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SUZUKI SWIFT

SUZUKI

SWIFT

SUZUKI MOTOR CORPORATION

VOL.
1 OF 2

SERVICE MANUAL

RS415

VOLUME 1 OF 2

SERVICE MANUAL

99500-63J00-24E

SUZUKI
Caring for Customers
99500-63J00-24E
（英）

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:

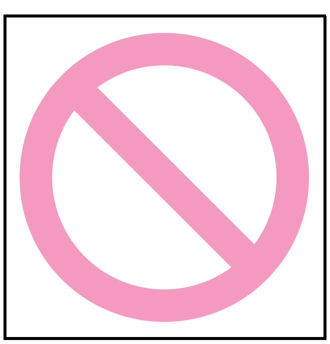
This service manual is intended for authorized Suzuki dealers and qualified service technicians only. Inexperienced technicians or technicians without the proper tools and equipment may not be able to properly perform the services described in this manual.
Improper repair may result in injury to the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

WARNING:

For vehicles equipped with a Supplemental Restraint or 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, that is air bag or inflator modules, SDM and/or seat belt with pretensioner, beforehand to avoid component damage or unintended activation.**

The circle with a slash in this manual means "Don't do this" or "Don't let this happen".



FOREWORD

This manual (Volumes 1 and 2) contains procedures for diagnosis, maintenance, adjustments, minor service operations, replacement of components (Service) and for disassembly and assembly of major components (Unit Repair-Overhaul).

VOLUME 1 contains General information, Engine, Suspension, Drive/Axle and Brakes sections (Sections 0 – 4).
VOLUME 2 contains Transmmision/Transaxle, Steering, HVAC, Restraint, Body/Cab/Accessories and Control Systems sections (Sections 5 – 10).

Applicable model:
SWIFT (RS415) vehicles on and after following vehicle identification numbers (VINs).

ⓍJSAEZC21S00100001Ⓧ

The contents are classified into sections each of which is given a section number as indicated in the Table of Contents on following page. And on the first page of each individual section is an index of that section.
This manual should be kept in a handy place for ready reference of the service work.
Strict observance of the so specified items will enable one to obtain the full performance of the vehicle.

When replacing parts or servicing by disassembling, it is recommended to use SUZUKI genuine parts, tools and service materials 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.

SUZUKI MOTOR CORPORATION

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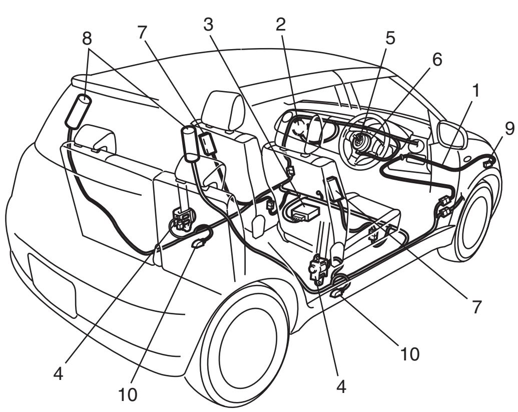
Precautions for Vehicles Equipped with a Supplemental Restraint (Air Bag) System

S4RS0A0000001

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 Air Bag System section. 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.**



I4RS0A000001-

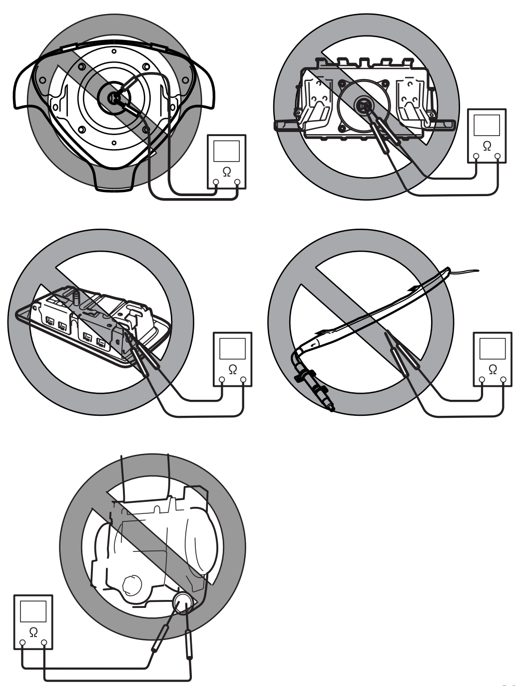
1. Air bag wire harness (in floor, main and instrument panel harness)	6. Driver air bag (inflator) module
2. Passenger air bag (inflator) module	7. Side air bag (inflator) module (if equipped)
3. SDM	8. Curtain air bag (inflator) module (if equipped)
4. Seat belt pretensioner	9. Forward sensor
5. Contact coil	10. Side sensor (if equipped)

Diagnosis

- When troubleshooting air bag system, be sure to follow “Diagnosis” in Air Bag System section. Bypassing these procedures may result in extended diagnostic time, incorrect diagnosis, and incorrect parts replacement.
- Never use electrical test equipment other than that specified.

WARNING:

Never attempt to measure the resistance of the air bag (inflator) modules (driver, passenger, side and curtain) 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.



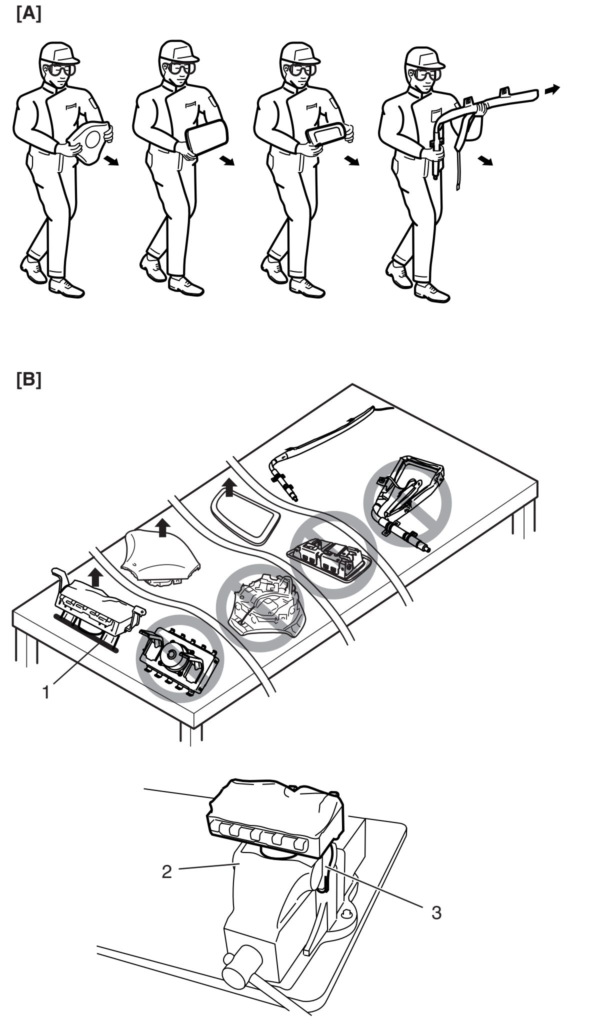
I4RS0A000002-

Servicing and Handling

WARNING:

Many of service procedures require disconnection of “A/BAG” fuse and all air bag (inflator) module(s) from initiator circuit to avoid an accidental deployment.
Driver, Passenger, Side and Curtain 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). 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, side and curtain). If disposal is necessary, be sure to deploy them according to deployment procedures described in “Air Bag (Inflator) Module and Seat Belt Pretensioner Disposal: in Section 8B” 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.**



I4RS0A000003-

[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.

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

- **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 “Air Bag (Inflator) Module and Seat Belt Pretensioner Disposal: in Section 8B” 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 Accident: in Section 8B”.
- 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, side and curtain), seat belt pretensioners (driver and passenger), forward sensor, 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, side and curtain) 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 flow requests it, as this will set a DTC.
- 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 8B”.

General Precautions

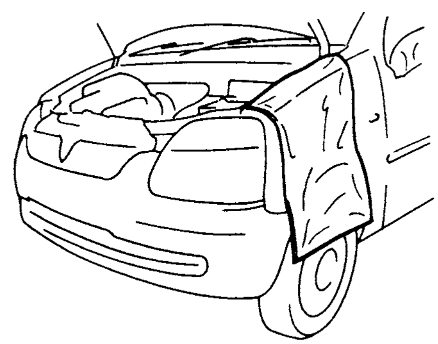
S4RS0A0000002

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

WARNING:

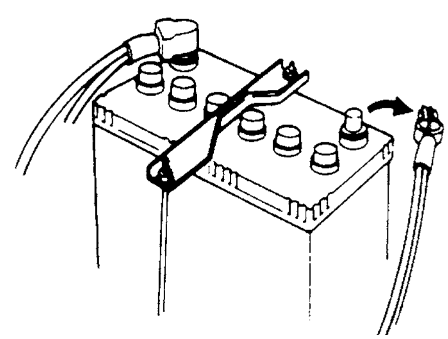
- **Whenever raising a vehicle for service, be sure to follow the instructions under "Vehicle Lifting Points: in Section 0A".**
- **When it is necessary to do service work with the engine running, make sure that the parking brake is set fully and the transmission is in Neutral (for manual transmission 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.**
- **Be sure to observe following instructions when handling service materials such as fuel, oil, fluid, coolant, grease, sealant, thread lock cement, etc. Otherwise, your health may be ruined.**
  - **Whenever handling any of these service materials, wear safety glasses to protect your eyes. If it gets into your eye, it may cause inflammation.**
  - **Whenever handling any of these service materials, wear moisture-proof gloves to protect your skin. If it adheres to your skin, it may cause inflammation.**
  - **Do not swallow any of these service materials. It would cause diarrhea or nausea.**
  - **Keep all these materials out of children's reach.**
- **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.



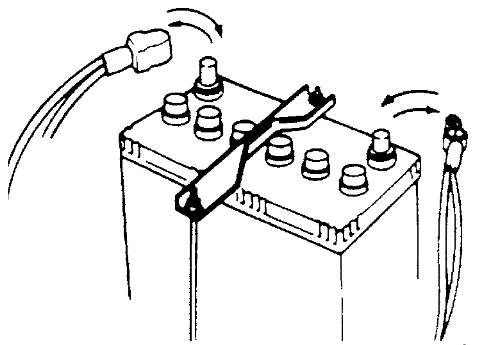
I2RH01010025-

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



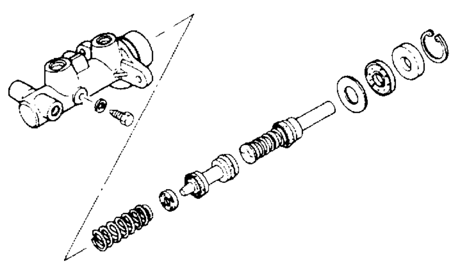
I2RH01010026-

- 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.



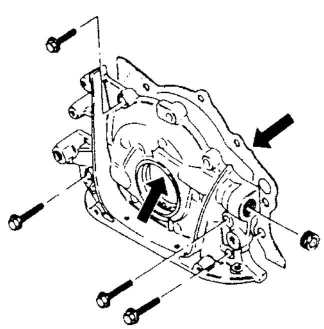
I2RH01010027-

- 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.



I2RH01010028-

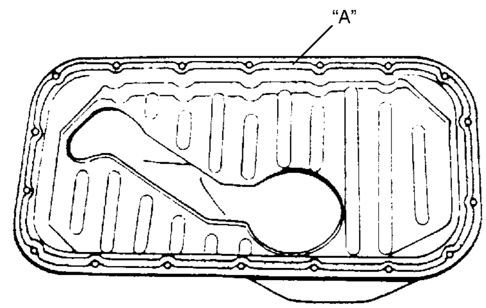
- Whenever you use oil seals, gaskets, packing, O-rings, locking washers, split pins, self-locking nuts, and certain other parts as specified, be sure to use new ones. Also, before installing new gaskets, packing, etc., be sure to remove any residual material from the mating surfaces.



I2RH01010029-

- 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.

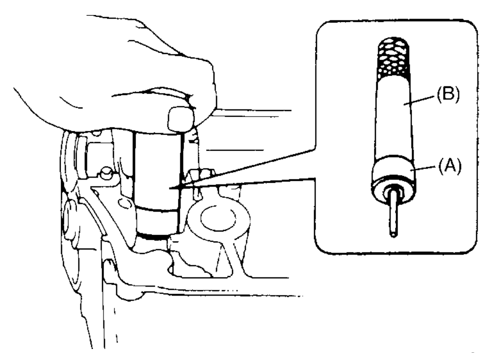
  “A”: Water tight sealant 99000–31250



I2RH01010030-

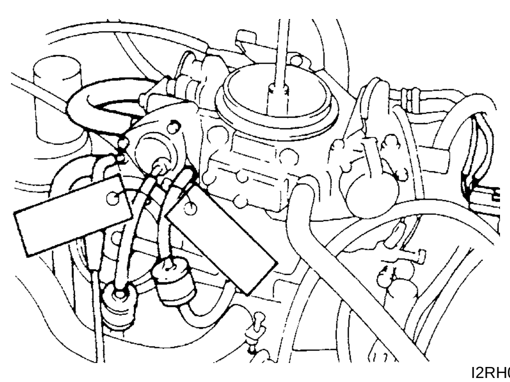
- Be sure to use special tools when instructed.

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



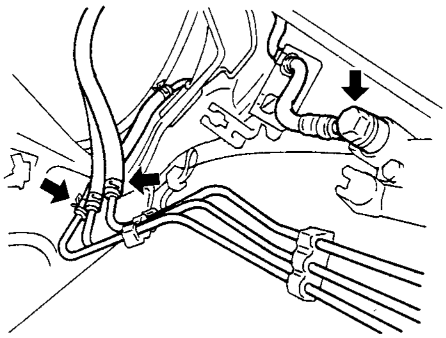
I2RH01010031-

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



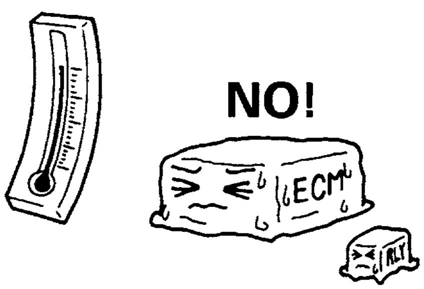
I2RH01010032-

- After servicing fuel, oil, coolant, vacuum, exhaust or brake systems, check all lines related to the system for leaks.



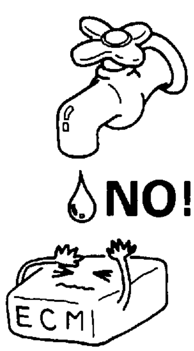
I2RH01010033-

- 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.



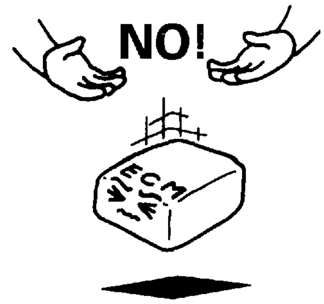
I2RH01010034-

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



I2RH01010035-

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



I2RH01010036-

Precautions for Catalytic Converter

S4RS0A0000003

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.)

Precautions for Installing Mobile Communication Equipment

S4RS0A0000004

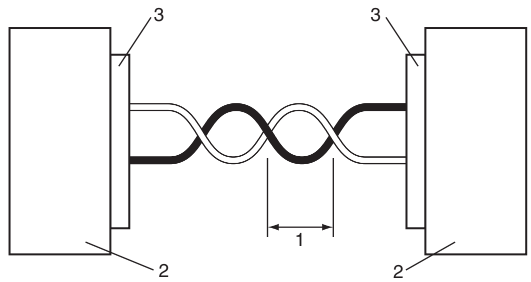
When installing mobile communication equipment such as CB (Citizens-Band)-radio or cellular-telephone, be sure to observe the following precautions.
Failure to follow cautions may adversely affect electronic control system.

- 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 for CAN Communication System

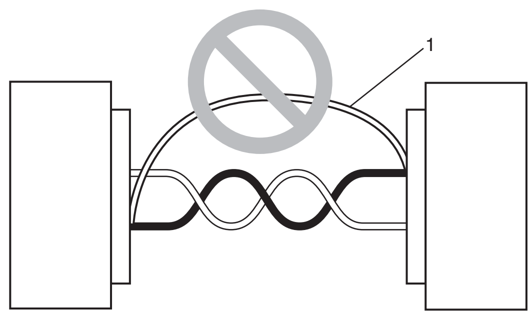
S4RS0A0000014

- 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 lines discrimination. Excessively-loosed lines may be influenced by the electric noise.



I4JA01000002-

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

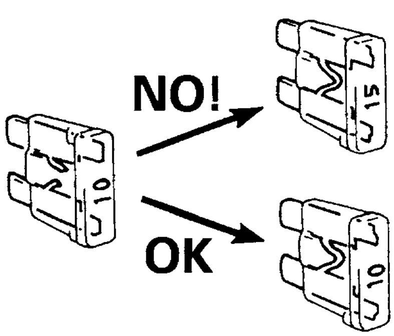


I4JA01000003-

Precautions for Electrical Circuit Service

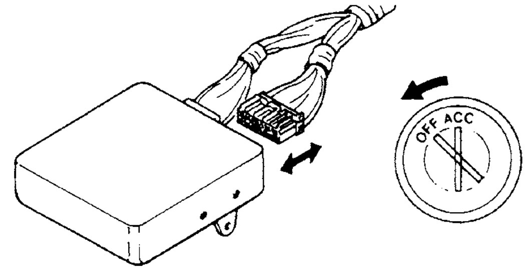
S4RS0A0000007

- 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.



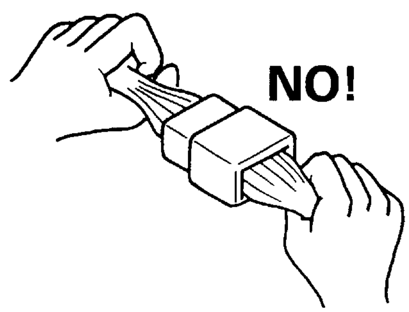
I2RH01010038-

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



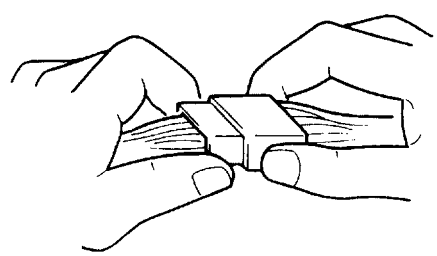
I2RH01010039-

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



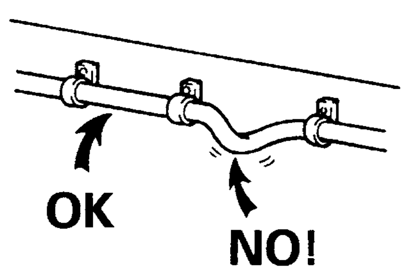
I2RH01010040-

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



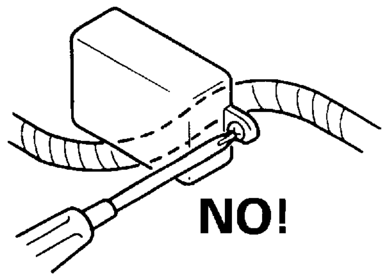
I2RH01010041-

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



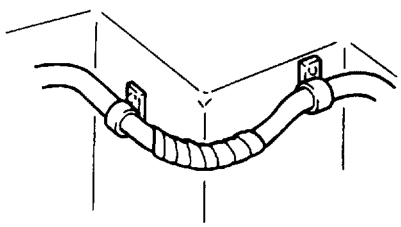
I2RH01010042-

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



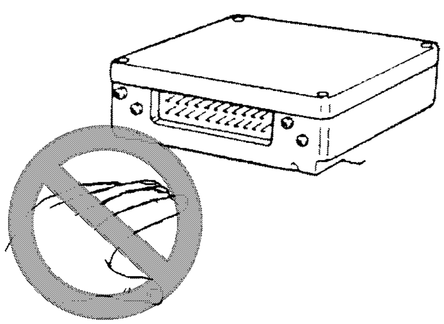
I2RH01010043-

- 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.



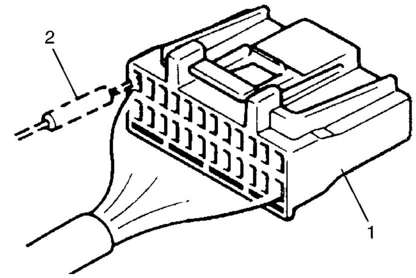
I2RH01010044-

- 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.



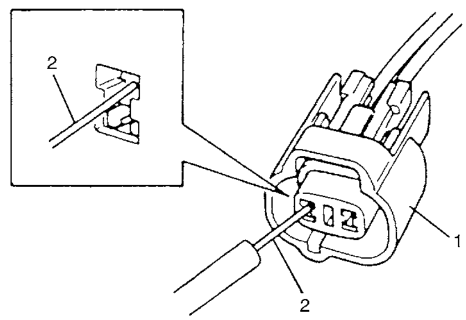
I3RM0A000004-

- 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 (M Ω/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).



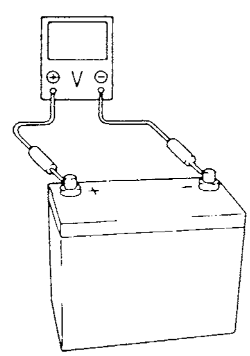
I2RH01010046-

- 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.



I2RH01010047-

- 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.



I2RH01010048-

Air Bag Warning

S4RS0A0000008

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, Wiring and Connectors Location: in Section 8B" in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Precautions on Service and Diagnosis of Air Bag System: in Section 8B" 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).**

Air Bag System Service Warning

S4RS0A0000009

WARNING:

- **Service on or around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Please observe all WARNINGS in Air Bag System and "Precautions on Service and Diagnosis of Air Bag System: in Section 8B" before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintended activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.**
- **The procedures in the air bag system section must be followed in the order listed to disable the air bag system temporarily and prevent false DTCs from setting. Failure to follow procedures could result in possible activation of the air bag system, personal injury or otherwise unneeded air bag system repairs.**

Fastener Caution

S4RS0A0000010

CAUTION:

When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread-locking compound, will be called out. The correct torque value must be used when installing fasteners that require it. If the conditions are not followed, parts or system damage could result.

Suspension Caution

S4RS0A0000011

CAUTION:

- **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.**

Wheels and Tires Caution

S4RS0A0000012

CAUTION:

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.

Brake Caution

S4RS0A0000013

CAUTION:

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.

Repair Instructions

Electrical Circuit Inspection Procedure

S4RS0A0006001

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.

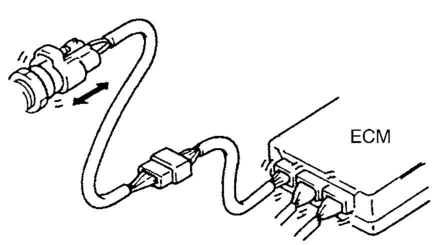
Open Circuit Check

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

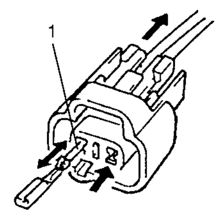
When checking system circuits including an electronic control unit such as ECM, TCM, ABS control module, etc., it is important to perform careful check, starting with items which are easier to check.

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.



I2RH01010049-

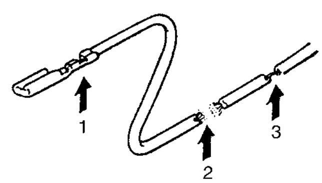
3) Using a test male terminal, check both terminals of the circuit being checked for contact tension of its female terminal. Check each terminal visually for poor contact (possibly caused by dirt, corrosion, rust entry of foreign object, etc.). At the same time, check to make sure that each terminal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



I2RH01010050-

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.

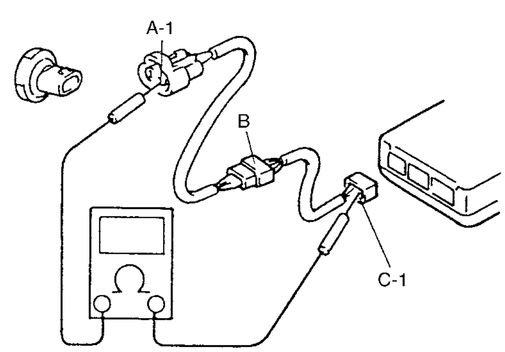


I2RH01010051-

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

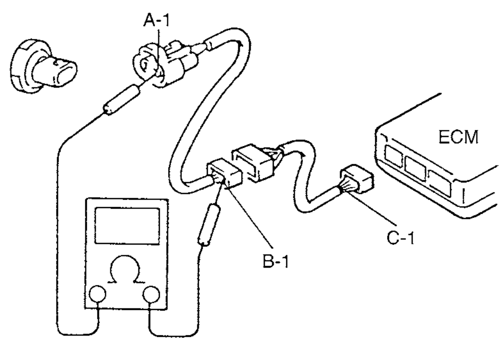
Continuity Check

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”.



I2RH01010052-

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.



I2RH01010053-

Voltage Check

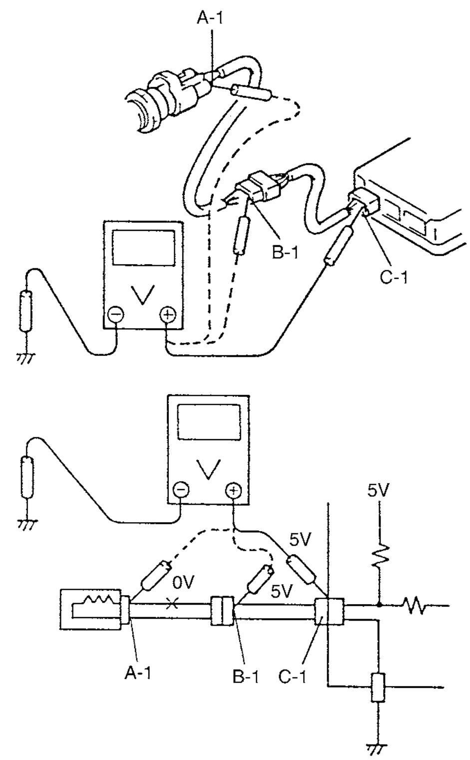
If voltage is supplied to the circuit being checked, voltage check can be used as circuit check.

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 in the following, 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 in the following, 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



I5RH01000005-

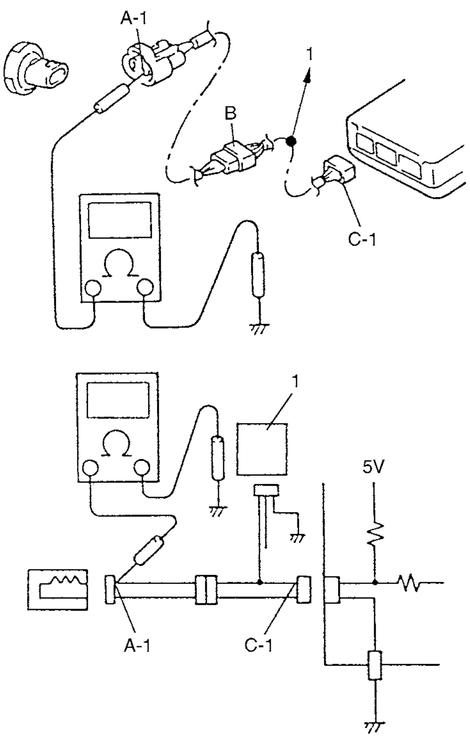
Short Circuit Check (Wire Harness to Ground)

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

   NOTE:

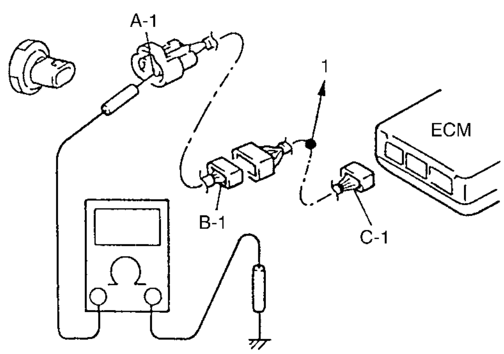
   If the circuit to be checked is connected to other parts (1), disconnect all connectors of those parts.
   Otherwise, diagnosis will be misled.

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.



I5RH01000006-

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”.



I2RH01010056-

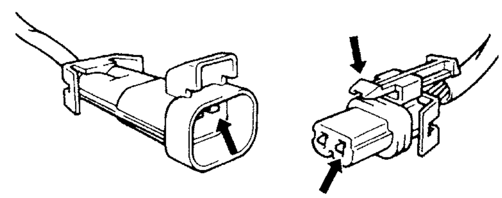
1.	To other parts

Intermittent and Poor Connection Inspection

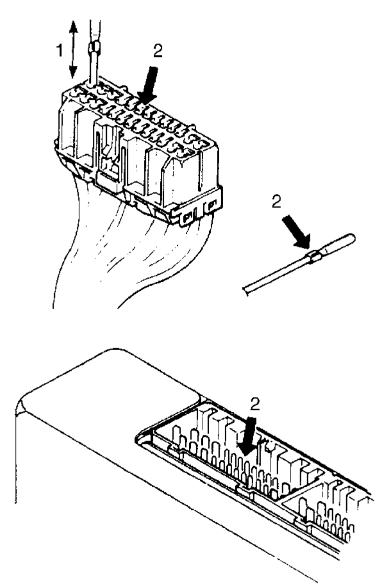
S4RS0A0006002

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.


I2RH01010057-

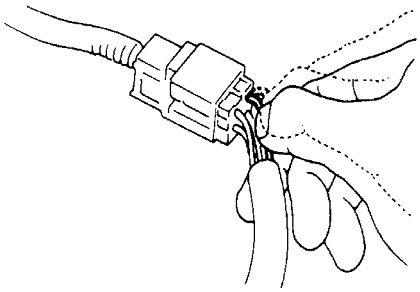
- Improperly formed or damaged terminals.
  Check each connector terminal in problem circuits carefully to ensure good contact tension by using the corresponding mating terminal.
  If contact tension is not enough, reform it to increase contact tension or replace.



I5RH01000007-

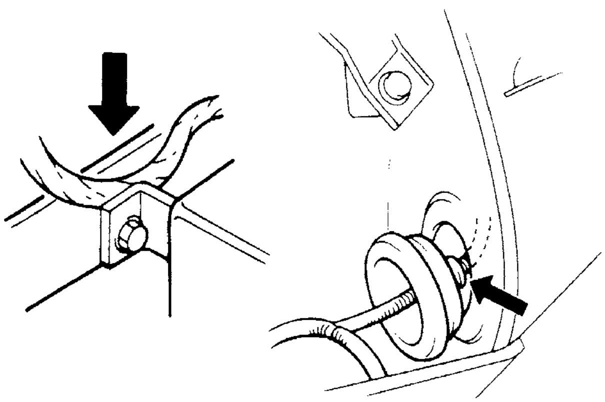
1.	Check contact tension by inserting and removing just once.
2.	Check each terminal for bend and proper alignment.

- 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.



I2RH01010059-

- 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.



I2RH01010060-

Section 0

General Information

CONTENTS

0

General Information

General Description

Abbreviations

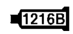
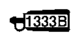
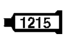
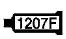
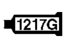
S4RS0A0101001

A:
ABS: Anti-lock Brake System
ATDC: After Top Dead Center
API: American Petroleum Institute
ATF: Automatic Transmission Fluid, Automatic Transaxle Fluid
ALR: Automatic Locking Retractor
AC: Alternating Current
A/T: Automatic Transmission, Automatic Transaxle
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
BCM: Body Electrical Control Module
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)
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
HAVC: Heating, Ventilating and Air Conditioning
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, Manual Transaxle
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
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

S4RS0A0101002

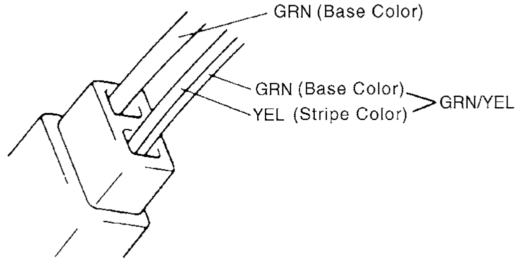
Symbol	Definition	Symbol	Definition
	Tightening torque		Apply SUZUKI BOND NO. 1216B 99000-31230
	Apply oil (engine, transmission, transfer, differential)		Apply SILICONE SEALANT 99000-31120
	Apply fluid (brake, power steering or automatic transmission fluid)		Apply SEALING COMPOUND 366E 99000-31090
	Apply SUZUKI SUPER GREASE A 99000-25010		
	Apply SUZUKI SUPER GREASE C 99000-25030		Apply THREAD LOCK 1322 99000-32110
	Apply SUZUKI SUPER GREASE E 99000-25050		Apply THREAD LOCK 1333B 99000-32020
	Apply SUZUKI SUPER GREASE H 99000-25120		Apply THREAD LOCK 1342 99000-32050
	Apply SUZUKI SUPER GREASE I 99000-25210		
	Apply SUZUKI BOND NO. 1215 99000-31110		Do not reuse
	Apply SUZUKI BOND NO. 1207F 99000-31250		Note on reassembly
	Apply SUZUKI BOND NO. 1217G 99000-31260		

Wire Color Symbols

S4RS0A0101003

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).



I2RH01010010-

Fasteners Information

S4RS0A0101004

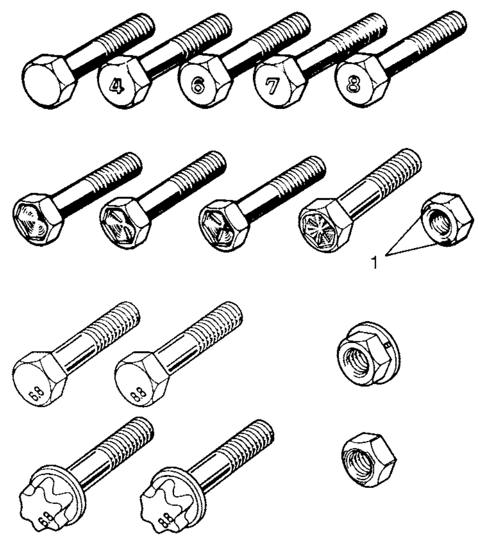
Metric Fasteners

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

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).



I5RH01010001-

1. Nut strength identification

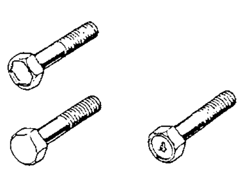
Standard Tightening Torque

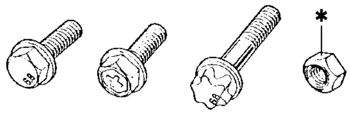
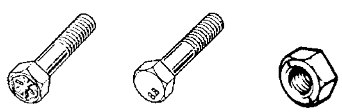
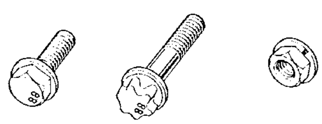
Each fastener should be tightened to the torque specified in each section. If no description or specification is provided, refer to the following tightening torque chart for the applicable torque for each fastener. When a fastener of greater strength than the original one is used, however, use the torque 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 following chart.**
- **The following chart is applicable only where the fastened parts are made of steel light alloy.**

Tightening torque chart

Strength	Unit	Thread diameter (Nominal diameter) (mm)								
		4	5	6	8	10	12	14	16	18
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
 I2RH01010012-01	lb-ft	1.0	2.5	4.0	9.5	21.0	32.5	47.0	76.0	116.0

Strength	Unit	Thread diameter (Nominal diameter) (mm)								
		4	5	6	8	10	12	14	16	18
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
 I2RH01010013-01	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
*: Self-lock nut	kg-m	0.24	0.49	0.88	2.1	4.4	8.4	13.3	20.3	29.8
 I2RH01010014-01	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
 I2RH01010015-01	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
 I2RH01010016-01	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
 I2RH01010017-01	lb-ft	2.5	5.0	9.0	21.0	43.0	82.0	126.5	195.5	286.0

***:Self-lock nut**

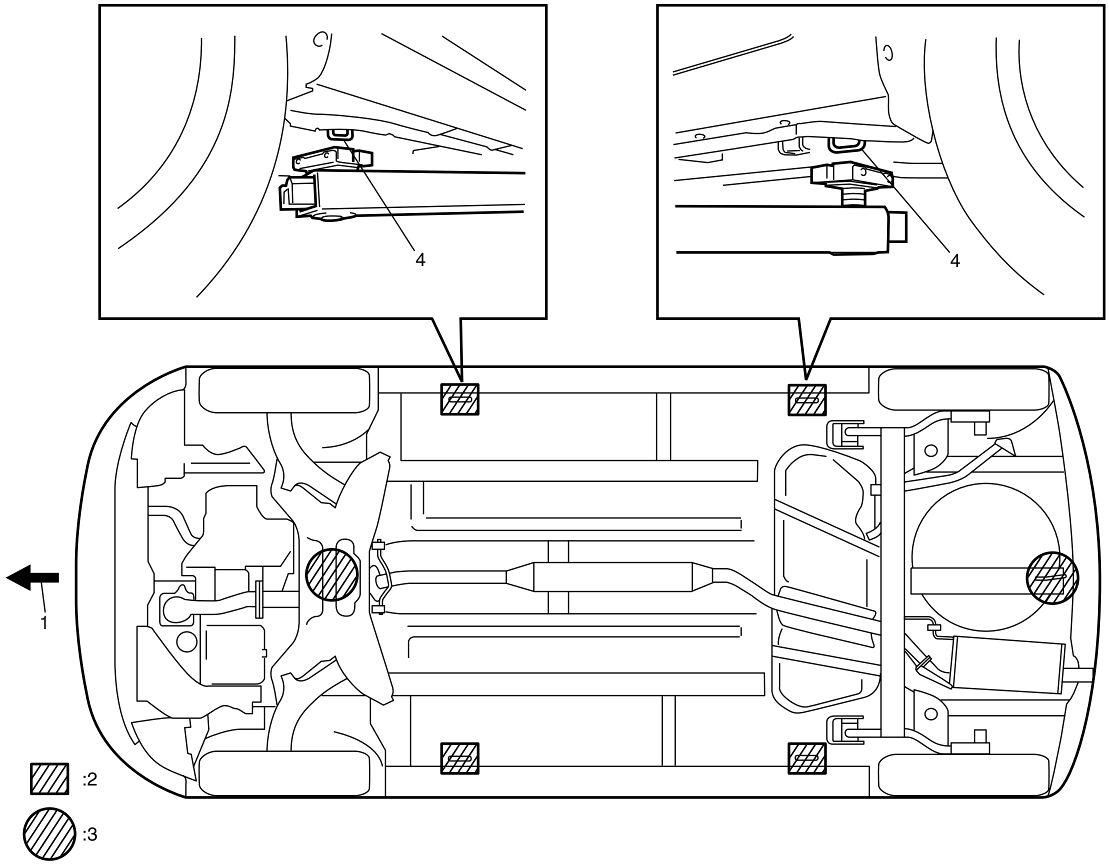
Vehicle Lifting Points

S4RS0A0101005

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



I4RS0A010001-

1. Vehicle front	3. Floor jack position
2. Support position for frame contact hoist and safety stand	4. Body mounting stay

When Using Floor Jack

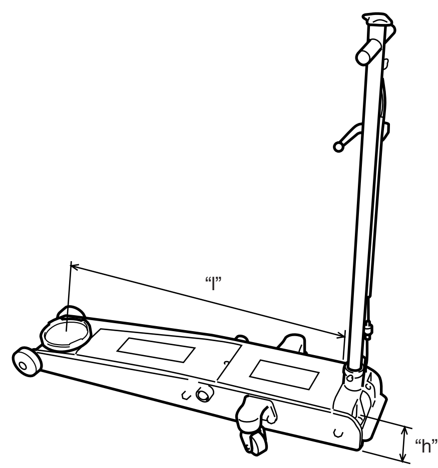
WARNING:

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:

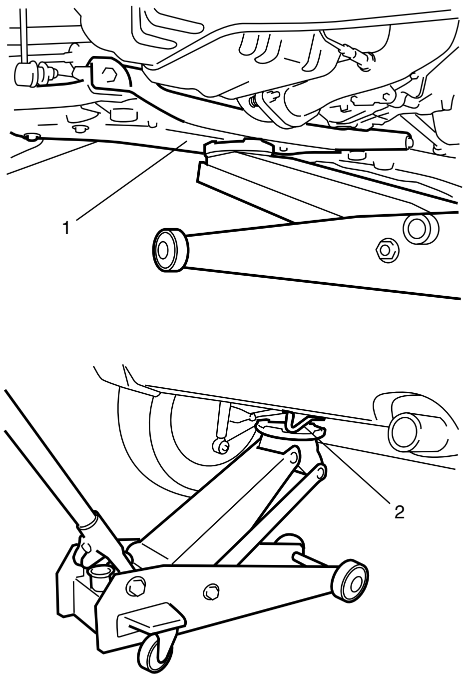
- **Never apply jack against rear suspension parts (i.e., stabilizer, etc.) or vehicle floor, or it may get deformed.**
- **When jacking up the front end, be sure to use an air type floor jack with the following specified height or a manual type floor jack of the following size. Otherwise, the jack may cause the bumper or vehicle body panel a damage.**

Jack size
Height “h”: under 145 mm (under 5.71 in.)
Length “l”: above 900 mm (above 35.4 in.)



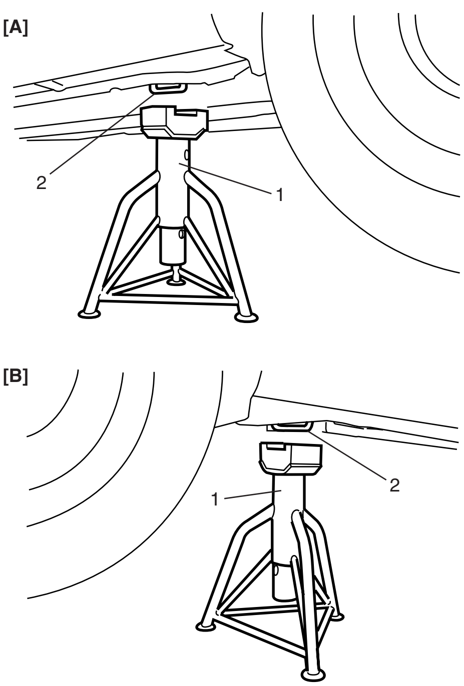
I4RS0A010002-

In raising front or rear vehicle end off the floor by jacking, be sure to put the jack against front suspension frame (1) or rear jacking bracket (2).



I4RS0A010003-

To perform service with either front or rear vehicle end jacked up, be sure to place safety stands (1) under body mounting stay (2) so that vehicle body is securely supported. And then check to ensure that body mounting stay (2) does not slide on safety stands (1) and the vehicle is held stable for safety's sake.



I4RS0A010004-

[A]:	Front
[B]:	Rear

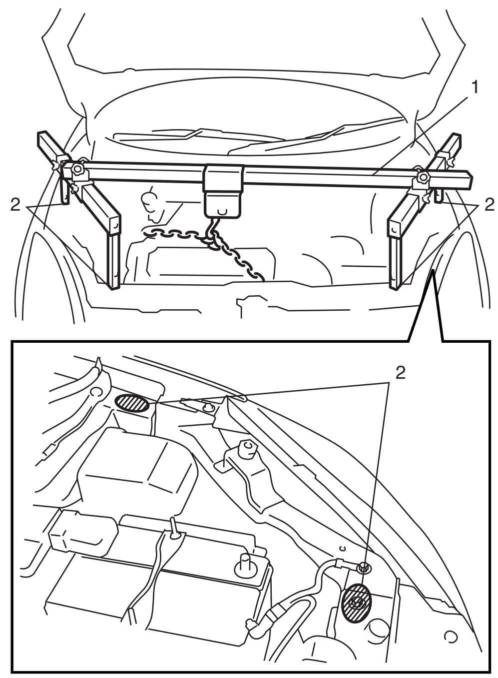
Engine Supporting Points

S4RS0A0101008

WARNING:

When using engine supporting device (1), be sure to observe the followings.
Otherwise, not only deformation of vehicle body but also personal injury may result.

- **Apply supporting device at the specified positions (2) indicated in figure**
- **Install supporting device taking a well-balanced posture.**
- **Do not contact supporting device with other parts than engine room body panel and engine hooks.**

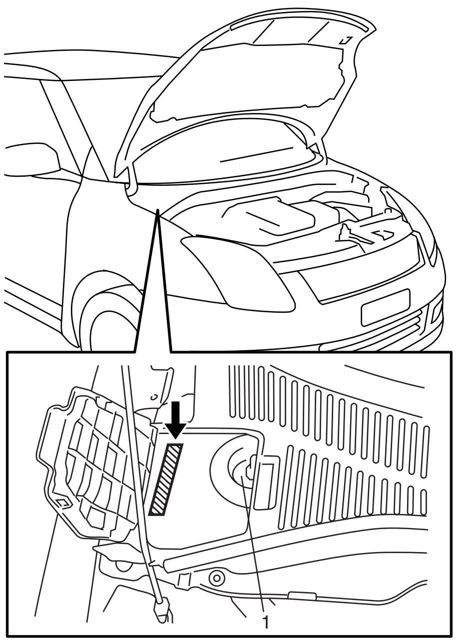


I4RS0A010005-

Vehicle Identification Number

S4RS0A0101006

The number is punched close by the right side strut support (1) in engine room.

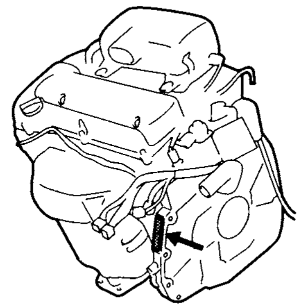


I4RS0A010006-

Engine Identification Number

S4RS0A0101007

The number is punched on cylinder block.

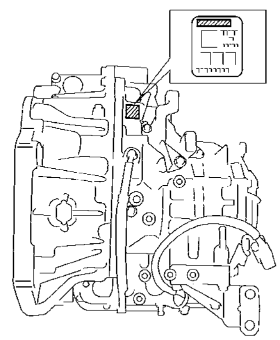


I3RM0A010005-

Transmission Identification Number

S4RS0A0101009

The automatic transmission identification number is located on transmission case.



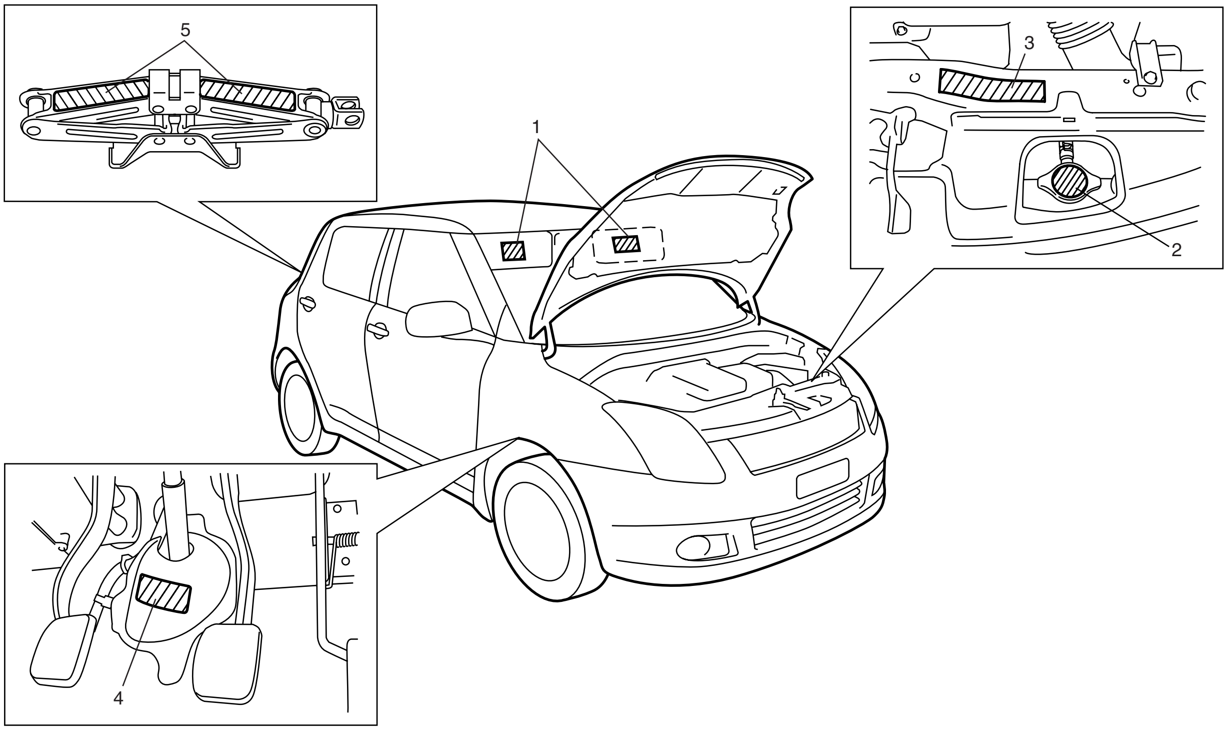
I4RS0A010008-

Component Location

Warning, Caution and Information Labels Location

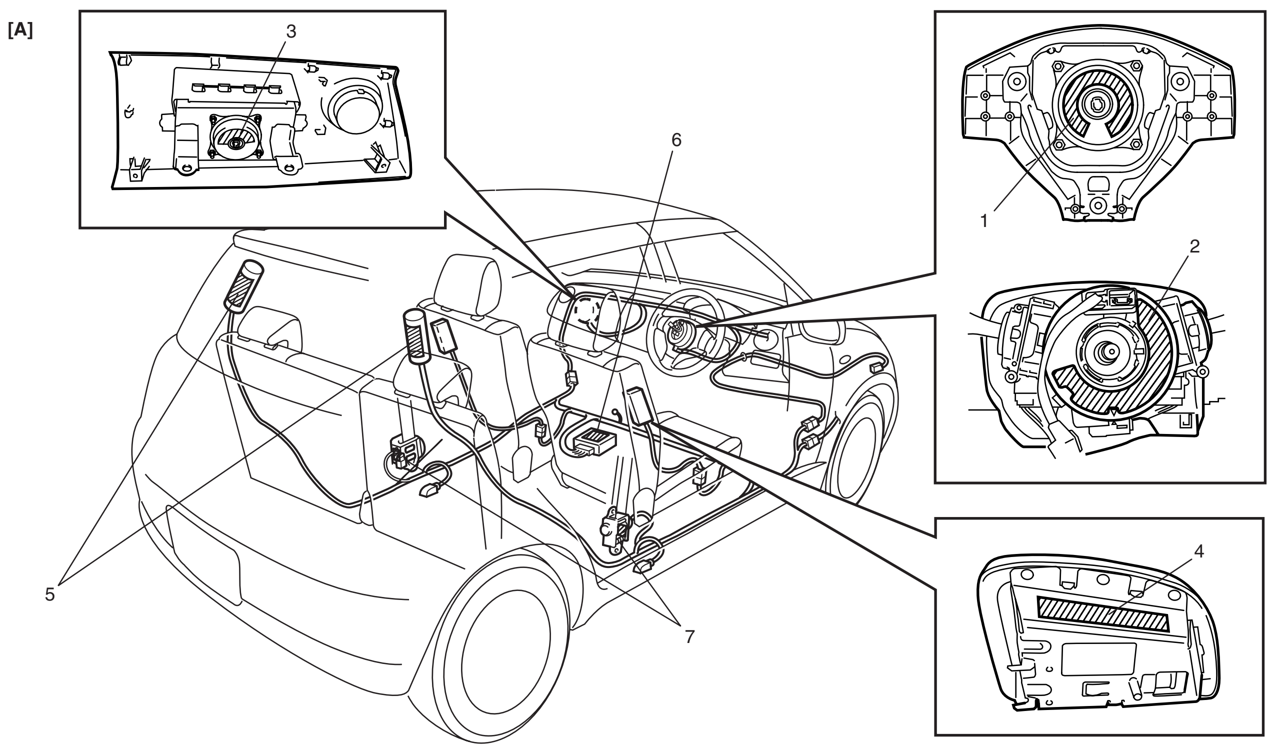
S4RS0A0103001

The figure 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.



I4RS0A010007-

1. Air bag label on sun visor (if equipped)	4. Steering shaft joint cover label (if equipped)
2. Radiator cap label	5. Jack label
3. Engine cooling fan label	



I4RS0A010009-

1. Air bag label on driver air bag (inflator) module	5. Air bag label on curtain air bag (inflator) module
2. Air bag label on combination switch and contact coil assembly	6. Air bag label on SDM
3. Air bag label on passenger air bag (inflator) module	7. Pretensioner label on seat belt retractor
4. Air bag label on side air bag (inflator) module	[A]: These labels are attached on vehicle equipped with air bag system only.

Maintenance and Lubrication

Precautions

Precautions for Maintenance and Lubrication

S4RS0A0200001

Air Bag Warning

Refer to “Air Bag Warning: in Section 00”.

Scheduled Maintenance

Maintenance Schedule under Normal Driving Conditions

S4RS0A0205001

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									
Accessory drive belt (I: ☞, R: ☞)				—	—	I	—	—	R
Valve lash (clearance) (I: ☞)				—	I	—	I	—	I
Engine oil and oil filter (R: ☞)				R	R	R	R	R	R
Engine coolant (R: ☞)				—	—	R	—	—	R
Exhaust system (I: ☞)				—	I	—	I	—	I
Ignition system									
Spark plugs (R: ☞)	When unleaded fuel is used	Vehicle without HO2S	Nickel plug	—	R	—	R	—	R
			Iridium plug	—	—	—	R	—	—
		Vehicle with HO2S	Nickel plug	—	—	R	—	—	R
			Iridium plug (Highly recommended)	Replace every 105,000 km (63,000 miles) or 84 months					
	When leaded fuel is used, refer to “Maintenance Recommended under Severe Driving Conditions: ”.								
Fuel system									
Air cleaner filter (R: ☞, I: ☞)			Paved-road	I	I	R	I	I	R
			Dusty conditions	Refer to “Maintenance Recommended under Severe Driving Conditions: ”.					
Fuel lines and connections (I: ☞)				—	I	—	I	—	I
Fuel filter (R: ☞)				Replace every 105,000 km (63,000 miles)					
Fuel tank (I: ☞)				—	—	I	—	—	I
Emission control system									
PCV valve (I: ☞)		Vehicle without HO2S		—	—	I	—	—	I
		Vehicle with HO2S		—	—	—	—	—	I
Fuel evaporative emission control system (I: ☞)				—	—	—	—	—	I
Brake									
Brake discs and pads (thickness, wear, damage) (I: ☞)				I	I	I	I	I	I
Brake drums and shoes (wear, damage) (I: ☞)				—	I	—	I	—	I
Brake hoses and pipes (leakage, damage, clamp) (I: ☞)				—	I	—	I	—	I
Brake fluid (R: ☞)				—	R	—	R	—	R
Brake lever and cable (damage, stroke, operation) (I: ☞)				Inspect at first 15,000 km (9,000 miles only)					
Chassis and body									
Clutch (fluid level, leakage) (I: ☞)				—	I	—	I	—	I
Tires (wear, damage, rotation) / wheels (damage) (I: ☞ / ☞)				I	I	I	I	I	I
Suspension system (tightness, damage, rattle, breakage) (I: ☞)				—	I	—	I	—	I

Interval		15	30	45	60	75	90
	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**
Steering system (tightness, damage, breakage, rattle) (I: ☞)		—	I	—	I	—	I
Drive shaft (axle) boots (I: ☞)		—	—	I	—	—	I
Manual transaxle oil (leakage, level) (I: ☞ 1st 15,000 km only) (R: ☞)		I	—	R	—	—	R
Automatic transaxle fluid	Fluid level (I: ☞)	—	I	—	I	—	I
	Fluid change (R: ☞)	Replace every 165,000 km (99,000 miles)					
	Fluid hose (I: ☞)	—	—	—	I	—	—
All latches, hinges and locks (I: ☞)		—	I	—	I	—	I
Air conditioning filter (if equipped) (I: ☞) (R: ☞)		—	I	R	—	I	R

NOTE:

- **"R": Replace or change**
- **"I": Inspect and correct, replace or lubricate if necessary**
- **For spark plugs, replace every 50,000 km if the local law requires.**
- **Nickel spark plug: BKR6E-11 (NGK) or K20PR-U11 (DENSO)**
- **Iridium spark plug: IFR6J11 (NGK)**

Maintenance Recommended under Severe Driving Conditions

S4RS0A0205002

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)

Severe condition code	Maintenance		Maintenance operation	Maintenance interval
– B C D – – – –	Accessory drive belt		☞ I	Every 15,000 km (9,000 miles) or 12 months
			☞ R	Every 45,000 km (27,000 miles) or 36 months
A – C D E F – H	Engine oil and oil filter		☞ R	Every 7,500 km (4,500 miles) or 6 months
– – C – – – – –	Air cleaner filter *1		☞ I	Every 2,500 km (1,500 miles)
			☞ R	Every 30,000 km (18,000 miles) or 24 months
A B C – E F – H	Spark plugs	Nickel spark plug	☞ R	Every 10,000 km (6,000 miles) or 8 months
		Iridium spark plug		Every 30,000 km (18,000 miles) or 24 months
– B C D – – – H	Wheel bearings		☞ I	Every 15,000 km (9,000 miles) or 12 months
– B – D E – – H	Drive shafts		☞ I	Every 15,000 km (9,000 miles) or 12 months

Severe condition code	Maintenance	Maintenance operation	Maintenance interval
– B – – E – – H	Manual transaxle oil	☞ R	First time only: 15,000 km (9,000 miles) or 12 months
			Second time and after: Every 30,000 km (18,000 miles) or 24 months reckoning from 0 km (0 mile) or 0 month
– B – – E – – H	Automatic transaxle fluid	☞ R	Every 30,000 km (18,000 miles) or 24 months
– – C D – – – –	Air conditioning filter *2	☞ I	Every 15,000 km (9,000 miles) or 12 months
		☞ R	Every 45,000 km (27,000 miles) or 36 months

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 air conditioning decreases.**

Repair Instructions

Accessory Drive Belt Inspection

S4RS0A0206001

WARNING:

All inspection and replacement are to be performed with ENGINE NOT RUNNING.

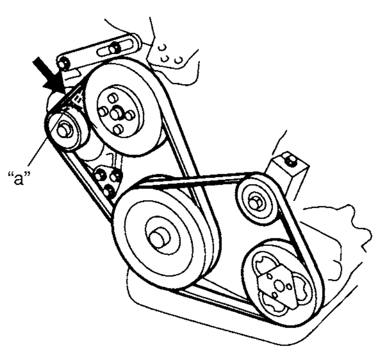
Water Pump and Generator Drive Belt

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.)



I3RM0A020001-

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.

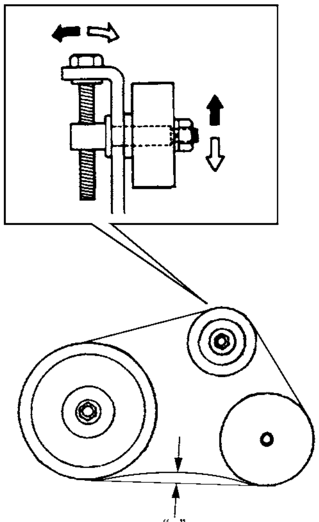
A/C Compressor Drive Belt (If Equipped)

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 "Compressor Drive Belt Inspection and Adjustment: in Section 7B".

   A/C compressor drive belt tension
   "a": 7 – 8 mm (0.28 – 0.31 in.) deflection under 100 N (10 kg, 22 lb) pressure

NOTE:

When replacing belt with a new one, adjust belt tension to 6 – 7 mm (0.24 – 0.28 in.).



I4RS0A020001-

3) Connect negative (–) cable to battery

Accessory Drive Belt Replacement

S4RS0A0206002

Water Pump and Generator Drive Belt

Replace belt with new one referring to "Water Pump / Generator Drive Belt Removal and Installation: in Section 1F".

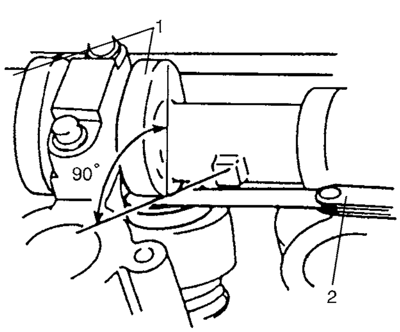
A/C Compressor Drive Belt (If Equipped)

Replace belt with new one referring to "Compressor Drive Belt Removal and Installation: in Section 7B".

Valve Lash (Clearance) Inspection

S4RS0A0206003

Inspect intake and exhaust valve lash and adjust as necessary.
Refer to "Valve Lash (Clearance) Inspection: in Section 1D" for valve lash inspection and adjustment procedure.



I2RH0B020003-

1. Camshaft	2. Thickness gauge

Engine Oil and Filter Change

S4RS0A0206004

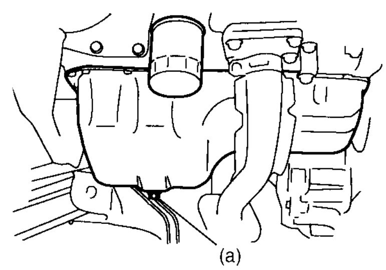
WARNING:

- **New and used engine oil can be hazardous.**
  Be sure to read "WARNING" in "General Precautions: in Section 00" and observe what is 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.

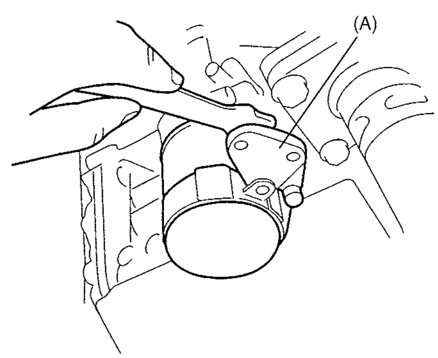
Tightening torque
Engine oil drain plug (a): 35 N·m (3.5 kg-m, 25.5 lb-ft)



I2RH0B020004-

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

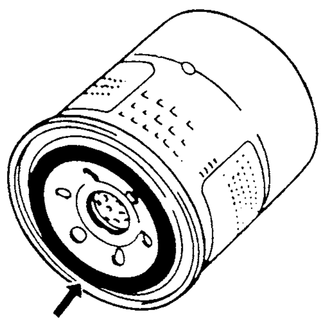
Special tool
(A): 09915–47331



I2RH0B020005-

NOTE:

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



IYSQ01020009-

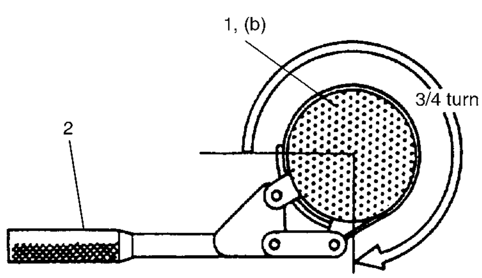
4) Screw new filter on oil filter stand by hand until the filter O-ring contacts mounting surface.

CAUTION:

To tighten oil filter properly, it is important to accurately identify the position at which filter O-ring first contacts 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)



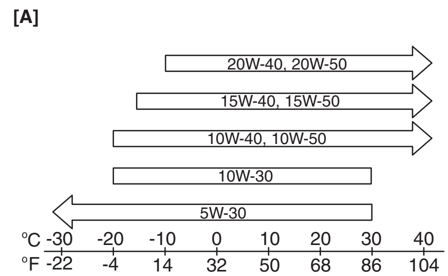
IYSQ01020010-

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].

NOTE:

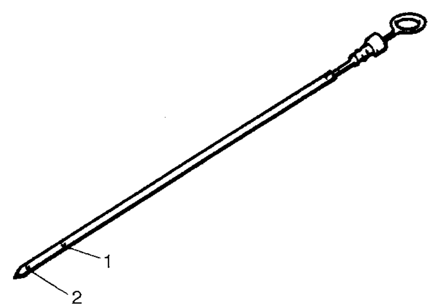
Engine oil capacity is specified as the following.
However, note that the amount of oil required when actually changing oil may somewhat differ from the data depending on various conditions (temperature, viscosity, etc.).

Engine oil specification
Oil pan capacity: About 3.7 liters (7.8 / 6.5 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 4.2 liters (8.9 / 7.4 US / Imp pt.)



I4RS0A020002-

7) Check oil filter and drain plug for oil leakage.
8) Start engine and run it for 3 minutes. Stop it and wait another 5 minutes before checking oil level. Add oil, as necessary, to bring oil level to FULL level mark (1) on dipstick.



IYSQ01020012-

2. Low level mark (hole)

Engine Coolant Change

S4RS0A0206005

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 1F”.

Exhaust System Inspection

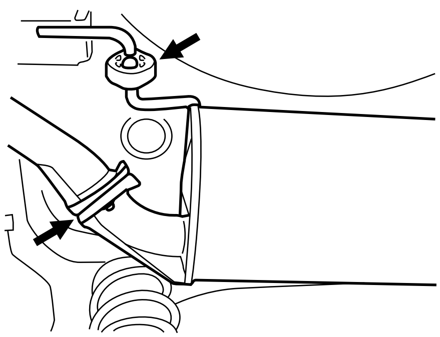
S4RS0A0206006

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 floor carpet.



I4RS0A020003-

- Any defects should be fixed at once.

Spark Plugs Replacement

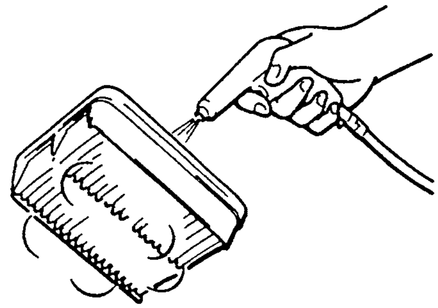
S4RS0A0206007

Replace spark plugs with new ones referring to “Spark Plug Removal and Installation: in Section 1H”.

Air Cleaner Filter Inspection

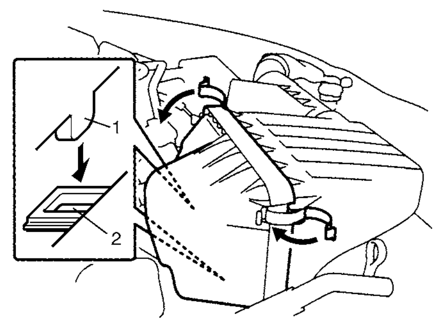
S4RS0A0206008

1) Remove 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.



I2RH01140007-

4) Install air cleaner filter and then case cap by inserting cap tab (1) into case groove (2). Clamp cap securely.



I4RS0A020004-

Air Cleaner Filter Replacement

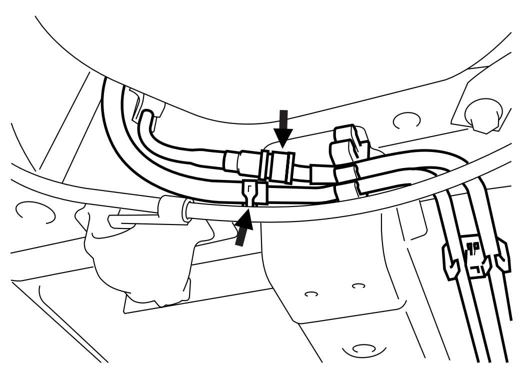
S4RS0A0206009

Replace air cleaner filter with new one according to Steps 1), 2) and 4) of “Air Cleaner Filter Inspection: ”.

Fuel Lines and Connections Inspection

S4RS0A0206010

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.



I4RS0A020005-

Fuel Filter Replacement

S4RS0A0206042

WARNING:

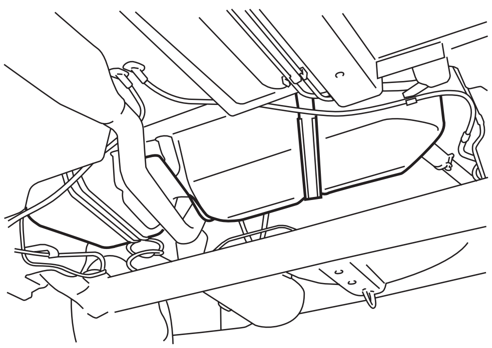
This work must be performed in a well ventilated area and away from any open flames (such as gas hot water heaters).

Fuel filter is installed in fuel pump assembly in fuel tank. Replace fuel filter or fuel pump assembly with new one, referring to “Fuel Pump Assembly Removal and Installation: in Section 1G” for proper procedure.

Fuel Tank Inspection

S4RS0A0206012

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



I4RS0A020019-

PCV Valve Inspection

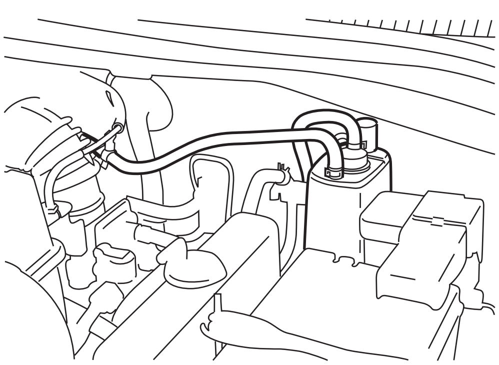
S4RS0A0206013

Check crankcase ventilation hose and PCV hose for leaks, cracks or clog, and PCV valve for stick or clog. Refer to “PCV Valve Inspection: in Section 1B” for PCV valve checking procedure.

Fuel Evaporative Emission Control System Inspection

S4RS0A0206014

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 Inspection: in Section 1B”.
   If a malfunction is found, repair or replace.

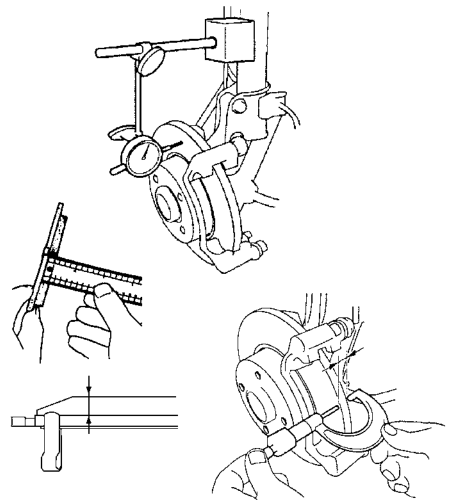


I4RS0A020006-

Brake Discs and Pads (Front) Inspection

S4RS0A0206015

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: in Section 4B” and “Front Brake Disc Inspection: in Section 4B”.
   Be sure to torque caliper pin bolts to specification.

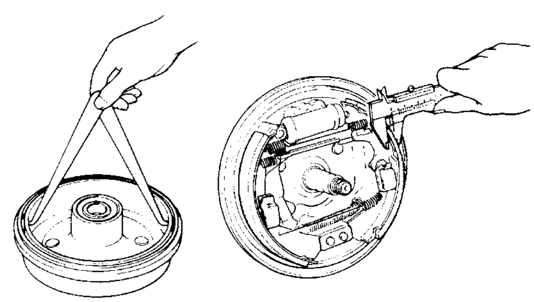


I3RM0A020006-

Brake Drums and Shoes (Rear) Inspection

S4RS0A0206016

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.
   For details, refer to “Rear Brake Drum and Shoe Inspection: in Section 4C” and “Rear Brake Shoe Inspection: in Section 4C”.



I4RS0A020007-

Brake Hoses and Pipes Inspection

S4RS0A0206017

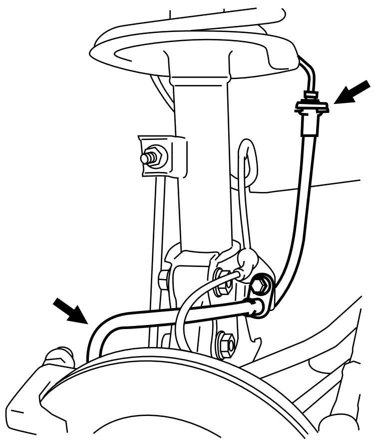
Perform this inspection where these is enough light and use a mirror as necessary.

- 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.



I4RS0A020008-

Brake Fluid Replacement

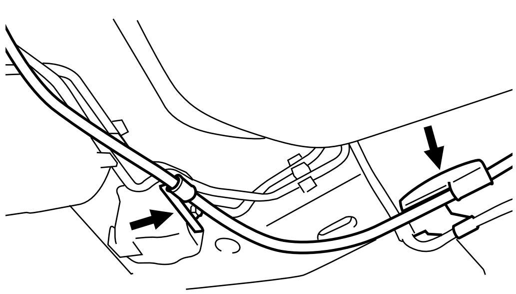
S4RS0A0206018

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 “Air Bleeding of Brake System: in Section 4A”.

Brake Lever and Cable Inspection

S4RS0A0206019

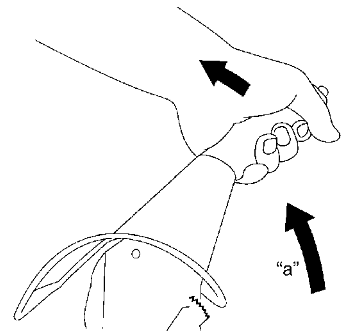
1) Inspect brake cable for damage and smooth movement.
   Replace cable if it is in deteriorated condition.



I4RS0A020009-

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 4D”.

<u>**Parking brake lever stroke**</u>
“a”: 4 – 9 notches (with 200 N (20 kg, 44 lbs) of pull pressure)

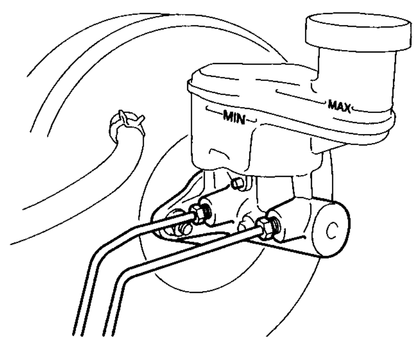


I4RS0A020010-

Clutch fluid Inspection

S4RS0A0206020

1) Check clutch system for evidence of fluid leakage. Repair leaky point if any.
2) Check reservoir for fluid level referring to “Clutch Fluid Level Inspection: in Section 5C”.
   If fluid is lower than minimum level of reservoir, refill reservoir with specified brake fluid indicated on reservoir cap.

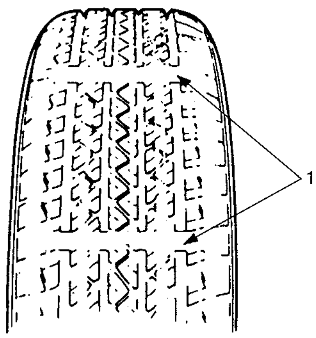


I4RS0A410006-

Tires Inspection

S4RS0A0206021

1) Check tires for uneven or excessive wear, or damage. If defective, replace.
Refer to "Irregular and/or Premature Wear Description: in Section 2D" and "Wear Indicators Description: in Section 2D" for details.



I2RH01020022-

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 2D".

Wheel Discs Inspection

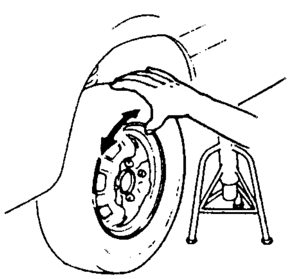
S4RS0A0206022

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

Wheel Bearing Inspection

S4RS0A0206023

1) Check front wheel bearing for wear, damage, abnormal noise or rattles. For details, refer to "Front Wheel Hub, Disc, Nut and Bearing Check: in Section 2B".
2) Check rear wheel bearing for wear, damage, abnormal noise or rattles. For details, refer to "Rear Wheel Disc, Nut and Bearing Inspection: in Section 2C".

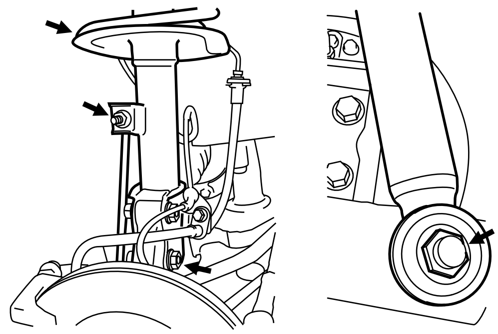


I2RH01020023-

Suspension System Inspection

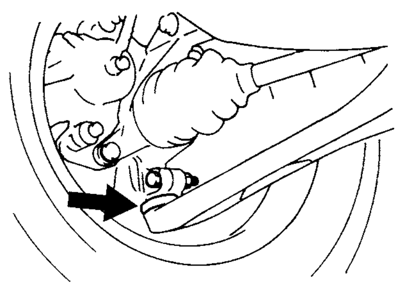
S4RS0A0206024

- Inspect front struts and 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.



I4RS0A020011-

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



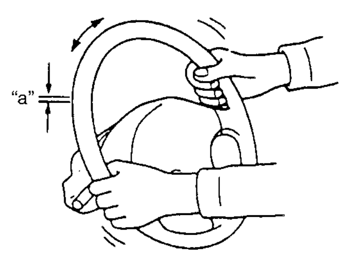
I4RS0A020012-

Steering System Inspection

S4RS0A0206025

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

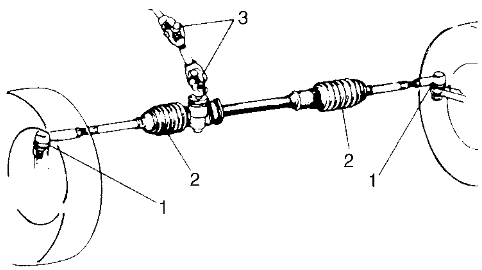
<u>Steering wheel play</u>
"a": 0 – 30 mm (0 – 1.1 in.)



I2RH01020026-

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.



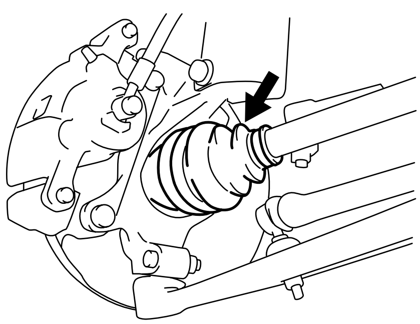
I4RS0A020013-

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 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 2B".

Drive Shaft (Axle) Boots Inspection

S4RS0A0206026

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

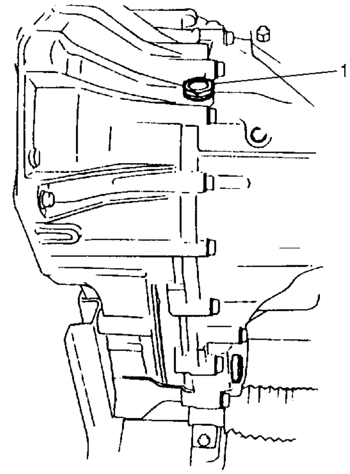


I2RH01310001-

Manual Transaxle Oil Inspection

S4RS0A0206028

1) Inspect transaxle 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 transaxle.



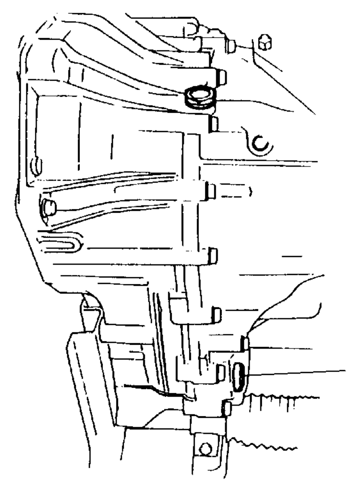
I4RS0A020014-

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 5B".
5) Apply sealant to filler/level plug and tighten it to specified torque.

Manual Transaxle Oil Replacement

S4RS0A0206029

1) Place the vehicle level and drain oil by removing drain plug (1).



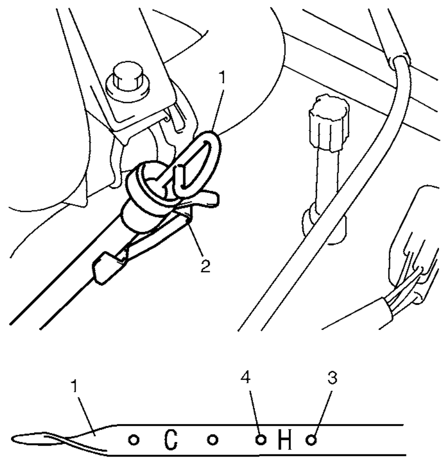
I4RS0A020015-

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 5B".

Automatic Transaxle Fluid Level Inspection

S4RS0A0206039

1) Inspect transaxle 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 "A/T Fluid Level Check: in Section 5A" and be sure to perform it under specified conditions.
If fluid level is low, replenish specified fluid.



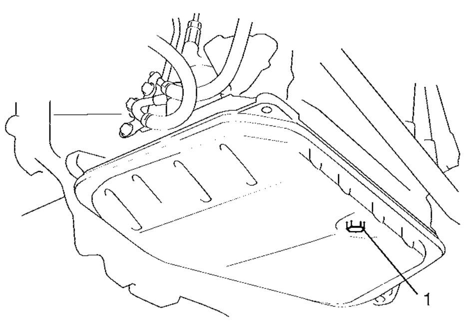
I4RS0A020016-

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

Automatic Transaxle Fluid Replacement

S4RS0A0206040

1) Inspect transaxle 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 "A/T Fluid Change: in Section 5A".



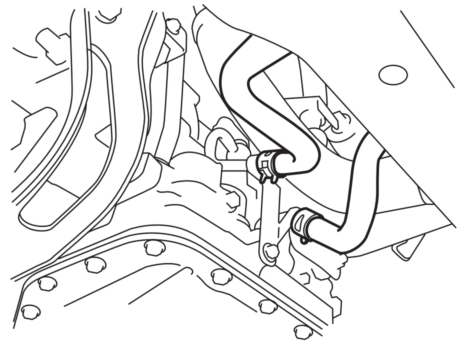
I4RS0A020017-

1. Drain plug

Automatic Transaxle Fluid Cooler Hose Inspection

S4RS0A0206041

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



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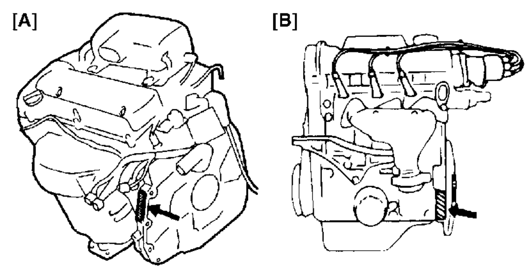


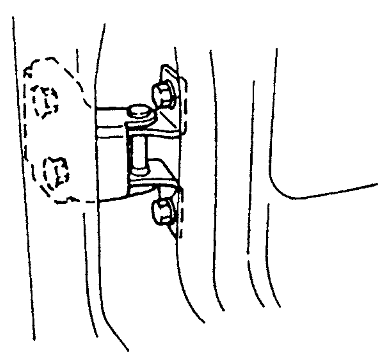
I3RB0A010004-

All Latches, Hinges and Locks Inspection

S4RS0A0206035

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.



I2RH01020033-

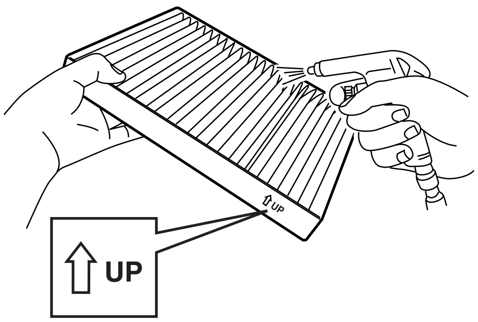
Engine Hood

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.

Air Conditioning Filter (If Equipped) Inspection

S4RS0A0206036

1) Remove the air conditioning filter from the HVAC unit referring to “Air Filter Removal and Installation: in Section 7A”.
2) Check for dirt and dust. If the air conditioning filter is excessively dirty, replace the air conditioning filter with the new one. If not, go to the next step.
3) Blow compressed air on the air outlet side of the air conditioning filter for removing dust.



I4RS0A020018-

4) Install the air conditioning filter into the HVAC unit referring to “Air Filter Removal and Installation: in Section 7A”.

Air Conditioning Filter (If Equipped) Replacement

S4RS0A0206038

Replace air conditioning filter with new one referring to “Air Filter Removal and Installation: in Section 7A”.

Final Inspection for Maintenance Service

S4RS0A0206037

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 transaxle 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 transaxle vehicles, place the shift lever in “Neutral,” depress clutch pedal fully and try to start.

Exhaust System Check

Check for leakage, cracks or loose supports.

Clutch (for Manual Transaxle)

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 (Transaxle)

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

Brake

Foot brake

Check the following:

- 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.

Specifications

Tightening Torque Specifications

S4RS0A0207001

Fastening part	Tightening torque			Note
	N·m	kg-m	lb-ft	
Engine oil drain plug	35	3.5	25.5	☞
Oil filter	14	1.4	10.5	(for reference) ☞

Reference:
For the tightening torque of fastener not specified in this section, refer to “Fasteners Information: in Section 0A”.

Special Tools and Equipment

Recommended Fluids and Lubricants

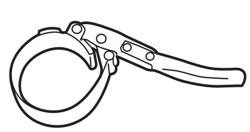
S4RS0A0208001

Engine oil	SG, SH, SJ or SL grade (Refer to “Engine Oil and Filter Change: ” for engine oil viscosity.)
Engine coolant (Ethylene glycol base coolant)	“Antifreeze/Anticorrosion coolant”
Brake fluid	DOT 3 or SAE J1703
Manual transaxle oil	Refer to “Manual Transaxle Oil Change: in Section 5B”.
Automatic transaxle fluid	Refer to “A/T Fluid Change: in Section 5A”.
Door hinges	Engine oil or water resistance chassis grease
Hood latch assembly	Engine oil or water resistance chassis grease
Key lock cylinder	Spray lubricant

Special Tool

S4RS0A0208002

09915–47331
Oil filter wrench
☞



Section 1

Engine

CONTENTS

Precautions

Precautions

Precautions for Engine

S4RS0A1000001

Air Bag Warning
Refer to “Air Bag Warning: in Section 00”.

Precautions on Engine Service
Refer to “Precautions on Engine Service: in Section 1A”.

Precautions in Diagnosing Trouble
Refer to “Precautions in Diagnosing Trouble: in Section 1A”.

Precautions of ECM Circuit Inspection
Refer to “Precautions of ECM Circuit Inspection: in Section 1A”.

Precautions on Fuel System Service
Refer to “Precautions on Fuel System Service: in Section 1G”.

Precaution for CAN Communication System
Refer to “Precaution for CAN Communication System: in Section 00”.

Precautions for Catalytic Converter
Refer to “Precautions for Catalytic Converter: in Section 00”.

Precautions for Electrical Circuit Service
Refer to “Precautions for Electrical Circuit Service: in Section 00”.

Engine General Information and Diagnosis

Precautions

Precautions on Engine Service

S4RS0A1100001

CAUTION:

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.

Precautions in Diagnosing Trouble

S4RS0A1100002

- 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 indistinguishable which module turns on MIL because not only ECM but also TCM turns on MIL (For details of on-board diagnostic system for A/T, refer to "On-Board Diagnostic System Description: in Section 5A"). 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 DTCs are stored, proceed to the DTC flow which has been detected earliest in the order and follow the instruction in that flow.
  If no instructions are given, troubleshoot DTCs according to the following priorities.
  a. 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)
  b. DTC P0171 / P0172 (Fuel system too lean / too rich) and DTC P0401 / P0402 (EGR flow malfunction)
  c. DTC P0300 / P0301 / P0302 / P0303 / P0304 (Misfire detected)
- Be sure to read "Precautions for Electrical Circuit Service: in Section 00" 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, A/C refrigerant pressure sensor (if equipped with A/C) and TP sensor are in good condition and none of power circuits of these sensors is shorted to ground.
- Communication of ECUs, ECM, BCM, combination meter and TCM, is established by CAN (Controller Area Network). (For more detail of CAN communication for ECM, refer to "CAN Communication System Description: "). Therefore, handle CAN communication line with care referring to "Precaution for CAN Communication System: in Section 00".
- Immobilizer transponder code registration after replacing ECM
  When ECM is replaced with new one or with another one, make sure to register immobilizer transponder code to ECM correctly according to "Procedure after ECM Replacement: in Section 10C".

Precautions of ECM Circuit Inspection

S4RS0A1100003

- ECM connectors are waterproofed. Each terminal of the ECM connectors is sealed up with the grommet. Therefore, when measuring circuit voltage, resistance and/or pulse signal at ECM connector, do not insert the tester's probe into the sealed terminal at the harness side. When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to the ECM connectors. And, insert the tester's probe into the special tool's

connectors at the harness side, and then measure voltage, resistance and/or pulse signal. Or, ECM and its circuits may be damaged by water.
- Wire colors of the special tool's connectors are different from the ones of the ECM connectors. However, the circuit arrangement of the special tool's connectors is same as the one of the ECM connectors. Therefore, measure circuit voltage and resistance by identifying the terminal location subject to the measurement.

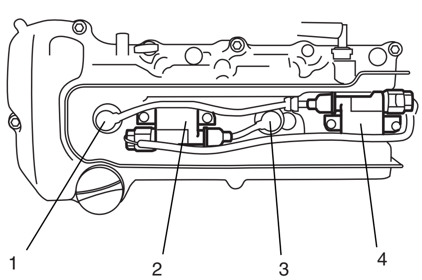
General Description

Statement on Cleanliness and Care

S4RS0A1101001

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.
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.
- 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.



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Engine Diagnosis General Description

S4RS0A1101002

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 Description: " and each item in "Precautions 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 "Engine and Emission Control System Check: ".

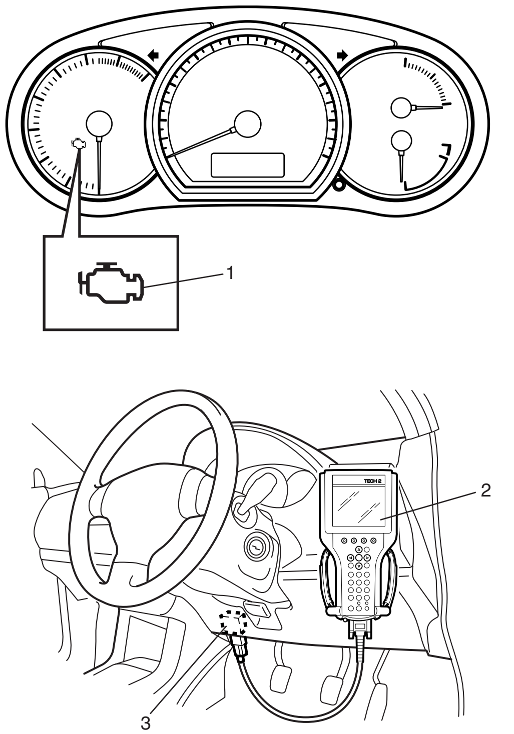
On-Board Diagnostic System Description

S4RS0A1101003

ECM in this vehicle has the 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.)



I4RS0A110001-

3.	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

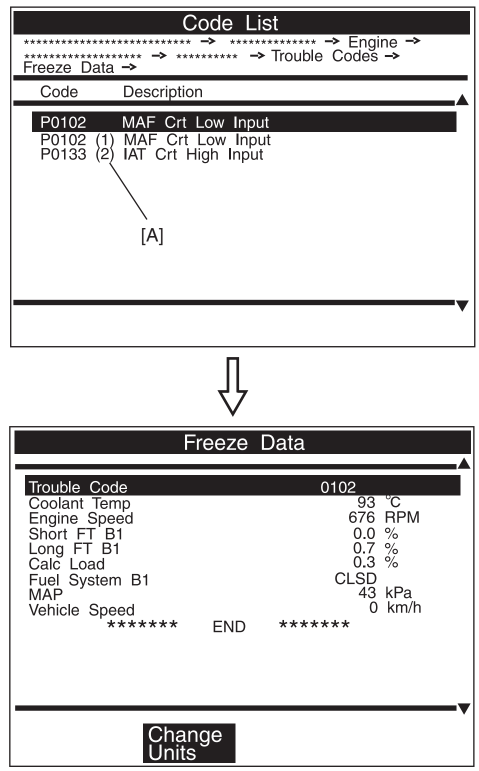
The malfunction detected in the first driving cycle is stored in ECM memory (in the form of pending DTC) but the malfunction indicator lamp does not light at this time. It lights up at the second detection of same malfunction also in the next driving cycle.

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 each 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.



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

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. (If malfunction as described in the upper square “1” 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”.)

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” is detected

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

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

Malfunction detected order		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
	No malfunction	No freeze frame data			
1	P0401 (EGR) detected	Data at P0401 detection	Data at P0401 detection	—	—
2	P0171 (Fuel system) detected	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

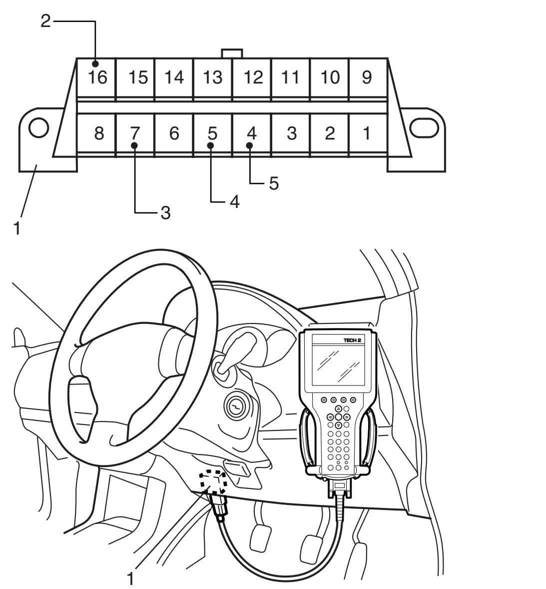
Freeze frame data clearance:

The freeze frame data is cleared at the same time as clearance of 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 (in ECM), BCM (Body electrical Control Module), TCM (Transmission Control Module) and ABS control module.



I4RS0A110002-

2.	B + (Unswitched vehicle battery positive)
4.	ECM ground (Signal ground)
5.	Vehicle body ground (Chassis ground)

Engine and Emission Control System Description

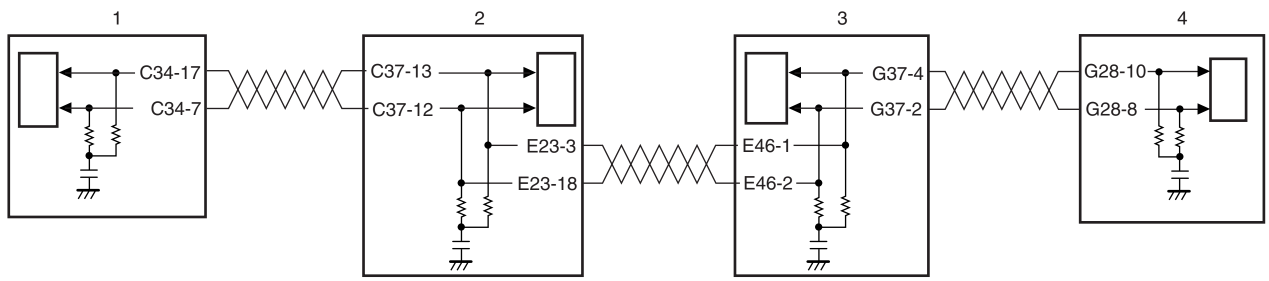
S4RS0A1101004

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.

CAN Communication System Description

S4RS0A1101008

ECM (2), TCM (equipped with A/T) (1), BCM (3) and combination meter (4) of this vehicle communicate control data between each control module.
Communication of each control module is established by CAN (Controller Area Network) communication system.



I4RS0A110085-

CAN communication system uses the serial communication in which data is transmitted at a high speed. It uses a twisted pair of two communication lines for the high-speed data transmission. As one of its characteristics, multiple control modules can communicate simultaneously. In addition, it has a function to detect a communication error automatically. Each module reads necessary data from the received data and transmits data. ECM communicates control data with each control module as follows.

ECM Transmission Data

				TCM	BCM	Combination Meter
ECM	Transmit	DATA	Engine torque driver requested	○		
			Engine speed	○		○
			Top gear inhibit	○		
			Torque converter clutch control inhibit	○		
			Lock up / slip control inhibit signal	○		
			Throttle position	○		
			Immobilizer indication			○
			Engine emissions related malfunction			○
			Vehicle speed		○	○
			Engine coolant temperature	○	○	○
			Fuel level percent			○
			Brake pedal switch active	○		
			A/C refrigerant pressure		○	
			Distance kilometers per liter of fuel		○	
			Stand by to engage air conditioning compressor clutch	○		

I4RS0A110003-

NOTE:

In communication between ECM and combination meter, data is transmitted only from ECM to combination meter. (Combination meter does not transmit data to ECM.)

ECM Reception Data

				TCM	BCM
ECM	Receive	DATA	Torque down ignition delay request	○	
			Coast slip control signal	○	
			Vehicle speed pulse	○	
			TCM data validity	○	
			Transmission gear selector position	○	
			Transmission actual gear	○	
			A/C switch ON		○
			Electric load active (small light)		○
			Electric load active (rear defogger)		○
			Ignition key switch ON		○

I4RS0A110004-

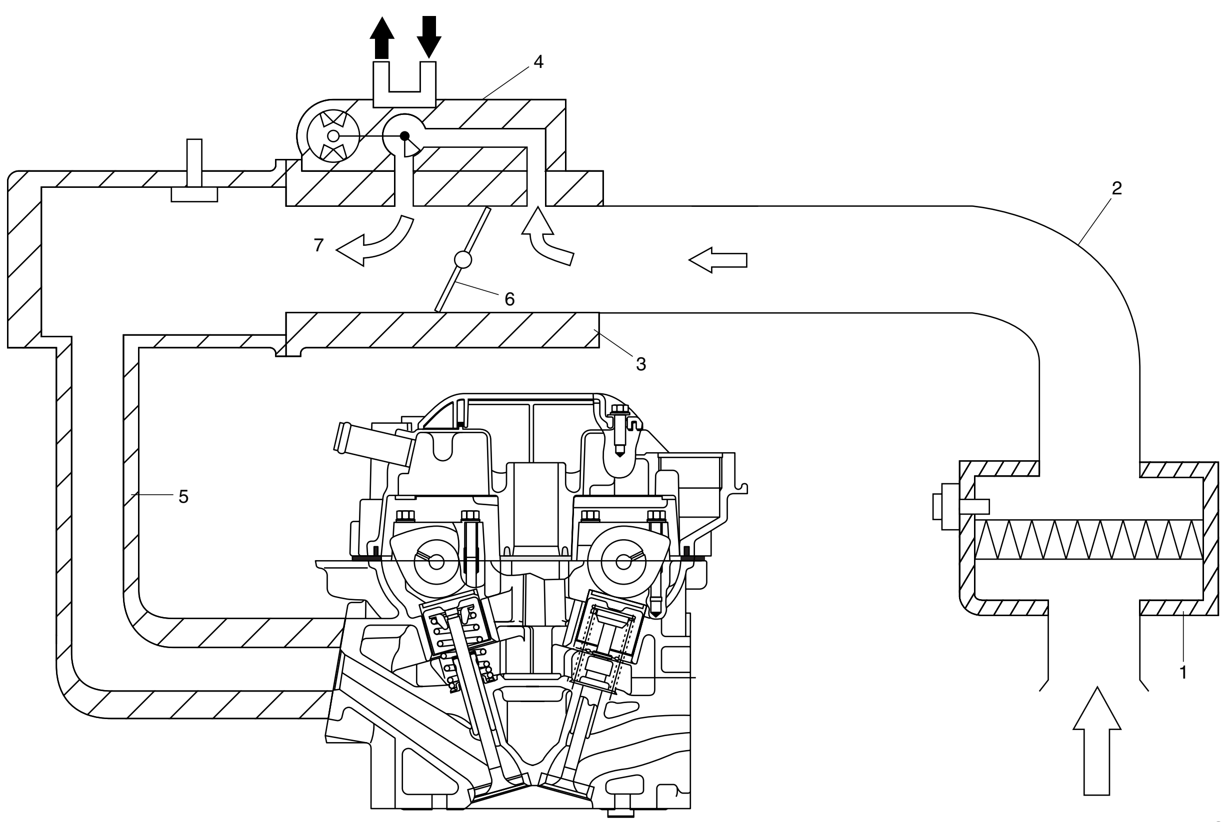
Air Intake System Description

S4RS0A1101005

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 throttle valve (6) opening and engine speed) is filtered by the air cleaner, passes through the throttle body, distributed by the intake manifold and finally drawn into each combustion chamber.

When the idle air control valve is opened according to the signal from ECM, the air (7) bypasses the throttle valve through bypass passage and is finally drawn into the intake manifold.



I4RS0A110005-

Electronic Control System Description

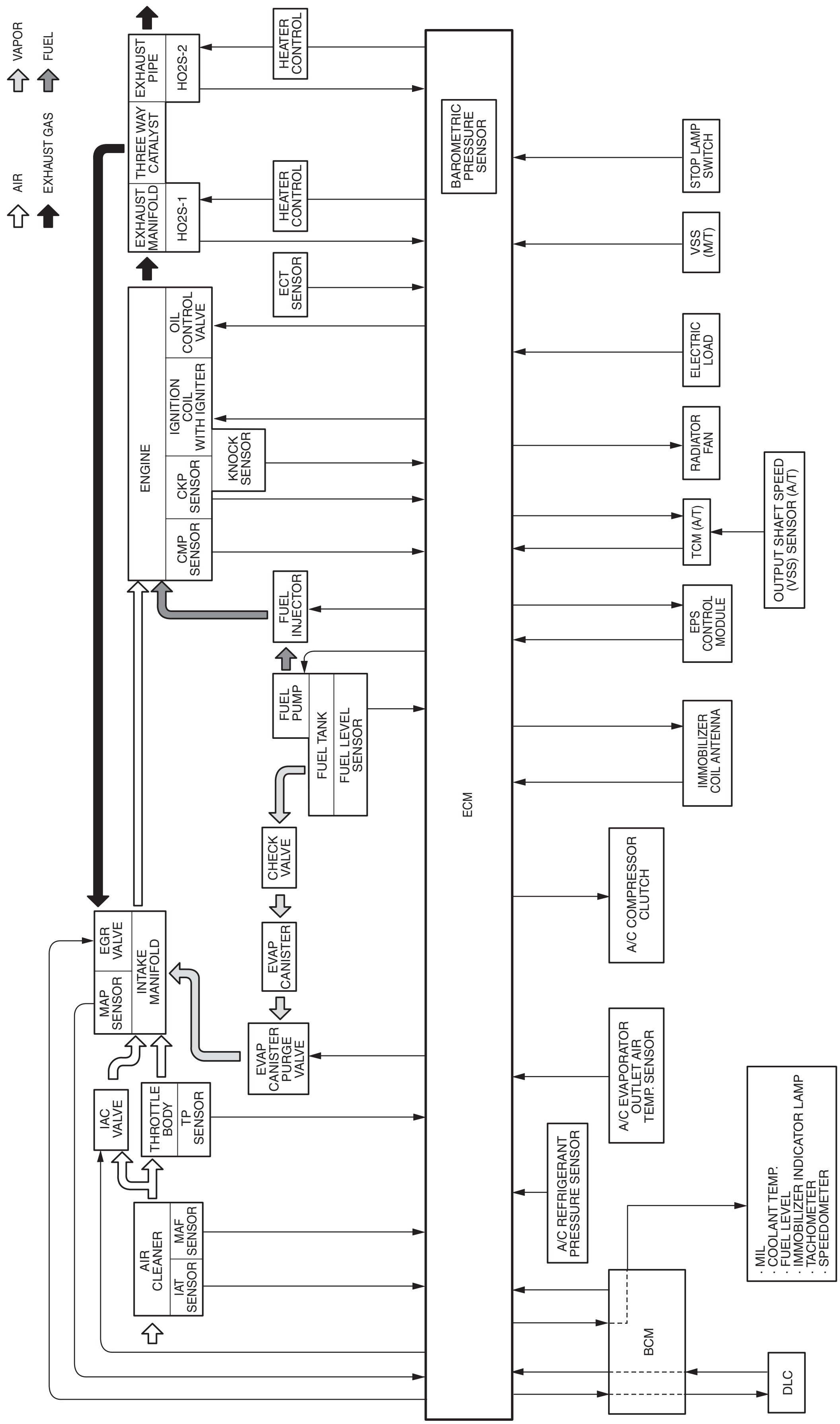
S4RS0A1101006

The electronic control system consists of 1) various sensors which detect the state of engine and driving conditions, 2) ECM which controls various devices according to the signals from the sensors and 3) various controlled devices. Functionally, it is divided into the following sub systems:

- Fuel injection control system
- Ignition control system
- Idle speed control system
- Fuel pump control system
- Radiator cooling fan control system
- Evaporative emission control system
- EGR system
- Oxygen sensor heater control system
- A/C control system (if equipped)
- Camshaft position control system
- Immobilizer control system
- Controller (computer) communication system

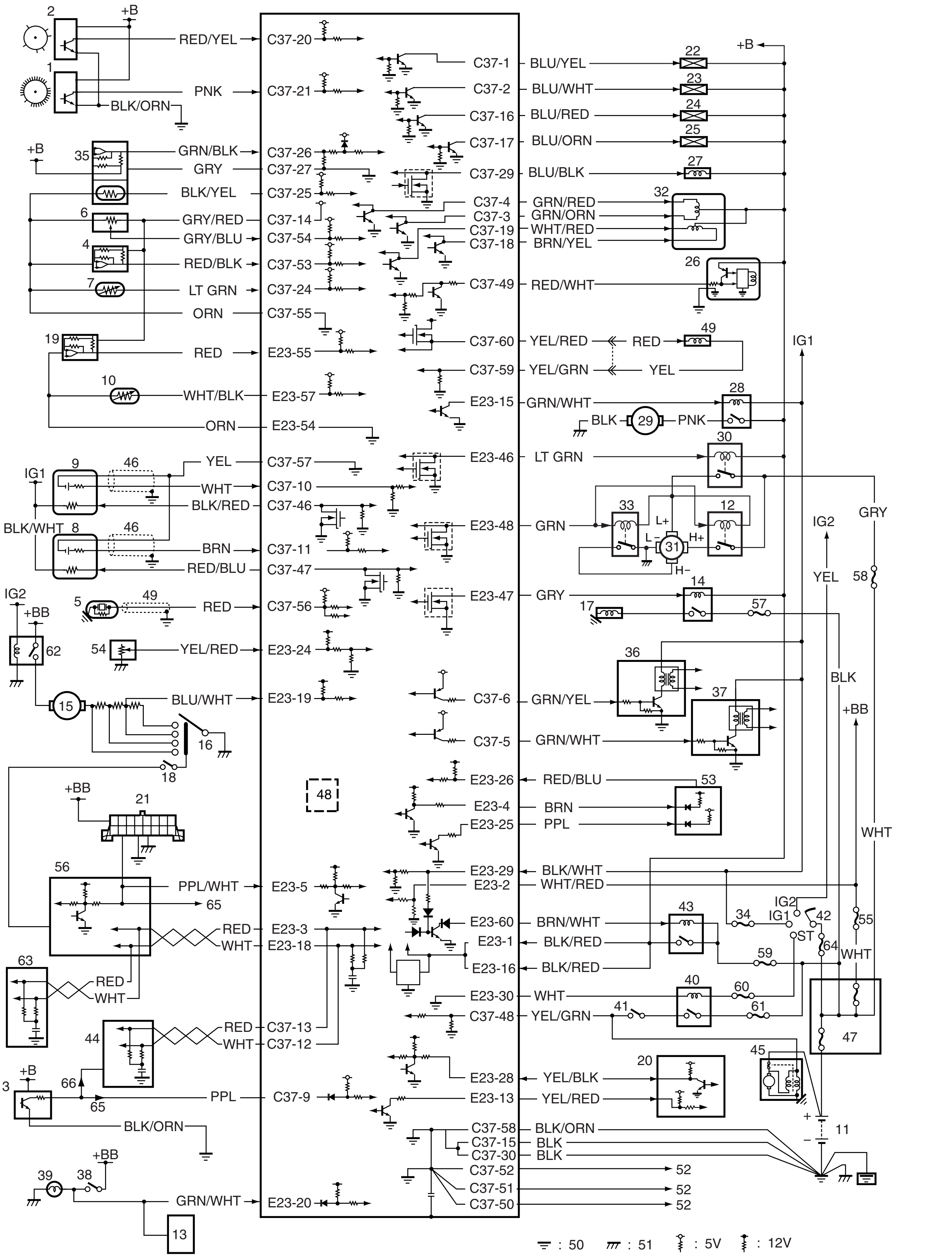
Especially, ECM (Engine Control Module), BCM (Body electrical Control Module), combination meter and TCM (Transmission Control Module (For A/T vehicle only)) intercommunicate by means of CAN (Controller Area Network) communication.

Engine and Emission Control System Flow Diagram



I4RS0A110006-

ECM Input / Output Circuit Diagram

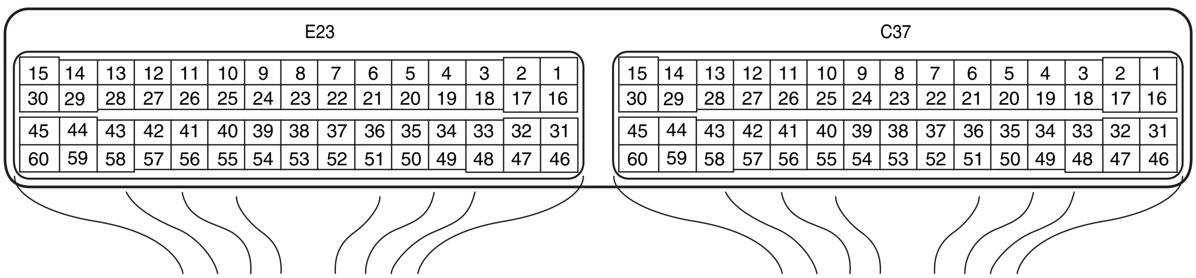


I4RS0A110007-

1. CKP sensor	23. Injector No.2	45. Starting motor
2. CMP sensor	24. Injector No.3	46. Shield wire
3. VSS	25. Injector No.4	47. Main fuse box

4. MAP sensor	26. IAC valve	48. Barometric pressure sensor
5. Knock sensor	27. EVAP canister purge valve	49. Oil control valve (Camshaft position control)
6. TP sensor	28. Fuel pump relay	50. Engine ground
7. ECT sensor	29. Fuel pump	51. Body ground
8. Heated oxygen sensor-2	30. Radiator cooling fan relay No.1	52. Shield ground
9. Heated oxygen sensor-1	31. Radiator cooling fan motor	53. EPS control module
10. A/C evaporator outlet air temp. sensor	32. EGR valve	54. Fuel level sensor
11. Battery	33. Radiator cooling fan relay No.3	55. “RADIO” fuse
12. Radiator cooling fan relay No.2	34. “IG COIL” fuse	56. BCM
13. ABS control module	35. MAF and IAT sensor	57. “A/C COMP” fuse
14. A/C compressor relay	36. Ignition coil assembly (for No.1 and No.4 spark plugs)	58. “RDTR FAN” fuse
15. Blower motor	37. Ignition coil assembly (for No.2 and No.3 spark plugs)	59. “FI” fuse
16. Blower speed selector	38. Stop lamp switch	60. “ST SIG” fuse
17. Magnet clutch of compressor	39. Stop lamp	61. “ST MOT” fuse
18. A/C switch	40. Starting motor control relay	62. Blower motor relay
19. A/C refrigerant pressure sensor	41. Transmission range switch (A/T)	63. Combination meter
20. Immobilizer coil antenna	42. Ignition switch	64. “IG ACC” fuse
21. Data link connector	43. Main relay	65. Only for M/T vehicle
22. Injector No.1	44. TCM (A/T)	66. Only for A/T vehicle

Terminal Arrangement of ECM Coupler (Viewed from Harness Side)



I4RS0A110008-

Connector: C37

Terminal	Wire color	Circuit	Terminal	Wire color	Circuit
1	BLU/YEL	Fuel injector No.1 output	31	—	—
2	BLU/WHT	Fuel injector No.2 output	32	—	—
3	GRN/ORN	EGR valve (stepper motor coil 2) output	33	—	—
4	GRN/RED	EGR valve (stepper motor coil 1) output	34	—	—
5	GRN/WHT	Ignition coil No.2 and No.3 output	35	—	—
6	GRN/YEL	Ignition coil No.1 and No.4 output	36	—	—
7	—	—	37	—	—
8	—	—	38	—	—
9	PPL	Vehicle speed sensor signal (M/T)	39	—	—
10	WHT	Oxygen signal of heated oxygen sensor-1	40	—	—
11	BRN	Oxygen signal of heated oxygen sensor-2	41	—	—
12	WHT	CAN (low) communication line (active low signal) to TCM	42	—	—
13	RED	CAN (high) communication line (active high signal) to TCM	43	—	—
14	GRY/RED	Output of 5 V power source for TP sensor, MAP sensor, A/C refrigerant pressure sensor	44	—	—
15	BLK	Ground for ECM	45	—	—

Terminal	Wire color	Circuit	Terminal	Wire color	Circuit
16	BLU/RED	Fuel injector No.3 output	46	BLK/RED	Heater output of heated oxygen sensor-1
17	BLU/ORN	Fuel injector No.4 output	47	RED/BLU	Heater output of heated oxygen sensor-2
18	BRN/YEL	EGR valve (stepper motor coil 4) output	48	YEL/GRN	Starting motor signal
19	WHT/RED	EGR valve (stepper motor coil 3) output	49	RED/WHT	IAC valve output
20	RED/YEL	CMP sensor signal	50	—	Ground of ECM for shield wire
21	PNK	CKP sensor signal	51	—	Ground of ECM for shield wire
22	—	—	52	—	Ground of ECM for shield wire
23	—	—	53	RED/BLK	Manifold absolute pressure (MAP) sensor signal
24	LT GRN	Engine coolant temp. (ECT) sensor signal	54	GRY/BLU	Throttle position (TP) sensor signal
25	BLK/YEL	Intake air temp. (IAT) sensor signal	55	ORN	Ground for sensors
26	GRN/BLK	Mass air flow (MAF) sensor signal	56	RED	Knock sensor signal
27	GRY	Ground for MAF sensor	57	YEL	Ground for sensors
28	—	—	58	BLK/ORN	Ground for ECM
29	BLU/BLK	EVAP canister purge valve output	59	YEL/GRN	Oil control valve ground
30	BLK	Ground for ECM	60	YEL/RED	Oil control valve output

Connector: E23

Terminal	Wire color	Circuit	Terminal	Wire color	Circuit
1	BLK/RED	Main power supply	31	—	—
2	WHT/RED	Power source for ECM internal memory	32	—	—
3	RED	CAN communication line (active high signal) for BCM, combination meter	33	—	—
4	BRN	Engine revolution signal output for EPS control module	34	—	—
5	PPL/WHT	Serial communication line of data link connector 12 V	35	—	—
6	—	—	36	—	—
7	—	—	37	—	—
8	—	—	38	—	—
9	—	—	39	—	—
10	—	—	40	—	—
11	—	—	41	—	—
12	—	—	42	—	—
13	YEL/RED	Clock signal for immobilizer coil antenna	43	—	—
14	—	—	44	—	—
15	GRN/WHT	Fuel pump relay output	45	—	—
16	BLK/RED	Main power supply	46	LT GRN	Radiator cooling fan relay No.1 output
17	—	—	47	GRY	A/C compressor relay output
18	WHT	CAN communication line (active low signal) for BCM, combination meter	48	GRN	Radiator cooling fan relay No.2 and No.3 output
19	BLU/WHT	Electric load signal for heater blower motor	49	—	—
20	GRN/WHT	Stop lamp switch signal	50	—	—
21	—	—	51	—	—
22	—	—	52	—	—

Terminal	Wire color	Circuit	Terminal	Wire color	Circuit
23	—	—	53	—	—
24	YEL/RED	Fuel level sensor signal	54	ORN	Ground for sensors
25	PPL	Vehicle speed signal output for EPS control module	55	RED	A/C refrigerant pressure sensor signal
26	RED/BLU	EPS signal	56	—	—
27	—	—	57	WHT/BLK	A/C evaporator outlet air temp. sensor signal
28	YEL/BLK	Serial communication line for immobilizer coil antenna	58	—	—
29	BLK/WHT	Ignition switch signal	59	—	—
30	WHT	Starting motor control relay output	60	BRN/WHT	Main power supply relay output

Engine and Emission Control Input / Output Table

S4RS0A1101007

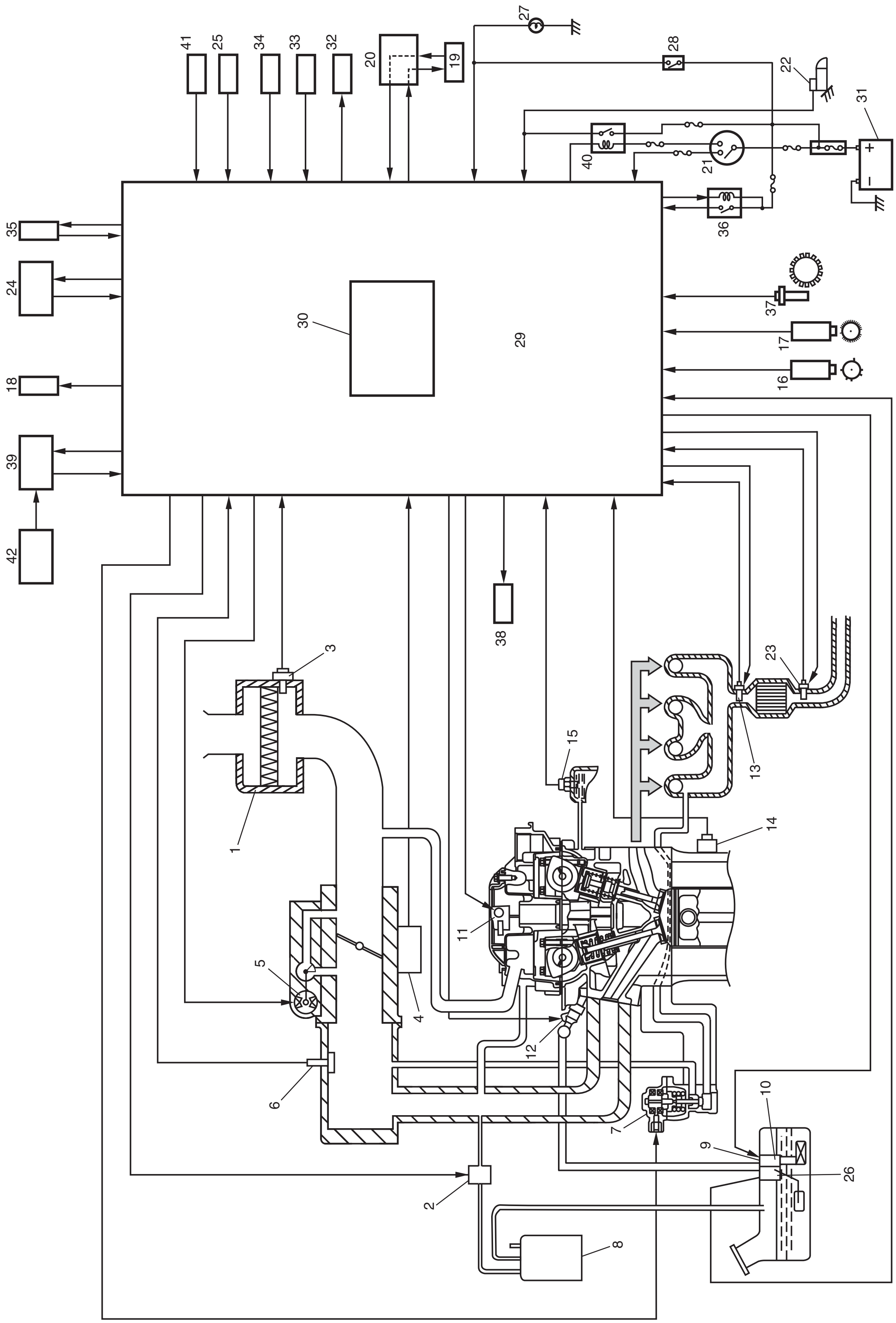
	OUTPUT / INPUT	ELECTRIC CONTROL DEVICE: FUEL PUMP RELAY	FUEL INJECTOR	HO2S HEATER	IAC VALVE	IGNITION COIL WITH IGNITER	EGR VALVE	EVAP CANISTER PURGE VALVE	A/C COMPRESSOR RELAY	RADIATOR FAN RELAY	MIL	MAIN RELAY	OIL CONTROL VALVE
SIGNAL FROM SENSOR, SWITCH AND CONTROL MODULE	FUEL LEVEL SENSOR	For detecting fuel level											
	BAROMETRIC PRESSURE SENSOR		○		○	○	○	○			○		
	STOP LAMP SWITCH		○		○								
	START SWITCH	○	○		○	○			○				
	IGNITION SWITCH	○	○	○	○	○	○	○	○	○	○	○	○
	A/C REFRIGERANT PRESSURE SENSOR		○		○				○	○			
	BLOWER SWITCH				○				○				
	A/C SWITCH		○		○			○	○	○			
	A/C EVAP OUTLET AIR TEMP. SENSOR		○		○				○	○			
	VSS		○	○	○	○	○	○	○	○	○		○
	HEATED OXYGEN SENSOR-1		○					○			○		
	HEATED OXYGEN SENSOR-2		○								○		
	MAF SENSOR		○	○	○	○	○	○			○		○
	IAT SENSOR		○		○	○	○	○			○		
	ECT SENSOR		○	○	○	○	○	○	○	○	○		○
	TP SENSOR		○	○	○	○	○	○	○		○		○
	MAP SENSOR		○			○	○				○		
	CMP SENSOR		○			○					○		○
	CKP SENSOR	○	○	○	○	○	○	○	○		○		○
	KNOCK SENSOR					○					○		
	ABS CONTROL MODULE				○								
	IMMOBILIZER CONTROL MODULE (IN ECM)	○	○			○					○		

I4RS0A110009-

Schematic and Routing Diagram

Engine and Emission Control System Diagram

S4RS0A1102001



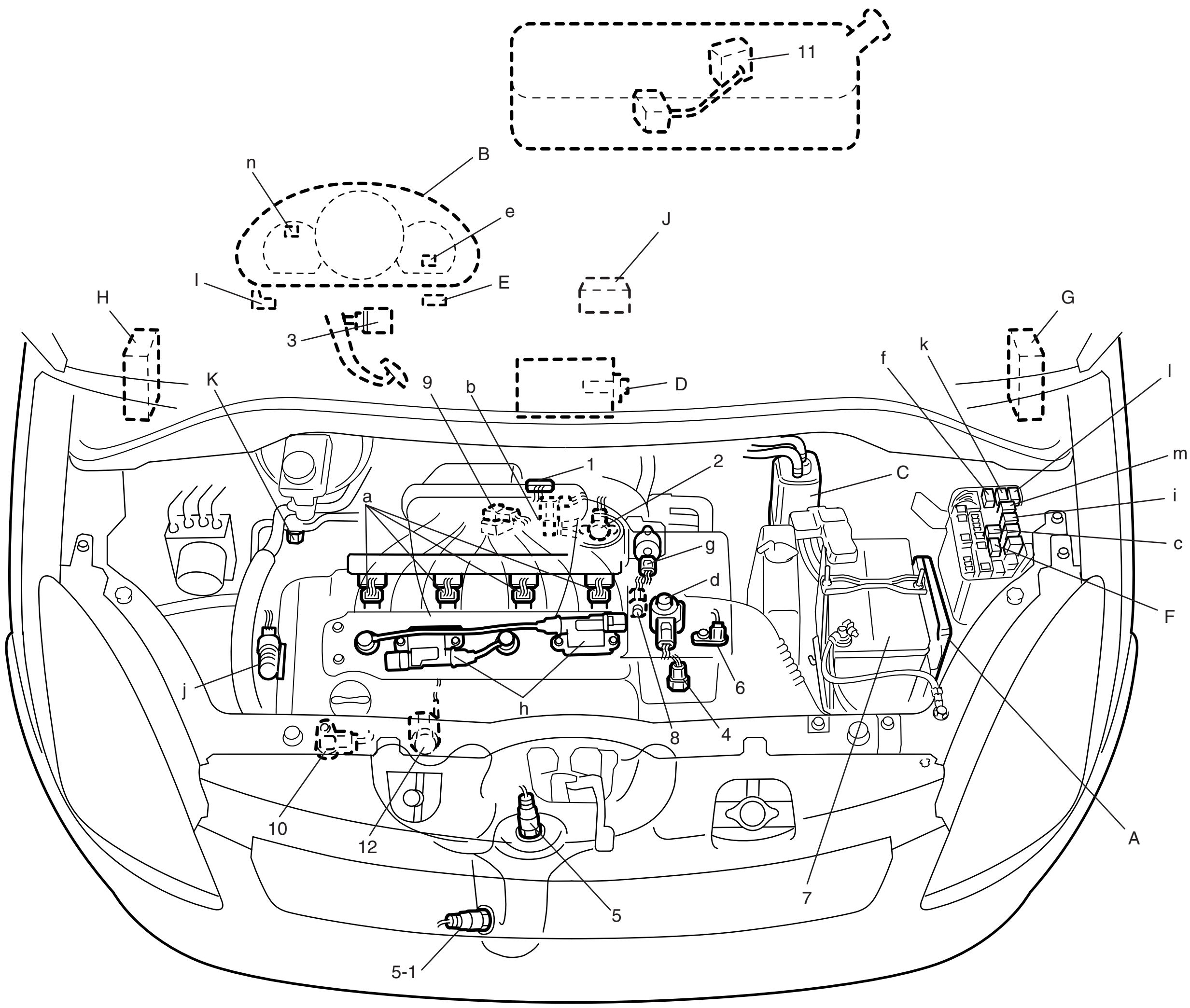
I4RS0A110011-

1. Air cleaner	15. ECT sensor	29. ECM
2. EVAP canister purge valve	16. CMP sensor	30. Barometric pressure sensor
3. MAF and IAT sensor	17. CKP sensor	31. Battery
4. TP sensor	18. Radiator cooling fan	32. A/C compressor relay
5. IAC valve	19. Combination meter	33. A/C switch
6. MAP sensor	20. BCM	34. A/C evaporator outlet air temp. sensor
7. EGR valve	21. Ignition switch	35. Immobilizer coil antenna
8. EVAP canister	22. Starter magnetic switch	36. Main relay
9. Tank pressure control valve (built-in fuel pump)	23. Heated oxygen sensor (HO2S)-2	37. VSS (M/T)
10. Fuel pump (with pressure regulator)	24. DLC	38. Oil control valve
11. Ignition coil assembly	25. Electric load	39. TCM (A/T)
12. Fuel injector	26. Fuel level sensor	40. Starting motor control relay
13. Heated oxygen sensor (HO2S)-1	27. Stop lamp	41. A/C refrigerant pressure sensor
14. Knock sensor	28. Stop lamp switch	42. Output shaft speed (VSS) sensor

Component Location

Electronic Control System Components Location

S4RS0A1103001



I4RS0A110010-

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
5. Heated oxygen sensor-1	e: Malfunction indicator lamp	E: Data link connector
5-1. Heated oxygen sensor-2	f: Radiator cooling fan relay No.1	F: A/C compressor relay

Information sensors	Control devices	Others
6. VSS	g: IAC valve	G: TCM (A/T)
7. Battery	h: Ignition coil assembly (with ignitor)	H: BCM (included in junction block assembly)
8. CMP sensor	i: Main relay	I: Immobilizer coil antenna
9. MAP sensor	j: Oil control valve	J: EPS control module
10. CKP sensor	k: Radiator cooling fan relay No.2	K: A/C refrigerant pressure sensor
11. Fuel level sensor	l: Radiator cooling fan relay No.3	
12. Knock sensor	m: Starting motor control relay	
	n: Immobilizer indicator lamp	

Diagnostic Information and Procedures

Engine and Emission Control System Check

S4RS0A1104001

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

Step	Action	Yes	No
1	☞ **Customer complaint analysis** 1) Perform customer complaint analysis referring to “Customer Complaint Analysis”. *Was customer complaint analysis performed?*	Go to Step 2.	Perform customer complaint analysis.
2	☞ **DTC / Freeze frame data check, record and clearance** 1) Check for DTC (including pending DTC) referring to “DTC / Freeze Frame Data Check, Record and Clearance”. *Is there any DTC(s)?*	Print DTC and freeze frame data or write them down and clear them by referring to “DTC Clearance: ”, and go to Step 3.	Go to Step 4.
3	☞ **Visual inspection** 1) Perform visual inspection referring to “Visual Inspection”. *Is there any faulty condition?*	Repair or replace malfunction part, and go to Step 11.	Go to Step 5.
4	☞ **Visual inspection** 1) Perform visual inspection referring to “Visual Inspection”. *Is there any faulty condition?*	Repair or replace malfunction part, and go to Step 11.	Go to Step 8.
5	☞ **Trouble symptom confirmation** 1) Confirm trouble symptom referring to “Trouble Symptom Confirmation”. *Is trouble symptom identified?*	Go to Step 6.	Go to Step 7.
6	☞ **Rechecking and record of DTC / Freeze frame data** 1) Recheck for DTC and freeze frame data referring to “DTC Check: ”. *Is there any DTC(s)?*	Go to Step 9.	Go to Step 8.
7	☞ **Rechecking and record of DTC / Freeze frame data** 1) Recheck for DTC and freeze frame data referring to “DTC Check: ”. *Is there any DTC(s)?*	Go to Step 9.	Go to Step 10.
8	☞ **Engine basic inspection and engine symptom diagnosis** 1) Check and repair according to “Engine Basic Inspection: ” and “Engine Symptom Diagnosis: ”. *Are check and repair complete?*	Go to Step 11.	Check and repair malfunction part(s), and go to Step 11.
9	☞ **Troubleshooting for DTC** 1) Check and repair according to applicable DTC diag. flow. *Are check and repair complete?*	Go to Step 11.	Check and repair malfunction part(s), and go to Step 11.

Step	Action	Yes	No
10	☞ **Intermittent problems check** 1) Check for intermittent problems referring to “Intermittent Problems Check”. *Is there any faulty condition?*	Repair or replace malfunction part(s), and go to Step 11.	Go to Step 11.
11	☞ **Final confirmation test** 1) Clear DTC if any. 2) Perform final confirmation test referring to “Final Confirmation Test”. *Is there any problem symptom, DTC or abnormal condition?*	Go to Step 6.	End.

Step 1: Customer Complaint Analysis

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

Customer problem inspection form (Example)

User name:	Model:	VIN:	
Date of issue:	Date 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 ( )

I2RH01110010-

NOTE:

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

Step 2: DTC / Freeze Frame Data Check, Record and Clearance
First, check DTC (including pending DTC), referring to "DTC Check: ". If DTC is indicated, print it and freeze frame data or write them down and then clear them by referring to "DTC Clearance: ". DTC indicates malfunction that occurred in the system but does not indicate whether it exists now or it occurred in the past and the normal condition has been restored now. To check which case applies, check the symptom in question according to Step 5 and recheck DTC according to Step 6 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.

Step 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: ".

Step 5: Trouble Symptom Confirmation
Based on information obtained in "Step 1: Customer Complaint Analysis: " and "Step 2: DTC / Freeze Frame Data Check, Record and Clearance: ", confirm trouble symptoms. Also, reconfirm DTC according to "DTC Confirmation Procedure" described in each DTC diag. flow.

Step 6 and 7: Rechecking and Record of DTC / Freeze Frame Data
Refer to "DTC Check: " for checking procedure.

Step 8: Engine Basic Inspection and Engine Symptom Diagnosis
Perform basic engine check according to "Engine Basic Inspection: " first. When the end of the flow 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.

Step 9: Troubleshooting for DTC (See each DTC Diag. Flow)
Based on the DTC indicated in Step 6 or 7 and referring to the applicable DTC diag. flow, 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.

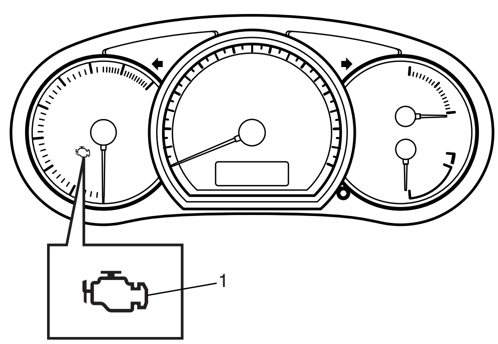
Step 10: Intermittent Problems Check
Check parts where an intermittent trouble is easy to occur (e.g., wire harness, connector, etc.), referring to "Intermittent and Poor Connection Inspection: in Section 00" and related circuit of DTC recorded in Step 2.

Step 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.

Malfunction Indicator Lamp (MIL) Check

S4RS0A1104002

1) Turn ON ignition switch (with 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 with Ignition Switch ON and Engine Stop (but Engine Can Be Started): " for troubleshooting.
   If MIL does not light with ignition switch ON and engine does not start though it is cranked up, go to "ECM Power and Ground Circuit Check: ".
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.



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DTC Check

S4RS0A1104003

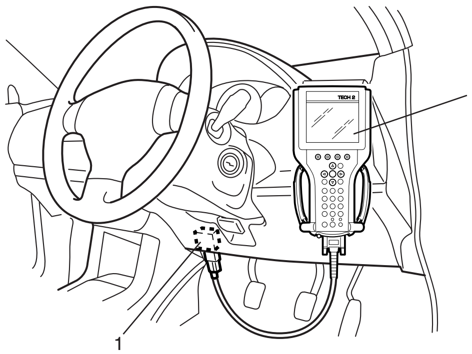
NOTE:

The MIL is turned on when the ECM and/or TCM detect malfunction(s). Each ECM and TCM stores diagnostic information as the diagnostic trouble code (DTC) in its memory and outputs the DTC to the scan tool. Therefore, check both of the ECM and TCM for any DTC with the scan tool because the DTC stored in ECM and TCM is not read and displayed at a time. However, each of the ECM and TCM needs not to be checked with the generic scan tool because the DTC stored in ECM and TCM is read and displayed at a time.

1) Prepare OBD generic scan tool or SUZUKI scan tool.

2) With ignition switch turned 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



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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 them or write them 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. If OK, check that power supply and ground circuits of ECM and DLC are in good condition referring to "ECM Power and Ground Circuit Check: ".
5) After completing the check, turn ignition switch off and disconnect scan tool from data link connector.

DTC Clearance

S4RS0A1104004

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 "Warm-Up Cycle" of "On-Board Diagnostic System Description: ".)**

DTC Table

S4RS0A1104005

NOTE:

- **With the generic scan tool, only star (*) marked DTC No. in the following table can be read.**
- **1 driving cycle: MIL lights up when DTC is detected during 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 Detected / Cylinder 1 / Cylinder 2 / Cylinder 3 / Cylinder 4 Misfire Detected: " for details.

DTC No.	Detecting item	Detecting condition (DTC will set when detecting:)	MIL
☞ *P0010	Camshaft position actuator circuit	Oil control valve circuit open or short.	1 driving cycle
☞ *P0011	Camshaft position – timing over-advanced or system performance	Actual value 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 less 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

DTC No.	Detecting item	Detecting condition (DTC will set when detecting:)	MIL
☞ *P0037	HO2S heater control circuit low (Sensor-2)	Heater current is less 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
☞ *P0101	Mass air flow circuit range/ performance	MAF sensor volume is more than specification or less than specification.	2 driving cycles
☞ *P0102	Mass air flow circuit low input	Output voltage of MAF sensor is less than specification.	1 driving cycle
☞ *P0103	Mass air flow circuit high input	Output voltage of MAF sensor is more than specification.	1 driving cycle
☞ *P0106	Manifold absolute pressure circuit range/performance	Difference between Max. manifold absolute pressure value and Min. manifold pressure value is less than specification or difference between barometric pressure value and manifold pressure value is less than specification	2 driving cycles
☞ *P0107	Manifold absolute pressure circuit low input	Output voltage of MAP sensor is less than specification.	1 driving cycle
☞ *P0108	Manifold absolute pressure circuit high input	Output voltage of MAP sensor is more than specification.	1 driving cycle
☞ *P0111	Intake air temperature sensor circuit range/performance	Variation of intake air temperature from engine start is less than specification.	2 driving cycles
☞ *P0112	Intake air temperature sensor circuit low	Circuit voltage of IAT sensor is less than specification.	1 driving cycle
☞ *P0113	Intake air temperature sensor circuit high	Circuit voltage of IAT sensor is more than specification.	1 driving cycle
☞ *P0116	Engine coolant temperature circuit range/performance	Engine coolant temperature is less than specified temperature for specified time from engine start.	2 driving cycles
☞ *P0117	Engine coolant temperature circuit low	Circuit voltage of ECT sensor is less than specification.	1 driving cycle
☞ *P0118	Engine coolant temperature circuit high	Circuit voltage of ECT sensor is more than specification.	1 driving cycle
☞ *P0121	Throttle position sensor circuit range/performance	Difference between actual throttle opening and opening calculated by ECM is out of specification.	2 driving cycles
☞ *P0122	Throttle position sensor circuit low	Output voltage of TP sensor is less than specification.	1 driving cycle
☞ *P0123	Throttle position sensor circuit high	Output voltage of TP sensor is more than specification.	1 driving cycle
☞ *P0131	O2 sensor (HO2S) circuit low voltage (Sensor-1)	Max. output voltage of HO2S-1 is less than specification.	2 driving cycles
☞ *P0132	O2 sensor (HO2S) circuit high voltage (Sensor-1)	Min. output voltage of HO2S-1 is more than specification.	2 driving cycles
☞ *P0133	O2 sensor (HO2S) circuit slow response (Sensor-1)	Response time of HO2S-1 output voltage between rich and lean is longer than specification.	2 driving cycles
☞ *P0134	O2 sensor (HO2S) circuit no activity detected (Sensor-1)	Output voltage of HO2S-1 is more than specification or less than specification. (or HO2S-1 circuit open or short)	2 driving cycles
☞ *P0137	O2 sensor (HO2S) circuit low voltage (Sensor-2)	Output voltage of HO2S-2 is less than specification while engine is idling after driving with high engine load and Max. output voltage of HO2S-2 minus Min. output voltage of HO2S-2 is less than specification.	2 driving cycles
☞ *P0138	O2 sensor (HO2S) circuit high voltage (Sensor-2)	Output voltage of HO2S-2 is more than specification while engine is idling after driving with high engine load and Max. output voltage of HO2S-2 minus Min. output voltage of HO2S-2 is less than specification.	2 driving cycles
☞ *P0140	O2 sensor (HO2S) circuit no activity detected (Sensor-2)	Output voltage of HO2S-2 is more than specification after warming up engine.	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

DTC No.	Detecting item	Detecting condition (DTC will set when detecting:)	MIL
☞ *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	Output voltage of knock sensor is less than specification.	1 driving cycle
☞ *P0328	Knock sensor circuit high	Output voltage of knock sensor is more than specification.	1 driving cycle
☞ *P0335	Crankshaft position sensor circuit	No signal of CKP sensor for specified time even if starting motor signal is input.	1 driving cycle
☞ *P0340	Camshaft position sensor circuit	CMP sensor pulse is out of specification.	1 driving cycle
☞ *P0401	Exhaust gas recirculation flow detected as insufficient	Difference in intake manifold absolute pressure between opened EGR valve and closed EGR valve is less than specification.	2 driving cycles
☞ *P0402	Exhaust gas recirculation flow detected as excessive	Difference in intake manifold absolute pressure between opened EGR valve and closed EGR valve is more than specification.	2 driving cycles
☞ *P0403	Exhaust gas recirculation control circuit	Output voltage is different from output command with more than one pole out of 4 poles.	1 driving cycle
☞ *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
☞ P0462	Fuel level sensor circuit low	Circuit voltage of fuel level sensor is less than specification.	—
☞ P0463	Fuel level sensor circuit high	Circuit voltage of fuel level sensor is more than specification.	—
☞ *P0480	Fan 1 (Radiator cooling fan) control circuit	Monitor signal of radiator cooling fan relay is different from command signal.	1 driving cycle
☞ *P0500	Vehicle speed sensor (VSS) malfunction	No VSS signal during fuel cut for specified time or longer, or VSS signal is not input even if vehicle is driving with more than specified engine speed and D-range (A/T).	2 driving cycles
☞ *P0505	Idle air control system	IAC control duty pulse is not detected in its monitor signal.	2 driving cycles
☞ P0532	A/C refrigerant pressure sensor circuit low	Output voltage of A/C refrigerant pressure sensor is less than specification.	—
☞ P0533	A/C refrigerant pressure sensor circuit high	Output voltage of A/C refrigerant pressure sensor is more than specification.	—
☞ *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
☞ *P0616	Starter relay circuit low	Starter signal is low voltage even though engine is started with vehicle at stop.	2 driving cycles
☞ *P0617	Starter relay circuit high	Starter signal is high voltage for specified time while engine is running.	2 driving cycles
☞ *P1510	ECM backup power supply malfunction	Backup power voltage is out of specification after starting engine.	1 driving cycle
☞ *P1603	TCM trouble code detected	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.	1 driving cycle

DTC No.	Detecting item	Detecting condition (DTC will set when detecting:)	MIL
☞ *P1674	CAN communication (buss off error)	Transmission error that is inconsistent between transmission data and transmission monitor (CAN bus monitor) data is detected more than 7 times continuously.	1 driving cycle
☞ *P1675	CAN communication (transmission error)	Transmission error of communication data for ECM is detected for longer than specified time continuously.	1 driving cycle
☞ *P1676	CAN communication (reception error for TCM)	Reception error of communication data for TCM is detected for longer than specified time continuously.	1 driving cycle
☞ P1678	CAN communication (reception error for BCM)	Reception error of communication data for BCM is detected for longer than specified time continuously.	—
☞ *P2227	Barometric pressure circuit range/performance	Difference of barometric pressure value and intake manifold pressure value is more than specification at engine start.	2 driving cycles
☞ *P2228	Barometric pressure circuit low	Barometric pressure sensor voltage is less than specification.	1 driving cycle
☞ *P2229	Barometric pressure circuit high	Barometric pressure sensor voltage is more than specification.	1 driving cycle
P1614	Transponder response error	Refer to “Diagnostic Trouble Code (DTC) Table: in Section 10C”.	1 driving cycle
P1621	Immobilizer communication error	Refer to “Diagnostic Trouble Code (DTC) Table: in Section 10C”.	1 driving cycle
P1622	EEPROM error	Refer to “Diagnostic Trouble Code (DTC) Table: in Section 10C”.	1 driving cycle
P1623	Unregistered transponder	Refer to “Diagnostic Trouble Code (DTC) Table: in Section 10C”.	1 driving cycle
P1625	Immobilizer antenna error	Refer to “Diagnostic Trouble Code (DTC) Table: in Section 10C”.	1 driving cycle

For Vehicle Equipped with A/T

When using OBD generic scan tool, not only the previous star (*) marked ECM DTC(s) but also the following DTC(s) is displayed on OBD generic scan tool simultaneously.

DTC No.	Detecting item	Detecting condition (DTC will set when detecting)
*P0705	Transmission range sensor circuit malfunction (PRNDL input)	Refer to “DTC Table: in Section 5A”.
*P0707	Transmission range sensor circuit low	
*P0712	Transmission fluid temperature sensor circuit low	
*P0713	Transmission fluid temperature sensor circuit high	
*P0717	Input / Turbine speed sensor circuit no signal	
*P0722	Output speed sensor circuit no signal	
*P0741	Torque converter clutch circuit performance or stuck off	
*P0742	Torque converter clutch circuit stuck on	
*P0751	Shift solenoid-A (No.1) performance or stuck off	
*P0752	Shift solenoid-A (No.1) stuck on	
*P0756	Shift solenoid-B (No.2) performance or stuck off	
*P0757	Shift solenoid-B (No.2) stuck on	
*P0787	Shift / Timing solenoid control circuit low	
*P0788	Shift / Timing solenoid control circuit high	
*P0962	Pressure control solenoid control circuit low	
*P0963	Pressure control solenoid control circuit high	
*P0973	Shift solenoid-A (No.1) control circuit low	
*P0974	Shift solenoid-A (No.1) control circuit high	
*P0976	Shift solenoid-B (No.2) control circuit low	
*P0977	Shift solenoid-B (No.2) control circuit high	
*P1702	Internal control module memory check sum error	
*P1774	Control module communication bus off	
*P1775	High speed can communication bus (Transmission error)	
*P1777	TCM lost communication with ECM (Reception error)	
*P2763	Torque converter clutch pressure control solenoid control circuit high	
*P2764	Torque converter clutch pressure control solenoid control circuit low	

Fail-Safe Table

S4RS0A1104006

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 cooling fan.
☞ P0118	Engine coolant temperature circuit high	
☞ P0122	Throttle position sensor circuit low input	ECM controls actuators assuming that throttle opening is about 20°.
☞ P0123	Throttle position sensor circuit high input	
☞ P0335	Crankshaft position sensor circuit	• Ignition timing is fixed. • 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 that vehicle speed is 0 km/h (0 mile/h). • ECM stops IAC feedback control.
☞ P2227	Barometric pressure sensor performance problem	ECM controls actuators assuming that barometric pressure is 101.33 kPa (762 mmHg).

Scan Tool Data

S4RS0A1104007

As the data values 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 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 following table 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	It idling with no load after warming up	Desired idle speed ± 50 r/min.
	☞ 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.

	Scan tool data	Vehicle condition		Normal condition / reference values
	☞ TP SENSOR VOLT (THROTTLE POSITION SENSOR OUTPUT VOLTAGE)	Ignition switch ON / warmed up engine stopped	Accelerator pedal released	0.5 – 1.0 V
			Accelerator pedal depressed fully	Less than 4.8 V
	☞ DESIRED IDLE (DESIRED IDLE SPEED)	It idling with radiator cooling fan stopped and all electrical parts turned OFF after warming up, M/T at neutral		700 r/min.
	☞ IAC FLOW DUTY (IDLE AIR CONTROL FLOW DUTY)	It 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 B1	At specified idle speed after warming up		–35 – +35%
*	☞ 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)	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, 7.1 – 11.2 in.Hg
	☞ BAROMETRIC PRESS	—		Barometric pressure is displayed
	☞ STEP EGR FLOW DUTY	At specified idle speed after warming up		0%
	☞ FUEL CUT	Engine at fuel cut condition		ON
		Engine at other than fuel cut condition		OFF

	Scan tool data	Vehicle condition		Normal condition / reference values
	☞ A/C PRESSURE (A/C REFRIGERANT ABSOLUTE PRESSURE)	Engine running	A/C ON (A/C is operating) at ambient temperature: 30 °C (86 °F) and humidity: 50%	1350 – 1650 kPa For more details, refer to pressure of high pressure gage under “A/C System Performance Inspection: in Section 7B”.
			A/C OFF (A/C is not operating) at ambient temperature: 30 °C (86 °F) and engine coolant temperature: 90 – 100 °C (194 – 212 °F)	600 – 1000 kPa After longer than 10 min from A/C switch turned 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 at stop		10 – 14 V
	☞ FUEL PUMP	Within 3 seconds after ignition switch ON or engine running		ON
		Engine at stop with 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
	☞ RADIATOR FAN (RADIATOR COOLING FAN CONTROL RELAY)	Ignition switch ON	Engine coolant temp.: Lower than 95 °C (203 °F)	OFF
			Engine coolant temp.: 97.5 °C (208 °F) or higher	ON
	☞ 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	Engine running after warming up, A/C not operating		OFF
		Engine running after warming up, A/C operating		ON
	☞ A/C COMP RELAY	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 (0 mph)
	☞ VVT GAP (TARGET-ACTUAL POSITION)	At specified idle speed after warming up		0 – 3°

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.

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 implies an enleanment correction.

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.

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 × 100%

THROTTLE POS (ABSOLUTE THROTTLE POSITION, %)
When throttle position sensor is at fully closed position, throttle opening is indicated as 0 – 5% 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.

MAP (MANIFOLD ABSOLUTE PRESSURE, in.Hg, 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, in.Hg)
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

A/C PRESSURE (A/C REFRIGERANT ABSOLUTE PRESSURE, kPa)
This parameter indicates A/C refrigerant absolute pressure calculated by ECM.

CLOSED THROTTLE POS (CLOSED THROTTLE POSITION, ON/OFF)
This parameter reads ON when throttle valve is fully closed, or OFF when it is not fully closed.

CANIST PRG 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 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 COOLING FAN (RADIATOR COOLING FAN CONTROL RELAY, ON/OFF)
ON: Command for radiator cooling 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 HVAC.
OFF: Command for A/C operation not being output.

A/C COMP RELAY (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.

VVT GAP (TARGET-ACTUAL POSITION, °)
It is calculated using the formula: target valve timing advance – actual valve timing advance.

Visual Inspection

S4RS0A1104008

Visually check the following parts and systems.

Inspection item	Reference section
• Engine oil – level, leakage	"Engine Oil and Filter Change: in Section 0B"
• Engine coolant – level, leakage	"Coolant Level Check: in Section 1F"
• Fuel – level, leakage	"Fuel Lines and Connections Inspection: in Section 0B"
• Air cleaner element – dirt, clogging	"Air Cleaner Filter Inspection: in Section 0B"
• Battery – fluid level, corrosion of terminal	"Battery Description: in Section 1J"
• Water pump belt – tension damage	"Accessory Drive Belt Inspection: in Section 0B"
• Throttle cable – play (under warm engine), installation	"Accelerator Cable Adjustment: in Section 1D"
• Vacuum hoses of air intake system – disconnection, looseness, deterioration, bend	"Vacuum Hose Inspection: in Section 1B"
• 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: "
• Charge warning lamp – Operation	"Generator Symptom Diagnosis: in Section 1J"
• Engine oil pressure warning lamp – Operation	"Oil Pressure Switch Inspection: in Section 9C"
• Engine coolant temp. meter – Operation	"Engine Coolant Temperature (ECT) Sensor Inspection: in Section 9C"
• Fuel level meter – Operation	"Fuel Level Sensor Inspection: in Section 9C"

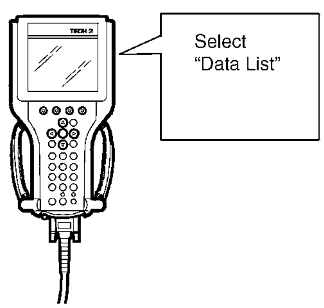
Inspection item	Reference section
• Tachometer – Operation • Abnormal air being inhaled from air intake system • Exhaust system – leakage of exhaust gas, noise • Other parts that can be checked visually	

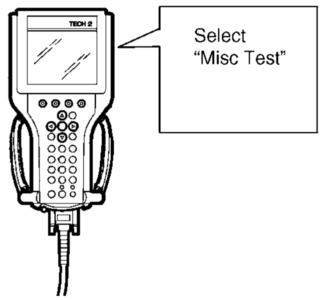
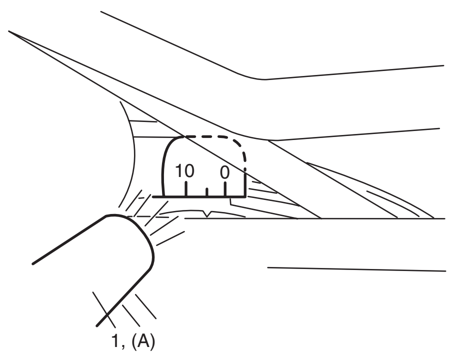
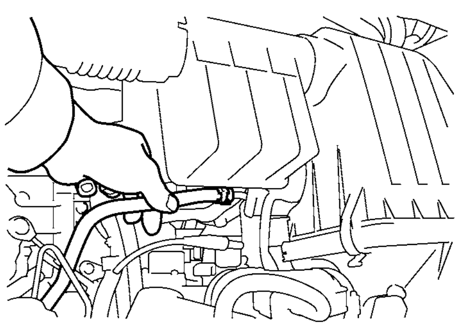
Engine Basic Inspection

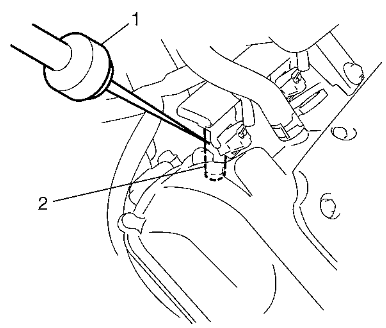
S4RS0A1104009

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 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: ”.
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 1I”.
4	*Does engine start?*	Go to Step 5.	Go to Step 7.
5	**Check idle speed** 1) Warm up engine to normal operating temperature. 2) Shift transmission to neutral position for M/T (“P” position for A/T). 3) Make sure that a electrical loads are switched off. 4) Check engine idle speed with scan tool.  I2RH01110005- *Is it 650 – 750 r/min.?*	Go to Step 6.	Go to “Engine Symptom Diagnosis: ”.

<table>
<tr><th>Step</th><th>Action</th><th>Yes</th><th>No</th></tr>
<tr><td>6</td><td>Check ignition timing
1) Using SUZUKI scan tool, select “Misc Test” mode on SUZUKI scan tool and fix ignition timing to initial one.

I2RH01110006-
2) Using timing light, check initial ignition timing.
Special tool
(A): 09930–76420

I3RB0A180004-
Is it 5 °±3 °BTDC at specified idle speed?</td><td>Go to “Engine Symptom Diagnosis: ”.</td><td>Check ignition control related parts referring to “Ignition Timing Inspection: in Section 1H”.</td></tr>
<tr><td>7</td><td>Check immobilizer system malfunction
1) Check immobilizer indicator lamp for flashing.
Is it flashing when ignition switch is turned to ON position?</td><td>Go to “Diagnostic Trouble Code (DTC) Check: in Section 10C”.</td><td>Go to Step 8.</td></tr>
<tr><td>8</td><td>Check fuel supply
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.
Is fuel pressure felt from fuel feed hose when ignition switch is turned ON?

I3RM0A110014-</td><td>Go to Step 10.</td><td>Go to Step 9.</td></tr>
</table>

Step	Action	Yes	No
9	**Check fuel pump for operation** *Was fuel pump operating sound heard from fuel filler for about 3 seconds after ignition switch ON and stop?*	Go to “Fuel Pressure Check: ”.	Go to “Fuel Pump and Its Circuit Check: ”.
10	**Check ignition spark** 1) Disconnect injector couplers. 2) Remove spark plugs and connect them to high-tension cords or ignition coil assembly. 3) Ground spark plugs. 4) Crank engine and check if each spark plug sparks. *Is it in good condition?*	Go to Step 11.	Go to “Ignition Spark Test: in Section 1H”.
11	**Check fuel injector for operation** 1) Install spark plugs and connect injector connectors. 2) Using sound scope (1), check operating sound of each injector (2) when cranking engine.  I3RM0A110015- *Was injector operating sound heard from all injectors?*	Go to “Engine Symptom Diagnosis: ”.	Go to “Fuel Injector Circuit Check: ”.

Engine Symptom Diagnosis

S4RS0A1104010

Perform troubleshooting referring to the followings when ECM has detected no DTC and no abnormality has been found in “Visual Inspection: ” and “Engine Basic Inspection: ”.

Condition	Possible cause	Correction / Reference Item
Hard starting (Engine cranks OK)	Faulty spark plug	*“Spark Plug Inspection: in Section 1H”*
	Leaky high-tension cord	*“High-Tension Cord Inspection: in Section 1H”*
	Loose connection or disconnection of high-tension cord(s) or lead wire(s)	*“High-Tension Cord Removal and Installation: in Section 1H”*
	Faulty ignition coil	*“Ignition Coil Assembly (Including ignitor) Inspection: in Section 1H”*
	Dirty or clogged fuel hose or pipe	*“Fuel Pressure Check: ”*
	Malfunctioning fuel pump	*“Fuel Pressure Check: ”*
	Air drawn in through intake manifold gasket or throttle body gasket	
	Faulty idle air control system	*“Idle Air Control System Check: ”*
	Faulty ECT sensor or MAF sensor	*“Engine Coolant Temperature (ECT) Sensor Inspection: in Section 1C” or “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection: in Section 1C”*
	Faulty ECM	
	Low compression	*“Compression Check: in Section 1D”*
	Poor spark plug tightening or faulty gasket	*“Spark Plug Removal and Installation: in Section 1H”*
	Compression leak from valve seat	*“Valves and Valve Guides Inspection: in Section 1D”*
	Sticky valve stem	*“Valves and Valve Guides Inspection: in Section 1D”*
	Weak or damaged valve springs	*“Valve Spring Inspection: in Section 1D”*
	Compression leak at cylinder head gasket	*“Cylinder Head Inspection: in Section 1D”*
	Sticking or damaged piston ring	*“Cylinders, Pistons and Piston Rings Inspection: in Section 1D”*
	Worn piston, ring or cylinder	*“Cylinders, Pistons and Piston Rings Inspection: in Section 1D”*
	Malfunctioning PCV valve	*“PCV Valve Inspection: in Section 1B”*
	Camshaft position control (VVT) system out of order	*“Oil Control Valve Inspection: in Section 1D”*
	Faulty EGR system	*“EGR System Inspection: in Section 1B”*
Low oil pressure	Improper oil viscosity	*“Engine Oil and Filter Change: in Section 0B”*
	Malfunctioning oil pressure switch	*“Oil Pressure Switch Inspection: in Section 9C”*
	Clogged oil strainer	*“Oil Pan and Oil Pump Strainer Cleaning: in Section 1E”*
	Functional deterioration of oil pump	*“Oil Pump Inspection: in Section 1E”*
	Worn oil pump relief valve	*“Oil Pump Inspection: in Section 1E”*
	Excessive clearance in various sliding parts	
Engine noise – Valve noise	Improper valve lash	*“Camshaft, Tappet and Shim Inspection: in Section 1D”*
NOTE:	Worn valve stem and guide	*“Valves and Valve Guides Inspection: in Section 1D”*
Before checking mechanical noise, make sure that:	Weak or broken valve spring	*“Valve Spring Inspection: in Section 1D”*
• Specified spark plug is used. ***• Specified fuel is used.***	Warped or bent valve	*“Valves and Valve Guides Inspection: in Section 1D”*

Condition	Possible cause	Correction / Reference Item
Engine noise – Piston, ring and cylinder noise ***NOTE:*** ***Before checking mechanical noise, make sure that:*** • ***Specified spark plug is used.*** • ***Specified fuel is used.***	Worn piston, ring and cylinder bore	*"Cylinders, Pistons and Piston Rings Inspection: in Section 1D"*
Engine noise – Connecting rod noise ***NOTE:*** ***Before checking mechanical noise, make sure that:*** • ***Specified spark plug is used.*** • ***Specified fuel is used.***	Worn piston, ring and cylinder bore	*"Cylinders, Pistons and Piston Rings Inspection: in Section 1D"*
	Worn rod bearing	*"Crank Pin and Connecting Rod Bearings Inspection: in Section 1D"*
	Worn crank pin	*"Crank Pin and Connecting Rod Bearings Inspection: in Section 1D"*
	Loose connecting rod nuts	*"Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation: in Section 1D"*
	Low oil pressure	*Condition "Low oil pressure"*
Engine noise – Crankshaft noise ***NOTE:*** ***Before checking mechanical noise, make sure that:*** • ***Specified spark plug is used.*** • ***Specified fuel is used.***	Low oil pressure	*Condition "Low oil pressure"*
	Worn bearing	*"Main Bearings Inspection: in Section 1D"*
	Worn crankshaft journal	*"Crankshaft Inspection: in Section 1D"*
	Loose bearing cap bolts	*"Main Bearings, Crankshaft and Cylinder Block Removal and Installation: in Section 1D"*
	Excessive crankshaft thrust play	*"Crankshaft Inspection: in Section 1D"*
Engine overheating	Inoperative thermostat	*"Thermostat Inspection: in Section 1F"*
	Poor water pump performance	*"Water Pump Inspection: in Section 1F"*
	Clogged or leaky radiator	*"Radiator On-Vehicle Inspection and Cleaning: in Section 1F"*
	Improper engine oil grade	*"Engine Oil and Filter Change: in Section 0B"*
	Clogged oil filter or oil strainer	*"Oil Pressure Check: in Section 1E"*
	Poor oil pump performance	*"Oil Pressure Check: in Section 1E"*
	Faulty radiator cooling fan control system	*"Radiator cooling fan Low Speed Control System Check: " or "Radiator cooling fan High Speed Control System Check: "*
	Dragging brakes	*Condition "Dragging brakes" in "Brakes Symptom Diagnosis: in Section 4A"*
	Slipping clutch	*Condition "Slipping clutch" in "Clutch System Symptom Diagnosis: in Section 5C"*
	Blown cylinder head gasket	*"Cylinder Head Inspection: in Section 1D"*
	Air mixed in cooling system	

Condition	Possible cause	Correction / Reference Item
Poor gasoline mileage	Leaks or loose connection of high-tension cord	*"High-Tension Cord Removal and Installation: in Section 1H"*
	Faulty spark plug (improper gap, heavy deposits and burned electrodes, etc.)	*"Spark Plug Inspection: in Section 1H"*
	Malfunctioning EGR valve	*"EGR Valve Inspection: in Section 1B"*
	High idle speed	*Condition "Improper engine idling or engine fails to idle"*
	Poor performance of ECT sensor, TP sensor or MAF sensor	*"Engine Coolant Temperature (ECT) Sensor Inspection: in Section 1C", "Throttle Position (TP) Sensor On-Vehicle Inspection: in Section 1C" or "Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection: in Section 1C"*
	Faulty fuel injector(s)	*"Fuel Injector Circuit Check: "*
	Faulty ECM	
	Low compression	*"Compression Check: in Section 1D"*
	Poor valve seating	*"Valves and Valve Guides Inspection: in Section 1D"*
	Dragging brakes	*Condition "Dragging brakes" in "Brakes Symptom Diagnosis: in Section 4A"*
	Slipping clutch	*Condition "Slipping clutch" in"Clutch System Symptom Diagnosis: in Section 5C"*
	Thermostat out of order	*"Thermostat Inspection: in Section 1F"*
	Improper tire pressure	*"Tires Description: in Section 2D"*
	Camshaft position control (VVT) system out of order	*"Oil Control Valve Inspection: in Section 1D"*
Excessive engine oil consumption – Oil leakage	Blown cylinder head gasket	*"Cylinder Head Inspection: in Section 1D"*
	Leaky camshaft oil seals	*"Camshaft, Tappet and Shim Inspection: in Section 1D"*
Excessive engine oil consumption – Oil entering combustion chamber	Sticky piston ring	*"Cylinders, Pistons and Piston Rings Inspection: in Section 1D"*
	Worn piston and cylinder	*"Cylinders, Pistons and Piston Rings Inspection: in Section 1D"*
	Worn piston ring groove and ring	*"Cylinders, Pistons and Piston Rings Inspection: in Section 1D"*
	Improper location of piston ring gap	*"Pistons, Piston Rings, Connecting Rods and Cylinders Disassembly and Assembly: in Section 1D"*
	Worn or damaged valve stem seal	*"Valves and Valve Guides Inspection: in Section 1D"*
	Worn valve stem	*"Valves and Valve Guides Inspection: in Section 1D"*
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 Plug Inspection: in Section 1H"*
	Leaky high-tension cord	*"High-Tension Cord Inspection: in Section 1H"*
	Fuel pressure out of specification	*"Fuel Pressure Check: "*
	Malfunctioning EGR valve	*"EGR Valve Inspection: in Section 1B"*
	Poor performance of TP sensor, ECT sensor or MAF sensor	*"Throttle Position (TP) Sensor On-Vehicle Inspection: in Section 1C", "Engine Coolant Temperature (ECT) Sensor Inspection: in Section 1C" or "Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection: in Section 1C"*
	Faulty fuel injector	*"Fuel Injector Circuit Check: "*
	Faulty ECM	
	Engine overheating	*Condition "Engine overheating"*
	Low compression	*"Compression Check: in Section 1D"*
	Camshaft position control (VVT) system out of order	*"Oil Control Valve Inspection: in Section 1D"*

Condition	Possible cause	Correction / 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 Cord Removal and Installation: in Section 1H"*
	Faulty spark plug (excess carbon deposits, improper gap, burned electrodes, etc.)	*"Spark Plug Inspection: in Section 1H"*
	Variable fuel pressure	*"Fuel Pressure Check: "*
	Kinky or damaged fuel hose and lines	
	Faulty fuel pump (clogged fuel filter)	
	Malfunctioning EGR valve	*"EGR Valve Inspection: in Section 1B"*
	Poor performance of MAF sensor	*"Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection: in Section 1C"*
	Faulty fuel injector	*"Fuel Injector Circuit Check: "*
	Faulty ECM	
Excessive detonation – Engine makes continuously sharp metallic knocks that change with throttle opening. Sounds like pop corn popping.	Faulty spark plug	*"Spark Plug Inspection: in Section 1H"*
	Loose connection of high-tension cord	*"High-Tension Cord Removal and Installation: in Section 1H"*
	Engine overheating	*Condition "Engine overheating"*
	Clogged fuel filter (faulty fuel pump) or fuel lines	*"Fuel Injector Circuit Check: " or "Fuel Pump and Its Circuit Check: "*
	Air drawn in through intake manifold or throttle body gasket	
	Malfunctioning EGR valve	*"EGR Valve Inspection: in Section 1B"*
	Poor performance of knock sensor, ECT sensor or MAF sensor	*"DTC P0327 / P0328: Knock Sensor Circuit Low / High: ", "Engine Coolant Temperature (ECT) Sensor Inspection: in Section 1C" or "Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection: in Section 1C"*
	Faulty fuel injector(s)	*"Fuel Injector Circuit Check: "*
	Faulty ECM	
	Excessive combustion chamber deposits	*"Cylinders, Pistons and Piston Rings Inspection: in Section 1D" and/or "Piston Pins and Connecting Rods Inspection: in Section 1D"*
	Camshaft position control (VVT) system out of order	*"Oil Control Valve Inspection: in Section 1D"*

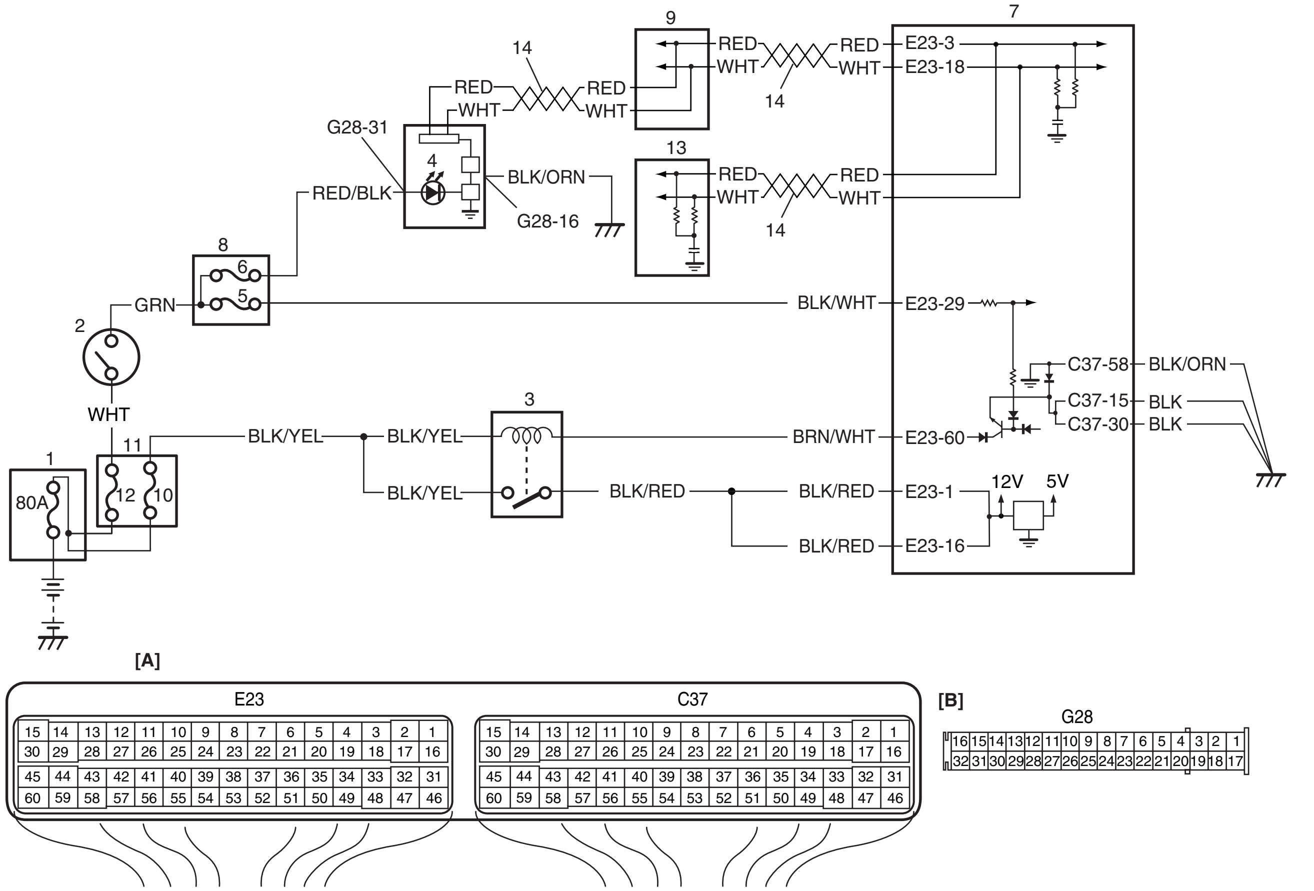
Condition	Possible cause	Correction / Reference Item
Engine has no power	Faulty spark plug	*“Spark Plug Inspection: in Section 1H”*
	Faulty ignition coil with ignitor	*“Ignition Coil Assembly (Including ignitor) Inspection: in Section 1H”*
	Leaks, loose connection or disconnection of high-tension cord	*“High-Tension Cord Removal and Installation: in Section 1H”*
	Faulty knock sensor	*“DTC P0327 / P0328: Knock Sensor Circuit Low / High: ”*
	Clogged fuel hose or pipe	*“Fuel Pressure Check: ”*
	Malfunctioning fuel pump	*“Fuel Pump and Its Circuit Check: ”*
	Air drawn in through intake manifold gasket or throttle body gasket	
	Engine overheating	*Condition “Engine overheating”*
	Malfunctioning EGR valve	*“EGR Valve Inspection: in Section 1B”*
	Maladjusted accelerator cable play	*“Accelerator Cable Adjustment: in Section 1D”*
	Poor performance of TP sensor, ECT sensor or MAF sensor	*“Throttle Position (TP) Sensor On-Vehicle Inspection: in Section 1C”, “Engine Coolant Temperature (ECT) Sensor Inspection: in Section 1C” or “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection: in Section 1C”*
	Faulty fuel injector(s)	*“Fuel Injector Circuit Check: ”*
	Faulty ECM	
	Dragging brakes	*Condition “Dragging brakes” in “Brakes Symptom Diagnosis: in Section 4A”*
	Slipping clutch	*Condition “Slipping clutch” in “Clutch System Symptom Diagnosis: in Section 5C”*
	Low compression	*“Compression Check: in Section 1D”*
	Camshaft position control (VVT) system out of order	*“Oil Control Valve Inspection: in Section 1D”*
Improper engine idling or engine fails to idle	Faulty spark plug	*“Spark Plug Inspection: in Section 1H”*
	Leaky or disconnected high-tension cord	*“High-Tension Cord Removal and Installation: in Section 1H”*
	Faulty ignition coil with ignitor	*“Ignition Coil Assembly (Including ignitor) Inspection: in Section 1H”*
	Fuel pressure out of specification	*“Fuel Pressure Check: ”*
	Leaky manifold, throttle body, or cylinder head gasket	
	Malfunctioning EGR valve	*“EGR Valve Inspection: in Section 1B”*
	Faulty idle air control system	*“Idle Air Control System Check: ”*
	Faulty evaporative emission control system	*“EVAP Canister Purge Inspection: in Section 1B”*
	Faulty EGR system	*“EGR System Inspection: in Section 1B”*
	Faulty fuel injector(s)	*“Fuel Injector Circuit Check: ”*
	Poor performance of ECT sensor, TP sensor or MAF sensor	*“Engine Coolant Temperature (ECT) Sensor Inspection: in Section 1C”, “Throttle Position (TP) Sensor On-Vehicle Inspection: in Section 1C” or “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection: in Section 1C”*
	Faulty ECM	
	Loose connection or disconnection of vacuum hoses	
	Malfunctioning PCV valve	*“PCV Valve Inspection: in Section 1B”*
	Engine overheating	*Condition “Engine overheating”*
	Low compression	*“Compression Check: in Section 1D”*
	Camshaft position control (VVT) system out of order	*“Oil Control Valve Inspection: in Section 1D”*

Condition	Possible cause	Correction / Reference Item
Excessive hydrocarbon (HC) emission or carbon monoxide (CO)	Faulty spark plug	*“Spark Plug Inspection: in Section 1H”*
	Leaky or disconnected high-tension cord	*“High-Tension Cord Removal and Installation: in Section 1H”*
	Faulty ignition coil with ignitor	*“Ignition Coil Assembly (Including ignitor) Inspection: in Section 1H”*
	Low compression	*“Compression Check: in Section 1D”*
	Lead contamination of three way catalytic converter	*Check for absence of filler neck restrictor.*
	Faulty evaporative emission control system	*“EVAP Canister Purge Inspection: in Section 1B”*
	Fuel pressure out of specification	*“Fuel Pressure Check: ”*
	Closed loop system (A/F feedback compensation) fails (Faulty TP sensor, Poor performance of ECT sensor or MAF sensor)	*“Throttle Position (TP) Sensor On-Vehicle Inspection: in Section 1C”, “Engine Coolant Temperature (ECT) Sensor Inspection: in Section 1C” or “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection: in Section 1C”*
	Faulty injector(s)	*“Fuel Injector Circuit Check: ”*
	Faulty ECM	
	Engine not at normal operating temperature	
	Clogged air cleaner	*“Air Cleaner Element Inspection and Cleaning: in Section 1D”*
	Vacuum leaks	*“Engine Vacuum Check: in Section 1D”*
	Camshaft position control (VVT) system out of order	*“Oil Control Valve Inspection: in Section 1D”*
Excessive nitrogen oxides (NOx) emission	Improper ignition timing	*“Ignition Timing Inspection: in Section 1H”*
	Lead contamination of catalytic converter	*Check for absence of filler neck restrictor.*
	Faulty EGR system	*“EGR System Inspection: in Section 1B”*
	Fuel pressure out of specification	*“Fuel Pressure Check: ”*
	Closed loop system (A/F feedback compensation) fails (Faulty TP sensor, Poor performance of ECT sensor or MAF sensor)	*“Throttle Position (TP) Sensor On-Vehicle Inspection: in Section 1C”, “Engine Coolant Temperature (ECT) Sensor Inspection: in Section 1C”or “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection: in Section 1C”*
	Faulty injector(s)	*“Fuel Injector Circuit Check: ”*
	Faulty ECM	
	Camshaft position control (VVT) system out of order	*“Oil Control Valve Inspection: in Section 1D”*

Malfunction Indicator Lamp Does Not Come ON with Ignition Switch ON and Engine Stop (but Engine Can Be Started)

S4RS0A1104011

Wiring Diagram



I4RS0A110014-

[A]:	ECM connector (viewed from harness side)	3.	Main relay	7.	ECM	11.	Relay box
[B]:	Combination meter connector (viewed from harness side)	4.	Malfunction indicator lamp in combination meter	8.	Junction block assembly	12.	“IG ACC” fuse
1.	Main fuse box	5.	“IG COIL” fuse	9.	BCM	13.	TCM
2.	Ignition switch	6.	“METER” fuse	10.	“FI” fuse	14.	CAN communication line

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, transmits indication ON signal of malfunction indicator lamp (MIL) to combination meter in order to turn MIL ON. And then, combination meter turns MIL ON. When the engine starts to run and no malfunction is detected in the system, ECM transmits MIL indication OFF signal to combination meter in order to turn MIL OFF. And then, combination meter turns MIL OFF, but if a malfunction was or is detected, MIL remains ON even when the engine is running.

Troubleshooting

NOTE:

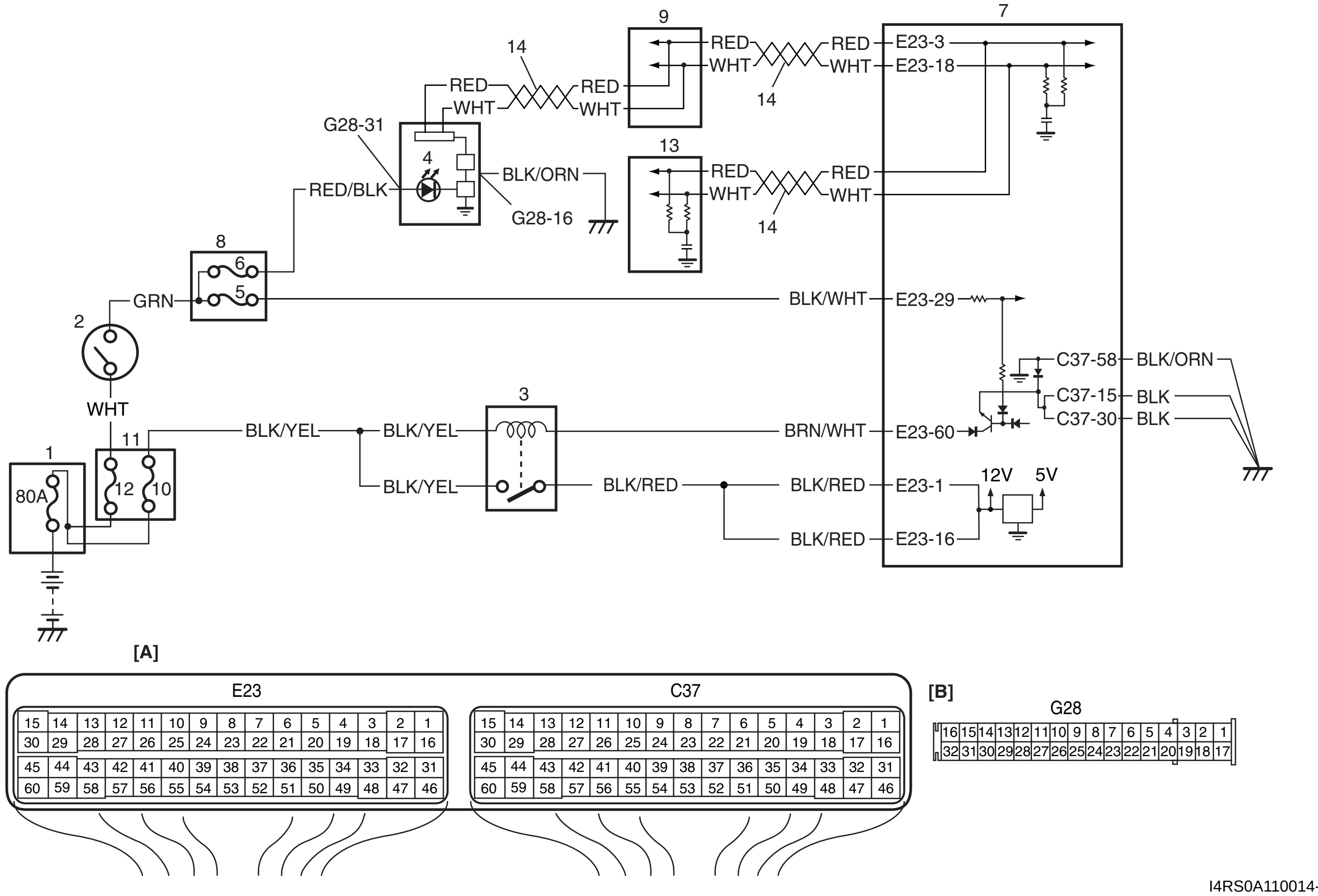
- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**

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 2.	Go to Step 3.
2	**DTC check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Turn ON ignition switch and check DTC. *Is there DTC(s) P1674, P1675 and/or P1678?*	Go to applicable DTC diag. flow.	Substitute a known-good combination meter and recheck. If MIL still remains OFF, substitute a known-good ECM and recheck.
3	**CAN communication line circuit check** 1) Check CAN communication circuit between combination meter and ECM or TCM (equipped with A/T) referring to Step 9 to 14 of "DTC P1674: CAN Communication (Bus Off Error): " *Is circuit in good condition?*	Go to Step 4.	Repair or replace.
4	**"METER" fuse check** 1) Turn ignition switch to OFF position. 2) Check for fuse blown at "METER" fuse in junction block assembly. *Is "METER" fuse in good condition?*	Go to Step 5.	Replace "METER" fuse and check for short.
5	**Combination meter power supply check** 1) Remove combination meter referring to "Combination Meter Removal and Installation: in Section 9C". 2) Check for proper connection to combination meter connector at "G28-31" and "G28-16" terminals. 3) If OK, then turn ignition switch to ON position and measure voltage between combination meter connector at "G28-31" terminal and vehicle body ground. *Is it 10 – 14 V?*	Go to Step 6.	"RED/BLK" wire is open circuit.
6	**Combination meter circuit check** 1) Turn ignition switch to OFF position. 2) Measure resistance between "G28-16" terminal of combination meter connector and vehicle body ground. *Is resistance 1 Ω or less?*	Substitute a known-good combination meter and recheck. If MIL still remains OFF, substitute a known-good ECM and recheck.	"BLK/ORN" wire is open or high resistance circuit.

Malfunction Indicator Lamp Remains ON after Engine Starts

S4RS0A1104012

Wiring Diagram



[A]:	ECM connector (viewed from harness side)	3.	Main relay	7.	ECM	11.	Relay box
[B]:	Combination meter connector (viewed from harness side)	4.	Malfunction indicator lamp in combination meter	8.	Junction block assembly	12.	"IG ACC" fuse
1.	Main fuse box	5.	"IG COIL" fuse	9.	BCM	13.	TCM
2.	Ignition switch	6.	"METER" fuse	10.	"FI" fuse	14.	CAN communication line

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, transmits indication ON signal of malfunction indicator lamp (MIL) to combination meter in order to turn MIL ON. And then, combination meter turns MIL ON. When the engine starts to run and no malfunction is detected in the system, ECM transmits MIL indication OFF signal to combination meter in order to turn MIL OFF. And then, combination meter turns MIL OFF, but if a malfunction was or is detected, MIL remains ON even when the engine is running.

Troubleshooting

NOTE:

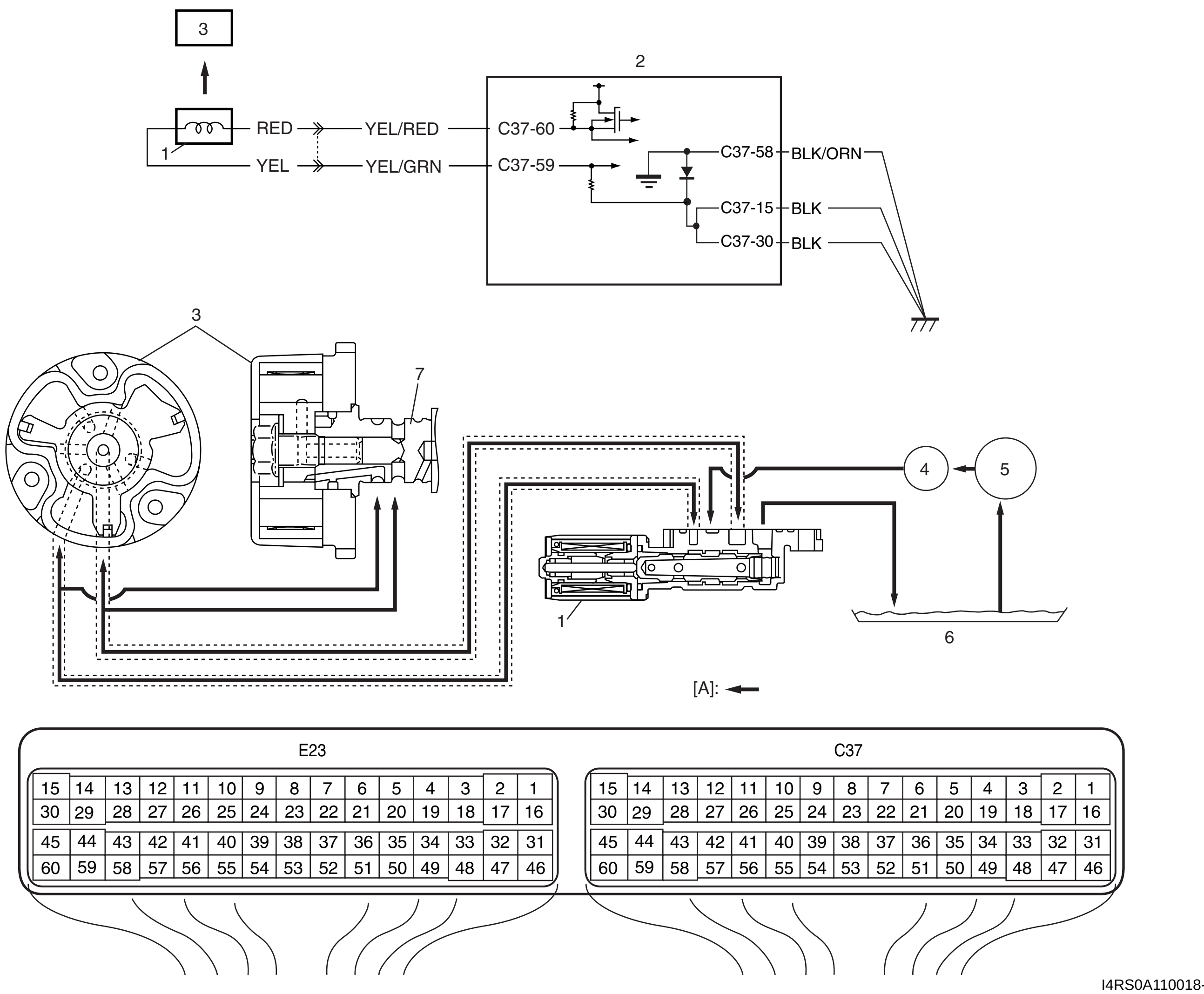
- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**

Step	Action	Yes	No
1	**DTC check** 1) Start engine and recheck DTC of ECM and TCM while engine running. *Is there any DTC(s)?*	Go to Step 2 of “Engine and Emission Control System Check: ” or Step 2 of “A/T System Check: in Section 5A”.	Go to Step 2.
2	**CAN communication line circuit check** 1) Check CAN communication line circuit between combination meter and ECM or TCM (equipped with A/T) referring to Step 9 to 14 “DTC P1674: CAN Communication (Bus Off Error): ”. *Is circuit in good condition?*	Substitute a known-good combination meter and recheck. If MIL still remains OFF, substitute a known-good ECM and recheck.	Repair or replace CAN communication circuit.

DTC P0010: Camshaft Position Actuator Circuit

S4RS0A1104014

System and 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 to “DTC Check: ”.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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	**Oil control valve electrical circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Check for proper connection at “C37-60” and “C37-59” terminals of ECM connector. 3) If OK, measure resistance between “C37-60” and “C37-59” terminals of ECM connector. *Is resistance below 10 Ω?*	Go to Step 3.	Go to Step 8.
3	**Oil control valve electrical circuit check** *Was resistance more than 6.5 Ω in Step 2?*	Go to Step 4.	Go to Step 7.
4	**Oil control valve electrical circuit for power short check** 1) Turn ON ignition switch. 2) Measure voltage between “C37-60” terminal of ECM connector and engine ground. *Is voltage below 1 V?*	Go to Step 5.	“RED”, “YEL/RED”, “YEL” or “YEL/GRN” wire is shorted to power supply circuit.
5	**Oil control valve electrical circuit for ground short check** 1) Disconnect connector from oil control valve with ignition switch turned OFF. 2) Measure resistance between “C37-60” terminal of ECM connector and engine ground. *Is resistance infinity?*	Go to Step 6.	“YEL/RED” wire is shorted to ground circuit.
6	**Oil control valve electrical circuit for ground short check** 1) Measure resistance between “C37-59” terminal of ECM connector and engine ground. *Is resistance infinity?*	Go to Step 9.	“YEL/GRN” wire is shorted to ground circuit.
7	**Oil control valve electrical circuit for short check** 1) Disconnect connector from oil control valve with ignition switch turned OFF. 2) Measure resistance between “C37-60” and “C37-59” terminals of ECM connector. *Is resistance infinity?*	Go to Step 9.	“YEL/RED” wire is shorted to “YEL/GRN” wire.

Step	Action	Yes	No
8	**Oil control valve electrical circuit check** 1) Disconnect connector from oil control valve with ignition switch turned OFF. 2) Measure resistance between “C37-60” terminal of ECM connector and “YEL/RED” wire terminal of oil control valve connector and between “C37-59” terminal of ECM connector and “YEL/GRN” wire terminal of oil control valve connector. *Is resistance below 1 Ω?*	Go to Step 9.	“YEL/RED” wire or “YEL/GRN” wire circuit is open or high resistance.
9	**Oil control valve check** Check oil control valve referring to “Oil Control Valve Inspection: in Section 1D”. *Is resistance within specified value?*	Substitute a known-good ECM and recheck.	Faulty oil control valve.

DTC P0011 / P0012: Camshaft Position - Timing Over-Advanced or System Performance / -Retarded

S4RS0A1104015

System 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 value 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 (Camshaft position control (VVT) actuator) • Oil control 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 by 2 persons, 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”.

- **altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)**

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 turn OFF ignition switch OFF.
9) Repeat Step 4) to 7) one time.
10) Stop vehicle.

11) Check DTC. Refer to “DTC Check: ”.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

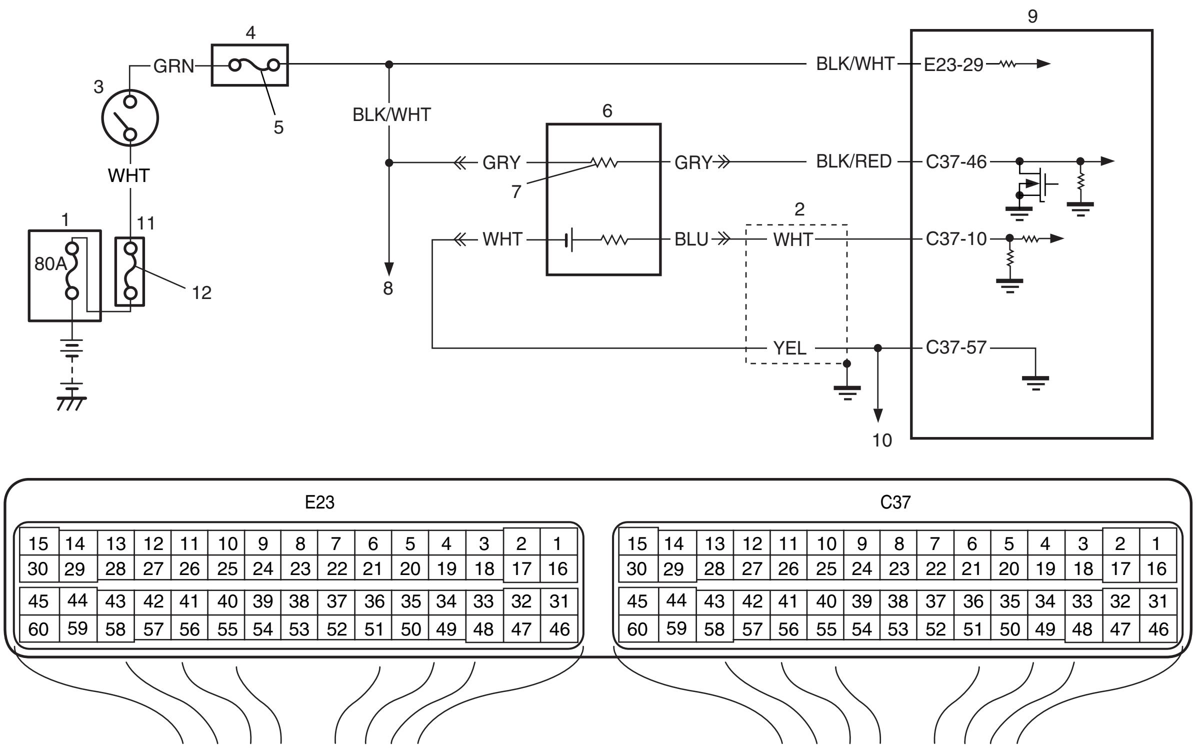
Step	Action	Yes	No
1	*Is DTC P0010 detected together?*	Go to “DTC P0010: Camshaft Position Actuator Circuit: ”.	Go to Step 2.
2	*Do you have SUZUKI scan tool?*	Go to Step 3.	Go to Step 5.
3	**Camshaft position control check** 1) With ignition switch turned OFF, connect SUZUKI scan tool. 2) Start engine 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 “Timing Chain and Chain Tensioner Removal and Installation: in Section 1D”. If OK, go to Step 5.
4	**Camshaft position control check** 1) Drive vehicle under following conditions. • Vehicle speed at 80 km/h (50 mile/h). • Gear position at 5th or D range. 2) Check that “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 1D”. 2) Check oil pressure leakage from oil control circuit. *Is it in good condition?*	Go to Step 6.	Repair or replace.
6	**Oil control valve and oil gallery pipe check** 1) Remove oil control valve referring to “Oil Control Valve Removal and Installation: in Section 1D”. 2) Remove oil gallery pipe referring to “Timing Chain Cover Removal and Installation: in Section 1D”. 3) Check oil gallery pipe and oil control valve for clog or sludge. *Are they 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	**Oil control valve electrical circuit check** 1) Check that oil control valve circuit is in good condition referring to “DTC P0010: Camshaft Position Actuator Circuit: ”. *Is circuit in good condition?*	Repair circuit.	Go to Step 8.

Step	Action	Yes	No
8	**Oil control valve check** 1) Check oil control valve referring to“Oil Control Valve Inspection: in Section 1D”. *Is it in good condition?*	Replace camshaft timing sprocket.	Replace oil control valve.

DTC P0031 / P0032: HO2S Heater Control Circuit Low / High (Sensor-1)

S4RS0A1104029

Wiring Diagram



I4RS0A110029-

1. Main fuse box	4. Junction block assembly	7. Heater	10. To other sensor
2. Shield wire	5. “IG COIL” fuse	8. To HO2S-2 heater	11. Relay box
3. Ignition switch	6. HO2S-1	9. ECM	12. “IG ACC” fuse

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
Current of HO2S-1 heater is more than specified value or lower than specified value for 5 seconds continuously. (2 driving cycle detection logic)	• HO2S-1 heater circuit • HO2S-1 heater • 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.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

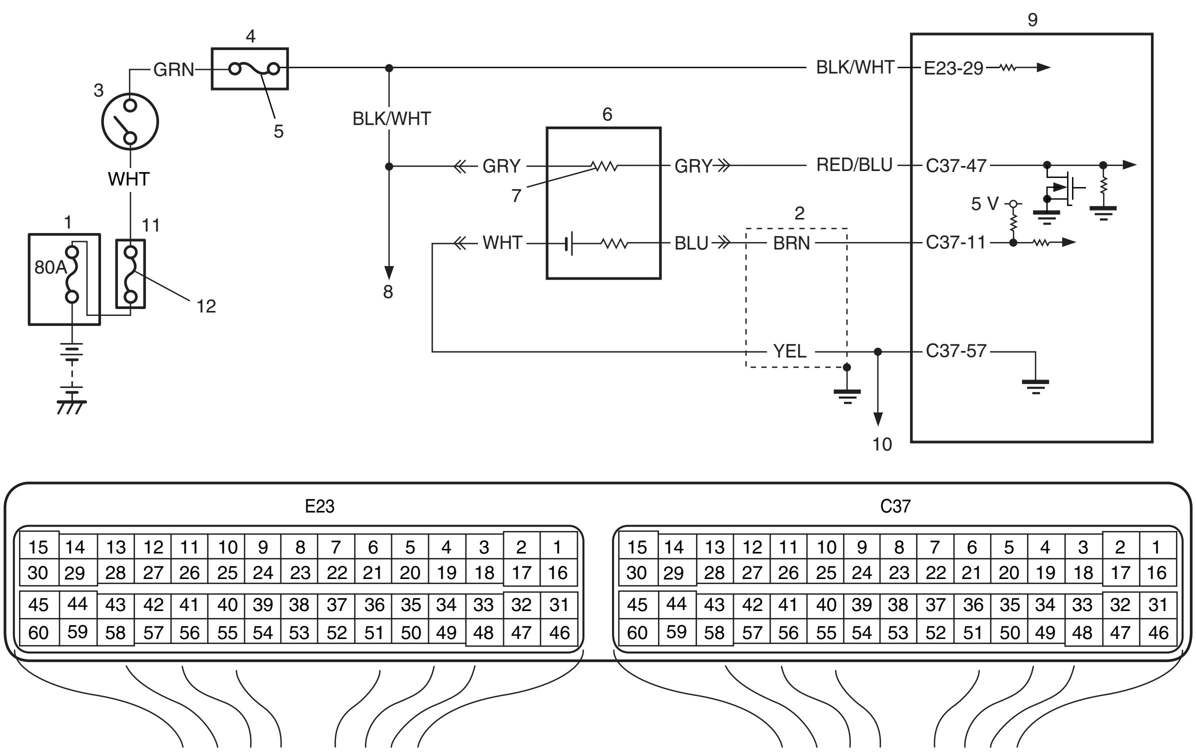
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**HO2S-1 heater power circuit check** 1) Disconnect connector from HO2S-1 with ignition switch turned OFF. 2) Check for proper connection to HO2S-1 at “BLK/WHT” and “BLK/RED” 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 is open circuit or shorted to ground circuit.
3	**HO2S-1 heater power circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “BLK/WHT” wire terminal of HO2S-1 connector and “E23-29” terminal of ECM connector. *Is resistance below 5 Ω?*	Go to Step 4.	“BLK/WHT” wire is high resistance circuit.
4	**HO2S-1 heater drive circuit check** 1) Measure resistance between “C37-46” terminal of ECM connector and vehicle body ground. *Is resistance infinity?*	Go to Step 5.	“BLK/RED” wire is shorted to ground circuit.
5	**HO2S-1 heater drive circuit check** 1) Turn ON ignition switch. 2) Measure voltage between “C37-46” terminal of ECM connector and vehicle body ground. *Is voltage 0 V?*	Go to Step 6.	“BLK/RED” wire is shorted to power circuit.
6	**HO2S-1 heater drive circuit check** 1) Connect connector to HO2S-1 with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Measure voltage between “C37-46” terminal of ECM connector and vehicle body ground with connector disconnected from ECM. *Is voltage over 10 V?*	Go to Step 7.	“BLK/RED” wire is open circuit.

Step	Action	Yes	No
7	**HO2S-1 heater check** 1) Disconnect HO2S-1 connector with ignition switch turned OFF. 2) Check HO2S-1 heater resistance referring to “Heated Oxygen Sensor (HO2S-1 and HO2S-2) Heater On-Vehicle Inspection: in Section 1C”. *Is resistance within specified value range?*	Go to Step 8.	Replace HO2S-1.
8	**HO2S-1 heater power circuit check** 1) Connect connector to HO2S-1 with ignition switch turned OFF. 2) Measure resistance between “E23-29” and “C37-46” terminals of ECM connector. *It resistance below 12 Ω?*	HO2S-1 heater circuit is OK. Substitute a known-good ECM and recheck.	“BLK/WHT”, “BLK/RED” and / or “GLY” wire is high resistance circuit.

DTC P0037 / P0038: HO2S Heater Control Circuit Low / High (Sensor-2)

S4RS0A1104031

Wiring Diagram



I4RS0A110030-

1. Main fuse box	4. Junction block assembly	7. Heater	10. To other sensor
2. Shield wire	5. “IG COIL” fuse	8. To HO2S-1 heater	11. Relay box
3. Ignition switch	6. HO2S-2	9. ECM	12. “IG ACC” fuse

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

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.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

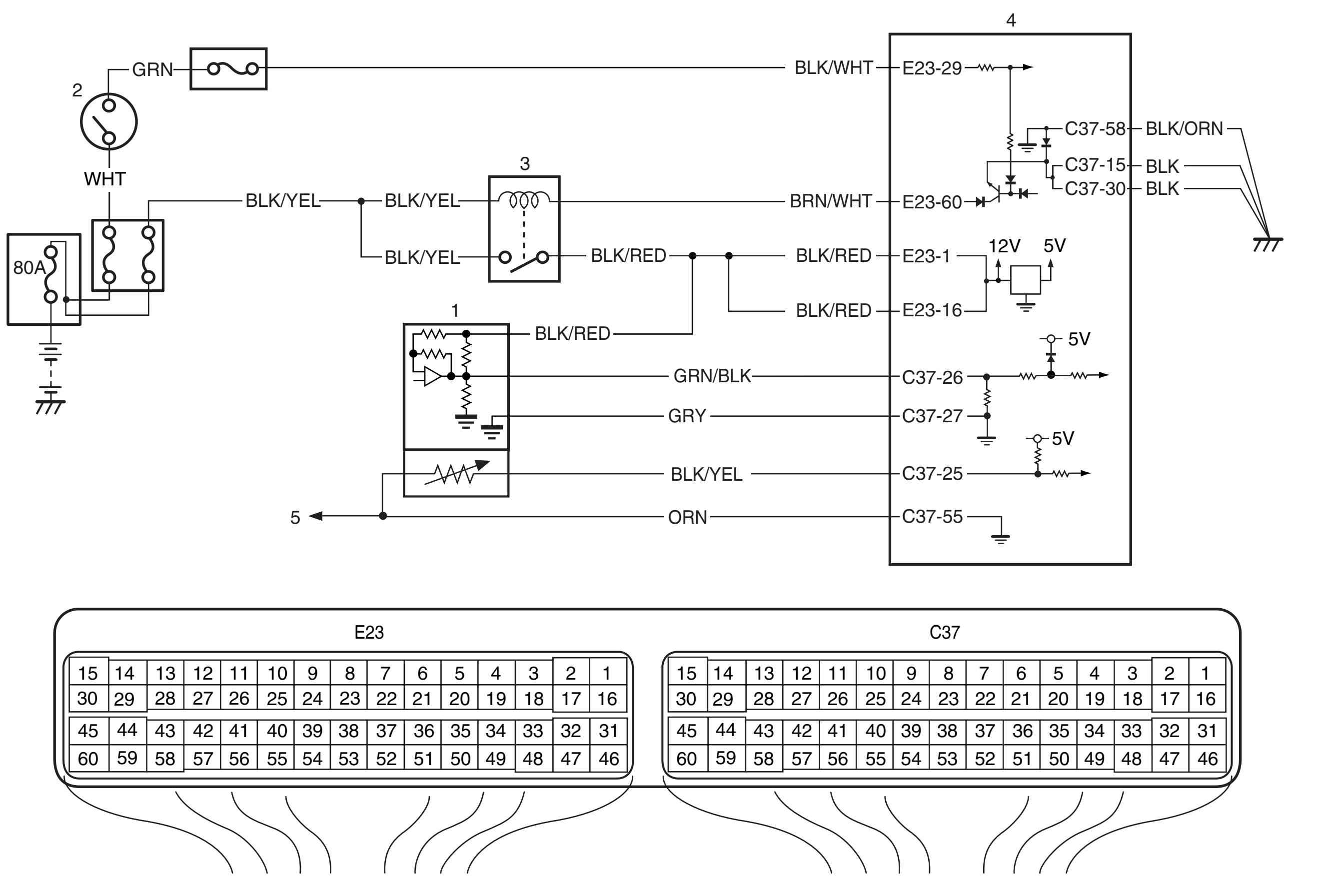
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**HO2S-2 heater power circuit check** 1) Disconnect connector from HO2S-2 with ignition switch turned OFF. 2) Check for proper connection to HO2S-2 at “BLK/WHT” and “RED/BLU” wire terminals. 3) If wire and connection are OK, measure voltage between “BLK/WHT” wire terminal of HO2S-2 connector and engine ground with ignition switch turned ON. *Is voltage over 10 V?*	Go to Step 3.	“BLK/WHT” wire is open circuit or shorted to ground circuit.
3	**HO2S-2 heater power circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “BLK/WHT” wire terminal of HO2S-2 connector and “E23-29” terminal wire of ECM connector. *Is resistance below 5 Ω?*	Go to Step 4.	“BLK/WHT” wire is high resistance circuit.
4	**HO2S-2 heater drive circuit check** 1) Measure resistance between “RED/BLU” wire terminal of HO2S-2 connector and vehicle body ground. *Is resistance infinity?*	Go to Step 5.	“RED/BLU” wire is shorted to ground circuit.
5	**HO2S-2 heater drive circuit check** 1) Turn ON ignition switch. 2) Measure voltage between “RED/BLU” wire terminal of HO2S-2 connector and vehicle body ground. *Is voltage 0 V?*	Go to Step 6.	“RED/BLU” wire is shorted to power circuit.
6	**HO2S-2 heater drive circuit check** 1) Connect connector to HO2S-2 with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Measure voltage between “C37-47” terminal of disconnected ECM connector and vehicle body ground. *Is voltage over 10 V?*	Go to Step 7.	“RED/BLU” wire is open circuit.

Step	Action	Yes	No
7	**HO2S-2 heater check** 1) Disconnect HO2S-2 connector with ignition switch turned OFF. 2) Check HO2S-2 heater resistance referring to “Heated Oxygen Sensor (HO2S-1 and HO2S-2) Heater On-Vehicle Inspection: in Section 1C”. *Is resistance within specified value?*	Go to Step 8.	Replace HO2S-2.
8	**HO2S-2 heater power circuit check** 1) Connect connector to HO2S-2 with ignition switch turned OFF. 2) Measure resistance between “E23-9” and “C37-47” terminals of ECM connector. *Is resistance below 30 Ω?*	HO2S-2 heater circuit is OK. Substitute a known-good ECM and recheck.	“RED/BLU” wire is high resistance circuit.

DTC P0101: Mass Air Flow Circuit Range / Performance

S4RS0A1104067

Wiring Diagram



I4RS0A110019-

1. MAF and IAT sensor	3. Main relay	5. To other sensors
2. Ignition switch	4. ECM	

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
• MAF volume is greater than 20 g/sec even if engine revolution is less than 900 rpm and intake manifold pressure is less than 40 kPa (5.80 psi) with TP less than 1.5°. • MAF volume is lower than 10 g/sec even if engine revolution is more than 2500 rpm and intake manifold pressure is more than 60 kPa (8.70 psi) with TP more than 12°. (2 driving cycle detection logic)	• Air intake system (clog or leakage) • MAF sensor and/or its circuit • TP sensor and/or its circuit • MAP sensor and/or its 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 by 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”.

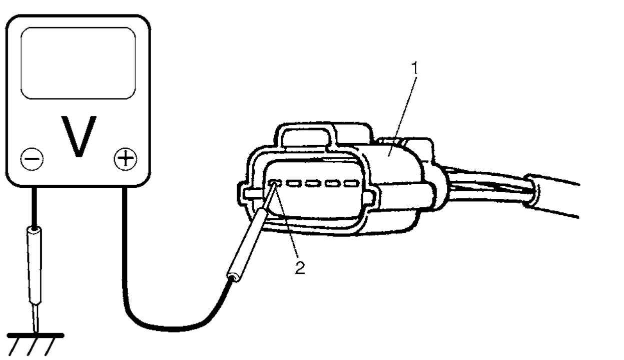
- **Intake air temperature at engine start: -10 °C (14°F) to 80 °C (176 °F)**
- **Intake air temperature: –10 °C (14 °F) to 70 °C (158 °F)**
- **Engine coolant temperature: 70 °C (158 °F) to 150 °C (302 °F)**
- **Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)**

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. (ECT approx. 90 – 95 °C, 194 – 203 °F)
4) Drive vehicle with engine speed: more than 2500 rpm for 1 min.
5) Increase vehicle speed to 80 km/h (45 mile/h) at 5th gear or D range.
6) Release accelerator pedal to decrease vehicle speed to 40 km/h (25 mile/h).
7) Stop vehicle and run it idle for 1 min.
8) Check DTC and pending DTC.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

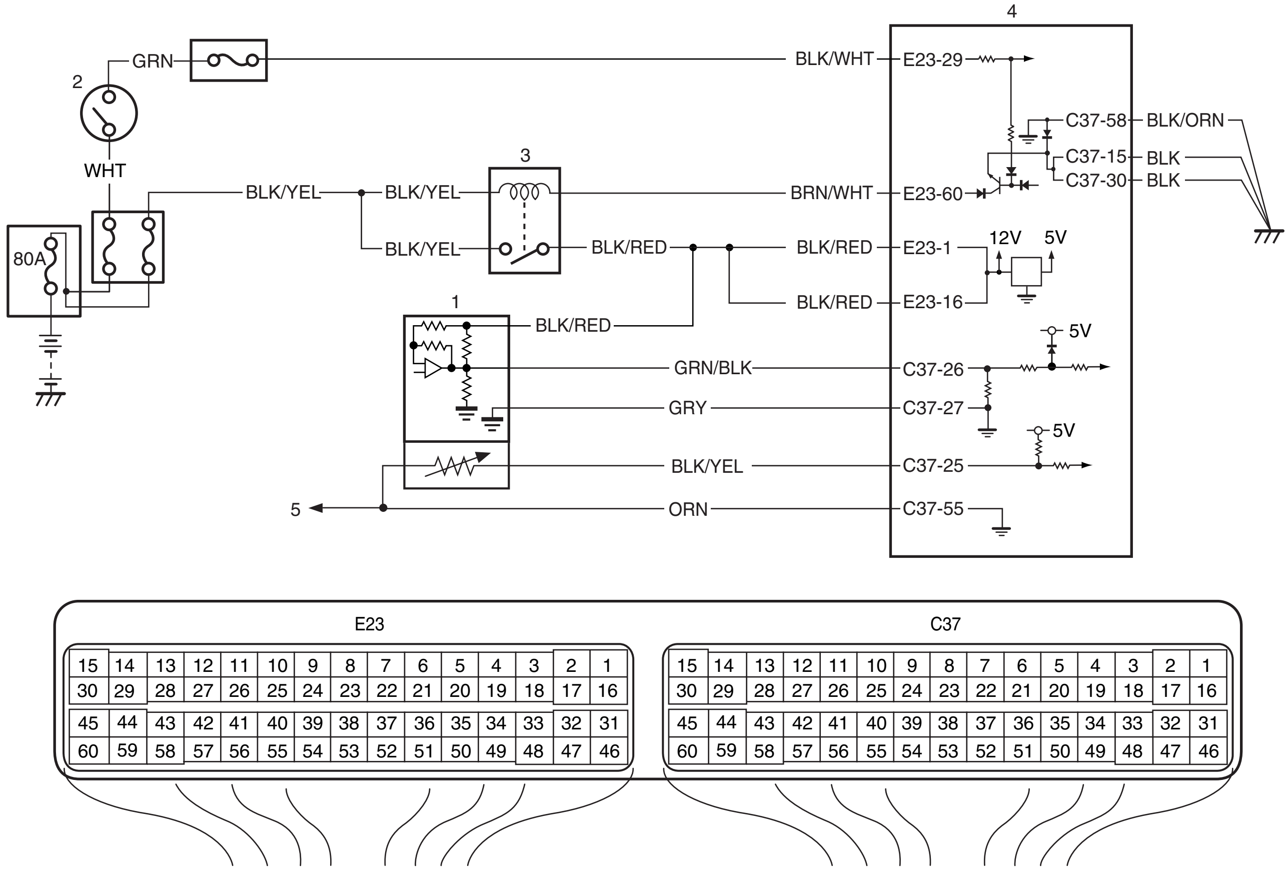
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**Visual inspection** Check MAF sensor and air intake system for: • Objects which block measuring duct and resistor of MAF sensor. • Other air flow which does not pass the MAF sensor. *Are they in good condition?*	Go to Step 3.	Repair or replace.
3	**MAF sensor and its circuit 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. (Refer to “Scan Tool Data: ” for normal value.) *Is each value within specified range?*	Go to Step 11.	Go to Step 4.
4	**MAF sensor output voltage check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connectors connected. 3) Measure voltage between “C37-26” and “C37-27” terminals of ECM connector referring to “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor On-Vehicle Inspection: in Section 1C”. *Is each value within specified range?*	Poor “C37-26” and/or “C37-27” terminal connection. If OK, substitute a known-good ECM and recheck.	Go to Step 5.
5	**MAF sensor power supply voltage check** 1) Disconnect connector from MAF and IAT sensor with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between engine ground and “BLK/RED” wire terminal (2) of MAF and IAT sensor connector (1).  I4RS0A110020- *Is voltage 10 – 14 V?*	Go to Step 6.	“BLK/RED” wire is open circuit.
6	**MAF sensor ground circuit check** 1) Turn OFF ignition switch, measure resistance between “GRY” wire terminal of MAF and IAT sensor connector and engine ground. *Is resistance below 5 Ω?*	Go to Step 8.	Go to Step 7.

Step	Action	Yes	No
7	**Ground circuit check** 1) Measure resistance between “C37-27” terminal of ECM connector and vehicle body ground. *Is resistance below 5 Ω?*	“GRY” wire is open or high resistance circuit.	ECM grounds “C37-58”, “C37-15” and/or “C37-30” circuit is open or high resistance. If wires are OK, substitute a known-good ECM and recheck.
8	**MAF sensor signal circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between “GRN/BLK” wire terminal of MAF and IAT sensor connector and engine ground. *Is voltage 0 V?*	Go to Step 9.	“GRN/BLK” wire is shorted to others circuit.
9	**MAF sensor signal circuit check** 1) Turn OFF ignition switch, measure resistance between “GRN/BLK” wire terminal of MAF and IAT sensor connector and engine ground. *Is resistance infinity?*	Go to Step 10.	“GRN/BLK” wire is shorted to ground circuit.
10	**MAF sensor signal circuit check** 1) Measure resistance between “GRN/BLK” wire terminal of MAF and IAT sensor connector and “C37-26” terminal of ECM connector. *Is resistance below 3 Ω?*	Faulty MAF and IAT sensor.	“GRN/BLK” wire is open or high resistance circuit.
11	*Is DTC P0121 detected?*	Go to “DTC P0121: Throttle Position Sensor Circuit Range / Performance: ”.	Go to Step 12.
12	*Is DTC P0106 displayed?*	Go to “DTC P0106: Manifold Absolute Pressure Range / Performance: ”.	Substitute a known-good ECM and recheck.

DTC P0102: Mass Air Flow Circuit Low Input

S4RS0A1104017

Wiring Diagram



I4RS0A110019-

1. MAF and IAT sensor	4. ECM
2. Ignition switch	5. To other sensors
3. Main relay	

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
DTC will be set when all of following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of MAF sensor output is less than specified value for specified time continuously. (1 driving cycle detection logic)	• 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.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

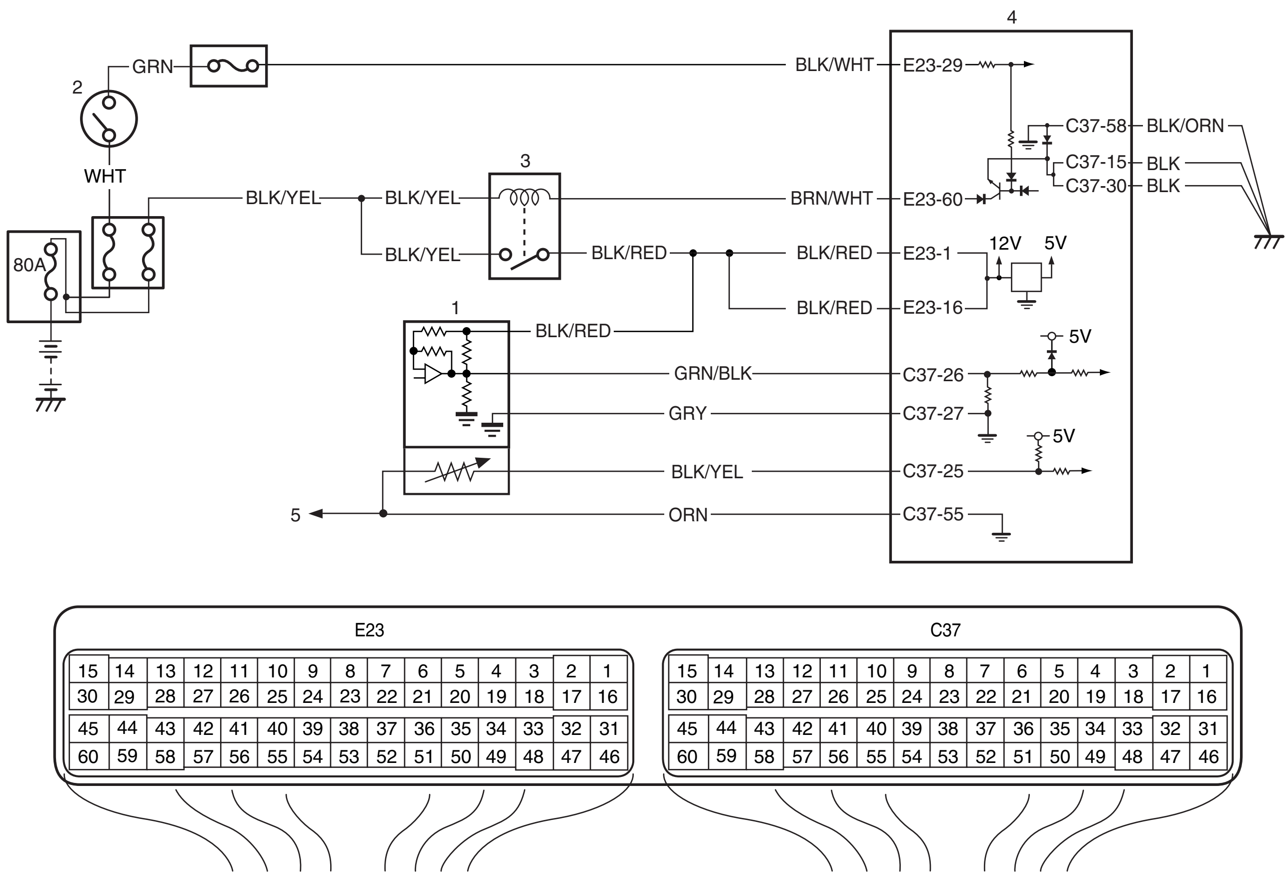
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**MAF sensor and its circuit check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Start engine and check MAF value displayed on scan tool. (Refer to “Scan Tool Data: ” for normal value.) *Is normal value indicated?*	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.	Go to Step 3.
3	**MAF sensor power supply voltage check** 1) Disconnect connector from MAF and IAT sensor with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between engine ground and “BLK/RED” wire terminal of MAF and IAT sensor connector. *Is voltage 10 – 14 V?*	Go to Step 4.	“BLK/RED” wire is open circuit.
4	**MAF sensor ground circuit check** 1) Turn OFF ignition switch, measure resistance between “GRY” wire terminal of MAF and IAT sensor connector and engine ground. *Is resistance below 5 Ω?*	Go to Step 6.	Go to Step 5.
5	**Ground circuit check** 1) Remove ECM from its bracket with ECM connectors connected. 2) Measure resistance between “C37-27” terminal of ECM connector and engine ground. *Is resistance below 5 Ω?*	“GRY” wire is open or high resistance circuit.	ECM grounds “C37-58”, “C37-15” and/or “C37-30” circuit are open or high resistance. If wires are OK, substitute a known-good ECM and recheck.
6	**MAF sensor signal circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure voltage between “GRN/BLK” wire terminal of MAF and IAT sensor connector and engine ground with ignition switch turned ON. *Is voltage 0 V?*	Go to Step 7.	“GRN/BLK” wire is shorted to other circuit.
7	**MAF sensor signal circuit check** 1) Measure resistance between “GRN/BLK” wire terminal of MAF and IAT sensor connector and engine ground with ignition switch turned OFF. *Is resistance infinity?*	Go to Step 8.	“GRN/BLK” wire is shorted to ground circuit.

Step	Action	Yes	No
8	**MAF sensor signal circuit check** 1) Measure resistance between “GRN/BLK” wire terminal of MAF and IAT sensor connector and “C37-26” terminal of ECM connector. *Is resistance below 3 Ω?*	Go to Step 9.	“GRN/BLK” wire is open or high resistance circuit.
9	**MAF sensor output signal check** 1) Connect connectors to MAF and IAT sensor and ECM with ignition switch turned OFF. 2) Measure voltage between “C37-26” and “C37-27” terminals of ECM connector referring to “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor On-Vehicle Inspection: in Section 1C”. *Is each value within specified range?*	Substitute a known-good ECM and recheck.	Faulty MAF and IAT sensor.

DTC P0103: Mass Air Flow Circuit High Input

S4RS0A1104018

Wiring Diagram



I4RS0A110019-

1. MAF and IAT sensor	4. ECM
2. Ignition switch	5. To other sensors
3. Main relay	

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
DTC will be set when all of following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of MAF sensor output is more than specified value for specified time continuously. (1 driving cycle detection logic)	• 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.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

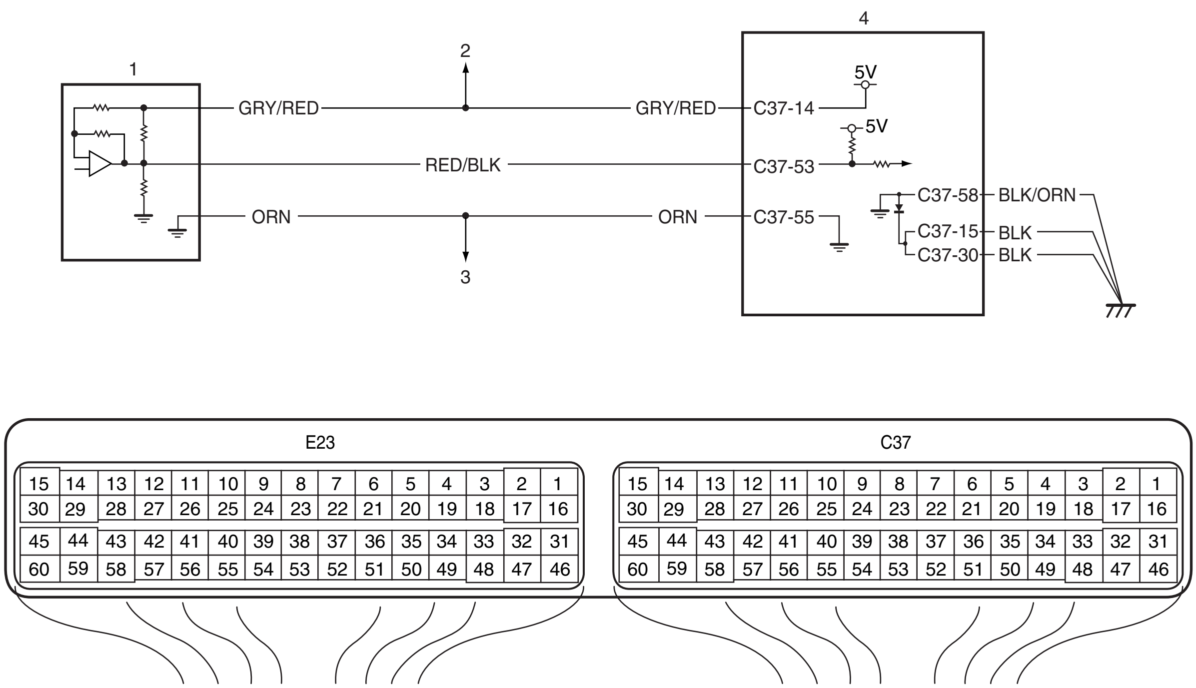
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**MAF sensor and its circuit check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Start engine and check MAF value displayed on scan tool. (Refer to “Scan Tool Data: ” for normal value.) *Is normal value indicated?*	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.	Go to Step 3.
3	**MAF sensor power supply voltage check** 1) Disconnect connector from MAF and IAT sensor with ignition switch tuned OFF. 2) Turn ON ignition switch, measure voltage between engine ground and “BLK/RED” wire terminal of MAF and IAT sensor connector. *Is voltage 10 – 14 V?*	Go to Step 4.	“BLK/RED” wire is open circuit.
4	**MAF sensor ground circuit check** 1) Turn OFF ignition switch, measure resistance between “GRY” wire terminal of MAF and IAT sensor connector and engine ground. *Is resistance below 5 Ω?*	Go to Step 6.	Go to Step 5.
5	**Ground circuit check** 1) Remove ECM from its bracket with ECM connectors connected. 2) Measure resistance between “C37-27” terminal of ECM connector and engine ground. *Is resistance below 5 Ω?*	“GRY” wire is open or high resistance circuit.	ECM grounds “C37-58”, “C37-15” and/or “C37-30” circuit are open or high resistance. If wires are OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
6	**MAF sensor signal circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure voltage between “GRY/BLK” wire terminal of MAF and IAT sensor connector and engine ground. *Is voltage 0 V?*	Go to Step 7.	“GRY/BLK” wire is shorted to other circuit.
7	**MAF sensor output signal check** 1) Connect connector to MAF and IAT sensor and ECM with ignition switch turned OFF. 2) Measure voltage between “C37-26” and “C37-27” terminal of ECM connector referring to “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor On-Vehicle Inspection: in Section 1C”. *Is each value within specified range?*	Substitute a known-good ECM and recheck.	Faulty MAF and IAT sensor.

DTC P0106: Manifold Absolute Pressure Range / Performance

S4RS0A1104079

Wiring Diagram



I4RS0A110049-

1. Manifold absolute pressure sensor	3. To other sensors
2. To TP sensor and A/C refrigerant pressure sensor	4. ECM

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
• Difference between Max. manifold absolute pressure value and Min. manifold pressure value is less than 1.3 kPa (0.19 psi) when engine running at idle speed. • Difference between barometric pressure value and manifold pressure value is less than 33.3 kPa (4.83 psi) for 2 sec. at 2000 r/mini. or more. (2 driving cycle detection logic)	• Manifold absolute pressure sensor • Manifold absolute pressure sensor vacuum passage • Air intake system • ECM

DTC Confirmation Procedure

NOTE:

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

- **Intake air temperature at engine start: –10 °C (14 °F) to 80 °C (176 °F)**
- **Intake air temperature: –10 °C (14 °F) to 70 °C (158 °F)**
- **Engine coolant temperature: 70 °C (158 °F) to 150 °C (302 °F)**
- **Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)**

1) Connect scan tool to DLC with ignition switch OFF.
2) Turn ON ignition switch and clear DTC using scan tool and warm up engine completely.
3) Run engine at idle speed for 1 min.
4) Check DTC and pending DTC.

DTC Troubleshooting

NOTE:

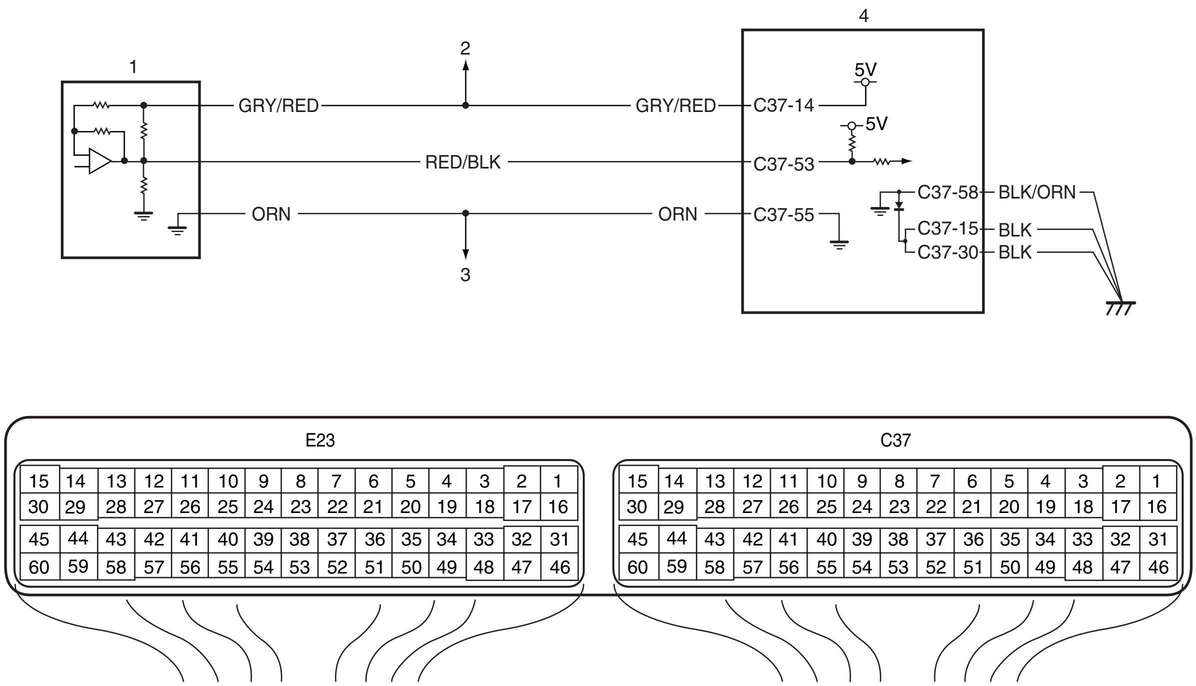
- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

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	**MAP sensor and its circuit check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check DTC. *Is there DTC P0107 or DTC P0108?*	Go to applicable DTC diag. flow.	Go to Step 3.
3	**MAP sensor output signal check** 1) Check MAP sensor according to "Manifold Absolute Pressure (MAP) Sensor Inspection: in Section 1C". *Is it in good condition?*	Go to Step 4.	Faulty MAP sensor.
4	**MAP sensor circuit check** 1) Check MAP sensor circuit referring to Step 3 to 6 of "DTC P0107: Manifold Absolute Pressure Circuit Low Input: " or Step 3 to 8 of "DTC P0108: Manifold Absolute Pressure Circuit High Input: ". *Is circuit in good condition?*	Go to Step 5.	Repair or replace.
5	**Air intake system check** 1) Check air intake system for clog or leak. *Is it in good condition?*	Substitute a known-good ECM and recheck.	Repair or replace.

DTC P0107: Manifold Absolute Pressure Circuit Low Input

S4RS0A1104050

Wiring Diagram



I4RS0A110049-

1. Manifold absolute pressure sensor	3. To other sensors
2. To TP sensor and A/C refrigerant pressure sensor	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 • TP sensor • A/C refrigerant pressure sensor • ECM

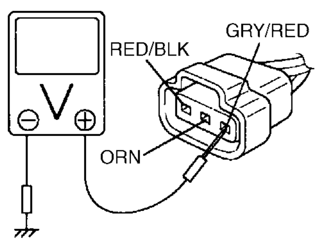
DTC Confirmation Procedure

1) Connect scan tool to DLC with ignition switch turned OFF.
2) Turn ON ignition switch and clear DTC using scan tool and warm up engine completely.
3) Run engine at idle speed for 1 min.
4) Check DTC and pending DTC.

DTC Troubleshooting

NOTE:

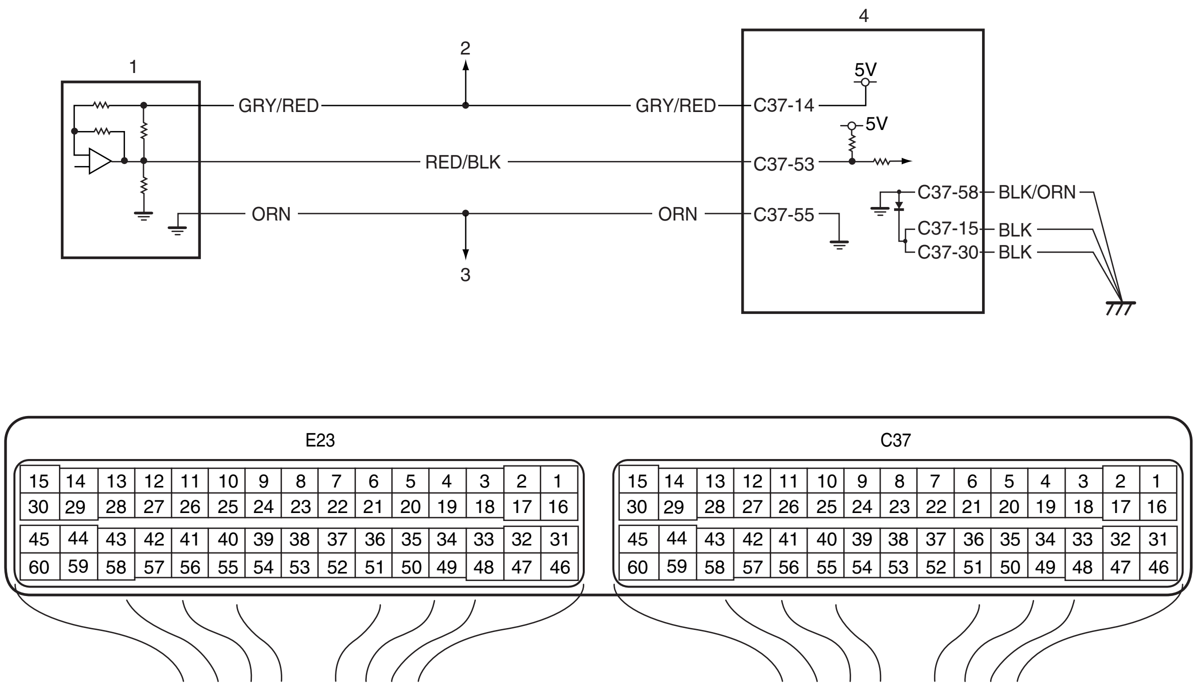
- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

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	**MAP sensor and its circuit check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check intake manifold pressure displayed on scan tool. *Is it 0 kPa (0 in.Hg)?*	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.
3	**MAP sensor power supply voltage check** 1) Disconnect connector from MAP sensor with ignition switch turned OFF. 2) Check for proper connection of MAP sensor at “GRY/RED”, “RED/BLK” and “ORN” wire terminals. 3) Turn ON ignition switch, measure voltage between engine ground and “GRY/RED” wire terminal of MAP sensor connector.  I4RS0A110050- *Is voltage 4 – 6 V?*	Go to Step 5.	Go to Step 4.
4	**MAP sensor power supply circuit check** 1) Disconnect connectors from TP sensor and A/C refrigerant pressure sensor with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between engine ground and “GRY/RED” wire terminal of MAP sensor connector. *Is voltage 4 – 6 V?*	Faulty TP sensor and/or A/C refrigerant pressure sensor.	“GRY/RED” wire is shorted to ground circuit. If wires are OK, substitute a known-good ECM and recheck.
5	**MAP sensor signal circuit check** 1) Measure voltage between “RED/BLK” wire terminal of MAP sensor connector and engine ground. *Is voltage 4 – 6 V?*	Go to Step 7.	Go to Step 6.
6	**MAP sensor signal circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “C37-53” terminal of ECM connector and vehicle body ground. *Is resistance infinity?*	Go to Step 7.	“RED/BLK” wire is shorted to ground circuit.
7	**MAP sensor output signal check** 1) Check MAP sensor according to “Manifold Absolute Pressure (MAP) Sensor Inspection: in Section 1C”. *Is it in good condition?*	Substitute a known-good ECM and recheck.	Faulty MAP sensor.

DTC P0108: Manifold Absolute Pressure Circuit High Input

S4RS0A1104051

Wiring Diagram



I4RS0A110049-

1. Manifold absolute pressure sensor	3. To other sensors
2. To TP sensor and A/C refrigerant pressure 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 • TP sensor • A/C refrigerant pressure sensor • ECM

NOTE:

When DTC P0113, P0118 and P0123 are indicated together, it is possible that "ORN" wire circuit is open.

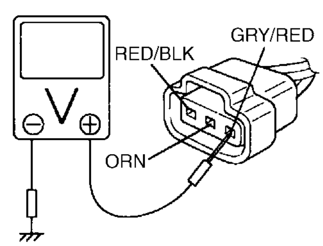
DTC Confirmation Procedure

1) Connect scan tool to DLC with ignition switch turned OFF.
2) Turn ON ignition switch and clear DTC using scan tool and warm up engine completely.
3) Run engine at idle speed for 1 min.
4) Check DTC and pending DTC.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

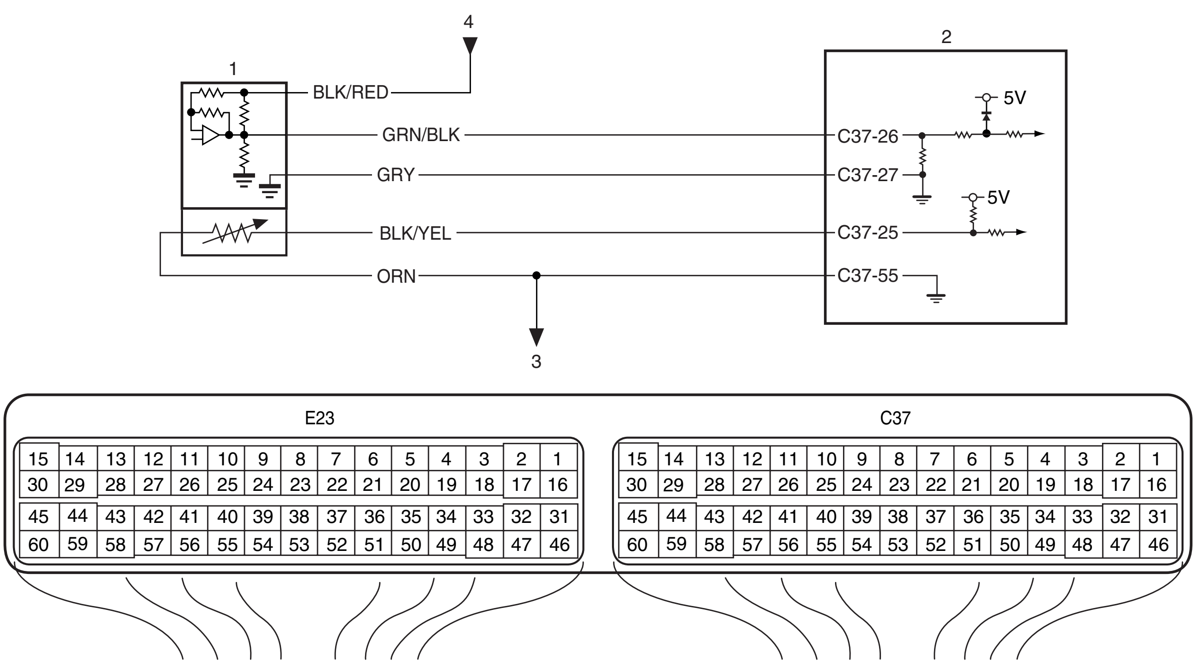
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**MAP sensor and its circuit check** 1) Connect scan tool to DLC with ignition switch OFF. 2) Turn ignition switch ON. 3) Check intake manifold pressure displayed on scan tool. *Is it 127 kPa (37.5 in.Hg)?*	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.
3	**MAP sensor power supply voltage check** 1) Disconnect connector from MAP sensor with ignition switch turned OFF. 2) Check for proper connection of MAP sensor at “GRY/RED”, “RED/BLK” and “ORN” wire terminals. 3) Turn ON ignition switch, measure voltage between engine ground and “GRY/RED” wire terminal of MAP sensor connector.  I4RS0A110050- *Is voltage 4 – 6 V?*	Go to Step 5.	Go to Step 4.
4	**MAP sensor power supply circuit check** 1) Disconnect connectors from TP sensor and A/C refrigerant pressure sensor with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between engine ground and “GRY/RED” wire terminal of MAP sensor connector. *Is voltage 4 – 6 V?*	Faulty TP sensor and/or A/C refrigerant pressure sensor.	“GRY/RED” wire is open or shorted to power circuit.
5	**MAP sensor ground circuit check** 1) Measure resistance between “ORN” wire terminal of MAP sensor connector and engine ground with ignition switch turned OFF. *Is resistance below 5 Ω?*	Go to Step 7.	Go to Step 6.

Step	Action	Yes	No
6	**Ground circuit check** 1) Measure resistance between “C37-55” terminal of ECM connector and vehicle body ground. *Is resistance below 5 Ω?*	“ORN” wire is open or high resistance circuit.	ECM grounds “C37-58”, “C37-15” and/or “C37-30” circuit are open or high resistance. If wires are OK, substitute a known-good ECM and recheck.
7	**MAP sensor signal circuit check** 1) Turn ON ignition switch. 2) Measure voltage between “RED/BLK” wire terminal of MAP sensor connector and engine ground. *Is voltage 4 – 6 V?*	Go to Step 9.	Go to Step 8.
8	**MAP sensor signal circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “RED/BLK” wire terminal of MAP sensor connector and “C37-53” terminal of ECM connector. *Is resistance below 2 Ω?*	“RED/BLK” wire is shorted to power supply circuit.	“RED/BLK” wire is open or high resistance circuit.
9	**MAP sensor output signal check** 1) Check MAP sensor according to “Manifold Absolute Pressure (MAP) Sensor Inspection: in Section 1C”. *Is it in good condition?*	Substitute a known-good ECM and recheck.	Faulty MAP sensor.

DTC P0111: Intake Air Temperature Circuit Range / Performance

S4RS0A1104068

Wiring Diagram



I4RS0A110021-

1. MAF and IAT sensor	3. To other sensors
2. ECM	4. From main relay

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
Difference of maximum IAT minus minimum IAT is less than 0.3 °C (32.5 °F) while ECT is over 70 °C (158 °F) after 10 min from cold engine start (ECT is lower than 30°C (86 °F) at engine start). (2 driving cycle detection logic)	• High resistance circuit • MAF and IAT sensor • ECM

DTC Confirmation Procedure

NOTE:

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

- **Intake air temperature at engine start: –10 °C (14 °F) to 80 °C (176 °F)**
- **Intake air temperature: –10 °C (14 °F) to 70 °C (158 °F)**
- **Engine coolant temperature at engine start: less than 30 °C (86 °F)**
- **Engine coolant temperature: 70 °C (158 °F) to 150 °C (302 °F)**
- **Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)**

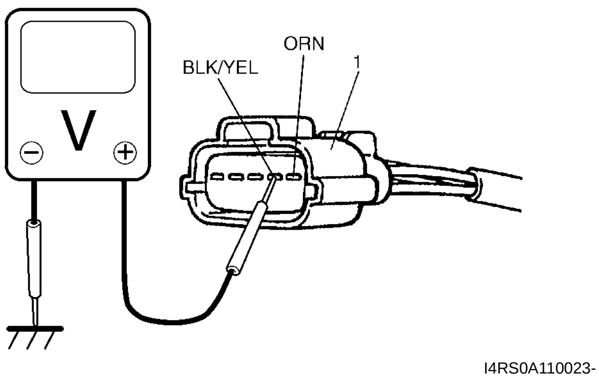
1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch, clear DTC using scan tool.
3) Start engine and warm up to normal operating temperature. (ECT approx. 70 – 205°C, 158 – 401°F)
4) Run engine at idle speed for 10 min. or more.
5) Check DTC and pending DTC.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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	**IAT sensor and its circuit check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Turn ignition switch to ON position. 3) Check intake air temp. displayed on scan tool. *Is –40 °C (–40 °F) or 119 °C (246 °F) indicated?*	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.

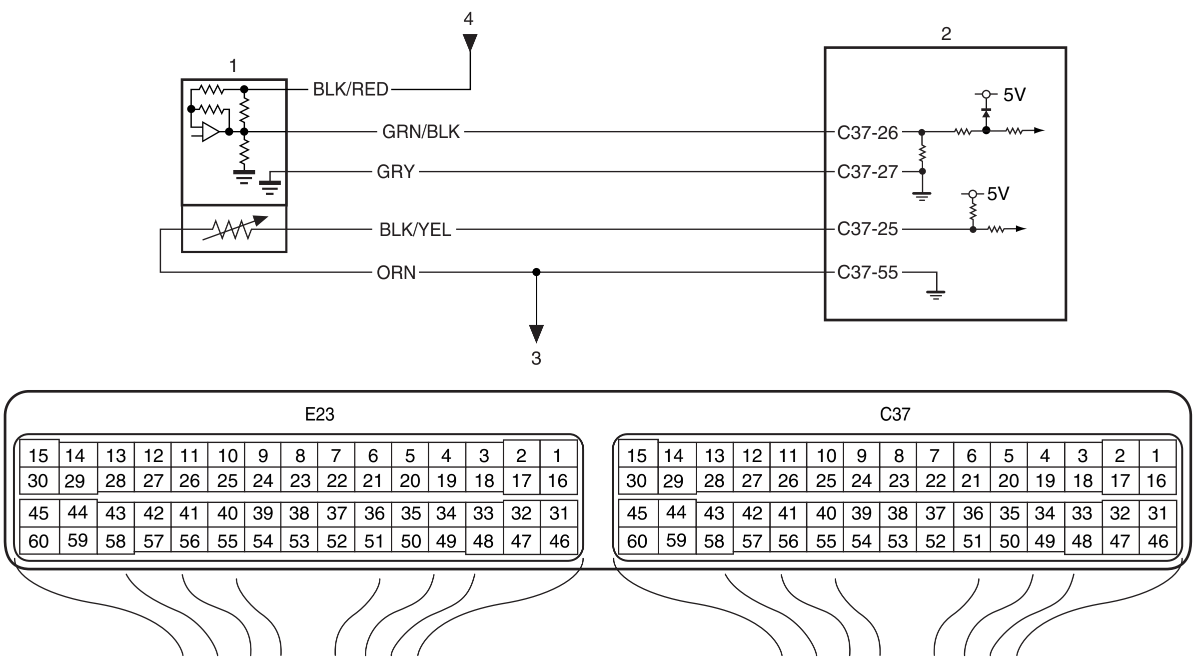
Step	Action	Yes	No
3	**Wire harness check** 1) Disconnect MAF and IAT sensor connector (1) with ignition switch turned OFF. 2) Check for proper connection to MAF and IAT sensor connector (1) at “BLK/YEL” and “ORN” wire terminals. 3) If OK, then with ignition switch turned ON, measure voltage between “BLK/YEL” wire terminal of MAF and IAT sensor connector and vehicle body ground.  *Is measured voltage applied to “BLK/YEL” wire terminal about 4 – 6 V?*	Go to Step 8.	Go to Step 4.
4	**ECM voltage check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connectors connected. 3) Check for proper connection of ECM connector at “C37-25” terminal. 4) If OK, then turn ON ignition switch, measure voltage between “C37-25” terminal of ECM connector and vehicle body ground. *Is voltage about 4 – 6 V at terminal?*	“BLK/YEL” wire is open circuit. If wire and connection are OK, go to Step 5.	Go to Step 5.
5	**Wire circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “BLK/YEL” wire terminal of MAF and IAT sensor connector and vehicle body ground. *Is resistance infinity?*	Go to Step 6.	“BLK/YEL” wire is shorted to ground or other circuits. If wire is OK, substitute a known-good ECM and recheck.
6	**Wire circuit check** 1) Turn ignition switch to ON position. 2) Measure voltage between “BLK/YEL” wire terminal of MAF and IAT sensor connector and body ground. *Is voltage about 0 V?*	Go to Step 7.	“BLK/YEL” wire is shorted to other circuits. If wire is OK, substitute a known-good ECM and recheck.
7	**Wire circuit check** 1) Measure resistance between “C37-25” terminal of ECM connector and “BLK/YEL” wire terminal of MAF and IAT sensor connector with ignition switch turned OFF. *Is resistance below 3 Ω?*	Go to Step 8.	“BLK/YEL” wire is high resistance circuit.

Step	Action	Yes	No
8	**Ground circuit check** 1) Connect connectors to ECM. 2) Check for proper connection of MAF and IAT sensor connector at “ORN” wire terminal. 3) Measure resistance between “ORN” wire terminal of MAF and IAT sensor connector and vehicle body ground with ignition switch turned OFF. *Is resistance below 5 Ω?*	Go to Step 10.	Go to Step 9.
9	**Ground circuit check** 1) Remove ECM from its bracket with ECM connectors connected. 2) Measure resistance between “C37-55” terminal of ECM connector and vehicle body ground. *Is resistance below 3 Ω?*	“ORN” wire is open or high resistance circuit. Poor “C37-55” connection.	Faulty ECM ground circuit. If circuit is OK, substitute a known-good ECM and recheck.
10	**IAT sensor check** 1) Check IAT sensor according to “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection: in Section 1C”. *Is it in good condition?*	Substitute a known-good ECM and recheck.	Replace MAF and IAT sensor.

DTC P0112: Intake Air Temperature Sensor Circuit Low

S4RS0A1104019

Wiring Diagram



I4RS0A110021-

1. MAF and IAT sensor	3. To other sensors
2. ECM	4. From main relay

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
DTC will be set when all of following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of IAT sensor output is less than specified value (High intake air temperature (low voltage / low resistance)) (1 driving cycle detection logic)	• IAT sensor circuit • IAT sensor • ECM

DTC Confirmation Procedure

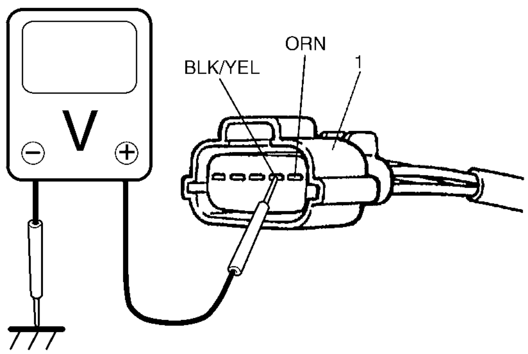
1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and run it for 10 sec.
4) Check DTC and pending DTC.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

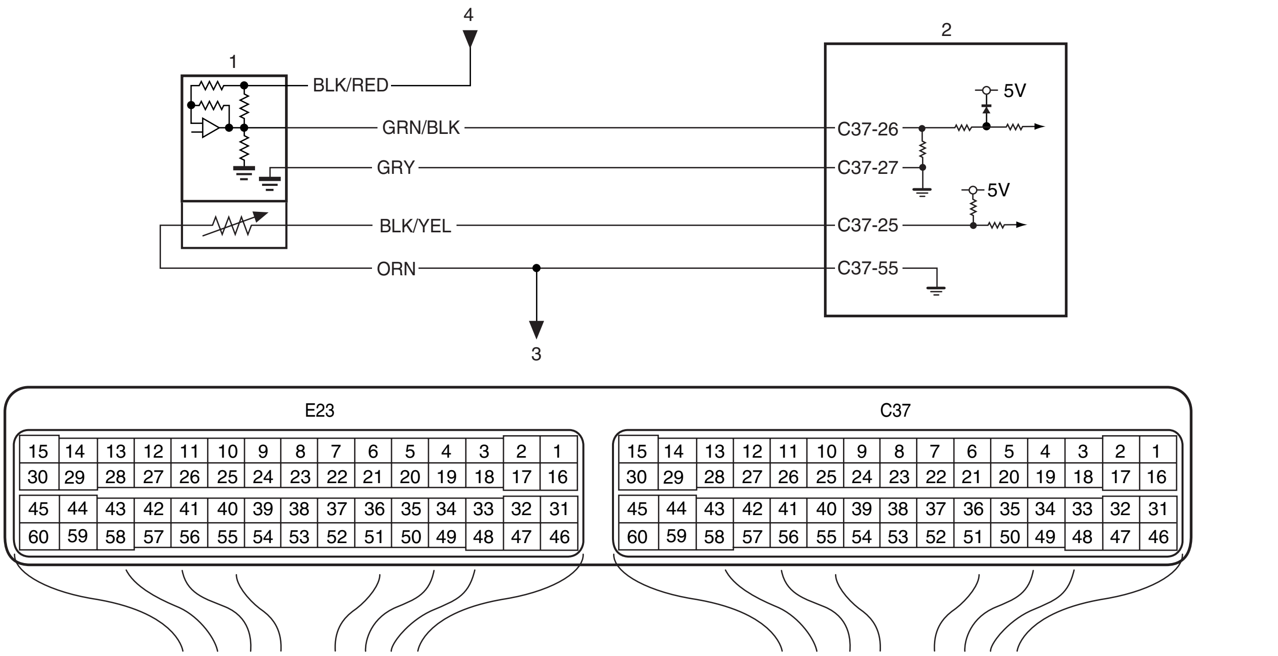
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**IAT sensor and its circuit check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check intake air temp. displayed on scan tool. *Is 119 °C (246 °F) indicated?*	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.

Step	Action	Yes	No
3	**ECM voltage check** 1) Disconnect connector from MAF and IAT sensor with ignition switch turned OFF. 2) Check for proper connection to MAF and IAT sensor at “BLK/YEL” and “ORN” wire terminals. 3) If OK, then turn ON ignition switch, measure voltage between “BLK/YEL” wire terminal of MAF and IAT sensor connector (1) and vehicle body ground.  I4RS0A110023- *Is voltage about 4 – 6 V?*	Go to Step 6.	Go to Step 4.
4	**IAT short circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “BLK/YEL” wire terminal of MAF and IAT sensor connector and vehicle body ground. *Is resistance infinity?*	Go to Step 5.	“BLK/YEL” wire is shorted to ground circuit. If wire is OK, substitute a known-good ECM and recheck.
5	**IAT short circuit check** 1) Turn ON ignition switch. 2) Measure voltage between “BLK/YEL” wire terminal of MAF and IAT sensor connector and vehicle body ground. *Is voltage about 0 V?*	Go to Step 6.	“BLK/YEL” wire is shorted to other circuit. If wire is OK, substitute a known-good ECM and recheck.
6	**IAT sensor for performance check** 1) Check IAT sensor according to “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection: in Section 1C”. *Is it in good condition?*	Substitute a known-good ECM and recheck.	Replace MAF and IAT sensor.

DTC P0113: Intake Air Temperature Sensor Circuit High

S4RS0A1104020

Wiring Diagram



I4RS0A110024-

1. MAF and IAT sensor	3. To other sensors
2. ECM	4. From main relay

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
DTC will be set when all of following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of IAT sensor output is more than specified value (Low intake air temperature (high voltage / high resistance)) (1 driving cycle detection logic)	• IAT sensor circuit • IAT sensor • ECM

NOTE:

When DTC P0108, P0118 and P0123 are indicated together, it is possible that "ORN" wire circuit open.

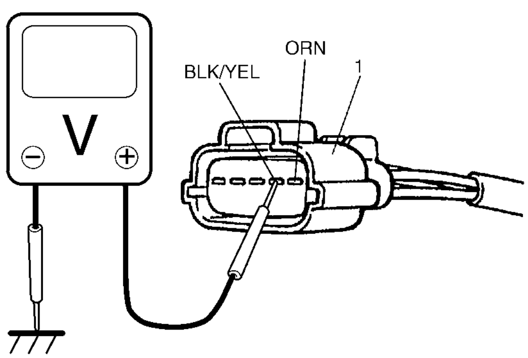
DTC Confirmation Procedure

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.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

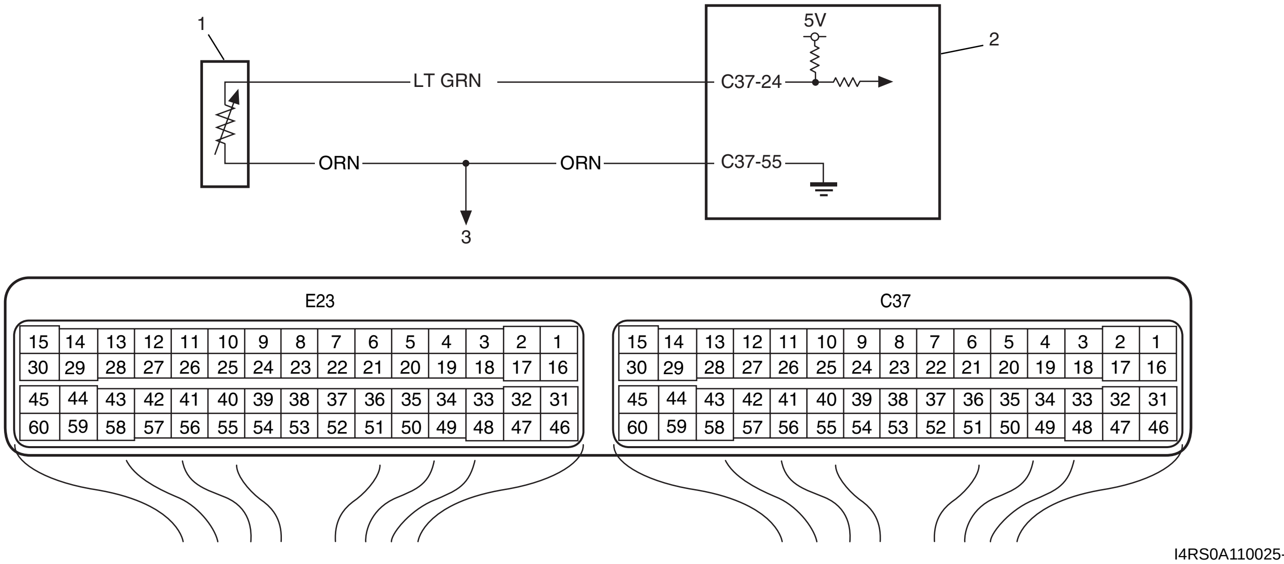
Step	Action	Yes	No
1	*Was "Engine and Emission Control System Check" performed?*	Go to Step 2.	Go to "Engine and Emission Control System Check: ".
2	**IAT sensor and its circuit check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check intake air temp. 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 00".
3	**IAT sensor voltage check** 1) Disconnect connector from MAF and IAT sensor with ignition switch turned OFF. 2) Check for proper connection to MAF and IAT sensor at "BLK/YEL" and "ORN" wire terminals. 3) If OK, then turn ON ignition switch, measure voltage between "BLK/YEL" wire terminal of MAF and IAT sensor connector (1) and vehicle body ground.  I4RS0A110023- *Is voltage about 4 – 6 V?*	Go to Step 7.	Go to Step 4.
4	**ECM voltage check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connectors connected. 3) Check for proper connection of ECM connector at "C37-25" terminal. 4) If OK, then turn ON ignition switch, measure voltage between "C37-25" terminal of ECM connector and vehicle body ground. *Is voltage about 4 – 6 V?*	"BLK/YEL" wire is open circuit. If wire and connection are OK, go to Step 5.	Go to Step 5.
5	**Wire circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Measure voltage between "BLK/YEL" wire terminal of MAF and IAT sensor connector and vehicle body ground. *Is voltage about 0 V?*	Go to Step 6.	"BLK/YEL" wire is shorted to other circuits. If wire is OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
6	**Wire circuit check** 1) Measure resistance between “C37-25” terminal of ECM connector and “BLK/YEL” wire terminal of MAF and IAT sensor connector with ignition switch turned OFF. *Is resistance below 5 Ω?*	Go to Step 7.	“BLK/YEL” wire is high resistance circuit.
7	**Ground circuit check** 1) Connect connectors to ECM. 2) Measure resistance between “ORN” wire terminal of MAF and IAT sensor connector and body ground with ignition switch turned OFF. *Is resistance below 5 Ω?*	Go to Step 9.	Go to Step 8.
8	**Ground circuit check** 1) Remove ECM from its bracket with ECM connectors connected. 2) Measure resistance between “C37-55” terminal of ECM connector and vehicle body ground. *Is resistance below 5 Ω?*	“ORN” wire is open circuit or high resistance circuit. Poor “C37-55” connection.	Faulty ECM ground circuit. If circuit is OK, substitute a known-good ECM and recheck.
9	**IAT sensor for performance check** 1) Check IAT sensor according to “Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection: in Section 1C”. *Is it in good condition?*	Substitute a known-good ECM and recheck.	Replace MAF and IAT sensor.

DTC P0116: Engine Coolant Temperature Circuit Range / Performance

S4RS0A1104069

Wiring Diagram



1.	ECT sensor
2.	ECM
3.	To other sensors

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
ECT sensor values is less than –5 °C (23 °F) while engine is running under more than specified engine load (more than 1000 rpm) for 2 to 1112 min (depending on ECT at engine start) continuously from engine start. (2 driving cycle detecting logic)	• ECT sensor • ECT sensor circuit • Thermostat • 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 by 2 persons, a driver and tester, on a level road.**

NOTE:

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

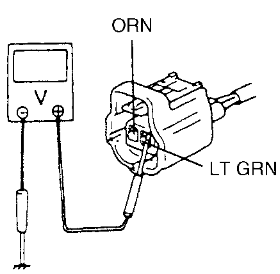
- **Intake air temperature at engine start: –10 °C (14 °F) to 80 °C (176 °F)**
- **Intake air temperature: –10 °C (14 °F) to 70 °C (158 °F)**
- **Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)**

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch, clear DTC.
3) Start engine.
4) Drive vehicle at 40 mph (60 km/h) or higher for 20 min. or more.
5) Stop vehicle.
6) Check DTC and pending DTC.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

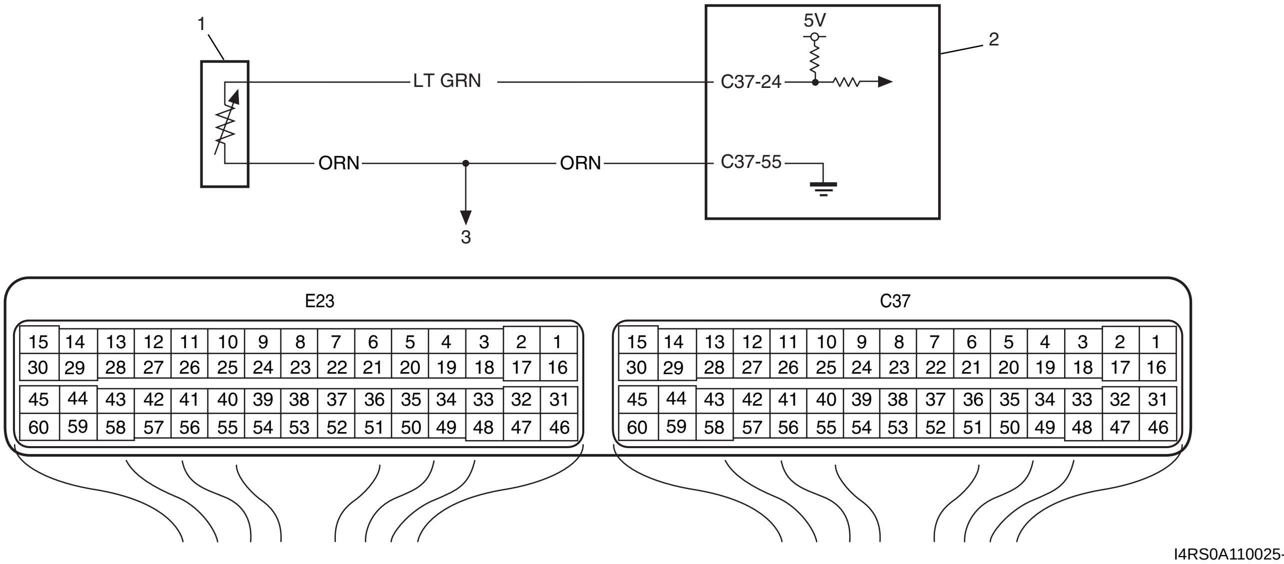
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**DTC check** 1) With ignition switch turned OFF, install scan tool to DLC. 2) Turn ON ignition switch and check DTC with scan tool. *Is DTC P0118 displayed?*	Go to “DTC P0118: Engine Coolant Temperature Circuit High: ”.	Go to Step 3.
3	**Engine coolant temp. check** 1) Turn ON ignition switch and check engine coolant temp. displayed on scan tool. 2) Warm up engine to normal operating temp. and check engine coolant temp. displayed on scan tool. *Does engine coolant temp. vary more than 1 °C (1 °F) and rise higher than 70 °C (158 °F)?*	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.	Go to Step 4.
4	**Thermostat check** *Is there a symptom due to thermostat remaining open (it takes a long time before vehicle heater becomes effective or before engine is warmed to normal operating temp., etc.)?*	Check thermostat referring to “Thermostat Inspection: in Section 1F”.	Go to Step 5.
5	**Wire harness check** 1) Disconnect ECT sensor connector with ignition switch turned OFF. 2) Check for proper connection to ECT sensor connector at “ORN” and “LT GRN” wire terminals. 3) If OK, then with ignition switch ON, measure voltage between “LT GRN” wire terminal of ECT sensor connector and vehicle body ground.  I2RH01110067- *Is measured voltage applied to “LT GRN” wire terminal about 4 – 6 V?*	Go to Step 9.	Go to Step 6.

Step	Action	Yes	No
6	**ECM voltage check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connectors connected. 3) Check for proper connection of ECM connector at “C37-24” terminal. 4) If OK, then turn ON ignition switch, measure voltage between “C37-24” terminal of ECM connector and body ground. *Is voltage about 4 – 6 V?*	“LT GRN” wire is open circuit. If wire and connection are OK, go to Step 7.	Go to Step 7.
7	**Wire circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Turn ignition switch to ON position. 3) Measure voltage between “LT GRN” wire terminal of ECT sensor connector and body ground. *Is voltage about 0 V?*	Go to Step 8.	“LT GRN” wire is shorted to other circuit. If wire is OK, substitute a known-good ECM and recheck.
8	**Wire circuit check** 1) Measure resistance between “C37-24” terminal of ECM connector and “LT GRN” wire terminal of ECT sensor connector with ignition switch turned OFF. *Is resistance below 5 Ω?*	Go to Step 9.	“LT GRN” wire is high resistance circuit.
9	**Ground circuit check** 1) Connect connectors to ECM. 2) Check for proper connection of ECT sensor connector at “ORN” wire terminal. 3) Measure resistance between “ORN” wire terminal of ECT sensor connector and vehicle body ground. *Is resistance below 5 Ω?*	Go to Step 11.	Go to Step 10.
10	**Ground circuit check** 1) Remove ECM from its bracket with ECM connectors connected. 2) Measure resistance between “C37-55” terminal of ECM connector and vehicle body ground. *Is resistance below 5 Ω?*	“ORN” wire is open or high resistance circuit. Poor “C37-55” connection.	Faulty ECM ground circuit. If circuit is OK, substitute a known-good ECM and recheck.
11	**ECT sensor check** 1) Check ECT sensor according to “Engine Coolant Temperature (ECT) Sensor Inspection: in Section 1C”. *Is it in good condition?*	Substitute a known-good ECM and recheck.	Replace ECT sensor.

DTC P0117: Engine Coolant Temperature Circuit Low

S4RS0A1104021

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 following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of ECT sensor output is less than specified value (High engine coolant temperature (low voltage / low resistance)) (1 driving cycle detection logic)	• ECT sensor circuit • ECT sensor • ECM

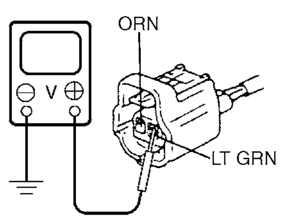
DTC Confirmation Procedure

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.

DTC Troubleshooting

NOTE:

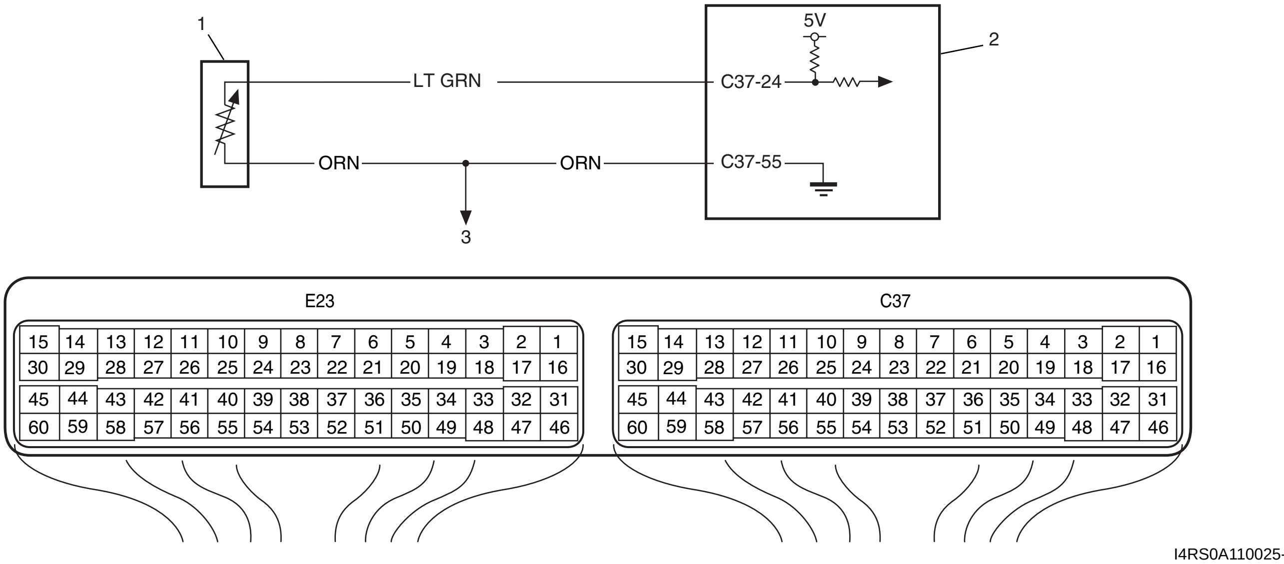
- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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	**ECT sensor and its circuit check** 1) Connect scan tool with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check engine coolant temp. displayed on scan tool. *Is 119 °C (246 °F) indicated?*	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.
3	**ECM voltage check** 1) Disconnect connector from ECT sensor with ignition switch turned OFF. 2) Check for proper connection to ECT sensor at “LT GRN” and “ORN” wire terminals. 3) If OK, then turn ON ignition switch, measure voltage between “LT GRN” wire terminal of ECT sensor connector and vehicle body ground.  I4RS0A110026- *Is voltage about 4 – 6 V?*	Go to Step 6.	Go to Step 4.
4	**ECT sensor short circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “LT GRN” wire terminal of ECT sensor connector and vehicle body ground. *Is resistance infinity?*	Go to Step 5.	“LT GRN” wire is shorted to ground circuit. If wire is OK, substitute a known-good ECM and recheck.
5	**ECT sensor short circuit check** 1) Turn ON ignition switch. 2) Measure voltage between “LT GRN” wire terminal of ECT sensor connector and vehicle body ground. *Is voltage about 0 V?*	Go to Step 6.	“LT GRN” wire is shorted to other circuit. If wire is OK, substitute a known-good ECM and recheck.
6	**ECT sensor for performance check** 1) Check ECT sensor according to “Engine Coolant Temperature (ECT) Sensor Inspection: in Section 1C”. *Is it in good condition?*	Substitute a known-good ECM and recheck.	Replace ECT sensor.

DTC P0118: Engine Coolant Temperature Circuit High

S4RS0A1104022

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 following conditions are detected for 0.5 seconds continuously. • Engine is running • Voltage of ECT sensor output is more than specified value (Low engine coolant temperature (high voltage / high resistance)) (1 driving cycle detection logic)	• ECT sensor circuit • ECT sensor • ECM

NOTE:

When DTC P0108, P0113 and P0123 are indicated together, it is possible that "ORN" wire circuit open.

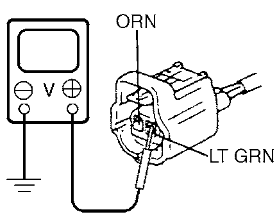
DTC Confirmation Procedure

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.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

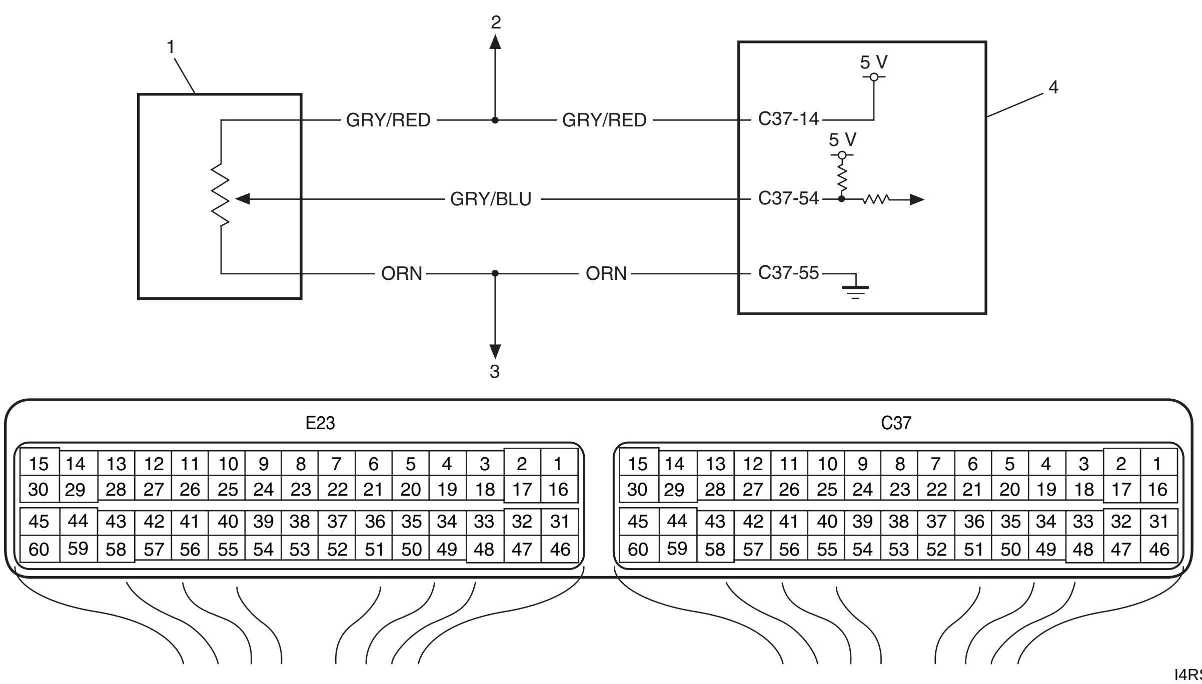
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**ECT sensor and its circuit check** 1) Connect scan tool with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check engine coolant temp. displayed 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 00”.
3	**ECT voltage check** 1) Disconnect connector from ECT sensor with ignition switch turned OFF. 2) Check for proper connection to ECT sensor at “LT GRN” and “ORN” wire terminals. 3) If OK, then turn ON ignition switch, measure voltage between “LT GRN” wire terminal of ECT sensor connector and vehicle body ground.  I4RS0A110026- *Is voltage about 4 – 6 V?*	Go to Step 6.	Go to Step 4.
4	**ECM voltage check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connectors connected. 3) Check for proper connection of ECM connector at “C37-24” terminal. 4) If OK, then turn ON ignition switch, measure voltage between “C37-24” wire terminal of ECM connector and vehicle body ground. *Is voltage about 4 – 6 V?*	“LT GRN” wire is open circuit. If wire and connection are OK, go to Step 5.	Go to Step 5.
5	**ECT sensor harness voltage check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Measure voltage between “LT GRN” wire terminal of ECT sensor connector and vehicle body ground. *Is voltage about 0 V?*	Go to Step 6.	“LT GRN” wire is shorted to other circuit. If wire is OK, substitute a known-good ECM and recheck.
6	**ECT sensor harness resistance check** 1) Measure resistance between “C37-24” terminal of ECM connector and “LT GRN” wire terminal of ECT sensor connector with ignition switch turn OFF. *Is resistance below 5 Ω?*	Go to Step 7.	“LT GRN” wire is high resistance circuit.

Step	Action	Yes	No
7	**ECT sensor ground circuit check** 1) Connect connectors to ECM. 2) Check for proper connection of ECT sensor connector at "ORN" wire terminal. 3) Measure resistance between "ORN" wire terminal of ECT sensor connector and vehicle body ground. *Is resistance below 5 Ω?*	Go to Step 9.	Go to Step 8.
8	**ECT sensor ground circuit check** 1) Measure resistance between "C37-55" terminal of ECM connector and vehicle body ground. *Is resistance below 5 Ω?*	"ORN" wire is open circuit or high resistance circuit. Poor "C37-55" connection.	Faulty ECM ground circuit. If circuit is OK, substitute a known-good ECM and recheck.
9	**ECT sensor for performance check** 1) Check ECT sensor according to "Engine Coolant Temperature (ECT) Sensor Inspection: in Section 1C". *Is it in good condition?*	Substitute a known-good ECM and recheck.	Replace ECT sensor.

DTC P0121: Throttle Position Sensor Circuit Range / Performance

S4RS0A1104023

Wiring Diagram



1. TP sensor	3. To other sensors
2. To MAP sensor and A/C refrigerant pressure 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 mass air flow) is out of specified range (–20 degree to 20 degree). (2 driving cycle detection logic)	• Throttle body • TP sensor • TP sensor circuit • ECM • MAF sensor • Idle air control valve • Air intake system

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 by 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”.

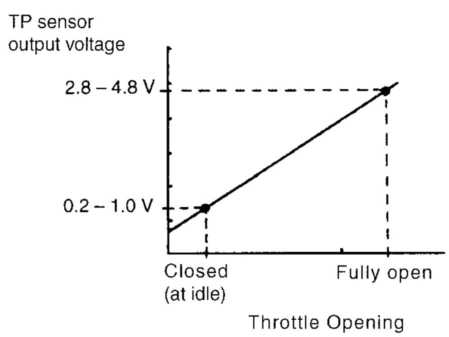
- **Intake air temperature at engine start: –10 °C (14 °C) to 80 °C (176 °F)**
- **Intake air temperature: –10 °C (14 °C) to 70 °C (158 °F)**
- **Engine coolant temperature: 70 °C (158 °F) to 150 °C (302 °F)**
- **Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)**

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 to 60 km/h (38 mile/h).
7) Repeat Step 4) to 6) for 3 times.
8) Stop vehicle and check DTC and pending DTC.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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	**TP sensor and its circuit check** 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.  I2RH0B110029- *Does voltage vary within specified value linearly as shown in the graph?*	Go to Step 14.	Go to Step 3.
3	**TP sensor voltage check** 1) Disconnect connector from TP sensor with ignition switch turned OFF. 2) Check for proper connection to TP sensor connector at “GRY/RED”, “GRY/BLU” and “ORN” wire terminals. 3) If OK, then with ignition switch turned ON, check following terminal voltages. • Between “GRY/RED” wire terminal of TP sensor connector and vehicle body ground • Between “GRY/BLU” wire terminal of TP sensor connector and vehicle body ground *Is each terminal voltage about 4 – 6 V?*	Go to Step 11.	Go to Step 4.
4	*Was “GRY/RED” wire terminal voltage in Step 3 within specification?*	Go to Step 7.	Go to Step 5.

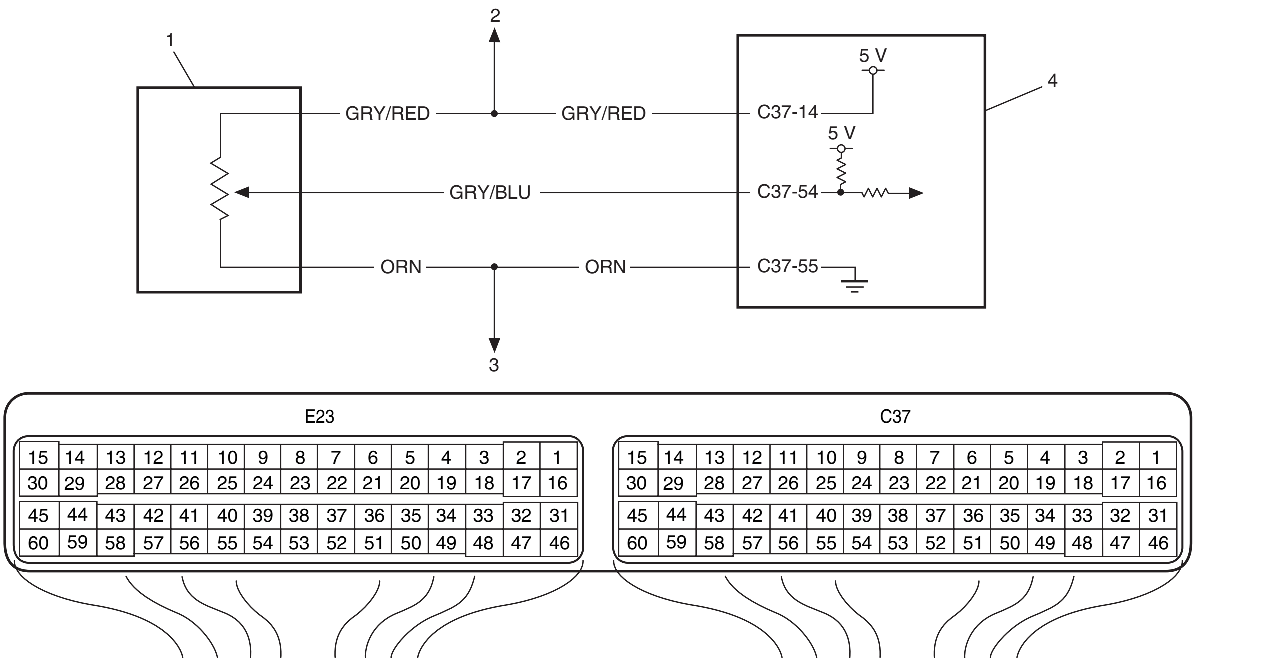
Step	Action	Yes	No
5	**Wire harness check** 1) Turn ignition switch to OFF position. 2) Disconnect connectors from MAP sensor and A/C refrigerant pressure sensor. 3) Turn ignition switch to ON position. 4) Measure voltage between “GRY/RED” wire terminal of TP sensor connector and vehicle body ground. *Is terminal voltage about 4 – 6 V?*	Faulty MAP sensor and/or A/C refrigerant pressure sensor, check MAP sensor and/or A/C refrigerant pressure sensor according to “Manifold Absolute Pressure (MAP) Sensor Inspection: in Section 1C” or “A/C Refrigerant Pressure Sensor and Its Circuit Inspection: in Section 7B”.	Go to Step 6.
6	**ECM voltage check** 1) Turn ignition switch to OFF position. 2) Remove ECM from its bracket with ECM connectors connected. 3) Check for proper connection of ECM connector at “C37-14” terminal. 4) Turn ignition switch to ON position. 5) Measure voltage between “C37-14” terminal of ECM connector and vehicle body ground. *Is terminal voltage about 4 – 6 V?*	“GRY/RED” wire is open or high resistance circuit.	Go to Step 8.
7	**ECM voltage check** 1) Turn ignition switch to OFF position. 2) Check for proper connection of ECM connector at “C37-54” terminal. 3) Turn ignition switch to ON position. 4) Measure voltage between “C37-54” terminal of ECM connector and vehicle body ground. *Is terminal voltage about 4 – 6 V?*	“GRY/BLU” wire is open or high resistance circuit.	Go to Step 8.
8	**Wire circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “GRY/RED” wire terminal of TP sensor connector and vehicle body ground, between “GRY/BLU” wire terminal of TP sensor connector and body ground and between “GRY/BLU” and “ORN” wire terminals of TP sensor connector. *Is resistance infinity?*	Go to Step 9.	“GRY/RED” and/or “GRY/BLU” wire are shorted to ground circuit and /or “GRY/BLU” wire is shorted to “ORN” wire. If wires are OK, substitute a known-good ECM and recheck.
9	**Wire circuit check** 1) Turn ON ignition switch. 2) Measure voltage between “GRY/RED” wire terminal of ECM connector and vehicle body ground and between “GRY/BLU” wire terminal of ECM connector and vehicle body ground. *Is voltage about 0 V at each terminal?*	Go to Step 10.	“GRY/RED” and/or “GRY/BLU” wire are shorted to power circuit. If wires are OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
10	**Wire circuit check** 1) Measure resistance between “C37-14” terminal of ECM connector and “GRY/RED” wire terminal of TP sensor connector, between “C37-54” terminal of ECM connector and “GRY/BLU” wire terminal of TP sensor connector with ignition switch turned OFF. *Is each resistance below 5 Ω?*	Go to Step 11.	“GRY/RED” and/or “GRY/BLU” wire are high resistance circuit.
11	**Ground circuit check** 1) Connect connectors to ECM with ignition switch turned OFF. 2) Measure resistance between “ORN” wire terminal of TP sensor connector and vehicle body ground. *Is resistance below 5 Ω?*	Go to Step 13.	Go to Step 12.
12	**Ground circuit check** 1) Remove ECM from its bracket with ECM connectors connected. 2) Measure resistance between “C37-55” terminal of ECM connector and vehicle body ground. *Is resistance below 5 Ω?*	“ORN” wire is open circuit or high resistance circuit. Poor “C37-55” connection.	Faulty ECM ground circuit. If circuit is OK, substitute a known-good ECM and recheck.
13	**TP sensor check** 1) Measure resistance between terminals of TP sensor referring to “Throttle Position (TP) Sensor On-Vehicle Inspection: in Section 1C”. *Are measured values within specifications?*	Go to Step 14.	Replace TP sensor.
14	**MAF sensor for performance check** 1) Check MAF sensor performance referring to Step 3 of “DTC P0101: Mass Air Flow Circuit Range / Performance: ”. *Is it in good condition?*	Go to Step 15.	Repair MAF and IAT sensor circuit or replace MAF and IAT sensor.
15	*Is DTC P0505 detected?*	Go to “DTC P0505: Idle Air Control System: ”.	Go to Step 16.
16	**Idle air control (IAC) valve check** 1) Check idle air control valve referring to “Idle Air Control (IAC) Valve Operation Inspection: in Section 1C”. *Is it in good condition?*	Go to Step 17.	Repair idle air control valve circuit or replace idle air control valve.
17	**Throttle body check** 1) Check throttle body for clog or leak. *Is it OK?*	Substitute a known-good ECM and recheck.	Repair throttle body.

DTC P0122: Throttle Position Sensor Circuit Low

S4RS0A1104024

Wiring Diagram



1. TP sensor	3. To other sensors
2. To MAP sensor and A/C refrigerant pressure sensor	4. ECM

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
Voltage of TP sensor output is less than specified value for 0.5 seconds continuously. (1 driving cycle detection logic)	• TP sensor circuit • TP sensor • MAP sensor • A/C refrigerant pressure sensor • ECM

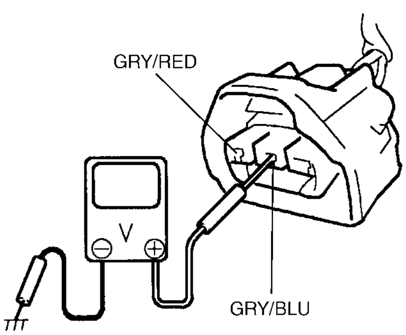
DTC Confirmation Procedure

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.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

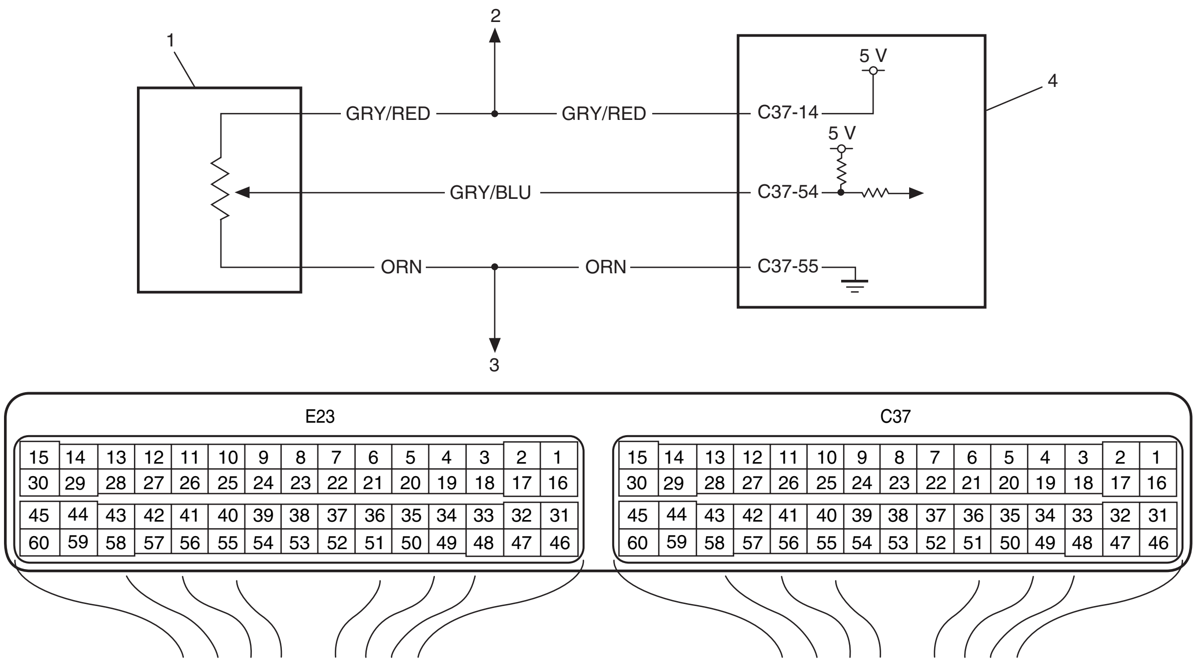
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**TP sensor and its circuit check** 1) Connect scan tool to DLC with ignition switch turned OFF and then turn ON ignition switch. 2) Check throttle valve 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 displayed value 0%?*	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.
3	**Wire harness check** 1) Disconnect connector from TP sensor with ignition switch turned OFF. 2) Check for proper connection to TP sensor at “GRY/RED”, “GRY/BLU” and “ORN” wire terminals. 3) If OK, then with ignition switch turned ON, check following terminal voltages. • Between “GRY/RED” wire terminal of TP sensor connector and vehicle body ground • Between “GRY/BLU” wire terminal of TP sensor connector and vehicle body ground  I4RS0A110028- *Is each terminal voltage about 4 – 6 V?*	Go to Step 7.	Go to Step 4.

Step	Action	Yes	No
4	**Wire harness check** 1) Turn ignition switch to OFF position. 2) Disconnect connectors from MAP sensor and A/C refrigerant pressure sensor. 3) Turn ignition switch to ON position. 4) Measure voltage between “GRY/RED” wire terminal of TP sensor connector and vehicle body ground. *Is terminal voltage about 4 – 6 V?*	Faulty MAP sensor and/or A/C refrigerant pressure sensor, check MAP sensor and/or A/C refrigerant pressure sensor according to “Manifold Absolute Pressure (MAP) Sensor Inspection: in Section 1C” or “A/C Refrigerant Pressure Sensor and Its Circuit Inspection: in Section 7B”.	Go to Step 5.
5	**ECM voltage check** 1) Turn ignition switch to OFF position. 2) Remove ECM from its bracket with ECM connectors connected. 3) Check for proper connection of ECM connector at “C37-14” terminal. 4) Turn ignition switch to ON position. 5) Measure voltage between “C37-14” terminal of ECM connector and vehicle body ground. *Is terminal voltage about 4 – 6 V?*	“GRY/RED” wire is open or high resistance circuit.	Go to Step 6.
6	**Wire circuit check** 1) Disconnect connectors from ECM with ignition switch turn OFF. 2) Measure resistance between “GRY/RED” wire terminal of TP sensor connector and vehicle body ground, between “GRY/BLU” wire terminal of TP sensor connector and vehicle body ground and between “GRY/BLU” and “ORN” wire terminals of TP sensor connector. *Is resistance infinity?*	Go to Step 7.	“GRY/RED” and/or “GRY/BLU” wires are shorted to ground circuit and/or “GRY/BLU” wire is shorted to “ORN” wire. If wires are OK, substitute a known-good ECM and recheck.
7	**TP sensor check** 1) Measure resistance between terminals of TP sensor referring to “Throttle Position (TP) Sensor On-Vehicle Inspection: in Section 1C”. *Are measured values within specifications?*	Substitute a known-good ECM and recheck.	Replace TP sensor.

DTC P0123: Throttle Position Sensor Circuit High

S4RS0A1104025

Wiring Diagram



1. TP sensor	3. To other sensors
2. To MAP sensor and A/C refrigerant pressure sensor	4. ECM

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
Voltage of TP sensor output is more than specified value for 0.5 seconds continuously. (1 driving cycle detection logic)	• TP sensor circuit • TP sensor • MAP sensor • A/C refrigerant pressure sensor • ECM

DTC Confirmation Procedure

NOTE:

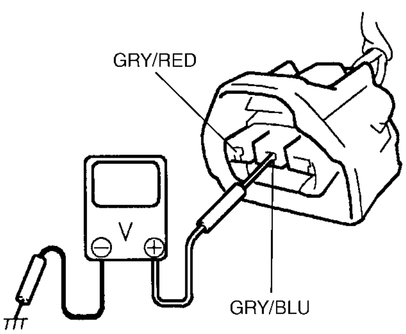
When DTC P0108, P0113 and P0118 are indicated together, it is possible that "ORN" wire circuit open.

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.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

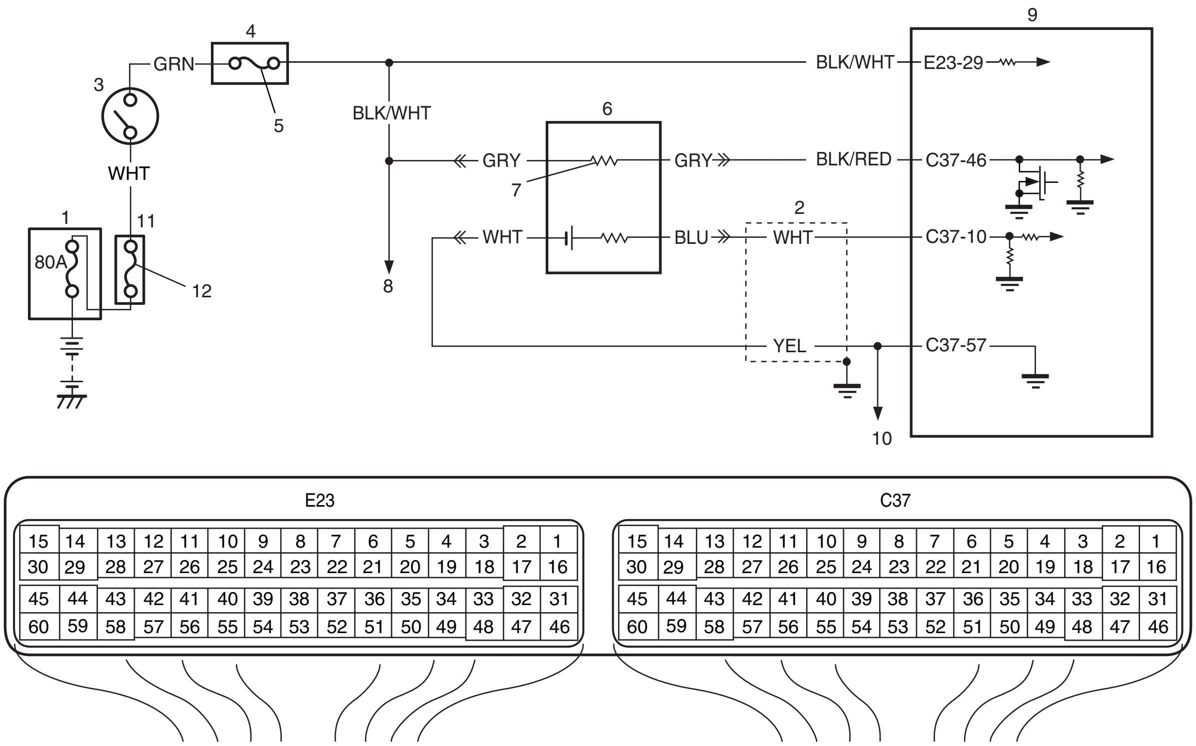
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**TP sensor and its circuit check** 1) Connect scan tool to DLC with ignition switch turned OFF and then turn ON ignition switch. 2) Check throttle valve 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 displayed value 100%?*	Go to Step 3.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.
3	**Wire harness check** 1) Disconnect connector from TP sensor with ignition switch turned OFF. 2) Check for proper connection to TP sensor at “GRY/RED”, “GRY/BLU” and “ORN” wire terminals. 3) If OK, then with ignition switch turned ON, check following terminal voltages. • Between “GRY/RED” wire terminal of TP sensor connector and vehicle body ground • Between “GRY/BLU” wire terminal of TP sensor connector and vehicle body ground  I4RS0A110028- *Is each terminal voltage about 4 – 6 V?*	Go to Step 8.	Go to Step 4.
4	*Was “GRY/RED” wire terminal voltage in Step 3 within specification?*	Go to Step 6.	Go to Step 5.
5	**Wire harness check** 1) Turn ignition switch to OFF position. 2) Disconnect connectors from ECM. 3) Check for proper connection of ECM connector at “C37-14” terminal. 4) Turn ignition switch to ON position. 5) Measure voltage between “GRY/RED” wire terminal of TP sensor connector and vehicle body ground. *Is terminal voltage about 0 V?*	Substitute a known-good ECM and recheck.	“GRY/RED” wire is shorted to power circuit.

Step	Action	Yes	No
6	**Wire circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check for proper connection of ECM connector at "C37-54" terminal. 4) Measure voltage between "GRY/BLU" wire terminal of TP sensor connector and vehicle body ground. *Is voltage about 0 V at each terminal?*	Go to Step 7.	"GRY/BLU" wire is shorted to power circuit. If wire is OK, substitute a known-good ECM and recheck.
7	**Wire circuit check** 1) Measure resistance between "C37-54" wire terminal of ECM connector and "GRY/BLU" wire terminal of TP sensor connector with ignition switch turned OFF. *Is resistance below 5 Ω?*	Go to Step 8.	"GRY/BLU" wire is open or high resistance circuit.
8	**Ground circuit check** 1) Connect connectors to ECM with ignition switch turned OFF. 2) Measure resistance between "ORN" wire terminal of TP sensor connector and vehicle body ground. *Is resistance below 5 Ω?*	Go to Step 10.	Go to Step 9.
9	**Ground circuit check** 1) Remove ECM from its bracket with ECM connectors connected. 2) Measure resistance between "C37-55" terminal of ECM connector and vehicle body ground. *Is resistance below 5 Ω?*	"ORN" wire is open circuit or high resistance circuit. Poor "C37-55" connection.	Faulty ECM ground circuit. If circuit is OK, substitute a known-good ECM and recheck.
10	**TP sensor check** 1) Measure resistance between terminals of TP sensor referring to "Throttle Position (TP) Sensor On-Vehicle Inspection: in Section 1C". *Are measured values within specifications?*	Substitute a known-good ECM and recheck.	Replace TP sensor.

DTC P0131 / P0132: O2 Sensor (HO2S) Circuit Low Voltage / High Voltage (Sensor-1)

S4RS0A1104026

Wiring Diagram



I4RS0A110029-

1. Main fuse box	4. Junction block assembly	7. Heater	10. To other sensors
2. Shield wire	5. “IG COIL” fuse	8. To HO2S-2 heater	11. Relay box
3. Ignition switch	6. HO2S-1	9. ECM	12. “IG ACC” fuse

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
DTC P0131: Maximum HO2S voltage is less than 0.6 V (2 driving cycle detection logic) **DTC P0132:** Minimum HO2S voltage is 0.34 V or more (*2 driving cycle detection logic, monitoring once / 1 driving)	• HO2S-1 circuit • HO2S-1 • Fuel system • ECM • Fuel shortage • Exhaust system • Air intake system

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 by 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 temperature at engine start: –10 °C (14 °F) to 80 °C (176 °F)**
- **Intake air temperature: –10 °C (14 °F) to 70 °C (158 °F)**
- **Engine coolant temperature: 70 °C (158 °F) to 150 °C (302 °F)**
- **Altitude (barometric pressure): 2400 m, 8000 ft or less (560 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.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

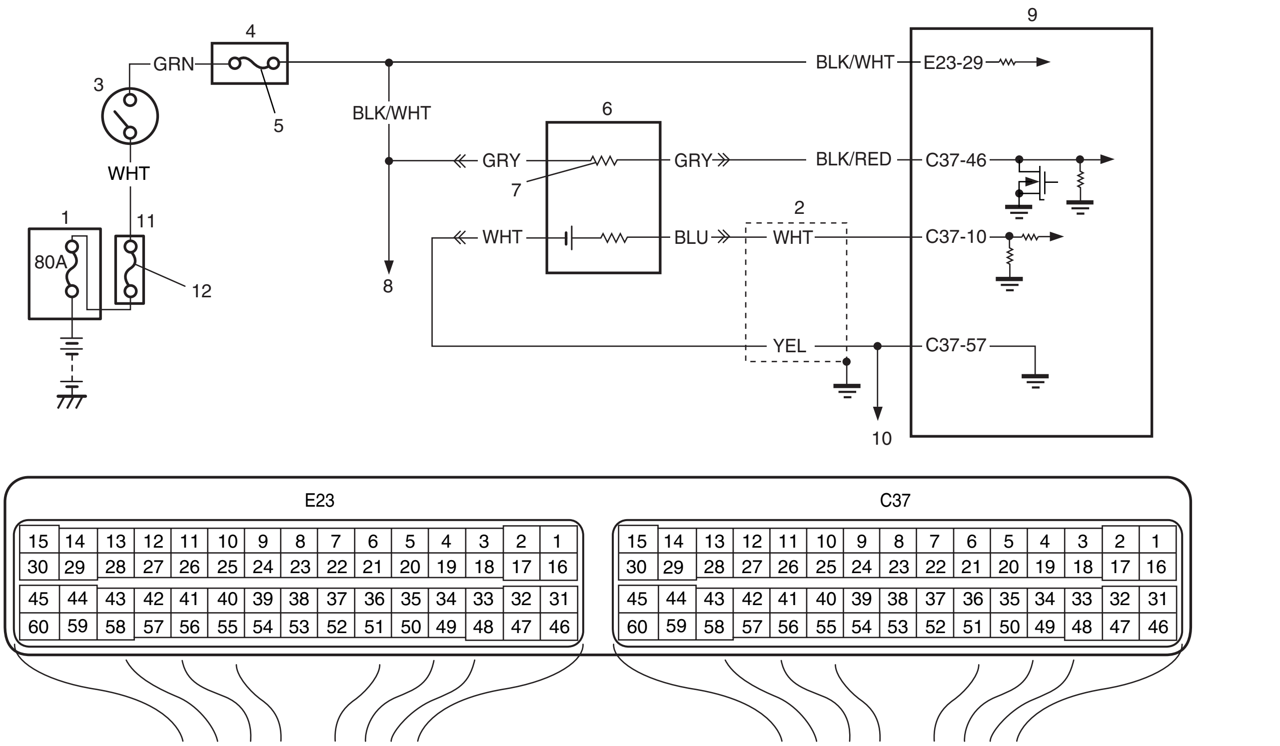
Step	Action	Yes	No
1	*Was "Engine and Emission Control System Check" performed?*	Go to Step 2.	Go to "Engine and Emission Control System Check: ".
2	*Is there DTC(s) other than HO2S-1?*	Go to applicable DTC diag. flow.	Go to Step 3.
3	**HO2S-1 signal check** 1) Connect scan tool to DLC with ignition 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 it). *Does HO2S-1 output voltage deflect between below 0.3 V and over 0.6 V repeatedly?*	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection Inspection: in Section 00". If check result is OK, go to Step 9.	Go to Step 4.
4	**HO2S-1 ground check** 1) Disconnect connector from HO2S-1 with ignition switch turned OFF. 2) Check for proper connection to HO2S-1 connector at "BLK/RED", "WHT", "BLK/WHT" and "YEL" wire terminals. 3) If connections are OK, measure resistance between "YEL" wire terminal of HO2S-1 connector and engine ground. *Is measured resistance less than 5 Ω?*	Go to Step 5.	"YEL" wire is open circuit or high resistance circuit. Poor "C37-57" terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
5	**Wire circuit check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connectors connected. 3) Measure resistance between “WHT” wire terminal of HO2S-1 connector and “C37-10” terminal of ECM connector. *Is resistance less than 5 Ω?*	Go to Step 6.	“WHT” wire is high resistance circuit or open circuit. Poor “C37-10” terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.
6	**Wire circuit check** 1) Disconnect connectors from ECM with ignition switch turn OFF. 2) Measure resistance between “WHT” wire terminal of HO2S-1 connector and vehicle body ground. *Is resistance infinity?*	Go to Step 7.	“WHT” wire is shorted to ground circuit.
7	**HO2S-1 signal circuit check** 1) Measure voltage between “WHT” wire terminal of HO2S-1 connector and vehicle body ground. *Is voltage 0 V?*	Go to Step 8.	“WHT” wire is shorted to other circuits.
8	**HO2S-1 heater circuit check** 1) Check HO2S-1 heater circuit referring to “DTC P0031 / P0032: HO2S Heater Control Circuit Low / High (Sensor-1): ”. *Is circuit in good condition?*	Go to Step 9.	Repair HO2S-1 circuit.
9	**Exhaust system check** 1) Check exhaust system for exhaust gas leakage. *Is it OK?*	Go to Step 4 in “DTC P0171 / P0172: Fuel System Too Lean / Rich: ”. If it is in good condition, go to Step 10.	Repair leakage of exhaust system for leakage.
10	**Air intake system check** 1) Check air intake system for clog or leak. *Is it OK?*	Check HO2S-1 referring to “Heated Oxygen Sensor (HO2S-1 and HO2S-2) Heater On-Vehicle Inspection: in Section 1C”. If it is in good condition, substitute a known-good ECM and recheck.	Repair or replace air intake system.

DTC P0133: O2 Sensor (HO2S) Circuit Slow Response (Sensor-1)

S4RS0A1104027

Wiring Diagram



I4RS0A110029-

1. Battery fuse box	4. Junction block assembly	7. Heater	10. To HO2S-2
2. Shield wire	5. “IG COIL” fuse	8. To HO2S-2 heater	11. Relay box
3. Ignition switch	6. HO2S-1	9. ECM	12. “IG ACC” fuse

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 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 be very careful during testing to avoid occurrence of an accident.**
- **Road test should be carried out by 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 temperature at engine start: –10 °C (14 °F) to 80 °C (176 °F)**
- **Intake air temperature: –10 °C (14 °F) to 70 °C (158 °F)**
- **Engine coolant temperature: 70 °C (158 °F) to 150 °C (302 °F)**
- **Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 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 if DTC and pending DTC exist by using scan tool. If not, check if oxygen sensor monitoring test has been 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).

DTC Troubleshooting

NOTE:

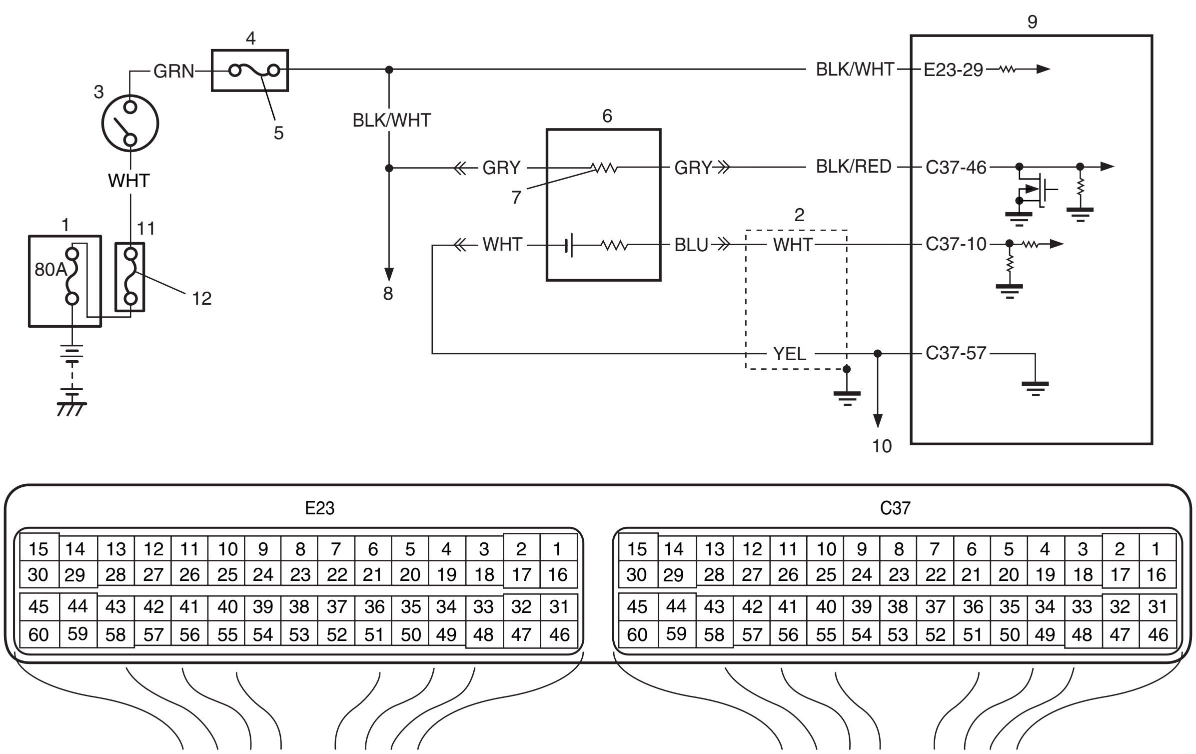
- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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 there DTC(s) other than HO2S-1 (DTC P0133)?*	Go to applicable DTC diag. flow.	Replace HO2S-1.

DTC P0134: O2 Sensor (HO2S) Circuit No Activity Detected (Sensor-1)

S4RS0A1104028

Wiring Diagram



I4RS0A110029-

1. Battery fuse box	4. Junction block assembly	7. Heater	10. To HO2S-2
2. Shield wire	5. “IG COIL” fuse	8. To HO2S-2 heater	11. Relay box
3. Ignition switch	6. HO2S-1	9. ECM	12. “IG ACC” fuse

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
HO2S voltage is higher than 0.6 V for more than 1 min continuously after warming up engine or HO2S voltage is lower than 0.3 V for more than 1 min continuously after warming up engine. (2 driving cycle detection logic)	• HO2S-1 • HO2S-1 circuit • Fuel system • Exhaust gas leakage • ECM • Fuel shortage • Air intake system

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 by 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 temperature at engine start: –10 °C (14 °F) to 80 °C (176 °F)**
- **Intake air temperature: –10 °C (14 °F) to 70 °C (158 °F)**
- **Engine Coolant temperature: 70 °C (158 °F) to 150 °C (302 °F)**
- **Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 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 if DTC and pending DTC exist by using scan tool. If not, check if oxygen sensor monitoring test has been 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).

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

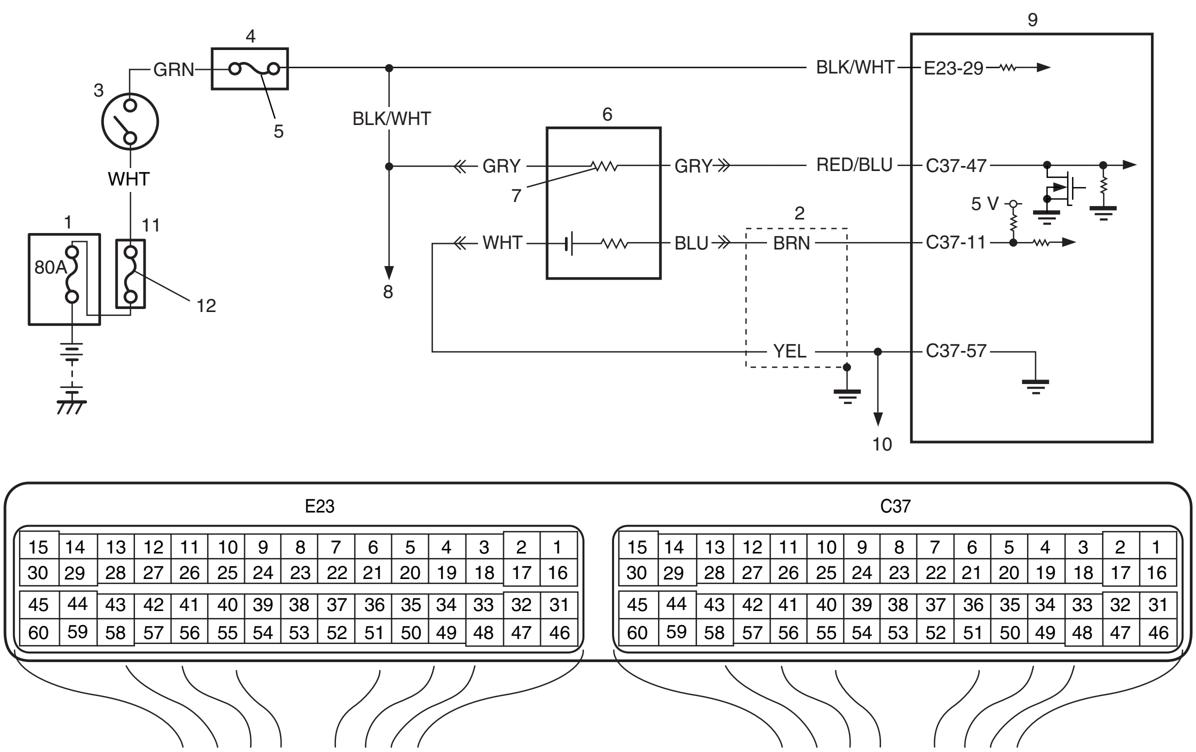
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**HO2S-1 output voltage check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Warm up engine to normal operating temperature and keep 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 it) and check HO2S output voltages displayed on scan tool. *Is over 0.6 V and below 0.3 V indicated?*	Intermittent trouble, check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”. If check result is OK, go to Step 3.	Go to Step 3.
3	**HO2S-1 ground check** 1) Disconnect connector from HO2S-1 with ignition switch turned OFF. 2) Check for proper connection to HO2S-1 at “BLK/RED”, “WHT”, “BLK/WHT” and “YEL” wire terminals. 3) If wire and connection are OK, measure resistance between “YEL” wire terminal of HO2S-1 connector and engine ground. *Is resistance less than 5 Ω?*	Go to Step 4.	“YEL” wire is open or high resistance circuit. Poor “C37-57” terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.
4	**Wire circuit check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connectors connected. 3) Measure resistance between “WHT” wire terminal of HO2S-1 connector and “C37-10” terminal. *Is resistance less than 5 Ω?*	Go to Step 5.	“WHT” wire is high resistance circuit or open circuit. Poor “C37-10” terminal connection of ECM connector. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.
5	**Wire circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “WHT” wire terminal of HO2S-1 connector and vehicle body ground. *Is resistance infinity?*	Go to Step 6.	“WHT” wire is shorted to ground circuit.
6	**HO2S-1 heater circuit check** 1) Check HO2S-1 heater circuit referring to “DTC P0031 / P0032: HO2S Heater Control Circuit Low / High (Sensor-1): ”. *Is it in good condition?*	Go to Step 7.	Repair HO2S-1 circuit.
7	**Exhaust system check** 1) Check exhaust system for exhaust gas leakage. *Is it OK?*	Go to Step 4 in “DTC P0171 / P0172: Fuel System Too Lean / Rich: ”. If it is in good condition, go to Step 8.	Repair leakage of exhaust system.

Step	Action	Yes	No
8	**Air intake system check** 1) Check air intake system for clog or leak. *Is it OK?*	Check HO2S-1 referring to "Heated Oxygen Sensor (HO2S-1 and HO2S-2) Heater On-Vehicle Inspection: in Section 1C". If it is in good condition, substitute a known-good ECM and recheck.	Repair or replace air intake system.

DTC P0137 / P0138: O2 Sensor (HO2S) Circuit Low Voltage / High Voltage (Sensor-2)

S4RS0A1104070

Wiring Diagram



I4RS0A110030-

1. Battery fuse box	4. Junction block assembly	7. Heater	10. To other sensors
2. Shield wire	5. "IG COIL" fuse	8. To HO2S-1 heater	11. Relay box
3. Ignition switch	6. HO2S-2	9. ECM	12. "IG ACC" fuse

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
DTC P0137: HO2S-2 voltage is lower than 0.4 V while engine is idling after driving with high engine load (high speed) for specified time. And HO2S-2 max. voltage minus HO2S-2 min. voltage is less than 0.2 V for 40 sec continuously. (2 driving cycle detection logic) **DTC P0138:** HO2S-2 voltage is higher than 0.85 V while engine is idling after driving with high engine load (high speed) for specified time. And HO2S-2 max. voltage minus HO2S-2 min. voltage is less than 0.2 V for 40 sec continuously. (2 driving cycle detection logic)	• HO2S-2 • HO2S-2 circuit • Fuel system • ECM • Fuel shortage • Exhaust system • Air intake system

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 by 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 temperature at engine start: –10 °C (14 °F) to 80 °C (176 °F)**
- **Intake air temperature: –10 °C (14 °F) to 70 °C (158 °F)**
- **Engine Coolant temperature: 70 °C (158 °F) to 150 °C (302°F)**
- **Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 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 60 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.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

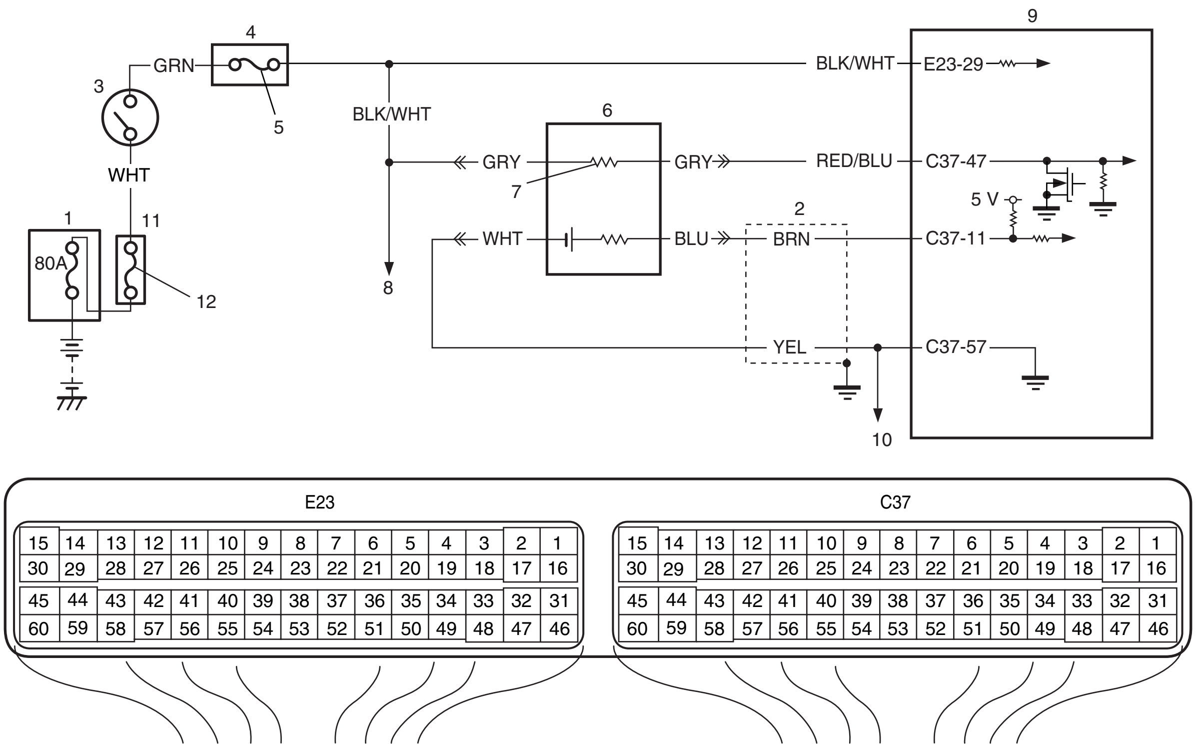
Step	Action	Yes	No
1	*Was "Engine and Emission Control System Check" performed?*	Go to Step 2.	Go to "Engine and Emission Control System Check: ".
2	*Is there DTC(s) other than fuel system (DTC P0171 / P0172) and HO2S-2 (DTC P0140)?*	Go to applicable DTC diag. flow.	Go to Step 3.
3	**HO2S-2 and its circuit 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 it). *Does HO2S-2 output voltage indicate deflection between over 0.35 V and below 0.25 V?*	Go to "DTC P0171 / P0172: Fuel System Too Lean / Rich: ".	Go to Step 4.

Step	Action	Yes	No
4	**HO2S-2 ground check** 1) Disconnect connector from HO2S-2 with ignition switch turned OFF. 2) Check for proper connection to HO2S-2 connector at “RED/BLU”, “BRN”, “YEL” and “BLK/WHT” wire terminals. 3) If connections are OK, measure resistance between “YEL” wire terminal of HO2S-2 connector and engine ground. *Is resistance less than 5 Ω?*	Go to Step 5.	“YEL” wire is open or high resistance circuit. Poor “C37-57” terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.
5	**Wire circuit check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connectors connected. 3) Measure resistance between “BRN” wire terminal of HO2S-2 connector and “C37-11” terminal of ECM connector. *Is resistance less than 5 Ω?*	Go to Step 6.	“BRN” wire is high resistance circuit or open circuit. Poor “C37-11” terminal connection. If they are OK, substitute a known-good ECM and recheck.
6	**Wire circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “BRN” wire terminal of HO2S-2 connector and vehicle body ground. *Is resistance infinity?*	Go to Step 7.	“BRN” wire is shorted to ground circuit.
7	**HO2S-2 signal circuit check** 1) Measure voltage between “BRN” wire terminal of HO2S-2 connector and vehicle body ground. *Is voltage 0 V?*	Go to Step 8.	“BRN” wire is shorted to other circuit.
8	**HO2S-2 heater circuit check** 1) Check HO2S-2 heater circuit referring to “DTC P0037 / P0038: HO2S Heater Control Circuit Low / High (Sensor-2): ”. *Is circuit in good condition?*	Go to Step 9.	Repair HO2S-2 circuit
9	**Exhaust system check** 1) Check exhaust system for exhaust gas leakage. *Is it OK?*	Go to Step 4 in “DTC P0171 / P0172: Fuel System Too Lean / Rich: ”. If it is in good condition, go to Step 10.	Repair leakage of exhaust system.
10	**Air intake system check** 1) Check air intake system for clog or leak. *Is it OK?*	Check HO2S-2 referring to “Heated Oxygen Sensor (HO2S-1 and HO2S-2) Heater On-Vehicle Inspection: in Section 1C”. If it is in good condition, substitute a known-good ECM and recheck.	Repair or replace air intake system.

DTC P0140: O2 Sensor (HO2S) Circuit No Activity Detected (Sensor-2)

S4RS0A1104030

Wiring Diagram



I4RS0A110030-

1. Main fuse box	4. Junction block assembly	7. Heater	10. To other sensors
2. Shield wire	5. “IG COIL” fuse	8. To HO2S-1 heater	11. Relay box
3. Ignition switch	6. HO2S-2	9. ECM	12. “IG ACC” fuse

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
HO2S-2 voltage is higher than specified value after warming up engine (circuit open). (2 driving cycle detection logic)	• HO2S-2 • HO2S-2 circuit • ECM • Exhaust gas leakage • Air intake system

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 by 2 persons, a driver and a 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) 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 60 sec. or more.
6) Check DTC and pending DTC.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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	**HO2S-2 ground check** 1) Disconnect connector from HO2S-2 with ignition switch turned OFF. 2) Check for proper connection to HO2S-2 connector at “RED/BLU”, “BRN”, “YEL” and “BLK/WHT” wire terminals. 3) If connections are OK, measure resistance between “YEL” wire terminal of HO2S-2 connector and engine ground. *Is resistance less than 5 Ω?*	Go to Step 3.	“YEL” wire is open or high resistance circuit. Poor “C37-57” terminal connection. Faulty ECM ground. If they are OK, substitute a known-good ECM and recheck.
3	**Wire circuit check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connectors connected. 3) Measure resistance between “BRN” wire terminal of HO2S-2 connector and “C37-11” terminal of ECM connector. *Is resistance less than 5 Ω?*	Go to Step 4.	“BRN” wire is high resistance circuit or open circuit. Poor “C37-11” terminal connection. If they are OK, substitute a known-good ECM and recheck.
4	**HO2S-2 signal circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure voltage between “BRN” wire terminal of HO2S-2 connector and vehicle body ground. *Is voltage 0 V?*	Go to Step 5.	“BRN” wire is shorted to other circuits.
5	**HO2S-2 heater circuit check** 1) Check HO2S-2 heater circuit referring to “DTC P0037 / P0038: HO2S Heater Control Circuit Low / High (Sensor-2): ”. *Is circuit in good condition?*	Go to Step 6.	Repair HO2S-2 circuit. If circuit is OK, substitute a known-good ECM and recheck.
6	**HO2S-2 check** 1) Check HO2S-2 referring to “Heated Oxygen Sensor (HO2S-1 and HO2S-2) Heater On-Vehicle Inspection: in Section 1C”. *Is it in good condition?*	Substitute a known-good ECM and recheck.	Replace HO2S-2.

DTC P0171 / P0172: Fuel System Too Lean / Rich

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DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
DTC P0171: Total fuel trim is higher than 35% or short term fuel trim is higher than 20% for more than 1 min. continuously. (2 driving cycle detection logic) **DTC P0172:** Total fuel trim is lower than –35% or short term fuel trim is lower than –20% for more than 1 min. continuously. (2 driving cycle detection logic)	• Vacuum leakage • 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 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 the following conditions are satisfied when using this “DTC Confirmation Procedure”.

- **Intake air temperature at engine start: –10 °C (14 °F) to 80 °C (176 °F)**
- **Intake air temperature: –10 °C (14 °F) to 70 °C (158 °F)**
- **Engine coolant temperature: 70 °C (158 °F) to 150 °C (302 °F)**
- **Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 kPa or more)**

1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and print freeze frame data or write them down using scan tool.
3) Clear DTC using scan tool.
4) Start engine and warm up to normal operating temperature.
5) Operate vehicle with condition as noted freeze frame data for 5 min.
6) Stop vehicle and check DTC and pending DTC.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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 there DTC(s) other than fuel system (DTC P0171 / P0172)?*	Go to applicable DTC diag. flow.	Go to Step 3.
3	**Intake system and exhaust system for leakage check** *Are intake system and exhaust system in good condition?*	Go to Step 4.	Repair or replace defective part.
4	**Fuel pressure check** 1) Check fuel pressure referring to “Fuel Pressure Check: ”. *Is check result satisfactory?*	Go to Step 5.	Repair or replace defective part.
5	**Fuel injectors and its circuit check** 1) Check fuel injectors referring to “Fuel Injector Inspection: in Section 1G”. *Is check result satisfactory?*	Go to Step 6.	Faulty injector(s) or its circuit.
6	**Visual inspection** 1) Check MAF sensor and air intake system. • Objects which block measuring duct and resistor of MAF sensor. • Other air flow which does not pass the MAF sensor. *Are they in good condition?*	Go to Step 7.	Repair or replace detective part.
7	**MAF sensor for performance check** 1) With ignition switch turned OFF, install scan tool. 2) Start engine and warm up to normal operating temperature. 3) Check MAF value using scan tool (Refer to “Scan Tool Data: ” for normal value.). *Is each value within specified range?*	Go to Step 8.	Go to “DTC P0101: Mass Air Flow Circuit Range / Performance: ”.
8	**ECT sensor for performance check** 1) Check ECT sensor referring to Step 3 and 4 of “DTC P0118: Engine Coolant Temperature Circuit High: ”. *Is check result satisfactory?*	Go to Step 9.	Faulty ECT sensor or its circuit.
9	**HO2S-1 for performance check** 1) Check HO2S-1 referring to Step 3 of “DTC P0131 / P0132: O2 Sensor (HO2S) Circuit Low Voltage / High Voltage (Sensor-1): ”. *Is check result satisfactory?*	Substitute a known-good ECM and recheck.	Faulty HO2S-1 or its circuit.

DTC P0300 / P0301 / P0302 / P0303 / P0304: Random Misfire Detected / Cylinder 1 / Cylinder 2 / Cylinder 3 / Cylinder 4 Misfire Detected

S4RS0A1104033

System Description

ECM measures 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 determines the cylinder where the misfire occurred and output it as DTC.

DTC Detecting Condition and Trouble Area

<table>
<tr><th>DTC detecting condition</th><th>Trouble area</th></tr>
<tr><td>DTC 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)</td><td rowspan="2">• Ignition system
• Fuel injector and its circuit
• Fuel pressure
• EGR system
• Abnormal air drawn in
• Engine compression
• Valve lash adjuster
• Valve timing
• Fuel shortage</td></tr>
<tr><td>DTC 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)</td></tr>
</table>

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 by 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.: –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 print freeze frame data or write them down using scan tool.
3) Clear DTC using scan tool.
4) Drive vehicle under condition as noted freeze frame data for 1 min. or more.
5) Stop vehicle and check DTC and pending DTC.

DTC Troubleshooting

NOTE:

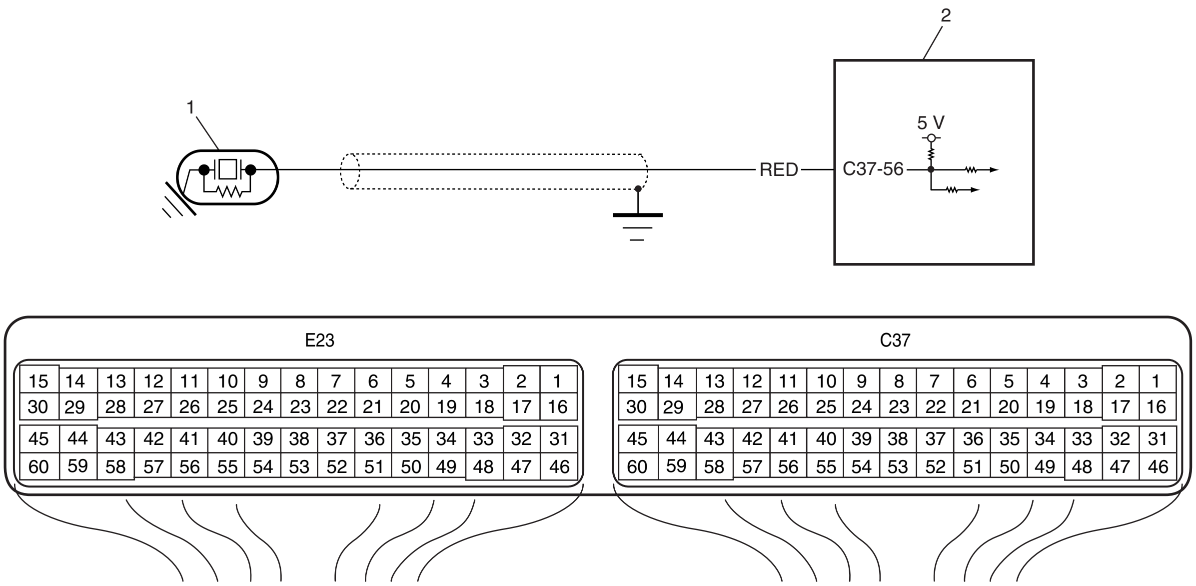
- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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	*Does fuel level meter indicate “E” level (empty)?*	Add fuel and recheck.	Go to Step 3.
3	**Ignition system check** 1) Check spark plug and ignition spark of cylinder where misfire occurs, referring to “Spark Plug Inspection: in Section 1H” and “Ignition Spark Test: in Section 1H”. *Are they 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 check** 1) Check fuel pressure referring to “Fuel Pressure Check: ”. *Is check result satisfactory?*	Go to Step 6.	Repair or replace fuel system.
6	**Fuel injector check** 1) Check fuel injector(s) referring to “Fuel Injector Inspection: in Section 1G”. *Is check result satisfactory?*	Go to Step 7.	Replace defective injector.
7	**Ignition timing check** 1) Check ignition timing referring to “Ignition Timing Inspection: in Section 1H”. *Is check result satisfactory?*	Go to Step 8.	Check related sensors.
8	**EGR system check** 1) Check EGR system referring to “EGR System Inspection: in Section 1B”. *Is check result satisfactory?*	Go to Step 9.	Repair or replace EGR system.
9	**Engine mechanical system check** 1) Check engine mechanical parts or system which can cause engine rough idle or poor performance. • Engine compression (Refer to “Compression Check: in Section 1D”.) • Valve lash (Refer to “Valve Lash (Clearance) Inspection: in Section 1D”.) • Valve timing (Refer to “Timing Chain and Chain Tensioner Removal and Installation: in Section 1D”.) *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 defective engine part.

DTC P0327 / P0328: Knock Sensor Circuit Low / High

S4RS0A1104034

Wiring Diagram



I4RS0A110031-

1.	Knock sensor
2.	ECM

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
DTC will be set when all of following conditions are detected for 0.5 seconds continuously. **DTC P0327:** • Engine is running • Voltage of knock sensor is less than 1.23 V (1 driving cycle detection logic) **DTC P0328:** • Engine is running • Voltage of knock sensor is 3.91 V or more (1 driving cycle detection logic)	• Knock sensor circuit (open or short) • Knock sensor • ECM

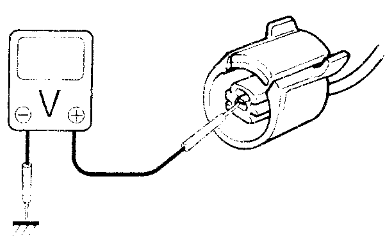
DTC Confirmation Procedure

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.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

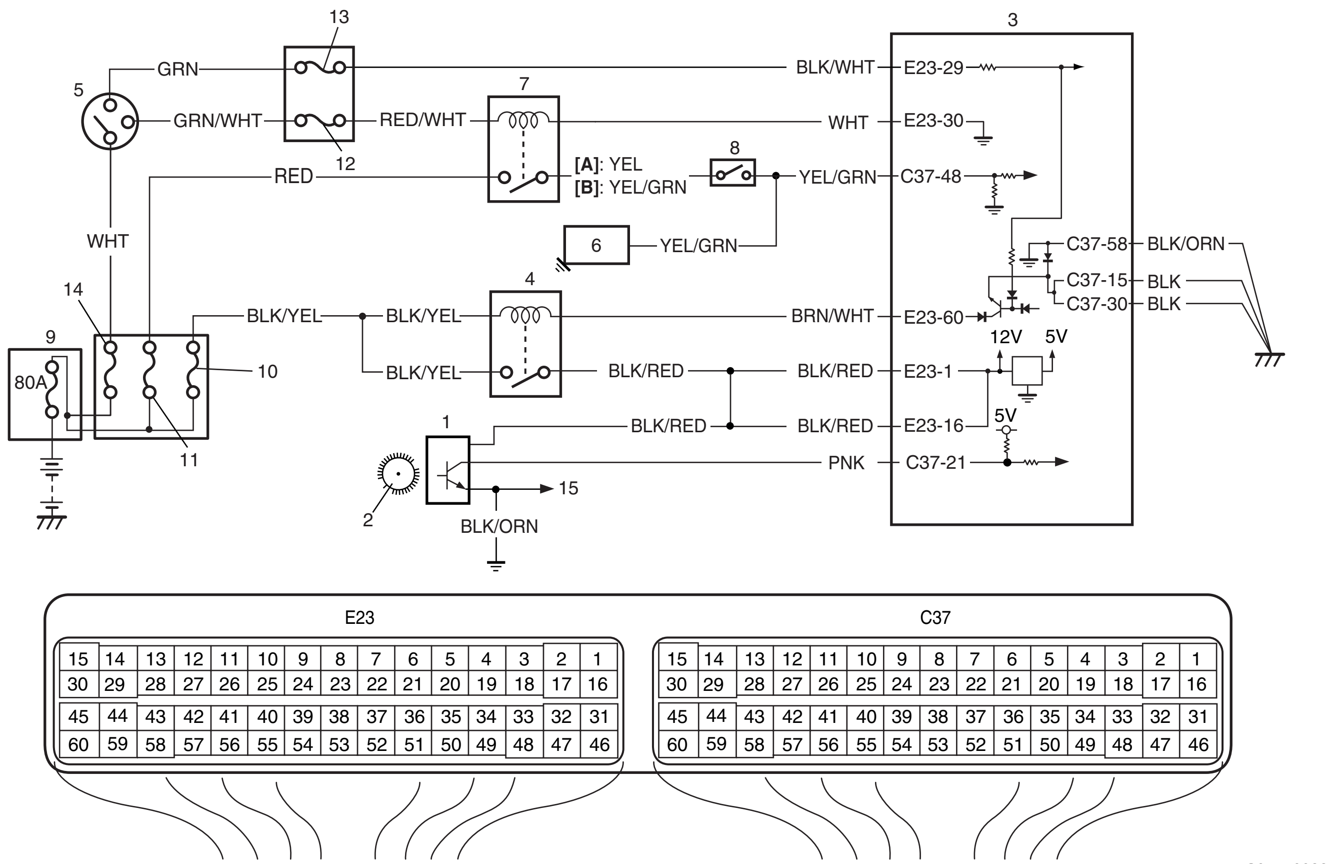
Step	Action	Yes	No
1	*Was "Engine and Emission Control System Check" performed?*	Go to Step 2.	Go to "Engine and Emission Control System Check: ".
2	**Knock sensor circuit check** 1) Remove ECM from its bracket with ECM connectors connected. 2) Measure voltage between "C37-56" terminal of ECM connector and vehicle body ground with engine running. *Is voltage within 1.23 – 3.91 V?*	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection Inspection: in Section 00". If OK, substitute a known-good ECM and recheck.	Go to Step 3.
3	**Knock sensor circuit for open check** 1) Disconnect connector from knock sensor with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between "RED" wire of knock sensor connector and engine ground.  I2RH01110089- *Is voltage 4 – 6 V?*	Go to Step 6.	Go to Step 4.
4	**Knock sensor circuit for open check** 1) Turn ON ignition switch, measure voltage between "C37-56" terminal of ECM connector and engine ground *Is voltage 4 – 6 V?*	"RED" wire is open circuit.	Go to Step 5.
5	**Knock sensor circuit for short check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between "C37-56" terminal of ECM connector and vehicle body ground. *Is resistance infinity?*	Go to Step 6.	"RED" wire is shorted to ground circuit. If wire is OK, substitute a known-good ECM and recheck.
6	**Knock sensor circuit for short check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between "C37-56" terminal of ECM connector and vehicle body ground. *Is voltage 0 V?*	Go to Step 7.	"RED" wire is shorted to other circuit.

Step	Action	Yes	No
7	**Knock sensor circuit for high resistance check** 1) Turn OFF ignition switch, measure resistance between “C37-56” terminal of ECM connector and “RED” wire terminal of knock sensor harness connector. *Is resistance below 5 Ω?*	Faulty knock sensor.	“RED” wire is high resistance circuit.

DTC P0335: Crankshaft Position (CKP) Sensor Circuit

S4RS0A1104035

Wiring Diagram



I4RS0A110032-

[A]: A/T vehicle	5. Ignition switch	11. “ST MOT” fuse
[B]: M/T vehicle	6. Starting motor	12. “ST SIG” fuse
1. CKP sensor	7. Starting motor control relay	13. “IG COIL” fuse
2. Sensor plate on crankshaft	8. Transmission range switch (A/T vehicle)	14. “IG ACC” fuse
3. ECM	9. Battery fuse	15. To CMP sensor
4. Main relay	10. “FI” fuse	

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
No CKP sensor signal for 2 sec. even if starting motor signal is inputted at engine cranking. (1 driving cycle detection logic)	• CKP sensor circuit open or short • Sensor plate teeth damaged • CKP sensor malfunction, foreign material being attached or improper installation • ECM • Engine start signal circuit malfunction

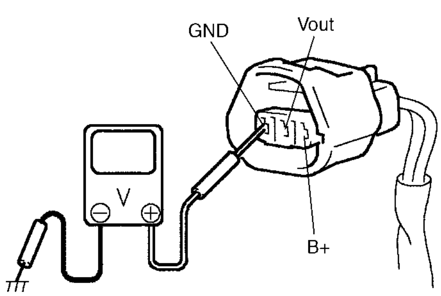
DTC Confirmation Procedure

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.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

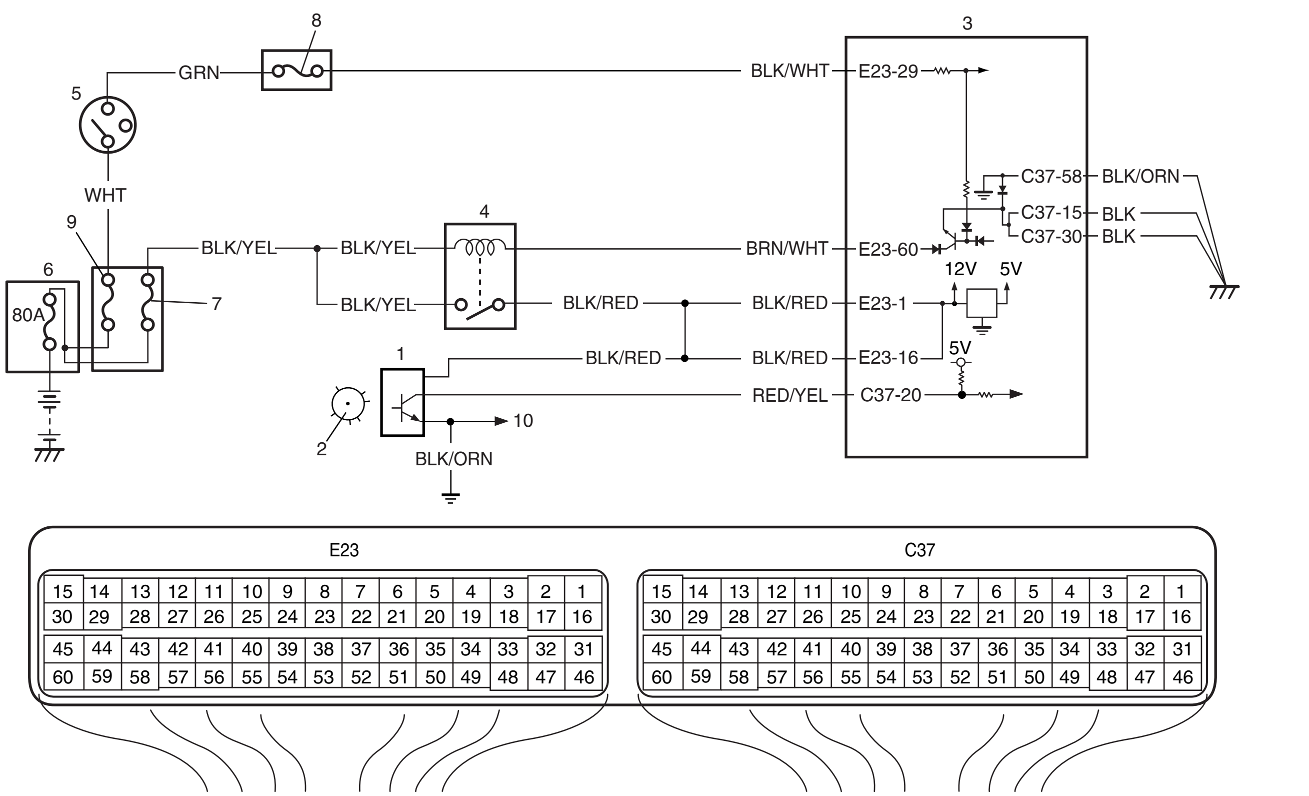
Step	Action	Yes	No
1	*Was "Engine and Emission Control System Check" performed?*	Go to Step 2.	Go to "Engine and Emission Control System Check: ".
2	**CKP sensor and connector for proper installation check** *Is CKP sensor installed properly and connector connected securely?*	Go to Step 3.	Correct.
3	**Wire harness and connection check** 1) Disconnect connector from CKP sensor with ignition switch turned OFF. 2) Check for proper connection to CKP sensor at "BLK/RED", "PNK" and "BLK/ORN" wire terminals. 3) If OK, turn ON ignition switch and check voltage at "BLK/RED", "PNK" and "BLK/ORN" wire terminals of disconnected CKP sensor connector. **<u>CKP sensor voltage</u>** **Terminal "B+": 10 – 14 V** **Terminal "Vout": 4 – 5 V** **Terminal "GND": 0 V**  I2RH0B110048- *Is check result satisfactory?*	Go to Step 6.	Go to Step 4.
4	*Was terminal "Vout" voltage in Step 3 within specification?*	Go to Step 5.	"PNK" wire is open or shorted to ground / power supply circuit. If wire and connection are OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
5	**Ground circuit check** 1) Turn ignition switch to OFF position. 2) Measure resistance between “BLK/ORN” wire terminal of CKP sensor connector and engine ground. *Is measured resistance value less than 3 Ω?*	Go to Step 6.	“BLK/ORN” wire is open or high resistance.
6	*Was terminal “B+” voltage in Step 3 within specification?*	Go to Step 7.	“BLK/RED” wire is open circuit. If wire and connection are OK, substitute a known-good ECM and recheck.
7	**Engine start signal check** 1) Check starting motor circuit for opening and short referring to Step 2 of “DTC P0616: Starter Relay Circuit Low: ” and Step 3 and 4 of “DTC P0617: Starter Relay Circuit High: ”. *Is check result satisfactory?*	Go to Step 8.	Repair or replace.
8	**CKP sensor check** 1) Check CKP sensor and sensor plate tooth referring to “Crankshaft Position (CKP) Sensor Inspection: in Section 1C”. *Is check result satisfactory?*	Substitute a known-good ECM and recheck.	Replace CKP sensor and/or sensor plate.

DTC P0340: Camshaft Position (CMP) Sensor Circuit

S4RS0A1104036

Wiring Diagram



I4RS0A110034-

1. CMP sensor	4. Main relay	7. “FI” fuse	10. To CKP sensor
2. Signal rotor	5. Ignition switch	8. “IG COIL” fuse	
3. ECM	6. Battery fuse	9. “IG ACC” fuse	

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: ”.
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
• CMP sensor pulse is less than 20 pulses per crankshaft 8 revolutions • CMP sensor pulse is more than 28 pulses per crankshaft 8 revolutions • CMP sensor pulse is less than 20 pulses between BTDC 155° CA and BTDC 5° CA with crankshaft 8 revolutions from engine start. (1 driving cycle detection logic)	• CMP sensor circuit open or short • Signal rotor teeth damaged • CMP sensor malfunction, foreign material being attached or improper installation • ECM

DTC Confirmation Procedure

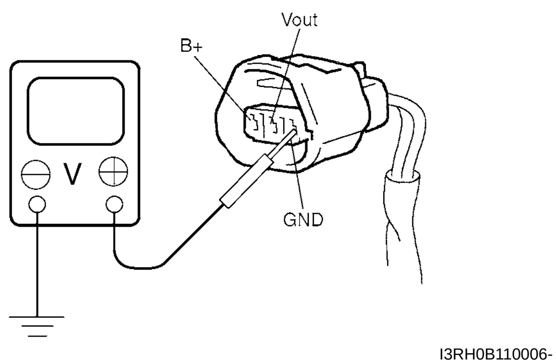
1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Crank engine for 5 sec.
4) Check DTC and pending DTC.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

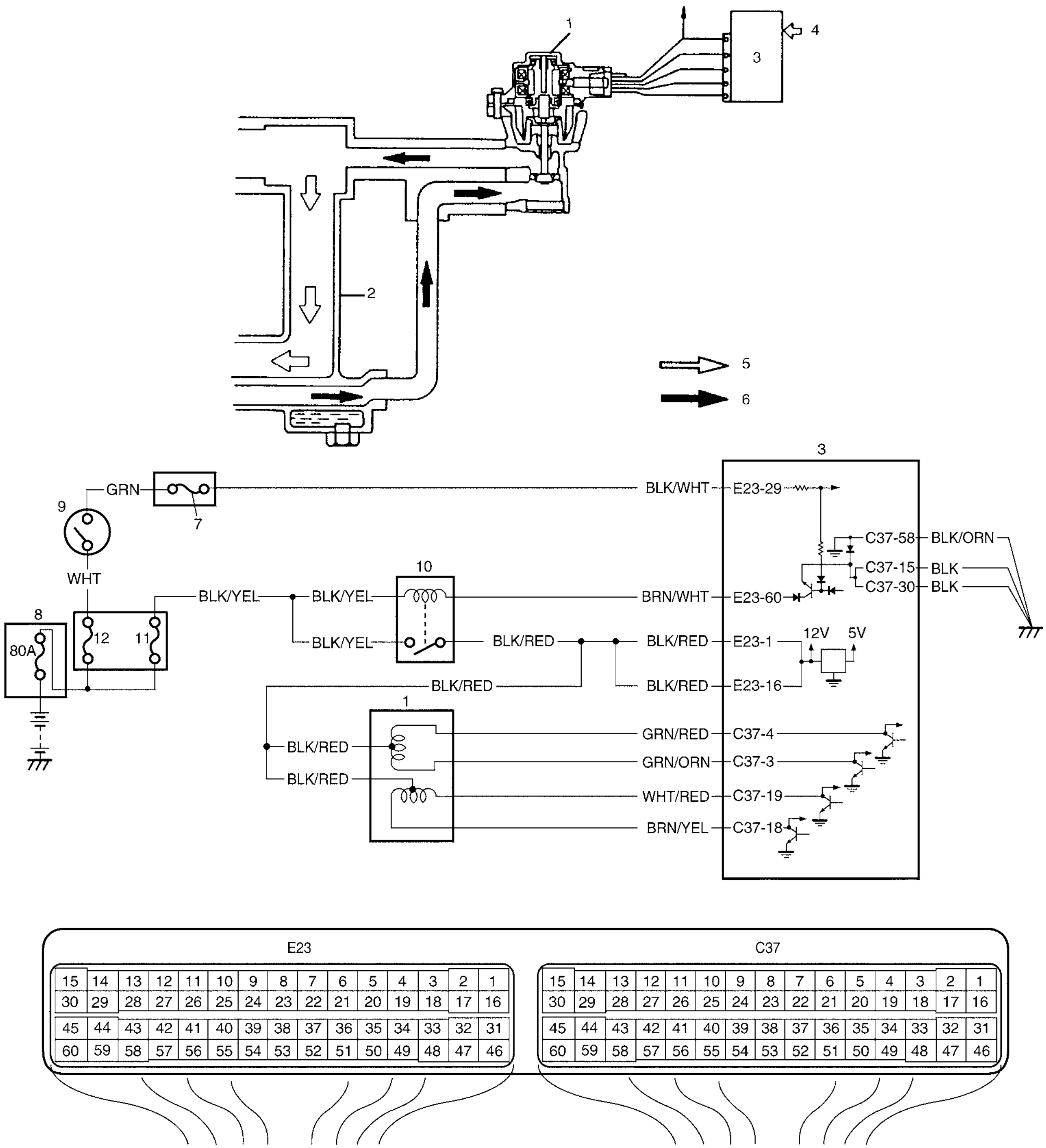
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**CMP sensor and connector for proper installation check** *Is CMP sensor installed properly and connector connected securely?*	Go to Step 3.	Correct.

Step	Action	Yes	No
3	**Wire harness and connection check** 1) Disconnect connector from CMP sensor. 2) Check for proper connection to CMP sensor at “BLK/RED”, “RED/YEL” and “BLK/ORN” wire terminals. 3) If OK, turn ON ignition switch and check voltage at “BLK/RED”, “RED/YEL” and “BLK/ORN” wire terminals of disconnected CMP sensor connector. **<u>CMP sensor voltage</u>** **Terminal “B+”: 10 – 14 V** **Terminal “Vout”: 4 – 5 V** **Terminal “GND”: 0 V**  *Is check result satisfactory?*	Go to Step 7.	Go to Step 4.
4	*Was terminal “Vout” voltage in Step 3 within specification?*	Go to Step 5.	“RED/YEL” wire is open or shorted to ground / power supply circuit. If wire and connection are OK, substitute a known-good ECM and recheck.
5	**Ground circuit check** 1) Turn ignition switch to OFF position. 2) Measure resistance between “BLK/ORN” wire terminal of CMP sensor connector and engine ground. *Is measured resistance value less than 3 Ω?*	Go to Step 6.	“BLK/ORN” wire is open or high resistance circuit.
6	*Was terminal “B+” voltage in Step 3 within specification?*	Go to Step 7.	“BLK/RED” wire is open circuit. If wire and connection are OK, substitute a known-good ECM and recheck.
7	**CMP sensor check** 1) Check CMP sensor and signal rotor tooth referring to “Camshaft Position (CMP) Sensor Inspection: in Section 1C”. *Is check result satisfactory?*	Substitute a known-good ECM and recheck.	Replace CMP sensor and/or intake camshaft.

DTC P0401 / P0402: Exhaust Gas Recirculation Flow Insufficient Detected / Excessive Detected

S4RS0A1104037

System and Wiring Diagram



I4RS0A110035-

1. EGR valve	4. Sensed information	7. “IG COIL” fuse	10. Main relay
2. Intake manifold	5. Fresh air	8. Battery fuse box	11. “FI” fuse
3. ECM	6. Exhaust gas	9. Ignition switch	12. “IG ACC” fuse

DTC Detecting Condition and Trouble Area

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. (*2 driving cycle detection logic, monitoring once / 1 driving) **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

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 by 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 temperature at engine start: –10 °C (14 °F) to 80 °C (176 °F)**
- **Intake air temperature: –10 °C (14 °F) to 70 °C (158 °F)**
- **Engine coolant temperature: 70 °C (158 °F) to 150 °C (302 °F)**
- **Altitude (barometric pressure): 2400 m, 8000 ft or less (560 mmHg, 75 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) Run engine at idle for 10 min.
5) Drive vehicle and increase engine speed 3000 rpm in 3rd gear.
6) 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.
7) Stop vehicle and run engine at idle.
8) Check DTC and pending DTC by using scan tool.

DTC Troubleshooting

NOTE:

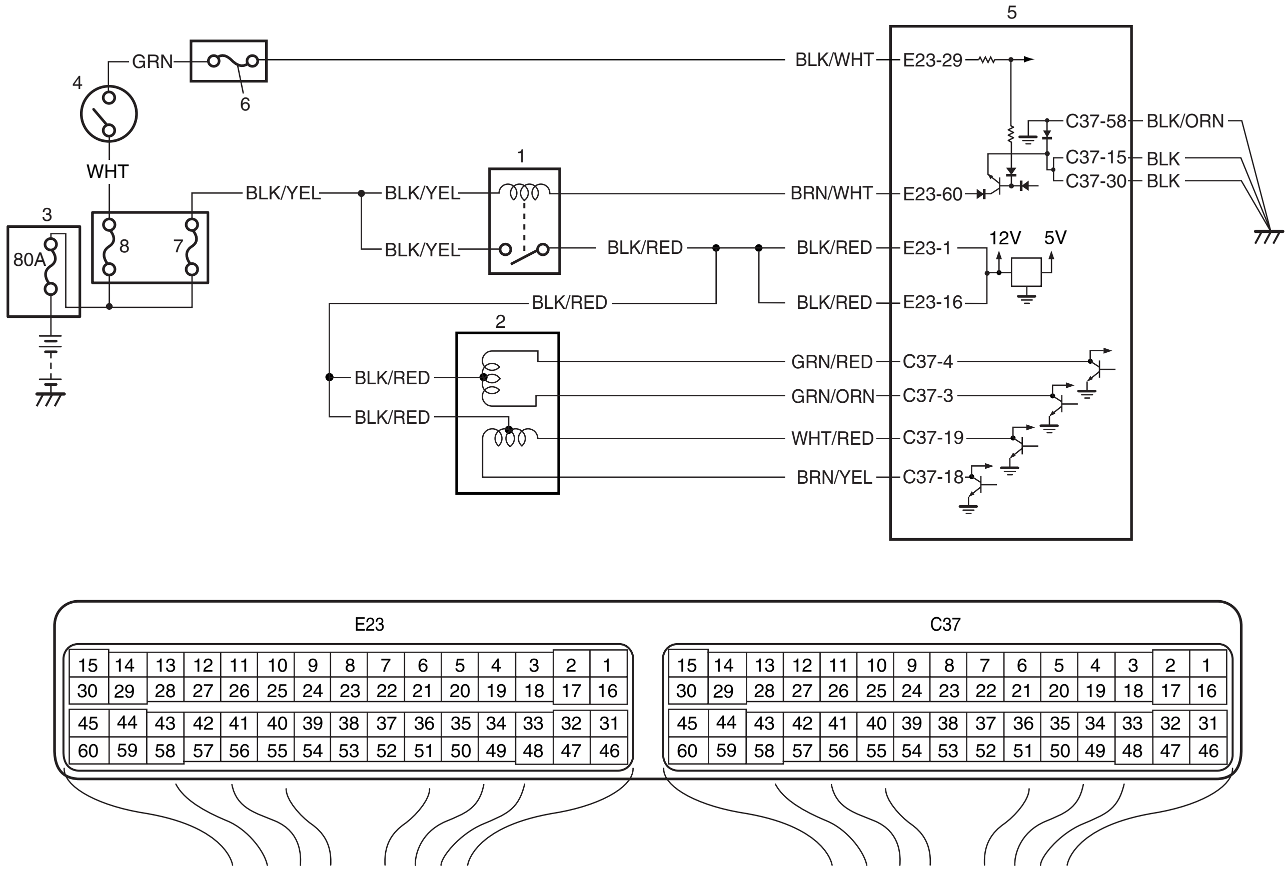
- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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 to DTC. 2) Check EGR system referring to “EGR System Inspection: in Section 1B”. *Is it in good condition?*	Go to Step 4.	Go to Step 5.
4	**MAP sensor check** 1) Check MAP sensor for performance referring to “Manifold Absolute Pressure (MAP) Sensor Inspection: in Section 1C”. *Is check result satisfactory?*	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.	Replace MAP sensor.
5	**EGR valve control circuit check** 1) Check that EGR valve control circuits are in good condition referring to Step 2 to 5 of “DTC P0403: Exhaust Gas Recirculation Control Circuit: ” *Are circuits in good condition?*	Go to Step 6.	Repair or replace EGR valve control circuit(s).
6	**EGR valve check** 1) Check EGR valve referring to “EGR Valve Inspection: in Section 1B”. *Is check result satisfactory?*	Go to Step 7.	Faulty EGR valve.
7	**MAP sensor check** 1) Check MAP sensor for performance referring to “Manifold Absolute Pressure (MAP) Sensor Inspection: in Section 1C”. *Is check result satisfactory?*	EGR passage clogged. If OK, substitute a known-good ECM and recheck.	Replace MAP sensor.

DTC P0403: Exhaust Gas Recirculation Control Circuit

S4RS0A1104071

Wiring Diagram



I4RS0A110036-

1. Main relay	3. Battery fuse box	5. ECM	7. “FI” fuse
2. EGR valve	4. Ignition switch	6. “IG COIL” fuse	8. “IG ACC” fuse

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
EGR valve output voltage is different from output command with more than one pole out of 4 poles. (1 driving cycle detection logic)	• EGR valve circuit open • EGR valve • 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 by 2 persons, a driver and a tester, on a level road.**

1) With ignition switch turned OFF, connect scan tool to DLC.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Start engine and warm it up to normal operating temperature.
4) Drive vehicle in 2000 – 3500 rpm of engine speed.
5) Keep above vehicle speed for 1 min. (Throttle valve opening is kept constant in this step.)
6) Stop vehicle and check DTC and pending DTC.

DTC Troubleshooting

NOTE:

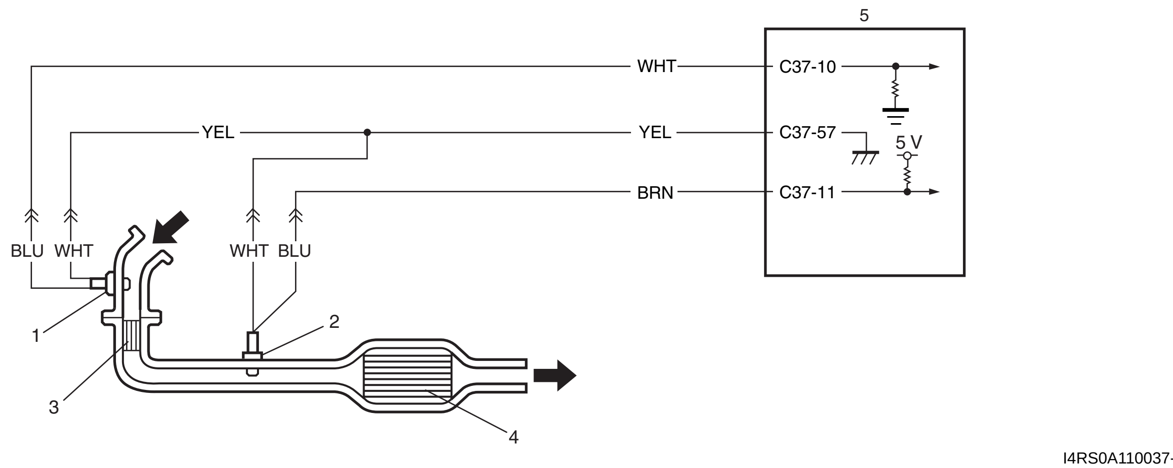
- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

Step	Action	Yes	No
1	*Was "Engine and Emission Control System Check" performed?*	Go to Step 2.	Go to "Engine and Emission Control System Description: ".
2	**EGR valve power supply circuit check** 1) Remove air intake pipe. 2) With ignition switch turned OFF, disconnect EGR valve connector. 3) With ignition switch turned ON, measure voltage between "BLK/RED" wire terminal of EGR valve connector and vehicle body ground. *Is check voltage 10 – 14 V?*	Go to Step 3.	"BLK/RED" wire is open circuit.
3	**Wire circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Measure voltage between engine ground and each "GRN/RED", "GRN/ORN", "WHT/RED", "BRN/YEL" wire terminals of EGR valve connector. *Is each voltage 0 V?*	Go to Step 4.	Faulty wire(s) are shorted to other circuit. If wires are OK, substitute a known-good ECM and recheck.
4	**Wire circuit check** 1) With ignition switch turned OFF, measure resistance between engine ground and each "GRN/RED", "GRN/ORN", "WHT/RED", "BRN/YEL" wire terminals of EGR valve connector. *Is resistance infinity?*	Go to Step 5.	Faulty wire(s) are shorted to ground circuit. If wires are OK, substitute a known-good ECM and recheck.
5	**Short circuit check for EGR valve control circuit** 1) With ignition turned OFF, measure resistance between each EGR valve control circuit wire ("GRN/RED", "GRN/ORN", "WHT/RED" and "BRN/YEL" wire) and each EGR valve control circuit wire. *Is each resistance infinity?*	Go to Step 6.	Faulty wire(s) are short circuit.
6	**EGR valve stepper motor coil circuit check** 1) With ignition switch turned OFF, connect EGR valve connector. 2) Measure resistance between "E23-1/16" and each "C37-4", "C37-3", "C37-19", "C37-18" terminals of ECM connector. *Is each resistance 20 – 31 Ω at 20 °C, 68 °F?*	Faulty ECM. Substitute a known-good ECM and recheck.	Go to Step 7.
7	**EGR valve check** 1) Check EGR valve resistance referring to "EGR Valve Inspection: in Section 1B". *Is resistance within specified value?*	Faulty wire(s) are open or high resistance circuit. If wires are OK, substitute a known-good ECM and recheck.	Faulty EGR valve.

DTC P0420: Catalyst System Efficiency below Threshold

S4RS0A1104039

System and Wiring Diagram



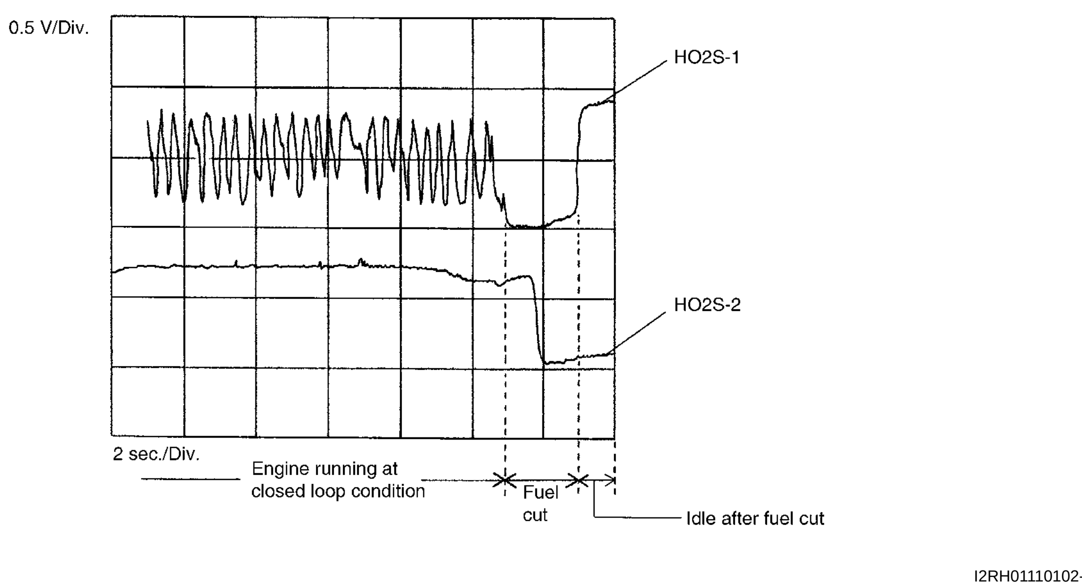
1. HO2S-1	3. Warm up three way catalytic converter	5. ECM
2. HO2S-2	4. Three way catalytic converter	

Circuit Description

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

Reference

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 • Warm up 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 by 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 been 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).

DTC Troubleshooting

NOTE:

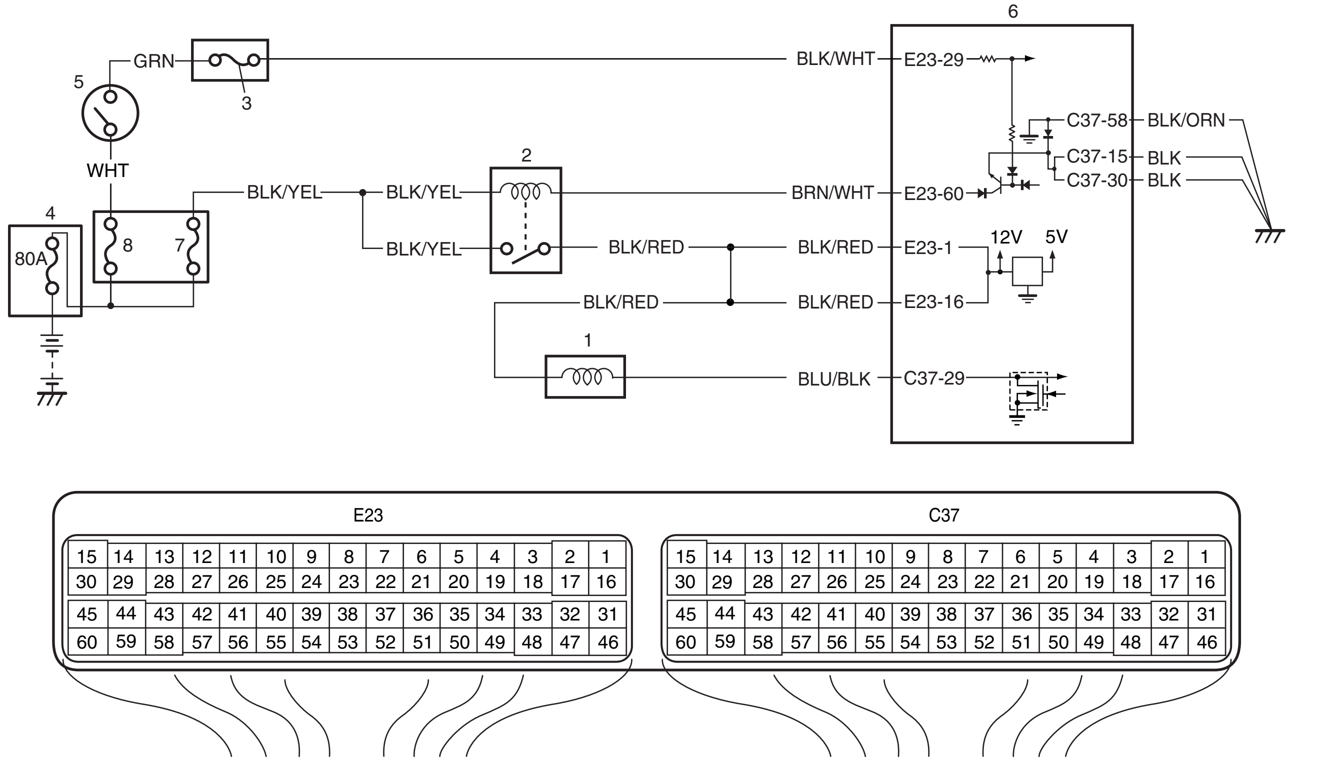
- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

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	**Exhaust system visual check** 1) Check exhaust system for leaks, damage and loose connection. *Is it in good condition?*	Go to Step 3.	Repair or replace defective part.
3	**HO2S-2 output voltage check** 1) Check output voltage of HO2S-2 referring to "DTC P0137 / P0138: O2 Sensor (HO2S) Circuit Low Voltage / High Voltage (Sensor-2): " and "DTC P0137 / P0138: O2 Sensor (HO2S) Circuit Low Voltage / High Voltage (Sensor-2): ". *Is check result satisfactory?*	Replace exhaust manifold (built in warm up three way catalytic converter) and exhaust center pipe (built in three way catalytic converter).	Check "BRN" and / or "YEL" 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

S4RS0A1104040

Wiring Diagram



I4RS0A110038-

1. EVAP canister purge valve	3. "IG COIL" fuse	5. Ignition switch	7. "FI" fuse
2. Main relay	4. Battery fuse box	6. ECM	6. "IG ACC" fuse

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 by 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 warm up normal operating temperature.
4) Drive vehicle at more than 40 km/h, 25 mph for 5 min. or more.
5) Check DTC and pending DTC.

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 water heater.

NOTE:

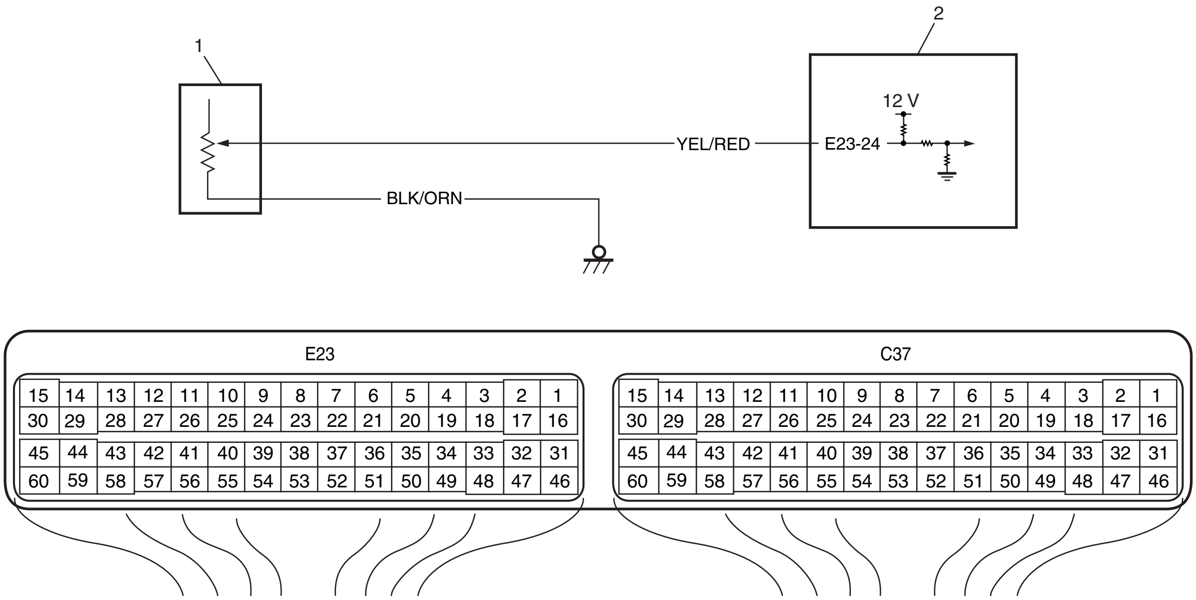
- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

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	**EVAP canister purge power supply circuit check** 1) Turn OFF ignition switch and 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 is open circuit.
3	**Wire circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between "C37-29" terminal of ECM connector and vehicle body ground. *Is resistance infinity?*	Go to Step 4.	"BLU/BLK" wire is shorted to ground circuit.
4	**Wire circuit check** 1) Measure voltage between "C37-29" terminal of ECM connector and vehicle body ground with ignition switch turned ON. *Is voltage 0 V?*	Go to Step 5.	"BLU/BLK" wire is shorted to other circuit.
5	**Wire circuit check** 1) Connect connector to purge control valve with ignition switch turned OFF. 2) Turn ON ignition switch and measure voltage between "C37-29" terminal of ECM connector and vehicle body ground. *Is it voltage 10 – 14 V?*	Go to Step 6.	"BLU/BLK" wire is open circuit.
6	**EVAP canister purge control valve check** 1) Check EVAP canister purge control valve referring to "EVAP Canister Purge Valve Inspection: in Section 1B". *Is it in good condition?*	Go to Step 7.	Faulty EVAP canister purge control valve.
7	**EVAP canister purge control circuit check** 1) With ignition switch turn OFF, measure resistance between "E23-1/16" terminal and "C37-29" 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 "BLU/BLK" wire are high resistance circuit.

DTC P0462: Fuel Level Sensor Circuit Low

S4RS0A1104072

Wiring Diagram



I4RS0A110039-

1.	Fuel level sensor (gauge)
2.	ECM

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
Fuel level sensor voltage is lower than 0.45 V for 3 seconds continuously. (1 driving cycle detection logic but MIL does not light up)	• “YEL/RED” circuit short • Fuel level sensor malfunction • ECM and/or its power and ground circuit malfunction • Combination meter 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) Start engine and run it for 30 sec. or more.
4) Check DTC and pending DTC.

DTC Troubleshooting

NOTE:

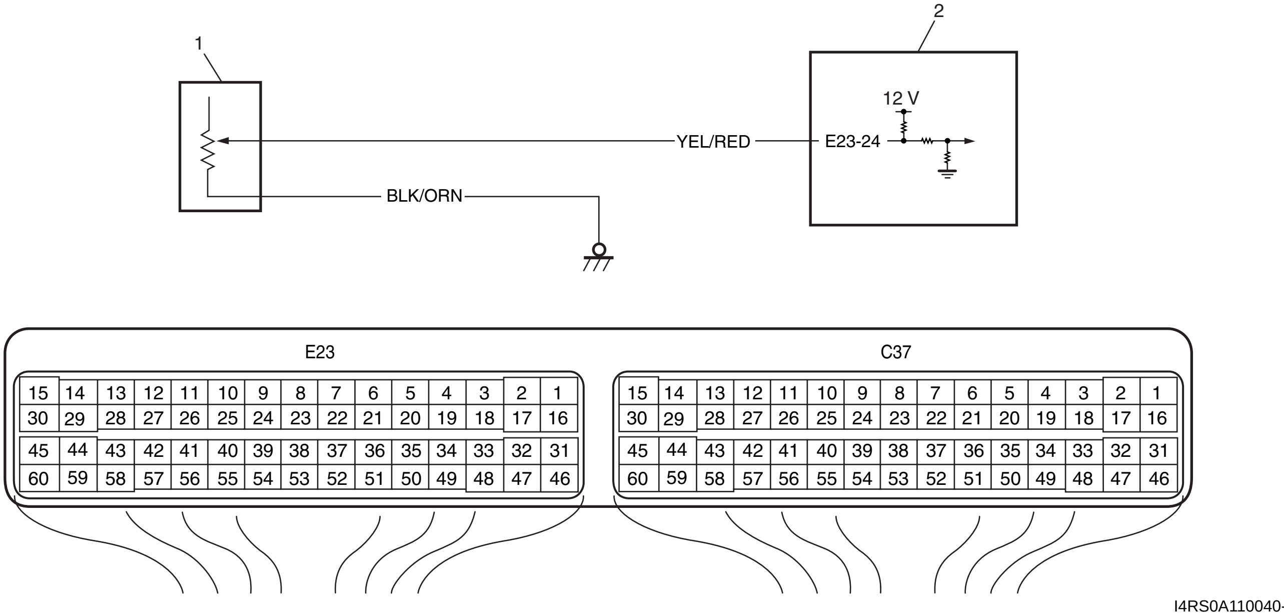
- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

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 4.
3	**Fuel level sensor output signal check with SUZUKI scan tool** 1) Connect SUZUKI scan tool to DLC with ignition switch turned OFF. 2) Turn ON ignition switch and check fuel level displayed on SUZUKI scan tool. *Is 100% displayed?*	Go to Step 5.	Intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection Inspection: in Section 00".
4	**Fuel level sensor output signal check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connector connected. 3) Turn ON ignition switch and measure voltage between "E23-24" terminal of ECM connector and vehicle body ground. *Is voltage about 3.5 V or less?*	Go to Step 5.	Intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection Inspection: in Section 00".
5	**Fuel level sensor output signal circuit check** 1) Disconnect fuel pump connector referring to "Fuel Tank Removal and Installation: in Section 1G". 2) Disconnect connectors from ECM with ignition switch turned OFF. 3) Measure resistance between "E23-24" terminal of ECM connector and vehicle body ground. *Is it infinity?*	Go to Step 6.	"YEL/RED" wire is shorted to ground circuit.
6	**Fuel level sensor output signal circuit check** 1) Connect connectors to ECM. 2) Measure voltage between "E23-24" terminal of ECM connector and engine ground with ignition switch turned ON. *Is voltage 10 – 14 V?*	Go to Step 7.	Substitute a known-good ECM and recheck.
7	**Fuel level sensor check** 1) Check fuel level sensor referring to "Fuel Level Sensor Inspection: in Section 9C". *Is it in good condition?*	Substitute a known-good ECM and recheck.	Faulty fuel level sensor.

DTC P0463: Fuel Level Sensor Circuit High

S4RS0A1104073

Wiring Diagram



1.	Fuel level sensor (gauge)
2.	ECM

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
Fuel level sensor voltage is higher than 4.95 V for 3 seconds continuously. (1 driving cycle detection logic but MIL does not light up)	• "YEL/RED" or "BLK/ORN" circuit open • Fuel level sensor malfunction • ECM and/or its power and ground circuit malfunction • Combination meter faulty

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 30 sec. or more.
4) Check DTC and pending DTC.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

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	*Does fuel level meter in combination meter indicate "E" (empty)?*	Replenish fuel tank with fuel and go to Step 3.	Go to Step 3.
3	*Do you have SUZUKI scan tool?*	Go to Step 4.	Go to Step 5.

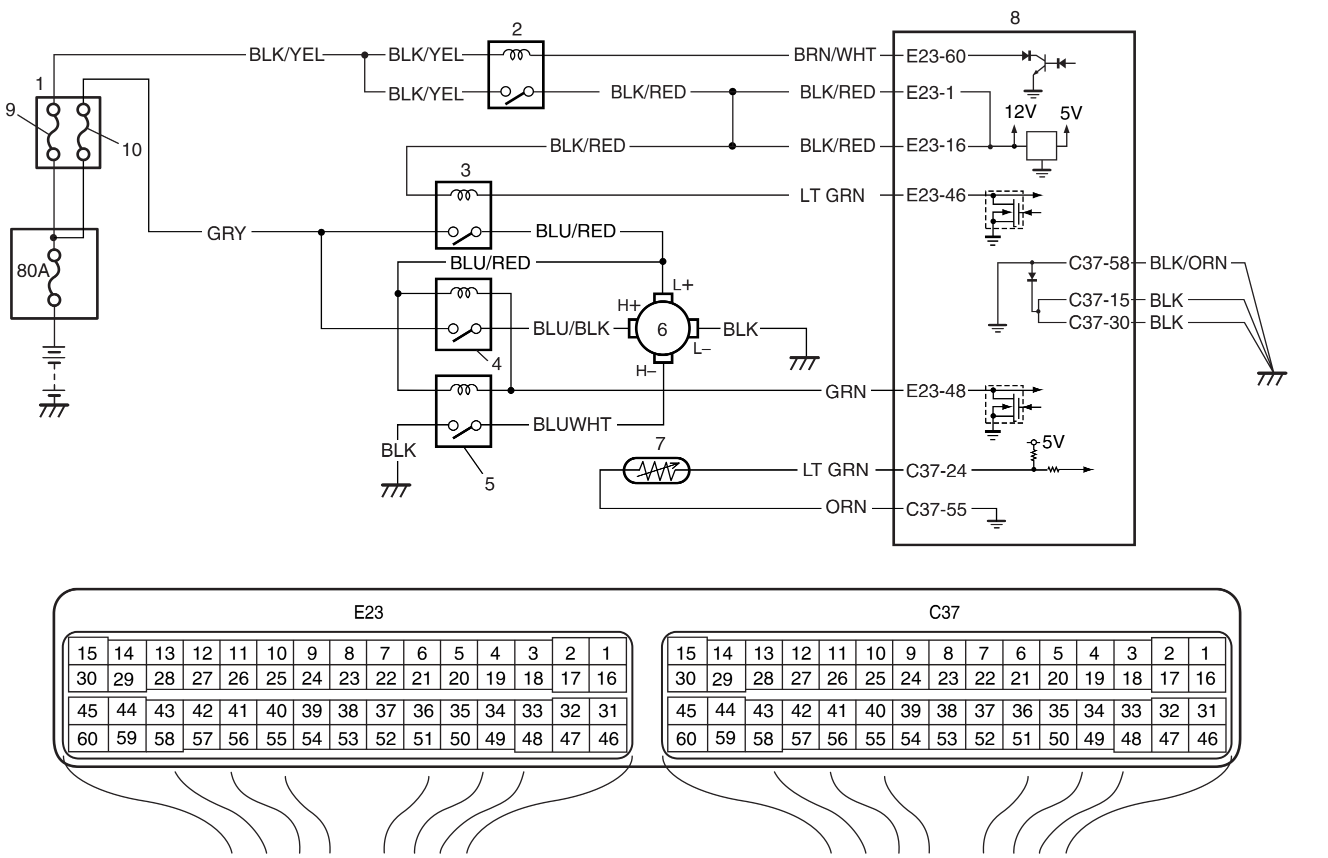
Step	Action	Yes	No
4	**Fuel level sensor output signal check with SUZUKI scan tool** 1) Connect SUZUKI scan tool to DLC with ignition switch turned OFF. 2) Turn ON ignition switch and check fuel level displayed on SUZUKI scan tool. *Is it 3% or less?*	Go to Step 6.	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.
5	**Fuel level sensor output signal check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connectors connected. 3) Turn ON ignition switch and measure voltage between “E23-24” terminal of ECM connector and vehicle body ground. *Is voltage about 3.5 V or more?*	Go to Step 6.	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.
6	**Fuel level sensor circuit resistance check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Check for proper connection to “E23-24” terminal of ECM connector. 3) If OK, measure resistance between “E23-24” terminal of ECM connector and vehicle body ground. *Is resistance below 280 Ω?*	Go to Step 7.	Go to Step 8.
7	**Short circuit check for fuel level sensor output signal circuit** 1) Turn ON ignition switch and measure voltage between “E23-24” terminal of ECM connector and vehicle body ground. *Is voltage 0 V?*	Go to Step 8.	“YEL/RED” wire is shorted to power supply circuit.
8	**Open circuit check for fuel level sensor output signal circuit** 1) Disconnect fuel pump connector referring to “Fuel Tank Removal and Installation: in Section 1G”. 2) Check for proper connection to “YEL/RED” and “BLK/ORN” wire terminals of fuel pump connector. 3) Connect connectors to ECM. 4) Turn ON ignition switch, measure voltage between “YEL/RED” wire terminal of disconnected fuel pump connector and vehicle body ground. *Is voltage 10 – 14 V?*	Go to Step 10.	Go to Step 9.
9	**Open circuit check for fuel level sensor output signal circuit** 1) Measure voltage between “E23-24” terminal of ECM connector and engine ground. *Is voltage 10 – 14 V?*	Go to Step 10.	“YEL/RED” wire is open circuit.
10	**Fuel level sensor ground circuit check** 1) Turn ignition switch to OFF position. 2) Measure resistance between “BLK/ORN” wire terminal of fuel pump connector and vehicle body ground. *Is resistance below 5 Ω?*	Go to Step 11.	“BLK/ORN” wire is open or high resistance circuit.

Step	Action	Yes	No
11	**High resistance circuit check for fuel level sensor circuit** 1) Disconnect connectors from ECM. 2) Measure resistance between “YEL/RED” wire terminal of fuel pump connector and “E23-24” wire terminal of ECM connector. *Is resistance below 5 Ω?*	Go to Step 12.	“YEL/RED” wire is high resistance circuit.
12	**Fuel level sensor check** 1) Check fuel level sensor referring to “Fuel Level Sensor Inspection: in Section 9C”. *Is it in good condition?*	Substitute a known-good ECM and recheck.	Faulty fuel level sensor.

DTC P0480: Fan 1 (Radiator Cooling Fan) Control Circuit

S4RS0A1104074

Wiring Diagram



I4RS0A110041-

1. Relay box	5. Radiator cooling fan relay No. 3	9. “FI” fuse
2. Main relay	6. Radiator cooling fan motor	10. “RDTR FAN” fuse
3. Radiator cooling fan relay No. 1	7. ECT sensor	
4. Radiator cooling fan relay No. 2	8. ECM	

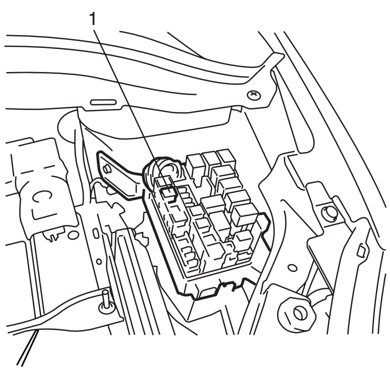
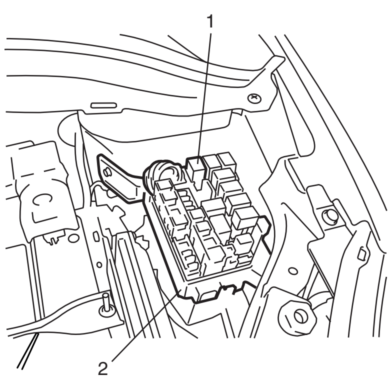
DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
Monitor signal of radiator cooling fan relay is different from command signal. (1 driving cycle detection logic)	• Radiator cooling fan relay circuit malfunction • Radiator cooling fan relay malfunction • ECM malfunction

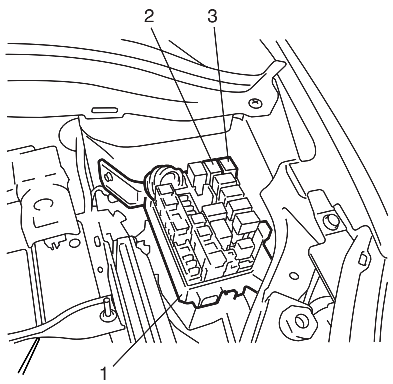
DTC Confirmation Procedure

1) Turn OFF ignition switch turned.
2) Clear DTC with ignition switch turned ON.
3) Run engine at idle speed.
4) Check pending DTC in “ON BOARD TEST” or “PENDING DTC” mode and DTC in “DTC” mode.

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	**Circuit fuse check** 1) Check “RDTR FAN” fuse (1) in relay box with ignition switch turned OFF.  I4RS0A110022- *Is “RDTR FAN” fuse in good condition?*	Go to Step 3.	Check for short in circuits connected to this fuse.
3	**Wire circuit check** 1) Disconnect radiator cooling fan relay No. 1 (1) from relay box (2) with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between each engine ground to “BLK/RED” and “GRY” wire terminal.  I4RS0A110042- *Is voltage 10 – 14 V?*	Go to Step 4.	“BLK/RED” and/or “GRY” wire are open circuit.

Step	Action	Yes	No
4	**Wire circuit check** 1) Connect radiator cooling fan relay No. 1 to relay box with ignition switch turned OFF. 2) Remove ECM from its bracket with ECM connectors connected. 3) Turn ON ignition switch, measure voltage between vehicle body ground and “E23-46” terminal of ECM connector when engine coolant temp. is below 97.5 °C, 207.5 °F. *Is voltage 10 – 14 V?*	Go to Step 8.	Go to Step 5.
5	**Wire circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Disconnect radiator cooling fan relay No. 1 from relay box. 3) Measure resistance between “E23-46” terminal of ECM connector and vehicle ground. *Is resistance infinity?*	Go to Step 6.	“LT GRN” wire is shorted to ground circuit.
6	**Wire circuit check** 1) Turn ON ignition switch. 2) Measure voltage between “E23-46” terminal of ECM connector and vehicle body ground. *Is voltage 0 V?*	Go to Step 7.	“LT GRN” wire is shorted to other circuit.
7	**Radiator cooling fan relay No. 1 check** 1) Check radiator cooling fan relay No. 1 referring to “Radiator Cooling Fan Relay Inspection: in Section 1F”. *Is check result satisfactory?*	“LT GRN” wire is open circuit.	Replace relay.
8	**Radiator cooling fan control No. 1 check** 1) Run engine until ECT is over 97.5 °C, 207.5 °F. 2) Measure voltage between vehicle body ground and “E23-46” terminal of ECM connector. *Is voltage lower than 1.5 V?*	Go to Step 9.	Faulty ECM. Substitute a known-good ECM and recheck.

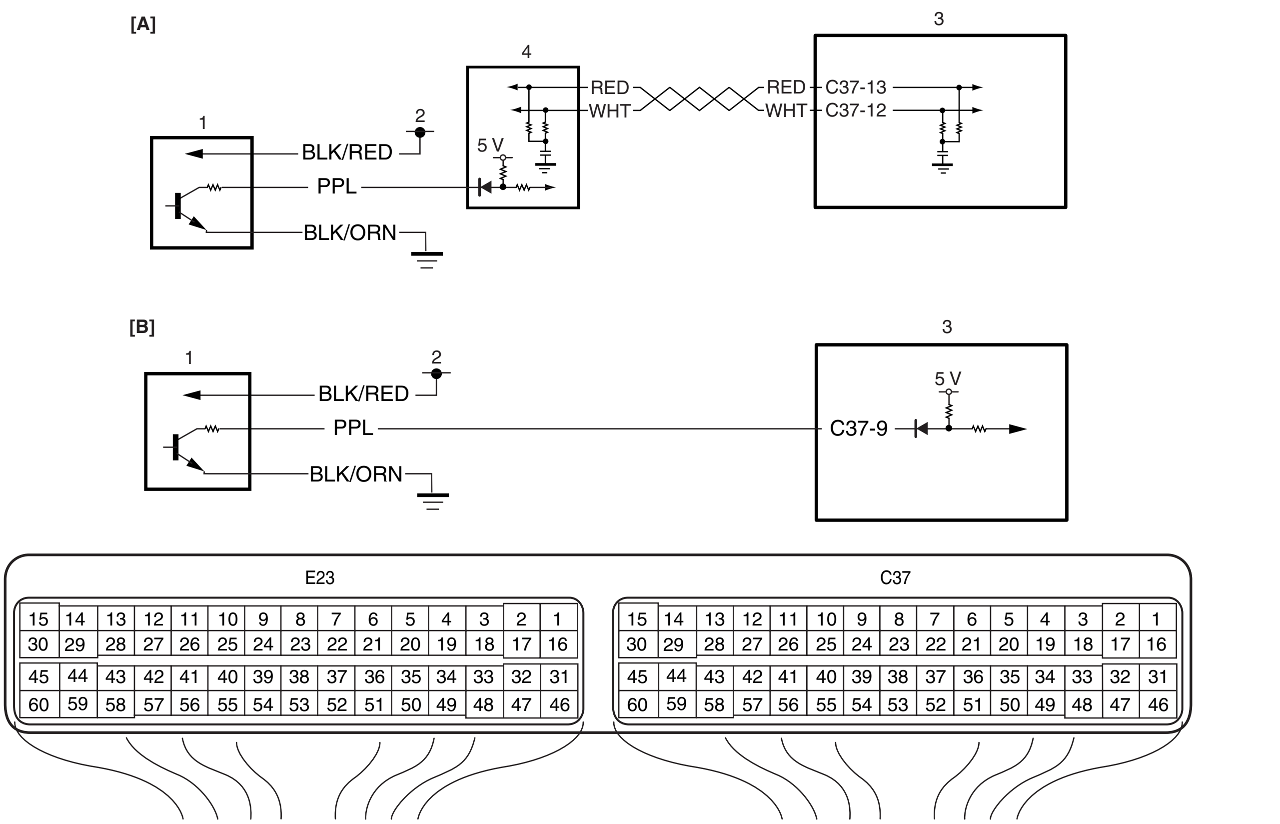
Step	Action	Yes	No
9	**Radiator cooling fan control check** 1) Disconnect radiator cooling fan relay No. 2 (2) and No. 3 (3) from relay box (1) with ignition switch turned OFF. 2) Run engine until ECT is over 97.5 °C, 207.5 °F. 3) Measure voltage between vehicle body ground and each “BLU/RED” wire terminal of radiator cooling fan control relay No. 2 and No. 3 connectors.  I4RS0A110043- *Is voltage 10 – 14 V?*	Go to Step 10.	“BLU/RED” wire is open circuit.
10	**Wire circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Connect radiator cooling fan relay No. 2 to relay box. 3) Using service wire, ground “E23-46” and “E23-60” terminals of ECM connector. 4) Turn ON ignition switch, measure voltage between vehicle body ground and “E23-48” terminal of ECM connector. *Is voltage 10 – 14 V?*	Go to Step 11.	Go to Step 12.
11	**Wire circuit check** 1) Disconnect radiator cooling fan relay No. 2 and then connect radiator cooling fan relay No. 3 to relay box with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between vehicle body ground and “E23-48” terminal of ECM connector. *Is voltage 10 – 14 V?*	Go to Step 15.	Go to Step 12.
12	**Wire circuit check** 1) Disconnect radiator cooling fan control relay No. 2 and No. 3 from relay box with ignition switch turned OFF. 2) Measure resistance between “E23-48” terminal of ECM connector and vehicle body ground. *Is resistance infinity?*	Go to Step 13.	“GRN” wire is shorted to ground circuit.
13	**Wire circuit check** 1) Turn ON ignition switch. 2) Measure voltage between “E23-48” terminal of ECM connector and vehicle body ground. *Is voltage 0 V?*	Go to Step 14.	“GRN” wire is shorted to power supply circuit.

Step	Action	Yes	No
14	**Radiator cooling fan relay No. 2 and No. 3 check** 1) Check radiator cooling fan relay No. 2 and No. 3 referring to "Radiator Cooling Fan Relay Inspection: in Section 1F". *Are relays in good condition?*	"GRN" wire is open circuit.	Replace relay.
15	**Radiator cooling fan control No. 2 and No. 3 check** 1) Connect connectors to ECM with ignition switch turned OFF. 2) Connect radiator cooling fan relay No. 2 to relay box. 3) Run engine until ECT is over 102.5 °C, 216.5 °F. 4) Measure voltage between vehicle body ground and "E23-48" terminal of ECM connector. *Is voltage lower than 1.5 V?*	Intermittent trouble. Check for intermittent refer to "Intermittent and Poor Connection Inspection: in Section 00". If OK, substitute a known-good ECM and recheck.	Faulty ECM.

DTC P0500: Vehicle Speed Sensor (VSS) Malfunction

S4RS0A1104045

Wiring Diagram



I4RS0A110044-

[A]: A/T vehicle	1. VSS	3. ECM
[B]: M/T vehicle	2. To main relay	4. TCM

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
• Vehicle speed signal is not input while fuel is cut at deceleration for 4 seconds continuously at 3600 rpm or less. • Vehicle speed signal is not input even if engine is running with more than 3000 rpm at D-Range for 4 sec (for A/T model). (2 driving cycle detection logic)	• “BLK/ORN” circuit open • “PPL” or “BLK/RED” circuit open or short • VSS malfunction • TCM 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 by 2 persons, a driver and a tester.**

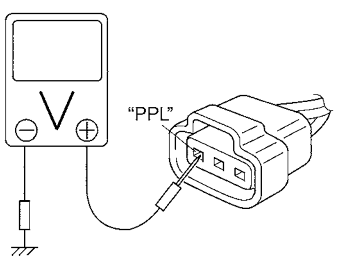
1) With ignition switch turned OFF, connect scan tool.
2) Turn ON ignition switch and clear DTC using scan tool.
3) Warm up engine to normal operating temperature.
4) Drive vehicle at 4000 rpm (engine speed) with 3rd gear (for M/T vehicle) or “3” range (for A/T vehicle) or more.
5) Release accelerator 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) For A/T vehicle, drive vehicle at more than 3600 rpm for 10 sec.
7) Check pending DTC and DTC.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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	**Vehicle speed signal check** *Is vehicle speed displayed on scan tool in Step 4) and 5) of “DTC Confirmation Procedure”?*	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.	Go to Step 3.
3	**Vehicle spec check** *Is vehicle equipped with A/T?*	Go to Step 4.	Go to Step 5.
4	**DTC check in TCM** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Check TCM for DTC. *Is there DTC P0722 in TCM?*	Go to applicable DTC diag. flow.	Substitute a known-good ECM and recheck.

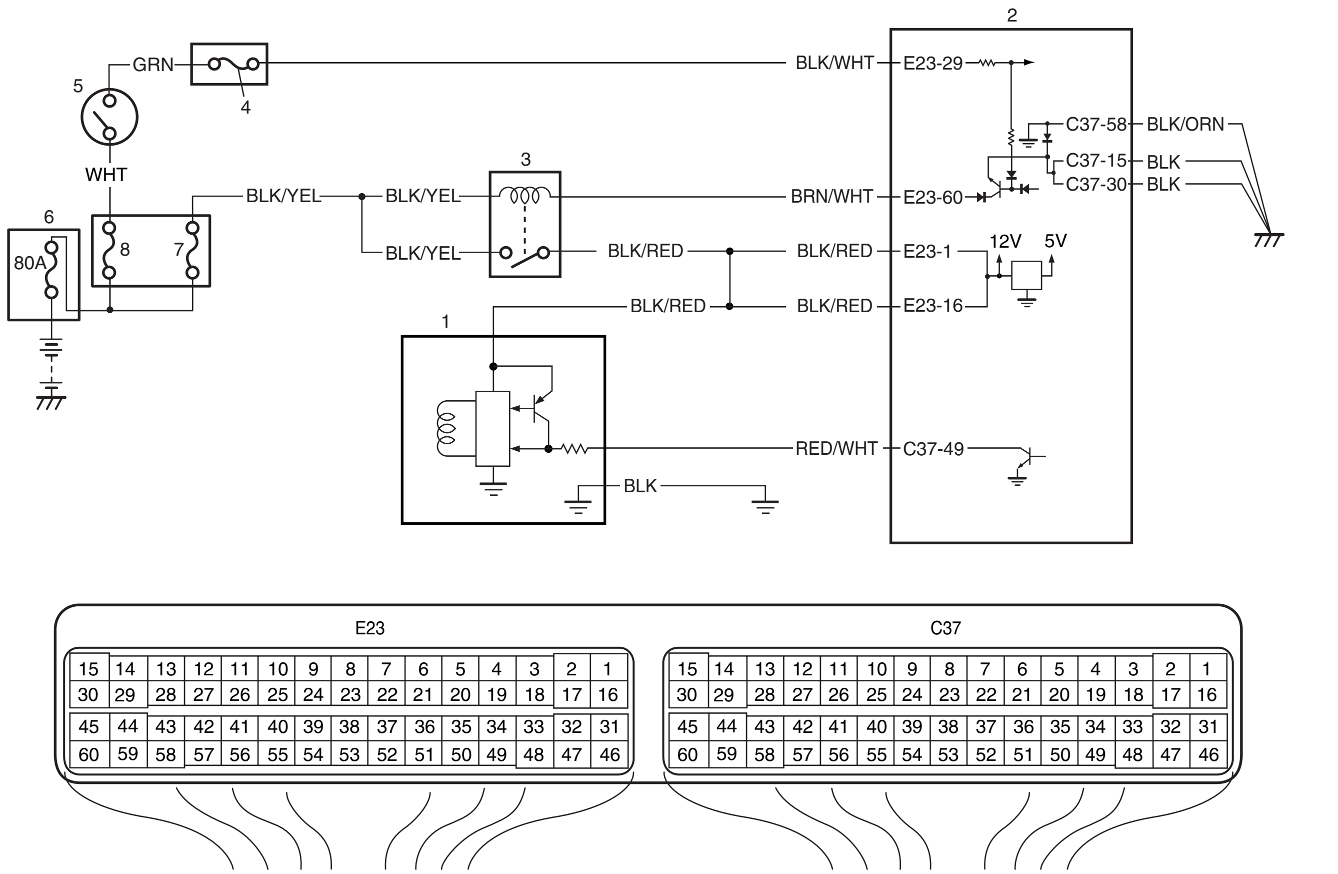
Step	Action	Yes	No
5	**Power supply circuit check** 1) With ignition switch turned OFF, disconnect connector from VSS. 2) Check for proper connection to "BLK/RED", "PPL" and "BLK/ORN" wire terminals of VSS connector. 3) If wires are OK, turn ON ignition switch, measure voltage between engine ground and "BLK/RED" wire terminal of VSS connector. *Is voltage 10 – 14 V?*	Go to Step 6.	"BLK/RED" wire is open circuit.
6	**Ground circuit check** 1) Measure resistance between engine ground and "BLK/ORN" wire terminal of VSS connector with ignition switch turned OFF. *Is resistance below 5 Ω?*	Go to Step 7.	"BLK/ORN" wire is open or high resistance circuit.
7	**Wire circuit check** 1) Turn ON ignition switch, measure voltage between engine ground and "PPL" wire terminal of VSS connector.  I4RS0A110087- *Is measured voltage 4 – 5 V?*	Go to Step 11.	Go to Step 8.
8	**ECM voltage check** 1) Turn OFF ignition switch. 2) Remove ECM form its bracket with ECM connectors connected. 3) Turn ON ignition switch, measure voltage between vehicle body ground and "C37-9" terminal of ECM connector. *Is measured voltage 4 – 5 V?*	"PPL" wire is open circuit.	Go to Step 9.
9	**Short circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between engine ground and "C37-9" terminal of ECM connector. *Is it voltage 0 V?*	Go to Step 10.	"PPL" wire is shorted to power supply circuit.
10	**Short circuit check** 1) Measure resistance between engine ground and "C37-9" terminal of ECM connector with ignition switch turned OFF. *Is resistance infinity?*	Go to Step 11.	"PPL" wire is shorted to ground circuit. If wire is OK, substitute a known-good ECM and recheck.

Step	Action	Yes	No
11	**VSS check** 1) Check VSS and signal rotor tooth referring to "Vehicle Speed Sensor (VSS) Inspection (M/T model): in Section 1C". *Is check result satisfactory?*	Substitute a known-good ECM and recheck.	Replace VSS or signal rotor.

DTC P0505: Idle Air Control System

S4RS0A1104046

Wiring Diagram



I4RS0A110045-

1. IAC valve	4. "IG COIL" fuse	7. "FI" fuse
2. ECM	5. Ignition switch	8. "IG ACC" fuse
3. Main relay	6. Battery fuse box	

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
IAC control duty pulse is not detected in its monitor signal. (2 driving cycle detection logic)	• Idle air control valve and / or its 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) Run engine at idle speed (more than 600 rpm) for 1 min. or more.
4) Check DTC and pending DTC.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

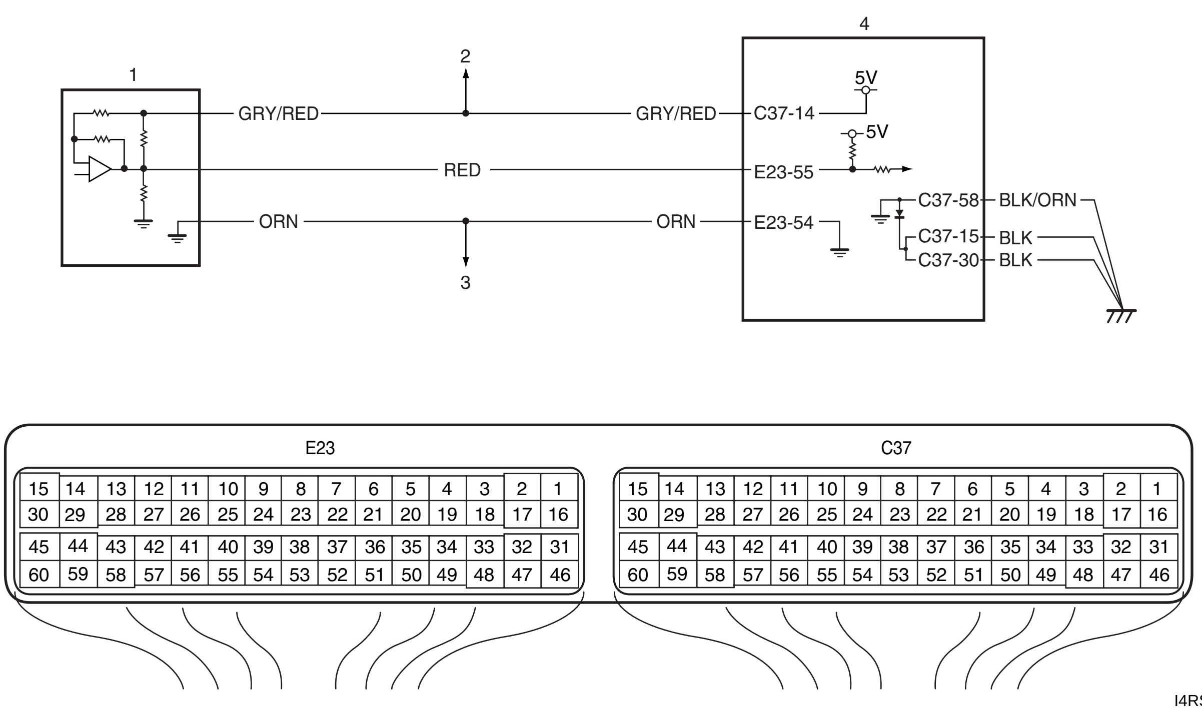
Step	Action	Yes	No
1	*Was “Engine and Emission Control System Check” performed?*	Go to Step 2.	Go to “Engine and Emission Control System Check: ”.
2	**Idle speed check** 1) Check idle speed / idle air control duty referring to “Idle Speed / Idle Air Control (IAC) Duty Inspection: ”. *Is check result 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 Inspection: in Section 1C”. *Is check result as specified?*	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”. 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 terminal of idle air control valve connector and engine ground. *Is voltage 10 – 14 V?*	Go to Step 5.	“BLK/RED” wire is open or high resistance circuit.
5	**Idle air control valve circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “RED/WHT” wire terminal of idle air control valve connector and “C37-49” terminal of ECM connector. *Is resistance 2 Ω or less?*	Go to Step 6.	“RED/WHT” wire is open or high resistance circuit.
6	**Idle air control valve circuit check** 1) Measure resistance between each “C37-49” terminal of ECM connector and vehicle body ground. *Is resistance infinity?*	Go to Step 7.	“RED/WHT” wire is shorted to ground circuit.
7	**Idle air control valve circuit check** 1) Connect connectors to ECM. 2) Turn ON ignition switch, measure voltage between “C37-49” terminal of ECM connector and vehicle body ground. *Is each voltage 0 V?*	Go to Step 8.	“RED/WHT” wire is shorted to power circuit.

Step	Action	Yes	No
8	**Idle air control valve circuit check** 1) Measure resistance between “BLK” wire terminal of idle air control valve connector and vehicle body ground with ignition switch turned OFF. *Is resistance continuity?*	Go to Step 9.	“BLK” wire is open circuit.
9	**Idle air control valve signal check** 1) Connect connector to idle air control valve. 2) Using oscilloscope, check that idle air control valve duty pulse is outputted referring to “Reference waveform No.19” and “Reference waveform No.20” of “Inspection of ECM and Its Circuits: ”. *Is duty pulse outputted at “C37-49” terminal of ECM connector?*	Replace idle air control valve.	Go to Step 10.
10	**Idle air control valve circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Using service wire, ground “E23-60” terminal of ECM connector because of main relay turned ON. 3) Measure voltage between “C37-49” 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.	Replace idle air control valve.

DTC P0532: A/C Refrigerant Pressure Sensor Circuit Low

S4RS0A1104075

Wiring Diagram



1. A/C refrigerant pressure sensor	3. To other sensors
2. To TP sensor and MAP sensor	4. ECM

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
A/C refrigerant pressure sensor signal voltage is less than 0.15 V for 0.5 sec. continuously. (1 driving detection logic but MIL does not light up)	• A/C refrigerant pressure sensor circuit • A/C refrigerant pressure sensor • TP sensor • MAP sensor • ECM

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.
3) Check DTC and pending DTC.

Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

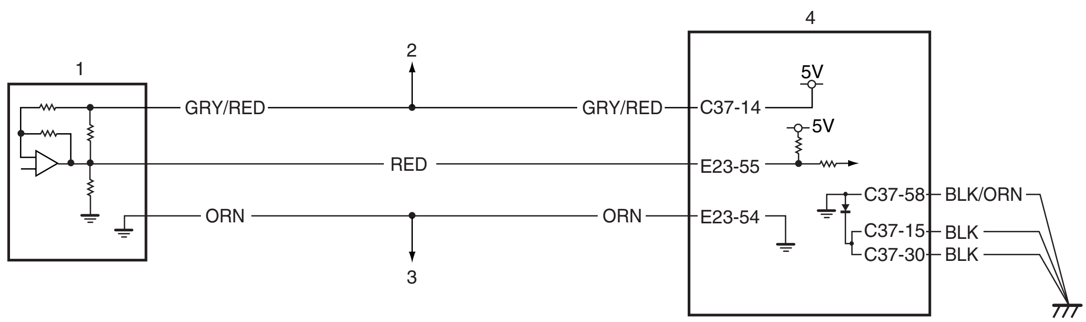
Step	Action	Yes	No
1	*Was "Engine and Emission Control System Check" performed?*	Go to Step 2.	Go to "Engine and Emission Control System Check: ".
2	**A/C refrigerant pressure sensor power supply circuit check** 1) Disconnect connector from A/C refrigerant pressure sensor with ignition switch turned OFF. 2) Check for proper connection of A/C refrigerant pressure sensor at "GRY/RED", "RED" and "ORN" wire terminals. 3) Turn ON ignition switch, measure voltage between engine ground and "GRY/RED" wire terminal of A/C refrigerant pressure sensor connector. *Is voltage 4 – 6 V?*	Go to Step 5.	Go to Step 3.
3	**A/C refrigerant pressure sensor power supply circuit check** 1) Disconnect connectors from TP sensor and MAP sensor with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between engine ground and "GRY/RED" wire terminal of A/C refrigerant pressure sensor connector. *Is voltage 4 – 6 V?*	Faulty TP sensor and/or MAP sensor.	Go to Step 4.
4	**A/C refrigerant pressure sensor power supply circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between engine ground and "C37-14" terminal of ECM connector. *Is resistance infinity?*	Go to Step 6.	"GRY/RED" wire is shorted to ground circuit.

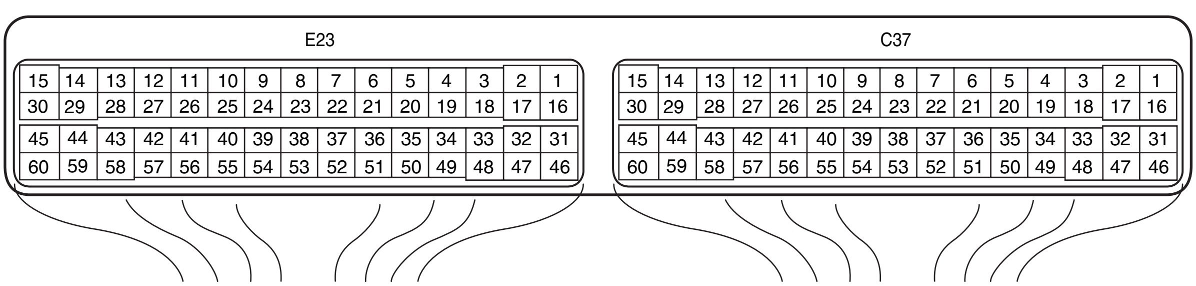
Step	Action	Yes	No
5	**A/C refrigerant pressure sensor signal circuit check** 1) Connect connectors to ECM. 2) Turn ON ignition switch, measure voltage between engine ground and "RED" wire terminal of A/C refrigerant pressure sensor connector. *Is voltage 4 – 6 V?*	Go to Step 7.	Go to Step 6.
6	**A/C refrigerant pressure sensor signal circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between engine ground and "E23-55" terminal of ECM connector. *Is resistance infinity?*	Go to Step 7.	"RED" wire is shorted to ground circuit.
7	**A/C refrigerant pressure sensor check** 1) Check A/C refrigerant pressure sensor referring to "A/C Refrigerant Pressure Sensor and Its Circuit Inspection: in Section 7B" *Is it in good condition?*	Substitute a known-good ECM and recheck.	Faulty A/C refrigerant pressure sensor.

DTC P0533: A/C Refrigerant Pressure Sensor Circuit High

S4RS0A1104076

Wiring Diagram





I4RS0A110047-

1. A/C refrigerant pressure sensor	3. To other sensors
2. To TP sensor and MAP sensor	4. ECM

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
A/C refrigerant pressure sensor signal voltage is higher than 4.93 V for 0.5 sec. continuously. (1 driving detection logic but MIL does not light up)	• A/C refrigerant pressure sensor circuit • A/C refrigerant pressure sensor • TP sensor • MAP sensor • ECM

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.
3) Check DTC and pending DTC.

Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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	**A/C refrigerant pressure sensor power supply circuit check** 1) Disconnect connector from A/C refrigerant pressure sensor with ignition switch turned OFF. 2) Check for proper connection of A/C refrigerant pressure sensor at “GRY/RED”, “RED” and “ORN” wire terminals. 3) Turn ON ignition switch, measure voltage between engine ground and “GRY/RED” wire terminal of A/C refrigerant pressure sensor connector. *Is voltage 4 – 6 V?*	Go to Step 4.	Go to Step 3.
3	**A/C refrigerant pressure sensor power supply circuit check** 1) Disconnect connectors from TP sensor and MAP sensor with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between engine ground and “GRY/RED” wire terminal of A/C refrigerant pressure sensor connector. *Is voltage 4 – 6 V?*	Faulty TP sensor and/or MAP sensor.	“GRY/RED” wire is open or shorted to power circuit.
4	**A/C refrigerant pressure sensor signal circuit check** 1) Turn ON ignition switch, measure voltage between engine ground and “RED” wire terminal of A/C refrigerant pressure sensor connector. *Is voltage 4 – 6 V?*	Go to Step 6.	Go to Step 5.
5	**A/C refrigerant pressure sensor signal circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “RED” wire terminal of A/C refrigerant pressure sensor connector and “E23-55” terminal of ECM connector. *Is resistance below 2 Ω?*	“RED” wire is shorted to power supply circuit.	“RED” wire is open or high resistance circuit.
6	**A/C refrigerant pressure sensor ground circuit check** 1) Turn OFF ignition switch, measure resistance between engine ground and “ORN” wire terminal of A/C refrigerant pressure sensor connector. *Is resistance below 5 Ω?*	Go to Step 8.	Go to Step 7.

Step	Action	Yes	No
7	**ECM ground circuit check** 1) Remove ECM from its bracket with ECM connectors connected. 2) Measure resistance between engine ground and "E23-54" terminal of ECM connector. *Is resistance below 5 Ω?*	"ORN" wire is open or high resistance circuit.	ECM grounds "C37-58", "C37-15" and/or "C37-30" is open or high resistance circuit.
8	**A/C refrigerant pressure sensor check** 1) Check A/C refrigerant pressure sensor referring to "A/C Refrigerant Pressure Sensor and Its Circuit Inspection: in Section 7B" *Is it good condition?*	Substitute a known-good ECM and recheck.	Faulty A/C refrigerant pressure sensor.

DTC P0601 / P0602: Internal Control Module Memory Check Sum Error / Control Module Programming Error

S4RS0A1104052

System Description

Internal control module is installed in ECM.

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
DTC P0601: Data write error or check sum error (1 driving cycle detection logic) **DTC P0602:** Data programming error (1 driving cycle detection logic)	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 at idle if possible.
4) Check DTC and pending DTC by using scan tool.

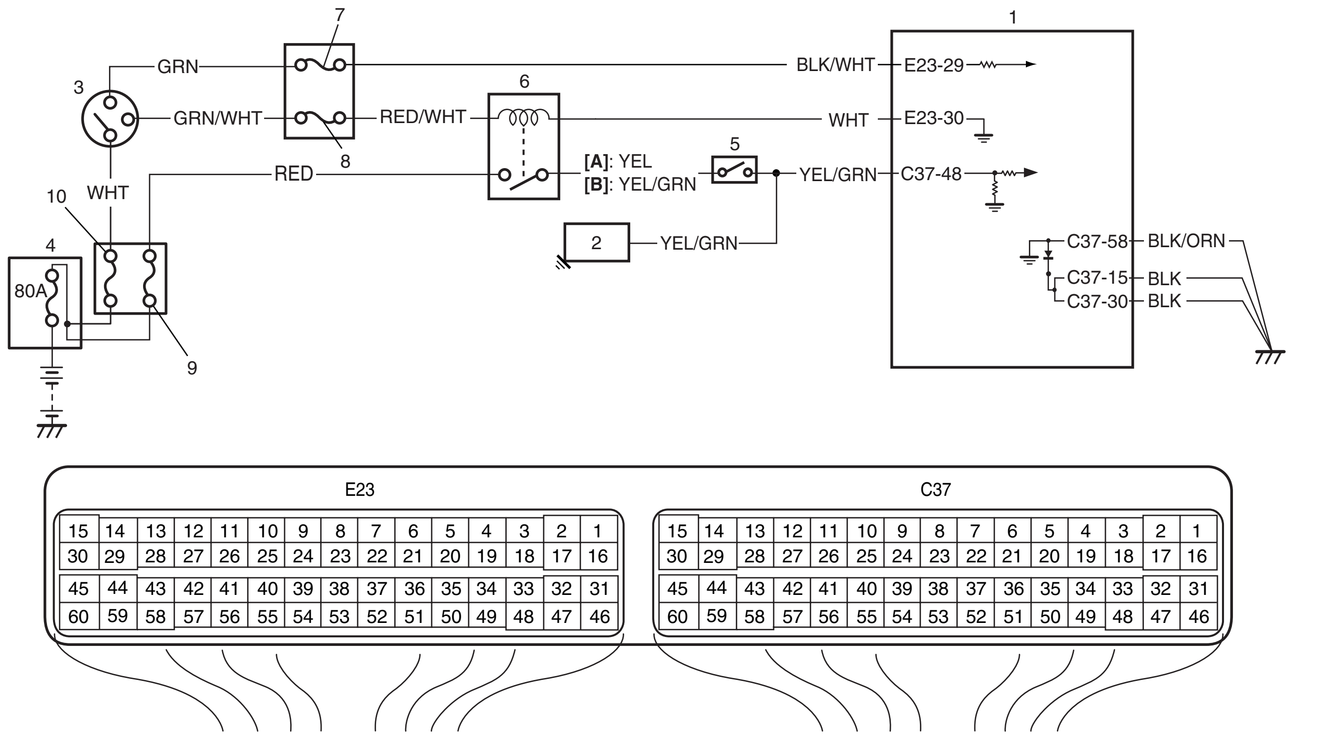
DTC Troubleshooting

Step	Action	Yes	No
1	**DTC recheck** 1) Clear DTC referring to "DTC Clearance: ". 2) Turn OFF ignition switch. 3) Turn ON ignition switch and check DTC. *Is DTC P0601 or P0602 still indicated?*	Go to Step 2.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection Inspection: in Section 00"
2	**ECM power and ground circuit check** 1) Check that ECM power supply and ground circuit is in good condition referring to "ECM Power and Ground Circuit Check: ". 2) Check that ECM ground is in good condition. *Are check results OK?*	Substitute a known-good ECM and recheck.	Repair ECM power or ground circuit.

DTC P0616: Starter Relay Circuit Low

S4RS0A1104077

Wiring Diagram



I4RS0A110048-

[A]:	A/T vehicle	3.	Ignition switch	7.	"IG COIL" fuse
[B]:	M/T vehicle	4.	Battery fuse box	8.	"ST SIG" fuse
1.	ECM	5.	Transmission range switch (A/T vehicle)	9.	"ST MOT" fuse
2.	Starter motor	6.	Starting motor control relay	10.	"IG ACC" fuse

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
Engine starts even though vehicle is at stop and engine starter signal is low voltage. (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.
4) Check DTC and pending DTC.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

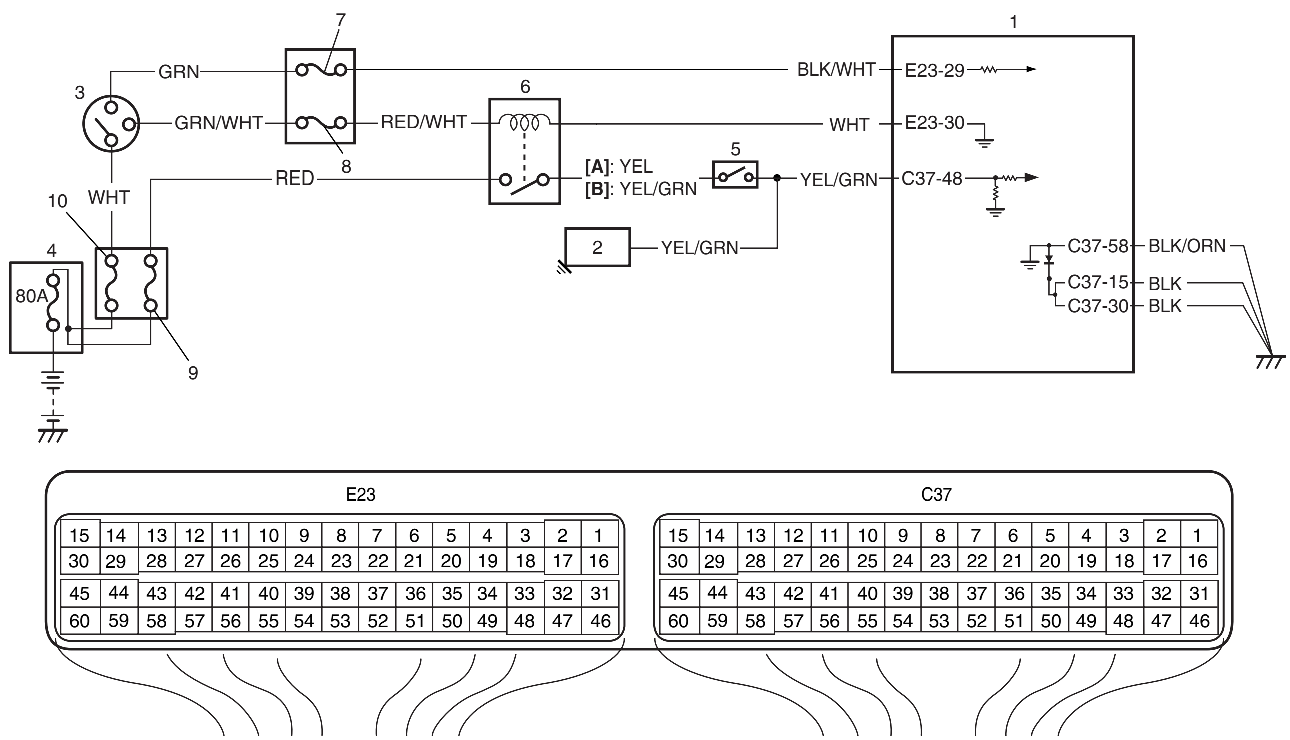
Step	Action	Yes	No
1	*Was "Engine and Emission Control System Check" performed?*	Go to Step 2.	Go to "Engine and Emission Control System Check: ".

Step	Action	Yes	No
2	**Signal circuit check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connectors connected. 3) Measure voltage at terminal "C37-48" of ECM connector, under following condition. **Voltage at terminal "C37-48" of ECM connector** **While engine cranking: 6 – 14 V** **After starting engine: 0 – 1 V** *Is each voltage within specified range?*	Poor "C37-48" connection or intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection Inspection: in Section 00". If wire and connections are OK, substitute a known-good ECM and recheck.	"YEL/GRN" wire is open or high resistance circuit.

DTC P0617: Starter Relay Circuit High

S4RS0A1104078

Wiring Diagram



I4RS0A110048-

[A]: A/T vehicle	3. Ignition switch	7. "IG COIL" fuse
[B]: M/T vehicle	4. Battery fuse box	8. "ST SIG" fuse
1. ECM	5. Transmission range switch (A/T vehicle)	9. "ST MOT" fuse
2. Starter motor	6. Starting motor control relay	10. "IG ACC" fuse

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
Engine starter signal is high voltage for 180 seconds continuously while engine is running. (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.

DTC Troubleshooting

NOTE:

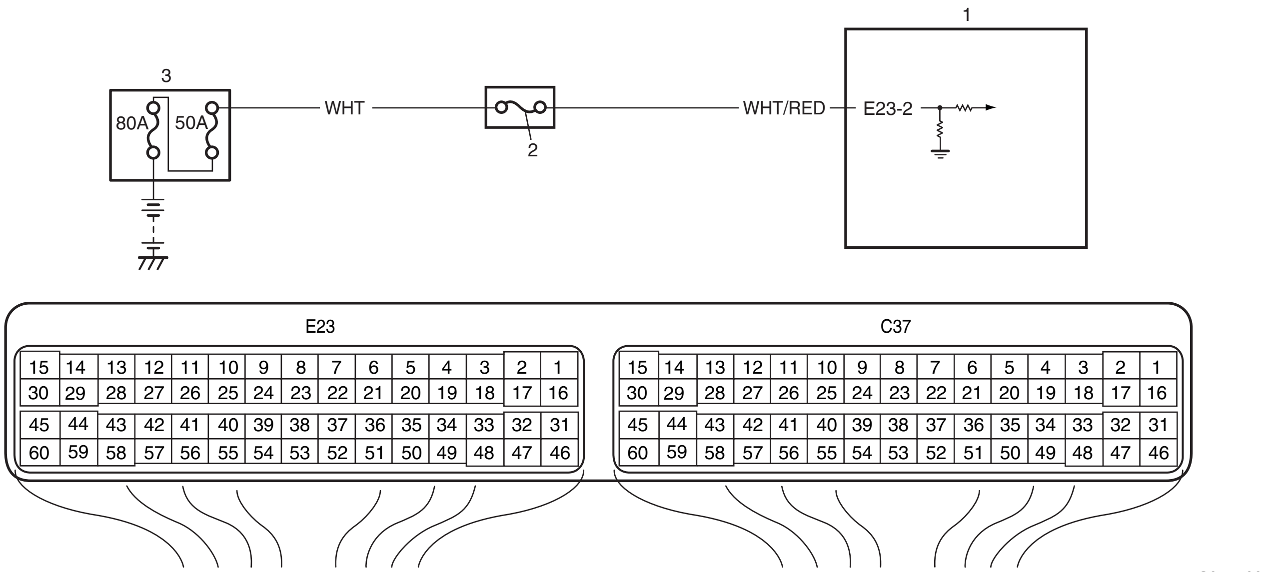
- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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	**Starter signal check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connectors connected. 3) Start engine, measure voltage between “C37-48” terminal of ECM connector and vehicle body ground. *Is voltage 0 – 1 V?*	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”. If OK, substitute a known-good ECM and recheck.	Go to Step 3.
3	**Wire circuit check** 1) Disconnect starting motor control relay in relay box with ignition switch turned OFF. 2) Check for proper connection to starting motor control relay at “RED/WHT”, “RED”, “WHT”, “YEL” (A/T vehicle) and “YEL/GRN” (M/T vehicle) wire terminals. 3) Disconnect connectors from starting motor. 4) Check for proper connection to ECM at “C37-48” terminal. 5) Measure voltage between “C37-48” terminal of ECM connector and vehicle body ground with ignition switch turned ON. *Is voltage 0 – 1 V?*	Go to Step 4.	For A/T vehicle, “YEL” or “YEL/GRN” wire is shorted to power circuit. For M/T vehicle, “YEL/GRN” wire is shorted to power circuit. If wires are OK, substitute a known-good ECM and recheck.
4	**Wire circuit check** 1) Measure voltage between “RED/WHT” wire terminal of starting motor control relay connector and vehicle body ground wire ignition switch turned ON. *Is voltage 0 – 1 V?*	Go to Step 5.	Faulty ignition switch, check ignition switch referring to “Ignition Switch Inspection: in Section 9C”. If ignition switch is OK, check for short circuit between ignition switch and starting motor control relay to power circuit.
5	**Starting motor control relay check** 1) Check starting motor control relay referring to “Main Relay, Fuel Pump Relay, Starting Motor Control Relay and Throttle Actuator Control Relay Inspection: in Section 1C”. *Is it in good condition?*	Substitute a known-good ECM and recheck.	Replace starting motor control relay.

DTC P1510: ECM Back-Up Power Supply Malfunction

S4RS0A1104053

Wiring Diagram



1.	ECM
2.	"RADIO" fuse
3.	Battery fuse box

Circuit Description

Battery voltage is supplied so that DTC 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 power circuit voltage is less than 70% battery voltage for 5 seconds continuously while engine is running. (1 driving cycle detection logic)	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.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

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: ".

Step	Action	Yes	No
2	**Battery voltage supply circuit check** 1) Turn OFF ignition switch. 2) Remove ECM from its bracket with ECM connectors connected. 3) With engine running, measure voltage between "E23-2" terminal of ECM connector and engine ground. *Is voltage 10 – 14 V?*	Poor "E23-2" connection or intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection Inspection: in Section 00". If wire and connections are OK, substitute a known-good ECM and recheck.	"RADIO" fuse blown, "WHT" or "WHT/RED" wire is open or short circuit.

DTC P1603: TCM Trouble Code Detected

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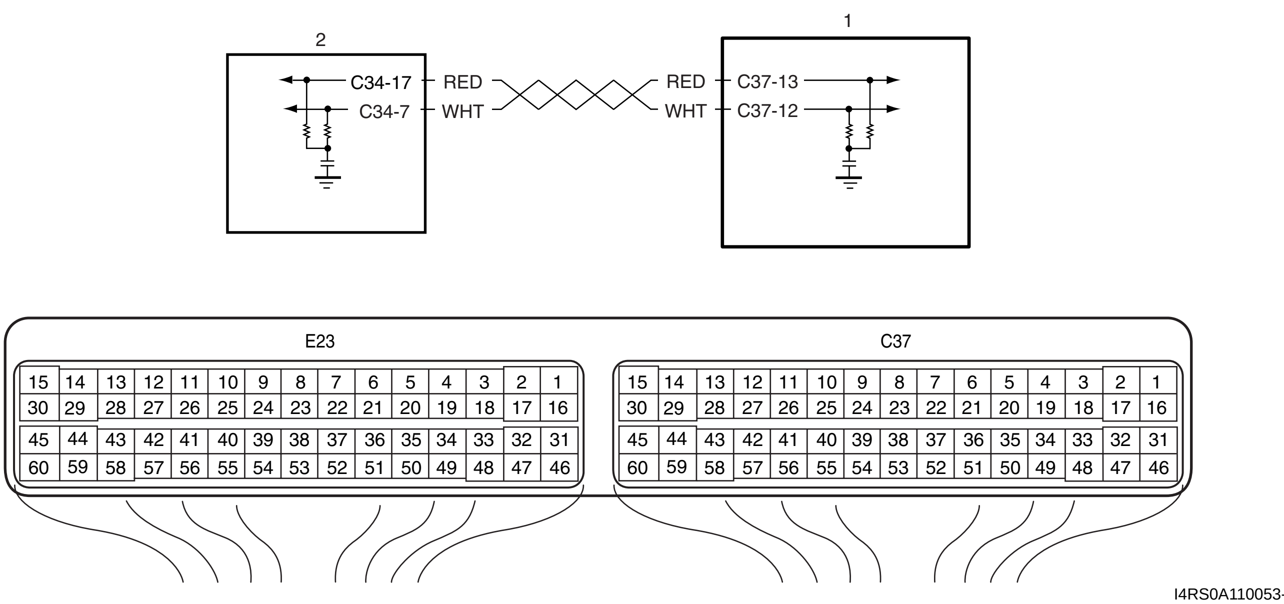
Wiring Diagram



1. ECM	2. TCM (A/T vehicle)

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

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

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	**DTC check** 1) Check DTC of TCM referring to "DTC Check: in Section 5A". *Is there any DTC(s)?*	Go to applicable DTC diag. flow.	Substitute a known-good ECM and recheck.

DTC P1674: CAN Communication (Bus Off Error)

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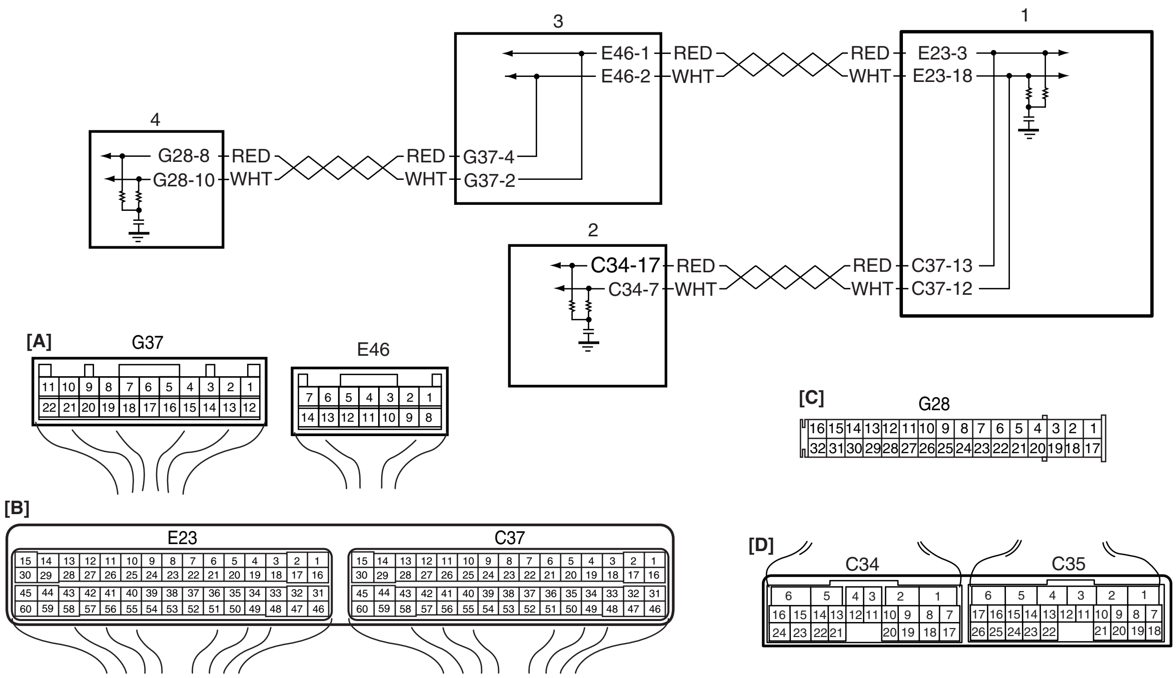
Wiring Diagram



I4RS0A110052-

[A]: BCM connector (viewed from harness side)	[D]: TCM connector (equipped with A/T) (viewed from harness side)	3. BCM
[B]: ECM connector (viewed from harness side)	1. ECM	4. Combination meter
[C]: Combination meter connector (viewed from harness side)	2. TCM (equipped with A/T)	

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
Transmission error that is inconsistent between transmission data and transmission monitor (CAN bus monitor) data is detected more than 7 times continuously. (1 driving detection logic)	• ECM • BCM • TCM (equipped with A/T) • Combination meter • CAN communication line circuit

DTC Confirmation Procedure

1) Connect scan tool to DLC with ignition switch turned OFF.
2) Turn ON ignition switch and clear DTC by using scan tool.
3) Start engine and run it for 1 min. or more.
4) Check DTC and pending DTC.

Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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	**DTC check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Check ECM, TCM (equipped with A/T) and BCM for DTC. *Is there any DTC(s) (other than DTC P1674, P1675, P1676, P1678 in ECM, DTC P1774, P1775, P1777, P1778 in TCM (equipped with A/T) and DTC U1073, U1001, U1100, U1101 in BCM)?*	Go to applicable DTC diag. flow.	Go to Step 3.
3	**ECM, TCM (equipped with A/T), BCM and combination meter connectors check** 1) Check for proper connection at each ECM, TCM (equipped with A/T), BCM and combination meter connector terminals with ignition switch turned OFF. 2) If connections are OK, recheck ECM for DTC with engine running. *Is there DTC P1674?*	Go to Step 4.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”
4	**ECM power and ground circuit check** 1) Check ECM power and ground circuit referring to “ECM Power and Ground Circuit Check: ”. *Are they in good condition?*	Go to Step 5.	Repair ECM power and/or ground circuits.
5	**DTC check in BCM and TCM (equipped with A/T) (bus off)** 1) Check DTC(s) in TCM (equipped with A/T) and BCM. *Is there DTC(s) P1774 in TCM (equipped with A/T) and/or U1073 in BCM?*	Go to Step 6.	Go to Step 7.
6	**DTC check in ECM (bus off)** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Check TCM (equipped with A/T) and BCM for DTC(s). *Is there DTC(s) P1774 in TCM (equipped with A/T) and/or U1073 in BCM?*	Go to Step 7.	Substitute a known-good ECM and recheck.
7	**DTC check in ECM** 1) Connect connectors to ECM and disconnect connectors from TCM (equipped with A/T) with ignition switch turned OFF. 2) Check ECM for DTC. *Is there DTC P1674?*	Go to Step 8.	Substitute a known-good TCM (equipped with A/T) and recheck.

Step	Action	Yes	No
8	**DTC check in ECM** 1) Disconnect connector from combination meter with ignition switch turned OFF. 2) Check ECM for DTC. *Is there DTC P1674?*	Go to Step 9.	Substitute a known-good combination meter and recheck.
9	**CAN communication line circuit insulation check** 1) Disconnect connectors from BCM with ignition switch turned OFF. 2) Measure resistance between “G37-2” and “G37-4” terminals of BCM connector. *Is resistance infinity?*	Go to Step 10.	Repair insulation of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”
10	**CAN communication line circuit insulation check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Measure resistance between “E23-3” and “E23-18” terminals of ECM connector. *Is resistance infinity?*	Go to Step 11.	Repair insulation of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”.
11	**CAN communication line circuit insulation check (equipped with A/T)** 1) Measure resistance between “C37-13” and “C37-12” terminals of ECM connector. *Is resistance infinity?*	Go to Step 12.	Repair insulation of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”.
12	**CAN communication line circuit continuity check** 1) Measure resistance at following connector terminals. • Between “E23-3” terminal of ECM connector and “E46-1” terminal of BCM connector • Between “E23-18” terminal of ECM connector and “E46-2” terminal of BCM connector • Between “C37-13” terminal of ECM connector and “C34-17” terminal of TCM connector (equipped with A/T) • Between “C37-12” terminal of ECM connector and “C34-7” terminal of TCM connector (equipped with A/T) • Between “G37-4” terminal of BCM connector and “G28-8” terminal of combination meter connector • Between “G37-2” terminal of BCM connector and “G28-10” terminal of combination meter connector *Is each resistance below 1 Ω?*	Go to Step 13.	Repair open or high resistance of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”

Step	Action	Yes	No
13	**CAN communication line circuit ground short check** 1) Measure resistance at following connector terminals. • Between “E23-3” terminal of ECM connector and vehicle body ground • Between “E23-18” terminal of ECM connector and vehicle body ground • Between “C37-13” terminal of ECM connector and vehicle body ground • Between “C37-12” terminal of ECM connector and vehicle body ground • Between “G37-4” terminal of BCM connector and vehicle body ground • Between “G37-2” terminal of BCM connector and vehicle body ground *Is each resistance infinity?*	Go to Step 14.	Repair short to ground of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”
14	**Check for short circuit of CAN communication line to power circuit** 1) Measure voltage at following connector terminals with ignition switch turned ON. • Between “E23-3” terminal of ECM connector and vehicle body ground • Between “E23-18” terminal of ECM connector and vehicle body ground • Between “C37-13” terminal of ECM connector and vehicle body ground • Between “C37-12” terminal of ECM connector and vehicle body ground • Between “G37-4” terminal of BCM connector and vehicle body ground • Between “G37-2” terminal of BCM connector and vehicle body ground *Is each voltage 0 – 1 V?*	Substitute a known-good BCM (included in junction block assembly) and recheck. If DTC is still detected, substitute a known-good ECM and recheck.	Repair short to power supply of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”

DTC P1675: CAN Communication (Transmission Error)

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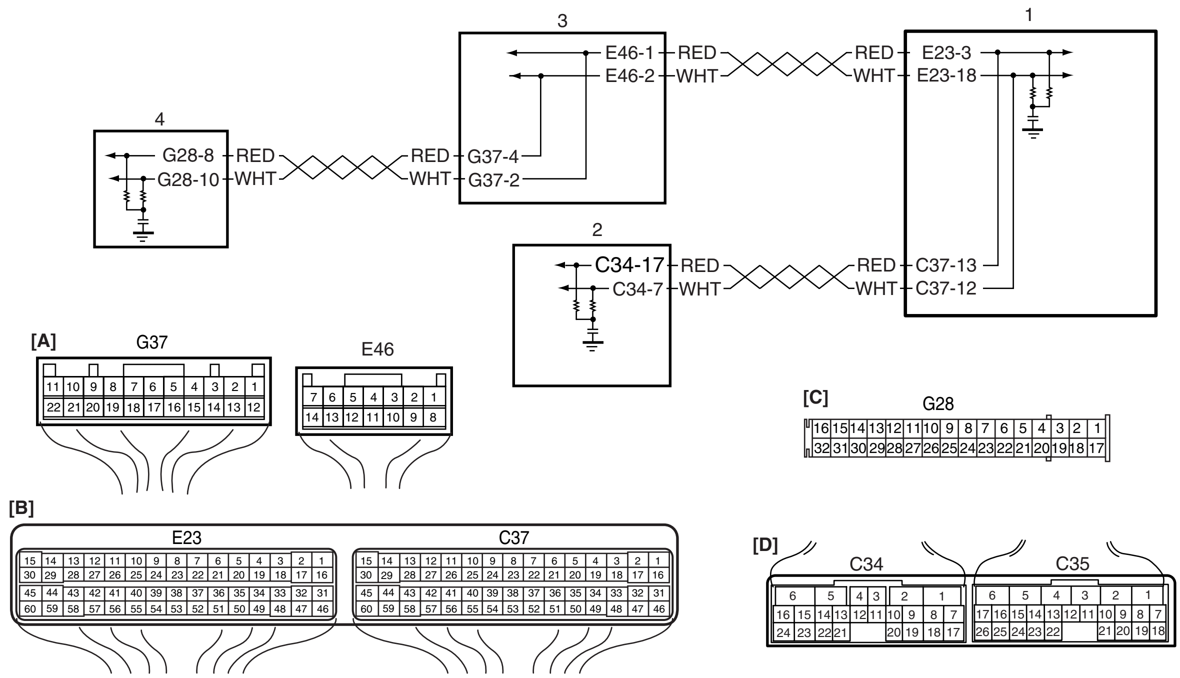
Wiring Diagram



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[A]: BCM connector (viewed from harness side)	[D]: TCM connector (equipped with A/T) (viewed from harness side)	3. BCM
[B]: ECM connector (viewed from harness side)	1. ECM	4. Combination meter
[C]: Combination meter connector (viewed from harness side)	2. TCM (equipped with A/T)	

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
Transmission error of communication data for ECM is detected for longer than specified time continuously. (1 driving detection logic)	• ECM • BCM • TCM (equipped with A/T) • Combination meter • CAN communication line circuit

DTC Confirmation Procedure

1) Connect scan tool to DLC with ignition switch turned OFF.
2) Turn ON ignition switch and clear DTC by using scan tool.
3) Start engine and run it for 1 min. or more.
4) Check DTC and pending DTC.

Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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	**DTC check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Check ECM, TCM (equipped with A/T) and BCM for DTC. *Is there any DTC(s) (other than DTC P1674, P1675, P1676, P1678 in ECM, DTC P1774, P1775, P1777, P1778 in TCM (equipped with A/T) and DTC U1073, U1001, U1100, U1101 in BCM)?*	Go to applicable DTC diag. flow.	Go to Step 3.
3	**CAN communication error check for ECM** 1) Check ECM for DTC. *Is there DTC P1674?*	Go to “DTC P1674: CAN Communication (Bus Off Error): ”	Go to Step 4.
4	**CAN communication error check for BCM and TCM (equipped with A/T)** 1) Check BCM and TCM (equipped with A/T) for DTC(s). *Are there DTC U1073 in BCM and DTC P1774 in TCM (equipped with A/T)?*	Go to applicable DTC diag. flow.	Go to Step 5.
5	**ECM, TCM (equipped with A/T), BCM and combination meter connectors check** 1) Check for proper connection at each ECM, TCM (equipped with A/T), BCM and combination meter connector terminals with ignition switch turned OFF. 2) If connections are OK, recheck ECM for DTC with engine running. *Is there DTC P1675?*	Go to Step 6.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”
6	**ECM power and ground circuit check** 1) Check ECM power and ground circuits referring to “ECM Power and Ground Circuit Check: ”. *Are they in good condition?*	Go to Step 7.	Repair ECM power and/or ground circuits.
7	**DTC check in ECM** 1) Check ECM for DTC(s). *Are there DTCs P1676 and P1678?*	Go to Step 8.	Go to Step 10.
8	**DTC check in TCM (equipped with A/T) and BCM** 1) Check TCM (equipped with A/T) and BCM for DTC(s). *Are there DTCs P1777, P1778 in TCM (equipped with A/T) and DTCs U1100, U1101 in BCM?*	Go to Step 10.	Go to Step 9.

Step	Action	Yes	No
9	**Combination meter operation check** 1) Check combination meter operation for seat belt warning lamp (fastening and unfastening driver side seat belt) and shift position indicator lamp (equipped with A/T) with ignition switch turned ON. *Are they OK?*	Substitute a known-good ECM and recheck.	Substitute a known-good BCM (included in junction block assembly), TCM (equipped with A/T) and recheck.
10	**CAN communication line circuit continuity check** 1) Disconnect connectors from ECM, BCM, TCM (equipped with A/T) and combination meter with ignition switch turned OFF. 2) Measure resistance at following connector terminals. • Between “E23-3” terminal of ECM connector and “E46-1” terminal of BCM connector • Between “E23-18” terminal of ECM connector and “E46-2” terminal of BCM connector • Between “C37-13” terminal of ECM connector and “C34-17” terminal of TCM connector (equipped with A/T) • Between “C37-12” terminal of ECM connector and “C34-7” terminal of TCM connector (equipped with A/T) • Between “G37-4” terminal of BCM connector and “G28-8” terminal of combination meter connector • Between “G37-2” terminal of BCM connector and “G28-10” terminal of combination meter connector *Is each resistance below 1 Ω?*	Go to Step 11.	Repair open or high resistance of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”
11	**CAN communication line circuit insulation check** 1) Measure resistance at following connector terminals. • Between “E23-3” and “E23-18” terminals of ECM connector • Between “C37-13” and “C37-12” terminals of ECM connector (equipped with A/T) • Between “G37-4” and “G37-2” terminals of BCM connector *Is each resistance infinity?*	Go to Step 12.	Repair insulation of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”
12	**CAN communication line circuit ground short check** 1) Measure resistance at following connector terminals. • Between “E23-3” terminal of ECM connector and vehicle body ground • Between “E23-18” terminal of ECM connector and vehicle body ground • Between “C37-13” terminal of ECM connector and vehicle body ground • Between “C37-12” terminal of ECM connector and vehicle body ground • Between “G37-4” terminal of BCM connector and vehicle body ground • Between “G37-2” terminal of BCM connector and vehicle body ground *Is each resistance infinity?*	Go to Step 13.	Repair short to ground of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”

Step	Action	Yes	No
13	**Check for short circuit of CAN communication line to power circuit** 1) Measure voltage at following connector terminals with ignition switch turned ON. • Between “E23-3” terminal of ECM connector and vehicle body ground • Between “E23-18” terminal of ECM connector and vehicle body ground • Between “C37-13” terminal of ECM connector and vehicle body ground • Between “C37-12” terminal of ECM connector and vehicle body ground • Between “G37-4” terminal of BCM connector and vehicle body ground • Between “G37-2” terminal of BCM connector and vehicle body ground *Is each voltage 0 – 1 V?*	Substitute a known-good ECM and recheck.	Repair short to power supply of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”

DTC P1676: CAN Communication (Reception Error for TCM)

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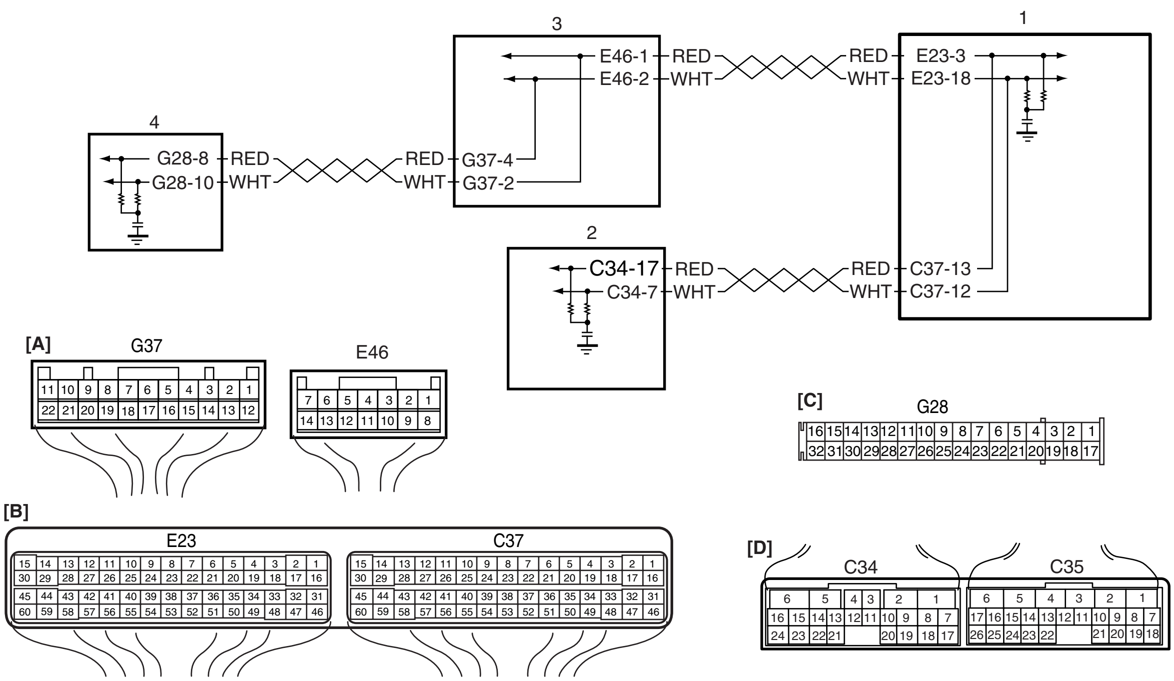
Wiring Diagram



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[A]: BCM connector (viewed from harness side)	[D]: TCM connector (viewed from harness side)	3. BCM
[B]: ECM connector (viewed from harness side)	1. ECM	4. Combination meter
[C]: Combination meter connector (viewed from harness side)	2. TCM	

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
Reception error of communication data for TCM is detected for longer than specified time continuously (1 driving detection logic)	• ECM • TCM • CAN communication line circuit

DTC Confirmation Procedure

1) Connect scan tool to DLC with ignition switch turned OFF.
2) Turn ON ignition switch and clear DTC by using scan tool.
3) Start engine and run it for 1 min. or more.
4) Check DTC and pending DTC.

Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**
- **Upon completion of inspection and repair work, perform "DTC Confirmation Procedure" and confirm that the trouble has been corrected.**

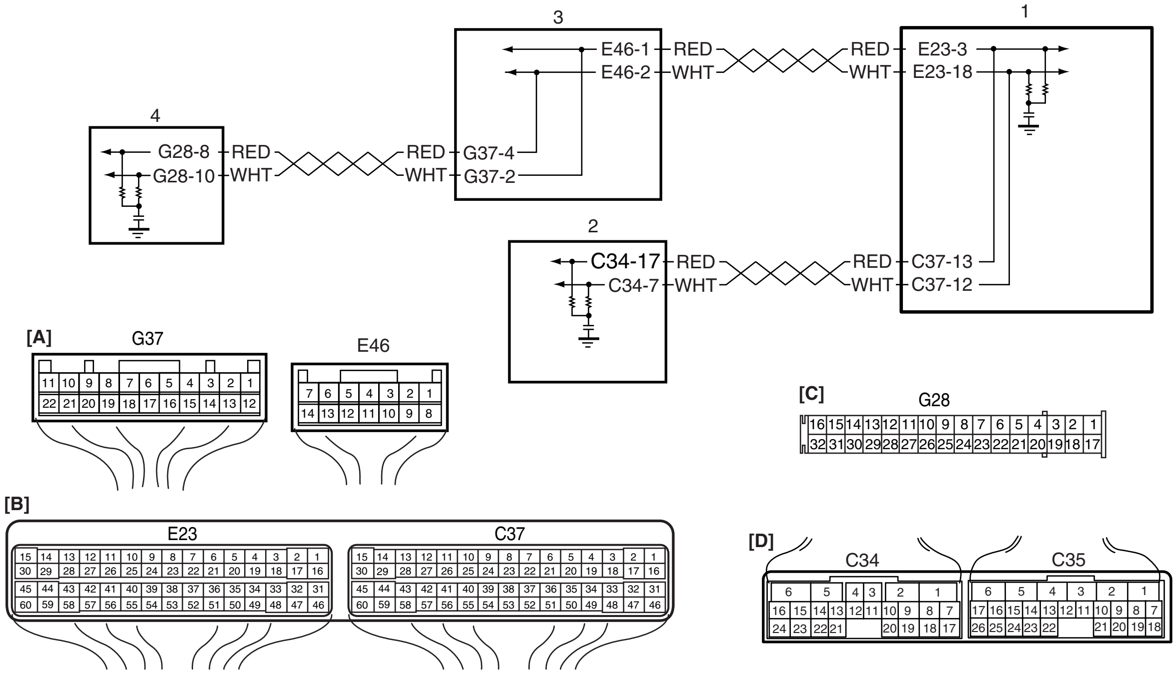
Step	Action	Yes	No
1	*Was "Engine and Emission Control System Check" performed?*	Go to Step 2.	Go to "Engine and Emission Control System Check: ".
2	**DTC check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Check ECM, TCM and BCM for DTC. *Is there any DTC(s) (other than DTC P1674, P1675, P1676, P1678 in ECM, DTC P1774, P1775, P1777, P1778 in TCM and DTC U1073, U1001, U1100, U1101 in BCM)?*	Go to applicable DTC diag. flow.	Go to Step 3.
3	**Check CAN communication error for ECM** 1) Check ECM for DTC. *Is there DTC P1674?*	Go to "DTC P1674: CAN Communication (Bus Off Error): ".	Go to Step 4.
4	**ECM and TCM connector check** 1) Check for proper connection at each ECM and TCM connector terminals with ignition switch turned OFF. 2) If connections are OK, recheck ECM for DTC with engine running. *Is there DTC P1676?*	Go to Step 5.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection Inspection: in Section 00".
5	**ECM power and ground circuit check** 1) Check ECM power and ground circuits referring to "ECM Power and Ground Circuit Check: ". *Are they in good condition?*	Go to Step 6.	Repair ECM power and/or ground circuits.
6	**DTC check in TCM** 1) Check DTC P1774 in TCM. *Is it indicated?*	Go to"DTC P1774: Control Module Communication Bus Off: in Section 5A"	Go to Step 7.
7	**DTC check in BCM** 1) Check DTC U1101 in BCM. *Is it indicated?*	Go to "DTC U1101 (No.1101): Lost communication with TCM: in Section 10B".	Go to Step 8

Step	Action	Yes	No
8	**CAN communication line circuit continuity check** 1) Disconnect connectors from ECM and TCM with ignition switch turned OFF. 2) Measure resistance at following connector terminals. • Between “C37-13” terminal of ECM connector and “C34-17” terminal of TCM connector • Between “C37-12” terminal of ECM connector and “C34-7” terminal of TCM connector *Is each resistance below 1 Ω?*	Go to Step 9.	Repair open or high resistance of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”.
9	**CAN communication line circuit insulation check** 1) Measure resistance between “C37-13” and “C37-12” terminals of ECM connector. *Is resistance infinity?*	Go to Step 10.	Repair insulation of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”.
10	**CAN communication line circuit ground short check** 1) Measure resistance at following connector terminals. • Between “C37-13” terminal of ECM connector and vehicle body ground • Between “C37-12” terminal of ECM connector and vehicle body ground *Is each resistance infinity?*	Go to Step 11.	Repair short to ground of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”.
11	**Check for short circuit of CAN communication line to power circuit** 1) Measure voltage at following connector terminals with ignition switch turned ON. • Between “C37-13” terminal of ECM connector and vehicle body ground • Between “C37-12” terminal of ECM connector and vehicle body ground *Is each voltage 0 – 1 V?*	Go to Step 12.	Repair short to power supply of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”.
12	**ECM circuit check** 1) Disconnect connectors from BCM with ignition switch turned OFF. 2) Connect connectors to ECM. 3) Measure resistance at following connector terminals. • Between “E23-3” and “C37-13” terminals of ECM connectors • Between “E23-18” and “C37-12” terminals of ECM connectors *Is resistance below 1 Ω?*	Substitute a known-good TCM and recheck.	Substitute a known-good ECM and recheck.

DTC P1678: CAN Communication (Reception Error for BCM)

S4RS0A1104083

Wiring Diagram



[A]: BCM connector (viewed from harness side)	[D]: TCM connector (equipped with A/T) (viewed from harness side)	3. BCM
[B]: ECM connector (viewed from harness side)	1. ECM	4. Combination meter
[C]: Combination meter connector (viewed from harness side)	2. TCM (equipped with A/T)	

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
Reception error of communication data for BCM is detected for longer than specified time continuously (1 driving detection logic but MIL does not light up)	• ECM • BCM • CAN communication line circuit

DTC Confirmation Procedure

1) Connect scan tool to DLC with ignition switch turned OFF.
2) Turn ON ignition switch and clear DTC by using scan tool.
3) Start engine and run it for 1 min. or more.
4) Check DTC and pending DTC.

Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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: ”.

Step	Action	Yes	No
2	**DTC check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Check ECM, TCM (equipped with A/T) and BCM for DTC. *Is there any DTC(s) (other than DTC P1674, P1675, P1676, P1678 in ECM, DTC P1774, P1775, P1777, P1778 in TCM (equipped with A/T) and DTC U1073, U1001, U1100, U1101 in BCM)?*	Go to applicable DTC diag. flow.	Go to Step 3.
3	**CAN communication error check for ECM** 1) Check ECM for DTC. *Is there DTC P1674?*	Go to “DTC P1674: CAN Communication (Bus Off Error): ”.	Go to Step 4.
4	**ECM, TCM (equipped with A/T) and BCM connector check** 1) Check for proper connection at each ECM, TCM (equipped with A/T) and BCM connector terminals with ignition switch turned OFF. 2) If connections are OK, recheck ECM for DTC with engine running. *Is there DTC P1678?*	Go to Step 5.	Intermittent trouble. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.
5	**ECM power and ground circuit check** 1) Check ECM power and ground circuits referring to “ECM Power and Ground Circuit Check: ”. *Are they in good condition?*	Go to Step 6.	Repair ECM power and/or ground circuits.
6	**DTC check in BCM** 1) Check DTC U1073 in BCM. *Is it indicated?*	Go to “DTC U1073 (No. 1073): Control Module Communication Bus Off: in Section 10B”.	Go to Step 7.
7	**CAN communication line circuit continuity check** 1) Disconnect connectors from ECM and BCM with ignition switch turned OFF. 2) Measure resistance at following connector terminals. • Between “E23-3” terminal of ECM connector and “E46-1” terminal of BCM connector • Between “E23-18” terminal of ECM connector and “E46-2” terminal of BCM connector *Is each resistance below 1 Ω?*	Go to Step 8.	Repair open or high resistance of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”.
8	**CAN communication line circuit insulation check** 1) Measure resistance between “E23-3” and “E23-18” terminals of ECM connector. *Is resistance infinity?*	Go to Step 9.	Repair insulation of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”.
9	**CAN communication line circuit ground short check** 1) Measure resistance at following connector terminals. • Between “E23-3” terminal of ECM connector and vehicle body ground • Between “E23-18” terminal of ECM connector and vehicle body ground *Is each resistance infinity?*	Go to Step 10.	Repair short to ground of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”.

Step	Action	Yes	No
10	**Check for short circuit of CAN communication line to power circuit** 1) Measure voltage at following connector terminals with ignition switch turned ON. • Between “E23-3” terminal of ECM connector and vehicle body ground • Between “E23-18” terminal of ECM connector and vehicle body ground *Is each voltage 0 – 1 V?*	Go to Step 11.	Repair short to power supply of CAN communication line circuit referring to “Precaution for CAN Communication System: in Section 00”.
11	**Vehicle spec check** *Is vehicle equipped with A/T?*	Go to Step 12.	Go to Step 14.
12	**DTC check in TCM (equipped with A/T)** 1) Connect connectors to ECM and BCM with ignition switch turned OFF. 2) Check DTC P1778 in TCM (equipped with A/T). *Is it indicated?*	Go to Step 13.	Substitute a known-good ECM and recheck.
13	**ECM circuit check** 1) Disconnect connectors from BCM and TCM (equipped with A/T) with ignition switch turned OFF. 2) Measure resistance at following connector terminals. • Between “E23-3” and “C37-13” terminals of ECM connector • Between “E23-18” and “C37-12” terminals of ECM connector *Is resistance below 1 Ω?*	Substitute a known-good BCM (included in junction block assembly) and recheck.	Substitute a known-good ECM and recheck.
14	**Combination meter operation check** 1) Check combination meter operation for seat belt warning lamp by fastening and unfastening driver side seat belt with ignition switch turned ON. *Is check result satisfactory?*	Go to Step 15.	Substitute a known-good BCM (included in junction block assembly) and recheck.
15	**BCM circuit check** 1) Disconnect connectors from combination meter with ignition switch turned OFF. 2) Connect connectors to BCM. 3) Measure resistance at following connector terminals. • Between “E46-1” and “G37-2” terminals of BCM connector • Between “E46-2” and “G37-2” terminals of BCM connector *Is resistance below 1 Ω?*	Substitute a known-good ECM and recheck.	Substitute a known-good BCM (included in junction block assembly) and recheck.

DTC P2227 / P2228 / P2229: Barometric Pressure Circuit Malfunction

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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.

DTC Detecting Condition and Trouble Area

DTC detecting condition	Trouble area
DTC P2227: Difference of barometric pressure value and intake manifold pressure value is higher than specified value while engine is cranking. (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. (1 driving cycle detection logic)	• Barometric pressure sensor in ECM
DTC P2229: Barometric pressure signal more than specified value is detected. (1 driving cycle detection logic)	

DTC Confirmation Procedure

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 by 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, pending DTC and freeze frame data by using scan tool and warm up engine to normal operating temperature.
3) Check DTC and pending DTC by using scan tool.

DTC P2228 / P2229:

1) Connect scan tool to DLC with ignition switch turned OFF.
2) Turn ON ignition switch, clear DTC by using scan tool and run engine for 1 min.
3) Check DTC and pending DTC by using scan tool.

DTC Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**
- **Upon completion of inspection and repair work, perform “DTC Confirmation Procedure” and confirm that the trouble has been corrected.**

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: Manifold Absolute Pressure Circuit Low Input: ”and/or “DTC P0108: Manifold Absolute Pressure Circuit High Input: ”. *Is check result satisfactory?*	Substitute a known-good ECM and recheck.	MAP sensor or its circuit malfunction.

Inspection of ECM and Its Circuits

S4RS0A1104055

ECM and its circuits can be checked by measuring voltage, pulse signal and resistance with special tool connected.

CAUTION:

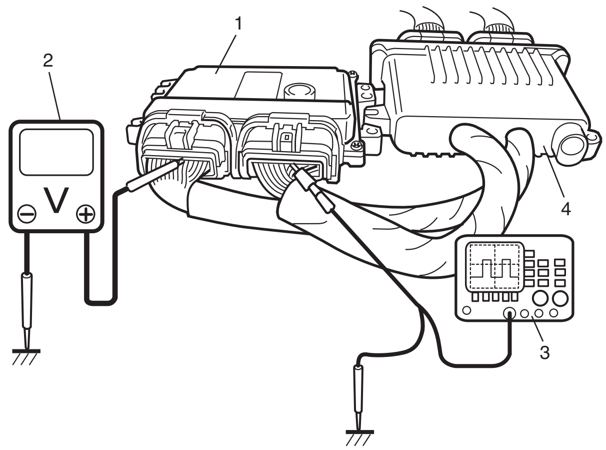
ECM cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to ECM with ECM connectors disconnected from it.

Voltage Check

1) Remove ECM (1) from its bracket referring to “Engine Control Module (ECM) Removal and Installation: in Section 1C”.
2) Connect special tool (4) between ECM and ECM connectors securely.
3) Check voltage and/or pulse signal using voltmeter (2) and oscilloscope (3).

NOTE:

- **As each terminal voltage is affected by battery voltage, confirm that it is 11 V or more when ignition switch is turned ON.**
- **Voltage with asterisk (*) cannot be measured with voltmeter because it is pulse signal. Use oscilloscope for its check if necessary.**



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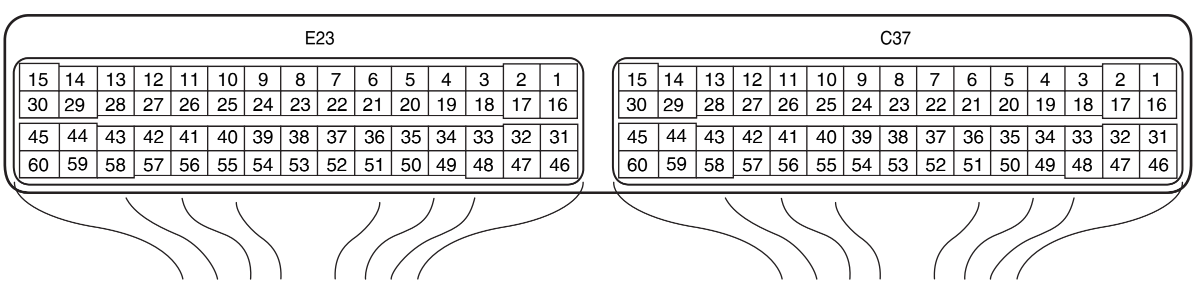
- **Before performed this inspection, be sure to read the “Precautions of ECM Circuit Inspection: ”.**

Viewed from harness side



I4RS0A110055-

Terminal No.	Wire color	Circuit	Normal voltage	Condition	Remarks
C37-1	BLU/YEL	Fuel injector No.1 output	10 – 14 V	Ignition switch turned ON.	—
			*0 – 0.6 V ↑↓ 10 – 14 V (“Reference waveform No.1: ”, “Reference waveform No.2: ” and “Reference waveform No.30: ”)	Engine running at idle after warmed up engine.	Output signal is active low pulse. Pulse frequency varies depending on engine speed.
C37-2	BLU/WHT	Fuel injector No.2 output	10 – 14 V	Ignition switch turned ON.	—
			*0 – 0.6 V ↑↓ 10 – 14 V (“Reference waveform No.1: ” and “Reference waveform No.3: ”)	Engine running at idle after warmed up engine.	Output signal is active low pulse. Pulse frequency varies depending on engine speed.
C37-3	GRN/ORN	EGR valve (stepper motor coil 2) output	10 – 14 V	Ignition switch turned ON.	—
			*0 – 1 V ↑↓ 10 – 14 V (“Reference waveform No.4: ”)	Ignition switch is turned to ST (cranking) position.	Output signal is active low duty pulse. Number of pulse generated times varies depending on vehicle condition.
C37-4	GRN/RED	EGR valve (stepper motor coil 1) output	10 – 14 V	Ignition switch turned ON.	—
			*0 – 1 V ↑↓ 10 – 14 V (“Reference waveform No.4: ”)	Ignition switch is turned to ST (cranking) position.	Output signal is active low duty pulse. Number of pulse generated times varies depending on vehicle condition.
C37-5	GRN/WHT	Ignition coil No.2 and No.3 output	0 – 0.6 V	Ignition switch turned ON.	—
			*0 – 0.6 V ↑↓ 3 – 5 V (“Reference waveform No.5: ” and “Reference waveform No.6: ”)	Engine running at idle after warmed up engine.	Output signal is active high pulse. Pulse frequency varies depending on engine speed.
C37-6	GRN/YEL	Ignition coil No.1 and No.4 output	0 – 0.6 V	Ignition switch turned ON.	—
			*0 – 0.6 V ↑↓ 3 – 5 V (“Reference waveform No.6: ”, “Reference waveform No.7: ” and “Reference waveform No.30: ”)	Engine running at idle after warmed up engine.	Output signal is active high pulse. Pulse frequency varies depending on engine speed.
C37-7	—	—	—	—	—
C37-8	—	—	—	—	—
C37-9	PPL	Vehicle speed sensor signal (for M/T)	*0 – 1 V ↑↓ 4 – 5 V (“Reference waveform No.8: ” (M/T))	Vehicle running.	Sensor signal is pulse. Pulse frequency varies depending on vehicle speed. (69 pulses (M/T) are generated per sec. at 30 km/h, 19 mph.) (8232 pulses/km (M/T))

Terminal No.	Wire color	Circuit	Normal voltage	Condition	Remarks
C37-10	WHT	Oxygen signal of heated oxygen sensor-1	0 – 1 V	Ignition switch turned ON.	—
			*Deflects between over 0.5 V and under 0.45 V (“Reference waveform No.9: ” and “Reference waveform No.10: ”)	While engine running at 2,000 r/min. for 1 min. or longer after warmed up.	
C37-11	BRN	Oxygen signal of heated oxygen sensor-2	4 – 5 V	Ignition switch turned ON.	—
			*Deflects between over 0.5 V and under 0.45 V (“Reference waveform No.11: ”)	While engine running at 2,000 r/min. or more after vehicle running over 30 km/h, 19 mph for 5 min.	
C37-12	WHT	CAN (low) (communication line (active low signal) to TCM (for A/T)	*0.5 – 2.5 V (“Reference waveform No.12: ”)	Ignition switch turned ON with engine stop.	CAN communication line signal is pulse. Pulse signal displayed with a regular frequency which varies depending on engine condition.
C37-13	RED	CAN (high) communication line (active high signal) to TCM (for A/T)	*2.5 – 4.5 V (“Reference waveform No.12: ”)		
C37-14	GRY/RED	Output of 5 V power source for TP sensor, MAP sensor, A/C refrigerant pressure sensor	4.5 – 5.5 V	Ignition switch turned ON.	—
C37-15	BLK	Ground for ECM	Below 0.3 V	Ignition switch turned ON.	—
C37-16	BLU/RED	Fuel injector No.3 output	10 – 14 V	Ignition switch turned ON.	—
			*0 – 0.6 V ↑↓ 10 – 14 V (“Reference waveform No.1: ” and “Reference waveform No.13: ”)	Engine running at idle after warmed up engine.	Output signal is active low pulse. Pulse frequency varies depending on engine speed.
C37-17	BLU/ORN	Fuel injector No.4 output	10 – 14 V	Ignition switch turned ON.	—
			*0 – 0.6 V ↑↓ 10 – 14 V (“Reference waveform No.1: ” and “Reference waveform No.14: ”)	Engine running at idle after warmed up engine.	Output signal is active low pulse. Pulse frequency varies depending on engine speed.
C37-18	BRN/YEL	EGR valve (stepper motor coil 4) output	10 – 14 V	Ignition switch turned ON.	—
			*0 – 1 V ↑↓ 10 – 14 V (“Reference waveform No.4: ”)	Ignition switch is turned to ST (cranking) position.	Output signal is active low duty pulse. Number of pulse generated times varies depending on vehicle condition.
C37-19	WHT/RED	EGR valve (stepper motor coil 3) output	10 – 14 V	Ignition switch turned ON.	—
			*0 – 1 V ↑↓ 10 – 14 V (“Reference waveform No.4: ”)	Ignition switch is turned to ST (cranking) position.	Output signal is active low duty pulse. Number of pulse generated times varies depending on vehicle condition.

<table>
<tr><th>Terminal No.</th><th>Wire color</th><th>Circuit</th><th>Normal voltage</th><th>Condition</th><th>Remarks</th></tr>
<tr><td rowspan="2">C37-20</td><td rowspan="2">RED/ YEL</td><td rowspan="2">CMP sensor signal</td><td>0 – 1 V or 4 – 5 V</td><td>Ignition switch turned ON.</td><td>—</td></tr>
<tr><td>*0 – 0.6 V
↑↓
4 – 5 V
(“Reference waveform No.15: ” and “Reference waveform No.16: ”)</td><td>Engine running at idle after warmed up engine.</td><td>Sensor signal is pulse. Pulse frequency varies depending on engine speed.
(6 pulses are generated per 1 camshaft revolution.)</td></tr>
<tr><td rowspan="2">C37-21</td><td rowspan="2">PNK</td><td rowspan="2">CKP sensor signal</td><td>0 – 1 V or 4 – 5 V</td><td>Ignition switch turned ON.</td><td>—</td></tr>
<tr><td>*4 – 5 V
↑↓
0 – 0.6 V
(“Reference waveform No.15: ” and “Reference waveform No.16: ”)</td><td>Engine running at idle after warming up engine.</td><td>Sensor signal is pulse. Pulse frequency varies depending on engine speed.
(30 (36 – 6) pulses are generated per 1 crankshaft revolution.)</td></tr>
<tr><td>C37-22</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>C37-23</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td rowspan="3">C37-24</td><td rowspan="3">LT GRN</td><td rowspan="3">Engine coolant temp. (ECT) sensor signal</td><td>3.3 – 3.8 V</td><td>Ignition switch turned ON, ECT at 0 °C, 32 °F.</td><td rowspan="3">—</td></tr>
<tr><td>1.38 – 1.72 V</td><td>Ignition switch turned ON, ECT at 50 °C, 122 °F.</td></tr>
<tr><td>0.40 – 0.53 V</td><td>Ignition switch turned ON, ECT at 100 °C, 212 °F.</td></tr>
<tr><td rowspan="3">C37-25</td><td rowspan="3">BLK/ YEL</td><td rowspan="3">Intake air temp. (IAT) sensor signal</td><td>3.18 – 3.67 V</td><td>Ignition switch turned ON, IAT at 0 °C, 32 °F.</td><td rowspan="3">—</td></tr>
<tr><td>1.32 – 1.65 V</td><td>Ignition switch turned ON, IAT at 40 °C, 104 °F.</td></tr>
<tr><td>0.46 – 0.60 V</td><td>Ignition switch turned ON, IAT at 80 °C, 176 °F.</td></tr>
<tr><td rowspan="2">C37-26</td><td rowspan="2">GRN/ BLK</td><td rowspan="2">Mass air flow (MAF) sensor signal</td><td>0.5 – 1.5 V</td><td>Ignition switch turned ON with engine at stop.</td><td rowspan="2">—</td></tr>
<tr><td>1.5 – 2.0 V
(“Reference waveform No.17: ”)</td><td>When engine running at specified idle speed after warmed up.</td></tr>
<tr><td>C37-27</td><td>GRY</td><td>Ground for MAF sensor</td><td>Below 0.3 V</td><td>Ignition switch turned ON.</td><td>—</td></tr>
<tr><td>C37-28</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td rowspan="2">C37-29</td><td rowspan="2">BLU/ BLK</td><td rowspan="2">EVAP canister purge valve output</td><td>10 – 14 V</td><td>Ignition switch turned ON with engine at stop.</td><td>—</td></tr>
<tr><td>*0 – 0.6 V
↑↓
10 – 14 V
(“Reference waveform No.18: ”)</td><td>Set EVAP canister purge valve at 52% by using “Misc Test” of scan tool.</td><td>Output signal is active low duty pulse. Duty ratio varies depending on vehicle condition.</td></tr>
<tr><td>C37-30</td><td>BLK</td><td>Ground for ECM</td><td>Below 0.3 V</td><td>Ignition switch turned ON.</td><td>—</td></tr>
<tr><td>C37-31</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>C37-32</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>C37-33</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>C37-34</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>C37-35</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>C37-36</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>C37-37</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>C37-38</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>C37-39</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>C37-40</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>C37-41</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>C37-42</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
</table>

Terminal No.	Wire color	Circuit	Normal voltage	Condition	Remarks
C37-43	—	—	—	—	—
C37-44	—	—	—	—	—
C37-45	—	—	—	—	—
C37-46	BLK/ RED	Heater output of heated oxygen sensor-1	10 – 14 V	Ignition switch turned ON.	—
			*0 – 2 V ↑↓ 10 – 14 V (“Reference waveform No.9: ” and “Reference waveform No.10: ”)	Engine running at idle after warmed up engine.	Output signal is active low duty pulse. Duty ratio varies depending on engine condition.
C37-47	RED/ BLU	Heater output of heated oxygen sensor-2	10 – 14 V	Ignition switch turned ON.	—
			0 – 1 V (“Reference waveform No.11: ”)	Engine running at idle after vehicle running over 30 km/h, 19 mph for 5 min.	
C37-48	YEL/ GRN	Starting motor signal	0 – 1 V	Ignition switch turned ON.	—
			6 – 14 V	While engine cranking.	
C37-49	RED/ WHT	IAC valve output	*0 – 2 V ↑↓ 8 – 14 V (“Reference waveform No.19: ”)	Ignition switch turned ON.	Ignition switch turned ON.
			*0 – 2 V ↑↓ 8 – 14 V (“Reference waveform No.20: ”)	Engine running at idle after warmed up engine.	Output signal is active low duty pulse. Number of pulse generated times varies depending on vehicle condition.
C37-50	—	Ground of ECM for shield wire	Below 0.3 V	Ignition switch turned ON.	—
C37-51	—	Ground of ECM for shield wire	Below 0.3 V	Ignition switch turned ON.	—
C37-52	—	Ground of ECM for shield wire	Below 0.3 V	Ignition switch turned ON.	—
C37-53	RED/ BLK	Manifold absolute pressure (MAP) sensor signal	Approx. 4 V (“Reference waveform No.21: ”)	Ignition switch turned ON with barometric pressure at 100 kPa, 760 mmHg.	—
			0.4 – 2.0 V (“Reference waveform No.22: ”)	While engine running at specified idle speed after warmed up with barometric pressure at 100 kPa, 760 mmHg.	
C37-54	GRY/ BLU	Throttle position (TP) sensor signal	0.5 – 1.0 V	Ignition switch turned ON and throttle valve at idle position after warmed up engine.	—
			3.4 – 4.7 V	Ignition switch turned ON and throttle valve at full open position after warmed up engine.	
C37-55	ORN	Ground for sensors	Below 0.3 V	Ignition switch turned ON.	—
C37-56	RED	Knock sensor signal	2 – 3 V (“Reference waveform No.23: ” and “Reference waveform No.24: ”)	Ignition switch turned ON.	—
				Engine running at 4000 r/min. after warmed up.	
C37-57	YEL	Ground for sensors	Below 0.3 V	Ignition switch turned ON.	—
C37-58	BLK/ ORN	Ground for ECM	Below 0.3 V	Ignition switch turned ON.	—

Terminal No.	Wire color	Circuit	Normal voltage	Condition	Remarks
C37-59	YEL/ GRN	Oil control valve ground	Below 1.3 V	Ignition switch turned ON.	—
C37-60	YEL/ RED	Oil control valve output	*0 – 0.6 V ↑↓ 10 – 14 V (“Reference waveform No.25: ” and “Reference waveform No.26: ”)	At the moment of ignition switch turned ON.	Output signal is active high pulse. Duty ratio varies depending on vehicle condition.

Terminal No.	Wire color	Circuit	Normal voltage	Condition	Remarks
E23-1	BLK/ RED	Main power supply	10 – 14 V	Ignition switch turned ON.	—
E23-2	WHT/ RED	Power source for ECM internal memory	10 – 14 V	Ignition switch turned ON.	—
E23-3	RED	CAN (high) communication line (active high signal) for BCM, combination meter	*2.5 – 4.5 V (“Reference waveform No.27: ”)	Ignition switch turned ON with engine at stop.	CAN communication line signal is pulse. Pulse signal displayed with a regular frequency with varies depending on engine condition.
E23-4	BRN	Engine revolution signal output for EPS control module	0 – 0.8 V	Ignition switch turned ON with engine at stop.	—
			*0 – 1 V ↑↓ 8 – 14 V (“Reference waveform No.28: ” and “Reference waveform No.29: ”)	While engine running.	Output signal is pulse. Pulse frequency varies depending on engine speed. (2 pulses are generated per 1 crankshaft revolution.) (3000 r/min. = 100 Hz)
E23-5	PPL/ WHT	Serial communication line of data link connector 12 V	8 – 14 V	Ignition switch turned ON.	—
E23-6	—	—	—	—	—
E23-7	—	—	—	—	—
E23-8	—	—	—	—	—
E23-9	—	—	—	—	—
E23-10	—	—	—	—	—
E23-11	—	—	—	—	—
E23-12	—	—	—	—	—
E23-13	YEL/ RED	Clock signal for immobilizer coil antenna	10 – 14 V	Ignition switch turned ON.	—
E23-14	—	—	—	—	—
E23-15	GRN/ WHT	Fuel pump relay output	0 – 2.5 V	For 3 sec. from the time ignition switch is turned ON or while engine is running.	—
			10 – 14 V	On and after 3 sec. from the time ignition switch is turned ON or while engine is at stop.	
E23-16	BLK/ RED	Main power supply	10 – 14 V	Ignition switch turned ON.	—

Terminal No.	Wire color	Circuit	Normal voltage	Condition	Remarks
E23-17	—	—	—	—	—
E23-18	WHT	CAN (low) communication line (active low signal) for BCM, combination meter	*0.5 – 2.5 V (“Reference waveform No.27: ”)	Ignition switch turned ON with engine at stop.	CAN communication line signal is pulse. Pulse signal displayed with a regular frequency which varies depending on engine condition.
E23-19	BLU/ WHT	Electric load signal for heater blower motor	10 – 14 V	Ignition switch turned ON, blower fan selector at OFF position.	—
			0 – 1 V	Ignition switch turned ON, blower fan selector at 2nd speed position or more.	
E23-20	GRN/ WHT	Stop lamp switch signal	0 – 1 V	Ignition switch turned ON, stop lamp not lit up.	—
			10 – 14 V	Ignition switch turned ON, stop lamp lit up.	
E23-21	—	—	—	—	—
E23-22	—	—	—	—	—
E23-23	—	—	—	—	—
E23-24	YEL/ RED	Fuel level sensor signal	0 – 6 V	Ignition switch turned ON. Voltage varies depends on fuel level.	—
E23-25	PPL	Vehicle speed signal output for EPS control module	*0 – 1 V ↑↓ 10 – 14 V (“Reference waveform No.8: ”)	Vehicle running.	Sensor signal is pulse. Pulse frequency varies depending on vehicle speed. (21 pulses are generated per sec. at 30 km/h (2561 pulses/km), 19 mph.)
E23-26	RED/ BLU	EPS signal	10 – 14 V	Ignition switch turned ON.	—
			0 – 1 V	With engine running at idle speed, and steering wheel turned to the right or left as far as it stops.	
E23-27	—	—	—	—	—
E23-28	YEL/ BLK	Serial communication line for immobilizer coil antenna	10 – 14 V	Ignition switch turned ON.	—
E23-29	BLK/ WHT	Ignition switch signal	0 – 1 V	Ignition switch turned OFF.	—
			10 – 14 V	Ignition switch turned ON.	
E23-30	WHT	Starting motor control relay output	0 – 1 V	Ignition switch turned ON.	—
			0 – 1 V	Ignition switch is turned to ST (engine cranking) position.	
E23-31	—	—	—	—	—
E23-32	—	—	—	—	—
E23-33	—	—	—	—	—
E23-34	—	—	—	—	—
E23-35	—	—	—	—	—
E23-36	—	—	—	—	—
E23-37	—	—	—	—	—
E23-38	—	—	—	—	—
E23-39	—	—	—	—	—
E23-40	—	—	—	—	—
E23-41	—	—	—	—	—
E23-42	—	—	—	—	—

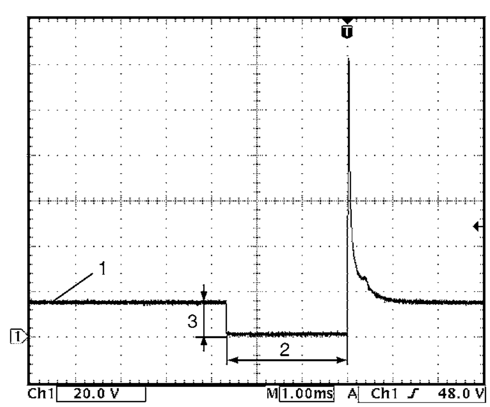
Terminal No.	Wire color	Circuit	Normal voltage	Condition	Remarks
E23-43	—	—	—	—	—
E23-44	—	—	—	—	—
E23-45	—	—	—	—	—
E23-46	LT GRN	Radiator cooling fan relay No.1 output	10 – 14 V	Ignition switch turned ON, engine coolant temp.: below 95 °C (203 °F), or A/C refrigerant pressure: below 600 kPa (87 psi) with A/C switch turned ON while engine is running.	—
			0 – 2 V	Ignition switch turned ON, engine coolant temp.: 97.5 °C (207.5 °F) or higher, or A/C refrigerant pressure: 1100 kPa (159.5 psi) or higher with A/C switch turned ON while engine is running.	
E23-47	GRY	A/C compressor relay output	10 – 14 V	Engine running, A/C switch OFF and blower selector at OFF position.	—
			0 – 1 V	Engine running, A/C switch ON and blower selector at 1st position or more.	
E23-48	GRN	Radiator cooling fan relay No.2 and No.3 output	10 – 14 V	Ignition switch turned ON, engine coolant temp.: below 100 °C (212 °F), or A/C refrigerant pressure: below 1200 kPa (174 psi) with A/C switch turned ON while engine is running.	—
			0 – 2 V	Ignition switch turned ON, engine coolant temp.: 102.5 °C (216.5 °F) or higher, or A/C refrigerant pressure: 1500 kPa (217.5 psi) or higher with A/C switch turned ON while engine is running.	
E23-49	—	—	—	—	—
E23-50	—	—	—	—	—
E23-51	—	—	—	—	—
E23-52	—	—	—	—	—
E23-53	—	—	—	—	—
E23-54	ORN	Ground for sensors	Below 0.3 V	Ignition switch turned ON.	—

Terminal No.	Wire color	Circuit	Normal voltage	Condition	Remarks
E23-55	RED	A/C refrigerant pressure sensor signal	1.38 – 1.52 V	Engine running, A/C switch OFF and blower selector at OFF position, A/C refrigerant pressure: 800 kPa (116 psi)	—
			2.15 – 2.38 V	Engine running, A/C switch ON and blower selector at 1st position or more, A/C refrigerant pressure: 1400 kPa (203 psi)	
			2.67 – 2.95 V	Engine running, A/C switch ON and blower selector at 1st position or more, A/C refrigerant pressure: 1800 kPa (261 psi)	
E23-56	—	—	—	—	—
E23-57	WHT/BLK	A/C evaporator outlet air temp. sensor signal	3.4 – 3.7 V	Ignition switch turned ON at A/C evaporator outlet temperature 0 °C (32 °F).	—
			2.5 – 2.8 V	Ignition switch turned ON at A/C evaporator outlet temperature 15 °C (59 °F).	
			1.7 – 2.0 V	Ignition switch turned ON at A/C evaporator outlet temperature 30 °C (86 °F).	
E23-58	—	—	—	—	—
E23-59	—	—	—	—	—
E23-60	BRN/WHT	Main power supply relay output	10 – 14 V	Ignition switch turned OFF.	—
			0 – 2 V	Ignition switch turned ON.	

Reference waveform No.1

Fuel injector signal (1) with engine idling

Measurement terminal	CH1: “C37-2” to “C37-58”
Oscilloscope setting	CH1: 20 V/DIV TIME: 1 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed



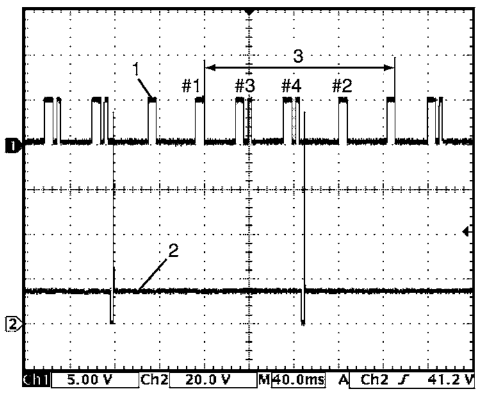
I4RS0B110050-

2.	Fuel injection pulse width: 2-4 msec.
3.	10 – 14 V

Reference waveform No.2

No.1 fuel injector signal (2) with engine idling

Measurement terminal	CH1: "C37-20" to "C37-58" CH2: "C37-1" to "C37-58"
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



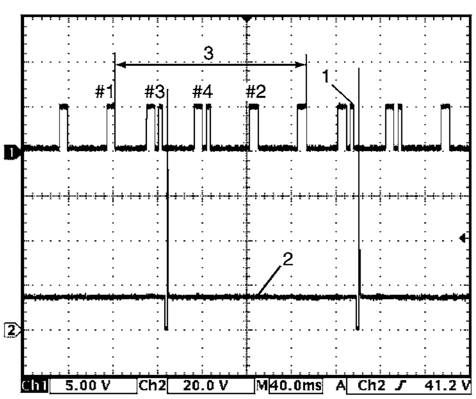
I4RS0A110088-

1.	Cylinder reference signal (CMP reference signal)
3.	720° crank angle

Reference waveform No.3

No.2 fuel injector signal (2) with engine idling

Measurement terminal	CH1: "C37-20" to "C37-58" CH2: "C37-2" to "C37-58"
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



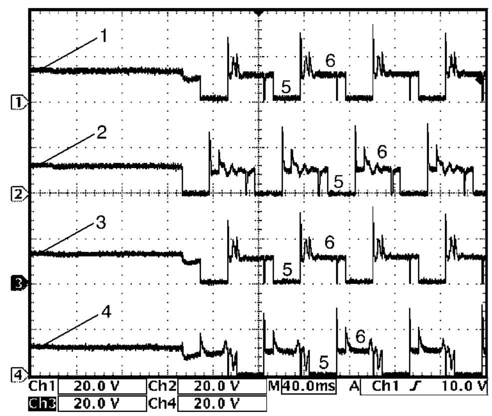
I4RS0A110089-

1.	Cylinder reference signal (CMP reference signal)
3.	720° crank angle

Reference waveform No.4

EGR valve signal

Measurement terminal	CH1: "C37-4" to "C37-58" CH2: "C37-3" to "C37-58" CH3: "C37-19" to "C37-58" CH4: "C37-18" to "C37-58"
Oscilloscope setting	CH1: 20 V/DIV, CH2: 20 V/DIV CH3: 20 V/DIV, CH4: 20 V/DIV TIME: 40 ms/DIV
Measurement condition	Engine at cranking



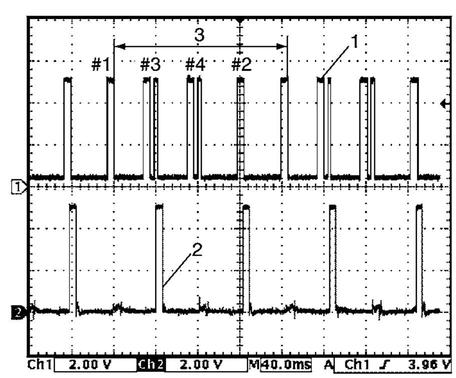
I4RS0B110053-

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
5.	ON signal
6.	OFF signal

Reference waveform No.5

Ignition coil No.2 and No.3 signal (2) with engine idling

Measurement terminal	CH1: "C37-20" to "C37-58" CH2: "C37-5" to "C37-58"
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



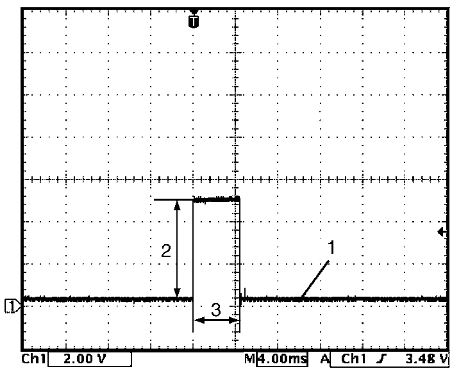
I4RS0A110090-

1.	Cylinder reference signal (CMP reference signal)
3.	720° crank angle

Reference waveform No.6

Ignition coil signal (1) with engine idling

Measurement terminal	CH1: "C37-6" to "C37-58"
Oscilloscope setting	CH1: 2 V/DIV TIME: 4 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed



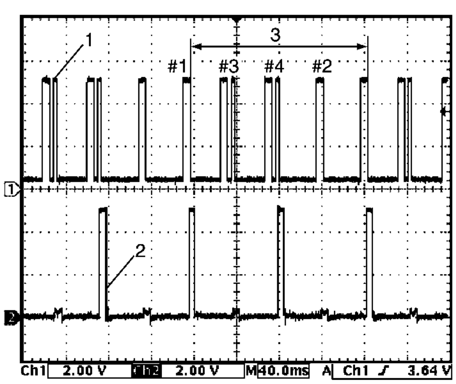
I4RS0B110055-

2.	4 – 6 V
3.	Ignition coil pulse width: 4 – 5 msec.

Reference waveform No.7

Ignition coil No.1 and No.4 signal (2) with engine idling

Measurement terminal	CH1: "C37-20" to "C37-58" CH2: "C37-6" to "C37-58"
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



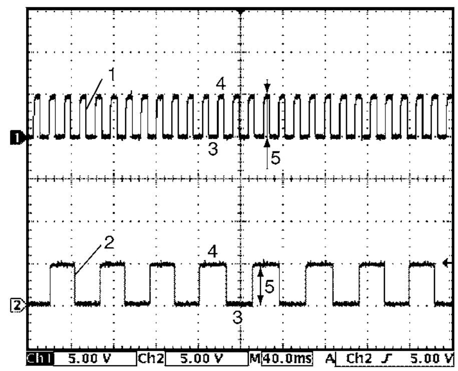
I4RS0A110091-

1.	Cylinder reference signal (CMP reference signal)
3.	720° crank angle

Reference waveform No.8

VSS signal at 30 km/h (19 mph) (for M/T model)

Measurement terminal	CH1: "C37-9" to "C37-58" CH2: "E23-25" to "C37-58"
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 mph)



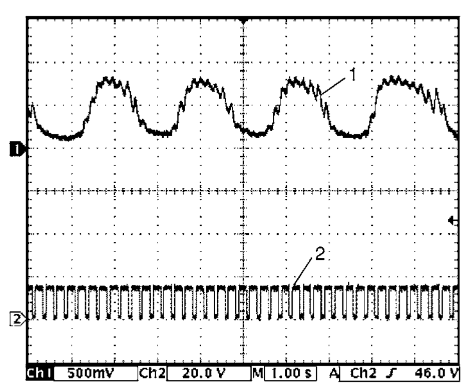
I4RS0B110057-

1.	VSS signal (M/T)
2.	VSS signal for EPS control module
3.	ON
4.	OFF
5.	4 – 5 V

Reference waveform No.9

Heated oxygen sensor-1 signal (1) with engine idling

Measurement terminal	CH1: "C37-10" to "C37-57" CH2: "C37-46" to "C37-58"
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



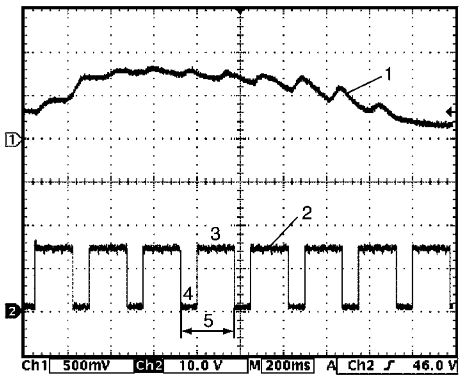
I4RS0B110058-

2.	Heated oxygen sensor-1 heater signal

Reference waveform No.10

Heated oxygen sensor-1 heater signal (2) with engine idling

Measurement terminal	CH1: "C37-10" to "C37-57" CH2: "C37-46" to "C37-58"
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



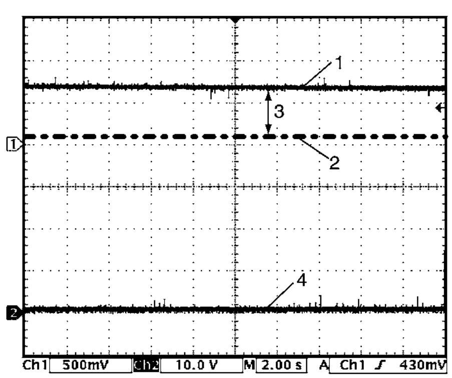
I4RS0B110059-

1.	Heated oxygen sensor-1 signal
3.	OFF signal
4.	ON signal
5.	One duty cycle

Reference waveform No.11

Heated oxygen sensor-2 heater signal (4) with engine idling

Measurement terminal	CH1: "C37-11" to "C37-57" CH2: "C37-47" to "C37-58"
Oscilloscope setting	CH1: 500 mV/DIV, CH2: 10 V/DIV TIME: 2 s/DIV
Measurement condition	• After warmed up to normal operating temperature • Drive vehicle at 60 km/h (37 mph) for 10 min. • Engine at specified idle speed



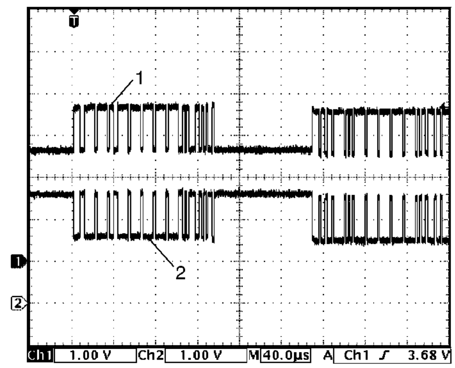
I4RS0B110060-

1.	Heated oxygen sensor-2 signal upper limit
2.	Heated oxygen sensor-2 signal lower limit
3.	Normal waveform range

Reference waveform No.12

CAN communication line signal from TCM (for A/T or AMT model) with ignition switch turned ON

Measurement terminal	CH1: "C37-13" to "C37-58" CH2: "C37-12" to "C37-58"
Oscilloscope setting	CH1: 1 V/DIV, CH2: 1 V/DIV TIME: 40 μs/DIV
Measurement condition	Ignition switch turned ON (Signal pattern is depending on engine condition)



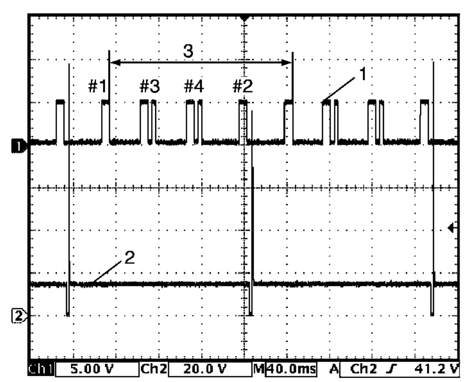
I4RS0B110061-

1.	CAN communication line signal (High)
2.	CAN communication line signal (Low)

Reference waveform No.13

No.3 fuel injector signal (2) with engine idling

Measurement terminal	CH1: "C37-20" to "C37-58" CH2: "C37-16" to "C37-58"
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



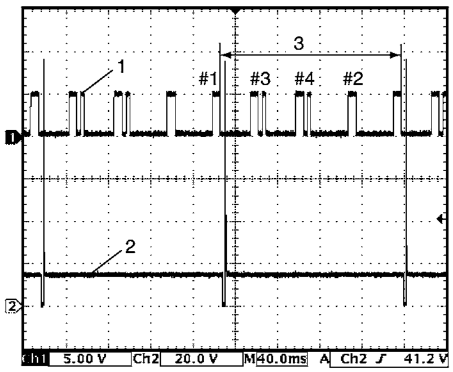
I4RS0A110092-

1.	Cylinder reference signal (CMP reference signal)
3.	720° crank angle

Reference waveform No.14

No.4 fuel injector signal (2) with engine idling

Measurement terminal	CH1: “C37-20” to “C37-58” CH2: “C37-17” to “C37-58”
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



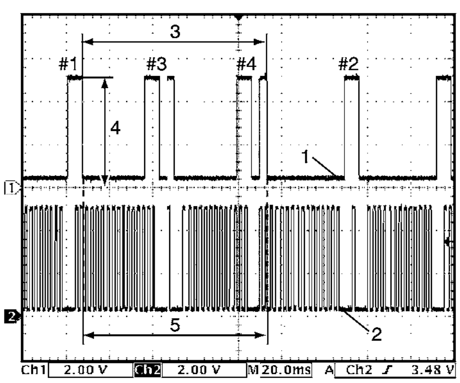
I4RS0A110093-

1.	Cylinder reference signal (CMP reference signal)
3.	720° crank angle

Reference waveform No.15

CMP sensor signal with engine idling

Measurement terminal	CH1: “C37-20” to “C37-58” CH2: “C37-21” to “C37-58”
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



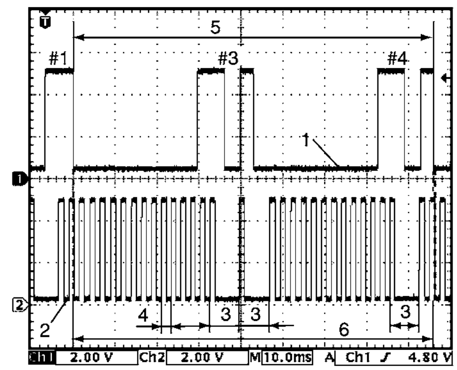
I4RS0A110094-

1.	Cylinder reference signal (CMP reference signal)
2.	CKP signal
3.	360° crank angle
4.	4 – 5 V
5.	36 – 6 = 30 CKP pulse

Reference waveform No.16

CMP sensor signal with engine idling

Measurement terminal	CH1: “C37-20” to “C37-58” CH2: “C37-21” to “C37-58”
Oscilloscope setting	CH1: 2 V/DIV, CH2: 2 V/DIV TIME: 10 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed



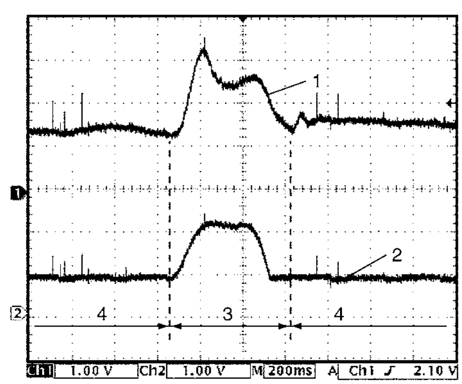
I4RS0A110095-

1.	Cylinder reference signal (CMP reference signal)
2.	CKP signal
3.	30° crank angle
4.	10° crank angle
5.	360° crank angle
6.	36 – 6 = 30 CKP pulse

Reference waveform No.17

Mass air flow sensor signal (1) with engine racing

Measurement terminal	CH1: “C37-26” to “C37-27” CH2: “C37-54” to “C37-55”
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



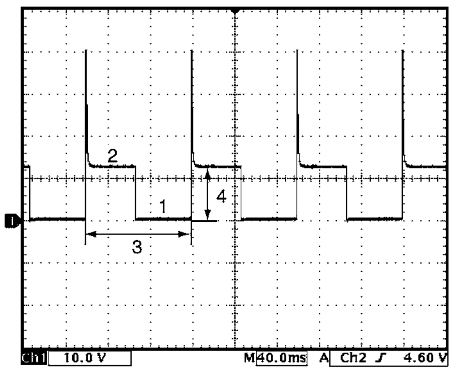
I4RS0B110066-

2.	Throttle position sensor signal
3.	Racing
4.	Idle

Reference waveform No.18

EVAP canister purge valve signal

Measurement terminal	CH1: “C37-29” to “C37-58”
Oscilloscope setting	CH1: 10 V/DIV TIME: 40 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Set EVAP canister purge valve at 52% by using “Misc Test” of scan tool



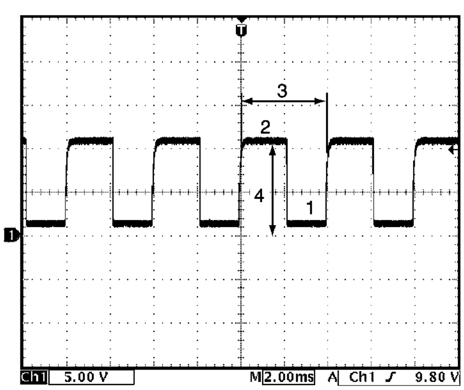
I4RS0B110067-

1.	ON signal
2.	OFF signal
3.	One duty cycle
4.	10 – 14 V

Reference waveform No.19

IAC valve signal with ignition switch turned ON

Measurement terminal	CH1: “C37-49” to “C37-58”
Oscilloscope setting	CH1: 5 V/DIV TIME: 2 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Ignition switch turned ON



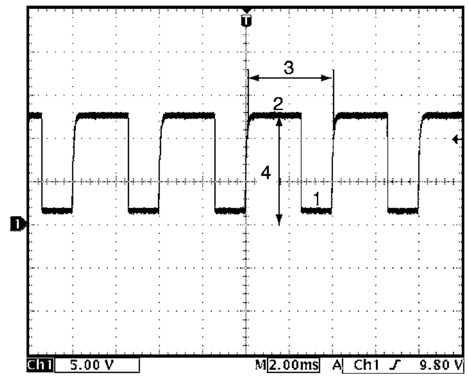
I4RS0B110068-

1.	ON signal
2.	OFF signal
3.	One duty cycle (Approx. 4 msec.)
4.	8 – 14 V

Reference waveform No.20

IAC valve signal

Measurement terminal	CH1: “C37-49” to “C37-58”
Oscilloscope setting	CH1: 5 V/DIV TIME: 2 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at specified idle speed



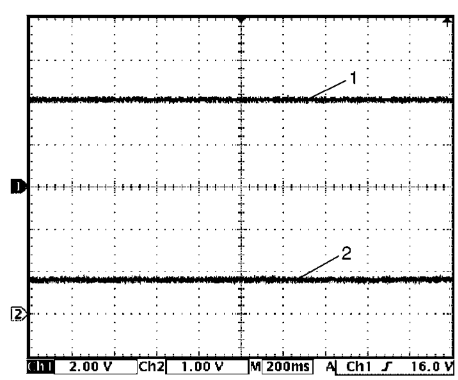
I4RS0B110069-

1.	ON signal
2.	OFF signal
3.	One duty cycle (Approx. 4 msec.)
4.	8 – 14 V

Reference waveform No.21

Manifold absolute pressure sensor signal (1) with ignition switch turned ON

Measurement terminal	CH1: “C37-53” to “C37-55” CH2: “C37-54” to “C37-55”
Oscilloscope setting	CH1: 2 V/DIV, CH2: 1 V/DIV TIME: 200 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Ignition switch turned ON



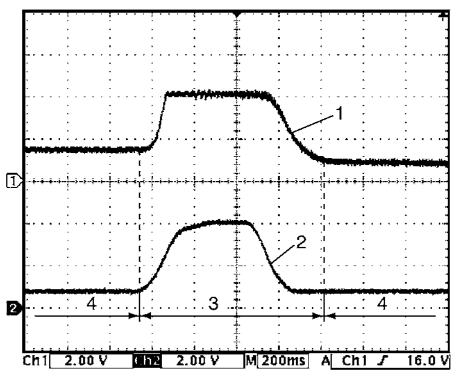
I4RS0B110070-

2.	Throttle position sensor signal

Reference waveform No.22

Manifold absolute pressure sensor signal (1) with engine racing

Measurement terminal	CH1: “C37-53” to “C37-55” CH2: “C37-54” to “C37-55”
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



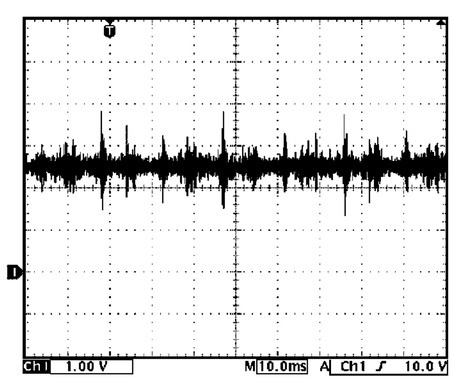
I4RS0B110071-

2.	Throttle position sensor signal
3.	Racing
4.	Idle

Reference waveform No.23

Knock sensor signal at engine speed 4000 r/min.

Measurement terminal	CH1: “C37-56” to “C37-58”
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.

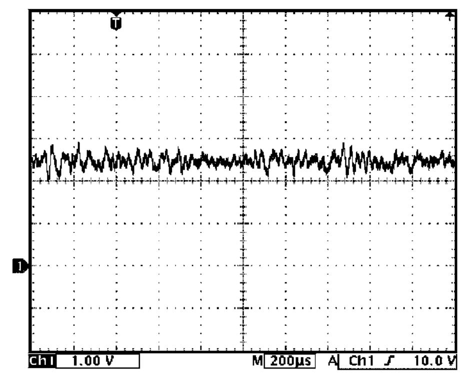


I4RS0B110072-

Reference waveform No.24

Knock sensor signal at engine speed 4000 r/min.

Measurement terminal	CH1: “C37-56” to “C37-58”
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.

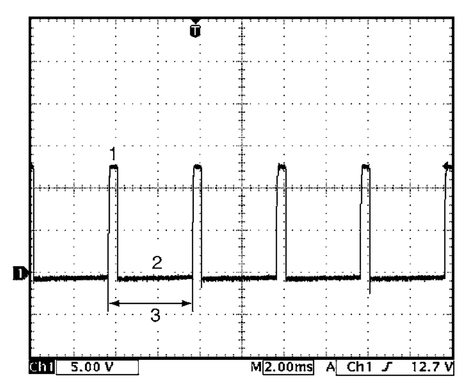


I4RS0B110073-

Reference waveform No.25

Oil control valve signal with engine idling (for M15 engine model)

Measurement terminal	CH1: “C37-60” to “C37-59”
Oscilloscope setting	CH1: 5 V/DIV TIME: 2 ms/DIV
Measurement condition	At the moment of the ignition switch turned on



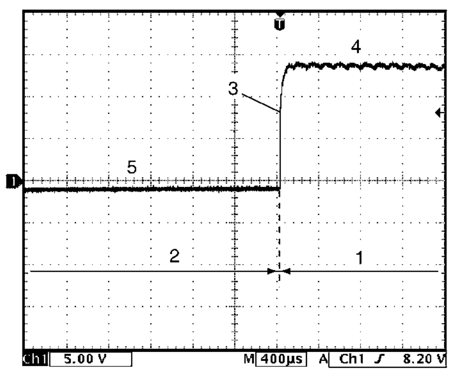
I4RS0B110074-

1.	ON signal
2.	OFF signal
3.	Only duty cycle

Reference waveform No.26

Oil control valve signal with engine racing (for M15 engine model)

Measurement terminal	CH1: “C37-60” to “C37-59”
Oscilloscope setting	CH1: 5 V/DIV TIME: 400 μs/DIV
Measurement condition	• After warmed up to normal operating temperature • Drive vehicle at 20 km/h (12 mph) and depress accelerator pedal fully



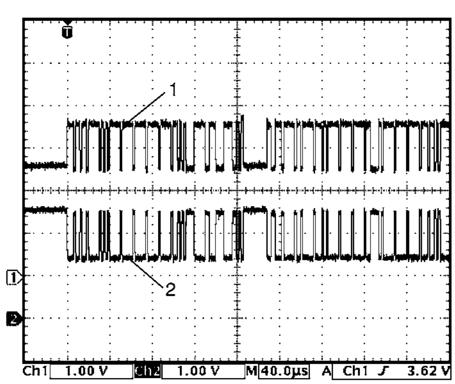
I4RS0B110075-

1.	Accelerator pedal depressed fully
2.	Accelerator pedal depressed partially
3.	Oil control valve signal
4.	ON signal
5.	OFF signal

Reference waveform No.27

CAN communication line signal from BCM with ignition switch turned ON

Measurement terminal	CH1: “E23-3” to “C37-58” CH2: “E23-18” to “C37-58”
Oscilloscope setting	CH1: 1 V/DIV, CH2: 1 V/DIV TIME: 40 μs/DIV
Measurement condition	Ignition switch turned ON (Signal pattern is depending on engine condition)



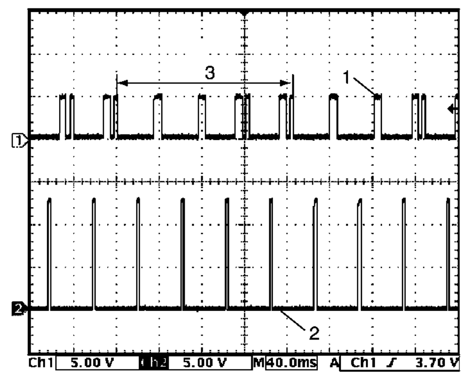
I4RS0B110076-

1.	CAN communication line signal (High)
2.	CAN communication line signal (Low)

Reference waveform No.28

Ignition pulse (engine revolution) signal (2) with engine idling

Measurement terminal	CH1: “C37-20” to “C37-58” CH2: “E23-4” to “C37-58”
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



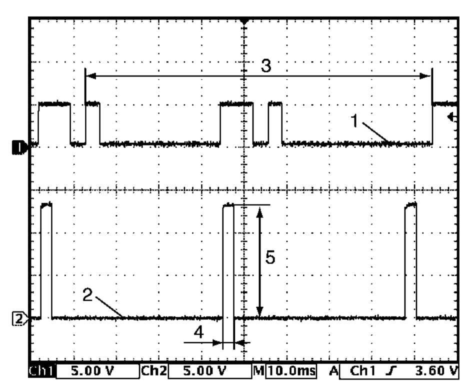
I4RS0A110096-

1.	Cylinder reference signal (CMP reference signal)
3.	720° crank angle

Reference waveform No.29

Ignition pulse (engine revolution) signal (2) with engine idling

Measurement terminal	CH1: “C37-20” to “C37-58” CH2: “E23-4” to “C37-58”
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



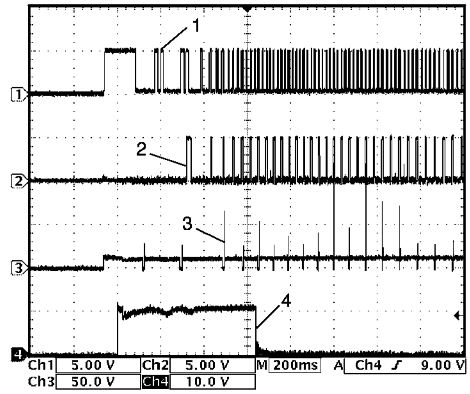
I4RS0A110097-

1.	Cylinder reference signal (CMP reference signal)
3.	360° crank angle
4.	2 to 4 msec.
5.	10 – 14 V

Reference waveform No.30

Ignition coil signal and fuel injector signal with engine cranking

Measurement terminal	CH1: "C37-20" to "C37-58" CH2: "C37-6" to "C37-58" CH3: "C37-1" to "C37-58" CH4: "C37-48" to "C37-58"
Oscilloscope setting	CH1: 5 V/DIV, CH2: 5 V/DIV CH3: 50 V/DIV, CH4: 10 V/DIV TIME: 200 ms/DIV
Measurement condition	• After warmed up to normal operating temperature • Engine at cranking



I4RS0A110098-

1.	Cylinder reference signal (CMP reference signal)
2.	Ignition coil No.1 and No.4 signal
3.	No.1 fuel injector signal
4.	Engine start signal

Resistance Check

1) Remove ECM from its bracket referring to "Engine Control Module (ECM) Removal and Installation: in Section 1C".

CAUTION:

Never touch terminals of ECM itself or connect voltmeter or ohmmeter (2).

2) Connect special tool to ECM connectors securely.

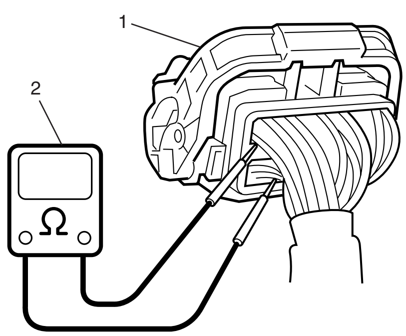
NOTE:

Do not connect the other connector of special tool to ECM.

3) Check resistance between each pair of terminals of disconnected connectors (1) 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 the following table represents that measured when parts temperature is 20 °C (68 °F).**



I4RS0A110086-

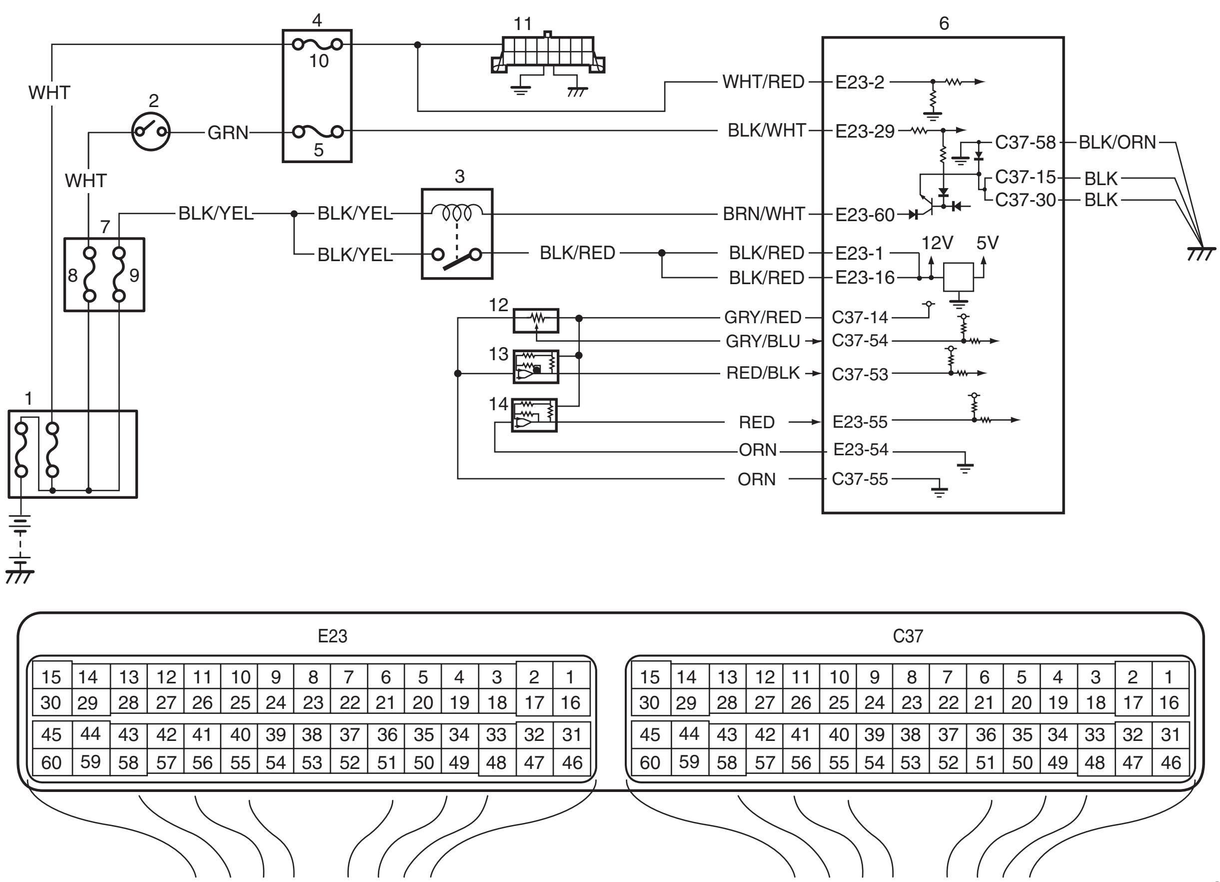
Terminals	Circuit	Standard resistance	Condition
C37-47 to E23-29	Heater of HO2S-2	4 – 15 Ω	—
E23-46 to E23-1/16	Radiator cooling fan relay No.1	160 – 240 Ω	—
E23-60 to E23-29	Main relay	160 – 240 Ω	Battery disconnected and ignition switch turned ON
E23-15 to E23-29	Fuel pump relay	160 – 240 Ω	—
C37-16 to E23-1/16	No.3 fuel injector	10.8 – 18.2 Ω	—
C37-17 to E23-1/16	No.4 fuel injector		

Terminals	Circuit	Standard resistance	Condition
C37-4 to E23-1/16	EGR valve (stepping motor No.1 coil)	20 – 31 Ω	—
C37-29 to E23-1/16	EVAP canister purge valve	28 – 35 Ω	—
C37-2 to E23-1/16	No.2 fuel injector	10.8 – 18.2 Ω	—
C37-3 to E23-1/16	EGR valve (stepping motor No.2 coil)	20 – 31 Ω	—
C37-18 to E23-1/16	EGR valve (stepping motor No.4 coil)		
C37-19 to E23-1/16	EGR valve (stepping motor No.3 coil)		
C37-46 to E23-29	Heater of HO2S-1	2 – 11 Ω	—
C37-1 to E23-1/16	No.1 fuel injector	10.8 – 18.2 Ω	—
E23-47 to E23-1/16	A/C compressor relay	160 – 240 Ω	—
C37-60 to C37-59	Oil control valve (for M15 engine model)	6 – 15 Ω	—
E23-45 to E23-1/16	Throttle actuator control relay (for AMT model)	160 – 240 Ω	—

ECM Power and Ground Circuit Check

S4RS0A1104066

Wiring Diagram



I4RS0A110099-

1. Main fuse box	5. “IG COIL” fuse	9. “FI” fuse	13. MAP sensor
2. Ignition switch	6. ECM	10. “RADIO” fuse	14. A/C refrigerant pressure sensor
3. Main relay	7. Relay box	11. DLC	
4. BCM (included in junction block assembly)	8. “IG ACC” fuse	12. TP sensor	

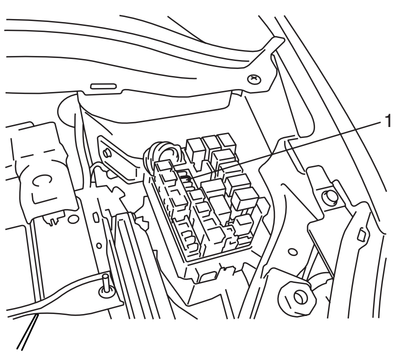
Circuit Description

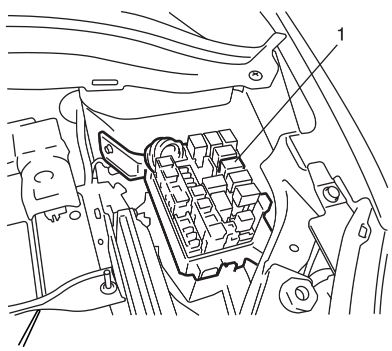
When the ignition switch is turned ON, the main relay turns ON (the contact point closes) and the main power is supplied to ECM.

Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**

Step	Action	Yes	No
1	**Circuit fuse check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Check for proper connection to ECM connector at "E23-2", "E23-29", "E23-60", "E23-1", "E23-16", "C37-58", "C37-15" and "C37-30" terminals. 3) If OK, check "RADIO" fuse and "IG COIL" fuse for blowing. *Are "RADIO" fuse and "IG COIL" fuse in good condition?*	Go to Step 2.	Replace fuse(s) and check for short in circuits connected to fuse(s).
2	**Power supply circuit check** 1) Measure voltage between "E23-2" terminal of ECM connector and body ground. *Is voltage 10 – 14 V?*	Go to Step 3.	"WHT/RED" or "WHT" wire is open circuit.
3	**Ignition signal check** 1) Turn ignition switch to ON position. 2) Measure voltage between "E23-29" terminal of ECM connector and body ground. *Is voltage 10 – 14 V?*	Go to Step 4.	"BLK/WHT" or "GRN" wire is open circuit.
4	**Main relay circuit check** 1) Turn ignition switch to OFF position. 2) Check "FI" fuse (1) (15 A) in relay box for blowing.  I4RS0A110016- 3) If OK, measure voltage between "E23-60" terminal of ECM connector and body ground. *Is voltage 10 – 14 V?*	Go to Step 5.	Go to Step 9.
5	**Main relay circuit check** 1) Connect connectors to ECM with ignition switch turned OFF. 2) Turn ignition switch to ON position. 3) Measure voltage between "E23-60" terminal of ECM connector and body ground. *Is voltage 0 – 1 V?*	Go to Step 7.	Go to Step 6.

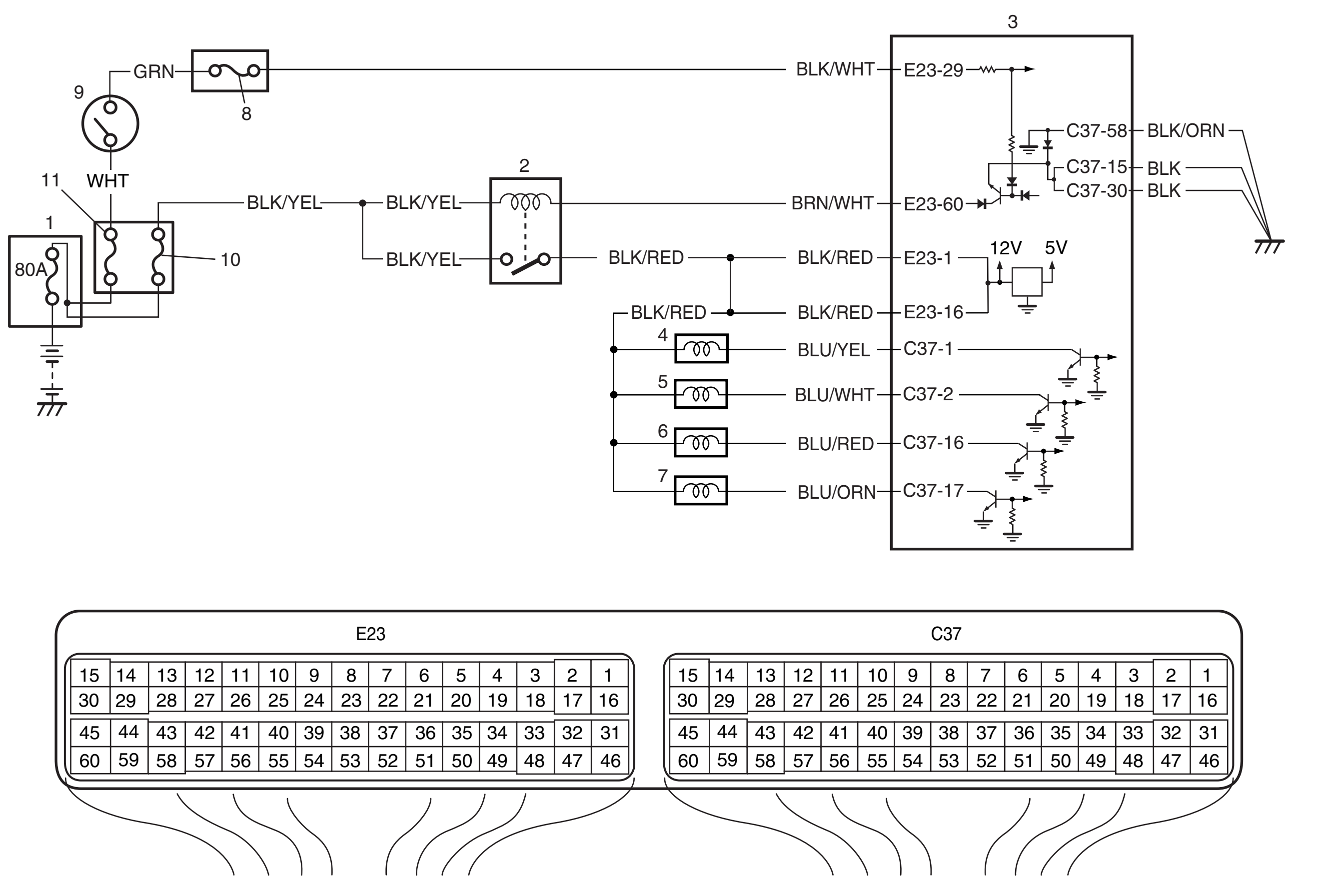
Step	Action	Yes	No
6	**ECM ground circuit check** 1) Turn ignition switch to OFF position. 2) Disconnect connectors from ECM. 3) Measure resistance between each “C37-58”, “C37-15” and “C37-30” terminals of ECM connector and body ground. *Is resistance 1 Ω or less?*	Substitute a known-good ECM and recheck.	“BLK/ORN” or “BLK” wire is open or high resistance circuit.
7	**Main relay circuit check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Using service wire, ground “E23-60” terminal of ECM connector and measure voltage between each “E23-1” and “E23-16” terminals of ECM connector and body ground. *Is voltage 10 – 14 V?*	Go to Step 11.	Go to Step 8.
8	**Main relay circuit check** 1) Remove main relay (1) from relay box.  I4RS0A110017- 2) Check for proper connection to main relay connector at “BLK/YEL” and “BLK/RED” wire terminals. 3) If OK, measure resistance between each “E23-1” and “E23-16” wire terminals of ECM connector and “BLK/RED” wire terminal of main relay connector. *Is resistance 1 Ω or less?*	Go to Step 9.	“BLK/RED” wire is open circuit or high resistance circuit.
9	**Main relay circuit check** 1) Remove main relay from relay box with ignition switch turned OFF. 2) Measure voltage between “BLK/YEL” wire terminal of main relay connector and body ground. *Is voltage 10 – 14 V?*	Go to Step 10.	“BLK/YEL” wire is open circuit.
10	**Main relay check** 1) Check main relay referring to “Main Relay, Fuel Pump Relay, Starting Motor Control Relay and Throttle Actuator Control Relay Inspection: in Section 1C”. *Is main relay in good condition?*	“BRN/WHT” wire is open or high resistance circuit.	Replace main relay.

Step	Action	Yes	No
11	**Sensor power source circuit check** 1) Connect connectors to ECM with ignition switch turned OFF. 2) Turn ON ignition switch, measure each voltage between “C37-14” terminal of ECM connector and vehicle body ground. *Is each voltage 4 – 6 V?*	ECM power and ground circuit is in good condition.	Go to Step 12.
12	**Sensor power source circuit check** 1) Disconnect connectors from ECM, TP sensor, MAP sensor, A/C refrigerant pressure sensor and accelerator pedal position (APP) sensor with ignition switch turned OFF. 2) Measure each resistance between “C37-14” terminal of ECM connector and vehicle body ground. *Is each resistance infinity?*	Check internal short circuit of TP sensor, MAP sensor and/or A/C refrigerant pressure sensor.	“GRY/RED” wire is shorted to ground circuit.

Fuel Injector Circuit Check

S4RS0A1104056

Wiring Diagram



I4RS0A110077-

1. Main fuse box	4. No.1 injector	7. No.4 injector	10. “FI” fuse
2. Main relay	5. No.2 injector	8. “IG COIL” fuse	11. “IG ACC” fuse
3. ECM	6. No.3 injector	9. Ignition switch	

Troubleshooting

NOTE:

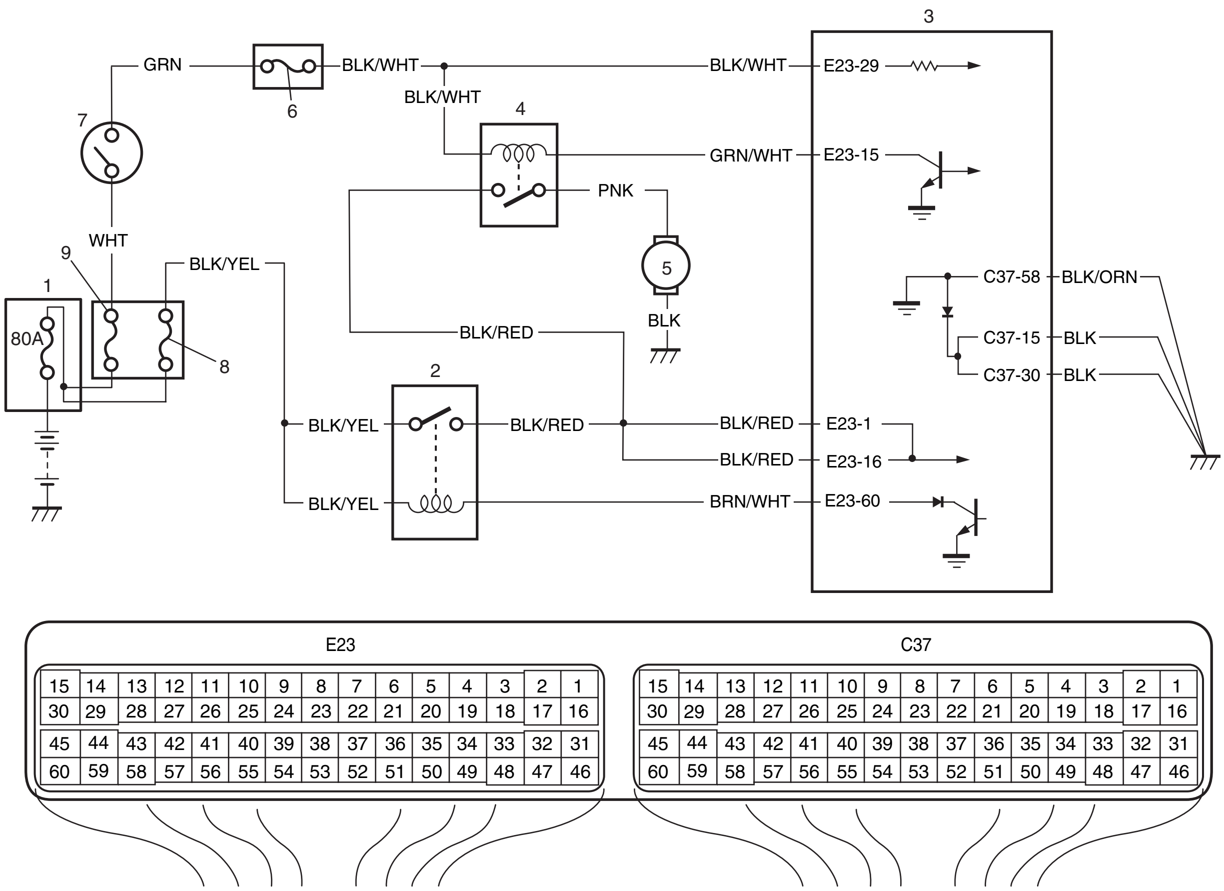
- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**

Step	Action	Yes	No
1	**Fuel injector check for operating sound** 1) Using sound scope, check each injector for operating sound at engine cranking. *Do all 4 injector make operating sound?*	Fuel injectors circuit is in good condition.	Go to Step 2.
2	**Fuel injector resistance check** 1) Disconnect connectors from fuel injectors with ignition switch turned 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 1G". *Are all injectors in good condition?*	Go to Step 3.	Faulty fuel injector.
3	**Fuel injector insulation resistance check** 1) Check that there is insulation between each fuel injector terminal and engine ground. *Is there insulation?*	Go to Step 4.	Faulty fuel injector.
4	**Fuel injector power supply check** 1) Measure voltage between each "BLK/RED" wire terminal of fuel injector connector and engine ground with ignition switch turned ON. *Is voltage 10 – 14 V?*	Go to Step 5.	"BLK/RED" wire is open or shorted to ground circuit. If it is in good condition, go to "ECM Power and Ground Circuit Check: ".
5	**Wire circuit check** 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 of fuel injector connector and vehicle body ground. *Is resistance infinity?*	Go to Step 6.	"BLU/YEL", "BLU/WHT", "BLU/RED" and/or "BLU/ORN" wire(s) are shorted to ground.
6	**Wire circuit check** 1) Measure voltage between each "BLU/YEL", "BLU/WHT", "BLU/RED", "BLU/ORN" wire terminal of fuel injector connector and vehicle body ground with ignition switch turned ON. *Is voltage 0 V?*	Go to Step 7.	"BLU/YEL", "BLU/WHT", "BLU/RED" and/or "BLU/ORN" wire(s) are shorted to power supply circuit.
7	**Fuel injector drive signal check** 1) Connect connectors to each fuel injector and ECM with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Measure voltage between each "C37-1", "C37-2", "C37-16", "C37-17" terminal of ECM connector and vehicle body ground. *Is voltage 10 – 14 V?*	Check fuel injector referring to "Fuel Injector Inspection: in Section 1G". If check result is satisfactory, substitute a known-good ECM and recheck.	"BLU/YEL", "BLU/WHT", "BLU/RED" and/or "BLU/ORN" wire(s) are open circuit.

Fuel Pump and Its Circuit Check

S4RS0A1104057

Wiring Diagram



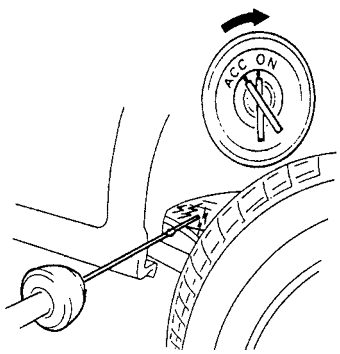
I4RS0A110078-

1. Main fuse box	4. Fuel pump relay	7. Ignition switch
2. Main relay	5. Fuel pump	8. “FI” fuse
3. ECM	6. “IG COIL” fuse	9. “IG ACC” fuse

Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**

Step	Action	Yes	No
1	**Fuel pump control system check for operation** *Is fuel pump heard to operate 3 sec. after ignition switch is turned ON?*  I2RH01110132-	Fuel pump circuit is in good condition.	Go to Step 2.
2	**Fuel pump relay power supply check** 1) Disconnect fuel pump relay from relay box with ignition switch turned OFF. 2) Check for proper connection to fuel pump relay at each terminal. 3) If OK, turn ON ignition switch, measure voltage between “BLK/WHT” wire terminal of fuel pump relay connector and engine ground. *Is voltage 10 – 14 V?*	Go to Step 3.	“BLK/WHT” wire is open or shorted to ground circuit.
3	**Fuel pump relay power supply check** 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 is open circuit.
4	**Fuel pump relay check** 1) Check fuel pump relay referring to “Main Relay, Fuel Pump Relay, Starting Motor Control Relay and Throttle Actuator Control Relay Inspection: in Section 1C”. *Is relay in good condition?*	Go to Step 5.	Faulty relay.
5	**Fuel pump relay drive signal check** 1) Connect fuel pump relay to relay box. 2) Connect voltmeter between “E23-15” terminal of ECM connector and vehicle body ground. 3) Measure voltage 3 second after ignition switch is turned ON. *Is voltage 10 – 14 V?*	Go to Step 6.	“GRN/WHT” wire is open circuit or shorted to ground circuit.
6	**Fuel pump relay drive signal check** 1) Measure voltage within 3 second after ignition switch is turned ON. *Is voltage 0 – 1 V?*	Go to Step 7.	Substitute a known-good ECM and recheck.

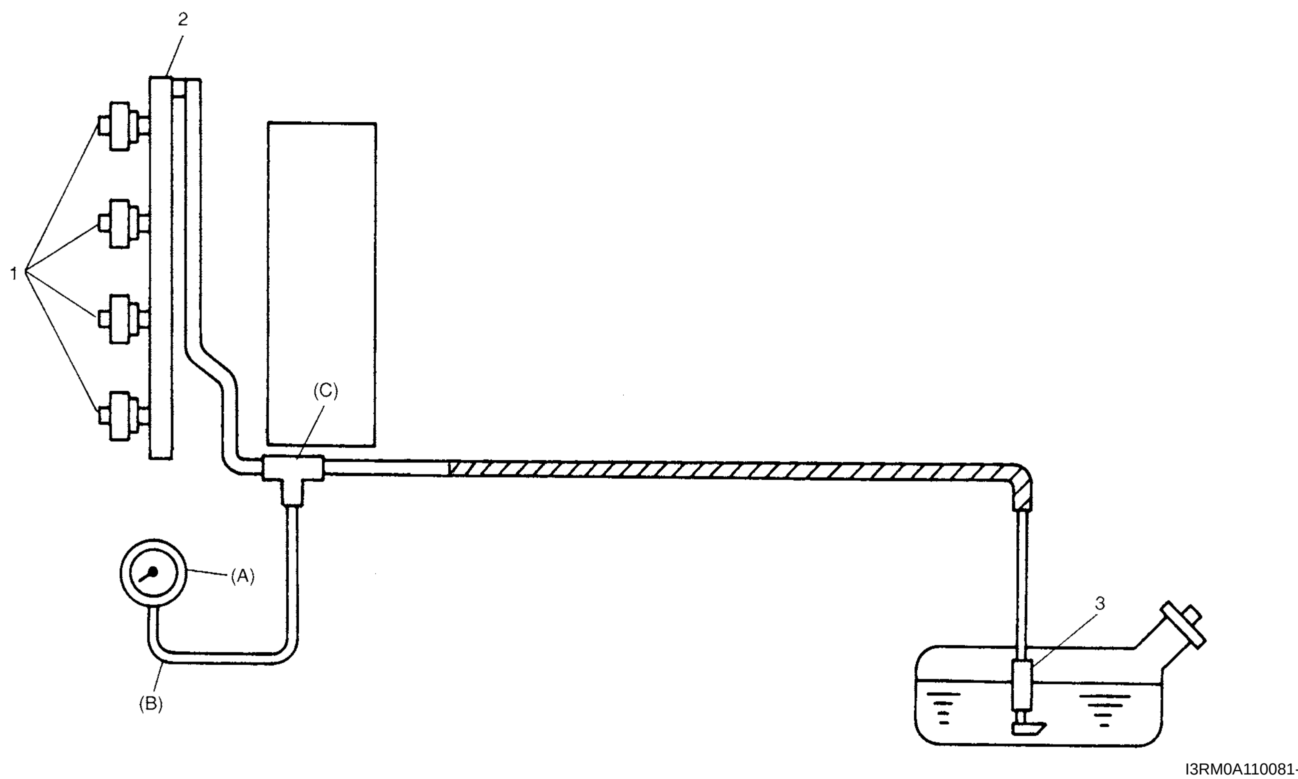
Step	Action	Yes	No
7	**Wire circuit check** 1) Turn OFF ignition switch. 2) Detach fuel tank referring to “Fuel Tank Removal and Installation: in Section 1G”. 3) Disconnect connector from fuel pump. 4) Measure resistance between “PNK” wire terminal of fuel pump connector and vehicle body ground. *Is resistance infinity?*	Go to Step 8.	“PNK” wire is shorted to ground.
8	**Fuel pump circuit check** 1) Turn OFF ignition switch. 2) Connect service wire between “E23-15” terminal of ECM connector 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 is open circuit.
9	**Fuel pump circuit check** 1) Turn OFF ignition switch. 2) Measure resistance between “BLK” wire terminal at fuel pump connector and vehicle body ground. *Is resistance less than 5 Ω?*	Faulty fuel pump.	“BLK” wire is open circuit.

Fuel Pressure Check

S4RS0A1104058

System Diagram

Special tool
(A): 09912–58442
(B): 09912–58432
(C): 09912–58490



1.	Injector
2.	Delivery pipe
3.	Fuel filter and fuel pump

Troubleshooting

NOTE:

Before using the following flow, 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.

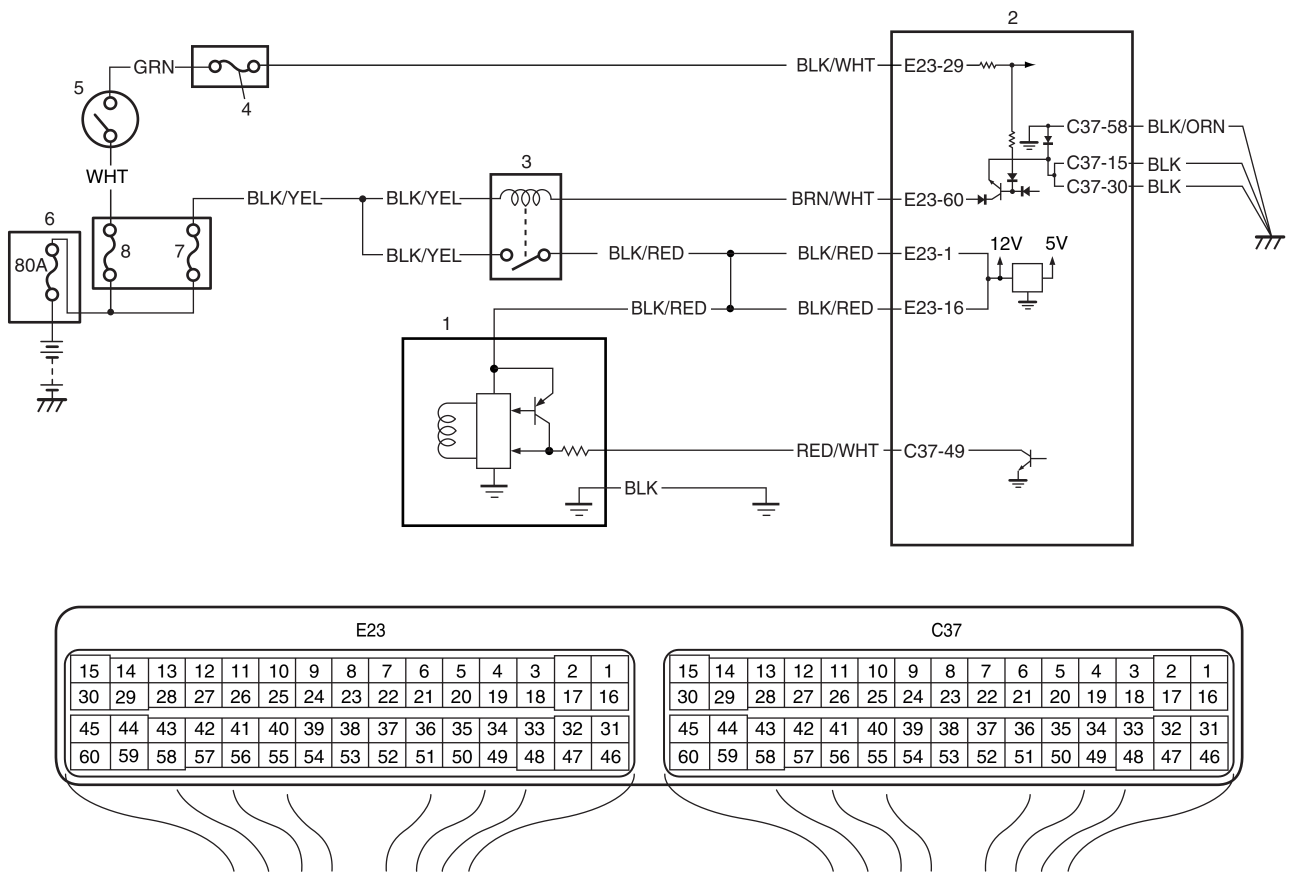
Step	Action	Yes	No
1	**Fuel pressure check** 1) Check fuel pressure referring to “Fuel Pressure Inspection: in Section 1G”. *Is check result satisfactory?*	Go to Step 2.	Go to Step 5.
2	**Fuel pressure check** 1) Start engine and warm it up to normal operating temperature. 2) Keep engine speed at 4000 rpm. *Does fuel pressure show about the same value 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 defective part.

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 damaged or deformed part.
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 damaged or deformed part.
7	**Fuel pump operating sound check** 1) Remove fuel filler cap and then turn ON ignition switch. *Can you hear operating 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 defective part.

Idle Air Control System Check

S4RS0A1104059

Wiring Diagram



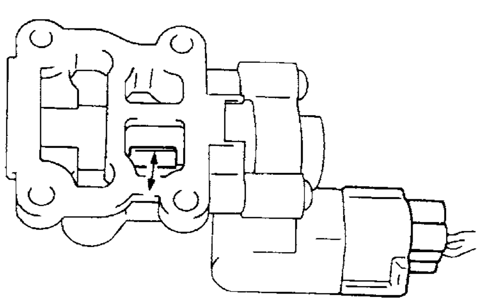
I4RS0A110079-

1. IAC valve	4. “IG COIL” fuse	7. “FI” fuse
2. ECM	5. Ignition switch	8. “IG ACC” fuse
3. Main relay	6. Main fuse box	

Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**

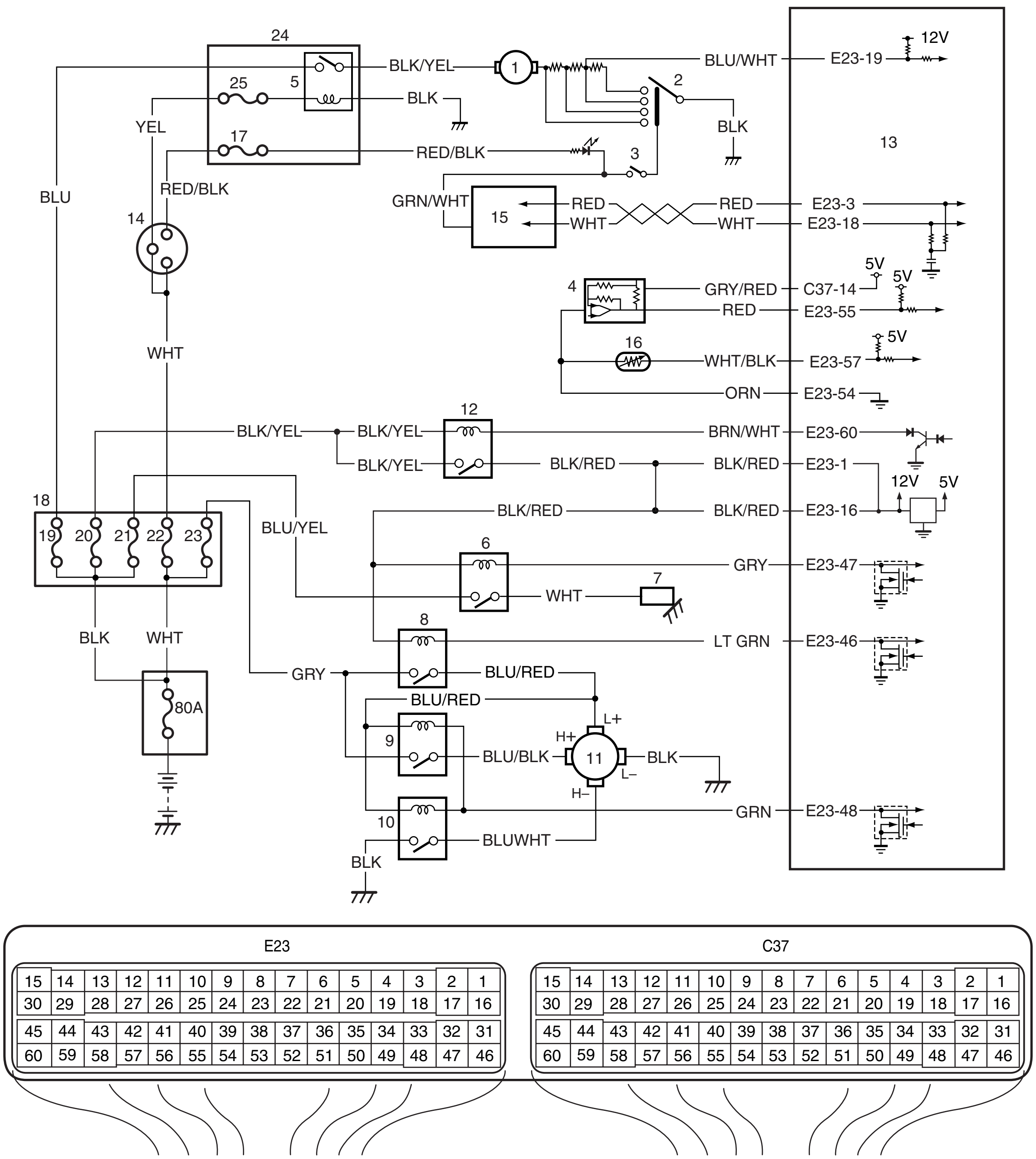
Step	Action	Yes	No
1	1) Check engine idle speed and IAC duty referring to “Idle Speed / Idle Air Control (IAC) Duty Inspection: ”. *Is idle speed within specification?*	Go to Step 2.	Go to Step 4.
2	*Is IAC duty within specification in Step 1?*	Go to Step 3.	Check for Vacuum leak, EVAP canister purge control system, Clog of IAC air passage, Accessory engine load, “Electric Load Signal Circuit Check: ”, Closed throttle position (TP sensor), Stuck of PCV valve.
3	*Is engine idle speed kept at specified speed even with headlight turned ON?*	System is in good condition.	Go to Step 7.
4	*Was idle speed higher than specification in Step 1?*	Go to Step 5.	Go to Step 7.
5	**A/C system circuit check** 1) Check A/C System circuit referring to Step 1 of “A/C System Circuits Check: ”. *Is it in good condition?*	Go to Step 6.	Repair or replace A/C system circuit or A/C system.
6	**ECT sensor check** 1) Check ECT sensor performance referring to “Engine Coolant Temperature (ECT) Sensor Inspection: in Section 1C”. *Is it in good condition?*	Go to Step 7.	Replace ECT sensor and recheck.
7	**Idle air control system check** 1) Remove IAC valve from throttle body referring to “Idle Air Control (IAC) Valve Removal and Installation: in Section 1C”. 2) Check IAC valve for operation referring to “Idle Air Control (IAC) Valve On-Vehicle Inspection: in Section 1C”.  I3RB0A110051- *Is check result satisfactory?*	Intermittent trouble or faulty ECM. Check for intermittent referring to “Intermittent and Poor Connection Inspection: in Section 00”.	Go to Step 8.

Step	Action	Yes	No
8	**Idle air control valve circuit check** 1) Check idle air control valve circuit referring to Step 4 to 10 of "DTC P0505: Idle Air Control System: ". *Is circuit in good condition?*	Replace IAC valve.	Repair IAC valve circuit.

A/C System Circuits Check

S4RS0A1104060

Wiring Diagram



I4RS0A110080-

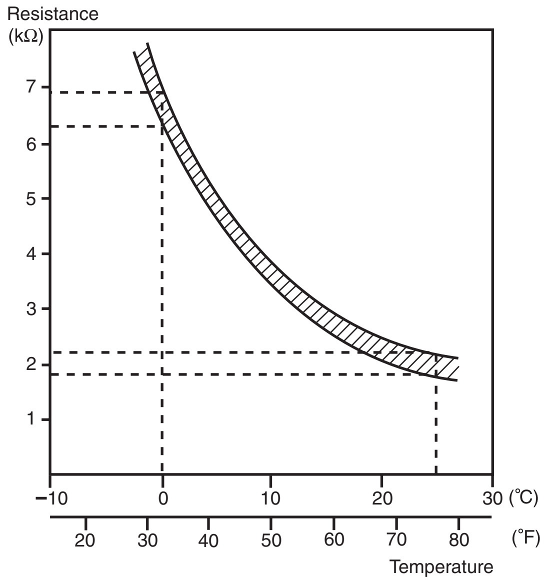
1. Blower fan motor	8. Radiator cooling fan motor relay No.1	15. BCM	22. "IG ACC" fuse
2. Blower fan switch	9. Radiator cooling fan motor relay No.2	16. Evaporator outlet air temp. sensor	23. "RDTR FAN" fuse
3. A/C switch	10. Radiator cooling fan motor relay No.3	17. "IG1 SIG" fuse	24. Junction block assembly
4. A/C refrigerant pressure sensor	11. Radiator cooling fan motor	18. Relay box	25. "IG2 SIG" fuse
5. Blower motor relay	12. Main relay	19. "HTR FAN" fuse	
6. Compressor relay	13. ECM	20. "FI" fuse	
7. A/C compressor	14. Ignition switch	21. "A/C COMP" fuse	

Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**

Step	Action	Yes	No
1	**Reception data check from BCM** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check DTC for reception data from BCM. *Is there DTC P1678?*	Go to applicable DTC diag. flow.	Go to Step 2.
2	**A/C switch signal circuit check** 1) Start engine and select "DATA LIST" mode on scan tool. 2) Check A/C switch signal under following conditions respectively. **A/C switch signal** **Engine running, A/C switch OFF: OFF** **Engine running, A/C switch ON and blower speed selector turned 1st position or more: ON** *Is check result satisfactory?*	Go to Step 3.	Check A/C switch circuit.
3	**DTC check of ECT sensor circuit** 1) Check ECM for DTC of ECT sensor circuit. *Is there DTC P0116, DTC P0117 or DTC P0118?*	Go to applicable DTC diag. flow.	Go to Step 4.
4	**Radiator cooling fan control system check** *Is radiator cooling fan started when A/C and blower speed selector switch are turned ON with engine running?*	Go to Step 10.	Go to Step 5.
5	**Radiator cooling fan control circuit check** 1) Check DTC with scan tool. *Is DTC P0480 displayed?*	Go to "DTC P0480: Fan 1 (Radiator Cooling Fan) Control Circuit: ".	Go to Step 6.

Step	Action	Yes	No
6	**A/C evaporator outlet air temp. sensor check** 1) Disconnect connectors from ECM with ignition switch turned OFF. 2) Check for proper connection to "E23-57" and "E23-54" wire terminals of ECM connector. 3) If OK, measure resistance between "E23-57" and "E23-54" wire terminals of ECM connector. **Evaporator temp. sensor resistance** **At 0 °C: 6.3 – 6.9 kΩ** **At 25 °C: 1.8 – 2.2 kΩ**  I3RB0A110053- *Is resistance within specification?*	Go to Step 7.	Faulty A/C evaporator outlet air temp. sensor or its circuit.
7	**DTC check of A/C refrigerant pressure sensor circuit** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Turn ON ignition switch. 3) Check ECM for DTC of A/C refrigerant pressure sensor circuit. *Is there DTC P0532 or DTC P0533?*	Go to applicable DTC diag. flow.	Go to Step 8.
8	**A/C refrigerant pressure sensor voltage check** 1) Check A/C refrigerant pressure sensor voltage referring to "Inspection of ECM and Its Circuits: ". *Is voltage within specified value?*	Go to Step 9.	Check amount of refrigerant. If OK, replace A/C refrigerant pressure sensor.
9	**Radiator cooling fan check** 1) Check radiator cooling fan referring to "Radiator Cooling Fan Motor On-Vehicle Inspection: in Section 1F". *Is check result satisfactory?*	Radiator cooling fan drive circuit malfunction. If circuit is OK, go to Step 6.	Replace radiator cooling fan motor.
10	**A/C compressor control system check** *Is A/C compressor started when A/C and blower speed selector switch are turned ON with engine running?*	A/C system is in good condition.	Go to Step 11.

Step	Action	Yes	No
11	**A/C compressor relay circuit check** 1) Measure voltage between “E23-47” wire terminal of ECM connector and vehicle body ground under following conditions respectively. **<u>Voltage between “E23-47” terminal of ECM connector and ground</u>** **While engine running and A/C switch turned OFF: 10 – 14 V** **While engine running, A/C and blower speed selector switch turned ON: 0 – 1 V** *Is check result satisfactory?*	Go to Step 12.	Go to Step 13.
12	**A/C compressor relay check** 1) Check A/C compressor relay referring to “Compressor Relay Inspection: in Section 7B”. *Is it in good condition?*	A/C compressor drive circuit malfunction.	Replace A/C compressor relay.
13	**A/C compressor relay circuit check** 1) Remove A/C compressor relay with ignition switch turned OFF. 2) Turn ON ignition switch, measure voltage between “BLK/RED” wire terminal of A/C compressor relay connector and vehicle body ground. *Is voltage 10 –14 V?*	Go to Step 14.	“BLK/RED” wire open circuit.
14	**A/C compressor relay check** 1) Check A/C compressor relay referring to “Compressor Relay Inspection: in Section 7B”. *Is it in good condition?*	“GRY” wire open circuit. If OK, substitute a known-good ECM and recheck.	Replace A/C compressor relay.

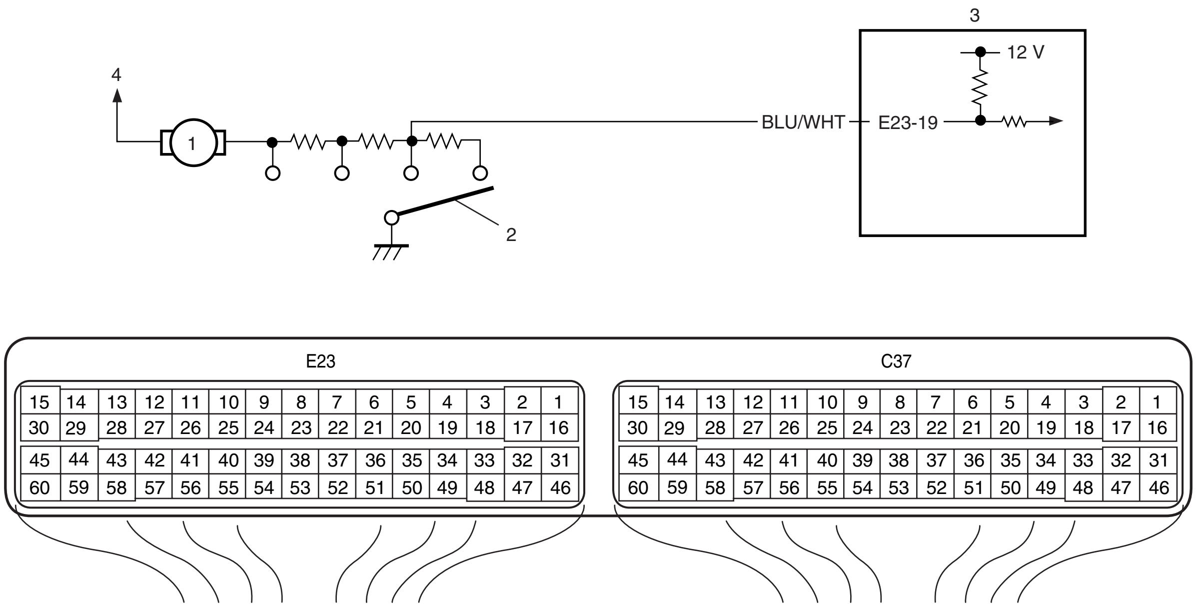
NOTE:

When A/C evaporator outlet air temp. is below 2.5 °C (36.5 °F), A/C remains OFF (“E23-47” terminal voltage becomes 10 – 14 V). This condition is not abnormal.

Electric Load Signal Circuit Check

S4RS0A1104061

Wiring Diagram



I4RS0A110081-

1. Blower fan motor	3. ECM
2. Blower fan switch	4. To blower motor relay

Troubleshooting

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**

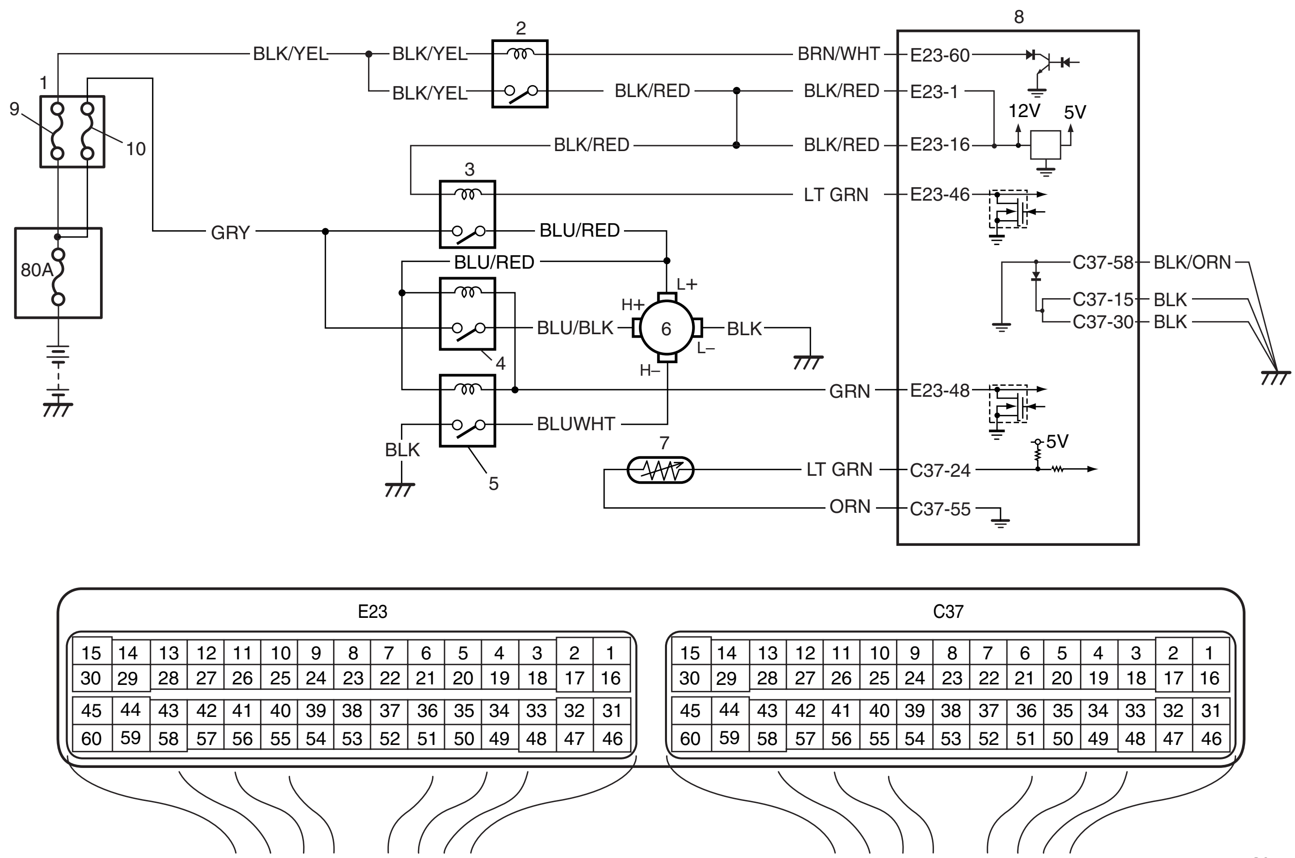
Step	Action	Yes	No
1	*Do you have SUZUKI scan tool?*	Go to Step 2.	Go to Step 3.
2	**Electric load signal circuit check** 1) Connect SUZUKI scan tool to DLC with ignition switch turned OFF. 2) Start engine and select “DATA LIST” mode on scan tool. 3) Check electric load signal under following conditions respectively. <u>**Electric load signal**</u> **Ignition switch turned ON, blower speed selector turned OFF or 1st position: OFF** **Ignition switch turned ON, blower speed selector turned to 2nd position or more: ON** *Is check result satisfactory?*	Electric load signal circuit is in good condition.	“BLU/WHT” wire is open circuit or short circuit, or blower circuit malfunction.

Step	Action	Yes	No
3	**Electric load signal circuit check** 1) Turn ON ignition switch. 2) Check voltage at terminal “E23-19” of ECM connector connected, under following conditions respectively. **<u>Voltage at “E23-19”</u>** **Ignition switch turned ON, blower speed selector turned OFF or 1st position: 10 – 14 V** **Ignition switch turned ON, blower speed selector turned to 2nd position or more: 0 V** *Is each voltage as specified?*	Electric load signal circuit is in good condition.	“BLU/WHT” wire is open circuit or short circuit, or electric load circuit malfunction.

Radiator cooling fan Low Speed Control System Check

S4RS0A1104062

Wiring Diagram



I4RS0A110082-

1. Relay box	5. Radiator cooling fan relay No. 3	9. “FI” fuse
2. Main relay	6. Radiator cooling fan motor	10. “RDTR FAN” fuse
3. Radiator cooling fan relay No. 1	7. ECT sensor	
4. Radiator cooling fan relay No. 2	8. ECM	

Troubleshooting

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 at the "ON" position.

NOTE:

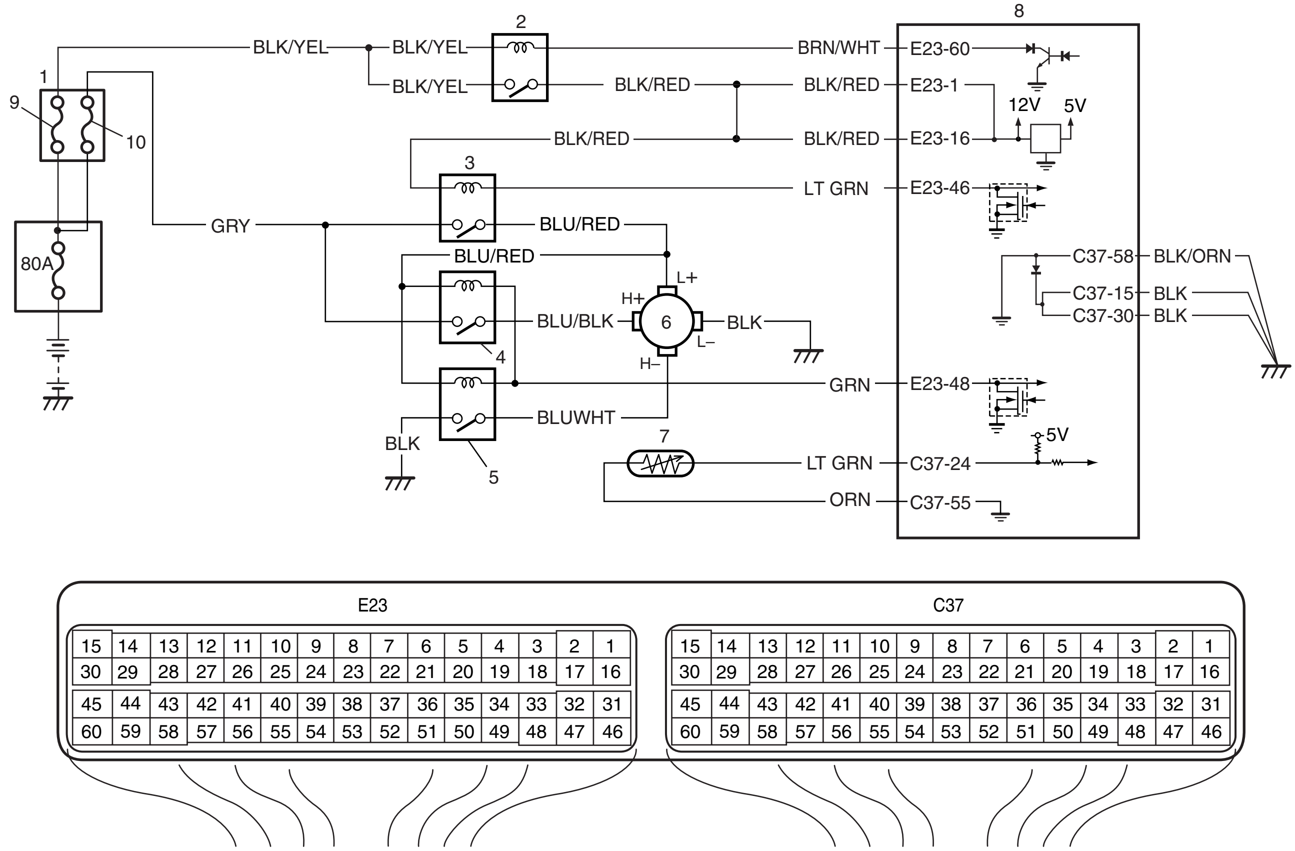
- **Before performed trouble shooting, be sure to read the "Precautions of ECM Circuit Inspection: ".**
- **When measuring circuit voltage, resistance and/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to "Inspection of ECM and Its Circuits: ".**

Step	Action	Yes	No
1	*Is there DTC(s) of ECT sensor circuit (DTC P0116 / P0117 / P0118) and/or radiator cooling fan circuit (DTC P0480)?*	Go to corresponding DTC flow.	Go to Step 2.
2	**Low speed radiator cooling fan control circuit check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Start engine and select "DATA LIST" mode on scan tool. 3) Warm up engine until coolant temp. is 97.5 °C, 207.5 °F or higher and A/C switch turns OFF. (If engine coolant temp. dose not rise, check engine cooling system or ECT sensor.) *Is radiator cooling fan started at low speed when engine coolant temp. reached above temp.?*	Radiator cooling fan low speed control system is in good condition.	Perform from Step 2 to Step 8 in DTC P0480 diag. flow. If OK, Go to Step 3.
3	**Radiator cooling fan control check** 1) Disconnect radiator cooling fan control relays No. 2, and No. 3 from relays box with ignition switch turned OFF. 2) Run engine when ECT is over 97.5 °C, 207.5 °F. 3) Measure voltage between vehicle body ground and "BLU/RED" wire terminal of disconnected radiator cooling fan motor connector. *Is voltage 10 – 14 V?*	Go to Step 4.	"BLU/RED" wire is open or high resistance circuit.
4	**Check radiator cooling fan wire circuit check** 1) Turn ignition switch to OFF position. 2) Measure resistance between "BLK" wire terminal of disconnected radiator cooling fan motor connector and vehicle body ground. *Is resistance below 1 Ω?*	Go to Step 5.	"BLK" wire is open or high resistance circuit.
5	**Radiator cooling fan check** 1) Check radiator cooling fan referring to "Radiator Cooling Fan Motor On-Vehicle Inspection: in Section 1F". *Is it in good condition?*	Substitute a known-good ECM and recheck.	Faulty radiator cooling fan.

Radiator cooling fan High Speed Control System Check

S4RS0A1104084

Wiring Diagram



I4RS0A110082-

1. Relay box	5. Radiator cooling fan relay No. 3	9. “FI” fuse
2. Main relay	6. Radiator cooling fan motor	10. “RDTR FAN” fuse
3. Radiator cooling fan relay No. 1	7. ECT sensor	
4. Radiator cooling fan relay No. 2	8. ECM	

Troubleshooting

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 at the “ON” position.

NOTE:

- **Before performed trouble shooting, be sure to read the “Precautions of ECM Circuit Inspection: ”.**
- **When measuring circuit voltage, resistance d/or pulse signal at ECM connector, connect the special tool to ECM and/or the ECM connectors referring to “Inspection of ECM and Its Circuits: ”.**

Step	Action	Yes	No
1	*Is there DTC(s) of ECT sensor circuit (DTC P0116 / P0117 / P0118) and/or radiator cooling fan circuit (DTC P0480)?*	Go to corresponding DTC flow.	Go to Step 2.
2	**Low speed radiator cooling fan control circuit check** 1) Connect scan tool to DLC with ignition switch turned OFF. 2) Start engine and select "DATA LIST" mode on scan tool. 3) Warm up engine until coolant temp. is 97.5 °C, 207.5 °F or higher and A/C switch turns OFF. (If engine coolant temp. dose not rise, check engine cooling system or ECT sensor.) *Is radiator cooling fan started at low speed when engine coolant temp. reached above temp.?*	Go to Step 3.	Perform from Step 2 to Step 5 in "Radiator cooling fan Low Speed Control System Check: ".
3	**High speed radiator cooling fan control circuit check** 1) Start engine and select "DATA LIST" mode on scan tool. 2) Warm up engine until coolant temp. is 102.5 °C, 216.5 °F or higher and A/C switch turns OFF. (If engine coolant temp. dose not rise, check engine cooling system or ECT sensor.) *Is radiator cooling fan started at high speed when engine coolant temp. reached above temp?*	Radiator cooling fan control system is in good condition.	Perform from Step 9 to Step 14 in DTC P0480 diag. flow. If OK, Go to Step 4.
4	**Radiator cooling fan control No. 2 and No. 3 check** 1) Run engine when ECT is over 102.5 °C, 216.5 °F. 2) Measure voltage between vehicle body ground and "E23-48" terminal of ECM connector. *Is voltage lower than 1.5 V?*	Go to Step 5.	Faulty ECM.
5	**Radiator cooling fan No. 2 wire circuit check** 1) Remove radiator cooling fan control relay No.2 with ignition switch turned OFF. 2) Measure voltage between "GRY" wire terminal of disconnected radiator cooling fan control relay No. 2 connector and vehicle body ground. *Is voltage 10 – 14 V?*	Go to Step 6.	"GRY" wire is open or high resistance circuit.
6	**Radiator cooling fan No. 2 wire circuit check** 1) Disconnect connector from radiator cooling fan motor with ignition switch turned OFF. 2) Measure resistance between "BLU/BLK" wire terminal of disconnected radiator cooling fan control relay No. 2 connector and vehicle body ground. *Is resistance infinity?*	Go to Step 7.	"BLU/BLK" wire is shorted to ground circuit.
7	**Radiator cooling fan No. 2 wire circuit check** 1) Turn ON ignition switch. 2) Measure voltage between "BLU/BLK" wire terminal of disconnected radiator cooling fan control relay No. 2 connector and vehicle body ground. *Is voltage 0 V?*	Go to Step 8.	"BLU/BLK" wire is shorted to power supply circuit.

Step	Action	Yes	No
8	**Radiator cooling fan control No. 2 check** 1) Connect radiator cooling fan control relay No. 2 to relay box with ignition switch turned OFF. 2) Run engine when ECT is over 102.5 °C, 216.5 °F. 3) Measure voltage between vehicle body ground and "BLU/BLK" wire terminal of disconnected radiator cooling fan motor connector. *Is voltage 10 – 14 V?*	Go to Step 10.	Go to Step 9.
9	**Radiator cooling fan control relay No.2 check** 1) Remove radiator cooling fan control relay No.2 with ignition switch turned OFF. 2) Check radiator cooling fan control relay No.2 referring to "Radiator Cooling Fan Relay Inspection: in Section 1F" *Is it in good condition?*	"BLU/BLK" wire is open or high resistance circuit.	Faulty radiator cooling fan control relay No.2.
10	**Radiator cooling fan No. 3 wire circuit check** 1) Remove radiator cooling fan control relay No.3 with ignition switch turned OFF. 2) Measure resistance between vehicle body ground and "BLK" wire terminal of disconnected radiator cooling fan control relay No. 3 connector in relay box. *Is resistance below 1 Ω?*	Go to Step 11.	"BLK" wire is open or high resistance circuit.
11	**Radiator cooling fan control No. 3 check** 1) Connect radiator cooling fan control relay No. 3 to relay box with ignition switch turned OFF. 2) Run engine when ECT is over 102.5 °C, 216.5 °F. 3) Measure resistance between vehicle body ground and "BLU/WHT" wire terminal of disconnected radiator cooling fan motor connector. *Is resistance below 2 Ω?*	Go to Step 13.	Go to Step 12.
12	**Radiator cooling fan control relay No. 3 check** 1) Remove radiator cooling fan control relay No.3 with ignition switch turned OFF. 2) Check radiator cooling fan control relay No.3 referring to "Radiator Cooling Fan Relay Inspection: in Section 1F" *Is it in good condition?*	"BLU/WHT" wire is open or high resistance circuit.	Faulty radiator cooling fan control relay No.3.
13	**Radiator cooling fan check** 1) Check radiator cooling fan referring to "Radiator Cooling Fan Motor On-Vehicle Inspection: in Section 1F". *Is it in good condition?*	Substitute a known-good ECM and recheck.	Faulty radiator cooling fan.

Repair Instructions

Idle Speed / Idle Air Control (IAC) Duty Inspection

S4RS0A1106001

Before idle speed / IAC duty check, make sure of the following.

- Lead wires and hoses of electronic fuel injection and engine and 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 drawn in from air intake system.

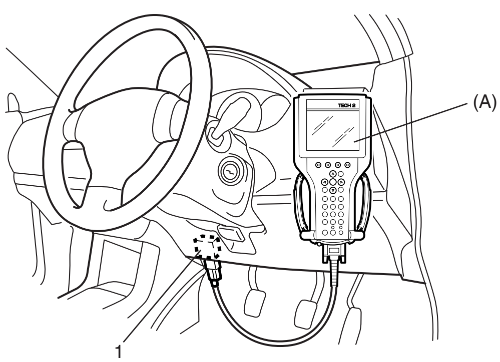
After all items are confirmed, check idle speed and IAC duty as follows.

NOTE:

Before starting engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T vehicle), and set parking brake and block drive wheels.

1) Connect SUZUKI scan tool to DLC (1) with ignition switch turned OFF.

Special tool
(A): SUZUKI scan tool



I4RS0A110013-

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 specification, inspect idle air control system referring to "Idle Air Control System Check: ".

Engine idle speed and IAC duty

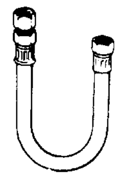
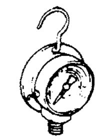
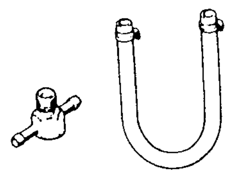
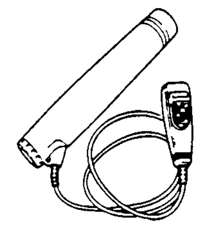
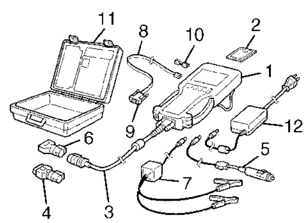
	A/C OFF	A/C ON
M/T vehicle	**700 ± 50 rpm 10 – 55%**	**850 ± 50 rpm**
A/T vehicle at P/N range	**750 ± 50 rpm 10 – 55%**	**850 ± 50 rpm**

5) Check that specified engine idle speed is obtained with A/C turned ON if vehicle is equipped with A/C. If not, check A/C system circuit and idle air control system.

Special Tools and Equipment

Special Tool

S4RS0A1108001

09912–58432 Fuel pressure gauge hose This tool is included in fuel pressure gauge set (09912-58413). ☞ 	09912–58442 Fuel pressure gauge This tool is included in fuel pressure gauge set (09912-58413). ☞ 
09912–58490 3-way joint & hose ☞ 	09930–76420 Timing-light (dry cell type) ☞ 
SUZUKI scan tool — This kit includes 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 loop back connector, 11. Storage case, 12. Power supply ☞ / ☞ 	

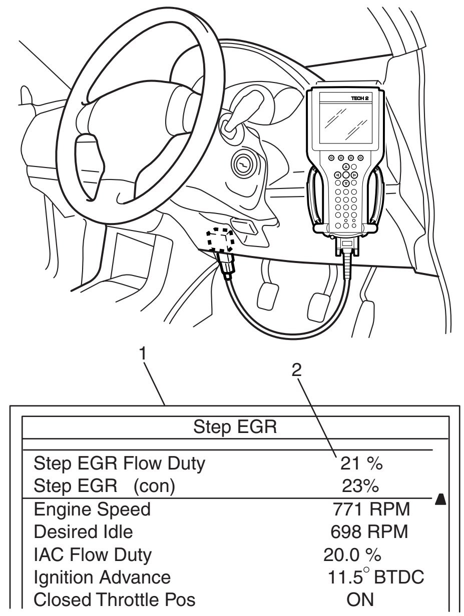
Aux. Emission Control Devices

Diagnostic Information and Procedures

EGR System Inspection

S4RS0A1204001

1) Connect SUZUKI scan tool to data link connector (DLC) with ignition switch turned OFF.
2) Turn ON ignition switch and erase DTC using "CLEAR DTC" in "TROUBLE CODES" menu.
3) Start engine and warm it up to normal operating temperature then select "DATA LIST" mode on scan tool.
4) Make sure that vehicle condition is as follows.
   - 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 by using "STEP EGR" mode in "MISC TEST" menu. In this state, as EGR valve opening increases engine idle speed drops. If not, possible cause is clogged EGR gas passage, stuck or faulty EGR valve.



I4RS0A120001-

1.	SUZUKI scan tool display
2.	EGR valve opening (0: Close, 100: Full open)

Repair Instructions

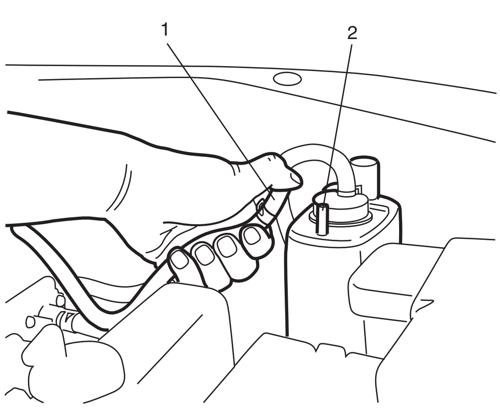
EVAP Canister Purge Inspection

S4RS0A1206001

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.



I4RS0A120002-

EVAP Canister Purge Valve and Its Circuit Inspection

S4RS0A1206002

WARNING:

Do not apply vacuum by mouth; otherwise harmful fuel vapor can be breathed in.

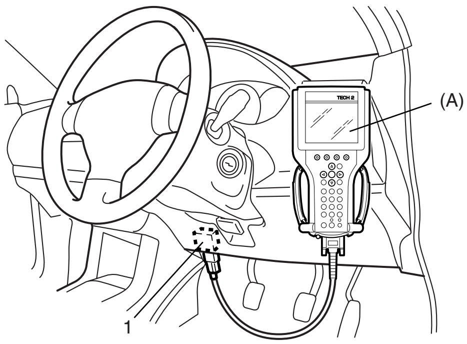
CAUTION:

Do not apply vacuum more than –86 kPa (–12.47 psi); otherwise EVAP canister purge valve could be damaged.

1) Prepare to operate EVAP canister purge valve as follows.
   a) When using SUZUKI scan tool:
      i) Connect SUZUKI scan tool to DLC (1) with ignition switch turned OFF and disconnect purge valve vacuum hoses from intake manifold and EVAP canister.

ii) Turn ON ignition switch, clear DTC and select "MISC TEST" mode on SUZUKI scan tool.

Special tool
(A): SUZUKI scan tool



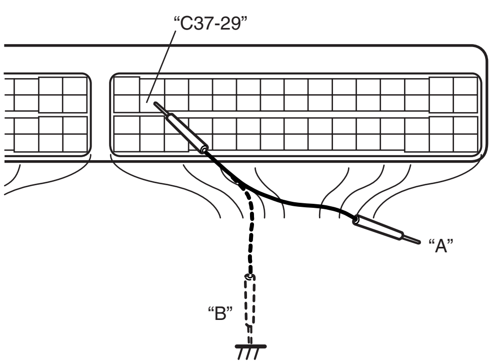
I4RS0A120003-

b) When not using SUZUKI scan tool:

NOTE:

Before performed this check, be sure to read the "Precautions of ECM Circuit Inspection: in Section 1A".

i) Disconnect purge valve vacuum hoses from intake manifold and EVAP canister.
ii) Remove ECM from its bracket with ECM connectors connected referring to "Engine Control Module (ECM) Removal and Installation: in Section 1C".
iii) Connect special tool between ECM and ECM connector referring to "Inspection of ECM and Its Circuits: in Section 1A".
iv) Turn ON ignition switch.
Using service wire, ground "C37-29" terminal circuit of special tool (valve ON: "B") and unground it (valve OFF: "A").

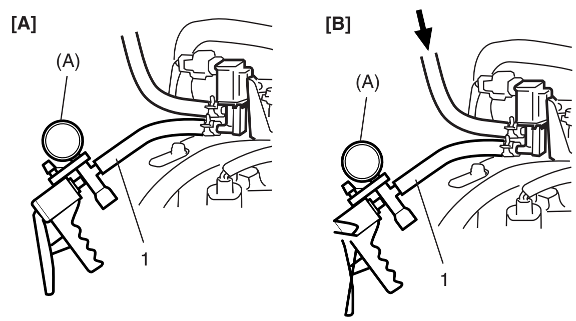


I4RS0A120004-

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 satisfactory, check vacuum hoses, EVAP canister purge valve, wire harness and connections.

<u>EVAP canister purge valve specification</u>
[A] Valve OFF: When vacuum (–60 kPa (–8.7 psi)) 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): 09917–47011

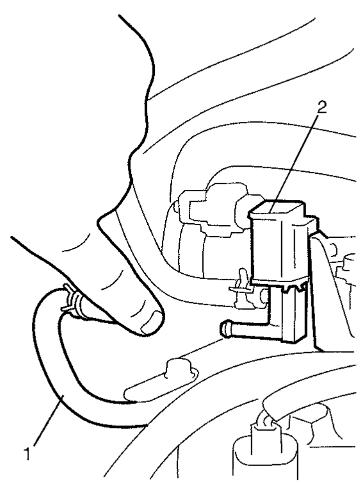


I3RB0A120005-

Vacuum Passage Inspection

S4RS0A1206003

Start engine and run it at idle speed. Disconnect vacuum hose (1) from EVAP canister purge valve (2). With finger placed against disconnected hose, check that vacuum is applied.
If it is not applied, clean vacuum passage by blowing compressed air.

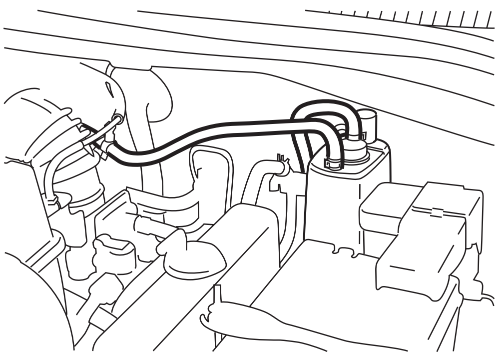


I3RM0A120006-

Vacuum Hose Inspection

S4RS0A1206004

Check hoses for connection, leakage, clog and deterioration.
Replace as necessary.



I4RS0A120005-

EVAP Canister Purge Valve Inspection

S4RS0A1206005

WARNING:

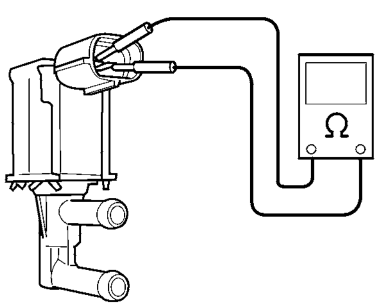
Do not apply vacuum by mouth; otherwise harmful fuel vapor can be breathed in.

CAUTION:

Do not apply vacuum more than –86 kPa (–12.47 psi); otherwise EVAP canister purge valve could be damaged.

1) With ignition switch turned OFF, disconnect coupler and vacuum hoses 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 purge valve.

   EVAP canister resistance
   30 – 34 Ω at 20 °C (68 °F)



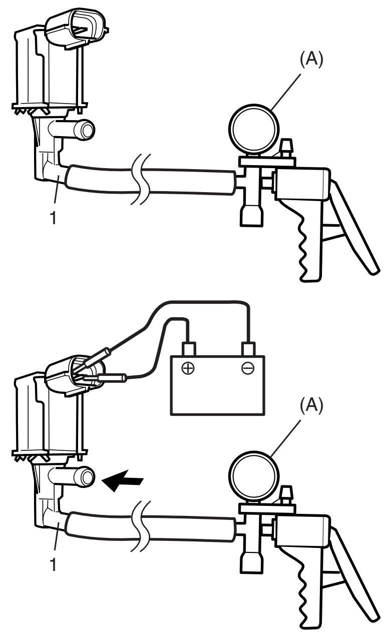
I3RM0A120008-

4) With coupler disconnected, apply vacuum (–60 kPa (–8.7 psi)) to pipe (1). If vacuum can be applied, go to next step. If vacuum can not be applied, replace EVAP canister purge valve.
5) In this state, connect 12 V-battery to EVAP canister purge valve terminals. 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 is harmful.

Special tool
(A): 09917–47011



I3RB0A120007-

6) Install EVAP canister purge valve to air cleaner assembly.

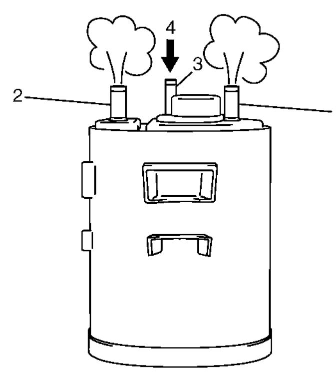
EVAP Canister Inspection

S4RS0A1206006

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 is 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 this inspection, replace EVAP canister.



I4RS0A120006-

EGR Valve Removal and Installation

S4RS0A1206007

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 the following.

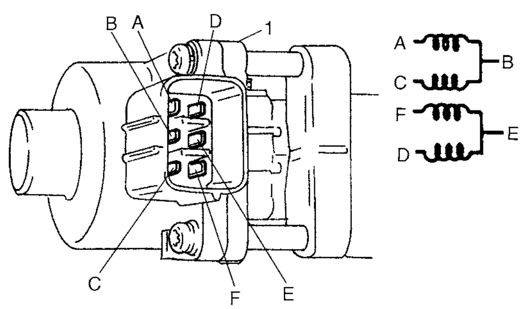
- Clean mating surface of valve and cylinder head.
- Use new gaskets.

EGR Valve Inspection

S4RS0A1206008

1) Check resistance between following terminals of EGR valve (1) in each pair.
   If found faulty, replace EGR valve assembly.

   EGR valve resistance (A – B, C – B, F – E, D – E terminal)
   20 – 24 Ω



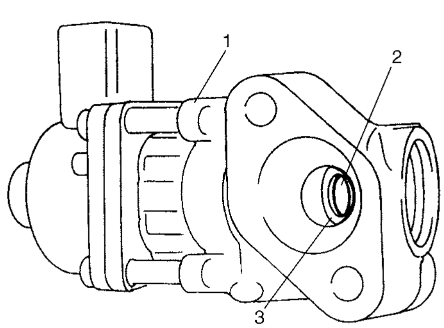
I2RH0B120005-

2) Remove carbon from EGR valve gas passage.

CAUTION:

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.



I2RH0B120006-

PCV Hose Inspection

S4RS0A1206009

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.

Check hoses for connection, leakage, clog and deterioration.
Replace as necessary.

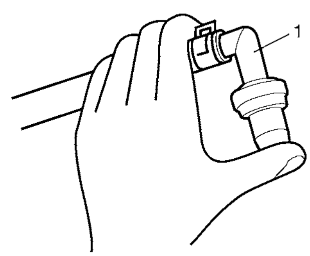
PCV Valve Inspection

S4RS0A1206010

NOTE:

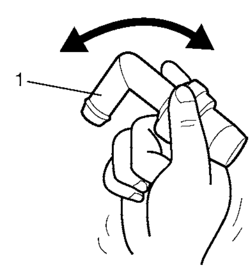
Be sure to check that there is no obstruction in PCV valve or its hoses before checking IAC duty, for obstructed PCV valve or hose hampers its accurate adjustment.

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.



I2RH0B120007-

6) After checking vacuum, stop engine and remove PCV valve (1).
   Shake valve and listen for rattle of check needle inside the valve. If valve does not rattle, replace it.



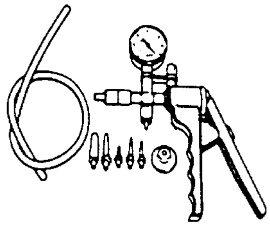
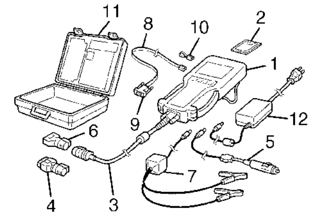
I2RH0B120008-

7) After checking, remove plug and install PCV valve.
8) Install air cleaner assembly securely.

Special Tools and Equipment

Special Tool

S4RS0A1208001

09917–47011 Vacuum pump gauge ☞ / ☞ 	SUZUKI scan tool — This kit includes 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 loop back connector, 11. Storage case, 12. Power supply ☞ 

Engine Electrical Devices

Repair Instructions

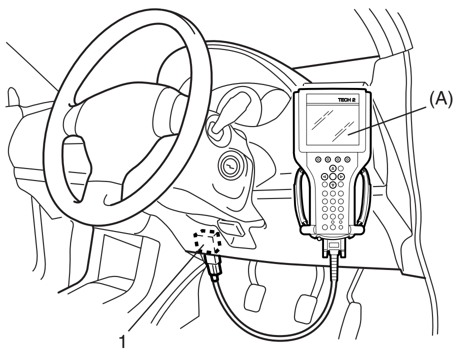
Idle Air Control (IAC) Valve Operation Inspection

S4RS0A1306001

Using SUZUKI scan tool

1) Connect SUZUKI scan tool to DLC (1) with ignition switch turned OFF.

   Special tool
   (A): SUZUKI scan tool



I4RS0A130001-

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.

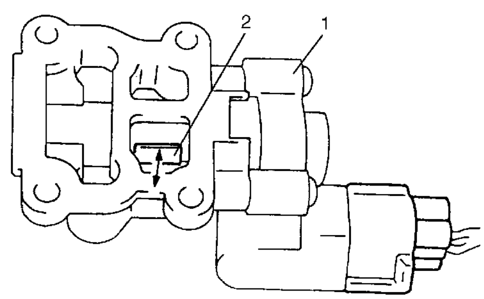
Idle Air Control (IAC) Valve On-Vehicle Inspection

S4RS0A1306002

1) Remove IAC valve referring to “Idle Air Control (IAC) Valve Removal and Installation: ”.
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.



I2RH0B130002-

4) Install IAC valve referring to “Idle Air Control (IAC) Valve Removal and Installation: ”.

Idle Air Control (IAC) Valve Removal and Installation

S4RS0A1306003

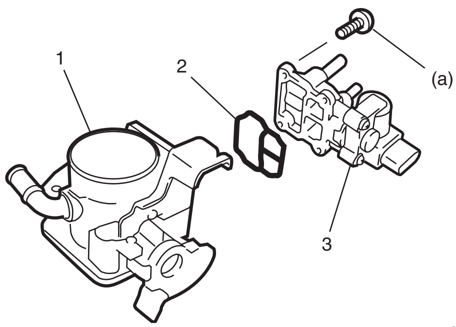
Removal

1) Remove throttle body referring to “Throttle Body Removal and Installation: in Section 1D”.
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.
   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)



I3RB0A130001-

3) Install throttle body referring to “Throttle Body Removal and Installation: in Section 1D”.

Engine Control Module (ECM) Removal and Installation

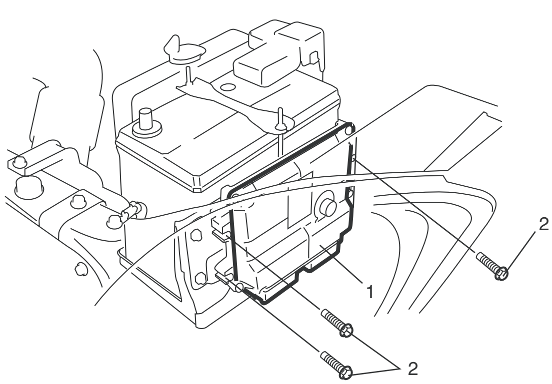
S4RS0A1306004

CAUTION:

As ECM consists of precision parts, be careful not to expose it to excessive shock.

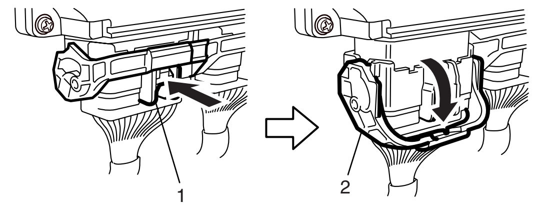
Removal

1) Disconnect negative cable at battery.
2) Remove ECM (1) from its bracket by removing its mounting bolts (2).



I4RS0A130002-

3) Disconnect connectors from ECM as follows.
   a) Push lock (1) to release locking of lock lever (2).
   b) Turn lock lever to arrow direction until it stops.

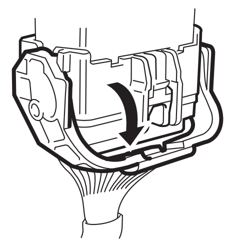


I4RS0A130003-

Installation

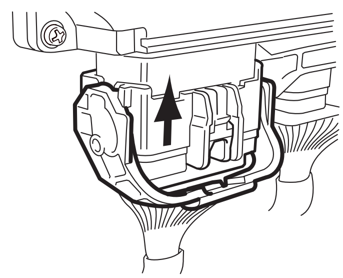
Reverse removal procedure noting the following:

- Connect connectors to ECM as follows.
  a. Make sure that lock lever of ECM connector is unlock position.



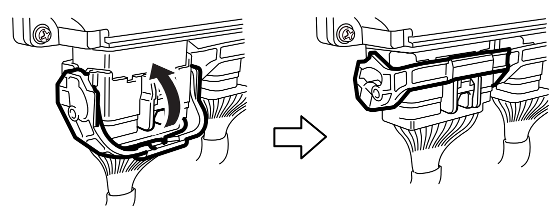
I4RS0B130021-

  b. Insert ECM connectors to ECM until it stops with unlocked lock lever.



I4RS0B130022-

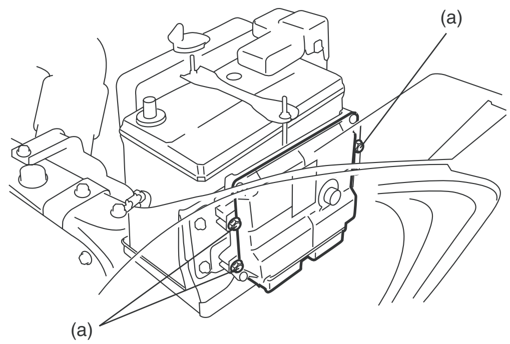
  c. Lock ECM connectors securely by pulling its lock lever up.



I4RS0A130004-

- Tighten ECM mounting bolts to specified torque.

  Tightening torque
  ECM mounting bolt (a): 8 N·m (0.8 kg-m, 6.0 lb-ft)



I4RS0A130005-

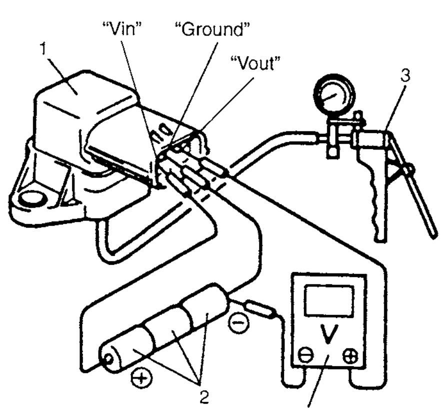
Manifold Absolute Pressure (MAP) Sensor Inspection

S4RS0A1306005

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

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 – 2000	0 – 610	760 – 707	100 – 94	3.3 – 4.3
2001 – 5000	611 – 1524	Under 707 over 634	94 – 85	3.0 – 4.1
5001 – 8000	1525 – 2438	Under 634 over 567	85 – 76	2.7 – 3.7
8001 – 10000	2439 – 3048	Under 567 over 526	76 – 70	2.5 – 3.3



I3RM0A130005-

5) Install MAP sensor securely.
6) Connect MAP sensor connector securely.
7) Install air cleaner assembly.

Throttle Position (TP) Sensor On-Vehicle Inspection

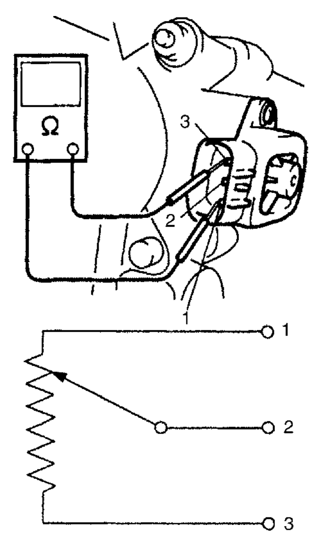
S4RS0A1306006

1) Disconnect negative cable at battery.
2) Disconnect TP sensor connector.
3) Using ohmmeter, check resistance between terminals under each condition.
If check result is not satisfactory, replace TP sensor.

TP sensor resistance
Between terminals “1” and “3”: 4.0 – 6.0 kΩ
Between terminals “2” and “3”: 20 Ω – 6.0 kΩ, varying according to throttle valve opening

NOTE:

There should be more than 2 kΩ resistance difference between when throttle valve is at idle position and when it is fully open.



I3RB0A130003-

1.	Reference voltage terminal
2.	Output voltage terminal
3.	Ground terminal

4) Connect TP sensor connector securely.
5) Connect negative cable to battery.

Throttle Position (TP) Sensor Removal and Installation

S4RS0A1306007

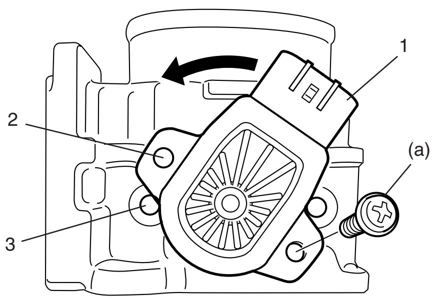
Removal

1) Disconnect negative cable at battery.
2) 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 the figure and turn TP sensor counterclockwise so that those holes align.

   Tightening torque
   TP sensor screw (a): 2.5 N·m (0.25 kg-m, 1.8 lb-ft)



I3RB0A130004-

2) Connect connector to TP sensor securely.
3) Connect negative cable to battery.

Engine Coolant Temperature (ECT) Sensor Removal and Installation

S4RS0A1306008

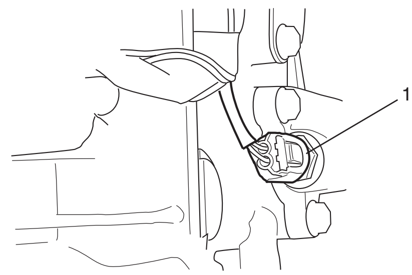
Removal

1) Disconnect negative cable at battery.
2) Drain coolant referring to “Cooling System Draining: in Section 1F”.

   WARNING:

   To 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 (1).



I2RH0B130008-

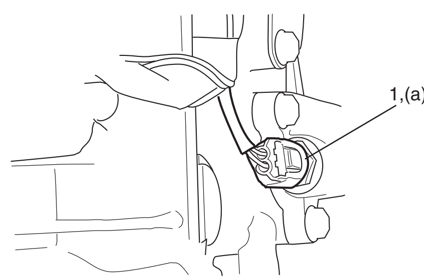
5) Remove ECT sensor from thermostat case.

Installation

Reverse removal procedure noting the following.

- Clean mating surfaces of ECT sensor and thermostat case.
- Check O-ring for damage and replace, if necessary.
- Tighten ECT sensor (1) to specified torque.

  Tightening torque
  ECT sensor (a): 15 N·m (1.5 kg-m, 11.0 lb-ft)



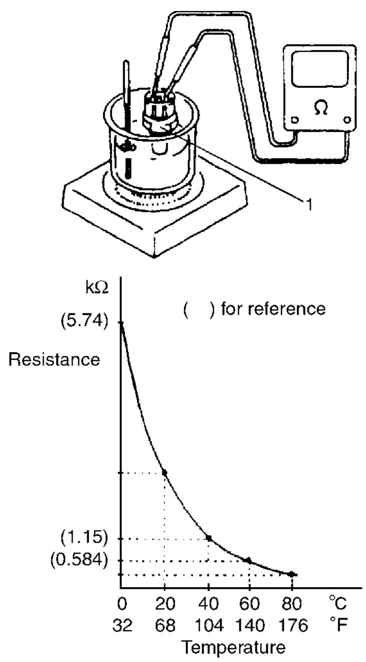
I2RH0B130009-

- Connect connector to ECT sensor securely.
- Refill coolant referring to “Cooling System Flush and Refill: in Section 1F”.

Engine Coolant Temperature (ECT) Sensor Inspection

S4RS0A1306009

Immerse temperature sensing part of ECT sensor (1) in water (or ice) and measure resistance between sensor terminals while heating water gradually.
If measured resistance doesn't show such characteristic as shown, replace ECT sensor.



I3RB0A130005-

Heated Oxygen Sensor (HO2S-1 and HO2S-2) Heater On-Vehicle Inspection

S4RS0A1306010

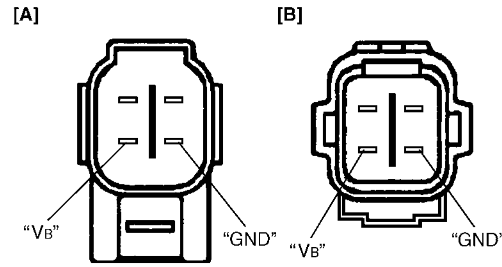
1) Disconnect sensor connector.
2) Using ohmmeter, measure resistance between terminals "V_B" and "GND" of sensor connector.
   If found faulty, replace oxygen sensor.

NOTE:

Temperature of sensor affects resistance value largely. Make sure that sensor heater is at correct temperature.

<u>Resistance of oxygen sensor heater</u>
HO2S-1: 5.0 – 6.4 Ω at 20 °C (68 °F)
HO2S-2: 11.7 – 14.5 Ω at 20 °C (68 °F)

Viewed from terminal side



I4RS0A130006-

[A]:	HO2S-1
[B]:	HO2S-2

3) Connect sensor connector securely.

Heated Oxygen Sensor (HO2S-1 and HO2S-2) Removal and Installation

S4RS0A1306011

Removal

WARNING:

To avoid danger of being burned, do not touch exhaust system when system is hot. Oxygen sensor removal should be performed when system is cool.

1) Disconnect negative cable at battery.
2) Disconnect connector of heated oxygen sensor and release its wire harness from clamps.
3) Perform following items before removing heated oxygen sensor.
   a) For HO2S-1, remove exhaust manifold referring to "Exhaust Manifold Removal and Installation: in Section 1K", if necessary.
   b) For HO2S-2, hoist vehicle.
4) Remove heated oxygen sensor (1) from exhaust pipe or exhaust manifold.

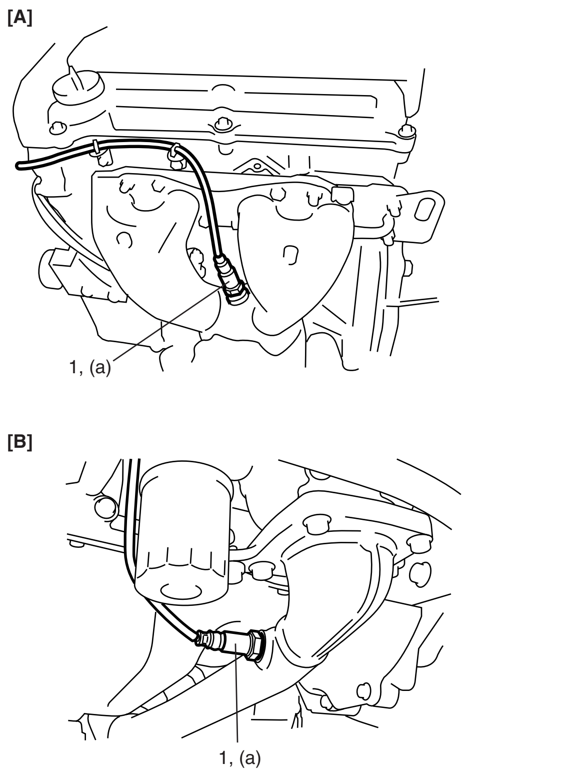
Installation

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)

- Install exhaust manifold referring to "Exhaust Manifold Removal and Installation: in Section 1K", if removed.
- Connect connector of heated oxygen sensor (1) and clamp wire harness securely.
- After installing heated oxygen sensor, start engine and check that no exhaust gas leakage exists.



I3RM0A130007-

[A]:	HO2S-1
[B]:	HO2S-2

Camshaft Position (CMP) Sensor Removal and Installation

S4RS0A1306013

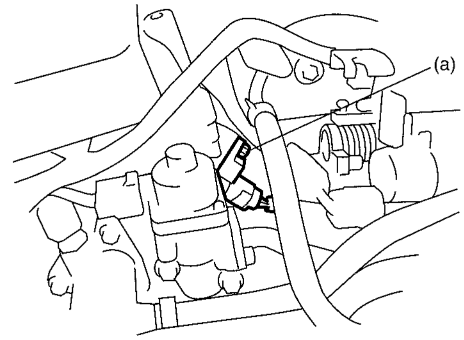
Removal

1) Disconnect negative cable at battery.
2) Disconnect connector from CMP sensor.
3) Remove camshaft position sensor from cylinder head.

Installation

1) Install camshaft position sensor to cylinder head.

   Tightening torque
   CMP sensor bolt (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)



I4RS0A130013-

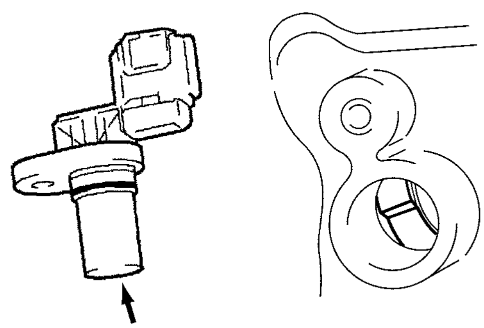
2) Connect connector to CMP sensor securely.
3) Connect negative cable to battery.

Camshaft Position (CMP) Sensor Inspection

S4RS0A1306014

Visual check

- Check that O-ring is free from damage.
- Check that end face of sensor and signal rotor tooth are free from any metal particles and damage.



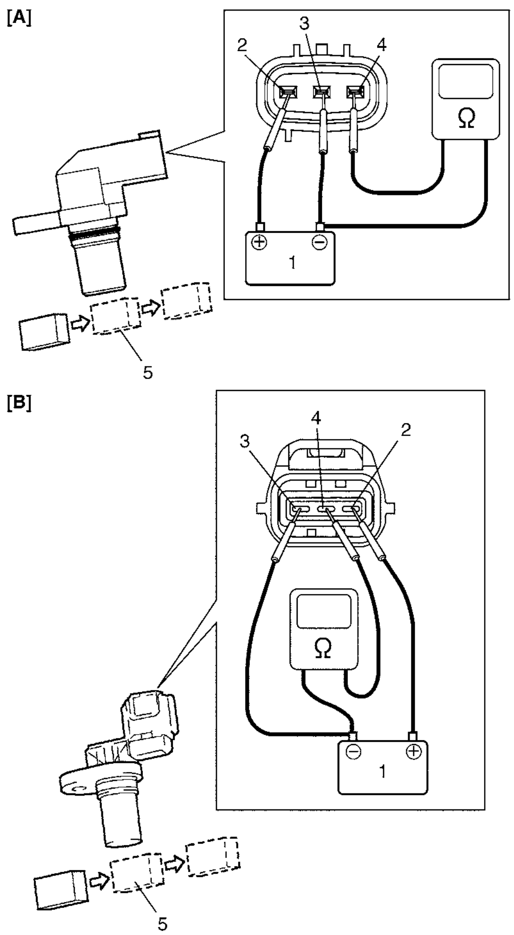
I4RS0B130015-

Performance check

1) Remove metal particles on end face of CMP sensor, if any.
2) Arrange 12 V battery (1) and connect its positive terminal to "Vin" terminal (2) and negative terminal to "Ground" terminal (3) of sensor. Then using ohmmeter, measure resistance between "Vout" terminal (4) of sensor and negative terminal of battery by passing magnetic substance (iron) (5) while keeping approximately 1 mm (0.03 in.) gap with respect to end face of CMP sensor.
   If resistance does not vary as specified below, replace CMP sensor.

<u>CMP sensor resistance</u>

Resistance varies from less than 220 Ω (ON) to infinity (OFF) or from infinity (OFF) to less than 220 Ω (ON)



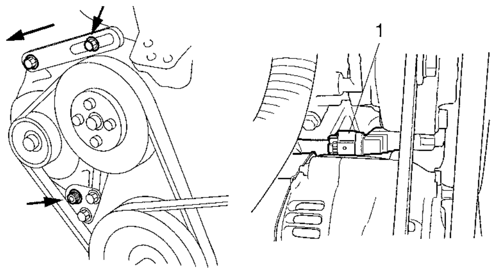
I4RS0B130016-

Crankshaft Position (CKP) Sensor Removal and Installation

S4RS0A1306015

Removal

1) Disconnect negative cable at battery.
2) Remove generator drive belt, loosen pivot bolt and move generator rearward.
3) Disconnect connector from crankshaft position sensor.
4) Remove crankshaft position sensor (1) from cylinder block.

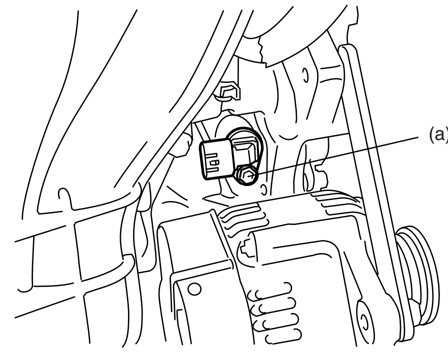


I2RH0B130012-

Installation

1) Install crankshaft position sensor to cylinder block. Tighten CKP sensor bolt to specified torque.

Tightening torque
CKP sensor bolt (a): 10 N·m (1.0 kg-m, 7.5 lb-ft)



I4RS0A130007-

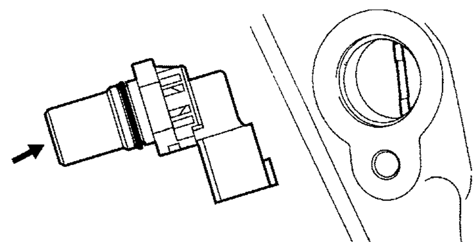
2) Connect connector to CKP sensor securely.
3) Adjust generator drive belt tension referring to “Water Pump / Generator Drive Belt Tension Inspection and Adjustment: in Section 1F”.
4) Connect negative cable to battery.

Crankshaft Position (CKP) Sensor Inspection

S4RS0A1306023

Visual check

- Check that O-ring is free from damage.
- Check that end face of sensor and signal pulley tooth are free from any metal particles and damage.

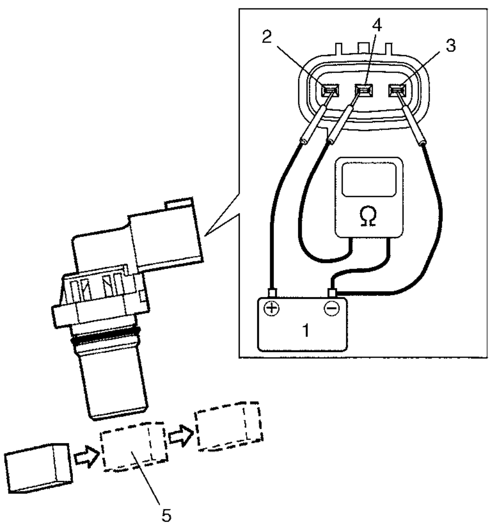


I3RB0A130006-

Performance check

1) Remove metal particles on end face of CKP sensor, if any.
2) Arrange 12 V battery (1) and connect its positive terminal to “Vin” terminal (2) and negative terminal to “Ground” terminal (3) of sensor. Then using ohmmeter, measure resistance between “Vout” terminal (4) of sensor and negative terminal of battery by passing magnetic substance (iron) (5) while keeping approximately 1 mm (0.03 in.) gap with respect to end face of CKP sensor.
If resistance does not vary as specified below, replace CKP sensor.

CKP sensor resistance
Resistance varies from less than 220 Ω (ON) to infinity (OFF) or from infinity (OFF) to less than 220 Ω (ON)



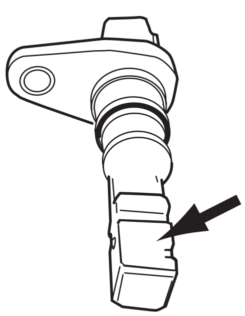
I4RS0B130017-

Vehicle Speed Sensor (VSS) Inspection (M/T model)

S4RS0A1306016

Visual check

- Check that O-ring is free from damage
- Check that end face of sensor and signal rotor tooth are free from any metal particles and damage.

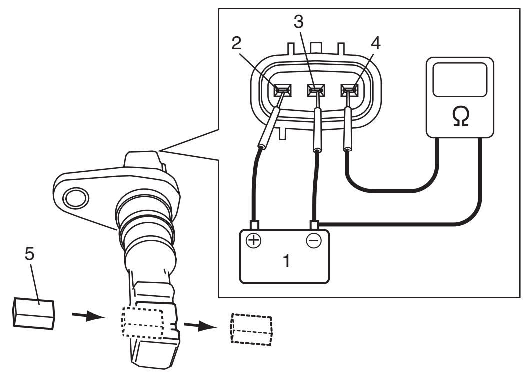


I4RS0B130018-

Performance check

1) Remove metal particles on end face of VSS, if any.
2) Arrange 12 V battery (1) and connect its positive terminal to “Vin” terminal (2) and negative terminal to “Ground” terminal (3) of sensor. Then using ohmmeter, measure resistance between “Vout” terminal (4) of sensor and negative terminal of battery by passing magnetic substance (iron) (5) while keeping approximately 1 mm (0.03 in.) gap with respect to end face of VSS.
If resistance does not vary as specified below, replace VSS.

VSS resistance
Resistance varies from less than 100 Ω (ON) to infinity (OFF) or from infinity (OFF) to less than 100 Ω (ON)



I4RS0B130019-

Knock Sensor Removal and Installation

S4RS0A1306018

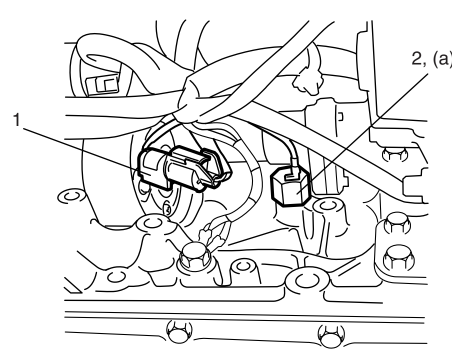
Removal

1) Disconnect negative cable at battery.
2) Hoist vehicle.
3) Remove right side drive shaft referring to “Front Drive Shaft Assembly Removal and Installation: in Section 3A”.
4) Disconnect knock sensor connector (1).
5) 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)

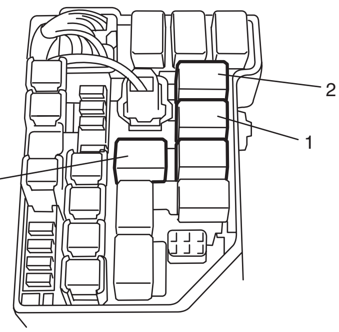


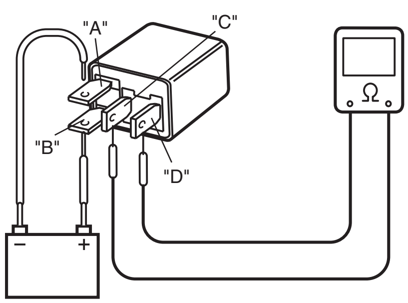
I3RB0A130007-

Main Relay, Fuel Pump Relay, Starting Motor Control Relay and Throttle Actuator Control Relay Inspection

S4RS0A1306019

1) Disconnect negative cable at battery.
2) Remove main relay (1), fuel pump relay (3) and starting motor control relay (2) 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 to terminal “A” of relay. Check for continuity between terminal “C” and “D”. If there is no continuity when relay is connected to the battery, replace relay.





I4RS0A130014-

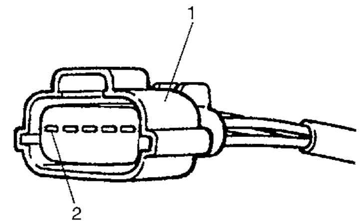
Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor On-Vehicle Inspection

S4RS0A1306020

NOTE:

Before performed this inspection, be sure to read the “Precautions of ECM Circuit Inspection: in Section 1A”.

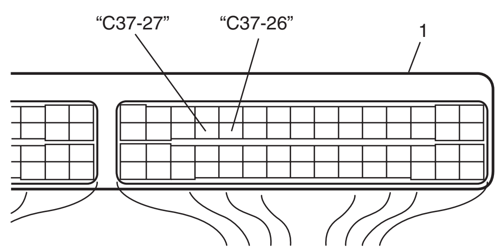
1) Disconnect negative cable at battery.
2) Disconnect MAF and IAT sensor connector.
3) Connect voltmeter to “BLK/RED” wire terminal (2) of MAF and IAT sensor connector (1) disconnected and ground.



I3RB0A130009-

4) Turn ON ignition switch position and check that voltage is battery voltage.
If not, check if wire harness is open or connection is poor.
5) Turn OFF ignition switch position and connect connector to MAF and IAT sensor.
6) Remove ECM from its bracket referring to “Engine Control Module (ECM) Removal and Installation: ”
7) Connect special tool between ECM and ECM connector referring to “Inspection of ECM and Its Circuits: in Section 1A”.
8) Turn ON ignition switch position and check MAF signal voltage between “C37-26” terminal circuit and “C37-27” terminal circuit of special tool.

<u>MAF signal voltage between “C37-26” terminal circuit and “C37-27” terminal circuit of special tool</u>
MAF signal voltage of MAF and IAT sensor with ignition switch turned ON: 0.5 – 1.0 V



I4RS0A130009-

1.	ECM

9) Start engine and check that voltage is lower than 5 V and it rises as engine speed increases.

<u>MAF signal voltage between “C37-26” terminal circuit and “C37-27” terminal circuit of special tool</u>
MAF signal reference voltage of MAF and IAT sensor at specified Idle speed: 1.3 – 1.8 V

10) If check result is not as specified above, cause may lie in wire harness, connector connection, MAF and IAT sensor or ECM.

Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Removal and Installation

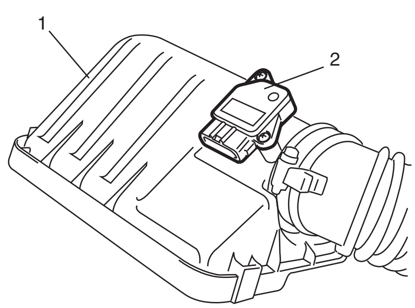
S4RS0A1306021

CAUTION:

- **Do not disassemble MAF and IAT sensor.**
- **Do not expose MAF and IAT sensor to any shock.**
- **Do not clean MAF and IAT sensor.**
- **If MAF and IAT sensor has been dropped, it should be replaced.**
- **Do not blow 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 connector.
3) Remove air cleaner case (1).
4) Remove MAF and IAT sensor (2) from air cleaner case.



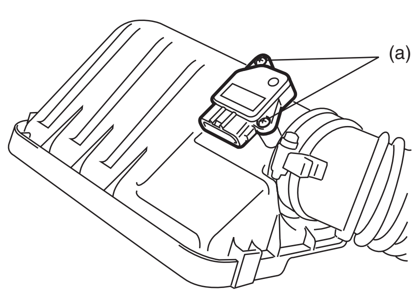
I4RS0A130010-

Installation

Reverse removal procedure noting the followings.

- Tighten MAF and IAT sensor screws to specified torque.

  Tightening torque
  MAF and IAT sensor screw (a): 1.5 N·m (0.15 kg-m, 1.1 lb-ft)



I4RS0A130011-

- Connect MAF and IAT sensor connector securely.

Mass Air Flow (MAF) and Intake Air Temperature (IAT) Sensor Inspection

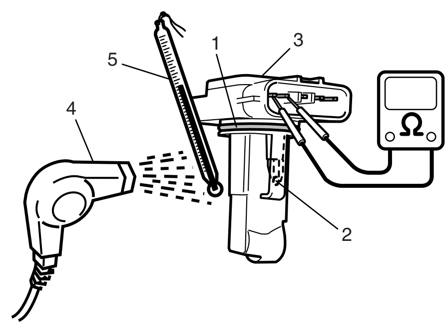
S4RS0A1306022

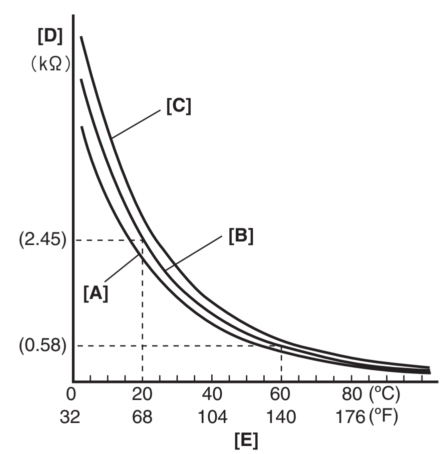
CAUTION:

Do not heat up MAF and IAT sensor more than 100 °C (212 °F). Otherwise, MAF and IAT sensor will be 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
  –20 °C (–4 °F): 13.6 – 18.4 kΩ
  20 °C (68 °F): 2.21 – 2.69 kΩ
  60 °C (140 °F): 0.493 – 0.667 kΩ





I4RS0A130012-

[A]:	Lower limit
[B]:	Nominal
[C]:	Upper limit
[D]:	Resistance
[E]:	Temperature
5.	Temperature gauge

Specifications

Tightening Torque Specifications

S4RS0A1307001

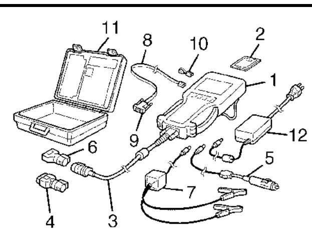
Fastening part	Tightening torque			Note
	N·m	kg-m	lb-ft	
IAC valve screw	3.5	0.35	2.5	☞
ECM mounting bolt	8	0.8	6.0	☞
TP sensor screw	2.5	0.25	1.8	☞
ECT sensor	15	1.5	11.0	☞
Heated oxygen sensor	45	4.5	32.5	☞
CMP sensor bolt	10	1.0	7.5	☞
CKP sensor bolt	10	1.0	7.5	☞
Knock sensor	22	2.2	16.0	☞
MAF and IAT sensor screw	1.5	0.15	1.1	☞

Reference:
For the tightening torque of fastener not specified in this section, refer to “Fasteners Information: in Section 0A”.

Special Tools and Equipment

Special Tool

S4RS0A1308001

SUZUKI scan tool — This kit includes 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 loop back connector, 11. Storage case, 12. Power supply ☞ 	

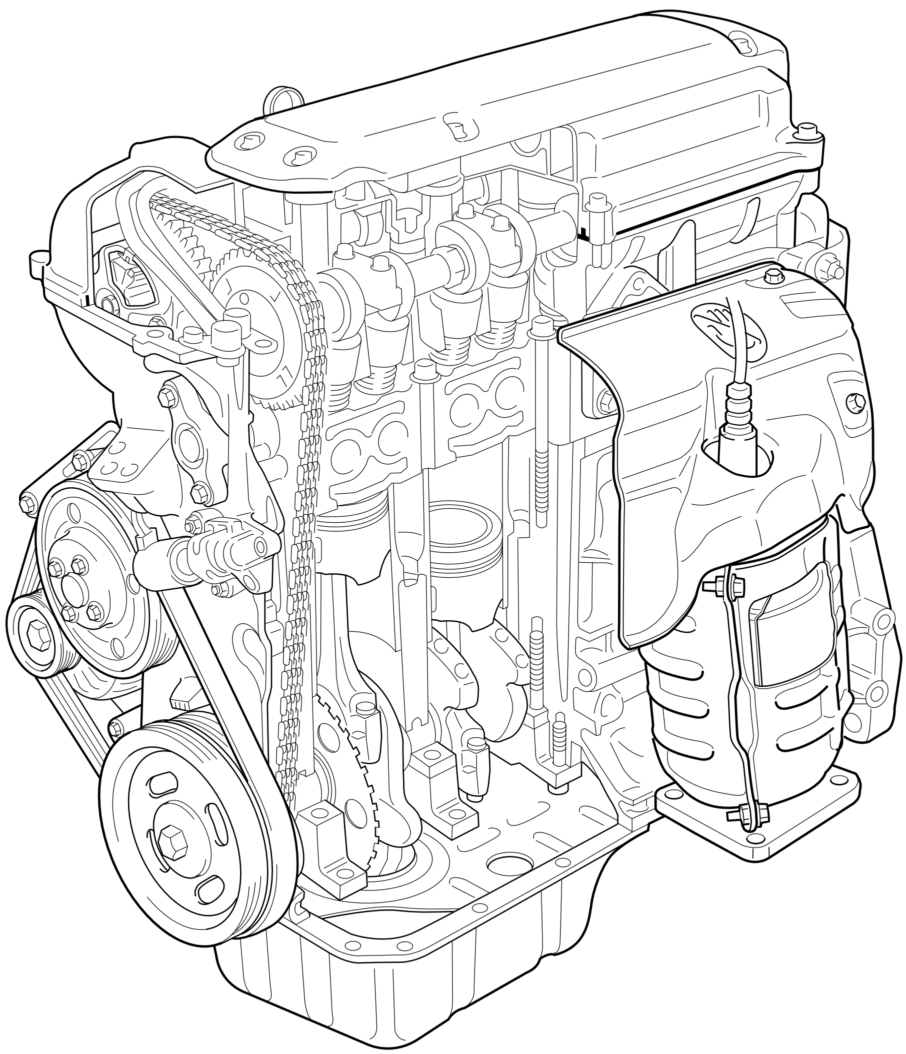
Engine Mechanical

General Description

Engine Construction Description

S4RS0A1401001

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.



I3RM0A140001-

Camshaft Position Control (VVT Variable Valve Timing) System Description

S4RS0A1401002

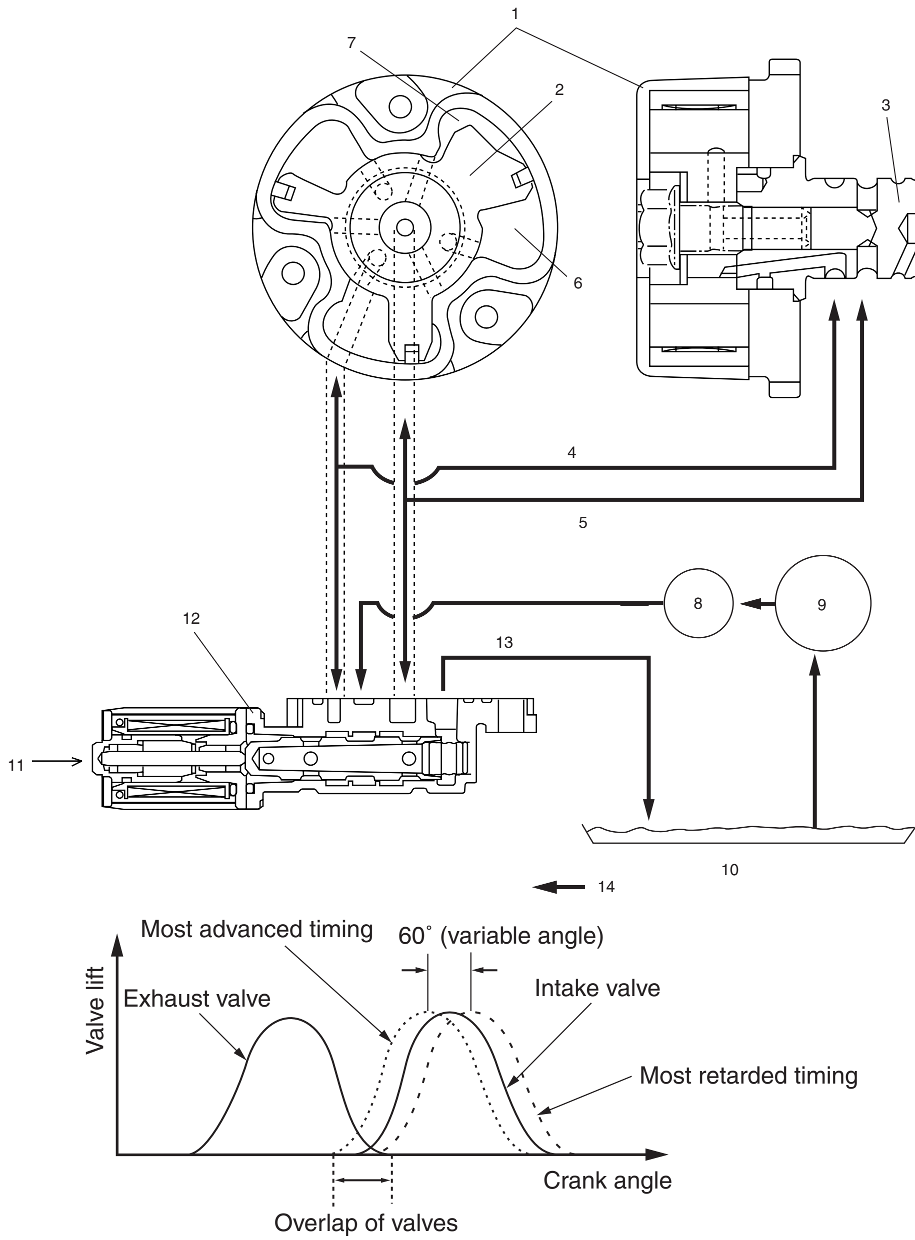
System Description

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).

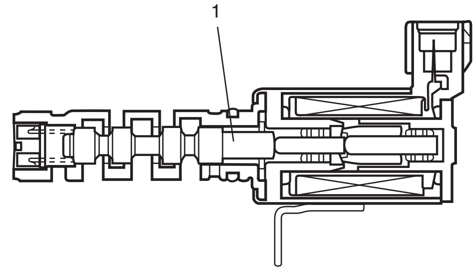


I3RH0B140002-

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

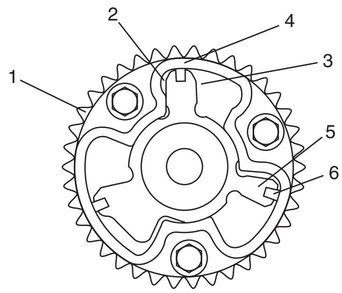
The oil control valve switches and adjusts the hydraulic pressure applied to the cam timing sprocket by moving the spool valve (1) according to the duty pulse signals output from the ECM. By this operation, the intake valve timing is varied continuously. Signals output from the ECM are the duty pulse of about 240 Hz.



I3RH0B140003-

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.

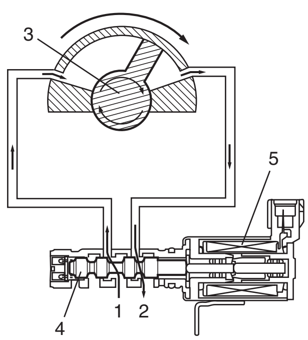


I3RH0B140004-

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.

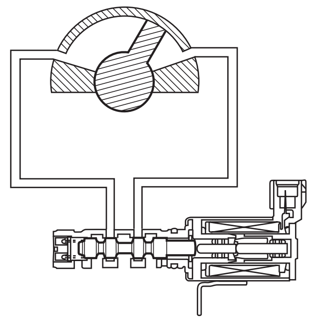


I3RH0B140005-

2.	Drain

Timing Holding

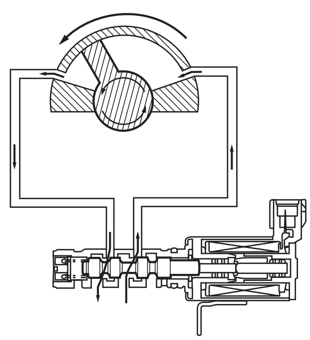
When the duty ratio of the signal output from the ECM shows that of holding, the spool valve of the oil control valve is located at hold position. Because this condition generates no oil pressure changes in both chambers, the rotor is fixed at a target position.



I3RH0B140006-

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.



I3RH0B140007-

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.

Driving condition	Valve timing	Target of control	Effect
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.

Diagnostic Information and Procedures

Compression Check

S4RS0A1404001

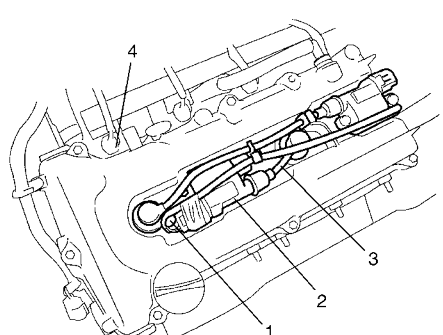
Check compression pressure on all 4 cylinders as follows:

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”, and set parking brake and block drive wheels.

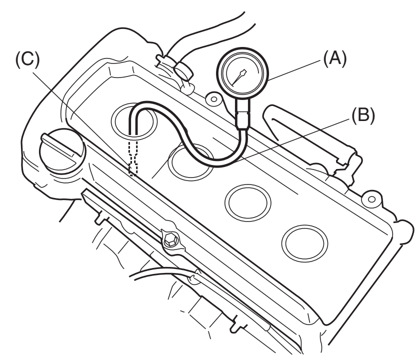
3) Disconnect ignition coil couplers (1).
4) Remove ignition coil assemblies (2) with high-tension cord (3).
5) Remove all spark plugs.
6) Disconnect fuel injector wires (4) at the coupler.



I2RH0B140003-

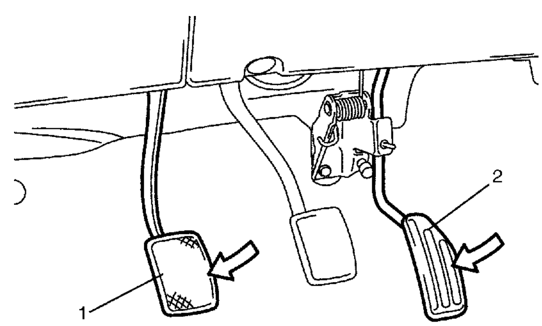
7) Install special tools (Compression gauge) into spark plug hole.

Special tool
(A): 09915–64512
(B): 09915–64530
(C): 09915–67010



I3RH0B140009-

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.



I2RH0B140005-

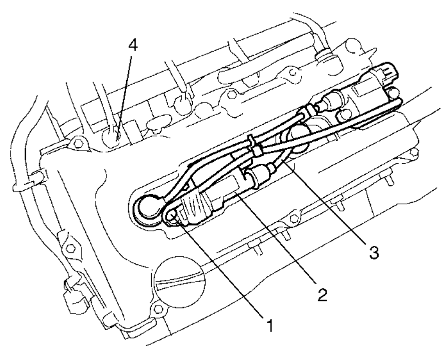
9) Crank engine with fully charged battery, and read the highest pressure on compression gauge.

NOTE:

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

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

10) Carry out Steps 7) through 9) on each cylinder to obtain 4 readings.
11) After checking, install spark plugs and ignition coil assemblies (2) with high-tension cord (3).
12) Connect ignition coil couplers (1).
13) Connect fuel injector wires (4) at the coupler.



I2RH0B140003-

Engine Vacuum Check

S4RS0A1404002

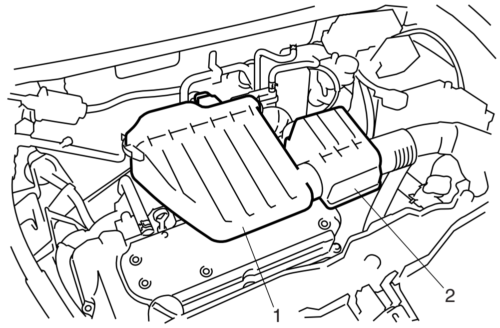
The engine vacuum that develops in the intake line is a good indicator of the condition of the engine. The vacuum checking procedure is as follows:

1) Warm up engine to normal operating temperature.

NOTE:

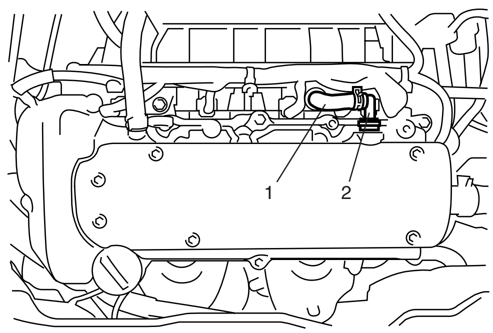
After warming up engine, be sure to place transaxle gear shift lever in “Neutral”, and set parking brake and block drive wheels.

2) Stop engine and turn off the all electric switches.
3) Remove air cleaner case (1) and resonator (2).



I3RM0A140002-

4) Remove PCV hose (1) from PCV valve (2).

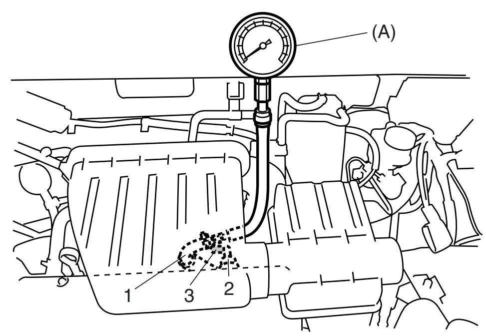


I3RH0B140011-

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.



I3RM0A140003-

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 in.Hg) 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.

Valve Lash (Clearance) Inspection

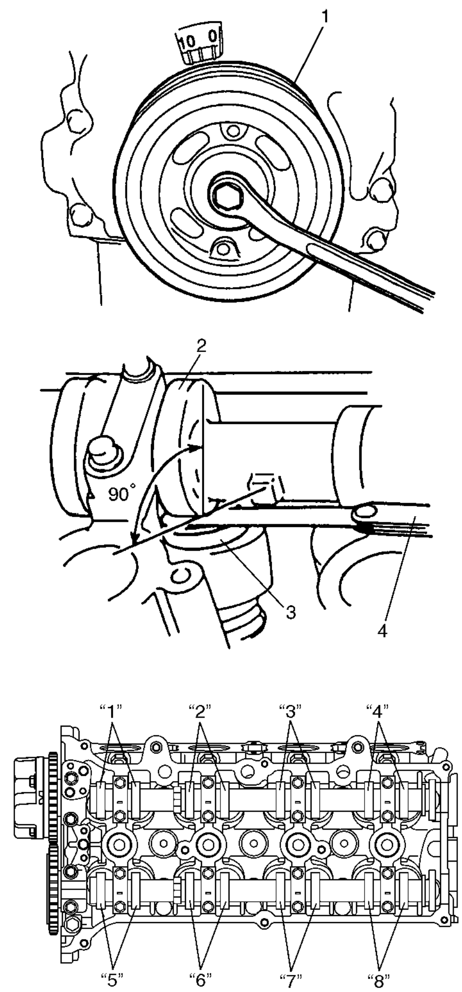
S4RS0A1404003

1) Remove negative cable at battery.
2) Remove cylinder head cover referring to “Cylinder Head Cover Removal and Installation: ”.
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 the figure.
5) Check valve lashes with thickness gauge (4) according to the following procedure.
   a) Check valve lashes at valves “1” and “7”.
   b) Turn camshafts by 90° (by turning crankshaft with wrench).
   c) Make sure that cam lobes are perpendicular to shim faces at valves to be checked (in this case, “3” and “8”), if not, adjust it by turning crankshaft. Check valve lashes.
   d) In the same manner as b) – c), check valve lashes at valves “4” and “6”.
   e) In the same manner as b) – c) again, check valve lashes at valves “2” and “5”.

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

Valve clearance specification

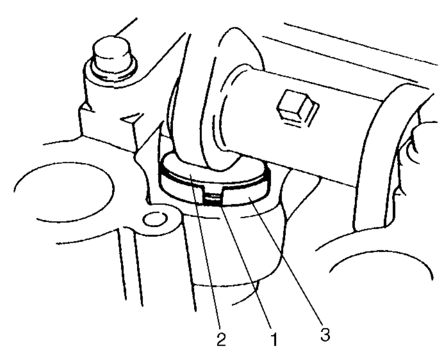
	When cold (Coolant temperature is 15 – 25 °C (59 – 77 °F))	When hot (Coolant temperature is 60 – 68 °C (140 – 154 °F))
Intake	**0.18 – 0.22 mm (0.007 – 0.009 in.)**	**0.21 – 0.27 mm (0.008 – 0.011 in.)**
Exhaust	**0.28 – 0.32 mm (0.011 – 0.013 in.)**	**0.30 – 0.36 mm (0.012 – 0.014 in.)**



I3RM0A140004-

Replacement of Shim

1) Close the valve whose shim (2) is to be replaced by turning crankshaft, then turn tappet (3) till its cut section (1) faces inside as shown in the figure.

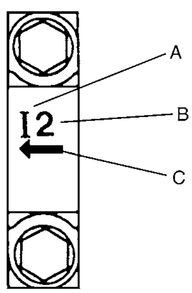


I2RH0B140006-

2) Lift down the valve by turning crankshaft to 360°.
3) Hold tappet at that position using special tool as follows.
    a) Remove its housing bolts.
    b) Check housing No. and select special tool corresponding to housing No., referring to "Special tool selection table".

Special tool selection table

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



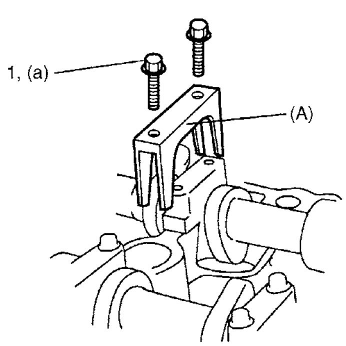
I2RH0B140011-

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
(A): 09916–67021

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

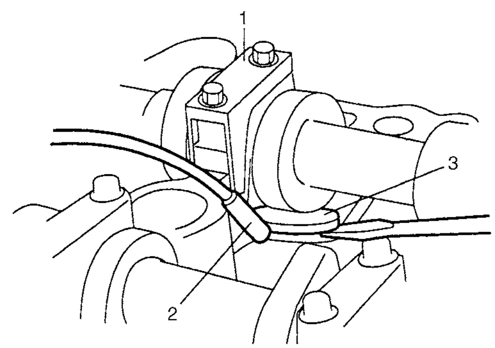


I3RM0A140005-

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

WARNING:

Never put in the hand between camshaft and tappet.

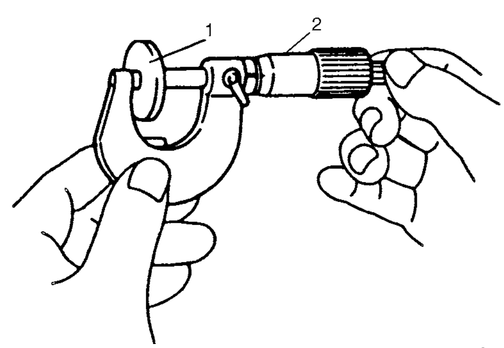


I2RH0B140013-

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.

<u>**Shim thickness specification**</u>
Intake side:
A = B + C – 0.20 mm (0.008 in.)
Exhaust side:
A = B + C – 0.30 mm (0.012 in.)
A: Thickness of new shim
B: Thickness of removed shim
C: Measured valve clearance



I2RH0B140014-

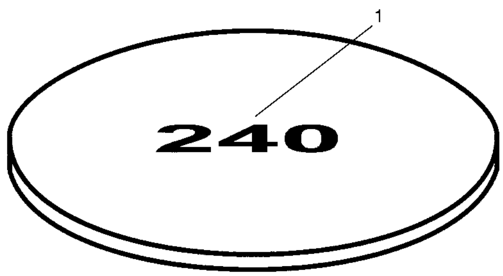
For example of intake side:
When thickness of removed shim is 2.40 mm (0.094 in.), and measured valve clearance is 0.45 mm (0.018 in.).
A = 2.40 mm (0.094 in.) + 0.45 mm (0.018 in.) – 0.20 mm (0.008 in.) = 2.65 mm (0.104 in.)
Calculated thickness of new shim = 2.65 mm (0.104 in.)

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

Available new shims No.

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

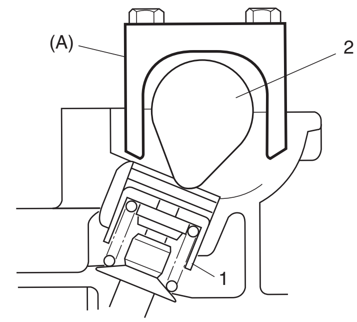
7) Install new shim facing shim No. side with tappet.



I2RH0B140015-

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

Special tool
(A): 09916–67020
(A): 09916–67021

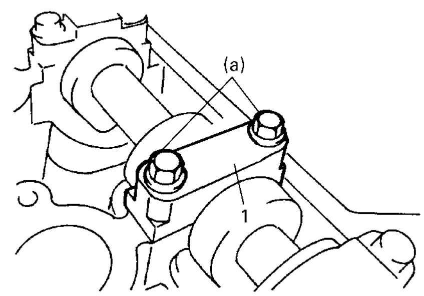


I3RM0A140006-

1.	Tappet
2.	Camshaft

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

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



I2RH0B140149-

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: ”.

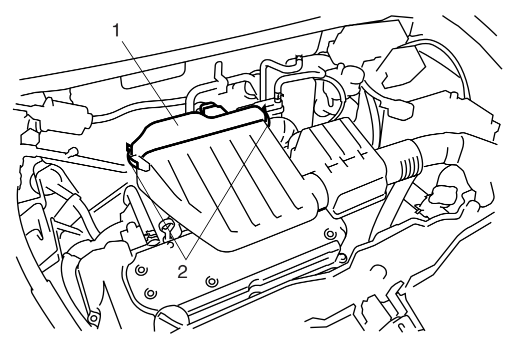
Repair Instructions

Air Cleaner Element Removal and Installation

S4RS0A1406001

Removal

1) Open air cleaner case (1) by unhooking its clamps (2).
2) Remove air cleaner element from case.



I3RM0A140007-

Installation

Reverse removal procedure for installation.

Air Cleaner Element Inspection and Cleaning

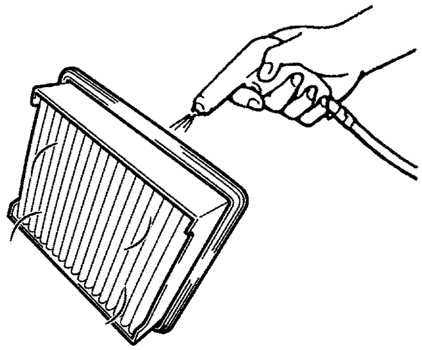
S4RS0A1406002

Inspection

Check air cleaner element for dirt. Replace excessive dirty element.

Cleaning

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



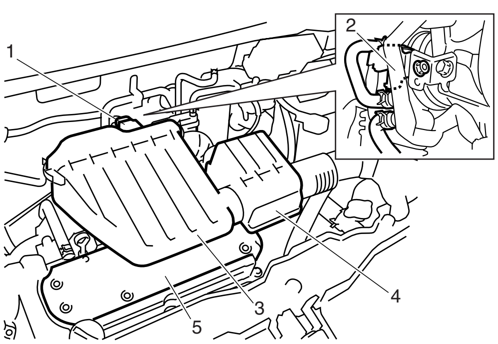
I2RH0B140150-

Cylinder Head Cover Removal and Installation

S4RS0A1406011

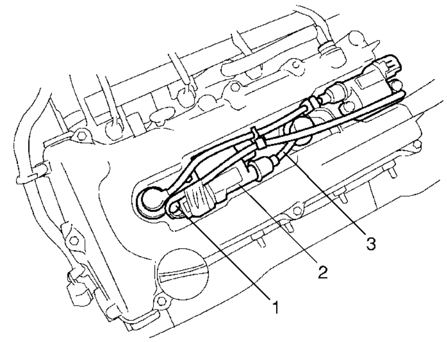
Removal

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).



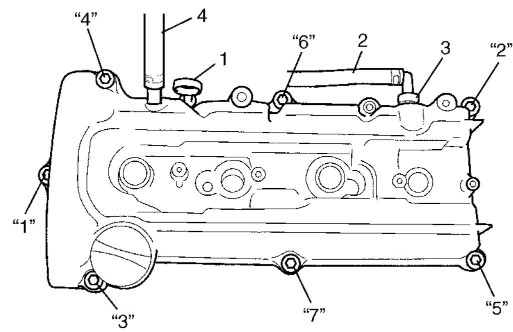
I3RM0A140008-

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.



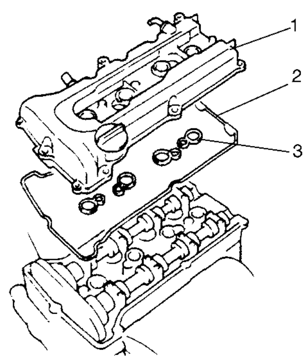
I2RH0B140032-

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 the figure.



I2RH0B140033-

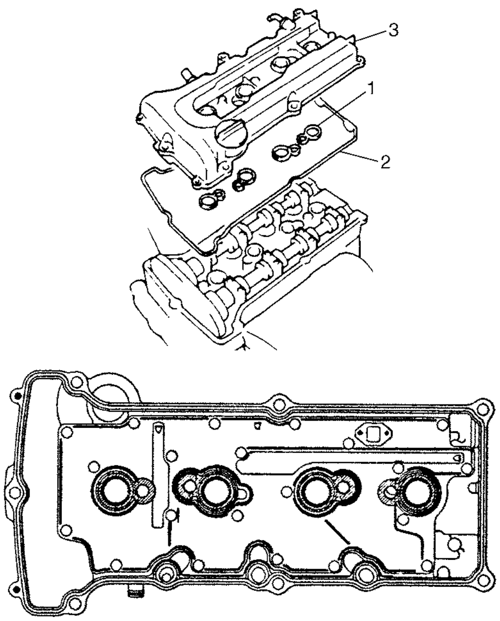
12) Remove cylinder head cover (1) with cylinder head cover gasket (2) and spark plug hole gasket (3).



I2RH0B140034-

Installation

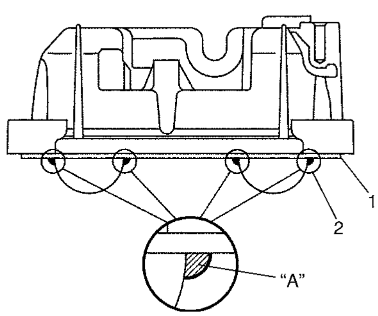
1) Install new spark plug hole gaskets (1) and new cylinder head cover gasket (2) to cylinder head cover (3) as shown in the figure.



I2RH0B140035-

2) Remove oil, old sealant, and dust from sealing surfaces 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.

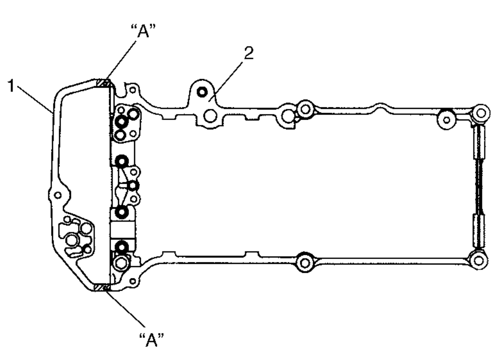
     "A": Water tight sealant 99000–31250



I2RH0B140036-

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

     "A": Water tight sealant 99000–31250



I2RH0B140037-

3) Install cylinder head cover to cylinder head.

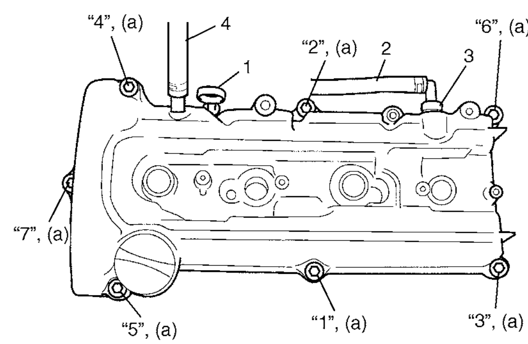
   NOTE:

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

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

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



I3RH0B140016-

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.

Accelerator Cable Adjustment

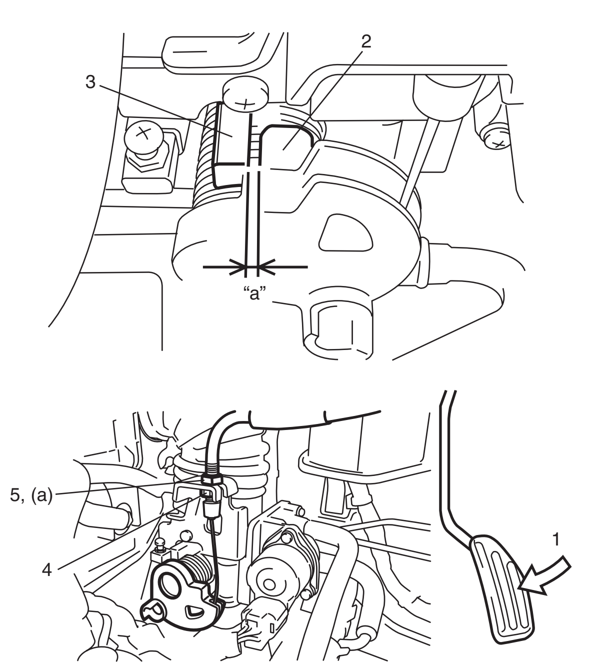
S4RS0A1406003

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), and then tighten accelerator cable locking nut to specified torque.

Tightening torque
Accelerator cable locking nut (a): 12 N·m (1.2 kg-m, 9.0 lb-ft)

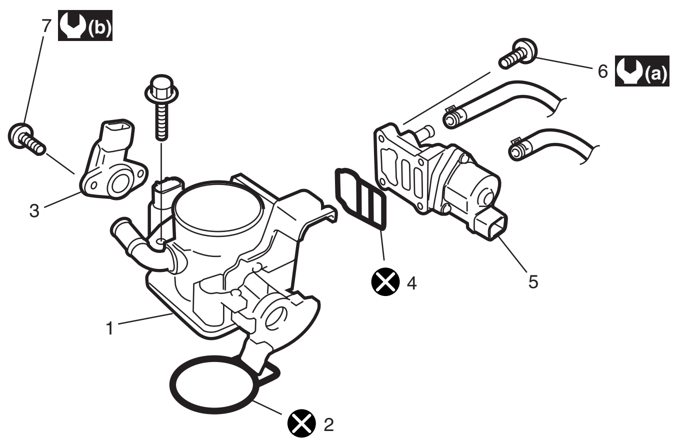
<u>Accelerator cable adjustment clearance (with pedal depressed fully)</u>
"a": 0.5 – 2.0 mm (0.02 – 0.07 in.)



I4RS0A140001-

Throttle Body Components

S4RS0A1406004



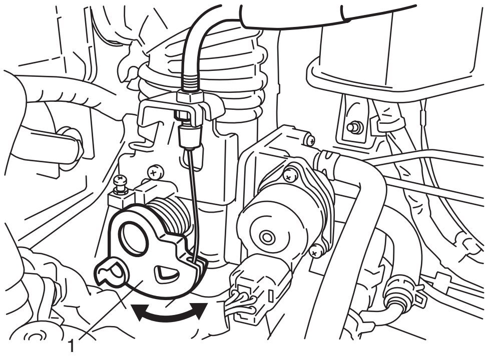
I4RS0A140002-

1. Throttle body	5. Idle air control valve	(b) : 2.5 N·m (0.25 kg-m, 2.0 lb-ft)
2. Throttle body gasket	6. IAC valve screws	⊗ : Do not reuse.
3. TP sensor	7. TP sensor screws	
4. Gasket	(a) : 3.5 N·m (0.35 kg-m, 2.5 lb-ft)	

Throttle Body On-Vehicle Inspection

S4RS0A1406005

Check that throttle lever (1) moves smoothly.



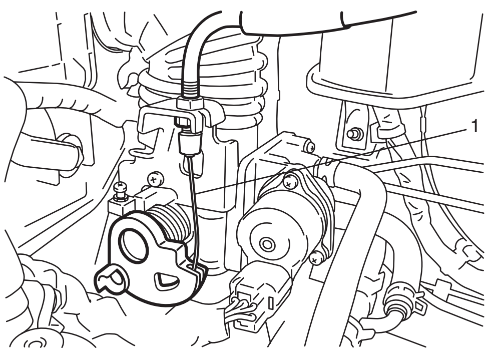
I3RM0A140011-

Throttle Body Removal and Installation

S4RS0A1406006

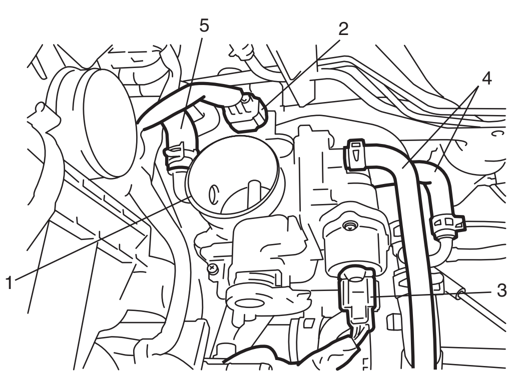
Removal

1) Disconnect negative cable at battery.
2) Drain coolant referring to “Cooling System Draining: in Section 1F”.
3) Disconnect accelerator cable (1) from throttle body.



I3RM0A140012-

4) Detach EVAP canister and purge valve chamber, and remove air cleaner outlet hose.
5) Disconnect connectors from TP sensor (2) and IAC valve (3).
6) Disconnect engine coolant hoses (4) and breather hose (5) from throttle body (1).



I3RM0A140013-

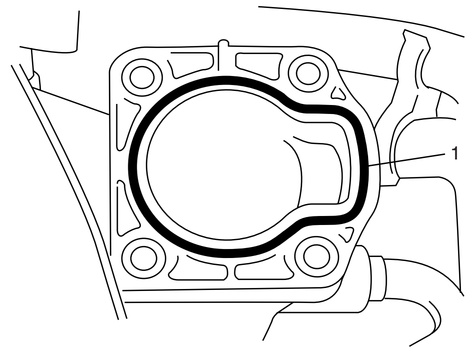
7) Remove throttle body from intake manifold.
8) Remove TP sensor and IAC valve from throttle body.

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.

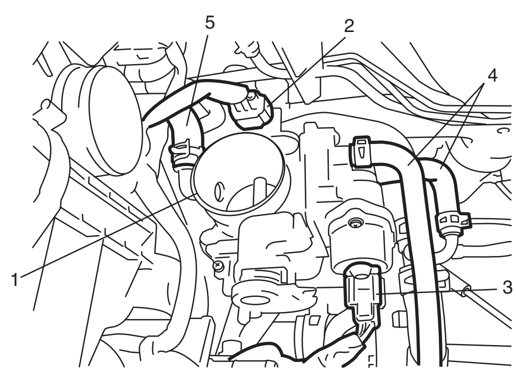
Installation

1) Install IAC valve to throttle body referring to “Idle Air Control (IAC) Valve Removal and Installation: in Section 1C”.
2) Install TP sensor to throttle body referring to “Throttle Position (TP) Sensor Removal and Installation: in Section 1C”.
3) Clean mating surfaces and install new throttle body gasket (1) to intake manifold.



I3RM0A140014-

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).



I3RM0A140013-

7) Connect accelerator cable and adjust cable play to specification referring to “Accelerator Cable Adjustment: ”.
8) Install air cleaner outlet hose, purge valve chamber and EVAP canister.
9) Refill coolant referring to “Cooling System Flush and Refill: in Section 1F”.
10) Connect negative cable at battery.

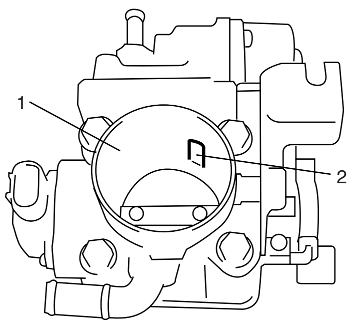
Throttle Body Cleaning

S4RS0A1406008

Clean throttle body bore (1) and idle air passage (2) by blowing compressed air.

NOTE:

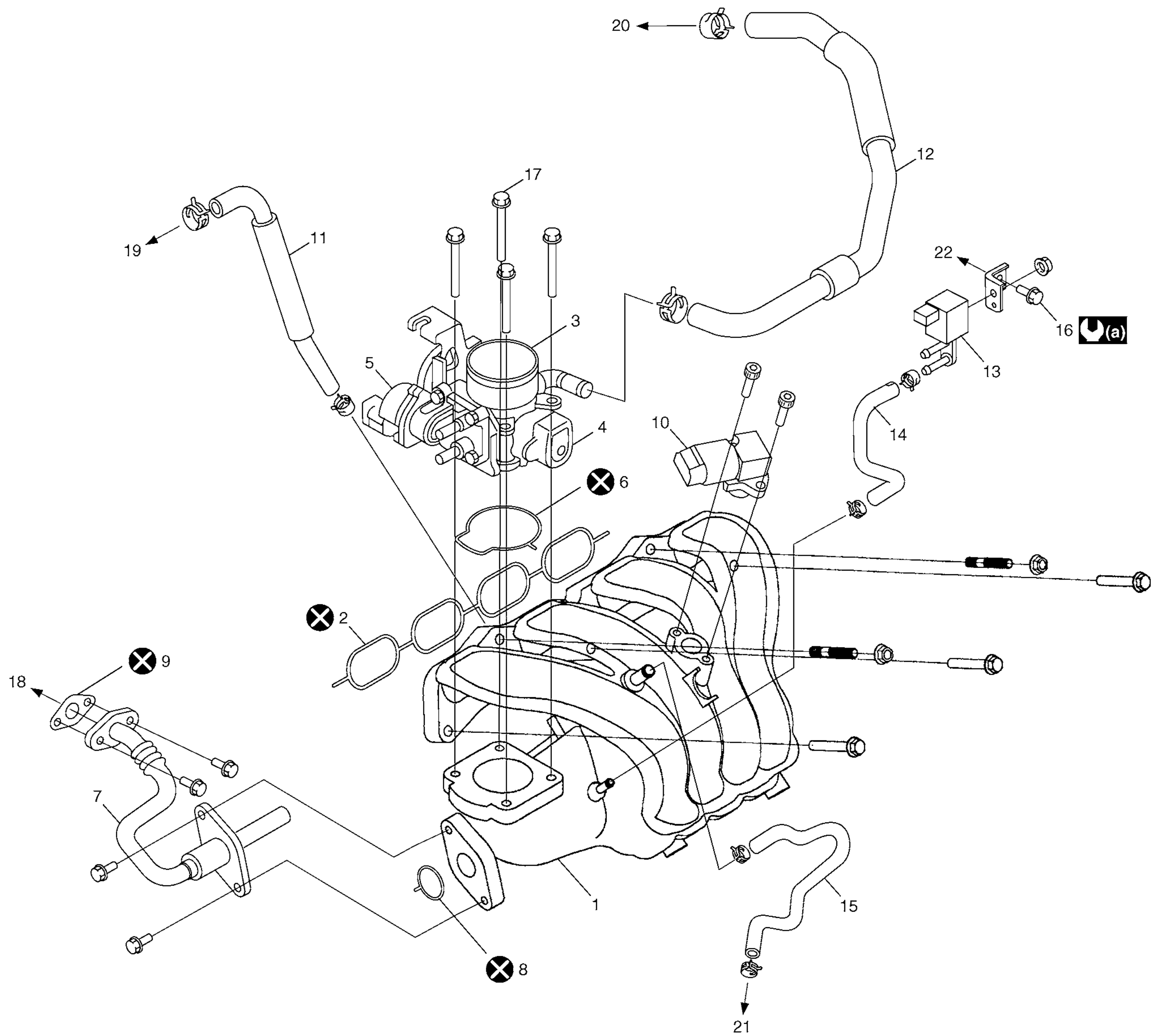
TP sensor, idle air control valve or other components containing rubber must not be placed in a solvent or cleaner both. A chemical reaction will cause these parts to swell, harden or get distorted.



I3RM0A140015-

Throttle Body and Intake Manifold Components

S4RS0A1406009



I4RS0A140003-

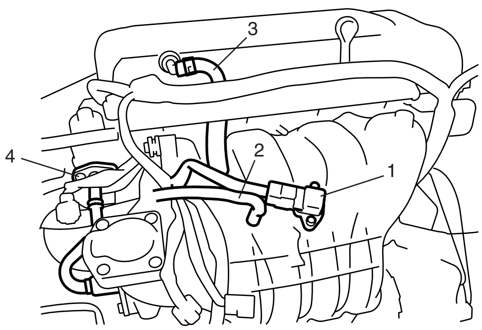
1.	Intake manifold	7.	EGR pipe	13.	EVAP canister purge valve	19.	To PCV valve
2.	Intake manifold O-ring	8.	O-ring	14.	EVAP canister purge valve hose	20.	To cylinder head cover
3.	Throttle body	9.	Gasket	15.	Brake booster hose	21.	To brake booster
4.	TP sensor	10.	MAP sensor	16.	EVAP canister purge valve bracket bolt	22.	To air cleaner case
5.	IAC valve	11.	PCV valve hose	17.	Throttle body mounting bolt	(a) :	5 N·m (0.5 kg-m, 4.0 lb-ft)
6.	O-ring	12.	Breather hose	18.	To EGR valve	:	Do not reuse.

Intake Manifold Removal and Installation

S4RS0A1406010

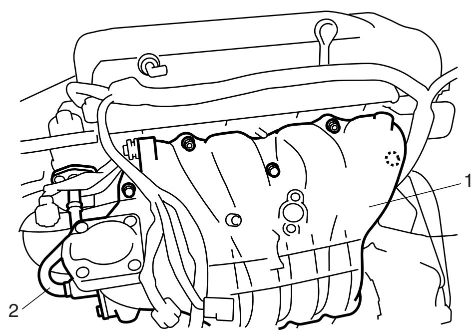
Removal

1) Remove throttle body referring to “Throttle Body Removal and Installation: ”.
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) Remove EGR pipe bolt (4) from EGR valve.



I4RS0A140004-

5) Remove intake manifold (1) and EGR pipe (2) from cylinder head, and then remove its gasket and O-ring.



I3RM0A140018-

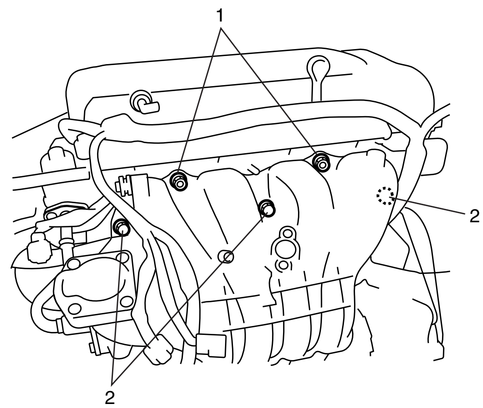
Installation

Reverse removal procedure for installation noting the followings.

- Use new intake manifold O-ring.
- Use new EGR pipe gasket and O-ring.
- Tighten EVAP canister purge valve bracket bolt to specified torque.

  Tightening torque
  EVAP canister purge valve bracket bolt: 5 N·m (0.5 kg-m, 4.0 lb-ft)

- Install intake manifold bolt (2) and nut (1) as shown in figure.

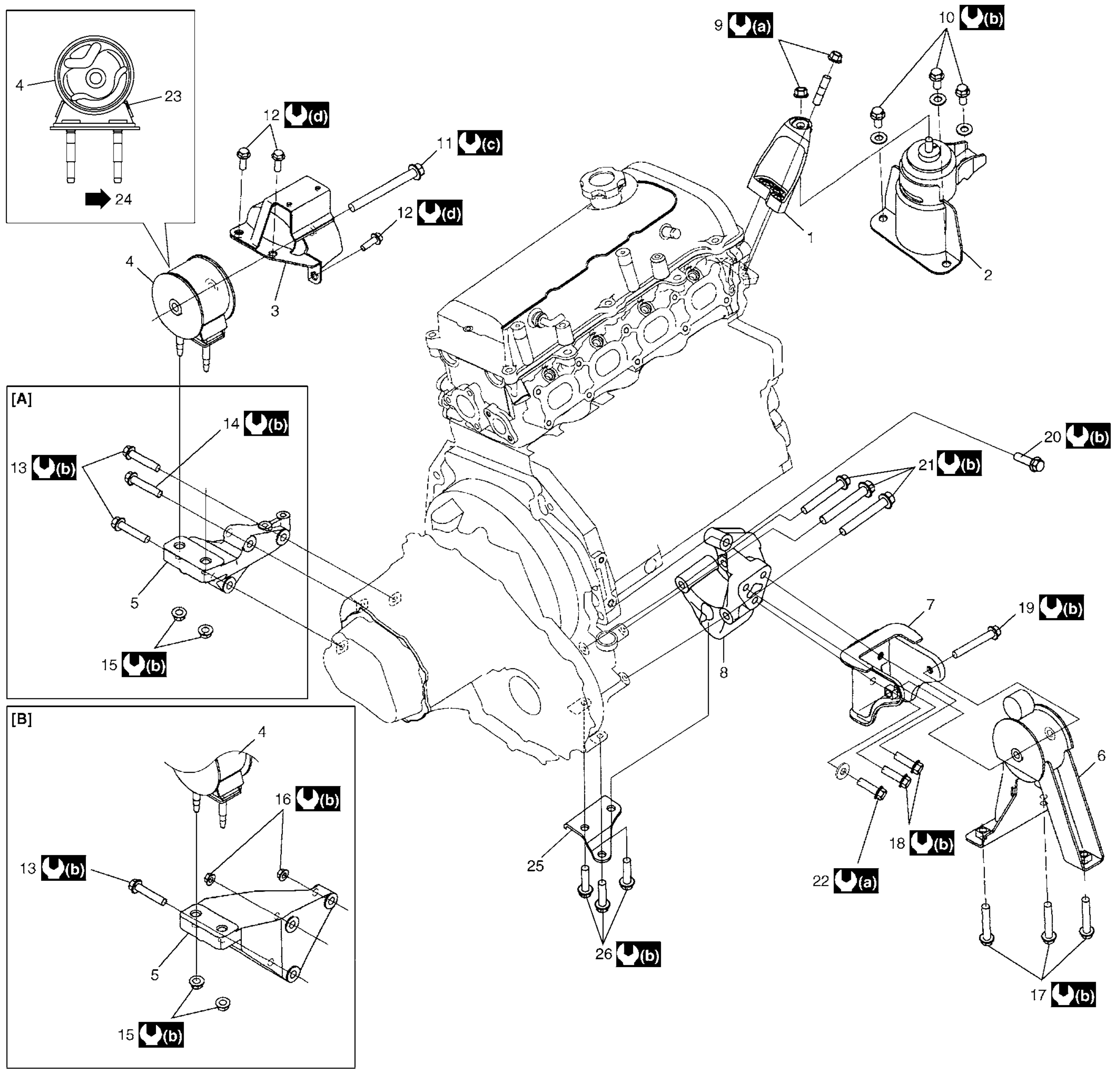


I4RS0A140005-

- 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: ”.
- Refill cooling system referring to “Cooling System Flush and Refill: in Section 1F”.
- 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.

Engine Mountings Components

S4RS0A1406012



I4RS0A140006-

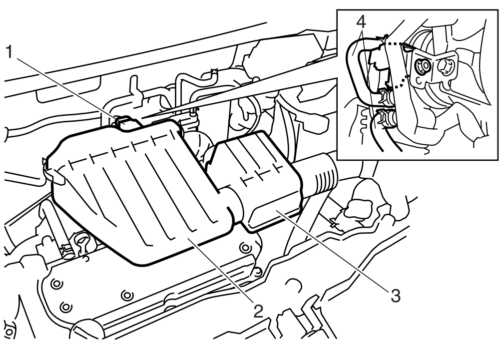
[A]:	A/T model	10.	Engine right mounting bolt	21.	Engine rear mounting body bracket bolt
[B]:	M/T model	11.	Engine left mounting bush bolt	22.	Engine rear mounting No.3 bracket bolt
1.	Engine right mounting bracket	12.	Engine left mounting No.1 bracket bolt	23.	Yellow mark
2.	Engine right mounting	13.	Engine left mounting No.2 bracket bolt (short)	24.	Vehicle forward
3.	Engine left mounting No.1 bracket	14.	Engine left mounting No.2 bracket bolt (long)	25.	Engine rear mounting stiffener
4.	Engine left mounting	15.	Engine left mounting bracket nut	26.	Engine rear mounting stiffener bolt
5.	Engine left mounting No.2 bracket	16.	Engine left mounting nut	(a) :	65 N·m (6.5 kg-m, 47.0 lb-ft)
6.	Engine rear mounting	17.	Engine rear mounting bolt	(b) :	55 N·m (5.5 kg-m, 40.0 lb-ft)
7.	Engine rear mounting No.1 bracket	18.	Engine rear mounting No.1 bracket bolt	(c) :	85 N·m (8.5 kg-m, 61.5 lb-ft)
8.	Engine rear mounting No.2 bracket	19.	Engine rear mounting bush bolt	(d) :	25 N·m (2.5 kg-m, 18.0 lb-ft)
9.	Engine right mounting nut	20.	Engine rear mounting No.2 bracket bolt		

Engine Assembly Removal and Installation

S4RS0A1406013

Removal

1) Relieve fuel pressure according to “Fuel Pressure Relief Procedure: in Section 1G”.
2) Disconnect negative and positive cable at battery.
3) Remove battery and tray.
4) Remove engine hood after disconnecting windshield washer hose.
5) Remove right and left side engine under covers.
6) Remove A/C compressor belt by referring to “Compressor Drive Belt Removal and Installation: in Section 7B”.
7) Drain engine oil referring to “Engine Oil and Filter Change: in Section 0B”.
8) Drain transaxle oil.
9) Drain coolant.
10) Remove cowl top plate referring to “Cowl Top Components: in Section 9K”.
11) Disconnect MAF sensor coupler (1).
12) Remove air cleaner case (2) and resonator (3).
13) Remove canister purge hose (4) from EVAP canister purge valve.



I3RM0A140022-

14) With hose connected, detach A/C compressor from its bracket (if equipped) referring to “Compressor Assembly Removal and Installation: in Section 7B”.

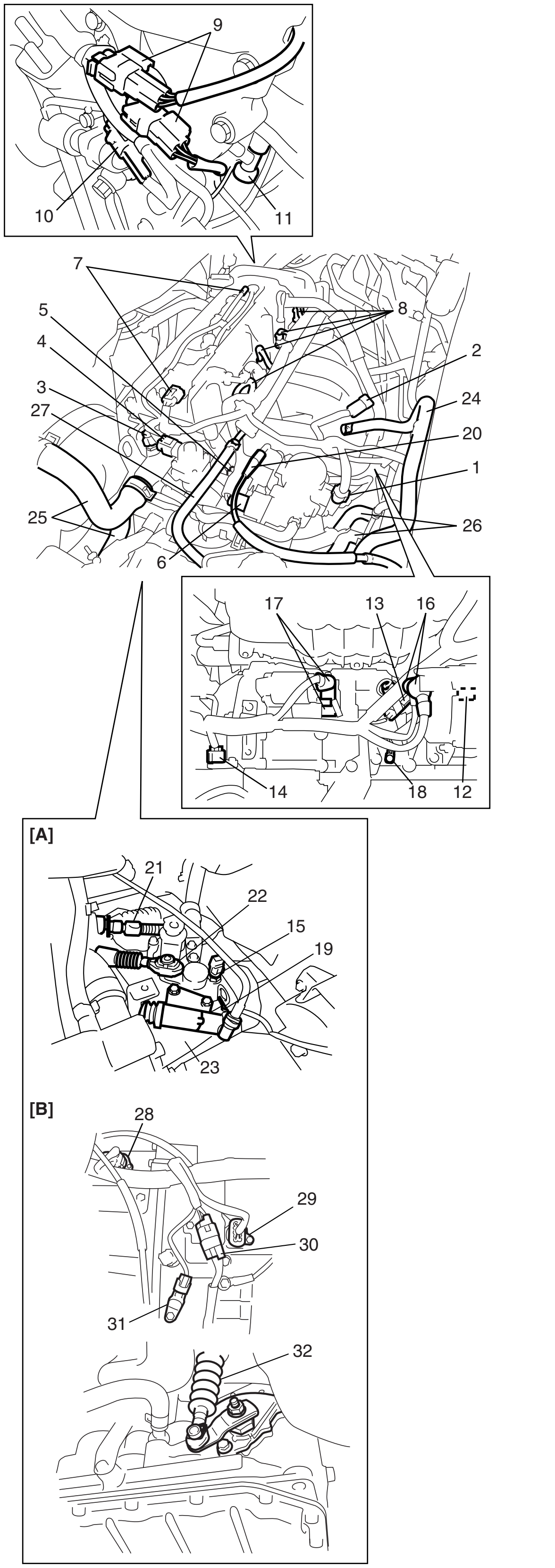
CAUTION:

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

15) Disconnect the following electric 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) (For M/T vehicle)
    - Generator (16)
    - Starting motor (17)
    - Ground terminal (18) from cylinder block
    - Battery ground cable (19) from transaxle
    - Output shaft speed sensor (VSS) (28) (For A/T vehicle)
    - Solenoid valve (29) (For A/T vehicle)
    - Transmission range sensor (30) (For A/T vehicle)
    - Input shaft speed sensor (31) (For A/T vehicle)
    - Magnet clutch switch of A/C compressor (if equipped)
    - Each wire harness clamps
16) Remove fuse box from its bracket.
17) Disconnect the following cables:
    - Accelerator cable (20)
    - Gear select control cable (21) (For M/T vehicle)
    - Gear shift control cable (22) (For M/T vehicle)
    - A/T select cable (32) (For A/T vehicle)
18) Disconnect the following hoses:
    - A/T fluid cooler 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
19) With hose connected, detach clutch operating cylinder (23). (For M/T vehicle)

CAUTION:

Suspend removed clutch operating cylinder at a place where no damage will be caused during removal and installation of engine assembly.



I4RS0A140007-

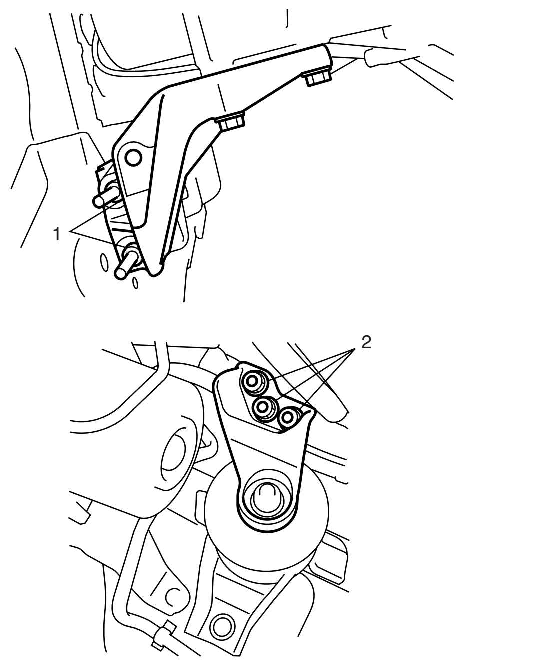
[A]:	M/T vehicle
[B]:	A/T vehicle

20) Disconnect right and left drive shaft joints from differential gear referring to “Front Drive Shaft Assembly Removal and Installation: in Section 3A”.

NOTE:

For engine and transaxle removal, it is not necessary to remove drive shafts from steering knuckle.

21) Remove exhaust No.1, No.2 and center pipes referring to “Exhaust Manifold Removal and Installation: in Section 1K”.
22) Support engine assemble by using supporting device referring to “Engine Supporting Points: in Section 0A”.
23) Remove suspension frame referring to “Front Suspension Frame, Stabilizer Bar and/or Bushings Removal and Installation: in Section 2B”.
24) Remove engine rear mounting from engine rear mounting No.1 bracket.
25) Support engine and transaxle with jack, and then remove supporting device.
26) Remove engine left mounting bracket nuts (1) and engine right mounting nuts (2).



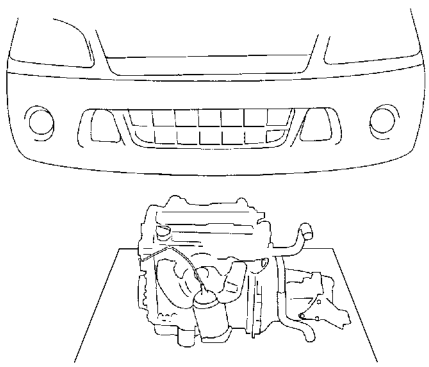
I4RS0A140008-

27) Before removing engine with transaxle from engine compartment, recheck to make sure all hoses, electric wires and cables are disconnected from engine and transaxle.

28) Lower engine with transaxle from engine compartment.

CAUTION:

Before lowering engine, to avoid damage to A/C compressor and clutch operating cylinder, make clearance by rising them. Be sure not to damage suspended A/C compressor and clutch operating cylinder.



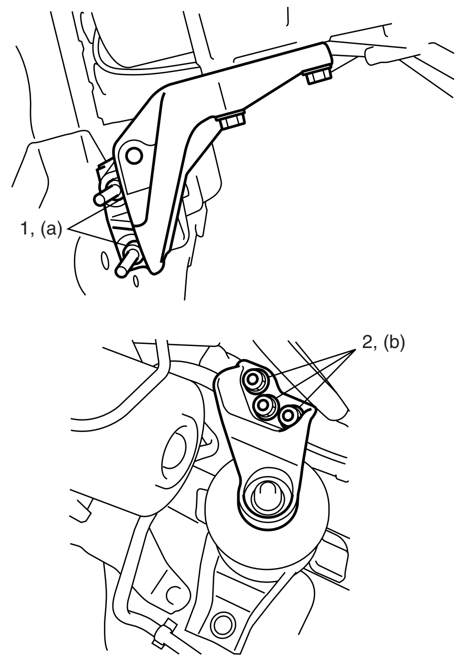
I4RS0A140009-

29) Disconnect transaxle from engine, referring to "Manual Transaxle Unit Dismounting and Remounting: in Section 5B" or "Automatic Transaxle Unit Dismounting and Remounting: in Section 5A".
30) Remove clutch cover and clutch disk referring to "Clutch Cover, Clutch Disc and Flywheel Removal and Installation: in Section 5C".

Installation

1) Install clutch cover and clutch disk referring to "Clutch Cover, Clutch Disc and Flywheel Removal and Installation: in Section 5C".
2) Connect transaxle to engine referring to "Manual Transaxle Unit Dismounting and Remounting: in Section 5B" or "Automatic Transaxle Unit Dismounting and Remounting: in Section 5A".
3) Lift engine and transaxle into engine compartment with jack.
4) Install engine left mounting bracket nuts (1) and engine right mounting nuts (2).
   Tighten these nuts to specified torque.

   Tightening torque
   Engine left mounting bracket nut (a): 55 N·m (5.5 kg-m, 40.0 lb-ft)
   Engine right mounting nut (b): 65 N·m (6.5 kg-m, 47.0 lb-ft)



I4RS0A140010-

5) Support engine assemble by using supporting device referring to "Engine Supporting Points: in Section 0A".
6) Install engine rear mounting to engine rear mounting No.1 bracket.

   Tightening torque
   Engine rear mounting bush bolt: 55 N·m (5.5 kg-m, 40.0 lb-ft)

7) Install suspension frame referring to "Front Suspension Frame, Stabilizer Bar and/or Bushings Removal and Installation: in Section 2B".
8) Remove supporting device.
9) Install exhaust No.1, No.2 and center pipes referring to "Exhaust Pipe and Muffler Removal and Installation: in Section 1K".
10) Connect drive shaft joints referring to "Front Drive Shaft Assembly Removal and Installation: in Section 3A".
11) Reverse disconnected hoses, cables and electric wires for connection noting the followings.
    - Tighten nuts to specified torque.

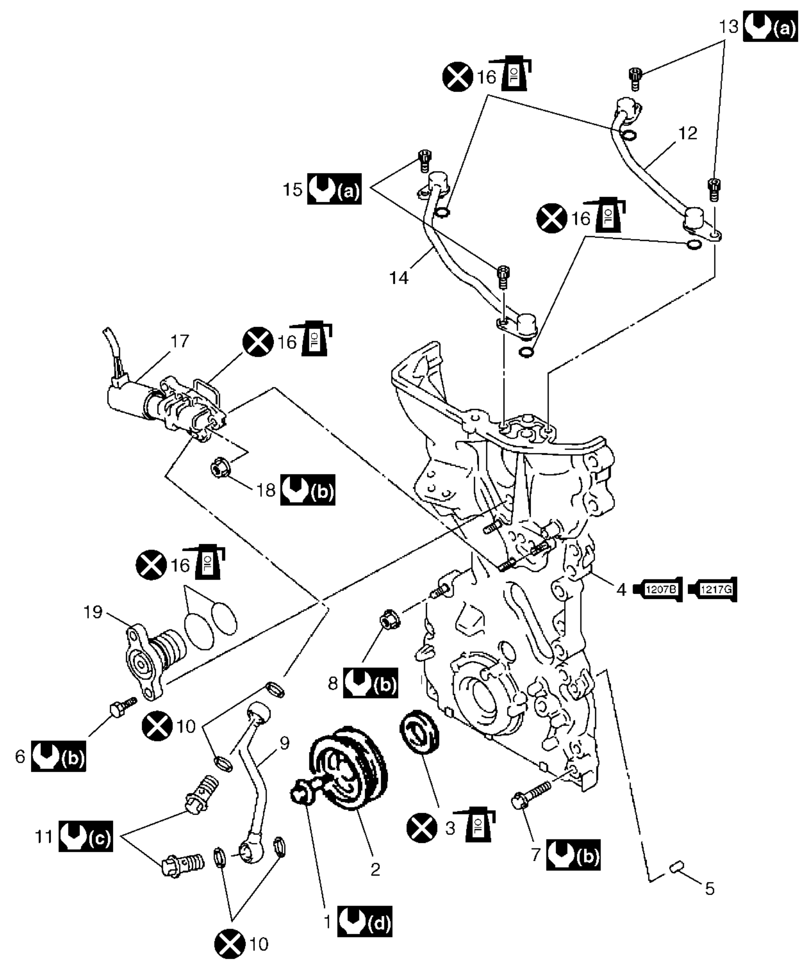
    Tightening torque
    Starting motor terminal nut: 11 N·m (1.1 kg-m, 8.0 lb-ft)
    Generator terminal nut: 6 N·m (0.6 kg-m, 4.5 lb-ft)

12) Install air cleaner case and resonator.
13) Install cowl top referring to "Cowl Top Components: in Section 9K".
14) Install A/C compressor to its bracket (if equipped) referring to "Compressor Assembly Removal and Installation: in Section 7B".

15) Adjust A/C compressor belt tension (if equipped) referring to “Compressor Drive Belt Inspection and Adjustment: in Section 7B”.
16) Adjust accelerator cable play referring to “Accelerator Cable Adjustment: ” in this section.
17) Check to ensure that all removed parts are back in place.
    Reinstall any necessary parts which have not been reinstalled.
18) Refill cooling system with coolant referring to “Cooling System Flush and Refill: in Section 1F”.
19) Refill engine with engine oil referring to “Engine Oil and Filter Change: in Section 0B”.
20) Refill transaxle with transaxle oil referring to “Manual Transaxle Oil Change: in Section 5B” or “A/T Fluid Change: in Section 5A”.
21) Install battery and tray.
22) Connect positive and negative cable at battery.
23) Verify that there is no fuel leakage, coolant leakage, oil leakage and exhaust gas leakage at each connection.

Timing Chain Cover Components

S4RS0A1406014



I4RS0A140011-

1. Crankshaft pulley bolt	9. Oil gallery pipe No.1	17. Oil control valve
2. Crankshaft pulley	10. Copper washer	18. Oil control valve mounting nut
OIL 3. Oil seal : Apply engine oil to oil seal lip.	11. Oil gallery pipe No.1 bolt	19. Cap
1207B 1217G 4. Timing chain cover : Apply sealant 99000-31140 to the mating surface of cylinder and cylinder head. : Apply sealant 99000-31260 to the mating surface of timing chain cover referring to the figure of Step 5) of “Installation” under “Timing Chain Cover Removal and Installation: ”.	12. Oil gallery pipe No.2	(a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)
5. Pin	13. Oil gallery pipe No.2 bolt	(b) : 25 N·m (2.5 kg-m, 18.0 lb-ft)
6. Cap bolt	14. Oil gallery pipe No.3	(c) : 30 N·m (3.0 kg-m, 22.0 lb-ft)
7. Timing chain cover mounting bolts	15. Oil gallery pipe No.3 bolt	(d) : 150 N·m (15.0 kg-m, 108.5 lb-ft)
8. Timing chain cover mounting nut	OIL 16. O-ring : Apply engine oil.	⊗ : Do not reuse.

Timing Chain Cover Removal and Installation

S4RS0A1406015

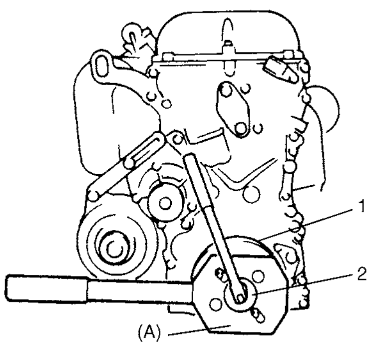
CAUTION:

- **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.**

Removal

1) Remove engine assembly from vehicle referring to "Engine Assembly Removal and Installation: ".
2) Remove water pump / generator drive belt referring to "Water Pump / Generator Drive Belt Removal and Installation: in Section 1F".
3) Remove crankshaft pulley bolt.
   To lock crankshaft pulley (1), use special tool with it as shown in the figure.

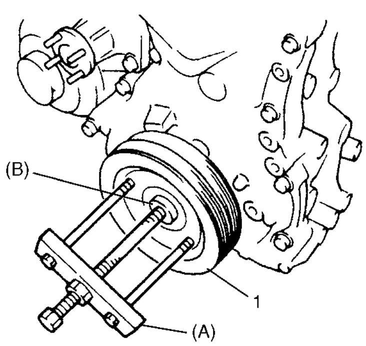
   Special tool
   (A): 09917–68221



I2RH0B140051-

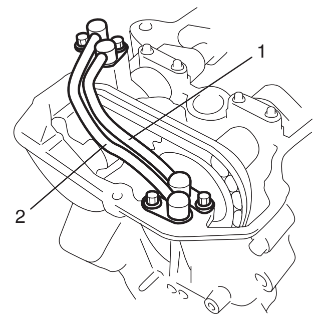
4) Remove crankshaft pulley (1).
   If it is hard to remove, use special tools as shown in the figure.

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



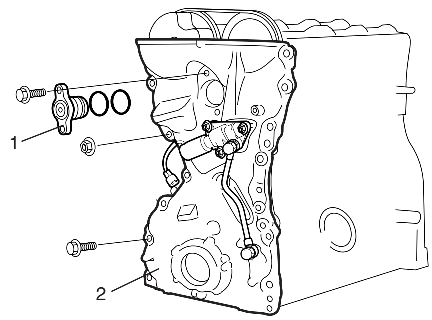
I2RH0B140052-

5) Remove cylinder head cover referring to "Cylinder Head Cover Removal and Installation: ".
6) Remove oil pan referring to "Oil Pan and Oil Pump Strainer Removal and Installation: in Section 1E".
7) Remove water pump pulley.
8) Remove A/C bracket from cylinder block.
9) Remove oil gallery pipes No.2 (1) and No.3 (2).



I3RH0B140021-

10) Remove cap (1) from timing chain cover (2).
11) Remove timing chain cover (2).



I3RH0B140022-

12) Remove oil control valve from timing chain cover referring to "Oil Control Valve Removal and Installation: ".

Installation

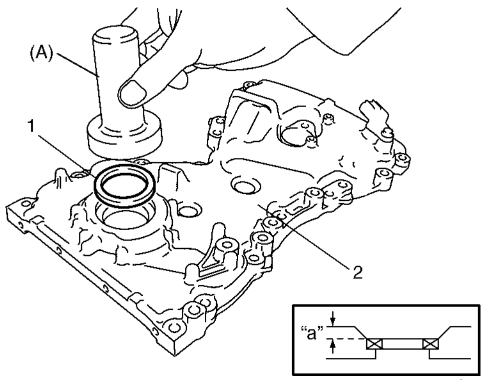
1) Clean sealing surface on timing chain cover, cylinder block and cylinder head.
   Remove oil, old sealant and dust from sealing surface.
2) Install oil seal (1) to timing chain cover, if removed.

   NOTE:

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

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

   Special tool
   (A): 09913–75810

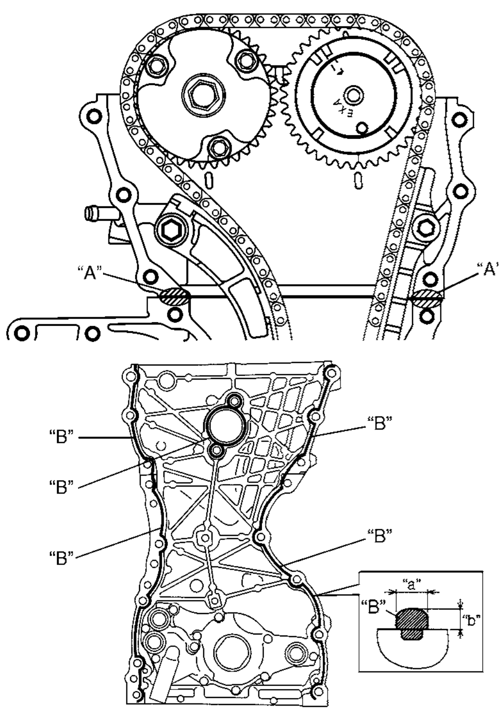


I2RH0B140058-

3) Install oil control valve to timing chain cover referring to "Oil Control Valve Removal and Installation: ".
4) Apply sealant "A" to mating surface of cylinder and cylinder head and "B" to mating surface of timing chain cover as shown in the figure.

"A": Sealant 99000–31140
"B": Sealant 99000–31260

<u>Sealant amount for timing chain cover</u>
Width "a": 3 mm (0.12 in.)
Height "b": 2 mm (0.08 in.)



I3RH0B140025-

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

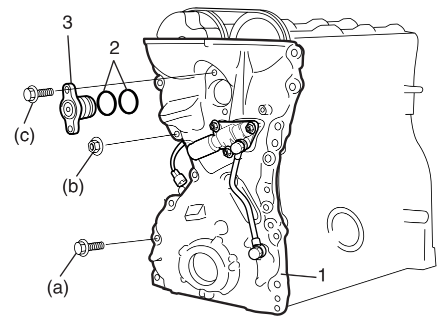
NOTE:

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

Tightening torque
Timing chain cover bolt (a): 25 N·m (2.5 kg-m, 18.0 lb-ft)
Timing chain cover nut (b): 25 N·m (2.5 kg-m, 18.0 lb-ft)

6) Apply engine oil to new O-rings (2) and install them to cap (3).
7) Install cap (3) to timing chain cover (1).
Tighten bolts to specified torque.

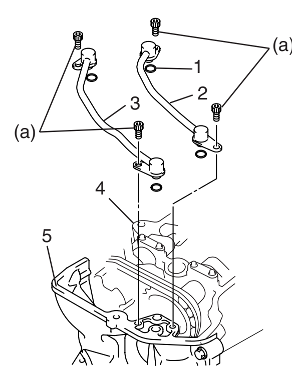
Tightening torque
Cap bolt (c): 25 N·m (2.5 kg-m, 18.0 lb-ft)



I3RH0B140026-

8) Install new O-ring (1) to oil gallery pipes No.2 (2) and No.3 (3).
9) 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 pipe No.2 and No.3 bolt (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



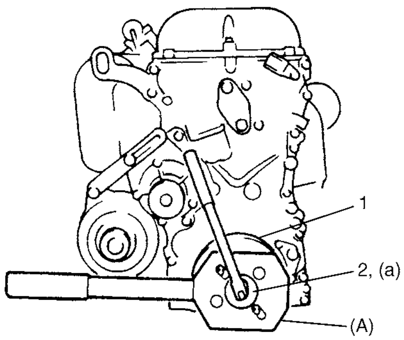
I3RH0B140027-

10) Install water pump pulley.
11) Install cylinder head cover referring to "Cylinder Head Cover Removal and Installation: ".
12) Install oil pan referring to "Oil Pan and Oil Pump Strainer Removal and Installation: in Section 1E".

13) 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

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



I2RH0B140056-

14) Install engine assembly to vehicle referring to “Engine Assembly Removal and Installation: ”.

Timing Chain Cover Inspection

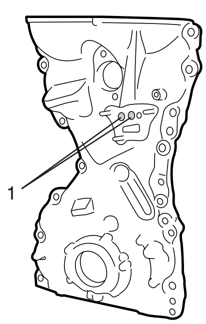
S4RS0A1406016

Oil Seal

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

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.



I3RH0B140028-

Oil Control Valve Removal and Installation

S4RS0A1406043

Removal

Remove oil gallery pipe No.1 (1) and oil control valve (2) from timing chain cover (3).

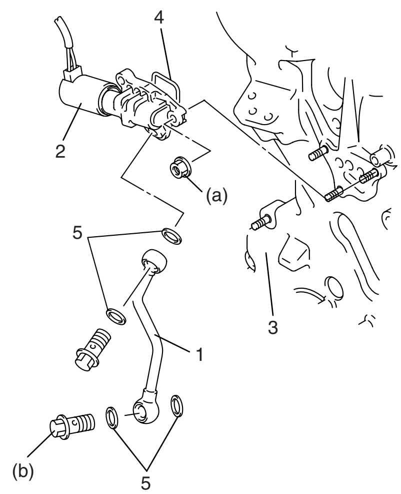
Installation

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 nut (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 bolt (b): 30 N·m (3.0 kg-m, 21.5 lb-ft)



I3RM0A140027-

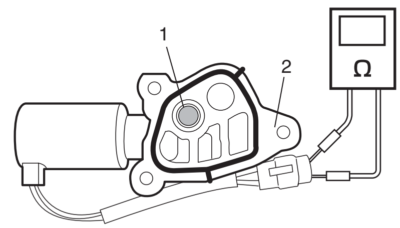
Oil Control Valve Inspection

S4RS0A1406044

Oil Control Valve

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.

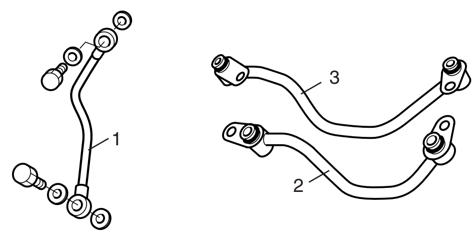
   Oil control valve resistance
   6.7 – 7.7 Ω (at 20 °C (68 °F))



I3RM0A140028-

Oil Gallery Pipe

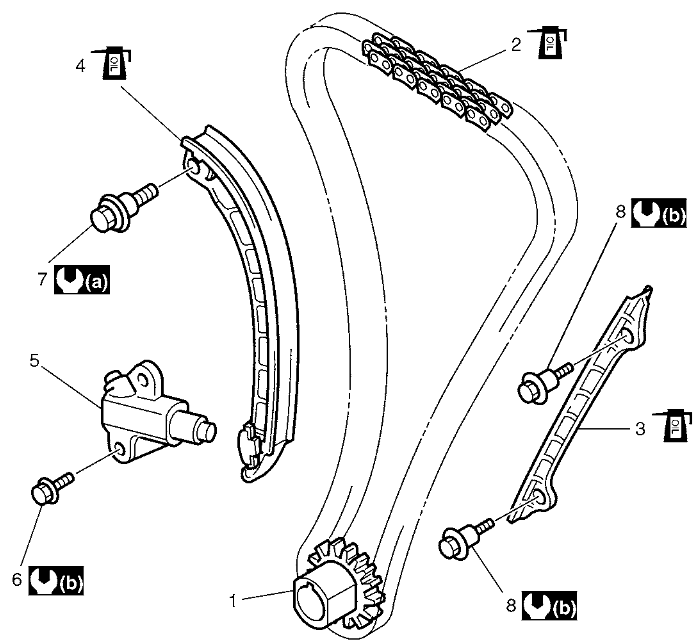
Inspect oil gallery pipes No.1, No.2 (2) and No.3 (3). Replace if crack, deformation or clog exists.



I3RH0B140030-

Timing Chain and Chain Tensioner Components

S4RS0A1406017



I4RS0A140012-

1. Crankshaft timing sprocket	5. Timing chain tensioner adjuster assembly	(a) : 25 N·m (2.5 kg-m, 18.0 lb-ft)
OIL 2. Timing chain : Apply engine oil.	6. Chain tensioner adjuster mounting bolt	(b) : 11 N·m (1.1 kg-m, 8.0 lb-ft)
OIL 3. Timing chain No.1 guide : Apply engine oil to sliding surface.	7. Timing chain tensioner bolt	
OIL 4. Timing chain tensioner : Apply engine oil to sliding surface.	8. Timing chain No.1 guide bolt	

Timing Chain and Chain Tensioner Removal and Installation

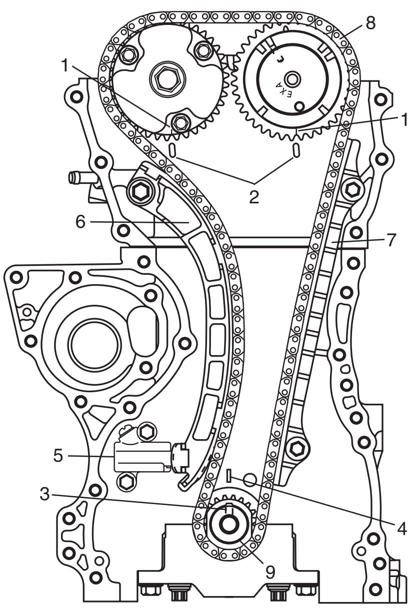
S4RS0A1406018

Removal

CAUTION:

After timing chain is removed, never turn crankshaft and camshafts independently more than its allowable turning range described in "Installation".
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: ".
2) By turning crankshaft, align both intake and exhaust camshaft timing sprocket marks (1) with notches (2) of cylinder head respectively and align crankshaft 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).



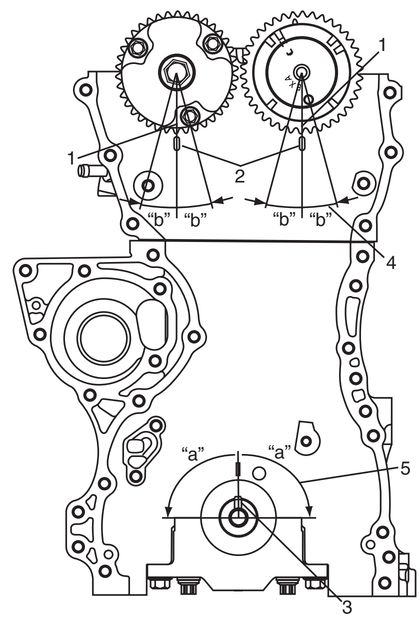
I3RH0B140032-

Installation

CAUTION:

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

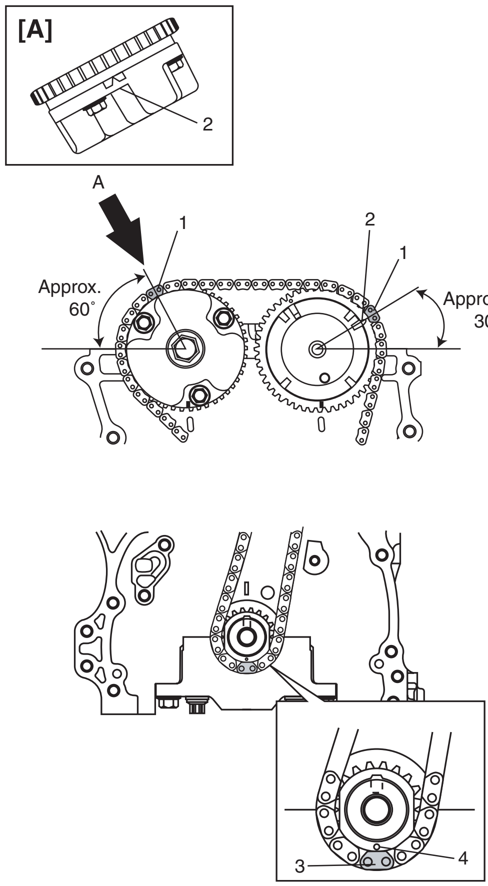
1) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with notches (2) on cylinder head as shown in the figure.
2) Set key (3) and turn crankshaft to position key on upside of crankshaft.



I4RS0A140021-

"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 the 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.

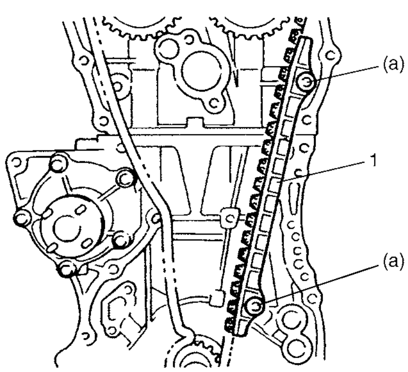


I3RH0B140034-

[A]:	View A

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

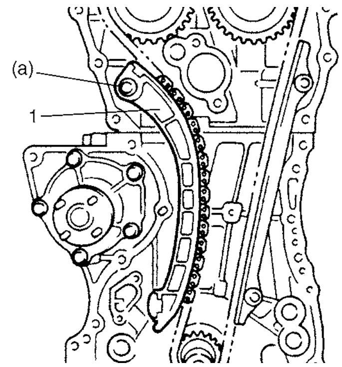
Tightening torque
Timing chain No.1 guide bolt (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



I2RH0B140062-

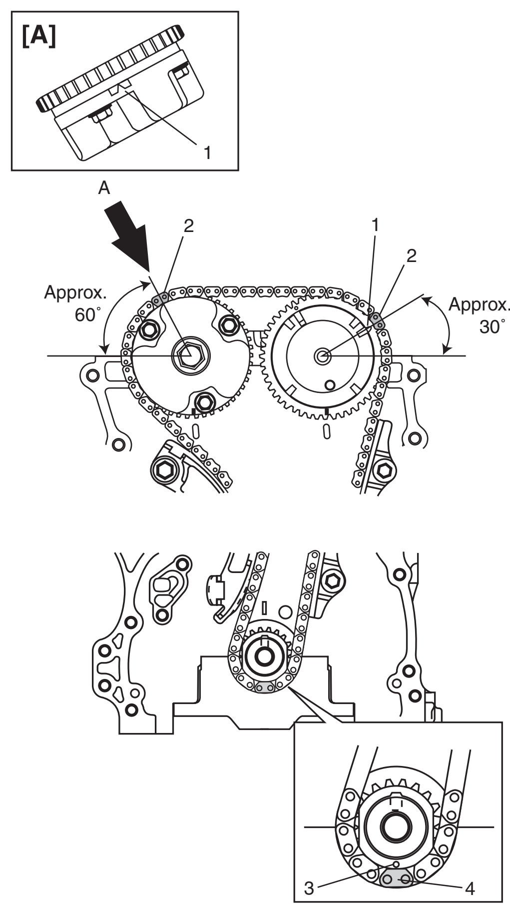
6) Apply engine oil to sliding surface of chain tensioner (1) and install chain tensioner and spacer. Tighten tensioner bolt to specified torque.

Tightening torque
Timing chain tensioner bolt (a): 25 N·m (2.5 kg-m, 18.0 lb-ft)



I2RH0B140063-

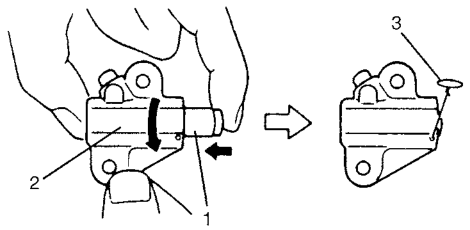
7) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with dark blue plates (2) of timing chain and match mark (3) on crankshaft timing sprocket is in match with gold plate (4) of timing chain.



I3RH0B140035-

[A]:	View A

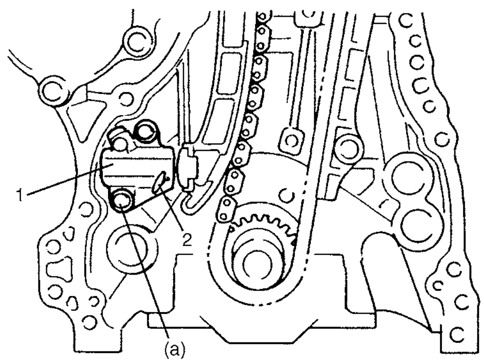
8) Screw in plunger (1) by turning body (2) in arrow direction and install a retainer (3) (wire) to hold plunger in place.



I2RH0B140065-

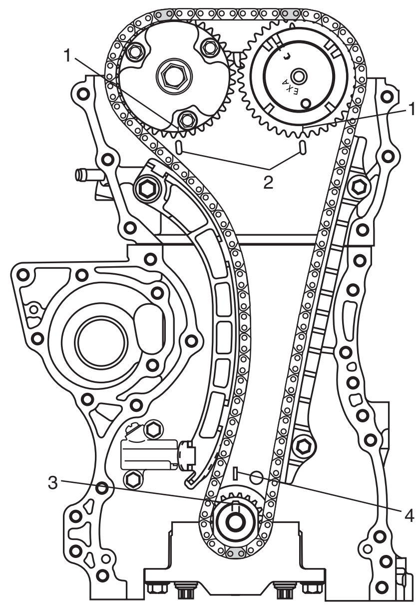
9) Install timing chain tensioner adjuster assembly (1) with a retainer (2).
   Tighten adjuster bolts to specified torque and then remove a retainer from chain tensioner adjuster assembly.

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



I2RH0B140066-

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 black as shown in the figure.
   If each marking chain and each match mark are no matches, adjust each sprockets and timing chain.



I3RH0B140036-

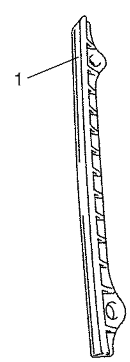
11) Install timing chain cover referring to "Timing Chain Cover Removal and Installation: ".
12) Perform Steps 3) to 8) of "Installation" of "Timing Chain Cover Removal and Installation: ".

Timing Chain and Chain Tensioner Inspection

S4RS0A1406019

Timing Chain No.1 Guide

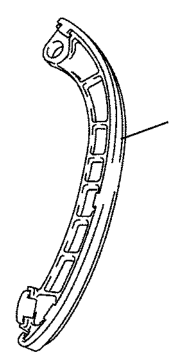
Check shoe (1) for wear or damage.



I2RH0B140068-

Timing Chain Tensioner

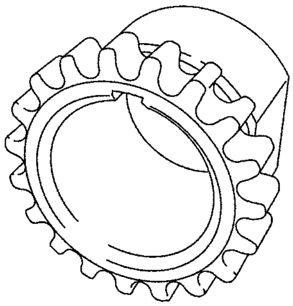
Check shoe (1) for wear or damage.



I2RH0B140069-

Crankshaft Timing Sprocket

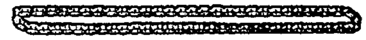
Check teeth of sprocket for wear or damage.



I2RH0B140070-

Timing Chain

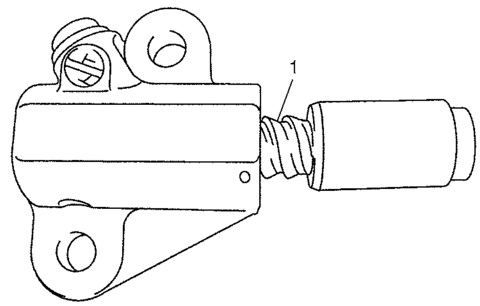
Check timing chain for wear or damage.



I2RH01140077-

Timing Chain Tensioner Adjuster

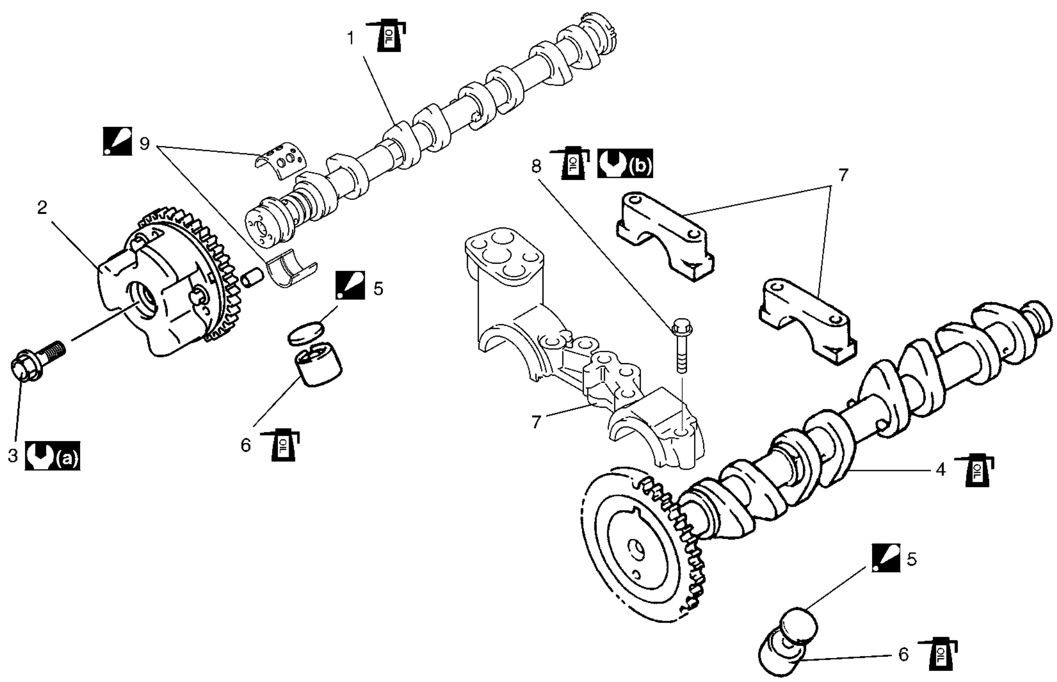
Check that tooth surface (1) are free from damage.



I2RH0B140071-

Camshaft, Tappet and Shim Components

S4RS0A1406020



I4RS0A140013-

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	(a) : 60 N·m (6.0 kg-m, 43.5 lb-ft)
3. Intake camshaft sprocket bolt	7. Camshaft housing	(b) : 11 N·m (1.1 kg-m, 8.0 lb-ft)
4. Exhaust camshaft	8. Camshaft housing bolt	: Apply engine oil to sliding surface of each part.

Camshaft, Tappet and Shim Removal and Installation

S4RS0A1406021

CAUTION:

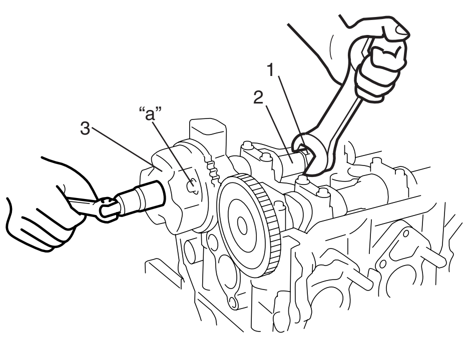
- **Keep working table, tools and hands clean while overhauling.**
- **Use special care to handle aluminum parts so as not to damage them.**
- **Do not expose removed parts to dust. Keep them always clean.**

Removal

1) Remove timing chain cover referring to “Timing Chain Cover Removal and Installation: ”.
2) Remove timing chain referring to “Timing Chain and Chain Tensioner Removal and Installation: ”.
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.

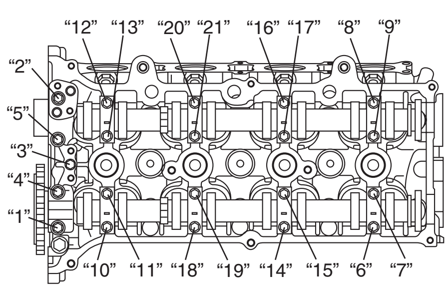
CAUTION:

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.



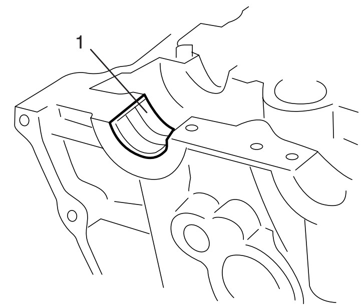
I3RM0A140030-

4) Loosen camshaft housing bolts in such order as indicated in the figure and remove them.



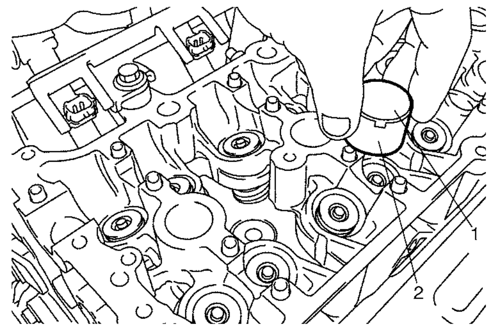
I3RM0A140031-

5) Remove camshaft housings.
6) Remove intake and exhaust camshafts.
7) Remove camshaft bearing (1).



I3RH0B140039-

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



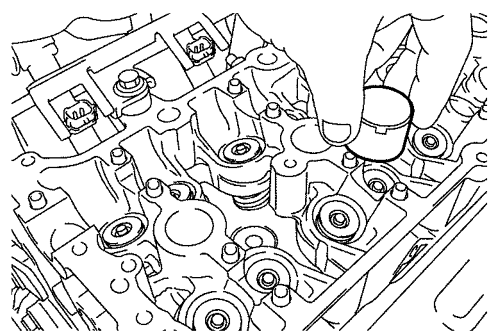
I2RH0B140074-

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.

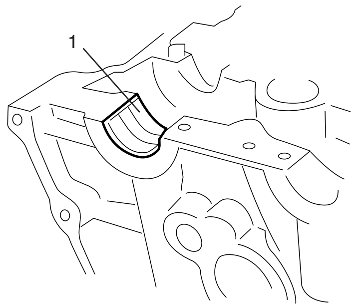


I2RH0B140075-

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.

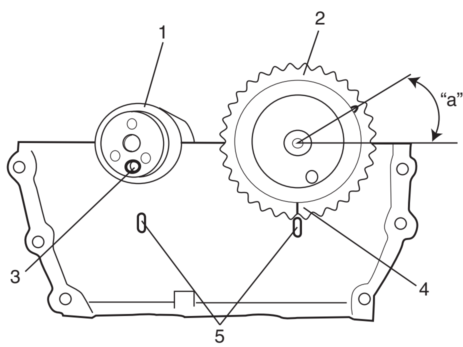


I3RH0B140039-

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.

NOTE:

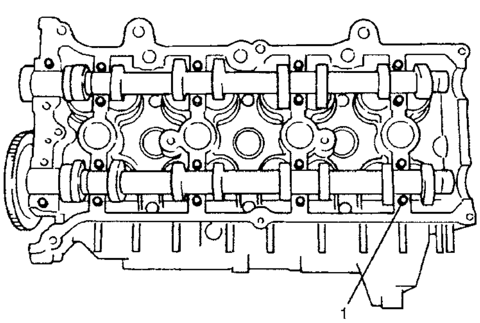
Before installing camshafts, turn crankshaft until key position faces upward.
Refer to "Timing Chain and Chain Tensioner Removal and Installation: ".



I4RS0A140014-

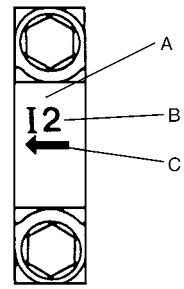
"a":	Approx. 30°

4) Apply engine oil to sliding surface of each camshaft and camshaft journal then install them as shown in the figure.
5) Install camshaft housing pins (1) as shown in the figure.



I3RM0A140033-

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.

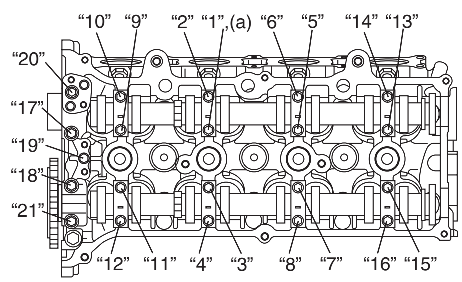


I2RH0B140078-

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 the 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.

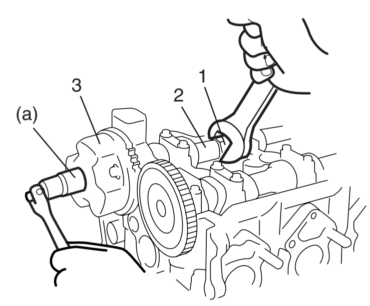
Tightening torque
Camshaft housing bolt (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



I3RH0B140041-

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, 43.5 lb-ft)



I3RH0B140042-

9) Install timing chain with crankshaft sprocket referring to "Timing Chain and Chain Tensioner Removal and Installation: ".
10) Install timing chain cover referring to "Timing Chain Cover Removal and Installation: ".
11) Check valve lashes referring to "Valve Lash (Clearance) Inspection: ".

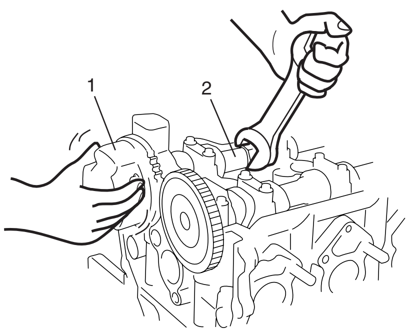
12) Perform Steps 3) to 8) of “Installation” of “Timing Chain Cover Removal and Installation: ”.

Camshaft, Tappet and Shim Inspection

S4RS0A1406022

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.



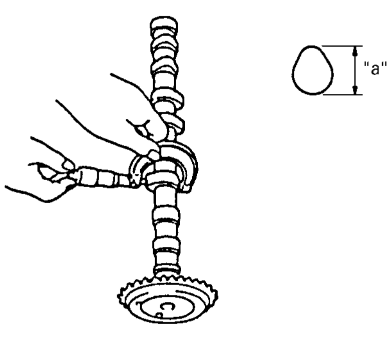
I3RH0B140043-

Cam Wear

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

Cam height “a”

Cam height	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.)**

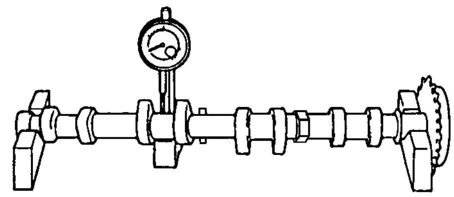


I2RH0B140080-

Camshaft Runout

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

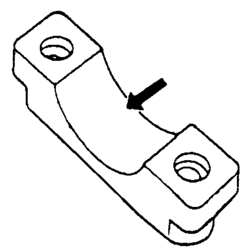
Camshaft runout limit
0.10 mm (0.0039 in.)



I2RH0B140081-

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.



I2RH0B140082-

Check clearance by using gauging plastic. Checking procedure is as follows.

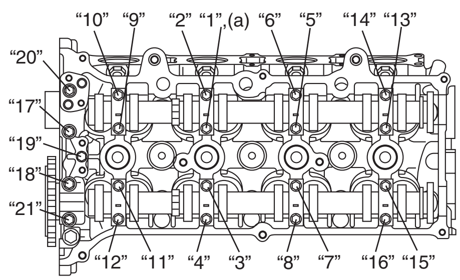
1) Clean housings and camshaft journals.
2) Remove all tappets with shims.
3) Install camshafts to cylinder head.
4) Place a piece of gauging plastic to full width of journal of camshaft (parallel to camshaft).
5) Install camshaft housing.

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

NOTE:

Do not rotate camshaft while gauging plastic is installed.

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

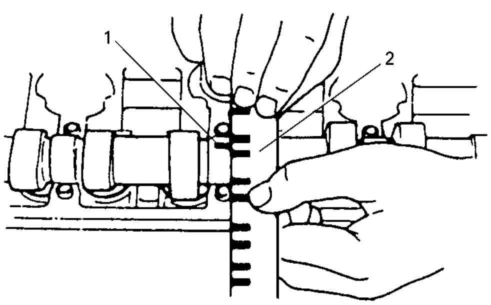


I3RH0B140041-

7) Remove housing, and using scale (2) on gauging plastic envelop, measure gauging plastic (1) 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.)



I2RH0B140083-

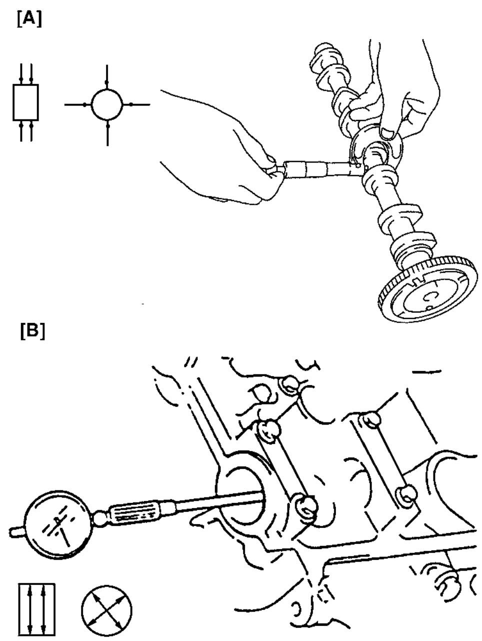
If measured camshaft journal clearance exceeds limit, measure journal (housing) bore and outside diameter of camshaft journal. Replace camshaft or cylinder head assembly whichever the difference from specification is greater.

Camshaft journal diameter [A]

Item	Standard
Intake side No.1 housing	26.940 – 26.955 mm (1.0606 – 1.0612 in.)
Exhaust side No.1 housing	26.934 – 26.955 mm (1.0604 – 1.0612 in.)
Others	22.934 – 22.955 mm (0.9029 – 0.9037 in.)

Camshaft journal bearing bore [B]

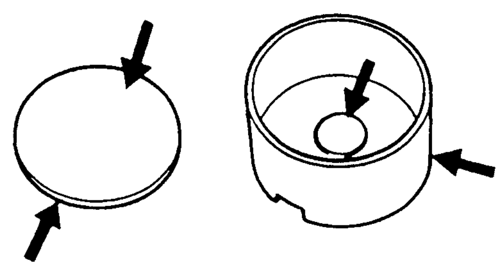
Item	Standard
Intake side No.1 housing	—
Exhaust side No.1 housing	27.000 – 27.021 mm (1.0630 – 1.0638 in.)
Others	23.000 – 23.021 mm (0.9055 – 0.9063 in.)



I2RH0B140084-

Wear of Tappet and Shim

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



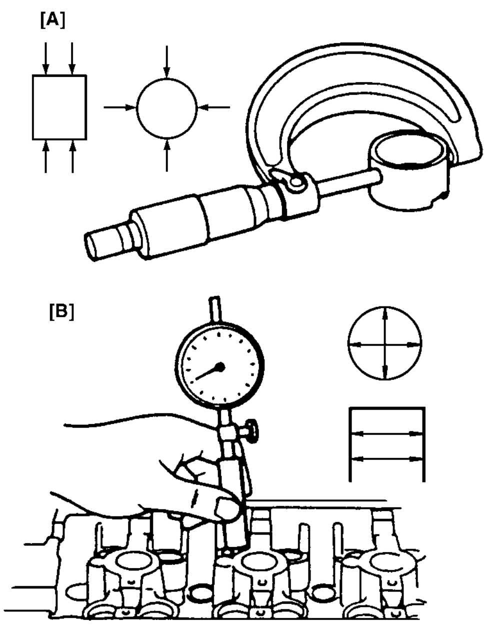
I2RH0B140085-

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 – 0.026 in.)
Limit: 0.15 mm (0.0059 in.)

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

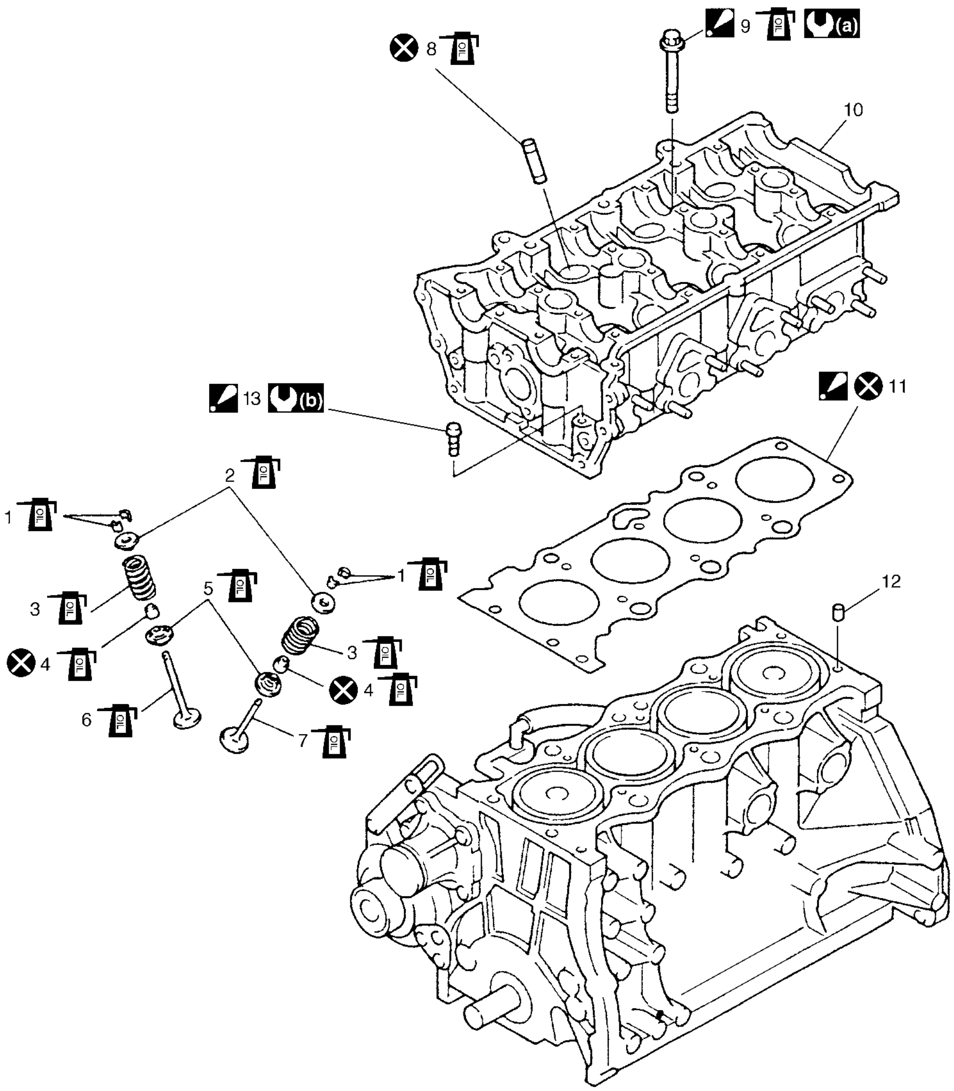
Cylinder head tappet bore [B]
Standard: 31.000 – 31.025 mm (1.2205 – 1.2215 in.)



I2RH0B140086-

Valves and Cylinder Head Components

S4RS0A1406023



I4RS0A140015-

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	(a) : 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.
3. Valve spring	9. Cylinder head bolt (M10) : Never reuse cylinder head bolts once disassembled it due to plastic deformation tightening. Be sure to use new cylinder head bolts when installing.	(b) : 25 N·m (2.5 kg-m, 18.0 lb-ft)
4. Valve stem seal	10. Cylinder head	: Do not reuse.
5. Valve spring seat	11. Cylinder head gasket : “TOP” mark provided on gasket comes to crankshaft pulley side, facing up.	: Apply engine oil to sliding surface of each part.
6. Intake valve	12. Knock pin	

Valves and Cylinder Head Removal and Installation

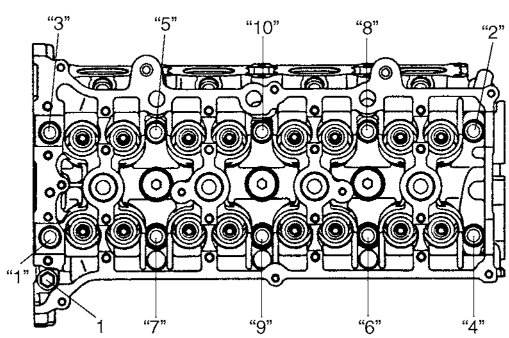
S4RS0A1406024

Removal

1) Remove engine assembly from vehicle referring to "Engine Assembly Removal and Installation: ".
2) Remove oil pan referring to "Oil Pan and Oil Pump Strainer Removal and Installation: in Section 1E".
3) Remove cylinder head cover referring to "Cylinder Head Cover Removal and Installation: ".
4) Remove timing chain cover referring to Steps 2) to 7) of "Removal" in "Timing Chain Cover Removal and Installation: ".
5) Remove timing chain referring to Steps 2) to 6) of "Removal" in "Timing Chain and Chain Tensioner Removal and Installation: ".
6) Remove intake and exhaust camshafts referring to Steps 3) to 7) of "Removal" in "Camshaft, Tappet and Shim Removal and Installation: ".
7) Loosen cylinder head bolts in such order as indicated in the figure by using a 12 corner socket wrenches and remove them.

NOTE:

- **Don't forget to remove bolt (M8) (1) as shown in the figure.**
- **Never reuse cylinder head bolts once disassembled it due to plastic deformation tightening. Be sure to use new cylinder head bolts when installing.**

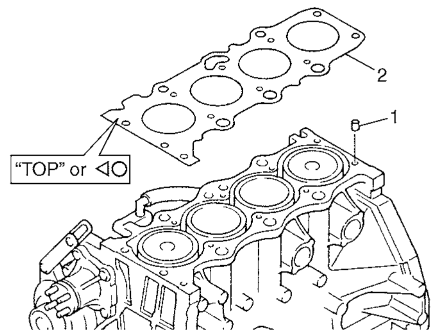


I2RH0B140088-

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 Section 1K".
10) Remove cylinder head with intake manifold and exhaust manifold. Use lifting device, if necessary.

Installation

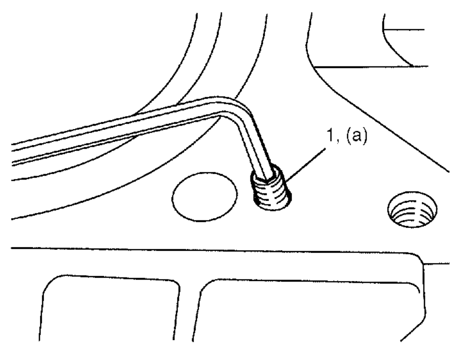
1) Clean mating surface of cylinder head and cylinder block. Remove oil, old gasket and dust from mating surface.
2) Install knock pins (1) to cylinder block.
3) Install new cylinder head gasket (2) to cylinder block. "Top" mark or "Triangle/circle" provided on gasket comes to crankshaft pulley side, facing up (toward cylinder head side).



I4RS0B140018-

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)



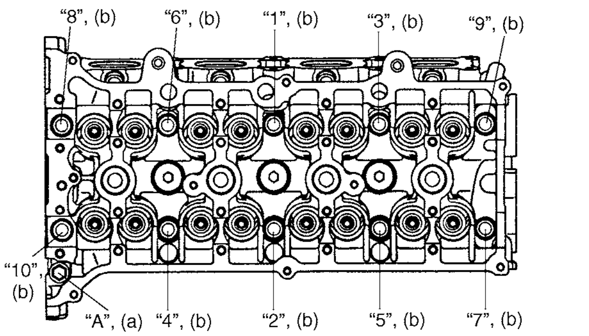
I2RH0B140089-

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 the figure.
   d) Repeat Step c).
   e) Tighten bolt "A" to specified torque.

NOTE:

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

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): 20 N·m (2.0 kg-m, 14.5 lb-ft), 40 N·m (4.0 kg-m, 29.0 lb-ft) and then retighten by turning through to 60° twice



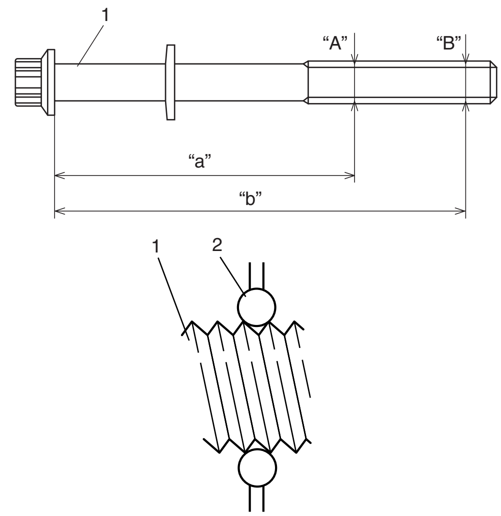
I2RH0B140091-

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 83.5 mm (2.81 in.) from seat side of flange bolt and “B” on 115 mm (4.53 in.) 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”: 83.5 mm (2.81 in.)
“b”: 115 mm (4.53 in.)

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



I2RH0B140092-

6) Install camshafts, tappet and shim referring to “Camshaft, Tappet and Shim Removal and Installation: ”.
7) Install timing chain referring to “Timing Chain and Chain Tensioner Removal and Installation: ”.
8) Install timing chain cover referring to “Timing Chain Cover Removal and Installation: ”.
9) Install cylinder head cover referring to “Cylinder Head Cover Removal and Installation: ”.
10) Install oil pan referring to “Oil Pan and Oil Pump Strainer Removal and Installation: in Section 1E”.

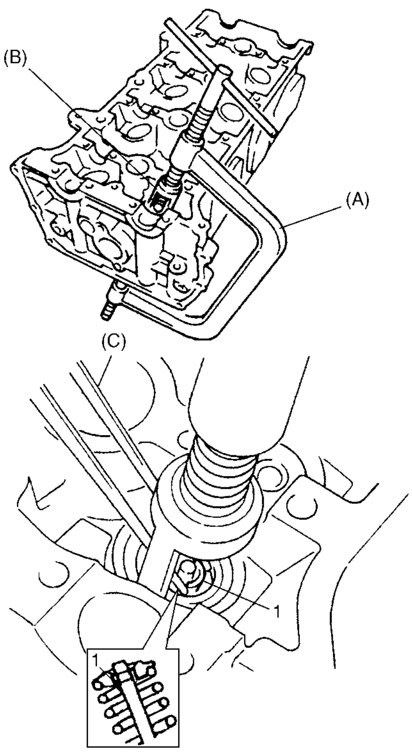
Valves and Cylinder Head Disassembly and Assembly

S4RS0A1406025

Disassembly

1) For ease in servicing cylinder head, remove intake manifold, injectors, exhaust manifold from cylinder head.
2) Using special tools (Valve lifter), compress valve spring and then remove valve cotters (1) also by using special tool (Forceps).

Special tool
(A): 09916–14510
(B): 09916–14521
(C): 09916–84511

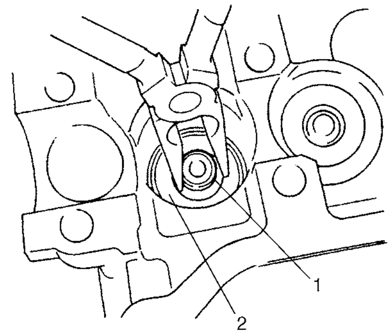


I2RH0B140093-

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 once disassembled. Be sure to use new seal when assembling.



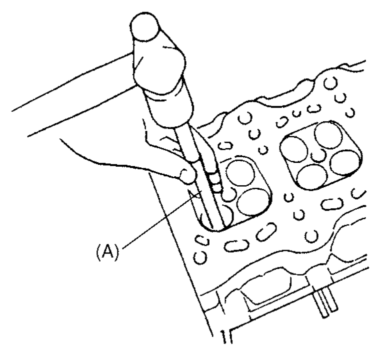
I2RH0B140094-

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.



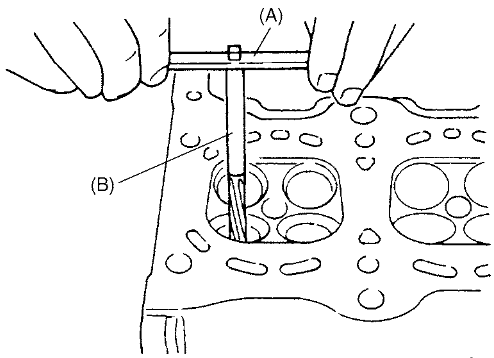
I2RH0B140095-

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



I2RH0B140096-

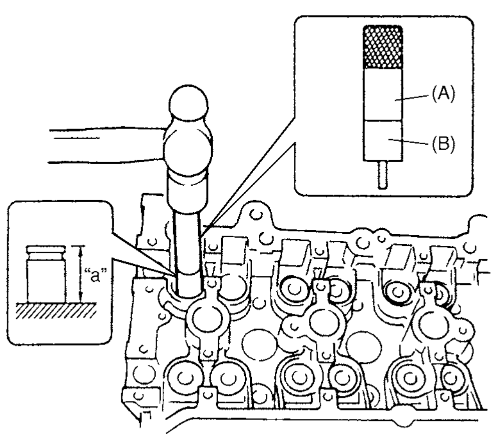
2) Install valve guide to cylinder head.
   Heat cylinder head uniformly at a temperature of 80 to 100 °C (176 to 212 °F) so that head will not be distorted, and drive new valve guide into hole with special tools.
   Drive in new valve guide until special tool (Valve guide installer) contacts cylinder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

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

   NOTE:

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

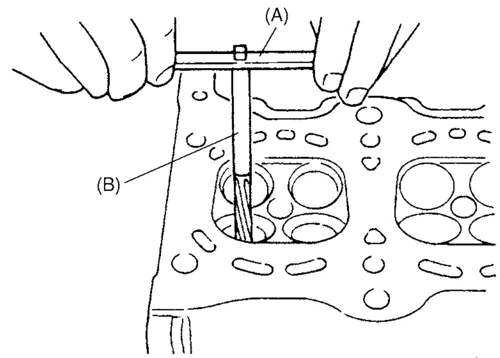
   Valve guide protrusion (In and Ex)
   “a”: 11.3 mm (0.44 in.)



I2RH0B140097-

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

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



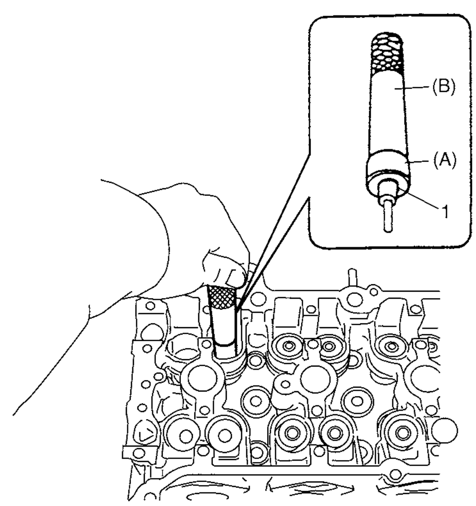
I2RH0B140096-

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 tool
   (A): 09917–98221
   (B): 09916–58210

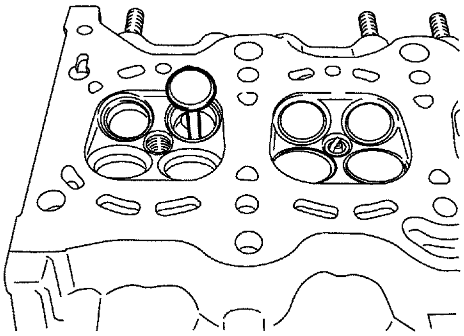
   NOTE:

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



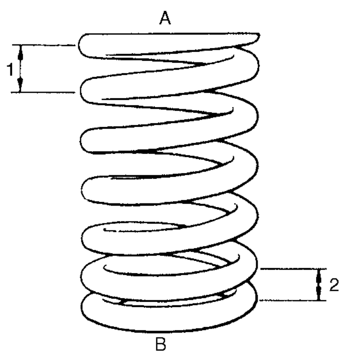
I2RH0B140098-

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



I2RH0B140099-

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).



I2RH0B140100-

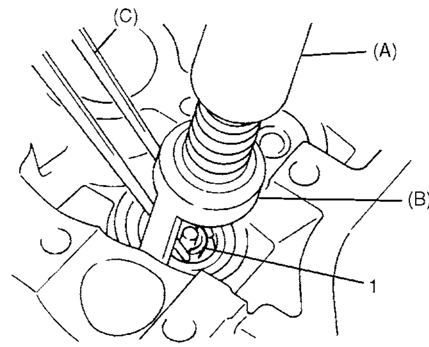
A:	Valve spring retainer side
B:	Valve spring seat side

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

NOTE:

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

Special tool
(A): 09916–14510
(B): 09916–14521
(C): 09916–84511



I2RH0B140101-

9) Install intake manifold referring to “Intake Manifold Removal and Installation: ”.
10) Install fuel injectors referring to “Fuel Injector Removal and Installation: in Section 1G”.
11) Install exhaust manifold referring to “Exhaust Manifold Removal and Installation: in Section 1K”.

Valves and Valve Guides Inspection

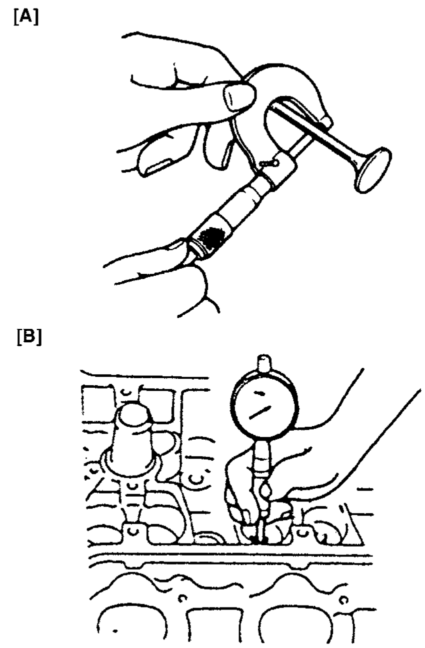
S4RS0A1406026

Valve Guide

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 and valve guide specification

Item		Standard	Limit
Valve stem diameter [A]	In	5.465 – 5.480 mm (0.2150 – 0.2157 in.)	—
	Ex	5.440 – 5.455 mm (0.2142 – 0.2148 in.)	—
Valve guide bore [B]	In & Ex	5.500 – 5.512 mm (0.2165 – 0.2170 in.)	—
Stem-to-guide clearance	In	0.020 – 0.047 mm (0.0008 – 0.0018 in.)	0.070 mm (0.0028 in.)
	Ex	0.045 – 0.072 mm (0.0017 – 0.0028 in.)	0.090 mm (0.0035 in.)

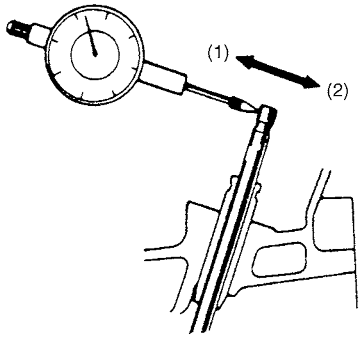


I3RM0A140035-

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.)

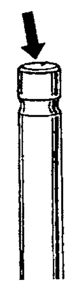


IYSQ01141096-

Valve

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.

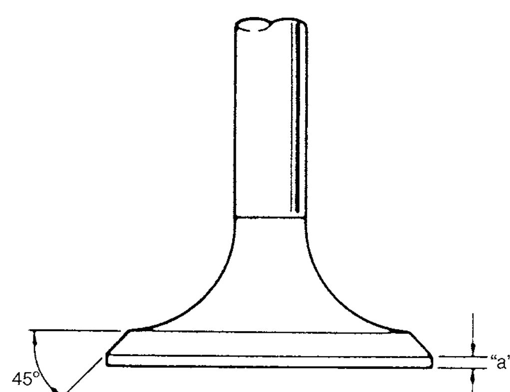


I2RH01140135-

Valve head thickness

Measure thickness “a” of valve head. If measured thickness exceeds limit, replace valve.

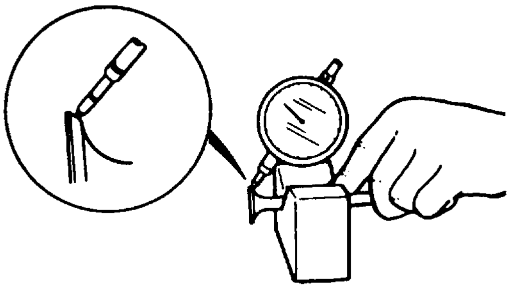
Valve head thickness “a” (In and Ex)
Standard: 1.25 – 1.55 mm (0.049 – 0.061 in.)
Limit: 0.9 mm (0.035 in.)



I2RH0B140102-

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.

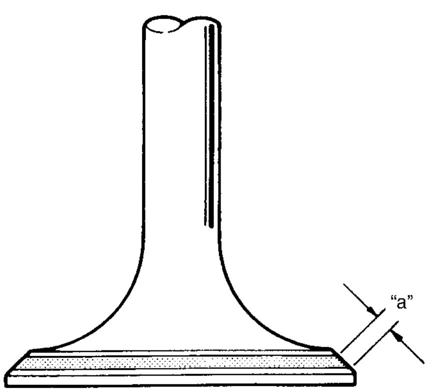
Valve head radial runout
Limit: 0.08 mm (0.003 in.)



I2RH01140136-

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
Intake and Exhaust: 1.0 – 1.4 mm (0.0389 – 0.0551 in.)



I2RH0B140103-

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.

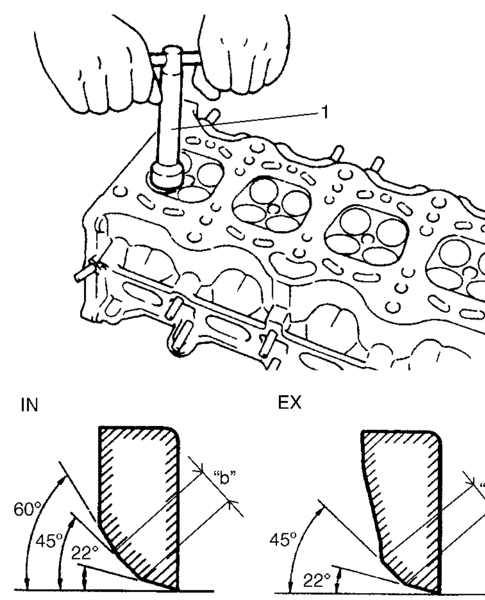
1) **Exhaust valve seat:**
Use valve seat cutters (1) to make two cuts as illustrated in the figure. Two cutters must be used: the first for making 22° angle, and the second for making 45° angle. The second cut must be made to produce desired seat width.

Seat width for exhaust valve seat
"a": 1.0 – 1.4 mm (0.0389 – 0.0551 in.)

2) **Intake valve seat:**
Use valve seat cutters (1) to make three cuts as illustrated in the figure. Three cutters must be used: the 1st for making 22° 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 (0.0389 – 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.



I3RM0A140036-

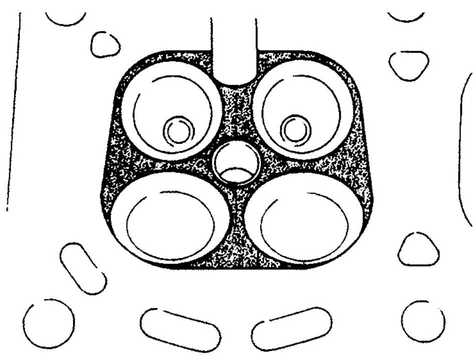
Cylinder Head Inspection

S4RS0A1406027

- Remove all carbon deposits from combustion chambers.

NOTE:

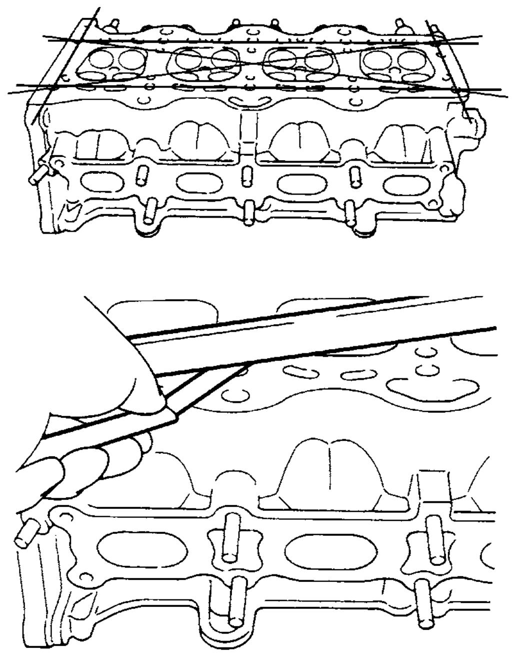
Do not use any sharp-edged tool to scrape off carbon deposits. Be careful not to scuff or nick metal surfaces when decarbonizing. The same applies to valves and valve seats, too.



I2RH0B140105-

- 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 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.

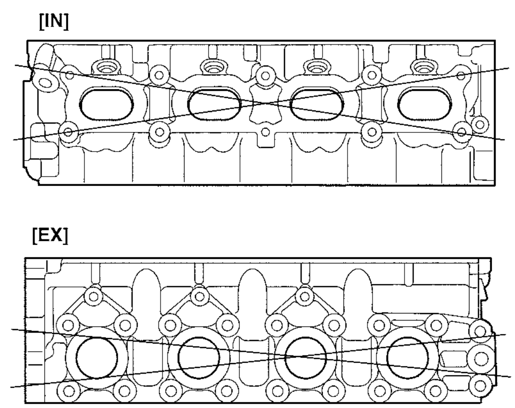
  Distortion for cylinder head surface on piston side
  Limit: 0.03 mm (0.001 in.)



I2RH0B140106-

- 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.

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



I2RH0B140107-

Valve Spring Inspection

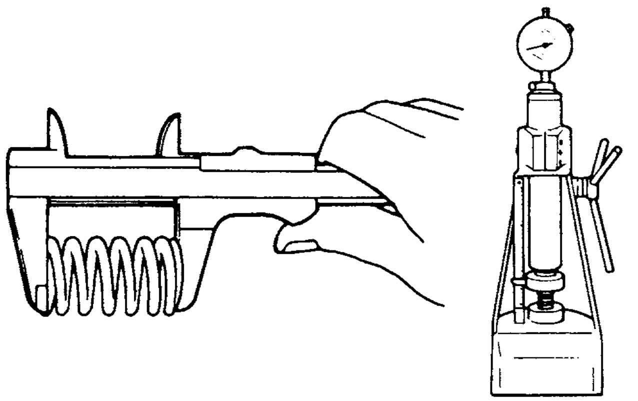
S4RS0A1406028

Valve Spring Free Length and Preload

Referring to data, 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.)

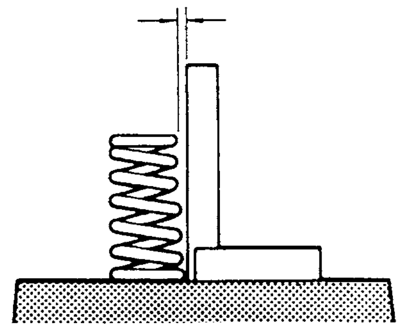


I2RH01140143-

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 must be replaced.

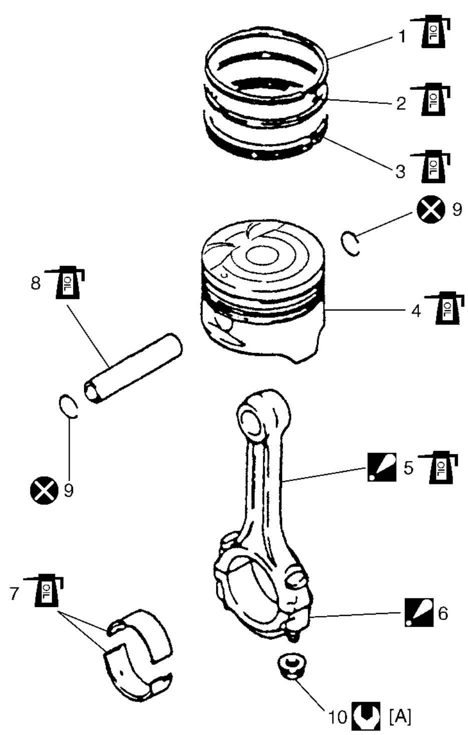
Valve spring squareness
Limit: 1.6 mm (0.063 in.)



I2RH01140144-

Pistons, Piston Rings, Connecting Rods and Cylinders Components

S4RS0A1406029



I2RH0B140108-

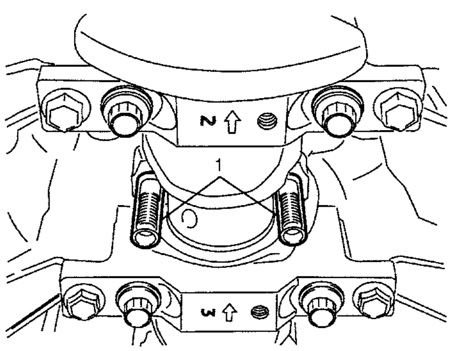
[A]:	1) Tighten all nuts to 15 N·m (1.5 kg-m). 2) Then retighten all nuts by turning through 45°. 3) Repeat Step 2) again.	7.	Connecting rod bearing
1.	Top ring	8.	Piston pin
2.	2nd ring	9.	Piston pin circlip
3.	Oil ring	10.	Bearing cap nut
4.	Piston	:	Tightening torque
5.	Connecting rod : See “A”	:	Apply engine oil to sliding surface of each part.
6.	Connecting rod bearing cap : See “B”	:	Do not reuse.
“A”:	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 “Piston Pins and Connecting Rods Inspection: ”.		
“B”:	Point arrow mark on cap to crankshaft pulley side.		

Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation

S4RS0A1406030

Removal

1) Remove engine assembly from vehicle referring to “Engine Assembly Removal and Installation: ”.
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.



I2RH0B140109-

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.

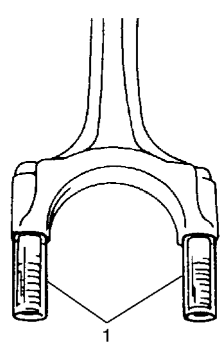
Installation

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

NOTE:

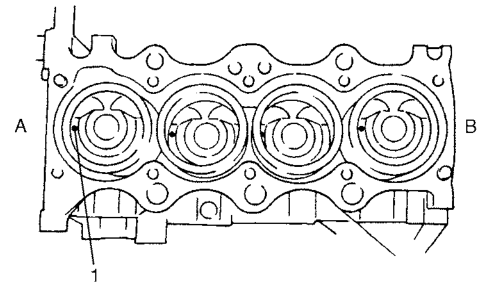
Do not apply oil between connecting rod and bearing or between bearing cap and bearing.

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.



I2RH01140147-

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

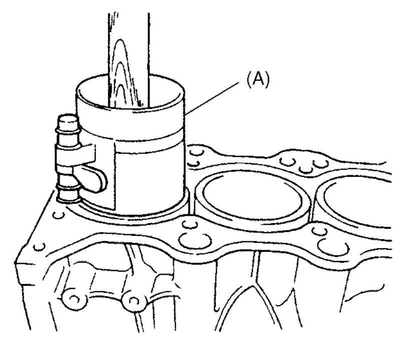


I2RH0B140110-

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



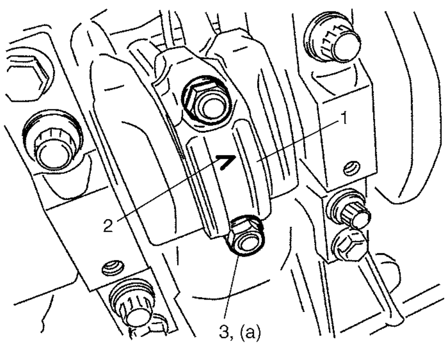
I2RH0B140111-

5) Install bearing cap (1):
Point arrow mark (2) on cap to crankshaft pulley side.
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.

NOTE:

Before installing bearing cap, make sure that checking for connecting rod bolt deformation. Refer to "Piston Pins and Connecting Rods Inspection: ".

Tightening torque
Connecting rod bearing cap nut (a): 15 N·m (1.5 kg-m, 11.0 lb-ft) and then retighten by turning through 45° twice



I2RH0B140112-

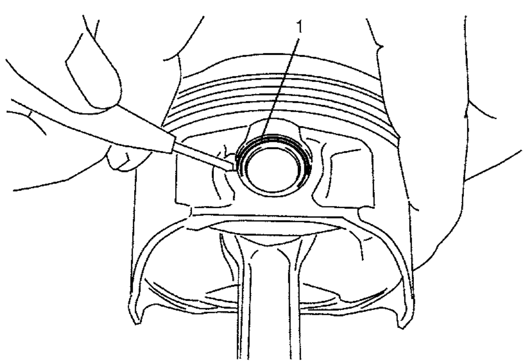
6) Install cylinder head referring to "Valves and Cylinder Head Removal and Installation: ".

Pistons, Piston Rings, Connecting Rods and Cylinders Disassembly and Assembly

S4RS0A1406031

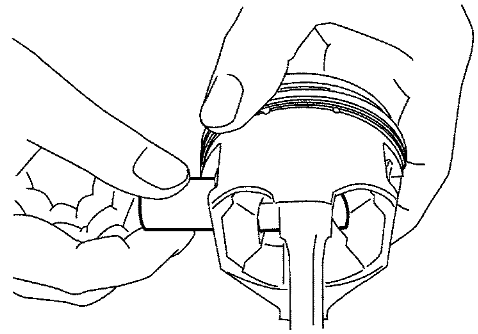
Disassembly

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.



I2RH0B140113-

   b) Force piston pin out.



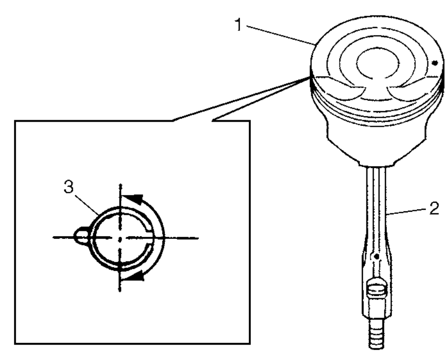
I2RH0B140114-

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 the figure.
   c) Insert piston pin to piston and connecting rod.
   d) Install piston pin circlips (3).

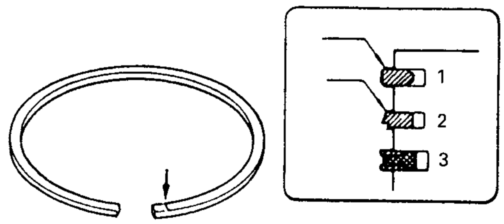
NOTE:

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



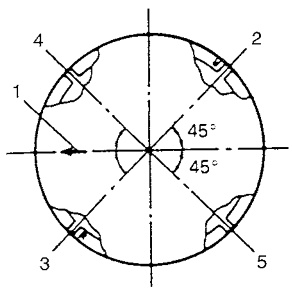
I2RH0B140115-

3) Install piston rings to piston:
   - As indicated in the 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.
   - 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 the figure.
   - When installing oil ring (3), install spacer first and then two rails.



I2RH0B140116-

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



IYSQ01142102-

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

Cylinders, Pistons and Piston Rings Inspection

S4RS0A1406032

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 over size 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 the figure.
If any of the following conditions is noted, rebore cylinder.

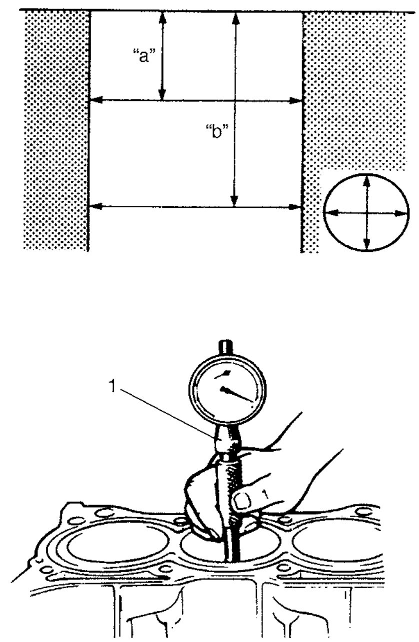
1) Cylinder bore dia. exceeds limit.
2) Difference of measurements at two positions exceeds taper limit.
3) Difference between thrust and axial measurements exceeds out-of-round limit.

<u>**Cylinder bore diameter**</u>
Standard: 78.00 – 78.014 mm (3.0709 – 3.0714 in.)
Limit: 78.050 mm (3.073 in.)

<u>**Cylinder taper and out-of-round**</u>
Limit: 0.10 mm (0.004 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.



I2RH0B140117-

“a”:	50 mm (1.96 in.)
“b”:	100 mm (3.94 in.)

Piston

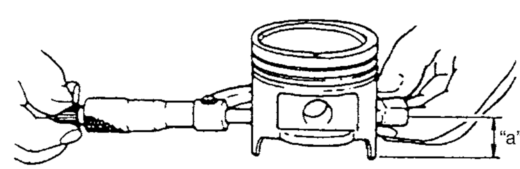
Visual inspection

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

Piston diameter

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

<u>**Piston diameter specification**</u>
Standard size: 77.953 – 77.968 mm (3.0690 – 3.0696 in.)
Standard size (new one (with coating)): 77.969 – 77.984 mm (3.0696 – 3.0702 in.)
Oversize (0.50 mm (0.0196 in.)): 78.453 – 78.468 mm (3.0887 – 3.0893 in.)



I2RH01140157-

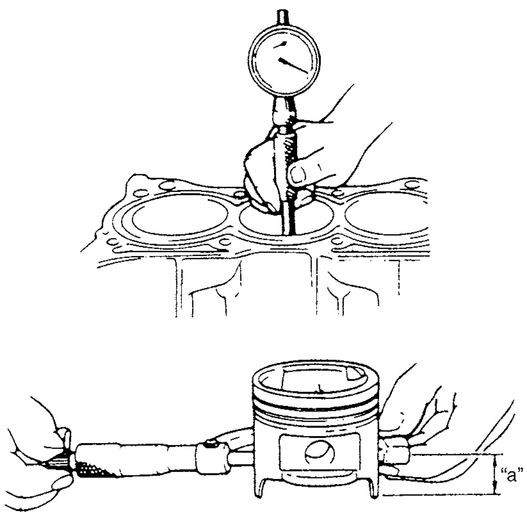
Piston clearance

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

NOTE:

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

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



I4RS0A140022-

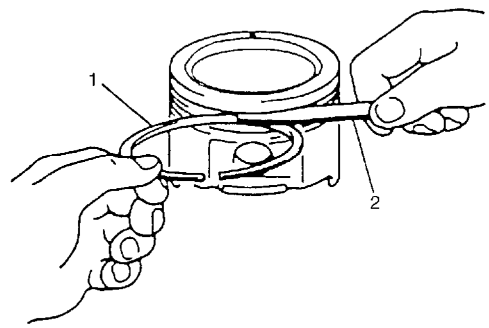
"a": 19.5 mm (0.77 in.)

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 specification, replace piston.

Ring groove clearance

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



I2RH01140159-

Piston Ring

Piston ring end gap

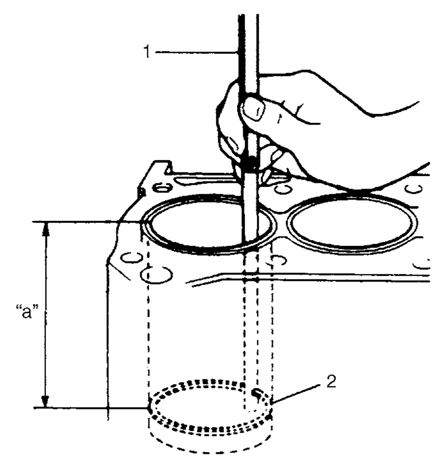
To measure end gap, insert piston ring (2) into cylinder bore and then measure the gap by using thickness gauge (1).
If measured gap exceeds limit, replace ring.

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 – 0.0138 in.)	0.7 mm (0.0276 in.)
2nd ring	0.35 – 0.50 mm (0.0138 – 0.0197 in.)	1.0 mm (0.0394 in.)
Oil ring	0.20 – 0.70 mm (0.0079 – 0.0276 in.)	1.2 mm (0.0472 in.)



I2RH01140161-

"a": 120 mm (4.72 in.)

Piston Pins and Connecting Rods Inspection

S4RS0A1406033

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.

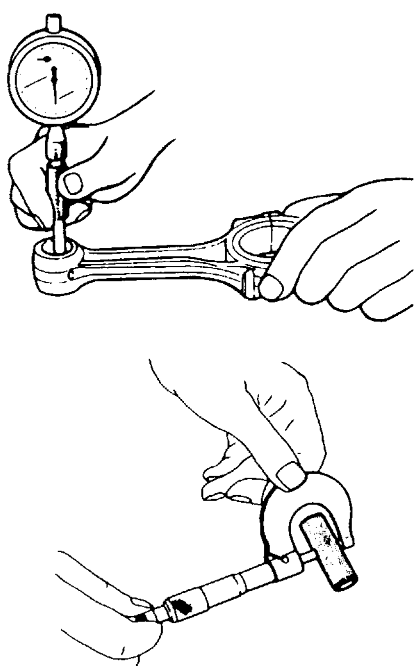
<u>Piston pin clearance in connecting rod small end</u>
Standard: 0.003 – 0.014 mm (0.0001 – 0.0006 in.)
Limit: 0.05 mm (0.00020 in.)

<u>Piston pin clearance in piston</u>
Standard: 0.006 – 0.017 mm (0.00024 – 0.00067 in.)
Limit: 0.05 mm (0.0020 in.)

<u>Small-end bore</u>
20.003 – 20.011 mm (0.7875 – 0.7878 in.)

<u>Piston pin dia.</u>
19.997 – 20.000 mm (0.7873 – 0.7874 in.)

<u>Piston bore</u>
20.006 – 20.014 mm (0.7876 – 0.7880 in.)



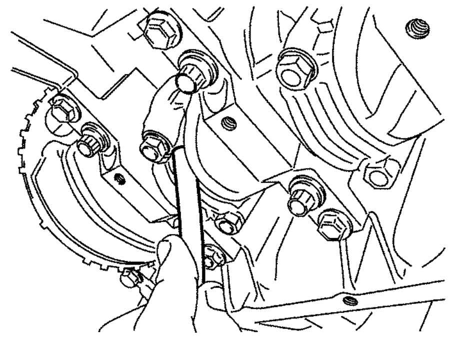
I4RS0A140023-

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.

<u>Big-end side clearance</u>
Standard: 0.25 – 0.40 mm (0.0098 – 0.0157 in.)
Limit: 0.55 mm (0.0217 in.)

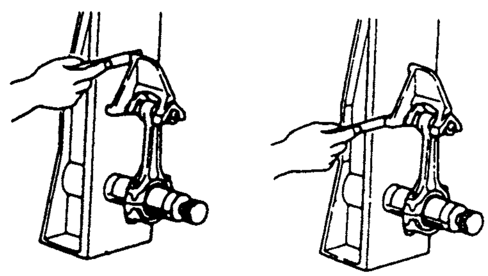


I2RH0B140148-

Connecting rod alignment

Mount connecting rod on aligner to check it for bow and twist. If measured value exceeds the limit, replace it.

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



I4RH01140053-

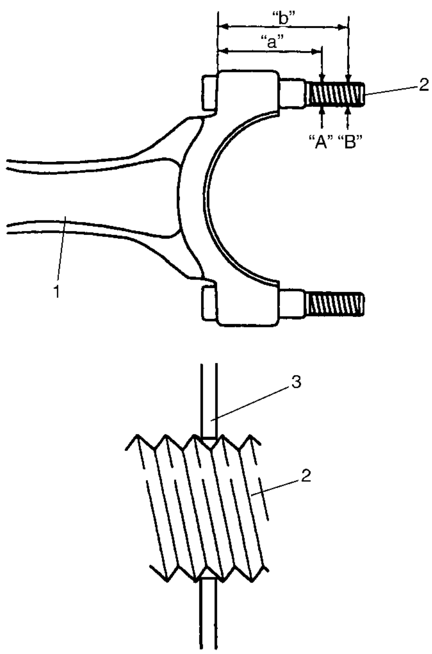
Connecting rod bolt deformation (Plastic deformation tightening bolt)

Measure each thread diameter of connecting rod 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 is exceeds limit, replace connected rod (1).

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.)



I2RH0B140119-

Crank Pin and Connecting Rod Bearings Inspection

S4RS0A1406034

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.

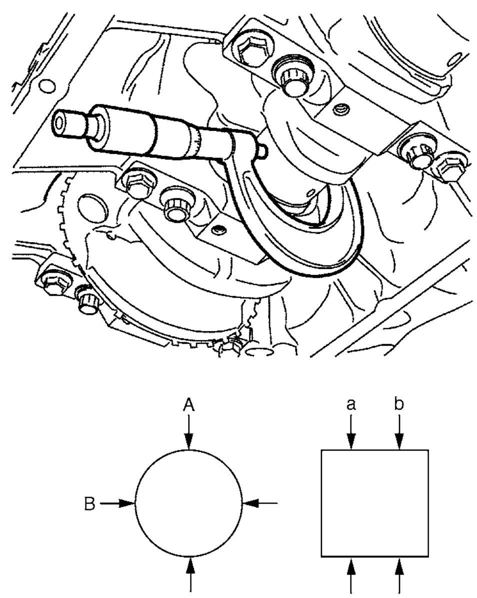
Crank pin diameter

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

Out-of-round
A – B

Taper
a – b

Crank pin taper and out-of-round
Limit: 0.01 mm (0.0004 in.)

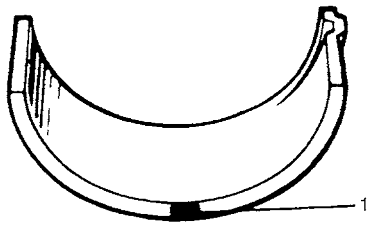


I2RH0B140120-

Connecting Rod Bearing General Information

Service connecting rod bearings are available in standard size and 0.25 mm (0.0098 in.) undersize bearing, 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 the figure, undersize bearing thickness is 1.605 – 1.615 mm (0.0632 – 0.0635 in.) at the center of it.



I2RH01140164-

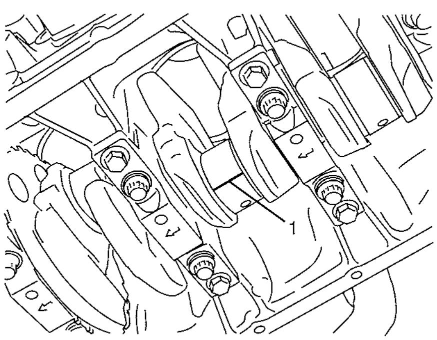
1. Red paint

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

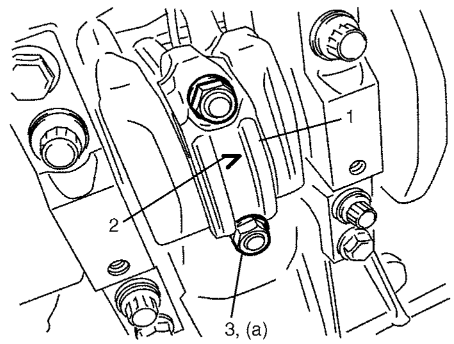
1) Before checking bearing clearance, clean bearing and crank pin.
2) Install bearing in connecting rod and bearing cap.
3) Place a piece of gauging plastic (1) to full width of crank pin as contacted by bearing (parallel to crankshaft), avoiding oil hole.



I2RH0B140121-

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 the figure. After applying engine oil to rod bolts, tighten cap nuts (3) gradually as follows.
   a) Tighten all cap nuts to 15 N·m (1.5 kg-m, 11.0 lb-ft)
   b) Retighten them to 45°
   c) Repeat Step b) once again.

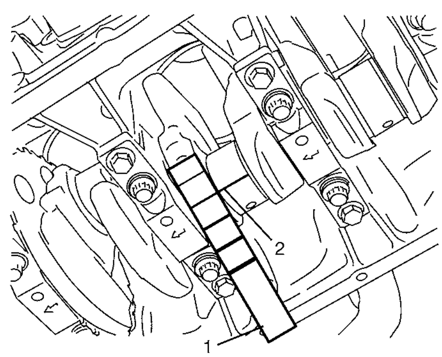
   Tightening torque
   Connecting rod bearing cap nut (a): 15 N·m (1.5 kg-m, 11.0 lb-ft) and then retighten by turning through 45° twice



I2RH0B140122-

5) Remove cap and using a scale (1) on gauging plastic envelope (2), measure gauging plastic (2) width at the widest point (clearance). If clearance exceed its limit, use a new standard size bearing referring to “Selection of Connecting Rod Bearings: ”. After selecting new bearing, recheck clearance.

   <u>Connecting rod bearing clearance</u>
   Standard: 0.029 – 0.047 mm (0.0011 – 0.0018 in.)
   Limit: 0.065 mm (0.0026 in.)



I2RH0B140123-

6) If clearance can not be brought to its limit even by using a new standard size bearing, use next thicker bearing and recheck clearance or regrind crank pin to undersize and use 0.25 mm undersize bearing.

Selection of Connecting Rod Bearings

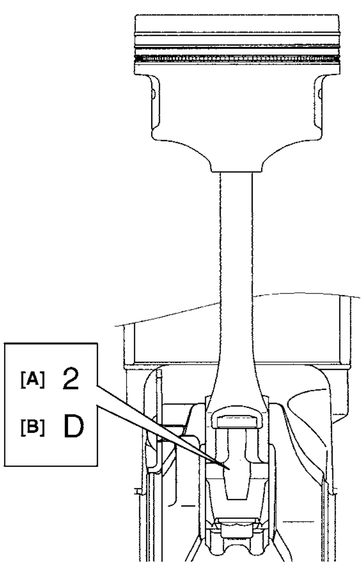
NOTE:

- **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 45.000 – 45.006 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.)



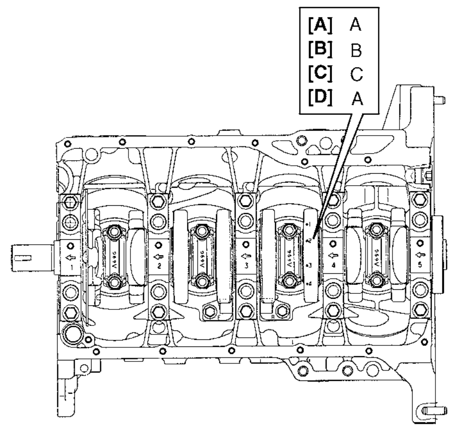
I3RH0A140017-

[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 the 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 41.994 – 42.000 mm (1.6533 – 1.6534 in.).

Crankshaft pin outer diameter

Stamped alphabet	Crankshaft pin diameter
A	41.9940 – 42.0000 mm (1.6533 – 1.6534 in.)
B	41.9880 – 41.9939 mm (1.6531 – 1.6532 in.)
C	41.9820 – 41.9879 mm (1.6529 – 1.6530 in.)



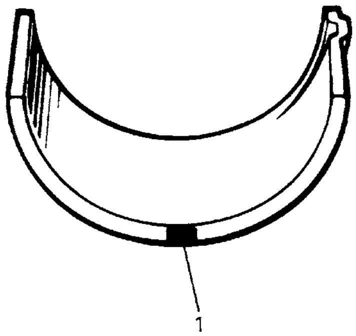
I3RH0A140018-

[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 the 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 (0.05878 – 0.05889 in.)
Black	1.4901 – 1.4930 mm (0.05867 – 0.05877 in.)
Green	1.4870 – 1.4900 mm (0.05855 – 0.05866 in.)



I3RH0A140019-

1. Paint

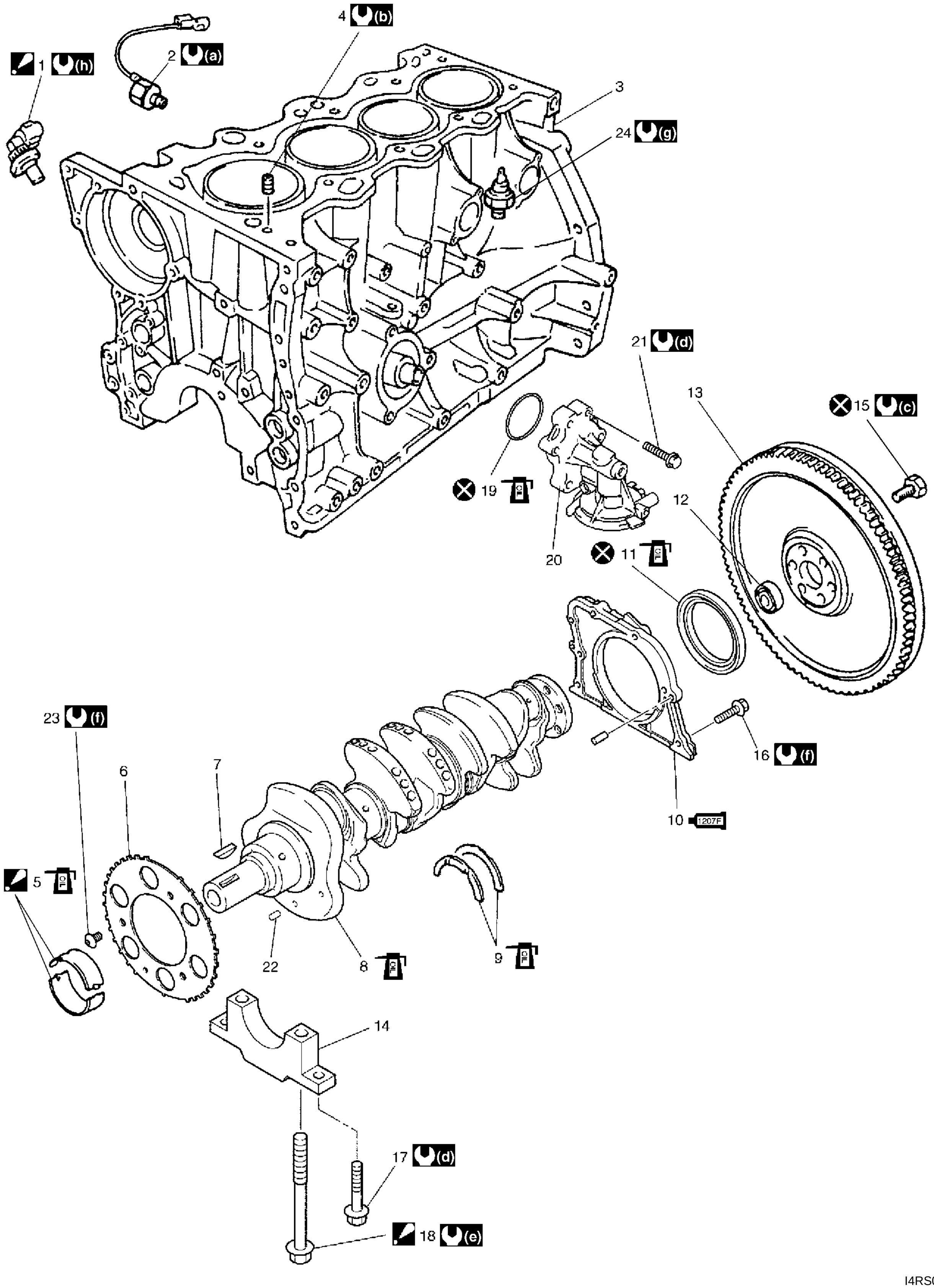
4) From number stamped on connecting rod and its cap and alphabets stamped on crank web No.3, determine new standard bearing to be installed to connecting rod big end inside, by referring to the table.
   For example, if number stamped on connecting rod and its cap is “1” and alphabet stamped on crank 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.		

Main Bearings, Crankshaft and Cylinder Block Components

S4RS0A1406035



I4RS0A140016-

1.	CKP sensor (if equipped) : See “A”	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	24.	Oil pressure switch
5.	Main bearing : See “B”	15.	Flywheel mounting bolt	(a) :	22 N·m (2.2 kg-m, 16.0 lb-ft)
6.	Sensor plate	16.	Rear oil seal housing mounting bolt	(b) :	5 N·m (0.5 kg-m, 4.0 lb-ft)
7.	Crankshaft timing sprocket key	17.	Main bearing cap No.2 bolt	(c) :	70 N·m (7.0 kg-m, 51.0 lb-ft)
8.	Crankshaft	18.	Main bearing cap No.1 bolt : See “D”	(d) :	Tighten 25 N·m (2.5 kg-m, 18.0 lb-ft) by the specified procedure.
9.	Thrust bearing	19.	O-ring	(e) :	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.
1207F 10.	Rear oil seal housing : See “C”	20.	Oil filter adapter case	(f) :	11 N·m (1.1 kg-m, 8.0 lb-ft)
“A”:	When installing CKP sensor, use new sensor mounting bolt.			(g) :	13 N·m (1.3 kg-m, 9.5 lb-ft)
“B”:	Upper half of bearing has an oil groove.			(h) :	10 N·m (1.0 kg-m, 7.5 lb-ft)
“C”:	Apply sealant 99000-31250 to mating surface.			:	Do not reuse.
“D”:	Make sure main bearing cap No.1 bolt deformation when reuse it due to plastic deformation tightening referring to “Main Bearings Inspection: ”.			:	Apply engine oil to inside / sliding surface.

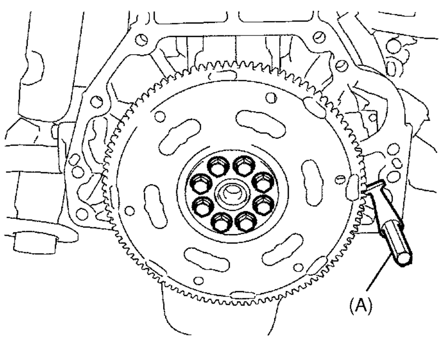
Main Bearings, Crankshaft and Cylinder Block Removal and Installation

S4RS0A1406036

Removal

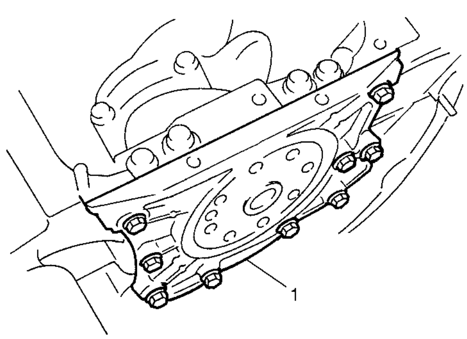
1) Remove engine assembly from vehicle referring to “Engine Assembly Removal and Installation: ”.
2) Remove clutch cover, clutch disc and flywheel (drive plate for A/T) by using special tool.

Special tool
(A): 09924–17810



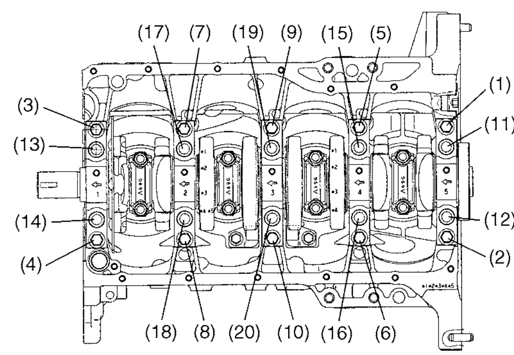
I2RH0B140125-

3) Remove piston and connecting rod referring to “Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation: ”.
4) Remove rear oil seal housing (1).



I2RH0B140126-

5) Loosen main bearing cap No.1 and No.2 bolts in such order as indicated in the figure and remove them.



I2RH0B140127-

6) Remove crankshaft from cylinder block.

Installation

NOTE:

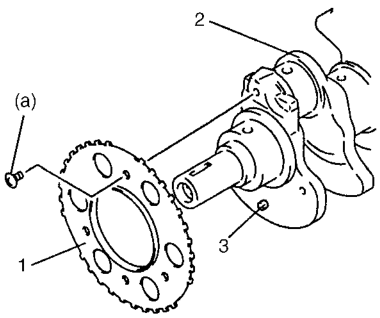
- **Use new bearing cap No.1 bolts. They are deformed once they are used because they are plastic deformation tightening bolts.**
- **All parts to be installed must be perfectly clean.**
- **Be sure to oil crankshaft journals, journal bearings, thrust bearings, crankpins, connecting rod bearings, pistons, piston rings and cylinder bores.**
- **Journal bearings, bearing caps, connecting rods, rod bearings, rod bearing caps, pistons and piston rings are in combination sets. Do not disturb such combination and make sure that each part goes back to where it came from, when installing.**

1) Install sensor plate (1) to crankshaft (2) and tighten bolts to specified torque.

NOTE:

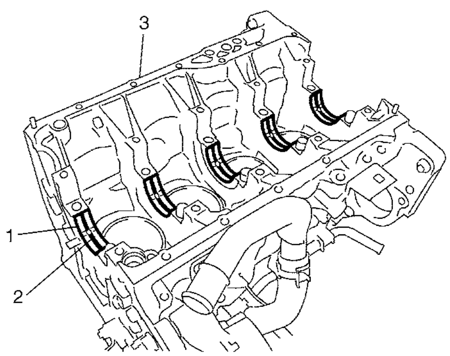
When installing sensor plate, align spring pin (3) on crankshaft and hole of sensor plate.

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



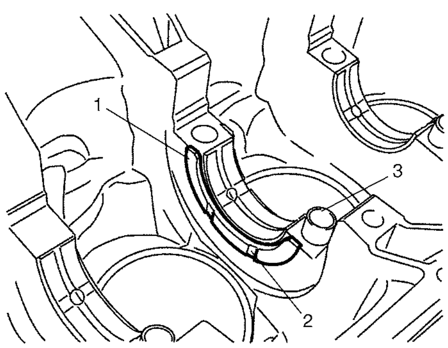
I2RH0B140128-

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.



I2RH0B140129-

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.



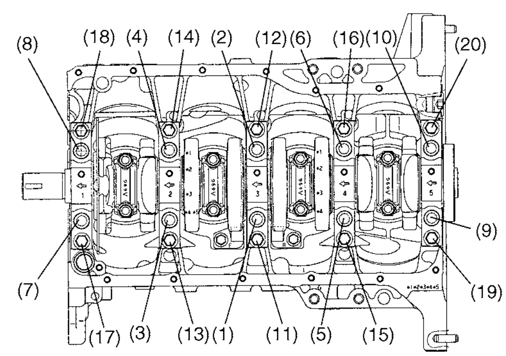
I2RH0B140130-

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)): 30 N·m (3.0 kg-m, 22.0 lb-ft), 50 N·m (5.0 kg-m, 36.5 lb-ft) and then retighten by turning through 60°
Main bearing cap No.2 bolt ((11) – (20)): 25 N·m (2.5 kg-m, 18.0 lb-ft)

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.

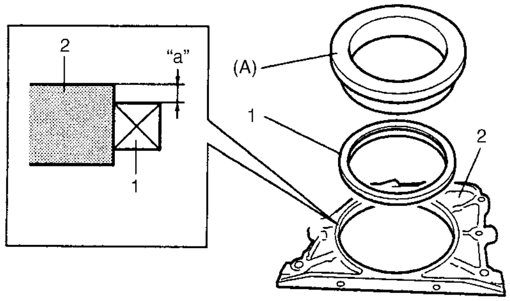


I2RH0B140131-

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

<u>Crank rear oil seal installing position (dimension)</u>
"a": 2 mm (0.08 in.)

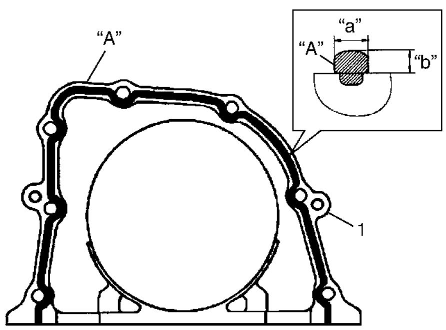


I4RS0A140017-

8) Apply sealant to mating surface of rear oil seal housing (1).

"A": Water tight sealant 99000–31250

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

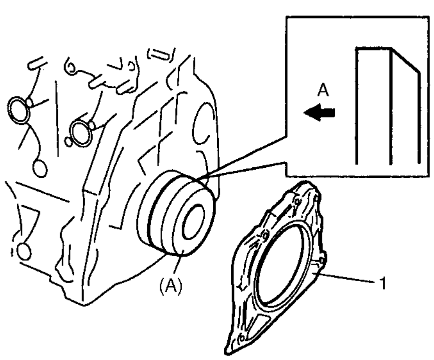


I4RS0A140018-

9) Install rear oil seal housing (1) and tighten bolts to specified torque by using special tool.

Special tool
(A): 09911–97720

Tighting torque
Rear oil seal housing bolt: 11 N·m (1.1 kg-m, 8.0 lb-ft)



I4RS0A140019-

A:	Crankshaft side

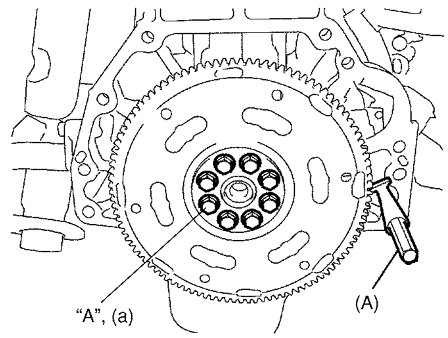
10) Install flywheel (for M/T).
Using special tool, lock flywheel, and tighten flywheel bolts to specified torque.

NOTE:

Use new flywheel bolts.

Special tool
(A): 09924–17810

Tightening torque
Flywheel bolt (a): 70 N·m (7.0 kg-m, 51.0 lb-ft)



I2RH0B140134-

11) Install piston and connecting rod referring to "Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation: ".
12) Install engine assembly to vehicle referring to "Engine Assembly Removal and Installation: ".

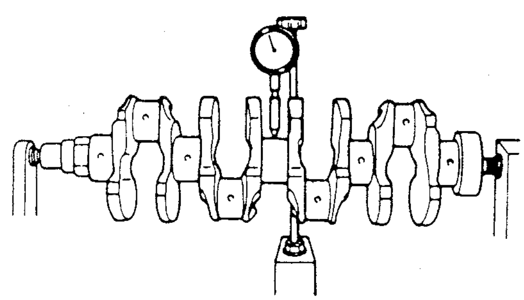
Crankshaft Inspection

S4RS0A1406037

Crankshaft Runout

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

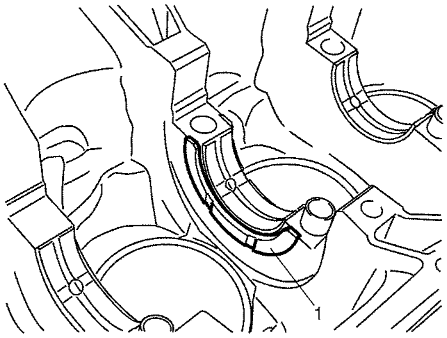
Crankshaft runout
Limit: 0.02 mm (0.0008 in.)


I2RH0B140135-

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.

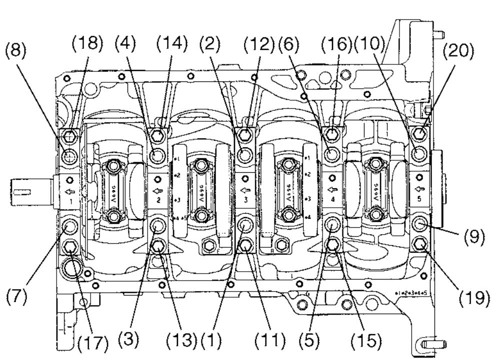
   <u>Thickness of crankshaft thrust bearing</u>
   Standard: 2.500 mm (0.0984 in.)
   Oversize (0.125 mm (0.0049 in.)): 2.563 mm (0.1009 in.)



I2RH0B140136-

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 the 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 the figure.

   Tightening torque
   Main bearing cap No.1 bolt ((1) – (10)): 30 N·m (3.0 kg-m, 22.0 lb-ft), 50 N·m (5.0 kg-m, 36.5 lb-ft) and then retighten by turning through 60°
   Main bearing cap No.2 bolt ((11) – (20)): 25 N·m (2.5 kg-m, 18.0 lb-ft)



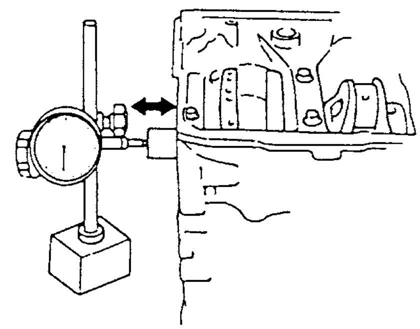
I2RH0B140137-

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.

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

   NOTE:

   After checking the thrust play, make sure that thread deformation of each bearing cap No.1 bolt referring to "Main Bearing Cap No.1 Bolt" in "Main Bearings Inspection: ".



I2RH01140183-

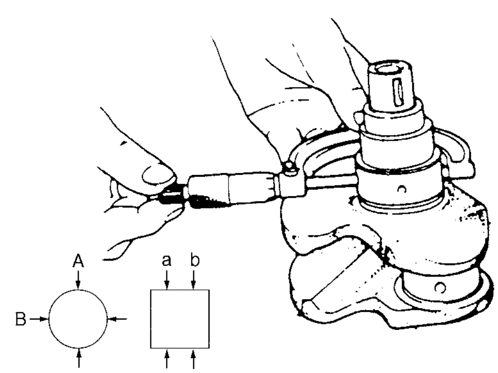
Out-of-Round and Taper (Uneven Wear) of Journals

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 exceeds its limit, regrind or replace crankshaft.

<u>Crankshaft out-of-round and taper</u>
Limit: 0.01 mm (0.0004 in.)

<u>Out-of-round</u>
A – B

<u>Taper</u>
a – b



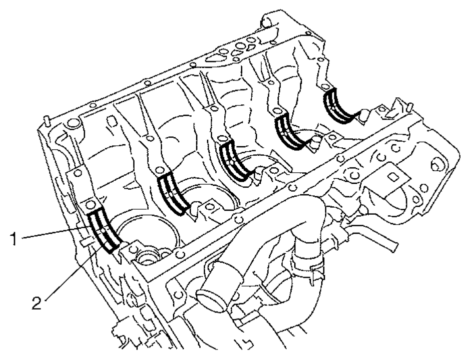
I2RH0B140138-

Main Bearings Inspection

S4RS0A1406038

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



I2RH0B140139-

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.

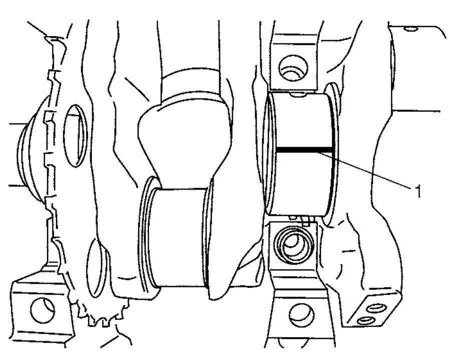
Main Bearing Clearance

NOTE:

Do not rotate crankshaft while gauging plastic is installed.

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

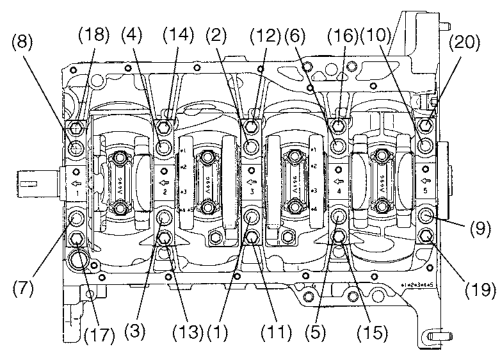
1) Remove bearing caps.
2) Clean bearings and main journals.
3) Place a piece of gauging plastic (1) the full width of bearing (parallel to crankshaft) on journal, avoiding oil hole.



I2RH0B140140-

4) 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 the 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 the figure.

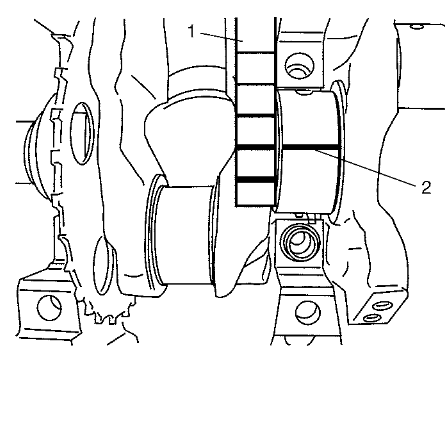
   Tightening torque
   Main bearing cap No.1 bolt ((1) – (10)): 30 Nm (3.0 kg-m, 22.0 lb-ft), 50 Nm (5.0 kg-m, 36.5 lb-ft) and then retighten by turning through 60°
   Main bearing cap No.2 bolt ((11) – (20)): 25 N·m (2.5 kg-m, 18.0 lb-ft)



I2RH0B140137-

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

   Main bearing clearance
   Standard: 0.021 – 0.041 mm (0.0008 – 0.0016 in.)
   Limit: 0.054 mm (0.0021 in.)



I2RH0B140141-

Selection of Main Bearings

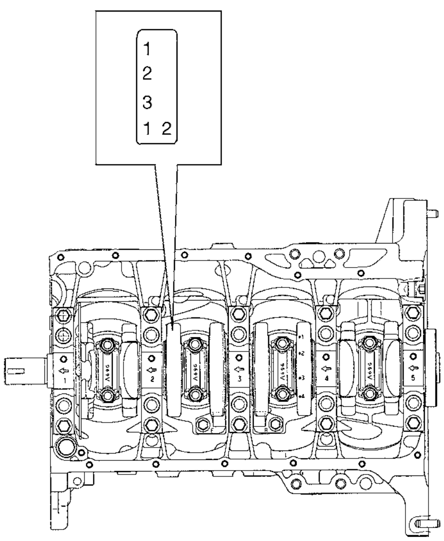
Standard bearing

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 the 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 the figure respectively. For example, stamped number "1" indicates that corresponding journal diameter is 51.9940 – 52.0000 mm (2.0471 – 2.0472 in.).

Crankshaft journal diameter

Stamped numbers	Journal diameter
1	**51.9940 – 52.0000 mm (2.0471 – 2.0472 in.)**
2	**51.9880 – 51.9939 mm (2.0468 – 2.0470 in.)**
3	**51.9820 – 51.9879 mm (2.0465 – 2.0467 in.)**

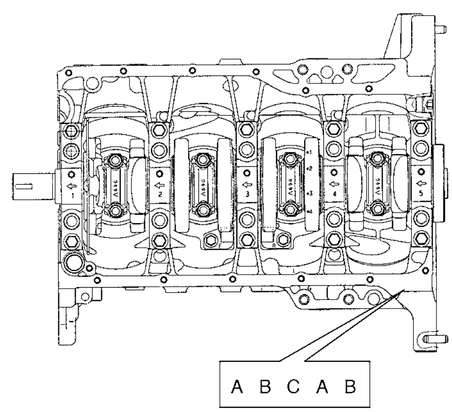


I2RH0B140142-

2) Next, check bearing cap bore diameter without bearing. On mating surface of cylinder block, five alphabets are stamped as shown in the 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 the figure respectively.
   For example, stamped "A" or "1" indicates that corresponding bearing cap bore diameter is 56.0000 – 56.0060 mm (2.2048 – 2.2049 in.).

Crankshaft bearing cap bore

Stamped alphabet (number)	Bearing cap bore diameter (without bearing)
A (1)	**56.0000 – 56.0060 mm (2.2048 – 2.2049 in.)**
B (2)	**56.0061 – 56.0120 mm (2.2050 – 2.2051 in.)**
C (3)	**56.0121 – 56.0180 mm (2.2052 – 2.2054 in.)**

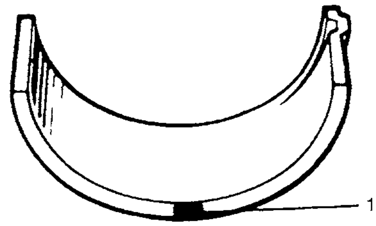


I2RH0B140143-

3) There are 5 kinds of standard bearings differing in thickness. To distinguish them, they are painted in the following colors at the position as indicated in the figure.
   Each color indicated the following thickness at the center of bearing.

Standard size of crankshaft main bearing thickness

Color painted	Bearing thickness
Purple	**1.992 – 1.996 mm (0.07843 – 0.07858 in.)**
Brown	**1.995 – 1.999 mm (0.07855 – 0.07870 in.)**
Green	**1.998 – 2.002 mm (0.07867 – 0.07882 in.)**
Black	**2.001 – 2.005 mm (0.07878 – 0.07893 in.)**
Colorless (no paint)	**2.004 – 2.008 mm (0.07890 – 0.07906 in.)**



I2RH01140191-

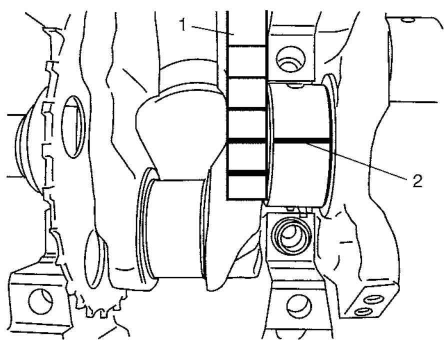
1. Paint

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 the table shown.
   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 “Brown” to its journal.

New standard size crankshaft main bearing specification

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

5) Using scale (1) on gauging plastic (2), check bearing clearance with newly selected standard bearing.
   If clearance still exceeds its limit, use next thicker bearing and recheck clearance.



I2RH0B140141-

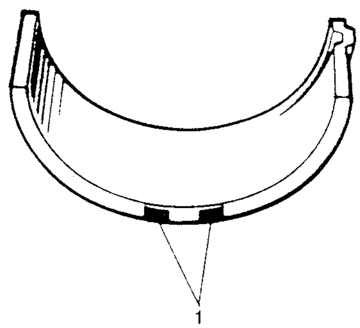
6) When replacing crankshaft or cylinder block due to any reason, select new standard bearings to be installed by referring to number stamped on new crankshaft or alphabets stamped on new cylinder block.

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 the figure.
  Each color represents the following thickness at the center of bearing.

Undersize of crankshaft main bearing thickness

Color painted	Bearing thickness
Red and Purple	2.117 – 2.121 mm (0.08335 – 0.08350 in.)
Red and Brown	2.120 – 2.124 mm (0.08347 – 0.08362 in.)
Red and Green	2.123 – 2.127 mm (0.08359 – 0.08374 in.)
Red and Black	2.126 – 2.130 mm (0.08371 – 0.08385 in.)
Red only	2.129 – 2.133 mm (0.08382 – 0.08397 in.)



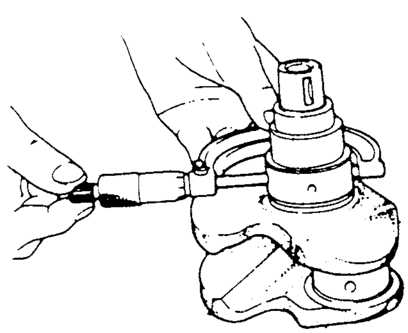
I2RH01140192-

1. Paint

- If necessary, regrind crankshaft journal and select undersize bearing to use with it as follows.
  a. Regrind journal to the following finished diameter.

     Finished journal diameter
     51.732 – 51.750 mm (2.0367 – 2.0374 in.)

  b. Using micrometer, measure regrind journal diameter.
     Measurement should be taken in two directions perpendicular to each other in order to check for out-of-round.
  c. Using journal diameter measured above and alphabets stamped on cylinder block, select an undersize bearing by referring to the following table.
     Check bearing clearance with newly selected undersize bearing.



I2RH0B140144-

New undersize crankshaft main bearing specification

		Measured journal diameter		
		51.7320 – 51.7379 mm (2.0367 – 2.0369 in.)	51.7380 – 51.7439 mm (2.0370 – 2.0371 in.)	51.7440 – 51.7500 mm (2.0372 – 2.0373 in.)
Alphabets stamped on cylinder block	A (1)	Red and Green	Red and Brown	Red and Purple
	B (2)	Red and Black	Red and Green	Red and Brown
	C (3)	Red only	Red and Black	Red and Green
		Undersize bearing to be installed		

Main Bearing Cap No.1 Bolt

Measure each thread diameter main bearing cap No.1 bolts (1) at “A” on 60 mm (2.36 in.) from seat side of flange bolt and “B” on 90 mm (3.54 in.) 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.

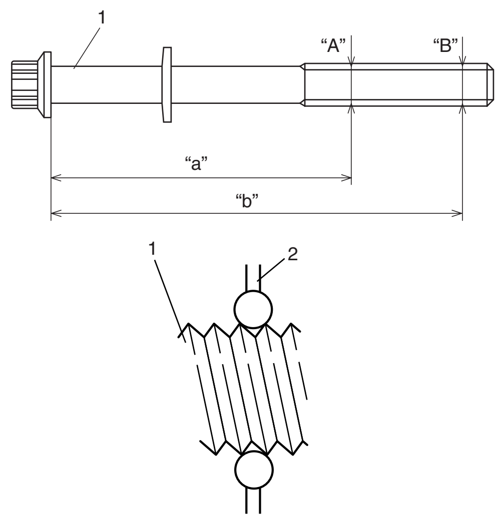
Main bearing cap No.1 bolt diameter measurement points

“a”: 60 mm (2.36 in.)

“b”: 90 mm (3.54 in.)

Main bearing cap No.1 bolt diameter difference

Limit (“A” – “B”): 0.2 mm (0.008 in.)

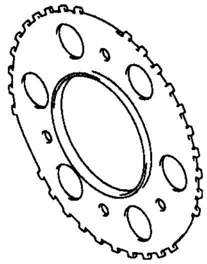


I2RH0B140145-

Sensor Plate Inspection

S4RS0A1406039

Check sensor plate for crack damage.
If malcondition is found, replace it.

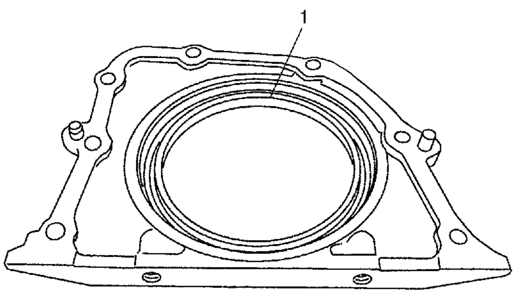


I2RH0B140151-

Rear Oil Seal Inspection

S4RS0A1406040

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



I4RS0A140020-

Flywheel Inspection

S4RS0A1406041

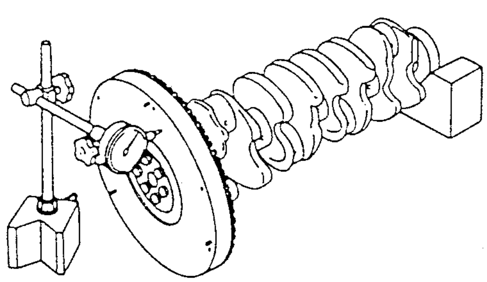
Visual Inspection

- 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.

<u>**Flywheel face runout**</u>
Limit: 0.2 mm (0.0079 in.)



I2RH01140198-

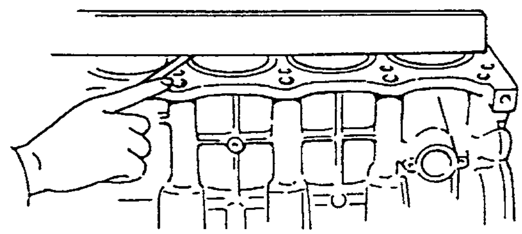
Cylinder Block Inspection

S4RS0A1406042

Distortion of Gasketed Surface

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

<u>**Cylinder block flatness**</u>
Limit: 0.03 mm (0.0012 in.)



I2RH01140199-

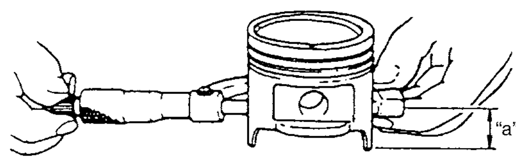
Honing or Reboring Cylinders

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.

   <u>**Oversize piston specification**</u>
   Oversize 0.50: 78.453 – 78.468 mm (3.0887 – 3.0893 in.)

3) Using micrometer, measure piston diameter.

   <u>**Measurement position for piston diameter**</u>
   "a": 19.5 mm (0.77 in.)



I2RH01140157-

4) Rebore and hone cylinder to the following dimension.

   NOTE:

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

   <u>**Cylinder bore diameter to be rebored**</u>
   Oversize 0.50: 78.500 – 78.514 mm (3.0906 – 3.0911 in.)

5) Measure piston clearance after honing.

   <u>**Piston clearance**</u>
   0.032 – 0.061 mm (0.0013 – 0.0024 in.)

Specifications

Tightening Torque Specifications

S4RS0A1407001

Fastening part	Tightening torque			Note
	N·m	kg-m	lb-ft	
Camshaft housing bolts	8	0.8	6.0	(for tightening of special tool) ☞
Camshaft housing bolt	11	1.1	8.0	☞ / ☞ / ☞
Cylinder head cover bolt	8	0.8	6.0	☞
Accelerator cable locking nut	12	1.2	9.0	☞
EVAP canister purge valve bracket bolt	5	0.5	4.0	☞
Engine left mounting bracket nut	55	5.5	40.0	☞
Engine right mounting nut	65	6.5	47.0	☞
Engine rear mounting bush bolt	55	5.5	40.0	☞
Starting motor terminal nut	11	1.1	8.0	☞
Generator terminal nut	6	0.6	4.5	☞
Timing chain cover bolt	25	2.5	18.0	☞
Timing chain cover nut	25	2.5	18.0	☞
Cap bolt	25	2.5	18.0	☞
Oil gallery pipe No.2 and No.3 bolt	11	1.1	8.0	☞
Crankshaft pulley bolt	150	15.0	108.5	☞
Oil control valve mounting nut	11	1.1	8.0	☞
Oil gallery pipe No.1 bolt	30	3.0	21.5	☞
Timing chain No.1 guide bolt	11	1.1	8.0	☞
Timing chain tensioner bolt	25	2.5	18.0	☞
Timing chain tensioner adjuster bolt	11	1.1	8.0	☞
Intake cam timing sprocket bolt	60	6.0	43.5	☞
Venturi plug	5	0.5	3.5	☞
Cylinder head bolt for M8	25	2.5	18.0	☞
Cylinder head bolt for M10	20 N·m (2.0 kg-m, 14.5 lb-ft), 40 N·m (4.0 kg-m, 29.0 lb-ft) and then retighten by turning through to 60° twice			☞
Connecting rod bearing cap nut	15 N·m (1.5 kg-m, 11.0 lb-ft) and then retighten by turning through 45° twice			☞ / ☞
Sensor plate bolt	11	1.1	8.0	☞
Main bearing cap No.1 bolt ((1) – (10))	30 N·m (3.0 kg-m, 22.0 lb-ft), 50 N·m (5.0 kg-m, 36.5 lb-ft) and then retighten by turning through 60°			☞ / ☞ / ☞
Main bearing cap No.2 bolt ((11) – (20))	25	2.5	18.0	☞ / ☞ / ☞
Rear oil seal housing bolt	11	1.1	8.0	☞
Flywheel bolt	70	7.0	51.0	☞

NOTE:

The specified tightening torque is also described in the following.
“Throttle Body Components: ”
“Throttle Body and Intake Manifold Components: ”
“Engine Mountings Components: ”
“Timing Chain Cover Components: ”
“Timing Chain and Chain Tensioner Components: ”
“Camshaft, Tappet and Shim Components: ”
“Valves and Cylinder Head Components: ”
“Pistons, Piston Rings, Connecting Rods and Cylinders Components: ”
“Main Bearings, Crankshaft and Cylinder Block Components: ”

Reference:
For the tightening torque of fastener not specified in this section, refer to “Fasteners Information: in Section 0A”.

Special Tools and Equipment

Recommended Service Material

S4RS0A1408001

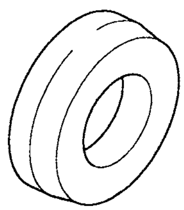
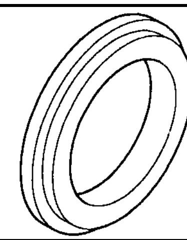
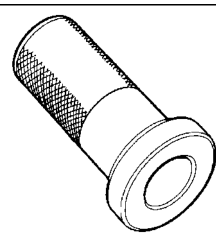
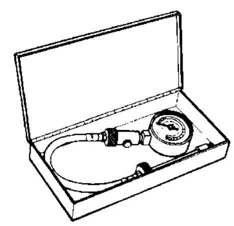
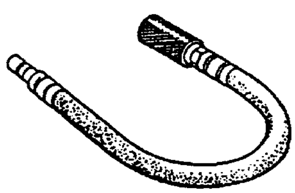
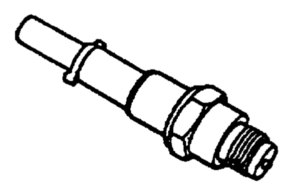
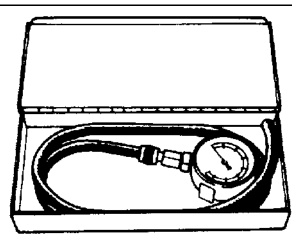
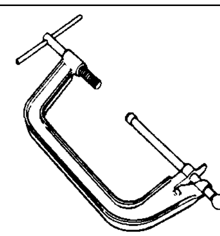
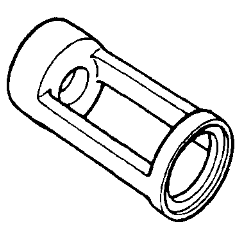
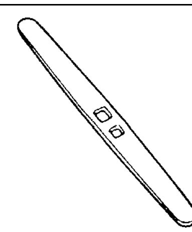
Material	SUZUKI recommended product or Specification		Note
Sealant	SUZUKI Bond No.1207B	P/No.: 99000–31140	☞
	SUZUKI Bond No.1217G	P/No.: 99000–31260	☞
Water tight sealant	SUZUKI Bond No.1207F	P/No.: 99000–31250	☞ / ☞ / ☞

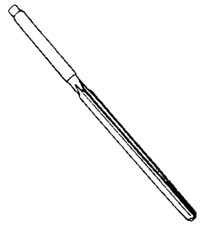
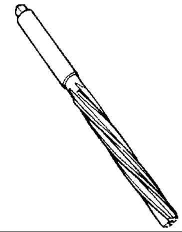
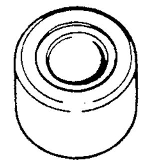
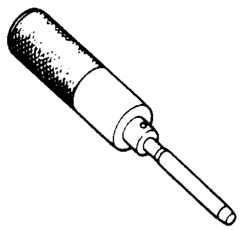
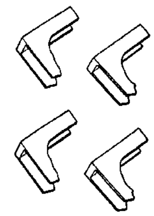
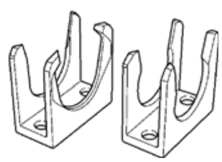
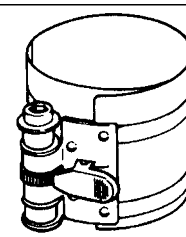
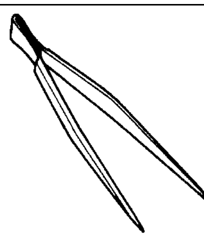
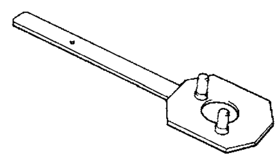
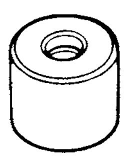
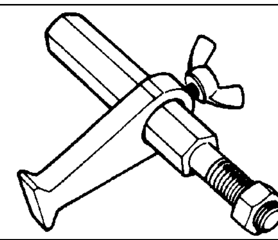
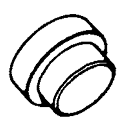
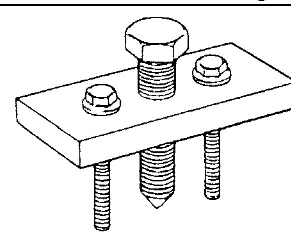
NOTE:

Required service material is also described in the following.
“Timing Chain Cover Components: ”
“Timing Chain and Chain Tensioner Components: ”
“Camshaft, Tappet and Shim Components: ”
“Valves and Cylinder Head Components: ”
“Pistons, Piston Rings, Connecting Rods and Cylinders Components: ”
“Main Bearings, Crankshaft and Cylinder Block Components: ”

Special Tool

S4RS0A1408002

09911–97720 Oil seal installer ☞ 	09911–97820 Oil seal installer ☞ 
09913–75810 Bearing installer ☞ 	09915–64512 Compression gauge ☞ 
09915–64530 Compression gauge hose ☞ 	09915–67010 Compression gauge attachment (C) ☞ 
09915–67311 Vacuum gauge ☞ 	09916–14510 Valve lifter ☞ / ☞ 
09916–14521 Valve spring compressor attachment ☞ / ☞ 	09916–34542 Reamer handle ☞ / ☞ 

09916–34550 Reamer handle ☞ 	09916–37320 Valve guide outer reamer (10.5 mm) ☞ 
09916–44910 Valve guide installer & remover ☞ 	09916–56011 Valve guide installer attachment (protrusion: 11.5 mm) ☞ 
09916–58210 Valve guide installer handle ☞ / ☞ 	09916–67020 Tappet holder (Overseas) ☞ / ☞ 
09916–67021 Tappet holder ☞ / ☞ 	09916–77310 Piston ring compressor (50-125 mm) ☞ 
09916–84511 Forceps ☞ / ☞ 	09917–68221 Camshaft pulley holder ☞ / ☞ 
09917–98221 Valve guide stem attachment ☞ 	09924–17810 Flywheel holder (drive plate stopper) ☞ / ☞ 
09926–58010 Bearing remover attachment ☞ 	09944–36011 Steering wheel remover ☞ 

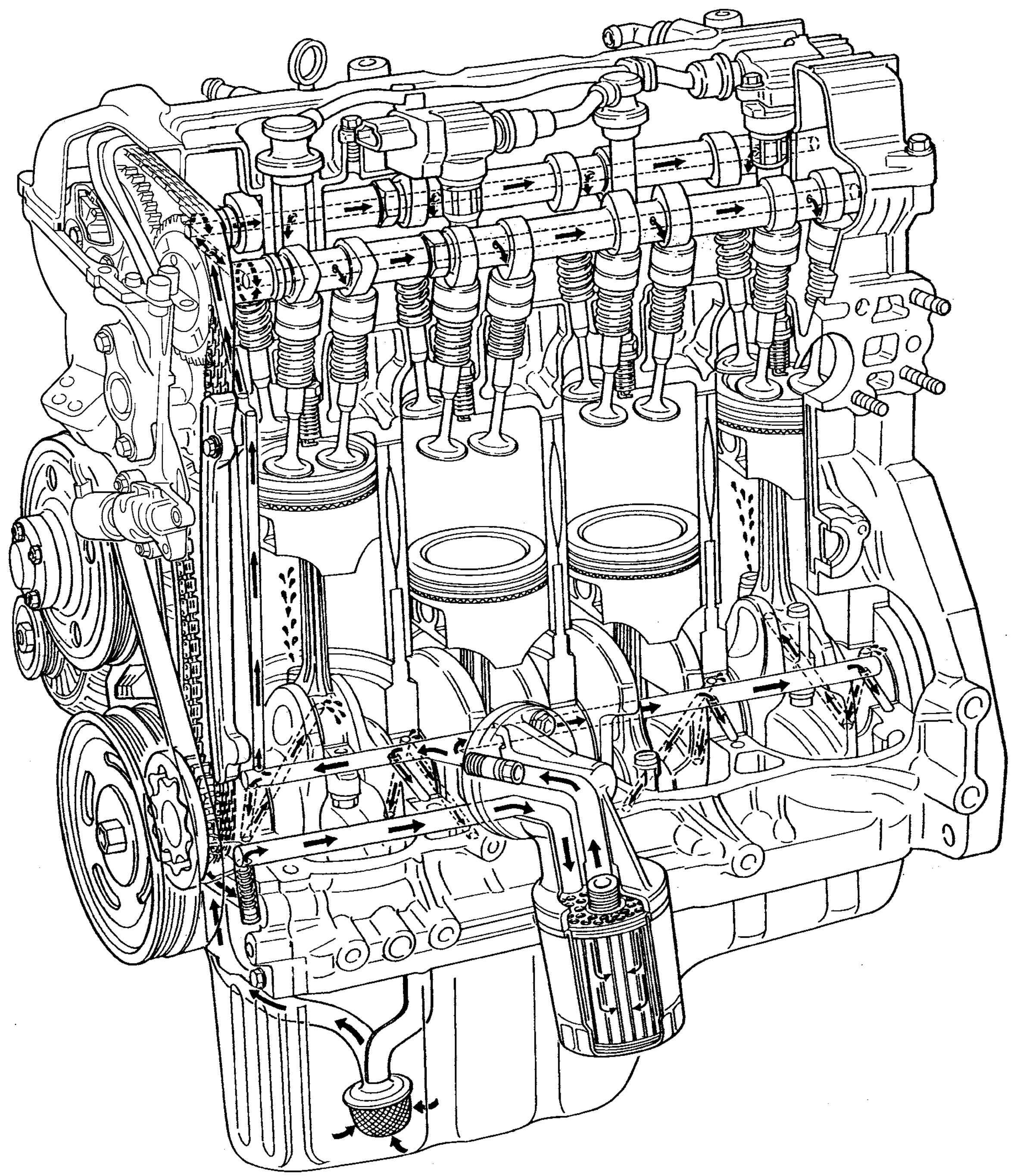
Engine Lubrication System

General Description

Engine Lubrication Description

S4RS0A1501001

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 two paths in cylinder block.
In one path, oil reaches the crankshaft journal bearings. Oil from the crankshaft journal bearings is supplied to the connecting rod bearings by means of intersecting passages drilled in the crankshaft, and then injected from the big end of connecting rod to lubricate piston, rings and cylinder wall.
In the 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 350 kPa (3.5 kg/cm^2, 49.8 psi).



I3RH0B150001-

Diagnostic Information and Procedures

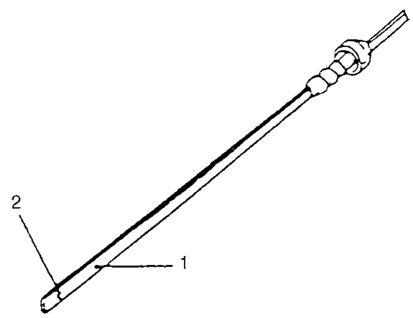
Oil Pressure Check

S4RS0A1504001

NOTE:

Prior to checking oil pressure, check the following.

- **Oil level in oil pan**
  If oil level is low, add oil up to Full level mark (hole) (1) on oil level gauge referring to "Engine Oil and Filter Change: in Section 0B".

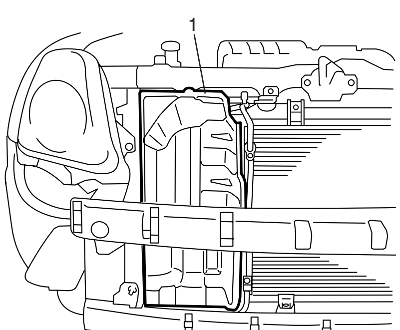


I2RH0B150002-

2. Low level mark (hole)

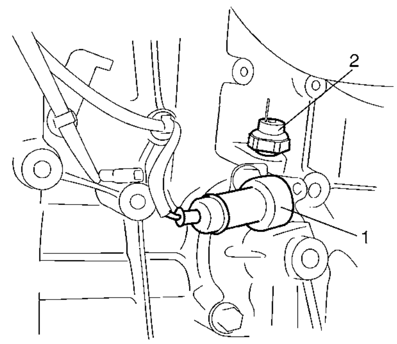
- **Oil quality**
  If oil is discolored or deteriorated, change it. For particular oil to be used, refer to "Engine Oil and Filter Change: in Section 0B".
- **Oil leaks**
  If leak is found, repair it.

1) Remove front bumper referring to "Front Bumper and Rear Bumper Components: in Section 9K".
2) Remove engine front cover (1).



I4RS0A150001-

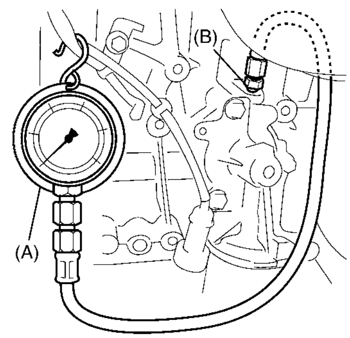
3) Disconnect oil pressure switch coupler (1).
4) Remove oil pressure switch (2) from cylinder block.



I2RH0B150003-

5) Install special tools (oil pressure gauge) to vacated threaded hole of oil pressure switch.

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



I2RH0B150004-

6) Start engine and warm engine up to normal operating temperature.

   NOTE:

   Be sure to shift transaxle gear shift lever in "Neutral" (shift select lever in "P" range for A/T vehicle), set parking brake and block drive wheels.

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

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

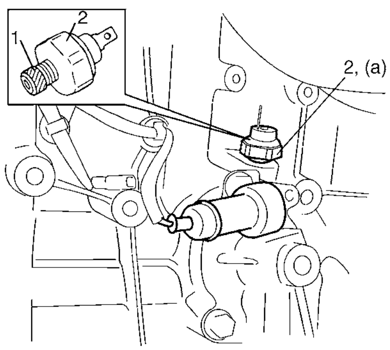
8) After checking oil pressure, stop engine and remove oil pressure gauge and attachment.

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

NOTE:

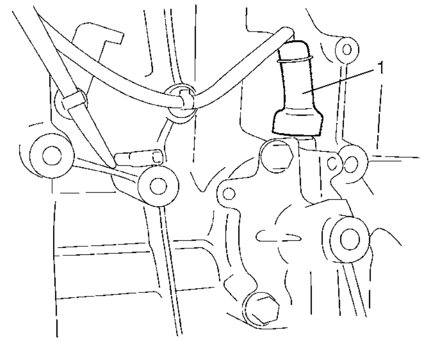
If sealing tape edge is bulged out from screw threads of switch, cut it off.

Tightening torque
Oil pressure switch (a): 13 N·m (1.3 kg-m, 9.5 lb-ft)



I2RH0B150005-

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

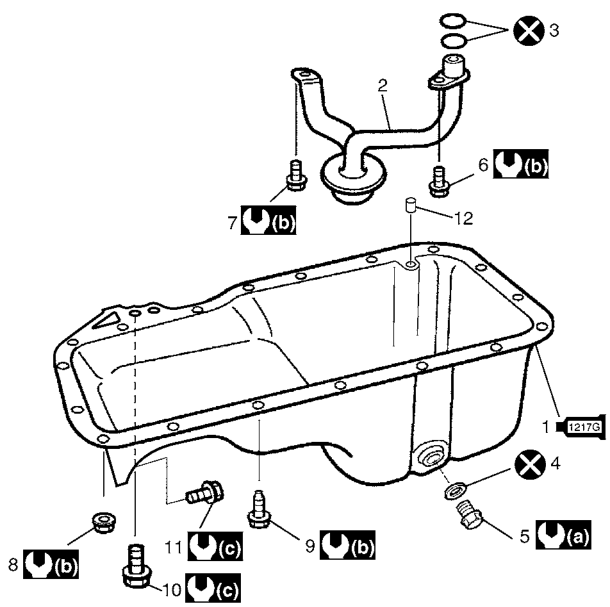


I2RH0B150006-

Repair Instructions

Oil Pan and Oil Pump Strainer Components

S4RS0A1506001



I4RS0A150002-

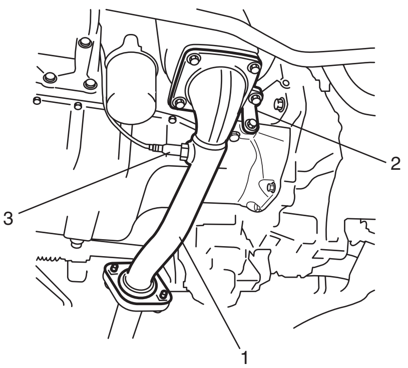
1217G 1.	Oil pan : Apply sealant 99000-31260 to mating surface.	6.	Strainer bolt	11.	Transaxle stiffener bolt
2.	Strainer	7.	Bracket bolt	(a) :	35 N·m (3.5 kg-m, 25.5 lb-ft)
3.	O-ring	8.	Oil pan nut	(b) :	Tighten 11 N·m (1.1 kg-m, 8.0 lb-ft) by the specified procedure.
4.	Gasket	9.	Oil pan bolt (M6)	(c) :	55 N·m (5.5 kg-m, 40.0 lb-ft)
5.	Drain plug	10.	Oil pan bolt (M10)	:	Do not reuse.

Oil Pan and Oil Pump Strainer Removal and Installation

S4RS0A1506002

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 heated oxygen sensor No.1 (connector color: green) (3) referring to “Exhaust System Components: in Section 1K”.

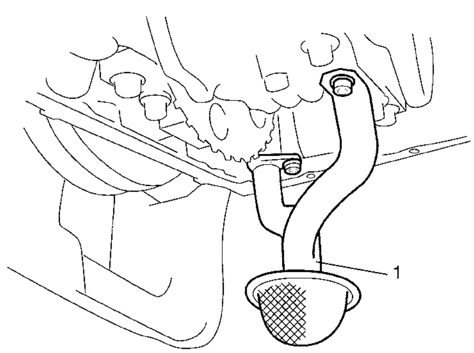


I4RS0A150003-

4) Remove clutch housing lower plate (1).

I4RS0A150004-

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

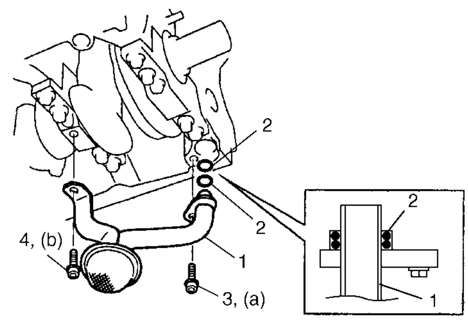


I2RH0B150010-

Installation

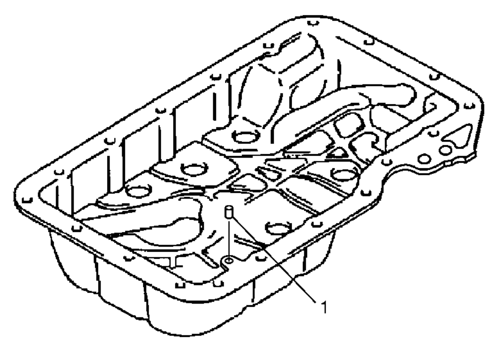
1) Install new O-rings (2) in the position as shown in the figure and install oil pump strainer (1).
   Tighten strainer bolt (3) first and then bracket bolt (4) to specified torque.

   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)



I2RH0B150012-

2) Install dowel pin (1) to oil pan.

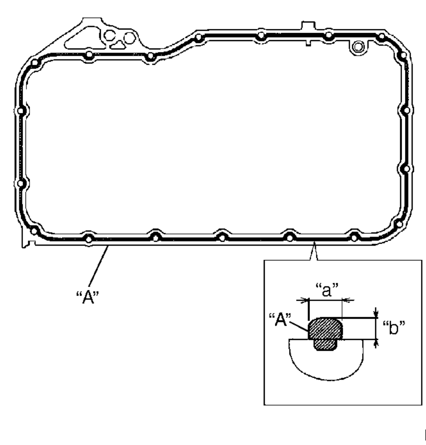


I4RS0A150005-

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

   “A”: Sealant 99000–31260

   <u>Sealant amount for oil pan</u>
   Width “a”: 3 mm (0.12 in.)
   Height “b”: 2 mm (0.08 in.)

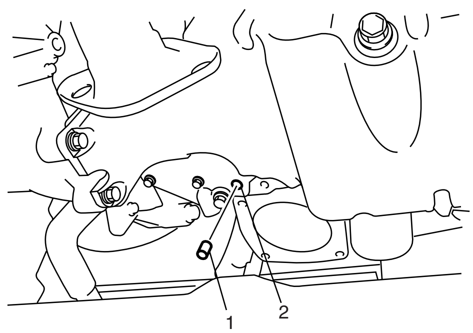


I4RS0A150006-

4) Install oil pan to cylinder block temporarily.
5) Insert knock pin (1) in hole (2) of oil pan in order to locate oil pan precisely.

NOTE:

Knock pin is available as a spare part (part number: 04211–13189).



I4RS0A150007-

6) 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.

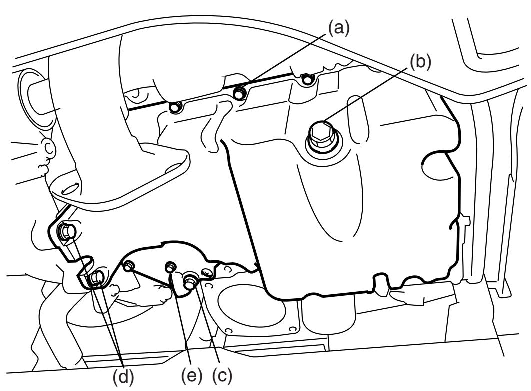
Tightening torque
Oil pan bolt (M6) (a): 11 N·m (1.1 kg-m, 8.0 lb-ft)
Oil pan bolt (M10) (c): 55 N·m (5.5 kg-m, 40.0 lb-ft)
Oil pan nut (e): 11 N·m (1.1 kg-m, 8.0 lb-ft)

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

Tightening torque
Oil pan drain plug (b): 35 N·m (3.5 kg-m, 25.5 lb-ft)

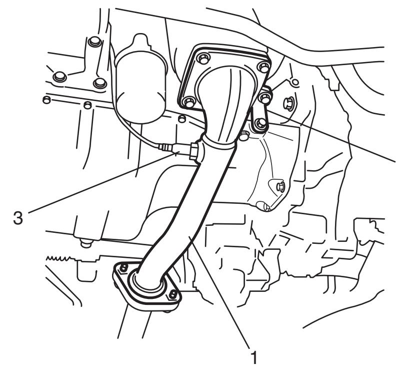
8) Tighten transaxle stiffener bolts to specified torque.

Tightening torque
Transaxle stiffener bolt (d): 55 N·m (5.5 kg-m, 40.0 lb-ft)



I4RS0A150008-

9) Install exhaust manifold stiffener (2) and exhaust No.1 pipe (1) and heated oxygen sensor No.1 (connector color: green) (3) referring to “Exhaust System Components: in Section 1K”.



I4RS0A150003-

10) Install clutch housing lower plate (1).

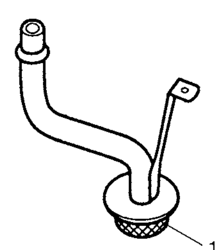
I4RS0A150004-

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.

Oil Pan and Oil Pump Strainer Cleaning

S4RS0A1506003

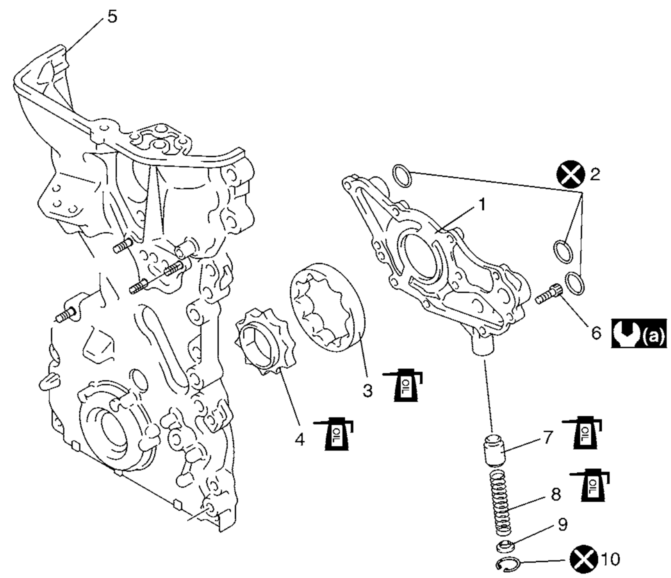
- Clean sealing surface between oil pan and cylinder block.
  Remove oil, old sealant, and dust from sealing surface.
- Clean oil pump strainer screen (1).



I2RH0B150016-

Oil Pump Components

S4RS0A1506004



I4RS0A150010-

1. Rotor plate	6. Rotor plate bolt	10. Circlip
2. O-ring	7. Relief valve	(a) : 11 N·m (1.1 kg-mm 8.0 lb-ft)
3. Outer rotor	8. Spring	: Do not reuse.
4. Inner rotor	9. Retainer	: Apply thin coat of engine oil to sliding surface.
5. Timing chain cover	10. Circlip	

Oil Pump Removal and Installation

S4RS0A1506005

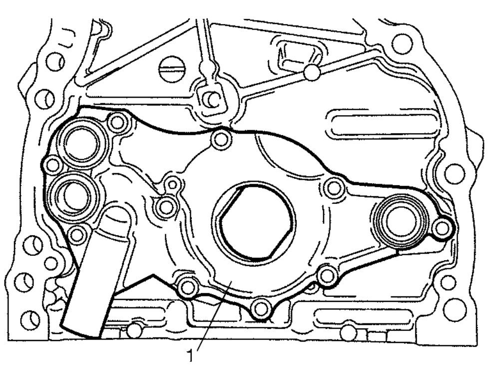
Oil pump is incorporated with timing chain cover. For removal and installation, refer to “Timing Chain Cover Removal and Installation: in Section 1D”.

Oil Pump Disassembly and Reassembly

S4RS0A1506006

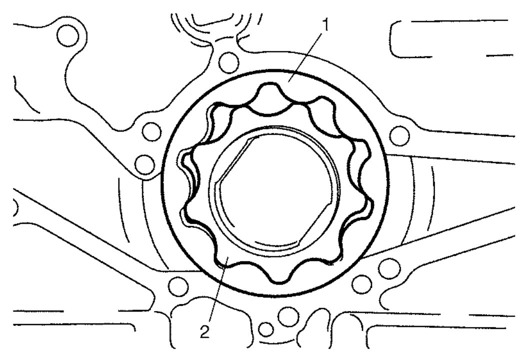
Disassembly

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



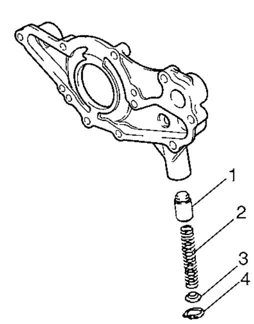
I2RH0B150018-

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



I2RH0B150019-

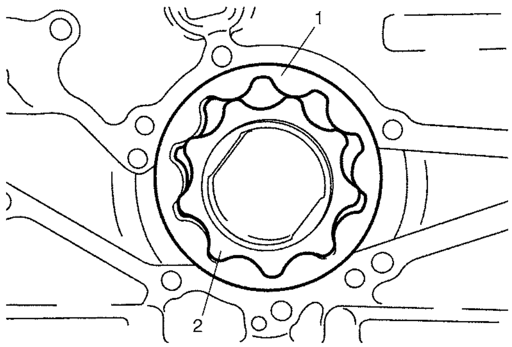
3) Remove relief valve (1), spring (2) and retainer (3) by removing circlip (4).



I2RH0B150020-

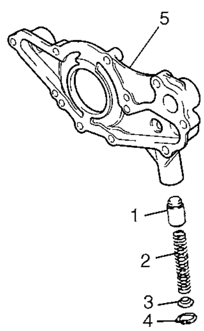
Reassembly

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.



I2RH0B150019-

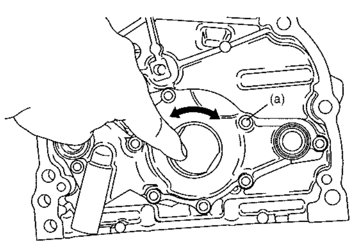
4) Apply engine oil to relief valve (1) and spring (2), and install them with retainer (3) and new circlip (4) to rotor plate (5).



I3RM0A150005-

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)



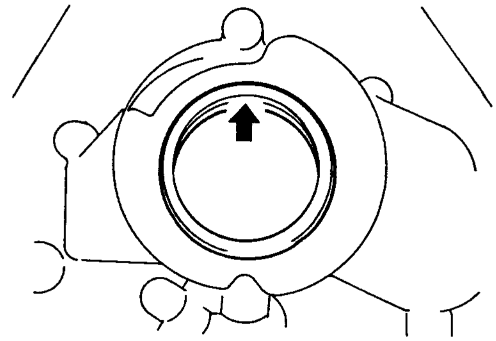
I2RH0B150022-

Oil Pump Inspection

S4RS0A1506007

Oil Seal

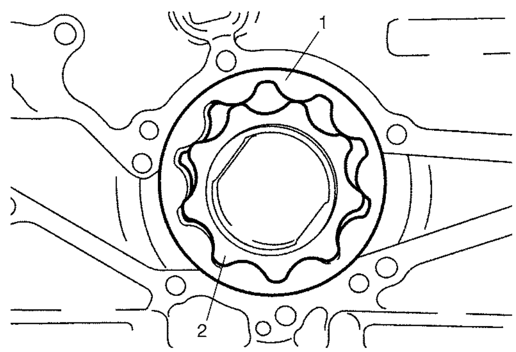
Check oil seal lip for fault or other damage. Replace as necessary.



I2RH0B150023-

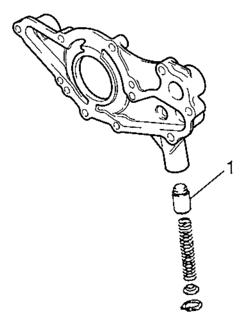
Oil Pump

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



I2RH0B150019-

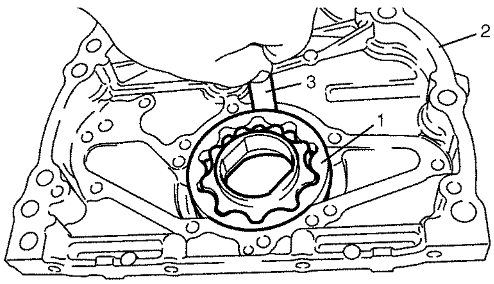
- Check relief valve (1) for excessive wear or damage and operates smoothly.



I2RH0B150025-

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

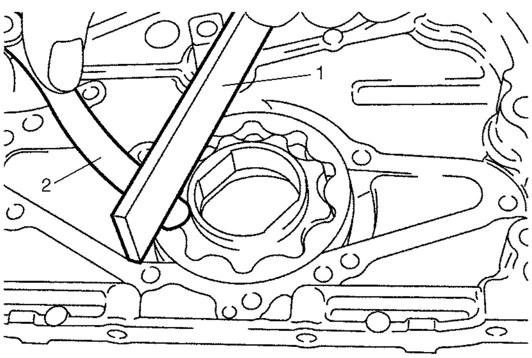
Radial clearance between outer rotor and case for oil pump
Limit: 0.310 mm (0.0122 in.)



I2RH0B150026-

Side clearance
Using straightedge (1) and thickness gauge (2), measure side clearance.
If side clearance exceeds its limit, replace oil pump assembly.

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

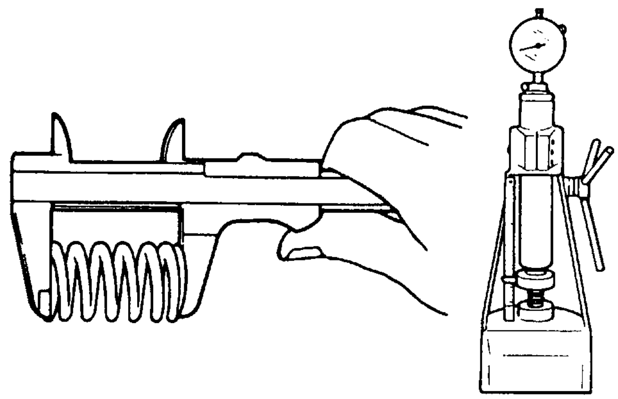


I2RH0B150027-

Relief valve spring free length and load
Check relief valve spring free length and load as shown in the figure. If the measured valve spring length is lower than the specification, replace relief valve spring.

Relief valve spring free length and load

	Standard	Limit
Free length	**52.4 mm (2.06 in.)**	**—**
Load at spring length 38.5 mm (1.52 in.)	**77 N (7.7 kgf, 17.0 lb)**	**69 N (6.9 kgf, 15.0 lb)**



I2RH01150023-

Specifications

Tightening Torque Specifications

S4RS0A1507001

Fastening part	Tightening torque			Note
	N·m	kg-m	lb-ft	
Oil pressure switch	13	1.3	9.5	☞
Oil pump strainer bolt	11	1.1	8.0	☞
Oil pump strainer bracket bolt	11	1.1	8.0	☞
Oil pan bolt (M6)	11	1.1	8.0	☞
Oil pan bolt (M10)	55	5.5	40.0	☞
Oil pan nut	11	1.1	8.0	☞
Oil pan drain plug	35	3.5	25.5	☞
Transaxle stiffener bolt	55	5.5	40.0	☞
Oil pump rotor plate bolt	11	1.1	8.0	☞

NOTE:

The specified tightening torque is also described in the following.
“Oil Pan and Oil Pump Strainer Components: ”
“Oil Pump Components: ”

Reference:
For the tightening torque of fastener not specified in this section, refer to “Fasteners Information: in Section 0A”.

Special Tools and Equipment

Recommended Service Material

S4RS0A1508001

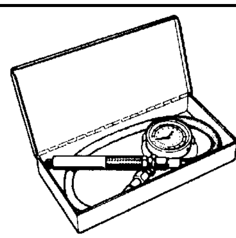
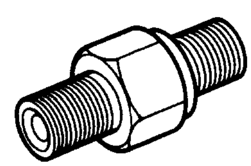
Material	SUZUKI recommended product or Specification		Note
Sealant	SUZUKI Bond No.1217G	P/No.: 99000–31260	☞

NOTE:

Required service material is also described in the following.
“Oil Pan and Oil Pump Strainer Components: ”
“Oil Pump Components: ”

Special Tool

S4RS0A1508002

09915–77310 Oil pressure gauge (0-10kg/cm2) ☞		09915–78211 Oil pressure gauge attachment ☞	

Engine Cooling System

General Description

Cooling System Description

S4RS0A1601001

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

Coolant Description

S4RS0A1602002

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.**
- **Check to make sure that engine coolant temperature is cold before removing any part of cooling system.**
- **Also be sure to disconnect negative cable from battery terminal before removing any part.**

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 deminerated water or distilled water.**

Anti-freeze proportioning table

		For M/T vehicle	For A/T vehicle
Freezing temperature	°C	–36	–36
	°F	–33	–33
Anti-freeze / Anti-corrosion coolant concentration	%	50	50
Ratio of compound to cooling water	ltr.	3.10/3.10	3.05/3.05
	US pt.	6.55/6.55	6.44/6.44
	Imp pt.	5.46/5.46	5.37/5.37

Coolant capacity

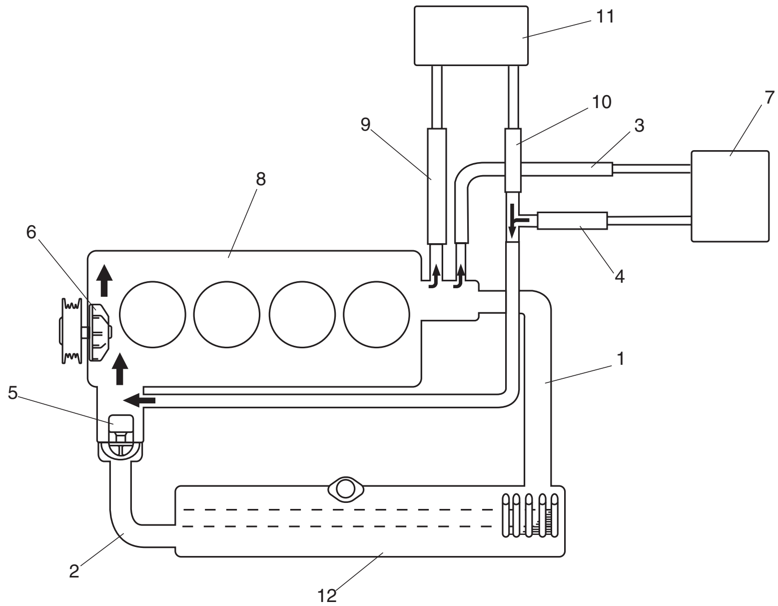
- **For M/T vehicle**
  Engine, radiator and heater: 5.5 liters (11.62/9.68 US/Imp pt.)
  Reservoir: 0.7 liters (1.48/1.23 US/Imp pt.)
  Total: 6.2 liters (13.10/10.91 US/Imp pt.)
- **For A/T vehicle**
  Engine, radiator and heater: 5.4 liters (11.41/9.50 US/Imp pt.)
  Reservoir: 0.7 liters (1.48/1.23 US/Imp pt.)
  Total: 6.1 liters (12.89/10.74 US/Imp pt.)

Schematic and Routing Diagram

Coolant Circulation

S4RS0A1602001

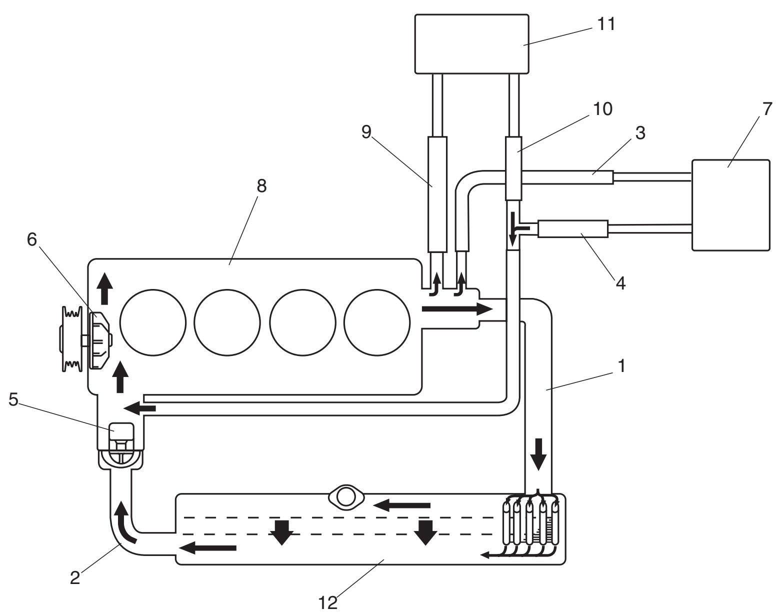
While the engine is warmed up (thermostat closed), coolant circulates as follows.



I3RM0A160001-

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.



I3RM0A160002-

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

Diagnostic Information and Procedures

Engine Cooling Symptom Diagnosis

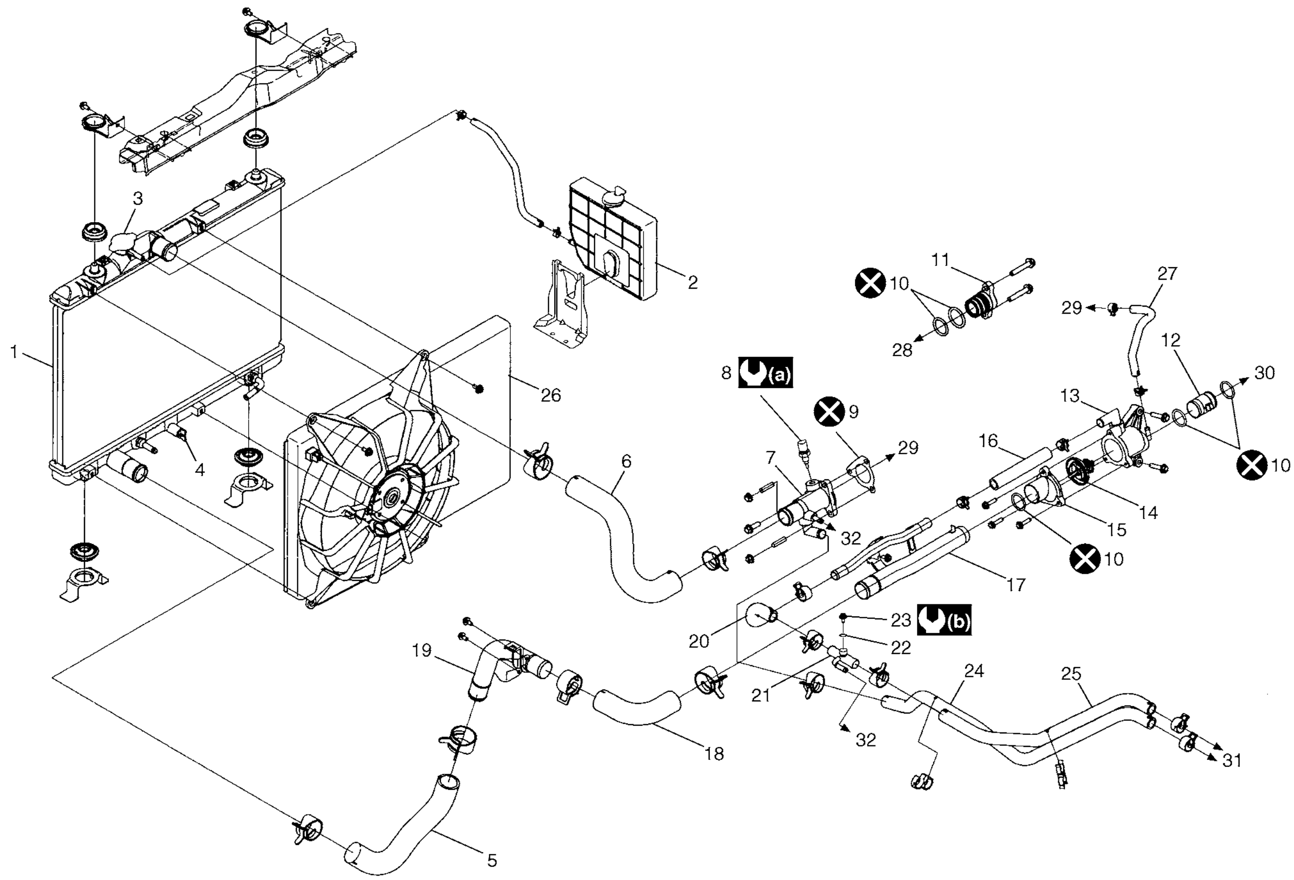
S4RS0A1604001

Condition	Possible cause	Correction / Reference Item
Engine overheats (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.*
	ECT sensor faulty	*Check and replace as necessary.*
	Radiator cooling fan relay No.2 and/or No.3 faulty	*Check and replace as necessary.*
	Radiator fan motor faulty	*Check and replace as necessary.*
	ECM faulty	*Check and replace as necessary.*
	Wiring or grounding faulty	*Repair as necessary.*
	Equipped with too much electric load part(s)	*Dismount.*
Engine overheats (Radiator fan does not operate)	Fuse blown	*Check 30 A fuse of relay/fuse box and check for short circuit to ground.*
	Radiator cooling fan relay No.1 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.*

Repair Instructions

Cooling System Components

S4RS0A1606001



I4RS0A160001-

1.	Radiator	13.	Thermostat case	25.	Heater outlet No.1 hose
2.	Reservoir	14.	Thermostat	26.	Engine cooling fan assembly
3.	Radiator cap	15.	Thermostat cap	27.	Water bypass No.2 hose
4.	Drain plug	16.	Water bypass No.1 hose	28.	To timing chain cover
5.	Radiator outlet hose	17.	Water inlet No.1 pipe	29.	To cylinder head
6.	Radiator inlet hose	18.	Water inlet hose	30.	To water pump
7.	Water outlet cap	19.	Water inlet No.2 pipe	31.	To heater core
8.	ECT sensor	20.	Heater outlet No.2 hose	32.	To throttle body
9.	Water outlet cap gasket	21.	Heater union	(a) :	15 N·m (1.5 kg-m, 11.0 lb-ft)
10.	O-ring	22.	Heater union gasket	(b) :	4.5 N·m (0.45 kg-m, 3.5 lb-ft)
11.	Water outlet plug	23.	Air ventilation bolt	:	Do not reuse.
12.	Thermostat case water outlet pipe	24.	Heater inlet hose		

Coolant Level Check

S4RS0A1606002

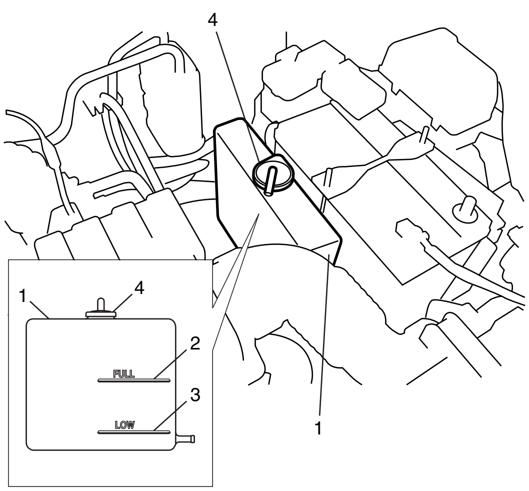
WARNING:

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 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).

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.



I4RS0A160002-

Engine Cooling System Inspection and Cleaning

S4RS0A1606003

WARNING:

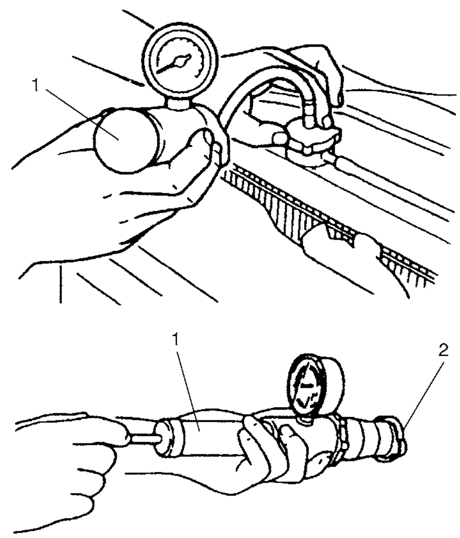
To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.

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.

NOTE:

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

<u>Cooling system and radiator cap holding pressure (for inspection)</u>
110 kPa (1.1 kg/cm^2, 15.6 psi)



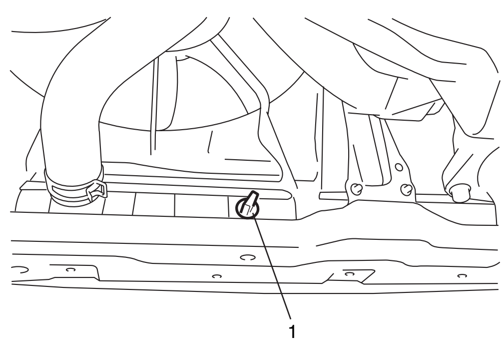
I5RH01160001-

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 Draining

S4RS0A1606019

1) Remove radiator cap.
2) Drain coolant from radiator drain plug (1).
3) After draining coolant, be sure to tighten drain plug (1) securely.



I4RS0A160003-

Cooling System Flush and Refill

S4RS0A1606004

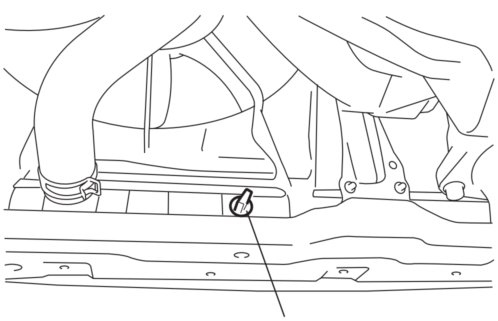
WARNING:

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 Description: ”.

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. 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.



I4RS0A160003-

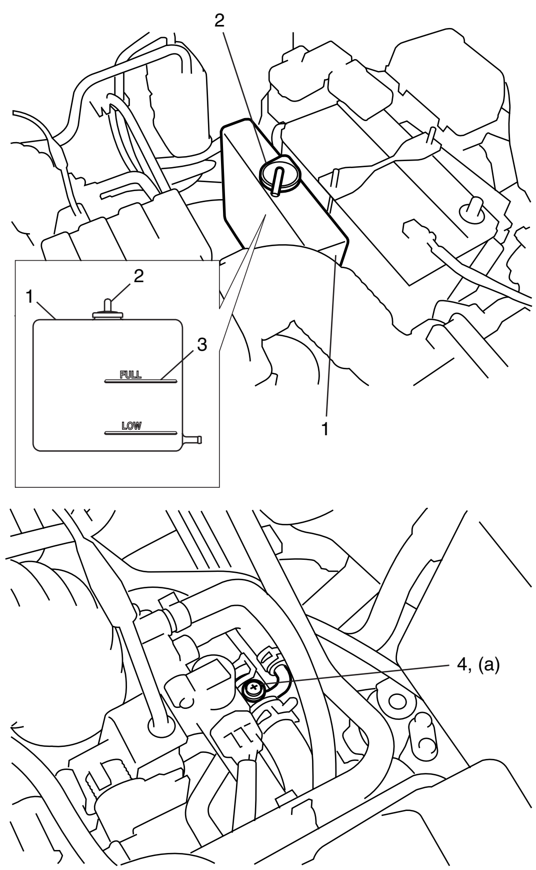
7) Remove reservoir (1) and remove cap (2) from reservoir (1).
8) Pour out any fluid, scrub and clean inside of reservoir with soap and water.
   Flush it well with clean water and drain, Reinstall reservoir.
9) Fill reservoir with coolant up to “Full” level mark (3).
10) Install reservoir cap (2) on reservoir.
11) Loosen air ventilation bolt (4) one and a half turns.
12) Fill radiator with coolant up to spilling coolant from air ventilation bolt (4).
13) Tighten air ventilation bolt (4) 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 (4) one and a half turns.
17) Run engine at 2000 – 3000 rpm, and tighten air ventilation bolt (4) to specified torque after spilling coolant from air ventilation bolt (4).

    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).



I4RS0A160004-

Cooling Water Pipes or Hoses Removal and Installation

S4RS0A1606005

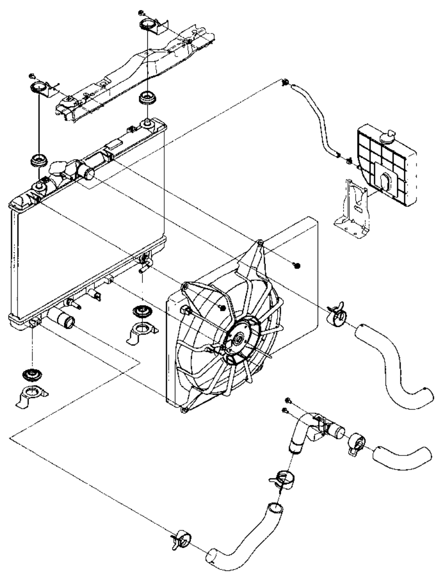
Removal

1) Drain coolant referring to "Cooling System Draining: ".
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 Flush and Refill: ".



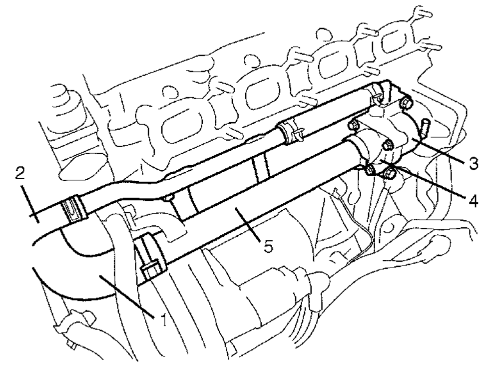
I4RS0A160005-

Thermostat Removal and Installation

S4RS0A1606006

Removal

1) Drain coolant referring to "Cooling System Draining: ".
2) Remove intake manifold referring to "Intake Manifold Removal and Installation: in Section 1D".
3) Remove generator referring to "Generator Dismounting and Remounting: in Section 1J".
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 with thermostat cap from thermostat case.
7) Remove thermostat from thermostat case (3).

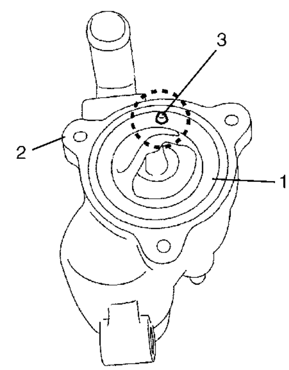


I3RM0A160007-

Installation

Reverse removal procedure for installation noting the following points.

- When positioning thermostat (1) on thermostat case (2), be sure to position it so that air bleed valve (3) comes at position as shown in the figure.



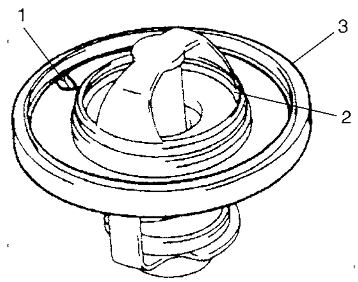
I2RH0B160006-

- Use new O-rings when installing.
- Adjust water pump belt tension referring to "Water Pump / Generator Drive Belt Tension Inspection and Adjustment: ".
- Adjust A/C compressor belt tension referring to "Compressor Drive Belt Inspection and Adjustment: in Section 7B".
- Refill cooling system referring to Step 7) to 22) of "Cooling System Flush and Refill: ".
- Verify that there is no coolant leakage at each connection.

Thermostat Inspection

S4RS0A1606007

- Make sure that air bleed valve (1) of thermostat is clean.
  Should this valve be clogged, engine would tend to overheat.
- Check to make sure that valve seat (2) is free from foreign matters which would prevent valve from seating tight.
- Check thermostat seal (3) for breakage, deterioration or any other damage.



I3RM0A160008-

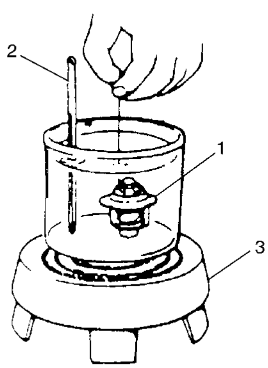
- Check thermostatic movement of wax pellet as follows:
  a. Immerse thermostat (1) in water, and heat water gradually.
  b. Check that valve starts to open at specific temperature.

Temperature at which valve begins to open
80 – 84 °C (176 – 183 °F)

Temperature at which valve become fully open
95 – 97 °C (203 °F)

Valve lift
More than 8 mm at 95 °C (203 °F)

If valve starts to open at a temperature substantially below or above specific temperature, thermostat unit should be replaced with a new one. Such a unit, if reused, will bring about overcooling or overheating tendency.



I2RH01160012-

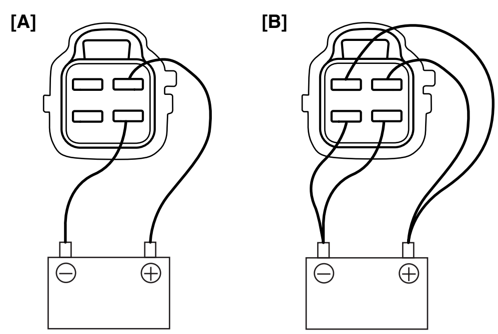
2. Thermometer	3. Heater

Radiator Cooling Fan Motor On-Vehicle Inspection

S4RS0A1606010

1) Check low speed operation of radiator cooling fan as follows.
   a) Connect battery to fan motor coupler as shown in figure.
   b) Check that radiator cooling fan rotates smoothly. If any abnormality is found, replace fan motor.
2) Check high speed operation of radiator cooling fan as follows.
   a) Connect battery to fan motor coupler as shown in figure.
   b) Check that radiator cooling fan rotates smoothly and its rotational speed is faster than low speed operation.
      If any abnormality is found, replace fan motor.

Reference: Fan motor specified current at 12 V
Low speed operation: 14.0 A maximum
High speed operation: 18.0 A maximum



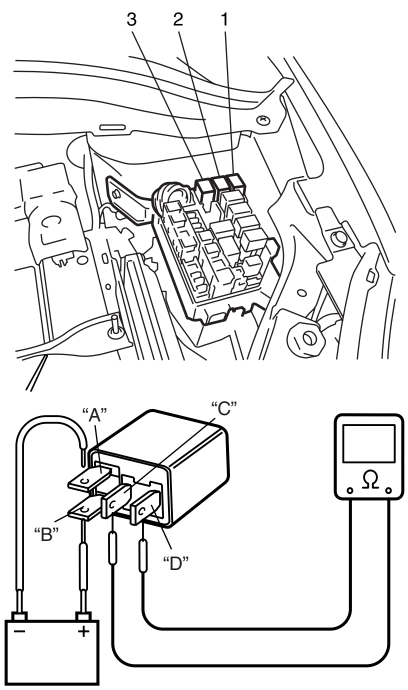
I4RS0A160006-

[A]:	Low speed operation
[B]:	High speed operation

Radiator Cooling Fan Relay Inspection

S4RS0A1606020

1) Disconnect negative (–) cable at battery.
2) Remove radiator cooling fan relay No.1 (1), No.2 (2) and/or No.3 (3) from relay box.
3) Check that there is no continuity between terminal “C” and “B”. If there is continuity, replace relay.
4) Connect battery positive (+) terminal to terminal “B” of relay.
5) Connect battery negative (–) terminal “A” of relay.
6) Check continuity between terminal “C” and “D”. If there is no continuity when relay is connected to the battery, replace relay.



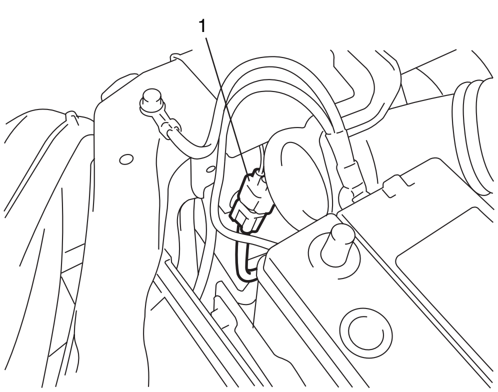
I4RS0A160007-

Radiator Cooling Fan Removal and Installation

S4RS0A1606021

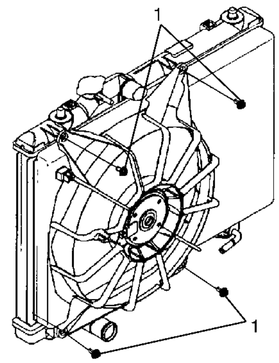
Removal

1) Disconnect negative (–) cable at battery.
2) Disconnect connector (1) of cooling fan motor.



I4RS0A160008-

3) Drain coolant.
4) Remove front bumper, front bumper upper absorber and upper member referring to “Front Bumper and Rear Bumper Components: in Section 9K”.
5) Remove radiator inlet hose and reservoir hose.
6) Remove cooling fan mounting bolts (1).



I4RS0A160009-

7) Slide condenser with radiator, and then remove radiator cooling fan.

CAUTION:

Be sure not to damage condenser outlet pipe.

Installation

Reverse removal procedure for installation noting the following.

- Refill cooling system referring to Step 7) to 22) of “Cooling System Flush and Refill: ”.
- After installation, verify there is no coolant leakage at each connection.

Radiator On-Vehicle Inspection and Cleaning

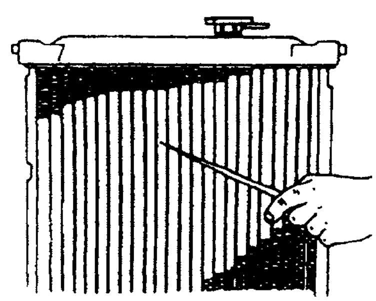
S4RS0A1606013

Inspection

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

Cleaning

Clean frontal area of radiator cores.



I2RH01160014-

Radiator Removal and Installation

S4RS0A1606014

Removal

1) Disconnect negative cable at battery.
2) Drain A/T fluid.
3) Drain coolant.
4) Remove cooling fan assembly referring to "Radiator Cooling Fan Removal and Installation: ".
5) Remove A/T fluid cooler inlet and outlet hoses.
6) Remove radiator outlet hose from radiator.
7) Remove radiator from vehicle.

Installation

Reverse removal procedures, noting the following.

- Refill cooling system referring to Step 7) to 22) of "Cooling System Flush and Refill: ".
- After installation, verify there is no coolant leakage each connection.
- Refill A/T fluid referring to "A/T Fluid Change: in Section 5A".

Water Pump / Generator Drive Belt Tension Inspection and Adjustment

S4RS0A1606015

WARNING:

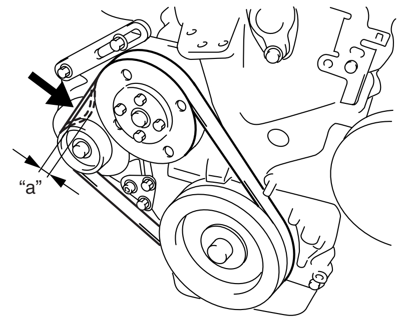
- **Disconnect negative cable at battery before checking and adjusting belt tension.**
- **To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.**

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: ".
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:

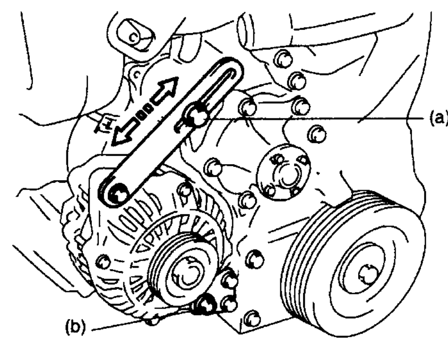
When replacing belt with a new one, adjust belt tension to 3 – 4 mm (0.12 – 0.16 in.).



I2RH0B160012-

3) If belt is too tight or too loose, adjust it to proper tension by displacing generator position.
4) Tighten generator adjusting bolt and pivot bolts as specified torque.

Tightening torque
Generator adjusting bolt (a): 23 N·m (2.3 kg-m, 17.0 lb-ft)
Generator pivot bolt (b): 50 N·m (5.0 kg-m, 36.0 lb-ft)



I2RH0B160013-

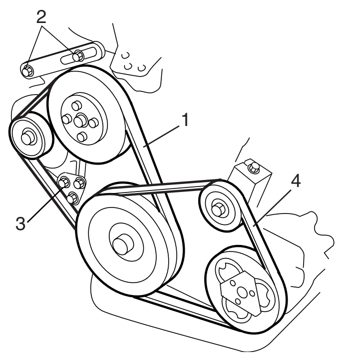
5) Connect negative cable at battery.

Water Pump / Generator Drive Belt Removal and Installation

S4RS0A1606016

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 7B”.
3) Loosen drive belt adjusting bolt (2) and generator pivot bolt (3).

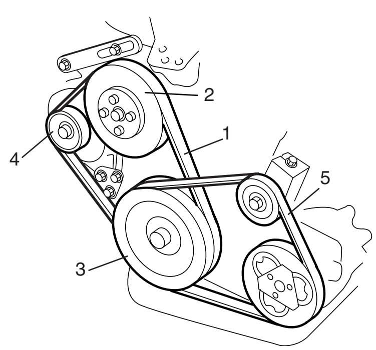


I3RM0A160014-

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: ”.
3) If vehicle equipped with A/C, install compressor drive belt (5) referring to “Compressor Drive Belt Removal and Installation: in Section 7B”.



I3RM0A160015-

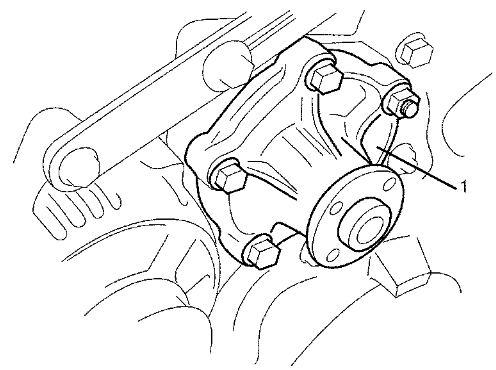
4) Connect negative cable at battery.

Water Pump Removal and Installation

S4RS0A1606017

Removal

1) Disconnect negative cable at battery.
2) Drain coolant.
3) Remove water pump / generator drive belt referring to “Water Pump / Generator Drive Belt Removal and Installation: ”.
4) Remove water pump assembly (1).



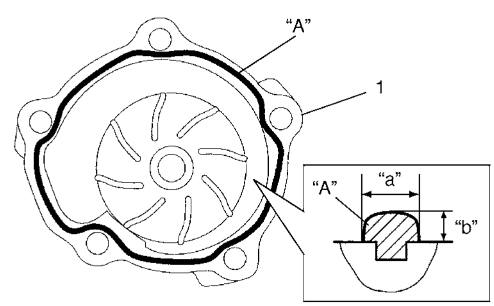
I2RH0B160016-

Installation

1) Apply sealant to mating surface of water pump (1) as shown in the figure.

   “A”: Water tight sealant 99000–31250

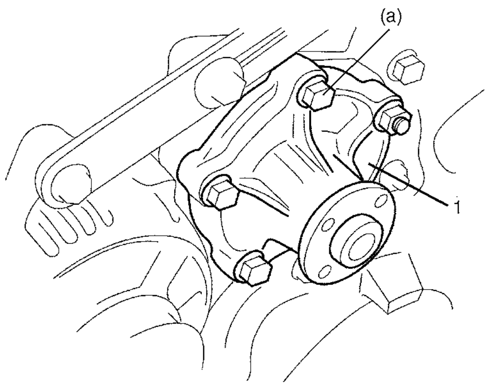
   <u>Sealant quantity (to mating surface of water pump)</u>
   Width “a”: 3 mm (0.12 in.)
   Height “b”: 2 mm (0.08 in.)



I3RM0A160016-

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): 25 N·m (2.5 kg-m, 18.0 lb-ft)



I2RH0B160018-

3) Install water pump pulley.
4) Install water pump / generator drive belt referring to “Water Pump / Generator Drive Belt Removal and Installation: ”.
5) Install A/C compressor belt (if equipped) referring to “Compressor Drive Belt Removal and Installation: in Section 7B”.
6) Refill cooling system referring to Step 7) to 22) of “Cooling System Flush and Refill: ”.
7) Connect negative cable at battery.
8) Check each part for leakage.

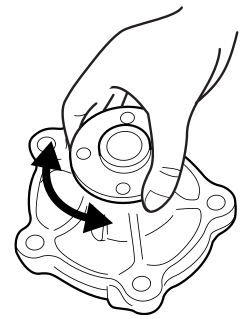
Water Pump Inspection

S4RS0A1606018

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.



I2RH0B160019-

Specifications

Tightening Torque Specifications

S4RS0A1607001

Fastening part	Tightening torque			Note
	N·m	kg-m	lb-ft	
Air ventilation bolt	4.5	0.45	3.5	☞ / ☞
Generator adjusting bolt	23	2.3	17.0	☞
Generator pivot bolt	50	5.0	36.0	☞
Water pump bolt and nut	25	2.5	18.0	☞

NOTE:

The specified tightening torque is also described in the following.
“Cooling System Components: ”

Reference:
For the tightening torque of fastener not specified in this section, refer to “Fasteners Information: in Section 0A”.

Special Tools and Equipment

Recommended Service Material

S4RS0A1608001

Material	SUZUKI recommended product or Specification		Note
Water tight sealant	SUZUKI Bond No.1207F	P/No.: 99000–31250	☞

Fuel System

Precautions

Precautions on Fuel System Service

S4RS0A1700001

WARNING:

Before attempting service of any type on fuel system, the following should be always observed in order to reduce the risk or fire and personal injury.

- **Disconnect negative cable at battery.**
- **Do not smoke, and place no smoking signs near work area.**
- **Be sure to have CO_2 fire extinguisher handy.**
- **Be sure to perform work in a well-ventilated area and away from any open flames (such as gas hot heater).**
- **Wear safety glasses.**
- **To relieve fuel vapor pressure in fuel tank, remove fuel filler cap from fuel filler neck and then reinstall it.**
- **As fuel feed line is still under high fuel pressure even after stopping engine, loosening or disconnecting fuel feed line directly may cause dangerous spout of fuel. Before loosening or disconnecting fuel feed line, make sure to relieve fuel pressure referring to "Fuel Pressure Relief Procedure: ".**
- **A small amount of fuel may be released when the fuel line is disconnected. In order to reduce the risk of personal injury, cover a shop cloth to the fitting to be disconnected. Be sure to put that cloth in an approved container after disconnecting.**
- **Never run engine with fuel pump relay disconnected when engine and exhaust system are hot.**
- **Note that fuel hose connection varies with each type of pipe. Be sure to connect and clamp each hose correctly referring to "Fuel Hose Disconnecting and Reconnecting: ".**
  After connecting, make sure that it has no twist or kink.
- **When installing injector or fuel feed pipe, lubricate its O-ring with gasoline.**

General Description

Fuel System Description

S4RS0A1701001

CAUTION:

This engine requires the unleaded fuel only. The leaded and/or low lead fuel can result in engine damage and reduce the effectiveness of the emission control system.

The main components of the fuel system are fuel tank, fuel pump assembly (with fuel filter, fuel level gauge, fuel pressure regulator, fuel feed line and fuel vapor line.
For the details of fuel flow, refer to "Fuel Delivery System Diagram: ".

Fuel Delivery System Description

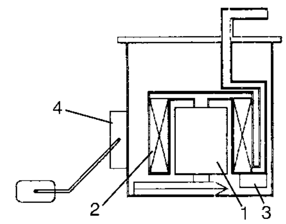
S4RS0A1701002

The fuel delivery system consists of the fuel tank, fuel pump assembly (with built-in fuel filter and fuel pressure regulator), delivery pipe, injectors and fuel feed line.
The fuel in the fuel tank is pumped up by the fuel pump, sent into delivery pipe and injected by the injectors.
As the fuel pump assembly is equipped with built-in fuel filter and fuel pressure regulator, the fuel is filtered and its pressure is regulated before being sent to the feed pipe.
The excess fuel at fuel pressure regulation process is returned back into the fuel tank.
Also, fuel vapor generated in fuel tank is led through the fuel vapor line into the EVAP canister.
For system diagram, refer to "Fuel Delivery System Diagram: ".

Fuel Pump Description

S4RS0A1701003

The fuel pump (1) is an in-tank type electric pump. Incorporated in the pump assembly are;
a fuel filter (2) and a fuel pressure regulator (3) are included and a fuel level gauge (4) is attached.
Addition of the fuel pressure regulator 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.

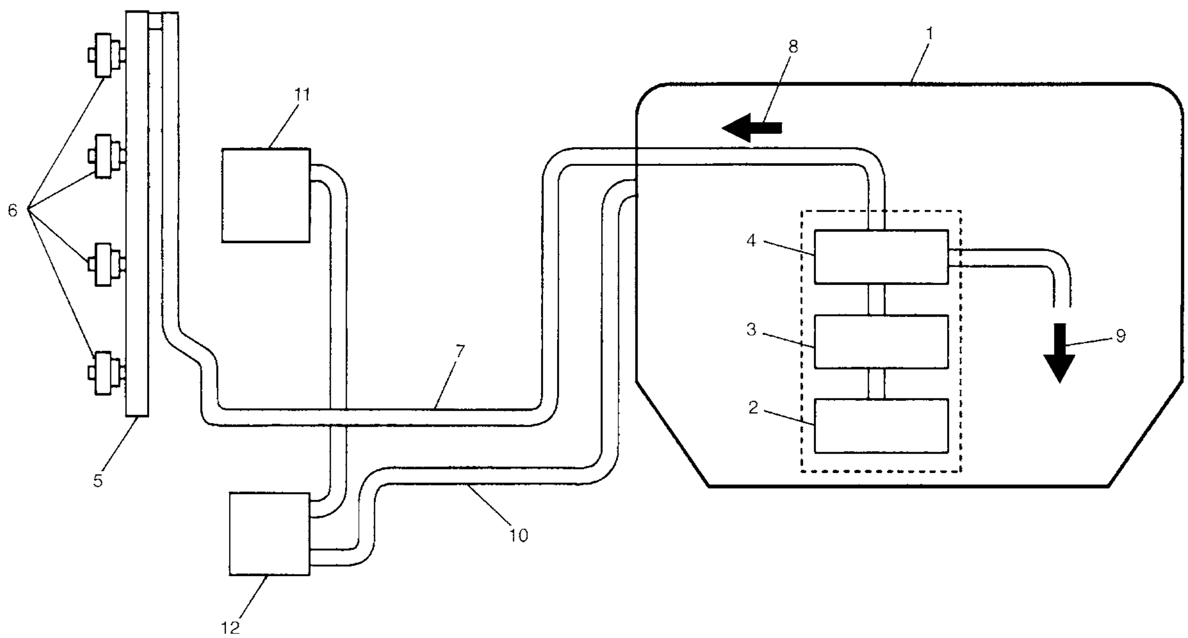


I4RS0A170001-

Schematic and Routing Diagram

Fuel Delivery System Diagram

S4RS0A1702001



I4RS0A170002-

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

Diagnostic Information and Procedures

Fuel Pressure Inspection

S4RS0A1704001

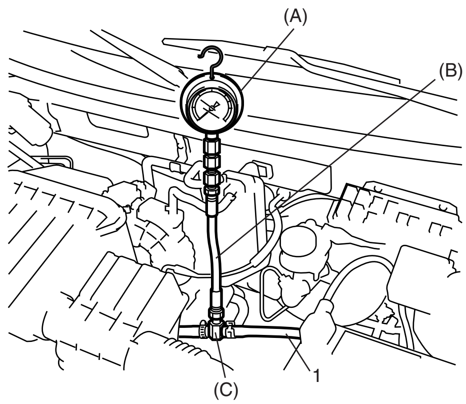
WARNING:

Before starting the following procedure, be sure to observe “Precautions on Fuel System Service: ” in order to reduce the risk or fire and personal injury.

1) Relieve fuel pressure in fuel feed line referring to “Fuel Pressure Relief Procedure: ”.
2) Disconnect fuel feed hose from fuel delivery pipe.

3) Connect special tools and hose between fuel feed hose (1) and fuel delivery pipe as shown in the figure, and clamp hoses securely in order to ensure that no leaks occur during checking.

Special tool
(A): 09912–58442
(B): 09912–58432
(C): 09912–58490



I3RM0A170004-

4) Check that battery voltage is 11 V or more.
5) Measure fuel pressure at each condition.
If measured pressure is out of specification, refer to "Fuel Pressure Check: in Section 1A" and check each possibly defective part. Replace if found defective.
   a) 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
      With fuel pump operating and engine stopped: 270 – 310 kPa (2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi)

   b) Start engine and warm it up to normal operating temperature, and measure fuel pressure at idling.

      Fuel pressure specification
      At specified idle speed: 270 – 310 kPa (2.7 – 3.1 kg/cm^2, 38.4 – 44.0 psi)

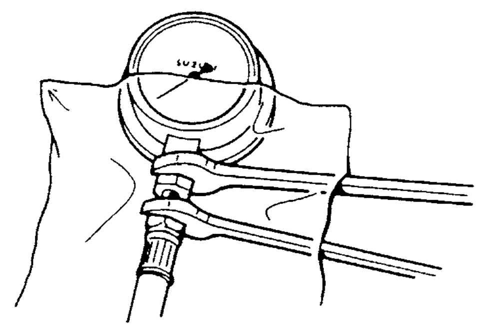
   c) Stop engine, and measure fuel pressure at one minute after stopping.

      Fuel pressure specification
      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) After checking fuel pressure, remove fuel pressure gauge.

WARNING:

As fuel feed line is still under high fuel pressure, make sure to release fuel pressure according to the following procedures.
- **Place fuel container under joint.**
- **Cover joint with rag and loosen joint nut slowly in order to release fuel pressure gradually.**



I2RH01170032-

7) Remove special tools from fuel delivery pipe and fuel feed hose.
8) Connect fuel feed hose to fuel delivery pipe and clamp it securely.
9) With engine OFF and ignition switch ON, check for fuel leaks.

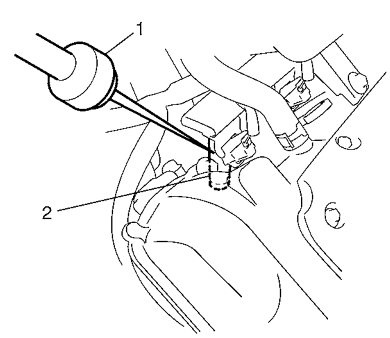
Fuel Cut Operation Inspection

S4RS0A1704002

NOTE:

Before inspection, make sure that gear shift lever is in neutral position (shift select lever is "P" range for A/T vehicle), A/C is OFF and parking brake lever is pulled all the way up.

1) Warm engine up to normal operating temperature.
2) While listening to sound of injector (2) by using sound scope (1) or such, increase engine speed to higher than 3,000 r/min.



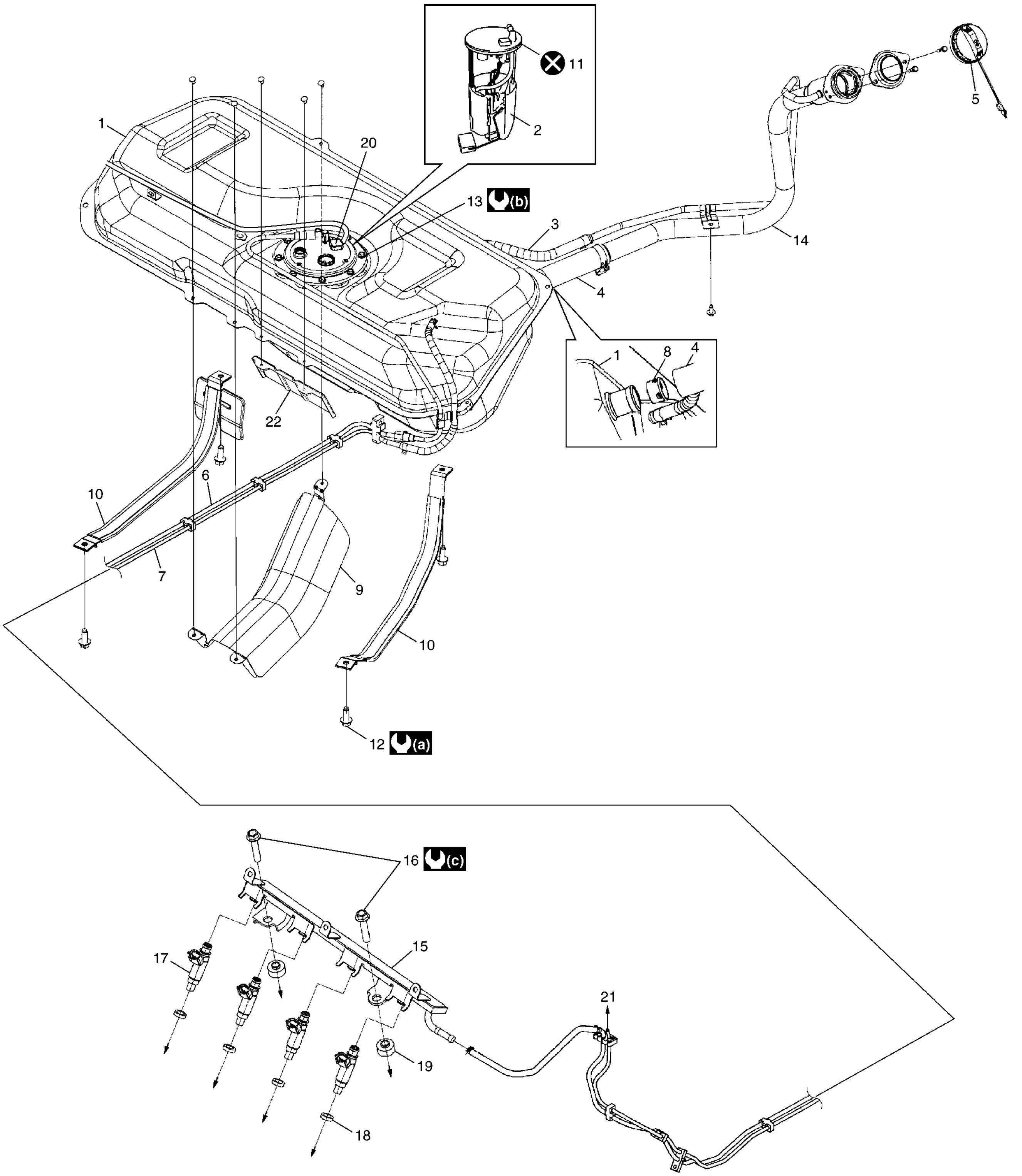
I2RH0B170004-

3) Check to make sure that injector operation sound is stop when throttle valve is closed instantly and it is heard again when engine speed is reduced to approx. 2,000 r/min or less.

Repair Instructions

Fuel System Components

S4RS0A1706001



I4RS0A170003-

1. Fuel tank	10. Fuel tank belt	19. Fuel delivery pipe insulator
2. Fuel pump assembly	11. Fuel pump gasket	20. Wire harness for fuel pump
3. Breather hose	12. Fuel tank bolt	21. To canister
4. Fuel tank filler hose	13. Fuel pump bolt	22. Fuel tank cover
5. Fuel filler cap	14. Fuel filler neck	⊗ : Do not reuse.
6. Fuel feed line	15. Fuel delivery pipe	(a) : 50 N·m (5.0 kg-m, 36.5 lb-ft)

7. Fuel vapor line	16. Fuel delivery pipe bolt	(b) : 11 N·m (1.1 kg-m, 8.0 lb-ft)
8. Fuel tank inlet valve	17. Fuel injector	(c) : 25 N·m (2.5 kg-m, 18.0 lb-ft)
9. Fuel tank protector	18. Injector cushion	

Fuel Hose Disconnecting and Reconnecting

S4RS0A1706023

WARNING:

Before starting the following procedure, be sure to observe "Precautions on Fuel System Service: " in order to reduce the risk or fire and personal injury.

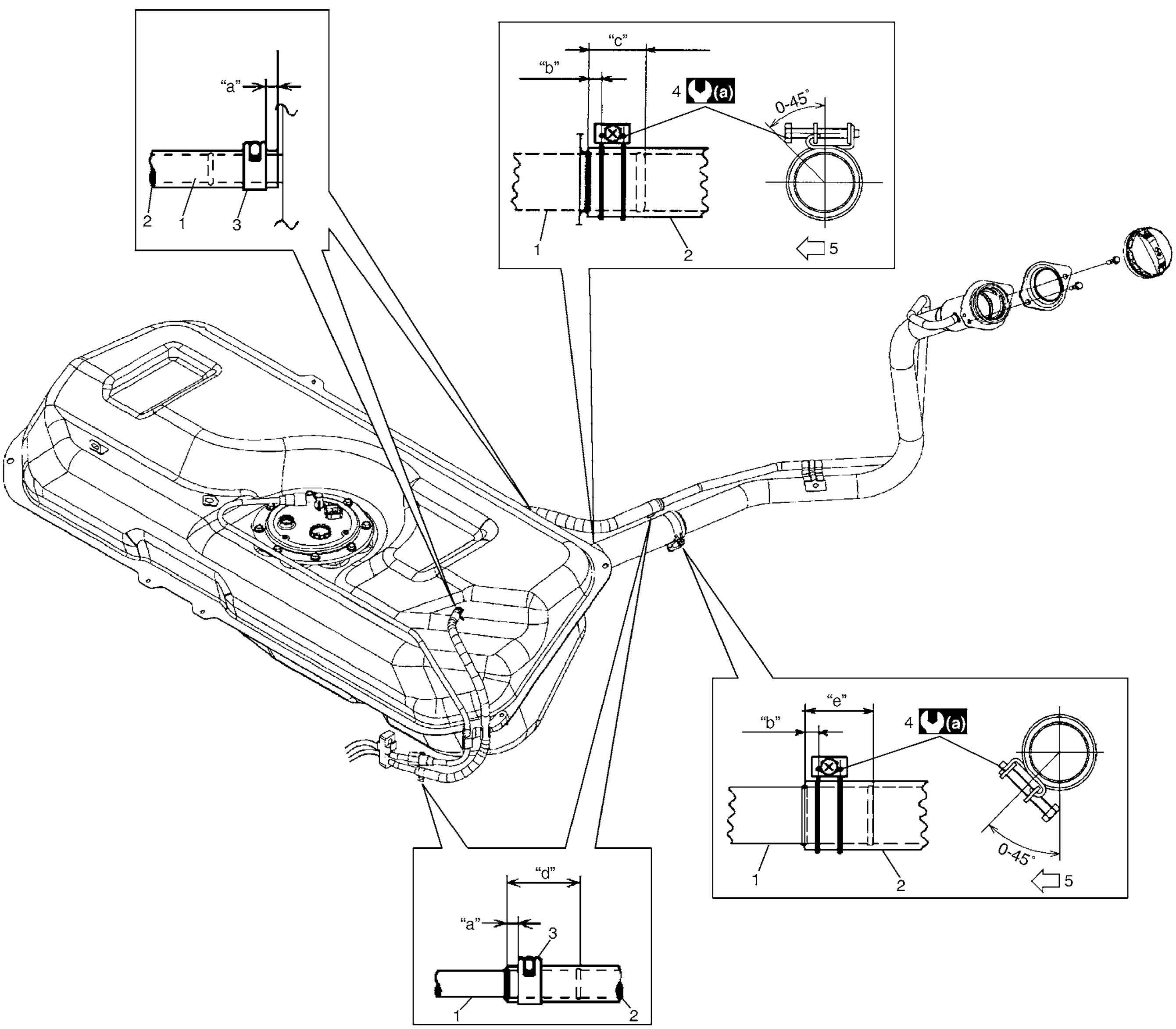
Be sure to connect and clamp each hose correctly as shown in figure.

For Normal Clamp

Fuel tank system

NOTE:

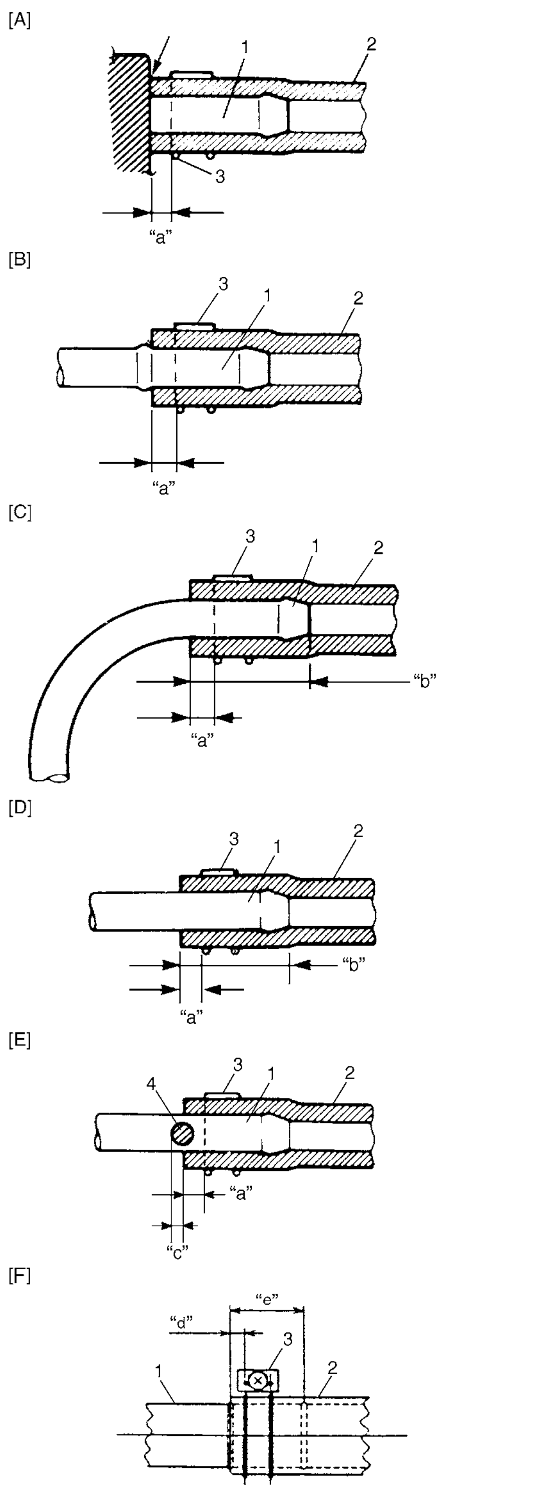
Be sure to install hose to spool of pipe surely.



I4RS0A170018-

1. Pipe	5. Vehicle leftward	“d” 30 mm (1.18 in.)
2. Hose	“a” 3 – 7 mm (0.12 – 0.28 in.)	“e” 38 mm (1.50 in.)
3. Clamp	“b” 5 – 12 mm (0.20 – 0.48 in.)	(a) : 2 N·m (0.2 kg-m, 1.5 lb-ft)
4. Fuel filler hose clamp screw	“c” 33 mm (1.30 in.)	

The other than fuel tank system



I3RM0A170001-

[A]:	With short pipe, fit hose as far as it reaches pipe joint as shown.
[B]:	With the following type pipe, fit hose as far as its peripheral projection as shown.
[C]:	With bent pipe, fit hose as its bent part as shown or till depth “b”.
[D]:	With straight pipe, fit hose till depth “b”.
[E]:	With red marked pipe, fit hose end reaches red mark on pipe.
[F]:	For fuel tank filler hose, insert it to spool or welding-bead.
“a”:	Clamp securely at a position 3 – 7 mm (0.12 – 0.27 in.) from hose end.
“b”:	20 – 30 mm (0.79 – 1.18 in.)
“c”:	0 – 5 mm (0 – 0.19 in.)
“d”:	5 – 12 mm (0.2 – 0.47 in.)
“e”:	40 mm (1.57 in.)
4.	Red mark

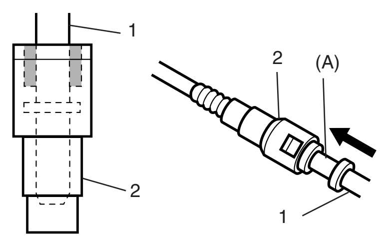
For Quick Joint

Disconnecting

1) Remove mud, dust and/or foreign material between pipe (1) and quick joint (2) by blowing compressed air.
2) Unlock joint lock by inserting special tool between pipe and quick joint.

   Special tool
   (A): 09919–47020

3) Disconnect quick joint from pipe.



I4RS0A170019-

Reconnecting

Insert quick joint to fuel pipe until they lock securely (a click is heard), and confirm that quick joint is not disconnected by hand.

Fuel Pressure Relief Procedure

S4RS0A1706002

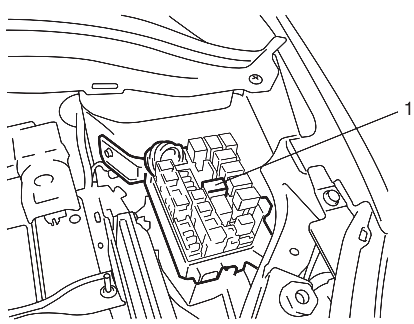
CAUTION:

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

NOTE:

If ECM detects DTC(s) after servicing, clear DTC(s) referring to "DTC Clearance: in Section 1A".

1) Make sure that engine is cold.
2) Shift transaxle gear shift lever in "Neutral" (shift select lever in "P" range for A/T model), set parking brake and block drive wheels.
3) Remove relay / fuse box cover.
4) Disconnect fuel pump relay (1) from relay / fuse box (2).
5) Remove fuel filter cap in order to release fuel vapor pressure in fuel tank, and then reinstall it.
6) Start engine and run it until engine stops for lack of fuel. Repeat cranking engine 2 – 3 times for about 3 seconds each time in order to dissipate fuel pressure in lines. Fuel connections are now safe for servicing.
7) After servicing, connect fuel pump relay (1) to relay / fuse box and install relay / fuse box cover.



I4RS0A170004-

Fuel Leakage Check Procedure

S4RS0A1706003

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 until 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.

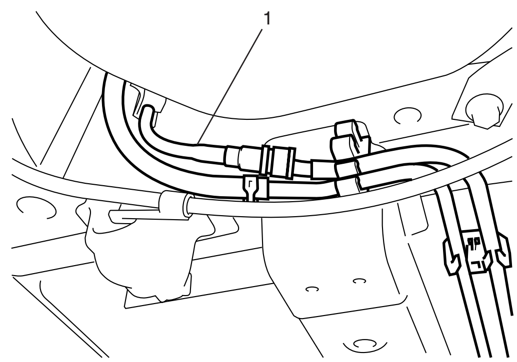
Fuel Lines On-Vehicle Inspection

S4RS0A1706004

CAUTION:

Due to the fact that fuel feed line (1) is under high pressure, use special care when servicing it.

Visually inspect fuel lines for evidence of fuel leakage, hose crack and deterioration or damage.
Make sure all clamps are secure.
Replace parts as needed.



I4RS0A170005-

Fuel Pipe Removal and Installation

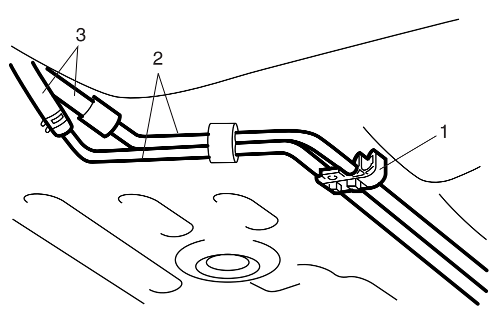
S4RS0A1706005

WARNING:

Before starting the following procedure, be sure to observe "Precautions on Fuel System Service: " in order to reduce the risk or fire and personal injury.

Removal

1) Relieve fuel pressure in fuel feed line according to "Fuel Pressure Relief Procedure: ".
2) Disconnect negative cable at battery.
3) Disconnect fuel pipe joint and fuel hose (3) from fuel pipe (2) at the front and rear of each fuel pipe referring to "Fuel Hose Disconnecting and Reconnecting: ".
4) Mark the location of clamps (1) on fuel pipes (2), so that the clamps can be reinstalled to where they were.
5) Remove pipes (2) with clamp (1) from vehicle.
6) Remove clamp (1) from pipes (2).



I4RS0A170020-

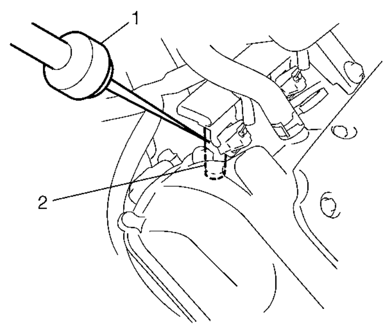
Installation

1) Install clamps to marked location on pipes. If clamp is deformed, its claw is bent or broken, replace it with new one.
2) Install pipes with pipe clamps to vehicle.
3) Connect fuel hoses and pipes to each pipe referring to “Fuel Hose Disconnecting and Reconnecting: ”.
4) Connect negative cable at battery.
5) With engine OFF, turn ignition switch to ON position and check for fuel leaks.

Fuel Injector On-Vehicle Inspection

S4RS0A1706006

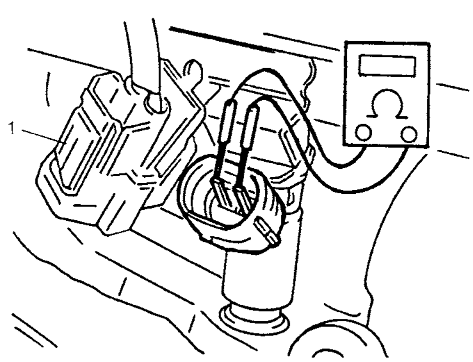
1) Using sound scope (1) or such, check operating sound of injector (2) when engine is running or cranking.
   Cycle of operating sound should vary according to engine speed.
   If no sound or an unusual sound is heard, check injector circuit (wire or coupler) or injector.



I2RH0B170007-

2) Disconnect connector (1) from injector, connect ohmmeter between terminals of injector and check resistance.
   If resistance is out of specification, replace.

   <u>Resistance of fuel injector</u>
   11.3 – 13.8 Ω at 20 °C, 68 °F



I2RH0B170008-

3) Connect connector to injector securely.

Fuel Injector Removal and Installation

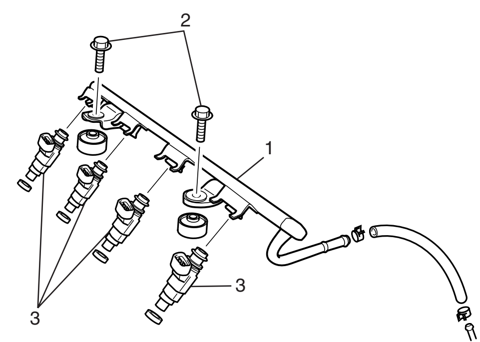
S4RS0A1706007

WARNING:

Before starting the following procedure, be sure to observe “Precautions on Fuel System Service: ” in order to reduce the risk or fire and personal injury.

Removal

1) Relieve fuel pressure according to “Fuel Pressure Relief Procedure: ”.
2) Disconnect negative cable at battery.
3) Disconnect MAF 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).



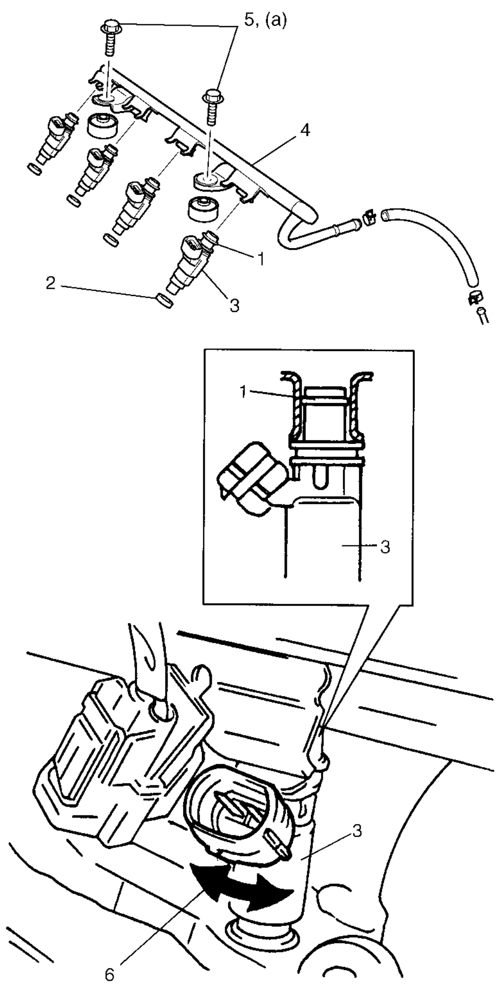
I3RM0A170010-

Installation

Reverse removal procedure for installation noting the following.

- 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 rotate smoothly (6). If not, probable cause is incorrect installation of O-ring. Replace O-ring with new one.
- Tighten delivery pipe bolts (5) to specified torque and make sure that injectors rotate smoothly.

  Tightening torque
  Fuel delivery pipe bolt (a): 25 N·m (2.5 kg-m, 18.0 lb-ft)



I3RM0A170011-

- After installation, with engine OFF and ignition switch ON, check for fuel leaks around fuel line connection.

Fuel Injector Inspection

S4RS0A1706008

WARNING:

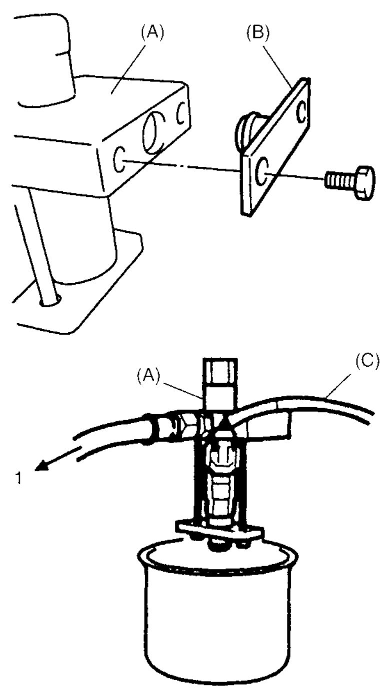
Before starting the following procedure, be sure to observe "Precautions on Fuel System Service: " in order to reduce the risk or fire and personal injury.

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

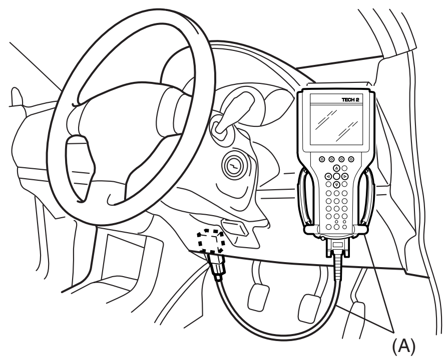


I3RM0A170012-

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 with ignition switch OFF.
      ii) Turn ignition switch ON, clear DTC and select “MISC TEST” mode on scan tool.
      iii) Turn fuel pump ON by using scan tool.

      Special tool
      (A): SUZUKI scan tool



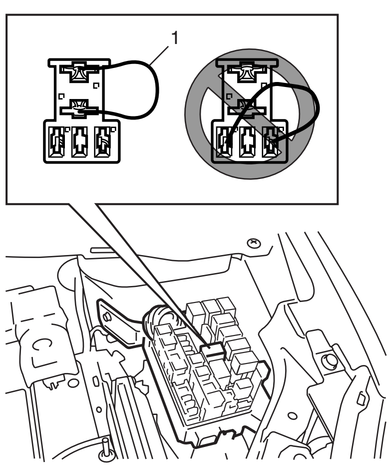
I4RS0A170021-

   b) When not using scan tool:
      i) Remove fuel pump relay from connector.
      ii) Connect two terminals of relay connector using service wire (1) as shown in the 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.



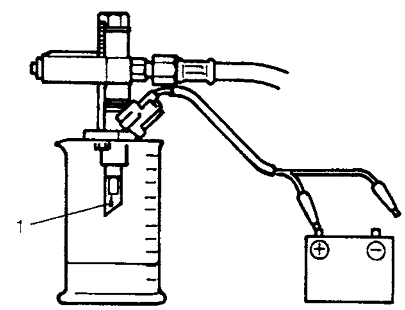
I4RS0A170006-

7) Apply battery voltage to injector (1) 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 the following specifications, replace.

   Fuel leakage
   Less than 1 drop/min.



I2RH0B170013-

Fuel Filler Cap Inspection

S4RS0A1706011

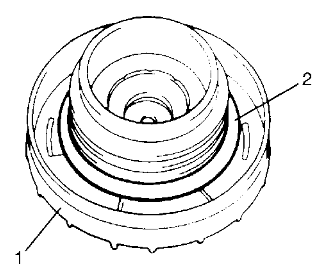
WARNING:

Before starting the following procedure, be sure to observe “Precautions on Fuel System Service: ” in order to reduce the risk or fire and personal injury.

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

NOTE:

If cap requires replacement, only a cap with the same features should be used. Failure to use correct cap can result in fire and personal injury.



I2RH01170008-

Fuel Tank Inlet Valve Removal and Installation

S4RS0A1706015

WARNING:

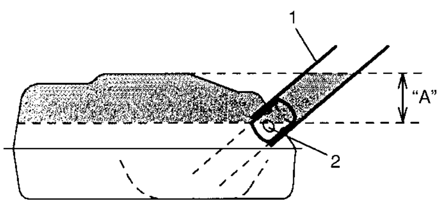
Before starting the following procedure, be sure to observe "Precautions on Fuel System Service: " in order to reduce the risk or fire and personal injury.

Removal

1) Remove fuel filler cap.
2) Insert hose of a hand operated pump into fuel filler hose (1) and drain fuel in space "A" as shown in figure.

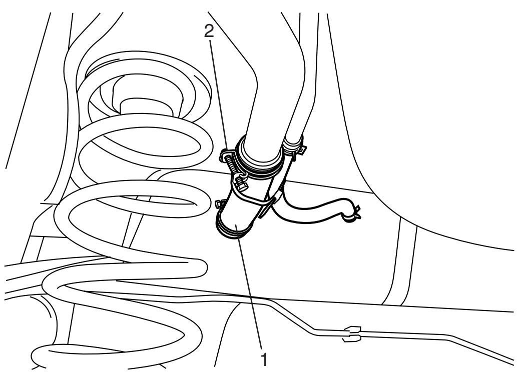
CAUTION:

Do not force pump hose into fuel tank, or pump hose may damage to fuel tank inlet valve (2).



IYSQ01170010-

3) Hoist vehicle, and remove clamp (2) and fuel filler hose (1) from fuel tank.

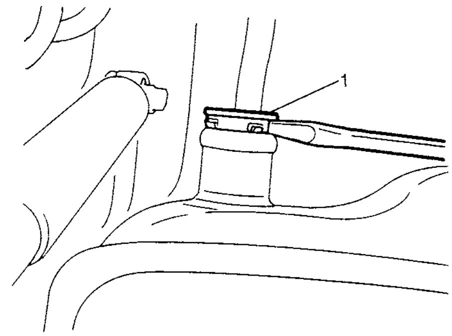


I4RS0A170007-

4) Remove fuel tank inlet valve (1) using flat head rod (2) or the like.

CAUTION:

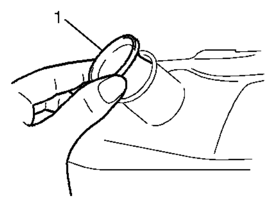
Be careful not to damage fuel tank inlet valve (1) with flat head rod (2) or the like.



I2RH0B170017-

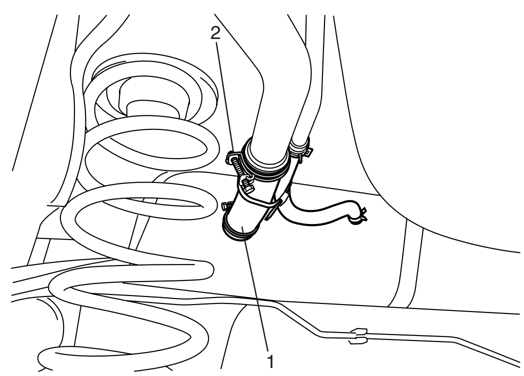
Installation

1) Install fuel tank inlet valve (1) to fuel tank.



I2RH0B170018-

2) Install fuel filler hose (1) to fuel tank and secure it with clamp (2).
   For proper installation, refer to "Fuel Hose Disconnecting and Reconnecting: ".



I4RS0A170007-

3) Lower vehicle and install fuel filler cap.

Fuel Tank Inlet Valve Inspection

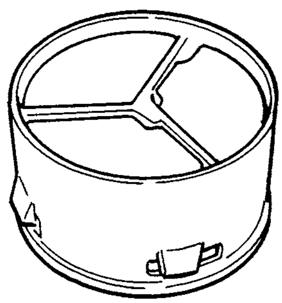
S4RS0A1706016

WARNING:

Before starting the following procedure, be sure to observe “Precautions on Fuel System Service: ” in order to reduce the risk or fire and personal injury.

Check fuel tank inlet valve for the following.
If any damage or malfunction is found, replace.

- Damage
- Smooth opening and closing



I2RH0B170019-

Fuel Tank Removal and Installation

S4RS0A1706012

WARNING:

Before starting the following procedure, be sure to observe “Precautions on Fuel System Service: ” in order to reduce the risk or fire and personal injury.

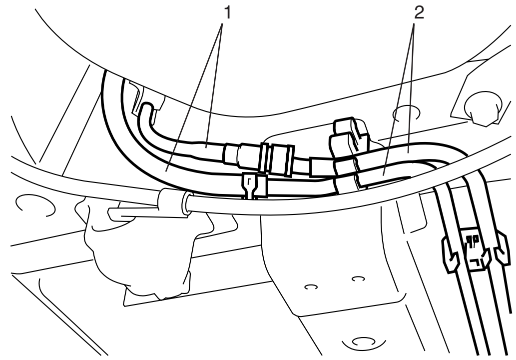
Removal

1) Relieve fuel pressure in fuel feed line according to “Fuel Pressure Relief Procedure: ”.
2) Disconnect negative cable at battery.
3) Hoist vehicle.
4) Remove exhaust center pipe.
5) Disconnect fuel filler hose and breather hose from filler neck referring to “Fuel Tank Inlet Valve Removal and Installation: ”.
6) Due to absence of fuel tank drain plug, drain fuel tank by pumping fuel out through fuel tank filler. Use hand operated pump device to drain fuel tank.

CAUTION:

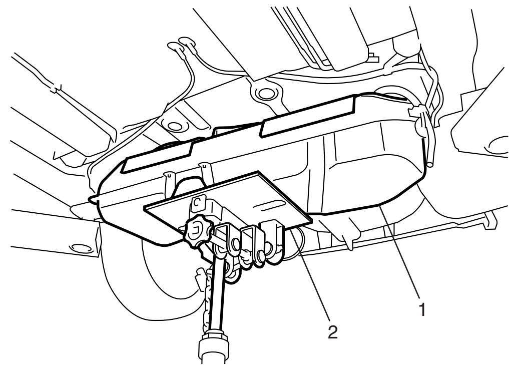
- **Do not force pump hose into fuel tank, or pump hose may damage fuel tank inlet valve.**
- **Never store fuel in an open container due to possibility of fire or explosion.**

7) Disconnect fuel pipe joint and fuel hoses (1) from fuel pipes (2) referring to “Fuel Hose Disconnecting and Reconnecting: ”.



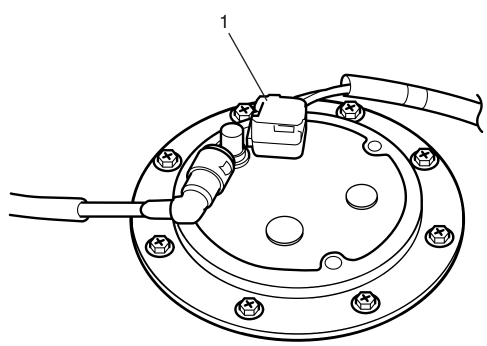
I4RS0A170008-

8) Support fuel tank (1) with jack (2) and remove its mounting bolts.



I4RS0A170009-

9) Lower fuel tank a little as to disconnect wire harness at connector (1), then remove fuel tank.



I4RS0A170010-

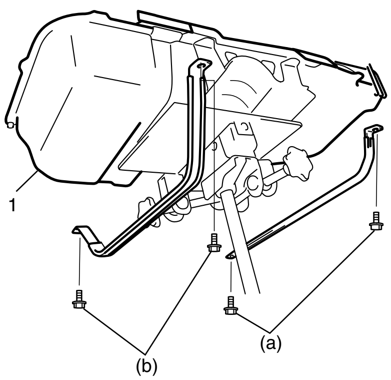
Installation

CAUTION:

- **When connecting joint, clean outside surfaces of pipe where joint is to be inserted, push joint into pipe till joint lock clicks and check to ensure that pipes are connected securely, or fuel leak may occur.**
- **Never let the fuel hoses touch the ABS sensor harness (if equipped).**

1) If parts have been removed from fuel tank, install them before installing fuel tank to vehicle.
2) Raise fuel tank (1) with jack and connect fuel pump connector and gauge and clamp wire harness.
3) Install fuel tank to vehicle.

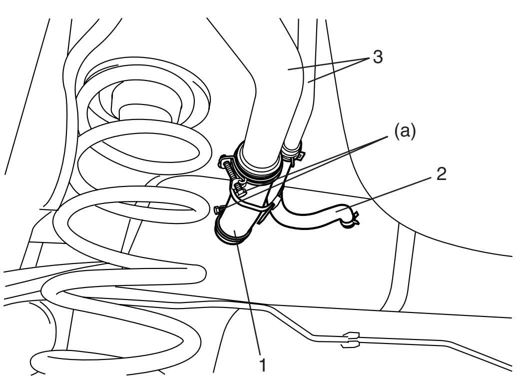
Tightening torque
Fuel tank bolt (a): 50 N·m (5.0 kg-m, 36.5 lb-ft)



I4RS0A170011-

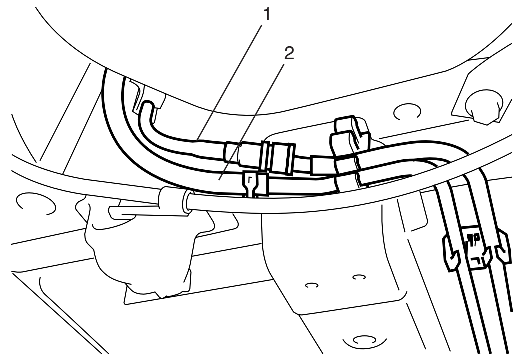
4) Connect fuel filler hose (1) and breather hose (2) to filler neck (3) as shown in figure, and clamp them securely.

Tightening torque
Fuel filler hose clamp (a): 2 N·m (0.2 kg-m, 1.5 lb-ft)



I4RS0A170012-

5) Connect fuel feed hose (1) and vapor hose (2) to each pipe as shown in figure, and clamp them securely.
6) Install exhaust center pipe referring to “Exhaust Pipe and Muffler Removal and Installation: in Section 1K”.



I4RS0A170013-

7) Connect negative cable at battery.
8) With engine OFF, turn ignition switch to ON position and check for fuel leaks.

Fuel Tank Inspection

S4RS0A1706013

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

Fuel Tank Purging Procedure

S4RS0A1706014

WARNING:

- **Before starting the following procedure, be sure to observe “Precautions on Fuel System Service: ” in order to reduce the risk or fire and personal injury.**
- **This purging procedure will not remove all fuel vapor.**
  Do not attempt any repair on tank using heat of flame as an explosion resulting in personal injury could occur.

CAUTION:

Never remain water in fuel tank after washing, or fuel tank inside will get corrosion.

The following procedure are used for purging fuel tank.

1) After removing fuel tank, remove all hoses, pipes and fuel pump assembly from fuel tank.
2) Drain all remaining fuel from tank.
3) Place fuel tank to flushing area.
4) Fill tank with warm water or tap water, and agitate vigorously and drain. Repeat this washing until inside of tank is clean. Replace tank if its inside is rusty.
5) Completely flush out remaining water after washing.

Fuel Pump On-Vehicle Inspection

S4RS0A1706017

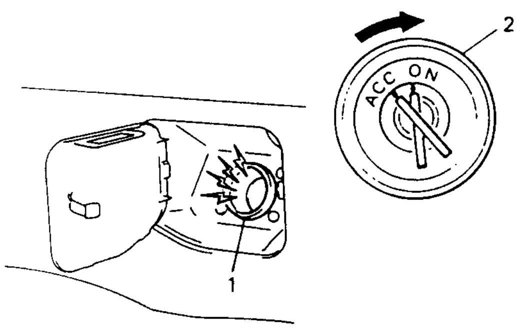
WARNING:

Before starting the following procedure, be sure to observe "Precautions on Fuel System Service: " in order to reduce the risk or fire and personal injury.

NOTE:

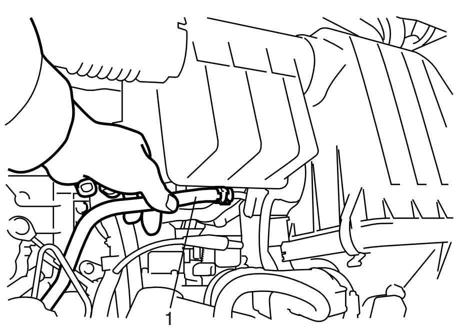
The fuel pressure regulator is incorporated with the fuel pump assembly so individual inspection of it is impossible.

1) Remove filler cap and turn ON ignition switch (2). Then fuel pump operating sound should be heard from fuel filler (1) for about 2 seconds and stop. Be sure to reinstall fuel filler cap after checking.
   If the check result is not satisfactory, go to "Fuel Pump and Its Circuit Check: in Section 1A".



IVSY01170013-

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, go to "Fuel Pressure Check: in Section 1A".



I3RM0A170019-

Fuel Pump Assembly Removal and Installation

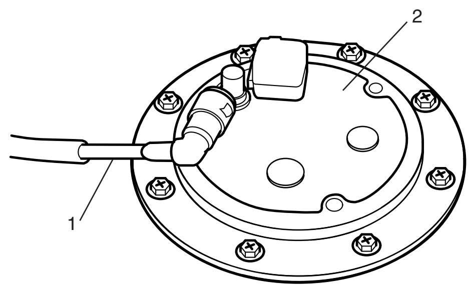
S4RS0A1706019

WARNING:

Before starting the following procedure, be sure to observe "Precautions on Fuel System Service: " in order to reduce the risk or fire and personal injury.

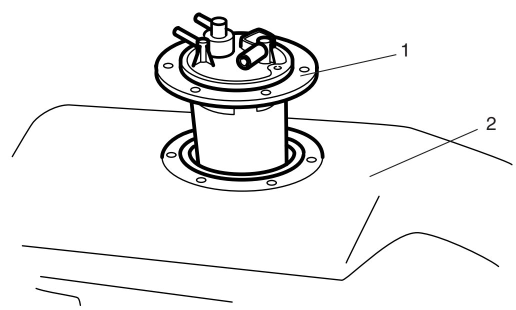
Removal

1) Remove fuel tank from vehicle. Refer to "Fuel Tank Removal and Installation: ".
2) Disconnect fuel feed pipe (1) from fuel pump assembly (2) referring to "Fuel Hose Disconnecting and Reconnecting: ".



I4RS0A170014-

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



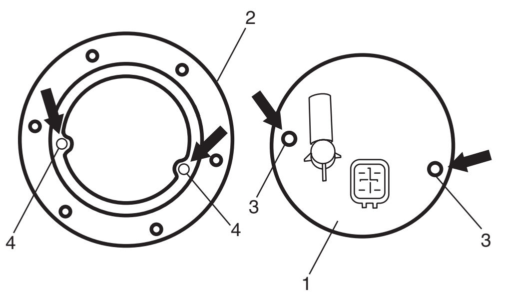
I3RM0A170021-

Installation

CAUTION:

When connecting joint, clean outside surface of pipe where joint is to be inserted, push joint into pipe till joint lock clicks and check to ensure that pipes are connected securely, or fuel leak may occur.

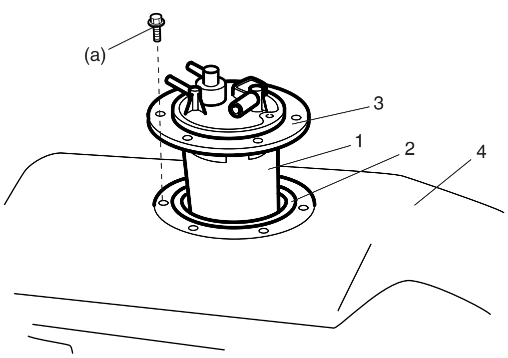
1) Clean mating surfaces of fuel pump assembly (1) and fuel tank.
2) Put plate (2) on fuel pump assembly (1) by matching the protrusion of fuel pump assembly (3) to plate hole (4) as shown.



I4RS0A170015-

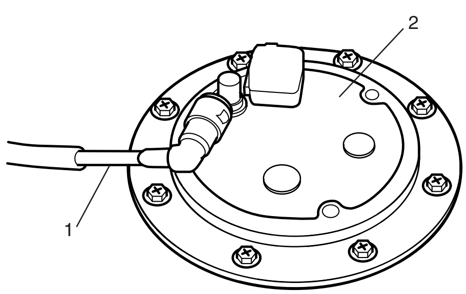
3) Install new gasket (2) and fuel pump assembly (1) with plate (3) to fuel tank (4).

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



I3RM0A170023-

4) Connect fuel feed line (1) (pipe joint) to fuel pump assembly (2).



I4RS0A170014-

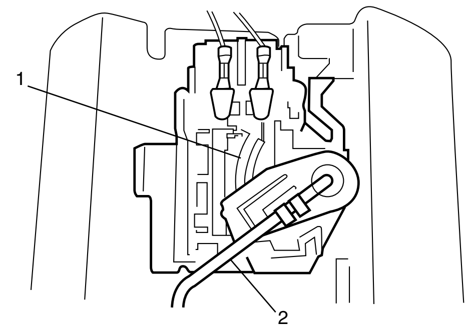
5) Install fuel tank to vehicle. Refer to “Fuel Tank Removal and Installation: ”.

Fuel Level Sensor Removal and Installation

S4RS0A1706022

CAUTION:

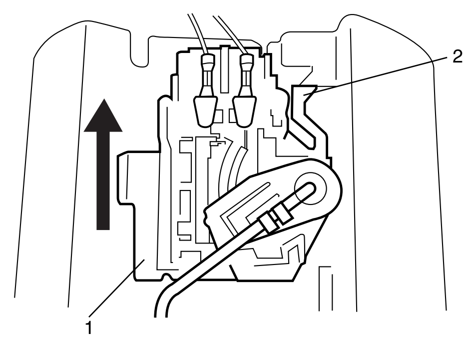
- **Do not touch resister plate (1) and deform arm (2). It may cause fuel level sensor to fail.**
- **Be very careful not to cause damage to fuel tube installed section (sealed section in bore). If it be damaged, replace it with new one, or fuel will leak from the part.**



I4RS0A170016-

Removal

1) Remove fuel pump assembly from fuel tank referring to “Fuel Pump Assembly Removal and Installation: ”.
2) Disconnect fuel level sensor connector.
3) With pressing snap-fit part (2), remove fuel level sensor (1) by sliding it in the arrow direction as shown in figure.



I4RS0A170017-

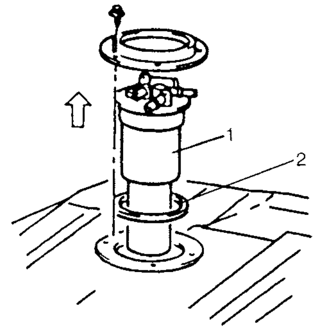
Installation

Reverse removal procedure for installation.

Fuel Pump Inspection

S4RS0A1706021

- Check fuel pump assembly for damage.
- Check fuel suction filter (1) for evidence of dirt and contamination.
  If present, replace or clean and check for presence of dirt in fuel tank.
- For electrical circuit, refer to “Fuel Pressure Check: in Section 1A”.
- For inspection of fuel level gauge (2), refer to “Fuel Level Sensor Inspection: in Section 9C”.



I3RM0A170024-

Specifications

Tightening Torque Specifications

S4RS0A1707001

Fastening part	Tightening torque			Note
	N⋅m	kg-m	lb-ft	
Fuel delivery pipe bolt	25	2.5	18.0	☞
Fuel tank bolt	50	5.0	36.5	☞
Fuel filler hose clamp	2	0.2	1.5	☞
Fuel pump assembly bolt	11	1.1	8.0	☞

NOTE:

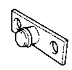
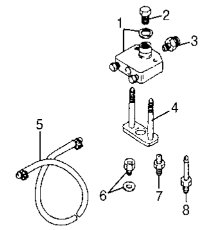
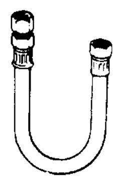
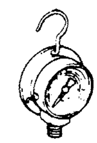
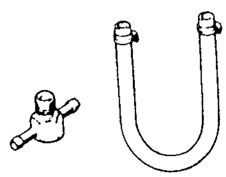
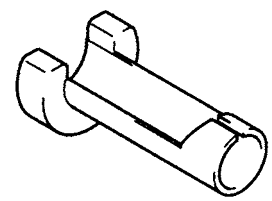
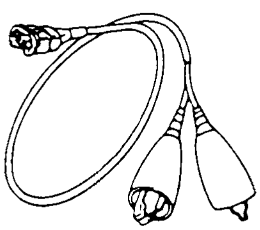
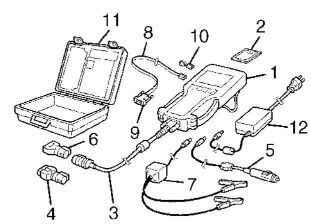
The specified tightening torque is also described in the following.
“Fuel System Components: ”
“Fuel Hose Disconnecting and Reconnecting: ”

Reference:
For the tightening torque of fastener not specified in this section, refer to “Fasteners Information: in Section 0A”.

Special Tools and Equipment

Special Tool

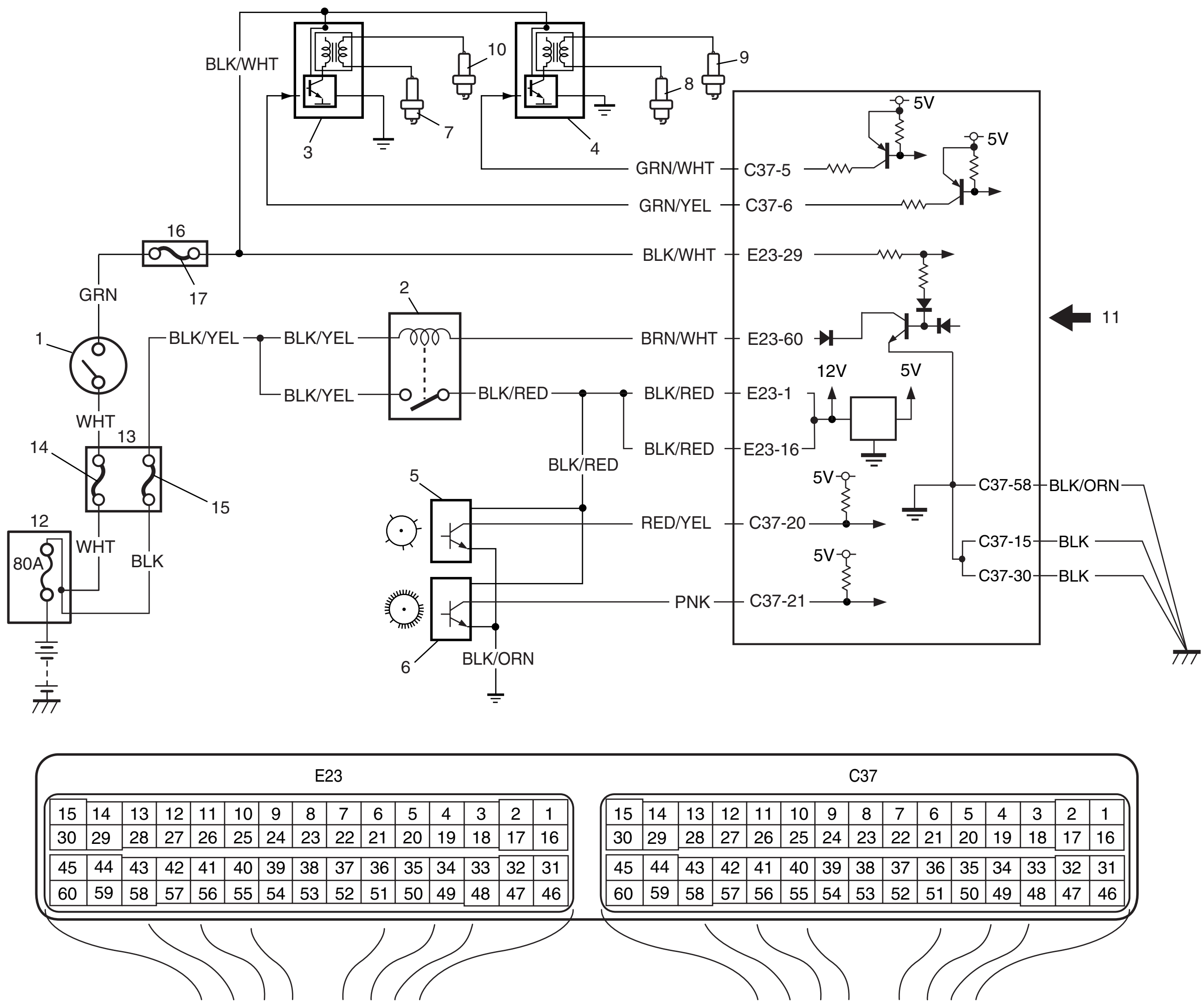
S4RS0A1708001

09912–57610 Injector checking tool plate ☞ 	09912–58421 Checking tool set This kit includes the following items. 1. Tool body and washer, 2. Body plug, 3. Body attachment-1, 4. Holder, 5. Return hose and clamp, 6. Body attachment-2 and washer, 7. Hose attachment-1, 8. Hose attachment-2 ☞ 
09912–58432 Fuel pressure gauge hose This tool included in fuel pressure gauge set (09912-58413). ☞ 	09912–58442 Fuel pressure gauge This tool included in fuel pressure gauge set (09912-58413). ☞ 
09912–58490 3-way joint & hose ☞ 	09919–47020 Quick joint remover ☞ 
09930–88530 Injector test lead ☞ 	SUZUKI scan tool — This kit includes 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 loop back connector, 11. Storage case, 12. Power supply ☞ 

Schematic and Routing Diagram

Ignition System Wiring Circuit Diagram

S4RS0A1802001



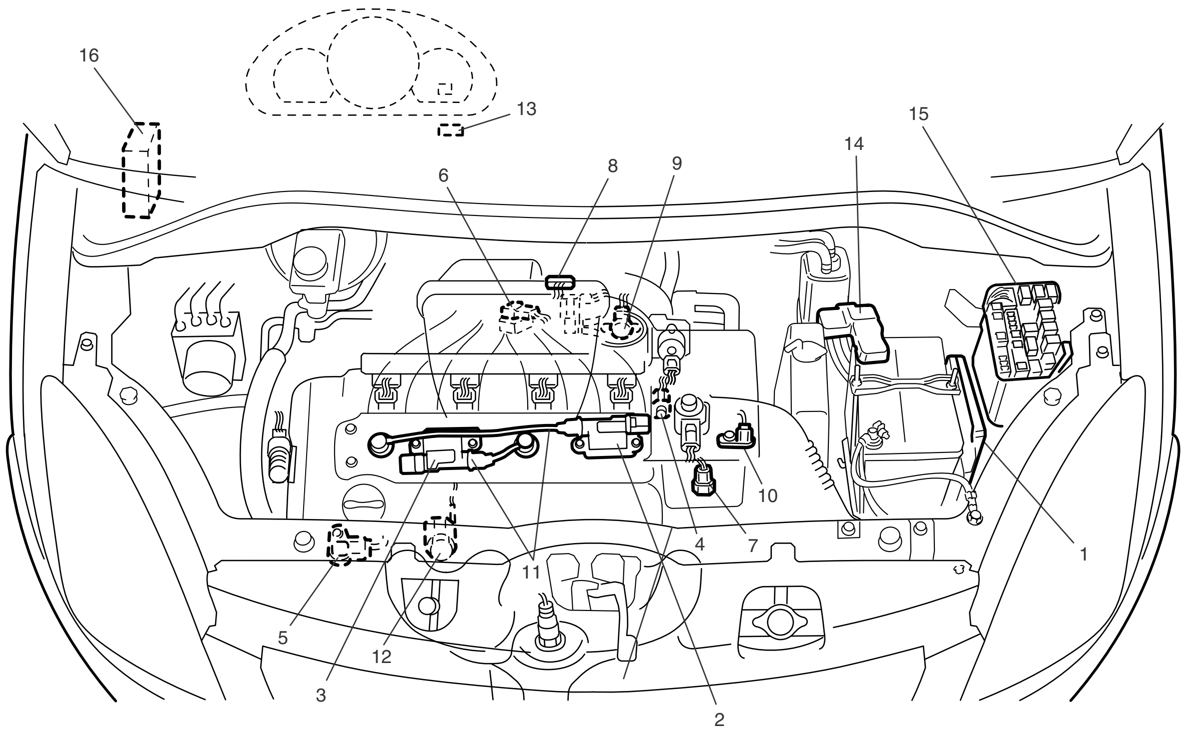
I4RS0A180001-

1. Ignition switch	7. No.1 spark plug	13. Relay box
2. Main relay	8. No.2 spark plug	14. “IG ACC” fuse
3. Ignition coil assembly for No.1 and No.4 spark plugs	9. No.3 spark plug	15. “FI” fuse
4. Ignition coil assembly for No.2 and No.3 spark plugs	10. No.4 spark plug	16. Junction block assembly
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)	17. “IG COIL” fuse
6. CKP sensor	12. Main relay box	

Component Location

Ignition System Components Location

S4RS0A1803001



I4RS0A180002-

1. ECM	7. ECT sensor	13. Data link connector
2. Ignition coil assembly for No.1 and No.4 spark plugs	8. MAF and IAT sensor	14. Main relay box
3. Ignition coil assembly for No.2 and No.3 spark plugs	9. TP sensor	15. Relay box
4. CMP sensor	10. VSS	16. Junction block assembly
5. CKP sensor	11. High-tension cords	
6. MAP sensor	12. Knock sensor	

Diagnostic Information and Procedures

Ignition System Symptom Diagnosis

S4RS0A1804001

Condition	Possible cause	Correction / Reference Item
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 knock sensor	*Replace.*
	Faulty ECM	*Replace.*

Reference Waveform of Ignition System

S4RS0A1804002

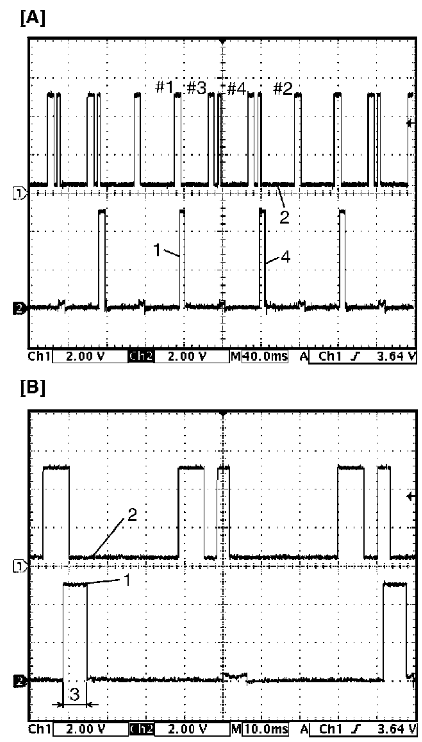
1) Remove ECM from its bracket with ECM connectors connected referring to “Engine Control Module (ECM) Removal and Installation: in Section 1C”.
2) Oscilloscope waveform of CMP sensor and No.1/ No.4 ignition trigger signal are as shown in the figure when connecting oscilloscope between terminal “C37-20” of ECM connector and ground, and between terminal “C37-6” and ground.

Measurement condition for waveform [A]

Measurement terminal	**CH1: “C37-20” to “C37-58”** **CH2: “C37-6” to “C37-58”**
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: “C37-20” to “C37-58”** **CH2: “C37-6” to “C37-58”**
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**



I3RB0A180003-

[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 Check

S4RS0A1804003

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 Section 1A".
2	**Ignition spark test** 1) Check all spark plugs for condition and type referring to "Spark Plug Inspection: ". 2) If OK, perform ignition spark test referring to "Ignition Spark Test: ". *Is spark emitted from all spark plugs?*	Go to Step 11.	Go to Step 3.
3	**DTC check** 1) Perform DTC check referring to "DTC Check: in Section 1A". *Is DTC stored in ECM?*	Go to applicable DTC diag. flow.	Go to Step 4.
4	**Electrical connection check** 1) Check ignition coil assemblies and high-tension cords for electrical connection. *Are they connected securely?*	Go to Step 5.	Connect securely.
5	**High-tension cords check** 1) Check high-tension cord for resistance referring to "High-Tension Cord Inspection: ". *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: ". *Is check result satisfactory?*	Go to Step 8.	Replace ignition coil assembly.
8	**CKP sensor check** 1) Check CKP sensor referring to "Crankshaft Position (CKP) Sensor Inspection: in Section 1C". *Is check result satisfactory?*	Go to Step 9.	Tighten CKP sensor bolt, replace CKP sensor or CKP sensor plate.
9	**CMP sensor check** 1) Check CMP sensor referring to "Camshaft Position (CMP) Sensor Inspection: in Section 1C". *Is check result satisfactory?*	Go to Step 10.	Tighten CMP sensor bolt, replace CMP sensor or intake camshaft.
10	**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 11.	Repair or replace.
11	**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 12.	Substitute a known-good ECM and then repeat Step 2.

Step	Action	Yes	No
12	**Knock sensor check** 1) Confirm that knock sensor circuit is in good condition referring to “DTC P0327 / P0328: Knock Sensor Circuit Low / High: in Section 1A” 2) Check oscilloscope waveform of knock sensor signal referring to “Reference waveform No.20” and “Reference waveform No.21” under “Inspection of ECM and Its Circuits: in Section 1A” *Is check result satisfactory?*	Go to Step 13.	Substitute a known-good knock sensor and recheck.
13	**Ignition timing check** 1) Check initial ignition timing and ignition timing advance referring to “Ignition Timing Inspection: ”. *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.

Ignition Spark Test

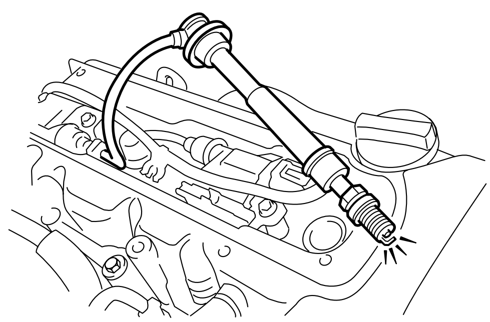
S4RS0A1804004

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 Plug Inspection: ”.
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.



I4RS0A180006-

6) If no spark is emitted, inspect the related parts as described in “Ignition System Symptom Diagnosis: ”.

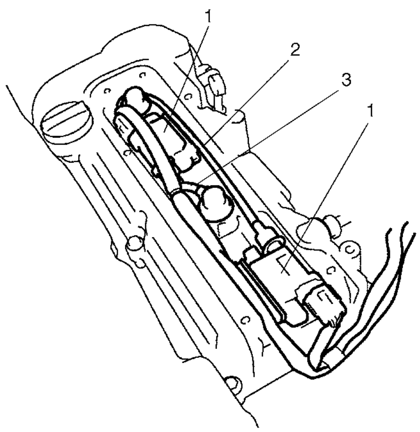
Repair Instructions

High-Tension Cord Removal and Installation

S4RS0A1806001

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.



I4RS0A180003-

3) Pull out high-tension cords from spark plugs while gripping each cap.

CAUTION:

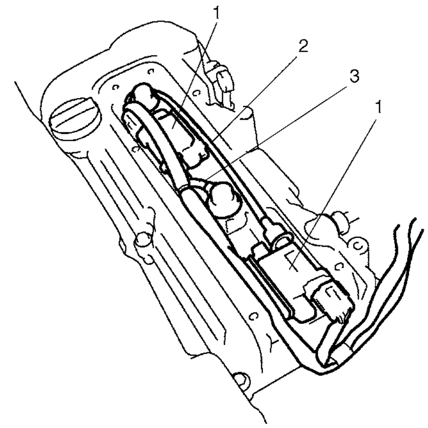
- **Removal of high-tension cords together with clamps will be recommended so as not to damage their inside wire (resistive conductor).**
- **For the same reason, pull out each connection by gripping cap portion.**

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.**



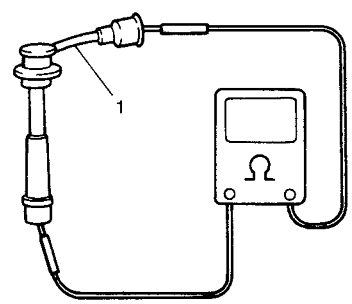
I4RS0A180004-

High-Tension Cord Inspection

S4RS0A1806002

Measure resistance of high-tension cord (1) by using ohmmeter.
If resistance exceeds specification, replace high-tension cord(s).

<u>High-tension cord resistance</u>
No.1 cylinder high-tension cord resistance: 1.4 – 4.0 kΩ
No.3 cylinder high-tension cord resistance: 0.6 – 2.0 kΩ



I2RH0B180005-

Spark Plug Removal and Installation
S4RS0A1806003

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: ".
3) Remove spark plugs.

Installation
1) Install spark plugs and tighten them to specified torque.

   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: ".
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 Plug Inspection
S4RS0A1806004

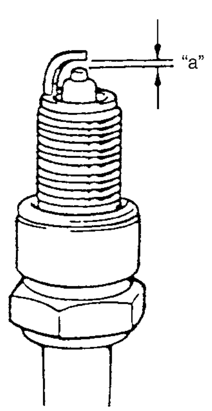
Inspect spark plug for:

- Electrode wear
- Carbon deposits
- Insulator damage

If any abnormality is found, adjust air gap, clean with spark plug cleaner or replace them with new plugs.

Spark plug air gap
"a": 1.0 – 1.1 mm (0.040 – 0.043 in.)

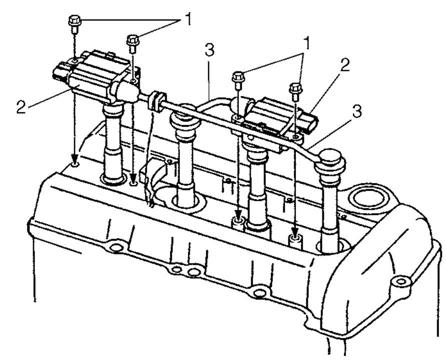
Spark plug type
NGK: BKR6E-11
DENSO: K20PR-U11



IYSQ01181012-

Ignition Coil Assembly (Including ignitor) Removal and Installation
S4RS0A1806005

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.

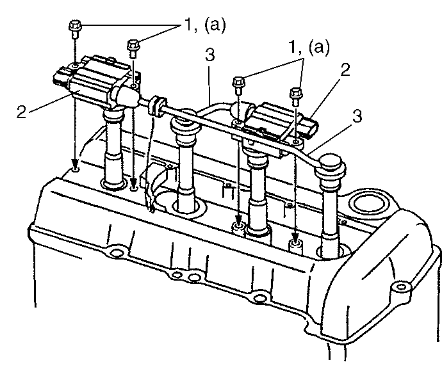


I2RH0B180006-

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.



I3RM0A180004-

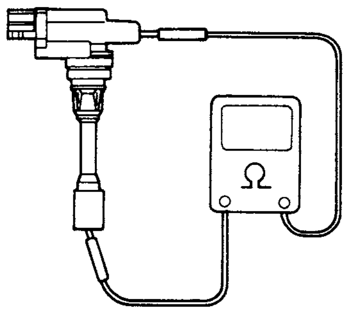
4) Install cylinder head upper cover and air cleaner assembly with air intake pipe.
5) Connect negative cable to battery.

Ignition Coil Assembly (Including ignitor) Inspection

S4RS0A1806006

Measure secondary coil for resistance.
If resistance is out of specification, replace ignition coil assembly.

Secondary coil resistance
7.6 – 10.2 kΩ at 20 °C, 68 °F



I2RH0B180007-

Ignition Timing Inspection

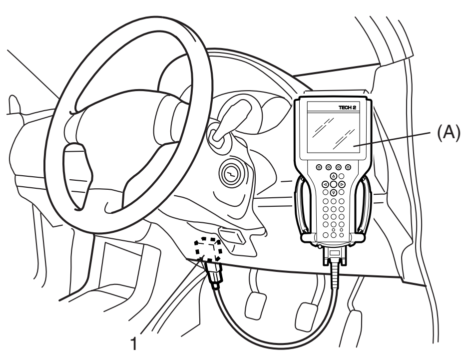
S4RS0A1806007

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



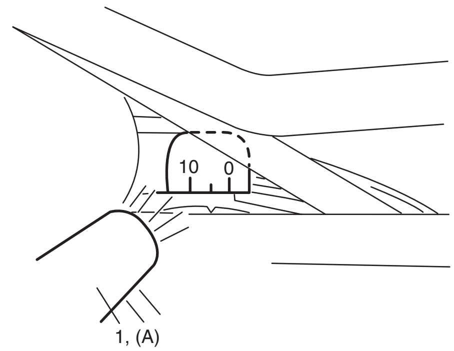
I4RS0A180005-

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 1A".
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 SUZUKI scan tool)
   5 ± 3° BTDC (at specified idle speed)

   Ignition order
   1 – 3 – 4 – 2

   Special tool
   (A): 09930–76420



I3RB0A180004-

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 vehicle 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 the check results are not satisfactory, check CKP sensor and ECM.

Specifications

Tightening Torque Specifications

S4RS0A1807001

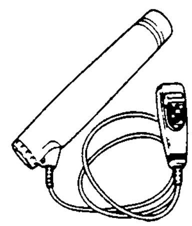
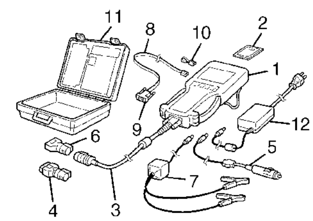
Fastening part	Tightening torque			Note
	N·m	kg-m	lb-ft	
Spark plug	25	2.5	18.0	☞
Ignition coil bolt	10	1.0	7.5	☞

Reference:
For the tightening torque of fastener not specified in this section, refer to “Fasteners Information: in Section 0A”.

Special Tools and Equipment

Special Tool

S4RS0A1808001

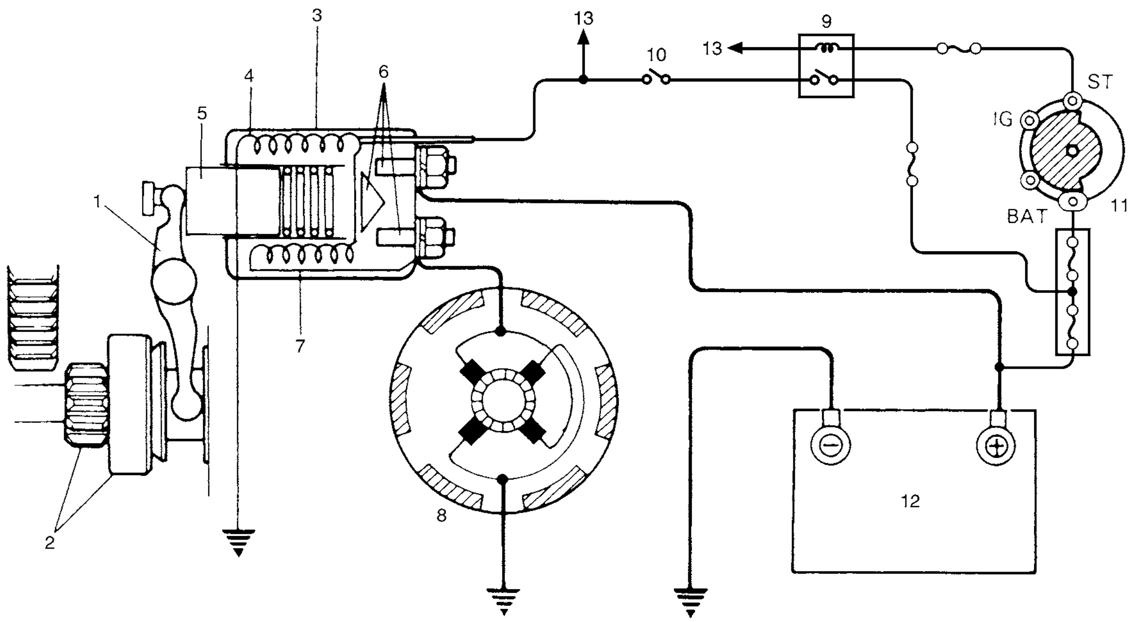
09930–76420 Timing-light (dry cell type) ☞ 	SUZUKI scan tool — This kit includes following items. 1. Tech 2, 2. PCMCIA card, 3. DLC cable, 4. SAE 16/19 adapter, 5. Cigarette cable, 6. DLC loopback adapter, 7. Battery power cable, 8. RS232 cable, 9. RS232 adapter, 10. RS232 loop back connector, 11. Storage case, 12. Power supply ☞ 

Starting System

Schematic and Routing Diagram

Cranking System Circuit Diagram

S4RS0A1902001



I4RS0A190001-

1. Pinion drive lever	6. Magnetic switch contacts	11. Ignition & Starter switch
2. Pinion & Over-running clutch	7. Pull-in coil	12. Battery
3. Magnetic switch	8. Starting motor	13. To ECM
4. Hold-in coil	9. Starting motor control relay	
5. Plunger	10. A/T: Transmission range switch (shift lever switch)	

Diagnostic Information and Procedures

Cranking System Symptom Diagnosis

S4RS0A1904001

Possible symptoms due to starting system trouble would be as follows:

- Starting motor does not run (or runs slowly)
- Starting motor runs but fails to crank engine
- Abnormal noise is heard

Proper diagnosis must be made to determine exactly where the cause of each trouble lies in battery, wiring harness, (including starting motor switch), starting motor or engine.

Do not remove motor just because starting motor does not run. Check the following items and narrow down scope of possible causes.

1) Condition of trouble
2) Tightness of battery terminals (including ground cable connection on engine side) and starting motor terminals
3) Discharge of battery
4) Mounting of starting motor

Condition	Possible cause	Correction / Reference Item
Motor not running (No operating sound of magnetic switch)	Shift lever switch is not in P or N, or not adjusted (A/T)	*Shift in P or N, or adjust switch. (A/T)*
	Battery run down	*Recharge battery.*
	Battery voltage too low due to battery deterioration	*Replace battery.*
	Poor contact in battery terminal connection	*Retighten or replace.*
	Loose grounding cable connection	*Retighten.*
	Fuse set loose or blown off	*Tighten or replace.*
	Poor contacting action of ignition switch and magnetic switch	*Replace.*
	Lead wire coupler loose in place	*Retighten.*
	Open-circuit between ignition switch and magnetic switch	*Repair.*
	Open-circuit in pull-in coil	*Replace magnetic switch.*
	Brushes are seating poorly or worn down	*Repair or replace.*
	Poor sliding of plunger and/or pinion	*Repair.*
	Faulty starting motor control relay	*"Main Relay, Fuel Pump Relay, Starting Motor Control Relay and Throttle Actuator Control Relay Inspection: in Section 1C".*
	Faulty ECM and its circuit	*"Inspection of ECM and Its Circuits: in Section 1A".*
Motor not running (Operating sound of magnetic switch heard)	Battery run down	*Recharge battery.*
	Battery voltage too low due to battery deterioration	*Replace battery.*
	Loose battery cable connections	*Retighten.*
	Burnt main contact point, or poor contacting action of magnetic switch	*Replace magnetic switch.*
	Brushes are seating poorly or worn down	*Repair or replace.*
	Weakened brush spring	*Replace.*
	Burnt commutator	*Replace armature.*
	Layer short-circuit of armature	*Replace.*
	Crankshaft rotation obstructed	*Repair.*
Starting motor running but too slow (small torque) (If battery and wiring are satisfactory, inspect starting motor)	Insufficient contact of magnetic switch main contacts	*Replace magnetic switch.*
	Layer short-circuit of armature	*Replace.*
	Disconnected, burnt or worn commutator	*Repair commutator or replace armature.*
	Worn brushes	*Replace brush.*
	Weakened brush springs	*Replace spring.*
	Burnt or abnormally worn end bush	*Replace bush.*
Starting motor running, but not cranking engine	Worn pinion tip	*Replace over-running clutch.*
	Poor sliding of over-running clutch	*Repair.*
	Over-running clutch slipping	*Replace over-running clutch.*
	Worn teeth of ring gear	*Replace flywheel (M/T) or drive plate (A/T).*
Noise	Abnormally worn bush	*Replace bush.*
	Worn pinion or worn teeth of ring gear	*Replace over-running clutch, flywheel (M/T) or drive plate (A/T).*
	Poor sliding of pinion (failure in return movement)	*Repair or replace.*
	Worn internal or planetary gear teeth	*Replace.*
	Lack of oil in each part	*Lubricate.*

Condition	Possible cause	Correction / Reference Item
Starting motor does not stop running	Fused contact points of magnetic switch	*Replace magnetic switch.*
	Short-circuit between turns of magnetic switch coil (layer short-circuit)	*Replace magnetic switch.*
	Failure of returning action in ignition switch	*Replace.*

Cranking System Test

S4RS0A1904002

CAUTION:

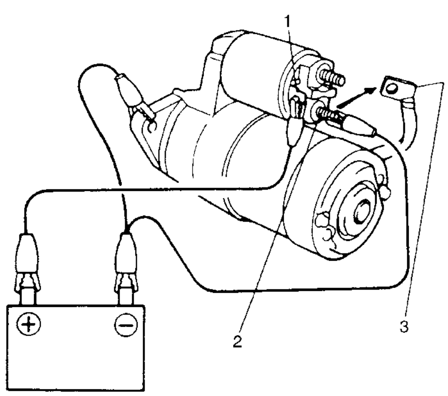
Each test must be performed within 3 – 5 seconds to avoid coil from burning.

Pull-In Test

Connect battery to the magnetic switch as shown.
Check that plunger and pinion move outward.
If plunger and pinion don't move, replace the magnetic switch.

NOTE:

Before testing, disconnect lead wire from terminal "M" (2).

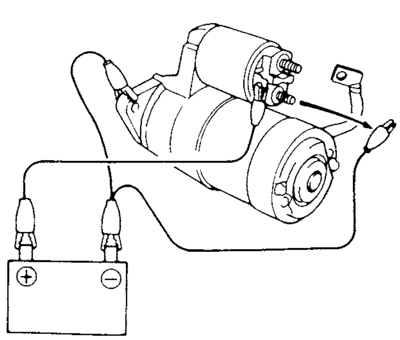


I2RH01190002-

1.	Terminal "S"
3.	Lead wire (switch to motor)

Hold-In Test

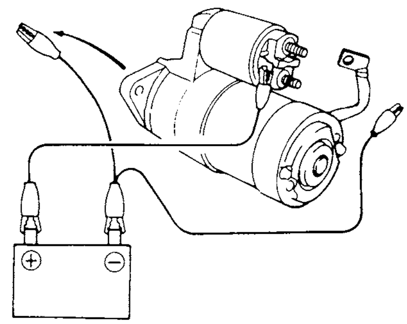
While connected as the figure with plunger out, disconnect negative lead from terminal "M".
Check that plunger and pinion remain out.
If plunger and pinion return inward, replace the magnetic switch.



I2RH01190003-

Plunger and Pinion Return Test

Disconnect negative lead from starting motor body.
Check that plunger and pinion return inward.
If plunger and pinion don't return, replace the magnetic switch.

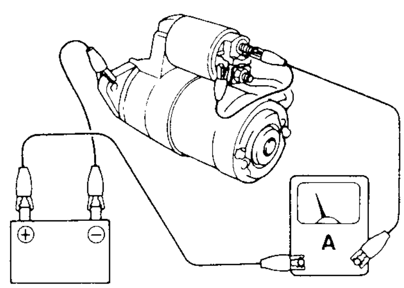


I2RH01190004-

No-Load Performance Test

Connect battery and ammeter to starter as shown.
Check that starter rotates smoothly and steadily with pinion moving out. Check that ammeter indicates specified current.

<u>Specified current (No-load performance test)</u>
90 A MAX. at 11 V

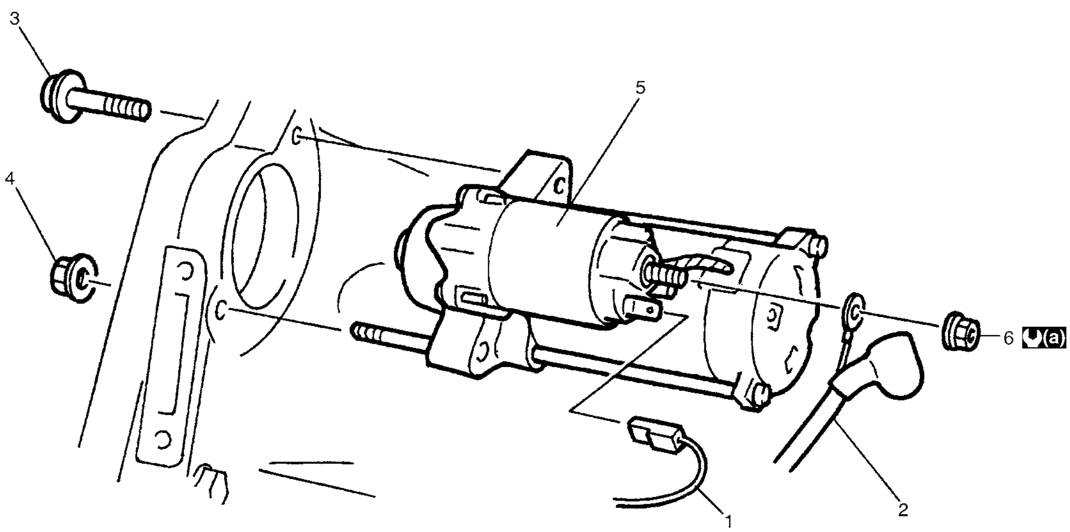


I2RH01190005-

Repair Instructions

Starting Motor Dismounting and Remounting

S4RS0A1906001



I4RS0A190002-

(a) :	9.8 N·m (0.98 kg-m, 7.0 lb-ft)

Dismounting

1) Disconnect negative (–) battery lead at battery.
2) Disconnect magnetic switch lead wire (1) and battery cable (2) from starting motor terminals.
3) Detach shift & select control cable bracket from transaxle. (M/T model only)
4) Remove starting motor mount bolt (3) and nut (4).
5) Remove starting motor (5).

Remounting

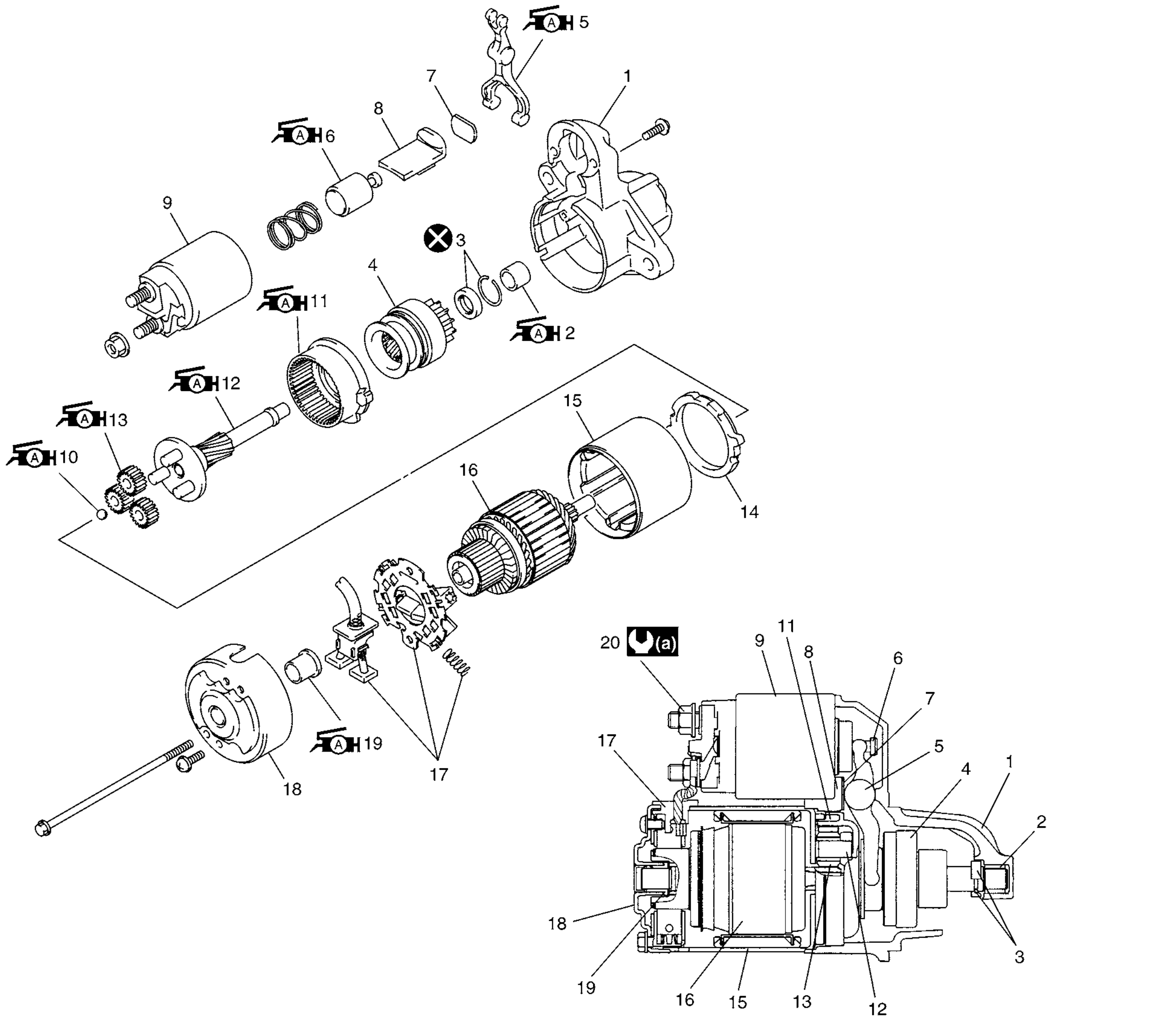
Reverse the dismounting procedure noting the following.

- Tighten battery cable nut (6) to specified torque.

Tightening torque
Starting motor battery cable nut (a): 9.8 N·m (0.98 kg-m, 7.0 lb-ft)

Starting Motor Components

S4RS0A1906002



I4RS0A190003-

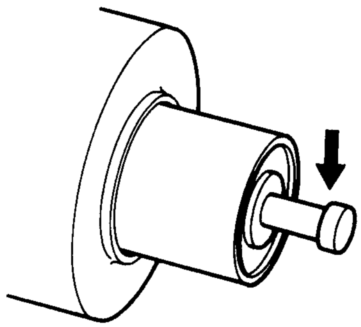
1. Front housing	8. Seal rubber	15. Yoke	: Do not reuse.
2. Bush	9. Magnetic switch	16. Armature	: Apply grease 99000-25010 to sliding surface of each part.
3. Pinion stop ring	10. Ball	17. Brush assembly	
4. Over-running clutch	11. Internal gear	18. Rear bracket	
5. Lever	12. Planetary carrier shaft	19. Rear bush	
6. Plunger	13. Planetary gear	20. Starting motor battery cable nut	
7. Plate	14. Packing	(a) : 9.8 N·m (0.98 kg-m, 7.0 lb-ft)	

Starting Motor Inspection

S4RS0A1906003

Plunger

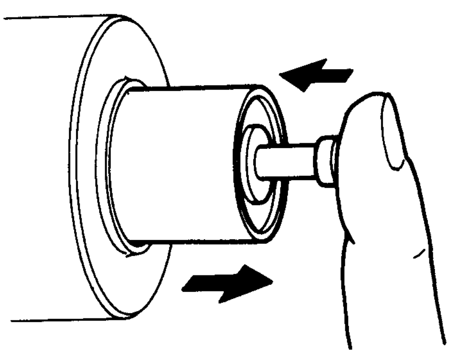
Inspect plunger for wear. Replace if necessary.



I2RH01190008-

Magnetic Switch

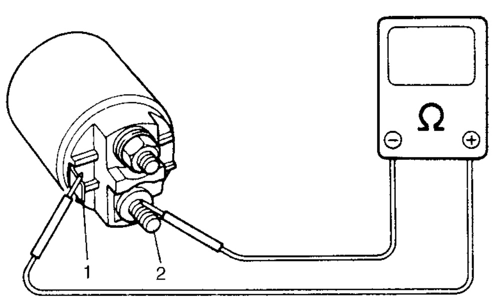
Push in plunger and release it. The plunger should return quickly to its original position. Replace if necessary.



I2RH01190009-

Pull-in coil open circuit test

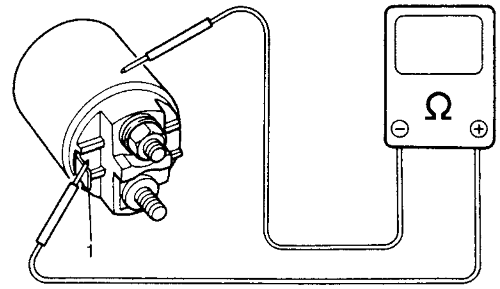
Check for continuity across magnetic switch “S” terminal (1) and “M” terminal (2). If no continuity, coil is open and should be replaced.



I2RH01190010-

Hold-in coil open circuit test

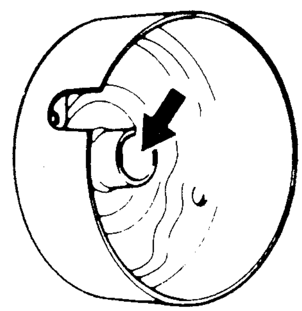
Check for continuity across magnetic switch “S” terminal (1) and coil case. If no continuity, coil is open and should be replaced.



I2RH01190011-

Rear Bracket Bush

Inspect bush for wear or damage. Replace if necessary.

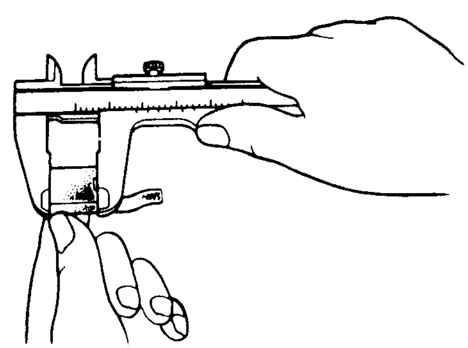


I2RH01190012-

Brush

- Check brushes for wear.
  Measure length of brushes and if below the limit, replace the brush.

  <u>Brush length</u>
  Standard: 12.3 mm (0.48 in.)
  Limit: 7.0 mm (0.28 in.)



I2RH01190013-

- Install brushes to each brush holder and check for smooth movement.

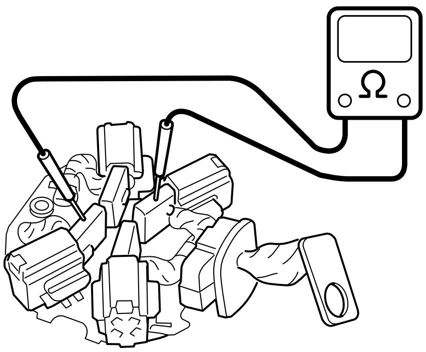
Spring

Inspect brush springs for wear, damage or other abnormal conditions. Replace if necessary.

<u>**Brush spring tension**</u>
Standard: 2.2 kg (4.85 lb)
Limit: 0.6 kg (1.33 lb)

Brush Holder

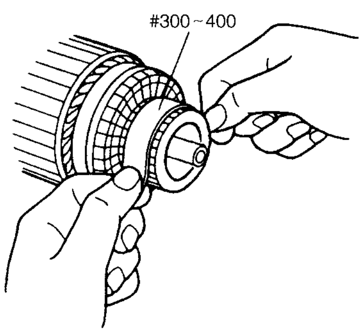
- Check movement of brush in brush holder. If brush movement within brush holder is sluggish, check brush holder for distortion and sliding faces for contamination.
  Clean or correct as necessary.
- Check for continuity across insulated brush (positive side) and grounded brush (negative side).
  If continuity exists, brush holder is grounded due to defective insulation and should be replaced.



I4RS0A190004-

Armature

- Inspect commutator for dirt or burn. Correct with sandpaper or lathe, if necessary.



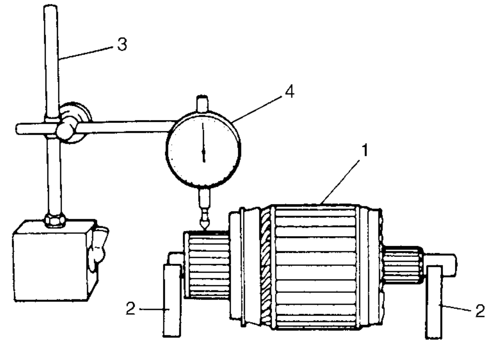
I2RH01190015-

- Check commutator for uneven wear with armature (1) supported on V-blocks (2). If deflection of dial gauge (4) pointer exceeds limit, repair or replace.

NOTE:

The following specification presupposes that the armature is free from bend. Bent armature must be replaced.

<u>Commutator out of round</u>
Standard: 0.05 mm (0.002 in.) or less
Limit: 0.4 mm (0.016 in.)

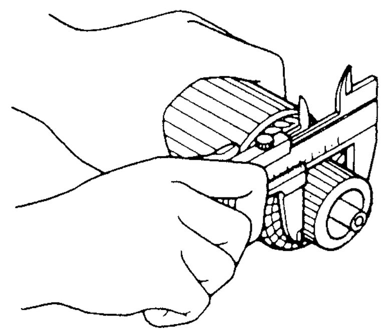


I2RH01190016-

3. Magnetic stand

- Inspect the commutator for wear. If diameter is below limit, replace the armature.

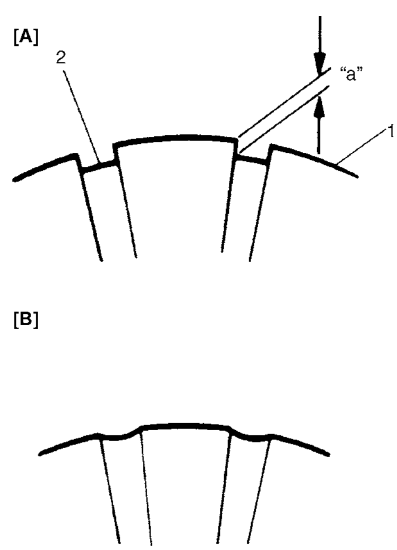
<u>Commutator outside diameter</u>
Standard: 29.4 mm (1.16 in.)
Limit: 28.8 mm (1.14 in.)



I2RH01190017-

- Inspect the commutator (1) for insulator (2) depth. Correct or replace if below limit.

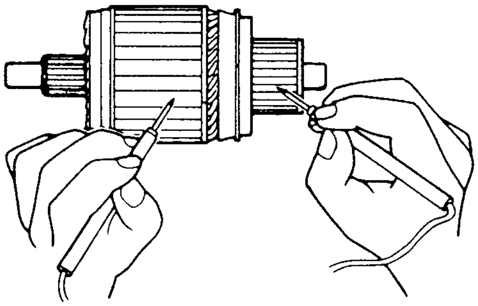
<u>Commutator insulator depth “a”</u>
Standard: 0.4 – 0.6 mm (0.016 – 0.023 in.)
Limit: 0.2 mm (0.008 in.)



I3RH0A190005-

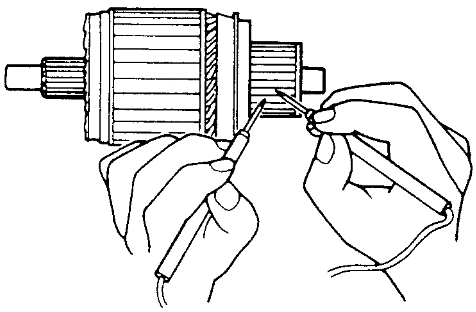
[A]:	Correct
[B]:	Incorrect

- Check the commutator and armature core. If there is continuity, the armature is grounded and must be replaced.



I2RH01190019-

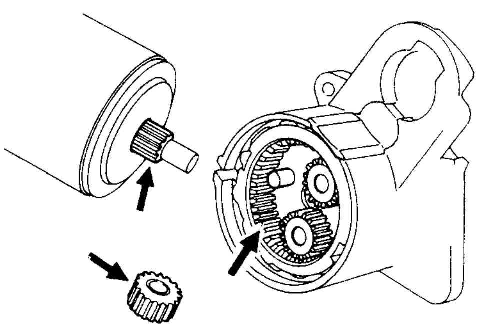
- Check for continuity between segments. If there is no continuity at any test point, there is an open circuit and the armature must be replaced.



I2RH01190020-

Gears

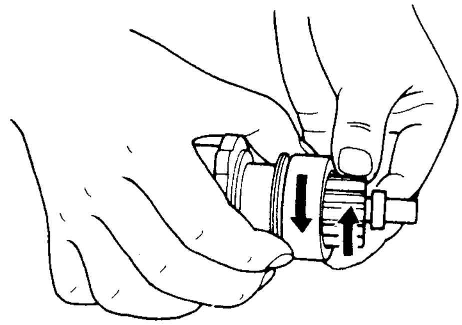
Inspect the internal gear and the planetary gears for wear, damage or other abnormal conditions. Replace if necessary.



I2RH01190021-

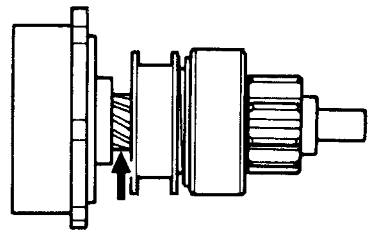
Pinion and Over-Running Clutch

- Inspect the pinion for wear, damage or other abnormal conditions.
  Check that clutch locks up when turned in direction of drive and rotates smoothly in reverse direction.
  Replace if necessary.



I2RH01190022-

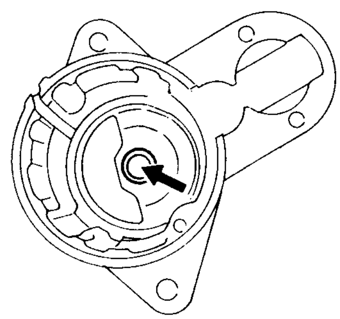
- Inspect the spline teeth for wear or damage. Replace if necessary.
  Inspect the pinion for smooth movement.



I2RH01190023-

Front Housing Bush

Inspect the bush for wear or damage. Replace if necessary.



I2RH01190024-

Specifications

Cranking System Specifications

S4RS0A1907002

<table>
<tr><td colspan="3">Voltage</td><td colspan="2">12 volts</td></tr>
<tr><td colspan="3">Output</td><td colspan="2">1.2 kW</td></tr>
<tr><td colspan="3">Rating</td><td colspan="2">30 seconds</td></tr>
<tr><td colspan="3">Direction of rotation</td><td colspan="2">Clockwise as viewed from pinion side</td></tr>
<tr><td colspan="3">Brush length</td><td>Standard: 12.3 mm (0.48 in.)</td><td>Limit: 7.0 mm (0.28 in.)</td></tr>
<tr><td colspan="3">Number of pinion teeth</td><td colspan="2">8</td></tr>
<tr><td colspan="2">Performance</td><td>Condition</td><td colspan="2">Guarantee</td></tr>
<tr><td rowspan="4">Around at 20 °C (68 °F)</td><td>No load characteristic</td><td>11.0 V</td><td colspan="2">90 A maximum
2370 r/min minimum</td></tr>
<tr><td>Load characteristic</td><td>7.5 V
300 A</td><td colspan="2">10.65 N·m (1.065 kg-m, 7.70 lb-ft) minimum
840 r/min minimum</td></tr>
<tr><td>Locked characteristic</td><td>4.0 V</td><td colspan="2">780 A maximum
20 N·m (2.0 kg-m, 14.5 lb-ft) minimum</td></tr>
<tr><td colspan="2">Magnetic switch operating voltage</td><td colspan="2">8 volts maximum</td></tr>
</table>

Tightening Torque Specifications

S4RS0A1907001

Fastening part	Tightening torque			Note
	N·m	kg-m	lb-ft	
Starting motor battery cable nut	9.8	0.98	7.0	☞

NOTE:

The specified tightening torque is also described in the following.
“Starting Motor Dismounting and Remounting: ”
“Starting Motor Components: ”

Reference:
For the tightening torque of fastener not specified in this section, refer to “Fasteners Information: in Section 0A”

Special Tools and Equipment

Recommended Service Material

S4RS0A1908001

NOTE:

Required service material is also described in the following.
“Starting Motor Components: ”

Charging System

General Description

Battery Description

S4RS0A1A01001

The battery has three major functions in the electrical system.

- It is a source of electrical energy for cranking the engine.
- It acts as a voltage stabilizer for the electrical system.
- It can, for a limited time, provide energy when the electrical load exceeds the output of the generator.

Carrier and Hold-Down

The battery carrier should be in good condition so that it will support the battery securely and keep it level. Before installing the battery, the battery carrier and hold-down clamp should be clean and free from corrosion and make certain there are no parts in carrier.
To prevent the battery from shaking in its carrier, the hold-down bolts should be tight enough but not over-tightened.

Electrolyte Freezing

The freezing point of electrolyte depends on its specific gravity. Since freezing may ruin a battery, it should be protected against freezing by keeping it in a fully charged condition. If a battery is frozen accidentally, it should not be charged until it is warmed.

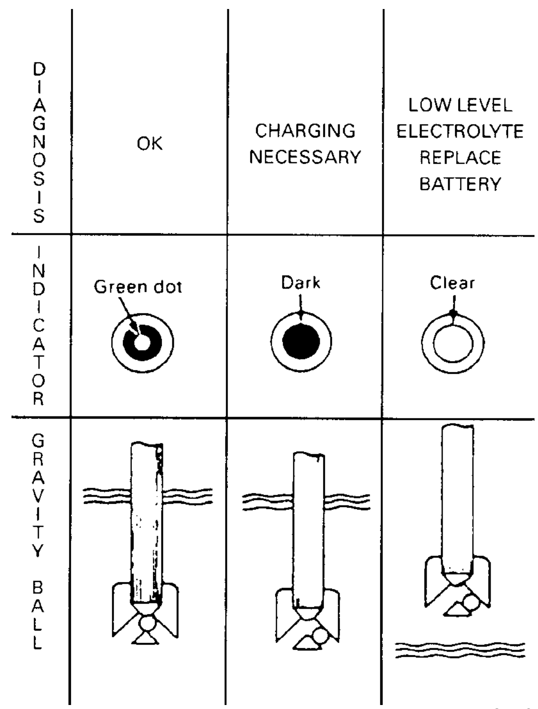
Sulfation

If the battery is allowed to stand for a long period in discharged condition, the lead sulfate becomes converted into a hard, crystalline substance, which will not easily turn back to the active material again during the subsequent recharging. “Sulfation” means the result as well as the process of that reaction. Such a battery can be revived by very slow charging and may be restored to usable condition but its capacity is lower than before.

Built-In Indicator (If Equipped)

The battery has a built-in temperature compensated indicator in the top of the battery. This indicator is to be used with the following diagnostic procedure. When checking the indicator, make sure that the battery has a clean top. A light may be needed in some poorly-lit areas.
Three types of indication available under normal operation are as follows.

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



I2RH011A0001-

Care of battery

WARNING:

- **Never expose battery to open flame or electric spark because of battery generate gas which is flammable and explosive.**
- **Do not allow battery fluid to contact eyes, skin, fabrics, or painted surfaces as fluid is a corrosive acid. Flush any contacted area with water immediately and thoroughly.**
- **Batteries should always be kept out of reach of children.**

1) The battery is a very reliable component, but needs periodical attentions.
   - Keep the battery carrier clean.
   - Prevent rust formation on the terminal posts.
   - Keep the electrolyte up to the upper level uniformly in all cells.

- When keeping battery on vehicle over a long period of time, follow instructions given below.
  - Weekly, start the engine and run it until it reaches normal operating temperature with engine speed of 2000 to 3000 rpm. Make sure all electric switches are off before storing the vehicle.
  - Recharge the battery twice a month to prevent it from discharging excessively. This is especially important when ambient temperature is low.
    The battery discharges even when it is not used, while vehicles are being stored. Battery electrolyte can freeze and battery case can crack at cold ambient condition if battery is not properly charged.

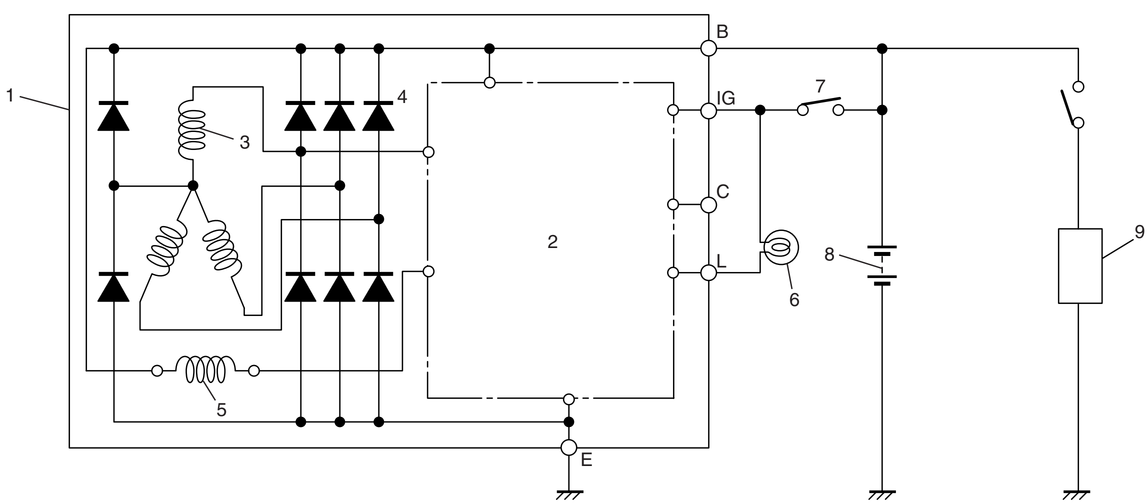
2) Keep the battery cable connections clean.
   The cable connections, particularly at the positive (+) terminal post, tend to become corroded. The product of corrosion, or rust, on the mating faces of conductors resists the flow of current.
   Clean the terminals and fittings periodically to ensure good metal-to-metal contact, and grease the connections after each cleaning to protect them against rusting.
3) Be always in the know as to the state of charge of the battery. The simplest way to tell the state of charge is to carry out a hydrometer test. The hydrometer is an instrument for measuring the specific gravity (S.G.) of the battery electrolyte. The S.G. of the electrolyte is indicative of the state of charge. Refer to “Battery Inspection: ”.

Generator Description

S4RS0A1A01002

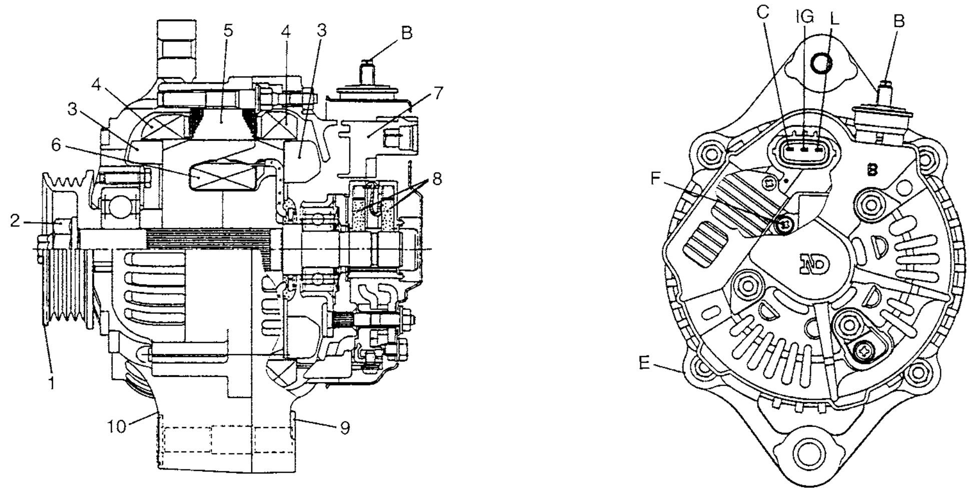
The generator is a small and high performance type with an IC regulator incorporated. The internal components are connected electrically as shown in the following figure.
The generator features are as follows:

- Solid state regulator is mounted inside the generator.
- All regulator components are enclosed into a solid mold.
- This unit along with the brush holder assembly is attached to the rear housing.
- The IC regulator uses integrated circuits and controls the voltage produced by the generator, and the voltage setting cannot be adjusted.
- The generator rotor bearings contain enough grease to eliminate the need for periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor, and under normal conditions will provide long period of attention-free service.
- The stator windings are assembled on the inside of a laminated core that forms part of the generator frame.



I4RS0A1A0001-

1. Generator with regulator assembly	3. Stator coil	5. Field coil (rotor coil)	7. Main switch	9. Load
2. I.C. regulator	4. Diode	6. Charge indicator light	8. Battery	



I2RH0B1A0002-

1. Pulley	5. Stator core	9. Rear end frame	E: Ground
2. Pulley nut	6. Field coil	10. Drive end frame	F: Field coil terminal
3. Rotor fan	7. Regulator	B: Generator output (Battery terminal)	IG: Ignition terminal
4. Stator coil	8. Brush	C: C terminal	L: Lamp terminal

Diagnostic Information and Procedures

Battery Inspection

S4RS0A1A04001

Visual Inspection

Check for obvious damage, such as cracked or broken case or cover, that could permit loss of electrolyte. If obvious damage is noted, replace battery. Determine cause of damage and correct as needed.

Generator Symptom Diagnosis

S4RS0A1A04002

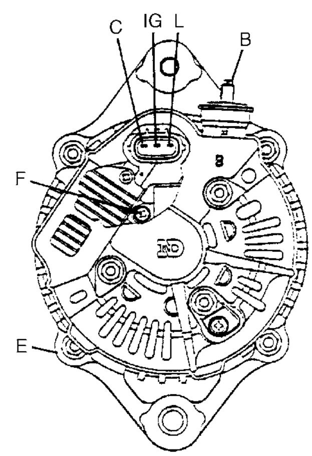
CAUTION:

- **Do not mistake polarities of “IG” terminal and “L” terminal.**
- **Do not create short circuit between “IG” and “L” terminals. Always connect these terminals through a lamp.**
- **Do not connect any load between “L” and “E” terminals.**
- **When connecting charger or booster battery to vehicle battery, refer to “Jump Starting in Case of Emergency: ”.**

Trouble in charging system will show up as one or more of the following conditions:

1) Faulty indicator lamp operation.
2) An undercharged battery as evidenced by slow cranking or indicator dark.
3) An overcharged battery as evidenced by excessive spewing of electrolyte from vents.

Noise from generator may be caused by loose drive pulley, loose mounting bolts, worn or dirty bearings, defective diode, or defective stator.



I2RH0B1A0004-

B: Generator output (Battery terminal)	F: Field coil terminal
C: C terminal	IG: Ignition terminal
E: Ground	L: Lamp terminal

Charging Indicator Lamp Operation

Condition	Possible cause	Correction / Reference Item
Charge light does not light with ignition ON and engine off	Fuse blown	*Check fuse.*
	Indicator lamp (LED) faulty	*Replace combination meter.*
	Wiring connection loose	*Tighten loose connection.*
	IC regulator or field coil faulty	*Check generator.*
	Poor contact between brush and slip ring	*Repair or replace.*
Charge light does not go out with engine running (battery requires frequent recharging)	Drive belt loose or worn	*Adjust or replace drive belt.*
	IC regulator or generator faulty	*Check charging system.*
	Wiring faulty	*Repair wiring.*

Generator Test (Undercharged Battery Check)

S4RS0A1A04003

This condition, as evidenced by slow cranking or low specific gravity can be caused by one or more of the following conditions even though indicator lamp may be operating normal. The following procedure also applies to cars with voltmeter and ammeter.

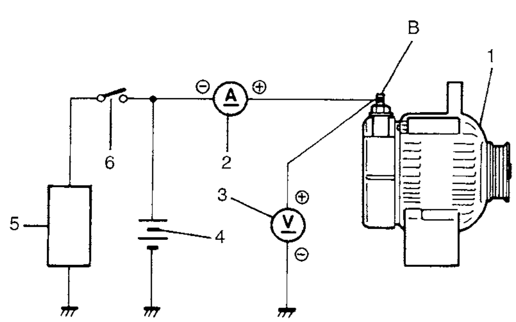
- Make sure that undercharged condition has not been caused by accessories left on for extended period of time.
- Check drive belt for proper tension.
- If battery defect is suspected, refer to "Battery Description: ".
- Inspect wiring for defects. Check all connections for tightness and cleanliness, 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.



I2RH011A0006-

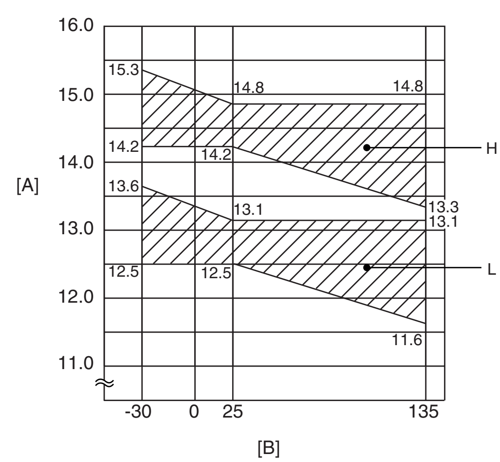
1.	Generator
2.	Ammeter (between generator "B" terminal and battery (+) terminal)
3.	Voltmeter (between generator "B" terminal and ground)
4.	Battery
5.	Load
6.	Switch

2) Run engine from idling up to 2,000 rpm with all accessories turned off and read meters.
If voltage is higher than standard value, check ground of brushes.
If brushes are not grounded, replace IC regulator.
If voltage is lower than standard value, proceed to the following check.

<u>Specification for undercharged battery (No-load check)</u>
Current: 10 A
Voltage: 14.2 – 14.8 V at Hi (H) (at 25 °C, 77 °F)
Voltage: 12.5 – 13.1 V at Lo (L) (at 25 °C, 77 °F)

NOTE:

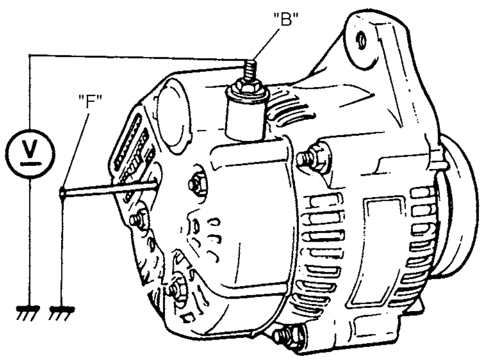
Consideration should be taken that voltage will differ somewhat with regulator case temperature as shown in the figure.



I2RH0B1A0005-

[A]:	Regulated voltage (V)
[B]:	Heatsink temperature (°C)

3) Ground “F” terminal and start engine, then measure voltage at “B” terminal as shown in the figure.
   - Voltage is higher than standard value. It is considered that generator itself is good but IC regulator has been damaged, replace IC regulator.
   - Voltage is lower than standard value. It is considered that generator itself has problem, check the generator.



I2RH011A0008-

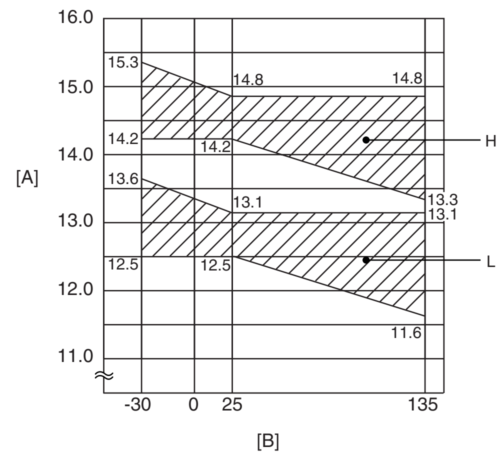
Load Check

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.

Generator Test (Overcharged Battery Check)

S4RS0A1A04004

1) To determine battery condition, refer to “Battery Description: ”.
2) If obvious overcharged condition exists as evidenced by excessive spewing of electrolyte, measure generator “B” terminal voltage at engine 2000 rpm.
3) If measured voltage is higher than upper limit value, disassemble generator.
4) Check ground of brushes. If brushes are not grounded, replace IC regulator. Then check field coil for grounds and shorts.



I2RH0B1A0005-

[A]:	Regulated voltage (V)
[B]:	Heatsink temperature (°C)

Repair Instructions

Jump Starting in Case of Emergency

S4RS0A1A06001

With Auxiliary (Booster) Battery

CAUTION:

If vehicle is manual transaxle model and has a catalytic converter, do not push or tow it to start. Damage to its emission system and/or to other parts may result.

Both booster and discharged battery should be treated carefully when using jumper cables. Follow the procedure outlined as follows, being careful not to cause sparks.

WARNING:

- **Departure from these conditions or procedure described as follows could result in:**
  - **Serious personal injury (particularly to eyes) or property damage from such causes as battery explosion, battery acid, or electrical burns.**
  - **Damage to electronic components of either vehicle.**
- **Remove rings, watches, and other jewelry. Wear approved eye protection.**
- **Be careful so that metal tools or jumper cables do not contact positive battery terminal (or metal in contact with it) and any other metal on vehicle, because a short circuit could occur.**
- **Do not connect negative cable directly to negative terminal of dead battery.**

1) Set parking brake and place automatic transaxle in PARK (NEUTRAL on manual transaxle). Turn off ignition, turn off lights and all other electrical loads.
2) Check electrolyte level. If it is below low level line, add distilled water.
3) Attach end of one jumper cable to positive terminal of booster battery and the other end of the same cable to positive terminal of discharged battery. (Use 12-volt battery only to jump start engine).
4) Attach one end of the remaining negative cable to negative terminal of booster battery, and the other end to a solid engine ground (such as exhaust manifold) at least 45 cm (18 in.) away from battery of vehicle being started.
5) Start engine of vehicle with booster battery and turn off electrical accessories. Then start engine of the vehicle with discharged battery.
6) Disconnect jumper cables in the exact reverse order.

With Charging Equipment

CAUTION:

When jump starting engine with charging equipment, be sure equipment used is 12-volt and negative ground. Do not use 24-volt charging equipment. Using such equipment can cause serious damage to electrical system or electronic parts.

Battery Dismounting and Remounting

S4RS0A1A06002

Dismounting

1) Disconnect negative cable (1).
2) Disconnect positive cable (2).
3) Remove retainer (3).
4) Remove battery (4).

Handling

When handling battery, the following safety precautions should be followed:

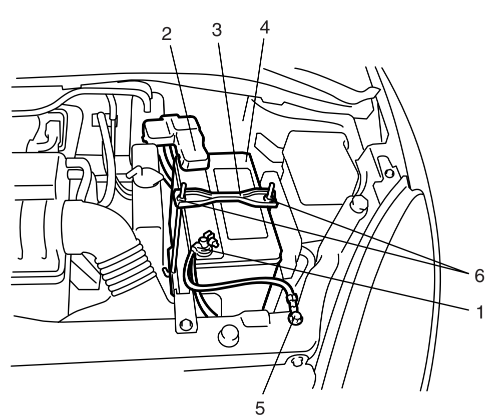
- Hydrogen gas is produced by battery. A flame or spark near battery may cause the gas to ignite.
- Battery fluid is highly acidic. Avoid spilling on clothing or other fabric. Any spilled electrolyte should be flushed with large quantity of water and cleaned immediately.

Remounting

1) Reverse removal procedure.
2) Tighten battery cables securely.

NOTE:

Check to be sure that ground cable has enough clearance to hood panel by terminal.



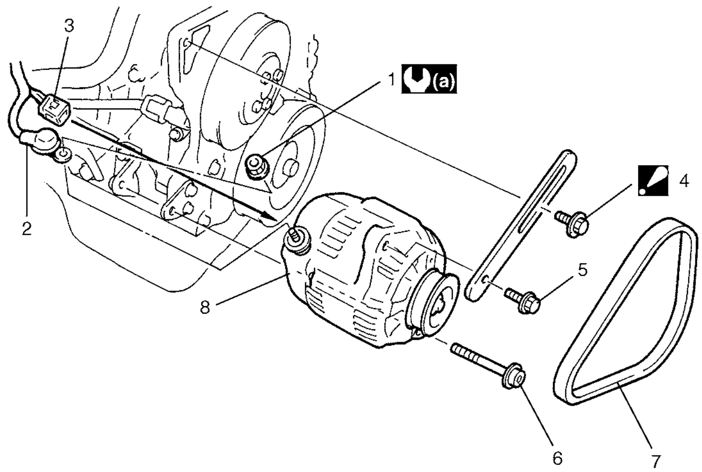
I4RS0A1A0005-

5.	Body ground bolt
6.	Nut

Generator Dismounting and Remounting

S4RS0A1A06003

1) Disconnect negative cable at battery.
2) Remove right side drive shaft referring to “Front Drive Shaft Assembly Removal and Installation: in Section 3A”
3) Dismount in numerical order as shown in the figure.
4) Reverse dismounting procedure for remounting.

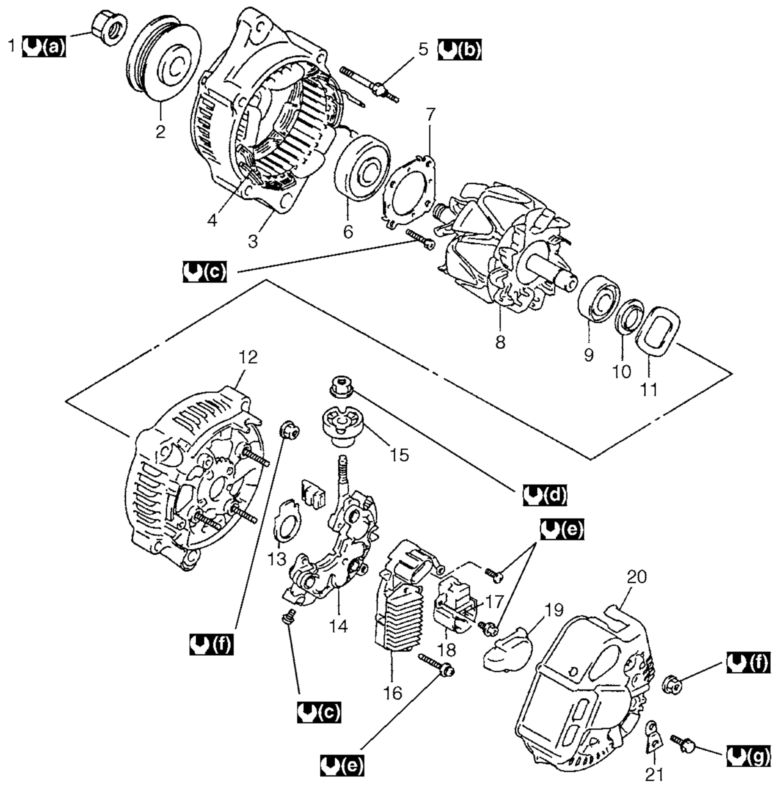


I4RS0A1A0003-

1. “B” terminal nut	4. Generator adjusting bolt : Only loosen this bolt.	7. Generator belt
2. “B” terminal wire	5. Generator adjusting arm bolt	8. Generator
3. Connector	6. Generator pivot bolt	(a) : 8.0 N·m (0.8 kg·m, 6.0 lb-ft)

Generator Components

S4RS0A1A06004



I4RS0A1A0004-

1. Pulley nut	7. Bearing retainer	13. Seal plate	19. Brush holder cover	(d) : 3.6 N·m (0.36 kg-m, 3.0 lb-ft)
2. Pulley	8. Rotor	14. Rectifier	20. Rear end cover	(e) : 2.0 N·m (0.2 kg-m, 1.5 lb-ft)
3. Drive end frame	9. End housing bearing	15. Insulator	21. Terminal plate	(f) : 4.5 N·m (0.45 kg-m, 3.5 lb-ft)
4. Stator	10. Bearing cover	16. Regulator	(a) : 111 N·m (11.1 kg-m, 80.5 lb-ft)	(g) : 3.8 N·m (0.38 kg-m, 3.0 lb-ft)
5. Stud bolt	11. Wave washer	17. Brush	(b) : 9.8 N·m (0.98 kg-m, 7.0 lb-ft)	
6. Drive end bearing	12. Rear end frame	18. Brush holder	(c) : 3.0 N·m (0.3 kg-m, 2.5 lb-ft)	

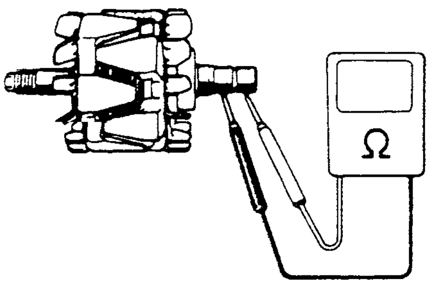
Generator Inspection

S4RS0A1A06005

Rotor

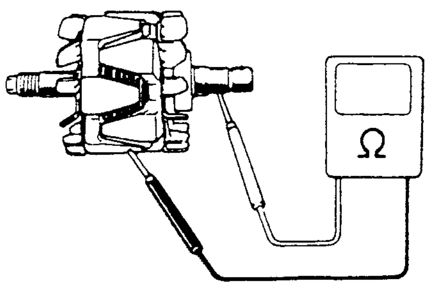
1) Using an ohmmeter, check for continuity between slip rings of rotor. If there is no continuity, replace the rotor.

<u>Standard resistance between slip rings of rotor</u>
2.7 – 3.1 Ω at 20 °C (68 °F)



IYSQ011A0042-

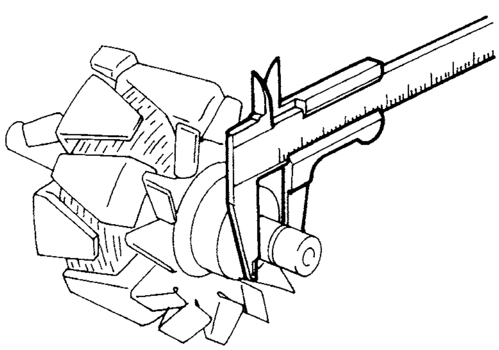
2) Using an ohmmeter, check that there is no continuity between slip ring and rotor. If there is continuity, replace the rotor.



IYSQ011A0043-

3) Check slip rings for roughness or scoring. If rough or scored, replace the rotor.
Using a vernier caliper, measure the slip ring diameter. If the diameter is less than minimum, replace the rotor.

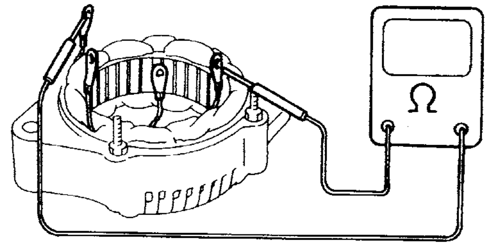
<u>Slip ring diameter</u>
Standard: 14.2 – 14.4 mm (0.560 – 0.566 in.)
Limit: 12.8 mm (0.503 in.)



IYSQ011A0044-

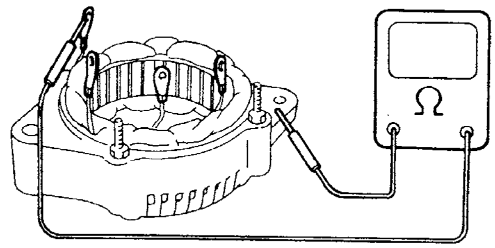
Stator

1) Using an ohmmeter, check all leads for continuity. If there is no continuity, replace the stator.



I2RH011A0014-

2) Using an ohmmeter, check that there is no continuity between coil leads and stator core. If there is continuity, replace the stator.

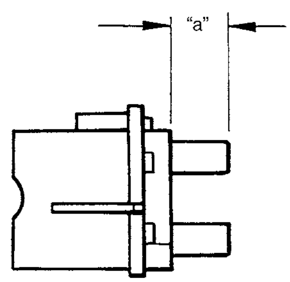


I2RH011A0015-

Brush and Brush Holder

Check each brush for wear by measuring its length as shown. If the brush is found worn down to service limit, replace the brush.

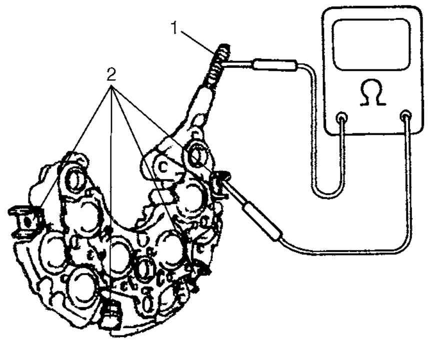
<u>Exposed brush length “a”</u>
Standard: 10.5 mm (0.41 in.)
Limit: 1.5 mm (0.05 in.)



IYSQ011A0047-

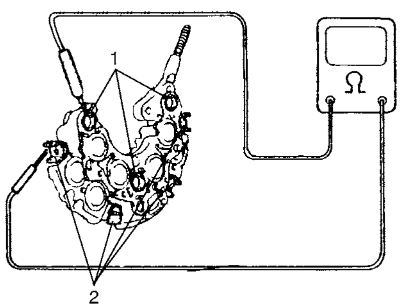
Rectifier

1) Using an ohmmeter, connect one tester probe to the "B" terminal (1) and the other to each rectifier terminal (2).



I1JA011A0002-

2) Reverse the polarity of the tester probes and repeat Step 1).
3) Check that one shows continuity and the other shows no continuity.
   If there is continuity, replace the rectifier.
4) Using an ohmmeter, connect one tester probe to each negative terminal (1) and the other to each rectifier terminal (2).



I2RH011A0017-

5) Reverse the polarity of the tester probes and repeat Step 4).
6) Check that one shows continuity and the other shows no continuity.
   If there is continuity, replace the rectifier.

Specifications

Charging System Specifications

S4RS0A1A07002

Battery

Battery type		46B24R
Rated capacity	AH/5HR, 12 Volts	36
Electrolyte	L (US / lmp pt.)	3.2 (6.76 / 5.63)

Generator

Type	70 A type
Rated voltage	12 V
Nominal output	70 A
Permissible max. speed	18,000 r/min.
No-load speed	1020 r/min. (rpm)
Regulated voltage	14.2 – 14.8 V (Hi), 12.5 – 13.1 V (Lo)
Exposed brush length	Standard: 10.5 mm (0.41 in.) Limit: 1.5 mm (0.05 in.)
Permissible ambient temperature	–30 to 90 °C (–22 to 194 °F)
Polarity	Negative ground
Rotation	Clockwise viewed from pulley side

Tightening Torque Specifications

S4RS0A1A07001

NOTE:

The specified tightening torque is also described in the following.
“Generator Dismounting and Remounting: ”
“Generator Components: ”

Reference:
For the tightening torque of fastener not specified in this section, refer to “Fasteners Information: in Section 0A”

Exhaust System

General Description

Exhaust System Description

S4RS0A1B01001

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.

Diagnostic Information and Procedures

Exhaust System Check

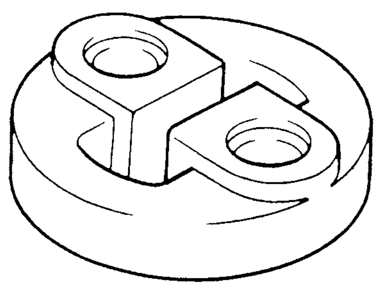
S4RS0A1B04001

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 for damage, deterioration, and out of position.



IYSY011B0003-

- 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: ”.
- 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.

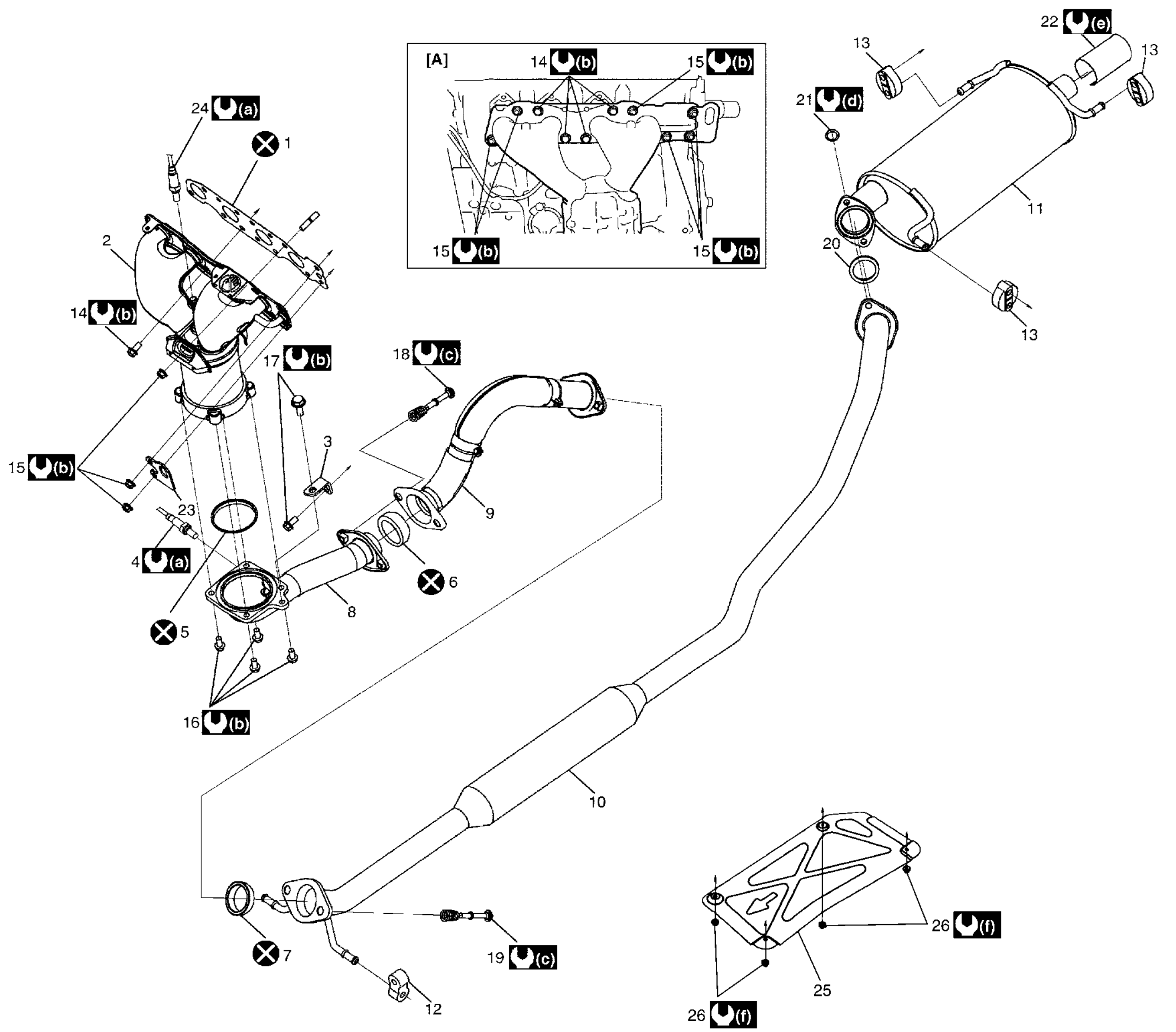
Repairment Instructions

Exhaust System Components

S4RS0A1B06001

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.



I4RS0A1B0001-

[A]:	Installing location of exhaust manifold bold and nut.	11.	Muffler	22.	Muffler tail pipe
1.	Exhaust manifold gasket	12.	Center pipe mounting	23.	Engine hook
2.	Exhaust manifold	13.	Muffler mounting	24.	Heated oxygen sensor No.2 (connector color: gray)
3.	Exhaust manifold stiffener	14.	Exhaust manifold bolt	25.	Heat insulator
4.	Heated oxygen sensor No.1 (connector color: green)	15.	Exhaust manifold nut	(a) :	45 N·m (4.5 kg-m, 32.5 lb-ft)
5.	Exhaust pipe No.1 gasket	16.	Exhaust No.1 pipe bolt	(b) :	50 N·m (5.0 kg-m, 36.5 lb-ft)
6.	No.1 seal ring	17.	Exhaust manifold stiffener bolt	(c) :	43 N·m (4.3 kg-m, 31.0 lb-ft)
7.	No.2 seal ring	18.	Exhaust No.2 pipe bolt	(d) :	60 N·m (6.0 kg-m, 43.5 lb-ft)
8.	Exhaust No.1 pipe	19.	Exhaust center pipe bolt	(e) :	10 N·m (1.0 kg-m, 7.5 lb-ft)
9.	Exhaust No.2 pipe	20.	Exhaust pipe No.2 gasket	(f) :	3 N·m (0.3 kg-m, 2.5 lb-ft)
10.	Exhaust center pipe	21.	Muffler nut	⊗ :	Do not reuse.

Exhaust Manifold Removal and Installation

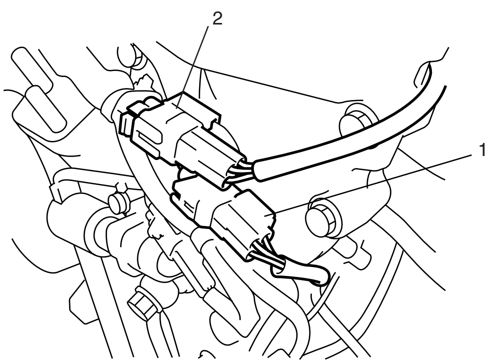
S4RS0A1B06003

Removal

WARNING:

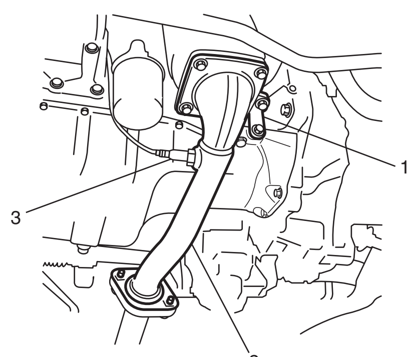
To avoid danger of being burned, do not service exhaust system while it is still hot. Service should be performed after system cools down.

1) Disconnect negative cable at battery.
2) Remove front bumper with front grille referring to "Front Bumper and Rear Bumper Components: in Section 9K".
3) Remove radiator referring to "Radiator Removal and Installation: in Section 1F" 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 No.1 connector (1) (connector color: green) and heated oxygen sensor No.2 connector (2) (connector color: gray), and then detach it from its stay.



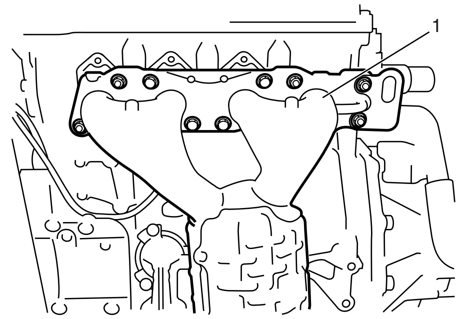
I4RS0A1B0006-

6) Remove exhaust manifold stiffener (1).
7) Remove heated oxygen sensors (3) from exhaust manifold and exhaust No.1 pipe, if necessary.
8) Disconnect exhaust No.1 pipe (2) from exhaust manifold.



I4RS0A1B0002-

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



I4RS0A1B0003-

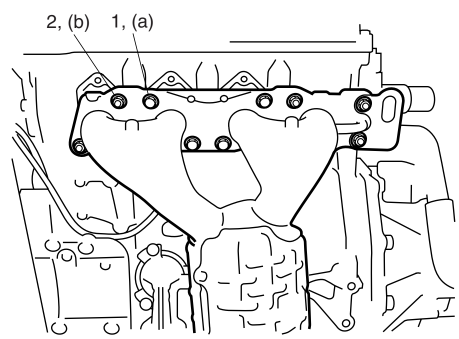
Installation

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 (a): 50 N·m (5.0 kg-m, 36.5 lb-ft)
   Exhaust manifold nut (b): 50 N·m (5.0 kg-m, 36.5 lb-ft)

   NOTE:

   Be sure to install exhaust manifold bolts and nuts to proper location referring to "Exhaust System Components: ".



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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)

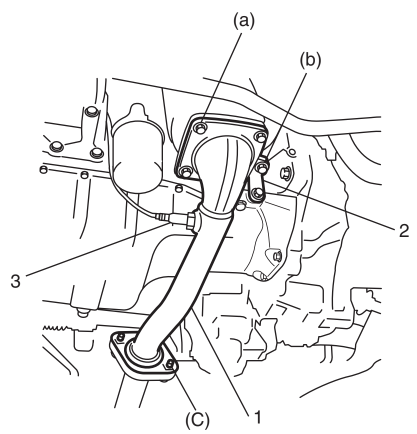
4) Install new seal ring and connect exhaust No.1 pipe (1) to exhaust No.2 pipe. Tighten pipe fasteners to specified torque.

   Tightening torque
   Exhaust No.2 pipe bolt (c): 43 N·m (4.3 kg-m, 31.0 lb-ft)

5) Install heated oxygen sensors (3) referring to “Exhaust System Components: ”, if removed.

   NOTE:

   Be sure to identify heated oxygen sensor No.1 and No.2 by its connector color.



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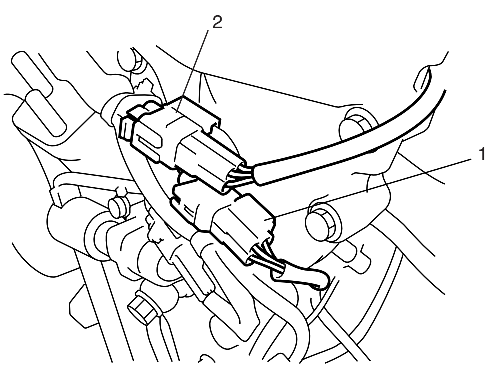
6) Connect heated oxygen sensor No.1 connector (1) (connector color: green) and heated oxygen sensor No.2 connector (2) (connector color: gray), and then fit coupler to bracket securely.



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7) Install A/C condenser to vehicle body for equipped with A/C.
8) Install radiator referring to “Radiator Removal and Installation: in Section 1F” for equipped with A/C.
9) Install front bumper with front grille by referring to “Front Bumper and Rear Bumper Components: in Section 9K”.
10) Connect negative cable at battery.
11) Check exhaust system for exhaust gas leakage.

Exhaust Pipe and Muffler Removal and Installation

S4RS0A1B06004

For replacement of exhaust pipe, be sure to hoist vehicle and observe WARNING under “Exhaust System Components: ” 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. Refer to “Exhaust System Components: ”.
- After installation, start engine and check each joint of exhaust system for leakage.

Specifications

Tightening Torque Specifications

S4RS0A1B07001

Fastening part	Tightening torque			Note
	N·m	kg-m	lb-ft	
Exhaust manifold bolt	50	5.0	36.5	☞
Exhaust manifold nut	50	5.0	36.5	☞
Exhaust No.1 pipe bolt	50	5.0	36.5	☞
Exhaust manifold stiffener bolt	50	5.0	36.5	☞
Exhaust No.2 pipe bolt	43	4.3	31.0	☞

NOTE:

The specified tightening torque is also described in the following.
“Exhaust System Components: ”

Reference:

For the tightening torque of fastener not specified in this section, refer to “Fasteners Information: in Section 0A”.