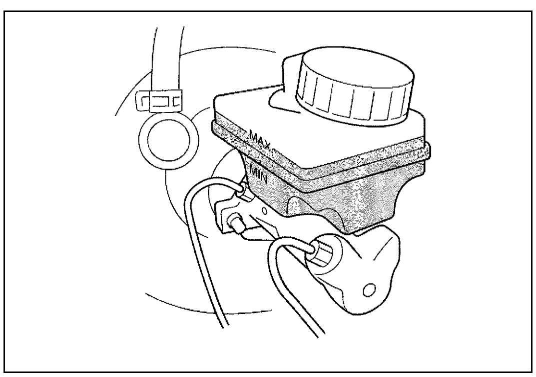
4) When fluid pressure in the cylinder is almost depleted, retighten bleeder plug.
5) Repeat this operation until there are no more air bubbles in hydraulic line.



6) When bubbles stop, with depressing brake pedal, tighten bleeder plug.

Tightening torque
Brake bleeder plug
(b): 8.5 N·m (0.85 kg-m, 6.5 lb-ft) ……**for rear brake**
Brake bleeder plug
(b): 6.5 N·m (0.65 kg-m, 5.0 lb-ft) ……**for front brake**

7) Then attach bleeder plug cap.
8) After completing bleeding operation, apply fluid pressure to pipe line and check for leakage.

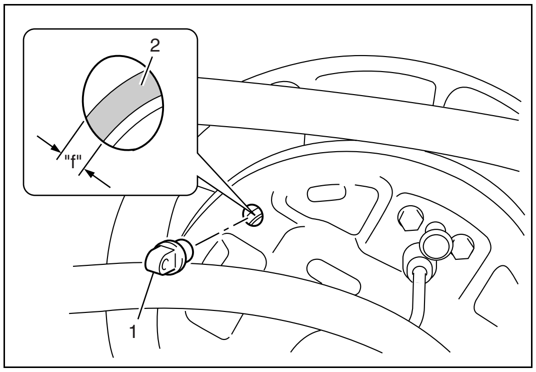


9) Replenish fluid into reservoir up to specified level.
10) Check brake pedal for “sponginess”. If found spongy, repeat entire procedure of bleeding.

Brake Shoe Check

Inspection should be carried out on the following points after brake pedal travel “c” (pedal to silencer clearance) check as described on previous page of this section, even when it is more than specification.
Amount of brake shoe wear can be checked as follows.

1) Hoist vehicle.



2) Remove rubber cover (plug) (1) from brake back plate.
3) Through hole of back plate, visually check for thickness of brake shoe lining (2). If lining thickness “f” is found less than below specified wear limit, replace all brake shoes with new ones.

Thickness “f”
Service limit: 1.0 mm (0.04 in.)

Tightening Torque Specifications

Fastening part		Tightening torque		
		N•m	kg-m	lb-ft
Brake pipe flare nut		16	1.6	11.5
Brake bleeder plug	Front caliper	6.5	0.65	5.0
	Wheel cylinder	8.5	0.85	6.5
Wheel bolt		95	9.5	69.0

SECTION 5A

BRAKES PIPE/HOSE/MASTER CYLINDER

WARNING:

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

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**
- **Do not removal all of the wheel bolts at once, because all the wheels of this vehicle are mounted by the wheel bolts.**
  Leave a bolt at least not to drop the wheel.
  Support the wheel and/or tire and then remove the bolt(s) left with the wheel.

NOTE:

- **All brake fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.**
- **For descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.**

CONTENTS

On-Vehicle Service

Rear Brake Hose/Pipe

CAUTION:

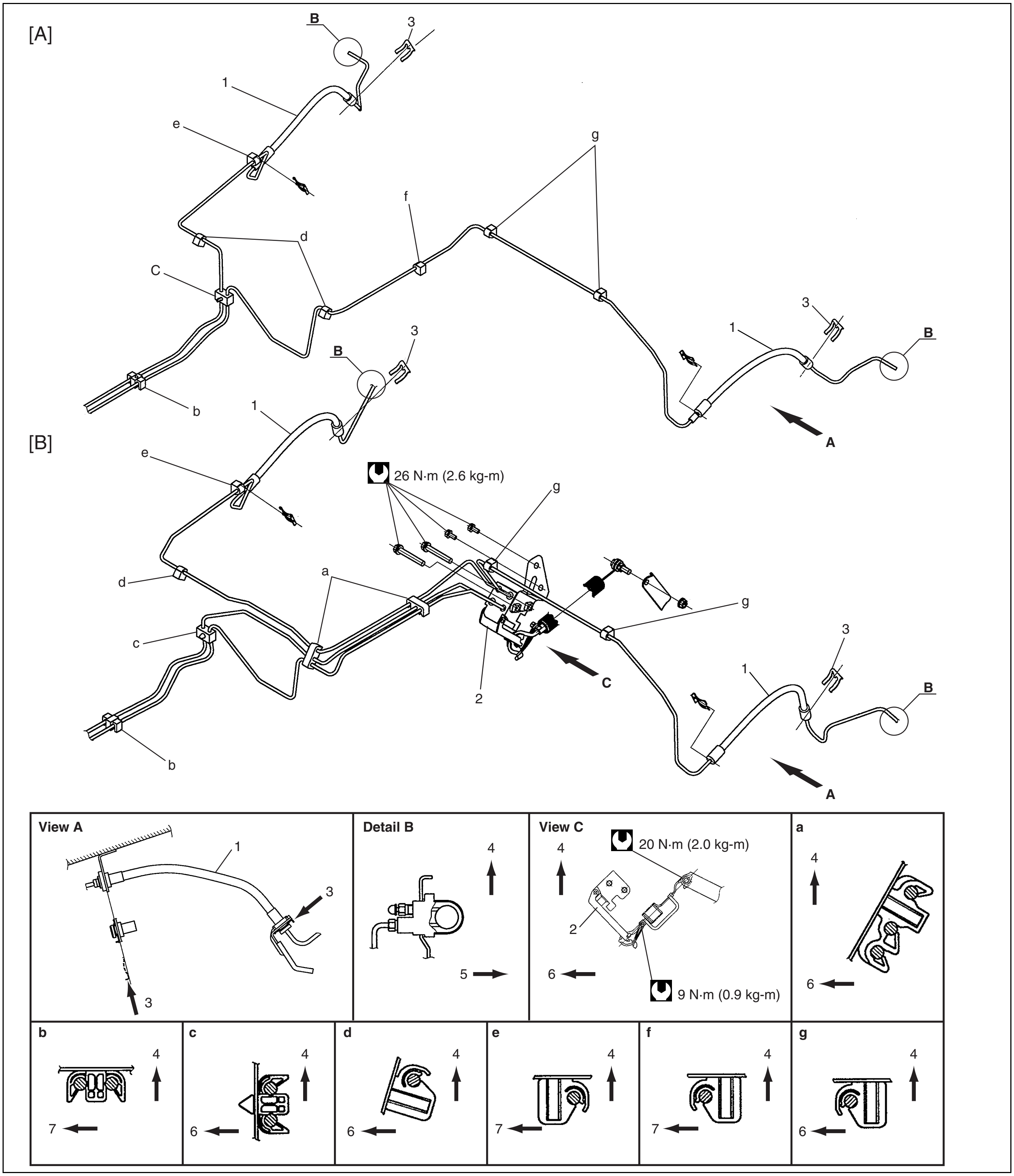
- **Do not use lubricated shop air on brake parts as damage to rubber components may result.**
- **If any hydraulic component is removed or brake line disconnected, bleed the brake system.**
- **The torque values specified are for dry, unlubricated fasteners.**
- **Do not allow brake fluid to get on painted surfaces. Painted surfaces will be damaged by brake fluid.**

Removal

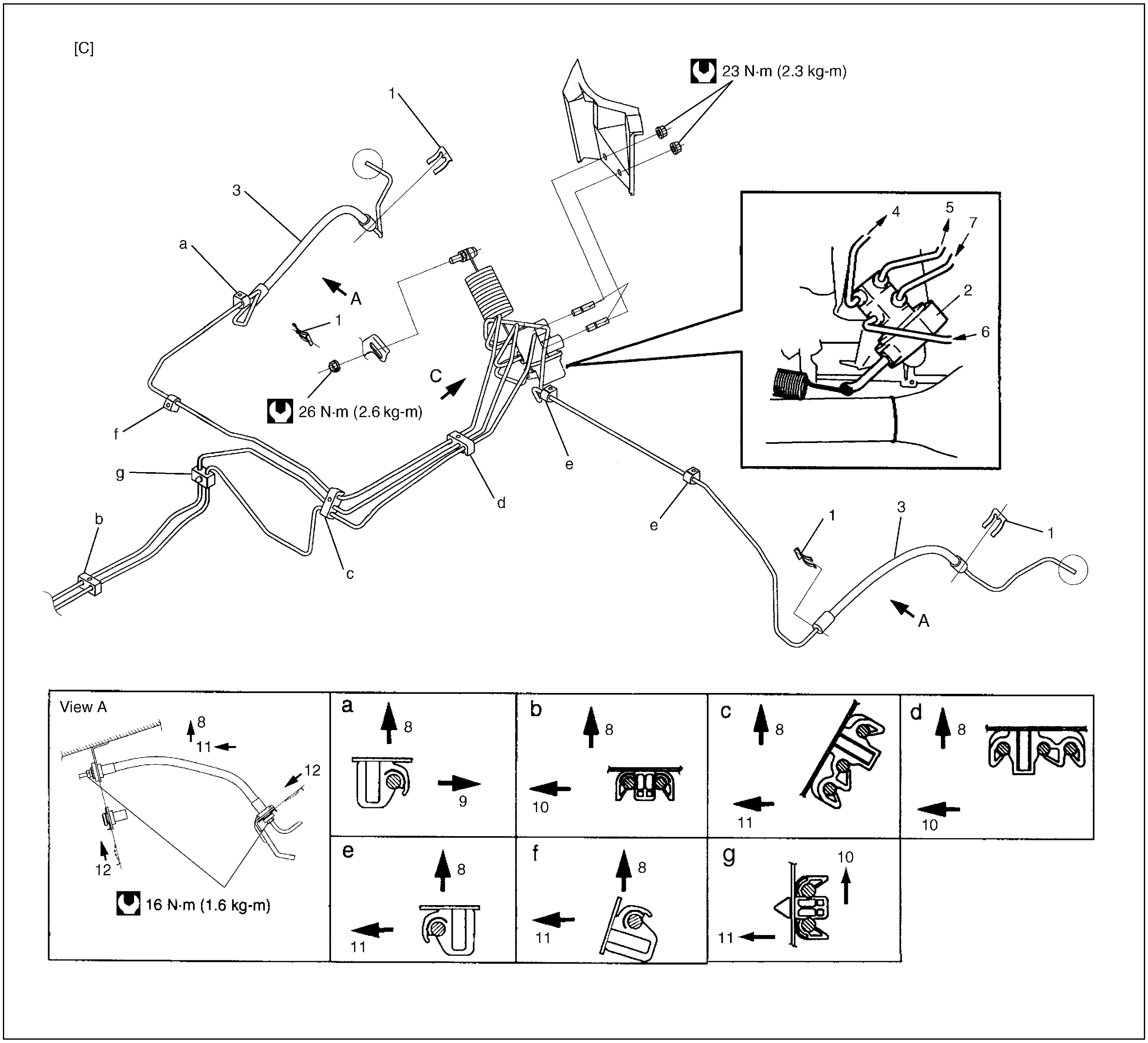
1) Raise and suitably support vehicle. Remove tire and wheel.
2) Clean dirt and foreign material from both hose end or pipe end fittings. Remove brake hose or pipe.

Installation

1) Reverse removal procedure for brake hose or pipe installation procedure.
   - Install clamps properly referring to figure below.
   - When installing hose, make sure that it has no twist or kink.
2) Fill and maintain brake fluid level in reservoir. Bleed brake system.
3) Perform brake test and check each installed part for fluid leakage.



[A]:	with ABS vehicle	1.	Rear brake hose	4.	Top side	7.	Right side
[B]:	without ABS vehicle (2WD)	2.	LSPV assembly	5.	Out side		Tightening torque
a – g:	Clamp	3.	E–ring (Insert delection)	6.	Front side		



[C]:	without ABS vehicle (4WD)	3.	Rear brake hose	7.	From master cylinder (Secondary)	11.	Front side
a – g:	Clamp	4.	To left rear wheel cylinder	8.	Top side	12.	E–ring (Insert delection)
1.	E–ring	5.	To right rear wheel cylinder	9.	Left side		Tightening torque
2.	LSPV assembly	6.	From master cylinder (Primary)	10.	Right side		

SECTION 5B

FRONT BRAKE

WARNING:

Do not removal all of the wheel bolts at once, because all the wheels of this vehicle are mounted by the wheel bolts.
Leave a bolt at least not to drop the wheel.
Support the wheel and/or tire and then remove the bolt(s) left with the wheel.

NOTE:

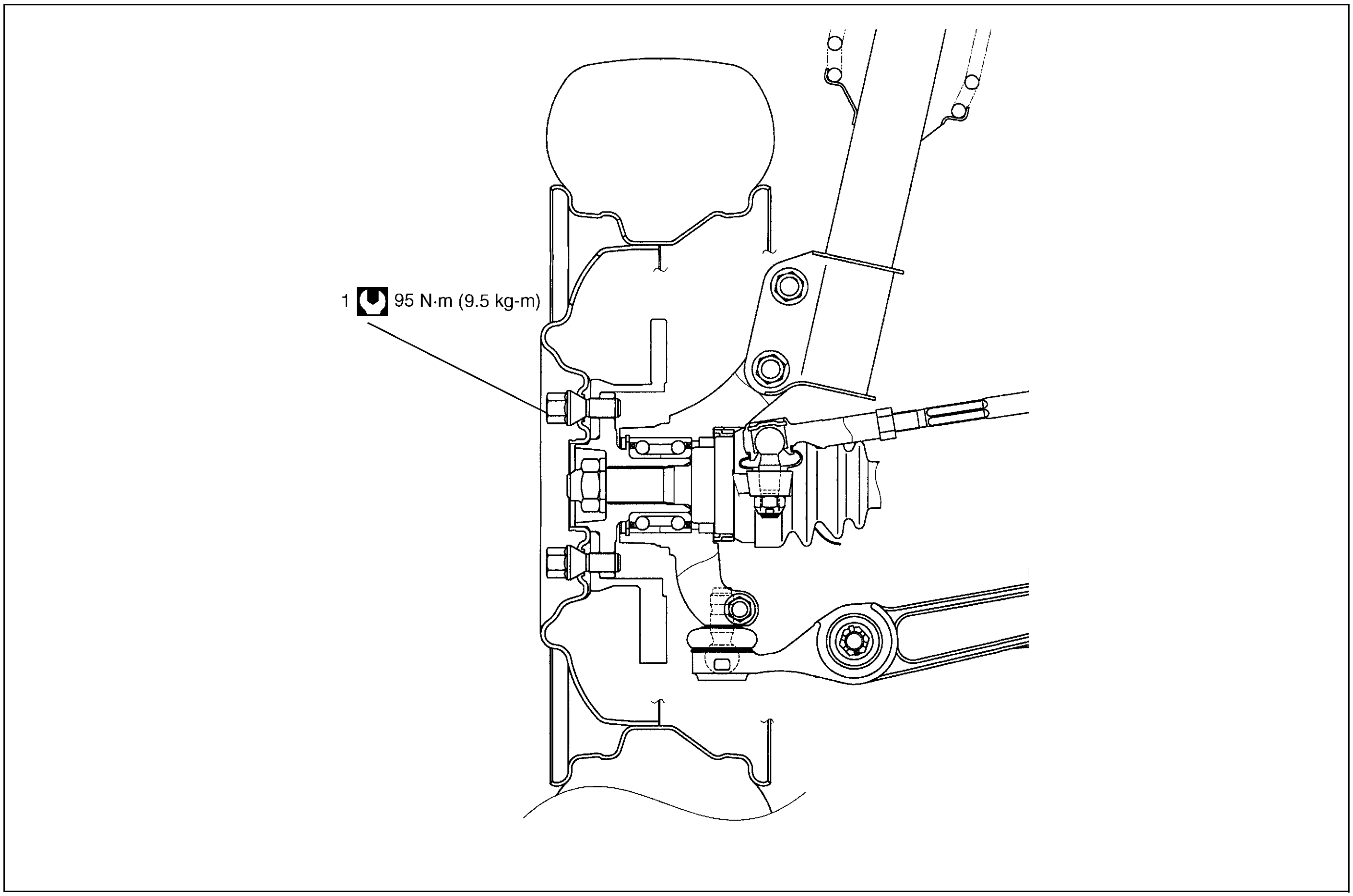
- **All brake fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.**
- **For descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.**

CONTENTS

On-Vehicle Service

CAUTION:

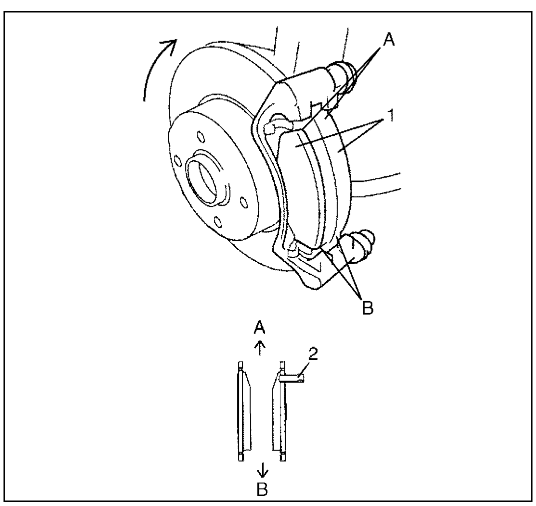
Lubricate parts as specified. Do not use lubricated shop air on brake parts as damage to rubber components may result. If any component is removed or line disconnected, bleed the brake system. Replace pads in axle sets only. The torque values specified are for dry, unlubricated fasteners.



1. Wheel bolt	Tightening torque

Front Disc Brake Pad

Installation

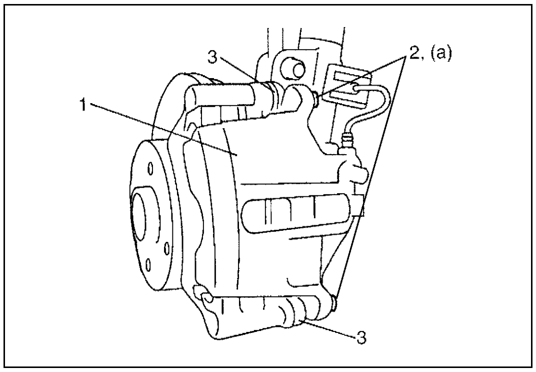


1) Install pads (1).

NOTE:

- **When installing brake pad, make sure that its tapered side is positioned upward (A) as shown in figure.**
- **Install pad with sensor (2) to vehicle center side on right wheel brake.**

A: Upper side	
B: Lower side	

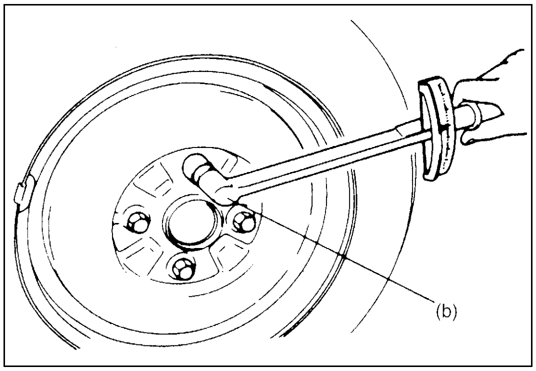


2) Install caliper (1) and tighten caliper pin bolts (2) to specification.

NOTE:

Make sure that boots (3) are fit into groove securely.

Tightening torque
Caliper pin bolt (a): 30 N·m (3.0 kg-m, 22.0 lb-ft)



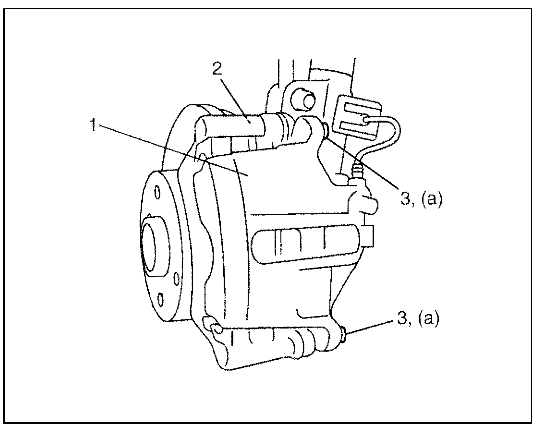
3) Tighten front wheel bolts to specification.

Tightening torque
Wheel bolt (b): 95 N·m (9.5 kg-m, 69.0 lb-ft)

4) Upon completion of installation, perform brake test.

Front Disc Brake Caliper

Installation



CAUTION:

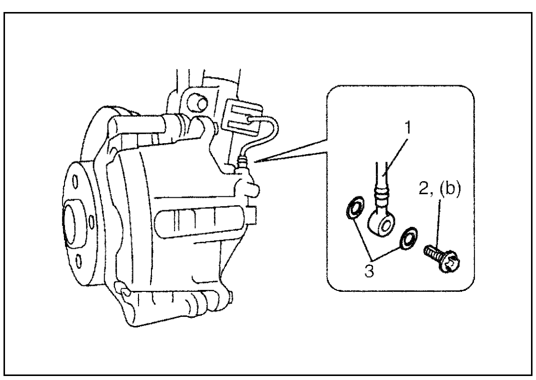
Observe CAUTION at the beginning of On-Vehicle Service.

1) Install caliper (1) to caliper carrier (2).
2) Torque caliper pin bolts (3) to specifications.

NOTE:

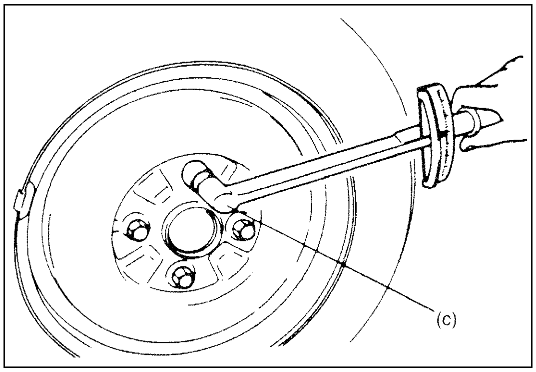
Make sure that boots are fit into groove securely.

Tightening torque
Caliper pin bolt (a): 30 N·m (3.0 kg-m, 22.0 lb-ft)



3) Install brake flexible hose (1) and new gaskets (3) as shown and torque hose bolt (2) to specification.

Tightening torque
Flexible hose bolt (b): 23 N·m (2.3 kg-m, 17.0 lb-ft)



4) Torque wheel bolts to specification.

Tightening torque

Wheel bolt (c): 95 N·m (9.5 kg-m, 69.0 lb-ft)

5) After completing installation, fill reservoir with brake fluid and bleed brake system. Perform brake test and check each installed part for oil leakage.

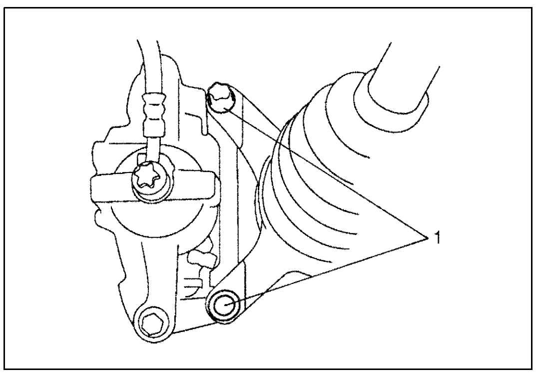
Front Brake Disc

CAUTION:

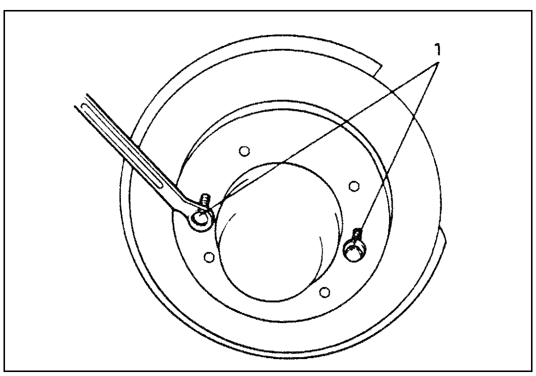
During removal, be careful not to damage brake flexible hose and not to depress brake pedal.

Removal

1) Hoist vehicle and remove wheel.

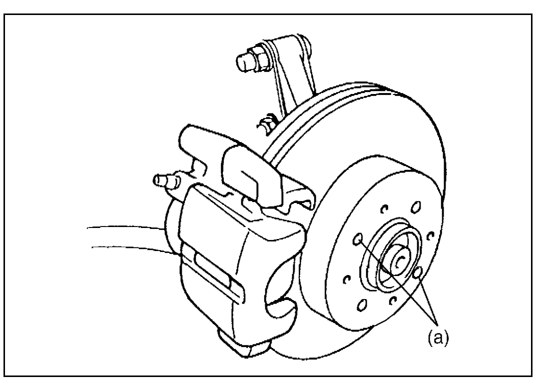


2) Remove caliper assembly by loosening carrier bolts (1).
3) Remove brake disc screws.



4) Remove disc by using M8 x 1.25 bolts (1) (2 pcs).

Installation

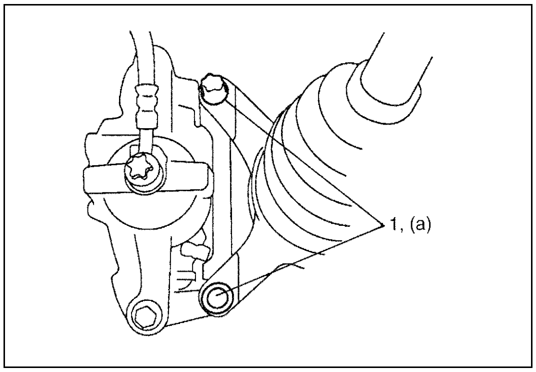


1) Install brake disc to wheel hub and tighten brake disc screws.

Tightening torque

Disc securing screw (a): 9 N·m (0.9 kg-m, 6.5 lb-ft)

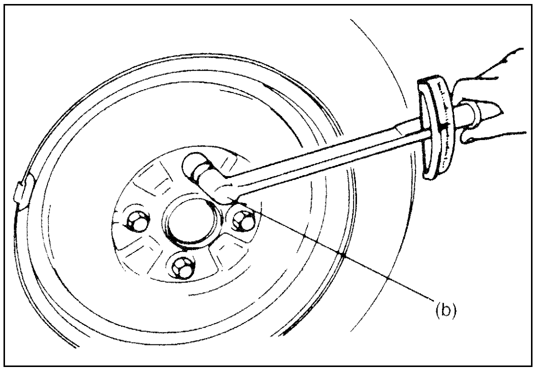
2) Install caliper assembly to steering knuckle.



3) Torque caliper carrier bolts (1) to specification.

Tightening torque

Caliper carrier bolt (a): 95 N·m (9.5 kg-m, 69.0 lb-ft)



4) Torque front wheel bolts to specifications.

Tightening torque

Wheel bolt (b): 95 N·m (9.5 kg-m, 69.0 lb-ft)

5) Upon completion of installation, perform brake test.

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Caliper pin bolt	30.0	3.0	22.0
Wheel bolt	95.0	9.5	69.0
Flexible hose bolt	23.0	2.3	17.0
Caliper carrier bolt	95.0	9.5	69.0
Brake disc securing screw	9.0	0.9	6.5

SECTION 5C

PARKING AND REAR BRAKE

WARNING:

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

- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).**
- **Do not removal all of the wheel bolts at once, because all the wheels of this vehicle are mounted by the wheel bolts.**
  Leave a bolt at least not to drop the wheel.
  Support the wheel and/or tire and then remove the bolt(s) left with the wheel.

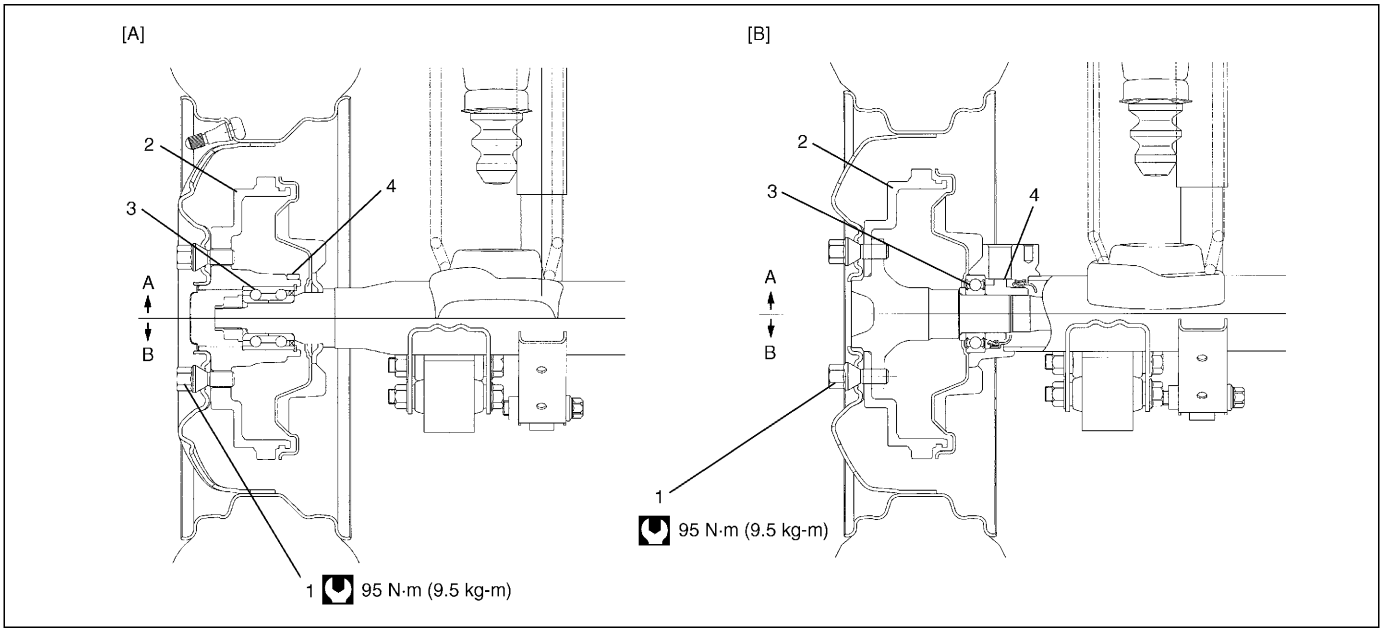
NOTE:

- **All brake fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.**
- **For descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.**

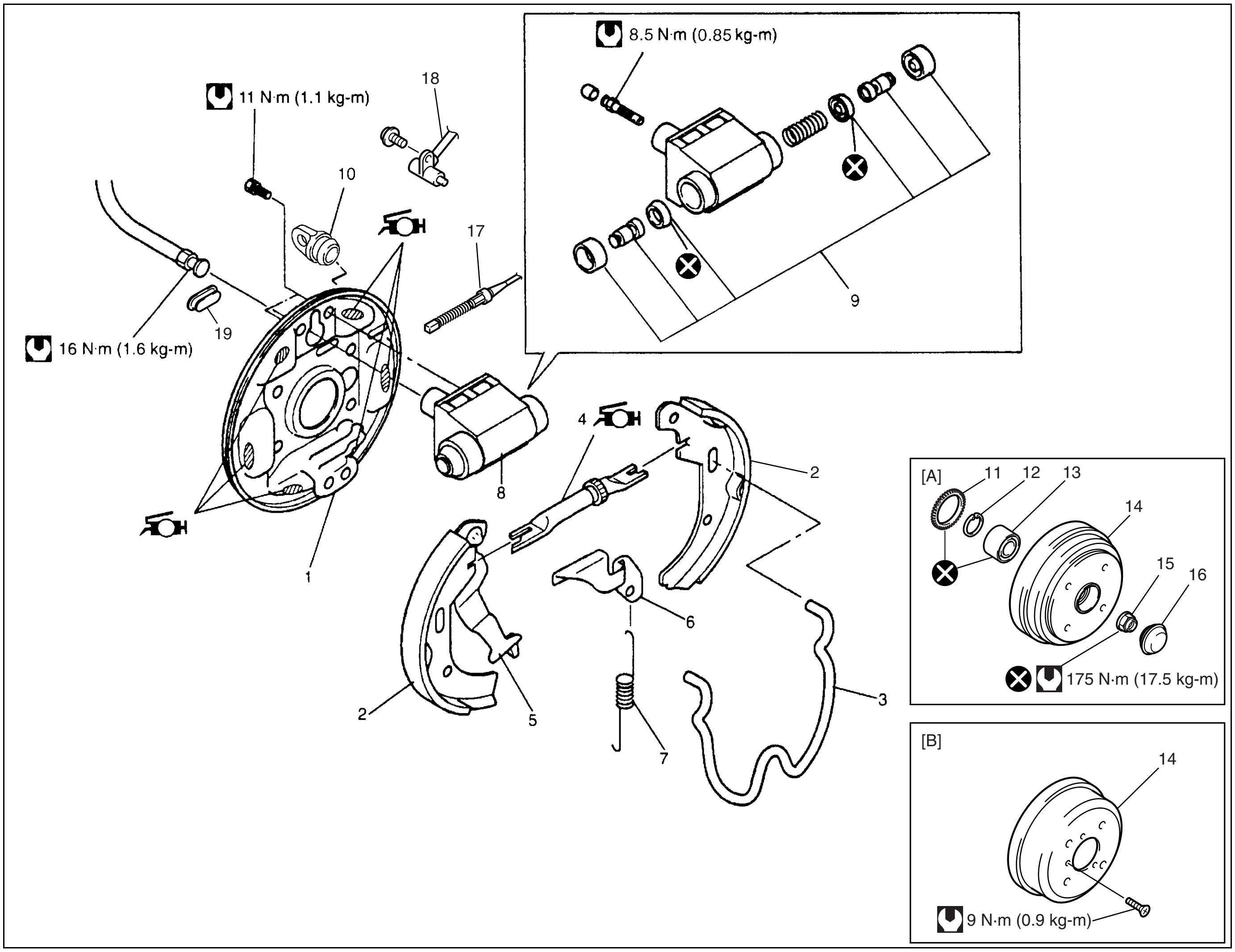
CONTENTS

On-Vehicle Service

CAUTION:
- **Replace all components included in repair kits to service this drum brake. Lubricate parts as specified.**
- **If any hydraulic component is removed or brake line disconnected, bleed the brake system.**
- **The torque values specified are for dry, unlubricated fasteners.**

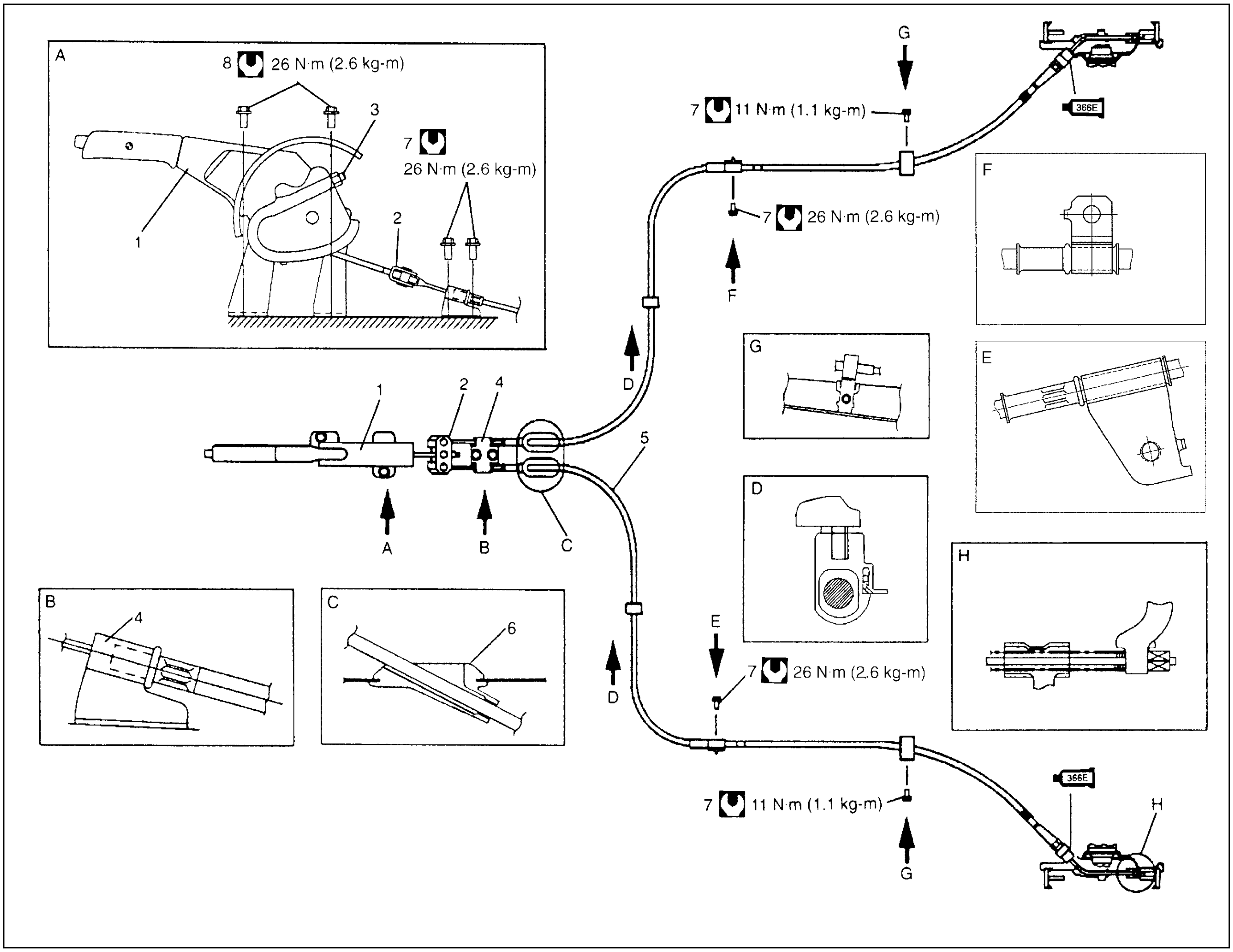


[A]: 2WD Model	A: with ABS	1. Wheel bolt	3. Wheel bearing	Tightening torque
[B]: 4WD Model	B: without ABS	2. Brake drum	4. ABS sensor ring	



	1. Brake back plate: Clean back plate and apply thin coat of Bentonite base brake grease (anti-squeal agent) to six surfaces on which shoe rims rest.	9. Piston assembly	17. Parking brake cable
	2. Brake shoe	10. Cover	18. Wheel speed sensor •••if equipped with ABS
	3. Retractor spring	11. Sensor ring •••if equipped with ABS	19. Adjuster cover
	4. Brake adjuster (strut): Apply Bentonite base brake grease between actuator and shoe rim and at actuator pivot points.	12. Circlip	[A] 2WD model
	5. Parking brake shoe lever	13. Wheel bearing	[B] 4WD model
	6. Adjuster actuator	14. Brake drum	Tightening torque
	7. Adjuster spring	15. Spindle nut	Do not reuse.
	8. Wheel cylinder	16. Spindle cap	

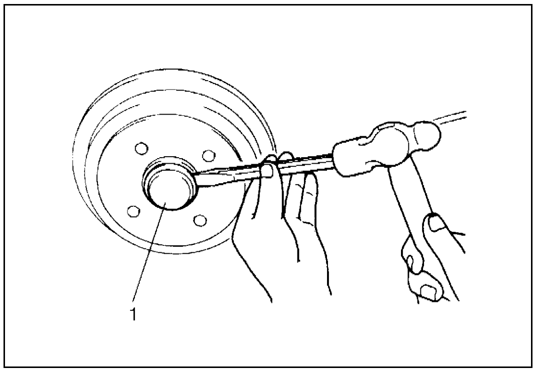
Parking Brake Cable Component Location



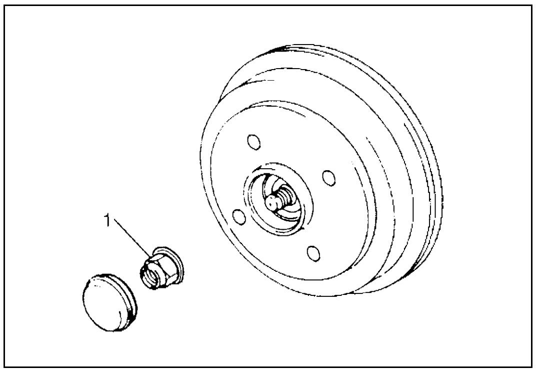
1. Parking brake lever assembly	4. Parking cable bracket	7. Parking brake cable bolt
2. Equalizer	5. Parking brake cable: Apply water tight sealant 99000-31090 to plate and cable contact.	8. Parking brake lever bolt
3. Adjusting nut	6. Grommet	Tightening torque

Brake Drum (for 2WD Model)

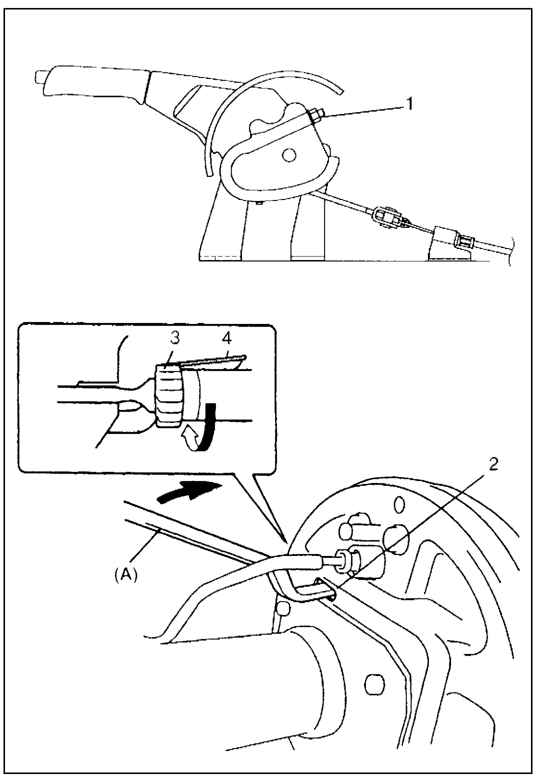
Removal



1) Hoist vehicle and remove wheel referring to “Wheel” Removal in Section 3F.
2) Remove spindle cap (1) as shown (by hammering lightly at 3 locations around it so as not to deform or cause damage to seating part of cap).



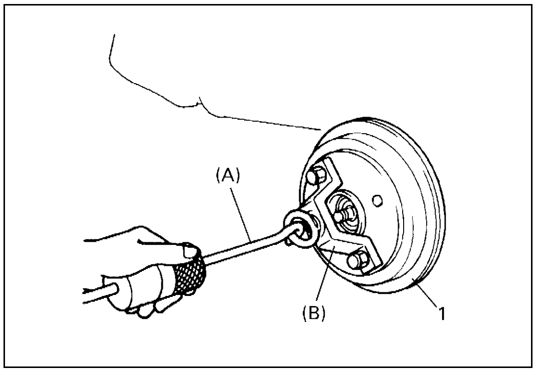
3) Uncaulk spindle nut, remove spindle nut (1).



4) Release parking brake lever.
5) Remove brake drum.
   If brake drum can not be removed easily, increase clearance between brake shoes and drum as follows.
   a) Remove console box cap and loosen parking brake cable adjusting nut (1).
   b) Remove adjuster cover on back plate.
   c) Insert special tool through hole (2) in back plate.

   Special tool
   (A): Snap-on Part No. B3404B or equivalent

   d) Pressing adjuster actuator (4) to the outside of the vehicle, turn adjuster (3) with special tool (A) in such direction as indicated in figure so as to obtain larger clearance.

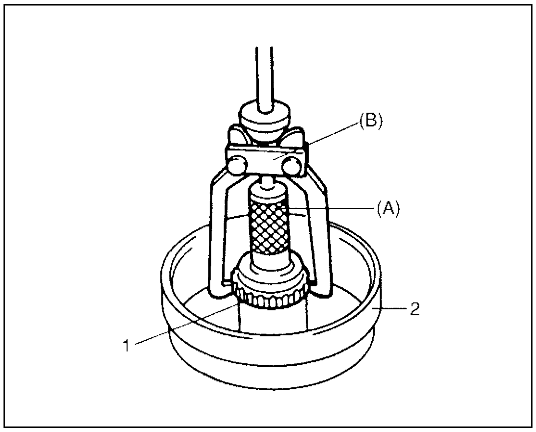


e) Pull brake drum (1) off by hand.
If it is hard to remove, use special tools.

NOTE:

When drum is removed, visually inspect wheel cylinder for brake fluid leakage. Correct leaky point if any.

Special tool
(A): 09942-15511
(B): 09943-17912



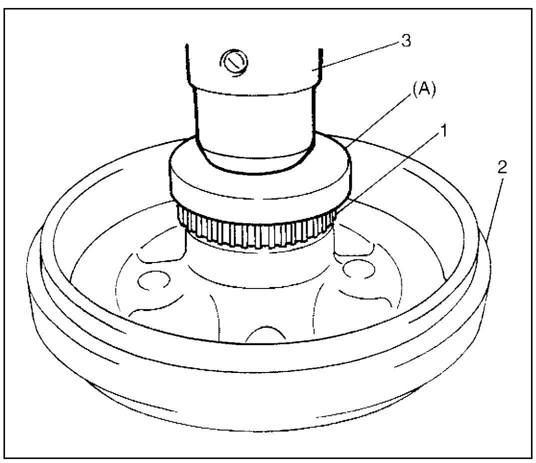
6) Remove sensor ring (1) from brake drum (2) using special tool (if equipped with ABS).

CAUTION:

Pull out sensor ring from brake drum gradually and evenly. Attempt to pull it out partially may cause it to be deformed.

Special tool
(A): 09913-75520
(B): 09913-65135

Installation

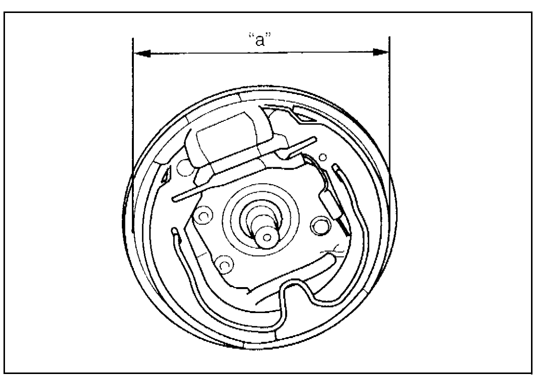


1) Install new sensor ring (1) to brake drum (2) by using special tool and hydraulic press (3) (if equipped with ABS).

CAUTION:

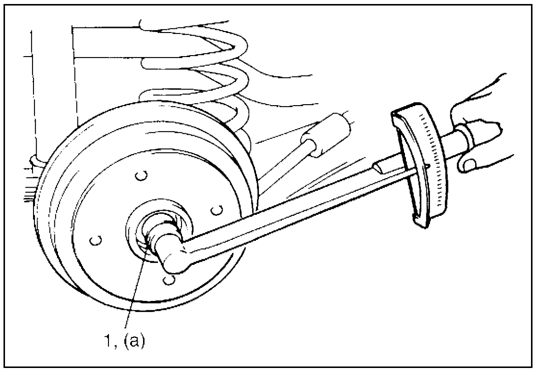
- **Do not reuse (reinstall) removed sensor ring.**
- **Used sensor ring can not be press-fitted securely.**

Special tool
(A): 09926-68310



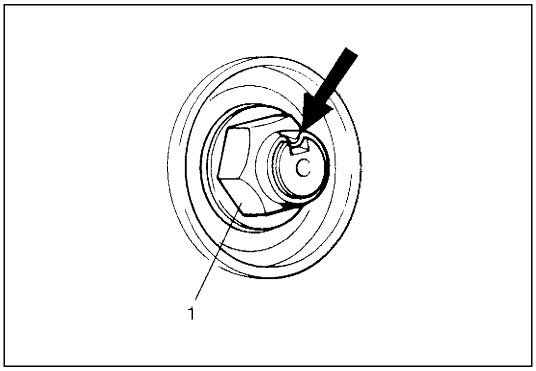
2) Before installing brake drum, check outer diameter “a” of brake shoes. If it is not within value as specified below, adjust it to specification by turning adjuster.

Brake shoes outer diameter “a”	=	Measured brake drum inside diameter	–	0.5 to 1.0 mm (0.02 to 0.04 in.)



3) Install brake drum after making sure that inside of brake drum and brake shoes are free from dirt and oil.
4) Install new spindle nut (1).
5) Tighten spindle nut (1) to specified torque.

Tightening torque
Spindle nut (a): 175 N·m (17.5 kg-m, 126.5 lb-ft)

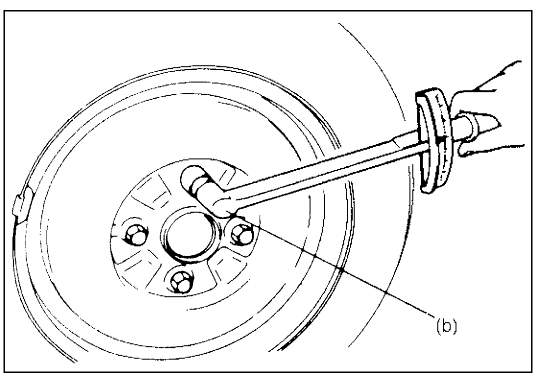


6) Calk spindle nut (1).
7) Install spindle cap.

NOTE:

- **When installing spindle cap, hammer lightly several locations on the collar of cap until collar comes closely into contact with brake drum.**
- **If fitting part of cap is deformed or damaged or if it is fitted loosely, replace with new one.**

8) Upon completion of all jobs, depress brake pedal with about 300 N (30 kg, 66 lbs) load at least 15 – 20 times until adjuster actuator clicking sound from drum brake can not be heard so as to obtain proper drum-to-shoe clearance.
   Adjust parking brake cable. (For adjustment, refer to "Parking Brake Inspection and Adjustment" in Section 5.)
9) Install console box cap if removed.



10) Install wheel and tighten wheel bolts to specified torque.

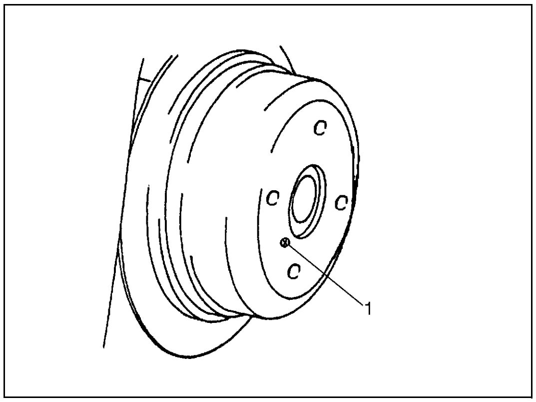
Tightening torque
Wheel bolt (b): 95 N·m (9.5 kg-m, 69.0 lb-ft)

11) Check to ensure that brake drum is free from dragging and proper braking is obtained. Then remove vehicle from hoist and perform brake test (foot brake and parking brake).

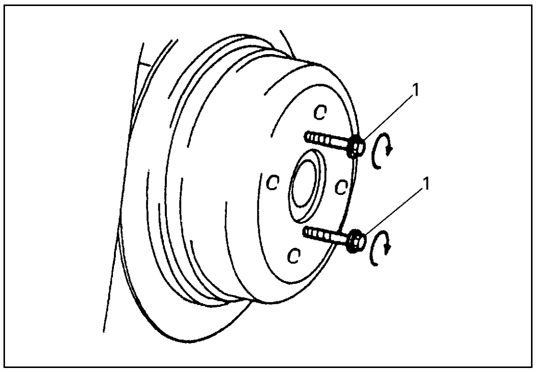
Brake Drum Removal and Installation (for 4WD Model)

Removal

1) Hoist vehicle and remove wheel referring to "Wheel Removal" in Section 3F.



2) Remove brake drum screw (1) and release parking brake lever.

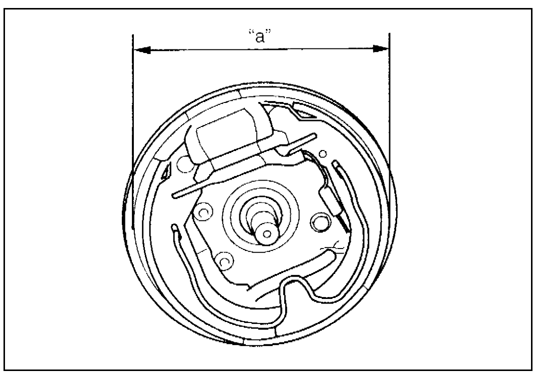


3) Remove brake drum.
If brake drum can not be removed easily, increase clearance between brake shoes and drum, referring to step a) – d) in “Brake Drum (for 2WD Model)”.
   a) Pull brake drum off by using 8 mm bolts (1).

NOTE:

When drum is removed, visually inspect wheel cylinder for brake fluid leakage. Correct leaky point, if any.

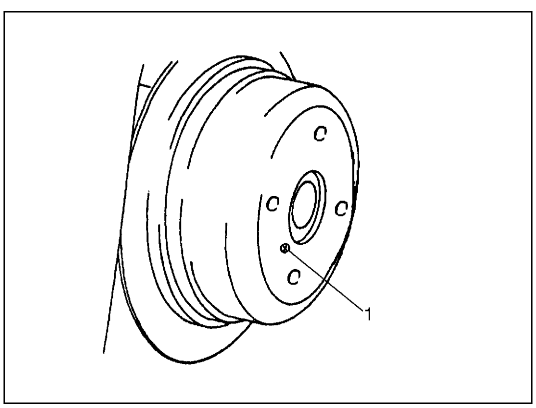
Installation



1) Before installing brake drum, check outer diameter “a” of brake shoes. If it is not within value as specified below, adjust it to specification by turning adjuster.

Brake shoes outer diameter “a”	=	Measured brake drum inside diameter	–	0.5 to 1.0 mm (0.02 to 0.04 in.)

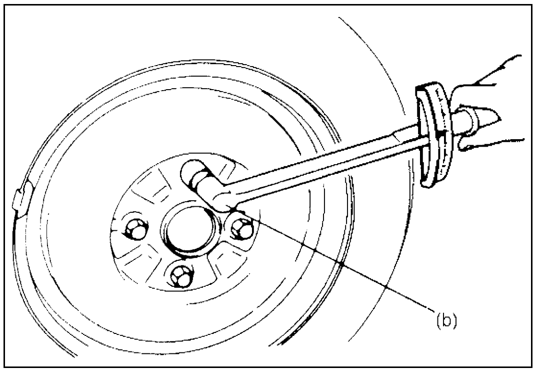
2) Install brake drum after making sure that inside of brake drum and brake shoes are free from dirt and oil.



3) Tighten screw (1) to specified torque.

Tightening torque
Brake dram screw (a): 9 N·m (0.9 kg-m, 6.5 lb-ft)

4) Upon completion of all jobs, depress brake pedal with about 300 N (30 kg, 66 lbs) load at least 15 – 20 times until adjuster actuator clicking sound from drum brake can not be heard so as to obtain proper drum-to-shoe clearance.
Adjust parking brake cable. For adjustment refer to “Parking Brake Inspection and Adjustment” in Section 5.
5) Install console box cap if removed.



6) Install wheel and tighten wheel bolts to specified torque.

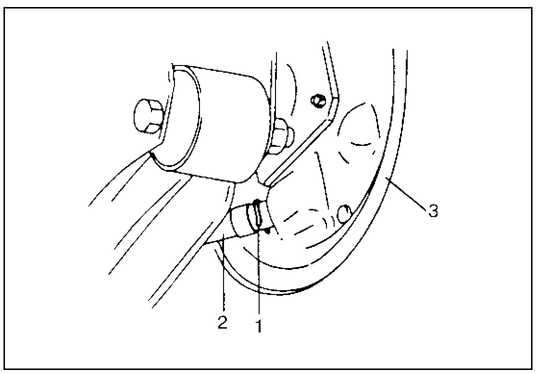
Tightening torque
Wheel bolt (b): 95 N·m (9.5 kg-m, 69.0 lb-ft)

7) Check to ensure that brake drum is free from dragging and proper braking is obtained. Then remove vehicle from hoist and perform brake test (foot brake and parking brake).

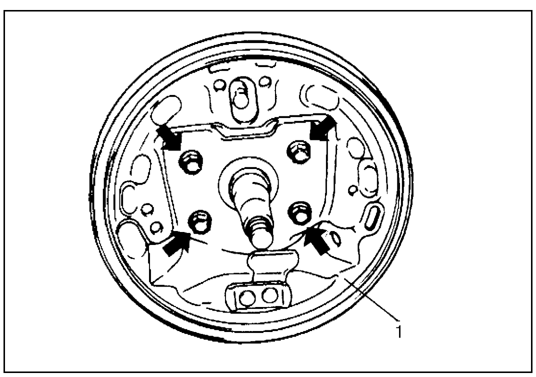
Brake Back Plate (for 2WD Model)

Removal

1) Remove brake drum referring to step 1) to 5) of “Brake Drum Removal” in this section.
2) Remove brake shoe referring to step 2) to 4) of “Brake Shoe Removal” in this section.
3) Remove wheel cylinder referring to step 3) to 4) of “Wheel Cylinder Removal” in this section.

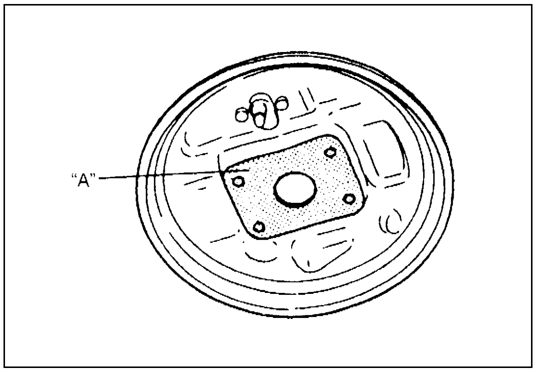


4) Remove parking brake cable securing clip (1) and disconnect brake cable (2) from brake back plate (3).



5) Remove brake back plate (1) from rear axle.

Installation

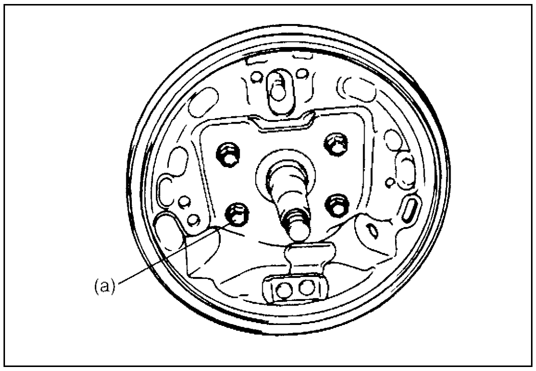


1) Apply water tight sealant to mating surfaces of brake back plate and rear axle.

"A": Sealant 366E, 99000-31090

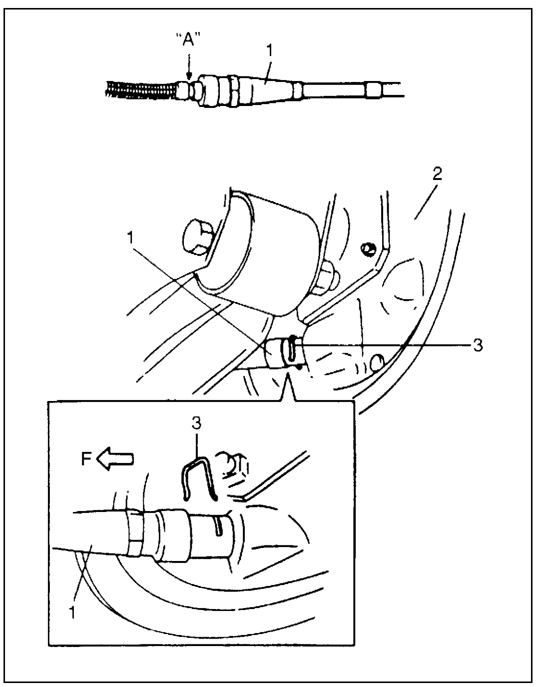
NOTE:

In case of vehicle equipped with ABS, do not apply sealant around hole for wheel speed sensor.



2) Install brake back plate and tighten back plate bolts to specified torque.

Tighting torque
Brake back plate bolt (a): 24 N·m (2.4 kg-m, 17.5 lb-ft)

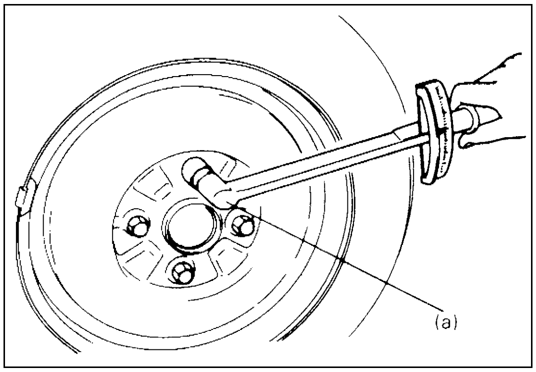


3) Apply water tight sealant where plate and cable contact, and run parking brake cable (1) through brake back plate (2) and secure it with clip (3).

"A": Sealant 366E, 99000-31090

F: Forward

4) Install wheel cylinder, and tighten wheel cylinder bolts and brake pipe flare nut to specified torque. Refer to steps 1) to 4) of "Wheel Cylinder Installation" in this section.
5) Install brake shoes, referring to steps 1) to 5) of "Brake Shoe Installation" in this section.
6) Install brake drum. Refer to steps 3) to 8) of its "Installation" in this section.
7) Fill reservoir with brake fluid and bleed brake system. For bleeding operation, referring to "Bleeding Brake" in Section 5.



8) Install wheel and tighten wheel bolts to specified torque.

Tightening torque
Wheel bolt (a): 95 N·m (9.5 kg-m, 69.0 lb-ft)

9) Upon completion of all jobs, depress brake pedal with about 300 N (30 kg, 66 lbs) load at least 10 – 15 times until adjuster actuator clicking sound from drum brake can not be heard so as to obtain proper drum-to-shoe clearance.
Adjust parking brake cable. (For adjustment, refer to “Parking Brake Inspection and Adjustment” in Section 5.)
10) Install console box cap.
11) Check to ensure that brake drum is free from dragging and proper braking is obtained. Then remove vehicle from hoist and perform brake test (foot brake and parking brake).
12) Check each installed part for oil leakage.

Brake Back Plate (for 4WD Model)

Refer to “Rear Axle Shaft and Wheel Bearing (for 4WD Model)” in Section 3E.

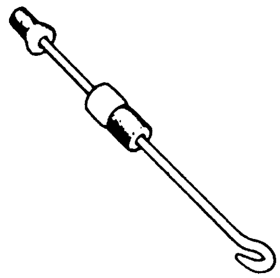
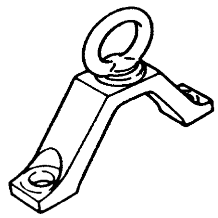
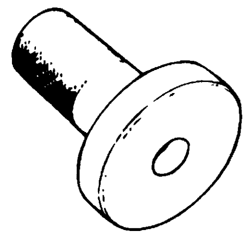
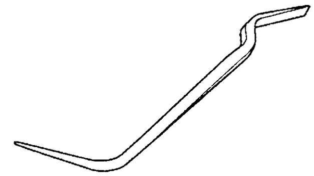
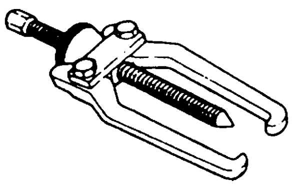
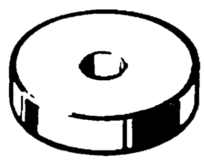
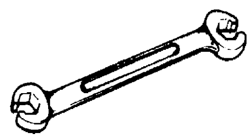
Tightening Torque Specifications

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Brake back plate bolt	24	2.4	17.5
Brake dram screw	9	9.0	6.5
Spindle nut	175	17.5	126.5
Wheel bolt	95	9.5	69.0

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Water tight sealant	SUZUKI SEALING COMPOUND 366E (99000-31090)	• To apply to mating surfaces of brake back plate and rear axle • To apply to mating surfaces of brake back plate and parking brake cable.

Special Tools

 09942-15511 Sliding hammer	 09943-17912 Brake drum remover (Front wheel hub remover)	 09913-75520 Bearing installer (for 2WD model)	 Snap-on Part NO. B3404B or equivalent
 09913-65135 Bearing puller (for 2WD model)	 09926-68310 Bearing installer (for 2WD model)	 09950-78230 Flare nut wrench (10 – 11mm)	

SECTION 6-2

ENGINE GENERAL INFORMATION AND DIAGNOSIS (M13 ENGINE)

WARNING:

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

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

CONTENTS

General Information

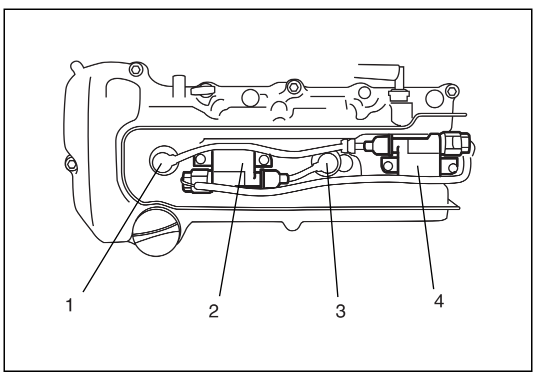
Statement on Cleanliness and Care

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the thousands of an millimeter (ten thousands of an inch).

Accordingly, when any internal engine parts are serviced, care and cleanliness are important.

Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

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



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

Precaution

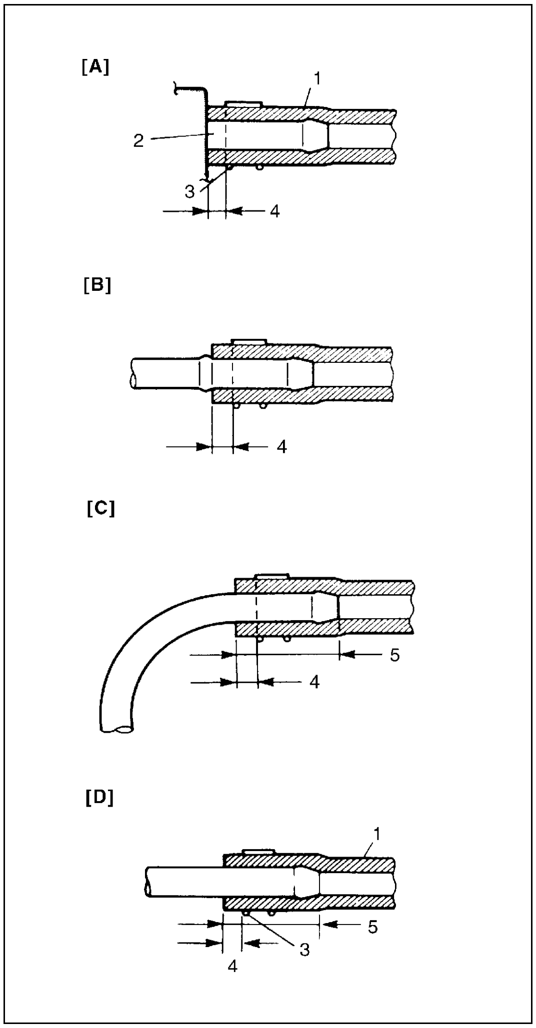
Precaution on engine service

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

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

Precaution on fuel system service

- Work must be done with no smoking, in a well-ventilated area and away from any open flames.
- As fuel feed line (between fuel pump and fuel 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 possibility 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 the figure Hose Connection.
  After connecting, make sure that it has no twist or kink.
- When installing injector, fuel feed pipe or lubricate its O-ring with gasoline.

[A]:	With short pipe, fit hose as far as it reaches pipe joint as shown.
[B]:	With following type pipe, fit hose as far as its peripheral projection as shown.
[C]:	With bent pipe, fit hose as its bent part as shown or till pipe is about 20 to 30 mm (0.79 – 1.18 in.) into the hose.
[D]:	With straight pipe, fit hose till pipe is, about 20 to 30 mm (0.79 – 1.18 in.) into the hose.
1.	Hose
2.	Pipe
3.	Clamp
4.	Clamp securely at a position 3 to 7 mm (0.12 – 0.27 in.) from hose end.
5.	20 to 30 mm (0.79 – 1.18 in.)

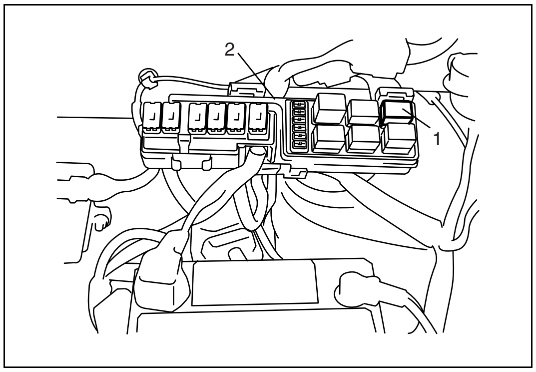
Fuel pressure relief procedure

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

NOTE:
If any service shown below is performed, ECM may detect DTC(s). Therefore, clear DTC(s) by referring to "DTC Clearance" in this section in case that DTC(s) is detected after all services are done.

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

1) Place transmission gear shift lever in "Neutral" (Shift selector lever to "P" range for A/T model), set parking brake, and block drive wheels.
2) Remove relay box cover.



3) Disconnect fuel pump relay (1) from relay box (2).
4) Remove fuel filter cap to release fuel vapor pressure in fuel tank and then reinstall it.
5) Start engine and run it till it stops for lack of fuel. Repeat cranking engine 2-3 times for about 3 seconds each time to dissipate fuel pressure in lines. Fuel connections are now safe for servicing.
6) Upon completion of servicing, connect fuel pump relay (1) to relay box (2) and install relay box cover.

Fuel leakage check procedure

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

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

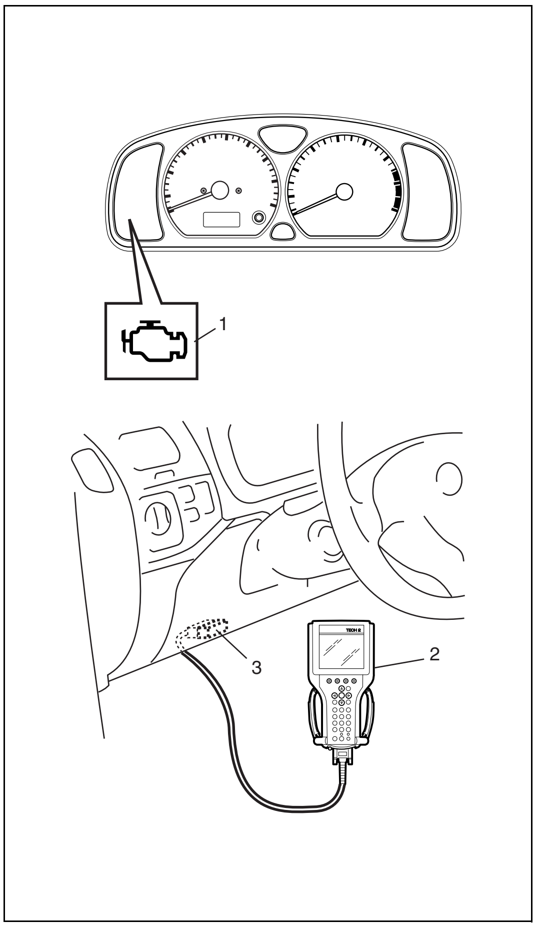
Diagnosis

Engine Diagnosis General Description

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

On-Board Diagnostic System Description

ECM in this vehicle has following functions.



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

3. Data link connector (DLC)

Warm-up Cycle

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

Driving Cycle

A "Driving Cycle" consists of engine startup and engine shutoff.

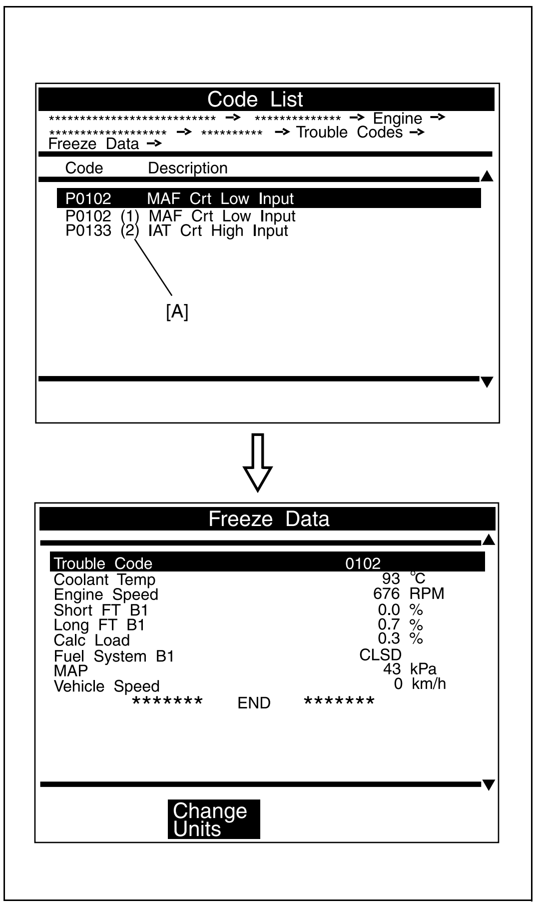
2 Driving Cycle Detection Logic

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

Pending DTC

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

Freeze Frame Data



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

Priority of Freeze Frame Data:

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

[A]: 1st or 2nd in parentheses here represents which position in the order the malfunction is detected.

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

In the 2nd through the 4th frames, the freeze frame data of each malfunction is stored in the order as the malfunction is detected. These data are not updated.

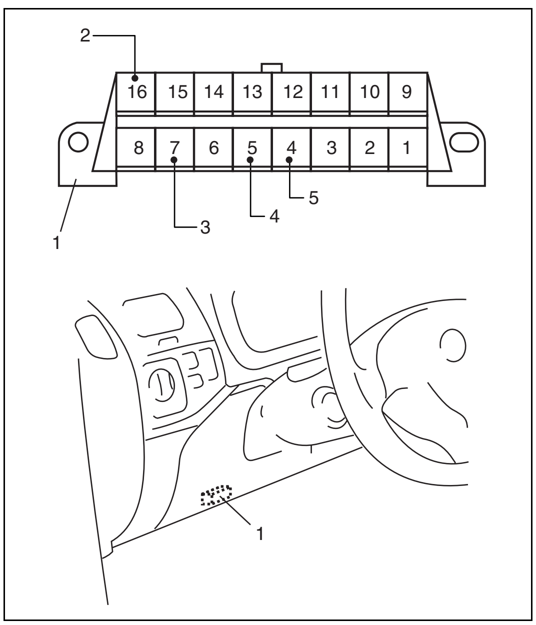
Shown in the table below are examples of how freeze frame data are stored when two or more malfunctions are detected.

			FRAME			
			FRAME 1	FRAME 2	FRAME 3	FRAME 4
			FREEZE FRAME DATA to be updated	1st FREEZE FRAME DATA	2nd FREEZE FRAME DATA	3rd FREEZE FRAME DATA
MALFUNCTION DETECTED ORDER		No malfunction	No freeze frame data			
	1	P0401 (EGR) detected	Data at P0401 detection	Data at P0401 detection	–	–
	2	P0171 (Fuel system) detection	Data at P0171 detection	Data at P0401 detection	Data at P0171 detection	–
	3	P0300 (Misfire) detected	Data at P0171 detection	Data at P0401 detection	Data at P0171 detection	Data at P0300 detection
	4	P0301 (Misfire) detected	Data at P0171 detection	Data at P0401 detection	Data at P0171 detection	Data at P0300 detection

Freeze Frame Data Clearance:

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

Data Link Connector (DLC)



DLC (1) is in compliance with SAE J1962 in the shape of connector and pin assignment.

OBD serial data line (3) (K line of ISO 9141) is used for SUZUKI scan tool or OBD generic scan tool to communicate with ECM, Air bag SDM, immobilizer control module and ABS control module.

2. B + (Unswitched Vehicle Battery Positive)
4. ECM ground (Signal Ground)
5. Vehicle body ground (Chassis Ground)

Precaution in Diagnosing Trouble for Engine

- Don't disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine or main fuse before confirming diagnostic information (DTC, freeze frame data, etc.) stored in ECM memory. Such disconnection will erase memorized information in ECM memory.
- Diagnostic information stored in ECM memory can be cleared as well as checked by using SUZUKI scan tool or OBD generic scan tool. Before using scan tool, read its Operator's (Instruction) Manual carefully to have good understanding as to what functions are available and how to use it.
  It is in indistinguishable which module turns on MIL because not only ECM but also TCM turns on MIL. Therefore, check both ECM and TCM for DTC when MIL lights on.
  When checking ECM for DTC, keep in mind that DTC is displayed on the scan tool as follows depending on the scan tool used.
  - SUZUKI scan tool displays DTC detected by ECM.
  - OBD-II generic scan tool displays DTC detected by each of ECM and TCM simultaneously.
- Priorities for diagnosing troubles
  If two or more diagnostic trouble codes (DTCs) are stored, proceed to the flow table of the DTC which has detected earliest in the order and follow the instruction in that table.
  If no instructions are given, troubleshoot diagnostic trouble codes according to the following priorities.
  - Diagnostic trouble codes (DTCs) other than DTC P0171/P0172 (Fuel system too lean/too rich), DTC P0300/P0301/P0302/P0303/P0304 (Misfire detected) and DTC P0401/P0402 (EGR flow malfunction)
  - DTC P0171/P0172 (Fuel system too lean/too rich) and DTC P0401/P0402 (EGR flow malfunction)
  - DTC P0300/P0301/P0302/P0303/P0304 (Misfire detected)
- Be sure to read "Precautions for Electrical Circuit Service" in Section 0A before inspection and observe what is written there.
- ECM Replacement
  When substituting a known-good ECM, check for the following conditions. Neglecting this check may cause damage to a known-good ECM.
  - Resistance value of all relays, actuators is as specified respectively.
  - MAP sensor and TP sensor are in good condition and none of power circuits of these sensors is shorted to ground.
- Communication of ECUs, ECM and TCM, is established by CAN (Computer Area Network). Therefore, handle CAN communication line with care referring to "Precaution" described in Section 0A.

Engine and Emission Control System Check

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

<table>
<tr><th>Step</th><th>Action</th><th>Yes</th><th>No</th></tr>
<tr><td>1</td><td>Customer Complaint Analysis
1) Perform customer complaint analysis referring to “Customer Complaint Analysis” in followings.
Was customer complaint analysis performed?</td><td>Go to Step 2.</td><td>Perform customer complaint analysis.</td></tr>
<tr><td>2</td><td>Diagnostic Trouble Code (DTC) and Freeze Frame Data Check, Record and Clearance
1) Check for DTC (including pending DTC) referring to the “Diagnostic Trouble Code (DTC)/Freeze Frame Data Check, Record and Clearance” in followings.
Is there any DTC(s)?</td><td>Print DTC and freeze frame data or write them down and clear them by referring to “DTC Clearance” in this section, and go to Step 3.</td><td>Go to Step 4.</td></tr>
<tr><td>3</td><td>Visual Inspection
1) Perform visual inspection referring to the “Visual Inspection” in followings.
Is there any faulty condition?</td><td rowspan="2">Repair or replace malfunction part, and go to Step 11.</td><td>Go to Step 5.</td></tr>
<tr><td>4</td><td>Visual Inspection
1) Perform visual inspection referring to the “Visual Inspection” in followings.
Is there any faulty condition?</td><td>Go to Step 8.</td></tr>
<tr><td>5</td><td>Trouble Symptom Confirmation
1) Confirm trouble symptom referring to the “Trouble Symptom Confirmation” in followings.
Is trouble symptom identified?</td><td>Go to Step 6.</td><td>Go to Step 7.</td></tr>
<tr><td>6</td><td>Rechecking and Record of DTC/Freeze Frame Data
1) Recheck for DTC and freeze frame data referring to “Diagnostic Trouble Code (DTC) Check” in this section.
Is there any DTC(s)?</td><td rowspan="2">Go to Step 9.</td><td>Go to Step 8.</td></tr>
<tr><td>7</td><td>Rechecking and Record of DTC/Freeze Frame Data
1) Recheck for DTC and freeze frame data referring to “Diagnostic Trouble Code (DTC) Check” in this section.
Is there any DTC(s)?</td><td>Go to Step 10.</td></tr>
<tr><td>8</td><td>Engine Basic Inspection and Engine Symptom Diagnosis
1) Check and repair according to “Engine Basic Inspection” and “Engine Symptom Diagnosis” in this section.
Are check and repair complete?</td><td rowspan="2">Go to Step 11.</td><td rowspan="2">Check and repair malfunction part(s). Go to Step 11.</td></tr>
<tr><td>9</td><td>Trouble Shooting for DTC
1) Check and repair according to applicable DTC diag. flow table.
Are check and repair complete?</td></tr>
<tr><td>10</td><td>Check for Intermittent Problems
1) Check for intermittent problems referring to “Check for Intermittent Problem” in followings.
Is there any faulty condition?</td><td>Repair or replace malfunction part(s), and go to Step 11.</td><td>Go to Step 11.</td></tr>
</table>

Step	Action	Yes	No
11	Final Confirmation Test 1) Clear DTC if any. 2) Perform final confirmation test referring to “Final Confirmation Test” in followings. Is there any problem symptom, DTC or abnormal condition?	Go to Step 6.	End.

1. CUSTOMER COMPLAINT ANALYSIS

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

2. DIAGNOSTIC TROUBLE CODE (DTC)/FREEZE FRAME DATA CHECK, RECORD AND CLEARANCE

First, check DTC (including pending DTC), referring to “DTC Check” in this section. If DTC is indicated, print it and freeze frame data or write them down and then clear them by referring to “DTC Clearance” in this section. DTC indicates malfunction that occurred in the system but does not indicate whether it exists now or it occurred in the past and the normal condition has been restored now. To check which case applies, check the symptom in question according to Step 4 and recheck DTC according to Step 6 and 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

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

5. TROUBLE SYMPTOM CONFIRMATION

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

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

Refer to “DTC check” in this section for checking procedure.

8. ENGINE BASIC INSPECTION AND ENGINE SYMPTOM DIAGNOSIS

Perform basic engine check according to the “Engine Basic Inspection” 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 Symptom Diagnosis” and based on symptoms appearing on the vehicle (symptoms obtained through steps of customer complaint analysis, trouble symptom confirmation and/or basic engine check) and repair or replace faulty parts, if any.

9. DIAGNOSTIC TROUBLE CODE FLOW TABLE (See each DTC Diag. Flow Table)

Based on the DTC indicated in Step 6 or 7 and referring to the applicable DTC diag. flow table in this section, locate the cause of the trouble, namely in a sensor, switch, wire harness, connector, actuator, ECM or other part and repair or replace faulty parts.

10. CHECK FOR INTERMITTENT PROBLEM

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

11. FINAL CONFIRMATION TEST

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

Customer Problem Inspection Form (Example)

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

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

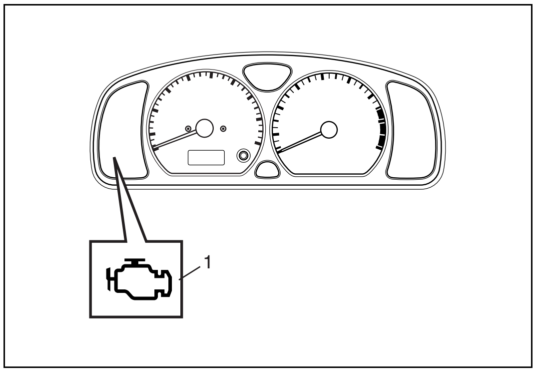
VEHICLE/ENVIRONMENTAL CONDITION WHEN PROBLEM OCCURS	
Environmental Condition	
Weather	☐Fair ☐Cloudy ☐Rain ☐Snow ☐Always ☐Other
Temperature	☐Hot ☐Warm ☐Cool ☐Cold (°F/ °C) ☐Always
Frequency	☐Always ☐Sometimes (times/ day, month) ☐Only once ☐Under certain condition
Road	☐Urban ☐Suburb ☐Highway ☐Mountainous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

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

NOTE:

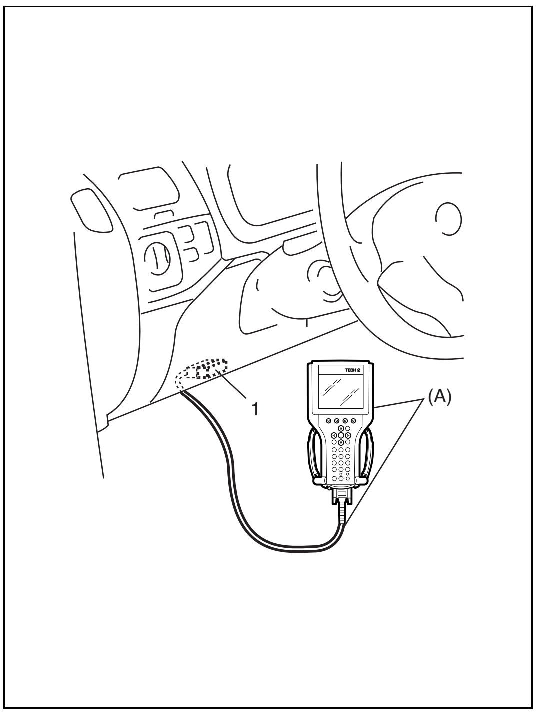
The above form is a standard sample. It should be modified according to conditions characteristic of each market.

Malfunction Indicator Lamp (MIL) Check



1) Turn ON ignition switch (but the engine at stop) and check that MIL (1) lights.
   If MIL does not light up (or MIL dims), go to “Malfunction Indicator Lamp Does Not Come “ON” at Ignition Switch ON (But Engine Stops)” for troubleshooting.
2) Start engine and check that MIL turns OFF.
   If MIL remains ON and no DTC is stored in ECM, go to “Malfunction Indicator Lamp Remains “ON” after Engine Starts” for troubleshooting.

Diagnostic Trouble Code (DTC) Check



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

   Special tool
   (A): SUZUKI scan tool

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

Diagnostic Trouble Code (DTC) Clearance

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

NOTE:

DTC and freeze frame data stored in ECM memory are also cleared in the following cases. Be careful not to clear them before keeping their record.

- **When power to ECM is cut off (by disconnecting battery cable, removing fuse or disconnecting ECM connectors).**
- **When the same malfunction (DTC) is not detected again during 40 engine warm-up cycles (see item "Warm-up Cycle" of "On-Board Diagnostic System Description" in this section).**

DTC Table

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	MIL
P0010	Camshaft position actuator circuit	Actual valve timing fails to become close to target advance level of each function although advance control function or retarding control function is at work.	1 driving cycle
P0011	Camshaft position – timing over-advanced or system performance	Actual valve of advanced valve timing does not reach target value, or valve timing is advanced although ECM command is most retarding.	2 driving cycles
P0012	Camshaft position – timing over-retarded		2 driving cycles
P0031	HO2S heater control circuit low (Sensor–1)	Heater current is lees than specification while heater ON.	2 driving cycles
P0032	HO2S heater control circuit high (Sensor–1)	Heater current is more than specification while heater ON.	2 driving cycles
P0037	HO2S heater control circuit low (Sensor–2)	Heater current is lees than specification while heater ON.	2 driving cycles
P0038	HO2S heater control circuit high (Sensor–2)	Heater current is more than specification while heater ON.	2 driving cycles
P0102	Mass air flow circuit low input	Low voltage	1 driving cycle
P0103	Mass air flow circuit high input	High voltage	
P0107	Manifold absolute pressure low input	Low voltage (or manifold absolute pressure sensor circuit open or shorted to ground)	1 driving cycle
P0108	Manifold absolute pressure high input	High voltage (or manifold absolute pressure sensor circuit shorted to power circuit)	1 driving cycle
P0112	Intake air temperature sensor circuit low	High temperature – low voltage (or IAT sensor circuit shorted to ground)	1 driving cycle
P0113	Intake air temperature sensor circuit high	Low temperature – high voltage (or IAT sensor circuit open)	
P0117	Engine coolant temperature sensor circuit low	High temperature – low voltage (or ECT sensor circuit shorted to ground)	1 driving cycle
P0118	Engine coolant temperature sensor circuit high	Low temperature – high voltage (or ECT sensor circuit open)	
P0121	Throttle position circuit range/performance	Poor performance of TP sensor	2 driving cycles
P0122	Throttle position circuit low	Low voltage (or TP sensor circuit shorted to ground)	1 driving cycle
P0123	Throttle position circuit high	High voltage (or TP sensor circuit open)	
P0131	O2 sensor (HO2S) circuit low voltage (Sensor–1)	Min. output voltage of HO2S–1 higher than specification	2 driving cycles
P0132	O2 sensor (HO2S) circuit high voltage (Sensor–1)	Max. output voltage of HO2S–1 is lower or higher than specification	
P0133	O2 sensor (HO2S) circuit slow response (Sensor–1)	Response time of HO2S–1 output voltage between rich and lean is longer than specification.	

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	MIL
P0134	O2 sensor (HO2S) circuit no activity detected (Sensor–1)	Output voltage of HO2S–1 fails to go above specification. (or HO2S–1 circuit open or short)	2 driving cycles
P0136	O2 sensor (HO2S) circuit (Sensor–2)	Maximum output voltage of HO2S–2 is lower than specification or minimum output voltage of HO2S–2 is higher than specification.	2 driving cycles
P0171	System too lean	Total fuel trim is larger than specification for specified time or longer. (Fuel trim toward rich side is large.)	2 driving cycles
P0172	System too rich	Total fuel trim is smaller than specification for specified time or longer. (Fuel trim toward lean side is large.)	2 driving cycles
P0300	Random misfire detected	Misfire of such level as to cause damage to three way catalyst.	*2 driving cycles
P0301 P0302 P0303 P0304	Cylinder 1 misfire detected Cylinder 2 misfire detected Cylinder 3 misfire detected Cylinder 4 misfire detected	Misfire of such level as to deteriorate emission but not to cause damage to three way catalyst.	2 driving cycles
P0327	Knock sensor circuit low	Knock sensor circuit shorted to ground (low voltage)	1 driving cycle
P0328	Knock sensor circuit high	Knock sensor circuit open (high voltage)	1 driving cycle
P0335	Crankshaft position sensor circuit	No signal during engine running	1 driving cycle
P0340	Camshaft position sensor circuit	No reference signal during engine cranking or pulse number of position signal is out of specification.	
P0401	Exhaust gas recirculation flow insufficient detected	Insufficient EGR flow	2 driving cycles
P0402	Exhaust gas recirculation flow excessive detected	Excessive EGR flow	2 driving cycles
P0420	Catalyst system efficiency below threshold	Output waveforms of HO2S–1 and HO2S–2 are similar.	2 driving cycles
P0443	Evaporative emission system purge control valve circuit	Monitor signal of EVAP canister purge valve is different from command signal (circuit open or shorted to ground)	2 driving cycles
P0480	Fan 1 (Radiator cooling fan) control circuit	Radiator cooling fan relay terminal voltage is low when cooling temp. is lower than specification.	2 driving cycles
P0500	Vehicle speed sensor	No signal during fuel cut for specified time or longer	2 driving cycles
P0505	Idle air control system	Voltage is out of specification for longer than specified time	2 driving cycles
P0601	Internal control module memory check sum error	Data write error or check sum error	1 driving cycle
P0602	Control module programming error	Data programming error	1 driving cycle
P1500	Starter signal circuit malfunction	Starter signal is not inputted from engine cranking till its start and after or it is always inputted.	2 driving cycles
P1510	ECM backup power supply malfunction	Backup power voltage is out of specification after starting engine.	1 driving cycle

<table>
<tr><th>DTC NO.</th><th>DETECTING ITEM</th><th>DETECTING CONDITION
(DTC will set when detecting:)</th><th>MIL</th></tr>
<tr><td>P1601</td><td>CAN communication error</td><td>Transmitting or receiving error detected to ECM for specified time continuously.</td><td>1 driving cycle</td></tr>
<tr><td>P1603</td><td>TCM trouble code detected</td><td>When ECM receives a trouble code from TCM, which indicates that some problem occurred in sensor circuits and its calculated values used for operations such as idle speed control, engine power control, and so on by TCM, this DTC is detected by ECM.</td><td>1 driving cycle</td></tr>
<tr><td>P2227</td><td>Barometric pressure circuit range/performance</td><td>Difference between barometric pressure sensor value and calculated barometric pressure value is larger than specification.</td><td>2 driving cycles</td></tr>
<tr><td>P2228</td><td>Barometric pressure circuit low</td><td>Barometric pressure sensor circuit shorted to ground.</td><td>1 driving cycle</td></tr>
<tr><td>P2229</td><td>Barometric pressure circuit high</td><td>Barometric pressure sensor circuit open</td><td>1 driving cycle</td></tr>
<tr><td>P1610</td><td>Secret key and password not registered</td><td rowspan="5" colspan="2">Refer to “DTC Table” in Section 8G</td></tr>
<tr><td>P1611</td><td>Password not matched</td></tr>
<tr><td>P1612</td><td rowspan="2">No signal from immobilizer</td></tr>
<tr><td>P1613</td></tr>
<tr><td>P1614</td><td>Incorrect signal</td></tr>
</table>

NOTE:

- **1 driving cycle: MIL lights up when DTC is detected while 1 driving cycle.**
- **2 driving cycles: MIL lights up when the same DTC is detected also in the next driving cycle after DTC is detected and stored temporarily in the first driving cycle.**
- **∗2 driving cycles:**
  MIL blinks or lights up. Refer to “DTC P0300/P0301/P0302/P0303/P0304: Random Misfire/Cylinder 1 Misfire/Cylinder 2 Misfire/Cylinder 3 Misfire/Cylinder 4 Misfire Detected” for details.

Fail-Safe Table

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

DTC NO.	DETECTED ITEM	FAIL-SAFE OPERATION
P0102	Mass air flow circuit low input	• ECM controls injector drive time (fuel injection volume) according to throttle valve opening (closed throttle position or not). • ECM stops EGR control.
P0103	Mass air flow circuit high input	
P0112	Intake air temperature sensor circuit low	• ECM controls actuators assuming that intake air temperature is 20°C (68°F).
P0113	Intake air temperature sensor circuit high	
P0117	Engine coolant temperature circuit low	• ECM controls actuators assuming that engine coolant temperature is 80°C (176°F). • ECM operates radiator fan.
P0118	Engine coolant temperature circuit high	
P0122	Throttle position circuit low input	• ECM controls actuators assuming that throttle opening is about 20 deg.
P0123	Throttle position circuit high input	
P0335	Crankshaft position sensor circuit	• Fix ignition timing. • ECM changes injection control system from sequential injection to simultaneous one.
P0340	Camshaft position sensor circuit	ECM changes injection control system from sequential injection to simultaneous one.
P0500	Vehicle speed sensor	ECM controls actuators assuming vehicle speed is 0 km/h (0 mile/h).
P2227	Barometric pressure sensor performance problem	ECM controls actuators assuming that barometric pressure is 101.33 kPa (762 mmHg).

Visual Inspection

Visually check the following parts and systems.

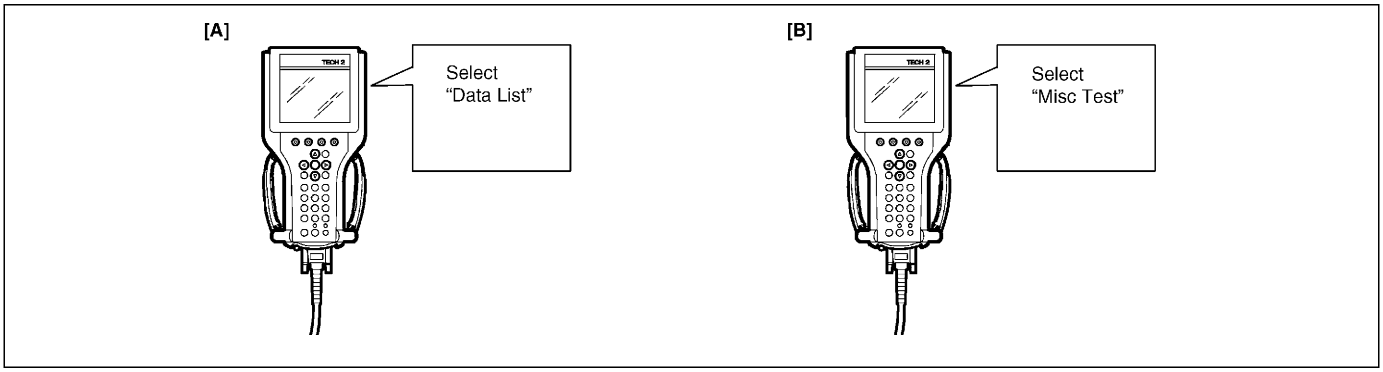
INSPECTION ITEM	REFERRING SECTION
• Engine oil – level, leakage	“Engine Oil and Oil Filter” in Section 0B.
• Engine coolant – level, leakage	“Engine Coolant” in Section 0B.
• Fuel – level, leakage	“Fuel System” in Section 0B.
• Air cleaner element – dirt, clogging	“Air Cleaner Filter” in Section 0B.
• Battery – fluid level, corrosion of terminal	“Battery” in Section 6H.
• Water pump belt – tension damage	“Drive Belt” in Section 0B.
• Throttle cable – play (under warm engine), installation	“Accelerator Cable Adjustment” in Section 6E2.
• Vacuum hoses of air intake system – disconnection, looseness, deterioration, bend	“Evaporative Emission Control System Inspection” in Section 6E2.
• Connectors of electric wire harness – disconnection, friction	
• Fuses – burning	
• Parts – installation, bolt – looseness	
• Parts – deformation	
• Other parts that can be checked visually	
Also check the following items at engine start, if possible	
• Malfunction indicator lamp – Operation	“Malfunction Indicator Lamp (MIL) Check” in this section.
• Charge warning lamp – Operation	“Charging Indicator Lamp Operation” in Section 6H.
• Engine oil pressure warning lamp – Operation	“Engine Oil Pressure Switch Inspection” in Section 8C.
• Engine coolant temp. meter – Operation	“Engine Coolant Temperature (ECT) Gauge Inspection” in Section 8C.
• Fuel level meter – Operation	“Fuel Gauge Inspection” in Section 8C.
• Tachometer – Operation	
• Abnormal air being inhaled from air intake system	
• Exhaust system – leakage of exhaust gas, noise	“Exhaust System” in Section 0B.
• Other parts that can be checked visually	

Engine Basic Inspection

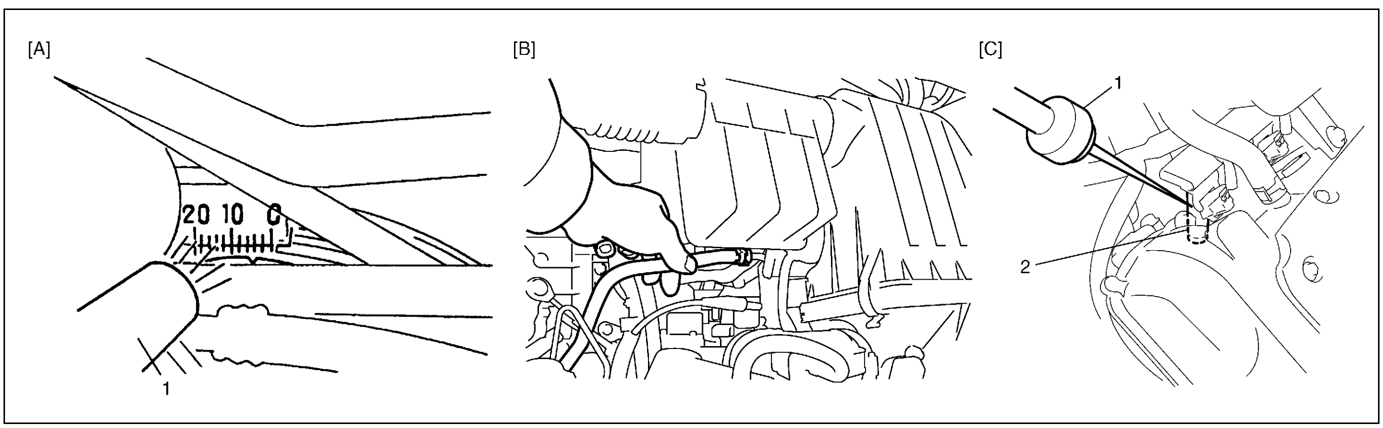
This check is very important for troubleshooting when ECM has detected no DTC and no abnormality has been found in visual inspection.
Follow the flow table carefully.

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
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 “Cranking System Symptom Diagnosis” in Section 6G.
4	Does engine start?	Go to Step 5.	Go to Step 7.
5	Check idle speed as follows: 1) Warm up engine to normal operating temp. 2) Shift transmission to neutral position for M/T. (“P” position for A/T.) 3) All of electrical loads are switched off. 4) Check engine idle speed with scan tool. See Fig. 1. Is it 650 – 750 r/min?	Go to Step 6.	Go to “Engine Symptom Diagnosis” in this section.
6	Check ignition timing as follows: 1) Using SUZUKI scan tool, select “MISC” mode on SUZUKI scan tool and fix ignition timing to initial one. See Fig. 2. 2) Using timing light (1), check initial ignition timing. See Fig. 3. Is it 5° ± 3° BTDC at specified idle speed?	Go to “Engine Symptom Diagnosis” in this section.	Check ignition control related parts referring to “Ignition Timing Inspection in Section 6F2.
7	Is immobilizer control system equipped?	Go to Step 8.	Go to Step 9.
8	Check immobilizer system malfunction as follows. 1) Check immobilizer indicator lamp for flashing. Is it flashing when ignition switch is turned to ON position?	Go to “DTC Check” in Section 8G.	Go to Step 9.
9	Check fuel supply as follows: 1) Check to make sure that enough fuel is filled in fuel tank. 2) Turn ON ignition switch for 3 seconds and then OFF. Repeat this a few times. See Fig. 4. Is fuel pressure felt from fuel feed hose (4) when ignition switch is turned ON?	Go to Step 11.	Go to Step 10.
10	Check fuel pump for operating. Was fuel pump operating sound heard from fuel filler for about 3 seconds after ignition switch ON and stop?	Go to “Table B-3 Fuel Pressure Check” in this section.	Go to “Table B-2 Fuel Pump and Its Circuit Check” in this section.

Step	Action	Yes	No
11	Check ignition spark as follows: 1) Disconnect injector couplers. 2) Remove spark plugs and connect them to high-tension cords or ignition coils. 3) Ground spark plugs. 4) Crank engine and check if each spark plug sparks. Is it in good condition?	Go to Step 12.	Go to “Ignition Spark Test” in Section 6F2.
12	Check fuel injector for operation as follows: 1) Install spark plugs and connect injector connectors. 2) Using sound scope (1), check operating sound of each injector (2) when cranking engine. See Fig. 5. Was injector operating sound heard from all injectors?	Go to “Engine Symptom Diagnosis” in this section.	Go to “Table B-1 Fuel Injector Circuit Check” in this section.



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



[A]:	Fig. 3 for Step 6
[B]:	Fig. 4 for Step 9
[C]:	Fig. 5 for Step 12

Engine Symptom Diagnosis

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

Condition	Possible Cause	Reference Item
Hard Starting (Engine cranks OK)	Faulty spark plug	"Spark Plugs Inspection" in Section 6F2.
	Leaky high-tension cord	"High-tension Cords Inspection" in Section 6F2.
	Loose connection or disconnection of high-tension cords or lead wires	"High-tension Cords Inspection" in Section 6F2.
	Faulty ignition coil	"Ignition Coil Assembly (Including Ignitor) Inspection" in Section 6F2.
	Dirty or clogged fuel hose or pipe	"Table B-3 Fuel Pressure Check" in this section.
	Malfunctioning fuel pump	"Table B-3 Fuel Pressure Check" in this section.
	Air inhaling from intake manifold gasket or throttle body gasket	
	Faulty idle air control system	"Table B-4 Idle Air Control System Check" in this section.
	Faulty ECT sensor or MAF sensor	"ECT Sensor Inspection" or "Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection" in Section 6E2.
	Faulty ECM	
	Low compression	"Compression Check" in Section 6A1.
	Poor spark plug tightening or faulty gasket	"Spark Plugs Removal and Installation" in Section 6F2.
	Compression leak from valve seat	"Valves and Cylinder Head Inspection" in Section 6A2.
	Sticky valve stem	"Valves and Cylinder Head Inspection" in Section 6A2.
	Weak or damaged valve springs	"Valves and Cylinder Head Inspection" in Section 6A2.
	Compression leak at cylinder head gasket	"Valves and Cylinder Head Inspection" in Section 6A2.
	Sticking or damaged piston ring	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A2.
	Worn piston, ring or cylinder	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A2.
	Malfunctioning PCV valve	"PCV System Inspection" in Section 6E2.
	VVT system out of order	"Oil Control Valve Inspection" in Section 6E2.

Condition	Possible Cause	Reference Item
Low oil pressure	Improper oil viscosity	"Engine Oil and Oil Filter Replacement" in Section 0B.
	Malfunctioning oil pressure switch	"Oil Pressure Switch Inspection" in Section 8C.
	Clogged oil strainer	"Oil Pan and Oil Pump Strainer" in Section 6A2.
	Functional deterioration of oil pump	"Oil Pan and Oil Pump Strainer" in Section 6A2.
	Worn oil pump relief valve	"Oil Pan and Oil Pump Strainer" in Section 6A2.
	Excessive clearance in various sliding parts	
Engine noise **Note: Before checking mechanical noise, make sure that:** **Specified spark plug is used.** **Specified fuel is used.**	Improper valve lash	"Valves and Cylinder Head Inspection" in Section 6A2.
	Worn valve stem and guide	"Valves and Cylinder Head Inspection" in Section 6A2.
	Weak or broken valve spring	"Valves and Cylinder Head Inspection" in Section 6A2.
	Warped or bent valve	"Valves and Cylinder Head Inspection" in Section 6A2.
	Worn piston, ring and cylinder bore	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A2.
	Worn rod bearing	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A2.
	Worn crank pin	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A2.
	Loose connecting rod nuts	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A2.
	Low oil pressure	"Low Oil Pressure" in this table.
	Low oil pressure	"Low Oil Pressure" in this table.
	Worn bearing	"Main bearings, Crankshaft and Cylinder Block Inspection" in Section 6A2.
	Worn crankshaft journal	"Main bearings, Crankshaft and Cylinder Block Inspection" in Section 6A2.
	Loose bearing cap bolts	"Main bearings, Crankshaft and Cylinder Block Inspection" in Section 6A2.
	Excessive crankshaft thrust play	"Main bearings, Crankshaft and Cylinder Block Inspection" in Section 6A2.

Condition	Possible Cause	Reference Item
Overheating	Inoperative thermostat	“Thermostat Inspection” in Section 6B2.
	Poor water pump performance	“Water Pump Inspection” in Section 6B2.
	Clogged or leaky radiator	“Radiator Inspection” in Section 6B2.
	Improper engine oil grade	“Engine Oil and Oil Filter Replacement” in Section 0B.
	Clogged oil filter or oil strainer	“Oil Pressure Check” in Section 6A2.
	Poor oil pump performance	“Oil Pressure Check” in Section 6A2.
	Faulty radiator fan control system	“Table B-7 Radiator Fan Control System Check” in this section.
	Dragging brakes	“Diagnosis Table” in Section 5.
	Slipping clutch	“Diagnosis Table” in Section 7C.
	Blown cylinder head gasket	“Valves and Cylinder Head Inspection” in Section 6A2.
Poor gasoline mileage	Leaks or loose connection of high-tension cord	“High-tension Cords Inspection” in Section 6F2.
	Faulty spark plug (improper gap, heavy deposits and burned electrodes, etc.)	“Spark Plugs Inspection” in Section 6F2.
	Malfunctioning EGR valve	“EGR Valve Inspection” Section 6E2.
	High idle speed	“Improper Engine Idling or Engine Fails to Idle” in this table.
	Poor performance of TP sensor, ECT sensor or MAF sensor	“TP Sensor On-Vehicle Inspection”, “ECT Sensor Inspection” or “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection” in Section 6E2.
	Faulty fuel injector(s)	“Table B-1 Fuel Injector Circuit Check” in this section.
	Faulty ECM	
	Low Compression	“Low Compression” in this table.
	Poor valve seating	“Valves and Cylinder Head Inspection” in Section 6A2.
	Dragging brakes	“Diagnosis Table” in Section 5.
	Slipping clutch	“Diagnosis Table” in Section 7C.
	Thermostat out of order	“Thermostat Inspection” in Section 6B2.
	Improper tire pressure	“Replacement Tires” in Section 3F.
	VVT system out of order	“Oil Control Valve Inspection” in Section 6E2.

Condition	Possible Cause	Reference Item
Excessive engine oil consumption	Blown cylinder head gasket	"Valves and Cylinder Head Inspection" in Section 6A2.
	Leaky camshaft oil seals	"Camshaft, Tappet and Shim" in Section 6A2.
	Sticky piston ring	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A2.
	Worn piston and cylinder	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A2.
	Worn piston ring groove and ring	"Pistons, Piston rings, Connecting Rods and Cylinders Inspection" in Section 6A2.
	Improper location of piston ring gap	"Pistons, Piston rings, Connecting Rods and Cylinders Disassembly and Assembly" in Section 6A2.
	Worn or damaged valve stem seal	"Valves and Cylinder Head Disassembly and Assembly in Section 6A2.
	Worn valve stem	"Valves and Cylinder Head Inspection" in Section 6A2.
Engine hesitates (Momentary lack of response as accelerator is depressed. Can occur at all vehicle speeds. Usually most severe when first trying to make vehicle move, as from a stop sign.)	Spark plug faulty or plug gap out of adjustment	"Spark Plugs Inspection" in Section 6F2.
	Leaky high-tension cord	"High-tension Cords Inspection" in Section 6F2.
	Fuel pressure out of specification	"Table B-3 Fuel Pressure Check" in this section.
	Malfunctioning EGR valve	"EGR Valve Inspection" in Section 6E2.
	Poor performance of TP sensor, ECT sensor or MAF sensor	"TP Sensor On-Vehicle Inspection", "ECT Sensor Inspection" or "Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection" in Section 6E2.
	Faulty fuel injector	"Table B-1 Fuel Injector Circuit Check" in this section.
	Faulty ECM	
	Engine overheating	"Overheating" in this table.
	Low compression	"Low Compression" in this table.
	VVT system out of order	"Oil Control Valve Inspection" in Section 6E2.

Condition	Possible Cause	Reference Item
Surge (Engine power variation under steady throttle or cruise. Feels like vehicle speeds up and down with no change in accelerator pedal.)	Leaky or loosely connected high-tension cord	“High-tension Cords Inspection” in Section 6F2.
	Faulty spark plug (excess carbon deposits, improper gap, and burned electrodes, etc.)	“Spark Plugs Inspection” in Section 6F2.
	Variable fuel pressure	“Table B-3 Fuel Pressure Check” in this section.
	Kinky or damaged fuel hose and lines	
	Faulty fuel pump (clogged fuel filter)	
	Malfunctioning EGR valve	“EGR Valve Inspection” in Section 6E2.
	Poor performance of MAF sensor	“Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection” in Section 6E2.
	Faulty fuel injector	“Table B-1 Fuel Injector Circuit” in this section.
	Faulty ECM	
Excessive detonation (Engine makes continuously sharp metallic knocks that change with throttle opening. Sounds like pop corn popping.)	Faulty spark plug	“Spark Plugs Inspection” in Section 6F2.
	Loose connection of high-tension cord	“High-tension Cords Removal and Installation” in Section 6F2.
	Engine overheating	“Overheating” in this table.
	Clogged fuel filter (faulty fuel pump) or fuel lines	“Table B-1 Fuel Injector Circuit Check” or “Table B-2 Fuel Pump and Its Circuit Check” in this section.
	Air inhaling from intake manifold or throttle body O-ring	
	Malfunctioning EGR valve	“EGR Valve Inspection” in Section 6E2.
	Poor performance of knock sensor, ECT sensor or MAF sensor	“DTC P0327 Knock Sensor Circuit Low” or “DTC P0328 Knock Sensor Circuit High” in this section, “ECT Sensor Inspection” or “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection” in Section 6E2.
	Faulty fuel injector(s)	“Table B-1 Fuel Injector Circuit Check” in this section.
	Faulty ECM	
	Excessive combustion chamber deposits	“Pistons, Piston rings, Connecting Rods and Cylinders Inspection” in Section 6A2.
	VVT system out of order	“Oil Control Valve Inspection” in Section 6E2.

Condition	Possible Cause	Reference Item
Engine has no power	Faulty spark plug	“Spark Plugs Inspection” in Section 6F2.
	Faulty ignition coil with ignitor	“Ignition Coil Assembly (Including Ignitor) Inspection” in Section 6F2.
	Leaks, loose connection or disconnection of high-tension cord	“High-tension Cords Inspection” in Section 6F2.
	Faulty knock sensor	“DTC P0327 Knock Sensor Circuit Low” or “DTC P0328 Knock Sensor Circuit High” in this section.
	Clogged fuel hose or pipe	“Table B-3 Fuel Pressure Check” in this section.
	Malfunctioning fuel pump	“Table B-2 Fuel Pump and Its Circuit Check” in this section.
	Air inhaling from intake manifold gasket or throttle body gasket	
	Engine overheating	“Overheating” in this table.
	Malfunctioning EGR valve	“EGR Valve Inspection” in Section 6E2.
	Maladjusted accelerator cable play	“Accelerator cable Adjustment” in Section 6E2.
	Poor performance of TP sensor, ECT sensor or MAF sensor	“TP Sensor On-Vehicle Inspection”, “ECT Sensor Inspection” or “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection” in Section 6E2.
	Faulty fuel injector(s)	“Table B-1 Fuel Injector Circuit Check” in this section.
	Faulty ECM	
	Dragging brakes	“Diagnosis Table” in Section 5.
	Slipping clutch	“Diagnosis Table” in Section 7C.
	Low compression	“Compression Check” in Section 6A2.
	VVT system out of order	“Oil Control Valve Inspection” in Section 6E2.

Condition	Possible Cause	Reference Item
Improper engine idling or engine fails to idle	Faulty spark plug	"Spark Plugs Inspection" in Section 6F2.
	Leaky or disconnected high-tension cord	"High-tension Cords Inspection" in Section 6F2.
	Faulty ignition coil with ignitor	"Ignition Coil Assembly (Including Ignitor) Inspection" in Section 6F2.
	Fuel pressure out of specification	"Table B-3 Fuel Pressure Check" in this section.
	Leaky manifold, throttle body, or cylinder head gasket	
	Malfunctioning EGR valve	"EGR Valve Inspection" in Section 6E2.
	Faulty idle air control system	"Table B-4 Idle Air Control System Check" in this section.
	Faulty evaporative emission control system	"Evaporative Emission Control System Inspection" in Section 6E2.
	Faulty EGR system	"EGR Valve Inspection" in Section 6E2.
	Faulty fuel injector(s)	"Table B-1 Fuel Injector Circuit Check" in this section.
	Poor performance of ECT sensor, TP sensor or MAF sensor	"TP Sensor On-Vehicle Inspection", "ECT Sensor Inspection" or "Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection" in Section 6E2.
	Faulty ECM	
	Loose connection or disconnection of vacuum hoses	
	Malfunctioning PCV valve	"PCV System Inspection" in Section 6E2.
	Engine overheating	"Overheating" in this section.
	Low compression	"Compression Check" in Section 6A2.
	VVT system out of order	"Oil Control Valve Inspection" in Section 6E2.

Condition	Possible Cause	Reference Item
Excessive hydrocarbon (HC) emission or carbon monoxide (CO)	Faulty spark plug	“Spark Plugs Inspection” in Section 6F2.
	Leaky or disconnected high-tension cord	“High-tension Cords Inspection” in Section 6F2.
	Faulty ignition coil with ignitor	“Ignition Coil Assembly (Including Ignitor) Inspection” in Section 6F2.
	Low compression	“Compression Check” in Section 6A2.
	Lead contamination of three way catalytic converter	Check for absence of filler neck restrictor.
	Faulty evaporative emission control system	“Evaporative Emission Control System Inspection” in Section 6E2.
	Fuel pressure out of specification	“Table B-3 Fuel Pressure Check” in this section.
	Closed loop system (A/F feed back compensation) fails • Faulty TP sensor • Poor performance of ECT sensor or MAF sensor	 “TP Sensor On-Vehicle Inspection” in Section 6E2. “ECT Sensor Inspection” or “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection” in Section 6E2.
	Faulty injector(s)	“Table B-1 Fuel Injector Circuit Check” in this section.
	Faulty ECM	
	Engine not at normal operating temperature	
	Clogged air cleaner	
	Vacuum leaks	
	VVT system out of order	“Oil Control Valve Inspection” in Section 6E2.
Excessive nitrogen oxides (NOx) emission	Improper ignition timing	“Ignition Timing Inspection” in Section 6F2.
	Lead contamination of catalytic converter	Check for absence of filler neck restrictor.
	Faulty EGR system	“EGR Valve Inspection” in Section 6E2.
	Fuel pressure out of specification	“Table B-3 Fuel Pressure Check” in this section.
	Closed loop system (A/F feed back compensation) fails • Faulty TP sensor • Poor performance of ECT sensor or MAF sensor	 “TP Sensor On-Vehicle Inspection” in Section 6E2. “ECT Sensor Inspection” or “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection” in Section 6E2.
	Faulty injector(s)	“Table B-1 Fuel Injector Circuit Check” in this section.
	Faulty ECM	
	VVT system out of order	“Oil Control Valve Inspection” in Section 6E2.

Scan Tool Data

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

NOTE:
- **With the generic scan tool, only star (∗) marked data in the table below can be read.**
- **When checking the data with the engine running at idle or racing, be sure to shift M/T gear to the neutral gear position and A/T gear to the "Park" position and pull the parking brake fully. Also, if nothing or "no load" is indicated, turn OFF A/C, all electric loads, P/S and all the other necessary switches.**

	SCAN TOOL DATA	VEHICLE CONDITION	NORMAL CONDITION/ REFERENCE VALUES
∗	COOLANT TEMP (ENGINE COOLANT TEMP.)	At specified idle speed after warming up	80 – 100°C, 176 – 212°F
∗	INTAKE AIR TEMP	At specified idle speed after warming up	–5°C (23°F) + environmental temp. to 40°C (104°F) + environmental temp.
∗	ENGINE SPEED	At idling with no load after warming up	Desired idle speed ±50 RPM
	VVT GAP (TARGET-ACTUAL POSITION)	At specified idle speed after warming up	0 – 3°
	INJ PULSE WIDTH (FUEL INJECTION PULSE WIDTH)	At specified idle speed with no load after warming up	2.0 – 4.0 msec.
		At 2500 r/min with no load after warming up	2.0 – 3.6 msec.
	TP SENSOR VOLT (THROTTLE POSITION SENSOR OUTPUT VOLTAGE)	Ignition switch ON/ warmed up engine stopped: Accelerator pedal released	0.5 – 1.0 V
		Ignition switch ON/ warmed up engine stopped: Accelerator pedal depressed fully	Less than 4.8 V
	DESIRED IDLE (DESIRED IDLE SPEED)	At idling with radiator cooling fan stopped and all electrical parts turned OFF after warming up, M/T at neutral	700 RPM
	IAC FLOW DUTY (IDLE AIR CONTROL FLOW DUTY)	At idling with no load after warming up	5 – 55%
∗	SHORT FT B1 (SHORT TERM FUEL TRIM)	At specified idle speed after warming up	– 20 – +20%
∗	LONG FT B1 (LONG TERM FUEL TRIM)	At specified idle speed after warming up	– 20 – +20%
	TOTAL FUEL TRIM	At specified idle speed after warming up	– 35 – +35%

	SCAN TOOL DATA	VEHICLE CONDITION		NORMAL CONDITION/ REFERENCE VALUES
✱	MAF (MASS AIR FLOW RATE)	At specified idle speed with no load after warming up		1.0 – 4.0 g/s 0.14 – 0.52 lb/min
		At 2500 r/min with no load after warming up		4.0 – 12.0 g/s 0.53 – 1.58 lb/min
✱	CALC LOAD (CALCULATED LOAD VALUE)	At specified idle speed with no load after warming up		0 – 10%
		At 2500 r/min with no load after warming up		0 – 10%
✱	THROTTLE POSITION (ABSOLUTE THROTTLE POSITION)	Ignition switch ON/ warmed up engine stopped	Accelerator pedal released	0 – 5%
			Accelerator pedal depressed fully	90 – 100%
✱	O2S B1 S1 (HEATED OXYGEN SENSOR–1)	At specified idle speed after warming up		0.1 – 0.95 V
✱	O2S B1 S2 (HEATED OXYGEN SENSOR–2)	When engine is running at 2000 r/min. for 3 min or longer after warming up.		0.1 – 0.95 V
	FUEL SYSTEM B1 (FUEL SYSTEM STATUS)	At specified idle speed after warming up		CLOSED (closed loop)
✱	MAP (INTAKE MANIFOLD ABSOLUTE PRESSURE)	At specified idle speed with no load after warming up		24 – 38 kPa 180 – 285 mmHg
	BAROMETRIC PRES	–		Display the barometric pressure
	STEP EGR FLOW DUTY	At specified idle speed after warming up		0%
	FUEL CUT	When engine is at fuel cut condition		ON
		Other than fuel cut condition		OFF
	CLOSED THROTTLE POS (CLOSED THROTTLE POSITION)	Throttle valve at idle position		ON
		Throttle valve opens larger than idle position		OFF
	CANIST PRG DUTY (EVAP CANISTER PURGE FLOW DUTY)	At specified idle speed after warming up		0%
✱	IGNITION ADVANCE (IGNITION TIMING ADVANCE FOR NO.1 CYLINDER)	At specified idle speed with no load after warming up		3 – 13° BTDC
	BATTERY VOLTAGE	Ignition switch ON/engine stop		10 – 14 V
	FUEL PUMP	Within 3 seconds after ignition switch ON or engine running		ON
		Engine stop at ignition switch ON		OFF
	ELECTRIC LOAD	Ignition switch ON/Headlight, small light, all turned OFF		OFF
		Ignition switch ON/Headlight, small light, turned ON		ON
	BRAKE SWITCH	Ignition switch ON	Brake pedal is released	OFF
			Brake pedal is depressed	ON

	SCAN TOOL DATA	VEHICLE CONDITION		NORMAL CONDITION/ REFERENCE VALUES
	RADIATOR FAN (RADIATOR FAN CONTROL RELAY)	Ignition switch ON	Engine coolant temp.: Lower than 92.5°C (198.5°F)	OFF
			Engine coolant temp.: 97.5°C (208°F) or higher	ON
	BLOWER FAN	Ignition switch ON	Blower fan switch: 2nd speed position or more	ON
			Blower fan switch: under 2nd speed position	OFF
	A/C SWITCH (if equipped with A/C)	Engine running after warming up, A/C not operating		OFF
		Engine running after warming up, A/C operating		ON
	A/C MAG CLUTCH (if equipped with A/C)	Engine running	A/C switch and blower motor switch turned ON	ON
			A/C switch and blower motor switch turned OFF	OFF
	VEHICLE SPEED	At stop		0 km/h

Scan Tool Data Definitions

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

It is detected by engine coolant temp. sensor.

INTAKE AIR TEMP. (°C, °F)

It is detected by intake air temp. sensor.

ENGINE SPEED (rpm)

It is computed by reference pulses from the camshaft position sensor.

TOTAL FUEL TRIM B1 (%)

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

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

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

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

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

DESIRED IDLE (DESIRED IDLE SPEED, rpm)

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

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

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

SHORT FT B1 (SHORT TERM FUEL TRIM, %)

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

LONG FT B1 (LONG TERM FUEL TRIM, %)
Long term fuel trim value represents long term corrections to the air/fuel mixture computation. A value of 0 indicates no correction, a value greater than 0 means an enrichment correction, and a value less than 0 means an enrichment correction, and a value less than 0 implies an enleanment correction.

VVT GAP [TARGET-ACTUAL POSITION] (°)
It is calculated using the formula: target valve timing advance – actual valve timing advance.

MAF (MASS AIR FLOW RATE, g/s, lb/min)
It represents total mass of air entering intake manifold which is measured by mass air flow sensor.

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

THROTTLE POS (ABSOLUTE THROTTLE POSITION, %)
When throttle position sensor is fully closed position, throttle opening is indicated as 0% and 90 – 100% full open position.

O2S SENSOR B1 S1 (HEATED OXYGEN SENSOR–1, V)
It indicates output voltage of HO2S–1 installed on exhaust manifold (pre-catalyst).

O2S SENSOR B1 S2 (HEATED OXYGEN SENSOR–2, V)
It indicates output voltage of HO2S–2 installed on exhaust pipe (post-catalyst). It is used to detect catalyst deterioration.

FUEL SYSTEM (FUEL SYSTEM STATUS)
Air/fuel ratio feedback loop status displayed as one of the followings.
OPEN: Open loop-has not yet satisfied conditions to go closed loop.
CLOSED: Closed loop-using oxygen sensor(s) as feedback for fuel control.
OPEN-DRIVE COND: Open loop due to driving conditions (Power enrichment, etc.).
OPEN SYS FAULT: Open loop due to detected system fault.
CLOSED-ONE O2S: Closed loop, but fault with at least one oxygen sensor-may be using single oxygen sensor for fuel control.

MAP (MANIFOLD ABSOLUTE PRESSURE, mmHg, kPa)
This value indicates how much correction is necessary to keep the air/fuel mixture stoichiometrical.
It is detected by manifold absolute pressure sensor.

BAROMETRIC PRESS (kPa, inHg)
This parameter represents a measurement of barometric air pressure and is used for altitude correction of the fuel injection quantity and IAC valve control.

STEP EGR FLOW DUTY (%)
This parameter indicates opening rate of EGR valve which controls the amount of EGR flow.

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

CLOSED THROTTLE POSITION (ON/OFF)
This parameter will read ON when throttle valve is fully closed, or OFF when the throttle is not fully closed.

CANIST PURGE DUTY (EVAP CANISTER PURGE FLOW DUTY, %)
This parameter indicates valve ON (valve open) time rate within a certain set cycle of EVAP canister purge valve which controls the amount of EVAP purge.

IGNITION ADVANCE (IGNITION TIMING ADVANCE FOR NO.1 CYLINDER, °)
Ignition timing of NO.1 cylinder is commanded by ECM. The actual ignition timing should be checked by using the timing light.

BATTERY VOLTAGE (V)
This parameter indicates battery positive voltage inputted from main relay to ECM.

FUEL PUMP (ON/OFF)
ON is displayed when the ECM activates the fuel pump via the fuel pump relay switch.

ELECTRIC LOAD (ON/OFF)
ON: Headlight or small light ON signal inputted.
OFF: Above electric loads all turned OFF.

BRAKE SW (ON/OFF)
This parameter indicates the state of the brake switch.

RADIATOR FAN (RADIATOR FAN CONTROL RELAY, ON/OFF)
ON: Command for radiator fan control relay operation being output.
OFF: Command for relay operation not being output.

BLOWER FAN (ON/OFF)
This parameter indicates the state of the blower fan motor switch.

A/C SWITCH (ON/OFF)
ON: Command for A/C operation being output from ECM to A/C amplifier.
OFF: Command for A/C operation not being output.

A/C MAG SWITCH (A/C COMPRESSOR RELAY, ON/OFF)
This parameter indicates the state of the A/C switch.

VEHICLE SPEED (km/h)
It is computed based on pulse signals from vehicle speed sensor.

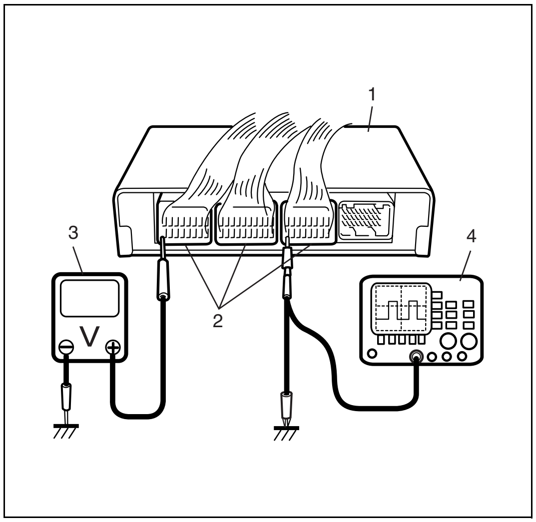
Inspection of ECM and Its Circuits

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

CAUTION:

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

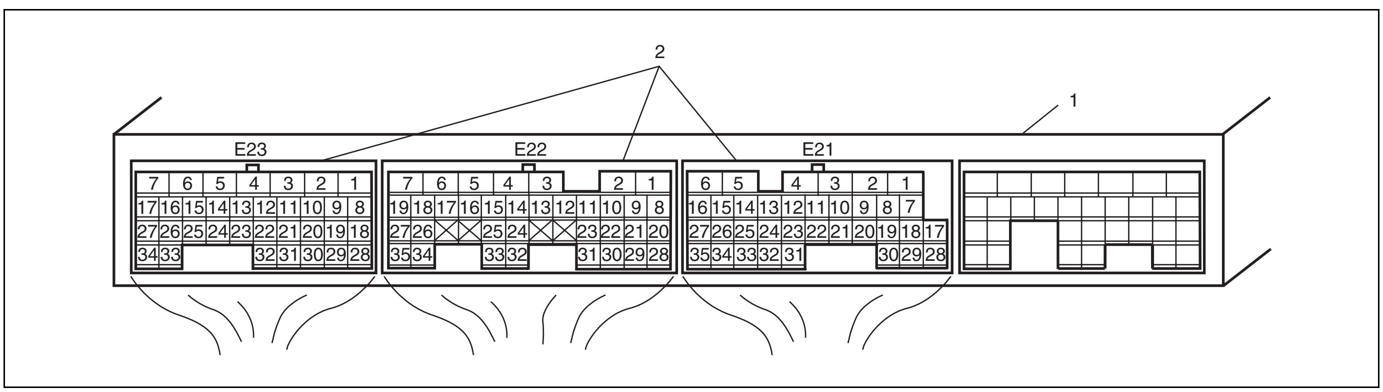
Voltage Check



1) Remove ECM (1) from vehicle body referring to “Engine Control Module (ECM) Removal and Installation” in Section 6E2.
2) Check voltage and/or pulse signal at each terminal of couplers (2) connected, using voltmeter (3) and oscilloscope (4).

NOTE:

- **As each terminal voltage is affected by the battery voltage, confirm that it is 11 V or more when ignition switch is turned ON.**
- **Voltage with asterisk(*) cannot be measured by voltmeter because it is pulse signal.**
  Check it with oscilloscope if necessary.



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

TERMINAL NUMBER	WIRE COLOR	CIRCUIT	NORMAL VOLTAGE	CONDITION
E23-1	BLK/YEL	Ground for ECM	Below 0.3 V	Ignition switch turned ON
E23-2	BLK/YEL	Ground for ECM	Below 0.3 V	Ignition switch turned ON
E23-3	BLU/RED	Heater output of heated oxygen sensor–2	10 – 14 V	Ignition switch turned ON
			0 – 1 V (Reference waveform No.1)	Engine running at idling after vehicle running over 30 km/h, 19ml/h for 5 min.
E23-4	YEL	Heater output of heated oxygen sensor–1	10 – 14 V	Ignition switch turned ON
			*0 – 2 V ↑↓ 13.5 –14.8 V (Reference waveform No.2 and No.3)	Engine running at idling with after warming up. (Output signal is active low duty pulse. Duty ratio varies depending on engine condition.)
E23-5	–	–	–	–
E23-6	–	–	–	–
E23-7	–	–	–	–
E23-8	GRN/YEL	IAC valve output	0 – 1 V	Ignition switch turned ON
			*0 – 2 V ↑↓ 8 – 14 V (Reference waveform No.4)	Engine running at idling with after warming up. (Output signal is active low duty pulse. Pulse generated times depending on vehicle condition)
E23-9	–	–	–	–
E23-10	–	–	–	–
E23-11	ORN	A/C compressor relay output (if equipped)	10 – 14 V	Engine running, A/C request signal high input
			0 – 1 V	Engine running, A/C request signal low input
E23-12	–	–	–	–
E23-13	RED/BLK	EVAP canister purge valve output	10 – 14 V	Ignition switch turned ON with engine stop
			*0 – 0.6 V ↑↓ 10 – 14 V (Reference waveform No.25)	Engine running and vehicle running over 40 km/h, 25 ml/h (Output signal is 10 Hz duty pulse. Duty ratio varies depending on vehicle condition.)
E23-14	GRN	Fuel pump relay output	0 – 2.5 V	For 3 sec. from the time is ignition switch turned to ON or while engine is running
			10 – 14 V	On and after 3 sec. from the time is ignition switch turned to ON or while engine is stop
E23-15	BLU/BLK	Main power supply relay output	10 – 14 V	Ignition switch is turned OFF
			0 – 2 V	Ignition switch is turned ON

TERMINAL NUMBER	WIRE COLOR	CIRCUIT	NORMAL VOLTAGE	CONDITION
E23-16	BLK/RED	EGR valve (stepper motor coil 3) output	10 – 14 V	Ignition switch is turned ON
			*0 – 2 V ↑↓ 8 – 14 V (Reference waveform No.5)	Ignition switch is turned to ST (cranking) position. (Output signal is active low duty pulse. Pulse generated times depending on vehicle condition)
E23-17	GRN/YEL	EGR valve (stepper motor coil 1) output	0 – 2 V	Ignition switch turned ON
			*0 – 2 V ↑↓ 8 – 14 V (Reference waveform No.5)	Ignition switch is turned to ST (cranking) position. (Output signal is active low duty pulse. Pulse generated times depending on vehicle condition)
E23-18	–	–	–	–
E23-19	–	–	–	–
E23-20	–	–	–	–
E23-21	–	–	–	–
E23-22	–	–	–	–
E23-23	–	–	–	–
E23-24	–	–	–	–
E23-25	–	–	–	–
E23-26	–	–	–	–
E23-27	–	–	–	–
E23-28	–	–	–	–
E23-29	–	–	–	–
E23-30	–	–	–	–
E23-31	RED/BLU	Ignition coil No.2 and No.3 output	0 – 0.6 V	Ignition switch turned ON
			*0 – 0.6 V ↑↓ 2 – 5 V (Reference waveform No.6)	Engine running (Output signal is active high pulse. Pulse frequency varies depending on engine speed.)
E23-32	YEL/BLU	Ignition coil No.1 and No.4 output	0 – 0.6 V	Ignition switch turned ON
			*0 – 0.6 V ↑↓ 2 – 5 V (Reference waveform No.7)	Engine running (Output signal is active high pulse. Pulse frequency varies depending on engine speed.)
E23-33	GRN/ORN	EGR valve (stepper motor coil 4) output	0 – 2 V	Ignition switch turned ON
			*0 – 2 V ↑↓ 8 – 14 V (Reference waveform No.5)	Ignition switch is turned to ST (cranking) position. (Output signal is active low duty pulse. Pulse generated times depending on vehicle condition)

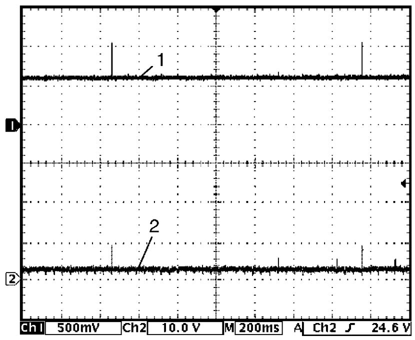
TERMINAL NUMBER	WIRE COLOR	CIRCUIT	NORMAL VOLTAGE	CONDITION
E23-34	GRN/BLK	EGR valve (stepper motor coil 2) output	10 – 14 V	Ignition switch turned ON
			*0 – 2 V ↑↓ 8 – 14 V (Reference wave-form No.5)	Ignition switch is turned to ST (cranking) position. (Output signal is active low duty pulse. Pulse generated times depending on vehicle condition)
E22-1	BLK	Ground for ECM	Below 0.3 V	Ignition switch turned ON
E22-2	BRN/YEL	Oil control valve ground	Below 0.3 V	Ignition switch turned ON
E22-3	BLK/YEL	Oil control valve output	*0 – 0.6 V ↑↓ 13 – 14 V (Reference wave-form No.8 and No.9)	Ignition switch turned ON
				Vehicle running. (Output signal is active low duty pulse. Duty ratio varies depending on vehicle condition)
E22-4	BLU/ORN	Fuel injector No.4 out-put	10 – 14 V	Ignition switch turned ON
			*0 – 0.6 V ↑↓ 10 – 14 V (Reference wave-form No.10 and No.11)	Engine running (Output signal is active low pulse. Pulse frequency varies depending on engine speed.)
E22-5	BLU/RED	Fuel injector No.3 out-put	10 – 14 V	Ignition switch turned ON
			*0 – 0.6 V ↑↓ 10 – 14 V (Reference wave-form No.10 and No.12)	Engine running (Output signal is active low pulse. Pulse frequency varies depending on engine speed.)
E22-6	BLU/YEL	Fuel injector No.2 out-put	10 – 14 V	Ignition switch turned ON
			*0 – 0.6 V ↑↓ 10 – 14 V (Reference wave-form No.10 and No.13)	Engine running (Output signal is active low pulse. Pulse frequency varies depending on engine speed.)
E22-7	BLU/WHT	Fuel injector No.1 out-put	10 – 14 V	Ignition switch turned ON
			*0 – 0.6 V ↑↓ 10 – 14 V (Reference wave-form No.10 and No.14)	Engine running (Output signal is active low pulse. Pulse frequency varies depending on engine speed.)
E22-8	WHT/GRN	Output of 5 V power source for throttle posi-tion (TP) sensor	4.5 – 5.5 V	Ignition switch turned ON

TERMINAL NUMBER	WIRE COLOR	CIRCUIT	NORMAL VOLTAGE	CONDITION
E22-9	WHT	Knock sensor signal	*2 – 3 V (Reference wave-form No.15 and No.16)	Ignition switch turned ON
				Engine running at idling with after warm-ing up
E22-10	ORN	Reference (classified cylinder) signal for CMP sensor	*0 – 0.6 V ↑↓ 4 – 5 V (Reference wave-form No.17)	Engine running at idling with after warm-ing up (Sensor signal is pulse. Pulse frequency varies depending on engine speed.) (6 pulses are generated par 1camshaft revolution)
E22-11	RED	Oxygen signal of heated oxygen sen-sor–1	0.5 – 1.5 V	Ignition switch turned ON
			*Deflects between over 0.5 V and under 0.45 V (Reference wave-form No.2 and No.3)	While engine running at 2,000 r/min. for 1min. or longer after warmed up
E22-12	–	–	–	–
E22-13	–	–	–	–
E22-14	WHT	Mass air flow (MAF) sensor signal	0.5 – 1.5 V	Ignition switch turned ON and engine stops
			1.5 – 2.0 V (Reference wave-form No.18)	When engine running at specified idle speed after warming up
E22-15	LT GRN/ RED	Manifold absolute pressure (MAP) sensor signal	About 4 V (Reference wave-form No.19)	Ignition switch turned ON with baromet-ric pressure at 100kPa, 760mmHg
			0.4 – 1.8 V (Reference wave-form No.20)	While specified idle speed after warming up with barometric pressure at 100kPa, 760mmHg
E22-16	YEL/GRN	Engine coolant temp. (ECT) sensor signal	3.3 – 3.6 V	Ignition switch turned ON, ECT at 0°C, 32°F
			1.1 – 1.5 V	Ignition switch turned ON, ECT at 50°C, 122°F
			0.3 – 0.45 V	Ignition switch turned ON, ECT at 100°C, 212°F
E22-17	LT GRN	Intake air temperature (IAT) sensor signal	3.3 – 3.6 V	Ignition switch turned ON, IAT at 0°C, 32°F
			1.6 – 1.9 V	Ignition switch turned ON, IAT at 40°C, 104°F
			0.6 – 0.8 V	Ignition switch turned ON, IAT at 80°C, 176°F
E22-18	–	–	–	–
E22-19	YEL	Vehicle speed sensor signal	*0 – 1 V ↑↓ 10 – 14 V (Reference wave-form No.21)	Vehicle running. (Sensor signal is pulse. Pulse frequency varies depending on vehicle speed. (8190 pulses are generated par 60 km/h, 37.5 ml/h)
E22-20	–	–	–	–

TERMINAL NUMBER	WIRE COLOR	CIRCUIT	NORMAL VOLTAGE	CONDITION
E22-21	–	–	–	–
E22-22	–	–	–	–
E22-23	–	–	–	–
E22-24	–	–	–	–
E22-25	–	–	–	–
E22-26	–	–	–	–
E22-27	–	–	–	–
E22-28	BRN/WHT	Ground for sensors	Below 0.3 V	Ignition switch turned ON
E22-29	–	–	–	–
E22-30	PNK	CKP sensor signal	0 – 1 V	Ignition switch turned ON
			*4.4 – 4.6 V ↑↓ 0.1 – 0.3 V (Reference waveform No.17)	Engine running at idling with after warming up. (Sensor signal is pulse. Pulse frequency varies depending on engine speed.) (31 (34–4) pulses are generated par 1crankshaft revolution)
E22-31	BLK	Ground of ECM for shield wire	Below 0.3 V	Ignition switch turned ON
E22-32	–	–	–	–
E22-33	BLU	Oxygen signal of heated oxygen sensor–2	0.5 – 1.5 V	Ignition switch turned ON
			*Deflects between over 0.5 V and under 0.45 V (Reference waveform No.1)	While engine running at 2,000 r/min. for 1min. or longer after vehicle running over 30 km/h, 19 ml/h
E22-34	GRY	Throttle position (TP) sensor signal	0.5 – 1.0 V	Ignition switch turned ON and throttle valve at idle position with warmed engine
			3.4 – 4.7 V	Ignition switch turned ON and throttle valve at full open position
E22-35	BLK/YEL	Starting motor signal	0 – 1 V	Ignition switch turned ON
			6 – 14 V	While engine cranking
E21-1	PPL/WHT	MIL (Malfunction indicator lamp) output	0 – 2.5 V	Ignition switch turned ON with engine stop
			10 – 14 V	Engine running
E21-2	GRY/RED	Immobilizer indicator lamp output (if equipped)	10 – 14 V	While engine running
			0 – 1 V	Ignition switch turned ON with engine stop
E21-3	–	–	–	–
E21-4	BLU	Radiator fan motor relay output	10 – 14 V	Ignition switch turned ON, engine coolant temperature under 95°C, 203°F
			0 – 1 V	Ignition switch turned ON, engine coolant temperature more than 97.5°C, 207.5°F
E21-5	BLK/RED	Main power supply	10 – 14 V	Ignition switch turned ON
E21-6	BLK/RED	Main power supply	10 – 14 V	Ignition switch turned ON
E21-7	–	–	–	–
E21-8	–	–	–	–

TERMINAL NUMBER	WIRE COLOR	CIRCUIT	NORMAL VOLTAGE	CONDITION
E21-9	GRN/WHT	Electric load signal for stop lamp	0 – 1 V	Ignition switch turned ON, stop lamp not lighted up
			10 – 14 V	Ignition switch turned ON, stop lamp lighted up
E21-10	–	–	–	–
E21-11	WHT/BLK	Serial communication line of data link connector 12 V	10 – 14 V	Ignition switch turned ON
E21-12	BRN/YEL	Engine revolution signal output for tachometer	0 – 0.8 V	Ignition switch turned ON with engine stop
			*0 – 1 V ↑↓ 8 – 14 V (Reference waveform No.22 and No.23)	While engine running. (Output signal is pulse. Pulse frequency varies depending on engine speed.) (2 pulses are generated par 1crankshaft revolution.) (3000 r/min = 100 Hz)
E21-13	PNK/BLU	Electric load signal for heater blower motor	10 – 14 V	Ignition switch turned ON, blower fan selector selected at OFF
			0 – 1 V	Ignition switch turned ON, blower fan selector selected at 2nd speed position or more
E21-14	YEL/RED	Fuel level sensor signal	0 – 6 V	Ignition switch turned ON Voltage depends on fuel level
E21-15	GRN/RED	A/C evaporator outlet air temp. sensor signal (if equipped)	3.3 – 3.8 V	Ignition switch turned ON at A/C evaporator inlet air temperature 0°C (32°F)
			2.5 – 2.9 V	Ignition switch turned ON at A/C evaporator inlet air temperature 15°C (59°F)
			1.9 – 2.3 V	Ignition switch turned ON at A/C evaporator inlet air temperature 25°C (77°F)
E21-16	WHT/BLU	Power source for ECM internal memory	10 – 14 V	Ignition switch turned ON and turned OFF
E21-17	–	–	–	–
E21-18	–	–	–	–
E21-19	–	–	–	–
E21-20	–	–	–	–
E21-21	–	–	–	–
E21-22	–	–	–	–
E21-23	–	–	–	–
E21-24	–	–	–	–
E21-25	–	–	–	–
E21-26	–	–	–	–
E21-27	–	–	–	–
E21-28	BLK/WHT	Ignition switch signal	0 – 1 V	Ignition switch turned OFF
			10 – 14 V	Ignition switch turned ON
E21-29	–	–	–	–

TERMINAL NUMBER	WIRE COLOR	CIRCUIT	NORMAL VOLTAGE	CONDITION
E21-30	LT GRN/ RED	A/C request signal (if equipped)	10 – 14 V (High input)	Ignition switch turned ON, blower fan selector selected OFF position or A/C switch turned OFF or A/C evaporator temp. less than 2.5°C, 36.5°F
			0 – 1 V (Low input)	Ignition switch turned ON, blower fan selector selected other than OFF position and A/C switch turned ON with A/C evaporator temp. more than 4°C, 39.2°F
E21-31	PPL	Vehicle speed sensor signal for speedometer	*0 – 1 V ↑↓ 10 – 14 V (Reference waveform No.21)	Vehicle running. (Sensor signal is pulse. Pulse frequency varies depending on vehicle speed.) (8190 pulses/sec. are generated par 60 km/h, 37.5 ml/h)
E21-32	WHT/GRN	ECT sensor signal for combination meter	*0 – 0.6 V ↑↓ 13 – 14 V (Reference waveform No.24)	Ignition switch turned ON (Output signal is 5 Hz active low duty pulse. Duty ratio varies depending on ECT.) ECT –30°C = 10% ON duty ECT 130°C = 90% ON duty
E21-33	RED/YEL	Electric load signal for clearance lamp	0 – 1 V	Ignition switch turned ON, clearance lamp not lighted up
			10 – 14 V	Ignition switch turned ON, clearance lamp lighted up
E21-34	–	–	–	–
E21-35	–	–	–	–

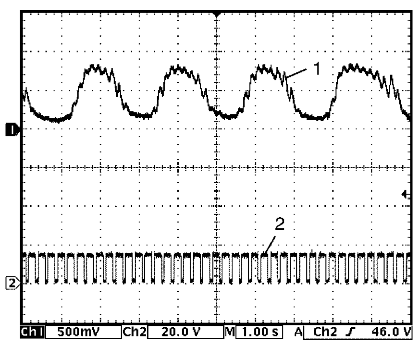


1. Reference waveform No.1

Heated oxygen sensor–2 heater signal at engine idling

Measurement terminal	CH1: E22-33 to E23-1 CH2: E23-3 to E23-1
Oscilloscope setting	CH1: 500 mV/DIV, CH2: 10 V/DIV TIME: 200 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Drive vehicle at 60 km/h (37 mil/h) for 10 min. • Engine at specified idle speed

1.	Heated oxygen sensor–2 signal
2.	Heated oxygen sensor–2 heater signal

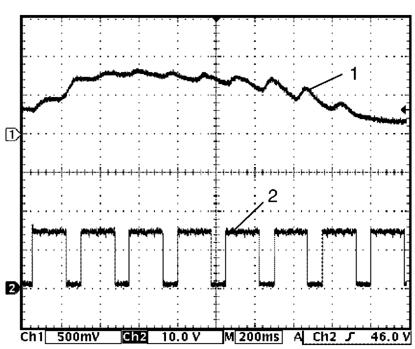


2. Reference waveform No.2

Heated oxygen sensor–1 signal at engine idling

Measurement terminal	CH1: E22-11 to E23-1 CH2: E23-4 to E23-1
Oscilloscope setting	CH1: 500 mV/DIV, CH2: 20 V/DIV TIME: 1 s/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1.	Heated oxygen sensor–1 signal
2.	Heated oxygen sensor–1 heater signal

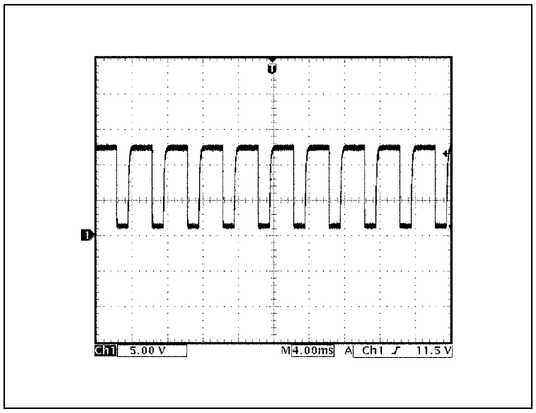


3. Reference waveform No.3

Heated oxygen sensor–1 heater signal at engine idling

Measurement terminal	CH1: E22-11 to E23-1 CH2: E23-4 to E23-1
Oscilloscope setting	CH1: 500 mV/DIV, CH2: 10 V/DIV TIME: 200 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

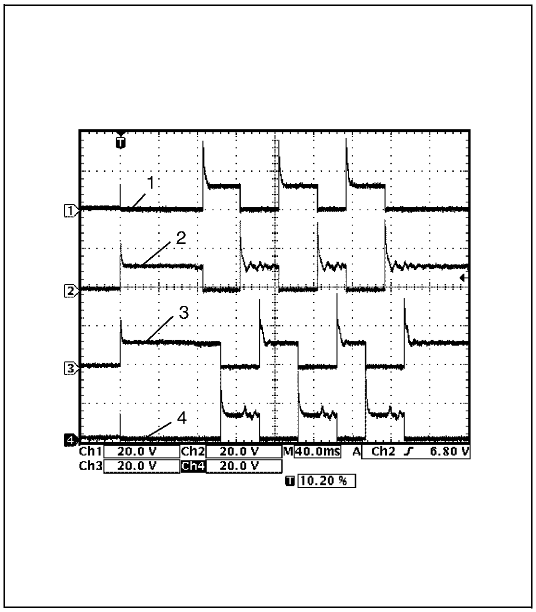
1.	Heated oxygen sensor–1 signal
2.	Heated oxygen sensor–1 heater signal



4. Reference waveform No.4

IAC valve signal

Measurement terminal	CH1: E23-8 to E23-1
Oscilloscope setting	CH1: 5 V/DIV TIME: 4 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

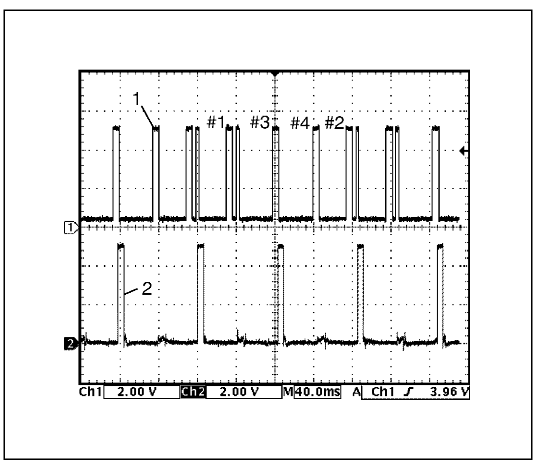


5. Reference waveform No.5

EGR valve signal

Measurement terminal	CH1: E23-17 to E23-1 CH2: E23-34 to E23-1 CH3: E23-16 to E23-1 CH4: E23-33 to E23-1
Oscilloscope setting	CH1: 20 V/DIV, CH2: 20 V/DIV CH3: 20 V/DIV, CH4: 20 V/DIV TIME: 40 ms/DIV
Measurement condition	At the moment of the ignition switch in turned on

1.	EGR valve stepper motor coil 1 signal
2.	EGR valve stepper motor coil 2 signal
3.	EGR valve stepper motor coil 3 signal
4.	EGR valve stepper motor coil 4 signal

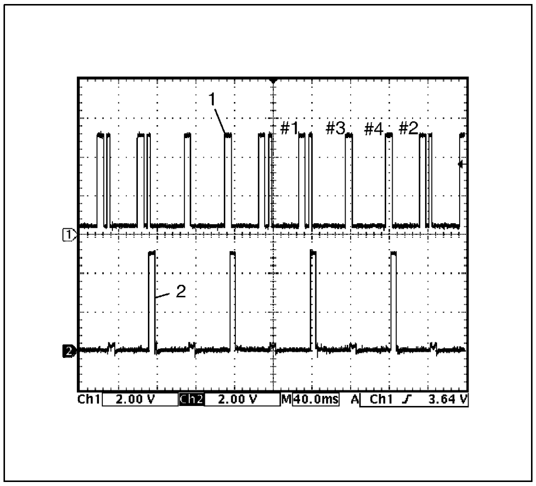


6. Reference waveform No.6

Ignition coil No.2 and No.3 signal at engine idling

Measurement terminal	CH1: E22-10 to E23-1 CH2: E23-31 to E23-1
Oscilloscope setting	CH1: 2 V/DIV, CH2: 2 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1.	Cylinder reference signal (CMP reference signal)
2.	No.2 and No.3 ignition signal

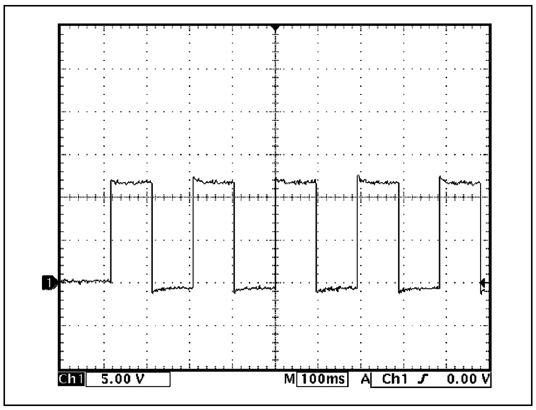


7. Reference waveform No.7

Ignition coil No.1 and No.4 signal at engine idling

Measurement terminal	CH1: E22-10 to E23-1 CH2: E23-32 to E23-1
Oscilloscope setting	CH1: 2 V/DIV, CH2: 2 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

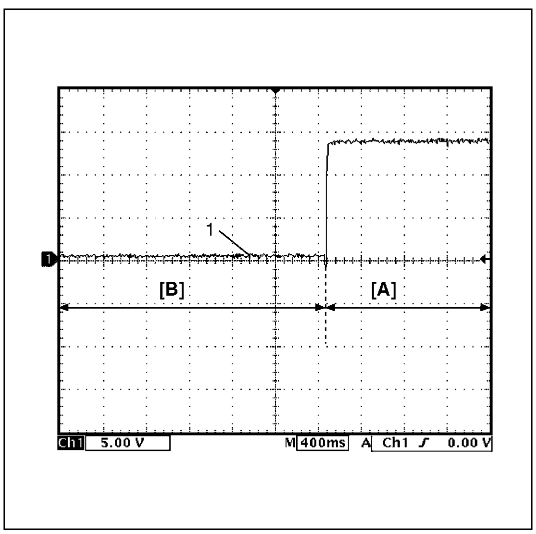
1.	Cylinder reference signal (CMP reference signal)
2.	No.1 and No.4 ignition signal



8. Reference waveform No.8

Oil control valve signal at engine idling

Measurement terminal	CH1: E22-3 to E23-1
Oscilloscope setting	CH1: 5 V/DIV TIME: 2 ms/DIV
Measurement condition	At the moment of the ignition switch in turned on

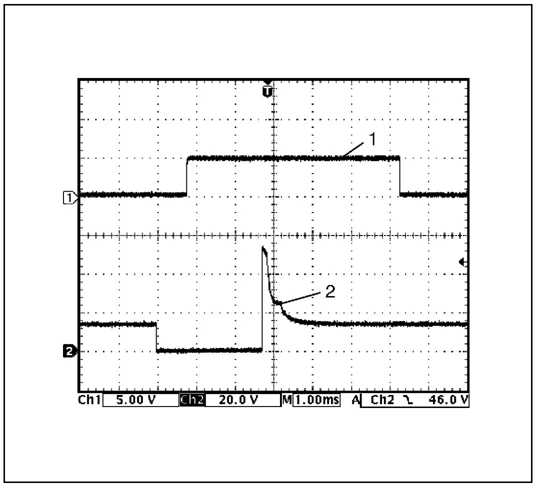


9. Reference waveform No.9

Oil control valve signal at vehicle driving

Measurement terminal	CH1: E22-3 to E23-1
Oscilloscope setting	CH1: 5 V/DIV TIME: 2 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Drive vehicle at 20 km/h (12 mil/h) and depress accelerator pedal fully

[A]:	Accelerator pedal depress fully
[B]:	Accelerator pedal depress partially
1.	Oil control valve signal

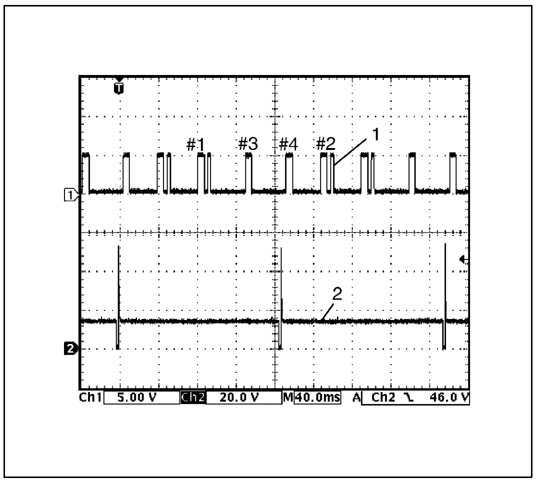


10. Reference waveform No.10

Fuel injector signal at engine racing

Measurement terminal	CH1: E22-10 to E23-1 CH2: E22-6 to E23-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 20 V/DIV TIME: 1 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1.	Cylinder reference signal (CMP reference signal)
2.	Fuel injector signal

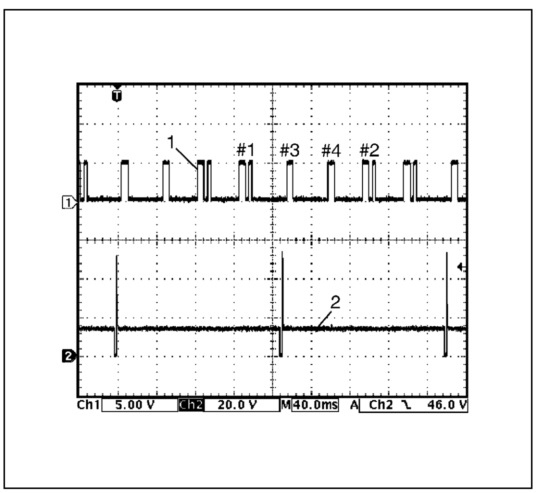


11. Reference waveform No.11

No.4 fuel injector signal at engine idling

Measurement terminal	CH1: E22-10 to E23-1 CH2: E22-4 to E23-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 20 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1.	Cylinder reference signal (CMP reference signal)
2.	No.4 fuel injector signal\

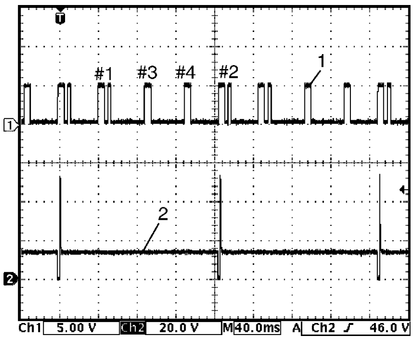


12. Reference waveform No.12

No.3 fuel injector signal at engine idling

Measurement terminal	CH1: E22-10 to E23-1 CH2: E22-5 to E23-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 20 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1.	Cylinder reference signal (CMP reference signal)
2.	No.3 fuel injector signal

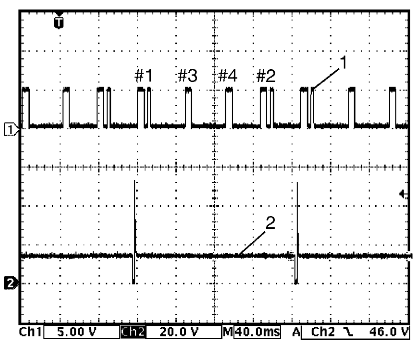


13. Reference waveform No.13

No.2 fuel injector signal at engine idling

Measurement terminal	CH1: E22-10 to E23-1 CH2: E22-6 to E23-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 20 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1. Cylinder reference signal (CMP reference signal)
2. No.2 fuel injector signal

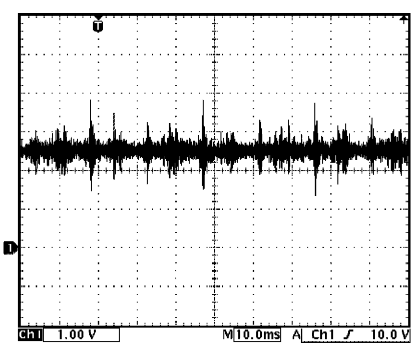


14. Reference waveform No.14

No.1 fuel injector signal at engine idling

Measurement terminal	CH1: E22-10 to E23-1 CH2: E22-7 to E23-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 20 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

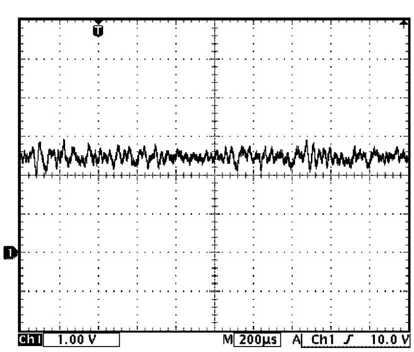
1. Cylinder reference signal (CMP reference signal)
2. No.1 fuel injector signal



15. Reference waveform No.15

Knock sensor signal at engine speed 4000 r/min.

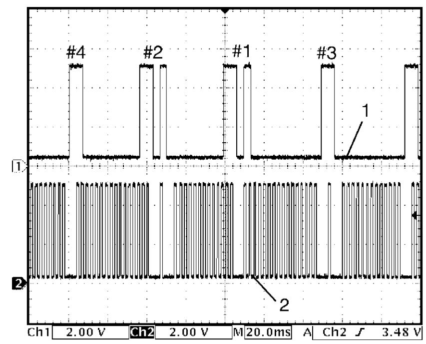
Measurement terminal	CH1: E22-9 to E23-1
Oscilloscope setting	CH1: 1 V/DIV TIME: 10 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Run engine at 4000 r/min.



16. Reference waveform No.16

Knock sensor signal at engine speed 4000 r/min.

Measurement terminal	CH1: E22-9 to E23-1
Oscilloscope setting	CH1: 1 V/DIV TIME: 200 µs/DIV
Measurement condition	• After warmed up to normal operating temperature • Run engine at 4000 r/min.

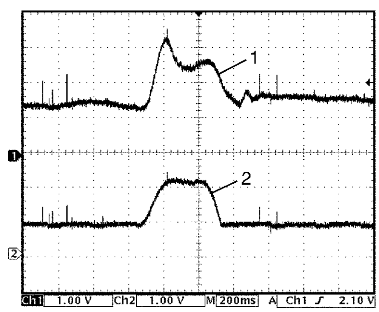


17. Reference waveform No.17

CMP sensor signal at engine idling

Measurement terminal	CH1: E22-10 to E23-1 CH2: E22-30 to E23-1
Oscilloscope setting	CH1: 2 V/DIV, CH2: 2 V/DIV TIME: 20 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1.	Cylinder reference signal (CMP reference signal)
2.	CKP signal

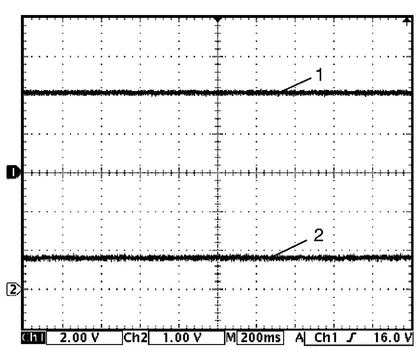


18. Reference waveform No.18

Mass air flow sensor signal at engine racing

Measurement terminal	CH1: E22-14 to E22-28 CH2: E22-34 to E22-28
Oscilloscope setting	CH1: 1 V/DIV, CH2: 1 V/DIV TIME: 200 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine racing

1.	Mass air flow sensor signal
2.	Throttle position sensor signal

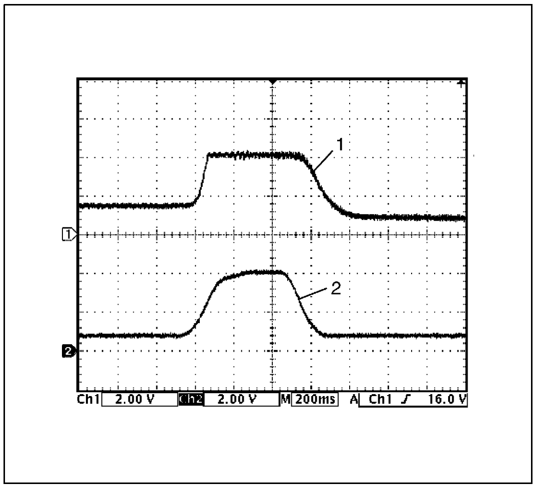


19. Reference waveform No.19

Manifold absolute pressure sensor signal at ignition switch turned ON

Measurement terminal	CH1: E22-15 to E22-28 CH2: E22-34 to E22-28
Oscilloscope setting	CH1: 2 V/DIV, CH2: 2 V/DIV TIME: 200 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Ignition switch turned ON

1.	Manifold absolute pressure sensor signal
2.	Throttle position sensor signal

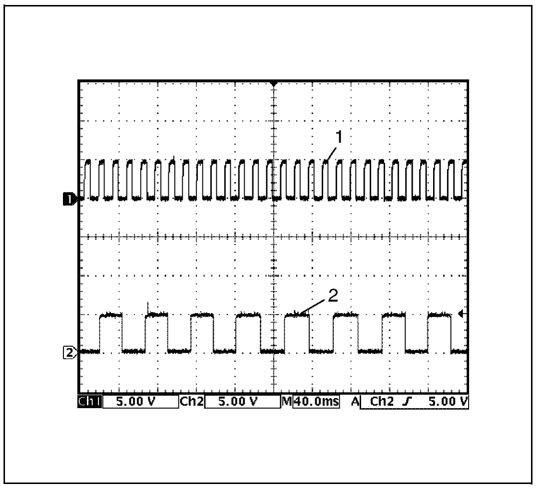


20. Reference waveform No.20

Manifold absolute pressure sensor signal at engine racing

Measurement terminal	CH1: E22-15 to E22-28 CH2: E22-34 to E22-28
Oscilloscope setting	CH1: 2 V/DIV, CH2: 2 V/DIV TIME: 200 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine racing

1.	Manifold absolute pressure sensor signal
2.	Throttle position sensor signal

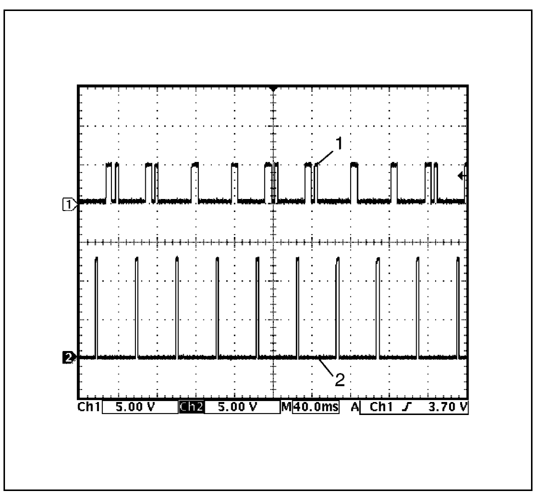


21. Reference waveform No.21

VSS signal at 30 km/h (19 mil/h)

Measurement terminal	CH1: E21-31 to E23-1 CH2: E22-19 to E23-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 5 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Drive vehicle at 30 km/h (19 mil/h)

1.	VSS signal for speedometer
2.	VSS signal

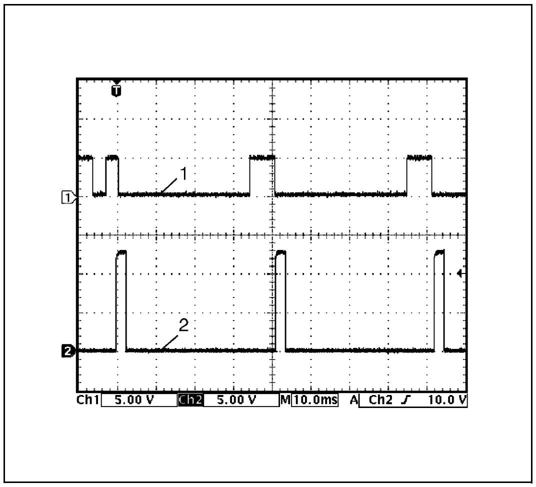


22. Reference waveform No.22

Ignition pulse (engine revolution) signal at engine idling

Measurement terminal	CH1: E22-10 to E23-1 CH2: E21-12 to E23-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 5 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1.	Cylinder reference signal (CMP reference signal)
2.	Ignition pulse signal

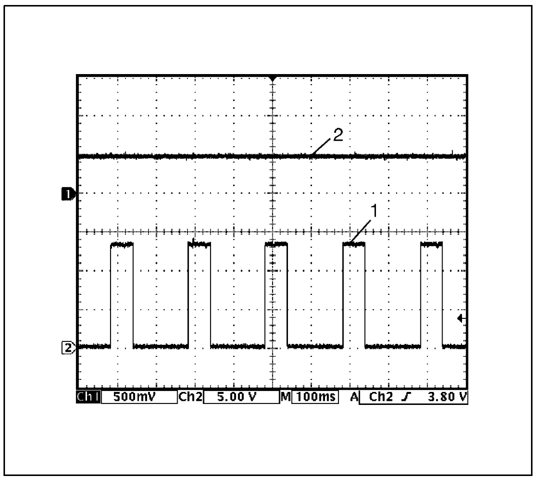


23. Reference waveform No.23

Ignition pulse (engine revolution) signal at engine idling

Measurement terminal	CH1: E22-10 to E23-1 CH2: E21-12 to E23-1
Oscilloscope setting	CH1: 5 V/DIV, CH2: 5 V/DIV TIME: 10 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1.	Cylinder reference signal (CMP reference signal)
2.	Ignition pulse signal

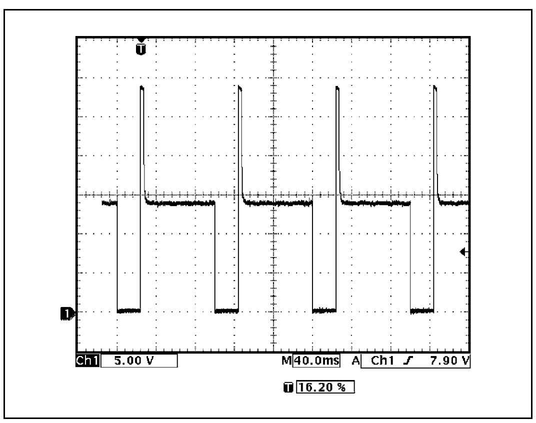


24. Reference waveform No.24

Engine coolant temperature signal at engine idling

Measurement terminal	CH1: E22-16 to E22-28 CH2: E21-32 to E23-1
Oscilloscope setting	CH1: 500 mV/DIV, CH2: 5 V/DIV TIME: 100 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed

1.	Engine coolant temperature signal for combination meter
2.	Engine coolant temperature sensor signal

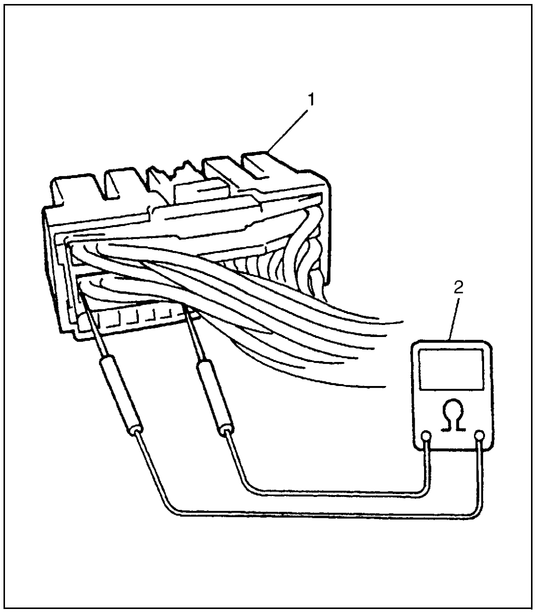


25. Reference waveform No.25

EVAP canister purge valve signal

Measurement terminal	CH1: E23-13 to E23-1
Oscilloscope setting	CH1: 5 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Drive vehicle at 40 km/h (25 mil/h) or more

Resistance Check



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

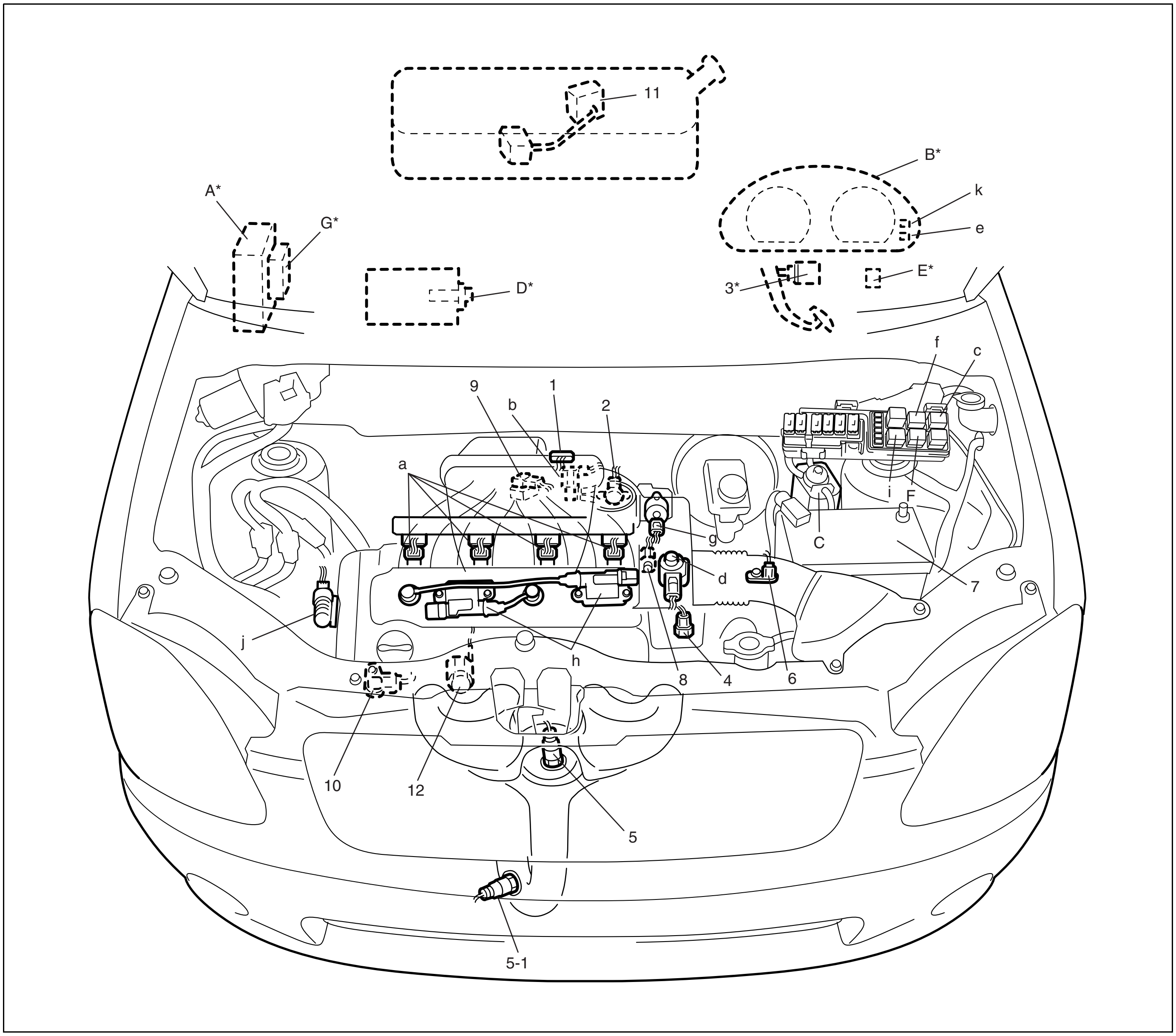
CAUTION:
Never touch terminals of ECM itself or connect voltmeter or ohmmeter (2).

2) Check resistance between each pair of terminals of disconnected couplers as listed in the 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).**

TERMINALS	CIRCUIT	STANDARD RESISTANCE	CONDITION
E23-3 to E21-28	Heater of HO2S–2	4 – 15 Ω	–
E21-4 to E21-5/6	Radiator fan relay	160 – 240 Ω	–
E23-15 to E21-28	Main relay	160 – 240 Ω	Battery disconnected and ignition switch ON
E23-14 to E21-28	Fuel pump relay	160 – 240 Ω	–
E23-5 to E21-5/6	A/C condenser fan relay No.2 (if equipped)	100 – 150 Ω	–
E22-5 to E21-5/6	No.3 fuel injector	10.8 – 18.2 Ω	–
E22-4 to E21-5/6	No.4 fuel injector		
E23-17 to E21-5/6	EGR valve (stepping motor No.1 coil)	20 – 29 Ω	–
E23-13 to E21-5/6	EVAP canister purge valve	28 – 35 Ω	–
E22-6 to E21-5/6	No.2 fuel injector	10.8 – 18.2 Ω	–
E23-34 to E21-5/6	EGR valve (stepping motor No.2 coil)	20 – 31 Ω	–
E23-33 to E21-5/6	EGR valve (stepping motor No.4 coil)		
E23-16 to E21-5/6	EGR valve (stepping motor No.3 coil)		
E23-4 to E21-28	Heater of HO2S–1	2 – 11 Ω	–
E22-7 to E21-5/6	No.1 fuel injector	10.8 – 18.2 Ω	–
E23-8 to E21-5/6	Idle air control valve	24 – 35 Ω	–
E23-11 to E21-5/6	A/C compressor relay (if equipped)	160 – 240 Ω	–
E22-2 to E22-3	Oil control valve	6 – 15 Ω	–

Component Location



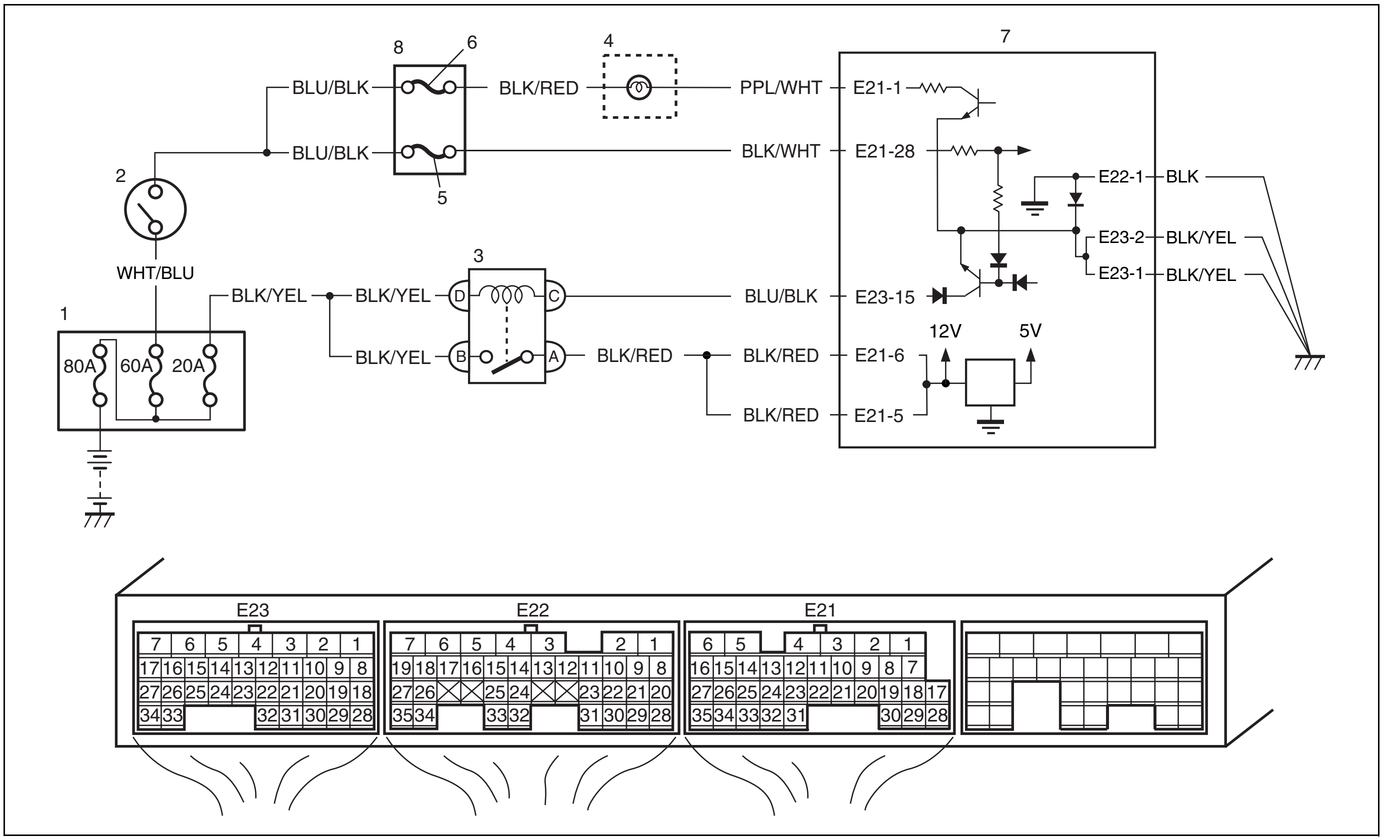
	INFORMATION SENSORS		CONTROL DEVICES		OTHERS
1.	MAF and IAT sensor	a:	Fuel injector	A:	ECM
2.	TP sensor	b:	EVAP canister purge valve	B:	Combination meter
3.	Stop lamp switch	c:	Fuel pump relay	C:	EVAP canister
4.	ECT sensor	d:	EGR valve	D:	A/C evaporator inlet air temp. sensor (if equipped)
5.	Heated oxygen sensor–1	e:	Malfunction indicator lamp	E:	Data link connector
5-1.	Heated oxygen sensor–2	f:	Radiator fan control relay	F:	A/C compressor relay (if equipped)
6.	VSS	g:	IAC valve	G:	TCM (A/T)
7.	Battery	h:	Ignition coil assembly (with ignitor)		
8.	CMP sensor	i:	Main relay		
9.	MAP sensor	j:	Oil control valve		
10.	CKP sensor	k:	Immobilizer indicator lamp		
11.	Fuel level sensor				
12.	Knock sensor				

NOTE:

Above figure shows left-hand steering vehicle. For right-hand steering vehicle, parts with (*) are installed at the opposite side.

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

Wiring Diagram



1. Relay box	4. Malfunction indicator lamp in combination meter	7. ECM
2. Ignition switch	5. "IG COIL" fuse	8. Circuit fuse box
3. Main relay	6. "METER" fuse	

Circuit Description

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

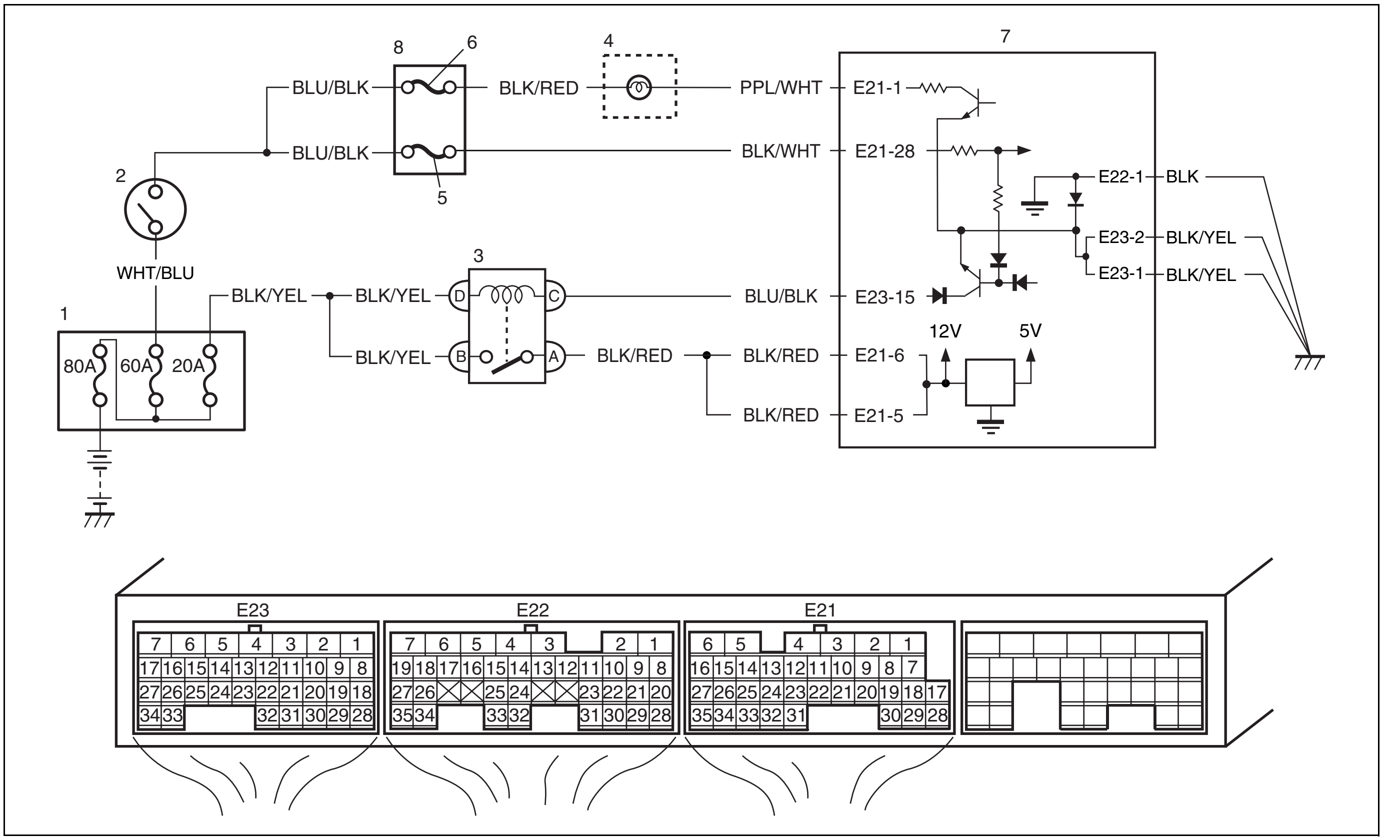
Troubleshooting

Step	Action	Yes	No
1	MIL Power Supply Check 1) Turn ignition switch to ON position. Do other warning lights come ON?	Go to Step 4.	Go to Step 2.
2	METER Fuse Check 1) Turn ignition switch to OFF position. 2) Check for fuse blow at "METER" fuse. Is "METER" fuse in good condition?	Go to Step 3.	Replace "METER" fuse and check for short.

Step	Action	Yes	No
3	MIL Power Supply Check 1) Disconnect ignition switch connector. 2) Remove “METER” fuse. 3) Measure resistance between “BLU/BLK” wire terminal of ignition switch connector and “BLU/BLK” wire terminal of “METER” fuse connector. Is resistance 1Ω or less?	Go to Step 4.	“BLU/BLK” wire circuit open or poor connection.
4	MIL Power Supply Check 1) Connect ignition switch connector. 2) Install “METER” fuse. 3) Remove combination meter referring to “Combination Meter Removal and Installation” in Section 8. 4) Check for proper connection to combination meter connector at “BLK/RED” wire and “PPL/WHT” wire terminals. 5) If OK, then turn ignition switch to ON position and measure voltage between combination meter connector at “BLK/RED” wire terminal and body ground. Is it 10 – 14 V?	Go to Step 5.	“BLK/RED” wire circuit open.
5	MIL Circuit Check 1) Turn ignition switch OFF position. 2) Disconnect ECM connector “E21”. 3) Check for proper connection to ECM connector at “E21-1” wire terminal. 4) Measure resistance between “PPL/WHT” wire terminal of combination meter connector and “E21-1” wire terminal of ECM connector. Is resistance 1 Ω or less?	Go to Step 6.	“PPL/WHT” wire circuit open.
6	MIL Circuit Check 1) Connect combination meter connectors. 2) Turn ignition switch to ON position. 3) Using service wire, ground “E21-1” terminal wire of disconnected ECM connector. Does MIL turn ON?	Substitute a known-good ECM and recheck.	Replace bulb.

Table A-2 Malfunction Indicator Lamp Circuit Check-lamp Remains "ON" after Engine Starts

Wiring Diagram



1. Relay box	4. Malfunction indicator lamp in combination meter	7. ECM
2. Ignition switch	5. "IG COIL" fuse	8. Circuit fuse box
3. Main relay	6. "METER" fuse	

Circuit Description

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

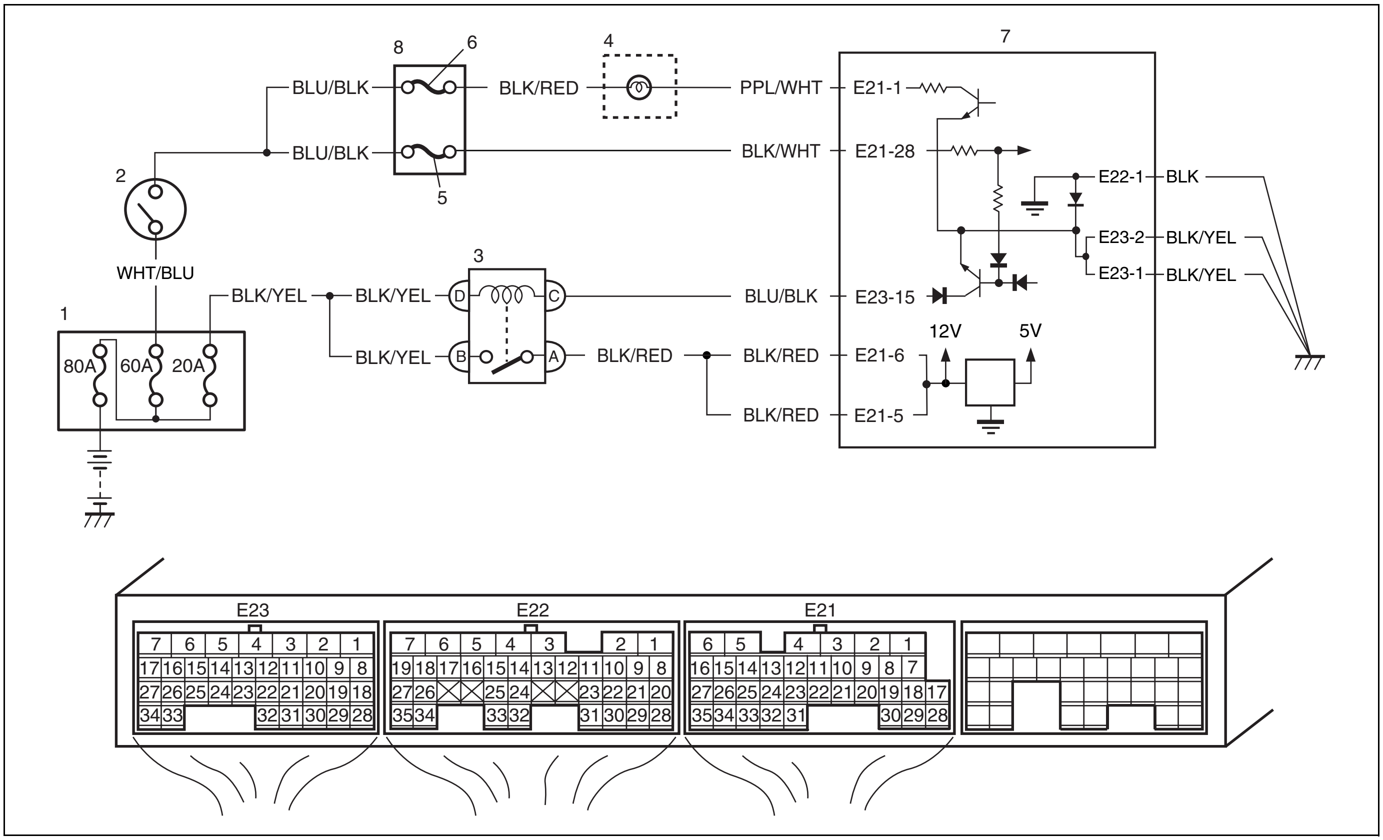
Troubleshooting

Step	Action	Yes	No
1	DTC Check 1) Start engine and recheck DTC while engine running. Is there any DTC(s)?	Go to Step 2 of "Engine and Emission Control System Check" in this section.	Go to Step 2.

Step	Action	Yes	No
2	MIL Circuit Check 1) Turn ignition switch to OFF position. 2) Remove combination meter referring to “Combination Meter Removal and Installation” in Section8. 3) Disconnect connectors from ECM. 4) Measure resistance between “PPL/WHT” wire terminal of combination meter connector and body ground. Is resistance infinity?	Go to Step 3.	“PPL/WHT” wire circuit shorted to ground.
3	MIL Circuit Check 1) Connect connectors to combination meter. Does MIL turn ON at ignition switch turned ON?	Replace combination meter.	Substitute a known-good ECM and recheck.

Table A-3 ECM Power and Ground Circuit Check-MIL Doesn't Light with Ignition Switch ON and Engine Doesn't Start Though It Is Cranked Up

Wiring Diagram



1. Relay box	4. Malfunction indicator lamp in combination meter	7. ECM
2. Ignition switch	5. "IG COIL" fuse	8. Circuit fuse box
3. Main relay	6. "METER" fuse	

Circuit Description

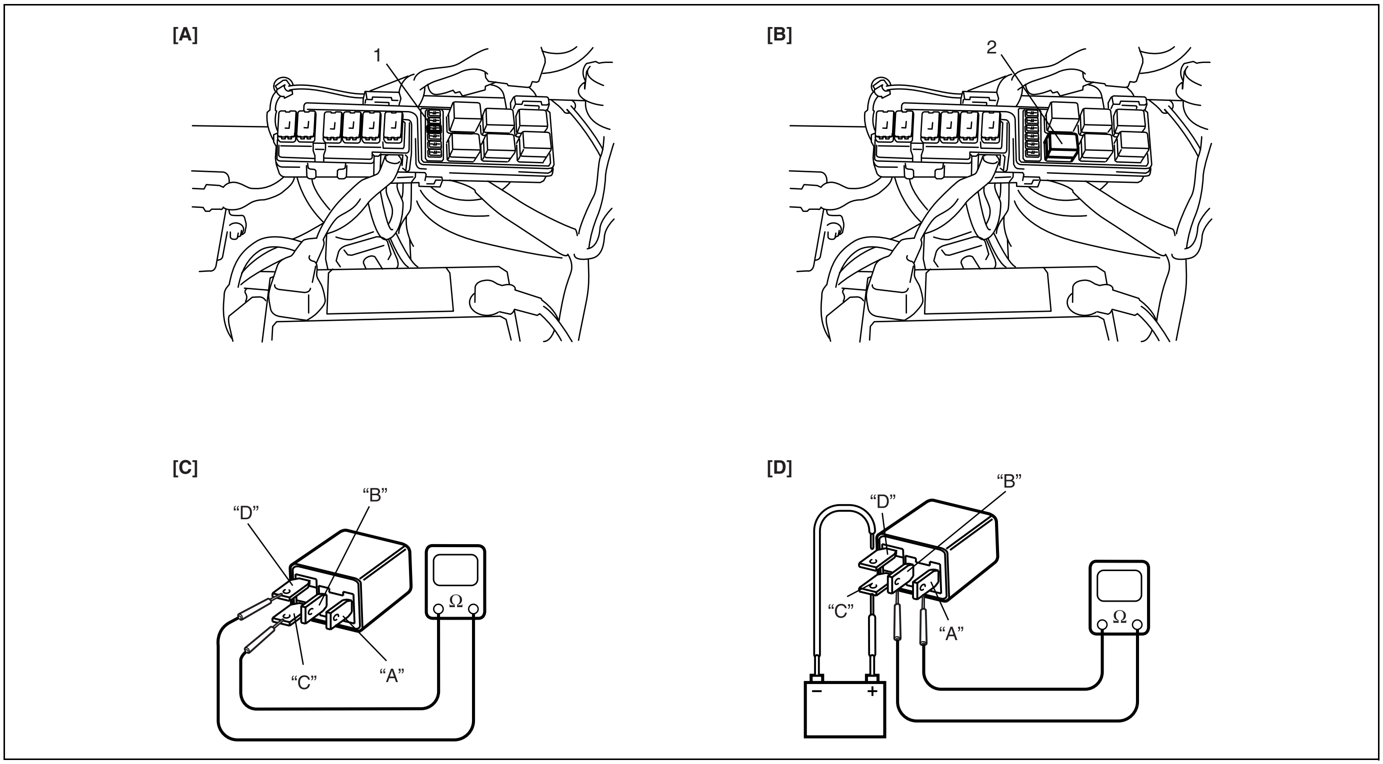
When the ignition switch tuned ON, the main relay turns ON (the contact point closes) and the main power is supplied to ECM.

Troubleshooting

Step	Action	Yes	No
1	IG COIL Fuse Check 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Check for proper connection to ECM connector at "E21-1", "E21-28", "E23-15", "E21-6", "E21-5", "E22-1", "E23-1" and "E23-2" wire terminals. 3) If OK, check "IG COIL" fuse for fuse blow. Is "IG COIL" fuse in good condition?	Go to Step 2.	Replace fuse and check for short in circuits connected to this fuse.
2	Ignition Signal Check 1) Turn ignition switch to ON position. 2) Measure voltage between "E21-28" wire terminal of ECM connector and body ground. Is voltage 10 – 14 V?	Go to Step 3.	"BLK/WHT" or "BLU/BLK" wire circuit open.

Step	Action	Yes	No
3	Main Relay Circuit Check 1) Turn ignition switch to OFF position. 2) Check for fuse blow at FI fuse (20 A). (See Fig. 1.) 3) If OK, measure voltage between "E23-15" wire terminal of ECM connector and body ground. Is voltage 10 – 14 V?	Go to Step 4.	Go to Step 8.
4	Main Relay Circuit Check 1) Remove ECM from vehicle body and connect connectors to ECM. 2) Turn ignition switch to ON position. 3) Measure voltage between "E23-15" wire terminal of ECM connector and body ground. Is voltage 0 – 1 V?	Go to Step 6.	Go to Step 5.
5	ECM Ground Circuit Check 1) Turn ignition switch to OFF position. 2) Disconnect connectors from ECM. 3) Measure resistance between each "E22-1", "E23-1" and "E23-2" wire terminals of ECM connector and body ground. Is resistance 1 Ω or less?	Substitute a known-good ECM and recheck.	"BLK/YEL" or "BLK" wire open circuit or high resistance circuit.
6	Main Relay Circuit Check 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Using service wire, ground "E23-15" wire terminal of ECM connector and measure voltage between each "E21-5" and "E21-6" wire terminals of ECM connector and body ground. Is voltage 10 – 14 V?	Substitute a known-good ECM and recheck.	Go to Step 7.
7	Main Relay Circuit Check 1) Remove main relay from relay box. (See Fig. 2.) 2) Check for proper connection to main relay connector at "BLK/YEL" and "BLK/RED" wire terminals. 3) If OK, measure resistance between each "E21-5" and "E21-6" wire terminals of ECM connector and "BLK/RED" wire terminal of main relay connector. Is resistance 1Ω or less?	Go to Step 8.	"BLK/RED" wire open circuit or high resistance circuit.
8	Main Relay Circuit Check 1) Remove main relay from relay box. 2) Measure voltage between "BLK/YEL" wire terminals of main relay connector and body ground. Is voltage 10 – 14 V?	Go to Step 9.	"BLK/YEL" wire circuit open.

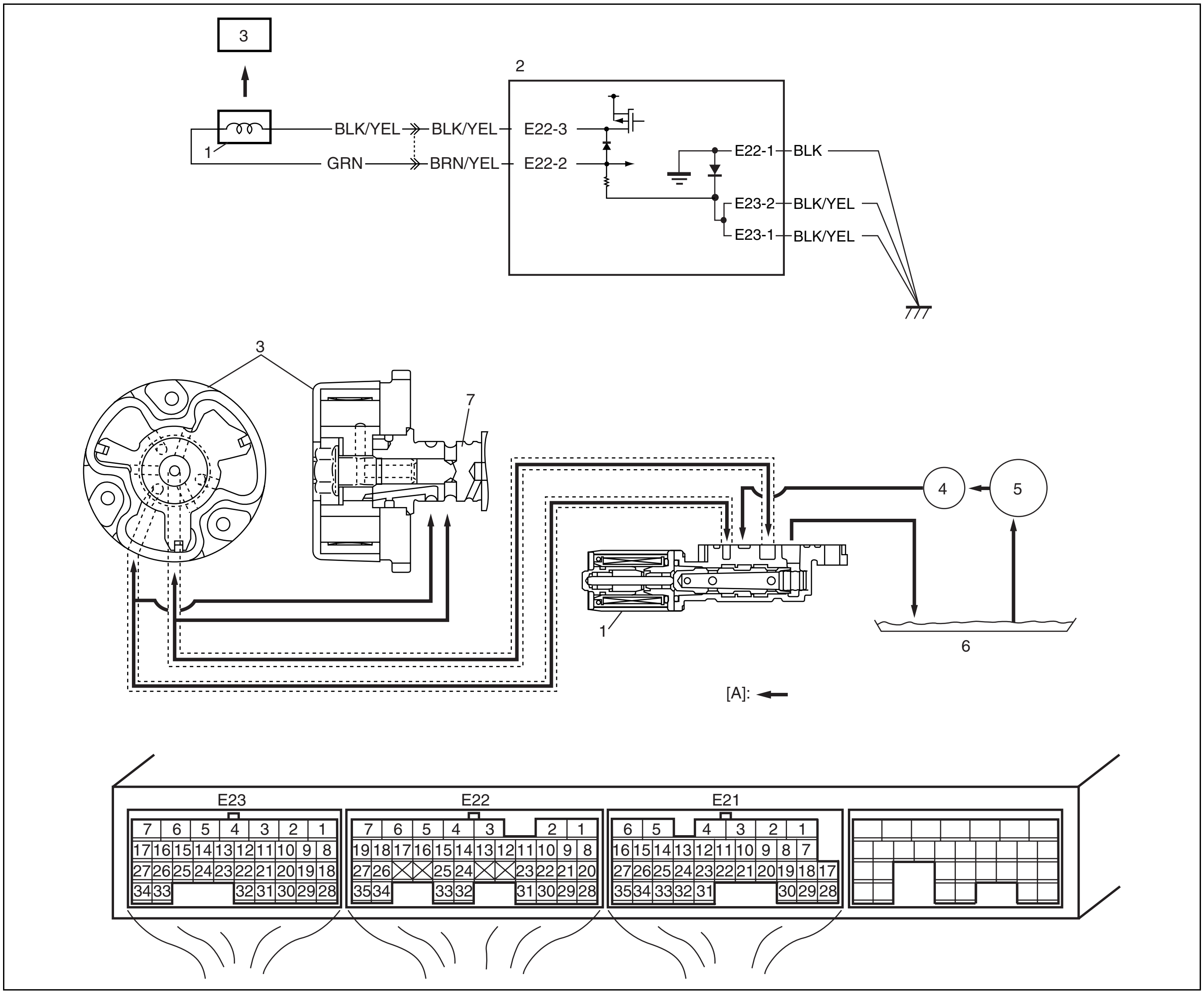
Step	Action	Yes	No
9	Main Relay Check 1) Measure resistance between each two terminals of main relay. (See Fig. 3). Between main relay terminals "A" and "B": Infinity "C" and "D": 160 – 240 Ω at 20°C (68°F) 2) Check that there is continuity between terminals "A" and "B" when battery is connected to terminals "C" and "D" (See Fig. 4). Is main relay in good condition?	"BLU/BLK" wire open circuit or high resistance circuit.	Replace main relay.



[A]: Fig. 1 for Step 3	[C]: Fig. 3 for Step 9	1. FI fuse (20 A)
[B]: Fig. 2 for Step 7	[D]: Fig. 4 for Step 9	2. Main relay

DTC P0010 Camshaft Position Actuator Circuit

Wiring Diagram



[A]: Oil flow	3. Camshaft timing sprocket	6. Oil pan
1. Oil control valve	4. Oil filter	7. Intake camshaft
2. ECM	5. Oil pump	

Circuit Description

Actual valve timing fails to become close to target advance level of each function although advance control function or retarded advance control function is at work.

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Monitor signal of oil control valve is different from command signal. (Circuit open or short) (1 driving cycle detection logic)	• Oil control valve • Oil control valve circuit • ECM

DTC Confirmation Procedure

1) Clear DTC. Refer to “DTC Clearance”.
2) Start engine and keep it at idle for 10 seconds.
3) Check DTC. Refer “DTC Check”.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Check oil control valve power supply circuit. 1) Disconnect connectors from oil control valve with ignition switch turned OFF. 2) Connect oscilloscope between “E22-3” terminal of ECM connector and engine ground with ignition switch turned ON. 3) Check waveform of oil control valve referring to “Inspection of ECM and Its Circuits” in this section. Is it in good condition?	Go to Step 3.	Go to Step 8.
3	Check wire circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure voltage between “E22-3” terminal of ECM connector and vehicle body ground. Is voltage 0 – 1 V?	Go to Step 4.	“BLK/YEL” wire shorted to power supply circuit.
4	Check wire circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Check for proper connection to “E22-2” and “E22-3” terminals of ECM connector 3) If OK, measure resistance between “E22-2” terminal of ECM connector and vehicle body ground. Is resistance infinity?	Go to Step 5.	“GRN” or “BRN/YEL” wire shorted to ground circuit.
5	Check wire circuit 1) Measure voltage between “E22-2” terminal of ECM connector and engine ground with ignition switch turned ON. Is voltage 0 – 1 V?	Go to Step 6	“GRN” or “BRN/YEL” wire shorted to power supply circuit.
6	Check wire circuit 1) Turn ignition switch to OFF position. 2) Measure resistance between “E22-2” terminal of ECM connector and “GRN” wire terminal of oil control valve connector. Is resistance 1 Ω or less?	Go to Step 7.	“GRN” or “BRN/YEL” wire open or high resistance circuit.
7	Check oil control valve. 1) Check oil control valve referring to “Oil Control Valve Inspection” in Section 6E2. Is it in good condition?	Substitute a know-good ECM and recheck.	Replace oil control valve.

Step	Action	Yes	No
8	Check wire circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “E22-3” terminal of ECM connector and “BLK/YEL” wire terminal of oil control valve connector. Is resistance 1 Ω or less?	Go to Step 9.	“BLK/YEL” wire open or high resistance circuit.
9	Check wire circuit. 1) Measure resistance between “E22-3” terminal of ECM connector and vehicle body ground. Is resistance infinity?	Substitute a know-good ECM and recheck.	“BLK/YEL” wire shorted to ground circuit.

DTC P0011 Camshaft Position – Timing Over-Advanced or System Performance

DTC P0012 Camshaft Position – Timing Over-Retarded

Description

Actual value of advanced valve timing does not reach target value.
Valve timing is advanced although ECM command is most retarding.

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Actual valve of advanced valve timing does not reach target value, or valve timing is advanced although ECM command is most retarding. (2 driving cycle detection logic)	• Oil control valve • Oil galleries of timing sprocket • Intake camshaft timing sprocket (VVT actuator)

DTC Confirmation Procedure

1) Clear DTC. Refer to “DTC Clearance”
2) Start engine and drive vehicle under usual driving condition for 5 minutes or longer until engine is warmed up to normal operating temperature.
3) Stop vehicle.
4) Run engine at idle speed for 1 minute.
5) Start vehicle and increase vehicle speed up to 80 km/h (50 mile/h).
6) Keep vehicle speed at 80 km/h (50 mile/h) for 1 minute or longer at 5th gear position or D range.
7) Decrease vehicle speed gradually.
8) Stop vehicle and ignition switch OFF.
9) Repeat step 4) to 7) one time.
10) Stop vehicle.

Check DTC. Refer to “DTC Check” in this section.

Troubleshooting

Step	Action	Yes	No
1	Is DTC P0010 detected together?	Go to “DTC P0010 Camshaft Position Actuator Circuit” in this section.	Go to Step 2.
2	Do you have SUZUKI scan tool?	Go to Step 3.	Go to Step 5.
3	VVT GAP Check 1) With ignition switch turned OFF, connect SUZUKI scan tool. 2) Start engine and warm up to normal operating temperature. 3) Select menu to DATA LIST. 4) Check that the VVT GAP displayed on SUZUKI scan tool is 0 – 5°. Is it OK?	Go to Step 4.	Check valve timing referring to “2nd Timing Chain and Chain Tensioner Removal and Installation” in Section 6A1. If OK, go to Step 5.

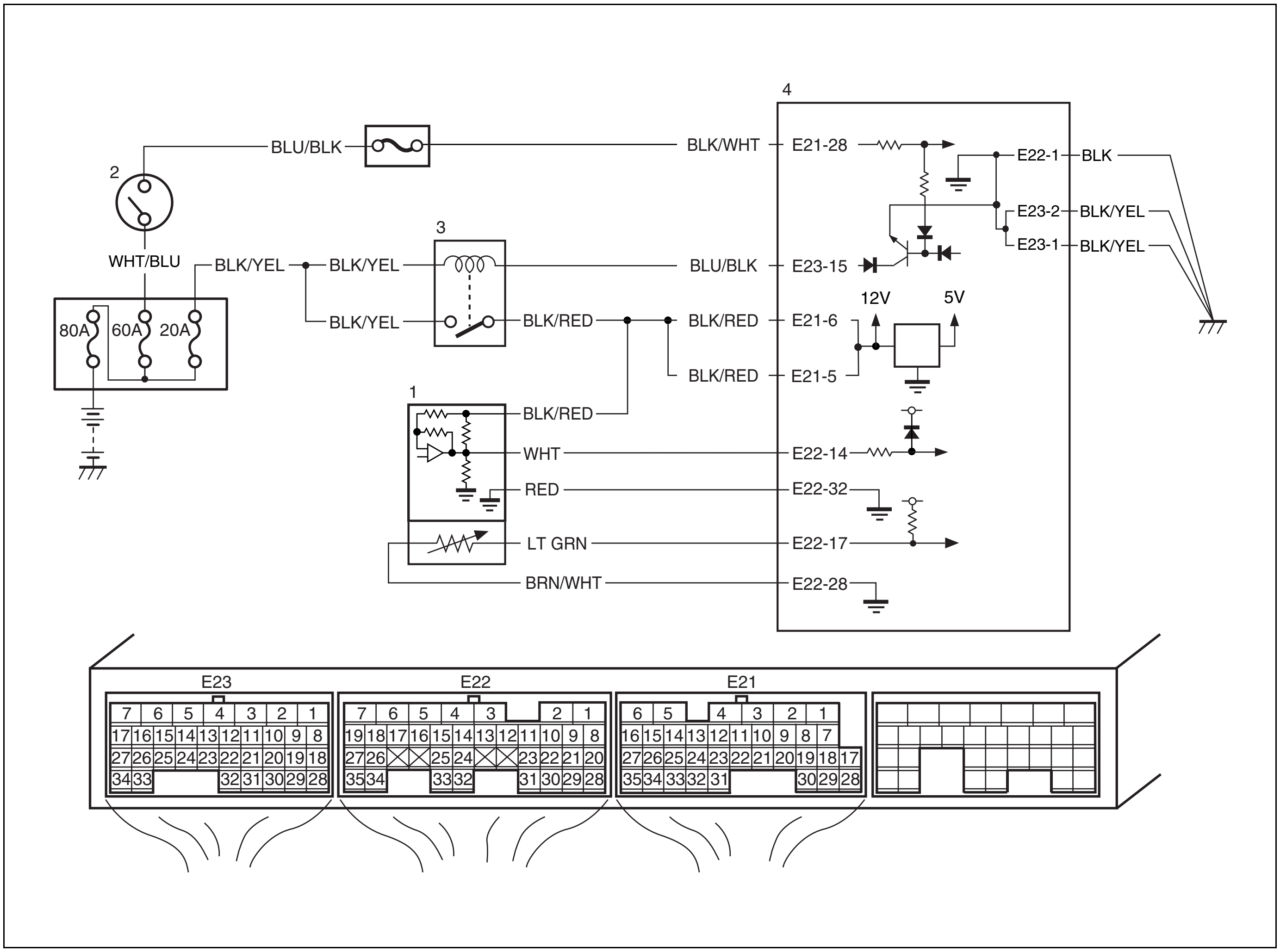
Step	Action	Yes	No
4	VVT Signal Check 1) Drive vehicle the following condition. • Vehicle speed at 80 km/h (50 mile/h). • Gear position at 5th or D range. 2) Check that the VVT GAP displayed on SUZUKI scan tool is 0 – 5°. Is it OK?	Substitute a known-good ECM and recheck.	Go to Step 5.
5	Oil Control Circuit Visual Inspection 1) Remove cylinder head cover referring to "Cylinder Head Cover Removal and Installation" in Section 6A1. 2) Check oil pressure leakage from oil control circuit. Is it in good condition?	Go to Step 6.	Repair or replace.
6	Check Oil Control Circuit. 1) Remove oil control valve referring to "Oil Control Valve Removal and Installation" in Section 6A1. 2) Remove oil gallery pipe referring to "Oil Gallery Pipe Removal and Installation" in Section 6A1. 3) Check oil gallery pipe and oil control valve for clog or sludge. Is it in good condition?	Go to Step 7.	Clean oil control valve and oil gallery pipe. Replace oil control valve if a problem is not solved after cleaning oil control valve and oil gallery pipe.
7	Check Oil Control Valve 1) Check oil control valve referring to "Oil Control Valve Inspection" in Section 6E1. Is it in good condition?	Replace camshaft timing sprocket.	Replace oil control valve.

NOTE:

Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.

DTC P0102 Mass Air Flow Circuit Low Input

Wiring Diagram



1. MAF and IAT sensor	3. Main relay
2. Ignition switch	4. ECM

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC will be set when all of the following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of MAF sensor output is less than the specified value for the specified time continuously.	• Open or short in MAF sensor circuit • MAF sensor • ECM

DTC Confirmation Procedure

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and run it for 10 sec.
4) Check DTC and pending DTC.

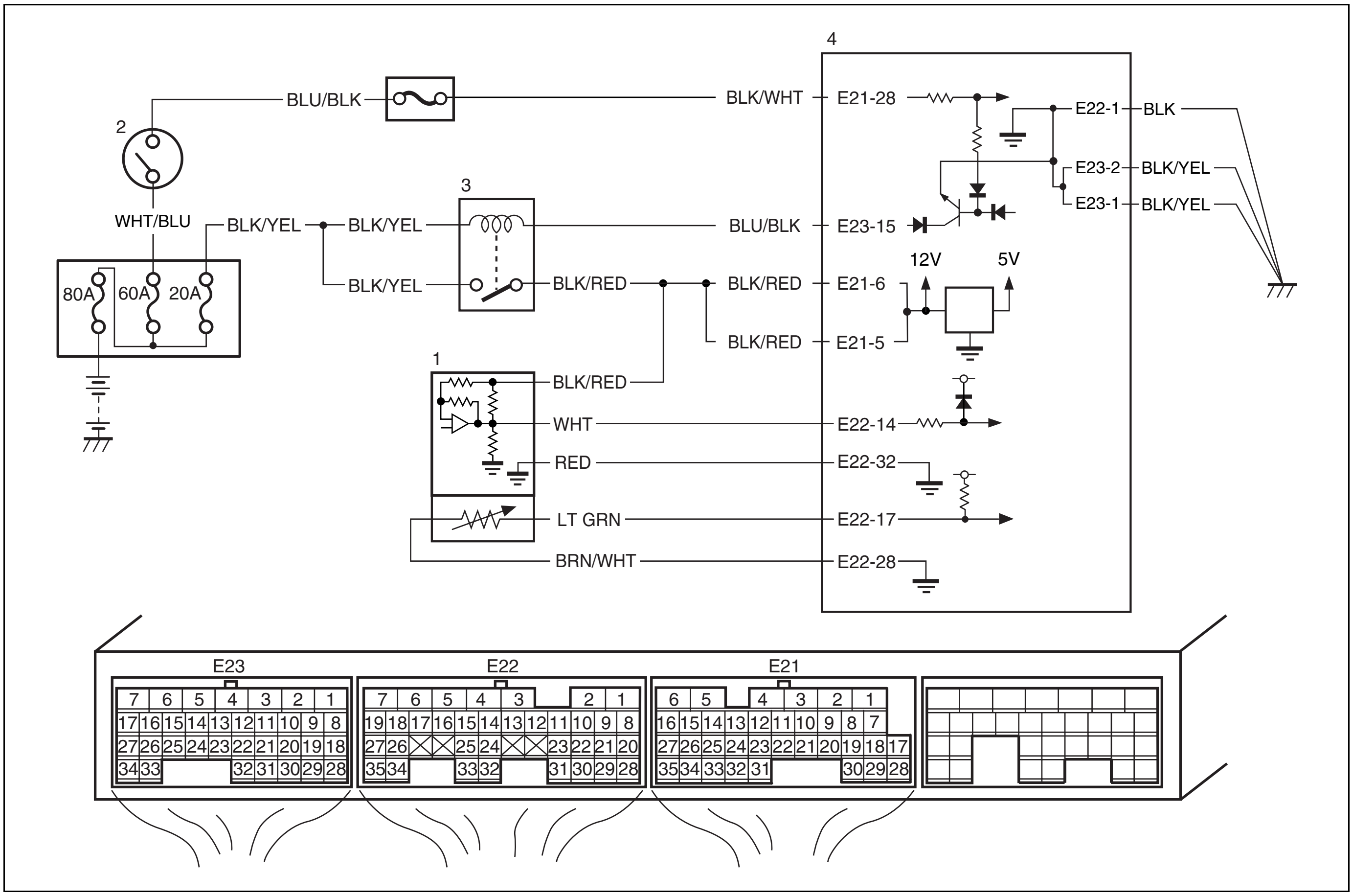
Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	MAF Sensor Check. 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Start engine and check MAF value displayed on scan tool. (Refer to “Scan Tool Data” in this section for normal value.) Is normal value indicated?	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 3.
3	Check MAF sensor power supply voltage. 1) Disconnect connector from MAF sensor with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between engine ground and “BLK/RED” wire terminal of MAF sensor connector. Is voltage 10 – 14 V?	Go to Step 4.	“BLK/RED” wire in open circuit.
4	Check MAF sensor ground circuit. 1) Measure resistance between “RED” wire terminal of MAF sensor connector and engine ground. Is resistance below 5 Ω?	Go to Step 6.	Go to Step 5.
5	Check ground circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and connect connectors to ECM. 3) Measure resistance between “E22-32” terminal of ECM connector and vehicle body ground. Is resistance below 5 Ω?	“RED” wire in open or high resistance circuit.	ECM grounds “E22-1”, “E23-1” and/or “E23-2” circuit open or high resistance. If wires are OK, substitute a known-good ECM and recheck.
6	Check MAF sensor signal circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure voltage between “WHT” wire terminal of MAF sensor connector and engine ground with ignition switch turned ON. Is voltage 0 V?	Go to Step 7.	“WHT” wire shorted to other circuit.
7	Check MAF sensor signal circuit. 1) Measure resistance between “WHT” wire terminal of MAF sensor connector and vehicle body ground with ignition switch turned OFF. Is resistance infinity?	Go to Step 8.	“WHT” wire shorted to ground circuit.
8	Check MAF sensor signal circuit. 1) Measure resistance between “WHT” wire terminal of MAF sensor connector and “E22-14” terminal of ECM connector. Is resistance below 3 Ω?	Go to Step 9.	“WHT” wire in open or high resistance circuit.

Step	Action	Yes	No
9	Check MAF sensor output signal. 1) Connect connectors to MAF sensor and ECM with ignition switch turned OFF. 2) Check voltage between “E22-14” and “E22-32” under the following condition. **Voltage between “E22-14” and “E22-32” of ECM connector at ignition switch ON, leaving engine stop: 0.5 – 1.2 V** **Idling: 1.0 – 1.8 V** Is each value as specified?	Substitute a known-good ECM and recheck.	Faulty MAF and IAT sensor.

DTC P0103 Mass Air Flow Circuit High Input

Wiring Diagram



1. MAF and IAT sensor	3. Main relay
2. Ignition switch	4. ECM

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC will be set when all of the following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of MAF sensor output is more than the specified value for the specified time continuously.	• Open or short in MAF sensor circuit • MAF sensor • ECM

DTC Confirmation Procedure

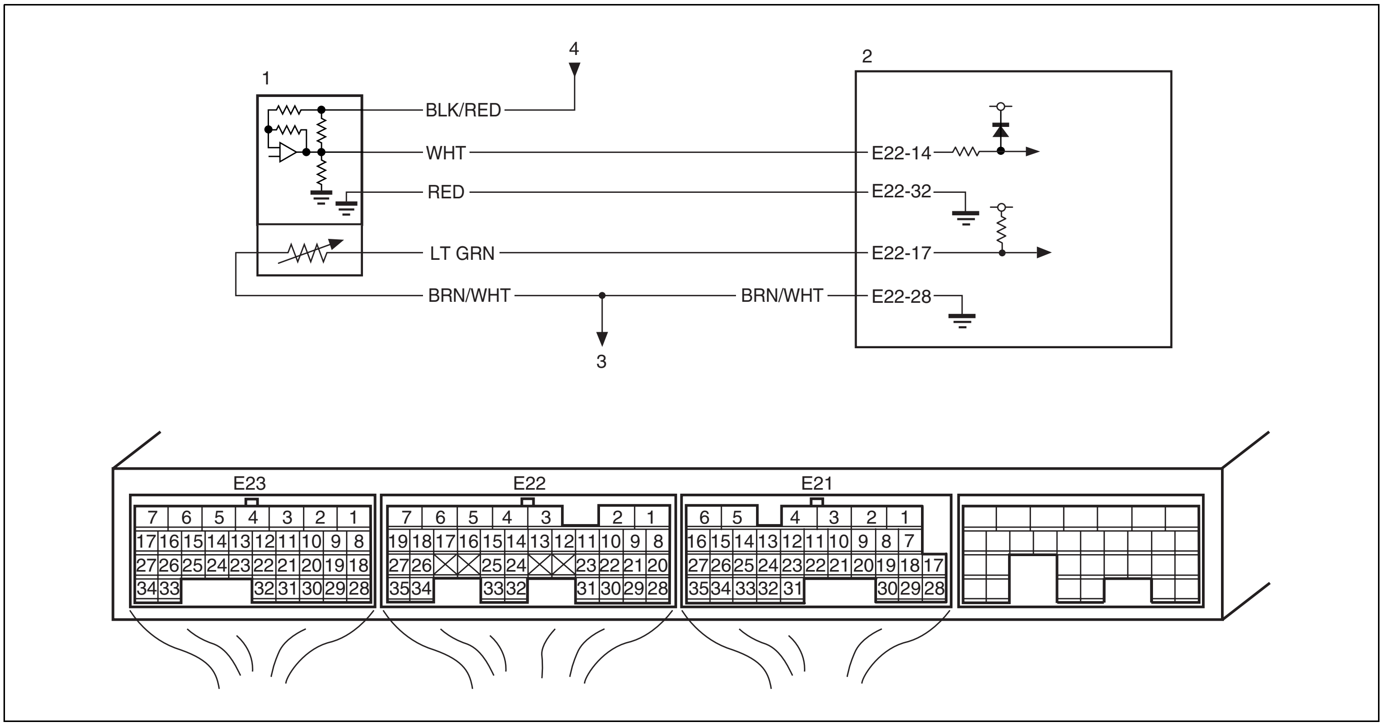
1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and run it for 10 sec.
4) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	MAF sensor check. 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Start engine and check MAF value displayed on scan tool. (Refer to “Scan Tool Data” in this section for normal value.) Is normal value indicated?	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 3.
3	Check MAF sensor power supply voltage. 1) Disconnect connector from MAF sensor with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between engine ground and “BLK/RED” wire terminal of MAF sensor connector. Is voltage 10 – 14 V?	Go to Step 4.	“BLK/RED” wire in open circuit.
4	Check MAF sensor ground circuit. 1) Measure resistance between “RED” wire terminal of MAF sensor connector and engine ground. Is resistance below 5 Ω?	Go to Step 6.	Go to Step 5.
5	Check ground circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and connect connectors to ECM. 3) Measure resistance between “E22-32” terminal of ECM connector and vehicle body ground. Is resistance below 5 Ω?	“RED” wire in open or high resistance circuit.	ECM grounds “E22-1”, “E23-1” and/or “E23-2” circuit in open or high resistance. If wires are OK, substitute a known-good ECM and recheck.
6	Check MAF sensor signal circuit. 1) Disconnect connectors from MAF sensor and ECM with ignition switch turned OFF. 2) Measure voltage between “WHT” wire terminal of MAF sensor connector and engine ground. Is voltage 0 V?	Go to Step 7.	“WHT” wire shorted to others circuit.
7	Check MAF sensor output signal 1) Connect connector to MAF sensor with ignition switch turned OFF. 2) Check voltage between “E22-14” and “E22-32” under the following condition. **Voltage between “E22-14” and “E22-32” of ECM connector at ignition switch ON, leaving engine OFF: 0.5 – 1.0 V** **Idling: 1.0 – 1.8 V** Is each value as specified?	Substitute a known-good ECM and recheck.	Faulty MAF and IAT sensor.

DTC P0112 Intake Air Temperature Sensor Circuit Low

Wiring Diagram



1. MAF and IAT sensor	3. To other sensor
2. ECM	4. From main relay

DTC Detecting Condition and Trouble Area

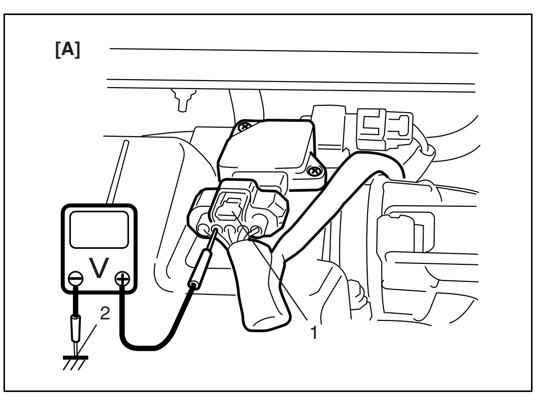
DTC Detecting Condition	Trouble Area
DTC will be set when all of the following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of IAT sensor output is less than the specified value (High intake air temperature (low voltage/low resistance))	• IAT sensor circuit • IAT sensor • ECM

DTC Confirmation Procedure

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and run it for 10 sec.
4) Check DTC and pending DTC.

Troubleshooting

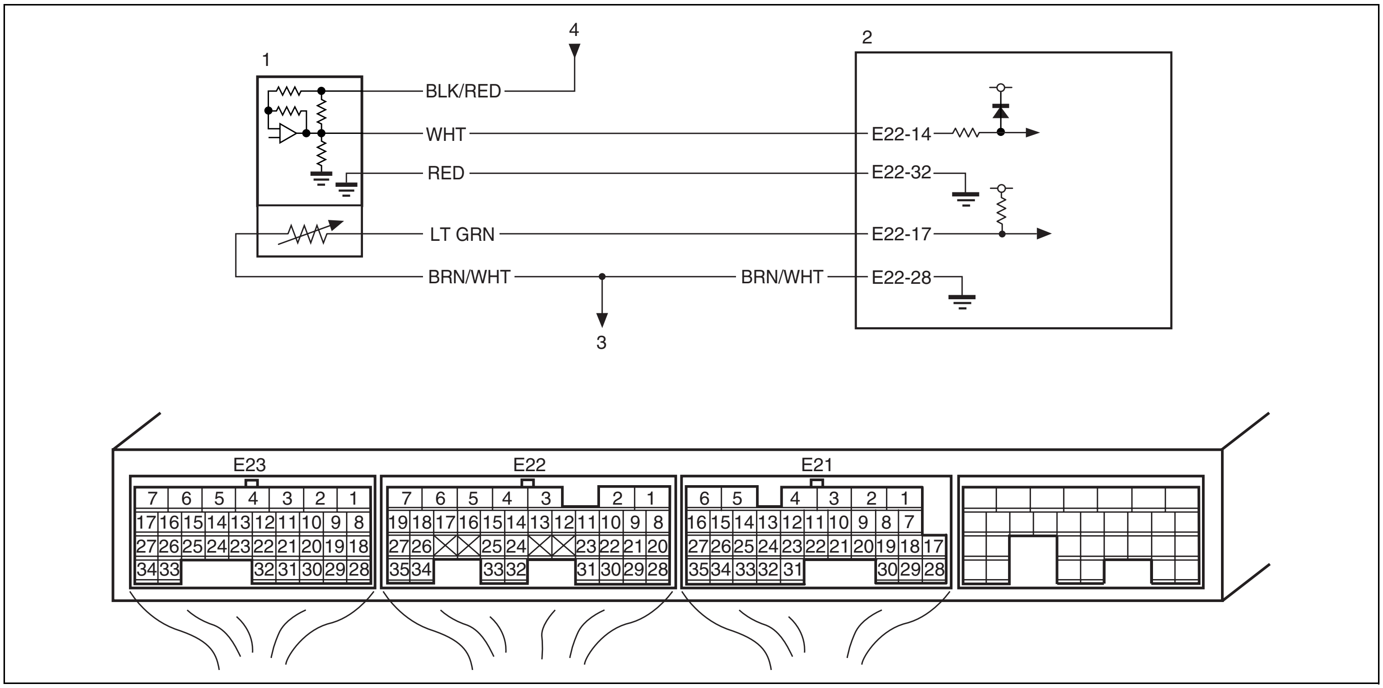
Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	IAT sensor and its circuit check. 1) Connect scan tool with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check intake air temp. displayed on scan tool. Is 165°C (329°F) indicated?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection” in Section 0A.
3	Check ECM voltage. 1) Disconnect connector from IAT sensor with ignition switch turned OFF. 2) Check for proper connection to IAT sensor at “LT GRN” and “BRN/WHT” wire terminals. 3) If OK, then turn ON ignition switch, check voltage between “LT GRN” wire terminal of IAT sensor connector and vehicle body ground. See Fig. 1. Is voltage about 4 – 6 V?	Go to Step 6.	Go to Step 4.
4	Check IAT circuit insulation. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “LT GRN” wire terminal of IAT sensor connector and body ground. Is resistance infinity?	Go to Step 5.	“LT GRN” wire shorted to ground circuit. If wire are OK, substitute a known-good ECM and recheck.
5	Check IAT short circuit. 1) Turn ON ignition switch. 2) Check voltage between “LT GRN” wire terminal of IAT sensor connector and vehicle body ground. Is voltage about 0 V?	Go to Step 6.	“LT GRN” wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.
6	Check IAT sensor according to “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection” in Section 6E2. Is it in good condition?	Substitute a known-good ECM and recheck.	Replace MAF and IAT sensor.



[A]:	Fig.1 for Step 3
1.	Disconnected MAF and IAT sensor connector
2.	Engine ground

DTC P0113 Intake Air Temperature Sensor Circuit High

Wiring Diagram



1. MAF and IAT sensor	3. To other sensor
2. ECM	4. From main relay

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC will be set when all of the following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of IAT sensor output is more than the specified value (Low intake air temperature (high voltage/high resistance))	• IAT sensor circuit • IAT sensor • ECM

DTC Confirmation Procedure

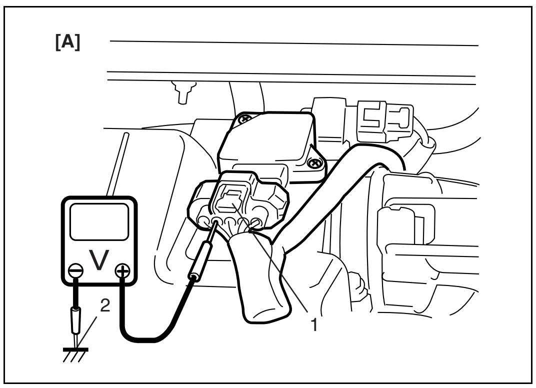
1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and run it for 10 sec.
4) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.

Step	Action	Yes	No
2	IAT sensor and its circuit check. 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check intake air temp. displayed on scan tool. Is –40°C (–40°F) indicated?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection” in Section 0A.
3	Check IAT sensor voltage. 1) Disconnect connector from IAT sensor with ignition switch turned OFF. 2) Check for proper connection to IAT sensor at “LT GRN” and “BRN/WHT” wire terminals. 3) If OK, then turn ON ignition switch, check voltage between “LT GRN” wire terminal of IAT sensor connector and vehicle body ground. See Fig. 1. Is voltage about 4 – 6 V?	Go to Step 7.	Go to Step 4.
4	Check ECM voltage. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and connect connectors to ECM. 3) Check for proper connection of ECM connector at “E22-17” terminal. 4) If OK, then turn ON ignition switch, check voltage between “E22-17” terminal of ECM connector and vehicle body ground. Is voltage about 4 – 6 V?	“LT GRN” wire open circuit. If wire and connection are OK, go to Step 5.	Go to Step 5.
5	Check wire circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between “LT GRN” wire terminal of IAT sensor connector and vehicle body ground. Is voltage about 0 V?	Go to Step 6.	“LT GRN” wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.
6	Check wire circuit. 1) Measure resistance between “E22-17” terminal of ECM connector and “LT GRN” wire terminal of IAT sensor connector with ignition switch turned OFF. Is resistance below 5 Ω?	Go to Step 7.	“LT GRN” wire in high resistance circuit.

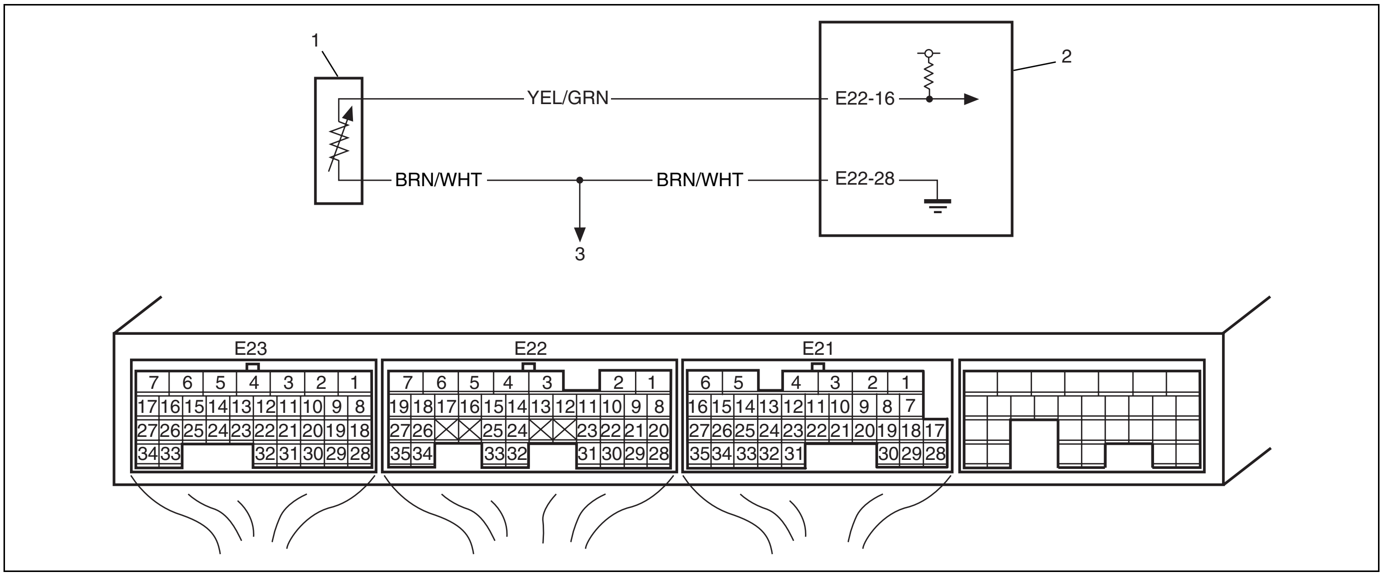
Step	Action	Yes	No
7	Check ground circuit. 1) Connect connectors to ECM. 2) Check for proper connection of IAT sensor connector at “BRN/WHT” wire terminal. 3) Measure resistance between “BRN/WHT” wire terminal of IAT sensor connector and body ground. Is resistance below 5 Ω?	Go to Step 9.	Go to Step 8.
8	Check ground circuit. 1) Measure resistance between “E22-28” terminal of ECM connector and body ground. Is resistance below 5 Ω?	“BRN/WHT” wire open circuit or high resistance circuit. Poor “E22-28” connection.	Faulty ECM ground circuit. If circuit are OK, substitute a known-good ECM and recheck.
9	Check IAT sensor according to “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection” in Section 6E2. Is it in good condition?	Substitute a known-good ECM and recheck.	Replace MAF and IAT sensor.



[A]:	Fig. 1 for Step 3
1.	Disconnected MAF and IAT sensor connector
2.	Engine ground

DTC P0117 Engine Coolant Temperature Circuit Low

Wiring Diagram



1. ECT sensor	2. ECM	3. To other sensors

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC will be set when all of the following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of ECT sensor output is less than the specified value (High engine coolant temperature (low voltage/low resistance))	• ECT sensor circuit • ECT sensor • ECM

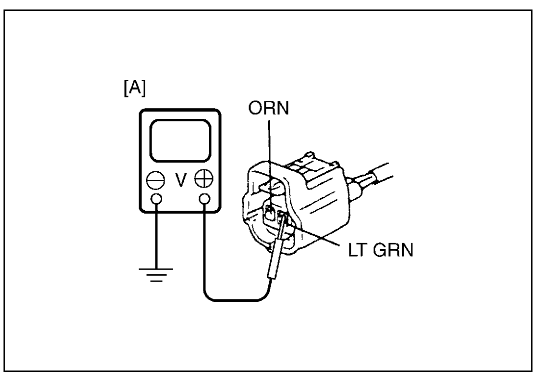
DTC Confirmation Procedure

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and run it for 10 sec. or more.
4) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	ECT sensor and its circuit check. 1) Connect scan tool with ignition switch turned OFF. 2) Turn ignition switch ON. 3) Check engine coolant temp. displayed on scan tool. Is 164°C (327°F) indicated?	Go to Step 3.	Intermittent trouble check for intermittent referring to “Intermittent and Poor Connection Inspection” in section 0A.

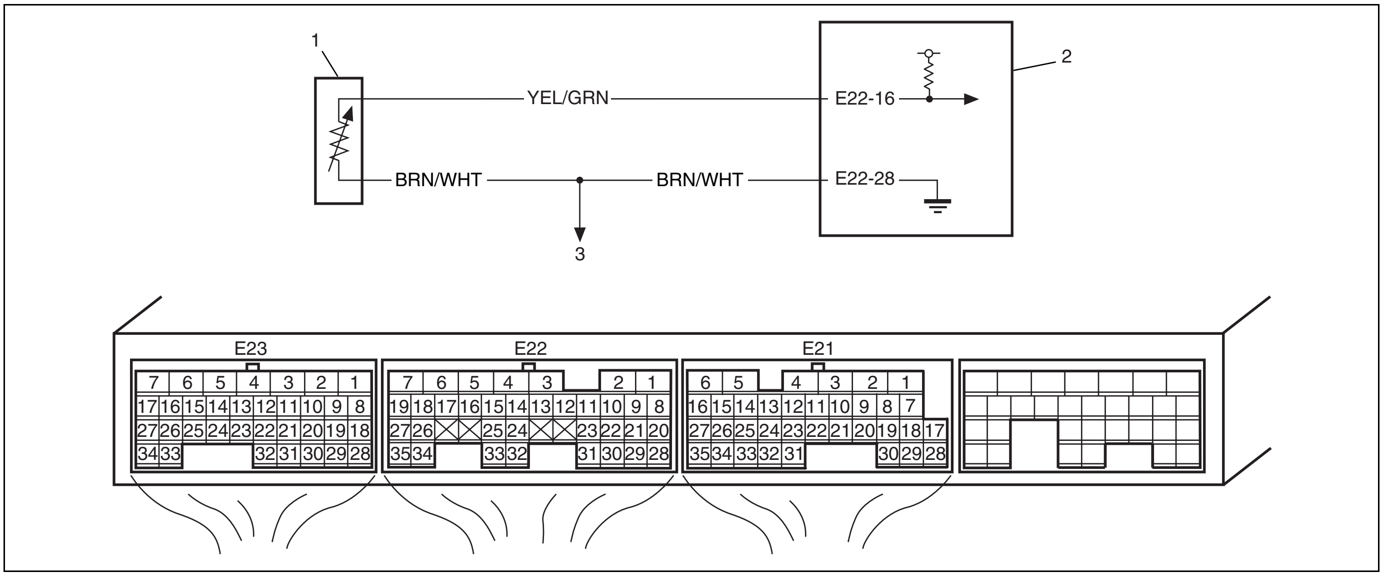
Step	Action	Yes	No
3	Check ECM voltage. 1) Disconnect connector from ECT sensor with ignition switch turned OFF. 2) Check for proper connection to ECT sensor at “YEL/GRN” and “BRN/WHT” wire terminals. 3) If OK, then turn ON ignition switch, check voltage between “YEL/GRN” wire terminal and vehicle body ground. See Fig. 1. Is voltage about 4 – 6 V?	Got to Step 6.	Go to Step 4.
4	Check ECT sensor circuit insulation. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “YEL/GRN” wire terminal of ECT sensor connector and body ground. Is resistance infinity?	Got to Step 5.	“YEL/GRN” wire shorted to ground circuit. If wire are OK, substitute a known-good ECM and recheck.
5	Check ECT sensor short circuit. 1) Turn ON ignition switch. 2) Check voltage between “YEL/GRN” wire terminal of ECT sensor connector and vehicle body ground. Is voltage about 0 V?	Got to Step 6.	“YEL/GRN” wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.
6	Check ECT sensor according to “Engine Coolant Temperature Sensor (ECT Sensor) Inspection” in Section 6E2. Is it in good condition?	Substitute a known-good ECM and recheck.	Replace ECT sensor.



[A]: Fig. 1 for Step 3

DTC P0118 Engine Coolant Temperature Circuit High

Wiring Diagram



1.	ECT sensor
2.	ECM
3.	To other sensors

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC will be set when all of the following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of ECT sensor output is more than the specified value (Low engine coolant temperature (high voltage/high resistance))	• ECT sensor circuit • ECT sensor • ECM

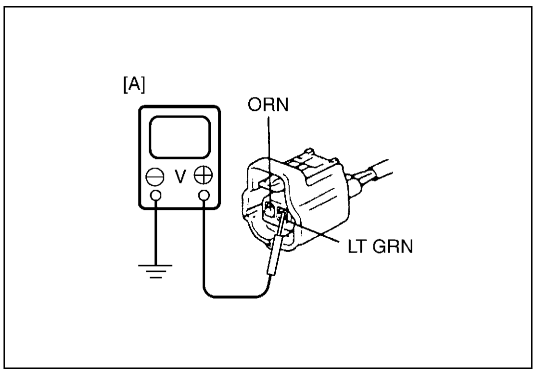
DTC Confirmation Procedure

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and run it for 10 sec. or more.
4) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check" in this section.
2	ECT sensor and its circuit check. 1) Connect scan tool with ignition switch turned OFF. 2) Turn ignition switch ON. 3) Check engine coolant temp. displayed on scan tool. Is –40°C (–40°F) indicated?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection Inspection" in Section 0A.
3	Check ECT voltage. 1) Disconnect connector from ECT sensor with ignition switch turned OFF. 2) Check for proper connection to ECT sensor at "YEL/GRN" and "BRN/WHT" wire terminals. 3) If OK, then turn ON ignition switch, check voltage between "YEL/GRN" wire terminal of ECT sensor connector and vehicle body ground. See fig. 1. Is voltage about 4 – 6 V?	Go to Step 6.	Go to Step 4.
4	Check ECM voltage. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and connect connectors to ECM. 3) Check for proper connection of ECM connector at "E22-16" terminals. 4) If OK, then turn ON ignition switch, check voltage between "E22-16" wire terminal of ECM connector and vehicle body ground. Is voltage about 4 – 6 V?	"YEL/GRN" wire open circuit. If wire and connection are OK, go to Step 5.	Go to Step 5.
5	Check ECT sensor harness voltage. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between "YEL/GRN" wire terminal of ECT sensor connector and vehicle body ground. Is voltage about 0 V?	Go to Step 6.	"YEL/GRN" wire shorted to other circuits. If wire are OK, substitute a known-good ECM and recheck.
6	Check ECT sensor harness resistance. 1) Measure resistance between "E22-16" terminal of ECM connector and "YEL/GRN" wire terminal of ECT sensor connector with ignition switch turn OFF. Is resistance below 5 Ω?	Go to Step 7.	"YEL/GRN" wire in high resistance circuit.

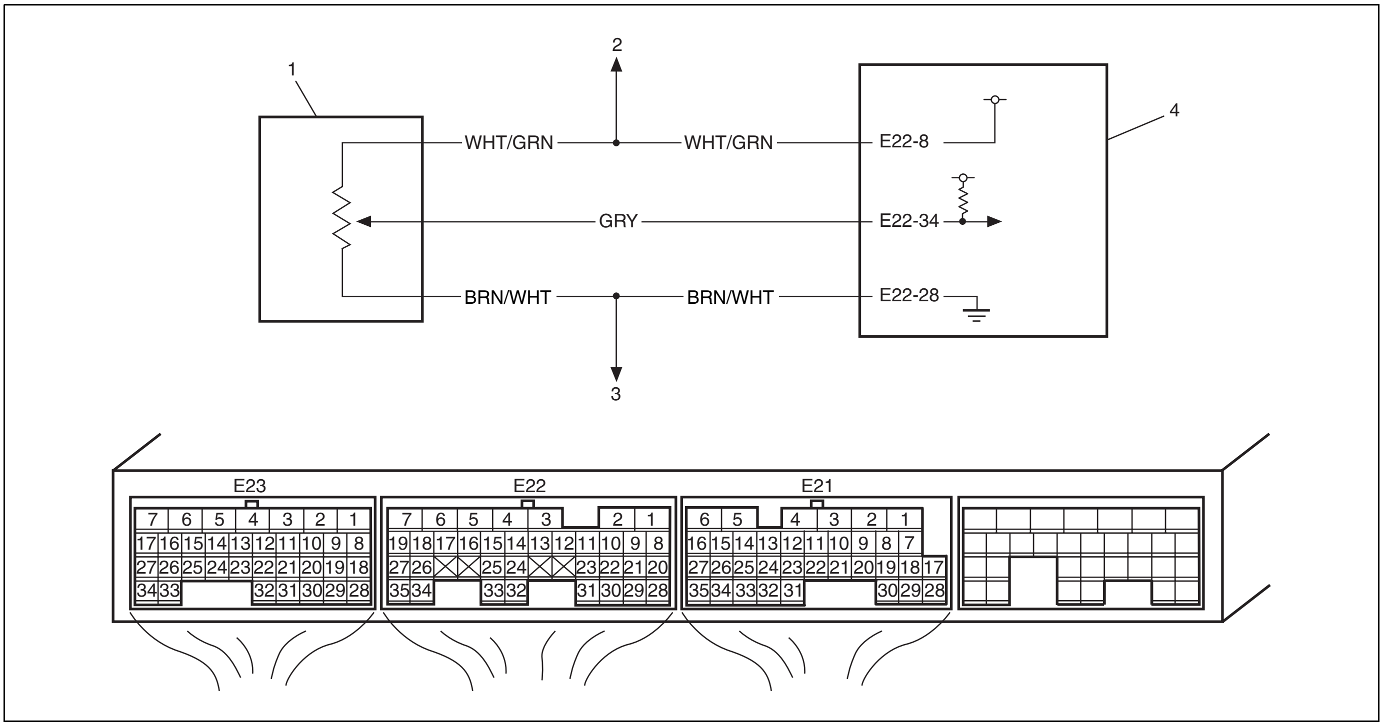
Step	Action	Yes	No
7	Check ECT sensor ground circuit. 1) Connect connectors to ECM. 2) Check for proper connection of ECT sensor connector at “BRN/WHT” wire terminal. 3) Measure resistance between “BRN/WHT” wire terminal of ECT sensor connector and vehicle body ground. Is resistance below 5 Ω?	Go to Step 9.	Go to Step 8.
8	Check ECT sensor ground circuit. 1) Measure resistance between “E22-28” terminal of ECM connector and vehicle body ground. Is resistance below 5 Ω?	“BRN/WHT” wire open circuit or high resistance circuit. Poor “E22-28” connection.	Faulty ECM ground circuit. If circuit are OK, substitute a known-good ECM and recheck.
9	Check ECT sensor according to “Engine Coolant Temperature Sensor (ECT Sensor) Inspection” in Section 6E2. Is it in good condition?	Substitute a known-good ECM and recheck.	Replace ECT sensor.



[A]: Fig. 1 for Step 3

DTC P0121 Throttle Position Sensor Circuit Range/Performance

Wiring Diagram



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

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Difference between actual throttle opening (detected from TP sensor) and opening calculated by ECM (obtained on the basis of engine speed and intake manifold pressure) is larger than specified value. (2 driving cycle detection logic)	• Air intake system • TP sensor • TP sensor circuit • ECM • MAF sensor • Idle air control valve

DTC Confirmation Procedure

WARNING:

- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and 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.**

NOTE:

Check to make sure that the following conditions are satisfied when using this DTC CONFIRMATION PROCEDURE.

- **Intake air temp.: –7°C, 19.4°F or higher**
- **Engine coolant temp.: 70°C, 158°F or higher**
- **Altitude (barometric pressure): 2500 m, 8200 ft or less (540 mmHg, 72 kPa or more)**

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and warm up to normal operating temperature.
4) Drive vehicle at 60 km/h (38 mile/h) at 5th gear or D range.
5) Increase vehicle speed to 65 km/h (40 mile/h) at 5th gear or D range.
6) Release accelerator pedal to decrease vehicle speed till 60 km/h (38 mile/h).
7) Repeat Step 4) to 6) for 3 times.
8) Stop vehicle and check DTC and pending DTC.

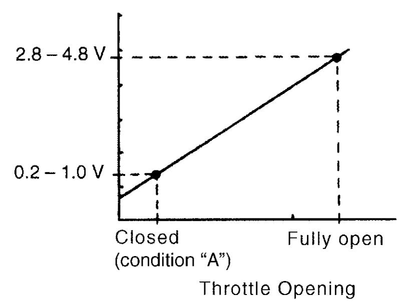
Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Check TP sensor and its circuit. 1) Turn OFF ignition switch and connect SUZUKI scan tool to DLC. 2) Turn ON ignition switch and check TP sensor output voltage when throttle valve is at idle position and fully opened. See Fig. 1. Does voltage vary within specified value linearly as shown in figure?	Go to Step 11.	Go to Step 3.
3	Check TP sensor voltage. 1) Disconnect connector from TP sensor with ignition switch turned OFF. 2) Check for proper connection to TP sensor connector at “WHT/GRN”, “GRY” and “BRN/WHT” wire terminals. 3) If OK, then with ignition switch turned ON, check for the following terminal voltages. • Between “WHT/GRN” terminal of TP sensor connector and body ground • Between “GRY” terminal of TP sensor connector and body ground Is each terminal voltage about 4 – 6 V?	Go to Step 7.	Go to Step 4.
4	Check ECM voltage. 1) Turn ignition switch to OFF position. 2) Check for proper connection of ECM connector at “E22-8” and “E22-34” wire terminals. 3) If OK, disconnect connector from MAP sensor. 4) Turn ignition switch to ON position. 5) Check for the following terminal voltages. • Between “E22-8” terminal of ECM connector and body ground • Between “E22-34” terminal of ECM connector and body ground Is each terminal voltage about 4 – 6 V?	“GRY/RED” wire open or high resistance circuit. Faulty MAP sensor, check MAP sensor according to “MAP Sensor Individual Check” under “DTC P0108 Manifold Absolute Pressure High Input” in this section. If they are OK, go to Step 5.	Go to Step 5.

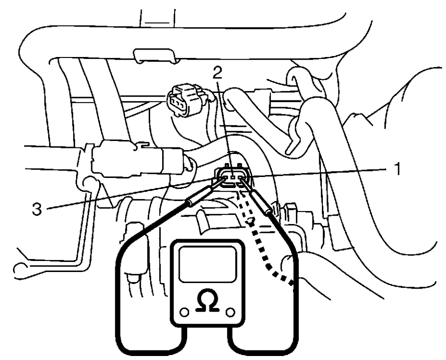
Step	Action	Yes	No
5	Check wire circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “WHT/GRN” wire terminal of ECM connector and body ground and between “GRY” wire terminal of ECM connector and body ground. Is resistance infinity?	Go to Step 6.	“WHT/GRN” and/or “GRY” wire shorted to ground circuit. If wire are OK, substitute a known-good ECM and recheck.
6	Check wire circuit. 1) Turn ON ignition switch. 2) Check voltage between “WHT/GRN” wire terminal of ECM connector and body ground and between “GRY” wire terminal of ECM connector and body ground. Is voltage about 0 V at each terminal?	Go to Step 7.	“WHT/GRN” and/or “GRY” wire shorted to power circuit. If wire are OK, substitute a known-good ECM and recheck.
7	Check wire circuit. 1) Measure resistance between “E22-34” wire terminal of ECM connector and “GRY” wire terminal of TP sensor connector with ignition switch turned OFF. Is resistance below 5 Ω?	Go to Step 8.	“GRY” wire in high resistance circuit.
8	Check ground circuit. 1) Connect connectors to ECM. 2) Check for proper connection of MAP sensor connector at “BRN/WHT” wire terminal. 3) Measure resistance between “BRN/WHT” wire terminal of MAP sensor connector and body ground. Is resistance below 5 Ω?	Go to Step 10.	Go to Step 9.
9	Check ground circuit. 1) Measure resistance between “E22-28” wire terminal of ECM connector and body ground. Is resistance below 5 Ω?	“BRN/WHT” wire open circuit or high resistance circuit. Poor “E22-28” connection.	Faulty ECM ground circuit. If circuit are OK, substitute a known-good ECM and recheck.
10	Check TP sensor. 1) Turn OFF ignition switch. 2) Disconnect TP sensor connector. 3) Check for proper connection to TP sensor at each terminal. 4) If OK, then measure resistance between TP sensor terminals and check if each measured value is as specified. See Fig. 2. **TP sensor resistance** **Between 1 and 3: 4.0 – 6.0 kΩ** **Between 1 and 2: 0.1 – 6.5 kΩ, varying according to throttle valve opening.** Are measured values as specified?	Go to Step 11.	Replace TP sensor.

Step	Action	Yes	No
11	Check MAF sensor and its circuit. 1) Check MAF sensor and its circuit, referring to "DTC P0102 Mass Air Flow Circuit Low Input" and "DTC P0103 Mass Air Flow Circuit High Input" in this section. Is it in good condition?	Go to Step 12.	Repair or replace it.
12	Is DTC P0506 or P0507 detected?	Go to applicable DTC diag. flow table.	Go to Step 13.
13	Check idle air control (IAC) valve 1) Check idle air control valve referring to "Idle Air Control (IAC) Valve Operation Check" in this section. Is it in good condition?	Go to Step 14.	Repair or replace idle air control valve.
14	Check throttle body. 1) Check throttle body for clog or leak. Is it OK?	Substitute a known-good ECM and recheck.	Repair throttle body.

[A]



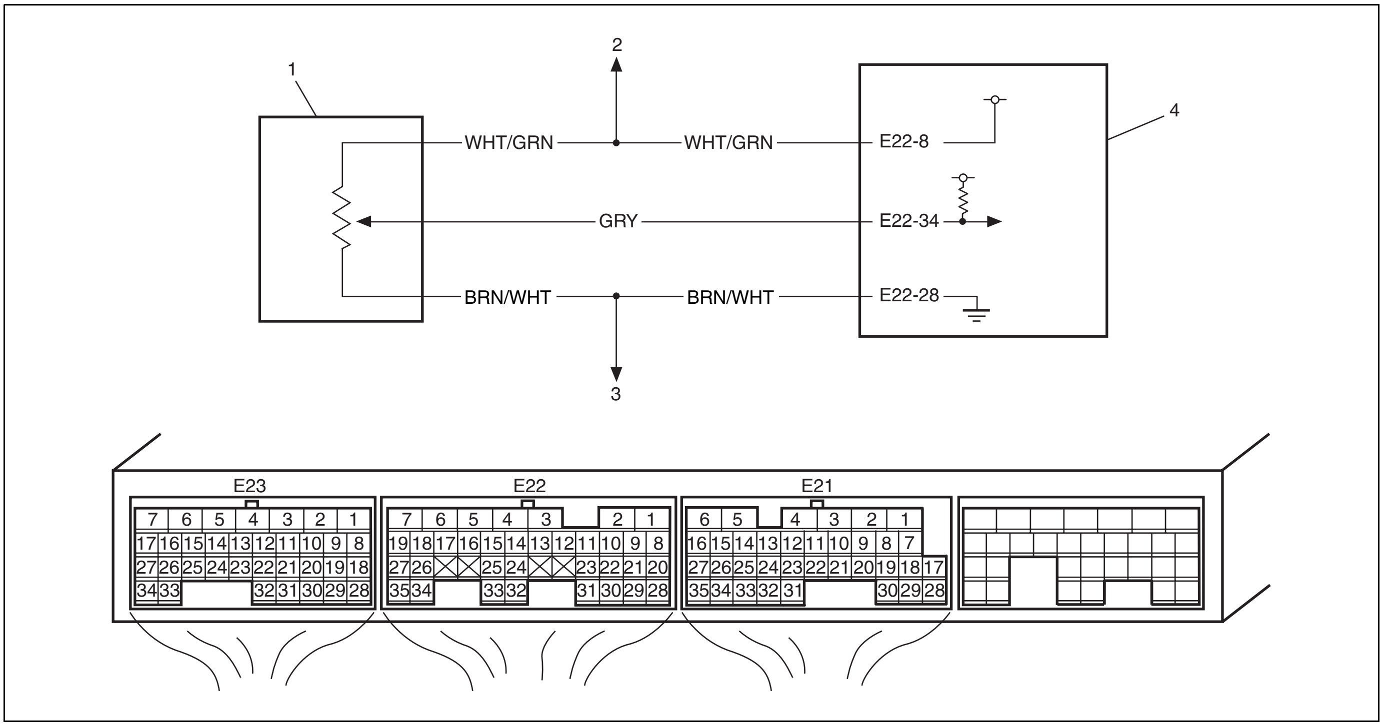
[B]



[A]:	Fig. 1 for Step 2
[B]:	Fig. 2 for Step 10

DTC P0122 Throttle Position Sensor Circuit Low

Wiring Diagram



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

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC will be set when all of the following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of TP sensor output is less than the specified value	• TP sensor circuit • TP sensor • ECM

DTC Confirmation Procedure

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and run it for 10 sec. or more.
4) Check DTC and pending DTC.

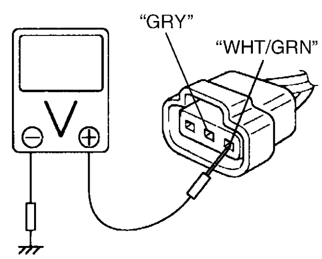
Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.

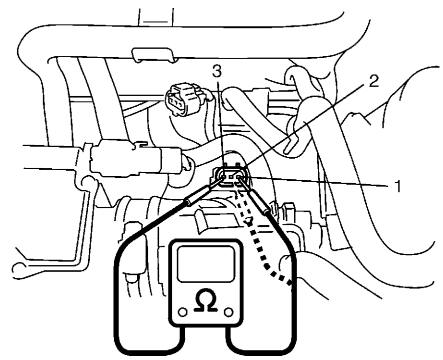
Step	Action	Yes	No
2	Check TP sensor and its circuit. 1) Connect scan tool to DLC with ignition switch turned OFF and then turn ON ignition switch. 2) Check throttle valve opening percentage displayed on scan tool. 3) Check throttle valve opening percentage displayed on scan tool while opening throttle valve from idle position to full open position. Is it displayed 0%?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection Inspection" in Section 0A.
3	Check wire harness. 1) Disconnect connector from TP sensor with ignition switch turned OFF. 2) Check for proper connection to TP sensor at "WHT/GRN", "GRY" and "BRN/WHT" wire terminals. 3) If OK, then with ignition switch turned ON, check for the following terminal voltages. • Between "WHT/GRN" terminal of TP sensor connector and body ground • Between "GRY" terminal of TP sensor connector and body ground (See Fig. 1) Is each terminal voltage about 4 – 6 V?	Go to Step 5.	Go to Step 4.
4	Check ECM voltage. 1) Check for proper connection of ECM connector at "E22-8" and "E22-34" wire terminals. 2) If OK, disconnect connector from MAP sensor. 3) Turn ignition switch to ON position. 4) Check for the following terminal voltages. • Between "E22-8" terminal of ECM connector and body ground • Between "E22-34" terminal of ECM connector and body ground Is each terminal voltage about 4 – 6 V?	Check MAP sensor referring to "Manifold Absolute Pressure Sensor (MAP Sensor) Inspection" in Section 6E2. If they are OK, go to Step 5.	Go to Step 5.
5	Check wire circuit. 1) Disconnect connectors from ECM with ignition switch turn OFF. 2) Check that there is insulation between "WHT/GRN" wire terminal of TP sensor connector and body ground and between "GRY" wire terminal of TP sensor connector and body ground. Is there insulation?	Go to Step 6.	"WHT/GRN" and/or "GRY" wire shorted to ground circuit. If wires are OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
6	Check TP sensor. 1) Check resistance between terminals of TP sensor. See Fig. 2. **TP sensor resistance** **Between 1 and 3: 4.0 – 6.0 kΩ** **Between 1 and 2: 0.1 – 6.5 kΩ** Are measured values within specifications?	Substitute a known-good ECM and recheck.	Replace TP sensor.

[A]



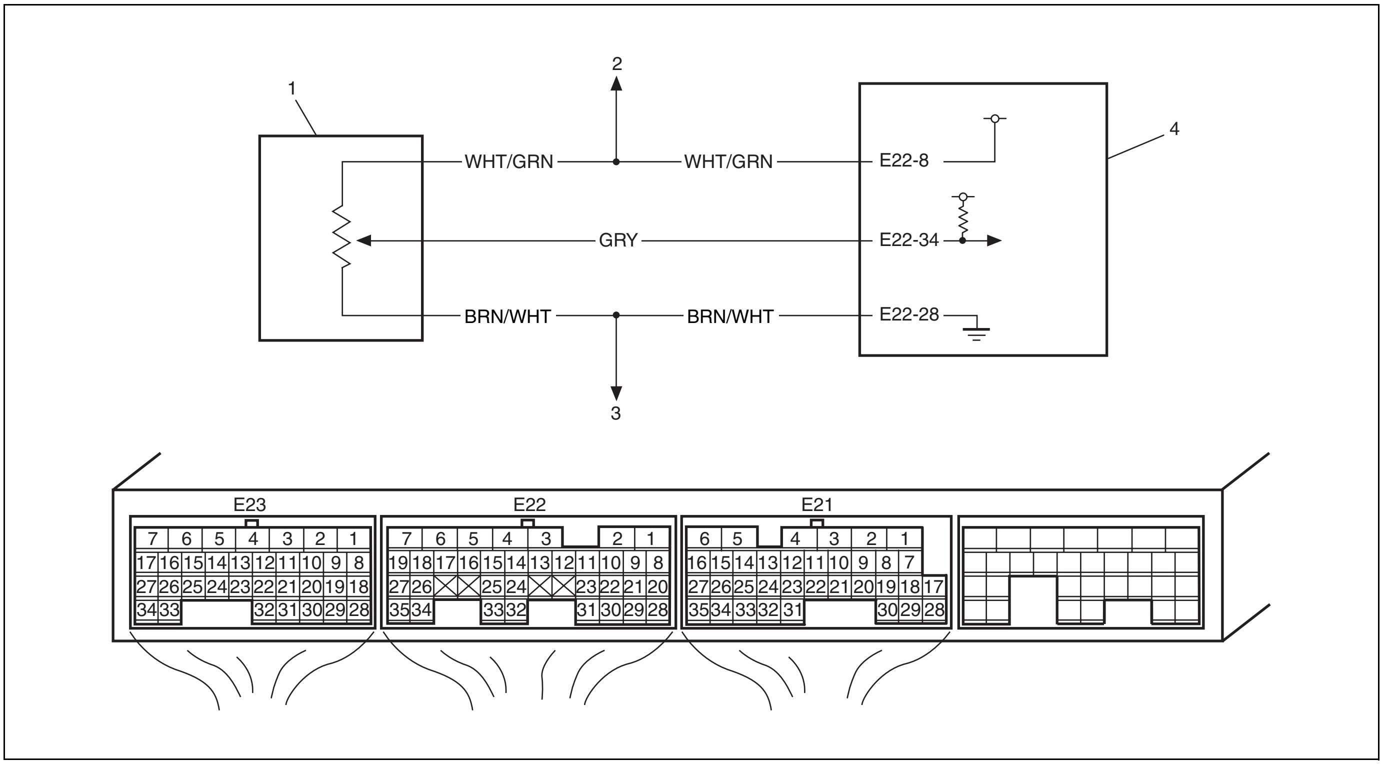
[B]



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

DTC P0123 Throttle Position Circuit High Input

Wiring Diagram



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

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC will be set when all of the following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of TP sensor output is more than the specified value	• TP sensor circuit • TP sensor • ECM

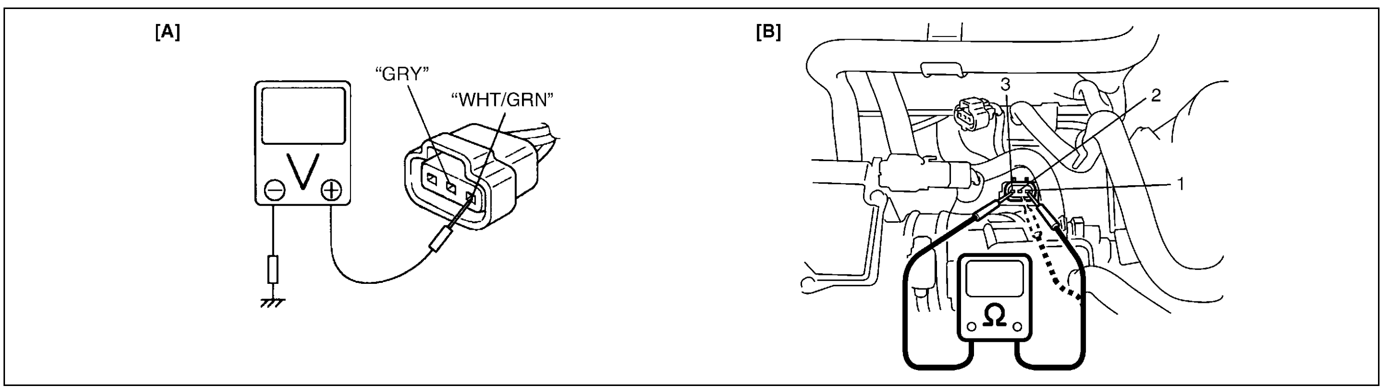
DTC Confirmation Procedure

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and run it for 10 sec. or more.
4) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check" in this section.
2	Check TP sensor and its circuit. 1) Connect scan tool to DLC with ignition switch turned OFF and then turn ignition switch ON. 2) Check throttle valve opening percentage displayed on scan tool. 3) Check throttle valve opening percentage displayed on scan tool while opening throttle valve from idle position to full open position. Is it displayed 100%?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection Inspection" in Section 0A.
3	Check wire harness. 1) Disconnect connector from TP sensor with ignition switch turned OFF. 2) Check for proper connection to TP sensor at "WHT/GRN", "GRY" and "BRN/WHT" wire terminals. 3) If OK, then with ignition switch turned ON, check for the following terminal voltages. • Between "WHT/GRN" terminal of TP sensor connector and body ground • Between "GRY" terminal of TP sensor connector and body ground (See Fig. 1.) Is each terminal voltage about 4 – 6 V?	Go to Step 6.	Go to Step 4.
4	Check ECM voltage. 1) Check for proper connection of connector at "E22-8" and "E22-34" wire terminals. 2) If OK, disconnect connector from MAP sensor. 3) Turn ignition switch to ON position. 4) Check for the following terminal voltages. • Between "E22-8" terminal of ECM connector and body ground • Between "E22-34" terminal of ECM connector and body ground Is each terminal voltage about 4 – 6 V?	"GRY/RED" and/or "GRY/BLU" wire open circuit. Check MAP sensor referring to "Manifold Absolute Pressure Sensor (MAP Sensor) Inspection" in Section 6E2. If they are OK, go to Step 5.	Go to Step 5.
5	Check wire circuit. 1) Disconnect connector from ECM with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check voltage between "WHT/GRN" wire terminal of TP sensor connector and body ground and between "GRY" wire terminal of TP sensor connector and body ground. Is voltage about 0 V at each terminal?	Go to Step 7.	"WHT/GRN" and/or "GRY" wire shorted to power circuit. If wire are OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
6	Check wire circuit. 1) Measure resistance between "E22-34" wire terminal of ECM connector and "GRY" wire terminal of TP sensor connector with ignition switch turned OFF. Is resistance below 5 Ω?	Go to Step 8.	"GRY" wire open circuit or high resistance circuit.
7	Check ground circuit. 1) Connect connector to ECM. 2) Check for proper connection of MAP sensor at "BRN/WHT" wire terminal. 3) Measure resistance between "BRN/WHT" wire terminal of MAP sensor connector and body ground. Is resistance below 5 Ω?	Go to Step 9.	Go to Step 8.
8	Check ground circuit. 1) Measure resistance between "E22-28" wire terminal of ECM connector and body ground. Is resistance below 5 Ω?	"BRN/WHT" wire open circuit or high resistance circuit. Poor "E22-28" connection.	Faulty ECM ground circuit. If circuit are OK, substitute a known-good ECM and recheck.
9	Check TP sensor. 1) Check resistance between terminals of TP sensor. See Fig. 2. **TP sensor resistance** **Between 1 and 3: 4.0 – 6.0 kΩ** **Between 1 and 2: 0.1 – 6.5 kΩ** Are measured values within specifications?	Substitute a known-good ECM and recheck.	Replace TP sensor.

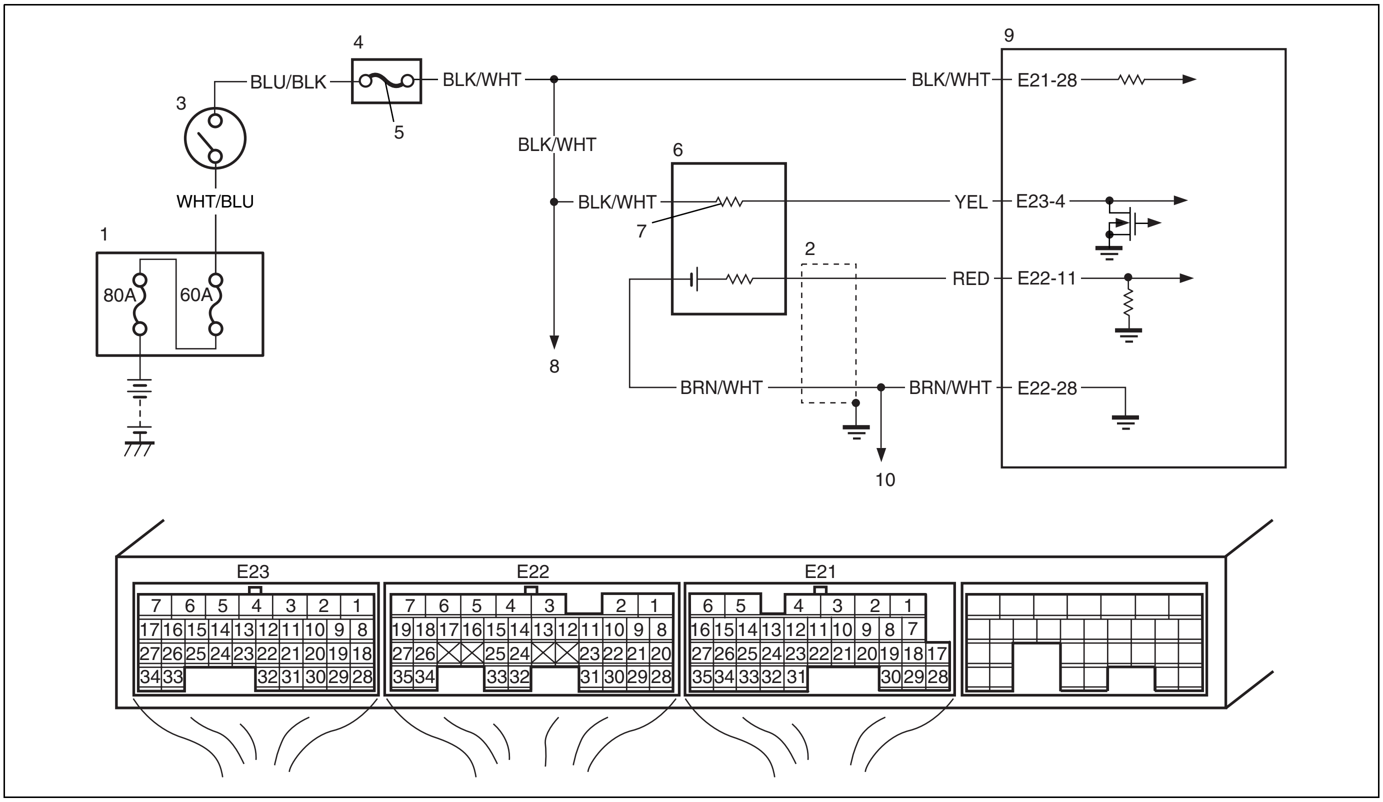


[A]:	Fig. 1 for Step 3
[B]:	Fig. 2 for Step 9

DTC P0131 O2 Sensor (HO2S) Circuit Low Voltage (Sensor-1)

DTC P0132 O2 Sensor (HO2S) Circuit High Voltage (Sensor-1)

Wiring Diagram



1. Relay box	4. Circuit fuse box	7. Heater	10. To other sensor
2. Shield wire	5. "IG COIL" fuse	8. To HO2S–2 heater	
3. Ignition switch	6. HO2S–1	9. ECM	

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC P0131: • HO2S voltage is higher than 4.5 V even after engine running for specified time continuously from engine start • Maximum HO2S voltage is less than 0.6 V or minimum HO2S voltage is less than 0.3 V (2 driving cycle detection logic) DTC P0132: • HO2S voltage is less than 3.0 V even after engine running for specified time continuously from engine start • Maximum HO2S voltage is 0.74 V or more or minimum HO2S voltage is 0.34 V or more (✱2 driving cycle detection logic, monitoring once/1 driving)	• HO2S–1 sensor circuit • HO2S–1 sensor • Fuel system • ECM • Fuel shortage

DTC Confirmation Procedure

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

NOTE:

Check to make sure that the following conditions are satisfied when using this DTC CONFIRMATION PROCEDURE.

- **Intake air temp.: –7°C, 19.4°F or higher**
- **Engine coolant temp.: 70°C, 158°F or higher**
- **Altitude (barometric pressure): 2500 m, 8200 ft or less (540 mmHg, 72 kPa or more)**

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and warm up to normal operating temperature.
4) Drive vehicle at 40 mph (60 km/h) or higher. (engine speed: 2500 – 3000 r/min.)
5) Keep above vehicle speed for 6 min. or more. (Throttle valve opening is kept constant in this step.)
6) Release accelerator pedal and with engine brake applied, keep vehicle coasting (with fuel cut for 3 sec. or more) and then stop vehicle.
7) Check DTC and pending DTC.

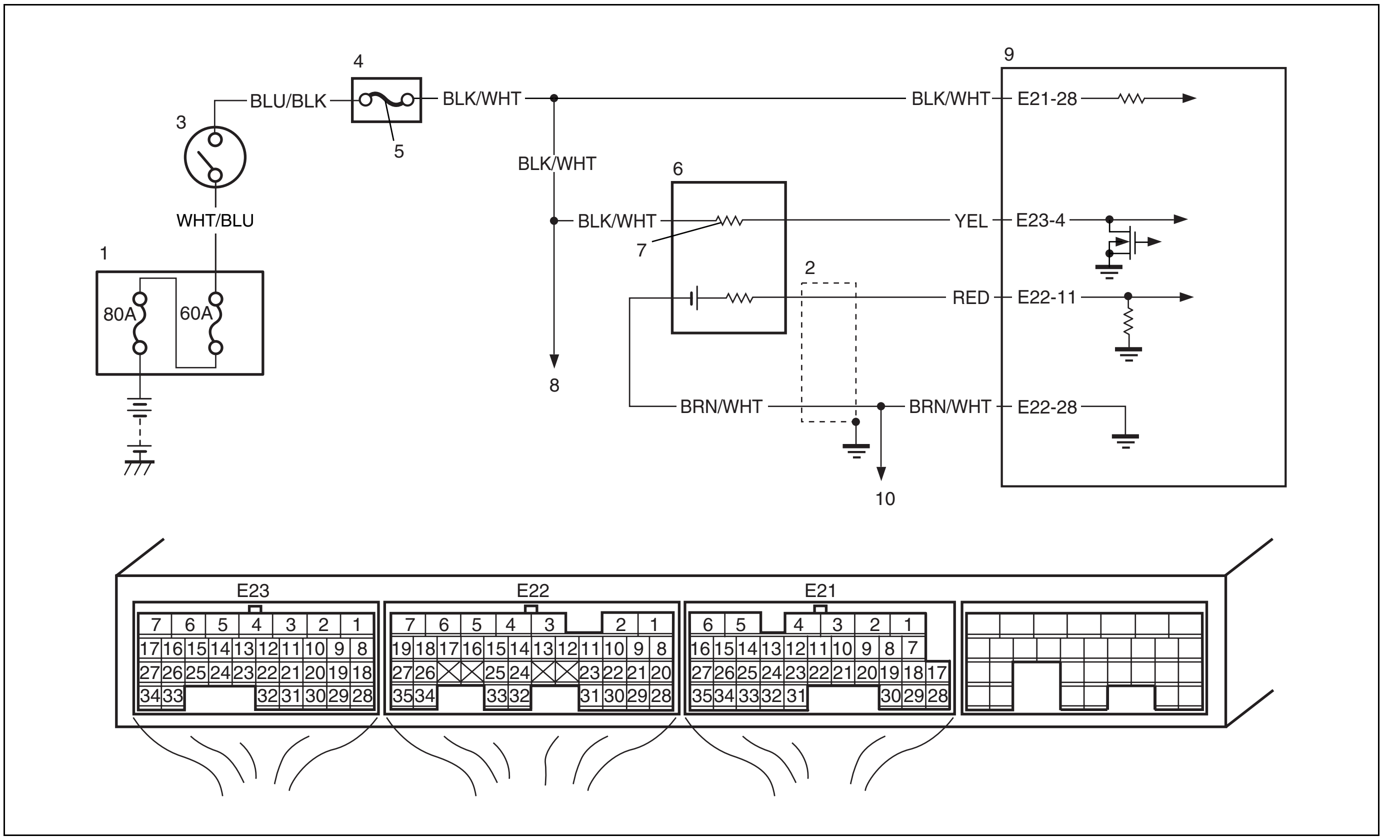
Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Is there DTC(s) other than HO2S–1?	Go to applicable DTC diag. flow table.	Go to Step 3.
3	Check HO2S–1 signal. 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Warm up engine to normal operating temperature and keep it at 2000 r/min. for 60 sec. 3) Repeat racing engine (Repeat depressing accelerator pedal 5 to 6 times continuously and take foot off from pedal to enrich and enlean A/F mixture). Does HO2S–1 output voltage deflect between below 0.3 V and over 0.5 V repeatedly?	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection” in Section 0A. If they are OK, go to Step 8.	Go to Step 4.
4	Check HO2S–1 sensor ground. 1) Disconnect connector from HO2S–1 sensor with ignition switch turned OFF. 2) Check for proper connection to HO2S–1 sensor connector at “YEL”, “RED”, “BLK/WHT” and “BRN/WHT” wire terminals. 3) If wire and connection are OK, check there is continuity between “BRN/WHT” wire terminal of HO2S–1 sensor connector and engine ground. Is it continuity?	Go to Step 5.	“BRN/WHT” wire open circuit. Poor “E22-28” terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
5	Check HO2S–1 sensor ground. 1) With ignition switch turned ON, check voltage between “BRN/WHT” wire terminal of HO2S–1 sensor connector and engine ground. Is voltage about 0.1 V or less?	Go to Step 6.	“BRN/WHT” wire high resistance circuit. Poor “E22-28” terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.
6	Check wire circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and connect connectors to ECM. 3) Measure resistance between “RED” wire terminal of HO2S–1 connector and “E22-11” wire terminal of ECM connector. Is resistance less than 5 Ω?	Go to Step 7.	“RED” wire high resistance circuit or open circuit. Poor “E22-11” terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.
7	Check wire circuit. 1) Disconnect connector from ECM with ignition switch turn OFF. 2) Measure resistance between “RED” wire terminal of HO2S–1 sensor connector and body ground. Is resistance infinity?	Go to Step 8.	“RED” wire shorted to ground circuit.
8	Check HO2S–1 signal circuit. 1) Measure voltage between “RED” wire terminal of HO2S–1 connector and vehicle body ground. Is voltage 0 V?	Go to Step 9.	“RED” wire shorted to others circuit.
9	Check HO2S–1 heater circuit. 1) Check HO2S–1 heater circuit, referring to DTC P0031 and P0032 diagnosis flow table. Is circuit in good condition?	Go to Step 10.	Repair or replace it.
10	Check exhaust system. 1) Check exhaust system for exhaust gas leakage. Is it OK?	Go to Step 4 in DTC P0171 and P0172 diagnosis flow table. If it is in good condition, go to Step 11.	Repair exhaust system for leakage.
11	Check air intake system. 1) Check air intake system for clog or leak. Is it OK?	Check HO2S–1 sensor, referring to “Heated Oxygen Sensor (HO2S–1 and HO2S–2) Heater On-Vehicle Inspection” in Section 6E2. If it in good condition, substitute a known-good ECM and recheck.	Repair or replace.

DTC P0133 O2 Sensor (HO2S) Circuit Slow Response (Sensor-1)

Wiring Diagram



1. Relay box	4. Circuit fuse box	7. Heater	10. To other sensor
2. Shield wire	5. "IG COIL" fuse	8. To HO2S–2 heater	
3. Ignition switch	6. HO2S–1	9. ECM	

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Response time (time to change from lean to rich or from rich to lean) of HO2S–1 output voltage is about 1 sec. at minimum or average time of 1 cycle is 5.5 sec. at minimum. (✱2 driving cycle detection logic, monitoring once/1 driving)	• Heated oxygen sensor–1

DTC Confirmation Procedure

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

NOTE:
Check to make sure that the following conditions are satisfied when using this DTC CONFIRMATION PROCEDURE.
- **Intake air temp.: –7°C (19.4°F) or higher**
- **Engine coolant temp.: 70°C (158°F) or higher**
- **Altitude (barometric pressure): 2500 m, 8200 ft or less (540 mmHg, 72 kPa or more)**

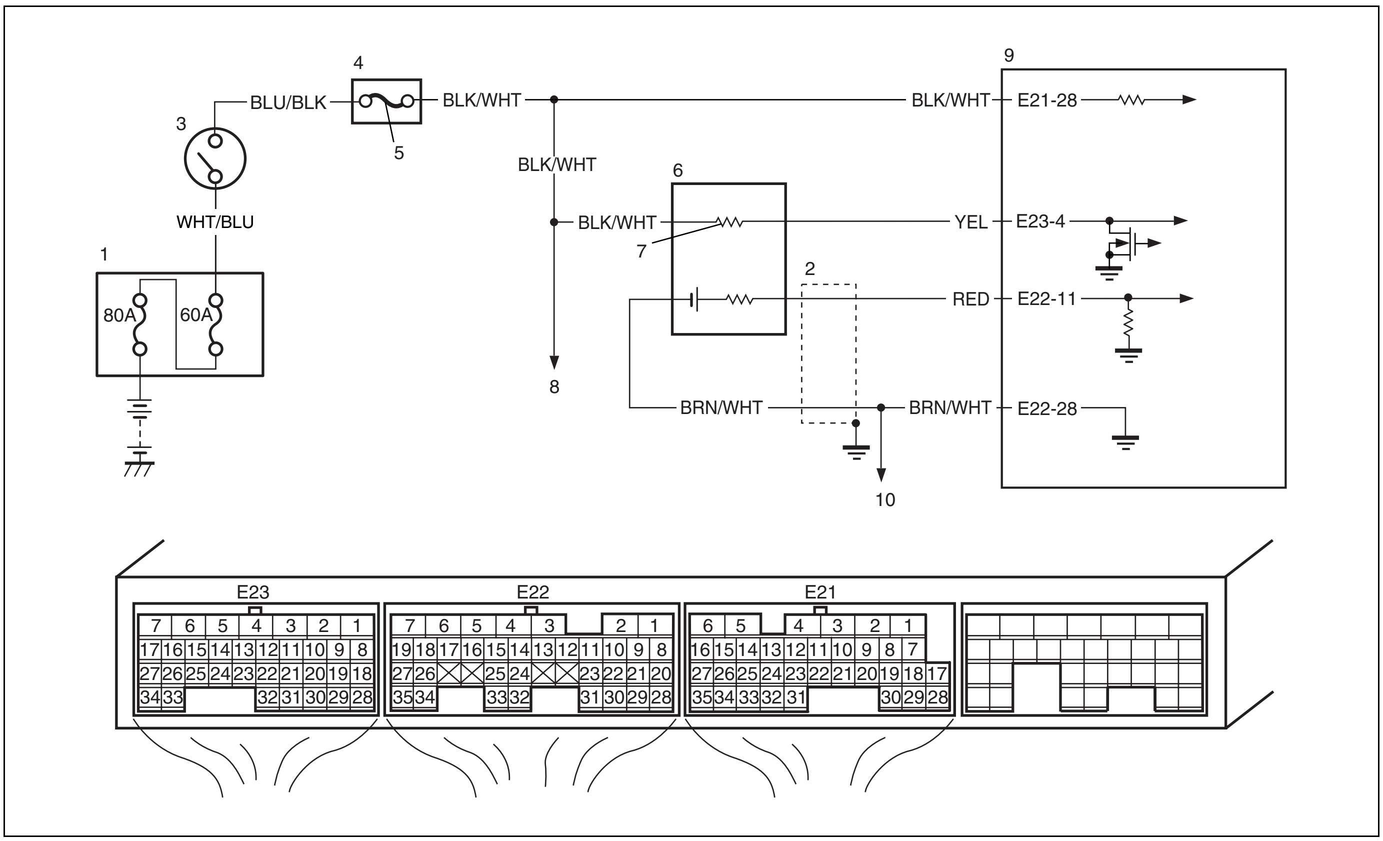
1) Perform step 1) to 6) of DTC P0131/P0132 confirmation procedure.
2) Check if DTC and pending DTC exists by using scan tool. If not, check if oxygen sensor monitoring test has completed by using scan tool. If not in both of above checks (i.e., no DTC and pending DTC and oxygen sensor monitoring test not completed), check vehicle condition (environmental) and repeat step 3) through 6) of DTC P0131/P0132 confirmation procedure.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Is there DTC(s) other than HO2S–1 (DTC P0133)?	Go to applicable DTC diag. flow table.	Replace HO2S–1.

DTC P0134 O2 Sensor (HO2S) No Activity Detected (Sensor-1)

Wiring Diagram



1. Relay box	4. Circuit fuse box	7. Heater	10. To other sensor
2. Shield wire	5. “IG COIL” fuse	8. To HO2S–2 heater	
3. Ignition switch	6. HO2S–1	9. ECM	

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Maximum HO2S voltage is lower than 0.45 V. (2 driving cycle detection logic)	• HO2S–1 • HO2S–1 circuit • Fuel system • Exhaust gas leakage • ECM • Fuel shortage

DTC Confirmation Procedure

Refer to “DTC P0133 O2 Sensor (HO2S) Circuit Slow Response (Sensor–1)” in this section.

Troubleshooting

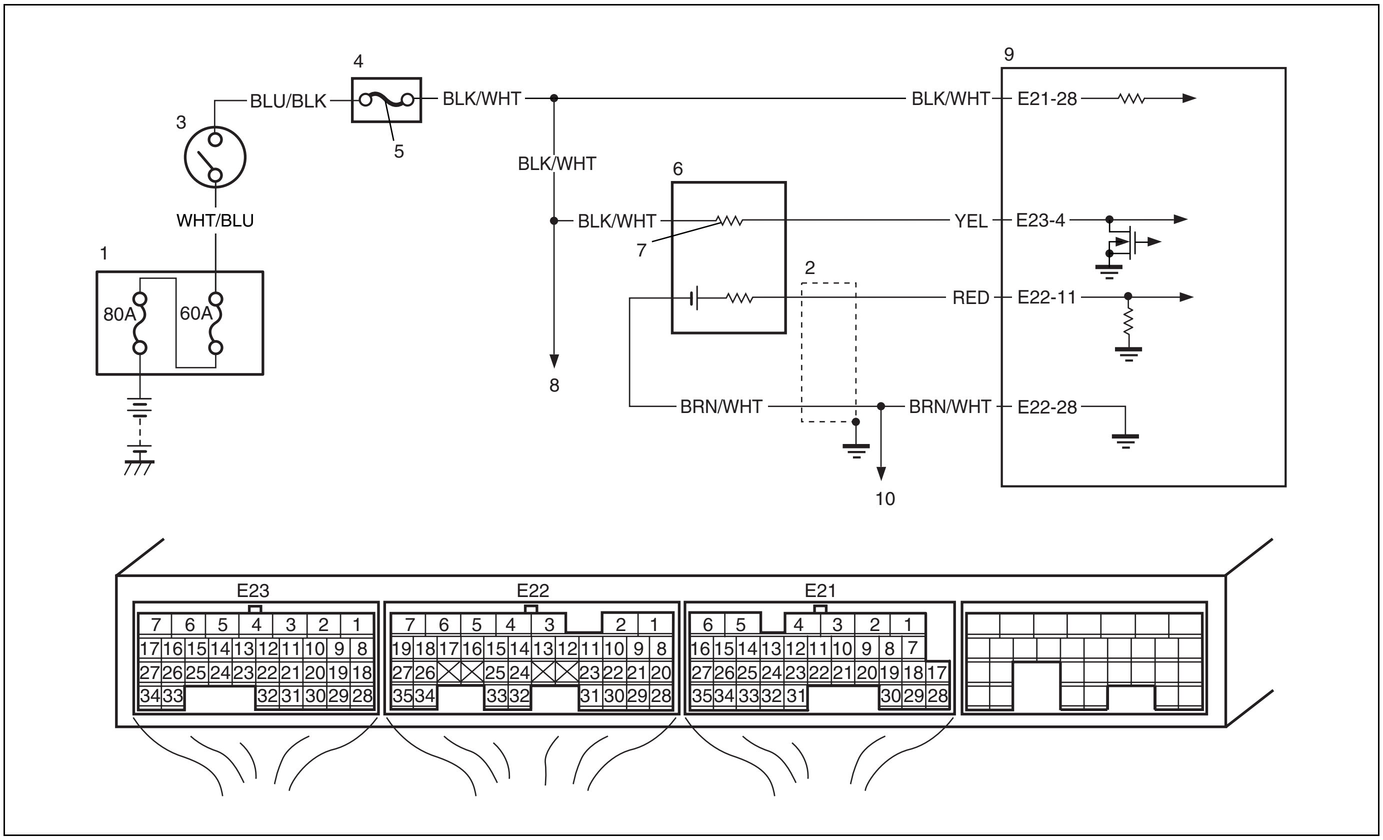
Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	HO2S–1 output voltage check. 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Warm up engine to normal operating temperature and keep it at 2000 r/min. for 60 sec. 3) Repeat racing engine (Repeat depressing accelerator pedal 5 to 6 times continuously to enrich A/F mixture and take foot off from pedal to enlean) and check HO2S output voltage displayed on scan tool. Is over 0.5 V and below 0.3 V indicated?	Go to Step 4.	Go to Step 3.
3	Check HO2S–1 sensor ground. 1) Disconnect connector from HO2S–1 sensor with ignition switch turned OFF. 2) Check for proper connection to HO2S–1 sensor at “YEL”, “RED”, “BLK/WHT” and “BRN/WHT” wire terminals. 3) If wire and connection are OK, check there is continuity between “BRN/WHT” wire terminal of HO2S–1 sensor connector and engine ground. Is it continuity?	Go to Step 4.	“BRN/WHT” wire open circuit. Poor “E22-28” terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.
4	Check HO2S–1 sensor ground. 1) With ignition switch turn ON, check voltage between “BRN/WHT” wire terminal of HO2S–1 sensor connector and engine ground. Is voltage about 0.1 V or less?	Go to Step 5.	“BRN/WHT” wire high resistance circuit. Poor “E22-28” terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
5	Check wire circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and connect connectors to ECM. 3) Measure resistance between "RED" wire terminal of HO2S–1 harness connector and "E22-11" terminal. Is resistance less than 5 Ω?	Go to Step 6.	"RED" wire high resistance circuit or open circuit. Poor "E22-11" terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.
6	Check wire circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between "RED" wire terminal of HO2S–1 sensor connector and body ground. Is resistance infinity?	Go to Step 7.	"RED" wire shorted to ground circuit.
7	Check HO2S–1 heater circuit. 1) Check HO2S–1 heater circuit, referring to DTC P0031 and P0032 diagnosis flow table. Is result in good condition?	Go to Step 8.	Repair or replace it.
8	Check exhaust system. 1) Check exhaust system for exhaust gas leakage. Is it OK?	Go to Step 4 in DTC P0171 and P0172 diagnosis flow table. If it is in good condition, go to Step 9.	Repair exhaust system for leakage.
9	Check air intake system. 1) Check air intake system for clog or leak. Is it OK?	Check HO2S–1 sensor, referring to "Heated Oxygen Sensor (HO2S–1 and HO2S–2) Heater On-Vehicle Inspection" in Section 6E2. If it in good condition, substitute a known-good ECM and recheck.	Repair or replace.

DTC P0031 HO2S Heater Control Circuit Low (Sensor-1)

DTC P0032 HO2S Heater Control Circuit High (Sensor-1)

Wiring Diagram



1. Relay box	4. Circuit fuse box	7. Heater	10. To other sensor
2. Shield wire	5. "IG COIL" fuse	8. To HO2S–2 heater	
3. Ignition switch	6. HO2S–1	9. ECM	

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Current of HO2S–2 heater is more than specified value or lower than specified value for 5 seconds continuously (2 driving cycle detection logic)	• HO2S–1 heater • HO2S–1 heater circuit • ECM

DTC Confirmation Procedure

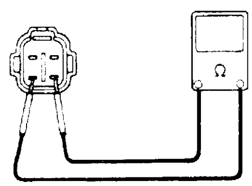
1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and warm up to normal operating temperature.
4) Run engine at idle speed for 1 min. or more.
5) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Check HO2S–1 heater power circuit. 1) Disconnect connector from HO2S–1 sensor with ignition switch turned OFF. 2) Check for proper connection to HO2S–1 sensor at “BLK/WHT” and “YEL” wire terminals. 3) If wire and connection are OK, measure voltage between “BLK/WHT” wire terminal and engine ground with ignition switch turned ON. Is voltage over 10 V?	Go to Step 3.	“BLK/WHT” wire open circuit or shorted to ground circuit.
3	Check HO2S–1 heater power circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “BLK/WHT” wire terminal of HO2S–1 connector and “E21-28” terminal wire of ECM connector. Is resistance below 5 Ω?	Go to Step 4.	“BLK/WHT” wire high resistance circuit.
4	Check HO2S–1 heater drive circuit. 1) Measure resistance between “E23-4” wire terminal of ECM connector and vehicle body ground. Is resistance infinity?	Go to Step 5.	“YEL” wire shorted to ground circuit.
5	Check HO2S–1 heater drive circuit. 1) Turn ON ignition switch. 2) Measure voltage between “E23-4” wire terminal of ECM connector and vehicle body ground. Is voltage 0 V?	Go to Step 6.	“YEL” wire shorted to power circuit.
6	Check HO2S–1 heater drive circuit. 1) Connect connector to HO2S–1 with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Measure voltage between “E23-4” wire terminal of ECM connector and vehicle body ground with disconnect connector from ECM. Is voltage over 10 V?	Go to Step 7.	“YEL” wire open circuit.
7	Check heater of sensor–1. 1) Disconnect HO2S–1 coupler with ignition switch turned OFF. 2) Check HO2S–1 heater resistance. See Fig. 1. It is 5.0 – 6.4 Ω at 20°C (68°F)?	Go to Step 8.	Replace HO2S–1.

Step	Action	Yes	No
8	Check HO2S–1 heater power circuit. 1) Disconnect connector from ECM with ignition switch turned OFF. 2) Connect connector to HO2S–1 with ignition switch turned OFF. 3) Measure resistance between “E23-4” wire and “E21-28” wire terminals of ECM connector. It resistance below 12 Ω?	HO2S–1 heater circuit are OK. Substitute a known-good ECM and recheck.	“BLK/WHT” and “YEL” wire high resistance circuit.

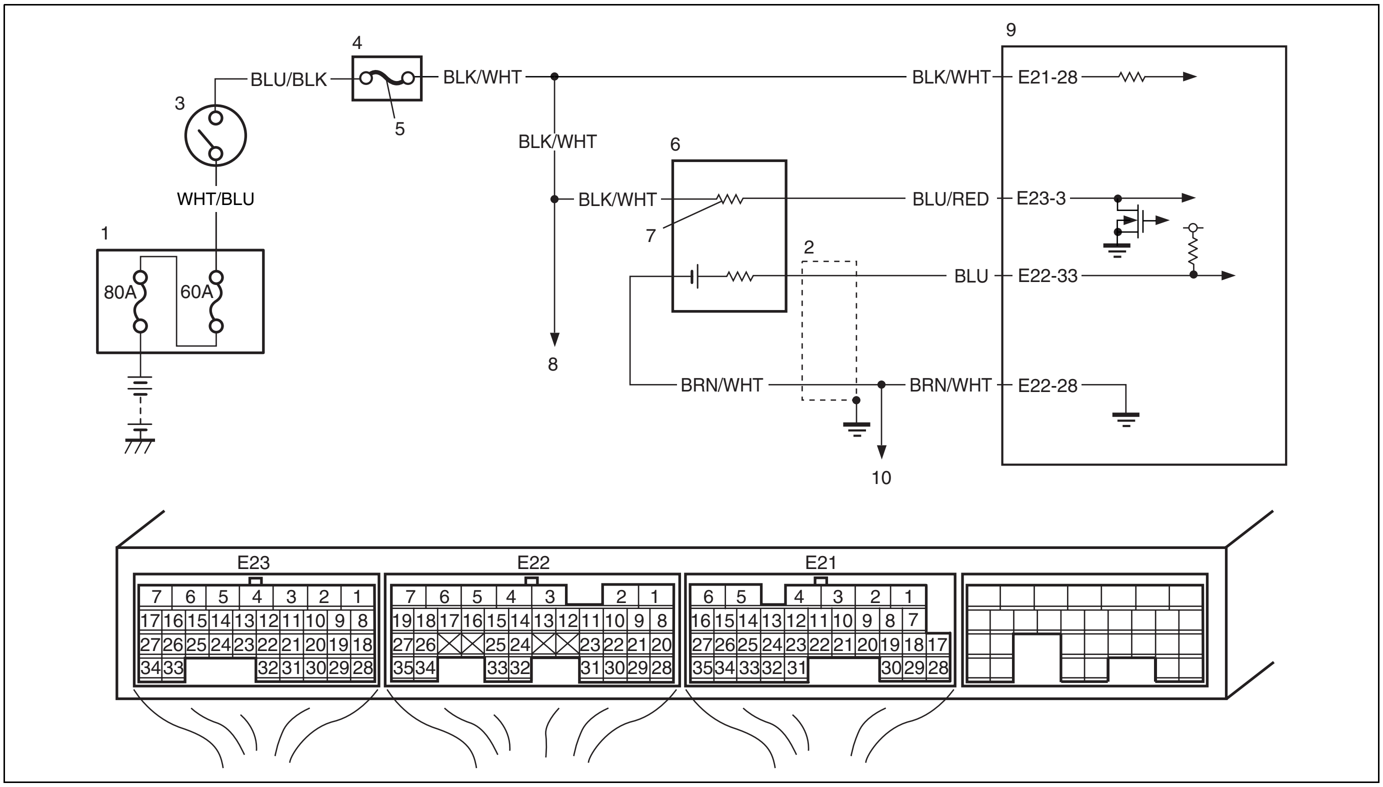
[A]



[A]: Fig. 1 for Step 7

DTC P0136 O2 Sensor (HO2S) Circuit (Sensor-2)

Wiring Diagram



1. Relay box	3. Ignition switch	5. “IG COIL” fuse	7. Heater	9. ECM
2. Shield wire	4. Circuit fuse box	6. HO2S–2	8. To HO2S–1 heater	10. To other sensor

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC will set when one of the following conditions is detected. • Maximum output voltage of HO2S–2 is lower than specified value or minimum output voltage is higher than specified value while vehicle driving. • Engine is warmed up and HO2S–2 voltage is higher than specified value (circuit open) (2driving cycle detection logic)	• HO2S–2 • HO2S–2 circuit • Fuel system • ECM • Fuel shortage • Exhaust gas leakage

DTC Confirmation Procedure

WARNING:

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

NOTE:

Check to make sure that the following conditions are satisfied when using this DTC CONFIRMATION PROCEDURE.

- **Intake air temp.: –7°C, 19.4°F or higher**
- **Engine coolant temp.: 70°C, 158°F or higher**
- **Altitude (barometric pressure): 2500 m, 8200 ft or less (540 mmHg, 72 kPa or more)**

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and warm up to normal operating temperature.
4) Increase vehicle speed to 60 – 80 km/h (37 – 50 mile/h) at 5th gear or D range.
5) Release accelerator pedal and with engine brake applied, keep vehicle coasting (with fuel cut for 4 sec. or more), then stop vehicle and run engine at idle speed for 6 sec. or more.
6) Repeat Step 4).
7) Keep above vehicle speed for 8 min. or more. (Throttle valve opening is kept constant in this Step.)
8) Repeat Step 5).
9) Check DTC and pending DTC.

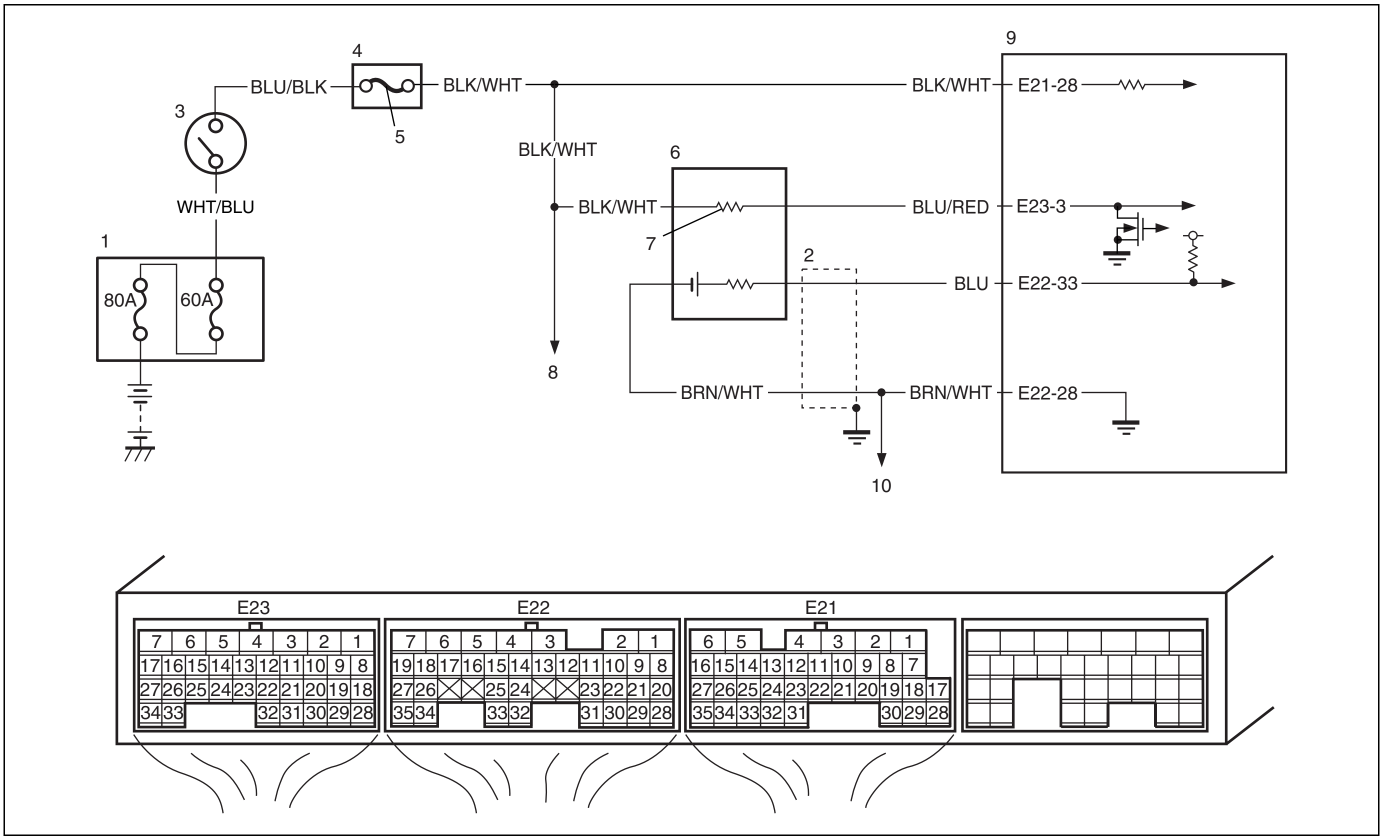
Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Is there DTC(s) other than fuel system (DTC P0171/P0172) and HO2S–2 (DTC P0134)?	Go to applicable DTC diag. flow table.	Go to Step 3.
3	Check HO2S–2 and its circuit. 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Warm up engine to normal operating temperature and keep it at 2000 r/min. for 60 sec. 3) Repeat racing engine (Repeat depressing accelerator pedal 5 to 6 times continuously and take foot off from pedal to enrich and enlean A/F mixture). Does HO2S–2 output voltage indicate deflect between over 0.35 V and below 0.25 V?	Go to DTC P0171 and P0172 diag. flow table (Fuel System Check).	Go to Step 4.
4	Check HO2S–2 sensor ground. 1) Disconnect connector from HO2S–2 sensor with ignition switch turned OFF. 2) Check for proper connection to HO2S–2 sensor connector at “BLU/RED”, “BLU”, “BRN/WHT” and “BLK/WHT” wire terminals. 3) If wire and connection are OK, check there is continuity between “BRN/WHT” wire terminal of HO2S–2 sensor connector and engine ground. Is it continuity?	Go to Step 5.	“BRN/WHT” wire open circuit. Poor “E22-28” terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.
5	Check HO2S–2 sensor ground. 1) With ignition switch turn ON, check voltage between “BRN/WHT” wire terminal of HO2S–2 sensor connector and engine ground. Is voltage about 0.1 V or less?	Go to Step 6.	“BRN/WHT” wire high resistance circuit. Poor “E22-28” terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
6	Check wire circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and connect connectors to ECM. 3) Measure resistance between “BLU” wire terminal of HO2S–2 sensor connector and “E22-33” wire terminal of ECM connector. Is resistance less than 5 Ω?	Go to Step 7.	“BLU” wire high resistance circuit or open circuit. Poor “E22-33” terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.
7	Check wire circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “BLU” wire terminal of HO2S–2 sensor connector and body ground. Is resistance infinity?	Go to Step 8.	“BLU” wire shorted to ground circuit.
8	Check HO2S–2 signal circuit. 1) Measure voltage between “BLU” wire terminal of HO2S–2 sensor connector and vehicle body ground. Is voltage 0 V?	Go to Step 9.	“BLU” wire shorted to others circuit.
9	Check HO2S–2 heater circuit. 1) Check HO2S–2 heater circuit, referring to DTC P0037 and P0038 diagnosis flow table. Is circuit in good condition?	Go to Step 10.	Repair or replace it.
10	Check exhaust system. 1) Check exhaust system for exhaust gas leakage. Is it OK?	Go to Step 4 in DTC P0171 and P0172 diagnosis flow table. If it is in good condition, go to Step 11.	Repair exhaust system for leakage.
11	Check air intake system. 1) Check air intake system for clog or leak. Is it OK?	Check HO2S–2 sensor, referring to “Heated Oxygen Sensor (HO2S–1 and HO2S–2) Heater On-Vehicle Inspection” in Section 6E2. If it is in good condition, substitute a known-good ECM and recheck.	Repair or replace.

DTC P0037 HO2S Heater Control Circuit Low (Sensor-2)
DTC P0038 HO2S Heater Control Circuit High (Sensor-2)

Wiring Diagram



1. Relay box	4. Circuit fuse box	7. Heater	10. To other sensor
2. Shield wire	5. "IG COIL" fuse	8. To HO2S–1 heater	
3. Ignition switch	6. HO2S–2	9. ECM	

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Current of HO2S–2 heater is more than specified value or less than specified value for 5 seconds continuously (2 driving cycle detection logic)	• HO2S–2 heater • HO2S–2 heater circuit • ECM

DTC Confirmation Procedure

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

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and warm up to normal operating temperature.
4) Run engine at idle speed for 1 min.
5) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check" in this section.
2	Check HO2S–2 heater power circuit. 1) Disconnect connector from HO2S–2 sensor with ignition switch turned OFF. 2) Check for proper connection to HO2S–2 sensor at "BLK/WHT" and "BLU/RED" wire terminals. 3) If wire and connection are OK, measure voltage between "BLK/WHT" wire terminal of HO2S–2 sensor connector and engine ground with ignition switch turned ON. Is voltage over 10 V?	Go to Step 3.	"BLK/WHT" wire open circuit or shorted to ground circuit.
3	Check HO2S–2 heater power circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between "BLK/WHT" wire terminal of HO2S–2 sensor connector and "E21-28" terminal wire of ECM connector. Is resistance below 5 Ω?	Go to Step 4.	"BLK/WHT" wire high resistance circuit.
4	Check HO2S–2 heater drive circuit. 1) Measure resistance between "BLU/RED" wire terminal of HO2S–2 sensor connector and vehicle body ground. Is resistance infinity?	Go to Step 5.	"BLU/RED" wire shorted to ground circuit.
5	Check HO2S–2 heater drive circuit. 1) Turn ON ignition switch. 2) Measure voltage between "BLU/RED" wire terminal of HO2S–2 sensor connector and vehicle body ground. Is voltage 0 V?	Go to Step 6.	"BLU/RED" wire shorted to power circuit.
6	Check HO2S–2 heater drive circuit. 1) Connect connector to HO2S–2 with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Measure voltage between "E23-3" wire terminal of disconnected ECM connector and vehicle body ground. Is voltage over 10 V?	Go to Step 7.	"BLU/RED" wire open circuit.
7	Check heater of sensor–2. 1) Disconnect HO2S–2 coupler with ignition switch turned OFF. 2) If OK, then check heater resistance. Is it 11.7 – 14.3 Ω at 20°C, 68°F?	Go to Step 8.	Replace HO2S–2.

Step	Action	Yes	No
8	Check HO2S–2 heater power circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Connect connector to HO2S–2 with ignition switch turned OFF. 3) Measure resistance between “E23-3” and “E21-28” wire terminals of ECM connector. Is resistance below 30 Ω?	HO2S–2 heater circuit are OK. Substitute a known-good ECM and recheck.	“BLU/RED” wire high resistance circuit.

DTC P0171 System Too Lean

DTC P0172 System Too Rich

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
P0171: Total fuel trim is higher than 35%. P0172: Total fuel trim is lower than –35%. (2 driving cycle detection logic)	• Vacuum leaks • Exhaust gas leakage • Fuel pressure out of specification • Fuel injector malfunction • Heated oxygen sensor–1 malfunction • MAF sensor malfunction • ECT sensor malfunction

DTC Confirmation Procedure

WARNING:

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

NOTE:

Check to make sure that the following conditions are satisfied when using this DTC CONFIRMATION PROCEDURE.

- **Intake air temp.: –7°C (19.4°F) or higher**
- **Altitude (barometric pressure): 2500 m, 8200 ft or less (540 mmHg, 72 kPa or more)**

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and warm up to normal operating temperature.
4) Operate vehicle within freeze frame data condition as noted for 5 min.
5) Stop vehicle and check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Is there DTC(s) other than “P0171” and “P0172”?	Go to applicable DTC flow table.	Go to Step 3.
3	Check intake system and exhaust system for leakage. Are intake system and exhaust system in good condition?	Go to Step 4.	Repair or replace.
4	Check fuel pressure referring to “Table B-3 Fuel Pressure Check” in this section. Is check result satisfactory?	Go to Step 5.	Repair or replace.
5	Check fuel injectors referring to “Fuel Injector Inspection” in Section 6E2. Is check result satisfactory?	Go to Step 6.	Faulty injector(s) or its circuit.
6	Visual inspection. Check MAF sensor and air intake system for: 1) Objects which block measuring duct and resistor of MAF sensor. 2) Other air flow which does not pass the MAF sensor. Are there in good condition?	Go to Step 7.	Repair or replace.
7	MAF sensor performance check. 1) With ignition switch turned OFF, install scan tool. 2) Start engine and warm up to normal operation temperature. 3) Check MAF value using scan tool, under the following conditions. **MAF value specification** **Idling: 1.0 – 4.0 g/sec.** **Racing at 2500 r/min: 4.0 – 12.0 g/sec.** Is each value as specified?	Go to Step 8.	Go to “DTC P0102 Mass Air Flow Circuit Low Input” and “DTC P0103 Mass Air Flow Circuit High Input” in this section.
8	Check ECT sensor referring to Step 3 and 4 of DTC P0118 diag. flow table. Is check result satisfactory?	Go to Step 9.	Faulty ECT sensor or its circuit.
9	Check HO2S–1 referring to Step 2 of DTC P0131 diag. flow table. Is check result satisfactory?	Substitute a known-good ECM and recheck.	Faulty HO2S–1 or its circuit.

DTC P0300 Random Misfire Detected
DTC P0301 Cylinder 1 Misfire Detected
DTC P0302 Cylinder 2 Misfire Detected
DTC P0303 Cylinder 3 Misfire Detected
DTC P0304 Cylinder 4 Misfire Detected

SYSTEM DESCRIPTION

ECM measure the angle of the crankshaft based on the pulse signal from the CKP sensor and CMP sensor for each cylinder. If it detects a large change in the angle speed of the crankshaft, it concludes occurrence of a misfire. When the number of misfire is counted by ECM beyond the DTC detecting condition, it determine the cylinder where the misfire occurred and output it as DTC.

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
P0300 • Misfire, which causes catalyst to overheat during 200 engine revolutions, is detected at 2 or more cylinders. (MIL flashes as long as this misfire occurs continuously.) or • Misfire, which affects exhaust emission adversely during 1000 engine revolution, is detected at 2 or more cylinders. (2 driving cycle detection logic)	• Ignition system • Fuel injector and its circuit • Fuel pressure • EGR system • Abnormal air drawn in • Engine compression • Valve lash adjuster • Valve timing • Fuel shortage
P0301, P0302, P0303, P0304 • Misfire, which causes catalyst to overheat during 200 engine revolutions, is detected at 1 cylinder. (MIL flashes as long as this misfire occurs continuously.) or • Misfire, which affects exhaust emission adversely during 1000 engine revolution, is detected at 1 cylinder. (2 driving cycle detection logic)	

DTC Confirmation Procedure

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

NOTE:
Check to make sure that the following conditions are satisfied when using this DTC CONFIRMATION PROCEDURE.
- **Intake air temp.: –7°C, 19.4°F or higher**
- **Engine coolant temp.: –10°C (14°F) or higher**
- **Altitude (barometric pressure): 2500 m, 8200 ft or less (540 mmHg, 72 kPa or more)**

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Drive vehicle under freeze frame data condition as noted for 1 min. or more.
4) Stop vehicle and check DTC and pending DTC.

Troubleshooting

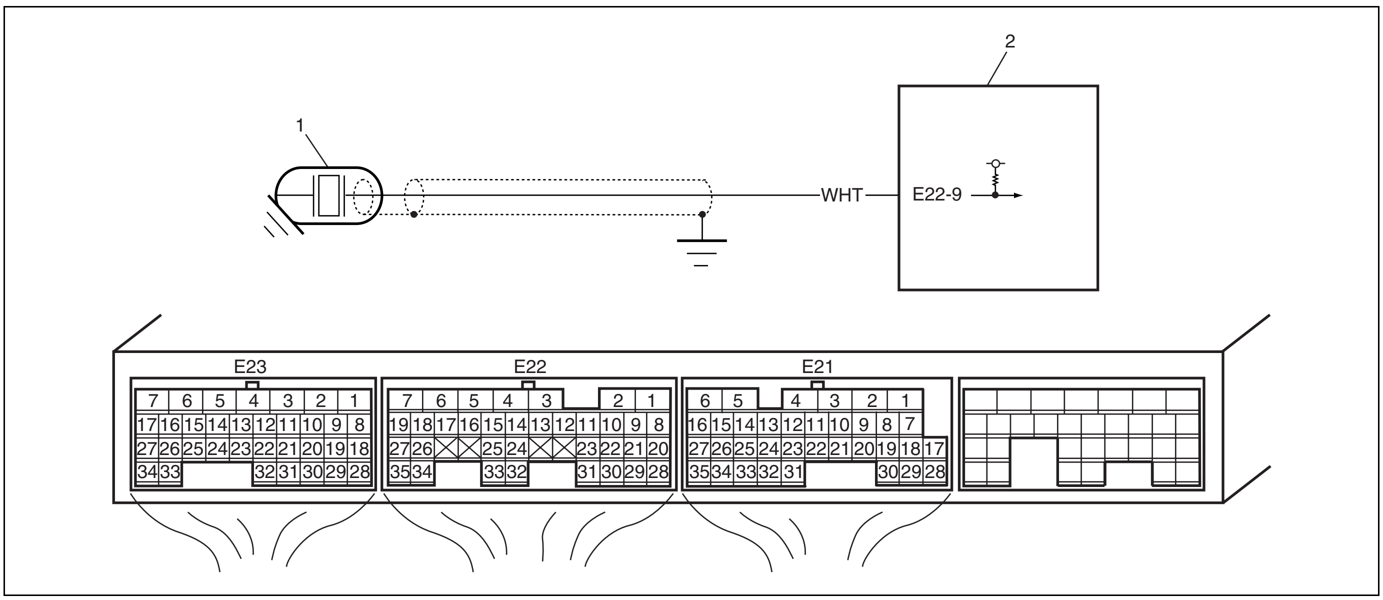
Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check" in this section.
2	Does fuel level meter indicate "E" level (empty)?	Add fuel and recheck.	Go to Step 3.
3	Ignition system inspection. 1) Check spark plug and ignition spark of cylinder where misfire occurs, referring to "Spark Plugs Inspection" and "Ignition Spark Test" in Section 6F2. Is it in good condition?	Go to Step 4.	Faulty ignition coil, wire harness, spark plug or other system parts.
4	Fuel injector circuit check. 1) Using sound scope, check each injector operating sound at engine cranking or idling. Do all injectors make operating sound?	Go to Step 5.	Check coupler connection and wire harness of injector not making operating sound and injector itself. If OK, substitute a known-good ECM and recheck.
5	Fuel pressure inspection. 1) Check fuel pressure referring to "TABLE B-3 Fuel Pressure Check" in this section. Is check result satisfactory?	Go to Step 6.	Repair or replace.
6	Fuel injector inspection. 1) Check fuel injector(s) referring to "Fuel Injector Inspection" in Section 6E2. Is check result satisfactory?	Go to Step 7.	Replace.
7	Ignition timing inspection. 1) Check ignition timing referring to "Ignition Timing Inspection" in Section 6F2. Is check result satisfactory?	Go to Step 8.	Check related sensors.
8	EGR system inspection. 1) Check EGR system referring to "EGR Valve Inspection" in Section 6E2. Is check result satisfactory?	Go to Step 9.	Repair or replace.

Step	Action	Yes	No
9	Engine mechanical systems check. Check engine mechanical parts or system which can cause engine rough idle or poor performance. – Engine compression (Refer to "Compression Check" in Section 6A2.) – Valve lash adjustor (Refer to "Valve Lash (Clearance) Inspection in Section 6A2.) – Valve timing (Refer to "Timing Chain and Chain Tensioner Removal and Installation in Section 6A2.) Are they in good condition?	Check wire harness and connection of ECM ground, ignition system and fuel injector for intermittent open and short.	Repair or replace.

DTC P0327 Knock Sensor Circuit Low

DTC P0328 Knock Sensor Circuit High

Wiring Diagram



1. Knock sensor	2. ECM

DTC Detecting Condition and Trouble Area

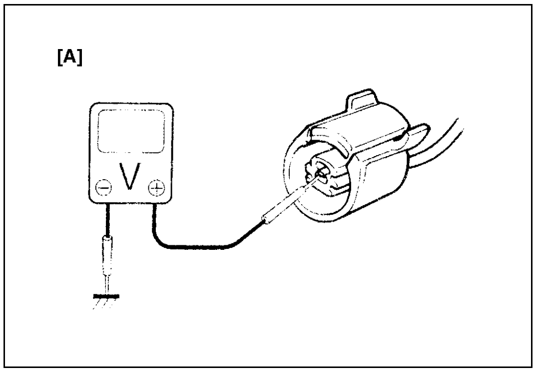
DTC Detecting Condition	Trouble Area
DTC will be set when all of the following conditions are detected for 0.5 seconds continuously. P0327 • Engine is running • Voltage of knock sensor is less than 1.23 V P0328 • Engine is running • Voltage of knock sensor is 3.91 V or more	• Open or short in knock sensor circuit • Knock sensor • ECM

DTC Confirmation Procedure

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

Troubleshooting

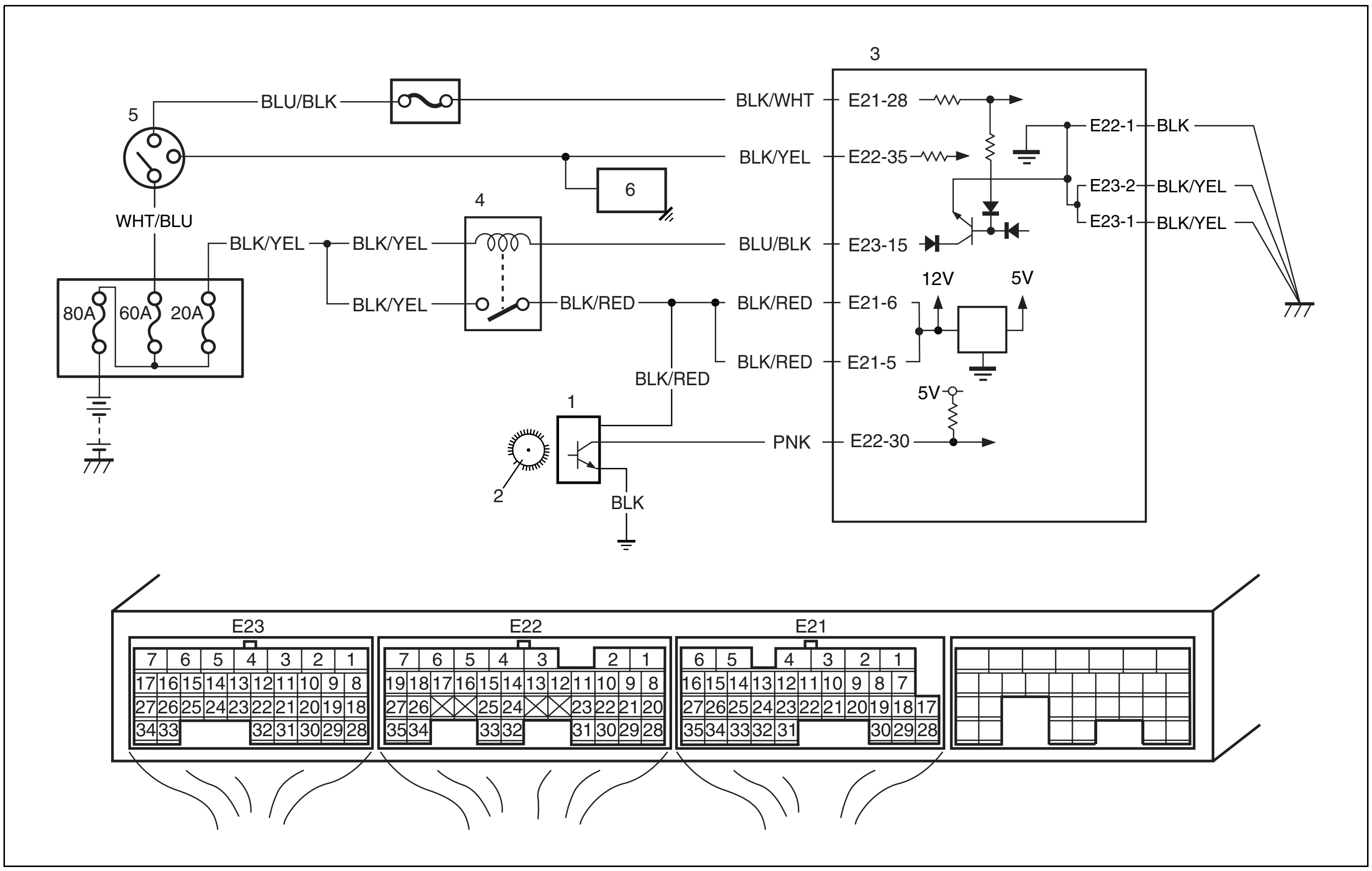
Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Check sensor circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and connect connectors to ECM. 3) Measure voltage between “E22-9” wire terminal of ECM connector and vehicle body ground with engine running. Is voltage within 1.23 – 3.91 V?	Intermittent trouble. Check for intermittent refer to “Intermittent and Poor Connection Inspection” in Section 0A. If OK, substitute a known-good ECM and recheck.	Go to Step 3.
3	Check sensor circuit for open. 1) Disconnect connector from knock sensor with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between “WHT” wire of knock sensor connector and engine ground. See Fig. 1. Is voltage 4 – 6 V?	Go to Step 6.	Go to Step 4.
4	Check sensor circuit for open. 1) Turn ON ignition switch, measure voltage between “E22-9” wire terminal of ECM connector and engine ground. Is voltage 4 – 6 V?	“WHT” wire in open circuit.	Go to Step 5.
5	Check sensor circuit for short. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “E22-9” terminal of ECM connector and vehicle body ground. Is resistance infinity?	Go to Step 6.	“WHT” wire in shorted to ground circuit. If wire is OK, substitute a known-good ECM and recheck.
6	Check sensor circuit for short. 1) Turn ON ignition switch, measure voltage between “E22-9” terminal of ECM connector and vehicle body ground. Is voltage 0 V?	Go to Step 7.	“WHT” wire in shorted to other circuit.
7	Check sensor circuit for high resistance. 1) Measure resistance between “E22-9” wire terminal of ECM connector and “WHT” wire terminal of knock sensor harness connector. Is resistance below 5Ω?	Faulty knock sensor	“WHT” wire in high resistance circuit.



[A]: Fig. for Step 3

DTC P0335 Crankshaft Position (CKP) Sensor Circuit

Wiring Diagram



1. CKP sensor	4. Main relay
2. Sensor plate on crankshaft	5. Ignition switch
3. ECM	6. Starting motor

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
No CKP sensor signal for 2 seconds at engine cranking while starting motor signal is inputting	• CKP sensor circuit open or short • Crankshaft timing pulley teeth damaged • CKP sensor malfunction, foreign material being attached or improper installation • ECM • Engine start signal circuit malfunction

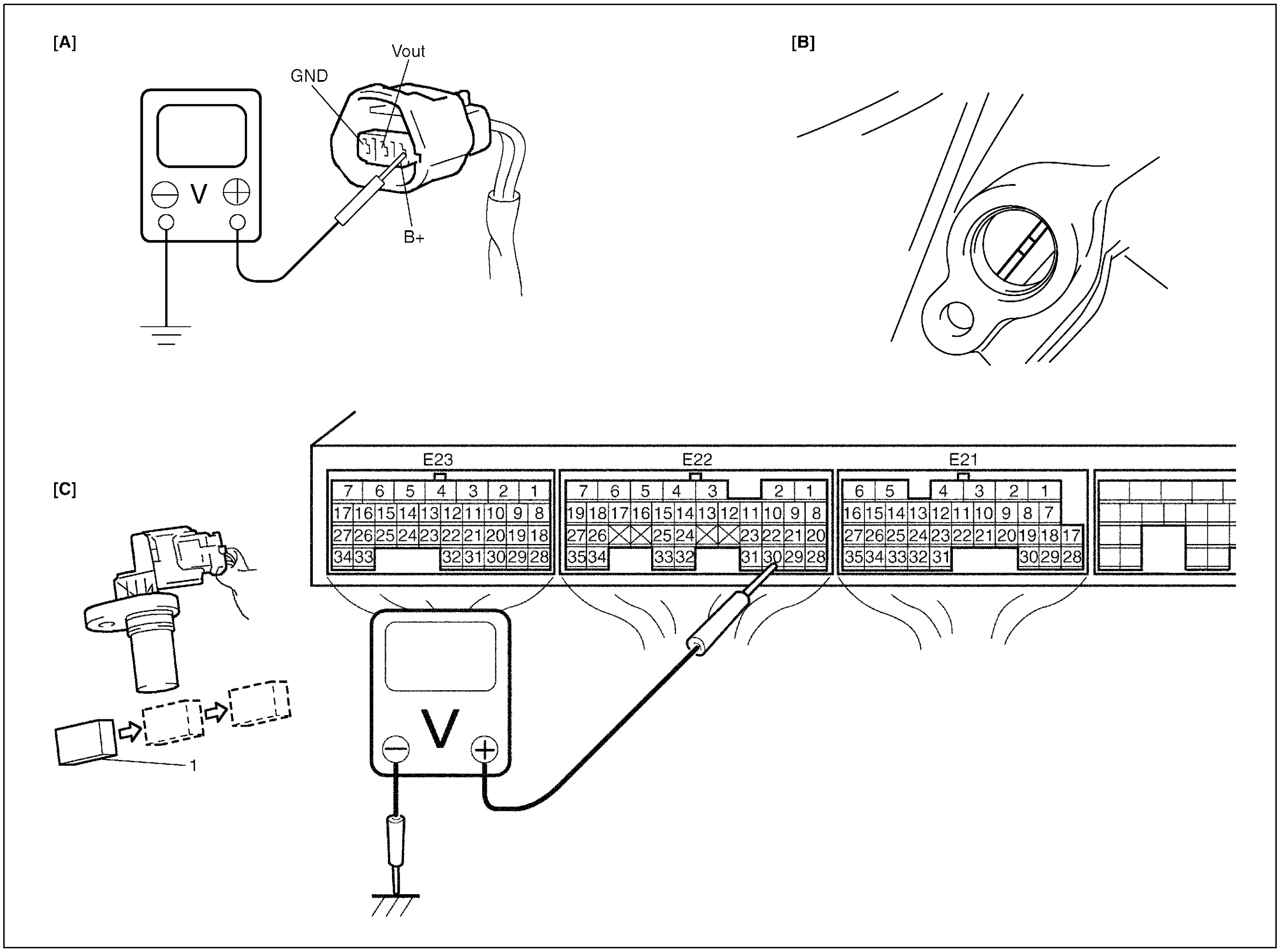
DTC Confirmation Procedure

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Crank engine for 3 – 5 sec.
4) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Check CKP sensor and connector for proper installation. Is CKP sensor installed properly and connector connected securely?	Go to Step 3.	Correct.
3	Check Wire Harness and Connection. 1) Disconnect connector from CKP sensor. 2) Check for proper connection to CKP sensor at “BLK/RED”, “PNK” and “BLK” wire terminals. 3) If OK, turn ignition switch ON and check for voltage at “BLK/RED”, “PNK” and “BLK” wire terminals of disconnected CKP sensor connector. See fig. 1. Terminal “B+”: 10 – 14 V Terminal “Vout”: 4 – 5 V Terminal “GRD”: 0 V Is check result satisfactory?	Go to Step 5.	Go to Step 4.
4	Was terminal “Vout” voltage in Step 3 out of specification?	“PNK” wire open, short or poor connection. If wire and connection are OK, substitute a known-good ECM and recheck.	“BLK/RED” and “BLK” wire open, short or poor connection.
5	Check Ground Circuit. 1) Turn ignition switch to OFF position. 2) Measure resistance between “BLK” wire terminal of CKP sensor connector and engine ground. Is resistance below 5 Ω?	Go to Step 6.	“BLK” wire open or high resistance.
6	Check Engine Start Signal. 1) Check voltage between “E22-35” wire terminal of ECM connector and engine ground with engine cranking. Does it voltage more than 6 V?	Go to Step 7.	“BLK/YEL” wire circuit open, high resistance or shorted to ground. If wire are OK, check starting motor referring to “Performance Test” in Section 6G.

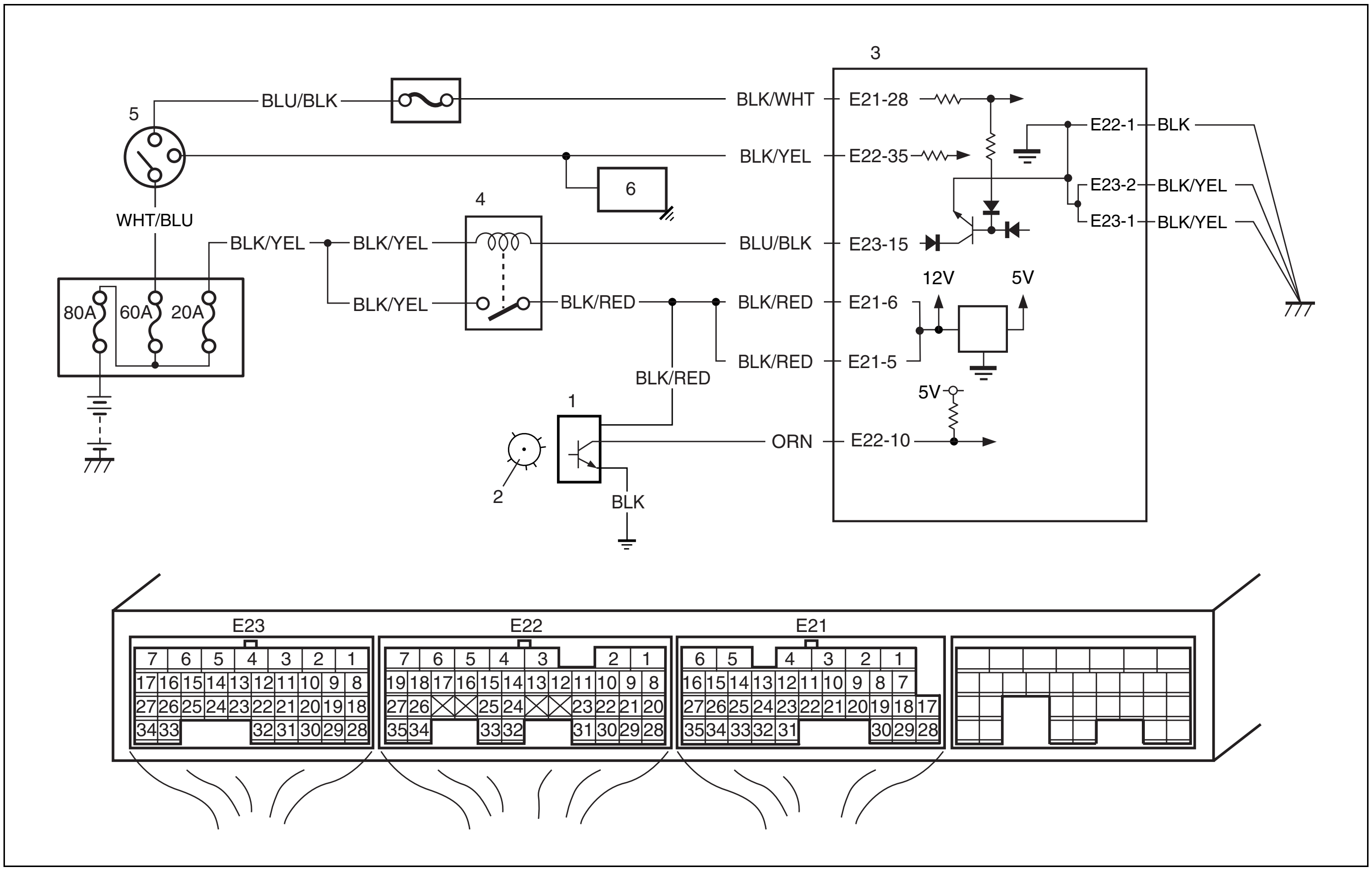
Step	Action	Yes	No
7	Check CKP Sensor. 1) Remove CKP sensor referring to “CKP Sensor Removal and Installation” in Section 6E2. 2) Remove metal particles on end face of CKP sensor, if any. 3) Connect CKP sensor connector. 4) Turn ignition switch to ON position. 5) Check voltage between “E22-30” wire terminal of ECM connector and engine ground by passing magnetic substance (iron) (1) while keeping approx. 1 mm (0.03 in.) gap with respect to end face of CKP sensor. See fig. 2. Does voltage vary from low (0 – 1 V) to high (4 – 5 V) or from high to low?	Go to Step 8.	Replace CKP sensor.
8	Check signal rotor for the following. See fig. 3. • Damage • No foreign material attached Is it in good condition?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection Inspection” in Section 0A.	Clean rotor teeth or replace signal rotor.



[A]: Fig. 1 for Step 3	[B]: Fig. 3 for Step 8	[C]: Fig. 2 for Step 7

DTC P0340 Camshaft Position Sensor Circuit

Wiring Diagram



1. CMP sensor	3. ECM	5. Ignition switch
2. Signal rotor	4. Main relay	6. Starting motor

System Description

The CMP sensor located on the transmission side of cylinder head consists of the signal generator (magnetic sensor) and signal rotor (intake camshaft portion).
The signal generator generates Reference signal through slits in the slit plate which turns together with the camshaft.

Reference signal

The CMP sensor generates 6 pulses of signals each of which has a different waveform length while the camshaft makes one full rotation. Refer to “Inspection of ECM and Its Circuits” in this section.
Based on these signals, ECM judges which cylinder piston is in the compression stroke and the engine speed.

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
No CMP sensor signal for 2.4 seconds at engine cranking while starting motor signal is inputting	• CMP sensor circuit open or short • Signal rotor teeth damaged • CMP sensor malfunction, foreign material being attached or improper installation • ECM • Engine start signal circuit malfunction

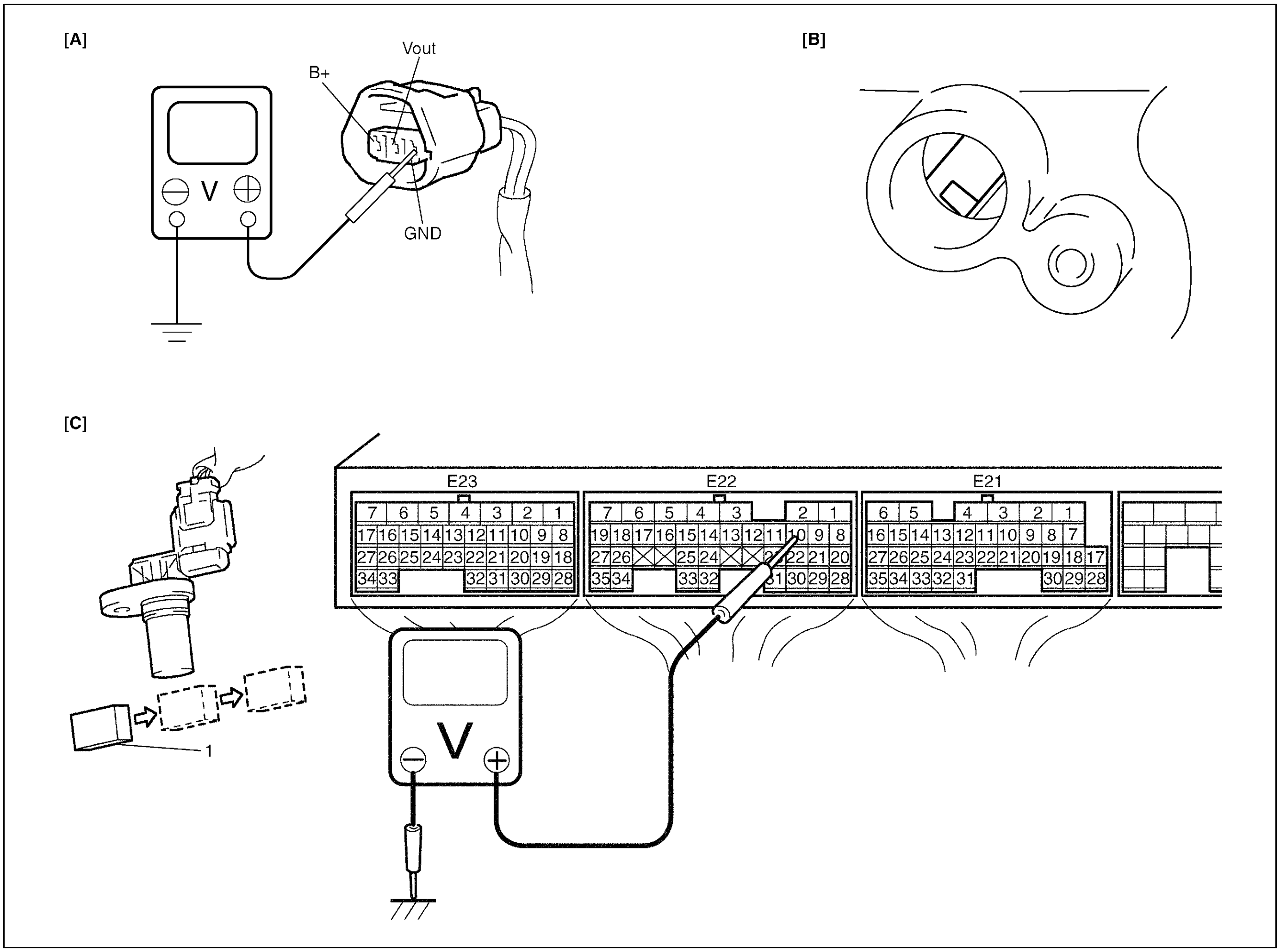
DTC Confirmation Procedure

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Crank engine for 5 sec.
4) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check" in this section.
2	Check CMP sensor and connector for proper installation. Is CMP sensor installed properly and connector connected securely?	Go to Step 3.	Correct.
3	Check Wire Harness and Connection. 1) Disconnect connector from CMP sensor. 2) Check for proper connection to CMP sensor at "BLK/RED", "ORN" and "BLK" wire terminals. 3) If OK, turn ignition switch ON and check for voltage at "BLK/RED", "ORN" and "BLK" wire terminals of disconnected CMP sensor connector. See fig. 1. Terminal "B+": 10 – 14 V Terminal "Vout": 4 – 5 V Terminal "GRD": 0 V Is check result satisfactory?	Go to Step 5.	Go to Step 4.
4	Was terminal "Vout" voltage in Step 3 out of specification?	"ORN" wire open, short or poor connection. If wire and connection are OK, substitute a known-good ECM and recheck.	"BLK/RED" and "BLK" wire open, short or poor connection.
5	Check Ground Circuit. 1) Turn ignition switch to OFF position. 2) Check for continuity between "BLK" wire terminal of CKP sensor connector and engine ground. Is continuity indicated?	Go to Step 6.	"BLK" wire open or poor connection.
6	Check Engine Start Signal. 1) Check voltage between "E22-35" wire terminal of ECM connector and engine ground with engine cranking. Does it voltage more than 6 V?	Go to Step 7.	"BLK/YEL" wire circuit open or shorted to ground. If wire are OK, check starting motor referring to "Performance Test" in Section 6G.

Step	Action	Yes	No
7	Check CMP Sensor. 1) Remove CMP sensor referring to “CMP Sensor Removal and Installation” in Section 6E2. 2) Remove metal particles on end face of CMP sensor, if any. 3) Connect CMP sensor connector. 4) Turn ignition switch to ON position. 5) Check voltage between “E22-10” terminal of ECM connector and engine ground by passing magnetic substance (iron) (1) while keeping approx. 1 mm (0.03 in.) gap with respect to end face of CMP sensor. See fig. 2. Does voltage vary from low (0 – 1 V) to high (4 – 5 V) or from high to low?	Go to Step 8.	Replace CMP sensor.
8	Check signal rotor for the following. See fig. 3. • Damage • No foreign material attached Is it in good condition?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection Inspection” in Section 0A.	Clean rotor teeth or replace signal rotor.

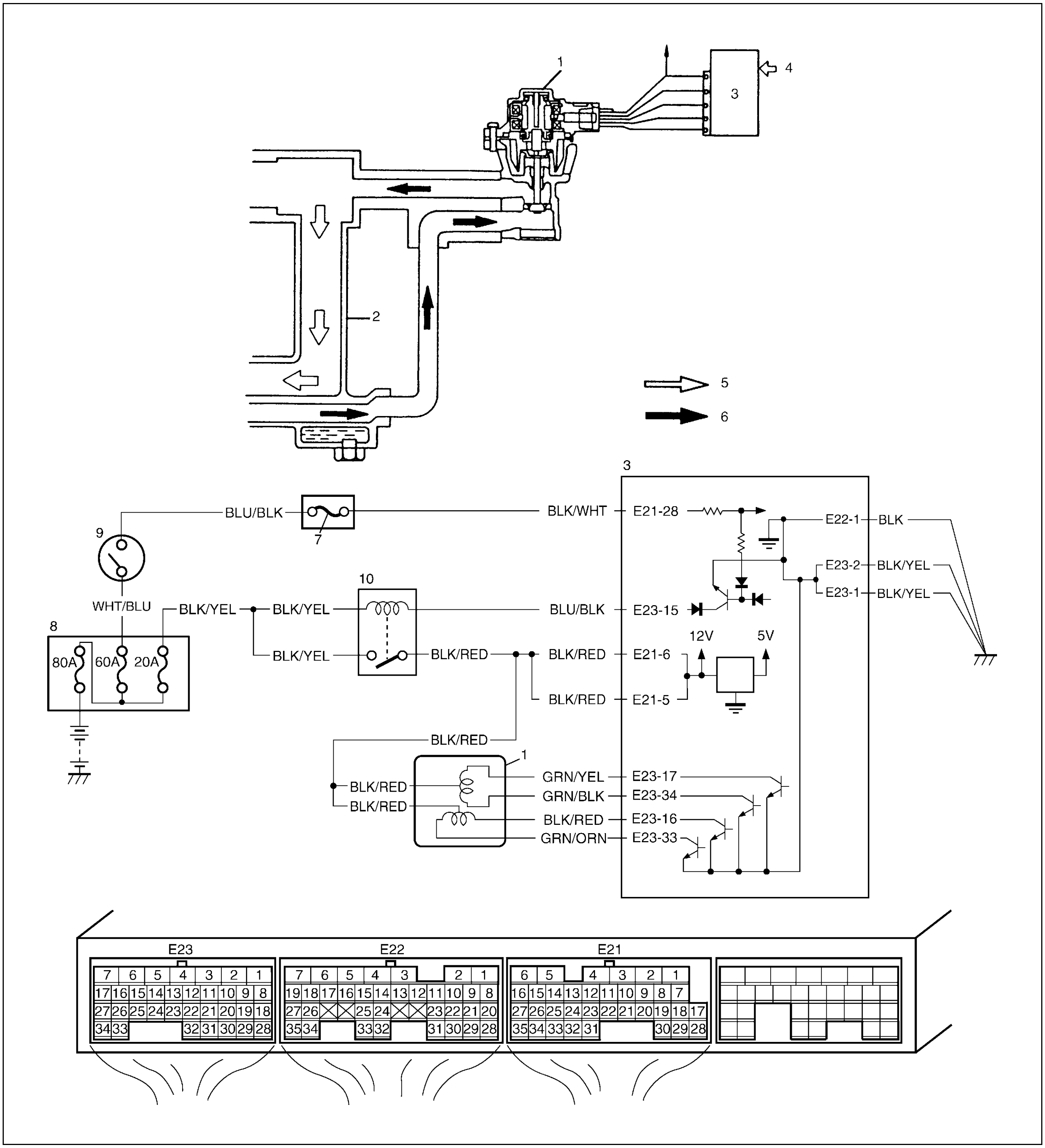


[A]: Fig. 1 for Step 3	[B]: Fig. 3 for Step 8	[C]: Fig. 2 for Step 7

DTC P0401 Exhaust Gas Recirculation Flow Insufficient Detected

DTC P0402 Exhaust Gas Recirculation Flow Excessive Detected

System/Wiring Diagram



1. EGR value	4. Sensed information	7. “IG COIL” fuse	10. Main relay
2. Intake manifold	5. Fresh air	8. Relay box	
3. ECM	6. Exhaust gas	9. Ignition switch	

DTC Detecting Condition and Trouble Area (DTC P0401/P0402)

DTC Detecting Condition	Trouble Area
DTC P0401: Difference in intake manifold absolute pressure between opened EGR valve and closed EGR valve is smaller than specified value. DTC P0402: Difference in intake manifold absolute pressure between opened EGR valve and closed EGR valve is larger than specified value. (✱2 driving cycle detection logic, monitoring once/1 driving)	• EGR valve • EGR passage • MAP sensor • ECM

DTC Confirmation Procedure (DTC P0401/P0402)

WARNING:

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

NOTE:

Check to make sure that following conditions are satisfied when using this DTC CONFIRMATION PROCEDURE.

- **Intake air temp.: –7°C (19.4°F) or higher**
- **Engine coolant temp.: 70°C (158°F) or higher**
- **Altitude (barometric pressure): 2500 m, 8200 ft or less (540 mmHg, 72 kPa or more)**

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and warm up to normal operating temperature.
4) Increase engine speed to 3000 rpm in 3rd gear.
5) Release accelerator pedal and with engine brake applied, keep vehicle coasting for 5 sec. or more. (Keep fuel cut condition for 5 sec. or more) If fuel cut condition is not kept for 5 sec. or more, coast down a slope in engine speed 1000 – 3000 rpm for 5 sec. or more.
6) Step vehicle and run engine at idle.
7) Check DTC and pending DTC by using scan tool.

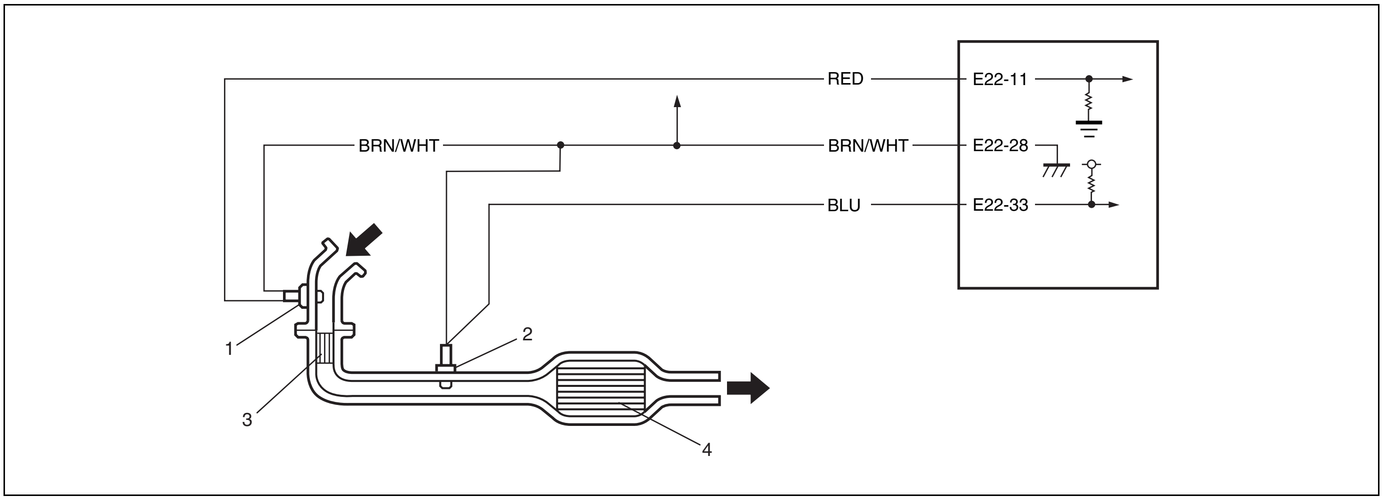
Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Do you have SUZUKI scan tool?	Go to Step 3.	Go to Step 5.
3	EGR valve operation check. 1) With ignition switch turned OFF, install SUZUKI scan tool. 2) Check EGR system referring to “EGR System Inspection” in Section 6E2. Is it in good condition?	Go to Step 4.	Go to Step 10.

Step	Action	Yes	No
4	MAP sensor check. 1) Check MAP sensor for performance referring to "MAP Sensor Individual Check" in "DTC P0108" Diag. Flow Table. Is check result satisfactory?	Intermittent trouble or faulty ECM Check for intermittent referring to "Intermittent and Poor Connection Inspection" in Section 0A.	Repair or replace.
5	EGR valve power supply circuit check. 1) With ignition switch turned OFF, disconnect EGR valve coupler. 2) With ignition switch turned ON, check voltage between "BLK/RED" wire terminal of EGR valve coupler and engine ground. Is each voltage 10 – 14 V?	Go to Step 6.	Faulty "BLK/RED" wire.
6	Check wire circuit. 1) Measure voltage between engine ground and each "GRN/YEL", "GRN/BLK", "BLK/RED" and "GRN/ORN" wire terminal of EGR valve connector. Is each voltage 0 V?	Go to Step 7.	Some wire shorted to other circuits. If wires are OK, substitute a known-good ECM and recheck.
7	Check wire circuit. 1) With ignition switch turned OFF, check that there are insulating between engine ground and each "GRN/YEL", "GRN/BLK", "BLK/RED" and "GRN/ORN" wire terminal of EGR valve connector. Are there insulating?	Go to Step 8.	Some wire shorted to ground circuit. If wires are OK, substitute a known-good ECM and recheck.
8	EGR valve stepping motor coil circuit check. 1) With ignition switch turned OFF, connect EGR valve coupler and disconnect ECM couplers. 2) Check resistance between "E21-5/6" and "E23-17", "E23-34", "E23-16", "E23-33" wire terminal of ECM connector. Is each resistance 20 – 24 Ω at 20°C, 68°F.	Go to Step 9.	Faulty "GRN/YEL", "GRN/BLK", "BLK/RED" and "GRN/ORN" wire or EGR valve.
9	Check wire circuit. 1) Measure voltage between engine ground and each "GRN/YEL", "GRN/BLK", "BLK/RED" and "GRN/ORN" wire terminal of EGR valve connector. Is each voltage 10 – 14 V?	Some wire in high resistance circuit. If wires are good condition, faulty EGR valve.	Some wire open circuit. If wires are good condition, faulty EGR valve.
10	MAP sensor check: 1) Check MAP sensor for performance referring to "MAP Sensor Individual Check" in "DTC P0108" Diag. Flow Table. Is check result satisfactory?	EGR passage clogged or EGR valve malfunction, If all above are OK, substitute known-good ECM and recheck.	Repair or replace.

DTC P0420 Catalyst System Efficiency Below Threshold

System/Wiring Diagram

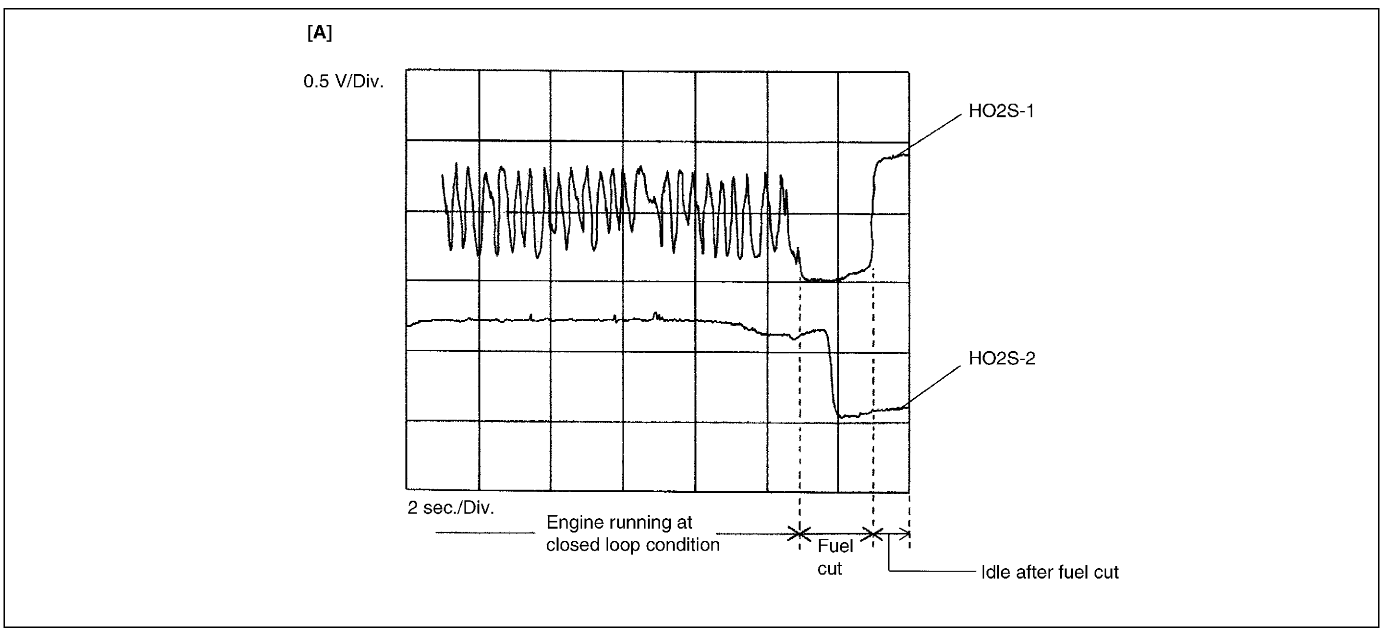


Circuit Description

ECM monitors oxygen concentration in the exhaust gas which has passed the three way catalytic converter by HO2S–2 (2).

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

Reference



[A]: Oscilloscope Waveforms

DTC Detecting Condition and Trouble Area

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

DTC Confirmation Procedure

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

NOTE:
Check to make sure that following conditions are satisfied when using this DTC CONFIRMATION PROCEDURE.
- **Intake air temp.: –7°C (19.4°F) or higher**
- **Engine coolant temp.: 70°C (158°F) or higher**
- **Altitude (barometric pressure): 2500 m, 8200 ft or less (540 mmHg, 72 kPa or more)**

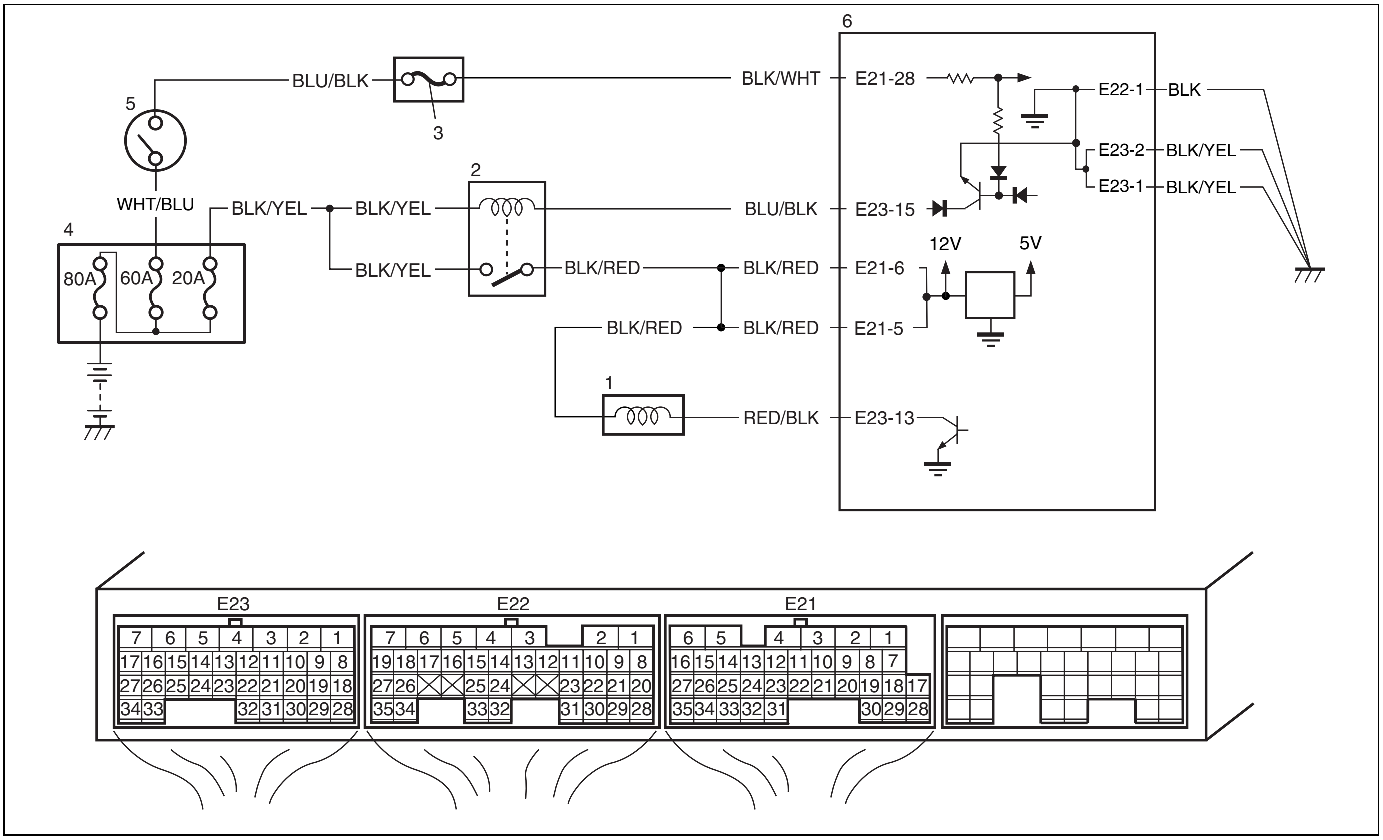
1) Connect scan tool to DLC with ignition switch turned OFF.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Increase vehicle speed to 50 – 60 mph, 80 – 100 km/h. (engine speed: 2500 – 3000 r/min.)
4) Keep above vehicle speed for 10 min. or more (Throttle valve opening is kept constant in this step).
5) Stop vehicle and check if DTC/pending DTC exists using scan tool. If not, check if catalyst monitoring test has completed using scan tool. If not in both of above checks (i.e., no DTC/pending DTC and catalyst monitoring test not completed), check vehicle condition (environmental) and repeat step 3) through 5).

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Exhaust system visual inspection. 1) Check exhaust system for leaks, damage and loose connection. Is it in good condition?	Go to Step 3.	Repair or replace.
3	HO2S–2 output voltage check. 1) Check output voltage of HO2S–2 referring to DTC P0137 or P0138 Diag. Flow Table. Is check result satisfactory?	Replace three way catalytic converter.	Check “BLU” and “BRN/WHT” wires for open and short, and connections for poor connection. If wires and connections are OK, replace HO2S–2.

DTC P0443 Evaporative Emission System Purge Control Valve Circuit

Wiring Diagram



1. EVAP canister purge valve	3. "IG COIL" fuse	5. Ignition switch
2. Main relay	4. Relay box	6. ECM

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Monitor signal of EVAP canister purge valve is different from command signal. (Circuit open or short) (2 driving cycle detection logic)	• EVAP canister purge valve • EVAP canister purge valve circuit • ECM

DTC Confirmation Procedure

WARNING:

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

1) With ignition switch OFF, connect scan tool to DLC.
2) Turn On ignition switch and clear DTC using scan tool.
3) Start engine and run engine at idle speed (600 rpm or more) for 1 minute with all electric loads turned OFF.
4) Check DTC and pending DTC.

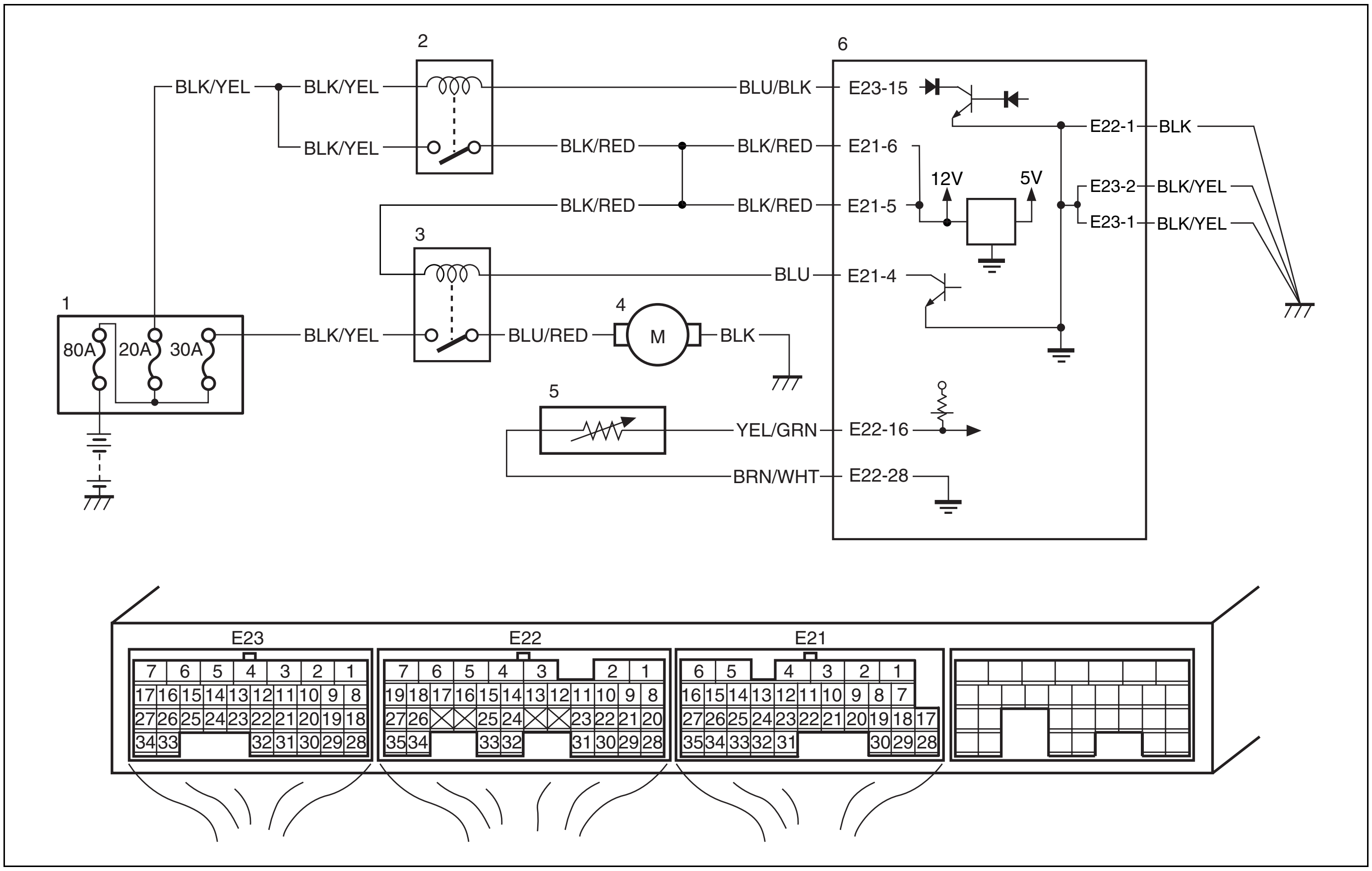
Troubleshooting

WARNING:
In order to reduce risk of fire and personal injury, this work must be performed in a well ventilated area and away from any open flames such as gas hot water.

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check".
2	Check EVAP canister purge power supply circuit. 1) Turn OFF ignition switch, disconnect connector from EVAP canister purge valve. 2) Measure voltage between engine ground and "BLK/RED" wire terminal of EVAP canister purge valve connector with ignition switch turned ON. Is it voltage 10 – 14 V?	Go to step 3.	"BLK/RED" wire open circuit.
3	Check wire circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between "E23-13" terminal of ECM connector and vehicle body ground. Is resistance infinity?	Go to Step 4.	"RED/BLK" wire shorted to ground circuit.
4	Check wire circuit. 1) Measure voltage between "E23-13" terminal of ECM connector and vehicle body ground. Is voltage 0 V?	Go to Step 5.	"RED/BLK" wire shorted to others circuit.
5	Check wire circuit. 1) Connect connector to purge control valve with ignition switch turned OFF. 2) Remove ECM from vehicle body and then connect connectors to ECM. 3) Turn ON ignition switch, measure voltage between "E23-13" terminal of ECM connector and vehicle body ground. Is it voltage 10 – 14 V?	Go to Step 6.	"RED/BLK" wire open circuit.
6	Check EVAP canister purge control valve. 1) Check EVAP canister purge control valve referring to "Evaporative Emission Control System Inspection" in Section 6E2. Is it in good condition?	Go to Step 7.	Faulty EVAP canister purge control valve.
7	Check EVAP canister purge control circuit. 1) With ignition switch turn OFF, measure resistance between "E21-5/6" terminal and "E23-13" terminal of ECM connector. Is resistance below 40 Ω at 20°C, 68°F?	Faulty ECM, substitute a known-good ECM and recheck.	"BLK/RED" and/or "RED/BLK" wire in high resistance circuit.

DTC P0480 Fan 1 (Radiator Cooling Fan) Control Circuit

Wiring Diagram



1. Relay box	3. Radiator fan relay	5. ECT sensor
2. Main relay	4. Radiator fan motor	6. ECM

Circuit Description

Radiator fan relay is controlled by ECM if ECT is specified value.
When A/C condenser fan motor is running while head light is turned ON and engine is running at below 1500 r/min, radiator fan relay is turned OFF for 2 sec. by ECM.

DTC Detecting Condition	Trouble Area
• Monitor signal of radiator fan relay is different from command signal.	• “BLK/RED” or “BLU” circuit open or short • Radiator fan relay malfunction • ECM malfunction

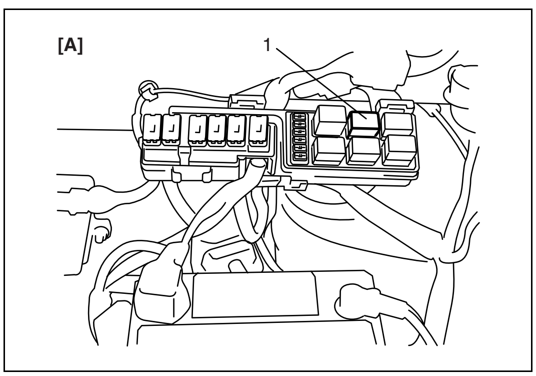
DTC Confirmation Procedure

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

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Check Relay Circuit 1) Disconnect radiator fan relay from relay box with ignition switch turned OFF. (See Fig. 1.) 2) Turn ignition switch to ON position. 3) Measure voltage between “BLK/RED” wire terminal of radiator fan relay connector and engine ground. Is voltage 10 – 14 V?	Go to Step 3.	“BLK/RED” wire in open or high resistance circuit.
3	Check Relay Circuit 1) Turn ignition switch to OFF position. 2) Install radiator fan relay to relay box. 3) Disconnect connectors from ECM. 4) Remove ECM from vehicle body and then connect connectors to ECM. 5) Turn ignition switch to ON position. 6) Measure voltage between “E21-4” wire terminal of ECM connector and vehicle body ground. Is voltage 10 – 14 V?	Go to Step 4.	Go to Step 6.
4	Check Relay Circuit 1) Turn ignition switch to OFF position. 2) Disconnect connectors from ECM. 3) Remove radiator fan relay from relay box. 4) Measure voltage between “E21-4” wire terminal of ECM connector and vehicle body ground with ignition switch turned ON. Is voltage 0 V?	Go to Step 5.	“BLU” wire shorted to power circuit.
5	Radiator Fan Control Signal Check 1) Disconnect negative (–) cable at battery. 2) Disconnect connector from ECT sensor. 3) Connect connectors to ECM. 4) Install radiator fan relay to relay box. 5) Connect negative (–) cable to battery. 6) Measure voltage between “E21-4” wire terminal of ECM connector and vehicle body ground with ignition switch turned ON. Is voltage about 0 V?	System is in good condition.	Substitute a known-good ECM and recheck.
6	Radiator Fan Control Signal Check 1) Turn ignition switch to OFF position. 2) Install radiator fan relay to relay box. 3) Disconnect connectors from ECM. 4) Measure voltage between “E21-4” wire terminal of ECM connector and vehicle body ground with ignition switch turned ON. Is voltage 10 – 14 V?	Substitute a known-good ECM and recheck.	Go to Step 7.

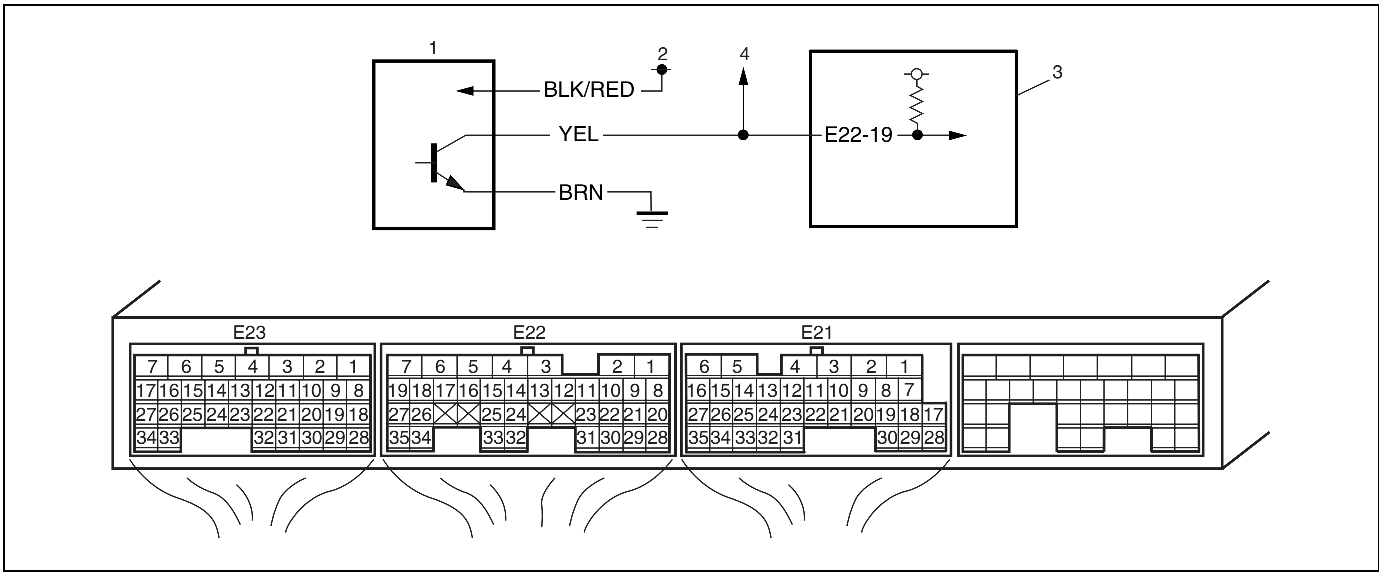
Step	Action	Yes	No
7	Check Relay Circuit 1) Turn ignition switch to OFF position. 2) Disconnect connectors from ECM. 3) Remove radiator fan relay from relay box. 4) Check for proper connection to “E21-4” wire terminal of ECM connector and “BLU” wire terminal of radiator fan relay connector. 5) If OK, measure resistance between “E21-4” wire terminal of ECM connector and “BLU” wire terminal of radiator fan relay connector. Is resistance 1 Ω or less?	Go to Step 8.	“BLU” wire in open or high resistance circuit.
8	Check Relay Circuit 1) Measure resistance between “E21-4” wire terminal of ECM connector and vehicle body ground. Is it infinite?	Go to Step 9.	“BLU” wire shorted to ground circuit.
9	Check Radiator Fan Relay 1) Check radiator fan relay referring to “Main Relay, Fuel Pump Relay and Radiator Fan Relay Inspection” in Section 6E2. Is it in good condition?	System is in good condition. Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection” in Section 0A.	Replace radiator fan relay.



[A]:	Fig. 1 for Step 2
1.	Radiator fan relay

DTC P0500 Vehicle Speed Sensor (VSS) Malfunction

Wiring Diagram



1. VSS	3. ECM
2. To main relay	4. To TCM (if equipped)

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• Vehicle speed signal is not input while fuel cut at deceleration for 4 seconds continuously.	• “BRN” circuit open • “YEL” or “BLK/RED” circuit open or short • VSS malfunction • ECM malfunction

DTC Confirmation Procedure

WARNING:

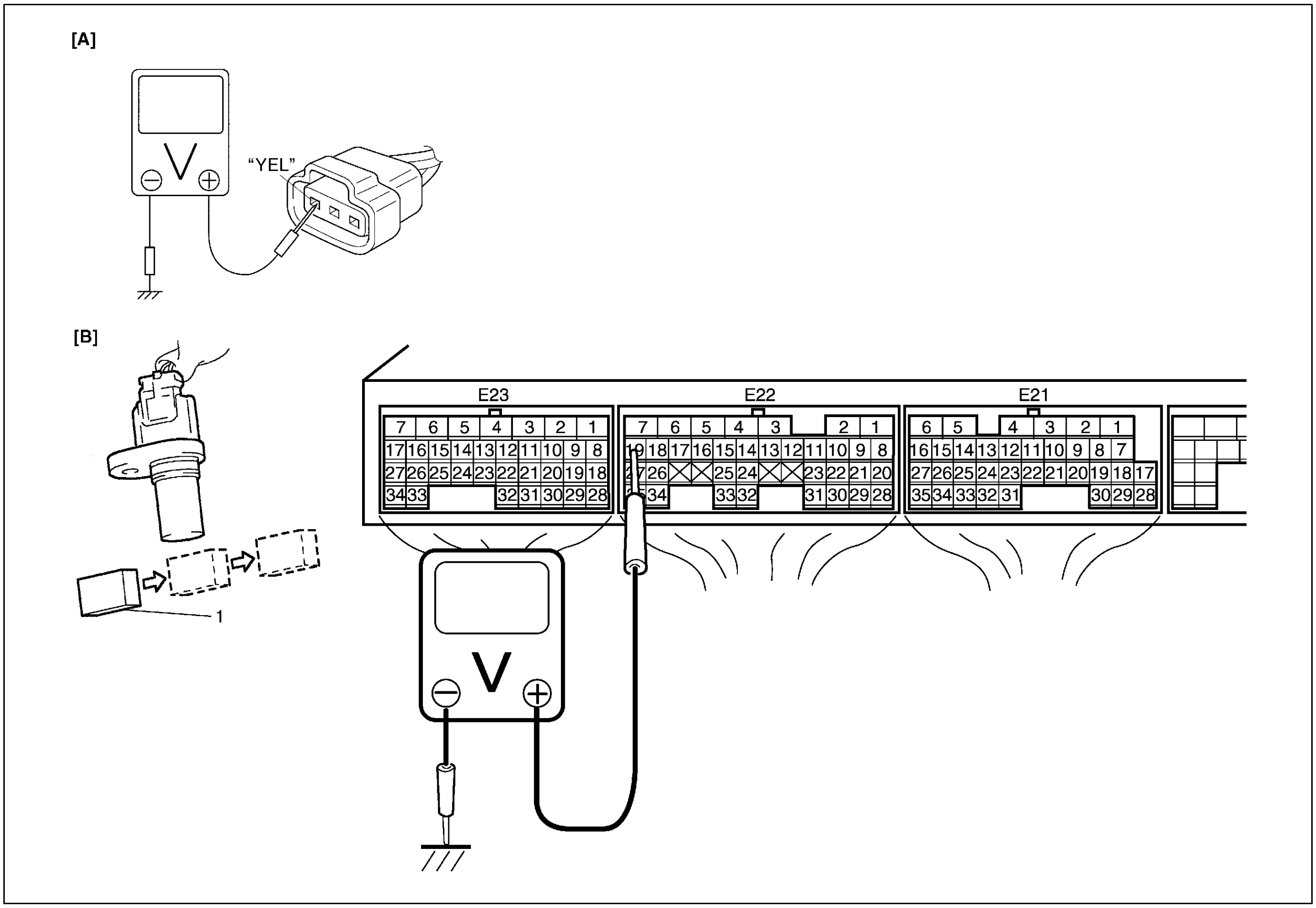
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester.**

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Warm up engine to normal operating temperature.
4) Increase vehicle speed to 50 mph, 80 km/h.
5) Release accelerator pedal and with engine brake applied, keep vehicle coasting for 6 sec. or more (fuel cut condition for 5 sec. or more) and stop vehicle.
6) Check pending DTC and DTC.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check".
2	Check vehicle speed signal. Is vehicle speed displayed on scan tool in step 4) and 5) of DTC confirmation procedure?	Intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection Inspection" in Section 0A.	Go to Step 3.
3	Check power supply circuit. 1) With ignition switch turned OFF, disconnect connector from VSS. 2) Check for proper connection for "BLK/RED", "BRN" and "YEL" wire terminal. 3) If wires are OK, turn ON ignition switch, measure voltage between engine ground and "BLK/RED" wire terminal. Is it voltage 10 – 14 V?	Go to Step 4.	"BLK/WHT" wire open circuit.
4	Check ground circuit. 1) Measure resistance between engine body ground and "BRN" wire terminal with ignition switch turn OFF. Is resistance below 5 Ω?	Go to Step 5.	"BRN" wire open or high resistance circuit.
5	Check wire circuit. 1) Turn ON ignition switch, measure voltage between engine ground and "YEL" wire terminal at VSS connector. See Fig. 1. Is it voltage 4 – 5 V?	Go to Step 9.	Go to Step 6.
6	Check ECM voltage. 1) Turn ON ignition switch, measure voltage between vehicle body ground and "E22-19" terminal at ECM connector. Is it voltage 4 – 5 V?	"YEL" wire open circuit.	Go to Step 7.
7	Check short circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between engine ground and "E22-19" terminal. Is it voltage 0 V?	Go to Step 8.	"YEL" wire shorted to power supply circuit.
8	Check short circuit. 1) Measure resistance between engine ground and "E22-19" terminal with ignition switch turned OFF. Is resistance infinity?	Go to Step 9.	"YEL" wire shorted to ground circuit. If wire are OK, substitute a known-good ECM and recheck.

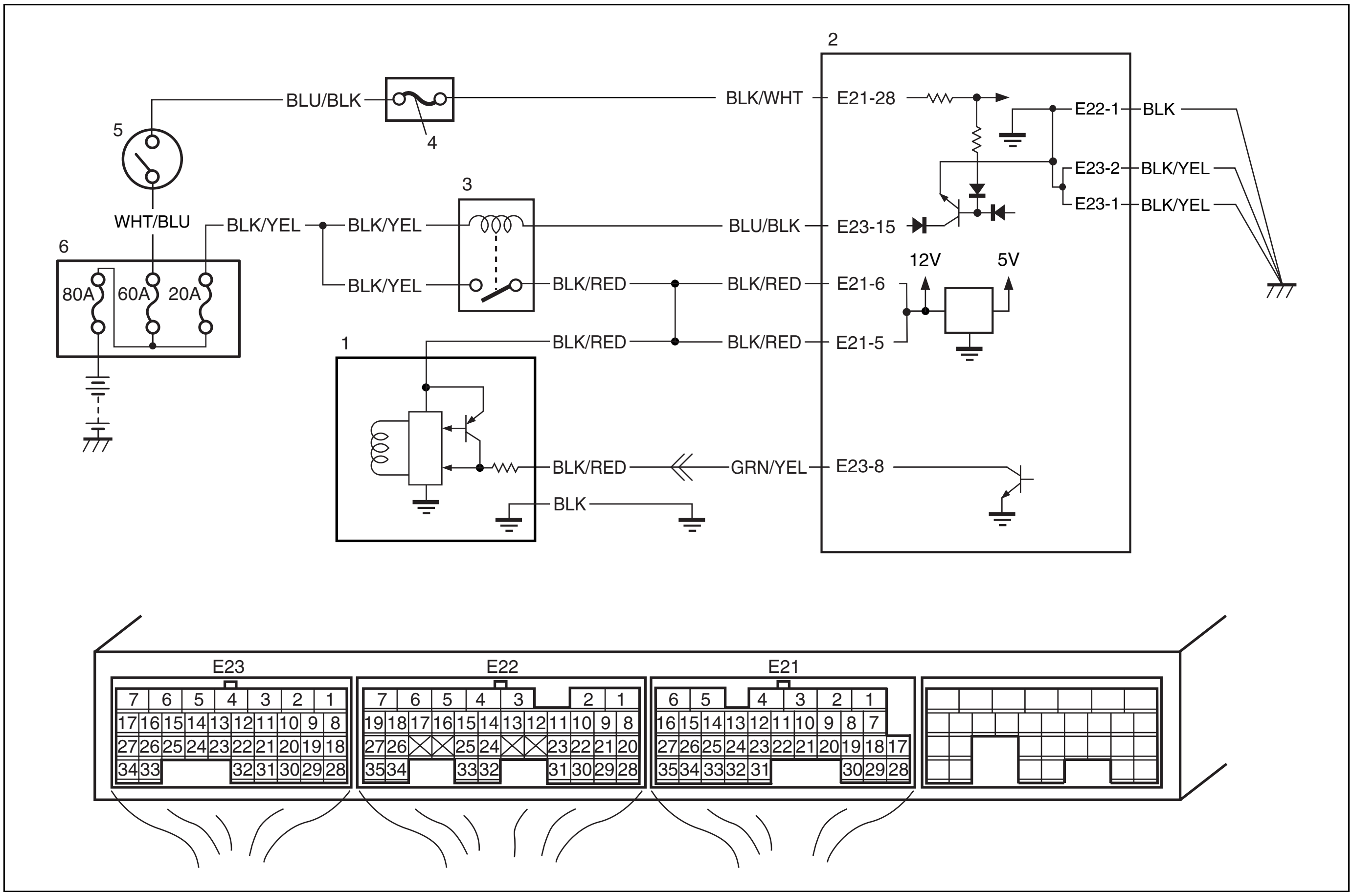
Step	Action	Yes	No
9	Check vehicle speed sensor signal. 1) Remove VSS referring to “Vehicle Speed Sensor (VSS)” in Section 7A2 or “Output Shaft Speed Sensor (VSS)” in Section 7B1. 2) Remove metal particles on end face of VSS, if any. 3) Connect connectors to ECM and VSS with ignition switch turned OFF. 4) Turn ignition switch to ON position. 5) Check voltage between “E22-19” terminal of ECM connector and engine ground by passing magnetic substance (iron) (1) while keeping approx. 1 mm (0.03 in.) gap with respect to end face of VSS. See Fig. 2. Does voltage vary from low (0 – 1 V) to high (4 – 5 V) or from high to low?	Go to Step 12.	Go to Step 10.
10	Check vehicle speed sensor signal. 1) Turn ignition switch to OFF position. 2) Disconnect connectors from combination meter. 3) Turn ignition switch to ON position. 4) Check voltage between “E22-19” terminal of ECM connector and engine ground by passing magnetic substance (iron) (1) while keeping approx. 1 mm (0.03 in.) gap with respect to end face of VSS. Does voltage vary from low (0 – 1 V) to high (4 – 5 V) or from high to low?	Replace combination meter.	Go to Step 11.
11	Check vehicle speed sensor signal. 1) Turn ignition switch to OFF position. 2) Disconnect connectors from TCM. 3) Turn ignition switch to ON position. 4) Check voltage between “E22-19” terminal of ECM connector and engine ground by passing magnetic substance (iron) (1) while keeping approx. 1 mm (0.03 in.) gap with respect to end face of VSS. Does voltage vary from low (0 – 1 V) to high (4 – 5 V) or from high to low?	Substitute a known-good TCM and recheck.	Replace VSS.
12	Check signal rotor. 1) Remove VSS referring to “Vehicle Speed Sensor (VSS)” in Section 7A2 or “Output Shaft Speed Sensor (VSS)” in Section 7B1. 2) Visually inspect VSS sensor signal rotor for damage. Was any damage found?	Faulty VSS signal rotor.	Substitute a known-good VSS and recheck.



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

DTC P0505 Idle Air Control System

System/Wiring Diagram



1. IAC valve	4. “IG COIL” fuse
2. ECM	5. Ignition switch
3. Main relay	6. Relay box

DTC Detecting Condition and Trouble Area (DTC P0505)

DTC Detecting Condition	Trouble Area
IAC valve signal voltage is out of specification for specified time continuously. (2 driving cycle detection logic)	• Idle air control valve or its circuit • ECM

DTC Confirmation Procedure

NOTE:

Check to make sure that the following conditions are satisfied when using this DTC CONFIRMATION PROCEDURE.
Electric load (lighting, heater blower, rear defogger, etc.) and A/C are turned OFF.

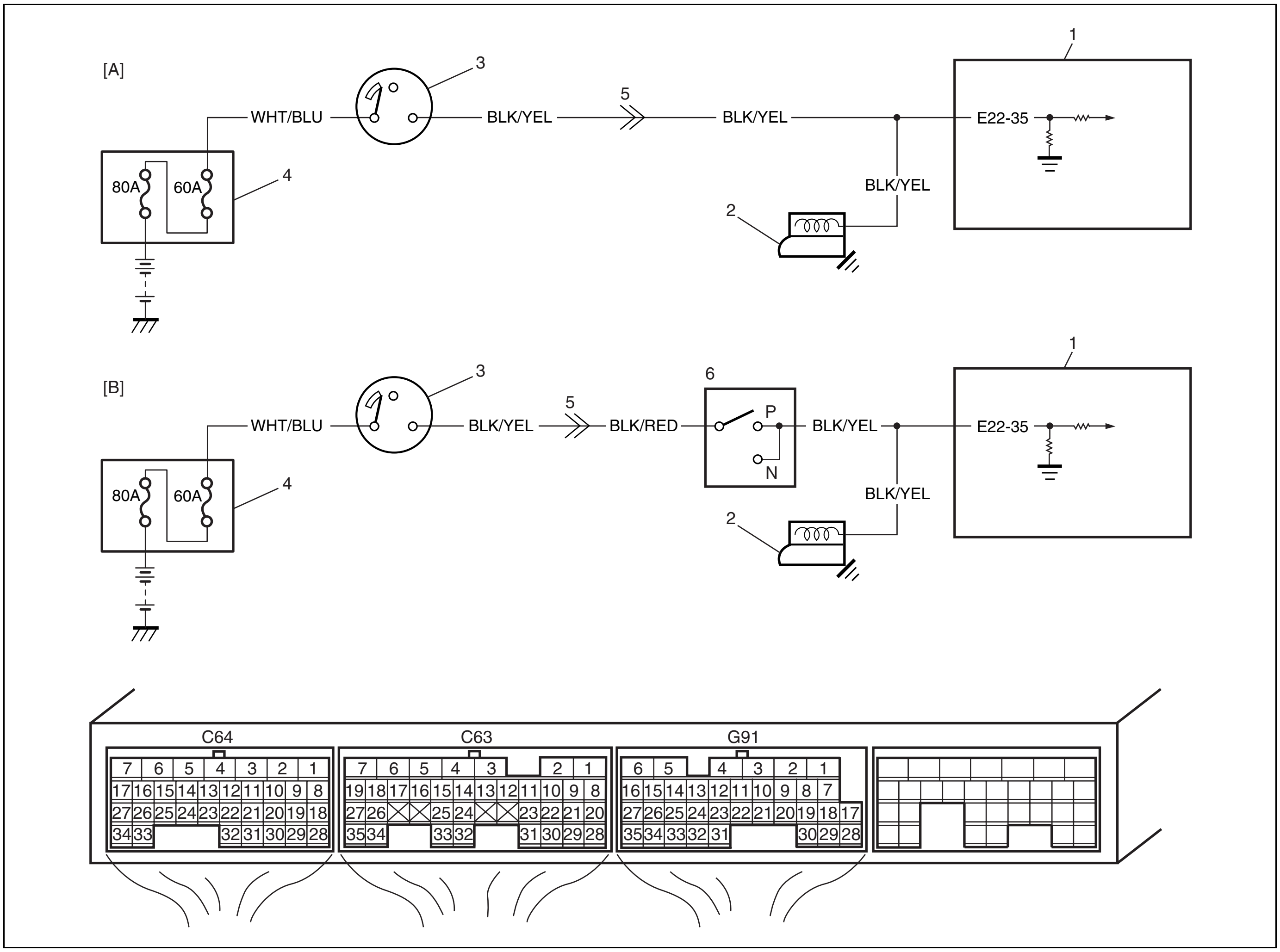
1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and warm up to normal operating temperature (80°C – 110°C, 176°F – 230°F).
4) Run engine at idle speed (600 – 1000 r/min.) for 1 min. or more.
5) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	Idle Speed Check 1) Check idle speed/idle air control duty referring to “Idle Speed/Idle Air Control Duty Inspection” in Section 6E1. Is check result as specified?	Go to Step 3.	Go to Step 4.
3	Idle Air Control Valve Operation Check 1) Check idle air control valve for operation referring to “Idle Air Control (IAC) Valve Operation Check” in this section. Is check result satisfactory?	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection” in Section 0A. If OK, substitute a known-good ECM and recheck.	Go to Step 4.
4	Idle Air Control Valve Circuit Check 1) Disconnect connector from idle air control valve with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between “BLK/RED” wire terminals of idle air control valve connector and engine ground. Is voltage 10 – 14 V?	Go to Step 5.	“BLK/RED” wire in open or high resistance circuit.
5	Idle Air Control Valve Check 1) Check idle air control valve for resistance referring to “Idle Air Control (IAC) Valve Check” in this section. Is check result satisfactory?	Go to Step 6.	Replace idle air control valve.
6	Idle Air Control Valve Circuit Check 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “BLK/RED” wire terminal of idle air control valve connector and “E23-8” terminal of ECM connector. Are resistance 2 Ω or less?	Go to Step 7.	“BLK/RED” or “GRN/YEL” wire in open or high resistance circuit.
7	Idle Air Control Valve Circuit Check 1) Measure resistance between “E23-8” terminal of ECM connector and vehicle body ground. Is resistance infinite?	Go to Step 8.	“BLK/RED” or “GRN/REL” wire in shorted to ground circuit.
8	Idle Air Control Valve Circuit Check 1) Connect connectors to ECM. 2) Turn ON ignition switch, measure voltage between “E23-8” terminal of ECM connector and vehicle body ground. Is each voltage 0 V?	Replace idle air control valve.	“BLK/RED” or “GRN/YEL” wire in shorted to power circuit.

DTC P1500 Starter Signal Circuit Malfunction

Wiring Diagram



[A]: M/T Vehicle	1. ECM	3. Ignition switch	5. Instrument panel harness/engine harness connector
[B]: A/T Vehicle	2. Starter motor	4. Relay box	6. Transmission range sensor (shift switch)

DTC Detecting Condition	Trouble Area
• Low voltage at terminal “E22-35” when cranking engine • High voltage at terminal “E22-35” after starting engine (2 driving cycle detection logic)	• Engine starter signal circuit • ECM

DTC Confirmation Procedure

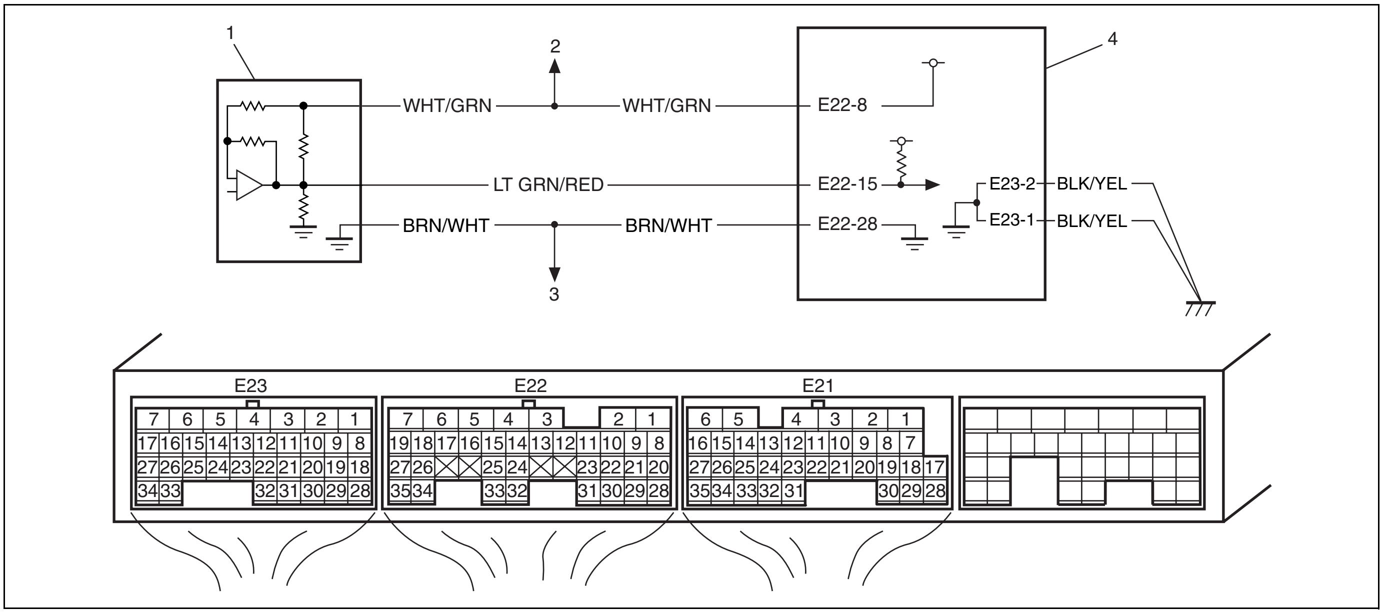
1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and run it at idle for 3 min. or more.
4) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Signal circuit check 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and then connect connectors to ECM. 3) Check for voltage at terminal “E22-35”, under the following condition. While engine cranking: 6 – 14 V After starting engine: 0 – 1 V Is voltage as specified?	Poor “E22-35” connection or intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection” in Section 0A. If wire and connections are OK, substitute a known-good ECM and recheck.	“BLK/YEL” wire or “BLK/RED” wire circuit open.

DTC P0107 Manifold Absolute Pressure Low Input

Wiring Diagram



1. Manifold absolute pressure sensor	2. To TP sensor	3. To other sensors	4. ECM

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• Manifold absolute pressure sensor output voltage is lower than specified value for specified time continuously. (1 driving cycle detection logic)	• Manifold absolute pressure sensor circuit • Manifold absolute pressure sensor • Manifold absolute pressure sensor vacuum passage • ECM

DTC Confirmation Procedure

WARNING:

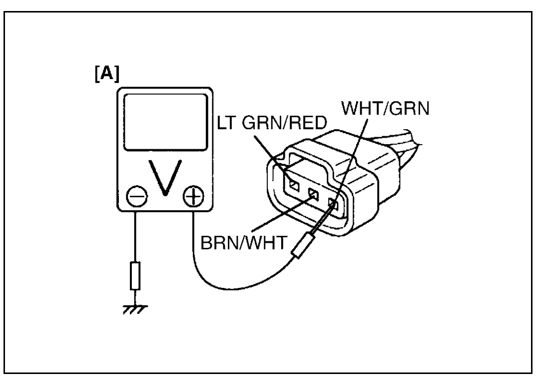
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester, on a level road.**

1) Connect scan tool to DLC with ignition switch OFF.
2) Turn ON ignition switch and clear DTC using scan tool and warm up engine completely.
3) Drive the vehicle with the speed of 40 km/h (25 mile/h) in the 5th gear or D range, and then accelerate the vehicle for more than 5 seconds by stepping only half of the accelerator pedal.
4) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check".
2	Check MAP sensor and its circuit. 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Turn ignition switch ON. 3) Check intake manifold pressure. Is it 146 kPa (43.1 in.Hg) or 0 kPa (0 in.Hg)?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection Inspection" in Section 0A. If OK, go to Step 9.
3	Check MAP sensor power supply voltage. 1) Disconnect connector from MAP sensor with ignition switch tuned OFF. 2) Check for proper connection of MAP sensor at "WHT/GRN", "LT GRN/RED" and "BRN/WHT" wire terminals. 3) Turn ON ignition switch, measure voltage between engine ground and "WHT/GRN" wire terminal. See Fig. 1. Is voltage 4 – 5 V?	Go to Step 6.	Go to Step 4.
4	Check MAP sensor power supply voltage. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and then connect connectors to ECM. 3) Turn ON ignition switch, measure voltage between vehicle body ground and "E22-8" terminal. Is voltage 4 – 5 V?	"WHT/GRN" wire in open circuit.	Go to Step 5.
5	Check MAP sensor power supply circuit. 1) Disconnect connectors from TP sensor with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between vehicle body ground and "E22-8" terminal. Is voltage 4 – 5 V?	Faulty TP sensor.	"WHT/GRN" wire shorted to ground or other circuit. If wires are OK, substitute a known-good ECM and recheck.
6	Check MAP sensor ground circuit. 1) Measure resistance between "BRN/WHT" wire terminal in MAP sensor harness connector and engine ground. Is resistance below 5 Ω?	Go to Step 8.	Go to Step 7.
7	Check ground circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and connect connectors to ECM. 3) Measure resistance between "E22-28" terminal and vehicle body ground. Is resistance below 5 Ω?	"BRN/WHT" wire in open or high resistance circuit.	ECM grounds "E23-1" and/or "E23-2" circuit in open or high resistance. If wires are OK, substitute a known-good ECM and recheck.

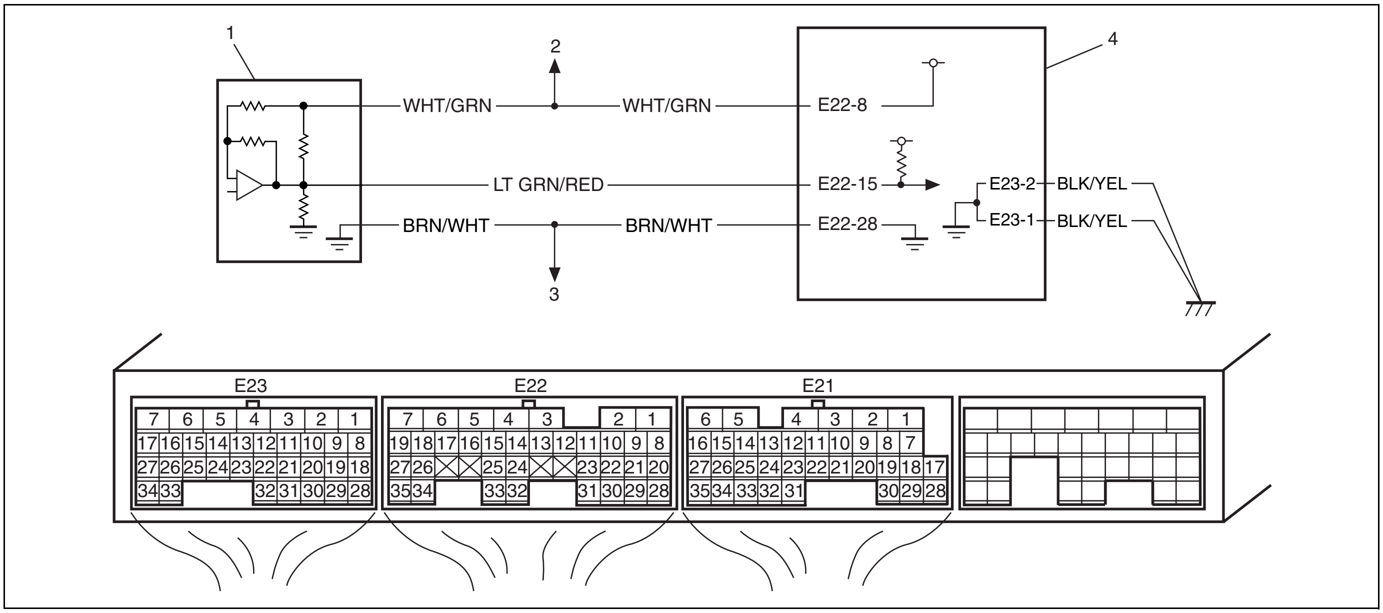
Step	Action	Yes	No
8	Check MAP sensor signal circuit. 1) Turn ON ignition switch. 2) Measure voltage between “LT GRN/RED” wire terminal in MAP sensor harness connector and engine ground. Is voltage 4 – 5 V?	Go to Step 11.	Go to Step 9.
9	Check MAP sensor signal circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “E22-15” terminal and vehicle body ground. Is resistance infinity?	Go to Step 10.	“LT GRN/RED” wire shorted to ground circuit.
10	Check MAP sensor signal circuit. 1) Measure resistance between “LT GRN/RED” wire terminal in MAP sensor harness connector and “E22-15” terminal in ECM connector. Is resistance below 5 Ω?	Go to Step 12.	“LT GRN/RED” wire in open or high resistance circuit.
11	Check MAP sensor signal circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure voltage between “LT GRN/RED” wire terminal of MAP sensor connector and engine ground with ignition switch turned ON. Is voltage 4 – 5 V?	“LT GRN/RED” wire shorted to other circuit	Go to Step 12.
12	Check MAP sensor output signal. 1) Check MAP sensor according to “Manifold Absolute Pressure Sensor (MAP Sensor) Inspection” in Section 6E2. Is it in good condition?	Substitute a known-good ECM and recheck.	Faulty MAP sensor.



[A]: Fig. 1 for Step 3

DTC P0108 Manifold Absolute Pressure High Input

Wiring Diagram



1. Manifold absolute pressure sensor	3. To other sensors
2. To TP sensor	4. ECM

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
• Manifold absolute pressure sensor output voltage is higher than specified value for specified time continuously. (1 driving cycle detection logic)	• Manifold absolute pressure sensor circuit • Manifold absolute pressure sensor • Manifold absolute pressure sensor vacuum passage • ECM

DTC Confirmation Procedure

WARNING:

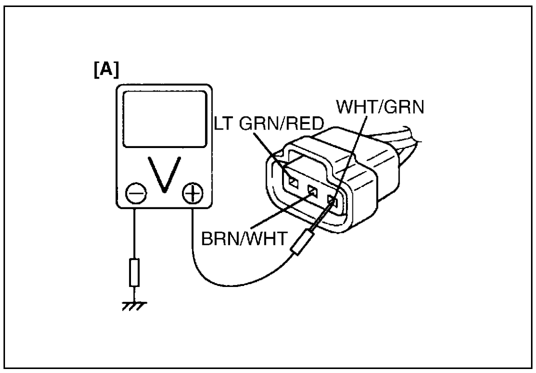
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester, on a level road.**

1) Connect scan tool to DLC with ignition switch turned OFF.
2) Turn ON ignition switch and clear DTC using scan tool and warm up engine completely.
3) Run engine at idle speed for 1 min.
4) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Check MAP sensor and its circuit. 1) Connect scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON. 3) Check intake manifold pressure. Is it 146 kPa (43.1 in.Hg) or 0 kPa (0 in.Hg)?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection” in Section 0A. If OK, go to Step 8.
3	Check MAP sensor power supply voltage. 1) Disconnect connector from MAP sensor with ignition switch tuned OFF. 2) Check for proper connection of MAP sensor at “WHT/GRN”, “LT GRN/RED” and “BRN/WHT” wire terminals. 3) Turn ON ignition switch, measure voltage between engine ground and “WHT/GRN” wire terminal. See Fig. 1. Is voltage 4 – 5 V?	Go to Step 5.	Go to Step 4.
4	Check MAP sensor power supply voltage. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and then connect connectors to ECM. 3) Turn ON ignition switch, measure voltage between vehicle body ground and “E22-8” terminal. Is voltage 4 – 5 V?	“WHT/GRN” wire in open circuit.	“WHT/GRN” wire shorted to other circuit. If wires are OK, substitute a known-good ECM and recheck.
5	Check MAP sensor ground circuit. 1) Measure resistance between “BRN/WHT” wire terminal in MAP sensor harness connector and engine ground. Is resistance below 5 Ω?	Go to Step 7.	Go to Step 6.
6	Check ground circuit. 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and connect connectors to ECM. 3) Measure resistance between “E22-28” terminal and vehicle body ground. Is resistance below 5 Ω?	“BRN/WHT” wire in open or high resistance circuit.	ECM grounds “E23-1” and/or “E23-2” circuit in open or high resistance. If wires are OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
7	Check MAP sensor signal circuit. 1) Disconnect connectors from ECM with ignition switch turn OFF. 2) Turn ON ignition switch. 3) Measure voltage between “LT GRN/RED” wire terminal in MAP sensor harness connector and engine ground. Is voltage 0 V?	Go to Step 8.	“LT GRN/RED” wire shorted to power supply or other circuit.
8	Check MAP sensor output signal. 1) Check MAP sensor according to “Manifold Absolute Pressure Sensor (MAP Sensor) Inspection” in Section 6E2. Is it in good condition?	Substitute a known-good ECM and recheck.	Faulty MAP sensor.



[A]: Fig. 1 for Step 3

DTC P0601 Internal Control Module Memory Check Sum Error

DTC P0602 Control Module Programming Error

System Description

Internal control module is installed in ECM.

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Data write error or check sum error	ECM

DTC Confirmation Procedure

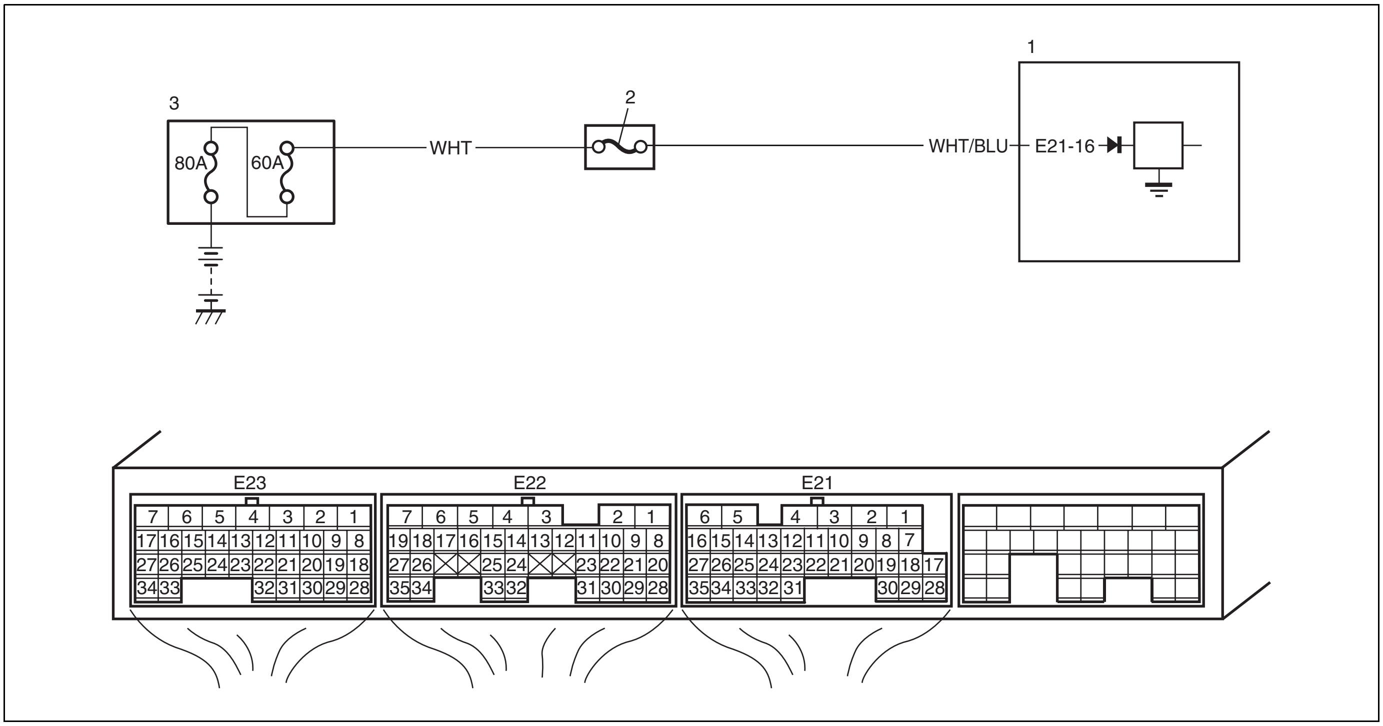
1) Connect scan tool to DLC with ignition switch OFF.
2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
3) Start engine and run it at idle if possible.
4) Check DTC and pending DTC by using scan tool.

Troubleshooting

Substitute a known-good ECM and recheck.

DTC P1510 ECM Back-up Power Supply Malfunction

Wiring Diagram



1.	ECM
2.	"DOME RADIO" fuse
3.	Relay box

Circuit Description

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

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Back-up circuit voltage is less than specified value for 5 seconds continuously while engine running.	Battery voltage supply circuit

DTC Confirmation Procedure

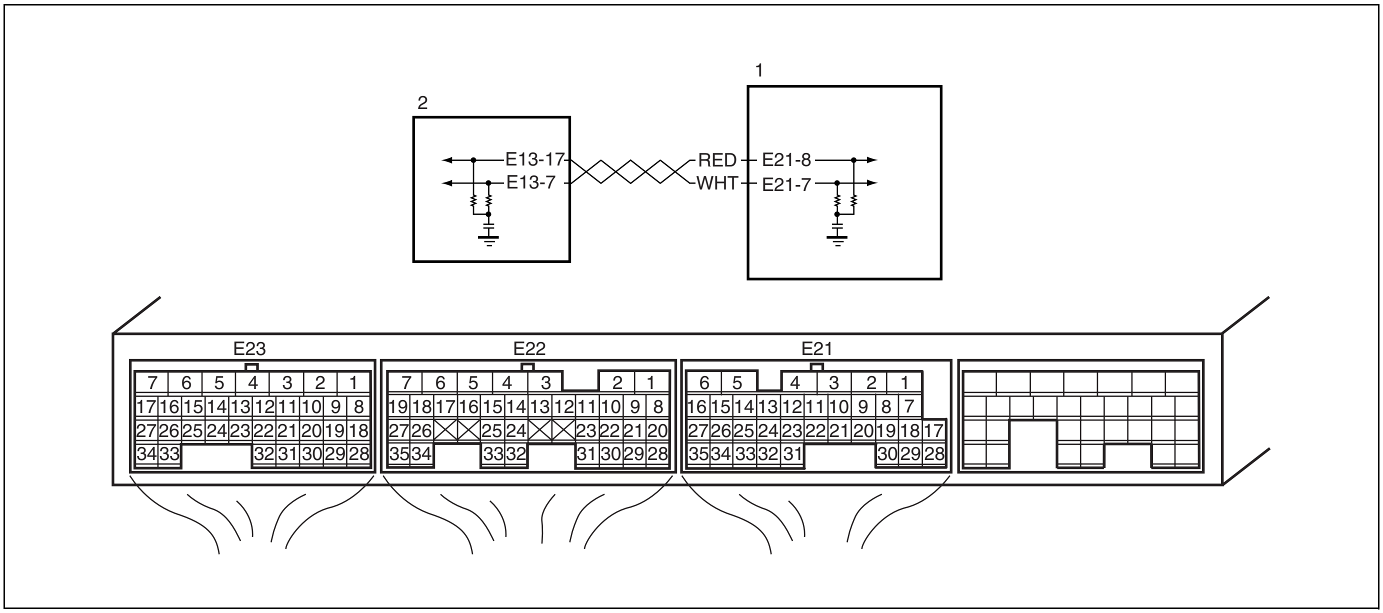
1) Connect scan tool to DLC with ignition switch turned OFF.
2) Turn ON ignition switch and clear DTC using scan tool and run engine at idle speed for 1 min.
3) Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was "Engine and Emission Control System Check" performed?	Go to Step 2.	Go to "Engine and Emission Control System Check".
2	Battery voltage supply circuit check 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Remove ECM from vehicle body and then connect connectors to ECM. 3) While engine running, check voltage between "E21-16" and ground. Is voltage 10 – 14 V?	Poor "E21-16" connection or intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection Inspection" in Section 0A. If wire and connections are OK, substitute a known-good ECM and recheck.	"DOME RADIO" fuse blown "WHT" or "WHT/BLU" wire circuit open or short.

DTC P1601 Can Communication Error

Wiring Diagram



1. ECM	
2. TCM	

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
Transmission or reception error of communication data is detected by ECM for specified time continuously. (1 driving cycle detection logic)	• “RED” or “WHT” wire circuit open or short • TCM malfunction • ECM malfunction

DTC Confirmation Procedure

- Connect scan tool to DLC with ignition switch turned OFF.
- Turn ON ignition switch and clear DTC by using scan tool, then start engine and run it for 1 min. or more.
- Check DTC and pending DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System” performed?	Go to Step 2.	Go to “Engine and Emission Control System” in this section.
2	DTC check 1) Check DTC of ECM and TCM. Is there any DTC(s) (other than DTC P1601 and DTC P1701)?	Go to applicable DTC diag. flow table.	Go to Step 3.

Step	Action	Yes	No
3	Circuit Check 1) Turn ignition switch to OFF position. 2) Disconnect connectors from ECM and TCM. 3) Check for proper connection to “E21-7” terminal of ECM connector and “E13-7” terminal of TCM connector. 4) If OK, measure resistance between “E21-7” terminal of ECM connector and “E13-7” terminal of TCM connector. Is resistance 1 Ω or less?	Go to Step 4.	“WHT” wire circuit open or high resistance.
4	Circuit Check 1) Turn ignition switch to ON position. 1) Measure voltage between “E21-7” terminal of ECM connector and vehicle body ground. Is voltage 0 – 1 V ?	Go to Step 4.	“WHT” wire in shorted to power circuit.
5	Circuit Check 1) Turn ignition switch to OFF position. 2) Measure resistance between “E21-7” terminal of ECM connector and vehicle body ground. Is it infinite?	Go to Step 6.	“WHT” wire in shorted to ground circuit.
6	Circuit Check 1) Check for proper connection to “E21-8” terminal of ECM connector and “E13-17” terminal of TCM connector. 2) If OK, measure resistance between “E21-8” terminal of ECM connector and “E13-17” terminal of TCM connector. Is resistance 1 Ω or less?	Go to Step 7.	“RED” wire circuit open or high resistance.
7	Circuit Check 1) Turn ignition switch to ON position. 2) Measure voltage between “E21-8” terminal of ECM connector and vehicle body ground. Is voltage 0 – 1 V?	Go to Step 8.	“RED” wire in shorted to power circuit.
8	Circuit Check 1) Turn ignition switch to OFF position. 2) Measure resistance between “E21-8” terminal of ECM connector and vehicle body ground. Is it infinite?	Go to Step 9.	“RED” wire in shorted to ground circuit.
9	DTC Check 1) Connect connectors to ECM and TCM. 2) Connect scan tool to DLC. 3) Check DTC of TCM. Is DTC P1701 indicated?	Substitute a known-good TCM and recheck. If OK, substitute a known-good ECM and recheck.	Substitute a known-good ECM and recheck.

DTC P1603 TCM Trouble Code Detected

DTC Detecting Condition

When ECM receives a trouble code from TCM, which indicates that some problem occurred in sensor circuits and its calculated values used for operations such as idle speed control, engine power control, and so on by TCM, ECM sets DTC P1603. (TCM outputs the trouble code to ECM when TCM can not compute the engine control signal due to malfunctions of sensor circuits used for gear shift control.)

DTC Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in this section.
2	DTC Check Check DTC of TCM referring to “Diagnostic Trouble Code (DTC) Check” in Section 7B1. Is there any DTC(s)?	Go to applicable DTC troubleshooting.	Substitute a known-good ECM and recheck.

DTC P2227 Barometric Pressure Circuit Range/Performance
DTC P2228 Barometric Pressure Circuit Low
DTC P2229 Barometric Pressure Circuit High

System Description

Barometric pressure sensor is installed in ECM (PCM).

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
DTC P2227: While running under conditions described for "DTC Confirmation Procedure", barometric pressure value compared with intake manifold vacuum value in fuel cut state is not as specified. (2 driving cycle detection logic)	• Manifold absolute pressure sensor performance problem • Barometric pressure sensor in ECM
DTC P2228: Barometric pressure signal less than specified value is detected.	• Barometric pressure sensor in ECM
DTC P2229: Barometric pressure signal more than specified value is detected.	

DTC Confirmation Procedure

DTC P2228/P2229

1) Connect scan tool to DLC with ignition switch OFF.
2) Turn ON ignition switch and clear DTC by using scan tool and run engine for 1 min.
3) Check DTC and pending DTC by using scan tool.

DTC P2227

WARNING:

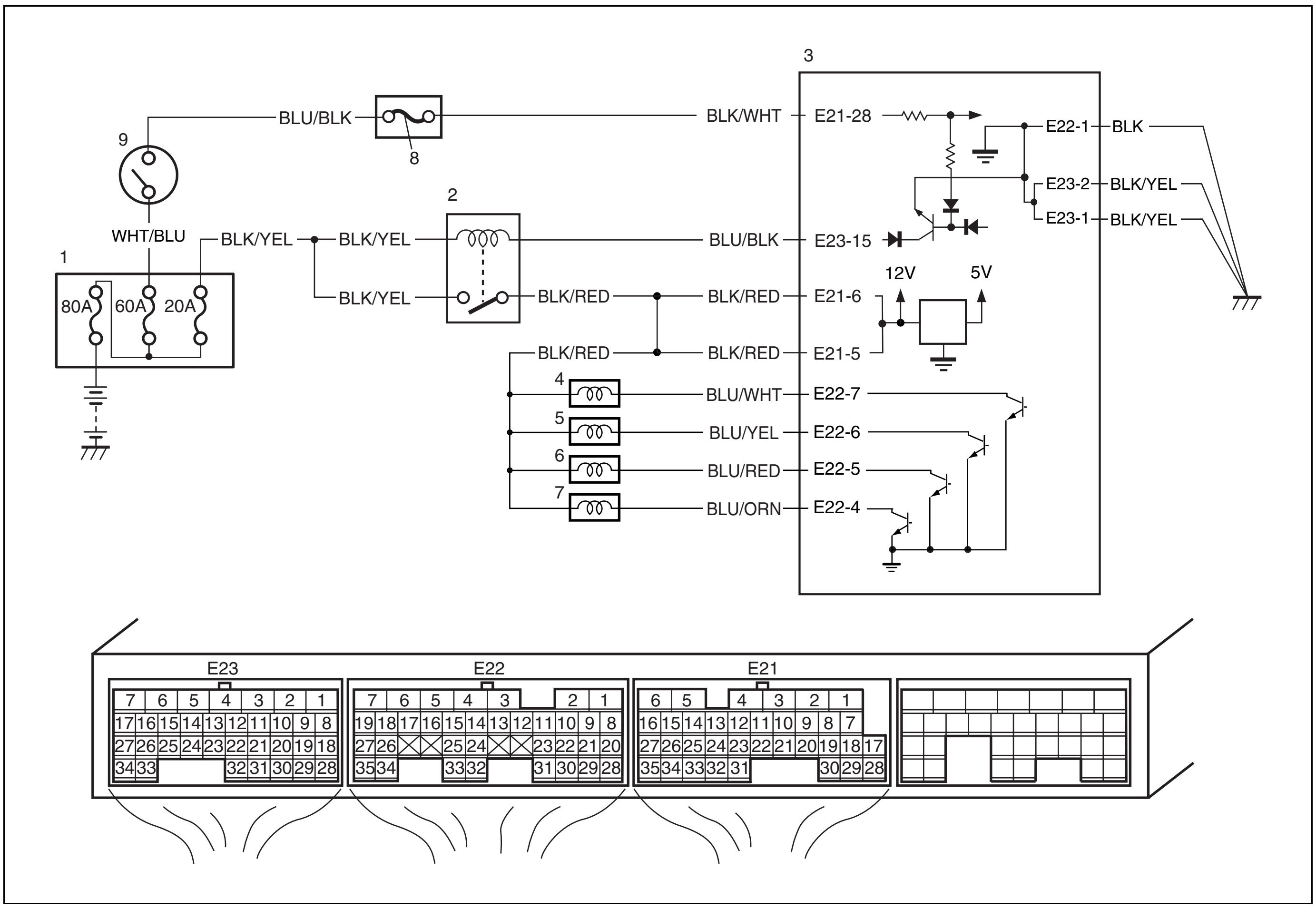
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and a tester, on a level road.**

1) Connect scan tool to DLC with ignition switch OFF.
2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and warm up engine to normal operating temperature.
3) Increase engine speed to 3000 rpm in 3rd gear in case of M/T.
4) Release accelerator pedal and with engine brake applied, keep vehicle coasting for 5 sec. or more. (Keep fuel cut condition for 5 sec. or more) If fuel cut condition is not kept for 5 sec. or more, coast down a slope in engine speed 1000 – 3000 rpm for 5 sec. or more.
5) Stop vehicle and run engine at idle.
6) Repeat Steps 3) – 5) 2 times.
7) Check DTC and pending DTC by using scan tool.

DTC Troubleshooting

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” performed?	Go to Step 2.	Go to “Engine and Emission Control System Check”.
2	Is DTC P2227 set?	Go to Step 3.	Substitute a known-good ECM and recheck.
3	MAP sensor check 1) Check MAP sensor and its circuit referring to “DTC P0107/P0108 Manifold Absolute Pressure Low Input/High Input”. Is check result satisfactory?	Substitute a known-good ECM and recheck.	MAP sensor or its circuit malfunction.

Table B-1 Fuel Injector Circuit Check

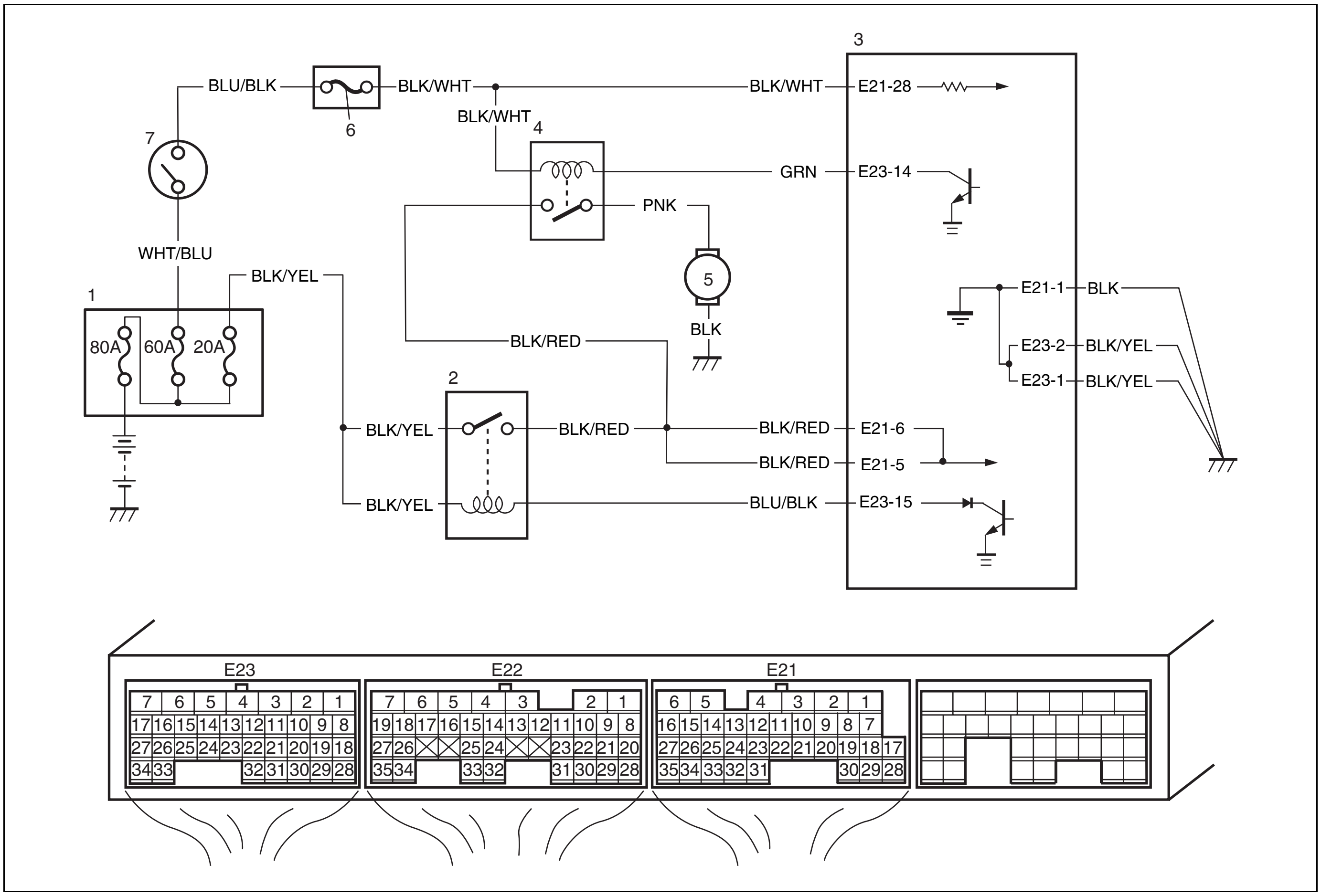


1. Relay box	4. No.1 injector	7. No.4 injector
2. Main relay	5. No.2 injector	8. “IG COIL” fuse
3. ECM	6. No.3 injector	9. Ignition switch

Troubleshooting

Step	Action	Yes	No
1	Check each injector for operating sound at engine cranking using sound scope. Do all 4 injector make operating sound?	Fuel injector circuit is in good condition.	Go to Step 2.
2	Check fuel injector resistance. 1) Disconnect connectors from fuel injectors with ignition switch turn OFF. 2) Check for proper connection to fuel injector at each terminals. 3) If OK, check all 4 fuel injectors for resistance, referring to “Fuel Injector Inspection” in Section 6E2. Are all injectors in good condition?	Go to Step 3.	Faulty fuel injector.
3	Check fuel injector insulation resistance. 1) Check that there is insulating between each fuel injector terminals and engine ground. Is there insulating?	Go to Step 4.	Faulty fuel injector.
4	Check fuel injector power supply. 1) Measure voltage between each “BLK/RED” wire terminal and engine ground with ignition switch turned ON. Is voltage 10 – 14 V?	Go to Step 5.	“BLK/RED” wire in open circuit or shorted to ground circuit. If it is in good condition, go to diag flow table A-3.
5	Check wire circuit. 1) Turn OFF ignition switch. 2) Disconnect connectors from ECM. 3) Measure resistance between each “BLU/YEL”, “BLU/WHT”, “BLU/RED”, “BLU/ORN” wire terminal and vehicle body ground. Is resistance infinity?	Go to Step 6.	“BLU/YEL”, “BLU/WHT”, “BLU/RED”, “BLU/ORN” wire shorted to ground.
6	Check wire circuit. 1) Measure voltage between each “BLU/YEL”, “BLU/WHT”, “BLU/RED”, “BLU/ORN” wire terminal and vehicle body ground with ignition switch turned ON. Is voltage 0 V?	Go to Step 7.	“BLU/YEL”, “BLU/WHT”, “BLU/RED”, “BLU/ORN” wire shorted to power supply circuit.
7	Check fuel injector drive signal. 1) Connect connectors to each fuel injectors and ECM with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Measure voltage “E22-7”, “E22-6”, “E22-5”, “E22-4” terminal and vehicle body ground. Is voltage 10 – 14 V?	Check fuel injector, referring to “Fuel Injector Inspection” in Section 6E2. If result in good condition, substitute a known-good ECM and recheck.	“BLU/YEL”, “BLU/WHT”, “BLU/RED”, “BLU/ORN” open circuit.

Table B-2 Fuel Pump and Its Circuit Check



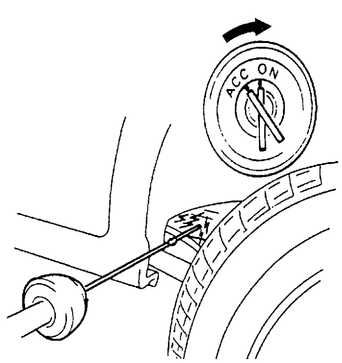
1. Relay box	4. Fuel pump relay	7. Ignition switch
2. Main relay	5. Fuel pump	
3. ECM	6. "IG COIL" fuse	

Troubleshooting

Step	Action	Yes	No
1	Check fuel pump control system for operation. See Fig.1. Is fuel pump heard to operate for 3 sec. after ignition switch ON?	Fuel pump circuit is in good condition.	Go to Step 2.
2	Check fuel pump relay power supply. 1) Disconnect fuel pump relay from relay box with ignition switch turned OFF. 2) Check for proper connection to fuel pump relay at each terminals. 3) If OK, turn ON ignition switch, measure voltage between "BLK/WHT" wire terminal and engine ground. Is voltage 10 – 14 V?	Go to Step 3.	"BLK/WHT" wire open or shorted to ground circuit.
3	Check fuel pump relay power supply. 1) Turn ON ignition switch, measure voltage between "BLK/RED" wire terminal of fuel pump relay connector and engine ground. Is voltage 10 –14 V?	Go to Step 4.	"BLK/RED" wire open circuit.

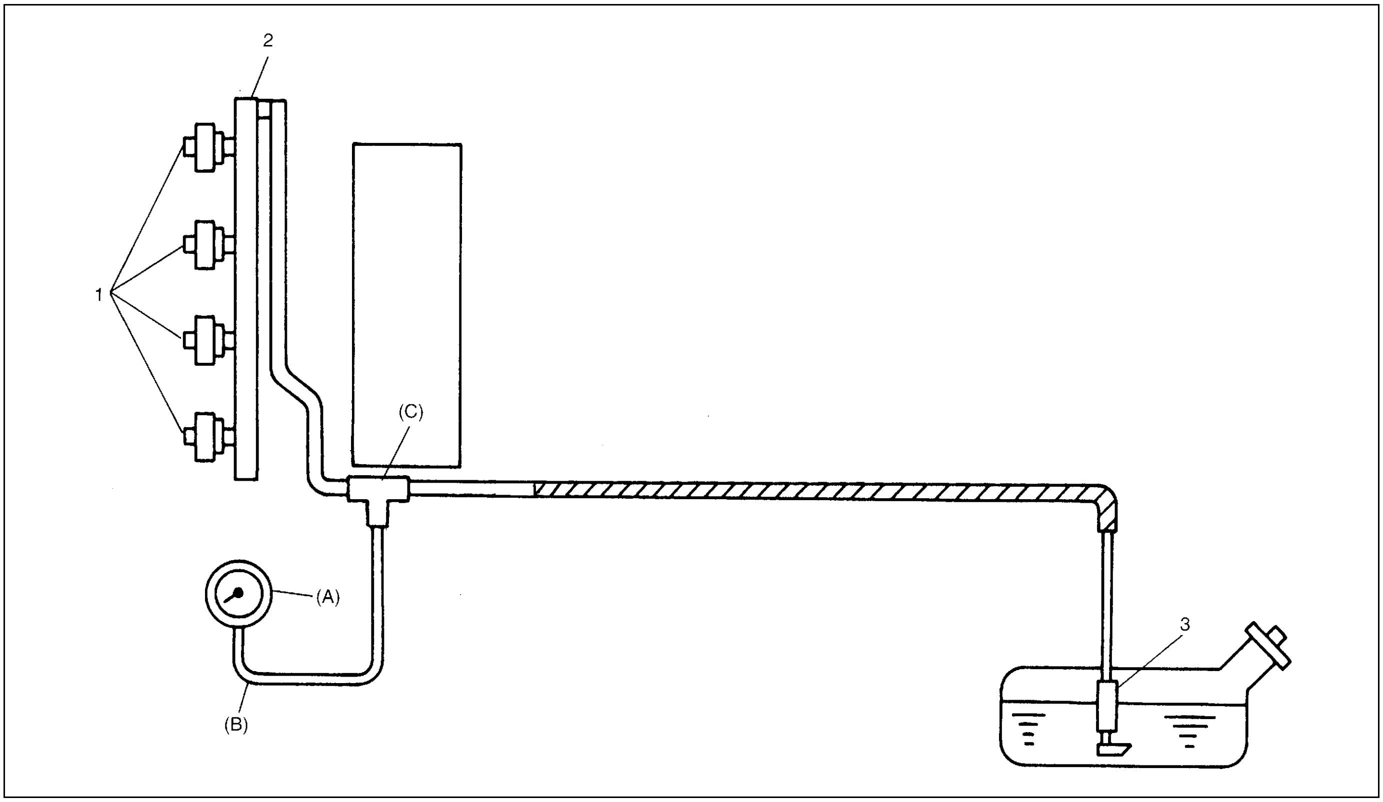
Step	Action	Yes	No
4	Check fuel pump relay. 1) Check fuel pump relay, referring to “Main Relay, Fuel Pump Relay and Radiator Fan Relay Inspection” in Section 6E2. Is relay in good condition?	Go to Step 5.	Faulty relay.
5	Check fuel pump relay drive signal. 1) Connect fuel pump relay to relay box. 2) Connect voltmeter between “E23-14” terminal and vehicle body ground. 3) Measure voltage at after 3 second ignition switch turned ON. Is voltage 10 – 14 V?	Go to Step 6.	“GRN” wire open circuit or shorted to ground circuit.
6	Check fuel pump relay drive signal. 1) Measure voltage at within 3 second after ignition switch turned ON. Is voltage 0 – 1 V?	Go to Step 7.	Substitute a known-good ECM and recheck.
7	Check wire circuit. 1) Turn OFF ignition switch. 2) Detach fuel tank, referring to “Fuel Tank Removal and Installation” in Section 6C. 3) Disconnect connector from fuel pump. 4) Measure resistance between “PNK” wire terminal and vehicle body ground. Is resistance infinity?	Go to Step 8.	“PNK” wire shorted to ground.
8	Check fuel pump circuit. 1) Turn OFF ignition switch. 2) Connect service wire between “E23-14” terminal and vehicle body ground. 3) Turn ON ignition switch, measure voltage between “PNK” terminal at fuel pump connector and vehicle body ground. Is voltage 10 – 14 V?	Go to Step 9.	“PNK” wire open circuit.
9	Check fuel pump circuit. 1) Turn OFF ignition switch. 2) Check that there is continuity between “BLK” terminal at fuel pump connector and vehicle body ground. Is there continuity?	Faulty fuel pump.	“BLK” wire open circuit.

[A]



[A]: Fig. 1 for Step 1

Table B-3 Fuel Pressure Check



1. Injector	3. Fuel filter and fuel pump	B: Hose
2. Delivery pipe	A: Gauge	C: 3-way joint

Troubleshooting

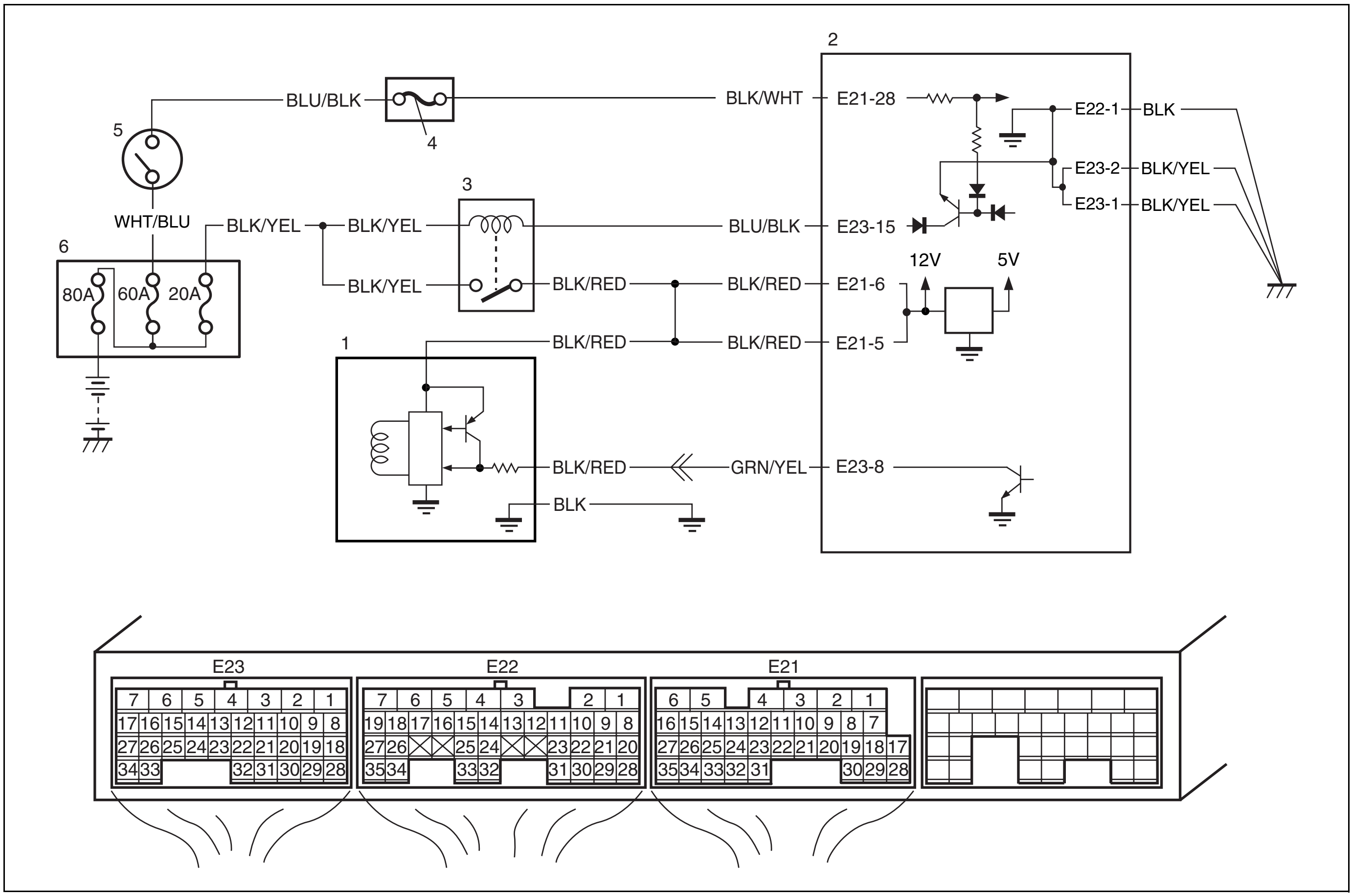
NOTE:

Before using the following table, check to make sure that battery voltage is higher than 11 V. If battery voltage is low, pressure becomes lower than specification even if fuel pump and line are in good condition.

Step	Action	Yes	No
1	Fuel Pressure Check 1) Check fuel pressure referring to “Fuel Pressure Inspection” under “Fuel Delivery System” in Section 6E2. Are they satisfied each condition?	Go to Step 2.	Go to Step 5.
2	Fuel Pressure Check 1) Start engine and warm it up to normal operating temperature. 2) Keep engine speed to 4000 rpm. Does fuel pressure shows the value which is about the same as Step 1?	Go to Step 3.	Go to Step 8.
3	Fuel Line Check 1) Check fuel pipe, fuel hose and joint for fuel leakage. Are they in good condition?	Go to Step 4.	Repair or replace.

Step	Action	Yes	No
4	Fuel Line Check 1) Check fuel pipe, fuel hose and joint for damage or deform. Are they in good condition?	Faulty fuel pressure regulator.	Repair or replace.
5	Was fuel pressure higher than specification in Step 1?	Go to Step 6.	Go to Step 7.
6	Fuel Line Check 1) Check fuel pipe, fuel hose and joint for damage or deform. Are they in good condition?	Faulty fuel pressure regulator.	Repair or replace.
7	Fuel Pump Operating Sound Check 1) Remove fuel filler cap and then turn ON ignition switch. Can you hear operation sound?	Go to Step 8.	Faulty fuel pump.
8	Fuel Line Check 1) Check fuel pipe, fuel hose and joint for damage or deform. Are they in good condition?	Clogged fuel filter, faulty fuel pump, faulty fuel pressure regulator or fuel leakage from hose connection in fuel tank.	Repair or replace.

Table B-4 Idle Air Control System Check

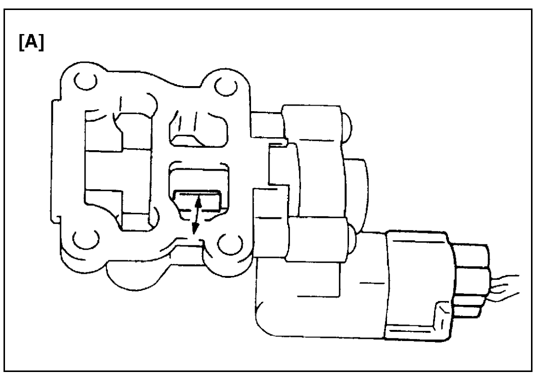


1. IAC valve	3. Main relay	5. Ignition switch
2. ECM	4. “IG COIL” fuse	6. Relay box

Troubleshooting

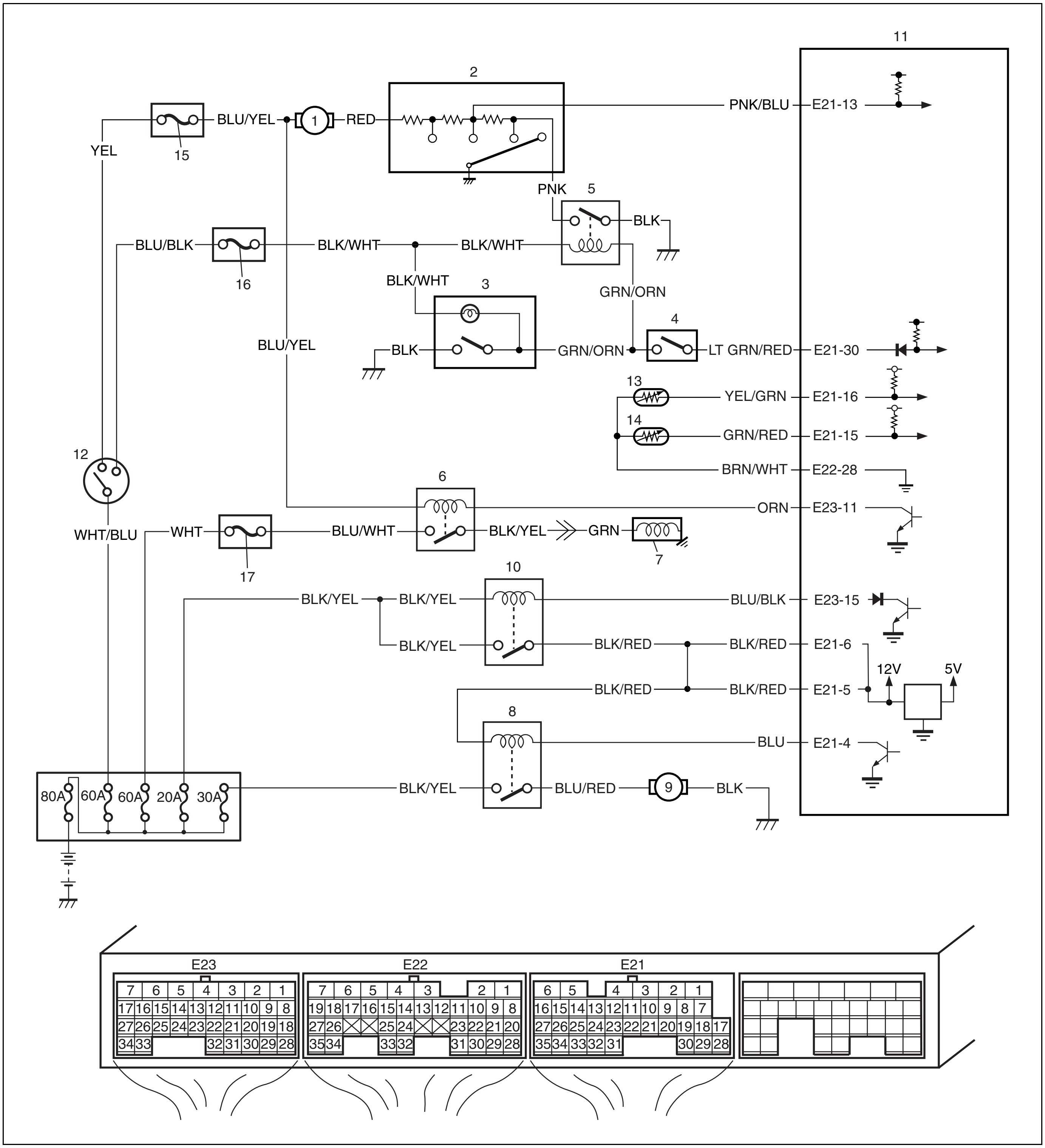
Step	Action	Yes	No
1	Check engine idle speed and IAC duty referring to “Idle Speed/IAC Duty Inspection” in Section 6E2. Is idle speed within specification?	Go to Step 2.	Go to Step 4.
2	Is IAC duty within specification in Step 1?	Go to Step 3.	Check for followings: • Vacuum leak • EVAP canister purge control system • Clog of IAC air passage • Accessory engine load • “Table B-6 Electric Load Signal Circuit Check” Closed throttle position (TP sensor) • Stuck to PCV valve
3	Is engine idle speed kept specified speed even with headlight ON?	System is in good condition.	Go to Step 6.
4	Was idle speed higher than specification in Step 1?	Go to Step 5.	Go to Step 6.

Step	Action	Yes	No
5	Check A/C (input) signal circuit referring to Step 1 of “Table B-5 A/C Signal Circuit Check”, if equipped. Is it in good condition?	Go to Step 6.	Repair or replace A/C signal circuit or A/C system.
6	Check Idle Air Control system. 1) Remove IAC valve from throttle body referring to “IAC Valve Removal and Installation” in Section 6E2. 2) Check IAC valve for operation referring to “IAC Valve Inspection” in Section 6E2. See Fig. 1. Is check result satisfactory?	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection Inspection” in Section 0A.	Go to Step 7.
7	Check Wire Harness for Open or Short. 1) Turn ignition switch OFF. 2) Disconnect IAC valve connector. 3) Check for proper connection to IAC valve at each terminals. 4) If OK, disconnect connectors from ECM. 5) Check for proper connection to ECM at “E23-28” terminal. 6) If OK, check “BLK/RED” and “GRN/YEL” circuit for open or short. Are they in good condition?	Replace IAC valve and recheck.	Repair or replace.



[A]: Fig. 1 for Step 6

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



1. Blower fan motor	6. Compressor relay	11. ECM	16. “IG COIL” fuse
2. Blower fan switch	7. A/C compressor	12. Ignition switch	17. “A/C” fuse
3. A/C switch	8. Radiator fan motor relay	13. ECT sensor	
4. A/C pressure switch	9. Radiator fan motor	14. Evaporator thermistor	
5. Blower motor relay	10. Main relay	15. “HEATER” fuse	

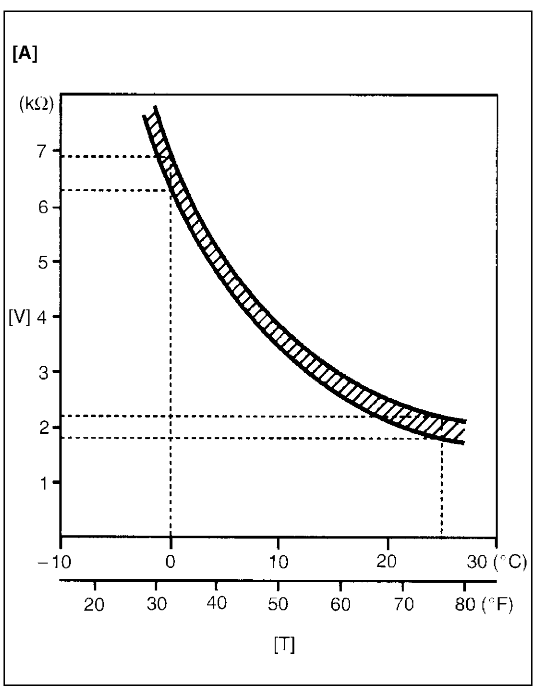
Troubleshooting

Step	Action	Yes	No
1	Check Evaporator Temp. Sensor 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Check for proper connection to “E21-15” and “E22-28” wire terminals of ECM connector. 3) If OK, measure resistance between “E21-15” and “E22-28” wire terminals of ECM connector. (See Fig. 1.) At 0°C: 6.3 – 6.9 kΩ At 25°C: 1.8 – 2.2 kΩ Is it within specification?	Go to Step 2.	Faulty A/C evaporator temperature sensor or its circuit.
2	Check A/C signal 1) Measure voltage between “E21-30” terminal of ECM connector and vehicle body ground under the following condition. With ignition switch ON and A/C switch OFF: 10 – 14 V With ignition switch ON, A/C and heater blower switch ON: 0 – 1 V Is check result as specified?	Go to Step 3.	A/C and heater blower switch circuit, A/C refrigerant pressure switch or heater controller malfunction.
3	Check A/C signal 1) Connect connectors to ECM with ignition switch turned OFF. 2) Measure voltage between “E21-30” wire terminal of ECM connector and vehicle body ground under the following condition. With ignition switch ON and A/C switch OFF: 10 – 14 V With ignition switch ON, A/C and heater blower switch ON: 0 – 1 V Is check result as specified?	Go to Step 4.	Poor “E21-30” terminal connection. If OK, substitute a known-good ECM and recheck.
4	Check Radiator Fan Control System Is radiator cooling fan started when A/C and heater blower switch turned ON?	Go to Step 7.	Go to Step 5.
5	Check Radiator Fan Control Circuit 1) Check DTC with scan tool. Is DTC P0480 displayed?	Go to “DTC P0480 Fan 1 (Radiator Cooling Fan) Control Circuit” in this section.	Go to Step 6.
6	Check Radiator Cooling Fan 1) Check radiator cooling fan referring to “Radiator Cooling Fan Inspection” in Section 6B2. Is check result satisfactory?	Radiator cooling fan drive circuit malfunction. If circuit OK, go to Step 7.	Replace radiator cooling fan motor.
7	Check A/C Compressor Control System Is A/C compressor started when A/C and heater blower switch turned ON while engine running?	A/C system is in good condition.	Go to Step 8.

Step	Action	Yes	No
8	Check A/C Compressor Relay Circuit 1) Check voltage between “E23-11” wire terminal of ECM connector and vehicle body ground under the following condition. While engine running and A/C switch OFF: 10 – 14 V While engine running, A/C and heater blower switch ON: 0 – 1 V Are check result satisfactory?	Go to Step 9.	Go to Step 10.
9	Check A/C Compressor Relay 1) Check A/C compressor relay referring to “A/C Compressor Relay Inspection” in Section 1B. Is it in good condition?	A/C Compressor drive circuit malfunction.	Replace A/C compressor relay.
10	Check A/C Compressor Relay Circuit 1) Remove A/C compressor relay with ignition switch turned OFF. 2) Turn ON ignition switch, check voltage between “BLU/YEL” wire terminal of A/C compressor relay connector and vehicle body ground. Is voltage 10 –14 V?	Go to Step 12.	“BLU/YEL” wire circuit open.
11	Check A/C Compressor Relay 1) Check A/C compressor relay referring to “A/C Compressor Relay” in Section 1B. Is it in good condition?	“ORN” wire circuit open. If OK, substitute a known-good ECM and recheck.	Replace A/C compressor relay.

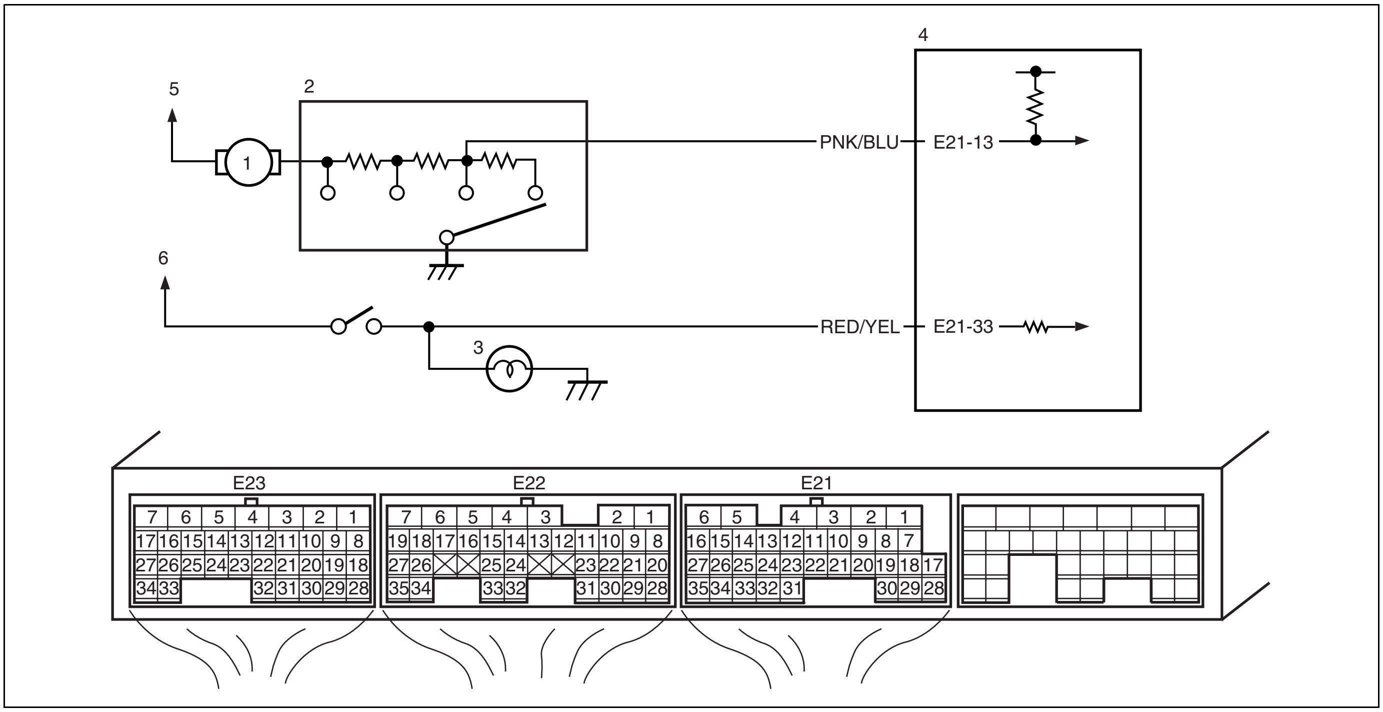
NOTE:

When A/C evaporator thermistor temp. is below 2.5°C (36.5°F), A/C remains OFF (E23-11 terminal voltage becomes 0 – 1 V). This condition is not abnormal.



[A]:	Fig. 1 for Step 1
[V]:	Resistance
[T]:	Temperature

Table B-6 Electric Load Signal Circuit Check



1. Blower fan motor	3. Position lamp	5. To “HEATER” fuse
2. Blower fan switch	4. ECM	6. To “TAIL” fuse

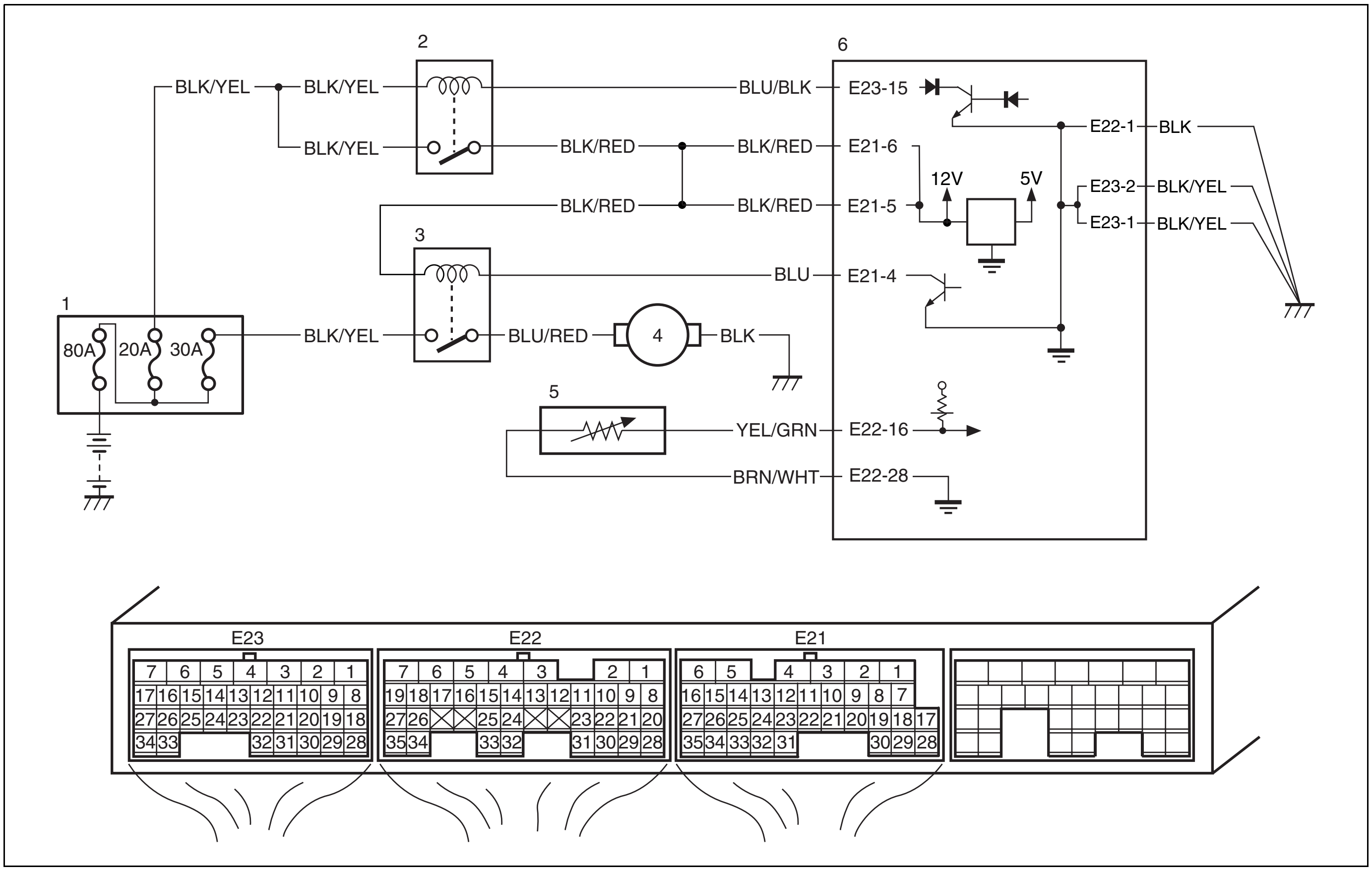
Troubleshooting

Step	Action	Yes	No
1	Do you have SUZUKI scan tool?	Go to Step 2.	Go to Step 3.
2	Check electric load signal circuit. 1) Connect SUZUKI scan tool to DLC with ignition switch OFF. 2) Start engine and select “DATA LIST” mode on scan tool. 3) Check electric load signal under following each condition. See Table 1. Is check result satisfactory?	Electric load signal circuit is in good condition.	“PNK/BLU” and/or “RED/YEL” circuit open or short, electric load diodes malfunction or each electric load circuit malfunction.
3	Check electric load signal circuit. 1) Turn ignition switch ON. 2) Check voltage at each terminals “E21-13” and “E21-33” of ECM connector connected, under above each condition. See Table 1. Is each voltage as specified?	Electric load signal circuit is in good condition.	“PNK/BLU” and/or “RED/YEL” circuit open or short, electric load diodes malfunction or each electric load circuit malfunction.

Table 1 for Step 2 and 3

		Scan tool or voltmeter		
		SUZUKI SCAN TOOL	VOLTAGE AT E21-33	VOLTAGE AT E21-13
Ignition switch ON, Small light and heater blower fan all turned	OFF	OFF	0 V	10 – 14 V
	ON	ON	10 – 14 V	0 V

Table B-7 Radiator Fan Control System Check



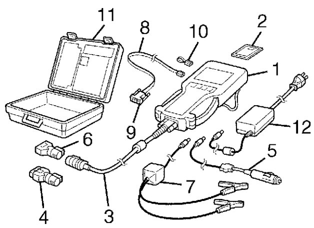
1. Relay box	3. Radiator fan relay	5. ECT sensor
2. Main relay	4. Radiator fan motor	6. ECM

Troubleshooting

Step	Action	Yes	No
1	DTC Check Is there DTC(s) ETC sensor circuit (DTC P0117/P0118) and/or radiator fan circuit (DTC P0480) displayed?	Go to corresponding DTC diag. flow table.	Go to Step 2.
2	Radiator Fan Motor Check 1) Disconnect negative cable at battery. 2) Disconnect connector from ECT sensor. 3) Connect negative cable to battery. Does radiator fan motor rotate at ignition switch turned ON?	System is in good condition.	Go to Step 3.
3	Main Fuse Check 1) Turn ignition switch to OFF position. 2) Remove main fuse from relay box. Is main (30 A) fuse in good condition?	Go to Step 4.	Replace main fuse.
4	Radiator Fan Motor Circuit Check 1) Remove radiator fan relay from relay box. 2) Measure voltage between “BLK/YEL” wire terminal of radiator fan relay connector and vehicle body ground. Is voltage 10 – 14 V?	Go to Step 5.	“BLK/YEL” wire open or high resistance circuit.

Step	Action	Yes	No
5	Check Radiator Fan Relay 1) Check radiator fan relay referring to “Main Relay, Fuel Pump Relay and Radiator Fan Relay Inspection” in Section 6E2. Is it in good condition?	Go to Step 6.	Replace radiator fan relay.
6	Radiator Fan Control Circuit Check 1) Disconnect radiator fan motor connector. 2) Measure resistance between “BLU/RED” wire terminal of radiator fan motor connector and “BLU/RED” wire terminal of radiator fan relay connector. Is resistance 1Ω or less?	Go to Step 7.	“BLU/RED” wire circuit open or poor connection.
7	Radiator Fan Control Circuit Check 1) Measure resistance between “BLU/RED” wire terminal of radiator fan motor connector and vehicle body ground. Is it infinite?	Go to Step 8.	“BLU/RED” wire circuit shorted to ground.
8	Radiator Fan Control Circuit Check 1) Turn ON ignition switch. 2) Measure voltage between “BLU/RED” wire terminal of radiator fan motor connector and vehicle body ground. Is voltage 0 V?	Go to Step 9.	“BLU/RED” wire shorted to power circuit.
9	Radiator Fan Control Circuit Check 1) Measure resistance between “BLK” wire terminal of radiator fan motor connector and vehicle body ground. Is resistance 1Ω or less?	Replace radiator fan motor.	“BLK” wire open or high resistance circuit.

Special Tool



Tech 2 kit (SUZUKI scan tool) (See NOTE “C”.)

NOTE:

“C”: This kit includes the following items.
1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adapter, 5. Cigarette cable, 6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter, 10. RS232 loopback connector, 11. Storage case, 12. Power supply

SECTION 6A2

ENGINE MECHANICAL (M13 ENGINE)

WARNING:

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

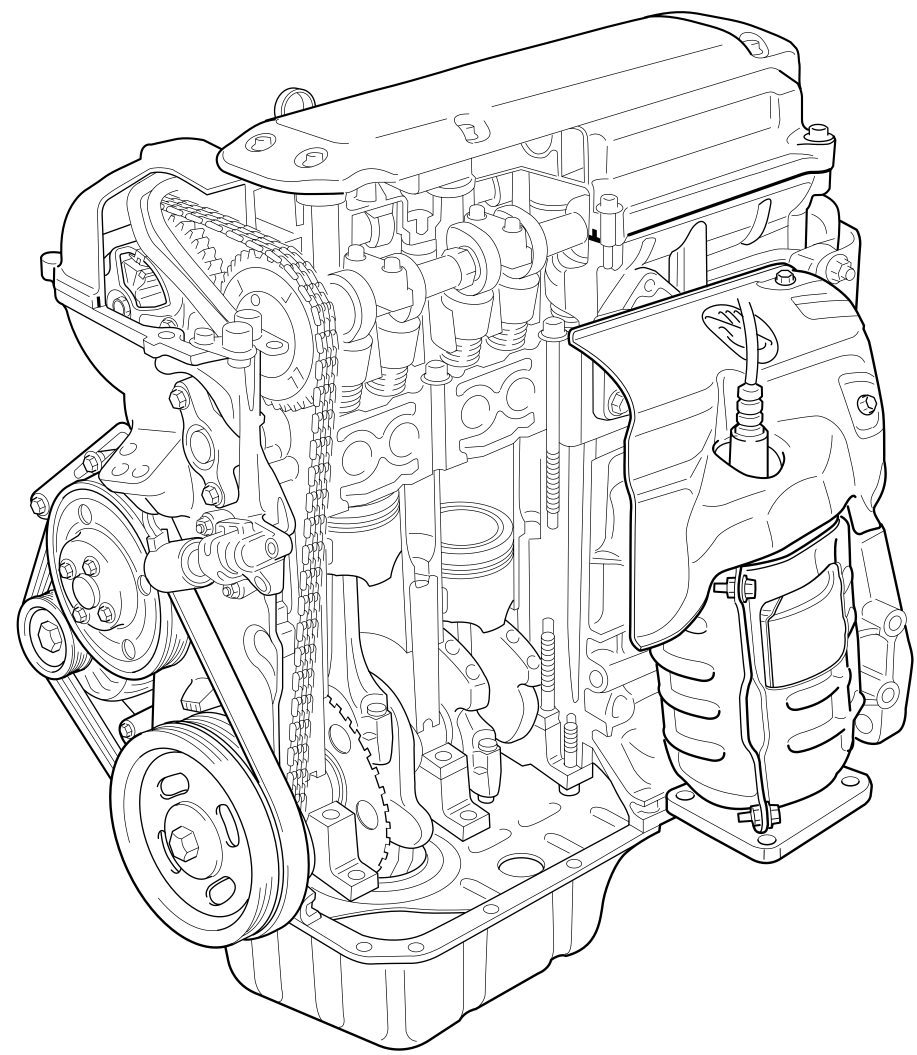
- **Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near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

CONTENTS

General Description

Engine Construction Description

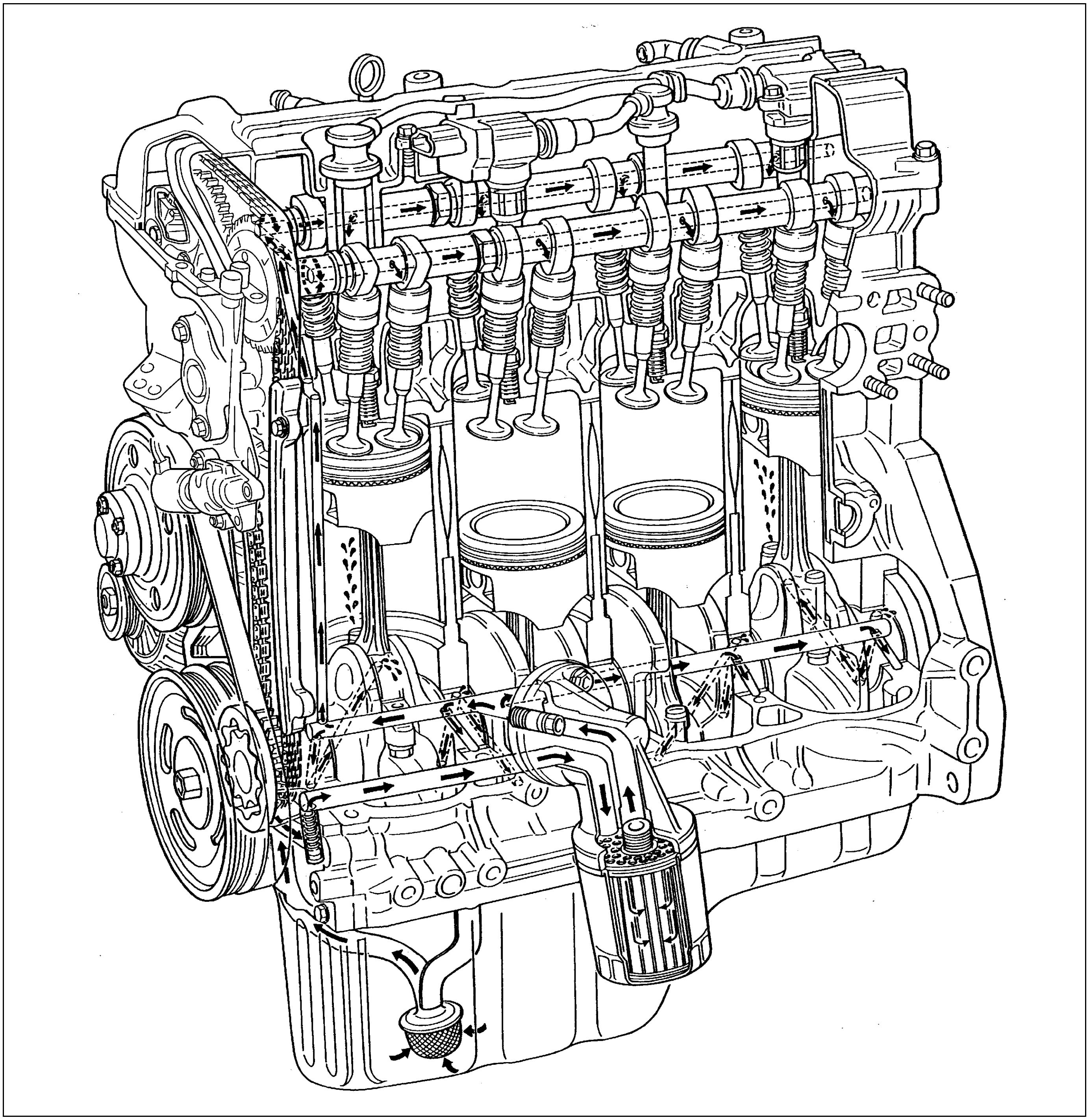
The engine is water-cooled, in line 4 cylinders, 4 stroke cycle gasoline unit with its DOHC (Double overhead camshaft) valve mechanism arranged for “V” type valve configuration and 16 valves (4 valves/one cylinder). The double overhead camshaft is mounted over the cylinder head; it is driven from crankshaft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



Engine Lubrication Description

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

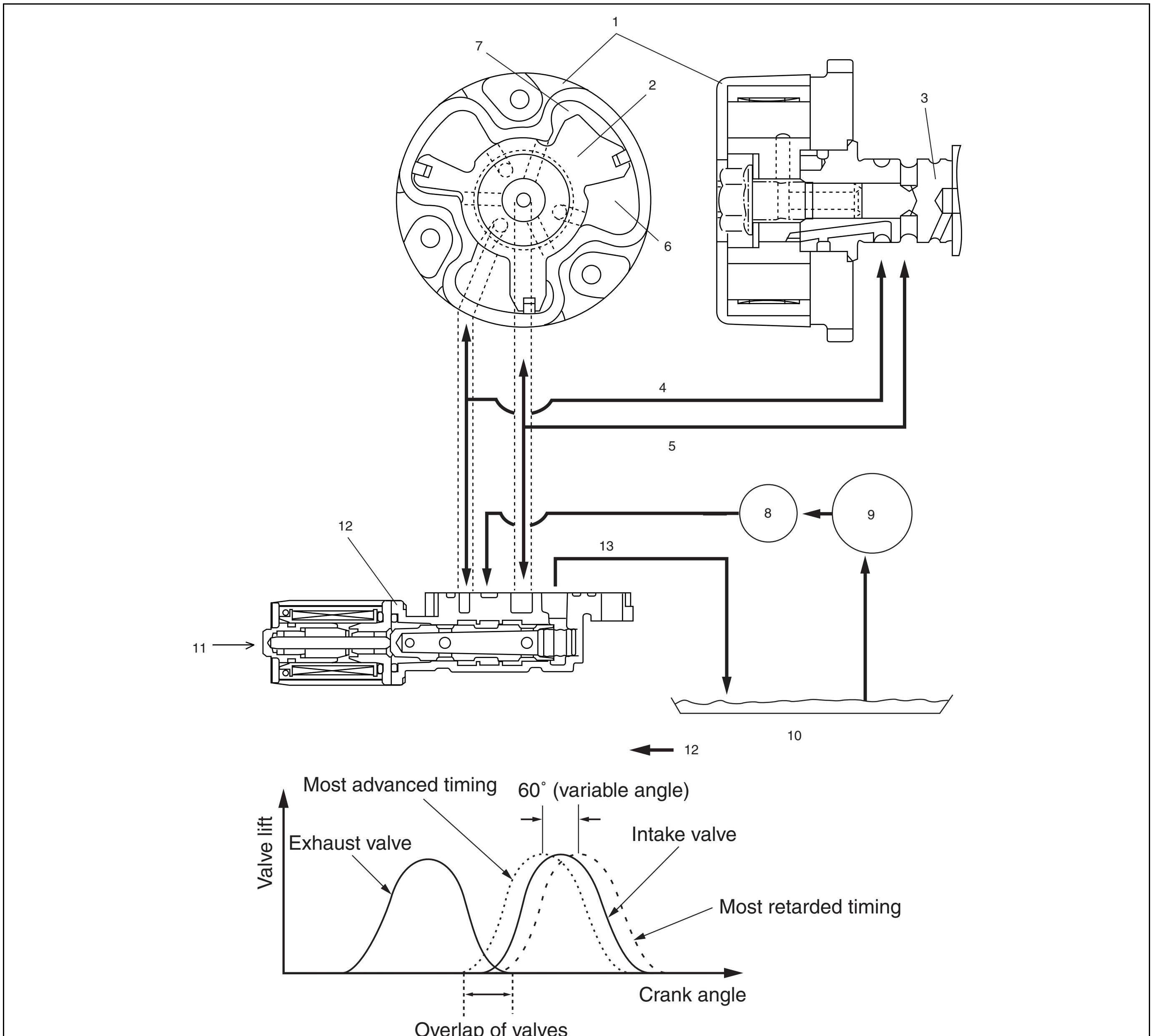
An oil relief valve is provided on the oil pump. This valve starts relieving oil pressure when the pressure exceeds about 390 kPa (3.9 kg/cm^2, 56.6 psi).



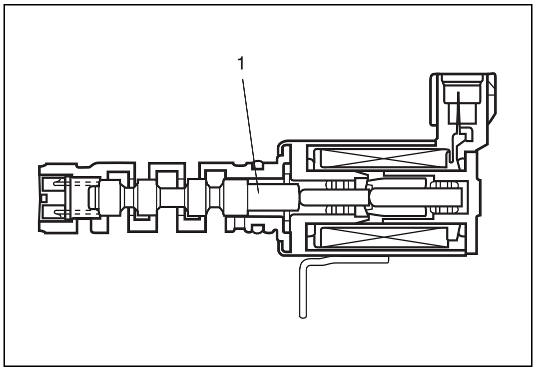
Variable Valve Timing (VVT) System Description

System description

The VVT system is an electronic control system which continuously vary and optimize the intake valve timing in response to the engine operating condition.
The optimized intake valve timing produce such an air intake with high efficiency that both the higher power generation and lower fuel consumption can be attained in the whole engine speed range from low to high. In the area of the average engine load, low emission of nitrogen oxides (NOx) and high fuel efficiency can also be attained by making the valve opening overlap between the intake and exhaust valves longer.
For the brief of the system operation, the intake valve timing is varied by the cam timing sprocket (1) which varies the rotational phase between the intake camshaft (3) and sprocket. The rotor (2) in the cam timing sprocket is actuated by switching or adjusting the hydraulic pressure applied to the chambers for the timing advancing (7) and/or retarding (6). To switch or adjust the hydraulic pressure appropriately, ECM operates the oil control valve (12) with detecting the engine speed, intake air value, throttle opening, engine coolant temperature and camshaft position (angle).

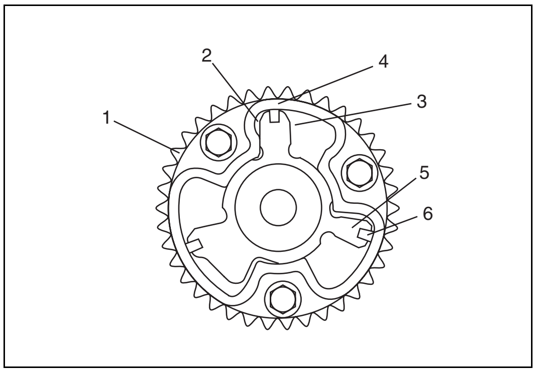


4. Oil passage to chamber for timing retarding	8. Oil filter	10. Oil pan	12. Oil flow
5. Oil passage to chamber for timing advancing	9. Oil pump	11. Control signal from ECM	



Oil control valve

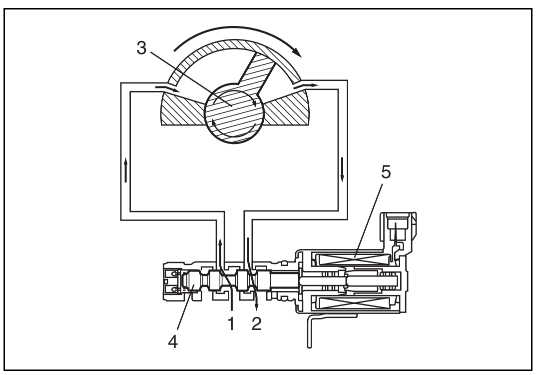
The oil control valve switches and adjusts the hydraulic pressure applied to the cam timing sprocket by moving the spool valve (1) according to the duty pulse signals output from the ECM. By this operation, the intake valve timing is varied continuously. Signals output from the ECM are the duty pulse of about 240 Hz.



Cam timing sprocket

The cam timing sprocket is equipped with the chambers for timing advancing (2) and retarding (3) which are separated by the rotor (5). The rotor rotates receiving the hydraulic pressure applied to both the chambers. The sprocket (1) is installed on the housing (4) and the rotor is secured on the intake camshaft by fastening the bolts. Therefore, the actuation of the rotor makes the phase difference between the sprocket and intake camshaft.

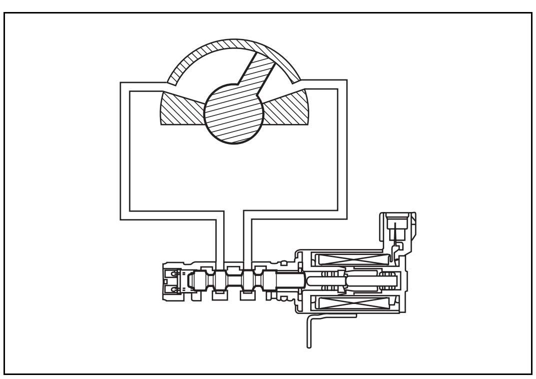
6. Seal



Timing advancing

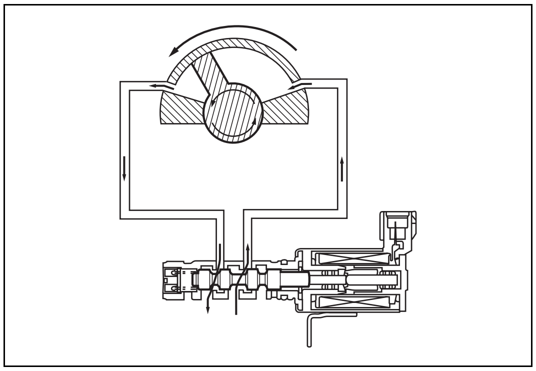
When the duty ratio of the signal output from the ECM is heavy, the spool valve (4) of the oil control valve moves to the left (opposite direction against the coil (5)). By this spool valve movement, the pressurized oil (1) is led into the chambers for timing advancing and the oil in the chambers for timing retarding is drained. This operations actuate the rotor (3) and result in the advanced timing of the intake valve.

2. Drain



Timing holding

When the duty ratio of the signal output from the ECM shows that of holding, the spool valve of the oil control valve is located at hold position. Because this condition generates no oil pressure changes in both chambers, the rotor is fixed at a target position.



Timing retarding

When the duty ratio of the signal output from the ECM is light, the spool valve of the oil control valve moves to the right (head for the coil). By this spool valve movement, the pressurized oil is led into the chambers for timing retarding and the oil in the chambers for timing advancing is drained. This operations actuate the rotor and result in the retarded timing of the intake valve.

Targeted timing varying operation

DRIVING CONDITION	VALVE TIMING	TARGET OF CONTROL	EFFECT
Engine running at idle speed	Most retarded	To shorten the valve opening overlap in order to prevent the exhaust gas counterflow to intake manifold.	Stabilization of the engine rotation at idle speed.
Average engine load range	To the advanced side	To lengthen the valve opening overlap in order to enhance the internal exhaust gas recirculation and reduce the pumping loss.	Improvement of the fuel efficiency. Lowering of the exhaust emission.
Light engine load range	To the retarded side	To shorten the valve opening overlap in order to prevent the exhaust gas counterflow to intake manifold.	Keeping of the engine stability.
Low or average engine speed range with heavy engine load	To the advanced side	To advance the closing timing of the intake valve in order to improve the volumetric efficiency.	Improvement of generating the engine torque at low and average engine speed.
High engine speed range with heavy engine load	To the retarded side	To retard the closing timing of the intake valve in order to improve the volumetric efficiency.	Improvement of generating the engine power.
Low engine coolant temperature	Most retarded	To shorten the valve opening overlap in order to prevent the exhaust gas counterflow to intake manifold and reduce the fuel increasing. To slow the fast idle speed of the engine as a result of stabilizing the engine idling.	Stabilization of the fast idling of the engine. Improvement of the fuel efficiency.
At engine starting and stopping	Most retarded	To shorten the valve opening overlap in order to prevent the exhaust gas counterflow to intake manifold.	Improvement of start ability

Diagnosis

Diagnosis Table

Refer to "Engine and Emission Control System Check" in Section 6-2.

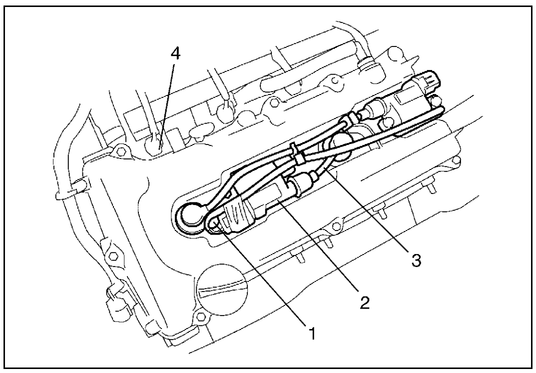
Compression Check

Check compression pressure on all 4 cylinders as follows:

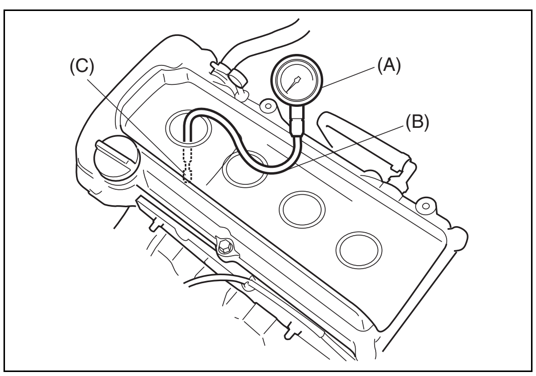
1) Warm up engine to normal operating temperature.
2) Stop engine after warming up.

NOTE:

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

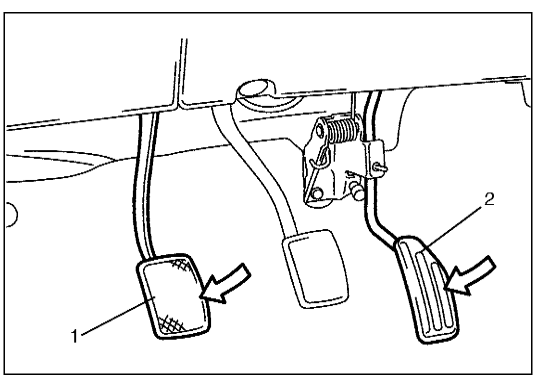


3) Disconnect ignition coil couplers (1).
4) Remove ignition coil assemblies (2) with high-tension cord (3).
5) Remove all spark plugs.
6) Disconnect fuel injector wires (4) at the coupler.



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

Special tool
(A): 09915-64512
(B): 09915-64530
(C): 09915-67010



8) Disengage clutch (1) (to lighten starting load on engine) for M/T vehicle, and depress accelerator pedal (2) all the way to make throttle fully open.
9) Crank engine with fully charged battery, and read the highest pressure on compression gauge.

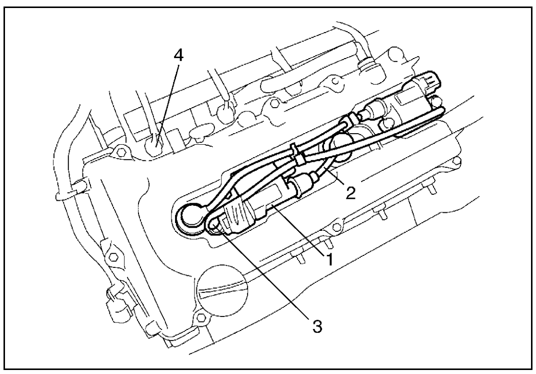
NOTE:

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

Compression pressure

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

10) Carry out Steps 7) through 9) on each cylinder to obtain 4 readings.



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

Engine Vacuum Check

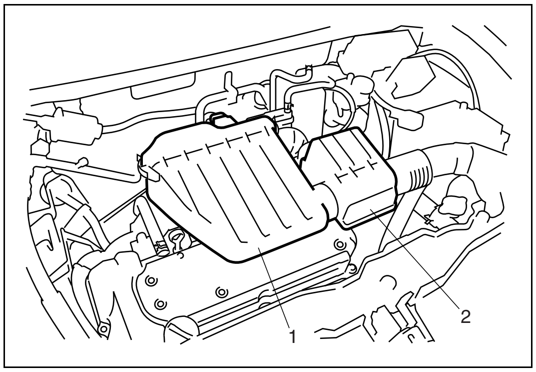
The engine vacuum that develops in the intake line is a good indicator of the condition of the engine. The vacuum checking procedure is as follows:

1) Warm up engine to normal operating temperature.

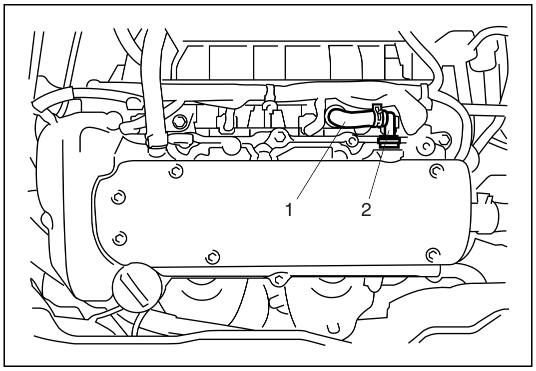
NOTE:

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

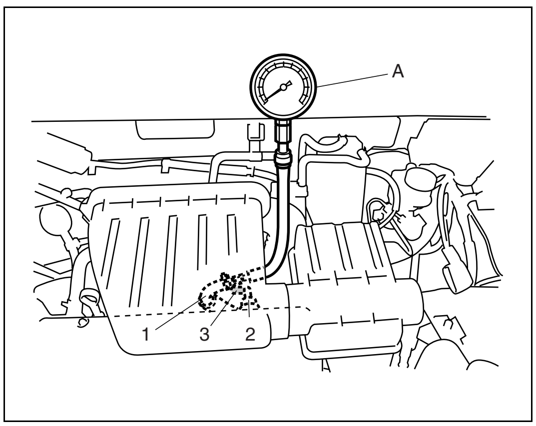
2) Stop engine and turn off the all electric switches.



3) Remove air cleaner case (1) and resonator (2).



4) Remove PCV hose (1) from PCV valve (2).



5) Connect special tool (Vacuum gauge) to PCV hose (1).

Special tool
(A): 09915-67311

6) Blind PCV valve (2) using tape (3) or the like.
7) Install air cleaner case and resonator.
8) Run engine at specified idle speed and read vacuum gauge. Vacuum should be within specification.

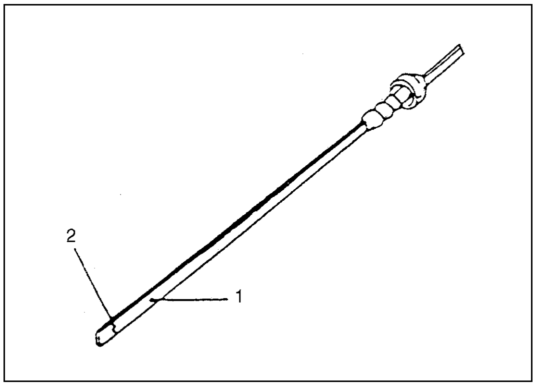
Vacuum specification (at sea level)
59 – 73 kPa (45 – 55 cmHg, 17.7 – 21.6 inHg)
at specified idle speed

9) After checking, disconnect special tool (Vacuum gauge) from PCV valve.
10) Detach blind cap from PCV valve.
11) Install air cleaner case and resonator.

Oil Pressure Check

NOTE:

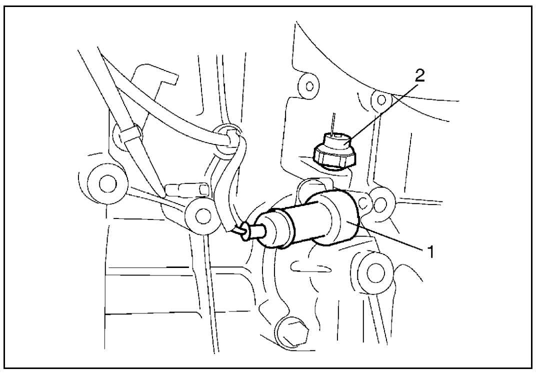
Prior to checking oil pressure, check the following items.



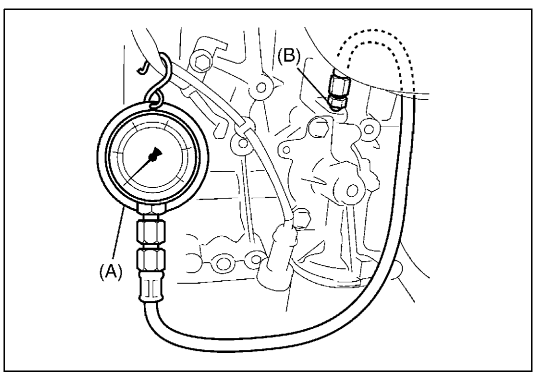
- Oil level in oil pan
  If oil level is low, add oil up to Full level mark (hole) on oil level gauge.
- Oil quality
  If oil is discolored or deteriorated, change it.
  For particular oil to be used, refer to “Engine Oil and Filter Change” in Section 0B.

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

- Oil leaks
  If leak is found, repair it.



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



4) Install special tools (Oil pressure gauge) to threaded hole of oil pressure switch.

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

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

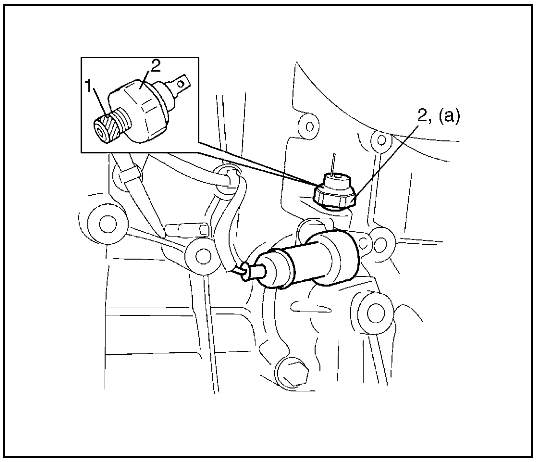
NOTE:

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

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

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

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



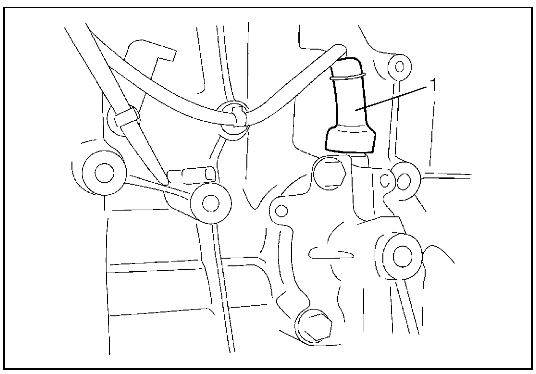
8) Before reinstalling oil pressure switch (2), be sure to wrap its screw threads with sealing tape (1) and tighten switch to specified torque.

NOTE:

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

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

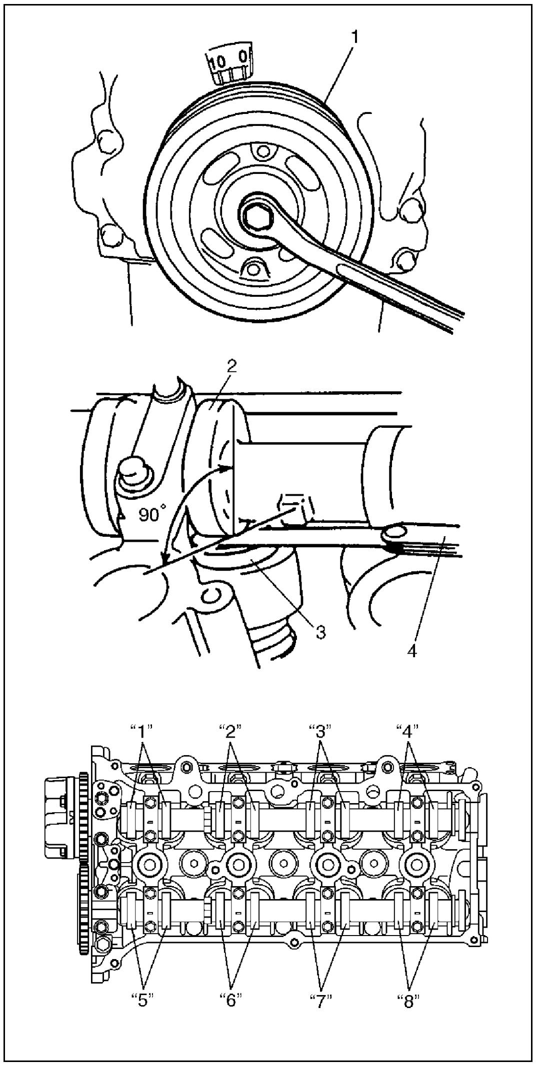
9) Start engine and check oil pressure switch (2) for oil leakage. If oil leakage is found, repair it.



10) Connect oil pressure switch coupler and fit cover (1) firmly.

Valve Lash (Clearance) Inspection

1) Remove negative cable at battery.
2) Remove cylinder head cover referring to "Cylinder Head Cover Removal and Installation" in this section.
3) Remove right side engine under cover, if necessary.



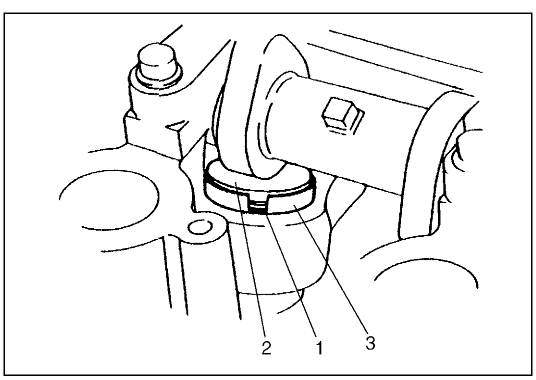
4) Using 17 mm wrench, turn crankshaft pulley (1) clockwise until cam lobes (2) become perpendicular to shim faces (3) at valves "1" and "7" as shown in figure.
5) Check valve lashes with thickness gauge (4) according to the following procedure.
   a) Check valve lashes at valves "1" and "7".
   b) Turn camshafts by 90° (by turning crankshaft with wrench).
   c) Make sure that cam lobes (2) are perpendicular to shim faces (3) at valves to be checked (in this case, "3" and "8"), if not, adjust it by turning crankshaft. Check valve lashes.
   d) In the same manner as b) – c), check valve lashes at valves "4" and "6".
   e) In the same manner as b) – c) again, check valve lashes at valves "2" and "5".

If valve lash is out of specification, record valve lash and adjust it to specification referring to "Shim Replacement" in this section.

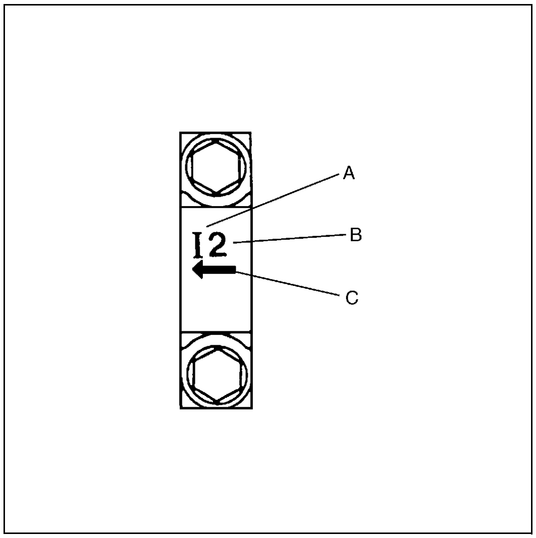
Valve clearance specification

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

Shim Replacement



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

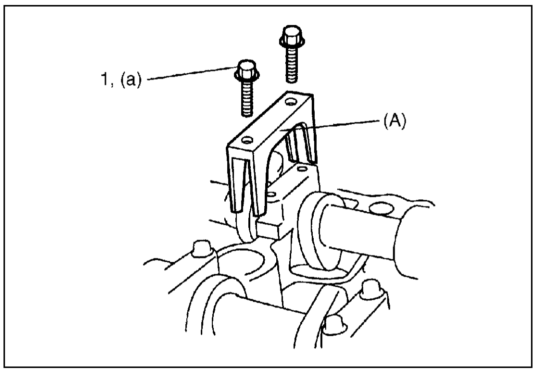


b) Check housing No. and select special tool corresponding to housing No. referring to the following table.

Special tool selection table

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

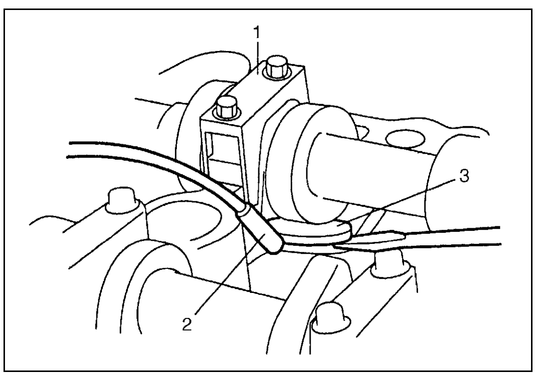
A:	I: Intake side or E: Exhaust side
B:	Position from timing chain side
C:	Pointing to timing chain side



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

Special tool
(A): 09916-67020 or 09916-67021

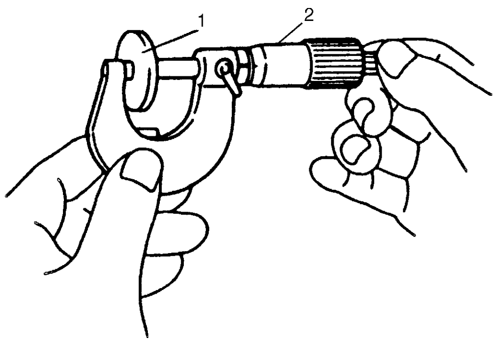
Tightening torque
Camshaft housing bolt (for tightening of special tool)
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



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

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

1.	Special tool
2.	Magnet

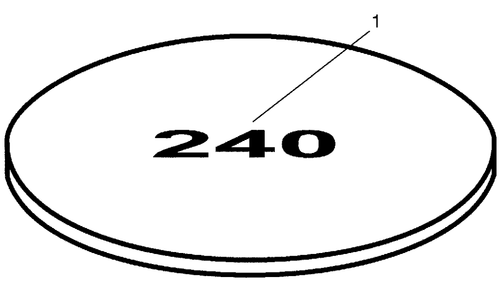


5) Using a micrometer (2), measure the thickness of the removed shim (1), and determine replacement shim by calculating the thickness of new shim with the following formula and table.

Intake side:
A = B + C – 0.200 mm (0.0078 in.)
Exhaust side:
A = B + C – 0.300 mm (0.0118 in.)

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

For example of intake side:
When thickness of removed shim is 2.400 mm (0.0945 in.), and measured valve clearance is 0.450 mm (0.0177 in.).
A = 2.400 mm (0.0945 in.) + 0.450 mm (0.0177 in.) – 0.200 mm (0.0078 in.) = 2.650 mm (0.1044 in.)
Calculated thickness of new shim = 2.650 mm (0.1043 in.)

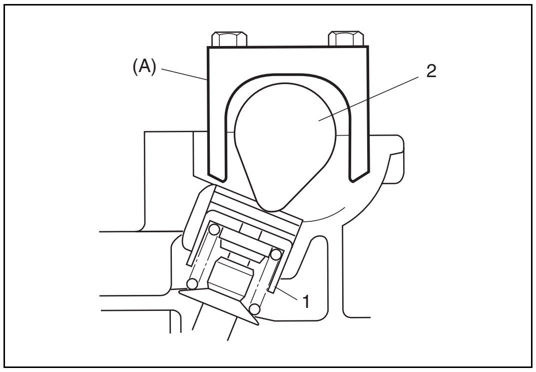


6) Select new shim No. (1) with a thickness as close as possible to calculated value.

Available new shims No.

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

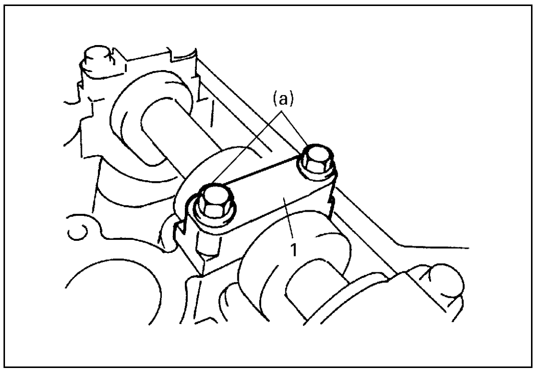
7) Install new shim facing shim No. side with tappet.



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

Special tool
(A): 09916-67020 or 09916-67021

1.	Tappet
2.	Camshaft



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

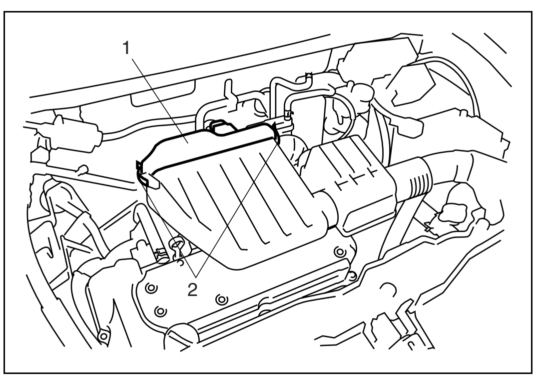
Tightening torque
Camshaft housing bolt
(a): Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft)
by the specified procedure.

10) Check valve clearance again after adjusting it.
11) After checking and adjusting all valves.
12) Install cylinder head cover referring to “Cylinder Head Cover Removal and Installation” in this section.

On-Vehicle Service

Air Cleaner Element Removal and Installation

Removal

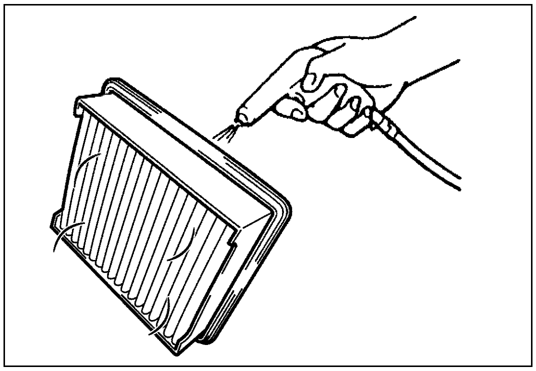


1) Open air cleaner case (1) by unhooking its clamps (2).
2) Remove air cleaner element from case.

Installation

Reverse removal procedure for installation.

Air Cleaner Element Inspection and Cleaning



- Check air cleaner element for dirt. Replace excessively dirty element.
- Blow off dust by compressed air from air outlet side of element.

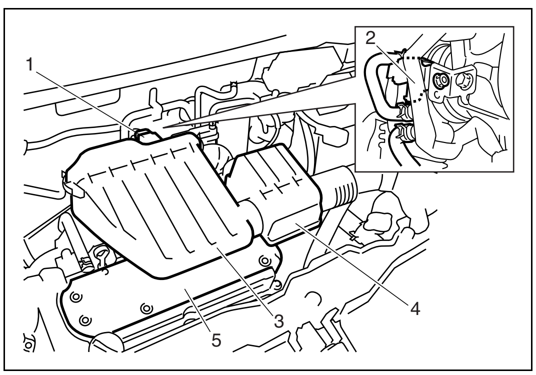
Knock Sensor Removal and Installation

Refer to “Knock Sensor Removal and Installation” in Section 6E2.

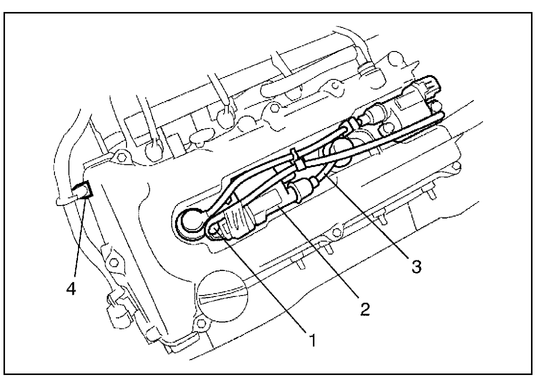
Cylinder Head Cover Removal and Installation

Removal

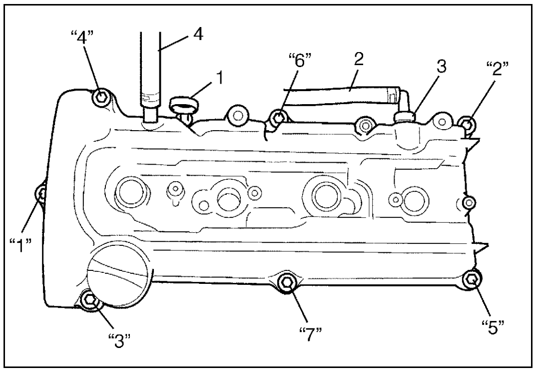
1) Disconnect negative cable at battery.



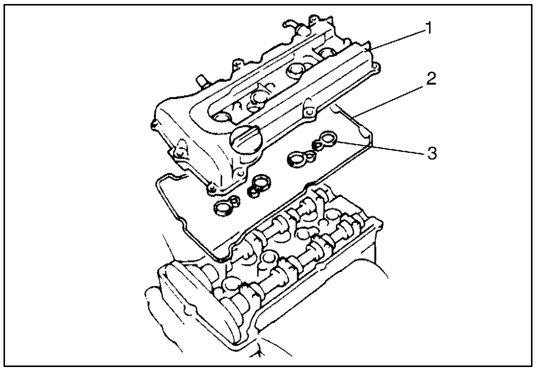
2) Disconnect MAF sensor coupler (1).
3) Remove EVAP canister purge valve (2).
4) Remove air cleaner case (3) and resonator (4).
5) Remove cylinder head upper cover (5).



6) Disconnect ignition coil couplers (1).
7) Remove ignition coil assemblies (2) with high-tension cord (3).
8) Remove wire harness clamp (4) from cylinder head cover.

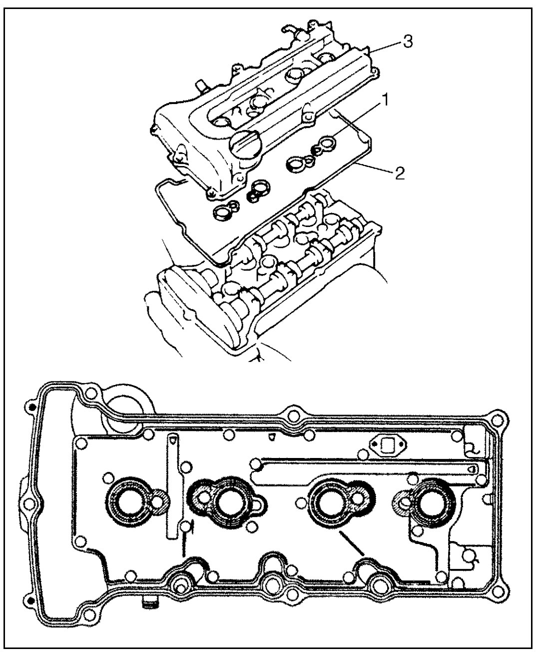


9) Remove oil level gauge (1).
10) Disconnect PCV hose (2) from PCV valve (3) and disconnect breather hose (4) from cylinder head cover.
11) Remove cylinder head cover mounting bolts in such order as indicated in figure.

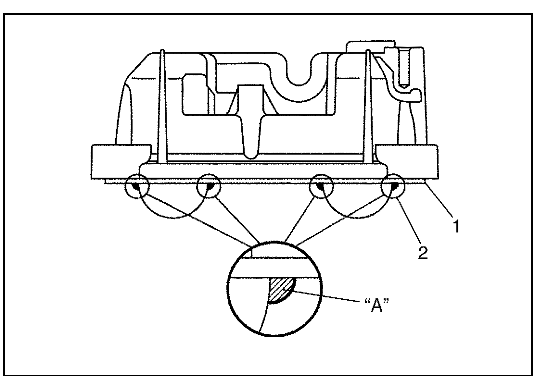


12) Remove cylinder head cover (1) with cylinder head cover gasket (2) and spark plug hole gasket (3).

Installation

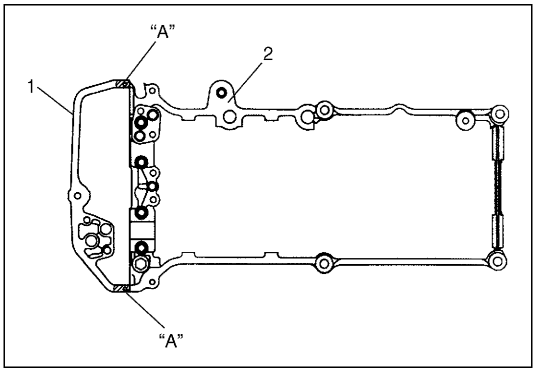


1) Install new spark plug hole gaskets (1) and new cylinder head cover gasket (2) to cylinder head cover (3) as shown in figure.



2) Remove oil, old sealant and dust from sealing surface on cylinder head and cover. After cleaning, apply sealant "A" to the following point.
   - Cylinder head cover gasket (1) sealing surface area (2) as shown.

"A": Sealant 99000-31250



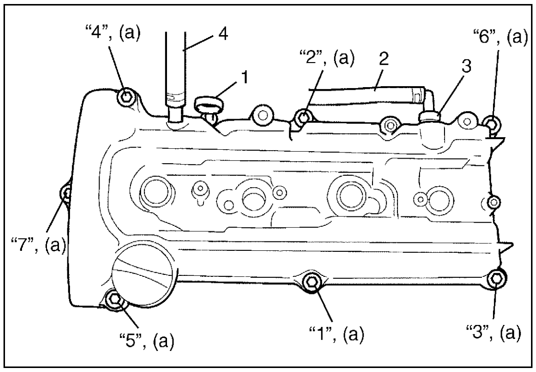
- Timing chain cover (1) and cylinder head (2) mating surface as shown.

"A": Sealant 99000-31250

3) Install cylinder head cover to cylinder head.

NOTE:

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

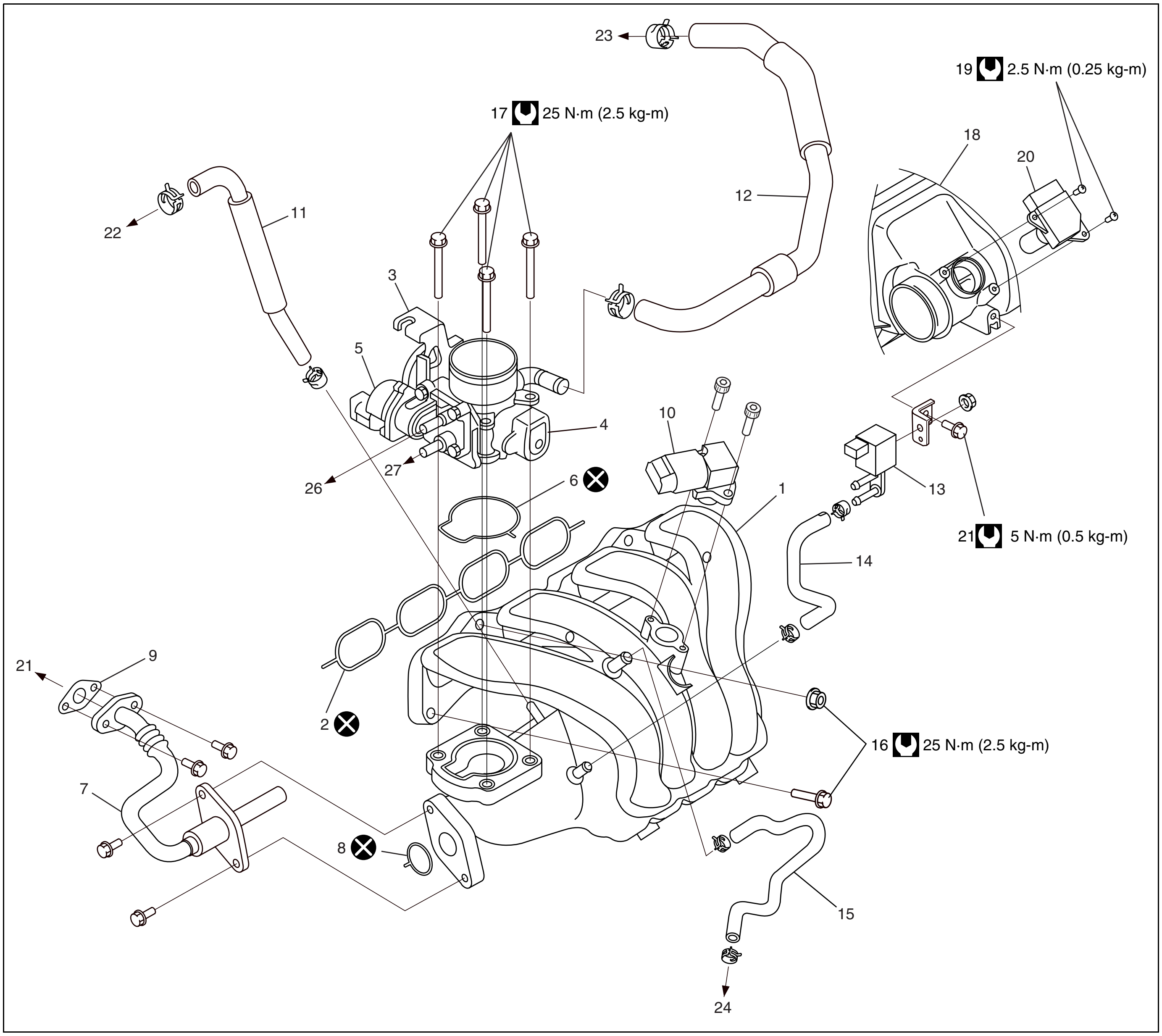


4) Tighten bolts in such order as indicated in figure a little at a time till they are tightened to specified torque.

Tightening torque
Cylinder head cover bolt
(a): Tighten 5.0 N·m (0.5 kg-m, 3.5 lb-ft),
7.5 N·m (0.75 kg-m, 5.5 lb-ft) by the specified procedure.

5) Connect PCV hose (2) to PCV valve (1).
6) Connect breather hose (4).
7) Install oil level gauge (3).
8) Install wire harness clamp to cylinder head cover.
9) Install ignition coil assemblies with high-tension cord.
10) Connect ignition coil couplers and clamp harness securely.
11) Install cylinder head upper cover.
12) Install air cleaner case and resonator.
13) Connect negative cable at battery.

Throttle Body and Intake Manifold Components

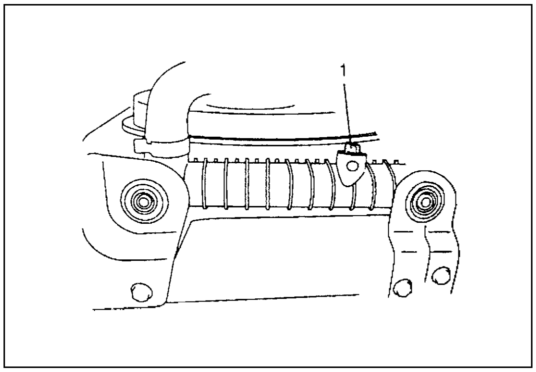


1. Intake manifold	9. Gasket	17. Throttle body mounting bolt	25. To brake booster
2. Intake manifold O-Ring	10. MAP sensor	18. Air cleaner case	26. To water outlet cap
3. Throttle body	11. PCV valve hose	19. MAF sensor bolt	27. To heater union
4. TP sensor	12. Breather hose	20. MAF sensor	Tightening torque
5. IAC valve	13. EVAP canister purge valve	21. VSV bracket bolt	Do not reuse.
6. O-Ring	14. EVAP canister purge valve hose	22. To EGR valve	
7. EGR pipe	15. Brake booster hose	23. To PCV valve	
8. O-Ring	16. Intake manifold mounting bolt and nut	24. To cylinder head cover	

Throttle Body Removal and Installation

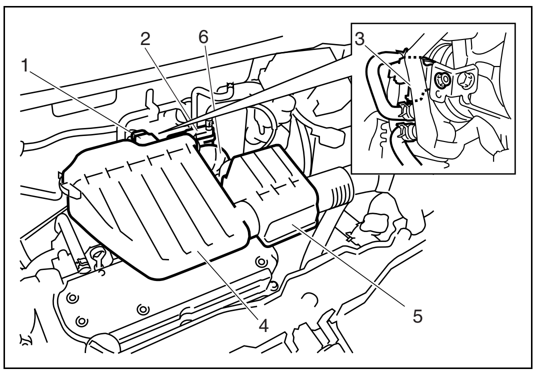
Removal

1) Relieve fuel pressure referring to "Fuel pressure Relief Procedure" in Section 6-2.
2) Disconnect negative cable at battery.

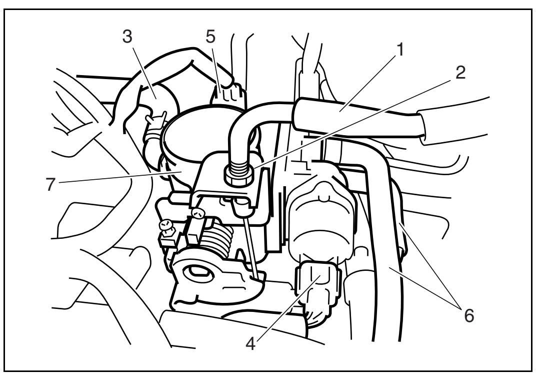


3) Drain coolant by loosening drain plug (1).

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



4) Disconnect MAF sensor coupler (1).
5) Remove EVAP canister purge valve chamber (2) from air cleaner outlet hose.
6) Remove EVAP canister purge valve (3).
7) Remove air cleaner case (4) and resonator (5).
8) Remove air cleaner outlet hose (6).



9) Remove accelerator cable (1) by loosening lock nut (2).
10) Disconnect breather hose (3) and water hoses (6) from throttle body.
11) Disconnect IAC valve coupler (4) and TP sensor coupler (5).
12) Remove throttle body (7) from intake manifold.

Installation

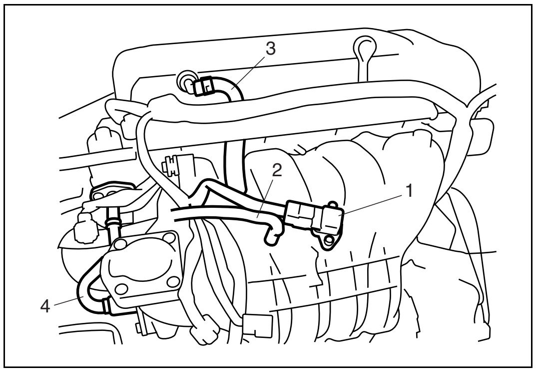
Reverse removal procedure for installation noting the followings.

- Use new throttle body O-ring.
- Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- Adjust accelerator cable play referring to "Accelerator Cable Adjustment" in Section 6E2.
- Refill cooling system referring to "Cooling System Flush and Refill" in Section 6B2.
- 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.

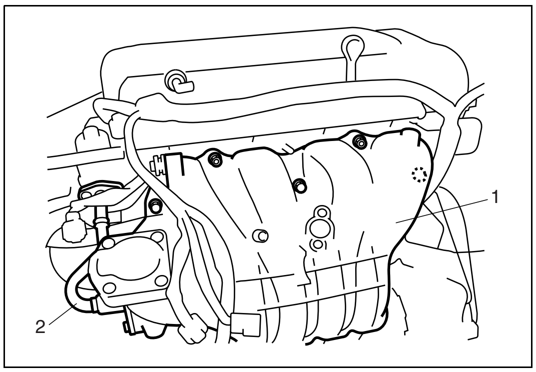
Intake Manifold Removal and Installation

Removal

1) Remove throttle body referring to "Throttle Body Removal and Installation" in this section.



2) Disconnect MAP sensor coupler (1).
3) Disconnect the following hoses:
   - Brake booster hose (2) from cylinder head cover
   - PCV hose (3) from PCV valve
4) Disconnect EGR pipe (4) from EGR valve.

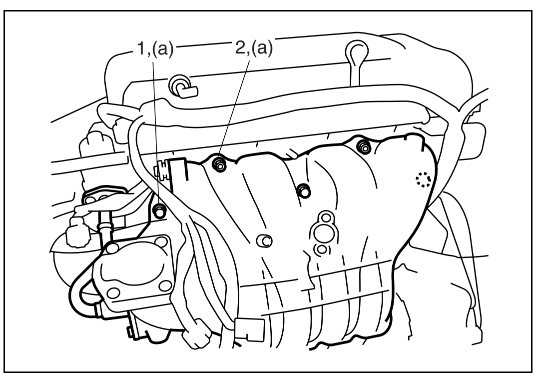


5) Remove intake manifold (1) and EGR pipe (2) from cylinder head, and then remove its gasket and O-ring.

Installation

Reverse removal procedure for installation noting the followings.

- Use new intake manifold O-ring.
- Use new EGR pipe gasket and O-ring.

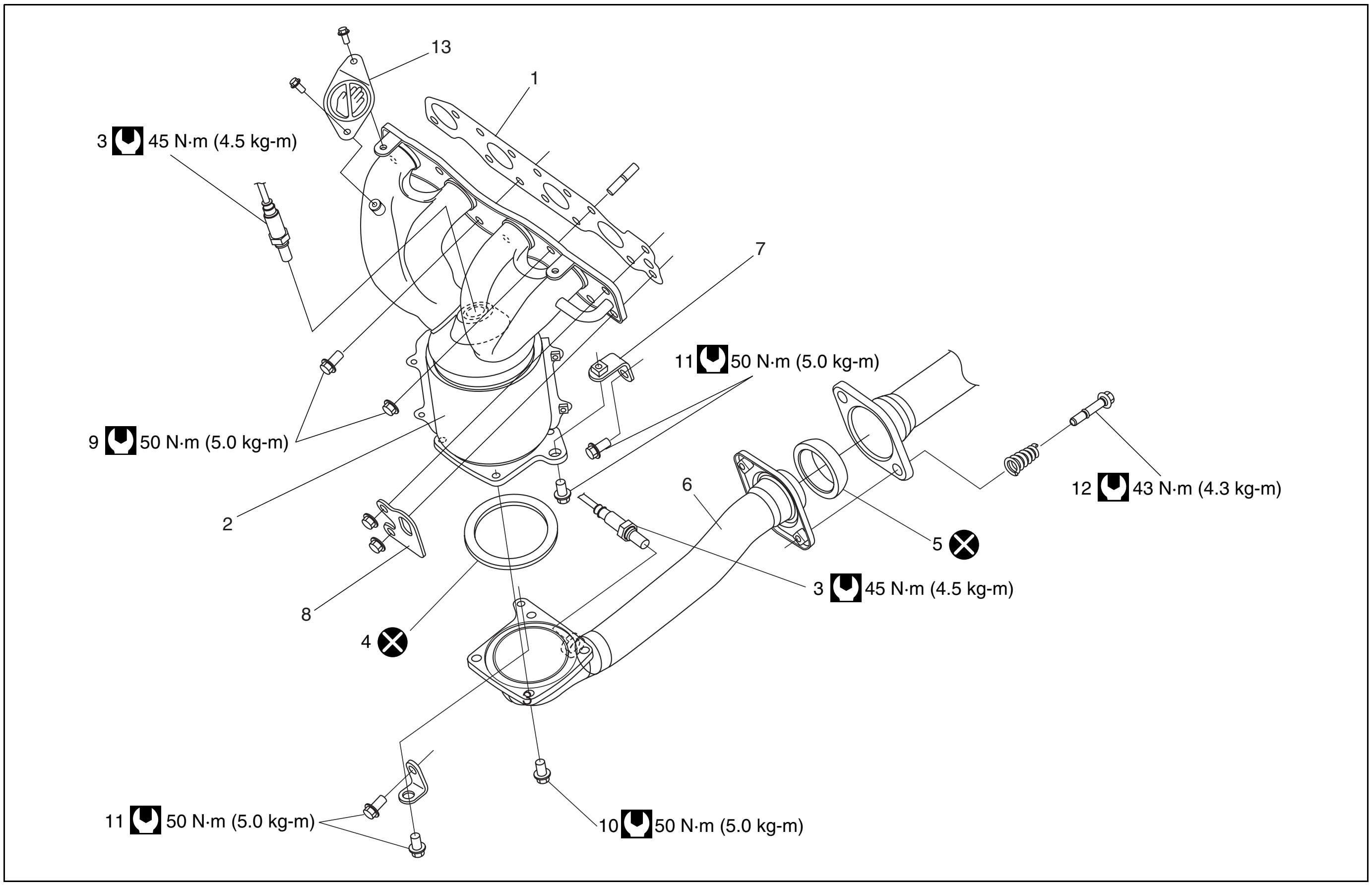


- Tighten bolts (1) and nuts (2) to specified torque.

Tighting torque
Intake manifold bolt and nut
(a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

- Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- Adjust accelerator cable play referring to "Accelerator Cable Adjustment" in Section 6E2.
- Refill cooling system referring to "Cooling System Flush and Refill" in Section 6B2.
- 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 Components



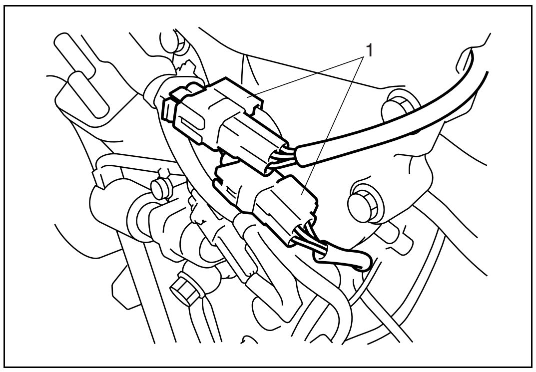
1. Exhaust manifold gasket	6. Exhaust No.1 pipe	11. Exhaust manifold stiffener bolt
2. Exhaust manifold	7. Exhaust manifold stiffener	12. Exhaust pipe No.2 bolt
3. Exhaust oxygen sensor	8. Engine hook	13. Caution plate
4. Exhaust pipe gasket	9. Exhaust manifold mounting bolt and nut	Tightening torque
5. Seal ring No.1	10. Exhaust pipe No.1 bolt	Do not reuse.

Exhaust Manifold Removal and Installation

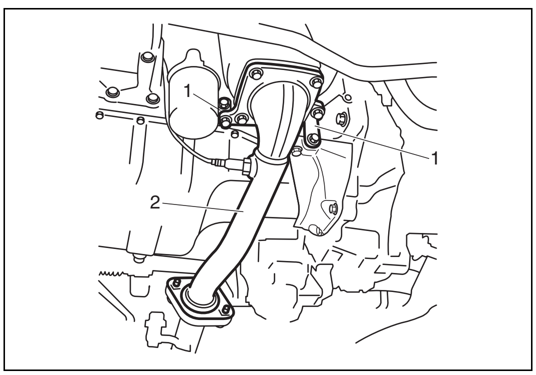
> **WARNING:**
> **To avoid danger of being burned, do not service exhaust system while it is still hot. Service should be performed after system cools down.**

Removal

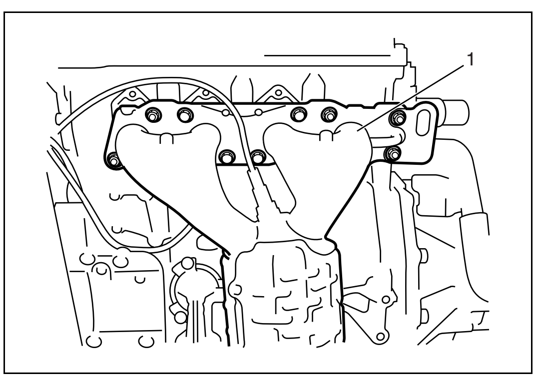
1) Disconnect negative cable at battery.
2) Remove front bumper with front grille referring to “Front Bumper and Rear Bumper” in Section 9.
3) Remove radiator referring to “Radiator Removal and Installation” in Section 6B2 for equipped with A/C.
4) With hose connected, detach A/C condenser from vehicle body for equipped with A/C.



5) Disconnect heated oxygen sensor coupler (1) and detach it from its stay.

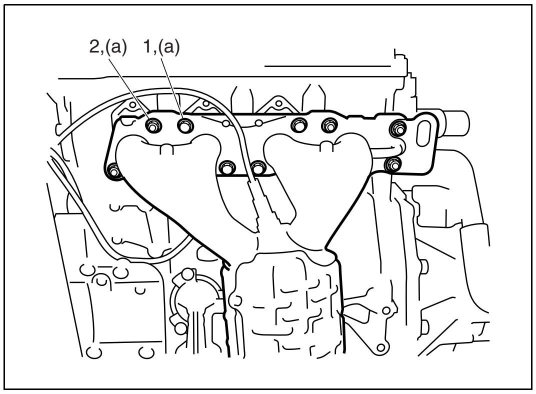


6) Remove exhaust manifold stiffener (1).
7) Disconnect exhaust No.1 pipe (2) from exhaust manifold.



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

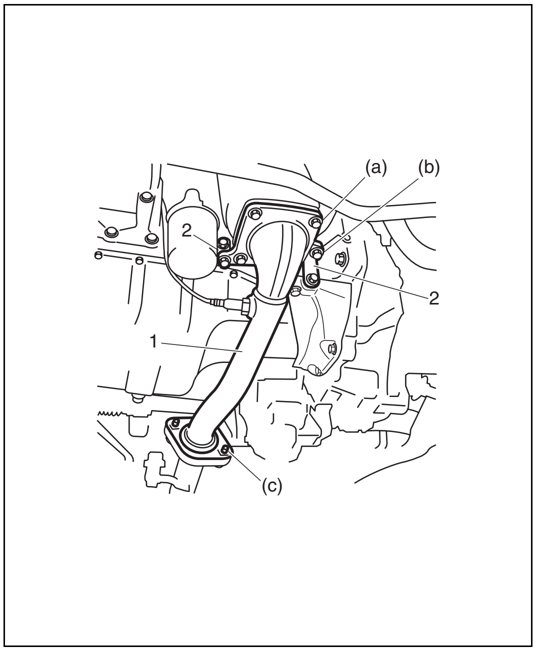
Installation



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

Tightening torque
Exhaust manifold bolt and nut
(a): 50 N·m (5.0 kg-m, 36.5 lb-ft)

NOTE:
The figure on the left varies with specification.



2) Install new seal ring and connect exhaust No.1 pipe (1) to exhaust manifold.
   Tighten pipe fasteners to specified torque.

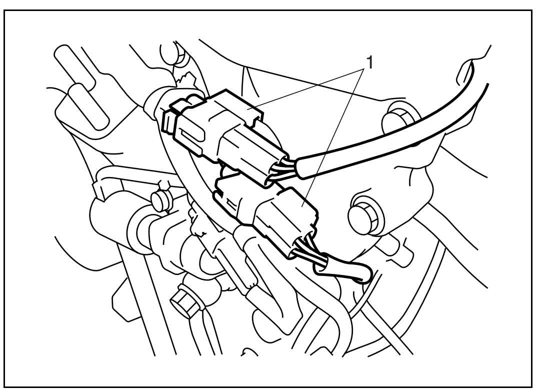
Tightening torque
Exhaust No.1 pipe bolt (a): 50 N·m (5.0 kg-m, 36.5 lb-ft)

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

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

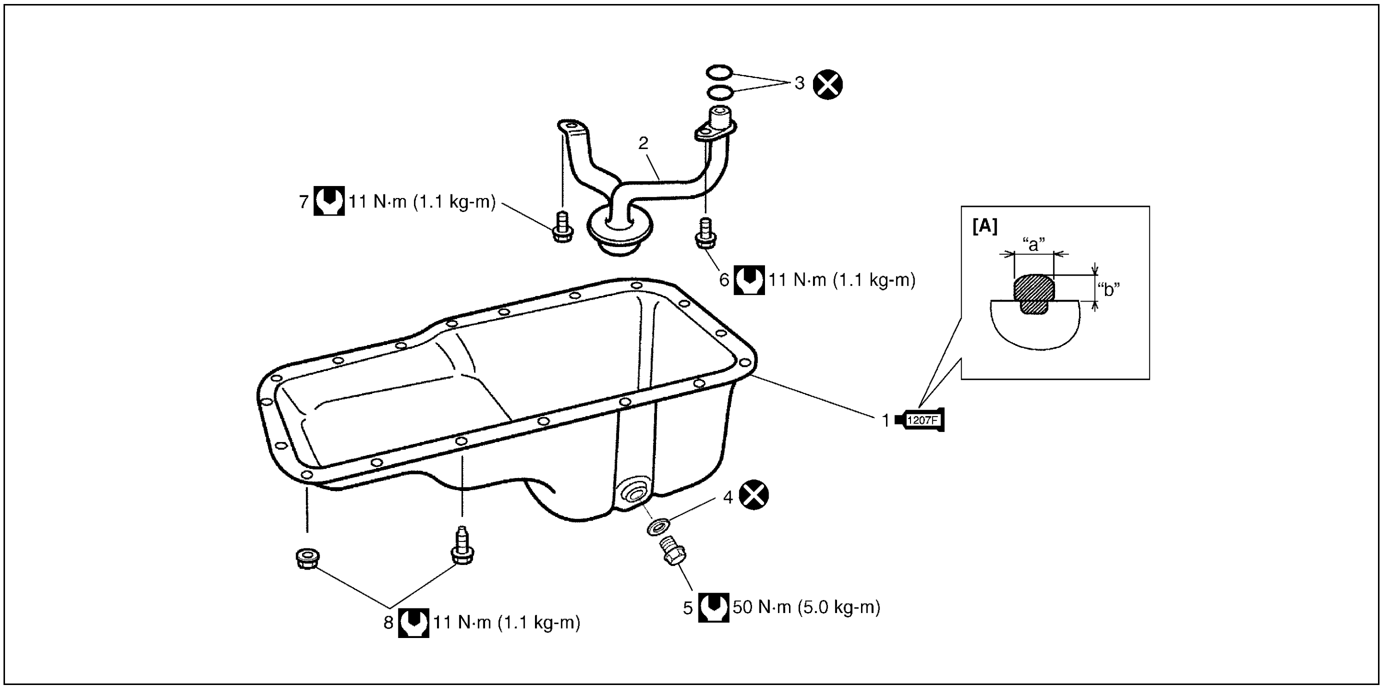
4) Install new seal ring and connect exhaust No.1 pipe (1) to exhaust No.2 pipe.
   Tighten pipe fasteners to specified torque.

Tightening torque
Exhaust No.2 pipe bolt (c): 43 N·m (4.3 kg-m, 31.5 lb-ft)



5) Connect heated oxygen sensor coupler (1) and fit coupler to bracket securely.
6) Install A/C condenser to vehicle body for equipped with A/C.
7) Install radiator referring to “Radiator Removal and Installation” in Section 6B2 for equipped with A/C.
8) Install front bumper with front grille by referring to “Front Bumper and Rear Bumper” in Section 9.
9) Connect negative cable to battery.
10) Check exhaust system for exhaust gas leakage.

Oil Pan and Oil Pump Strainer Components

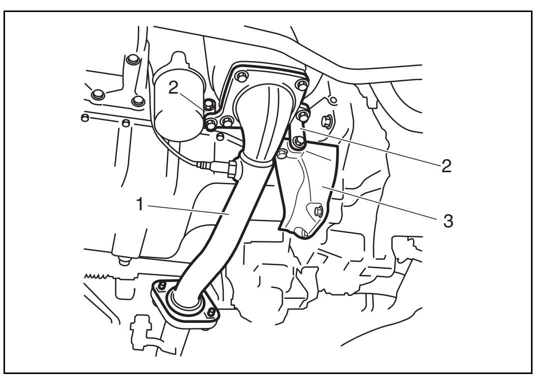


	[A]: Sealant application amount	3. O-ring	8. Oil pan bolt and nut
	"a": 3 mm (0.12 in.)	4. Gasket	Tightening torque
	"b": 2 mm (0.08 in.)	5. Oil pan drain plug bolt	Do not reuse.
1207F	1. Oil pan : Apply sealant 99000-31250 to mating surface.	6. Oil pump strainer bolt	
	2. Strainer	7. Oil pump strainer bracket bolt	

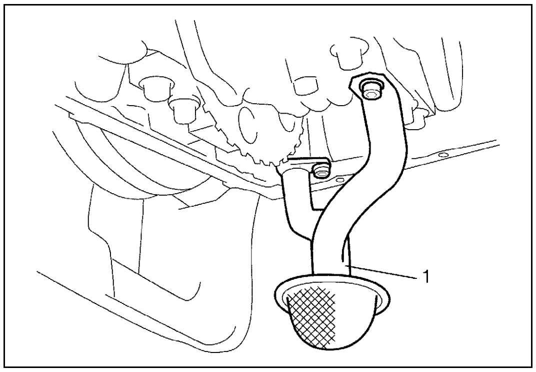
Oil Pan and Oil Pump Strainer Removal and Installation

Removal

1) Remove oil level gauge.
2) Drain engine oil by removing drain plug.

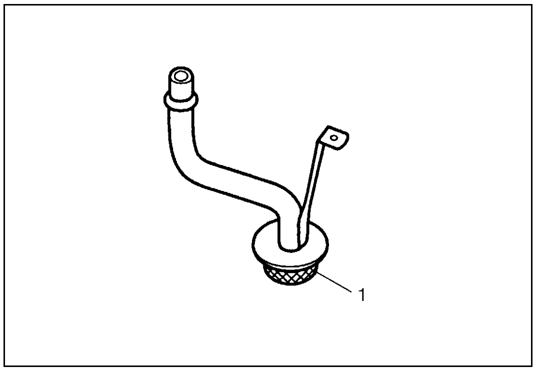


3) Remove exhaust No.1 pipe (1), exhaust manifold stiffener (2) and clutch housing lower plate (3).
4) For 2WD vehicle, remove engine rear mounting bracket.
5) For 4WD vehicle, remove transfer referring to "Transfer Dismounting and Mounting" in Section 7D.

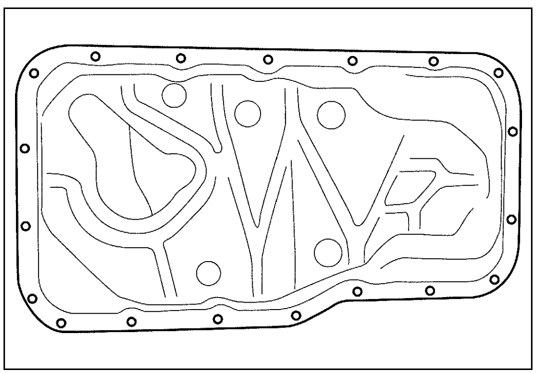


6) Remove oil pan and then oil pump strainer (1) from cylinder block.

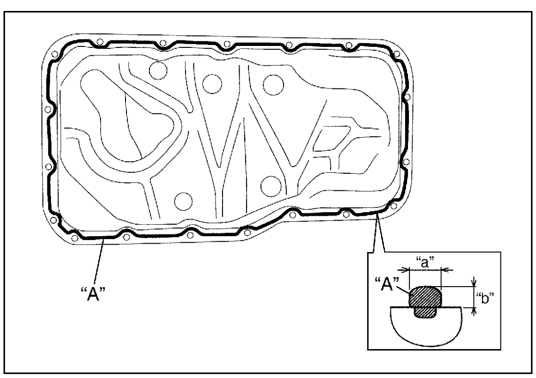
Installation



1) Clean oil pump strainer screen (1).



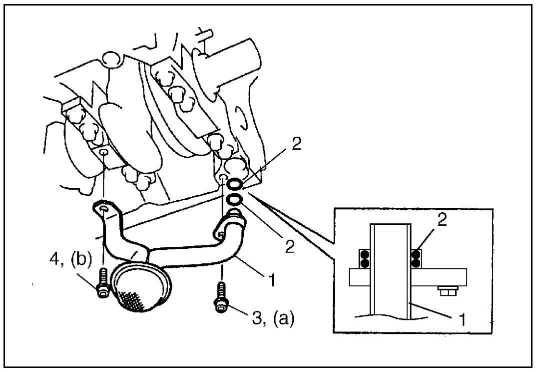
2) Clean sealing surface on oil pan and cylinder block. Remove oil, old sealant and dust from sealing surface.



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

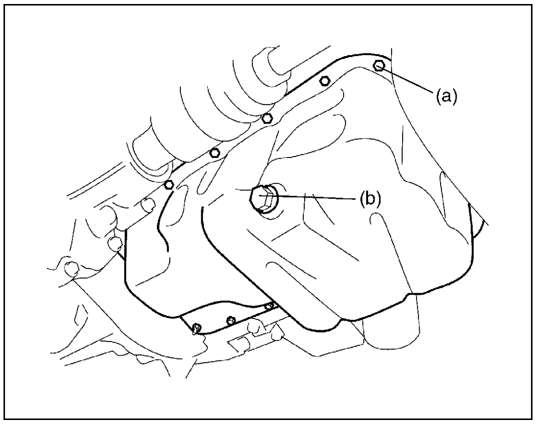
"A": sealant 99000-31250

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



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

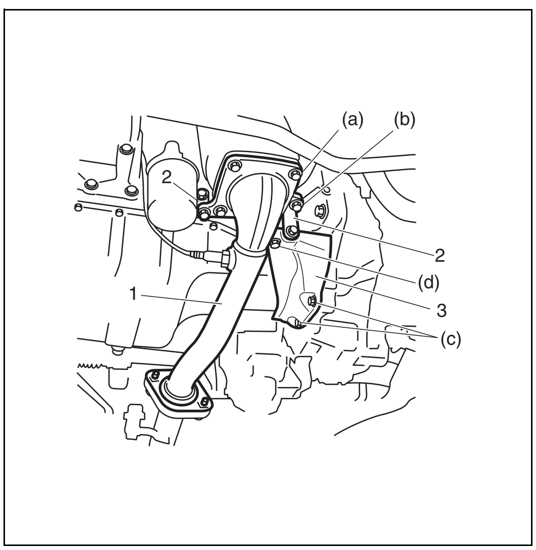
   Tightening torque
   Oil pump strainer bolt (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)
   Oil pump strainer bracket bolt
   (b): 11 N·m (1.1 kg-m, 8.0 lb-ft)



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

   Tightening torque
   Oil pan bolt and nut (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)
6) Install new gasket and drain plug to oil pan.
   Tighten drain plug to specified torque.

   Tightening torque
   Oil pan drain plug bolt (b): 50 N·m (5.0 kg-m, 36.5 lb-ft)
7) For 2WD vehicle, install Engine rear mounting bracket.
8) For 4WD vehicle, install transfer referring to “Transfer Dismounting and Mounting” in Section 7D.

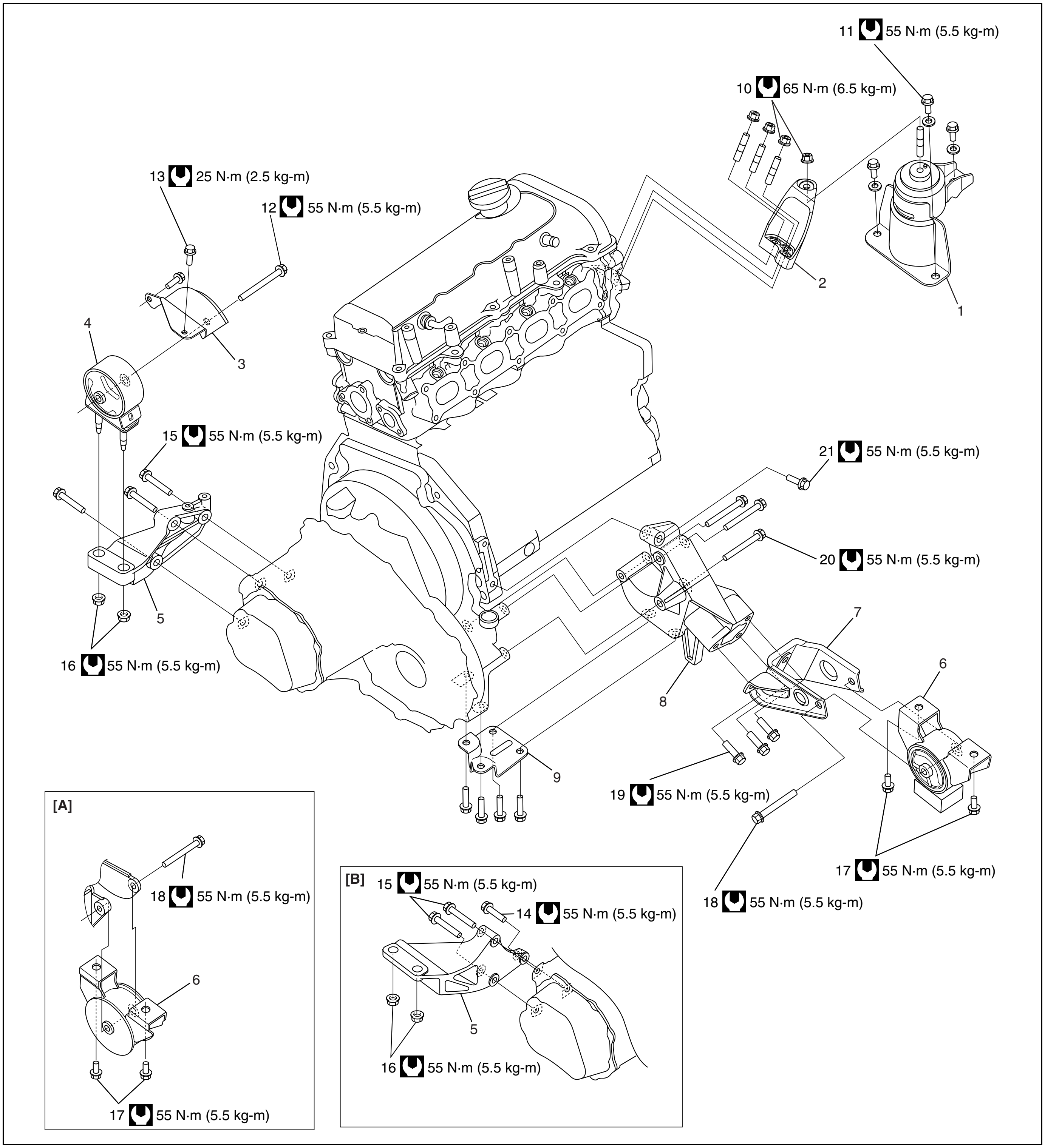


9) Install clutch housing lower plate (3).
   Tighten clutch housing lower plate bolts (c) first and next (d) with specified torque.

   Tightening torque
   Clutch housing lower plate bolt (c and d)
   : 50 N·m (5.0 kg-m, 36.5 lb-ft)
10) Install exhaust manifold stiffener (2) and exhaust No.1 pipe (1).
    Tighten bolts to specified torque.

    Tightening torque
    Exhaust pipe No.1 bolt (a): 50 N·m (5.0 kg-m, 36.5 lb-ft)
    Exhaust manifold stiffener bolt (b):
    50 N·m (5.0 kg-m, 36.5 lb-ft)
11) Install oil level gauge.
12) Refill engine with engine oil referring to “Engine Oil and Filter Change” in Section 0B.
13) Verify that there is no engine oil leakage and exhaust gas leakage at each connection.

Engine Mountings Components



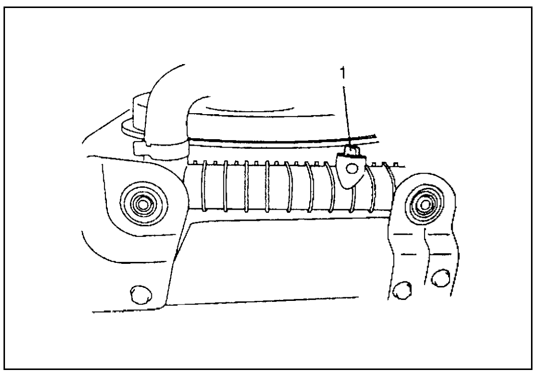
[A]:	4WD model	7.	Engine rear mounting No.1 bracket	15.	Engine left mounting bracket bolt (long)
[B]:	M/T model	8.	Engine rear mounting No.2 bracket	16.	Engine left mounting nut
1.	Engine right mounting	9.	Engine rear mounting bracket stiffener	17.	Engine rear mounting bolt (short)
2.	Engine right engine side bracket	10.	Engine right mounting nut	18.	Engine rear mounting bolt (long)
3.	Engine left body side bracket	11.	Engine right mounting bolt	19.	Engine rear mounting No.1 bracket bolt
4.	Engine left mounting	12.	Engine left mounting bolt	20.	Engine rear mounting No.2 bracket bolt (long)
5.	Engine left mounting bracket	13.	Engine left body side bracket bolt	21.	Engine rear mounting No.2 bracket bolt (short)
6.	Engine rear mounting	14.	Engine left mounting bracket bolt (short)	(torque symbol)	Tightening torque

Unit Repair Overhaul

Engine Assembly Removal and Installation

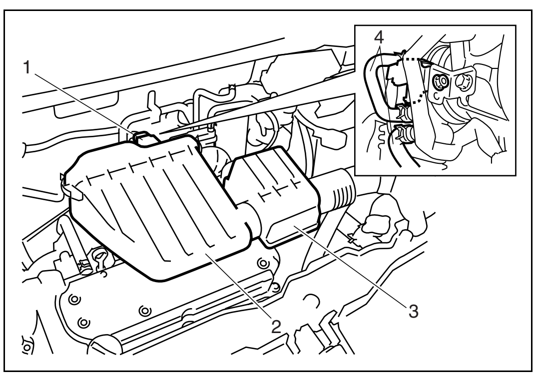
Removal

1) Relieve fuel pressure referring to “Fuel Pressure Relief Procedure” in Section 6-2.
2) Disconnect negative and positive cables at battery.
3) Remove engine hood after disconnecting windshield washer hose.
4) Remove right and left side engine under covers.
5) Remove A/C compressor belt by referring to “Compressor Drive Belt Removal and Installation” in Section 1B (if equipped).
6) Drain engine oil referring to “Engine Oil and Filter Change” in Section 0B.
7) Drain transaxle oil referring to “Manual Transaxle Oil Change” in Section 7A2.
8) Drain transfer oil referring to “Transfer Oil Change” in Section 7D (for 4WD vehicle).



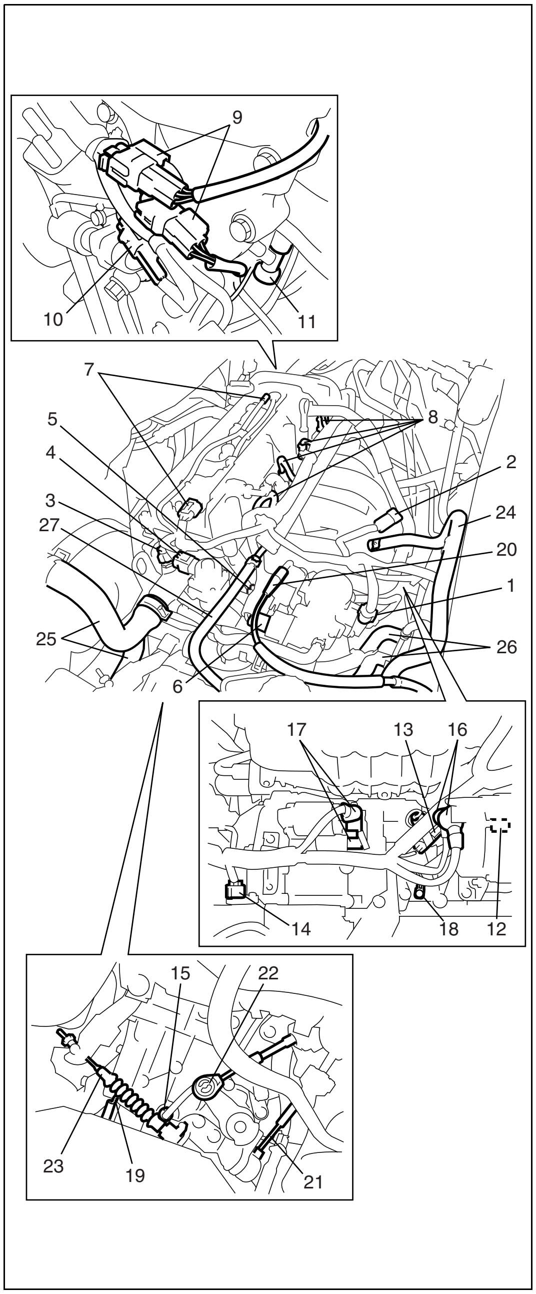
9) Drain coolant by referring to “Cooling System Flush and Refill” in Section 6B2.

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

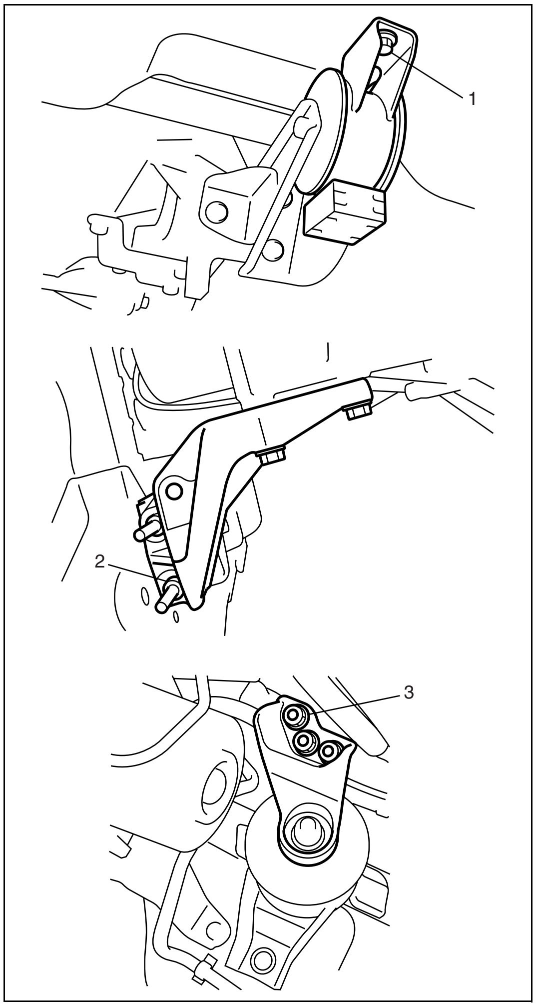


10) Disconnect MAF sensor coupler (1).
11) Remove air cleaner case (2) and resonator (3).
12) Remove canister purge hose (4) from EVAP canister purge valve.
13) With hose connected, detach A/C compressor from its bracket (if equipped).

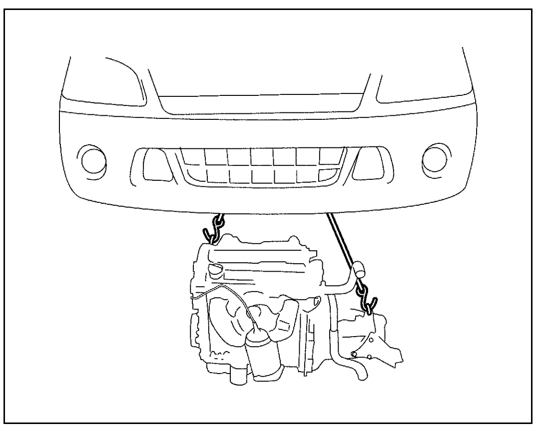
NOTE:
Suspend removed A/C compressor at a place where no damage will be caused during removal and installation of engine assembly.



14) Disconnect the following electric lead wires:
    - TP sensor (1)
    - MAP sensor (2)
    - ECT sensor (3)
    - EGR valve (4)
    - CMP sensor (5)
    - IAC valve (6)
    - Ignition coil assembly (7)
    - Injectors (8)
    - Heated oxygen sensor (9)
    - Oil control valve (10)
    - Engine oil pressure switch (11)
    - CKP sensor (12)
    - Knock sensor (13)
    - VSS (14)
    - Back up light switch (15)
    - Generator (16)
    - Starting motor (17)
    - Ground terminal (18) from cylinder block
    - Battery ground cable (19) from transaxle
    - Magnet clutch switch of A/C compressor (if equipped)
    - Each wire harness clamps
15) Remove fuse box from its bracket.
16) Disconnect the following cables:
    - Accelerator cable (20)
    - Gear select control cable (21)
    - Gear shift control cable (22)
    - Clutch cable (23)
17) Disconnect the following hoses:
    - Brake booster hose (24) from intake manifold
    - Radiator inlet and outlet hoses (25) from each pipe
    - Heater inlet and outlet hoses (26) from each pipe
    - Fuel feed hoses (27) from fuel feed pipe
18) Remove exhaust No.1 pipe referring to “Exhaust Manifold Removal and Installation” in this section.
19) Disconnect right and left drive shaft joints to differential gear referring to “Removal” in Section 4.
    For engine and transaxle removal, it is not necessary to remove drive shafts from steering knuckle.
20) For 4WD vehicle, remove propeller shaft referring to “On-Vehicle Service” in Section 4B.



21) Install lifting device.
22) Remove engine rear mounting bolts (1), engine left mounting bracket nuts (2) and engine right mounting nuts (3).



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

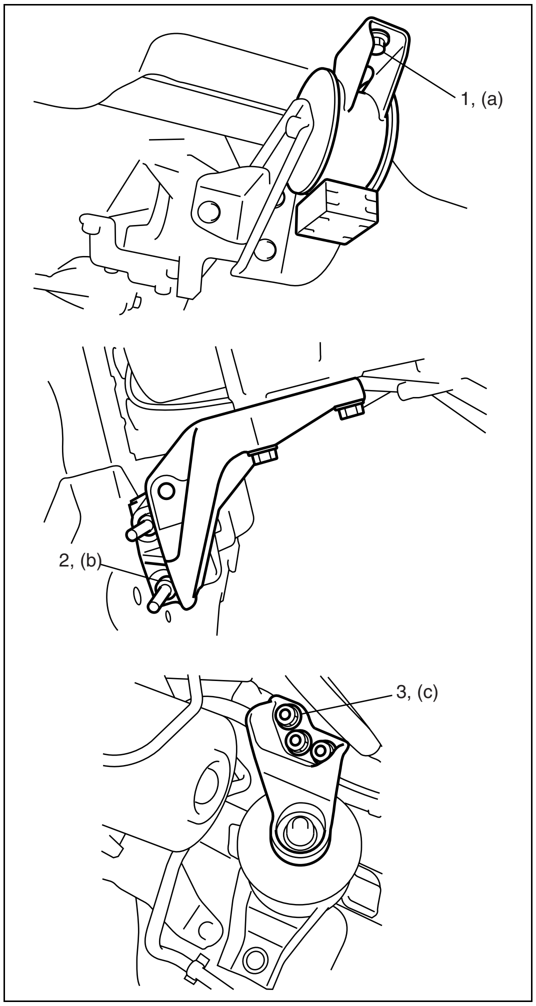
NOTE:

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

25) Disconnect transaxle from engine referring to "Transaxle Unit Dismounting and Remounting" in Section 7A2.
26) Remove clutch cover and clutch disk referring to "Clutch Cover, Clutch Disc and Flywheel Removal and Installation" in Section 7C2.

Installation

1) Install clutch cover and clutch disk referring to "Clutch Cover, Clutch Disc and Flywheel Removal and Installation" in Section 7C2.
2) Connect transaxle to engine referring to "Transaxle Unit Dismounting and Remounting" in Section 7A2.

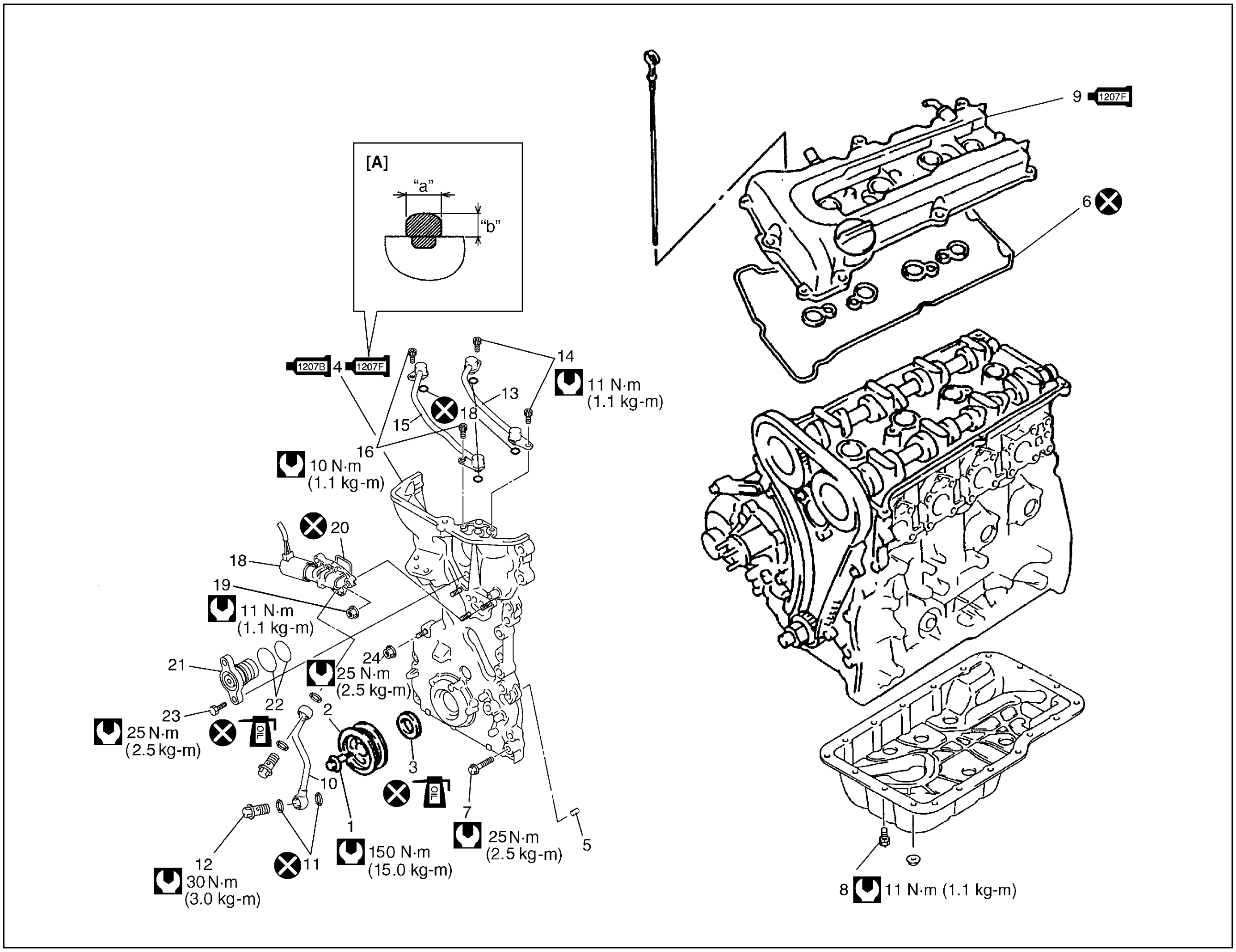


3) Lift engine with transaxle into engine compartment, but do not remove lifting device.
4) Install engine rear mounting bolts (1), engine left mounting bracket nuts (2) and engine right mounting nuts (3).
   Tighten these bolts and nuts to specified torque.

Tightening torque
Engine rear mounting bolt
(a): 55 N·m (5.5 kg-m, 40.0 lb-ft)
Engine left mounting bolt
(b): 55 N·m (5.5 kg-m, 40.0 lb-ft)
Engine right mounting nut
(c): 65 N·m (6.5 kg-m, 47.0 lb-ft)

5) Remove lifting device.
6) For 4WD vehicle, install propeller shaft referring to "On-Vehicle Service" in Section 4B.
7) Connect drive shaft joints referring to "Installation" in Section 4.
8) Install exhaust No.1 pipe referring to "Exhaust Manifold Removal and Installation" in this section.
9) Reverse disconnected hoses, cables and electric wires for connection.
10) Install air cleaner case and resonator.
11) Install A/C compressor to its bracket (if equipped).
12) Adjust A/C compressor belt tension (if equipped) referring to "Compressor Drive Belt Inspection and Adjustment" in Section 1B.
13) Adjust accelerator cable play referring to "Accelerator Cable Adjustment" in Section 6E2.
14) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
15) Refill cooling system with coolant referring to "Cooling System Flush and Refill" in Section 6B2.
16) Refill engine with engine oil referring to "Engine Oil and Filter Change" in Section 0B.
17) Refill transaxle with transaxle oil referring to "Transaxle Oil Change" in Section 7A2.
18) Refill transfer with transfer oil referring to "Transfer Oil Change" in Section 7D (for 4WD vehicle).
19) Connect negative cable at battery.
20) Verify that there is no fuel leakage, coolant leakage, oil leakage and exhaust gas leakage at each connection.

Timing Chain Cover Components



	[A]: Sealant application amount		8. Oil pan mounting bolt and nut		18. Oil control valve
	"a": 3 mm (0.12 in.)	1207F	9. Cylinder head cover : Apply sealant 99000-31250 to the sealing point for timing chain cover mating surface and cylinder head gasket sealing point referring to "Installation" under "Cylinder Head Cover Removal and Installation" in this section.		19. Oil control valve mounting nut
	"b": 2 mm (0.08 in.)		10. Oil gallery pipe No.1		20. O-ring
	1. Crankshaft pulley bolt		11. Copper washer		21. Water outlet cap
	2. Crankshaft pulley		12. Oil gallery pipe No.1 bolt	OIL	22. O-ring
OIL	3. Oil seal : Apply engine oil to oil seal lip.		13. Oil gallery pipe No.2		23. Water outlet cap bolt
1207B 1207F	4. Timing chain cover : Apply sealant 99000-31140 to the mating surface of cylinder and cylinder head. : Apply sealant 99000-31250 to the mating surface of timing chain cover referring to the figure of Step 1) of "Installation" under "Timing Chain Cover Removal and Installation" in this section.		14. Oil gallery pipe No.2 bolt		24. Timing chain cover mounting nut
	5. Pin		15. Oil gallery pipe No.3		Tightening torque
	6. Cylinder head cover gasket		16. Oil gallery pipe No.3 bolt		Do not reuse.
	7. Timing chain cover mounting bolts		17. O ring		

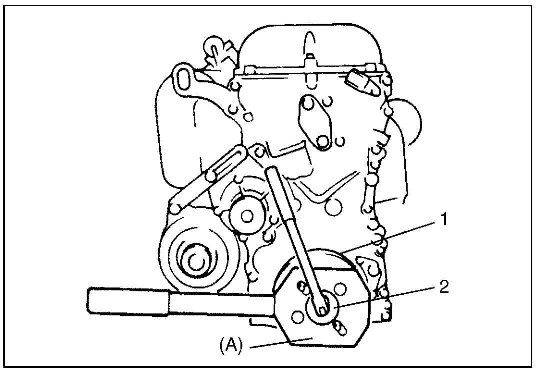
Timing Chain Cover Removal and Installation

Removal

CAUTION:

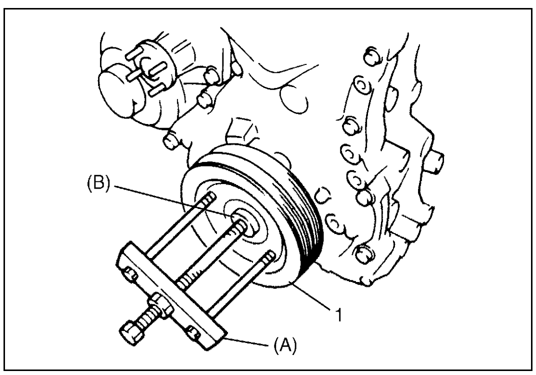
- **Keep working table, tools and hands clean while overhauling.**
- **Use special care to handle aluminum parts so as not to damage them.**
- **Do not expose removed parts to dust. Keep them always clean.**

1) Remove engine assembly from vehicle referring to “Engine Assembly Removal and Installation” in this section.



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

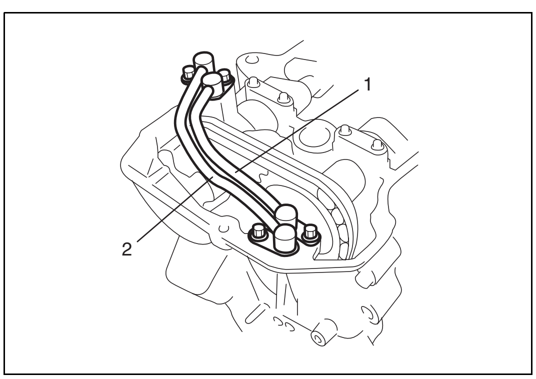
   Special tool
   (A): 09917-68221



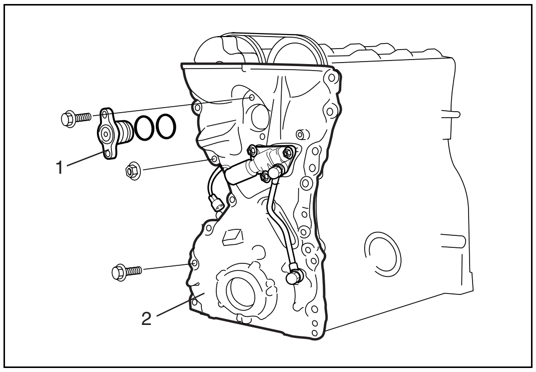
3) Remove crankshaft pulley (1).
   If it is hard to remove, use special tools as shown in figure.

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

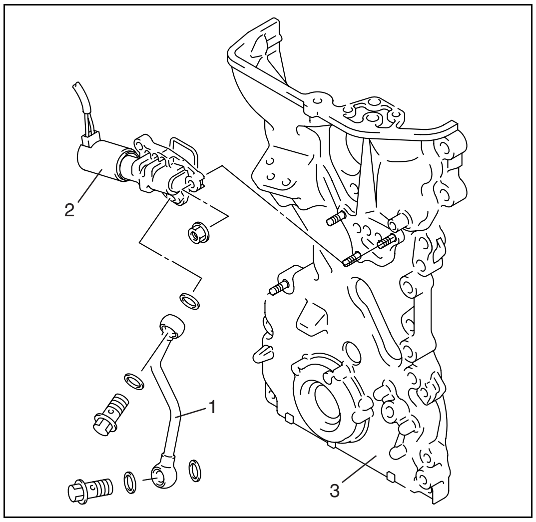
4) Remove cylinder head cover referring to “Cylinder Head Cover Removal and Installation” in this section.
5) Remove oil pan referring to “Oil Pan and Oil Pump Strainer Removal and Installation” in this section.
6) Remove water pump pulley.



7) Remove oil gallery pipes No.2 (1) and No.3 (2).



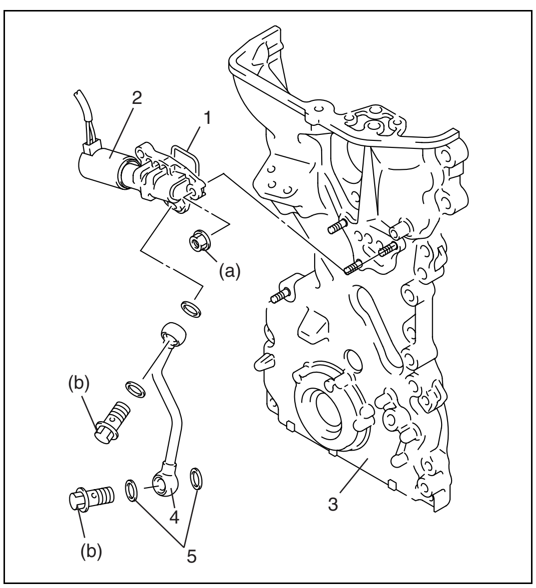
8) Remove water outlet cap (1) from timing chain cover (2).
9) Remove timing chain cover.



10) Remove oil gallery pipe No.1 (1) and oil control valve (2) from timing chain cover (3).

Installation

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

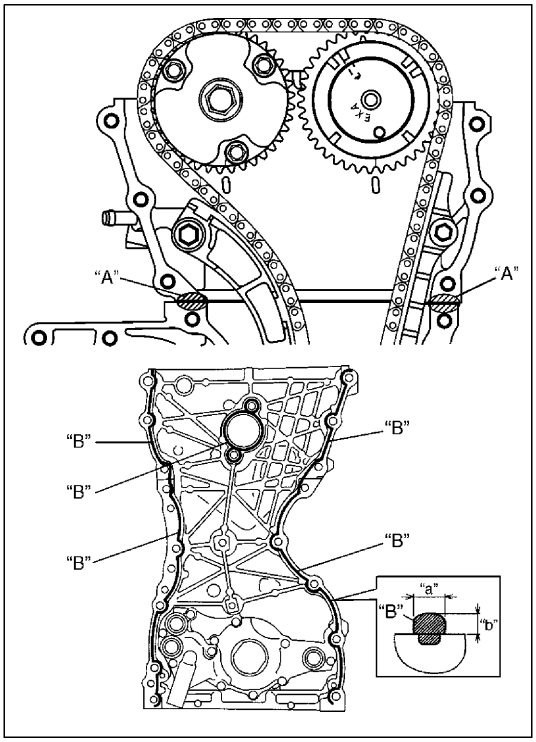


2) Install new O-ring (1) to oil control valve (2).
3) Install oil control valve to timing chain cover (3).
   Tighten nuts to specification.

Tightening torque
Oil control valve mounting nut
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

4) Install oil gallery pipe No.1 (4) with new copper washers (5) to timing chain cover.
   Tighten bolts to specification.

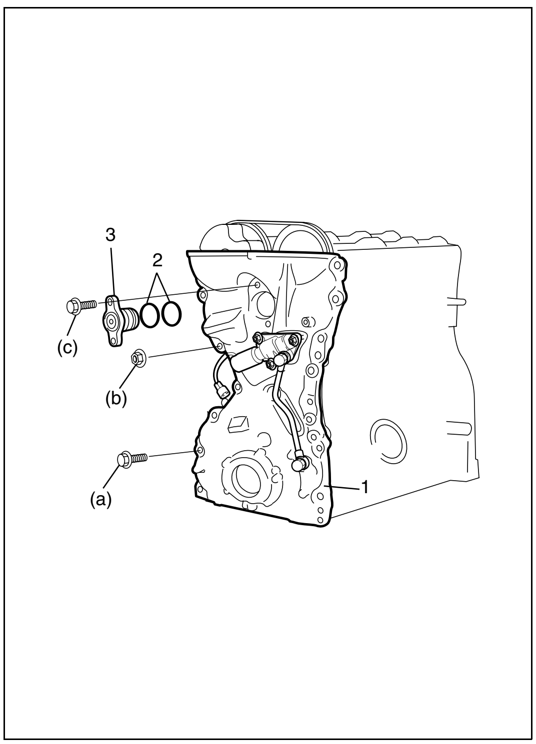
Tightening torque
Oil gallery pipe No.1 bolt
(b): 30 N·m (3.0 kg-m, 21.5 lb-ft)



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

"A": Sealant 99000-31140
"B": Sealant 99000-31250

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



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

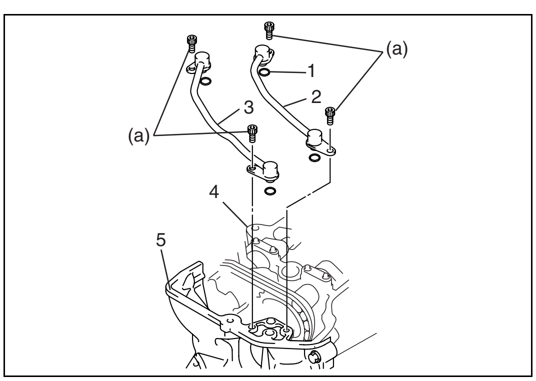
NOTE:

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

Tightening torque
Timing chain cover mounting bolt
(a): 25 N·m (2.5 kg-m, 18.0 lb-ft)
Timing chain cover mounting nut
(b): 25 N·m (2.5 kg-m, 18.0 lb-ft)

7) Apply engine oil to new O-rings (2) and install them to cap (3).
8) Install water outlet cap (3) to timing chain cover (1).
   Tighten bolts to specified torque.

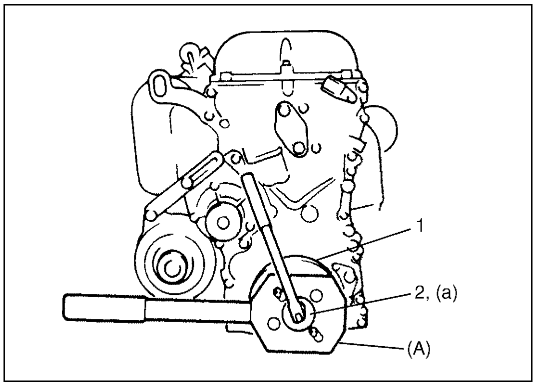
Tightening torque
Water outlet cap bolt (c): 25 N·m (2.5 kg-m, 18.0 lb-ft)



9) Install new O-ring (1) to oil gallery pipes No.2 (2) and No.3 (3).
10) Install oil gallery pipes No.2 and No.3 to cylinder head (4) and timing chain cover (5).
   Tighten bolts to specified torque.

Tightening torque
Oil gallery pipes No.2 and No.3 bolt
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

11) Install water pump pulley.
12) Install cylinder head cover referring to “Cylinder Head Cover Removal and Installation” in this section.
13) Install oil pan referring to “Oil Pan and Oil Pump Strainer Removal and Installation” in this section.



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

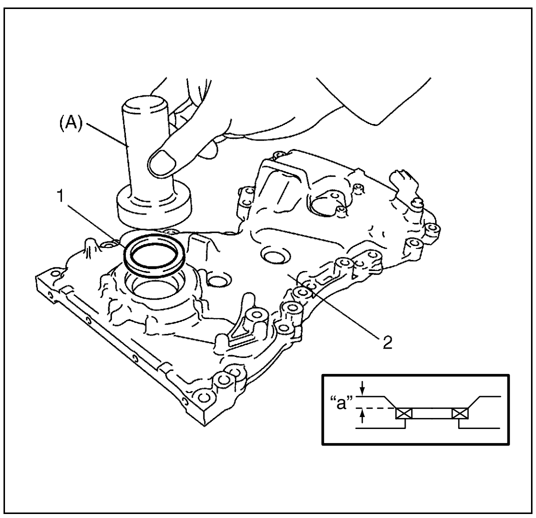
Special tool
(A): 09917-68221

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

15) Install engine assembly to vehicle referring to “Engine Assembly Removal and Installation” in this section.

Timing Chain Cover Inspection

Oil seal



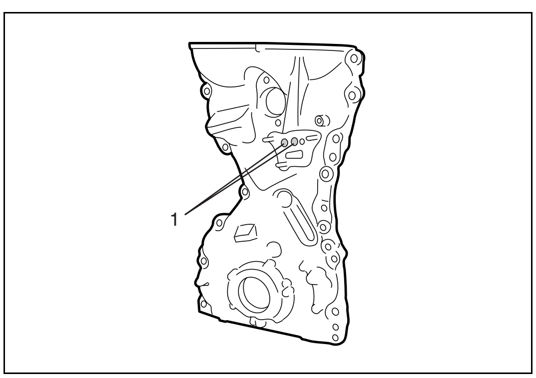
- Check oil seal (1) lip for fault or other damage.
  Replace as necessary.

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

Special tool
(A): 09913-75810

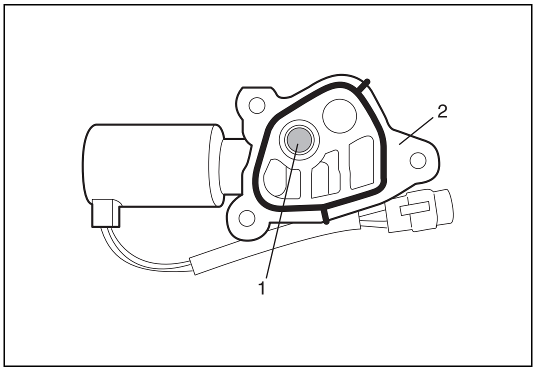
Drive in dimension
“a”: 1.5 mm (0.06 in.)

Timing chain cover



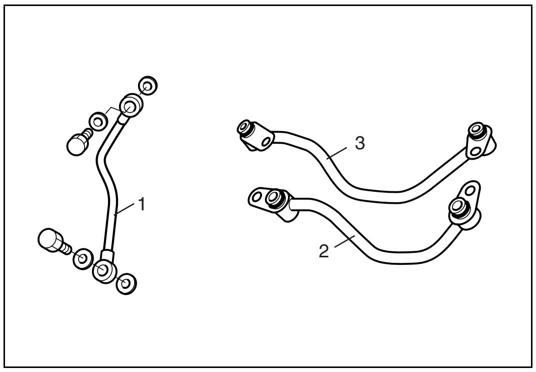
Inspect strainer (1) of oil passage for driving intake cam timing sprocket assembly (VVT actuator).
If clog or foreign matter exists, clean strainer.

Oil control valve



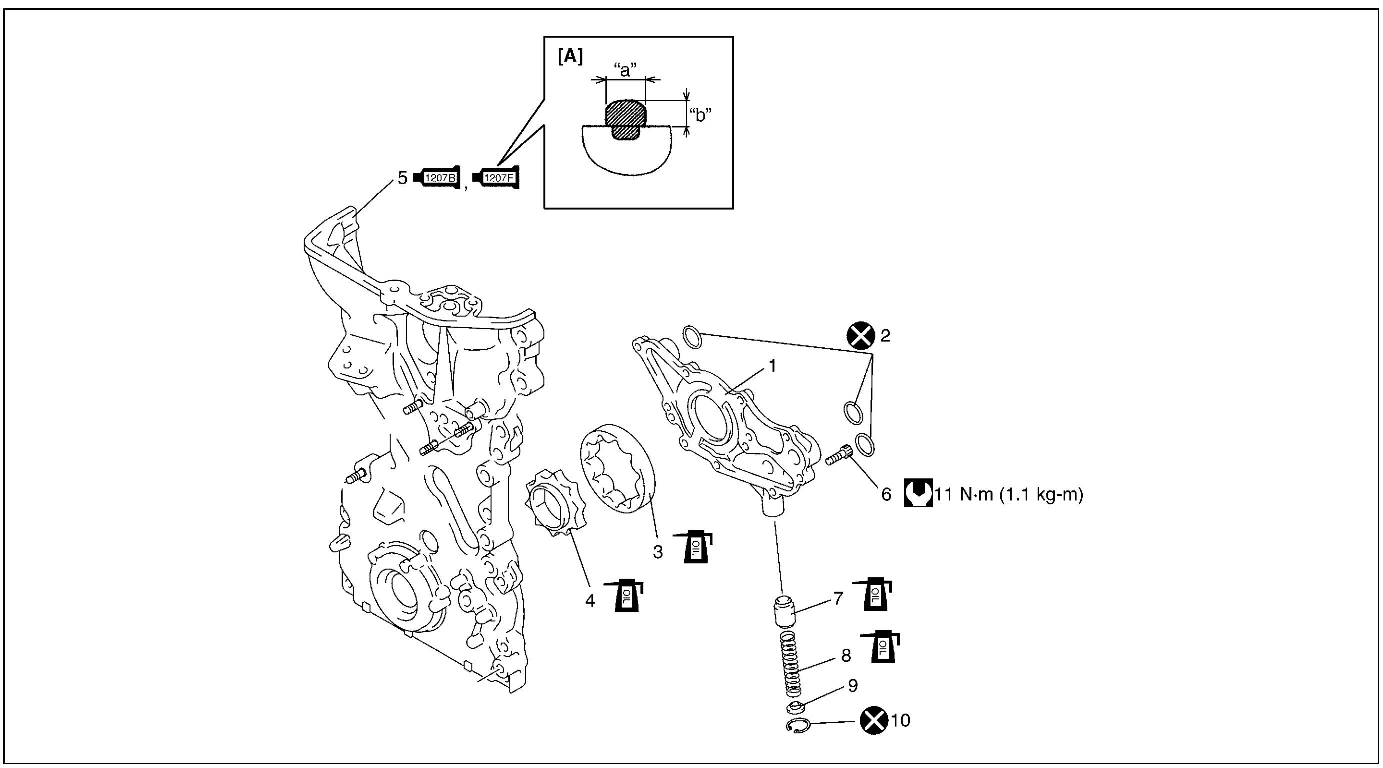
Inspect strainer (1) and mating surface (2) of oil control valve.
Clean oil control valve.

Oil gallery pipe



Inspect oil gallery pipes No.1 (1), No.2 (2) and No.3 (3).
Replace if crack, deformation or clog exists.

Oil Pump Components



[A]: Sealant application amount	4. Inner rotor	10. Circlip
"a": 3 mm (0.12 in.)	1207B 1207F 5. Timing chain cover : Apply sealant 99000-31140 to the mating surface of cylinder and cylinder head. : Apply sealant 99000-31250 to mating surface of timing chain cover referring to the figure of Step 4) of "Installation" under "Timing Chain Cover Removal and Installation" in this section.	Tightening torque
"b": 2 mm (0.08 in.)	6. Oil pump rotor plate bolt	Do not reuse.
1. Rotor plate	7. Relief valve	Apply thin coat of engine oil to sliding surface of each parts.
2. O ring	8. Spring	
3. Outer rotor	9. Retainer	

Oil Pump Removal and Installation

Removal

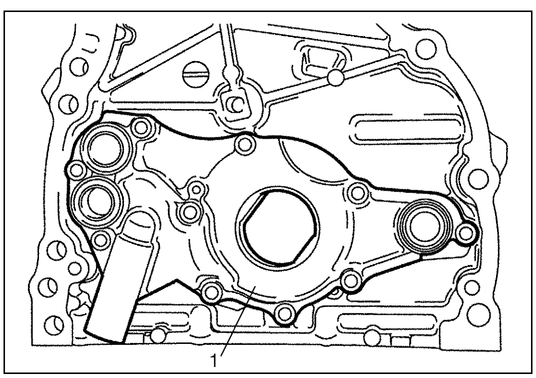
Remove timing chain cover referring to "Timing Chain Cover Removal and Installation" in this section.

Installation

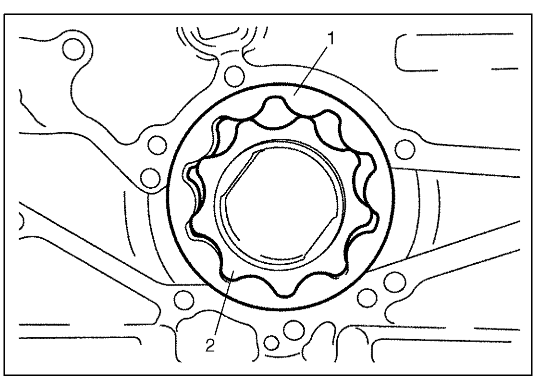
For installation referring to "Timing Chain Cover Removal and Installation" in this section.

Oil Pump Disassembly and Assembly

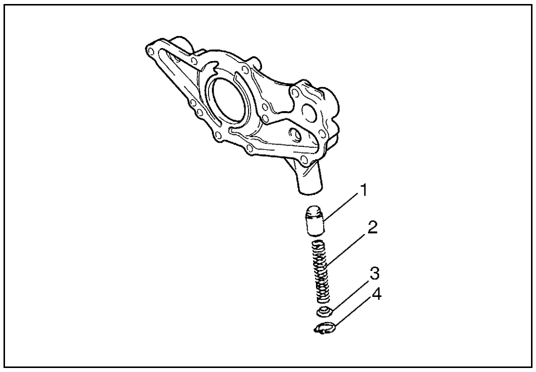
Disassembly



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



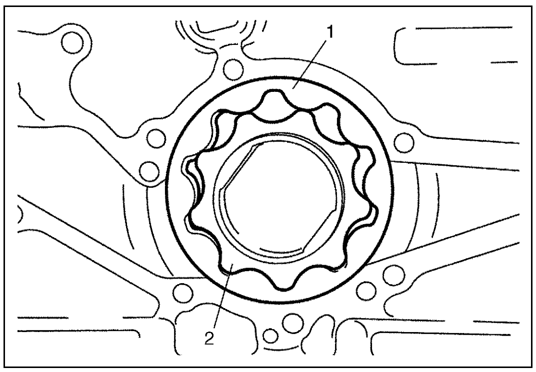
2) Remove outer rotor (1) and inner rotor (2).



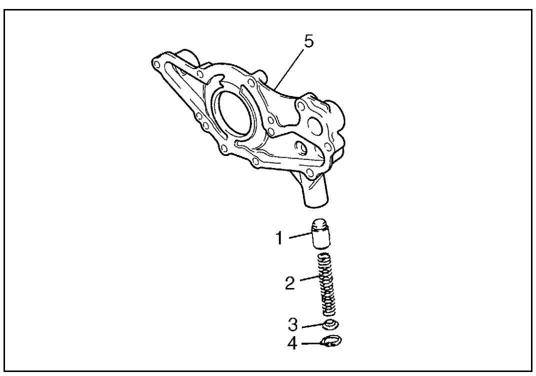
3) Remove relief valve (1), spring (2) and retainer (3) by removing circlip (4).

Assembly

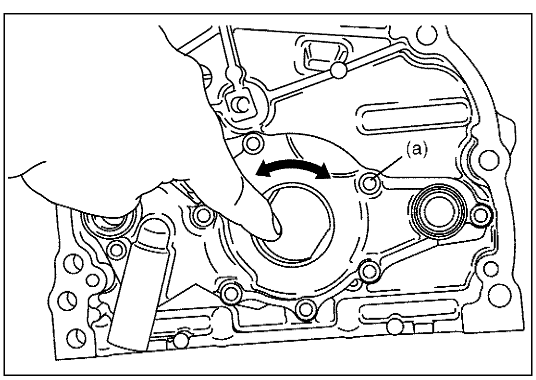
1) Wash, clean and then dry all disassembled parts.
2) Apply thin coat of engine oil to inner and outer rotors, oil seal lip portion, inside surfaces of oil pump case and plate.



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



4) Apply engine oil to relief valve (1) and spring (2), and install them with retainer (3) and new circlip (4) to rotor plate (5).

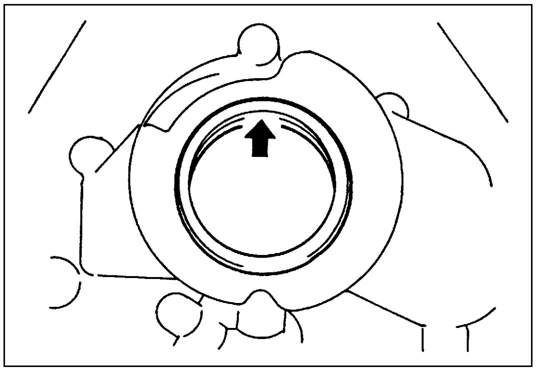


5) Install rotor plate and tighten all bolts to specified torque. After installing plate, check to be sure that rotors turn smoothly by hand (0.3 N·m (0.03 kg-m, 0.25 lb-ft) torque or below).

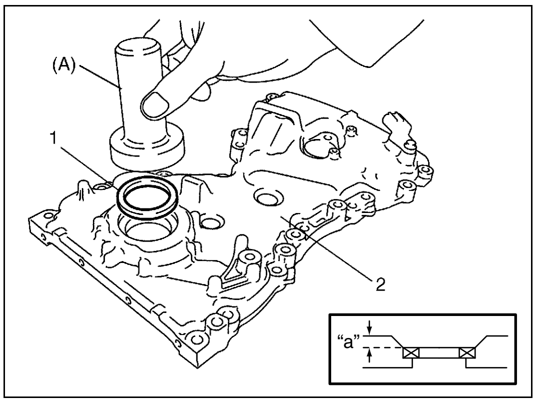
Tightening torque
Oil pump rotor plate bolt (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

Oil Pump Inspection

Oil seal



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



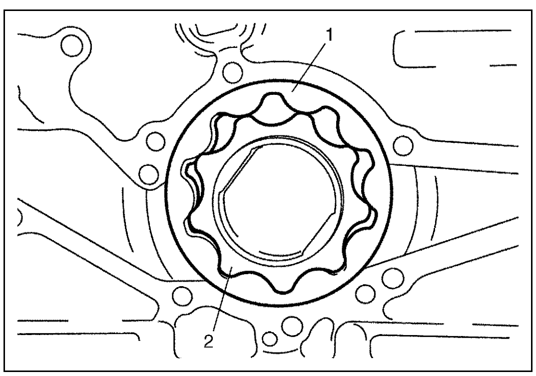
NOTE:

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

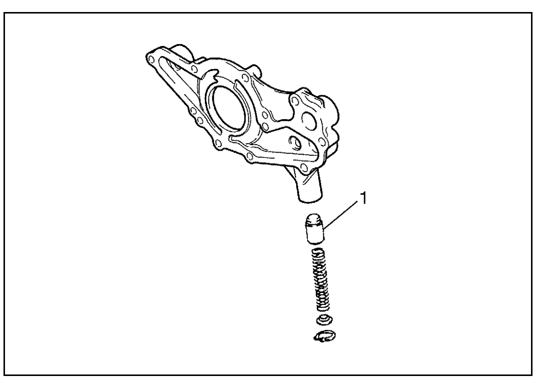
Special tool
(A): 09913-75810

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

Oil pump assembly

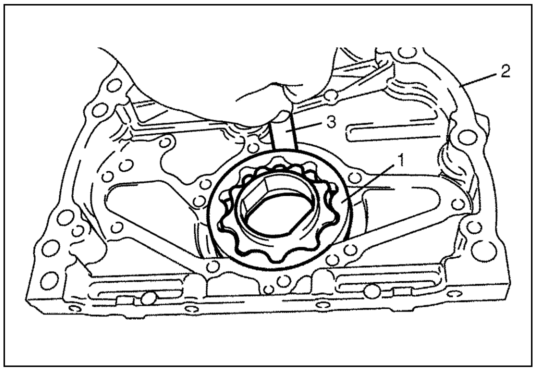


- Check outer (1) and inner rotors (2), rotor plate, and oil pump case for excessive wear or damage.



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

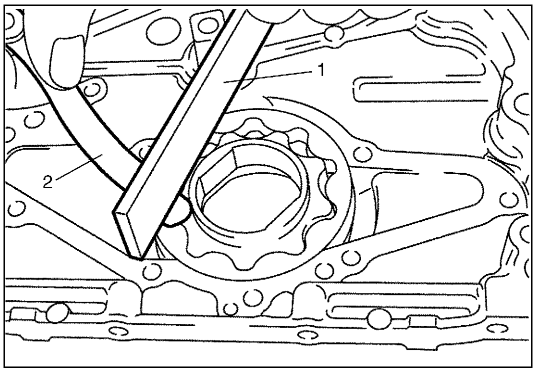
Radial clearance



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

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

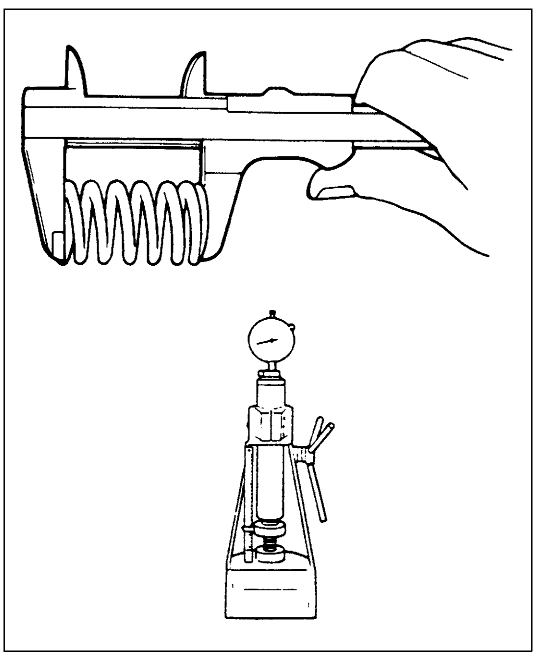
Side clearance



Using straight edge (1) and thickness gauge (2), measure side clearance.
If clearance exceeds its limit, replace oil pump assembly.

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

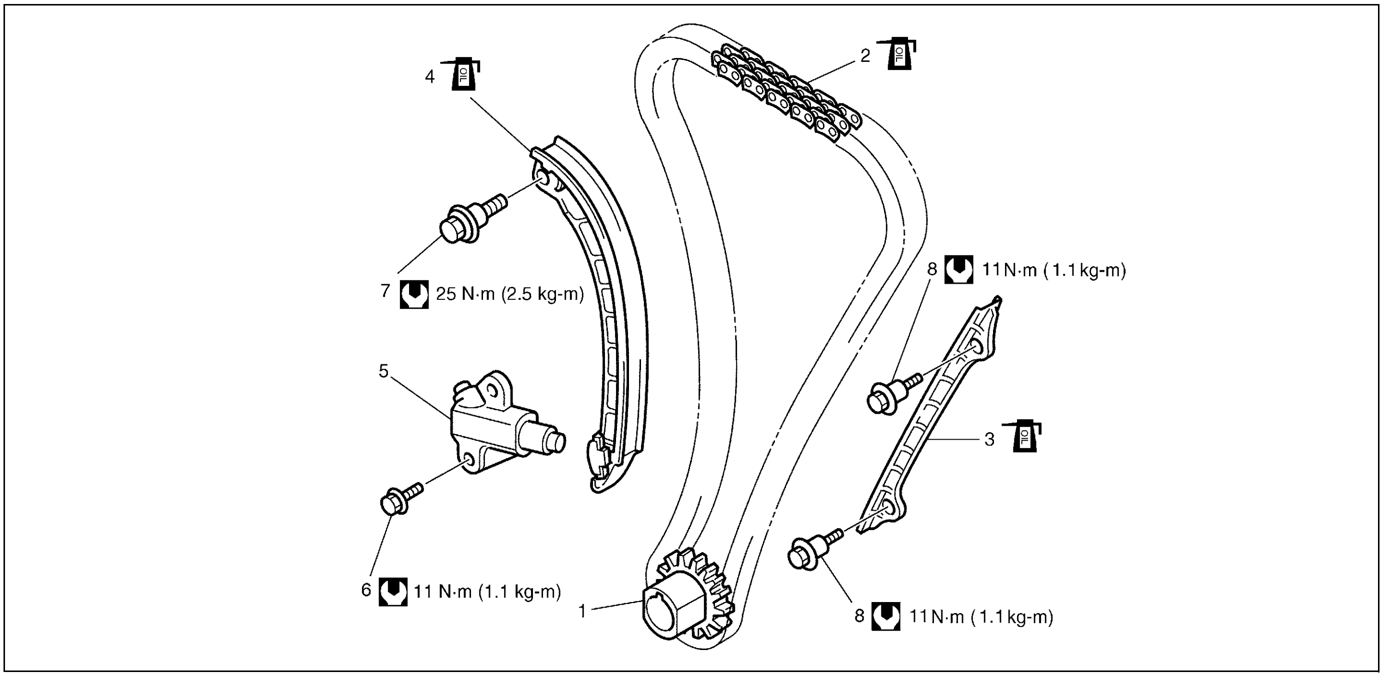
Relief valve spring free length and load



Check relief valve spring free length and load as shown in figure.
If the measured valve spring length is lower than the specification, replace relief valve spring.

	Standard	Limit
Free length	52.4 mm (2.06 in.)	–
Load at spring length 38.5 mm (1.52 in.)	79 N (7.9 kgf, 17.5 lb)	69 N (6.9 kgf, 15.0 lb)

Timing Chain and Chain Tensioner Components



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

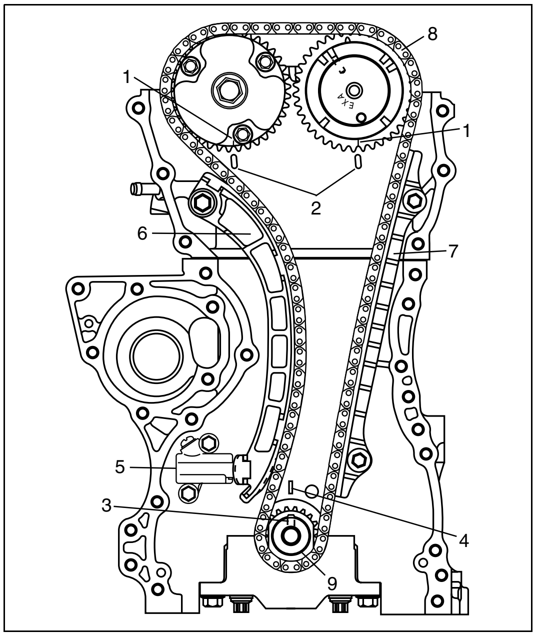
Timing Chain and Chain Tensioner Removal and Installation

Removal

CAUTION:

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

1) Remove timing chain cover referring to "Timing Chain Cover Removal and Installation" in this section.

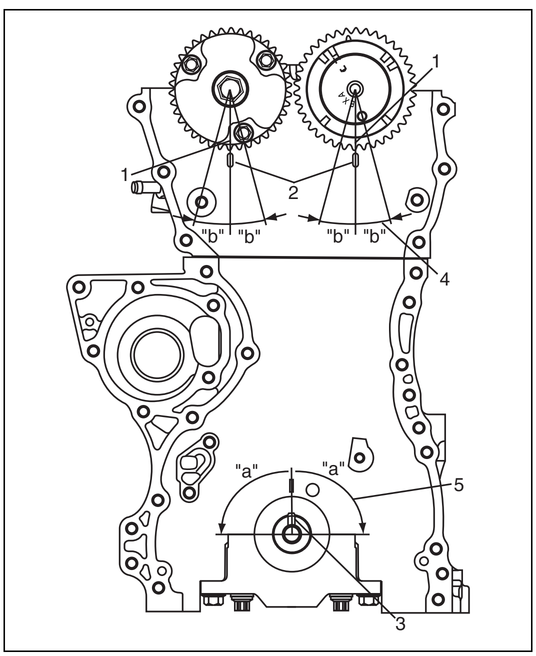


2) By turing crankshaft, align both intake and exhaust camshaft timing sprocket marks (1) with notches (2) of cylinder head respectively and align crank shaft sprocket key (3) with notch of cylinder block (4).
3) Remove timing chain tensioner adjuster assembly (5).
4) Remove timing chain tensioner (6).
5) Remove timing chain No.1 guide (7).
6) Remove timing chain (8) with crankshaft timing sprocket (9)

Installation

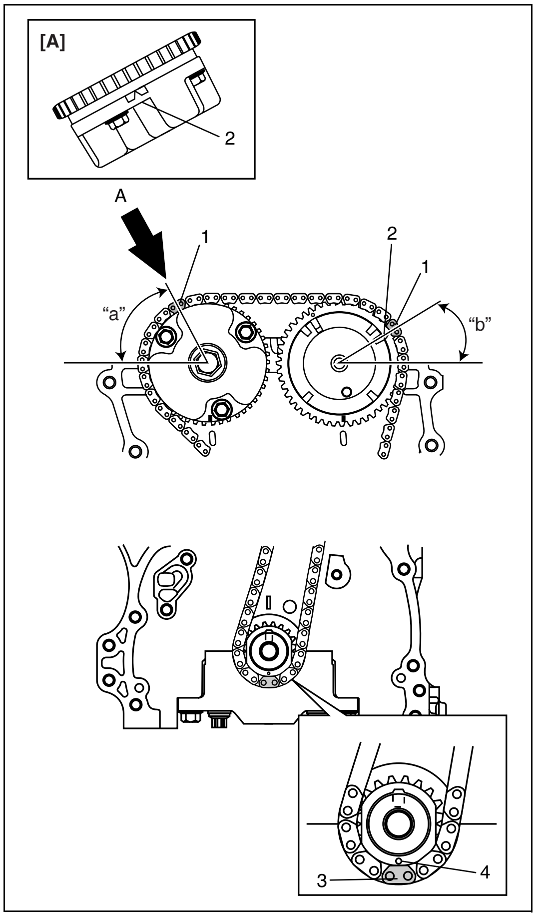
CAUTION:

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



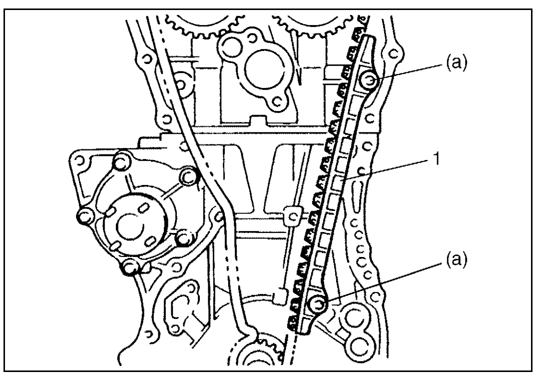
1) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with notches (2) on cylinder head as shown in figure.
2) Set key (3) and turn crankshaft to position key on upside of crankshaft.

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



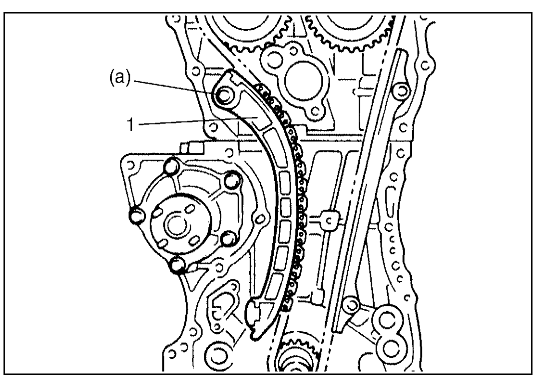
3) Install timing chain by aligning dark blue plate (1) of timing chain and triangle mark (2) on camshaft timing sprocket as shown in figure.
4) Fit crankshaft timing sprocket to timing chain by aligning gold plate (3) of timing chain and circle mark (4) on crankshaft timing sprocket. Then install crankshaft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

[A]:	View A
"a":	Approx. 60°
"b":	Approx. 30°



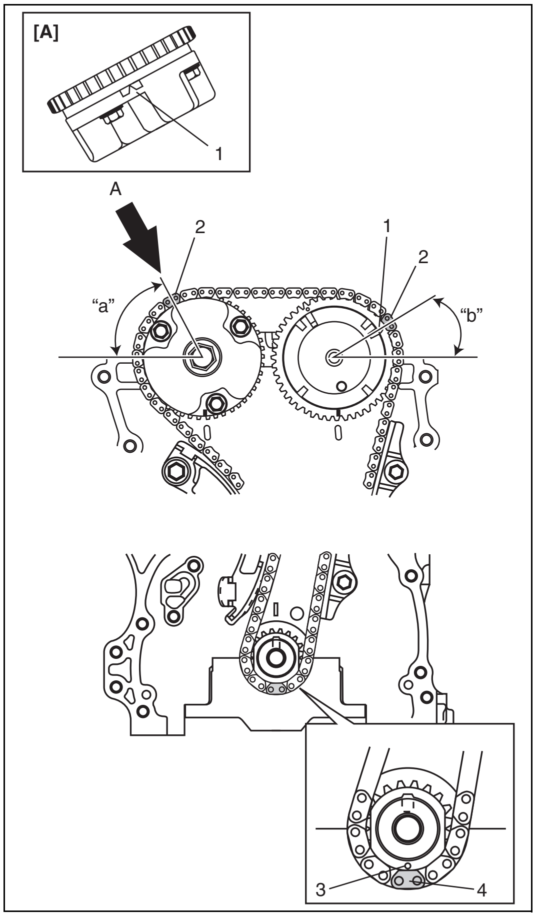
5) Apply engine oil to sliding surface of timing chain No.1 guide (1) and install it as shown in figure.
   Tighten guide bolts to specified torque.

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



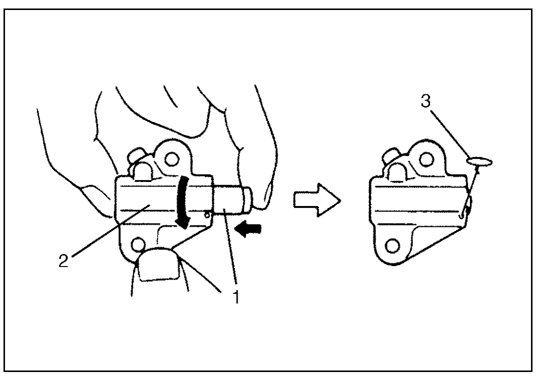
6) Apply engine oil to sliding surface of chain tensioner (1) and install chain tensioner and spacer.
   Tighten tensioner bolt to specified torque

Tightening torque
Timing chain tensioner bolt
(a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

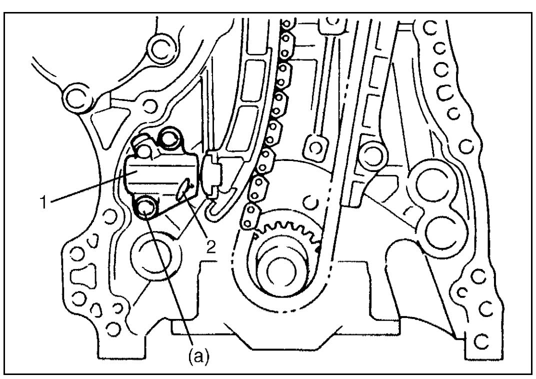


7) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with marking of timing chain (2) and match mark on crankshaft timing sprocket (3) are in with marking of timing chain (4).

[A]:	View A
"a":	Approx. 60°
"b":	Approx. 30°

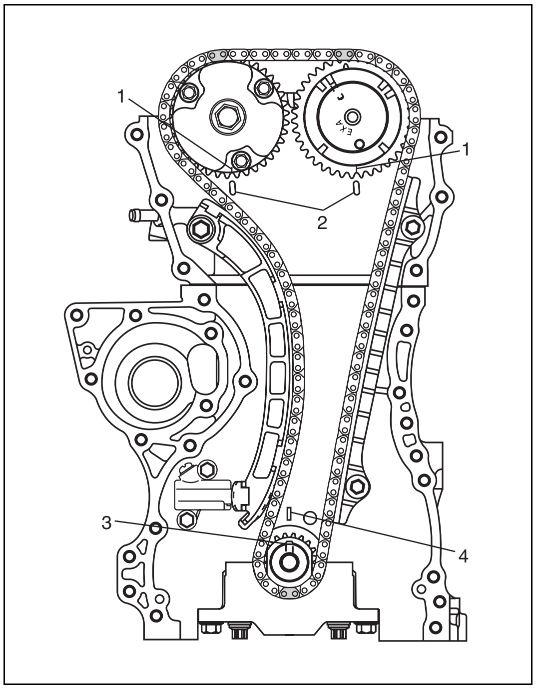


8) Screw in plunger (1) by turning body (2) in arrow direction and install a retainer (3) (wire) to hold plunger in place.



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

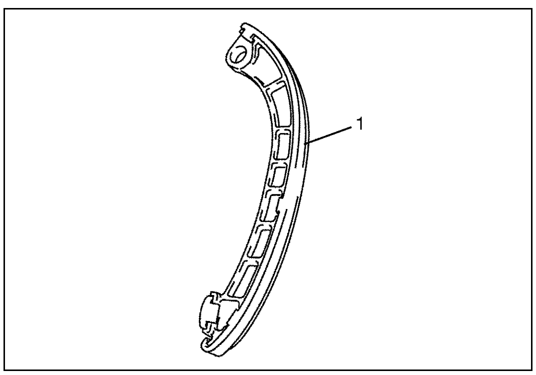
Tightening torque
Tensioner adjuster bolt
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



10) Apply engine oil to timing chain and then turn crankshaft clockwise by 2 revolutions and check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with notches (2) on cylinder head and key (3) is in match with notch (4) on cylinder block as shown in figure.
If each marking chain and each match mark are no matches, adjust each sprockets and timing chain.
11) Install timing chain cover referring to “Timing Chain Cover Removal and Installation” in this section.
12) Perform Steps 3) to 8) of “Installation” of “Timing Chain Cover Removal and Installation” in this section.

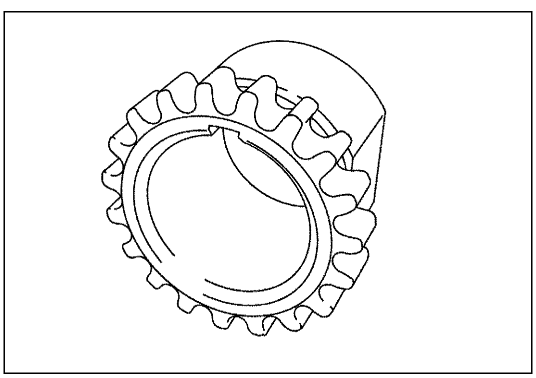
Timing Chain and Timing Chain Tensioner Inspection

Timing chain tensioner



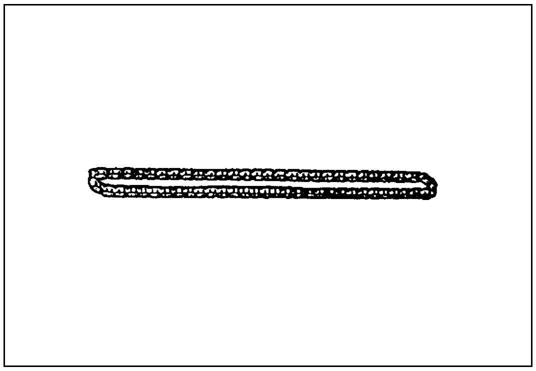
- Check timing chain tensioner (1) for wear or damage.

Crankshaft timing sprocket



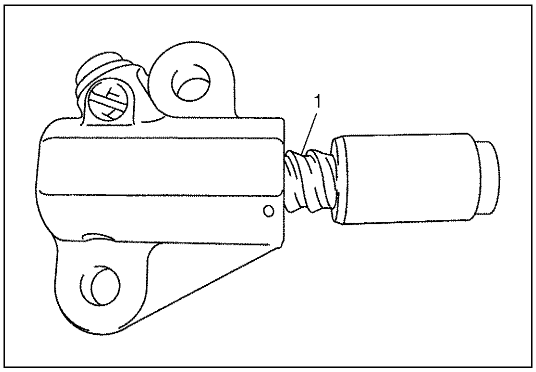
- Check teeth of sprocket for wear or damage.

Timing chain



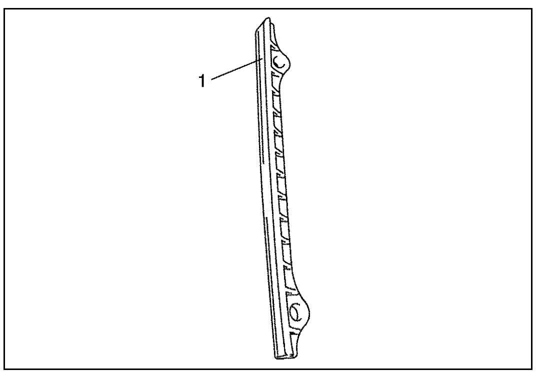
- Check timing chain for wear or damage.

Timing chain tensioner adjuster



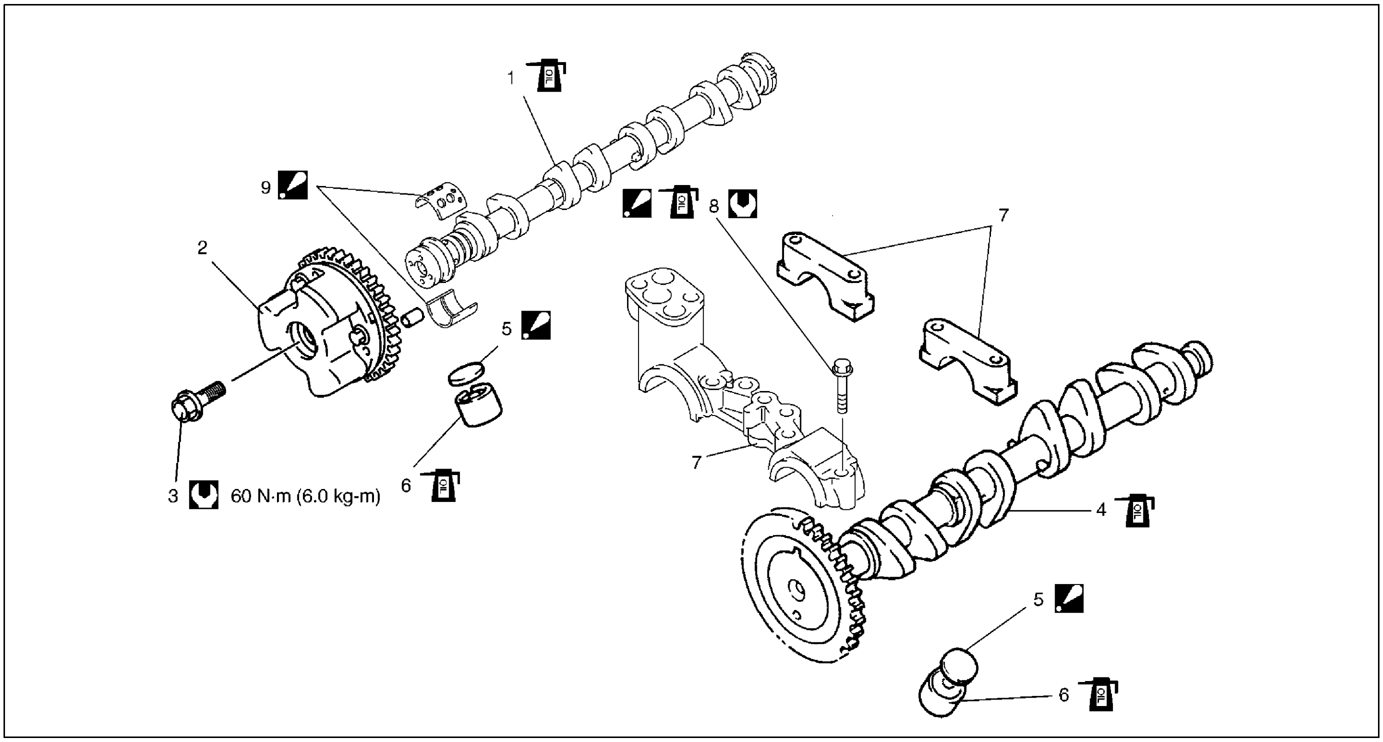
- Check that tooth surface (1) are free from damage.

Timing chain No.1 guide



- Check timing chain No.1 guide (1) for wear or damage.

Camshaft, Tappet and Shim Components



1. Intake camshaft	5. Shim : Shim No. on it faces tappet side.	9. Upper camshaft bearing : Install a bearing half with some holes to upper side of intake camshaft No.1 bearing.
2. Intake camshaft sprocket assembly	6. Tappet	Tightening torque
3. Intake camshaft sprocket bolt	7. Camshaft housing	Apply engine oil to sliding surface of each part.
4. Exhaust camshaft	8. Camshaft housing bolt Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft) by the specified procedure.	

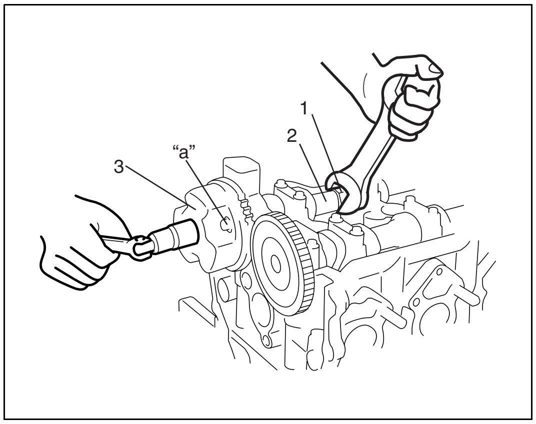
Camshaft, Tappet and Shim Removal and Installation

Removal

CAUTION:

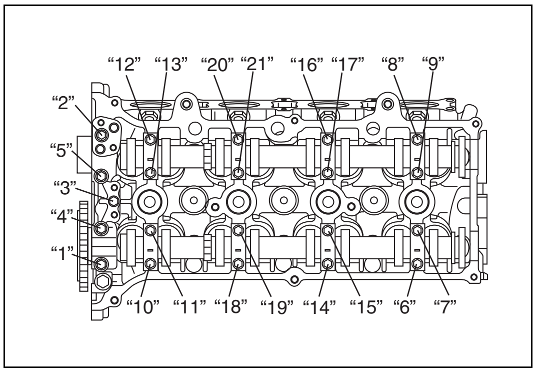
- **Keep working table, tools and hands clean while overhauling.**
- **Use special care to handle aluminum parts so as not to damage them.**
- **Do not expose removed parts to dust. Keep them always clean.**

1) Remove timing chain cover referring to “Timing Chain Cover Removal and Installation” in this section.
2) Remove timing chain referring to “Timing Chain and Chain Tensioner Removal and Installation” in this section.

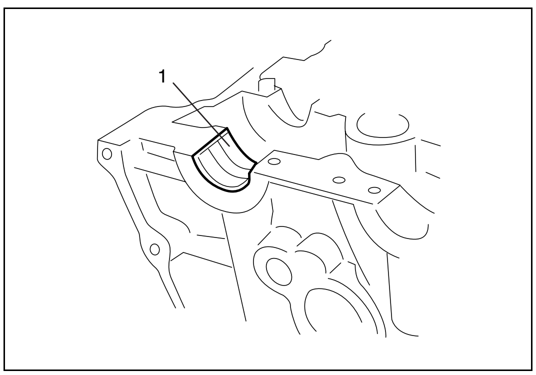


3) With hexagonal section (1) of intake camshaft (2) held stationary with spanner or the like, loosen mounting bolt of intake cam timing sprocket assembly (3) and remove it.

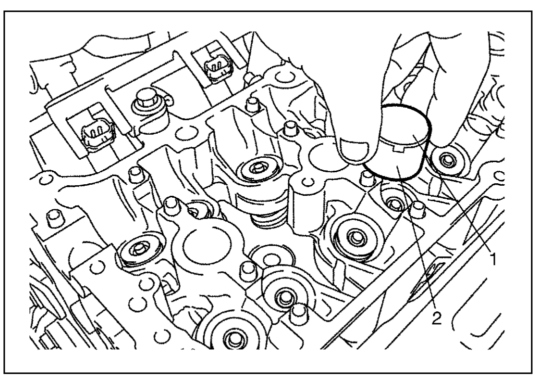
CAUTION:
Never attempt to loosen mounting bolt with intake cam timing sprocket assembly held stationary. Failure to follow this could result in damage to lock pin.
Do not loosen bolt "a" because intake cam timing sprocket assembly is not serviceable.



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

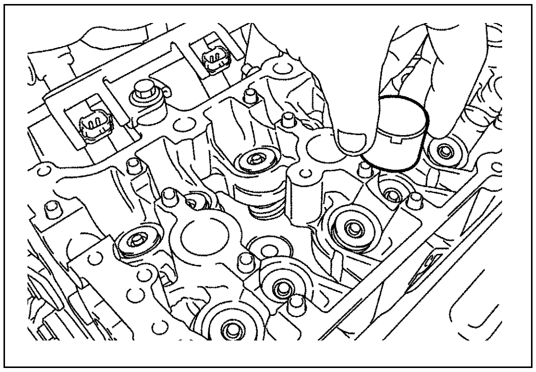


7) Remove camshaft bearing (1).



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

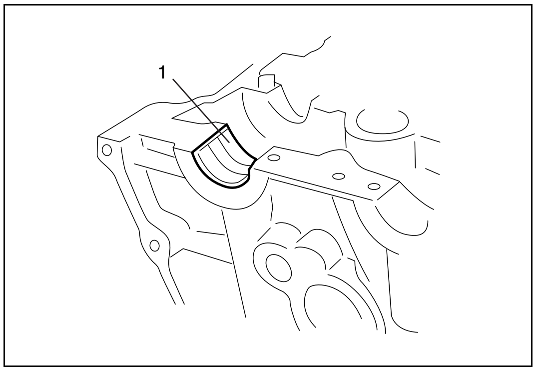
Installation



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

NOTE:

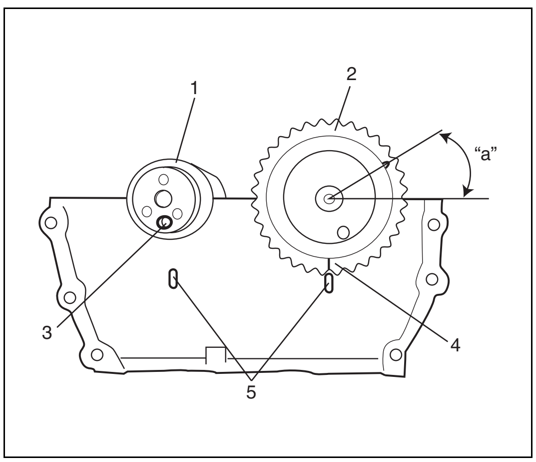
When installing shim, make sure to direct shim No. side toward tappet.



2) Install camshaft bearing (1) to cylinder head.

CAUTION:

Do not apply engine oil to camshaft bearing back.
Only a upper half bearing of intake camshaft bearing No.1 has some holes. Other bearings.



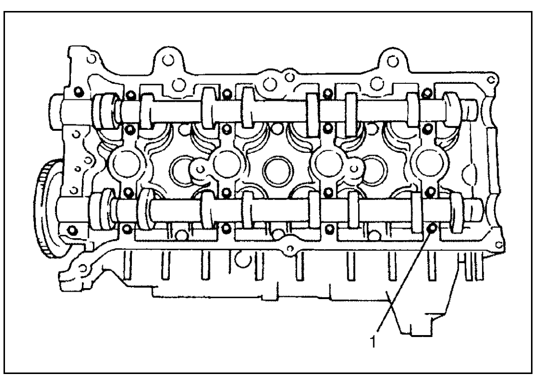
3) Install intake camshaft (1) and exhaust camshaft (2).
   Align knock pin (3) and match mark (4) with notches (5) as shown in the figure.

"a":	Approx. 30°

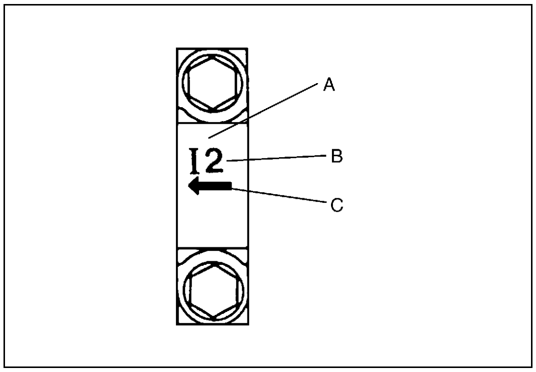
NOTE:

Before installing camshafts, turn crankshaft until key faces upward. Refer to "Timing Chain and Chain Tensioner".

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

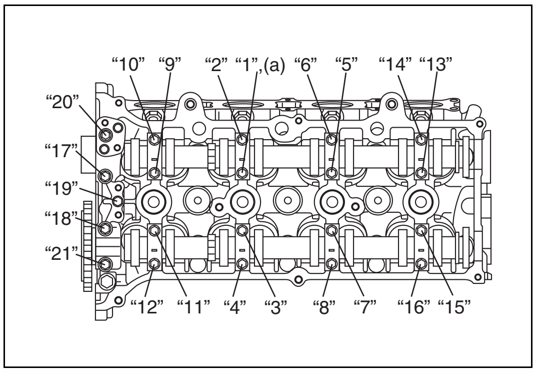


5) Install camshaft housing pins (1) as shown in figure.



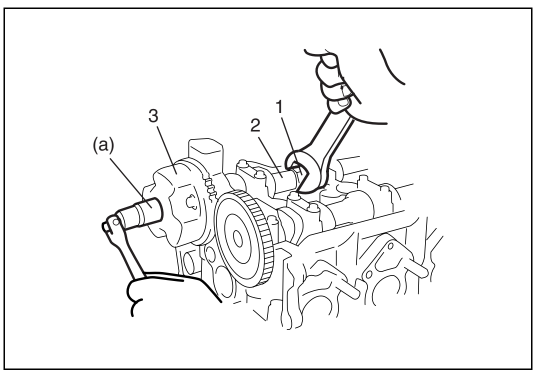
6) Check position of camshaft housings.
   Embossed marks are provided on each camshaft housing, indicating position and direction for installation. Install housings as indicated by these marks.

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



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

Tightening torque
Camshaft housing bolt
(a): Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft)
by the specified procedure.



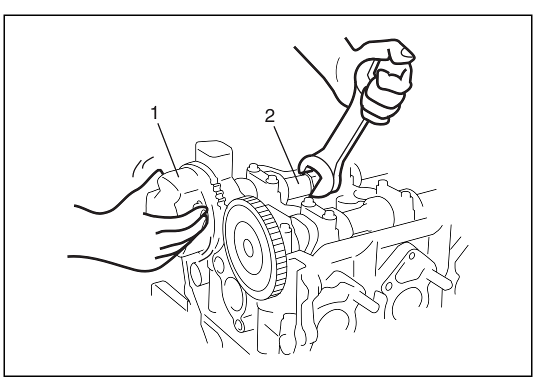
8) With hexagonal section (1) of intake camshaft (2) held stationary with spanner or the like, tighten bolt of intake cam timing sprocket assembly (3) to specification.

Tightening torque
Intake cam timing sprocket bolt
(a): 60 N·m (6.0 kg-m, 43 lb-ft)

9) Install timing chain with crankshaft sprocket referring to “Timing Chain and Chain Tensioner Removal and Installation” in this section.
10) Install timing chain cover referring to “Timing Chain Cover Removal and Installation” in this section.
11) Check valve lashes as previously outlined.
12) Perform Steps 3) to 8) of “Installation” of “Timing Chain Cover Removal and Installation” in this section.

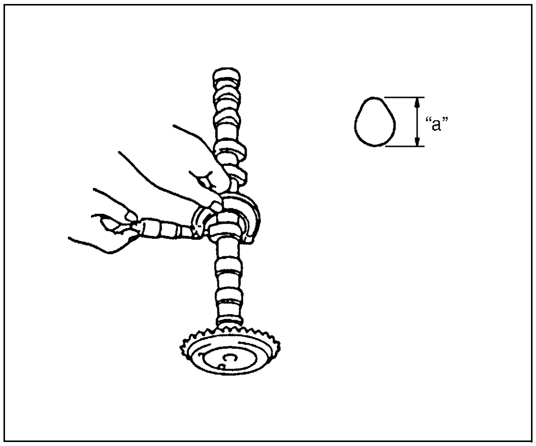
Camshaft, Tappet and Shim Inspection

Intake cam timing sprocket assembly



Fit intake cam timing sprocket assembly to camshaft (2) and hold hexagonal section of camshaft by using spanner or the like.
Check if sprocket (1) is not turned by hand.
If moved, replace intake cam timing sprocket assembly.

Cam wear

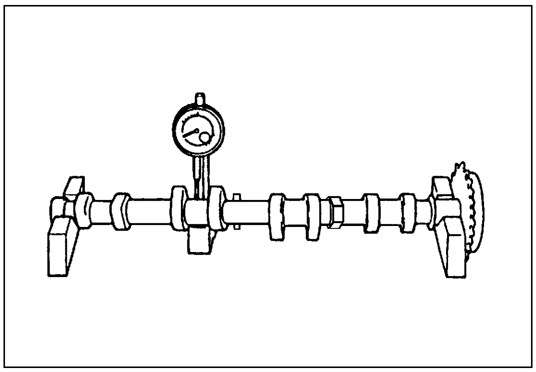


Using a micrometer, measure cam height "a". If measured height underruns its limit, replace camshaft.

Cam height "a" of camshaft

	Standard	Limit
Intake cam	**44.929 – 45.089 mm (1.769 – 1.775 in.)**	**44.80 mm (1.764 in.)**
Exhaust cam	**44.399 – 44.559 mm (1.748 – 1.754 in.)**	**44.28 mm (1.743 in.)**

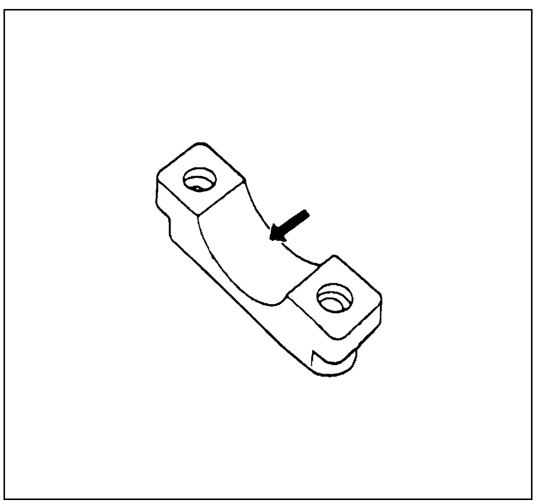
Camshaft runout



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

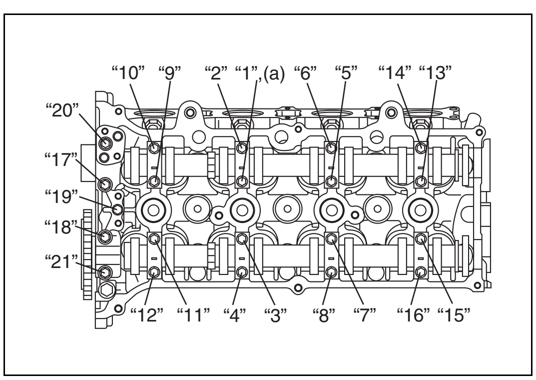
Camshaft runout limit
: 0.10 mm (0.0039 in.)

Camshaft journal wear



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

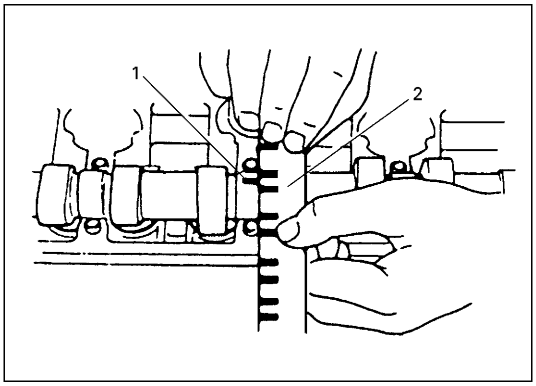
1) Clean housings and camshaft journals.
2) Remove all tappets with shims.
3) Install camshafts to cylinder head.
4) Place a piece of gaging plastic to full width of journal of camshaft (parallel to camshaft).
5) Install camshaft housing.



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

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

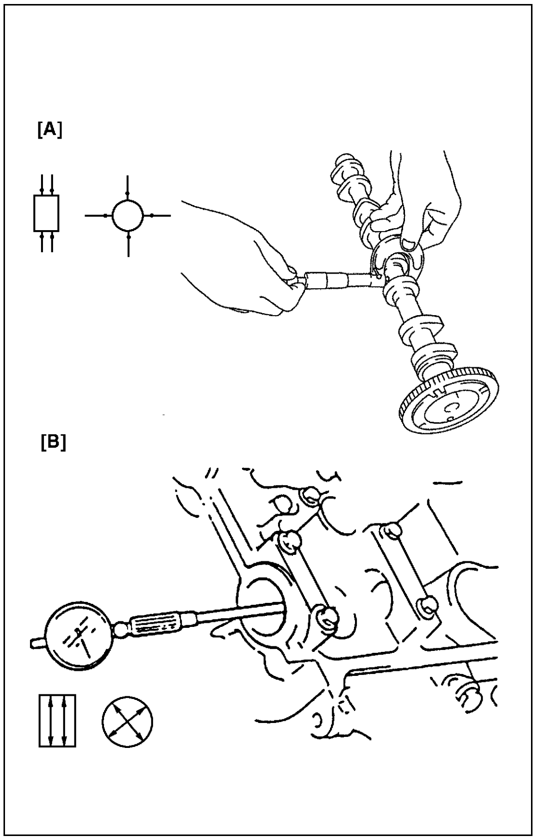
Tightening torque
Camshaft housing bolt
(a): Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft) by the specified procedure.



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

Camshaft journal clearance

	Standard	Limit
Intake side No.1 housing	0.020 – 0.072 mm (0.0008 – 0.0028 in.)	0.10 mm (0.0039 in.)
Others	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.

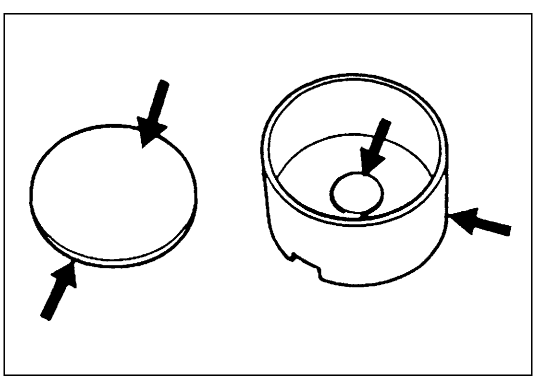
Camshaft journal diameter [A]

Item	Standard
Intake side No.1 housing	26.940 – 26.955 mm (1.0607 – 1.0612 in.)
Exhaust side No.1 housing	26.934 – 26.955 mm (1.0604 – 1.0612 in.)
Others	22.934 – 22.955 mm (0.9030 – 0.9037 in.)

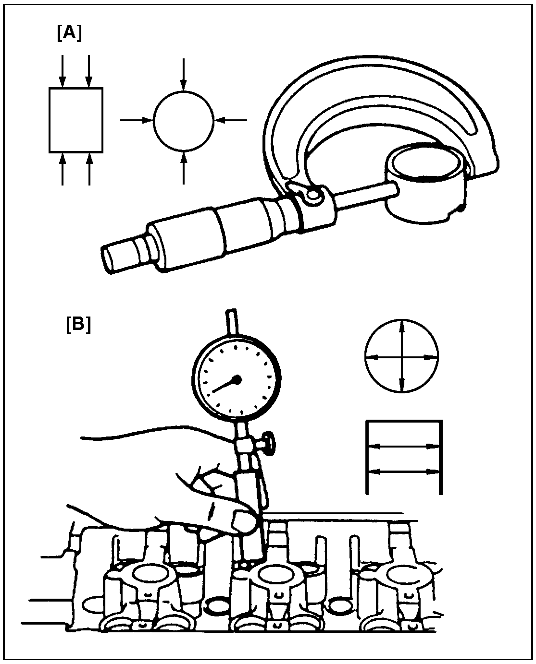
Camshaft journal bearing bore [B]

Item	Standard
Intake side No.1 housing	–
Exhaust side No.1 housing	27.000 – 27.021 mm (1.0630 – 1.0638 in.)
Others	23.000 – 23.021 mm (0.9056 – 0.9063 in.)

Wear of tappet and shim



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



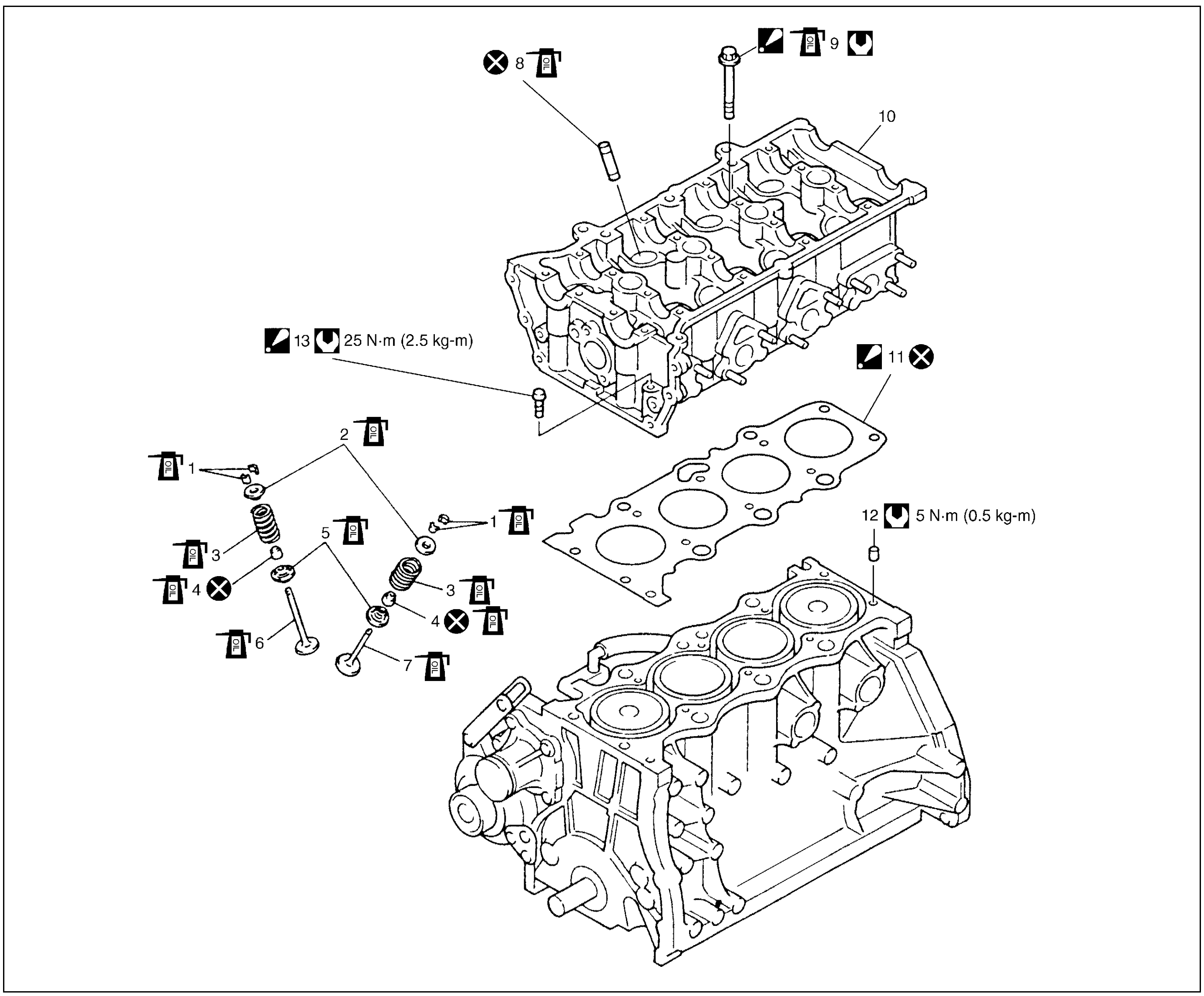
Measure cylinder head bore and tappet outside diameter to determine cylinder head-to-tappet clearance. If clearance exceeds limit, replace tappet or cylinder head.

Cylinder head to tappet clearance
Standard: 0.025 – 0.066 mm (0.0010 – 0.0025 in.)
Limit: 0.15 mm (0.0059 in.)

Tappet outside diameter [A]
Standard: 30.959 – 30.975 mm (1.2189 – 1.2194 in.)

Cylinder head tappet bore [B]
Standard: 31.000 – 31.025 mm (1.2205 – 1.2214 in.)

Valves and Cylinder Head Components

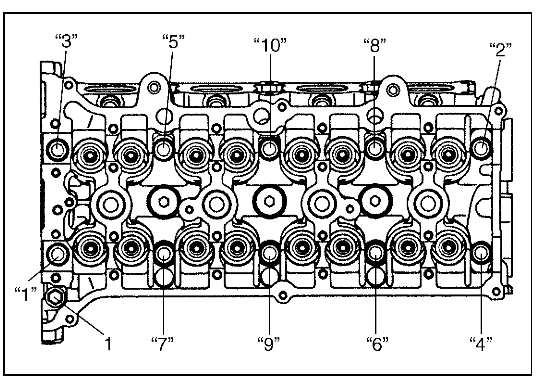


1. Valve cotters	7. Exhaust valve	13. Cylinder head bolt (M8) : Be sure to tighten cylinder head bolt (M8) after securing the other cylinder head bolt (M10).
2. Valve spring retainer	8. Valve guide	Tightening torque
3. Valve spring	9. Cylinder head bolt (M10) Tighten 20 N·m (2.0 kg-m, 14.5 lb-ft), 40 N·m (4.0 kg-m, 29.0 lb-ft), 60° and 60° by the specified procedure. : Never reuse cylinder head bolts once disassembled it due to plastic deformation tightening. Be sure to use new cylinder head bolts when installing.	Do not reuse.
4. Valve stem seal	10. Cylinder head	Apply engine oil to sliding surface of each part.
5. Valve spring seat	11. Cylinder head gasket : "TOP" mark provided on gasket comes to crankshaft pulley side, facing up.	
6. Intake valve	12. Knock pin	

Valves and Cylinder Head Removal and Installation

Removal

1) Remove engine assembly from vehicle referring to "Engine Assembly Removal and Installation" in this section.
2) Remove oil pan referring to "Oil Pan and Oil Pump Strainer Removal and Installation" in this section.
3) Remove cylinder head cover referring to "Cylinder Head Cover Removal and Installation" in this section.
4) Remove timing chain cover referring to Steps 2) to 7) of "Removal" in "Timing Chain Cover Removal and Installation" in this section.
5) Remove timing chain referring to Steps 2) to 6) of "Removal" under "Timing Chain and Chain Tensioner Removal and Installation" in this section.
6) Remove intake and exhaust camshafts referring to Steps 3) to 7) of "Removal" under "Camshaft, Tappet and Shim Removal and Installation" in this section.



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

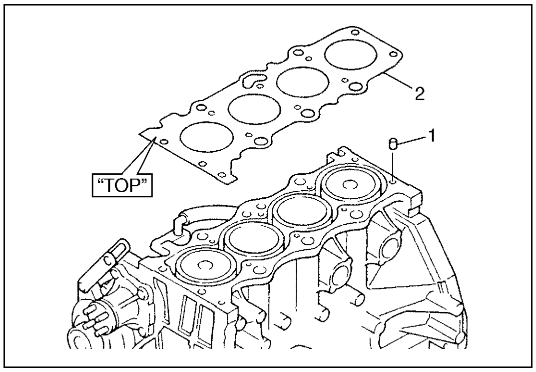
NOTE:

- **Don't forget to remove bolt (M8) (1) as shown in figure.**
- **Never reuse cylinder head bolts once disassembled it due to plastic deformation tightening. Be sure to use new cylinder head bolts when installing.**

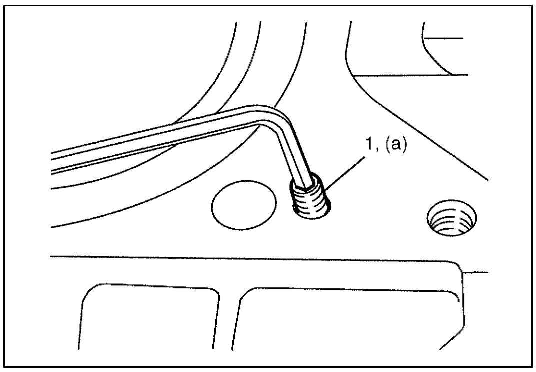
8) Check all around cylinder head for any other parts required to be removed or disconnected and remove or disconnect whatever necessary.
9) Remove exhaust manifold, if necessary, referring to "Exhaust Manifold Removal and Installation" in this section.
10) Remove cylinder head with intake manifold and exhaust manifold. Use lifting device, if necessary.

Installation

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

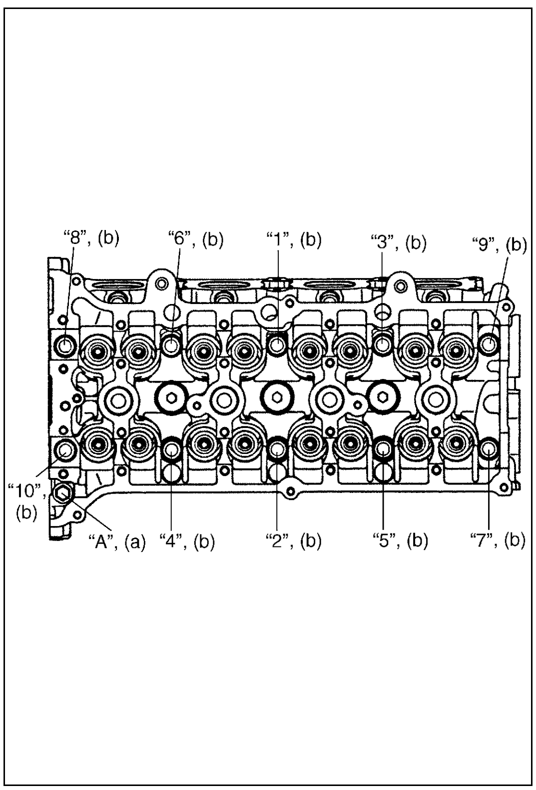


2) Install knock pins (1) to cylinder block.
3) Install new cylinder head gasket (2) to cylinder block. "TOP" mark provided on gasket comes to crankshaft pulley side, facing up (toward cylinder head side).



4) Make sure that oil jet (venturi plug) (1) is not clogged. If it is not installed, install it as specified torque.

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

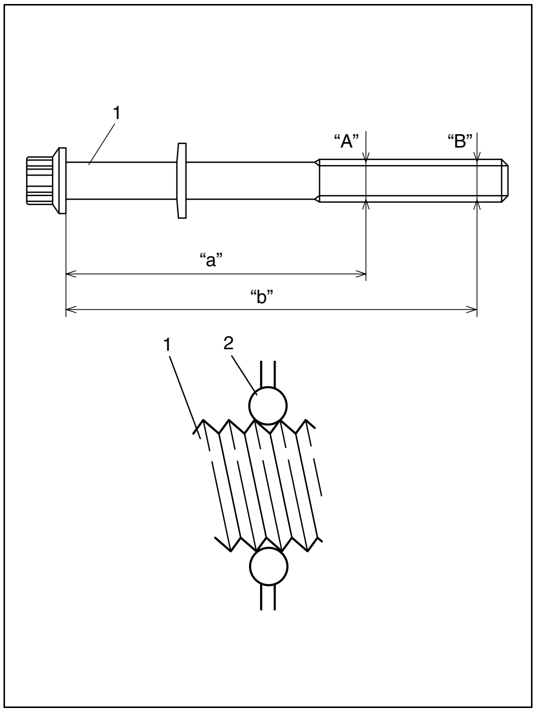


5) Install cylinder head to cylinder block. Apply engine oil to new cylinder head bolts and tighten them gradually as follows.
   a) Tighten cylinder head bolts ("1" – "10") to 20 N·m (2.0 kg-m, 14.5 lb-ft) according to numerical order as shown by using a 12 corner socket wrenches.
   b) In the same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

NOTE:

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

Tightening torque
Cylinder head bolt for M8 (a): 25 N·m (2.5 kg-m, 18.0 lb-ft)
Cylinder head bolt for M10
(b): Tighten 20 N·m (2.0 kg-m, 14.5 lb-ft),
40 N·m (4.0 kg-m, 29.0 lb-ft), 60° and 60° by the specified procedure.



NOTE:

If they are reused, check thread diameters of cylinder head bolt (1) for deformation according to the follows and replace them with new ones if thread diameter difference exceeds limit.

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

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

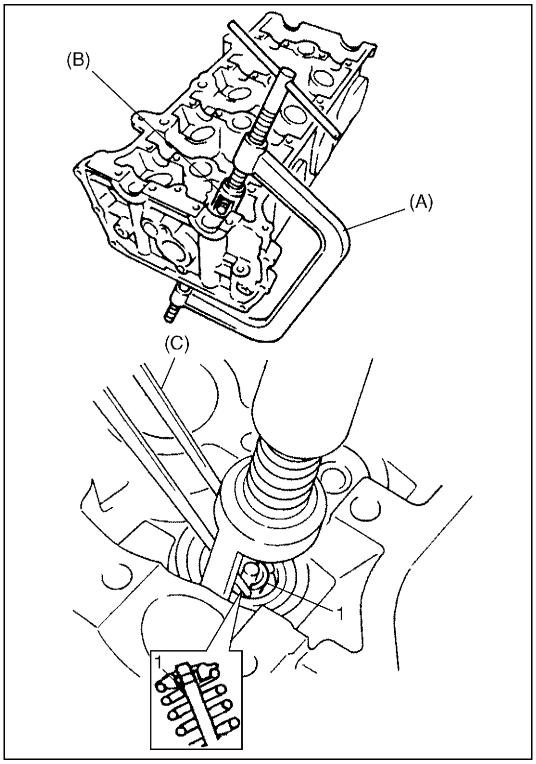
Cylinder head bolt diameter difference (deformation)
Limit ("A" – "B"): 0.1mm (0.004in.)

6) Install camshafts, tappet and shim referring to "Camshaft, Tappet and Shim Removal and Installation" in this section.
7) Install timing chain referring to "Timing Chain and Chain Tensioner Removal and Installation" in this section.
8) Install timing chain cover referring to "Timing Chain Cover Removal and Installation" in this section.
9) Install cylinder head cover referring to "Cylinder Head Cover Removal and Installation" in this section.
10) Install oil pan referring to "Oil Pan and Oil Pump Strainer Removal and Installation" in this section.

Valves and Cylinder Head Disassembly and Assembly

Disassembly

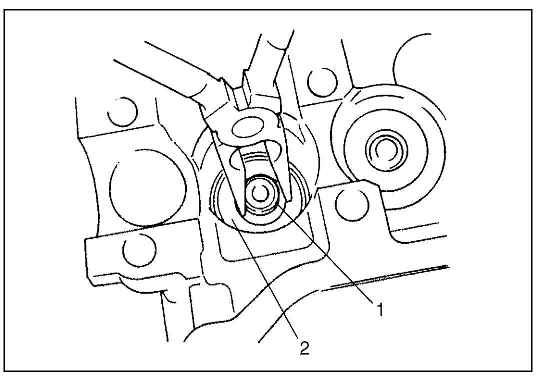
1) For ease in servicing cylinder head, remove intake manifold, injectors and exhaust manifold from cylinder head.



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

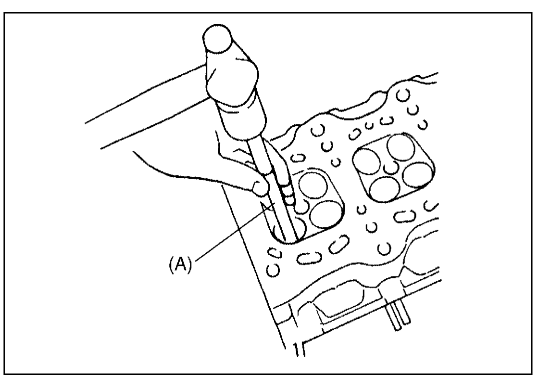
Special tool
(A): 09916-14510
(B): 09916-14521
(C): 09916-84511

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



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

NOTE:
Do not reuse valve stem seal (1) once disassembled. Be sure to use new valve stem seal when assembling.



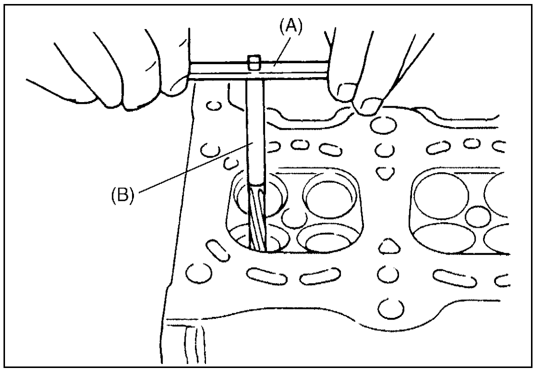
6) Using special tool (valve guide remover), drive valve guide out from combustion chamber side to valve spring side.

Special tool
(A): 09916-44910

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

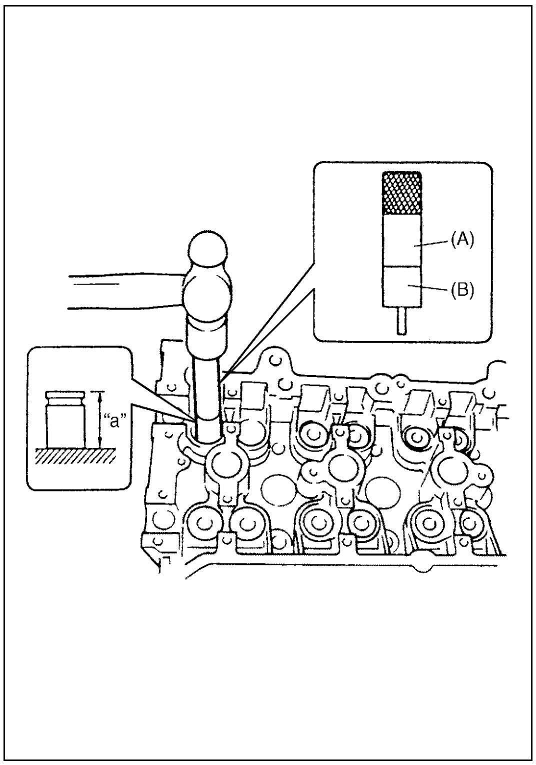
7) Place disassembled parts except valve stem seal and valve guide in order so that they can be installed in their original position.

Assembly



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

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



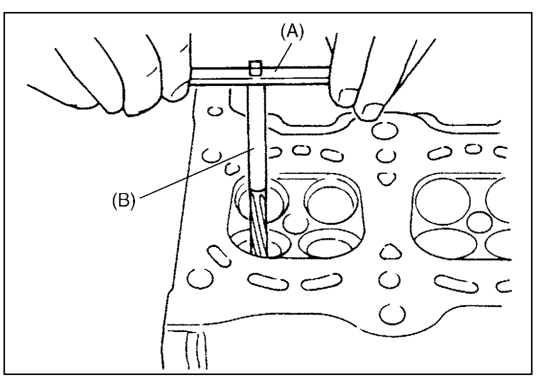
2) Install valve guide to cylinder head.
Heat cylinder head uniformly to a temperature of 80 to 100 °C (176 to 212 °F) so that head will not be distorted, and drive new valve guide into hole with special tools. Drive in new valve guide until special tool (Valve guide installer) contacts cylinder head.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

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

NOTE:

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

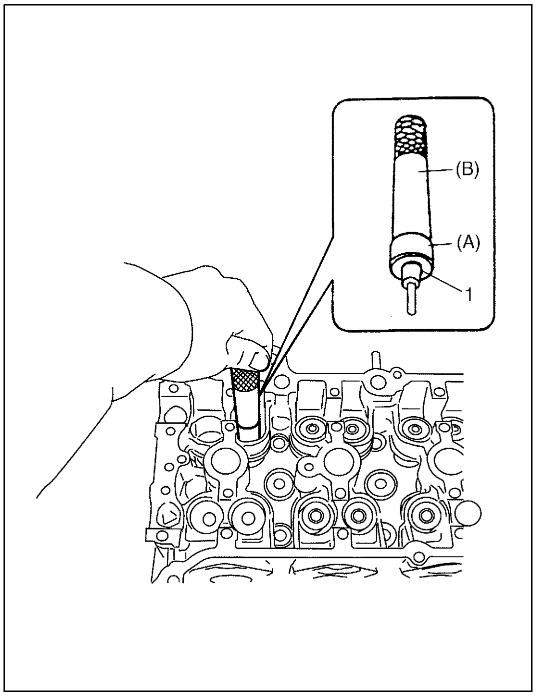
Specification for valve guide protrusion "a"
Intake side: 11.3 mm (0.44 in.)
Exhaust side: 11.3 mm (0.44 in.)



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

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

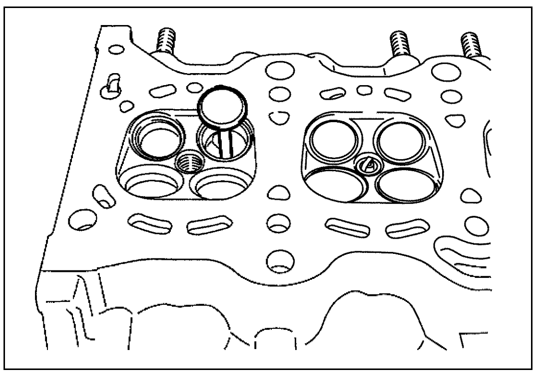
4) Install valve spring seat to cylinder head.



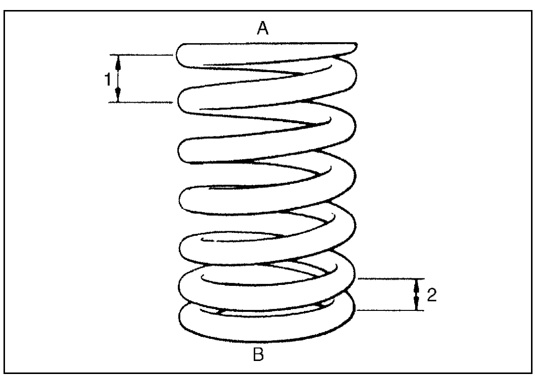
5) Install new valve stem seal (1) to valve guide.
After applying engine oil to seal and spindle of special tool (Valve guide installer handle), fit oil seal to spindle, and then install seal to valve guide by pushing special tool by hand.
After installing, check to be sure that seal is properly fixed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

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

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

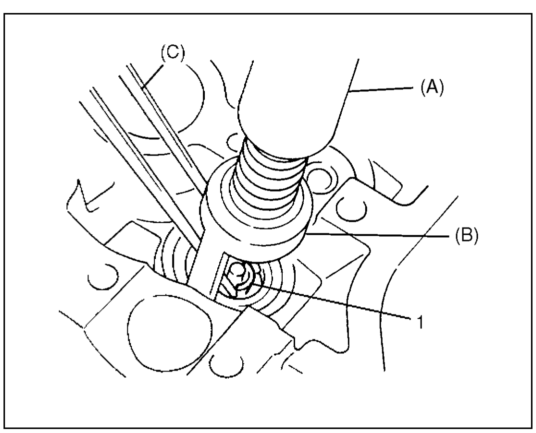


6) Install valve to valve guide.
Before installing valve to valve guide, apply engine oil to stem seal, valve guide bore and valve stem.



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

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



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

Special tool
(A): 09916-14510
(B): 09916-14521
(C): 09916-84511

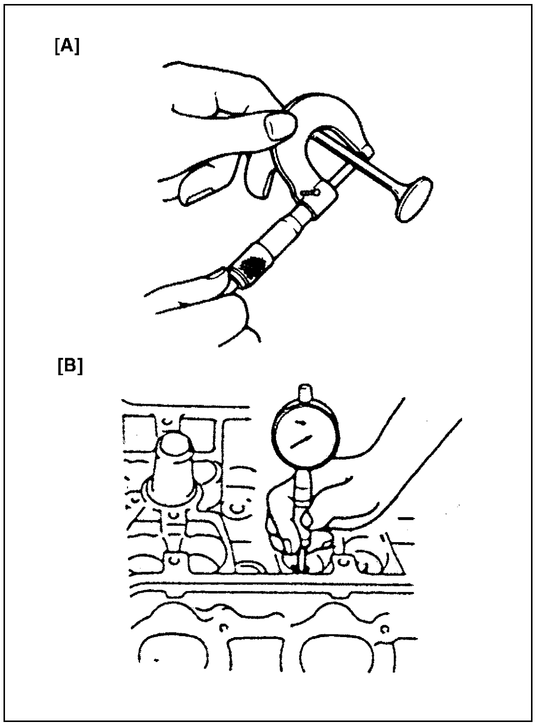
NOTE:
When compressing the valve spring, be carefully to free from damage in inside face of tappet installing hole.

9) Install intake manifold referring to “Intake Manifold Removal and Installation” in this section.
10) Install fuel injectors referring to “Fuel Injector Removal and Installation” in Section 6E2.
11) Install exhaust manifold referring to “Exhaust Manifold Removal and Installation” in this section.

Valves and Cylinder Head Inspection

Valve guides

Valve stem-to-guide clearance



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

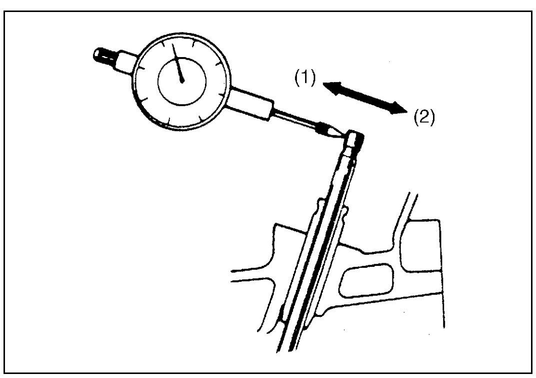
Valve stem-to-guide clearance

Item	Standard	Limit
In	0.020 – 0.047 mm (0.0008 – 0.0018 in.)	0.07 mm (0.0028 in.)
Ex	0.045 – 0.072 mm (0.0018 – 0.0028 in.)	0.09 mm (0.0035 in.)

Valve stem diameter [A] standard
In: 5.465 – 5.480 mm (0.2152 – 0.2157 in.)
Ex: 5.440 – 5.455 mm (0.2142 – 0.2147 in.)

Valve guide bore [B] standard
In and Ex: 5.500 – 5.512 mm (0.2166 – 0.2170 in.)

Valve stem end deflection



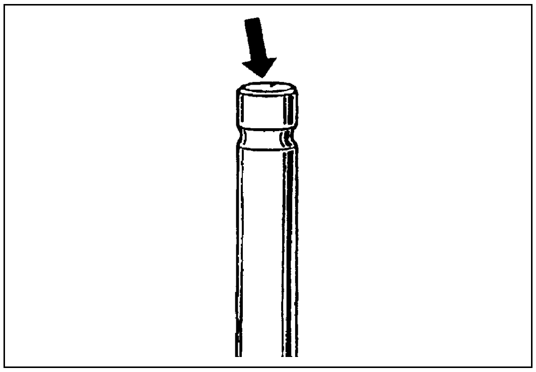
If bore gauge is not available, check end deflection of valve stem with a dial gauge instead.
Move stem end in directions (1) and (2) to measure end deflection.
If deflection exceeds its limit, replace valve stem and valve guide.

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

Valves

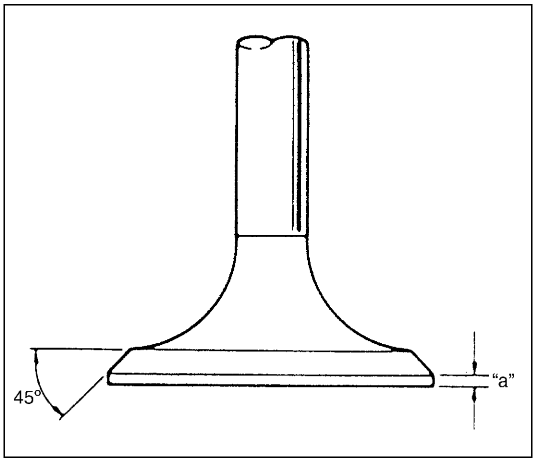
Visual inspection

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



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

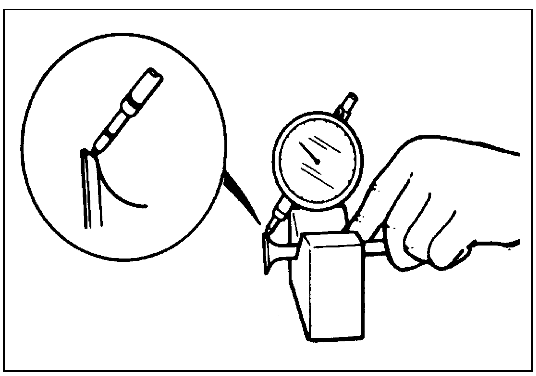
Valve head thickness



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

Valve head thickness "a" (In and Ex)
Standard: 1.25 – 1.55 mm (0.050 – 0.061 in.)
Limit: 0.9 mm (0.035 in.)

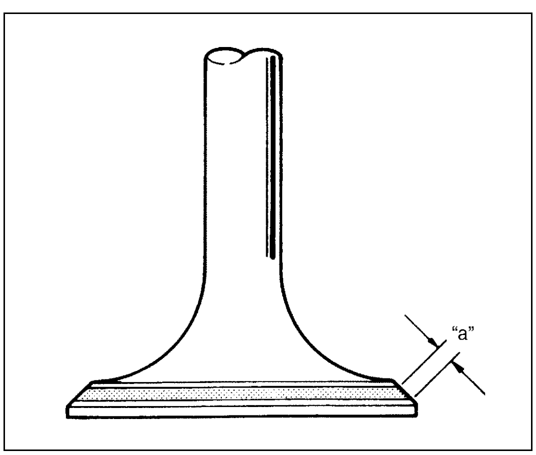
Valve head radial runout



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

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

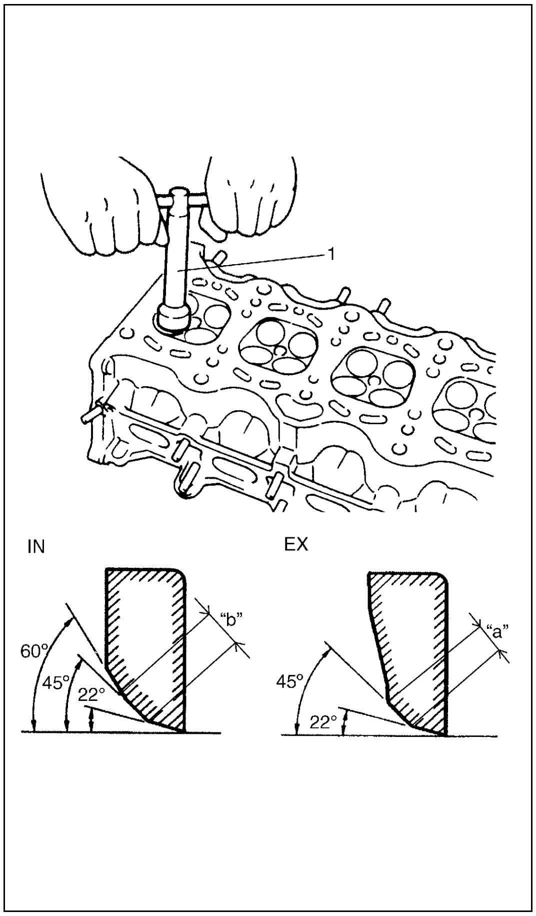
Seating contact width



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

Standard seating width "a" revealed by contact pattern on valve face
In and Ex: 1.0 – 1.4 mm (0.0394 - 0.0551 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 cutters (1) to make two cuts as illustrated in figure. Two cutters must be used: the first for making 22° angle, and the second for making 45° angle. The second cut must be made to produce desired seat width.

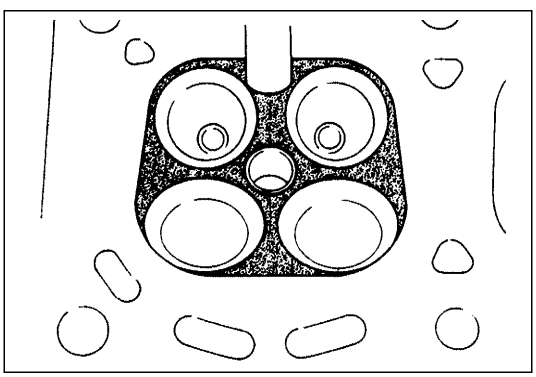
Seat width for exhaust valve seat
"a": 1.0 – 1.4 mm (0.0394 – 0.0551 in.)

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

Seat width for intake valve seat
"b": 1.0 – 1.4 mm (0.0394 – 0.0551 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.

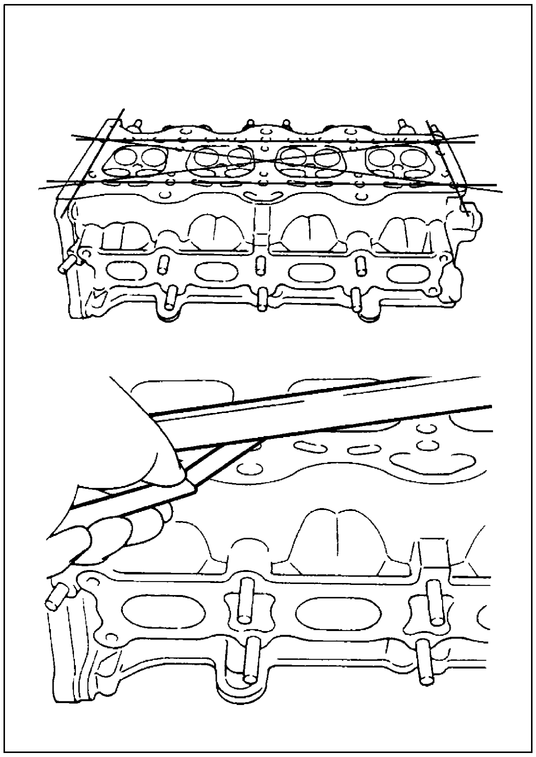
Cylinder head



- Remove all carbon deposits from combustion chambers.

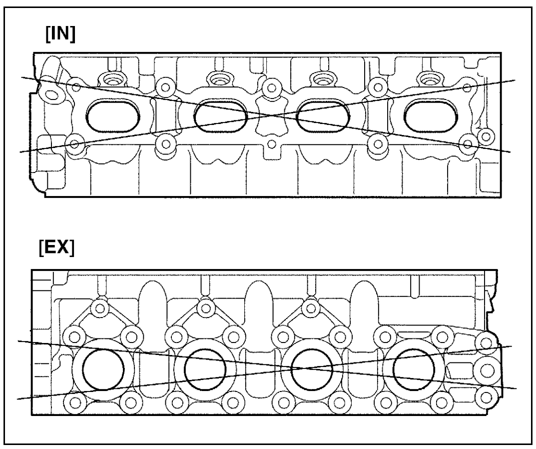
NOTE:

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



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

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

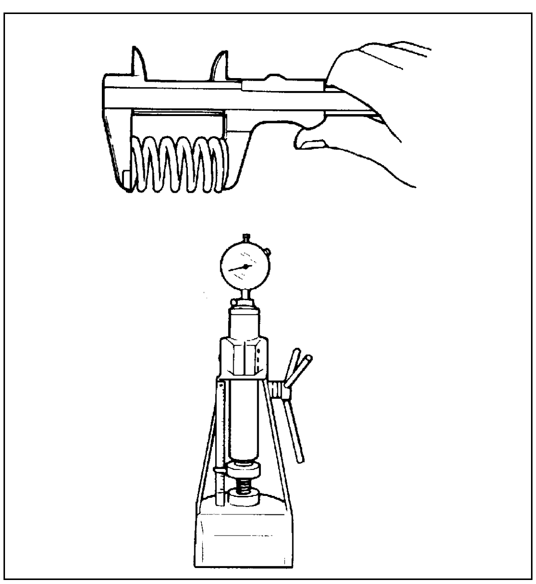


- Distortion of manifold seating faces:
  Check seating faces of cylinder head for manifolds, using a straightedge and thickness gauge, in order to determine whether these faces should be corrected or cylinder head replaced.

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

Valve springs

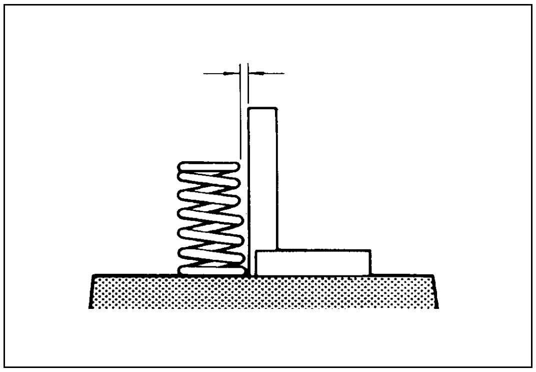
Valve spring free length and preload



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

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

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

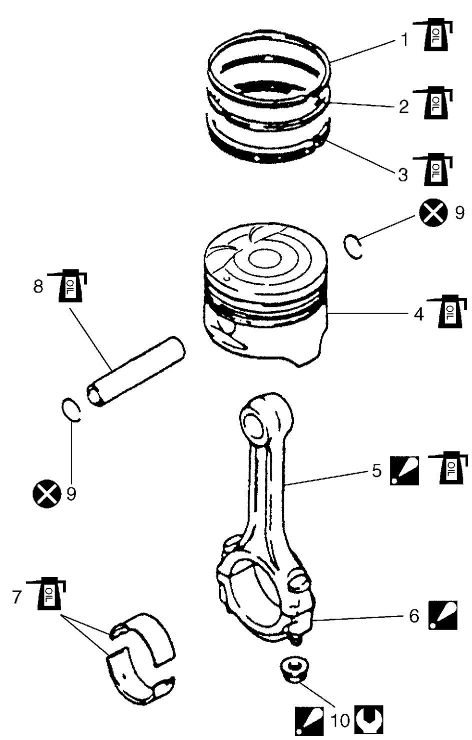


Spring squareness

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

Valve spring squareness limit
1.6 mm (0.079 in.)

Pistons, Piston Rings, Connecting Rods and Cylinders Components

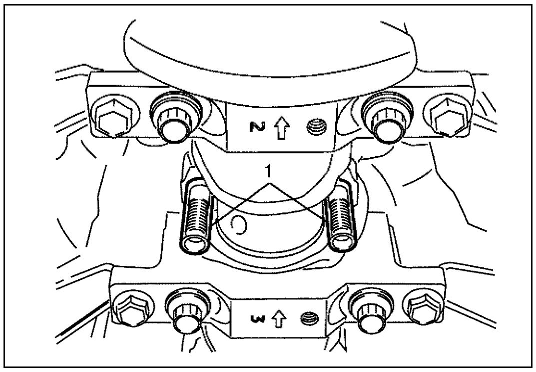


	1. Top ring		8. Piston pin
	2. 2nd ring		9. Piston pin circlip
	3. Oil ring		10. Bearing cap nut Tighten 15 N·m (1.5 kg-m, 11.0 lb-ft), 45° and 45° by the specified procedure.
	4. Piston		Tightening torque
	5. Connecting rod : Apply engine oil to sliding surface except inner surface of big end, and rod bolts. Make sure rod bolt diameter when reuse it due to plastic deformation tightening. Refer to “Inspection” of “Connecting Rod”.		Apply engine oil to sliding surface of each parts.
	6. Connecting rod bearing cap : Point arrow mark on cap to crankshaft pulley side.		Do not reuse.
	7. Connecting rod bearing		

Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation

Removal

1) Remove engine assembly from vehicle referring to “Engine Assembly Removal and Installation” in this section.
2) Remove cylinder head referring to “Valves and Cylinder Head Removal and Installation”.
3) Mark cylinder number on all pistons, connecting rods and connecting rod caps using silver pencil or quick drying paint.
4) Remove rod bearing caps.



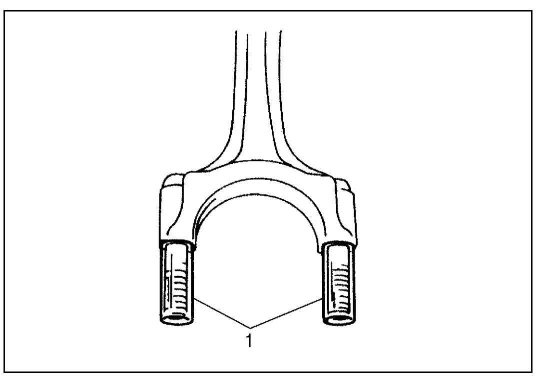
5) Install guide hose (1) over threads of rod bolts.
   This prevents damage to bearing journal and rod bolt threads when removing connecting rod.
6) Decarbonize top of cylinder bore before removing piston from cylinder.
7) Push piston and connecting rod assembly out through the top of cylinder bore.

Installation

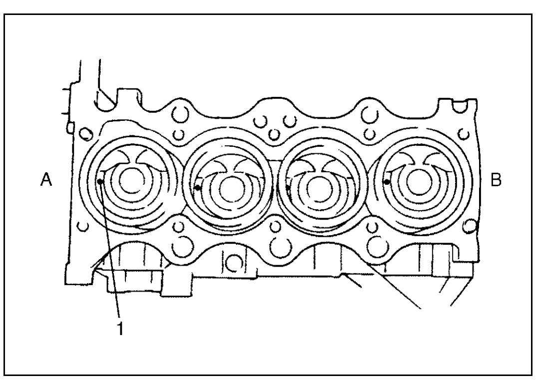
1) Apply engine oil to pistons, rings, cylinder walls, connecting rod bearings and crank pins.

NOTE:

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

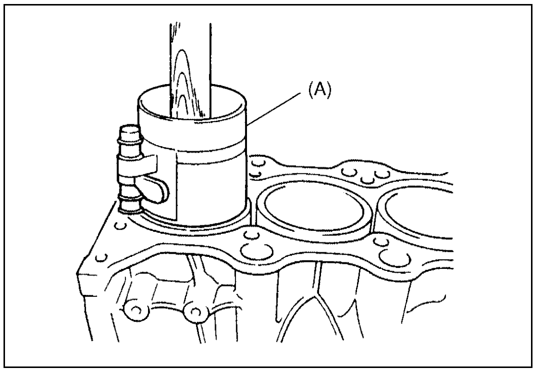


2) Install guide hoses (1) over connecting rod bolts.
   These guide hoses protect crank pin and threads of rod bolt from damage during installation of connecting rod and piston assembly.



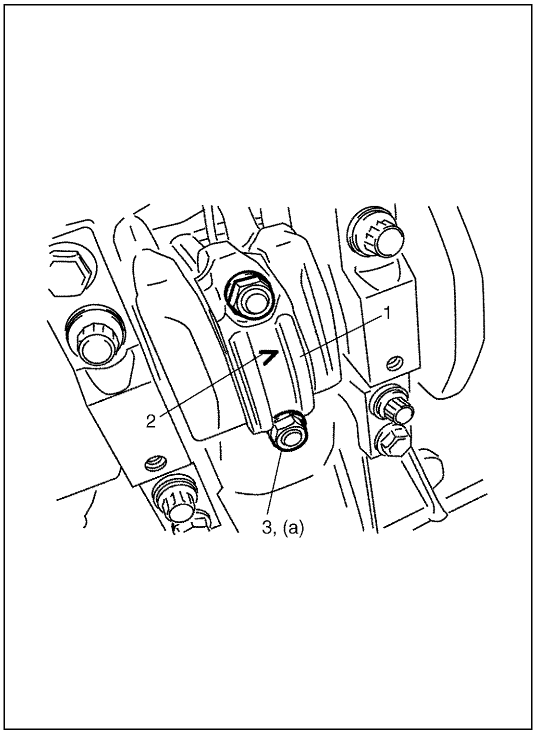
3) When installing piston and connecting rod assembly into cylinder bore, point front mark (1) on piston head to crankshaft pulley side.

A:	Crankshaft pulley side
B:	Flywheel side



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

Special tool
(A): 09916-77310



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

Tightening torque
Bearing cap nut
(a): Tighten 15 N·m (1.5 kg-m, 11.0 lb-ft), 45° and 45° by the specified procedure.

NOTE:

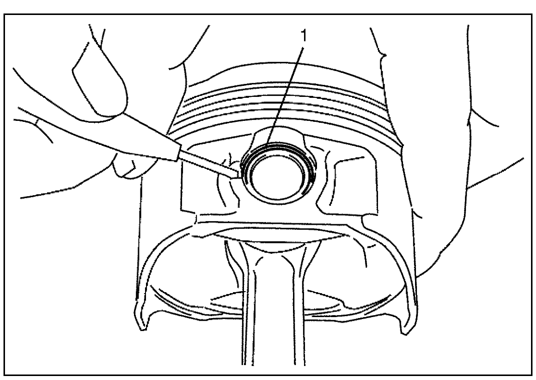
Before installing bearing cap, make sure that checking for connecting rod bolt deformation.
Refer to "Connecting Rod" of "Pistons, Piston Rings, Connecting Rods and Cylinders Inspection" in this section.

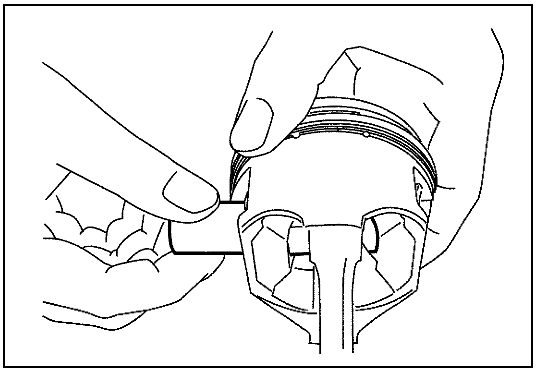
6) Install cylinder head referring to "Valves and Cylinder Head Removal and Installation" in this section.

Pistons, Piston Rings, Connecting Rods and Cylinders Disassembly and Assembly

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

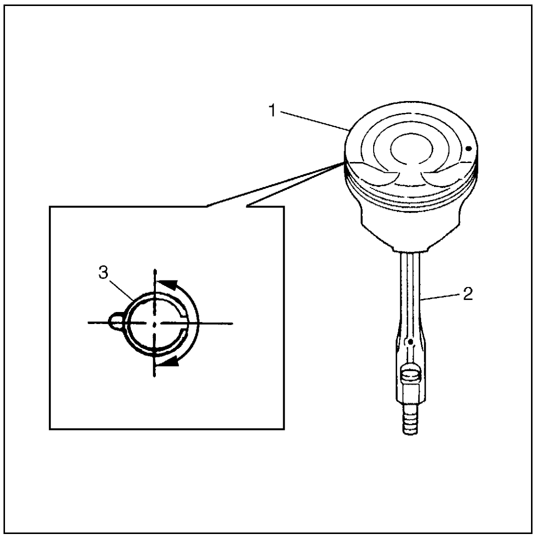




b) Force piston pin out.

Assembly

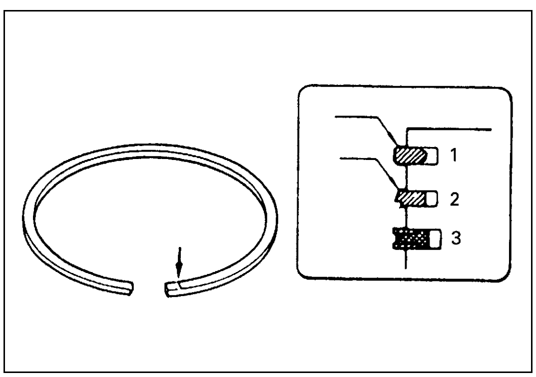
1) Decarbonize piston head and ring grooves using a suitable tool.



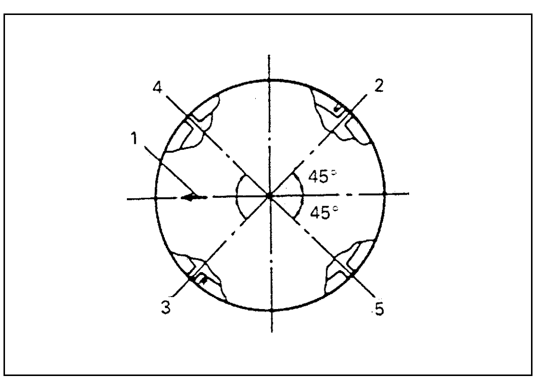
2) Install piston pin to piston (1) and connecting rod (2):
   a) After applying engine oil to piston pin and piston pin holes in piston and connecting rod.
   b) Fit connecting rod as shown in figure.
   c) Insert piston pin to piston and connecting rod.
   d) Install piston pin circlips (3).

NOTE:

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



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



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

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

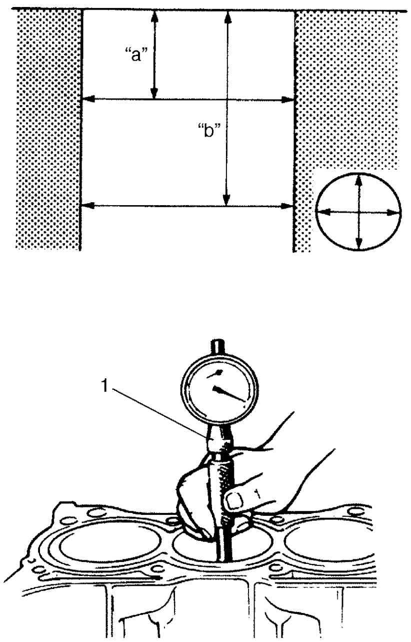
Pistons, Piston Rings, Connecting Rods and Cylinders Inspection

Cylinder

Visual inspection

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.

Cylinder bore diameter, taper and out-of-round



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

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

Cylinder bore diameter
Standard: 78.00 – 78.014 mm (3.0709 – 3.0714 in.)
Limit: 78.050 mm (3.073 in.)

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

"a": 50 mm (1.96 in.)
"b": 100 mm (3.94 in.)

NOTE:

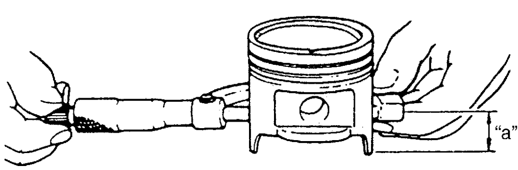
If any one of four cylinders has to be rebored, rebore all four to the same next oversize. This is necessary for the sake of uniformity and balance.

Pistons

Visual inspection

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

Piston diameter

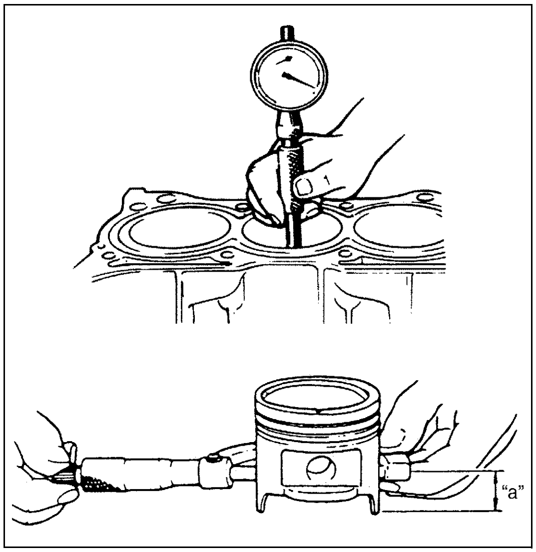


As indicated in figure, piston diameter should be measured at a position 19.5 mm (0.77 in.) from piston skirt end in the direction perpendicular to piston pin.

Piston diameter specification

Standard size	**77.953 – 77.968 mm (3.0691 – 3.0696 in.)**
Oversize 0.50 mm (0.0196 in.)	**78.453 – 78.468 mm (3.0887 – 3.0892 in.)**

"a": 19.5 mm (0.77 in.)



"a": 19.5 mm (0.77 in.)

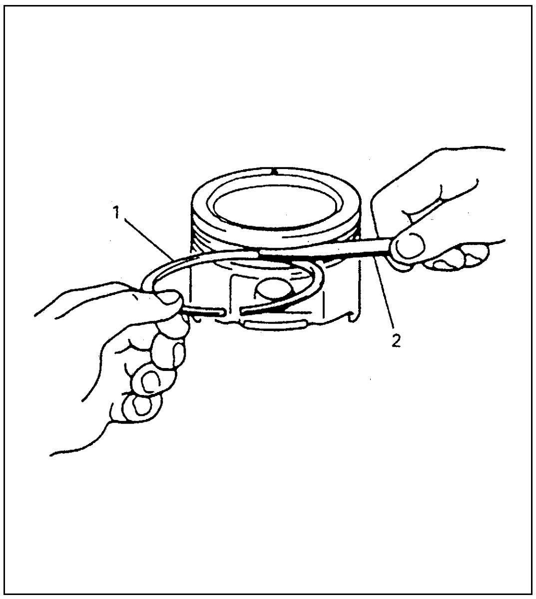
Piston clearance

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

Piston clearance
Standard: 0.032 – 0.061 mm (0.0013 – 0.0024 in.)

NOTE:

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



Ring groove clearance

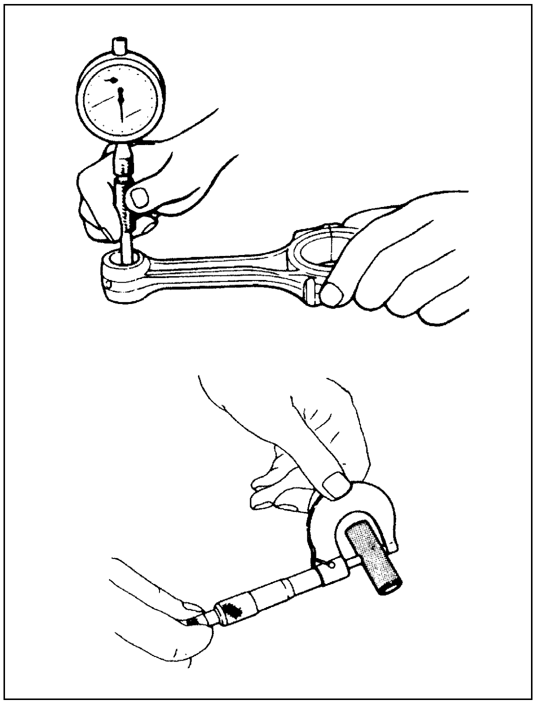
Before checking, piston grooves must be clean, dry and free of carbon deposits.
Fit new piston ring (1) into piston groove, and measure clearance between ring and ring land by using thickness gauge (2). If clearance is out of limit, replace piston.

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

Piston pin

Visual inspection

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



Piston pin clearance

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

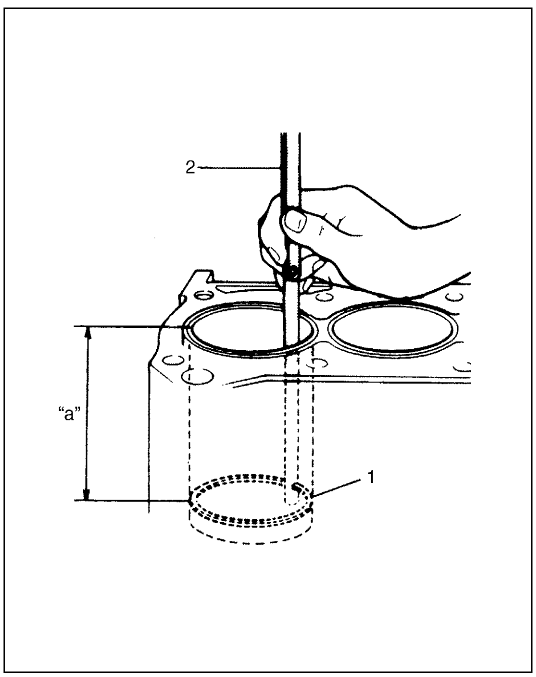
Piston pin clearance in connecting rod small end
Standard: 0.003 – 0.014 mm (0.00012 – 0.00055 in.)
Limit: 0.05 mm (0.0020 in.)

Piston pin clearance in piston
Standard: 0.006 – 0.017 mm (0.00024 – 0.00066 in.)
Limit: 0.05 mm (0.0020 in.)

Small-end bore
20.003 – 20.011 mm (0.7876 – 0.7878 in.)

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

Piston bore
20.006 – 20.014 mm (0.7877 – 0.7879 in.)



Piston rings

Piston ring end gap

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

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

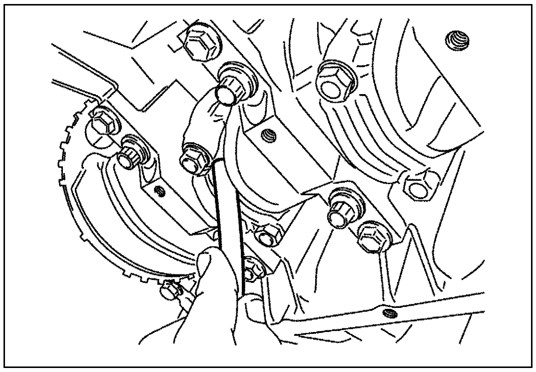
Piston ring end gap

Item	Standard	Limit
Top ring	0.20 – 0.35 mm (0.0079 – 0.0137 in.)	0.7 mm (0.0276 in.)
2nd ring	0.30 – 0.45 mm (0.0119 – 0.0177 in.)	1.0 mm (0.0394 in.)
Oil ring	0.20 – 0.70 mm (0.0079 – 0.0275 in.)	1.2 mm (0.0472 in.)

"a": 120 mm (4.72 in.)

Connecting rod

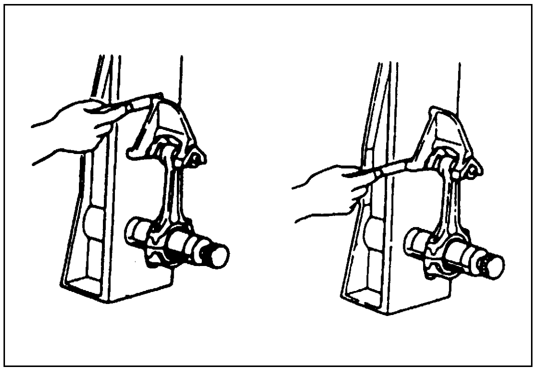
Big-end side clearance



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

Big-end side clearance
Standard: 0.25 – 0.40 mm (0.0099 – 0.0157 in.)
Limit: 0.55 mm (0.0217 in.)

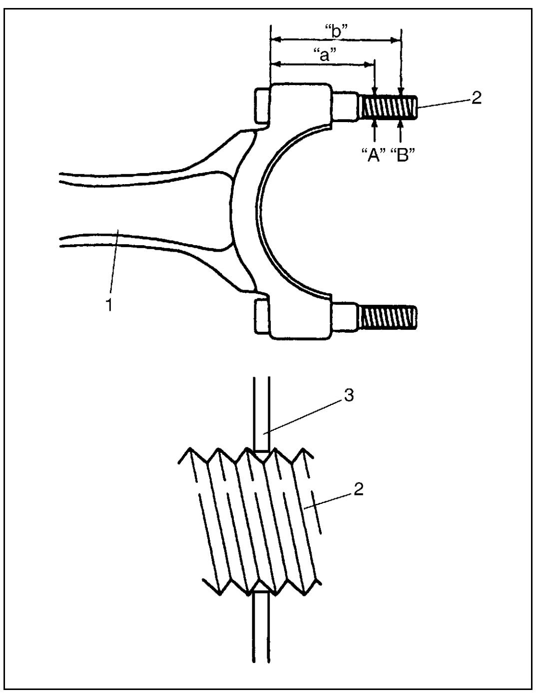
Connecting rod alignment



Mount connecting rod on aligner to check it for bow and twist. If the measured value exceeds the limit, replace it.

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

Connecting rod bolt deformation (Plastic deformation tightening bolt)



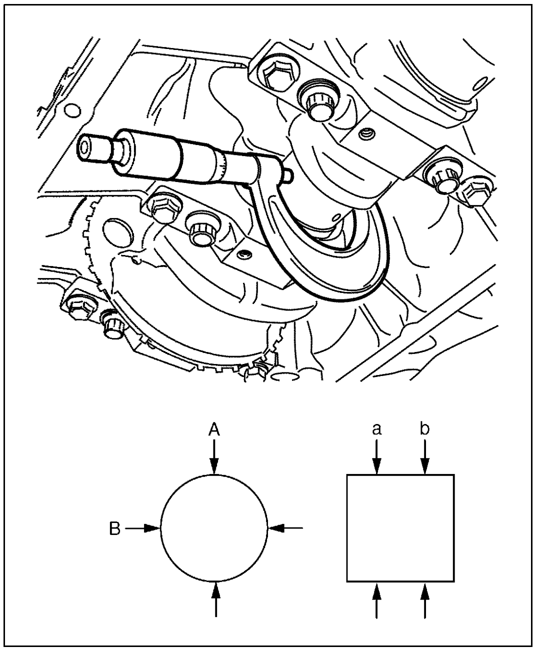
Measure each thread diameter of connecting rod (1) bolt (2) at "A" on 32 mm (1.25 in.) from bolt mounting surface and "B" on 40 mm (1.57 in.) from bolt mounting surface by using a micrometer (3). Calculate difference in diameters ("A" – "B"). If it exceeds limit, replace connecting rod.

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

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

Crank pin and connecting rod bearings

Crank pin diameter



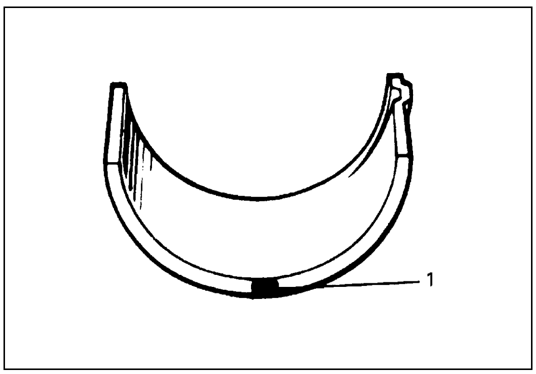
Inspect crank pin for uneven wear or damage. Measure crank pin for out-of-round or taper with a micrometer. If crank pin is damaged or out-of round or taper is out of limit, replace crankshaft or regrind crank pin to undersize and use undersize bearing.

Crank pin diameter

Connecting rod bearing size	Crank pin diameter
Standard	41.982 – 42.000 mm (1.6529 – 1.6535 in.)
Undersize 0.25 mm (0.0098 in.)	41.732 – 41.750 mm (1.6430 – 1.6436 in.)

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

Connecting rod bearing general information



Service connecting rod bearings are available in standard size and 0.25 mm (0.0098 in.) undersize, and standard size bearing has 5 kinds of bearings differing in tolerance.
For identification of undersize bearing, it is painted red at the position as indicated in figure, undersize bearing thickness is 1.605 – 1.615 mm (0.0632 – 0.0635 in.) at the center of it.

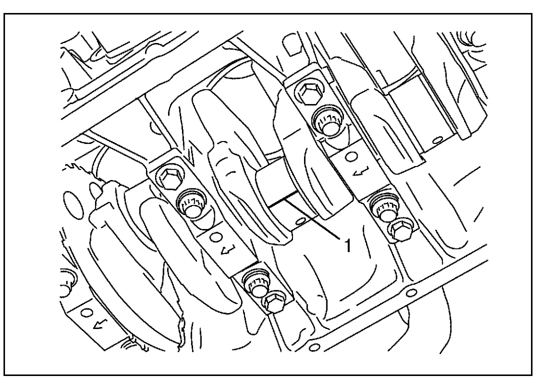
1. Painting

Connecting rod bearing visual inspection

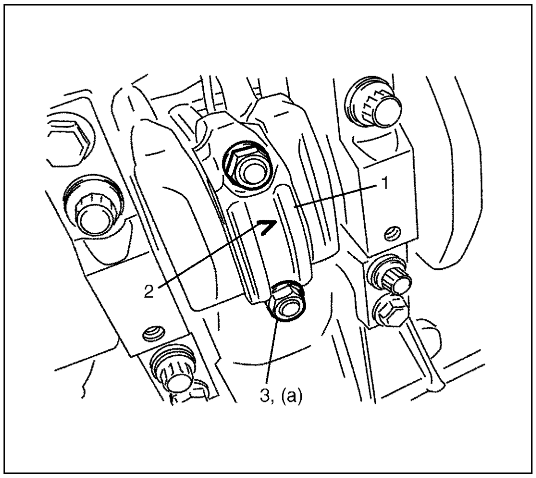
Inspect bearing shells for signs of fusion, pitting, burn or flaking and observe contact pattern. Bearing shells found in defective condition must be replaced.

Connecting rod bearing clearance

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

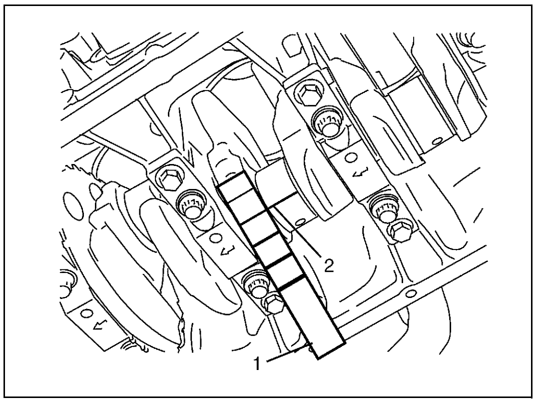


3) Place a piece of gaging plastic (1) to full width of crank pin as contacted by bearing (parallel to crankshaft), avoiding oil hole.



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

Tightening torque
Bearing cap nut
(a): Tighten 15 N·m (1.5 kg-m, 11.0 lb-ft), 45° and 45° by the specified procedure.



5) Remove cap and using a scale (1) on gaging plastic (2) envelope, measure gaging plastic width at the widest point (clearance).
If clearance exceed its limit, use a new standard size bearing referring to "Selection of Connecting Rod Bearings" in this section.
After selecting new bearing, recheck clearance.

Connecting rod bearing clearance
Standard: 0.029 – 0.047 mm (0.0011 – 0.0018 in.)
Limit: 0.065 mm (0.0026 in.)

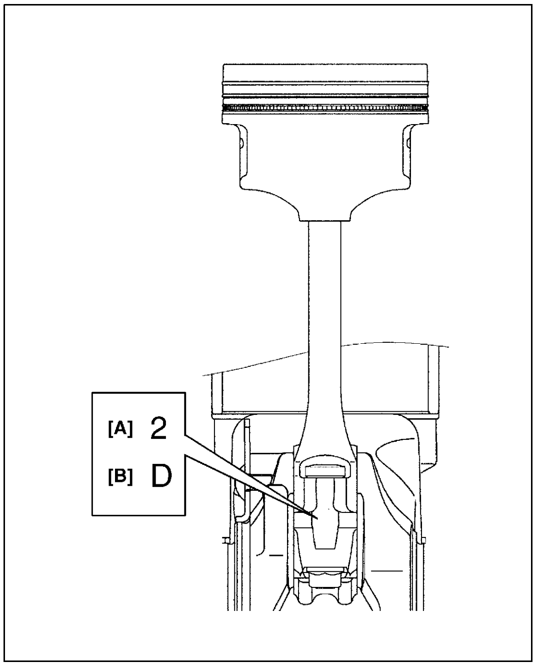
6) If clearance can not be brought to its limit even by using a new standard size bearing, regrind crank pin to undersize and use 0.25 mm undersize bearing.

NOTE:
After checking the rod bearing clearance, make sure that checking for Connecting rod bolt deformation.
Refer to "Connecting Rod" under "Pistons, Piston Rings, Connecting Rods and Cylinders Inspection".

Selection of connecting rod bearings

NOTE:

- **If bearing is in malcondition, or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.**
- **When replacing crankshaft or connecting rod and its bearing due to any reason, select new standard bearings to be installed by referring to numbers stamped on connecting rod and its cap and/or alphabets stamped on crank web of No.3 cylinder.**

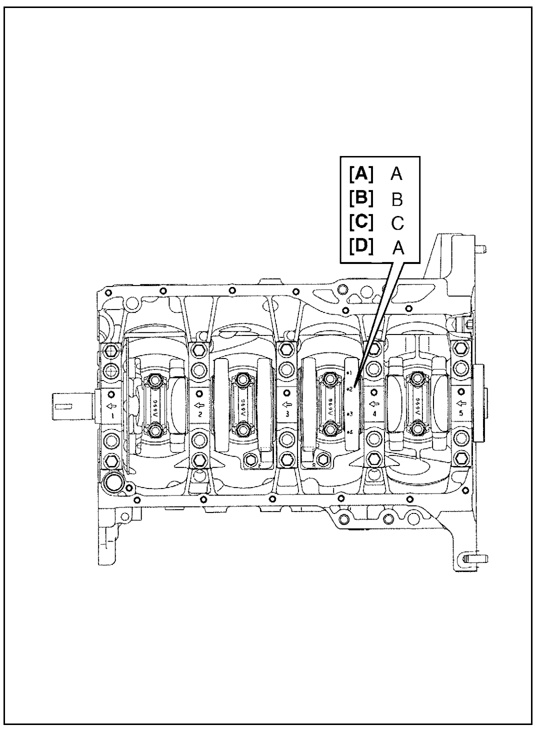


1) Check stamped numbers on connecting rod and its cap as shown.
   Three kinds of numbers ("1", "2" and "3") represent the following connecting rod big end inside diameters.
   For example, stamped number "1" indicates that corresponding connecting rod big end inside diameter is 45.0000 – 45.0060 mm (1.7717 – 1.7718 in.).

Connecting rod big end inside diameter

Stamped numbers	connecting rod big end inside diameter
1	45.0000 – 45.0060 mm (1.7717 – 1.7718 in.)
2	45.0061 – 45.0120 mm (1.7719 – 1.7721 in.)
3	45.0121 – 45.0180 mm (1.7722 – 1.7723 in.)

[A]:	Connecting rod big end inside diameter number
[B]:	Weight indication mark

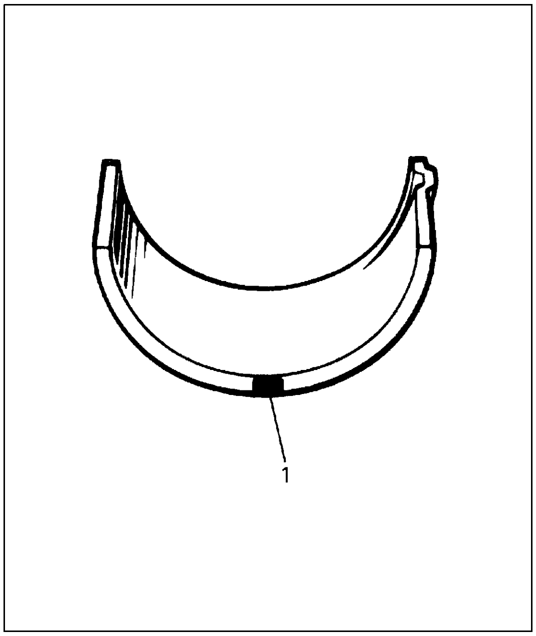


2) Next, check crankshaft pin diameter. On crank web No.3, four alphabets are stamped as shown in figure.
   Three kinds of alphabet ("A", "B" and "C") represent the following crankshaft pin diameter respectively.
   For example, stamped "A" indicates that corresponding crankshaft pin diameter is 41.9940 – 42.0000 mm (1.6534 – 1.6535 in.).

Crankshaft pin outer diameter

Stamped alphabet	Crankshaft pin diameter
A	41.9940 – 42.0000 mm (1.6534 – 1.6535 in.)
B	41.9880 – 41.9939 mm (1.6531 – 1.6533 in.)
C	41.9820 – 41.9879 mm (1.6529 – 1.6530 in.)

[A]:	Crankshaft pin diameter for No.1 cylinder
[B]:	Crankshaft pin diameter for No.2 cylinder
[C]:	Crankshaft pin diameter for No.3 cylinder
[D]:	Crankshaft pin diameter for No.4 cylinder



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

Standard size of connecting rod bearing thickness

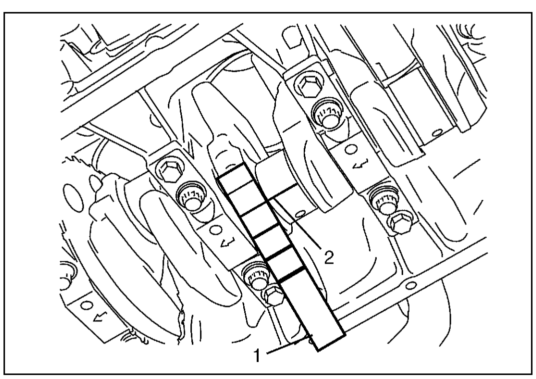
Color painted	Bearing thickness
Blue	1.4991 – 1.5020 mm (0.05902 – 0.05913 in.)
Yellow	1.4961 – 1.4990 mm (0.05890 – 0.05901 in.)
Nothing	1.4931 – 1.4960 mm (0.05879 – 0.05889 in.)
Black	1.4901 – 1.4930 mm (0.05867 – 0.05878 in.)
Green	1.4870 – 1.4900 mm (0.05855 – 0.05866 in.)

1. Paint

4) From number stamped on connecting rod and its cap and alphabets stamped on crank web No.3, determine new standard bearing to be installed to connecting rod big end inside, by referring to table.
For example, if number stamped on connecting rod and its cap is “1” and alphabet stamped on crank web No.3 is “B”, install a new standard bearing painted in “Black” to its connecting rod big end inside.

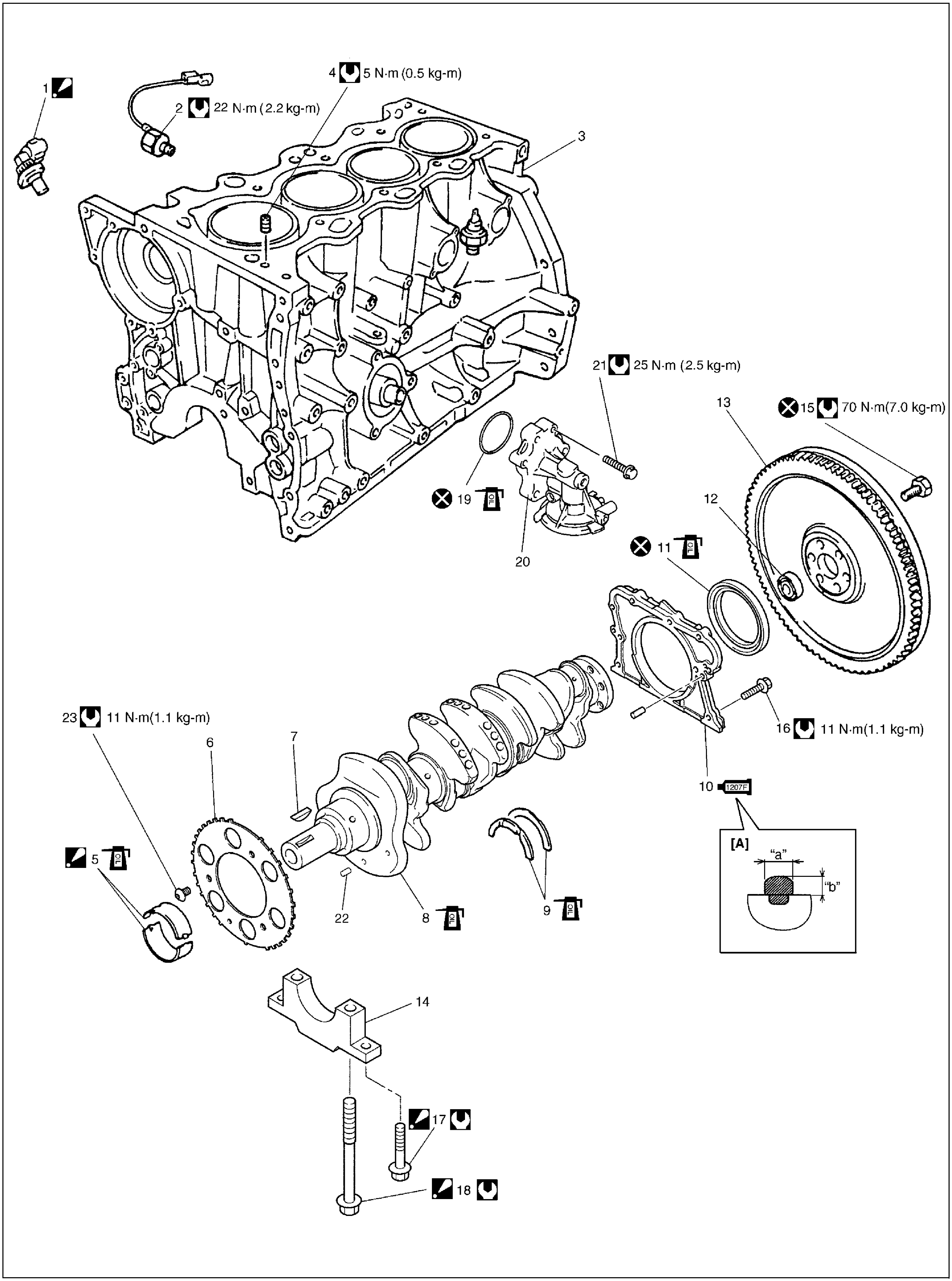
Specification of new standard connecting rod bearing size

		Number stamped on connecting rod and its cap (connecting rod big end inside diameter)		
		1	2	3
Alphabet stamped on crank web No.3 (Crankshaft pin diameter)	A	Green	Black	Nothing
	B	Black	Nothing	Yellow
	C	Nothing	Yellow	Blue
		New standard bearing to be installed.		



5) Using scale (1) on gaging plastic (2), check bearing clearance with newly selected standard bearing.
If clearance still exceeds its limit, use next thicker bearing and recheck clearance.

Main Bearings, Crankshaft and Cylinder Block Components

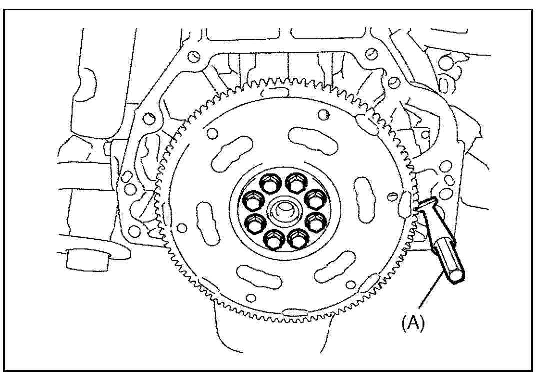


[A]:	Sealant application amount	5.	Main bearing : Upper half of bearing has an oil groove	15.	Flywheel mounting bolt
	Tightening torque	6.	Sensor plate	16.	Rear oil seal housing bolt
	Do not reuse.	7.	Crankshaft timing sprocket key	17.	Main bearing cap No.2 bolt Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft) by the specified procedure.
	Apply engine oil to inside / sliding surface.	8.	Crankshaft	18.	Main bearing cap No.1 bolt Tighten 30 N·m (3.0 kg-m, 22.0 lb-ft), 50 N·m (5.0 kg-m, 36.5 lb-ft) and 60° by the specified procedure. : Never reuse main bearing cap No.1 bolts once disassembled it due to plastic deformation tightening. Be sure to use new main bearing cap No.1 bolts when installing.
"a":	3 mm (0.12 in.)	9.	Thrust bearing	19.	O-ring
"b":	2 mm (0.08 in.)	1207F 10.	Rear oil seal housing : Apply sealant 99000-31250 to mating surface.	20.	Oil filter adapter case
1.	CKP sensor (if equipped) : When installing CKP sensor, use new sensor mounting bolt.	11.	Rear oil seal	21.	Oil filter adapter bolt
2.	Knock sensor	12.	Input shaft bearing	22.	Spring pin
3.	Cylinder block	13.	Flywheel	23.	Sensor plate bolt
4.	Venturi plug	14.	Main bearing cap		

Main Bearings, Crankshaft and Cylinder Block Removal and Installation

Removal

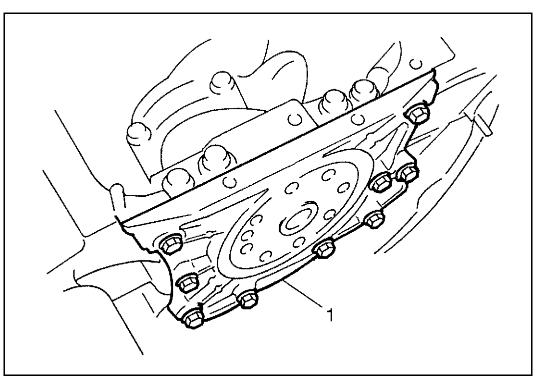
1) Remove engine assembly from vehicle referring to "Engine Assembly Removal and Installation" in this section.



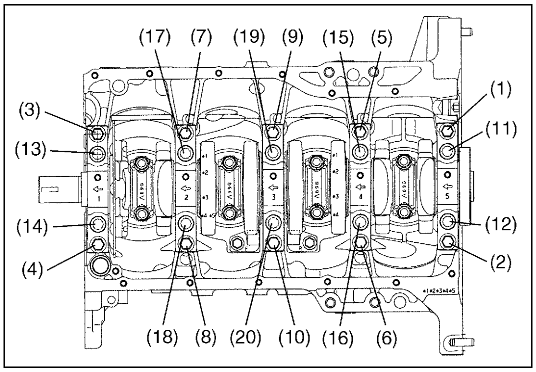
2) Remove clutch cover, clutch disc and flywheel (drive plate for A/T) by using special tool.

Special tool
(A): 09924-17810

3) Remove piston and connecting rod referring to "Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation" in this section.



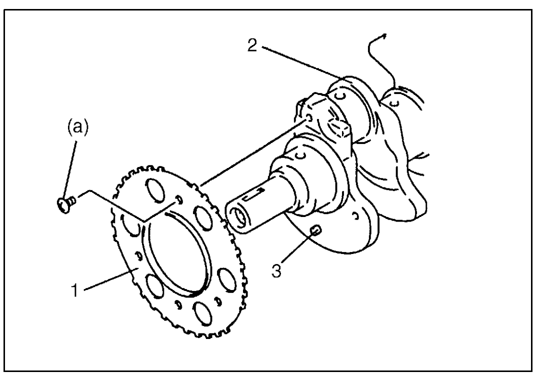
4) Remove rear oil seal housing (1).



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

Installation

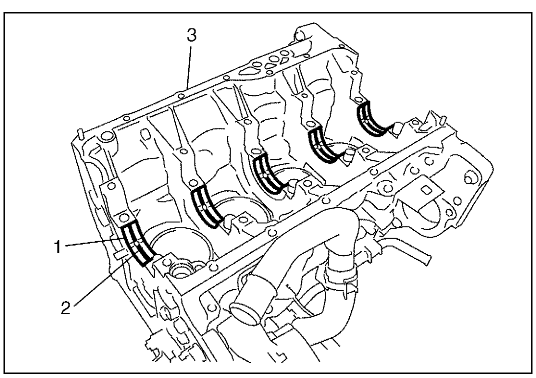
CAUTION:
- **Use new bearing cap No.1 bolts. They are deformed once they are used because they are plastic deformation tightening bolts.**
- **All parts to be installed must be perfectly clean.**
- **Be sure to oil crankshaft journals, journal bearings, thrust bearings, crankpins, connecting rod bearings, pistons, piston rings and cylinder bores.**
- **Journal bearings, bearings caps, connecting rods, rod bearings, rod bearing caps, pistons and piston rings are in combination sets. Do not disturb such combination and make sure that each part goes back to where it came from, when installing.**



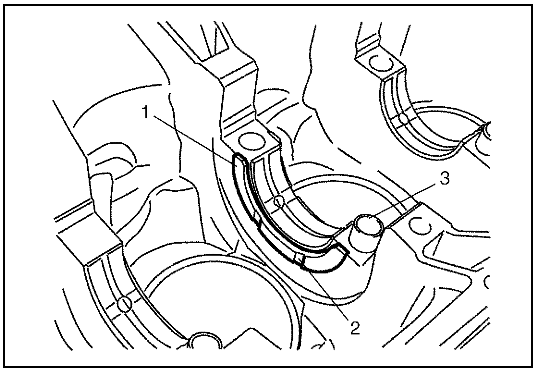
1) Install sensor plate (1) to crankshaft (2) and tighten bolts to specified torque.

NOTE:
When installing sensor plate, align spring pin (3) on crankshaft and hole of sensor plate.

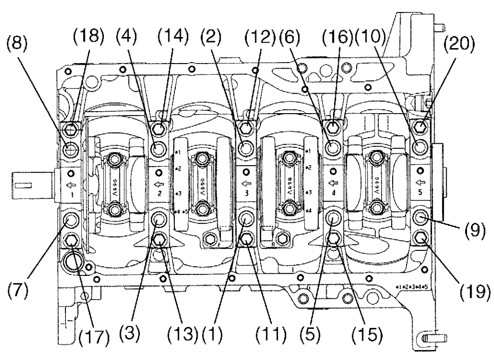
Tightening torque
Sensor plate bolt (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



2) Install main bearings to cylinder block.
Upper half of bearing (1) has an oil groove (2).
Install it to cylinder block (3), and the other half without oil groove to bearing cap.
Make sure that two halves are painted in the same color.



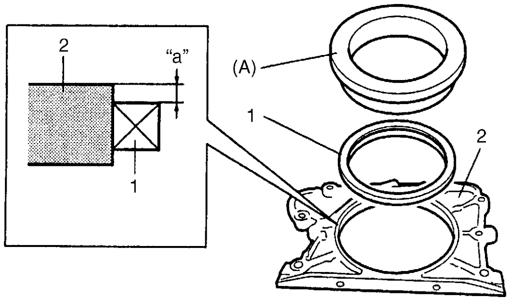
3) Install thrust bearings (1) to cylinder block between No.2 and No.3 cylinders. Face oil groove (2) sides to crank webs.
4) Confirm that dowel pins (3) are installed to intake side of each journal.
5) Install crankshaft to cylinder block.



6) Install bearing cap to cylinder block, making sure to point arrow mark (on each cap) to crankshaft pulley side. Fit them sequentially in ascending order, 1, 2, 3, 4 and 5, starting from pulley side.
   After applying engine oil to main bearing cap No.1 bolts ((1) – (10)) and main bearing cap No.2 bolts ((11) – (20)), tighten them gradually as follows.
   a) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order as shown by using a 12 corner socket wrenches.
   b) In the same manner as in Step a), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
   c) In the same manner as in Step a), retighten them to 60°.
   d) Tighten bolts (11) – (20) to 25 N·m (2.5 kg-m, 18.0 lb-ft) according to numerical order as shown.

Tightening torque
Main bearing cap No.1 bolt (1) – (10)
: Tighten 30 N·m (3.0 kg-m, 22.0 lb-ft), 50 N·m (5.0 kg-m, 36.5 lb-ft) and 60° by the specified procedure.
Main bearing cap No.2 bolt (11) – (20)
: Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft) by the specified procedure.

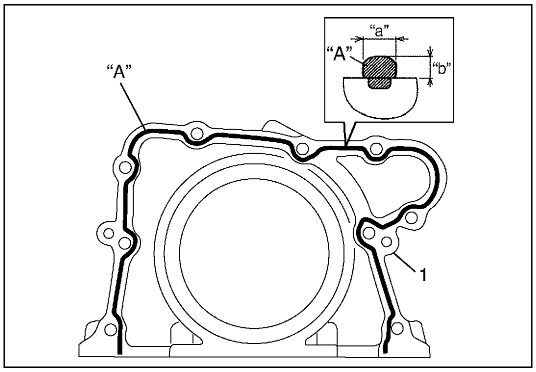
CAUTION:
After tightening cap bolts, check to be sure that crankshaft rotates smoothly when turning it by 12 N·m (1.2 kg-m, 9.0 lb-ft) torque or below.



7) If necessary, press-fit rear oil seal (1) to oil seal housing (2) by using special tool as shown in the figure.

Special tool
(A): 09911-97820

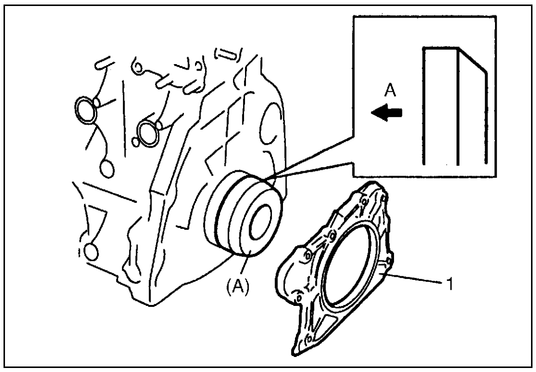
Crank rear oil seal installing position (dimension)
"a": 3 mm (0.12 in.)



8) Apply sealant to mating surface of rear oil seal housing (1).

"A": Sealant 99000-31250

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

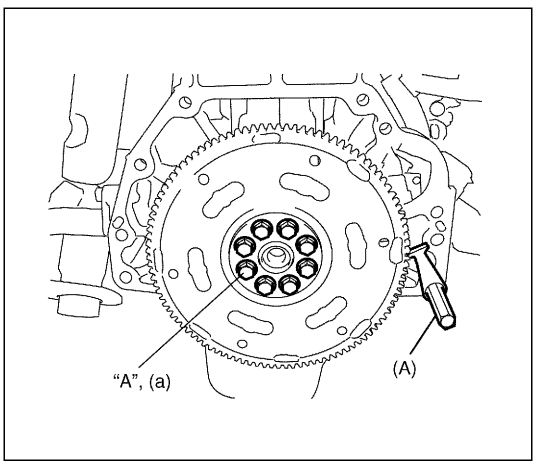


9) Install rear oil seal housing (1) and tighten bolts to specified torque by using special tool.

Special tool
(A): 09911-97720

Tightening torque
Rear oil seal bolt: 11 N·m (1.1 kg-m, 8.0 lb-ft)

A: Crankshaft side



10) Install flywheel ((for M/T) or drive plate (for A/T)).
Using special tool, lock flywheel or drive plate, and tighten flywheel or drive plate bolts to specified torque.

NOTE:
Use new flywheel or drive plate bolts.

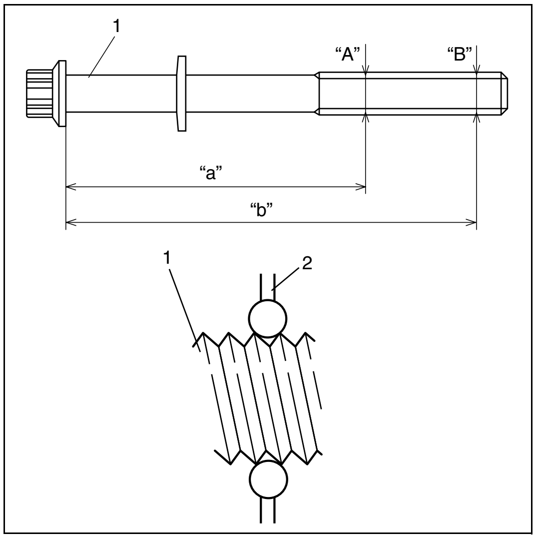
Special tool
(A): 09924-17810

Tightening torque
Flywheel or drive plate bolt
(a): 70 N·m (7.0 kg-m, 51.0 lb-ft)

11) Install piston and connecting rod referring to "Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation" in this section.
12) Install engine assembly to vehicle referring to "Engine Assembly Removal and Installation" in this section.

Main Bearings, Crankshaft and Cylinder Block Inspection

Main bearing cap No.1 bolt



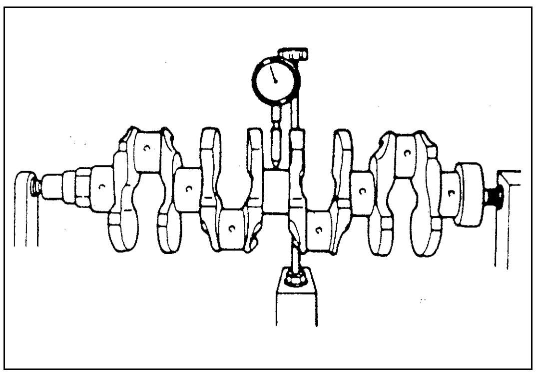
Measure each thread diameter main bearing cap No.1 bolts (1) at "A" on 60mm(2.36in.) from seat side of flange bolt and "B" on 90mm(3.54in.) from seat side of flange bolt by using a micrometer (2).
Calculate difference in diameters ("A" – "B").
If it exceeds limit, replace with new one.

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

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

Crankshaft

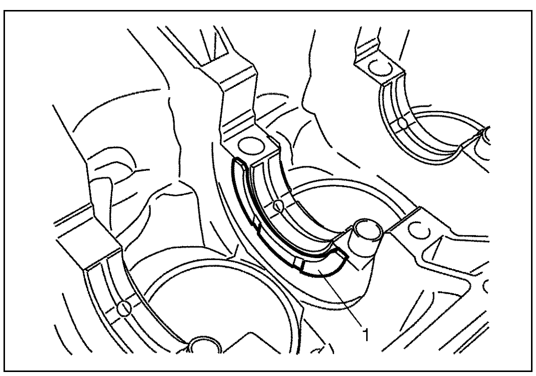
Crankshaft runout



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

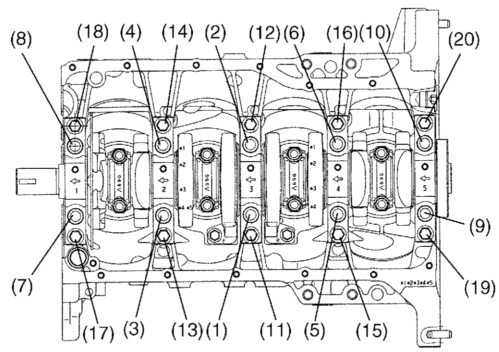
Crankshaft runout
Limit: 0.02 mm (0.0008 in.)

Crankshaft thrust play



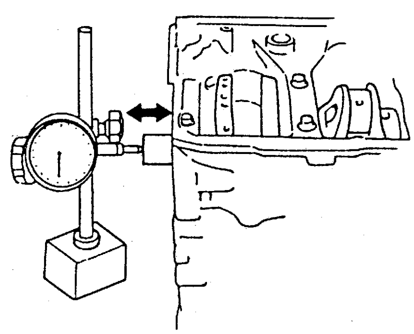
1) Measure this play with crankshaft set in cylinder block in the normal manner, that is with thrust bearing (1) and journal bearing caps installed.

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



2) Tighten main bearing cap No.1 bolts (1) – (10) and main bearing cap No.2 bolts (11) – (20) gradually as follows.
   a) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order in figure.
   b) In the same manner as in Step 1), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
   c) In the same manner as in step 1), retighten them to 60°.
   d) Tighten bolts (11) – (20) to 25 N·m (2.5 kg-m, 18.0 lb-ft) according to numerical order in figure.

Tightening torque
Main bearing cap No.1 bolt (1) – (10)
: Tighten 30 N·m (3.0 kg-m, 22.0 lb-ft), 50 N·m (5.0 kg-m, 36.5 lb-ft) and 60° by the specified procedure.
Main bearing cap No.2 bolt (11) – (20)
: Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft) by the specified procedure.



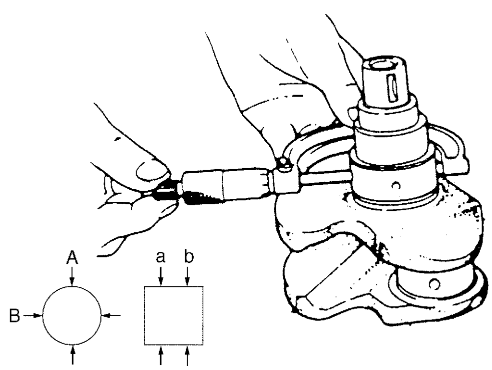
3) Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.
   If its limit is exceeded, replace thrust bearing with new standard one or oversize one to obtain standard thrust play.

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

NOTE:

After checking the thrust play, make sure that thread deformation of each main bearing cap No.1 bolt referring to “Main Bearing Cap No.1 Bolt” in this section.

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



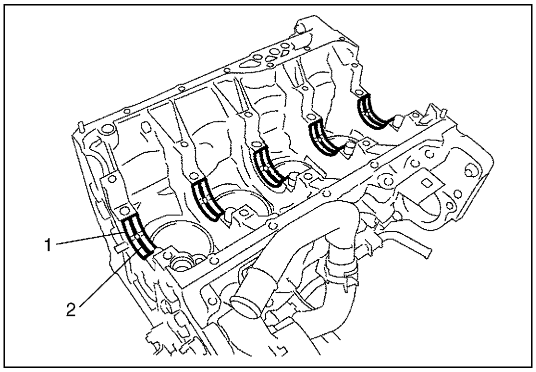
An unevenly worn crankshaft journal shows up as a difference in diameter at a cross section or along its length (or both). This difference, if any, is determined by taking micrometer readings. If any one of journals is badly damaged or if amount of uneven wear in the sense explained below exceeds its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

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

Main bearings

General information

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



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

Visual inspection

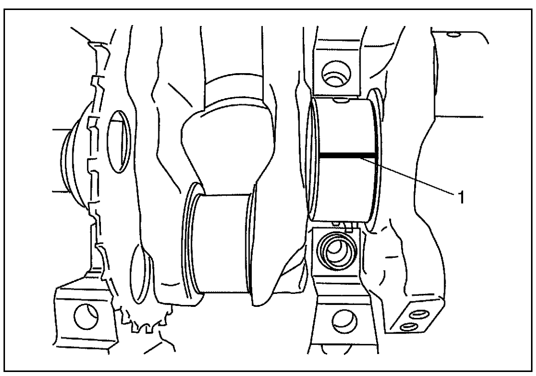
Check bearings for pitting, scratches, wear or damage.
If any malcondition is found, replace both upper and lower halves.
Never replace either half without replacing the other half.

Main bearing clearance

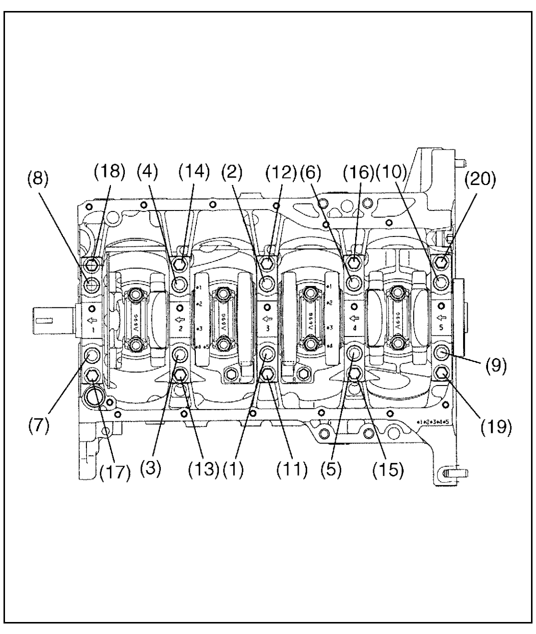
CAUTION:
Do not rotate crankshaft while gaging plastic is installed.

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

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

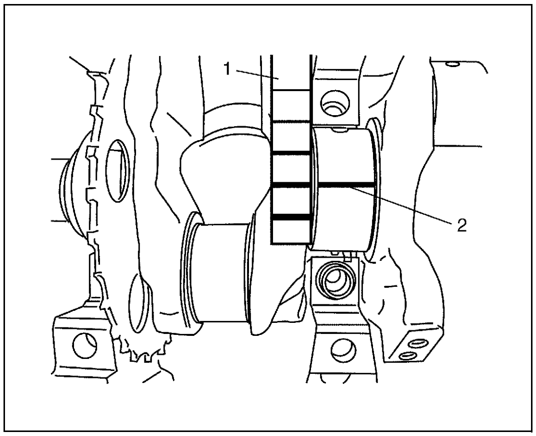


3) Place a piece of gaging plastic (1) the full width of bearing (parallel to crankshaft) on journal, avoiding oil hole.



4) Tighten main bearing cap No.1 bolts (1) – (10) and main bearing No.2 cap bolts (11) – (20) gradually as follows.
   a) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order in figure.
   b) In the same manner as in Step a), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
   c) In the same manner as in step a), retighten them to 60°.
   d) Tighten bolts (11) – (20) to 25 N·m (2.5 kg-m, 18.0 lb-ft) according to numerical order in figure.

Tighting torque
Main bearing cap No.1 bolt (1) – (10)
: Tighten 30 N·m (3.0 kg-m, 22.0 lb-ft), 50 N·m (5.0 kg-m, 36.5 lb-ft) and 60° by the specified procedure.
Main bearing cap No.2 bolt (11) – (20)
: Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft) by the specified procedure.



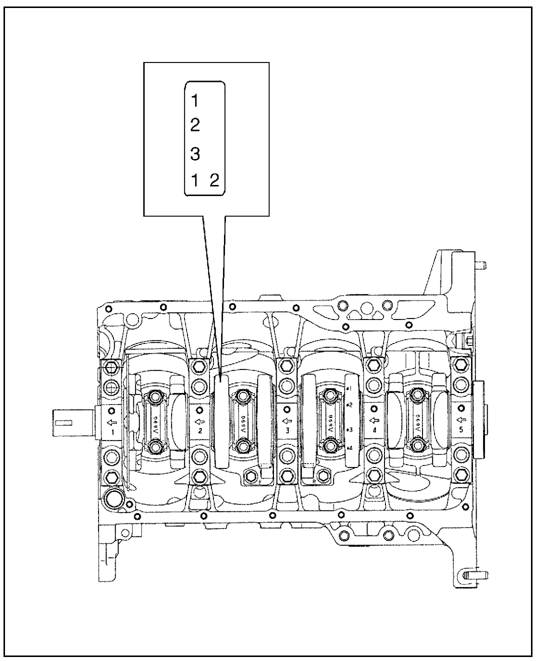
5) Remove bearing caps and using scale (1) on gaging plastic (2) envelop, measure gaging plastic width at its widest point. If clearance exceeds its limit, replace bearing. Always replace both upper and lower inserts as a unit.
   A new standard bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use of 0.25 mm (0.0098 in.) undersize bearing.
   After selecting new bearing, recheck clearance.

Main bearing clearance
Standard: 0.025 – 0.045 mm (0.0010 – 0.0017 in.)
Limit: 0.058 mm (0.0023 in.)

Selection of main bearings

Standard bearing

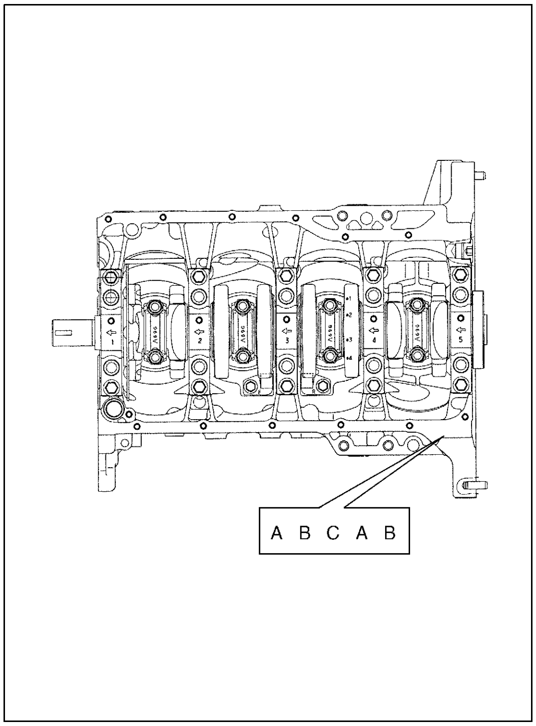
If bearing is in malcondition, or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.



1) First check journal diameter. As shown in figure, crank web No.2 has stamped numbers.
   Three kinds of numbers (“1”, “2” and “3”) represent the following journal diameters.
   Stamped numbers on crank web No.2 represent journal diameters marked with an arrow in figure respectively.
   For example, stamped number “1” indicates that corresponding journal diameter is 44.9940 – 45.0000 mm (1.7715 – 1.7716 in.).

Crankshaft journal diameter

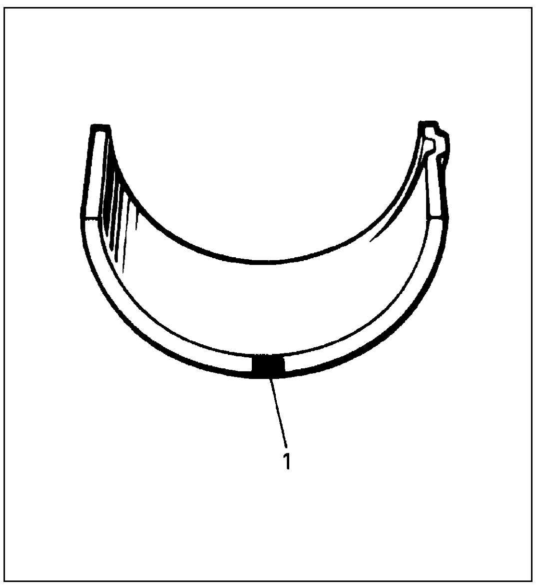
Stamped numbers	Journal diameter
1	44.9940 – 45.0000 mm (1.7715 – 1.7716 in.)
2	44.9880 – 44.9939 mm (1.7712 – 1.7714 in.)
3	44.9820 – 44.9879 mm (1.7710 – 1.7711 in.)



2) Next, check bearing cap bore diameter without bearing. On mating surface of cylinder block, five alphabets are stamped as shown in figure.
   Three kinds of alphabets ("A", "B" and "C") or numbers ("1", "2" and "3") represent the following cap bore diameters.
   Stamped alphabets or numbers on cylinder block represent bearing cap bore diameter marked with an arrow in figure respectively. For example, stamped "A" or "1" indicates that corresponding bearing cap bore diameter is 49.0000 – 49.0060 mm (1.9292 – 1.9293 in.).

Crankshaft bearing cap bore

Stamped alphabet (number)	Bearing cap bore diameter (without bearing)
A (1)	49.0000 – 49.0060 mm (1.9292 – 1.9293 in.)
B (2)	49.0061 – 49.0120 mm (1.9294 – 1.9296 in.)
C (3)	49.0121 – 49.0180 mm (1.9297 – 1.9298 in.)



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

Standard size of crankshaft main bearing thickness

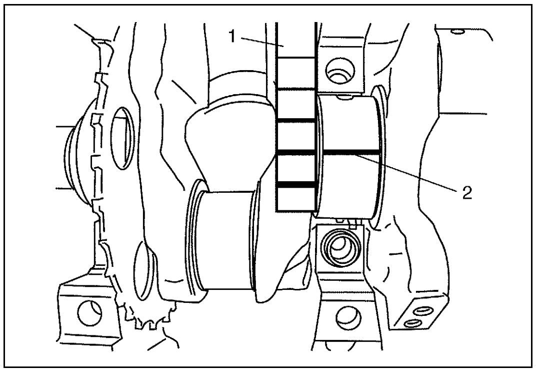
Color painted	Bearing thickness
Pink	1.990 – 1.994 mm (0.0784 – 0.0785 in.)
Purple	1.993 – 1.997 mm (0.0785 – 0.0786 in.)
Brown	1.996 – 2.000 mm (0.0786 – 0.0787 in.)
Green	1.999 – 2.003 mm (0.0787 – 0.0788 in.)
Black	2.002 – 2.006 mm (0.0789 – 0.0789 in.)

1. Paint

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

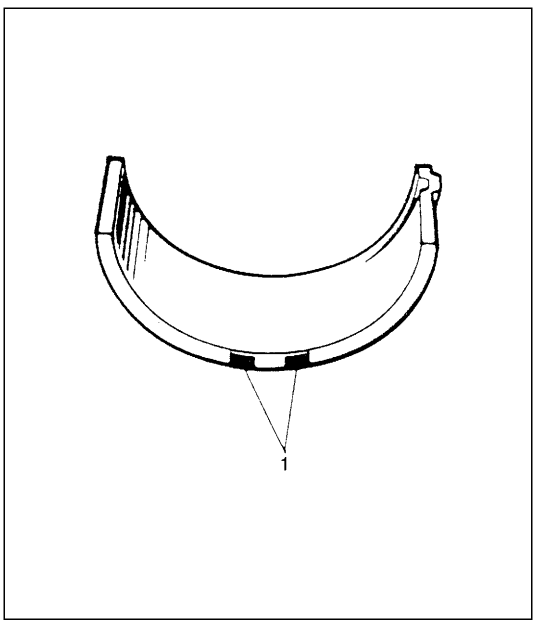
Specification of new standard crankshaft main bearing size

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



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

Undersize bearing (0.25 mm (0.0098 in.))



- 0.25 mm (0.0098 in.) undersize bearing is available, in five kinds varying in thickness.
  To distinguish them, each bearing is painted in the following colors at such position as indicated in figure.
  Each color represents the following thickness at the center of bearing.

Undersize of crankshaft main bearing thickness

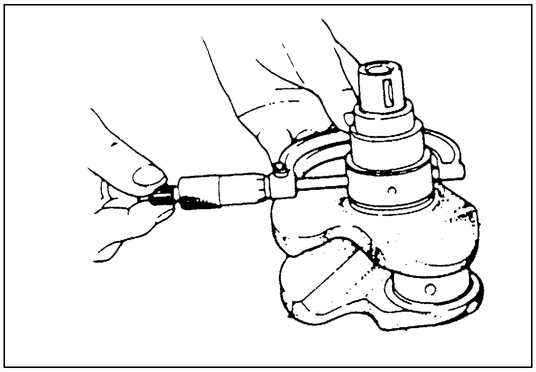
Color painted	Bearing thickness
Red and Pink	2.115 – 2.119 mm (0.08327 – 0.08342 in.)
Red and Purple	2.118 – 2.122 mm (0.08339 – 0.08354 in.)
Red and Brown	2.121 – 2.125 mm (0.08351 – 0.08366 in.)
Red and Green	2.124 – 2.128 mm (0.08363 – 0.08377 in.)
Red and Black	2.127 – 2.131 mm (0.08374 – 0.08389 in.)

1. Paint

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

1) Regrind journal to the following finished diameter.

Finished diameter
44.732 – 44.750 mm (1.7611 – 1.7618 in.)

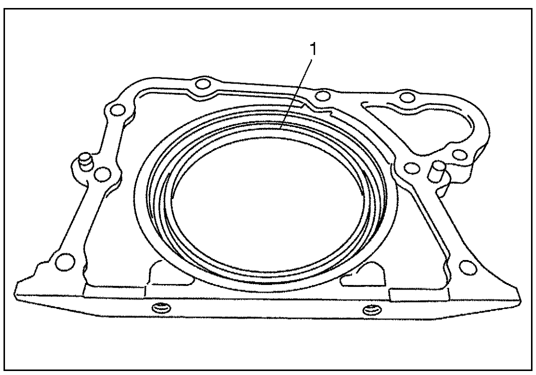


2) Using micrometer, measure reground journal diameter. Measurement should be taken in two directions perpendicular to each other in order to check for out-of-round.
3) Using journal diameter measured above and alphabets stamped on cylinder block, select an undersize bearing by referring to table given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

Specification of new standard undersize crankshaft main bearing

		Measured journal diameter		
		44.7440 – 44.7500 mm (1.7616 – 1.7618 in.)	44.7380 – 44.7439 mm (1.7614 – 1.7615 in.)	44.7320 – 44.7379 mm (1.7611 – 1.7613 in.)
Alphabets stamped on cylinder block	A (1)	Red and Pink	Red and Purple	Red and Brown
	B (2)	Red and Purple	Red and Brown	Red and Green
	C (3)	Red and Brown	Red and Green	Red and Black
		Undersize bearing to be installed		

Rear oil seal



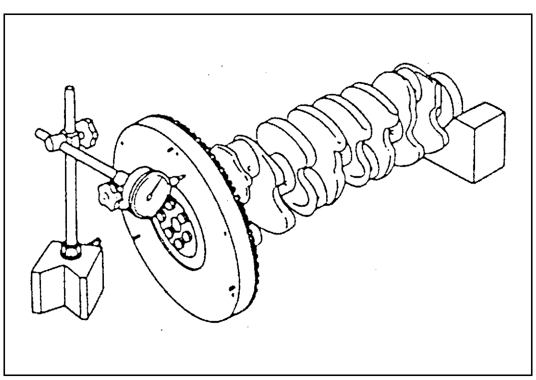
Carefully inspect oil seal (1) for wear or damage.
If its lip is worn or damaged, replace it.

Flywheel

Visual inspection

- If ring gear is damaged, cracked or worn, replace flywheel.
- If the surface contacting clutch disc is damaged, or excessively worn, replace flywheel.

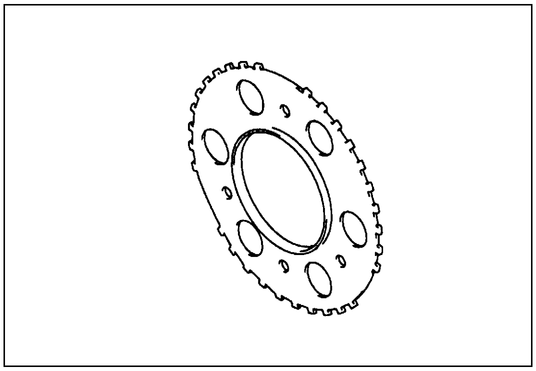
Flywheel face runout



Check flywheel face runout with a dial gauge.
If runout exceeds its limit, replace flywheel.

Flywheel face runout
Limit: 0.2 mm (0.0079 in.)

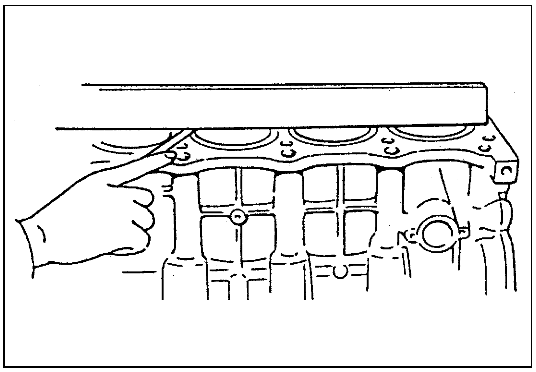
Sensor plate



Check sensor plate for crack or damage. If malcondition is found, replace it.

Cylinder block

Distortion of gasketed surface



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

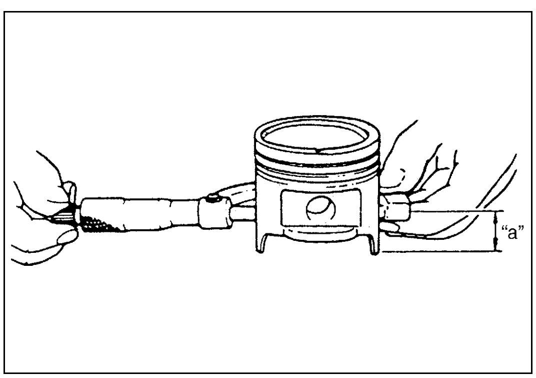
Cylinder block flatness
Limit: 0.03 mm (0.0012 in.)

Honing or reboring cylinders

1) When any cylinder needs reboring, all other cylinders must also be rebored at the same time.
2) Select oversized piston according to amount of cylinder wear.

Oversize piston diameter

Size	Piston diameter
Oversize 0.50	78.453 – 78.468 mm (3.0887 – 3.0892 in.)



3) Using micrometer, measure piston diameter.

Measurement position for piston diameter
"a": 19.5 mm (0.77 in.)

4) Rebore and hone cylinder to the following dimension.

Cylinder bore diameter to be rebored
Oversize 0.50: 78.500 – 78.514 mm (3.0906 – 3.0911 in.)

NOTE:

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

5) Measure piston clearance after honing.

Piston clearance: 0.032 – 0.061 mm (0.0013 – 0.0024 in.)

Required Service Material

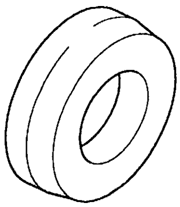
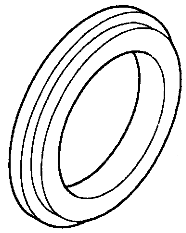
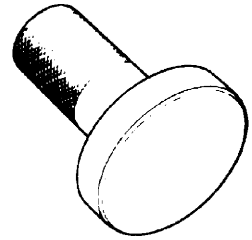
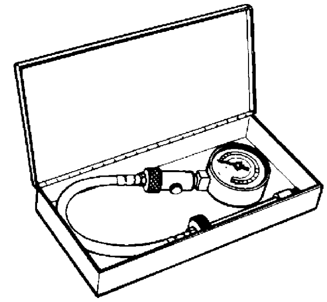
Material	Recommended SUZUKI product (Part Number)	Use
Sealant	SUZUKI BOND NO. 1207F (99000-31250)	• To apply to mating surfaces of cylinder block and oil pan. • To apply to mating surfaces of cylinder block and timing chain cover. • To apply to sealing surfaces of cylinder head cover. • To apply to mating surfaces to rear oil seal housing.
	SUZUKI BOND NO. 1207B (99000-31140)	• To apply to mating surface of cylinder block, cylinder head and timing chain cover.
	SUZUKI BOND NO. 1215 (99000-31110)	• To apply to the thread of the bolt of water outlet pipe.

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Oil pressure switch	14	1.4	10.5
Camshaft housing bolt (for tightening of special tool)	11	1.1	8.0
Camshaft housing bolt	Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft) by the specified procedure.		
Cylinder head cover bolt	Tighten 5.0 N·m (0.5 kg-m, 3.5 lb-ft), 7.5 N·m (0.75 kg-m, 5.5 lb-ft) by the specified procedure.		
Intake manifold bolt and nut	25	2.5	18.0
Throttle body mounting bolt	25	2.5	18.0
MAF sensor bolt	2.5	0.25	2.0
VSV bracket bolt	5	0.5	3.5
Exhaust manifold bolt and nut	50	5.0	36.5
Exhaust pipe No.1 bolt	50	5.0	36.5
Exhaust manifold stiffener bolt	50	5.0	36.5
Exhaust pipe No.2 bolt	43	4.3	31.5
Exhaust oxygen sensor	45	4.5	32.5
Oil pump strainer bolt	11	1.1	8.0
Oil pump strainer bracket bolt	11	1.1	8.0
Oil pan bolt and nut	11	1.1	8.0
Oil pan drain plug bolt	50	5.0	36.5
Timing chain cover mounting bolt	25	2.5	18.0
Timing chain cover mounting nut	25	2.5	18.0
Crank shaft pulley bolt	150	15.0	108.5
Oil pump rotor plate bolt	11	1.1	8.0
Timing chain guide bolt	11	1.1	8.0
Tensioner adjuster bolt	11	1.1	8.0
Venturi plug	5	0.5	3.5
Cylinder head bolt for M8	25	2.5	18.0

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Cylinder head bolt for M10	Tighten 20 N·m (2.0 kg-m, 14.5 lb-ft), 40 N·m (4.0 kg-m, 29.0 lb-ft), 60° and 60° by the specified procedure.		
Bearing cap nut	Tighten 15 N·m (1.5 kg-m, 11.0 lb-ft), 45° and 45° by the specified procedure.		
Engine mounting bolt for M8	25	2.5	18.0
Engine mounting bolt and nut for M10	55	5.5	40.0
Engine right mounting nut	65	6.5	47.0
Main bearing cap No.1 bolt	Tighten 30 N·m (3.0 kg-m, 22.0 lb-ft), 50 N·m (5.0 kg-m, 36.5 lb-ft) and 60° by the specified procedure.		
Main bearing cap No.2 bolt	Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft) by the specified procedure.		
Sensor plate bolt	11	1.1	8.0
Rear oil seal housing bolt	11	1.1	8.0
Flywheel mounting bolt	70	7.0	51.0
Oil filter adapter bolt	25	2.5	18.0
Clutch housing lower plate bolt	50	5.0	36.5
Timing chain tensioner bolt	25	2.5	18.0
Oil gallery pipe No.1 bolt	30	3.0	21.5
Oil gallery pipe No.2 bolt	11	1.1	8.0
Oil gallery pipe No.3 bolt	11	1.1	8.0
Oil control valve mounting nut	11	1.1	8.0
Water outlet cap bolt	25	2.5	18.0
Intake camshaft sprocket bolt	60	6.0	43.0

Special Tool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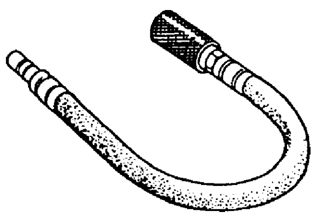
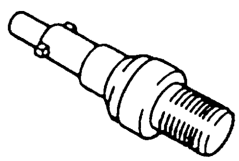
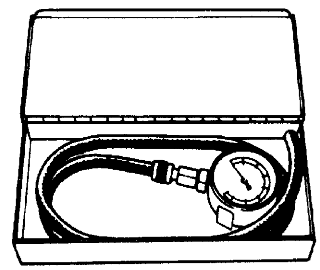
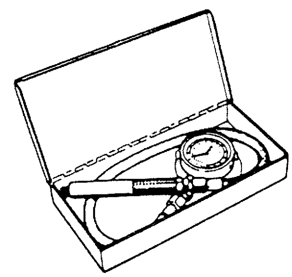
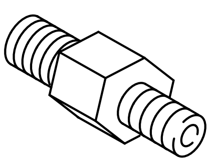
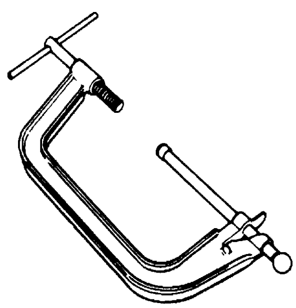
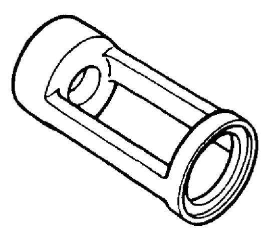
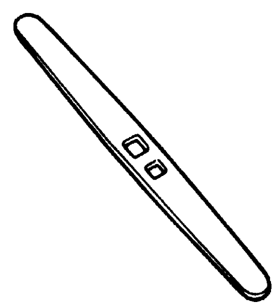
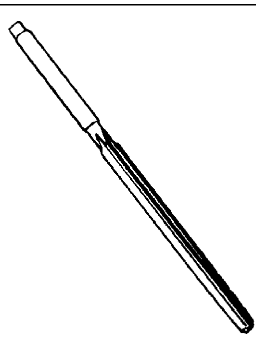
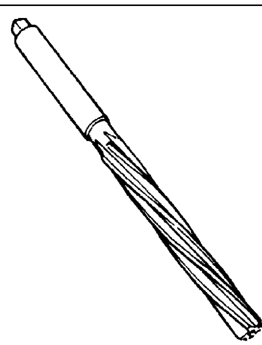
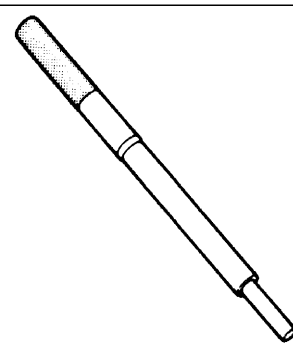
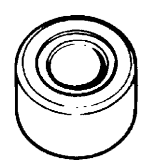
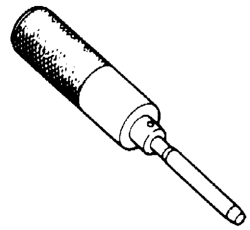
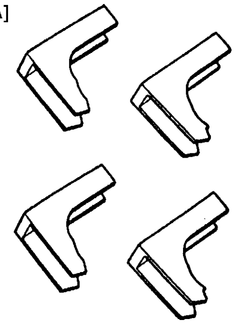
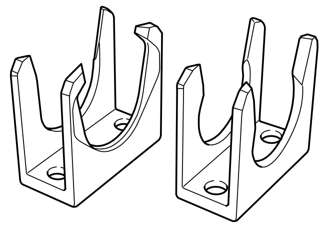
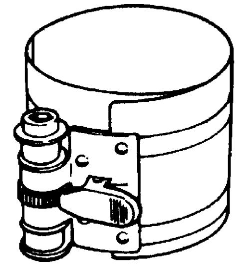
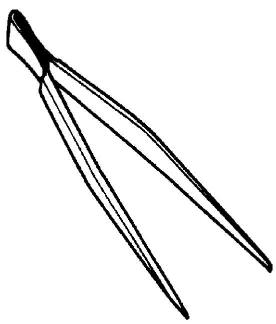
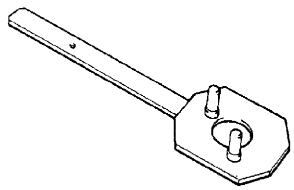
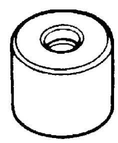
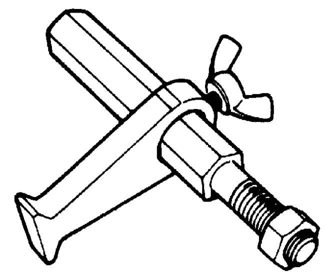
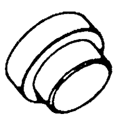
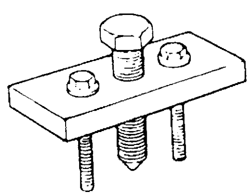
			
09915-64530 Hose	09915-67010 Attachment	09915-67311 Vacuum gauge	09915-77310 Oil pressure gauge
			
09915-78211 Oil pressure gauge attach- ment	09916-14510 Valve lifer	09916-14521 Valve lifer attachment	09916-34542 Reamer handle
			
09916-34550 Reamer (5.5 mm)	09916-37320 Reamer (10.5 mm)	09916-44910 Valve guide remover	09916-56011 Valve guide installer

 09916-58210 Valve guide installer handle	[A]  09916-67020 Tappet holder See NOTE below	[B]  09916-67021 Tappet holder	 09916-77310 Piston ring compressor
 09916-84511 Forceps	 09917-68221 Camshaft lock holder	 09917-98221 Valve stem seal installer	 09924-17810 Flywheel holder
 09926-58010 Bearing puller attachment	 09944-36011 Steering wheel remover		

NOTE:

[A] and [B] tools in the above table are interchangeable.

SECTION 6B2

ENGINE COOLING (M13 ENGINE)

CONTENTS

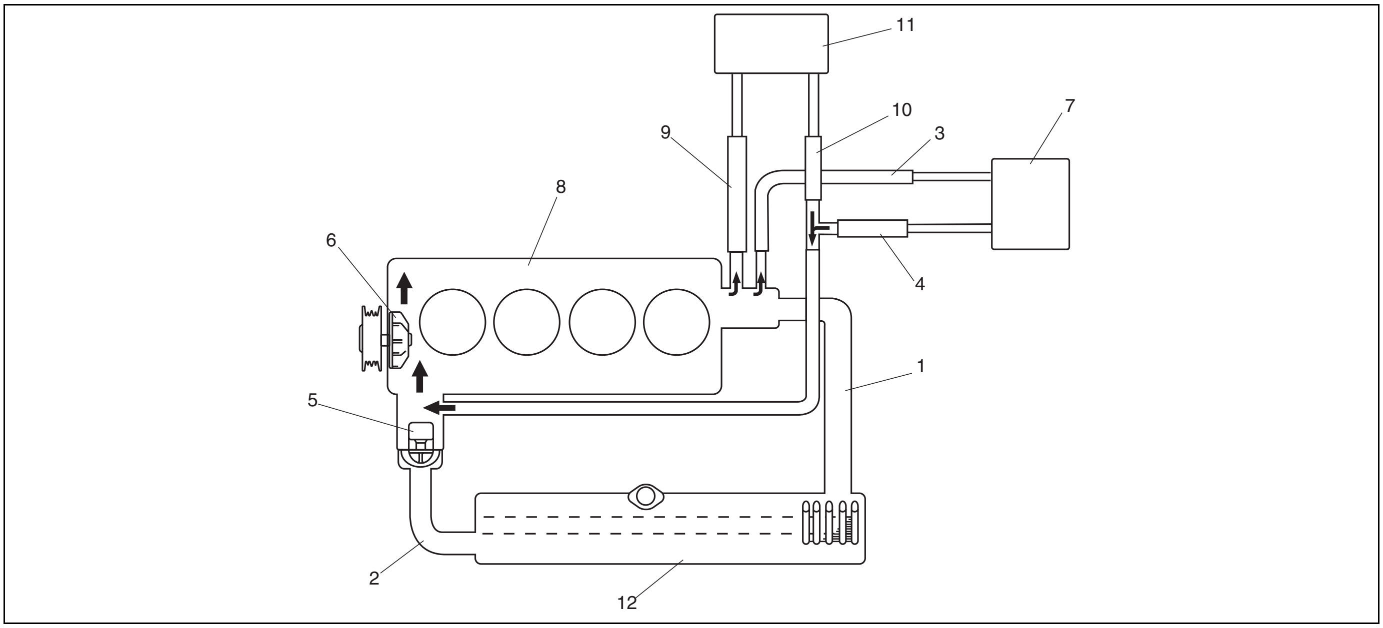
6B2

General Description

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

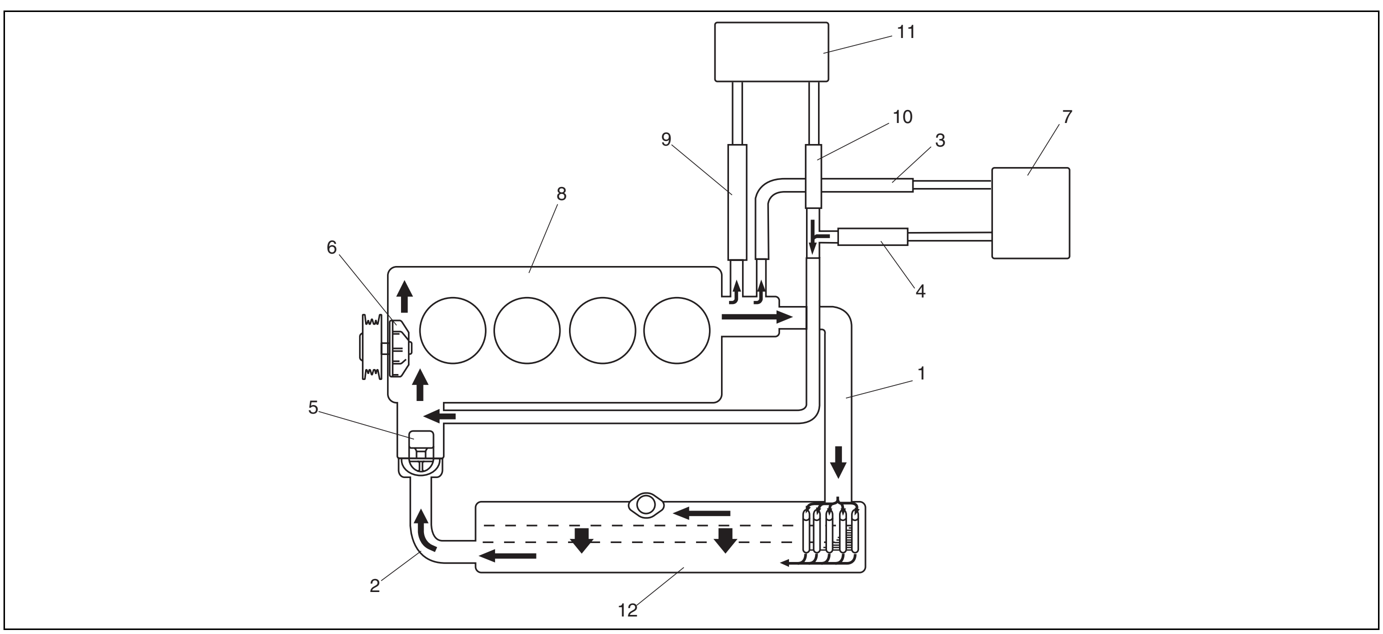
Cooling System Circulation

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



1. Radiator inlet hose	5. Thermostat	9. Heater core inlet hose
2. Radiator outlet hose	6. Water pump	10. Heater core outlet hose
3. Throttle body inlet hose	7. Throttle body	11. Heater core
4. Throttle body outlet hose	8. Engine	12. Radiator

When coolant is warmed up to normal temperature and the thermostat opens, coolant passes through the radiator core to be cooled as follows.



1. Radiator inlet hose	5. Thermostat	9. Heater core inlet hose
2. Radiator outlet hose	6. Water pump	10. Heater core outlet hose
3. Throttle body inlet hose	7. Throttle body	11. Heater core
4. Throttle body outlet hose	8. Engine	12. Radiator

Coolant

The coolant recovery system is standard. The coolant in the radiator expands with heat, and the coolant is overflowed to the reservoir.
When the system cools down, the coolant is drawn back into the radiator.

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

This 50/50 mixture coolant solution provides freezing protection to –36°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.**
- **Coolant must be mixed with demineraled water or distilled water.**

Anti-freeze proportioning table

		For M/T model	For A/T model
Freezing temperature	°C	–36	–36
	°F	–33	–33
Anti-freeze/Anti-corrosion coolant concentration	%	50	50
Ratio of compound to cooling water	ltr.	2.80/2.80	2.70/2.70
	US pt.	5.97/5.97	5.76/5.76
	Imp pt.	4.93/4.93	4.75/4.75

Coolant capacity

	For M/T model	For A/T model
Engine radiator and heater	5.0 liters (10.67/8.80 US/Imp. pt.)	4.8 liters (10.24/8.45 US/Imp. pt.)
Reservoir	0.6 liters (1.28/1.06 US/Imp. pt.)	0.6 liters (1.28/1.06 US/Imp. pt.)
Total	5.6 liters (11.94/9.86 US/Imp. pt.)	5.4 liters (11.52/9.51 US/Imp. pt.)

Diagnosis

Diagnosis Table

Condition	Possible Cause	Correction
Engine overheats (It is in case that radiator fan operates)	Loose or broken water pump belt	Adjust or replace.
	Not enough coolant	Check coolant level and add as necessary.
	Faulty thermostat	Replace.
	Faulty water pump	Replace.
	Dirty or bent radiator fins	Clean or remedy.
	Coolant leakage on cooling system	Repair.
	Clogged radiator	Check and replace radiator as necessary.
	Faulty radiator cap	Replace.
	Improper ignition timing	Adjust.
	Dragging brakes	Adjust brake.
	Slipping clutch	Adjust or replace.
	Poor charge battery	Check and replace as necessary.
	Poor generation generator	Check and repair.
	Wiring or grounding faulty	Repair and necessary.
	Equipped with too much electric load part(s)	Dismount.
	Radiator cooling fan motor faulty	Check and replace as necessary.
Engine overheats (It is in case that radiator fan won't operates)	Fuse blown	Check 30A fuse of relay/fuse box and check for short circuit to ground.
	Radiator cooling fan relay faulty	Check and replace as necessary.
	ECT sensor faulty	Check and replace as necessary.
	Radiator cooling fan motor faulty	Check and replace as necessary.
	Wiring or grounding faulty	Repair as necessary
	ECM faulty	Check and replace as necessary.

System Circuit Inspection

Refer to “Table B-7 Radiator Fan Control System Check” in Section 6-2

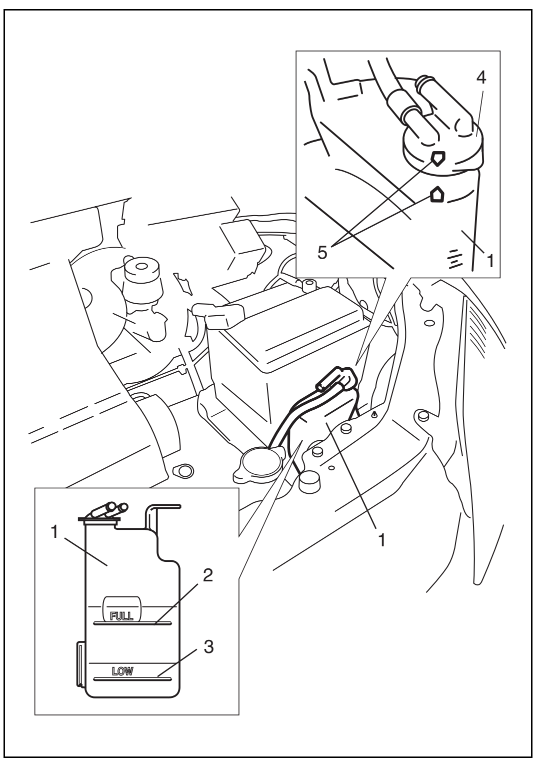
Maintenance

WARNING:
- **Do not remove radiator cap to check engine coolant level; check coolant visually at the see-through coolant reservoir.**
  Coolant should be added only to reservoir as necessary.
- **As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the radiator cap while engine is hot and pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the solution over engine, fenders and person removing cap. If the solution contains flammable anti-freeze such as alcohol (not recommended for use at any time), there is also the possibility of causing a serious fire.**

Coolant Level Check

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 radiator cap is taken off too soon.

To check level, lift hood and look at “see-through” coolant reservoir.
It is not necessary to remove radiator cap to check coolant level.



When engine is cool, check coolant level in reservoir (1).
A normal coolant level should be between “FULL” mark (2) and “LOW” mark (3) on reservoir (1).
If coolant level is below “LOW” mark (3), remove reservoir cap (4) and add proper coolant to reservoir to bring coolant level up to “FULL” mark (2). Then, reinstall cap (4) and align match marks (5) on reservoir and cap (4).

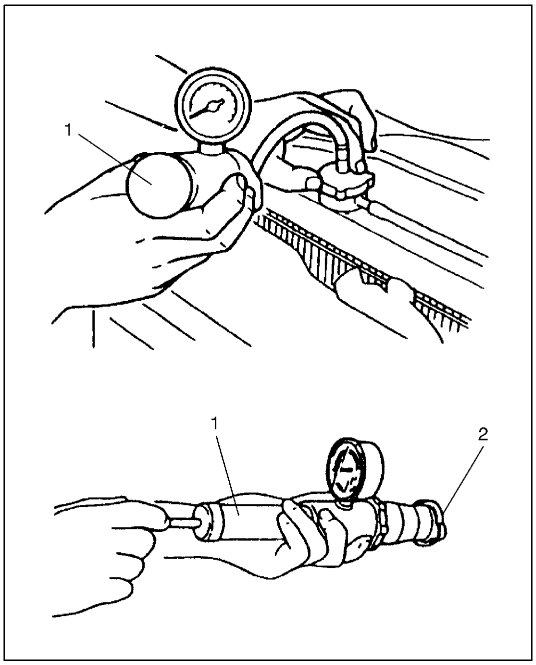
NOTE:
- **If proper quality antifreeze is used, there is no need to add extra inhibitors or additives that claim to improve system.**
  They may be harmful to proper operation of system, and are unnecessary expense.
- **When installing reservoir cap, align arrow marks (5) on reservoir and cap.**

Engine Cooling System Inspection and Service

WARNING:

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

1) Check cooling system for leakage or damage.
2) Wash radiator cap and filler neck with clean water by removing radiator cap when engine is cold.
3) Check coolant for proper level and freeze protection.



4) Using a pressure tester (1), check system and radiator cap (2) for proper pressure holding capacity.
   If replacement of cap is required, use a proper cap for this vehicle.

Cooling system and radiator cap holding pressure (for inspection)
: 110 kPa (1.1 kg/cm^2, 15.6 psi)

NOTE:

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

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

Cooling System Flush and Refill

WARNING:

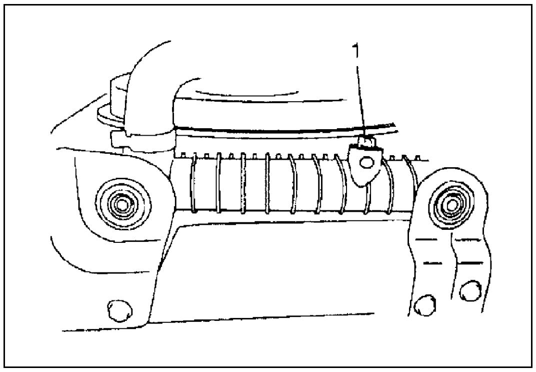
To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot.
Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.

NOTE:

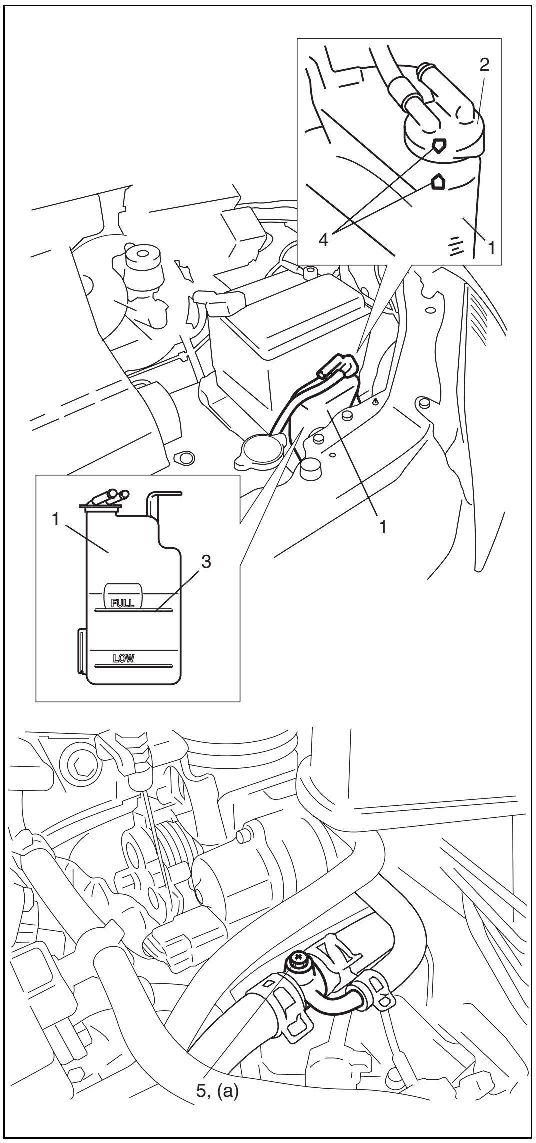
For detail of coolant specification, refer to "Coolant" in this section.

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

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 from radiator drain plug (1).
4) Close radiator drain plug (1). 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) Close radiator drain plug (1) tightly.



7) Remove reservoir (1), and remove cap (2) from reservoir (1).
8) Pour out any fluid, scrub and clean inside of reservoir with soap and water.
   Flush it well with clean water and drain. Reinstall reservoir.
9) Fill reservoir with coolant up to "Full" level mark (3).
10) Install reservoir cap (2) and align match marks (4) on reservoir and its cap.
11) Loosen air ventilation bolt (5) one and a half turns.
12) Fill radiator with coolant up to spilling coolant from air ventilation bolt (5).
13) Tighten air ventilation bolt (5) to specified torque.

Tightening torque
Air ventilation bolt (a): 4.5 N·m (0.45 kg-m, 3.5 lb-ft)

14) Fill radiator with coolant up to bottom of radiator filler neck and install radiator cap, making sure that the ear of cap lines is parallel to radiator.
15) Run engine at idle speed.
16) Loosen air ventilation bolt (5) one and a half turns.
17) Run engine at 2000-3000 rpm, and tighten air ventilation bolt (5) to specified torque after spilling coolant from air ventilation bolt (5).

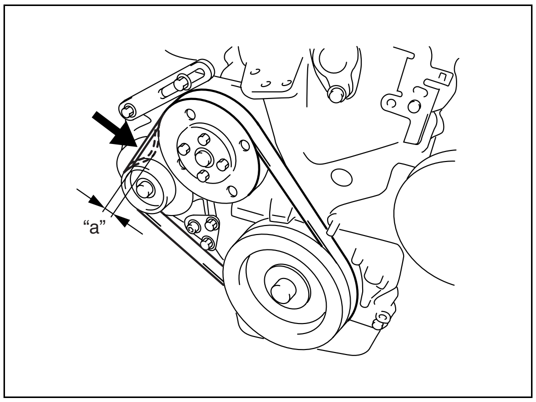
Tightening torque
Air ventilation bolt (a): 4.5 N·m (0.45 kg-m, 3.5 lb-ft)

18) Run engine until radiator fan motor is operated.
19) Stop engine and wait until engine comes cooled down to help avoid danger of being burned.
20) Add coolant to radiator up to bottom of radiator filler neck, and install radiator cap, making sure that the ear of cap lines is parallel to radiator.
21) Repeat step 15) through 20).
22) Confirm that reservoir coolant level is "Full" level mark (3). If coolant is insufficient, repeat step 9) and 10).

Water Pump/Generator Drive Belt Tension Inspection and Adjustment

WARNING:
- **Disconnect negative cable at battery before checking and adjusting belt tension.**
- **To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.**

1) Inspect belt for cracks, cuts, deformation, wear and cleanliness. If it is necessary to replace belt, refer to "Water Pump/ Generator Drive Belt Removal and Installation" in this section.

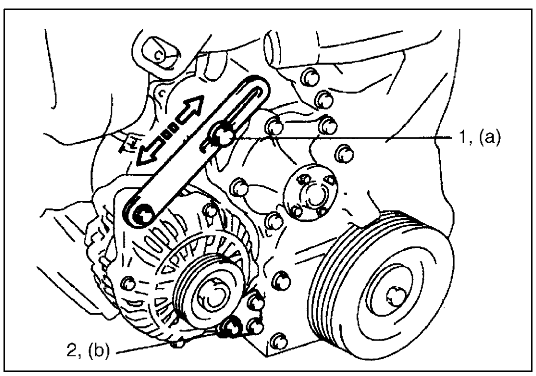


2) Check belt for tension. Belt is in proper tension when it deflects the following specification under thumb pressure (about 10 kg or 22 lb.).

Water pump / generator drive belt tension "a"
4.5 – 5.5 mm (0.18 – 0.22 in.) as deflection/10 kg (22 lbs)

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

3) If belt is too tight or too loose, adjust it to proper tension by displacing generator position.



4) Tighten generator adjusting bolt (1) and pivot bolts (2) as specified torque.

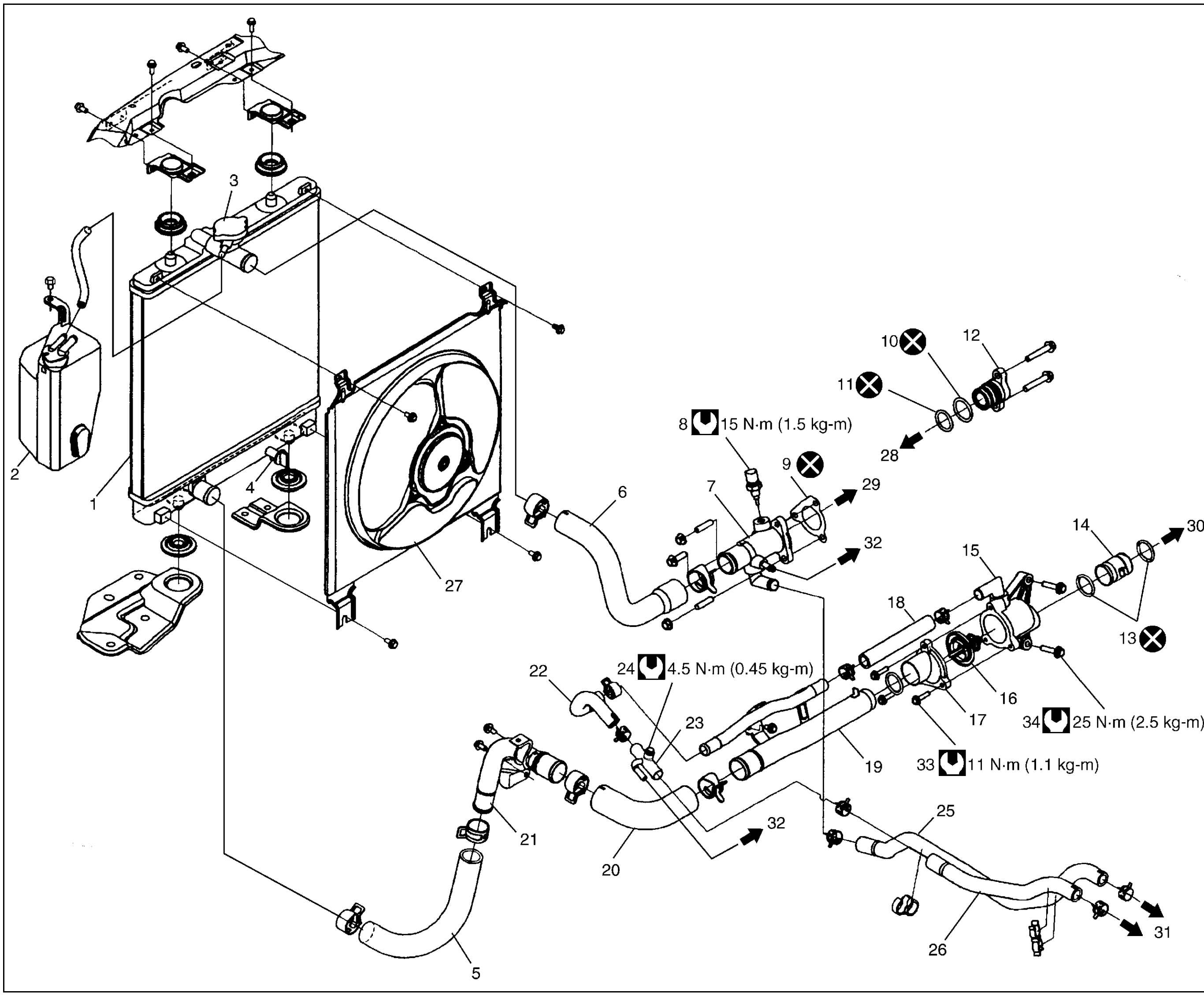
Tightening torque
Generator adjusting bolt (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)
Generator pivot bolt (b): 50 N·m (5.0 kg-m, 36.0 lb-ft)

5) Connect negative cable at battery.

On-Vehicle Service

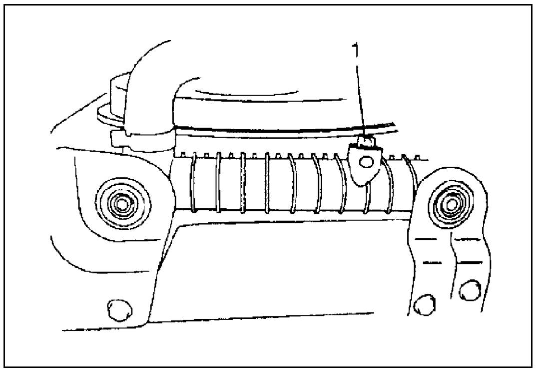
WARNING:
- **Check to make sure that engine coolant temperature is cold before removing any part of cooling system.**
- **Also be sure to disconnect negative cord from battery terminal before removing any part.**

Cooling System Components



1. Radiator	13. O-ring	25. Heater core inlet hose
2. Reservoir	14. Thermostat case water outlet pipe	26. Heater core outlet hose
3. Radiator cap	15. Thermostat case	27. Radiator cooling fan assembly
4. Drain plug	16. Thermostat	28. To timing chain cover
5. Radiator outlet hose	17. Thermostat cap	29. To cylinder head
6. Radiator inlet hose	18. Water bypass hose	30. To water pump
7. Water outlet cap	19. Water inlet pipe No.1	31. To heater core
8. ECT sensor	20. Water inlet hose	32. To throttle body
9. Gasket	21. Water inlet pipe No.2	33. Thermostat cap bolt
10. Water outlet cap O-ring No.1	22. Heater outlet hose No.2	34. Thermostat case bolt
11. Water outlet cap O-ring No.2	23. Heater union	Tightening torque
12. Water outlet plug	24. Air ventilation bolt	Do not reuse.

Cooling System Draining

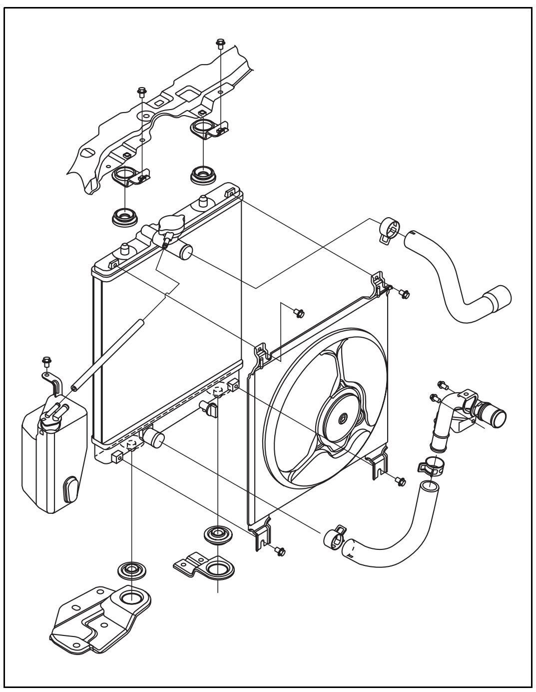


1) Remove radiator cap.
2) Drain coolant from radiator drain plug (1).
3) After draining coolant, be sure to tighten drain plug (1) securely.

Cooling System Refill

Refer to step 7) to 22) of "Cooling System Flush and Refill" in this section.

Cooling Water Pipes or Hoses



Removal

1) Drain coolant referring to "Cooling System Draining" in this section.
2) To remove these pipes or hoses, loosen clamp on each hose and pull hose end off.

Installation

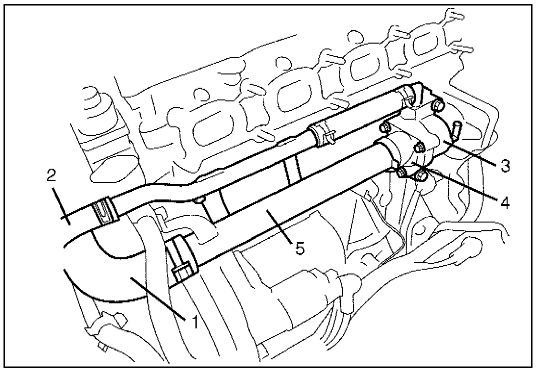
Install removed parts in reverse order of removal procedure, noting the following.

- Tighten each clamp securely.
- Refill cooling system referring to step 7) to 22) of "Cooling System Flash and Refill" in this section.

Thermostat Removal and Installation

Removal

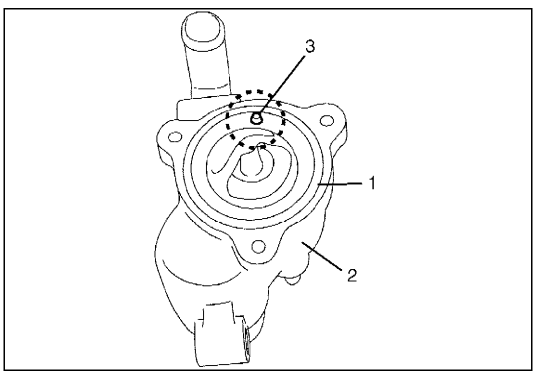
1) Drain coolant referring to “Cooling System Draining” in this section.
2) Remove intake manifold referring to “Intake Manifold Removal and Installation” in Section 6A2.
3) Remove generator referring to “Generator Dismounting and Remounting” in Section 6H.



4) Disconnect water hose (1) and heater hose (2) from each pipe.
5) Remove thermostat case (3) with thermostat cap (4) and water inlet pipe (5).
6) Remove water inlet pipe (5) with thermostat cap (4) from thermostat case.
7) Remove thermostat.

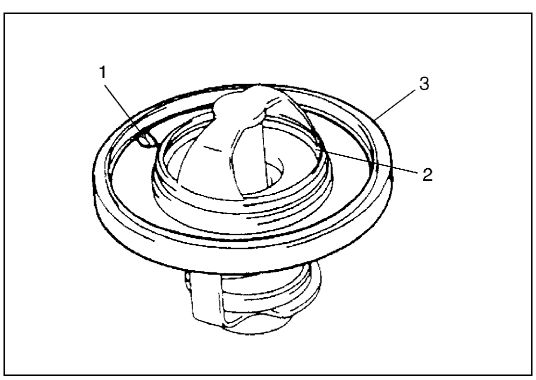
Installation

Reverse removal procedure for installation noting the following points.

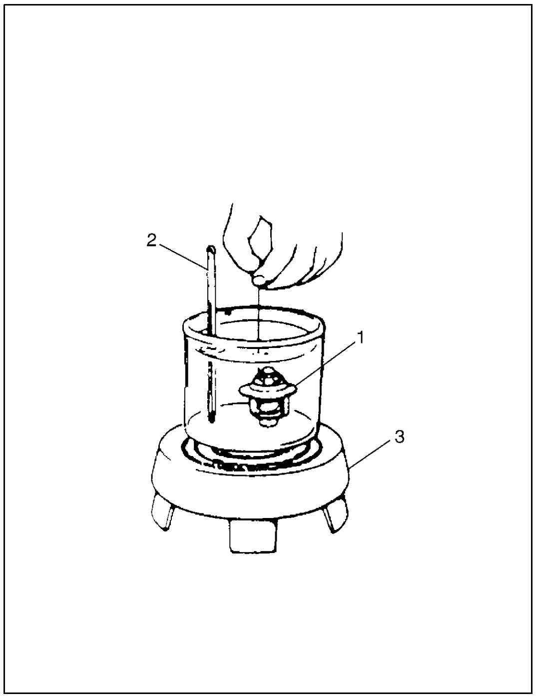


- When positioning thermostat (1) on thermostat case (2), be sure to position it so that jiggle valve (3) comes at position as shown in figure.
- Use new O-rings when installing.
- Adjust water pump belt tension referring to “Water Pump/ Generator Drive Belt Tension Inspection and Adjustment” in this section.
- Adjust A/C compressor belt tension (if equipped) referring to “Compressor Drive Belt Inspection and Adjustment” in Section 1B.
- Refill cooling system referring to step 7) to 22) of “Cooling System Flush and Refill” in this section.
- Verify that there is no coolant leakage at each connection.

Thermostat Inspection



- Make sure that jiggle valve (1) of thermostat is clean. Should this valve be clogged, engine would tend to overheat.
- Check to make sure that valve seat (2) is free from foreign matters which would prevent valve from seating tight.
- Check thermostat seal (3) for breakage, deterioration or any other damage.



- Check thermostatic movement of wax pellet as follows:

a) Immerse thermostat (1) in water, and heat water gradually as shown.
b) Check that valve starts to open at specific temperature.

Temperature at which valve begins to open
: 80 – 84°C (176 – 183°F)
Temperature at which valve become fully open
: 95 – 97°C (203°F)
Valve lift
: More than 8 mm (0.315 in.) at 95°C (203°F)

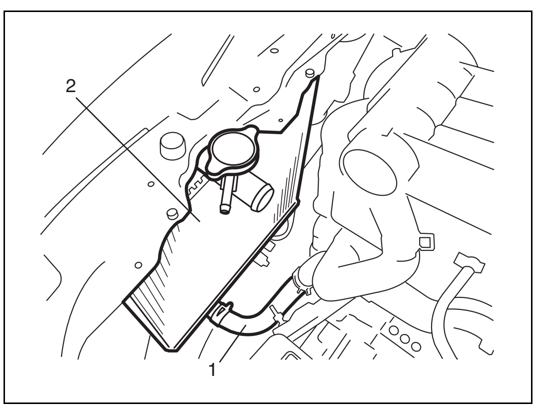
If valve starts to open at a temperature substantially below or above specific temperature, thermostat unit should be replaced with a new one. Such a unit, if reused, will bring about overcooling or overheating tendency.

2.	Thermometer
3.	Heater

Radiator Removal and Installation

Removal

1) Disconnect negative cable at battery.
2) Drain cooling system referring to "Cooling System Draining" in this section.
3) Remove cooling fan assembly referring to "Radiator Cooling Fan Removal and Installation" in this section.



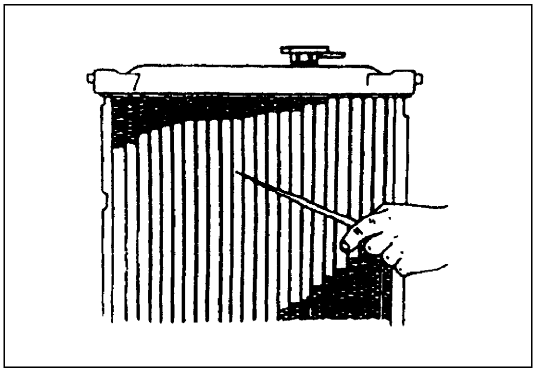
4) Remove radiator outlet hose (1) from radiator (2).
5) Remove radiator (2) from vehicle.

Installation

Reverse removal procedures noting the followings.

- Refill cooling system referring to step 7) to 22) of "Cooling System Flush and Refill" in this section.
- After installation, check each joint for leakage.

Radiator Inspection



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

Radiator Cleaning

Clean frontal area of radiator cores.

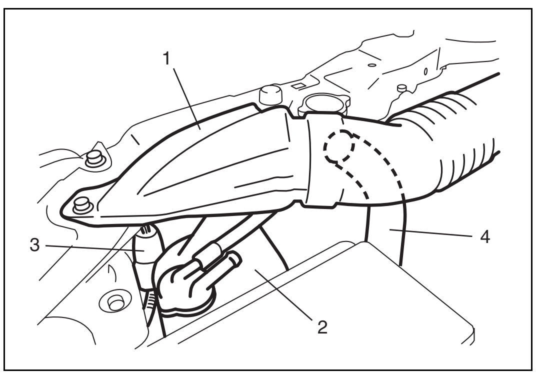
Radiator Cooling Fan Relay Inspection

Refer to “Main Relay, Fuel Pump Relay and Radiator Fan Relay” in Section 6E2.

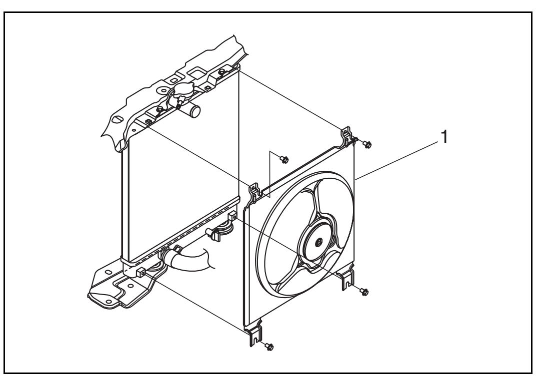
Radiator Cooling Fan Removal and Installation

Removal

1) Disconnect negative cable at battery.
2) Drain coolant referring to “Cooling System Draining” in this section.



3) Remove air cleaner suction pipe (1) and reservoir (2).
4) Disconnect cooling fan motor connector (3).
5) Remove radiator inlet hose (4) from radiator.



6) Remove radiator cooling fan motor (1) from radiator.

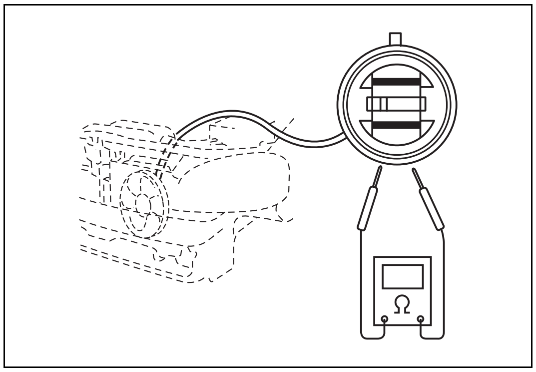
Installation

Reverse removal procedure for installation noting the following.

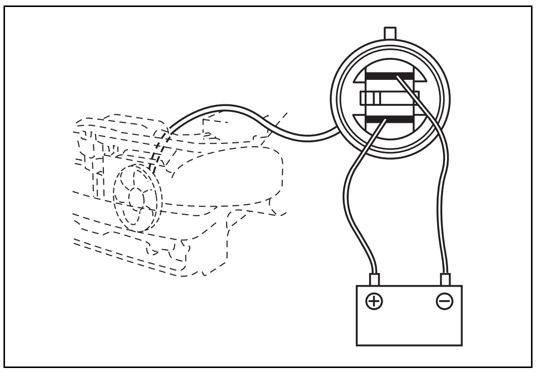
- Refill cooling system referring to step 7) to 18) of “Cooling System Flush and Refill” in this section.
- After installation, verify there is no coolant leakage at each connection.

Radiator Cooling Fan Inspection

For M/T vehicle



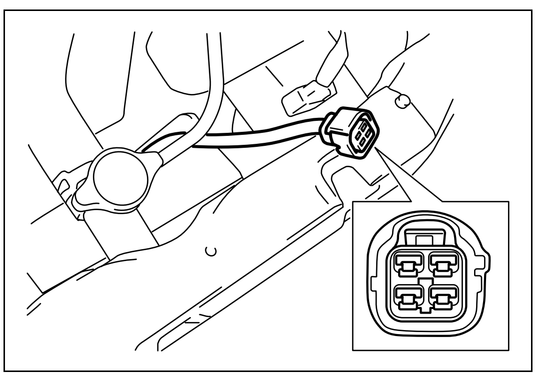
1) Check continuity between terminals. If there is no continuity, replace radiator fan motor.



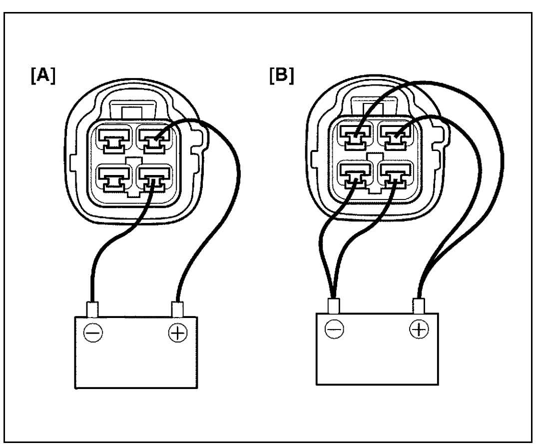
2) Connect battery to radiator fan motor coupler as shown in figure, then check that the radiator fan motor operates smoothly. If radiator fan motor does not operate smoothly, replace motor.

Radiator cooling fan motor specified current at 12 V
10.0 A maximum

For A/T vehicle



1) Check continuity between terminals.
If there is no continuity, replace radiator fan motor.



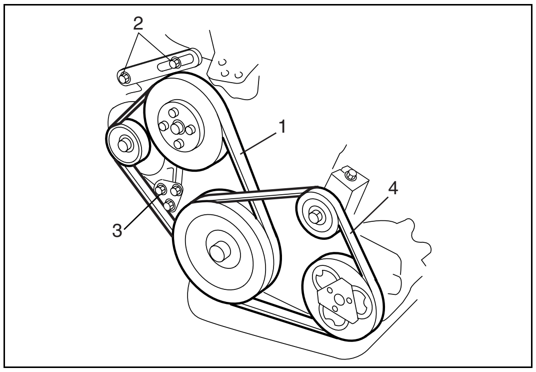
2) Connect battery to radiator fan motor coupler as shown in figure, then check that the radiator fan motor operates smoothly, fan speed varies and that specified current.
If radiator fan motor does not operate smoothly, replace motor.

Radiator cooling fan motor specified current at 12 V
LOW: 10 A maximum
HIGH: 15 A maximum

[A]:	LOW
[B]:	HIGH

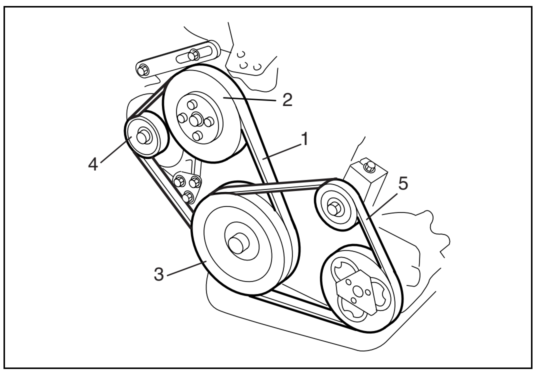
Water Pump/Generator Drive Belt Removal and Installation

Removal



1) Disconnect negative cable at battery.
2) If vehicle equipped with A/C, remove compressor drive belt (4) before removing water pump belt (1).
   Refer to "Compressor Drive Belt Removal and Installation" in Section 1B.
3) Loosen drive belt adjusting bolt (2) and generator pivot bolt (3).
4) Slacken belt by displacing generator and then remove it.

Installation

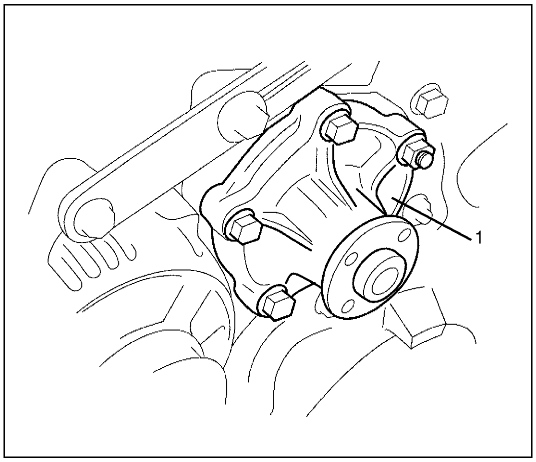


1) Install belt (1) to water pump pulley (2), crankshaft pulley (3) and generator pulley (4).
2) Adjust belt tension by referring to "Water Pump/Generator Drive Belt Tension Inspection and Adjustment" in this section.
3) If vehicle equipped with A/C, install compressor drive belt (5) referring to "Compressor Drive Belt Removal and Installation" in Section 1B.
4) Connect negative cable at battery.

Water Pump Removal and Installation

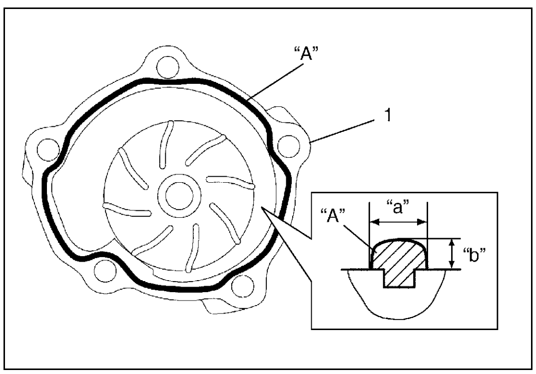
Removal

1) Disconnect negative cable at battery.
2) Drain coolant referring to “Cooling System Draining” in this section.
3) Remove water pump/generator drive belt referring to “Water Pump/Generator Drive Belt Removal and Installation” in this section.



4) Remove water pump assembly (1).

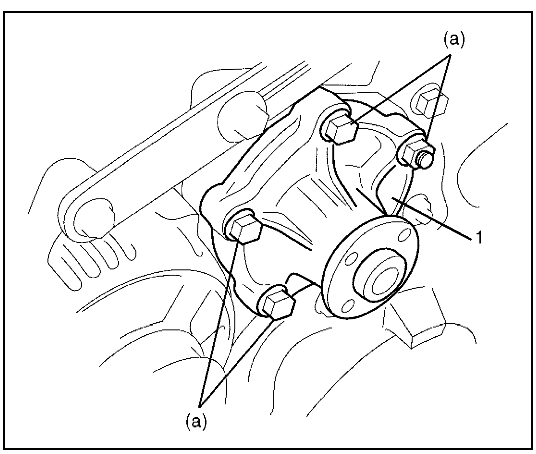
Installation



1) Apply sealant to mating surface of water pump (1) as shown in figure.

“A”: Sealant 99000-31250

Sealant quantity (to mating surface of water pump)
Width “a”: 3mm (0.12 in.)
Height “b”: 2mm (0.08 in.)



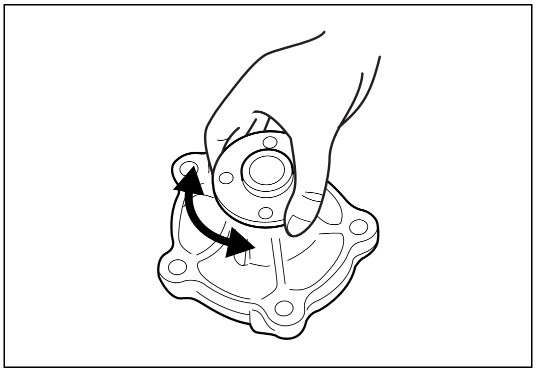
2) Install water pump assembly (1) to cylinder block and tighten bolts and nut to specified torque.

Tightening torque
Water pump bolt and nut (a): 22 N·m (2.2 kg-m, 16.0 lb-ft)

3) Install water pump pulley.
4) Install water pump/generator drive belt referring to “Water Pump/Generator Drive Belt Removal and Installation” in this Section.
5) Install A/C compressor belt (if equipped) referring to “Compressor Drive Belt Removal and Installation” in Section 1B.
6) Refill cooling system referring to step 7) to 22) of “Cooling System Flush and Refill” in this section.
7) Connect negative cable at battery.
8) Check each part for leakage.

Water Pump Inspection

CAUTION:
Do not disassemble water pump.
If any repair is required on pump, replace it as assembly.



- Rotate water pump by hand to check for smooth operation. If pump does not rotate smoothly or makes abnormal noise, replace it.

Engine Coolant Temperature Sensor (ECT Sensor) Removal and Installation

Refer to "Engine Coolant Temperature Sensor (ECT Sensor) Removal and Installation" in Section 6E2.

Engine Coolant Temperature Sensor (ECT Sensor) Inspection

Refer to "Engine Coolant Temperature Sensor (ECT Sensor)" in Section 6E2.

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Ethylene glycol base coolant (Anti-freeze/ Anti-corrosion coolant)	—	Additive to engine cooling system for improving cooling efficiency and for protection against rusting.
Water tight sealant	SUZUKI BOND NO. 1207F (99000-31250)	To apply to mating surface of water pump

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
ETC sensor	15	1.5	11.0
Air ventilation bolt	4.5	0.45	3.5
Thermostat cap bolt	11	1.1	8.0
Thermostat case bolt	25	2.5	18.0
Generator adjusting bolt	23	2.3	17.0
Generator pivot bolt	50	5.0	36.5
Water pump bolt and Nut	22	2.2	16.0

SECTION 6E2

ENGINE AND EMISSION CONTROL SYSTEM (M13 ENGINE)

WARNING:

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

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

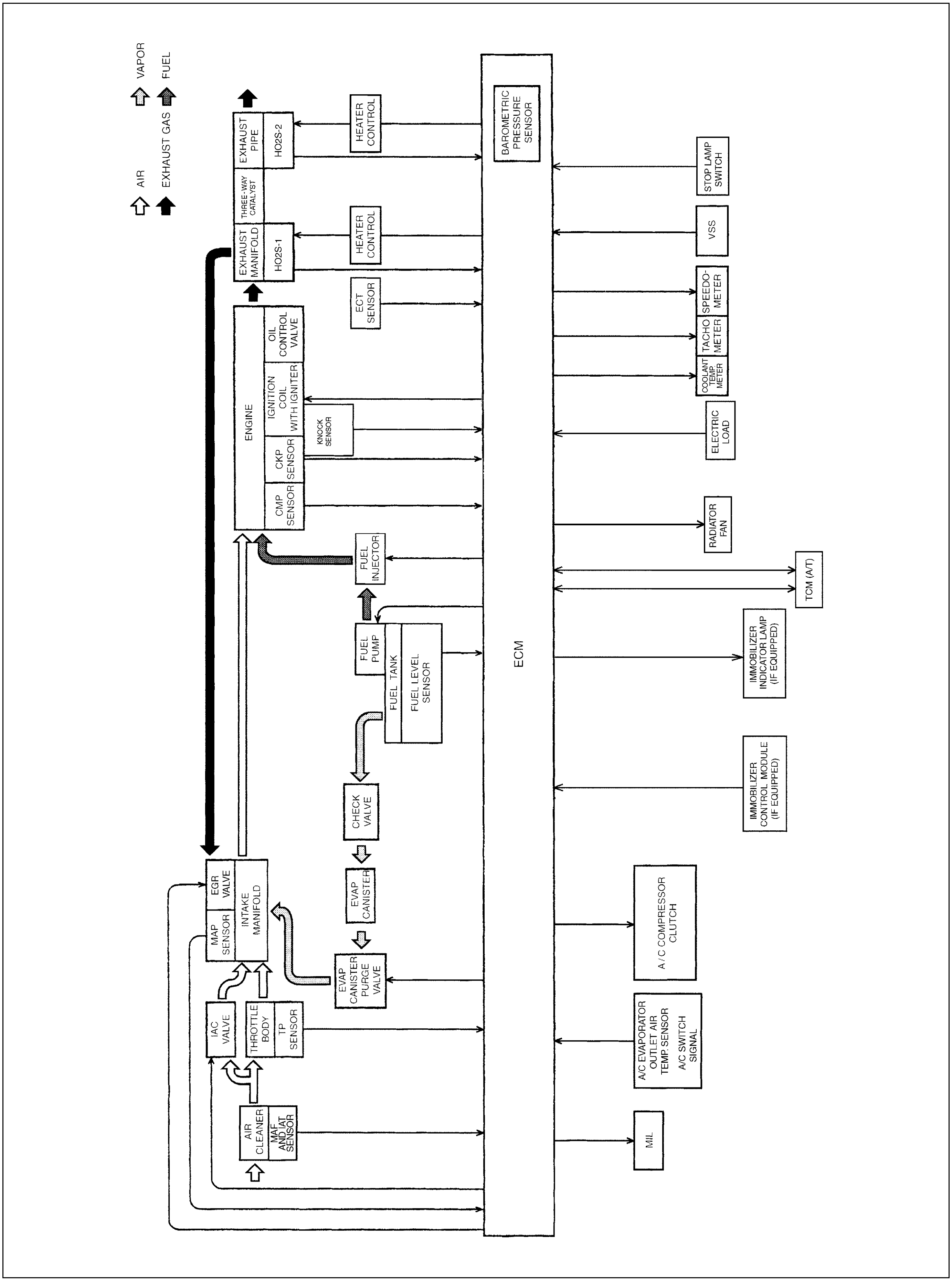
CONTENTS

General Description

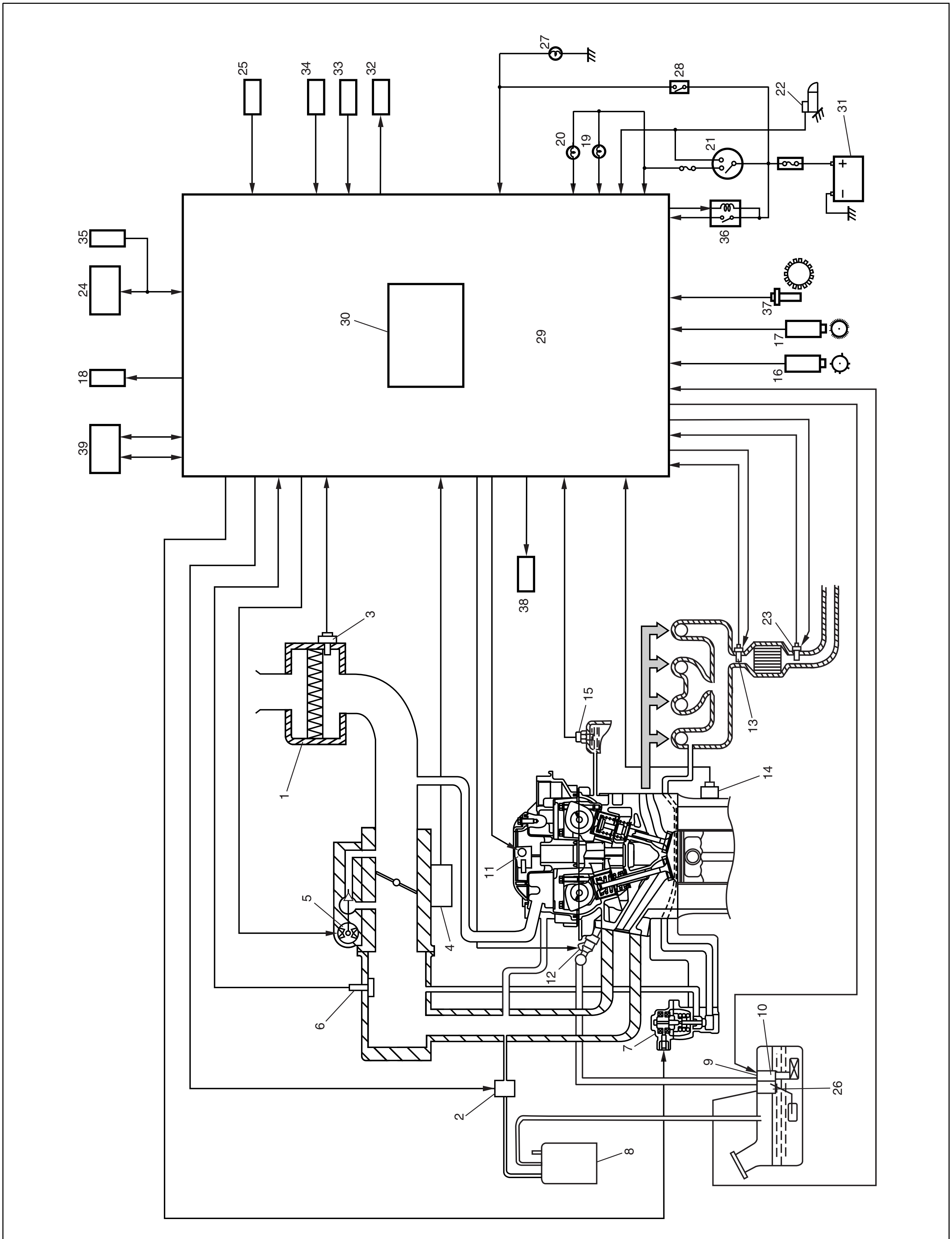
Engine and Emission Control System Construction

The engine and emission control system is divided into 4 major sub-systems: air intake system, fuel delivery system, electronic control system and emission control system.
Air intake system includes air cleaner, throttle body, IAC valve and intake manifold.
Fuel delivery system includes fuel pump, delivery pipe, etc. Electronic control system includes ECM, various sensors and controlled devices.
Emission control system includes EGR, EVAP and PCV system.

Engine and Emission Control System Flow Diagram



Engine and Emission Control System Diagram

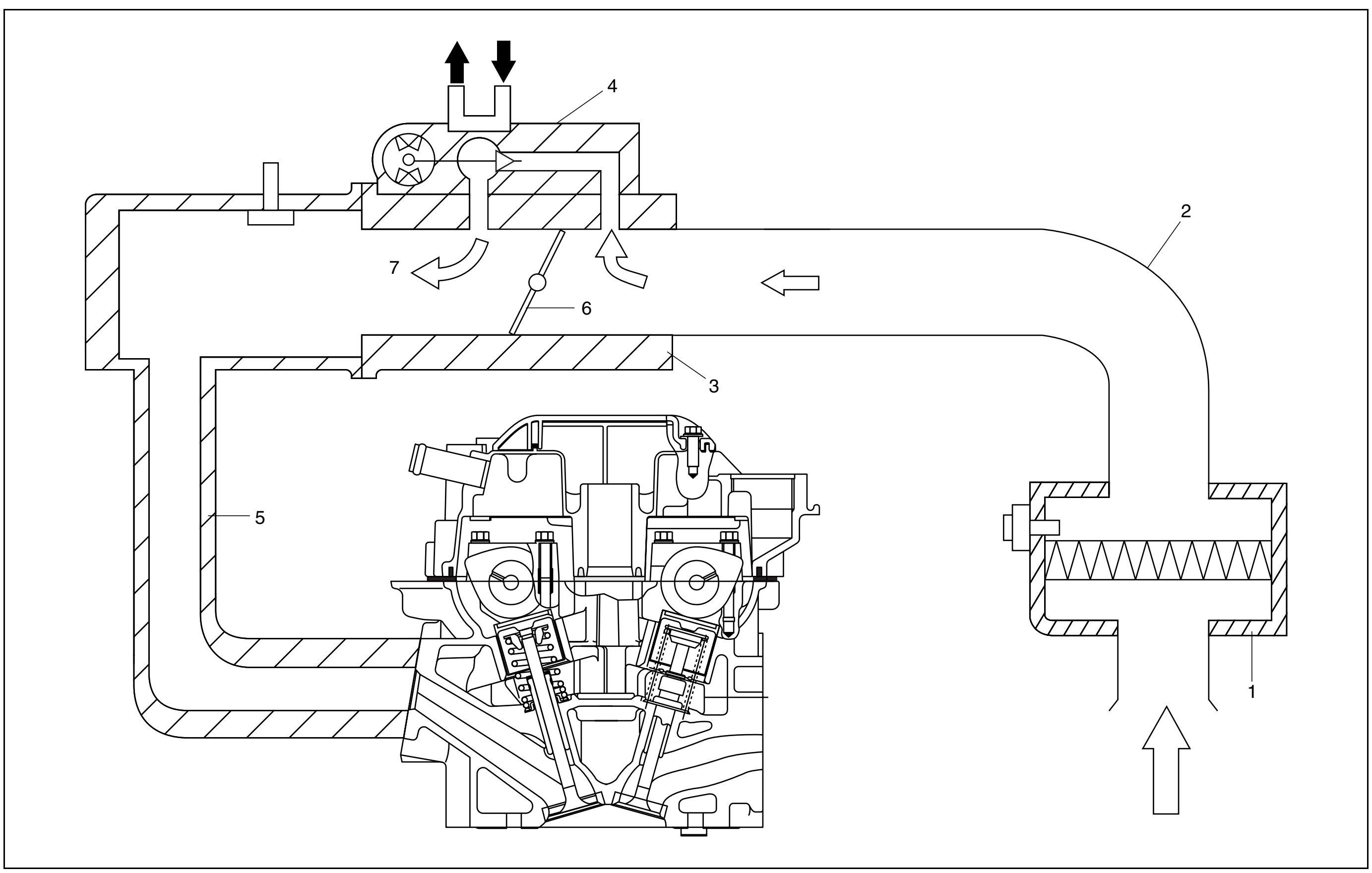


1. Air Cleaner	14. Knock sensor	27. Stop lamp
2. EVAP canister purge valve	15. ECT sensor	28. Stop lamp switch
3. MAF and IAT sensor	16. CMP sensor	29. ECM
4. TP sensor	17. CKP sensor	30. Barometric pressure sensor
5. IAC valve	18. Radiator fan	31. Battery
6. MAP sensor	19. Malfunction indicator lamp in combination meter	32. A/C compressor relay (if equipped)
7. EGR valve	20. Immobilizer indicator lamp in combination meter	33. A/C switch (if equipped)
8. EVAP canister	21. Ignition switch	34. A/C evaporator outlet air temp. sensor (if equipped)
9. Tank pressure control valve (built-in fuel pump)	22. Starter magnetic switch	35. Immobilizer control module (if equipped)
10. Fuel pump (with pressure regulator)	23. Heated Oxygen Sensor–2 (HO2S–2)	36. Main relay
11. Ignition coil assembly	24. DLC	37. VSS
12. Fuel injector	25. Electric load	38. Oil control valve
13. Heated Oxygen Sensor–1 (HO2S–1)	26. Fuel level sensor	39. TCM (A/T)

Air Intake System Description

The main components of the air intake system are air cleaner (1), air cleaner outlet hose (2), throttle body (3), idle air control valve (4) and intake manifold (5).
The air (by the amount corresponding to the throttle valve (6) opening and engine speed) is filtered by the air cleaner (1), passes through the throttle body (3), is distributed by the intake manifold (5) and finally drawn into each combustion chamber.
When the idle air control valve (4) is opened according to the signal from ECM, the air (7) bypasses the throttle valve (6) through bypass passage and is finally drawn into the intake manifold (5).

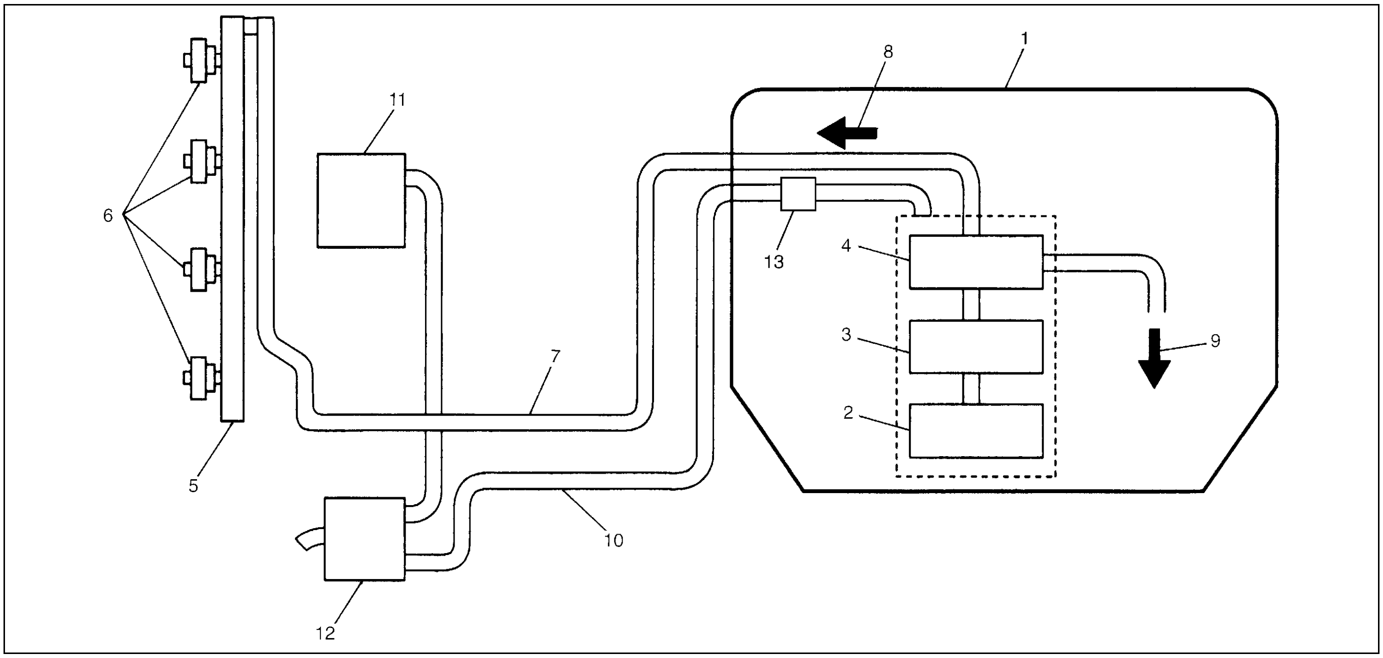
Air Intake System Diagram



Fuel Delivery System Description

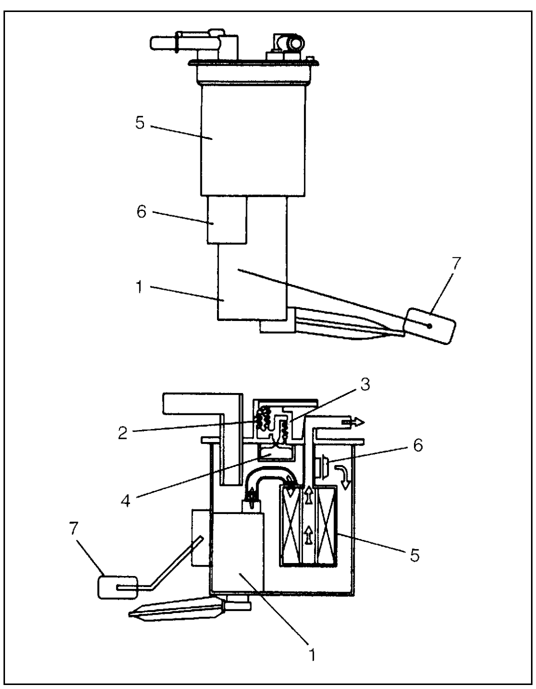
The fuel system consists of fuel tank (1), fuel pump (2) (with built-in fuel filter (3) and fuel pressure regulator (4)), delivery pipe (5), injectors (6) and fuel feed line (7).
The fuel (8) in the fuel tank (1) is pumped up by the fuel pump (2), sent into delivery pipe (5) and injected by the injectors (6).
As the fuel pump assembly is equipped with built-in fuel filter (3) and fuel pressure regulator (4), the fuel (8) is filtered and its pressure is regulated before being sent to the delivery pipe (5).
The excess fuel from fuel pressure regulation process is returned back (9) into the fuel tank.
Also, fuel vapor generated in fuel tank is led through the fuel vapor line (10) into the EVAP canister (12).

Fuel Delivery System Diagram



11. Intake manifold	13. Fuel vapor separator

Fuel Pump



An in-tank type electric pump has been adopted for the fuel pump (1). Incorporated in the pump assembly are;

- Tank pressure control valve (2) which keeps the pressure in the fuel tank constant, and prevents the fuel from spouting and tank itself from being deformed.
- Relief valve (3) which prevents the pressure in tank from rising excessively.
- Fuel cut valve (4) which closes as the float rises so that the fuel will not enter the canister when the fuel level in the tank rises high depending on the fuel level in the tank and the vehicle tilt angle.

Also, a fuel filter (5) and a fuel pressure regulator (6) are included and a fuel level gauge (7) is attached.
Addition of the fuel pressure regulator (6) to the fuel pump makes it possible to maintain the fuel pressure at constant level and ECM controls compensation for variation in the intake manifold pressure.

Electronic Control System Description

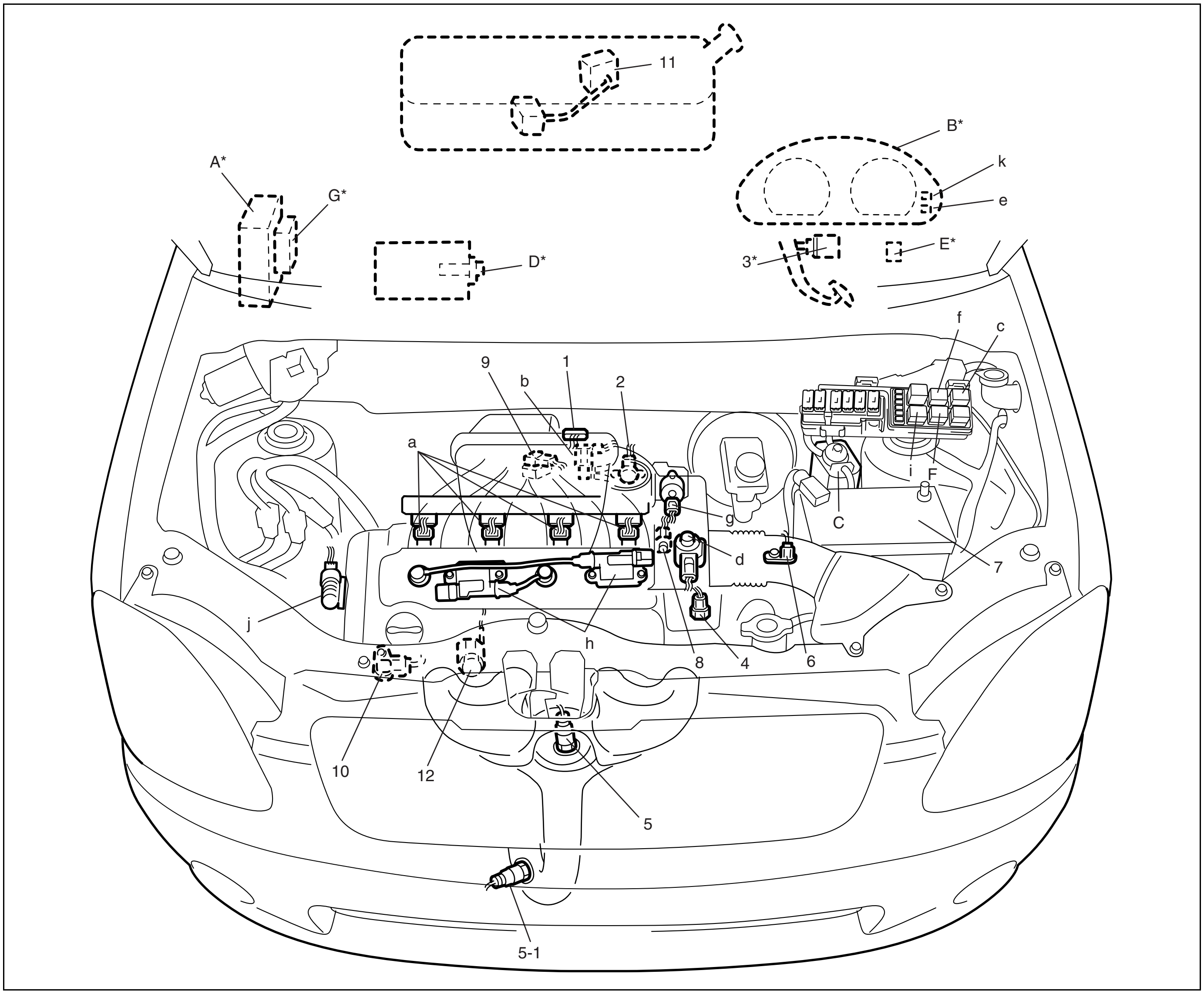
The electronic control system consists of 1) various sensors which detect the state of engine and driving conditions, 2) ECM which controls various devices according to the signals from the sensors and 3) various controlled devices.

Functionally, it is divided into nine sub systems:

- Fuel injection control system
- Idle speed control system
- Fuel pump control system
- A/C control system (if equipped)
- Radiator fan control system
- EGR system
- Evaporative emission control system
- Oxygen sensor heater control system
- Ignition control system
- Variable intake valve timing control system

ECM (Engine Control Module) and TCM (Transmission Control Module) intercommunicate by CAN (Controller Area Network). (For A/T vehicle only)

Electronic Control System Component Location



INFORMATION SENSORS	CONTROL DEVICES	OTHERS
1. MAF and IAT sensor	a: Fuel injector	A: ECM
2. TP sensor	b: EVAP canister purge valve	B: Combination meter
3. Stop lamp switch	c: Fuel pump relay	C: EVAP canister
4. ECT sensor	d: EGR valve	D: A/C evaporator outlet air temp. sensor (if equipped)
5. Heated oxygen sensor–1	e: Malfunction indicator lamp	E: Data link connector
5-1. Heated oxygen sensor–2	f: Radiator fan relay	F: A/C compressor relay (if equipped)
6. VSS	g: IAC valve	G: TCM (A/T)
7. Battery	h: Ignition coil assembly (with ignitor)	
8. CMP sensor	i: Main relay	
9. MAP sensor	j: Oil control valve	
10. CKP sensor	k: Immobilizer indicator lamp	
11. Fuel level sensor		
12. Knock sensor		

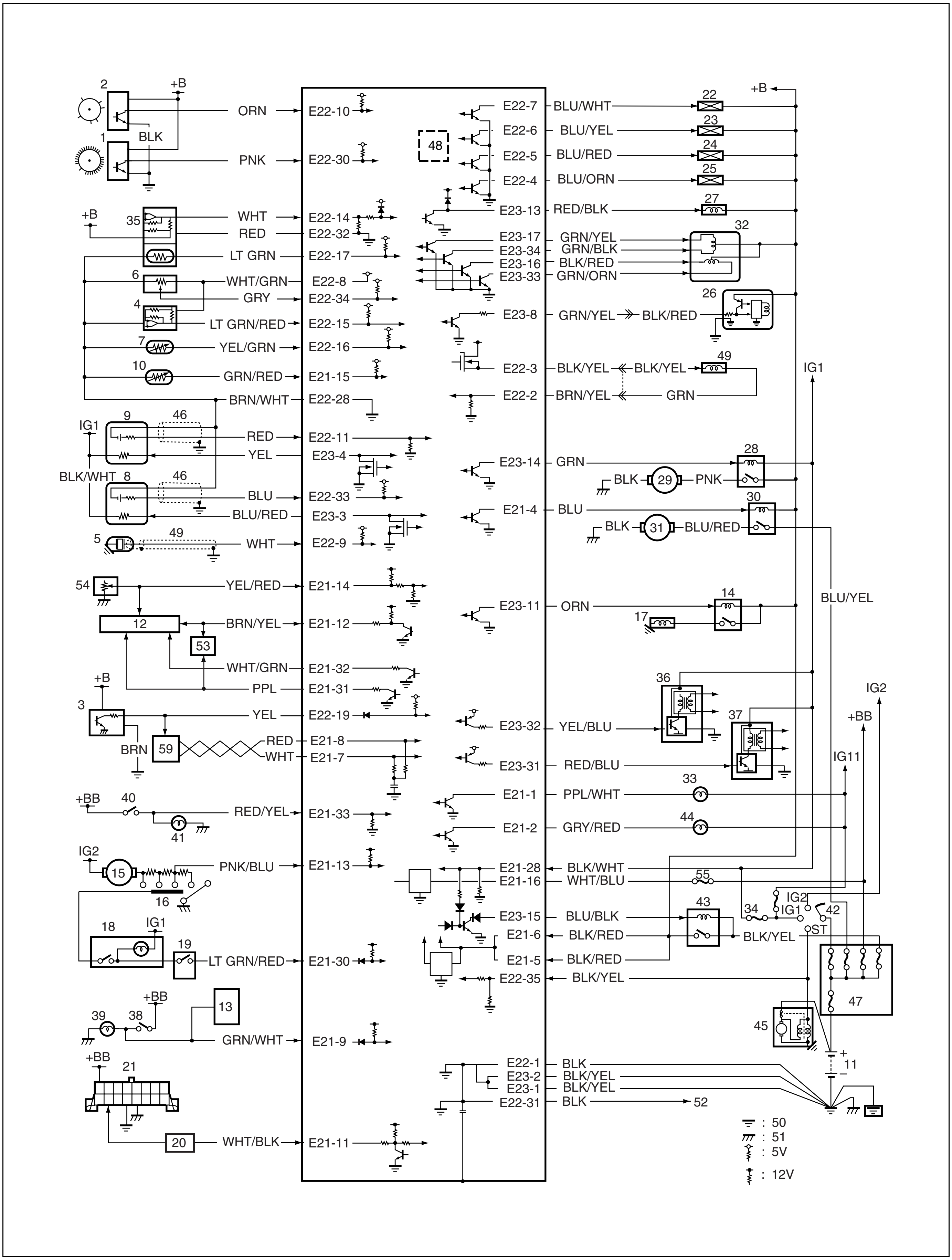
NOTE:

Above figure shows left-hand steering vehicle. For right-hand steering vehicle, parts with (*) are installed at the opposite side.

Engine and Emission Control Input/output Table

	INPUT \ OUTPUT	ELECTRIC CONTROL DEVICE											
		FUEL PUMP RELAY	FUEL INJECTOR	HO2S HEATER	IAC VALVE	IGNITION COIL WITH IGNITER	EGR VALVE	EVAP CANISTER PURGE VALVE	A/C COMPRESSOR RELAY	RADIATOR FAN RELAY	MIL	MAIN RELAY	OIL CONTROL VALVE
SIGNAL FROM SENSOR, SWITCH AND CONTROL MODULE	FUEL LEVEL SENSOR	For detecting fuel level											
	BAROMETRIC PRESSURE SENSOR		○		○	○		○			○		
	STOP LAMP SWITCH				○								
	START SWITCH	○	○	○	○		○		○		○		○
	IGNITION SWITCH	○	○	○	○	○	○	○	○	○		○	○
	LIGHTING SWITCH				○								
	BLOWER SWITCH				○				○				
	A/C SWITCH				○			○	○	○			
	A/C EVAP OUTLET AIR TEMP. SENSOR				○				○				
	VSS		○		○		○		○	○	○		○
	HEATED OXYGEN SENSOR-1		○					○			○		
	HEATED OXYGEN SENSOR-2	For detecting deterioration of three way catalytic converter									○		
	MAF SENSOR		○	○	○	○	○	○			○		
	IAT SENSOR		○		○	○	○	○			○		
	ECT SENSOR		○	○	○	○	○	○	○	○	○		○
	TP SENSOR		○		○	○	○	○	○		○		○
	MAP SENSOR		○	○	○	○	○	○	○		○		○
	CMP SENSOR	○	○			○					○		○
	CKP SENSOR	○	○	○	○	○	○	○	○		○		○
	KNOCK SENSOR					○					○		

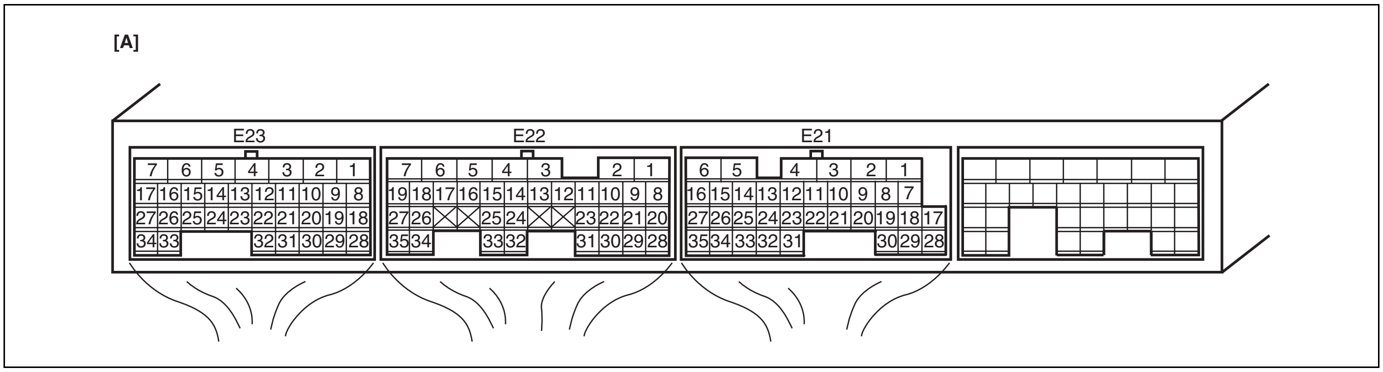
ECM Input/output Circuit Diagram



1. CKP sensor	20. Immobilizer control module	39. Stop lamp
2. CMP sensor	21. Data link connector	40. Lighting switch
3. VSS	22. Injector No.1	41. Position lamp
4. MAP sensor	23. Injector No.2	42. Ignition switch
5. Knock sensor	24. Injector No.3	43. Main relay
6. TP sensor	25. Injector No.4	44. Immobilizer indicator lamp
7. ECT sensor	26. IAC valve	45. Starting motor
8. Heated oxygen sensor–2	27. EVAP canister purge valve	46. Shield wire
9. Heated oxygen sensor–1	28. Fuel pump relay	47. Main fuse
10. A/C evaporator outlet air temp. sensor	29. Fuel pump	48. Barometric pressure sensor
11. Battery	30. Radiator fan relay	49. Oil control valve
12. Combination meter	31. Radiator fan motor	50. Engine ground
13. ABS control module	32. EGR valve	51. Body ground
14. A/C compressor relay	33. Malfunction indicator lamp	52. Shield ground
15. Heater fan motor	34. “IG COIL” fuse	53. EPS control module
16. Heater fan switch	35. MAF and IAT sensor	54. Fuel level sensor
17. A/C compressor clutch	36. Ignition coil assembly (for No.1 and No.4 spark plugs)	55. “DOME RADIO” fuse
18. A/C switch	37. Ignition coil assembly (for No.2 and No.3 spark plugs)	
19. A/C pressure switch	38. Stop lamp switch	

ECM Terminal Arrangement Table

CONNECTOR	TERMINAL	WIRE COLOR	CIRCUIT
E23	1	BLK/YEL	Ground for ECM
	2	BLK/YEL	Ground for ECM
	3	BLU/RED	Heater output of heated oxygen sensor–2
	4	YEL	Heater output of heated oxygen sensor–1
	5	–	–
	6	–	–
	7	–	–
	8	GRN/YEL	IAC valve output
	9	–	–
	10	–	–
	11	PNK/BLK	A/C compressor relay output (if equipped)
	12	–	–
	13	RED/BLK	EVAP canister purge valve output
	14	GRN	Fuel pump relay output
	15	BLU/BLK	Main power supply relay output
	16	BLK/RED	EGR valve (stepper motor coil 3) output
	17	GRN/YEL	EGR valve (stepper motor coil 1) output
	18	–	–
	19	–	–
	20	–	–
	21	–	–
	22	–	–
	23	–	–
	24	–	–
	25	–	–
	26	–	–
	27	–	–
	28	–	–
	29	–	–
	30	–	–
	31	RED/BLU	Ignition coil No.2 and No.3 output
	32	YEL/BLU	Ignition coil No.1 and No.4 output
	33	GRN/ORN	EGR valve (stepper motor coil 4) output
	34	GRN/BLK	EGR valve (stepper motor coil 2) output
E22	1	BLK	Ground for ECM
	2	BRN/YEL	Oil control valve output
	3	BLK/YEL	Output of 12 V power source for oil control valve
	4	BLU/ORN	Fuel injector No.4 output
	5	BLU/RED	Fuel injector No.3 output
	6	BLU/YEL	Fuel injector No.2 output
	7	BLU/WHT	Fuel injector No.1 output
	8	WHT/GRN	Output of 5V power source for throttle position (TP) sensor
	9	WHT	Knock sensor signal
	10	ORN	Reference signal for CMP sensor
	11	RED	Oxygen signal of heated oxygen sensor–1
	12	–	–
	13	–	–
	14	WHT	Mass air flow (MAF) sensor signal
	15	LT GRN/RED	Manifold absolute pressure (MAP) sensor signal
	16	YEL/GRN	Engine coolant temp. (ECT) sensor signal
	17	LT GRN	Intake air temperature (IAT) sensor signal
	18	–	–
	19	YEL	Vehicle speed sensor signal
	20	–	–
E22	21	–	–
	22	–	–
	23	–	–
	24	–	–
	25	–	–
	26	–	–
	27	–	–
	28	BRN/WHT	Ground for sensors
	29	–	–
	30	PNK	CKP sensor signal
	31	BLK	Ground of ECM for shield wire
	32	RED	Ground for MAF sensor
	33	BLU	Oxygen signal of heated oxygen sensor–2
	34	GRY	Throttle position (TP) sensor signal
	35	BLK/YEL	Starting motor signal
E21	1	PPL/WHT	MIL (Malfunction indicator lamp) output
	2	GRY/RED	Immobilizer indicator lamp output (if equipped)
	3	–	–
	4	BLU	Radiator fan motor relay output
	5	BLK/RED	Main power supply
	6	BLK/RED	Main power supply
	7	WHT	CAN communication line (active low signal)
	8	RED	CAN communication line (active high signal)
	9	GRN/WHT	Electric load signal for stop lamp
	10	–	–
	11	WHT/BLK	Serial communication line of data link connector 12 V
	12	BRN/YEL	Engine revolution signal output for tachometer
	13	PNK/BLU	Electric load signal for heater blower motor
	14	YEL/RED	Fuel level sensor signal
	15	GRN/RED	A/C evaporator outlet air temp. sensor signal (if equipped)
	16	WHT/BLU	Power source for ECM internal memory
	17	–	–
	18	–	–
	19	–	–
	20	–	–
	21	–	–
	22	–	–
	23	–	–
	24	–	–
	25	–	–
	26	–	–
	27	–	–
	28	BLK/WHT	Ignition switch signal
	29	–	–
	30	LT GRN/RED	A/C request signal (if equipped)
	31	PPL	Vehicle speed sensor signal for speedometer
	32	WHT/GRN	ECT sensor signal for combination meter
	33	RED/YEL	Electric load signal for clearance lamp
	34	–	–
	35	–	–



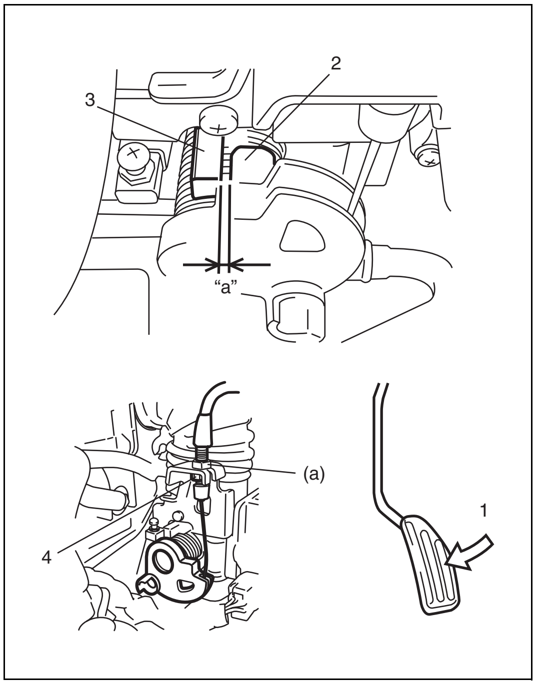
[A]: Terminal arrangement of ECM coupler (viewed from harness side)

NOTE:

For abbreviation of wire color, refer to “Abbreviations and Symbols May be Used in This Manual” in Section 0A.

On-Vehicle Service

Accelerator cable adjustment



With accelerator pedal depressed fully (1), check clearance between throttle lever (2) and lever stopper (3) of throttle body.
If measured value is out of specification, adjust it to specification with cable adjusting nut (4).

Accelerator cable adjustment clearance (with pedal depressed fully)
"a": 0.5 – 2.0 mm (0.02 – 0.07 in.)

Tightening torque
Accelerator cable lock nut (a): 12 N·m (1.2 kg-m, 9.0 lb-ft)

Idle speed/idle air control (IAC) duty inspection

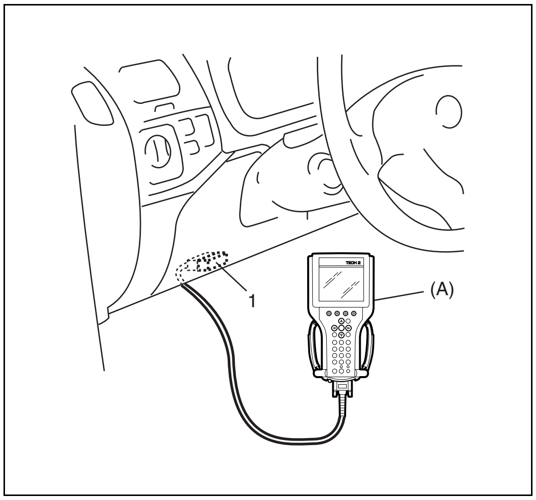
Before idle speed/IAC duty check, make sure of the following.

- Lead wires and hoses of Electronic Fuel Injection and engine emission control systems are connected securely.
- Accelerator cable has some play, that is, it is not tight.
- Valve lash is checked according to maintenance schedule.
- Ignition timing is within specification.
- All accessories (wipers, heater, lights, A/C, etc.) are out of service.
- Air cleaner has been properly installed and is in good condition.
- No abnormal air inhaling from air intake system.

After above items are all confirmed, check idle speed and IAC duty as follows.

NOTE:

Before starting engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T vehicle), and set parking brake and block drive wheels.



1) Connect scan tool to DLC (1) with ignition switch OFF.

Special tool
(A): SUZUKI scan tool

2) Warm up engine to normal operating temperature.
3) Check engine idle speed and “IAC duty” by using “Data List” mode on scan tool to check “IAC duty”.
4) If duty and/or idle speed is out of specifications, inspect idle air control system referring to “Diagnostic Flow Table B-4 Idle Air Control System Check” in Section 6-2.

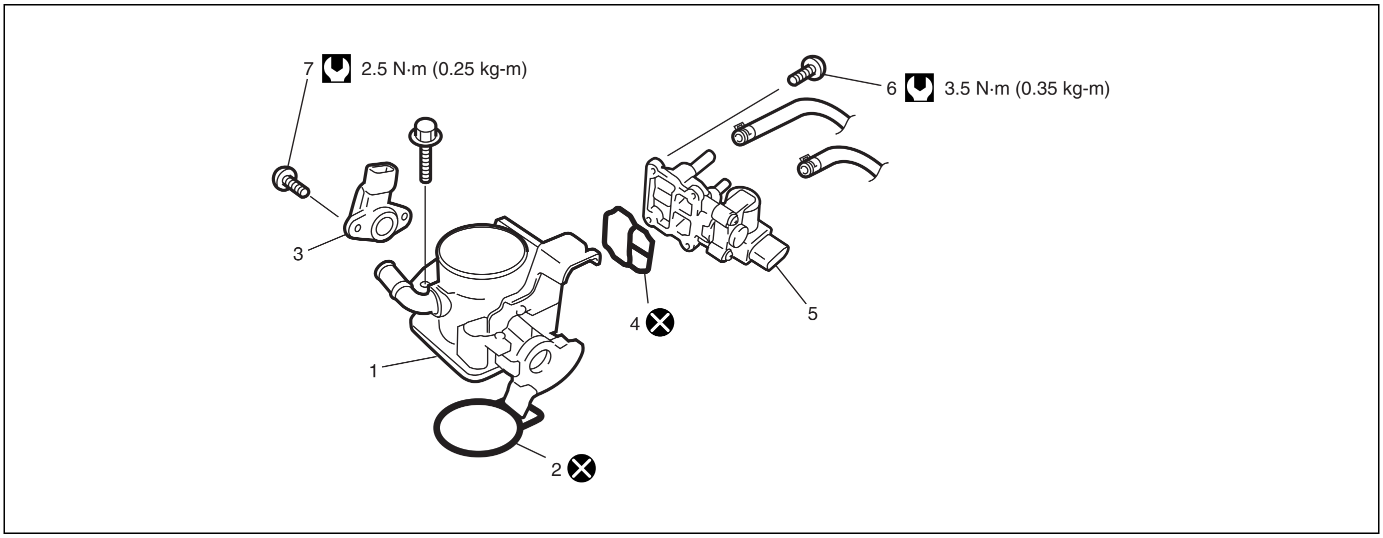
Engine idle speed and IAC duty

	A/C OFF	A/C ON
M/T vehicle	**700 ± 50 r/min (rpm)** **10 – 55%**	**850 ± 50 r/min (rpm)**
A/T vehicle at P/N range	**750 ± 50 r/min (rpm)** **10 – 55%**	**850 ± 50 r/min (rpm)**

5) Check that specified engine idle speed is obtained with A/C ON if vehicle is equipped with A/C.
   If not, check A/C request signal circuit and idle air control system.

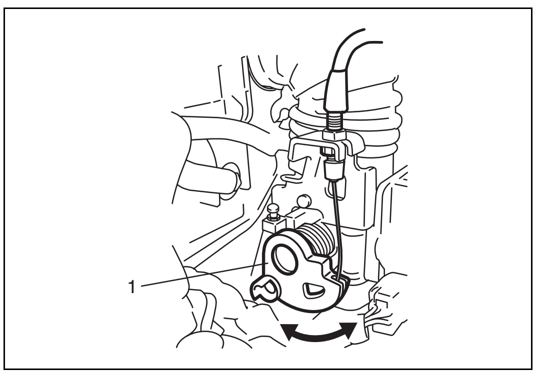
Air Intake System

Throttle body Components



1. Throttle body	4. Gasket	7. TP sensor screws
2. Throttle body gasket	5. Idle air control valve	Tightening torque
3. TP sensor	6. IAC valve screws	Do not reuse.

Throttle body on-vehicle inspection

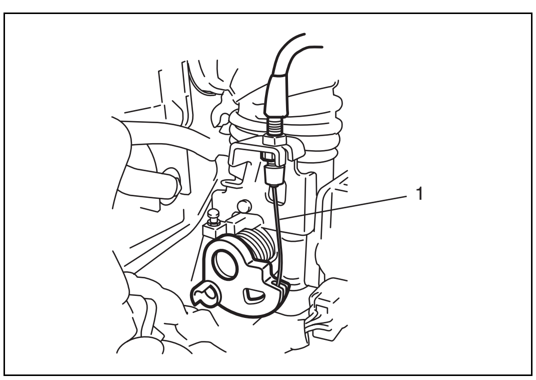


- Check that throttle valve lever (1) moves smoothly.

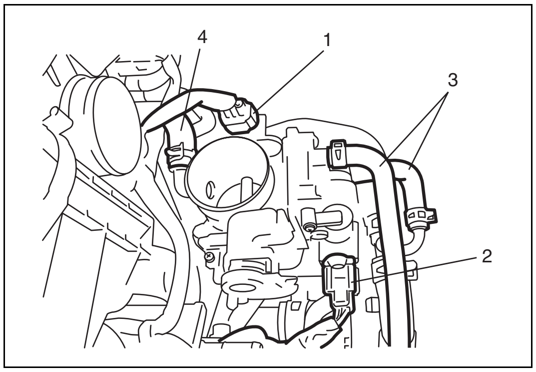
Throttle body removal and installation

Removal

1) Disconnect negative cable at battery.
2) Drain coolant referring to "Cooling System Draining" in Section 6B2.



3) Disconnect accelerator cable (1) from throttle body.
4) Detach purge valve chamber, and remove air cleaner outlet hose.



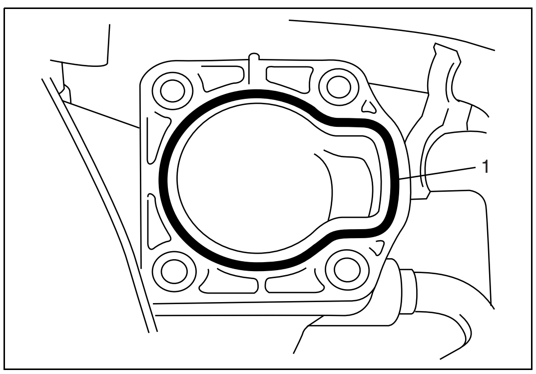
5) Disconnect connectors from TP sensor (1) and IAC valve (2).
6) Disconnect engine coolant hoses (3) and breather hose (4) from throttle body.
7) Remove throttle body from intake manifold.
8) Remove TP sensor and IAC valve from throttle body.

NOTE:

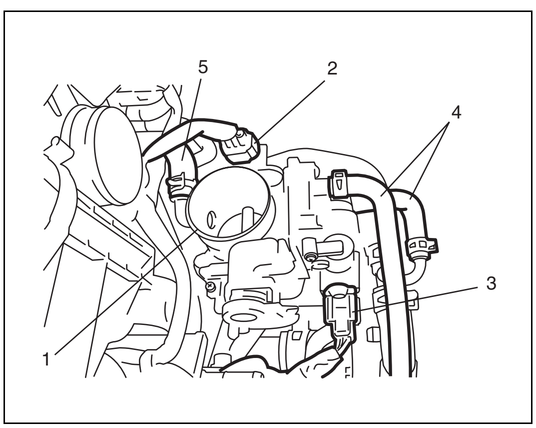
While disassembling and assembling throttle body, use special care not to deform levers on throttle valve shaft or cause damage to any other parts.

Installation

1) Install IAC valve to throttle body referring to "Installation" under "IAC Valve Removal and Installation" in this section.
2) Install TP sensor to throttle body referring to "Installation" under "TP Sensor Removal and Installation" in this section.

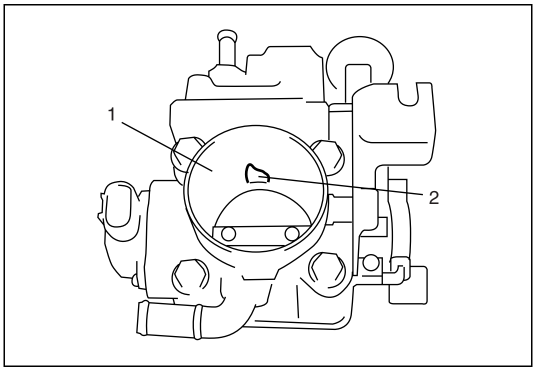


3) Clean mating surfaces and install new throttle body gasket (1) to intake manifold.



4) Install throttle body (1) to intake manifold.
5) Connect connectors to TP sensor (2) and IAC valve (3) securely.
6) Connect engine coolant hoses (4) and breather hose (5).
7) Connect accelerator cable and adjust cable play to specification.
8) Install air cleaner outlet hose and purge valve chamber.
9) Refill coolant referring to "Cooling System Refill" in Section 6B2.
10) Connect negative cable at battery.

Throttle body cleaning



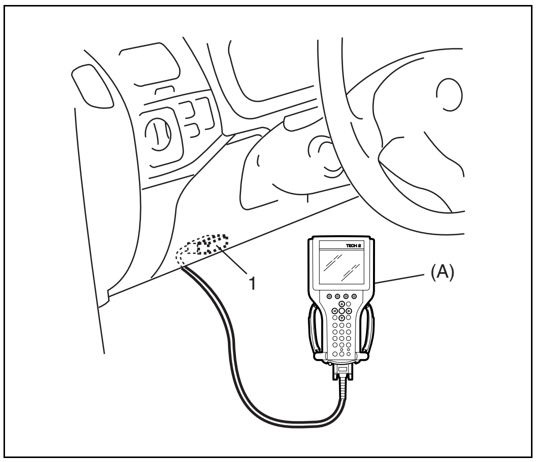
Clean throttle body bore (1) and idle air passage (2) by blowing compressed air.

NOTE:

TP sensor, idle air control valve or other components containing rubber must not be placed in a solvent or cleaner bath. A chemical reaction will cause these parts to swell, harden or get distorted.

Idle air control (IAC) valve operation check

Using Suzuki Scan Tool



1) Connect SUZUKI scan tool to DLC (1) with ignition switch OFF.

   Special tool
   (A): SUZUKI scan tool

2) Warm up engine to normal operating temperature.
3) Clear DTC and select "MISC TEST" mode on SUZUKI scan tool.
4) Check that idle speed increases and/or reduces when IAC valve is opened and/or when closed by SUZUKI scan tool.
   If idle speed does not change, check IAC valve and wire harness.

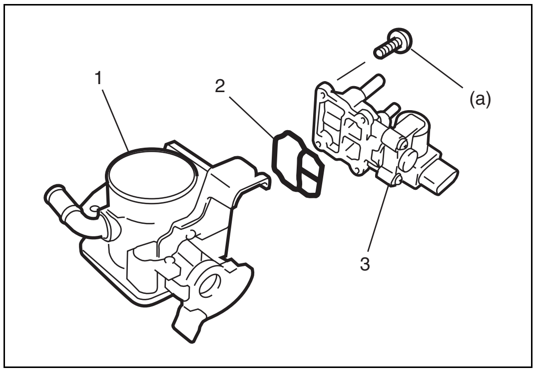
Not Using SUZUKI Scan Tool

1) Warm up engine to normal operating temperature.
2) Stop engine.
3) Turn ignition switch to ON position.
4) Disconnect IAC valve connector.
5) Start engine.
6) Connect IAC valve connector.
7) Check that idle speed increases and/or reduces when connector is connected to IAC valve.
   If idle speed does not change, check IAC valve and wire harness.

Idle air control (IAC) valve removal and installation

Removal

1) Remove throttle body referring to "Throttle Body Removal and Installation" in this section.
2) Remove IAC valve from throttle body.



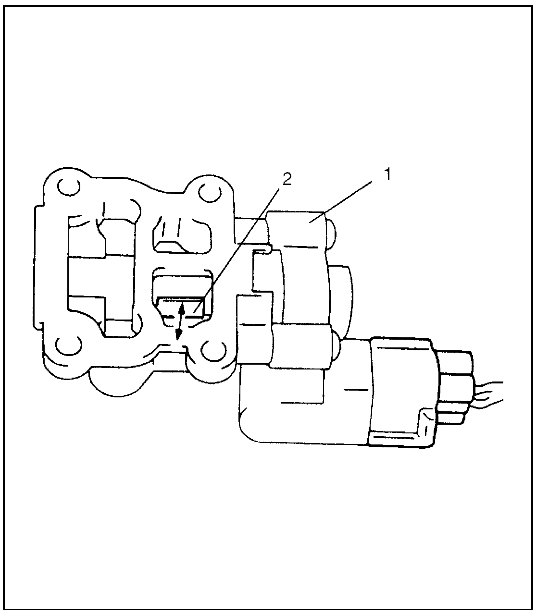
Installation

1) Install new gasket (2) to throttle body (1).
2) Install IAC valve (3) to throttle body (1).
   Tighten IAC valve screws to specified torque.

Tightening torque
IAC valve screw (a): 3.5 N·m (0.35 kg-m, 2.5 lb-ft)

3) Install throttle body referring to “Throttle Body Removel and Installation” in this section.

Idle air control (IAC) valve check



1) Remove IAC valve referring to “Idle Air Control (IAC) Valve Removal and Installation” in this section.
2) Connect each connector to IAC valve (1) and TP 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.

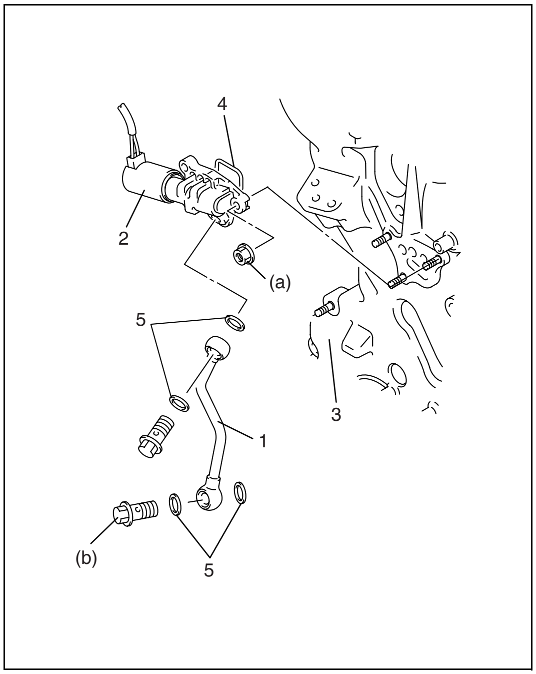
NOTE:

- **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 harness for open and short. If wire harness is in good condition, replace IAC valve and recheck.

4) Install IAC valve referring to “Idle Air Control (IAC) Valve Removal and Installation” in this section.

Oil control valve removal and installation

Removal



Remove oil gallery pipe No.1 (1) and oil control valve (2) from timing chain cover (3).

Installation

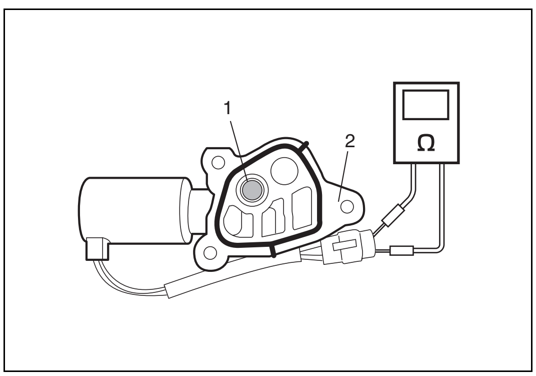
1) Install new O-ring (4) to oil control valve.
2) Install oil control valve to timing chain cover.
   Tighten nuts to specification.

Tightening torque
Oil control valve mounting nuts
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

3) Install oil gallery pipe No.1 with new copper washers (5) to timing chain cover.
   Tighten bolts to specification.

Tightening torque
Oil gallery pipe No.1 bolts
(b): 30 N·m (3.0 kg-m, 21.5 lb-ft)

Oil control valve inspection



1) Inspect strainer (1) and mating surface (2) of oil control valve for clog or damage. Clean oil control valve if clog or foreign matter is present on strainer or mating surface of oil control valve.
   Replace oil control valve if its mating surface is damaged.
2) Check resistance between terminals of oil control valve.

Resistance: 6.7 – 7.7 Ω (at 20°C (68°F))

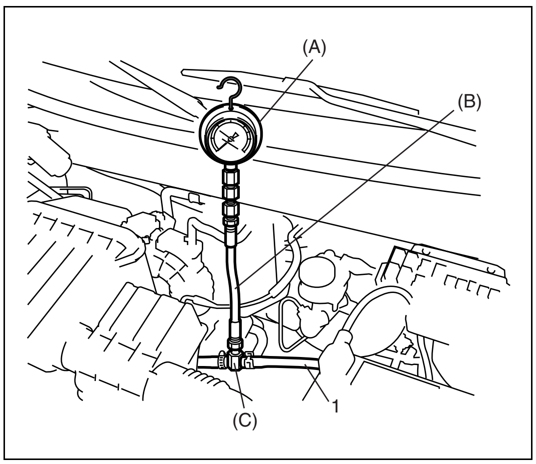
Fuel Delivery System

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.
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.

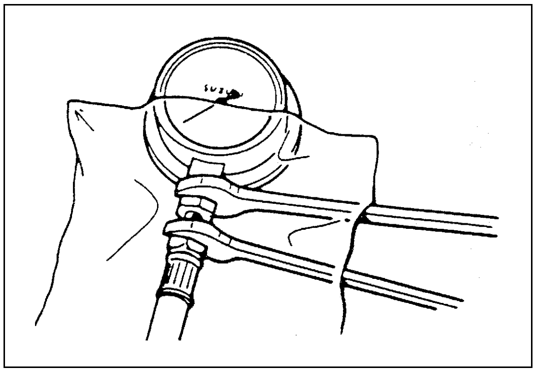
Special tool
(A): 09912-58442
(B): 09912-58432
(C): 09912-58490

4) Check that battery voltage is above 11 V.
5) Turn ignition switch ON to operate fuel pump and after 2 seconds turn it OFF. Repeat this 3 or 4 times and then check fuel pressure.

Fuel pressure specification

CONDITION	FUEL PRESSURE
With fuel pump operating and engine stopped	270 – 310 kPa ($2.7 – 3.1\ kg/cm^2$, 38.4 – 44.0 psi)
At specified idle speed	270 – 310 kPa ($2.7 – 3.1\ kg/cm^2$, 38.4 – 44.0 psi)
With 1 min. after engine (fuel pump) stop (Pressure reduces as time passes)	over 250 kPa ($2.5\ kg/cm^2$, 35.6 psi)

6) Start engine and warm it up to normal operating temperature.
7) Measure fuel pressure at idling.
   If measured pressure does not satisfy specification, refer to “Diagnostic Flow Table B-3” in Section 6-2 and check each possibly defective part. Replace if found defective.



8) After checking fuel pressure, remove fuel pressure gauge.

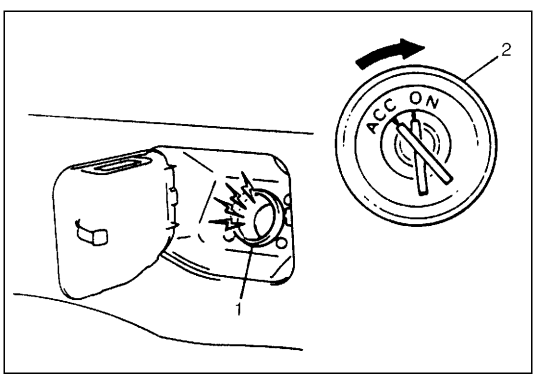
> **CAUTION:**
> **As fuel feed line is still under high fuel pressure, make sure to release fuel pressure according to following procedures.**
> - **Place fuel container under joint.**
> - **Cover joint with rag and loosen joint nut slowly to release fuel pressure gradually.**

9) Remove special tools from fuel delivery pipe and fuel feed hose.
10) Connect fuel feed hose to fuel delivery pipe and clamp it securely.
11) With engine "OFF" and ignition switch "ON", check for fuel leaks.

Fuel pump with pressure regulator on-vehicle inspection

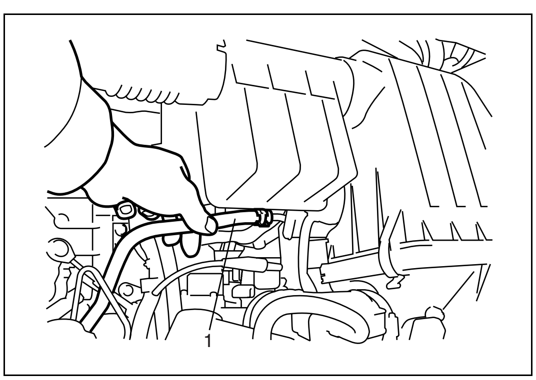
> **CAUTION:**
> **When fuel filler cap is removed in any procedure, work must be done in a well-ventilated area, keep away from any open flames and without smoking.**

NOTE:
The fuel pressure regulator is the one body with the fuel pump assembly so individual inspection of it is impossible.



1) Remove filler cap and turn ON ignition switch. Then fuel pump operating sound should be heard from fuel filler for about 2 seconds and stop. Be sure to reinstall fuel filler cap after checking.
   If above check result is not satisfactory, advance to "Diagnostic Flow Table B-2" in Section 6-2.

1.	Fuel filler
2.	Ignition switch



2) Turn OFF ignition switch and leave over 10 minutes as it is.
3) Fuel pressure should be felt at fuel feed hose (1) for about 2 seconds after ignition switch ON.
   If fuel pressure is not felt, advance to "Diagnostic Flow Table B-3" in Section 6-2.

Fuel pump with pressure regulator removal and installation

Removal

Remove fuel tank from body according to procedure described in "Fuel Tank Removal and Installation" of Section 6C and remove fuel pump from fuel tank.

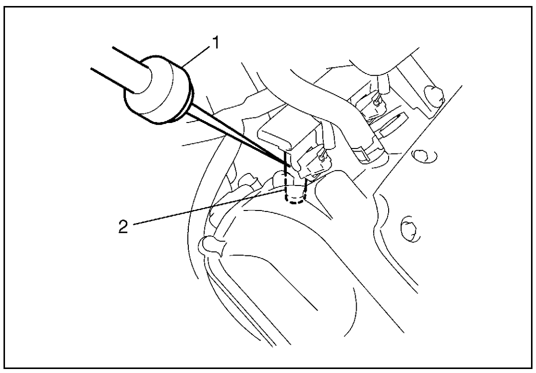
Installation

1) Install fuel pump to its bracket.
2) Install fuel pump to fuel tank and then install fuel tank to body according to procedure described in "Fuel Tank Removal and Installation" of Section 6C.

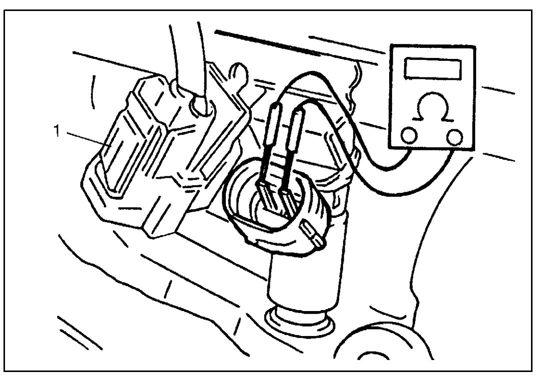
Fuel pump with pressure regulator inspection

Check fuel pump filter for evidence of dirt and contamination. If present, clean and check for presence of dirt in fuel tank.

Fuel injector on-vehicle inspection



1) Using sound scope (1) or such, check operating sound of injector (2) when engine is running or cranking.
   Cycle of operating sound should vary according to engine speed.
   If no sound or an unusual sound is heard, check injector circuit (wire or connector) or injector (2).



2) Disconnect connector (1) from injector, connect ohmmeter between terminals of injector and check resistance.
   If resistance is out of specification, replace.

Resistance of fuel injector
11.3 – 13.8 Ω at 20°C (68°F)

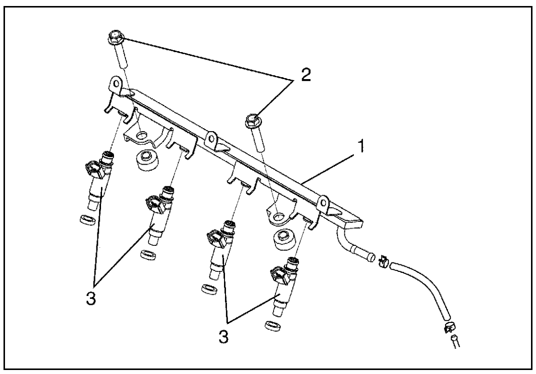
3) Connect connector (1) to injector securely.

Fuel injector removal and installation

Removal

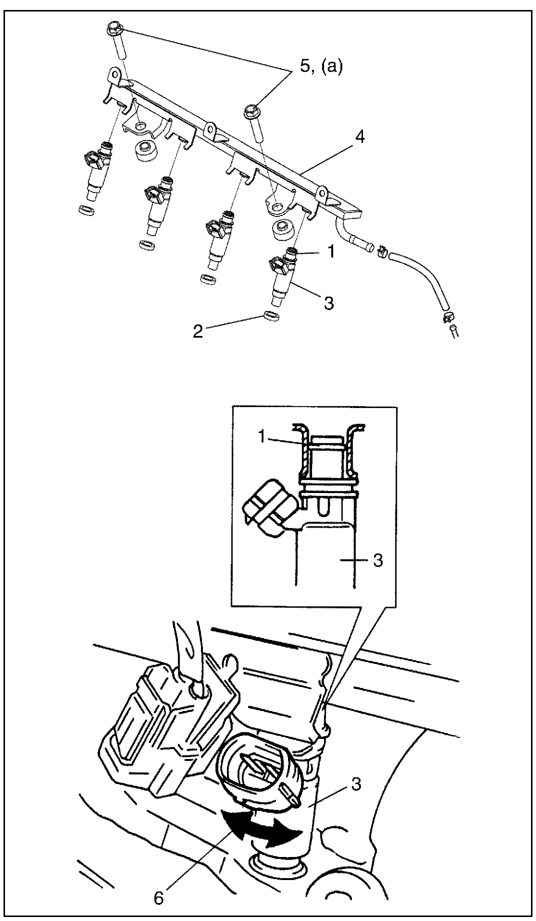
> **CAUTION:**
> **A small amount of fuel may come out after removal of fuel injectors, cover them with shop cloth.**

1) Relieve fuel pressure according to procedure described in “Fuel Pressure Relief Procedure” of Section 6-2.
2) Disconnect battery negative cable at battery.
3) Disconnect MAF and IAT sensor connector, and detach EVAP canister purge valve.
4) Remove air cleaner assembly with air intake pipe.
5) Disconnect fuel injector couplers.



6) Disconnect fuel feed hose from fuel delivery pipe (1).
7) Remove fuel delivery pipe bolts (2).
8) Remove fuel injector(s) (3).

Installation



For installation, reverse removal procedure and note following precautions.

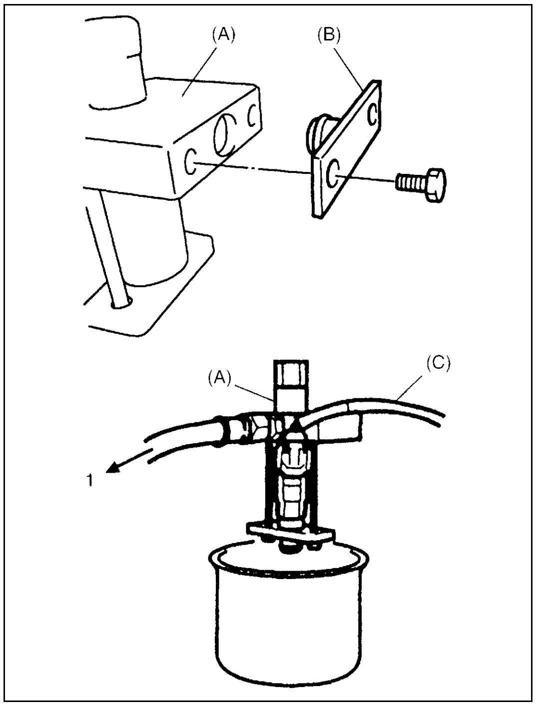
- Replace injector O-ring (1) with new one using care not to damage it.
- Check if cushion (2) is scored or damaged. If it is, replace with new one.
- Apply thin coat of fuel to O-rings (1) and then install injectors (3) into delivery pipe (4) and cylinder head.
  Make sure that injectors (3) rotate smoothly (6). If not, probable cause is incorrect installation of O-ring (1). Replace O-ring (1) with new one.
- Tighten delivery pipe bolts (5) and make sure that injectors (3) rotate smoothly (6).

Tightening torque
Delivery pipe bolts (a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

- After installation, with engine “OFF” and ignition switch “ON”, check for fuel leaks around fuel line connection.

Fuel injector inspection

> **WARNING:**
> **As fuel is injected in this inspection, perform in a well ventilated area and away from open flames.**
> **Use special care to prevent sparking when connecting and disconnecting test lead to and from battery.**



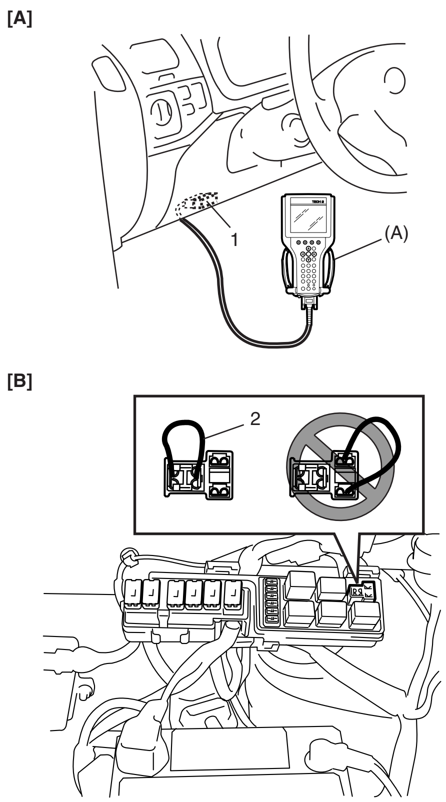
1) Install injector to special tool (injector checking tool).

Special tool
(A): 09912-58421
(B): 09912-57610

2) Connect special tools (hose and attachment) to fuel feed pipe (1) of vehicle.
3) Connect special tool (test lead) to injector.

Special tool
(C): 09930-88530

4) Install suitable vinyl tube onto injector nozzle to prevent fuel from splashing out when injecting.
5) Put graduated cylinder under injector.



6) Operate fuel pump and apply fuel pressure to injector as follows:
   a) When using scan tool:
      i) Connect scan tool to DLC (1) with ignition switch OFF.

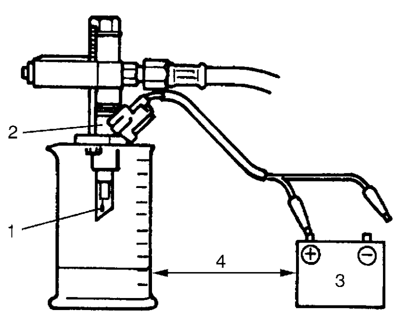
Special tool
(A): SUZUKI scan tool

      ii) Turn ignition switch ON, clear DTC and select "MISC TEST" mode on scan tool.
      iii) Turn fuel pump ON by using scan tool.
   b) Without using scan tool:
      i) Remove fuel pump relay from connector.
      ii) Connect two terminals of relay connector using service wire (2) as shown in figure.

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

      iii) Turn ignition switch ON.

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



7) Apply battery voltage (3) to injector (2) for 15 seconds and measure injected fuel volume with graduated cylinder.
   Test each injector two or three times.
   If not within specification, replace injector.

Injected fuel volume
43 – 47 cc/15 sec. (1.45/1.51 – 1.58/ 1.65 US/Imp. oz/15 sec.)

8) Check fuel leakage from injector nozzle. Do not operate injector for this check (but fuel pump should be at work).
   If fuel leaks (1) more than following specifications, replace.

Fuel leakage
Less than 1 drop/min.

4.	Keep as far apart as possible

Electronic Control System

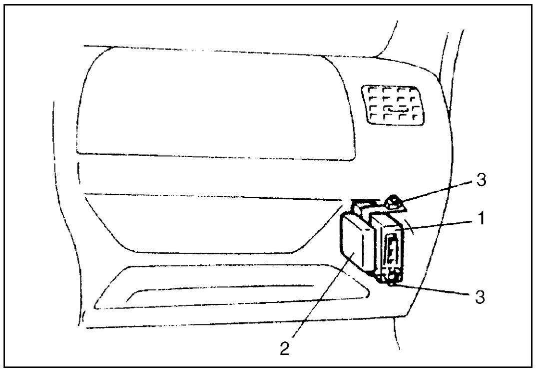
Engine control module (ECM) removal and installation

CAUTION:

As ECM consists of precision parts, be careful not to expose it to excessive shock.

Removal

1) Disconnect battery negative cable at battery.
2) Disable air bag system, refer to “Disabling Air Bag System” in Section 10B if equipped.
3) Remove glove box.



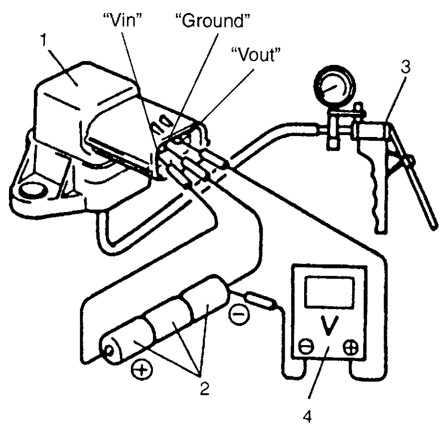
4) Disconnect ECM (1) and TCM (2) (if equipped) couplers.
5) Loosen 2 nuts (3) and remove ECM and TCM (if equipped).

Installation

Reverse removal procedure noting the following:

- Connect couplers to ECM and TCM (if equipped) securely.

Manifold absolute pressure sensor (MAP sensor) inspection



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

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

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

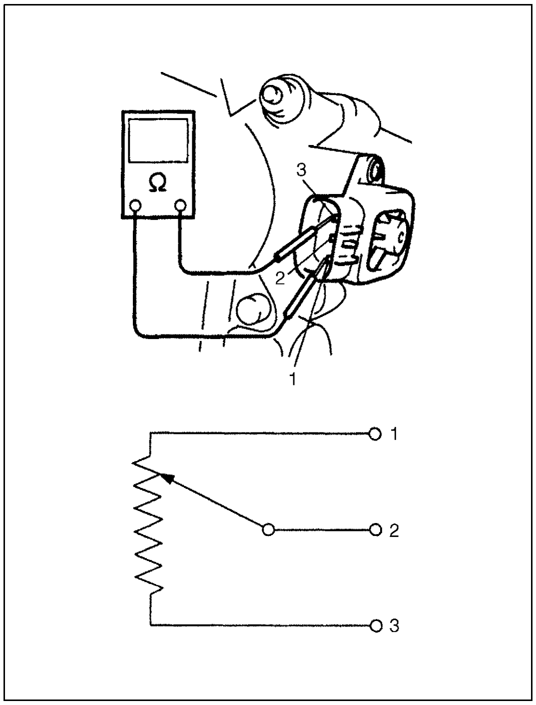
If check result is not satisfactory, replace MAP sensor (1).

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

4. Digital type voltmeter

Throttle position sensor (TP sensor) on-vehicle inspection

1) Disconnect negative cable at battery.
2) Detach purge valve chamber, and remove air cleaner outlet hose.
3) Disconnect TP sensor connector.



4) Using ohmmeter, check resistance between terminals under each condition given in table below.
   If check result is not satisfactory, replace TP sensor.

TP sensor resistance

TERMINALS	RESISTANCE
Between 1 and 3 terminals	4.0 – 6.0 kΩ
Between 2 and 3 terminals	20 Ω – 6.0 kΩ, varying according to throttle valve opening.

NOTE:

There should be more than 2 kΩ resistance difference between when throttle valve is at idle position and when it is fully open.

1.	Reference voltage terminal
2.	Output voltage terminal
3.	Ground terminal

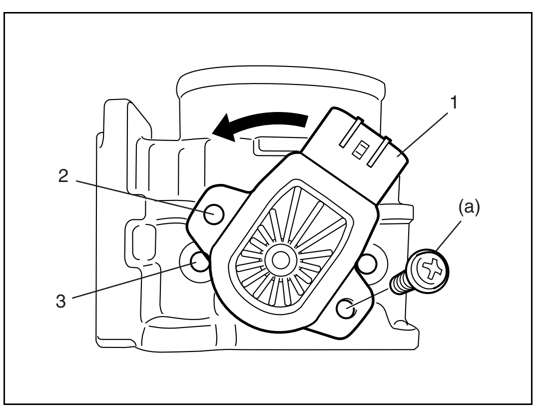
5) Connect TP sensor connector securely.
6) Connect negative cable to battery.

Throttle position sensor (TP sensor) removal and installation

Removal

1) Disconnect battery negative cable at battery.
2) Detach purge valve chamber, and remove air cleaner outlet hose.
3) Disconnect TP sensor connector and remove TP sensor from throttle body.

Installation



1) Install TP sensor (1) to throttle body.
   Fit TP sensor to throttle body in such way that its holes (3) are a little away from TP sensor screw holes (2) as shown in figure and turn TP sensor clockwise so that those holes align.

Tightening torque
TP sensor screw (a): 2.5 N·m (0.25 kg-m, 1.8 lb-ft)

2) Connect connector to TP sensor securely.
3) Connect battery negative cable to battery.

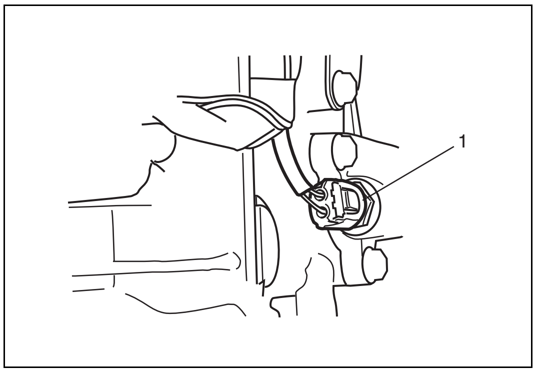
Engine coolant temperature sensor (ECT sensor) removal and installation

Removal

1) Disconnect battery negative cable at battery.
2) Drain coolant referring to "Cooling System Draining" in Section 6B2.

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

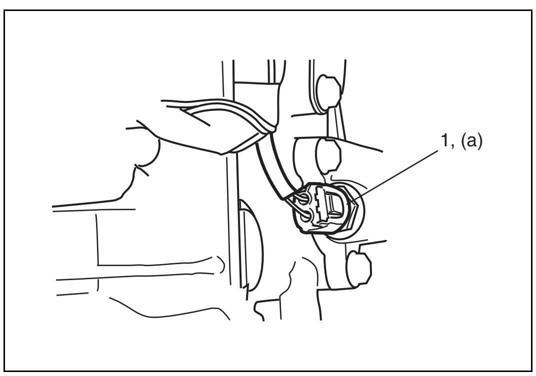
3) Remove air intake pipe.
4) Disconnect connector from ECT sensor.



5) Remove ECT sensor (1) from thermostat case.

Installation

Reverse removal procedure noting the following:

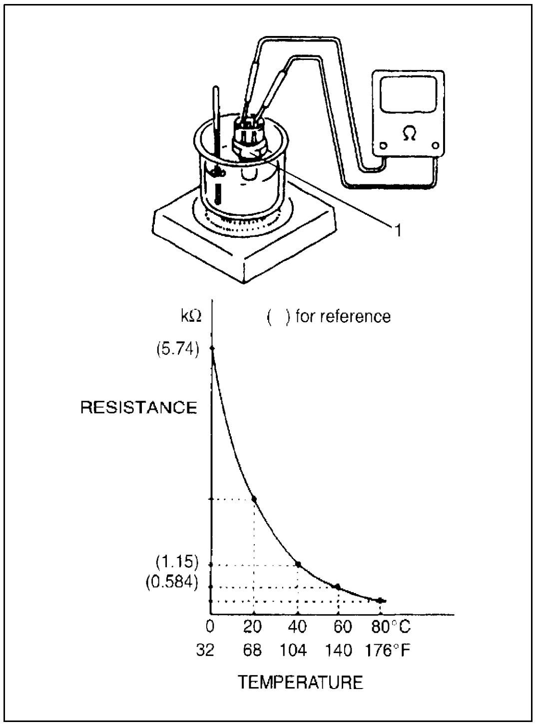


- Clean mating surfaces of ECT sensor (1) and water outlet cap.
- Check O-ring for damage and replace if necessary.
- Tighten ECT sensor (1) to specified torque.

Tightening torque
ECT sensor (a): 15 N·m (1.5 kg-m, 11.5 lb-ft)

- Connect connector to ECT sensor (1) securely.
- Refill coolant referring to "Cooling System Refill" in Section 6B2.

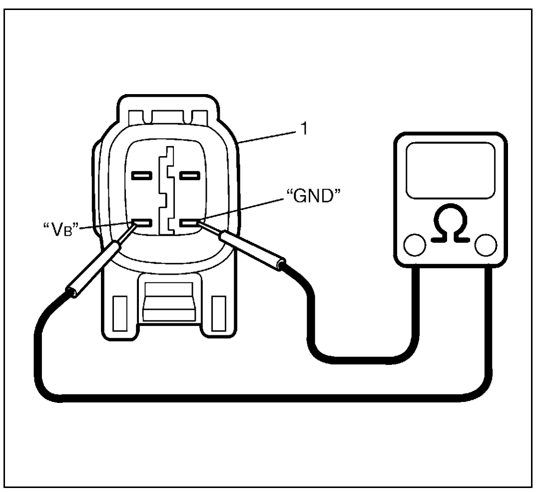
Engine coolant temperature sensor (ECT sensor) inspection



Immerse temperature sensing part of ECT sensor (1) in water (or ice) and measure resistance between terminals while heating water gradually.

If measured resistance does not show such characteristic as shown in the graph, replace ECT sensor (1).

Heated oxygen sensor (HO2S-1 and HO2S-2) heater on-vehicle inspection



1) Disconnect sensor connector.
2) Using ohmmeter, measure resistance between terminals "V_B" and "GND" of sensor connector.
   If found faulty, replace oxygen sensor.

NOTE:

Temperature of sensor affects resistance value largely.
Make sure that sensor heater is at correct temperature.

Resistance of oxygen sensor heater
HO2S–1: 5.0 – 6.4 Ω at 20°C (68°F)
HO2S–2: 11.7 – 14.3 Ω at 20°C (68°F)

1. Viewed from terminal side

3) Connect sensor connector securely.

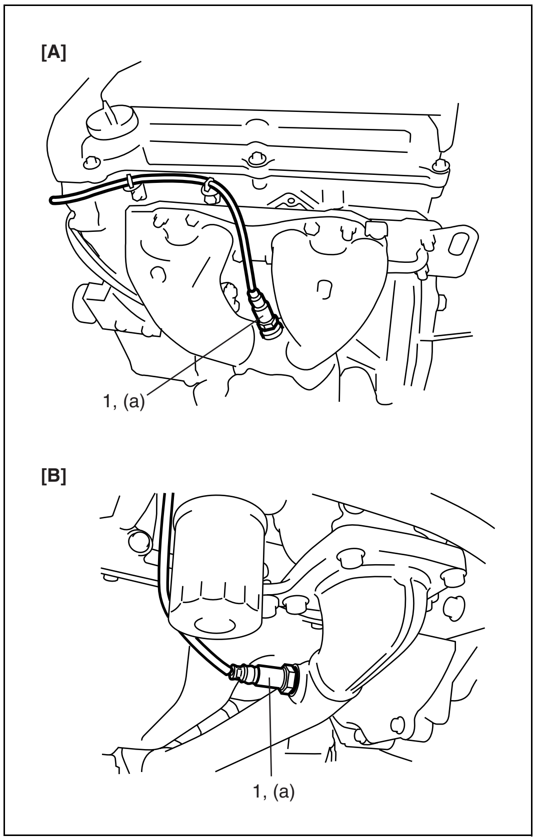
Heated oxygen sensor (HO2S-1 and HO2S-2) removal and installation

Removal

WARNING:

To avoid danger of being burned, do not touch exhaust system when system is hot. Oxygen sensor removal should be performed when system is cool.

1) Disconnect negative cable at battery.
2) For HO2S–1, disconnect connector of heated oxygen sensor and release its wire harness from clamps.
3) Remove front bumper and engine front cover.
4) For HO2S–2, disconnect connector of heated oxygen sensor and release its wire harness from clamp and hoist vehicle.
5) Remove heated oxygen sensor (1) from exhaust pipe.



Installation

Reverse removal procedure noting the following.

- Tighten heated oxygen sensor (1) to specified torque.

Tightening torque
Heated oxygen sensor (a): 45 N·m (4.5 kg-m, 32.5 lb-ft)

- Connect connector of heated oxygen sensor (1) and clamp wire harness securely.
- After installing heated oxygen sensor (1), start engine and check that no exhaust gas leakage exists.

[A]:	HO2S–1
[B]:	HO2S–2

Camshaft position sensor (CMP sensor) and its circuit inspection

1) Confirm that terminal voltages and ground circuit continuity at CMP sensor connector terminals are in good condition referring to Step 3 and 5 of “DTC P0340 Diag. Flow” in Section 6-2.
   If not, repair CMP sensor circuit.
2) Check that CMP sensor signal voltage varies from low to high or from high to low as specified referring to Step 7 of “DTC P0340 Diag. Flow” in Section 6-2.
   If signal voltage varies as specified, CMP sensor is in good condition.
   If not, replace CMP sensor.

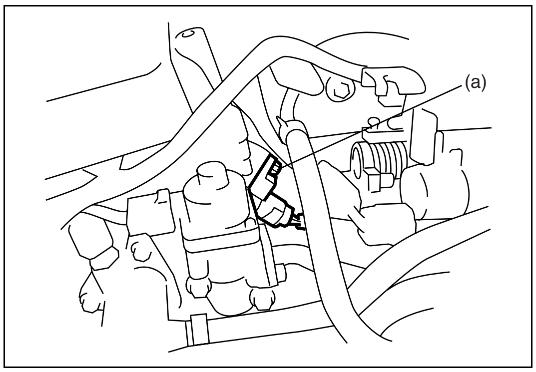
Camshaft position sensor (CMP sensor) removal and installation

Removal

1) Disconnect negative cable at battery.
2) Disconnect connector from camshaft position sensor.
3) Remove camshaft position sensor from cylinder head.

Installation

1) Check that O-ring is free from damage.
2) Check that camshaft position sensor and signal rotor teeth are free from any metal particles and damage.



3) Install camshaft position sensor to cylinder head.

Tightening torque
Camshaft position sensor bolt
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

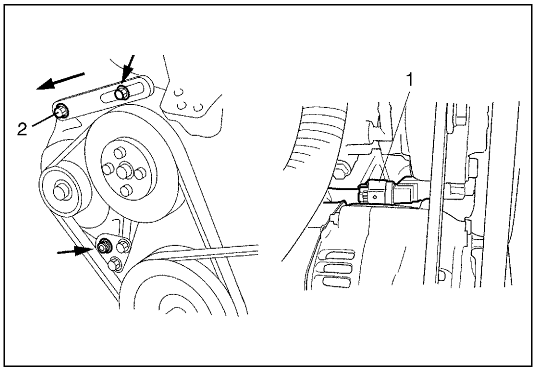
4) Connect connector to it securely.
5) Connect negative cable to battery.

Crankshaft position sensor (CKP sensor) and its circuit inspection

1) Confirm that terminal voltages and ground circuit continuity at CKP sensor connector terminals are in good condition referring to Step 3 and 5 of “DTC P0335 Diag. Flow” in Section 6-2.
   If not, repair CKP sensor circuit.
2) Check that CKP sensor signal voltage varies from low to high or from high to low as specified referring to Step 7 of “DTC P0335 Diag. Flow” in Section 6-2.
   If signal voltage varies as specified, CKP sensor is in good condition.
   If not, replace CKP sensor.

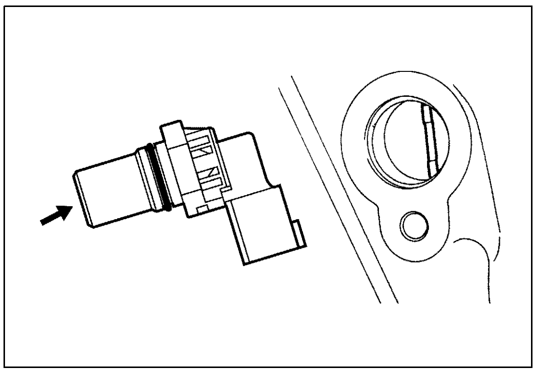
Crankshaft position sensor (CKP sensor) removal and installation

Removal



1) Disconnect negative cable at battery.
2) Remove generator drive belt, loosen pivot bolt (2) and move generator rearward.
3) Disconnect connector from crankshaft position sensor.
4) Remove crankshaft position sensor (1) from cylinder block.

Installation



1) Check to make sure that crankshaft position sensor and pulley teeth are free from any metal particles and damage.
2) Install crankshaft position sensor to cylinder block.
3) Connect connector to it securely.
4) Adjust generator belt tension, refer to “Water Pump/Generator Drive Belt Tension Inspection and Adjustment” in Section 6B2.
5) Connect negative cable to battery.

Fuel Level Sensor Removal and Installation

Refer to “Fuel Pump Assembly Removal and Installation” in Section 6C.

Fuel Level Sensor Inspection

Refer to “Fuel Meter/Fuel Gauge Unit” in Section 8C.

Vehicle speed sensor (VSS) and its circuit inspection

1) Confirm that terminal voltage and ground circuit continuity at VSS connector terminals are in good condition referring to Step 3 to 5 of “DTC P0500 Diag. Flow” in Section 6-2.
   If not, repair VSS circuit.
2) Check that VSS signal voltage varies from low to high or from high to low as specified voltage referring to Step 9 of “DTC P0500 Diag. Flow” in Section 6-2.
   If signal voltage varies as specified, VSS is in good condition.
   If not, replace VSS.

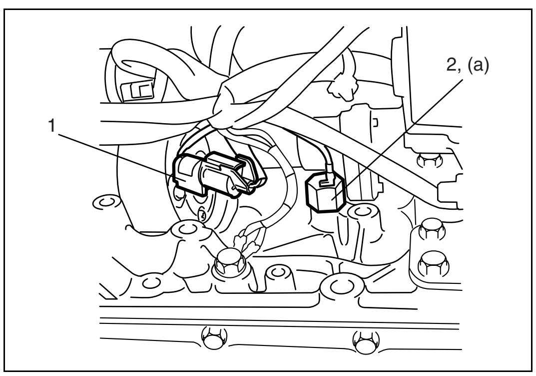
Vehicle speed sensor (VSS) removal and installation

Refer to “Vehicle Speed Sensor (VSS) Removal and Installation” in Section 7A2.

Knock sensor removal and installation

Removal

1) Disconnect negative cable from battery.
2) Hoist vehicle.



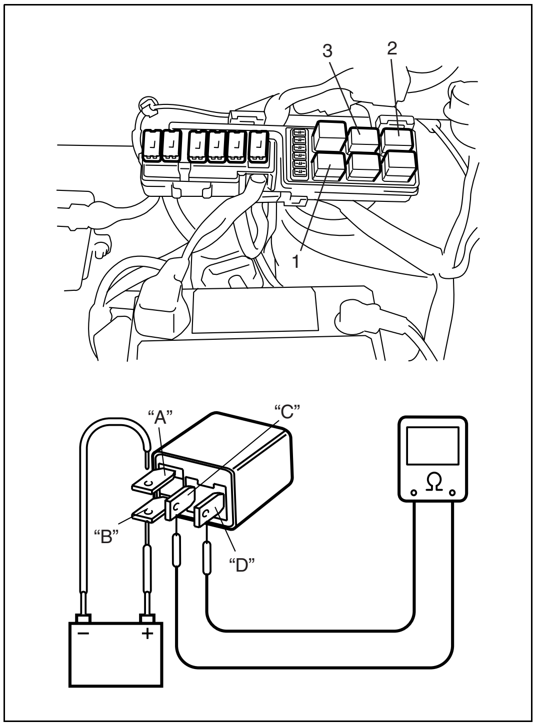
3) Disconnect knock sensor connector (1).
4) Remove knock sensor (2) from cylinder block.

Installation

Reverse removal procedure for installation.

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

Main relay, fuel pump relay and radiator fan relay inspection

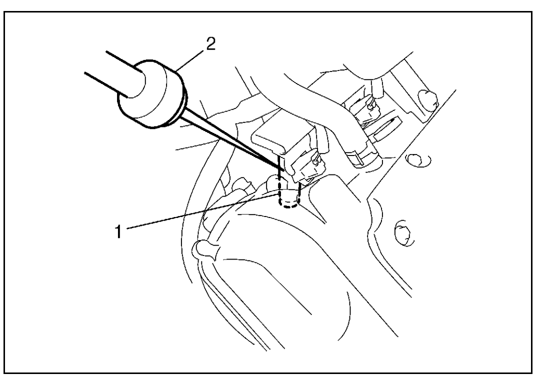


1) Disconnect negative cable at battery.
2) Remove main relay (1), fuel pump relay (2) and radiator fan relay (3) from relay box.
3) Check that there is no continuity between terminal "C" and "D". If there is continuity, replace relay.
4) Connect battery positive (+) terminal to terminal "B" of relay. Connect battery negative (–) terminal "A" of relay. Check continuity between terminal "C" and "D". If there is no continuity when relay is connected to the battery, replace relay.

Fuel cut operation inspection

NOTE:

Before inspection, check to make sure that gear shift lever is in neutral position (with A/T model, selector lever in "P" range), A/C is OFF and that parking brake lever is pulled all the way up.



1) Warm up engine to normal operating temperature.
2) While listening to sound of injector (1) by using sound scope (2) or such, increase engine speed to higher than 3,000 r/min.
3) Check to make sure that sound to indicate operation of injector stops when throttle valve is closed instantly and it is heard again when engine speed is reduced to less than about 2,000 r/min.

Radiator fan control system inspection

System Inspection

WARNING:

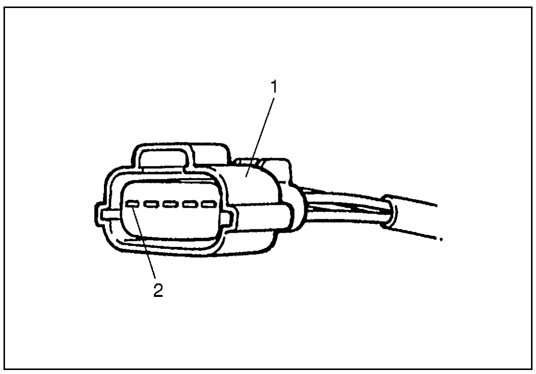
Keep hands, tools, and clothing away from engine cooling fan to help prevent personal injury. This fan is electric and can come on whether or not the engine is running. The fan can start automatically in response to the ECT sensor with the ignition switch in the "ON" position.

Check system for operation referring to "Diag. Flow Table B-7" in Section 6-2.

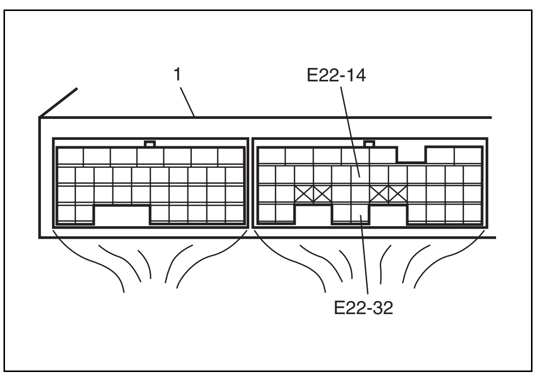
If radiator fan fails to operate properly, check relay, radiator fan and electrical circuit.

Mass air flow (MAF) and intake air temperature (IAT) sensor on-vehicle inspection

1) Disconnect negative cable at battery.
2) Disconnect MAF and IAT sensor connector.



3) Connect voltmeter to "BLK/RED" wire terminal (2) of MAF and IAT sensor coupler (1) disconnected and ground.
4) Turn ignition switch ON and check that voltage is battery voltage.
   If not, check if wire harness is open or connection is poor.



5) Turn ignition switch OFF and connect coupler to MAF and IAT sensor.
6) Turn ignition switch ON and check MAF signal voltage between "E22-14" terminal and "E22-32" terminal of ECM coupler.

MAF signal voltage of MAF and IAT sensor at ignition switch ON: 0.5 – 1.0 V

1. ECM

7) Start engine and check that voltage is lower than 5 V and it rises as engine speed increases.

MAF signal reference voltage of MAF and IAT sensor at specified Idle speed: 1.3 – 1.8 V

8) If check result is not as specified above, cause may lie in wire harness, coupler connection, MAF and IAT sensor or ECM.

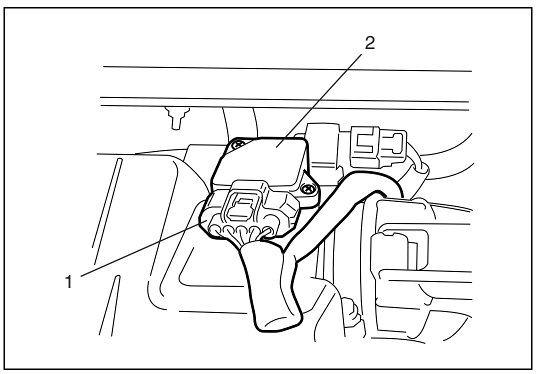
Mass air flow (MAF) and intake air temperature (IAT) sensor removal and installation

CAUTION:

- **Do not disassemble MAF and IAT sensor.**
- **Do not expose MAF and IAT sensor to any shock.**
- **Do not cleansing MAF and IAT sensor.**
- **If MAF and IAT sensor has been dropped, it should be replaced.**
- **Do not below compressed air by using air gun or the like.**
- **Do not put finger or any other object into MAF and IAT sensor. Malfunction may occur.**

Removal

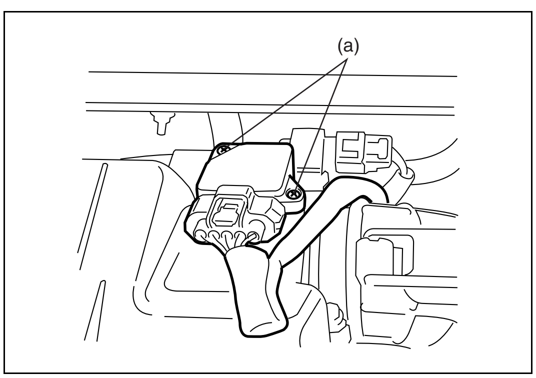
1) Disconnect negative cable at battery.



2) Disconnect MAF and IAT sensor coupler (1).
3) Remove MAF and IAT sensor (2) from air cleaner assembly.

Installation

Reverse removal procedure noting the followings.



- Tighten MAF and IAT sensor screws to specified torque.

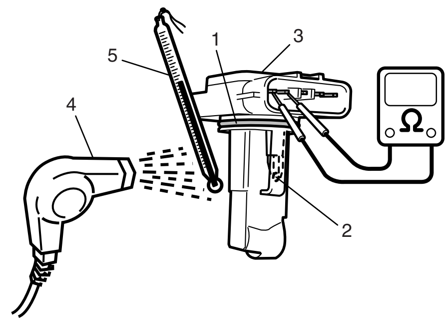
Tightening torque
MAF sensor screw (a): 2.5 N·m (0.25 kg-m, 1.8 lb-ft)

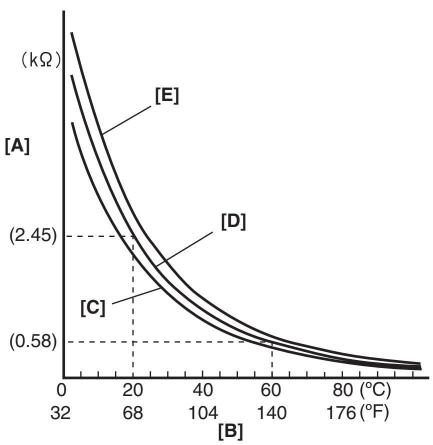
- Connect MAF and IAT sensor coupler securely.

Mass air flow (MAF) and intake air temperature (IAT) sensor inspection

CAUTION:

Do not heat up the MAF and IAT sensor more than 100°C (212°F). Otherwise, the MAF and IAT sensor is damaged.





- Check sensor O-ring (1) for damage and deterioration. Replace as necessary.
- Blow hot air to temperature sensing part (2) of MAF and IAT sensor (3) using hot air drier (4) and measure resistance between sensor terminals while heating air gradually.
  If measured resistance does not show such characteristic as shown, replace MAF and IAT sensor.

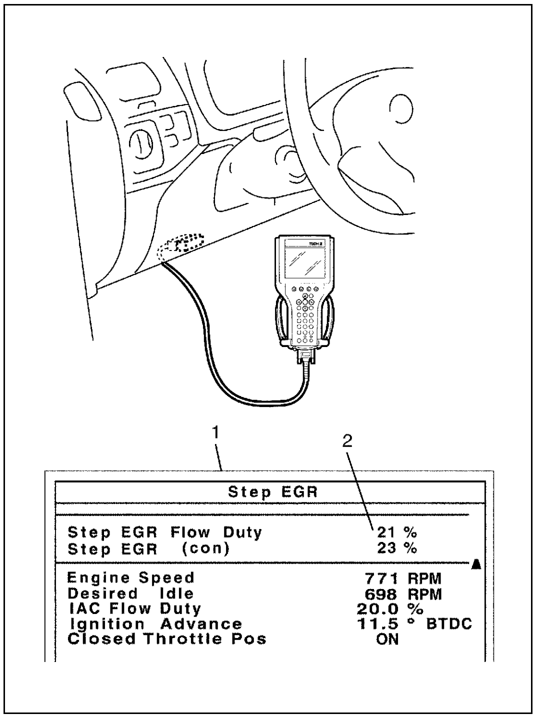
Intake air temperature sensor resistance

Temperature	Resistance
20°C (68°F)	2.21 – 2.69 kΩ
60°C (140°F)	0.493 – 0.667 kΩ

[A]:	Resistance
[B]:	Temperature
[C]:	Lower limit
[D]:	Nominal
[E]:	Upper limit
5.	Temperature gauge

Emission Control System

EGR system inspection



1) Connect SUZUKI scan tool to data link connector (DLC) with ignition switch turn OFF.
2) Turn ON ignition switch and erase DTC using “CLEAR DTC” in “TROUBLU CODES” menu.
3) Start engine and warm up it to normal operating temperature then select “DTATA LIST” mode on scan tool.
4) Make sure that vehicle condition is as following.
   - Vehicle speed = 0 km/h (0 KPH)
   - Engine speed ≤ 900 rpm
   - Engine coolant temp. ≥ 90°C, 164°F
5) With engine idling (without depressing accelerator pedal), open EGR valve using “STEP EGR” mode in “MISC. TEST” menu.
   In this state, according as EGR valve opening increases engine idle speed drops. If not, possible cause is clogged EGR gas passage, stuck or faulty EGR valve.

1.	SUZUKI scan tool display
2.	EGR valve opening (0: Close, 100: Full Open)

EGR valve removal and installation

Removal

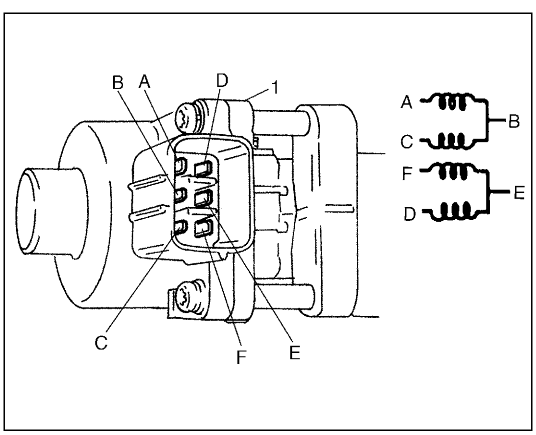
1) Disconnect negative cable at battery.
2) Remove air intake pipe.
3) Remove EGR pipe.
4) Disconnect EGR valve connector.
5) Remove EGR valve and gasket from cylinder head.

Installation

Reverse removal procedure noting following.

- Clean mating surface of valve and cylinder head.
- Use new gaskets.

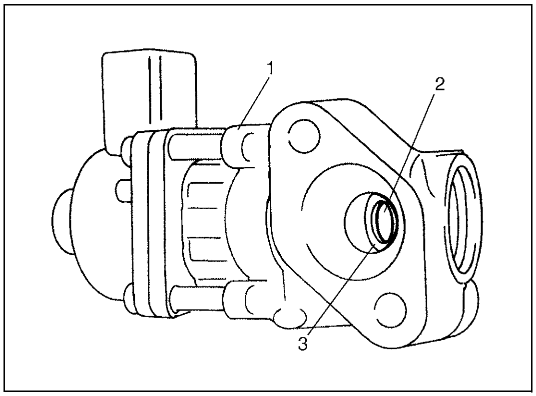
EGR valve inspection



1) Check resistance between following terminals of EGR valve (1) in each pair.
   If found faulty, replace EGR valve assembly.

EGR valve resistance

Terminal	Standard resistance
A – B C – B F – E D – E	20 – 24 Ω



2) Remove carbon from EGR valve gas passage.

NOTE:

Do not use any sharp–edged tool to remove carbon.
Be careful not to damage or bend EGR valve (1), valve seat (3) and rod.

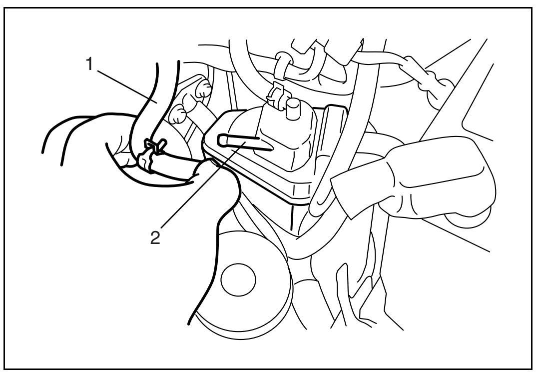
3) Inspect valve (2), valve seat and rod for fault, cracks, bend or other damage.
If found faulty, replace EGR valve assembly.

Evaporative emission control system inspection

EVAP Canister Purge

NOTE:

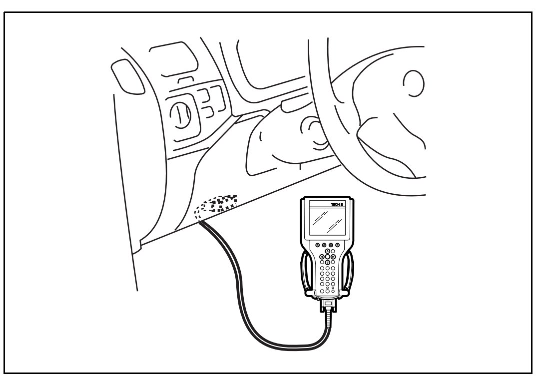
Before inspection, check to make sure that gear shift lever is in neutral position (with A/T model, selector lever in "P" range) and that parking brake lever is pulled all the way up.



1) Disconnect purge hose (1) from EVAP canister (2).
2) Place finger against the end of disconnected hose and check that vacuum is not felt there when engine is cool and running at idle speed.
If check result is not satisfactory, check EVAP canister purge valve, wire harness and ECM.

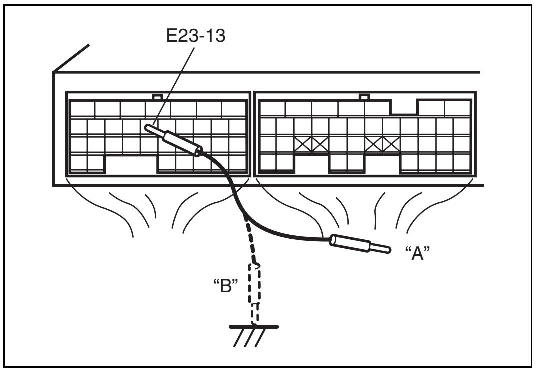
EVAP Canister Purge Valve and Its Circuit

1) Prepare to operate EVAP canister purge valve as follows.
   a) When using SUZUKI scan tool:

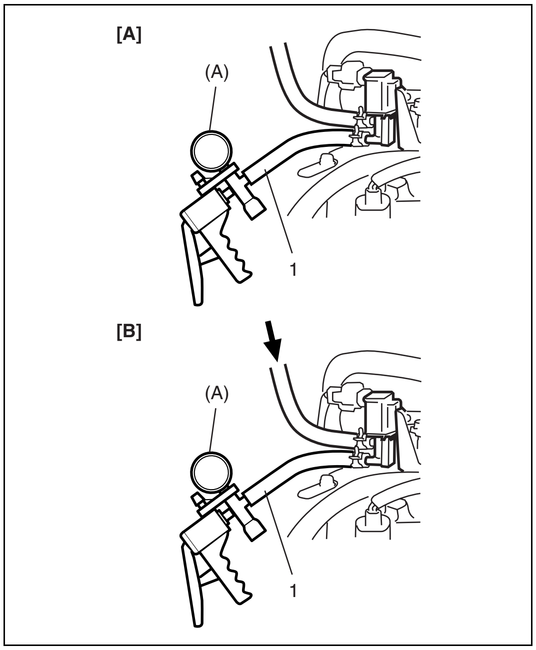


   i) Connect SUZUKI scan tool to DLC with ignition switch OFF and disconnect purge valve vacuum hoses from intake manifold and purge valve chamber.
   ii) Turn ON ignition switch, clear DTC and select "MISC TEST" mode on SUZUKI scan tool.

   b) When not using SUZUKI scan tool:
   i) Disconnect purge valve vacuum hoses from intake manifold and purge valve chamber.



ii) Turn ON ignition switch.
Using service wire, ground "E23-13" terminal of ECM connector (valve ON) "B" and unground it (valve OFF) "A".

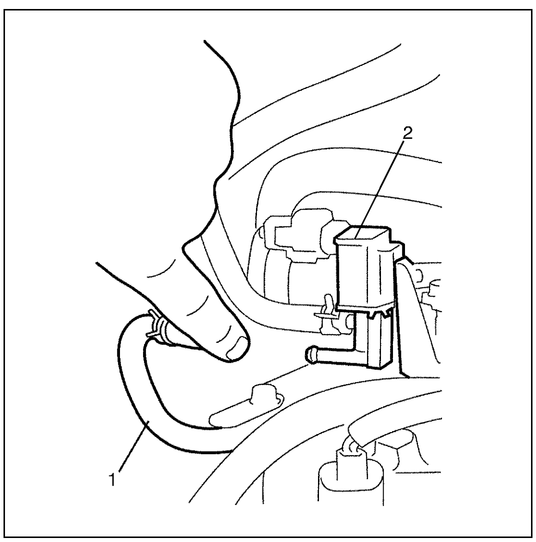


2) Check purge valve for operation and vacuum passage for clog when valve is switched ON and OFF by using SUZUKI scan tool or service wire.
If check result is not described, check vacuum hoses, EVAP canister purge valve, wire harness and connections.

EVAP canister purge valve specification
[A] Valve OFF:
When vacuum is applied to hose (1), vacuum can be applied.
[B] Valve ON:
When vacuum is applied to hose (1), vacuum can not be applied.

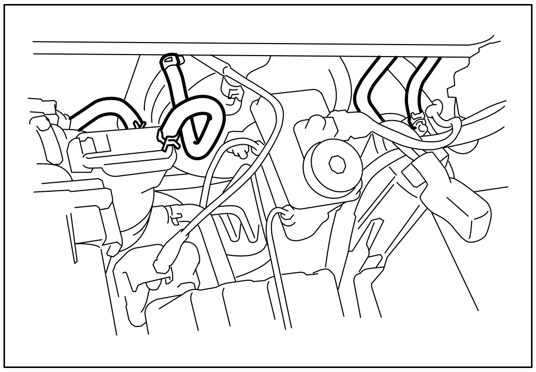
Special tool
(A): 09917-47911

Vacuum Passage



Start engine and run it at idle speed. Disconnect vacuum hose (1) from EVAP canister purge valve (2). With finger placed against hose disconnected, check that vacuum is applied.
If it is not applied, clean vacuum passage by blowing compressed air.

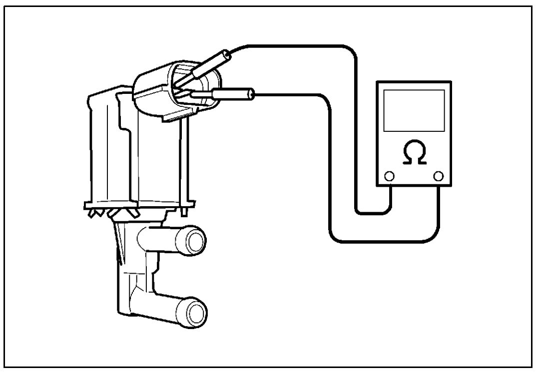
Vacuum Hose



Check hoses for connection, leakage, clog and deterioration. Replace as necessary.

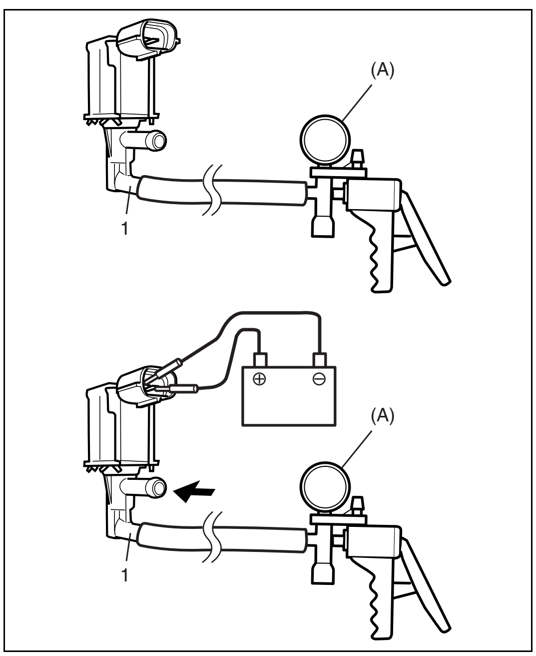
EVAP Canister Purge Valve

1) With ignition switch OFF, disconnect coupler from canister purge valve.
2) Remove EVAP canister purge valve from air cleaner assembly.



3) Check resistance between two terminals of EVAP canister purge valve.
   If resistance is not as specified, replace.

EVAP canister resistance
30 – 34 Ω at 20°C (68°F)



4) With coupler disconnected, apply vacuum to pipe (1).
   If vacuum can be appied, go to next step.
   If vacuum can not be applied, replace EVAP canister purge valve.
5) Connect 12 V-battery to EVAP canister purge valve terminals. In this state, apply vacuum to pipe (1).
   If vacuum can not be applied, EVAP canister purge valve is in good condition.
   If applied, replace EVAP canister purge valve.

WARNING:
Do not suck the air through valve. Fuel vapor inside valve in harmful.

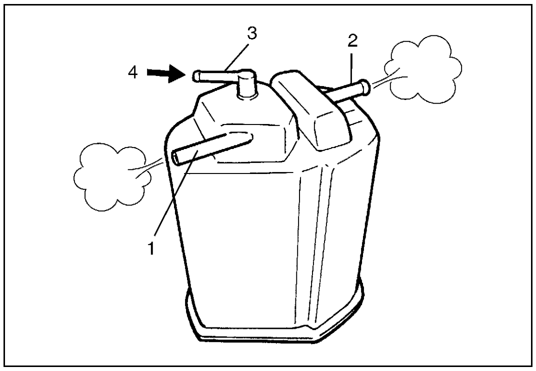
Special tool
(A): 09917-47911

6) Install EVAP canister purge valve to air cleaner assembly.

EVAP Canister

WARNING:
DO NOT SUCK nozzles on EVAP canister. Fuel vapor inside EVAP canister is harmful.

1) Check outside of EVAP canister visually.
2) Disconnect vacuum hoses from EVAP canister.



3) Check that there should be no restriction of flow through purge pipe (1) and air pipe (2) when air is blown (4) into tank pipe (3).
   If any faulty condition is found in above inspection, replace.

PCV system inspection

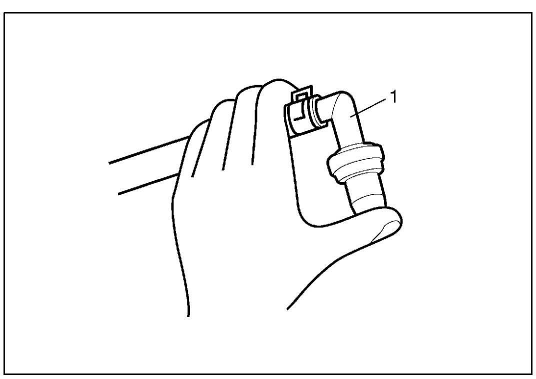
NOTE:
Be sure to check that there is no obstruction in PCV valve or its hoses before checking IAC duty, for obstructed PCV valve or hose hampers its accurate adjustment.

PCV Hose

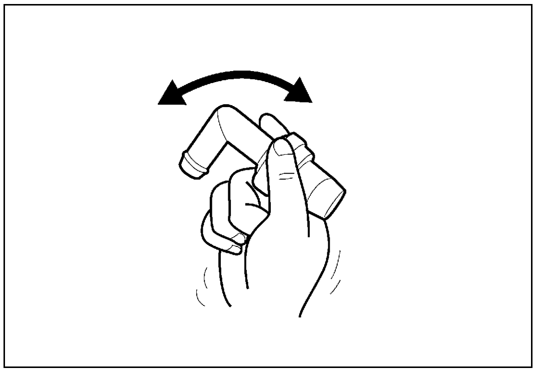
Check hoses for connection, leakage, clog and deterioration. Replace as necessary.

PCV Valve

1) Detach air cleaner assembly.
2) Disconnect PCV valve from cylinder head cover and install plug to head cover hole.
3) Install air cleaner assembly temporarily.
4) Run engine at idle.

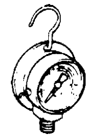
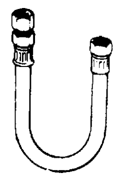
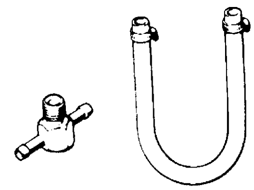
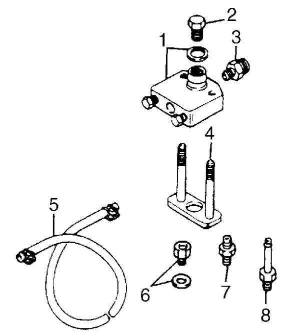
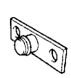
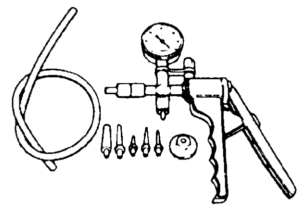
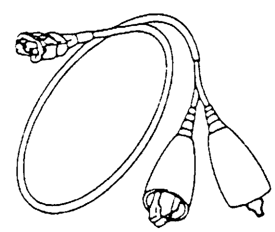
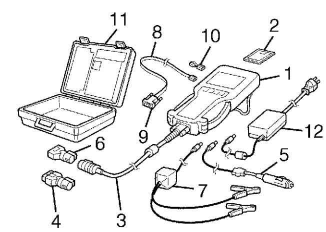


5) Place your finger over end of PCV valve (1) to check for vacuum.
   If there is no vacuum, check for clogged valve. Replace as necessary.



6) 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 the rattle, replace valve.
7) After checking, remove plug and install PCV valve.
8) Install air cleaner assembly securely.

Special Tool

 09912-58442 Pressure gauge	 09912-58432 Pressure hose	 09912-58490 3-way joint & hose	 09912-58421 Checking tool set (See NOTE "A".)
 09912-57610 Checking tool plate	 09917-47911 Vacuum pump gauge	 09930-88530 Injector test lead	 Tech 2 kit (SUZUKI scan tool) (See NOTE "B".)

NOTE:
- **"A": This kit includes the following items.**
  1. Tool body & washer, 2. Body plug, 3. Body attachment-1, 4. Holder, 5. Return hose & clamp, 6. Body attachment-2 & washer, 7. Hose attachment-1, 8. Hose attachment-2
- **"B": This kit includes the following items.**
  1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adaptor, 5. Cigarette cable, 6. DLC loopback adaptor, 7. Battery power cable, 8. RS232 cable, 9. RS232 adaptor, 10. RS 232 loopback connector, 11. Storage case, 12. Power supply

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
TP sensor mounting screw	2.5	0.25	1.8
IAC valve screw	3.5	0.35	2.5
ECT sensor	15	1.5	11.5
Heated oxygen sensor	45	4.5	32.5
Camshaft position sensor	10	1.0	7.5
Knock sensor	22	2.2	16.0
Oil control valve mounting nut	11	1.1	8.0
Oil gallery pipe No.1 bolt	30	3.0	21.5
Delivery pipe bolt	25	2.5	18.0
MAF and IAT sensor screw	2.5	0.25	1.8
Accelerator cable lock nut	12	1.2	9.0

SECTION 6F2

IGNITION SYSTEM (M13 ENGINE)

WARNING:

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

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

CONTENTS

General Description

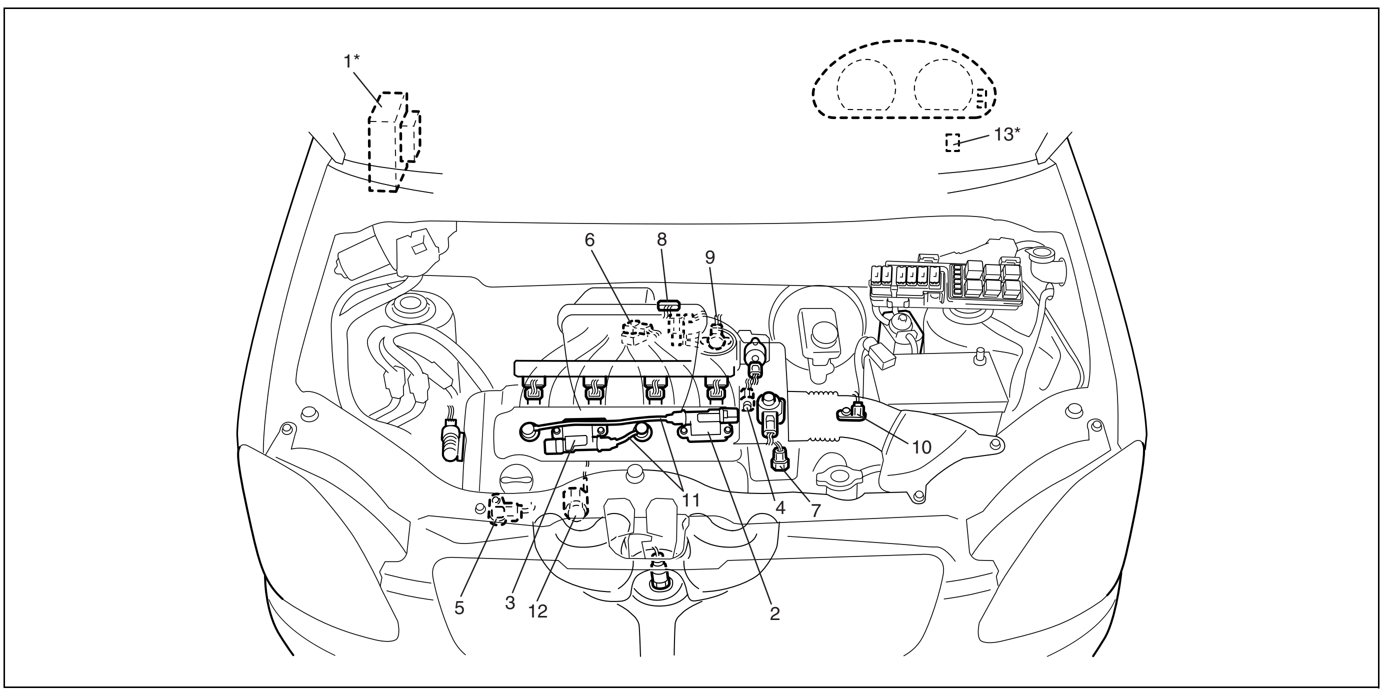
Ignition System Construction

The ignition system is an electronic (distributorless) ignition system. Its consists of the parts as described below.

- ECM
  It detects the engine and vehicle conditions through the signals from the sensors, determines the most suitable ignition timing and time for electricity to flow to the primary coil and sends a signal to the ignitor (power unit) in the ignition coil assembly.
- Ignition coil assembly (including an igniter)
  The ignition coil assembly has a built-in ignitor which turns ON and OFF the current flow to the primary coil according to the signal from ECM. When the current flow to the primary coil is turned OFF, a high voltage is induced in the secondary coil.
- High tension cords and spark plugs.
- CMP sensor (Camshaft position sensor) and CKP sensor (Crankshaft position sensor)
  Using signals from these sensors, ECM identifies the specific cylinder whose piston is in the compression stroke, detects the crank angle and adjusts ignition timing automatically.
- TP sensor, ECT sensor, MAP sensor, MAF sensor, IAT sensor and other sensors/switches
  Refer to “Electronic Control System” in Section 6E2 for details.

Although this ignition system does not have a distributor, it has two ignition coil assemblies (one is for No.1 and No.4 spark plugs and the other is for No.2 and No.3 spark plugs). When an ignition signal is sent from ECM to the ignitor in the ignition coil assembly for No.1 and No.4 spark plugs, a high voltage is induced in the secondary coil and that passes through the high-tension cords and causes No.1 and No.4 spark plugs to spark simultaneously. Likewise, when an ignition signal is sent to the ignitor in the other ignition coil assembly, No.2 and No.3 spark plugs spark simultaneously.

Ignition System Components Locator Diagram

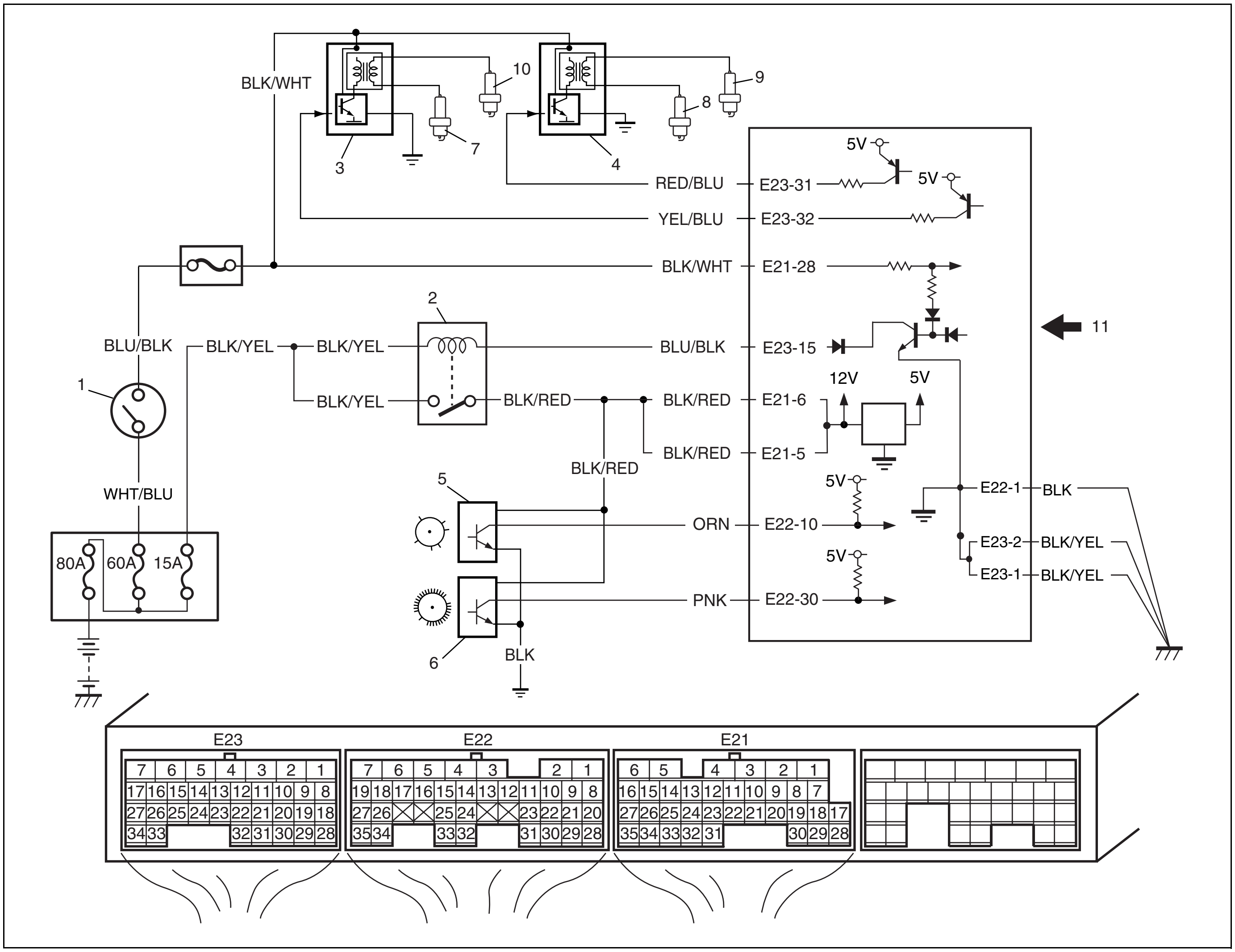


1. ECM	4. CMP sensor	7. ECT sensor	10. VSS	13. Data link connector
2. Ignition coil assembly for No.1 and No.4 spark plugs	5. CKP sensor	8. MAF and IAT sensor	11. High-tension cords	
3. Ignition coil assembly for No.2 and No.3 spark plugs	6. MAP sensor	9. TP sensor	12. Knock sensor	

NOTE:

Above figure shows left-hand steering vehicle. For right-hand steering vehicle, parts with (*) are installed at the opposite side.

Ignition System Wiring Circuit Diagram



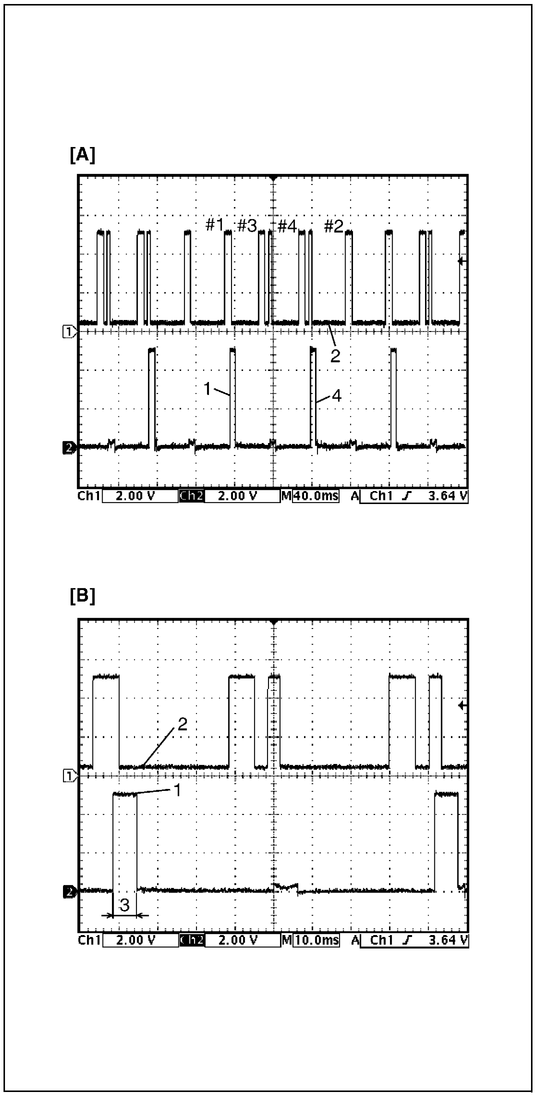
1. Ignition switch	7. No.1 spark plug
2. Main relay	8. No.2 spark plug
3. Ignition coil assembly for No.1 and No.4 spark plugs	9. No.3 spark plug
4. Ignition coil assembly for No.2 and No.3 spark plugs	10. No.4 spark plug
5. CMP sensor	11. Sensed information (MAP sensor, ECT sensor, MAF and IAT sensor, TP sensor, Knock sensor, VSS, Electric load signal, Engine start signal)
6. CKP sensor	

Diagnosis

Ignition System Symptom Diagnosis

Condition	Possible Cause	Correction
Engine cranks, but will not start or hard to start (No spark)	Blown fuse for ignition coil	Replace.
	Loose connection or disconnection of lead wire or high-tension cord(s)	Connect securely.
	Faulty high-tension cord(s)	Replace.
	Faulty spark plug(s)	Replace.
	Faulty ignition coil	Replace ignition coil assembly.
	Faulty CKP sensor or CKP sensor plate	Clean, tighten or replace.
	Faulty CMP sensor or sensor rotor tooth of camshaft	Clean, tighten or replace.
	Faulty ECM	Replace.
Poor fuel economy or engine performance	Incorrect ignition timing	Check related sensors and CKP sensor plate.
	Faulty spark plug(s) or high-tension cord(s)	Adjust, clean or replace.
	Faulty ignition coil assembly	Replace.
	Faulty CKP sensor or CKP sensor plate	Clean, tighten or replace.
	Faulty CMP sensor or sensor rotor tooth of camshaft	Clean, tighten or replace.
	Faulty ECM	Replace.

Reference Waveform



Oscilloscope waveforms of CMP sensor and No.1/No.4 ignition trigger signal are as shown in figure when connecting oscilloscope between terminals E22-10 of ECM connectors connected to ECM and ground, and between terminal E23-32 and ground.

Measurement condition for waveform [A]

Measurement terminal	**CH1: E22-10 to E23-1** **CH2: E23-32 to E23-1**
Oscilloscope setting	**CH1: 2 V/DIV, CH2: 2 V/DIV** **TIME: 40 ms/DIV**
Measurement condition	**After warmed up engine to normal operating temperature** **Engine at specified idle speed**

Measurement condition for waveform [B]

Measurement terminal	**CH1: E22-10 to E23-1** **CH2: E23-32 to E23-1**
Oscilloscope setting	**CH1: 2 V/DIV, CH2: 2 V/DIV** **TIME: 10 ms/DIV**
Measurement condition	**After warmed up engine to normal operating temperature** **Engine at specified idle speed**

[A]:	Oscilloscope waveforms at specified idle speed
[B]:	Detail waveforms at specified idle speed
1.	No.1 ignition trigger signal
2.	CMP sensor signal
3.	Primary coil current flow time
4.	No.4 ignition trigger signal

Ignition System Diagnostic Flow Table

Step	Action	Yes	No
1	Was “Engine and Emission Control System Check” in Section 6-2 performed?	Go to Step 2.	Go to “Engine and Emission Control System Check” in Section 6-2.
2	Ignition Spark Test 1) Check all spark plugs for condition and type referring to “Spark Plugs Inspection” 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.	Go to Step 3.
3	Diagnostic Trouble Code (DTC) Check Is DTC stored in ECM?	Go to applicable DTC Diag. Flow Table in Section 6-2.	Go to Step 4.

Step	Action	Yes	No
4	Electrical Connection Check 1) Check ignition coil assemblies and high-tension cords for electrical connection. Are they connected securely?	Go to Step 5.	Connect securely.
5	High-tension Cords Check 1) Check high-tension cord for resistance referring to “High-Tension Cords Inspection” in this section. Is check result satisfactory?	Go to Step 6.	Replace high-tension cord(s).
6	Ignition Coil Assembly Power Supply and Ground Circuit Check 1) Check ignition coil assembly power supply and ground circuits for open and short. Are circuits in good condition?	Go to Step 7.	Repair or replace.
7	Ignition Coil Assembly Check 1) Check ignition coil for resistance referring to “Ignition Coil Assembly (Including Ignitor) Inspection” in this section. Is check result satisfactory?	Go to Step 8.	Replace ignition coil assembly.
8	Crankshaft Position (CKP) Sensor Check 1) Check crankshaft position sensor referring to “Crank Position Sensor (CKP Sensor) Inspection” in Section 6E2. Is check result satisfactory?	Go to Step 9.	Tighten CKP sensor bolt, replace CKP sensor or CKP sensor plate.
9	Ignition Trigger Signal Circuit Check 1) Check ignition trigger signal wire for open, short and poor connection. Is circuit in good condition?	Go to Step 10.	Repair or replace.
10	A Known-good Ignition Coil Assembly Substitution 1) Substitute a known-good ignition coil assembly and then repeat Step 2. Is check result of Step 2 satisfactory?	Go to Step 11.	Substitute a known-good ECM and then repeat Step 2.
11	Ignition Timing Check 1) Check initial ignition timing and ignition timing advance referring to “Ignition Timing Inspection” in this section. Is check result satisfactory?	System is in good condition.	Check CMP sensor, CMP sensor rotor tooth of camshaft, CKP sensor, CKP sensor plate and/or input signals related to this system.

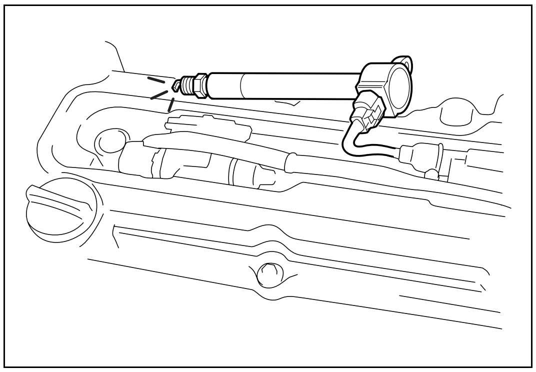
On-Vehicle Service

Ignition Spark Test

1) Remove air cleaner assembly with air intake pipe.
2) Disconnect all injector couplers from injectors.

WARNING:
Without disconnection of injector couplers, combustible gas may come out from spark plug holes during this test and may get ignited in engine room.

3) Remove spark plug and check it for condition and type referring to "Spark Plugs Removal and Installation" in this section.

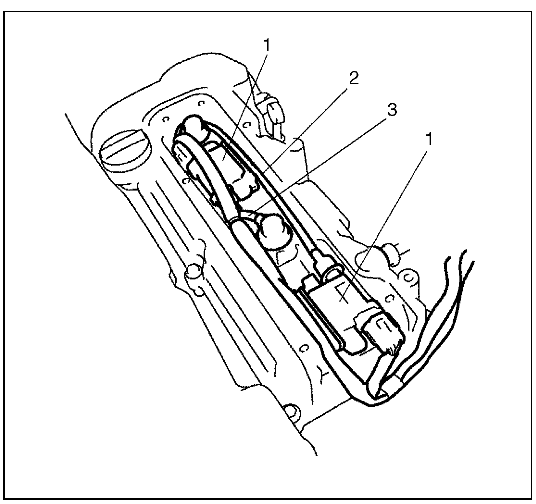


4) If OK, connect ignition coil coupler to ignition coil assembly and connect spark plug to ignition coil assembly or high-tension cord. Ground spark plug.
5) Crank engine and check if each spark plug sparks.
6) If no spark is emitted, inspect the related parts as described under "Ignition System Symptom Diagnosis" in this section.

High-Tension Cords Removal and Installation

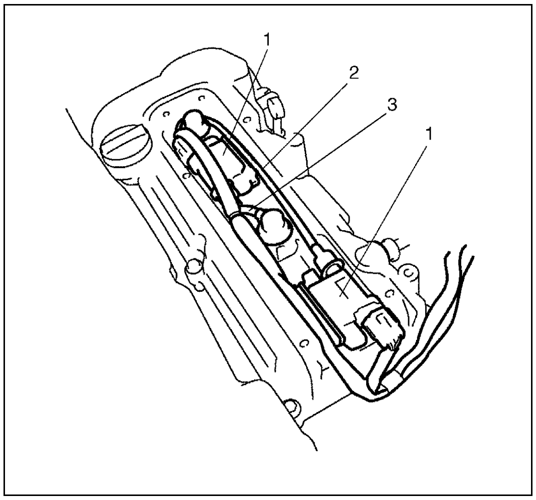
Removal

1) Remove air cleaner assembly with air intake pipe and cylinder head upper cover.



2) Disconnect No.1 cylinder (2) and No.3 cylinder (3) high-tension cords from ignition coil assemblies (1) while gripping each cap.
3) Pull out high-tension cords from spark plugs while gripping each cap.

CAUTION:
- **Removal of high-tension cords together with clamps will be recommended so as not to damage their inside wire (resistive conductor).**
- **For the same reason, pull out each connection by gripping cap portion.**



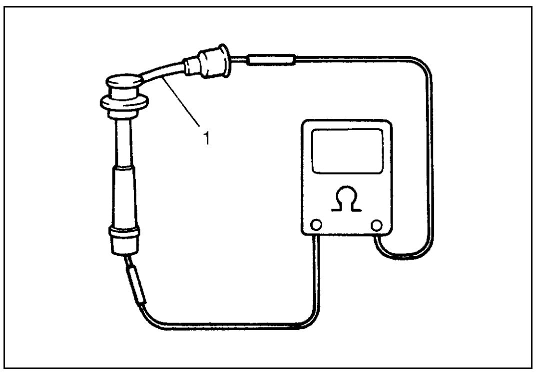
Installation

1) Install No.1 cylinder (2) and No.3 cylinder (3) high-tension cords to spark plugs and ignition coil assemblies (1) while gripping each cap.

> **CAUTION:**
> - **Never attempt to use metal conductor high-tension cords as replacing parts.**
> - **Insert each cap portion fully when installing high-tension cords.**

2) Install cylinder head upper cover and air cleaner assembly with air intake pipe.

High-Tension Cords Inspection



Measure resistance of high-tension cord (1) by using ohmmeter. If resistance exceeds specification, replace high-tension cord(s).

No.1 cylinder high-tension cord resistance
1.4 – 4.0 kΩ

No.3 cylinder high-tension cord resistance
0.6 – 2.0 kΩ

Spark Plugs Removal and Installation

> **CAUTION:**
> - **When servicing the iridium/platinum spark plugs (slender center electrode type plugs), do not touch the center electrode to avoid damage to it. The electrode is not strong enough against mechanical force as it is slender and its material is not mechanically tough**
> - **Do not clean or adjust gap for the iridium/platinum spark plugs.**

Removal

1) Remove air cleaner assembly with air intake pipe and cylinder head upper cover.
2) Pull out high-tension cords by gripping their caps and then remove ignition coil assemblies referring to “Ignition Coil Assembly (Including Ignitor) Removal and Installation” in this section.
3) Remove spark plugs.

Installation

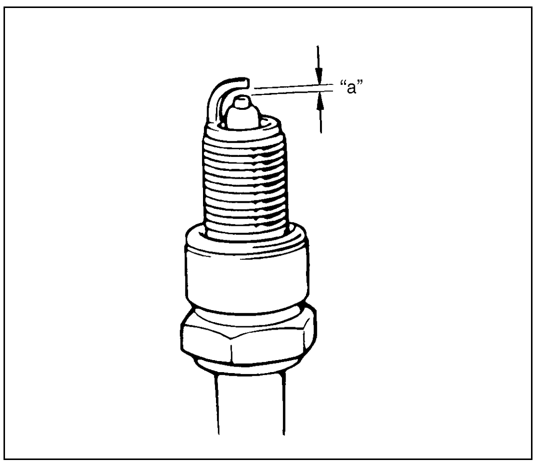
1) Install spark plugs and torque them to specification.

Tightening torque
Spark plug: 25 N·m (2.5 kg-m, 18.0 lb-ft)

2) Install ignition coil assemblies referring to “Ignition Coil Assembly (Including Ignitor) Removal and Installation” in this section.
3) Install high-tension cords securely by gripping their caps.
4) Install cylinder head upper cover and air cleaner assembly with air intake pipe.

Spark Plugs Inspection

- Inspect them for:
  - Electrode wear
  - Carbon deposits
  - Insulator damage



- If any abnormality is found, replace them with new plugs.

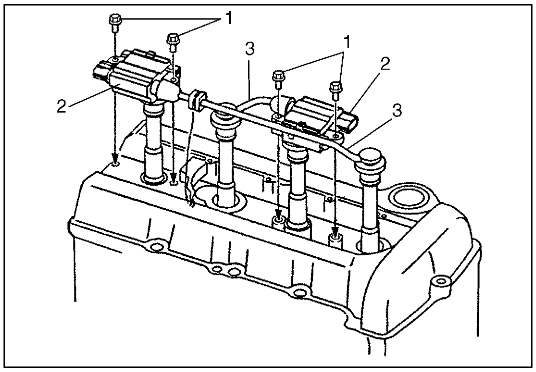
Spark plug air gap
“a”: 1.0 – 1.1 mm (0.040 – 0.043 in.)

Spark plug type
NGK: IFR6J11 (iridium/platinum spark plug)

Ignition Coil Assembly (Including Ignitor) Removal and Installation

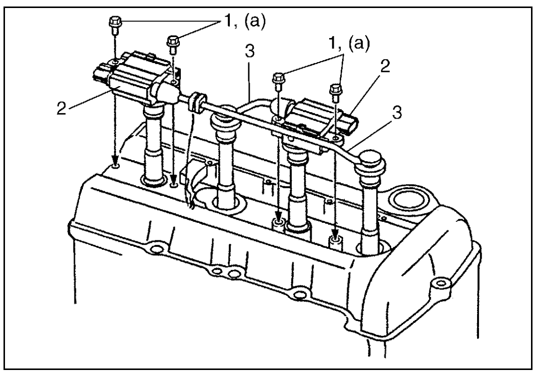
Removal

1) Disconnect negative cable at battery.
2) Remove air cleaner assembly with air intake pipe and cylinder head upper cover.
3) Disconnect ignition coil coupler.



4) Disconnect high-tension cord (3) from ignition coil assembly (2).
5) Remove ignition coil bolts (1) and then pull out ignition coil assembly.

Installation

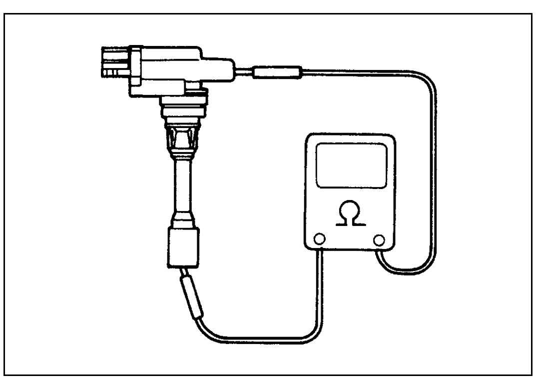


1) Install ignition coil assembly (2).
2) Tighten ignition coil bolts (1) to specified torque, and then connect ignition coil coupler.

Tightening torque
Ignition coil bolt (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

3) Install high-tension cord (3) to ignition coil assembly while gripping its cap.
4) Install cylinder head upper cover and air cleaner assembly with air intake pipe.
5) Connect negative cable to battery.

Ignition Coil Assembly (Including Ignitor) Inspection



Measure secondary coil for resistance.
If resistance is out of specification, replace ignition coil assembly.

Secondary coil resistance
7.1 – 9.5 kΩ at 20°C, 68°F

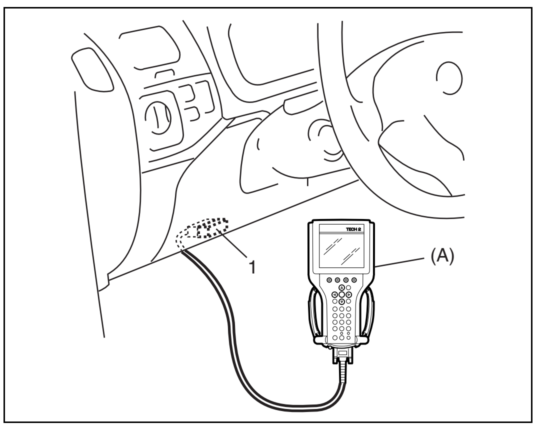
Crankshaft Position (CKP) Sensor

Refer to “Crankshaft Position Sensor (CKP Sensor) Removal and Installation” and “Crankshaft Position Sensor (CKP Sensor) Inspection” in Section 6E2 for removal, inspection and installation.

Ignition Timing Inspection

NOTE:

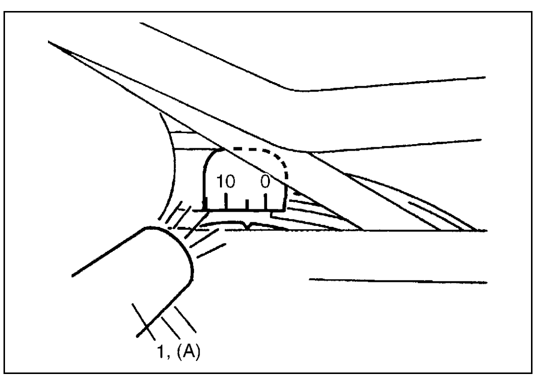
- **Ignition timing is not adjustable. If ignition timing is out of specification, check system related parts.**
- **Before starting engine, place transmission gear shift lever in “Neutral” (shift selector lever to “P” range for A/T model), and set parking brake.**



1) Connect scan tool to DLC (1) with ignition switch OFF.

   Special tool
   (A): SUZUKI scan tool

2) Start engine and warm it up to normal operating temperature.
3) Make sure that all of electrical loads except ignition are switched off.
4) Check to be sure that idle speed is within specification referring to “Idle Speed/Idle Air Control (IAC) Duty Inspection” in Section 6E2.
5) Fix ignition timing by using “Fixed Spark” of “Misc Test” mode on scan tool.



6) Set timing light (1) to high-tension cord for No.1 cylinder and check that ignition timing is within specification.

   Initial ignition timing (fixed with scan tool)
   5 ± 3° BTDC at idle speed

   Ignition order
   1-3-4-2

   Special tool
   (A): 09930 – 76420

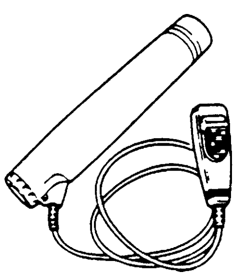
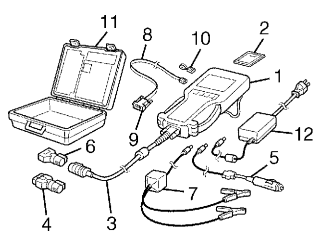
7) If ignition timing is out of specification, check the followings:
   - CKP sensor
   - CKP sensor plate
   - TP sensor
   - CMP sensor
   - CMP sensor rotor tooth of camshaft
   - VSS
   - Timing chain cover installation

8) After checking Initial Ignition Timing, release ignition timing fixation by using scan tool.
9) With engine idling (throttle opening at closed position and car stopped), check that ignition timing is about 3° – 13° BTDC. (Constant variation within a few degrees from 3° – 13° indicates no abnormality but proves operation of electronic timing control system.) Also, check that increasing engine speed advances ignition timing.
   If above check results are not satisfactory, check CKP sensor and ECM.

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Spark plug	25	2.5	18.0
Ignition coil bolt	10	1.0	7.5

Special Tool

 09930-76420 Timing light (Dry cell type)	 Tech 2 kit (SUZUKI scan tool) (See NOTE.)

NOTE:
This kit includes the following items.
1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adapter, 5. Cigarette cable,
6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter, 10. RS232 loopback connector, 11. Storage case, 12. Power supply

SECTION 6G

CRANKING SYSTEM (0.9 KW REDUCTION TYPE)

NOTE:

- **Starting motor vary depending on specifications, etc.**
  Therefore, be sure to check model and specification of the vehicle being serviced before replacing parts.
- **For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.**

CONTENTS

Specifications

Voltage			12 volts
Output			0.9 kW
Rating			30 seconds
Direction of rotation			Clockwise as viewed from pinion side
Brush length			12.3 mm (0.44 in.)
Number of pinion teeth			8
Performance		Condition	Guarantee
Around at 20 °C (68 °F)	No load characteristic	11.0 V	90 A maximum 2,800 rpm minimum
	Load characteristic	8 V 200 A	4.8 N·m (0.48 kg-m, 3.5 lb-ft) minimum 1,260 rpm minimum
	Locked characteristic	3.5 V	550 A maximum 12.2 N·m (1.22 kg-m, 8.8 lb-ft) minimum
	Magnetic switch operating voltage		8 volts maximum

SECTION 6H

CHARGING SYSTEM (G10/M13 ENGINES)

NOTE:
For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.

CONTENTS

Generator

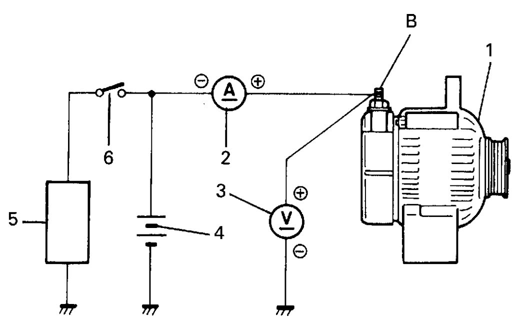
Diagnosis

Undercharged battery

This condition, as evidenced by slow cranking or indicator clear with red dot can be caused by one or more of the following conditions even though indicator lamp may be operating normal.
The following procedure also applies to cars with voltmeter and ammeter.

- Make sure that undercharged condition has not been caused by accessories left on for extended period of time.
- Check drive belt for proper tension.
- If battery defect is suspected referring to BATTERY section.
- Inspect wiring for defects. Check all connections for tightness and cleanliness, battery cable connections at battery, starting motor and ignition ground cable.

No-load Check

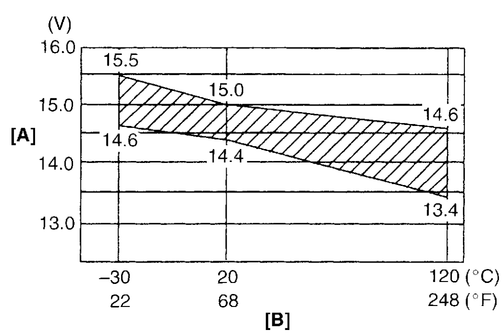


1) Connect voltmeter and ammeter as shown in the figure.

NOTE:

Use fully charged battery.

1.	Generator
2.	Ammeter (between generator (B) terminal and battery (+) terminal)
3.	Voltmetr (between generator (B) terminal and ground)
4.	Battery
5.	Load
6.	Switch



2) Run engine from idling up to 2,000 rpm and read meters.
   If voltage is higher than standard value, check ground of brushes.
   If brushes are not grounded, replace IC regulator.
   If voltage is lower than standard value, proceed to following check.

NOTE:

- **Turn off switches of all accessories (wiper, heater etc.).**
- **Consideration should be taken that voltage will differ somewhat with regulator case temperature as shown in the figure.**

Specification for undercharged battery (No-load check)
Current: 10 A
Standard voltage for G10 engine:
14.4 – 15.0 V at 20°C (68°F)
Standard voltage for M13 engine:
14.2 – 14.8 V at 25°C (77°F)

[A]:	Regulated voltage
[B]:	Regulator case temperature

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.

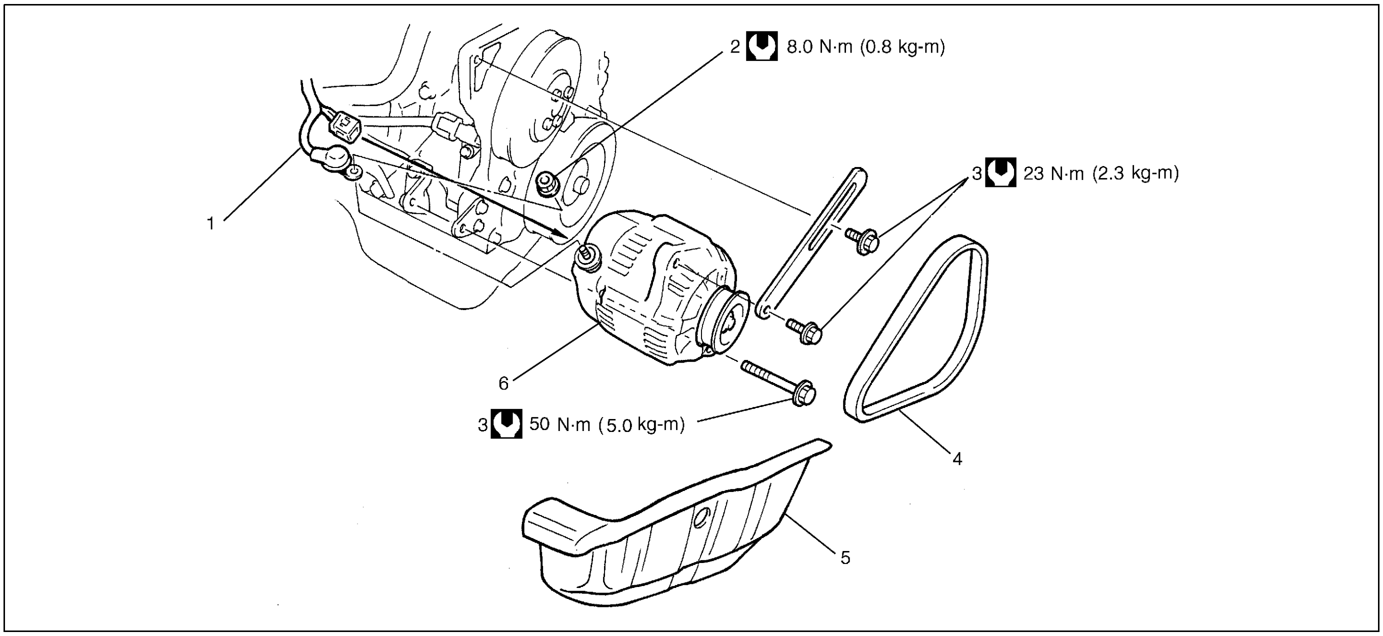
Unit Repair Overhaul

Removal and installation

For G10 Engine

Refer to “Unit Repair Overhaul” in the same section of the Service Manual mentioned in FOREWORD of this manual.

For M13 Engine



1. “B” terminal wire	3. Generator bolt	5. Splash cover	Tightening torque
2. “B” terminal nut	4. Generator belt	6. Generator	

Specifications

Generator

Rated voltage	12 V	
Nominal output	70 A	75 A
Permissible max. speed	18000 r/min.	
No-load speed	1300 r/min (rpm)	
Setting voltage	14.4 to 15.0 V (at 20°C (68°F)	14.2 to 14.8 V (at 25°C (77°F)
Permissible ambient temperature	–30 to 100°C (–22 to 212°F)	
Polarity	Negative ground	
Rotation	Clockwise viewed from pulley side	

SECTION 6K2

EXHAUST SYSTEM (M13 ENGINE)

CONTENTS

General Description

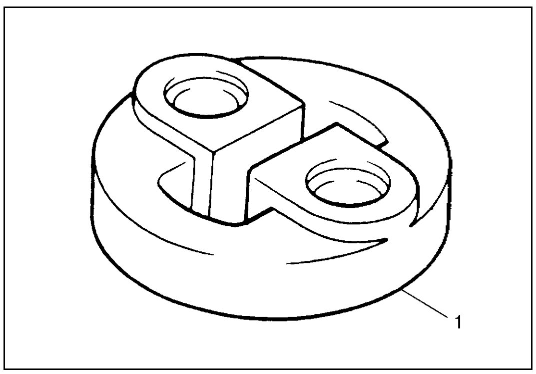
The exhaust system consists of an exhaust manifold, three-way catalytic converter (TWC) in catalyst case, exhaust pipes, a muffler and seals, gasket and etc.
The three-way catalytic converter is an emission control device added to the exhaust system to lower the levels of Hydrocarbon (HC), Carbon Monoxide (CO), and Oxides of Nitrogen (NOx) pollutants in the exhaust gas.

Maintenance

WARNING:

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

At every interval of periodic maintenance service, and when vehicle is raised for other service, check exhaust system as follows:

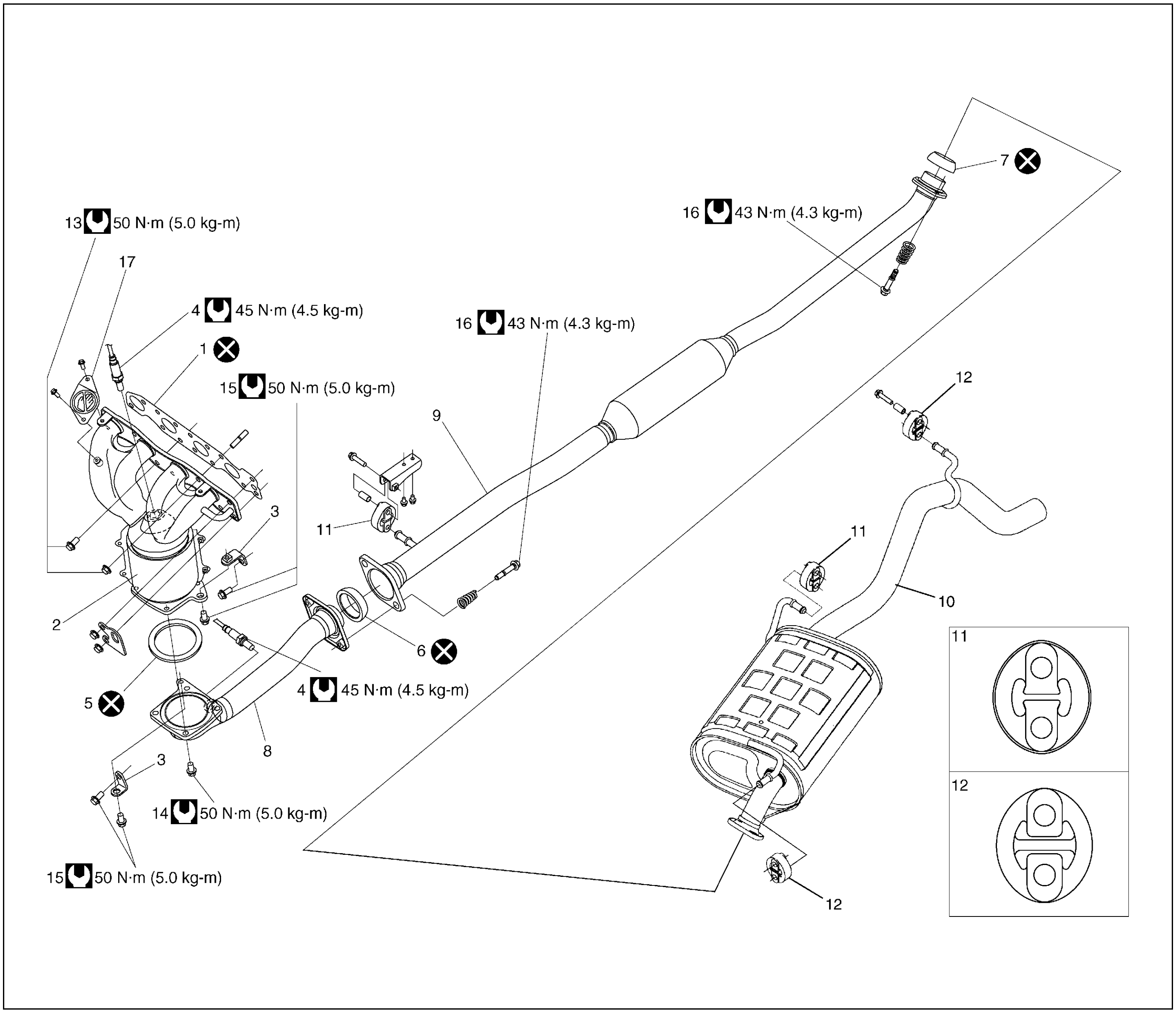


- Check rubber mountings (1) for damage, deterioration, and out of position.
- Check exhaust system for leakage, loose connection, dent and damage.
- If bolts or nuts are loosened, tighten them to specified torque referring to “Exhaust System Components” in this section.
- Check nearby body areas damaged, missing, or mispositioned part, open seam, hole connection or any other defect which could permit exhaust fumes to seep into vehicle.
- Make sure that exhaust system components have enough clearance from underbody to avoid overheating and possible damage to passenger compartment carpet.
- Any defect should be fixed at once.

On-Vehicle Service

Exhaust System Components

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



1. Gasket	8. Exhaust No.1 pipe	15. Exhaust manifold stiffener bolt
2. Exhaust manifold	9. Exhaust No.2 pipe	16. Exhaust No.2 pipe bolt
3. Exhaust manifold stiffener	10. Muffler	17. Caution plate
4. Oxygen sensor	11. Muffler mounting type 1	Tightening torque
5. Exhaust pipe gasket	12. Muffler mounting type 2	Do not reuse.
6. Seal ring No.1	13. Exhaust manifold bolt and nut	
7. Seal ring No.2	14. Exhaust No.1 pipe bolt	

Exhaust Manifold Removal and Installation

Removal and installation

Refer to “Exhaust Manifold Removal and Installation” in Section 6A2.

Exhaust Manifold Inspection

Check gasket and seal for deterioration or damage.
Replace them as necessary.

Exhaust Pipe Removal and Installation

Removal and installation

For replacement of exhaust pipe, be sure to hoist vehicle and observe “Warning” under “Maintenance” in this section and the following.

CAUTION:
Exhaust manifold have three way catalytic converter in it, it should not be exposed to any impulse. Be careful not to drop it or hit it against something.

- Tighten bolts and nuts to specified torque when reassembling referring to “Exhaust System Components” in this section.
- After installation, start engine and check each joint of exhaust system for leakage.

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Exhaust manifold bolt and nut	50	5.0	36.5
Exhaust No.1 pipe bolt	50	5.0	36.5
Exhaust manifold stiffer bolt	50	5.0	36.5
Exhaust No.2 pipe bolt	43	4.3	31.5
Oxygen sensor	45	4.5	32.5

SECTION 7A2

MANUAL TRANSAXLE (M13 ENGINE)

WARNING:

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

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

CONTENTS

General Description

Manual Transaxle Construction and Servicing

The transaxle provides five forward speeds and one reverse speed by means of three synchronizers and three shafts-input shaft, countershaft and reverse gear shaft. All forward gears are in constant mesh, and reverse uses a sliding idler gear arrangement.

The low speed synchronizer is mounted on counter shaft and engaged with counter shaft first gear or second gear, while the high speed synchronizer is done on input shaft and engaged with input shaft third gear or fourth gear.

The fifth speed synchronizer on input shaft is engaged with input shaft fifth gear mounted on the input shaft.

The double cone synchronizing mechanism is provided to 2nd gear synchromesh device for high performance of shifting to 2nd gear.

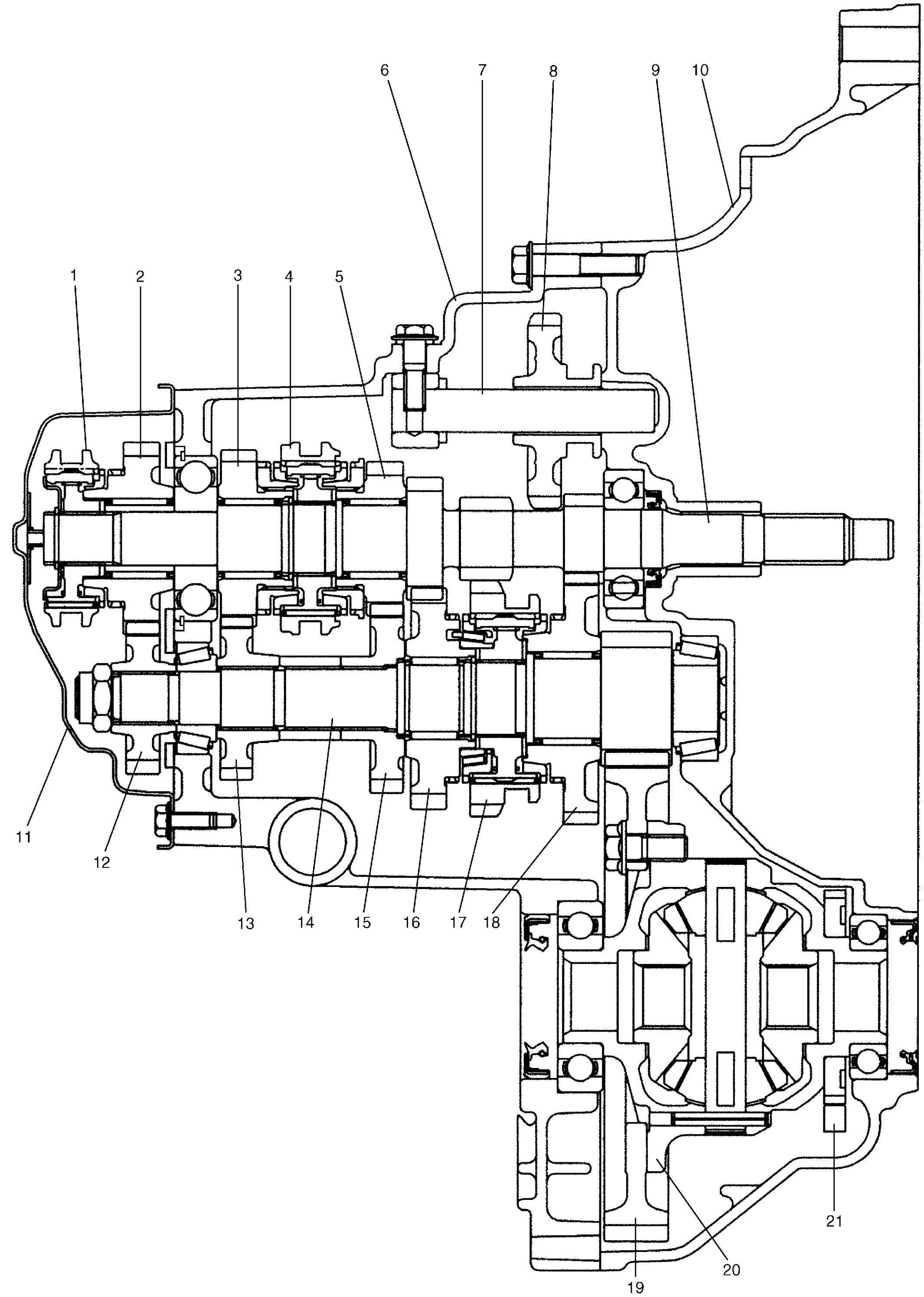
The countershaft turns the final gear and differential assembly, thereby turning the front drive shafts which are attached to the front wheels.

4WD model is equipped with transfer assembly on transaxle being mated to right side of differential output in transaxle.

For servicing, it is necessary to use genuine sealant or its equivalent on mating surfaces of transaxle case which is made of aluminum. The case fastening bolts must be tightened to specified torque by means of torque wrench. It is also important that all parts are thoroughly cleaned with cleaning fluid and air dried before reassembling.

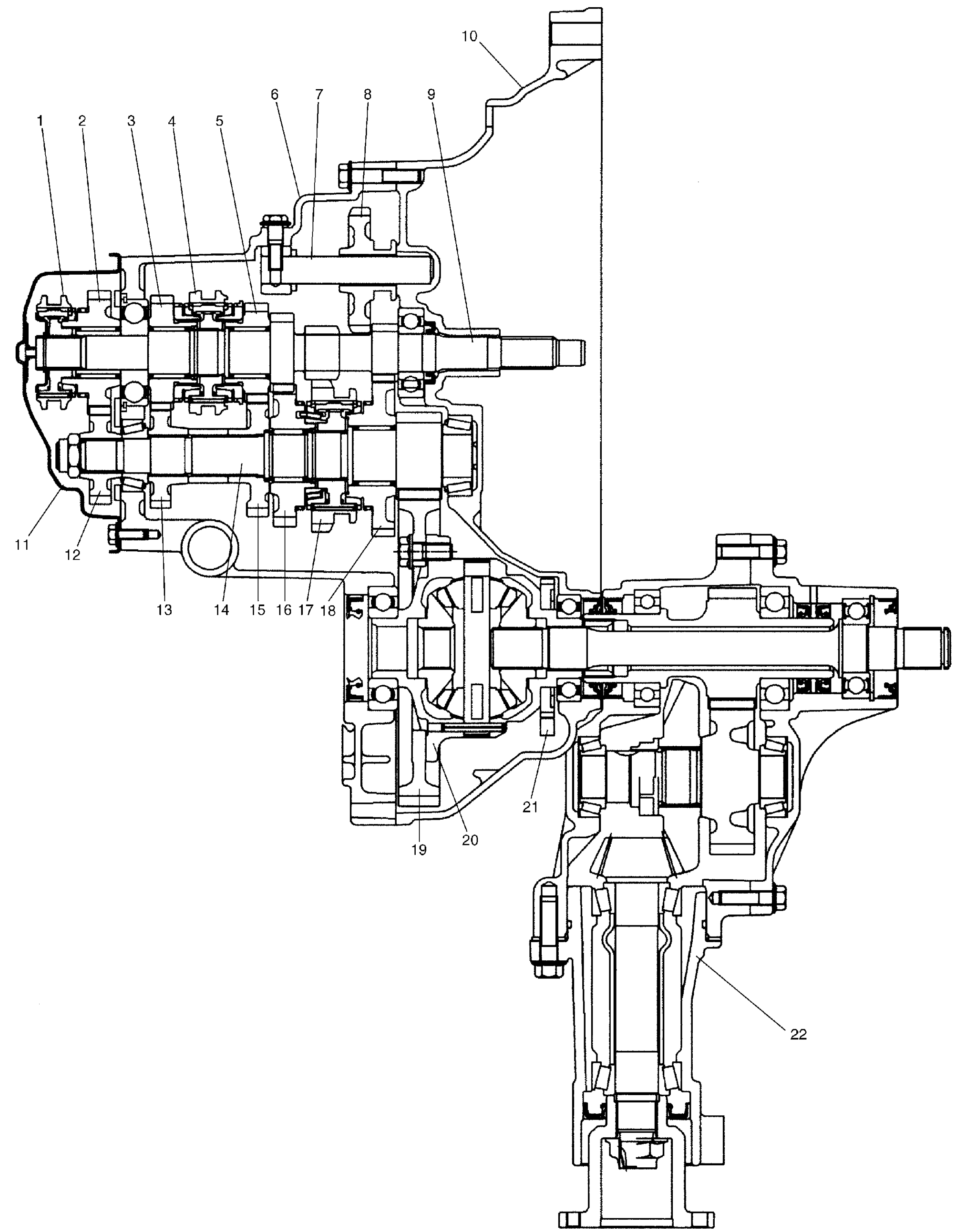
Further, care must be taken to adjust preload of counter shaft taper roller bearings. New synchronizer rings are prohibited from being lapped with respective gear cones by using lapping compound before they are assembled.

Transaxle for 2wd Model



1. 5th speed sleeve & hub	8. Reverse idler gear	15. Countershaft 3rd gear
2. Input shaft 5th gear	9. Input shaft	16. Countershaft 2nd gear
3. Input shaft 4th gear	10. Right case	17. Low speed sleeve & hub
4. High speed sleeve & hub	11. Side cover	18. Countershaft 1st gear
5. Input shaft 3rd gear	12. Countershaft 5th gear	19. Final gear
6. Left case	13. Countershaft 4th gear	20. Differential case
7. Reverse gear shaft	14. Countershaft	21. Vehicle speed sensor

Transaxle for 4wd Model



1. 5th speed sleeve & hub	7. Reverse gear shaft	13. Countershaft 4th gear	19. Final gear
2. Input shaft 5th gear	8. Reverse idler gear	14. Countershaft	20. Differential case
3. Input shaft 4th gear	9. Input shaft	15. Countershaft 3rd gear	21. Vehicle speed sensor
4. High speed sleeve & hub	10. Right case	16. Countershaft 2nd gear	22. Transfer assembly
5. Input shaft 3rd gear	11. Side cover	17. Low speed sleeve & hub	
6. Left case	12. Countershaft 5th gear	18. Countershaft 1st gear	

Diagnosis

Manual Transaxle Symptom Diagnosis

Condition	Possible Cause	Correction
Gears slipping out of mesh	Maladjusted gear shift/select control cables	Adjust.
	Worn shift fork shaft	Replace.
	Worn shift fork or synchronizer sleeve	Replace.
	Weak or damaged locating springs	Replace.
	Worn bearings on input shaft or counter shaft	Replace.
	Worn chamfered tooth on sleeve and gear	Replace sleeve and gear.
Hard shifting	Maladjusted gear shift/select control cables	Adjust.
	Inadequate or insufficient lubricant	Replenish.
	Improper clutch pedal free travel	Adjust.
	Distorted or broken clutch disc	Replace.
	Damaged clutch pressure plate	Replace clutch cover.
	Worn synchronizer ring	Replace.
	Worn chamfered tooth on sleeve or gear	Replace sleeve or gear.
	Worn gear shift/select control cables joint	Replace.
	Distorted shift shaft	Replace.
Noise	Inadequate or insufficient lubricant	Replenish.
	Damaged or worn bearing(s)	Replace.
	Damaged or worn gear(s)	Replace.
	Damaged or worn synchronizer parts	Replace.
	Maladjusted backlash between bevel pinion and gear	Adjust as prescribed
	Improper tooth contact in the mesh between bevel pinion and gear	Adjust or replace

On-Vehicle Service

CAUTION:
Do not reuse circlip, spring pin, E-ring, oil seal, gasket, self locking nut and specified parts. Reuse of it can result in trouble.

Manual Transaxle Oil Change

1) Before changing or inspecting oil, be sure to stop engine and lift vehicle horizontally.
2) With vehicle lifted up, check oil level and leakage. If leakage exists, correct it.
3) Drain old oil and fill new specified oil by specified amount (up to level hole).
4) Apply sealant to thread of drain plug (2) and level/filler plug (3) and torque them as specified below.

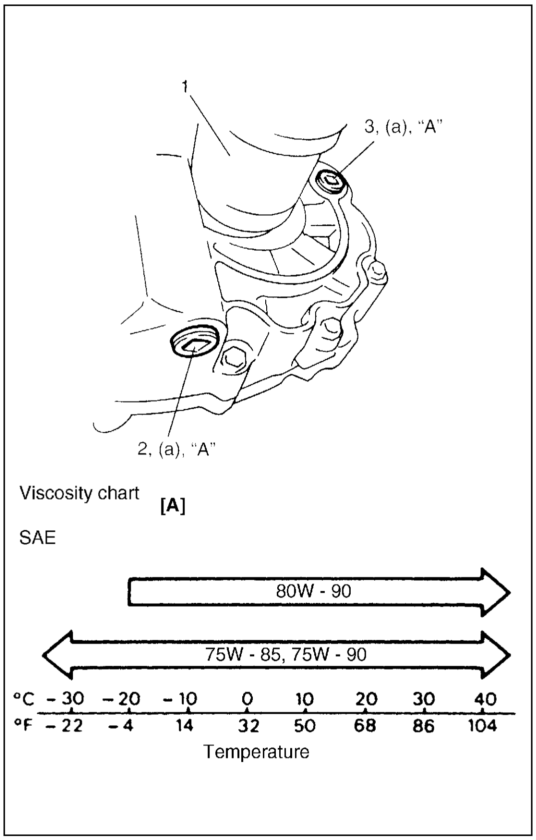
"A": Sealant 99000-31260

Tightening torque
Transaxle oil level/filler and drain plugs
(a): 21 N·m (2.1 kg-m, 15.5 lb-ft)

NOTE:
- **It is highly recommended to use API GL-4 75W-90 gear oil.**
- **Whenever vehicle is hoisted for any other service work than oil change, also be sure to check for oil leakage.**

Transaxle oil
: API GL-4
For SAE classification, refer to viscosity chart [A] in the figure.

Transaxle oil capacity
: 2.2 liters (4.6/3.9 US/Imp. pt)

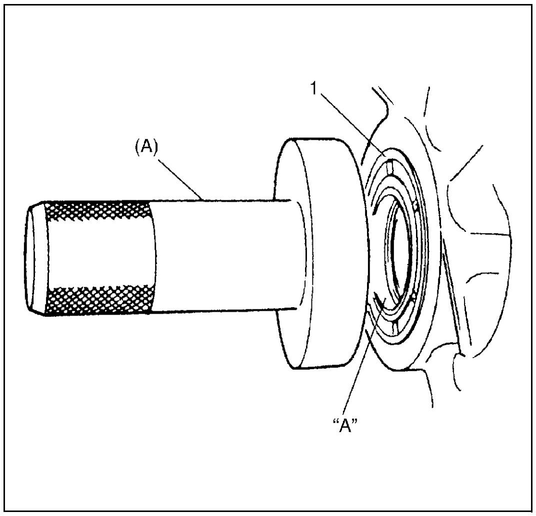


1. Drive shaft (LH)

Differential Side Oil Seal Replacement

Replacement

1) Lift up vehicle and drain transaxle oil.
2) Remove front drive shafts referring to "Drive Shaft Assembly Removal and Installation" in Section 4A.
3) Separate transfer from transaxle assembly. (for 4WD vehicle) For detail, refer to "Transfer Dismounting and Remounting" in Section 7D.



4) Remove oil seal (1) and install a new one until it becomes flush with case surface using special tool and hammer.

NOTE:

When installing oil seal, face its spring side inward.

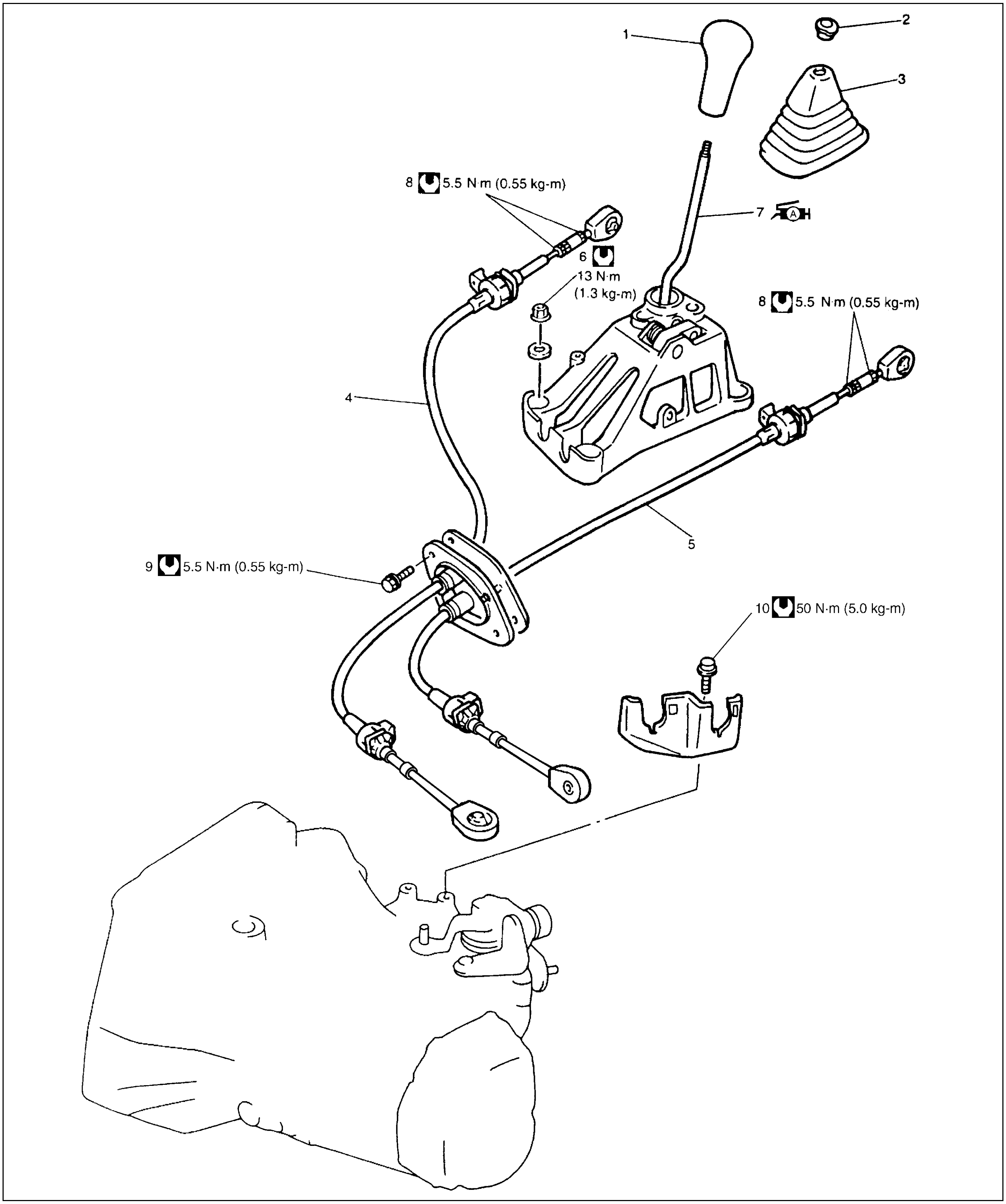
Special tool
(A): 09913-75510 (2WD and LH of 4WD)
(A): 09951-46010 (RH of 4WD)

5) Apply grease to oil seal lip and at the same time check drive shaft where oil seal contacts and make sure of its smoothness.

"A": Grease 99000-25010

6) Install transfer referring to "Transfer Dismounting and Remounting" in Section 7D.
7) Insert front drive shafts referring to "Drive Shaft Assembly Removal and Installation" in Section 4A.
8) Install ball stud and stabilizer mount brackets referring to "Wheel Hub and Steering Knuckle Removal and Installation" and "Stabilizer Bar and Bushings Removal and Installation" in Section 3D.
9) Install tie-rod end referring to "Suspension Control Arm/ Bushing Removal and Installation" in Section 3B.
10) Fill transaxle oil as specified referring to "Manual Transaxle Oil Change" in this section, and make sure that oil has been sealed with oil seal.

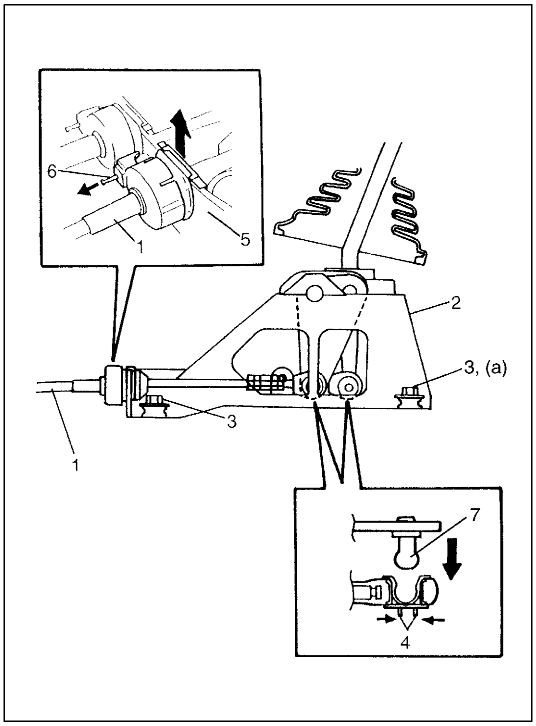
Gear Shift Control Lever and Cable Components



1. Gear shift control lever knob		5. Gear select control cable	9. Cable mounting bolt
2. Lever boot holder		6. Gear shift control lever assembly mounting nut	10. Cable bracket bolt
3. Gear shift lever boot	A H	7. Gear shift control lever assembly : Apply grease 99000-25010 to pin ends to which shift and select cables are connected.	Tightening torque
4. Gear shift control cable		8. Cable lock nut	

Gear Shift Control Lever and Cable Removal and Installation

Removal



1) Remove console box.
2) Disconnect gear shift and select control cables (1) from gear shift control lever assembly (2).
   a) Disconnect cable end from pivot (7) while pushing cable end bush (4).
   b) Detach cable from bracket (5) while pulling pin (6).
3) Remove gear shift control lever assembly mounting nuts (3) and gear shift lever assembly (2) from body.
4) Disconnect shift and select cables (1) from transmission in the same manner as step 2).
5) Remove cable grommet and cable clamp, and then remove shift and select cables (1) from body.

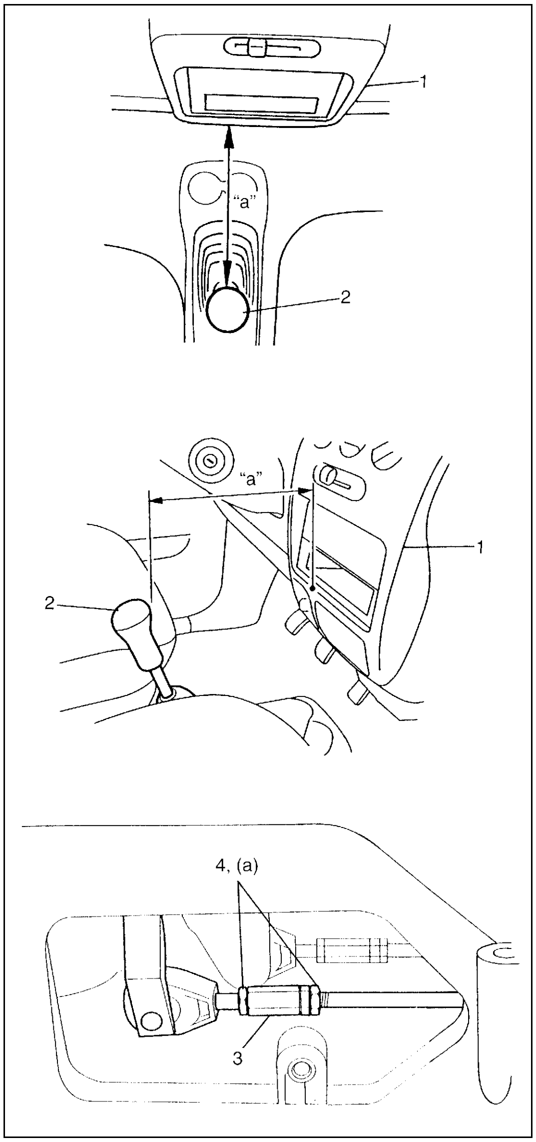
Installation

Reverse removal procedure for installation noting the following.

- Tighten gear shift control lever assembly mounting nuts (3) to specified torque.

Tighting torque
Gear shift control lever assembly mounting nut (a): 13 N·m (1.3 kg-m, 9.5 lb-ft)

Gear Shift Control Lever and Cable Adjustment



- Adjustment of shift cable:

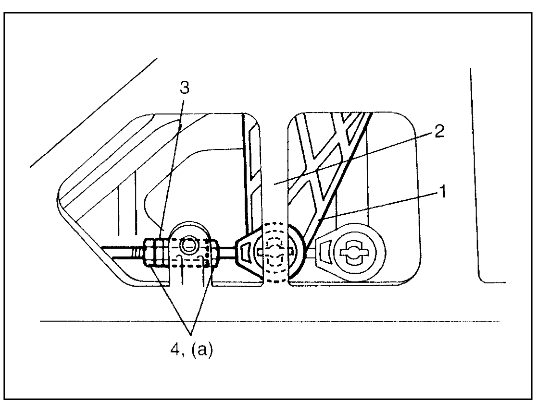
a) With shift control lever in "NEUTRAL" position, adjust shift cable adjusting nut (3) so that distance "a" between edge of instrument panel (1) and center of shift knob (2) measured as specified value.

Distance "a": 156 mm (6.14 in.)

b) After shift cable adjustment, tighten cable lock nut (4) to specified torque.

Tightening torque
Cable lock nut (a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

c) Make sure that boots are installed correctly.



- Adjustment of select cable:

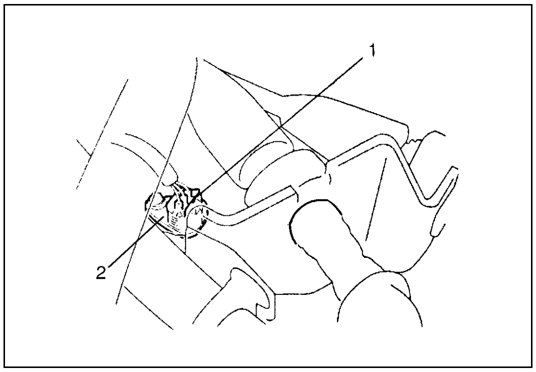
a) With shift control lever in "NEUTRAL" position, adjust select cable adjusting nut (3) so that the tip of select arm (cable joint point) (1) and the center rip of gear shift control lever assembly (2) are aligned as shown.

b) After select cable adjustment, tighten cable lock nut (4) to specified torque.

Tightening torque
Cable lock nut (a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

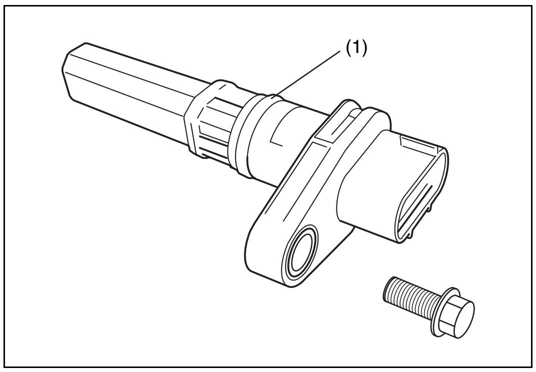
Vehicle Speed Sensor (VSS) Removal and Installation

Removal

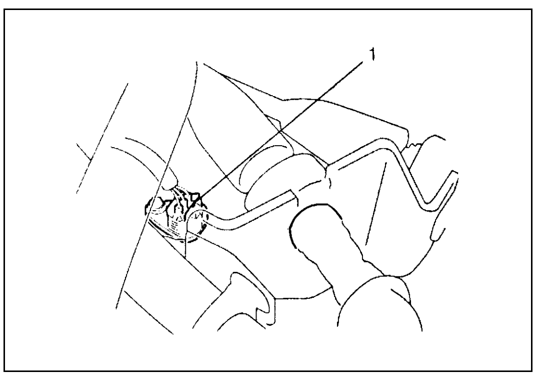


1) Disconnect negative cable at battery.
2) Disconnect VSS coupler (1).
3) Remove VSS (2).

Installation



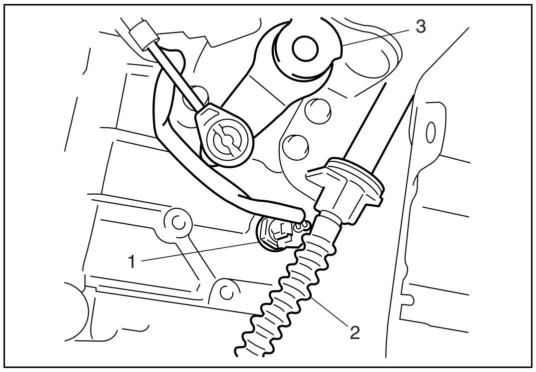
1) Apply oil to new O-ring (1) and then install VSS to transaxle.
2) Connect VSS coupler (1).



3) Connect negative cable at battery.

Back Up Lamp Switch Removal and Installation

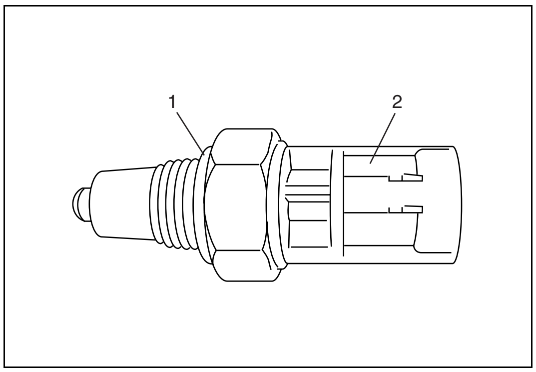
Removal



1) Disconnect negative cable at battery.
2) Disconnect back up lamp switch coupler.
3) Remove back up lamp switch (1).

2.	Clutch cable
3.	Gear shift and select shaft assembly

Installation

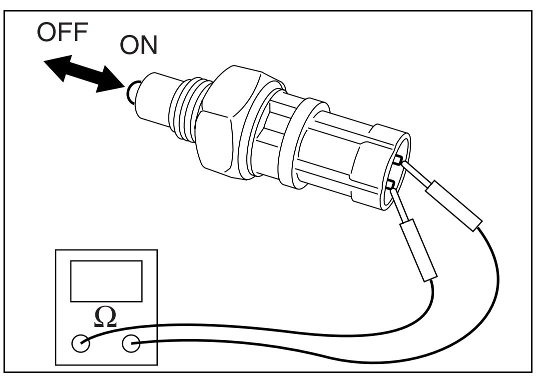


1) Apply oil to new O-ring (1) and tighten back up lamp switch (2) to specified torque.

Tightening torque
Back up lamp switch (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

2) Connect back up lamp switch coupler.
3) Connect negative cable at battery.

Back Up Lamp Switch Inspection

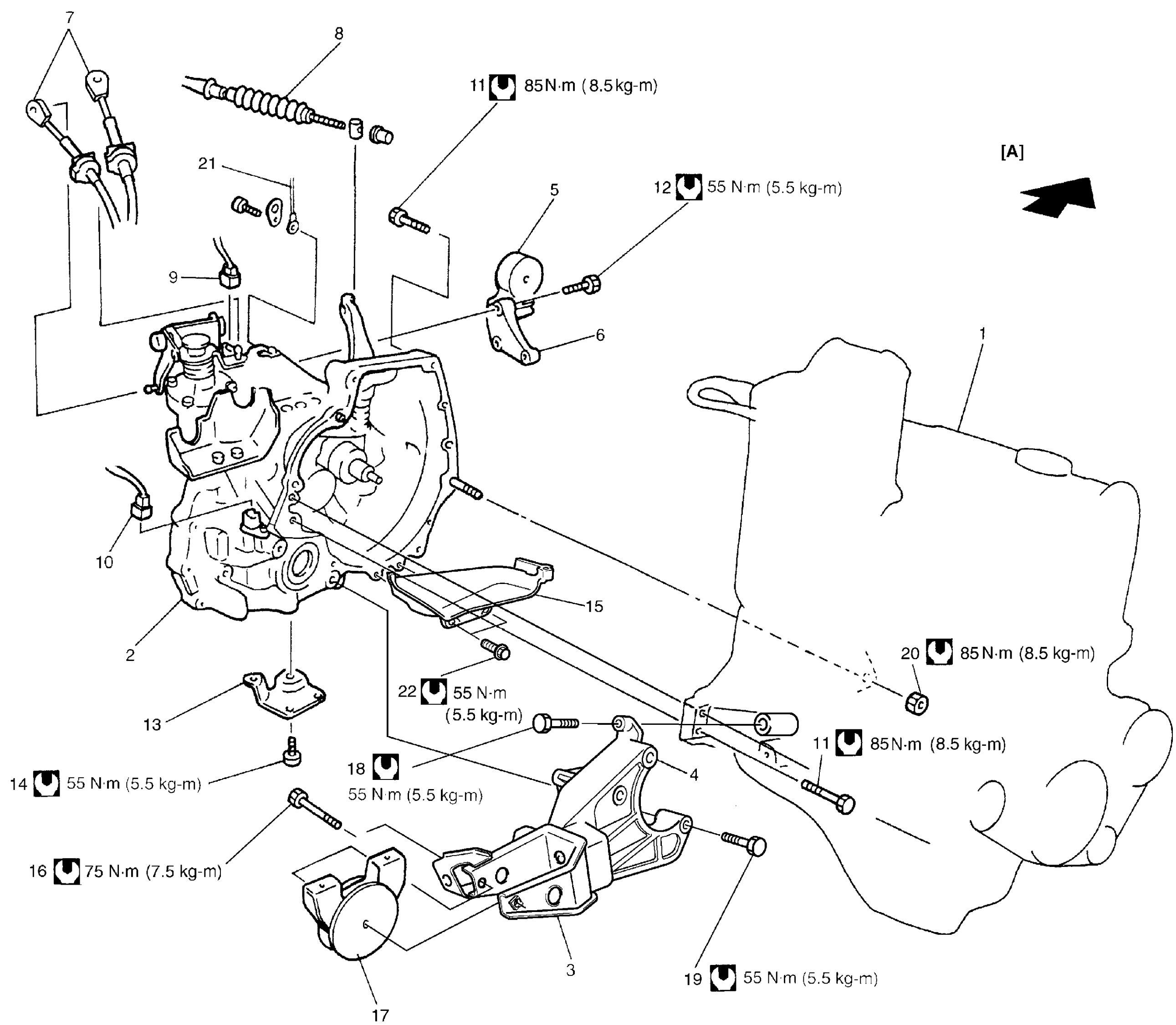


Check backup lamp switch for function using ohmmeter.

Switch ON: Continuity
Switch OFF: No continuity

Unit Repair Overhaul

Transaxle Unit Components



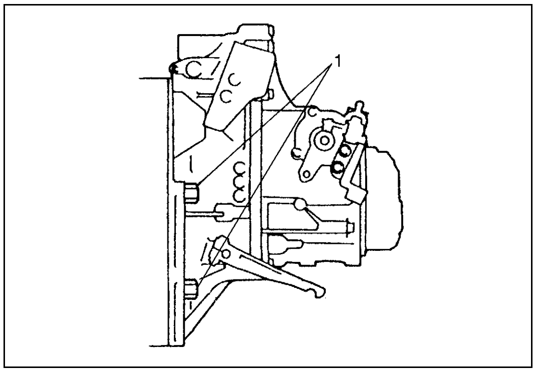
[A]: Forward	8. Clutch cable	16. Engine rear mounting bolt
1. Engine	9. Backup lamp switch connector	17. Engine rear mounting
2. Transaxle	10. VSS connector	18. Engine rear mounting No.2 bracket bolts
3. Engine rear mounting No.1 bracket	11. Transaxle to engine bolts	19. Transaxle to engine rear mounting No.2 bracket bolt
4. Engine rear mounting No.2 bracket	12. Engine left mounting bracket bolts	20. Transaxle to engine nut
5. Engine left mounting	13. Engine rear mounting bracket stiffener	21. Ground cable
6. Engine left mounting bracket	14. Stiffener bolts	22. Clutch housing lower plate bolts
7. Shift & select control cables	15. Clutch housing lower plate	Tightening torque

Transaxle Unit Dismounting and Remounting

Dismounting

Under hood

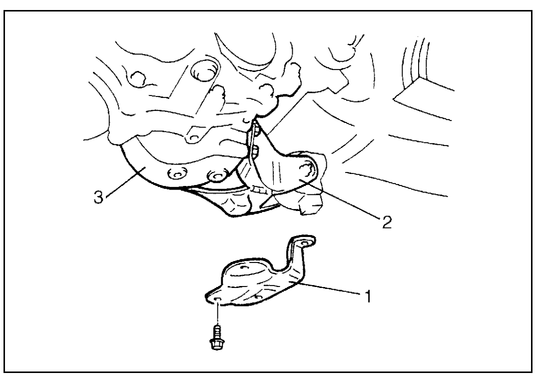
1) Disconnect negative cable at battery.
2) Undo wiring harness clamps, disconnect backup lamp switch coupler, VSS coupler and ground cable.
3) Disconnect clutch cable from clutch release lever and bracket.
4) Disconnect gear shift and select control cables.
5) Remove transaxle control cable bracket.
6) Remove water pipe bracket bolts from transaxle.



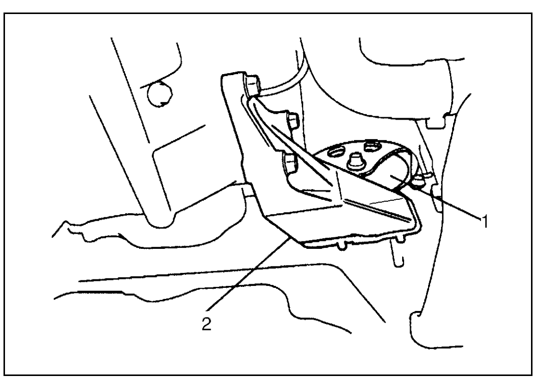
7) Remove transaxle to engine bolts (1).
8) Remove starting motor referring to "Starting Motor Dismounting and Remounting" in Section 6G.
9) Support engine by using lifting device.

On lift

10) Drain transaxle oil referring to "Manual Transaxle Oil Change" in this section.
11) Remove front drive shafts referring to "Front Drive Shaft Assembly Removal and Installation" in Section 4A.
12) Remove left side of engine under cover.



13) Remove engine rear mounting bracket stiffener (1).
14) Remove clutch housing lower plate.
15) Remove engine rear mounting No.1 bracket (2) with No.2 bracket (3).
16) Remove transfer referring to "Transfer Dismounting and Remounting" in Section 7D, if equipped.
17) Remove transaxle to engine bolts and nut.
18) Lower vehicle and support transaxle with transaxle jack.



19) Remove engine left mounting (1) with bracket (2).
20) Remove other attached parts from transaxle, if any.
21) Pull transaxle out so as to disconnect input shaft from clutch disc and then lower it.

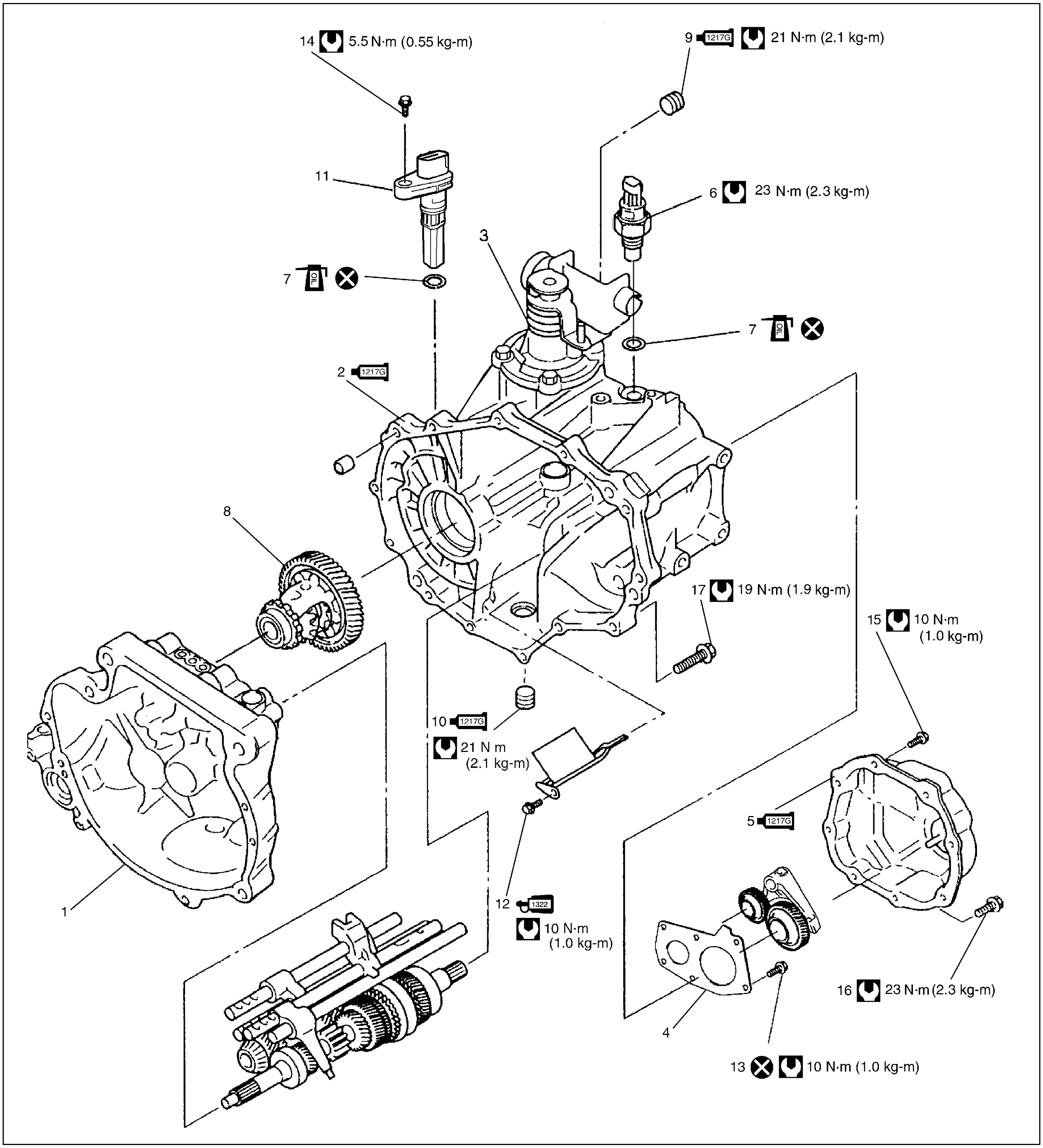
Remounting

> **CAUTION:**
> **Care should be taken not to scratch oil seal lip with drive shaft while raising transaxle.**
> **Do not hit drive shaft joint with hammer when installing it into differential gear.**

Reverse dismounting procedure for remounting noting the following.

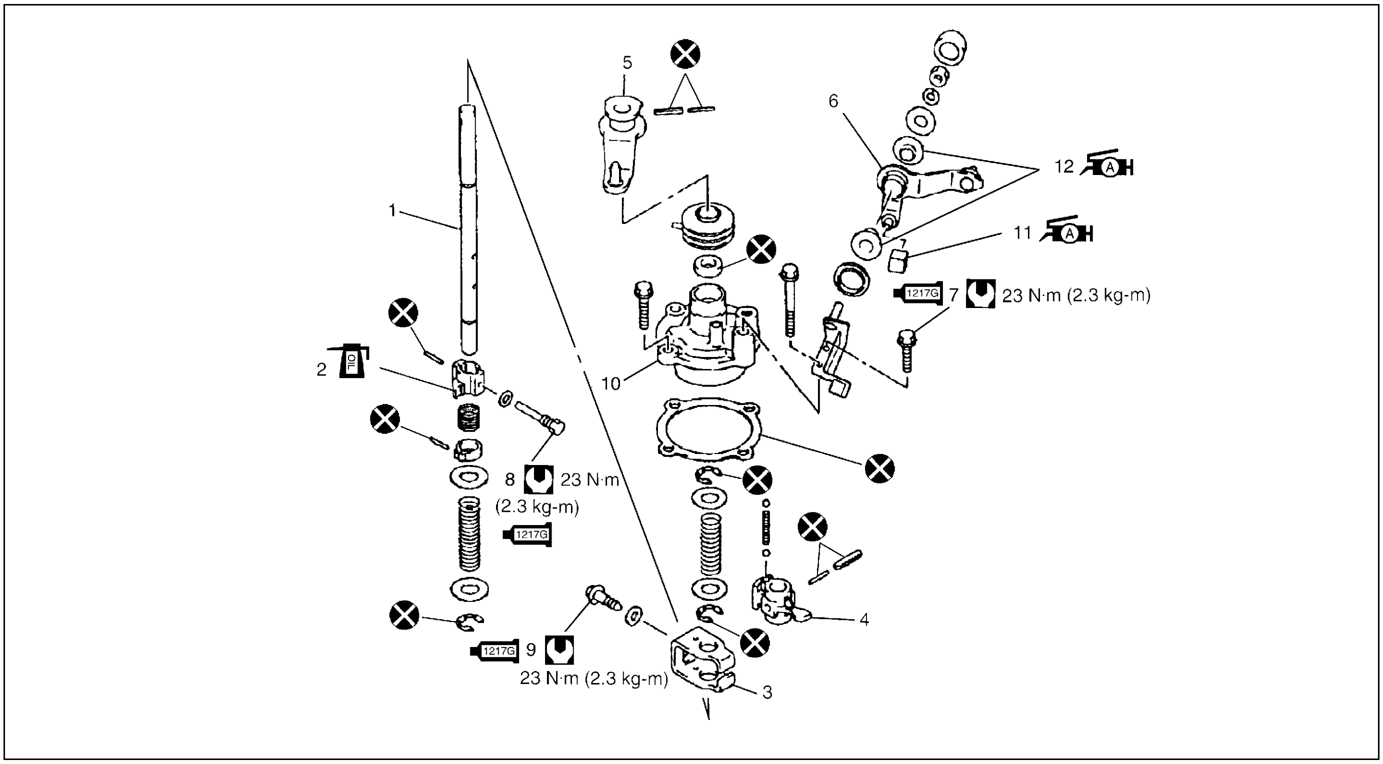
- Install transfer referring to “Transfer Dismounting and Remounting” in Section 7D, if equipped.
- Refer to “Transaxle Unit Components” for fastener specified torque.
- Push in drive shaft joints (right & left) fully so as to snap ring of shaft engages with differential gear.
- Set each clamp for wiring securely.
- Install starting motor referring to “Starting Motor Dismounting and Remounting” in Section 6G.
- After connecting clutch cable, be sure to adjust its play properly.
  Refer to “Clutch Pedal Inspection” in Section 7C.
- Fill transaxle with oil as specified referring to “Manual Transaxle Oil Change” in this section.
- Connect battery and check function of engine, clutch and transaxle.

Transaxle Case Components



	1. Transaxle right case		11. VSS
1217G	2. Transaxle left case : Apply sealant 99000-31260 to mating surface of left case and right case.	1322	12. Oil gutter bolt : Apply thread lock 99000-32110 to all around thread part of bolt.
	3. Gear shift and select shaft assembly		13. Left case plate screw and bolts
	4. Transaxle left case plate		14. VSS bolt
1217G	5. Transaxle side cover : Apply sealant 99000-31260 to mating surface of side cover and left case.		15. Side cover bolt No.1
	6. Back up lamp switch		16. Side cover bolt No.2
	7. O-ring		17. Transaxle case bolt
	8. Differential assembly		Tightening torque
1217G	9. Oil level/filler plug : Apply sealant 99000-31260 to all around thread part of plug.		Do not reuse.
1217G	10. Oil drain plug : Apply sealant 99000-31260 to all around thread part of plug.	OIL	Apply transaxle oil

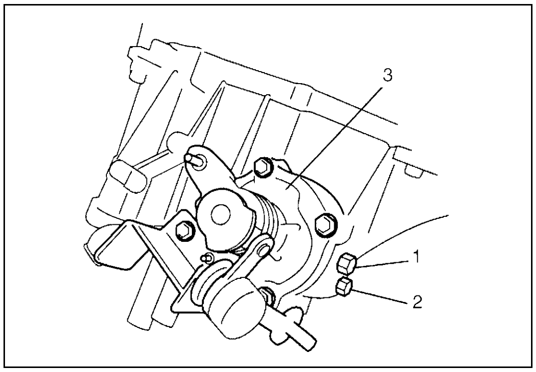
Gear Shift and Select Shaft Assembly Components



1. Gear shift & select shaft		6. Select cable lever	AH	11. Select lever shaft bush : Apply grease 99000-25010 to whole area of bush.
2. 5th & reverse gear shift cam	1217G	7. Guide case bolt No.1 : Apply sealant 99000-31260 to bolt thread.	AH	12. Select lever boss : Apply grease 99000-25010 to internal and external diameter
3. Gear shift interlock plate	1217G	8. 5th to reverse interlock guide bolt : Apply sealant 99000-31260 to bolt thread.		Tightening torque
4. Gear shift & select lever	1217G	9. Gear shift interlock bolt : Apply sealant 99000-31260 to bolt thread.		Do not reuse.
5. Shift cable lever		10. Guide case	OIL	Apply transaxle oil.

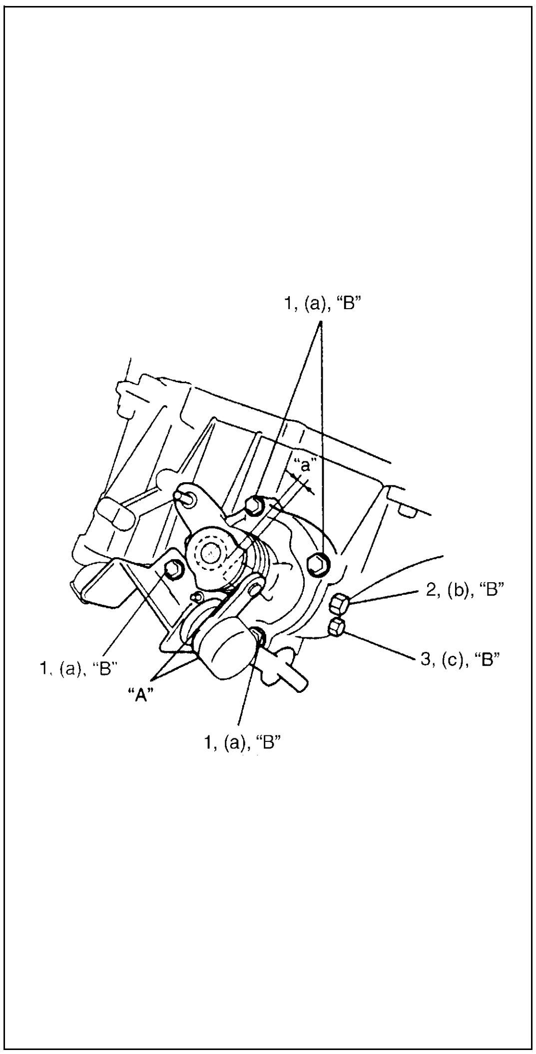
Gear Shift and Select Shaft Assembly Removal and Installation

Removal



1) Remove gear shift interlock bolt (1) and 5th to reverse interlock guide bolt (2) from transaxle case.
2) Remove gear shift and select shaft assembly (3).

Installation



1) Apply grease to select lever shaft bush and select lever boss, and install gear shift and select shaft assembly with new gasket into transaxle.

"A": Grease 99000-25010

2) Apply sealant to gear shift guide case bolts (1). Tighten gear shift guide case bolts (1) to specified torque at the position that clearance "a" is within 1 - 1.5 mm (0.04 - 0.06 in.).

"B": Sealant 99000-31260

Tightening torque
Gear shift guide case bolt
(a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

3) Install washer and gear shift interlock bolt (2) to which sealant have been applied and them tighten it to specified torque.

"B": Sealant 99000-31260

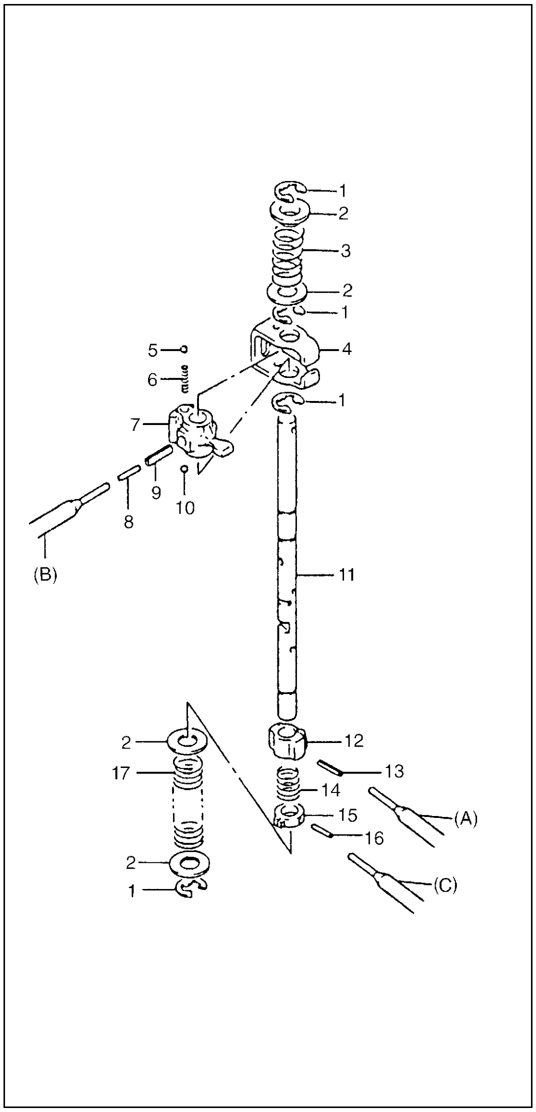
Tightening torque
Gear shift interlock bolt (b): 23 N·m (2.3 kg-m, 17.0 lb-ft)

4) Install washer and 5th to reverse interlock guide bolt (3) to which sealant have been applied and then tighten it to specified torque.

"B": Sealant 99000-31260

Tightening torque
5th to reverse interlock guide bolt
(c): 23 N·m (2.3 kg-m, 17.0 lb-ft)

Gear Shift and Select Shaft Disassembly and Assembly



1) Push spring pins out using specified spring pin removers as shown bellow.

Special tool
(A): 09922-85811 (4.5 mm)
(B): 09925-78210 (6.0 mm)
(C): 2.8 – 3.0 mm (0.11 – 0.12 in.) Commercially available spring pin remover

2) Inspect component parts for wear, distortion or damage. If any detect is found, replace detective part with new one.

NOTE:

- **When driving in spring pins, prevent shaft from being bent by supporting it with wood block.**
- **Assemble 5th & reverse gear shift cam with its pit and spring pin aligned.**
- **Make sure to select an appropriate spring by identifying the painted colors to keep gear shifting performance as designed.**
  - **Low speed select spring - No paint**
  - **Reverse select spring - Pink**

1. E-ring	10. Ball
2. Washer	11. Gear shift & select shaft
3. Reverse select spring	12. 5th & reverse gear shift cam
4. Gear shift interlock plate	13. Spring pin
5. Ball	14. Cam guide return spring
6. Gear shift interlock spring	15. 5th & reverse gear shift cam guide
7. Gear shift & select lever	16. Spring pin
8. Spring pin	17. Low speed select spring
9. Spring pin	

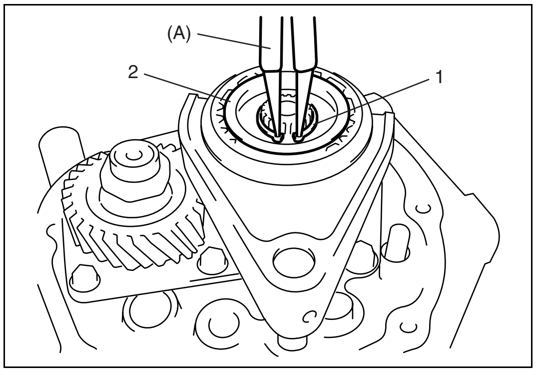
Fifth Gear Disassembly and Assembly

Disassembly

1) Remove side cover bolts and take off transaxle side cover.

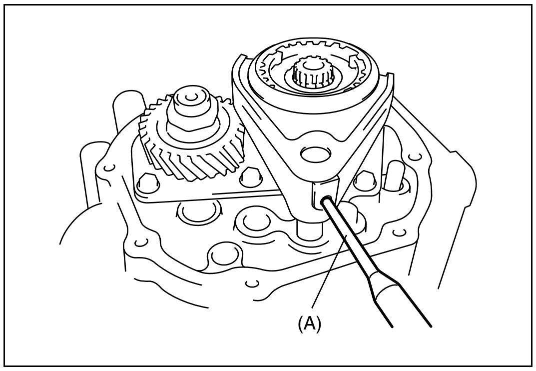
CAUTION:

Care should be taken not to distort side cover when it is removed from left case.



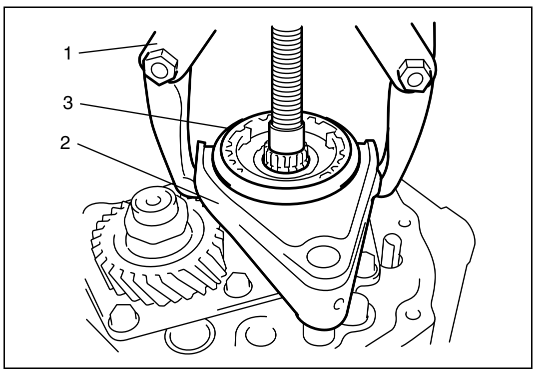
2) Using special tool, remove circlip (1) and then remove hub plate (2).

Special tool
(A): 09900-06107

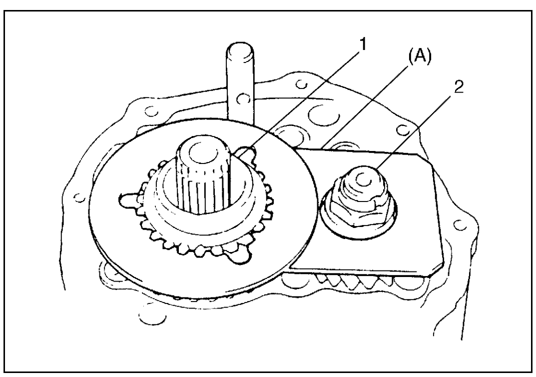


3) Drive out spring pin using special tool and hammer.

Special tool
(A): 09922-85811



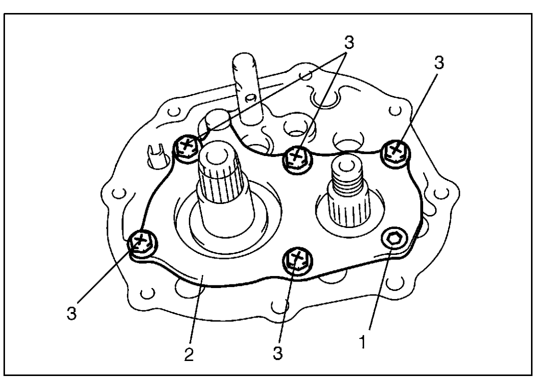
4) Remove gear shift fork (2), sleeve & hub assembly (3), synchronizer ring spring, synchronizer ring and 5th gear all together. Use gear puller (1) for removal if spline fitting of hub is tight.



5) Install input shaft 5th gear (1) and special tool to stop rotation of shafts, and remove countershaft nut (2).

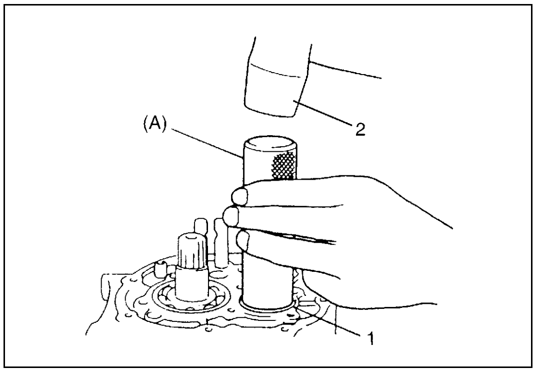
Special tool
(A): 09927-76010

6) Remove special tool, input shaft 5th gear, needle bearing of separated steel cage type and then remove counter shaft 5th gear.



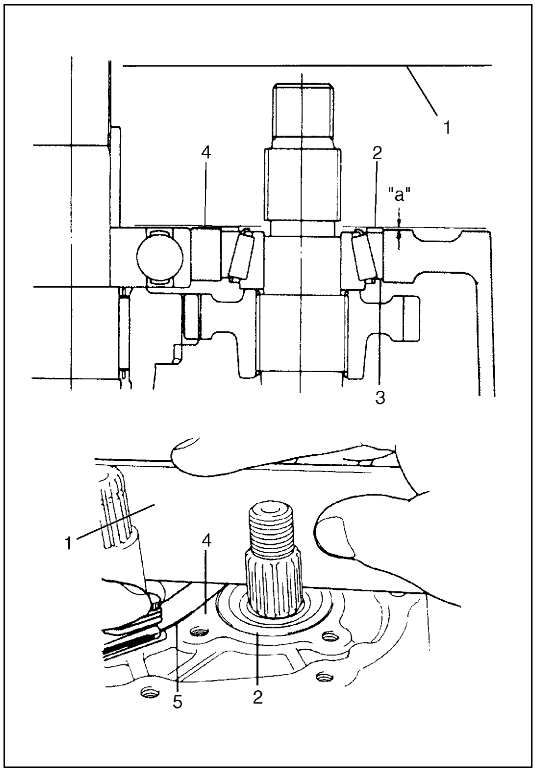
7) Remove left case plate screw (1) and bolts (3), and take off left case plate (2).
8) Remove bearing set shim.

Assembly



1) Install seat countershaft left bearing outer race (1) to bearing cone, tap cup using special tool and plastic hammer (2).

Special tool
(A): 09913-84510



2) With putting a shim (2) on bearing outer race (3), place straight edge (1) over it and compress it by hand through straight edge, and then measure clearance “a” between case surface (4) and straight edge using feeler gauge (5).

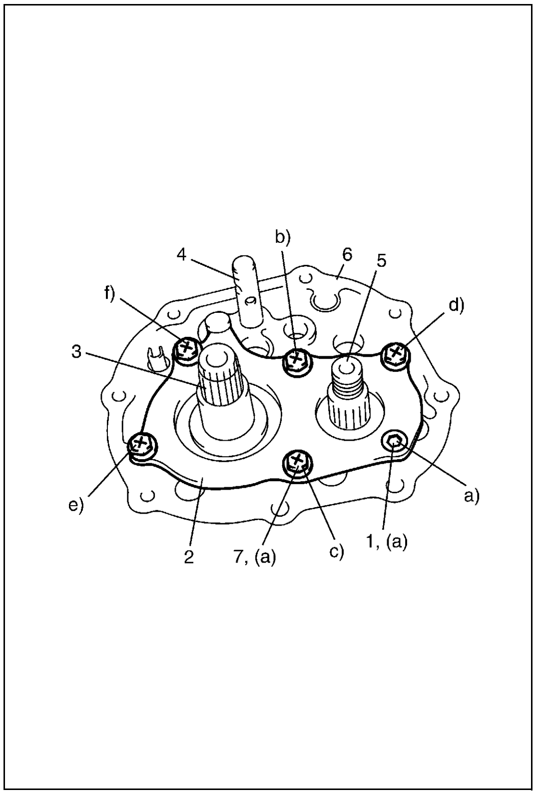
Clearance between case surface and straight edge
“a”: 0.13 – 0.17 mm (0.0051 – 0.0067 in.)
(Shim protrusion)

3) By repeating above step, select a suitable shim which adjusts clearance “a” to specification and put it on bearing outer race.

NOTE:

Insert 0.15 mm (0.0059 in.) feeler to know whether or not a shim fulfills specification quickly.

Available shim thickness
0.40, 0.45, 0.50, 0.55, 0.6, 0.65,0.7, 0.75, 0.8, 0.85, 0.9, 0.95, 1.0,1.05, 1.1 and 1.15 mm (0.015, 0.017, 0.019, 0.021, 0.023,0.025, 0.027, 0.029, 0.031, 0.033,0.035, 0.037, 0.039, 0.041, 0.043 and 0.045 in.)



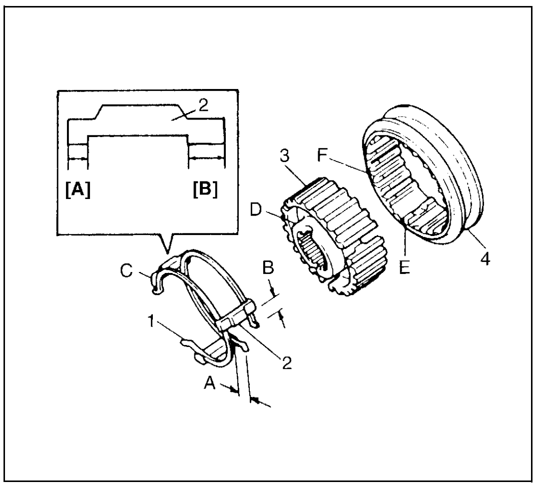
CAUTION:
Do not reuse left case plate screw (1) and bolts (7). Be sure to use new adhesive pre-coated screw and bolts. Otherwise, screw and bolts may loosen.

4) Place left case plate (2) inserting its end in groove of shift guide shaft (4) and tighten new adhesive pre-coated screw (1) and bolts (7) temporarily with less than specified toque.
5) Tighten new screw and new bolts to specified torque finally in the order of alphabet shown in figure.

NOTE:
After tightening screw and bolts, make sure that counter-shaft (5) can be rotated by hand feeling certain load.

Tightening torque
Left case plate screw and bolt
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

3. Input shaft
6. Transaxle left case

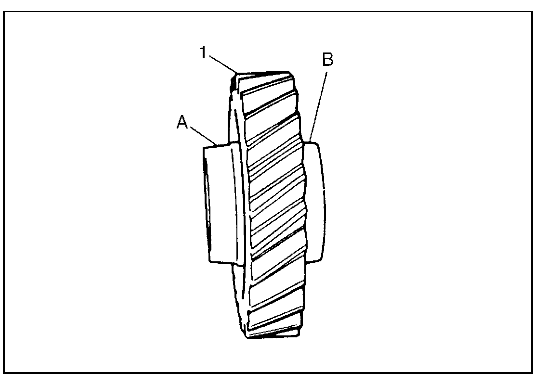


6) Assemble 5th speed synchronizer sleeve (4) and hub (3) with keys (2) and springs (1).

NOTE:
Short side C in keys, long flange D in hub and chamfered spline F in sleeve should face inward (5th gear side).

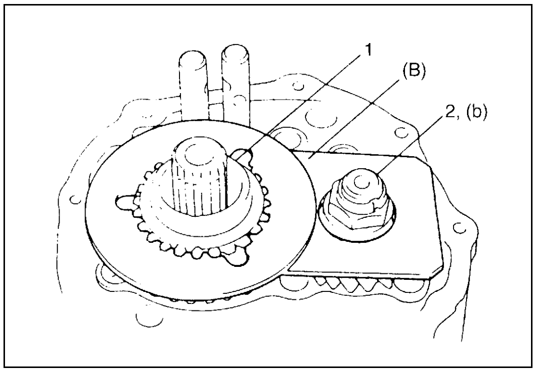
Synchronizer key installation position
: A = B

[A]: Short side C	D: Long flange (Inward)
[B]: Long side	E: Key way
C: Short side (Inward)	F: Chamfered spline (Inward)



7) Install 5th gear (1) to counter shaft facing machined boss A inward.

A: Machined boss (Inside)
B: No machining (Outside)

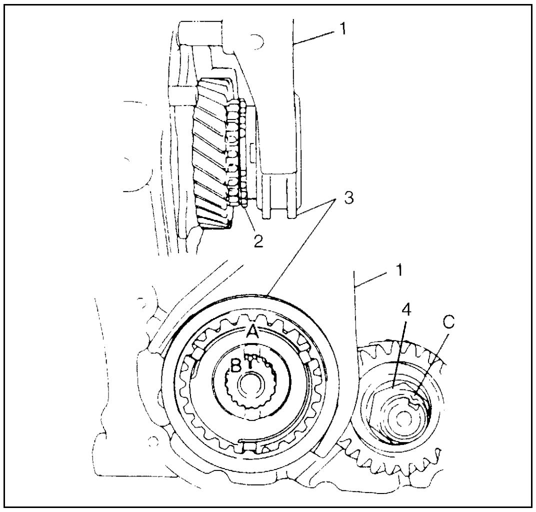


8) Install needle bearing of separated steel cage type to input shaft, apply oil then install 5th gear (1) and special tool to stop shaft rotation.

Special tool
(B): 09927-76010

9) Install new countershaft nut (2) and tighten it to specification.

Tightening torque
Countershaft nut (b): 70 N·m (7.0 kg-m, 51.0 lb-ft)

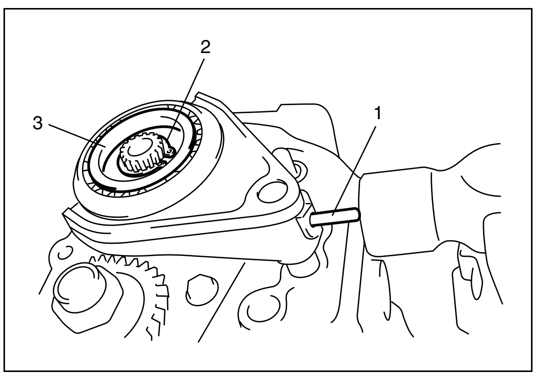


10) Remove special tool, then caulk countershaft nut (4) at C with caulking tool and hammer.
11) Install synchronizer ring (2).
12) Fit 5th gear shift fork (1) to sleeve & hub assembly (3) and install them into input shaft, shift shaft and shift guide shaft at once aligning hub oil groove A with shaft mark B.

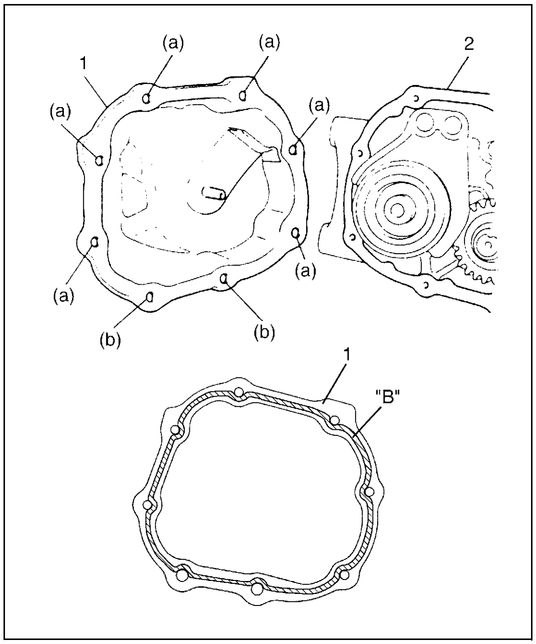
NOTE:

Long flange of hub faces inward (gear side).

A:	Oil groove (Align with B)
B:	Punch mark
C:	Caulking



13) Drive in spring pin (1).
14) Fit hub plate (3) and fix it with circlip (2).



15) Clean mating surface of both left case (2) and side cover (1), apply sealant to side cover (1) as shown in figure by such amount that its section is 1.5mm (0.059 in.) in diameter, mate it with left case and then tighten bolts.

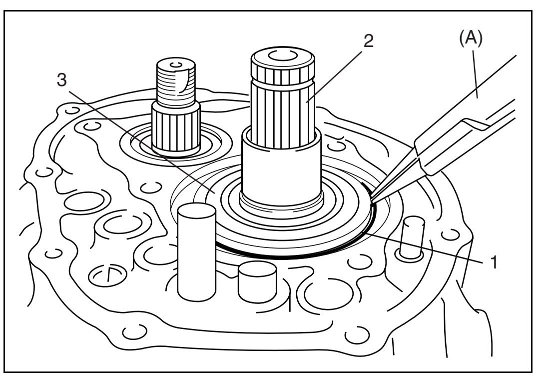
“B”: Sealant 99000-31260

Tightening torque
Side cover No.1 bolt (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)
Side cover No.2 bolt (b): 23 N·m (2.3 kg-m, 17.0 lb-ft)

Gear Shift Shaft, Input Shaft and Counter Shaft Removal and Installation

Removal

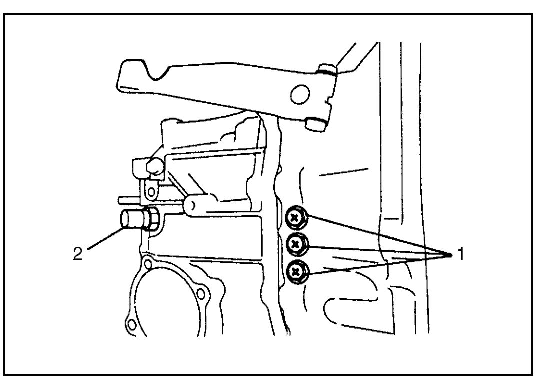
1) Remove gear shift and select shaft assembly referring to “Gear Shift and Select Shaft Assembly Removal and Installation” in this section.
2) Remove fifth gear referring to “Fifth Gear Disassembly and Assembly” in this section.



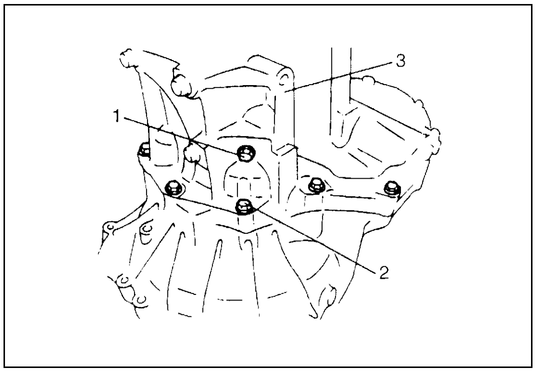
3) Remove snap ring (1) using special tool.

Special tool
(A): 09900-06107

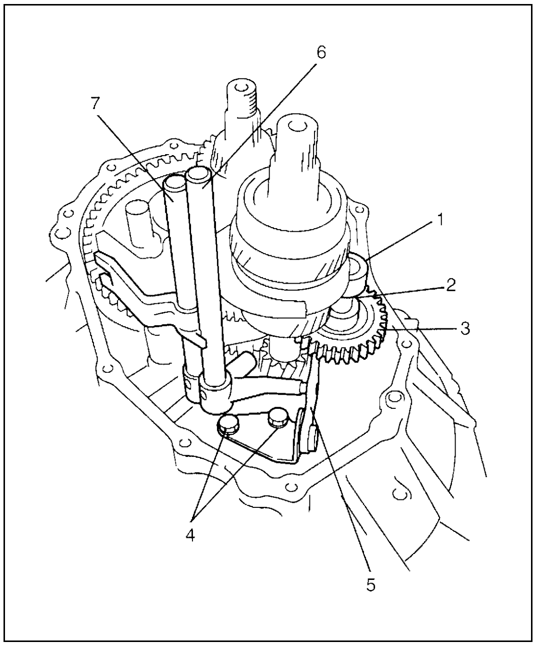
2.	Input shaft
3.	Input shaft left bearing



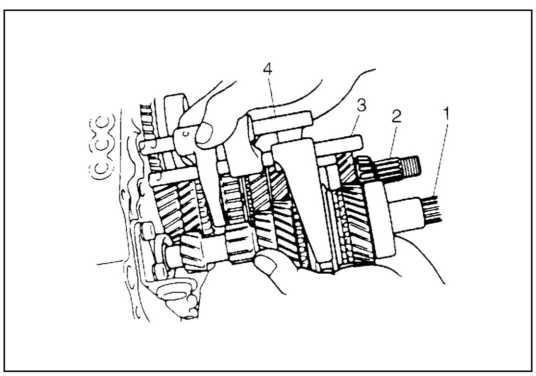
4) Remove gear shift locating bolts (1) with washers, then take out locating springs and steel balls.
5) Remove back up lamp switch (2).



6) Remove reverse shaft bolt (1) with washer.
7) Remove case bolts (2) from outside and another bolts from clutch housing side.
8) Tapping left case (3) flanges with plastic hammer, remove left case.

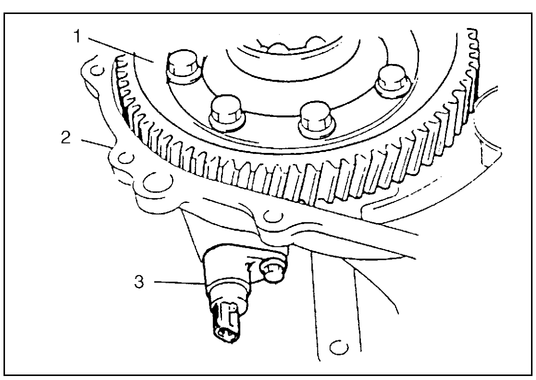


9) Pull out reverse gear shaft (1) with washer (2), then take off reverse idler gear (3).
10) Remove reverse gear shift lever bolts (4) and reverse gear shift lever (5).
11) Pull out 5th & reverse gear shift guide shaft (6) together with 5th & reverse gear shift shaft (7).



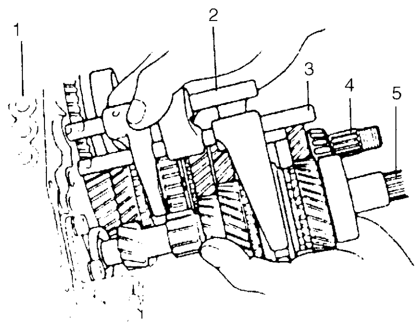
12) Tapping input shaft end with plastic hammer, push it out as assembly from case a little, then take out input shaft assembly (1), counter shaft assembly (2), high speed gear shift shaft (3) and low speed gear shift shaft (4) all at once.

Installation



1) Install differential assembly (1) into right case (2).
2) Insert VSS (3) with grease applied to its new O-ring, then tighten it with bolt.

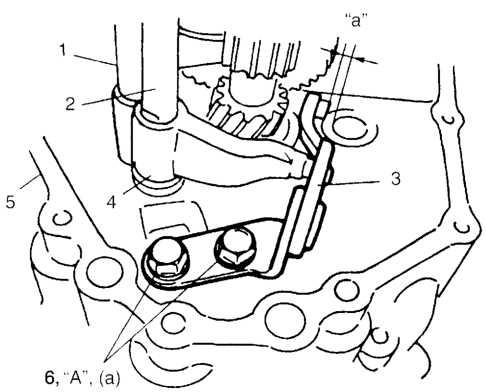
Grease 99000-25010



3) Join input shaft (5), countershaft (4), low speed gear shift shaft (2) and high speed gear shift shaft (3) assemblies all together, then install them into right case (1).

CAUTION:
Take care not to damage oil seal lip by input shaft, or oil leakage may take place.

NOTE:
- **Input shaft right bearing on shaft can be installed into right case tapping shaft with plastic hammer.**
- **Check to make sure that counter shaft is engaged with final gear while installing.**



4) Install 5th & reverse gear shift shaft (1) with 5th & reverse gear shift guide shaft (2) into right case (5). Reverse gear shift arm (4) has to be joined with reverse gear shift lever (3) at the same time.
5) Place reverse gear shift lever (3), fasten it with bolts (6) after applying thread lock cement.

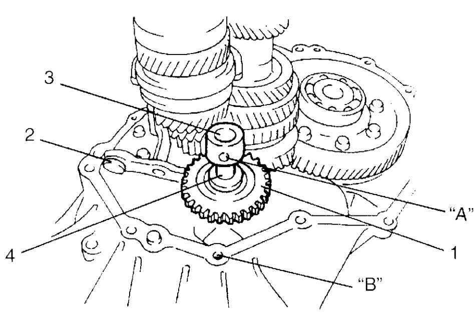
"A": Thread lock cement 99000-32110

Tightening torque
Reverse gear shift lever bolt
(a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

NOTE:
- **When installing reverse gear shift lever (3), set it as the following specification.**

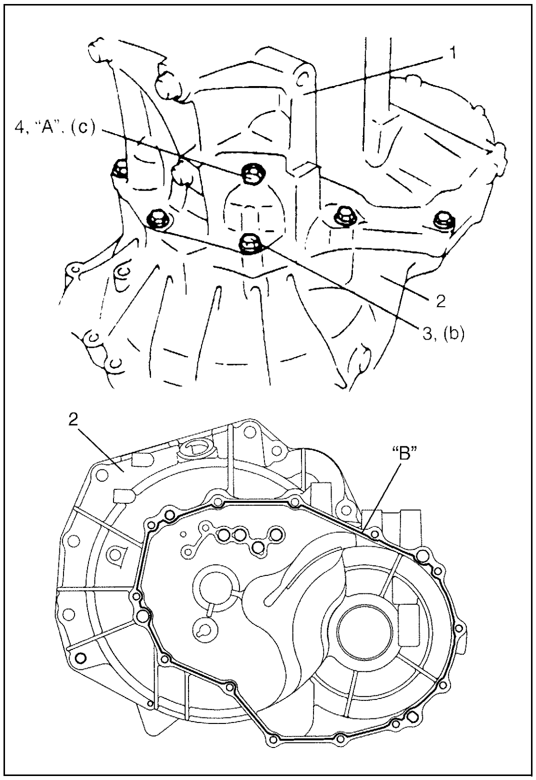
Distance between lever end and shaft bore
"a": 5 mm (0.2 in.)

- **Distance "a" must be measured after installing reverse gear shaft.**
- **When "a" is 5 mm (0.2 in.), clearance between reverse idler gear groove and shift lever end will be 1 mm (0.04 in.).**



6) Make reverse idler gear (1) with reverse gear shift lever (2), insert reverse gear shaft (3) into case through idler gear and then align "A" in shaft with "B" in case.

NOTE:
- **Make sure that washer (4) has been installed in shaft at above the gear.**
- **Check to confirm that reverse gear shift lever end has clearance 1 mm (0.04 in.) to idler gear groove.**



7) Clean mating surfaces of both right and left cases, apply sealant to right case (2) as shown in figure by such amount that its section is 1.5mm (0.059 in.) in diameter then mate it with left case (1).

"B": Sealant 99000-31260

8) Tighten case bolts (3) from left case side to specified torque.

Tightening torque
Transaxle case bolt (b): 19 N·m (1.9 kg-m, 14.0 lb-ft)

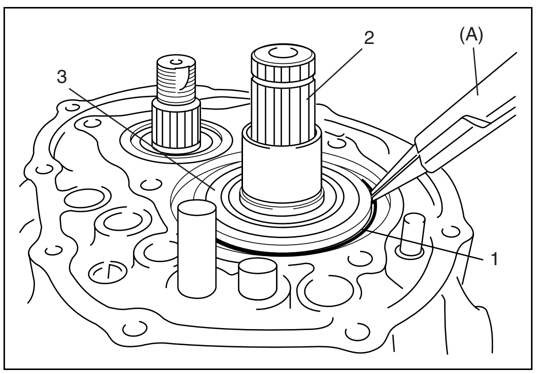
9) Install reverse shaft bolt (4) to which thread lock cement have been applied with aluminum washer and tighten it.

"A": Thread lock cement 99000-32110

Tightening torque
Reverse shaft bolt (c): 23 N·m (2.3 kg-m, 17.0 lb-ft)

10) Install another case bolts from clutch housing side and tighten them to specification.

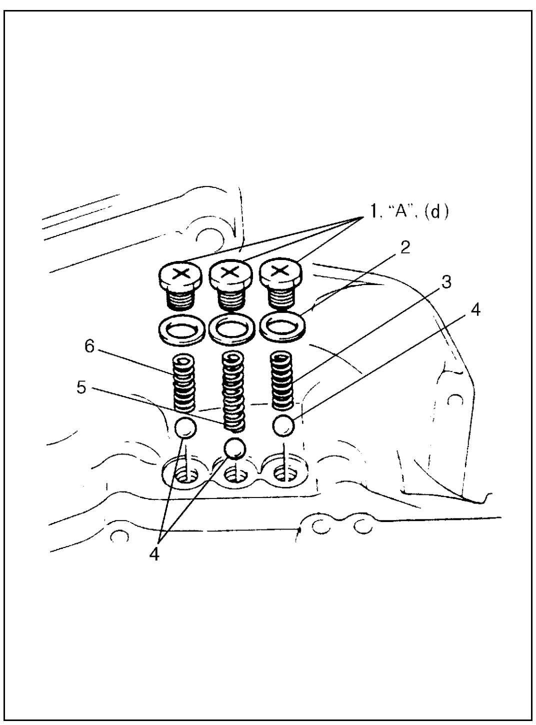
Tightening torque
Transaxle case bolt: 19 N·m (1.9 kg-m, 14.0 lb-ft)



11) Install new snap ring (1) using special tool.

Special tool
(A): 09900-06107

2.	Input shaft
3.	Input shaft left bearing



12) Check locating spring for deterioration and replace with new one as necessary.

Locating spring free length
For Low speed (3) and 5th & reverse (6)
Standard: 26.1 mm (1.028 in.)
Service Limit: 25.0 mm (0.984 in.)
For High speed (5)
Standard: 40.1 mm (1.579 in.)
Service Limit: 39.0 mm (1.535 in.)

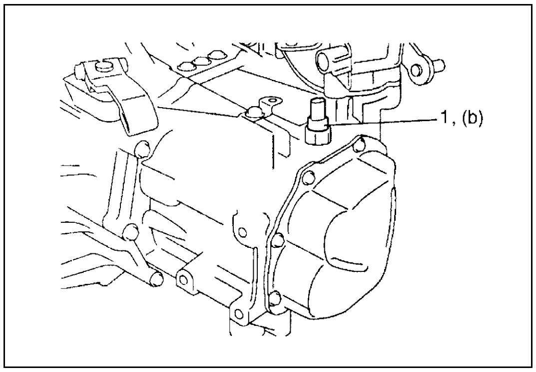
13) Install steel balls (4) and locating springs (4, 5 and 6) for respective gear shift shaft and tighten bolts (1) to which sealant have been applied to its thread part.

"A": Sealant 99000-31260

Tightening torque
Gear shift locating bolt (d): 13 N·m (1.3 kg-m, 9.5 lb-ft)

2.	Washer

14) Clean mating surface of guide case.
15) Install fifth gear referring to “Fifth Gear Disassembly and Assembly” in this section.
16) Install gear shift and select shaft assembly referring to “Gear Shift and Select Shaft Assembly Removal and Installation” in this section.



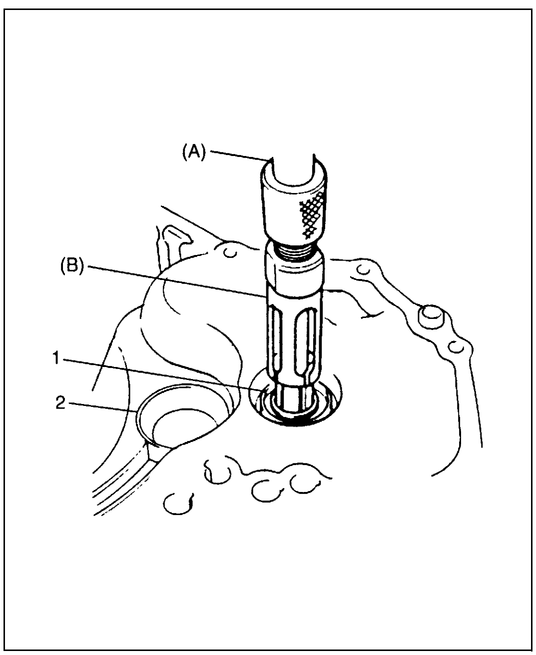
17) Tighten back up lamp switch (1) to specified torque.

Tightening torque
Back up lamp switch (b): 23 N·m (2.3 kg-m, 17.0 lb-ft)

18) Check input shaft for rotation in each gear position.
19) Also confirm continuity of back up lamp switch in reverse position using ohmmeter.

Transaxle Case Disassembly and Assembly

Disassembly



1) Remove input shaft oil seal (1) using special tools, if necessary.

Special tool
(A): 09930-30104
(B): 09923-74510

2) If input shaft right bearing has been left in right case, pull it out using special tools.

Special tool
(A): 09930-30104
(B): 09923-74510

3) Also pull out countershaft right bearing cup (2) using special tools, if necessary.

Special tool
09941-64511
09930-30104

4) Remove counter shaft left bearing cup from left case using special tools.

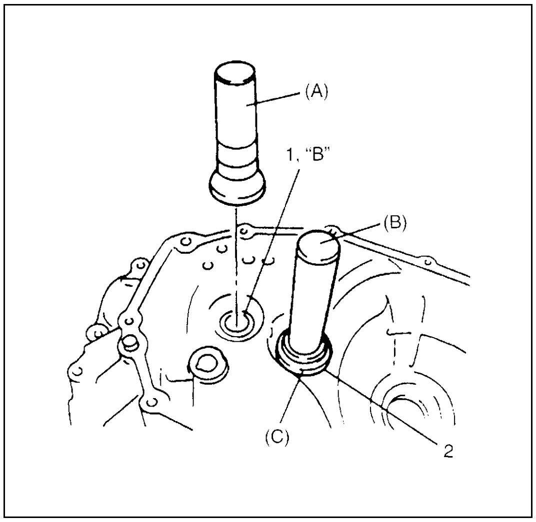
Special tool
09913-84510

5) Replace differential side oil seal(s) referring to “Differential Side Oil Seal Replacement” in this section, if necessary.
6) Remove oil gutter from left case, if necessary.

Assembly

NOTE:

Before installation, wash each part and apply specified transaxle oil to sliding faces of bearing and gear.



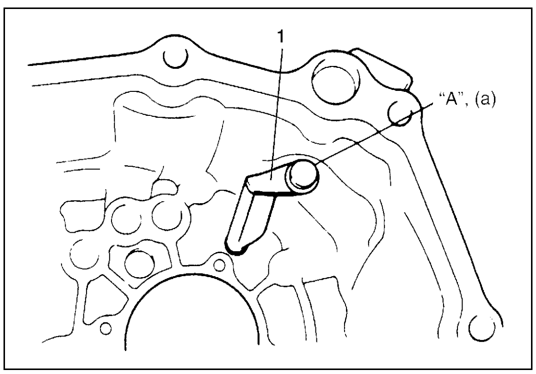
1) If input shaft oil seal (1) has been removed, install it with its spring side facing upward.
   Use special tool and hammer for installation and apply grease to oil seal lip.

   "B": Grease 99000-25010

   Special tool
   (A): 09951-76010

2) If counter shaft right bearing outer race (2) has been removed, install it using special tools and hammer.

   Special tool
   (B): 09924-74510
   (C): 09925-68210



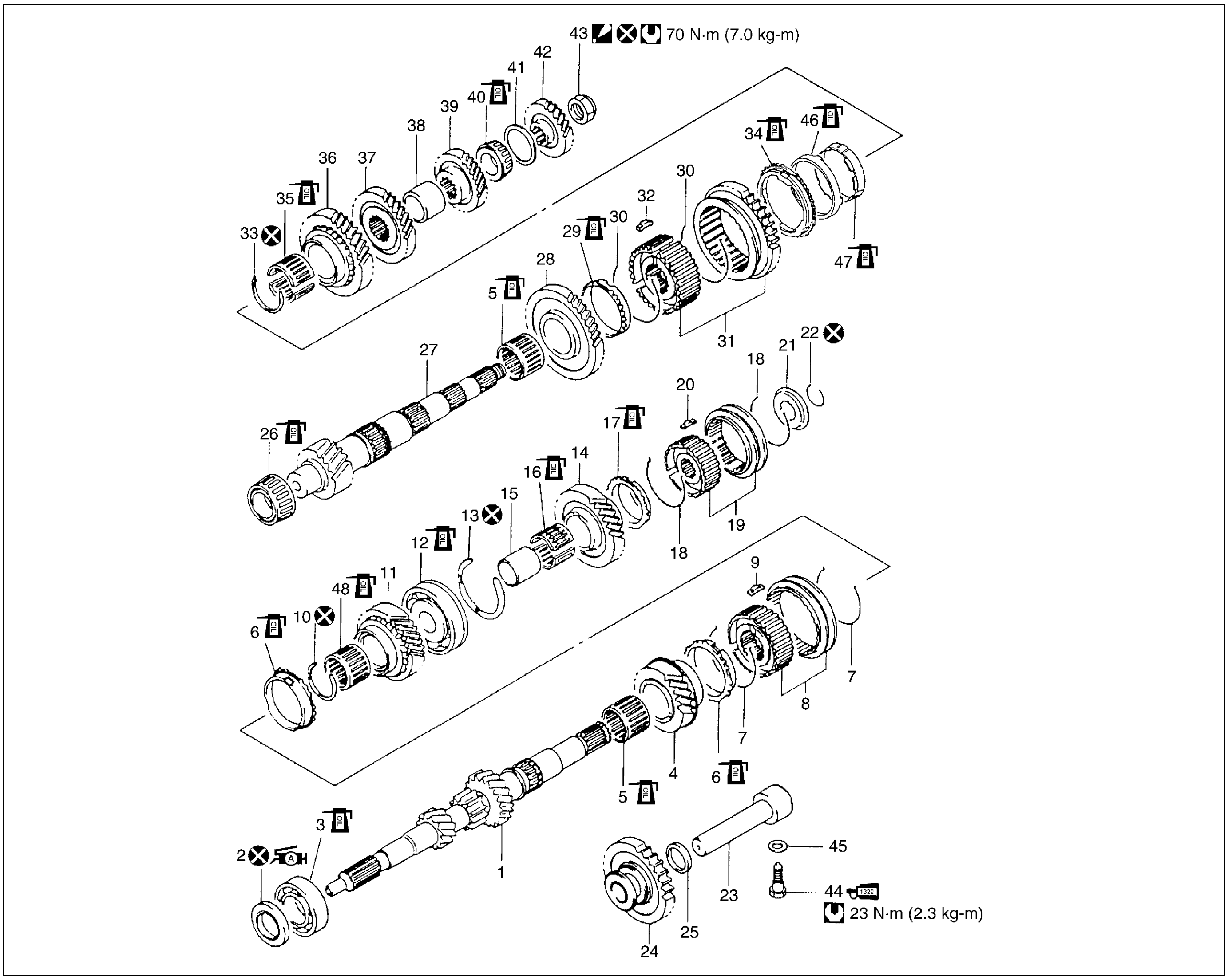
3) If input oil gutter (1) has been removed, install it with bolt to which thread lock cement have been applied.

   "A": Thread lock cement 99000-32110

   Tightening torque
   Oil gutter bolt (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)

4) Install counter shaft left bearing outer race into case bore tapping it with plastic hammer lightly.

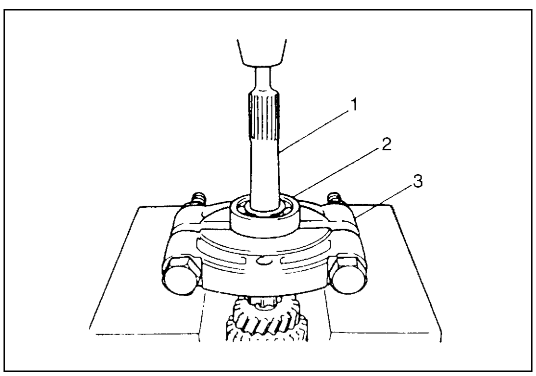
Input & Counter Shaft Components



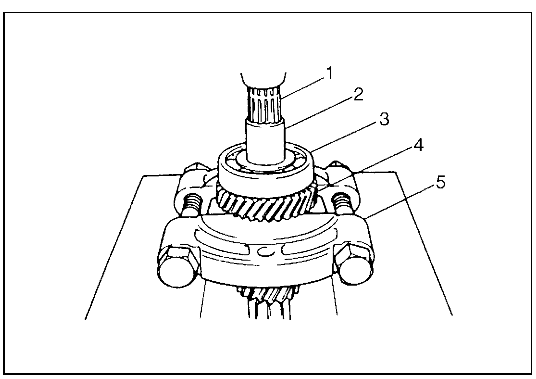
1. Input shaft	18. 5th synchronizer spring	35. Needle bearing (separated steel cage type)
2. Oil seal : Apply grease 99000-25010 to oil seal lip	19. 5th speed sleeve & hub	36. Countershaft 2nd gear
3. Input shaft right bearing	20. 5th synchronizer key	37. Countershaft 3rd gear
4. Input shaft 3rd gear	21. 5th synchronizer hub plate	38. 3rd & 4th gear spacer
5. Needle bearing (resin cage type)	22. Circlip	39. Countershaft 4th gear
6. High speed synchronizer ring	23. Reverse gear shaft	40. Countershaft left bearing
7. High speed synchronizer spring	24. Reverse idler gear	41. Bearing set shim
8. High speed sleeve & hub	25. Reverse shaft washer	42. Countershaft 5th gear
9. High speed synchronizer key	26. Countershaft right bearing	43. Countershaft nut : After tightening nut to specified torque, caulk nut securely.
10. Circlip	27. Countershaft	44. Reverse shaft bolt : Apply thread lock cement 99000-32110 to thread part of bolt.
11. Input shaft 4th gear	28. Countershaft 1st gear	45. Washer
12. Input shaft left bearing	29. 1st gear synchronizer ring	46. Center cone
13. Snap ring	30. Low speed synchronizer spring	47. 2nd gear synchronizer inner ring
14. Input shaft 5th gear	31. Low speed sleeve & hub	48. Needle bearing (steel cage type)
15. 5th gear spacer	32. Low speed synchronizer key	Tightening torque
16. 5th gear needle bearing (separated steel cage type)	33. Circlip	Do not reuse.
17. 5th speed synchronizer ring	34. 2nd gear synchronizer outer ring	Apply transaxle oil.

Input Shaft Disassembly and Assembly

Disassembly



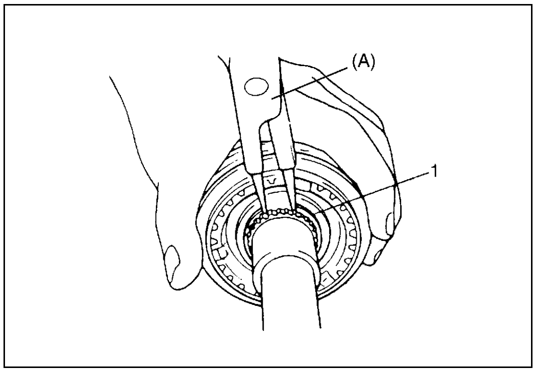
1) Remove input shaft right bearing (2) from input shaft (1) using bearing puller (3) and press.



2) Drive out 5th gear spacer (2), left bearing (3) and 4th gear (4) all at once from input shaft (1) using puller (5) and press.

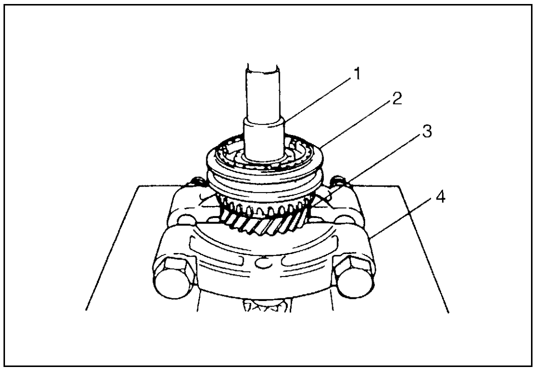
CAUTION:
To avoid gear tooth from being damaged, support it at flat side of bearing puller.

3) Take out 4th gear needle bearing and high speed synchronizer ring.



4) Using special tool, remove circlip (1).

Special tool
(A): 09900-06107



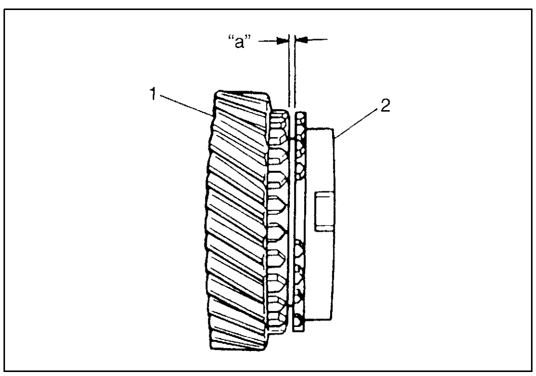
5) Drive out high speed synchronizer sleeve & hub assembly (2) together with 3rd gear (3) from input shaft (1) using puller (4) and press.

> **CAUTION:**
> **Make sure to use flat side of puller to avoid causing damage to 3rd gear tooth.**

6) Take out 3rd gear needle bearing from shaft.
7) Disassemble synchronizer sleeve & hub assembly.

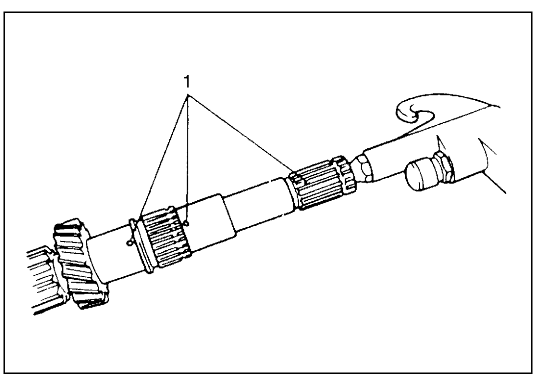
Assembly

1) Clean all components thoroughly, inspect them for any abnormality and replace with new ones as necessary.

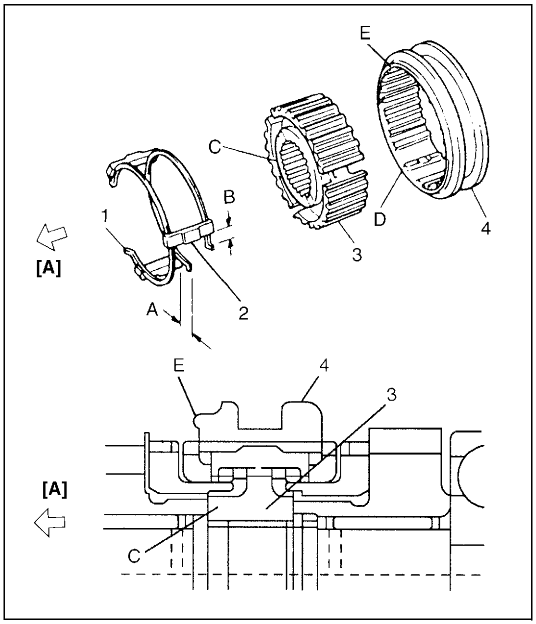


2) If synchronizer parts need to be repaired, check clearance "a" between ring (2) and gear (1), each chamfered tooth of gear, ring and sleeve, then determine parts replacement.

Clearance between synchronizer ring and gear
Standard "a": 1.0 – 1.4 mm (0.039 – 0.055 in.)
Service limit "a": 0.5 mm (0.019 in.)



3) To ensure lubrication, air blow oil holes (1) and make sure that they are free from any obstruction.



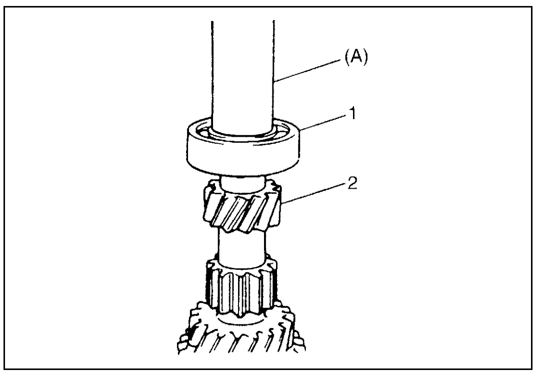
4) Fit high speed synchronizer sleeve (4) to hub (3), insert 3 keys (2) in it and then set springs (1) as shown in figure.

NOTE:

- **No specific direction is assigned to each key but it is assigned as sleeve & hub assembly.**
- **Size of high speed synchronizer sleeve, hub, keys and springs is between those of low speed and 5th speed ones.**

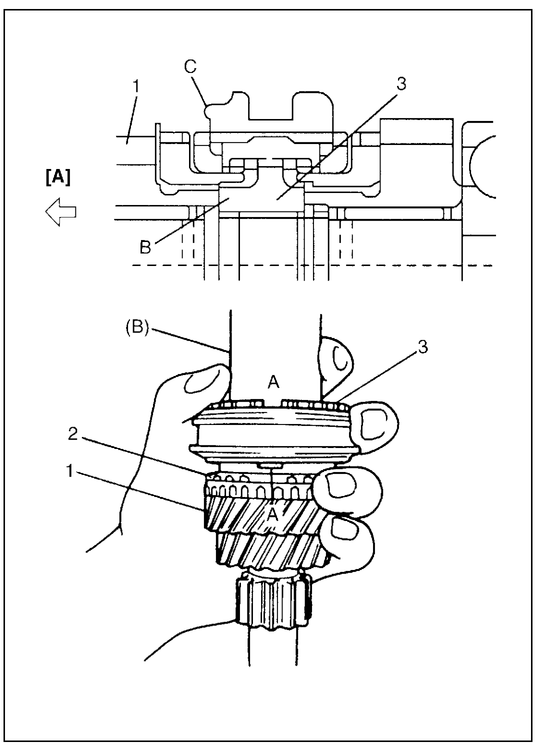
Synchronizer key installation position
: A = B

[A]:	3rd gear side
C:	Long flange
D:	Key way
E:	Projecting end



5) Drive in right bearing (1) to input shaft (2) using special tool and hammer.

Special tool
(A): 09913-80112



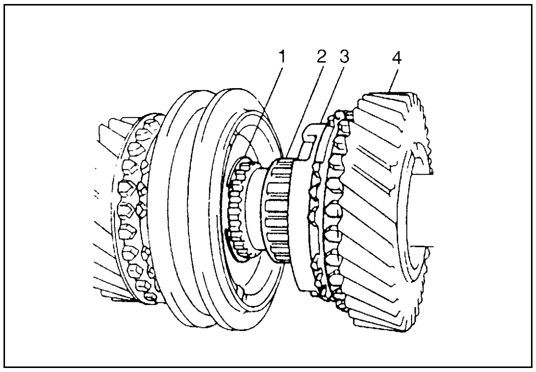
6) Install 3rd gear needle bearing of resin cage type, apply oil to it, then install 3rd gear (1) and synchronizer ring (2).
7) Drive in high speed sleeve & hub assembly (3) using special tool and hammer, facing long flange side of hub to 3rd gear.

NOTE:

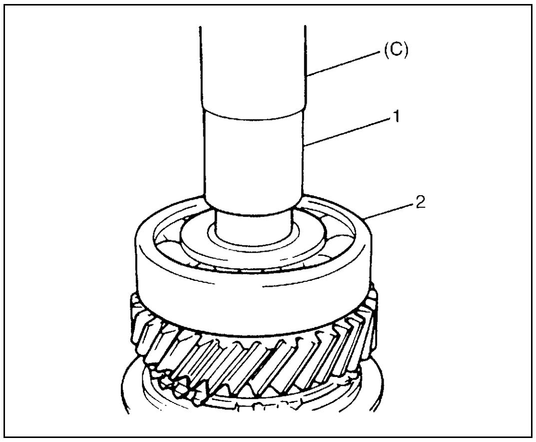
- **While press-fitting sleeve & hub, make sure that synchronizer ring key slots are aligned with keys in sleeve & hub assembly.**
- **Check free rotation of 3rd gear after press-fitting sleeve & hub assembly.**
- **Synchronizer rings for 3rd and 4th are identical.**

Special tool
(B): 09913-84510

[A]:	3rd gear side
A:	Key way
B:	Long flange
C:	Projecting end



8) Install circlip (1) and confirm that circlip is installed in groove securely.
   Install needle bearing (2) of steel cage type, apply oil to bearing and then install synchronizer ring (3) and 4th gear (4).



9) Press-fit left bearing (2) using special tool and hammer.

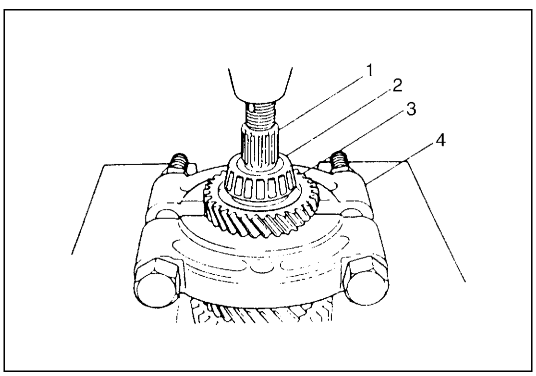
   Special tool
   (C): 09925-98221

10) Using the same special tool at step 9), drive in 5th gear spacer (1).

CAUTION:
To prevent 5th gear spacer from being distorted because of excessive compression, do not press-fit it with left bearing at once.

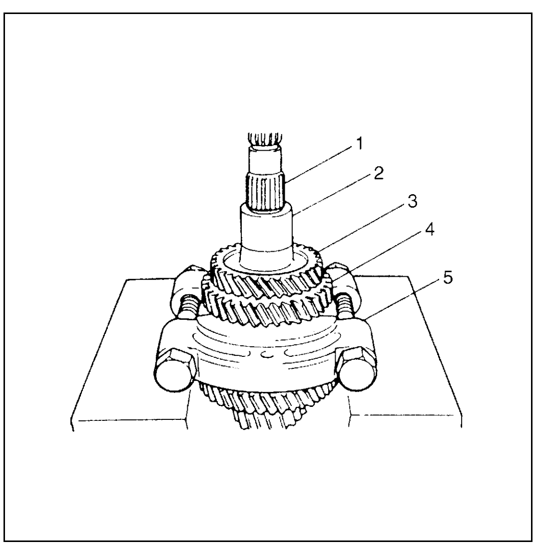
Counter Shaft Disassembly and Assembly

Disassembly



1) Drive out left bearing cone (2) with 4th gear (3) from counter shaft (1) using puller (4) and press.

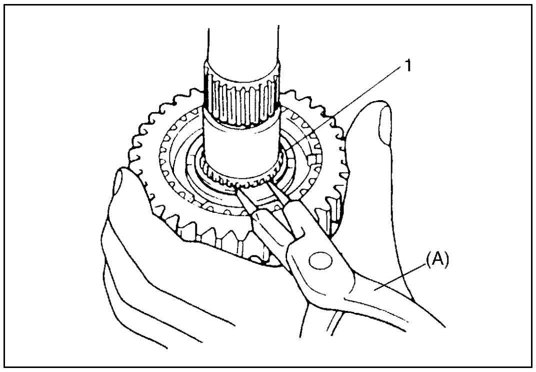
CAUTION:
- **Use puller and press that will bear at least 5 ton (11,000 lb) safely.**
- **To avoid tooth damage, support 4th gear at flat side of puller.**



2) Apply puller (5) to 2nd gear (4) and drive out 3rd & 4th gear spacer (2) and 3rd gear (3) together with 2nd gear (4) from counter shaft (1) using press. Take out needle bearing of separated steel cage type from counter shaft.

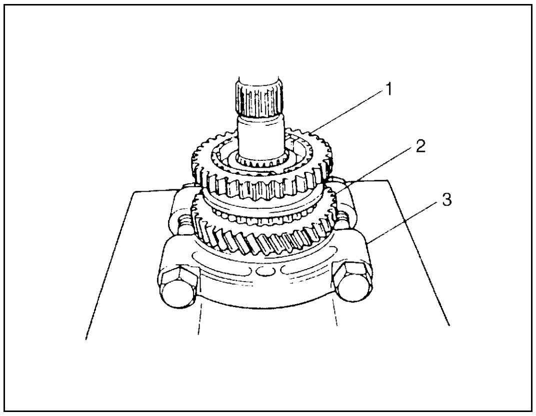
CAUTION:
- **If compression exceeds 5 ton (11,000 lb), release compression once, reset puller support and then continue press work again.**
- **To avoid gear tooth from being damaged, support it at flat side of bearing puller.**

3) Take out 2nd synchronizer outer ring, center cone and inner ring.



4) Using special tool, remove circlip (1).

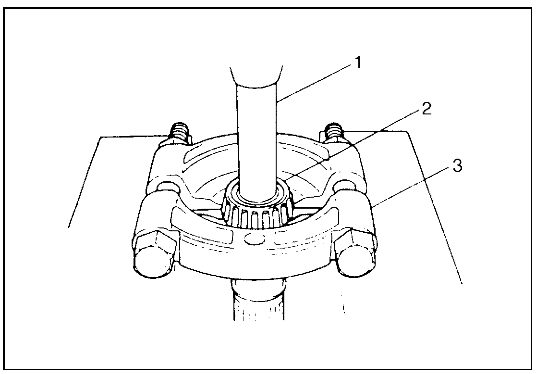
Special tool
(A): 09900-06107



5) Apply puller (3) to 1st gear (2) and drive out low speed synchronizer sleeve & hub assembly (1) with 1st gear (1) using press.

CAUTION:
To avoid gear tooth from being damaged, support it at flat side of bearing puller.

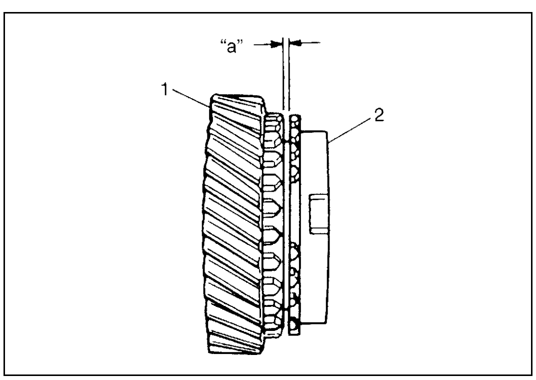
6) Disassemble synchronizer sleeve & hub assembly.
7) Take out 1st gear needle bearing of resin cage type from shaft.



8) Remove right bearing cone (2) using puller (3), metal stick (1) and press.

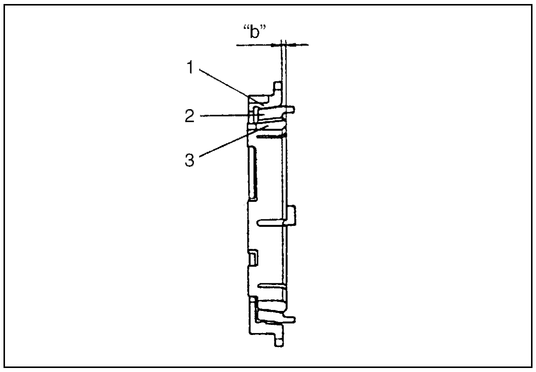
Assembly

1) Clean all components thoroughly, inspect them for any abnormality and replace with new ones as necessary.



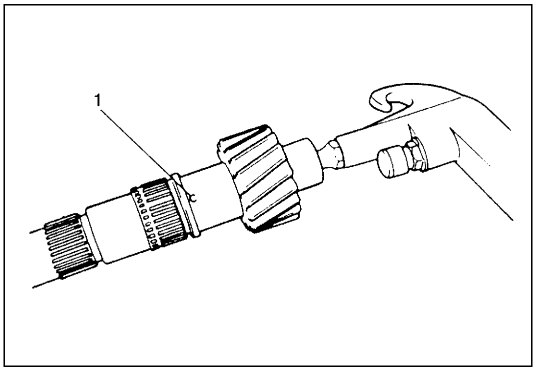
2) If synchronizer parts need to be repaired, check clearance "a" between ring (2) and gear (1), each chamfered tooth of gear, ring and sleeve, then determine parts replacement.

Clearance between synchronizer ring and gear
Standard "a": 1.0 – 1.4 mm (0.039 – 0.055 in.)
Service limit "a": 0.5 mm (0.019 in.)

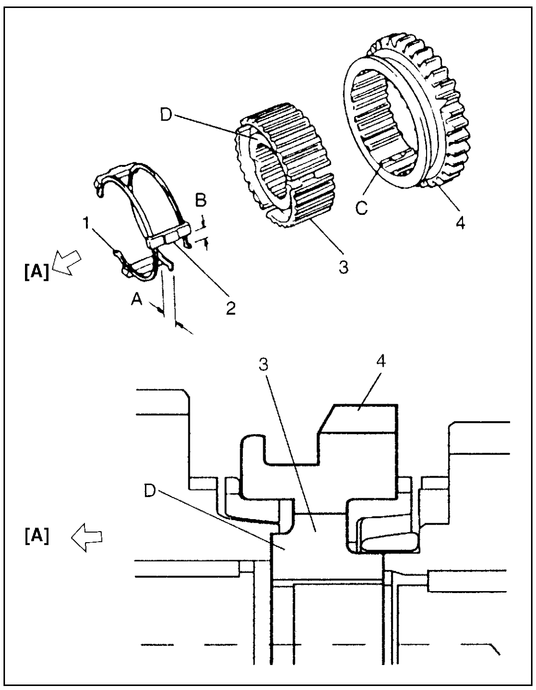


3) Put the synchronizer outer ring (1), inner ring (3) and the cone (2) together and then measure the step difference between the outer ring and the inner ring. And also check each chamfered tooth of gear and synchronizer ring and replace with new one, if necessary. Also, check gear tooth.

Difference between synchronizer outer ring and inner ring
Standard "b": 1.0 – 1.4 mm (0.039 – 0.055 in.)
Service limit "b": 0.5 mm (0.019 in.)



4) To ensure lubrication, air blow oil holes (1) and make sure that they are free from any obstruction.



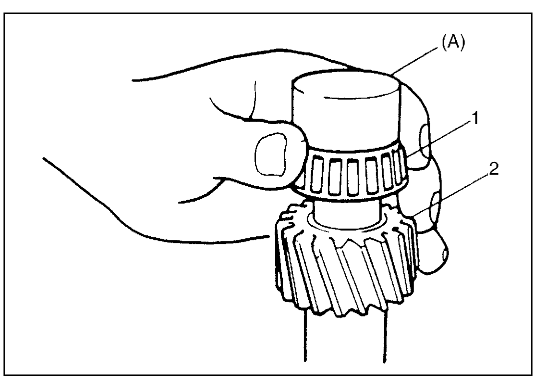
5) Fit low speed synchronizer sleeve (4) to hub (3), insert 3 keys (2) in it and then set springs (1) as shown in figure.

NOTE:

- **No specific direction is assigned to each key but it is assigned as sleeve & hub assembly.**
- **Size of low speed synchronizer keys and springs are the largest compared with those of high speed and 5th speed ones.**

Synchronizer key installation position
: A = B

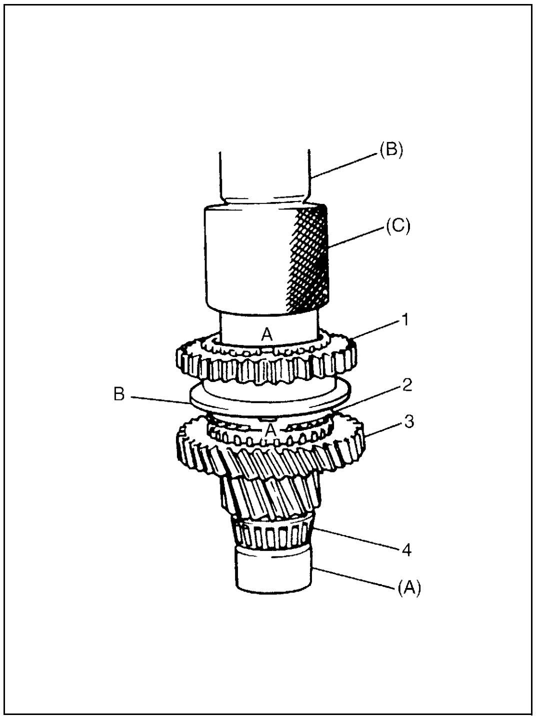
[A]:	1st gear side
C:	Key way
D:	Short flange



6) Install right bearing cone (1) to counter shaft (2) using special tool and hammer.

Special tool
(A): 09923-78210

7) Install needle bearing of resin cage type, apply oil to it, then install 1st gear and 1st gear synchronizer ring.

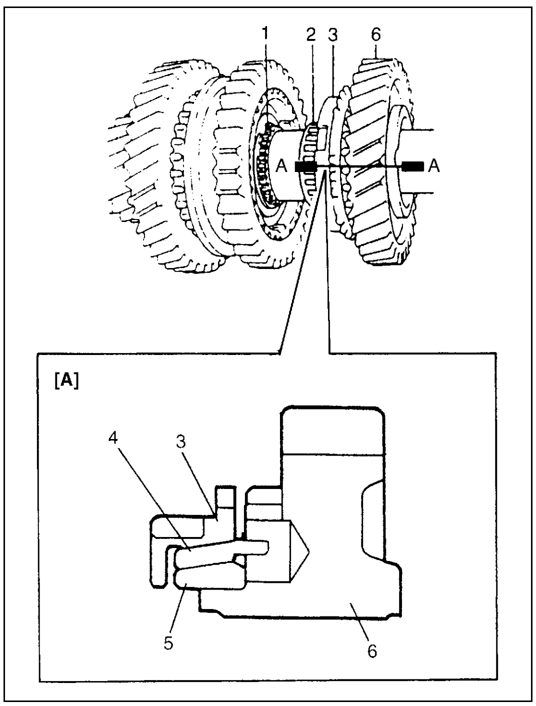


8) Drive in low speed sleeve & hub assembly (1) using special tools and hammer, facing “B” side of sleeve to 1st gear.

NOTE:
- **Support shaft with special tool as shown in figure so that retainer of bearing cone (4) will be free from compression.**
- **Make sure that synchronizer ring (2) key slots are aligned with keys while press-fitting sleeve & hub assembly.**
- **Check free rotation of 1st gear (3) after press-fitting sleeve & hub assembly.**

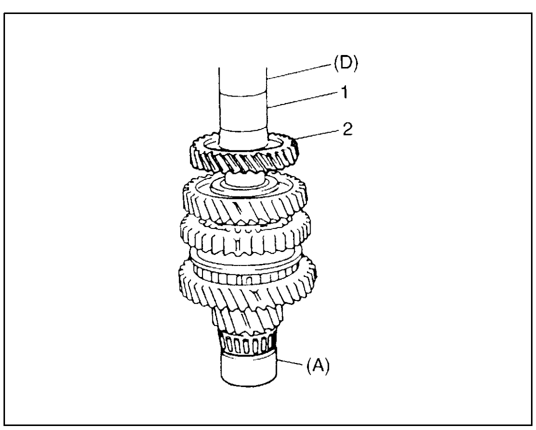
Special tool
(A): 09923-78210
(B): 09925-18011
(C): 09940-53111

A: Align key slots with keys



9) Install circlip (1) and confirm that circlip is installed in groove securely.
Install needle bearing (2) of separated steel cage type, apply oil to bearing.
With synchronizer outer ring (3), center cone (4) & inner ring (5) put together and installed to 2nd gear (6) as shown in figure.

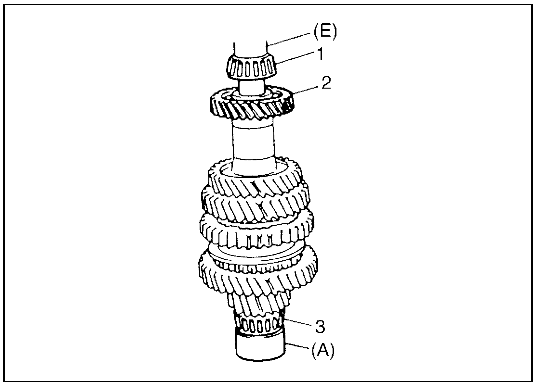
[A]: SECTION A - A



10) Press-fit 3rd gear (2) and spacer (1) using special tools and press.

CAUTION:
Press-fit 3rd gear (2) and spacer (1) first, and then 4th gear later separately so that counter shaft will not be compressed excessively.

Special tool
(A): 09923-78210
(D): 09913-80112



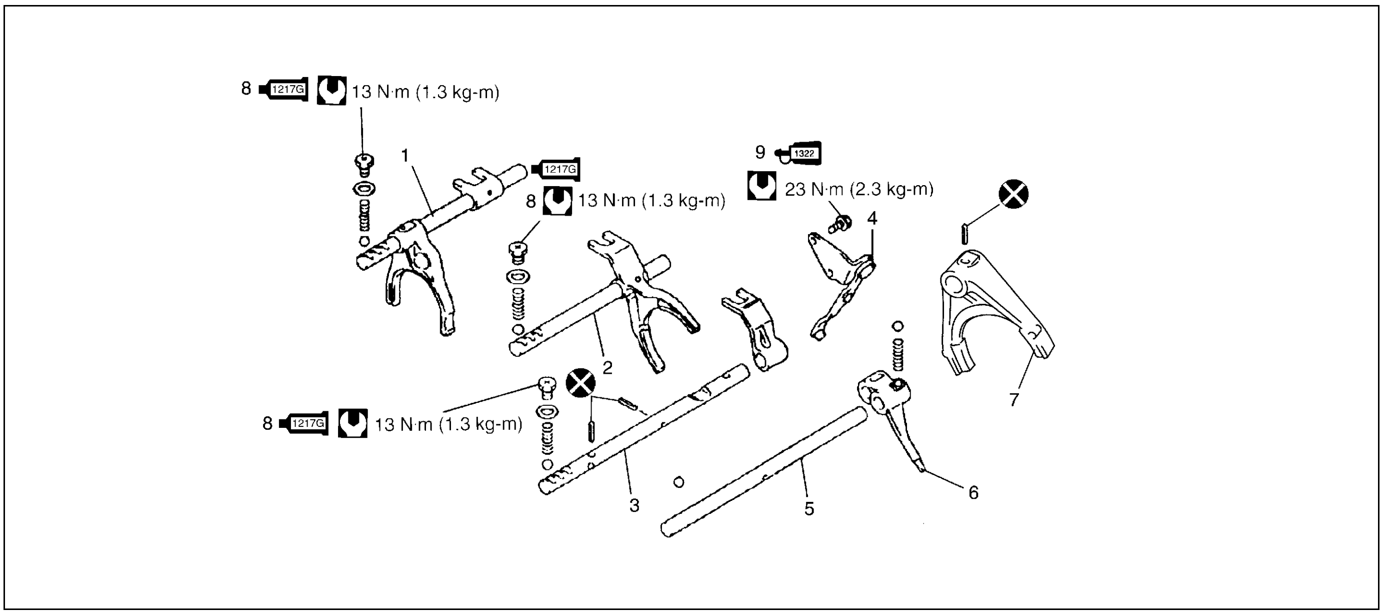
11) Press-fit 4th gear (2) using the same procedure as step 10).
12) Install left bearing cone (1) using special tools and hammer.

NOTE:

For protection of right bearing cone (3), always support shaft with special tool as illustrated.

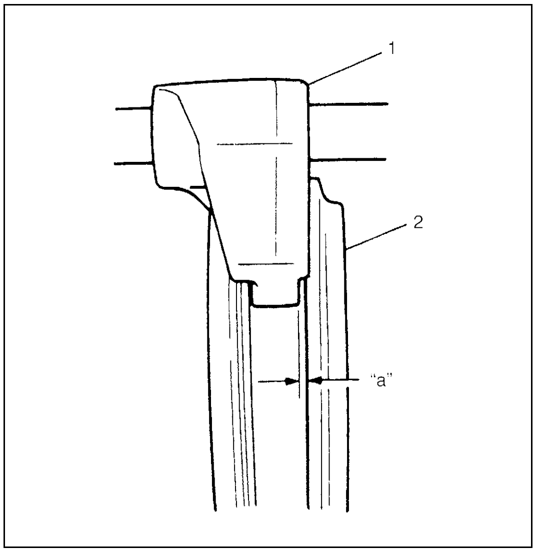
Special tool
(A): 09923-78210
(E): 09925-98221

Gear Shift Shaft Components



1. Low speed gear shift shaft		5. 5th & reverse gear shift guide shaft	1322	9. Reverse gear shift lever bolt : Apply thread lock 99000-32110 to all around thread part to bolt.
2. High speed gear shift shaft		6. Reverse gear shift arm		Tightening torque
3. 5th & reverse gear shift shaft		7. 5th gear shift fork		Do not reuse.
4. Reverse gear shift lever	1217G	8. Gear shift locating bolt : Apply sealant 99000-31260 to bolt thread.		

High Speed and Low Speed Gear Shift Shafts Inspection



1) Using feeler gauge, check clearance between fork (1) and sleeve (2) and replace those parts if it exceeds limit below.

NOTE:

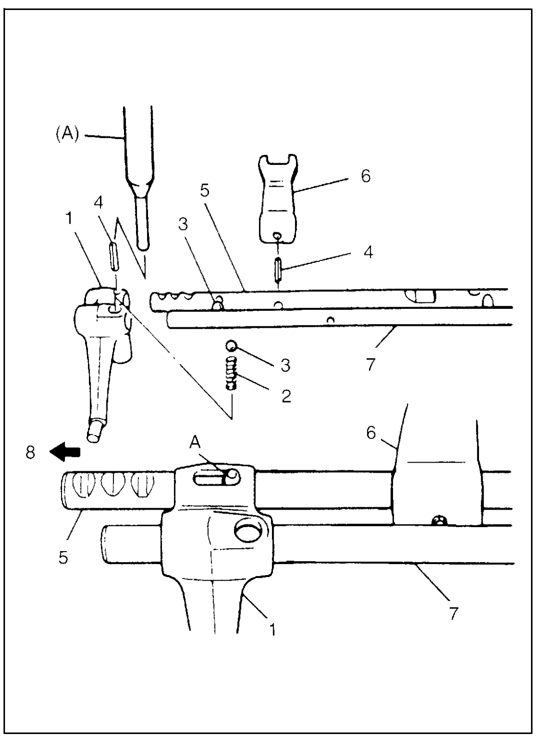
For correct judgement of parts replacement, carefully inspect contact portion of fork and sleeve.

Clearance between fork and sleeve
Service limit "a": 1.0 mm (0.039 in.)

2) Insert each gear shift shaft into case and check that it moves smoothly. If it doesn't, correct using oilstone, reamer or the like.

5th & Reverse Gear Shift Shafts Disassembly and Assembly

Disassembly



Disassemble component parts using special tool and hammer.

Special tool
(A): 09922-85811

Assembly

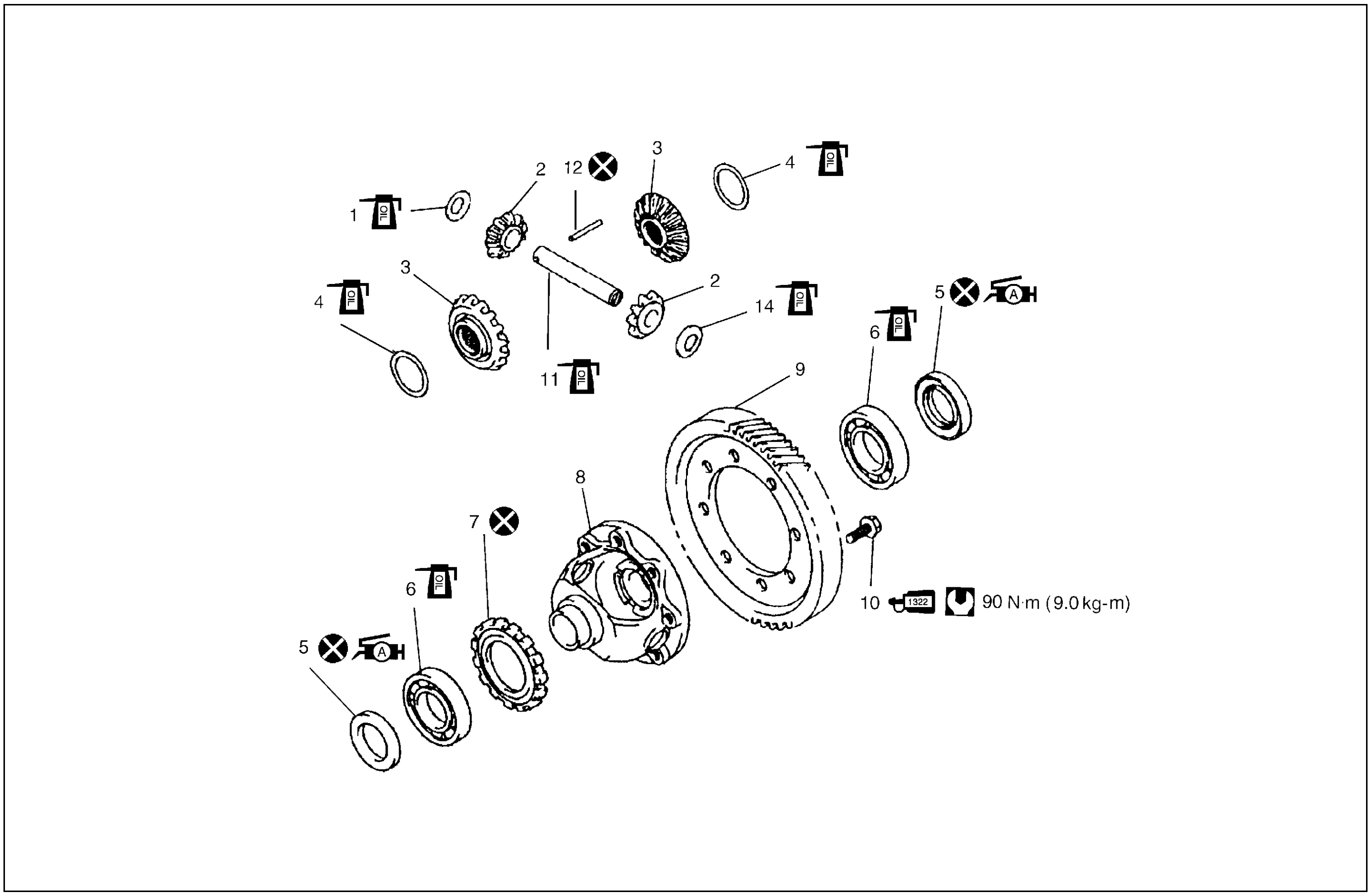
Replace or correct parts as required and assemble shafts making sure that component parts are in proper order as shown in figure.

NOTE:

- **Distinguish reverse gear shift arm spring (Blue) (2) from low speed locating spring (Yellow).**
- **Install 2 steel balls (3) in reverse gear shift arm (1) without fail.**
- **Drive in spring pin for reverse gear shift arm (1) facing slit A toward front.**

4. Spring pin	7. 5th & reverse gear shift guide shaft
5. 5th & reverse gear shift shaft	8. 5th gear side
6. 5th & reverse gear shift yoke	A: Face pin slit toward 5th gear side

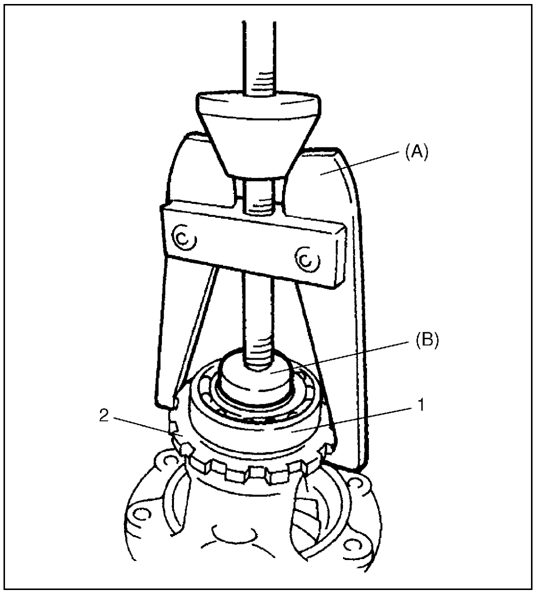
Differential Components



	1. Differential pinion washer		9. Final gear
	2. Differential side pinion gear		10. Final gear bolt : Apply thread lock 99000-32110 to all around thread part of bolt
	3. Differential side gear		11. Differential pinion shaft
	4. Side gear washer		12. Differential pinion shaft pin
	5. Differential side oil seal : Apply grease 99000-25010 to oil seal lip.		Tightening torque
	6. Differential side bearing		Do not reuse.
	7. Speed sensor ring		Apply transaxle oil.
	8. Differential case		

Differential Disassembly and Assembly

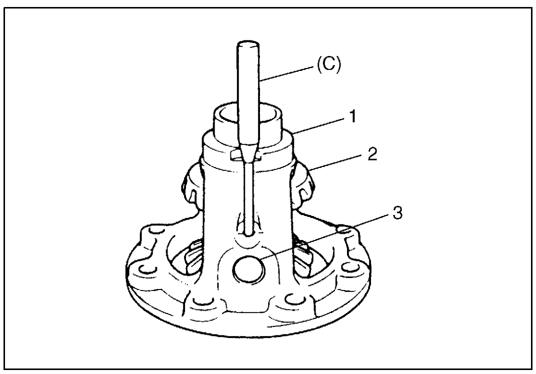
Disassembly



1) Using special tools, remove right bearing (1) and sensor rotor (2).

Special tool
(A): 09913-60910
(B): 09925-88210

2) Remove left bearing in the same manner at step 1).
3) Support differential case with soft jawed vise and remove final gear bolts then take out final gear.

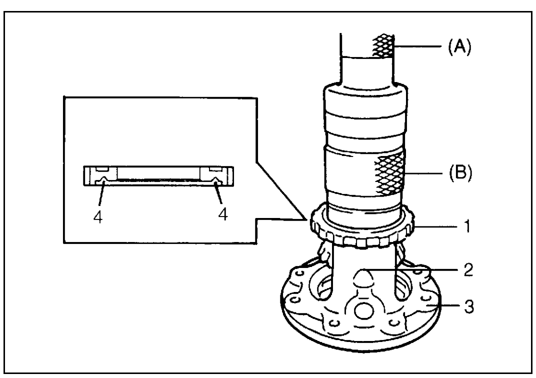


4) Using special tool and hammer, drive out differential pinion shaft pin and then disassemble component parts.

Special tool
(C): 09922-85811

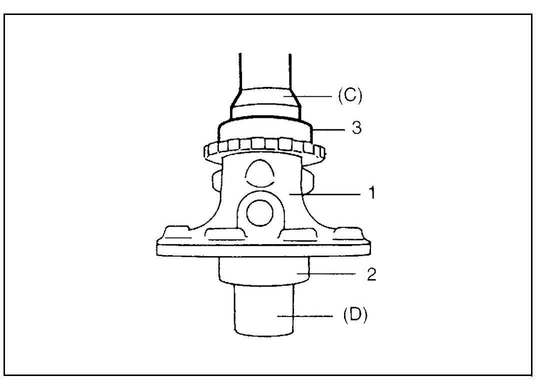
1.	Differential case
2.	Differential gear
3.	Differential pinion shaft

Assembly



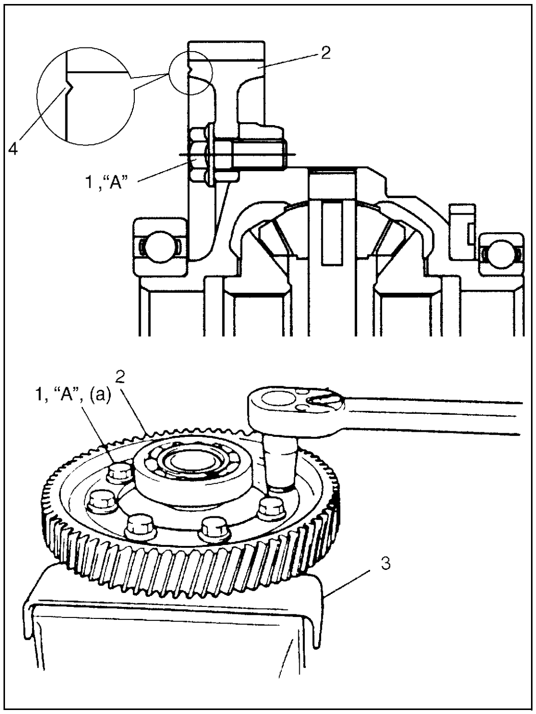
1) Drive in new differential pinion shaft pin (2) till the depth from differential case (3) surface is about 1 mm (0.04 in.).
2) Press-fit new sensor rotor (1) with groove (4) side downward as shown using special tools and copper hammer.

Special tool
(A): 09913-75510
(B): 09940-54910



3) Press-fit left bearing (2) using special tools and copper hammer.
4) Support differential assembly (1) as illustrated so as to left bearing (2) is floating, and then press-fit right bearing (3) like left bearing in Step 3).

Special tool
(C): 09951-76010
(D): 09951-16060



5) Hold differential assembly with soft jawed vise (3), install final gear (2) as shown in figure and then tighten bolts (1) with thread lock cement applied to specified torque.

NOTE:
Make sure to install final gear in correct installing direction.

CAUTION:
Use of any other bolts than specified ones is prohibited.

"A": Thread lock cement 99000-32110

Tightening torque
Final gear bolt (a): 90 N·m (9.0 kg-m, 65.0 lb-ft)

4. Groove

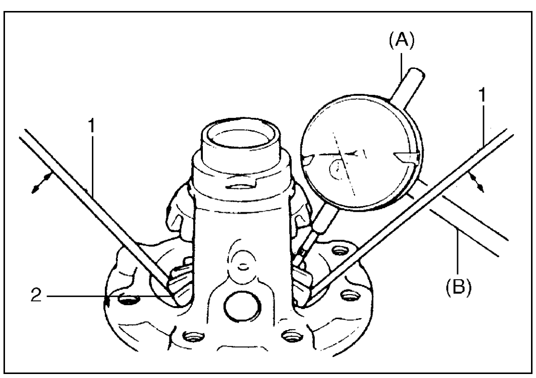
Differential Adjustment

Judging from abnormality noted before disassembly and what is found through visual check of component parts after disassembly, prepare replacing parts and proceed to reassembly. Make sure that all parts are clean.

1) Assemble differential gear and measure thrust play of differential gear as follows.

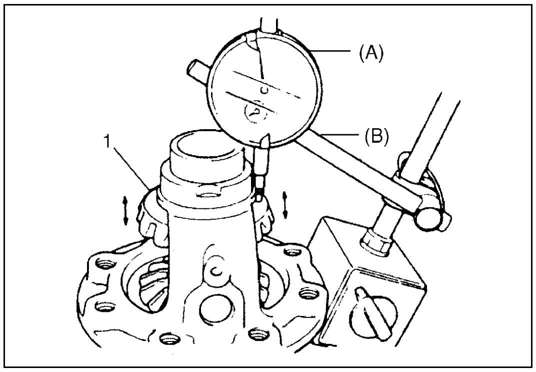
Differential gear thrust play
: 0.03 – 0.31 mm (0.001 – 0.012 in.)

- For left side



a) Hold differential assembly with soft jawed vise and apply measuring tip of dial gauge to top surface of gear.
b) Using 2 screwdrivers (1), move gear (2) up and down and read movement of dial gauge pointer.

Special tool
(A): 09900-20606
(B): 09900-20701



- For right side

a) Using similar procedure to the above, set dial gauge tip to gear (1) shoulder.
b) Move gear up and down by hand and read dial gauge.

Special tool
(A): 09900-20606
(B): 09900-20701

2) If thrust play is out of specification, select suitable thrust washer from among the following available size, install it and check again that specified gear play is obtained.

Available thrust washer thickness
0.9, 0.95, 1.0, 1.05, 1.1, 1.15 and 1.2 mm
(0.035, 0.037, 0.039, 0.041, 0.043, 0.045, and 0.047 in.)

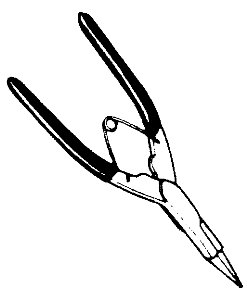
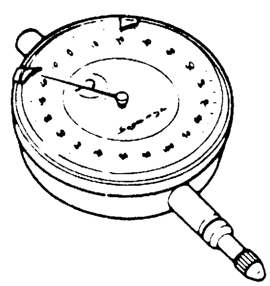
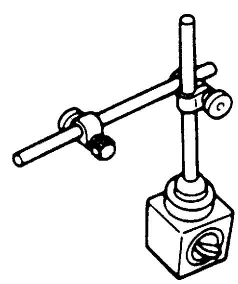
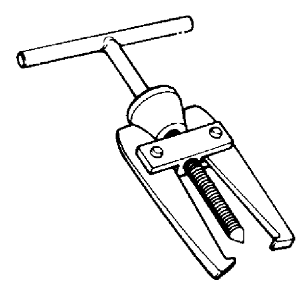
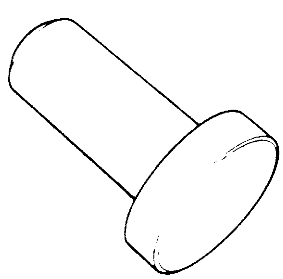
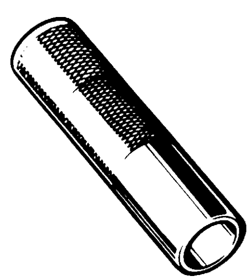
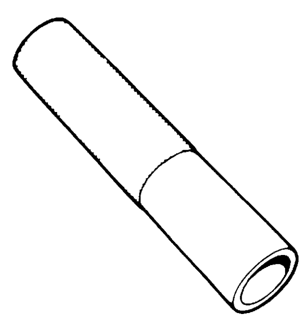
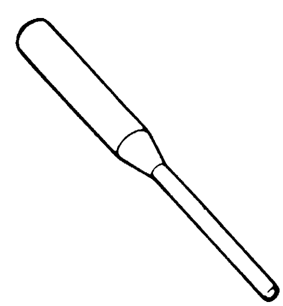
Tightening Torque Specification

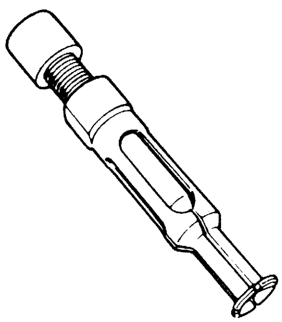
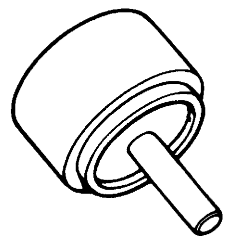
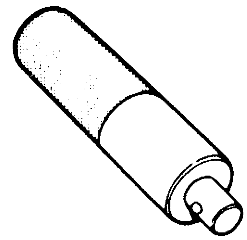
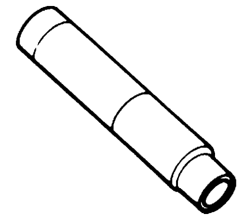
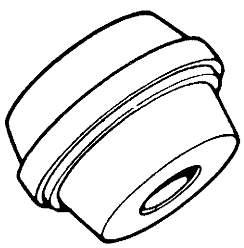
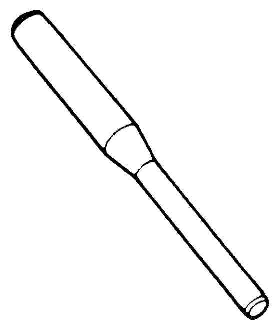
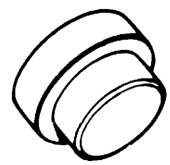
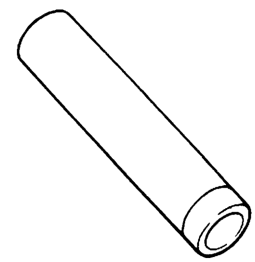
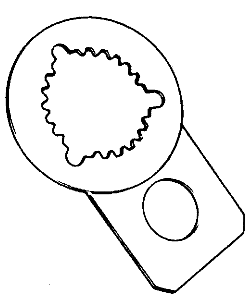
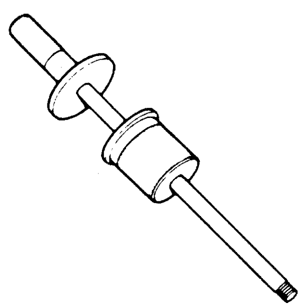
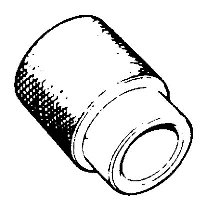
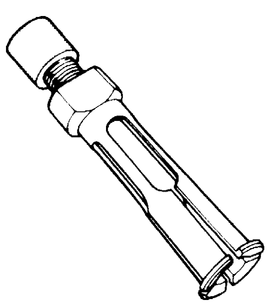
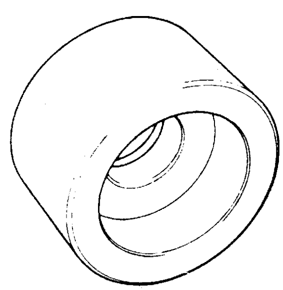
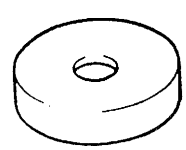
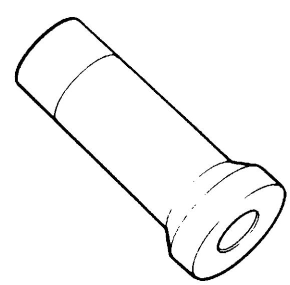
Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Transaxle oil level/filler and drain plugs	21	2.1	15.5
Oil gutter bolt	10	1.0	7.5
Final gear bolt	90	9.0	65.0
Reverse gear shift lever bolt	23	2.3	17.0
Transaxle case bolt	19	1.9	14.0
Reverse shaft bolt	23	2.3	17.0
Gear shift locating bolt	13	1.3	9.5
Left case plate screw and bolt	10	1.0	7.5
Countershaft nut	70	7.0	51.0
Side cover No.1 bolt	10	1.0	7.5
Side cover No.2 bolt	23	2.3	17.0
Gear shift guide case bolt	23	2.3	17.0
Gear shift interlock bolt	23	2.3	17.0
5th to reverse interlock guide bolt	23	2.3	17.0
Back up lamp switch	23	2.3	17.0
Gear shift control lever assembly mounting nut	13	1.3	9.5
Cable lock nut	5.5	0.55	4.0
Cable mounting bolt	5.5	0.55	4.0
Cable bracket bolt	50	5.0	37.5
Transaxle to engine bolt	85	8.5	63.5
Engine left mounting bracket bolt	55	5.5	42.0
Stiffener bolt	55	5.5	42.0
Engine rear mounting bolt	75	7.5	57.0
Engine rear mounting No.2 bracket bolt	55	5.5	42.0
Transaxle to engine rear mounting No.2 bracket bolt	55	5.5	42.0
Transaxle to engine nut	85	8.5	64.0
Clutch housing lower plate bolt	55	5.5	42.0
VSS bolt	5.5	0.55	4.0

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Oil seal lip • Select lever boss • Select lever shaft bush
Sealant	SUZUKI BOND NO.1217G (99000-31260)	• Oil drain plug and filler/level plug • Locating spring bolt • Mating surface of transaxle case • Mating surface of side cover • Gear shift interlock bolt • 5th to reverse interlock guide bolt • Guide case bolt
Thread lock cement	THREAD LOCK 1322 (99000-32110)	• Reverse gear shift lever bolt • Oil gutter bolt • Reverse shaft bolt • Final gear bolt

Special Tool

 09900-06107 Snap ring pliers (Opening type)	 09900-20606 Dial gauge	 09900-20701 Magnetic stand	 09913-60910 Bearing puller
 09913-75510 Bearing installer	 09913-80112 Bearing installer	 09913-84510 Bearing installer	 09922-85811 Spring pin remover 4.5 mm (0.18 in.)

 09923-74510 Bearing remover	 09923-78210 Bearing installer	 09924-74510 Installer attachment	 09925-18011 Bearing installer
 09925-68210 Bearing outer race installer	 09925-78210 Spring pin remover 6 mm (0.24 in.)	 09925-88210 Bearing puller attachment	 09925-98221 Bearing installer
 09927-76010 Gear holder	 09930-30104 Sliding shaft	 09940-53111 Bearing installer	 09940-54910 Sensor rotor installer
 09941-64511 Bearing remover	 09951-16060 Bush remover	 09951-46010 Bearing installer	 09951-76010 Bearing installer

SECTION 7B1

AUTOMATIC TRANSAXLE (M13 ENGINE)

WARNING:

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

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

CONTENTS

General Description

This automatic transaxle is electronic control full automatic transaxle with forward 3-speed plus overdrive (O/D) and reverse 1-speed.

The torque converter is a 3-element, 1-step and 2-phase type and is equipped with an automatically controlled lock-up mechanism.

The gear change device consists of a ravigneau type planetary gear unit, 3 multiple disc type clutches, 3 multiple disc type brakes and 2 one-way clutches.

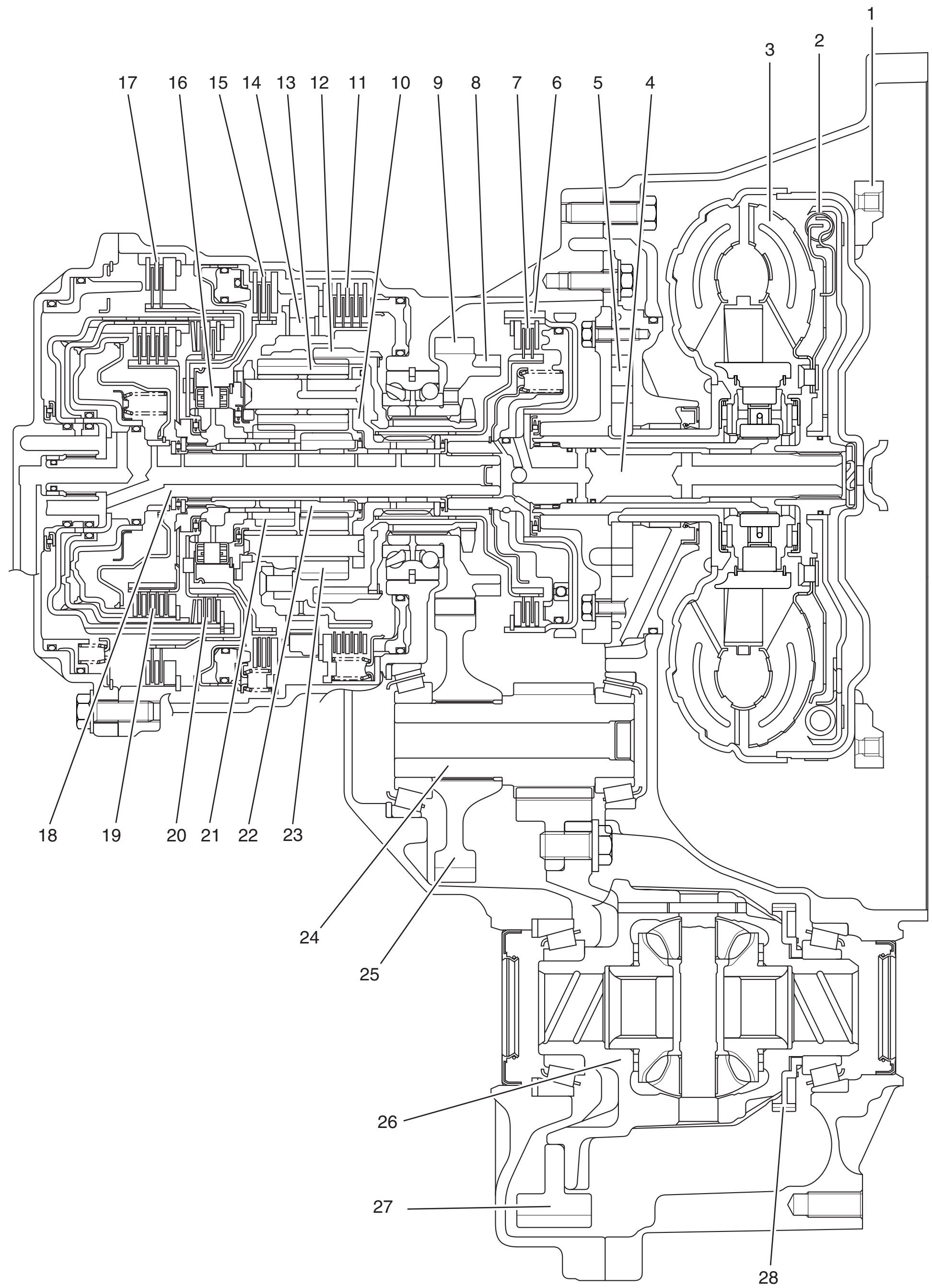
The hydraulic pressure control device consists of a valve body assembly, pressure control solenoid valve (linear solenoid), 2 shift solenoid valves, TCC (lock-up) solenoid valve and a timing solenoid valve. Optimum line pressure complying with engine torque is produced by the pressure control solenoid valve in dependence upon control signal from transmission control module (TCM). This makes it possible to control the line pressure with high accuracy in accordance with the engine power and running conditions to achieve smooth shifting characteristics and high efficiency.

A clutch-to-clutch control system is provided for shifting between 3rd gear and 4th gear. This clutch-to-clutch control system is made to function optimally, so that hydraulic pressure controls such as shown below are conducted.

- When upshifting from 3rd gear to 4th gear, to adjust the drain hydraulic pressure at releasing the forward clutch, a timing solenoid valve is used to switch a hydraulic passage with an orifice to another during shifting.
- When downshifting from 4th gear to 3rd gear, to adjust the line pressure applied to the forward clutch at engaging the forward clutch, a timing solenoid valve is used to switch a hydraulic passage with an orifice to another during shifting.
- When upshifting from 3rd gear to 4th gear with engine throttle opened, to optimize the line pressure applied to the forward clutch at releasing the forward clutch, the learning control is processed to compensate the switching timing of the timing solenoid at every shifting.
- When downshifting from 4th gear to 3rd gear with engine throttle opened, to optimize the line pressure applied to the forward clutch at engaging the forward clutch, the learning control is processed to compensate the line pressure every shifting.

Employing a ravigneau type planetary gear unit and this clutch-to-clutch control system greatly simplifies the construction to make possible a lightweight and compact transaxle.

A line pressure learning control is conducted to provide optimum shifting time at every upshifting with engine throttle opened. If long upshifting time is detected, the subsequent line pressure applied during upshifting is intensified. On the contrary, if short upshifting time is detected, the subsequent line pressure applied during upshifting is weakened.

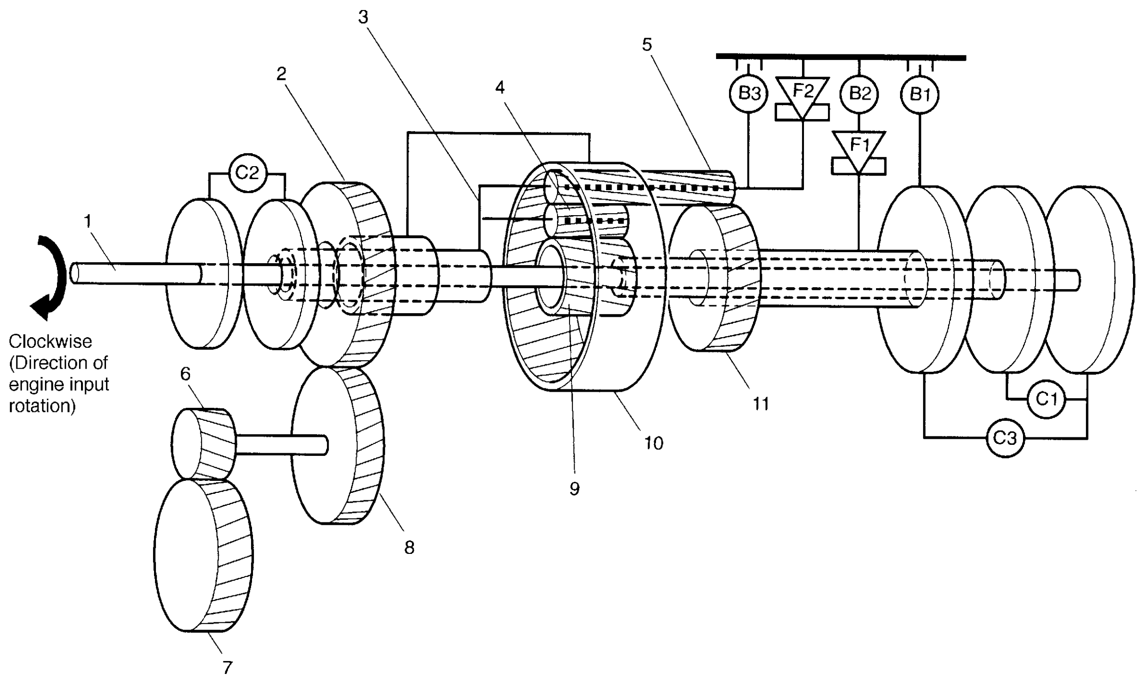


1. Drive plate	11. 1st and reverse brake	21. Rear sun gear
2. Torque converter clutch (TCC)	12. Ring gear	22. Front sun gear
3. Torque converter	13. Long planet pinion	23. Short planet pinion
4. Input shaft	14. One-way No.2 clutch	24. Countershaft
5. Oil pump	15. 2nd brake	25. Reduction driven gear
6. Direct clutch drum (double as sensor rotor for input shaft speed sensor)	16. One-way No.1 clutch	26. Differential case assembly
7. Direct clutch	17. O/D and 2nd coast brake	27. Final gear
8. Parking lock gear	18. Intermediate shaft	28. Output shaft speed sensor (VSS) drive gear
9. Reduction drive gear	19. Forward clutch	
10. Planet carrier	20. Reverse clutch	

Specifications

Item			Specifications	
Torque converter	Type		3-element, 1-step, 2-phase type (with TCC (lock-up) mechanism)	
	Stall torque ratio		1.9 – 2.1	
Oil pump	Type		Internal involute gear type oil pump (non crescent type)	
	Drive system		Engine driven	
Gear change device	Type		Forward 4-step, reverse 1-step planetary gear type	
	Shift position		“P” range	Gear in neutral, output shaft fixed, engine start
			“R” range	Reverse
			“N” range	Gear in neutral, engine start
			“D” range (O/D ON)	Forward 1st ↔ 2nd ↔ 3rd ↔ 4th (O/D) automatic gear change
			“D” range (O/D OFF)	Forward 1st ↔ 2nd ↔ 3rd ← 4th automatic gear change
			“2” range	Forward 1st ↔ 2nd ← 3rd automatic gear change
			“L” range	Forward 1st ← 2nd ← 3rd reduction, and fixed at 1st gear
	Gear ratio	1st	2.875	Number of teeth: Front sun gear: 24 Rear sun gear: 30 Long planet pinion: 20 Short planet pinion: 19 Ring gear: 69
		2nd	1.568	
		3rd	1.000	
		4th (overdrive gear)	0.697	
		Reverse (reverse gear)	2.300	
	Control elements		Wet type multiple-disc clutch ... 3 sets Wet type multiple-disc brake ... 3 sets One-way clutch ... 2 sets	
	Reduction gear ratio		1.019	
	Final gear reduction ratio		4.277	
Lubrication	Lubrication system		Force feed system by oil pump	
Cooling	Cooling system		Radiator assisted cooling (water-cooled)	
Fluid used			DEXRON®-III	

Clutch/Brake/Planetary Gear



1. Input shaft and intermediate shaft	8. Reduction driven gear	B1: O/D and 2nd coast brake
2. Reduction drive gear	9. Front sun gear	B2: 2nd brake
3. Planet carrier	10. Ring gear	B3: 1st and reverse brake
4. Short planet pinion	11. Rear sun gear	F1: One-way No.1 clutch
5. Long planet pinion	C1: Forward clutch	F2: One-way No.2 clutch
6. Final drive gear	C2: Direct clutch	
7. Final driven gear	C3: Reverse clutch	

Functions

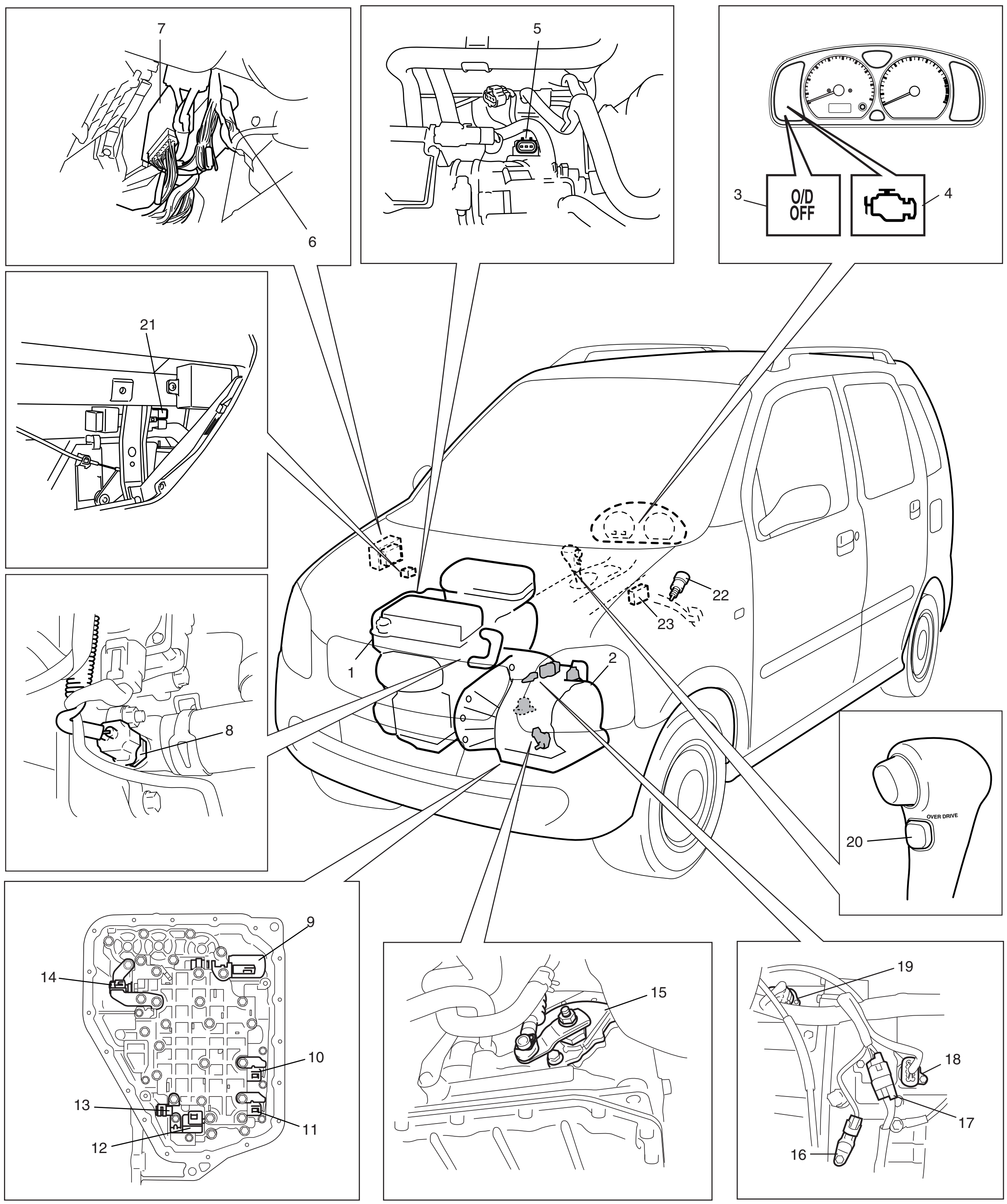
PART NAME	FUNCTION
Forward clutch	Meshes intermediate shaft and front sun gear
Direct clutch	Meshes input shaft and planet carrier
Reverse clutch	Meshes intermediate shaft and rear sun gear
O/D and 2nd coast brake	Fixes rear sun gear
2nd brake	Fixes rear sun gear
1st and reverse brake	Fixes planet carrier
One-way No.1 clutch	Prevents rear sun gear from turning counterclockwise
One-way No.2 clutch	Prevents planet carrier from turning counterclockwise

Table of Component Operation

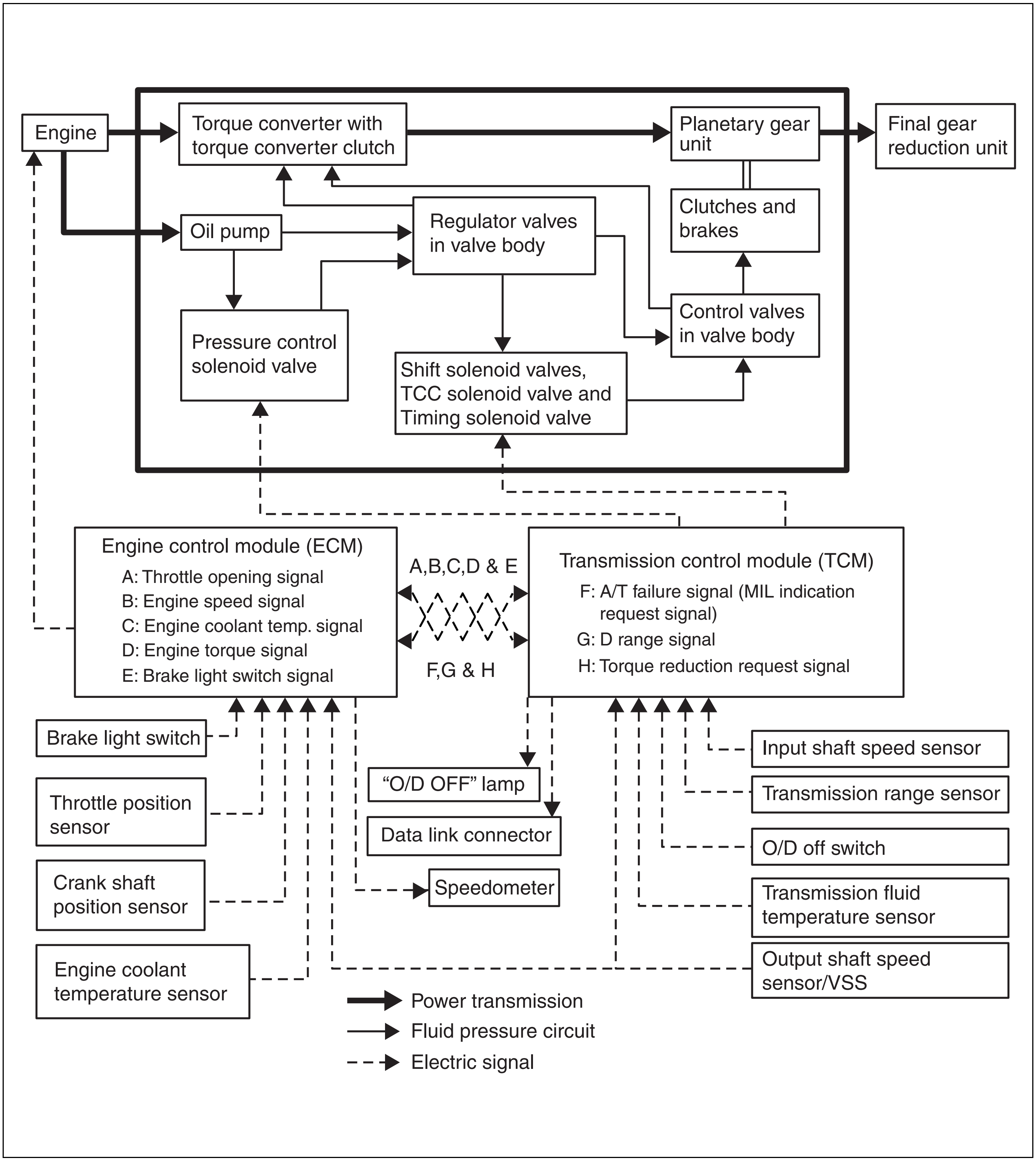
Selector position	Part / Gear position	Shift solenoid valve-A (No.1)	Shift solenoid valve-B (No.2)	TCC solenoid valve	Forward clutch	Direct clutch	Reverse clutch	O/D and 2nd coast brake	2nd brake	1st and reverse brake	One-way No.1 clutch	One-way No.2 clutch
P	Parking	○	○	×	×	×	×	×	×	×	×	×
R	Reverse	○	○	×	×	×	○	×	×	○	×	×
N	Neutral	○	○	×	×	×	×	×	×	×	×	×
D	1st	○	○	×	○	×	×	×	×	×	×	○
	2nd	○	×	×	○	×	×	×	○	×	○	×
	3rd	×	×	△	○	○	×	×	○	×	×	×
	4th	×	○	△	×	○	×	○	○	×	×	×
2	1st	○	○	×	○	×	×	×	×	×	×	○
	2nd	○	×	×	○	×	×	○	○	×	○	×
L	1st	○	○	×	○	×	×	×	×	○	×	○

○ : ON   × : OFF   △ : ON only when TCC is operating

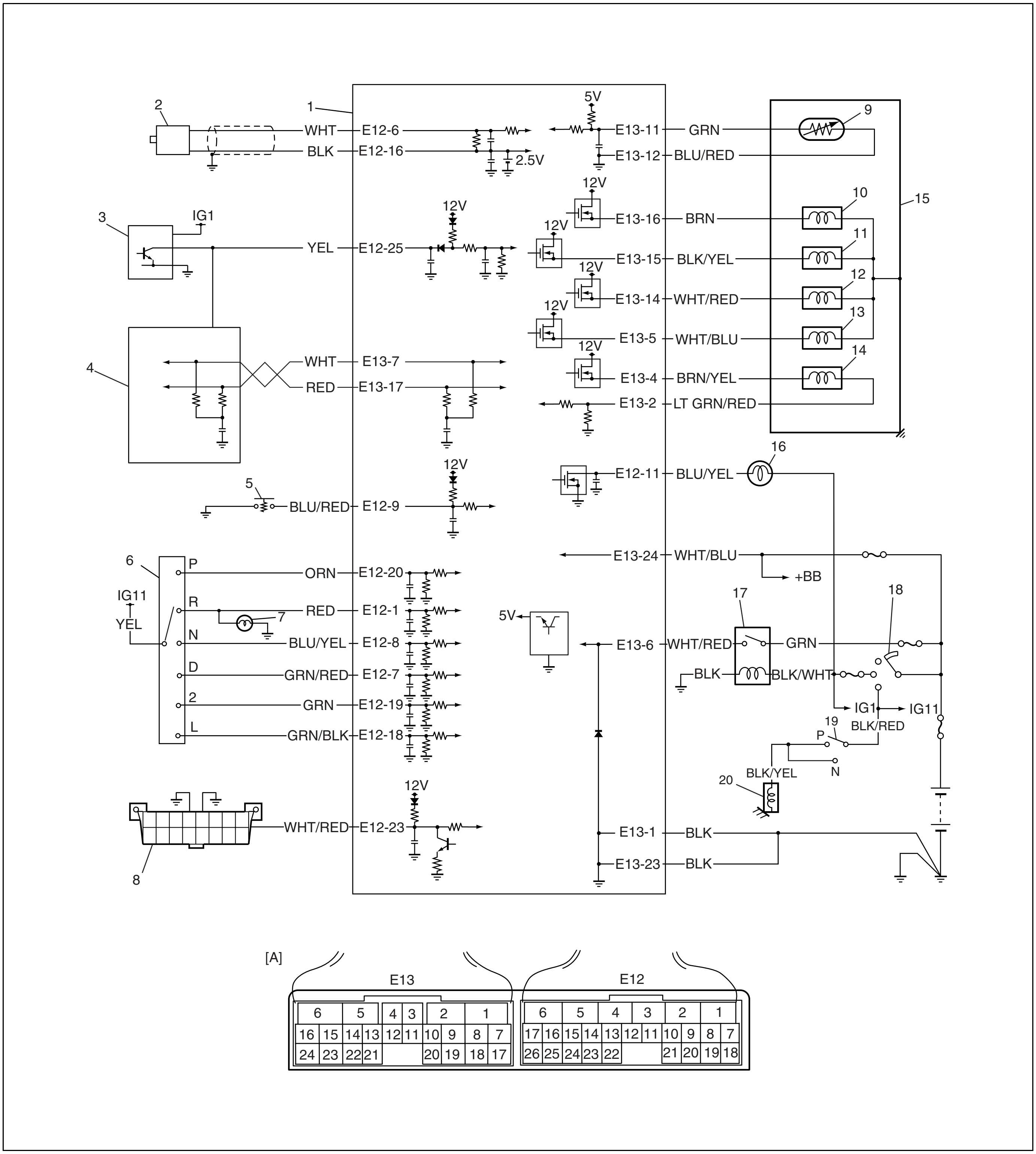
Electronic Shift Control System



1. Engine	9. Pressure control solenoid valve	17. Transmission range sensor coupler
2. Transaxle	10. Shift solenoid valve-B (No.2)	18. Solenoid valve coupler
3. “O/D OFF” lamp	11. Shift solenoid valve-A (No.1)	19. Output shaft speed sensor (VSS)
4. MIL	12. Timing solenoid valve	20. O/D OFF switch
5. Throttle position (TP) sensor	13. Transmission fluid temperature sensor	21. A/T relay
6. ECM	14. TCC (lock-up) solenoid valve	22. Brake light switch
7. TCM	15. Transmission range sensor	23. Data link connector (DLC)
8. Engine coolant temperature (ECT) sensor	16. Input shaft speed sensor	



Transmission Control Module (TCM)



1. TCM	8. Data link connector (DLC)	15. A/T
2. Input shaft speed sensor	9. Transmission fluid temperature sensor	16. “O/D OFF” lamp
3. Output shaft speed sensor (VSS)	10. Shift solenoid valve-A (No.1)	17. A/T relay
4. ECM	11. Shift solenoid valve-B (No.2)	18. Ignition switch
5. O/D off switch	12. Timing solenoid valve	19. Inhibitor switch
6. Transmission range sensor	13. TCC (lock-up) solenoid valve	20. Starter motor relay
7. Backup lamp	14. Pressure control solenoid valve	[A]: Terminal arrangement of TCM connector (viewed from harness)

Operation of shift solenoid valves, timing solenoid valve and TCC solenoid valve

Selector position	Solenoid / Gear position	Shift solenoid valve-A (No.1)	Shift solenoid valve-B (No.2)	Timing solenoid valve	TCC solenoid valve	Condition
P	Parking	○	○	×	×	
R	Reverse	○	○	×	×	When vehicle is traveling forwards in less than 9 km/h, 6 mile/h vehicle speed.
		○	○	○	×	When vehicle is traveling forwards in 11km/h, 7mile/h or more vehicle speed.
	(Reverse)	×	×	×	×	When fail safe function is operating.
N	Neutral	○	○	×	×	
D	Neutral → 1st			○		Timing solenoid is turned ON for about 0.5 sec. while on gear shifting
	1st	○	○	×	×	
	2nd	○	×	×	×	
	3rd	×	×	×	△	
	3rd ↔ 4th			○		Timing solenoid is turned ON for about 0.5 sec. while on gear shifting
	4th (O/D)	×	○	×	△	
	(3rd)	×	×	×	×	When fail safe function is operating.
2	1st	○	○	×	×	
	2nd	○	×	×	×	
	(3rd)	×	×	×	×	When fail safe function is operating.
L	1st	○	○	×	×	
	(3rd)	×	×	×	×	When fail safe function is operating.

○ : ON (Turn power ON)
× : OFF (Turn power OFF)
△ : ON only when TCC is operating

	Valve status	
	Turn power ON	Turn power OFF
Shift solenoid valve-A (No.1)	Close	Open
Shift solenoid valve-B (No.2)	Close	Open
Timing solenoid	Open	Close
TCC (lock-up) solenoid	Close	Open

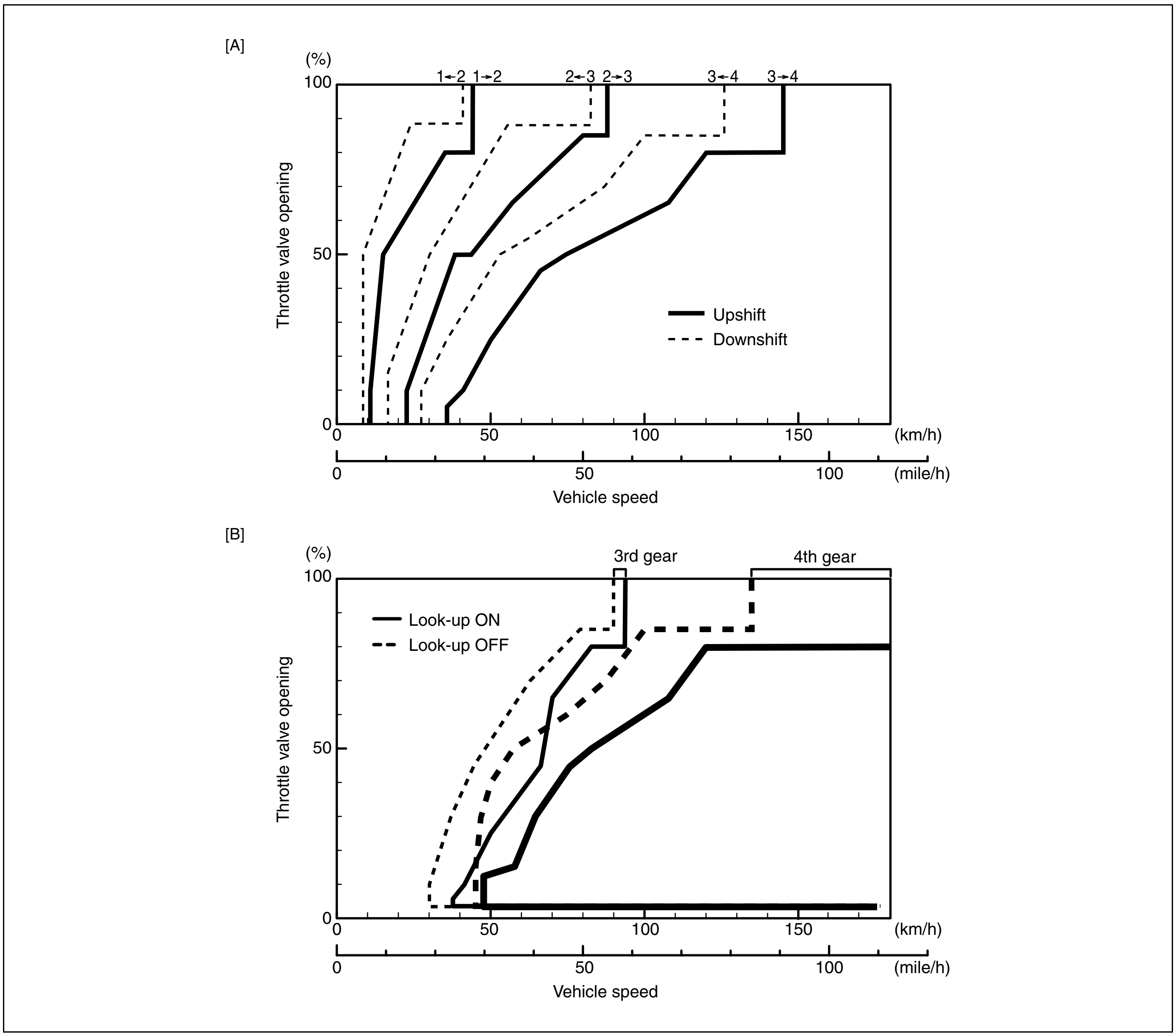
Automatic gear shift diagram

Automatic shift schedule as a result of shift control is shown below. In case that selector lever is shifted to “L” range at a higher than 44 km/h (27 mile/h) speed, 2nd gear is operated and then down shifts to 1st at a speed lower than that.

The same as, the select lever is shifted to “2” range at a higher than 88 km/h (55 mile/h) speed, 3rd gear is operated and then down shifts to 2nd at a speed lower than that.

	Shift					
Throttle opening	1→2	2→3	3→4	4→3	3→2	2→1
Full throttle km/h (mile/h)	44 (27)	88 (55)	145 (90)	126 (78)	82 (51)	41(25)
Closed throttle km/h (mile/h)	11 (7)	22(14)	36 (22)	27 (17)	17 (11)	9 (6)

Gear Shift Diagram [A] and TCC Lock-up Diagram [B]



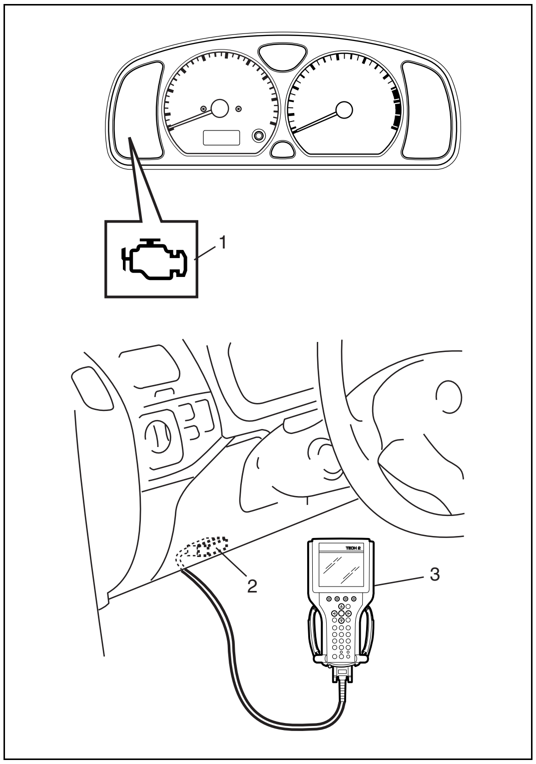
Diagnosis

General Description

This vehicle is equipped with an electronic transaxle control system, which controls the automatic shift up and shift down timing, TCC operation, etc. suitably to vehicle driving conditions.
TCM has an On-Board Diagnosis System which detects a malfunction in this system.
When diagnosing a trouble in transaxle including this system, 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 "Automatic Transaxle Diagnostic Flow Table" given below to obtain correct result smoothly.

On-board Diagnostic System

For automatic transaxle control system, TCM has following functions.



- When ignition switch is turned ON with O/D off switch turned OFF and no malfunction in A/T control system is detected, “O/D OFF” lamp (1) lights for about 2 seconds after ignition switch is turned ON and then goes OFF for bulb check.
- When TCM detects a malfunction in A/T control system, TCM desire turning on malfunction indicator lamp (MIL) (1) to ECM and stores malfunction DTC in TCM memory.
- It is possible to communicate with TCM through data link connector (DLC) (2) by using scan tool (3). (Diagnostic information can be checked and erased by using scan tool.)

Warm-up Cycle

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

Driving Cycle

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

2 Driving Cycles Detection Logic

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

Pending DTC

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

Precaution in Diagnosing Trouble

- Don't disconnect couplers from TCM, battery cable from battery, TCM ground wire harness from engine or main fuse before checking the diagnosis information stored in TCM memory.
  Such disconnection will clear memorized information in TCM memory.
- Using scan tool the diagnostic information stored in TCM memory can be checked and cleared as well. Before its use, be sure to read Operator's (instruction) Manual supplied with it carefully to have good understanding of its functions and usage.
- Be sure to read "Precautions for Electrical Circuit Service" in Section 0A before inspection and observe what is written there.
- TCM and/or ECM replacement
  - When substituting a known-good TCM and/or ECM, check that all relays and actuators have resistance of specified value.
    Neglecting this check may result in damage to good TCM and/or ECM.
- Communication of ECUs, ECM and TCM, is established by CAN (Computer Area Network).
  Therefore, handle CAN communication line with care referring to "Precaution" described in Section 0A.

Automatic Transaxle Diagnostic Flow Table

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

Step	Action	Yes	No
1	Customer Complaint Analysis 1) Perform customer complaint analysis. Was customer complaint analysis performed according to instruction?	Go to Step 2.	Perform customer complaint analysis.
2	Diagnostic Trouble Code (DTC)/Freeze Frame Data Check, Record and Clearance 1) Check for DTC referring to the followings. Is there any DTC(s)?	1) Print DTC or write them down and clear them by referring to “DTC Clearance” in this section. 2) Go to Step 3.	Go to Step 4.
3	Visual Inspection 1) Perform visual inspection referring to the followings. 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 followings. Is there any faulty condition?	1) Repair or replace malfunction part. 2) Go to Step 11.	Go to Step 8.
5	Trouble Symptom Confirmation 1) Confirm trouble symptom referring to the followings. Is trouble symptom identified?	Go to Step 6.	Go to Step 7.
6	Rechecking and Recording of DTC 1) Recheck for DTC referring to “DTC Check” in this section. Is there any DTC(s)?	Go to Step 9.	Go to Step 8.
7	Rechecking and Recording of DTC/Freeze Frame Data 1) Recheck for DTC referring to “DTC Check” in this section. Is there any DTC(s)?	Go to Step 9.	Go to Step 10.
8	Automatic Transaxle Basic Inspection and Trouble Diagnosis Table 1) Check and repair according to “A/T Basic Check” and “Trouble 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	Troubleshooting for DTC 1) Check and repair according to applicable DTC Flow Table. Are check and repair complete?	Go to Step 11.	1) Check and repair malfunction part(s). 2) Go to Step 11.
10	Check for Intermittent Problems 1) Check for intermittent problems referring to the followings. Is there any faulty condition?	1) Repair or replace malfunction part(s). 2) Go to Step 11.	Go to Step 11.

Step	Action	Yes	No
11	Final Confirmation Test 1) Clear DTC if any. 2) Perform final confirmation test referring to the followings. Is there any problem symptom, DTC or abnormal condition?	Go to Step 6.	End.

1. Customer Complaint Analysis (See Customer Problem Inspection Form)

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

2. Diagnostic Trouble Code (DTC)/Freeze Frame Data Check, Record and Clearance

First, check DTC (including pending DTC) referring to “DTC Check” in this section. If DTC exists, print or write down DTC/Freeze frame data and then clear malfunction DTC(s) by referring to “DTC Clearance” in this section. Malfunction DTC indicates malfunction in the system but it is not possible to know from it whether the malfunction is occurring now or it occurred in the past and normal condition has been restored. In order to know that, check symptom in question according to Step 5 and then recheck DTC according to Step 6.
Diagnosing a trouble based on the DTC in this step only or failure to clear the DTC in this step may result in an faulty diagnosis, trouble diagnosis of a normal circuit or difficulty in troubleshooting which is otherwise unnecessary.

3 and 4. Visual Inspection

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

5. Trouble Symptom Confirmation

Check trouble symptoms based on information obtained in Step 1 Customer Complaint Analysis and Step 2 DTC Check.
Also, reconfirm DTC according to “DTC Confirmation Procedure” described in each DTC Flow Table.

6 and 7. Rechecking and Record of DTC/Freeze Frame Data

Refer to “DTC Check” in this section for checking procedure.

8. Automatic Transmission Basic Check and Trouble Diagnosis Table

Perform basic check of A/T according to flow table of “Automatic Transaxle Basic Check” first. When the end of the flow table has been reached, check the parts of the system suspected as a possible cause referring to “Trouble Diagnosis Table” and based on symptoms appearing on the vehicle (symptoms obtained through steps of customer complaint analysis, trouble symptom confirmation and/or A/T basic check) and repair or replace faulty parts, if any.

9. Diagnostic Trouble Code Flow Table (See each DTC Flow Table)

Based on the DTC indicated in Step 6/7 and referring to Diagnostic Trouble Code Flow Table in this section, locate the cause of the trouble, namely in a sensor, switch, wire harness, connector, actuator, TCM 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 vehicle is free from any abnormal conditions. If what has been repaired is related to the malfunction DTC, clear the DTC once and check to ensure that no malfunction DTC is indicated.

Customer Problem Inspection Form (Example)

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

PROBLEM SYMPTOMS
☐ Vehicle does not move (R, D, 2, L or any range)
☐ No upshift automatically (☐ 1st to 2nd ☐ 2nd to 3rd ☐ 3rd to 4th (O/D) ☐ 2 range ☐ D range)
☐ No downshift automatically (☐ 3rd to 2nd ☐ 2nd to 1st ☐ 4th (O/D) to 3rd ☐ 2 range ☐ D range)
☐ No gear change manually (☐ 1st ↔ 3rd ☐ 3rd ↔ 4th)
☐ TCC no lock-up ☐ TCC no lock-up off
☐ Automatic shift point too high or too low
☐ Excessive gear change shock (1st/2nd/3rd/4th (O/D)/Reverse)
☐ No kickdown
☐ Transmission slipping in (1st/2nd/3rd/4th (O/D)/Reverse)
☐ Others ______________________

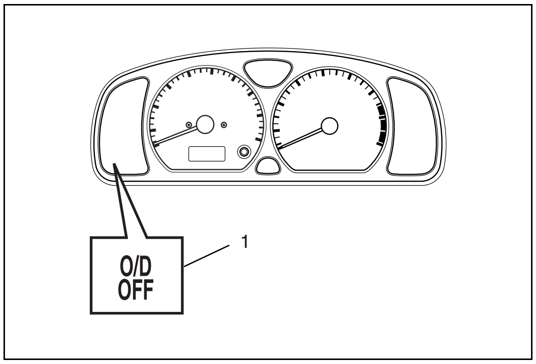
VEHICLE/ENVIRONMENTAL CONDITION WHEN PROBLEM OCCURS	
Environmental Condition	
Weather	☐ Fair ☐ Cloudy ☐ Rain ☐ Always ☐ Other ______________
Temperature	(°F/ °C) ☐ Hot ☐ Warm ☐ Cool ☐ Cold ☐ always
Frequency	☐ Always ☐ Sometimes (times/ day, month) ☐ Only once ☐ Under certain condition
Road	☐ Urban ☐ Suburb ☐ Highway ☐ Mountainous ☐ Uphill ☐ Downhill ☐ Tarmacadam ☐ Gravel ☐ Other ________
Vehicle Condition	
Engine & transmission condition	☐ Cold/ ☐ Warming up phase/ ☐ Warmed up Engine speed (r/min.) Throttle opening (☐ Idle/ ☐ About % ☐ full) O/D cut switch (☐ ON/ ☐ OFF)
Vehicle condition	☐ At stop/ ☐ During driving (☐ Constant speed ☐ Accelerating ☐ Decelerating ☐ Braking) ☐ Right hand corner ☐ Left hand corner ☐ Vehicle speed (km/h mile/h) ☐ Other ______________

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

NOTE:

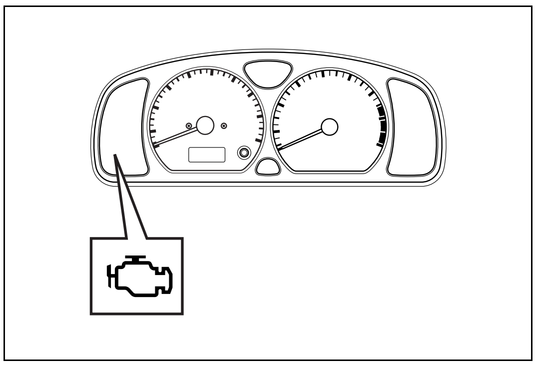
The above form is a standard sample. It should be modified according to conditions characteristic of each market.

"O/D OFF" Lamp Check



1) Turn ignition switch ON.
2) Check that "O/D OFF" lamp (1) lights for about 2 sec. and then goes OFF.
   If anything faulty is found, advance to "Diagnostic Flow Table A-3" or "Diagnostic Flow Table A-4".

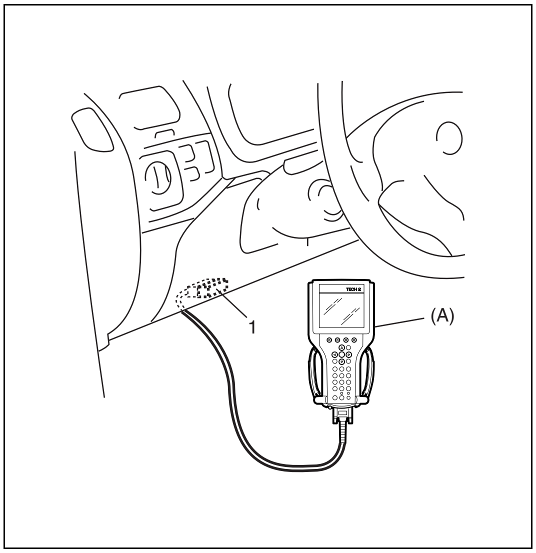
Malfunction Indicator Lamp (MIL) Check



Refer to the same item in Section 6 for checking procedure.

Diagnostic Trouble Code (DTC) Check

1) Turn ignition switch to OFF position.



2) Connect scan tool to data link connector (DLC) (1).

Special tool
(A): SUZUKI scan tool

3) Turn ignition switch ON.
4) Read DTC, pending DTC and freeze frame data according to instructions displayed on scan tool and print it down. Refer to scan tool operator's manual for further details.

NOTE:

If SUZUKI scan tool cannot communicate TCM, perform "Serial Data Circuit Check" described in this section.

5) After completing the check, turn ignition switch OFF and disconnect scan tool from data link connector (DLC) (1).

Diagnostic Trouble Code (DTC) Clearance

WARNING:

When performing a driving test, select a safe place where there is neither any traffic nor any traffic accident possibility and be very careful during testing to avoid occurrence of an accident.

After repair or replace malfunction part(s), clear all DTCs by performing the following procedure.

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

NOTE:

DTC and freeze frame data stored in TCM memory are also cleared in following cases. Be careful not to clear them before keeping their record.

- **When power to TCM is cut off (by disconnecting battery cable, removing fuse or disconnecting TCM connectors).**
- **When the same malfunction (DTC) is not detected again during 40 engine warm-up cycles.**

Diagnostic Trouble Code (DTC) Table

DTC No.	Detecting item	Detecting condition (DTC will set when detecting)	Driving cycle when MIL lighted
P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)	Multiple signals are inputted simultaneously.	1driving cycle
P0707	Transmission Range Sensor Circuit Low	No sensor signal is inputted.	2 driving cycles
P0712	Transmission Fluid Temperature Sensor “A” Circuit Low	Sensor output voltage is too low.	1driving cycle
P0713	Transmission Fluid Temperature Sensor “A” Circuit High	Sensor output voltage is too high.	1driving cycle
P0717	Input/Turbine Speed Sensor Circuit No Signal	No sensor signal is detected although output speed sensor signal is inputted.	1driving cycle
P0722	Output Speed Sensor Circuit No Signal	No sensor signal is inputted although input speed sensor signal is inputted.	1driving cycle
P0741	Torque Converter Clutch Circuit Performance or Stuck Off	Difference in revolution between engine and input shaft is too large although TCM is commanding TCC solenoid to turn ON.	2 driving cycles
P0742	Torque Converter Clutch Circuit Stuck On	Difference in revolution between engine and input shaft is too small although TCM is commanding TCC solenoid to turn OFF.	2 driving cycles
P0751	Shift Solenoid “A” Performance or Stuck Off	Actual gear position is 3rd gear although TCM command is for 2nd gear.	2 driving cycles
P0752	Shift Solenoid “A” Stuck On	Actual gear position is 2nd gear although TCM command is for 3rd gear.	2 driving cycles
P0756	Shift Solenoid “B” Performance or Stuck Off	Actual gear position is 3rd gear although TCM command is for 4th gear.	2 driving cycles
P0757	Shift Solenoid “B” Stuck On	Actual gear position is 4th gear although TCM command is for 3rd gear.	2 driving cycles
P0785	Shift/Timing Solenoid	Voltage of timing solenoid terminal is high although TCM is commanding timing solenoid to turn OFF. or Voltage of timing solenoid terminal is low although TCM is commanding timing solenoid to turn ON.	1driving cycle
P0962	Pressure Control Solenoid “A” Control Circuit Low	No electric flow is detected on pressure control solenoid circuit.	1driving cycle
P0963	Pressure Control Solenoid “A” Control Circuit High	Too much electric flow is detected on pressure control solenoid circuit.	1driving cycle
P0973	Shift Solenoid “A” Control Circuit Low	Voltage of shift solenoid terminal is low although TCM is commanding shift solenoid to turn ON.	1driving cycle
P0974	Shift Solenoid “A” Control Circuit High	Voltage of shift solenoid terminal is high although TCM is commanding shift solenoid to turn OFF.	1driving cycle
P0976	Shift Solenoid “B” Control Circuit Low	Voltage of shift solenoid terminal is low although TCM is commanding shift solenoid to turn ON.	1driving cycle

DTC No.	Detecting item	Detecting condition (DTC will set when detecting)	Driving cycle when MIL lighted
P0977	Shift Solenoid “B” Control Circuit High	Voltage of shift solenoid terminal is high although TCM is commanding shift solenoid to turn OFF.	1driving cycle
P1701	CAN Communication Problem - TCM	No signal inputted from ECM to TCM for specified time continuously.	1driving cycle
P1702	Internal Control Module Memory Check Sum Error	Calculation of current data stored in TCM is not correct comparing with pre-stored checking data in TCM.	1driving cycle
P1703	CAN Invalid Data- TCM	TCM receives malfunction signal of throttle position, engine coolant temperature, engine revolution and engine torque from ECM.	*1
P2769	Torque Converter Clutch Circuit Low	No electric flow is detected on TCC solenoid circuit.	1 driving cycle
P2770	Torque Converter Clutch Circuit High	Too much electric flow is detected on TCC solenoid circuit.	1 driving cycle

NOTE:

***1: TCM does not desire turning on malfunction indicator lamp to ECM but DTC is stored in TCM memory.**

Fail Safe Table

This function is provided by the safe mechanism that assures safe driveability even when the solenoid valve, sensor or its circuit fails.

The table below shows the fail safe function for each fail condition of solenoid, solenoid or its circuit.

DTC No.	Trouble Area	Fail Safe Operation
P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)	• Selected range is set in priority order shown below. D>2>L>R>N>P • Lock-up function is inhibited to operate. • Learning control is inhibited.
P0707	Transmission Range Sensor Circuit Low	• Selected range is assumed to be "D" range. • Lock-up function is inhibited to operate. • Learning control is inhibited.
P0712 P0713	Transmission Fluid Temperature Sensor "A" Circuit Low	• A/T fluid temperature is assumed to be 200°C (392°F). • Upshifting to O/D is inhibited. • Lock-up function is inhibited to operate. • Garage shift control is inhibited. • Learning control is inhibited.
P0717	Input/Turbine Speed Sensor Circuit No Signal	• Upshifting to O/D is inhibited. • Lock-up function is inhibited to operate. • Line pressure control at gear shifting is inhibited. • Torque reducing request to ECM (torque reduction control) is inhibited. • Garage shift control is inhibited. • Learning control is inhibited.
P0722	Output Speed Sensor Circuit No Signal	• Vehicle speed which is calculated by input shaft speed sensor signal is used for gear shifting control instead of vehicle speed calculated by output shaft speed sensor (VSS) signal. • Upshifting to O/D is inhibited. • Lock-up function is inhibited to operate. • Line pressure control at gear shifting is inhibited. • Torque reducing request to ECM (torque reduction control) is inhibited. • Garage shift control is inhibited. • Learning control is inhibited.
P0785	Shift/Timing Solenoid	• Power supply for all solenoid valves is cut. • Gear position is fixed in 3rd gear. • Line pressure control at gear shifting is inhibited. • Look-up function is inhibited to operate.
P0962	Pressure Control Solenoid "A" Control Circuit Low	
P0963	Pressure Control Solenoid "A" Control Circuit High	
P0973	Shift Solenoid "A" Control Circuit Low	
P0974	Shift Solenoid "A" Control Circuit High	
P0976	Shift Solenoid "B" Control Circuit Low	
P0977	Shift Solenoid "B" Control Circuit High	

DTC No.	Trouble Area	Fail Safe Operation
P1701	CAN Communication Problem - TCM	• Throttle opening used for line pressure control is assumed to be 100%. • Throttle opening used for gear shifting control is assumed to be 0%. • After 15 minutes pass from detecting malfunction, engine coolant temperature is assumed to be 90°C (194°F). • Upshifting to O/D is inhibited. • Lock-up function is inhibited to operate. • Line pressure control at gear shifting is inhibited. • Torque reducing request to ECM (torque reduction control) is inhibited. • Learning control is inhibited. • Garage shift control is inhibited.
P1702	Internal Control Module Memory Check Sum Error	• Power supply for all solenoid valves is cut. • Gear position is fixed in 3rd gear. • Line pressure control at gear shifting is inhibited. • Lock-up function is inhibited to operate.
P1703	CAN Invalid Data- TCM	In case of throttle position signal malfunction: • Throttle opening used for line pressure control is assumed to be 100%. • Throttle opening used for gear shifting control is assumed to be 0%. • Upshifting to O/D is inhibited. • Lock-up function is inhibited to operate. • Garage shift control is inhibited. • Learning control is inhibited. In case of engine coolant temperature signal malfunction: • After 15 minutes pass from detecting malfunction, engine coolant temperature is assumed to be normal operating temperature, and controls of overdrive and lock-up is released from inhibition. In case of engine revolution signal malfunction: • Upshifting to O/D is inhibited. • Lock-up function is inhibited to operate. • Line pressure control at gear shifting is inhibited. • Torque reducing request to ECM (torque reduction control) is inhibited. • Garage shift control is inhibited. • Learning control is inhibited.
P2769	Torque Converter Clutch Circuit Low	• Lock-up function is inhibited to operate.
P2770	Torque Converter Clutch Circuit High	• Lock-up function is inhibited to operate. • Vehicle speed is slower than 15 km/h (9 mile/h), gear position is fixed in 1st gear for prevention of engine stall.

Visual Inspection

Visually check the following parts and systems.

INSPECTION ITEM	REFERRING SECTION
• A/T fluid ----- level, leakage, color	Section 0B
• A/T fluid hoses ----- disconnection, looseness, deterioration	Section 7B1
• Throttle cable ----- play (under warm engine), installation	Section 6E2
• A/T select cable ----- installation	Section 7B1
• Engine oil ----- level, leakage	Section 0B
• Engine coolant ----- level, leakage	Section 0B
• Engine mountings ----- play, looseness, damage	Section 6A2
• Suspension ----- play, looseness	Section 3
• Drive shafts ----- damage	Section 4A
• Battery ----- indicator condition, corrosion of terminal	
• Connectors of electric wire harness ----- disconnection, friction	Section 6E2
• Fuses ----- burning	Section 8
• Parts ----- installation, damage	
• Bolts ----- looseness	
• Other parts that can be checked visually	
Also check the following items at engine start, if possible.	
• “O/D OFF” lamp ----- Operation	
• Malfunction indicator lamp ----- Operation	Section 6E2
• Charge warning lamp ----- Operation	Section 6H
• Engine oil pressure warning lamp ----- Operation	Section 8 (Section 6A2 for pressure check)
• Engine coolant temp. meter ----- Operation	
• Other parts that can be checked visually	

Automatic Transaxle Basic Check

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

Step	Action	Yes	No
1	Was “Automatic Transaxle Diagnostic Flow Table” preformed?	Go to Step 2.	Go to “Automatic Transaxle Diagnostic Flow Table”.
2	Perform “Road Test” in this section. Is it OK?	Go to Step 3.	Proceed to “Troubleshooting” in “Road Test”.
3	Perform “Manual Road Test” in this section. Is it OK?	Go to Step 4.	Proceed to “Troubleshooting” in “Manual Road Test”.
4	Perform “Engine Brake Test” in this section. Is it OK?	Go to Step 5.	Proceed to “Troubleshooting” in “Engine Brake Test”.
5	Perform “Stall Test” in this section. Is it OK?	Go to Step 6.	Proceed to “Troubleshooting” in “Stall Test”.
6	Perform “Time Lag Test” in this section. Is it OK?	Go to Step 7.	Proceed to “Troubleshooting” in “Time Lag Test”.
7	Perform “Line Pressure Test” in this section. Is it OK?	Go to Step 8.	Proceed to “Troubleshooting” in “Line Pressure Test”.
8	Proceed to “Trouble Diagnosis Table-1” in this section. Is trouble identified?	Repair or replace faulty parts.	Go to Step 9.
9	Proceed to “Trouble Diagnosis Table-2” in this section. Is trouble identified?	Repair or replace faulty parts.	Proceed to “Trouble Diagnosis Table-3” in this section.

Trouble Diagnosis Table

Trouble diagnosis table-1

Electrical Repair

Condition	Possible Cause	Correction
Excessive shift shock	Shift solenoid valve-A and/or-B circuit faulty	Inspect circuit for open, short and intermittent. If NG, repair.
	Pressure control solenoid valve circuit faulty	
	(Only when N→D or 3↔O/D shifting) Timing solenoid valve circuit faulty	
	Output shaft speed sensor (VSS) circuit faulty	
	Input shaft speed sensor circuit faulty	
	Transmission fluid temperature sensor circuit faulty	
	CAN communication circuit faulty	
	Throttle position sensor circuit faulty	Inspect circuit for open, short and intermittent referring to Section 6. If NG, repair.
	Crank position sensor circuit faulty	
	TCM	Substitute a known-good TCM and recheck.
	ECM	Substitute a known-good ECM and recheck.
No gear shift as 3rd gear	Shift solenoid valve-A and/or-B circuit faulty	Inspect circuit for open, short and intermittent. If NG, repair.
	Pressure control solenoid valve circuit faulty	
	Timing solenoid valve circuit faulty	
	TCM	Substitute a known-good TCM and recheck.
Poor 1→2 shift	Shift solenoid valve-B circuit faulty	Inspect circuit for open, short and intermittent. If NG, repair.
	Output shaft speed sensor (VSS) circuit faulty	
	Transmission range sensor circuit faulty	
	CAN communication circuit faulty	
	Throttle position sensor circuit faulty	Inspect circuit for open, short and intermittent referring to Section 6. If NG, repair.
	TCM	Substitute a known-good TCM and recheck.
	ECM	Substitute a known-good ECM and recheck.
Poor 2→3 shift	Shift solenoid valve-A circuit faulty	Inspect circuit for open, short and intermittent. If NG, repair.
	Output shaft speed sensor (VSS) circuit faulty	
	Transmission range sensor circuit faulty	
	CAN communication circuit faulty	
	Throttle position sensor circuit faulty	Inspect circuit for open, short and intermittent referring to Section 6. If NG, repair.
	TCM	Substitute a known-good TCM and recheck.
	ECM	Substitute a known-good ECM and recheck.

Condition	Possible Cause	Correction
Poor 3→O/D shift	Shift solenoid valve-B circuit faulty	Inspect circuit for open, short and intermittent. If NG, repair.
	Pressure control solenoid valve circuit faulty	
	Timing solenoid valve circuit faulty	
	Output shaft speed sensor (VSS) circuit faulty	
	Input shaft speed sensor circuit faulty	
	Transmission range sensor circuit faulty	
	Transmission fluid temperature sensor circuit faulty	
	CAN communication circuit faulty	
	Throttle position sensor circuit faulty	Inspect circuit for open, short and intermittent referring to Section 6. If NG, repair.
	Engine coolant temperature sensor circuit faulty	
	Crank position sensor circuit faulty	
	O/D off switch circuit faulty	Refer to “Diagnostic Flow Table A-1” in this section.
	TCM	Substitute a known-good TCM and recheck.
	ECM	Substitute a known-good ECM and recheck.
Poor O/D→3 shift	Shift solenoid valve-B circuit faulty	Inspect circuit for open, short and intermittent. If NG, repair.
	Pressure control solenoid valve circuit faulty	
	Timing solenoid valve circuit faulty	
	Output shaft speed sensor (VSS) circuit faulty	
	Input shaft speed sensor circuit faulty	
	CAN communication circuit faulty	
	Throttle position sensor circuit faulty	Inspect circuit for open, short and intermittent referring to Section 6. If NG, repair.
	O/D off switch circuit faulty	Refer to “Diagnostic Flow Table A-1” in this section.
	TCM	Substitute a known-good TCM and recheck.
	ECM	Substitute a known-good ECM and recheck.
Poor 3→2 shift	Shift solenoid valve-A circuit faulty	Inspect circuit for open, short and intermittent. If NG, repair.
	Output shaft speed sensor (VSS) circuit faulty	
	CAN communication circuit faulty	
	Throttle position sensor circuit faulty	Inspect circuit for open, short and intermittent referring to Section 6. If NG, repair.
	TCM	Substitute a known-good TCM and recheck.
	ECM	Substitute a known-good ECM and recheck.
Poor 2→1 shift	Shift solenoid valve-B circuit faulty	Inspect circuit for open, short and intermittent. If NG, repair.
	Output shaft speed sensor (VSS) circuit faulty	
	CAN communication circuit faulty	
	Throttle position sensor circuit faulty	Inspect circuit for open, short and intermittent referring to Section 6. If NG, repair.
	TCM	Substitute a known-good TCM and recheck.
	ECM	Substitute a known-good ECM and recheck.

Condition	Possible Cause	Correction
Incorrect gear shift point	Output shaft speed sensor (VSS) circuit faulty	Inspect circuit for open, short and intermittent. If NG, repair.
	Pressure control solenoid valve circuit faulty	
	CAN communication circuit faulty	
	Pressure control solenoid valve circuit faulty	
	Throttle position sensor circuit faulty	Inspect circuit for open, short and intermittent referring to Section 6. If NG, repair.
	TCM	Substitute a known-good TCM and recheck.
	ECM	Substitute a known-good ECM and recheck.
Non operate TCC (lock-up) system	TCC solenoid valve-B circuit faulty	Inspect circuit for open, short and intermittent. If NG, repair.
	Shift solenoid valve-A and/or-B circuit faulty	
	Pressure control solenoid valve circuit faulty	
	Output shaft speed sensor (VSS) circuit faulty	
	Input shaft speed sensor circuit faulty	
	Transmission range sensor circuit faulty	
	Transmission fluid temperature sensor circuit faulty	
	CAN communication circuit faulty	
	Brake light switch circuit faulty	Refer to “Diagnostic Flow Table A-2” in this section.
	Throttle position sensor circuit faulty	Inspect circuit for open, short and intermittent referring to Section 6. If NG, repair.
	Engine coolant temperature sensor circuit faulty	
	TCM	Substitute a known-good TCM and recheck.
	ECM	Substitute a known-good ECM and recheck.
Higher or lower stall speed	Pressure control solenoid valve circuit faulty	Inspect circuit for open, short and intermittent. If NG, repair.
	TCM	Substitute a known-good TCM and recheck.
Excessive “N”→“D” or “N”→“R” time lag	Pressure control solenoid valve circuit faulty	Inspect circuit for open, short and intermittent. if NG, repair
	Transmission fluid temperature sensor circuit faulty	
	TCM	Substitute a known-good TCM and recheck.
Higher or lower line pressure	Pressure control solenoid valve circuit faulty	Inspect circuit for open, short and intermittent. If NG, repair.
	TCM	Substitute a known-good TCM and recheck.

Trouble diagnosis table-2

On-vehicle Repair

Condition	Possible Cause	Correction
Unable to run in all range	Faulty valve body component	Replace valve body assembly
Excessive shift shock	Engine abnormal condition	Inspect and repair engine
	Malfunction of shift solenoid valve-A and/or-B	Inspect. If NG, replace
	Malfunction of output shaft speed sensor (VSS)	
	Malfunction of input shaft speed sensor	
	Malfunction of transmission range sensor	
	Malfunction of Transmission fluid temperature sensor	
	(Only when N→D or 3↔O/D shifting) Malfunction of timing solenoid valve	
	Malfunction of pressure control solenoid valve	Inspect. If NG, replace valve body assembly.
	(Except N→D or N→R shifting) Malfunction of brake light switch	Inspect referring to Section 5. If NG, replace.
	Malfunction of crank position sensor	Inspect referring to Section 6E2. If NG, replace.
	Malfunction of throttle position sensor	
	Faulty valve body component	Replace valve body assembly.
Poor 1→2 shift	Malfunction of shift solenoid valve-B	Inspect. If NG, replace.
	Malfunction of output shaft speed sensor (VSS)	
	Malfunction of transmission range sensor	
	Malfunction of throttle position sensor	Inspect referring to Section 6E2. If NG, replace.
	Faulty valve body component	Replace valve body assembly.
Poor 2→3 shift	Malfunction of shift solenoid valve-A	Inspect. If NG, replace.
	Malfunction of output shaft speed sensor (VSS)	
	Malfunction of transmission range sensor	
	Malfunction of throttle position sensor	Inspect referring to Section 6E2. If NG, replace.
	Faulty valve body component	Replace valve body assembly.
Poor 3→O/D shift	Malfunction of shift solenoid valve-B	Inspect. If NG, replace.
	Malfunction of timing solenoid valve	
	Malfunction of output shaft speed sensor (VSS)	
	Malfunction of input shaft speed sensor	
	Malfunction of transmission range sensor	
	Malfunction of Transmission fluid temperature sensor	
	Malfunction of O/D off switch	
	Malfunction of engine coolant temperature sensor	Inspect referring to Section 6E2. If NG, replace.
	Malfunction of throttle position sensor	
	Malfunction of pressure control solenoid valve	Inspect. If NG, replace valve body assembly.
	Faulty valve body component	Replace valve body assembly.

Condition	Possible Cause	Correction
Poor O/D→3 shift	Malfunction of shift solenoid valve-B	Inspect. If NG, replace.
Poor O/D→3 shift	Malfunction of timing solenoid valve	Inspect. If NG, replace.
Poor O/D→3 shift	Malfunction of output shaft speed sensor (VSS)	Inspect. If NG, replace.
Poor O/D→3 shift	Malfunction of input shaft speed sensor	Inspect. If NG, replace.
Poor O/D→3 shift	Malfunction of O/D off switch	Inspect. If NG, replace.
Poor O/D→3 shift	Malfunction of throttle position sensor	Inspect referring to Section 6E2. If NG, replace.
Poor O/D→3 shift	Malfunction of pressure control solenoid valve	Inspect. If NG, replace valve body assembly.
Poor O/D→3 shift	Faulty valve body component	Replace valve body assembly.
Poor 3→2 shift	Malfunction of shift solenoid valve-A	Inspect. If NG, replace.
Poor 3→2 shift	Malfunction of output shaft speed sensor (VSS)	Inspect. If NG, replace.
Poor 3→2 shift	Malfunction of throttle position sensor	Inspect referring to Section 6E2. If NG, replace.
Poor 3→2 shift	Faulty valve body component	Replace valve body assembly.
Poor 2→1 shift	Malfunction of shift solenoid valve-B	Inspect. If NG, replace.
Poor 2→1 shift	Malfunction of output shaft speed sensor (VSS)	Inspect. If NG, replace.
Poor 2→1 shift	Malfunction of throttle position sensor	Inspect referring to Section 6E2. If NG, replace.
Poor 2→1 shift	Faulty valve body component	Replace valve body assembly.
Incorrect shift point	Engine abnormal condition	Inspect and repair engine
Incorrect shift point	Malfunction of output shaft speed sensor (VSS)	Inspect. If NG, replace.
Incorrect shift point	Malfunction of throttle position sensor	Inspect referring to Section 6E2. If NG, replace.
Non operate TCC (lock-up) system	Malfunction of TCC solenoid valve	Inspect. If NG, replace.
Non operate TCC (lock-up) system	Malfunction of shaft solenoid valve-A and/or-B	Inspect. If NG, replace.
Non operate TCC (lock-up) system	Malfunction of output shaft speed sensor (VSS)	Inspect. If NG, replace.
Non operate TCC (lock-up) system	Malfunction of input shaft speed sensor	Inspect. If NG, replace.
Non operate TCC (lock-up) system	Malfunction of transmission range sensor	Inspect. If NG, replace.
Non operate TCC (lock-up) system	Malfunction of transmission fluid temperature sensor	Inspect. If NG, replace.
Non operate TCC (lock-up) system	Malfunction of pressure control solenoid valve	Inspect. If NG, replace valve body assembly.
Non operate TCC (lock-up) system	Malfunction of brake light switch	Inspect referring to Section 5. If NG, replace.
Non operate TCC (lock-up) system	Malfunction of throttle position sensor	Inspect referring to Section 6E2. If NG, replace.
Non operate TCC (lock-up) system	Malfunction of engine coolant temperature sensor	Inspect referring to Section 6E2. If NG, replace.
Non operate TCC (lock-up) system	Faulty valve body component	Replace valve body assembly.
Excessive "N"→"D" or "N"→"R" time lag	Malfunction of transmission fluid temperature sensor	Inspect. If NG, replace.
Excessive "N"→"D" or "N"→"R" time lag	Pressure control solenoid valve circuit faulty	Inspect. If NG, replace valve body assembly.
Excessive "N"→"D" or "N"→"R" time lag	Clogged oil strainer	Replace.
Excessive "N"→"D" or "N"→"R" time lag	Faulty valve body component	Replace valve body assembly.

Trouble diagnosis table-3

Off-vehicle Repair

Condition	Possible Cause	Correction
Unable to run in all range	Faulty oil pump	Inspect. If NG, replace.
	Seized or broken planetary gear	
	Faulty one-way No.2 clutch	
	Damaged drive plate	
	Faulty forward clutch	
	Faulty reverse clutch	
	Faulty 1st and reverse brake	
	Faulty torque converter	Replace
Excessive "N"→"D" shift shock	Faulty forward clutch	Inspect. If NG, replace.
Excessive "N"→"R" shift shock	Faulty reverse clutch	Inspect. If NG, replace.
	Faulty 1st and reverse brake	
Poor 1→2 shift, excessive shock or slippage	Faulty 2nd brake	Inspect. If NG, replace.
	Faulty one-way No.1 clutch	
Poor 2→3 shift, excessive shock or slippage	Faulty direct clutch	Inspect. If NG, replace.
Poor 3↔O/D shift, excessive shock or slippage	Faulty forward clutch	Inspect. If NG, replace.
	Faulty O/D and 2nd coast brake	
Poor 3→2 shift, excessive shock or slippage	Faulty direct clutch	Inspect. If NG, replace.
	Faulty one-way No.1 clutch	
Poor 2→1 shift, excessive shock or slippage	Faulty 2nd brake	Inspect. If NG, replace.
	Faulty one-way No.2 clutch	
Non operate TCC (lock-up) system	Faulty torque converter	Replace.
Excessive "N"→"D" time lag	Faulty oil pump	Inspect. If NG, replace.
	Faulty forward clutch	
	Faulty one-way No.2 clutch	
	Leakage from "D" range fluid pressure circuit	Overhaul or replace valve body assembly.
Excessive "N"→"R" time lag	Faulty oil pump	Inspect. If NG, replace.
	Faulty reverse clutch	
	Faulty 1st and reverse brake	
	Leakage from "R" range fluid pressure circuit	Overhaul or replace valve body assembly.
Poor engine brake in downshift to "2" range	Faulty O/D and 2nd coast brake	Inspect. If NG, replace.
Poor engine brake in downshift to "L" range	Faulty 1st and reverse brake.	Inspect. If NG, replace.

Road Test

This test is to check if upshift, downshift and lock-up take place at specified speeds while actually driving vehicle on a level road.

WARNING:
- **Carry out test in very little traffic area to prevent an accident.**
- **Test requires 2 persons, a driver and a tester.**

1) Warm up engine.
2) With engine running at idle, shift selector lever to “D” range.
3) Accelerate vehicle speed by depressing accelerator pedal gradually.
4) While driving in “D” range, check if gear shift and lock-up occur properly as shown in “Gear Shift Diagram and Lock-Up Diagram”. (Refer to “Automatic Gear Shift Diagram” in this section.)

Troubleshooting

Condition	Possible Cause	Correction
Unable to run in all range	Faulty valve body component	Replace valve body assembly
	Faulty oil pump	Inspect. If NG, replace.
	Seized or broken planetary gear	
	Faulty one-way No.2 clutch	
	Faulty forward clutch	
	Faulty reverse clutch	
	Faulty 1st and reverse brake	
	Damaged drive plate	
	Faulty torque converter	Replace.
No gear shift as 3rd gear	Malfunction of shift solenoid valve-A and/or-B	Inspect. If NG, replace.
	Malfunction of timing solenoid valve	
	Malfunction of pressure control solenoid valve	Inspect. If NG, replace valve body assembly.
1→2 upshift fails to occur	Malfunction of shift solenoid valve-B	Inspect. If NG, replace.
	Malfunction of output shaft speed sensor (VSS)	
	Malfunction of throttle position sensor	
	Malfunction of transmission range sensor	
	Faulty valve body component	Replace valve body assembly
	Faulty 2nd brake	Inspect. If NG, replace.
	Faulty one-way No.1 clutch	
2→3 upshift fails to occur	Malfunction of shift solenoid valve-A	Inspect. If NG, replace.
	Malfunction of output shaft speed sensor (VSS)	
	Malfunction of throttle position sensor	
	Malfunction of transmission range sensor	
	Faulty valve body component	Replace valve body assembly.
	Faulty direct clutch	Inspect. If NG, replace.

Condition	Possible Cause	Correction
3→O/D upshift fails to occur	Malfunction of shift solenoid valve-B	Inspect. If NG, replace.
	Malfunction of O/D off switch	
	Malfunction of engine coolant temperature sensor	
	Malfunction of output shaft speed sensor (VSS)	
	Malfunction of input shaft speed sensor	
	Malfunction of throttle position sensor	
	Malfunction of transmission range sensor	
	Malfunction of crankshaft position sensor	
	Malfunction of timing solenoid valve	
	Malfunction of transmission fluid temperature sensor	
	Malfunction of pressure control solenoid valve	Inspect. If NG, replace valve body assembly.
	Faulty valve body component	Replace valve body assembly.
	Faulty O/D and 2nd coast brake	Inspect. If NG, replace.
O/D→3 downshift fails to occur	Malfunction of shift solenoid valve-A	Inspect. If NG, replace.
	Malfunction of O/D off switch	
	Malfunction of output shaft speed sensor (VSS)	
	Malfunction of input shaft speed sensor	
	Malfunction of throttle position sensor	
	Malfunction of timing solenoid valve	
	Malfunction of pressure control solenoid valve	Inspect. If NG, replace valve body assembly.
	Faulty valve body component	Replace valve body assembly.
	Faulty forward clutch	Inspect. If NG, replace.
3→2 downshift fails to occur	Malfunction of shift solenoid valve-A	Inspect. If NG, replace.
	Malfunction of output shaft speed sensor (VSS)	
	Malfunction of throttle position sensor	
	Faulty valve body component	Replace valve body assembly.
	Faulty one-way No.1 clutch	Inspect. If NG, replace.
2→1 downshift fails to occur	Malfunction of shift solenoid valve-B	Inspect. If NG, replace.
	Malfunction of output shaft speed sensor (VSS)	
	Malfunction of throttle position sensor	
	Faulty valve body component	Replace valve body assembly.
	Faulty one-way No.2 clutch	Inspect. If NG, replace.
Gear shift point is incorrect	Abnormal engine condition	Inspect and repair engine.
	Malfunction of output shaft speed sensor (VSS)	Inspect. If NG, replace.
	Malfunction of throttle position sensor	
	Malfunction of pressure control solenoid valve	Inspect. If NG, replace valve body assembly.

Condition	Possible Cause	Correction
TCC (lock-up) function does not operate	Malfunction of TCC solenoid valve	Inspect. If NG, replace.
	Malfunction of shift solenoid valve-A and/or-B	
	Malfunction of brake light switch	
	Malfunction of engine coolant temperature sensor	
	Malfunction of output shaft speed sensor (VSS)	
	Malfunction of input shaft speed sensor	
	Malfunction of throttle position sensor	
	Malfunction of transmission range sensor	
	Malfunction of transmission fluid temperature sensor	
	Malfunction of pressure control solenoid valve	Inspect. If NG, replace valve body assembly.
	Faulty valve body component	Replace valve body assembly.
	Faulty torque converter	Replace.

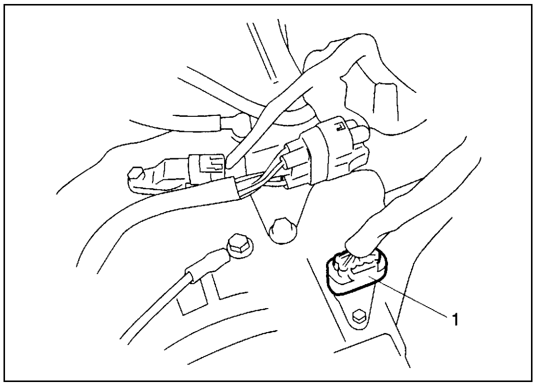
Manual Road Test

This test checks the gears being used in “L”, “2” or “D” range when driven with unoperated gear shift control system. Test drive vehicle on a level road.

NOTE:

Before this test, check diagnostic trouble code (DTC).

1) With select lever in “P”, start engine and warm it up.
2) After warming up engine, turn ignition switch OFF and disconnect valve body harness connector (1).



3) With select lever in “L” range, start vehicle and check that 3rd gear is being used referring to table shown below.

Vehicle speed per 1,000 rpm in engine speed (V1,000 table, reference)

Gear position	Vehicle speed
1st	8.1 km/h (5.0 mile/h)
2nd	14.8 km/h (9.2 mile/h)
3rd	23.3 km/h (14.5 mile/h)
4th (O/D)	33.3 km/h (20.7 mile/h)
Reverse	10.1 km/h (6.3 mile/h)

4) While vehicle is running, shift select lever to “2” range and check that 3rd gear is being used.
5) While vehicle is running, shift select lever to “D” range and check that 3rd gear is being used.
6) After above checks, stop vehicle then turn ignition switch OFF, and connect valve body harness connector.
7) Clear DTC.

Troubleshooting

Condition	Possible Cause	Correction
Operated gear is not correct	Faulty valve body component	Replace valve body assembly.
	Faulty clutch or brake	Inspect clutch and brake. If any parts are faulty, replace them.

Engine Brake Test

WARNING:

Before test, make sure that there is no vehicle behind so as to prevent rear-end collision.

1) While driving vehicle in 3rd gear of "D" range, shift select lever down to "2" range and check if engine brake operates.
2) In the same way as in Step 1), check engine brake for operation when select lever is shifted down to "L" range.
3) Engine brake should operate in above test.

Troubleshooting

Condition	Possible Cause	Correction
Failure to operate when shifted down to "2" range	Faulty valve body component	Replace valve body assembly.
	Faulty O/D and 2nd coast brake	Inspect. If NG, replace.
Failure to operate when shifted down to "L" range	Faulty valve body component	Replace valve body assembly.
	Faulty 1st and reverse brake	Inspect. If NG, replace.

Stall Test

This test is to check overall performance of automatic transaxle and engine by measuring stall speed at "D" and "R" ranges. Be sure to perform this test only when transaxle fluid is at normal operating temperature and its level is between FULL and LOW marks.

CAUTION:
- **Do not run engine at stall more than 5 seconds continuously, or fluid temperature may rise excessively high.**
- **After performing stall test, be sure to leave engine running at idle for longer than 1 minute before another stall test.**

1) Apply parking brake and block wheels.
2) Install tachometer.
3) Start engine with select lever shifted to "P" range.
4) Depress brake pedal fully.
5) Shift select lever to "D" range and depress accelerator pedal fully while watching tachometer. Read engine rpm quickly when it has become constant (stall speed).
6) Release accelerator pedal immediately after stall speed is checked.
7) In the same way, check stall speed in "R" range.
8) Stall speed should be within following specification.

Engine stall speed
Standard: 2,050 – 2,350 rpm

Troubleshooting

Condition	Possible Cause	Correction
Lower than standard level in both "D" and "R" range	Engine output torque failure	Inspect and repair engine.
	Faulty one-way clutch of torque converter	Replace torque converter.
Higher than standard level in "D" range	Malfunction of pressure control solenoid valve (Low line pressure)	Inspect. If NG, replace valve body assembly.
	Faulty valve body component	Replace valve body assembly.
	Slippery forward clutch	Inspect. If NG, replace.
	Faulty one-way No.2 clutch	
	Leakage from "D" range fluid pressure circuit	Overhaul or replace valve body assembly.
Higher than standard level in "R" range	Malfunction of pressure control solenoid valve (Low line pressure)	Inspect. If NG, replace valve body assembly.
	Faulty valve body component	Replace valve body assembly.
	Slippery reverse clutch	Inspect. If NG, replace.
	Slippery 1st and reverse brake	
	Leakage from "R" range fluid pressure circuit	Overhaul or replace valve body assembly.
Higher than standard level in both "D" and "R" range	Malfunction of pressure control solenoid valve (Low line pressure)	Inspect. If NG, replace valve body assembly.
	Faulty valve body component	Replace valve body assembly.
	Clogged oil strainer	Replace.
	Faulty oil pump	Inspect. If NG, replace.
	Leakage from both "D" and "R" range fluid pressure circuit	Overhaul or replace valve body assembly.

Time Lag Test

This test is to check conditions of clutch, brake and fluid pressure. “Time lag” means time elapsed since selector lever is shifted with engine idling till shock is felt.

1) With chocks placed before and behind front and rear wheels respectively, depress brake pedal.
2) Start engine.
3) With stop watch ready, shift select lever from “N” to “D” range and measure time from that moment till shock is felt.
4) Similarly measure time lag by shifting select lever from “N” to “R” range.

Gear shifting time lag
“N” → “D”: Less than 0.7 sec.
“N” → “R”: Less than 1.2 sec.

NOTE:

- **When repeating this test, be sure to wait at least one minute after select lever is shifted back to “N” range.**
- **Engine should be warmed up fully for this test.**
- **Repeat test 3 times and take average of those data for final time lag data.**

Troubleshooting

Condition	Possible Cause	Correction
“N” → “D” time lag exceeds specification	Malfunction of transmission fluid temperature sensor	Inspect. If NG, replace.
	Malfunction of pressure control solenoid valve (Low line pressure)	Inspect. If NG, replace valve body assembly.
	Faulty valve body component	Replace valve body assembly.
	Clogged oil strainer	Replace.
	Faulty oil pump	Inspect. If NG, replace.
	Faulty forward clutch	
	Faulty one-way No.2 clutch	
	Leakage from “D” range fluid pressure circuit	Overhaul or replace valve body assembly.
“N” → “R” time lag exceeds specification	Malfunction of transmission fluid temperature sensor	Inspect. If NG, replace.
	Malfunction of pressure control solenoid valve (Low line pressure)	Inspect. If NG, replace valve body assembly.
	Faulty valve body component	Replace valve body assembly.
	Clogged oil strainer	Replace.
	Faulty oil pump	Inspect. If NG, replace.
	Faulty reverse clutch	
	Faulty 1st and reverse brake	
	Leakage from “R” range fluid pressure circuit	Overhaul or replace valve body assembly.

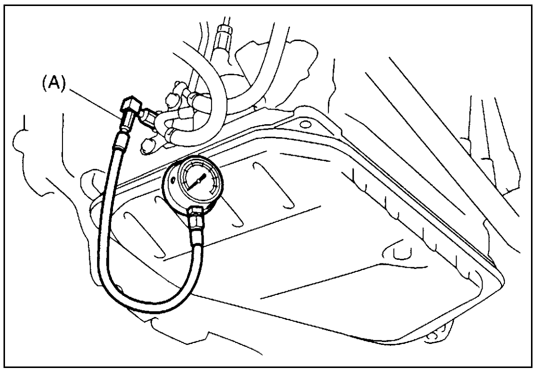
Line Pressure Test

Purpose of this test is to check operating conditions of each part by measuring fluid pressure in fluid pressure line.

Line pressure test requires following conditions.

- Automatic fluid is at normal operating temperature (70 – 80°C /158 – 176°F).
- Fluid is replenished to proper level (between FULL and LOW on dipstick).
- Air conditioner switch is turned OFF.

1) Apply parking brake securely and place chocks against wheels.
2) Remove fluid pressure check hole plug bolt.



3) Attach oil pressure gauge to fluid pressure check hole in transaxle case.

Special tool
(A): 09925-37811-001

> **CAUTION:**
> **After attaching oil pressure gauge, check that no fluid leakage exists.**

4) Depress foot brake fully, run engine at idle and stall then check fluid pressure in “D” or “R” range.

> **CAUTION:**
> - **Do not continue running engine at stall speed longer than 5 seconds.**
> - **After performing line pressure test, be sure to leave engine running at idle for longer than one minute before performing another line pressure test.**

Automatic transmission line pressure

	“D” range	“R” range
At idle speed	**3.6 – 4.0 kg/cm^2** **51 – 57 psi**	**5.8 – 6.7 kg/cm^2** **82 – 95 psi**
At stall speed	**12.3 – 13.4 kg/cm^2** **175 – 191 psi**	**16.2 – 18.6 kg/cm^2** **230 – 264 psi**

Troubleshooting

Condition	Possible Cause	Correction
Higher than standard level in each range	Malfunction of pressure control solenoid valve (Low line pressure)	Inspect. If NG, replace valve body assembly.
	Faulty valve body component	Replace valve body assembly.
Lower than standard level in each range	Malfunction of pressure control solenoid valve (Low line pressure)	Inspect. If NG, replace valve body assembly.
	Faulty valve body component	Replace valve body assembly.
	Clogged oil strainer	Replace.
	Faulty oil pump	Inspect. If NG, replace.
	Leakage from both “D” and “R” range fluid pressure circuit	Overhaul or replace valve body assembly.
Lower than standard level only in “D” range	Leakage from “D” range fluid pressure circuit	Overhaul or replace valve body assembly.
Lower than standard level only in “R” range	Leakage from “R” range fluid pressure circuit	Overhaul or replace valve body assembly.

“P” Range Test

1) Stop vehicle on a slope of 5 degrees or more, shift select lever to “P” range and at the same time apply parking brake.
2) After stopping engine, depress brake pedal and release parking brake.
3) Then, release brake pedal gradually and check that vehicle remains stationary.
4) Depress brake pedal and shift select lever to “N” range.
5) Then, release brake pedal gradually and check that vehicle moves.

WARNING:

Before test, make sure no one is around vehicle or down on a slope and keep watchful for safety during test.

Troubleshooting

Condition	Possible Cause	Correction
Vehicle moves at “P” range or remains stationary at “N” range	Defective parking lock pawl or spring	Inspect. If NG, repair.

Diagnostic Flow Table A-1: No Gear Shift to O/D

System Description

TCM does not shift to O/D gear under any of the following conditions.

- O/D OFF switch is turned ON ("O/D OFF" lamp lights).
- Engine coolant temperature is less than 50°C (122°F).
- A/T fluid temperature is less than 20°C (68°F).
- TCM detects the following DTCs.
  P0712/P0713/P0717/P0722/P0785/P0962/P0963/P0973/P0974/P0976/P0977/P1701/P1702/P1703

Troubleshooting

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

Step	Action	Yes	No
1	Was "A/T System Check" performed?	Go to Step 2.	Go to "A/T System Check".
2	Check DTC. Is DTC P0712, P0713, P0717, P0722, P0785, P0962, P0963, P0973, P0974, P0976, P0977, P1701, P1702 and/or P1703 detected?	Perform DTC flow table to repair and retry.	Go to Step 3.
3	Perform running test under the following conditions and measure voltage between terminal "E13-16" of TCM connector and ground, terminal "E13-15" of TCM connector and ground. • O/D OFF switch is turned OFF. ("O/D OFF" lamp does not light) • Engine coolant temperature is in normal operating temperature. • Select lever is in "D" range. • Drive vehicle with 4th gear condition referring to "Automatic Gear Shift Diagram" in this section. Do results satisfy the value as follows? Voltage between terminal "E13-16" of TCM connector and ground: 0 – 1 V Voltage between terminal "E13-15" of TCM connector and ground: 9 – 14 V	Faulty shift solenoid valve, circuit or transaxle.	"BRN" circuit shorted to power circuit or open, or "BLK/YEL" circuit shorted to ground. If wire is OK, go to Step 4.
4	O/D OFF switch signal inspection. With ignition switch ON, check voltage between terminal "E12-9" of TCM connector and ground. O/D OFF switch OFF ("O/D OFF" lamp does not light): 8 – 14 V O/D OFF switch ON ("O/D" OFF" lamp lights): 0 – 1 V Is result as specified?	Substitute a known-good TCM and recheck.	Faulty O/D OFF switch or its circuit. If OK substitute a known-good TCM and recheck.

Diagnostic Flow Table A-2: No Lock-Up Occurs

System Description

TCM turns TCC solenoid OFF under any of the following conditions.

- Brake light switch is turned ON. (Brake pedal is depressed)
- Engine coolant temperature is less than 60°C (140°F).
- Throttle opening is as much as 0%.
- TCM detects the following DTCs.
  P0705/P0707/P0712/P0713/P0717/P0722/P0785/P0962/P0963/P0973/P0974/P0976/P0977/P1701/
  P1702/P1703/P2769/P2770

Troubleshooting

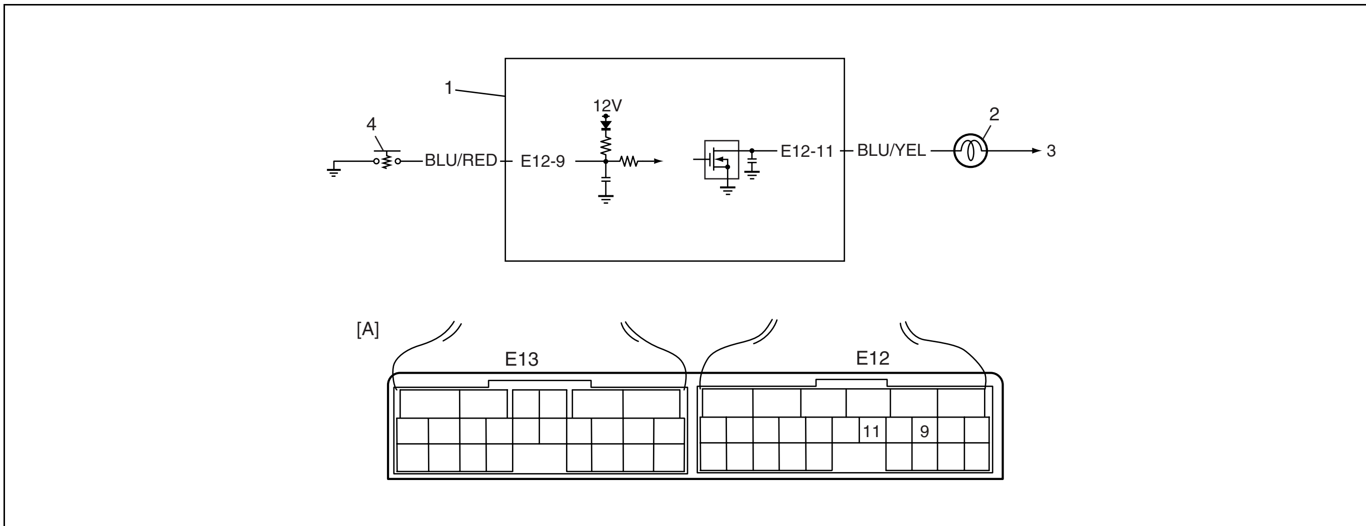
WARNING:

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

Step	Action	Yes	No
1	Was “A/T System Check” performed?	Go to Step 2.	Go to “A/T System Check”.
2	Check DTC. Is DTC P0705, P0707, P0712, P0713, P0717, P0722, P0785, P0962, P0963, P0973, P0974, P0976, P0977, P1701, P1702, P1703, P2769 and/or P2770 detected?	Perform DTC flow table to repair and retry.	Go to Step 3.
3	Perform running test under the following conditions and measure voltage between terminal “E13-5” of TCM connector and ground. • O/D OFF switch is turned OFF. (“O/D OFF” lamp does not light) • Engine coolant temperature is in normal operating temperature. • Select lever is in “D” range. • Brake pedal is released. • Drive vehicle with 4th gear and TCC ON condition referring to “Automatic Gear Shift Diagram” in this section. Is terminal voltage about 9 – 14 V?	Faulty TCC solenoid valve, circuit or transaxle.	“WHT/BLU” circuit shorted to ground. If wire is OK, go to step 4
4	Brake light switch signal inspection. With ignition switch ON, check voltage between terminal “E21-9” of ECM connector and ground. Brake pedal is released: 0 – 1 V Brake pedal is depressed: 8 – 14 V Is result as specified?	Substitute a known-good TCM and recheck.	Mis-adjusted brake light switch, faulty brake light switch or its circuit. If OK, substitute a known-good TCM and recheck.

Diagnostic Flow Table A-3: "O/D OFF" Lamp Circuit Check ("O/D OFF" Lamp Lights Steadily)

Wiring Diagram



1. TCM	4. O/D off switch
2. "O/D OFF" lamp	[A]: Terminal arrangement of TCM connector (viewed from harness side)
3. To ignition switch	

Circuit Description

"O/D OFF" lamp operation of ON/OFF is controlled by transmission control module (TCM) and combination meter.

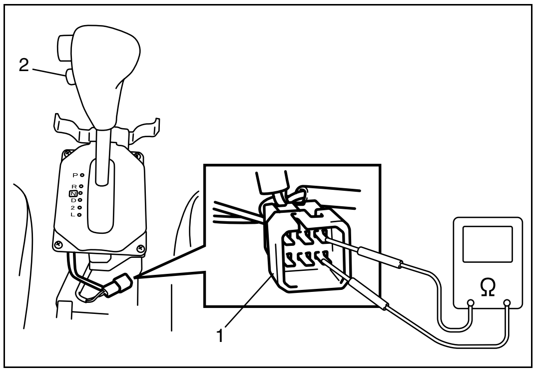
When ignition switch is turned ON with O/D OFF switch OFF and malfunction is not detected, TCM turn "O/D OFF" lamp ON only for 2 seconds to check bulb and terns it OFF.

Troubleshooting

Step	Action	Yes	No
1	Check O/D off switch status. Press O/D off switch button. Does "O/D OFF" lamp light steadily?	Go to Step 2.	System is OK.
2	Check "O/D OFF" lamp circuit for short. 1) Turn ignition switch OFF and disconnect TCM connectors. 2) Turn ignition switch ON. Does "O/D OFF" lamp light steadily yet?	"BLU/YEL" circuit shorted to ground.	Go to Step 3.
3	Check O/D off switch circuit. 1) Turn ignition switch OFF. 2) Check continuity between terminal "E12-9" of disconnected harness side connector and ground. Is continuity indicated?	Go to step 4.	Substitute a known-good TCM and recheck.

Step	Action	Yes	No
4	Check O/D off switch for operation. 1) Disconnect O/D off switch coupler. 2) Check continuity between terminals under each condition below. (See fig.) O/D off switch under being released: No continuity O/D off switch under being pressed: Continuity Is check result satisfactory?	"BLU/RED" circuit shorted to ground.	Replace O/D off switch.

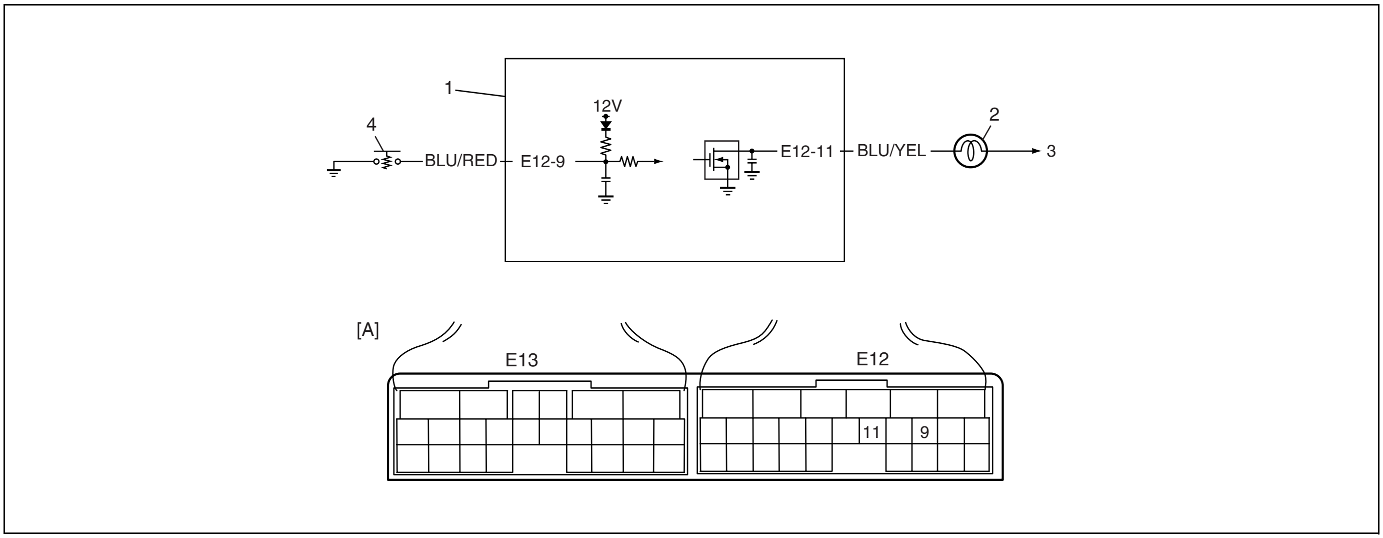
Fig. for Step 2 and Step 4



1.	O/D off switch coupler
2.	O/D off switch button

Diagnostic Flow Table A-4: "O/D OFF" Lamp Circuit Check ("O/D OFF" Lamp Does Not Light Anytime)

Wiring Diagram



1. TCM	4. O/D off switch
2. "O/D OFF" lamp	[A]: Terminal arrangement of TCM connector (viewed from harness side)
3. To ignition switch	

Circuit Description

"O/D OFF" lamp operation of ON/OFF is controlled by transmission control module (TCM) and combination meter.

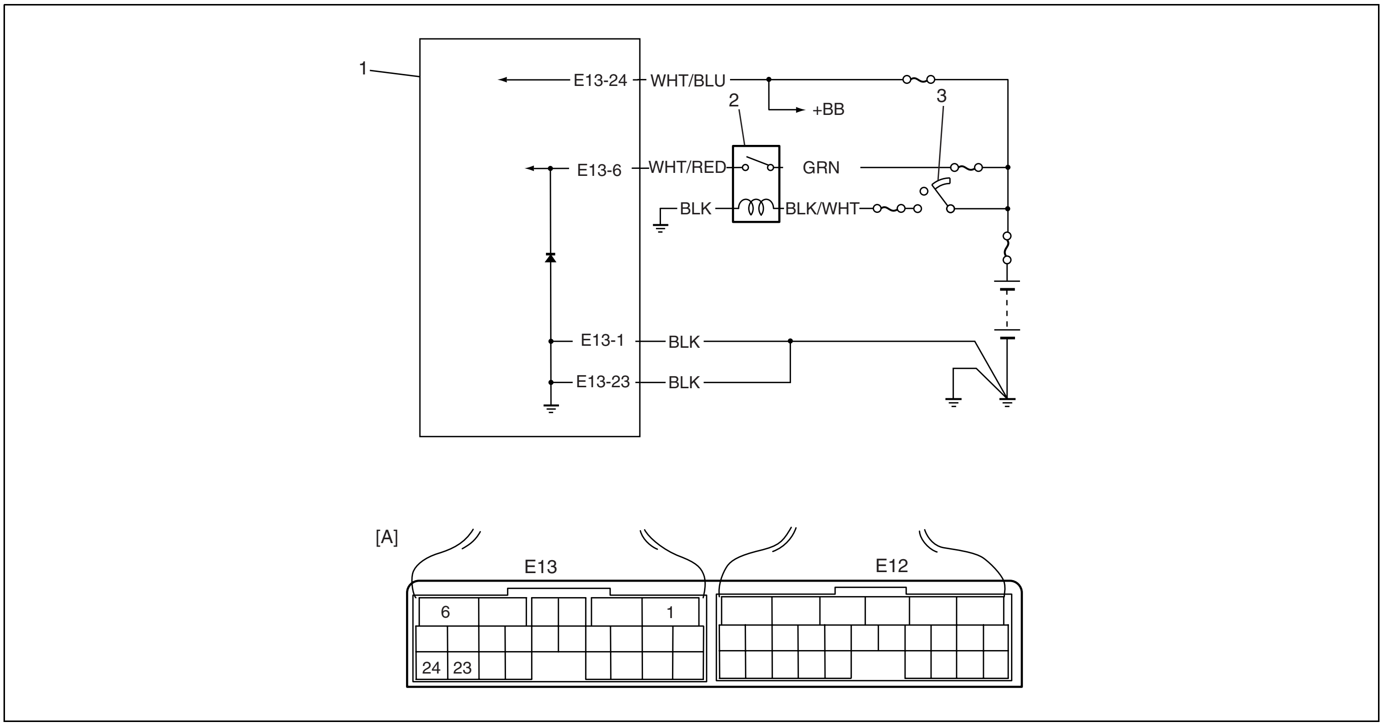
When ignition switch is turned ON with O/D OFF switch OFF and malfunction is not detected, TCM turn "O/D OFF" lamp ON only for 2 seconds to check bulb and turn it OFF.

Troubleshooting

Step	Action	Yes	No
1	Check "O/D OFF" lamp circuit. 1) Turn ignition switch OFF and disconnect TCM connectors. 2) Using service wire, connect terminal "E12-11" of disconnected harness side TCM connector and ground. 3) Turn ignition switch ON. Does "O/D OFF" lamp light?	Poor terminal "E12-11" connection. If OK, substitute a known-good TCM and recheck.	"BLU/YEL" circuit open or bulb burned out.

Diagnostic Flow Table A-5: TCM Power and Ground Circuit Check

Wiring Diagram



1. TCM	3. Ignition switch
2. A/T relay	[A]: Terminal arrangement of TCM connector (viewed from harness side)

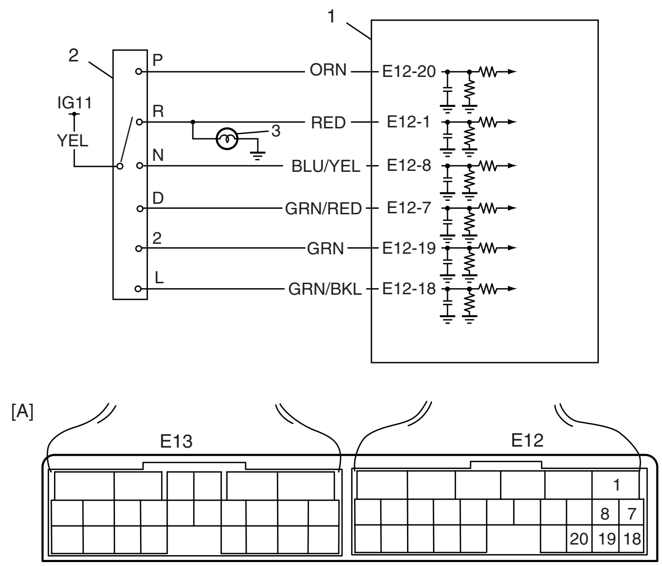
Troubleshooting

Step	Action	Yes	No
1	Check TCM Back-up Power Circuit 1) Disconnect TCM connector with ignition switch OFF. 2) Check for proper connection to TCM at "E13-24" terminal. 3) If OK, check voltage at terminal "E13-24" of disconnected TCM connector. Is it 10 – 14 V?	Go to Step 2.	"WHT/BLU" circuit open or shorted to ground.
2	Check TCM Power Circuit. 1) Disconnect TCM connector with ignition switch OFF. 2) Check for proper connection to TCM at "E13-6" terminal. 3) If OK, turn ignition switch ON and check voltage at terminal "E13-6" of disconnected TCM connector. Is it 10 – 14 V?	Go to Step 4.	Go to Step 3.
3	Check A/T Relay Operation. Check A/T relay operation referring to "A/T Relay Inspection" in this section. Is check result satisfactory?	"WHT/RED", "GRN". "BLK/WHT" or "BLK" circuit for power supply open.	Replace A/T relay.

Step	Action	Yes	No
4	Check TCM Ground Circuit. 1) Turn ignition switch OFF. 2) With TCM connectors disconnected, check for proper connection to TCM at “E13-1”/ “E13-23” terminal. 3) If OK, check resistance between “E13-1”/ “E13-23” terminal of disconnected TCM connector and body ground. Is continuity indicated?	TCM power and ground circuits are in good condition.	“BLK” circuit for TCM ground open.

DTC P0705 Transmission Range Sensor Circuit Malfunction

Wiring Diagram



1. TCM	3. Backup lamp
2. Transmission range sensor	[A]: Terminal arrangement of TCM connector (viewed from harness side)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
• Multiple signals are inputted simultaneously for 12 seconds.	• Select cable maladjusted. • Transmission range sensor (switch) maladjusted. • Transmission range sensor (switch) or its circuit malfunction. • TCM

DTC Confirmation Procedure

1) Connect scan tool to DLC with ignition switch OFF.
2) Clear DTCs in TCM memory by using scan tool.
3) Start engine and shift select lever to “D” range.
4) Keep engine running at idle speed for 25 seconds or more.
5) Stop vehicle and check DTC.

Troubleshooting

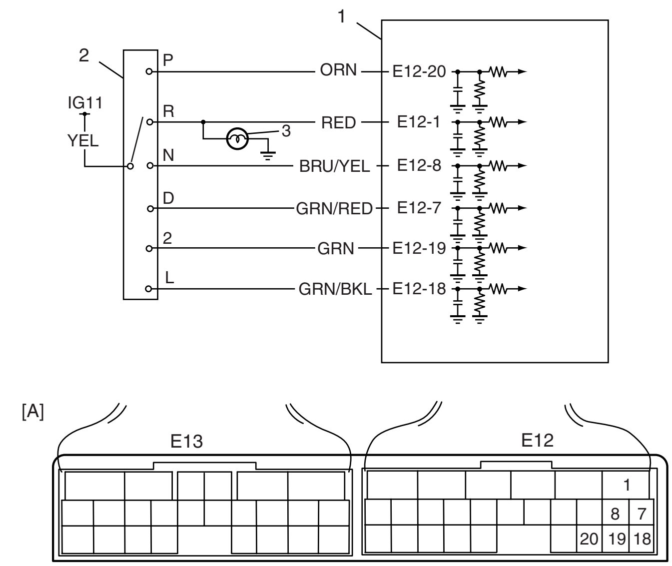
Step	Action	Yes	No
1	Was “Automatic Transaxle Diagnostic Flow Table” performed?	Go to Step 2.	Go to “Automatic Transaxle Diagnostic Flow Table” in this section.
2	Do you have SUZUKI scan tool?	Go to Step 3.	Go to Step 4.
3	Check Transmission range sensor(switch) circuit for operation. Check by using SUZUKI scan tool: 1) Connect SUZUKI scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON and check transmission range signal (P, R, N, D, 2 or L) on display when shifting select lever to each range. Is applicable range indicated? Are check results satisfactory?	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 5.
4	Check Transmission range sensor(switch) circuit for operation. Check by not using SUZUKI scan tool: 1) Turn ignition switch ON. 2) Check voltage at terminals “E12-1”, “E12-7”, “E12-8”, “E12-18”, “E12-19” and “E12-20” respectively with select lever shifted to each range. Taking terminal E12-19 as an example, is battery voltage indicated only when select lever is shifted to “2” range and 0 V for other ranges as shown in table below? Check voltage at other terminals likewise, referring to figure. Are check results satisfactory?	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 5.
5	Check transmission range sensor for installation position. 1) Shift select lever to “N” range. 2) Check that “N” reference line on sensor and needle direction shaped on lock washer are aligned. Are they aligned?	Go to Step 7.	Adjust.
6	Check select cable for adjustment referring to “Select Cable Adjustment” in this section. Is it adjusted correctly?	Go to Step 6.	Adjust.
7	Check Transmission range sensor(switch) referring to “Transmission Range Sensor” in this section. Are check results satisfactory?	“YEL”, “ORN”, “RED”, “BUL/YEL”, “GRN/RED”, “GRN” or “GRN/BLK” circuit shorted to power circuit or shorted each other. If wires and connections are OK, substitute a know-good TCM and recheck.	Replace Transmission range sensor.

Table for Step 4

		Terminal					
		E12-20	E12-1	E12-8	E12-7	E12-19	E12-18
Select lever position	P	8 – 14 V	0 V	0 V	0 V	0 V	0 V
	R	0 V	8 – 14 V	0 V	0 V	0 V	0 V
	N	0 V	0 V	8 – 14 V	0 V	0 V	0 V
	D	0 V	0 V	0 V	8 – 14 V	0 V	0 V
	2	0 V	0 V	0 V	0 V	8 – 14 V	0 V
	L	0 V	0 V	0 V	0 V	0 V	8 – 14 V

DTC P0707 Transmission Range Sensor Circuit Low

Wiring Diagram



1. TCM	3. Backup lamp
2. Transmission range sensor	[A]: Terminal arrangement of TCM connector (viewed from harness side)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
• Transmission range switch signal (P, R, N, D, 2, or L) is not inputted for more than 32 seconds when vehicle speed is faster than 30 km/h (19 mile/h) and engine speed is faster than 1,500 rpm.	• Select cable maladjusted. • Transmission range sensor (switch) maladjusted. • Transmission range sensor (switch) or its circuit malfunction. • TCM

DTC Confirmation Procedure

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

1) Connect scan tool to DLC with ignition switch OFF.
2) Clear DTCs in TCM memory by using scan tool.
3) Start engine and shift select lever.
4) Shift select lever to “D” range.
5) Start vehicle and increase vehicle speed to 40 km/h (25 mile/h) or more for 1 minutes.
6) Stop vehicle and turn ignition switch OFF.
7) Repeat Step 3) to 5) one time.
8) Stop vehicle and check DTC.

Troubleshooting

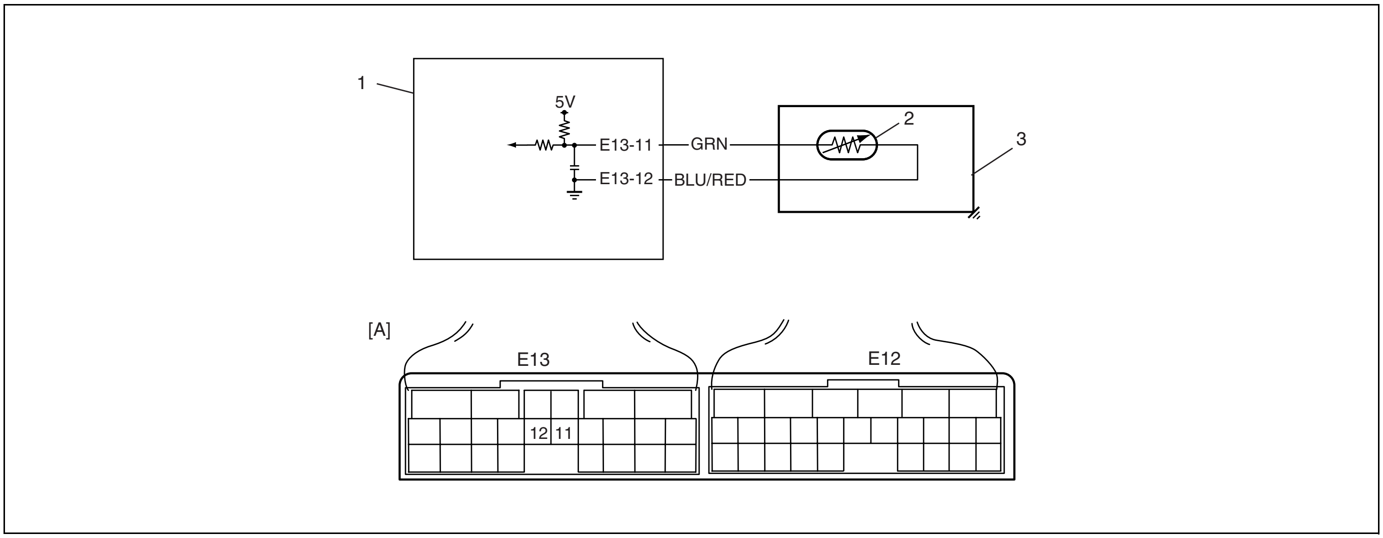
Step	Action	Yes	No
1	Was “Automatic Transaxle Diagnostic Flow Table” performed?	Go to Step 2.	Go to “Automatic Transaxle Diagnostic Flow Table” in this section.
2	Do you have SUZUKI scan tool?	Go to Step 3.	Go to Step 4.
3	Check Transmission range sensor(switch) circuit for operation. Check by using SUZUKI scan tool: 1) Connect SUZUKI scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON and check transmission range signal (P, R, N, D, 2 or L) on display when shifting select lever to each range. Is applicable range indicated? Are check results satisfactory?	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 5.
4	Check Transmission range sensor(switch) circuit for operation. Check by not using SUZUKI scan tool: 1) Turn ignition switch ON. 2) Check voltage at terminals E12-1, E12-7, E12-8, E12-18, E12-19 and E12-20 respectively with select lever shifted to each range. Taking terminal E12-19 as an example, is battery voltage indicated only when select lever is shifted to “2” range and 0 V for other ranges as shown in table below? Check voltage at other terminals likewise, referring to figure. Are check results satisfactory?	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A.	Go to Step 5.
5	Check transmission range sensor for installation position. 1) Shift select lever to “N” range. 2) Check that “N” reference line on sensor and needle direction shaped on lock washer are aligned. Are they aligned?	Go to Step 7.	Adjust.
6	Check select cable for adjustment referring to “Select Cable Adjustment” in this section. Is it adjusted correctly?	Go to Step 6.	Adjust.
7	Check Transmission range sensor(switch) referring to “Transmission Range Sensor” in this section. Are check results satisfactory?	“YEL”, “ORN”, “RED”, “BLU/YEL”, “GRN/RED”, “GRN” or “GRN/BLK” circuit open or short to ground. If wires and connections are OK, substitute a know-good TCM and recheck.	Replace Transmission range sensor.

Table for Step 4

		Terminal					
		E12-20	E12-1	E12-8	E12-7	E12-19	E12-18
Select lever position	P	8 – 14 V	0 V	0 V	0 V	0 V	0 V
	R	0 V	8 – 14 V	0 V	0 V	0 V	0 V
	N	0 V	0 V	8 – 14 V	0 V	0 V	0 V
	D	0 V	0 V	0 V	8 – 14 V	0 V	0 V
	2	0 V	0 V	0 V	0 V	8 – 14 V	0 V
	L	0 V	0 V	0 V	0 V	0 V	8 – 14 V

DTC P0712 Transmission Fluid Temperature Sensor Circuit Low

Wiring Diagram



1. TCM	3. A/T
2. Transmission fluid temperature sensor	[A]: Terminal arrangement of TCM connector (viewed from harness side)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Transmission temperature sensor terminal voltage is less than 0.05 V for 5 minutes or more after turning ignition switch ON.	• Transmission fluid temperature sensor or its circuit malfunction. • TCM

DTC Confirmation Procedure

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

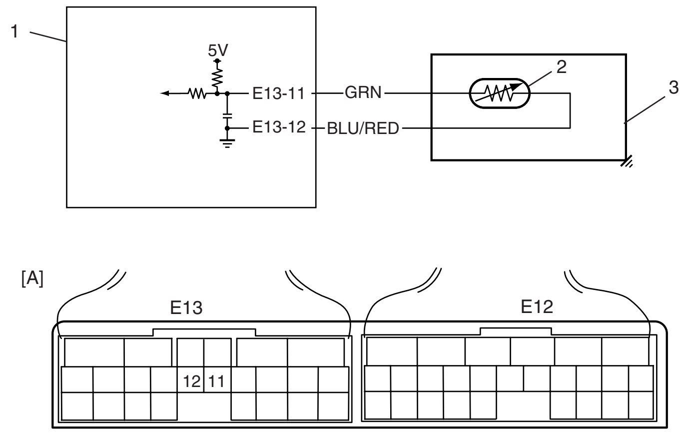
1) Connect scan tool to DLC with ignition switch OFF if available.
2) Clear DTC in TCM memory and start engine.
3) Keep engine running at idle speed for 10 minutes or more.
4) Stop vehicle and check DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “Automatic Transaxle Diagnostic Flow Table” performed?	Go to Step 2.	Go to “Automatic Transaxle Diagnostic Flow Table” in this section.
2	Check Transmission Fluid Temperature Circuit for Ground Short. Check continuity between terminal E13-11 of disconnected harness side TCM connector and ground. Is continuity indicated?	“GRN” circuit shorted to ground.	Go to Step 3.
3	Check Transmission Fluid Temperature Circuit for IG Short. 1) Cool down A/T fluid temperature under ambient temperature. 2) Connect TCM connectors to TCM with ignition switch OFF. 3) Turn ignition switch ON. 4) Measure voltage between terminal E13-11 of TCM connector and ground. Is it 4.6 V or more?	“GRN” circuit shorted to power circuit. If circuit is OK, go to Step 4.	Intermittent trouble or faulty TCM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A. If OK, substitute a known-good TCM and recheck.
4	Inspect Transmission Fluid Temperature Sensor. Inspect transmission temperature sensor referring to “Transmission Fluid Temperature Sensor” in this section. Is result satisfactory?	Intermittent trouble or faulty TCM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A. If OK, substitute a known-good TCM and recheck.	Replace transmission fluid temperature sensor.

DTC P0713 Transmission Fluid Temperature Sensor Circuit High

Wiring Diagram



1. TCM	3. A/T	[A]: Terminal arrangement of TCM connector (viewed from harness side)
2. Transmission fluid temperature sensor	4. Valve body connector	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
• Transmission temperature sensor terminal voltage is more than 4.6 V and shift range is in “R”, “D”, “2” or “L” for 15 minutes after starting engine.	• Transmission fluid temperature sensor or its circuit malfunction. • TCM

DTC Confirmation Procedure

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

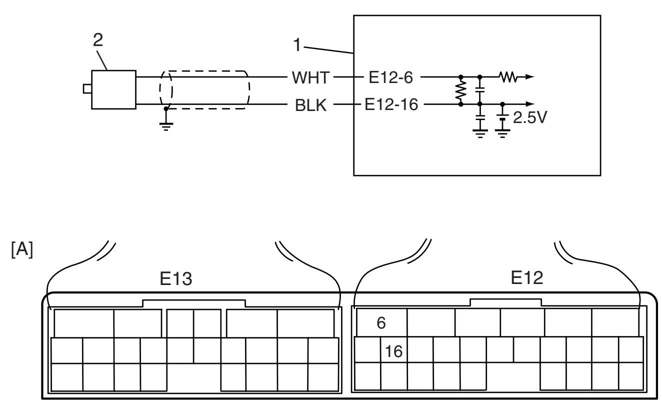
1) Connect scan tool to DLC with ignition switch OFF if available.
2) Clear DTC in TCM memory and start engine.
3) Start vehicle and increase vehicle speed to about 40 km/h (25 mile/h) for 20 minutes or more.
4) Stop vehicle and check DTC.

Troubleshooting

Step	Action	Yes	No
1	Was "Automatic Transaxle Diagnostic Flow Table" performed?	Go to Step 2.	Go to "Automatic Transaxle Diagnostic Flow Table" in this section.
2	Check Transmission Fluid Temperature Circuit for Open. 1) Turn ignition switch OFF. 2) Disconnect TCM connectors from TCM. 3) Check for proper connection to transmission fluid temperature sensor at terminals E13-11 and E13-12. 4) If OK, check continuity between terminals E13-11 and E13-12 of disconnected harness side TCM connector. Is continuity indicated?	Go to Step 3.	"BLU/RED" or "GRN/RED" circuit open.
3	Check Transmission Fluid Temperature Circuit for IG Short. 1) Cool down A/T fluid temperature under ambient temperature. 2) Connect TCM connectors to TCM with ignition switch OFF. 3) Turn ignition switch ON. 4) Measure voltage between terminal E13-11 of TCM connector and ground. Is it 4.6 V or more?	"GRN" circuit shorted to power circuit. If circuit is OK, go to Step 4.	Intermittent trouble or faulty TCM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM and recheck.
4	Inspect Transmission Fluid Temperature Sensor. Inspect transmission temperature sensor referring to "Transmission Fluid Temperature Sensor" in this section. Is result satisfactory?	Intermittent trouble or faulty TCM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM and recheck.	Replace transmission fluid temperature sensor.

DTC P0717 Input/Turbine Speed Sensor Circuit Malfunction

Wiring Diagram



1. TCM	2. Input shaft speed sensor	[A]: Terminal arrangement of TCM connector (viewed from harness side)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
No input shaft speed sensor signal is detected although output shaft speed sensor signals are detected.	• Input shaft speed sensor or its circuit malfunction. • Improper input shaft speed sensor installation. • Damaged direct clutch drum. • Foreign material attachment to sensor or drum. • TCM

DTC Confirmation Procedure

WARNING:

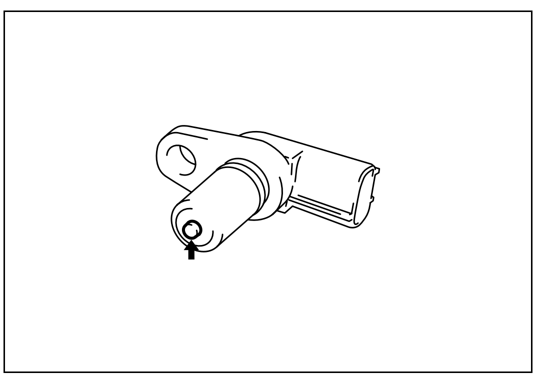
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and tester, on a level road.**

1) Connect scan tool to DLC with ignition switch OFF if available.
2) Clear DTC in TCM memory and start engine.
3) Shift selector lever to “D” range and drive vehicle at 50 km/h (31 mile/h) or more with 3rd gear at least for 5 minutes.
4) Stop vehicle and check DTC.

Troubleshooting

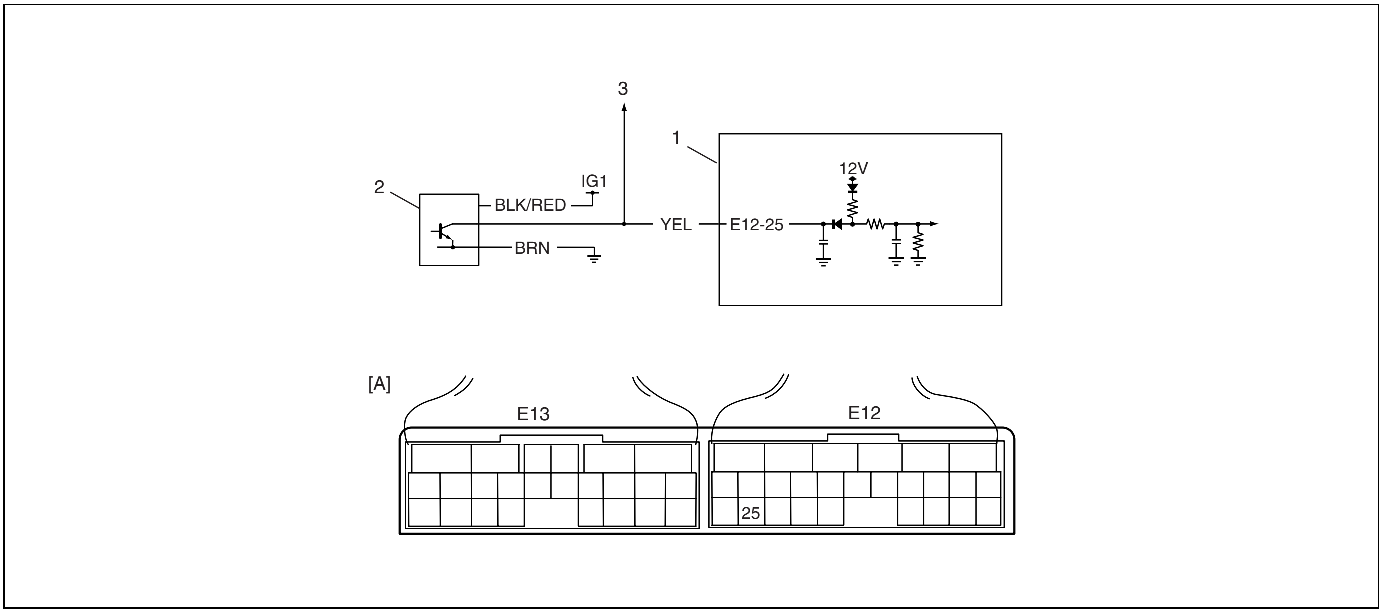
Step	Action	Yes	No
1	Was "A/T System Check" performed?	Go to Step 2.	Go to "A/T System Check" in this section.
2	Check Input Shaft Speed Sensor Circuit. 1) Disconnect TCM connectors with ignition switch OFF. 2) Check for proper connection to input shaft speed sensor at E12-6 and E12-16 terminals. 3) If OK, check resistance of sensor circuit. Resistance between terminals E12-6 and E12-16 of disconnected harness side TCM connector: 560 – 680 Ω at 20°C (68°F) Continuity between terminal E12-6/E12-16 of disconnected harness side TCM connector and ground: No continuity Are check result satisfactory?	Go to Step 4.	Go to Step 3.
3	Inspect Input Shaft Speed Sensor. Inspect input shaft speed sensor referring to "Input Shaft Speed Sensor Inspection". Is result satisfactory?	"WHT" or "BLK" circuit open or short.	Replace input shaft speed sensor.
4	Check visually input shaft speed sensor and direct clutch drum for the followings. See Fig. • No damage • No foreign material attached • Correct installation Are they in good condition?	Intermittent trouble or faulty TCM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM and recheck.	Clean, repair or replace.

Fig. for Step 4



DTC P0722 Output Speed Sensor (VSS) Circuit No Signal

Wiring Diagram



1. TCM	2. Output shaft speed sensor (VSS)	3. To ECM	[A]: Terminal arrangement of TCM connector (viewed from harness side)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
No output shaft speed sensor signal is detected although input shaft speed sensor signals are detected while vehicle is running at 5 km/h (3 mile/h) or more vehicle speed with “D”, “2” or “L” range.	• Output shaft speed sensor or its circuit malfunction. • Damaged sensor gear (driven gear). • Damaged output shaft speed sensor (VSS) drive gear. • TCM

DTC Confirmation Procedure

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

1) Connect scan tool to DLC with ignition switch OFF if available.
2) Clear DTC in TCM memory and start engine.
3) Shift selector lever to “D” range and drive vehicle at 50 km/h (31 mile/h) or more vehicle speed at least for 3 minutes.
4) Stop vehicle check DTC.

Troubleshooting

Step	Action	Yes	No
1	Was "Automatic Transaxle Diagnostic Flow Table" in this section performed?	Go to Step 2.	Go to "Automatic Transaxle Diagnostic Flow Table" in this section.
2	Check Output Shaft Speed Sensor (VSS) Power Circuit. 1) Turn ignition switch OFF. 2) Disconnect output shaft speed sensor connector. 3) Turn ignition switch ON. 4) Measure voltage between "BLK/RED" wire terminal of disconnected output shaft speed sensor harness side connector and ground. Is it 10 – 14 V?	Go to Step 3.	"BLK/RED" wire open or shorted to ground.
3	Check Output Shaft Speed Sensor (VSS) Ground Circuit. 1) Turn ignition switch OFF. 2) Check continuity between "BRN" wire terminal of disconnected output shaft speed sensor harness side connector and ground. Is continuity indicated?	Go to Step 4.	"BRN" wire open.
4	Check Output Shaft Speed Sensor (VSS) Signal Circuit for short. 1) Disconnect TCM connectors. 2) Check continuity between "YEL" wire terminal of disconnected output shaft speed sensor harness side connector and ground. Is continuity indicated?	"YEL" wire shorted to ground.	Go to Step 5.
5	Check Output Shaft Speed Sensor (VSS) Signal Circuit for open. 1) Check continuity between "YEL" wire terminal of disconnected output shaft speed sensor harness side connector and terminal E12-25 of disconnected harness side TCM connector. Is continuity indicated?	Go to Step 6.	"YEL" wire open.
6	Inspect Output Shaft Speed Sensor (VSS). Inspect output shaft speed sensor referring to "Output Shaft Speed Sensor (VSS) Inspection" in this section. Is check result satisfactory?	Go to Step 7.	Replace output shaft speed sensor.

Step	Action	Yes	No
7	Check Output Shaft Speed Sensor (VSS) Gears Visually. Check output shaft speed sensor gears for the followings. • No damage in drive gear on differential case • No damage in driven gear in output shaft speed sensor Is result satisfactory?	Intermittent trouble or Faulty TCM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM and recheck.	Replace drive gear and/or driven gear of output shaft speed sensor.

DTC P0741/P0742 TCC Circuit Performance or Stuck OFF/TCC Circuit Stuck ON

DTC Detecting Condition and Trouble Area

[DTC P0741]

DTC DETECTING CONDITION	TROUBLE AREA
When driving vehicle with 3rd or 4th gear in “D” range, difference in revolution between engine and A/T input (input shaft speed) is lager than specification although TCM commanded TCC solenoid to turn ON.	• Mechanical malfunction of TCC solenoid valve. • Malfunction of valve body assembly. • Fluid passage clogged or leaking. • Torque converter clutch malfunction.

[DTC P0742]

DTC DETECTING CONDITION	TROUBLE AREA
When driving vehicle with 2nd, 3rd or 4th gear in “D” range, difference in revolution between engine and A/T input (input shaft speed) is smaller than specification although TCM commanded TCC solenoid to turn OFF.	• Mechanical malfunction of TCC solenoid valve. • Malfunction of valve body assembly. • Fluid passage clogged or leaking. • Torque converter clutch malfunction.

DTC Confirmation Procedure

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

1) Connect scan tool to DLC with ignition switch OFF, if available.
2) Clear DTC in TCM memory.
3) Start engine and warm it up to normal operating temperature.
4) Shift select lever to “N” and “D” range for each 10 seconds.
5) Drive vehicle with 4th in “D” range and lock-up ON for 20 seconds or longer referring to “Automatic Gear Shift Diagram” in this section.
6) Turn O/D OFF switch ON keeping on driving in “D” range. (Confirm “O/D OFF” lamp lights.)
7) Drive vehicle with 2nd or 3rd gear in “D” range, 15 – 20% throttle opening and at vehicle speed of 25 – 40 km/h (16 – 25 mile/h).
8) Stop vehicle and turn ignition switch OFF.
9) Repeat Step 3) to 7) one time.
10) Stop vehicle and check DTC.

DTC Troubleshooting

Step	Action	Yes	No
1	Was “Automatic Transaxle Diagnostic Flow Table” performed?	Go to Step 2.	Go to “Automatic Transaxle Diagnostic Flow Table” in this section.
2	Check TCC solenoid valve for operation referring to “Shift Solenoid Valves, TCC solenoid valve and Timing solenoid valve Inspection” in this section. Are they in good condition?	Clean fluid passage or replace valve body assembly.	Replace TCC solenoid valve.

DTC P0751/P0752/P0756/P0757 Shift Solenoid-A (No.1) Performance or Stuck OFF/Shift Solenoid-A (No.1) Stuck ON/Shift Solenoid-B (No.2) Performance or Stuck OFF/Shift Solenoid-B (No.2) Stuck ON

DTC Detecting Condition and Trouble Area

[DTC P0751]

DTC DETECTING CONDITION	TROUBLE AREA
3rd gear ratio is detected although TCM command is for 2nd gear while vehicle running at 15 km/h (10 mile/h) or more in "D" range after engine being warmed up.	• Mechanical malfunction of shift solenoid valve-A (No.1). • Malfunction of valve body assembly. • Fluid passage clogged or leaking. • Mechanical malfunction of automatic transaxle (clutch, brake or gear etc.).

[DTC P0752]

DTC DETECTING CONDITION	TROUBLE AREA
2nd gear ratio is detected although TCM command is for 3rd gear while vehicle running at 15 km/h (10 mile/h) or more in "D" range after engine being warmed up.	• Mechanical malfunction of shift solenoid valve-A (No.1). • Malfunction of valve body assembly. • Fluid passage clogged or leaking. • Mechanical malfunction of automatic transaxle (clutch, brake or gear etc.).

[DTC P0756]

DTC DETECTING CONDITION	TROUBLE AREA
3rd gear ratio is detected although TCM command is for 4th gear while vehicle running at 15 km/h (10 mile/h) or more in "D" range after engine being warmed up.	• Mechanical malfunction of shift solenoid valve-B (No.2). • Malfunction of valve body assembly. • Fluid passage clogged or leaking. • Mechanical malfunction of automatic transaxle (clutch, brake or gear etc.).

[DTC P0757]

DTC DETECTING CONDITION	TROUBLE AREA
4th gear ratio is detected although TCM command is for 3rd gear while vehicle running at 15 km/h (10 mile/h) or more in "D" range after engine being warmed up.	• Mechanical malfunction of shift solenoid valve-B (No.2). • Malfunction of valve body assembly. • Fluid passage clogged or leaking. • Mechanical malfunction of automatic transaxle (clutch, brake or gear etc.).

DTC Confirmation Procedure

WARNING:

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

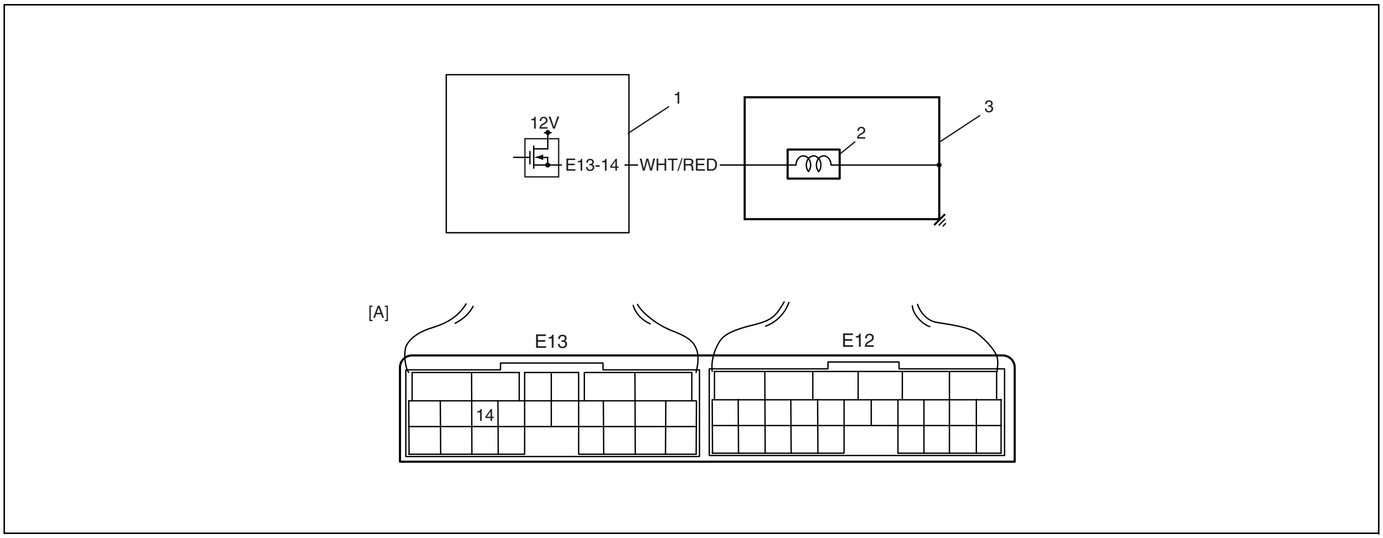
1) Connect scan tool to DLC with ignition switch OFF, if available.
2) Clear DTC in TCM memory.
3) Start engine and warm it up to normal operating temperature.
4) Shift select lever to “N” and “D” range for each 10 seconds.
5) Start vehicle and increase vehicle speed to 65 km/h (40 mile/h) with throttle position 10% or more.
6) Stop vehicle and turn ignition switch OFF.
7) Repeat Step 3) to 5) one time.
8) Stop vehicle and check DTC.

DTC Troubleshooting

Step	Action	Yes	No
1	Was “Automatic Transaxle Diagnostic Flow Table” performed?	Go to Step 2.	Go to “Automatic Transaxle Diagnostic Flow Table” in this section.
2	Check shift solenoid valve-A (No.1) or -B (No.2) for operation referring to “Shift Solenoid Valves, TCC Solenoid Valve and Timing Solenoid Valve Inspection” in this section. Are they in good condition?	Clean fluid passage or replace valve body assembly.	Replace shift solenoid valve-A or -B.

DTC P0785 Timing Solenoid

Wiring Diagram



1. TCM	3. A/T
2. Timing solenoid valve	[A]: Terminal arrangement of TCM connector (viewed from harness side)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
• Voltage of timing solenoid valve TCM terminal is low although TCM is commanding timing solenoid valve to turn ON. or • Voltage of timing solenoid valve TCM terminal is high although TCM is commanding timing solenoid valve to turn OFF.	• Timing solenoid valve circuit shorted to ground. • Timing solenoid valve circuit open or shorted to power circuit. • Timing solenoid valve malfunction. • TCM

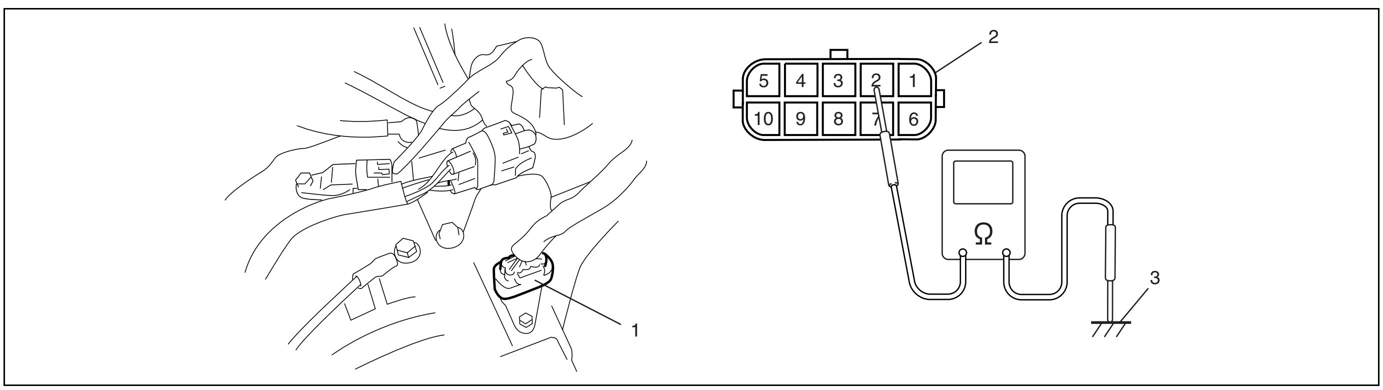
DTC Confirmation Procedure

1) Connect scan tool to DLC with ignition switch OFF, if available.
2) Clear DTC in TCM memory.
3) Start engine and shift selector lever to “N” range.
4) Repeat shifting selector lever from “N” range to “D” range and vice versa for 3 times.
5) Check DTC.

Troubleshooting

Step	Action	Yes	No
1	Was “A/T System Check” performed?	Go to Step 2.	Go to “A/T System Check” in this section.
2	Check Timing Solenoid Valve Circuit for IG Short or Open. 1) Turn ignition switch ON and measure voltage between terminal “E13-14” of harness side TCM connector and ground. 2) Is it 0 – 1 V?	Go to Step 3.	“WHT/RED” circuit shorted to power circuit or open.
3	Check Timing Solenoid Valve Resistance 1) Turn ignition switch OFF. 2) Disconnect valve body harness connector on transaxle. 3) Check for proper connection to solenoid valve at “WHT/RED” circuit. 4) Check resistance of solenoid valve. See Fig. Resistance between terminal of transaxle side valve body harness connector and transaxle: 11 – 15 Ω (at 20°C (68°F)) Is check result satisfactory?	Go to Step 4.	Replace timing solenoid valve or lead wire.
4	Check Timing Solenoid Valve Circuit for Ground Short. 1) Connect valve body harness connector. 2) Disconnect TCM connectors. 3) Measure resistance between terminal “E13-14” of disconnected harness side TCM connector and ground. Is it 11 – 15 Ω (at 20°C (68°F))	Intermittent trouble or faulty TCM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A. If OK, substitute a known-good TCM and recheck.	“WHT/RED” circuit shorted to ground.

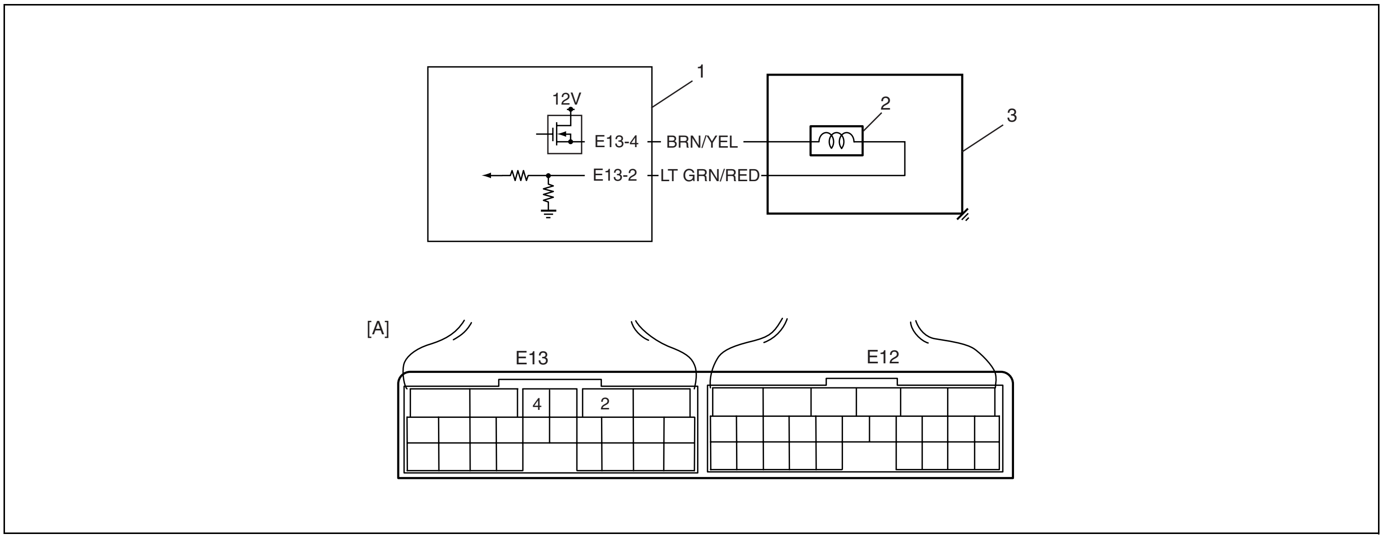
Fig. for Step 4



1.	Valve body harness connector on harness
2.	Valve body harness connector on transaxle
3.	Ground (Transaxle)

DTC P0962 Pressure Control Solenoid Control Circuit Low

Wiring Diagram



1. TCM	3. A/T
2. Pressure control solenoid valve	[A]: Terminal arrangement of TCM connector (Viewed from harness side)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Pressure control solenoid valve output voltage is too low comparing with TCM command value.	• Pressure control solenoid valve circuit open or shorted to ground. • Malfunction of pressure control solenoid valve • TCM

DTC Confirmation Procedure

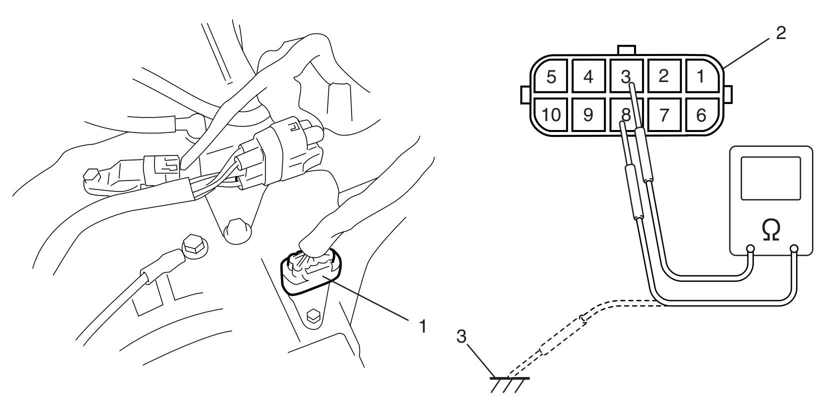
1) Connect scan tool to DLC with ignition switch OFF, if available.
2) Clear DTC in TCM memory.
3) Start engine.
4) Keep engine running at idle speed for 30 seconds or more.
5) Stop vehicle and check DTC.

DTC Troubleshooting

Step	Action	Yes	No
1	Was “Automatic Transaxle Diagnostic Flow Table” performed?	Go to Step 2.	Go to “Automatic Transaxle Diagnostic Flow Table” in this section.

Step	Action	Yes	No
2	Check pressure control solenoid valve resistance 1) Turn ignition switch OFF 2) Disconnect valve body harness connector on automatic transmission. 3) Check for proper connection to solenoid at "BRN/YEL" and "LT GRN/RED" circuit. 4) Check resistance of pressure control solenoid. See Fig. Resistance between pressure control solenoid valve terminals of transmission side valve body harness connector: 5.0 – 5.6 Ω (at 20°C (68°F)) Resistance between pressure control solenoid valve terminals of transmission side valve body harness connector and transmission body: Infinity Is check results satisfactory?	Go to Step 3.	Replace pressure control solenoid valve or valve body harness.
3	Check pressure control solenoid valve circuit for ground short 1) Connect valve body harness connector. 2) Disconnect TCM connectors. 3) Check for proper connection to TCM at terminals "E13-2" and "E13-4". If connection is OK, check continuity between terminal "E13-4" of disconnected harness side TCM connector and ground. Is continuity indicated?	"BRN/YEL" or "LT GRN/RED" circuit shorted to ground.	Go to Step 4.
4	Check pressure control solenoid valve circuit for open 1) Check resistance between terminals "E13-2" and "E13-4" of disconnected harness side TCM connector. Is it infinity?	"BRN/YEL" or "LT GRN/RED" circuit open.	Intermittent trouble or faulty TCM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM and recheck

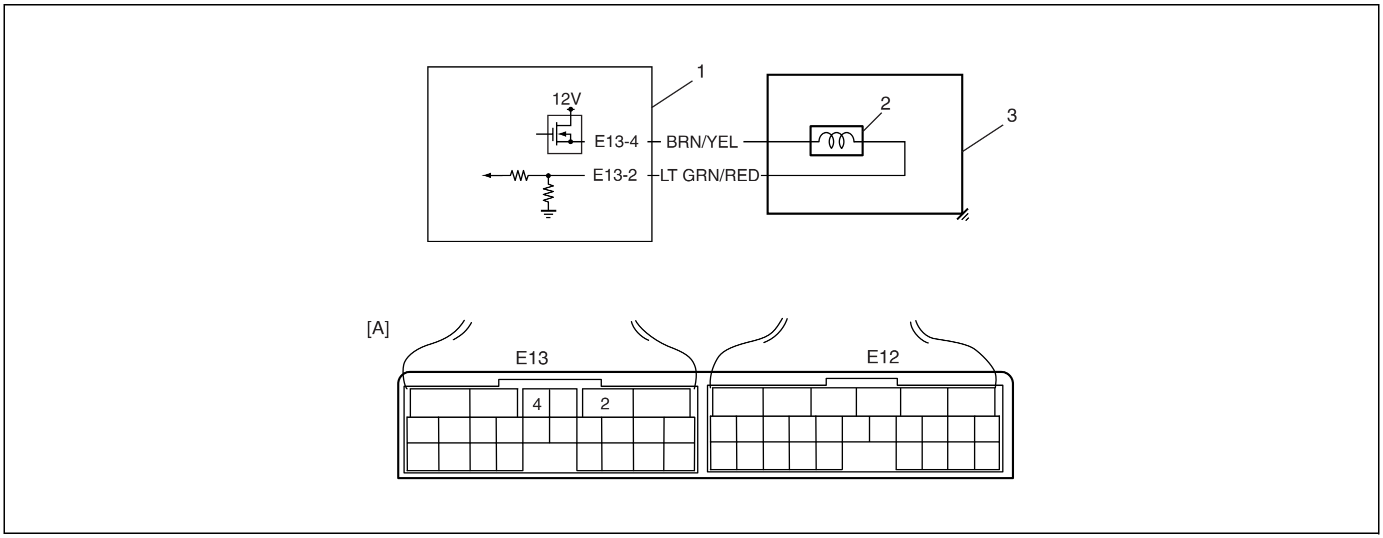
Fig. for Step 2.



1. Valve body harness connector on harness	2. Valve body harness connector on transaxle	3. Ground (transaxle)

DTC P0963 Pressure Control Solenoid Control Circuit High

Wiring Diagram



1. TCM	3. A/T
2. Pressure control solenoid valve	[A]: Terminal arrangement of TCM connector (Viewed from harness side)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Pressure control solenoid valve output voltage is too high comparing with TCM command value.	• Pressure control solenoid valve circuit shorted to power circuit. • Pressure control solenoid valve malfunction • TCM

DTC Confirmation Procedure

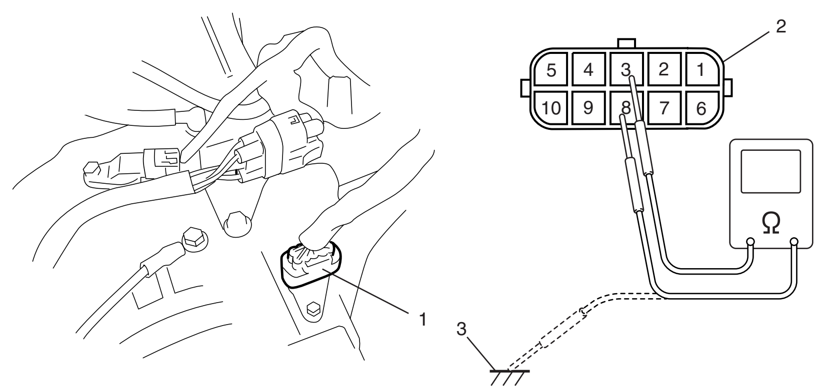
1) Connect scan tool to DLC with ignition switch OFF, if available.
2) Clear DTC in TCM memory.
3) Start engine.
4) Keep engine running at idle speed for 10 seconds or more.
5) Check DTC.

DTC Troubleshooting

Step	Action	Yes	No
1	Was “Automatic Transaxle Diagnostic Flow Table” performed?	Go to Step 2.	Go to “Automatic Transaxle Diagnostic Flow Table” in this section.
2	Check pressure control solenoid circuit for IG short 1) Connect valve body harness connector. 2) Disconnect TCM connectors. 3) Check for proper connection to TCM at terminal “E13-2” and “E13-4”. 4) If connection is OK, turn ignition switch ON and measure voltage between terminal “E13-4” of disconnected harness side TCM connector and ground. Is it 0 – 2 V?	Go to Step 3.	“BRN/YEL” or “LT GRN/RED” circuit shorted to power circuit.

Step	Action	Yes	No
3	Check pressure control solenoid valve resistance 1) Turn ignition switch OFF 2) Disconnect valve body harness connector on automatic transmission. 3) Check for proper connection to solenoid at "BRN/YEL" and "LT GRN/RED" circuit. 4) Check resistance of pressure control solenoid. See Fig. Resistance between pressure control solenoid valve terminals of transmission side valve body harness connector: 5.0 – 5.6 Ω (at 20°C (68°F)) Resistance between pressure control solenoid valve terminals of transmission side valve body harness connector and transmission body: Infinity Is check results satisfactory?	Intermittent trouble or faulty TCM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM and recheck.	Replace pressure control solenoid valve or valve body harness.

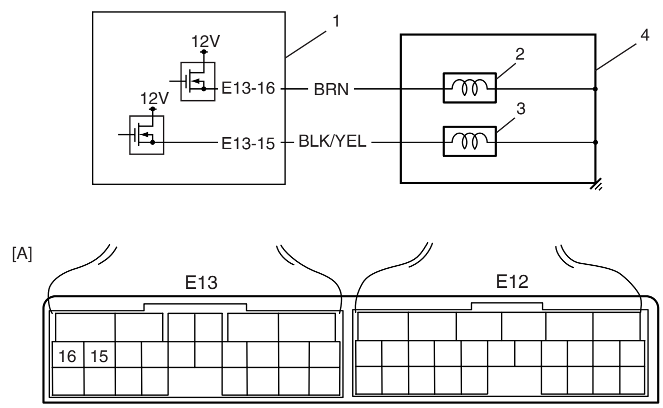
Fig. for Step 3.



1.	Valve body harness connector on harness
2.	Valve body harness connector on transaxle
3.	Ground (transaxle)

DTC P0974/P0977 Shift Solenoid-A (No.1) Control Circuit High/Shift Solenoid-B (No.2) Control Circuit High

Wiring Diagram



1. TCM	3. Shift solenoid valve-B (No.2)	[A]: Terminal arrangement of TCM connector (Viewed from harness side)
2. Shift solenoid valve-A (No.1)	4. A/T	

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Voltage of shift solenoid valve TCM terminal is high although TCM is commanding shift solenoid to turn OFF	• Shift solenoid valve circuit open or shorted to power circuit. • Malfunction of shift solenoid valve • TCM

DTC Confirmation Procedure

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

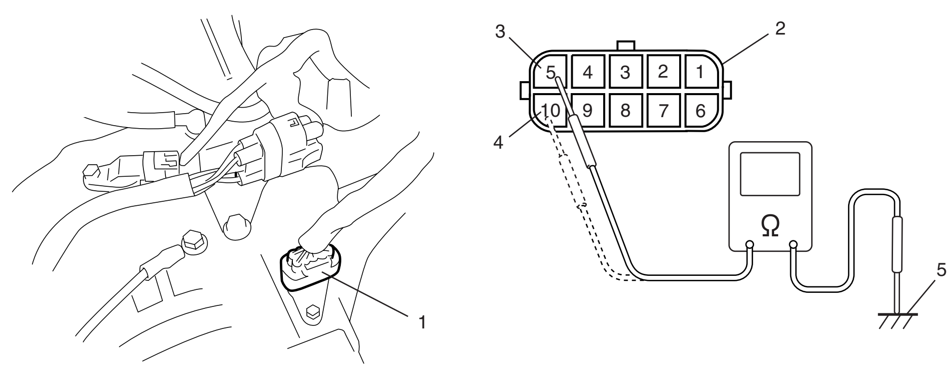
1) Connect scan tool to DLC with ignition switch OFF, if available.
2) Clear DTC in TCM memory.
3) Start engine shift select lever to “D” range.
4) Start vehicle and increase vehicle speed until gear position reaches 3rd or 4th gear.
5) Decrease vehicle speed and stop vehicle.
6) Check DTC.

DTC Troubleshooting

Step	Action	Yes	No
1	Was “Automatic Transaxle Diagnostic Flow Table” performed?	Go to Step 2.	Go to “Automatic Transaxle Diagnostic Flow Table” in this section.

Step	Action	Yes	No
2	Check shift solenoid valve circuit for IG short 1) Connect valve body harness connector. 2) Disconnect TCM connectors. 3) Check for proper connection to TCM at terminal "E13-16" (for shift solenoid valve-A (No.1)) or "E13-15" (for shift solenoid valve-B (No.2)). 4) If connection is OK, turn ignition switch ON and measure voltage between terminal "E13-16" (for shift solenoid valve-A (No.1)) or "E13-15" (for shift solenoid valve-B (No.2)) of disconnected harness side TCM connector and ground. Is it 0 – 2 V?	Go to Step 3.	DTC P0974: "BRN" circuit shorted to power circuit. DTC P0977: "BLK/YEL" circuit shorted to power circuit.
3	Check shift solenoid valve resistance 1) Turn ignition switch OFF. 2) Disconnect valve body harness connector on automatic transmission. 3) Check for proper connection to solenoid at "BRN" (for shift solenoid valve-A (No.1)) or "BLK/YEL" (for shift solenoid valve-B (No.2)) circuit. Check resistance of solenoid valve. See Fig. Resistance between shift solenoid valve-A (No.1) terminal and transaxle: 11 – 15 Ω at 20°C? (68°F) Resistance between shift solenoid valve-B (No.2) terminal and transaxle: 11 – 15 Ω at 20°C? (68°F) Is check results satisfactory?	Intermittent trouble or faulty TCM. Check for intermittent referring to "Intermittent and Poor Connection" in Section 0A. If OK, substitute a known-good TCM and recheck.	Replace applicable shift solenoid valve or valve body harness.

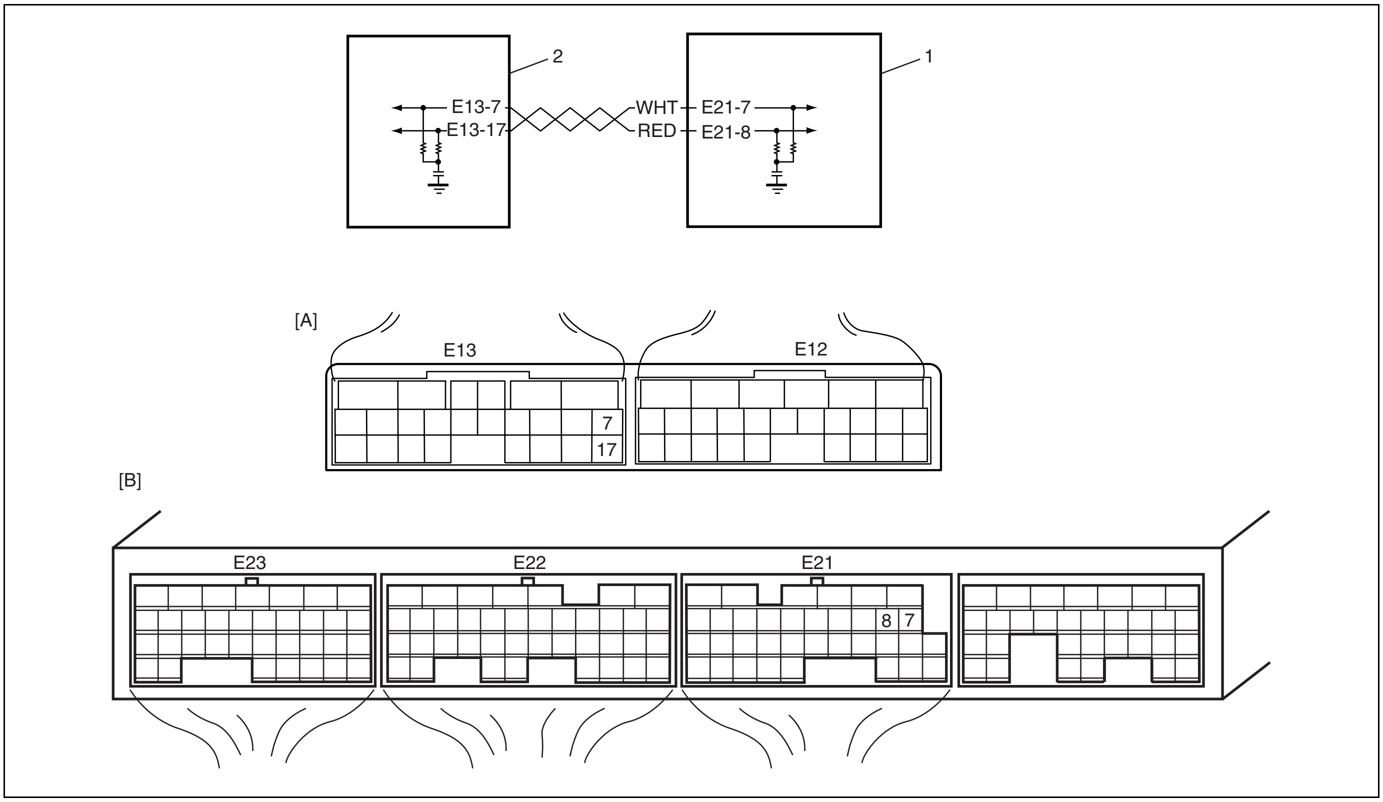
Fig. for Step 3.



1.	Valve body harness connector on harness
2.	Valve body harness connector on transaxle
3.	Shift solenoid valve-A (No.1) terminal
4.	Shift solenoid valve-B (No.2) terminal
5.	Ground (transaxle)

DTC P1701 CAN Communication Error

Wiring Diagram



1. ECM	[A]: Terminal arrangement of TCM connector (Viewed from harness side)
2. TCM	[B]: Terminal arrangement of ECM connector (Viewed from harness side)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Transmission or reception error of communication data is detected by TCM for specified time continuously.	• "RED" or "WHT" wire circuit open or short • TCM • ECM

DTC Confirmation Procedure

1) Connect scan tool to DLC with ignition switch OFF, if available.
2) Clear DTC in TCM memory.
3) Start engine and warm it up to normal operating temperature.
4) Check DTC.

DTC Troubleshooting

Step	Action	Yes	No
1	Was "Automatic Transaxle Diagnostic Flow Table" performed?	Go to Step 2.	Go to "Automatic Transaxle Diagnostic Flow Table" in this section.

Step	Action	Yes	No
2	Check CAN communication circuit for open. 1) Turn ignition switch to OFF position. 2) Disconnect connectors from ECM and TCM. 3) Check for proper connection to “E21-7” terminal of ECM connector and “E13-7” terminal of TCM connector. If OK, measure resistance between “E21-7” terminal of ECM connector and “E13-7” terminal of TCM connector. Is resistance 1 Ω or less?	Go to Step 3.	“RED” wire circuit open or high resistance.
3	Check CAN communication circuit for power short. 1) Turn ignition switch to ON position. 2) Measure voltage between “E13-7” terminal of TCM connector and vehicle body ground. Is voltage 0 – 1 V?	Go to Step 4.	“RED” wire circuit shorted to power circuit.
4	Check CAN communication circuit for ground short. 1) Turn ignition switch to OFF position. 2) Measure resistance between “E21-7” terminal of ECM connector and vehicle body ground. Is it infinite?	Go to Step 5.	“RED” wire circuit shorted to ground.
5	Check CAN communication circuit for open. 1) Turn ignition switch to OFF position. 2) Disconnect connectors from ECM and TCM. 3) Check for proper connection to “E21-8” terminal of ECM connector and “E13-17” terminal of TCM connector. 4) If OK, measure resistance between “E21-8” terminal of ECM connector and “E13-17” terminal of TCM connector Is resistance 1 Ω or less?	Go to Step 6.	“WHT” wire circuit open or high resistance.
6	Check CAN communication circuit for power short. 1) Turn ignition switch to ON position. 2) Measure voltage between “E13-17” terminal of TCM connector and vehicle body ground. Is voltage 0 – 1 V?	Go to Step 7.	“WHT” wire circuit shorted to power circuit.
7	Check CAN communication circuit for ground short. 1) Turn ignition switch to OFF position. 2) Measure resistance between “E13-17” terminal of ECM connector and vehicle body ground. Is it infinite?	Substitute a known-good TCM and recheck. If OK, substitute a known-good ECM and recheck.	“WHT” wire circuit shorted to ground.

DTC P1702 Internal Control Module Memory Check Sum Error

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Calculation of current data stored in TCM is not correct comparing with pre-stored checking data in TCM.	TCM

DTC Confirmation Procedure

1) Connect scan tool to DLC with ignition switch OFF.
2) Clear DTC in TCM memory.
3) After 10 seconds passed from turning ignition switch ON, check DTC.

Troubleshooting

Step	Action	Yes	No
1	Is DTC P1702 detected after performing “DTC Confirmation Procedure”?	Faulty TCM. Replace TCM.	Could be a temporary malfunction of TCM.

DTC P1703 CAN Invalid Data-TCM

DTC Detecting Condition and Trouble Area

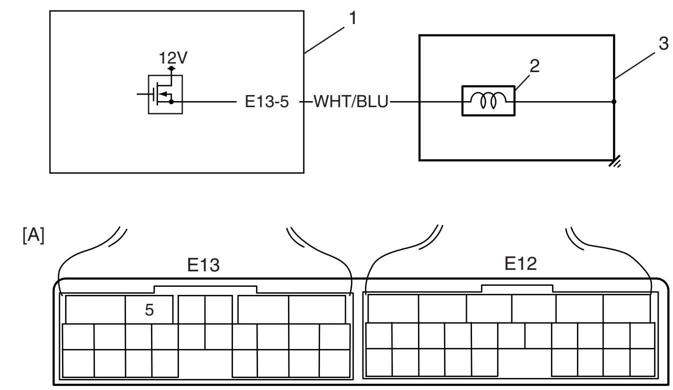
When abnormality either on the gear shift control signal from ECM is detected by TCM, TCM sets DTC P1703.

DTC Troubleshooting

Step	Action	Yes	No
1	Was “Automatic Transaxle Diagnostic Flow Table” performed?	Go to Step 2.	Go to “Automatic Transaxle Diagnostic Flow Table” in this section.
2	DTC check. Check DTC of ECM referring to “DTC check” in section 6. Is there any DTC (s)?	Go to applicable DTC diag. flow.	Substitute a known-good TCM and recheck. If OK, substitute a known-good ECM and recheck.

DTC P2769 Torque Converter Clutch (TCC) Circuit Low

Wiring Diagram



1. TCC solenoid valve	2. TCM	3. A/T	[A]: Terminal arrangement of TCM connector (Viewed from harness side)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Voltage of TCC solenoid valve TCM terminal is low although TCM is commanding TCC solenoid to turn ON	• TCC solenoid valve circuit shorted to ground. • Malfunction of TCC solenoid valve • TCM

DTC Confirmation Procedure

WARNING:

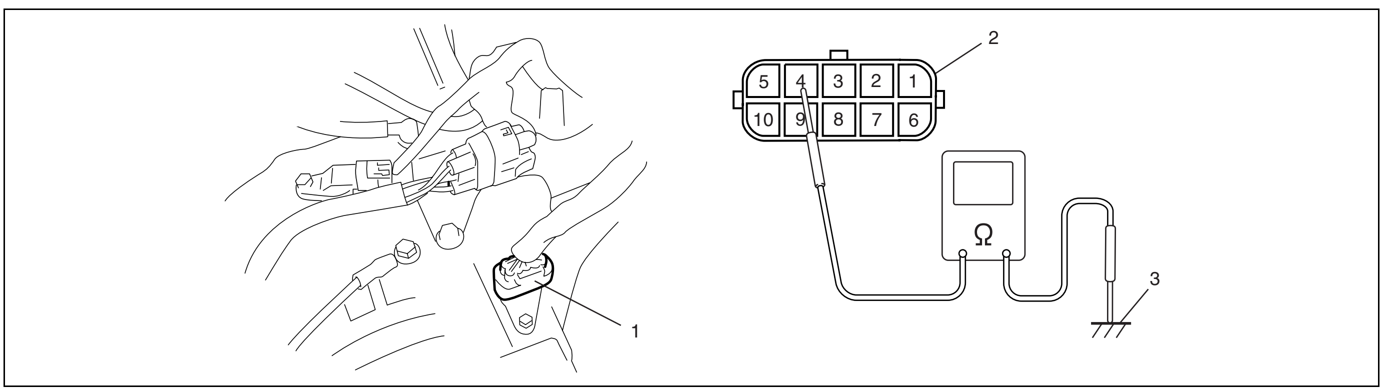
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and tester, on a level road.**

1) Connect scan tool to DLC with ignition switch OFF, if available.
2) Clear DTCs in TCM memory.
3) Start engine.
4) Keep engine running at idle speed in “P” range for 20 seconds or more.
5) Check DTC.

DTC Troubleshooting

Step	Action	Yes	No
1	Was “Automatic Transaxle Diagnostic Flow Table” performed?	Go to Step 2.	Go to “Automatic Transaxle Diagnostic Flow Table” in this section.
2	Check TCC solenoid valve resistance 1) Turn ignition switch OFF 2) Disconnect valve body harness connector on automatic transmission. 3) Check for proper connection to solenoid at “WHT/BLU” circuit. 4) Check resistance of solenoid valve. See Fig. Resistance between TCC solenoid valve terminals of transmission side valve body harness connector: 11 – 15 Ω at 20°C (68°F) Resistance between TCC solenoid valve terminals of transmission side valve body harness connector and transmission body: Infinity Is check results satisfactory?	Go to Step 3.	Replace TCC solenoid valve or lead wire.
3	Check TCC solenoid valve circuit for ground short 1) Disconnect TCM connectors. 2) Check for proper connection to TCM at terminals “E13-5”. 3) If connection is OK, check continuity between terminal “E13-5” of disconnected harness side TCM connector and ground. Is continuity indicated?	“WHT/BLU” circuit shorted to ground.	Intermittent trouble or faulty TCM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A. If OK, substitute a known-good TCM and recheck.

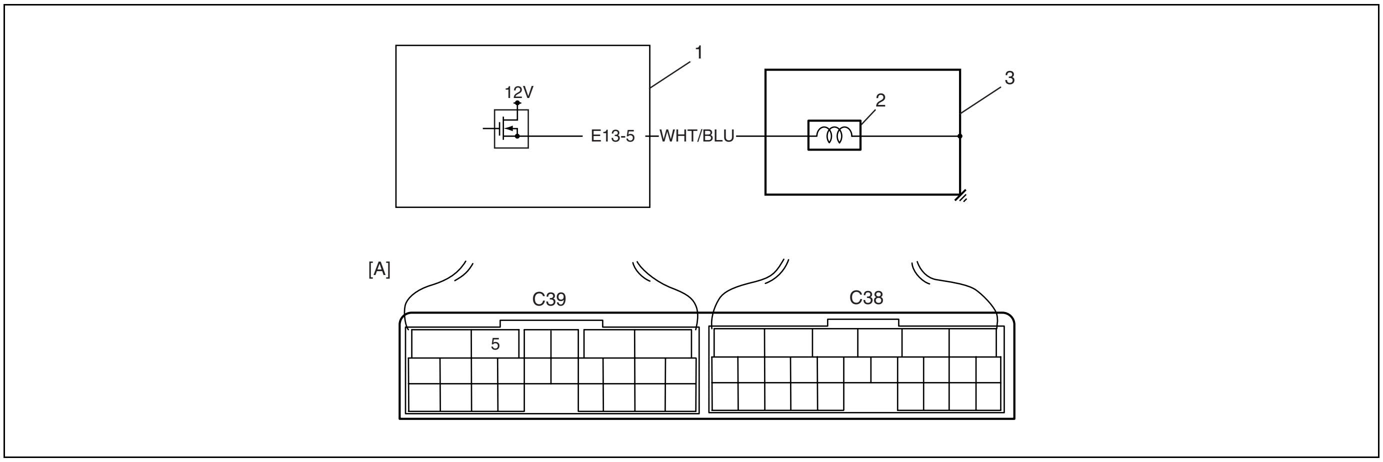
Fig. for Step 3.



1.	Valve body harness connector on harness
2.	Valve body harness connector on transaxle
3.	Ground (transaxle)

DTC P2770 Torque Converter Clutch (TCC) Circuit High

Wiring Diagram



1. TCC solenoid valve	2. TCM	3. A/T	[A]: Terminal arrangement of TCM connector (Viewed from harness side)

DTC Detecting Condition and Trouble Area

DTC DETECTING CONDITION	TROUBLE AREA
Voltage of TCC solenoid valve TCM terminal is high although TCM is commanding TCC solenoid to turn OFF	• TCC solenoid valve circuit shorted to ground. • Malfunction of TCC solenoid valve • TCM

DTC Confirmation Procedure

WARNING:

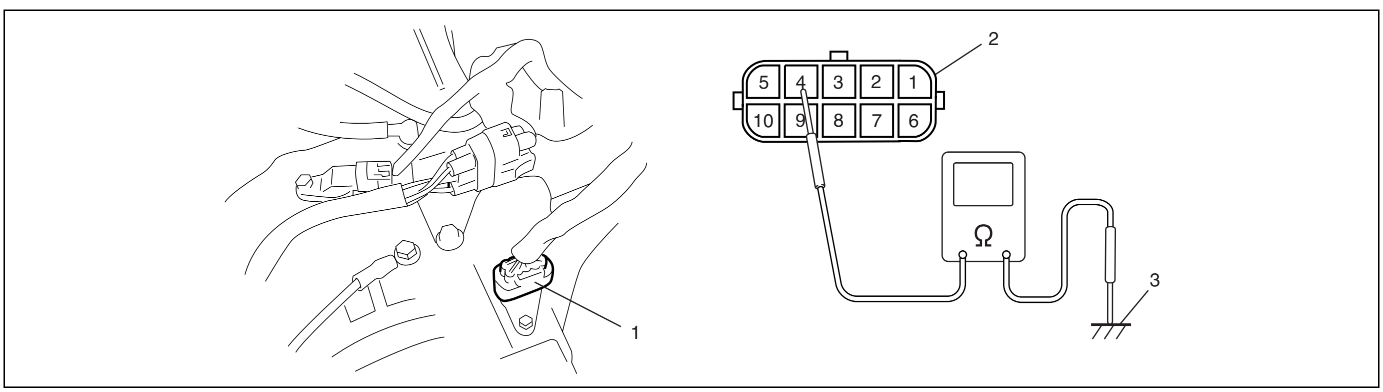
- **When performing a road test, select a place where there is no traffic or possibility of a traffic accident and be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out with 2 persons, a driver and tester, on a level road.**

1) Connect scan tool to DLC with ignition switch OFF, if available.
2) Clear DTCs in TCM memory.
3) Start engine.
4) Keep engine running at idle speed in “P” range for 10 seconds or more.
5) Check DTC.

DTC Troubleshooting

Step	Action	Yes	No
1	Was “Automatic Transaxle Diagnostic Flow Table” performed?	Go to Step 2.	Go to “Automatic Transaxle Diagnostic Flow Table” in this section.
2	Check TCC solenoid valve circuit for IG short 1) Connect valve body harness connector. 2) Disconnect TCM connectors. 3) Check for proper connection to TCM at terminal “E13-5”. 4) If connection is OK, turn ignition switch ON and measure voltage between terminal “E13-5” of disconnected harness side TCM connector and ground. Is it 0 – 2 V?	Go to Step3.	“WHT/BLU” circuit shorted to power circuit.
3	Check TCC solenoid valve resistance 1) Turn ignition switch OFF 2) Disconnect valve body harness connector on automatic transmission. 3) Check for proper connection to solenoid at “WHT/BLU” circuit. 4) Check resistance of solenoid valve. See Fig. Resistance between TCC solenoid valve terminals of transmission side valve body harness connector: 11 – 15 Ω at 20°C (68°F) Resistance between TCC solenoid valve terminals of transmission side valve body harness connector and transmission body: Infinity Is check results satisfactory?	Intermittent trouble or faulty TCM. Check for intermittent referring to “Intermittent and Poor Connection” in Section 0A. If OK, substitute a known-good TCM and recheck.	Replace TCC solenoid valve or lead wire.

Fig. for Step 3.



1.	Valve body harness connector on harness
2.	Valve body harness connector on transaxle
3.	Ground (transaxle)

Scan Tool Data

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

NOTE:
The following scan tool data related to automatic transaxle can be checked only by communicating with TCM.

SCAN TOOL DATA	VEHICLE CONDITION		NORMAL CONDITION/REFERENCE VALUES
GEAR POSITION	Ignition switch ON	Selector lever is in “P” position	P or N
		Selector lever is in “R” position	R
		Selector lever is in “N” position	P or N
		Selector lever is in “D” position	1
		Selector lever is in “2” position	1
		Selector lever is in “L” position	1
ENGINE SPEED	At engine idle speed		Engine idle speed is displayed
INPUT SHAFT REVOLUTION	Ignition switch ON and engine stop		0 RPM
	At 60 km/h (37.5 mile/h) constant speed, O/D off switch ON, 20% or less throttle opening and 3rd gear (“D” range)		2,600 RPM (displayed in increments of 50 rpm)
OUTPUT SHAFT REVOLUTION	At vehicle stop		0 RPM
	At 60 km/h (37.5 mile/h) constant speed, O/D off switch ON, 20% or less throttle opening and 3rd gear		2,600 RPM (displayed in increments of 50 rpm)
BATTERY VOLTAGE	Ignition switch ON and engine stop		Battery voltage is displayed (8 – 16 V)
ATF TEMPERATURE	After driving at 60 km/h (37.5 mile/h) for 15 minutes or more, and A/T fluid temperature around sensor reaches 70 – 80°C (158 – 176°F)		70 – 80°C, 158 – 176°F
SHIFT SOLENOID-A COMMAND	At vehicle stop		ON
	At 60 km/h (37.5 mile/h) constant speed, O/D off switch ON, 20% or less throttle opening and 3rd gear		OFF
SHIFT SOLENOID-A MONITOR	At vehicle stop		ON
	At 60 km/h (37.5 mile/h) constant speed, O/D off switch ON, 20% or less throttle opening and 3rd gear		OFF
SHIFT SOLENOID-B COMMAND	At vehicle stop		ON
	At 60 km/h (37.5 mile/h) constant speed, O/D off switch ON, 20% or less throttle opening and 3rd gear		OFF
SHIFT SOLENOID-B MONITOR	At vehicle stop		ON
	At 60 km/h (37.5 mile/h) constant speed, O/D off switch ON, 20% or less throttle opening and 3rd gear		OFF
TIMING SOLENOID COMMAND	Ignition switch ON and selector lever is in “N” range		OFF
	For about 0.5 sec. while on gear shifting between 3rd and 4th or gear shifting N to D		ON

SCAN TOOL DATA	VEHICLE CONDITION		NORMAL CONDITION/REFERENCE VALUES
TIMING SOLENOID MONITOR	Ignition switch ON and selector lever is in “N” range		OFF
	For about 0.5 sec. while on gear shifting between 3rd and 4th or gear shifting N to D		ON
TCC SOLENOID COMMAND	At 5 km/h (3 mile/h) constant speed, O/D off switch ON, closed throttle and 1st gear		OFF
	At 100 km/h (62.5 mile/h) constant speed, O/D off switch OFF, 20% or less throttle opening and 4th gear		ON
TCC SOLENOID COMMAND	At 5 km/h (3 mile/h) constant speed, O/D off switch ON, closed throttle and 1st gear		OFF
	At 100 km/h (62.5 mile/h) constant speed, O/D off switch OFF, 20% or less throttle opening and 4th gear		ON
PRESSURE CONTROL SOLENOID	At vehicle stop, closed throttle, engine idle speed and 1st gear		0%
VEHICLE SPEED	At vehicle stop		0 KM/H, 0 MPH
O/D OFF SWITCH	Ignition switch ON	O/D off switch OFF	OFF
		O/D off switch ON	ON
TRANSAXLE	Ignition switch ON	Selector lever is in “P” position	P
		Selector lever is in “R” position	R
		Selector lever is in “N” position	N
		Selector lever is in “D” position	D
		Selector lever is in “2” position	2
		Selector lever is in “L” position	L
D RANGE SIGNAL	Ignition switch ON	Selector lever is in “P” position	OFF
		Selector lever is in “R” position	ON
		Selector lever is in “N” position	OFF
		Selector lever is in “D” position	ON
		Selector lever is in “2” position	ON
		Selector lever is in “L” position	ON
THROTTLE POSITOIN	Ignition switch ON	Accelerator pedal is released	0%
		Accelerator pedal is depressed	0 – 100% (Varies depending on depressed value)
BRAKE SWITCH	Ignition switch ON	Brake pedal is depressed	ON
		Brake pedal is released	OFF
TORQUE REDUCTION SIGNAL	While on gear upshifting with 25% or more throttle opening		ON
	Under condition of not shifting gear		OFF
ENGINE COOLANT TEMPERATURE	Ignition switch ON		Engine coolant temperature is displayed
AIR CONDITIONER SIGNAL	Ignition switch ON and air conditioner switch OFF		OFF
ENGINE TORQUE SIGNAL	Ignition switch ON and engine stop		0 N·m

SCAN TOOL DATA DEFINITIONS:

GEAR POSITION
Current gear position computed by throttle position coming from ECM and vehicle speed.

ENGINE SPEED (RPM)
Engine speed computed by reference pulses from crankshaft position sensor.

INPUT SHAFT REVOLUTION (RPM)
Input shaft revolution computed by reference pulses coming from input shaft speed sensor on transaxle case.

OUTPUT SHAFT REVOLUTION (RPM)
Output shaft revolution computed by reference pulses coming from output shaft speed sensor (VSS) on transaxle case.

BATTERY VOLTAGE (V)
Battery voltage read by TCM as analog input signal by TCM.

ATF TEMPERATURE (°C, °F)
ATF temperature decided by signal from transmission fluid temperature sensor installed on valve body.

SHIFT SOLENOID-A COMMAND
ON: ON command being outputted to shift solenoid valve-A (No.1)
OFF: ON command not being outputted to shift solenoid valve-A (No.1)

SHIFT SOLENOID-A MONITOR
ON: Electricity being passed to shift solenoid valve-A (No.1)
OFF: Electricity not being passed to shift solenoid valve-A (No.1)

SHIFT SOLENOID-B COMMAND
ON: On command being outputted to shift solenoid valve-B (No.2)
OFF: ON command not being outputted to shift solenoid valve-B (No.2)

SHIFT SOLENOID-B MONITOR
ON: Electricity being passed to shift solenoid valve-B (No.2)
OFF: Electricity not being passed to shift solenoid valve-B (No.2)

TIMING SOLENOID COMMAND
ON: ON command being outputted to timing solenoid valve
OFF: ON command not being outputted to timing solenoid valve

TIMING SOLENOID MONITOR
ON: Electricity being passed to timing solenoid valve
OFF: Electricity not being passed to timing solenoid valve

TCC SOLENOID COMMAND
ON: ON command being outputted to TCC solenoid valve
OFF: ON command not being outputted to TCC shift solenoid valve

TCC SOLENOID MONITOR
ON: Electricity being passed to TCC solenoid valve
OFF: Electricity not being passed to TCC solenoid valve

PRESSURE CONTROL SOLENOID (%)
Electric current value ratio between electric current value being outputted from TCM to solenoid and maximum value can be outputted by TCM.

VEHICLE SPEED (KM/H/MPH)
Vehicle speed computed by reference pulse signals coming from vehicle speed sensor on transaxle case.

O/D OFF SWITCH
Inputted signal from O/D off switch on selector knob.
ON: O/D off switch ON
OFF: O/D off switch OFF

TRANSAXLE RANGE
Transaxle range detected by signal fed from transmission range sensor.

D RANGE SIGNAL
ON: Signal which TCM require ECM to increase idle speed
OFF: Signal which TCM does not require ECM to increase idle speed

THROTTLE POSITION (%)
Throttle opening ratio computed by duty pulse signal from ECM.

BRAKE SWITCH
Inputted signal from brake light switch on pedal bracket.
ON: Brake pedal depressed
OFF: Brake pedal released

TORQUE REDUCTION SIGNAL
ON: Signal which TCM require ECM to reduce output torque at shifting gear
OFF: Signal which TCM does not require ECM to reduce output torque

ENGINE COOLANT TEMPERATURE (°C, °F)
Engine coolant temperature computed by duty pulse signal from ECM.

AIR CONDITIONER SIGNAL
ON: Signal which inform that air conditioner compressor is turned ON.
OFF: Signal which inform that air conditioner compressor is not turned ON.

ENGINE TORQUE SIGNAL (N·m)
Engine torque computed by duty pulse signal outputted from ECM.

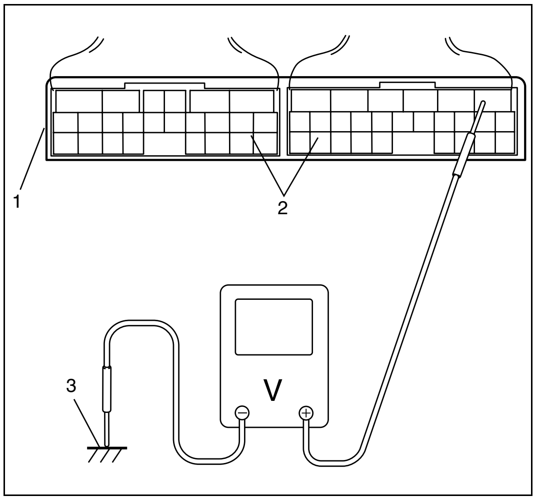
Inspection of TCM and Its Circuits

TCM and its circuits can be checked at TCM wiring connectors by measuring voltage and resistance.

CAUTION:

TCM cannot be checked by itself, it is strictly prohibited to connect voltmeter or ohmmeter to TCM with connector disconnected from it.

Inspection



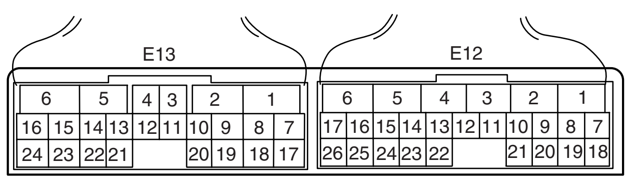
1) Remove TCM (1) from vehicle referring to "Transmission Control Module" in this section.
2) Connect TCM connectors (2) to TCM.
3) Check voltage at each terminal of connectors connected.

NOTE:

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

3. Body ground

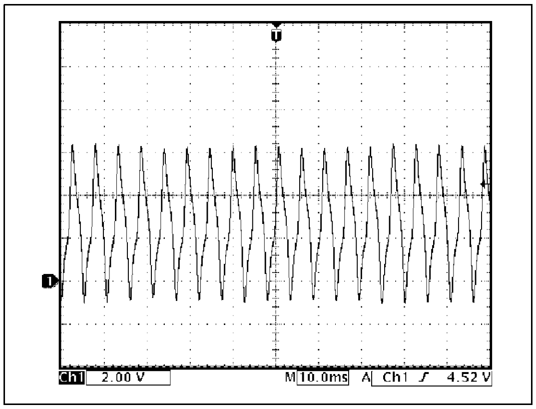
Terminal Arrangement of TCM Coupler (Viewed From Harness Side)



Connector	Terminal number	Wire color	Circuit	Normal Voltage	Condition
E12	1	RED	Transmission range sensor ("R" range)	8 – 14 V	Ignition switch ON, selector lever at "R" range
				0 – 1 V	Ignition switch ON, selector lever at other than "R" range
	2	–	–	–	–
	3	–	–	–	–
	4	–	–	–	–
	5	–	–	–	–

Connector	Terminal number	Wire color	Circuit	Normal Voltage	Condition
E12	6	WHT	Input shaft speed sensor (+)	2 – 3 V	Ignition switch turned ON, engine stops.
				(Reference waveform No.1)	While engine running. (Output signal is waveform. Waveform frequency varies depending on output shaft speed. (16 pulses are generated par 1 input shaft revolution.))
	7	GRN/RED	Transmission range sensor (“D” range)	8 – 14 V	Ignition switch ON, selector lever at “R” range
				0 – 1 V	Ignition switch ON, selector lever at other than “R” range
	8	BUL/YEL	Transmission range sensor (“N” range)	8 – 14 V	Ignition switch ON, selector lever at “N” range
				0 – 1 V	Ignition switch ON, selector lever at other than “N” range
	9	BLU/RED	O/D OFF switch	0 – 1 V	O/D OFF switch pressed
				8 – 14 V	O/D OFF switch released
	10	–	–	–	–
	11	BLU/YEL	“O/D OFF” light	0 – 1 V	Ignition switch ON (lamp turned ON)
				8 – 14 V	Ignition switch ON (lamp turned OFF)
	12	–	–	–	–
	13	–	–	–	–
	14	–	–	–	–
	15	–	–	–	–
	16	BLK	Input shaft speed sensor (–)	2 – 3 V	Ignition switch ON, engine at stop
	17	–	–	–	–
	18	GRN/BLK	Transmission range sensor (“L” range)	8 – 14 V	Ignition switch ON, selector lever at “L” range
				0 – 1 V	Ignition switch ON, selector lever at other than “L” range
	19	GRN	Transmission range sensor (“2” range)	8 – 14 V	Ignition switch ON, selector lever at “2” range
				0 – 1 V	Ignition switch ON, selector lever at other than “2” range
	20	ORN	Transmission range sensor (“P” range)	8 – 14 V	Ignition switch ON, selector lever at “P” range
				0 – 1 V	Ignition switch ON, selector lever at other than “P” range
	21	–	–	–	–
	22	–	–	–	–
	23	WHT/RED	Data link connector	8 – 14 V	Ignition switch ON
	24	–	–	–	–
	25	YEL	Output shaft speed sensor (VSS)	8 – 14 V	Ignition switch ON
				0 – 1 V ↑↓ 10 – 14 V (Reference waveform No.2)	Vehicle running. (Sensor signal is pulse. Pulse frequency varies depending on vehicle speed.)
	26	–	–	–	–

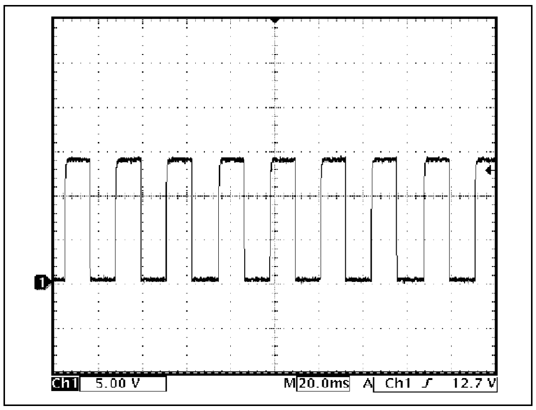
Connector	Terminal number	Wire color	Circuit	Normal Voltage	Condition
E13	1	BLK	Ground	0 – 1 V	Ignition switch ON
	2	LT GRN/RED	Pressure control solenoid valve (–)	0.6 – 1.0 V	Ignition switch ON
	3	–	–	–	–
	4	BRN/YEL	Pressure control solenoid valve (+)	0 – 0.6 V ↑↓ 10 – 14 V (Reference waveform No.3)	Engine running at idling. (Output signal is duty pulse. Duty ratio varies depending on throttle valve opening.)
	5	WHT/BLU	TCC solenoid valve	0 – 1 V	Engine running at idling speed.
	6	WHT/RED	Power source	10 – 14V	Ignition switch ON
	7	WHT	CAN communication line (Low)	2.5 – 3.6 V ↑↓ 1.6 – 2.5 V (Reference waveform No.4)	Engine running at idling with after warming up. (CAN communication signal is pulse. Pulse signal frequency varies depending on engine condition.)
	8	–	–	–	–
	9	–	–	–	–
	10	–	–	–	–
	11	GRN	Transmission fluid temperature sensor (+)	2.9 – 3.1 V	Ignition switch ON, fluid temperature is 20°C (68°F)
				0.3 – 0.5 V	Ignition switch ON, fluid temperature is 100°C (212°F)
	12	BLU/RED	Transmission fluid temperature sensor (–)	0 – 1 V	Ignition switch ON
	13	–	–	–	–
	14	WHT/RED	Timing solenoid valve	0 – 1 V	Ignition switch ON
	15	BLK/YEL	Shift solenoid valve-B (No.2)	9 – 14 V	Ignition switch ON, select lever in “P” range
	16	BRN	Shift solenoid valve-A (No.1)	9 – 14 V	Ignition switch ON, select lever in “P” range
	17	RED	CAN communication line (High)	2.5 – 3.6 V ↑↓ 1.6 – 2.5 V (Reference waveform No.4)	Engine running at idling with after warming up. (CAN communication signal is pulse. Pulse signal frequency varies depending on engine condition.)
	18	–	–	–	–
	19	–	–	–	–
	20	–	–	–	–
	21	–	–	–	–
	22	–	–	–	–
	23	BLK	Ground	0 – 1 V	Ignition switch ON
	24	WHT/BLU	Power source for back-up	10 – 14 V	Constantly



1. Reference waveform No.1

Input shaft speed sensor signal at engine idling.

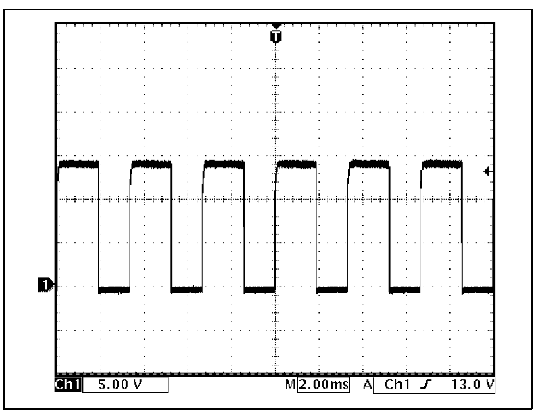
Measurement terminal	CH1: E12-6 to E13-1
Oscilloscope setting	CH1: 2 V/DIV TIME: 10 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed with “P” range.



2. Reference waveform No.2

Output shaft speed sensor (VSS) signal at vehicle speed 60 km/h (37 mile/h).

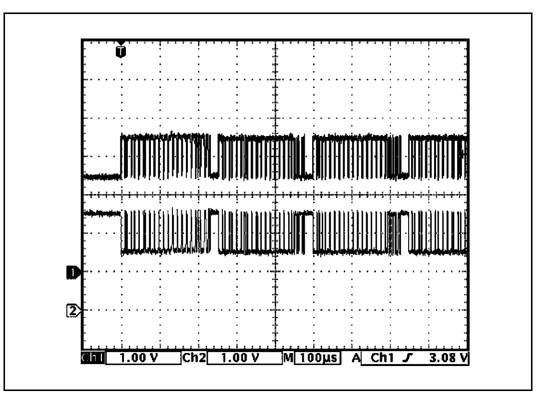
Measurement terminal	CH1: E12-25 to E13-1
Oscilloscope setting	CH1: 5 V/DIV TIME: 2 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Drive vehicle at 60 km/h (37 mile/h).



3. Reference waveform No.3

Pressure control solenoid valve signal at engine idling.

Measurement terminal	CH1: E13-4 to E13-1
Oscilloscope setting	CH1: 5 V/DIV TIME: 20 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed with “P” range.



4. Reference waveform No.4

CAN communication line (High & Low) signal at engine idling

Measurement terminal	CH1: E13-7 to E13-1 CH2: E13-17 to E13-1
Oscilloscope setting	CH1: 1 V/DIV TIME: 100 µs/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed with “P” range.

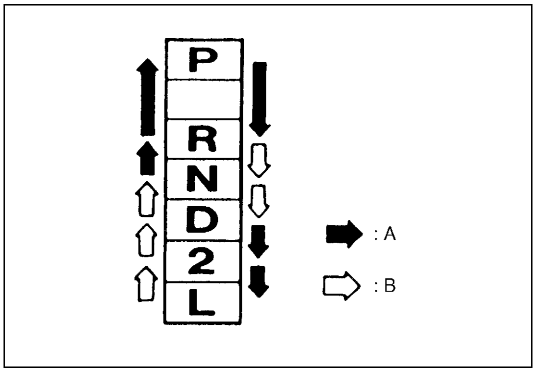
On-Vehicle Service

Maintenance Service

Fluid level check at normal operating (hot) temperature (Hot check)

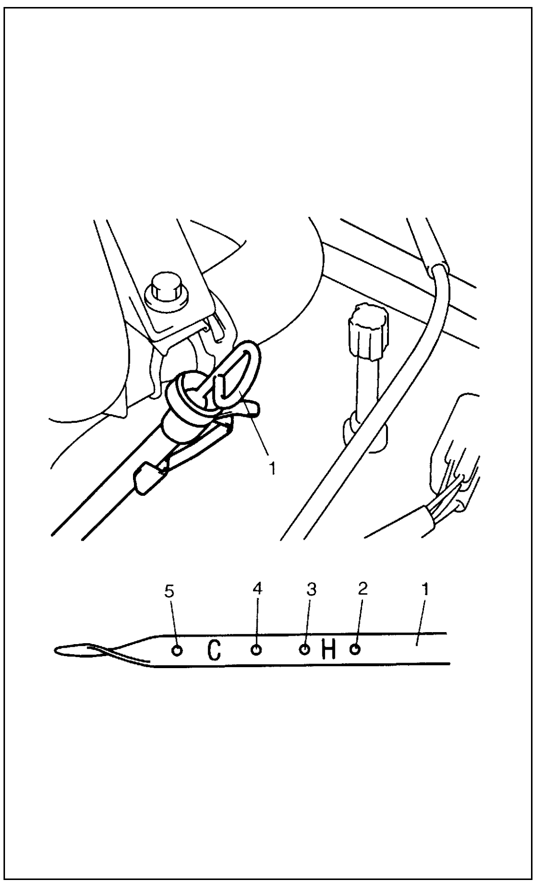
Inspection

1) Stop vehicle and place it level.
2) Apply parking brake and place chocks against wheels.
3) With selector at P position, start engine.
4) Warm up engine till fluid temperature reaches normal operating temperature (70 – 80°C/158 – 176°F). As a guide to check fluid temperature, warm up engine to normal operating.



5) Keep engine idling and shift selector slowly to “L” and back to “P” position.
6) With engine idling, pull out fluid level gauge, wipe it off with a clean cloth and put it back into place.

A.	Shift the select lever with its button pushed in.
B.	Shift the select lever without pushing its button.



7) Pull out fluid level gauge (1) again and check fluid level indicated on it. The lowest fluid level should be between FULL HOT and LOW HOT. If it is below LOW HOT, add an equivalent of DEXRON®-III up to FULL HOT.

Automatic transaxle fluid
An equivalent of DEXRON®-III

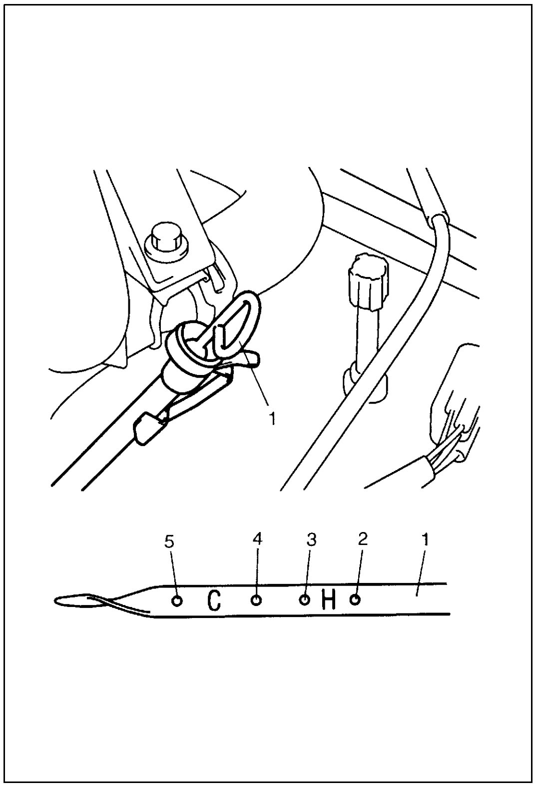
NOTE:

- **Do not race engine while checking fluid level, even after the engine start.**
- **Do not overfill. Overfilling can cause foaming and loss of fluid through breather. Then slippage and transaxle failure can result.**
- **Bringing the level from LOW HOT to FULL HOT requires 0.4 liters (0.85/0.70 US/Imp. pt).**
- **If vehicle was driven under high load such as pulling a trailer, fluid level should be checked about half an hour after it is stopped.**

2.	“FULL HOT” mark
3.	“LOW HOT” mark
4.	“FULL COLD” mark
5.	“LOW COLD” mark

Fluid level check at room (cold) temperature (Cold check)

Inspection



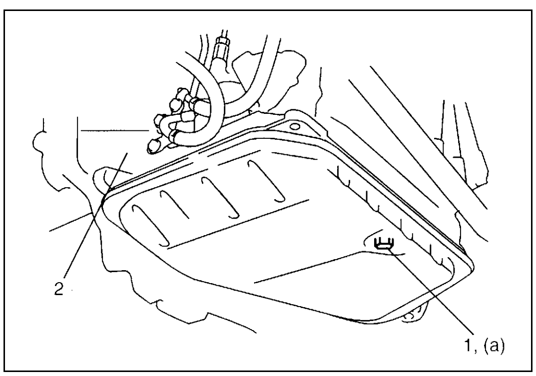
Fluid level can be checked temporarily at room (cold) temperature which correspond to 20 – 30°C (68 – 86°F). This level check is considered to be preparation before performing level check under normal operating (hot) temperature. Checking procedure itself is the same as that described in “Fluid Level Check at Normal Operating (Hot) Temperature (Hot Check)”. If fluid level is between FULL COLD and LOW COLD, proceed to test drive. And when fluid temperature has reached normal operating (hot) temperature, check fluid level again and adjust it as necessary.

CAUTION:

Fluid level check at room (cold) temperature is recommended only for preparation of level check under normal (hot) operating condition.
Failure to perform fluid level check under normal (hot) operating temperature may result in damage to transaxle.

1. Fluid level gauge
2. “FULL HOT” mark
3. “LOW HOT” mark
4. “FULL COLD” mark
5. “LOW COLD” mark

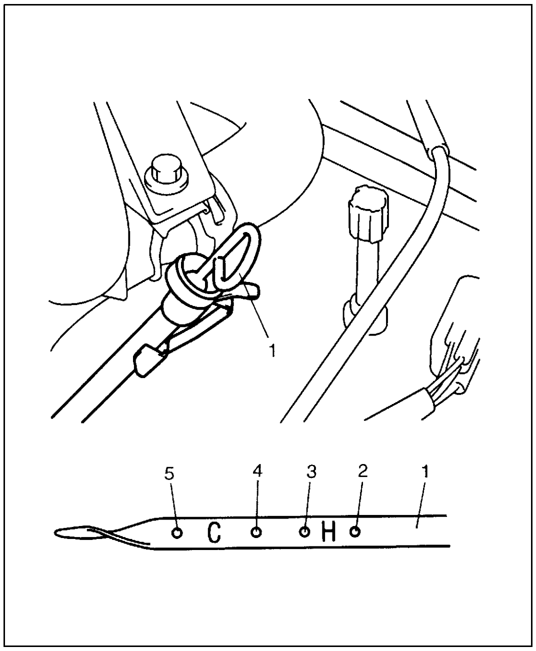
Fluid change



1) Lift up vehicle.
2) When engine is cool, remove drain plug (1) from transaxle housing (2) and drain A/T fluid.
3) Install drain plug (1).

Tightening torque
A/T fluid drain plug (a): 17 N·m (1.7 kg-m, 12.5 lb-ft)

4) Lower vehicle and fill proper amount of an equivalent of DEXRON®-III.



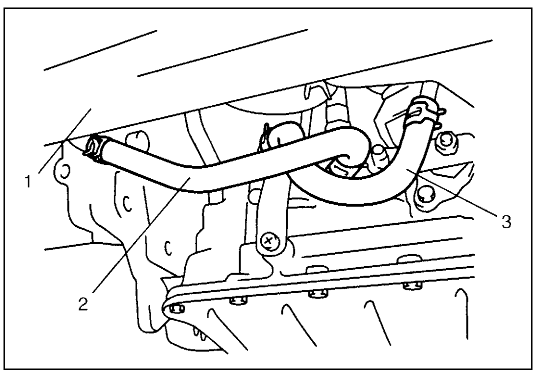
5) Check fluid level referring to “Fluid Level Check at Room (Cold) Temperature (Cold Check)” and “Fluid Level Check at Normal Operating (Hot) Temperature (Hot Check)” in this section.

Automatic transaxle fluid
An equivalent of DEXRON®-III

Automatic transaxle fluid capacity
When draining from drain plug hole:
3.3 liters (6.97/5.81 US/Imp. pt.)
When overhauling:
5.6 liters (11.83/9.86 US/Imp. pt.)

1.	Fluid level gauge
2.	“FULL HOT” mark
3.	“LOW HOT” mark
4.	“FULL COLD” mark
5.	“LOW COLD” mark

A/T fluid cooler hoses

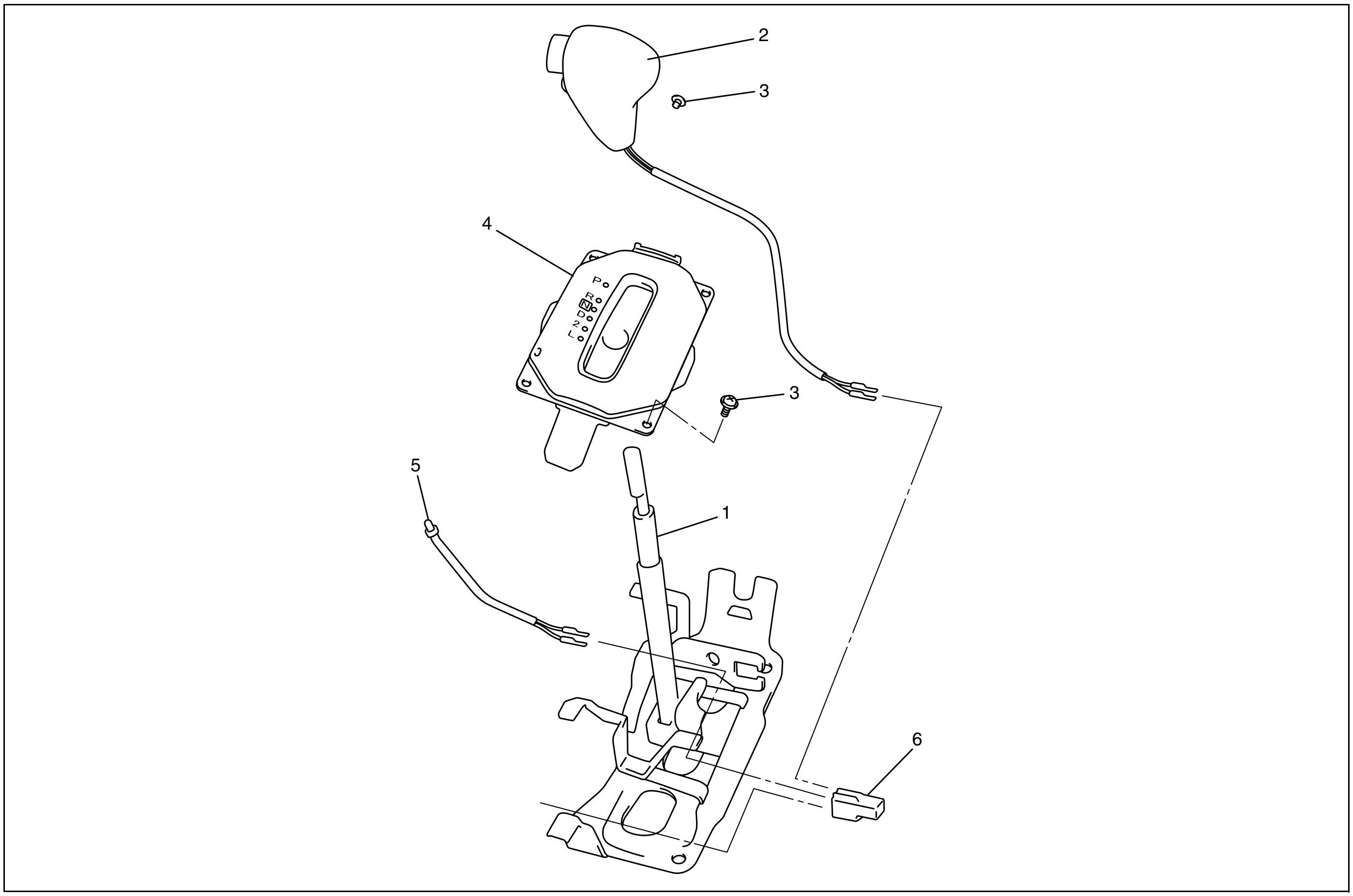


The rubber hoses for the A/T fluid cooler should be replaced at specified interval. When replacing them, be sure to note the following.

- to replace clamps at the same time
- to insert hose as far as its limit mark
- to clamp clamps securely

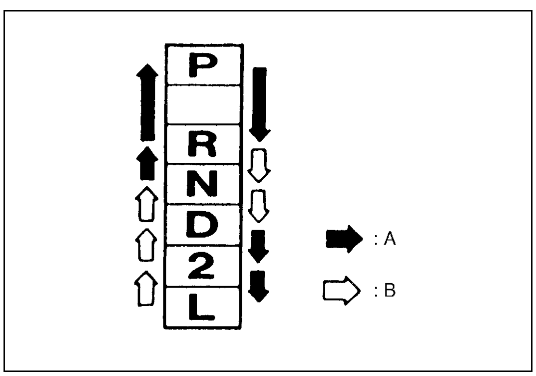
1.	Radiator
2.	Inlet hose (Outlet from A/T fluid cooler)
3.	Outlet hose (Inlet to A/T fluid cooler)

Selector Lever



1. Selector lever assembly	4. Indicator assembly
2. Knob assembly	5. Illumination lamp assembly
3. Screw	6. Connector

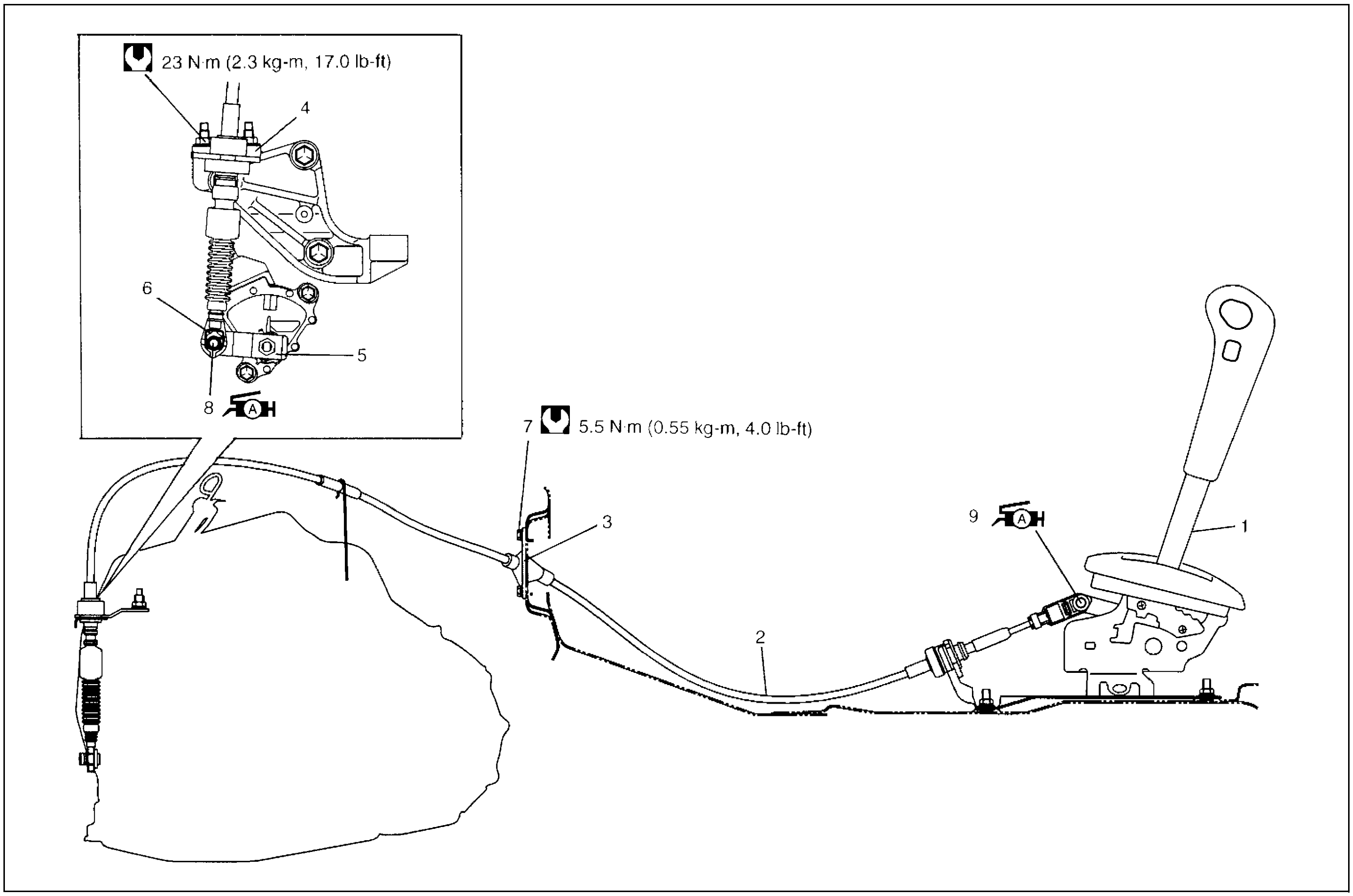
Inspection



Check selector lever for smooth and clear-cut movement and position indicator for correct indication.
For operation of select lever, refer to the figure.

A.	Shift the selector lever with its button pushed in.
B.	Shift the selector lever without pushing its button.

Select Cable



1. Selector lever assembly		6. Clip
2. Select cable		7. Select cable retainer bolt
3. Select cable retainer		8. Manual select lever pin : Apply lithium grease 99000-25010 to all around pin (0.15 g)
4. Cable bracket		9. Selector lever pin : Apply lithium grease 99000-25010 to all around pin (0.15 g)
5. Manual select lever		Tightening torque

Removal

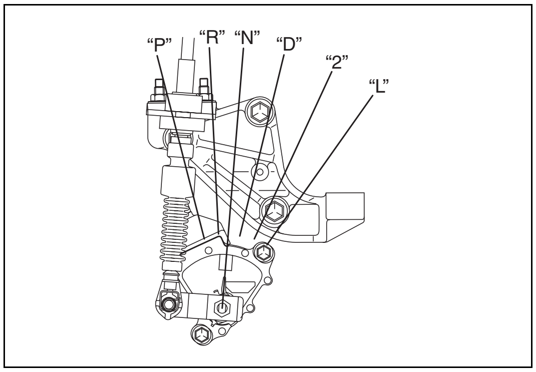
1) Remove parking brake lever cover.
2) Remove console box.
3) Disconnect select cable from selector lever and then detach from bracket.
4) Remove clip and disconnect select cable from manual select lever.
5) Remove select cable retainer from dash panel.

Installation

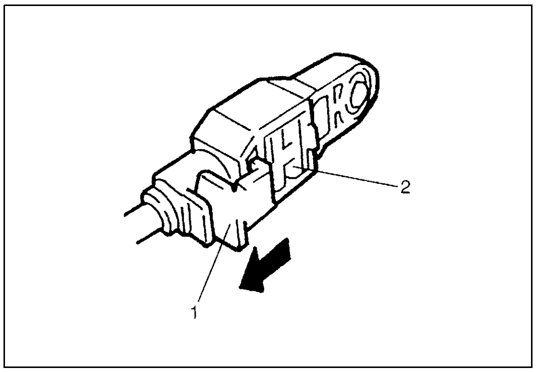
Install select cable by reversing removal procedure.
The important steps in installation are as follows.

- Apply grease to pin and cable joint.
- Tighten bolts in upper figure to specified torque.
- Adjusting procedure is as follows.

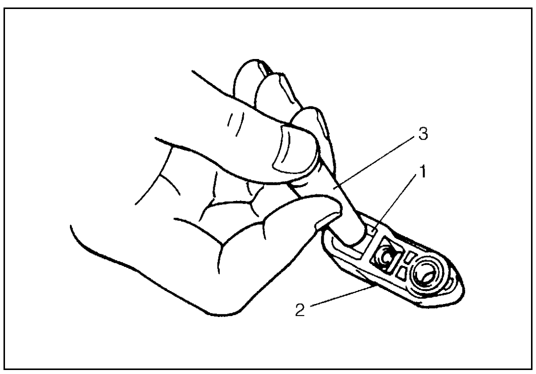
Adjustment



1) Shift manual shift lever to "N" range (transmission range sensor "N" range).
2) Remove adjuster (cable end) from selector lever pin of selector lever assembly.

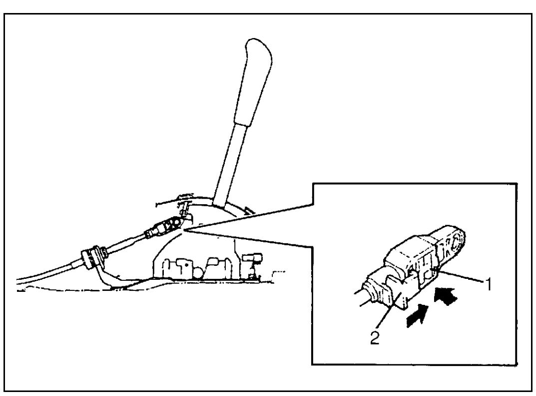


3) Release lock plate (1) which restrict moving of cable end holder (2).



4) Push cable end holder (1) out from eye-end (2) using an appropriate tool (3) to disengage cable.
5) Shift selector lever to "N" position.
6) Apply grease to selector lever pin and install adjuster (cable end) to it.

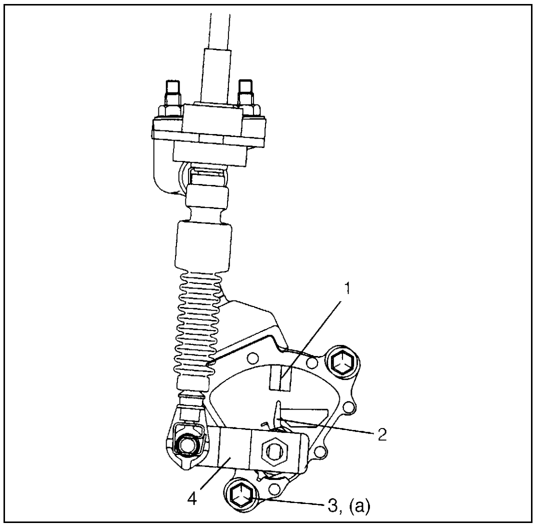
Grease 99000-25010



7) With both selector lever and transmission range sensor kept each "N" position, drive cable end holder (1) in until it locks cable.
8) Slide lock plate (2) to secure cable end holder in position.
9) After select cable was installed, check for the following.
   - Push vehicle with selector lever shifted to "P" range. Vehicle should not move.
   - Vehicle can not be driven in "N" range.
   - Vehicle can be driven in "D", "2" and "L" ranges.
   - Vehicle can be backed in "R" range.

Transmission Range Sensor (Shift Switch)

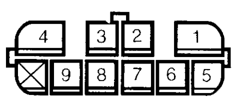
Adjustment and Inspection



1) Shift manual select lever (4) to “N” range.
2) Check that needle direction shaped on lock washer (2) and “N” reference line (1) on transmission range sensor are aligned. If not, loosen sensor bolts (3) and align them.
3) Check that engine starts in “N” and “P” ranges but it does not start in “D”, “2”, “L” or “R” range. Also, check that back-up lamp lights in “R” range.

Tightening torque
Transmission range sensor bolt
(a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

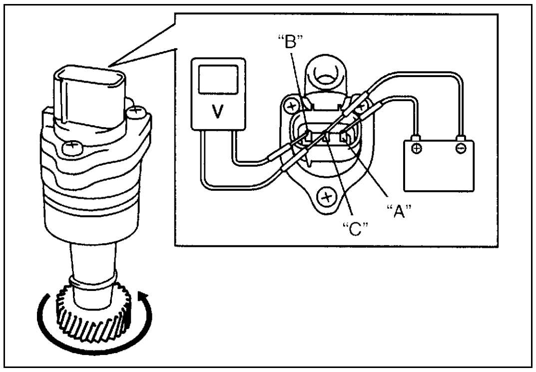
If faulty condition cannot be corrected by adjustment, disconnect transmission range sensor connector and check that continuity exists as shown by moving manual select lever.



Sensor Position	Terminal No. 1	2	3	4	5	6	7	8	9
P	○			○			○		○
R							○	○	
N	○			○	○		○		
D			○				○		
2						○	○		
L		○					○		

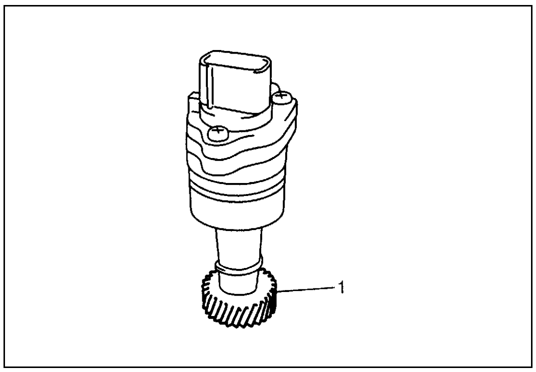
Output Shaft Speed Sensor (VSS)

Inspection



1) Connect positive cable of 12 volt battery to "A" terminal of sensor and ground cable to "C" terminal. Then using voltmeter, check voltage between "B" terminal and "C" terminal with output shaft speed sensor (VSS) driven gear rotated.
   If measured voltage (pulse signal) is not as specified, replace sensor.

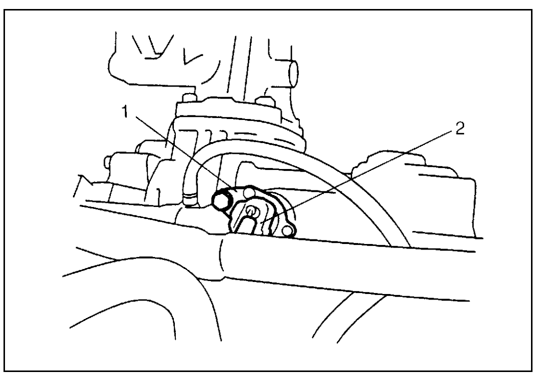
   Output shaft speed sensor (VSS) output voltage
   Pulse signal of alternating 0 – 1 V and 10 – 14 V



2) Check output shaft speed sensor (VSS) driven gear (1) for wear.
   Replace if necessary.

Removal

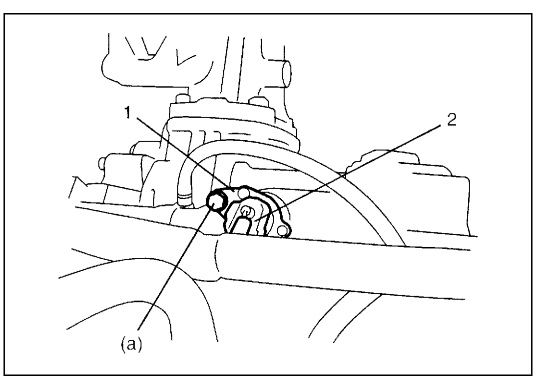
1) Disconnect negative cable at battery.



2) Disconnect output shaft speed sensor connector (2).
3) Remove output shaft speed sensor (VSS) (1) by removing its bolt.

Installation

1) Apply A/T fluid to output shaft speed sensor O-ring.



2) Install output shaft speed sensor (VSS) (1) to A/T case and tighten bolt to specified torque.

   Tightening torque
   Output shaft speed sensor (VSS) bolt
   (a): 13 N·m (1.3 kg-m, 9.5 lb-ft)

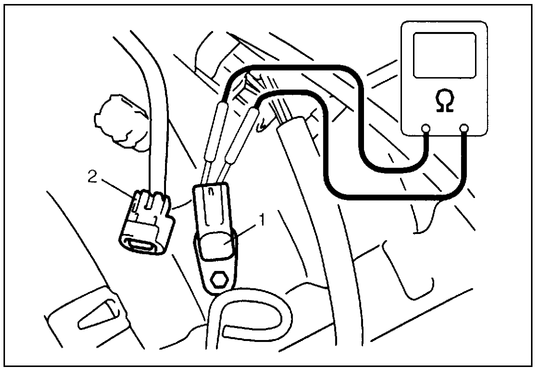
3) Connect output shaft speed sensor connector (2) to output shaft speed sensor (1).

4) Connect negative cable to battery.

Input Shaft Speed Sensor

Inspection

1) Disconnect negative cable at battery.



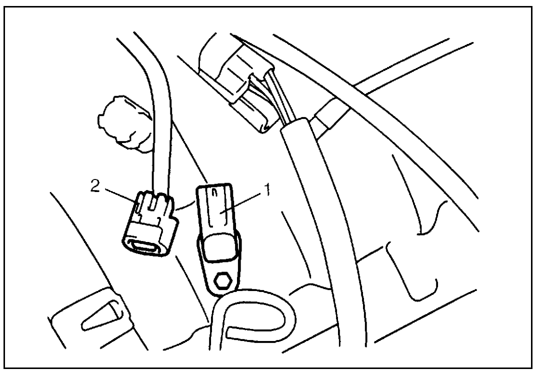
2) Disconnect input shaft speed sensor connector (2).
3) Check resistance between input shaft speed sensor terminals.

Input shaft speed sensor resistance
Standard: 560 – 680 Ω at 20°C (68°F)

1. Input shaft speed sensor

Removal

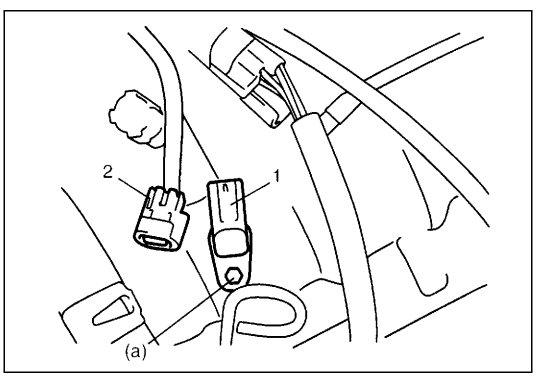
1) Disconnect negative cable at battery.



2) Disconnect input shaft speed sensor connector (2).
3) Remove input shaft speed sensor (1) by removing its bolt.

Installation

1) Apply A/T fluid to input shaft speed sensor O-ring.



2) Install input shaft speed sensor (1) to A/T case and tighten bolt to specified torque.

Tightening torque
Input shaft speed sensor bolt
(a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

3) Connect input shaft speed sensor connector (2) to input shaft speed sensor (1).
4) Connect negative cable to battery.

Throttle Position Sensor

Inspection

Check throttle position sensor referring to “Throttle Position Sensor” in Section 6E1.

Engine Coolant Temperature Sensor

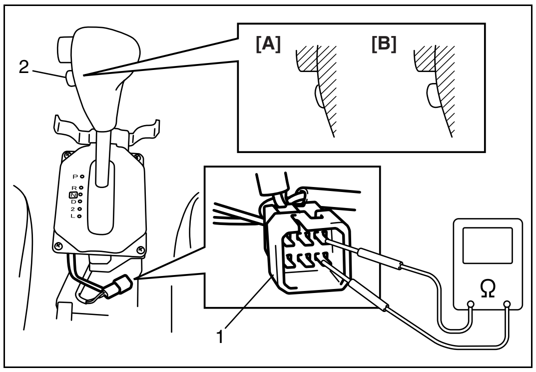
Inspection

Check engine coolant temperature sensor referring to “Engine Coolant Temperature Sensor” in Section 6E1.

O/D Off Switch

Inspection

1) Remove console box.
2) Disconnect O/D off switch connector (1).
3) Check continuity between O/D off switch terminals.



O/D off switch	Pushing	Free
Continuity	Continuity	No continuity

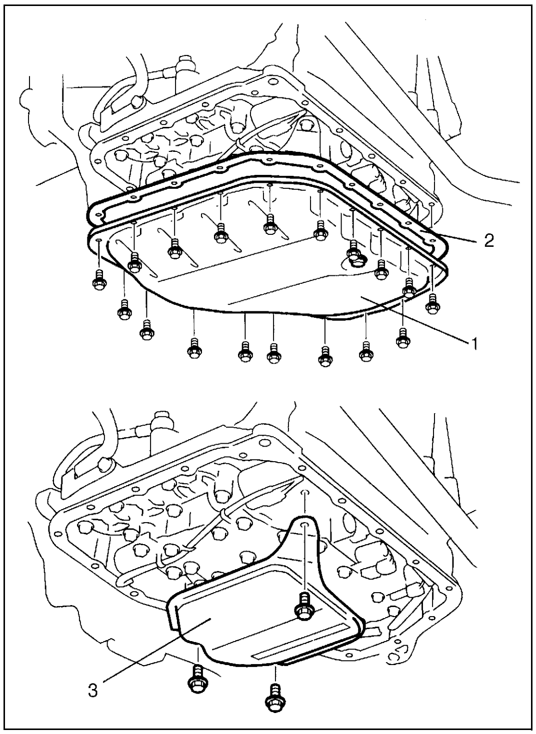
[A]:	Pushing position
[B]:	Free position
2.	O/D off switch

Solenoid Valves (Shift Solenoid Valves, TCC Solenoid Valve and Timing Solenoid Valve)

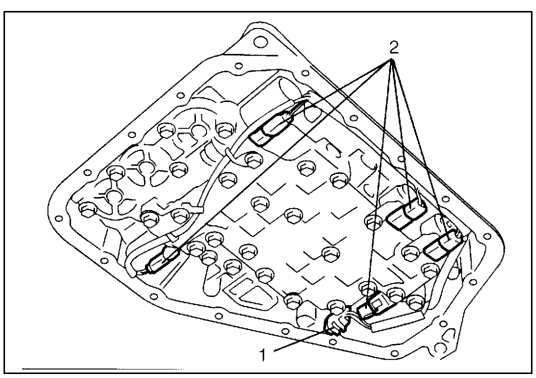
Removal

1) Disconnect negative cable at battery.
2) Lift up vehicle.
3) Remove drain plug and drain A/T fluid.
4) Install drain plug.

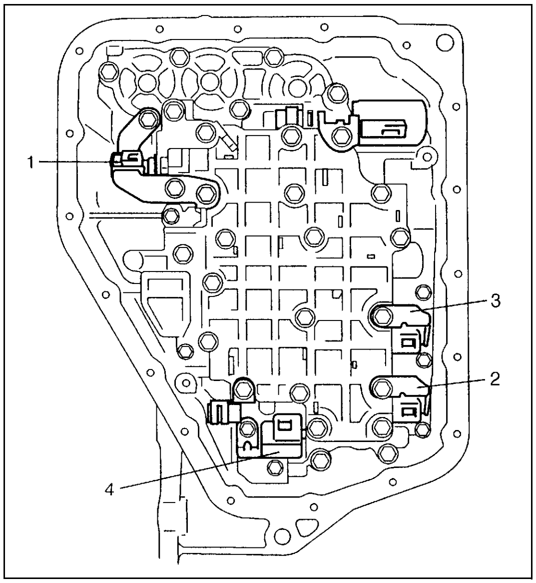
Tightening torque
A/T fluid drain plug: 17 N·m (1.7 kg-m, 12.5 lb-ft)



5) Remove A/T oil pan (1) and oil pan gasket (2).
6) Remove oil strainer assembly (3).



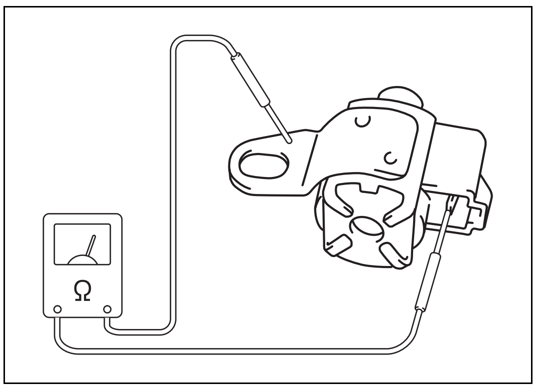
7) Remove transmission fluid temperature sensor (1) from sensor clamp.
8) Disconnect solenoid connectors (2).



9) Remove TCC solenoid valve (1), shift solenoid valve-A (No.1) (2), shift solenoid valve-B (No.2) (3) and timing solenoid valve (4) by removing bolts.

Inspection

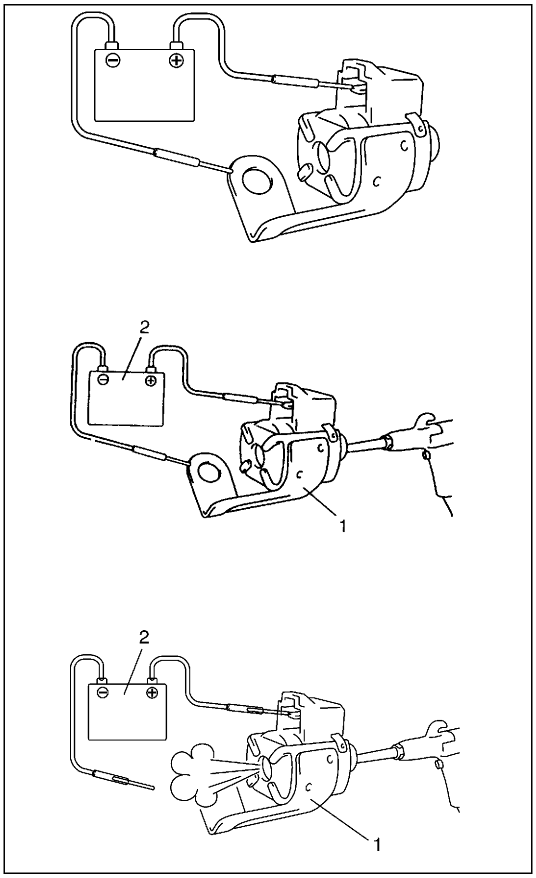
Resistance Check



Shift solenoid valves, Timing solenoid valve and TCC solenoid valve resistance
Standard: 11 – 15 Ω at 20°C (68°F)

Operation Check

Shift solenoid valve-A (No.1), -B (No.2) and TCC solenoid valve



CAUTION:

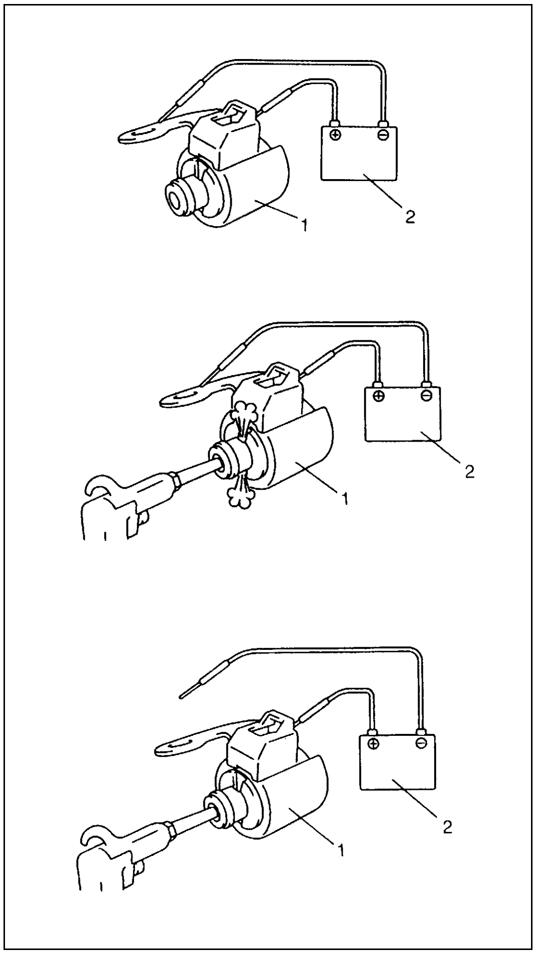
Do not insert air gun against strainer installed on inlet of solenoid valve too deeply, when blowing air into solenoid valve. If not, the strainer will be damaged.

- Check that solenoid valve (1) actuate with click sound when battery voltage is conducted.
- When solenoid valve (1) is connected to battery (2), confirm that solenoid valve is close condition by blowing air (50 – 200 kPa, 0.5 – 2.0 kg/cm^2, 7 – 28.5 psi) into solenoid valve as shown in the figure.
- When solenoid valve (1) is not connected to battery (2), confirm that solenoid valve is open condition by blowing air (50 – 200 kPa, 0.5 – 2.0 kg/cm^2, 7 – 28.5 psi) into solenoid valve as shown in the figure.

NOTE:

Do not fail to inspect with air to prevent mistaken checking because return spring for valve is not installed into solenoid valve.

Timing solenoid valve



CAUTION:

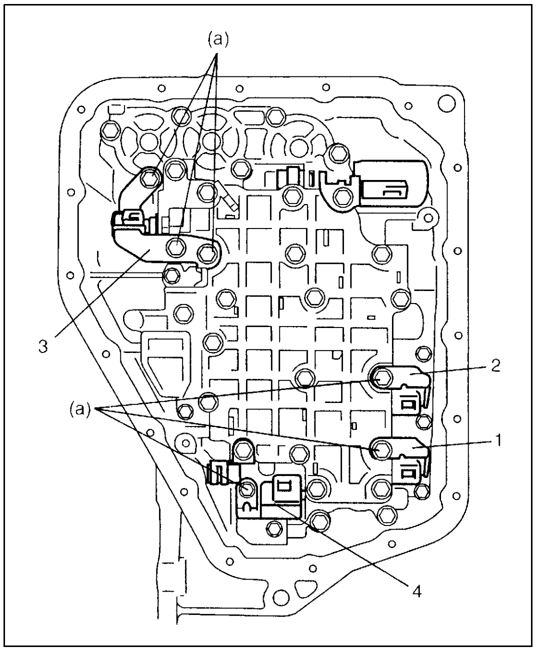
Do not insert air gun against strainer installed on inlet of solenoid valve too deeply, when blowing air into solenoid valve. If not, the strainer will be damaged.

- Check that solenoid valve (1) actuate with click sound when battery voltage is conducted.
- When timing solenoid valve (1) is connected to battery (2), confirm that timing solenoid valve is open condition by blowing air (50 – 200 kPa, 0.5 – 2.0 kg/cm^2, 7 – 28.5 psi) into solenoid valve as shown in the figure.
- When timing solenoid valve (1) is not connected to battery (2), confirm that timing solenoid valve is close condition by blowing air (50 – 200 kPa, 0.5 – 2.0 kg/cm^2, 7 – 28.5 psi) into solenoid valve as shown in the figure.

NOTE:

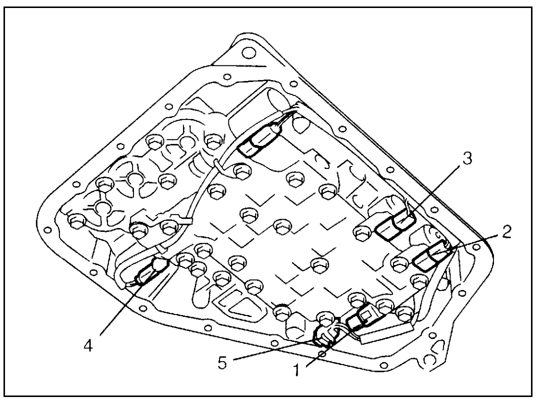
Do not fail to inspect with air to prevent mistaken checking because return spring for valve is not installed into solenoid valve.

Installation



1) Install shift solenoid valve-A (No.1) (1), shift solenoid valve-B (No.2) (2), TCC solenoid valve (3) and timing solenoid valve (4).

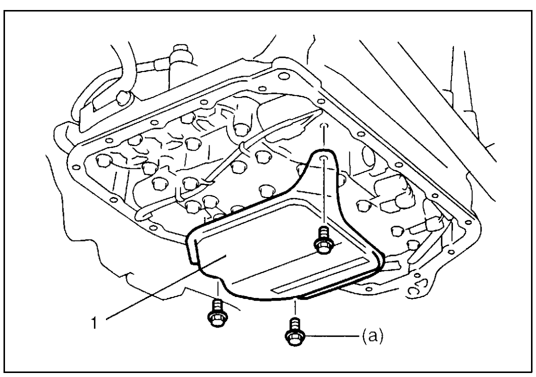
Tightening torque
Solenoid valve bolt (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



2) Connect solenoid connectors identifying their installing positions by wire color.

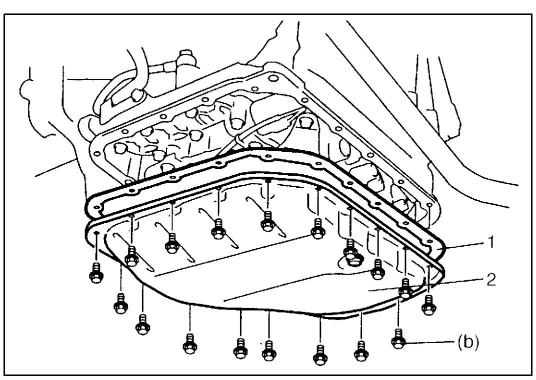
Solenoid coupler	Wire color
Shift solenoid valve-A (No.1) (2)	White
Shift solenoid valve-B (No.2) (3)	Black
Timing solenoid valve (1)	Yellow
TCC solenoid valve (4)	Light Green

3) Install transmission fluid temperature sensor (5) to sensor clamp.



4) Install oil strainer assembly (1).

Tightening torque
Oil strainer bolt
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)



5) Install new oil pan gasket (1) and oil pan (2).

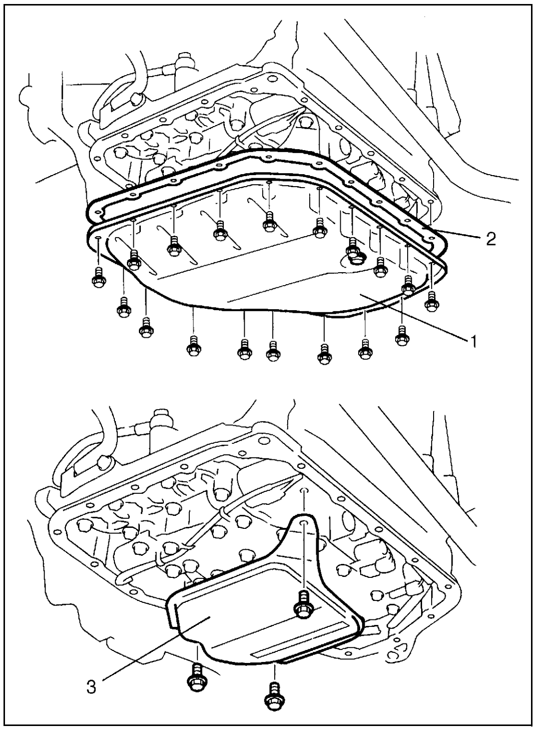
Tightening torque
Oil pan bolt
(b): 7.0 N·m (0.7 kg-m, 5.0 lb-ft)

Pressure Control Solenoid Valve

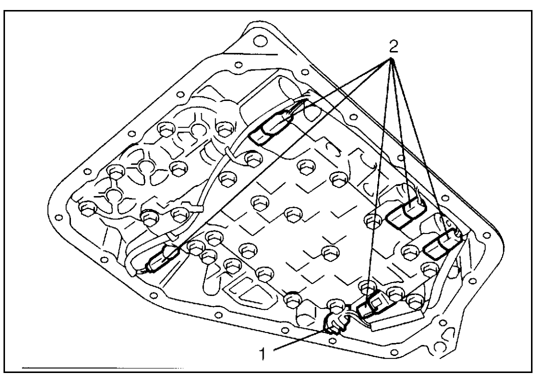
Removal

1) Disconnect negative cable at battery.
2) Lift up vehicle.
3) Remove drain plug and drain A/T fluid.
4) Install drain plug.

Tightening torque
A/T fluid drain plug: 17 N·m (1.7 kg-m, 12.5 lb-ft)



5) Remove A/T oil pan (1) and oil pan gasket (2).
6) Remove oil strainer assembly (3).

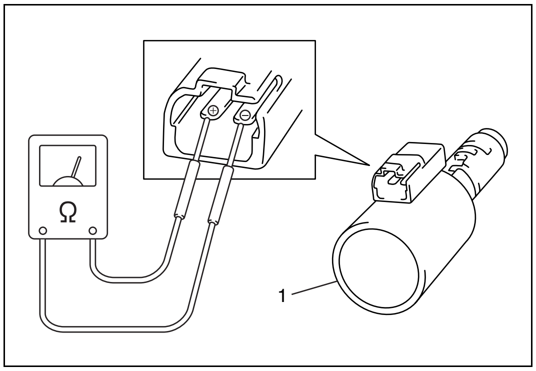


7) Remove transmission fluid temperature sensor (1) from sensor clamp.
8) Disconnect solenoid connectors (2).

9) Remove valve body assembly referring to “Unit Disassembly” in this section.
10) Remove pressure control solenoid valve referring to “Valve Body Assembly” in this section.

Inspection

Resistance Check



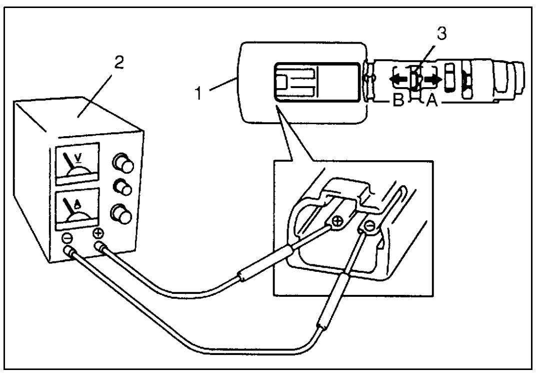
Measure resistance between pressure control solenoid valve (1) terminals.

Pressure control solenoid valve resistance
Standard: 5.0 – 5.6 Ω (at 20°C (68°F))

Operation Check

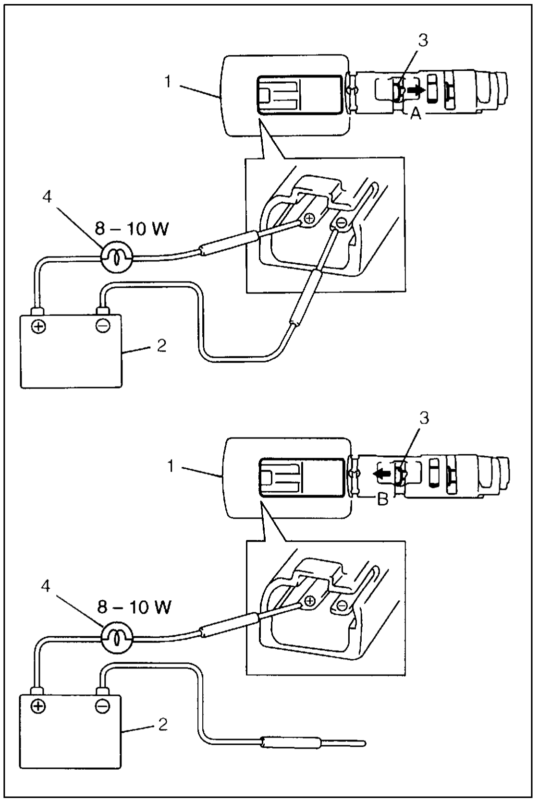
Check pressure control solenoid valve operation in the either manner of the followings.

[Using regulated DC power supply]



1) Connect pressure control solenoid valve (1) to regulated DC power supply (2) as shown in the figure.
2) Turn regulated DC power supply switch ON, increase voltage of power supply keeping current within 1.0 A.
3) Check for gradual movement of valve (3) in the direction of arrow “A” as voltage is increased.
4) Check for movement of valve (3) in the direction of arrow “B” as voltage is decreased.
5) Turn power supply switch OFF.

CAUTION:
Do not pass current 1.0 A or more, or pressure control solenoid is burned out.



[Not using regulated DC power supply]

1) Connect pressure control solenoid valve (1) to battery (2) setting the 8 – 10 W bulb (4) on the way as shown in the figure.
2) Check for movement of valve (3) in the direction of arrow “A”.
3) Disconnect pressure control solenoid valve (1) from battery (2) and check for movement of valve (3) in the direction of arrow “B” as shown in the figure.

> **CAUTION:**
> **Set 8 – 10 W bulb on the way, or pressure control solenoid valve is burned out.**

Installation

Reverse removal procedure to install pressure control solenoid valve and valve body assembly noting the following points.

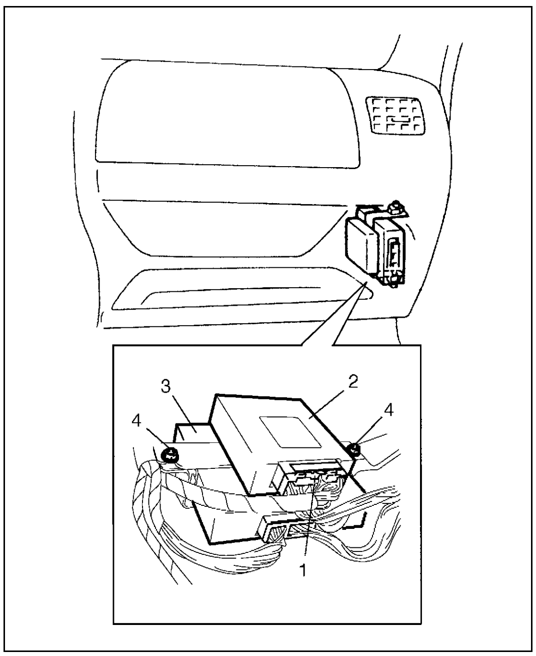
- For detail of pressure control solenoid valve installation, refer to “Valve Body Assembly” in this section.
- For detail of valve body assembly installation, refer to “Unit Assembly” in this section.
- For detail of installing wire harness for solenoid valves and sensor, refer to “Unit Assembly” in this section. Use new O-rings.
- For detail of A/T oil pan and oil strainer assembly installation, refer to “Unit Assembly” in this section. Use new oil pan gasket.
- Pour A/T fluid and check fluid level according to procedure described in “Fluid Change” in this section.
- Check for fluid leakage after warning up A/T.

Transmission Control Module (TCM)

CAUTION:
- **TCM and ECM consists of highly precise parts, therefore when handling it, be careful not to expose to excessive shock.**
- **When replacing TCM with used one, all learned contents, which have been stored in TCM memory by executing learning control, should be initialized after replacement.**

Removal

1) Disconnect negative cable at battery.
2) If the vehicle is equipped with air bag system, disable air bag system. Refer to “Disabling Air Bag System” in Section 10B.



3) Disconnect connectors (1) from TCM (2).
4) Remove TCM (2) by removing its nuts (4).

3. ECM

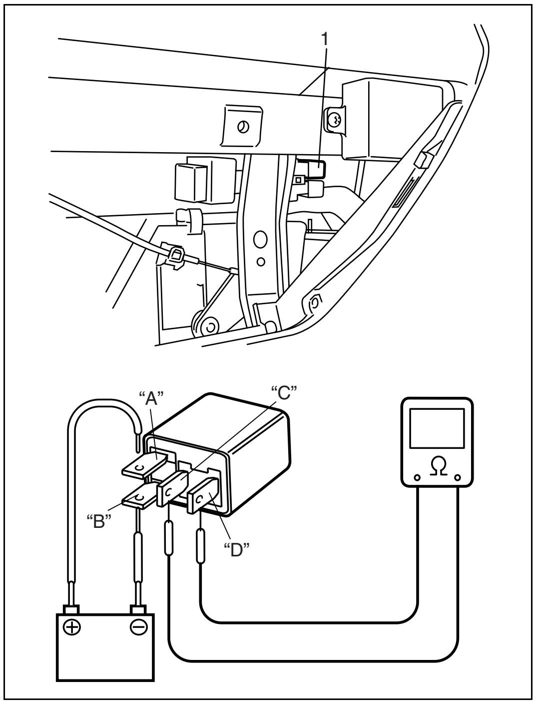
Installation

Reverse removal procedure noting the following.
- Connect TCM connectors securely.
- If the vehicle is equipped with air bag system, be sure to enable air bag system after TCM is back in place. Refer to “Enabling Air Bag System” in Section 10B.

A/T Relay

Inspection

1) Disconnect negative cable at battery.

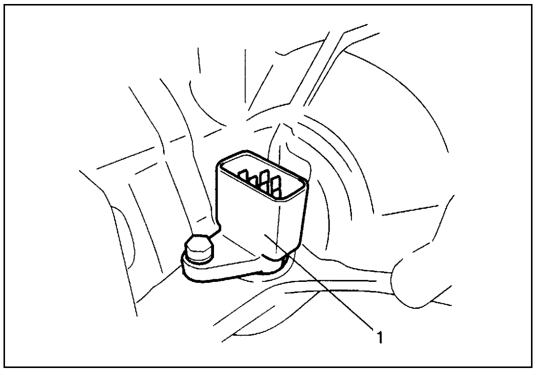


2) Remove glove box.
3) Remove A/T relay (1) from instrument panel wire harness.
4) Check that there is no continuity between terminal “C” and “D”.
   If continuity is indicated, replace A/T relay.
5) Connect battery positive (+) terminal to terminal “A” of A/T relay and battery negative (–) terminal to terminal “B” of A/T relay.
   Check continuity between terminal “C” and “D” of A/T relay.
   If continuity does not indicated, replace A/T relay.

Transmission Fluid Temperature Sensor

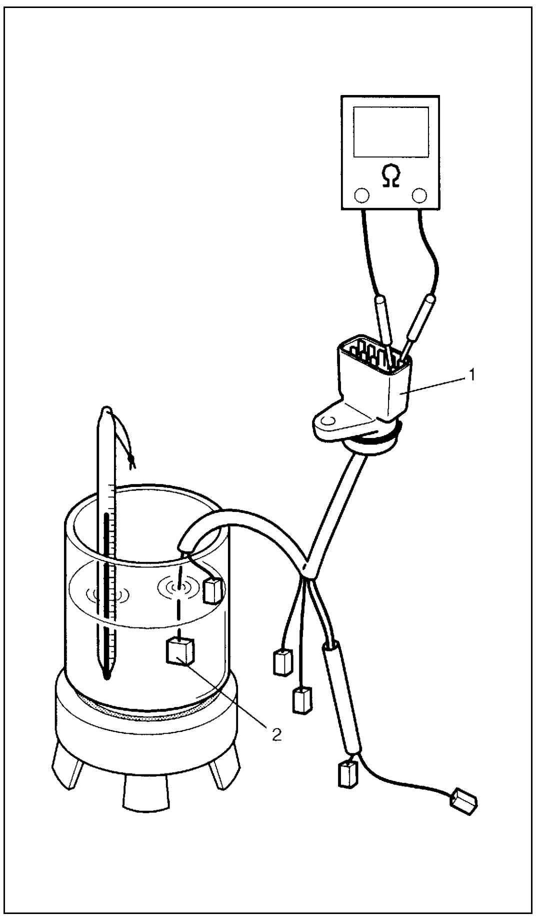
Inspection

1) Disconnect negative cable at battery.
2) Lift up vehicle.
3) With engine is cool, remove drain plug and drain A/T fluid.
4) Install drain plug. (Refer to “Fluid Change” in this section.)
5) Remove A/T oil pan.
6) Remove oil strainer assembly.
7) Remove valve body assembly referring to “Unit Disassembly” in this section.



CAUTION:
When pulling solenoid wire harness out of transaxle case, take care not to damage transmission fluid temperature sensor at narrow exit of case.
Careless sensor treatment might cause sensor malfunction.

8) Remove solenoid wire harness (1).



9) Warm up transmission fluid temperature sensor (2). Check resistance between terminals of valve body harness connector (1). Thus make sure its resistance decrease as its temperature increase.

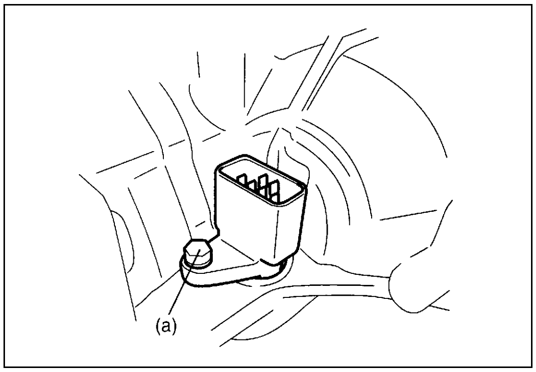
Transmission fluid temperature sensor resistance

Temperature	Resistance
10°C (50°F)	5.8 – 7.1 kΩ
110°C (230°F)	231 – 263 Ω
145°C (293°F)	105 – 117 Ω

Installation

Reverse removal procedure to install solenoid wire harness and valve body assembly noting the following points.

- For details of valve body assembly and their connectors installation, refer to “Unit Assembly” in this section.
- For details of A/T oil pan installation, refer to “Unit Assembly” in this section. Use new oil pan gasket.



- Tighten valve body harness connector bolt to specified torque.

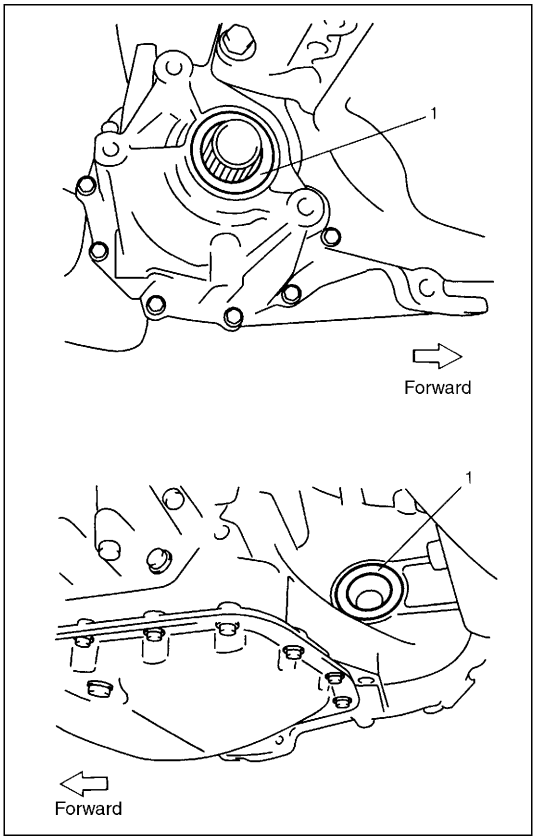
Tightening torque
Valve body harness connector bolt
(a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

- Pour A/T fluid and check fluid level according to procedure described in “Fluid Change” in this section.
- Check for fluid leakage after warning up A/T.

Differential Side Oil Seal

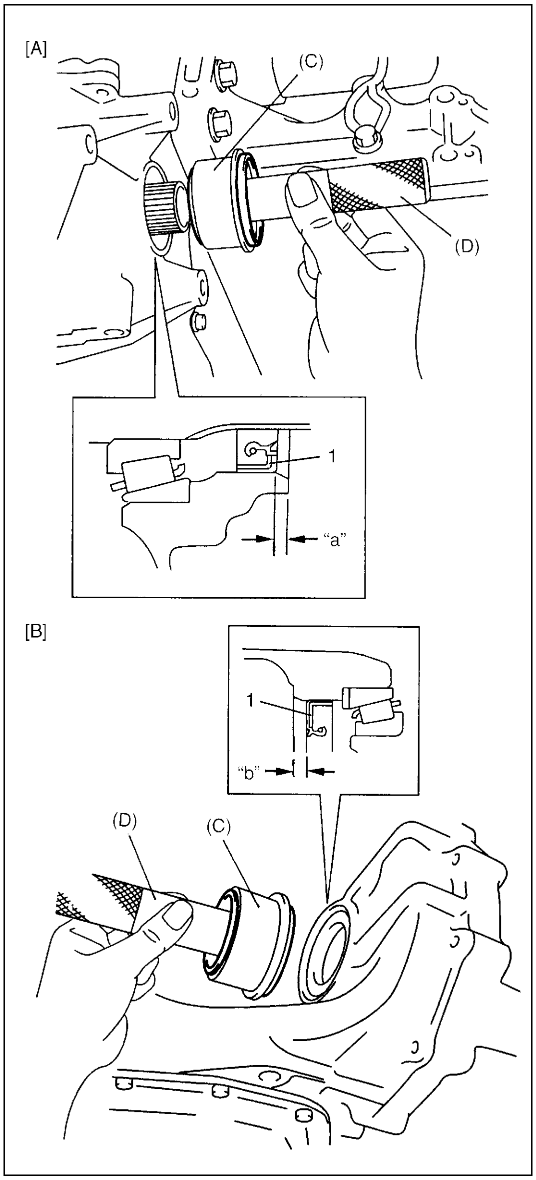
Replacement

1) Lift up vehicle and drain automatic transaxle fluid.
2) Remove drive shaft joints from differential gear of transaxle.
   Refer to "Drive Shaft Assembly" in Section 4A for procedure to disconnect drive shaft joints.
   For differential side oil seal removal, it is not necessary to remove drive shafts from steering knuckle.



3) Remove differential side oil seal (1) by using screw driver or like.
4) Apply grease to new differential side oil seal lips.

Grease 99000-25030



5) Install new differential side oil seals (1) by using special tool.

Special tool
(C): 09944-88220
(D): 09924-74510

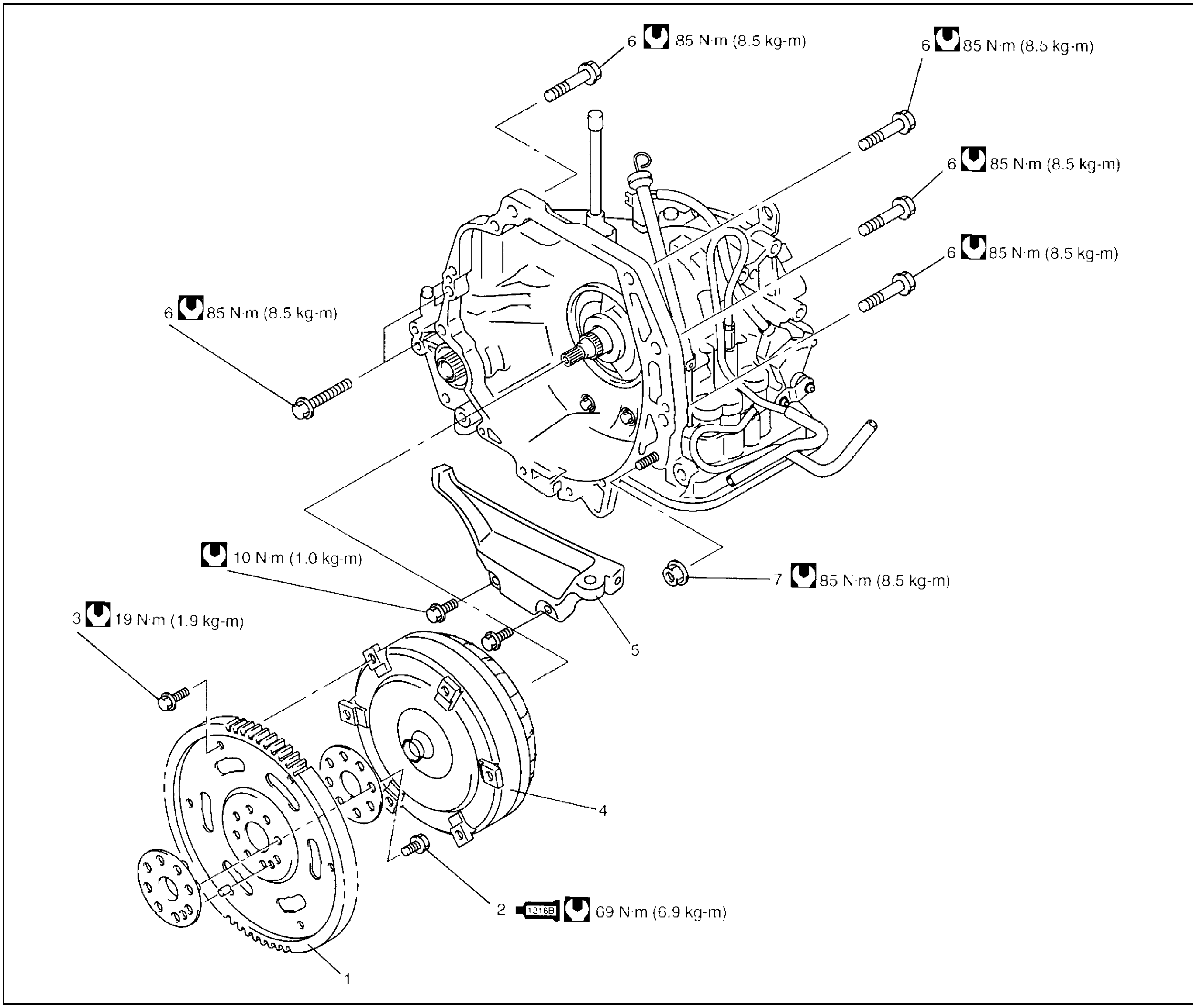
Differential side oil seal installing depth
Right side "a": 2.6 – 3.6 mm (0.10 – 0.14 in)
Left side "b": 3.8 – 4.8 mm (0.15 – 0.19 in)

[A]:	Right side
[B]:	Left side

6) Install drive shaft referring to "Drive Shaft Assembly" in Section 4A.
7) Pour A/T fluid referring to "Fluid Change" in this section.

Automatic Transaxle Assembly

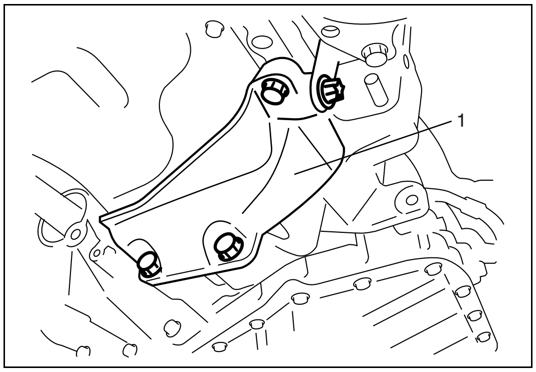
Components



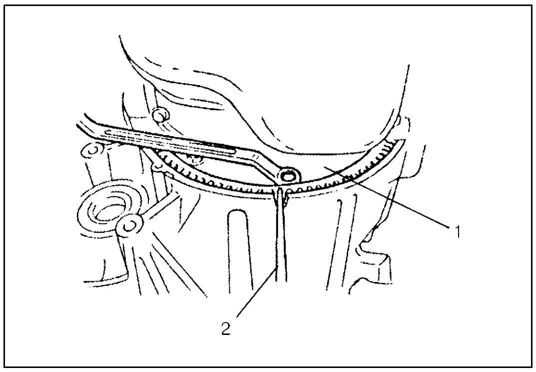
	1. Drive plate		5. Lower stiffener
1216B	2. Drive plate bolt : Apply sealant 99000-31230 to thread.		6. Transaxle and engine fastening bolt
	3. Drive plate to torque converter bolt		7. Transaxle and engine fastening nut
	4. Torque converter	(torque symbol)	Tightening torque

Dismounting

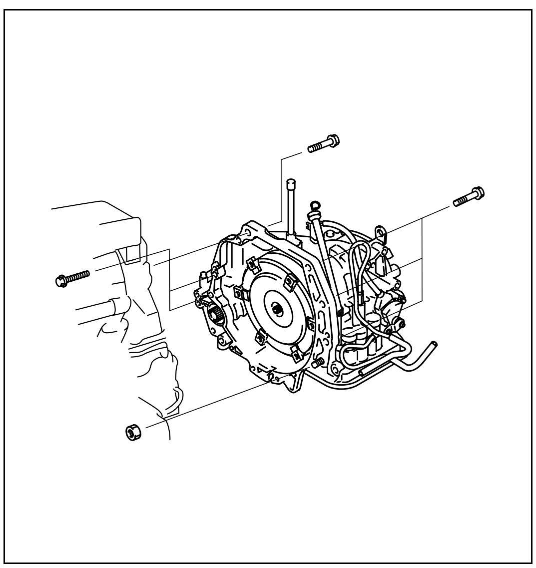
1) Take down transaxle with engine. For its procedure, refer to "Engine Assembly" in Section 6A2.



2) Remove lower stiffener (1).



3) Remove drive plate to torque converter bolts.
   To lock drive plate (1), engage flat head rod or the like (2) with drive plate ring gear.



4) Remove starting motor.

> **WARNING:**
> **Be sure to keep transaxle with torque converter horizontal or facing up throughout the work. Should it be tilted with torque converter down, converter may fall off and cause personal injury.**

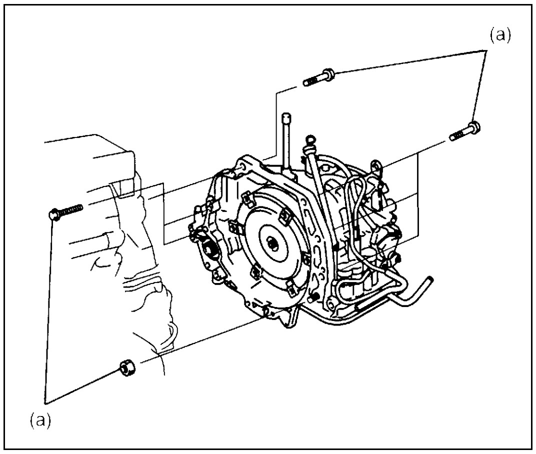
NOTE:

When detaching transaxle from engine, move it in parallel with crankshaft and use care so as not to apply excessive force to drive plate and torque converter.

5) Remove bolts and nut fastening engine and transaxle, then detach transaxle from engine.

Remounting

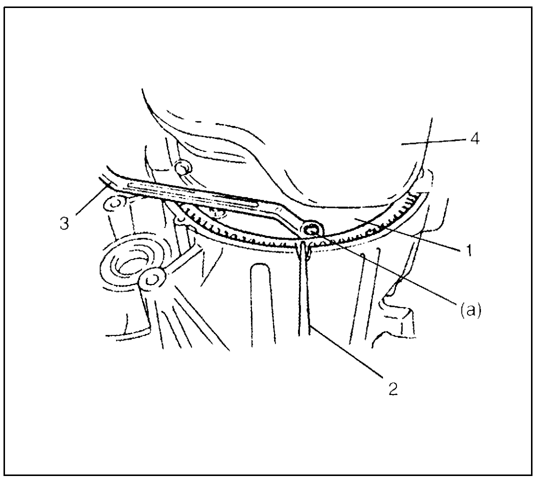
1) Make sure that torque converter is installed correctly to transaxle.
   Refer to “Unit Assembly” in this section.



WARNING:
Be sure to keep transaxle with torque converter horizontal or facing up throughout the work. Should it be tilted with torque converter down, converter may fall off and cause personal injury.

2) Attach transaxle to engine.

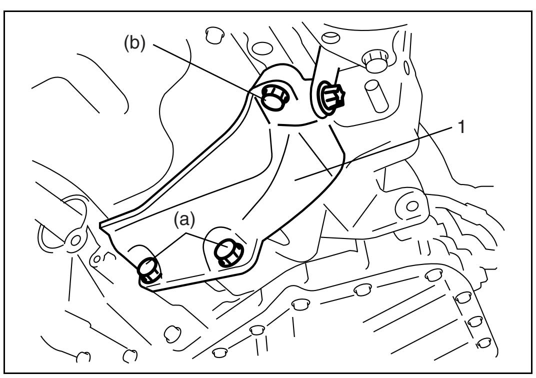
Tightening torque
Transaxle and engine fastening bolt and nut
(a): 85 N·m (8.5 kg-m, 61.5 lb-ft)



3) Tighten drive plate to torque converter bolts.
   Align bolt hole of drive plate and torque converter then tighten bolts through torque converter housing lower plate opening.
   Lock drive plate (1) by engaging flat head rod or the like (2) with drive plate gear.

Tightening torque
Drive plate to torque converter bolt
(a): 19 N·m (1.9 kg-m, 14.0 lb-ft)

3.	Wrench
4.	Engine oil pan



4) Install lower stiffener (1).
   Tighten lower stiffener bolts (a) first and next (b) with specified torque.

Tightening torque
Lower stiffener bolt
(a): 55 N·m (5.5 kg-m, 40 lb-ft)
(b): 55 N·m (5.5 kg-m, 40 lb-ft)

5) Install starter motor.

Tightening torque
Starter motor bolt and nut: 50 N·m (5.0 kg-m, 36.5 lb-ft)

6) Remount engine with transaxle assembly to vehicle. Refer to “Engine Assembly” in Section 6A2 for its procedure.

Unit Repair

When repairing automatic transaxle, it is necessary to conduct the on-vehicle test to investigate where the cause of the trouble lies first.
Then whether overhaul should be done or not is determined. If the transaxle is disassembled without such preliminary procedure, not only the cause of the trouble would be unknown, but also a secondary trouble may occur and often time would be wasted.

Precautions

As the automatic transaxle consists of high precision component, the following cautions should be strictly observed when handling its parts in disassembly and reassembly.

- Disassembling valve body assembly is prohibited essentially. However, a few parts can be disassembled. When disassembling valve body component parts, confirm whether their parts are allowed to disassemble or not referring to “Valve Body Assembly” in this section.
- Make sure to wash dirt off from the transaxle so that no such dirt will enter the transaxle during dismounting and remounting.
- Select a clean place free from dust and dirt for overhauling.
- Place a rubber mat on the work bench to protect parts from damage.
- Work gloves or shop cloth should not be used. (Use a nylon cloth or a paper towel.)
- When separating the case joint, do not pry with a screwdriver or such but tap with a plastic hammer lightly.
- Make sure to wash dirt off from the transaxle so that no such dirt will enter the transaxle during disassembly and reassembly.
- Wash the disassembled parts in ATF (Automatic Transaxle Fluid) or kerosene (using care not to allow ATF or kerosene to get on your face, etc.) and confirm that each fluid passage is not clogged by blowing air into it. But use kerosene to wash the discs, resin washers and rubber parts.
- Replace each gasket, oil seal and O-ring with a new one.
- Apply ATF to sliding or rotating parts before reassembly.
- A new discs should be soaked in ATF at least 2 hours before use.

Part Inspection and Correction Table

Part	Inspect for	Correction
Casted part, machined part	Small flaw, burr	Remove with oil stone.
	Deep or grooved flaw	Replace part.
	Clogged fluid passage	Clean with air or wire.
	Flaw on installing surface, residual gasket	Remove with oil stone or replace part.
	Crack	Replace part.
Bearing	Unsmooth rotation	Replace.
	Streak, pitting, flaw, crack	Replace.
Bushing, thrust washer	Flaw, burr, wear, burning	Replace.
Oil seal, gasket	Flawed or hardened seal ring	Replace.
	Worn seal ring on its periphery or side	Replace.
	Piston seal ring, oil seal, gasket, etc.	Replace.
Gear	Flaw, burr	Replace.
	Worn gear tooth	Replace.
Splined part	Burr, flaw, torsion	Correct with oil stone or replace.
Snap ring	Wear, flaw, distortion	Replace.
	No interference	Replace.
Thread	Burr	Replace.
	Damage	Replace.
Spring	Settling, sign of burning	Replace.
Friction plate	Wear, burning, distortion, damaged claw	Replace.
Separator plate, retaining plate	Wear, burning, distortion, damaged claw	Replace.
Sealing surface (where lip contacts)	Flaw, rough surface, stepped wear, foreign material	Replace.

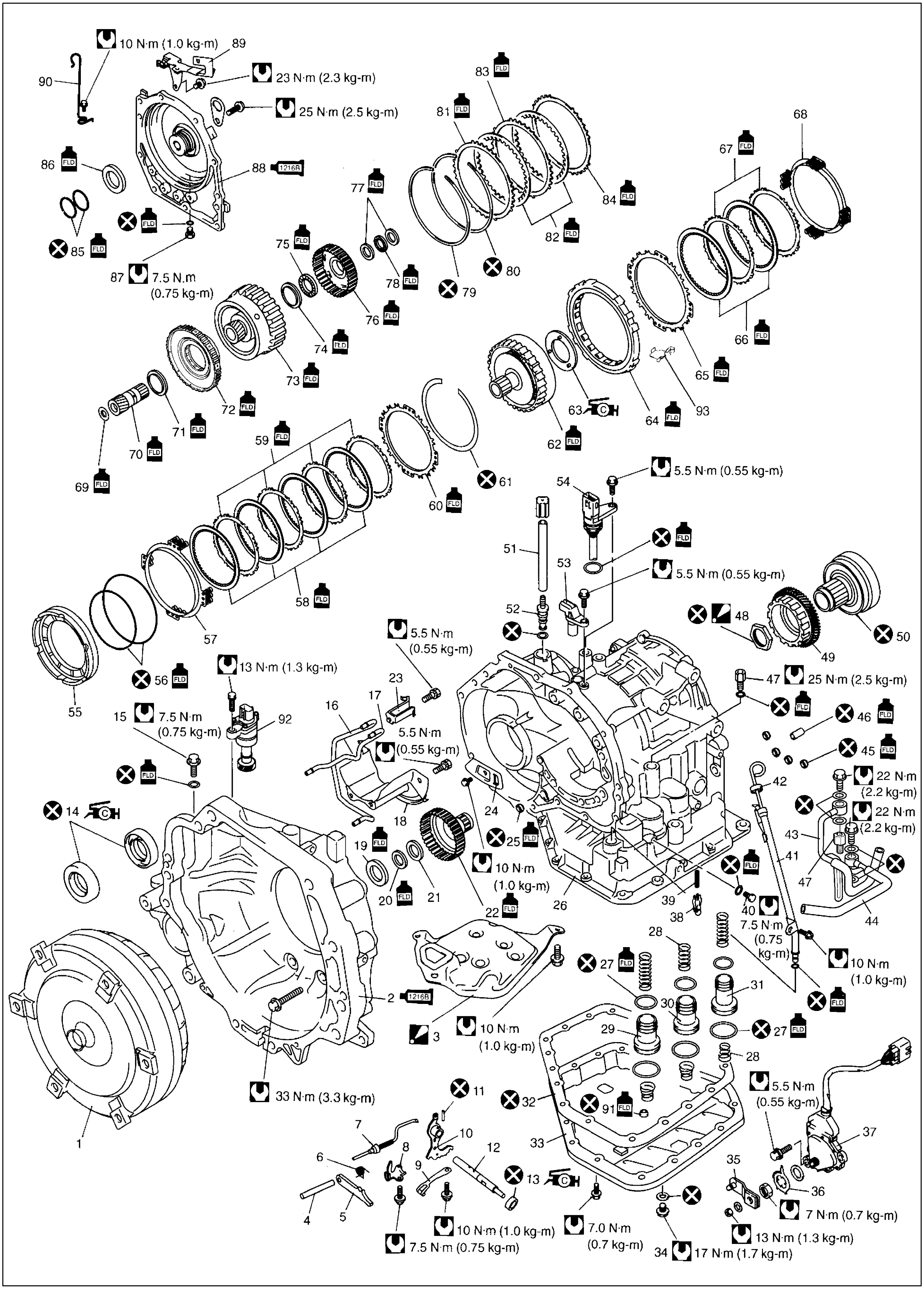
Unit Disassembly

CAUTION:
- **Thoroughly clean transaxle exterior before overhauling it.**
- **Keep working table, tools and hands clean while overhauling.**
- **Use special care to handle aluminum parts so as not to damage them.**
- **Do not expose removed parts to dust. Keep them always clean.**

Components

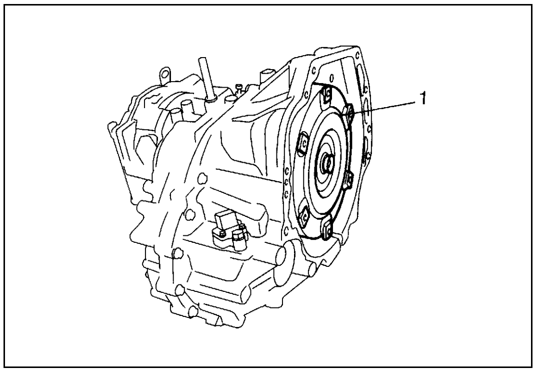
NOTE:

Oil pump assembly, direct clutch assembly, forward and reverse clutch assembly, 2nd brake piston assembly, O/D and 2nd coast brake piston and return spring, differential assembly, countershaft assembly and valve body assembly are not shown in figure below.
For the detail of these components, refer to "Disassembly/Assembly of Subassembly" in this section.


10 N·m (1.0 kg-m)
23 N·m (2.3 kg-m)
25 N·m (2.5 kg-m)
1216B
7.5 N.m (0.75 kg-m)
5.5 N·m (0.55 kg-m)
13 N·m (1.3 kg-m)
25 N·m (2.5 kg-m)
22 N·m (2.2 kg-m)
22 N·m (2.2 kg-m)
7.5 N·m (0.75 kg-m)
10 N·m (1.0 kg-m)
1216B
33 N·m (3.3 kg-m)
5.5 N·m (0.55 kg-m)
7 N·m (0.7 kg-m)
13 N·m (1.3 kg-m)
17 N·m (1.7 kg-m)
7.0 N·m (0.7 kg-m)
10 N·m (1.0 kg-m)
7.5 N·m (0.75 kg-m)
FLD

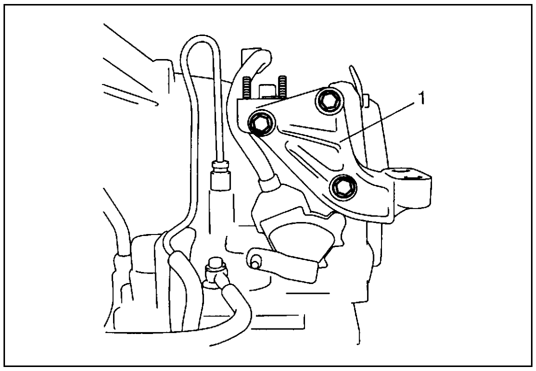
1. Torque converter	33. Oil pan	65. 2nd brake retaining plate
2. Torque converter housing : Apply sealant 99000-31230 to mating surface to transaxle case.	34. A/T fluid drain plug	66. 2nd brake disc
3. Oil strainer assembly : Replace oil strainer when overhauling.	35. Manual select lever	67. 2nd brake separator plate
4. Parking lock pawl shaft	36. Lock washer	68. 2nd brake return spring subassembly
5. Parking lock pawl	37. Transmission range sensor	69. Front sun gear thrust bearing race
6. Parking lock pawl return spring	38. Cooler check valve	70. Front planetary sun gear
7. Parking lock pawl rod	39. Spring	71. Planetary gear thrust bearing
8. Parking lock pawl bracket	40. Transaxle case plug	72. One-way clutch No.1 assembly
9. Manual detent spring	41. Fluid filler tube	73. Rear planetary sun gear subassembly
10. Manual valve lever	42. Fluid level gauge	74. Rear sun gear thrust bearing race
11. Manual valve lever pin	43. Fluid cooler inlet pipe	75. Rear sun gear thrust bearing
12. Manual shift shaft	44. Fluid cooler outlet pipe	76. Forward clutch hub
13. Manual shift shaft oil seal : Apply grease 99000-25030 to oil seal lip.	45. 2nd brake gasket	77. Intermediate shaft thrust bearing race
14. Differential side oil seal : Apply grease 99000-25030 to oil seal lip.	46. Brake drum gasket	78. Intermediate shaft thrust bearing
15. Torque converter housing plug	47. Pipe union	79. 2nd brake piston snap ring
16. Lubrication LH tube	48. Reduction drive gear nut : After tightening nut so as rotational torque of reduction drive gear to be in specified value, caulk nut securely.	80. O/D and 2nd coast brake retaining plate snap ring
17. Lubrication RH tube	49. Reduction drive gear	81. O/D and 2nd coast brake retaining plate
18. Fluid reservoir RH plate	50. Planetary ring gear subassembly	82. O/D and 2nd coast brake disc
19. Input shaft front thrust bearing	51. Breather hose	83. O/D and 2nd coast brake separator plate
20. Input shaft rear thrust bearing	52. Breather union	84. O/D and 2nd coast brake rear plate
21. Input shaft rear thrust bearing race	53. Input shaft speed sensor	85. Rear cover seal ring
22. Direct clutch hub	54. Valve body harness	86. Reverse clutch drum thrust bearing
23. Lubrication tube clamp	55. 1st and reverse brake piston	87. Rear cover plug
24. Fluid reservoir LH plate	56. O-ring	88. Transaxle rear cover : Apply sealant 99000-31230 to mating surface.
25. Governor apply No.2 gasket	57. 1st and reverse brake return spring subassembly	89. Harness bracket
26. Automatic transaxle case	58. 1st and reverse brake disc	90. Select cable clamp
27. Accumulator piston O-ring	59. 1st and reverse brake separator plate	91. Governor apply No.1 gasket
28. Accumulator spring	60. 1st and reverse brake retaining plate	92. Output shaft speed sensor (VSS)
29. C2 accumulator piston	61. 1st and reverse brake snap ring	93. One-way clutch outer race retainer
30. C1 accumulator piston	62. Planetary gear assembly	Do not reuse.
31. B1 accumulator piston	63. Planetary carrier thrust washer : Apply grease 99000-25030 to slide contact face.	Apply automatic transaxle fluid.
32. Oil pan gasket	64. One-way clutch No.2 assembly	Tightening torque

Disassembly

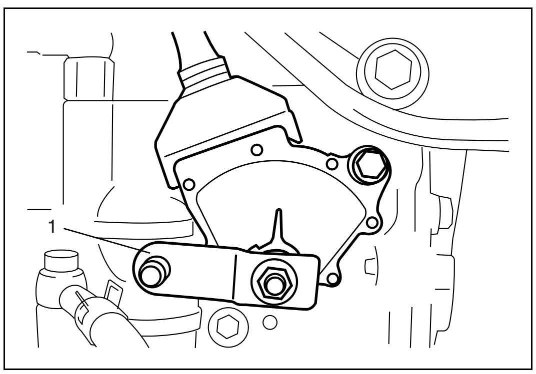


> **CAUTION:**
>
> **Remove torque converter as much straight as possible. Leaning it may cause to damage oil seal lip.**

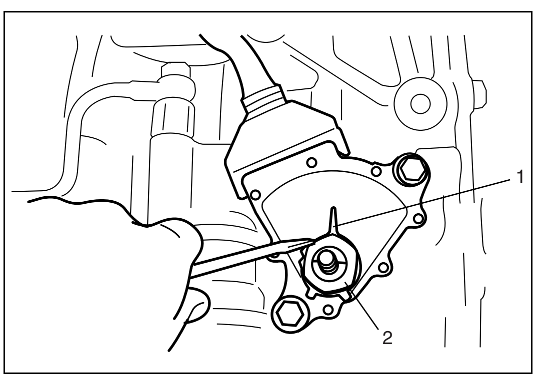
1) Remove torque converter (1).



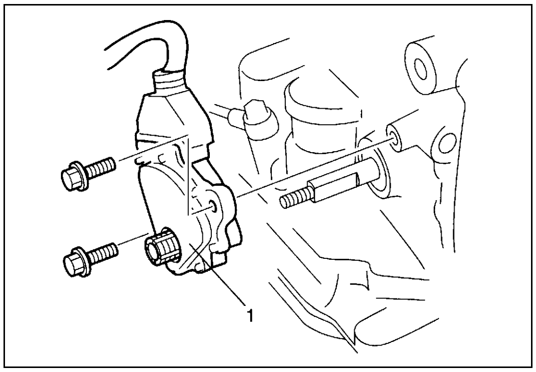
2) Remove engine mounting LH bracket (1).



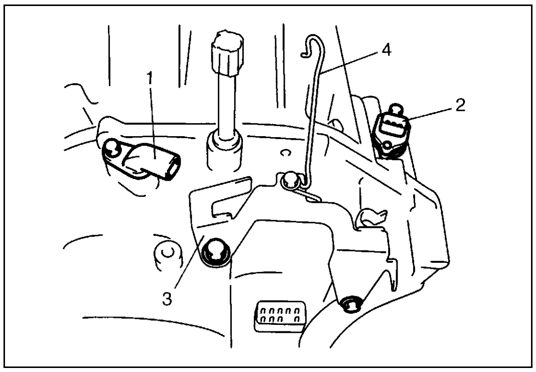
3) Remove manual select lever (1).



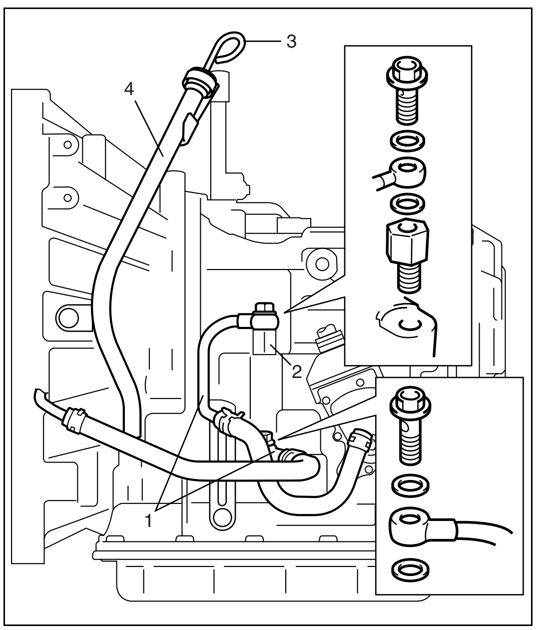
4) Uncaulk lock washer (1), then remove lock nut (2) and lock washer (1).



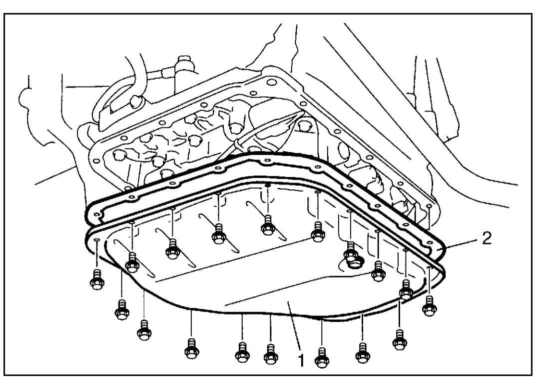
5) Remove transmission range sensor (1).



6) Remove input shaft speed sensor (1) and output shaft speed sensor (VSS) (2).
7) Remove harness bracket (3) and select cable clamp (4).



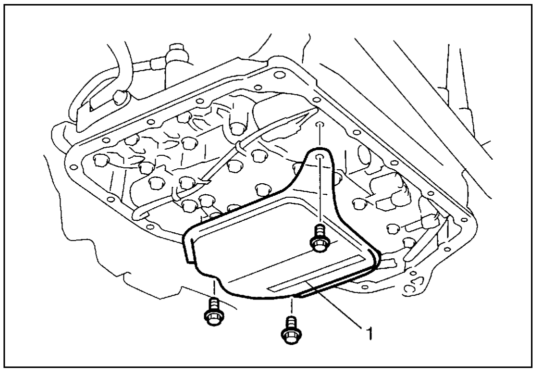
8) Remove fluid cooler pipes (1) and pipe union (2).
9) Remove fluid level gauge (3) and fluid filler tube (4).



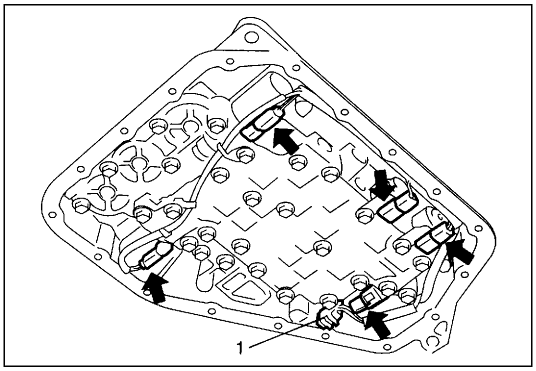
10) Remove oil pan (1) and oil pan gasket (2).

NOTE:

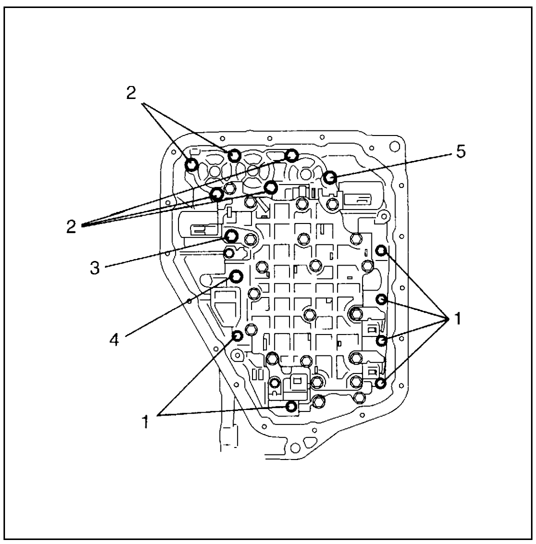
- **For removal of oil pan, do not turn transaxle over as this will contaminate valve body with foreign materials in bottom of oil pan.**
- **When removing oil pan, tap around it lightly with plastic hammer. Do not force it off by using screwdriver or the like.**



11) Remove oil strainer assembly (1).



12) Disconnect connectors from solenoid valves, and transmission fluid temperature sensor (1).



13) Remove valve body assembly bolts.

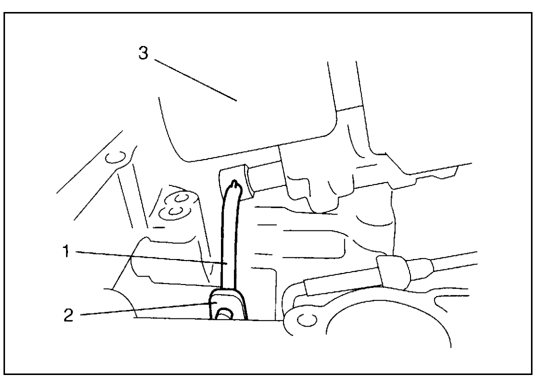
CAUTION:

Be careful not to let manual valve fall off when removing valve body assembly.

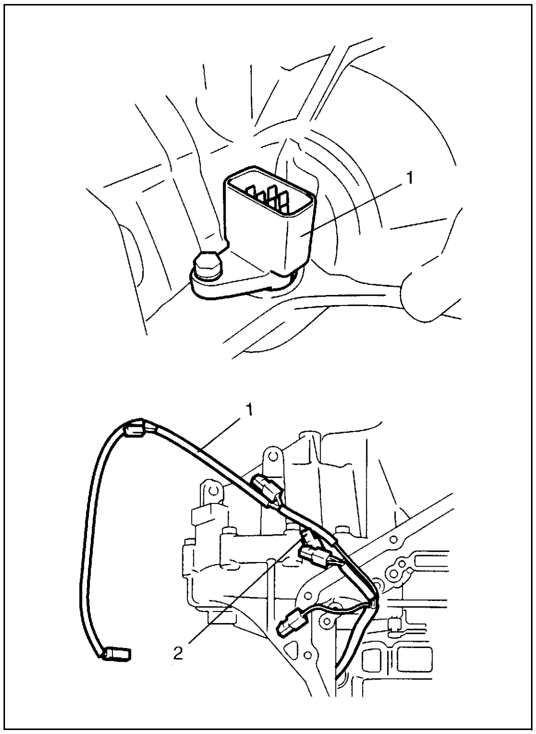
NOTE:

There are five kinds of bolts (bolts A, B, C, D and E) fixing valve body assembly

1.	Bolt A
2.	Bolt B
3.	Bolt C
4.	Bolt D
5.	Bolt E

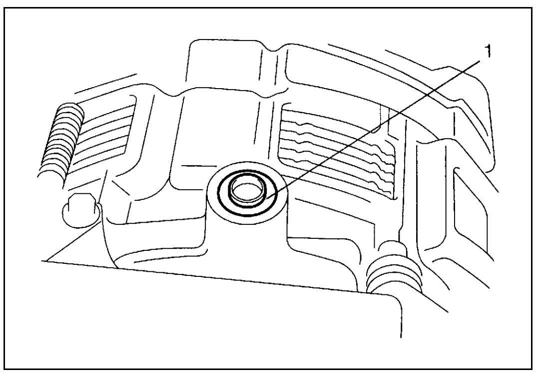


14) Remove manual valve rod (1) from manual valve lever (2), then remove valve body assembly (3).

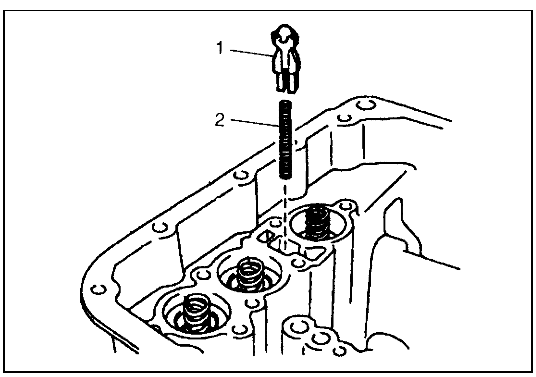


15) Remove valve body harness (1).

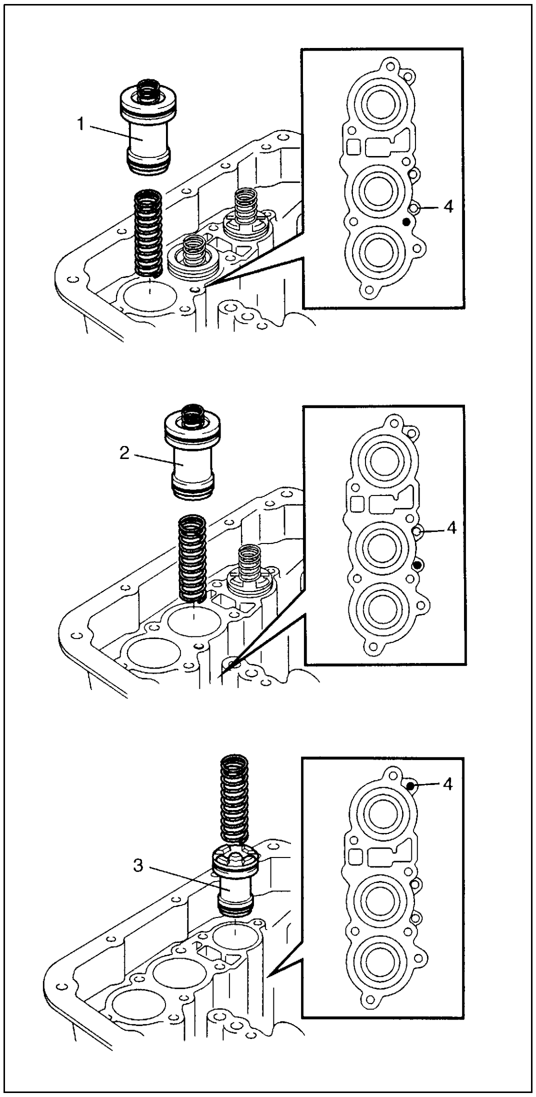
CAUTION:
When pulling valve body harness (1) out of transaxle case, take care not to damage transmission fluid temperature sensor (2) at narrow exit of case.
Careless sensor treatment might cause sensor malfunction.



16) Remove governor apply No.1 gasket (1).



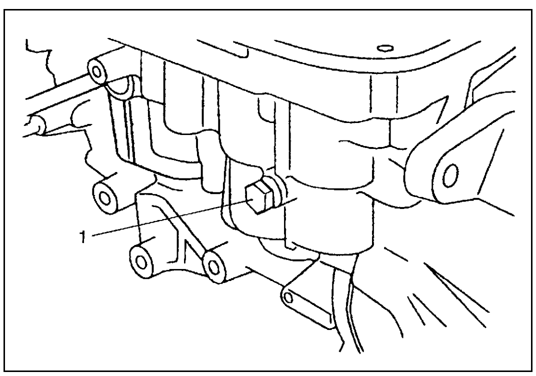
17) Remove cooler check valve (1) and spring (2).



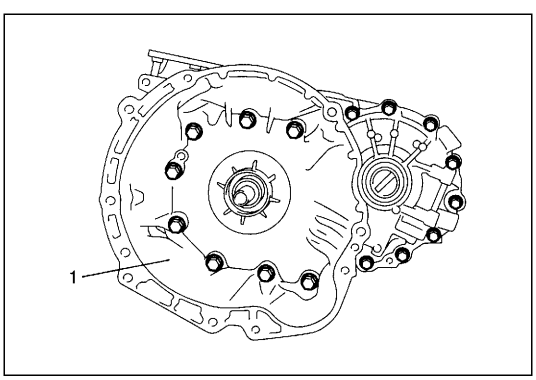
18) Remove accumulator pistons and springs.
To remove C2 (1), C1 (2) and B1 (3) accumulator pistons and springs, position rag on pistons to catch each piston. To remove pistons, force low-pressure compressed air (1 kg/ cm^2, 15 psi, 100 kPa, max) into hole (4) as shown in figure, and pop each piston into rag.

NOTE:

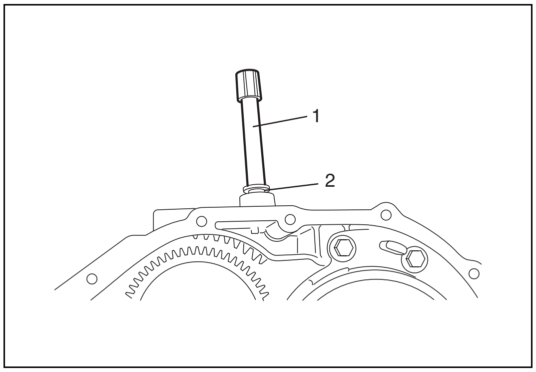
Do not push accumulator pistons with fingers or anything before removing them. Pushing them may cause compressed fluid in accumulator to spew out of hole and get to your face and clothes.



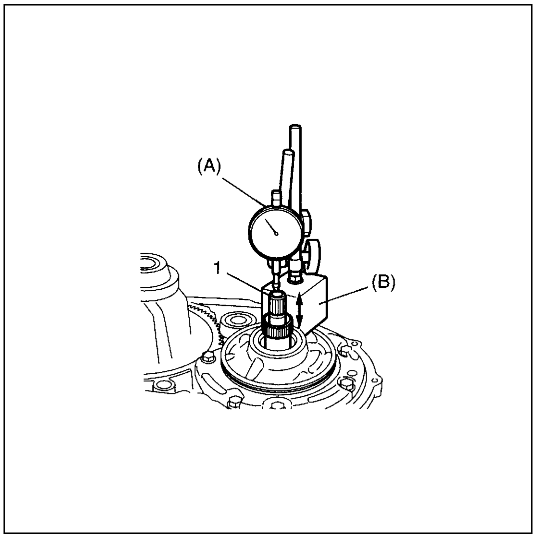
19) Remove transaxle case plug (1).



20) Remove torque converter housing bolts.
21) Remove torque converter housing (1) while tapping around it lightly with plastic hammer.



22) Remove breather hose (1).
23) Remove breather union (2).

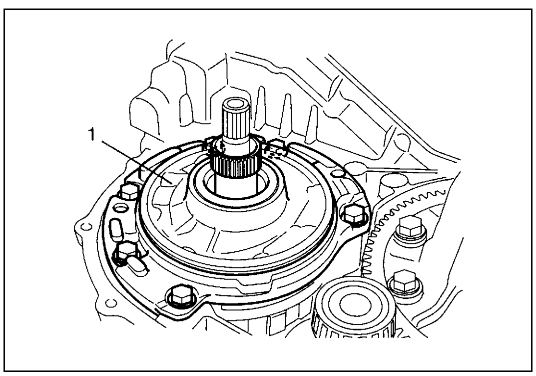


24) Measure input shaft thrust play.
    Apply dial gauge onto input shaft end (1) and measure thrust play of input shaft.
    When input shaft thrust play is out of specification, select input shaft front thrust bearing with proper thickness from among the list below and replace it.

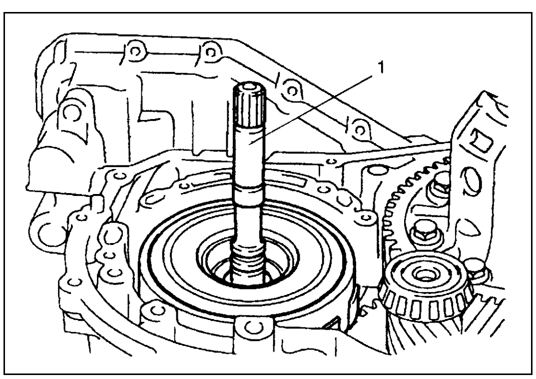
Special tool
(A): 09900-20607
(B): 09900-20701

Input shaft thrust play: 0.3 – 0.9 mm (0.012 – 0.035 in.)

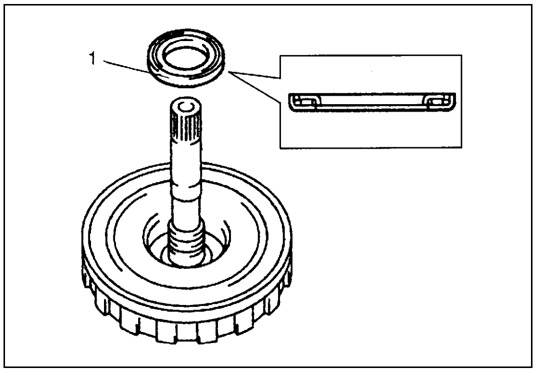
Available input shaft front thrust bearing thickness
0.8, 1.4 mm (0.032, 0.055 in.)



25) Remove oil pump assembly (1).



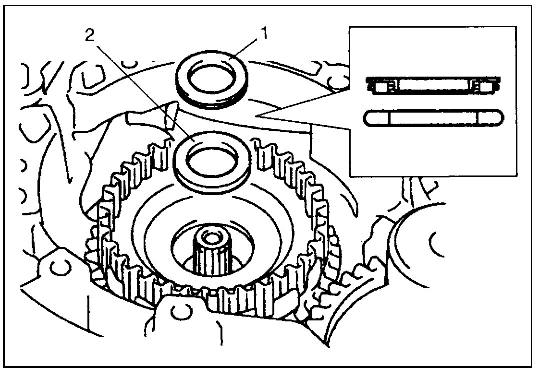
26) Remove direct clutch assembly (1).



27) Remove input shaft front thrust bearing (1).

NOTE:

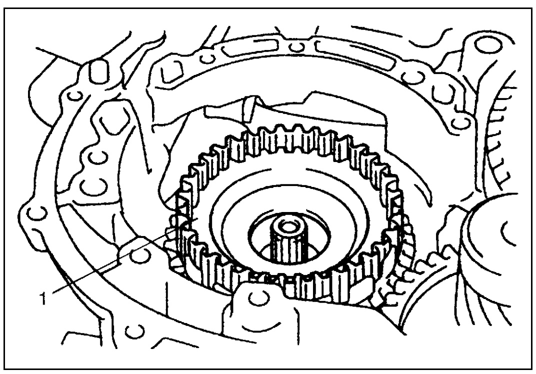
If input shaft front thrust bearing is not found, it may have been taken out with oil pump assembly.



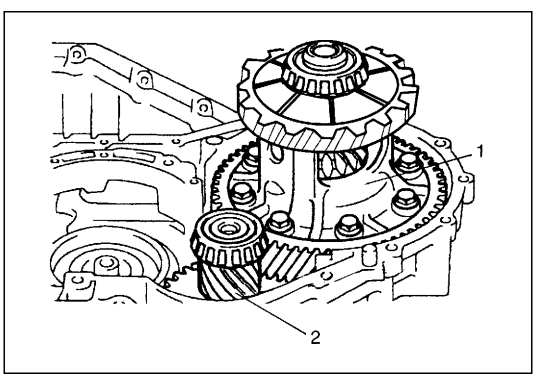
28) Remove input shaft rear thrust bearing (1) and thrust bearing race (2).

NOTE:

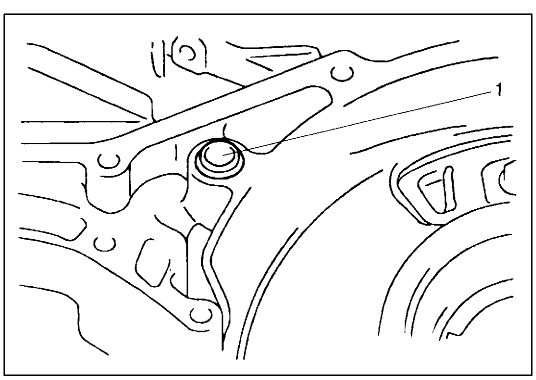
If input shaft rear thrust bearing is not found, it may have been taken out with direct clutch assembly.



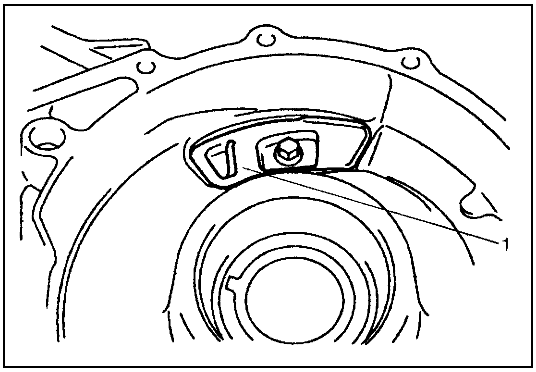
29) Remove direct clutch hub (1).



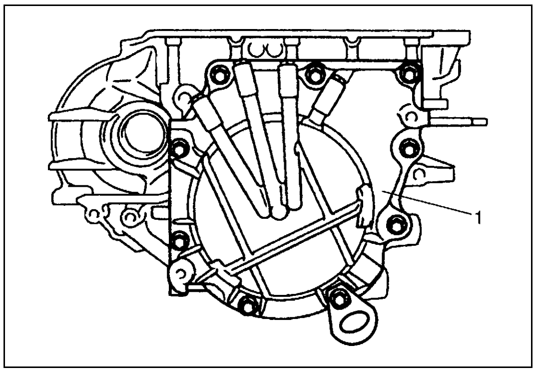
30) Remove differential assembly (1) and counter shaft assembly (2).



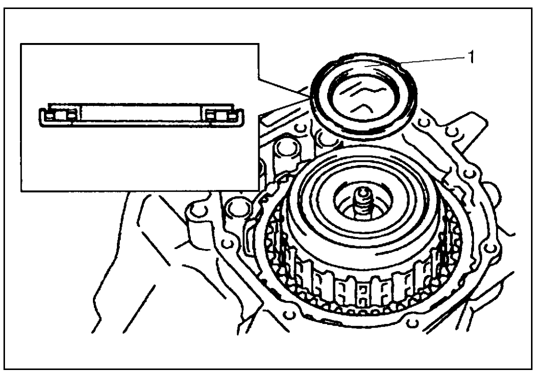
31) Remove governor apply No.2 gasket (1).



32) Remove fluid reservoir LH plate (1).



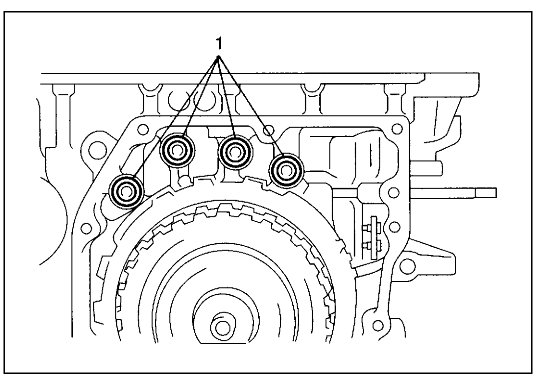
33) Turn over transaxle and remove rear cover assembly (1).



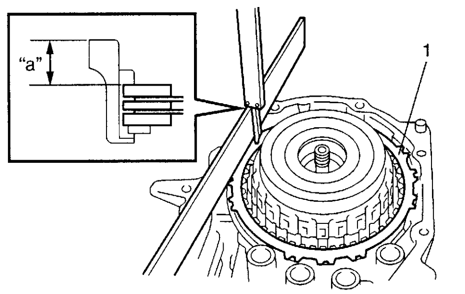
34) Remove reverse clutch drum thrust bearing (1).

NOTE:

If reverse clutch drum thrust bearing is not found, it may have been taken out with rear cover assembly.



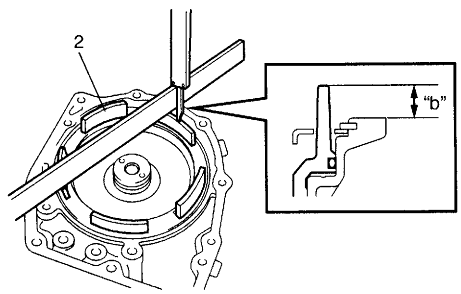
35) Remove 2nd brake gasket (1).

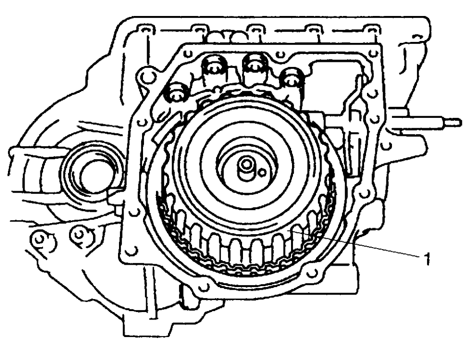


36) Measure O/D and 2nd coast brake piston stroke.
- Measure dimension “a” from mating surface of transaxle case to O/D and 2nd coast brake rear plate (1) using straightedge and micrometer caliper.
- Measure dimension “b” from O/D and 2nd coast brake piston (2) to rear cover assembly mating surface using straightedge and micrometer caliper.
- Calculate piston stroke from measured value of dimensions “a” and “b”.
- Piston stroke = “a” – “b”

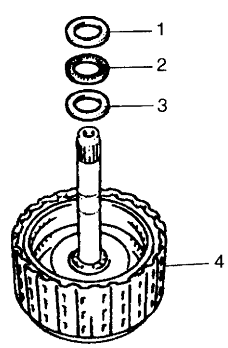
O/D and 2nd coast brake piston stroke
Standard: 0.65 – 1.05 mm (0.026 – 0.041 in.)

If piston stroke exceeds specification above, inspect and replace plates and discs.





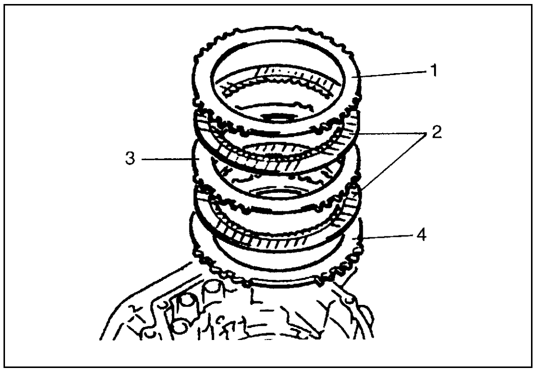
37) Remove forward and reverse clutch assembly (1).



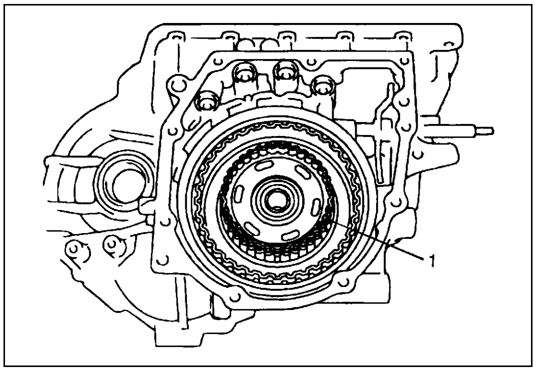
38) Remove intermediate shaft thrust bearing front race (1), thrust bearing (2) and rear race (3) from forward and reverse clutch assembly (4).

NOTE:

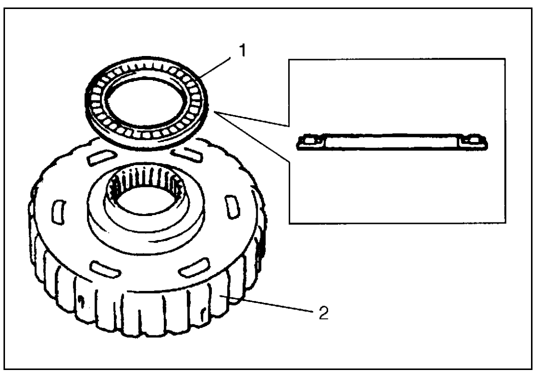
If intermediate shaft thrust bearing and/or races are not found on forward and reverse clutch assembly, they may have been left in transaxle.



39) Remove O/D and 2nd coast brake rear plate (1), discs (2), separator plate (3) and retaining plate (4).



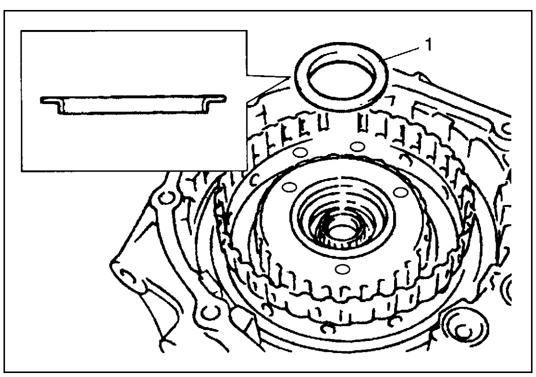
40) Remove forward clutch hub (1).



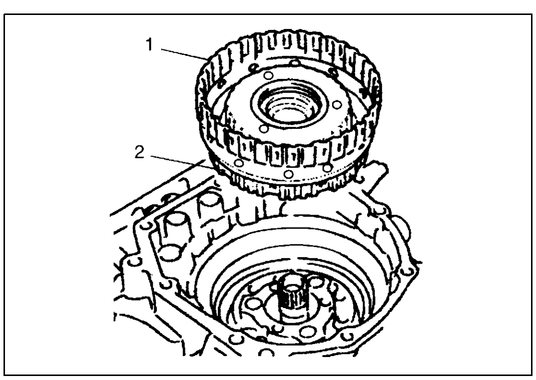
41) Remove rear sun gear thrust bearing (1) from forward clutch hub (2).

NOTE:

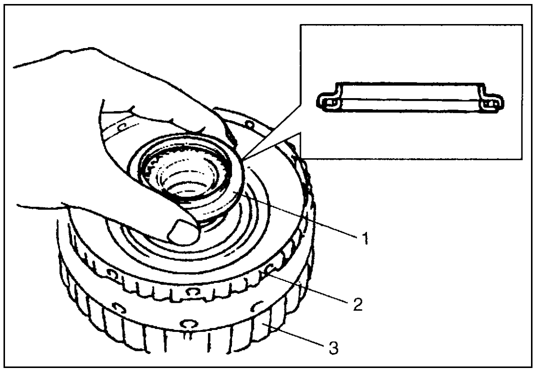
If rear sun gear thrust bearing is not found on forward clutch hub, it may have been left in transaxle.



42) Remove rear sun gear thrust bearing race (1).



43) Remove rear planetary sun gear subassembly (1) and one-way clutch No.1 assembly (2).

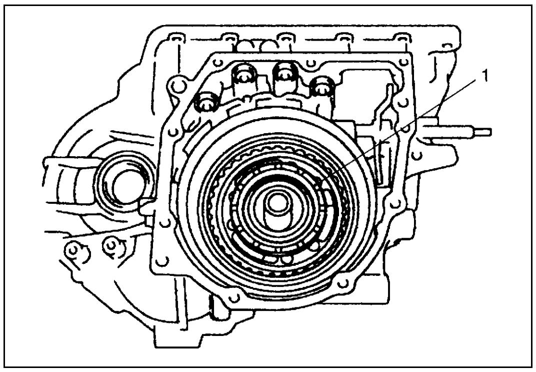


44) Remove planetary gear thrust bearing (1).

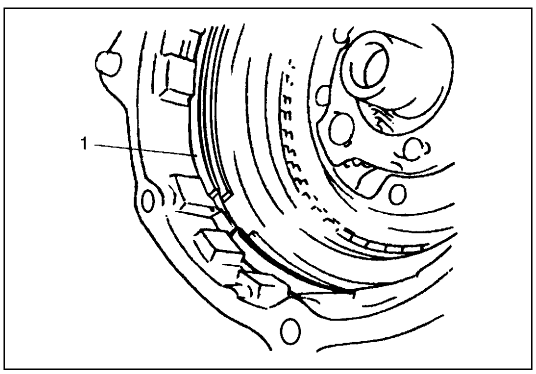
NOTE:

If planetary gear thrust bearing is not found on one-way clutch No.1 assembly, it may have been left in trasaxle.

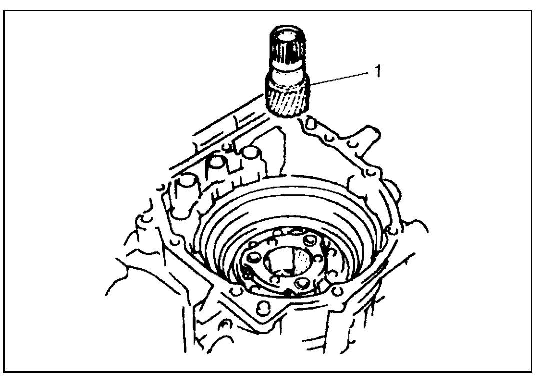
45) Remove one-way clutch No.1 assembly (2) from rear planetary sun gear subassembly (3).



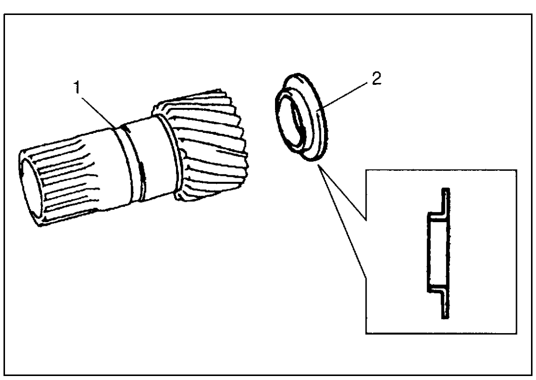
46) Remove planetary carrier thrust washer (1).



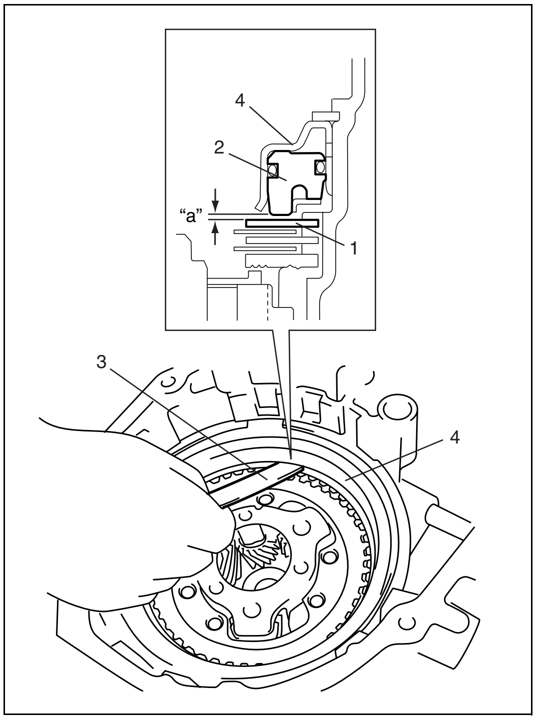
47) Remove O/D and 2nd coast brake retaining plate snap ring (1).



48) Remove front planetary sun gear (1).

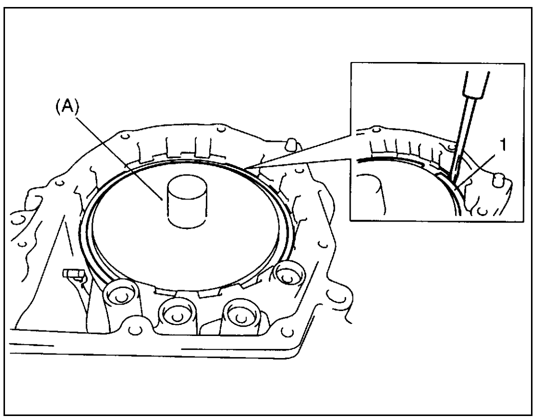


49) Remove front sun gear thrust bearing race (2) from front planetary sun gear (1).



50) Before disassembling 2nd brake piston assembly (4), check 2nd brake piston stroke by measuring clearance between 2nd brake separator plate (1) and piston (2) with feeler gauge (3).
If clearance (piston stroke) is out of specification, replace brake discs and plates with new ones.

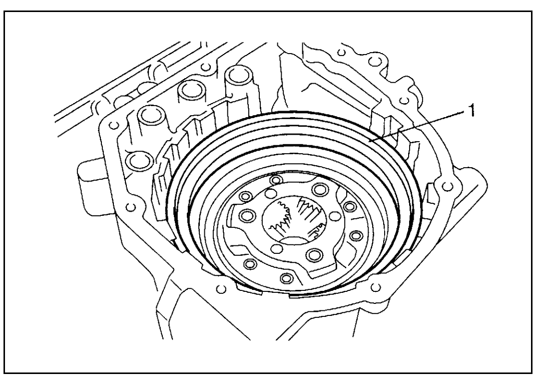
2nd brake piston stroke
"a": 0.40 – 1.25 mm (0.016 – 0.049 in.)



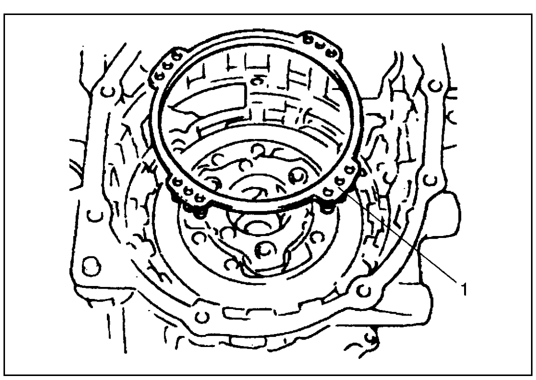
51) Using special tool and hydraulic press, remove 2nd brake piston snap ring (1).

> **CAUTION:**
> **Do not press 2nd brake piston assembly in over 0.4 mm (0.016 in.).**
> **Excessive compression may cause damage to piston assembly, return spring, plates and/or discs.**

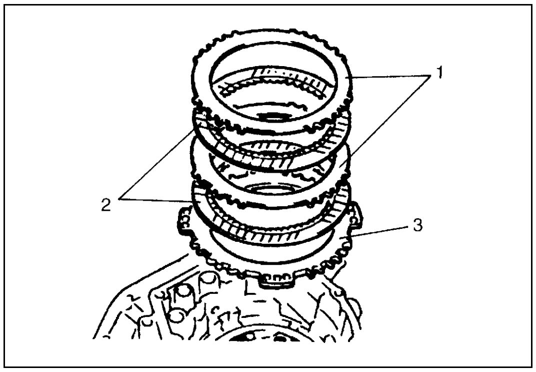
Special tool
(A): 09926-96050



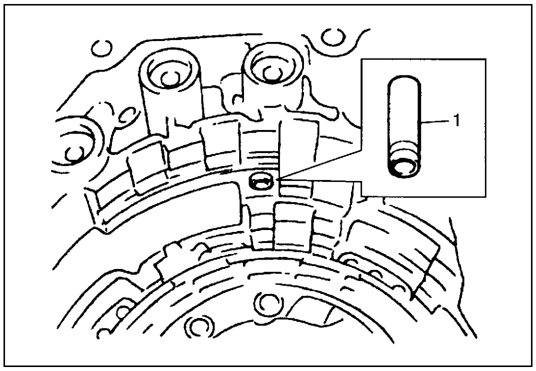
52) Remove 2nd brake piston assembly (1).



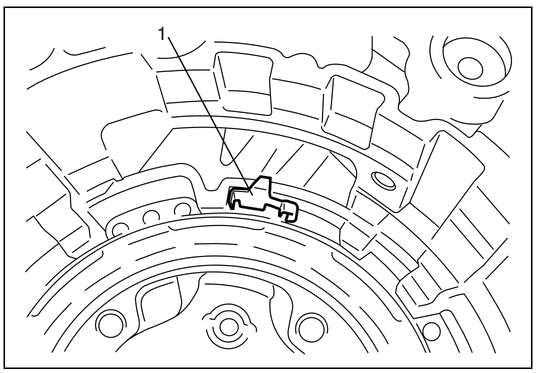
53) Remove 2nd brake return spring subassembly (1).



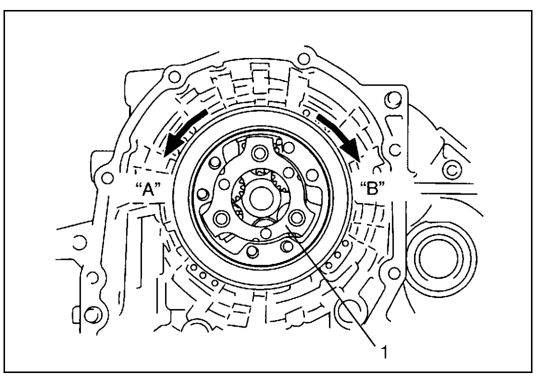
54) Remove 2nd brake separator plates (1) discs (2) and retaining plate (3).



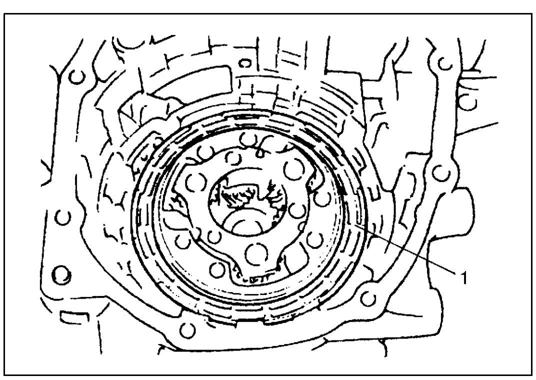
55) Remove brake drum gasket (1).



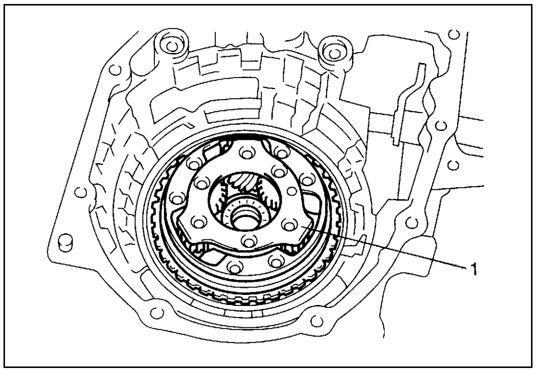
56) Remove one-way clutch outer race retainer (1).



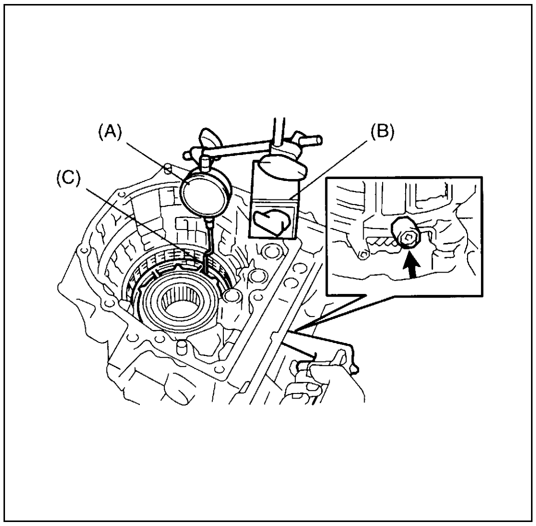
57) Check one-way clutch No.2 as follows.
- Ensure planetary carrier (1) rotates only in counterclockwise direction "A", never in clockwise direction "B".
- If the planetary carrier rotates both ways or does not rotate either way, one-way clutch No.2 assembly will need to be replaced with new one-way clutch No.2 assembly.



58) Remove one-way clutch No.2 assembly (1).



59) Remove planetary gear assembly (1).

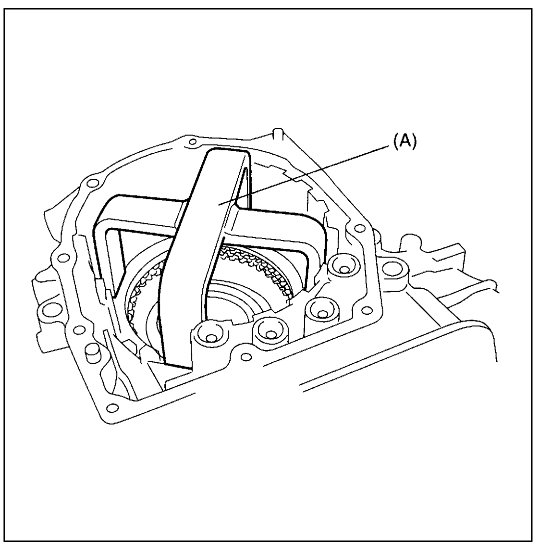


60) Measure 1st and reverse brake piston stroke
   - Using special tool, measure 1st and reserve brake piston stroke when compressed air (400 – 800 kPa, 4 – 8 kg/cm^2, 57 – 113 psi) is blown through oil hole.

Special tool
(A): 09900-20607
(B): 09900-20701
(C): 09952-06020

1st and reverse brake piston stroke
Standard: 0.79 – 1.49 mm (0.031 – 0.059 in.)

If piston stroke exceeds specified value, disassemble, inspect and replace discs and plates.

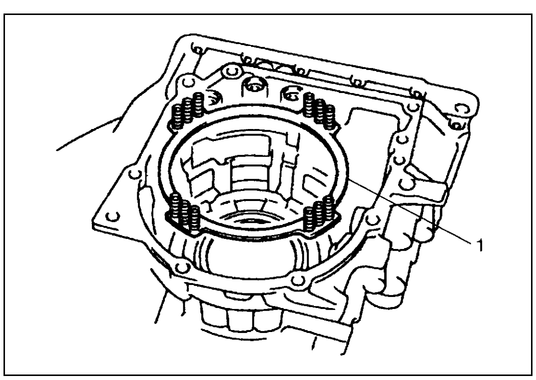


61) Remove snap ring while the 1st and reverse brake piston return springs are compressed using special tool and hydraulic press.

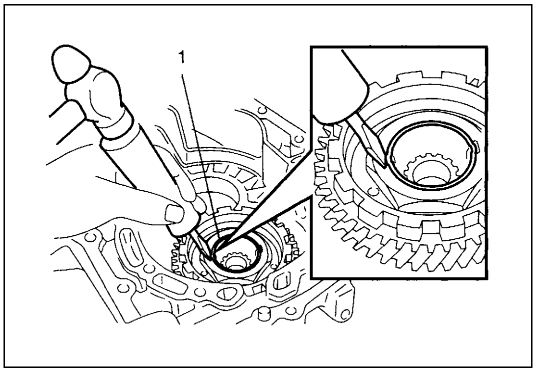
CAUTION:
Do not press 1st and reverse brake return spring subassembly in over 0.8 mm (0.031 in.).
Excessive compression may cause damage to return spring subassembly, discs, plates and/or piston.

Special tool
(A): 09926-97620

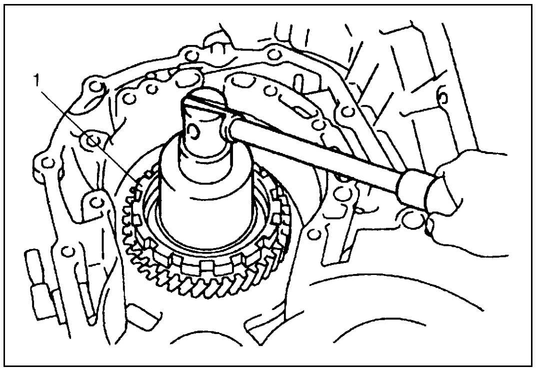
62) Remove 1st and reverse brake retaining plate, discs and separator plates.



63) Remove 1st and reverse brake return spring subassembly (1).

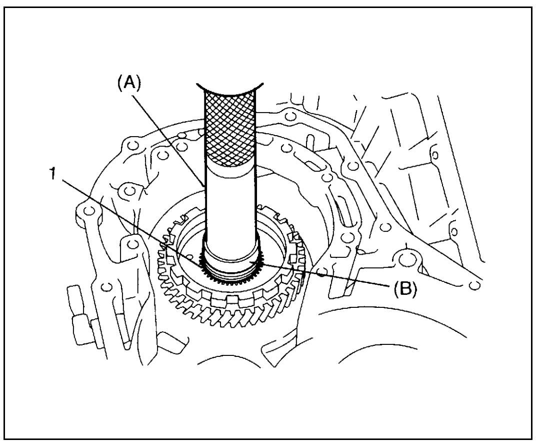


64) Turn over transaxle and uncaulk reduction drive gear nut (1).



65) Secure reduction drive gear (1) with parking lock pawl, then remove reduction drive gear nut.

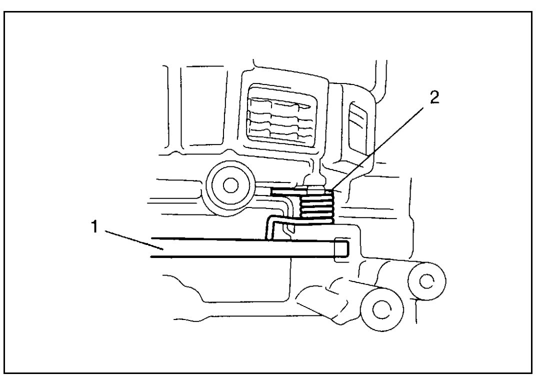
CAUTION:
- **It is recommended that this operation should be carried out on rubber mat to prevent damaging transaxle case.**
- **Never reuse removed nut.**



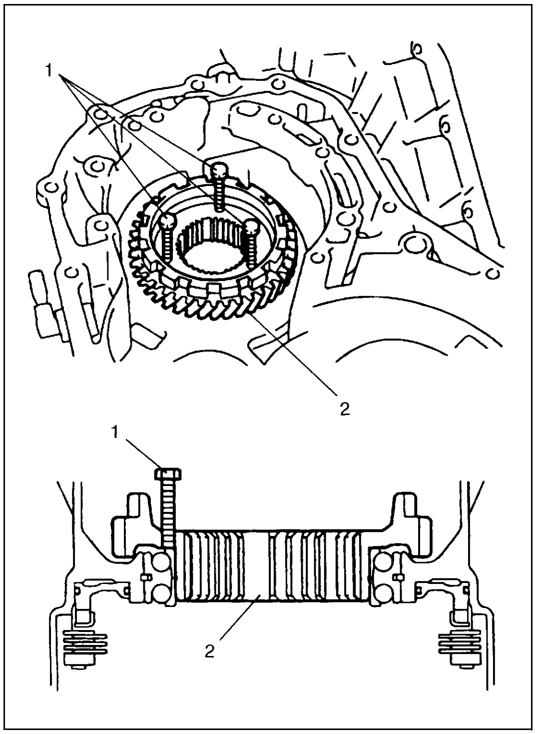
66) Using special tools and hydraulic press, remove planetary ring gear subassembly (1).

Special tool
(A): 09913-84510
(B): 09923-78210

CAUTION:
Do not reuse planetary ring gear subassembly. Otherwise it may cause damage to planetary gear unit and/or reduction gears.



67) Remove parking lock pawl shaft, then spring (2) and parking lock pawl (1).

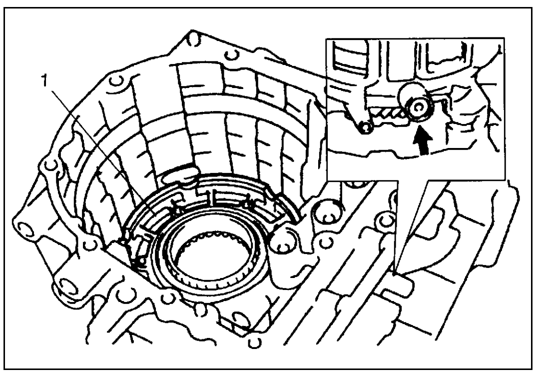


68) Screwing 3 bolts (1), remove reduction drive gear (2).

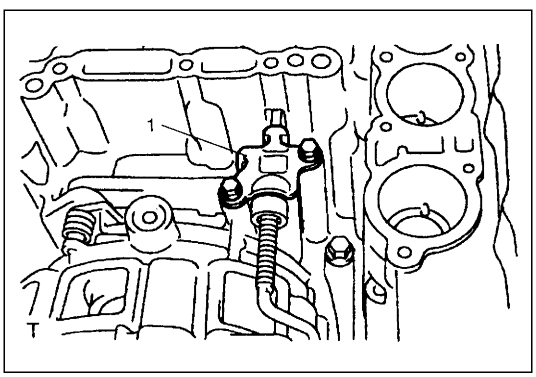
Bolt	Length
1	30 mm (1.20 in.)

CAUTION:

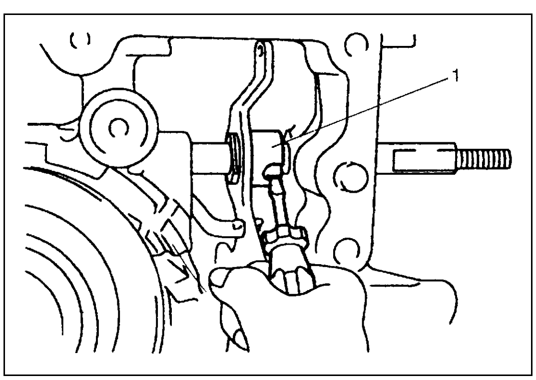
Screw 3 bolts into reduction drive gear uniformly, or reduction drive gear, bearing and transaxle case may be damaged.



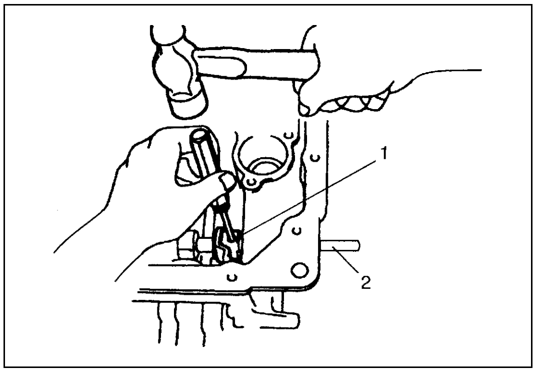
69) Blowing compressed air from oil hole of oil pump, remove 1st and reverse brake piston (1).



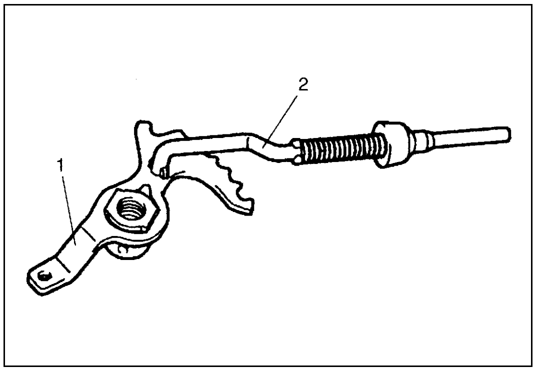
70) Remove parking lock pawl bracket (1).



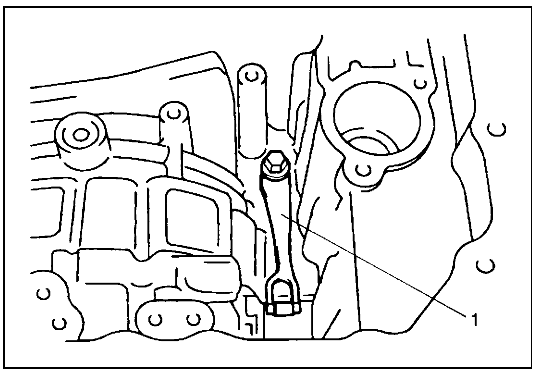
71) With slotted screw driver, cut and unfold manual valve lever spacer (1) and proceed to remove manual valve lever spacer.



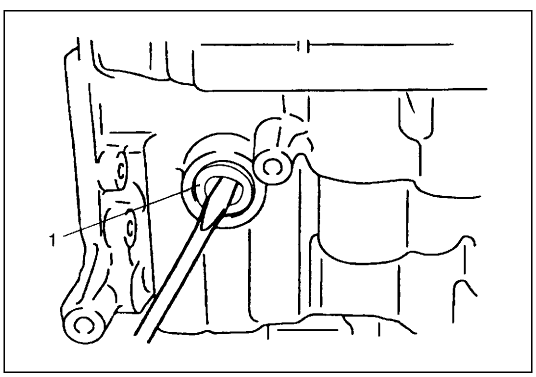
72) Using spring pin remover with 3 mm (0.12 in.) in diameter and hammer, drive out manual valve lever pin (1).
73) Remove manual shift shaft (2).



74) Remove parking lock pawl rod (2) from manual valve lever (1).



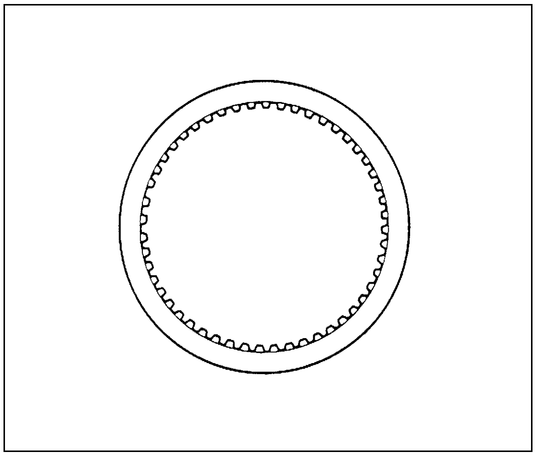
75) Remove manual detent spring (1).



76) Remove manual shift shaft oil seal (1).

Inspection

Brake Discs



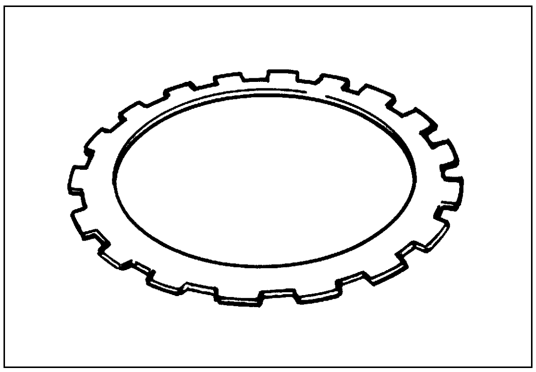
Dry and inspect them for pitting, burn flaking, significant wear, glazing, cracking, charring and chips or metal particles imbedded in lining.

If discs show any of the above conditions, replacement is required.

NOTE:

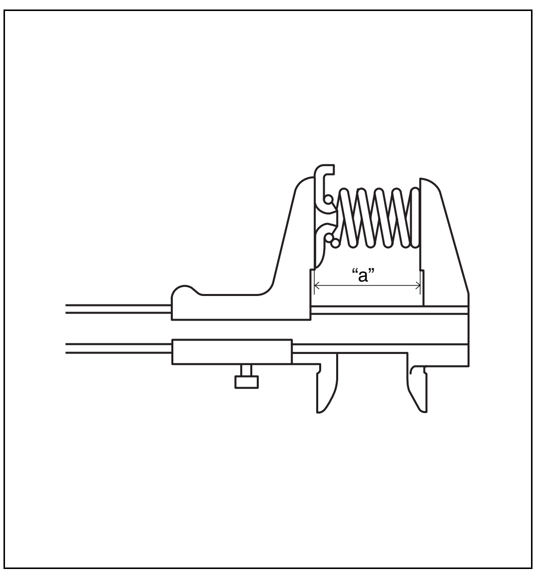
- **If disc lining is exfoliated or discolored, replace all discs.**
- **Before assembling new discs, soak them in A/T fluid for at least two hours.**

Brake Separator Plates and Retaining Plates



Dry plates and check for discoloration. If plate surface is smooth and even color smear is indicated, plate should be reused. If severe heat spot discoloration or surface scuffing is indicated, plate must be replaced.

Brake Return Spring Subassembly



Measure brake return springs.

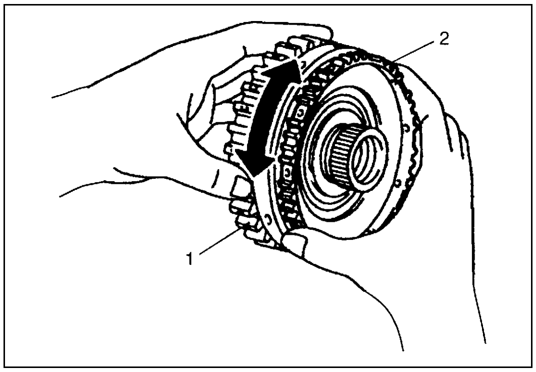
Free length of 1st & reverse brake return spring
"a": 21.71 mm (0.855 in.)

Free length of 2nd brake return spring
"a": 15.85 mm (0.624 in.)

NOTE:

- **Do not apply excessive force when measuring spring free length**
- **Perform measurement at several points.**

Evidence of extreme heat or burning in the area of clutch may have caused springs to take heat set and would require their replacement.



One-way Clutch No.1 Assembly

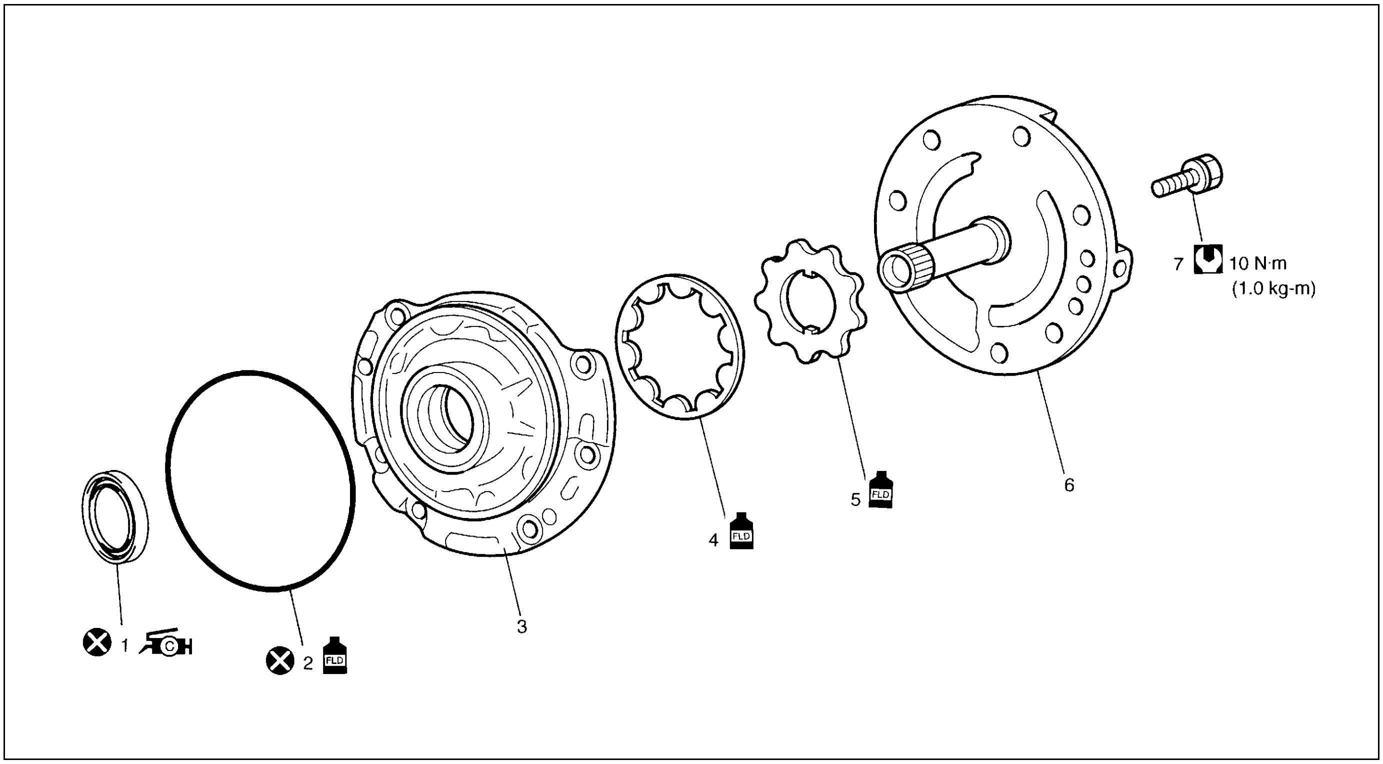
1) Install one-way clutch No.1 assembly (2) to rear planetary sun gear subassembly (1).
2) Securing rear planetary sun gear subassembly, ensure that one-way clutch No.1 assembly rotates only in one direction. If the one-way clutch rotates in both directions or it does not rotate in either direction, replace it with new one.

Disassembly/Assembly of Subassembly

CAUTION:

- **Keep component parts in group for each subassembly and avoid mixing them up.**
- **Clean all parts with cleaning solvent thoroughly and air dry them.**
- **Use kerosene or automatic transaxle fluid as cleaning solvent.**
- **Do not use wiping cloths or rags to clean or dry parts.**
- **All oil passages should be blown out and checked to make sure that they are not obstructed.**
- **Keep face and eyes away from solvent spray while air blowing parts.**
- **Check mating surface for irregularities and remove them, if any, and clean it again.**
- **Soak new clutch discs and brake discs in transaxle fluid for at least 2 hours before assembly.**
- **Replace all gaskets and O-ring with new ones.**
- **Apply automatic transaxle fluid to all O-rings.**
- **When installing seal ring, be careful so that it is not expanded excessively, extruded or caught.**
- **Replace oil seals that are removed and apply grease to their lips.**
- **Before installing, be sure to apply automatic transaxle fluid to sliding, rolling and thrusting surface of all component part. Also after installation, make sure to check each part for proper operation.**
- **Always use torque wrench when tightening bolts.**

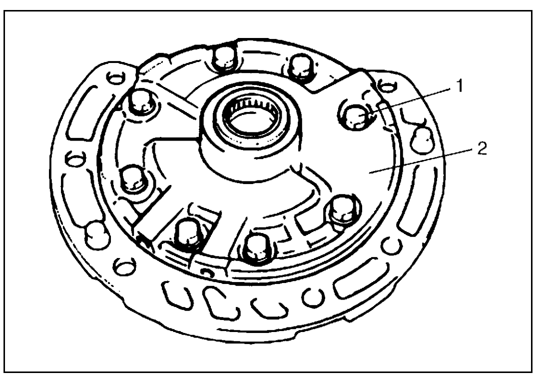
Oil pump assembly



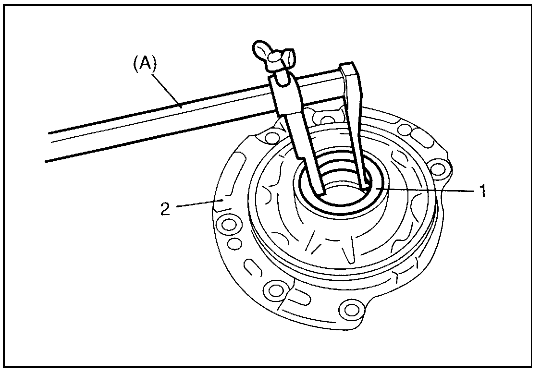
	1. Oil seal : Apply grease 99000-25030 to oil seal lip.		7. Oil pump subassembly bolts
	2. O-ring		Apply automatic transaxle fluid.
	3. Oil pump body		Tightening torque
	4. Oil pump driven gear		Do not reuse.
	5. Oil pump drive gear		
	6. Stator shaft assembly		

Disassembly

1) Remove O-ring from pump body.



2) Remove 8 oil pump subassembly bolts (1) and stator shaft assembly (2).

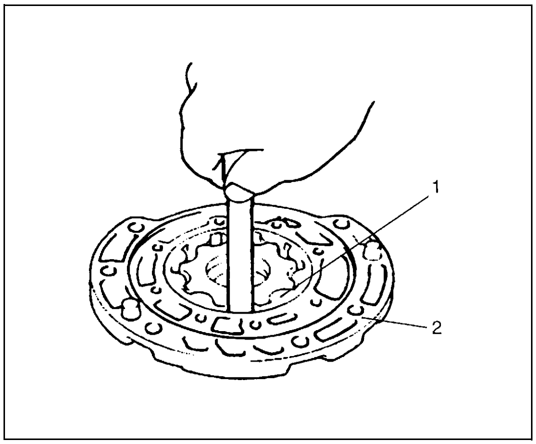


3) Remove oil seal (1) using special tool.

Special tool
(A): 09913-50121

2.	Oil pump body

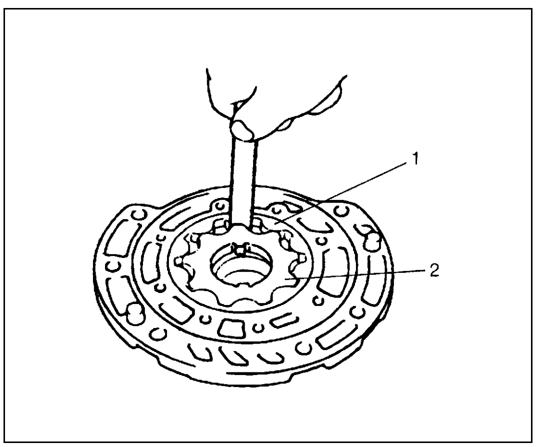
Inspection



1) Check body clearance of driven gear.
   Push driven gear to one side of body Using feeler gauge, measure clearance between driven gear and body.
   If clearance exceeds its standard value, replace oil pump assembly.

Clearance between oil pump driven gear and oil pump body
Standard: 0.1 – 0.17 mm (0.0039 – 0.0067 in.)

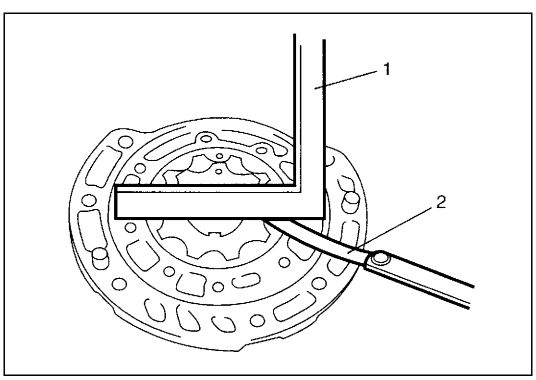
1.	Oil pump driven gear
2.	Oil pump body



2) Check tip clearance between drive and driven gear.
   Using a feeler gauge, measure clearance between drive and driven gear tips.
   If clearance exceeds its standard value, replace oil pump assembly.

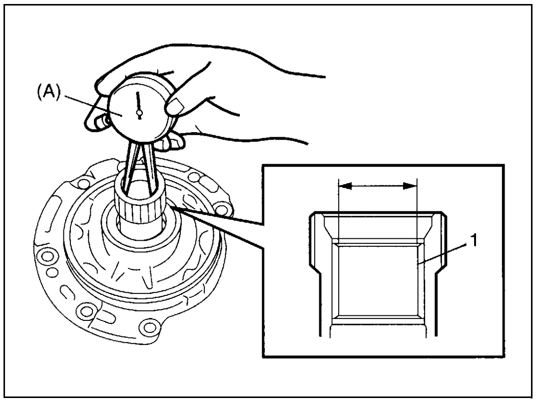
Tip clearance between oil pump drive gear and oil pump driven gear
Standard: 0.07 – 0.15 mm (0.0028 – 0.0059 in.)

1.	Oil pump driven gear
2.	Oil pump drive gear



3) Check side clearance of both gears.
   Using straightedge (1) and feeler gauge (2), measure side clearance between gears and pump body.
   If clearance exceeds its standard value, replace oil pump assembly.

Side clearance between gears and oil pump body
Standard: 0.02 – 0.05 mm (0.0008 – 0.0019 in.)

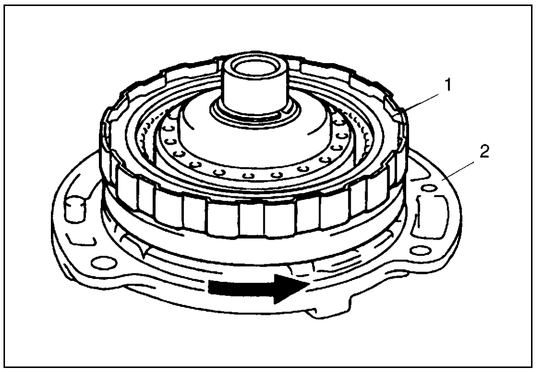


4) Using special tool, measure stator shaft bush bore.
   If measured stator shaft bush bore is out of specifications, replace oil pump assembly with new one.

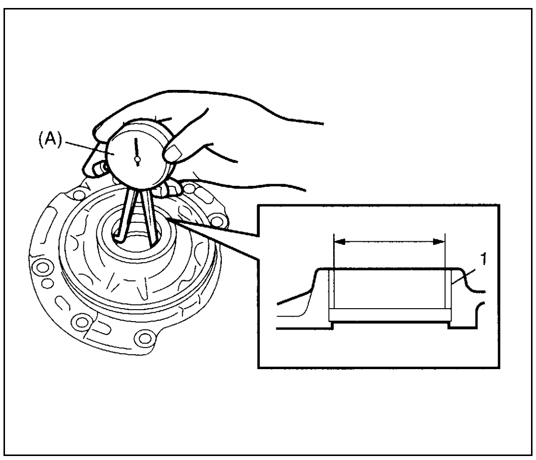
Special tool
(A): 09900-20605

Stator shaft bush bore
Standard: 18.424 – 18.450 mm (0.7254 – 0.7264 in.)

1. Stator shaft bush



5) Install direct clutch assembly (1) to stator shaft assembly (2), then ensure that direct clutch assembly turns smoothly.
   If unsmooth rotation or noise are found in oil pump assembly, replace oil pump assembly with new one. This check should also be done to input shaft assembly and replace input shaft assembly if necessary.



6) Using special tool, measure oil pump body bush bore.

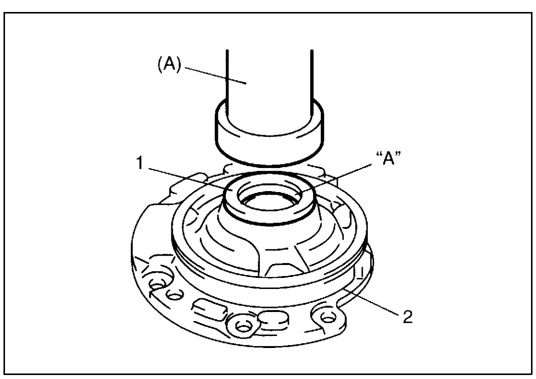
Special tool
(A): 09900-20605

Oil pump body bush bore
Standard: 38.113 – 38.138 mm (1.5005 – 1.5015 in.)

If measured oil pump body bush bore is out of specifications, replace oil pump assembly with new one. Torque converter also needs to be checked. Replace torque converter, if necessary.

1. Oil pump body bush

Assembly



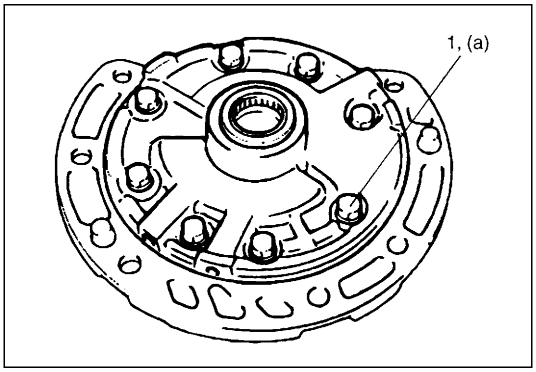
1) Install new oil pump body oil seal (1).
   Use special tool and hammer to install it, and then apply grease to its lip.

Special tool
(A): 09913-85210

"A": Grease 99000-25030

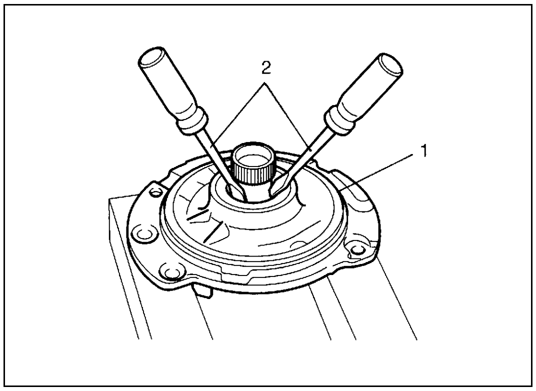
1. Oil pump body

2) Install driven gear and drive gear to oil pump body after applying A/T fluid.



3) Install stator shaft assembly to oil pump body and tighten 8 pump subassembly bolts (1) to specification.

Tightening torque
Oil pump subassembly bolt
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)



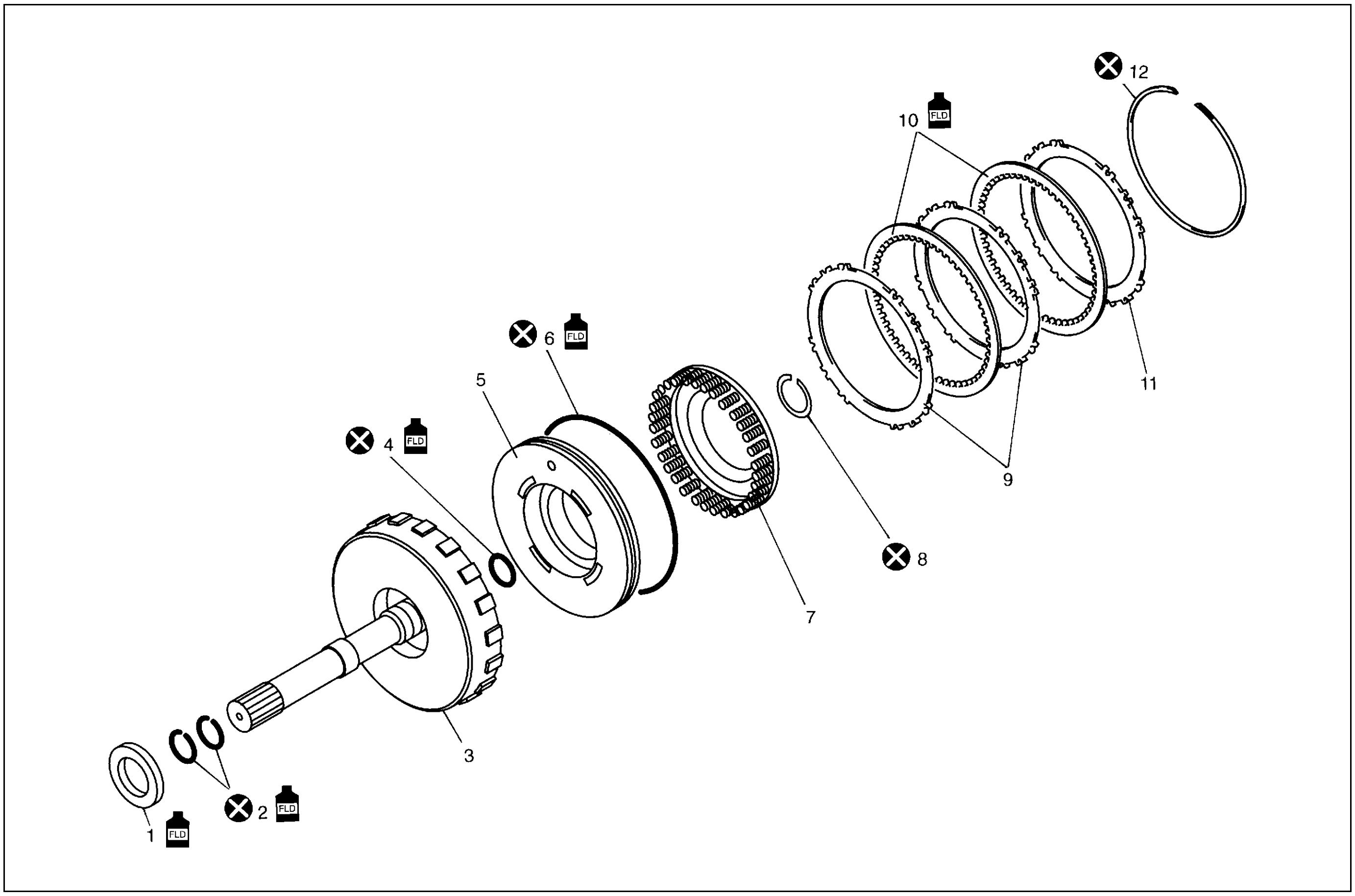
4) After applying A/T fluid to new O-ring, install it to oil pump body.

CAUTION:
Do not damage oil seal with slotted screw driver.

5) Check drive gear for smooth rotation by using slotted screw driver.

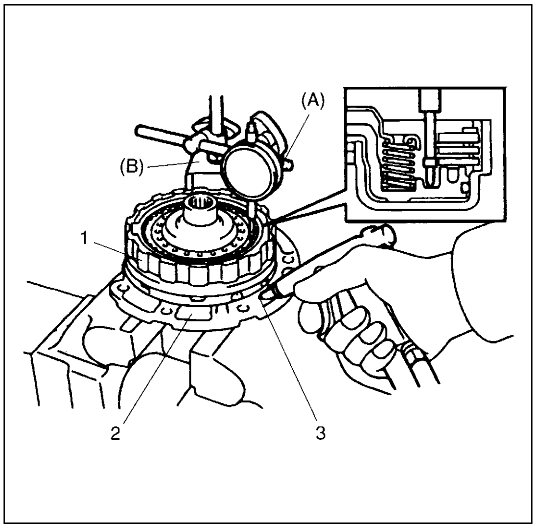
1.	Oil pump assembly
2.	Slotted screw driver

Direct clutch assembly



1. Input shaft front thrust bearing	8. Shaft snap ring
2. Input shaft seal ring	9. Direct clutch separator plate
3. Input shaft subassembly	10. Direct clutch disc
4. Inner O-ring	11. Direct clutch retaining plate
5. Direct clutch piston	12. Plate snap ring
6. Outer O-ring	FLD Apply automatic transaxle fluid.
7. Direct clutch return spring subassembly	Do not reuse.

Preliminary Check



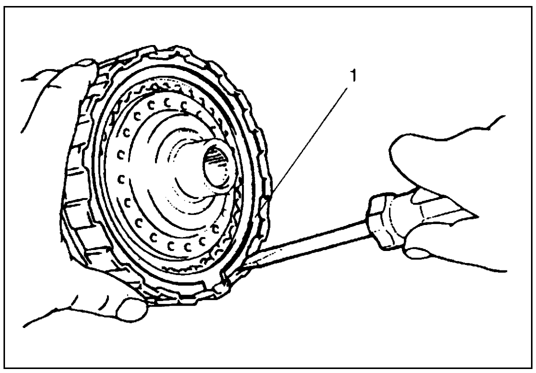
1) Install direct clutch assembly (1) to oil pump assembly (2), blow in air (400 – 800 kPa, 4 – 8 kg/cm^2, 57 – 113 psi) through oil hole (3) of oil pump assembly with special tool attached on upper surface of direct clutch piston, and measure piston stroke of direct clutch.

   Special tool
   (A): 09900-20607
   (B): 09900-20701

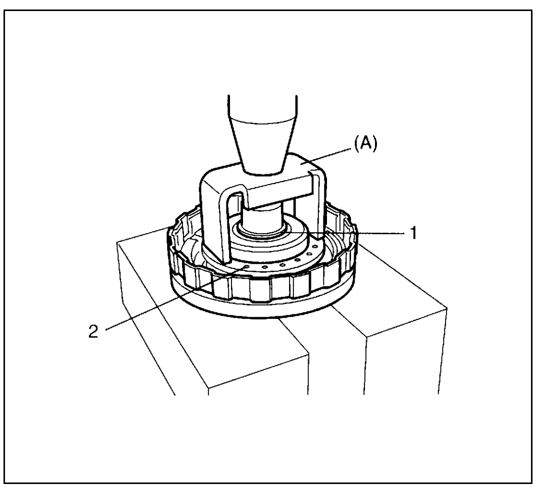
   Direct clutch piston stroke: 0.4 – 0.7 mm (0.016 – 0.027 in.)

If piston stroke exceeds specified value, disassemble, inspect and replace inner parts.

Disassembly



1) Remove plate snap ring (1), then remove direct clutch retaining plate, discs and separator plates.

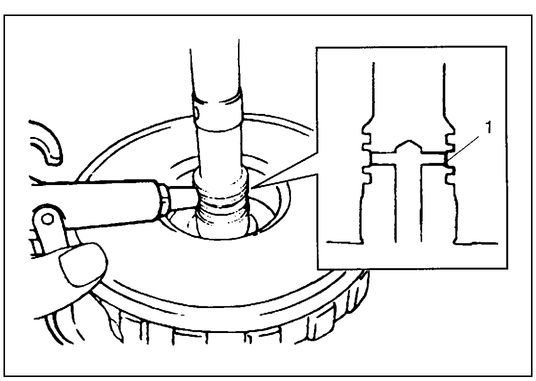


2) Using special tool and hydraulic press, remove shaft snap ring (1).

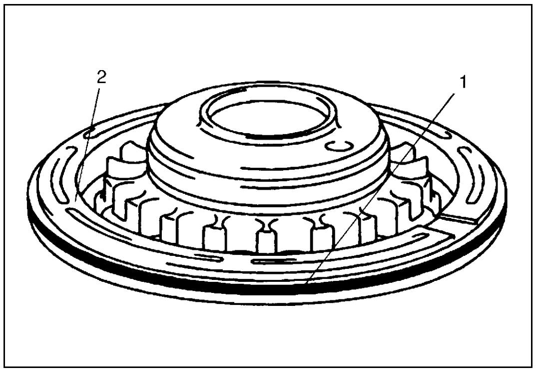
   CAUTION:
   Do not press direct clutch return spring subassembly in over 0.7 mm (0.027 in.).
   Excessive compression may cause damage to direct clutch return spring subassembly and/or piston.

   Special tool
   (A): 09926-98310

3) Remove direct clutch return spring assembly (2).

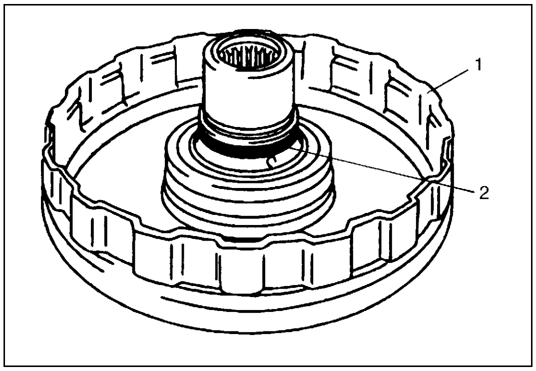


4) Using a finger to block oil hole (1), apply compressed air (400 – 800 kPa, 4 – 8 kg/cm^2, 57 – 113 psi) to opposite hole, which will assist in removal of the clutch piston.



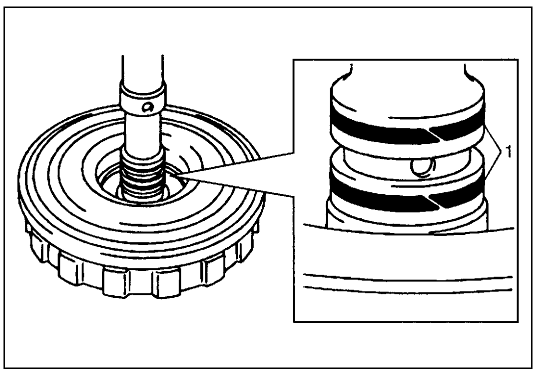
5) Remove outer O-ring (1).

2. Direct clutch piston



6) Remove inner O-ring (2).

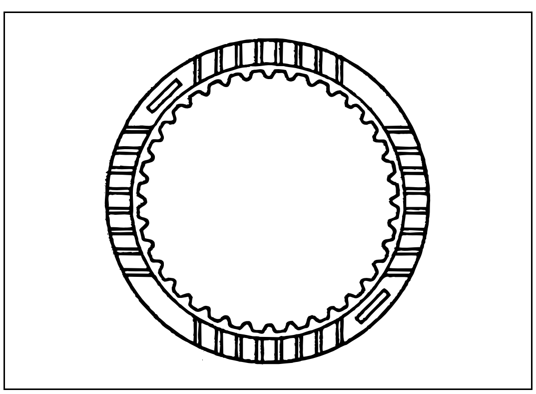
1. Input shaft subassembly



7) Remove input shaft seal rings (1).

Inspection

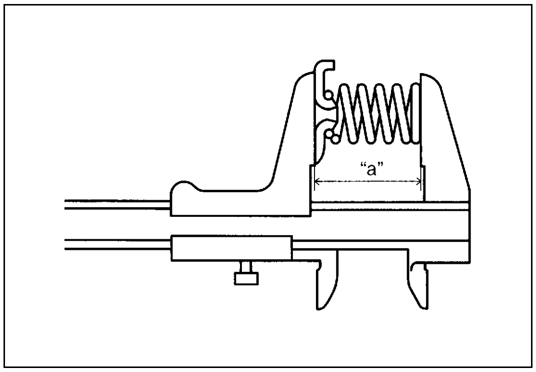
Clutch Discs, Plates and Retaining Plate



Check that sliding surfaces of discs, separator plates and retaining plate are not worn hard or burnt. If necessary, replace.

NOTE:

- **If disc lining is exfoliated or discolored, replace all discs.**
- **Before assembling new discs, soak them in A/T fluid for at least two hours.**



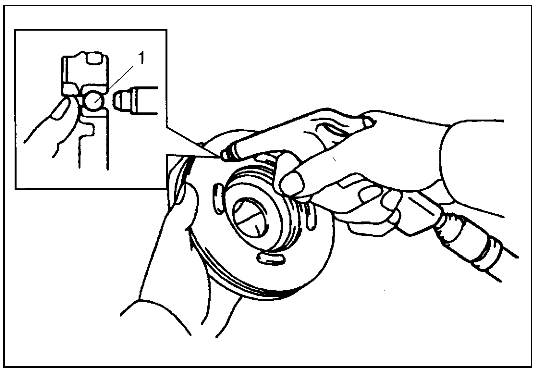
Direct Clutch Return Spring Subassembly

Measure free length of direct clutch return spring.

Free length of direct clutch return spring
"a": 36.04 mm (1.419 in.)

NOTE:

- **Do not apply excessive force when measuring spring free length.**
- **Perform measurement at several points.**



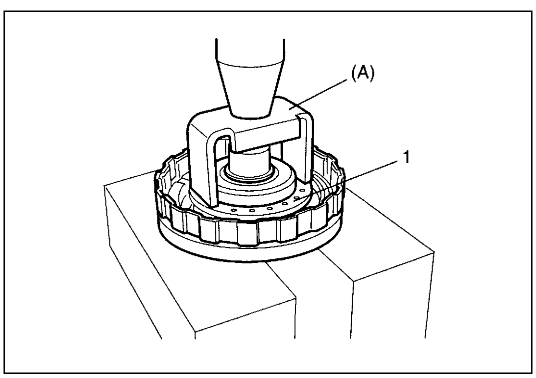
Direct Clutch Piston

Shake direct clutch piston lightly and check that check ball (1) is not stuck. Blow in low-pressure air (Max 100 kPa, 1 kg/cm^2, 15 psi) to check ball to check that there is no air leakage.

Assembly

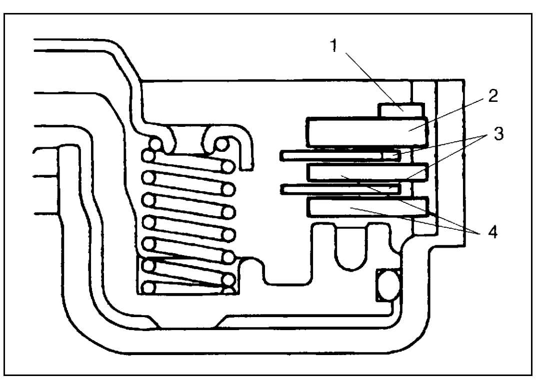
Reverse disassembly procedure for assembly, noting the following points.

- Use new seal ring and O-ring. Apply A/T fluid before installation.

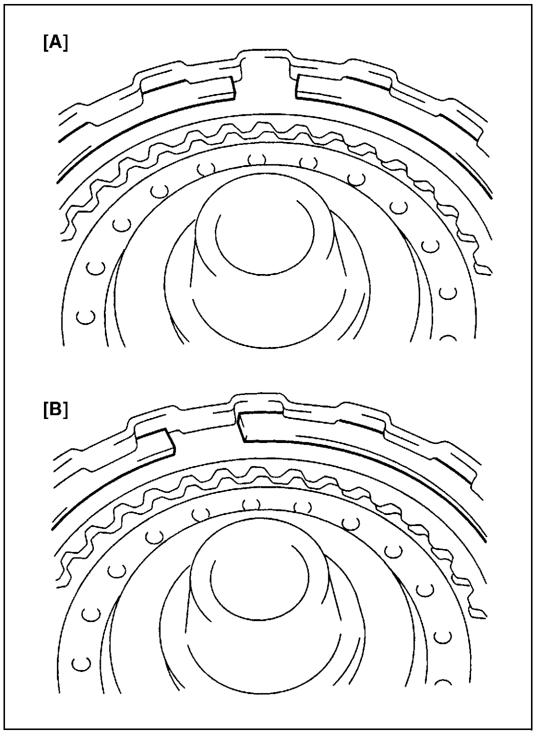


- Do not damage direct clutch return spring subassembly (1) and piston by pressing in direct clutch return spring subassembly passing through its original installing position over 0.7 mm (0.027 in.).

Special tool
(A): 09926-98310

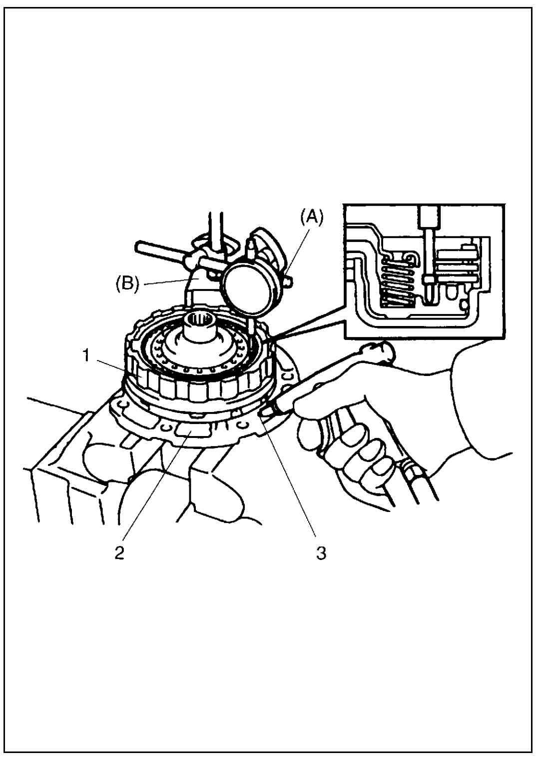


- Apply A/T fluid to direct clutch separator plates (4), discs (3) and retaining plate (2).
- Install direct clutch separator plates (4) discs (3) retaining plate (2) and snap ring (1) to input shaft subassembly.



- Install plate snap ring so that its both ends would be positioned in correct locations as shown in figure.

[A]	Correct
[B]	Incorrect



- After assembly, measure direct clutch piston stroke.

Special tool
(A): 09900-20607
(B): 09900-20701

Direct clutch piston stroke: 0.4 – 0.7 mm (0.016 – 0.027 in.)

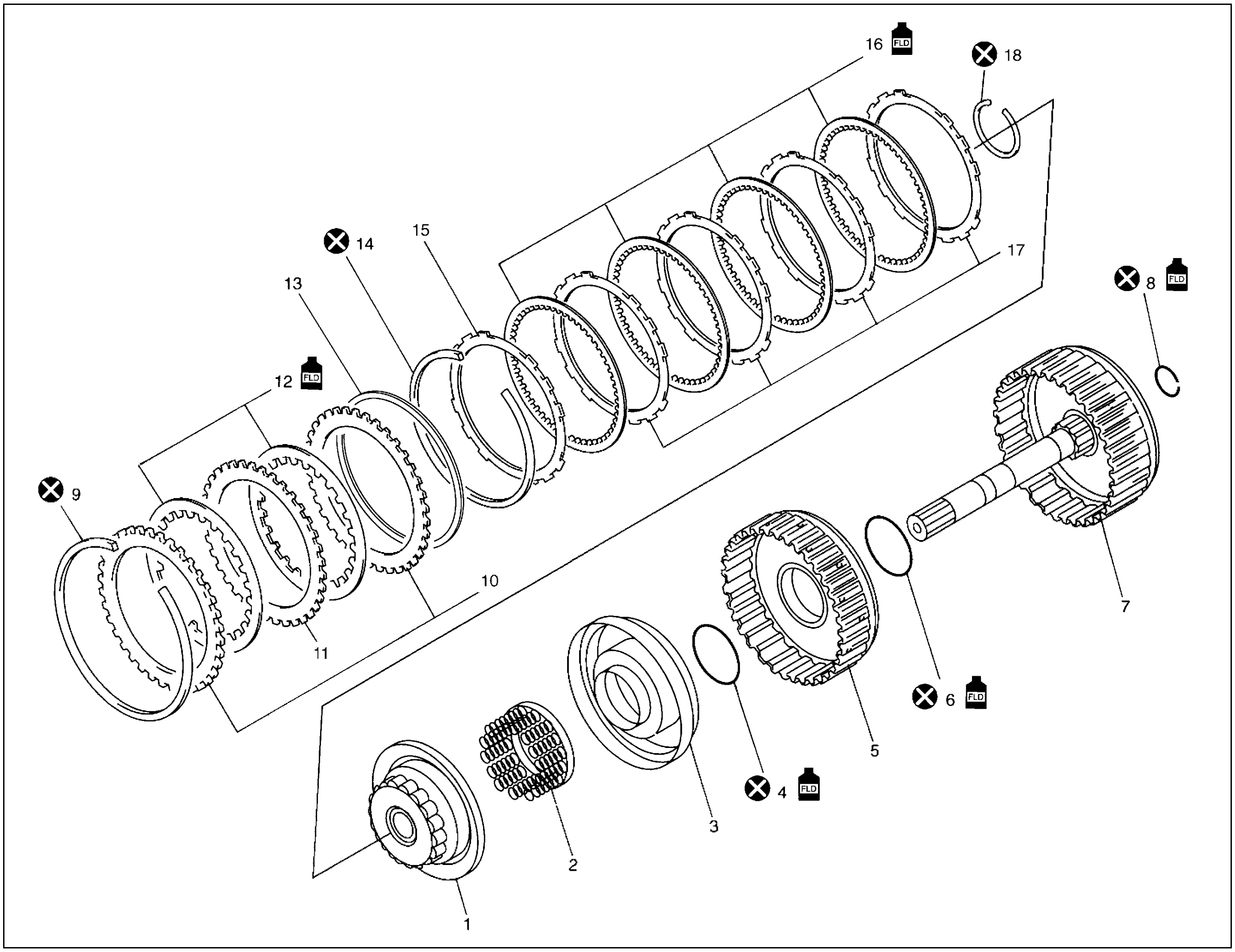
When piston strike is out of specification, select direct clutch retaining plate with suitable thickness from among the list below and replace it.

Available direct clutch retaining plate thickness

Thickness	Identification mark
2.8 mm	4
3.0 mm (0.118 in.)	1
3.2 mm (0.126 in.)	2
3.4 mm (0.134 in.)	3

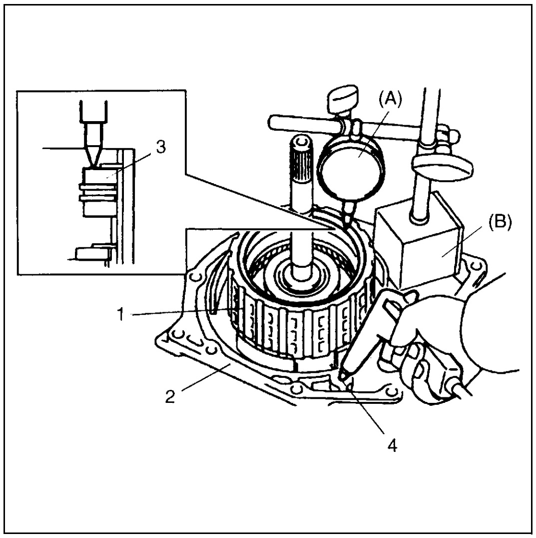
1.	Direct clutch assembly
2.	Oil pump assembly
3.	Oil hole

Forward and reverse clutch assembly



1.	Forward clutch balancer	11.	Reverse clutch separator plate
2.	Forward clutch return spring subassembly	12.	Reverse clutch disc
3.	Forward clutch piston	13.	Reverse clutch cushion plate
4.	Forward clutch piston O-ring	14.	Forward clutch plate snap ring
5.	Forward clutch drum	15.	Forward clutch retaining plate
6.	Forward clutch drum O-ring	16.	Forward clutch disc
7.	Intermediate shaft subassembly	17.	Forward clutch separator plate
8.	Inter mediate shaft seal ring	18.	Balancer snap ring
9.	Reverse clutch plate snap ring	FLD	Apply automatic transaxle fluid.
10.	Reverse clutch retaining plate		Do not reuse.

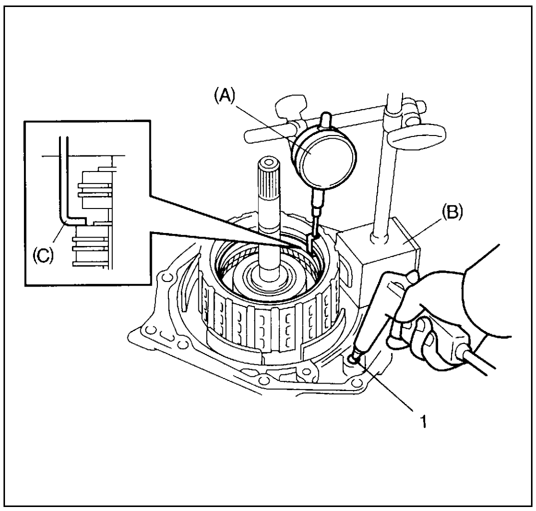
Preliminary Check



1) Install forward and reverse clutch assembly (1) to transaxle rear cover (2), blow in compressed air (400 – 800 kPa, 4 – 8 kg/cm^2, 57 – 113 psi) through oil hole (4) of transaxle rear cover with the special tool attached on the upper surface of reverse clutch retaining plate (3), and measure reverse clutch piston stroke.
   If piston stroke exceeds specified value, disassemble, inspect and replace inner parts.

Special tool
(A): 09900-20607
(B): 09900-20701

Reverse clutch piston stroke: 1.20 – 1.60 mm (0.047 – 0.063 in.)

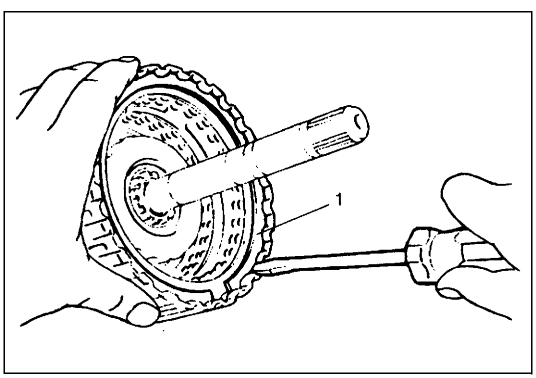


2) Blow compressed air (400 – 800 kPa, 4 – 8 kg/cm^2, 57 – 113 psi) through oil hole (1) of transaxle rear cover with the special tool attached on the upper surface of forward clutch retaining plate, and measure forward clutch piston stroke.
   If piston stroke exceeds specified value, disassemble, inspect and replace inner parts.

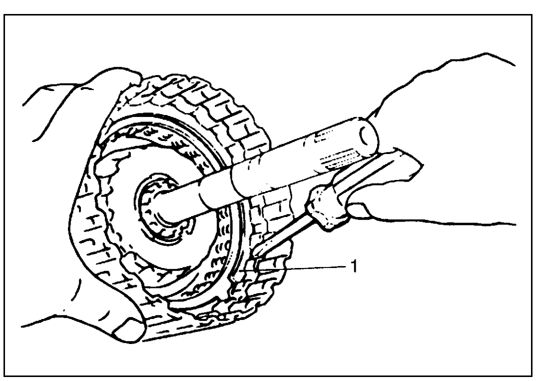
Special tool
(A): 09900-20607
(B): 09900-20701
(C): 09952-06020

Forward clutch piston stroke: 1.30 – 1.50 mm (0.051 – 0.059 in.)

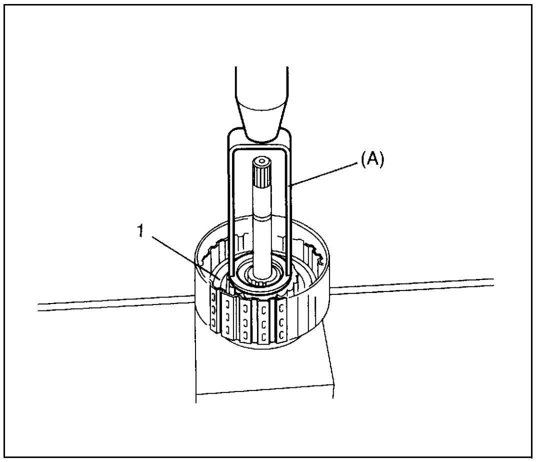
Disassembly



1) Remove reverse clutch plate snap ring (1) and take out reverse clutch retaining plate, discs, separator plates and reverse clutch cushion plate from intermediate shaft subassembly.



2) Remove forward clutch plate snap ring (1) and take out forward clutch retaining plate, discs and separator plates from forward clutch drum.



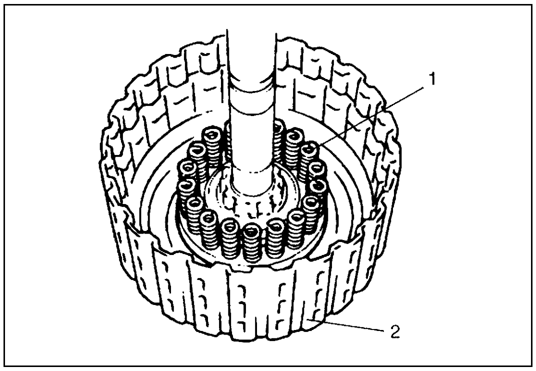
3) Remove balancer snap ring by using special tool and hydraulic press.

CAUTION:

Do not press forward clutch return spring subassembly in over 1.5 mm (0.059 in.).
Excessive compression may cause damage to return spring subassembly and/or balancer.

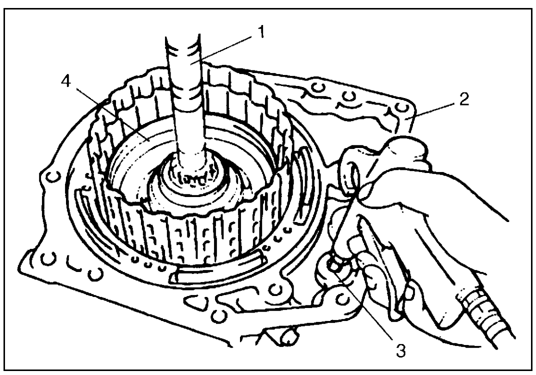
Special tool
(A): 09926-97610

4) Remove forward clutch balancer (1).

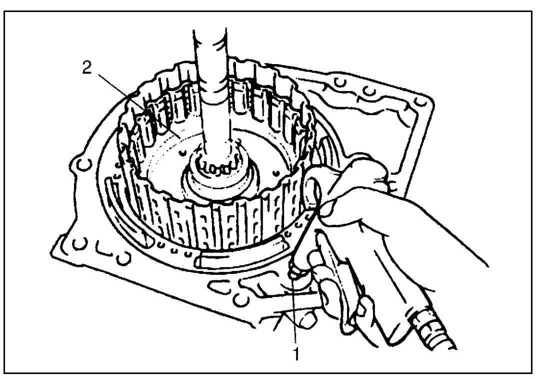


5) Remove forward clutch return spring subassembly (1).

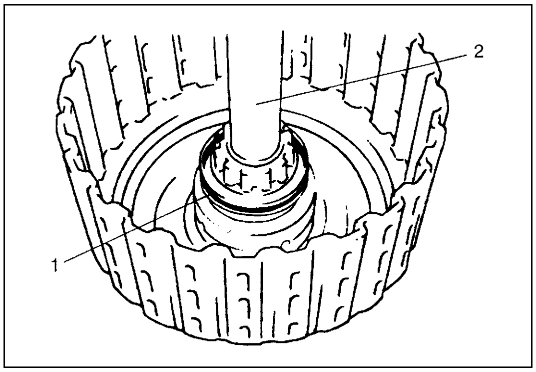
2. Intermediate shaft subassembly



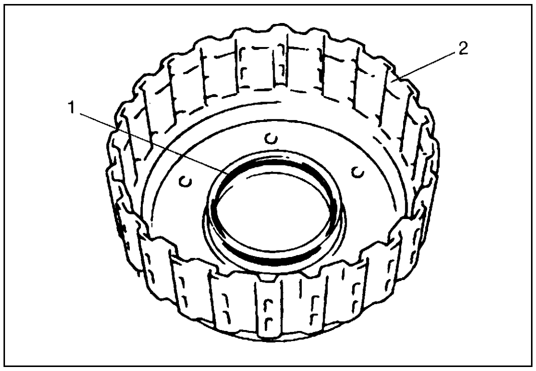
6) Install intermediate shaft subassembly (1) to transaxle rear cover (2). Apply compressed air (400 – 800 kPa, 4 – 8 kg/cm^2, 57 – 113 psi) to oil hole (3) of transaxle rear cover to remove forward clutch piston (4).



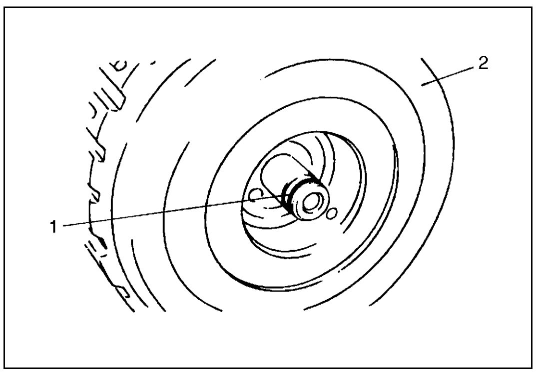
7) Apply compressed air (400 – 800 kPa, 4 – 8 kg/cm^2, 57 – 113 psi) to oil hole (1) of transaxle rear cover to remove forward clutch drum (2).



8) Remove forward clutch piston O-ring (1) from intermediate shaft subassembly (2).



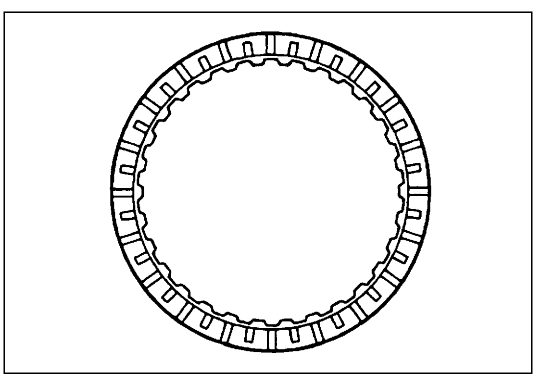
9) Remove forward clutch drum O-ring (1) from forward clutch drum (2).



10) Remove intermediate shaft seal ring (1) from intermediate shaft subassembly (2).

Inspection

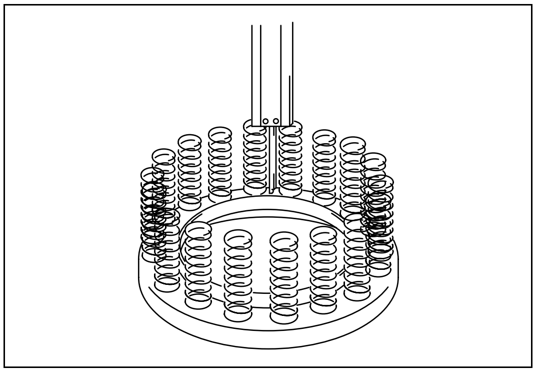
Clutch Discs, Separator Plates and Retaining Plate



Check that sliding surfaces of discs, separator plates and retaining plate are not worn hard or burnt. If necessary, replace.

NOTE:
- **If disc lining is exfoliated or discolored, replace all discs.**
- **Before assembling new discs, soak them in A/T fluid for at least two hours.**

Forward Clutch Return Spring Subassembly

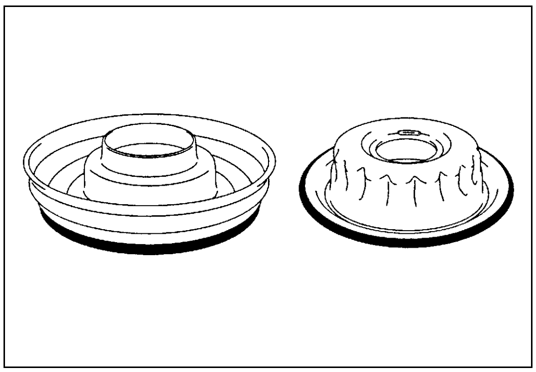


Measure free length of forward clutch return spring.

Free length of forward clutch return spring:
24.04 mm (0.946 in.)

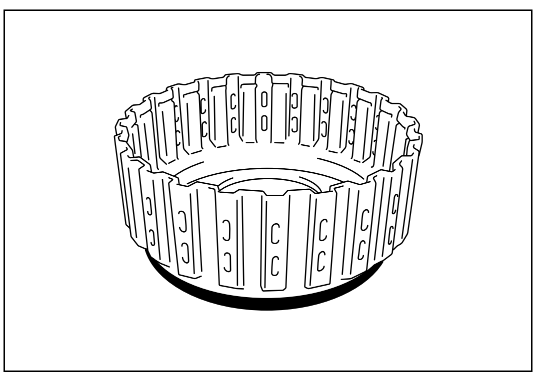
NOTE:
- **Do not apply excessive force when measuring spring free length.**
- **Perform measurement at several points.**

Forward Clutch Piston Lip and Forward Clutch Balancer Lip



Check each lip for wear, deformation, cut, and/or hardening. If necessary, replace.

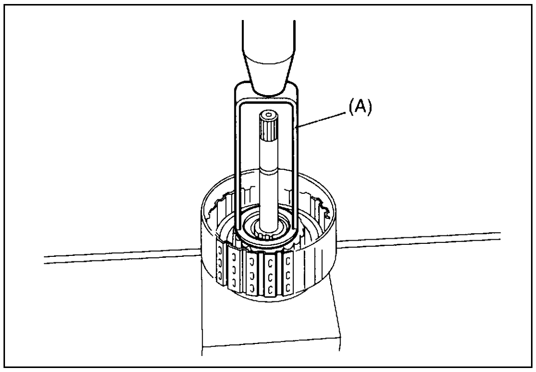
Forward Clutch Drum Lip



Check each lip for wear, deformation, cut, and/or hardening. If necessary, replace.

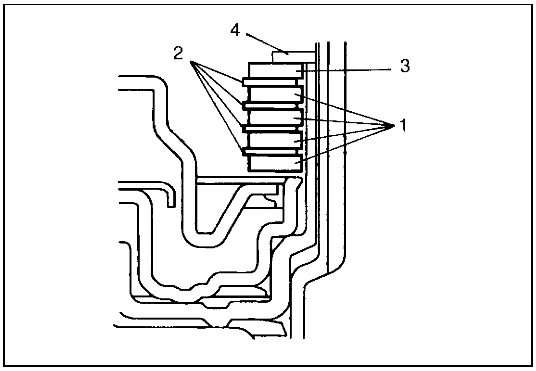
Assembly

Reverse disassembly procedure for assembly, noting the following points.
- Before assembling, apply automatic transaxle fluid to component parts.
- Replace O-rings and seal ring with new ones.

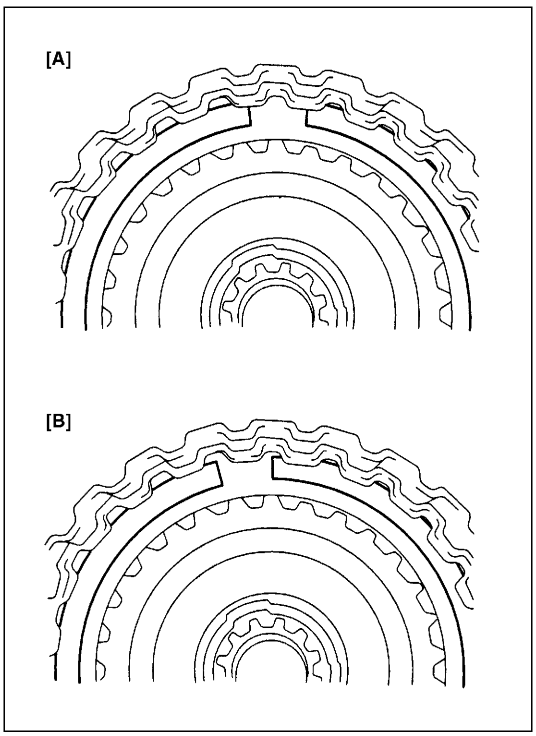


- Do not damage forward clutch return spring subassembly and balancer by pressing in forward clutch return spring subassembly passing through its original installing position over 1.5 mm (0.059 in.).

Special tool
(A): 09926-97610

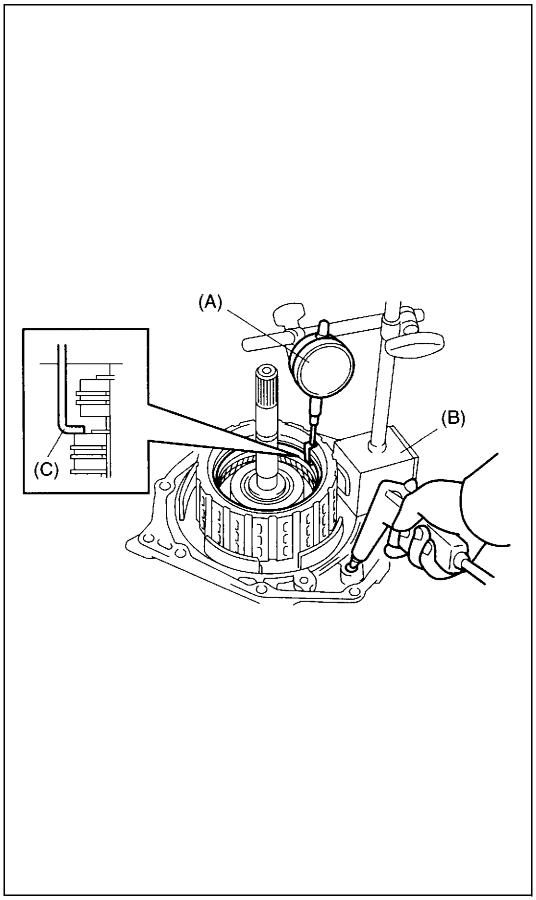


- Apply A/T fluid to forward clutch separator plates (1), discs (2) and retaining plate (3).
- Install forward clutch separator plates (1), discs (2) and retaining plate (3), then snap ring (4) to forward clutch drum.



- Install forward clutch plate snap ring so that its both ends would be positioned in correct locations as shown in figure.

[A]	Correct
[B]	Incorrect



- Measure forward clutch piston stroke in the same manner as "Preliminary Check".

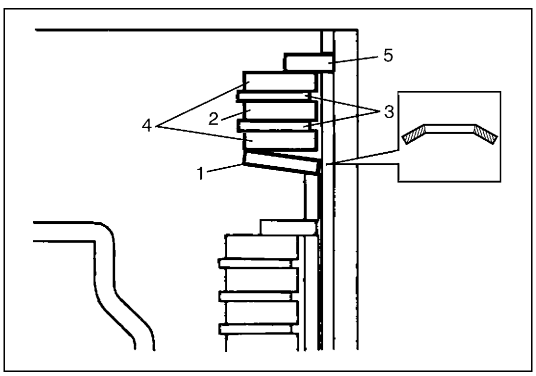
Special tool
(A): 09900-20607
(B): 09900-20701
(C): 09952-06020

Forward clutch piston stroke: 1.30 – 1.50 mm (0.051 – 0.059 in.)

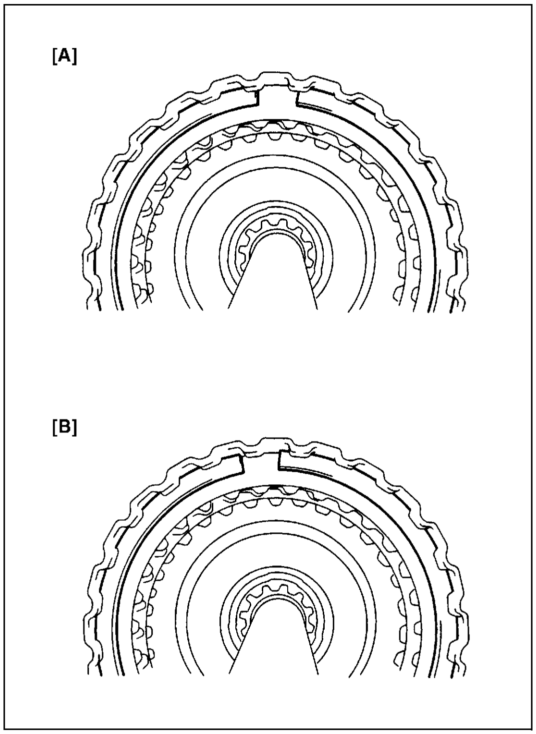
When piston stroke is out of specification, select forward clutch retaining plate with proper thickness from among the list below and replace it.

Available forward clutch retaining plate thickness

Thickness	Identification mark
3.0 mm (0.118 in.)	1
3.1 mm (0.122 in.)	5
3.2 mm (0.126 in.)	2
3.3 mm (0.130 in.)	6
3.4 mm (0.134 in.)	3
3.5 mm (0.138 in.)	7
3.6 mm (0.142 in.)	4

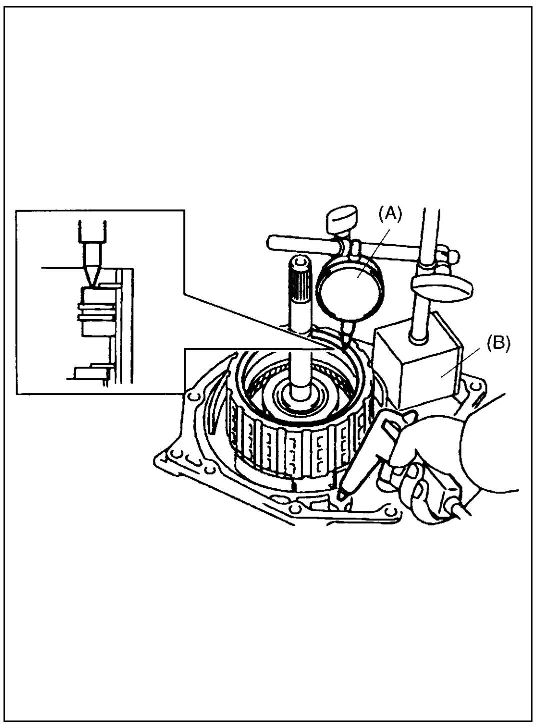


- Install reverse clutch cushion plate (1) in correct direction as shown in figure.
- Apply A/T fluid to reverse clutch cushion plate (1) reverse clutch separator plate (2) disces (3) and retaining plate (4).
- Install reverse clutch cushion plate (1) reverse clutch separator plate (2) disces (3) retaining plate (4) and then snap ring (5) to intermediate shaft subassembly.



- Install reverse clutch plate snap ring so that its both ends would be positioned in correct locations as shown in figure.

[A]:	Correct
[B]:	Incorrect



- Measure reverse clutch piston stroke in the same manner as "Preliminary Check".

Special tool
(A): 09900-20607
(B): 09900-20701

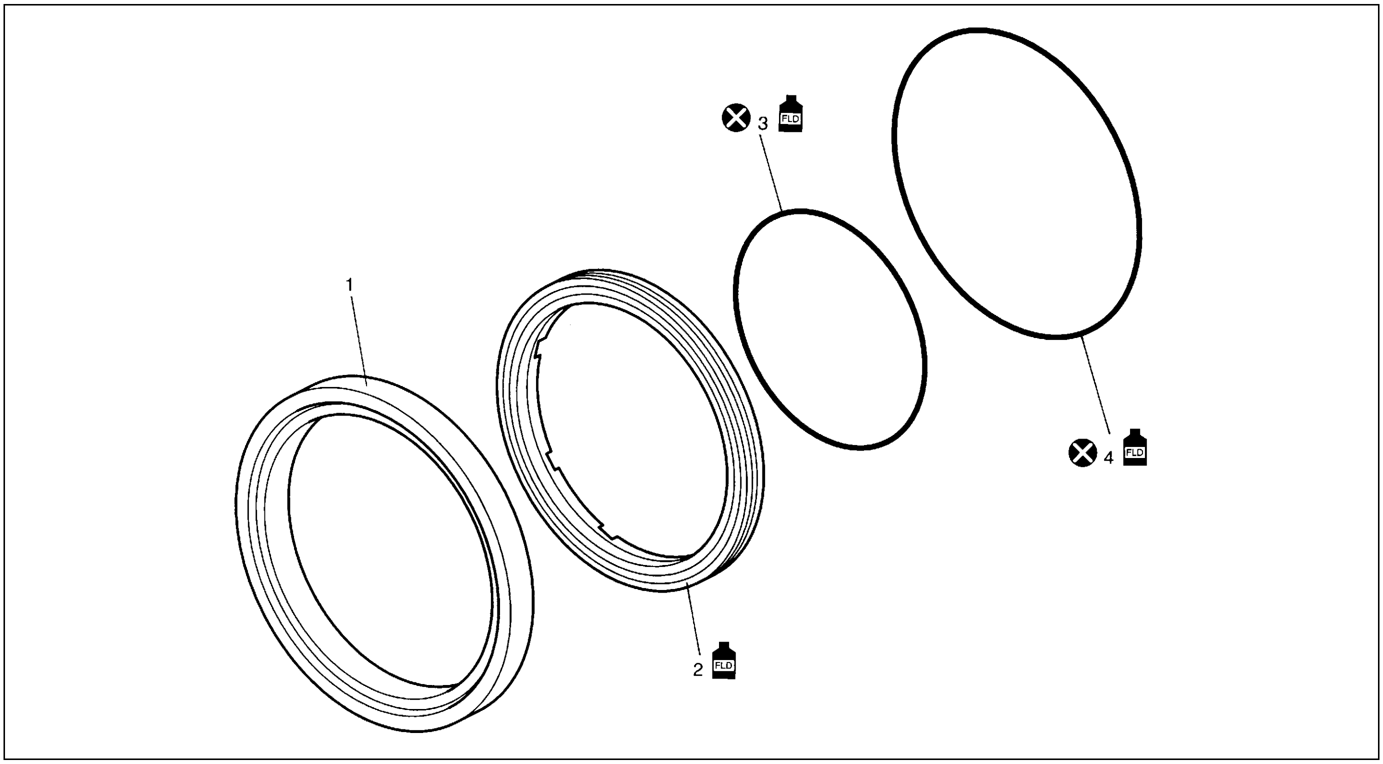
Reverse clutch piston stroke: 1.20 – 1.60 mm (0.047 – 0.063 in.)

When piston stroke is out of specification, select reverse clutch retaining plate with proper thickness from among the list below and replace it.

Available reverse clutch retaining plate thickness

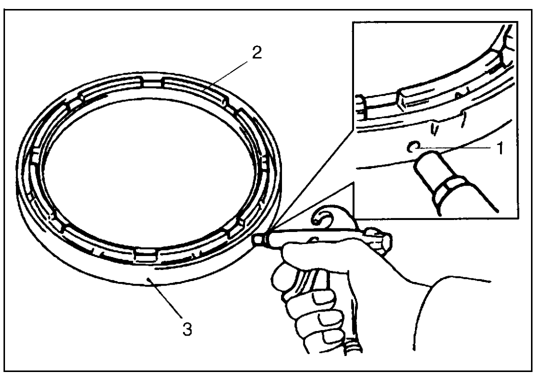
Thickness	Identification mark
3.0 mm (0.118 in.)	1
3.2 mm (0.126 in.)	2
3.4 mm (0.134 in.)	3
3.6 mm (0.142 in.)	4

2nd brake piston assembly

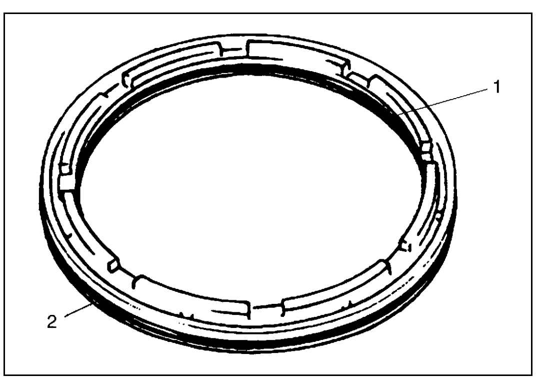


1. 2nd brake cylinder	4. Outer O-ring
2. 2nd brake piston	FLD Apply automatic transaxle fluid.
3. Inner O-ring	Do not reuse.

Disassembly



1) Apply compressed air (400 – 800 kPa, 4 – 8 kg/cm^2, 57 – 113 psi) to oil hole (1) of 2nd brake cylinder (3) to remove 2nd brake piston (2).

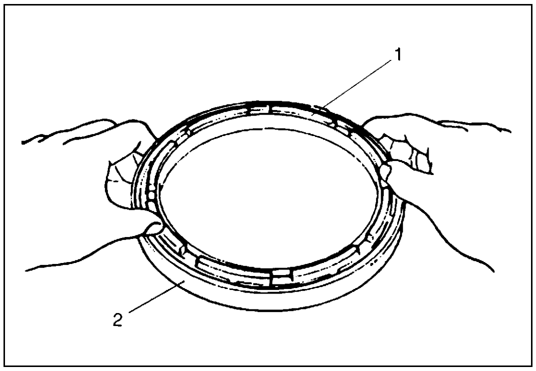


2) Remove inner O-ring (1) and outer O-ring (2).

Assembly

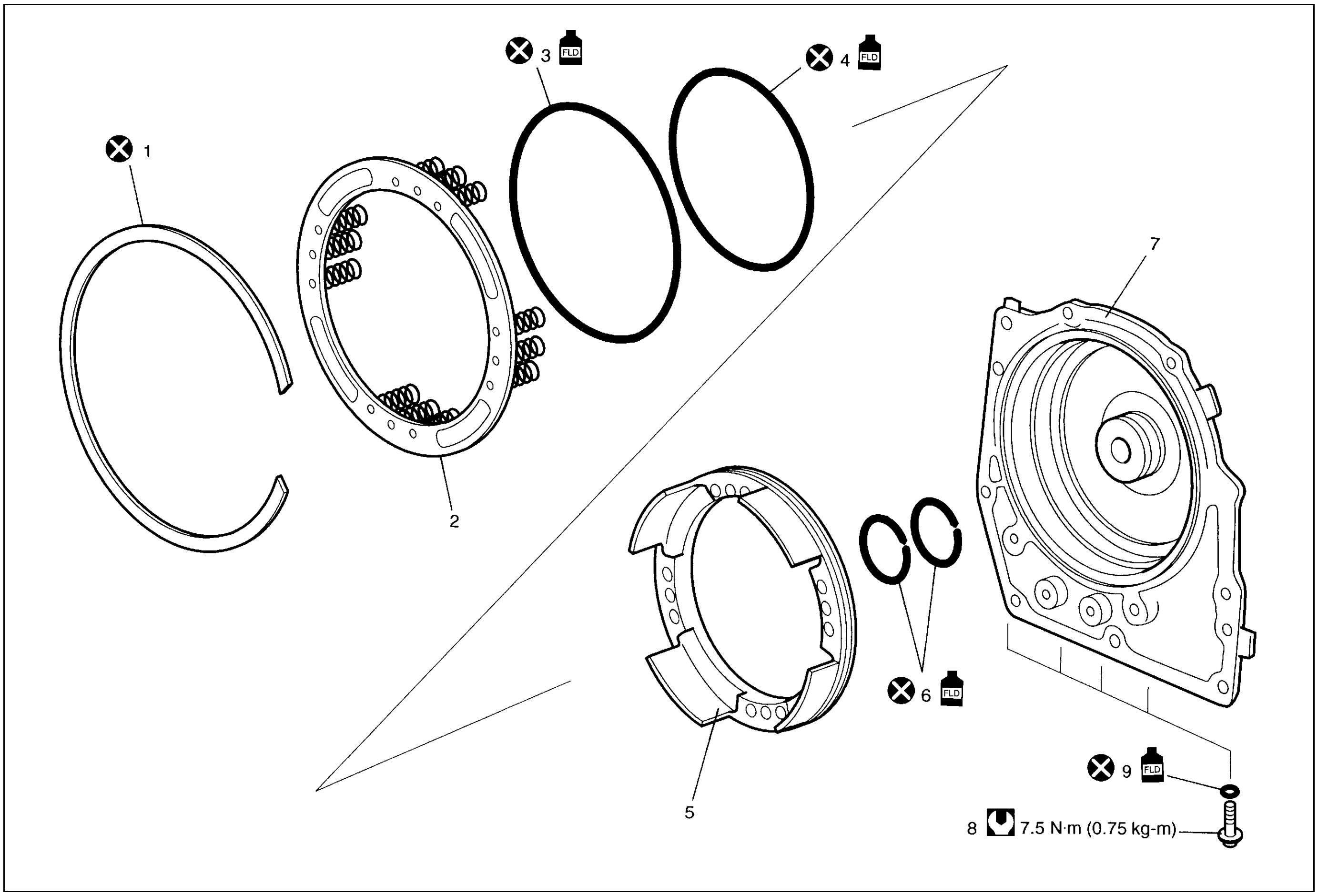
Reverse disassembly procedure for assembly, noting the following points.

- Use new O-rings. Apply A/T fluid to the O-rings, before installation.



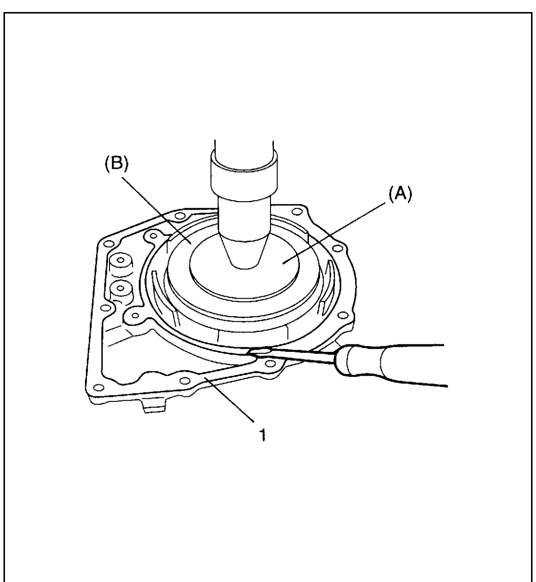
- Install 2nd brake piston (1) to which A/T fluid is applied to 2nd brake cylinder (2).
  Do not damage O-ring when installing 2nd brake piston.

Transaxle rear cover assembly (O/D and 2nd coast brake piston)



1.	Snap ring	7.	Transaxle rear cover
2.	O/D and 2nd coast brake return spring subassembly	8.	Rear cover plug
3.	O/D and 2nd coast brake piston front O-ring	9.	Rear cover plug O-ring
4.	O/D and 2nd coast brake piston rear O-ring	FLD	Apply automatic transaxle fluid.
5.	O/D and 2nd coast brake piston		Do not reuse.
6.	Rear cover seal ring		Tightening torque

Disassembly



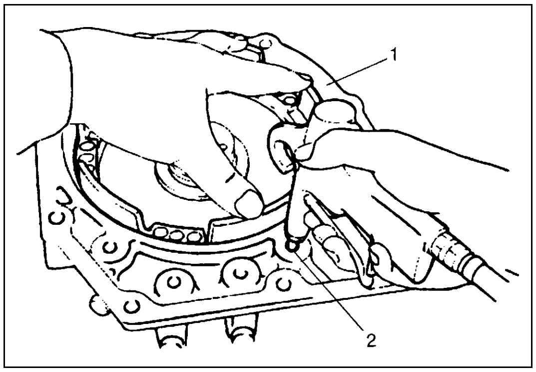
1) Remove snap ring by using special tools and hydraulic press.

CAUTION:
Do not press O/D and 2nd coast brake return spring subassembly in over 1.0 mm (0.039 in.).
Excessive compression may cause damage to O/D and 2nd coast brake return spring subassembly and/or piston.

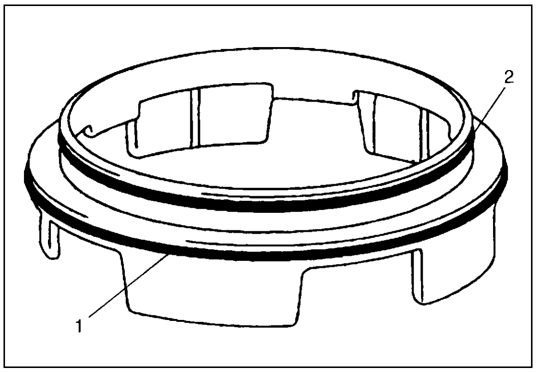
Special tool
(A): 09926-96030
(B): 09946-06710

2) Remove O/D and 2nd coast brake return spring assembly.

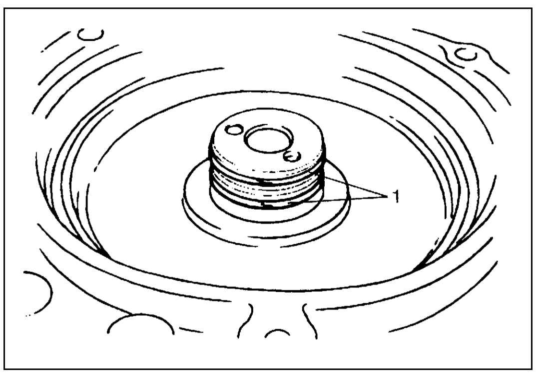
1.	Transaxle rear cover



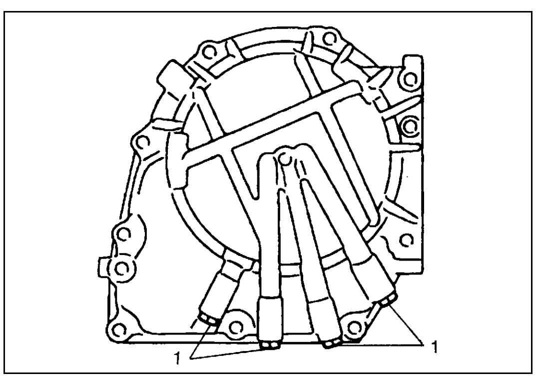
3) Apply compressed air (400 – 800 kPa, 4 – 8 kg/cm^2, 57 – 113 psi) to oil hole (2) of transaxle rear cover (1) to remove O/D and 2nd coast brake piston.



4) Remove O/D and 2nd coast brake piston front O-ring (1) and rear O-ring (2).



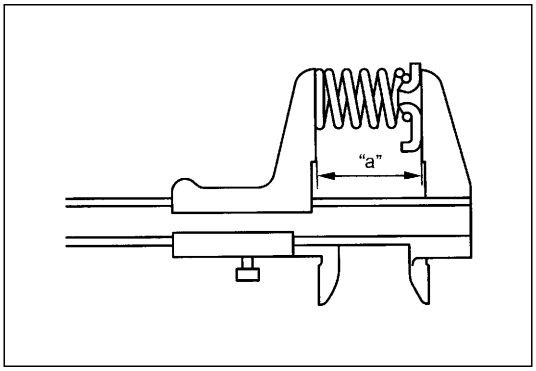
5) Remove rear cover seal rings (1).



6) Remove rear cover plugs (1).

Inspection

O/D and 2nd Coast Blake Return Spring Subassembly



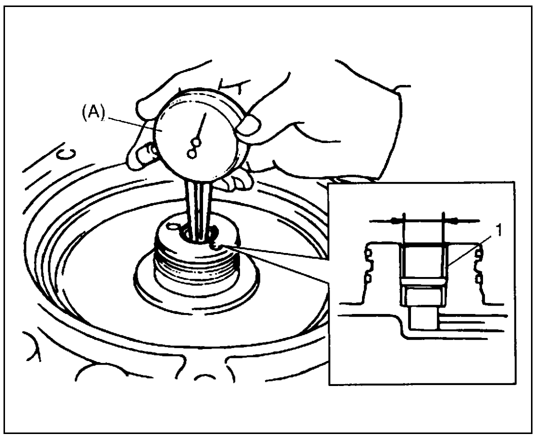
Measure free length of O/D and 2nd coast blake return spring.

Free length of O/D and 2nd coast blake return spring "a": 18.99 mm (0.748 in.)

NOTE:

- **Do not apply excessive force when measuring spring free length.**
- **Perform measurement at several points.**

Transaxle Rear Cover Bush



7) Measure transaxle rear cover bush bore by using special tool.

Special tool
(A): 09900-20605

Transaxle rear cover bush bore
Standard: 13.94 – 14.00 mm (0.549 – 0.551 in.)

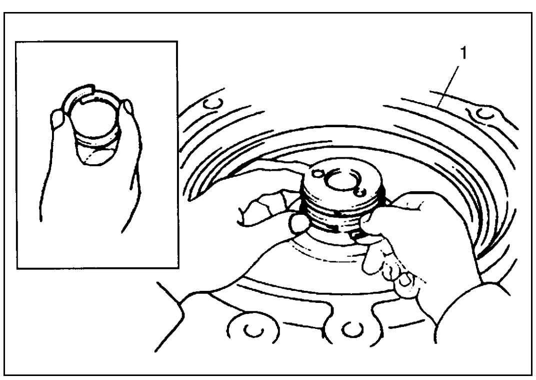
If measured transaxle rear cover bush bore is out of specifications, replace transaxle rear cover with new one. In replacement, intermediate shaft subassembly also needs to be checked. Replace intermediate shaft subassembly, if necessary.

Assembly

Reverse disassembly procedure for assembly, noting the following points.

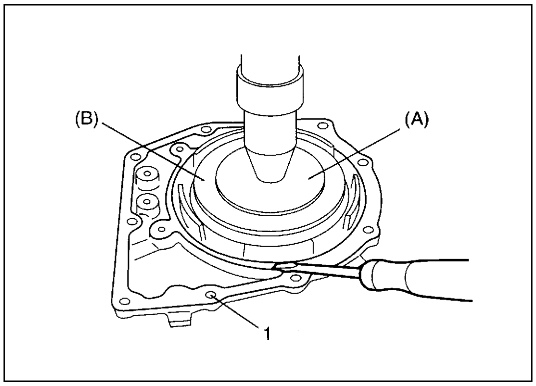
- Use new seal rings and O-rings. Apply A/T fluid to seal rings and O-rings before installation.
- Tighten rear cover plugs to specified torque.

Tightening torque
Rear cover plug: 7.5 N·m (0.75 kg-m, 5.5 lb-ft)



- Before installing rear cover seal ring, apply A/T fluid to ring. First, tighten seal ring to 5 mm (0.197 in.), then install seal ring.
- Do not open rear cover seal ring too wide to attach.

1. Transaxle rear cover

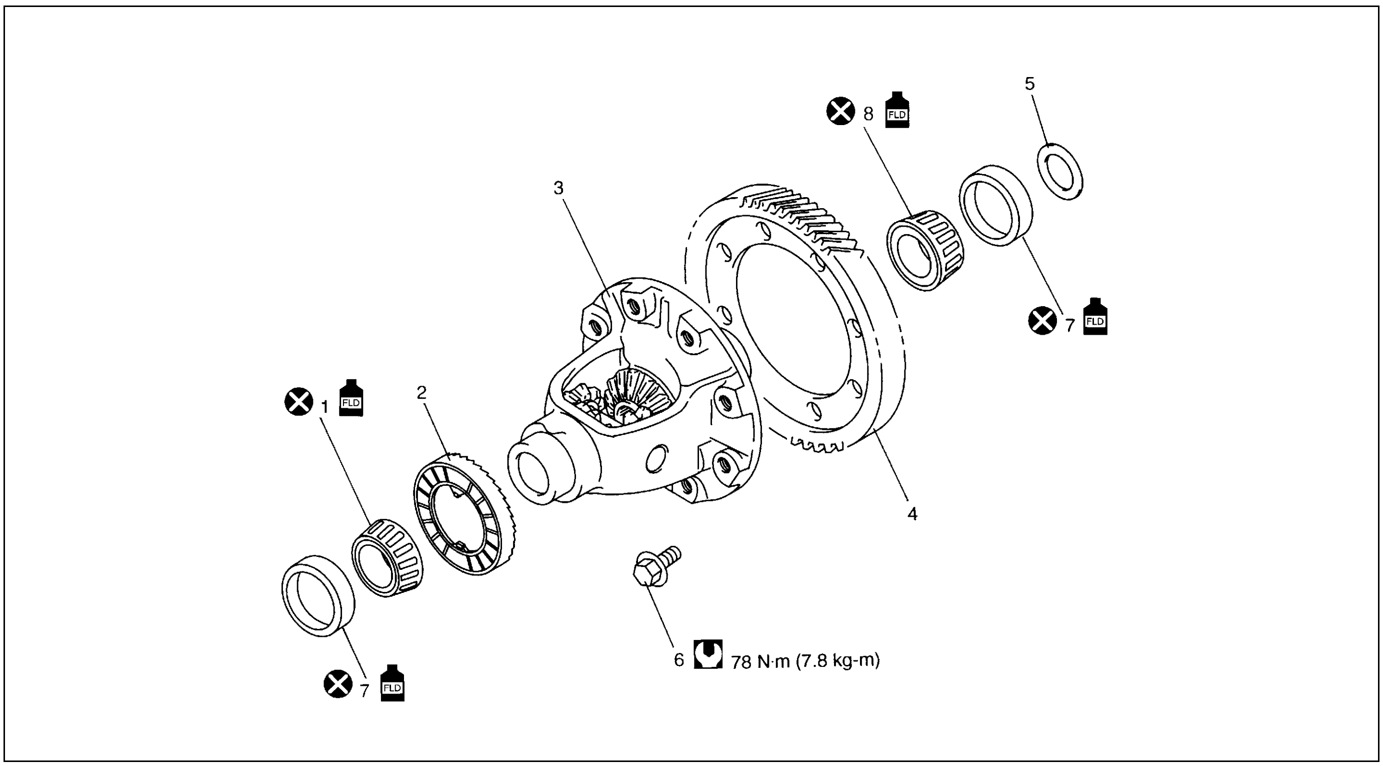


- Do not damage O/D and 2nd coast brake return spring subassembly and piston by pressing in O/D and 2nd coast brake return spring subassembly passing through its original installing position over 1.0 mm (0.039 in.).

Special tool
(A): 09926-96030
(B): 09946-06710

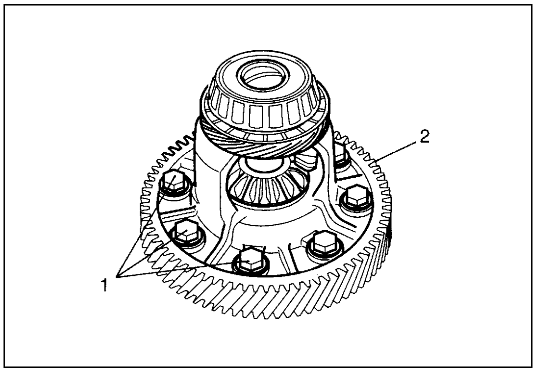
1. Transaxle rear cover

Differential Assembly

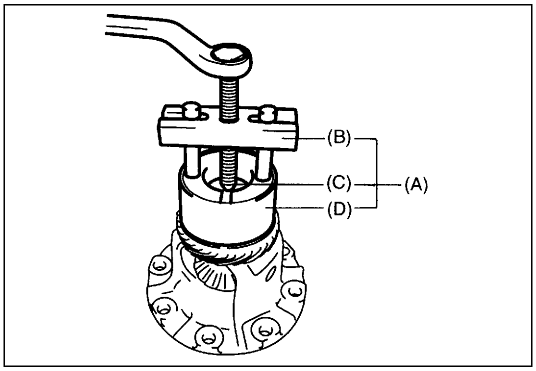


1. Differential side RH bearing	7. Side bearing cup
2. Output shaft speed sensor (VSS) drive gear	8. Differential side LH bearing
3. Differential case subassembly	FLD Apply automatic transaxle fluid.
4. Final gear	Tightening torque
5. Side bearing shim	Do not reuse.
6. Final gear bolt	

Disassembly

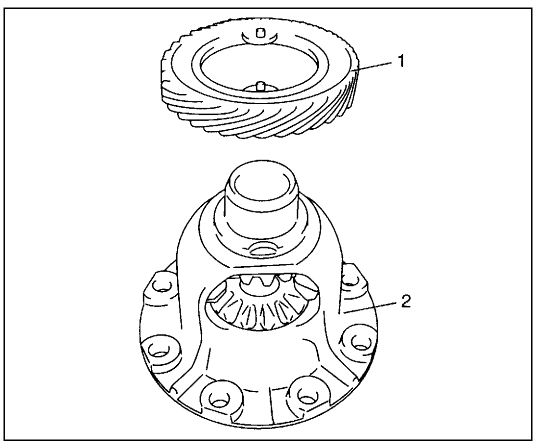


1) Remove final gear bolts (1), and then final gear (2).



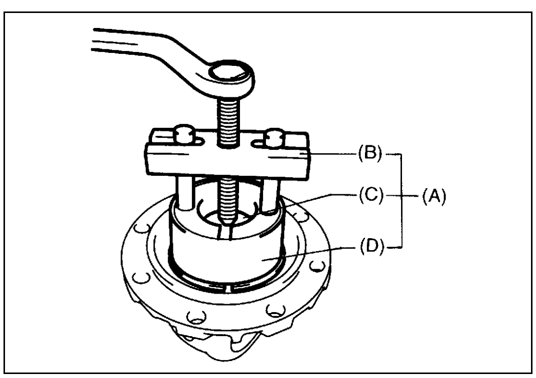
2) Remove differential side RH bearing by using special tools.

Special tool
(A): 09926-37610
(B): 09926-37610-001
(C): 09926-37610-003
(D): 09926-47610-002



3) Remove output shaft speed sensor (VSS) drive gear (1).

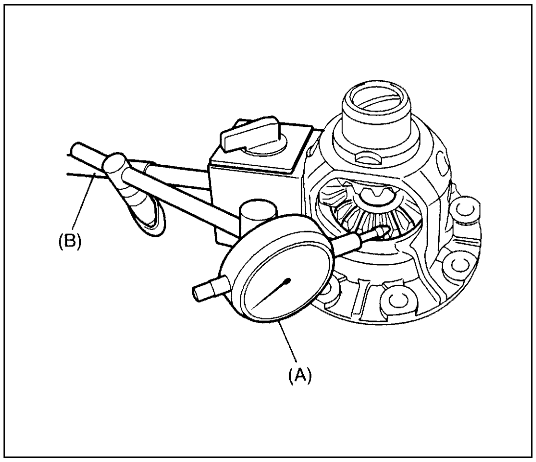
2. Differential case subassembly



4) Remove differential side LH bearing by using special tools.

Special tool
(A): 09926-37610
(B): 09926-37610-001
(C): 09926-37610-003
(D): 09926-37610-002

Inspection



1) Hold differential case subassembly with soft jawed vice and set special tools as shown.

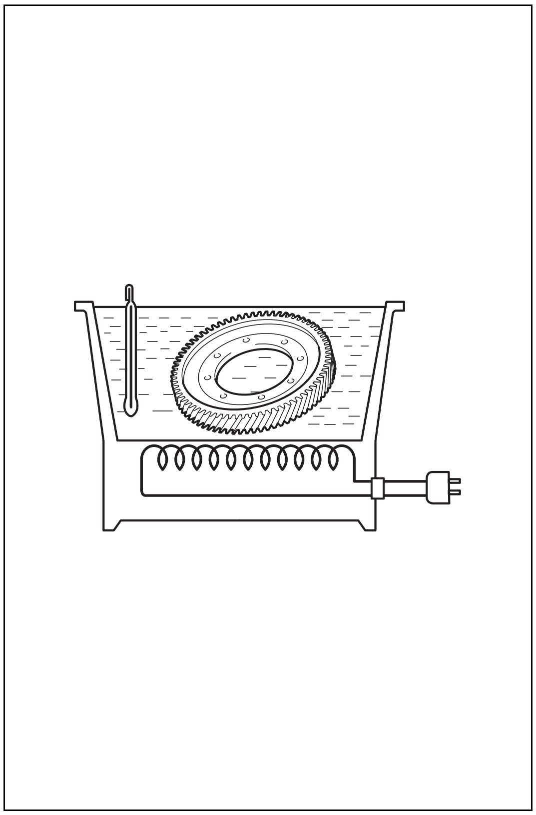
Special tool
(A): 09900-20607
(B): 09900-20701

2) Measure differential gear thrust play.

Differential gear thrust play:
0.05 – 0.20 mm (0.002 – 0.008 in.)

3) If thrust play is out of specification, replace differential case subassembly.

Assembly

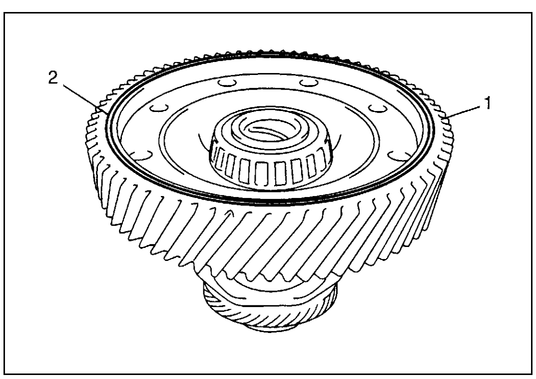


WARNING:
- **When taking warmed final driven gear out of vessel, use tongs or the like. Taking out it with bare hand will cause severe burn.**
- **While installing warmed final driven gear, use oven glove such as leather glove. Picking up it with bare hand may cause burn.**

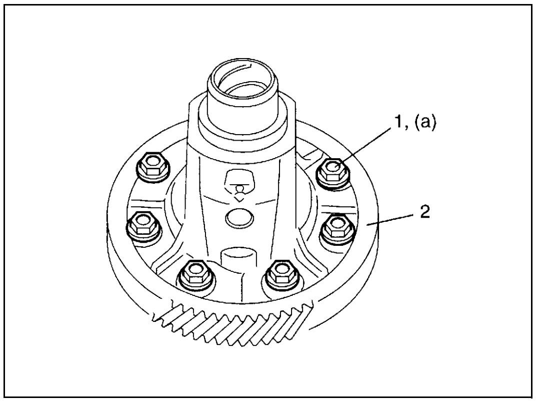
CAUTION:
Do not leave final driven gear in boiling water for longer than 5 min. Overheating the gear may cause strength reduction of gear.

1) Put final driven gear in water vessel, heat and remove when it boils, then remove moisture.

NOTE:
After removing moisture on final driven gear, install final driven gear to differential case as quickly as possible.



2) As shown in figure, facing groove (2) side upward, install final driven gear (1) to differential case.



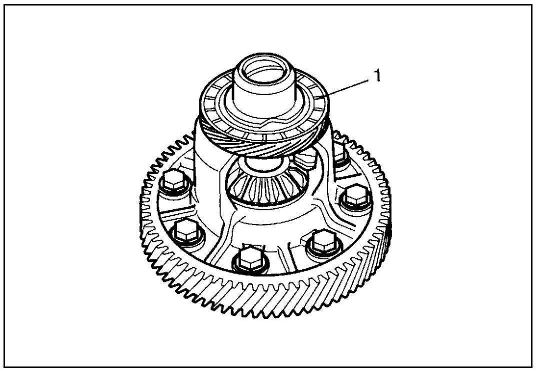
3) Tighten final gear bolts (1) to specified torque.

Tightening torque
Final gear bolt
(a): 78 N·m (7.8 kg-m, 56.5 lb-ft)

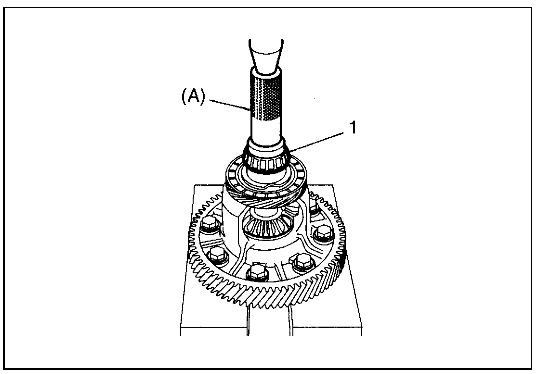
2. Final driven gear

NOTE:

- **To avoid rust, apply A/T fluid to final driven gear after installation.**



4) After applying A/T fluid to output shaft speed sensor (VSS) drive gear (1), install output shaft speed sensor drive gear.

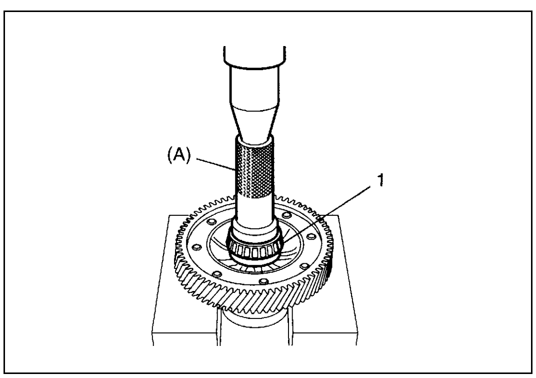


5) Install new differential side RH bearing (1) by using special tool and hydraulic press.

Special tool
(A): 09913-70123

NOTE:

Replace differential side RH bearing together with bearing cup as a set.



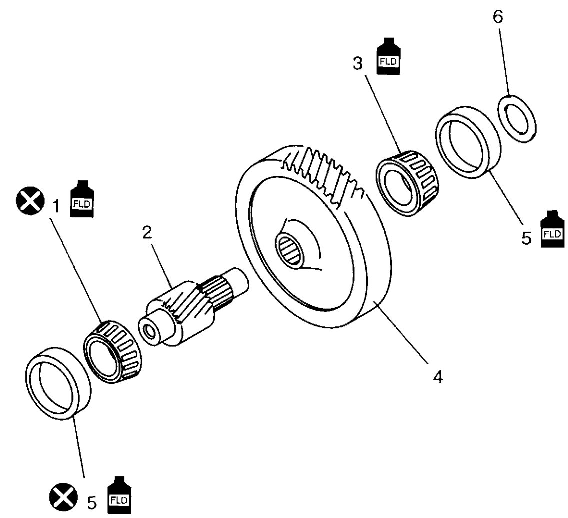
6) Install new differential side LH bearing (1) by using special tool and hydraulic press.

Special tool
(A): 09913-70123

NOTE:

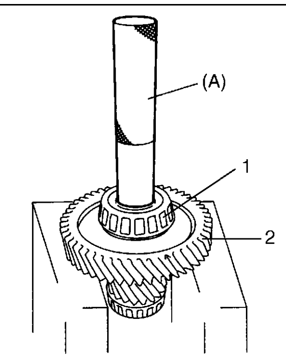
Replace differential side LH bearing together with bearing cup as a set.

Countershaft assembly



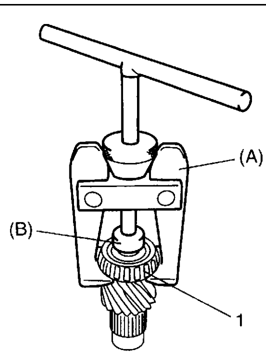
1.	Countershaft RH bearing	5.	Bearing cap
2.	Countershaft	6.	Countershaft bearing shim
3.	Countershaft LH bearing	FLD	Apply automatic transaxle fluid.
4.	Reduction driven gear	⊗	Do not reuse.

Disassembly



1) Remove countershaft LH bearing (1) and reduction driven gear (2) at once by using special tool and hydraulic press.

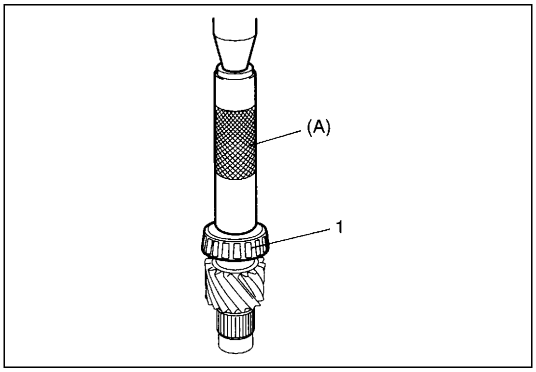
Special tool
(A): 09925-98221



2) Remove countershaft RH bearing (1) by using special tools.

Special tool
(A): 09913-61510
(B): 09926-58010

Assembly

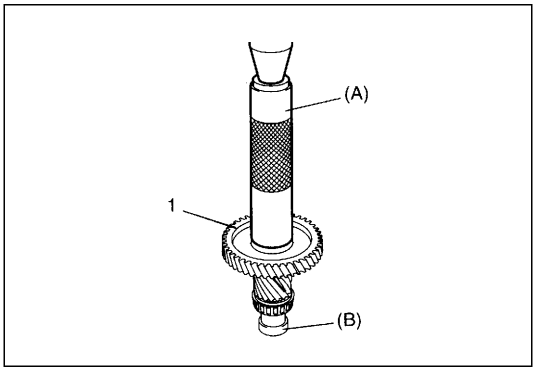


1) Install new countershaft RH bearing (1) by using special tool and hydraulic press.

Special tool
(A): 09913-84510

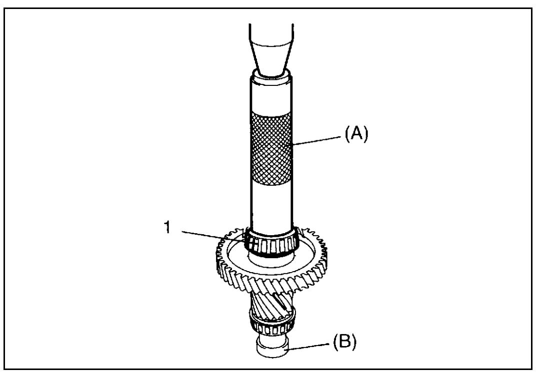
NOTE:

Replace countershaft RH bearing together with bearing cup as a set.



2) Install reduction driven gear (1) with special tools and hydraulic press.

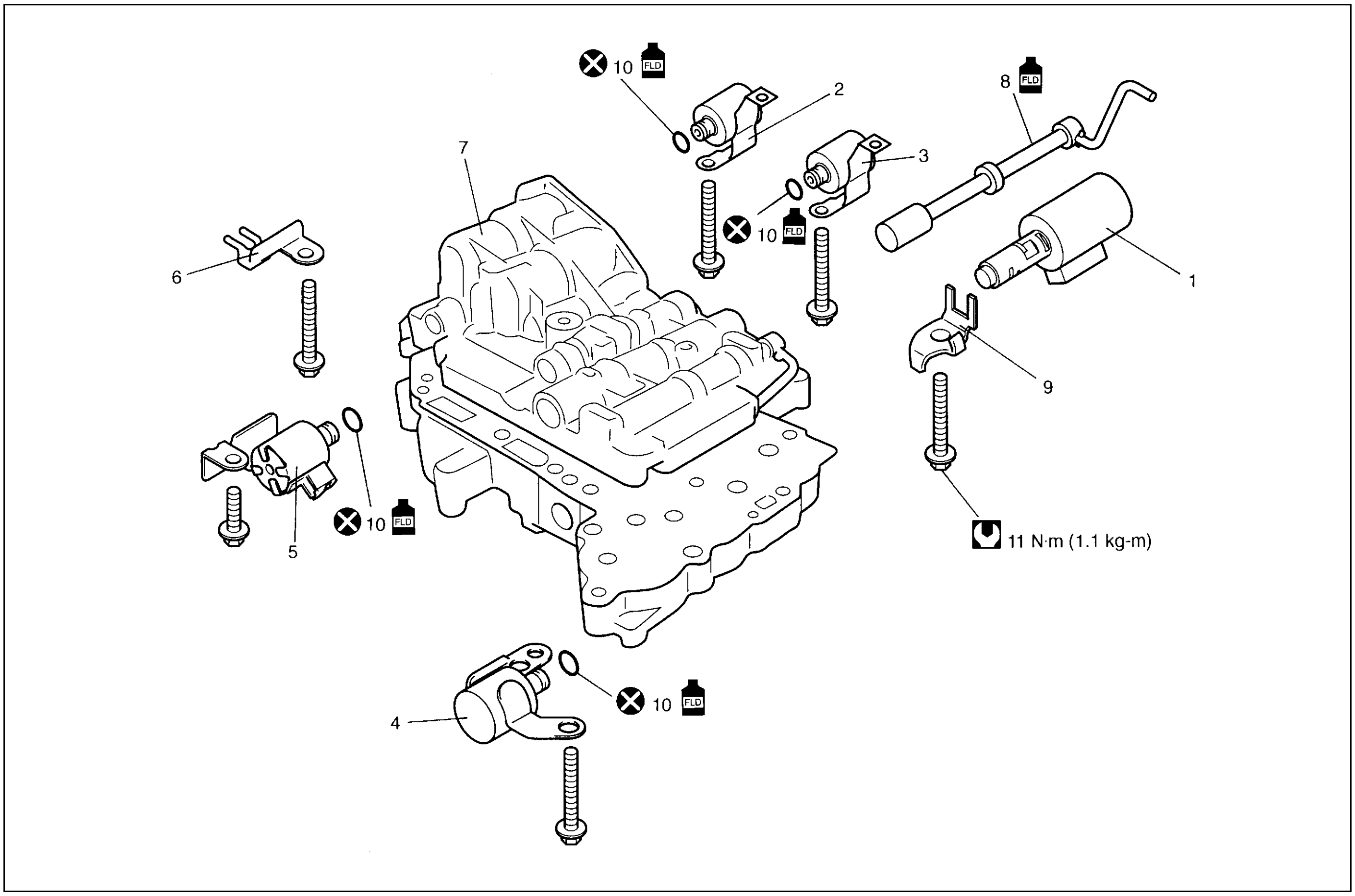
Special tool
(A): 09913-84510
(B): 09925-88210



3) Install countershaft LH bearing (1) with special tools and hydraulic press.

Special tool
(A): 09913-84510
(B): 09925-88210

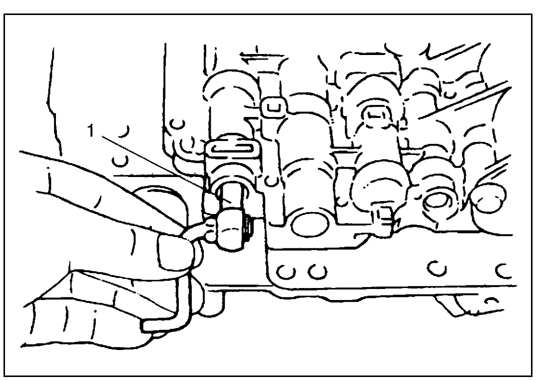
Valve body assembly



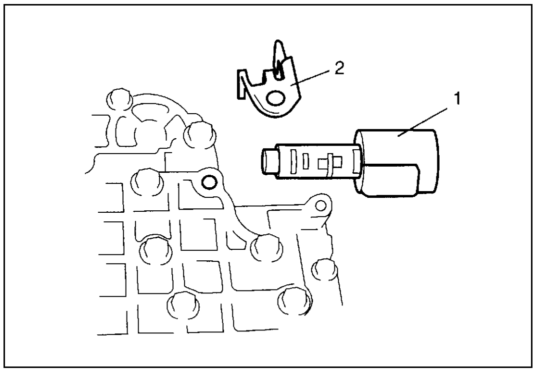
1. Pressure control solenoid valve	8. Manual valve
2. Shift solenoid valve-A (No.1)	9. Solenoid lock plate
3. Shift solenoid valve-B (No.2)	10. O-ring
4. TCC (Lock-up) solenoid valve	FLD: Apply automatic transaxle fluid.
5. Timing solenoid valve	Tightening torque
6. Temperature sensor clamp	Do not reuse.
7. Valve body assembly	

CAUTION:
When replacing pressure control solenoid valve, it is strictly required to replace it together with vale body assembly as a set. Replacing pressure control solenoid independently may cause excessive shift shock.

Disassembly

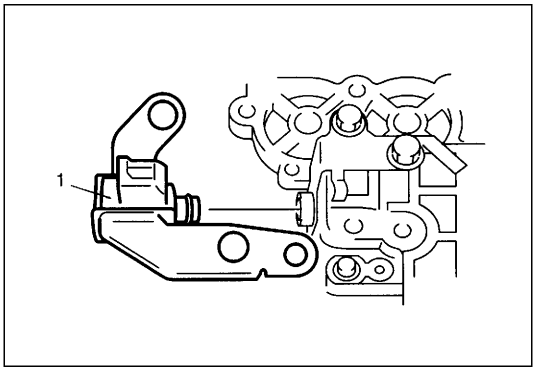


1) Pull out manual valve (1).

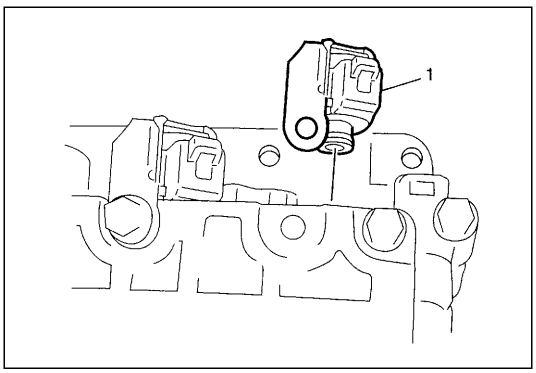


2) Remove pressure control solenoid valve (1).

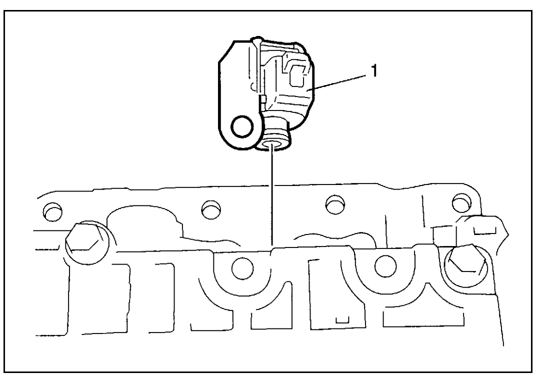
2. Solenoid lock plate



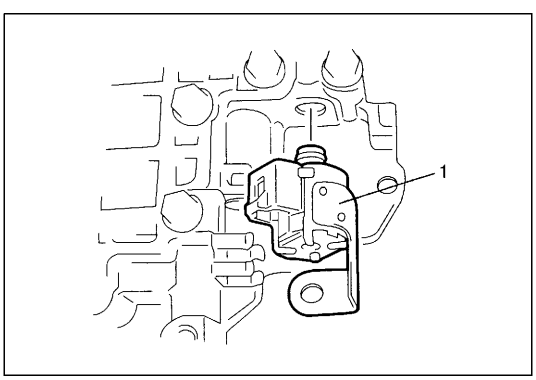
3) Remove TCC (Lock-up) solenoid valve (1).



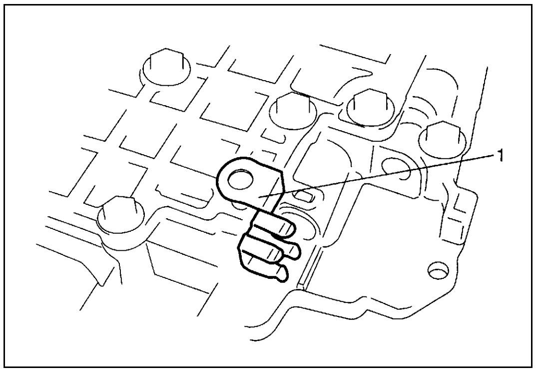
4) Remove shift solenoid valve-A (1).



5) Remove shift solenoid valve-B (1).



6) Remove timing solenoid valve (1).

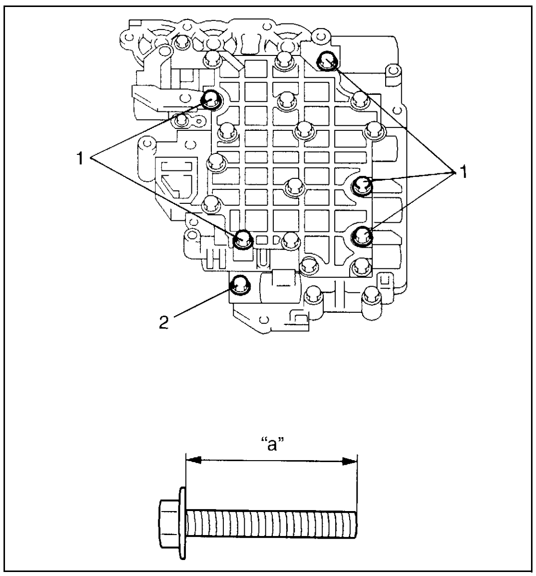


7) Remove temperature sensor clamp (1).

Assembly

Reverse disassembly procedure for assembly, noting following points.

- Shift solenoid valve-A and -B are identical
- After applying A/T fluid to new O-rings, fit them to solenoid valves, then install solenoid valves to valve body.



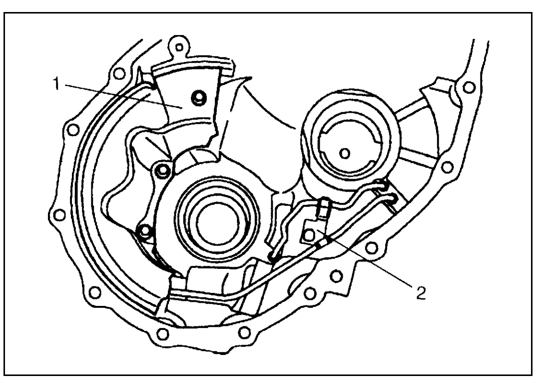
- Tighten solenoid valve bolts to specified torque

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

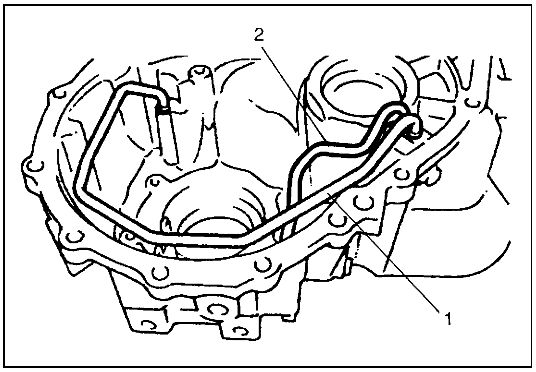
Bolt	Length "a"	Pieces
A (1)	49 mm (1.93 in.)	5
B (2)	20 mm (0.79 in.)	1

Torque converter housing

Disassembly

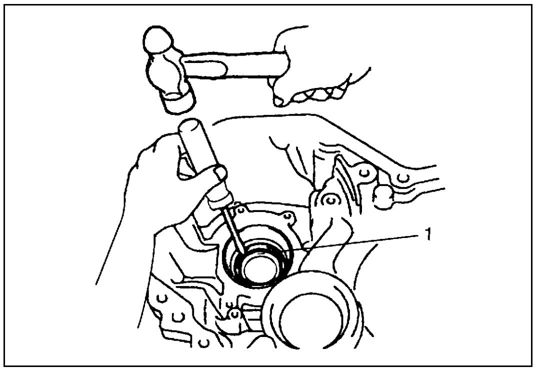


1) Remove fluid reservoir RH plate (1) and lubrication tube clamp (2).

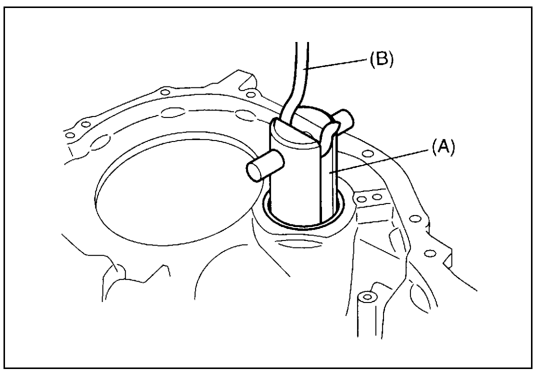


2) Remove lubrication LH tube (1) and RH tube (2).

NOTE:
Do not bend lubrication tube with excessive force.

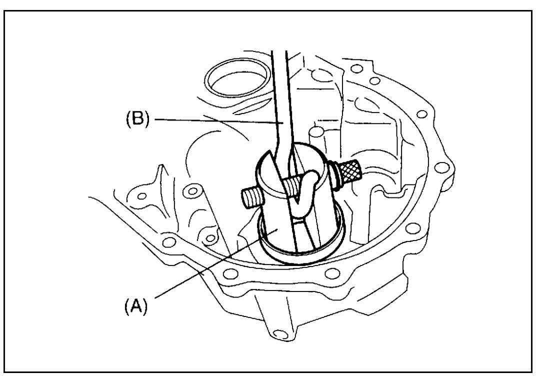


3) Remove differential side oil seal (1).



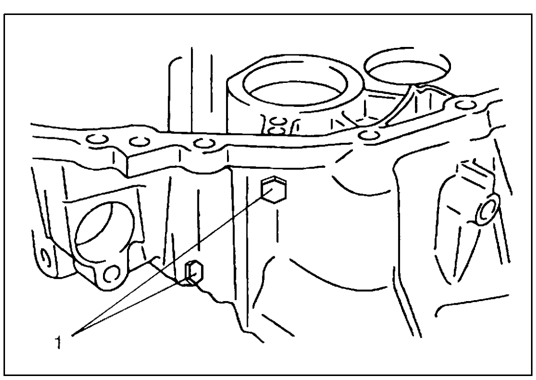
4) Remove countershaft RH bearing cup by using special tools.

Special tool
(A): 09944-96011
(B): 09942-15511



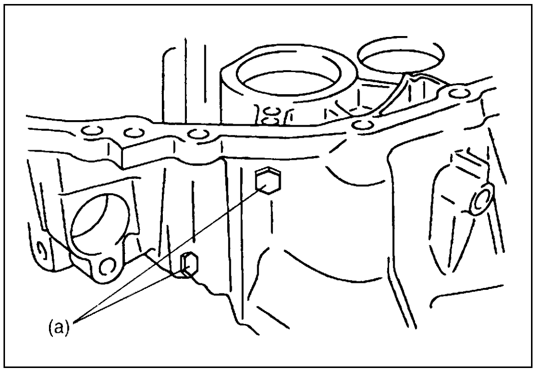
5) Remove differential side RH bearing cup by using special tools.

Special tool
(A): 09944-96011
(B): 09942-15511



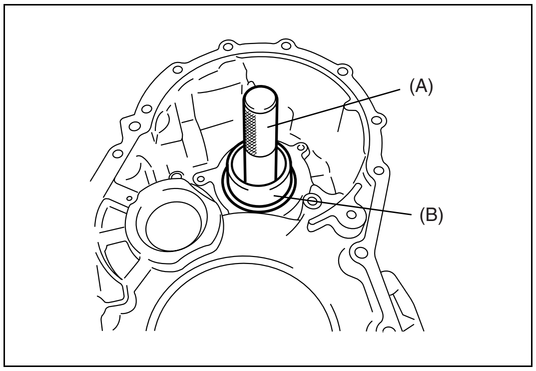
6) Remove torque converter case plugs (1).

Assembly



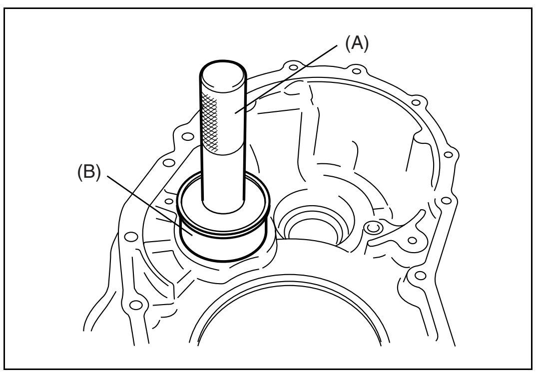
1) After applying A/T fluid to new O-rings, fit them to housing plugs. Finally install plugs to torque converter housing.

Tightening torque
Torque converter housing plug
(a): 7.5 N·m (0.75 kg-m, 5.5 lb-ft)



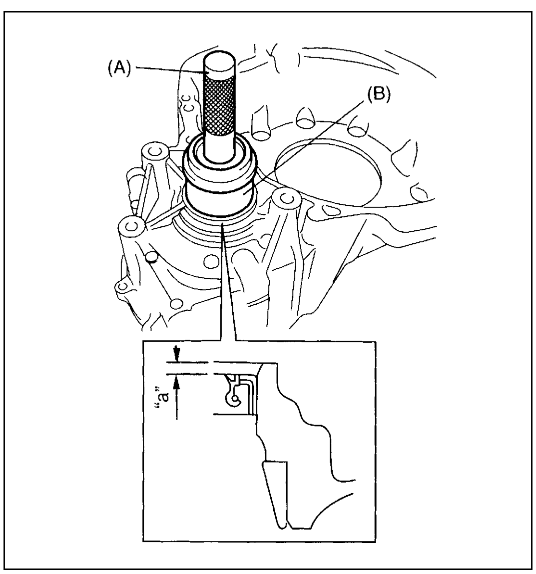
2) Using special tools, assemble differential side RH bearing cup.

Special tool
(A): 09924-74510
(B): 09944-88220



3) Using special tool, install countershaft RH bearing cup.

Special tool
(A): 09924-74510
(B): 09944-88220



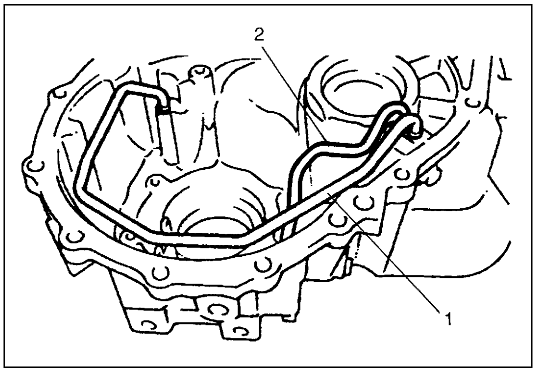
a)Using special tools, install new differential side oil seal to torque converter housing.

Special tool
(A): 09924-74510
(B): 09944-88220

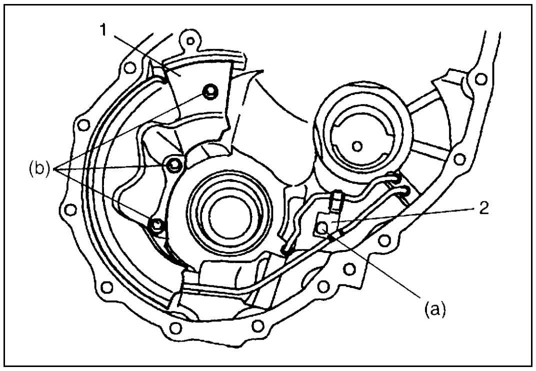
Differential side oil seal installing depth
"a": 2.6 – 3.6 mm (0.10 – 0.14 in.)

4) Apply grease to oil seal lip.

Grease 99000-25030



5) Install lubrication LH tube (1) and RH tube (2).

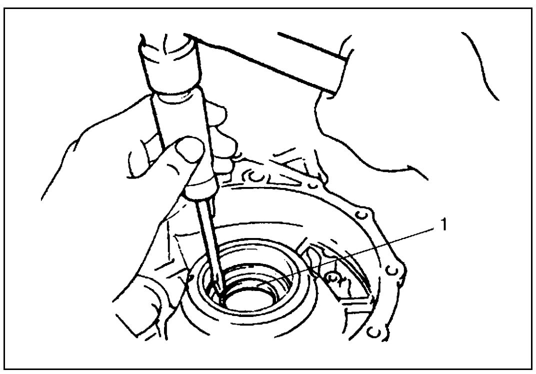


6) Install fluid reservoir RH plate (1) and lubrication tube clamp (2).

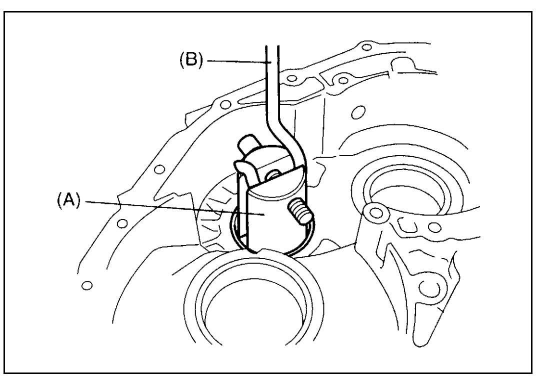
Tightening torque
Lubrication tube clamp bolt
(a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)
Fluid reservoir RH plate bolt
(b): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

Transaxle case

Disassembly

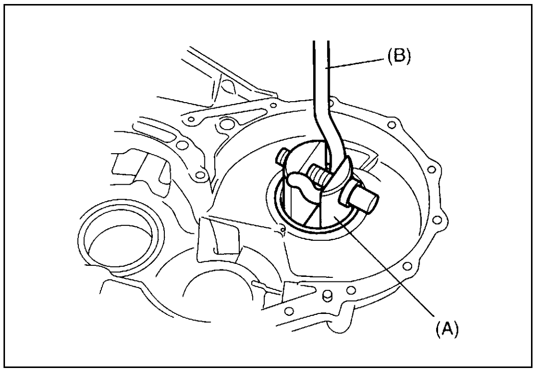


1) Remove differential side oil seal (1).



2) Remove countershaft LH bearing cup and shim with special tools.

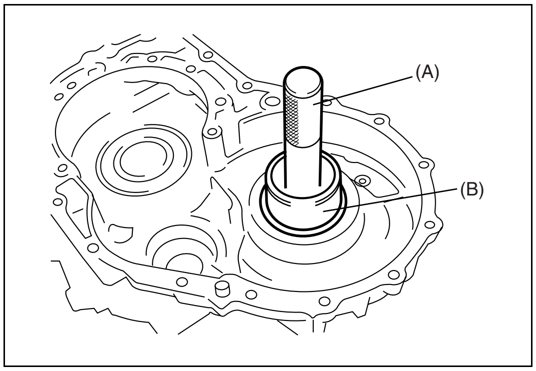
Special tool
(A): 09944-96011
(B): 09942-15511



3) Remove differential side LH bearing cup and shim with special tools.

Special tool
(A): 09944-96011
(B): 09942-15511

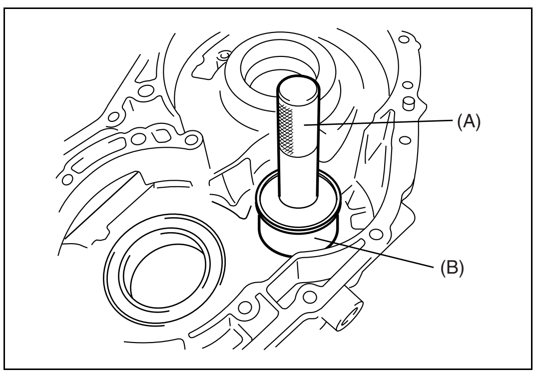
Assembly



1) Using special tools, assemble shim and differential side LH bearing cup.

Special tool
(A): 09924-74510
(B): 09944-88220

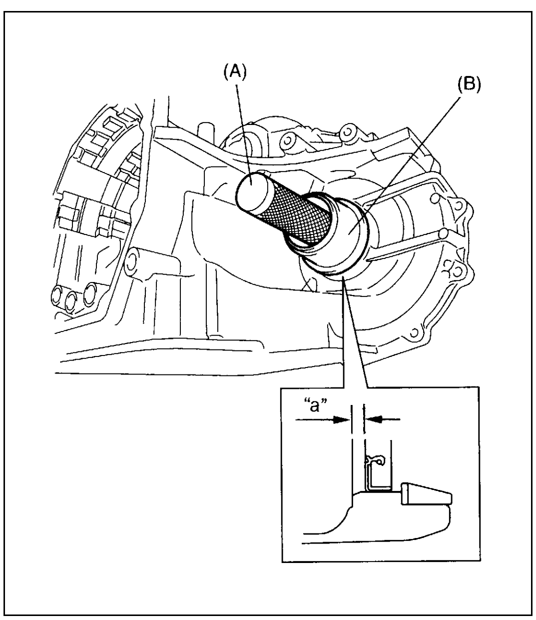
NOTE:
Use shim with same thickness as the removed one.



2) Using special tools, assemble shim and countershaft LH bearing cup.

Special tool
(A): 09924-74510
(B): 09944-88220

NOTE:
Use shim with same thickness as the removed one.



3) Install new differential side oil seal to transaxle case by using special tools.

Special tool
(A): 09924-74510
(B): 09944-88220

Differential side oil seal installing depth
"a": 3.8 – 4.8 mm (0.15 – 0.19 in.)

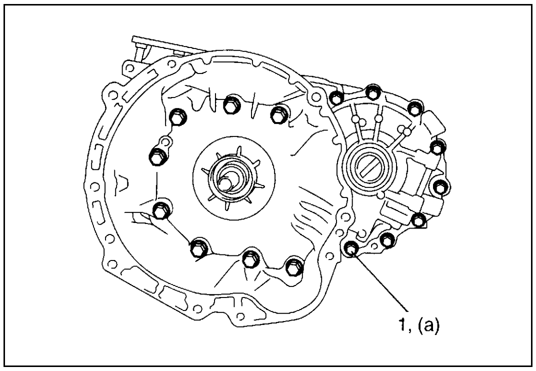
4) Apply grease to oil seal lip.

Grease 99000-25030

Adjustment before unit assembly

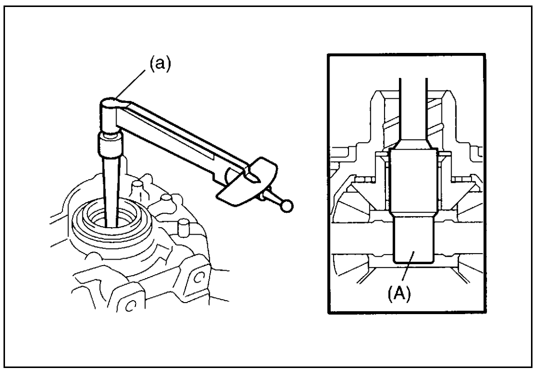
Differential Side Bearing Preload

1) After applying A/T fluid to differential assembly, fit it to transaxle case.



2) Install torque converter housing to transaxle case, then tighten bolts (1) to specified torque.

Tightening torque
Torque converter housing bolt
(a): 33 N·m (3.3 kg-m, 24.0 lb-ft)



3) Measure bearing preload (a) by using a special tool.

Special tool
(A): 09928-06050

Differential side bearing preload (starting torque)
In the case of new bearing
(a): 0.8 – 1.4 N·m (8.0 – 14.0 kg-cm, 0.58 – 1.01 lb-ft)

In the case of reused bearing
(a): 0.4 – 0.7 N·m (4.0 – 7.0 kg-cm, 0.29 – 0.51 lb-ft)

4) If bearing preload is out of specification, select shim with suitable thickness from among the list below and replace it. Then adjust differential side bearing preload within specification.

Available shim thickness

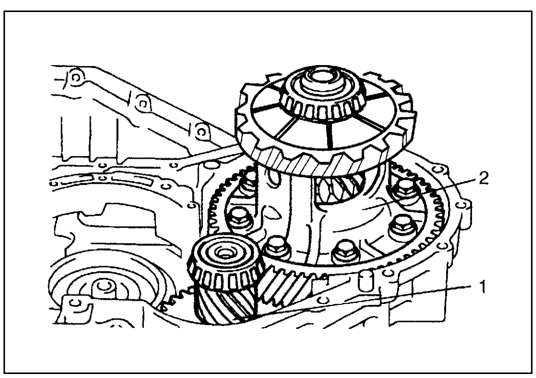
Thickness	Identification mark
1.80 mm (0.070 in.)	A
1.85 mm (0.072 in.)	B
1.90 mm (0.074 in.)	C
1.95 mm (0.076 in.)	D
2.00 mm (0.078 in.)	E
2.05 mm (0.080 in.)	F
2.08 mm (0.081 in.)	G
2.11 mm (0.083 in.)	H
2.14 mm (0.084 in.)	J
2.17 mm (0.085 in.)	K
2.20 mm (0.087 in.)	L
2.23 mm (0.088 in.)	M
2.26 mm (0.089 in.)	N
2.29 mm (0.090 in.)	P
2.32 mm (0.091 in.)	Q
2.35 mm (0.092 in.)	R
2.40 mm (0.094 in.)	S
2.45 mm (0.096 in.)	T
2.50 mm (0.098 in.)	U
2.55 mm (0.100 in.)	V
2.60 mm (0.102 in.)	W
2.65 mm (0.104 in.)	X
2.70 mm (0.106 in.)	Y

NOTE:

Record measured differential side bearing preload, because it is necessary to adjust counter shaft bearing preload.

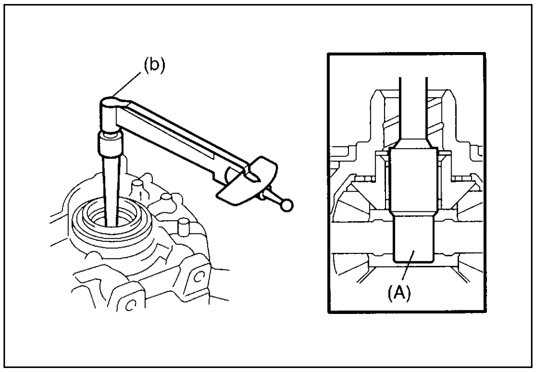
5) Remove differential assembly.

Counter Shaft Bearing Preload



1) After applying A/T fluid to countershaft assembly (1) and differential assembly (2), fit them.
2) Install torque converter housing to transaxle case, then tighten bolts to specified torque.

Tightening torque
Torque converter housing bolt: 33 N·m (3.3 kg-m, 24 lb-ft)



3) Measure bearing preload (b) by using special tool.

Special tool
(A): 09928-06050

Counter shaft bearing preload = (b) – Differential side bearing preload (a)

Counter shaft bearing preload (Starting torque)
In the case of new bearing
0.33 – 0.76 N·m (3.3 – 7.6 kg-cm, 0.24 – 0.55 lb-ft)

In the case of reused bearing
0.17 – 0.38 N·m (1.7 – 3.8 kg-cm, 0.12 – 0.28 lb-ft)

4) If bearing preload is out of specification, select shim with suitable thickness from among the list below and replace it. Then adjust countershaft bearing preload within specification.

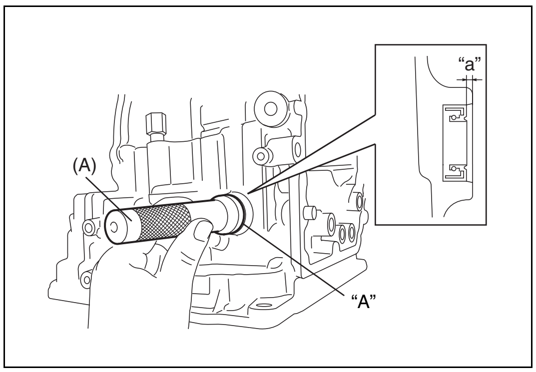
Available shim thickness

Thickness	Identification mark
1.70 (0.066 in.)	1
1.75 (0.068 in.)	2
1.80 (0.070 in.)	3
1.85 (0.072 in.)	4
1.90 (0.074 in.)	5
1.93 (0.075 in.)	6
1.96 (0.077 in.)	7
1.99 (0.078 in.)	A
2.02 (0.079 in.)	B
2.05 (0.080 in.)	C
2.08 (0.081 in.)	D
2.11 (0.083 in.)	E
2.14 (0.084 in.)	F
2.17 (0.085 in.)	G
2.20 (0.086 in.)	H
2.25 (0.088 in.)	K
2.30 (0.090 in.)	L
2.35 (0.092 in.)	M
2.40 (0.094 in.)	N
2.45 (0.096 in.)	P
2.50 (0.098 in.)	Q
2.55 (0.100 in.)	R
2.60 (0.102 in.)	S
2.65 (0.104 in.)	U
2.70 (0.106 in.)	W

5) Remove differential assembly and counter shaft assembly.

Unit Assembly

CAUTION:
- **Automatic transaxle consists of highly precise parts. As even flaw in small part may cause oil leakage or decrease in function, check each part carefully before installation.**
- **Clean all parts with compressed air. Never use wiping cloths or rags.**
- **Before assembling new clutch or brake discs, soak them in automatic transaxle fluid for at least 2 hours.**
- **Be sure to use new gaskets and O-rings.**
- **Lubricate O-rings with automatic transaxle fluid.**
- **Apply automatic transaxle fluid on sliding or rotating surfaces of the parts before assembly.**
- **Use Suzuki Super Grease "C" to retain parts in place.**
- **Be sure to install thrust bearings and races in correct direction and position.**
- **Make sure that snap ring ends are not aligned with one of cutouts and are installed in groove correctly.**
- **Do not use adhesive cements on gaskets and similar parts.**
- **Be sure to torque each bolt and nut to specification.**

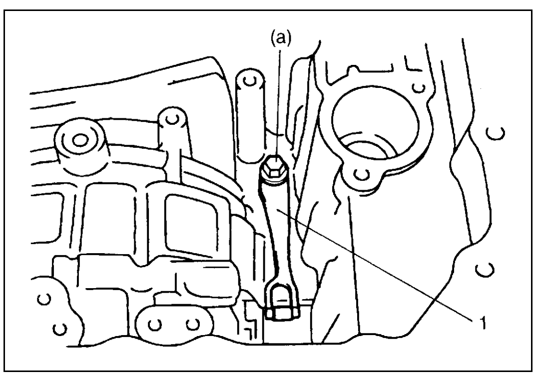


1) Install new manual shift shaft oil seal to transaxle case.
   Use special tool and hammer to install it, and then apply grease to its lip.

Special tool
(A): 09925-98210

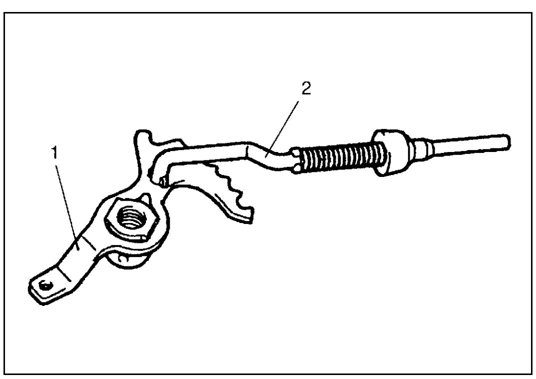
"A": Grease 99000-25030

Manual shift shaft oil seal installing depth
"a": 0.75 – 1.25 mm (0.03 – 0.05 in.)

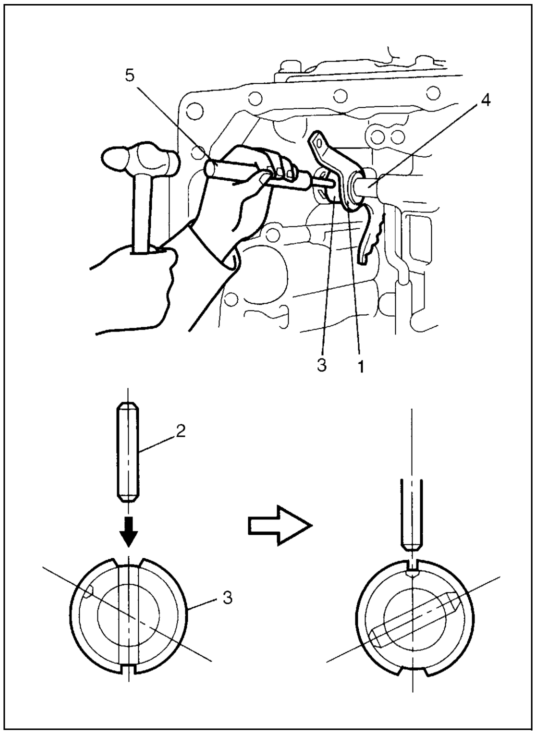


2) Install manual detent spring (1) to transaxle case and tighten manual detent spring bolt to specified torque.

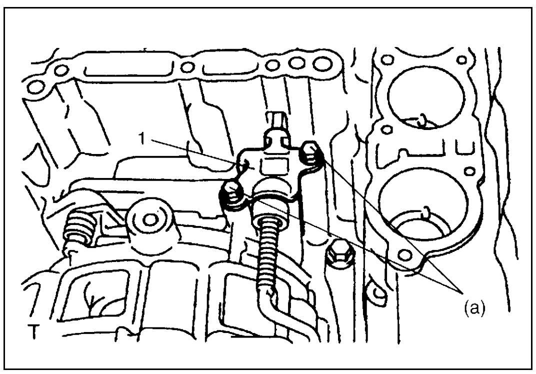
Tightening torque
Manual detent spring bolt
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)



3) Install parking lock pawl rod (2) to manual valve lever (1).

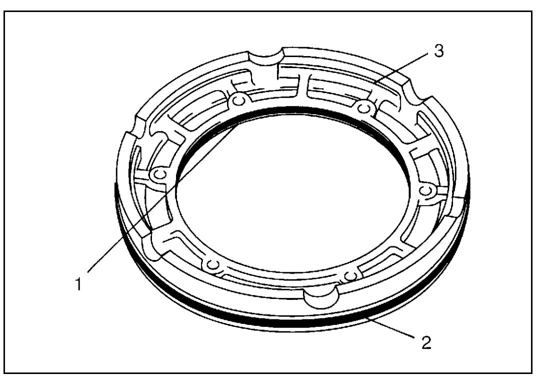


4) After applying A/T fluid to new manual valve lever (1), install new manual shift shaft (4), new spacer (3) and manual valve lever to transaxle case.
5) After installing manual valve lever pin (2) by using spring pin remover with 3 mm (0.12 in.) in diameter (5) and hammer, turn spacer to set the position as shown in the figure. Then calk spacer with a punch.



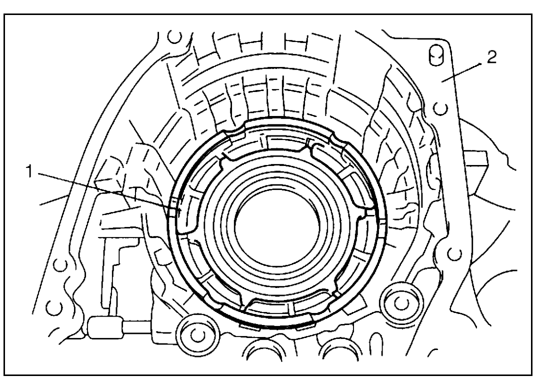
6) Install parking lock pawl bracket (1) to transaxle case.

Tightening torque
Parking lock pawl bracket bolt
(a): 7.5 N·m (0.75 kg-m, 5.5 lb-ft)



7) After applying A/T fluid to new O-rings, install them to 1st and reverse brake piston (3).

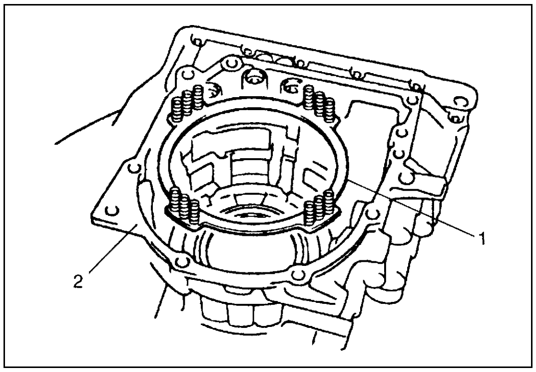
1.	Inner O-ring
2.	Outer O-ring



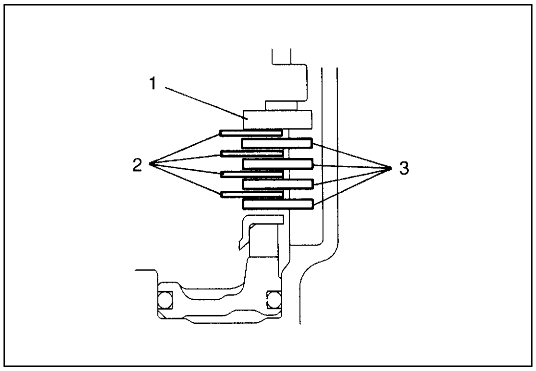
8) Install 1st and reverse brake piston (1) to transaxle case (2).

NOTE:

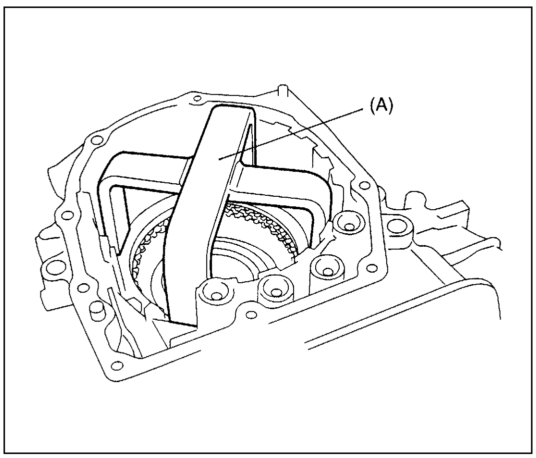
Be careful not to damage O-ring when installing 1st and reverse brake piston.



9) Install 1st and reverse brake return spring subassembly (1) to transaxle case (2).



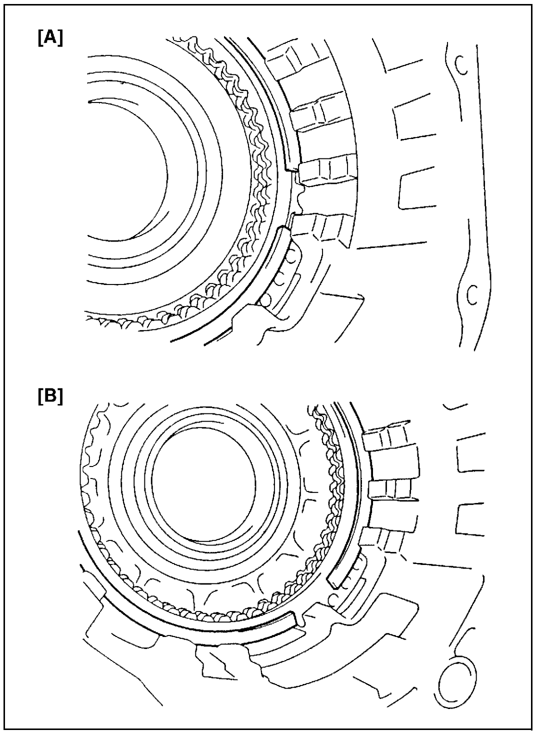
10) Apply A/T fluid to 1st and reverse brake discs (2) separator plates (3) and retaining plate (1), then install them to transaxle case.



11) Compress 1st and reverse brake return spring using special tool and hydraulic press, then attach snap ring.

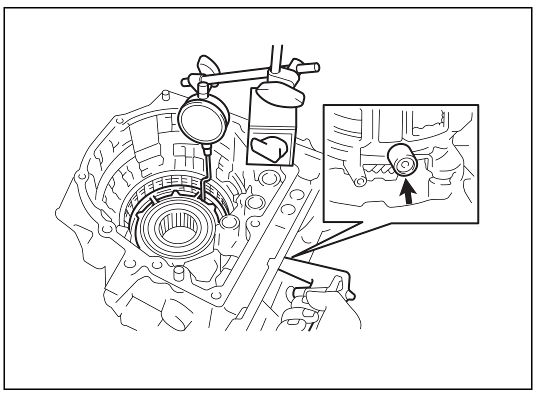
CAUTION:
Do not damage 1st and reverse brake return spring subassembly discs, plates and piston by pressing in 1st and reverse brake return spring subassembly passing through its original installing position over 0.8 mm (0.031 in.)

Special tool
(A): 09926-97620



12) Install 1st and reverse brake plate snap ring so that its both ends would be positioned in correct locations as shown in figure.

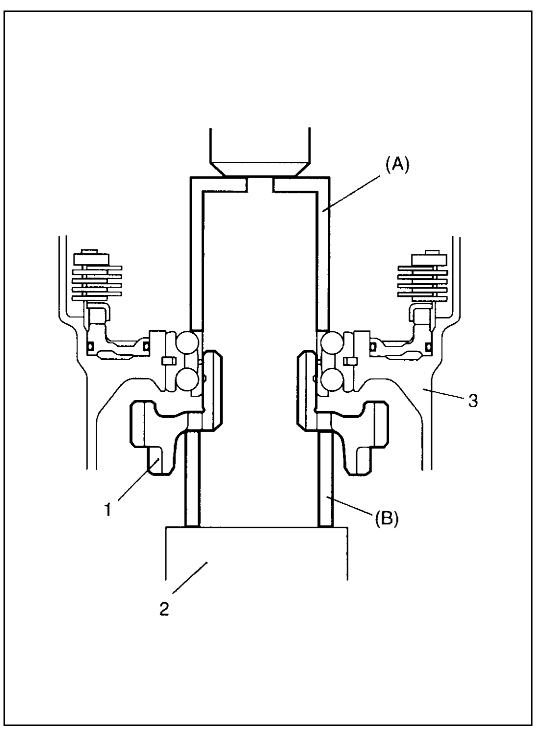
[A]	Correct
[B]	Incorrect



13) Using special tools, measure 1st and reverse brake piston stroke when compressed air (400 – 800 kPa, 4 – 8 kg/cm^2, 57 – 113 psi) is brown through oil hole.

Special tool
(A) 09900-20607
(B) 09900-20701
(C) 09952-06020

1st and reverse brake piston stroke
Standard: 0.791 – 1.489 mm (0.0311 – 0.0586 in.)



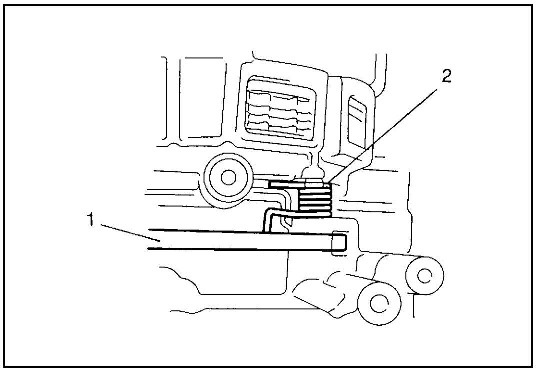
14) Install reduction drive gear (1) to transaxle case (3) by using special tools and hydraulic press.

CAUTION:
- **Do not use transaxle case as groundwork to press fit reduction drive gear.**
- **Do not give load more than 20 kN (2,000 kg, 4410 lb) with hydraulic press. Otherwise, it may result in damaging reduction drive gear bearing.**

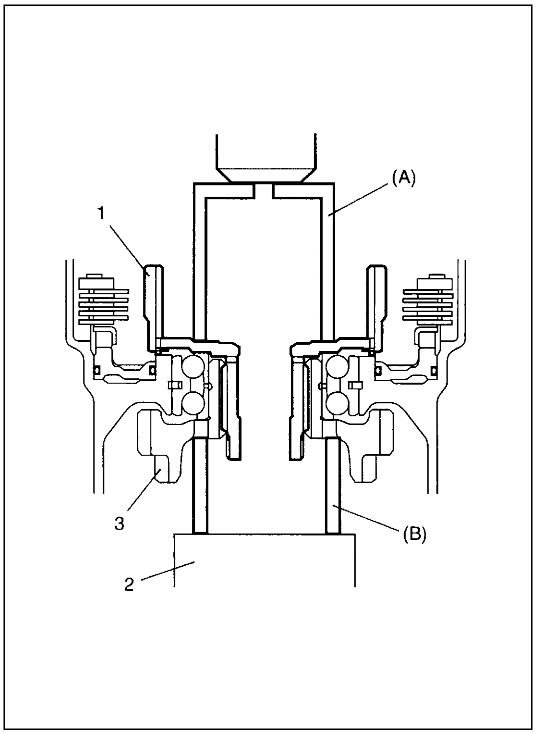
Special tool
(A): 09951-18210
(B): 09944-78210

2.	Stand that can slightly lift transaxle case.

NOTE:
When replacing reduction drive gear, replace it together with reduction driven gear as a set.



15) Install parking lock pawl (1) and spring (2). Apply A/T fluid to parking lock pawl shaft, then insert it into transaxle case.



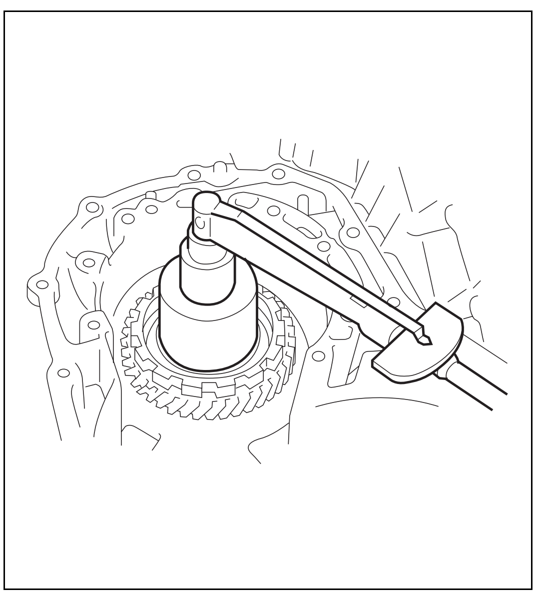
16) Install new planetary ring gear subassembly (1) to reduction drive gear (3) by using special tools and hydraulic press.

CAUTION:

- **Do not reuse planetary ring gear subassembly. Otherwise it may cause damage to planetary gear unit and/or reduction gears.**
- **Do not use transaxle case as groundwork to press fit planetary ring gear subassembly.**
- **Do not give load more than 20 kN (2,000 kg, 4410 lb) with hydraulic press. Otherwise, it may result in damaging reduction drive gear bearing.**

Special tool
(A): 09951-18210
(B): 09944-78210

2. Stand that can slightly lift transaxle case.



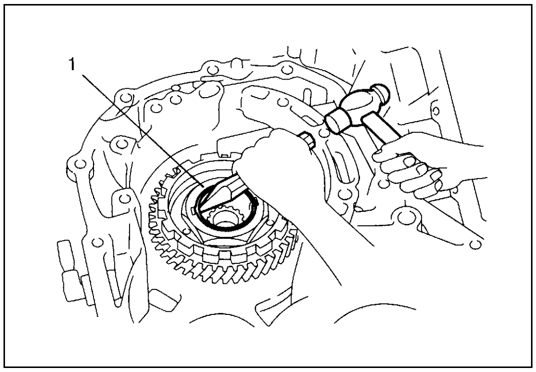
17) Tighten new reduction drive gear nut to planetary ring gear subassembly little by little until reduction drive gear bearing preload is within specification.

CAUTION:

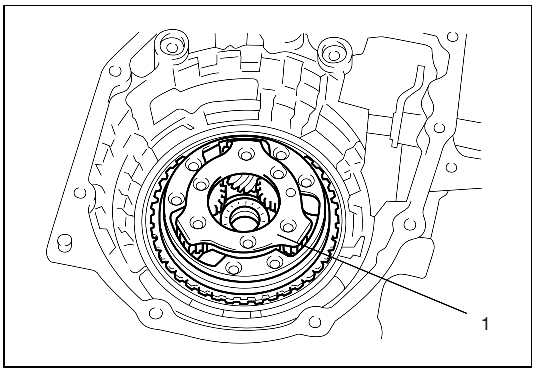
- **Do not tighten nut over the specifications so that reduction drive gear nut would not be broken.**
- **Carry out this procedure on rubber mat in order not to damage transaxle case.**

Tightening torque
Reference: 100 N·m (10.0 kg-m, 72.5 lb-ft)

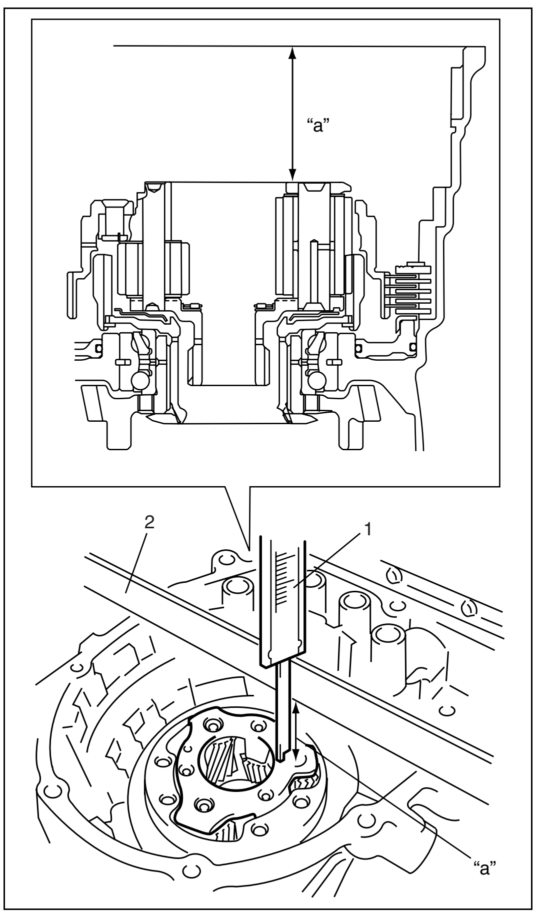
Reduction drive gear bearing preload (turning torque)
Standard: 0.05 – 0.35 N·m (0.5 – 3.5 kg-cm, 0.036 – 0.253 lb-ft)



18) Caulk reduction drive gear nut (1).

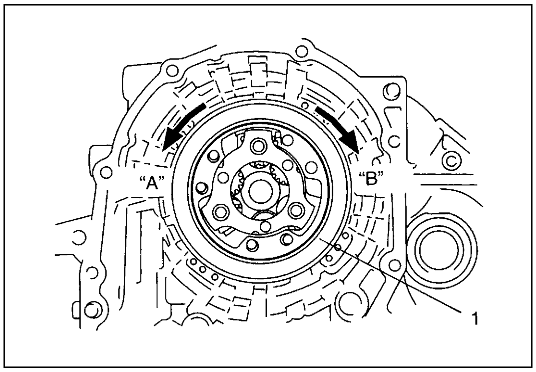


19) Apply A/T fluid to planetary gear assembly (1), then fit it to planetary ring gear assembly.

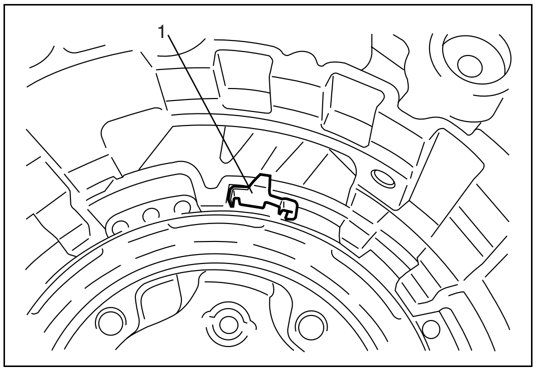


20) Check for correct installation of planetary gear assembly as follows.
Measure the distance "a" by using micrometer caliper (1) and straightedge (2). If measured value is out of specification, remove planetary gear assembly and reinstall it properly.

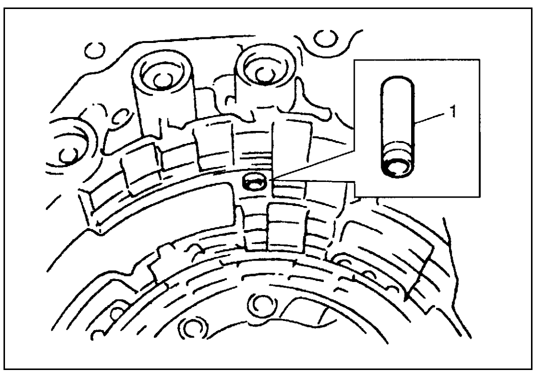
Distance between planetary gear assembly and mating surface of transaxle case
"a": 51.3 – 52.0 mm (2.020 – 2.047 in.)



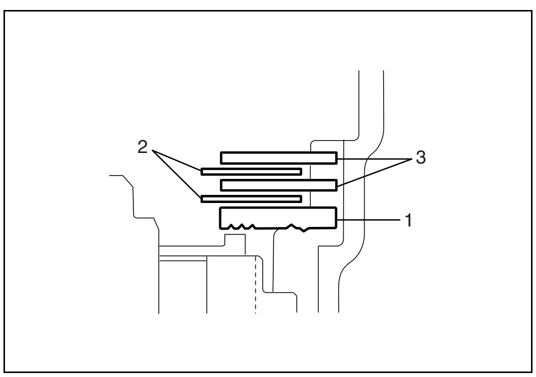
21) Apply A/T fluid to one-way clutch No.2 assembly (1), then install it to planetary gear assembly. After that, ensure that planetary carrier rotates only in counterclockwise direction "A", not in clockwise direction "B".



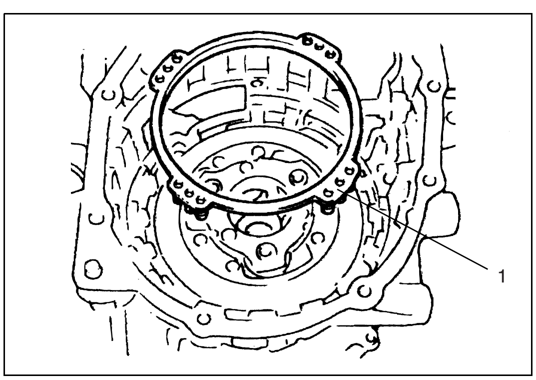
22) Install one-way clutch outer race retainer (1).



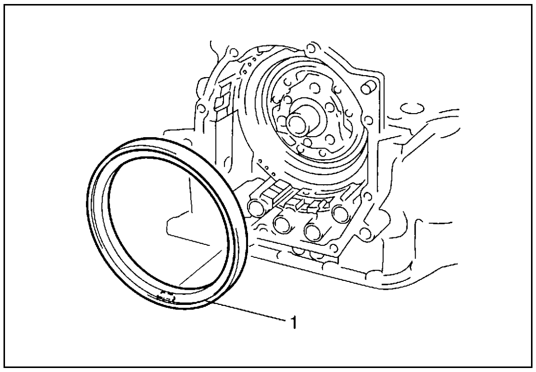
23) Apply A/T fluid to new brake drum gasket (1), then install it to transaxle case.



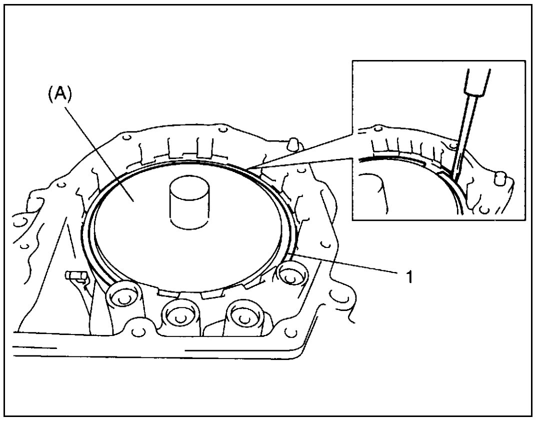
24) Apply A/T fluid to 2nd brake retaining plate (1), discs (2) and separator plates (3), then install them to transaxle case.



25) Install 2nd brake return spring subassembly (1) to transaxle case.



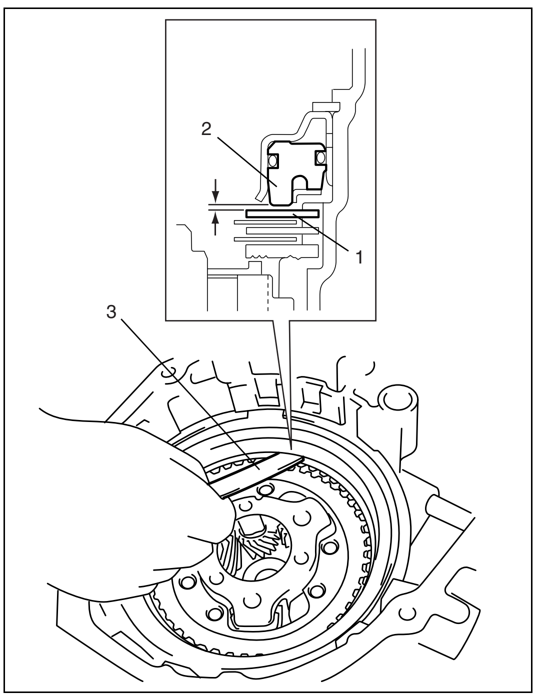
26) Apply A/T fluid to 2nd brake piston assembly (1), and align the projection of 2nd brake piston assembly with the groove of transaxle case, then put together.



27) Install 2nd brake piston snap ring (1) by using special tool and hydraulic press.

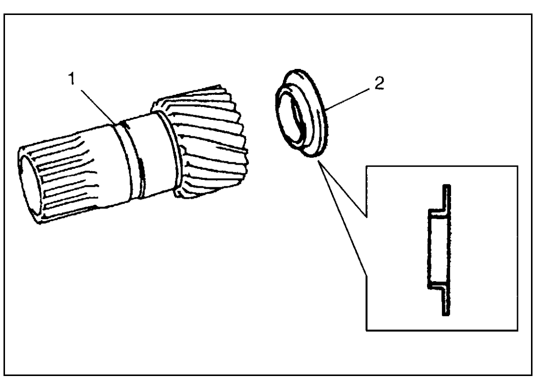
CAUTION:
Do not damage 2nd brake piston assembly, return spring subassembly, plates and discs by pressing in 2nd brake assembly passing through its original installing position over 0.4 mm (0.016 in.).

Special tool
(A): 09926-96050

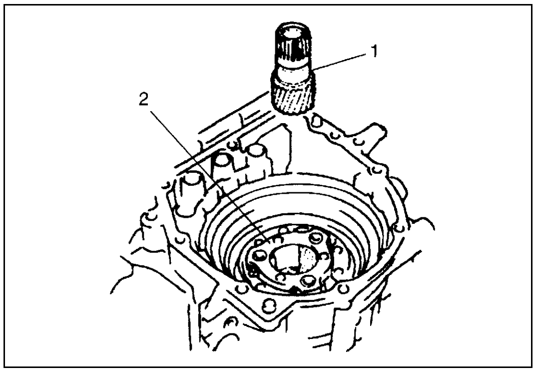


28) Check 2nd brake piston stroke by measuring clearance between 2nd brake separator plate (1) and piston (2) with feeler gauge (3).
If clearance (piston stroke) is out of specification replace clutch discs and plates with new ones.

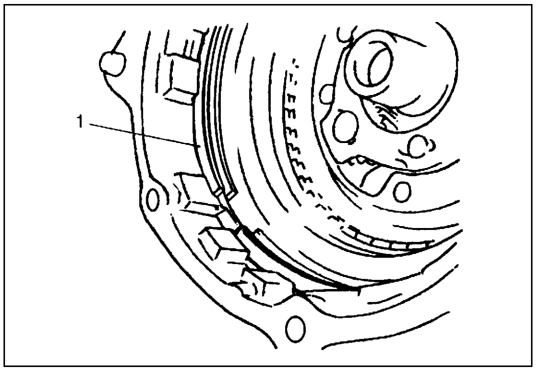
2nd brake piston stroke
Standard: 0.40 – 1.25 mm (0.016 – 0.049 in.)



29) After applying A/T fluid to front sun gear thrust bearing race (2), install it to front planetary sun gear (1).

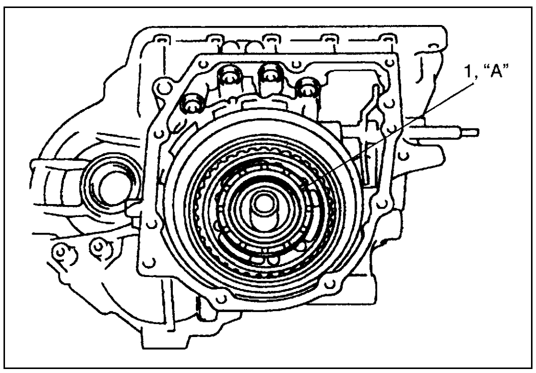


30) Apply A/T fluid to front planetary sun gear (1) and install it to planetary gear assembly (2).



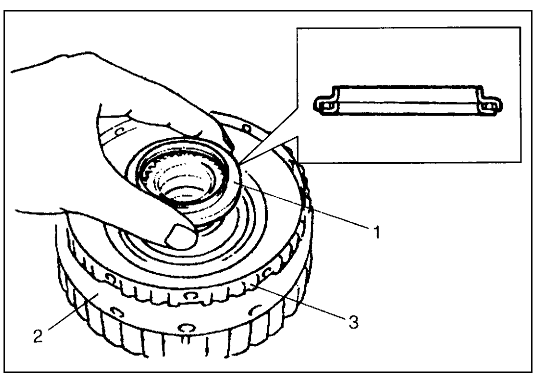
31) Install O/D and 2nd coast brake retaining plate snap ring (1).

CAUTION:
Be sure to install O/D and 2nd coast brake retaining plate snap ring correctly in groove of transaxle case.

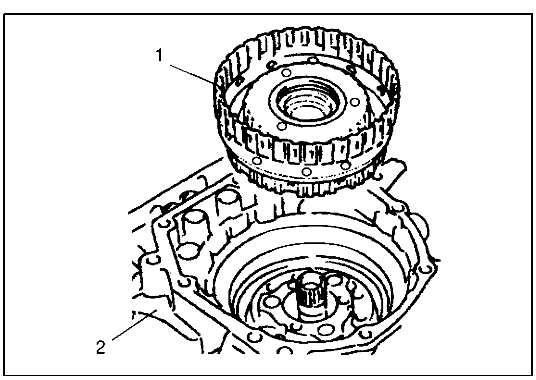


32) After applying grease to slide contact face of planetary carrier thrust washer (1), install it to planetary gear assembly.

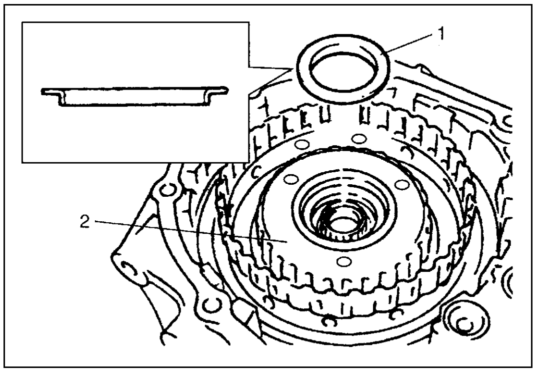
"A": Grease 99000-25030



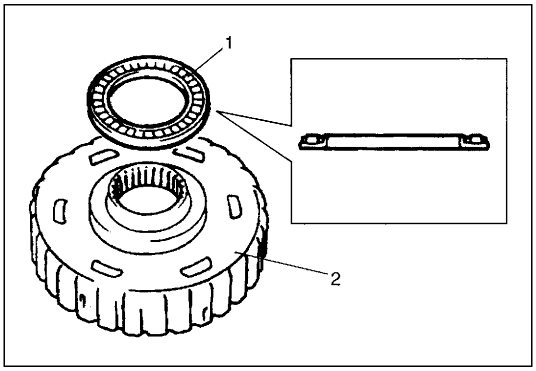
33) Apply A/T fluid to one-way clutch No.1 assembly (3) and install one-way clutch No.1 assembly (3) to rear planetary sun gear subassembly (2).
34) Apply A/T fluid to planetary gear thrust bearing (1), then install it to one-way clutch No.1 assembly (3).



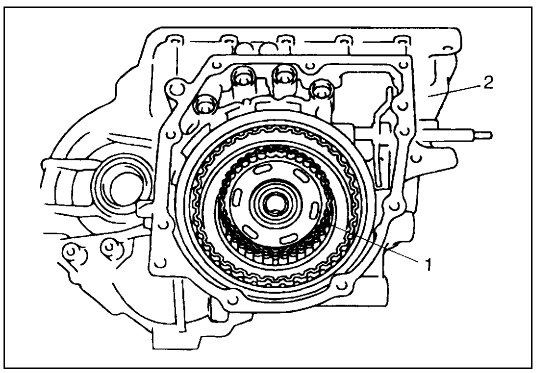
35) After applying A/T fluid to rear planetary sun gear subassembly and one-way clutch No.1 assembly (1), install them in transaxle case (2).



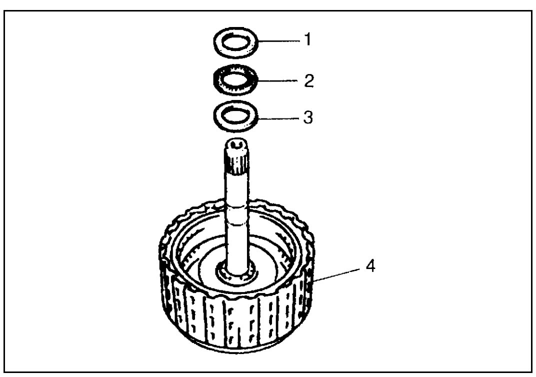
36) After applying A/T fluid to rear sun gear thrust bearing race (1), install it to rear planetary sun gear (2).



37) After applying A/T fluid to rear sun gear thrust bearing (1), install it to forward clutch hub (2).



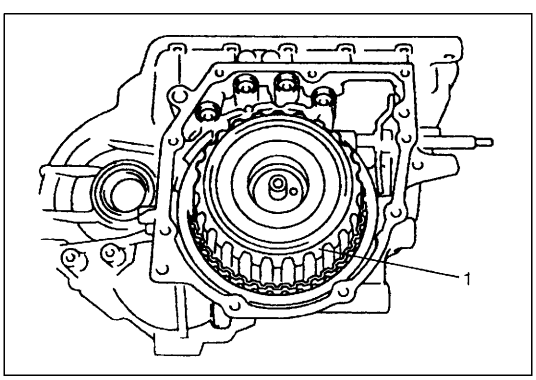
38) After applying A/T fluid to forward clutch hub (1), install it in transaxle case (2).



39) After applying A/T fluid to intermediate shaft thrust bearing rear race (3), thrust bearing (2) and front race (1), install them to forward and reverse clutch assembly (4).

Bearing race dimension

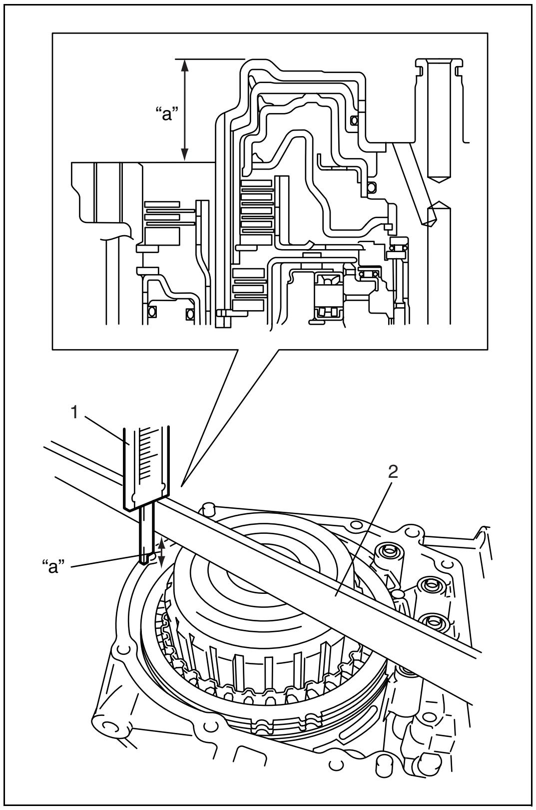
	Front race	Rear race
Outside diameter	30.6 mm (1.20 in.)	28.2 mm (1.11 in.)
Thickness	2.0 mm (0.08 in.)	2.0 mm (0.08 in.)



40) Apply A/T fluid to forward and reverse clutch assembly (1). Install forward and reverse clutch assembly while rotating clockwise and counter clockwise frequently to fit clutch discs to mating hubs.

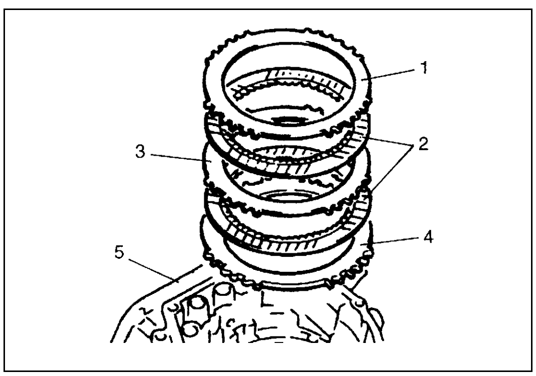
NOTE:

Before installation, align teeth of forward and reverse clutch discs to facilitate installation.

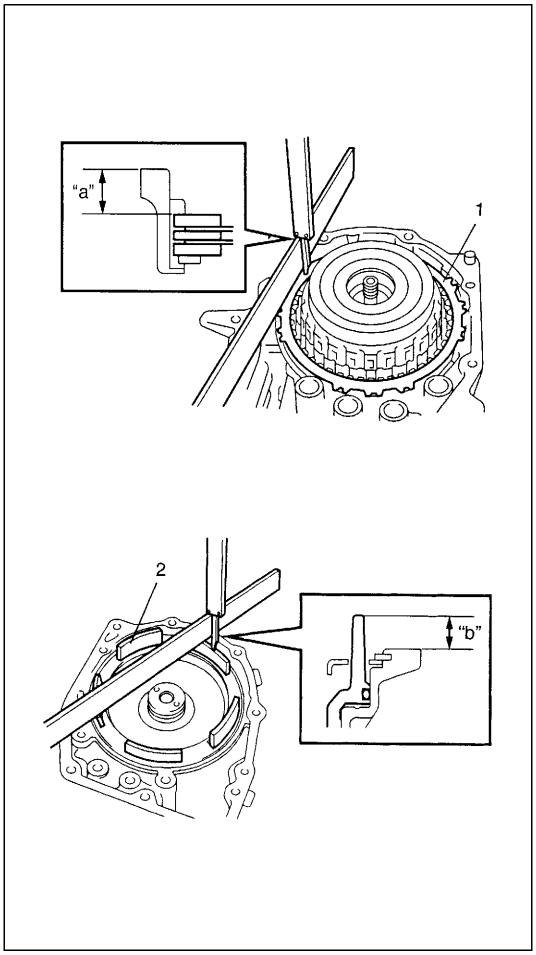


41) Check for correct installation of forward and reverse clutch assembly as follows.
Measure distance "a" by using micrometer caliper (1) and straightedge (2). If out of specification, remove forward and reverse clutch assembly, forward clutch hub, rear planetary sun gear subassembly and one-way clutch No.1 assembly, and reinstall them properly.

Distance between forward and reverse clutch assembly and mating surface of transaxle case
"a": 27.1 – 29.4 mm (1.067 – 1.157 in.)



42) After applying A/T fluid to O/D and 2nd coast brake retaining plate (4), separator plate (3), discs (2) and rear plate (1), install them to transaxle case (5).



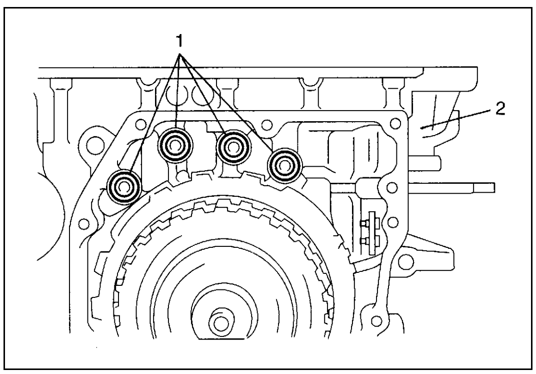
43) Measure O/D and 2nd coast brake piston stroke.
- Measure dimension "a" from end face of transaxle case to O/D and 2nd coast brake rear plate (1) using straightedge and micrometer caliper.
- Measure dimension "b" from O/D and 2nd coast brake piston (2) to rear cover assembly mating surface using straightedge and micrometer caliper.
- Calculate piston stroke from measured value of dimensions "a" and "b".
- Piston stroke = "a" – "b"

O/D and 2nd coast brake piston stroke
standard: 0.65 – 1.05 mm (0.026 – 0.041 in.)

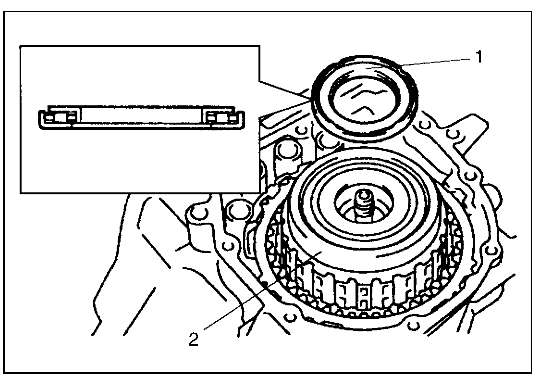
When piston stroke is out of specification, select O/D and 2nd coast brake rear plate with proper thickness from among the list below and replace it.

Available O/D and 2nd coast brake rear plate thickness

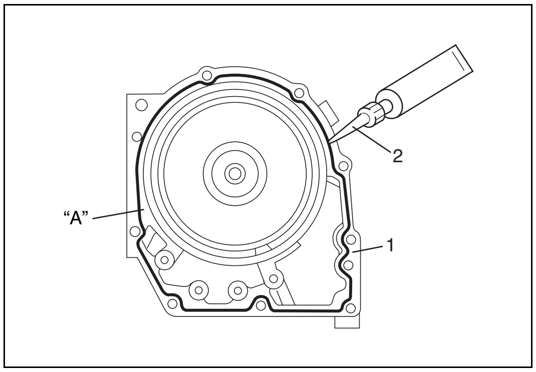
Thickness	Identification mark
1.8 mm (0.071 in.)	1
2.0 mm (0.079 in.)	2
2.2 mm (0.087 in.)	3
2.4 mm (0.094 in.)	4
2.6 mm (0.102 in.)	5
5.0 mm	



44) After applying A/T fluid to new 2nd brake gaskets (1), install them to transaxle case (2).



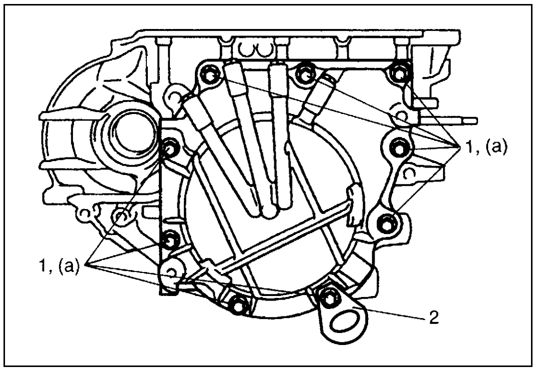
45) After applying A/T fluid to reverse clutch drum thrust bearing (1), install it to forward and reverse clutch assembly (2).



46) Remove sealant attached to mating surface of transaxle rear cover (1) completely.
47) Apply sealant to mating surface of transaxle rear cover (1) by using a nozzle (2) as shown in figure by such amount that its section is 1.2 mm (0.047 in.) in diameter.

"A": Sealant 99000-31230

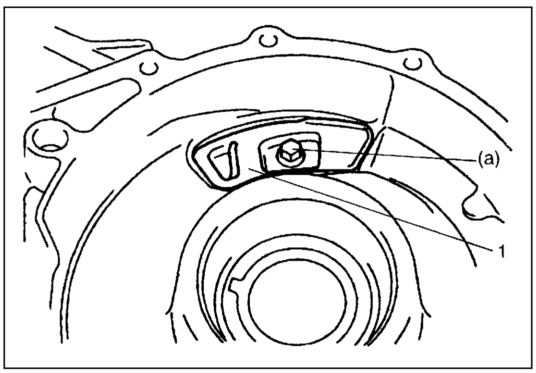
48) Install transaxle rear cover assembly on transaxle case.



49) Install hook (2) to location shown in figure.

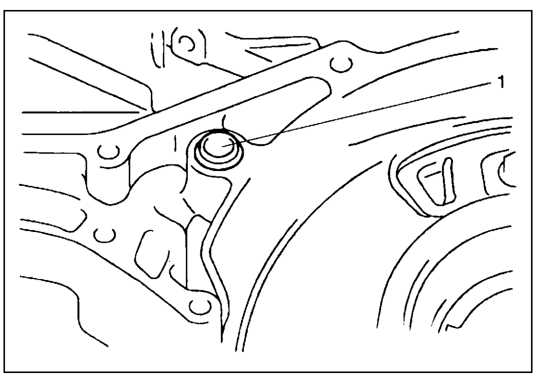
Tightening torque
Rear cover bolt
(a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

50) Tighten rear cover bolts (1).

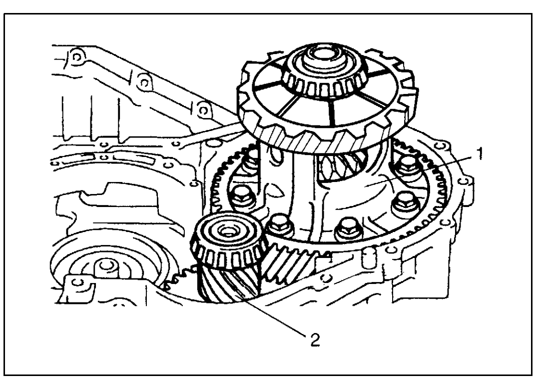


51) Install fluid reservoir LH plate (1).

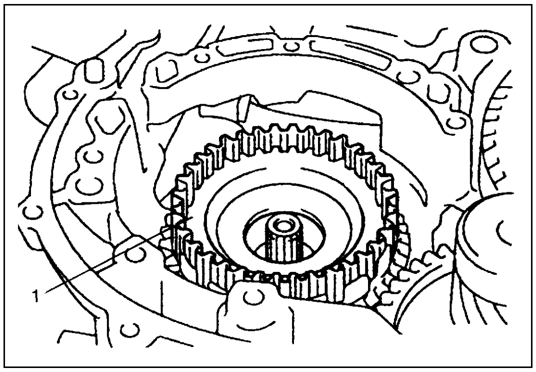
Tightening torque
Fluid reservoir LH plate bolt
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)



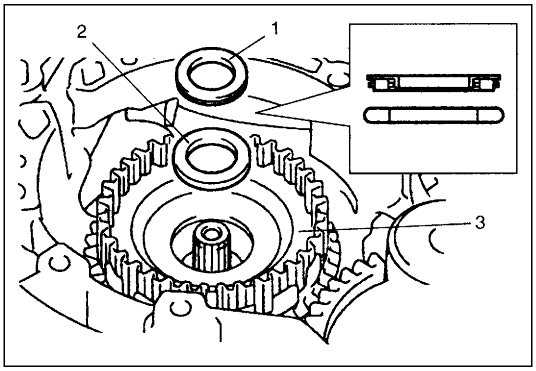
52) After applying A/T fluid to new governor apply No.2 gasket (1), install it to transaxle case.



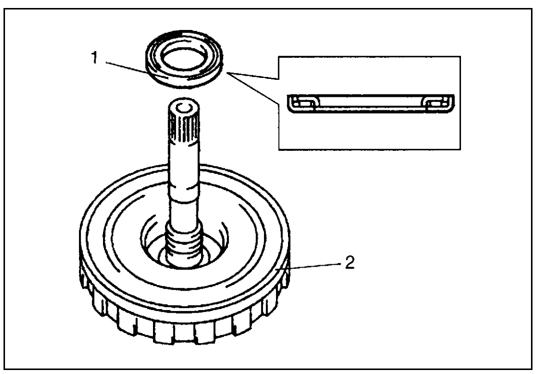
53) After applying A/T fluid to differential assembly (1) and countershaft assembly (2), install them to transaxle case.



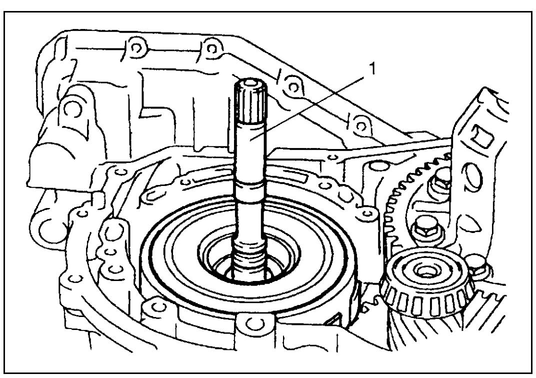
54) After applying A/T fluid to direct clutch hub (1), install it to planetary gear assembly.



55) After applying A/T fluid to input shaft rear thrust bearing (1) and thrust bearing race (2), install them into direct clutch hub (3).



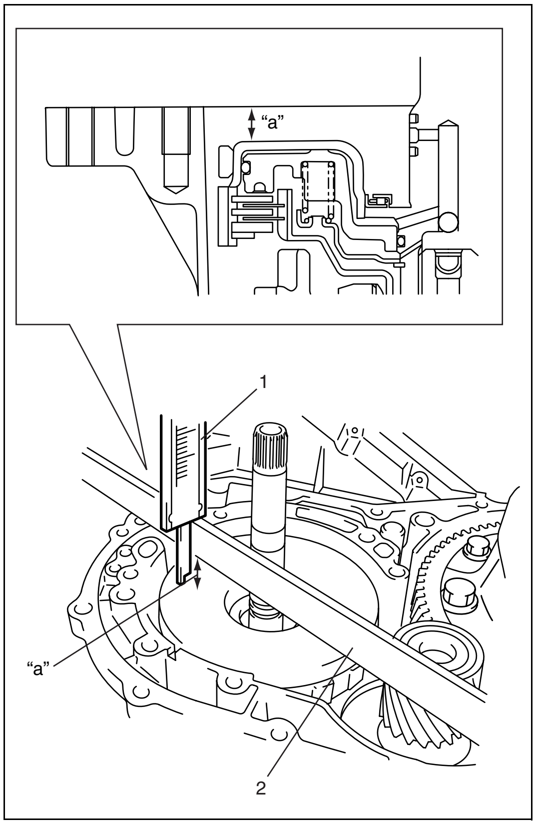
56) After applying A/T fluid to input shaft front thrust bearing (1), install it to direct clutch assembly (2).



57) Apply A/T fluid to direct clutch assembly (1).
Install direct clutch assembly while rotating clockwise and counter clockwise frequently to fit clutch discs to mating hub.

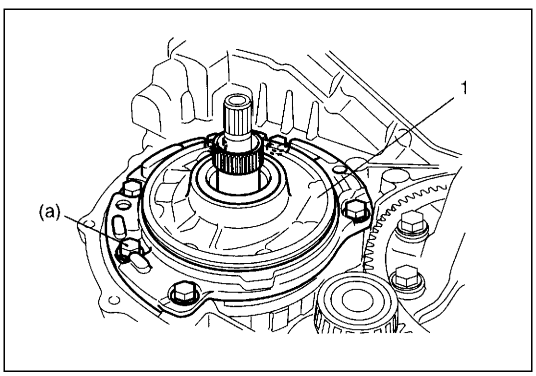
NOTE:

Before installation, align teeth of direct clutch discs to facilitate installation.



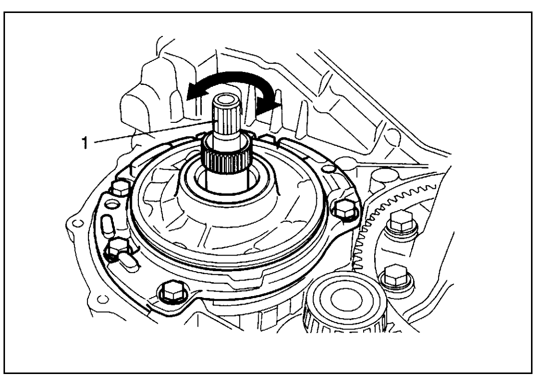
58) Check for correct installation of direct clutch assembly as follows.
    Measure distance "a" by using micrometer caliper (1) and straightedge (2). If out of specification, remove direct clutch assembly, direct clutch hub and reinstall them properly.

Distance between direct clutch assembly and mating surface of transaxle case
"a": 10.5 – 11.3 mm (0.413 – 0.445 in.)

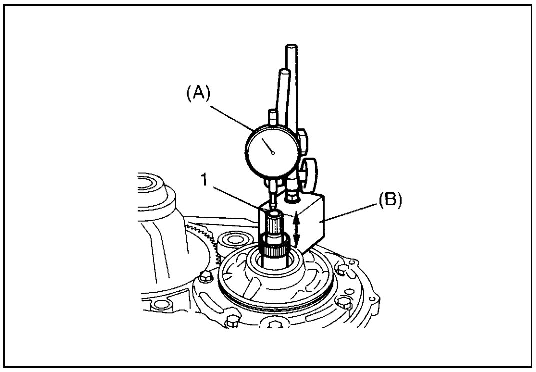


59) Install oil pump assembly (1) to transaxle case.

Tightening torque
Oil pump assembly bolt
(a): 25 N·m (2.5 kg-m, 18.0 lb-ft)



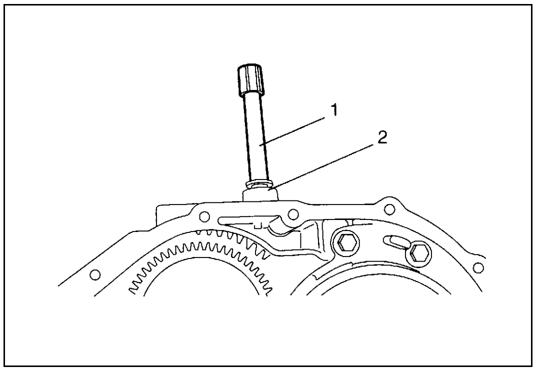
60) Make sure that input shaft (1) turns smoothly.



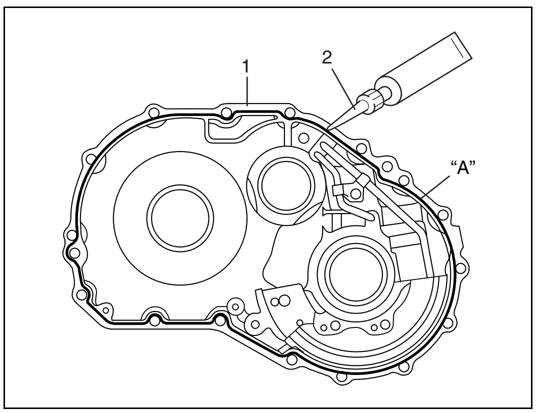
61) Measure input shaft thrust play.
    Apply dial gauge onto input shaft end (1) and measure thrust play of input shaft.

Special tool
(A): 09900-20607
(B): 09900-20701

Input shaft thrust play: 0.3 – 0.9 mm (0.012 – 0.035 in.)

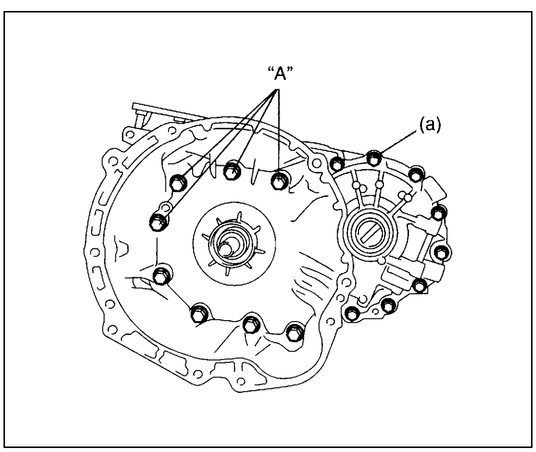


62) After applying A/T fluid to new O-ring, fit it to breather union (2). Then install breather union to transaxle case.
63) Install breather hose (1).



64) Wipe off and clean mating surface between transaxle case (1) and torque converter housing.
65) Apply sealant to torque converter housing (1) by using a nozzle (2) as shown in figure by such amount that its section is 1.2 mm (0.047 in.) in diameter.

"A": Sealant 99000-31230

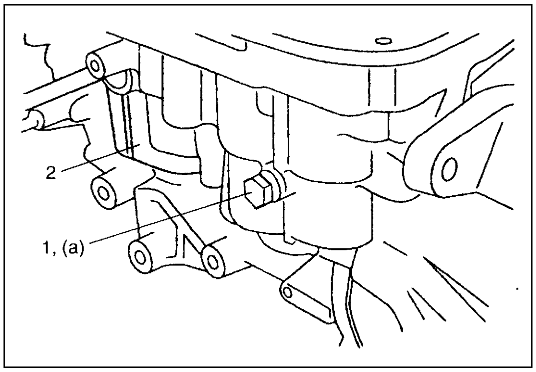


66) Install torque converter housing to transaxle case, tighten bolts to specified torque.

CAUTION:
Apply sealant to threads of four bolts shown in figure before tightening.

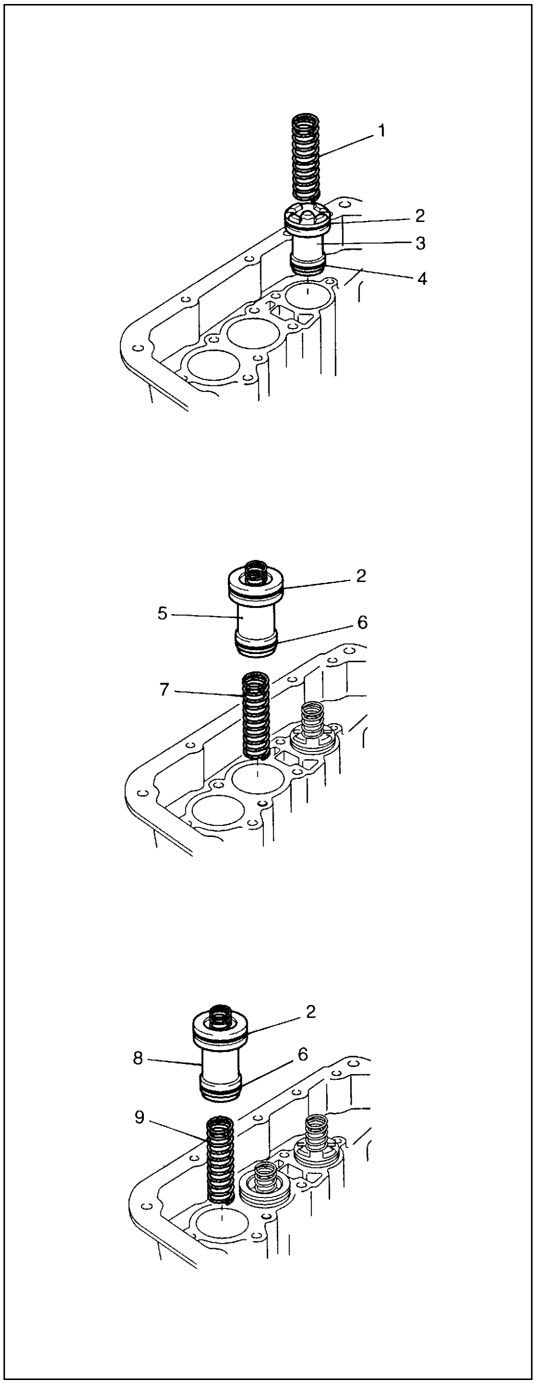
"A": Sealant 99000-31230

Tightening torque
Torque converter housing bolt
(a): 33 N·m (3.3 kg-m, 24.0 lb-ft)



67) After applying A/T fluid to new O-ring, fit it to transaxle case plug (1). Then install the transaxle case plug to transaxle case (2).

Tightening torque
Transaxle case plug
(a): 7.5 N·m (0.75 kg-m, 5.5 lb-ft)



68) Install new O-rings to each accumulator piston and apply A/T fluid to them.

Accumulator O-ring dimension

O-ring name	Inside diameter	Section diameter
B1 accumulator O-ring (Large) (2) C1 accumulator O-ring (Large) (2) C2 accumulator O-ring (Large) (2) (Above three O-rings are same.)	29.4 mm (1.16 in.)	2.6 mm (0.10 in.)
B1 accumulator O-ring (Small) (4)	19.7 mm (0.78 in.)	2.6 mm (0.10 in.)
C1 accumulator O-ring (Small) (6) C2 accumulator O-ring (Small) (6) (Above two O-rings are same.)	21.8 mm (0.86 in.)	2.6 mm (0.10 in.)

NOTE:

Make sure that O-rings are not twisted or caught when installing.

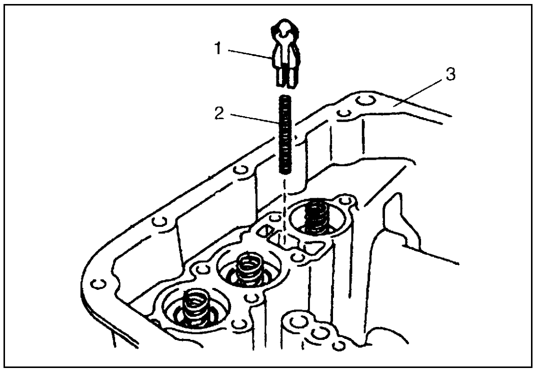
69) Install B1, C1, C2 accumulator pistons and springs.

Accumulator piston identification

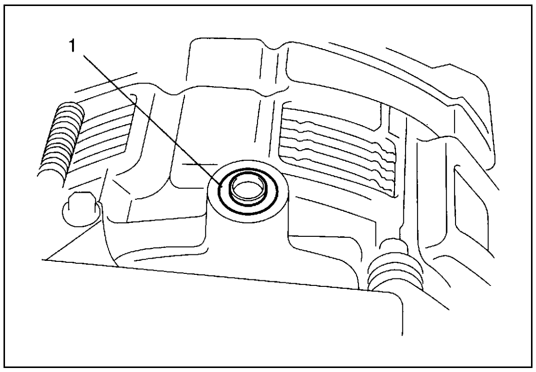
Piston name	Identification (Embossed letters on piston)
B1 accumulator piston (3)	SB-1
C1 accumulator piston (5)	S2C-1
C2 accumulator piston (8)	S2C-2

Accumulator spring identification

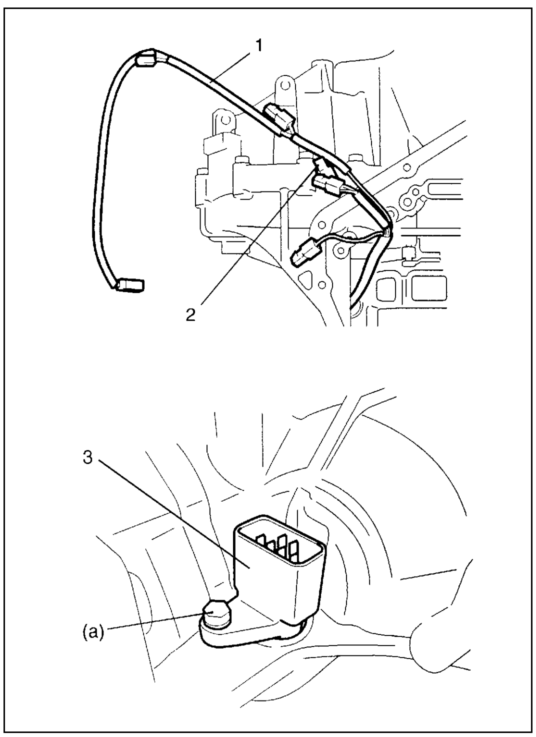
Spring name	Color of identification paint
B1 accumulator No.2 spring (1)	Pink
C1 accumulator No.2 spring (7)	Light Blue
C2 accumulator No.2 spring (9)	Yellow



70) After applying A/T fluid to cooler check valve (1) and spring (2), install them to transaxle case (3).



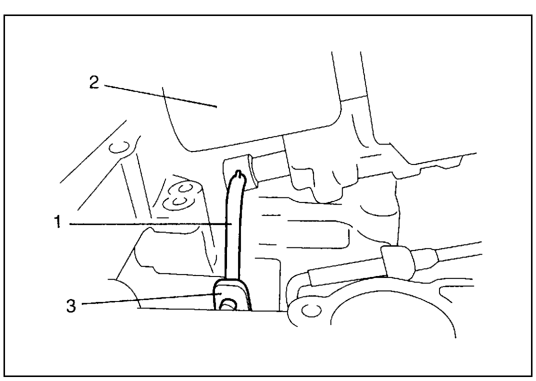
71) After applying A/T fluid to new governor apply No.1 gasket (1), install it to transaxle case.



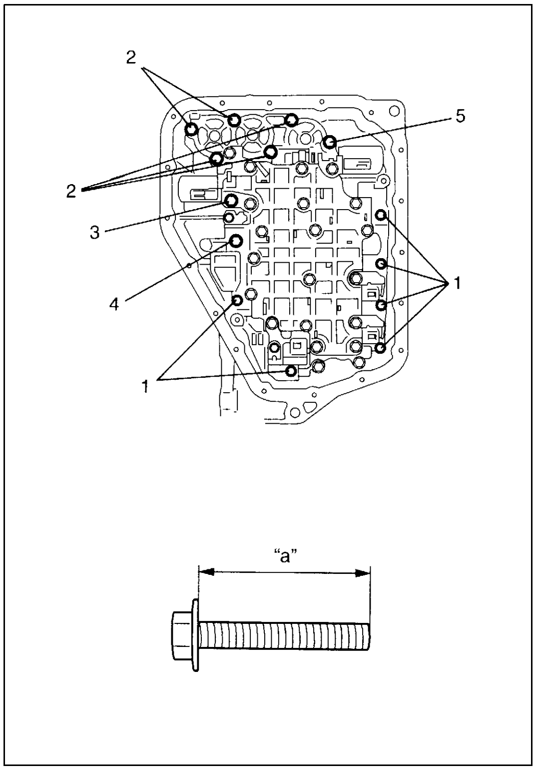
72) After applying A/T fluid to new O-ring, fit it to valve body harness connector (3), then install valve body harness to transaxle case.

CAUTION:
When put valve body harness (1) into transaxle case, take care not to damage transmission fluid temperature sensor (2) at narrow entrance of case.
Careless sensor treatment might cause sensor malfunction.

Tightening torque
Valve body harness connector bolt
(a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)



73) Install manual valve rod (1) to manual valve lever (3) and then install valve body assembly (2) to transaxle case.



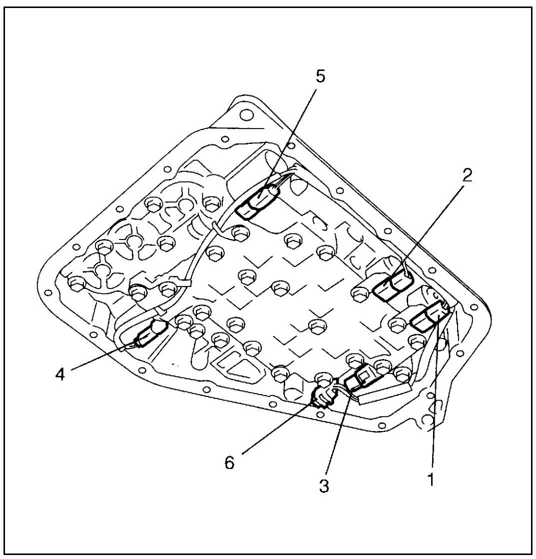
74) Tighten valve body bolts to specified torque.

Tightening torque
Valve body bolt
11 N·m (1.1 kg-m, 8.0 lb-ft)

Valve body bolt length

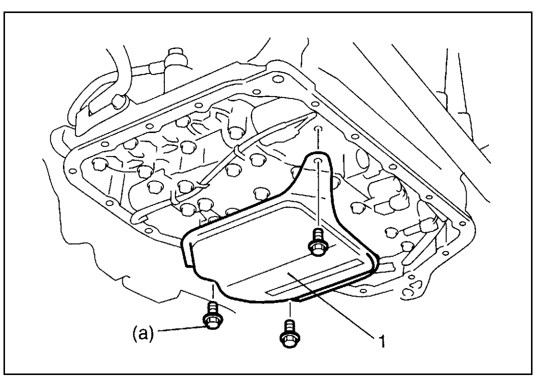
Bolt	Length "a"	Pieces
A	20 mm (0.79 in.)	6
B	28 mm (1.10 in.)	5
C	49 mm (1.93 in.)	1
D	36 mm (1.42 in.)	1
E	40 mm (1.58 in.)	1

1.	Bolt A
2.	Bolt B
3.	Bolt C
4.	Bolt D
5.	Bolt E



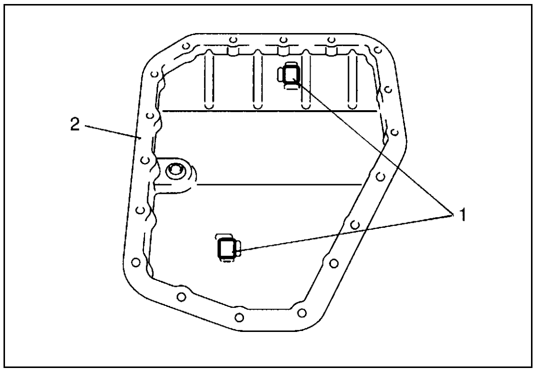
75) Connect solenoid connectors to solenoid valves identifying their installing positions by wire colors, and install transmission fluid temperature sensor to its clamp.

Solenoid valve coupler	Wire Color
Shift solenoid valve-A (1)	White
Shift solenoid valve-B (2)	Black
Timing solenoid valve (3)	Yellow
TCC (Lock-up) solenoid valve (4)	Light Green
Pressure control solenoid valve (5)	Gray + Green
Transmission fluid temperature sensor (6)	Orange



76) Install oil strainer assembly (1).

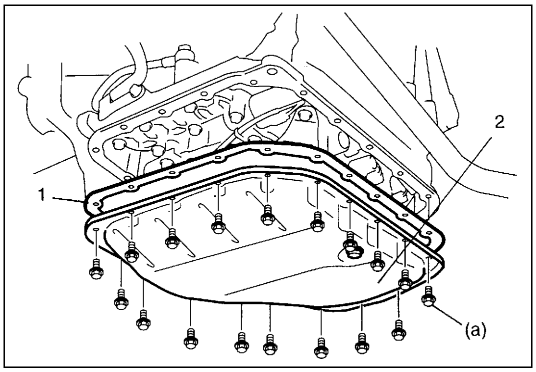
Tightening torque
Oil strainer bolt
(a): 10 N·m (1.0 kg-m, 7.5 lb-ft)



77) Install oil cleaner magnets (1) in oil pan (2).

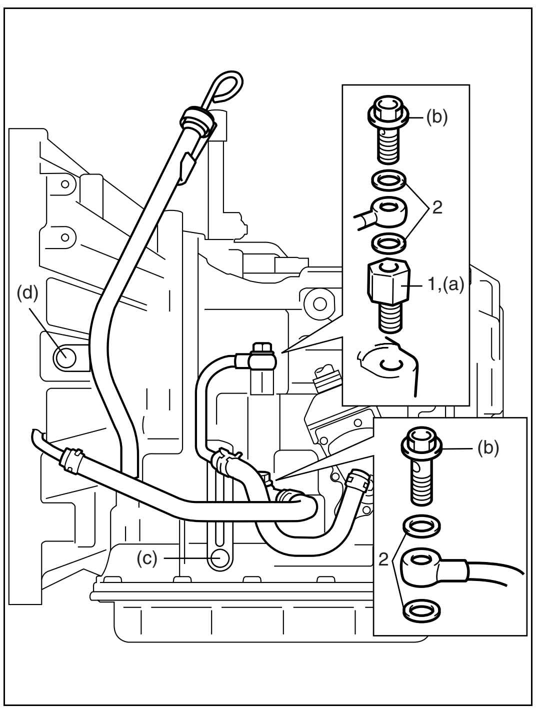
NOTE:

If metal particles are attached to the magnets, clean them before installing.



78) Install new oil pan gasket (1) between transaxle case and oil pan (2).

Tightening torque
Oil pan bolt
(a): 7.0 N·m (0.7 kg-m, 5.0 lb-ft)



79) After applying A/T fluid to new O-ring, fit it to fluid inlet union (1). Then install fluid outlet union to transaxle case.

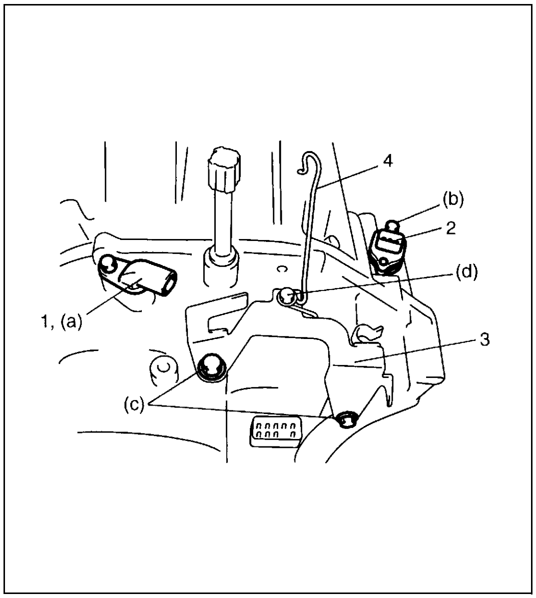
Tightening torque
Fluid outlet union
(a): 25 N·m (2.5 kg-m, 18.0 lb-ft)

80) Install new gasket (2) and then install fluid cooler pipes.

Tightening torque
Fluid cooler pipe bolt
(b): 22 N·m (2.2 kg-m, 16.0 lb-ft)
Fluid cooler pipe bracket bolt
(c): 10 N·m (1.0 kg-m, 7.5 lb-ft)

81) After applying A/T fluid to new O-ring, fit it to fluid filler tube. Then install fluid filler tube to transaxle case.

Tightening torque
Fluid filler tube bolt
(d): 10 N·m (1.0 kg-m, 7.5 lb-ft)

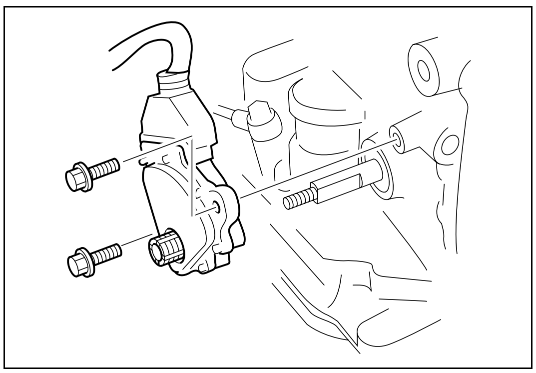


82) Apply A/T fluid to O-rings of each sensor and install input shaft speed sensor (1) and output shaft speed sensor (VSS) (2).

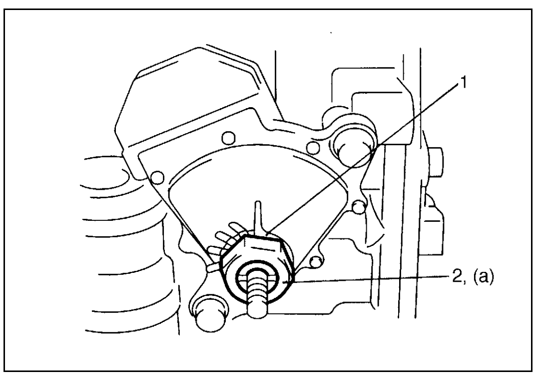
Tightening torque
Input shaft speed sensor bolt
(a): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)
Output shaft speed sensor (VSS) bolt
(b): 13 N·m (1.3 kg-m, 9.5 lb-ft)

83) Install harness bracket (3) and select cable clamp (4).

Tightening torque
Harness bracket bolt
(c): 23 N·m (2.3 kg-m, 17.0 lb-ft)
Select cable clamp bolt
(d): 10 N·m (1.0 kg-m, 7.5 lb-ft)

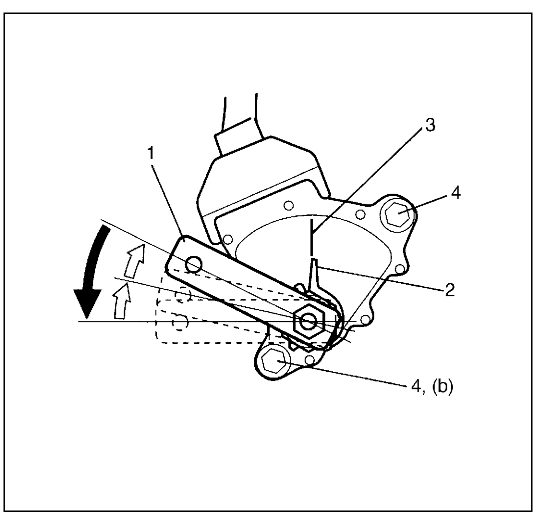


84) Install transmission range sensor to transaxle case, tighten bolts temporarily at this step.



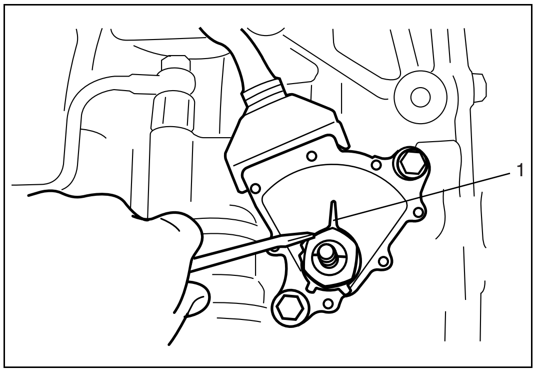
85) Install lock washer (1) and tighten lock nut (2) to specified torque.

Tightening torque
Transmission range sensor lock nut
(a): 7 N·m (0.7 kg-m, 5.0 lb-ft)

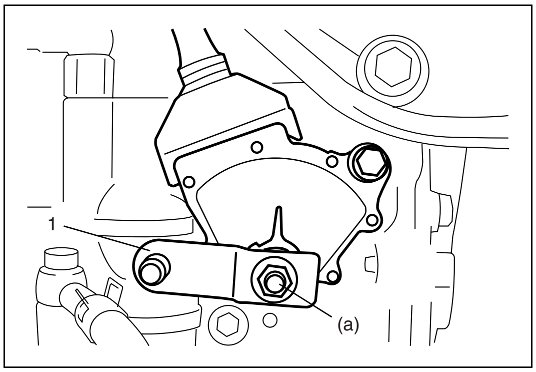


86) Install manual select lever (1) temporarily at this step.
87) After shifting manual select lever counterclockwise fully, select “N” range position by bringing it back 2 notches clockwise.
88) Remove manual select lever (1) at this step.
89) Loosen sensor bolts (4) and align needle direction shaped on lock washer (2) with “N” reference line (3) on transmission range sensor by moving sensor in rotative direction.
90) Tighten sensor bolts (4) to specified torque.

Tightening torque
Transmission range sensor bolt
(b): 5.5 N·m (0.55 kg-m, 4.0 lb-ft)

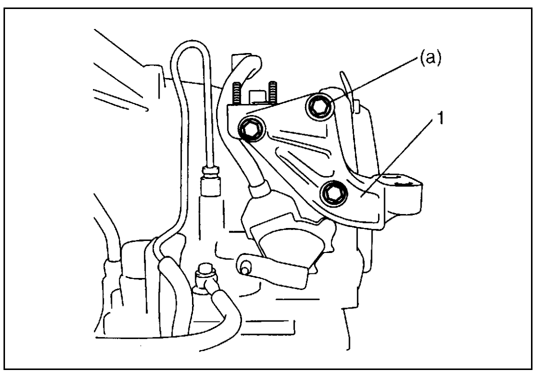


91) Bend dents of lock washer (1) in order to prevent displacement of lock washer.



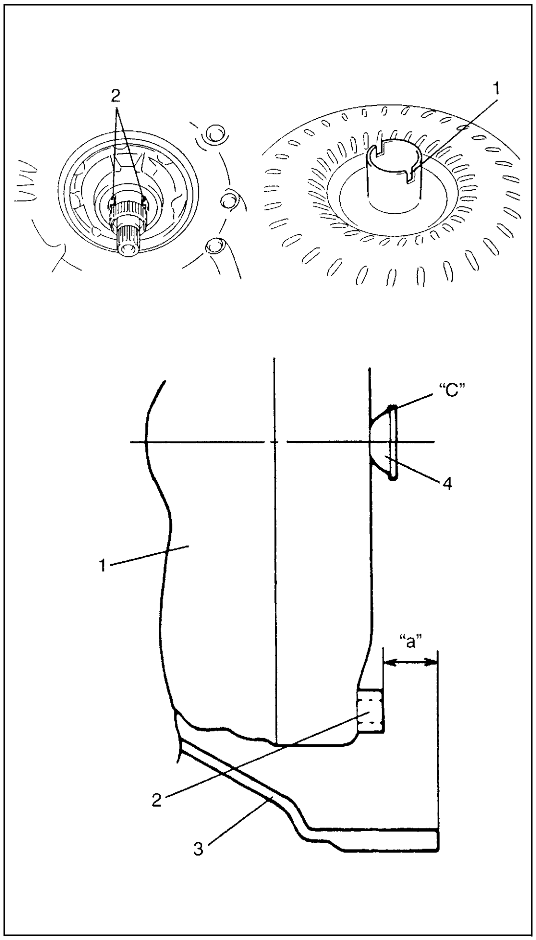
92) Install manual select lever (1).

Tightening torque
Manual select lever nut
(a): 13 N·m (1.3 kg-m, 9.5 lb-ft)



93) Install engine mounting LH bracket (1).

Tightening torque
Engine mounting LH bracket bolt
(a): 55 N·m (5.5 kg-m, 40.0 lb-ft)



CAUTION:
- **Before installing converter, make sure that its pump hub portion is free from nicks, burrs or damage which may cause oil seal to leak.**
- **Be very careful not to drop converter on oil pump gear. Damage in gear, should it occur, may cause a critical trouble.**

- Install torque converter aligning grooves (1) of torque converter and projection (2) of oil pump drive gear.
- Install torque converter, using care not to damage oil seal of oil pump.
- After installing torque converter, check that distance "a" is within specification.

Torque converter installing position
"a": More than 19.9 mm (0.783 in.)

- Check torque converter for smooth rotation.
- Apply grease around cup at the center of torque converter.

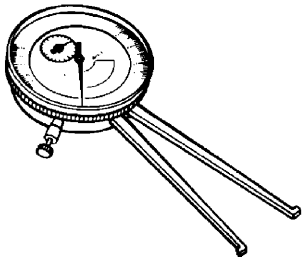
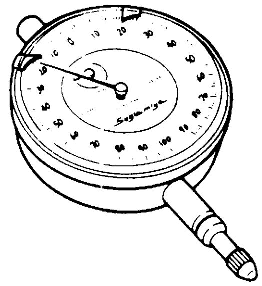
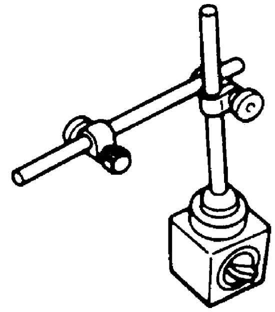
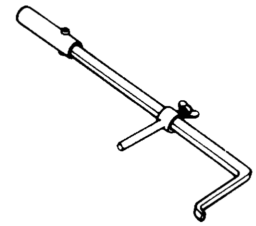
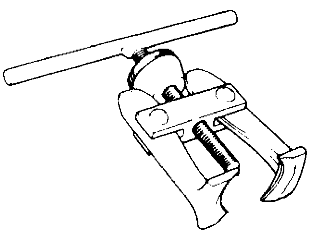
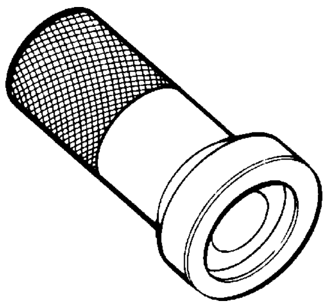
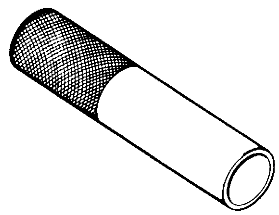
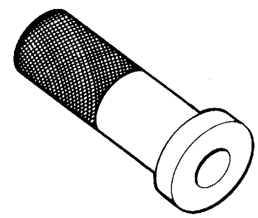
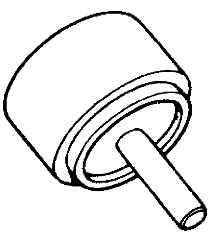
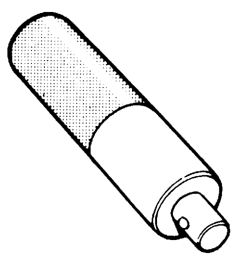
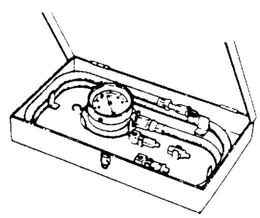
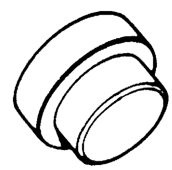
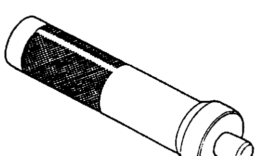
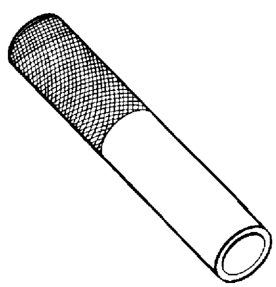
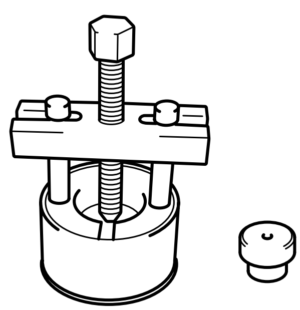
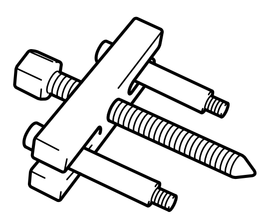
"C": Grease 99000-25010

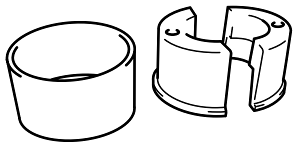
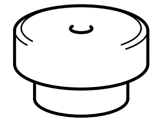
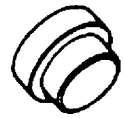
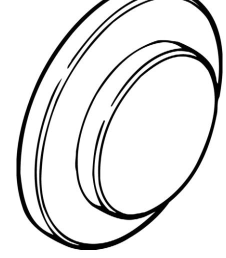
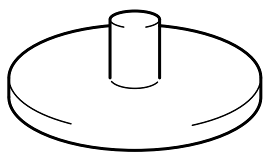
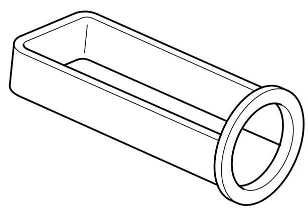
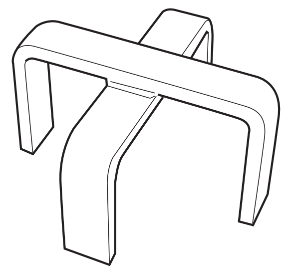
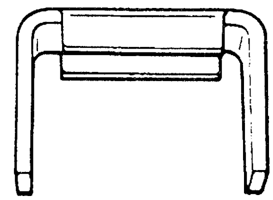
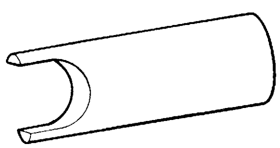
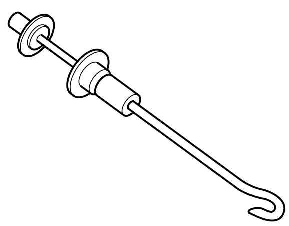
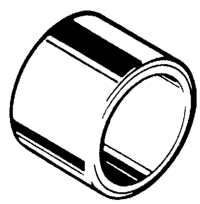
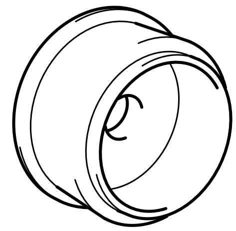
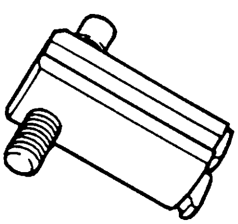
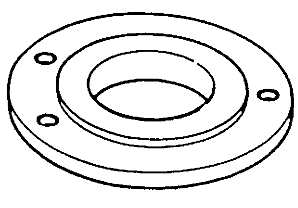
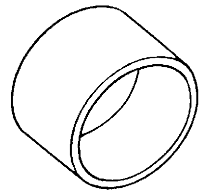
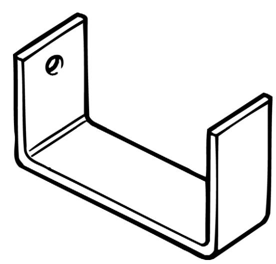
1.	Torque converter
2.	Flange nut
3.	Torque converter housing
4.	Cup

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
A/T fluid drain plug	17	1.7	12.5
Output shaft speed sensor bolt	13	1.3	9.5
Input shaft speed sensor bolt	5.5	0.55	4.0
Transaxle case plug	7.5	0.75	5.5
Solenoid valve bolt	11	1.1	8.0
Rear cover plug	7.5	0.75	5.5
Transaxle and engine fastening bolt and nut	85	8.5	61.5
Drive plate to torque converter bolt	19	1.9	14.0
Lower stiffener bolt	55	5.5	40.0
Starter motor bolt and nut	50	5.0	36.5
Oil pump subassembly bolt	10	1.0	7.5
Valve body bolt	11	1.1	8.0
Final gear bolt	78	7.8	56.5
Reduction drive gear nut (Reference)	100	10.0	72.5
Rear cover bolt	25	2.5	18.0
Fluid reservoir LH plate bolt	10	1.0	7.5
Manual detent spring bolt	10	1.0	7.5
Parking lock pawl bracket bolt	7.5	0.75	5.5
Oil pump assembly bolt	25	2.5	18.0
Torque converter housing bolt	33	3.3	24.0
Torque converter housing plug	7.5	0.75	5.5
Lubrication tube clamp bolt	5.5	0.55	4.0
Fluid reservoir RH plate bolt	5.5	0.55	4.0
Valve body harness connector bolt	5.5	0.55	4.0
Oil pan bolt	7.0	0.7	5.0
Oil strainer bolt	10	1.0	7.5
Fluid outlet union	25	2.5	18.0
Fluid cooler pipe flare nut	35	3.5	25.5
Fluid cooler pipe bolt	22	2.2	16.0
Fluid cooler pipe bracket bolt	10	1.0	7.5
Fluid filler tube bolt	10	1.0	7.5
Transmission range sensor lock nut	7	0.7	5.0
Transmission range sensor bolt	5.5	0.55	4.0
Manual select lever nut	13	1.3	9.5
Engine mounting LH bracket bolt	55	5.5	40.0
Harness bracket bolt	23	2.3	17.0
Select cable clamp bolt	10	1.0	7.5

Special Tool

 09900-20605 Dial caliper gauge	 09900-20607 Dial gauge	 09900-20701 Magnetic stand	 09913-50121 Oil seal remover
 09913-61510 Bearing puller	 09913-70123 Bearing installer	 09913-84510 Bearing installer	 09913-85210 Bearing installer
 09923-78210 Bearing installer	 09924-74510 Bearing installer handle	 09925-37811-001 Oil pressure gauge	 09925-88210 Bearing puller attachment
 09925-98210 Bearing installer	 09925-98221 Bearing installer	 09926-37610 Bearing remover See NOTE 1.	 09926-37610-001 Bearing puller See NOTE 2.

 09926-37610-002 Bearing puller attachment See NOTE 2.	 09926-37610-003 Bearing remover attach-ment See NOTE 2.	 09926-58010 Bearing remover attach-ment	 09926-96030 Clutch spring compressor
 09926-96050 Brake piston compressor	 09926-97610 Spring compressor	 09926-97620 Spring compressor	 09926-98310 Clutch spring compressor
 09928-06050 Differential preload adapter	 09942-15511 Sliding hammer	 09944-78210 Bearing installer support	 09944-88220 Oil seal installer
 09944-96011 Bearing outer race remover	 09946-06710 Bearing retainer dummy	 09951-18210 Oil seal installer	 09952-06020 Dial gauge plate No.2

NOTE:
- **“1”: This tool consists of Bearing Puller with 09926-37610-001, Bearing Puller Attachment with 09926-37610-002 and Bearing Remover Attachment with 09926-37610-003.**
- **“2”: This tool is constituent of Bearing Remover with 09926-37610.**

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Automatic transmission fluid	An equivalent of DEXRON®-III	• Automatic transaxle • Parts lubrication when installing • O-rings
Sealant	SUZUKI BOND No. 1216B (99000-31230)	• Mating surface of torque converter housing • Mating surface of rear cover assembly • Torque converter housing bolts • Drive plate bolts
Lithium grease	SUZUKI SUPER GREASE C (99000-25030)	• Oil seal lips • Planetary carrier thrust washer
	SUZUKI SUPER GREASE A (99000-25010)	• Cable ends • Converter center cup

SECTION 7C

CLUTCH (G10/M13 ENGINES)

WARNING:

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

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

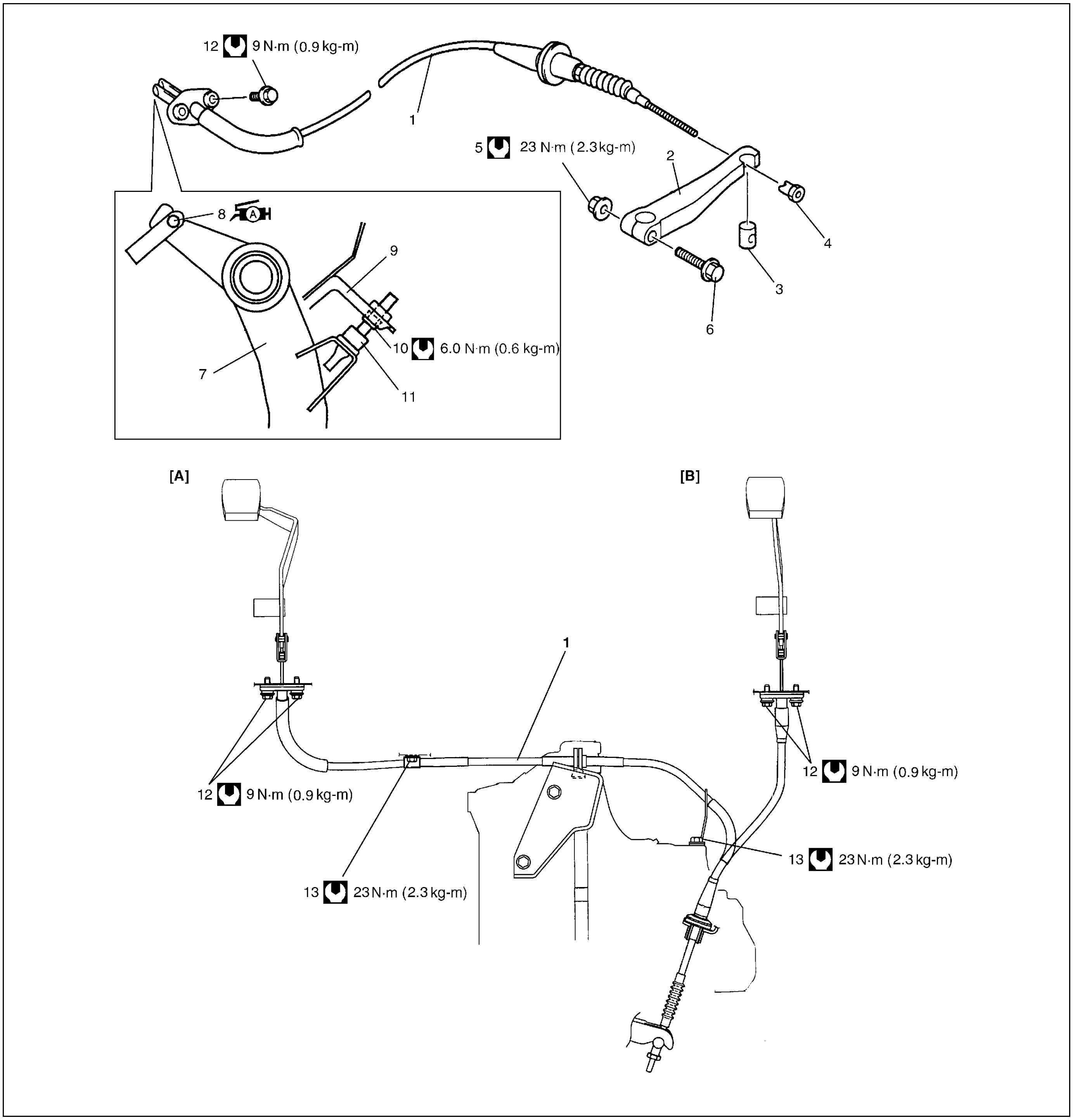
NOTE:

For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

CONTENTS

On-Vehicle Service

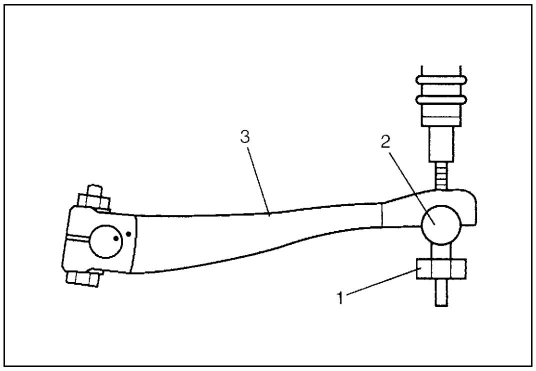
Clutch Cable



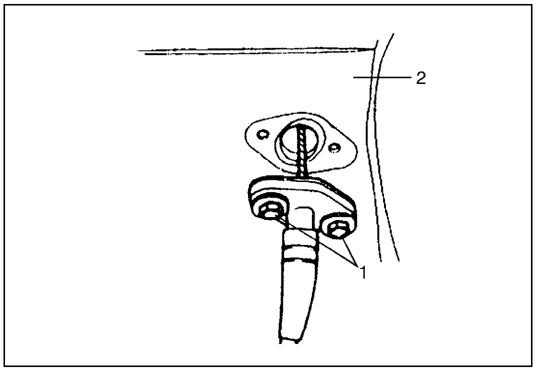
[A]: For RH vehicle	5. Clutch release lever nut	11. Adjust bolt
[B]: For LH vehicle	6. Clutch release lever bolt	12. Clutch cable outer bolt
1. Clutch cable	7. Clutch pedal	13. Clamp bolt
2. Clutch release lever	8. Clutch cable hook : Apply grease 99000-25010 to cable hook.	Tightening torque
3. Clutch cable joint pin : Apply grease 99000-25010 to joint pin.	9. Pedal bracket	
4. Clutch cable joint nut	10. Lock nut	

REMOVAL

1) Disconnect negative cable at battery.

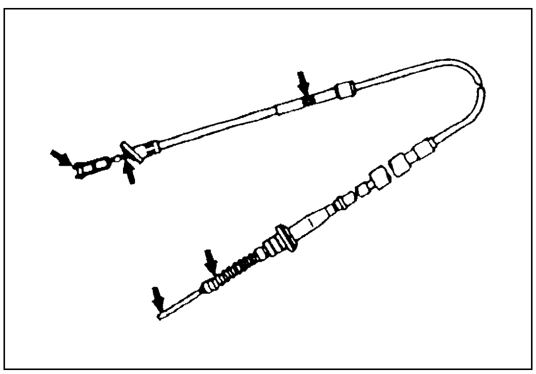


2) Remove clutch cable joint nut (1).
3) Remove joint pin (2) from clutch release lever (3).



4) Remove clutch cable outer bolts (1) from dash panel (2) in engine room.
5) Disconnect cable hook from clutch pedal, then take off cable.

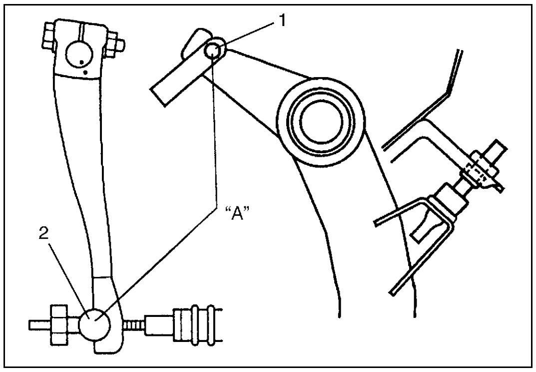
INSPECTION



Inspect clutch cable and replace it for any of the following conditions.

- Excessive cable friction
- Frayed cable
- Bent or kinked cable
- Broken boots
- Worn end

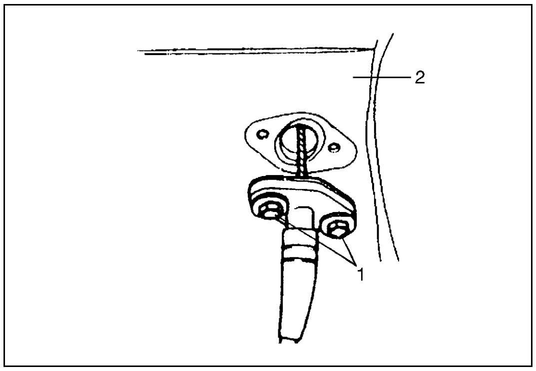
INSTALLATION



1) Apply grease to cable end hook (1) and also joint pin (2) before installing cable.

   "A": Grease 99000-25010

2) Hook cable end with pedal using screwdriver or long nose pliers from cabin inside, then join inner cable joint pin in release lever.

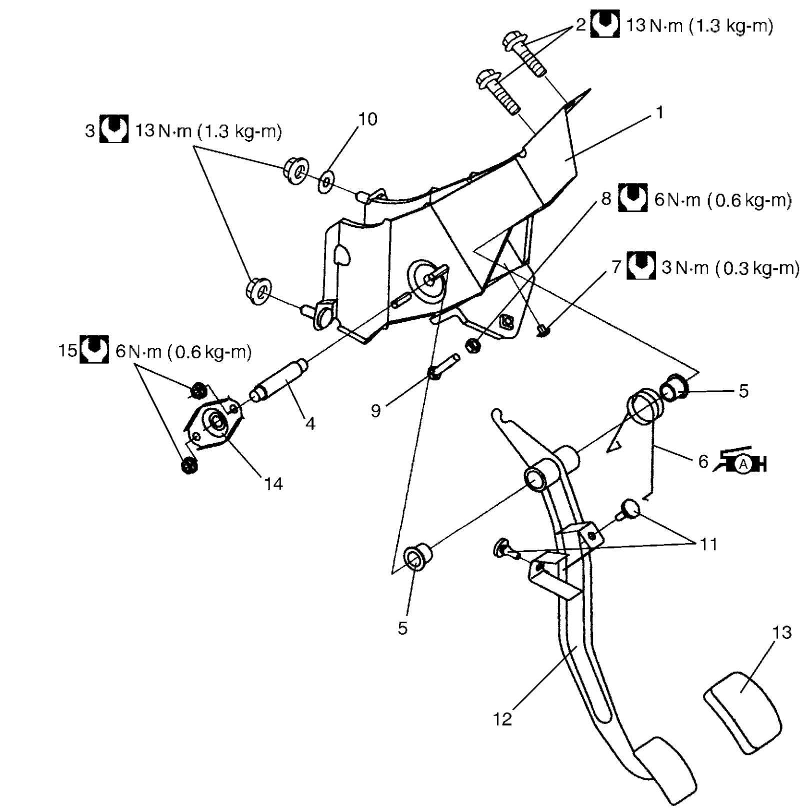


3) Fasten cable with clutch cable outer bolts (1) to dash panel (2).

   Tightening torque
   Clutch cable outer bolt (a): 9 N·m (0.9 kg-m, 6.0 lb-ft)

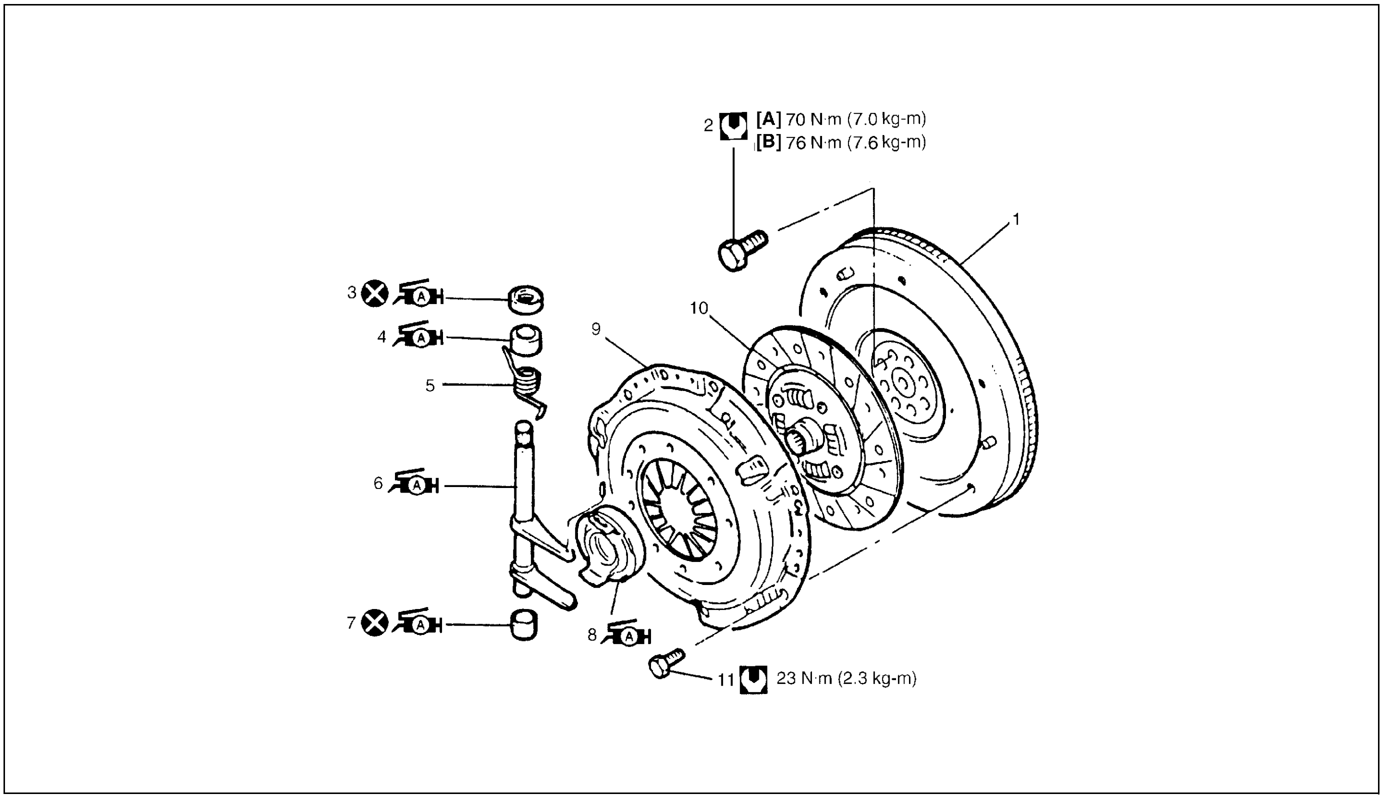
4) Screw in joint nut and adjust clutch pedal free travel referring to "DIAGNOSIS" in Section 7C of the Service Manual mentioned in the "FOREWORD" of this manual.

Clutch Pedal and Clutch Pedal Bracket



	1. Clutch pedal bracket	9.	Adjust bolt
	2. Pedal bracket bolt	10.	Packing (in cabin)
	3. Pedal bracket nut	11.	Pedal return cushion
	4. Pedal shaft	12.	Clutch pedal
	5. Pedal bush	13.	Pedal pad
AH	6. Pedal spring : Apply grease 99000-25010 to inside surface of spring.	14.	Pedal shaft bracket
	7. Pedal bracket screw	15.	Pedal shaft bracket nut
	8. Lock nut		Tightening torque

Clutch Cover, Clutch Disc and Flywheel

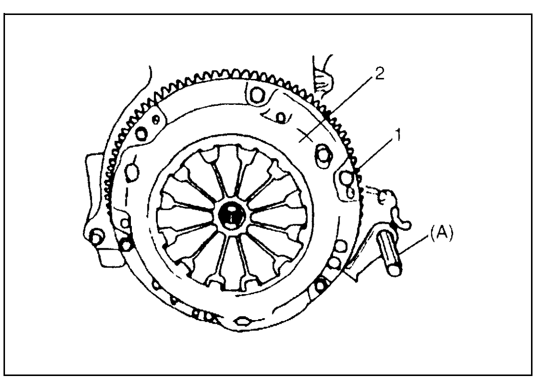


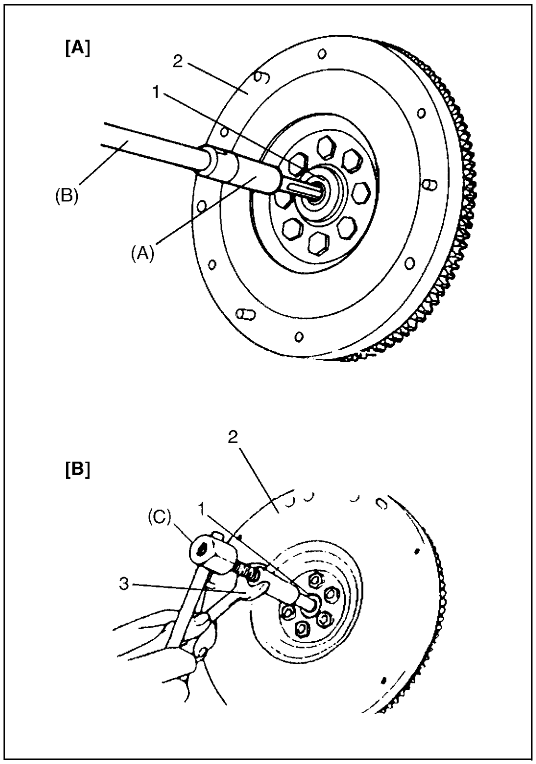
	[A]:	M13 engine		7.	Clutch release shaft No.1 bush : Apply grease 99000-25010 to bush inside. (0.3 g (0.01 oz))
	[B]:	G10 engine		8.	Release bearing : Apply grease 99000-25010 to joint of bearing and release shaft and also bearing inside. (0.3 g (0.01 oz))
	1.	Flywheel		9.	Clutch cover
	2.	Flywheel bolt		10.	Clutch disc
	3.	Clutch release shaft seal : Apply grease 99000-25010 to seal lip. (0.3 g (0.01 oz))		11.	Clutch cover bolt
	4.	Clutch release shaft No.2 bush : Apply grease 99000-25010 to bush inside. (0.3 g (0.01 oz))			Tightening torque
	5.	Return spring			Do not reuse.
	6.	Clutch release shaft Apply grease 99000-25010 to the end of release shaft arm. (0.3 g (0.01 oz))			

REMOVAL

1) Dismount transaxle assembly referring to “Transaxle unit Dismounting and Remounting” in Section 7A.
2) Hold flywheel with special tool and loosen clutch cover bolts (1). Remove clutch cover (2) and clutch disc.

Special tool
(A): 09924-17810





3) Pull out input shaft bearing (1) using the special tools, if bearing removal is necessary.

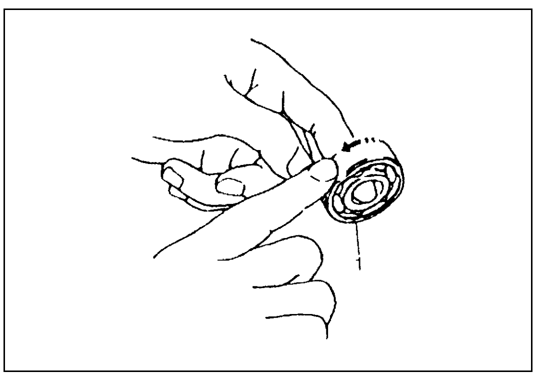
Special tool
(A): 09921-26020
(B): 09930-30104
(C): 09917-58010

[A]: M13 engine	2. Flywheel
[B]: G10 engine	3. Wrench

4) Loosen flywheel bolt while holding flywheel with special tool and removal flywheel from crank shaft.

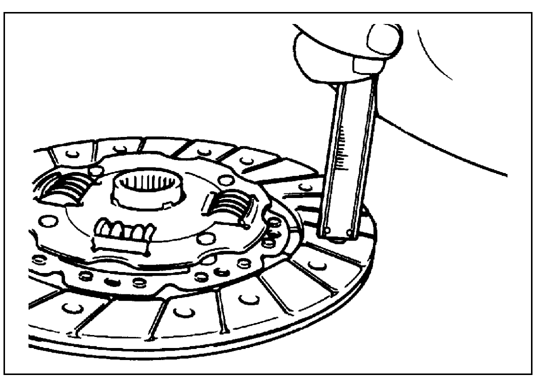
INSPECTION

Input shaft bearing



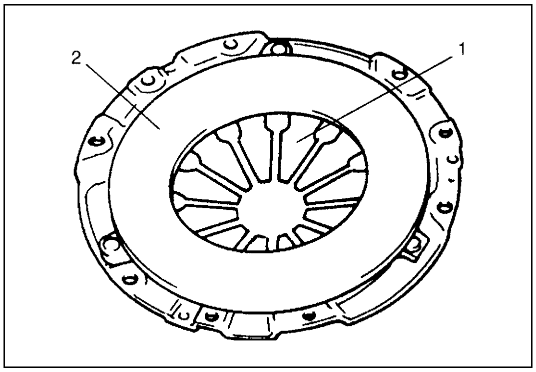
Check bearing (1) for smooth rotation and replace it if abnormality is found.

Clutch disc



Measure depth of rivet head depression, i.e. distance between rivet head and facing surface. If depression is found to have reached service limit at any of holes, replace disc assembly.

Rivet head depth
Standard: 1.65 – 2.25 mm (0.06 – 0.09 in.)
Service limit: 0.5 mm (0.02 in.)



Clutch cover

1) Check diaphragm spring (1) for abnormal wear or damage.
2) Inspect pressure plate (2) for wear or heat spots.
3) If abnormality is found, replace clutch cover. Do not disassemble it into diaphragm spring and pressure plate.

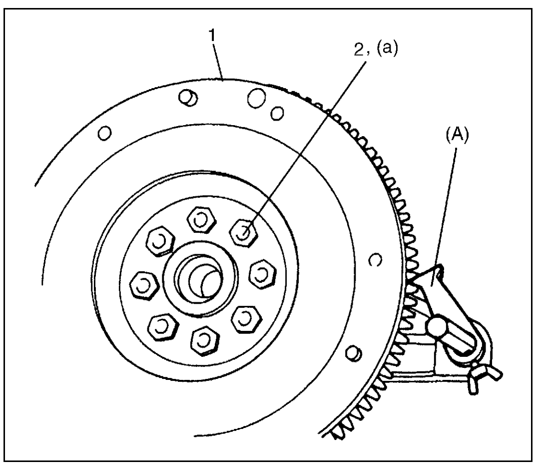
Flywheel

Check surface contacting clutch disc for abnormal wear or heat spots. Replace or repair as required.

INSTALLATION

NOTE:

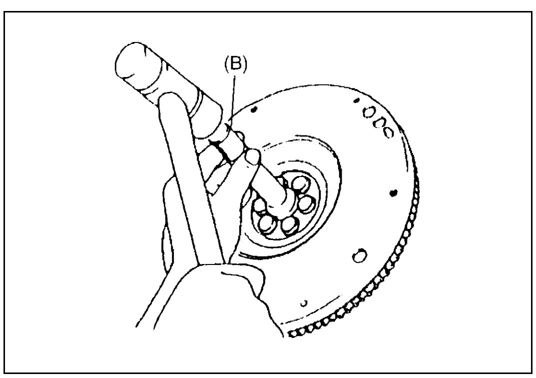
Before assembling, make sure that flywheel surface and pressure plate surface have been cleaned and dried thoroughly.



1) Install flywheel (1) to crankshaft and tighten bolts (2) to specified torque.

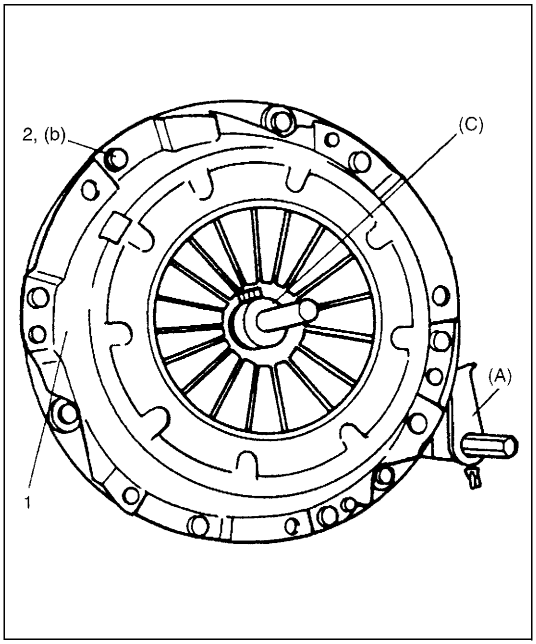
Special tool
(A): 09924-17810

Tightening torque
Flywheel bolt (M13 engine) (a): 70 N·m (7.0 kg-m, 50.5 lb-ft)
Flywheel bolt (G10 engine) (a): 76 N·m (7.6 kg-m, 54.5 lb-ft)



2) Using special tool, install input shaft bearing to flywheel.

Special tool
(B): 09925-98210



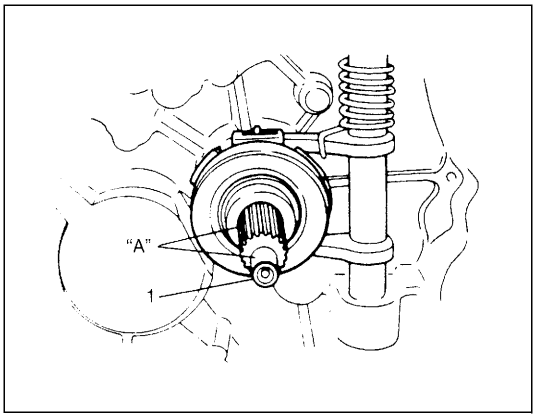
3) Aligning clutch disc to flywheel center using special tool, install clutch cover (1) and bolts (2). Then tighten bolts to specification.

NOTE:

- **While tightening clutch cover bolts, compress clutch disc with special tool (C) by hand so that disc centered.**
- **Tighten cover bolts little by little evenly in diagonal order.**

Special tool
(A): 09924-17810
(C): 09923-36320 (M13 engine)
(C): 09923-36330 (G10 engine)

Tightening torque
Clutch cover bolt (b): 23 N·m (2.3 kg-m, 16.5 lb-ft)



4) Slightly apply grease to input shaft (1), then join transaxle assembly with engine referring to "Unit Repair Overhaul" in Section 7A of the service manual mentioned in the FOREWORD of this manual or "Transaxle Unit Dismounting and Remounting" in Section 7A2.

"A": Grease 99000-25210

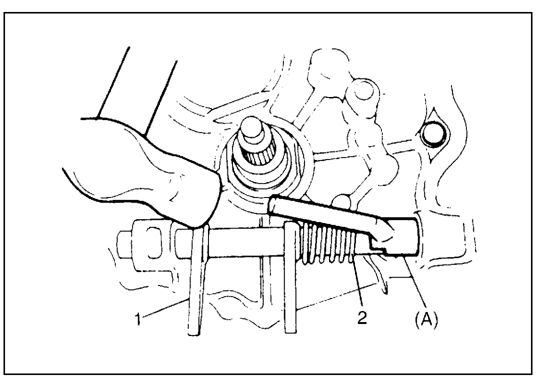
NOTE:

When inserting transaxle input shaft to clutch disc, turn crankshaft little by little to match splines.

Clutch Release Bearing / Shaft / Bush / Lever

REMOVAL

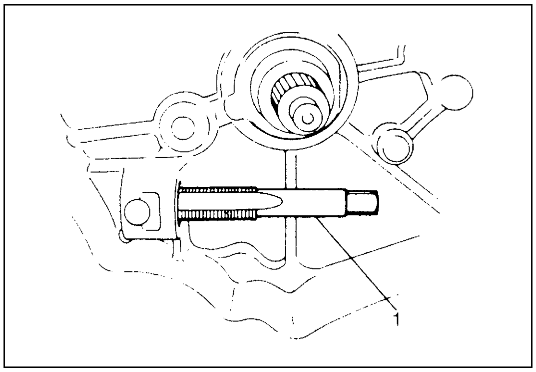
1) Remove release lever by loosening its bolt.



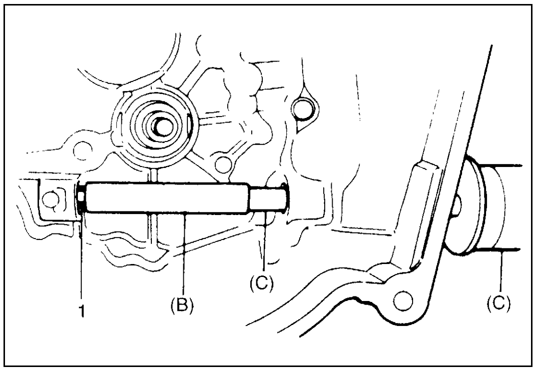
2) Take out release bearing by turning release shaft (1).
3) Unhook return spring (2) using pliers.
4) Drive out No.2 bush using special tool and hammer. Release shaft seal will also be pushed out.

Special tool
(A): 09922-46010

5) Remove release shaft (1) and return spring (2).



6) Install tap (M16 X 1.5) (1) to clutch release shaft No.1 bush.

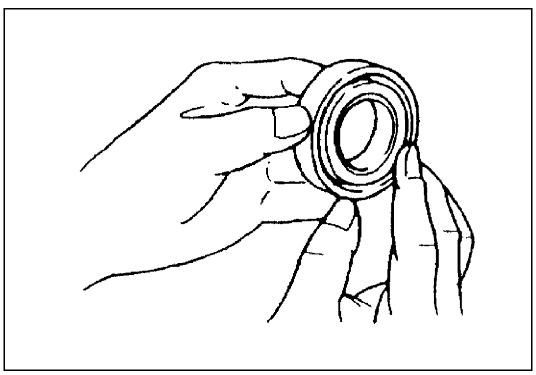


7) Pull out No.1 bush using tap (1) and special tools.

Special tool
(B): 09923-46020
(C): 09930-30104

INSPECTION

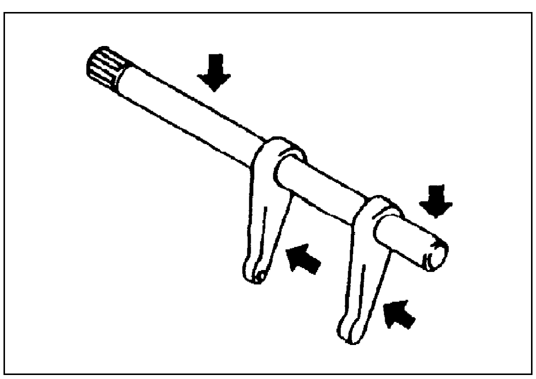
Clutch release bearing



Check clutch release bearing for smooth rotation.
If abnormality is found, replace it.

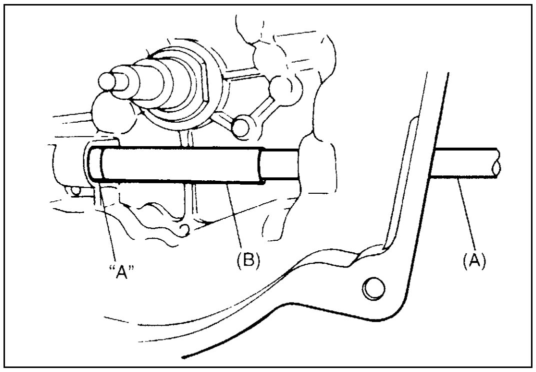
> **CAUTION:**
> **Do not wash release bearing. Washing may cause grease leakage and consequential bearing damage.**

Clutch release shaft



Check clutch release shaft and its pin for deflection or damage.
If abnormality is found, replace it.

INSTALLATION

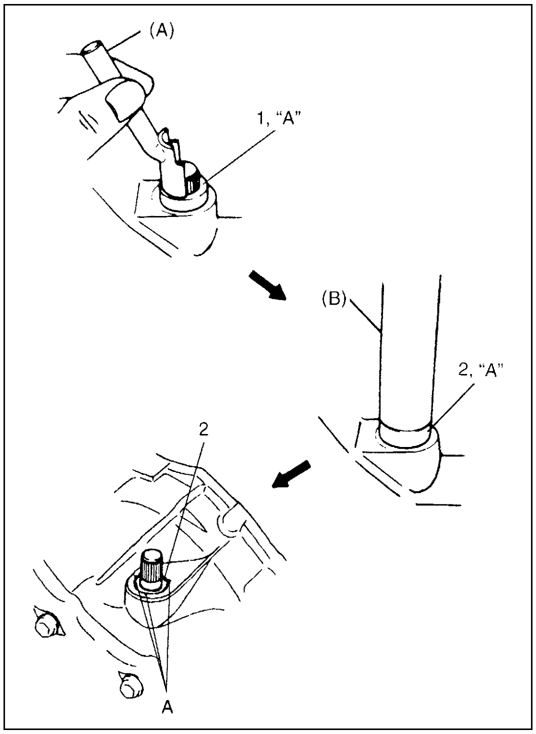


1) Drive in a new No.1 bush using special tools, and then apply grease to bush inside.

Special tool
(A): 09930-30104
(B): 09923-46030

"A": Grease 99000-25010

2) Install release shaft with return spring.



3) Apply grease to No.2 bush (1) inside and press-fit it using the same special tool as in removal.

"A": Grease 99000-25010

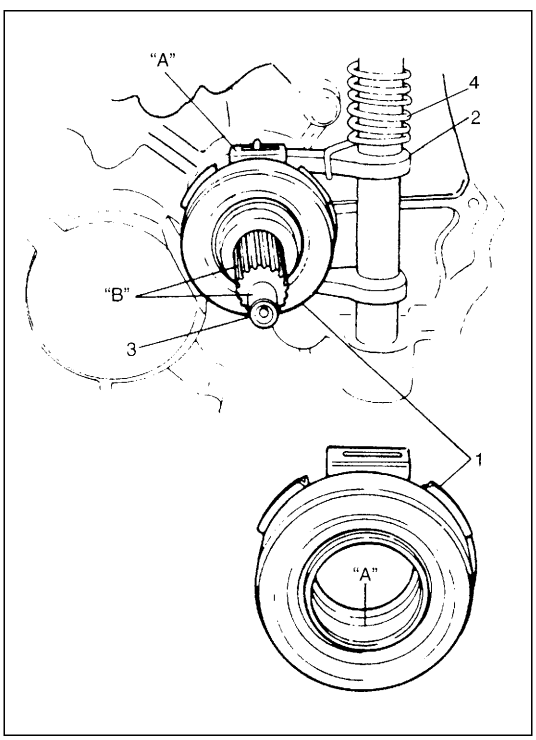
Special tool
(A): 09922-46010

4) Coat grease to shaft seal (2) lip and then install it till it is flush with case surface. Use special tool for this installation and face seal lip downward (inside).

"A": Grease 99000-25010

Special tool
(B): 09925-98221

5) Caulk seal at A using caulking tool and hammer.

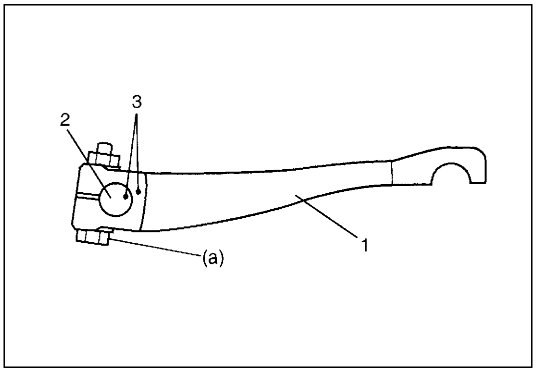


6) Hook return spring (4).
7) Apply grease to release bearing (1) inside and release shaft arm (2), then set release bearing.

"A": Grease 99000-25010

8) Apply small amount of grease to input shaft (3) spline (0.3 g) (0.01 oz) and front end (0.15 g) (0.005 oz) as well.

"B": Grease 99000-25210



9) Set release lever (1) to release shaft (2) aligning their punch marks (3), then tighten nut.

Tightening torque
Clutch release lever nut (a): 23 N·m (2.3 kg-m, 16.5 lb-ft)

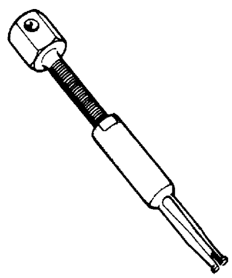
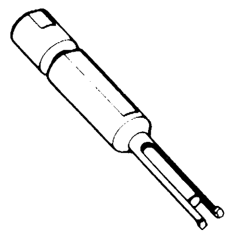
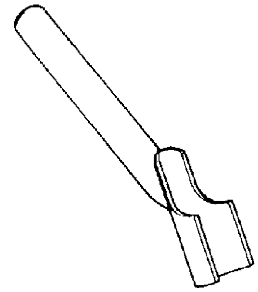
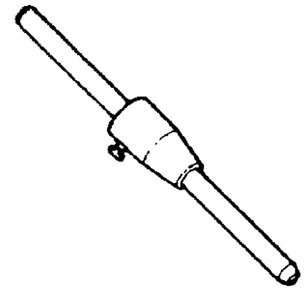
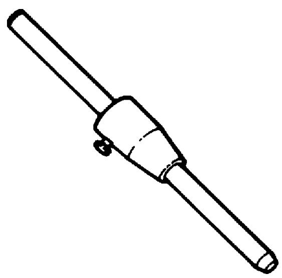
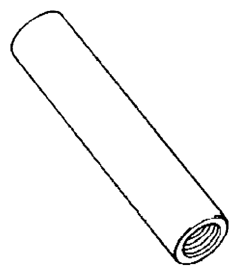
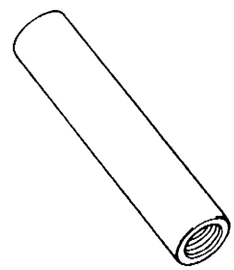
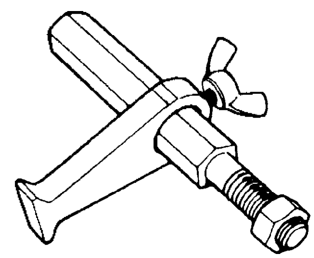
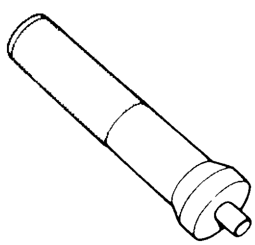
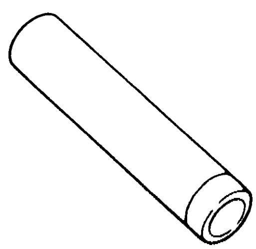
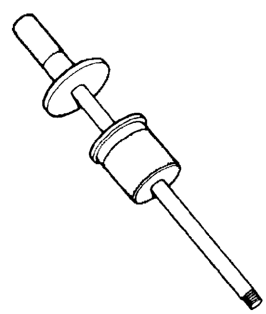
Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Flywheel bolt (M13 engine model)	70	7.0	50.5
Flywheel bolt (G10 engine model)	76	7.6	54.5
Clutch cover bolt	23	2.3	16.5
Clutch release lever nut	23	2.3	16.5
Pedal bracket bolt	13	1.3	9.5
Pedal bracket nut	13	1.3	9.5
Clutch cable clamp bolt	50	5.0	36.5
Lock nut	6.0	0.6	4.5
Clutch cable outer bolt	9.0	0.9	6.5
Pedal bracket screw	3	0.3	2.0
Pedal shaft bracket nut	6	0.6	4.5
Clump bolt	23	2.3	16.5

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Cable end hook and joint pin. • Release shaft bushes and seal. • Release shaft. • Release bearing inside. • Pedal spring.
	SUZUKI SUPER GREASE I (99000-25210)	Input shaft spline and front end.

Special Tool

 09917-58010 Bearing remover	 09921-26020 Bearing remover	 09922-46010 Bush remover	 09923-36320 Clutch center guide
 09923-36330 Clutch center guide	 09923-46020 Joint pipe	 09923-46030 Joint pipe	 09924-17810 Flywheel holder
 09925-98210 Input shaft bearing installer	 09925-98221 Bearing installer	 09930-30104 Sliding shaft	

SECTION 7D

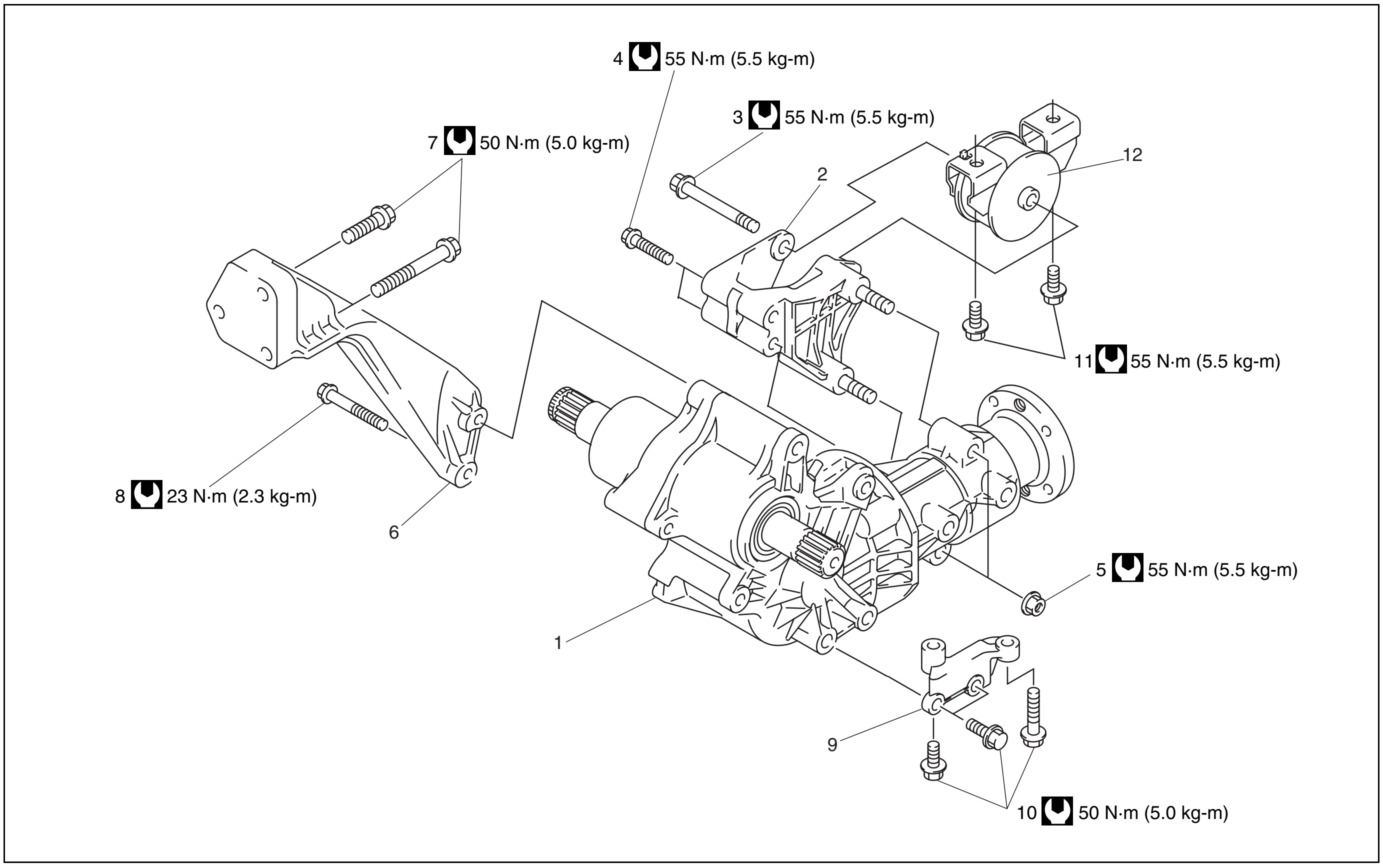
TRANSFER

NOTE:

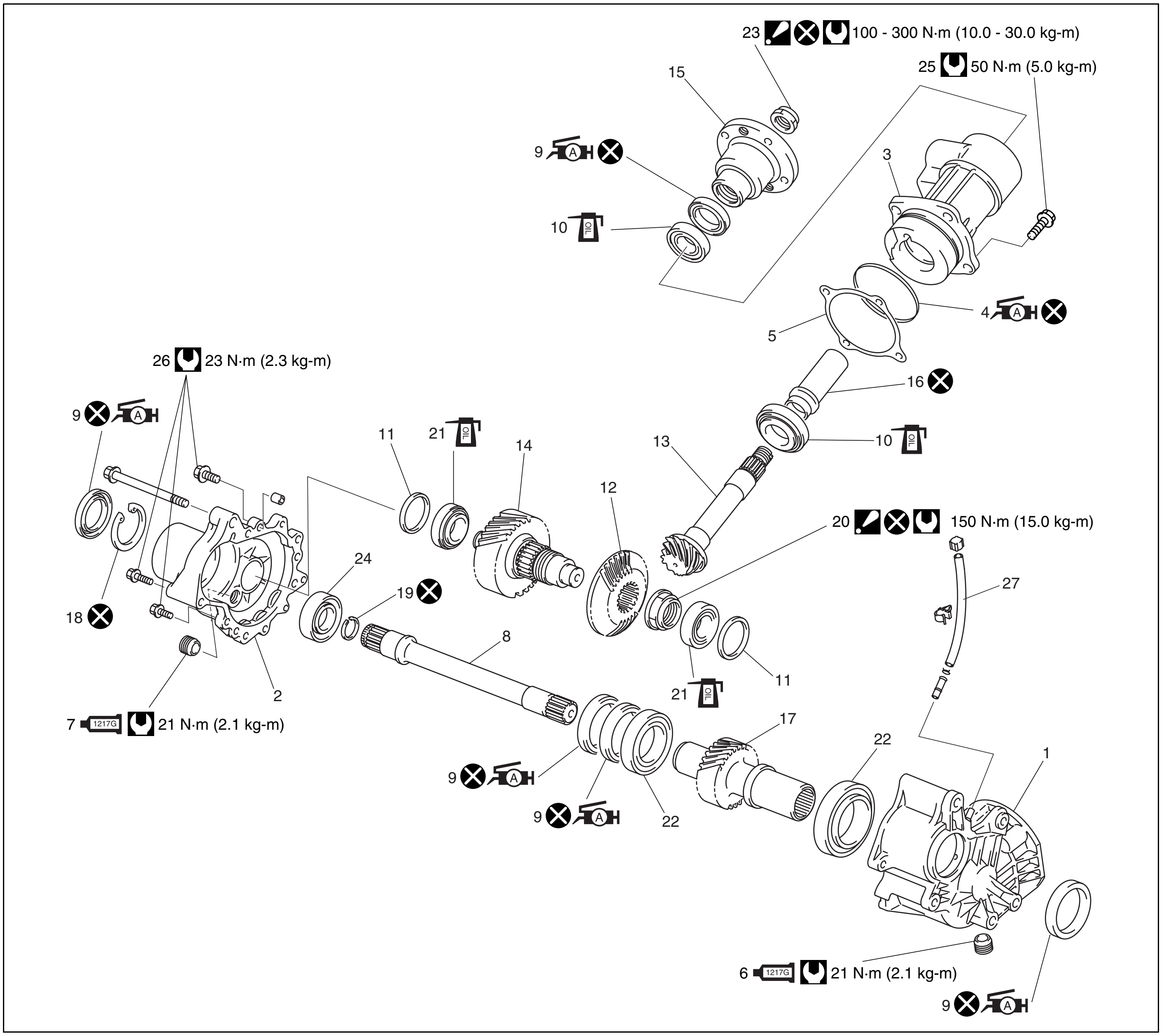
- **For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in “FOREWORD” of this manual.**
- **The sealant SUZUKI BOND NO.1215B (99000-31110) is changed to SUZUKI BOND NO.1217G (99000-31260). In the service manual mentioned in “FOREWORD” of this manual, it is instructed that the sealant SUZUKI BOND No.1215B (99000-31110) should be used for the servicing of transfer. Please apply sealant SUZUKI BOND NO.1217G (99000-31260) instead of the sealant SUZUKI BOND No.1215B (99000-31110).**

CONTENTS

Unit Repair Overhaul



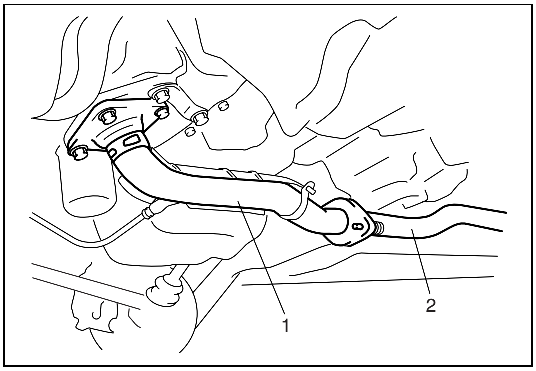
1. Transfer assy	6. Transfer to engine stiffener	11. Transfer rear mounting bracket bolts
2. Transfer rear mounting bracket	7. Transfer to engine stiffener No.1 bolts	12. Transfer rear mounting
3. Transfer mounting bolt	8. Transfer to engine stiffener No.2 bolts	Tightening torque
4. Transfer rear mounting bracket No.2 bolts	9. Transfer to transaxle stiffener	
5. Transfer rear mounting bracket nuts	10. Transfer to transaxle stiffener bolts	



1. Transfer left case	11. Bevel gear shim	21. Driven gear bearing
2. Transfer right case	12. Bevel gear (Hypoid gear)	22. Reduction drive gear bearing
3. Transfer output retainer	13. Bevel pinion shaft (Hypoid gear)	23. Flange nut : After tightening nut so as rotation torque of bevel pinion shaft to be in specified value, caulk nut securely.
4. O-ring : Apply grease 99000-25010 to all around surface.	14. Reduction driven gear	24. Intermediate right bearing
5. Bevel pinion shim	15. Flange	25. Transfer output retainer bolts
6. Transfer oil drain plug : Apply sealant 99000-31260 to all around thread part of drain plug.	16. Pinion shaft spacer	26. Transfer case bolt
7. Transfer oil level/Filler plug : Apply sealant 99000-31260 to all around thread part of level plug.	17. Reduction drive gear	27. Breather hose
8. Intermediate shaft	18. Snap ring	Do not reuse.
9. Reduction drive gear oil seal : Apply SUZUKI SUPER GREASE A 99000-25010 to oil seal lip.	19. Circlip	Tightening torque
10. Pinion shaft bearing	20. Bevel gear nut : After tightening nut to specified torque, caulk nut securely.	Apply transfer oil.

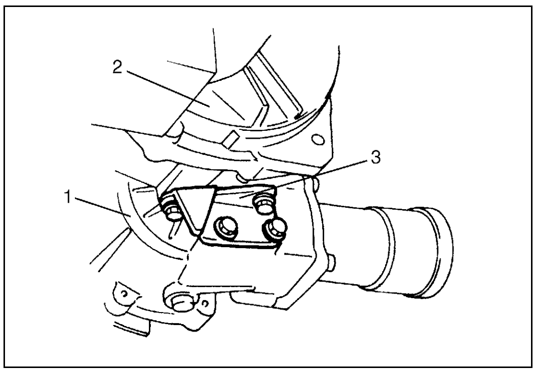
DISMOUNTING

1) Disconnect negative cable at battery.
2) Hoist vehicle and remove wheels.
3) Drain transaxle oil referring to “Manual Transaxle Oil Change” in Section 7A2.
4) Drain transfer oil referring to “Oil Change” in Section 7D of the Service Manual mentioned in the “FOREWORD” of this manual.



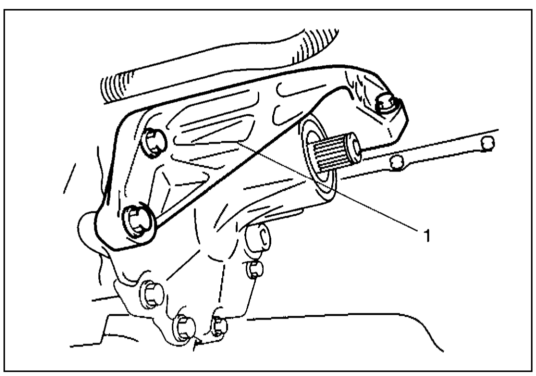
5) Remove exhaust No.1 pipe (1).
6) Remove propeller shaft referring to “Propeller Shaft Removal and Installation” in Section 4B.
7) Remove right side drive shaft referring to “Front Drive Shaft Assembly Removal and Installation” in Section 4A.

2.	Exhaust No.2 pipe

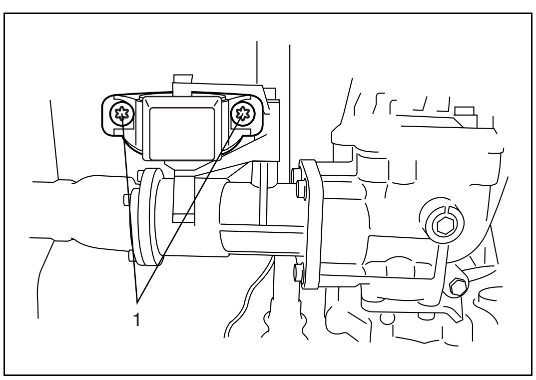


8) Remove transfer to transaxle stiffener (3).

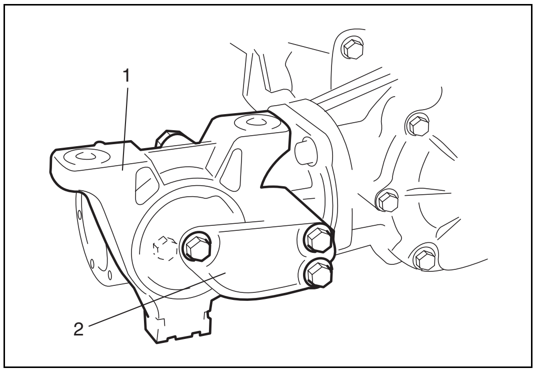
1.	Transfer
2.	Transaxle



9) Remove transfer to engine stiffener (1).



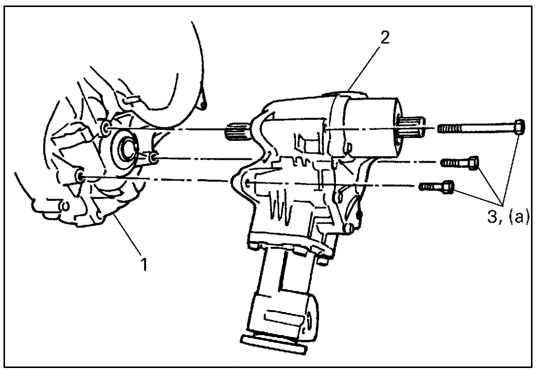
10) With transaxle assembly held on jack, remove rear mounting bracket bolts (1).
11) Remove transfer to transaxle bolts and draw out transfer assembly from transaxle assembly.



12) Remove transfer rear mounting bracket (2) with transfer rear mounting (1) from transfer assembly.

MOUNTING

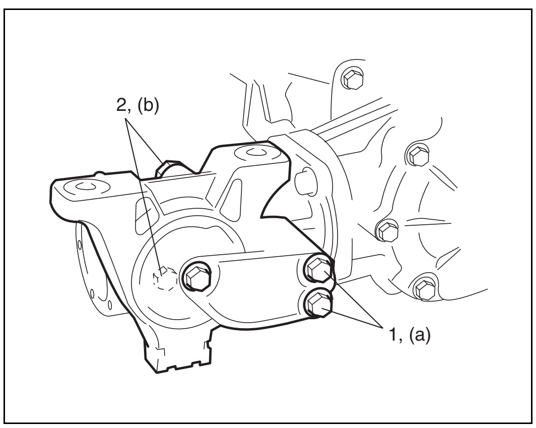
Reverse dismounting procedure for installation noting the following.



1) Tighten transfer mounting bolts (3) to specified torque.

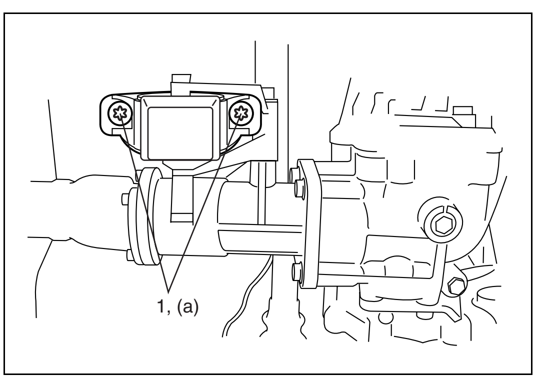
Tightening torque
Transfer mounting bolt (a): 55 N·m (5.5 kg-m, 40.0 lb-ft)

1.	Transaxle
2.	Transfer assembly



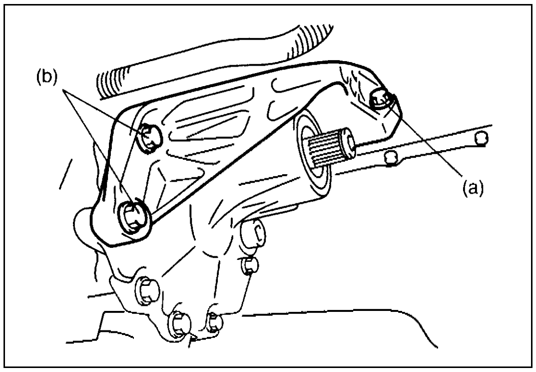
2) Tighten transfer rear mounting bracket No.2 bolts (1) and transfer rear mounting bracket nuts (2) to specified torque.

Tightening torque
Transfer rear mounting bracket No.2 bolt (a): 55 N·m (5.5 kg-m, 40.0 lb-ft)
Transfer rear mounting bracket nut (b): 55 N·m (5.5 kg-m, 40.0 lb-ft)



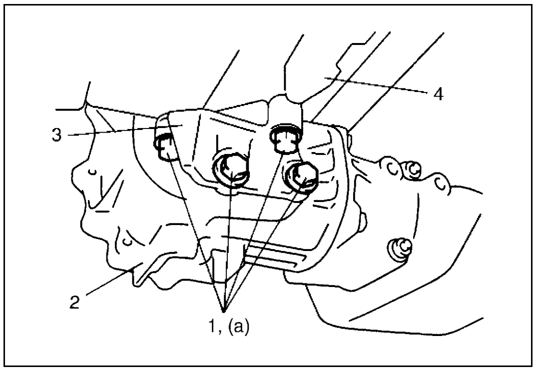
3) Tighten transfer rear mounting bracket bolts (1) to specified torque.

Tightening torque
Transfer rear mounting bracket bolt (a): 55 N·m (5.5 kg-m, 40.0 lb-ft)



4) Tighten transfer to engine stiffener bolts to specified torque.

Tightening torque
Transfer to engine stiffener No.1 bolt
(a): 50 N·m (5.0 kg-m, 36.5 lb-ft)
Transfer to engine stiffener No.2 bolt
(b): 23 N·m (2.3 kg-m, 17.0 lb-ft)



5) Tighten transfer to transaxle stiffener bolts (1) to specified torque.

Tightening torque
Transfer to transaxle stiffener bolt
(a): 50 N·m (5.0 kg-m, 36.5 lb-ft)

2.	Transfer
3.	Stiffener
4.	Transaxle

- Install exhaust No.1 pipe referring to “Exhaust System Components” in Section 6K2.
- Install right side drive shaft referring to “Drive Shaft Removal and Installation” in Section 4A.
- Install propeller shaft referring to “Propeller Shaft Removal and Installation” in Section 4B.
- Fill transfer with transfer oil referring to “Oil Change” in Section 7D of the Service Manual mentioned in the “FOREWORD” of this manual.
- Fill transaxle with transaxle oil referring to “Manual Transaxle Oil Change” in Section 7A2.

Tightening Torque Specification

Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Transfer oil level/filler and drain plug	21	2.1	15.5
Flange nut	100 – 300	10.0 – 30.0	72.5 – 217.0
Transfer case bolt	23	2.3	17.0
Transfer output retainer bolt	50	5.0	36.5
Transfer rear mounting bracket bolt	55	5.5	40.0
Transfer rear mounting bracket nut	55	5.5	40.0
Transfer mounting bolt	55	5.5	40.0
Transfer rear mounting bracket No.2 bolt	55	5.5	40.0
Transfer to engine stiffener No.1 bolt	50	5.0	36.5
Transfer to engine stiffener No.2 bolt	23	2.3	17.0
Bevel gear nut	150	15.0	108.5
Transfer to transaxle stiffener bolt	50	5.0	36.5

Required Service Material

Material	Recommended SUZUKI products (Part Number)	Use
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	• Oil seal lips • O-ring
Sealant	SUZUKI BOND NO. 1217G (99000-31260)	• Oil drain plug • Oil level plug • Mating surface of transfer case

SECTION 7F

REAR DIFFERENTIAL

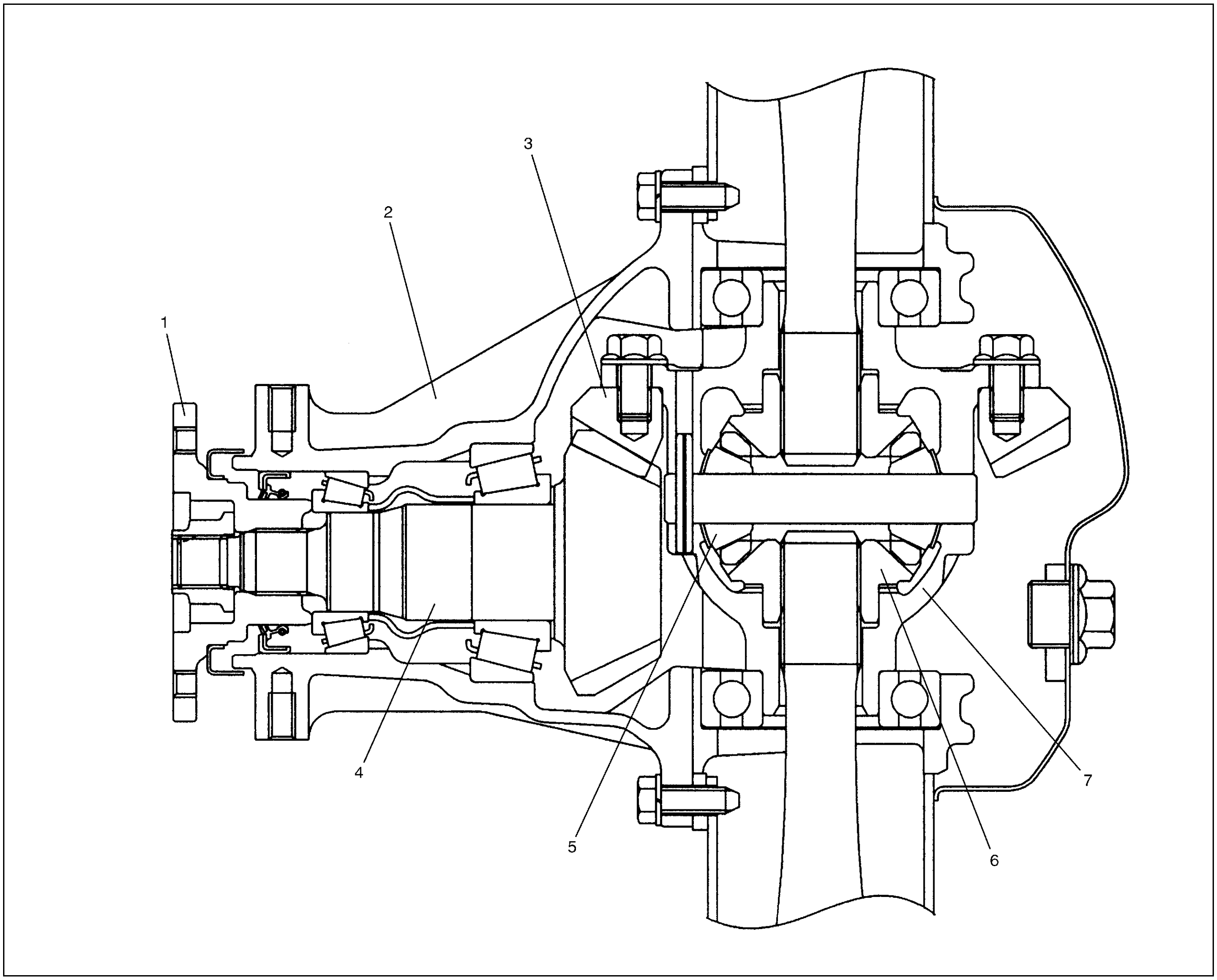
NOTE:

For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in "FOREWORD" of this manual.

CONTENTS

General Description

The rear differential assembly for 4WD model uses a hypoid bevel pinion and gear.
The differential assembly is decisive in that the drive power is concentrated there. Therefore, use of genuine parts and specified torque is compulsory. Further, because of sliding tooth meshing with high pressure between bevel pinion and gear, it is mandatory to lubricate them by hypoid gear oil.
The hypoid gears have an advantage of preventing gear noise, at the same time, they require accurate adjustment of tooth contract and backlash.

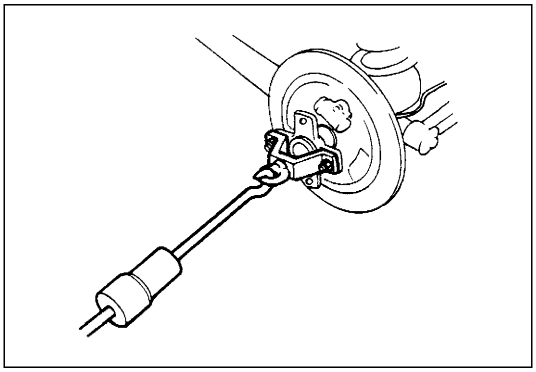


1. Companion flange	5. Differential pinion
2. Differential carrier	6. Differential side gear
3. Drive bevel gear (hypoid gear)	7. Differential case
4. Drive bevel pinion (hypoid gear)	

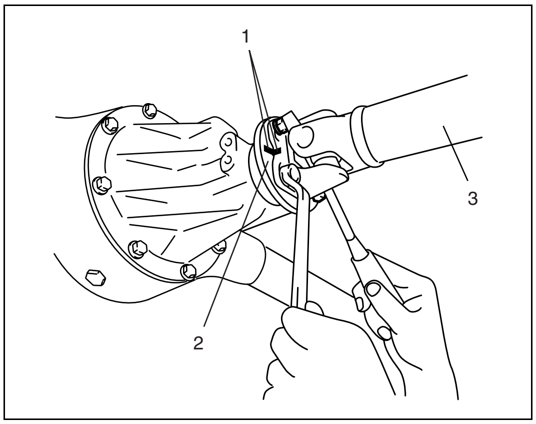
Differential Unit

DISMOUNTING

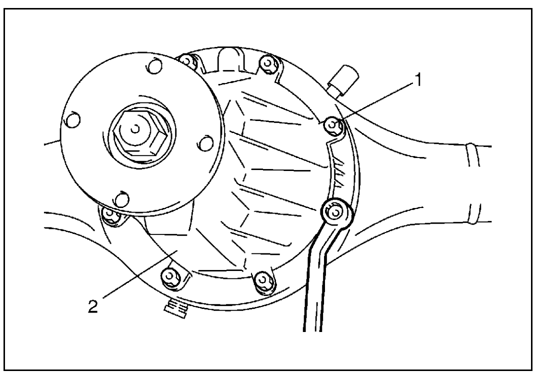
1) Hoist vehicle and remove wheels.
2) Drain differential oil referring to “Rear Differential Gear Oil Change” in this section.



3) Remove brake drum and disconnect parking brake cable from brake back plate referring to “Parking Brake Lever Cable Removal and Installation” in Section 5C.
4) Remove axle shafts referring to “Rear Axle Shaft and Wheel Bearing Remove and Installation (for 4WD Model)” in Section 3E.



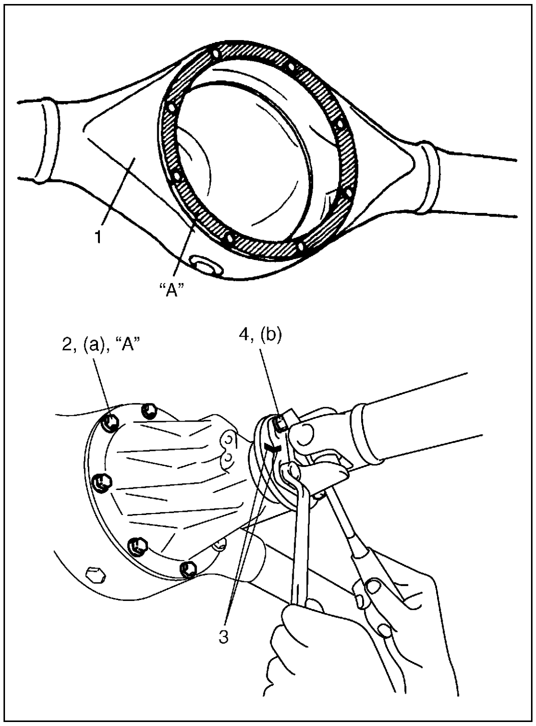
5) Before removing propeller shaft, give match marks (1) on companion flange (2) and propeller shaft (3) as shown.



6) Remove differential carrier bolts (1) and differential assembly (2).

REMOUNTING

Reverse removal procedure for installation, noting the following.



- Clean mating surfaces of axle housing (1) and differential carrier and apply sealant to housing side.

"A": Sealant 99000-31260

- Apply sealant to carrier bolts (2) and tighten carrier bolts to specified torque.

"A": Sealant 99000-31260

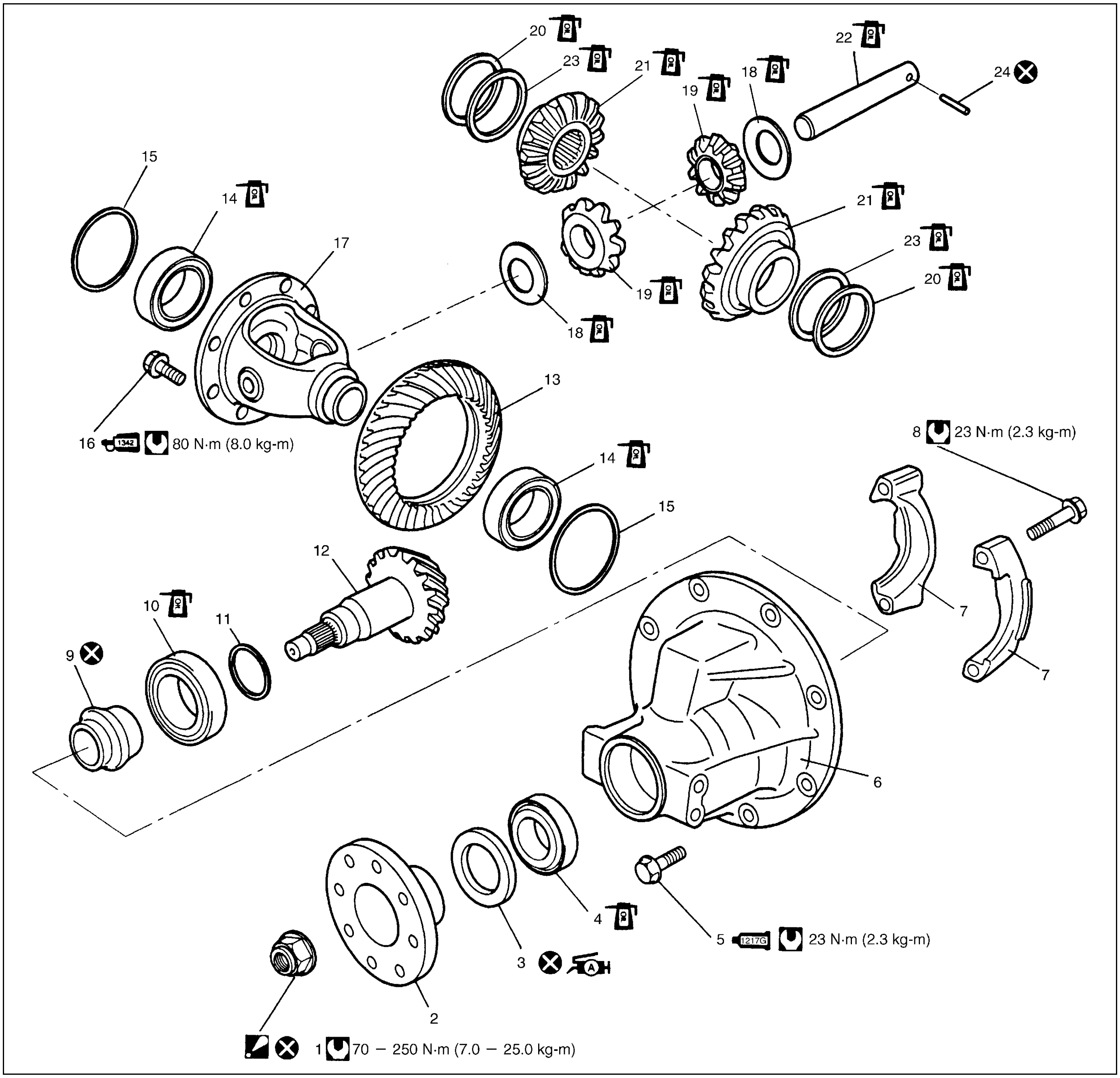
Tightening torque
Differential carrier bolt
(a): 23 N·m (2.3 kg-m, 17.0 lb-ft)

- Install propeller shaft to companion flange aligning match marks (3) and tighten propeller shaft bolts (4) to specified torque.

Tightening torque
Propeller shaft bolt
(b): 23 N·m (2.3 kg-m, 17.0 lb-ft)

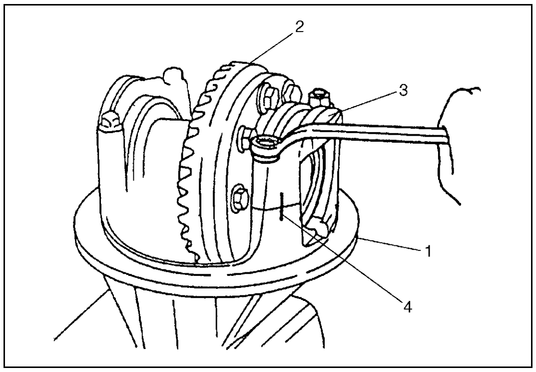
- For installation of rear axle shaft, refer to "Rear Axle Shaft and Wheel Bearing Removal and Installation (for 4WD Model)" in Section 3E.
- For installation of rear brake drum, refer to "Brake Drum Removal and Installation (for 4WD Model)" in Section 5C.
- Refill differential housing with new specified oil referring to "Rear Differential Gear Oil Change" in this section for refill.
- Make sure to purge air out of brake circuit referring to "Bleeding Brakes" in Section 5. Then, ensure that joint seam of pipe is free from oil leak.

Unit Repair Overhaul



[icon]	1. Drive bevel pinion nut : After tightening nut so as rotational torque of drive bevel pinion to be in specified torque, caulk nut securely.		10. Drive bevel pinion rear taper roller bearing		19. Differential pinion
	2. Companion flange		11. Bevel pinion shim		20. Differential side gear washer
[icon A]	3. Oil seal : Apply grease 99000-25010 to oil seal lip.		12. Drive bevel pinion (hypoid gear)		21. Differential side gear
	4. Drive bevel pinion front taper roller bearing		13. Drive bevel gear (hypoid gear)		22. Differential pinion shaft
1217G	5. Differential carrier bolt : Apply sealant 99000-31260 to thread part.		14. Differential side bearing		23. Differential side gear spring washer
	6. Differential carrier		15. Differential side bearing shim		24. Differential pinion shaft pin
	7. Differential side bearing cap	1322	16. Drive bevel gear bolt : Apply thread lock cement 99000-32110 to thread.	[icon]	Do not reuse.
	8. Differential side bearing cap bolt		17. Differential case	[icon]	Tightening torque
	9. Spacer		18. Differential pinion washer	OIL	Apply differential oil.

DISASSEMBLY

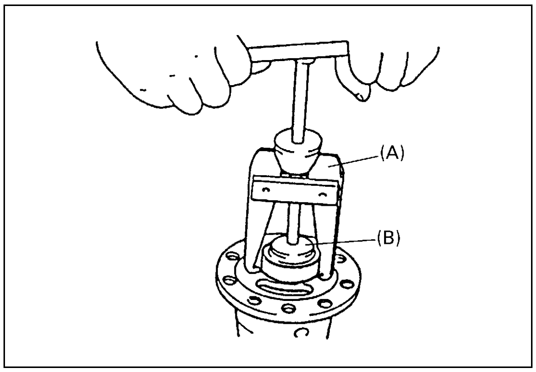


1) Put match marks (4) on differential side bearing caps (3) and differential carrier (1).
2) Take off differential side bearing caps by removing their bolts and remove differential gear assembly (2) with shims.

NOTE:

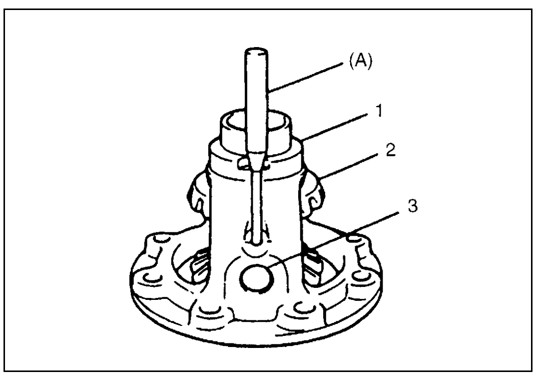
Check number of shims and thickness of each shim in advance.

3) With aluminum plates placed on vise first, grip differential case with it and remove drive bevel gear by removing its bolts.



4) Using special tools, pull out differential side bearings.

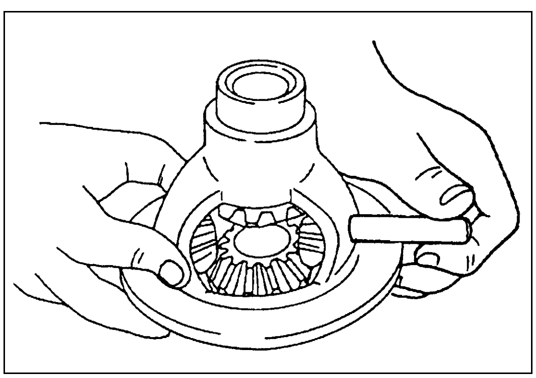
Special tool
(A): 09913-60910
(B): 09925-88210



5) Drive out differential pinion shaft pin with special tool.

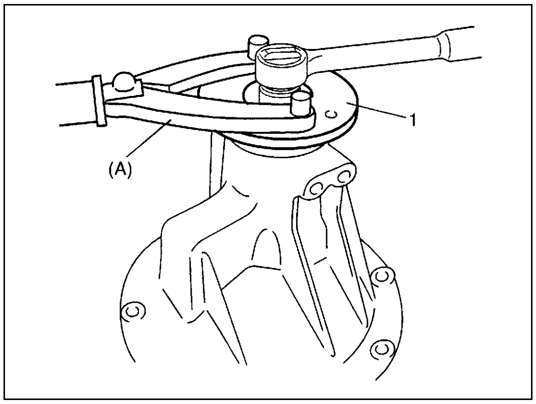
Special tool
(A): 09922-85811

1.	Differential case
2.	Differential side gear
3.	Differential pinion shaft



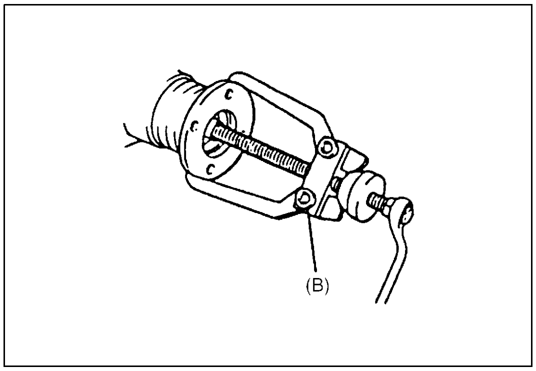
6) Remove differential pinion shaft.
7) Remove differential side gears, pinions and washers.

8) Uncaulk drive bevel pinion nut.



9) Hold companion flange (1) with special tool and then remove drive bevel pinion nut.

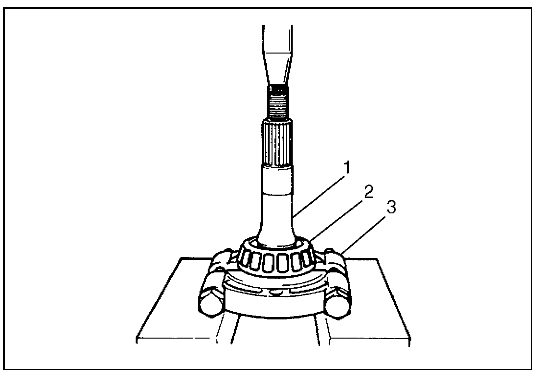
Special tool
(A): 09930-40113



10) Remove companion flange from drive bevel pinion. Use special tool if it is hard to remove.

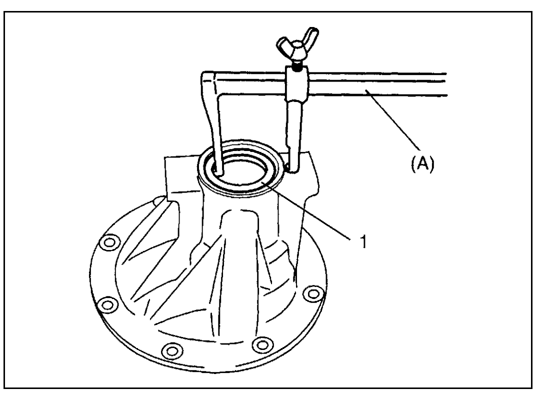
Special tool
(B): 09913-65135

11) Remove drive bevel pinion with rear bearing, and spacer from differential carrier.



12) Remove drive bevel pinion rear bearing (2) by using bearing puller (3) and hydraulic press.

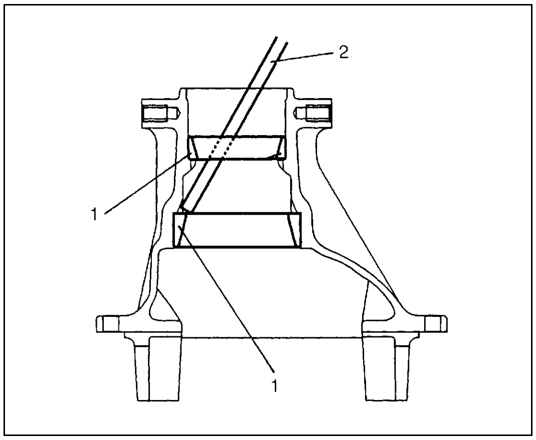
1. Drive bevel pinion



13) Remove oil seal (1) from differential carrier by using special tool.

Special tool
(A): 09913-50121

14) Remove drive bevel pinion front bearing.



15) Drive out drive bevel pinion bearing outer races (1) by using metallic stick (2).

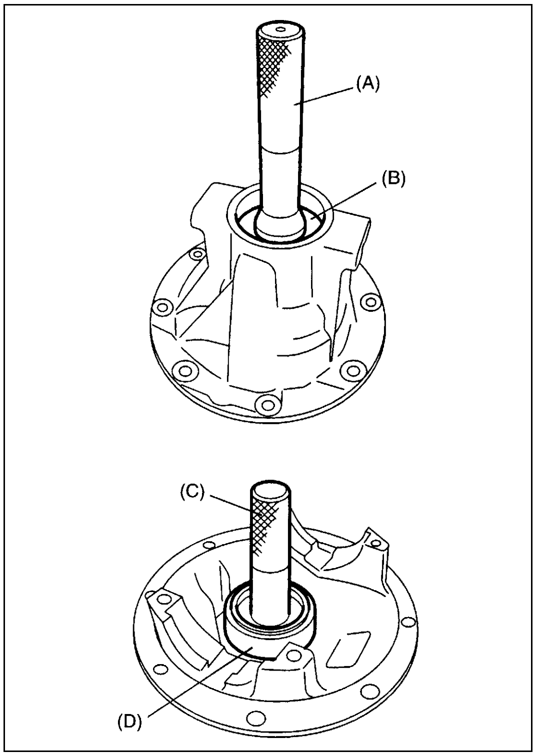
INSPECTION

- Check companion flange for wear of damage.
- Check bearings for wear or discoloration.
- Check differential carrier for cracks.
- Check drive bevel pinion and bevel gear for wear or cracks.
- Check side gears, pinion gears and pinion shaft for wear or damage.
- Check side gear spline for wear or damage.

ADJUSTMENT AND ASSEMBLY

Judging from faulty conditions noted before disassembly and what is found through visual check of bearing and gear tooth etc. after disassembly, prepare replacing parts and proceed to reassembly according to procedures as described below. Make sure that all parts are clean.

CAUTION:
- **Drive bevel gear and pinion must be replaced as a set when either replacement becomes necessary.**
- **When replacing taper roller bearing, replace as inner race & outer race assembly.**

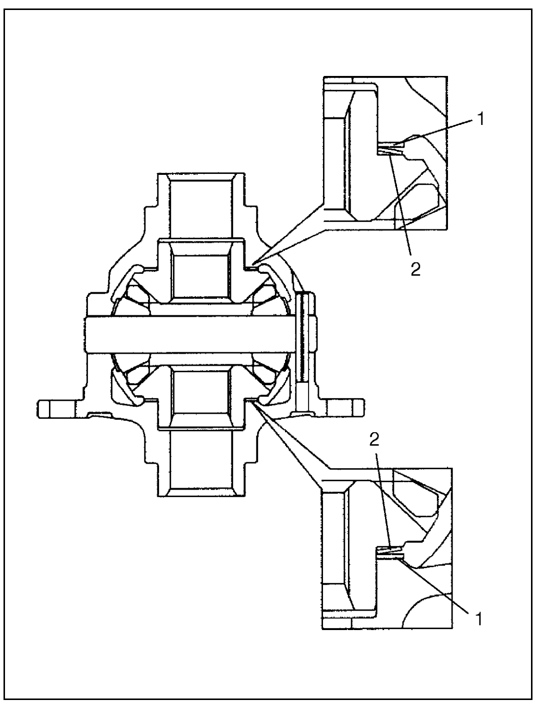


Drive bevel pinion bearing outer race

For press-fitting bevel pinion bearing outer races, use special tools as shown.

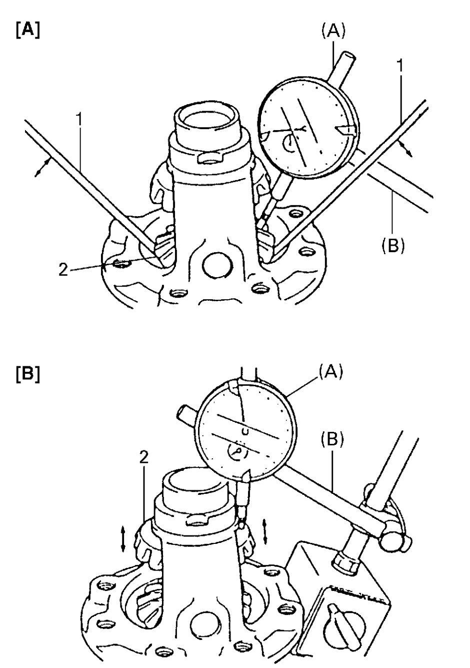
CAUTION:
Perform press-fitting carefully so as not to tilt outer race.

Special tool
(A): 09925-98210
(B): 09941-34513-004
(C): 09924-74510
(D): 09951-16090



Differential case assembly

1) Assemble differential case assembly noting installing position and direction of differential side gear washer (1) and spring washer (2).



2) Measure thrust play of differential gear (2) as follows.

Special tool
(A): 09900-20607
(B): 09900-20701

Differential gear thrust play
0 – 0.37 mm (0 – 0.014 in.)

[A]:	Right side
[B]:	Left side

Right side

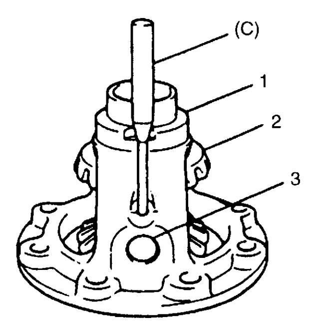
- Hold differential assembly with soft jawed vise and apply measuring tip of dial gauge to top surface of gear (2).
- Using 2 screwdrivers (1), move gear (2) up and down and read movement of dial gauge pointer.

Left side

- Using similar procedure to the above, set dial gauge tip to gear shoulder.
- Move gear (2) up and down by hand and read dial gauge.

3) If thrust play is out of specification, select suitable side washer from among the following available size, install it and check again that specified gear thrust play is obtained.

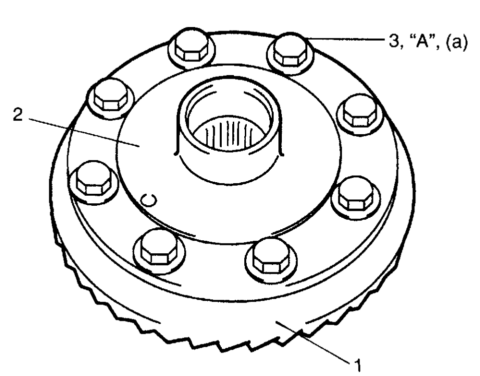
Available side washer thickness
0.10, 0.30, 0.50 and 0.70 mm (0.0039, 0.0118, 0.0196 and 0.0275 in.)



4) Drive in new differential pinion shaft pin for differential side pinion shaft till it is flush with differential case surface.

Special tool
(C): 09922-85811

1.	Differential case
2.	Differential gear
3.	Differential pinon shaft

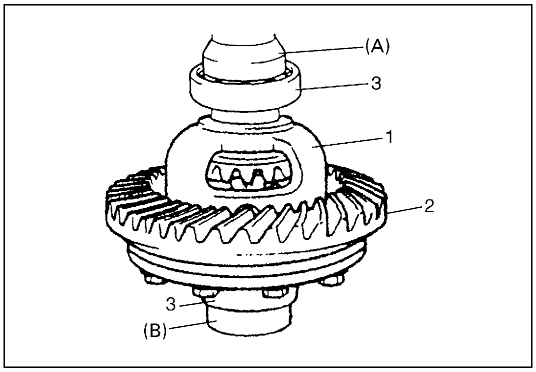


5) Put drive bevel gear (1) on differential case (2).
6) Apply thread lock cement to drive bevel gear bolts (3) and fasten drive bevel gear (1) on differential case (2) by tightening bolts to specified torque.

CAUTION:
Use of any other bolts than that specified is prohibited.

"A": Cement 99000-32110

Tightening torque
Drive bevel gear bolt
(a): 80 N·m (8.0 kg-m, 58.0 lb-ft)

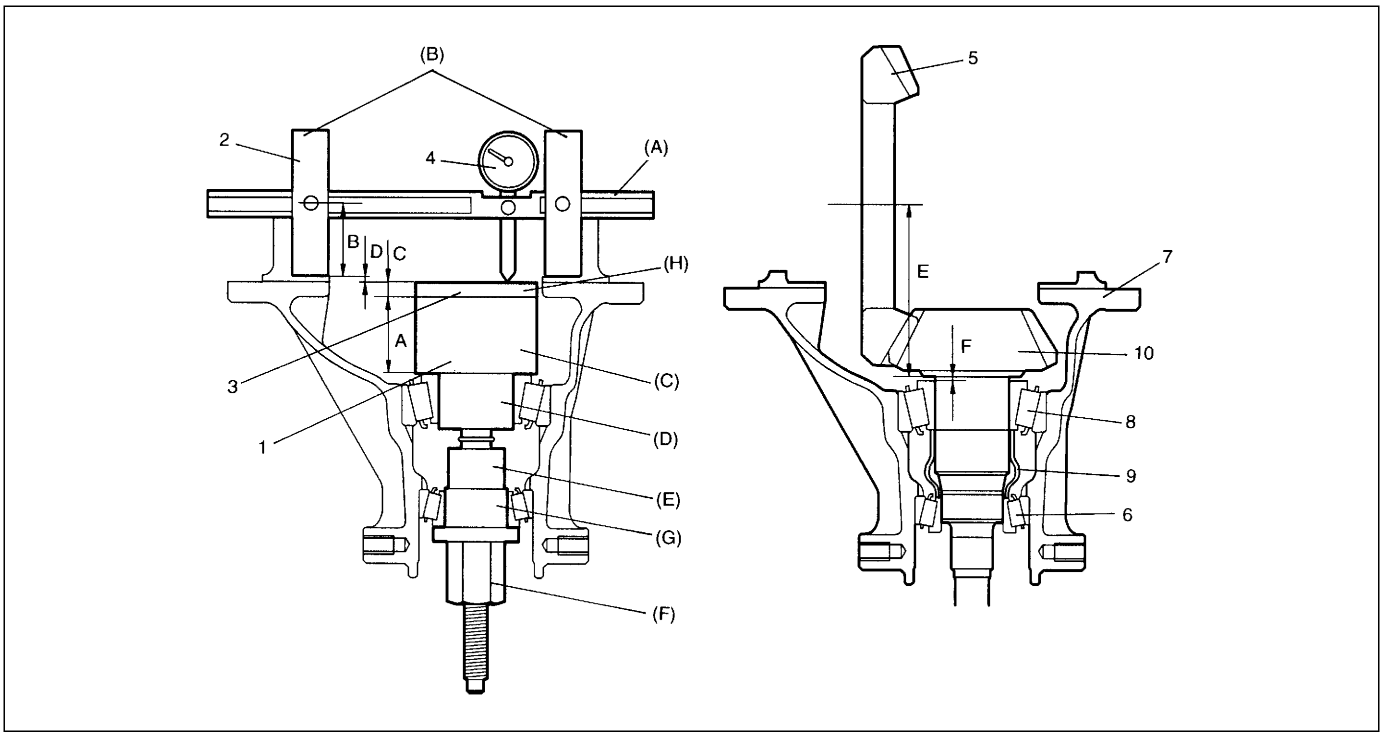


7) Press-fit differential side bearings (3) to differential case (1) by using special tools.

Special tool
(A): 09951-76010
(B): 09951-16060

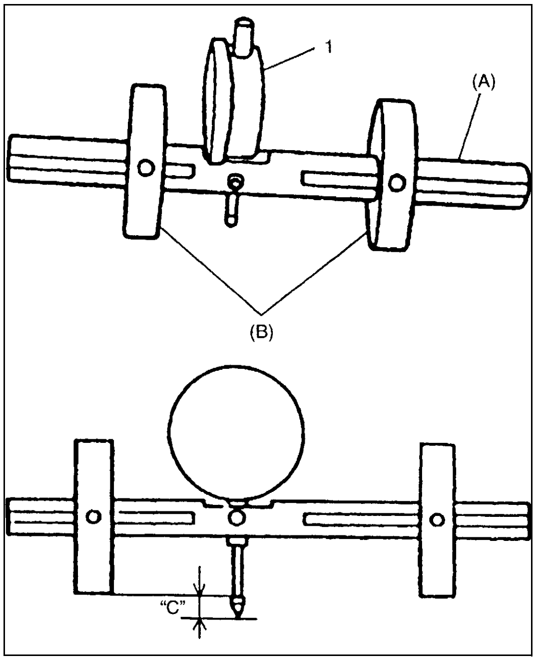
2. Drive bevel gear

Differential carrier and drive bevel pinion



A:	Dummy height of pinion form dummy (= 40 mm/1.575 in.)	F:	Shim thickness for mounting distance adjustment (= D)	6.	Front bearing
B:	Radius of bearing form dummy with dummy shaft (= 36 mm/1.417 in.)	1.	Pinion form dummy	7.	Differential carrier
C:	Block dummy thickness (= 4 mm/0.1575 in.)	2.	Bearing form dummy with dummy shaft	8.	Rear bearing
A + B + C:	Mounting distance adjusting dummy total size (= 80 mm/ 3.150 in.)	3.	Block dummy	9.	Spacer
D:	Measured dimension	4.	Dial gauge	10.	Drive bevel pinion
E:	Drive bevel pinion mounting distance (= 80 mm/3.150 in.)	5.	Drive bevel gear		

Special tool
(A): 09922-76120
(B): 09922-76230
(C): 09922-76140
(D): 09922-76410
(E): 09922-76340
(F): 09922-76150
(G): 09922-76320
(H): 09922-76510

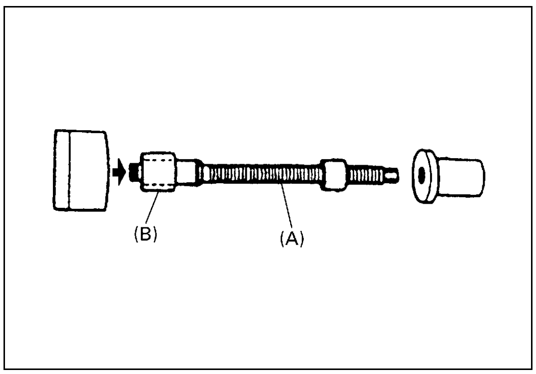


1) Assemble bearing form dummy with dummy shaft using special tools.

Special tool
(A): 09922-76120
(B): 09922-76230

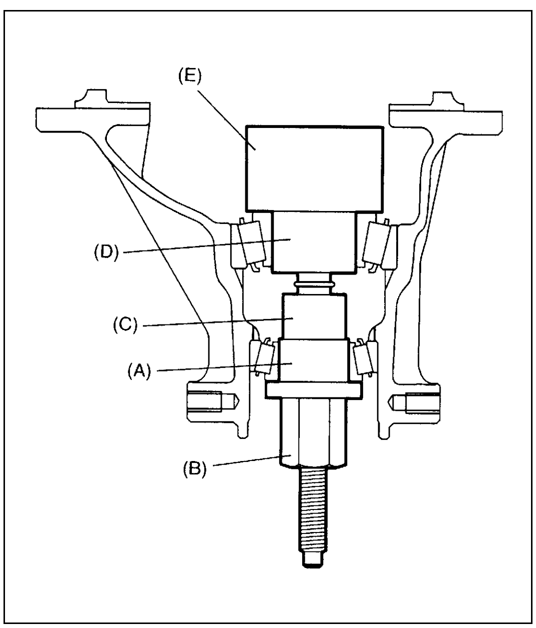
2) Install dial gauge (1) to bearing form dummy with dummy shaft as shown in figure.

Special tool set distance (reference)
"c": 2 – 3 mm (0.079 – 0.118 in.)



3) Assemble pinion form dummy using special tools.

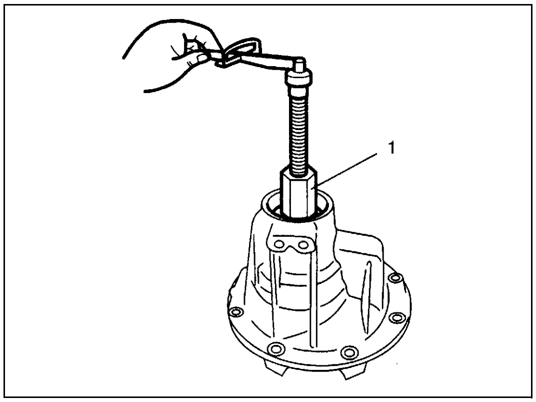
Special tool
(A): 09922-76140
(B): 09922-76410



4) Apply gear oil to drive bevel pinion rear bearing, install rear bearing to pinion form dummy and then install pinion form dummy to differential carrier.
5) Apply gear oil to drive bevel pinion front bearing and install bearing to pinion form dummy with other special tools as shown in figure.

NOTE:
This installation requires no spacer or oil seal.

Special tool
(A): 09922-76320
(B): 09922-76150
(C): 09922-76340
(D): 09922-76410
(E): 09922-76140

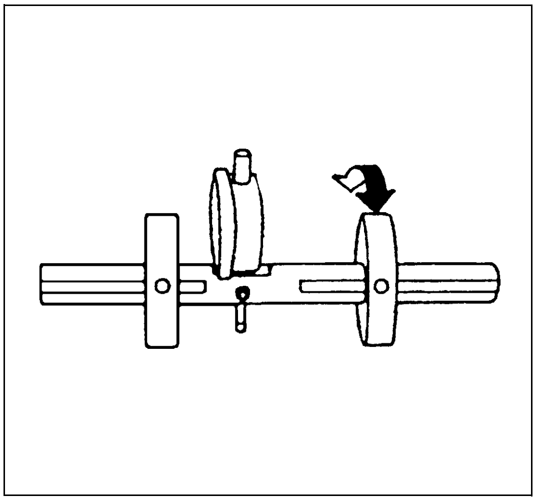


6) Tighten bevel pinion nut (special tool) (1) so that specified bearing preload is obtained.

NOTE:

Before taking measurement, check for rotation by hand more than 15 revolutions.

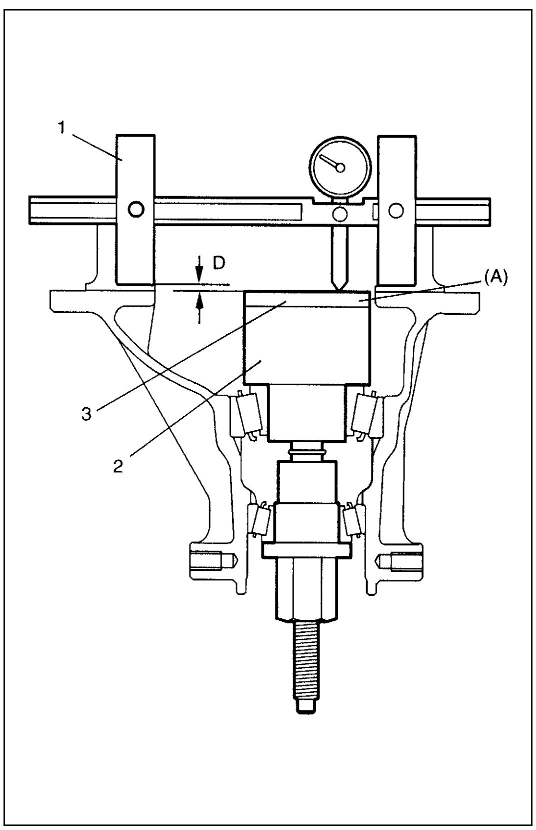
Drive bevel pinion bearing preload (at 50 rpm)
0.5 – 1.3 N·m (5.0 – 13.0 kg-cm, 0.35 – 0.90 lb-ft)



7) Set dial gauge to bearing form dummy with dummy shaft and make 0 (zero) adjustment on surface plate.

NOTE:

- **When setting dial gauge to bearing form dummy with dummy shaft, tighten screw lightly. Be careful not to overtighten it, which will cause damage to dial gauge.**
- **With dial gauge set, turn dummy back and forth by hand a couple of times and attain accurate 0 (zero) adjustment.**
- **It is desirable that short pointer indicates beyond 2 mm when long one is at 0 (zero).**



8) Put block dummy (3) on pinion form dummy (2).

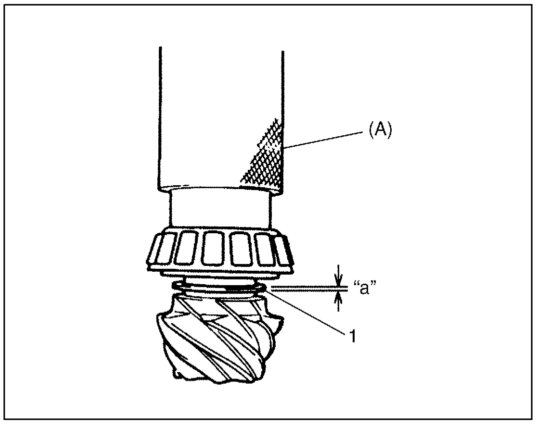
Special tool
(A): 09922-76510

NOTE:

- **Repeat turning back and forth of dummy and measure distance as far as top surface of block dummy accurately.**
- **When dial gauge measuring tip extends from 0 (zero) position, pointer turns counterclockwise.**
- **Measured value may exceed 1 mm. Therefore, it is also necessary to know reading of short pointer.**

9) Place zero-adjusted bearing form dummy with dummy shaft (1) and dial gauge set on block dummy (3) and take measurement between zero position and extended dial gauge measuring tip.
10) Obtain adjusting shim thickness by using measured value by dial gauge in the following equation.

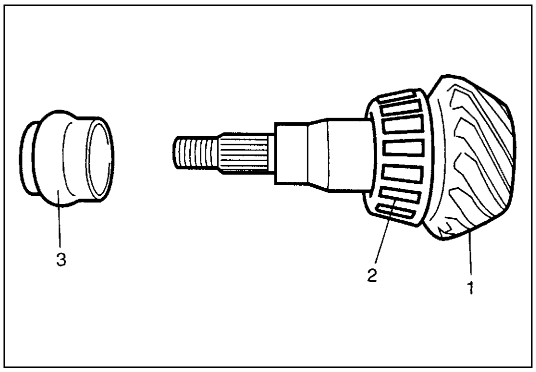
$\boxed{\text{Necessary shim thickness}} = \boxed{\text{Dial gauge measured value D}}$



11) Select adjusting shim(s) (1) closest to calculated value from among following available sizes and put it in place and then press-fit rear bearing.

Special tool
(A): 09940-51710

Available shim thickness
"a": 0.30, 1.00, 1.03, 1.06, 1.09, 1.12, 1.15, 1.18, 1.21, 1.24, 1.27, and 1.30 mm (0.012, 0.039, 0.041, 0.042, 0.043, 0.044, 0.045, 0.046, 0.048, 0.049, 0.050 and 0.051 in.)

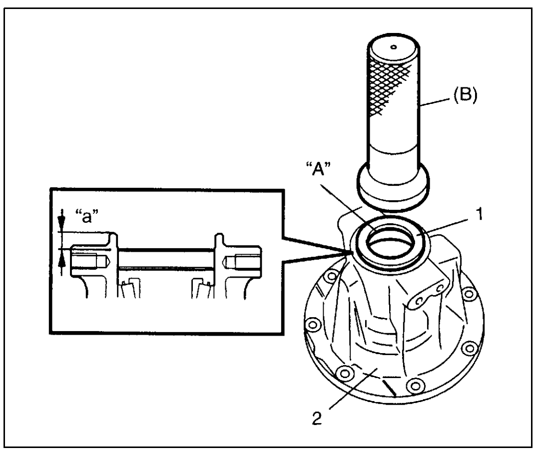


12) With new pinion spacer (3) inserted as shown, install front bearing to differential carrier.

NOTE:

- **Make sure to use new spacer (3) for reinstallation.**
- **Apply differential oil to bearings.**

1.	Drive bevel pinion
2.	Rear bearing



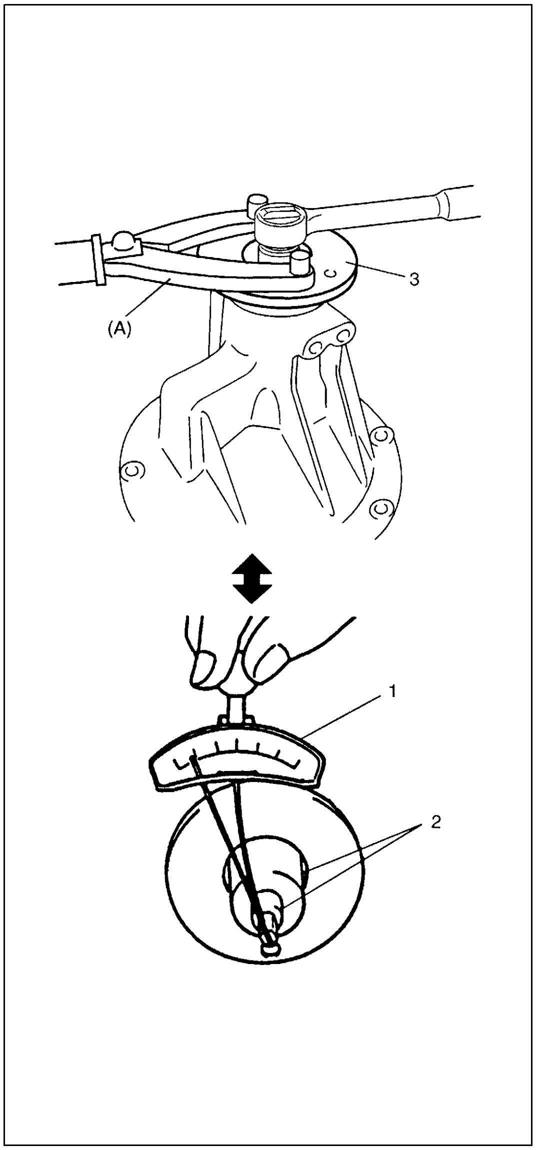
13) Install new oil seal (1) into differential carrier (2) by using special tool and hammer.

Special tool
(B): 09913-75810

Differential carrier oil seal installing depth
"a": 7.5 – 8.5 mm (0.295 – 0.335 in.)

14) Apply grease to new oil seal lip.

"A": Grease 99000-25010



15) Install companion flange (3) to drive bevel pinion and tighten drive bevel pinion nut gradually with special tool, set preload of bearing to specification.

NOTE:

- **Before taking measurement, check for smooth rotation by hand.**
- **Drive bevel pinion bearing preload is adjusted by tightening drive bevel pinon nut to deform spacer.**
  Therefore, be sure to use a new spacer for adjustment and tighten drive bevel pinion nut step by step and check for starting torque (preload) as often as tightening to prevent over crushing of spacer.
  If exceeds specification given below during adjustment, replace spacer and repeat preload adjustment procedure. Attempt to decrease starting torque (preload) by loosening drive bevel pinon nut will not do.
- **For measuring drive bevel pinion bearing preload, turning drive bevel pinion at about 50 rpm is required.**

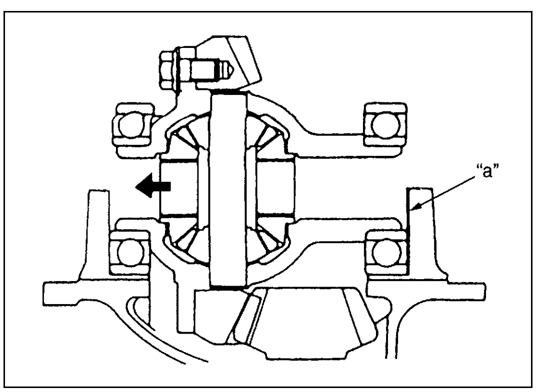
Tightening torque
Drive bevel pinion nut (reference)
70 – 250 N·m (7.0 – 25.0 kg-m, 51.0 – 181.0 lb-ft)

Drive bevel pinion bearing preload
0.5 – 1.3 N·m (5.0 – 13.0 kg-cm, 0.35 – 0.90 lb-ft)

Special tool
(A): 09930-40113

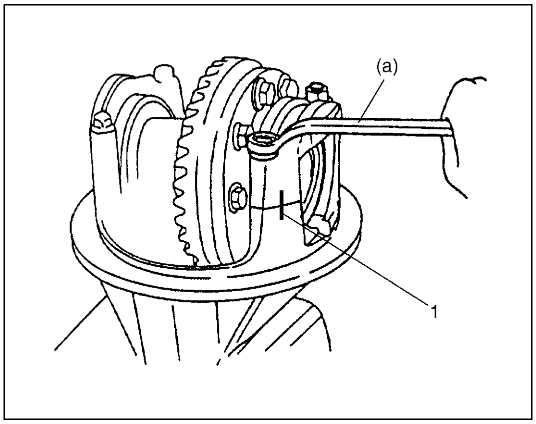
1. Torque wrench
2. Socket with adapter

Differential assembly



1) Place differential gear case assembly to differential carrier, push differential case to left side as shown in figure.
   Then measure clearance "a" between side bearing and differential carrier by using thickness gauge.
   Select shims closest to measured value.

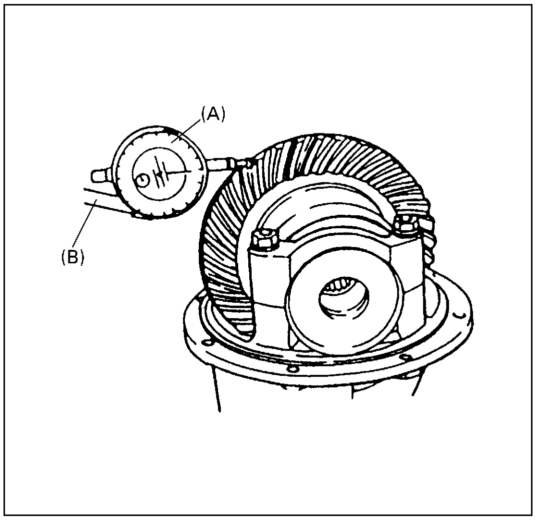
Available shim thickness
0.1, 0.3, 0.5 and 0.7 mm (0.0039, 0.0117, 0.0197 and 0.0276 in.)



2) Divide selected shim(s) between both sides (right and left) and install them to differential carrier. Then install differential side bearing caps.

NOTE:
- **Align match marks (1) on caps and carrier.**
- **Apply differential gear oil to bearings.**

Tightening torque
Differential side bearing cap bolt
(a): 23 N·m (2.3 kg-m, 17.0 lb-ft)



3) Measure backlash by using dial gauge.
If backlash is out of specification, change division of shims so that backlash is within specification.

NOTE:
Be sure to apply measuring tip of dial gauge at right angles to convex side (drive side) of tooth.

Drive bevel gear backlash
0.10 – 0.20 mm (0.0039 – 0.0078 in.)

Special tool
(A): 09900-20607
(B): 09900-20701

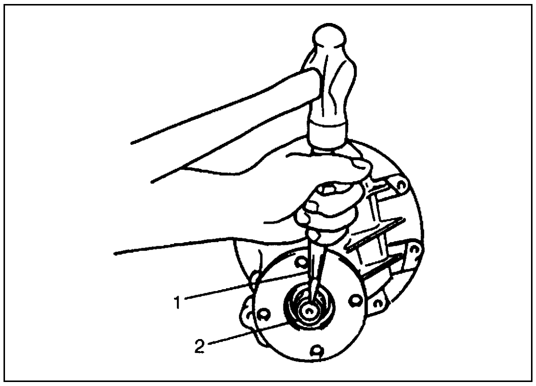
4) Check gear tooth contact as follows.

CAUTION:
When applying red lead paste to teeth, be sure to paint tooth surfaces uniformly. The paste must not be too dry or too fluid.

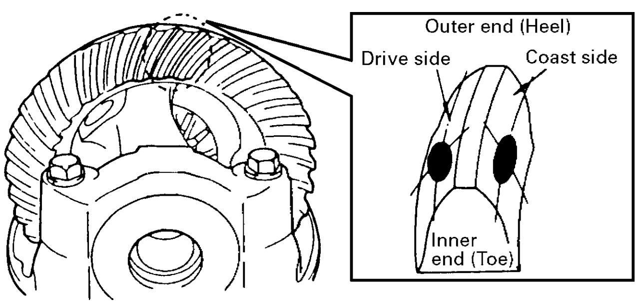
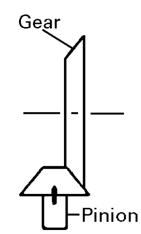
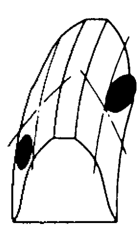
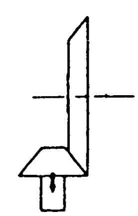
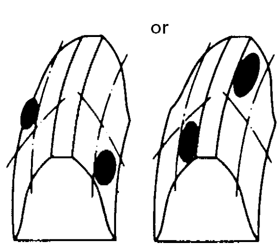
a) After cleaning tooth surface of drive bevel gear, paint teeth with gear marking compound evenly by using brush or sponge etc.
b) Turn gear to bring its painted part in mesh with bevel pinion and turn it back and forth by hand to repeat their contact.

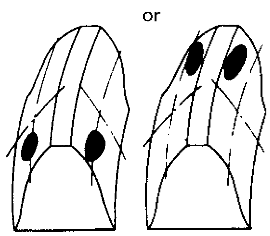
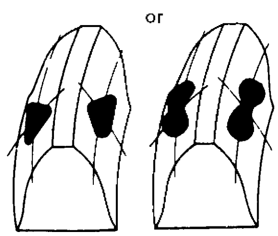
NOTE:
Be careful not to turn bevel gear more than one full revolution, or it will hinder accurate check.

c) Bring painted part up and check contact pattern, referring to the following chart. If contact pattern is not normal, readjust or replace as necessary according to instruction in chart.



5) After completing of gear tooth contact check, caulk drive bevel pinion nut (2) with caulking tool (1) and hammer.

Tooth Contact Pattern	Diagnosis and Remedy
	NORMAL
	HIGH CONTACT Pinion is positioned too far from the center of drive bevel gear. 1) Increase thickness of pinion height adjusting shim and position pinion closer to gear center. 2) Adjust drive bevel gear backlash to specification. 
	LOW CONTACT Pinion is positioned too close to the center of drive bevel gear. 1) Decrease thickness of pinion height adjusting shim and position pinion farther from gear center. 2) Adjust drive bevel gear backlash to specification. 
	These contact patterns indicate that the “offset” of differential is too much or too little. The remedy is to replace the carrier with a new one.

Tooth Contact Pattern	Diagnosis and Remedy
	These contact patterns, located on toe or heel on both drive and coast sides, mean that 1) both pinion and gear are defective, 2) carrier is not true and square, or 3) gear is not properly seated on differential case. The remedy is to replace the defective member.
	Irregular patterns: If the pattern is not oval, it means that bevel gear is defective. High or low spots on tooth surfaces or on the seat of bevel gear are the cause of irregular patterns appearing on some teeth. The remedy is to replace the pinion and-gear set and, if the seat is defective, so is transfer case.

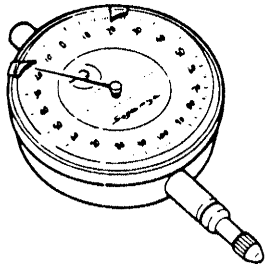
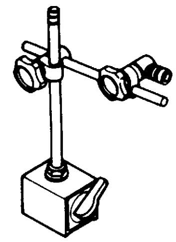
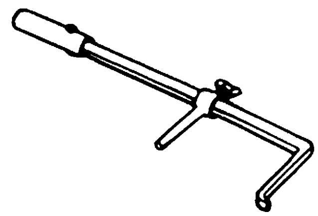
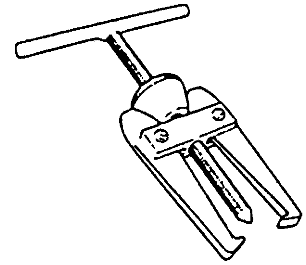
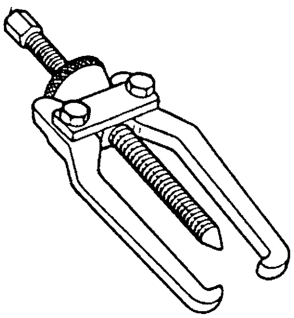
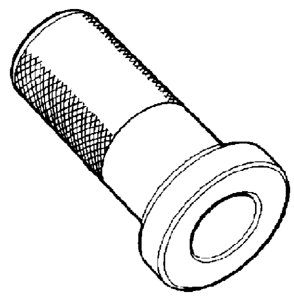
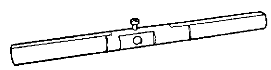
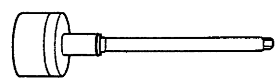
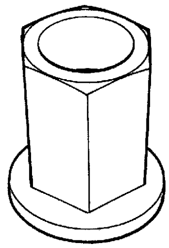
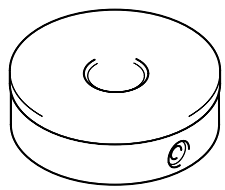
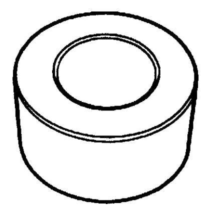
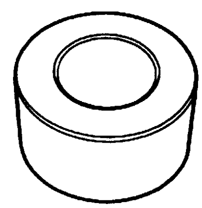
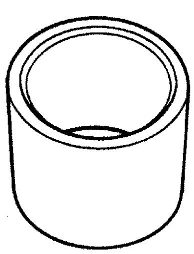
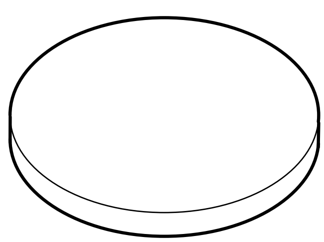
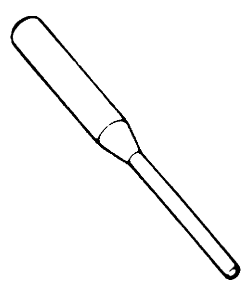
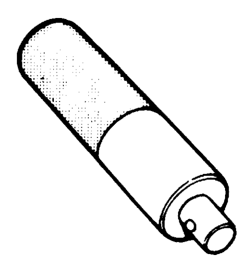
Tightening Torque Specification

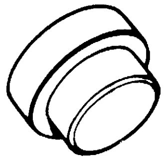
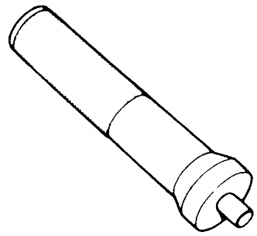
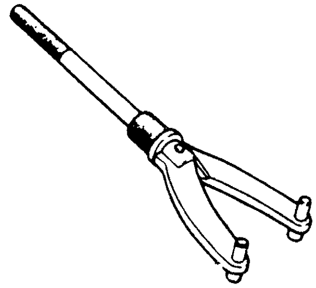
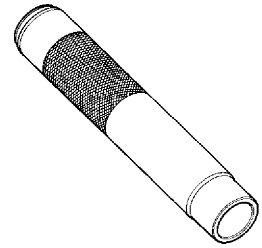
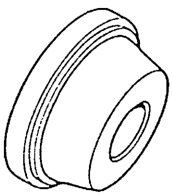
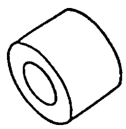
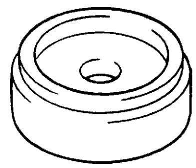
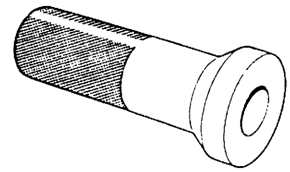
Fastening part	Tightening torque		
	N•m	kg-m	lb-ft
Rear differential oil drain plug	55	5.5	40.0
Rear differential oil level/filler plug	50	5.0	36.5
Drive bevel pinion nut (reference)	70 – 250	7.0 – 25.0	51.0 – 181.0
Drive bevel gear bolt	80	8.0	58.0
Differential side bearing cap bolt	23	2.3	17.0
Differential carrier bolt	23	2.3	17.0
Propeller shaft bolt	23	2.3	17.0

Required Service Material

Material	Recommended SUZUKI product (Part Number)	Use
Thread lock cement	THREAD LOCK CEMENT 1322 (99000-32110)	Drive bevel gear bolts
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	Oil seal lips
Sealant	SUZUKI BOND NO. 1217G (99000-31260)	• Thread part of differential carrier bolt • Mating surface of differential carrier • Mating surface of rear axle housing

Special Tool

 09900-20607 Dial gauge	 09900-20701 Magnetic stand	 09913-50121 Oil seal remover	 09913-60910 Bearing puller
 09913-65135 Bearing puller	 09913-75810 Bearing installer	 09922-76120 Dummy shaft	 09922-76140 Bevel pinion shaft
 09922-76150 Bevel pinion nut	 09922-76230 Bevel gear dummy	 09922-76320 Rear collar	 09922-76340 Rear collar
 09922-76410 Front collar	 09922-76510 Gauge block	 09922-85811 Spring pin remover	 09924-74510 Bearing installer handle

 09925-88210 Bearing puller attachment	 09925-98210 Bearing installer	 09930-40113 Flange holder	 09940-51710 Bearing installer
 09941-34513-004 Bearing installer	 09951-16060 Lower arm bush remover	 09951-16090 Oil seal installer	 09951-76010 Bearing installer

SECTION 8B

LIGHTING SYSTEM

WARNING:

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

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

NOTE:

- **For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.**

CONTENTS

Diagnosis

Rear Fog Light

Condition	Possible Cause	Correction
Rear fog light does not come on when head-lights and front fog lights (if equipped) come on	• Main fuse and/or fuses blown	Replace main fuse and/or fuses to check for short
	• Rear fog light switch faulty	Check switch
	• Wiring or grounding faulty	Repair as necessary
	• Bulb burnt out	Replace
	• Rear fog light controller faulty	Replace controller
[If front fog lights are equipped] Rear fog light does not come on when only headlights come on although it comes on when front fog lights come on	• Rear fog light controller harness “RED/ BLU” faulty	Repair
[If front fog lights are equipped] Rear fog light does not come on when only front fog lights come on although it comes on when headlights come on	• Rear fog light controller harness “PPL/ WHT” faulty	Repair

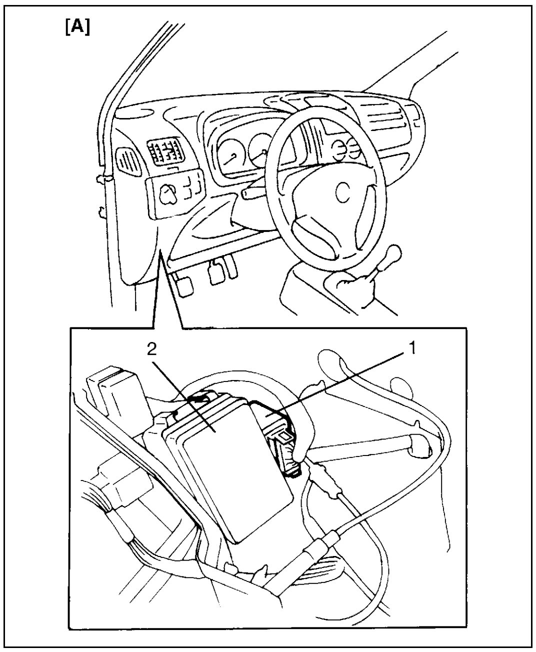
On-Vehicle Service

Rear Fog Light

Rear fog light circuit

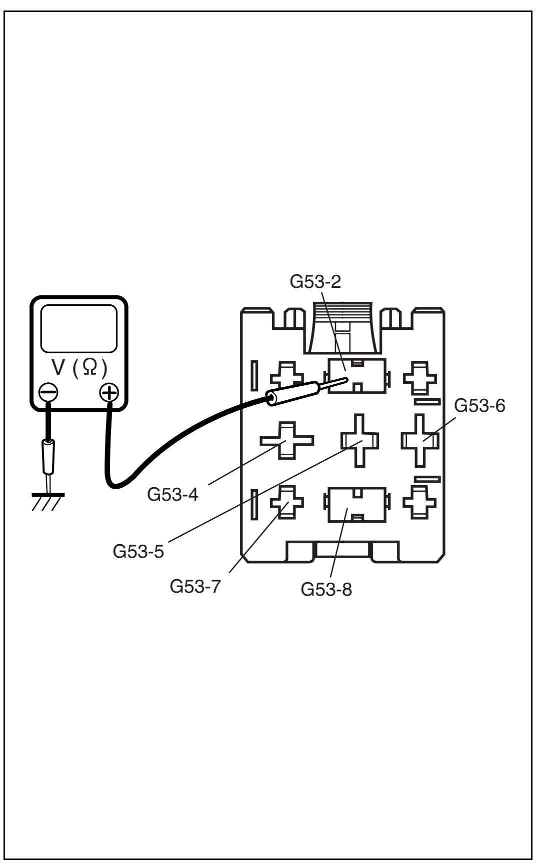
Inspection

1) Check headlights and front fog lights (if equipped) come on. If headlight and/or fog light does not come on, check for light controller circuit as follows.
2) Disconnect negative cable at battery.



3) Disconnect rear fog controller (1) coupler and connect negative cable at battery.

[A]:	The illustration shows LH steering vehicle. And RH steering vehicle is symmetrical.
2.	Fuse box



4) Check that the voltage and resistance between following terminals are specifications.

Terminals	Condition	Specification
G53-2 and ground	–	Continuity
G53-4 and ground	–	10 – 15 V
G53-5 and ground	When front fog lights come on	10 – 15 V
	When front fog lights do not come on	0 V
G53-6 and ground	–	Continuity
	When rear fog light bulb is removed	No continuity
G53-7 and ground	When rear fog light switch is pushed	10 – 15 V
	When rear fog light switch is free	0 V
G53-8 and ground	When headlight switch is in OFF	10 – 15 V
	When headlight switch is in ON	0 V

If check result is not satisfactory, repair.

SECTION 8C

INSTRUMENTATION/DRIVER INFORMATION

WARNING:

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

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

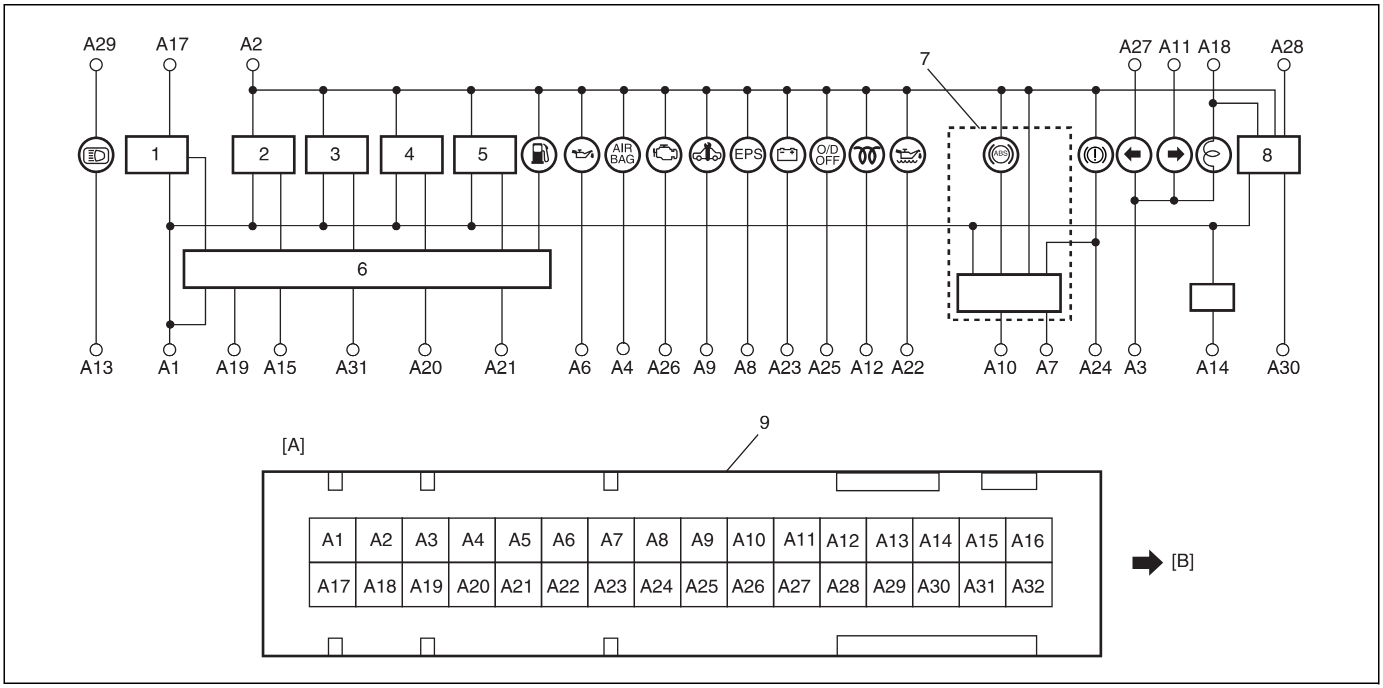
NOTE:

For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.

CONTENTS

General Description

Combination Meter



[A]: Terminal arrangement of coupler viewed from harness side	3. Tachometer (if equipped)	7. ABS/EBD circuit (if equipped)
[B]: The upper side of combination meter	4. Fuel meter	8. Buzzer
1. Voltage regulator	5. Temp. meter	9. Connector A
2. Speedometer	6. Interface circuit	

Terminal A					
A1	To ground	BLK	A17	To positive terminal at battery	WHT/BLU
A2	To ignition switch	BLK/RED	A18	To tail light relay	RED/YEL
A3	To ground	BLK	A19	To ground	BRN
A4	To SDM	BLU	A20	To fuel level gauge	YEL/RED
A5	–	–	A21	To ECM	WHT/GRN
A6	To oil pressure switch	YEL/BLK	A22	To ECM (Z13DT engine)	PNK
A7	To ABS control module	ORN	A23	To generator	WHT/RED
A8	To EPS control module	GRY	A24	To brake fluid level switch and parking brake switch	YEL/GRN
A9	To ECM (Z13DT engine)	GRY/RED	A25	To A/T control module (M13 engine)	BLU/YEL
A10	To ABS control module	BLU/BLK	A26	To ECM	PPL/WHT
A11	To turn and hazard switch	GRN/YEL	A27	To turn and hazard switch	GRN/RED
A12	To ECM (Z13DT engine)	GRN/YEL	A28	To ignition switch	YEL/BLK
A13	To dimmer switch	RED	A29	To positive terminal at battery	WHT/BLU
A14	–	–	A30	To door switch	BLK/ORN
A15	To speed sensor or ECM	PPL	A31	To ECM	BRN/YEL
A16	–	–	A32	–	–

Diagnosis

Low Engine Oil Level Warning Light Symptom Diagnosis for Z13DT Engine

Condition	Possible Cause	Correction
Low engine oil level warning light does not light up when low engine oil level	Fuse blown	Replace fuse to circuit for short.
	Wiring or grounding faulty	Repair circuit.
	Engine oil level switch faulty	Check engine oil level switch referring to “Engine Oil Level Switch” in Section 6E3.
	Combination meter faulty	Check combination meter circuit referring to “Combination Meter” in this section.
	ECM faulty	Check ECM referring to “Inspection of ECM and Its Circuits” in Section 6-3.
Low engine oil level warning light stays ON	Low engine oil	Refill engine oil referring to “Engine Oil and Oil Filter Replacement” in Section 0B.
	Wiring or grounding faulty	Repair circuit.
	Engine oil level switch faulty	Check engine oil level switch referring to “Engine Oil Level Switch” in Section 6E3.
	Combination meter faulty	Check combination meter circuit referring to “Combination Meter” in this section.
	ECM faulty	Check ECM referring to “Inspection of ECM and Its Circuits” in Section 6-3.

On-Vehicle Service

Low Fuel Warning System

Operation

This light comes ON for 4 seconds after ignition switch is turned to ON position, and goes out.
However, in insufficient fuel level, this light indicates low fuel level by the following operation.

Low fuel warning light operation

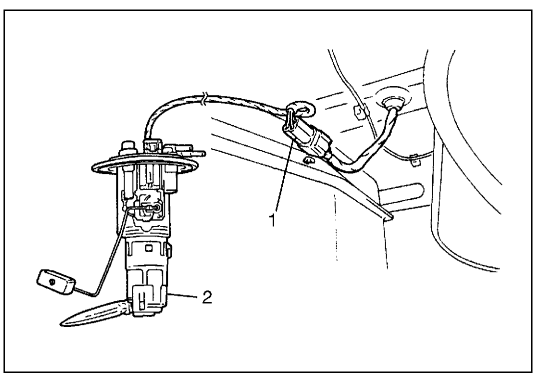
Low fuel warning light operation	**Fuel level in fuel tank**
OFF	6.0 litre (1.32 gal/Imp) or more
ON	2.9 – 6.0 litre (0.64 – 1.32 gal/Imp)
Flashing	0 – 2.9 litre (0 – 0.64 gal/Imp)

NOTE:

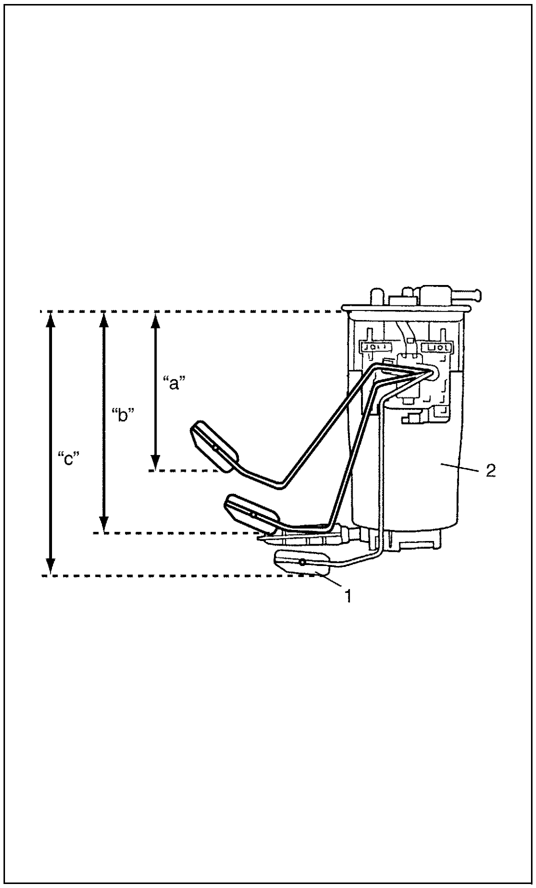
Low fuel warning light turns off until fuel level in fuel tank is more than 10 litre (2.2 gal/Imp) if it is turned ON or flashing once.

System Inspection

1) Confirm that low fuel warning light comes ON for 4 seconds after ignition switch turned to ON position, and goes out.
2) Remove fuel pump assembly referring to “Fuel Pump Assembly (With Fuel Filter, Fuel Level Gauge, Fuel Pressure Regulator and Fuel Cut Valve)” in Section 6C.
3) Check fuel sender gauge referring to “Fuel Sender Gauge” in this section.



4) Connect fuel pump connector (1) to fuel pump (2).
5) Connect negative (–) cable to battery.
6) Turn ignition switch to ON position.



7) After 4 seconds, check for low fuel warning lamp operation under the following each float position (1) of fuel pump (2).
If faulty condition is found, replace combination meter.

Low fuel warning light operation for G10/M13 engine

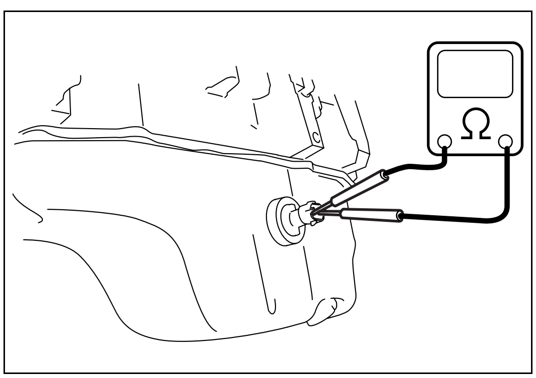
Float position		Low fuel warning light operation
"a"	188.5 – 191.3 mm (7.43 – 7.53 in.)	OFF
"b"	200.9 mm (7.91 in.) or more	ON
"c"	205.2 mm (8.08 in.) or more	Flashing

Low fuel warning light operation for Z13DT engine

Float position		Low fuel warning light operation
"a"	Above "b" position	OFF
"b"	184.0 mm (7.24 in.) or more	ON
"c"	194.3 mm (7.65 in.) or more	Flashing

Engine Oil Level Switch for Z13DT Engine

Inspection



Check engine oil level switch referring to "Engine Oil Level Switch" in Section 6E3.

SECTION 8G

IMMOBILIZER CONTROL SYSTEM (G10/M13 ENGINES)

WARNING:

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

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

NOTE:

For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.

CONTENTS

General Description

Components

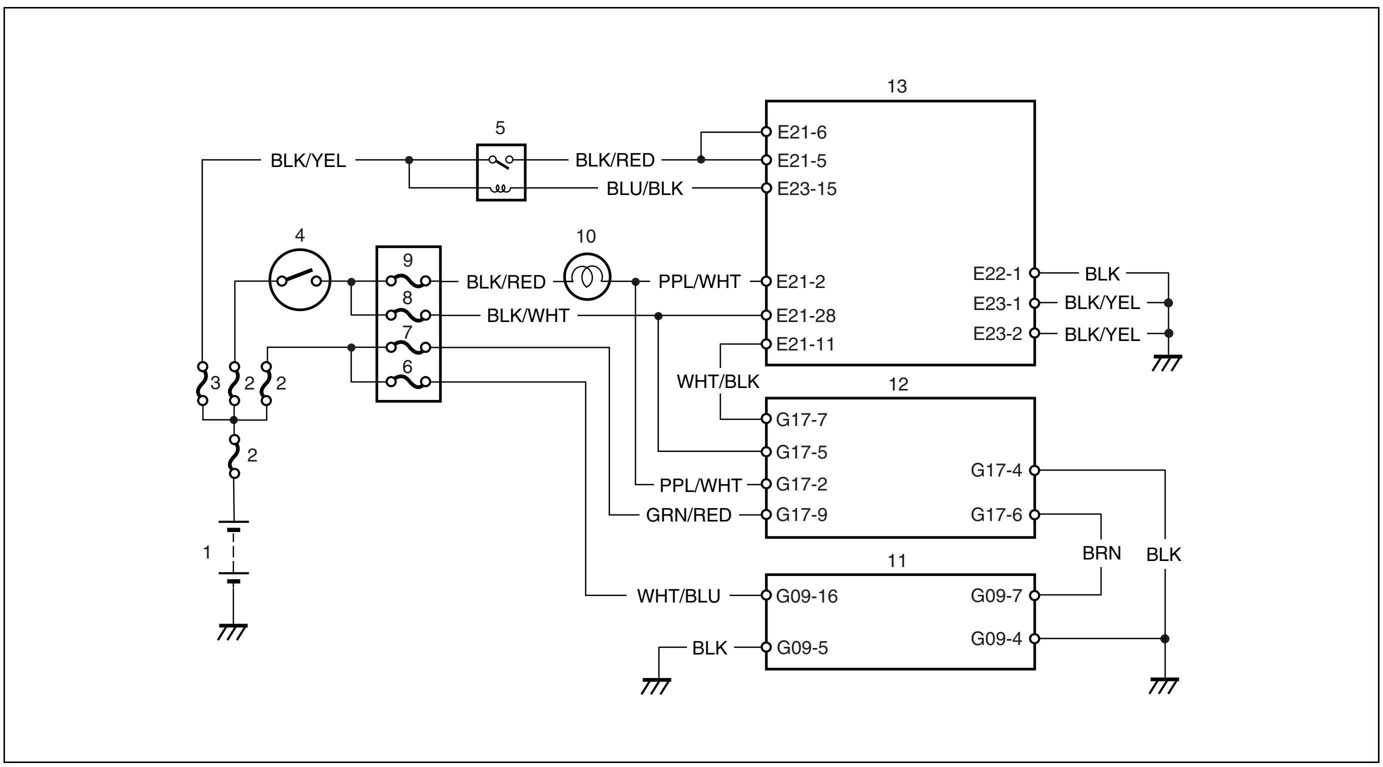
The immobilizer control system designed to prevent vehicle burglar and it consists of following components.

- Engine control module (ECM)
- Immobilizer control module (with coil antenna)
- Ignition key (with built-in transponder)

Operations

1) Each ignition key has its own FIX CODE (FC) stored in memory. When the ignition switch is turned to ON (II) position, immobilizer control module reads the FC through its coil antenna from ignition key.
2) Immobilizer control module compares FC read in step 1 and that registered in immobilizer control module and checks if they match.
3) ECM sends variable (generated randomly) to transponder via immobilizer control module, and then ECM calculates it with SECRET KEY (SKC) stored in its memory according to specified algorithm. On the other hand, transponder also calculates received variable with SKC stored in memory by means of same algorithm and sends back to ECM.
4) Only when ECM/transponder calculated values match, ECM keeps running engine. If two calculated values do not match, ECM stops operation of injectors and ignitor to stop engine after about 1.8 seconds at the first time. After the second time, ECM does not let engine start. And, so it does when FIX CODEs in step 2 do not match.

Wiring Circuit for M13 Engine Model



1. Battery	6. DOME RADIO fuse (15 A)	11. Data link connector (DLC)
2. Fuse	7. STOP fuse (15 A)	12. Immobilizer Control Module
3. FI fuse (20 A)	8. IG COIL fuse (15 A)	13. ECM
4. Ignition switch	9. METER fuse (10 A)	
5. Main relay	10. Immobilizer indicator lamp	

On-board Diagnostic System for M13 Engine Model

ECM and immobilizer control module diagnose troubles which may occur in the area including the following parts when the ignition switch is turned to ON position.

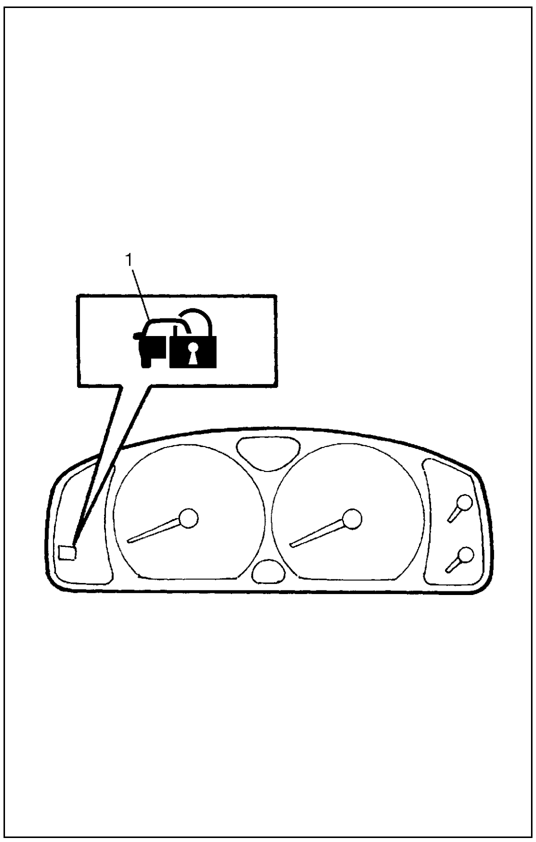
Immobilizer control module

- Immobilizer control module
- W-line (Communication line between ECM and immobilizer control module)
- Password
- MIL circuit
- Transponder (ignition key)
- Fix code

ECM

- ECM
- Secret key
- Password

When a trouble exists in the immobilizer control system (when immobilizer control module or ECM detects a diagnostic trouble code (DTC)), ECM stops operation of the injector and igniter.



With the ignition switch turned ON (but the engine at stop) regardless of the condition of the engine and emission control system, ECM indicates whether a trouble has occurred in the immobilizer control system or not by flashing or turning ON the immobilizer indicator lamp (1).

Immobilizer indicator lamp ON:
No trouble exists in the immobilizer control system.

Immobilizer indicator lamp flashing ON and OFF:
ECM or immobilizer control module has detected some trouble in the immobilizer control system.

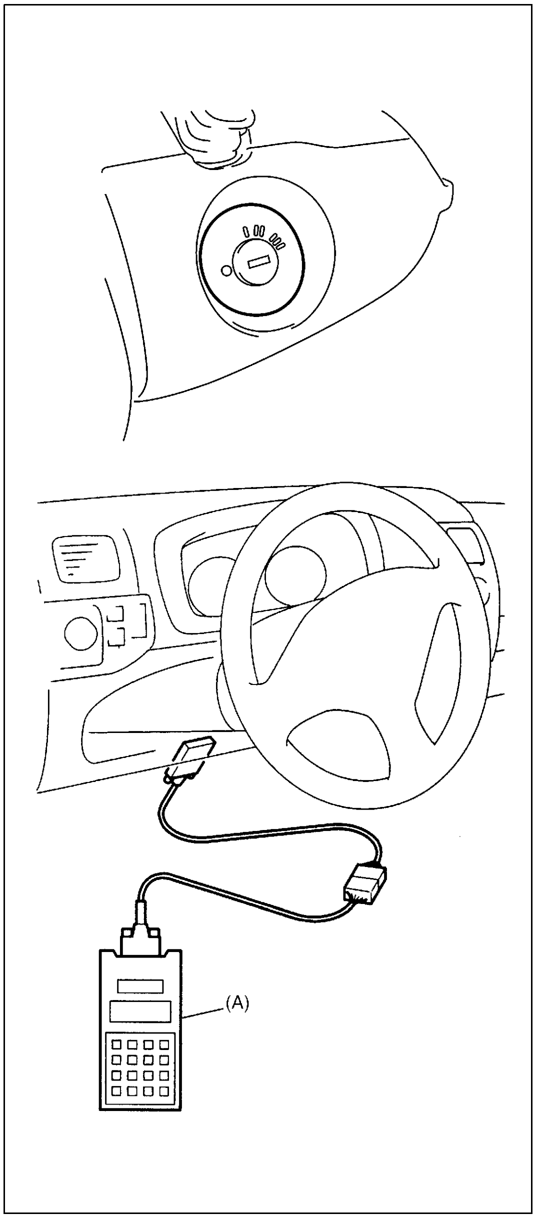
NOTE:

As soon as the ignition switch is turned to ON position, ECM and immobilizer control module diagnose if a trouble has occurred in the immobilizer control system in about 5 seconds at maximum.
While the diagnosis is being made, the MIL (malfunction indicator lamp) stays on and diagnosis result is abnormal, it immediately changes to flashing but if the result is normal, it remains on.

Diagnosis

Diagnostic Flow Table for M13 Engine Model

Step	Action	Yes	No
1	Turn ignition switch to start engine. Does engine run?	Go to step 5.	Go to step 2.
2	W-line circuit check Measure terminal voltage of immobilizer control module connector G17-7. Is it 10 – 14 V with ignition switch at ON position, 0 – 1 V with ignition switch at OFF position?	W-line circuit is in good condition. Go to step 3.	W-line circuit open or short Check and repair. Then, go to step 3.
3	Check for DTC referring to “Diagnostic Trouble Code (DTC) Check” in Section 6-2. Is there any DTC(s)?	Go to step 4.	Go to step 5.
4	Check, repair and/or perform necessary registration procedure according to flow table corresponding to DTC(s). Is there other DTC(s)?	Repeat step 4 until no DTC is indicated.	Go to step 5.
5	Check for DTC referring to “Diagnostic Trouble Code (DTC) Check” in this section. Is there any DTC(s)?	Go to step 6.	Immobilizer control system is in good condition. If engine does not run, electronic fuel injection system is failed. Proceed to “Engine and Emission Control System Check” in Section 6-2.
6	Check and repair according to flow table corresponding to DTC(s). Is there other DTC(s)?	Repeat step 6 until no DTC is indicated.	Immobilizer control system is in good condition. If engine does not run, electronic fuel injection system is failed. Proceed to “Engine and Emission Control System Check” in Section 6-2.



Diagnostic Trouble Code (DTC) Check for M13 Engine Model

Immobilizer Control Module

1) Prepare SUZUKI scan tool.
2) With ignition switch OFF position (●), connect SUZUKI scan tool to data link connector (DLC) located under instrument panel at driver's seat side.

Special tool
(A): SUZUKI scan tool (Tech-1A or Tech-2)

3) Turn ignition switch to ON position (II), and then read DTC according to instructions displayed on SUZUKI scan tool. If communication between scan tool and immobilizer control module can not be established, check if SUZUKI scan tool is communicable by connecting it to immobilizer control system 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 can not be established.

NOTE:

DTC No. B3040, B3042 and B3043 can not be confirmed by SUZUKI scan tool unless W-line circuit is repaired.

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

ECM

Refer to “Diagnostic Trouble Code (DTC) Check” in Section 6-2.

Diagnostic Trouble Code (DTC) Clearance for M13 Engine Model

Immobilizer Control Module

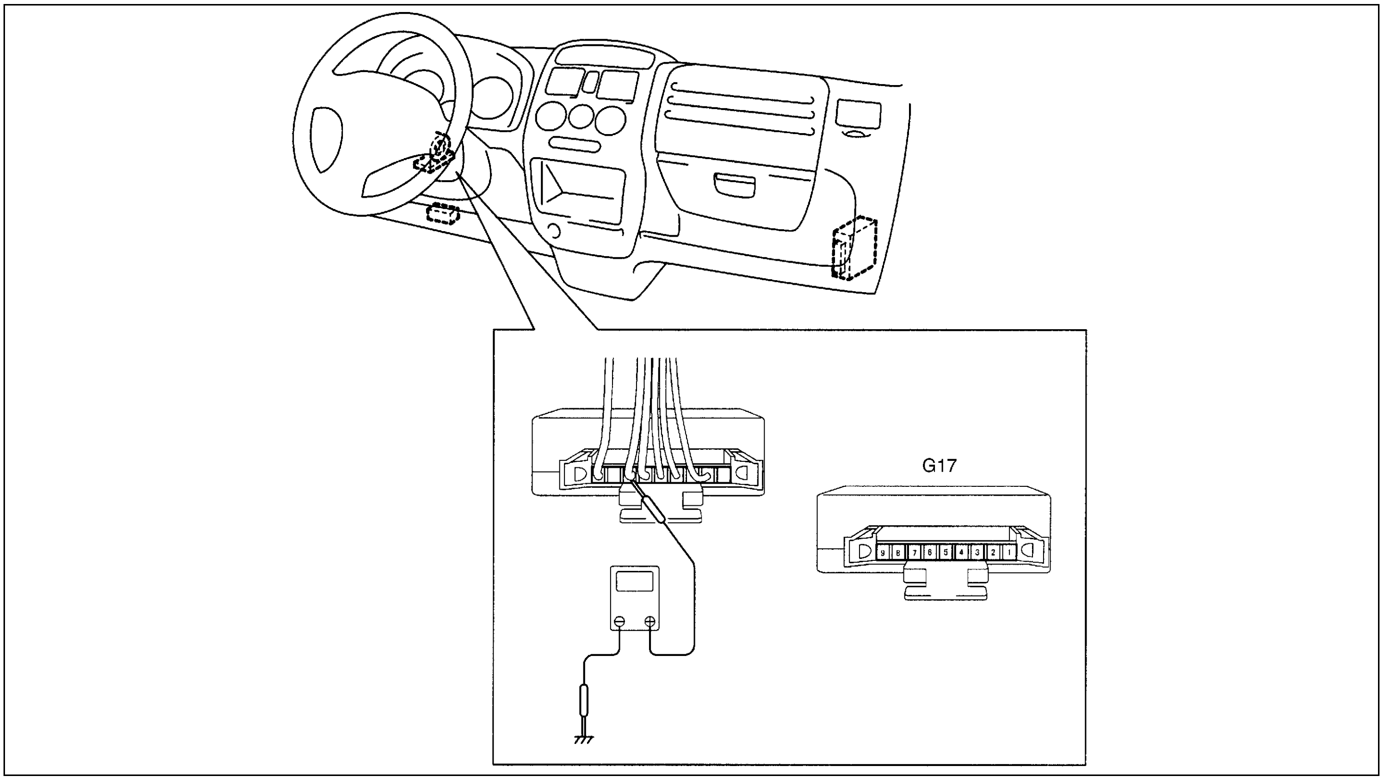
1) Connect SUZUKI scan tool to data link connector located under instrument panel at driver’s seat side.
2) Turn ignition switch to ON position (II).
3) Erase DTC according to instructions displayed on SUZUKI scan tool. Refer to scan tool operator's manual for further details.
4) After completing the clearance, turn ignition switch to OFF position and disconnect SUZUKI scan tool from DLC.

ECM

Refer to “Diagnostic Trouble code (DTC) check” in Section 6-2.

Inspection of Immobilizer Control Module and Its Circuits for M13 Engine Model

Voltage Inspection



Immobilizer control module can be checked at wiring connectors by measuring voltage.

CAUTION:

Immobilizer control module can not be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to immobilizer control module with coupler disconnected from it.

NOTE:

As the battery voltage affects each terminal voltage, confirm that it is 11 V or more when ignition switch is turned to ON position.

Connector	Terminal		Circuit	Nornal Voltage	Condition
G17	1	–	Not used	–	–
	2	PPL/WHT	MIL	0 – 1 V	MIL lights on.
	3	–	Not used	–	–
	4	BLK	Ground	0 – 1 V	Anytime
	5	BLK/WHT	Ignition switch signal	10 – 14 V	Ignition switch at ON position
				0 – 1 V	Ignition switch at OFF position
	6	WHT/RED	Data link connector (Serial data line)	10 – 14 V	Scan tool connected
				0 – 1 V	Scan tool disconnected
	7	WHT/BLK	W-line	10 – 14 V	Scan tool connected or ignition switch at ON position
				0 – 1 V	Scan tool disconnected and ignition switch at OFF position
	8	–	Not used	–	–
	9	GRN/RED	Power supply	10 – 14 V	Anytime

DTC B3040 W-line Communication Fail for M13 Engine Model

Wiring Circuit

Refer to “Wiring Circuit for M13 Engine Model” on page 8G-2.

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
No response from ECM while immobilizer control module requests signal	W-line circuit ECM power circuit

Troubleshooting

Step	Action	Yes	No
1	1) Ignition switch at OFF position. 2) Disconnect connector from ECM. 3) Check for proper connection to ECM at E22-11 terminal. Is it in good condition?	Go to step 2.	Repair or replace.
2	1) Ignition switch at OFF position. 2) Disconnect connector from immobilizer control module. 3) Check for proper connection to immobilizer control module at G17-7 terminal. Is it in good condition?	Go to step 3.	Repair or replace.
3	With connectors connected, measure voltage between terminal G17-7 and ground with ignition switch at ON position. Is it 10 – 14 V?	Go to step 4.	W-line (WHT/BLK) circuit open
4	With ignition switch at ON position, measure voltage between E21-5 or E21-6 terminal and ground. Are they 10 – 14 V?	Substitute a known-good ECM according to “Procedure After ECM Replacement” under “Registration Procedure of Immobilizer System Components”, and recheck.	ECM power supply (BLK/WHT) circuit open

DTC B3042 W-line CKT Malf (Short to Ground) for M13 Engine Model

Wiring Circuit

Refer to “Wiring Circuit for M13 Engine Model” on page 8G-2.

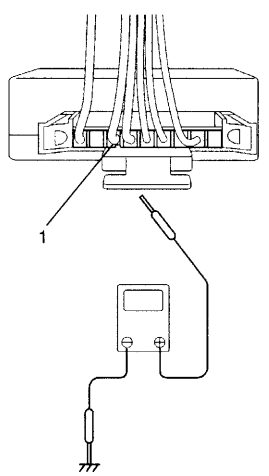
DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
W-line circuit voltage is low.	W-line circuit is shorted to ground.

Troubleshooting

Step	Action	Yes	No
1	1) Ignition switch at OFF position. 2) Disconnect connector from ECM. 3) Check for proper connection to ECM at E21-11 terminal. Is it in good condition?	Go to step 2.	Repair or replace.
2	1) Connect connector to ECM. 2) Measure voltage between G17-7 terminal of immobilizer control module and body ground with ignition switch at ON position. Is it 10 – 14 V?	Substitute a known-good ECM according to “Procedure After ECM Replacement” under “Registration Procedure of Immobilizer System Components”, and recheck.	W-line (WHT/BLK) is shorted to ground. Repair and recheck.

[A]



1.	G17-7 terminal
[A]:	Fig. for step 2

DTC B3043 W-line CKT Malf (Short to Battery) for M13 Engine Model

Wiring Circuit

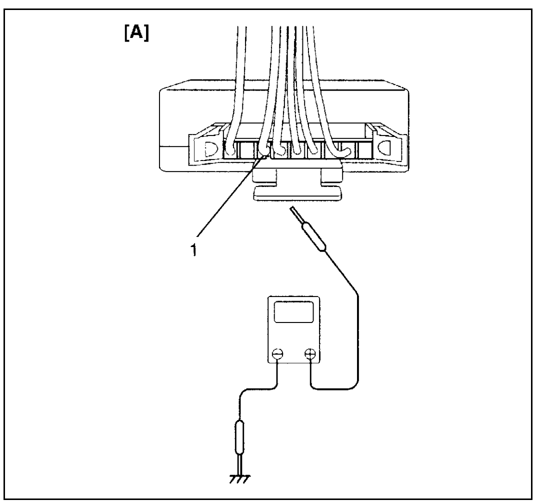
Refer to “Wiring Circuit for M13 Engine Model” on page 8G-2.

DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
W-line circuit voltage is high.	W-line circuit is shorted to power supply circuit.

Troubleshooting

Step	Action	Yes	No
1	1) Ignition switch at OFF position. 2) Disconnect connector from ECM. 3) Check for proper connection to ECM at E21-11. Is it in good condition?	Go to step 2.	Repair or replace.
2	1) Connect connector to ECM. 2) Measure voltage between G17-7 terminal of immobilizer control module and body ground with ignition switch at OFF position and scan tool disconnected. Is it 0 – 1 V?	Substitute a known-good ECM according to “Procedure after ECM Replacement” under “Registration Procedure of Immobilizer System Components”, and recheck.	W-line (WHT/BLK) is shorted to power supply circuit. Repair and recheck.



1.	G17-7 terminal
[A]:	Fig. for step 2

DTC B3059 No Request from ECM for M13 Engine Model

Wiring Circuit

Refer to “Wiring Circuit for M13 Engine Model” on page 8G-2.

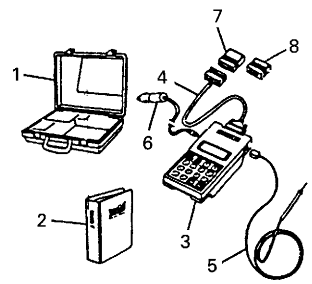
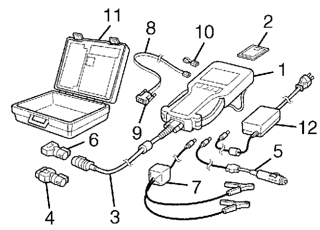
DTC Detecting Condition and Trouble Area

DTC Detecting Condition	Trouble Area
No request from ECM via MIL circuit Ignition switch is not reset correctly.	MIL circuit faulty Communication between ECM and immobilizer control module

Troubleshooting

Step	Action	Yes	No
1	Turn ignition switch to (I) position or (●) position for more than 5 seconds, then turn ignition switch to ON (II) position. Recheck DTC. Is DTC B3059 current?	Go to step 2.	Communication between ECM and immobilizer control module was not finished correctly.
2	1) Check for proper connection to ECM at E21-1 terminal. Is it in good condition?	Go to step 3.	Repair or replace.
3	1) Check for proper connection to immobilizer control module at G17-2 terminal. Is it in good condition?	Go to step 4.	Repair or replace.
4	1) Check PPL/WHT line for open or short. Is it in good condition?	Substitute a known-good ECM according to “Procedure after ECM Replacement” under “Registration Procedure of Immobilizer System Components”, and recheck.	Repair or replace.

Special Tools

	
09931-76011	
Tech-1A kit (SUZUKI scan tool) (See NOTE “A”.)	Tech-2 kit (SUZUKI scan tool) (See NOTE “B”.)

NOTE:

- **“A”: This kit includes the following items.**
  1. Storage case, 2. Operator's manual, 3. Tech-1A, 4. DLC cable, 5. Test lead/probe, 6. Power source cable, 7. DLC cable adapter, 8. Self-test adapter
- **“B”: This kit includes the following items and substitutes for the Tech-1A kit.**
  1. Tech 2. PCMCIA card, 3. DLC cable, 4. SAE 16-19 adapter, 5. Cigarette cable, 6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter, 10. RS232 loopback connector, 11. Storage case, 12. Power supply

SECTION 9

BODY SERVICE

WARNING:

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

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

NOTE:

- **Fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number of with an equivalent part if replacement becomes necessary.**
  Do not use a replacement part of lesser quality or substitute a design. Torque values must be used as specified during reassembly to assure proper retention of these parts.
- **For the description (items) not found in this section, refer to the same section of the Service Manual mentioned in FOREWORD of this manual.**

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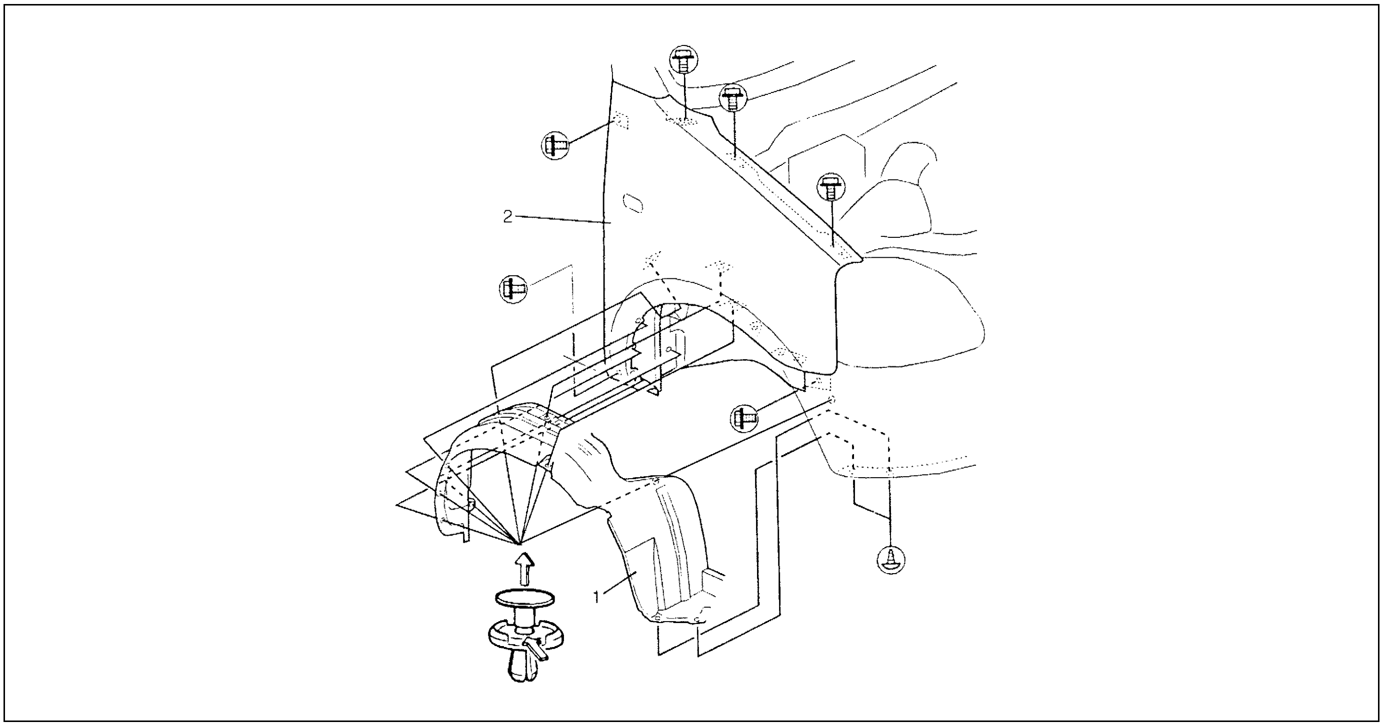
CONTENTS

Body Structure

Front Fender



Removal

1) Remove front bumper.
2) Disconnect connector of side turn signal lamp.
3) Remove front fender lining (1).
4) Remove front fender (2).

Installation

Reverse removal procedure for installation.

NOTE:

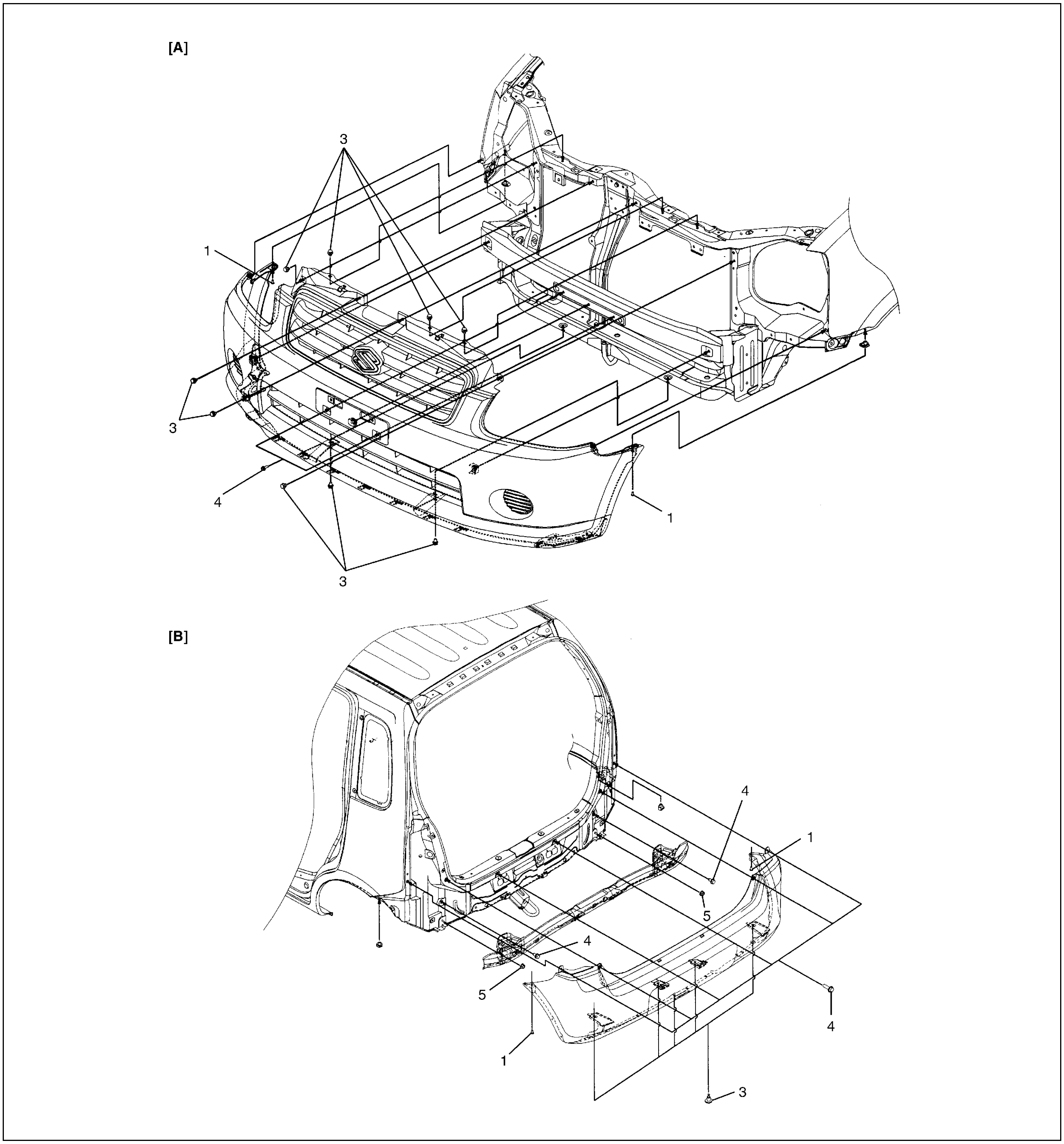
If paint on fender bolt is peeled off, be sure to apply paint again.

Adjust panel clearance referring to “Panel Clearance” in this section.

Front Bumper and Rear Bumper

NOTE:

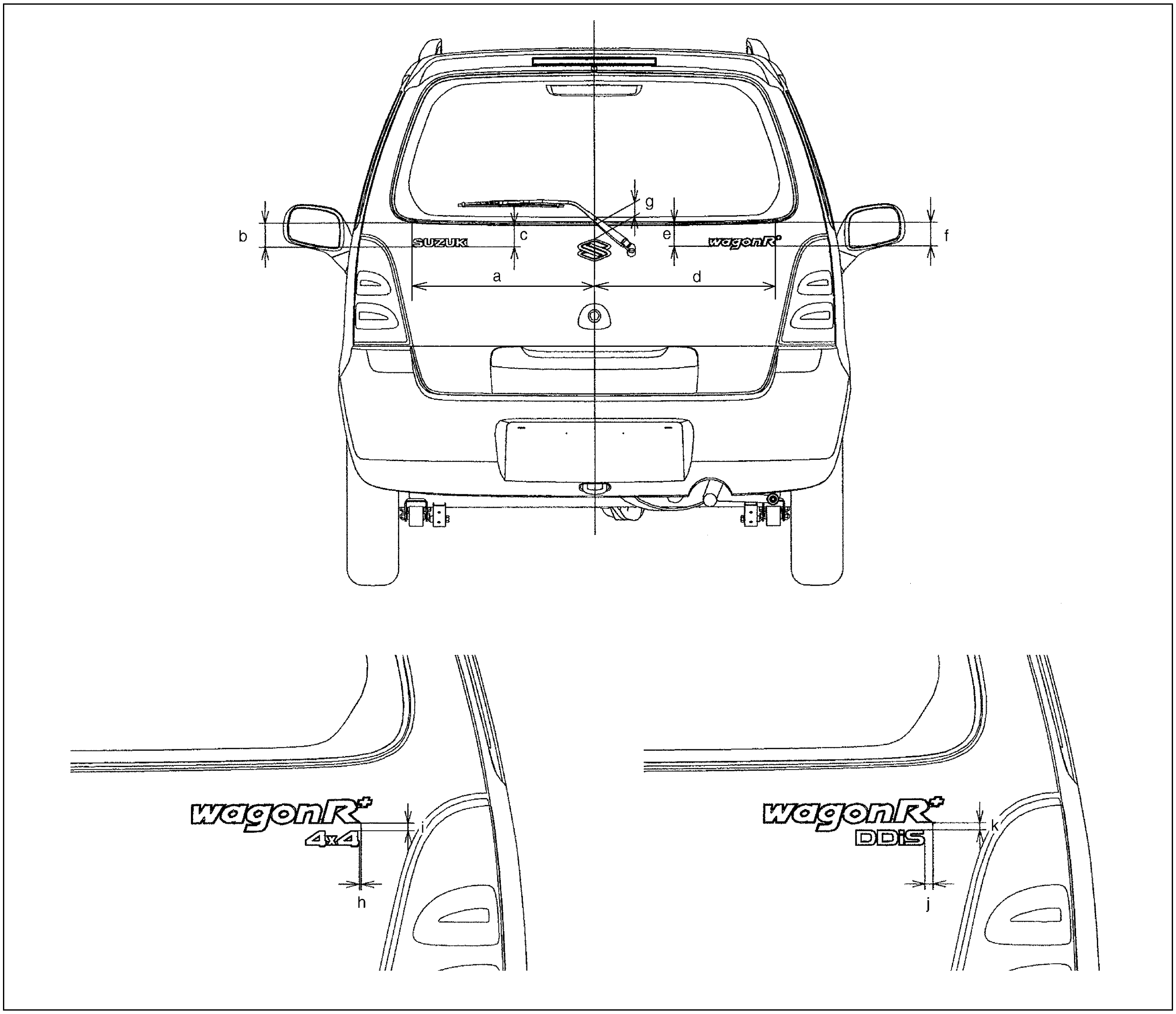
Fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary.
Do not use a replacement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



[A]: Front bumper	1. Screws	3. Clip	5. Nut
[B]: Rear bumper	2. Rear bumper member	4. Bolt	

Exterior and Interior Trim

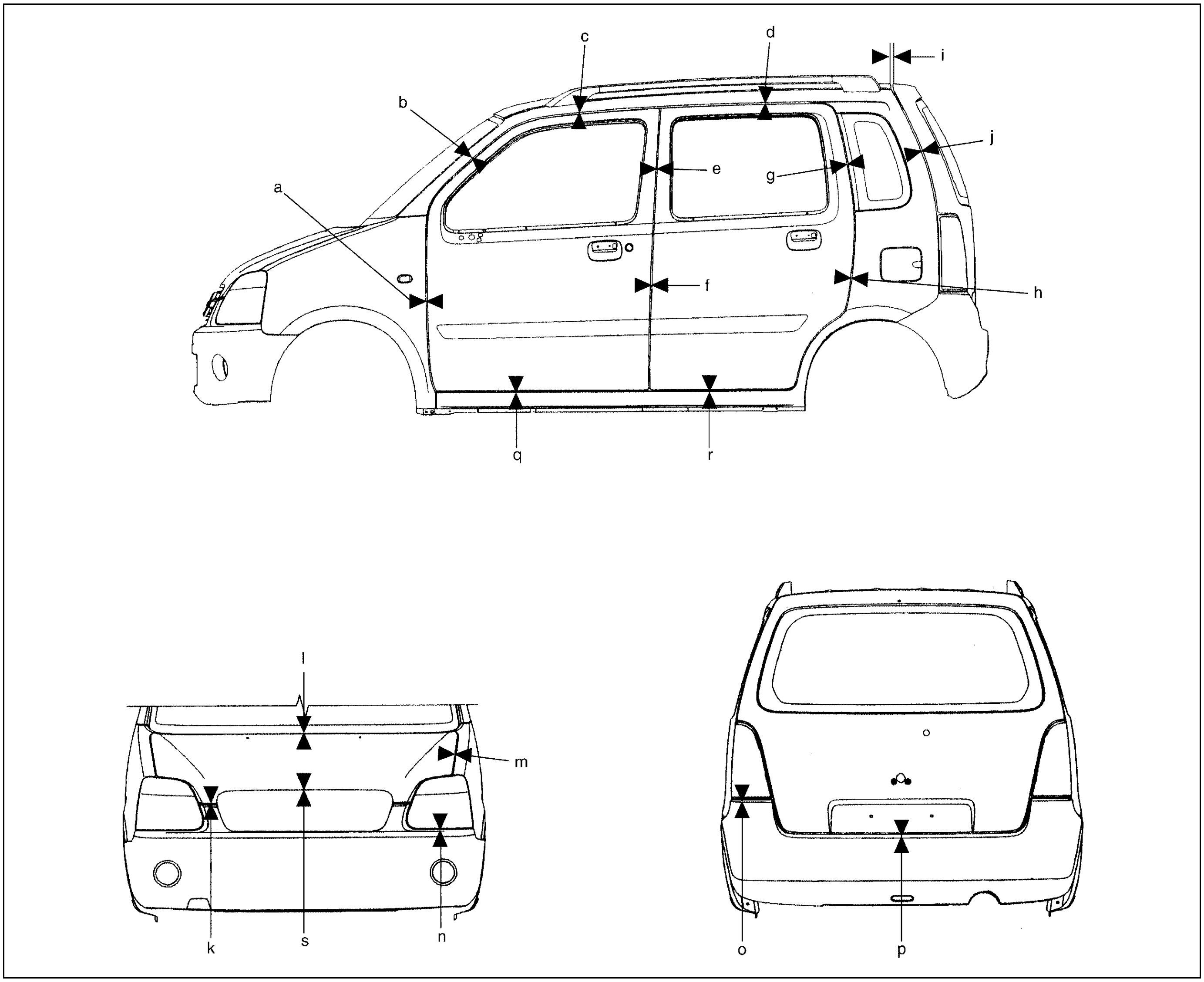
Back Door Emblem



Back door emblem dimension

Position	Dimension		Position	Dimension	
	mm	in		mm	in
a	568	22.36	g	40	1.57
b	76	2.99	h	2	0.08
c	69	2.72	i	9	0.35
d	574	22.6	j	9	0.35
e	74.5	2.93	k	9	0.35
f	74	2.91			

Panel Clearance



Panel to panel clearance

Position	Dimension		Position	Dimension	
	mm	in.		mm	in.
a	4.1 – 6.1	0.161 – 0.24	k	6 – 8	0.236 – 0.315
b	5 – 7	0.197 – 0.276	l	4.8 – 7.8	0.189 – 0.307
c	5 – 7	0.197 – 0.276	m	2.5 – 4.5	0.098 – 0.177
d	5 – 7	0.197 – 0.276	n	4.2 – 6.2	0.165 – 0.244
e	3.6 – 5.6	0.142 – 0.22	o	3.7 – 5.7	0.146 – 0.224
f	4.2 – 6.2	0.165 – 0.244	p	5.2 – 7.2	0.204 – 0.283
g	3.6 – 5.6	0.142 – 0.22	q	4.6 – 6.6	0.181 – 0.26
h	3.6 – 5.6	0.142 – 0.22	r	4.6 – 6.6	0.181 – 0.26
i	8.5 – 10.5	0.334 – 0.413	s	6.2 – 8.2	0.25 – 0.32
j	5 – 7	0.197 – 0.276			

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