

**SUZUKI**

**VITARA**

**SUPPLEMENTARY SERVICE MANUAL  
SE420 HDI**

USE THIS SERVICE MANUAL WITH  
MANUALS MENTIONED IN FOREWORD OF  
THIS MANUAL

With Bulletin SA-SE-006 (ABS)

**SUZUKI**

*Caring for Customers*  
SANTANA MOTOR, S.A.

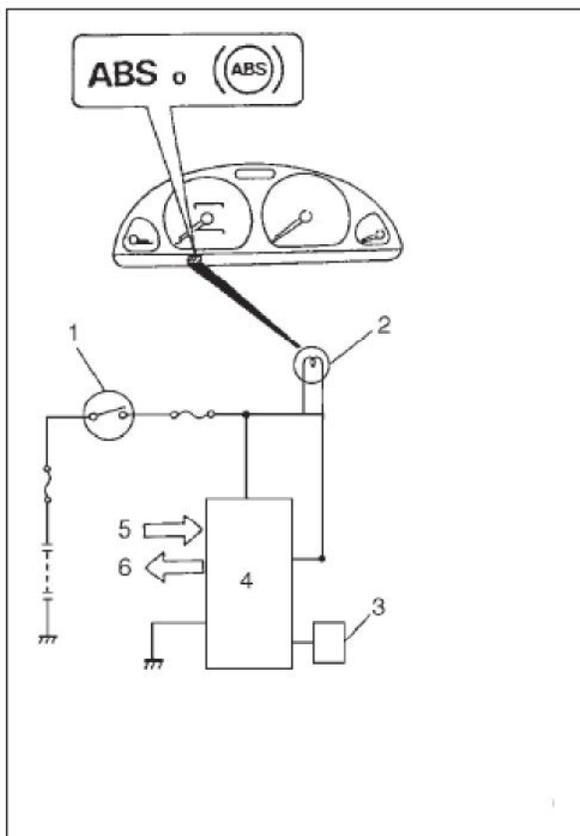
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Betrifft:	ABS Warnlampen Funktion
Modell:	SE420HDi
Ab Fahrgestellnummer:	EURO III Fahrzeuge mit WABCO ABS System

Auf Grund von Händleranfragen über die Funktion der ABS Warnlampen am SE Vitara, möchten wir Sie wie folgt informieren.

Die Vitara SE420HDi aus der Santana Produktion werden seit Ende 2004 mit dem ABS System von WABCO ausgeliefert. Bei diesem Modell funktioniert die ABS Warnlampe im Kombiinstrument wie folgt:

- Die ABS Warnlampe leuchtet auf wenn die Zündung auf „ON“ gestellt wird.
- Anschließend erlischt die Lampe für ca. eine Sekunde.
- Danach leuchtet die Lampe erneut auf und bleibt an, bis die Räder eine Geschwindigkeit von 7 km/h überschreiten.
- Unter dieser Situation weist die optische Anzeige darauf hin, daß sich das System unter Normalbedingungen befindet und das der Selbsttest korrekt verlaufen ist.
- Zum kurzzeitigen Erlöschen des Lichts kommt es nicht, wenn das System, obwohl es korrekt funktioniert, eine frühere Störung im ABS Steuergerät gespeichert hat.
- Bleibt das Licht an, wenn das Fahrzeug über 7 km/h schnell fährt, weist dies auf eine Störung hin. In einem solchen Fall ist für die Fehlerdiagnose, Fehlercodeabfrage und Löschung gespeicherter Codes, der Tech2 zu verwenden.



1. Zündschloß
2. „ABS“ Warnlampe
3. Tech2 Diagnosestecker
4. ABS Steuergerät
5. Eingehende Signale
6. Ausgehende Information

Das Herstellerwerk hat auf Grund der geringen Stückzahlen den Werkstatt-Handbuch-Nachtrag für das WABCO ABS System, nur in englischer Sprache publiziert. In der Anlage zu diesem Service Bulletin stellen wir Ihnen die ABS Sektion 5b und den ABS Schaltplan aus dem betreffenden Werkstatt Handbuch zur Verfügung.

Im Bedarfsfall kann das engl. Nachtragsbuch unter der Bestellnummer „00000A01807-01I“ über den Ersatzteiledienst in Papierform bestellt werden. Es erfolgt keine automatische Auslieferung.

## IMPORTANT

### WARNING/CAUTION/NOTE

Kindly read this manual and follow the instructions carefully. The words **WARNING**, **CAUTION** and **NOTE** highlight important information and have very specific significance. Please pay great attention to the messages emphasised in these terms of indication.

**WARNING:**

Indicates a potential danger which could result in personal injuries or death.

**CAUTION:**

Indicates potential danger which could damage the vehicle.

**NOTE:**

Provides special information to facilitate maintenance or clarify instructions.

**WARNING:**

This service manual has been produced solely for authorised Suzuki dealers and for specialised service mechanics. It is possible that inexperienced mechanics or those not equipped with appropriate tools and equipment might not be able to perform the servicing outlined in this manual. Badly carried out repairs might cause personal injury to the mechanic and also result in the vehicle being unsafe for both driver and passengers.

**WARNING:**

For vehicles equipped with Supplementary Air Bag System:

- Servicing which has to be carried out on or around Components or the Air bag Wiring System must be performed by an authorised Suzuki dealer. Please observe all WARNINGS and CAUTIONS IN SERVICING in Section 9J, in the "Vehicle Servicing" chapter and Air Bag System Components and Wiring System outline in Section 9J before performing any service work on or around Air Bag System Components or Wiring. Failure to respect WARNINGS could result in accidental inflation of the Air Bag or render the Air Bag inoperative, either of which could cause serious injury.
- When the Air Bag system and another vehicle system both need to be repaired, Suzuki recommends prior repair of the Air Bag system to avoid involuntary inflation of the Air Bag.
- Do not alter the steering wheel, glove compartment or any other Air Bag system component (on or around Air Bag system, components or wiring). Any modification could adversely affect effectiveness of the Air Bag system and cause personal injury.
- If the vehicle has to be exposed to temperatures exceeding 93 °C, 200 °F (during paint drying oven process for example), to avoid damage to components or accidental inflation remove Air Bag system components first.



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SECTION 0A

0A

# GENERAL INFORMATION

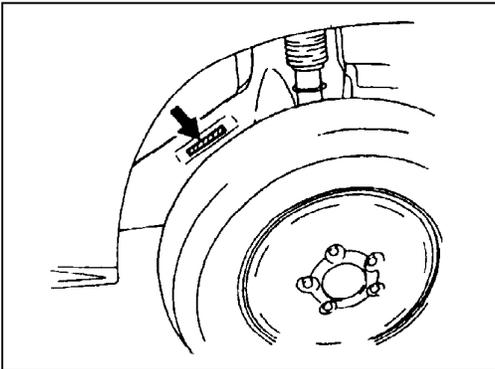
**NOTE:**

For points not covered in this section, please refer to corresponding Service Manual sections listed in the FOREWORD to this Manual.

## CONTENTS

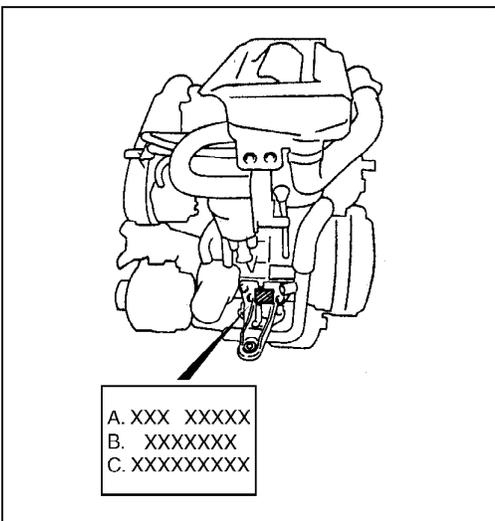
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## GENERAL INFORMATION



### VEHICLE IDENTIFICATION NUMBER

The number is punched on the chassis inside the tire housing on the right front side.



### ENGINE IDENTIFICATION NUMBER

The number is punched on the cylinder block.

**A: LEGISLATION TYPE**

**B: COMPONENT NUMBER**

**C: SERIAL NUMBER**

SECTION 0B

0B

# MAINTENANCE AND LUBRICATION

**NOTE:**

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

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## MAINTENANCE SCHEDULE

### MAINTENANCE SCHEDULE UNDER NORMAL DRIVING CONDITIONS

Interval: This interval should be judged by odometer reading or months, whichever comes first	This table includes services as scheduled up to 90,000 Km (54,000 miles), after that, carry out the same services at the same intervals respectively.						
	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
<b>1.- ENGINE</b>							
1.1.- Accessory drive belt	Trapezoidal	I	R	I	R	I	R
	Multitrapezoidal	-	-	I	-	-	R
1.2.- Camshaft timing belt	Replace every 150,000 Km (90,000 miles)						
1.4.- Engine oil and oil filter	CF (Except CF-2)	Replace every 20,000 Km (12,000 miles) or 16 months					
1.5.- Engine coolant		-	-	R	-	-	R
1.6.- Exhaust system		-	I	-	I	-	I
<b>2.- IGNITION</b>							
2.3.- Glow plugs	Replace every 120,000 Km. (72,000 miles)						
<b>3.- FUEL SYSTEM</b>							
3.1.- Air cleaner filter	Asphalt road	I	I	R	I	I	R
3.2.- Fuel lines and connections		-	I	-	I	-	I
3.3.- Fuel filter	Replace every 60,000 Km. (36,000 miles)						
3.4.- Purging fuel filter water	Every 20,000 Km (12,000miles)						
3.5.- Fuel tank		-	-	I	-	-	I
<b>6.- CHASSIS AND BODY</b>							
6.1.- Clutch		-	I	-	I	-	I
6.2.-	Brake discs and pads (front)	I	I	I	I	I	I
	Brake drums and shoes (rear) brake block (rear)	-	I	-	I	-	I
6.3.- Brake hoses and lines		-	I	-	I	-	I
6.4.- Brake fluid		-	R	-	R	-	R
6.5.- Hand brake lever and cable (just one service after 15,000 Km)		I	-	-	-	-	-
6.6.- Tyres		I	I	I	I	I	I
6.7.- Wheels and free wheeling hubs (if fitted)		I	I	I	I	I	I
6.8.- Suspension system		-	I	-	I	-	I
6.9.- Propeller shafts		-	-	I	-	-	I
6.10.- Transmission oil		I	-	R	-	-	R
6.12.- Transfer case oil		I	-	I	-	I	-
6.13.- Differential oil (to be changed only after first 15,000 Km)		R o I	-	I	-	I	-
6.14.- Steering		-	I	-	I	-	I
6.15.- Power assisted		I	I	I	I	I	I
6.16.- All locks and hinges		-	I	-	I	-	I

**NOTES:**

“R”: Replace or change

“I”: Inspect and correct or lubricate if necessary

**MAINTENANCE RECOMENDED UNDER SEVERE DRIVING CONDITIONS**

If the vehicle is usually used under the conditions corresponding to any severe condition code given below, it is recommended that applicable maintenance operation be performed at the particular interval as given in the chart below.

Code of severe conditions.

- A- Short frequent journeys.
- B- Driving on muddy surfaces.
- C- Driving on dusty surfaces.
- D- Driving in extremely cold climates and/or salted surfaces.
- E- Short frequent journey in extremely cold climates.
- G- Use in town/Trailer tow/Driving at high speed/At temperatures over 40 °C/Low quality lubricants or fuel.
- H- TrailerTow.

Severe condition code	Maintenance	Maintenance Operation	Maintenance interval
-BCD---	Drive belts	I	Every 15,000 Km (9,000 miles) or 12 months
		R	Every 45,000 Km (27,000 miles) or 36 months
A-CDEG-	Camshaft belts	R	Every 120,000 Km (72,000 miles) or 96 months
A-CDEGH	Engine oil and oil filter	R	Every 5,000 Km (3,000 miles) ó 4 months
-B-----	Exhaust pipes and fittings	I	Every 15,000 Km (9,000 miles) ó 12 months
--C----	Air filter element *1	I	Every 2,500 Km (1,500 miles)
		R	Every 30,000 Km (18,000 miles) or 24 months
--C--G-	Fuel filter	R	Every 10,000 Km (6,000 miles) or 8 months
-B-DE-H	Universal joints	I	Every 15,000 Km (9,000 miles) or 12 months
-B--E-H	Gear box, transfer and differential oil	I	Every 15,000 Km (9,000 miles) or 12 months
		R	Every 30,000 Km (18,000 miles) or 24 months
-B-----	Suspension nuts and bolts	T	Every 15,000 Km (9,000 miles) or 12 months
-BCD--H	Wheel bearings	I	Every 15,000 Km (9,000 miles) or 12 months

**NOTE:**

“R”: Replace or change.

“T”: Tighten as specified.

“I”: Inspect or correct or lubricate if necessary.

\*1: Inspect or replace more frequently if necessary.

## MAINTENANCE SERVICES

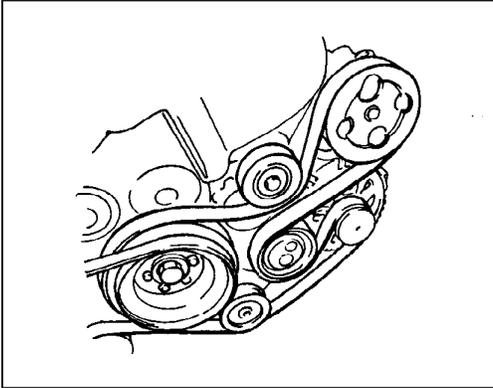
### ENGINE

#### POINT 1-1

#### Accessory Drive Belt Inspection and Replacement

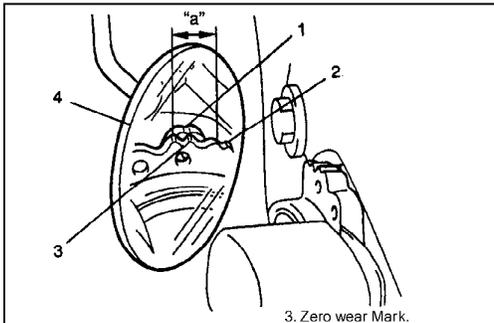
**WARNING:**

All inspection and replacement work must be carried out with the engine off and the battery disconnected.



**Inspection:**

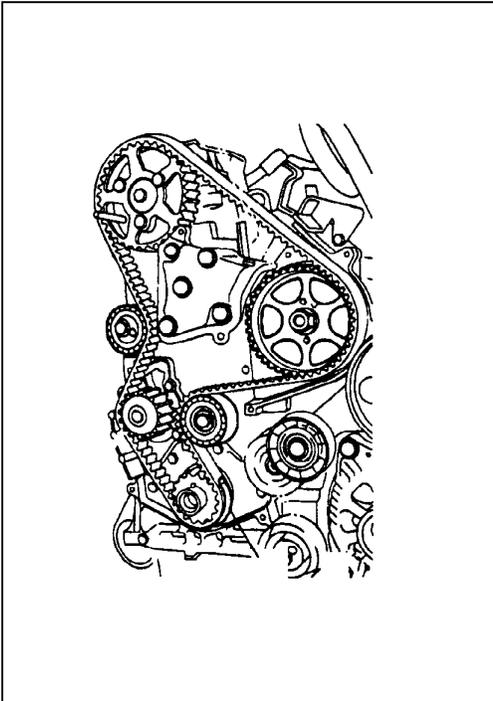
- 1) Disconnect negative cable at battery.
- 2) Inspect belt for cracks, cuts, deformation, wear and cleanliness using mirror under enough lighting.



- 3) Check that belt wear check mark (1) (tension indicator) is within range "a" using mirror (4) under enough lighting. If a wear check mark (1) is aligned with maximum wear mark (2) or out of range "a" passing mark (2), replace accessory drive belt with a new one.
- 4) Connect negative cable to battery.

**Replacement:**

Replace belt with a new one referring to GENERATOR in section 6H.



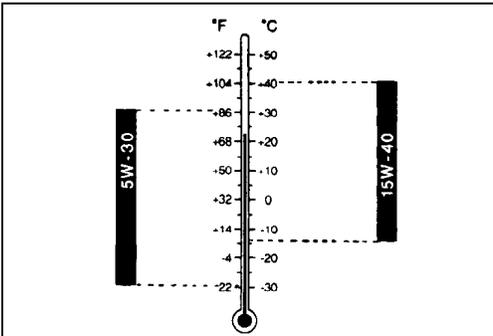
**POINT 1-2**

**Camshaft timing belt.**

Replace belt with a new one. Refer to "Timing Belt" in SECTION 6A3.

**CAUTION:**

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

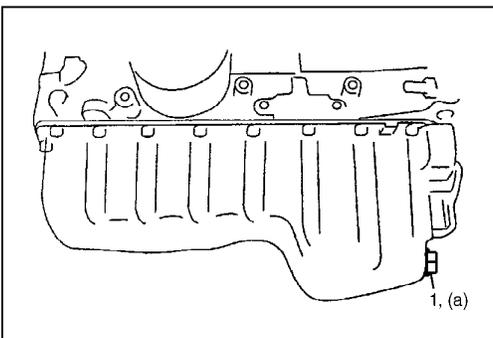


**POINT 1-4**

**Engine oil and oil filter change.**

It is recommended to use the engine oil API CF (except CF-2) or higher quality level oils.

Select the appropriate oil viscosity according to the left chart.

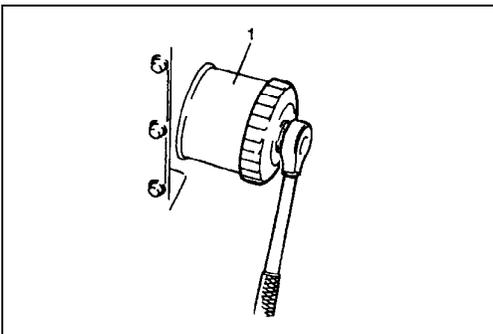


Before draining engine oil, check engine for oil leakage. If any evidence of leakage is found, make sure to correct defective part before performing the following work.

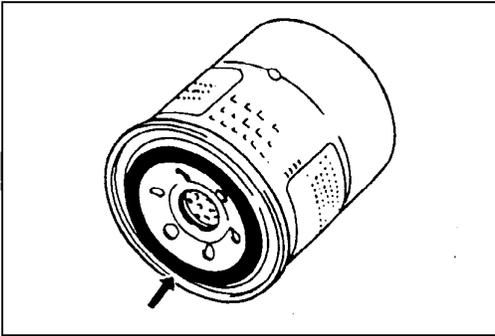
- 1) Drain engine oil by removing drain plug (1).
- 2) After draining oil, wipe drain plug clean. Reinstall drain plug, and tighten it securely as specified below.

**Tightening torque**

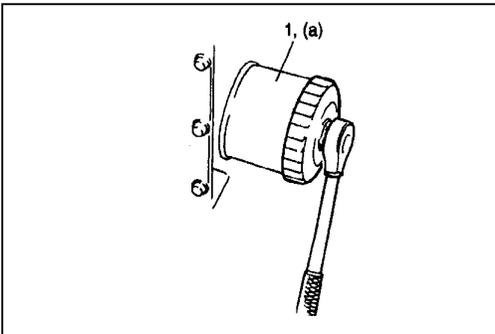
**(a): 34 N·m (3.4 kg·m)**



- 3) Loosen oil filter (1) by using oil filter wrench.

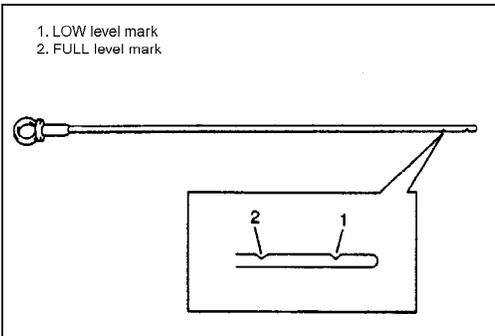


- 4) Apply engine oil to new oil filter O-ring.
- 5) Screw new filter on oil filter stand by hand.



- 6) Tighten filter (1) to specified torque.

**Tightening torque**  
**(a): 14 N·m (1.4 kg·m)**

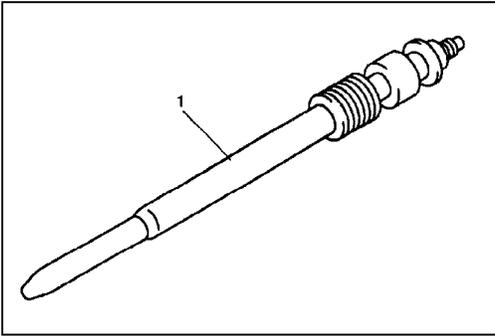


- 7) Replenish oil until level is brought to FULL level mark on dipstick (about 4.75 liters or 10.0/8.4 US/Imp pt.).

**NOTE:**

**Note that amount of oil required when actually changing oil may somewhat differ from this data depending on various conditions (temperature, viscosity, etc.).**

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



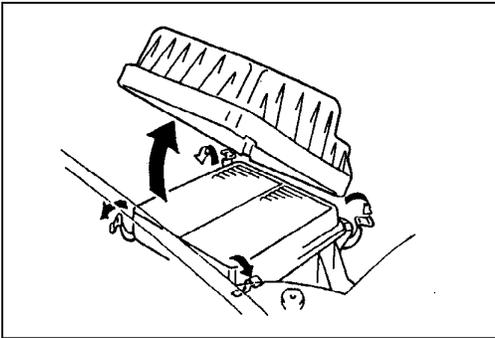
## IGNITION SYSTEM

### POINT 2-3

#### Glow plugs.

#### Inspection

- 1) Check the glow plugs (1) functioning visually by observing dashboard panel controls.
- 2) Observe engine running from a cold start. Any difficulty in starting cold could be a result of problems with glow plug heating system.
- 3) Check for external damage such as deformation, scratch, crack, etc.

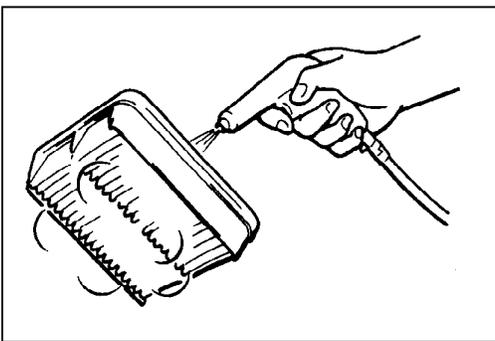


## FUEL SYSTEM

### POINT 3-1

#### Replacement

- 1) Release attaching strap and unclamp air cleaner case clamps.
- 2) Replace air cleaner filter with a new one.
- 3) Clamp case securely.



#### Air cleaner filter inspection

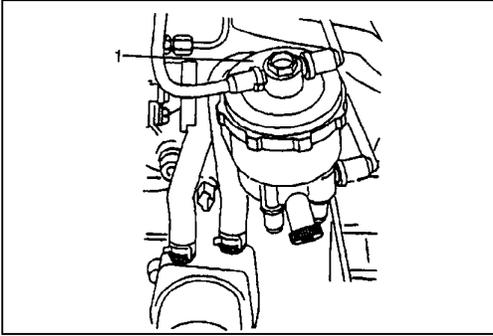
- 1) Visually check that air cleaner filter is not excessively dirty, damaged or oily.
- 2) Clean filter with compressed air from air outlet side of filter (i.e., the side facing up when installed).

**NOTE: Replace more frequently in dusty working conditions. Consult for maintenance in severe driving conditions (0B-3) for correct replacement interval.**

### POINT 3-2

#### Fuel lines and connections

- 1) 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.



**POINT 3-3**

**Fuel filter replacement.**

**Replacement**

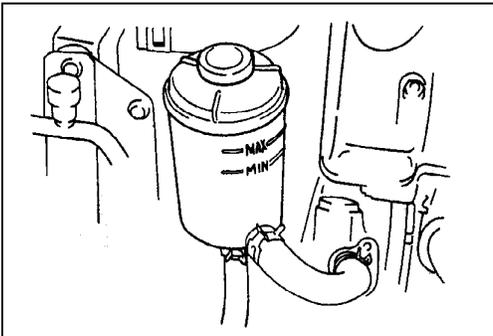
**WARNING:**

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

Replace fuel filter in fuel filter assembly (1) with a new one referring to FUEL FILTER in SECTION 6C.

**Water draining of fuel filter.**

- 1) Bleed fuel filter of water referring to FUEL FILTER in SECTION 6C.



**CHASSIS AND BODY**

**POINT 6-15**

**Power steering.**

- 1) Visually check power steering system for fluid leakage and hose for damage and deterioration.
- 2) With engine stopped, check fluid level indicated on fluid tank, which should be between MAX and MIN marks. If it is lower than MIN, fill fluid up to MAX mark.

**NOTE:**

- **Be sure to use an equivalent of DEXRON-II.**
  - **Fluid level should be checked when fluid is cool.**
- 3) Visually check pump drive belt for cracks and wear.
  - 4) Check belt for tension, referring to Point 1-1. If necessary, have belt adjusted or replaced.

**FINAL INSPECTION**

Carry out a driven test in a safe place.

**WARNING:**  
**When carrying out driven tests, make sure they are in a safe place with no passing pedestrians or vehicles. This will reduce the possibility of accidents.**

- 1) **Starting engine.**  
 Check that engine runs without problem.
- 2) **Clutch and clutch cable.**  
 Check the following points with engine running.
  - Test the six gears and ensure they all change without difficulty or scraping.
  - In 4<sup>th</sup> gear, engage the hand brake, accelerate a little and try to slowly release the clutch pedal. The engine should stall and the vehicle remain stationary. This means the clutch does not slip. If on releasing the clutch the engine tries to keep running, then the clutch is slipping.
- 3) **Brakes.**  
 Check the following points when driving.
  - There are no abnormal noises when braking.
  - The same brake power is applied to all the wheels.
  - The vehicle does not tend to veer one way when brakes are applied firmly.
  - Wheels do not lock.
- 4) **Hand brake**  
 Check hand brake functioning by stopping vehicle on pronounced slope and with only the hand brake fully engaged.

- 5) **Engine.**
  - Check that it responds quickly in all gears.
  - Check that engine does not produce abnormal noise or vibration.
- 6) **Body, wheels and transmission system.**  
 Check that body, wheels and transmission system do not produce abnormal noise or vibration.
- 7) **Meters and indicators**  
 Check speedometer, mileometer, fuel gauge, temperature gauge, etc. for correct functioning.
- 8) **Oil pressure and charge lights.**  
 Check these lights go off when engine is running. If any come on, with the engine running, there is some problem with the engine lubrication system or the charging system.
- 9) **Safety belt.**  
 Inspect safety belt system, including belts, buckles, latch plates, retractors, anchoring, etc.
- 10) **Body.**  
 Check the following points with the vehicle stationary:
  - Bonnet catch.
  - Door closure.
  - Seat gliding and reclining.
  - Battery electrolyte level.
  - Windscreen wipers.

**RECOMMENDED FLUIDS**

ENGINE OIL	Multigrade 10 W/40 API CF (except CF-2)
ENGINE COOLANT	DINAMIC – DINAGEL – 9103
BRAKE FLUID	DOT – 3 or SAE J – 1703
TRANSMISSION	API GL4 SAE 75 W – 90
TRANSFER CASE	API GL4 SAE 75 W – 90
DIFFERENTIALS	API GL5 SAE 80 W-90
POWER ASSISTED STEERING	Equivalent to DEXRON - II

## SECTION 1B

# AIR CONDITIONING (OPTIONAL)

**1B**

**WARNING:**

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

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

**CAUTION:**

The air conditioning system of this vehicle uses refrigerant HFC-134a (R-134a).

None of refrigerant, compressor oil and component parts is interchangeable between two types of A/C: one using refrigerant CFC-12 (R-12) and the other using refrigerant HFC-134a (R-134a).

Be sure to check which refrigerant is used before any service work including inspection and maintenance. For identification between these two types, refer to the same section of Service Manual mentioned in FOREWORD of this manual.

When replenishing or changing refrigerant and compressor oil and when replacing parts, make sure that the material or the part to be used is appropriate to the A/C installed in the vehicle being serviced. Use of incorrect one will result in leakage of refrigerant, damage in parts or other faulty condition.

**NOTE:**

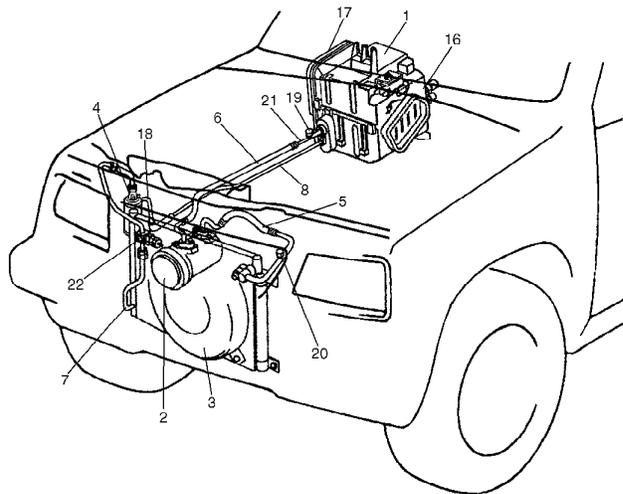
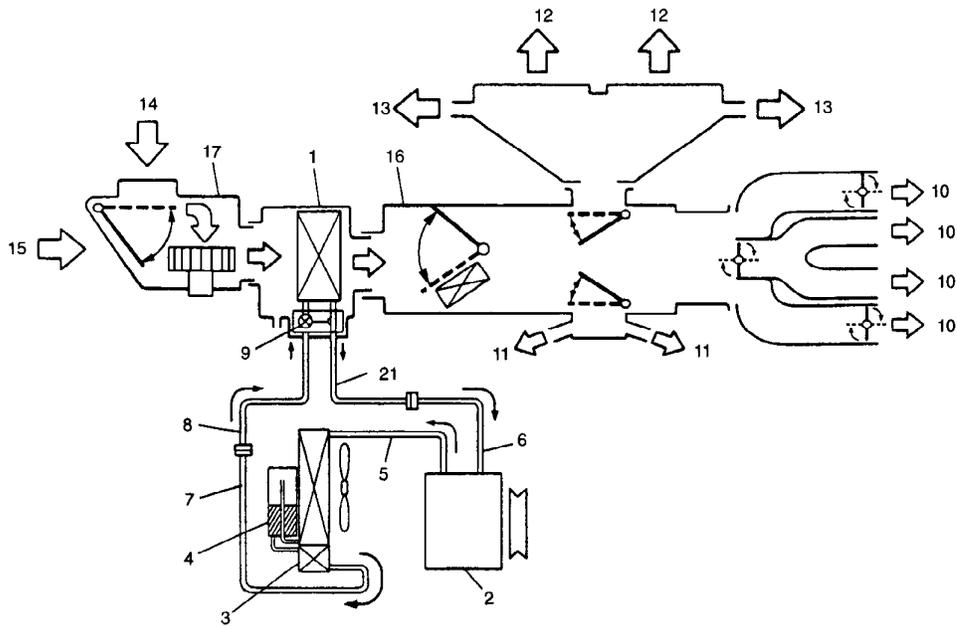
- For the descriptions (items) not found in this section, refer to the same section of the Service Manual mentioned in the FOREWORD of this manual.
- For basic servicing method of the air conditioning system that is not described in this section, refer to AIR CONDITIONING BASIC MANUAL (99520-02130).

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## GENERAL DESCRIPTION

### MAJOR COMPONENTS AND LOCATION



- |                          |                       |  |
|--------------------------|-----------------------|--|
| 1. Cooling unit          | 9. Expansion valve    | 17. Air inlet box                      |
| 2. Compressor            | 10. Ventilation air   | 18. Dual (Refrigerant) pressure switch |
| 3. Condenser assembly    | 11. Foot air          | 19. Low pressure charge valve          |
| 4. Receiver/dryer        | 12. Defroster air     | 20. High pressure charge valve         |
| 5. Discharge hose        | 13. Demister air      | 21. Suction pipe                       |
| 6. Suction hose          | 14. Fresh air         | 22. Sight glass                        |
| 7. Condenser outlet pipe | 15. Recirculation air |  |
| 8. Liquid pipe           | 16. Heater unit       |  |

## DIAGNOSIS

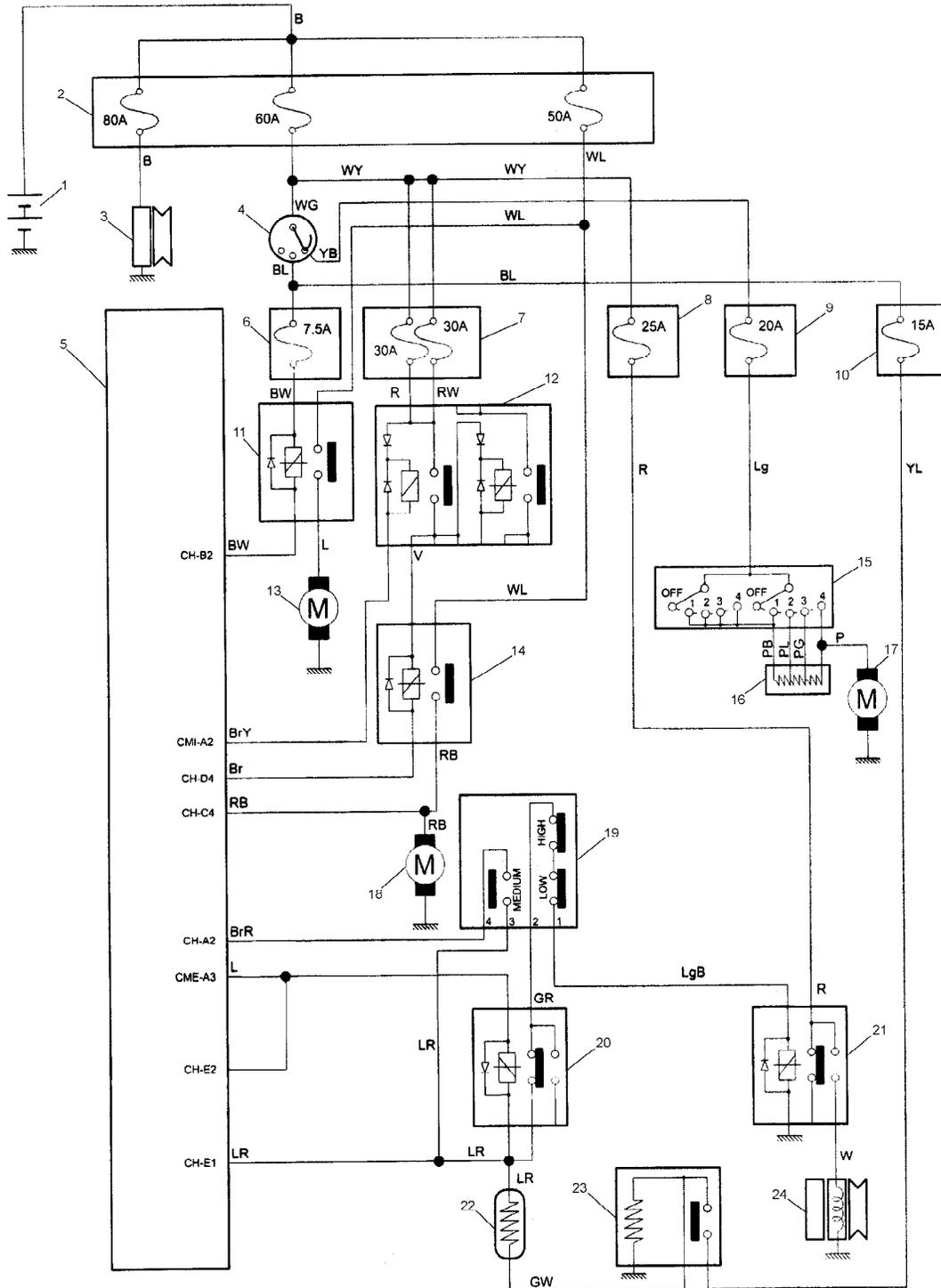
### GENERAL

Condition	Possible Cause	Correction
<b>Cool air won't come out (A/C system won't operate)</b>	<ul style="list-style-type: none"> <li>• No refrigerant</li> <li>• Fuse blown</li>   <li>• A/C switch faulty</li> <li>• Blower motor switch faulty</li> <li>• A/C evaporator thermistor faulty</li> <li>• Dual pressure switch faulty</li> <li>• Wiring or grounding faulty</li> <li>• A/C ON permission signal in ECM faulty</li> </ul>	Recover, evacuation and charging. Check "IG METER", "REAR DEFG", "FRONT BLOW", "25A A/C" fuses, and check for short circuit to ground. Check A/C switch. Check blower motor switch. Check A/C evaporator thermistor. Check dual pressure switch. Repair as necessary. Check ON permission signal.
<b>Cool air won't come out (A/C compressor won't operate)</b>	<ul style="list-style-type: none"> <li>• Magnet clutch faulty</li> <li>• Compressor relay faulty</li> <li>• Compressor thermal switch faulty</li> <li>• Compressor drive belt loose or broken</li> <li>• Compressor faulty</li> <li>• A/C ON permission signal in ECM faulty</li> </ul>	Check magnet clutch. Check compressor relay. Check compressor thermal switch. Adjust or replace compressor drive belt. Check compressor. Check ON permission signal.
<b>Cool air won't come out (A/C condenser fan motor won't operate)</b>	<ul style="list-style-type: none"> <li>• Condenser fan motor relay faulty</li> <li>• Wiring or grounding faulty</li> <li>• "A/C condenser fan relay" signal in ECM faulty</li> <li>• Condenser blower fan motor faulty</li> </ul>	Check condenser cooling fan relay. Repair as necessary. Check A/C condenser fan relay signal.  Check condenser blower fan motor.
<b>Cool air won't come out (Blower motor won't operate)</b>	<ul style="list-style-type: none"> <li>• Fuse blown</li>   <li>• Blower motor relay faulty</li> <li>• Blower motor resistor faulty</li> <li>• Blower motor switch faulty</li> <li>• Wiring or grounding faulty</li> <li>• Blower motor faulty</li> </ul>	Check "FRONT BLOW", "REAR DEFG" fuses, and check for short circuit to ground. Check blower motor relay. Check blower motor resistor. Check blower motor switch. Repair as necessary. Check blower motor.
<b>Cool air won't come out or insufficient cooling (A/C system normal operative)</b>	<ul style="list-style-type: none"> <li>• Insufficient or excessive charge of refrigerant</li> <li>• Refrigerant leak in system</li> <li>• Condenser clogged</li> <li>• A/C evaporator clogged or frosted</li> <li>• A/C evaporator thermistor faulty</li> <li>• Expansion valve faulty</li> <li>• Compressor drive belt loosen or broken</li> <li>• Magnetic clutch faulty</li> </ul>	Check charge of refrigerant.  Check system for leaks. Check condenser. Check A/C evaporator. Check A/C evaporator thermistor. Check expansion valve. Check or replace compressor drive belt. Check magnetic clutch.

1B-4 AIR CONDITIONING (OPTIONAL)

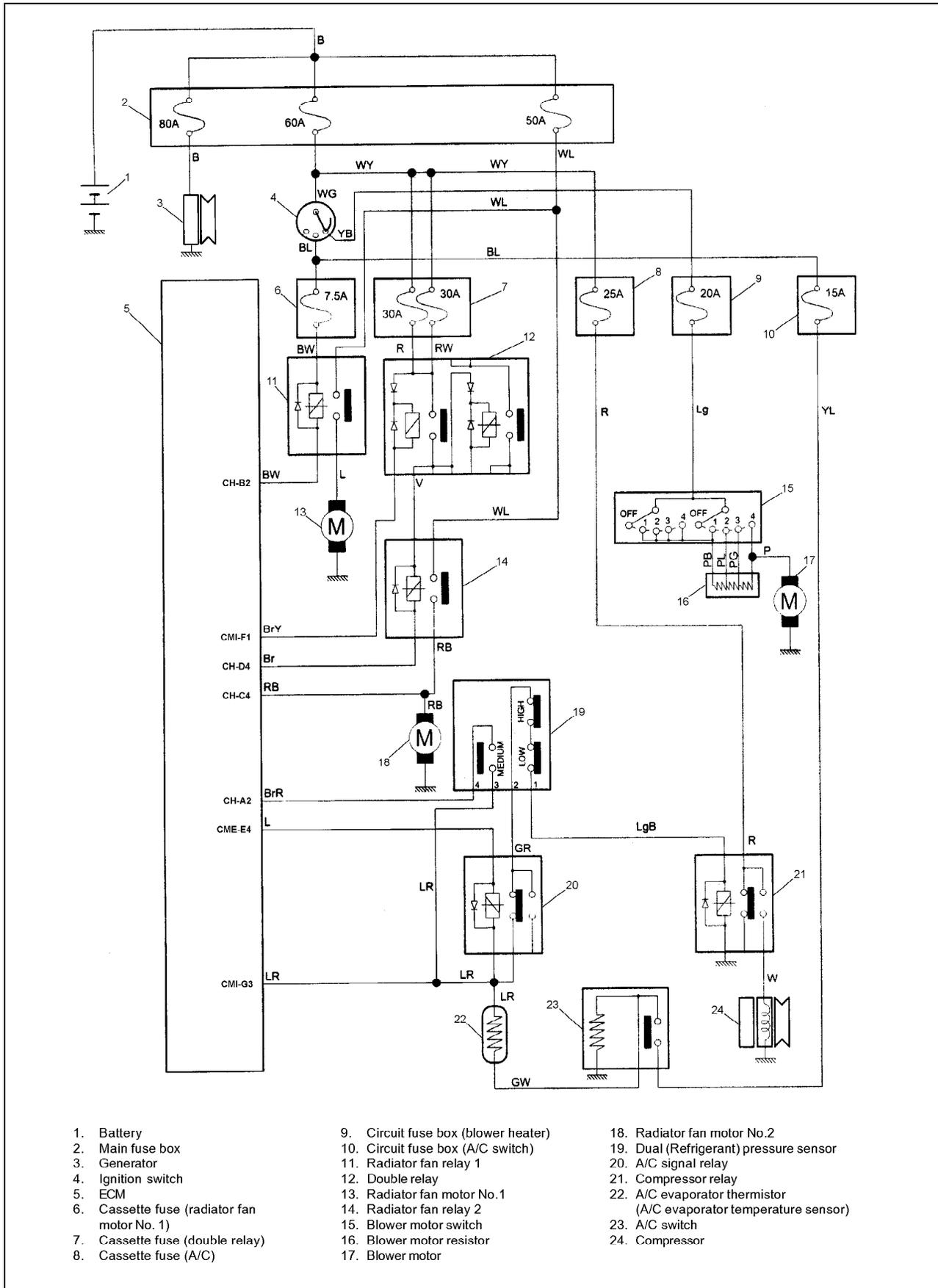
Condition	Possible Cause	Correction
<p><b>Cool air does not come out or insufficient cooling (A/C system normal operative)</b></p>	<ul style="list-style-type: none"> <li>• Compressor faulty</li> <li>• Air in A/C system</li>   <li>• Air leaking from cooling unit or air duct</li> <li>• Heater and ventilation system faulty</li>   <li>• Blower motor faulty</li> <li>• Excessive compressor oil existing in A/C system</li> </ul>	<p>Check compressor.                      Replace condenser dryer, and evacuation and charging.                      Repair as necessary.                      Check blower unit.                      Check heater control lever assembly.                      Check heater unit.                      Check blower motor.                      Pull out compressor oil in A/C system circuit, and replace compressor.</p>
<p><b>Cool air does not come out only intermittently</b></p>	<ul style="list-style-type: none"> <li>• Wiring connection faulty</li> <li>• Expansion valve faulty</li> <li>• Excessive moisture in A/C system</li>   <li>• Magnetic clutch faulty</li> <li>• Excessive charge of refrigerant</li> </ul>	<p>Repair as necessary.                      Check expansion valve.                      Replace condenser dryer, and evacuation and charging.                      Check magnetic clutch.                      Check charge of refrigerant.</p>
<p><b>Cool air comes out only at high speed</b></p>	<ul style="list-style-type: none"> <li>• Condenser clogged</li> <li>• Insufficient charge of refrigerant</li> <li>• Air in A/C system</li>   <li>• Compressor drive belt loosen or broken</li>   <li>• Compressor faulty</li> </ul>	<p>Check condenser.                      Check charge of refrigerant.                      Replace condenser dryer, and evacuation and charging.                      Adjust or replace compressor drive belt.                      Check compressor.</p>
<p><b>Cool air does not come out only at high speed</b></p>	<ul style="list-style-type: none"> <li>• Excessive charge of refrigerant</li> <li>• A/C evaporator frosted</li> </ul>	<p>Check charge refrigerant.                      Check A/C evaporator.                      Check A/C evaporator thermistor.</p>
<p><b>Insufficient velocity of cooled air</b></p>	<ul style="list-style-type: none"> <li>• A/C evaporator clogged or frosted</li> <li>• Air leaking from cooling unit or air duct</li> <li>• Blower motor faulty</li> <li>• Wiring or grounding faulty</li> </ul>	<p>Check A/C evaporator.                      Repair as necessary.                      Check blower motor.                      Repair as necessary.</p>

WIRING CIRCUIT (TYPE 1 VEHICLE)



- |   |                                     |  |
|---|-------------------------------------|--|
| 1. Battery                                  | 9. Circuit fuse box (blower heater) | 18. Radiator fan motor No.2  |
| 2. Main fuse box                            | 10. Circuit fuse box (A/C switch)   | 19. Dual (Refrigerant) pressure sensor                               |
| 3. Generator                                | 11. Radiator fan relay 1            | 20. A/C signal relay   |
| 4. Ignition switch                          | 12. Double relay                    | 21. Compressor relay   |
| 5. ECM                                      | 13. Radiator fan motor No.1         | 22. A/C evaporator thermistor<br>(A/C evaporator temperature sensor) |
| 6. Cassette fuse (radiator fan motor No. 1) | 14. Radiator fan relay 2            | 23. A/C switch   |
| 7. Cassette fuse (double relay)             | 15. Blower motor switch             | 24. Compressor   |
| 8. Cassette fuse (A/C)                      | 16. Blower motor resistor           |  |
|   | 17. Blower motor                    |  |

WIRING CIRCUIT (TYPE 2 VEHICLE)



- |   |                                     |  |
|---|-------------------------------------|--|
| 1. Battery                                  | 9. Circuit fuse box (blower heater) | 18. Radiator fan motor No.2  |
| 2. Main fuse box                            | 10. Circuit fuse box (A/C switch)   | 19. Dual (Refrigerant) pressure sensor                               |
| 3. Generator                                | 11. Radiator fan relay 1            | 20. A/C signal relay   |
| 4. Ignition switch                          | 12. Double relay                    | 21. Compressor relay   |
| 5. ECM                                      | 13. Radiator fan motor No.1         | 22. A/C evaporator thermistor<br>(A/C evaporator temperature sensor) |
| 6. Cassette fuse (radiator fan motor No. 1) | 14. Radiator fan relay 2            | 23. A/C switch   |
| 7. Cassette fuse (double relay)             | 15. Blower motor switch             | 24. Compressor   |
| 8. Cassette fuse (A/C)                      | 16. Blower motor resistor           |  |
|   | 17. Blower motor                    |  |

**ECM VOLTAGE VALUES TABLE**

Terminal	Wire	Circuit	Measurement ground	Normal value	Condition
CH-C4 (CH-C4)	RB	Radiator fan motor state input	ECM ground terminal	-0.3 - 0.3 V	Radiator fan state OFF with engine running
				4 - 5 V	Radiator fan state low with engine running
				12 - 15 V	Radiator fan state high with engine running
CH-D4 (CH-D4)	Br	Radiator fan motor relay drive output (high)	ECM ground terminal	-0.3 - 0.3 V	Engine coolant temperature sensor more than 105°C (221 °F) with engine running, in this case relay should be drive, and it come back at less than 101 °C (213.8°F)
				12 - 15 V	Except the above-mentioned condition with engine running
CHE1 (CMI-G3)	LR	A/C ON signal input from A/C switch	ECM ground terminal	12 - 15 V	A/C ON
				-0.3 - 0.3 V	A/C OFF
CH-B2 (CH-B2)	BW	Radiator fan motor relay drive (low)	ECM ground terminal	-0.3 - 0.3 V	A/C ON signal input from A/C switch through relay
					Engine coolant temperature at more than 97°C (206.6°F) with engine running, in this case relay should be drive and it come back at less than 93°C (199.4 ° F)
					12 - 15 V
CME-A3/ CH-E2 (CME-E4)	L	A/C ON permission signal to A/C switch	ECM ground terminal	12 - 15 V	A/C ON at engine running with normal condition
				-0.3 - 0.3 V	ECT sensor temperature more than 110°C (230°F), in this case ECM is not permission A/C signal and it come back at less than approx.108.5°C (227.3°F)

**NOTE:**

- For ( ) marked text in terminal column, it is indicated for Type 2 vehicles.

## COMPRESSOR DRIVE BELT

### INSPECTION

- Check compressor drive belt (1) for wear and cracks, and replace as necessary.
- Check compressor drive belt (1) tension by measuring how much it deflects when pushed at intermediate point between compressor pulley (2) and crank shaft additional pulley (3) with about 100 N (10 kg) force after crankshaft additional pulley 1 rotating. If belt tension is without specification, adjust belt tension referring to below procedures.

### Compressor drive belt tension

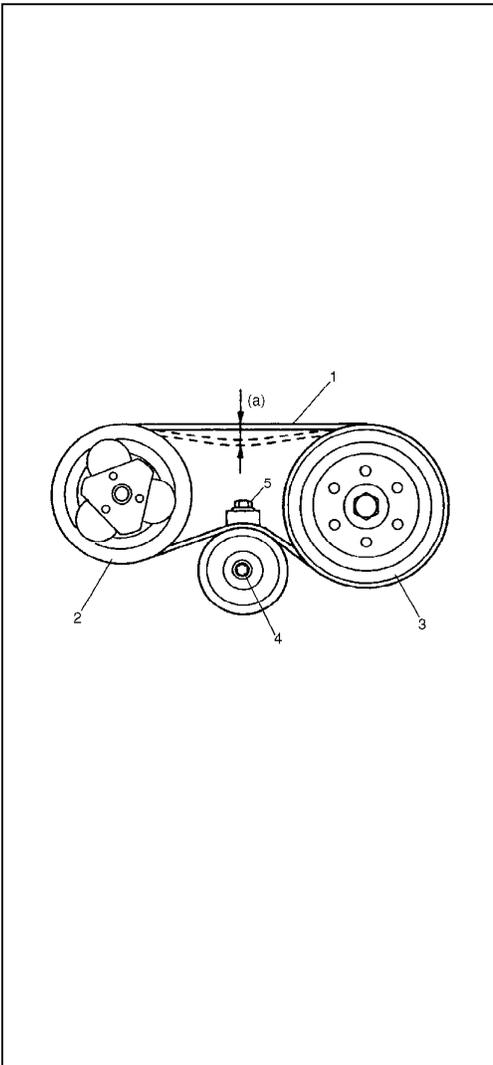
“a”: 9 mm (0.35 in.)

### ADJUSTMENT

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

### REPLACEMENT

- 1) Loosen tension pulley nut (4).
- 2) Loosen belt tension by loosen tension pulley adjusting bolt (5).
- 3) Remove compressor drive belt (1).
- 4) Install new compressor drive belt.
- 5) Adjust belt tension referring to above procedure.



## ON-VEHICLE SERVICE

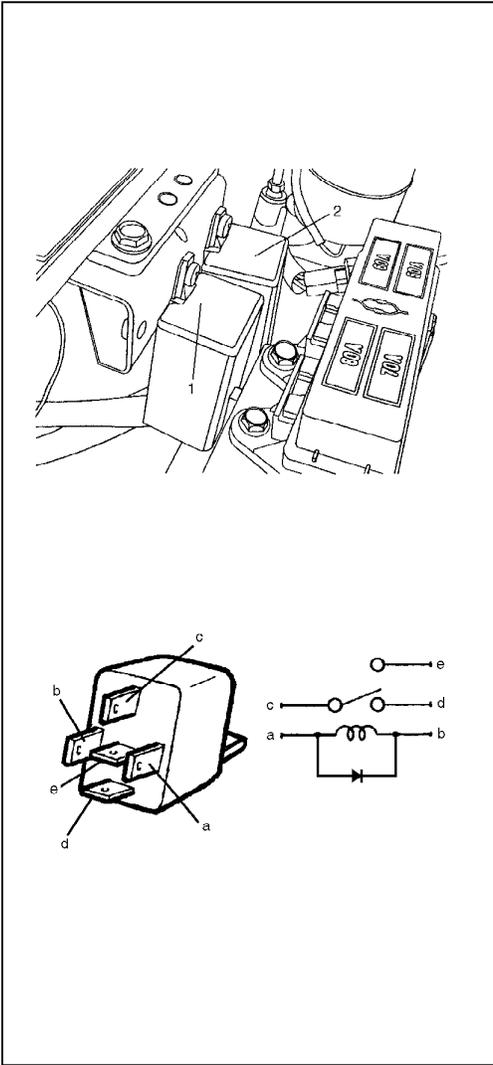
### RELAYS

#### NOTE:

Refer to "RADIATOR FAN CONTROL SYSTEM" in Section 6E3 for radiator fan relay 1 and radiator fan relay 2.

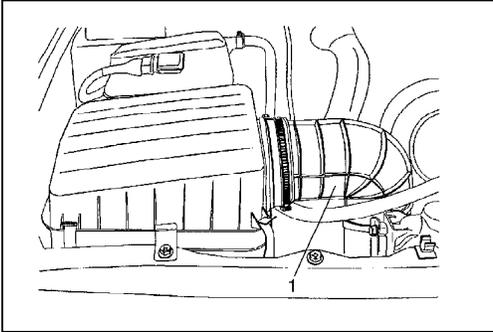
### INSPECTION

- 1) Disconnect negative (-) cable at battery.
- 2) Remove compressor relay (1), and/or A/C signal relay (2) from vehicle.
- 3) Check that there is continuity between terminal "c" and "d". If there is no continuity, replace relay.
- 4) Check that there is no continuity between terminal "c" and "e". If there is continuity, replace relay.
- 5) Connect battery positive (+) terminal to terminal "b" of relay. Connect battery negative (-) terminal "a" of relay.
  - Check continuity between terminal "c" and "d". If there is continuity when relay is connected to the battery, replace relay.
  - Check continuity between terminal "c" and "e". If there is no continuity when relay is connected to the battery, replace relay.



## COMPRESSOR ASSEMBLY REMOVAL

- 1) Run engine at idle with A/C ON for 10 minutes.
- 2) Disconnect negative (-) cable at battery.

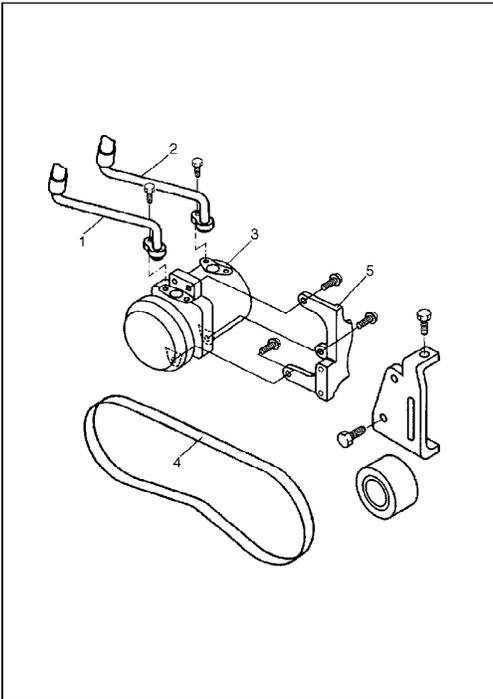


- 3) Remove air cleaner outlet hose (1).
- 4) Recover refrigerant from refrigeration system using recovery and recycling equipment.

**NOTE:**

The amount of compressor oil at removed must be measured and the same amount must be poured when installing the compressor.

- 5) Disconnect thermal protector lead wire.

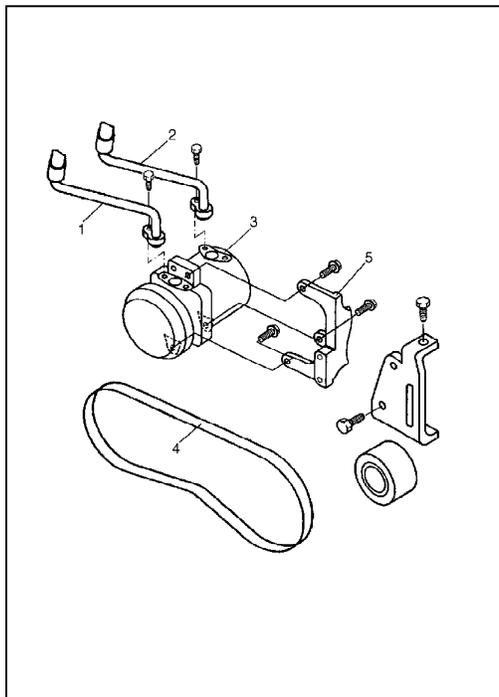


- 6) Disconnect suction hose (1) and discharge hose (2) from compressor (3).

**NOTE:**

Cap open fitting immediately to keep moisture out of system.

- 7) Remove compressor drive belt (4) referring to "DRIVE BELT" in this section.
- 8) Remove compressor (3) from engine mounting (5).
- 9) If compressor (3) is replaced, drain oil from compressor (3) and measure its amount.



## INSTALLATION

- 1) Pour new compressor oil. The amount must be the same with the amount measured in "REMOVAL".

### NOTE:

**Compressor supplied from factory is filled up with the following amount of oil.**

**Amount of oil in compressor: 120 cm<sup>3</sup> (120 cc)**

- 2) Install compressor (3) to engine bracket (5).
- 3) Connect suction hose (1) and discharge hose (2) to compressor.
- 4) Install compressor drive belt (4) referring to "DRIVE BELT" in this section.
- 5) Connect thermal protector lead wire.
- 6) Install air cleaner outlet hose.
- 7) Perform evacuation and charging referring to "REFRIGERANT RECOVERY, EVACUATION AND CHARGING" in this section.

## REQUIRED SERVICE MATERIAL

MATERIAL	RECOMMENDED SUZUKI PRODUCT	USE
Compressor oil	COMPRESSOR OIL RS20 (150 cc) 99000-99088-00D	<ul style="list-style-type: none"> <li>• O-ring</li> <li>• Each component</li> </ul>

---

SECTION 5

**BRAKES**

**5**

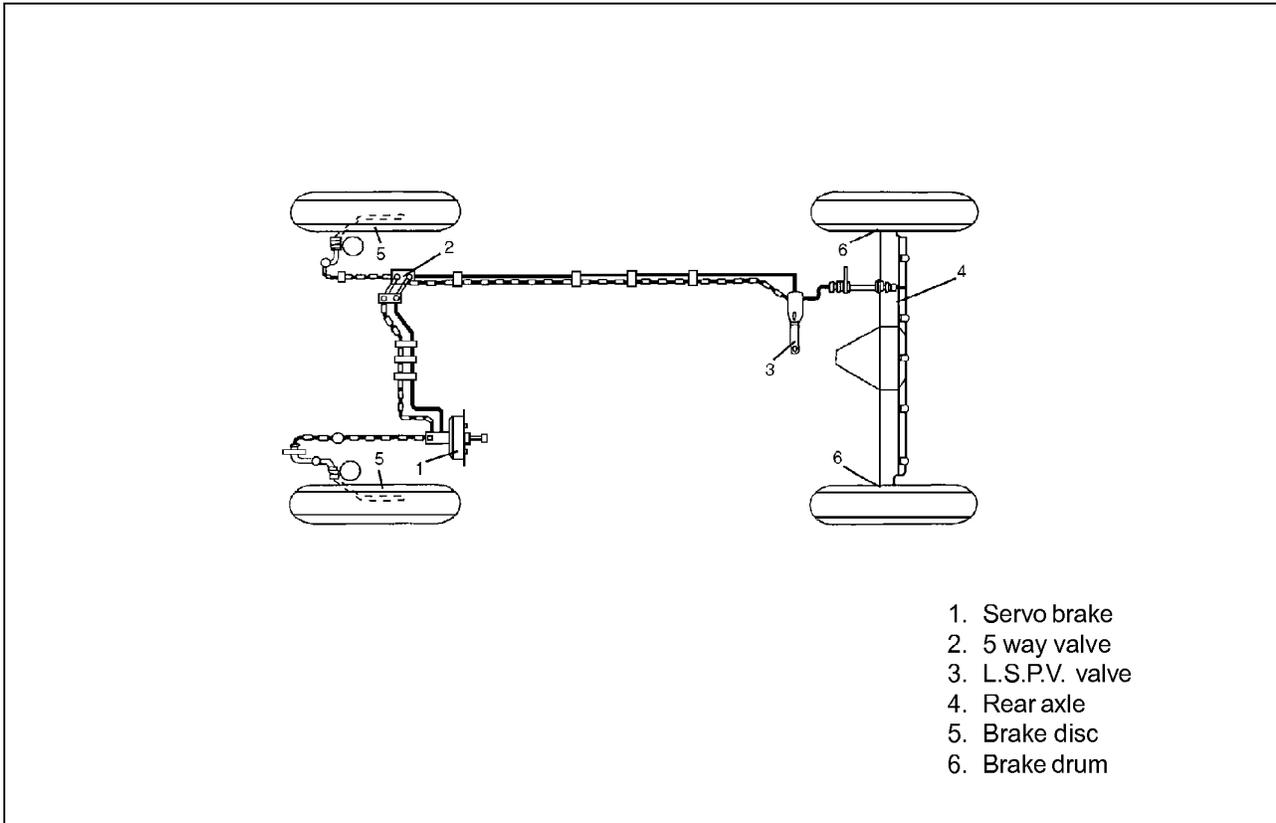
**NOTE:**

For points not covered in this section, please refer to corresponding Service Manual sections listed in the FOREWORD to this Manual.

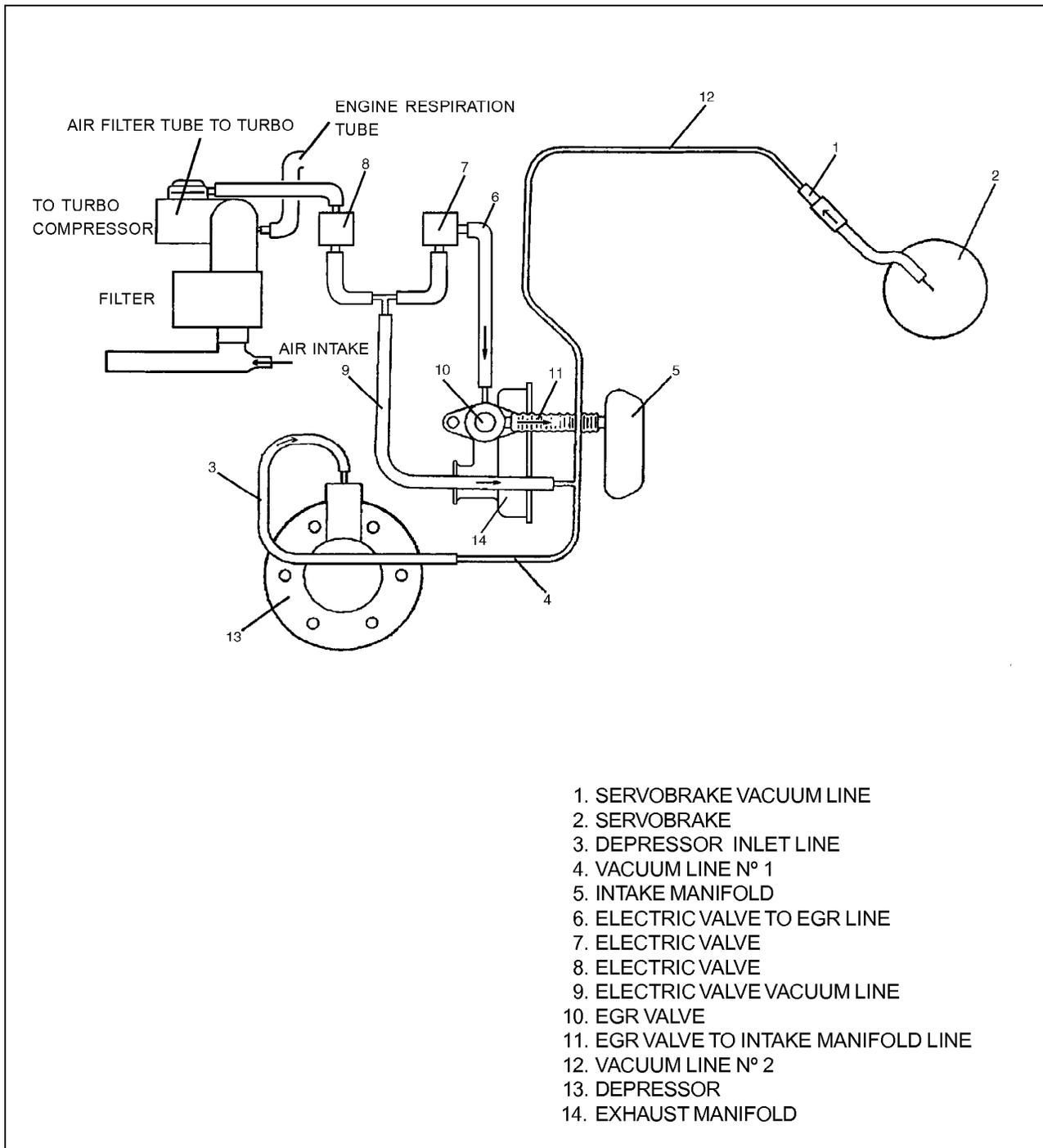
**CONTENTS**

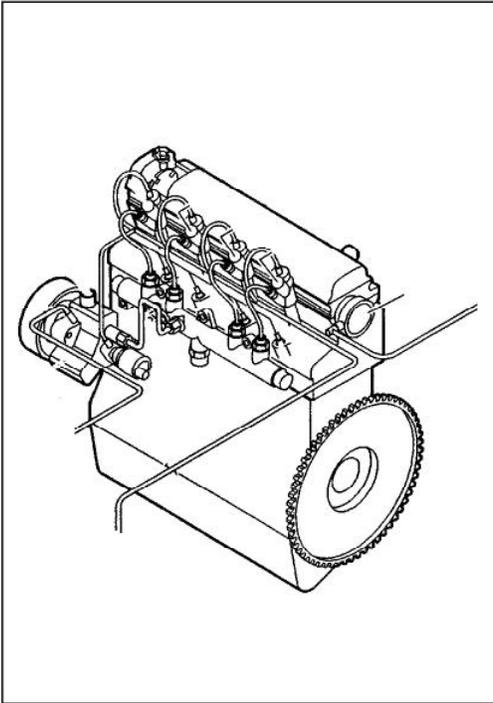
GENERAL OUTLINE .....	5- 2
VACUUM CIRCUIT .....	5- 3
CHECKING DEPRESSOR (VACUUM PUMP) .....	5- 4
REPLACING DEPRESSOR .....	5- 4

GENERAL OUTLINE



## VACUUM CIRCUIT

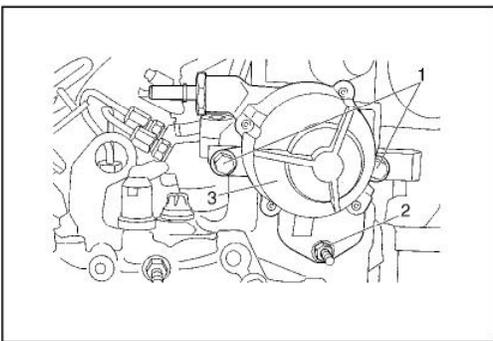
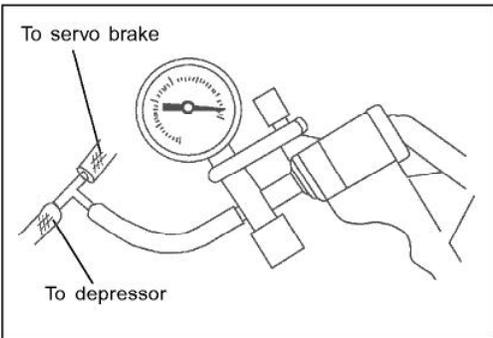




## CHECKING THE DEPRESSOR

### Inspection

- 1) Check, with engine running, that braking aid is sufficient.
- 2) If braking aid is not satisfactory, remove suction lines connecting servo brake with depressor and install a bypass vacuum gauge.
- 3) Rev engine to 1,000 rpm and check that vacuum level is close to 570 Hg mm.
- 4) If it is not, check for:
  - Possible leaks from suction lines.
  - Possible obstruction of depressor outlet hose.



## REPLACING THE DEPRESSOR

### Removal

- 1) Remove lower soundproofing plate of engine.
- 2) Remove suction and outlet lines.
- 3) Remove fixing bolts (1).
- 4) Remove nut (2).
- 5) Dismount depressor (3).

### Installation

- 1) Install by reversing order of above operations.
- 2) Dismount depressor using a new filter and O-ring. Apply engine oil to O-ring before mounting.

## SECTION 5B

**ANTI-LOCK BRAKING SYSTEM (ABS) (Wabco)****WARNING:**

For vehicles equipped with a Supplemental Inflatable Restraint Air Bag System:

- Service on or around Air Bag System Components or wiring must be performed only by an authorized Suzuki dealer. Please observe all WARNINGS and SERVICE PRECAUTIONS in Section 9J under “On-Vehicle Service” and the Air Bag System Component and Wiring Location View in Section 9J before performing service on or around Air Bag System components or wiring. Failure to follow WARNINGS could result in unintended air bag deployment or could render the air bag 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 air bags may be deployed by reserve energy in the Sensing and Diagnostic Module (SDM).

**NOTE:**

- When inspecting and servicing vehicle equipped with ABS, be sure to refer to Section 5B1 first.
- For descriptions (items) not found in this manual, refer to Section 5 of Service Manual mentioned in the FOREWORD of this manual.
- All brake fasteners are important attaching parts in that they could affect the performance of vital parts and system, and/or could result in major repair expense. They must be replaced with one of same part number or with an equivalent part of 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.

**CONTENTS**

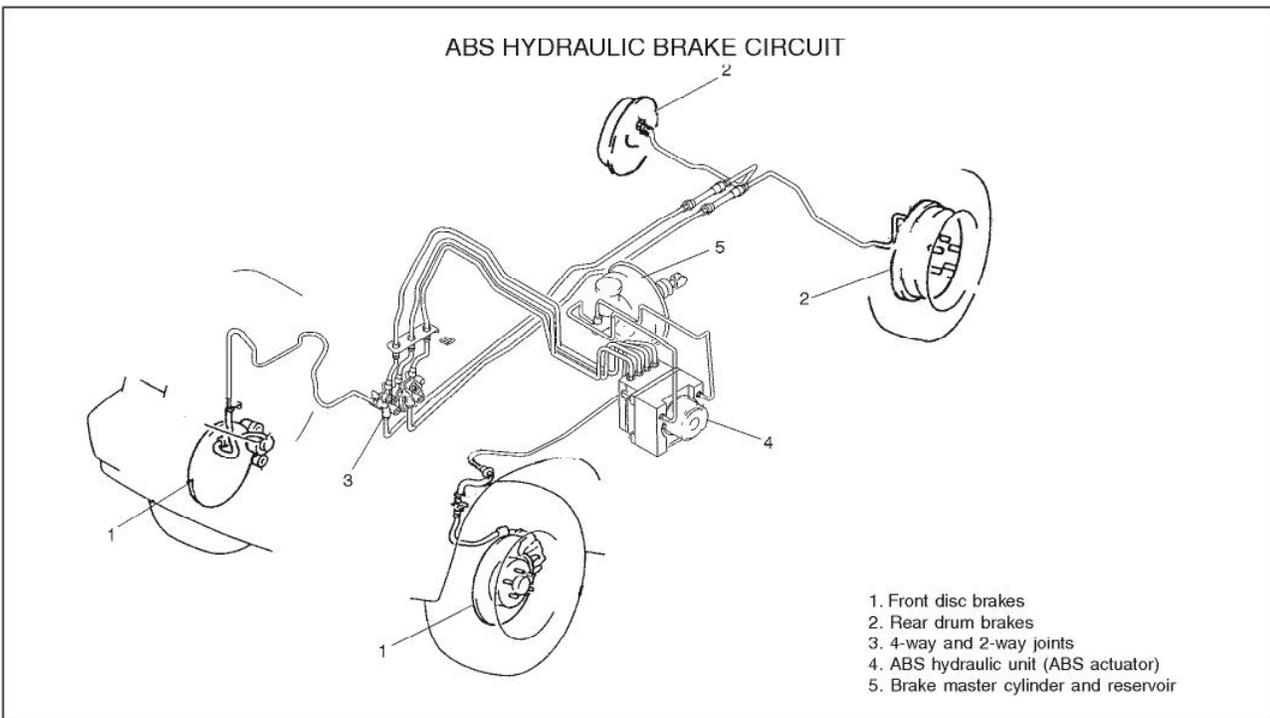
<b>GENERAL DESCRIPTION</b> .....	5B.2	<b>Bleeding brake circuit</b>	
Hydraulic ABS operation .....	5B.5	<b>(Manual procedure)</b> .....	5B.19
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<b>PRECAUTIONS IN DIAGNOSIS TROUBLES</b> .....	5B.8	ABS diagnostic flow table .....	5B.21
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Rear wheel speed sensor .....	5B.16		
ABS speed sensor ring wheel .....	5B.18		
ABS module control .....	5B.18		

## GENERAL DESCRIPTION

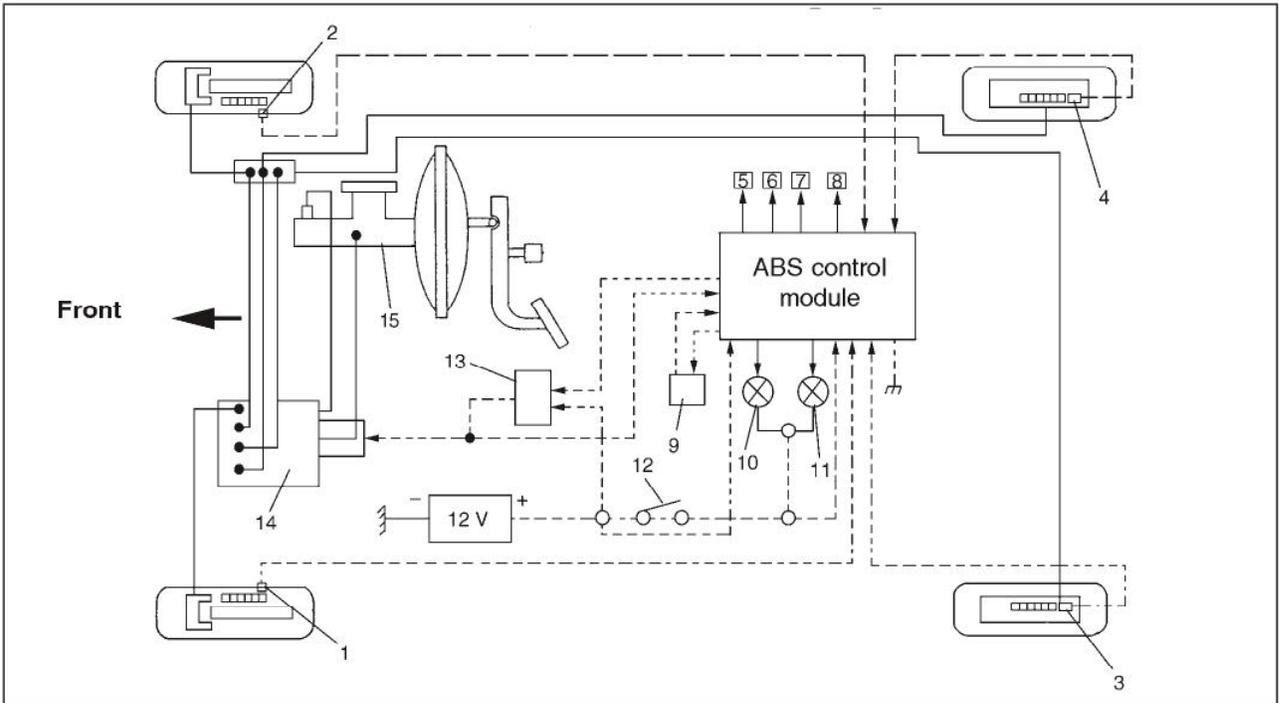
The ABS (Antiblock Brake System), monitors the fluid pressure coming from the master cylinder to each wheel brake cylinder, so that wheels do not block even in hard brakings. This ABS is a 4-wheel type and monitors fluid pressure to to every four brakes in each wheel, avoiding wheel blocking.

The component parts of this ABS includes following parts in addition to those of the conventional brake system.

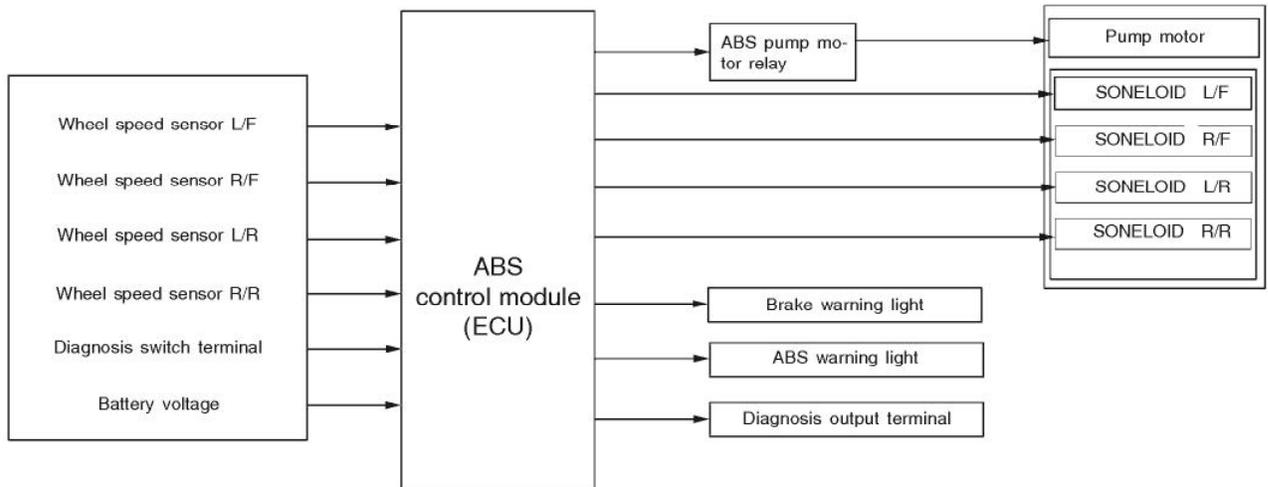
- A wheel speed sensor, sensing revolution speed of each wheel and sends its outputs to ABS control module.
- An ABS control module (ECU) sends the working signal of the unit to the hydraulic ABS unit (ABS actuator) in order to monitor fluid pressure applied to each wheel cylinder, based on the outputs from each wheel sensor, in order to avoid wheel blockage.
- An ABS hydraulic unit (ABS actuator) works according to the ouput coming from the ABS control module (ABS), that controls fluid pressure applied to wheel cylinder of each of 4 wheels.
- Pump motor relay supplies power to pump motor in ABS hydraulic unit.
- ABS warning light to inform abnormality when system fails to operate properly.



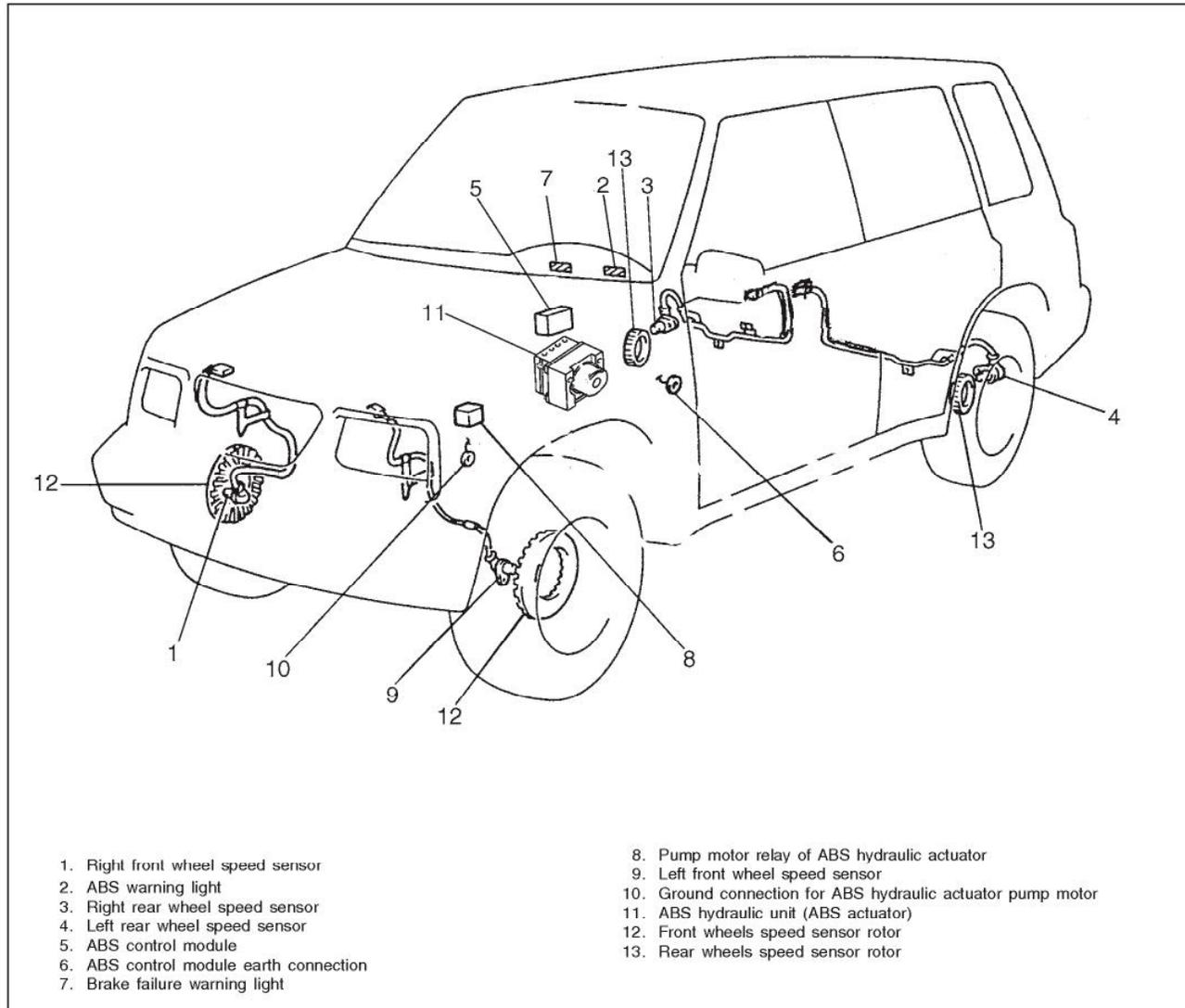
SYSTEM SCHEMATIC

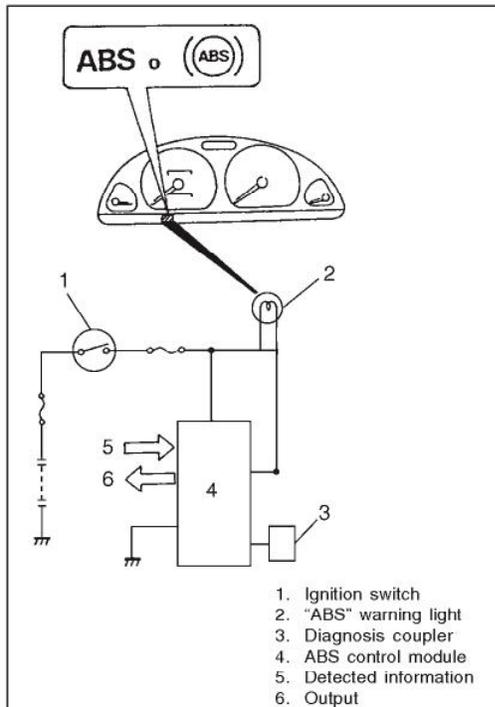


1. Left-front wheel speed sensor
2. Right-front wheel speed sensor
3. Left-rear wheel speed sensor
4. Right-rear wheel speed sensor
5. Left-front wheel solenoid valve output
6. Right-front wheel solenoid valve output
7. Left-rear wheel solenoid valve output
8. Right-rear wheel solenoid valve output
9. TECH-2 analyzer connector
10. ABS warning light
11. Brake failure warning light
12. Ignition switch
13. ABS actuator pump relay
14. ABS hydraulic unit (ABS actuator)
15. Brake master cylinder



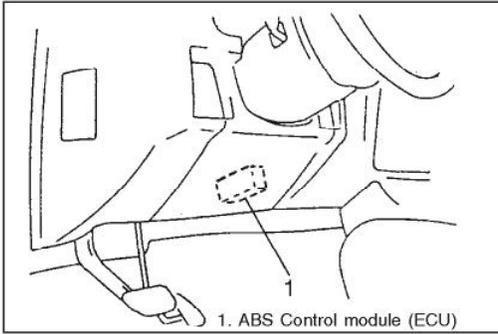
## ABS COMPONENTS LOCATION





## HYDRAULIC ABS OPERATION

- Wheel speed sensors read wheel rotation speed and send output signals to ABS control module (ECU) if wheels are about to get blocked. The control module sends output signals to the ABS hydraulic unit (ABS actuator) in order to regulate braking pressure to wheel that possible blockage has been detected.
- When wheels are about to get blocked, its corresponding solenoid valve in the hydraulic unit (ABS actuator) begins to open and close several times a second in order to control braking pressure at each wheel so that it avoids its blockage. When this happens, driver can notice pulsations on braking pedal.
- When ignition key turns to ON position, ABS warning light at instrument panel will lite on, then goes off inmediately for about one second and turns back on until vehicle reaches about 7 Km/h (5 Mph) speed, when lamp will turn off definitely, which indicates ABS system is working properly and its self-checking has been performed correctly.
- If ABS warning light turns on while driving, trip can be continued but vehicle must be checked in a SUZUKI dealer as soon as possible in order to have the system diagnosed.
- If ABS warning light does not turn off for about one second after turning the ignition key to "ON" position and keeps on even when vehicle reaches 7 Km/h (5 Mph) indicates ABS failure and system must be checked.
- If ABS warning light does not turn off for about one second after turning key to "ON" position but it turns off when vehicle reaches 7 Km/h, that indicates one failure has been memorized and needs to be checked and deleted if solved.
- Despite its low probability, if there is ABS malfunction at any wheel, ABS in that wheel will get disactivated, working as a conventional brake system. Rest of wheels will keep on working normally. If failure is located is in either ABS control module or ABS hydraulic unit means braking system will work conventionally, without ABS.
- When some abnormality is detected, ABS warning light turns on and information will be kept stored into ABS control module memory (ECU).



## DESCRIPTION OF ABS SYSTEM COMPONENTS

### ABS CONTROL MODULE

The ABS control module (ECU) is located in the underside of the instrument panel at driver's seat side.

Its main function is to deal with output signals coming from sensors and generate signals to activate solenoid valves of ABS hydraulic unit, reducing, maintaining or applying pressure to each wheel brakes avoiding braking blockages.

Also, it performs self-diagnosis and memorizes system failures to be checked and repaired. At the same time, it activates ABS warning light and protects brake system when there is an ABS system failure.

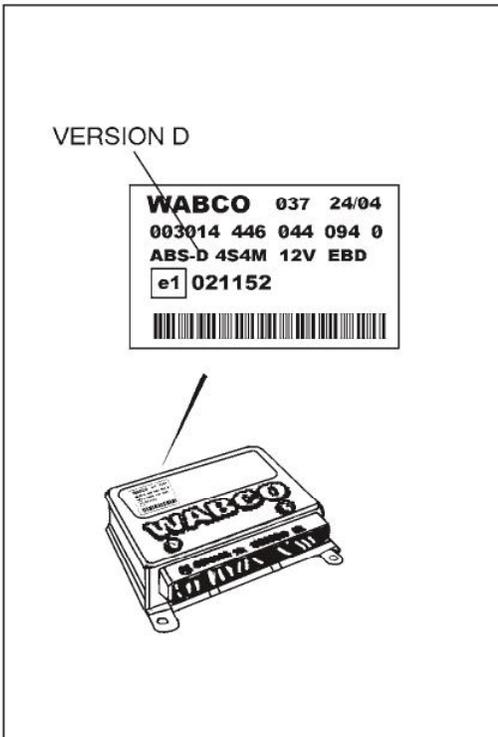
### Protection in case of malfunction

When some abnormality occurs (or an abnormal DTC is detected), ABS control module disactivates the relay that supplies power to ABS hydraulic unit, so that ABS turns inoperative and brakes will work as a conventional system.

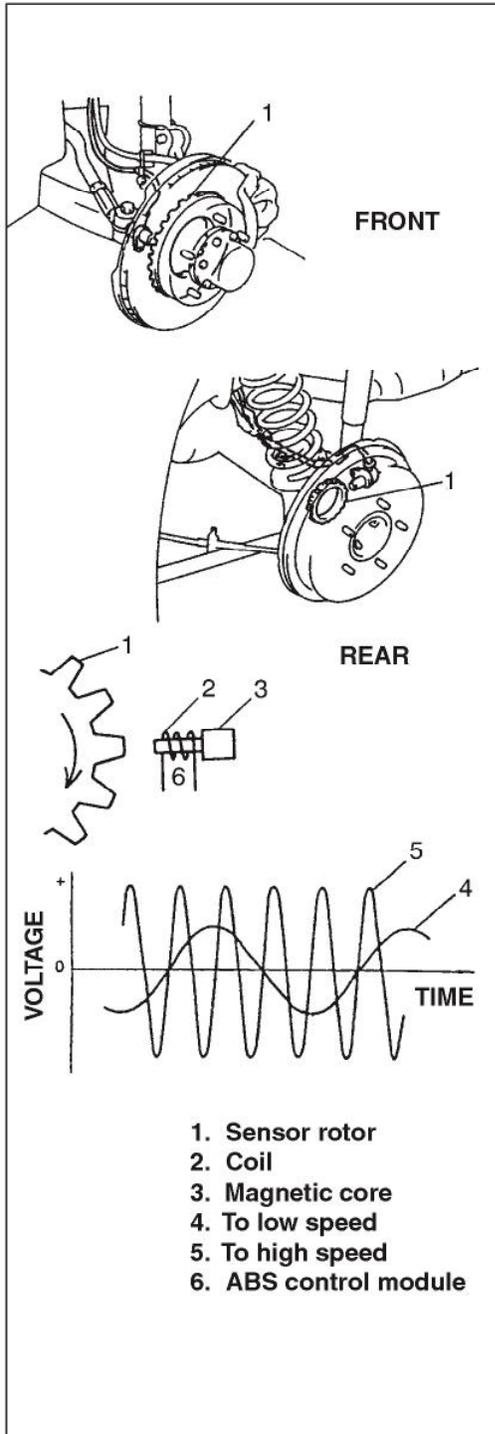
### ABS control module identification

**NOTE:**

**The control module should not be opened, otherwise guarantee will be cancelled.**



There is an easy way to identify the hydraulic ABS installed. Just have a look to the control module and you can see in the identification plate the part number and the "D" version printed on it. (See illustration next).



### RING WHEEL (ROTOR) AND SPEED SENSOR

The wheel speed sensor consists on a magnetic core and a coil installed in the steering knuckles (front wheels) and in the ends of the axis crankase (rear wheels).

The sensor rotor/ring wheel is installed either in the wheel hubs (for front wheels) or in the rear axle shaft ends (rear wheels)-

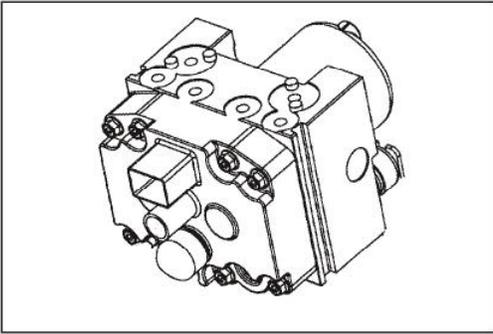
The speed sensor is mounted on a clamp that allows the full introduction of the sensor to the ring wheel and its self-adjusting when the vehicle begins to move.

When ring wheel spins, the magnetic flux coming from the magnetic core variates, generanting an a/c voltage to the coil.

Due to this a/c frecueny variates proportionally with the wheel revolutions, it determinates the speed of the wheel.

**NOTE:**

**Clearance between sensor and ring wheel can not be adjusted, as it is self-adjustable.**

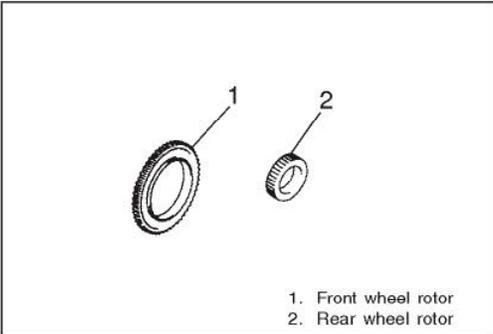


### ABS HYDRAULIC UNIT (ABS ACTUATOR)

The ABS hydraulic unit lodges the ABS solenoid control valves (one input valve and an output valve per wheel), a motor pump and two accumulators.

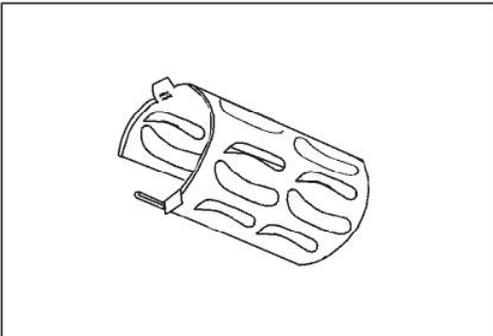
#### NOTE:

**It should not be exposed to blows neither excessive vibrations. Do not apply compressed air in the hydraulic conduits.**



### ROTOR/WHEEL SPEED RING SENSOR

The wheel speed sensor rotor is a serrated ring, installed in the wheel hub (front wheels) or rear axle shaft (rear wheels).



### SPEED SENSOR BUSH

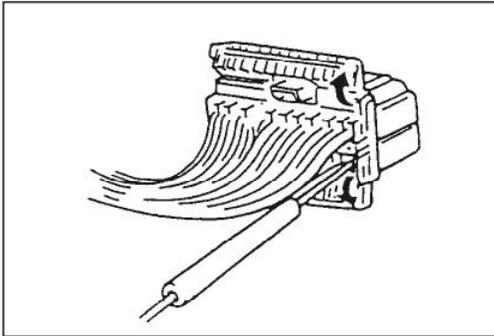
This bush maintains the appropriate distance between sensor and ring wheel.

## PRECAUTIONS ON DIAGNOSIS TROUBLES

In order to guarantee a correct diagnosis, take into account the following caution points:

- The following driving conditions will make the ABS warning light turn on momentarily, but it does not indicate ABS malfunction.
  - Vehicle had been driven with parking brake activated.
  - Vehicle had been driven with brake dragging.
  - Vehicle had been stuck in mud, sand, etc.
  - Wheels had been sliding while driving.
  - Wheels had been rotating while vehicle was jacked up.
- Make sure of reading "Precautions on electronic circuit servicing" in Section 0A" before the inspection and read what is indicated there.

- Be sure of using the diagnosis procedure described on the flow table, referring to Section 5B-21 "Diagnosis", otherwise diagnosis could be wrong (during inspection some other failure diagnosis code could be stored in the memory of ABS control module).
- When connecting an ohmmeter or voltmeter probe to a coupler terminal, be sure to connect it from wire harness side of the coupler.



## ON-VEHICLE SERVICE

### TESTS AND TROUBLE LOCATION

#### **Test equipment: Voltmeter/Ohmmeter (VOM).**

A VOM with automatic polarity sensing is recommended. This eliminates worry over polarity at the meter leads during voltage measurements.

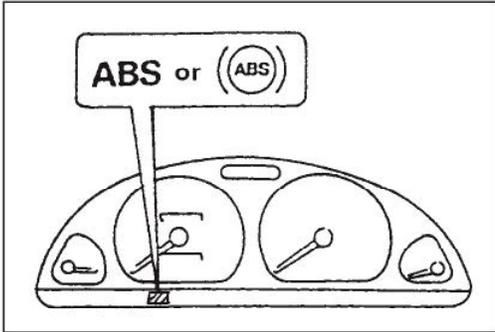
#### **Voltage check.**

Voltage range must be between 9.5 and 14 volts in order to allow 12 V hydraulic ABS to run properly.

Check voltage in control module (ECU) this way.

1. Turn ignition key to "ON" position.
2. Check for correct voltage into the 18-terminal connector. Terminals (12 & 1) and (12 & 2).

If voltage is not between 9.5 and 14 volts, check wiring connections.



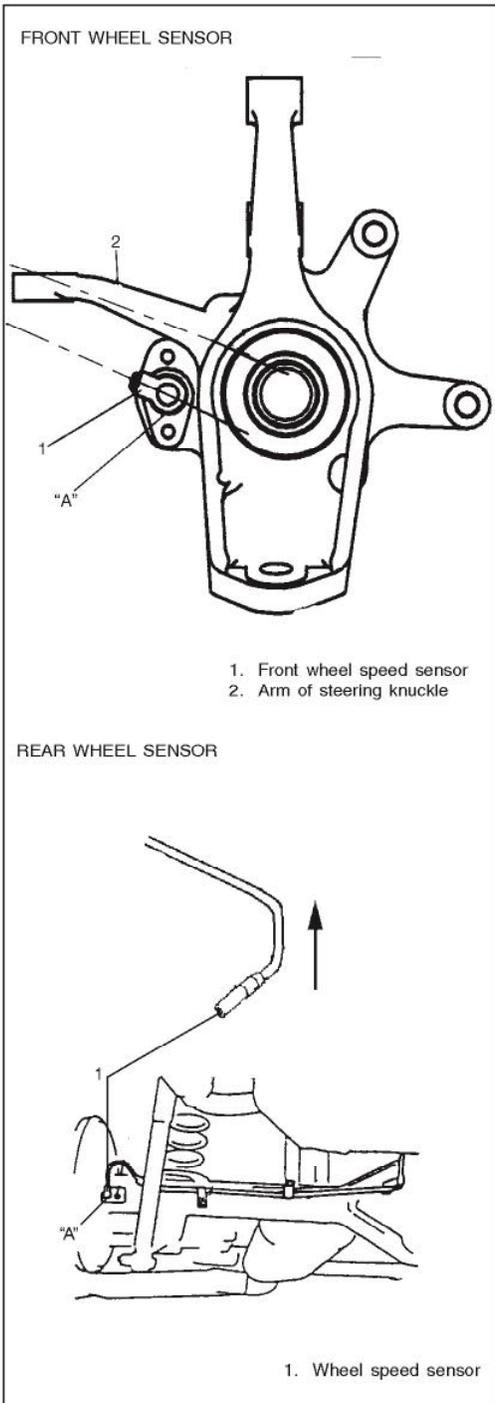
### ABS warning light

If ABS warning light does not turn on after turning the ignition key to "ON" position, check all ABS fuses and replace them if necessary. If fuses are in good condition, check the wiring of the lamp, the lamp itself and bulb holder following these steps:

1. Check tension in bulb holder.
2. Check continuity of bulb holder wiring.
3. Replace bulb.

If ABS warning light still not working test the ABS control module with the "TECH 2".

If ABS warning light lites on when starting the engine and it does not work according to its normal procedure, test it with TECH 2.



### Adjusting wheel speed sensor

For front axle, wheel speed sensor is reachable from inside the steering knuckle. For rear axle, sensor can be reached from rear face of axle.

For sensor adjusting, push it until it contacts the ring wheel, after it had been well cleaned and a drop of grease "A" had been applied.

**"A": Sensor grease 45133-86CA0**

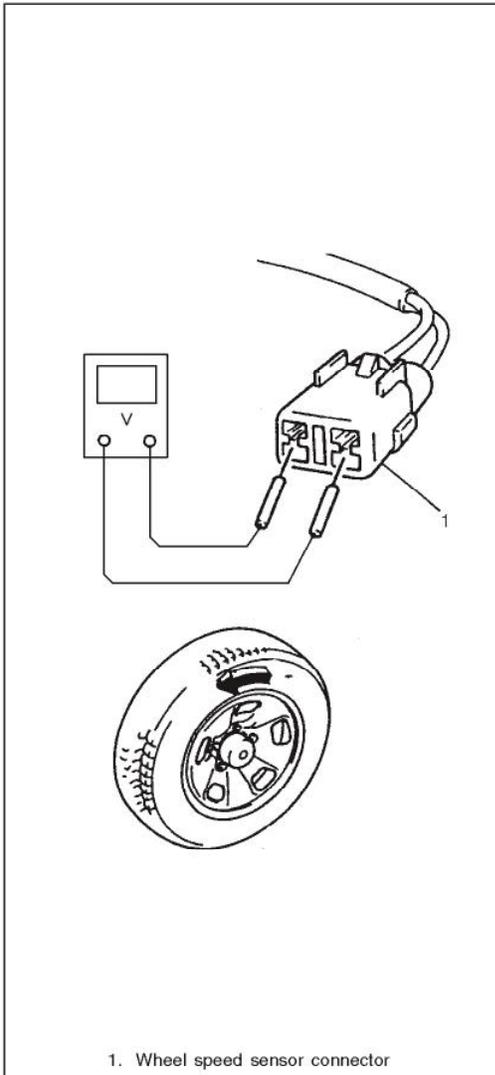
Set the front speed sensor parallel to the steering knuckle arm, guided to driving direction, as illustrated.

**NOTE:**

**Guide the wheel sensor up, like it is indicated in the figure.**

**CAUTION:**

- Do not pull cable when removing sensor.
- When installing, handle sensor just by hand.



## Checking wheel speed sensors

### Checking sensor output voltage

1. Hoist vehicle on an appropriate elevator, properly secured.
2. Turn ignition key to OFF position.
3. Disconnect the sensor coupler to be checked or the control module (ECU) coupler.
4. Connect voltmeter to sensor terminals (if it has been disconnected) or to the control module (ECU) terminals that corresponds, refer to flow table (A).

### Flow table (A): checking terminals for ECU sensor connector

Wheel speed sensor	Checking terminals (9-terminal connector)
Left front	1 & 2
Right front	4 & 5
Left rear	7 & 8
Right rear	3 & 6

5. Measure AC voltage while spin the corresponding wheel to the specified revolutions. This measurement must be under the specified range.

**Wheel revolutions: 30 rpm**  
**AC voltage: 0.2 V the lowest**

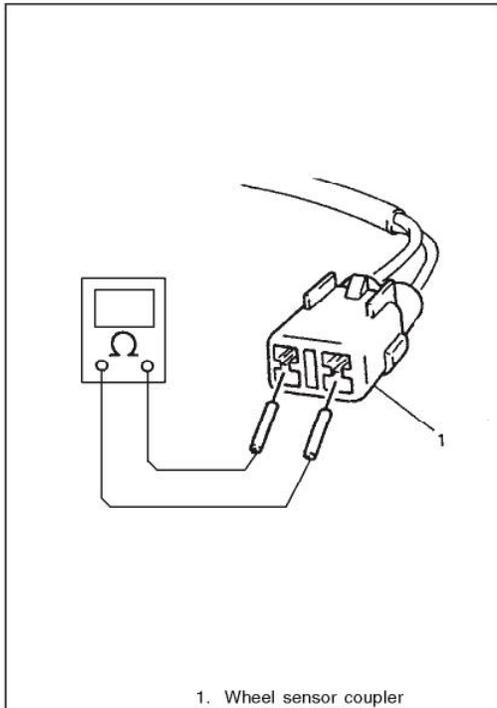
If measured voltage is not the specified, check sensor, rotor and installation condition.

### Checking sensor resistance

**NOTE:**

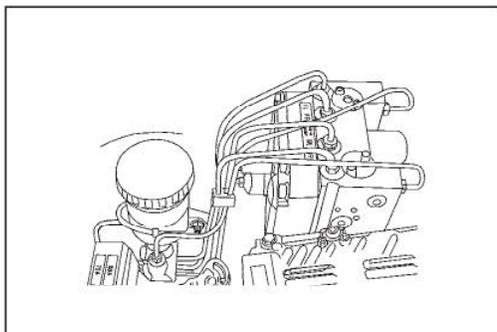
If resistance between sensor and its connector is going to be checked, hoist vehicle and wheels on an appropriate elevator, properly secured.

1. Turn off the ignition.



2. Disconnect sensor coupler (the one to be checked) or the control module (ECU) coupler.
3. Connect ohmmeter between terminals of sensor coupler (if it has been disconnected) or between the terminals that correspond of the ECU coupler. Refer to flow table (A) on previous test, "Checking sensor output voltage". Measurement obtained must correspond to the specified one, otherwise, check sensor and installation condition.

**Sensor resistance 900 to 2000  $\Omega$**



### Checking ABS hydraulic unit (ABS actuator)

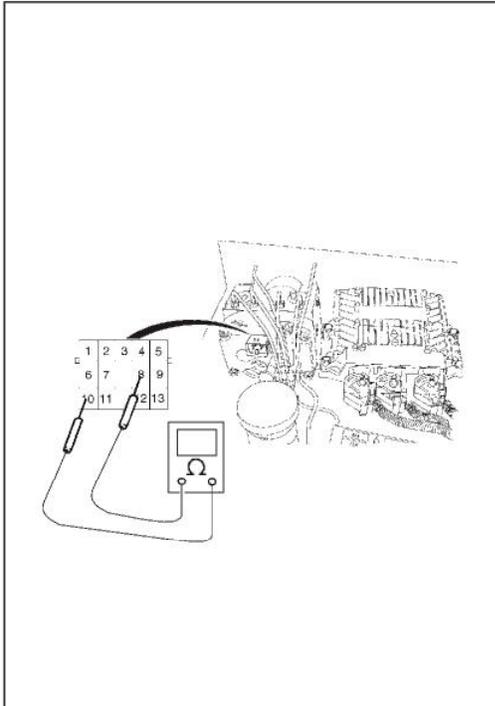
**Appearance inspection**

Check unit for fluid leakage, repair, if any.

Check electric couplers are firmly connected.

**Checking solenoid valve.**

1. Turn ignition switch off and disconnect negative cable from battery.

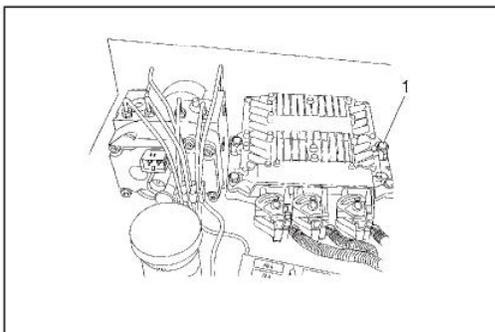


2. Disconnect solenoid connector.
3. Check resistance between terminals and whether or not short-circuit between each terminal and hydraulic unit body exists. If any measurement is not accorded with the specified one, replace hydraulic unit.

**Between terminals**

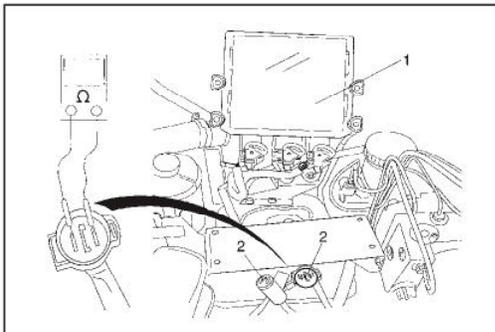
8 & 1 =	9.1 - 9.3 Ω
8 & 2 =	12.2 - 12.4 Ω
8 & 4 =	12.2 - 12.4 Ω
8 & 5 =	9.1 - 9.3 Ω
8 & 10 =	9.1 - 9.3 Ω
8 & 11 =	12.2 - 12.4 Ω
8 & 12 =	12.2 - 12.4 Ω
8 & 13 =	9.1 - 9.3 Ω

Approximately in ambient temperature of 28/30° C



**Checking pump motor**

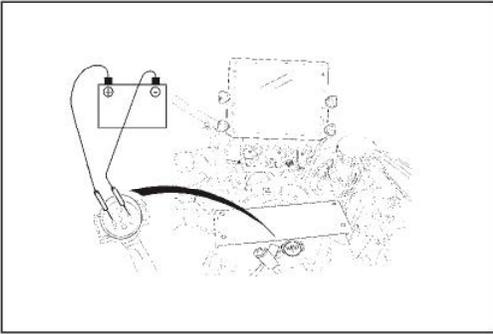
1. Turn ignition key to "OFF" position and disconnect battery.
2. Remove 4 bolts from ECM controller.



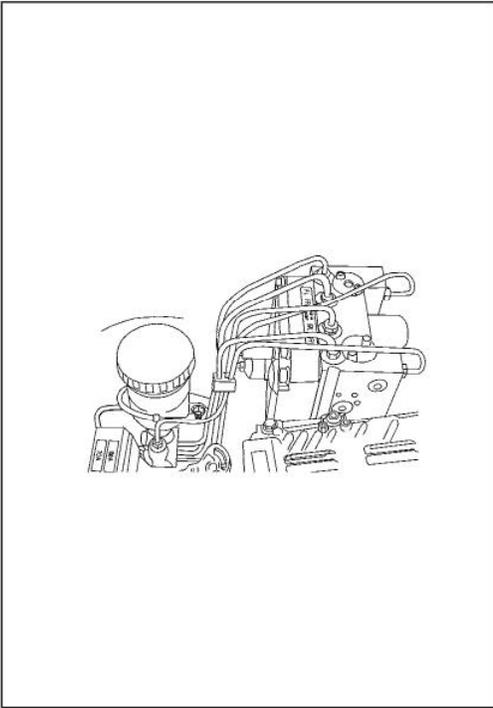
3. Separate the ECM to get access to the motor pump connector.
4. Measure resistance between terminals and between terminals and hydraulic unit body.

**Between terminals 5.4 - 5.6 Ω. Approximately in ambient temperature 28/30° C.**

**Between terminals and hydraulic unit body ∞.**



5. Connect terminal (1) to positive terminal of battery and terminal (2) to negative terminal.  
Check if pump motor works.  
If any failure is detected during steps 4 and 5, replace the hydraulic unit.



## ABS components, removal and installation

### ABS hydraulic unit (ABS actuator)

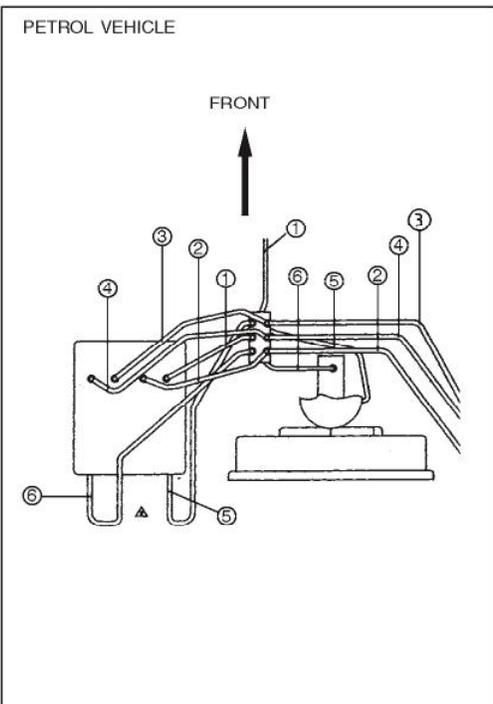
#### Removal

##### CAUTION

Hydraulic unit contains brake fluid, handle it carefully, otherwise fluid can cause damage on paint and skin irritation.

1. Place vehicle on an appropriate working area. Disconnect negative cable from battery.
2. Place an appropriate recipient to pour the liquid from hydraulic unit.
3. Unplug electric couplers.

4. Disconnect and gently separate the hoses of the hydraulic unit in the following recommended order:

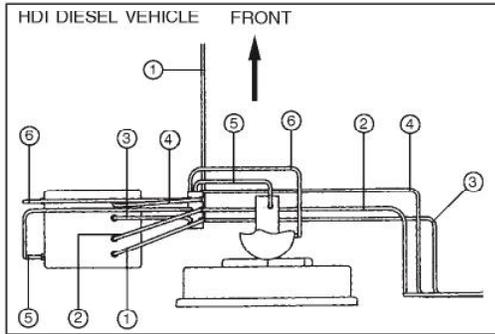


#### Petrol vehicle Disconnect

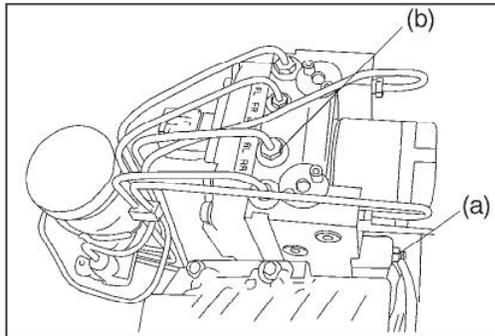
- 1 - N. 2
- 2 - N. 3
- 3 - N. 4
- 4 - N. 6
- 5 - N. 1
- 6 - N. 5

#### HDI diesel vehicle Disconnect

1. - N. 6
2. - N. 5
3. - N. 4
4. - N. 2
5. - N. 1
6. - N. 3



- Remove 3 bolts and washers that attach hydraulic unit to clamp and remove the unit.



### Installation

- Reverse the removal procedure to install the hydraulic unit and hoses and apply specified torque.

#### Tightening torque

**Clamp nuts (a): 15 N•m (1,2 Kg-m)**

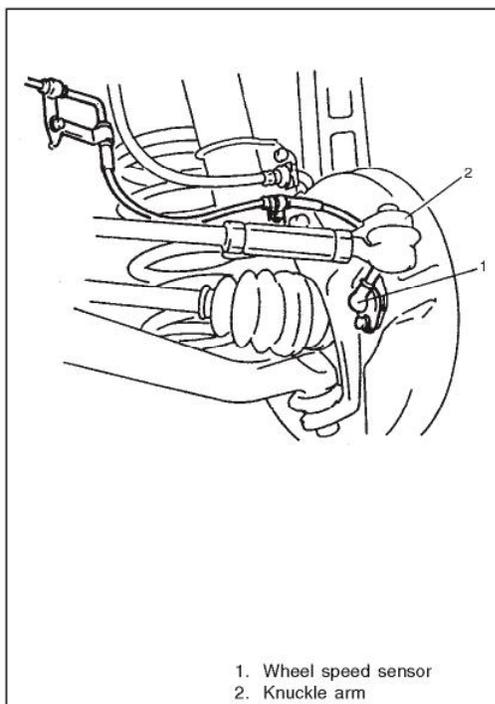
**Brake hose nuts:**

**Thin M10: 12 N•m (1,2 Kg-m)**

**(b)**

**Thick M12: 15 N•m (1,5 Kg-m)**

- Plug up the electric couplers
- Bleed brakes and check for fluid leakage.



### Wheel speed sensor

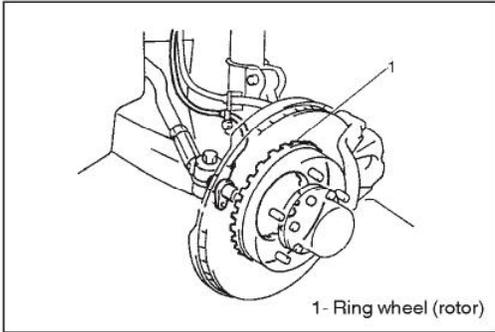
#### Removal

- Place vehicle on an adequate elevator, braked and properly secured.
- Remove wheel.
- Disconnect negative cable from battery.
- Unplug sensor wiring from sensor and release wiring from clamps.
- Remove sensors pulling and slightly rotate (right and left) at the same time. Do not pull cable.

#### CAUTION

**Do not pull cable when removing a sensor.**

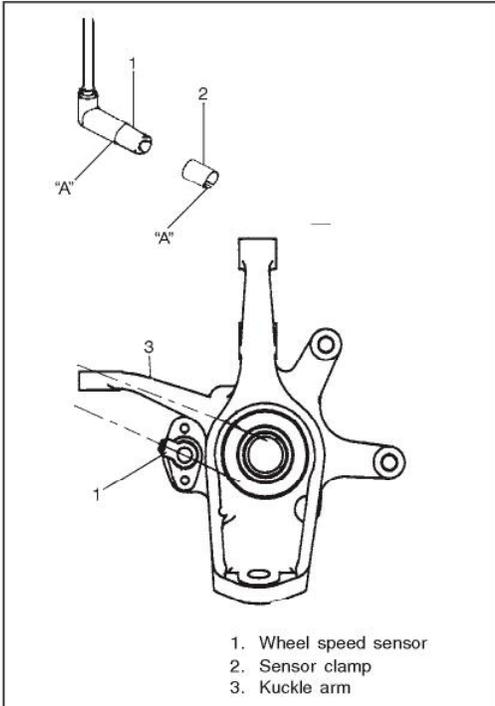
- Wheel speed sensor
- Knuckle arm



### Inspection

- Check outer voltage and resistance as indicated in this section.
- Check serration (teeth) condition of ring wheel for deformity, gaps or damages.
- Check that wheel ring is not deformed (distorted) and has not foreign materials attached.  
Repair or replace if any failure is detected.

### Installation



1. Clean sensor and snap ring if they have been removed.
2. Apply one drop of grease "A" to clamp surface and another one to sensor.
3. Place clamp in its housing with its stop ends facing the center of vehicle, install sensor pushing by hand until it contacts ring wheel and then guide it parallel to knuckle arm, as illustrated.

**"A": Sensor grease**  
**45133-86CA0**

**CAUTION:**  
Press sensor just by hand when installing.

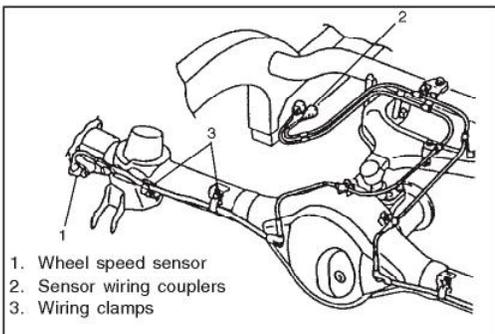
4. Connect the electric sensor coupler and attach wiring to its clamps.

### NOTE:

- Sensor will self-adjust when wheel starts rotation.
- Do not handle sensor with tough objects.
- Check output voltage to confirm a correct installation.

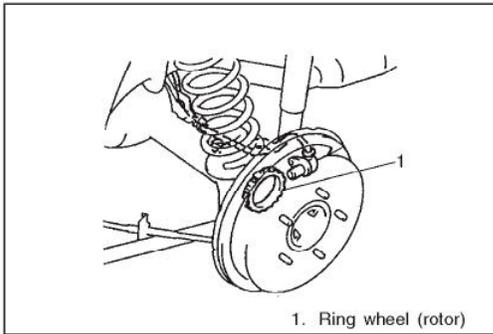
5. Carry on installation, reversing removal procedure.

### Rear wheel speed sensor



1. Place vehicle on an appropriate elevator, braked and secured.
2. Disconnect negative cable from battery.
3. Disconnect wiring coupler from sensor and release wiring from its clamps.
4. Pull out sensor gently turning it to right and left. Do not pull cable.

**PRECAUCION**  
Do not pull cable when removing sensor.



### Inspection

- Check outer voltage and esistance as indicated in this section.
- Check serration (teeth) condition for ring wheel for deformity, gaps or damages.
- Check that wheel ring is not deformed (distorted and has not foreign materials attached).

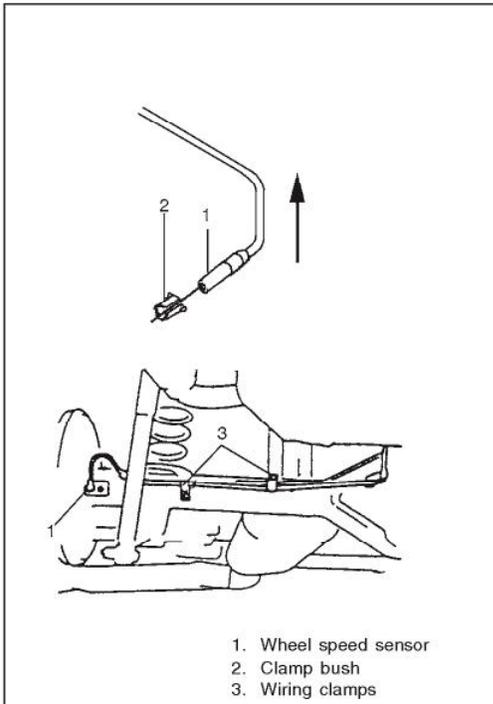
Repair or replace if any failure is detected.

### Installation

1. Wipe sensor and elastic clamp.
2. Apply a drop of grease "A" to clamp surface and another one to sensor.
3. Place clamp bush in its housing with its stop lashes facing to center of vehicle (inward). Install sensor by hand until it reaches the ring wheel and guide it perpendicular upward.

**"A": Sensor grease**  
45133-86CA0

**CAUTION:**  
Handle sensor just by hand when installing.

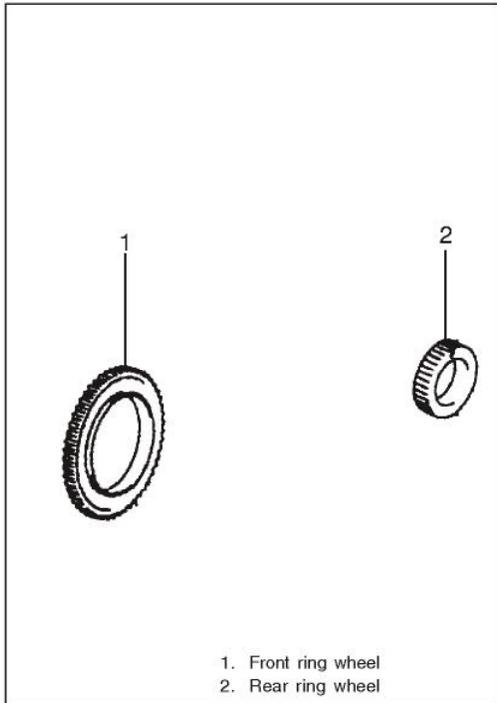


4. Connect the sensor electric coupler and fix wiring to its clamps.

### NOTE:

- Sensor will self-adjust when the wheel begins its rotation.
- Do not handle sensor with tough objects.
- Have an output voltage checking to confirm proper installation.

5. Continue the installation, reversing removal procedure.



## Ring wheel (rotor) of wheel speed sensor

### Removal and installation

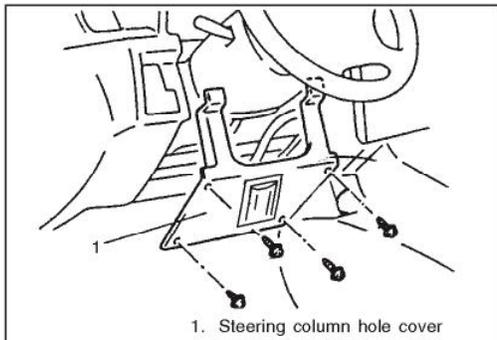
#### NOTE:

For rotor removal and installation, refer to section 3D (front ring wheel) and section 3E (rear ring wheel) in this manual.

### Inspection

- Check ring serration (teeth) for malformation, lack or damages.
- Check that there is not foreign materials attached.

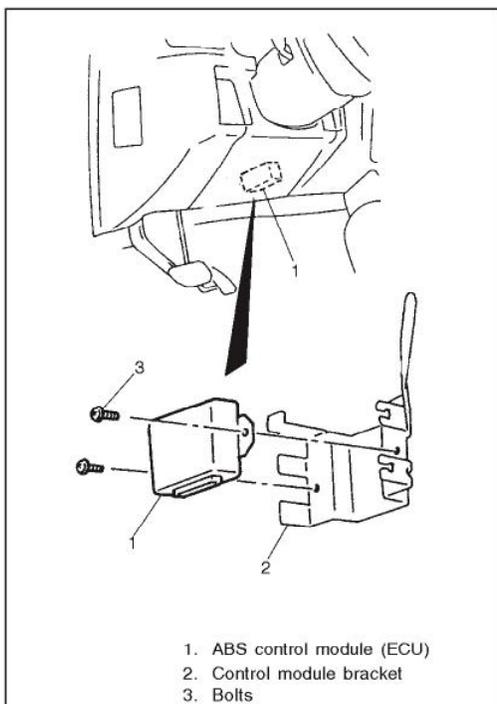
Repair or replace if some abnormality is detected.



## ABS control module

### Removal

1. Turn off the ignition.
2. Remove the hole cover from steering column.
3. Disconnect the electric coupler from ABS control module (ECU).
4. Remove bolts and take out ABS control module.



## Installation

For control module installation, reverse the removal procedure.

## BLEEDING BRAKE CIRCUIT (Manual Procedure)

1. Hoist vehicle, apply parking brake and secure the vehicle properly. Turn off the ignition and disconnect battery.

### NOTE:

Ignition and battery must be disconnected during bleeding process.

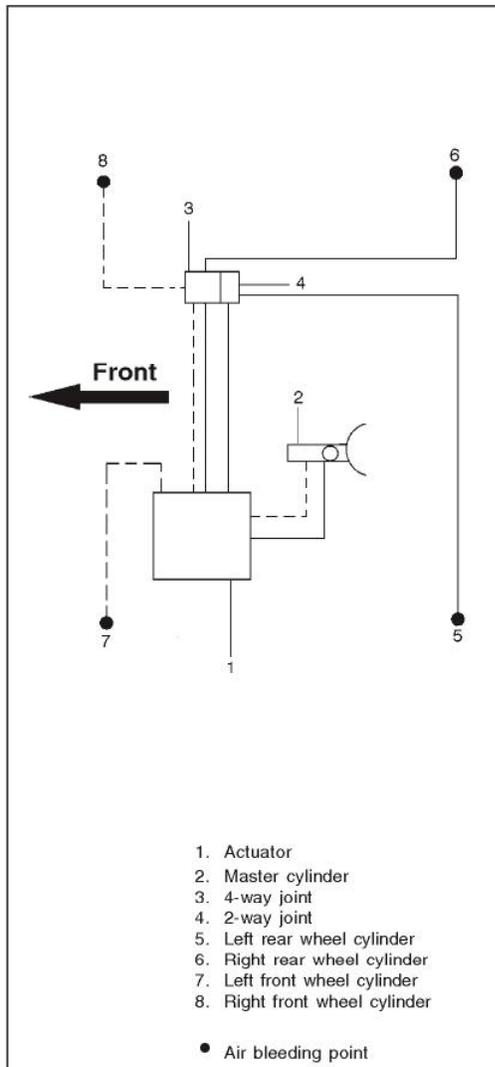
### CAUTION

Brake fluid is highly harmful for paint. If there is any accidental spillage on a painted surface, clean it properly the soonest.

2. Fill up the reservoir with new recommended and properly canned fluid. Maintain half reservoir during all purging process.

### NOTE:

Purge the master cylinder or ABS hydraulic unit prior to wheel cylinder bleeding, if master cylinder or hydraulic unit have been removed previously.



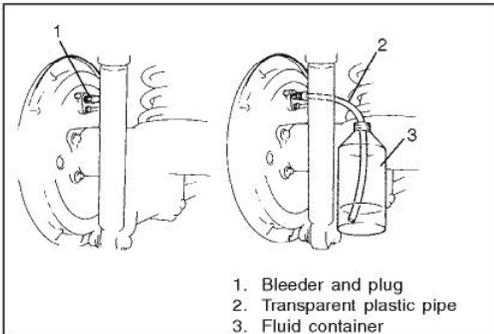
### Previous master cylinder and hydraulic unit bleeding

1. Pump 5 times with foot pedal 1/3 of its range, approximately and keep it pressed to the full during 5 seconds the longest.
2. Release brake pedal 5 to 10 seconds and air bubbles will ascend to reservoir.

Repeat steps 1 and 2 three more times until enough pedal resistance is felt.

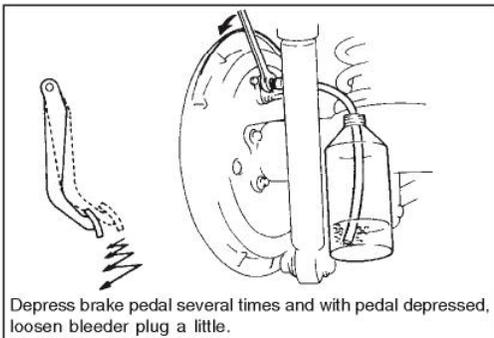
**NOTE:**

Do not allow brake fluid descend under minimum level during bleeding operation.

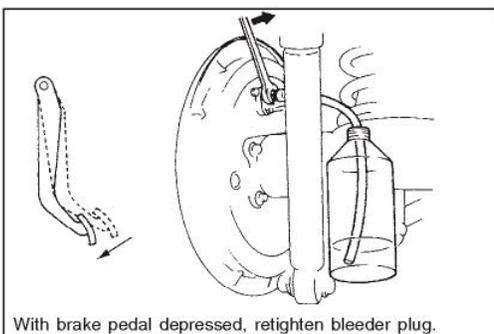


**Brake circuit bleeding**

1. Begin the bleeding by the furthest wheel cylinder from hydraulic unit, which is the one on the left rear side.
2. Depress brake pedal several times, maintain it depressed while slightly loosen the bleeder (1/3 torque) in order to discharge the cylinder.



3. Before the end of cylinder discharging process, re-tighten bleeder a little.
4. Repeat steps 2 and 3 until fluid flows free of bubbles through plastic pipe.  
Tight bleeder to specified torque and install the bleeder plug.



**Tightening torque**

**Wheel cylinder bleeder: 9-10 N•m (0,9-1,0 Kg-m)**

5. Repeat same procedure for the rest of three cylinders, follow procedure bellow:
  - (a) right rear
  - (b) right front
  - (c) left front
6. After purging, make sure of there is not fluid leakage and refill the reservoir using specified new fluid.

**CAUTION**

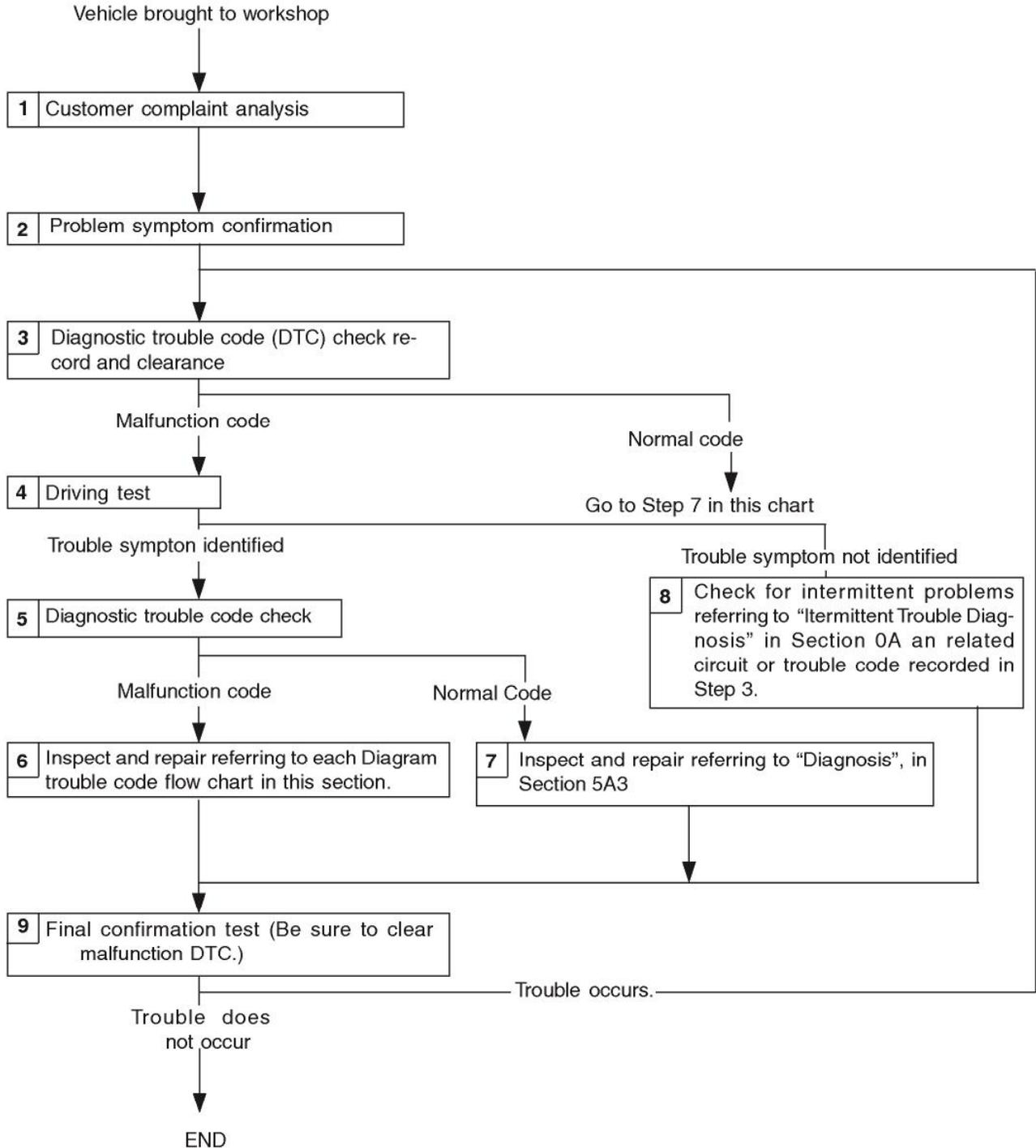
Do not re-use bleeding fluid. For re-filling use properly-canned new fluid.

## DIAGNOSIS

To ensure that the trouble diagnosis is done accurately, observe "Precautions in Diagnosing Troubles" and follow "ABS Diagnostic Flow Chart".

### ABS DIAGNOSTIC FLOW CHART

Refer to the following pages for the details of each 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 a questionnaire form as shown below will facilitate collecting information to the point required for proper analysis and diagnosis.

**CUSTOMER QUESTIONNAIRE (EXAMPLE)**

Customer's name:	Model:	VIN:	
Date of issue:	Date Reg :	Date of problem	Milleage:

Problem Symptoms	<ul style="list-style-type: none"> <li>• "ABS" warning light abnormal: fails to turn on/fails to go off/ flashes.</li> <li>• Abnormal noise while vehicle is running: from motor, from valve, other_____</li> <li>~ Wheel blocks when braking:</li> <li>• Pump motor does not stop (when marching).</li> <li>• Brakes does not work:</li> <li>• Other:</li> </ul>
Frequency of occurrence	<ul style="list-style-type: none"> <li>• Continuous/intermittent (            times a day, a month) / other_____</li> </ul>
Conditions for Occurrence of Problem	<ul style="list-style-type: none"> <li>• Vehicle at stop &amp; ignition switch ON:</li> <li>• When starting: at initial start only/ at every start _____</li> <li>• Vehicle speed: while accelerating/ while decelerating / at stop/ while turning/ while running at constant speed/ other_____</li> <li>• Road condition: paved road / rough road / snow-covered road / other_____</li> <li>• Chain equipment:</li> </ul>
Environmental Condition	<ul style="list-style-type: none"> <li>• Weather: fair / cloudy / rain / snow / other _____</li> <li>• Temperature:            °F (   °C)</li> </ul>
Diagnostic Trouble Code	<ul style="list-style-type: none"> <li>• First check: Normal code / Malfunction code (     )</li> <li>• Second check after driving test: Normal code/ malfunction code (     )</li> </ul>

**2. PROBLEM SYMPTOM CONFIRMATION**

Check if what the customer claimed in Step 1 is actually found in the vehicle and if that symptom is found, whether it is identified as a failure. (This step should be shared with the customer if possible.) When "ABS" warning light does not operate when ignition key is in position ON, check the circuit, referring to "ABS warning light circuit inspection".

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

Perform "Diagnostic Trouble Code Check" using "TECH 2" and then clear it.

If the malfunction DTC which was once displayed and then cleared does not appear when turning the ignition key to ON position, attempt to diagnose the trouble based on the DTC recorded in this step may mislead the diagnosis or make diagnosing difficult. Proceed to Step 4 to check ABS control module for proper self-diagnosis function.

If the malfunction DTC which was once displayed and then cleared can be detected again when ignition switch is turned ON, proceed to Step 5.

**4. DRIVING TEST**

Test drive the vehicle at 40 km/h for more than a minute and check if any trouble symptom (such as abnormal lighting of "ABS" warning lamp) exists.

If the malfunction DTC is confirmed again at ignition switch ON, driving test as described in above is not necessary. Proceed to Step 5.

**5. DIAGNOSTIC TROUBLE CODE CHECK**

Re-check diagnostic trouble code using the "TECH-2".

**6. DIAGNOSTIC TROUBLE CODE FLOW CHART**

According to Diagnostic flow chart for the diagnostic trouble code confirmed in Step 5, locate the cause of the trouble, namely in a sensor, switch, wire harness, connector, actuator, ABS control module or other part and repair or replace faulty parts.

**7. "DIAGNOSIS" in section 5A3**

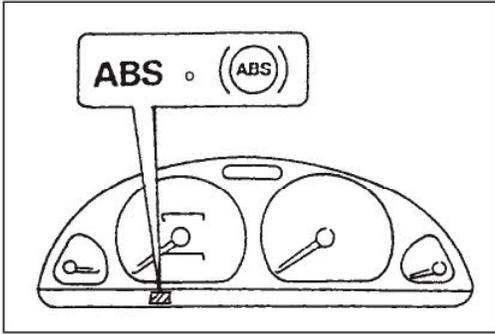
Check the parts or system suspected as a possible cause referring to "Diagnosis" in section 5A3 and based on symptoms spotted on the vehicle (symptoms obtained through Steps 1, 2 and 4) and repair or replace faulty parts, if any.

**8. CHECK FOR INTERMITTENT PROBLEM**

Check parts where an intermittent trouble is easy to occur (e.g., wire harness, connector, etc.). referring to INTERMITTENT TROUBLE in section 0A and related circuit of trouble code recorded in Step 3.

**9. FINAL CONFIRMATION TEST**

Confirm that the problem symptom has gone and the ABS is free from any abnormal conditions. If repair performed is related to the malfunction DTC, clear the DTC once and perform test driving and confirm that a normal code is indicated.



**“ABS”WARNING LAMP CHECK**

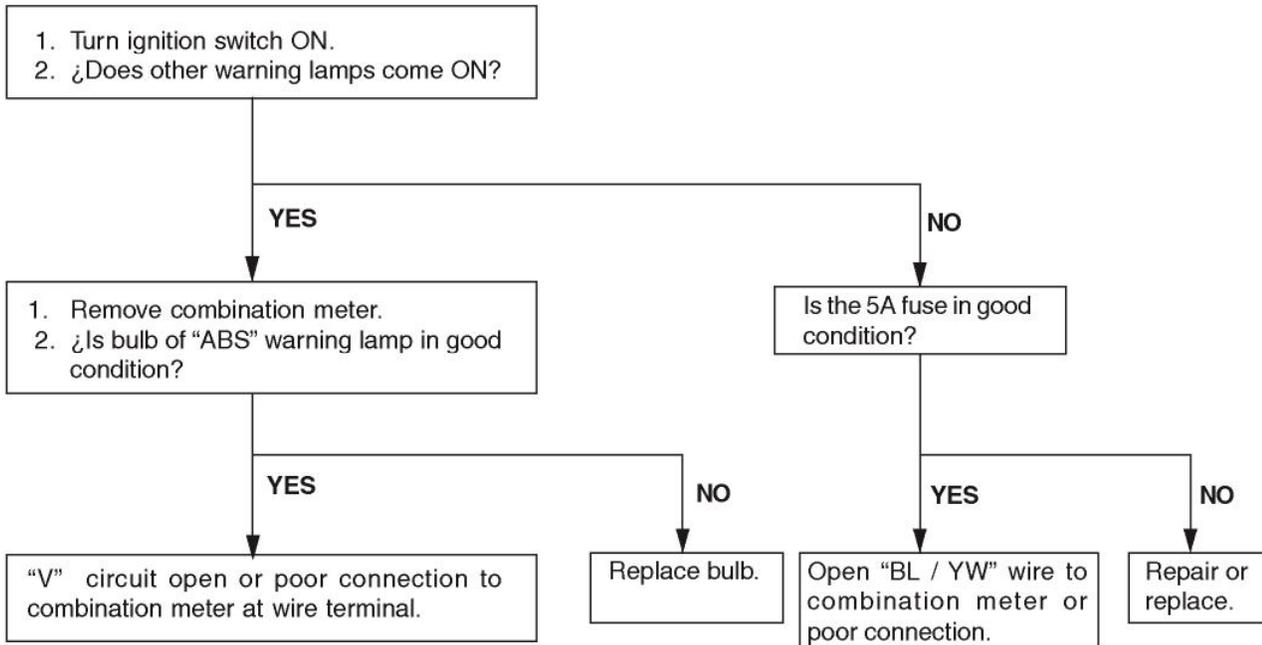
Turn ON the ignition switch and check that “ABS” warning lamp lights for about 3 seconds and then goes OFF.

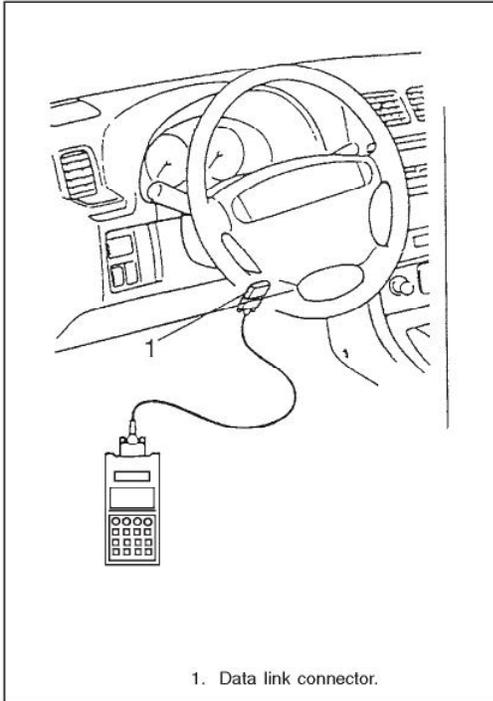
- If the lamp does not light after turning the ignition ON, check the circuit as shown below.
- If the light does not go off or blinks, perform a test using TECH 2.

**“ABS”WARNING LAMP CIRCUIT CHECK**

(Lamp does not come “ON” at ignition switch ON)

**Inspection**

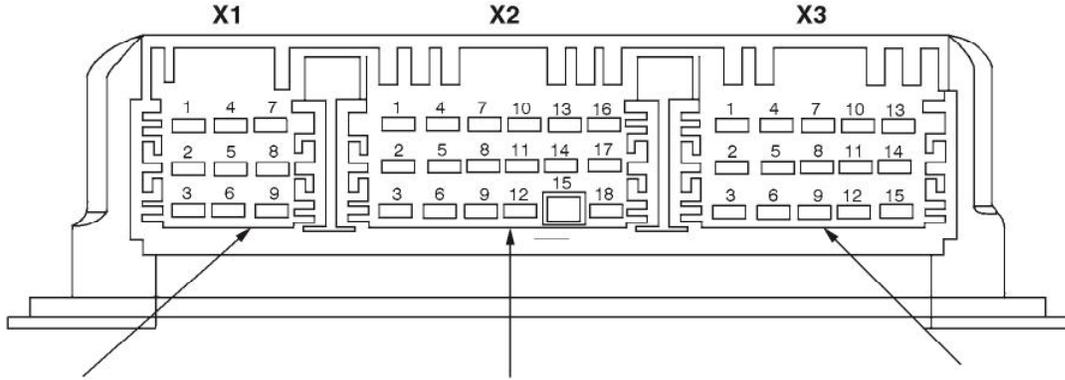




### DTC CHECK (USING SCANTOOL "TECH 2")

1. Connect TECH 2 to data link connector after setting cartridge for ABS to it.
2. Turn ignition switch ON.
3. Read DTC from TECH 2 and print it or write it down. For further details refer to TECH 2 operator's manual.
4. After completing the check, turn ignition switch off and disconnect SUZUKI scan tool from DLC.

**IDENTIFICATION OF CONTROL MODULE TERMINALS**



**9 Terminals connector**

**18 Terminals connector**

**15 terminals connector**

terminal	Circuit description
1	Left front sensor
2	Left front sensor
3	Right front sensor
4	Right front sensor
5	Right front sensor
6	Right front sensor
7	Left front sensor
8	Left front sensor
9	Not used

terminal	Circuit description
1	Battery +12
2	Ignition +12
3	Not used
4	Not used
5	Diagnostics K line
6	Not used
7	Not used
8	Engine monitor
9	Stop lamp switch
10	Not used
11	Not used
12	Ground
13	Not used
14	Not used
15	Link
16	Not used
17	Not used
18	ABS warning light switch

terminal	Circuit description
1	Left front outlet valve
2	Left front inlet valve
3	Ground
4	Right front outlet valve
5	Right front inlet valve
6	Shuttle valve switch
7	Left rear outlet valve
8	Left rear inlet valve
9	Not used
10	Right rear outlet valve
11	Right rear inlet valve
12	Not used
13	Not used
14	Not used
15	Pump relay

## DIAGNOSTIC CODE INTERPRETATION TABLE (USING SCAN TOOL “TECH 2”)

DTC	DIAGNOSTIC ITEM	COMPONENT	ECU PIN number	
00012	Pump motor, high level on pump motor monitor without pump motor actuation.	Pump motor monitor	X2 pin 8	
00013	Pump motor, low level on pump motor monitor during pump motor actuation.	Pump motor monitor.	X2 pin 8	
00014	Pump motor sticks.	Pump motor.	X3 pin 15-X2 pin 8	
00015	Pump motor relay sticks	Pump motor relay.	X3 pin 15	
00016	Shuttle valve switch, long supervision	Shuttle valve switch.	X3 pin 6	
00017	Valve supply voltage can't switched off.	Internal valve relay.	X2 pin 1	
00020	Valve supply voltage can't switched on.	Valve supply voltage (fuse)	X2 pin 1	
00021	Not used			
00022	Reference or ECU ground connection not correct	Ground connection.	X3 pin 3	
00023	Not used			
00024	Sensor voltage out of range	Right front.	X1 pin 4 & 5	
00025		Left rear.	X1 pin 7 & 8	
00026		Left front.	X1 pin 1 & 2	
00027		Right rear.	X1 pin 3 & 6	
00030	Power amplifier output with electrical connection interrupted	Inlet valve front right.	X3 pin 5	
00031		Outlet valve front right.	X3 pin 4	
00032		Inlet valve front left.	X3 pin 2	
00033		Outlet valve front left.	X3 pin 1	
00034		Inlet valve rear right.	X3 pin 11	
00035		Outlet valve rear right.	X3 pin 10	
00036		Inlet valve rear left.	X3 pin 8	
00037		Outlet valve rear left.	X3 pin 7	
00040		Pump motor relay.	X3 pin 15	
00041		Not used		
00042		Not used		
00043	Not used			
00044	Sensor airgap too large	Right hand front	X1 pin 4 & 5	
00045		Left hand rear	X1 pin 7 & 8	
00046		Left hand front	X1 pin 1 & 2	
00047		Right hand rear	X1 pin 3 & 6	
00050	Power amplifier output with short circuit to ground	Inlet valve front right.	X3 pin 5	
00051		Outlet valve front right.	X3 pin 4	
00052		Inlet valve front left.	X3 pin 2	
00053		Outlet valve front left.	X3 pin 1	
00054		Inlet valve rear right.	X3 pin 11	
00055		Outlet valve rear right.	X3 pin 10	
00056		Inlet valve rear left.	X3 pin 8	
00057		Outlet valve rear left.	X3 pin 7	
00060		Pump motor relay	X3 pin 15	
00061		Not used		
00062	Not used			
00063	Not used			
00064	Sensor DC-voltage out of range, broken wire, sensor impedance too low or too high.	Right hand front	X1 pin 4 & 5	
00065		Left hand rear	X1 pin / & 8	
00066		Left hand front	X 1 pin 1 & 2	
00067		Right hand rear	X 1 pin 3 & 6	

## 5B-28 ANTI-LOCK BRAKING SYSTEM (ABS) (WABCO)

DTC	Diagnostic item	COMPONENT	ECU PIN NUMBER
00070	Power amplifier with short circuit to power amplifier supply voltage	Inlet valve front right	x3 pin 5
00071		Outlet valve front right	x3 pin 4
00072		Inlet valve front left.	x3 pin 2
00073		Outlet valve front left.	x3 pin 1
00074		Inlet valve rear right.	x3 pin 11
00075		Outlet valve rear right.	x3 pin 10
00076		Inlet valve rear left.	x3 pin 8
00077		Outlet valve rear left.	x3 pin 7
00080		Pump motor relay.	x3 pin 15
00081		Not used	
00082	Not used		
00083	Not used		
00084	Intermittent sensor output during driving, possibly caused by broken wire	Right hand front	nx1 pin 4 & 5
00085		Left hand rear	x1 pin 7 & 8
00086		Left hand front	x1 pin 1 & 2
00087		Right hand rear	x1 pin 3 & 6
00090		Inlet valve front right	x3 pin 5
00091	Outlet valve front right	x3 pin 4	
00092	Power amplifier output with short circuit to battery	Inlet valve front left	x3 pin 2
00093		Outlet valve front left	x3 pin 1
00094		Inlet valve rear right	x3 pin 11
00095		Outlet valve rear right	x3 pin 10
00096		Inlet valve rear left	x3 pin 8
00097		Outlet valve rear left	x3 pin 7
00100		Pump motor relay	x3 pin 15
00101	Not used		
00102	Not used		
00103	Not used		
00104	No sensor output at all, possibly caused by extremely large airgap	Right hand front	x1 pin 4 & 5
00105		Left hand rear	x1 pin 7 & 8
00106		Left hand front	x1 pin 1 & 2
00107		Right hand rear	x 1 pin 3 & 6
00110	Not used		
00111	Not used		
00112	Not used		
00113	Not used		
00114	Electrical fault for the shuttle valve switch	Shuttle valve switch	x3 pin 6
00115	Not used		
00116	Not used		
00117	Not used		
00120	Not used		
00121	Not used		
00122	Not used		
00123	Not used		
00124	Not used		
00125	Not used		
00126	Not used		
00127	Not used		

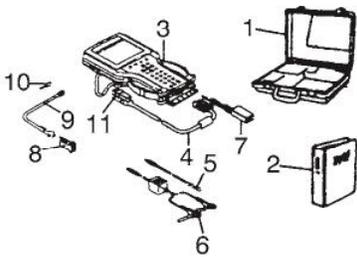
## TIGHTENING TORQUE SPECIFICATIONS

Fastening parts	Tightening torque	
	N•m	Kg-m
Hydraulic unit nut	15	1,5
Brake pipe nut	Thin M10 Thick M12	12 15
Wheel cylinder bleeder	9	0,9

## REQUIRED SERVICE MATERIALS

MATERIALS	RECOMMENDED SUZUKI PRODUCT	USE
Brake fluid	Indicated on reservoir cap DOT-3	To fill master cylinder reservoir. To clean and apply to master cylinder inner parts and to wheel cylinders.
Grease	Provided with repair kit	Wheel speed sensor bush ABS wheel speed sensor

## SPECIAL TOOLS

	<ol style="list-style-type: none"> <li>1. Storage case</li> <li>2. Operator's manual</li> <li>3. Tech 2</li> <li>4. DLC cable</li> <li>5. Power source cable (lighter)</li> <li>6. Power source cable (battery)</li> <li>7. Power source</li> <li>8. Adaptor RS232 DB</li> <li>9. Cable RS232</li> <li>10. Test connector RS232</li> <li>11. Test connector DLC</li> </ol>	 <p>SUZUKI ABS (WABCO) cartridge</p>
<p>Suzuki Scan tools set (Tech 2)</p>		



## SECTION 6

# ENGINE GENERAL INFORMATION AND DIAGNOSIS (HDI ENGINE)

6

**WARNING:**

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

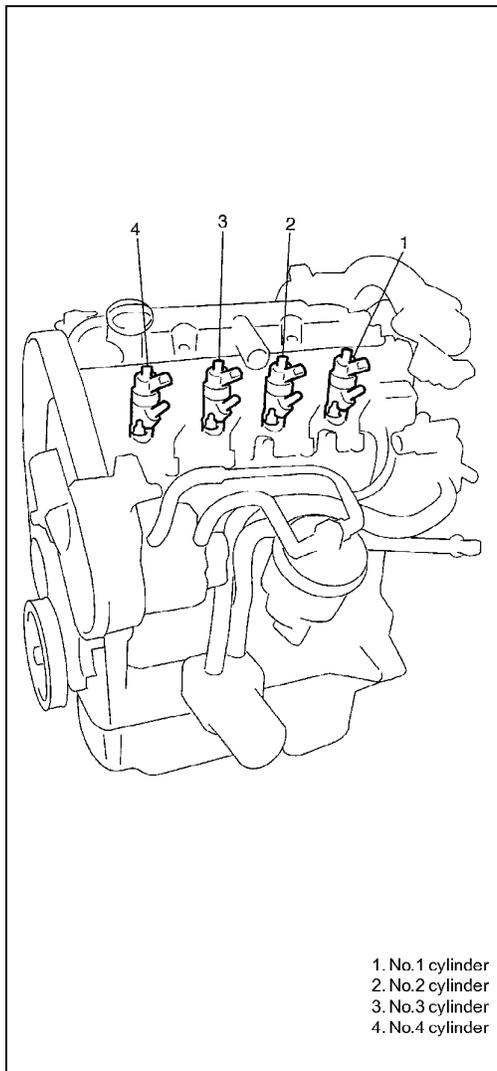
- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near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

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## GENERAL INFORMATION

### STATEMENT OF CLEANLINESS AND CARE

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

- A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surface on initial operation.
- Whenever valve train components, pistons, piston rings, connecting rods, rod bearings and crankshaft journal bearings are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.
- Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.
- Throughout this manual, the four cylinders of the engine are identified by numbers: No. 1, No. 2, No. 3, and No. 4 as counted from flywheel side to crankshaft pulley side.

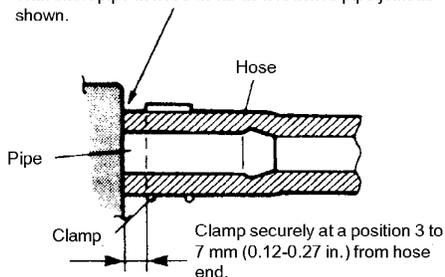
### GENERAL INFORMATION ON ENGINE SERVICE

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

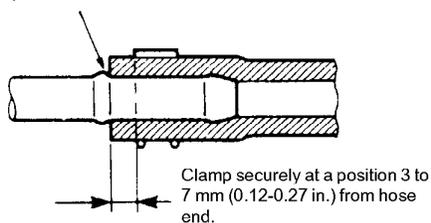
- When raising or supporting engine for any reason, do not use a jack under oil pan. Due to small clearance between oil pan and oil pump strainer, jacking against oil pan may cause it to be bent against strainer resulting in damaged oil pick-up unit.
- It should be kept in mind, while working on engine,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

## PRECAUTION ON FUEL SYSTEM SERVICE

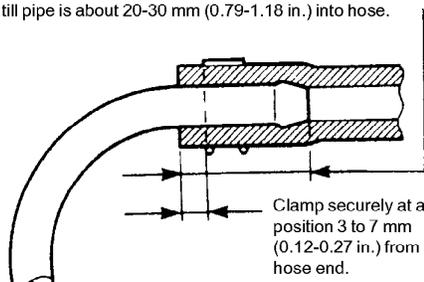
With short pipe fit hose as far as it reaches pipe joint as shown.



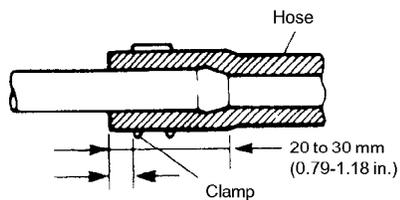
With following type pipe, fit hose as far as its peripheral projection as shown.



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



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

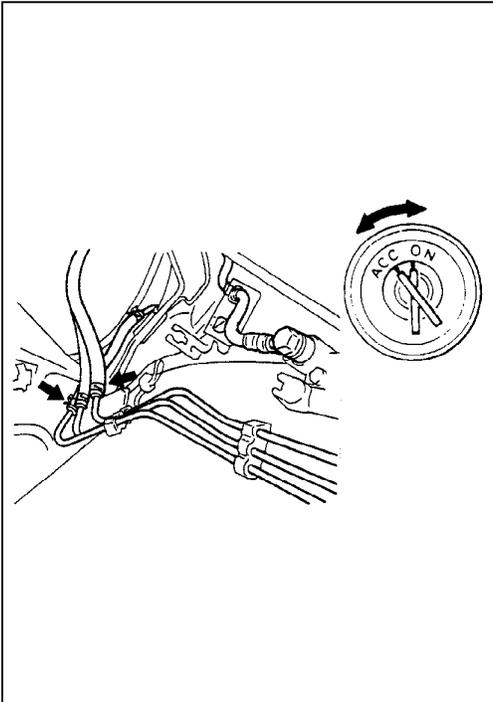


Clamp securely at a position 3 to 7 mm (0.12-0.27 in.) from hose end.

- Work must be done with no smoking, in a well-ventilated area and away from any open flames.
- A small amount of fuel may be released after fuel line is disconnected. In order to reduce the chance of personal injury, cover fitting to be disconnected with a shop cloth. Put that cloth in an approved container when disconnection is completed.
- Never run engine with double relay disconnected when engine and exhaust system are hot.
- Fuel or fuel vapor hose connection varies with each type of pipe. When reconnecting fuel or fuel vapor hose, be sure to connect and clamp each hose correctly referring to figure "Hose Connection".
- When installing fuel filter union bolt or plug bolt on union bolt, always use new gasket and tighten it to specified torque. See section 6C for specified torque.
- When installing injector, fuel feed pipe or fuel pressure regulator, lubricate its O-ring with spindle oil or fuel.
- When connecting fuel pipe flare nut, first tighten flare nut by hand and then tighten it to specified torque, using back-up wrench.

## FUEL PRESSURE RELIEF PROCEDURE

Refer to "Fuel Delivery System Precaution" in Section 6E3.



## FUEL LEAKAGE CHECK PROCEDURE

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

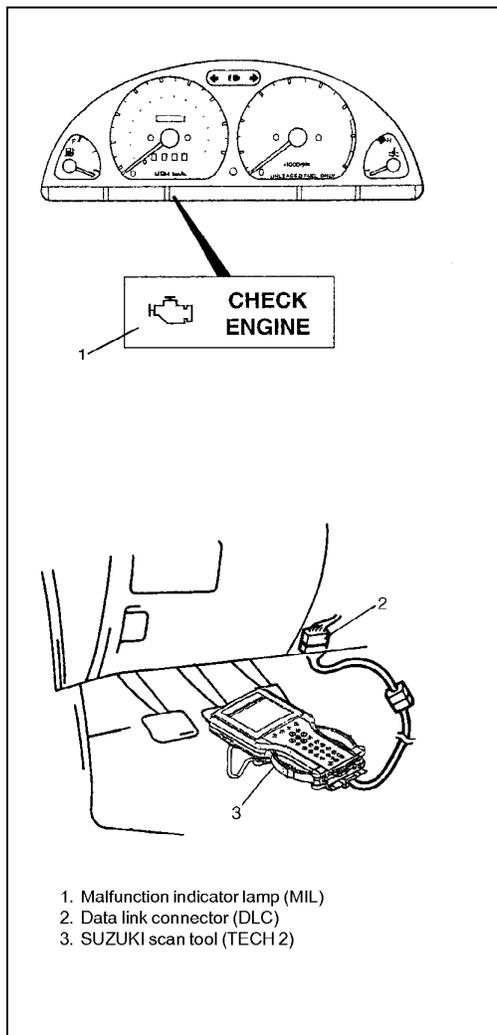
- 1) Turn ON ignition switch for 5 seconds (to operate fuel pump on Type 1 vehicles or high pressure injection pump on Type 2 vehicles) and then turn it OFF. Repeat this (ON and OFF) 3 or 4 times and apply fuel pressure to fuel line (till fuel pressure is felt by hand placed on fuel return hose).
- 2) In this state, check to see that there are no fuel leakages from any part of low pressure fuel system between fuel tank and injection pump.
- 3) Check that there are no fuel leakages from any part of high pressure fuel system between injection pump and fuel injector by performing the procedure below.
  - (1) Start engine and warm up to normal operating temperature.
  - (2) Check fuel leakage after turning off ignition switch.
  - (3) Again, start engine and accelerate the vehicle up to 3,500 rmp with 1<sup>st</sup> gear. Then stop vehicle.
  - (4) Check fuel leakage after turning off ignition switch.

## ENGINE DIAGNOSIS

### GENERAL DESCRIPTION

This vehicle is equipped with an engine and emission control system which are under control of ECM (PCM). The engine and emission control system in this vehicle are controlled by ECM (PCM). ECM (PCM) has an On-Board Diagnostic system which detects a malfunction in the system and abnormality of those parts that influence the engine exhaust emission. When diagnosing engine troubles, be sure to have full understanding of the outline of "On-Board Diagnostic System" and each item in "Precaution in Diagnosing Trouble" and execute diagnosis according to "ENGINE DIAGNOSTIC FLOW TABLE".

There is a close relationship between the engine mechanical, engine cooling system, exhaust system, etc. and the engine and emission control system in their structure and operation. In case of an engine trouble, even when the malfunction indicator lamp (MIL) doesn't turn ON, it should be diagnosed according to this flow table.



### ON-BOARD DIAGNOSTIC SYSTEM

ECM (PCM) in this vehicle has the following functions.

- When the ignition switch is turned ON with the engine at a stop, MIL turns ON to check the bulb of the malfunction indicator lamp (MIL)
- When ECM (PCM) detects a malfunction which gives an adverse effect to vehicle emission while the engine is running, it makes the malfunction indicator lamp in the meter cluster of the instrument panel turn ON and stores the malfunction area in its memory.
- As a condition for detecting a malfunction in some areas in the system being monitored by ECM (PCM) and turning ON the malfunction indicator lamp due to that malfunction, 2 driving cycles detection logic is adopted to prevent erroneous detection.
- When a malfunction is detected, engine and driving conditions then are stored in ECM (PCM) 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 (Tech-2) but also generic scan tool. (Diagnostic information can be accessed by using a scan tool.)

#### NOTE:

**When performing checking or clearing a pending DTC, operator must deactivate (unlock) the immobilizer function in advance. Checking isn't permitted when immobilizer is active (engine is locked).**

**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 two parts, engine startup and engine shutoff.

**2 Driving Cycle Detection Logic**

The malfunction detected in the first driving cycle is stored in ECM (PCM) 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 Diagnostic Trouble Code (DTC)**

**NOTE:**

**Pending diagnostic trouble code can be read using generic scan tool or Euro mode of Suzuki scan tool.**

**When performing checking or clearing a pending DTC, operator must deactivate (unlock) the immobilizer function in advance. Checking isn’t permitted when immobilizer is active (engine is locked).**

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**

**NOTE:**

**Freeze frame data can be read using generic scan tool or Euro mode of Suzuki scan tool.**

**When performing checking or clearing a pending DTC, operator must deactivate (unlock) the immobilizer function in advance. Checking isn’t permitted when immobilizer is active (engine is locked).**

ECM (PCM) stores the engine and driving conditions (in the form of data as shown beside) 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) when a malfunction was detected by checking the freeze frame data.

**Priority of freeze frame data (only Type 1 vehicles):**

As ECM can store freeze frame data for one malfunction only, the freeze frame data shown as 1 above has a priority for storage. (If malfunction as described in the upper square “1” above 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
1	Freeze frame data at initial detection of diagnostic trouble codes below. P0100, P0120, P0170, P0190, P0200, P0220, P0230, P0560, P0903
2	Freeze frame data when a diagnostic trouble code other than those in “1” above is detected.

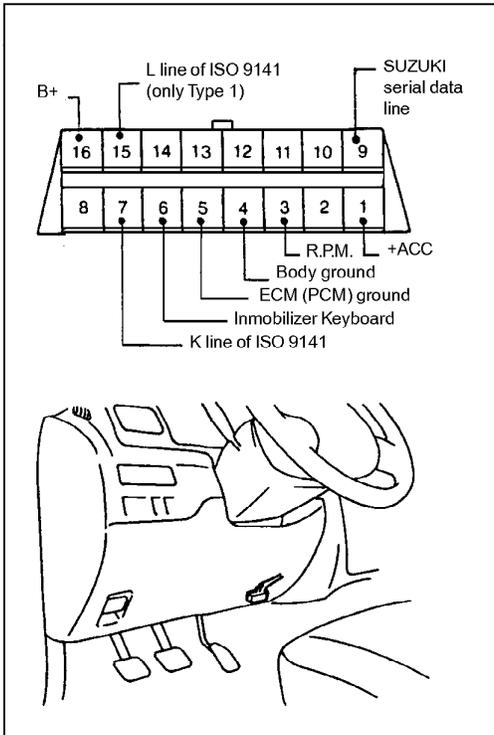
An example of Freeze Frame Data

- 1. Trouble Code P0102
- 2. Engine Speed 782 RPM
- 3. Eng Cool Tmp 80 °C
- 4. Vehicle Spd. 0 km/h
- 5. MAP Sensor 39kPa
- 6. St. Term FT1 -0.8% Lean
- 7. Lg. Term FT1 -1.6% Lean
- 8. Fuel 1 Stat. Closed Loop
- 9. Fuel 2 Stat. Not used
- 10. Load valve 25.5%

**Freeze frame data clearance:****NOTE:**

**When performing checking or clearing a pending DTC, operator must deactivate (unlock) the immobilizer function in advance. Checking isn't permitted when immobilizer is active (engine is locked).**

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

**Data Link Connector (DLC)**

DLC in compliance with SAE J1962 in its installation position, the shape of connector and pin assignment.

K and L lines of ISO 9141 (L line only in Type 1 vehicles) is used for SUZUKI scan tool (Tech-2) or generic scan tool to communication with ECM (PCM).

SUZUKI serial data line is used for SUZUKI scan tool (Tech-2) to communicate with an electronic control unit (Airbag SDM, etc.).

## PRECAUTION IN DIAGNOSING TROUBLE

- Don't disconnect couplers from ECM (PCM), battery cable from battery, ECM (PCM) ground wire harness from engine or main fuse before confirming diagnostic information (DTC, freeze frame data, etc.) stored in ECM (PCM) memory.
- Diagnostic information stored in ECM (PCM) memory can be cleared as well as checked by using SUZUKI scan tool (Tech-2) or 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.
- When performing checking or clearing a pending DTC, operator must deactivate (unlock) the immobilizer function in advance. Checking isn't permitted when immobilizer is active (engine is locked). On Type 2 vehicles, Tech 2 displays "Test operating..." and doesn't end if engine is locked (immobilizer active). Deactivating the immobilizer system would dissolve the problem.
- Priorities for diagnosing troubles (Only for Type 1 vehicles):  
If troubleshooting priorities for multiple diagnostic code are given in the applicable diagnostic chart, these should be followed.  
If no instructions are given, troubleshoot diagnostic trouble codes according to the following priorities.
  - 1) Fuel pressure (P1112 for Suzuki mode of Suzuki scan tool/P0230 for generic scan tool)
  - 2) Diagnostic trouble codes other than listed below

DTC indicated by generic scan tool or Euro mode of Suzuki scan tool	DTC indicated by Suzuki mode of Suzuki scan tool
P0100, P0120, P0170, P0190, P0200, P0220, P0230, P0560, P0903	P0100, P0101, P0121, P0604, P1169, P1170, P0190, P0201, P0202, P0203, P0204, P0221, P1112, P1138, P0560, P0561, P0401, P0402.

- 3) Diagnostic trouble codes described in above list
- Be sure to read "Precautions for Electrical Circuit Service" before inspection and observe what is written there.
  - ECM (PCM) replacement or substitution  
When substituting a known-good ECM, check for following conditions. Neglecting this check may cause damage to known-good ECM.
    - Resistance value of all relays, actuators is as specified respectively.
    - MAF sensor is in good condition and none of power circuit of its sensor is shorted to ground.

**ENGINE DIAGNOSTIC FLOW TABLE**

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

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

### 1. CUSTOMER COMPLAINT ANALYSIS

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

### 2. DIAGNOSTIC TROUBLE CODE (DTC)/FREEZE FRAME DATA CHECK, RECORD AND CLEARANCE

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

#### NOTE (ONLY FOR TYPE 1 VEHICLE DIAGNOSIS):

- If DTC P1112 (for Suzuki mode of Suzuki scan tool) or P0230 (for generic scan tool or Euro mode Suzuki scan tool) is indicated in this step, proceed to Diag. flow table for DTC P1112/P0230 first.
- Ignore DTC P1517 though it may be indicated on Suzuki scan tool. It does not affect engine and emission control system and immobilizer control system.

### 3 and 4. VISUAL INSPECTION

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

### 5. TROUBLE SYMPTOM CONFIRMATION

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

### 6 and 7. DTC/FREEZE FRAME DATA RECHECK, RECORD AND CLEARANCE

Refer to “DTC CHECK” section for checking procedure.

### 8. ENGINE BASIC CHECK AND ENGINE DIAGNOSIS TABLE

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

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

Based on the DTC indicated in Steps 6 or 7 and referring to the applicable DTC diag. flow table in this section, locate the cause of the trouble, namely in a sensor, switch, wire harness, connector, actuator, ECM (PCM) or other part and repair or replace faulty parts.

### 10. CHECK FOR INTERMITTENT PROBLEM

Check parts where intermittent trouble is easy to occur (e.g. wire harness, connector, etc.), and related circuit of DTC recorded in Step 2.

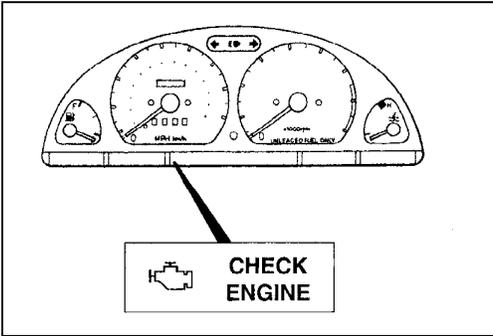
### 11. FINAL CONFIRMATION TEST

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

**CUSTOMER PROBLEM INSPECTION FORM (EXAMPLE)**

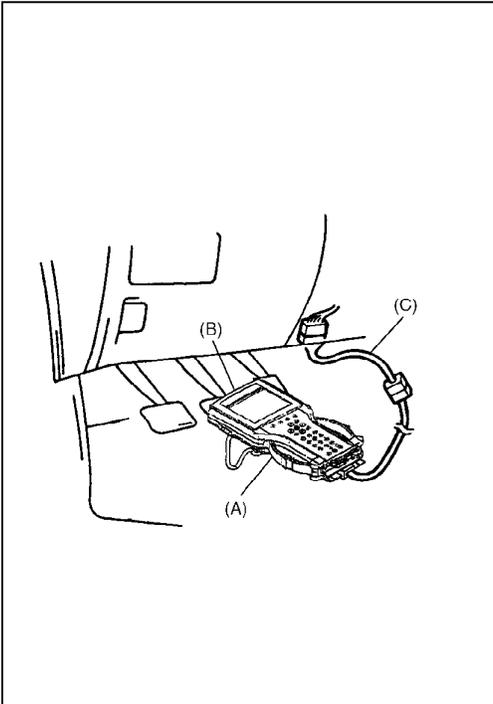
User name:	Model:	VIN:	
Date of issue:	Date reg.:	Date of problem:	Mileage:
<b>PROBLEM SYMPTOMS</b>			
<input type="checkbox"/> <b>Difficult Starting</b>		<input type="checkbox"/> <b>Poor Driveability</b>	
<input type="checkbox"/> No cranking <input type="checkbox"/> No initial combustion <input type="checkbox"/> Poor starting at ( <input type="checkbox"/> Cold/ <input type="checkbox"/> Warm/ <input type="checkbox"/> Always) <input type="checkbox"/> Other _____		<input type="checkbox"/> Hesitation on acceleration <input type="checkbox"/> Back fire/After fire <input type="checkbox"/> Loss of power <input type="checkbox"/> Surging <input type="checkbox"/> Abnormal knocking <input type="checkbox"/> Other _____	
<input type="checkbox"/> <b>Poor Idling</b>		<input type="checkbox"/> <b>Engine Stall when</b>	
<input type="checkbox"/> Poor fast idle <input type="checkbox"/> Abnormal idling speed ( <input type="checkbox"/> High/ <input type="checkbox"/> Low)(      r/min.) <input type="checkbox"/> Unstable <input type="checkbox"/> Hunting (      r/min. to      r/min.) <input type="checkbox"/> Other _____		<input type="checkbox"/> Immediately after start <input type="checkbox"/> Accel. pedal is depressed <input type="checkbox"/> Accel. pedal is released <input type="checkbox"/> Load is applied <input type="checkbox"/> A/C <input type="checkbox"/> Electrical load <input type="checkbox"/> P/S <input type="checkbox"/> Other _____	
<input type="checkbox"/> OTHERS:			
<b>VEHICLE/ENVIROMENTAL CONDITION WHEN PROBLEM OCCURS</b>			
<b>Enviromental condition</b>			
Weather	<input type="checkbox"/> Fair <input type="checkbox"/> Cluody <input type="checkbox"/> Rain <input type="checkbox"/> Snow <input type="checkbox"/> Always <input type="checkbox"/> Others _____ ( °F/ °C)		
Temperature	<input type="checkbox"/> Hot <input type="checkbox"/> Warm <input type="checkbox"/> Cool <input type="checkbox"/> Could <input type="checkbox"/> Always		
Frequency	<input type="checkbox"/> Always <input type="checkbox"/> Sometimes (    times/    day, month) <input type="checkbox"/> Only once <input type="checkbox"/> Under certain condition		
Road	<input type="checkbox"/> Urban <input type="checkbox"/> Suburb <input type="checkbox"/> Highways <input type="checkbox"/> Mountainous( <input type="checkbox"/> Uphill <input type="checkbox"/> Downhill) <input type="checkbox"/> Paved road <input type="checkbox"/> Gravel <input type="checkbox"/> Other _____		
<b>Vehicle Condition</b>			
Engine condition	<input type="checkbox"/> Cold <input type="checkbox"/> Warming up phase <input type="checkbox"/> Warmed up <input type="checkbox"/> Always <input type="checkbox"/> Other at starting <input type="checkbox"/> Immediately after start/ <input type="checkbox"/> Racing without load <input type="checkbox"/> Engine speed (      r/min)		
Vehicle condition	<input type="checkbox"/> During driving : <input type="checkbox"/> Constant speed(      km/h) <input type="checkbox"/> Accelerating <input type="checkbox"/> Decelerating <input type="checkbox"/> Right hand corner <input type="checkbox"/> Left hand corner <input type="checkbox"/> When shifting (Lever position      ) <input type="checkbox"/> At stop <input type="checkbox"/> Other(      )		
Malfunction indicator lamp condition	<input type="checkbox"/> Always ON <input type="checkbox"/> Sometimes ON <input type="checkbox"/> Always OFF <input type="checkbox"/> Good condition <input type="checkbox"/> Flashing		
Diagnostic trouble code	First check:	<input type="checkbox"/> No code	<input type="checkbox"/> Malfunction code (      )
	Second check:	<input type="checkbox"/> No code	<input type="checkbox"/> Malfunction code (      )

**NOTE:**  
 The above table is standard sample. It should be modified according to conditions characteristic of each market.



### MALFUNCTION INDICATOR LAMP (MIL) CHECK

- 1) Turn ON ignition switch (but the engine at stop) and check that MIL lights. If MIL does not light up or dims, go to "Diagnostic Flow Table A-1"
- 2) Start engine and check that MIL turns OFF. If MIL remains ON, and no DTC is stored in ECM (PCM), go to "Diagnostic Flow Table A-2" for troubleshooting.



### DIAGNOSTIC TROUBLE CODE (DTC) CHECK

- 1) Prepare generic scan tool or SUZUKI scan tool (Tech-2).
- 2) Connect it to data link connector (DLC) located on underside of instrument panel at driver's seat side.

#### Special Tool

- (A): SUZUKI scan tool
- (B): SUZUKI PCMCIA (10 MB) card.
- (C): 16/14 pin DLC cable (OBD-II adapter cable)

- 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 operator's manual for further details. If communication between scan tool and ECM (PCM) is not possible, check if scan tool is communicable by connecting it to ECM (PCM) in another car. 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 car with which communication was not possible.

#### NOTE:

When performing checking or clearing a pending DTC, operator must deactivate (unlock) the immobilizer function in advance. Checking isn't permitted when immobilizer is active (engine is locked). On type 2 vehicles, Tech 2 displays "Test operating..." and doesn't end if engine is locked (immobilizer active). Deactivating the immobilizer system would dissolve the problem.

- 5) After completing the check, turn ignition switch off and disconnect scan tool from data link connector.

### DIAGNOSTIC TROUBLE CODE (DTC) CLEARANCE

- 1) Connect generic scan tool or SUZUKI scan tool (Tech-2) 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.

**NOTE:**

- When DTC clear command is executed using Suzuki mode of Suzuki scan tool with engine run, DTC can not be cleared from ECM memory.
  - When performing checking or clearing a pending DTC, operator must deactivate (unlock) the immobilizer function in advance. Checking isn't permitted when immobilizer is active (engine is locked).
- 4) After completing the clearance, turn ignition switch OFF and disconnect scan tool from data link connector.

**DIAGNOSTIC TROUBLE CODE (DTC) TABLE FOR TYPE 1 VEHICLES**

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting)	DTC DRIVING CYCLE	MIL
P0100 (P0100)	Mass air flow sensor circuit malfunction	Sensor output low or high voltage	1 driving cycle	1 driving cycle
P0101 (P0100)	Mass air flow sensor circuit range / performance problem	Air flow is lower or higher than specification under specified engine RPM	1 driving cycle	1 driving cycle
P0115 (P0115)	Engine coolant temp. sensor circuit malfunction	Engine coolant temp sensor circuit low or high input	1 driving cycle (2 driving cycles)	-
P0121 (P0120)	Throttle position sensor circuit range/performance	Throttle position sensor circuit low or high input, or Poor performance of throttle position sensor	1 driving cycle	1 driving cycle
P0221 (P0220)	Throttle position sensor circuit range/performance problem 2			
P0180	Fuel temp. sensor circuit malfunction	Fuel temp. circuit low or high input	1 driving cycle	-
P0190 (P0190)	Fuel rail press sensor circuit malfunction	Fuel rail pressure sensor circuit low or high input	1 driving cycle	1 driving cycle
P0191 (P0230)	Fuel rail press sensor/press regulator consistency function (fuel pump primary circuit malfunction)	Poor performance of fuel rail pressure sensor	1 driving cycle	1 driving cycle
☆ P0201 (P0200)	Injector circuit malfunction cyl-1	Monitor signal of fuel injection #1 is different from command signal (circuit open or short), or Poor performance of Fuel Injector #1	1 driving cycle	1 driving cycle
☆ P0202 (P0200)	Injector circuit malfunction cyl-2	Monitor signal of fuel injection #2 is different from command signal (circuit open or short), or Poor performance of Fuel Injector #2	1 driving cycle	1 driving cycle
☆ P0203 (P0200)	Injector circuit malfunction cyl-3	Monitor signal of fuel injection #3 is different from command signal (circuit open or short), or Poor performance of Fuel Injector #3	1 driving cycle	1 driving cycle
☆ P0204 (P0200)	Injector circuit malfunction cyl-4	Monitor signal of fuel injection #4 is different from command signal (circuit open or short), or Poor performance of Fuel Injector #4	1 driving cycle	1 driving cycle
P0215	Double relay circuit malfunction	Poor performance of double relay	1 driving cycle	-
P0230	Fuel pump supply circuit malfunction	Fuel pump supply circuit low or high input, or Poor performance of fuel pump.	1 driving cycle	-
☆ P0335 (P0335)	Crankshaft position sensor Circuit Malfunction	Monitor signal of crankshaft position sensor is lower or higher than specification	1 driving cycle (2 driving cycles)	-
☆ P0340 (P0335/ P0340)	Camshaft position sensor Circuit Malfunction (Crankshaft position sensor Circuit Malfunction/Camshaft position sensor Circuit Malfunction)	Supply voltage low or high input, or Poor performance of camshaft or crankshaft position sensor	1 driving cycle (2 driving cycles)	-
P0380 (P0380)	Pre/post heat relay circuit malfunction	Both pre/post heating relay and diagnostic signals are high or low level	1 driving cycle (2 driving cycles)	-
P0381	Glow indicator lamp circuit malfunction	Monitor signal of glow indicator lamp circuit is different from command signal (circuit open or short)	1 driving cycle	-

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	DTC DRIVING CYCLE	MIL
P0403 (P0403)	EGR solenoid valve circuit malfunction	Monitor signal of EGR solenoid valve is different from command signal (circuit open or short)	1 driving cycle (2 driving cycles)	-
P0401 (P0903)	EGR solenoid valve flow insufficient detected	Insufficient EGR flow	1 driving cycle	1 driving cycle
P0402 (P0903)	EGR solenoid valve flow excessive detected	Excessive EGR flow	1 driving cycle (2 driving cycles)	-
P0500 (P0500)	VSS circuit malfunction	Vehicle speed is lower or higher than specification under certain condition	1 driving cycle (2 driving cycles)	-
P0560 (P0560)	Power supply circuit malfunction	Power supply low or high input	1 driving cycle (2 driving cycles)	-
P0561 (P0560)	Stabilization of sensor supply	Poor performance of ECM	1 driving cycle	1 driving cycle
P0603	ECU function (EEPROM error)	Poor performance of ECM	1 driving cycle	-
P0604 (P0120)	Throttle position sensor monitoring system malfunction	Poor performance of throttle position sensor	1 driving cycle	1 driving cycle
☆ P0606	ECU function (internal fault)	Poor performance of ECM	1 driving cycle	-
☆ P1613			1 driving cycle	1 driving cycle
P1101 (P0105)	Barometric press sensor circuit malfunction	Poor performance of ECM	1 driving cycle (2 driving cycles)	-
P1108	Radiator fan high speed circuit malfunction	Monitor signal of radiator relay (high) circuit is different from command signal (circuit open or short)	1 driving cycle	-
P1109	Radiator fan low speed circuit malfunction	Monitor signal of radiator relay (low) circuit is different from command signal (circuit open or short)	1 driving cycle	-
P1110	A/C cut signal circuit malfunction	Monitor signal of A/C cut signal circuit is different from command signal (circuit open or short)	1 driving cycle	-
☆ P1112 (P0230)	Fuel rail pressure monitoring circuit malfunction (Fuel pump primary circuit malfunction)	Fuel pressure in common rail is lower or higher than specification	1 driving cycle	1 driving cycle
P1138 (P0230)	Fuel press regulator circuit malfunction	Monitor signal of fuel pressure regulator is different from command signal (circuit open or short), or poor performance of regulator	1 driving cycle	1 driving cycle
☆ P1169 (P0170)	Condenser voltage function 1 (Fuel trim malfunction)	Poor performance of ECM	1 driving cycle	1 driving cycle
☆ P1170 (P0170)	Condenser voltage function 2 (Fuel trim malfunction)	Poor performance of ECM	1 driving cycle	1 driving cycle

**6-18 ENGINE DIAGNOSIS (HDI ENGINE)**

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting:)	DTC DRIVING CYCLE	MIL
P1171	ECU function (ECU internal fault)	Poor performance of ECM	1 driving cycle	-
P1402 (P0510)	Throttle solenoid valve circuit malfunction	Monitor signal of EGR throttle solenoid valve is different from command signal (circuit open or short), or poor performance of valve	1 driving cycle (2 driving cycles)	-
P1404 (P0380)	TL4226 circuit function (pre post heating relay command malfunction)	Monitor signal of pre post heating relay is different from command signal	1 driving cycle (2 driving cycles)	-
P1511	Ignition switch circuit malfunction	Ignition signal is not memorized in ECM	1 driving cycle	-
<sup>e</sup> P1517	Immobilizer system malfunction	-	-	-
P1519	Radiator fan circuit malfunction	Radiator fan relay signal is not corresponding to radiator fan state signal	1 driving cycle	-
P1135	3 <sup>rd</sup> piston deactivator (injection pump solenoid valve) circuit malfunction	Monitor signal of injection pump solenoid valve is different from command signal (circuit open or short)	1 driving cycle	-
P1606	MIL circuit malfunction	Monitor signal of MIL is different from command signal(circuit open or short)	1 driving cycle	-
P1608	Engine coolant temp. warning lamp circuit malfunction	Monitor signal of engine coolant temp. warning lamp circuit is different from command signal (circuit open or short)	1 driving cycle	-
P1614	Sensor supply function	Sensor power supply low or high voltage	1 driving cycle (2 driving cycles)	-

**NOTE:**

- For “☆” marked No. in DTC column, engine is hard to start unless DTC is cleared from ECM memory.
- For ( ) marked No. in DTC column, it is indicated when generic scan tool is used.
- DTC DRIVING CYCLE column indicates the number of driving cycles before DTC is stored in ECM memory.
- For ( ) marked item in DTC DRIVING CYCLE column, it is the number of driving cycles used for generic scan tool.
- For “e” marked items in MIL column, ignore this DTC though it may be indicated on Suzuki scan tool. It does not affect engine and emission control system.

**DIAGNOSTIC TROUBLE CODE (DTC) TABLE FOR TYPE 2 VEHICLES**

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting)	DTC DRIVING CYCLE	MIL
P0012	Intake air temp. sensor circuit malfunction	Sensor output short circuit to ground	1 driving cycle	-
P0113		Sensor output open or short circuit to positive	1 driving cycle	-
P0102	Mass air flow sensor circuit malfunction	Sensor output open or short circuit to ground	1 driving cycle	-
P0103		Sensor output short circuit to positive	1 driving cycle	-
P0107/ P0108	Barometric press sensor circuit malfunction	Poor performance of ECM	1 driving cycle	-
P0116	Engine coolant temp. sensor circuit malfunction	Consistency of engine coolant temp. sensor	1 driving cycle	-
P0117		Sensor input short circuit to ground	1 driving cycle	-
P0118		Sensor input open or short circuit to positive	1 driving cycle	-
P0122	Throttle solenoid valve circuit malfunction	Monitor signal of EGR throttle solenoid valve is different from command signal (short circuit to ground)	1 driving cycle	-
P0123		Monitor signal of EGR throttle solenoid valve is different from command signal (open or short circuit between two wires)	1 driving cycle	-
P0124		Monitor signal of EGR throttle solenoid valve is different from command signal (open circuit)	1 driving cycle	-
P0181	Fuel temperature sensor circuit malfunction	Consistency of fuel temp. circuit input	1 driving cycle	-
P0182		Fuel temp. circuit input short to ground	1 driving cycle	-
P0183		Fuel temp. circuit input open or short to positive	1 driving cycle	-
P0191/ P1164/ P1165	Fuel rail press sensor circuit malfunction	Consistency of fuel rail pressure sensor	1 driving cycle	1 driving cycle
P0192		Fuel rail pressure sensor input short circuit to ground	1 driving cycle	1 driving cycle
P0193		Fuel rail pressure sensor input open or short circuit to positive	1 driving cycle	1 driving cycle
P0215/ P1601	Fuel pump primary circuit malfunction	Injection pump open or short circuit	1 driving cycle	-
P0221/ P0226	Throttle position sensor circuit range/performance/monitoring	Poor performance of throttle position sensor	1 driving cycle	1 driving cycle
P0222/ P0227		Throttle position sensor input short to ground circuit	1 driving cycle	1 driving cycle
P0223/ P0228		Throttle position sensor input open or short to positive circuit	1 driving cycle	1 driving cycle
P0263	Injector circuit malfunction cyl-1	Monitor signal of fuel injection #1 is different from command signal (circuit open or short), or Poor performance of Fuel Injector #1	1 driving cycle	-
P1289/ P1354			1 driving cycle	1 driving cycle
P0266	Injector circuit malfunction cyl-2	Monitor signal of fuel injection #2 is different from command signal (circuit open or short), or Poor performance of Fuel Injector #2	1 driving cycle	-
P1295/ P1355			1 driving cycle	1 driving cycle

**6-20 ENGINE DIAGNOSIS (HDI ENGINE)**

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting)	DTC DRIVING CYCLE	MIL
P0269	Injector circuit malfunction cyl-3	Monitor signal of fuel injection #3 is different from command signal (circuit open or short), or Poor performance of Fuel Injector #3	1 driving cycle	-
P1298/ P1356			1 driving cycle	1 driving cycle
P0272	Injector circuit malfunction cyl-4	Monitor signal of fuel injection #4 is different from command signal (circuit open or short), or Poor performance of Fuel Injector #4	1 driving cycle	-
P1292/ P1357			1 driving cycle	1 driving cycle
P0336	Crankshaft position sensor circuit malfunction	Consistency in monitor signal of crankshaft position sensor	1 driving cycle	-
P0339		Open or short circuit in crankshaft position sensor	1 driving cycle	-
P0341	Camshaft position sensor circuit malfunction	Poor performance of camshaft position sensor	1 driving cycle	-
P0344		Open or short circuit in crankshaft position sensor	1 driving cycle	-
P0401/ P0402	EGR solenoid valve flow incorrect detected	Incorrect EGR flow	1 driving cycle	1 driving cycle
P0404	EGR solenoid valve circuit malfunction	Monitor signal of EGR solenoid valve is different from command signal (open circuit)	1 driving cycle	-
P0405		Monitor signal of EGR solenoid valve is different from command signal ( short circuit to ground)	1 driving cycle	-
P0406		Monitor signal of EGR solenoid valve is different from command signal ( short circuit between two wires)	1 driving cycle	-
P0480	Radiator fan high speed circuit malfunction	Monitor signal of radiator relay (high) circuit is different from command signal (circuit open or short)	1 driving cycle	-
P0481	Radiator fan low speed circuit malfunction	Monitor signal of radiator relay (low) circuit is different from command signal (circuit open or short)	1 driving cycle	-
P0483	Radiator fan circuit malfunction	Radiator fan relay signal is not corresponding to radiator fan state signal	1 driving cycle	-
P0500	Vss circuit malfunction	Vehicle speed is lower or higher than specification under certain condition	1 driving cycle	-
P0501		Consistency in monitor signal of vehicle speed sensor	1 driving cycle	-
P0532	Defective cooling pressure	Open or short circuit to ground	1 driving cycle	-
P0533		Short circuit to positive	1 driving cycle	-
P0562	Power supply circuit malfunction	Power supply too weak	1 driving cycle	-
P0563		Power supply too high	1 driving cycle	-
P0568	Defective speed regulation	Defective lever	1 driving cycle	-
P0571/ P0573	Defective brake contact switch signal	Consistency in monitor signal of vehicle brake switch	1 driving cycle	-

DTC NO.	DETECTING ITEM	DETECTING CONDITION (DTC will set when detecting)	DTC DRIVING CYCLE	MIL
P0601/ P0603/ P0604/ P0605/ P0606	ECU function	Poor performance of ECM	1 driving cycle	-
P0608	Sensor supply function	Sensor power supply low or high voltage (ex. fuel pressure sensor)	1 driving cycle	1 driving cycle
P0609		Sensor power supply low or high voltage (ex. pedal sensor)	1 driving cycle	1 driving cycle
P0650	MIL circuit malfunction	Monitor signal of MIL circuit is different from command signal (circuit open or short)	1 driving cycle	-
P0704	Defective clutch contact switch signal	Consistency in monitor signal of vehicle clutch switch	1 driving cycle	-
P1113/ P1166/ P1167	Fuel pressure regulator consistency / monitoring function	Consistency of fuel pressure regulation	1 driving cycle	1 driving cycle
P1198		Defective flow	1 driving cycle	1 driving cycle
P1114/ P1192	Defective injection feed cutoff test	Defective regulators	1 driving cycle	-
P1169	Defective voltage converter	Malfunction in voltage converter	1 driving cycle	-
P1176	3 <sup>rd</sup> piston deactivator circuit malfunction	Consistency in monitor signal of injection pump solenoid valve	1 driving cycle	1 driving cycle
P1177		Monitor signal of injection pump solenoid valve is different from command signal (short circuit to ground)	1 driving cycle	1 driving cycle
P1179		Monitor signal of injection pump solenoid valve is different from command signal (short circuit between two wires)	1 driving cycle	1 driving cycle
P1180		Monitor signal of injection pump solenoid valve is different from command signal (open circuit)	1 driving cycle	1 driving cycle
P1197/ P1641	Defective control of injectors	Power stage	1 driving cycle	-
P1199/ P1520	Defective low fuel level	Malfunction in low fuel level information	1 driving cycle	-
P1207	Fuel pressure regulator circuit malfunction	Consistency in monitor signal of fuel pressure regulator	1 driving cycle	1 driving cycle
P1208		Monitor signal of fuel pressure regulator is different from command signal (short circuit to ground)	1 driving cycle	1 driving cycle
P1209		Monitor signal of fuel pressure regulator is different from command signal (short circuit between two wires)	1 driving cycle	1 driving cycle
P1210		Monitor signal of fuel pressure regulator is different from command signal (open circuit)	1 driving cycle	1 driving cycle
P1349	Pre/post heat relay circuit malfunction	Both pre/post heating relay and diagnostic signal are high (short circuit to positive)	1 driving cycle	-
P1350		Both pre/post heating relay and diagnostic signal are low (open or short circuit to ground)	1 driving cycle	-
P1351/ P1352		Consistency in monitor signal of pre/post heating relay	1 driving cycle	1 driving cycle
P1403/ P1404	Defective additional heating	Malfunction in additional heating	1 driving cycle	-

**6-22 ENGINE DIAGNOSIS (HDI ENGINE)**

<b>DTC NO.</b>	<b>DETECTING ITEM</b>	<b>DETECTING CONDITION (DTC will set when detecting)</b>	<b>DTC DRIVING CYCLE</b>	<b>MIL</b>
P1543	A/C cut signal circuit malfunction	Monitor signal of A/C cut signal circuit is different from command signal (circuit open or short between two wires)	1 driving cycle	-
P1602	Glow indicator lamp circuit malfunction	Monitor signal of glow indicator lamp circuit is different from command signal (circuit open or short between two wires)	1 driving cycle	-
P1603	Defective water temperature information	Malfunction in water temperature information	1 driving cycle	-
P1608	ECT warning lamp circuit malfunction	Monitor signal of ECT warning lamp circuit is different from command signal(circuit open or short between two wires)	1 driving cycle	-
P1609	Defective engine speed information	Malfunction in engine speed information (circuit open or short between two wires)	1 driving cycle	-
P1610	Defective fuel consumption information	Malfunction in fuel consumption information (circuit open or short between two wires)	1 driving cycle	-
P1613	Defective telecoding	Malfunction in telecoding information	1 driving cycle	1 driving cycle
P1621/ P1667/ P1668/ P1669	ECU function	Poor performance of ECM	1driving cycle	1 driving cycle
P1627	Failure to provide torque requested by driver	Poor performance of injection system	1 driving cycle	1 driving cycle
P1670/ P1671/ P1672/ P1673	ECU function	Poor performance of ECM	1 driving cycle	-

**NOTE:**

- **DTC DRIVING CYCLE** column indicates the number of driving cycles before DTC is stored in ECM memory.

## LIST OF FAULT CODES THAT ARE LIGHTING ON THE MIL

Code	Purpose	Monitor strategy description	MIL Illumination
<b>Monitoring of Airflow Meter</b>			
P3007	Airflow meter: Airflow too low	Functional diagnosis of airflow meter (plausibility check)	3 driving cycle
P3008	Airflow meter: Airflow too high	Functional diagnosis of airflow meter (plausibility check)	3 driving cycle
P0102	Mass or Volume Air Flow Circuit Low Input	Electrical Diagnosis	3 driving cycle
P0103	Mass or Volume Air Flow Circuit High Input	Electrical Diagnosis	3 driving cycle
<b>Monitoring of Atmospheric Pressure Sensor</b>			
P0106	Manifold Absolute Pressure / barometric Pressure Circuit range / Performance	Functional diagnosis of atmospheric pressure sensor	3 driving cycle
P0107	Manifold Absolute Pressure / barometric Pressure Circuit Low Input	Electrical Diagnosis	3 driving cycle
P0108	Manifold Absolute Pressure / barometric Pressure Circuit High Input	Electrical Diagnosis	3 driving cycle
<b>Monitoring of Rail Pressure Sensor</b>			
P0191	Fuel Rail Pressure Sensor Circuit Range / Performance	Functional diagnosis of rail pressure sensor (gradient)	1 driving cycle
P0192	Fuel Rail Pressure Sensor Circuit Low	Electrical Diagnosis	1 driving cycle
P0193	Fuel Rail Pressure Sensor Circuit High	Electrical Diagnosis	1 driving cycle
P1164	Offset Rail Pressure	Offset measured at ECU Wake-up or at Power-Latch	1 driving cycle
P1166	Pressure difference too low	Difference of pressure between 2 measurements is too low (smaller than sensor tolerance)	1 driving cycle
<b>Monitoring of Air Intake Temperature Sensor (Sensor in Mass Airflow Meter T1)</b>			
P0111	Intake Air Temperature Sensor 1 Circuit range / Performance	Functional diagnosis of air temperature sensor in airflow meter 8 gradient	3 driving cycle
P0112	Intake Air Temperature Sensor 1 Circuit Low	Electrical Diagnosis	3 driving cycle
P0113	Intake Air Temperature Sensor 1 Circuit High	Electrical Diagnosis	3 driving cycle
<b>Monitoring of Water Temperature Sensor</b>			
P0115	Engine Coolant Temperature Circuit	Functional diagnosis of water temperature sensor (diagnosis of temperature rising)	3 driving cycle
P0116	Engine Coolant Temperature Circuit Range / Performance	Functional diagnosis of water temperature sensor (gradient)	3 driving cycle
P0117	Engine Coolant Temperature Circuit Low	Electrical Diagnosis	3 driving cycle
P0118	Engine Coolant Temperature Circuit High	Electrical Diagnosis	3 driving cycle
<b>Monitoring of Accelerator Pedal Sensor</b>			
P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low	Electrical Diagnosis sensor 1 (track 1)	1 driving cycle
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High	Electrical Diagnosis sensor 1 (track 1)	1 driving cycle
P0227	Throttle / Pedal Position Sensor / Switch "C" Circuit Low	Electrical Diagnosis sensor 2 (track 2)	1 driving cycle
P0228	Throttle / Pedal Position Sensor / Switch "C" Circuit High	Electrical Diagnosis sensor 2 (track 2)	1 driving cycle
P2137	Throttle / Pedal Position Sensor / Switch "B" / "C" Voltage Correlation	Monitoring of correlation between voltages of pedal sensors 1 and 2	1 driving cycle
P2299	Brake pedal position / Accelerator Pedal Position Incompatible	Monitoring of correlation between signals of pedal sensors and brake pedal (detection of accelerator pedal blocked)	1 driving cycle
<b>Monitoring of Vehicle Speed Sensor</b>			
P0500	Vehicle Speed Sensor "A"	Functional diagnosis (above upper limit)	3 driving cycle
P0501	Vehicle Speed Sensor "A" range / Performance	Functional diagnosis of vehicle speed signal (correlation test with engine speed and fuel delivery)	3 driving cycle
<b>Monitoring of Sensors and Actuators Supply</b>			
P0658	Actuator Supply Voltage "A" Circuit Low	5V supply sensors 1	1 driving cycle
P0659	Actuator Supply Voltage "A" Circuit High	5V supply sensors 1	1 driving cycle
P2670	Actuator Supply Voltage "B" Circuit Low	5V supply sensors 2	1 driving cycle
P2671	Actuator Supply Voltage "B" Circuit High	5V supply sensors 2	1 driving cycle
<b>Monitoring of Battery Supply</b>			
P0562	System Voltage Low	Battery voltage below threshold	3 driving cycle
P0563	System Voltage High	Battery voltage below threshold	3 driving cycle
<b>Monitoring of Fuel Volume Regulator</b>			
P0001	Fuel Volumen Regulator Control Circuit / Open	Electrical Diagnosis	1 driving cycle
P0002	Fuel Volumen Regulator Control Circuit Range / Performance	Monitoring of regulator current	1 driving cycle
P0003	Fuel Volumen Regulator Control Circuit Low	Electrical Diagnosis	1 driving cycle
P0004	Fuel Volumen Regulator Control Circuit High	Electrical Diagnosis	1 driving cycle

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<b>Monitoring of Rail Pressure Regulator</b>			
P0089	Fuel Pressure regulator 1 Performance	Functional diagnosis of high pressure fuel regulator (Plausibility check between current of control and pressure measured)	1 driving cycle
P0090	Fuel Pressure regulator 1 Control Circuit	Functional diagnosis of high pressure fuel regulator (Plausibility check at power-latch)	1 driving cycle
P0091	Fuel Pressure regulator 1 Control Circuit Low	Electrical Diagnosis	1 driving cycle
P0092	Fuel Pressure regulator 1 Control Circuit High	Electrical Diagnosis	1 driving cycle
P1210	Solenoid valve of fuel pressure regulator: open circuit	Electrical Diagnosis	1 driving cycle
<b>Monitoring of Fuel Pressure Regulator</b>			
P0087	Fuel Rail / System Pressure - Too Low	Rail pressure too low (command - measurement > 0)	1 driving cycle
P0088	Fuel Rail / System Pressure - Too High	Rail pressure too high (command - measurement > 0)	1 driving cycle
P1167	Dynamic monitoring of pressure	Oscillation of pressure controller	1 driving cycle
P1198	Fault adaptation at stop on VCV regulator	Fuel delivery too low to reach the pressure target	1 driving cycle
<b>Monitoring of Injectors Command</b>			
P0201	Injector Circuit / Open - Cylinder 1	Electrical Diagnosis	1 driving cycle
P1366	Monitoring 1 of current command cylinder 1		1 driving cycle
P0202	Injector Circuit / Open - Cylinder 2	Electrical Diagnosis	1 driving cycle
P1367	Monitoring 1 of current command cylinder 2		1 driving cycle
P0203	Injector Circuit / Open - Cylinder 3	Electrical Diagnosis	1 driving cycle
P1368	Monitoring 1 of current command cylinder 3		1 driving cycle
P0204	Injector Circuit / Open - Cylinder 4	Electrical Diagnosis	1 driving cycle
P1369	Monitoring 1 of current command cylinder 4		1 driving cycle
P1197	Global failure at injector or wiring		1 driving cycle
<b>Safety</b>			
P1621	SAFETY Level 2 ECU	Communication Microcontroller not plausible	1 driving cycle
P1627	SAFETY Level 2 ECU or pedal sensors	Pedal signal not plausible-Correlation between signal and calculated value from torque	1 driving cycle
P1667	Conversion analog / digital not plausible		1 driving cycle
P1668	Injection cut not plausible		1 driving cycle
P1669	Engine speed not plausible		1 driving cycle
P1672	Maximun speed not plausible		1 driving cycle
P1673	Time unit not plausible		1 driving cycle
<b>Monitoring of EGR Valve</b>			
P0400	Exhaust Gas Recirculation Flow	Functional diagnosis of EGR valve (detection valve blocked)	3 driving cycle
P2143	Exhaust Gas Recirculation Vent Control Circuit / Open	Electrical Diagnosis	3 driving cycle
P2144	Exhaust Gas Recirculation Vent Control Low	Electrical Diagnosis	3 driving cycle
P2145	Exhaust Gas Recirculation Vent Control High	Electrical Diagnosis	3 driving cycle
<b>Monitoring of EGR Regulation</b>			
P0401	Exhaust Gas Recirculation Flow Insufficient Detected	Functional diagnosis of EGR : command-measurement > 0	3 driving cycle
P0402	Exhaust Gas Recirculation Flow Excessive Detected	Functional diagnosis of EGR : command-measurement < 0	3 driving cycle
<b>Control Module Monitoring</b>			
P0601	Internal Control Module Memory Check Sum Error	Control module fault (checksum)	1 driving cycle
P0603	Internal Control Module Keep Alive Memory (KAM) Error	EEPROM memory	1 driving cycle
P0604	Internal Control Module Random Access Memory (KAM) Error	RAM fault	1 driving cycle
P0605	Internal Control Module Read Only Memory (KOM) Error	ROM fault	1 driving cycle
P0606	ECM / PCM Processor	Control module fault (Hardware - "Watchdog")	1 driving cycle
P1641	Piezo power stage reset : failure of control module or wiring		1 driving cycle
<b>Monitoring of Glow Plugs</b>			
P1352	Glow plug realy : plausibility test (relay blocked closed)	Realy is not controlled / Glow plugs are powered	1 driving cycle

LIST OF FAULT CODES THAT ARE NOT LIGHTING **ON** THE MIL

<b>Monitoring of Camshaft Position Sensor</b>			
P0341	Camshaft Position Sensor "A" Circuit Range / Performance	Signal of camshaft position sensor not available	NO
P0016	Crankshaft Position - Camshaft Position Correlation	Functional diagnosis of engine speed sensor + camshaft position sensor (correlation check between engine speed from sensor and calculated value from camshaft position sensor)	NO
<b>Monitoring of Engine Speed Sensor</b>			
P0336	Crankshaft Position Sensor "A" Circuit Range / Performance	Functional diagnosis (engine speed acceleration too high)	NO
P0337	Crankshaft position Sensor "A" Circuit Low	Electrical Diagnosis	NO
<b>Monitoring of Fuel Temperature Sensor</b>			
P0181	Fuel Temperature Sensor "A" Circuit Range / Performance	Functional diagnosis (gradient)	NO
P0182	Fuel Temperature Sensor "A" Circuit Low	Electrical Diagnosis	NO
P0183	Fuel Temperature Sensor "A" Circuit High	Electrical Diagnosis	NO
<b>Monitoring of Glow Plugs</b>			
P1349	Glow plug realy : Short circuit (+)		NO
P1350	Glow plug realy : Short circuit (-) or open circuit		NO
P1351	Glow plug realy : Plausibility test (open relay )	Realy is controlled / Glow plugs are not powered	NO
<b>Monitoring of Injectors Command</b>			
P0263	Cylinder 1 Contribution / Balance	Functional diagnosis of injector	NO
P0266	Cylinder 2 Contribution / Balance	Functional diagnosis of injector	NO
P0269	Cylinder 3 Contribution / Balance	Functional diagnosis of injector	NO
P0272	Cylinder 4 Contribution / Balance	Functional diagnosis of injector	NO
<b>Monitoring of MIL Lamp</b>			
P0650	Malfunction indicator lamp (MIL) Control Circuit	Electrical Diagnosis	NO

**VISUAL INSPECTION**

Visually check following parts and systems.

INSPECTION ITEM	REFERRING SECTION
<ul style="list-style-type: none"> <li>• Engine oil — — — — level, leakage</li> <li>• Engine coolant — — — — level, leakage</li> <li>• Fuel — — — — level, leakage</li> <li>• Air cleaner element — — — — dirt, clogging</li> <li>• Battery — — — — fluid level, corrosion of terminal</li> <li>• Drive belt — — — — tension, damage</li> <li>• Accelerator cable — — — — play (after warm up engine), installation</li> <li>• Vacuum hoses of air intake system — — — — disconnection, looseness, deterioration, bend</li> <li>• Connectors of electric wire harness — — — — disconnection, friction</li> <li>• Fuses — — — — burning</li> <li>• Parts — — — — installation, bolt — — — — looseness</li> <li>• Parts — — — — deformation</li> <li>• Other parts that can be checked visually</li> </ul>	<p>Section 0B                  Section 0B                  Section 0B                  Section 0B                    Section 0B                  Section 6E3                    Section 8</p>
<p>Also add following items at engine start, if possible.</p> <ul style="list-style-type: none"> <li>• Malfunction indicator lamp</li> <li>• Charge warning lamp</li> <li>• Engine oil pressure warning lamp</li> <li>• Engine coolant temp. warning lamp</li> <li>• Engine coolant temp. meter</li> <li>• Fuel level meter</li> <li>• Abnormal air being inhaled from air intake system</li> <li>• Exhaust system — — — — leakage of exhaust gas, noise</li> <li>• Other parts that can be checked visually</li> </ul>	<p>Section 6                  Section 6H                  Section 8                  Section 8                  Section 8                  Section 8</p>

## ENGINE BASIC CHECK

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

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check battery voltage. Is it 11 V or more?	Go to step 3.	Charge or replace battery.
3	Is engine cranked?	Go to step 4.	Go to "DIAGNOSIS" in Section 6G or 6G1
4	Does engine start?	Go to step 5.	Go to step 6.
5	Check engine idle speed referring to "Idle speed Inspection" in Section 6E3 Is check result as specified?	Go to step 11 in "ENGINE DIAG. FLOW TABLE".	Go to "Engine diagnosis Table" in this section
6	Is immobilizer control system equipped?	<ul style="list-style-type: none"> <li>• Go to step 7 if Suzuki scan tool is available.</li> <li>• Go to "DIAGNOSIS" in section 8B if Suzuki scan tool is not available.</li> </ul>	Go to step 8.
7	Check immobilizer system malfunction as follows. 1) Execute Data List mode of Suzuki mode using ECM application of Suzuki scan tool. Does Suzuki scan tool indicate communication error message?	Go to "DIAGNOSIS" in Section 8B.	Go to step 8.
8	Check fuel supply as follows: 1) Check to make sure that enough fuel is filled in fuel tank. 2) Turn ON ignition switch for 5 seconds and then OFF. Repeat this a few times. Is fuel return pressure (returning sounds) felt from fuel return hose when ignition switch is turned ON?	Go to step 10.	In Type 1 vehicles go to step 9. In Type 2 vehicles go to step 10.
9	Check fuel pump for operating. 1) Was fuel pump operating sound heard from fuel pump for about 5 seconds after ignition switch ON and stop?	Go to "LOW PRESSURE FUEL SUPPLY INSPECTION" in Section 6E3.	Go to "Diag. Flow Table B-1" (Type 1 vehicles). Go to "DTC P1176/1177/1179/1180 Flow Table" (Type 2 vehicles).
10	Check fuel injector referring to "Fuel Injector Inspection" in Section 6E3. Is it in good condition?	Go to "Engine Diagnosis Table" in this section.	Go to "DTC P0201/0202/0203/0204 Flow Table" (Type 1 vehicles). Go to "DTC P0263/0266/0269/0272 Flow Table" (Type 2 vehicles).

**ENGINE DIAGNOSIS TABLE**

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

Condition	Possible Cause	Reference item
<b>Hard starting (Engine cranks OK)</b>	<p><b>Fuel system out of order.</b></p> <ul style="list-style-type: none"> <li>• Lack of fuel in fuel tank</li> <li>• Fuel filter               <ul style="list-style-type: none"> <li>- Dirty or clogged</li> <li>- Water mixed in</li> </ul> </li> <li>• Dirty or clogged fuel hose or pipe</li> <li>• Fuel injection pipe               <ul style="list-style-type: none"> <li>- Cracks</li> <li>- Fuel leakage from joints</li> </ul> </li> <li>• Clogged fuel injector</li> <li>• Faulty fuel pump (Type 1 vehicles) / injection pump (Type 2 vehicles)</li> </ul> <p><b>Engine and emission control system out of order</b></p> <ul style="list-style-type: none"> <li>• Faulty ECM</li> <li>• Faulty fuel pressure sensor</li> <li>• Faulty CKP sensor (Engine speed sensor)</li> <li>• Faulty CMP sensor</li> <li>• Faulty fuel injection pump               <ul style="list-style-type: none"> <li>- Air mixed in</li> <li>- Pump internal damage</li> <li>- Faulty fuel pressure regulator</li> </ul> </li> <li>• Faulty fuel injector</li> <li>• Faulty ECT sensor</li> </ul> <p><b>Glow system out of order</b></p> <ul style="list-style-type: none"> <li>• Faulty glow plug</li> <li>• Faulty pre post heating relay</li> </ul> <p><b>Low compression.</b></p> <ul style="list-style-type: none"> <li>• Compression leak from valve seat</li> <li>• Sticky valve stem</li> <li>• Weak or damage valve springs</li> <li>• Compression leak at cylinder head gasket</li> <li>• Sticking or damaged piston ring</li> <li>• Worn piston, ring or cylinder</li> </ul> <p><b>Immobilizer control system out of order.</b></p> <p><b>Others</b></p> <ul style="list-style-type: none"> <li>• Broken valave timing belt</li> <li>• Faulty EGR throttle valve</li> </ul>	<p>Refill.</p> <p>Replace. Repair. Clean.</p> <p>Replace. Correct. Replace. Inspect and replace.</p> <p>Replace. Inspect and replace. Inspect and replace. Inspect, adjust and replace.</p> <p>Refill fuel in fuel tank. Replace. Inspect and replace. Inspect and replace. Inspect and replace.</p> <p>Inspect and replace. Inspect and replace.</p> <p>Remove cylinder head and lap valves. Correct or replace valve. Replace valve springs Repair or replace. Replace piston rings. Replace ring and piston. Rebore or replace cylinder.</p> <p>Refer to section 8G</p> <p>Replace timing belt and repair valve train. Inspect and replace.</p>

Condition	Possible Cause	Reference item
<b>Improper engine idling or engine fails to idle</b>	<p><b>Intake system out of order</b></p> <ul style="list-style-type: none"> <li>• Clogged air cleaner element</li> <li>• EGR throttle valve</li> </ul> <p><b>Fuel system out of order.</b></p> <ul style="list-style-type: none"> <li>• Shortage of fuel in fuel tank</li> <li>• Fuel filter               <ul style="list-style-type: none"> <li>- Dirty or clogged</li> <li>- Water mixed in</li> </ul> </li> <li>• Dirty or clogged fuel hose or pipe</li> <li>• Fuel injection pipe               <ul style="list-style-type: none"> <li>- Cracks</li> <li>- Fuel leakage from joints</li> </ul> </li> <li>• Clogged fuel injector</li> <li>• Faulty fuel pump (Type 1 vehicles) / injection pump (Type 2 vehicles)</li> </ul> <p><b>Engine overheating.</b></p> <p><b>Engine and emission control system out of order.</b></p> <ul style="list-style-type: none"> <li>• Faulty ECM</li> <li>• Faulty mass air flow sensor</li> <li>• Faulty fuel injector</li> <li>• Faulty fuel injection pump               <ul style="list-style-type: none"> <li>- Faulty injection pump solenoid valve (3<sup>rd</sup> piston deactivator)</li> <li>- Air mixed in</li> <li>- Pump internal damage</li> <li>- Faulty fuel pressure regulator</li> <li>- Faulty fuel pressure sensor</li> <li>- Faulty TP sensor (accelerator stroke sensor)</li> </ul> </li> <li>• Faulty CKP sensor</li> <li>• Faulty ECT sensor</li> </ul> <p><b>Glow system out of order.</b></p> <ul style="list-style-type: none"> <li>• Faulty glow plug</li> <li>• Faulty pre post heating relay</li> </ul> <p><b>EGR system out of order.</b></p> <ul style="list-style-type: none"> <li>• Faulty EGR solenoid valve</li> <li>• Faulty EGR valve</li> </ul> <p><b>Low compression.</b></p> <p><b>Others</b></p> <ul style="list-style-type: none"> <li>• Faulty A/C signal</li> <li>• Mal-adjusted accelerator cable</li> </ul>	<p>Clean or replace. Inspect and replace.</p> <p>Refill.</p> <p>Replace. Repair. Clean.</p> <p>Replace. Repair. Replace. Inspect and replace.</p> <p>Refer to "Overheating" Section.</p> <p>Replace. Inspect and replace. Inspect and replace.</p> <p>Inspect and replace.</p> <p>Refill fuel in fuel tank. Replace. Inspect and replace. Inspect and replace. Inspect and replace.</p> <p>Inspect and replace. Inspect and replace.</p> <p>Inspect and replace. Inspect and replace.</p> <p>Inspect and repair or replace EGR system. Inspect and repair or replace EGR system. Previously outlined.</p> <p>Inspect and replace. Adjust.</p>

Condition	Possible Cause	Reference item
<b>Abnormal Knocking</b>	<p><b>Fuel system out of order.</b></p> <ul style="list-style-type: none"> <li>• Fuel injection pipe <ul style="list-style-type: none"> <li>- Cracks</li> <li>- Fuel eakage from joints</li> </ul> </li> <li>• Faulty fuel injector <ul style="list-style-type: none"> <li>- Incorrect valve opening pressure</li> <li>- Seized needle valve</li> <li>- Improperly installed nozzle holder</li> <li>- Faulty nozzle gasket</li> </ul> </li> </ul> <p><b>Engine and emission control system out of order.</b></p> <ul style="list-style-type: none"> <li>• Faulty ECM</li> <li>• Faulty fuel injection pump <ul style="list-style-type: none"> <li>- Faulty fuel pressure regulator</li> <li>- Faulty timer control valve</li> </ul> </li> <li>• Faulty fuel temp. sensor</li> <li>• Faulty ECT sensor</li> </ul> <p><b>Other</b></p> <ul style="list-style-type: none"> <li>• Faulty EGR valve</li> </ul>	<p>Replace. Repair. Inspect and replace. Adjust. Replace. Repair. Replace.</p> <p>Replace. Inspect and replace. Inspect and replace. Inspect and replace. Inspect and replace.</p> <p>Inspect and replace.</p>
<b>Engine hesitates when accelerating</b>	<p><b>Intake system out of order.</b></p> <ul style="list-style-type: none"> <li>• Clogged air cleaner element</li> <li>• Faulty turbocharger</li> </ul> <p><b>Fuel system out of order</b></p> <ul style="list-style-type: none"> <li>• Fuel filter <ul style="list-style-type: none"> <li>- Dirty or clogged</li> <li>- Water mixed in</li> </ul> </li> <li>• Dirty or clogged fuel hose or pipe</li> <li>• Fuel injection pipe <ul style="list-style-type: none"> <li>- Cracks</li> <li>- Fuel leakage from joints</li> </ul> </li> <li>• Clogged fuel injector</li> </ul> <p><b>Engine overheating.</b></p> <p><b>Engine and emission control system out of order.</b></p> <ul style="list-style-type: none"> <li>• Faulty ECM</li> <li>• Faulty fuel injection pump <ul style="list-style-type: none"> <li>- Faulty fuel injection regulator</li> <li>- Air mixed in</li> <li>- Pump internal damage</li> <li>- Faulty injection pump solenoid valve (3<sup>rd</sup> piston deactivator)</li> <li>- Faulty MAF sensor</li> </ul> </li> <li>• Faulty TP sensor (Accelerator Stroke sensor)</li> <li>• Faulty CKP sensor</li> <li>• Faulty ECT sensor</li> </ul> <p><b>EGR system out of order.</b></p> <ul style="list-style-type: none"> <li>• Faulty EGR solenoid valve</li> <li>• Faulty EGR valve</li> </ul> <p><b>Low compression.</b></p> <p><b>Other</b></p> <ul style="list-style-type: none"> <li>• Mal-adjusted accelerator cable</li> </ul>	<p>Clean or replace. Replace.</p> <p>Replace. Repair. Clean or replace.</p> <p>Replace. Repair. Inspect and replace. Refer to "Overheating" section.</p> <p>Inspect and replace.</p> <p>Adjust. Refill fuel in fuel tank. Inspect and replace. Inspect and replace.</p> <p>Inspect and replace. Inspect and replace.</p> <p>Inspect and replace. Inspect and replace.</p> <p>Inspect and repair or replace EGR system. Inspect and repair or replace EGR system. Previously outlined.</p> <p>Replace.</p>

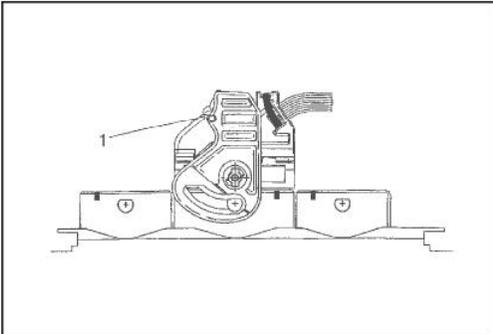
Condition	Possible Cause	Reference item
<b>Overheating</b>	<ul style="list-style-type: none"> <li>• Insufficient coolant</li> <li>• Loose water pump belt</li> <li>• Inoperative thermostat</li> <li>• Poor water pump performance</li> <li>• Clogged or leaky radiator</li> <li>• Improper engine oil grade</li> <li>• Clogged oil filter or oil strainer</li> <li>• Not enough oil</li> <li>• Poor oil pump performance</li> <li>• Oil leakage</li> <li>• Dragging brakes</li> <li>• Slipping clutch</li> <li>• Blown cylinder head gasket</li> </ul>	<ul style="list-style-type: none"> <li>Replenish.</li> <li>Adjust.</li> <li>Replace.</li> <li>Replace.</li> <li>Flush, repair or replace.</li> <li>Replace with proper grade oil.</li> <li>Replace or clean (oil strainer).</li> <li>Replenish.</li> <li>Repair or replace.</li> <li>Repair.</li> <li>Repair or replace.</li> <li>repair or replace.</li> <li>Replace.</li> </ul>
<b>Excessive engine oil consumption</b>	<p><b>Oil Leakage</b></p> <ul style="list-style-type: none"> <li>• Loose oil drain plug</li> <li>• Loose oil pan bolts</li> <li>• Deteriorated or broken oil pan sealant</li> <li>• Leaky crankshaft oil seal</li> <li>• Leaky cylinder head cover gasket</li> <li>• Improper tightening of oil filter</li> <li>• Loose oil pressure switch</li> <li>• Blown cylinder head gasket</li> <li>• Leaky crankshaft pulley oil seal</li> </ul> <p><b>Oil entering combustion chamber</b></p> <ul style="list-style-type: none"> <li>• Sticky piston ring</li> <li>• Worn piston and cylinder</li> </ul> <ul style="list-style-type: none"> <li>• Worn piston ring groove and ring</li> <li>• Improper location of piston ring gap</li> <li>• Worn or damaged valve stem seal</li> <li>• Worn valve stem</li> </ul>	<ul style="list-style-type: none"> <li>Tighten.</li> <li>Tighten.</li> <li>Replace sealant.</li> <li>Replace.</li> <li>Replace.</li> <li>Tighten.</li> <li>Tighten.</li> <li>Replace.</li> <li>Replace.</li> </ul> <ul style="list-style-type: none"> <li>Remove carbon and replace rings.</li> <li>Replace or rebore cylinder, and replace piston.</li> <li>Replace piston and ring.</li> <li>Reposition ring gap.</li> <li>Replace.</li> <li>Replace.</li> </ul>
<b>Low oil pressure</b>	<ul style="list-style-type: none"> <li>• Improper oil viscosity</li> <li>• Malfunctioning oil pressure switch</li> <li>• Not enough oil</li> <li>• Clogged oil strainer</li> <li>• Functional deterioration of oil pump</li> <li>• Worn oil pump relief valve</li> <li>• Excessive clearance in various sliding parts.</li> </ul>	<ul style="list-style-type: none"> <li>Use oil of proper viscosity.</li> <li>Replace.</li> <li>Replenish.</li> <li>Clean.</li> <li>Replace.</li> <li>Replace.</li> <li>Replace worn parts.</li> </ul>

Condition	Possible Cause	Reference item
<p><b>Engine noise</b>                      Note: Before checking the mechanical noise, make sure that:</p> <ul style="list-style-type: none"> <li>• Injection timing is properly adjusted.</li> <li>• Specified fuel is used.</li> </ul>	<p><b>Valve noise.</b></p> <ul style="list-style-type: none"> <li>• Improper valve lash</li> <li>• Worn valve stem and guide</li> <li>• Weak or broken valve spring</li> <li>• Warped or bent valve</li> </ul> <p><b>Piston, ring and cylinder noise.</b></p> <ul style="list-style-type: none"> <li>• Worn piston, ring and cylinder bore</li> </ul> <p><b>Connecting rod noise.</b></p> <ul style="list-style-type: none"> <li>• Worn crankpin bearing</li> <li>• Worn crankpin</li> <li>• Loose connecting rod nuts</li> </ul> <p><b>Low oil pressure.</b></p> <p><b>Crankshaft noise.</b></p> <ul style="list-style-type: none"> <li>• Worn crankshaft journal bearing</li> <li>• Worn crankshaft journal</li> <li>• Loose lower crankcase (bearing cap) bolts</li> <li>• Excessive crankshaft thrust play</li> </ul> <p><b>Engine and emission control system out of order.</b></p>	<p>Adjust.                      Replace.                      Replace.                      Replace.</p> <p>Rebore or replace cylinder.                      Replace piston and ring.</p> <p>Replace.                      Repair by grinding or replace crankshaft.                      Tighten nuts to specification.                      Previously outlined.</p> <p>Replace.                      Repair by grinding or replace crankshaft.                      Tighten bolts to specification.                      Replace thrust bearing.                      Refer to Section 6E3.</p>
<p><b>White or blue smoke</b></p>	<p><b>Intake system out of order.</b></p> <ul style="list-style-type: none"> <li>• Clogged air cleaner element</li> <li>• EGR throttle valve</li> </ul> <p><b>Engine and emission control system out of order.</b></p> <ul style="list-style-type: none"> <li>• Faulty ECM</li> <li>• Faulty fuel injection pump                             <ul style="list-style-type: none"> <li>- Pump internal damage</li> <li>- Fuel injector</li> </ul> </li> <li>• Faulty ECT sensor</li> </ul> <p><b>Glow system out of order.</b></p> <ul style="list-style-type: none"> <li>• Faulty glow plug</li> <li>• Faulty pre post heating relay</li> </ul> <p><b>Low compression</b></p> <p><b>Other</b></p> <ul style="list-style-type: none"> <li>• Improper oil level</li> </ul>	<p>Clean or replace.                      Inspect and replace.</p> <p>Inspect and replace.</p> <p>Replace.                      Inspect and replace.                      Inspect and replace.</p> <p>Inspect and replace.                      Inspect and replace.                      Previously outlined.</p> <p>Adjust.</p>
<p><b>Black smoke</b></p>	<p><b>Intake system out of order.</b></p> <ul style="list-style-type: none"> <li>• Faulty turbocharger</li> <li>• Clogged air cleaner element</li> <li>• EGR throttle valve</li> </ul> <p><b>Engine and emission control system out of order.</b></p> <ul style="list-style-type: none"> <li>• Faulty ECM</li> <li>• Faulty fuel injector</li> <li>• Faulty fuel injector pump                             <ul style="list-style-type: none"> <li>- Faulty fuel pressure regulator</li> <li>- Pump internal damage</li> </ul> </li> <li>• Faulty MAF sensor</li> <li>• Faulty ECT sensor</li> <li>• Faulty TP sensor</li> </ul> <p><b>EGR system out of order.</b></p> <ul style="list-style-type: none"> <li>• Faulty EGR solenoid valve</li> <li>• Faulty EGR valve</li> </ul> <p><b>Low compression</b></p>	<p>Inspect and replace.                      Clean or replace.                      Inspect and replace.</p> <p>Inspect and replace.                      Inspect and replace.</p> <p>Inspect and replace.                      Replace.                      Inspect and replace.                      Inspect and replace.                      Inspect and replace.</p> <p>Inspect and repair or replace EGR system.                      Inspect and repair or replace EGR system.                      Previously outlined.</p>

## INSPECTION OF PCM (ECM) AND ITS CIRCUITS

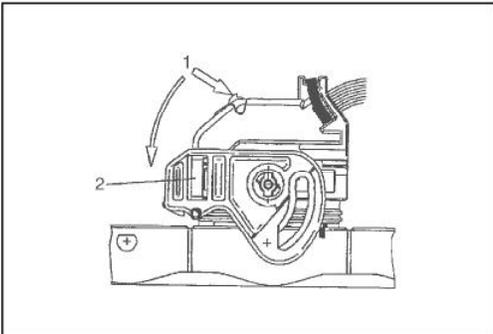
PCM (ECM) and its circuits can be checked at PCM (ECM) wiring couplers by measuring voltage and resistance.

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

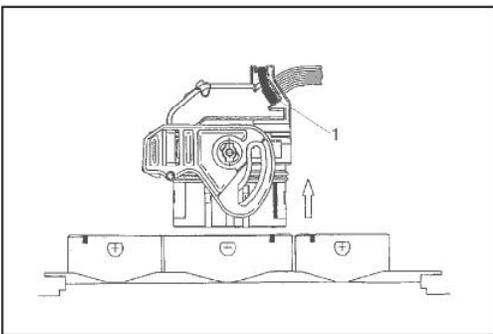


### Voltage check

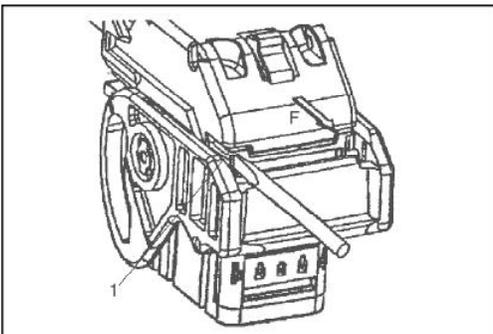
- 1) Disconnect ECM from bracket referring to "ENGINE CONTROL MODULE" in this section.
- 2) Disconnect each ECM connector as follows.
  - a) Cut and remove the lead seal wire (1).



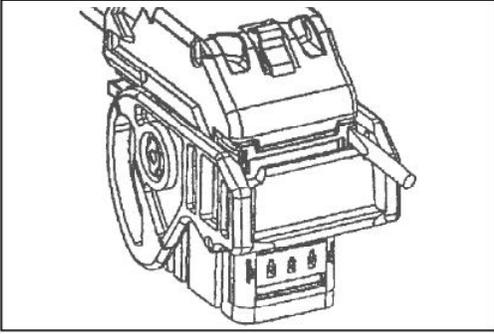
- b) Push on the locking (1) and rotate the lever till the stop in the connector (2).



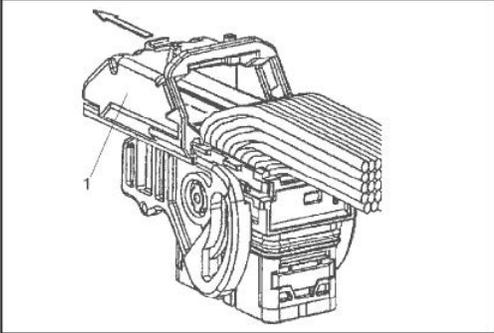
- c) Remove the female housings from the header.
  - d) Cut and remove the clamp (1).



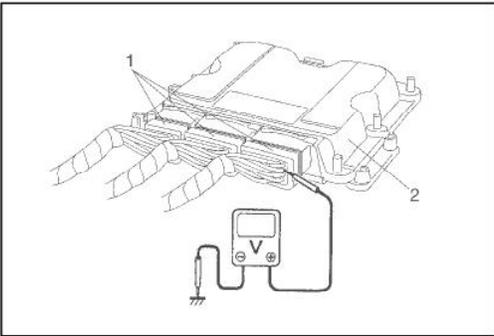
- e) Open the first locking clip in the cover (1) using a screwdriver and push cover in "F" direction.



f) Keeping pressure on the cover, repeat the operation in the second locking clip.



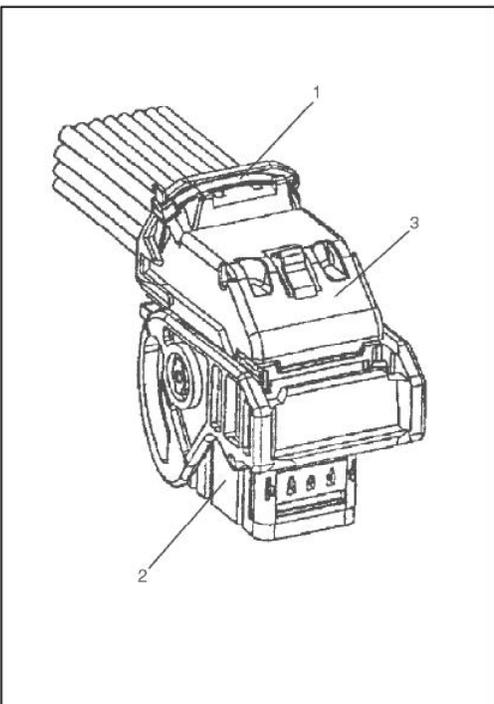
g) Pull on the cover (1) from ECM connector and remove it .



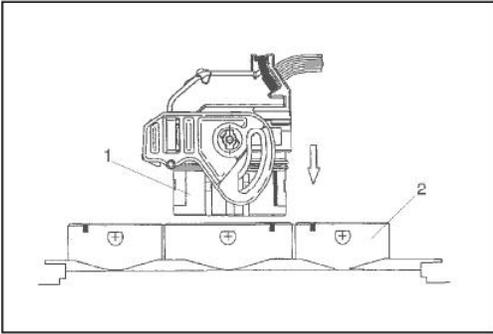
3) Measure voltage at each terminal with ignition switch turned on according to Diag. Flow Table after connecting ECM connectors (1) to ECM (2) securely.

**NOTE:**

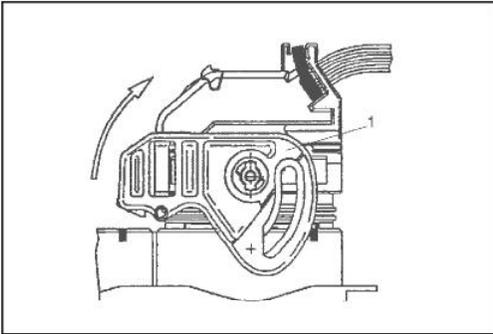
**As each terminal voltage is affected by the battery voltage, confirm that it is 11 V or more when ignition switch is ON.**



4) After measuring, disconnect ECM connectors from ECM.  
 5) Install harness covers (1) to ECM connectors assembly (2) by fastening clamps (3).



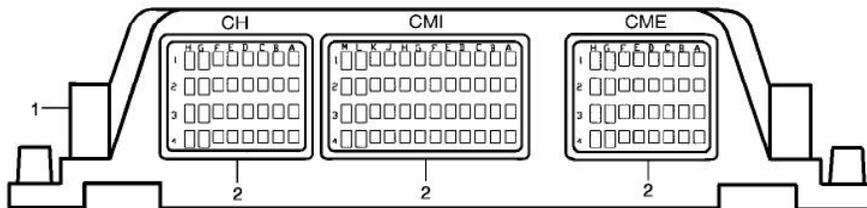
6) Connect ECM connectors (1) to ECM (2).



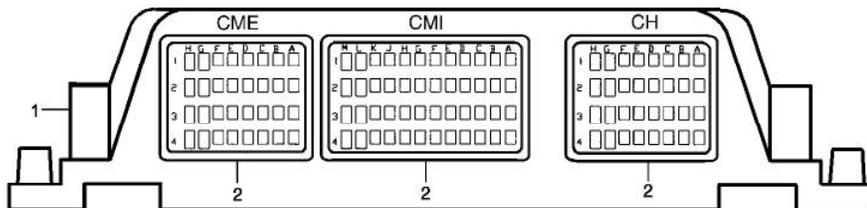
7) Lock ECM connectors by rotating the lock levers (1) till the stop and the locking on the cover.

8) Install ECM to bracket referring to "ENGINE CONTROL MODULE" in this section.

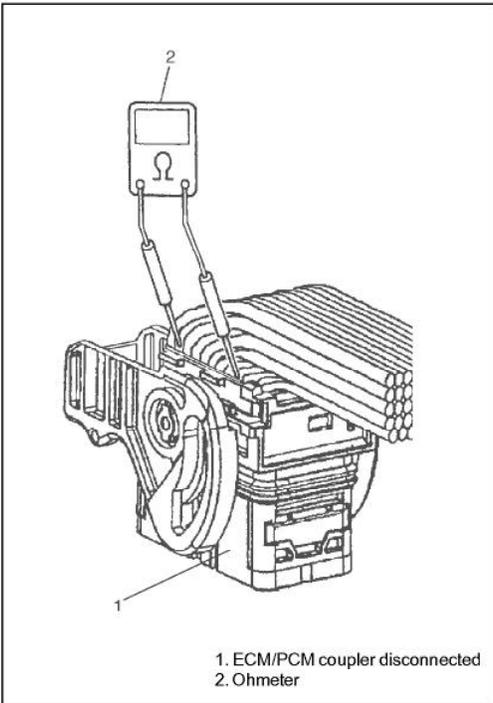
**TYPE 1 ECM**



**TYPE 2 ECM**



- 1. PCM (ECM)
- 2. PCM (ECM) connectors (Viewed from harness side)



**Resistance Check**

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

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

2) Check resistance between each pair of terminals of disconnected couplers as listed in the following table.

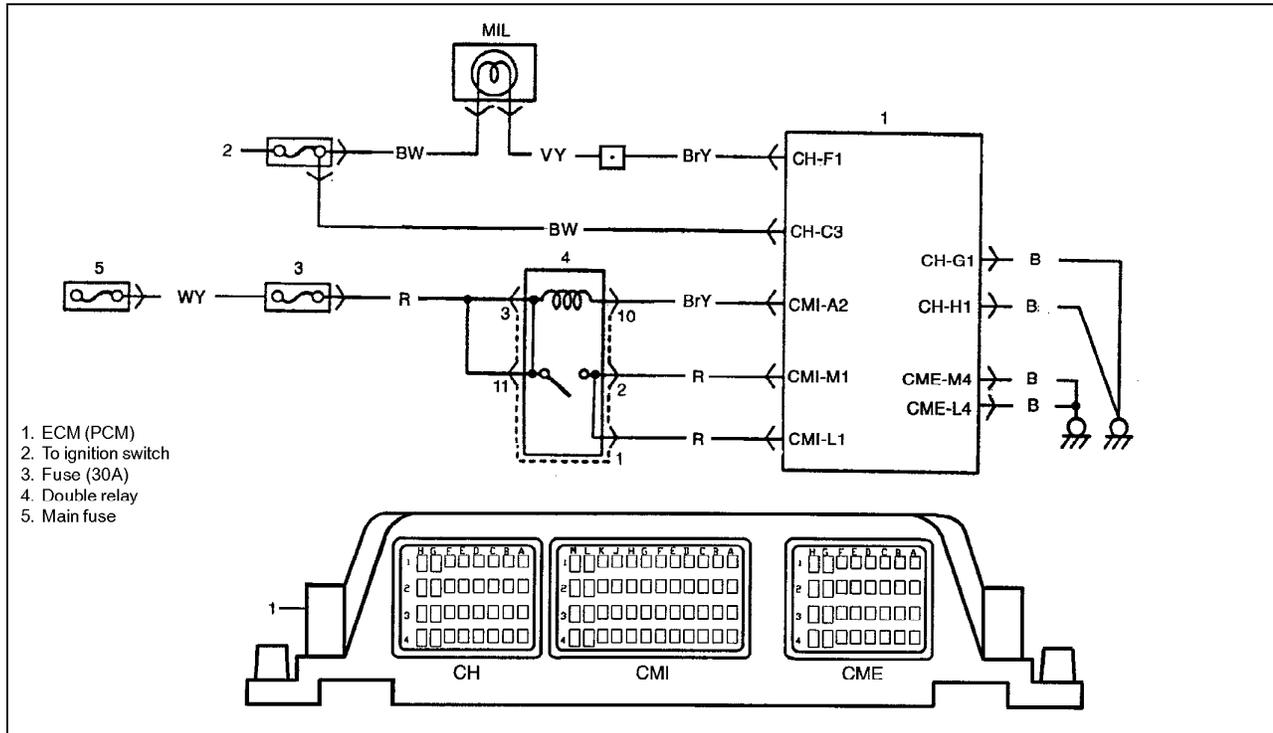
**CAUTION:**

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

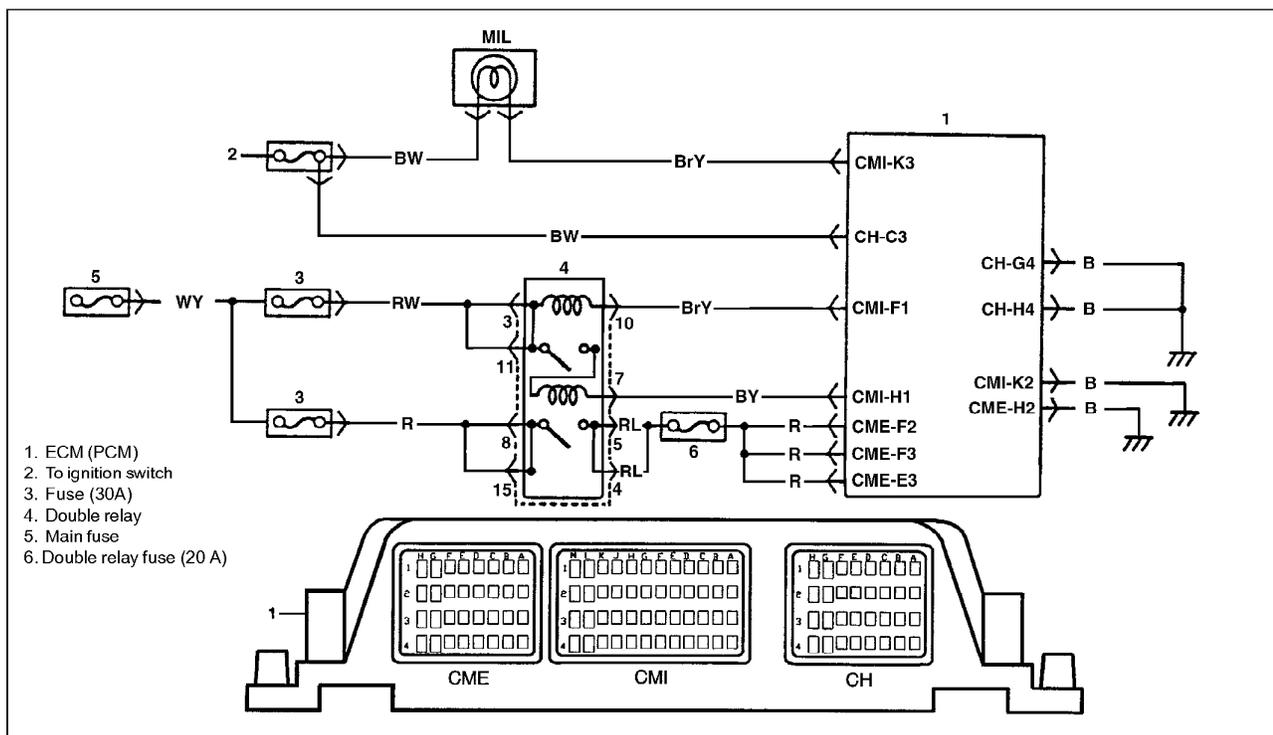
TERMINAL (TYPE 1)	TERMINAL (TYPE 2)	CIRCUIT	STANDARD RESISTANCE	CONDITION
CME-G1 to CME-H2	CMI-L3 to CMI-M2	Fuel injector No.1	Max. 0.6 Ω	-
CME-H4 to CME-H3	CMI-L4 to CMI-L1	Fuel injector No.2	Max. 0.6 Ω	-
CME-G4 to CME-G3	CMI-L2 to CMI-M3	Fuel injector No.3	Max. 0.6 Ω	-
CME-H1 to CME-G2	CMI-M4 to CMI-M1	Fuel injector No.4	Max. 0.6 Ω	-
CMI-J1 to CMI-K1	CMI-J4 to CMI-K4	CKP sensor	315 – 405 Ω	At 20 °C (68 °F)
CMI-D2 to CMI-E2	CMI-F3 to CMI-H4	Fuel temp. sensor	Refer to "FUEL TEMP. SENSOR" in Section 6E3.	
CMI-L2 to CMI-M1	CME-H1 to CME-E3	Fuel pressure regulator	2 – 3 Ω	At 20 °C (68 °F)
CMI-E1 to CMI-D1	CMI-E1 to CMI-E4	ECT sensor	Refer to "ECT SENSOR" in Section 6E3.	
CMI-L4 to Body ground	CMI-K2 to Body ground	Ground	Continuity	-
CH-G1 to Body ground	CH-H4 to Body ground	Ground	Continuity	-
CMI-M4 to Body ground	CME-H2 to Body ground	Ground	Continuity	-
CH-H1 to Body ground	CH-G4 to Body ground	Ground	Continuity	-

**TABLE A-1 MALFUNCTION INDICATOR LAMP CIRCUIT CHECK – MIL DOES NOT COME “ON” OR DIMS AT IGNITION SWITCH ON (BUT ENGINE AT STOP)**

**TYPE 1 WIRING DIAGRAM**



**TYPE 2 WIRING DIAGRAM**



**CIRCUIT DESCRIPTION**

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

**INSPECTION**

STEP	ACTION	YES	NO
1	MIL Power Supply Check: 1) Turn ignition switch ON. Do other indicator/warning lights in combination meter come ON?	Go to Step 2	"IG" fuse blown, main fuse blown, 30A fuse blown, Ignition switch malfunction, "BW" circuit between "IG" fuse and combination meter or poor coupler connection at combination meter.
2	ECM Power and Ground Circuit Check: Does engine start?	Go to Step 3	Go to TABLE A-3 ECM (PCM) POWER AND GROUND CIRCUIT CHECK. If engine is not cranked, go to DIAGNOSIS in Section 6G or 6G1 .
3	MIL Circuit check: 1) Turn ignition switch OFF and disconnect connectors from ECM. 2) In Type 1 vehicles, check for proper connection to ECM at terminal CH-F1. In Type 2 vehicles, check for proper connection to ECM at terminal CMI-K3. 3) If O.K., then using service wire, ground terminal CH-F1 (Type 1 Vehicles) or CMI-K3 (Type 2 vehicles) in connector disconnected. Does MIL turn on at ignition switch ON?	Substitute a knowngood ECM (PCM) and recheck.	Bulb burned out or "VY/BrY" wire circuit open.

**TABLE A-2 MALFUNCTION INDICATOR LAMP CIRCUIT CHECK – MIL REMAINS "ON" AFTER ENGINE STARTS**

**WIRING DIAGRAM/CIRCUIT DESCRIPTION**

Refer to TABLE A-1.

**INSPECTION**

STEP	ACTION	YES	NO
1	DTC Check. 1) With ignition switch OFF, install scan tool. 2) Start engine and check DTC. Is there any DTC(s)?	Go to step 2 of "ENGINE DIAG. FLOW TABLE" in this section.	Go to step 2
2	MIL circuit Check: 1) With ignition switch OFF, disconnect couplers from ECM (PCM). Does MIL turn ON at ignition switch ON?	"VY/BrY" wire shorted to ground circuit.	Substitute a known-good ECM (PCM) and recheck.

**TABLE A-3 ECM (PCM) POWER AND GROUND CIRCUIT CHECK-MIL DOESN'T LIGHT AT IGNITION SWITCH ON AND ENGINE DOESN'T START THOUGH IT IS CRANKED UP.****WIRING DIAGRAM**

Refer to TABLE A-1.

**CIRCUIT DESCRIPTION**

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

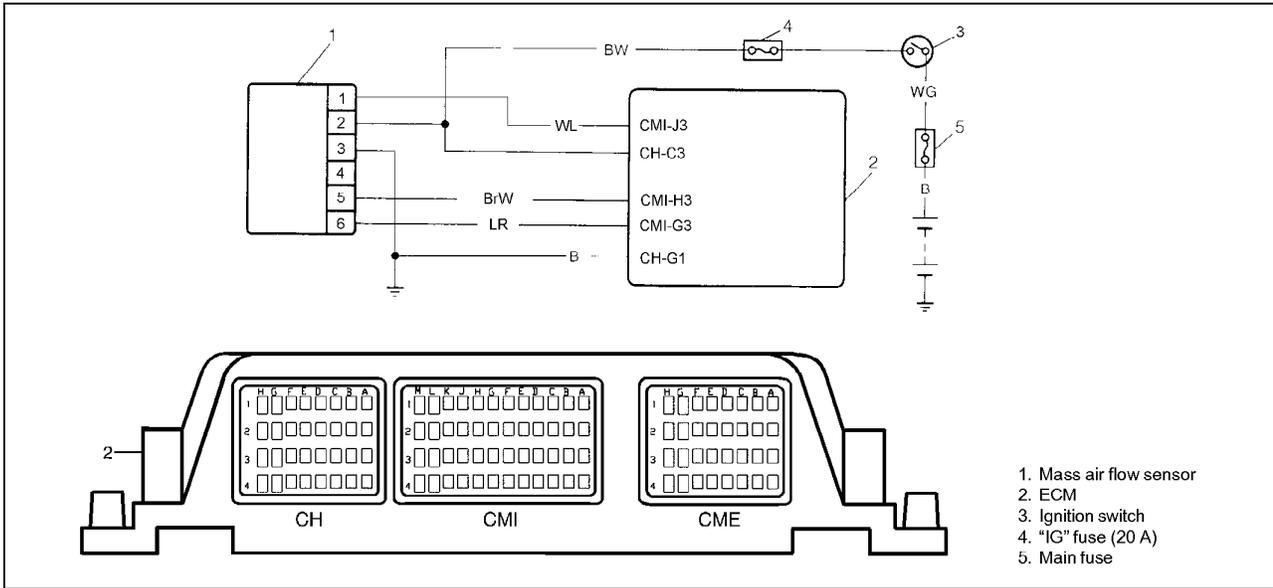
**INSPECTION**

STEP	ACTION	YES	NO
1	Double Relay Operating Sound Check: Is operating sound of double relay heard at ignition switch ON?	Go to Step 5.	Go to Step 2.
2	Fuse Check: Is main fuse in good condition?	Go to Step 3.	Check for short in circuits connected to this fuse.
3	Double Relay Check: 1) Turn OFF ignition switch and remove double relay. 2) Check for proper connection to double relay at terminal 3 and 10. 3) If OK, check double relay referring to "Double Relay Inspection" in Section 6E3. Is check result satisfactory?	Go to Step 4.	Replace main relay.
4	ECM (PCM) Power Circuit Check: 1) Turn OFF ignition switch, disconnect connectors from ECM (PCM) and install main relay. 2) Check for proper connection to ECM (PCM) at terminals CH-C3, CMI-A2, CMI-M1 and CMI-L1 (Type 1 vehicles) or at terminals CH-C3, CMI-F1, CMI-H1, CME-F2, CME-F3 and CME-E3 (Type 2 vehicles). 3) If OK, then measure voltage between terminal CH-C3 and ground and CMI-A2 and ground (Type 1 vehicles) or between terminal CH-C3 and ground, CMI-F1 and ground, CMI-H1 and ground, CME-F2 and ground, CME-F3 and ground and CME-E3 and ground (Type 2 vehicles), with ignition switch ON. Is each voltage 10 – 14 V?	Go to Step 5.	"BW", "BrY" or "R" circuit open (Type 1 vehicles). "BW", "BrY", "BY" or any "R" circuit open (Type 2 vehicles).
5	ECM Power Circuit Check: 1) Using service wire, ground terminal CMI-A2 and measure voltage between terminal CMI-M1 and ground, CMI-L1 and ground at ignition switch ON. Is it 10 – 14 V?	Check ground circuits "B" for open. If OK, then substitute a known-good ECM (PCM) and recheck.	Go to Step 6
6	Is operating sound of double relay heard in Step 1?	Go to Step 7.	Any "R" wire open
7	Double Relay Check: 1) Check double relay according to procedure in Step 3. Is main relay in good condition?	Any "R" wire open.	Replace double relay.

## TYPE 1 VEHICLE DIAGNOSIS

### DTC P0100 (DTC P0100) MASS AIR FLOW CIRCUIT MALFUNCTION

#### WIRING DIAGRAM



#### DTC CONFIRMATION PROCEDURE

##### NOTE:

Check to make sure that the following conditions are satisfied when using this DTC CONFIRMATION PROCEDURE.

- Intake air temp.: -8°C, 18°F or higher
- Engine coolant temp.: -8 - 110°C (18 - 230°F)
- Altitude (barometric pressure): 2,400 m, 8,000 ft or less (560 mmHg, 75 kPa or more)

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

**6-38 ENGINE DIAGNOSIS (HDI ENGINE)**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	MAF sensor power supply Check: 1) With ignition switch OFF, disconnect MAF sensor coupler. 2) With ignition switch ON, check voltage between "BW" wire terminal of MAF sensor coupler and ground. Is voltage 10 - 14 V?	Go to Step 3.	Faulty "BW" wire.
3	MAF sensor output voltage Check: 1) With ignition switch OFF, connect MAF sensor coupler. 2) Remove ECM (PCM) cover. 3) Start engine and check voltage between CMI-H3 and CH-G1 terminal at idle speed. Is voltage about 2 V?	Poor CMI-H3 connection, Faulty "LR" wire and Poor CMI-G3 connection. If OK, substitute a known-good ECM and recheck. (See NOTE)	Faulty "BrW" wire. Poor MAF sensor coupler terminal connection. If wire and connection are OK, substitute a known-good MAF sensor and recheck.

**NOTE:**

If DTC is checked using generic scan tool only and DTC P0101 (P0100) Diag. Flow Table is not performed yet, go to the table before ECM replacement.

**DTC P0101 (P0100) MAF SENSOR CIRCUIT RANGE/ PERFORMANCE PROBLEM****WIRING DIAGRAM**

Refer to DTC P0100.

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

Check to make sure that the following conditions are satisfied when using this DTC CONFIRMATION PROCEDURE.

- Intake air temp.: -8°C, 18°F or higher
- Engine coolant temp.: -8 -110°C (18 - 230°F)
- Altitude (barometric pressure): 2,400 m, 8,000 ft or less (560 mmHg, 75 kPa or more)

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Then run engine over 3,000 rpm for 10 sec. or more.
- 4) Check DTC and pending DTC.

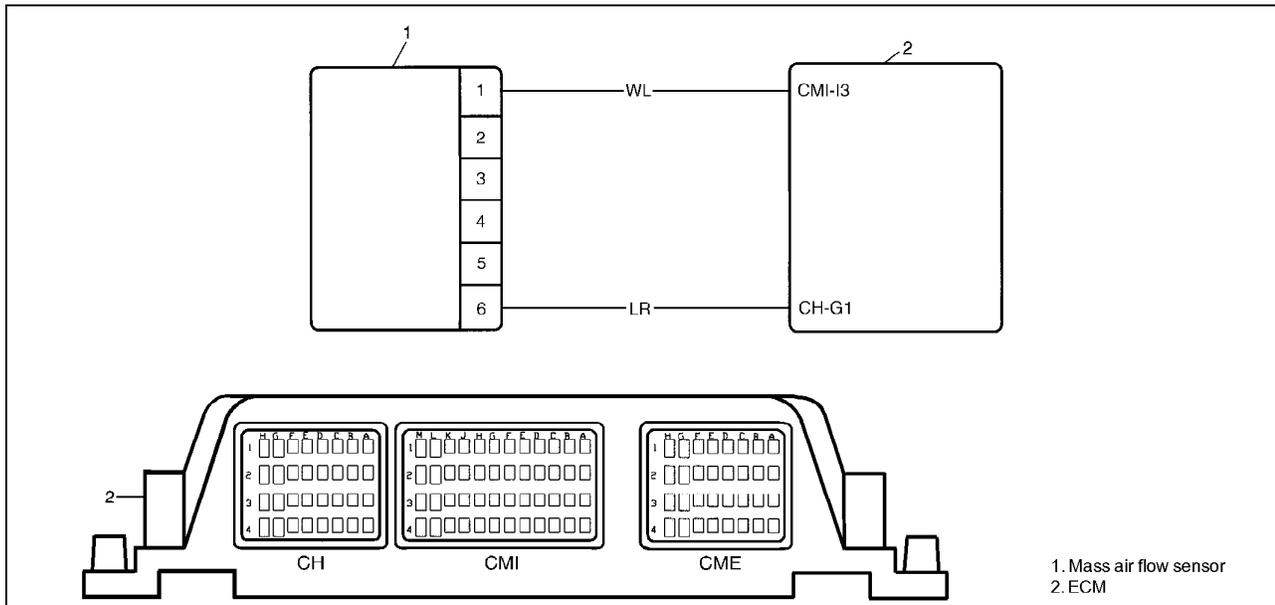
**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	1) Remove ECM (PCM) cover referring to "Voltage Check" in this section. 2) Start engine and check voltage between CMI-H3 and CH-G1 terminals. Engine speed at 3,000 rpm: about 3.1 V Engine speed at idling: about 2 V Is each value satisfied?	Intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section OA. (See NOTE.)	Clogged or leaky air intake system. If all are OK, substitute a known-good MAF sensor and recheck.

**NOTE:** If DTC is checked using generic scan tool only and DTC P0100 (P0100) Diag. Flow Table is not performed yet, go to the table before ECM replacement.

## DTC P0110 INTAKE AIR TEMP (IAT) CIRCUIT MALFUNCTION

### WIRING DIAGRAM



### DTC CONFIRMATION PROCEDURE

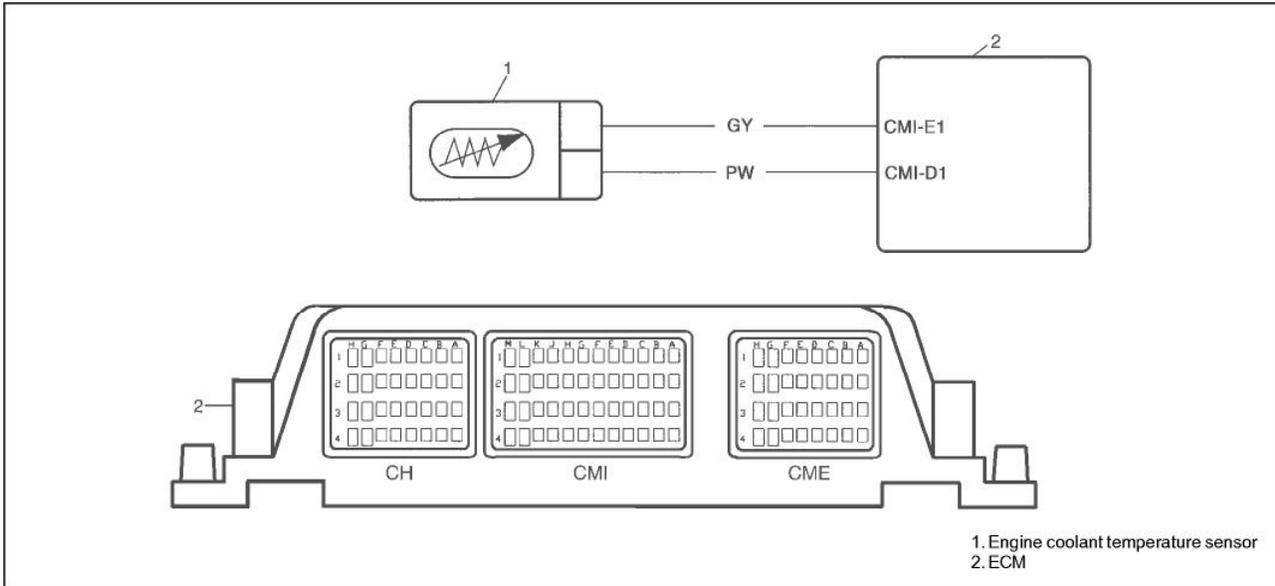
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn OFF ignition switch, then ON.
- 4) Check DTC and pending DTC by using scan tool.

## TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check IAT Sensor and Its Circuit. 1) Connect scan tool with ignition switch OFF. 2) Turn ignition switch ON. 3) Check intake air temp. displayed on scan tool. Is -40°C (-40°F) or 131 °C (268°F) indicated?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section OA.
3	Check Wire Harness. 1) Disconnect MAF sensor (built-in IAT sensor) connector with ignition switch OFF. 2) Check for proper connection to MAF sensor (built-in IAT sensor) at "WL" and "LR" wire terminals. 3) If OK, then with ignition switch ON, is voltage applied to "WL" wire terminal of harness side about 5 V?	Go to Step 4.	"WL" wire open or shorted to power, or poor CMI-J3 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Does scan tool indicate -40°C (-40°F) at Step 2?	Go to Step 6.	Go to Step 5.
5	Check Wire Harness. 1) Disconnect MAF sensor connector. 2) Check intake air temp. displayed on scan tool. Is -40°C (-40°F) indicated?	Replace MAF sensor.	"WL" wire shorted to ground. If wire is OK, substitute a known-good ECM and recheck.
6	Check Wire Harness. 1) Using service wire, connect MAF sensor (built-in IAT sensor) connector terminals (between "WL" wire terminal and "LR" wire terminal of harness side). 2) Turn ignition switch ON and check intake air temp. displayed on scan tool. Is 131 °C (268°F) indicated?	Replace MAF sensor (built-in IAT sensor).	"LR" wire open or poor CH-G1 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

**DTC P0115 (DTC P0115) ENGINE COOLANT TEMP. SENSOR CIRCUIT MALFUNCTION**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

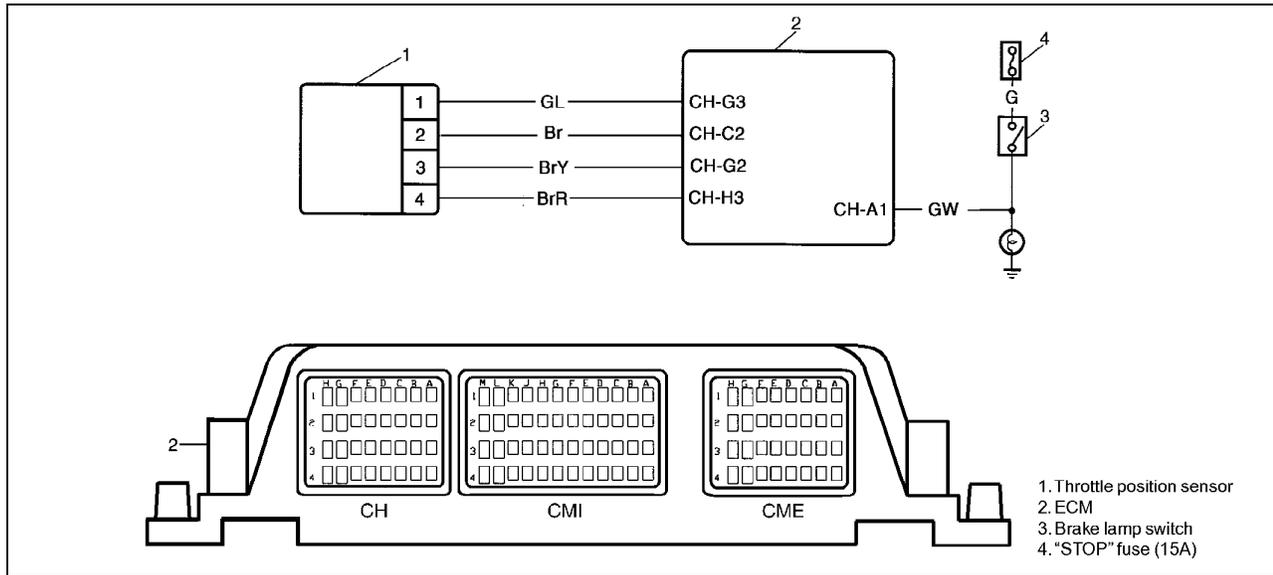
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Wire Harness. 1) Disconnect ECT sensor connector with ignition switch OFF. 2) Check for proper connection to ECT sensor at "PW" and "GY" wire terminals. 3) If OK, check voltage between "PW" and "GY" wire terminals of harness side with ignition switch ON. Is voltage about 5 V?	Go to Step 3.	"GY" wire open or shorted to power/ground. "PW" wire open. Poor CMI-E1 or CMI-D1 connection.
3	Check ECT Sensor and Its Circuit. 1) Connect ECT sensor to its connector. 2) Connect scan tool to DLC with ignition switch OFF and run engine. Does coolant temp. on scan tool vary?	Substitute a known-good ECM and recheck.	Faulty ECT sensor.

**DTC P0121 (P0120) THROTTLE POSITION CIRCUIT RANGE/PERFORMANCE PROBLEM**  
**DTC P0604 (P0120) THROTTLE POSITION SENSOR MONITORING SYSTEM MALFUNCTION**

**WIRING DIAGRAM**



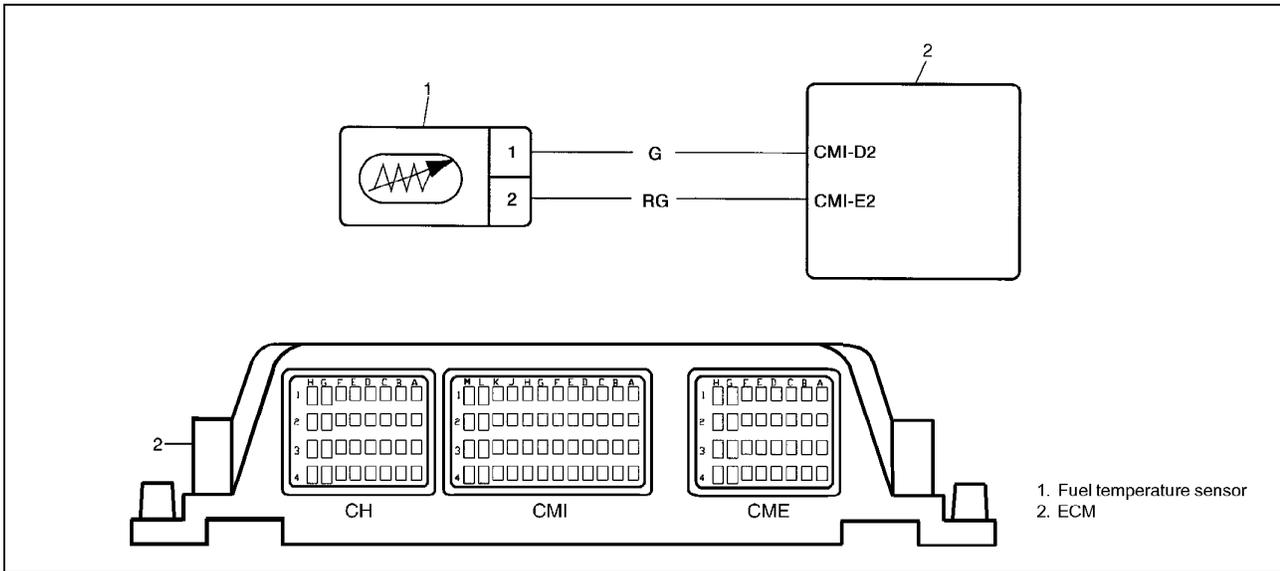
**DTC CONFIRMATION PROCEDURE**

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

## TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Sensor Power Supply Circuit Is DTC below also indicated? <Using Suzuki mode of Suzuki Scan tool> P1614 <Using Generic Scan tool or Euro mode of Suzuki Scan tool> P0560	Go to DTC P1614 (P0560) Diag. Flow Table.	Go to Step 3.
3	Check Wire Harness. 1) Disconnect connector from TP sensor with ignition switch OFF. 2) Check for proper connection to TP sensor at each terminals. 3) If OK, then with ignition switch ON, check voltage between "BrY" wire and "BrR" wire terminals at connector of TP sensor. Is voltage about 5 V?	Go to Step 4.	"BrY" wire open, "BrR" wire open, poor CH-G2 connection, or poor CH-H3 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check TP Sensor output voltage. 1) Remove ECM cover referring to "Voltage Check" in this section. 2) With ignition switch ON, check voltage between CH-G3 and ground, when accelerator pedal is at idle position to fully depressed position. Is voltage 0.5 - 3.35 V?	Substitute a known-good ECM and recheck.	"GL" wire open, "GL" wire shorted to ground circuit/power circuit. Poor TP sensor connector. If wire and connection are OK, substitute a known-good TP sensor.

**DTC P0180 FUEL TEMP. SENSOR CIRCUIT MALFUNCTION  
WIRING DIAGRAM**



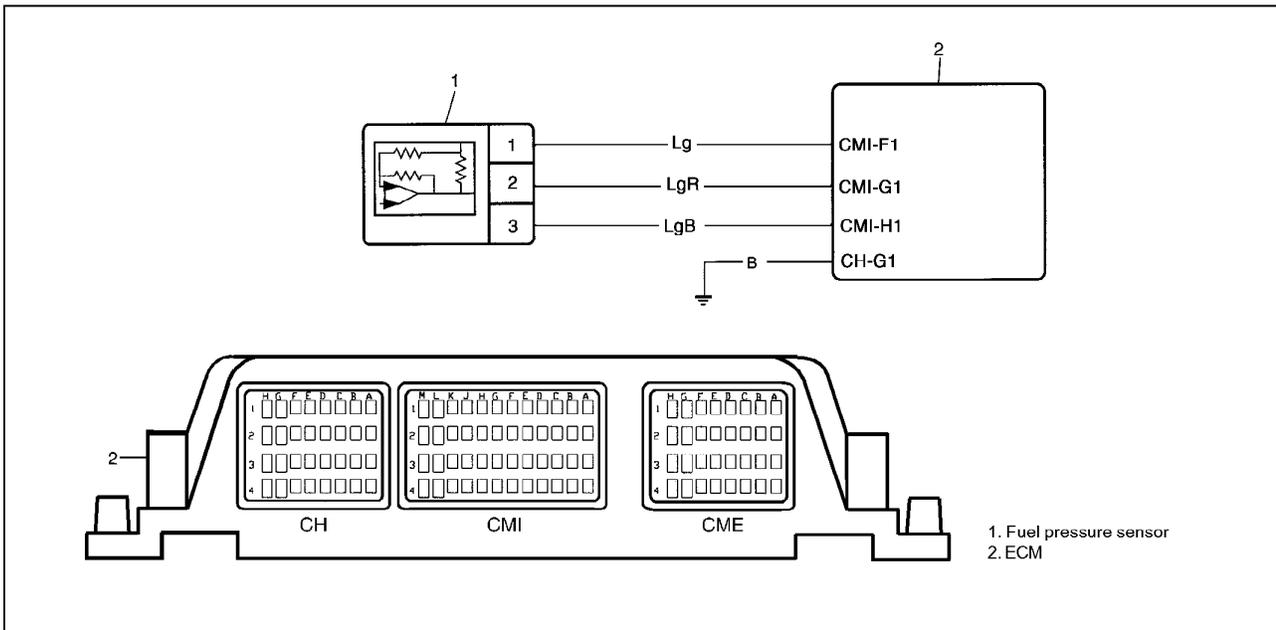
**DTC CONFIRMATION PROCEDURE**

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

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2. "FLOW TABLE".	Go to "ENGINE DIAG.
2	1) Disconnect fuel temp. sensor connector with ignition switch OFF. 2) Check for proper connection to fuel temp. sensor at "RG" and "G" wire terminals. 3) If OK, check voltage between "RG" and "G" wire terminals with ignition switch ON. Is voltage about 5 V?	Go to Step 3.	"RG" wire open or shorted to power/ground. "G" wire open, Poor CMI-E2 or CMI-D2 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
3	1) Check fuel temp. sensor for resistance referring to "FUEL TEMPERATURE SENSOR" in Section 6E3. Is resistance as specified?	Substitute a known-good fuel temp. sensor and recheck.	Replace fuel temp. sensor.

**DTC P0190 (P0190) FUEL RAIL PRESSURE SENSOR CIRCUIT MALFUNCTION  
WIRING DIAGRAM**



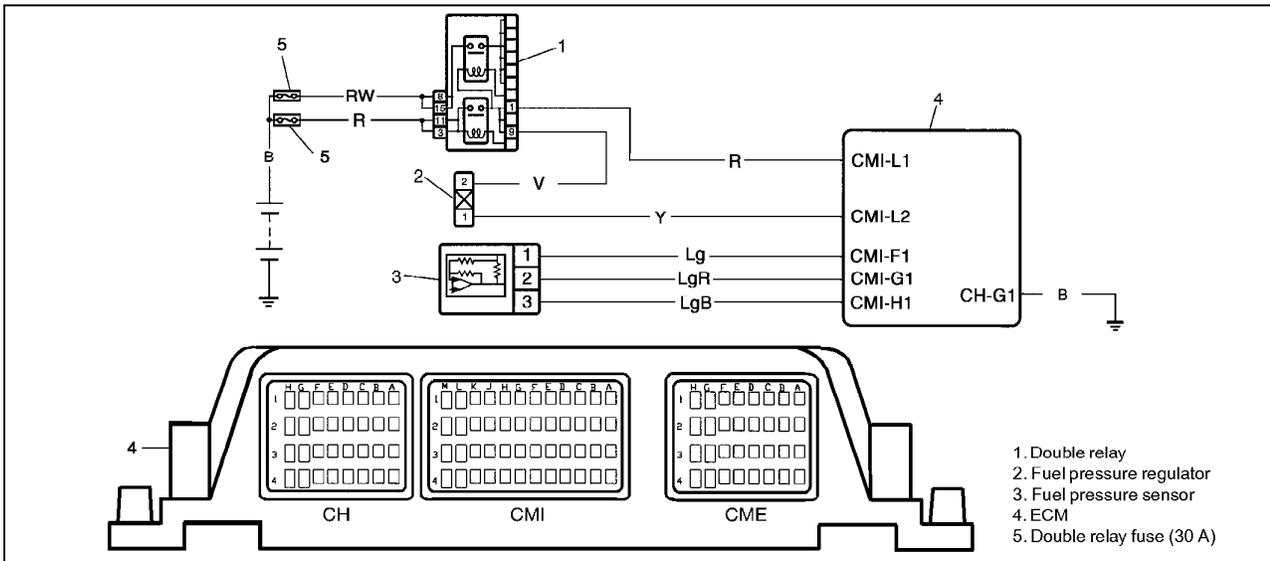
**DTC CONFIRMATION PROCEDURE**

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

## TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2. FLOW TABLE".	Go to "ENGINE DIAG.
2	Check Sensor Power Supply Circuit 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Does scan tool indicate DTC as shown below? <Using Suzuki mode of Suzuki Scan tool> P1614 <Using Generic Scan tool or Euro mode of Suzuki Scan tool> P0560	Go to DTC P1614 (P0560) Diag. Flow Table.	Go to Step 3.
3	Check Wire Harness 1) Disconnect connector from fuel pressure sensor with ignition switch OFF. 2) Check for proper connection to fuel pressure sensor at each terminals. 3) If OK, then with ignition switch ON, check voltage between "LgB" wire and "Lg" wire terminals at connector of fuel pressure sensor.	Go to Step 4.	"LgB" wire open, "LgB" wire shorted to ground circuit/power circuit, "Lg" wire open. Poor CMI-H1 connection, or poor CMI-F1 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check Fuel Pressure Sensor Output Voltage 1) Remove ECM cover referring to "Voltage Check" in this section. 2) Connect fuel pressure sensor connector. 3) Start engine and check voltage between CMI-G1 and CH-G1 terminal at idle speed. Is voltage about 1.3 V?	Substitute a known-good ECM and recheck.	"LgB" wire open, "LgR" wire shorted to ground circuit/power circuit. If wire and connection are OK, substitute a known-good fuel pressure sensor and recheck.

**DTC P0191 (P0230) FUEL RAIL PRESSURE SENSOR/PRESSURE REGULATOR CONSISTENCY FUNCTION**  
**DTC P1112 (P0230) FUEL PRESSURE MONITORING CIRCUIT MALFUNCTION**  
**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Then run engine 1000 rpm or more for 10 sec.
- 4) Check DTC and pending DTC by using scan tool.

## TROUBLESHOOTING

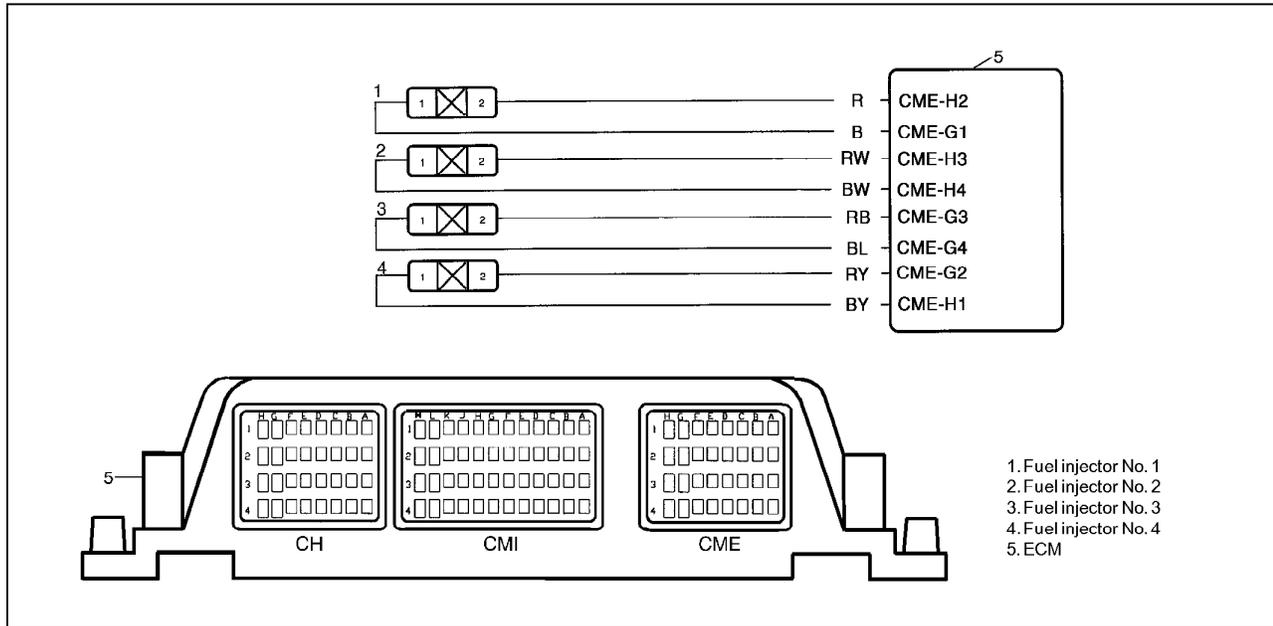
STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Fuel Shortage 1) Is there enough fuel in fuel tank?	Go to Step 3.	Supply fuel into fuel tank.
3	Check Wire Harness 1) With ignition switch OFF, disconnect ECM connector. 2) Check for proper connection to ECM at CMI-L1 and CMI-L2 terminals. 3) If OK, check resistance between CMI-L1 and CMI-L2 terminals. Is resistance 2 - 3 $\Omega$ ?	Go to Step 4.	Faulty "R" wire, "V" or "Y" wire. If wire is OK, substitute a known-good double relay or injection pump and recheck.
4	Check Fuel Pressure Sensor Output Voltage 1) Remove ECM cover referring to "Voltage Check" in the Section. 2) Connect fuel pressure sensor connector. 3) Start engine and check voltage between CMI-G1 and CH-G1 terminal at idle speed. Is voltage about 1.3 V?	Go to Step 5.	"LgR" wire open, "LgR" wire shorted to ground circuit/power circuit. Poor fuel pressure sensor connector terminal connection. If wire and connection are OK, substitute a known-good fuel pressure sensor and recheck.
5	Check Fuel Leakage 1) Perform step 1), 2) and 3) of "DTC CONFIRMATION PROCEDURE". 2) Check fuel leakage on Fuel System. Is it in good condition?	<ul style="list-style-type: none"> <li>• Fuel line clogged.</li> <li>• Faulty fuel pressure regulator.</li> </ul> If OK, substitute a known-good ECM and recheck. (See NOTE.)	Repair or replace.

**NOTE:**

If DTC is checked using generic scan tool only and DTC P1138 (P0230) Diag. Flow Table is not performed yet, go to the table before ECM replacement.

**DTC P0201 (P0200) INJECTOR CIRCUIT MALFUNCTION CYLINDER 1**  
**DTC P0202 (P0200) INJECTOR CIRCUIT MALFUNCTION CYLINDER 2**  
**DTC P0203 (P0200) INJECTOR CIRCUIT MALFUNCTION CYLINDER 3**  
**DTC P0204 (P0200) INJECTOR CIRCUIT MALFUNCTION CYLINDER 4**

**WIRING DIAGRAM**



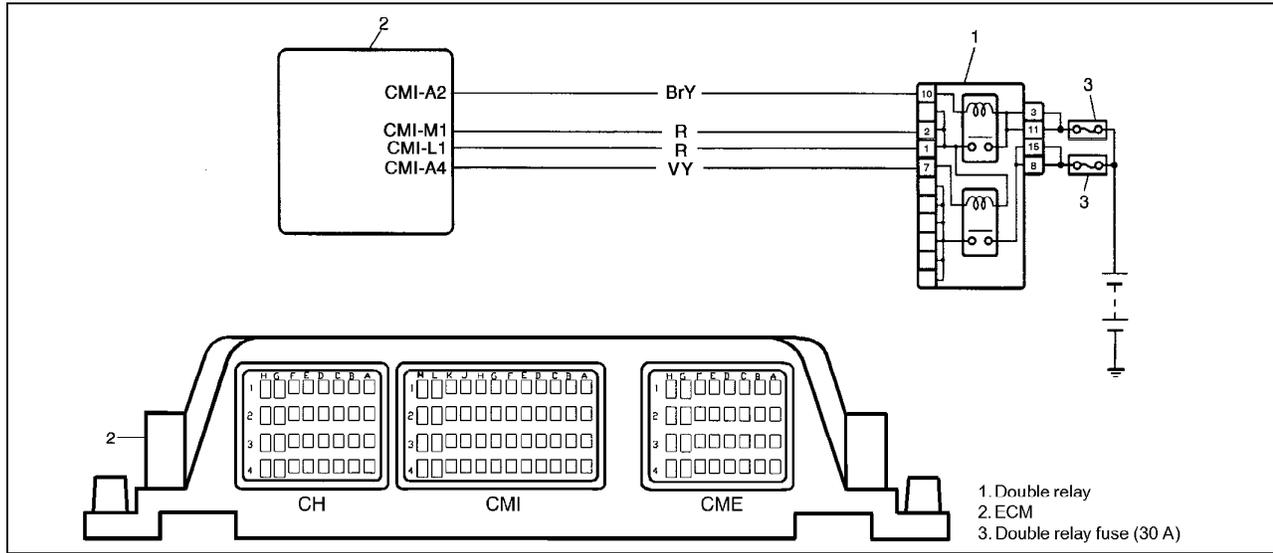
**DTC CONFIRMATION PROCEDURE**

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

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	<p>Check Fuel Injector Circuit For Short</p> <p>1) With ignition switch OFF, disconnect ECM connector.</p> <p>2) Check for proper connection to ECM at CME-H2, CME-G1, CME-H3, CME-H4, CME-G3, CME-G4, CME-G2 and CME-H1 terminals.</p> <p>3) If OK, disconnect connector at all fuel injectors.</p> <p>4) Check for resistance between injector connector terminals.</p> <p>Is resistance between terminals of all fuel injectors infinity (<math>\infty</math>)?</p>	Go to Step 3.	Short circuit between "B" wire and "R" wire, "RW" wire and "BW" wire, "RB" wire and "BL" wire, or "RY" wire and "BY" wire.
3	<p>Check Fuel Injector Circuit For Open</p> <p>1) Connect connector to all fuel injectors.</p> <p>2) Check for resistance between following terminals of ECM connector (Type 1 vehicles):</p> <ul style="list-style-type: none"> <li>CME-G1 and CME-H2: 0.56 <math>\Omega</math> (maximum)</li> <li>CME-H3 and CME-H4: 0.56 <math>\Omega</math> (maximum)</li> <li>CME-G3 and CME-G4: 0.56 <math>\Omega</math> (maximum)</li> <li>CME-G2 and CME-H1: 0.56 <math>\Omega</math> (maximum)</li> </ul> <p>Is check result as specified?</p>	Substitute a known-good ECM and recheck.	Open "B" wire, "R" wire, "RW" wire, "BW" wire, "RB" wire, "BL" wire, "RY" wire or "BY" wire. If wire is OK, substitute a known-good fuel injector and recheck.

**DTC P0215 DOUBLE RELAY CIRCUIT MALFUNCTION**  
**WIRING DIAGRAM**



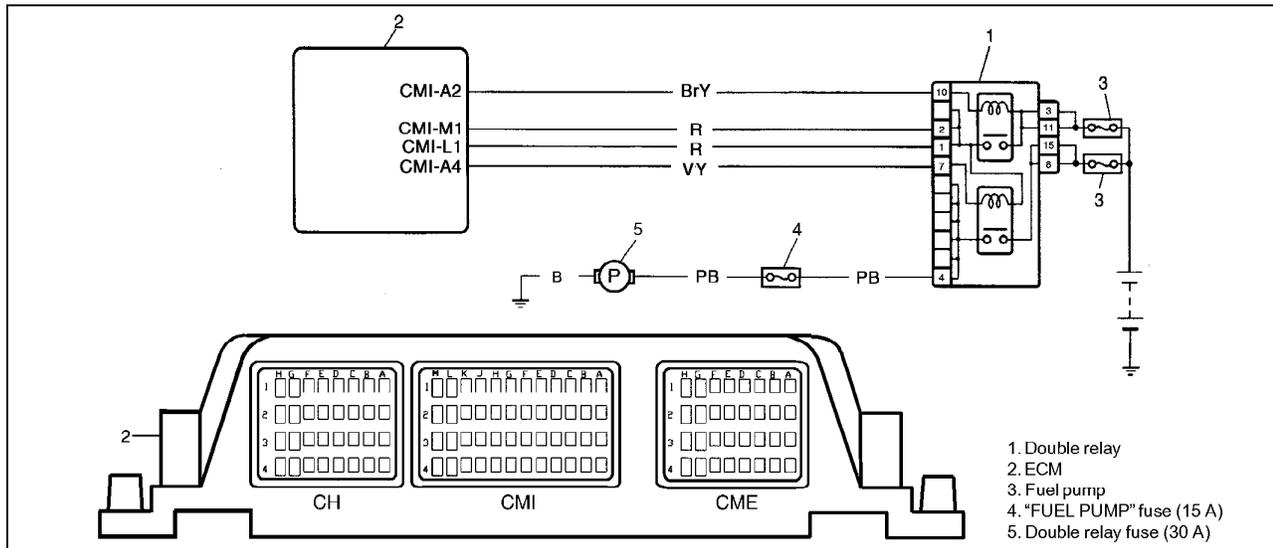
**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF:
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn ON ignition switch after OFF for 5 sec.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Double Relay Function 1) Turn ignition switch ON for 5 sec. and then OFF. Is click of double relay heard from double relay at 2 sec. after ignition switch OFF?	Substitute a known-good ECM and recheck.	Go to Step 3.
3	1) Remove ECM cover referring to "Voltage Check" in this section. 2) Check voltage between CMI-M1, CMI-L1 and ground. Ignition switch ON: 10 -14 V Ignition switch OFF: about 0 V Is check result as specified?	Poor CMI-M1, CMI-L1 connection. If connection is OK, substitute a known-good ECM and recheck.	Go to Step 4.
4	Check Double Relay 1) Check double relay referring to Section 6E3. Is it in good condition?	Go to Step 5.	Faulty double relay.
5	1) Check voltage between CMI-A2 and ground. Ignition switch ON: about 0 V Ignition switch OFF: 10-14 V Is check result as specified?	• Poor CMI-A2 connection, • "R" wire open/short	"BrY" wire open or short.

**DTC P0230 FUEL PUMP SUPPLY CIRCUIT MALFUNCTION  
WIRING DIAGRAM**



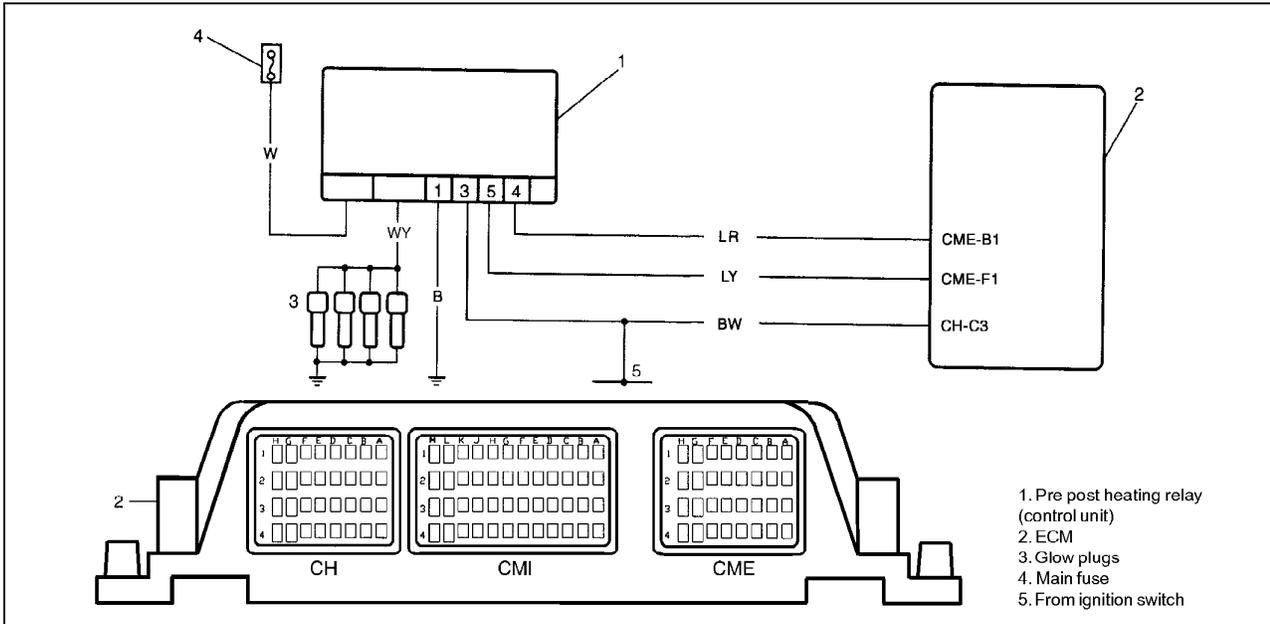
**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Turn ON ignition switch after OFF for 5 sec.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is operating sound heard from fuel pump?	Substitute a known-good ECM and recheck.	Go to Step 3.
3	Check Double Relay 1) Check double relay referring to Section 6E3. Is it in good condition?	Go to Step 4.	Faulty double relay.
4	Check Fuel Pump Output Circuit 1) Remove ECM cover referring to "Voltage Check" in this section. 2) Check voltage between CMI-A4 and ground. • Within 5 sec, after ignition switch ON: about 0 V • Over 5 sec. after Ignition switch OFF: 10 -14 V Is check result as specified?	<ul style="list-style-type: none"> <li>• Poor CMI-A4 connection</li> <li>• "B", "PB" or "PB" wire open/short</li> <li>• Fuse broken or</li> <li>• Faulty fuel pump</li> </ul> If all are OK, substitute a known-good ECM and recheck.	"VY" wire open/short.

**DTC P0380 (P0380)/P1404 (P0380) PRE/POST HEAT RELAY CIRCUIT MALFUNCTION  
WIRING DIAGRAM**



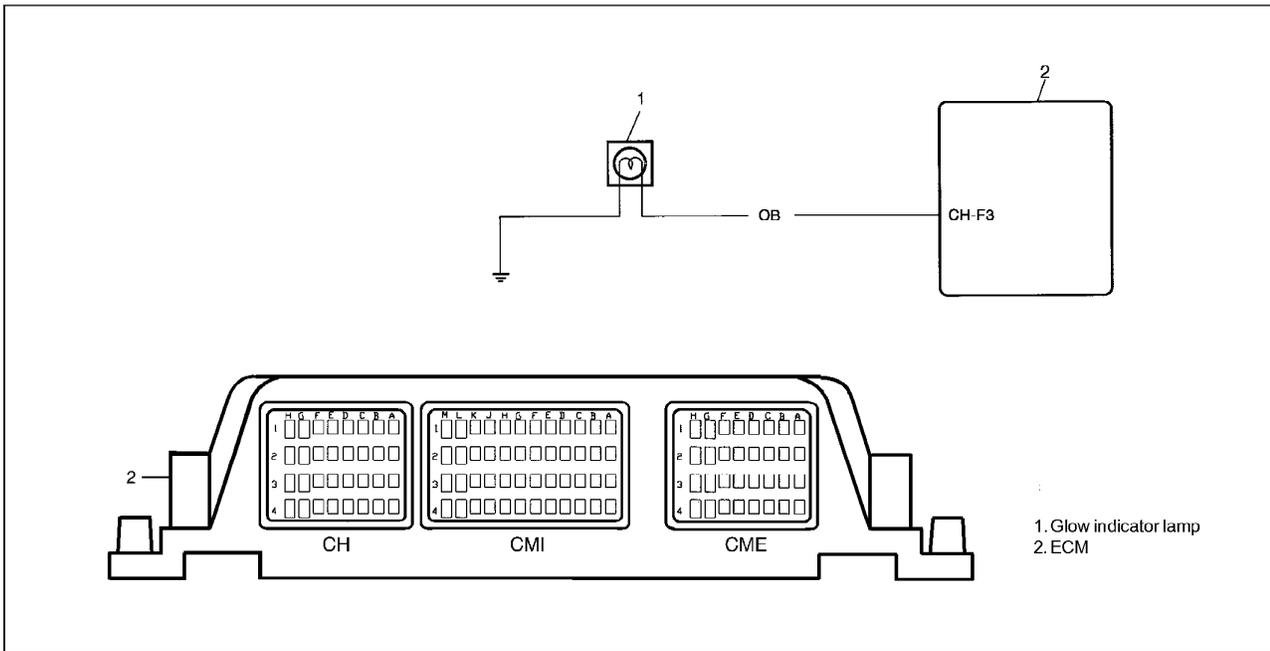
**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn ON ignition switch after OFF for 30 sec.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE",
2	Check Wire Harness 1) Remove ECM covers from ECM referring to "CHECK VOLTAGE" in this section. 2) Check voltage between CME-B1/CH-C3 and ground with ignition switch ON. Are they about 12 V?	Go to Step 3.	<ul style="list-style-type: none"> <li>• "LR" wire open or short to ground, or</li> <li>• "BW" wire open or short to ground</li> </ul>
3	Check Wire Harness 1) Check voltage between CME-F1 and ground with ignition switch ON. Is it about 0 V?	<ul style="list-style-type: none"> <li>• Poor CME-B1 or CME-F1 connection</li> </ul> If connections are in good condition, substitute a known-good ECM and recheck.	<ul style="list-style-type: none"> <li>• "LY" wire open or short,</li> <li>• "B" wire (between pre-post heating relay and ground) open or short to ground</li> <li>• "WY" wire (between pre-post heating relay and glow plug) open or short to ground</li> <li>• Poor glow plug "WY" wire terminal connection</li> </ul> If all are OK, substitute a known-good ECM and recheck.

**DTC P0381 GLOW INDICATOR LAMP CIRCUIT MALFUNCTION  
WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn ignition switch ON for 30 sec. after OFF. Then run engine at idle speed for 30 sec.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2. FLOW TABLE".	Go to "ENGINE DIAG.
2	Check Wire Harness <Not Using Suzuki Scan Tool> 1) Disconnect connectors at ECM with ignition switch OFF. 2) Supply battery power (12 V) to CH-F3 using service wire. Does glow indicator lamp turn on? <Using Suzuki Scan Tool> 1) Connect Suzuki scan tool to DLC. 2) Execute "Glow Indicator Lamp" in Misc Test. Does glow indicator lamp flash?	Substitute a known-good ECM and recheck.	<ul style="list-style-type: none"> <li>• Lamp bulb broken,</li> <li>• "OB" wire open or short or</li> <li>• Poor CH-F3 connection.</li> </ul>

**REFERENCE:**

As soon as ignition is switched on, ECM turns on glow indicator lamp for a period which depends on engine coolant temp. as shown below.

Engine coolant temp. (°C)	Time turning on glow indicator lamp (sec.)
-30	20
-10	5
0	0.5
18	0

**DTC P0401 (P0903) EGR SOLENOID VALVE FLOW INSUFFICIENT DETECTED**  
**DTC P0402 (P0903) EGR SOLENOID VALVE FLOW EXCESSIVE DETECTED**

**DTC CONFIRMATION PROCEDURE**

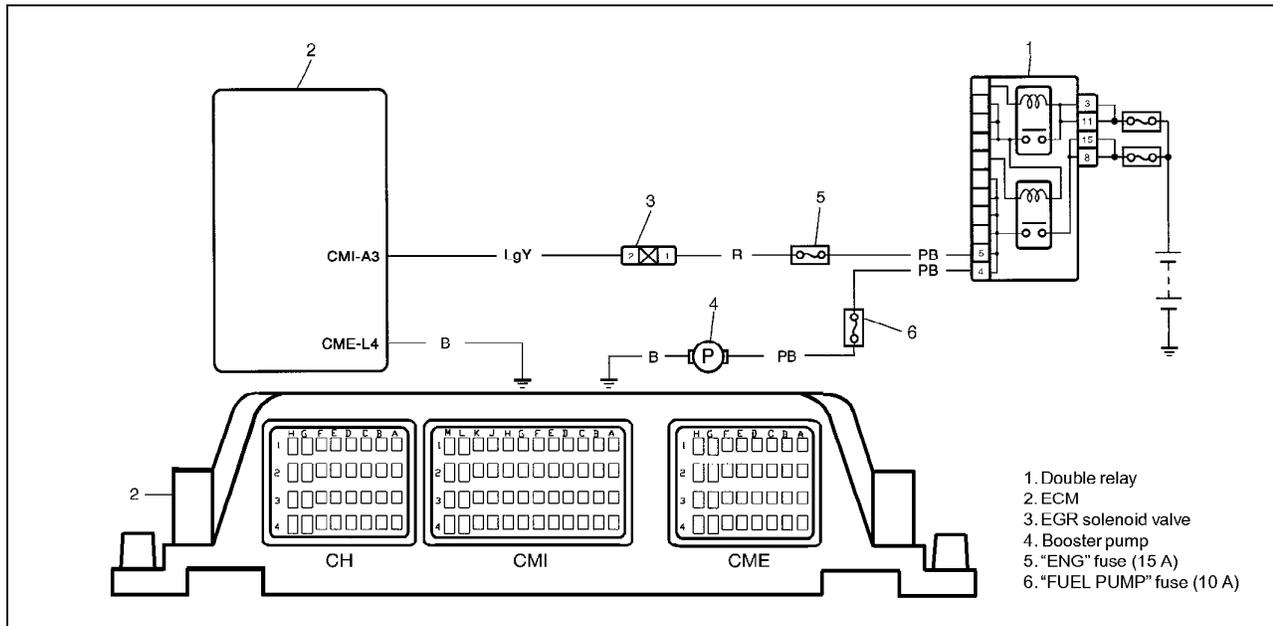
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine between 700 and 2,700 rpm for 10 sec. or more.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check EGR vacuum circuit and intake air circuit for leak. Is it in good condition?	Go to Step 3.	Repair or replace.
3	Check EGR valve referring to "EGR VALVE" in Section 6E3. Is it in good condition?	Go to Step 4.	Faulty EGR valve.
4	Check EGR solenoid valve for resistance referring to "EGR SOLENOID VALVE" in Section 6E3. Is resistance as specified?	Substitute a known-good ECM and recheck.	Replace EGR solenoid valve.

**DTC P0403 (P0403) EGR SOLENOID VALVE CIRCUIT MALFUNCTION**

**WIRING DIAGRAM**



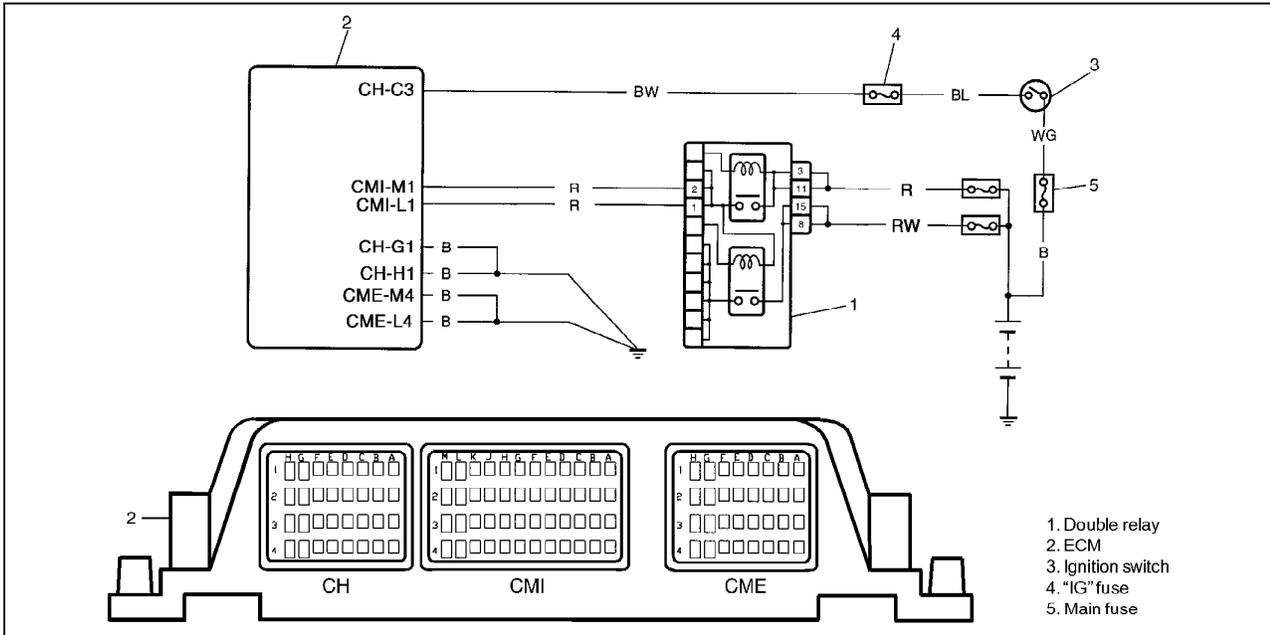
**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is operating sound heard from fuel pump?	Go to Step 3.	Proceed to DTC P0230 Diag. Flow table.
3	Check Wire Harness 1) Disconnect EGR solenoid valve connector with ignition switch turned OFF. 2) With ignition switch ON, check voltage between "R" wire terminal of solenoid valve connector and ground. • Within 5 sec. after ignition switch ON: 10 -14 V • Over 5 sec. after ignition switch ON: about 0 V Is check result as specified?	Go to Step 4.	"R" wire open, shorted to power/ground or fuse broken.
4	Check EGR Solenoid Valve 1) Check solenoid valve referring to Section 6E3. Is it in good condition?	<ul style="list-style-type: none"> <li>• "LgY" wire open or shorted to power/ground</li> <li>• Poor CMI-A3 connection</li> </ul> If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty EGR solenoid valve.

**DTC P0561 (P0560) STABILIZATION OF SENSOR SUPPLY  
 DTC P0603/P0606/P1171/P1617 ECM FUNCTION  
 DTC P1169 (P0170) CONDENSER VOLTAGE FUNCTION 1  
 DTC P1170 (P0170) CONDENSER VOLTAGE FUNCTION 2  
 DTC P1101 (P0105) BAROMETRIC PRESSURE SENSOR CIRCUIT MALFUNCTION  
 WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

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

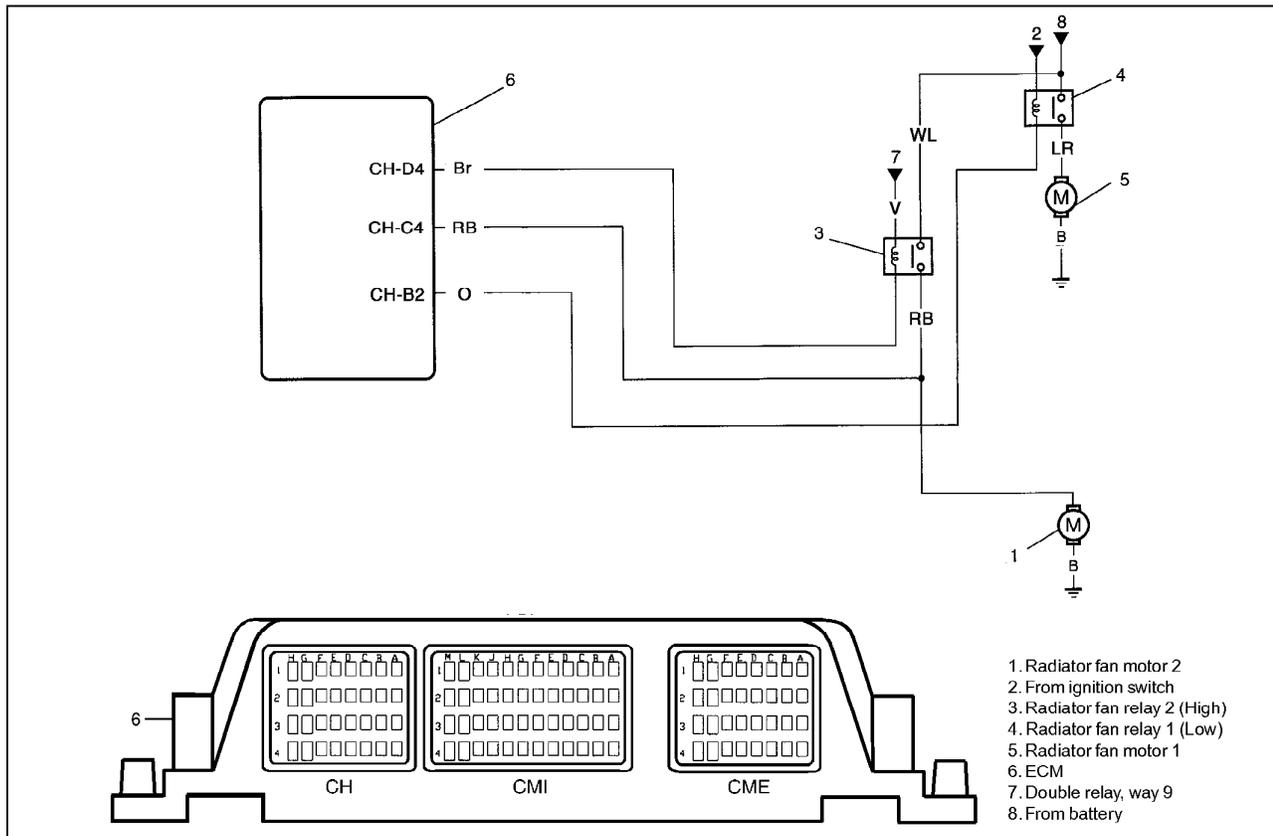
**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Substitute a known-good ECM and recheck. (See NOTE.)	Go to "ENGINE DIAG. FLOW TABLE".

**NOTE:**

If DTC is checked using generic scan tool only and DTC P1614 (P0560) and DTC P0560 (P0560) Diag. Flow Tables are not performed yet, go to the table before ECM replacement.

**DTC P1108 RADIATOR FAN HIGH SPEED CIRCUIT MALFUNCTION  
WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame dat by using scan tool.
- 3) Start engine and warm up completely.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2,	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Wire Harness 1) Disconnect connector at ECM. 2) Check voltage between CH-D4 and ground with ignition switch ON. Is it about 12 V?	Poor CH-D4 connection.	Go to Step 3.
3	Check Radiator Fan Relay 1) Check radiator fan relay 1 and 2 referring to Section 6E3. Are they in good condition?	<ul style="list-style-type: none"> <li>• "Br" wire open or short to ground,</li> <li>• "V" wire open or short to ground,</li> <li>• Fuse broken.</li> </ul>	Faulty radiator fan relay 1 or 2.

**DTC P1109 RADIATOR FAN LOW SPEED CIRCUIT MALFUNCTION****WIRING DIAGRAM**

Refer to DTC P1108

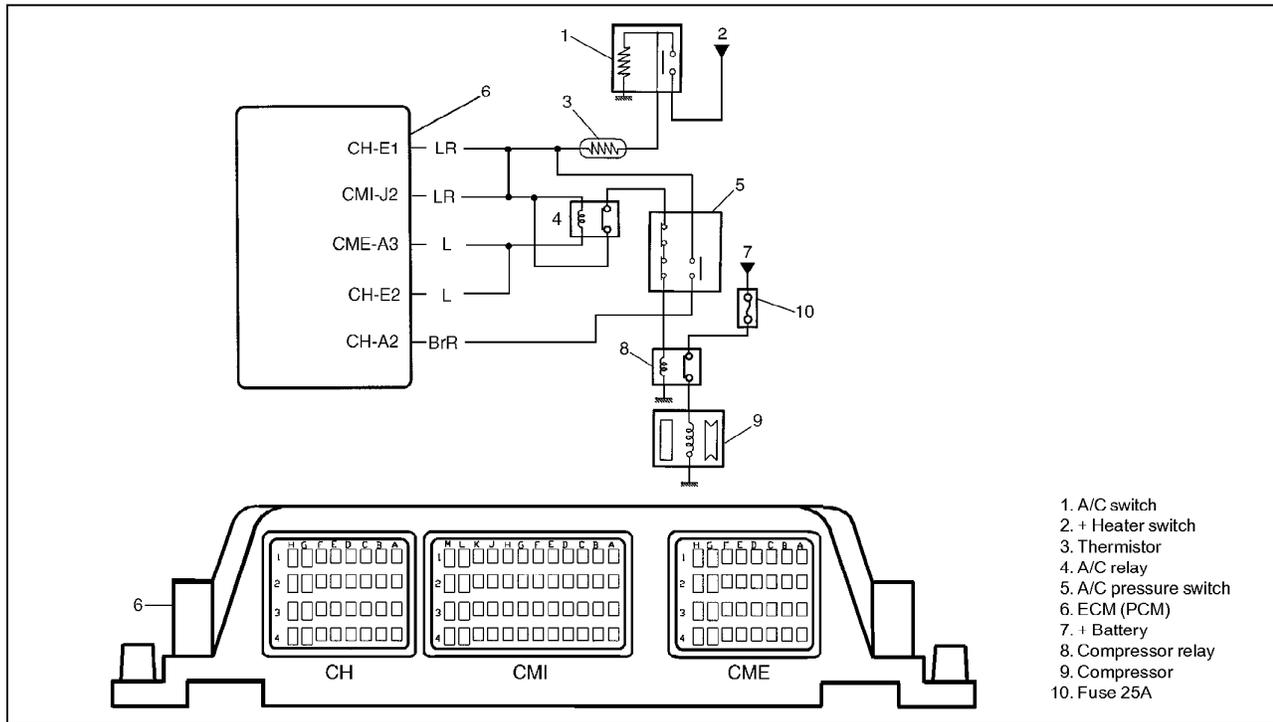
**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn On ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Start engine and warm up completely.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Wire Harness 1) Disconnect connector at ECM. 2) Check voltage between CH-B2 and ground with ignition switch ON. Is it about 12 V?	Poor CH-B2 connection.	Go to Step 3.
3	Check Radiator Fan Relay 1) Check radiator fan relay 2 referring to Section 6E3. Is it in good condition?	<ul style="list-style-type: none"> <li>• "O" wire open or short to ground,</li> <li>• Fuse broken</li> </ul>	Faulty radiator fan relay 2.

**DTC P1110 A/C SIGNAL CIRCUIT MALFUNCTION**  
**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

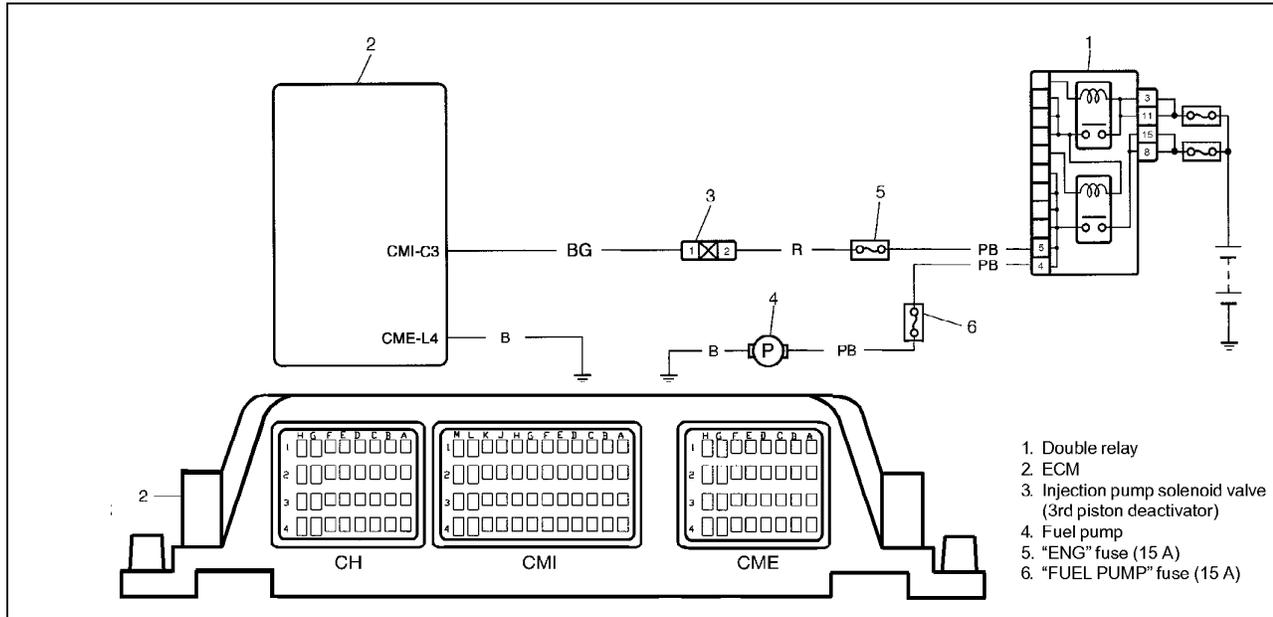
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Start engine and turn on A/C switch and heater blower fan switch.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Wire Harness 1) Remove ECM covers from ECM referring to "Voltage Check" in this section. 2) Check voltage between CH-E1/CMI-J2 and ground at engine idling. Is it as follows? • A/C switch and heater blower switch OFF: 0 V • A/C switch and heater blower switch ON: about 12V	Poor CH-E1/CMI-J2 connection. If OK, substitute a known-good ECM and recheck.	• "LR" wire open or short If all are in good condition, substitute a known-good thermistor and recheck.

## DTC P1135 3RD PISTON DEACTIVATOR (INJECTION PUMP SOLENOID VALVE) CIRCUIT MALFUNCTION

### WIRING DIAGRAM



### DTC CONFIRMATION PROCEDURE

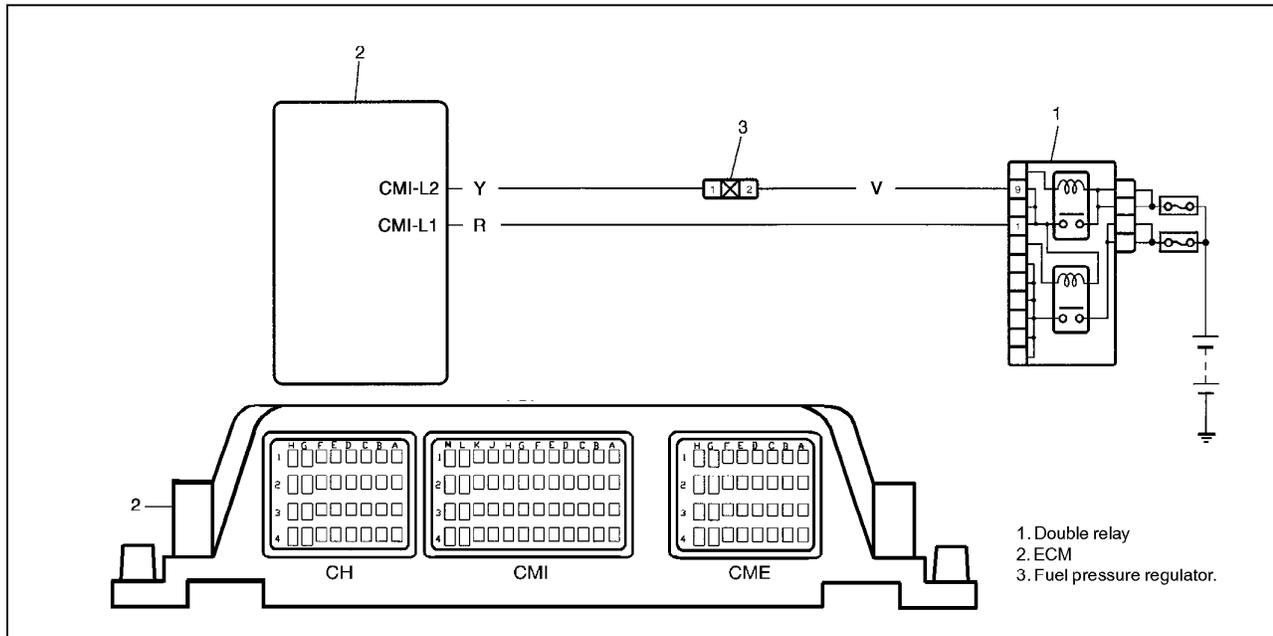
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine at idle speed.
- 4) Check DTC and pending DTC by using scan tool.

### TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is operating sound heard from fuel pump?	Go to Step 3.	Proceed to DTC P0230 Diag. Flow table.
3	Check Wire Harness 1) Disconnect injection pump solenoid valve connector with ignition switch turned OFF. 2) With ignition switch ON, check voltage between "R" wire terminal of solenoid valve connector and ground. • Within 5 sec. after ignition switch ON: 10-14 V • Over 5 sec. after ignition switch ON: about 0 V Is check result as specified?	Go to Step 4.	"R" wire open or short to ground,
4	Check Injector Pump Solenoid Valve Check resistance between "R" and "LgW" terminal of valve, Is it between 25 - 30 Ω?	<ul style="list-style-type: none"> <li>• "LgW" wire open or shorted to power/ground.</li> <li>• Poor CME-A4 connection.</li> </ul> If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty injection pump solenoid valve.

**DTC P1138 (P0230) FUEL PRESSURE REGULATOR CIRCUIT MALFUNCTION**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

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

**TROUBLESHOOTING**

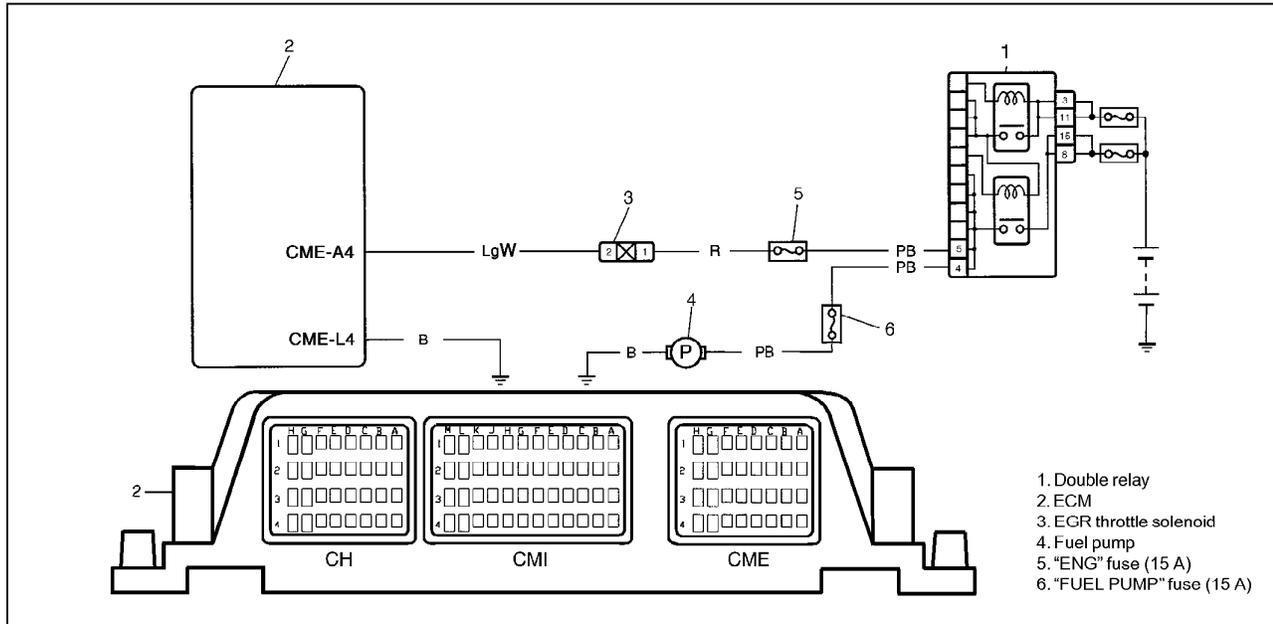
STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Wire Harness 1) Disconnect connector at fuel pressure regulator. 2) Check voltage between "V" terminal of regulator connector and ground with ignition switch ON. • Ignition switch ON: 10-14 V • Ignition switch OFF: about 0 V Is check result as specified?	Go to Step 3.	"V" wire open or shot to ground.
3	Check Fuel Pressure Regulator Check resistance between "V" and "Y" terminal of valve.	<ul style="list-style-type: none"> <li>• "Y" wire open or shorted to power/ground,</li> <li>• Poor CMI-L2 connection.</li> </ul> If wire and connection are OK, substitute a known-good ECM and recheck. (See NOTE.)	Faulty fuel pressure regulator.

**NOTE:**

If DTC is checked using generic scan tool only and DTC P0191 (P0230)/P1112 (P0230) Diag. Flow Table is not performed yet, go to the table before ECM replacement.

### DTC P1402 (P0510) THROTTLE SOLENOID VALVE CIRCUIT MALFUNCTION

#### WIRING DIAGRAM



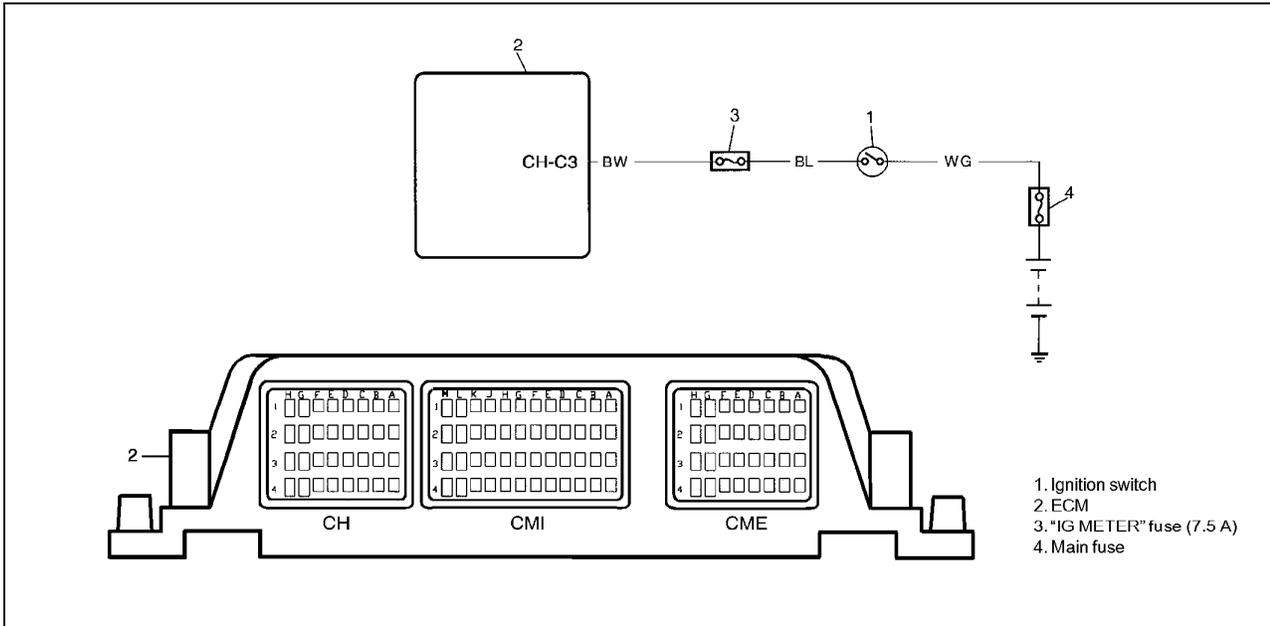
#### DTC CONFIRMATION PROCEDURE

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn OFF ignition and then ON.
- 4) Check DTC and pending DTC by using scan tool.

#### TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is operating sound heard from fuel pump?	Go to Step 3.	Proceed to DTC P0230 Diag. Flow table.
3	Check Wire Harness 1) Disconnect EGR throttle solenoid valve connector with ignition switch turned OFF. 2) With ignition switch ON, check voltage between "R" wire terminal of solenoid valve connector and ground. • Within 5 sec. after ignition switch ON: 10-14 V • Over 5 sec. after ignition switch ON: about 0 V Is check result as specified?	Go to Step 4.	"R" wire open, shorted to power/ground or fuse broken.
4	Check EGR Throttle Solenoid Valve 1) Check solenoid valve referring to Section 6E3. Is it in good condition?	• "LgW" wire open or shorted to power/ground • Poor CME-A4 connection If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty EGR solenoid valve.

**DTC P1511 IGNITION SWITCH CIRCUIT MALFUNCTION  
WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn OFF ignition switch and then ON.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Ignition Signal 1) Remove ECM cover referring to "Voltage Check" in this section. 2) Check voltage between CH-C3 and ground. • Ignition switch ON: 10-14 V • Ignition switch OFF: 0 V Is it within specified value?	Poor CH-C3 connection. If it is in good condition, substitute a known-good ECM and recheck.	"BW" wire open or short.

**DTC P1519 RADIATOR FAN CIRCUIT MALFUNCTION**

**WIRING DIAGRAM**

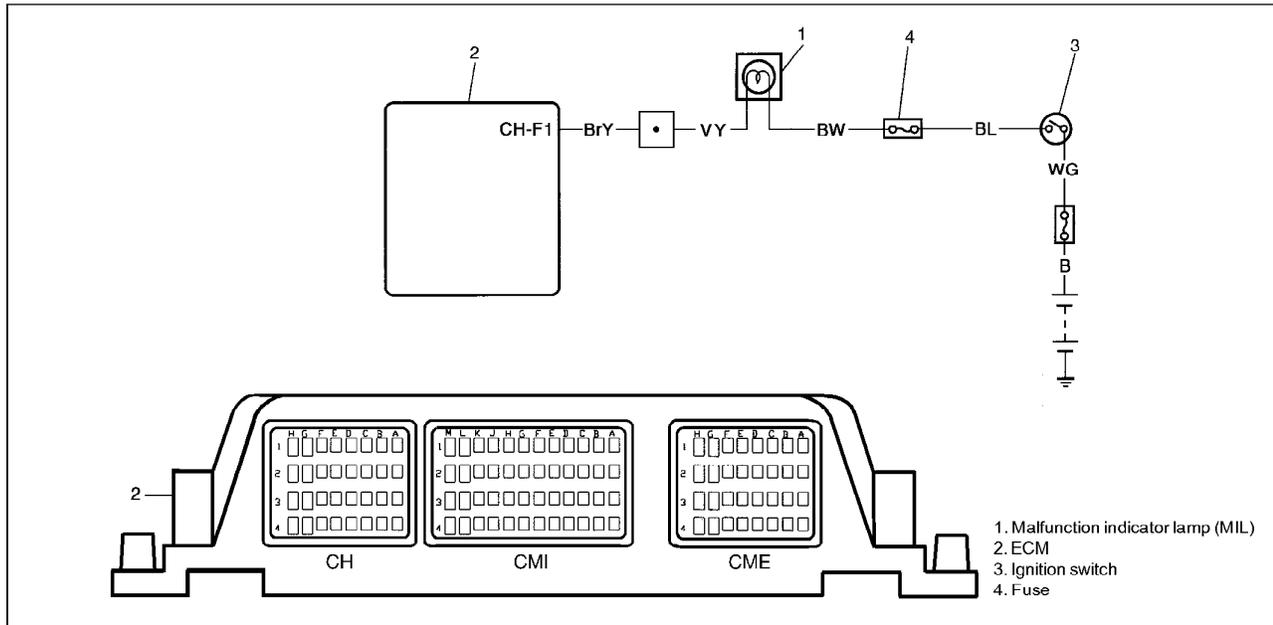
Refer to DTC P1108/P1109

**TROUBLESHOOTING**

Proceed to DTC P1108 and P1109 TROUBLESHOOTING.

## DTC P1606 MIL CIRCUIT MALFUNCTION

### WIRING DIAGRAM



### DTC CONFIRMATION PROCEDURE

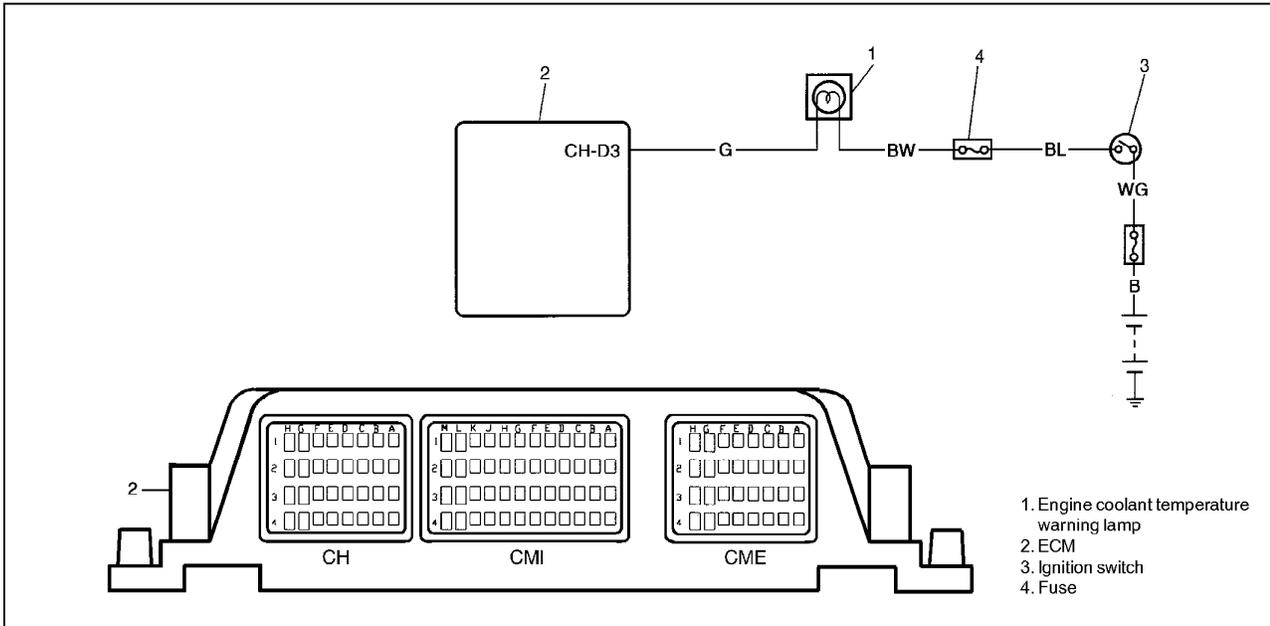
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn OFF ignition switch and then ON.
- 4) Check DTC and pending DTC by using scan tool.

### TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	MIL Circuit Check 1) Disconnect connector at ECM with ignition switch OFF. 2) Check voltage between "BrY/VY" wire terminal of ECM connector and ground. • Ignition switch ON: 10-14 V • Ignition switch OFF: 0 V Is check result as specified?	Poor CH-F1 connection. If it is in good condition, substitute a known-good ECM and recheck.	<ul style="list-style-type: none"> <li>• "BrY/VY" wire open or short to ground/battery or</li> <li>• Bulb burned out</li> </ul>

**DTC P1608 ECT WARNING LAMP CIRCUIT MALFUNCTION**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

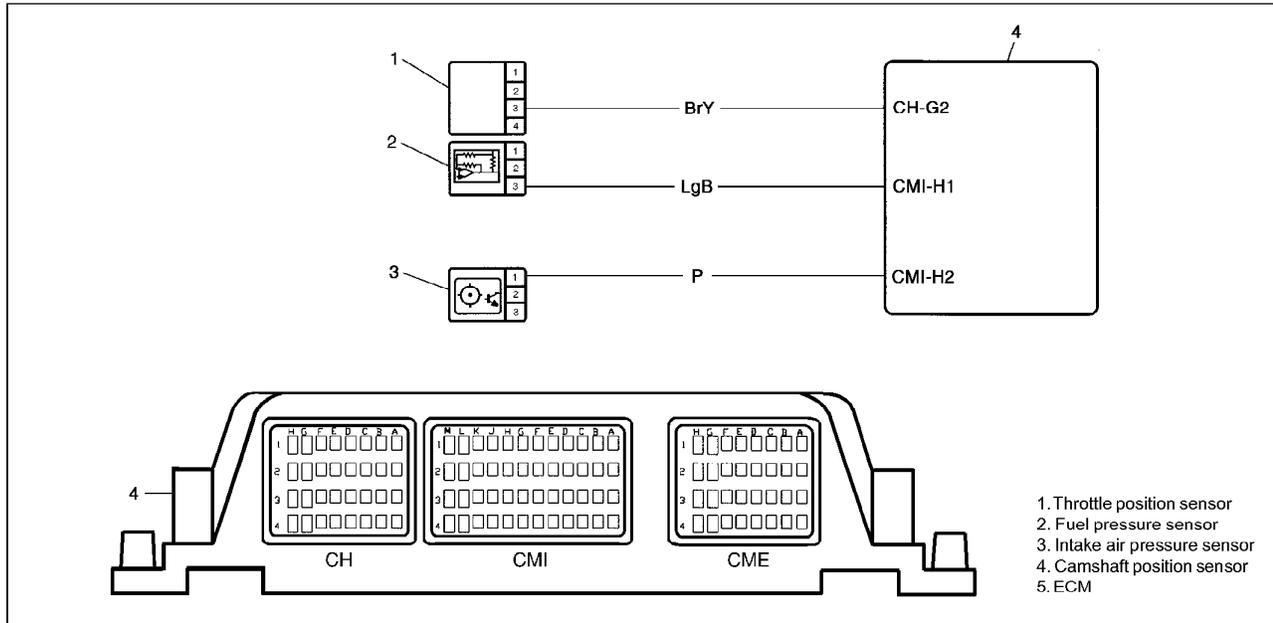
- 1) Connect scan tool to DLC with ignition switch off.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn OFF ignition and then ON.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Engine Coolant Warning Lamp Circuit Check 1) Disconnect connector at ECM with ignition switch OFF. 2) Check voltage between "G" wire terminal of ECM connector and ground. • Ignition switch ON: 10-14 V • Ignition switch OFF: 0 V Is check result as specified?	Poor CH-D3 connection. If it is in good condition, substitute a known-good ECM and recheck.	<ul style="list-style-type: none"> <li>• "G" wire open or short to ground/battery or</li> <li>• Bulb burned out</li> </ul>

## DTC P1614 (P0560) SENSOR SUPPLY FUNCTION

### WIRING DIAGRAM



### DTC CONFIRMATION PROCEDURE

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Check DTC and pending DTC by using scan tool.

### TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	"LgB" Circuit Check Check voltage between "LgB" wire terminal of connector and ground with ignition switch ON. Is it 5.1 V or more?	"LgB" wire short to battery,	Go to Step 3.
3	Is it 4.88 V or less?	"LgB" wire short to ground.	Go to Step 4.
4	"P" Circuit Check 1) Disconnect connector at camshaft position sensor, 2) Check voltage between "P" wire terminal of connector and ground with ignition switch ON. Is it 5.1 V or more?	"P" wire short to battery.	Go to Step 5.
5	Is it 4.88 V or less?	"P" wire short to ground.	Substitute a known good ECM and recheck.

**DTC P0221 (P0220) THROTTLE POSITION RANGE/PERFORMANCE PROBLEM 2****WIRING DIAGRAM**

Refer to DTC P0121.

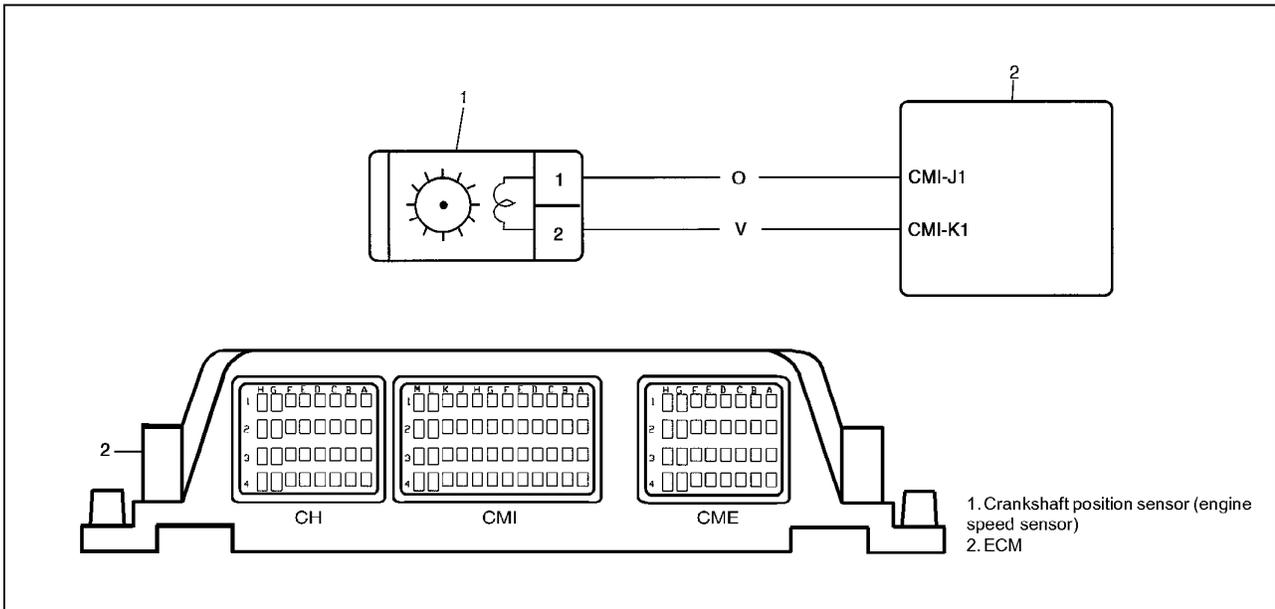
**DTC CONFIRMATION PROCEDURE**

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

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Sensor Power Supply Circuit 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Does scan tool indicate DTC as shown below? <Using Suzuki mode of Suzuki Scan tool> P1614 <Using Generic Scan tool or Euro mode of Suzuki Scan tool> P0560	Go to DTC P1614 (P0560) Diag. Flow Table.	Go to Step 3.
3	Check Wire Harness 1) Disconnect connector from TP sensor with ignition switch OFF. 2) Check for proper connection to TP sensor at each terminal. 3) If OK, then with ignition switch ON, check voltage between "BrY" wire and "BrR" wire terminals at connector of TP sensor. Is voltage about 5 V?	Go to Step 4.	"BrY" wire open, "BrR" wire open, poor CH-G2 connection, or poor CH-H3 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check TP Sensor Output Voltage 1) Remove ECM cover referring to "Voltage Check" in this section. 2) With ignition switch ON, check voltage between CH-C2 and ground, when accelerator pedal is at idle position to fully depressed position. Is voltage 0.2-1.6 V?	Substitute a known-good ECM and recheck.	"Br" wire open, "Br" wire shorted to ground/battery or poor TP sensor connector. If wire and connection are OK, substitute a known-good TP sensor and recheck.

### DTC P0335 (P0335) CRANKSHAFT POSITION SENSOR CIRCUIT MALFUNCTION WIRING DIAGRAM



#### DTC CONFIRMATION PROCEDURE

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

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2. DIAG. FLOW TABLE".	Go to "ENGINE
2	CKP Sensor and Its Circuit Resistance Check: 1) With ignition switch OFF, disconnect ECM couplers (CH, CMI and CME). 2) Check for proper connection to ECM at CMI-J1 and CMI-K1 terminals. 3) If OK, check resistance of followings. Resistance between CMI-J1 and CMI-K1 terminals: 315-405 Ω at 20 °C, 68 °F Resistance between each terminal and ground: 1 MΩ or more Is check result satisfactory?	Go to Step 4.	Go to Step 3.
3	CKP Sensor Resistance Check: 1) With ignition switch OFF, disconnect CKP sensor coupler and remove CKP sensor. 2) Check resistance between terminals of CKP sensor. (See Fig.) Were measured resistance values as specified in Step 2?	Faulty "V" wire or "O" wire.	Faulty CKP sensor.
4	CKP Sensor Visual Inspection: 1) Check visually CKP sensor and sensing rotor for the followings. (See Fig.) - Damage - No foreign material attached - Correct installation Are they in good condition?	Intermittent trouble or faulty ECM. Recheck for intermittent. (See NOTE).	Replace or reinstall.

**NOTE:**

If DTC is checked using generic scan tool only and DTC P0340 (P0335/P0340) Diag. Flow Table is not performed yet, go to table before ECM replacement.

Fig. for Step 3

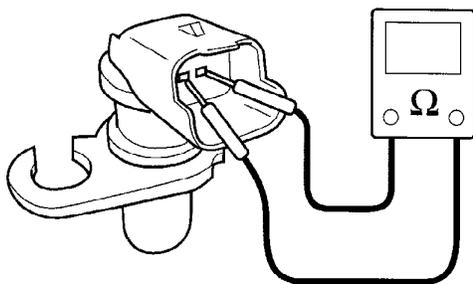


Fig. for Step 4

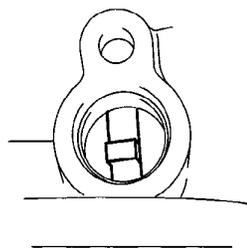
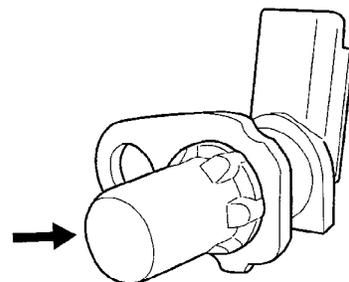
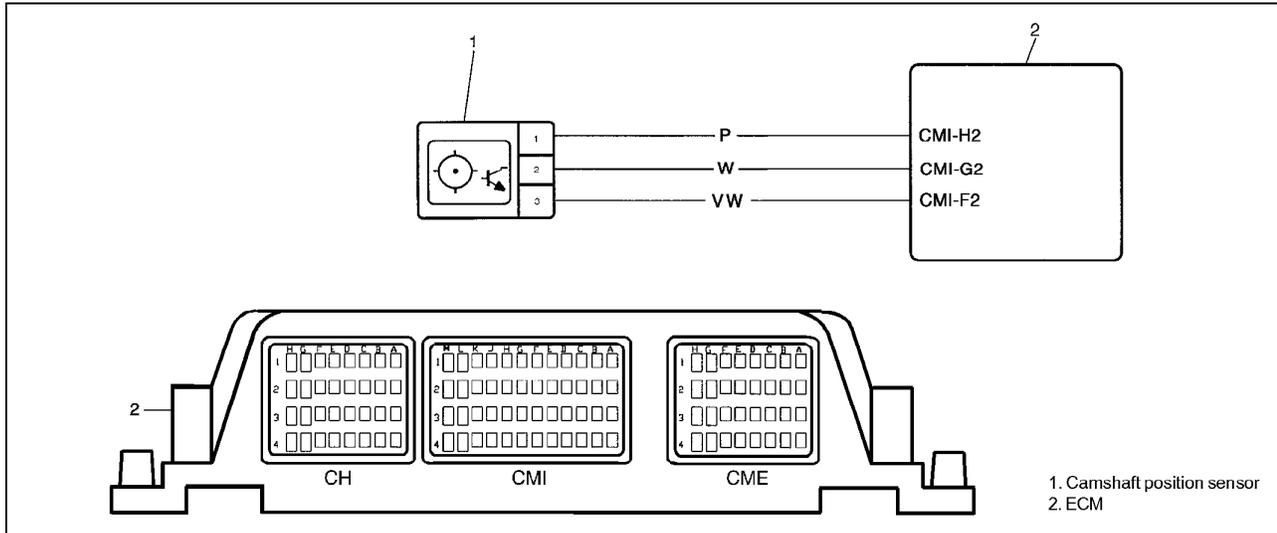


Fig. for Step 4



**DTC P0340 (P0335/P0340) CAMSHAFT POSITION SENSOR CIRCUIT MALFUNCTION  
WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Crank engine for 3 seconds or more and keep it at idle for 1 min. if engine starts.
- 4) Check DTC and pending DTC by using scan tool.

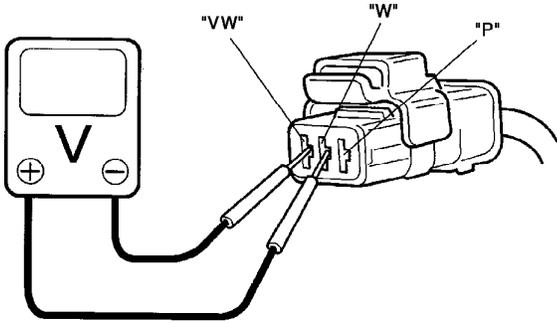
## TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed? FLOW TABLE".	Go to Step 2.	Go to "ENGINE DIAG.
2	Check Sensor Power Supply Circuit 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Does scan tool indicate DTC as shown below? <Using Suzuki mode of Suzuki Scan tool> P1614 <Using Generic Scan tool or Euro mode of Suzuki Scan tool> P0560	Go to DTC P1614 (P0560) Diag. Flow Table.	Go to Step 3.
3	Is engine cranked?	Go to Step 4.	Go to "CRANKING SYSTEM" section.
4	Is engine started?	Go to Step 5.	Check CKP sensor (Engine speed sensor) and its circuit according to DTC P0335 (P0335) Diag. Flow Table.
5	Check CMP sensor and connector for proper installation. Is CMP sensor installed properly and connector connected securely?	Go to Step. 6.	Correct.
6	Check Wire Harness and Connection. 1) Disconnect connector from CMP sensor. 2) Check for proper connection to CMP sensor at each terminal. 3) If OK, turn ignition switch ON and check for voltage between "W" and "VW" terminals of sensor connector disconnected. Is voltage 10-14 V?	Go to Step 7.	"W" or "VW" wire open, short or poor connection.
7	Check for voltage between "P" and "VW" terminals of sensor connector disconnected. Is voltage about 5 V?	Go to Step 8.	"P" wire open, short or poor connection. If wire and connection are OK, substitute a known-good ECM and recheck. (See NOTE).
8	Check Camshaft Hub 1) Remove upper timing belt cover. 2) Check camshaft hub for the following. • Damage • No foreign material attached Is it in good condition?	Check CMP sensor air gap referring to Section 6E3.	Clean surfaces of camshaft hub or replace camshaft hub. If check result is OK, substitute a known-good CMP sensor and recheck.

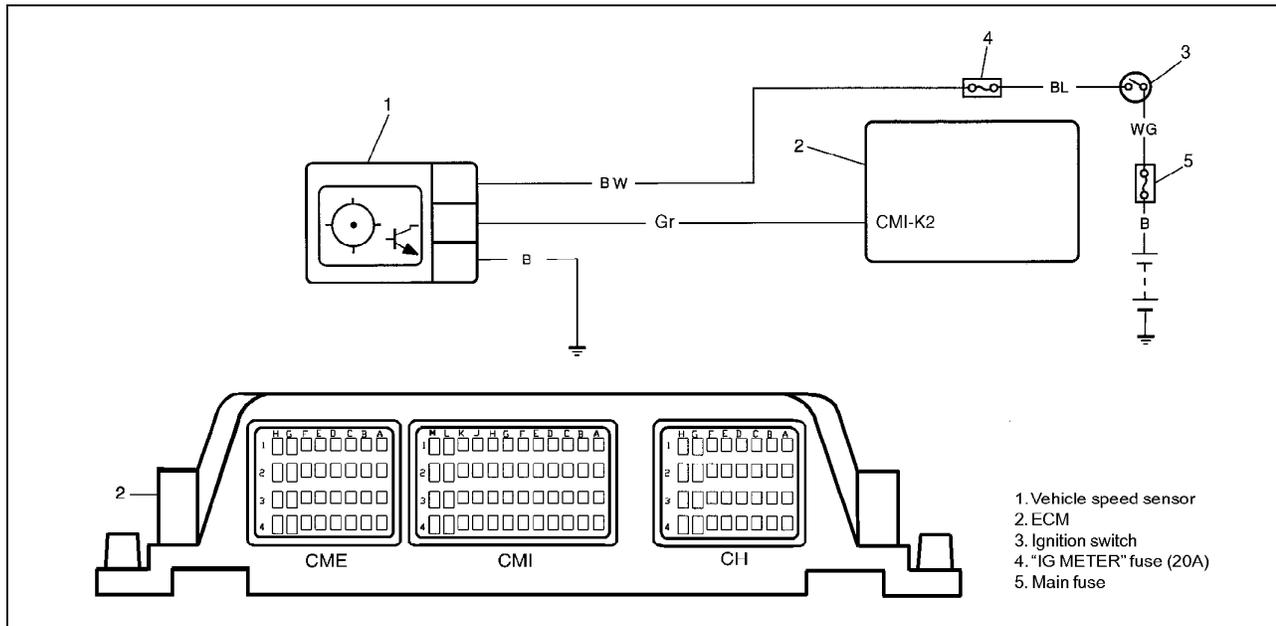
**NOTE:**

If DTC is checked using generic scan tool only and DTC P0335 (P0335) Diag. Flow Table is not performed yet, go to the table before ECM replacement.

Fig. for Step 6 and 7



## DTC P0500 (P0500) VEHICLE SPEED SENSOR CIRCUIT MALFUNCTION WIRING DIAGRAM



### DTC CONFIRMATION PROCEDURE

#### WARNING:

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

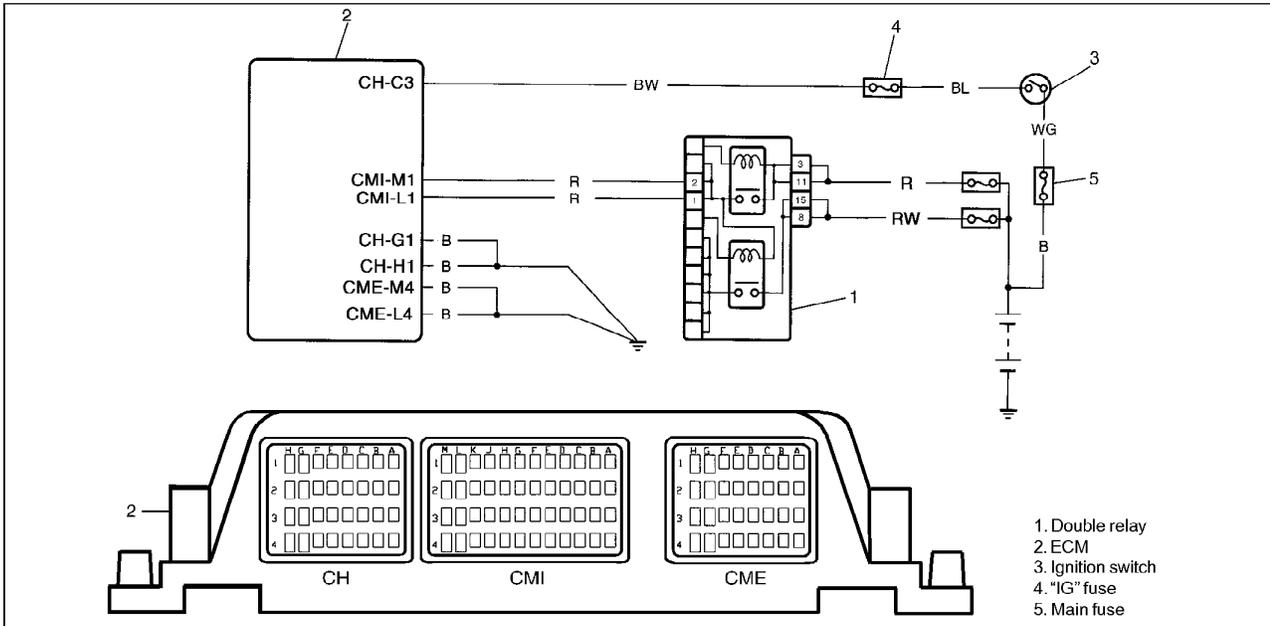
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and warm up engine completely.
- 3) Increase vehicle speed to 100-110 km/h (60-70 mph).
- 4) Release accelerator pedal and with engine brake applied, keep vehicle coasting and then stop vehicle.
- 5) Check DTC and pending DTC by using scan tool.

## TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Does speedometer indicate vehicle speed?	Faulty "Gr" wire or poor CMI-K2 connection. If wire and connection are OK, intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section OA.	Go to Step 3.
3	VSS Power Supply Voltage Check: 1) With ignition switch OFF, remove VSS coupler. 2) With ignition switch ON leaving engine OFF, check voltage between "BW" wire terminal and "B" wire terminal of VSS coupler. Is voltage 10 -14 V?	Go to Step 4.	"BW" or "B" wire open/short.
4	VSS Signal Harness Check: 1) With ignition switch ON leaving engine OFF, check voltage between "Gr" wire terminal and "B" wire terminal of VSS coupler. Is voltage 4 V or more?	Go to Step 5.	"Gr" or "B" wire open/short.
5	VSS Visual Inspection: 1) Remove VSS, mounted in combination meter. 2) Check that VSS connection aren't damaged. Are they in good condition?	VSS malfunction. If connection is OK, substitute the combination meter with a known-good VSS and recheck.	Substitute a known-good ECM and recheck.

**DTC P0560 (P560) POWER SUPPLY CIRCUIT MALFUNCTION**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

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

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	1) Remove ECM covers referring to "Voltage Check" in this section. 2) While engine running, check voltage between following terminals: CH-C3 and ground CMI-M1 and ground CMI-L1 and ground Is each voltage between 7 and 17.5 V?	Intermittent trouble. Check for intermittent. If wire and connections are OK, substitute a known good ECM and recheck. (See NOTE.)	"BW" or "R" circuits open or short.

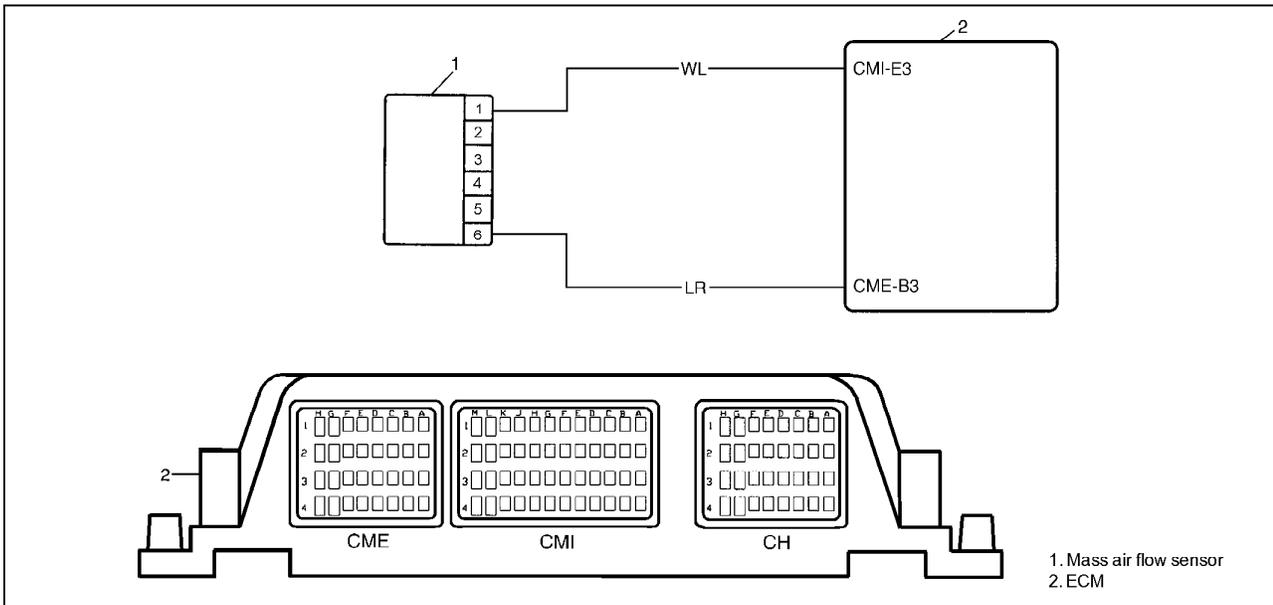
**NOTE:**

If DTC is checked using generic scan tool only and P1614 (P0560) Diag. Flow Table is not performed yet, go to the table before ECM replacement.

## TYPE 2 VEHICLES DIAGNOSING DTC

**DTC P0012 INTAKE AIR TEMP CIRCUIT MALFUNCTION (SHORT CIRCUIT TO GROUND)**  
**DTC P0113 INTAKE AIR TEMP CIRCUIT MALFUNCTION (OPEN OR SHORT CIRCUIT TO POSITIVE)**

### WIRING DIAGRAM



### DTC CONFIRMATION PROCEDURE

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn OFF ignition switch, then ON.
- 4) Check DTC and pending DTC by using scan tool.

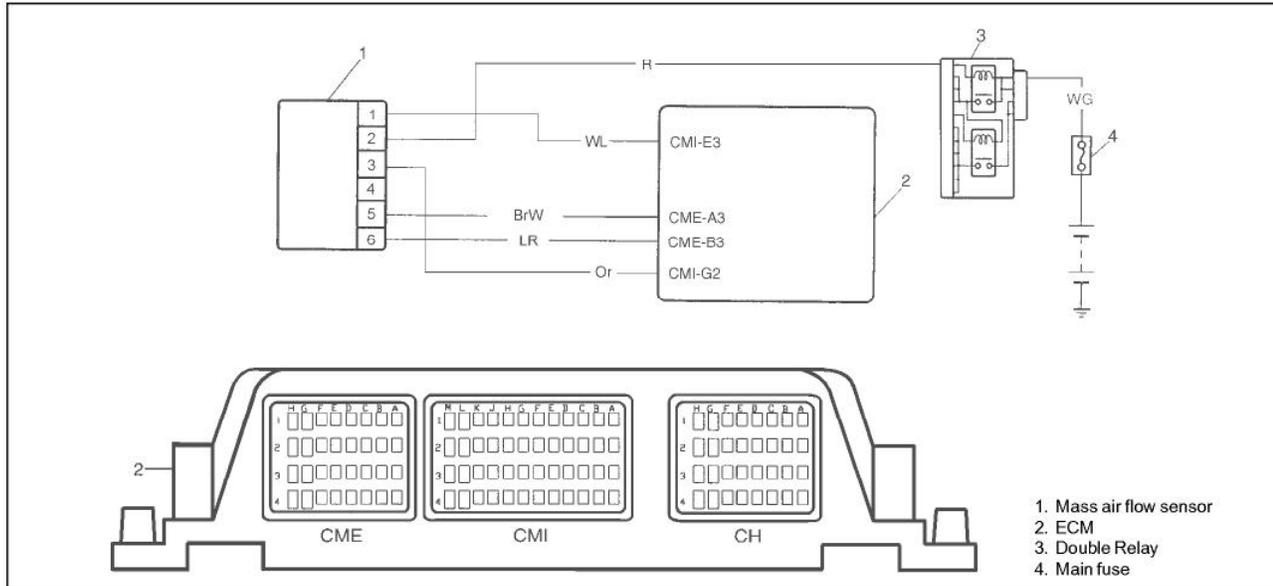
## TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check IAT Sensor and Its Circuit. 1) Connect scan tool with ignition switch OFF. 2) Turn ignition switch ON. 3) Check intake air temp. displayed on scan tool. Is -40°C (-40°F) or 131 °C (268°F) indicated?	Go to Step 3.	Intermittent trouble. Check for intermittent referring to "Intermittent and Poor Connection" in Section OA.
3	Check Wire Harness. 1) Disconnect MAF sensor (built-in IAT sensor) connector with ignition switch OFF. 2) Check for proper connection to MAF sensor (built-in IAT sensor) at "WL" and "LR" wire terminals. 3) If OK, then with ignition switch ON, is voltage applied to "WL" wire terminal of harness side about 5 V?	Go to Step 4.	"WL" wire open or shorted to power, or poor CMI-E3 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Does scan tool indicate -40°C (-40°F) at Step 2?	Go to Step 6.	Go to Step 5.
5	Check Wire Harness. 1) Disconnect MAF sensor connector. 2) Check intake air temp. displayed on scan tool. Is -40°C (-40°F) indicated?	Replace MAF sensor.	"WL" wire shorted to ground. If wire is OK, substitute a known-good ECM and recheck.
6	Check Wire Harness. 1) Using service wire, connect MAF sensor (built-in IAT sensor) connector terminals (between "WL" wire terminal and "LR" wire terminal of harness side). 2) Turn ignition switch ON and check intake air temp. displayed on scan tool. Is 131°C (268°F) indicated?	Replace MAF sensor (built-in IAT sensor).	"LR" wire open or poor CME-B3 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

**DTC P0102 MASS AIR FLOW CIRCUIT MALFUNCTION (OPEN OR SHORT CIRCUIT TO GROUND)**

**DTC P0103 MASS AIR FLOW CIRCUIT MALFUNCTION (SHORT CIRCUIT TO POSITIVE)**

**WIRING DIAGRAM**



- 1. Mass air flow sensor
- 2. ECM
- 3. Double Relay
- 4. Main fuse

**DTC CONFIRMATION PROCEDURE**

**NOTE:**

Check to make sure that the following conditions are satisfied when using this DTC CONFIRMATION PROCEDURE.

- Intake air temp.: -8°C, 18°F or higher
- Engine coolant temp.: -8 - 110°C (18 - 230°F)
- Altitude (barometric pressure): 2,400 m, 8,000 ft or less (560 mmHg, 75 kPa or more)

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

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	MAF sensor power supply Check: 1) With ignition switch OFF, disconnect MAF sensor coupler. 2) With ignition switch ON, check voltage between "R" wire terminal of MAF sensor coupler and ground. Is voltage 10 - 14 V?	Go to Step 3.	Faulty "R" wire.
3	MAF sensor output voltage Check: 1) With ignition switch OFF, connect MAF sensor coupler. 2) Remove ECM (PCM) cover. 3) Start engine and check voltage between CME-A3 and CMI-G2 terminal at idle speed. Is voltage about 2 V?	Poor CME-A3 connection, Faulty "LR" wire and Poor CME-B3 connection. If OK, substitute a known-good ECM and recheck.	Faulty "Br/W" wire. Poor MAF sensor coupler terminal connection. If wire and connection are OK, substitute a known-good MAF sensor and recheck.

**DTC P0107 BAROMETRIC PRESSURE SENSOR CIRCUIT MALFUNCTION (OPEN OR SHORT CIRCUIT TO GROUND)**

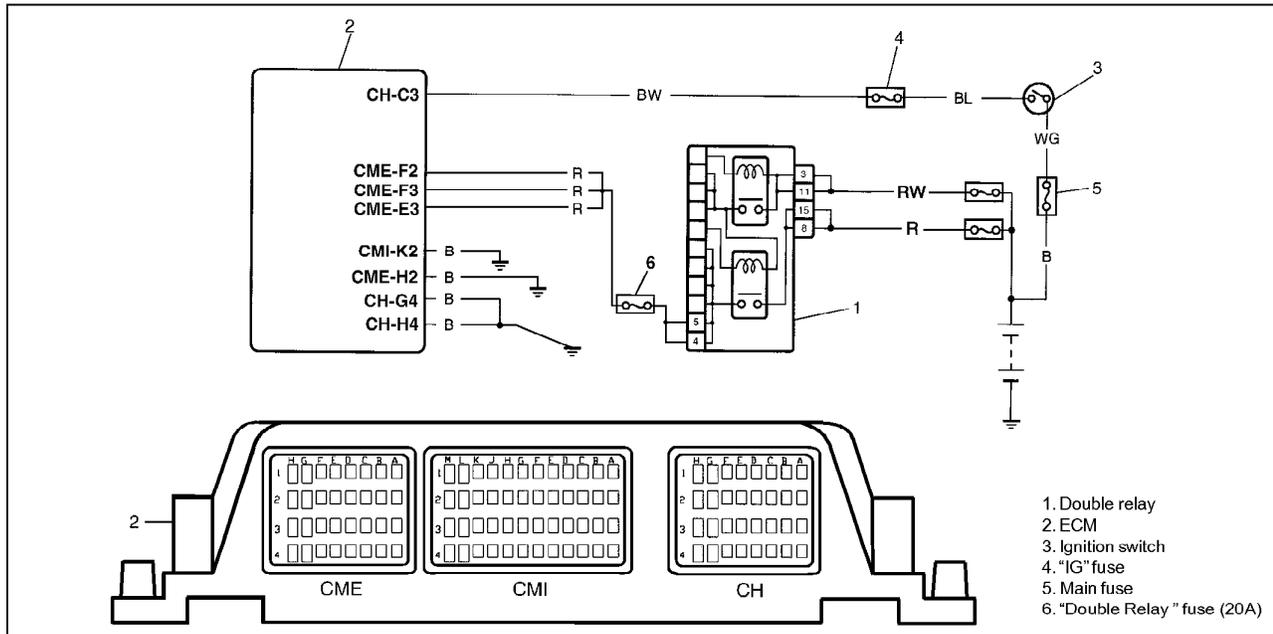
**DTC P0108 BAROMETRIC PRESSURE SENSOR CIRCUIT MALFUNCTION (SHORT CIRCUIT TO POSITIVE)**

**DTC P0601/P0603/P0604/P0605/P0606 ECM FUNCTION**

**DTC P1621/P1667/P1668/P1669 ECM FUNCTION**

**DTC P1670/P1671/P1672/P1673 ECM FUNCTION**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

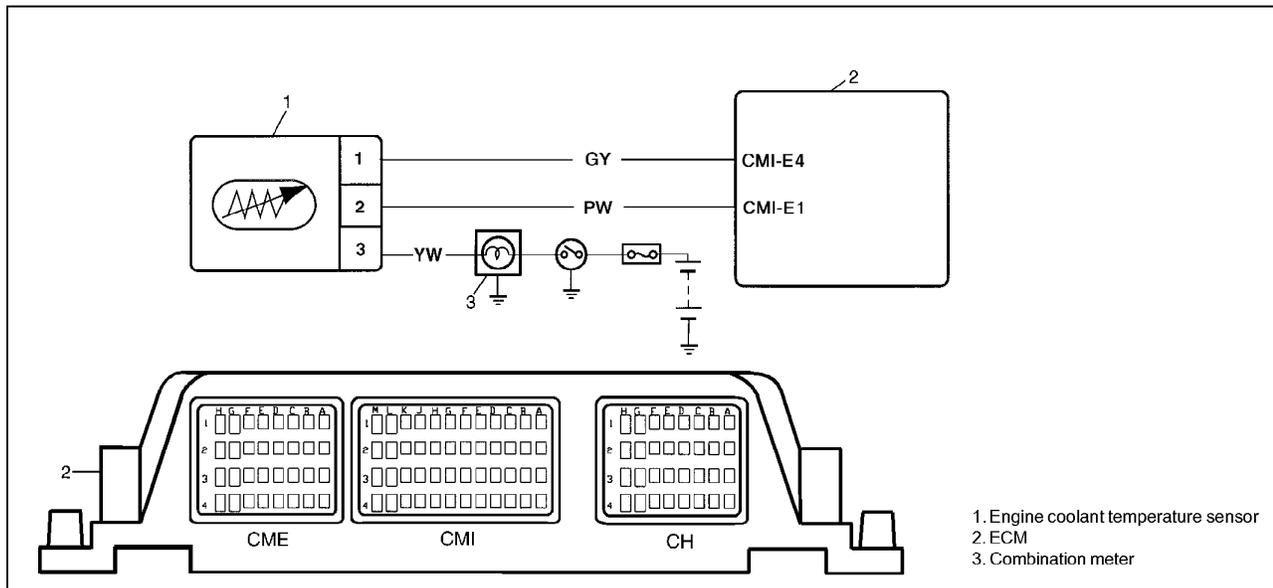
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine at idle speed for 10 sec.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Substitute a known-good ECM and recheck.	Go to "ENGINE DIAG. FLOW TABLE".

**DTC P0116 ECT SENSOR CIRCUIT MALFUNCTION (CONSISTENCY)**  
**DTC P0117 ECT SENSOR CIRCUIT MALFUNCTION (SHORT CIRCUIT TO GROUND)**  
**DTC P0118 ECT SENSOR CIRCUIT MALFUNCTION (OPEN OR SHORT CIRCUIT TO POSITIVE)**

**WIRING DIAGRAM**



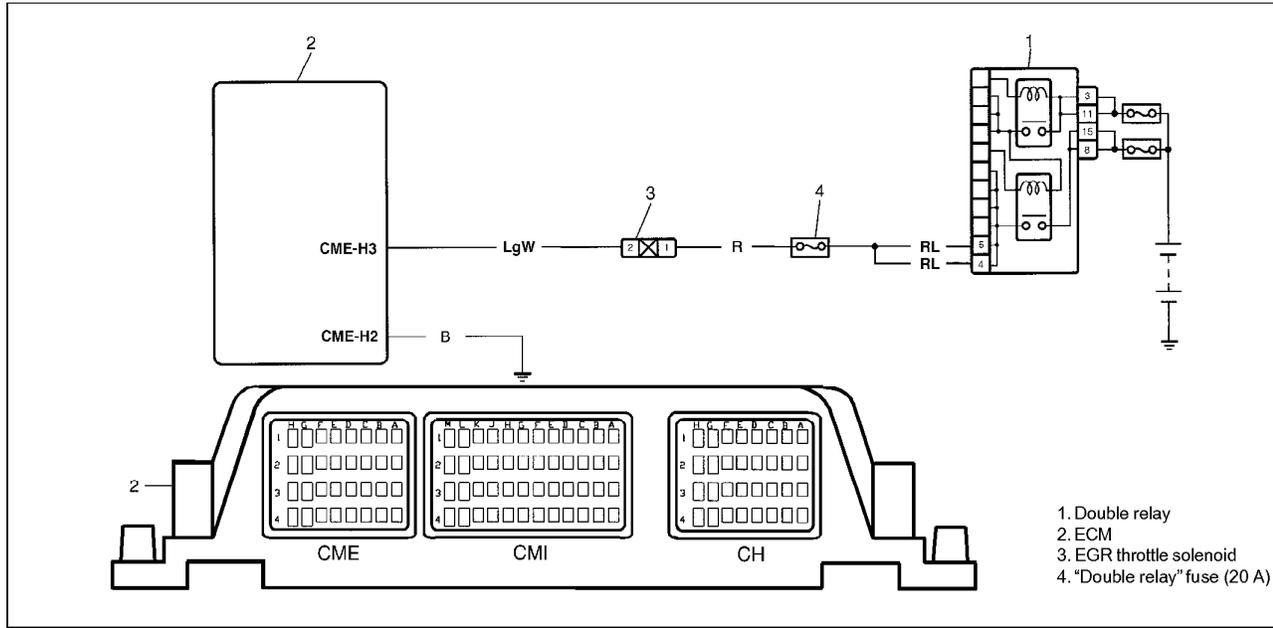
**DTC CONFIRMATION PROCEDURE**

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

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Wire Harness. 1) Disconnect ECT sensor connector with ignition switch OFF. 2) Check for proper connection to ECT sensor at "PW", "GY" and "YW" wire terminals. 3) If OK, check voltage between "PW" and "GY" wire terminals of harness side with ignition switch ON. Is voltage about 5 V?	Go to Step 3.	"GY" wire open or shorted to power/ground. "PW" wire open. Poor CMI-E4 or CMI-E1 connection.
3	Combination meter lamp check: 1) Using service wire, ground ECT sensor connector at "YW" wire terminal in connector disconnected. Does temperature signal in combination meter turn ON at ignition switch on?	Go to step 4.	Bulb burned out or "YW" wire circuit open.
4	Check ECT Sensor and Its Circuit. 1) Connect ECT sensor to its connector. 2) Connect scan tool to DLC with ignition switch OFF and run engine. Does coolant temp. on scan tool vary?	Substitute a known-good ECM and recheck.	Faulty ECT sensor.

**DTC P0122 THROTTLE SOLENOID VALVE CIRCUIT MALFUNCTION (SHORT CIRCUIT TO GROUND)**  
**DTC P0123 THROTTLE SOLENOID VALVE CIRCUIT MALFUNCTION (SHORT CIRCUIT BETWEEN TWO WIRES)**  
**DTC P0124 THROTTLE SOLENOID VALVE CIRCUIT MALFUNCTION (OPEN CIRCUIT)**  
**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

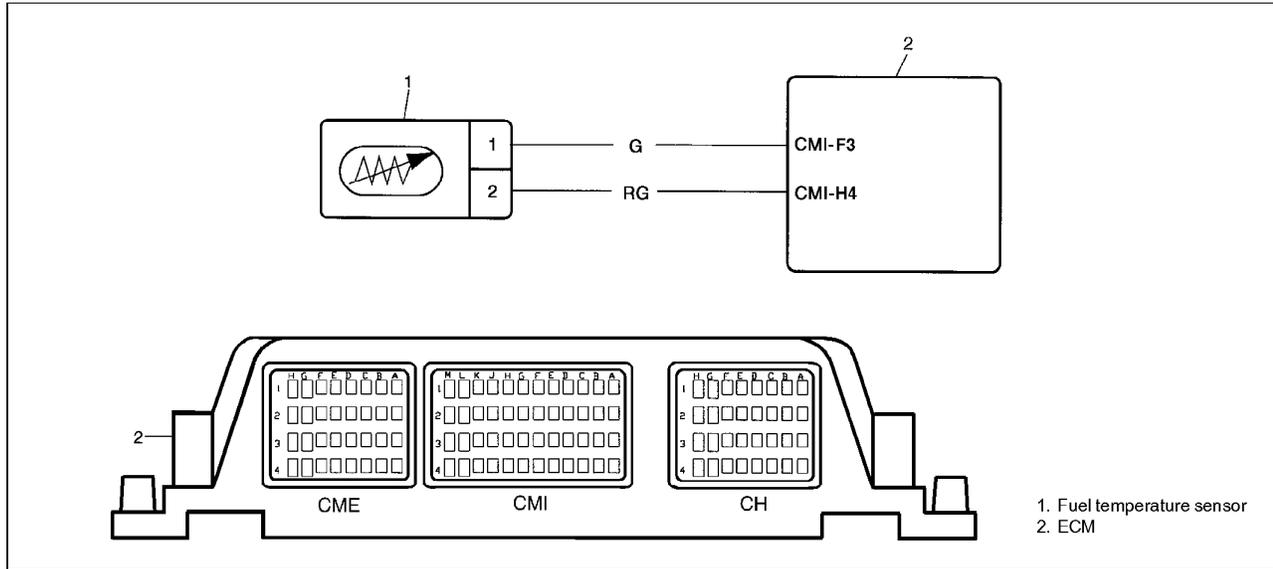
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn OFF ignition and then ON.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Wire Harness 1) Disconnect EGR throttle solenoid valve connector with ignition switch turned OFF. 2) With ignition switch ON, check voltage between "R" wire terminal of solenoid valve connector and ground. • Within 5 sec. after ignition switch ON: 10-14 V • Over 5 sec. after ignition switch ON: about 0 V Is check result as specified?	Go to Step 3.	"R" wire open, shorted to power/ground or fuse broken.
3	Check EGR Throttle Solenoid Valve 1) Check solenoid valve referring to Section 6E3. Is it in good condition?	• "LgW" wire open or shorted to power/ground • Poor CME-H3 connection If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty EGR solenoid valve.

**DTC P0181 FUEL TEMP. SENSOR CIRCUIT MALFUNCTION (CONSISTENCY)**  
**DTC P0182 FUEL TEMP. SENSOR CIRCUIT MALFUNCTION (SHORT CIRCUIT TO GROUND)**  
**DTC P0183 FUEL TEMP. SENSOR CIRCUIT MALFUNCTION (OPEN OR SHORT CIRCUIT TO POSITIVE)**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

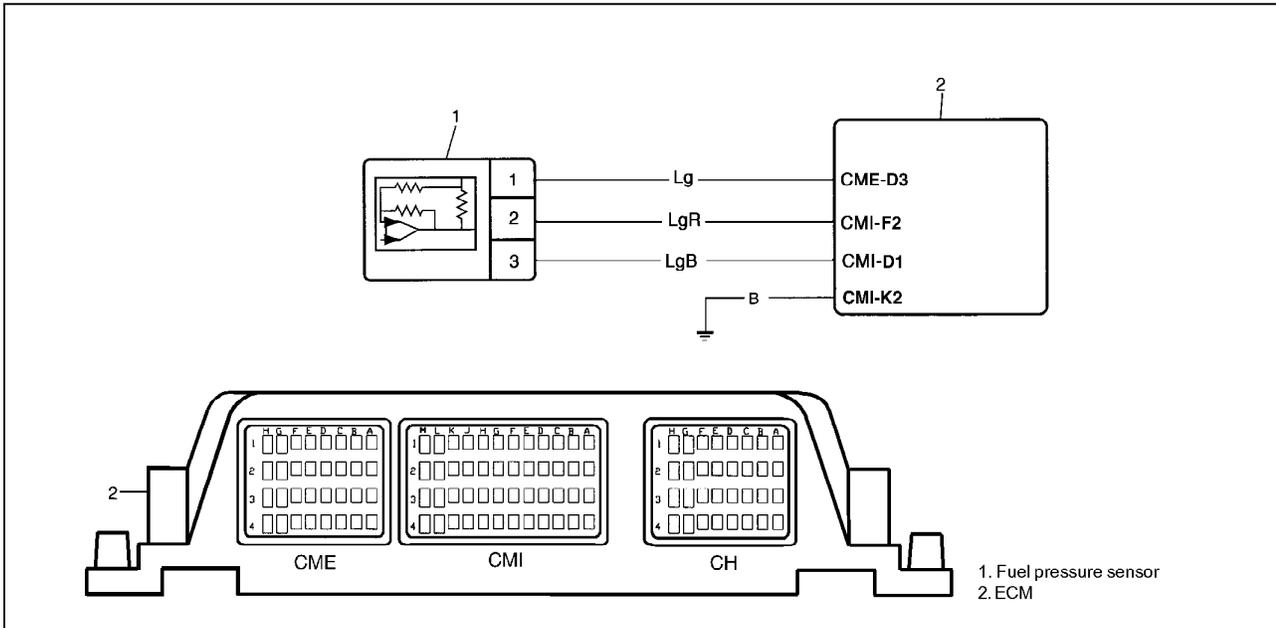
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	1) Disconnect fuel temp. sensor connector with ignition switch OFF. 2) Check for proper connection to fuel temp. sensor at "RG" and "G" wire terminals. 3) If OK, check voltage between "RG" and	Go to Step 3.	"RG" wire open or shorted to power/ground. "G" wire open, Poor CMI-H4 or CMI-F3 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
3	1) Check fuel temp. sensor for resistance referring to "FUEL TEMPERATURE SENSOR" in Section 6E3. Is resistance as specified?	Substitute a known-good fuel temp. sensor and recheck.	Replace fuel temp. sensor.

**DTC P0191/P1164/P1165 FUEL RAIL PRESSURE SENSOR CIRCUIT MALFUNCTION (CONSISTENCY)**  
**DTC P0192 FUEL RAIL PRESSURE SENSOR CIRCUIT MALFUNCTION (SHORT CIRCUIT TO GROUND)**  
**DTC P0193 FUEL RAIL PRESSURE SENSOR CIRCUIT MALFUNCTION (OPEN OR SHORT CIRCUIT TO POSITIVE)**

**WIRING DIAGRAM**



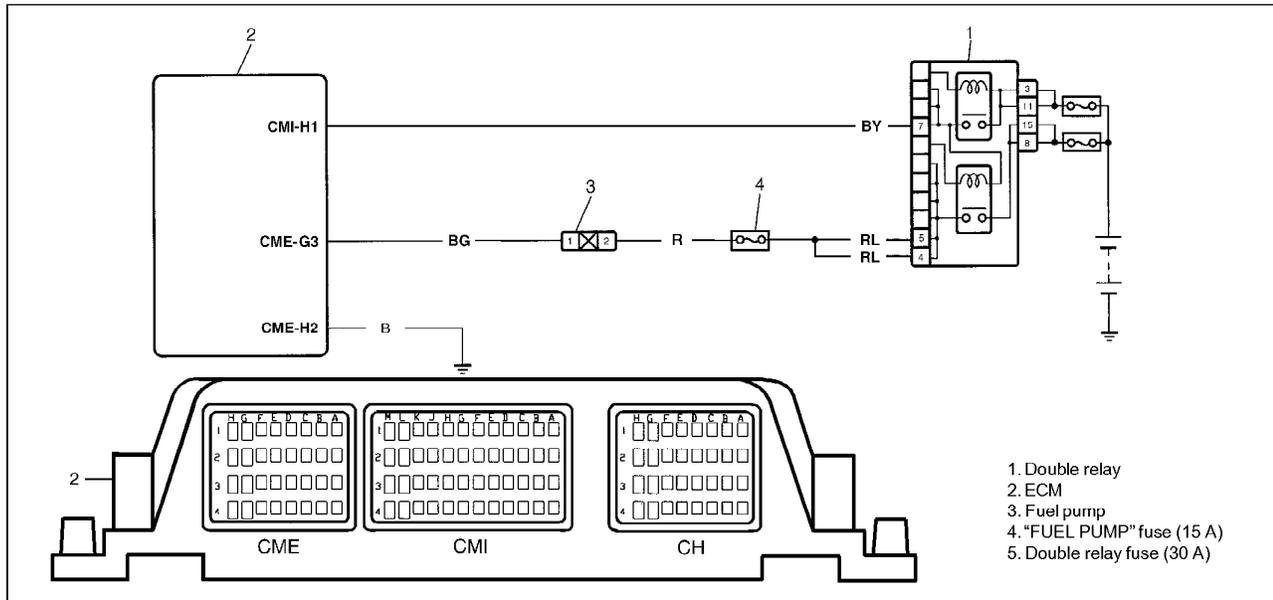
**DTC CONFIRMATION PROCEDURE**

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

## TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Sensor Power Supply Circuit 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Does scan tool indicate DTC as shown below? P0609	Go to DTC P0609 Diag. Flow Table.	Go to Step 3.
3	Check Wire Harness 1) Disconnect connector from fuel pressure sensor with ignition switch OFF. 2) Check for proper connection to fuel pressure sensor at each terminals. 3) If OK, then with ignition switch ON, check voltage between "LgB" wire and "Lg" wire terminals at connector of fuel pressure sensor. Is voltage about 5 V?	Go to Step 4.	"LgB" wire open, "LgB" wire shorted to ground circuit/power circuit, "Lg" wire open. Poor CMI-D1 connection, or poor CME-D3 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check Fuel Pressure Sensor Output Voltage 1) Remove ECM cover referring to "Voltage Check" in this section. 2) Connect fuel pressure sensor connector. 3) Start engine and check voltage between CMI-F2 and CMI-K2 terminal at idle speed. Is voltage about 1.3 V?	Substitute a known-good ECM and recheck.	"LgB" wire open, "LgR" wire shorted to ground circuit/power circuit. If wire and connection are OK, substitute a known-good fuel pressure sensor and recheck.

**DTC P0215/P1601 FUEL SUPPLY CIRCUIT MALFUNCTION  
WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

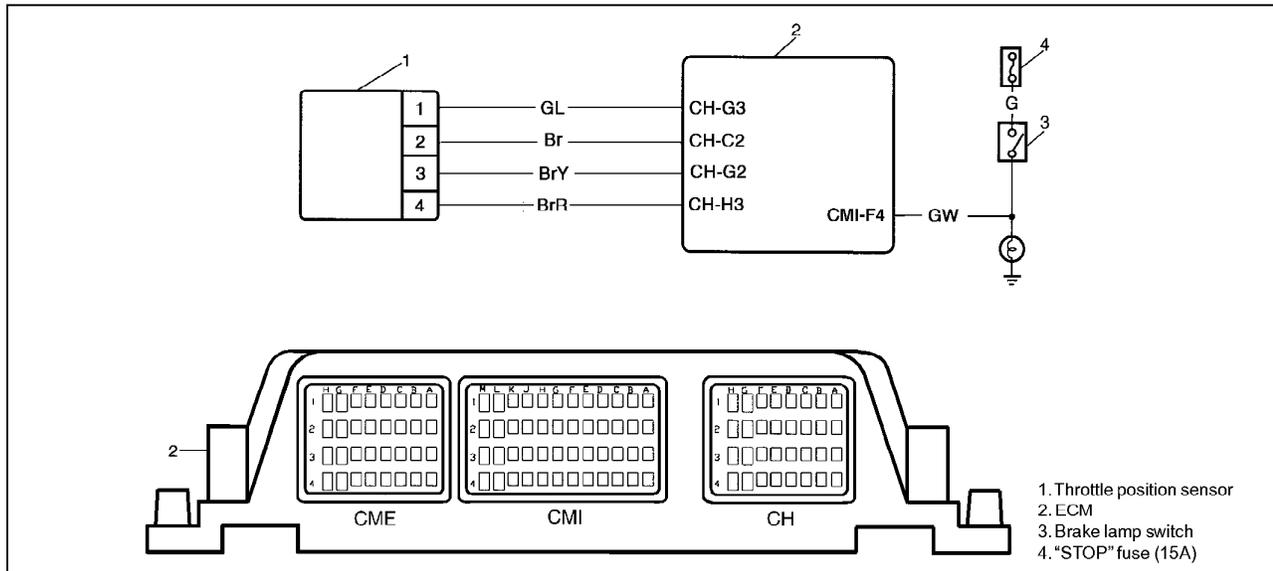
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Turn ON ignition switch after OFF for 5 sec.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is operating sound heard from high pressure fuel pump?	Substitute a known-good ECM and recheck.	Go to Step 3.
3	Check Double Relay 1) Check double relay referring to Section 6E3. Is it in good condition?	Go to Step 4.	Faulty double relay.
4	Check High Pressure Fuel Pump Output Circuit 1) Remove ECM cover referring to "Voltage Check" in this section. 2) Check voltage between CMI-H1 and ground. • Within 5 sec, after ignition switch ON: about 0 V • Over 5 sec. after Ignition switch OFF: 10 -14 V Is check result as specified?	<ul style="list-style-type: none"> <li>• Poor CMI-H1 connection</li> <li>• "BG" or "R" wire open/short</li> <li>• Fuse broken or</li> <li>• Faulty high pressure fuel pump</li> </ul> If all are OK, substitute a known-good ECM and recheck.	"BY" wire open/short.

**DTC P0221/P0226 THROTTLE POSITION CIRCUIT CONSISTENCY PROBLEM**  
**DTC P0222/P0227 THROTTLE POSITION SENSOR MALFUNCTION (SHORT CIRCUIT TO GROUND)**  
**DTC P0223/P0228 THROTTLE POSITION SENSOR MALFUNCTION (OPEN OR SHORT CIRCUIT TO POSITIVE)**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

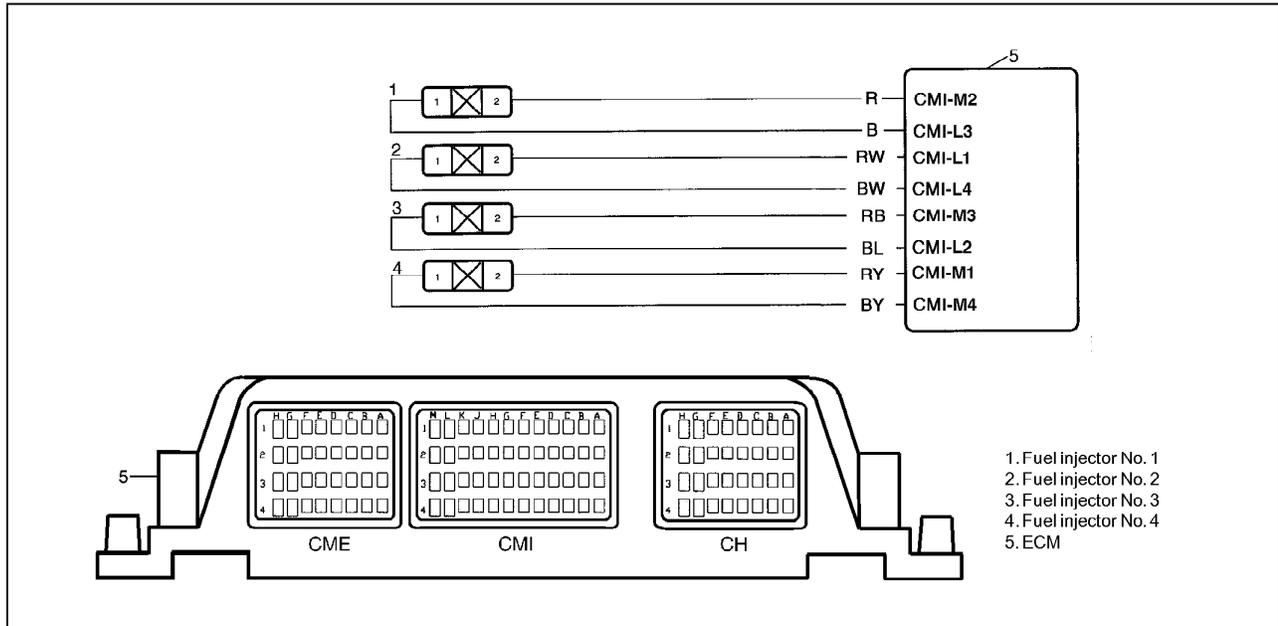
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

## TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Sensor Power Supply Circuit Is DTC below also indicated? P0608, P0609	Go to DTC P0608 or P0609 Diag. Flow Table.	Go to Step 3.
3	Check Wire Harness. 1) Disconnect connector from TP sensor with ignition switch OFF. 2) Check for proper connection to TP sensor at each terminals. 3) If OK, then with ignition switch ON, check voltage between "BrY" wire and "BrR" wire terminals at connector of TP sensor. Is voltage about 5 V?	Go to Step 4.	"BrY" wire open, "BrR" wire open, poor CH-G2 connection, or poor CH-H3 connection. If wire and connection are OK, substitute a known-good ECM and recheck.
4	Check TP Sensor output voltage. 1) Remove ECM cover referring to "Voltage Check" in this section. 2) With ignition switch ON, check voltage between CH-G3 and ground, and between CH-C2 and ground, when accelerator pedal is at idle position to fully depressed position. Is CH-G3 voltage 0.5 - 3.35 V and CH-C2 voltage 0.2-1.6 V?	Substitute a known-good ECM and recheck.	"GL" or "Br" wire open, "GL" or "Br" wire shorted to ground circuit/power circuit. Poor TP sensor connector. If wire and connection are OK, substitute a known-good TP sensor.

**DTC P0263/P1289/P1354 INJECTOR CIRCUIT MALFUNCTION CYLINDER 1**  
**DTC P0266/P1295/P1355 INJECTOR CIRCUIT MALFUNCTION CYLINDER 2**  
**DTC P0269/P1298/P1356 INJECTOR CIRCUIT MALFUNCTION CYLINDER 3**  
**DTC P0272/P1292/P1357 INJECTOR CIRCUIT MALFUNCTION CYLINDER 4**  
**DTC P1197/P1641 DEFECTIVE INJECTORS CONTROL**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

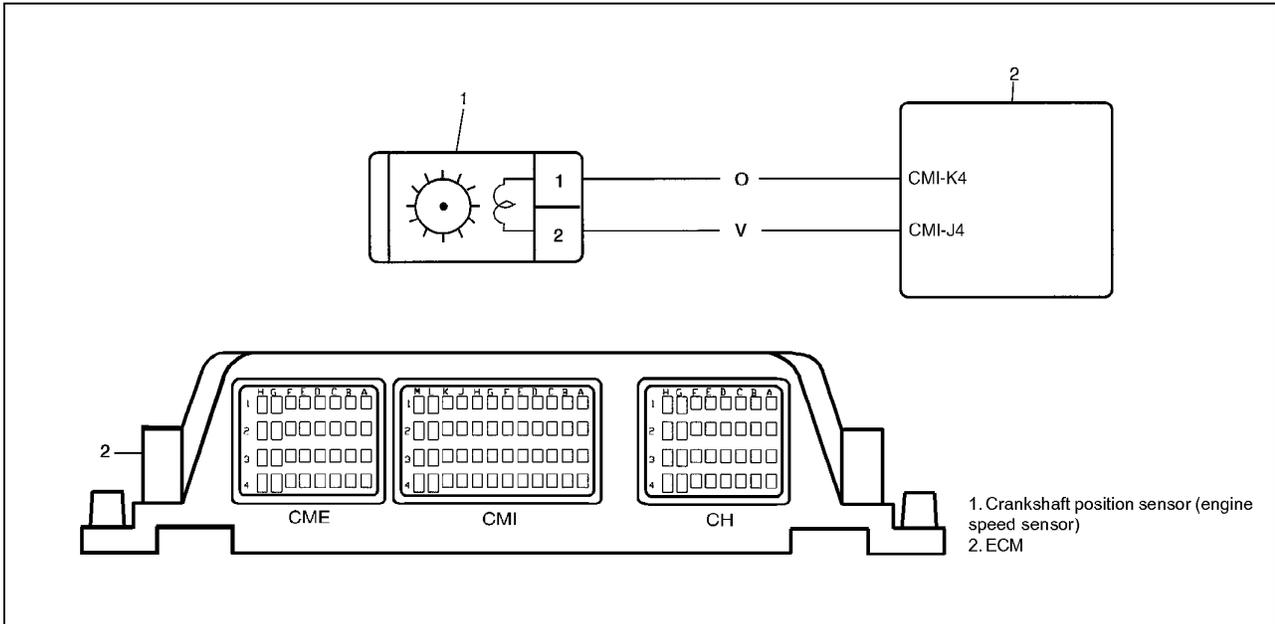
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Check DTC and pending DTC by using scan tool.

## TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	<p>Check Fuel Injector Circuit For Short</p> <p>1) With ignition switch OFF, disconnect ECM connector.</p> <p>2) Check for proper connection to ECM at CMI-M2, CMI-L3, CMI-L1, CMI-L4, CMI-M3, CMI-L2, CMI-M1 and CMI-M4 terminals.</p> <p>3) If OK, disconnect connector at all fuel injectors.</p> <p>4) Check for resistance between injector connector terminals.</p> <p>Is resistance between terminals of all fuel injectors infinity (<math>\infty</math>)?</p>	Go to Step 3.	Short circuit between "B" wire and "R" wire, "RW" wire and "BW" wire, "RB" wire and "BL" wire, or "RY" wire and "BY" wire.
3	<p>Check Fuel Injector Circuit For Open</p> <p>1) Connect connector to all fuel injectors.</p> <p>2) Check for resistance between following terminals of ECM connector:</p> <p style="padding-left: 20px;">CMI-M2 and CMI-L3: 0.56 <math>\Omega</math> (maximum)</p> <p style="padding-left: 20px;">CMI-L1 and CMI-L4: 0.56 <math>\Omega</math> (maximum)</p> <p style="padding-left: 20px;">CMI-M3 and CMI-L2: 0.56 <math>\Omega</math> (maximum)</p> <p style="padding-left: 20px;">CMI-M1 and CMI-M4: 0.56 <math>\Omega</math> (maximum)</p> <p>Is check result as specified?</p>	Substitute a known-good ECM and recheck.	Open "B" wire, "R" wire, "RW" wire, "BW" wire, "RB" wire, "BL" wire, "RY" wire or "BY" wire. If wire is OK, substitute a known-good fuel injector and recheck.

**DTC P0336 CRANKSHAFT POSITION SENSOR CIRCUIT MALFUNCTION (CONSISTENCY)**  
**DTC P0339 CRANKSHAFT POSITION SENSOR CIRCUIT MALFUNCTION (SHORT OR OPEN CIRCUIT BETWEEN TWO WIRES)**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

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

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2. DIAG. FLOW TABLE".	Go to "ENGINE
2	CKP Sensor and Its Circuit Resistance Check: 1) With ignition switch OFF, disconnect ECM couplers (CH, CMI and CME). 2) Check for proper connection to ECM at CMI-J4 and CMI-K4 terminals. 3) If OK, check resistance of followings. Resistance between CMI-J4 and CMI-K4 terminals: 315-405 Ω at 20 °C, 68 °F Resistance between each terminal and ground: 1 MΩ or more Is check result satisfactory?	Go to Step 4.	Go to Step 3.
3	CKP Sensor Resistance Check: 1) With ignition switch OFF, disconnect CKP sensor coupler and remove CKP sensor. 2) Check resistance between terminals of CKP sensor. (See Fig.) Were measured resistance values as specified in Step 2?	Faulty "V" wire or "O" wire.	Faulty CKP sensor.
4	CKP Sensor Visual Inspection: 1) Check visually CKP sensor and sensing rotor for the followings. (See Fig.) - Damage - No foreign material attached - Correct installation Are they in good condition?	Intermittent trouble or faulty ECM. Recheck for intermittent.	Replace or reinstall.

Fig. for Step 3

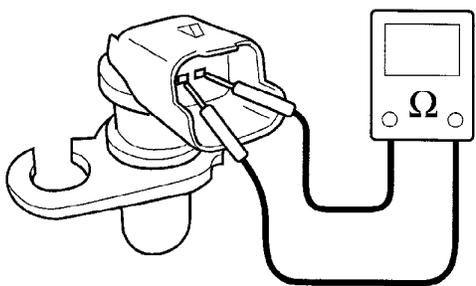


Fig. for Step 4

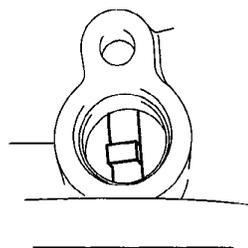
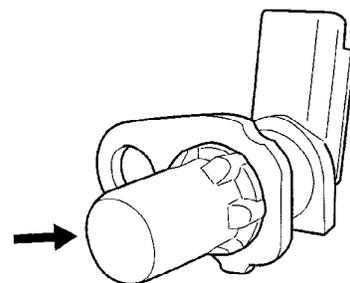


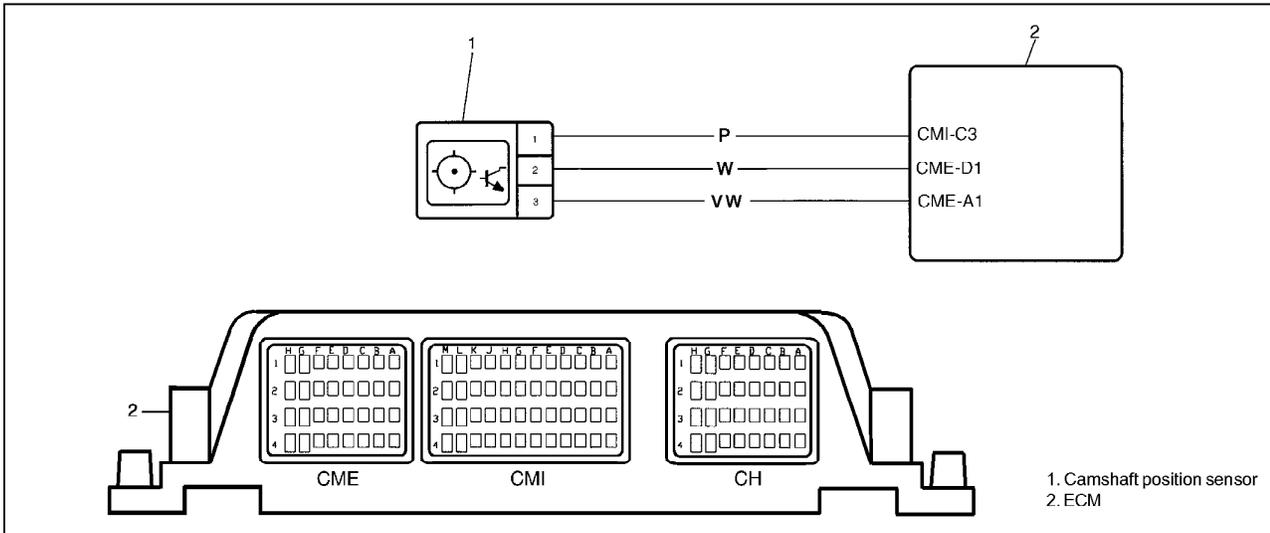
Fig. for Step 4



**DTC P0341 CAMSHAFT POSITION SENSOR CIRCUIT MALFUNCTION (INCORRECT VALUE RECEIVED)**

**DTC P0344 CAMSHAFT POSITION SENSOR CIRCUIT MALFUNCTION (OPEN OR SHORT CIRCUIT BETWEEN TWO WIRES)**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Crank engine for 3 seconds or more and keep it at idle for 1 min. if engine starts.
- 4) Check DTC and pending DTC by using scan tool.

## TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed? FLOW TABLE".	Go to Step 2.	Go to "ENGINE DIAG.
2	Check Sensor Power Supply Circuit 1) Connect scan tool to DLC with ignition switch OFF and then turn ignition switch ON. 2) Does scan tool indicate DTC as shown below? P0608, 90609	Go to DTC P0608, P0609 Diag. Flow Table.	Go to Step 3.
3	Is engine cranked?	Go to Step 4.	Go to "CRANKING SYSTEM" section.
4	Is engine started?	Go to Step 5.	Check CKP sensor (Engine speed sensor) and its circuit according to DTC P0336/P0339 Diag. Flow Table.
5	Check CMP sensor and connector for proper installation. Is CMP sensor installed properly and connector connected securely?	Go to Step 6.	Correct.
6	Check Wire Harness and Connection. 1) Disconnect connector from CMP sensor. 2) Check for proper connection to CMP sensor at each terminal. 3) If OK, turn ignition switch ON and check for voltage between "W" and "VW" terminals of sensor connector disconnected. Is voltage 10-14 V?	Go to Step 7.	"W" or "VW" wire open, short or poor connection.
7	Check for voltage between "P" and "VW" terminals of sensor connector disconnected. Is voltage about 5 V?	Go to Step 8.	"P" wire open, short or poor connection. If wire and connection are OK, substitute a known-good ECM and recheck.
8	Check Camshaft Hub 1) Remove upper timing belt cover. 2) Check camshaft hub for the following. • Damage • No foreign material attached Is it in good condition?	Check CMP sensor air gap referring to Section 6E3.	Clean surfaces of camshaft hub or replace camshaft hub. If check result is OK, substitute a known-good CMP sensor and recheck.

**DTC P0401/P0402 EGR SOLENOID VALVE FLOW INCORRECT DETECTED****DTC CONFIRMATION PROCEDURE**

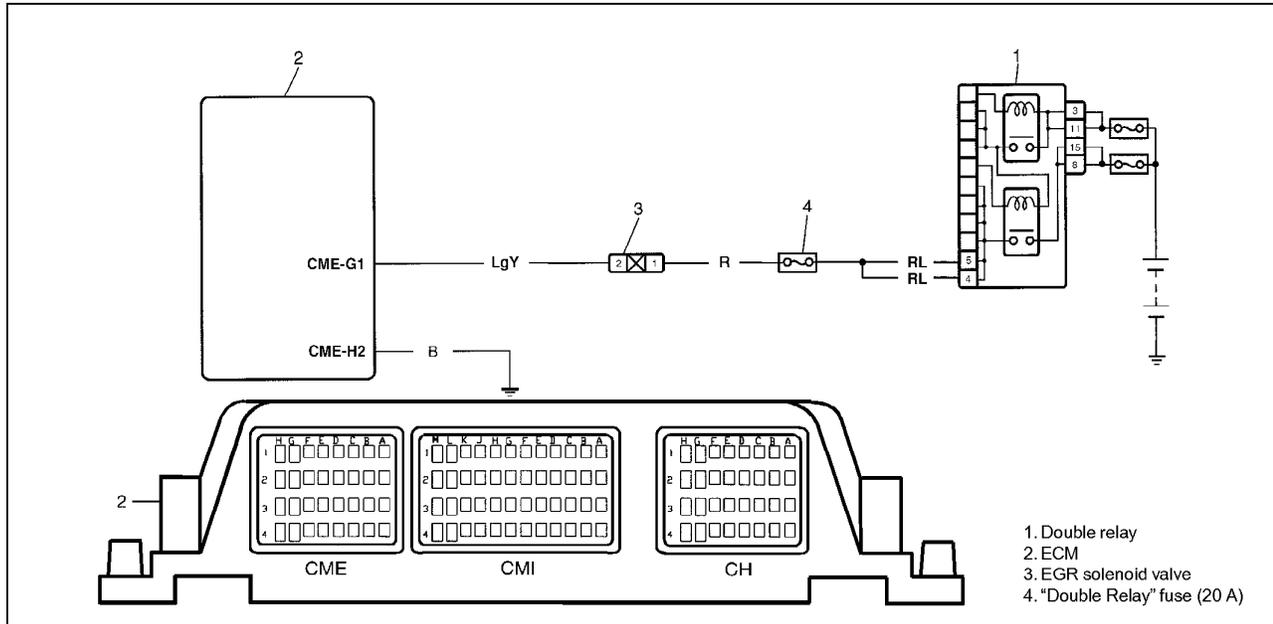
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Run engine between 700 and 2,700 rpm for 10 sec. or more.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check EGR vacuum circuit and intake air circuit for leak. Is it in good condition?	Go to Step 3.	Repair or replace.
3	Check EGR valve referring to "EGR VALVE" in Section 6E3. Is it in good condition?	Go to Step 4.	Faulty EGR valve.
4	Check EGR solenoid valve for resistance referring to "EGR SOLENOID VALVE" in Section 6E3. Is resistance as specified?	Substitute a known-good ECM and recheck.	Replace EGR solenoid valve.

- DTC P0404 EGR SOLENOID VALVE CIRCUIT MALFUNCTION (OPEN CIRCUIT)**  
**DTC P0405 EGR SOLENOID VALVE CIRCUIT MALFUNCTION (SHORT CIRCUIT TO GROUND)**  
**DTC P0406 EGR SOLENOID VALVE CIRCUIT MALFUNCTION (SHORT CIRCUIT BETWEEN TWO WIRES)**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

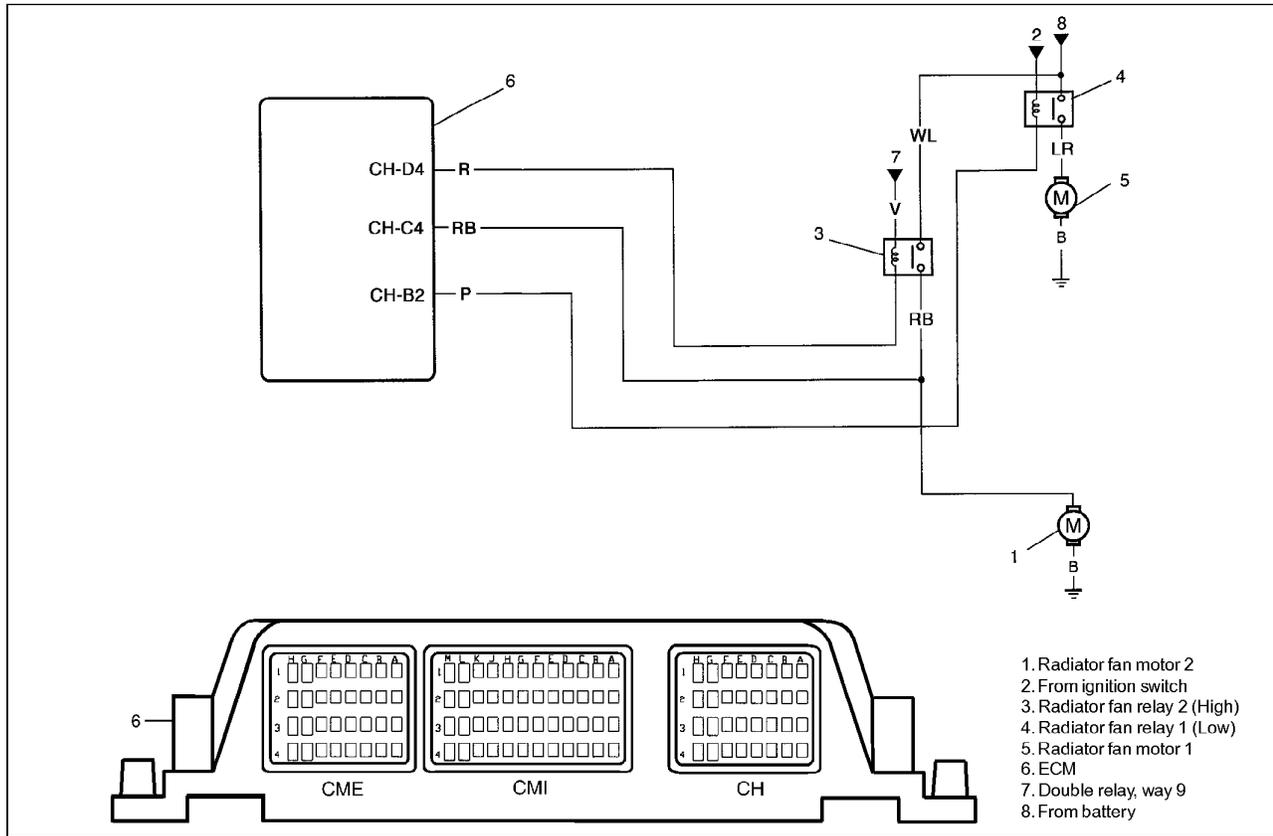
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is operating sound heard from high pressure injection pump?	Go to Step 3.	Proceed to DTC P0215/P1601 Diag. Flow table.
3	Check Wire Harness 1) Disconnect EGR solenoid valve connector with ignition switch turned OFF. 2) With ignition switch ON, check voltage between "R" wire terminal of solenoid valve connector and ground. • Within 5 sec. after ignition switch ON: 10-14 V • Over 5 sec. after ignition switch ON: about 0 V Is check result as specified?	Go to Step 4.	"R" wire open, shorted to power/ground or fuse broken.
4	Check EGR Solenoid Valve 1) Check solenoid valve referring to Section 6E3. Is it in good condition?	<ul style="list-style-type: none"> <li>• "LgY" wire open or shorted to power/ground</li> <li>• Poor CME-G1 connection</li> </ul> If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty EGR solenoid valve.

**DTC P0480 RADIATOR FAN HIGH SPEED CIRCUIT MALFUNCTION (OPEN OR SHORT CIRCUIT BETWEEN TWO WIRES)**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame dat by using scan tool.
- 3) Start engine and warm up completely.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE"
2	Check Wire Harness 1) Disconnect connector at ECM. 2) Check voltage between CH-D4 and ground with ignition switch ON. Is it about 12 V?	Poor CH-D4 connection.	Go to Step 3.
3	Check Radiator Fan Relay 1) Check radiator fan relay 1 and 2 referring to Section 6E3. Are they in good condition?	<ul style="list-style-type: none"> <li>• "R" wire open or short to ground,</li> <li>• "V" wire open or short to ground,</li> <li>• Fuse broken.</li> </ul>	Faulty radiator fan relay 1 or 2.

## DTC P0481 RADIATOR FAN LOW SPEED CIRCUIT MALFUNCTION (OPEN OR SHORT CIRCUIT BETWEEN TWO WIRES)

Refer to DTC P0480

### DTC CONFIRMATION PROCEDURE

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn On ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Start engine and warm up completely.
- 4) Check DTC and pending DTC by using scan tool.

### TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Wire Harness 1) Disconnect connector at ECM. 2) Check voltage between CH-B2 and ground with ignition switch ON. Is it about 12 V?	Poor CH-B2 connection.	Go to Step 3.
3	Check Radiator Fan Relay 1) Check radiator fan relay 2 referring to Section 6E3. Is it in good condition?	<ul style="list-style-type: none"> <li>• "P" wire open or short to ground.</li> <li>• Fuse broken</li> </ul>	Faulty radiator fan relay 2.

**DTC P0483 RADIATOR FAN CIRCUIT MALFUNCTION (CONSISTENCY)**

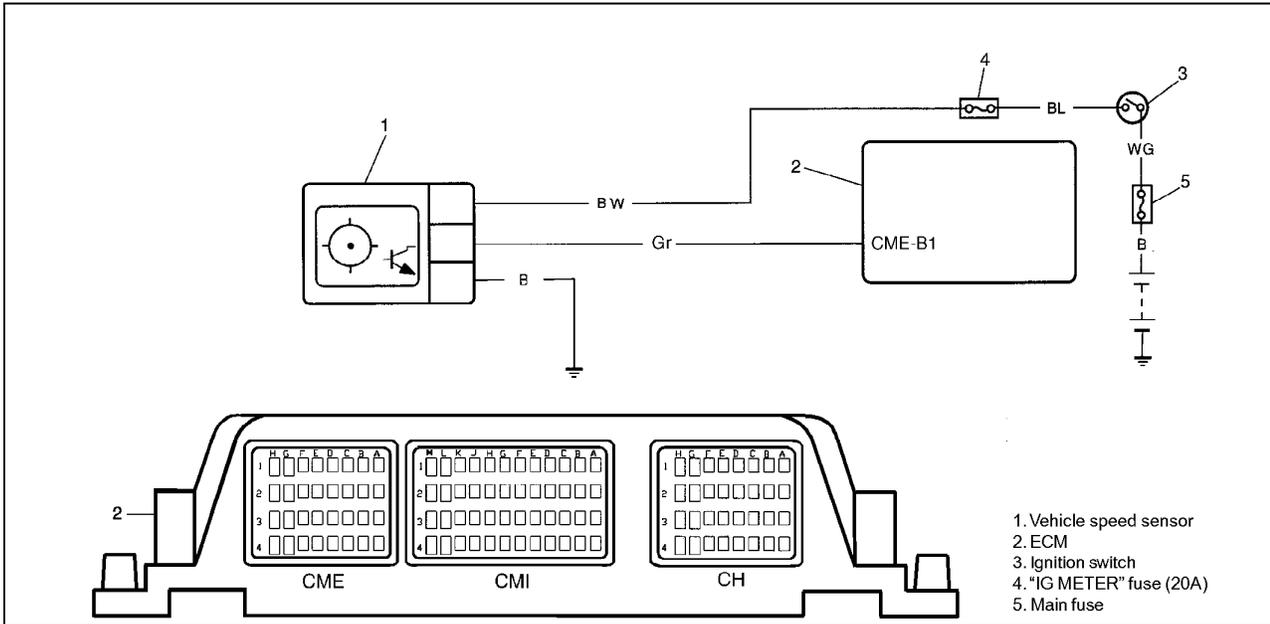
**WIRING DIAGRAM**

Refer to DTC P0480

**TROUBLESHOOTING**

Proceed to DTC P0480 and P0481 TROUBLESHOOTING.

**DTC P0500 VEHICLE SPEED SENSOR CIRCUIT MALFUNCTION (INCORRECT VALUE RECEIVED)**  
**DTC P0501 VEHICLE SPEED SENSOR CIRCUIT MALFUNCTION (CONSISTENCY)**  
**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

**WARNING:**

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

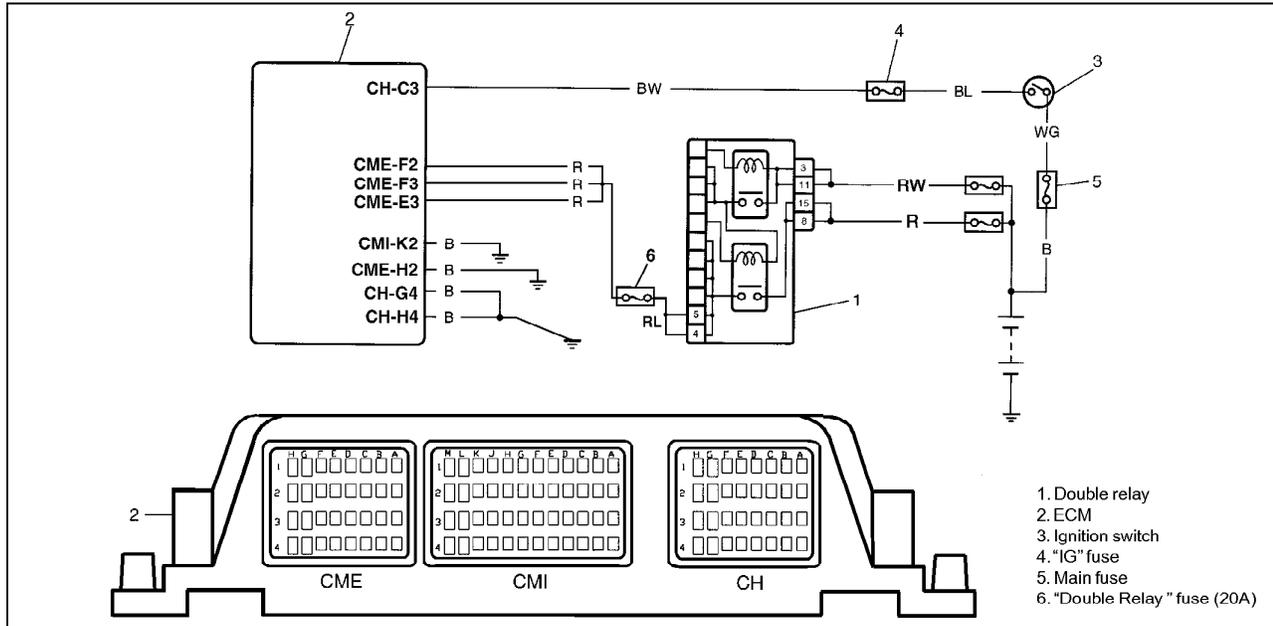
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and warm up engine completely.
- 3) Increase vehicle speed to 100-110 km/h (60-70 mph).
- 4) Release accelerator pedal and with engine brake applied, keep vehicle coasting and then stop vehicle.
- 5) Check DTC and pending DTC by using scan tool.

## TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Does speedometer indicate vehicle speed?	Faulty "Gr" wire or poor CME-B1 connection. If wire and connection are OK, intermittent trouble or faulty ECM. Check for intermittent referring to "Intermittent and Poor Connection" in Section OA.	Go to Step 3.
3	VSS Power Supply Voltage Check: 1) With ignition switch OFF, remove VSS coupler. 2) With ignition switch ON leaving engine OFF, check voltage between "BW" wire terminal and "B" wire terminal of VSS coupler. Is voltage 10 -14 V?	Go to Step 4.	"BW" or "B" wire open/short.
4	VSS Signal Harness Check: 1) With ignition switch ON leaving engine OFF, check voltage between "Gr" wire terminal and "B" wire terminal of VSS coupler. Is voltage 4 V or more?	Go to Step 5.	"Gr" or "B" wire open/short.
5	VSS Visual Inspection: 1) Remove VSS, mounted in combination meter. 2) Check that VSS connection aren't damaged. Are they in good condition?	VSS malfunction. If connection is OK, substitute the combination meter with a known-good VSS and recheck.	Substitute a known-good ECM and recheck.

**DTC P0562 POWER SUPPLY CIRCUIT MALFUNCTION (TOO WEAK)**  
**DTC P0563 POWER SUPPLY CIRCUIT MALFUNCTION (TOO HIGH)**

**WIRING DIAGRAM**



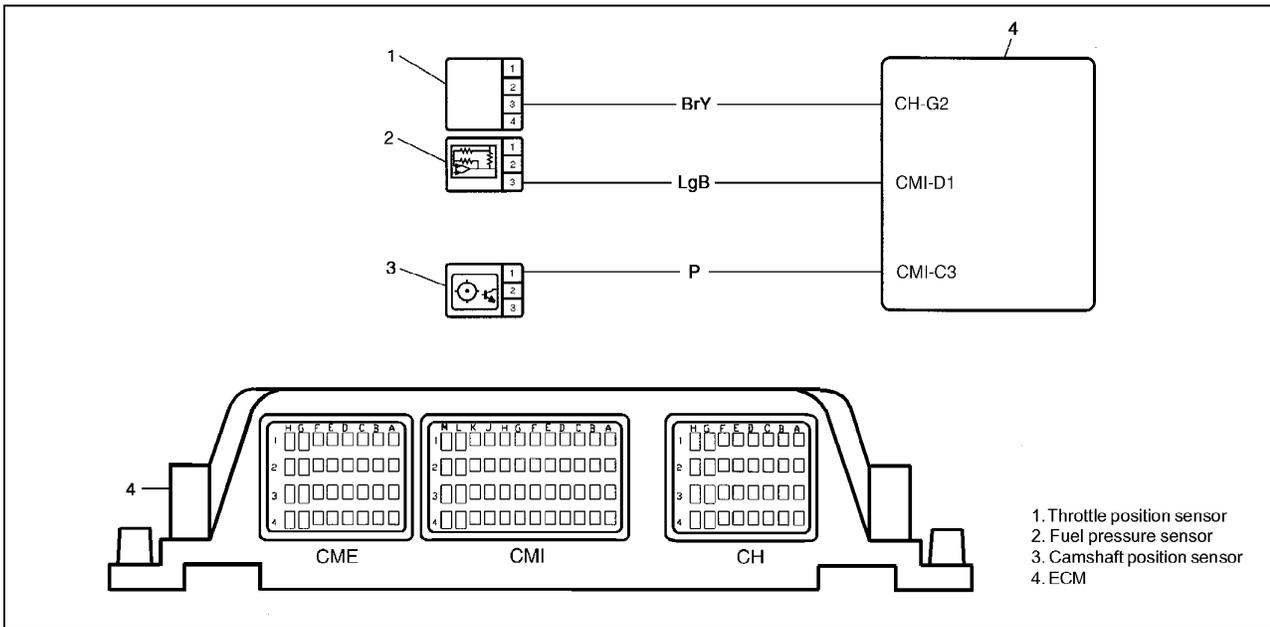
**DTC CONFIRMATION PROCEDURE**

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

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	1) Remove ECM covers referring to "Voltage Check" in this section. 2) While engine running, check voltage between following terminals: CME-F2 and ground CME-F3 and ground CME-E3 and ground Is each voltage between 7 and 17.5 V?	Intermittent trouble. Check for intermittent. If wire and connections are OK, substitute a known good ECM and recheck.	"BW" or "R" circuits open or short.

**DTC P0608 SENSOR SUPPLY FUNCTION (EX. FUEL PRESSURE SENSOR)**  
**DTC P0609 SENSOR SUPPLY FUNCTION (EX. THROTTLE POSITION SENSOR)**  
**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

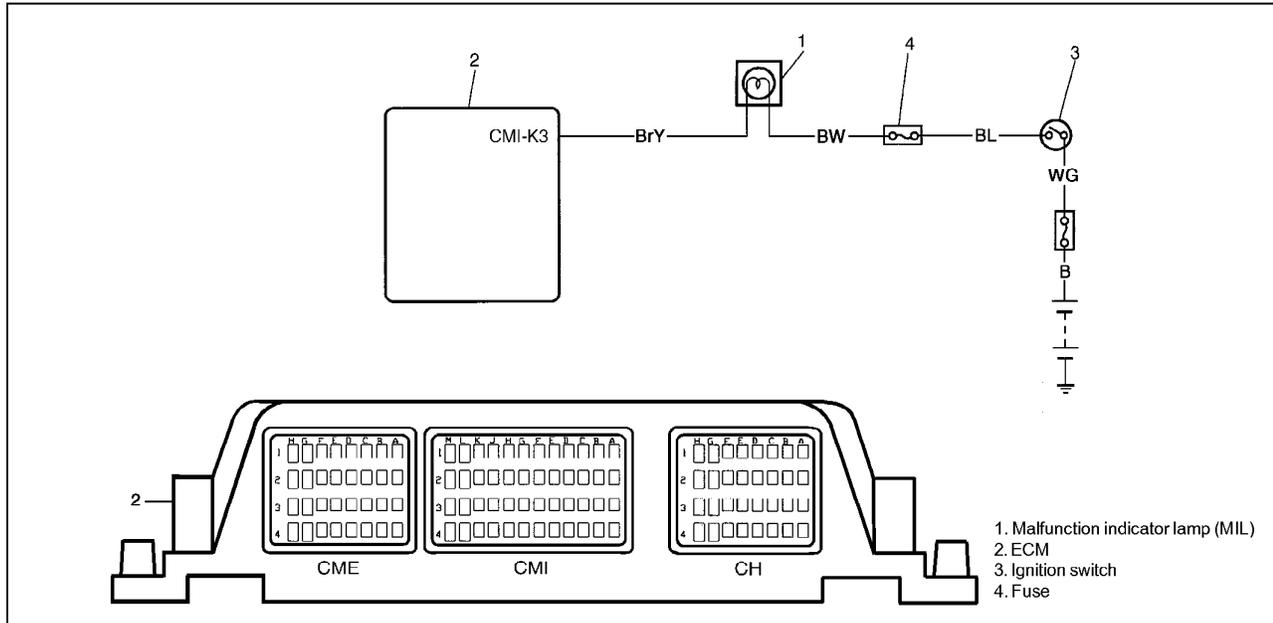
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	"LgB" Circuit Check Check voltage between "LgB" wire terminal of connector and ground with ignition switch ON. Is it 5.1 V or more?	"LgB" wire short to battery,	Go to Step 3.
3	Is it 4.88 V or less?	"LgB" wire short to ground.	Go to Step 4.
4	"P" Circuit Check 1) Disconnect connector at camshaft position sensor, 2) Check voltage between "P" wire terminal of connector and ground with ignition switch ON. Is it 5.1 V or more?	"P" wire short to battery.	Go to Step 5.
5	Is it 4.88 V or less?	"P" wire short to ground.	Substitute a known good ECM and recheck.

## DTC P0650 MIL CIRCUIT MALFUNCTION (OPEN OR SHORT CIRCUIT BETWEEN TWO WIRES)

### WIRING DIAGRAM



### DTC CONFIRMATION PROCEDURE

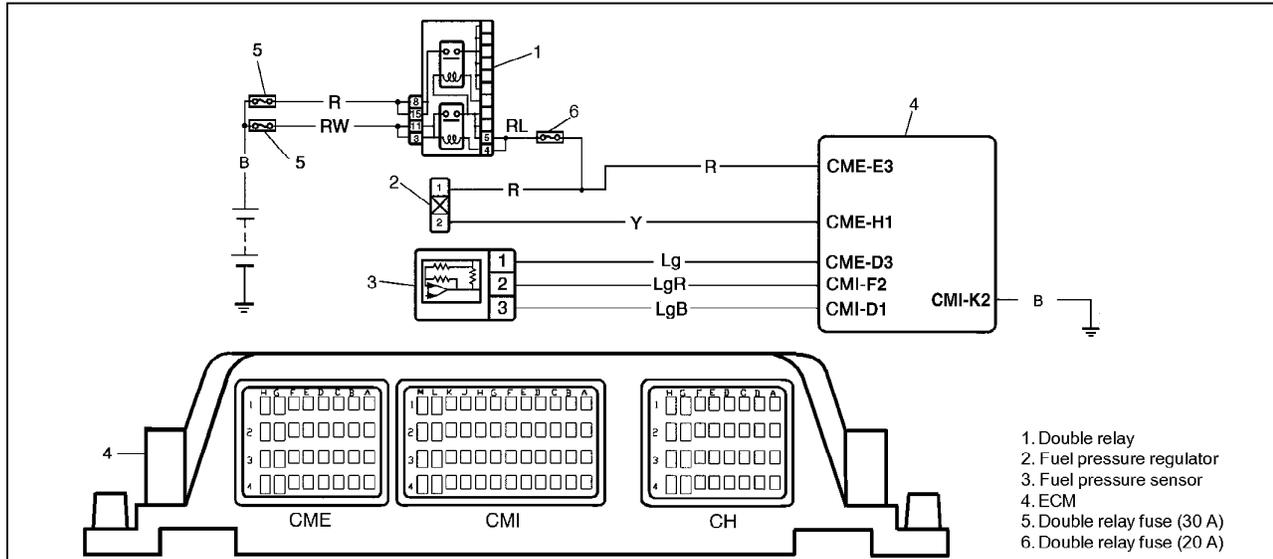
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn OFF ignition switch and then ON.
- 4) Check DTC and pending DTC by using scan tool.

### TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	MIL Circuit Check 1) Disconnect connector at ECM with ignition switch OFF. 2) Check voltage between "BrY" wire terminal of ECM connector and ground. • Ignition switch ON: 10-14 V • Ignition switch OFF: 0 V Is check result as specified?	Poor CMI-K3 connection. If it is in good condition, substitute a known-good ECM and recheck.	<ul style="list-style-type: none"> <li>• "BrY" wire open or short to ground/battery or</li> <li>• Bulb burned out</li> </ul>

**DTC P1113/P1166/P1167 FUEL RAIL PRESSURE SENSOR/PRESSURE REGULATOR CONSISTENCY FUNCTION**  
**DTC P1198 FUEL PRESSURE MONITORING CIRCUIT MALFUNCTION**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool and run engine at idle speed for 10 sec. or more.
- 3) Then run engine 1,000 rpm or more for 10 sec.
- 4) Check DTC and pending DTC by using scan tool.

## TROUBLESHOOTING

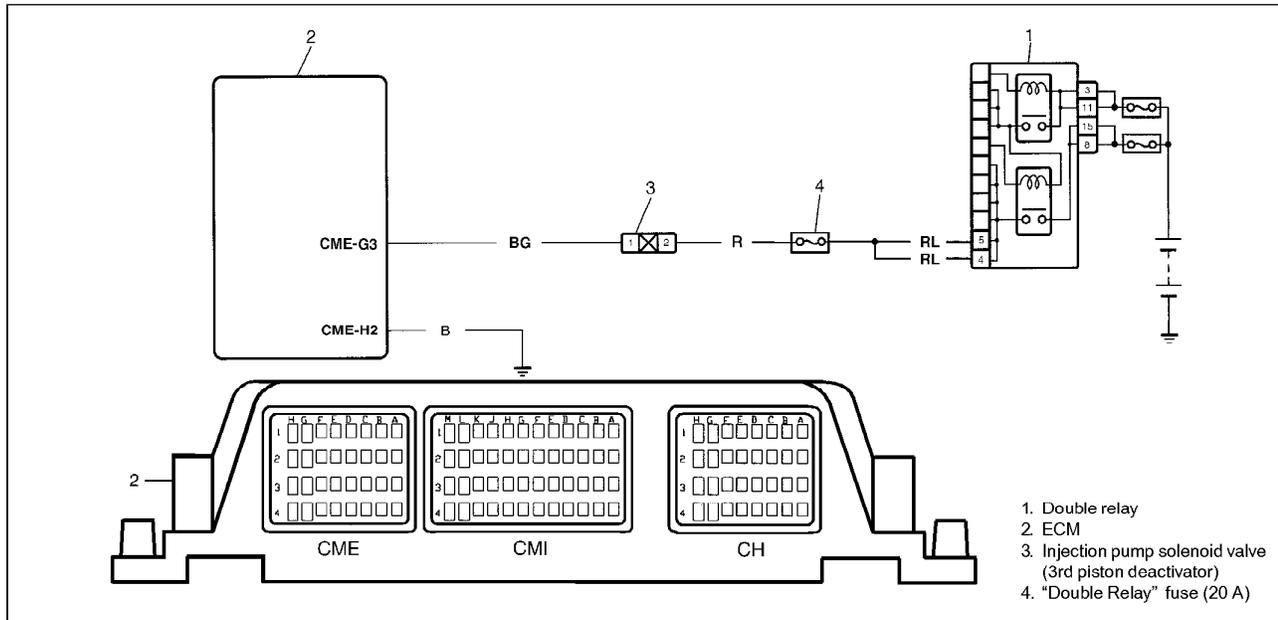
STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Fuel Shortage 1) Is there enough fuel in fuel tank?	Go to Step 3.	Supply fuel into fuel tank.
3	Check Wire Harness 1) With ignition switch OFF, disconnect ECM connector. 2) Check for proper connection to ECM at CME-E3 and CME-H1 terminals. 3) If OK, check resistance between CME-E3 and CME-H1 terminals. Is resistance 2 - 3 Ω?	Go to Step 4.	Faulty "R" wire, "RL" or "Y" wire. If wire is OK, substitute a known-good double relay or injection pump and recheck.
4	Check Fuel Pressure Sensor Output Voltage 1) Remove ECM cover referring to "Voltage Check" in the Section. 2) Connect fuel pressure sensor connector. 3) Start engine and check voltage between CMI-F2 and CMI-K2 terminal at idle speed. Is voltage about 1.3 V?	Go to Step 5.	"LgR" wire open, "LgR" wire shorted to ground circuit/power circuit. Poor fuel pressure sensor connector terminal connection. If wire and connection are OK, substitute a known-good fuel pressure sensor and recheck.
5	Check Fuel Leakage 1) Perform step 1), 2) and 3) of "DTC CONFIRMATION PROCEDURE". 2) Check fuel leakage on Fuel System. Is it in good condition?	<ul style="list-style-type: none"> <li>• Fuel line clogged.</li> <li>• Faulty fuel pressure regulator.</li> </ul> If OK, substitute a known-good ECM and recheck.	Repair or replace.

**DTC P1176 3RD PISTON DEACTIVATOR CIRCUIT MALFUNCTION (CONSISTENCY)**  
**DTC P1177 3RD PISTON DEACTIVATOR CIRCUIT MALFUNCTION (SHORT CIRCUIT TO GROUND)**

**DTC P1179 3RD PISTON DEACTIVATOR CIRCUIT MALFUNCTION (SHORT CIRCUIT BETWEEN TWO WIRES)**

**DTC P1180 3RD PISTON DEACTIVATOR CIRCUIT MALFUNCTION (OPEN CIRCUIT)**

**WIRING DIAGRAM**



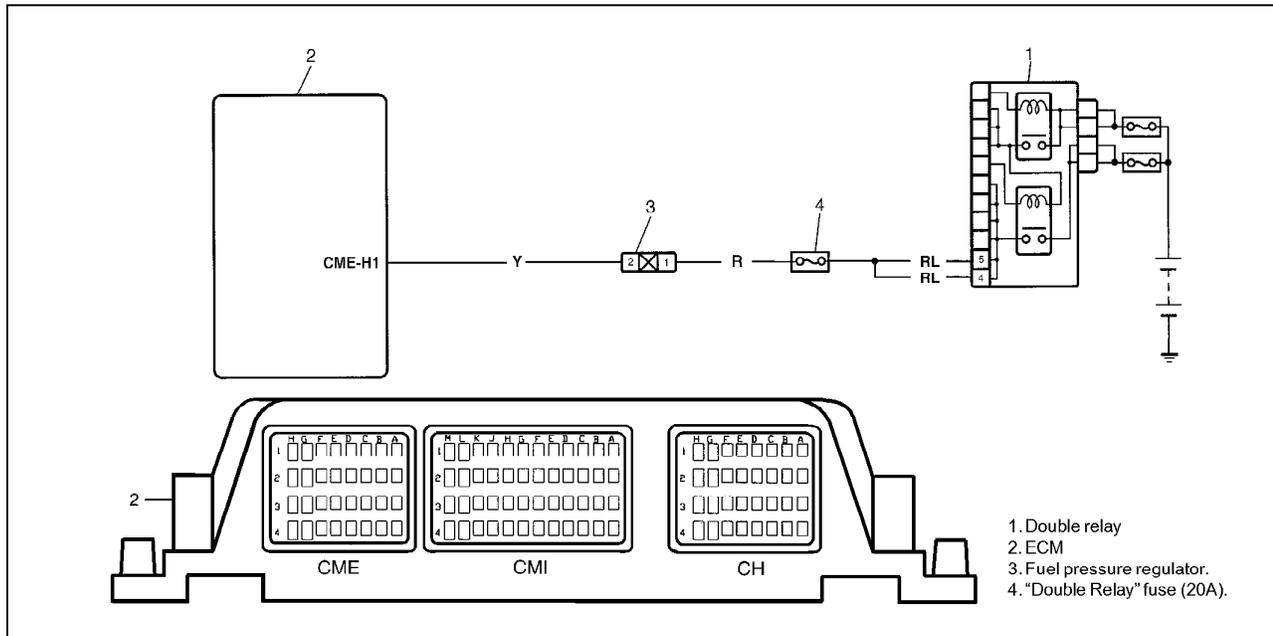
**DTC CONFIRMATION PROCEDURE**

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

## TROUBLESHOOTING

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Is operating sound heard from injection pump?	Go to Step 3.	Proceed to DTC P0215/P1601 Diag. Flow table.
3	<p>Check Wire Harness</p> <p>1) Disconnect injection pump solenoid valve connector with ignition switch turned OFF.</p> <p>2) With ignition switch ON, check voltage between "R" wire terminal of solenoid valve connector and ground.</p> <ul style="list-style-type: none"> <li>• Within 5 sec. after ignition switch ON: 10-14 V</li> <li>• Over 5 sec. after ignition switch ON: about 0 V</li> </ul> <p>Is check result as specified?</p>	Go to Step 4.	"R" wire open or short to ground,
4	<p>Check Injection Pump Solenoid Valve</p> <p>Check resistance between "R" and "BG" terminal of valve,</p> <p>Is it between 25 - 30 <math>\Omega</math>?</p>	<ul style="list-style-type: none"> <li>• "BG" wire open or shorted to power/ground.</li> <li>• Poor CME-G3 connection.</li> </ul> <p>If wire and connection are OK, substitute a known-good ECM and recheck.</p>	Faulty injection pump solenoid valve.

**DTC P1207 FUEL PRESSURE REGULATOR CIRCUIT MALFUNCTION (CONSISTENCY)**  
**DTC P1208 FUEL PRESSURE REGULATOR CIRCUIT MALFUNCTION (SHORT CIRCUIT TO GROUND)**  
**DTC P1209 FUEL PRESSURE REGULATOR CIRCUIT MALFUNCTION (SHORT CIRCUIT BETWEEN TWO WIRES)**  
**DTC P1210 FUEL PRESSURE REGULATOR CIRCUIT MALFUNCTION (OPEN CIRCUIT)**  
**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

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

**TROUBLESHOOTING**

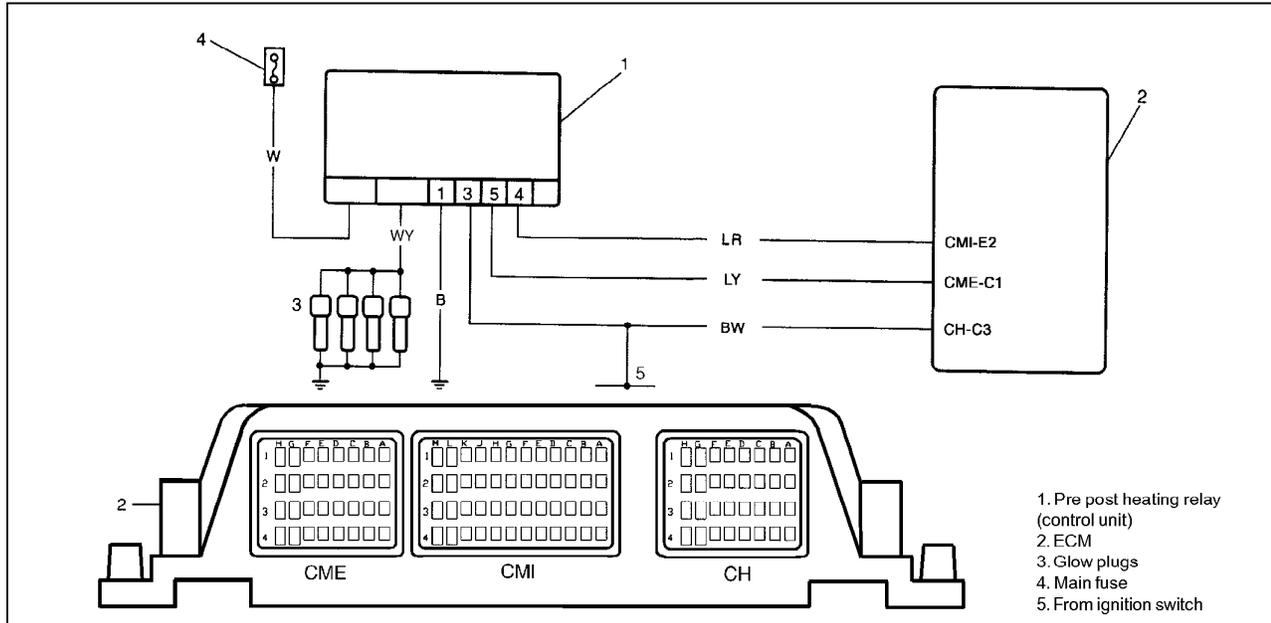
STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Wire Harness 1) Disconnect connector at fuel pressure regulator. 2) Check voltage between "R" terminal of regulator connector and ground with ignition switch ON. • Ignition switch ON: 10-14 V • Ignition switch OFF: about 0 V Is check result as specified?	Go to Step 3.	"R" wire open or shot to ground.
3	Check Fuel Pressure Regulator Check resistance between "R" and "Y" terminal of valve.	• "Y" wire open or shorted to power/ground, • poor CME-H1 connection. If wire and connection are OK, substitute a known-good ECM and recheck.	Faulty fuel pressure regulator.

**DTC P1349 PRE/POST HEAT RELAY CIRCUIT MALFUNCTION (SHORT CIRCUIT TO POSITIVE)**

**DTC P1350 PRE/POST HEAT RELAY CIRCUIT MALFUNCTION (OPEN OR SHORT CIRCUIT TO GROUND)**

**DTC P1351/P1352 PRE/POST HEAT RELAY CIRCUIT MALFUNCTION (CONSISTENCY)**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

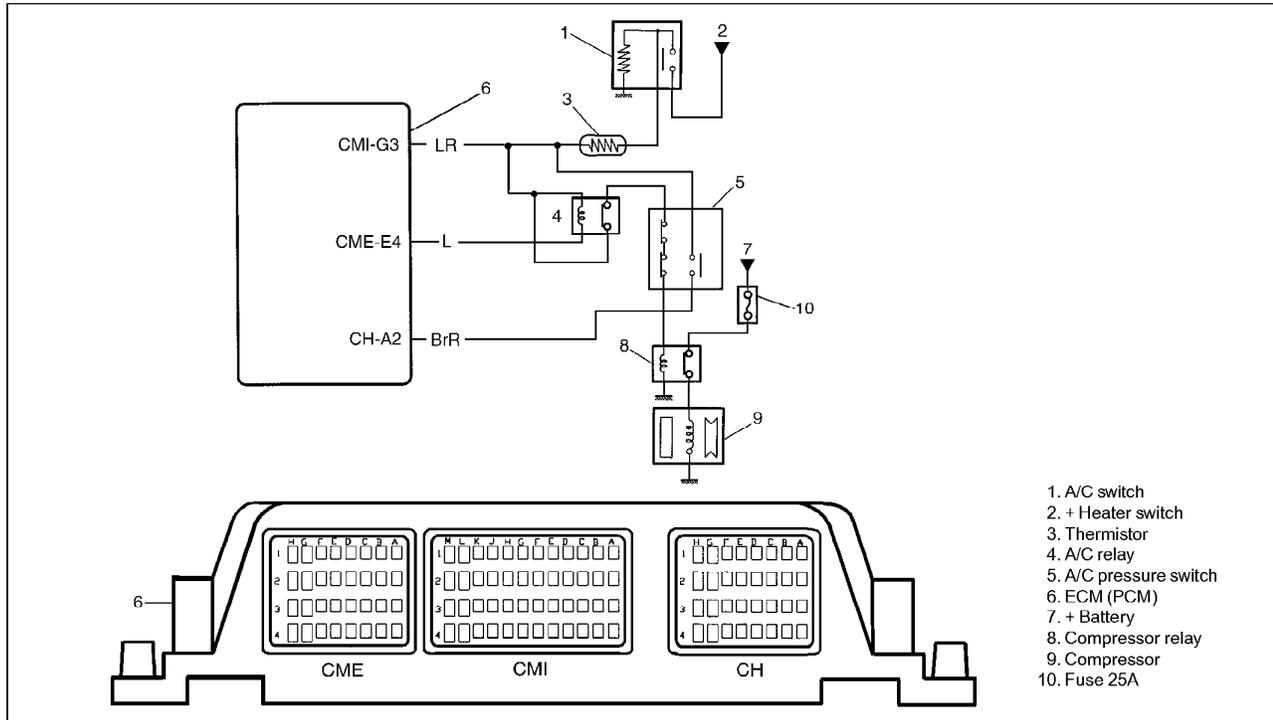
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn ON ignition switch after OFF for 30 sec.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE",
2	Check Wire Harness 1) Remove ECM covers from ECM referring to "CHECK VOLTAGE" in this section. 2) Check voltage between CMI-E2/CH-C3 and ground with ignition switch ON. Are they about 12 V?	Go to Step 3.	<ul style="list-style-type: none"> <li>• "LR" wire open or short to ground, or</li> <li>• "BW" wire open or short to ground</li> </ul>
3	Check Wire Harness 1) Check voltage between CME-C1 and ground with ignition switch ON. Is it about 0 V?	<ul style="list-style-type: none"> <li>• Poor CMI-E2 or CME-C1 connection</li> </ul> If connections are in good condition, substitute a known-good ECM and recheck.	<ul style="list-style-type: none"> <li>• "LY" wire open or short,</li> <li>• "B" wire (between pre-post heating relay and ground) open or short to ground</li> <li>• "WY" wire (between pre-post heating relay and glow plug) open or short to ground</li> <li>• Poor glow plug "WY" wire terminal connection</li> </ul> If all are OK, substitute a known-good ECM and recheck.

**DTC P1543 A/C SIGNAL CIRCUIT MALFUNCTION (SHORT CIRCUIT BETWEEN TWO WIRES)**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

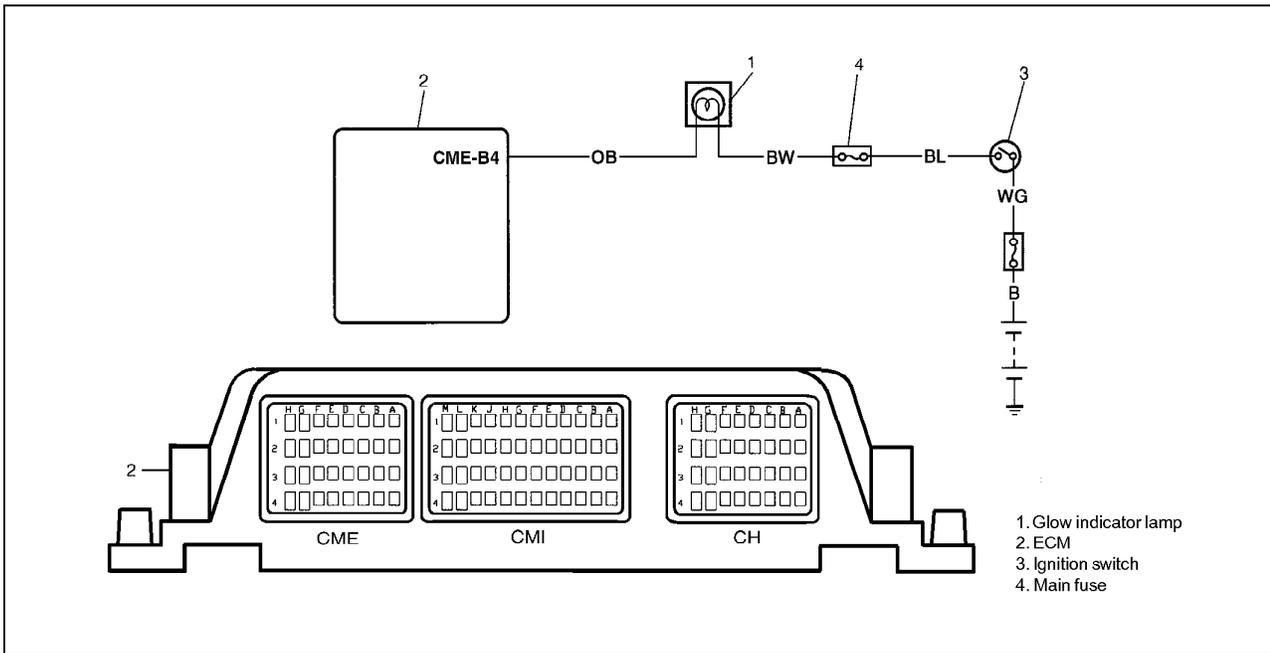
- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Start engine and turn on A/C switch and heater blower fan switch.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Check Wire Harness 1) Remove ECM covers from ECM referring to "Voltage Check" in this section. 2) Check voltage between CMI-G3 and ground at engine idling. Is it as follows? • A/C switch and heater blower switch OFF: 0 V • A/C switch and heater blower switch ON: about 12V	Poor CMI-G3 connection. If OK, substitute a known-good ECM and recheck.	• "LR" wire open or short If all are in good condition, substitute a known-good thermistor and recheck.

**DTC P1602 GLOW INDICATOR LAMP CIRCUIT MALFUNCTION (OPEN OR SHORT CIRCUIT BETWEEN TWO WIRES)**

**WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

- 1) Connect scan tool to DLC with ignition switch OFF.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn ignition switch ON for 30 sec. after OFF. Then run engine at idle speed for 30 sec.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

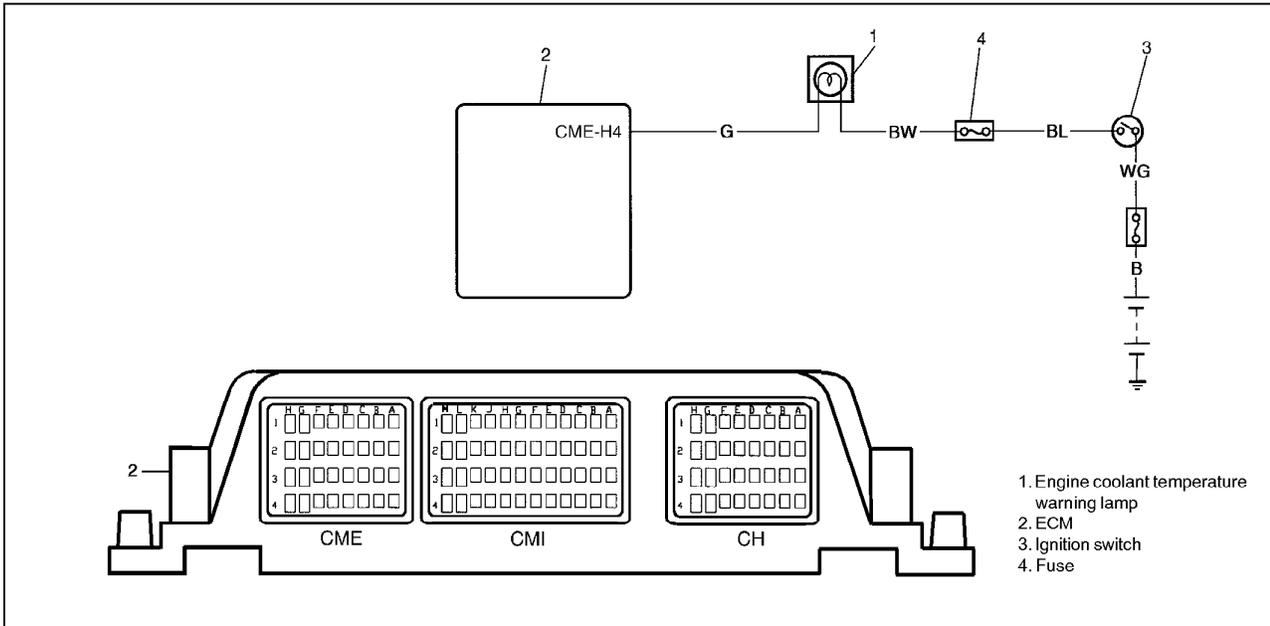
STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2. FLOW TABLE".	Go to "ENGINE DIAG.
2	Check Wire Harness <Not Using Suzuki Scan Tool> 1) Disconnect connectors at ECM with ignition switch OFF. 2) Ground CME-B4 with ignition switch ON using service wire. Does glow indicator lamp turn on? <Using Suzuki Scan Tool> 1) Connect Suzuki scan tool to DLC. 2) Execute "Glow Indicator Lamp" in Misc Test. Does glow indicator lamp flash?	Substitute a known-good ECM and recheck.	<ul style="list-style-type: none"> <li>• Lamp bulb broken,</li> <li>• "OB" wire open or short or</li> <li>• Poor CME-B4 connection.</li> </ul>

**REFERENCE:**

As soon as ignition is switched on, ECM turns on glow indicator lamp for a period which depends on engine coolant temp. as shown below.

Engine coolant temp. (°C)	Time turning on glow indicator lamp (sec.)
-30	20
-10	5
0	0.5
18	0

**DTC P1608 ECT WARNING LAMP CIRCUIT MALFUNCTION  
WIRING DIAGRAM**



**DTC CONFIRMATION PROCEDURE**

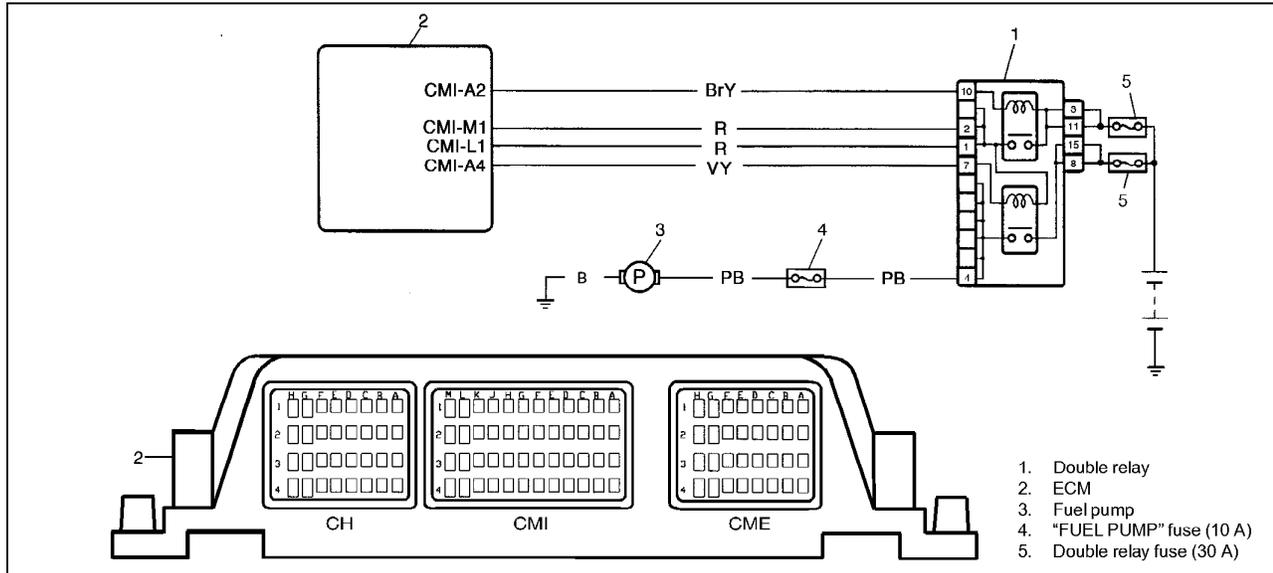
- 1) Connect scan tool to DLC with ignition switch off.
- 2) Turn ON ignition switch and clear DTC, pending DTC and freeze frame data by using scan tool.
- 3) Turn OFF ignition and then ON.
- 4) Check DTC and pending DTC by using scan tool.

**TROUBLESHOOTING**

STEP	ACTION	YES	NO
1	Was "ENGINE DIAG. FLOW TABLE" performed?	Go to Step 2.	Go to "ENGINE DIAG. FLOW TABLE".
2	Engine Coolant Warning Lamp Circuit Check 1) Disconnect connector at ECM with ignition switch OFF. 2) Check voltage between "G" wire terminal of ECM connector and ground. • Ignition switch ON: 10-14 V • Ignition switch OFF: 0 V Is check result as specified?	Poor CME-H4 connection. If it is in good condition, substitute a known-good ECM and recheck.	<ul style="list-style-type: none"> <li>• "G" wire open or short to ground/battery or</li> <li>• Bulb burned out</li> </ul>

**TABLE B-1 FUEL PUMP CIRCUIT INSPECTION (ONLY TYPE 1 VEHICLES)**

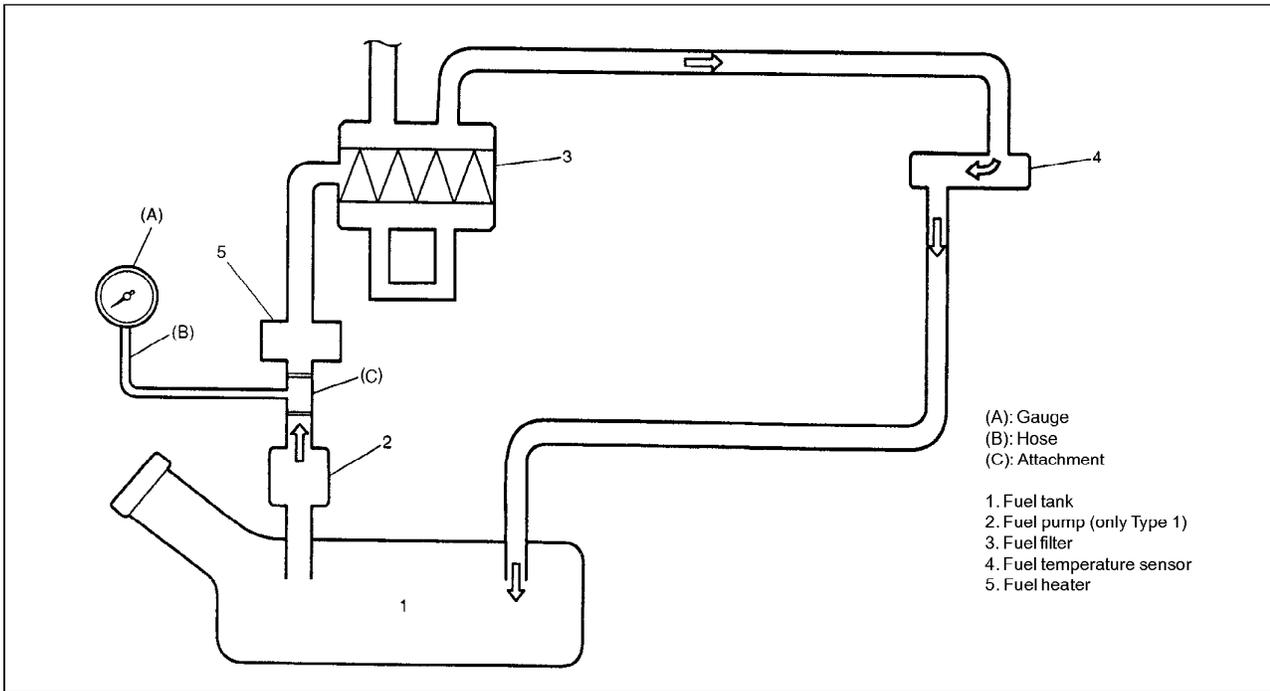
**WIRING DIAGRAM**



**INSPECTION**

STEP	ACTION	YES	NO
1	Fuel Pump Operation Check: 1) Turn ON ignition switch. Is fuel pump operation sound heard for 5 sec. after ignition switch ON?	Fuel pump circuit is in good condition.	Go to Step 2.
2	Fuel Pump Circuit Check: 1) With ignition switch OFF, remove double relay from connector. 2) Check for proper connection to relay at each terminal. 3) If OK, using service wire, connect terminals 8 and 4 of relay connector.  <b>CAUTION: Check to make sure that connection is made between correct terminals. Wrong connection can cause damage to ECM, wire harness etc.</b>  Is fuel pump heard to operate at ignition switch ON?	Go to Step 3.	"B" or "PB" circuits open or fuel pump malfunction.
3	Double Relay Check: 1) Check fuel pump relay referring to "Double Relay Inspection" in Section 6E3. Is it in good condition?	"VY" circuit open.	Replace fuel pump.

**TABLE B-2 FUEL PRESSURE INSPECTION SYSTEM DIAGRAM**



**INSPECTION**

**NOTE:**

Before using following flow table, check to make sure that battery voltage is higher than 11 V. If battery voltage is low, pressure becomes lower than specification even if fuel pump and line are in good condition.

STEP	ACTION	YES	NO
1	1) Install fuel pressure gauge, referring to "Low Pressure Fuel Supply System Inspection" in Section 6E3. 2) Operate fuel pump (Type 1) or high pressure fuel pump (Type 2). Is fuel pressure then about 220 kPa (2.2 kg/cm <sup>2</sup> , 31.3 psi)?	Normal fuel pressure.	Go to Step 2.
2	Was fuel pressure higher than spec. in Step 1?	Clogged fuel heater, fuel filter fuel temperature or fuel hose/pipe.	Go to Step 3.
3	Was no fuel pressure applied in Step 1?	<ul style="list-style-type: none"> <li>Shortage of fuel or</li> <li>Fuel pump (Type 1) or high pressure fuel pump (Type 2) and its circuit defective.</li> </ul> (Refer to Table B-1 "Fuel Pump Circuit Inspection")	Fuel leakage from fuel line.

# SPECIAL TOOLS

	<ol style="list-style-type: none"> <li>1. Pressure gauge 09912-58441</li> <li>2. Pressure hose 09912-58431</li> <li>3. Attachment 09919-46010</li> <li>4. Checking tool set 09912-58421</li> <li>4-1 Tool body &amp; washer</li> <li>4-2 Body plug</li> <li>4-3 Body attachment</li> <li>4-4 Holder</li> <li>4-5 Return hose &amp; clamp</li> <li>4-6 Body attachment-2 &amp; washer</li> <li>4-7 Hose attachment-1</li> <li>4-8 Hose attachment-2</li> </ol>	
<p>SUZUKI scan tool (Tech 2) kit</p>	<ol style="list-style-type: none"> <li>1. Storage case</li> <li>2. Operator's manual</li> <li>3. Tech 2</li> <li>4. DLC cable</li> <li>5. Power source cable (cigar)</li> <li>6. Power source cable (battery)</li> <li>7. Power source</li> <li>8. RS232 DB adaptor</li> <li>9. RS232 cable</li> <li>10. RS232 test connector</li> <li>11. DLC test connector</li> </ol>	<p>Suzuki PCMCIA (10 MB) card</p>

## SECTION 6A3

# ENGINE MECHANICAL (HDI ENGINE)

**WARNING:**

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

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Component and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service Precautions “ under “On-Vehicle Service” in air bag system section before performing service on or around the air bag 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).

**6A3**

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**NOTE:**

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

## MAINTENANCE

### OIL LEVEL CHECK, OIL CHANGE AND OIL FILTER CHANGE

Refer to "ENGINE" in section 0B.

## ON-VEHICLE SERVICE

### COMPRESSION CHECK

- 1) Cool off engine if it is hot.
- 2) Disconnect negative cable at battery and remove engine cover.
- 3) Disconnect ECM connectors from ECM.
- 4) Remove all glow plugs referring to "GLOW PLUG" in Section 6E3.

- 5) Install special tool to glow plug hole.

#### Special Tool

(A): 09912-57820

(B): 09916-96520

- 6) Connect negative cable at battery.
- 7) Disengage clutch (to lighten starting load on engine).
- 8) Crank engine and inspect compression pressure.

#### Compression pressure specification

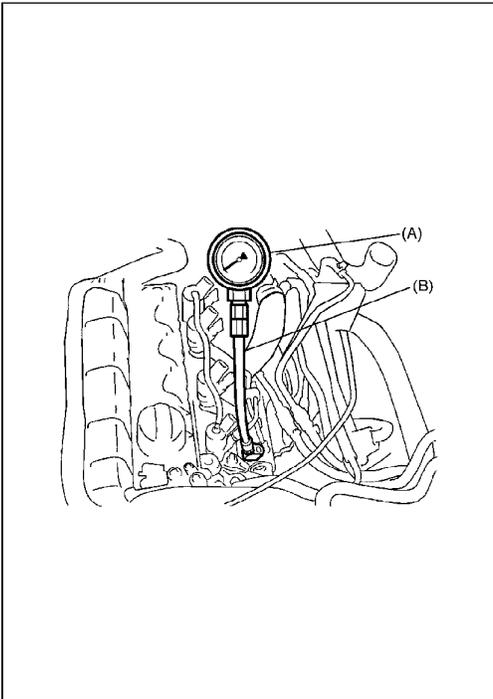
(at cranking engine (engine speed is 250 rpm or more)):

**Maximum: 2.5 MPa (25 kg/cm<sup>2</sup>, 356 psi)**

**Maximum difference between cylinders:**

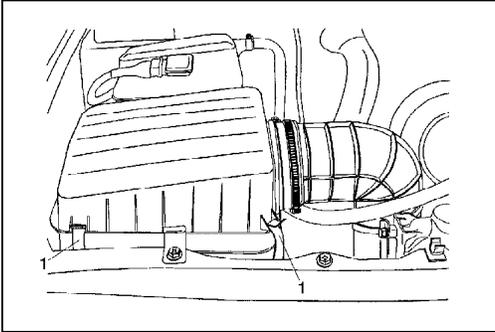
**0.5 MPa (5 kg/cm<sup>2</sup>, 72 psi)**

- 9) Perform above check for each cylinder.



- 10) If compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder and recheck compression.
  - If compression increases, piston, piston rings or cylinders wall may be worn.
  - If compression stays low, valve may be stuck or seating improperly.
  - If compression in adjacent cylinders stay low, cylinders head gasket may be damaged or cylinder head distorted.

- 11) Disconnect negative cable at battery.
- 12) Remove special tool and install all glow plugs referring to "GLOW PLUG" in Section 6E3.
- 13) Connect ECM connectors to ECM.
- 14) Install engine cover and connect negative cable at battery.



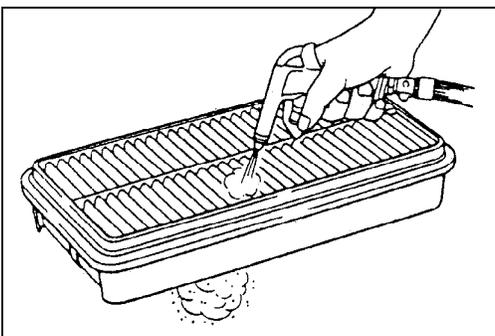
## AIR CLEANER ELEMENT

### REMOVAL

- 1) Release attaching strap.
- 2) Remove air cleaner case clamps (1).
- 3) Remove air cleaner element from case.

### INSPECTION

Check air cleaner element for clean. Replace excessively dirty element.

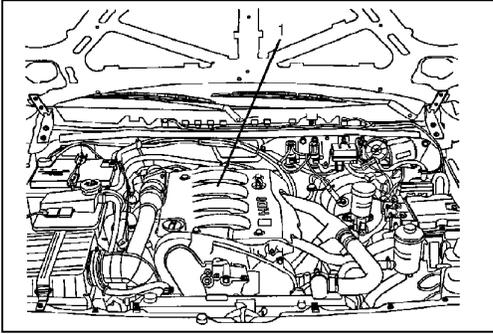


### CLEAN

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

### INSTALLATION

Reverse removal procedure for installation.



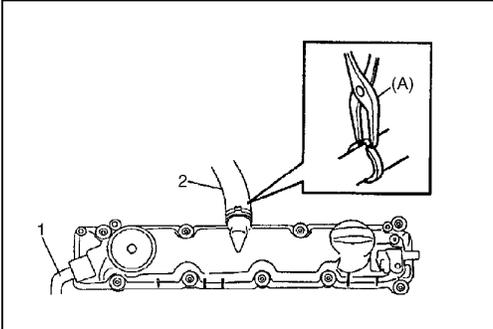
## CYLINDER HEAD COVER

### REMOVAL

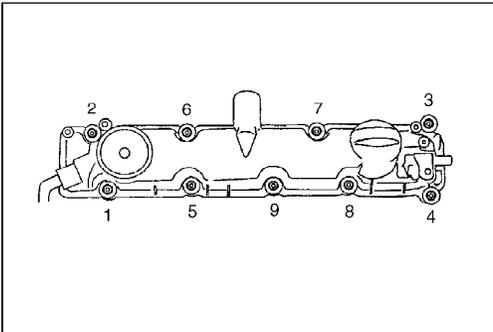
- 1) Disconnect negative cable at battery.
- 2) Remove engine cover (1).
- 3) Remove upper timing belt cover.
- 4) Disconnect breather hose and bracket (1) and PCV hose (2) from cylinder head cover.

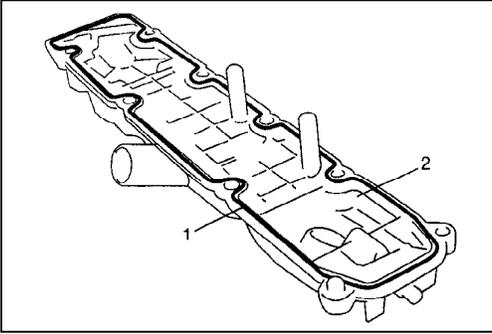
**Special Tool**  
**(A): 09919-46510/OUT0000110**

- 5) Disconnect CMP sensor connector. Remove CMP sensor, if necessary, and engine cover front bracket.



- 6) Loosen cylinder head cover bolts in such order as indicated in figure and remove them.
- 7) Remove cylinder head cover with its gasket.



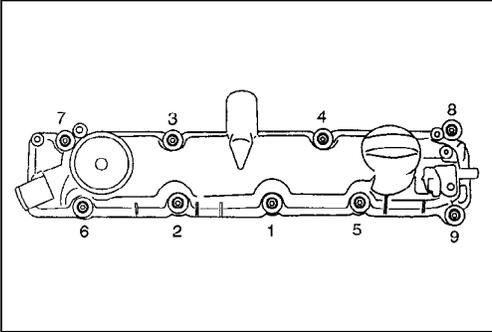
**INSTALLATION**

- 1) Install cylinder head cover gasket (1) to cylinder head cover (2).

**NOTE:**

**Be sure to check cylinder head cover gasket for deterioration or any damage before installation and replace if found defective.**

- 2) Install cylinder head cover to cylinder head.



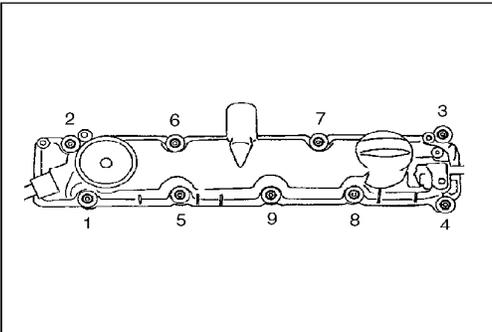
- 3) Tighten bolts in such order as indicated in figure a little at a time till they are tightened to specified torque.

**Tightening Torque**

**Cylinder head cover bolt: 10 N-m (1.0 kg-m, 7.5 lb-ft)**

**NOTE:**

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

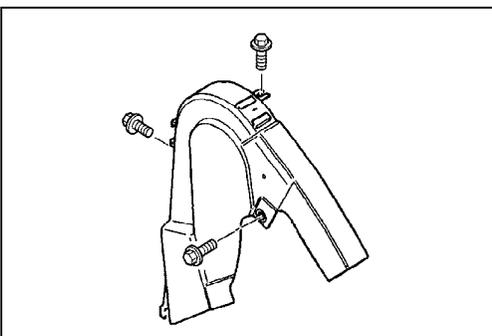


- 4) Connect breather hose (1) with his bracket and PCV hose (2) to cylinder head cover.

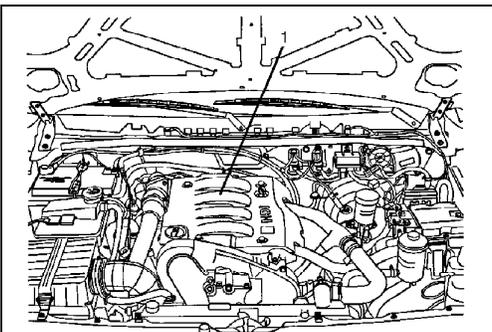
**Special Tool**

**(A): 09919-46510/OUT0000110**

- 5) Install CMP sensor, if removed, and engine cover front bracket.
- 6) Check CMP sensor air gap referring to "CAMSHAFT POSITION SENSOR" in Section 6E3.

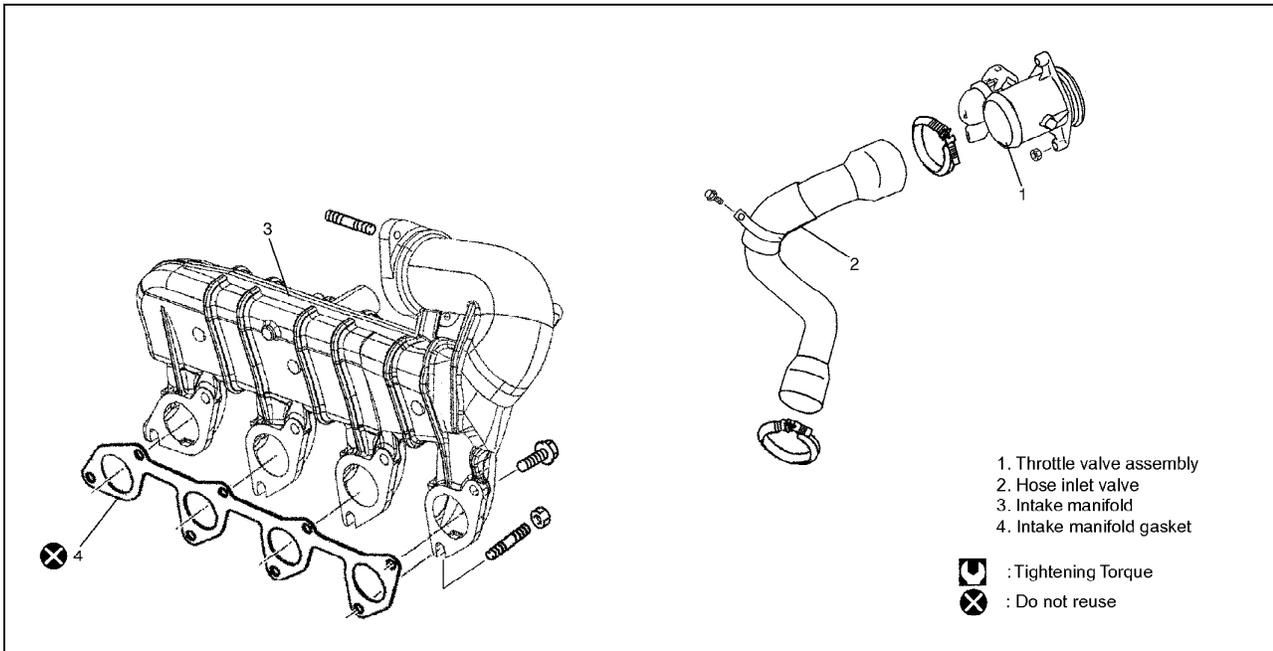


- 7) Install upper timing belt cover.



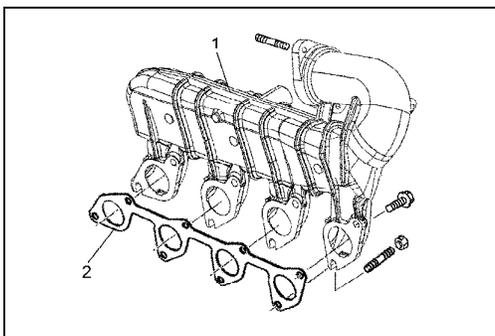
- 8) Install engine cover (1) and connect negative cable at battery.

## INTAKE MANIFOLD



### REMOVAL

- 1) Remove exhaust manifold with turbocharger referring to "TURBOCHARGER" in section 6E3.
- 2) Remove throttle valve assembly referring to "THROTTLE VALVE ASSEMBLY" in section 6E3.



- 3) Remove intake manifold (1) and the gasket (2).

### **INSTALLATION**

Reverse removal procedure for installation noting following points.

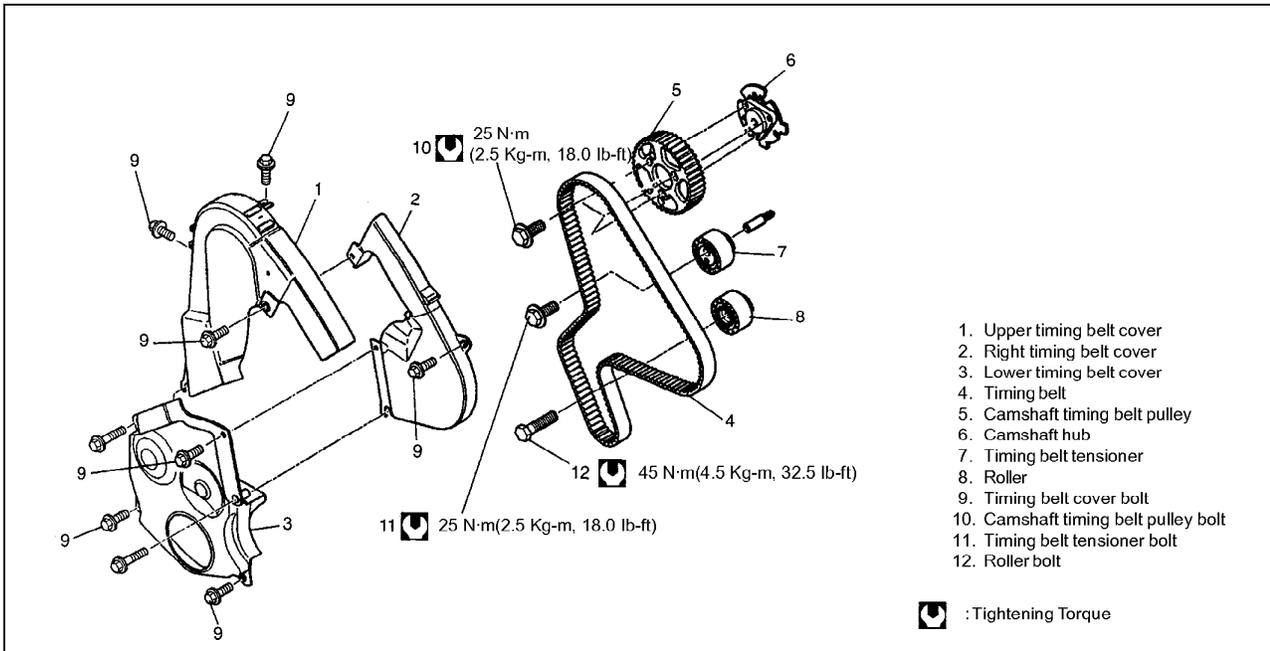
- Clean mating surfaces of intake manifold and cylinder head.
- ˆ Use new intake manifold gasket.
- ˆ Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- ˆ Install exhaust manifold with turbocharger referring to “TURBOCHARGER” in Section 6E3.
- ˆ Install throttle valve assembly referring to “THROTTLE VALVE ASSEMBLY” in Section 6E3.

## **EXHAUST MANIFOLD**

### **REMOVAL/INSTALLATION**

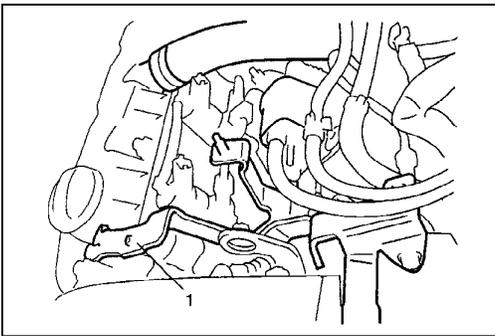
Refer to “TURBOCHARGER” in Section 6E3.

## TIMING BELT AND BELT TENSIONER

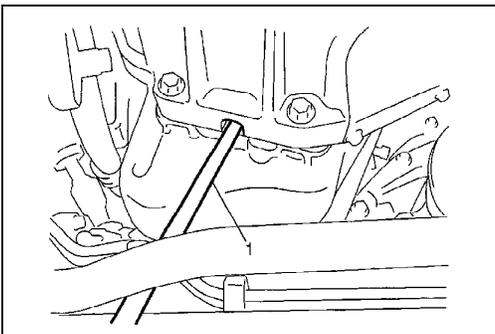


### REMOVAL

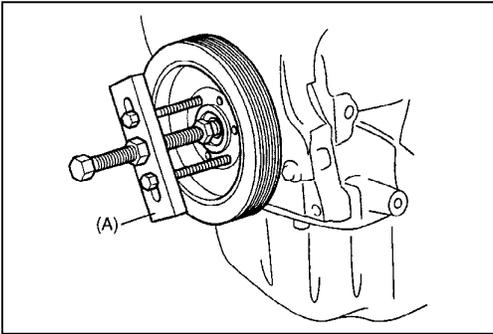
- 1) Disconnect negative cable at battery and remove engine cover.
- 2) Remove A/C compressor belt, if equipped.
- 3) Remove generator belt referring to "GENERATOR BELT" in Section 6H.
- 4) Remove radiator referring to "RADIATOR" in Section 6B.



- 5) Remove bracket (1).



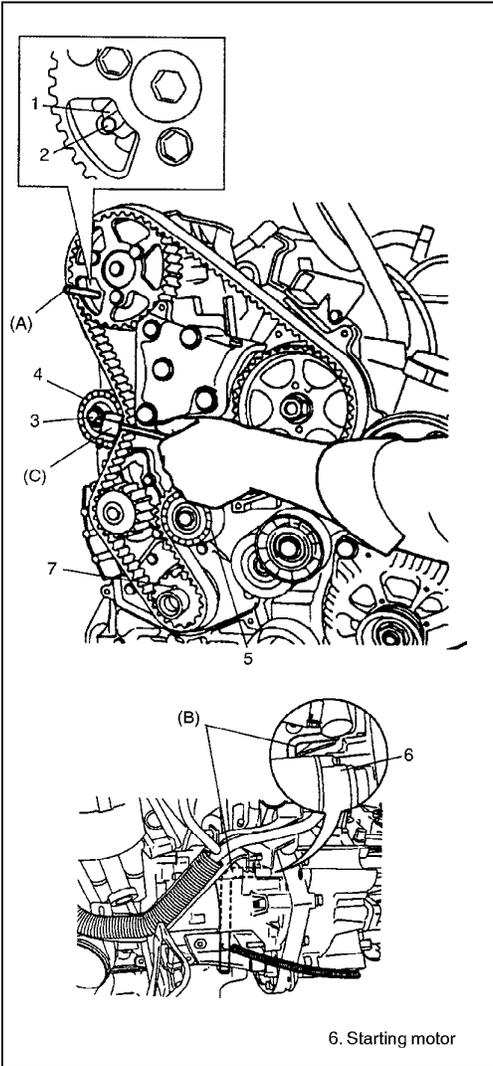
- 6) Remove crankshaft pulley bolt with crankshaft locked by using flat end rod (1) or the like as shown in figure.



- 7) Remove crankshaft pulley.  
If it is hard to remove, install crankshaft pulley bolt without washer and use special tools.

**Special Tool**  
**(A): 09944-36011**

- 8) Remove timing belt covers.



- 9) Remove fuel filter assembly.  
10) Turn crankshaft so that crank timing pulley key (7) turns up, and then lock camshaft hub (1) inserting special tool (A) into cylinder head hole (2) as shown in figure.

**Special Tool**  
**(A): 09910-26540/OUT0000151**

- 11) Lock flywheel inserting special tool (B) into holes in both cylinder block and flywheel with crank timing pulley key turned up.

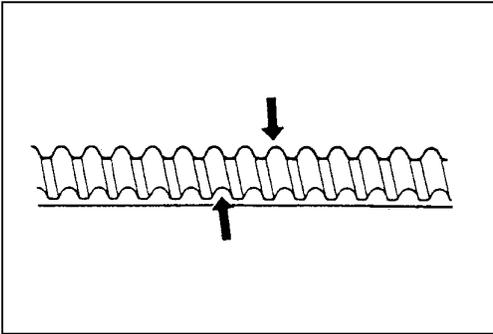
**Special Tool**  
**(B): 09910-26530/OUT0000160**

- 12) Loosen timing belt tensioner bolt (3). Then remove timing belt turning timing belt tensioner (4) counterclockwise with special tool (C).

**Special Tool**  
**(C): 09919-56550/OUT0000141**

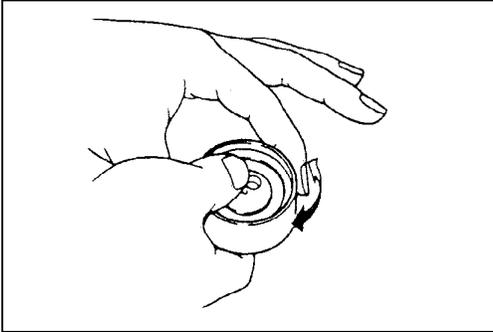
- 13) Remove timing belt tensioner and roller (5).

6. Starting motor

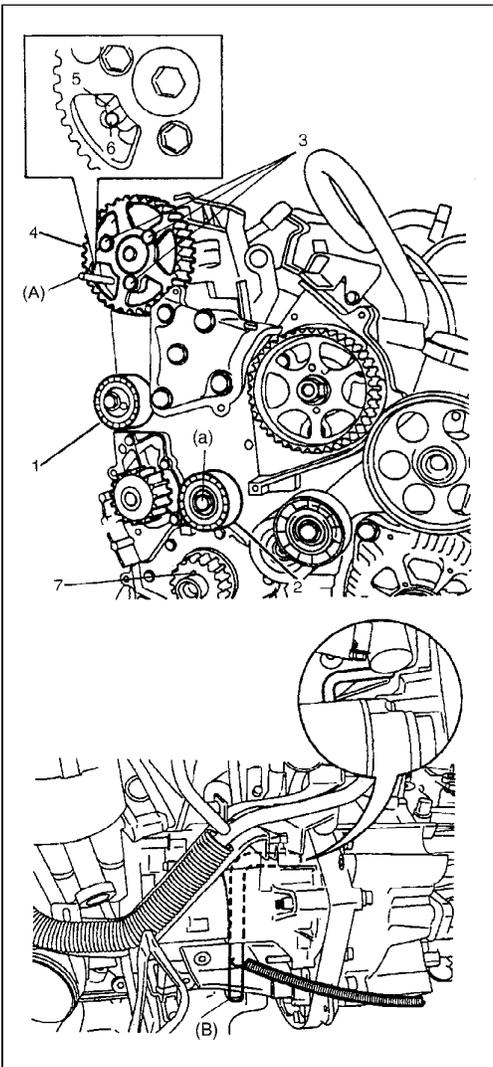


**INSPECTION**

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



Inspect timing belt tensioner and roller for smooth rotation.



**INSTALLATION**

- 1) Install timing belt tensioner (1) and roller (2).  
Do not tighten timing belt tensioner bolt with wrench yet. Tighten by hand only at this time.

**Tightening Torque**

**Roller bolt (a): 45 N-m (4.5 kg-m, 32.5 lb-ft)**

- 2) Check that camshaft hub (5) is locked inserting special tool (A) into cylinder head hole (6) as shown in figure.

**Special Tool**

**(A): 09910-26540/OUT0000151**

- 3) Check that flywheel is locked inserting special tool (B) into holes in both cylinder block and flywheel with crank timing pulley key (7) turned up.

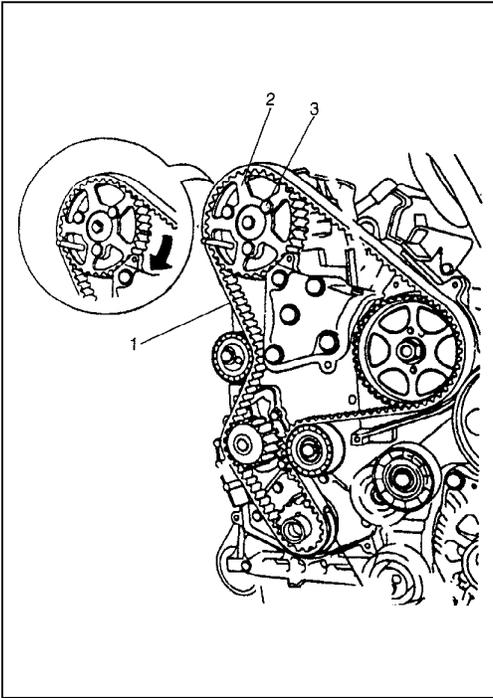
**Special Tool**

**(B): 09910-26530/OUT0000160**

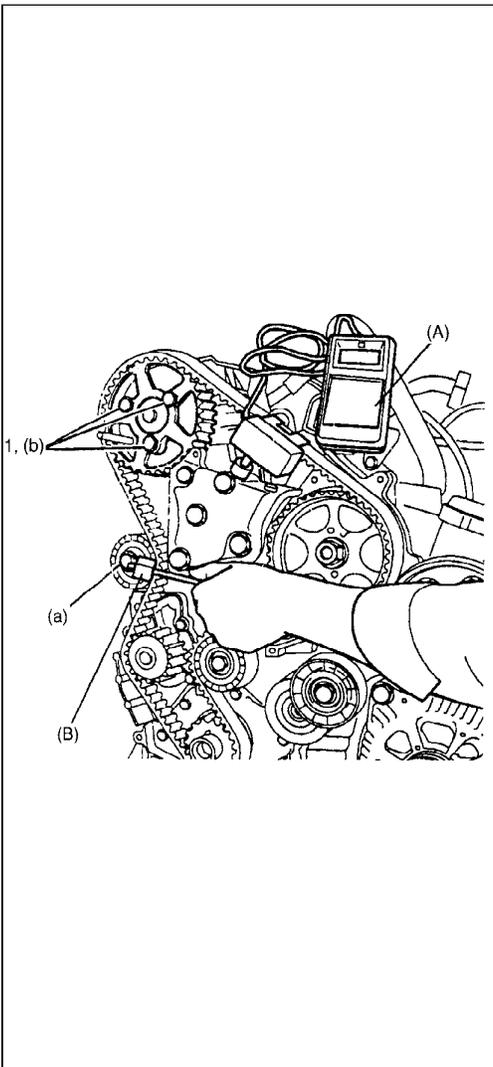
- 4) Loosen camshaft timing belt pulley bolts (3).

**NOTE:**

**Do not remove camshaft timing belt pulley bolts (3).**



- 5) Install timing belt (1) with camshaft timing belt pulley (2) turned clockwise within oblong hole (3) of camshaft timing belt pulley as shown in figure.



- 6) Fit special tool as shown in figure.

**Special Tool**

**(A): 09919-56560/OUT0000138**

- 7) Turn timing belt tensioner clockwise using special tool (B) until special tool (A) indicates  $98 \pm 2$  Seems (145 Hz). Then tighten timing belt tensioner bolt to specified torque.

**Special Tool**

**(B): 09919-56550/OUT0000141**

**Tightening Torque**

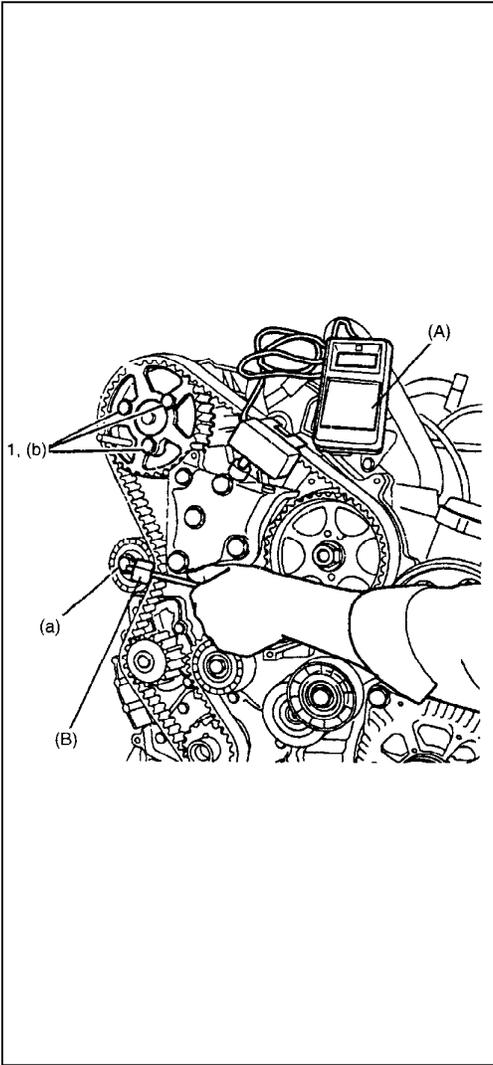
**Timing belt tensioner bolt (a):  
25 N·m (2.5 kg·m, 18.0 lb-ft)**

- 8) By removing camshaft timing belt pulley bolt (1), check to make sure that bolt is not at the limit of bolt slot in pulley.  
9) Install camshaft timing belt pulley bolts on camshaft timing belt pulley.  
Tighten bolts to specified torque.

**Tightening Torque**

**Camshaft timing belt pulley bolt (b):  
20 N·m (2.0 kg·m, 14.5 lb-ft)**

- 10) Remove all special tools and then turn crankshaft eight rotations clockwise.  
11) Install special tool referring to step 10) of "TIMING BELT AND BELT TENSIONER REMOVAL".



- 12) Loosen camshaft timing belt pulley bolts (1).

**NOTE:**

**Do not remove camshaft timing belt pulley bolts (1).**

- 13) Fit special tool as shown.

**Special Tool**

**(A): 09919-56560/OUT0000138**

- 14) Turn timing belt tensioner clockwise using special tool (B) until special tool (A) indicates  $54 \pm 2$  Seems (90 Hz). Then tighten timing belt tensioner bolt to specified torque.

**Special Tool**

**(B): 09919-56550/OUT0000141**

**Tightening Torque**

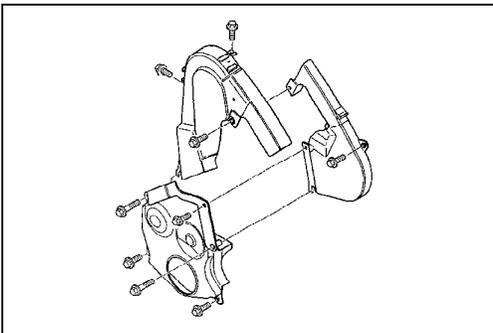
**Timing belt tensioner bolt (a):  
25 N·m (2.5 kg·m, 18.0 lb·ft)**

- 15) Tighten camshaft timing belt pulley bolts to specified torque.

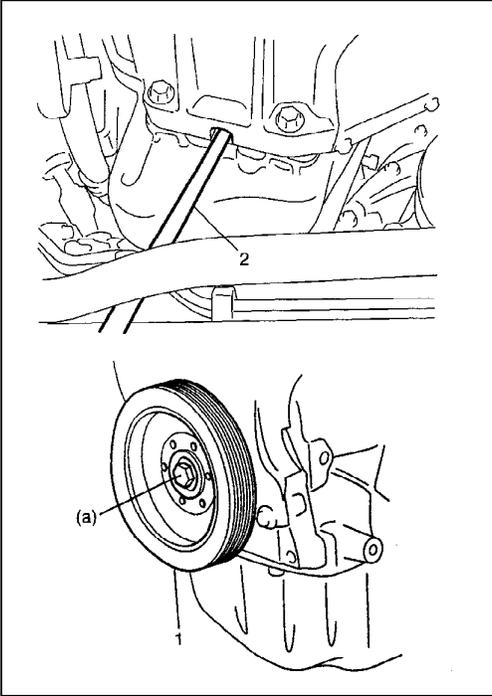
**Tightening Torque**

**Camshaft timing belt pulley bolt (b):  
20 N·m (2.0 kg·m, 14.5 lb·ft)**

- 16) Remove special tool (A) and then install it again.
- 17) Check that special tool (A) indicates between 51 and 57. If indication of tool is out of specified value, perform step 4) to 14) again after loosening timing belt.
- 18) Remove special tools.



- 19) Install timing belt covers.
- 20) Install fuel filter assembly and connect fuel hoses securely.



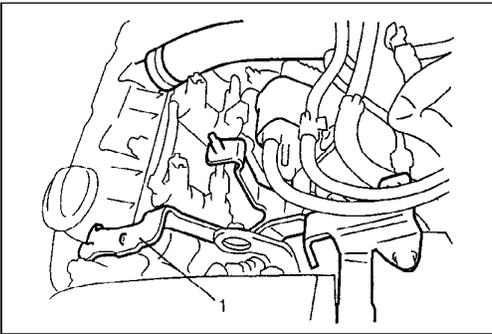
- 21) Install crankshaft pulley (1) with crankshaft locked by using flat end rod (2) or the like, apply sealant to crankshaft pulley bolt and tighten it gradually as follows.
- Tighten bolt to 40 N·m (4.0 kg-m, 29.0 lb-ft)
  - Tighten bolt to 195 N·m (19.5 kg-m, 141 lb-ft) by turning it to about 50°.

**Tightening Torque**

**Crankshaft pulley bolt (a): 195 N·m (19.5 kg-m, 141 lb-ft)**

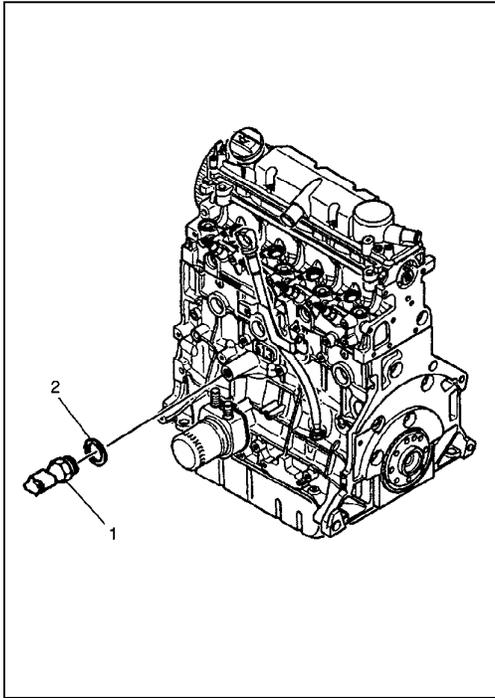
**Sealant:**

**“A” : LOCTITE 273**



- 22) Install bracket (1).

- Install radiator referring to “RADIATOR” in Section 6B.
- Refill cooling system referring to Section 6B.
- Install generator belt referring to “GENERATOR BELT” in Section 6H.
- Install engine cover and connect negative cable to battery.
- Check to make sure that there is no coolant leakage or fuel leakage at hose connection.



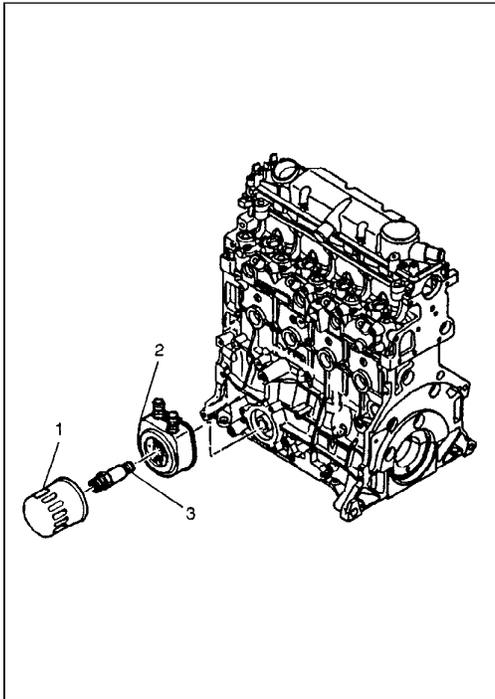
## OIL PRESSURE SWITCH

### REMOVAL

- 1) Remove engine wiring harness bracket.
- 2) Disconnect oil cooler hoses.
- 3) Disconnect oil pressure switch connector.
- 4) Remove oil pressure switch (1).

### INSTALLATION

- 1) Install oil pressure switch (1) with new gasket (2).
- 2) Tighten oil pressure switch.
- 3) Connect connector.
- 4) Connect oil cooler hoses.
- 5) Install engine wiring harness bracket.
- 6) Start engine and check for oil leakage.



## OIL COOLER

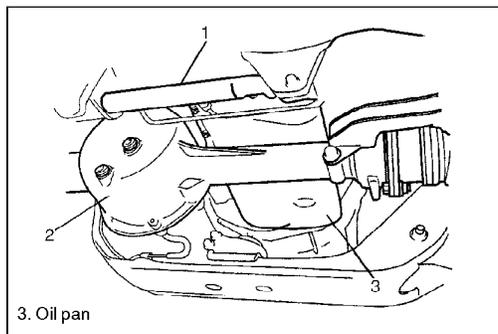
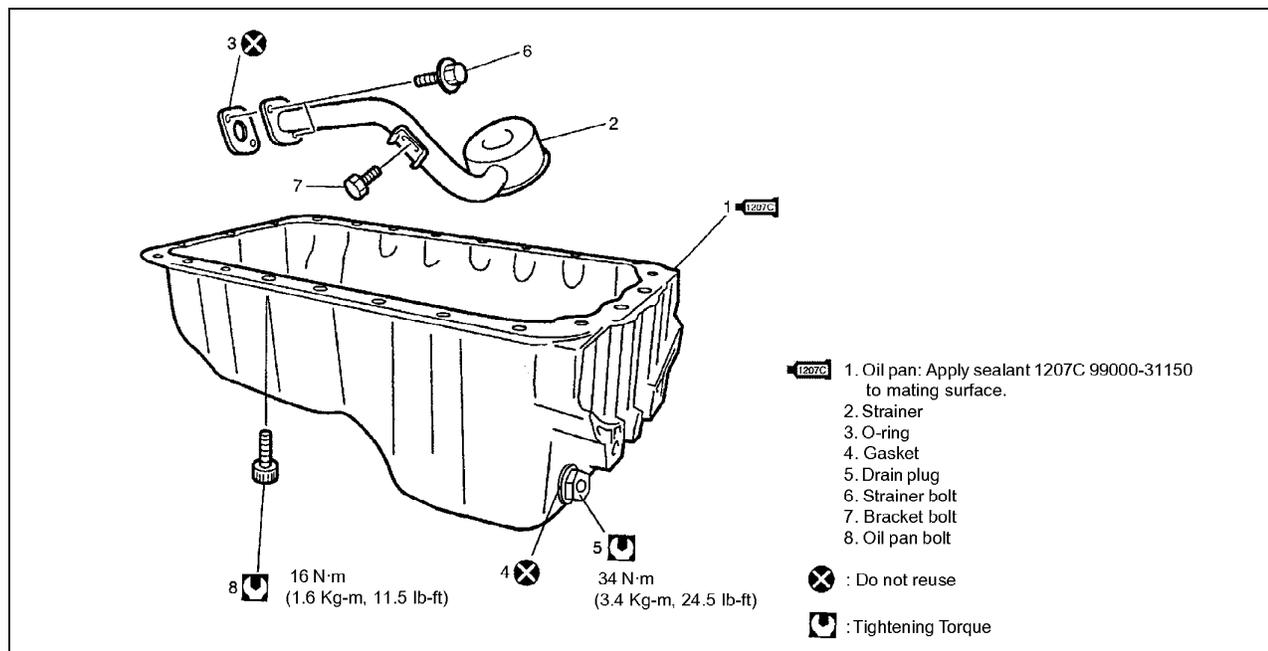
### REMOVAL

- 1) Drain engine coolant.
- 2) Remove engine wiring harness bracket.
- 3) Remove oil filter (1).
- 4) Disconnect hoses and remove oil cooler (2).

### INSTALLATION

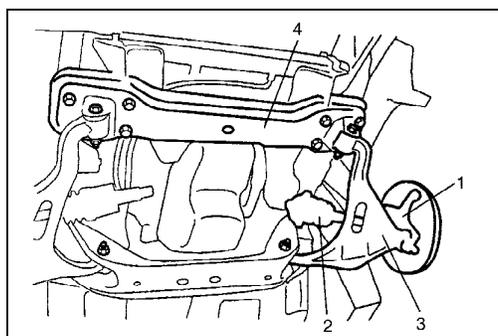
- 1) Install oil cooler (2) with new gasket.
- 2) Tighten cooler stud stand (3).
- 3) Connect hoses and tighten oil filter (1).
- 4) Install engine wiring harness bracket.
- 5) Fill engine coolant.
- 6) Check engine oil level. Refer to section 0B.
- 7) Check for oil leakage.

## OIL PAN AND OIL PUMP STRAINER

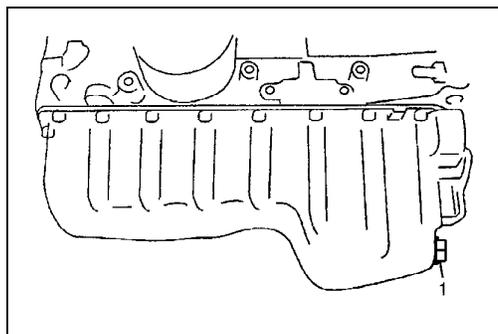


## REMOVAL

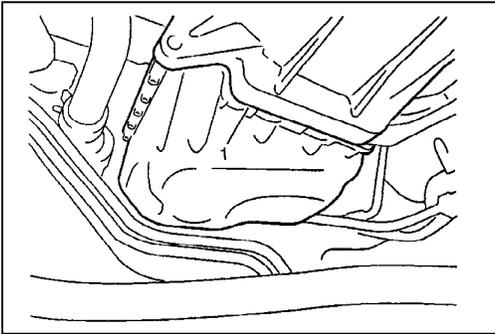
- 1) Remove oil level gauge.
- 2) Raise vehicle and remove both front wheels.
- 3) Remove steering bar (1) from vehicle referring to Section 3B1.
- 4) Remove front differential housing (2) with differential from chassis.



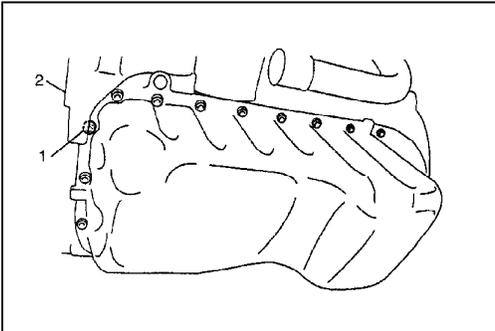
- 5) Remove knuckle (1), drive shaft (2) and suspension control arm (3) of either side after removing stabilizer bar. Refer to Section 3D of the Service Manual mentioned in FOREWORD of this manual.
- 6) Detach suspension frame (4) from chassis.



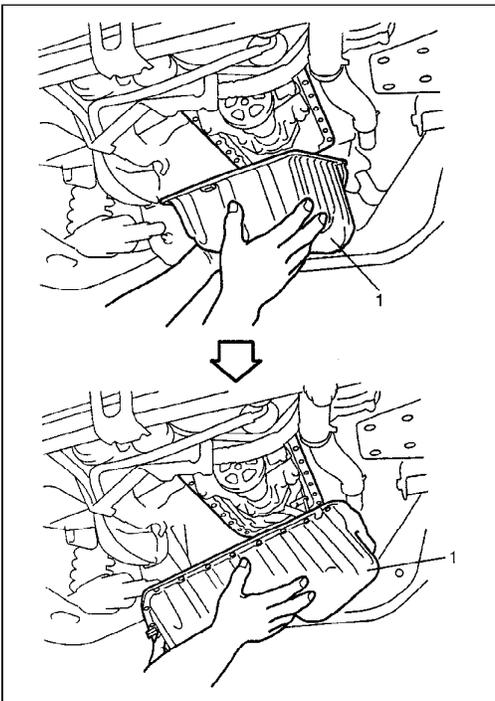
- 7) Drain engine oil by removing drain plug (1).



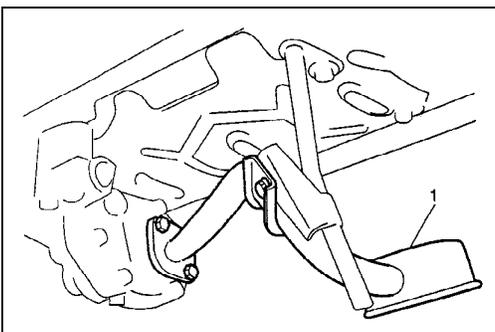
8) Remove front plate flywheel housing (1).



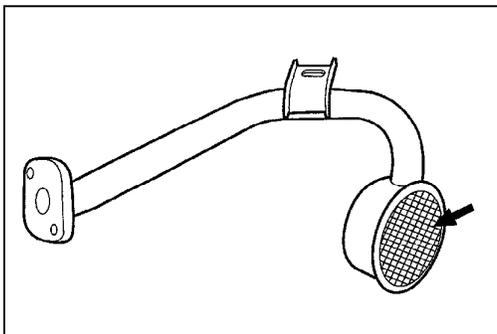
9) Remove oil pan bolts.



10) Remove oil pan (1) from cylinder block as shown.

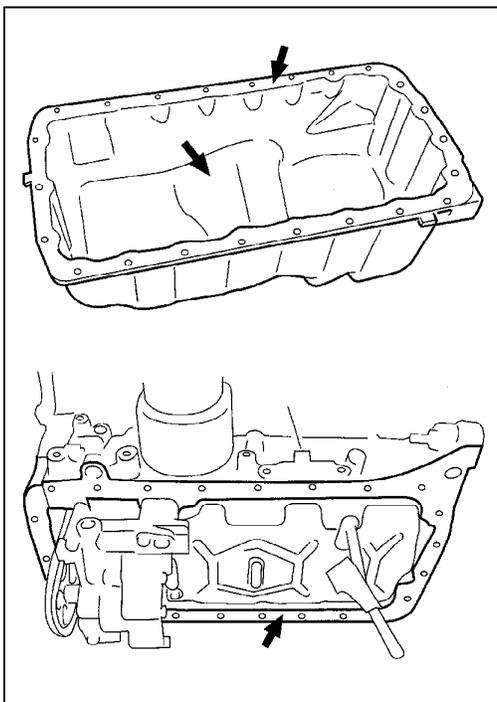


11) Remove oil pump strainer (1).



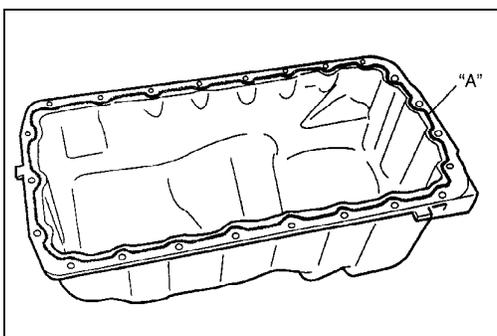
**CLEANING**

ˆ Clean oil pump strainer screen.



ˆ Clean mating surfaces of oil pan and cylinder block.

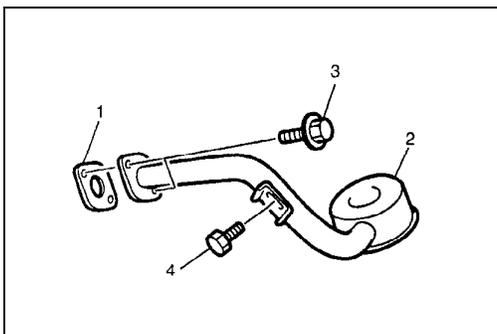
Remove oil, old sealant and dust from mating surfaces and inside of oil pan.



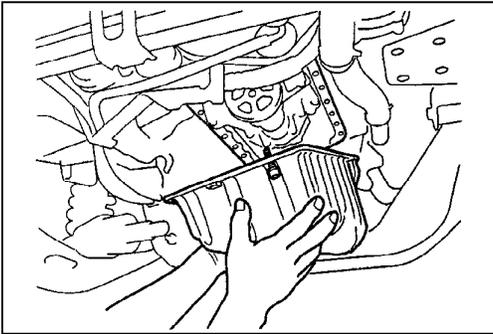
**INSTALLATION**

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

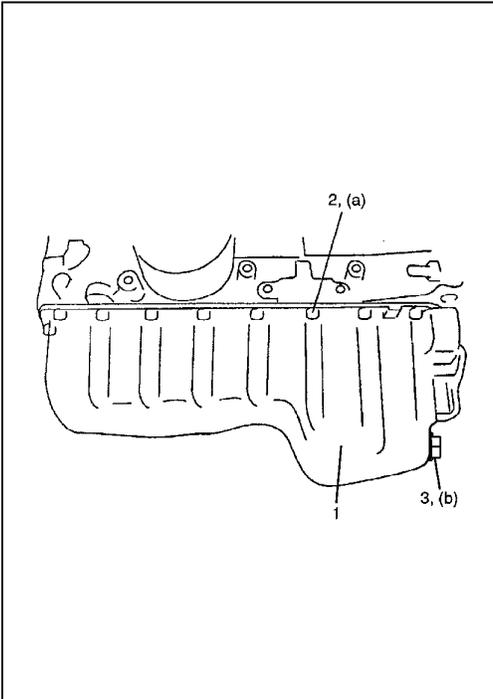
**“A” Sealant: 99000-31150**



2) Using new gasket (1), install oil pump strainer (2) to oil pump. Tighten strainer bolt (3) first and then bracket bolt (4) to specified torque.



- 3) Fit oil pan to cylinder block at the position as shown in figure.

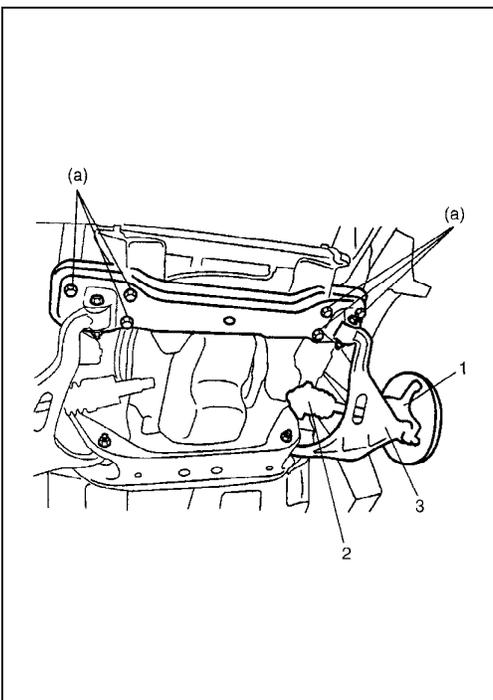


- 4) After fitting oil pan (1) to cylinder block, run in securing bolts (2) and start tightening at the center: move wrench outward, tightening one bolt at a time.  
Tighten bolts to specified torque.

**Tightening Torque**  
**(a): 16 N·m (1.6 kg·m, 11.5 lb-ft)**

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

**Tightening Torque**  
**(b): 34 N·m (3.4 kg·m, 24.5 lb-ft)**



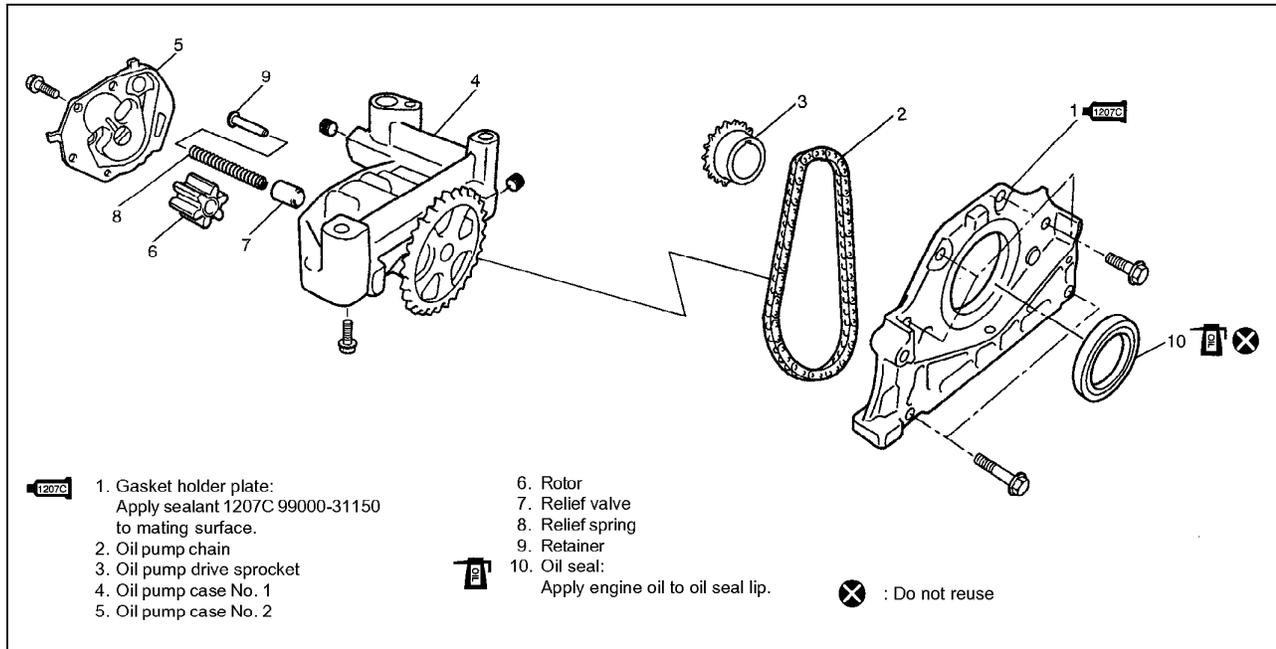
- 6) Install suspension frame to chassis.  
Tighten bolts to specified torque.

**Tightening Torque**  
**(a): 85 N·m (8.5 kg·m, 61.5 lb-ft)**

- 7) Install knuckle (1), drive shaft (2) and suspension control arm (3) referring to Section 3D.

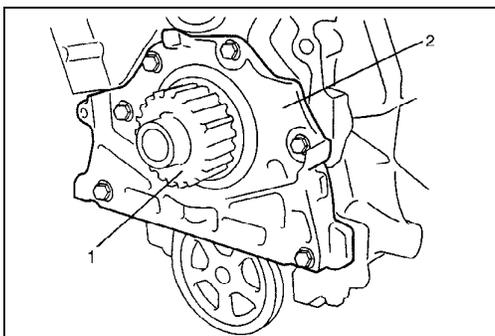
- 8) Install front differential housing.
- 9) Refill front differential housing with gear oil.
- 10) Install steering bar to vehicle.
- 11) Install oil level gauge.
- 12) Refill engine with engine oil, referring to item "ENGINE OIL CHANGE" in Section 0B.
- 13) Refill power steering system with specified fluid.
- 14) Check to make sure that there is no engine oil leakage or differential oil leakage at each connection.

## OIL PUMP

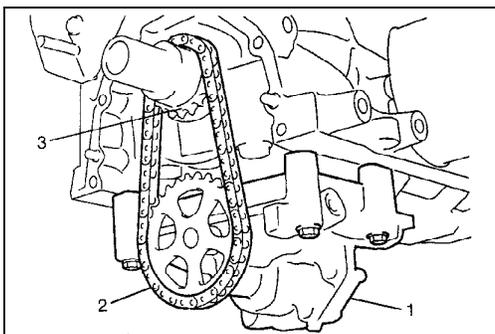


### REMOVAL

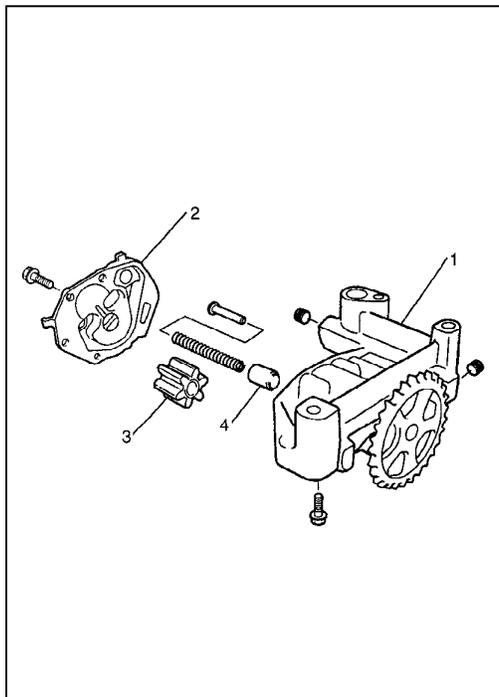
- 1) Disconnect negative cable at battery.
- 2) Remove timing belt referring to "TIMING BELT AND BELT TENSIONER" in this section.
- 3) Remove oil pan and oil pump strainer referring to "OIL PAN AND OIL PUMP STRAINER" in this section.



- 4) Remove crankshaft timing belt pulley (1) and then remove gasket holder plate (2).



- 5) After removing sprocket key from crankshaft, remove oil pump (1), oil pump chain (2) and oil pump drive sprocket (3) all together.



**DISASSEMBLY**

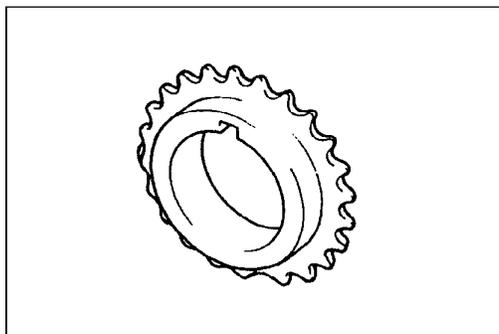
Disassemble oil pump as shown in figure.

**CAUTION:**

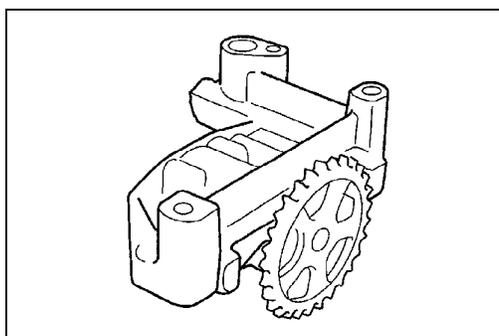
**Do not remove oil pump sprocket.  
Otherwise, oil pump sprocket and/ or oil pump rotor shaft  
might be damaged.**

**INSPECTION**

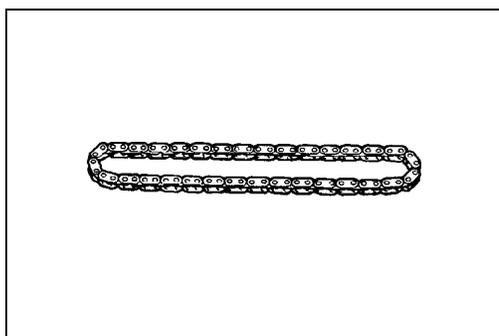
- ‘ Check rotor (3) and oil pump cases (1) (2) for excessive wear or damage.
- ‘ Check relief valve (4) for excessive wear or damage.



- ‘ Check teeth of oil pump drive sprocket for wear or damage.



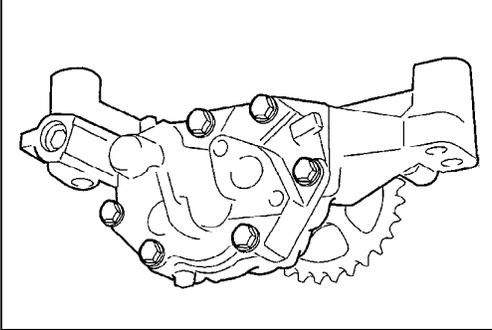
- ‘ Check teeth of oil pump sprocket for wear or damage.



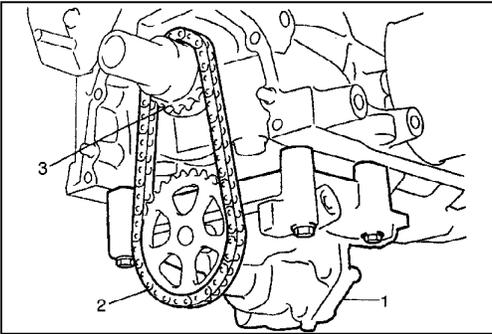
- ‘ Check oil pump chain for wear or damage.

**ASSEMBLY**

- 1) Wash, clean and then dry all disassembled parts.
- 2) Apply thin coat of engine oil to rotors and inside surface of each oil pump case.

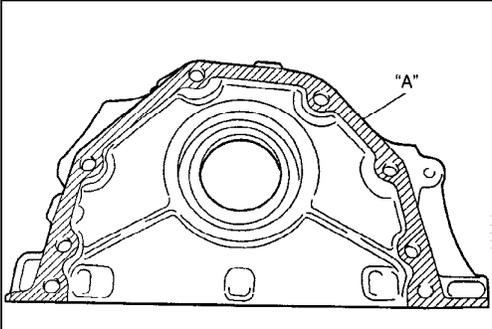


- 3) Assemble oil pump. After assembling oil pump, check to be sure that rotor turns smoothly by hand.



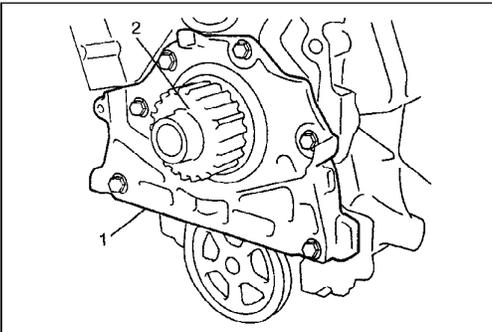
**INSTALLATION**

- 1) Install oil pump (1), oil pump chain (2) and oil pump drive sprocket (3) all together to cylinder block.
- 2) Install sprocket key.



- 3) Apply sealant to mating surface of gasket holder plate.

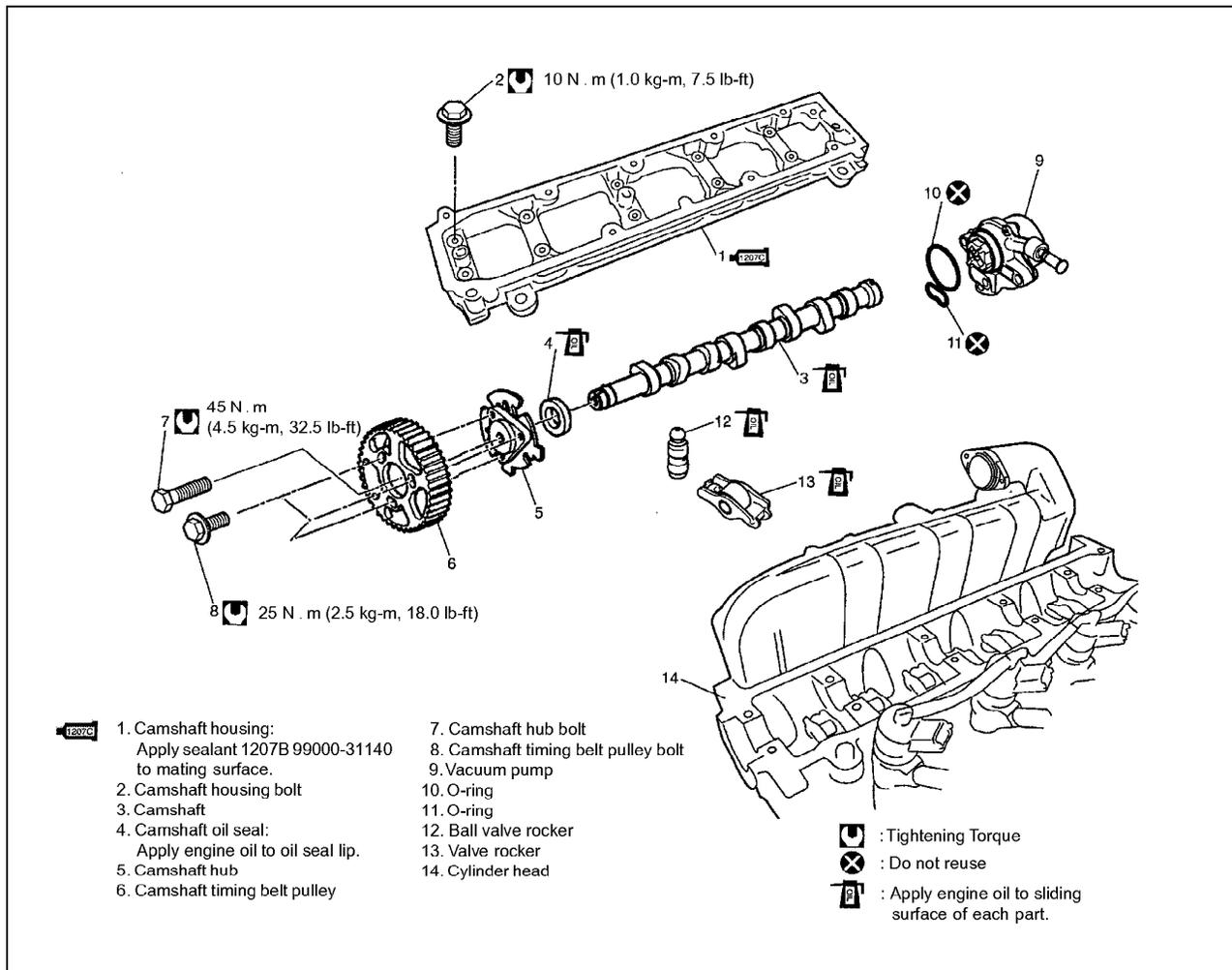
**"A" Sealant: 99000-31150**



- 4) Install gasket holder plate (1) to cylinder block.
- 5) Install crankshaft timing belt pulley (2).

- 6) Install oil pump strainer and oil pan referring to "OIL PAN AND OIL PUMP STRAINER" in this section.
- 7) Install timing belt referring to "TIMING BELT AND BELT TENSIONER" in this section.
- 8) Connect negative cable at battery.

## CAMSHAFT AND VALVE LASH ADJUSTERS



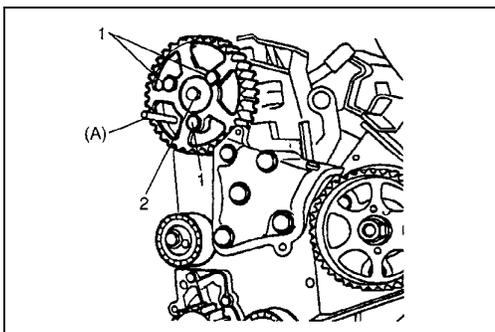
### REMOVAL

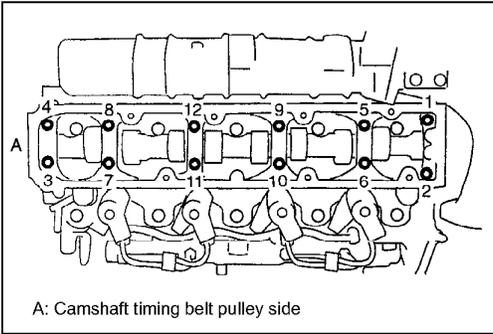
- 1) Disconnect negative cable at battery.
- 2) Remove timing belt referring to "TIMING BELT AND BELT TENSIONER" in this section.
- 3) Remove cylinder head cover referring to "CYLINDER HEAD COVER" in this section.
- 4) Remove vacuum pump from cylinder head referring to "VACUUM PUMP" in Section 6E3.
- 5) Remove camshaft timing belt pulley bolts (1) and camshaft hub bolt (2) by using special tool.

#### Special Tool

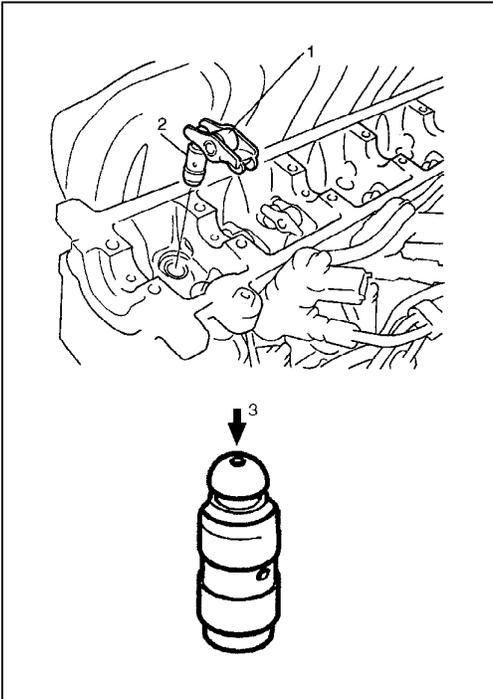
(A): 09910-26540/OUT0000151

- 6) Remove camshaft timing belt pulley and camshaft hub.





- 7) Loosen camshaft housing bolts in such order as indicated in figure and remove them.
- 8) Remove camshaft housing.
- 9) Remove camshaft and camshaft oil seal.



- 10) Remove valve rocker (1) with ball valve rocker (2).

**NOTE:**

- ' Never disassemble ball valve rocker.
- ' Don't apply force (3) to body of ball valve rocker, for oil in high pressure chamber in it will leak.
- ' Immerse removed ball valve rocker in clean engine oil and keep it there till reinstalling it so as to prevent oil leakage. If it is left in air, place it with its bucket body facing down. Don't place on its side or with bucket body facing up.

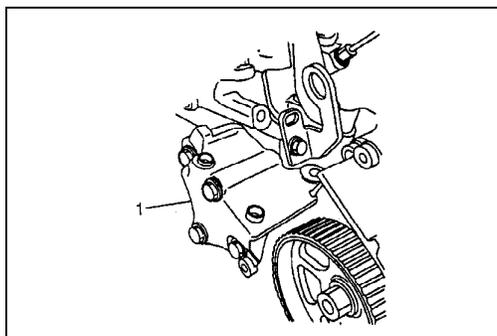
## VALVES AND CYLINDER HEAD

1. Valve cotters  
 2. Valve spring retainer  
 3. Valve spring  
 4. Valve stern seal  
 5. Valve spring seat  
 6. Intake valve  
 7. Exhaust valve  
 8. Cylinder head bolt:  
 Replace bolt if it is longer than specified valve.

9. Cylinder Head  
 10. Cylinder head gasket:  
 "Thickness Identification" mark provided on gasket should come to high pressure fuel pump side.  
 11. Knock pin

8 60 N·m(6.0 Kg-m, 43.5 lb-ft) and retighten 220°

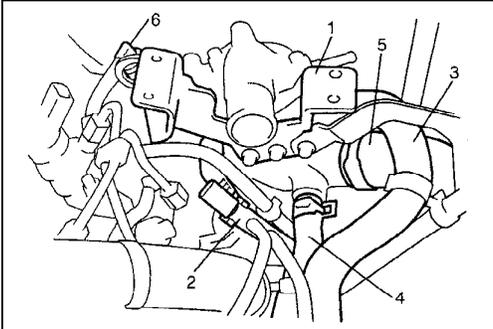
⊗ : Tightening Torque  
 ⊗ : Do not reuse  
 🛢️ : Apply engine oil to sliding surface of each part.



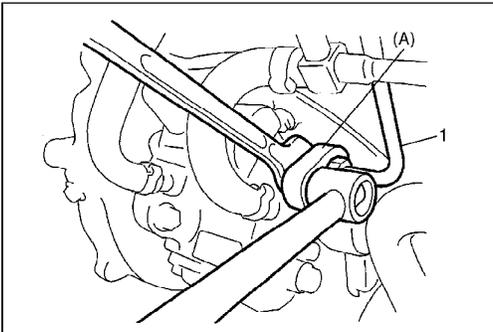
### REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Remove timing belt referring to "TIMING BELT AND BELT TENSIONER" in this section.
- 3) Remove engine bracket (1) from cylinder head and cylinder block.

- 4) Remove cylinder head cover referring to "CYLINDER HEAD COVER" in this section.
- 5) Disconnect vacuum hoses from throttle valve assembly, EGR valve and waste gate actuator.

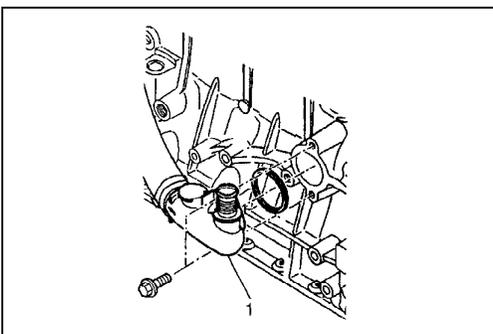


- 6) Remove bracket (1) from water outlet box.
- 7) Remove fuel temperature sensor (2).
- 8) Disconnect oil cooler inlet water hose (3), oil cooler outlet water hose (4), radiator outlet hose No.1 (5) and inlet fuel hoses (6) from water outlet box.
- 9) Remove oil level gauge upper guide bolt.
- 10) Disconnect fuel pressure sensor connector, ECT sensor connector and glow plug supply wire at the connector.

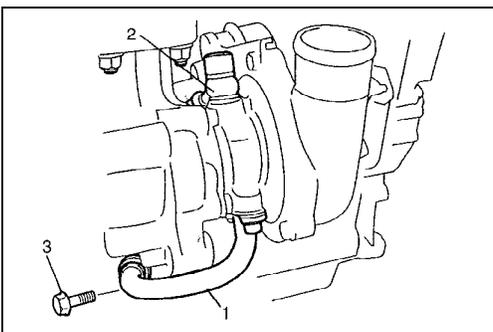


- 11) Remove high pressure supply pipe (1).  
When loosening union nut of high pressure supply pipe, hold union nut of injection pump with wrench.

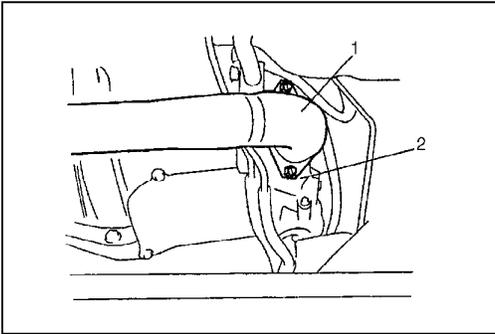
**Special Tool**  
**(A): 09950-76510/OUT0000148**



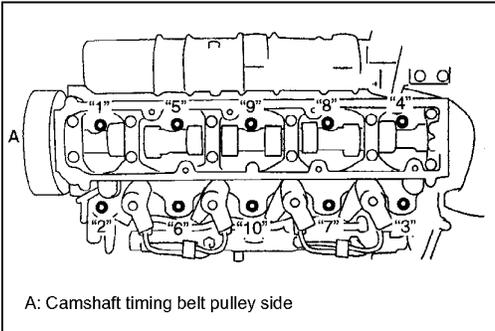
- 12) Detach water inlet box (1) from cylinder block.



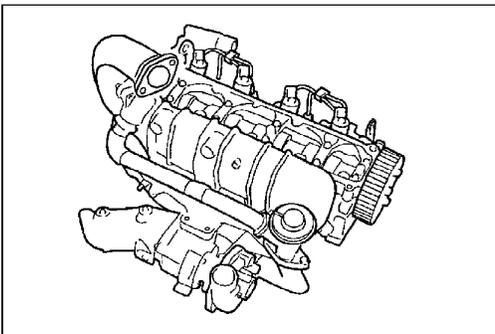
- 13) Disconnect oil return pipe (1) and lubrication pipe (2) from turbocharger.
- 14) Remove turbocharger bracket bolt (3).



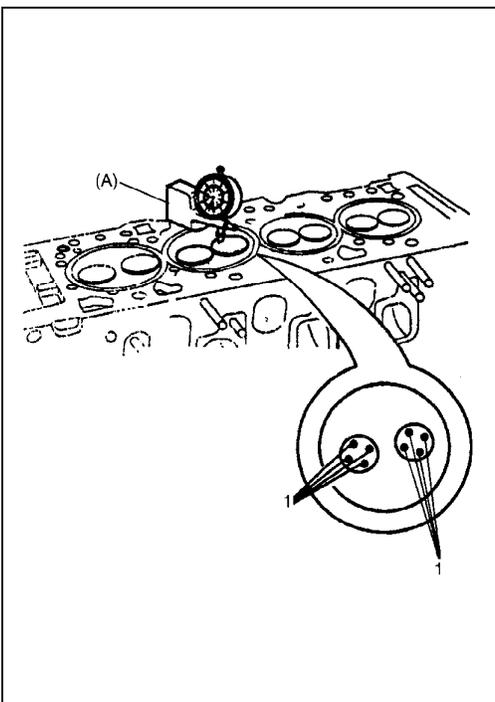
- 15) Disconnect exhaust No. 1 pipe (1) from turbocharger outlet pipe (2).



- 16) Loosen cylinder head bolts in such order as indicated in figure and remove them.
- 17) Check all around cylinder head for any other parts required to be removed or disconnected and remove or disconnect whatever necessary.



- 18) Remove cylinder head with intake manifold, exhaust manifold, turbocharger, water outlet box, injectors and common rail using lifting device.



**DISASSEMBLY**

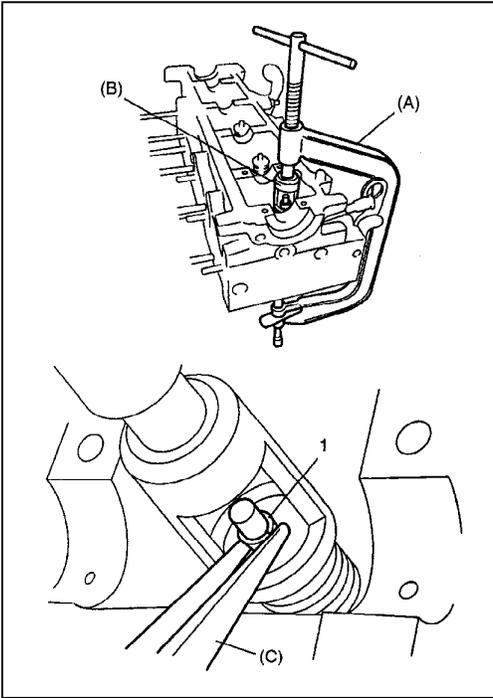
- 1) For ease in servicing cylinder head, remove intake manifold, exhaust manifold with turbocharger, water outlet box, injectors, common rail and glow plugs.
- 2) Remove camshaft and valve rockers referring to "CAMSHAFT AND VALVE ROCKERS" in this section.
- 3) Clean valve face and then measure protrusion at 4 points (1) of each valve using special tool as shown in figure.

**Special Tool**

(A): 09910-26510/OUT0000005

Average of values measured at 4 points	In	Max. 0.2 mm (0.008 in.)
	Ex	

If average is out of specification, grind valve seat and then lap valve on seat.



- 4) Using special tool (Valve lifter), compress valve springs and then remove valve cotters (1) by using special tool (Forceps) as shown.

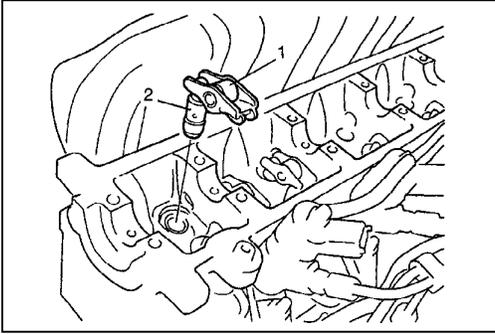
**Special Tool**

(A): 09916-14510

(B): 09916-14910

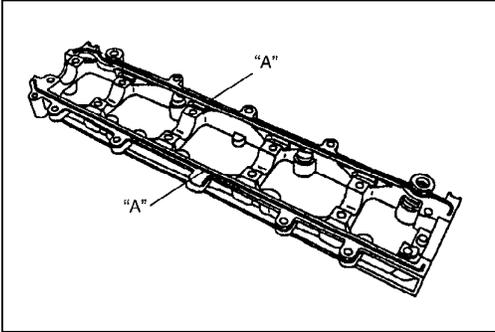
(C): 09916-84511

- 5) Release special tool, and remove spring retainer and valve spring.
- 6) Remove valve from combustion chamber side.



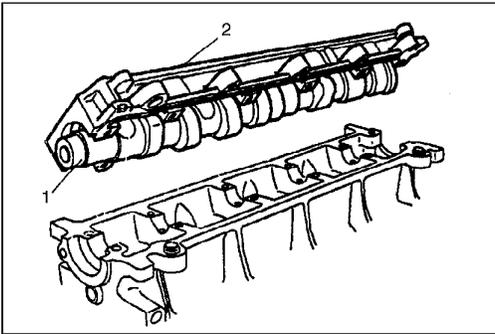
**INSTALLATION**

- 1) Install valve rocker (1) with ball valve rocker (2) to cylinder head. Apply engine oil around valve rocker and ball valve rocker and then install them to cylinder head.

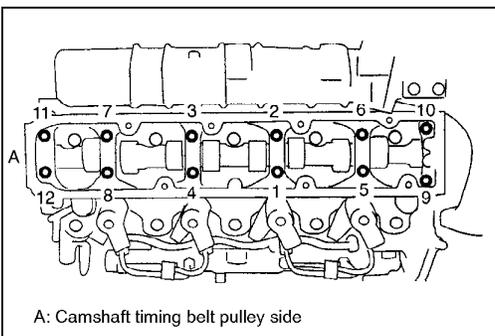


- 2) Apply sealant to mating surfaces of camshaft housing.

**"A" Sealant: 99000-31140**

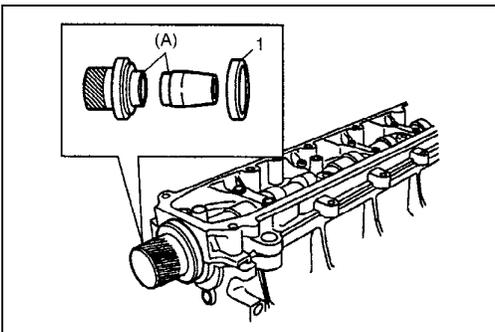


- 3) Apply engine oil to cams and journals on camshaft (1) and set camshaft to camshaft housing (2). Fit camshaft housing with camshaft to cylinder head.



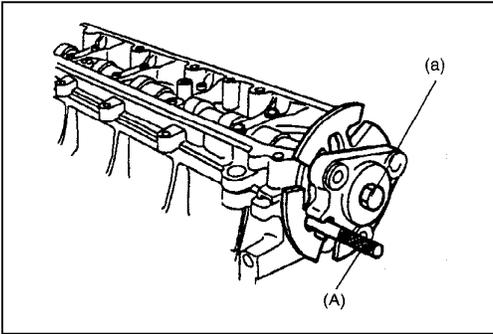
- 4) After applying oil to housing bolts, tighten them temporarily first. Then tighten them by following sequence as indicated in figure. Tighten a little at a time and evenly among bolts and repeat tightening sequence two or three times before they are tightened to specified torque.

**Tightening Torque**  
**10 N·m (1.0 kg·m, 7.5 lb-ft)**



- 5) After applying grease to oil seal lip, fit camshaft oil seal (1) by using special tool.

**Special Tool**  
**(A): 09913-56510/OUT0000152**



- 6) Install camshaft hub.  
Tighten camshaft hub bolt to specified torque by using special tool.

**Special Tool**

**(A): 09910-26540/OUT0000151**

**Tightening Torque**

**Camshaft hub bolt (a): 45 N·m (4.5 kg-m, 32.5 lb-ft)**

- 7) Install camshaft timing belt pulley and tighten bolts by hand.  
8) Install vacuum pump to cylinder head referring to VACUUM PUMP in Section 6E3.  
9) Install cylinder head cover referring to "CYLINDER HEAD COVER" in this section.  
10) Install timing belt referring to "TIMING BELT AND BELT TENSIONER" in this section.  
11) Connect negative cable at battery.

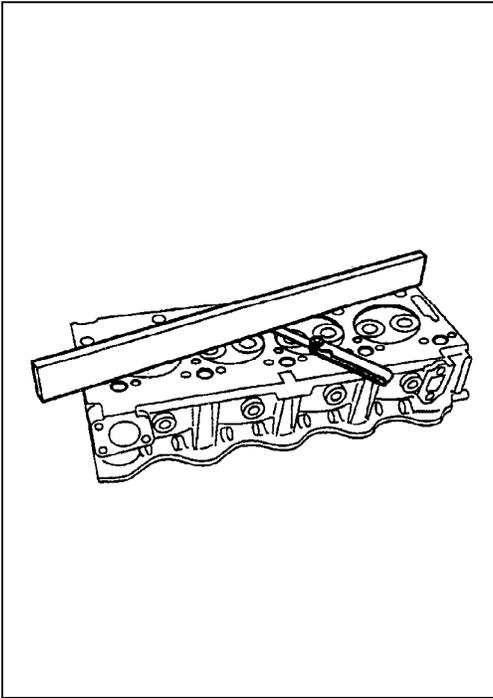
**Cylinder Head**

Remove all carbon from cylinder head surface.

**NOTE:**

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

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

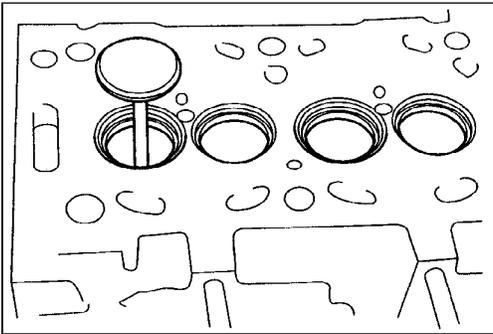


**Flatness of gasketed surface:**

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

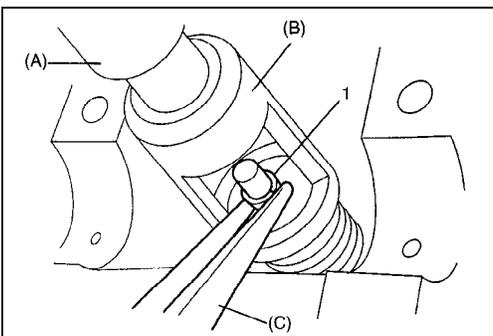
Leakage of combustion gases from this gasketed joint is often due to warped gasketed surface: such leakage results in reduced power output.

**Limit of distortion: 0.05 mm (0.002 in.)**



**ASSEMBLY**

- 1) Install valve to valve guide.  
Before installing valve to valve guide, apply engine oil to stem seal, valve guide bore, and valve stem.
- 2) Install valve spring and spring retainer.



- 3) Using special tool (valve lifter), compress valve spring and fit two valve cotters (1) into groove in valve stem.

**Special Tool**

**(A): 09916-14510**

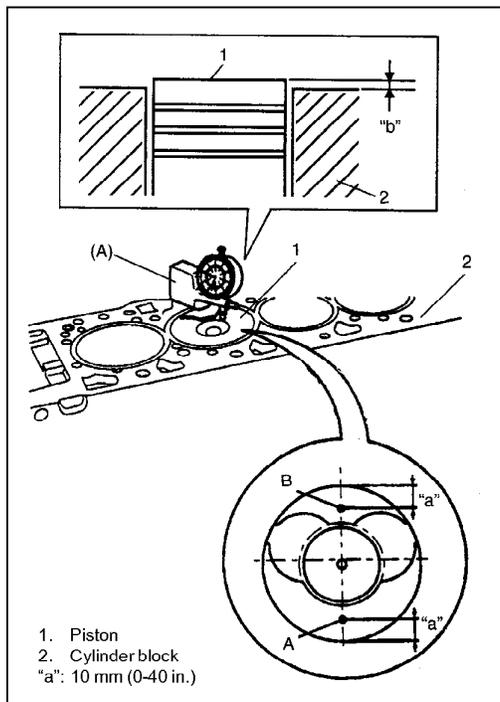
**(B): 09916-14910**

**(C): 09916-84511**

- 4) Install valve rockers and camshaft referring to "CAMSHAFT AND VALVE ROCKERS" in this section.
- 5) Install intake manifold, exhaust manifold with turbocharger, water outlet box, injectors, common rail and glow plugs to cylinder head.

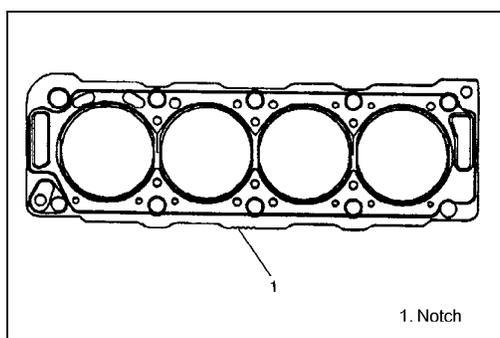
**INSTALLATION**

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



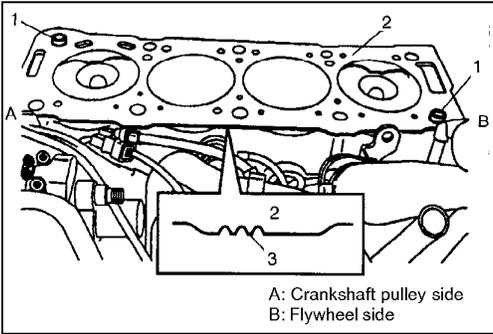
- 2) Prepare optimum cylinder head gasket according to following procedure.
  - a) As shown in figure, piston projects above cylinder block when it reaches top dead center. Using special tool and dial gauge, measure projection "b" at two points "A" and "B" and take an average. Repeat this procedure with each piston.

**Special Tool**  
**(A): 09910-26510/OUT 0000005**

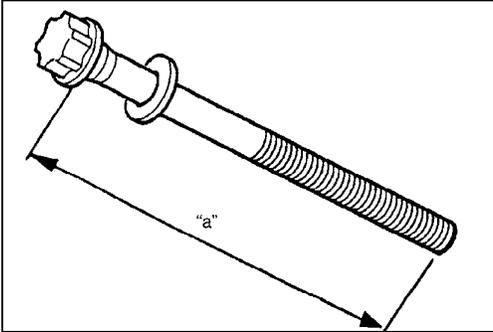


- b) Using the largest value among averages obtained above, prepare optimum cylinder head gasket referring to table below.

Notch	Thickness of Gasket (mm (in.))	Measured Value (mm (in.))
1 	1.24 - 1.36 (0.049 - 0.054)	0.470 - 0.604 (0.019 - 0.024)
2 	1.29 - 1.41 (0.051 - 0.056)	0.605 - 0.654 (0.024 - 0.026)
3 	1.34 - 1.46 (0.053 - 0.057)	0.655 - 0.704 (0.026 - 0.028)
4 	1.39 - 1.51 (0.055 - 0.059)	0.705 - 0.754 (0.028 - 0.030)
5 	1.44 - 1.56 (0.057 - 0.061)	0.755 - 0.830 (0.030 - 0.033)

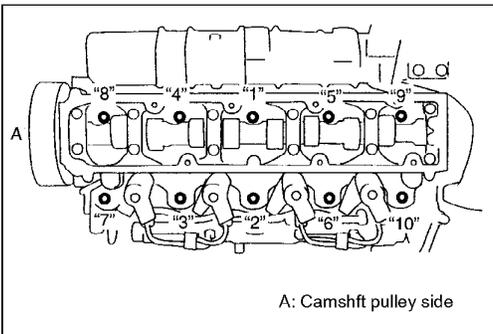


- 3) Install knock pins (1) to cylinder block.
- 4) Install new cylinder head gasket (2) to cylinder block. Thickness identification notch(es) (3) provided on gasket should come to oil filter side.

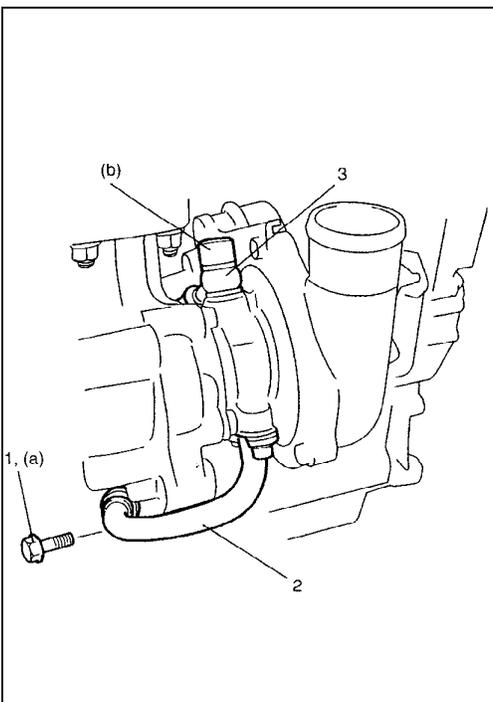


- 5) Check to make sure that length of cylinder head bolt as shown in figure does not exceed specified value.

“a”: Less than 133.4 mm (5.25 in.)



- 6) Apply engine oil to cylinder head bolts and tighten them gradually as follows.
  - a) Tighten all bolts to 20 N·m (2.0 kg-m, 14.5 lb-ft) according to numerical order in figure.
  - b) In the same manner as in Step a), tighten them to 60 N·m (6.0 kg-m, 43.5 lb-ft).
  - c) Retighten all bolts 220° according to numerical order in figure.



- 7) For installation, reverse removal procedure noting the following.

Install turbocharger bracket bolt (1). Tighten bolt to specified torque.

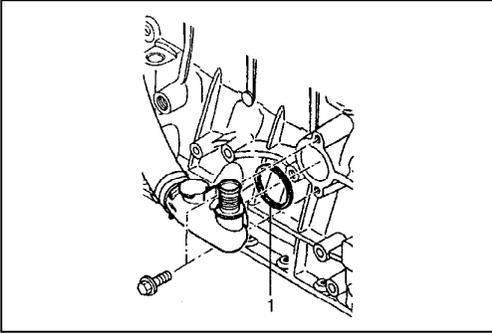
**Tightening Torque**

**Turbocharger bracket bolt (a): 30 N·m (3.0 kg-m, 22.0 lb-ft)**

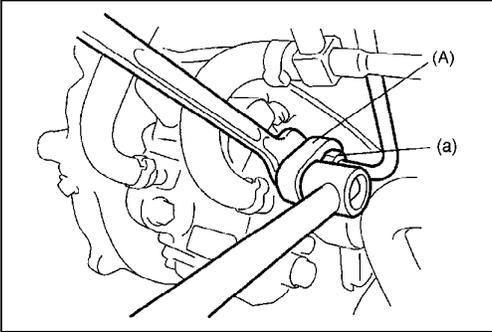
Using new gaskets, connect oil return pipe (2) and lubrication pipe (3) to turbocharger. Tighten bolt to specified torque.

**Tightening Torque**

**Lubrication pipe union bolt (b): 20 N·m (2.0 kg-m, 14.5 lb-ft)**



- Using new gasket (1), install water inlet box to cylinder block.



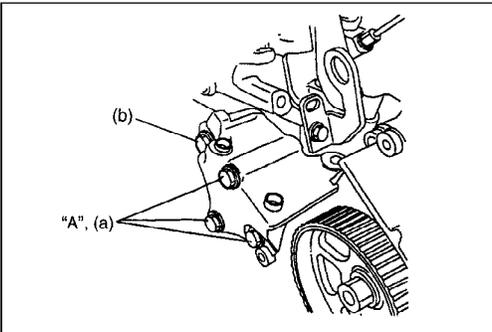
- Install high pressure supply pipe.  
When tightening union nut, hold union nut of injection pump with special tool.

**Special Tool**

(A): 09950-76510/ OUT0000148

**Tightening Torque**

High pressure supply pipe union nut (a):  
20 N·m (2.0 kg-m, 14.5 lb-ft)



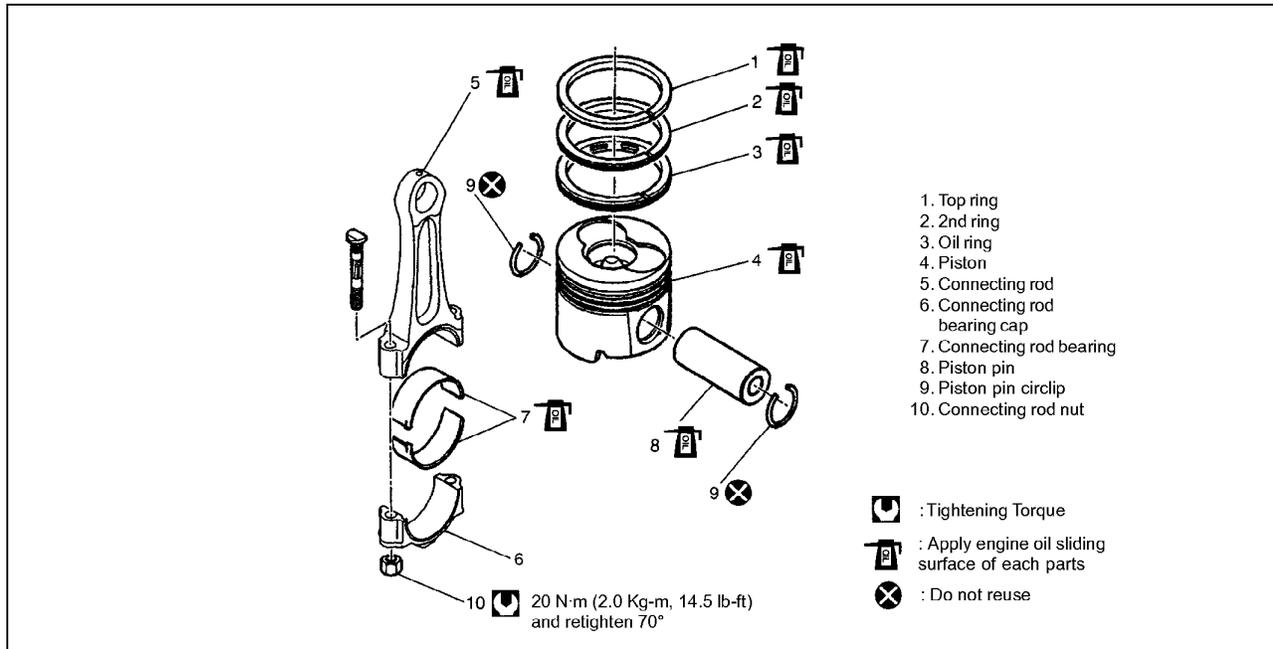
- Install engine bracket.

**Tightening Torque**

Engine bracket bolts No.1 (a): 45 N·m (4.5 kg-m, 32.5 lb-ft)  
Engine bracket bolt No.2 (b): 20 N·m (2.0 kg-m, 14.5 lb-ft)

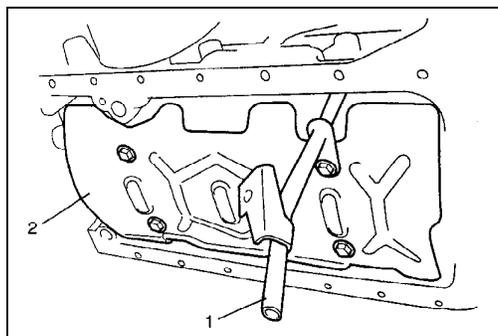
- Adjust generator belt tension referring to Section 6H.
- Adjust A/C compressor belt tension (if equipped).
- Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- Refill cooling system with coolant.
- Connect negative cable at battery.
- Check to make sure that there is no fuel leakage, coolant leakage, oil leakage and exhaust gas leakage at each connection.

## PISTON, PISTON RINGS, CONNECTING RODS AND CYLINDERS

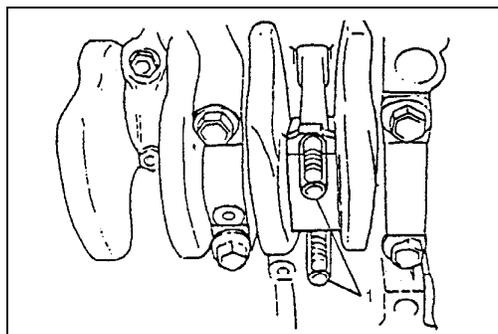


### REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Drain engine oil and engine coolant.
- 3) Remove oil pan and oil pump strainer referring to "OIL PAN AND OIL PUMP STRAINER" in this section.
- 4) Remove oil pump referring to "OIL PUMP" in this section.
- 5) Remove cylinder head referring to "VALVES AND CYLINDER HEAD" in this section.
- 6) Mark cylinder number on all pistons, connecting rods and rod bearing caps, using silver pencil or quick drying paint.



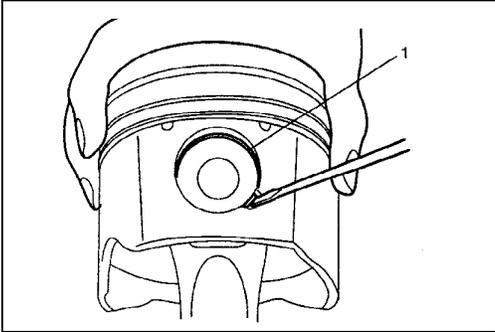
- 7) Remove oil level gauge lower guide (1) and oil partition (2).



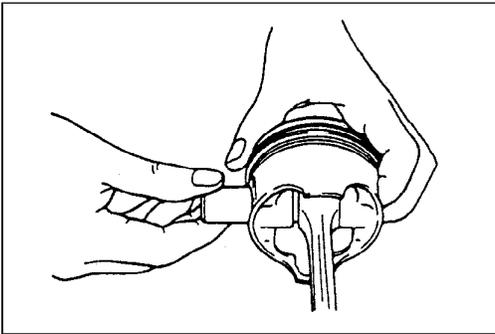
- 8) Remove rod bearing caps.
- 9) Install guide hose (1) over threads of rod bolts. This is to prevent damage to bearing journal and rod bolt threads when removing connecting rod.
- 10) Decarbon top of cylinder bore before removing piston from cylinder.
- 11) Push piston and connecting rod assembly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

**DISASSEMBLY**

- 1) Using piston ring expander, remove two compression rings (Top and 2nd) and oil ring from piston.



- 2) Remove piston pin from connecting rod.  
‘ Ease out piston pin circlips (1), as shown.



- ‘ Force piston pin out.

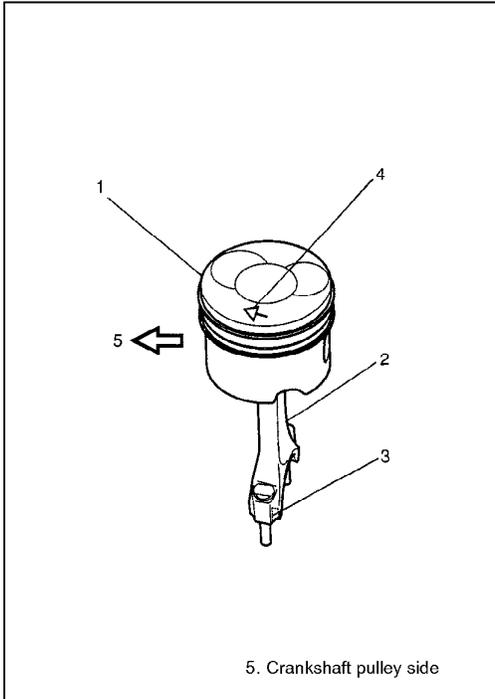
**CLEANING**

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

**INSPECTION**

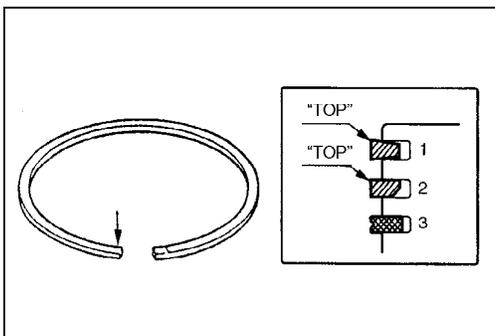
**Cylinders**

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

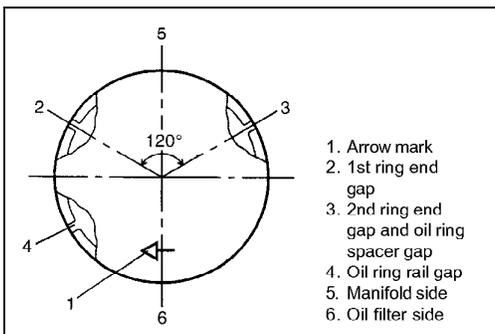


**ASSEMBLY**

1) Install piston pin to piston (1) and connecting rod (2):  
 After applying engine oil to piston pin and piston pin holes in piston and connecting rod, fit connecting rod to piston so that bearing lock tab (3) and arrow mark (4) come on the same side and insert piston pin to piston and connecting rod, and install piston pin circlips.



2) Install piston rings to piston:  
 As indicated in figure at the left, 1st and 2nd rings have "TOP" 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 figure.  
 When installing oil ring (3), install spacer first and then rail.



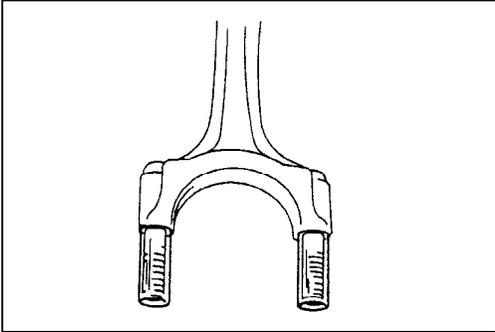
3) After installing three rings (1st, 2nd and oil rings), distribute their end gaps as shown in figure.

**INSTALLATION OR CONNECTION**

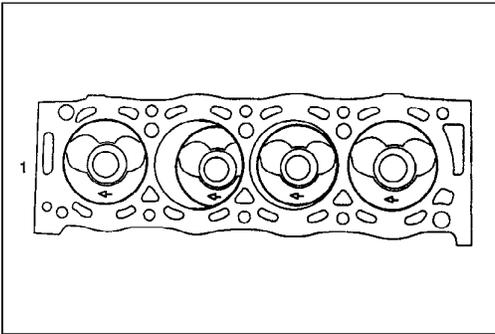
- 1) Apply engine oil to pistons, rings, cylinder walls, connecting rod bearings and crankpins.

**NOTE:**

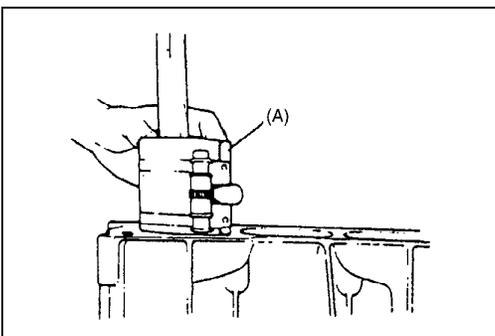
**Do not apply oil between connecting rod and bearing or between bearing cap and bearing.**



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



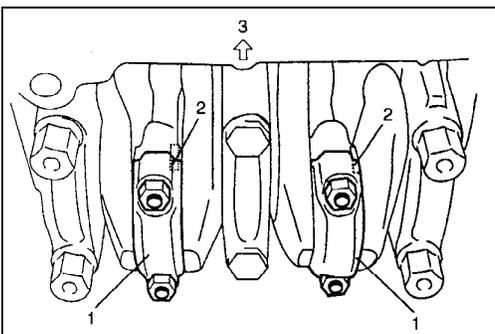
- 3) When installing piston and connecting rod assembly into cylinder bore, point arrow mark on piston head to crankshaft pulley side (1).



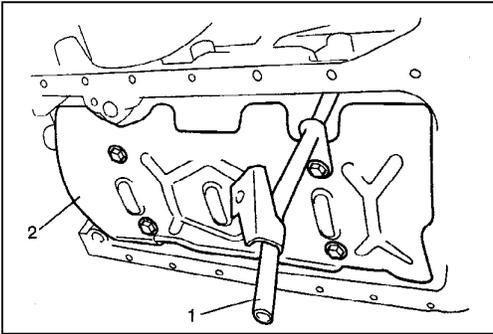
- 4) Install piston and connecting rod assembly into cylinder bore. Use special tool (Piston ring compressor) to compress rings. Guide connecting rod into place on crankshaft. Using a hammer handle, tap piston head to install piston into bore. Hold ring compressor firmly against cylinder block until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

**Special Tool**

**(A): 09916-77310**

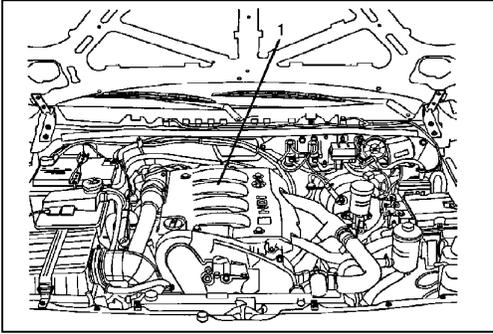


- 5) Install bearing cap (1): At this time, make sure that bearing lock tab (2) of bearing cap faces oil filter side (3).



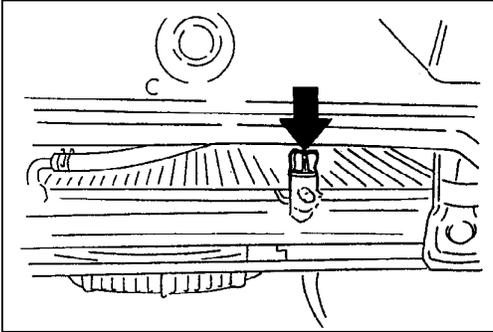
6) Install oil partition (2) and oil level gauge lower guide (1).

- 7) Reverse removal procedure for installation, as previously outlined.
- 8) Adjust generator belt tension, referring to Section 6H.
- 9) Adjust A/C compressor belt tension, if equipped.
- 10) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- 11) Refill engine with engine oil, referring to "ENGINE OIL CHANGE" in Section 0B.
- 12) Refill cooling system referring to "ENGINE COOLING" section.
- 13) Refill front differential housing with gear oil, referring to Section 7E of the Service Manual mentioned in this manual.
- 14) Connect negative cable at battery.
- 15) Check to make sure that there is no fuel leakage, coolant leakage, oil leakage and exhaust gas leakage at each connection.

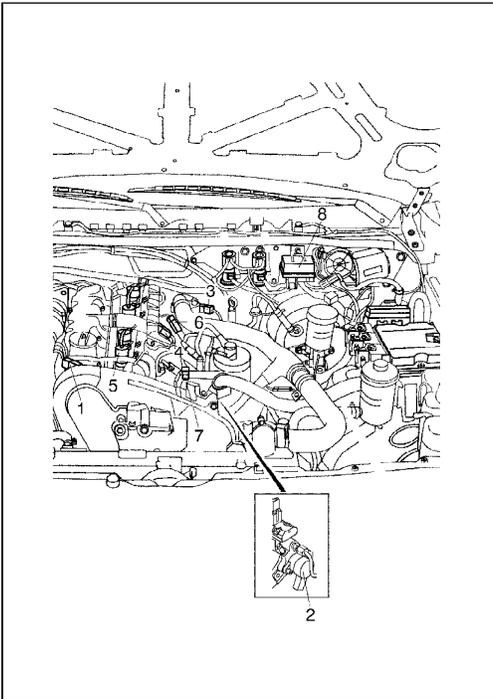


## UNIT REPAIR OVERHAUL ENGINE ASSEMBLY REMOVAL

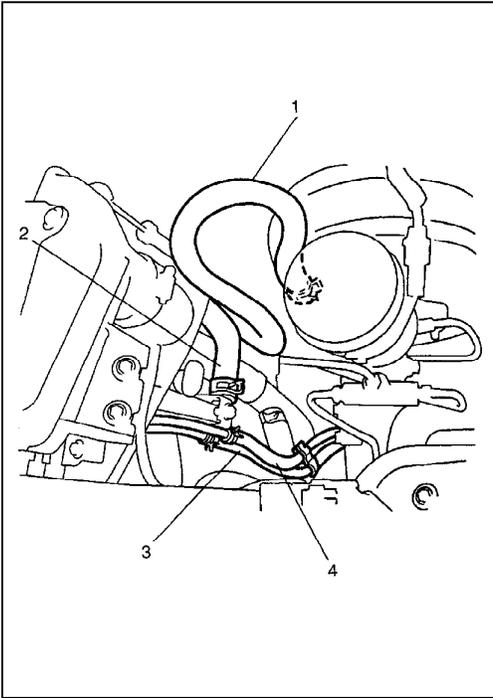
- 1) Disconnect negative cable at battery.
- 2) Remove engine hood after disconnecting windshield washer hose. Remove engine cover (1).



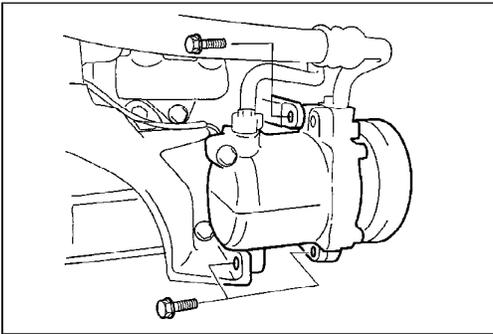
- 3) Drain cooling system.
- 4) Remove degassing tank and radiator with radiator fan motor assembly.  
Refer to "ENGINE COOLING" section.
- 5) Remove air cleaner outlet hose.
- 6) Remove transmission assembly.



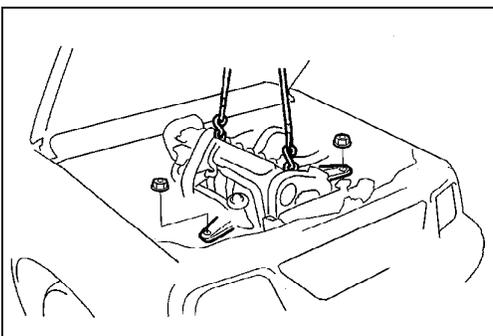
- 7) Disconnect following electric wires:
  - ' Camshaft position sensor (1)
  - ' Fuel pressure regulator (2)
  - ' Glow plug supply wire at the connector
  - ' Engine coolant temp. sensor (3)
  - ' Fuel pressure sensor (4) wire at the connector
  - ' Fuel injectors (5)
  - ' Fuel temp. sensor (6)
  - ' Injection pump solenoid valve (7)
  - ' Generator
  - ' Engine oil pressure switch
  - ' Pre post heating control unit (8)
 and then release wire harnesses from clamps.



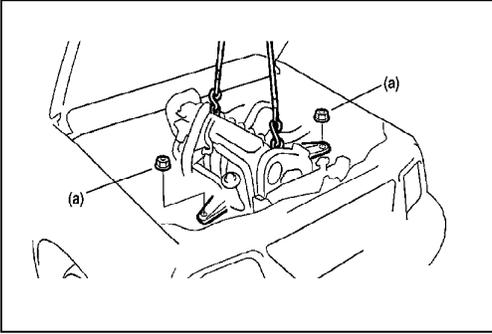
- 8) Disconnect following hoses:
- ' Brake booster hose (1) from vacuum pipe
  - ' Vacuum hoses from solenoid valves
  - ' Heater inlet and outlet hose (2) from pipe
  - ' Fuel feed hose (3) and return hose (4) from each pipe



- 9) With hose connected, detach A/C compressor and power steering pump from bracket if equipped.
- 10) Drain engine oil if necessary.



- 11) Install lifting device.
- 12) Remove engine mounting bracket nuts (R & L).
- 13) Before lifting engine, check to ensure all hoses, electric wires and cables are disconnected from engine.
- 14) Remove engine assembly from chassis.  
With transmission disconnected, engine can be removed by lifting upwards.

**INSTALLATION**

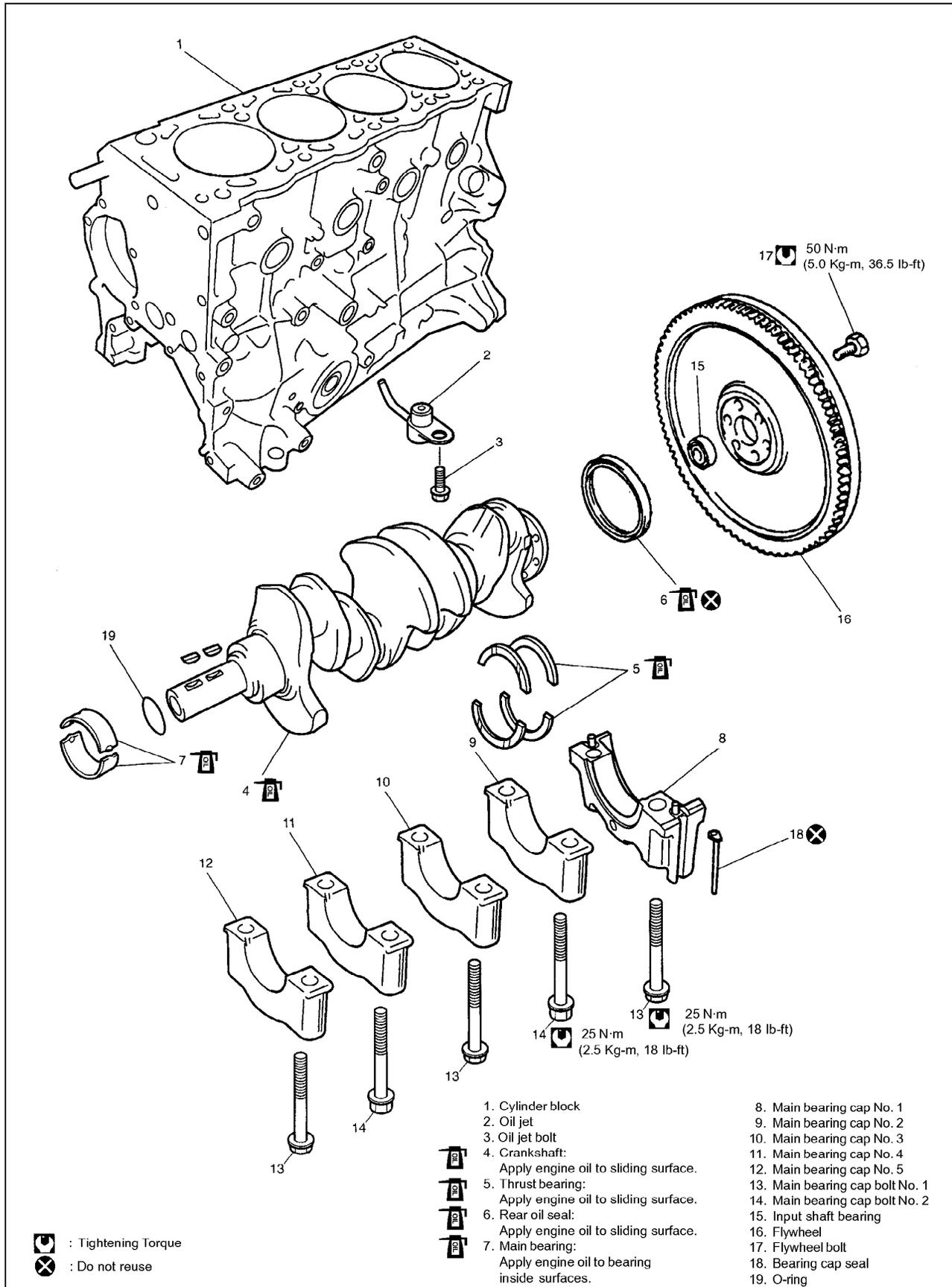
- 1) Lower engine assembly into engine compartment.
- 2) Tighten engine side mounting bracket nuts (R & L).

**Tightening Torque**

**(a): 50 N·m (5.0 kg·m, 36.5 lb·ft)**

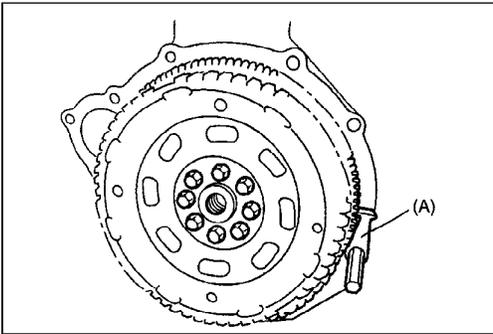
- 3) Remove lifting device.
  
- 4) Reverse removal procedure for installation, noting following points.
  - ‘ Install transmission assembly.
  - ‘ Adjust generator belt tension, referring to Section 6H.
  - ‘ Adjust A/C compressor belt tension, if equipped.
  - ‘ Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
  - ‘ Refill engine with engine oil, referring to item “ENGINE OIL CHANGE” in Section 0B.
  - ‘ Refill cooling system referring to “ENGINE COOLING” section.
  - ‘ Check to make sure that there is no fuel leakage, coolant leakage and exhaust gas leakage at each connection.

# MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK



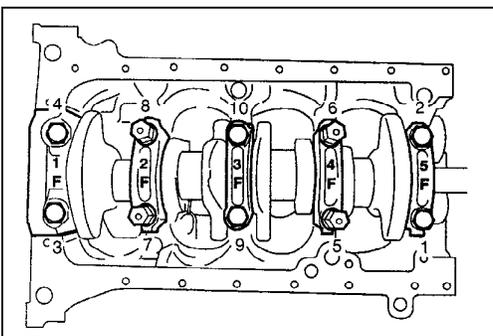
**REMOVAL**

- 1) Remove engine assembly from body as previously outlined.
- 2) Remove following parts from engine as previously outlined.
  - ˆ Oil pan and oil pump strainer
  - ˆ Intake manifold and exhaust manifold
  - ˆ Cylinder head cover
  - ˆ Timing belt cover
  - ˆ Timing belt, belt tensioner, roller and crankshaft timing belt pulley
  - ˆ Oil pump, oil pump drive sprocket and gasket holder plate
  - ˆ Cylinder head assembly
  - ˆ Piston and connecting rod

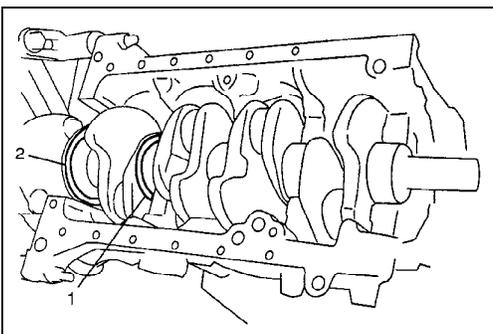


- 3) Remove clutch cover, clutch disc and flywheel.

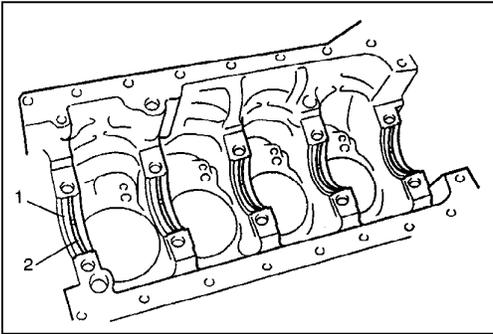
**Special Tool**  
**(A): 09924-17811**



- 4) Loosen crankshaft bearing cap bolts in such order as indicated in figure a little at a time and remove bearing caps.



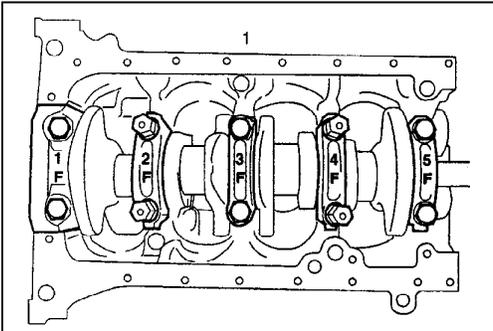
- 5) Remove thrust bearings (lower side) (1) and rear oil seal (2).
- 6) Remove crankshaft from cylinder block.
- 7) Remove thrust bearings (upper side).



### Main Bearings

#### General information

- Upper half of bearing (1) has oil groove (2) as shown in figure. Install this half with oil groove to cylinder block.



- On each main bearing cap, number is embossed as shown in figure.

When installing each bearing cap to cylinder block, point bearing lock tab toward oil filter side (1) and install each cap from that side to crankshaft pulley side in ascending order of numbers "1F", "2F", "3F", "4F" and "5F". Tighten cap bolts to specified torque.

#### Inspection

Check bearings for pitting, scratches, wear or damage.

If any malcondition is found, replace both upper and lower halves. Never replace one half without replacing the other half.

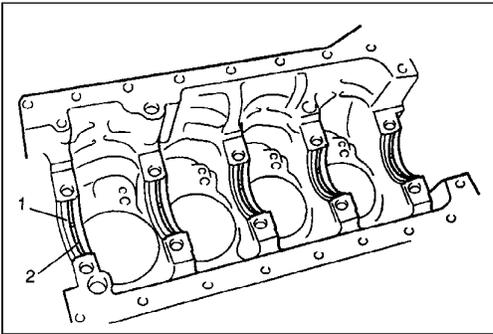
#### Rear Oil Seal

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

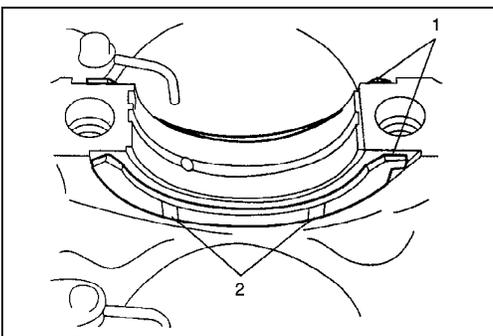
## INSTALLATION

## NOTE:

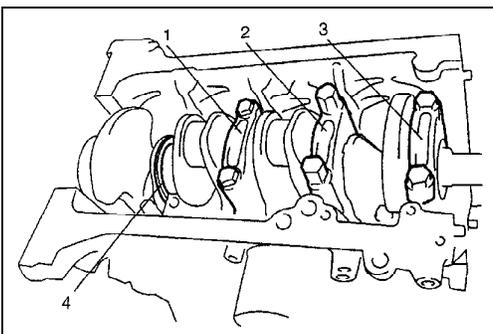
- ✓ All parts to be installed must be perfectly clean.
- ✓ Be sure to apply oil to crankshaft journals, journal bearings, thrust bearings, crankpins, connecting rod bearings, pistons, piston rings and cylinder bores.
- ✓ Journal bearings, bearing caps, connecting rods, rod bearings, rod bearing caps, pistons and piston rings are in combination sets. Do not disturb such combination and make sure that each part goes back to where it came from, when installing.



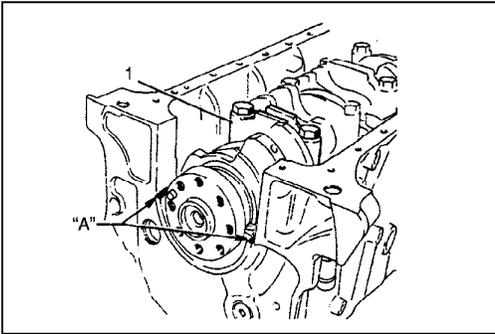
- 1) Install main bearings (1) to cylinder block.  
One of two halves of main bearing, has an oil groove (2). Install it to cylinder block, and the other half without oil groove to bearing cap.



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

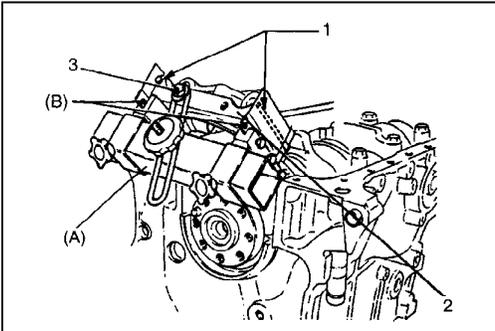


- 4) Install main bearing caps No.3 (1), No.4 (2) and No.5 (3).
- 5) Install thrust bearing (4) so that its oil groove faces flywheel side.



- 6) Install main bearing cap No.2 (1).
- 7) Apply sealant to the end of cylinder block as shown in figure.

**“A” Sealant: 99000-31140**



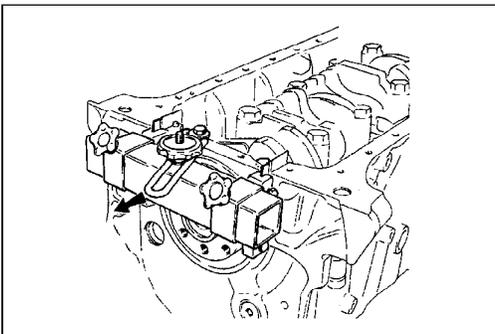
- 8) Fit new bearing cap seal (1) to main bearing cap No.1 (2).
- 9) Attach special tools (A) and (B) to main bearing cap No.1 by using bolt and washer (3).

**Special Tool**

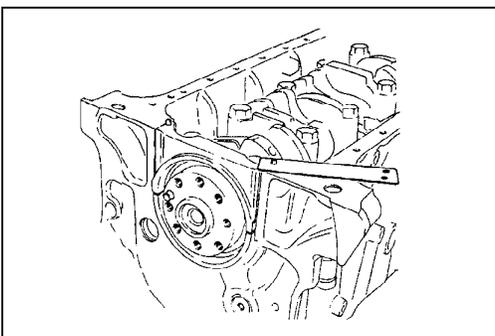
**(A): 09911-16510/ OUT0000002**

**(B): 09913-96510/ OUT0000012**

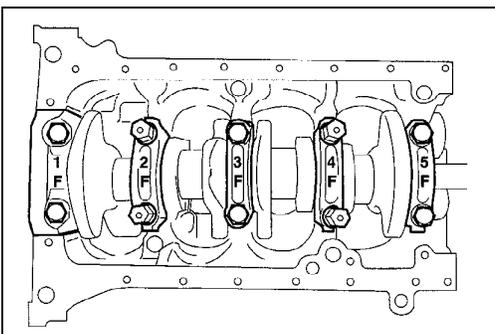
- 10) Apply oil to shims and their contact surface on block.



- 11) Install main bearing cap No.1 according to the following procedure.
  - a) Engage cap into block at a 45° angle.
  - b) Straighten it out.
  - c) Lower it slowly into block.
  - d) Remove bolt that holds special tool to cap.
  - e) Tighten both main bearing cap bolts temporarily.
  - f) Remove special tool straight out toward flywheel.



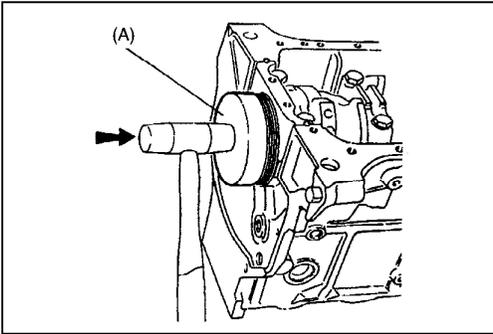
- 12) Cut side seals so that they protrude from cylinder block about 2 mm (0.08 in.).



- 13) Tighten bearing cap bolts in such order as shown in figure a little at a time.

**NOTE:**

**After tightening cap bolts, check to be sure that crankshaft rotates smoothly.**

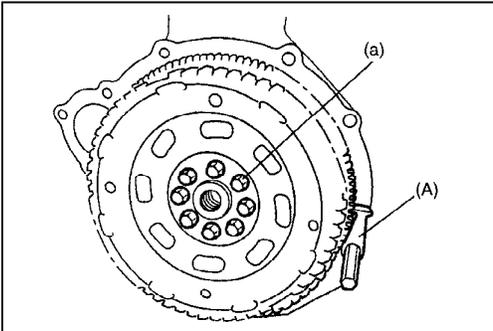


- 14) Place a new rear oil seal on special tool.

**Special Tool**

**(A): 09911-16520/OUT0000011**

- 15) Install rear oil seal, tapping it with plastic hammer until it fully seats.  
 16) Remove special tool by turning and pulling it out in direction of engine rotation.  
 17) Check that visible lip of rear oil seal faces outside.



- 18) Install flywheel.  
 Using special tool, lock flywheel.

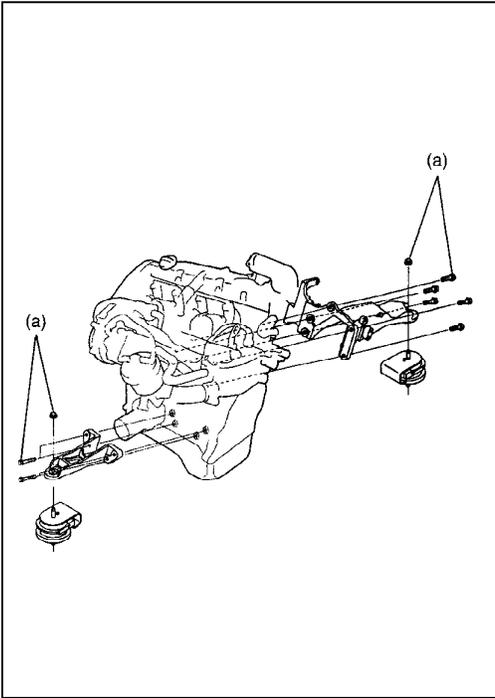
**Special Tool**

**(A): 09924-17811**

**Tightening Torque**

**(a): 50 N-m (5.0 kg-m, 36.5 lb-ft)**

- 19) Install following parts to engine as previously outlined.
- ˆ Piston and connecting rod
  - ˆ Cylinder head assembly
  - ˆ Oil pump, oil pump drive sprocket and gasket holder plate
  - ˆ Timing belt, belt tensioner, roller and crankshaft timing sprocket
  - ˆ Timing belt cover
  - ˆ Cylinder head cover
  - ˆ Intake manifold and exhaust manifold
  - ˆ Oil pan and oil pump strainer
- 20) Install clutch to flywheel.

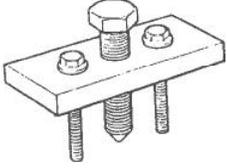
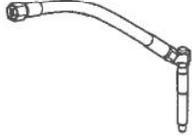
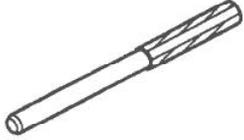
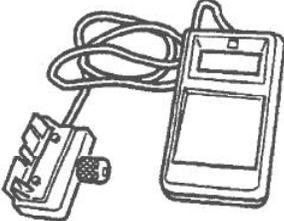
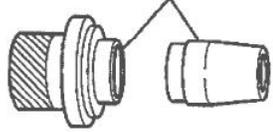
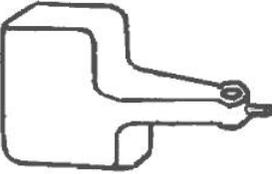
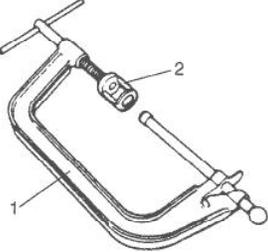
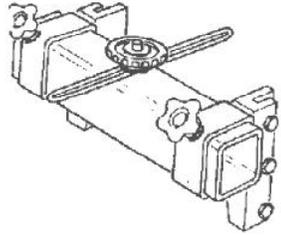
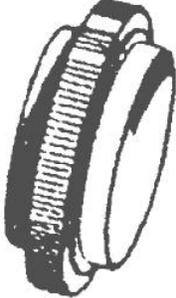
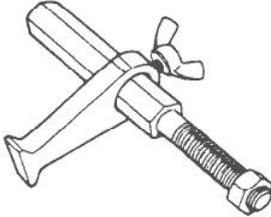
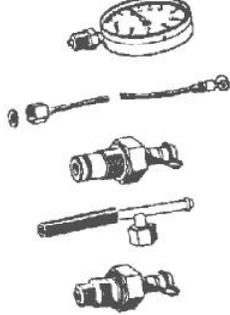


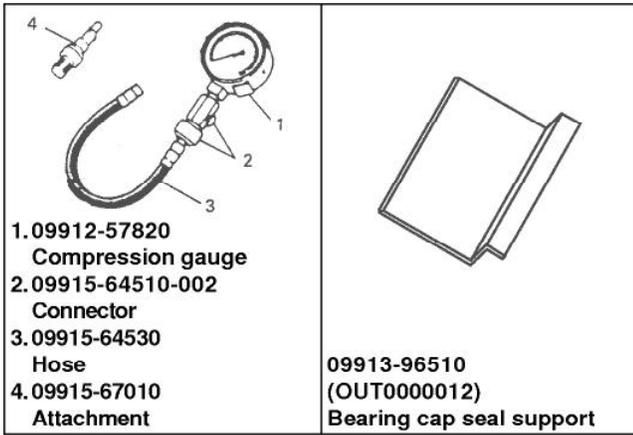
21) Install engine mounting brackets.

**Tightening Torque**  
**Engine side mounting nuts and bolts (a):**  
**50 N·m (5.0 kg-m, 36.5 lb-ft)**

22) Install engine assembly to vehicle as previously outlined.

**SPECIAL TOOLS**

 <p>09919-46510 (OUT0000110) Clamp pliers</p>	 <p>09944-36011 Steering wheel remover</p>	 <p>09910-26530 (OUT0000160) TDC rod positioner</p>	 <p>09916-96520 Compression gauge attachment</p>
 <p>09919-56550 (OUT0000141) Tension lever</p>	 <p>09910-26540 (OUT0000151) Camshaft TDC positioner</p>	 <p>09919-56560 (OUT0000138) Tension measuring equipment</p>	 <p>09913-56510 (OUT0000152) Oil seal installer</p>
 <p>09910-26510 (OUT0000005) Dial gauge support</p>	 <p>1. 09916-14510 Valve lifter 2. 09916-14910 Valve lifter attachment</p>	 <p>09916-84511 Forceps</p>	 <p>09911-16510 (OUT0000002) Rear oil seal installer</p>
 <p>09911-16520 (OUT0000011) Rear main seal installer</p>	 <p>09924-17811 Flywheel holder</p>	 <p>09916-77310 Piston ring compressor</p>	 <p>09915-76530 (OUT0000057) Oil pressure gauge kit</p>



### REQUIRED SERVICE MATERIALS

RECOMMENDED SUZUKI PRODUCT	USE
Sealant 1207C 99000-31150	<ul style="list-style-type: none"> <li>• To apply to mating surfaces of cylinder block and oil pan.</li> <li>• To apply to mating surfaces of cylinder block and gasket holder plate.</li> </ul>
Sealant 1207B 99000-31140	<ul style="list-style-type: none"> <li>• To apply to mating surface of camshaft housing cylinder head.</li> <li>• To apply to mating surfaces of cylinder block and main bearing cap No. 1.</li> </ul>

## TIGHTENING TORQUE SPECIFICATION

Fastening part	Tightening torque		
	N·m	kg-m	lb-ft
Camshaft housing bolts	10.0	1.0	7.5
Cylinder head cover bolts	10.0	1.0	7.5
Oil pan bolts	16.0	1.6	11.5
Oil pan drain plug bolt	34.0	3.4	24.5
Cylinder head bolts	a) Tighten 60 N·m b) Turn 220°	a) Tighten 6.0 kg-m b) Turn 220°	a) Tighten 43.5 lb-ft b) Turn 220°
Engine side mounting bracket bolts and nuts	50.0	5.0	36.5
Crankshaft pulley bolts	a) Tighten 40 N·m b) Tighten 195 N·m by turning about 50°	a) Tighten 4.0 kg-m b) Tighten 19.5 kg-m by turning about 50°	a) Tighten 29.0 lb-ft b) Tighten 141 lb-ft by turning about 50°
Flywheel bolts	50.0	5.0	36.5
Camshaft timing belt pulley bolt	25.0	2.5	18.0
Roller bolt	45.0	4.5	32.5
Timing belt tensioner bolt	25.0	2.5	18.0
Front suspension frame bolts	85.0	8.5	61.5
Camshaft hub bolts	45.0	4.5	32.5
Turbocharger bracket bolts	30.0	3.0	22.0
Lubrication pipe union bolt	20.0	2.0	14.5
High pressure supply pipe union nut	20.0	2.0	14.5
Engine bracket bolts No.1	45.0	4.5	32.5
Engine bracket bolts No.2	20.0	2.0	14.5
Bearing cap fixing screws	a) Tighten 25 N·m b) Turn 60°	a) Tighten 2.5 kg-m b) Turn 60°	a) Tighten 18.0 lb-ft b) Turn 60°
Connecting rods nuts	a) Tighten 20 N·m b) Turn 70°	a) Tighten 2.0 kg-m b) Turn 70°	a) Tighten 14.5 lb-ft b) Turn 70°

SECTION 6B

ENGINE COOLING

WARNING:

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

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “System Component 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. 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).

6B

NOTE:

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

CONTENTS

**GENERAL DESCRIPTION** ..... 6B- 2

**DIAGNOSIS** ..... 6B- 5

**MAINTENANCE** ..... 6B- 6

    Coolant Level ..... 6B- 6

    Cooling System Service ..... 6B- 6

    Cooling System Flush and Refill ..... 6B- 7

**ON VEHICLE SERVICE** ..... 6B- 9

    Cooling System Draining ..... 6B- 9

    Cooling Water Pipes or Hoses ..... 6B- 9

    Thermostat ..... 6B-10

    Radiator ..... 6B-11

    Radiator Fan Relay ..... 6B-12

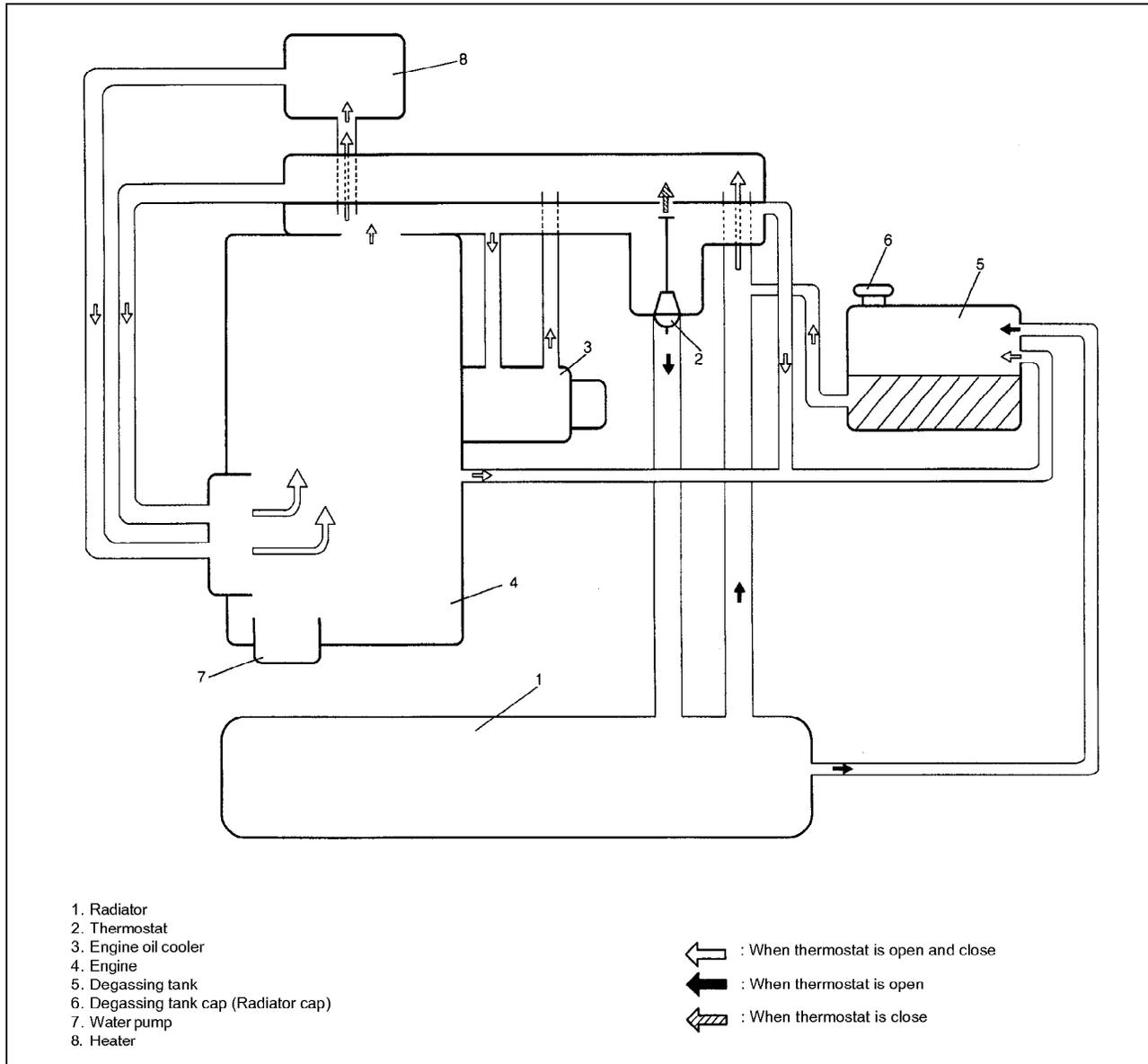
    Water Pump ..... 6B-13

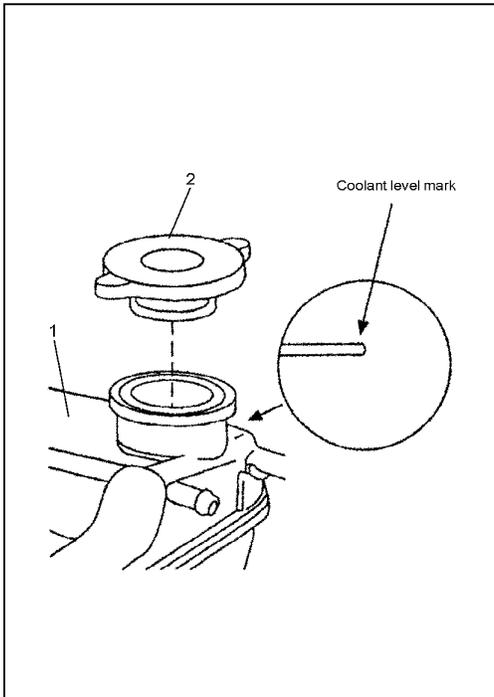
**REQUIRED SERVICE MATERIALS** ..... 6B-14

## GENERAL DESCRIPTION

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

## COOLING SYSTEM CIRCULATION





## COOLANT DEGASSING TANK

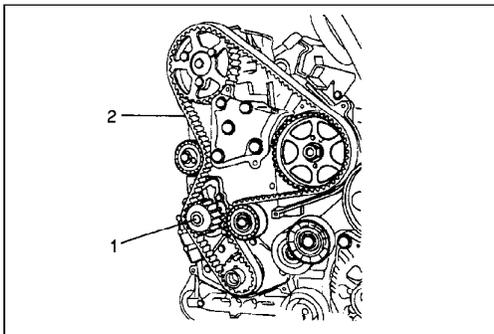
The degassing tank (1) consists of a plastic tank, a hose and a degassing tank cap (2).

During operation, the coolant circulates inside of the degassing tank constantly. As the coolant warms up and expands, the coolant level in the degassing tank rises. On the other hand, it lowers as the coolant cools down and contracts. When the pressure applied to the inside of the degassing tank constantly exceeds the specified value, the pressure is relieved through the degassing tank cap.

Thus, the radiator is kept filled with coolant to the desired level at all times, resulting in increased cooling efficiency.

Coolant level should be in the level mark on the degassing tank.

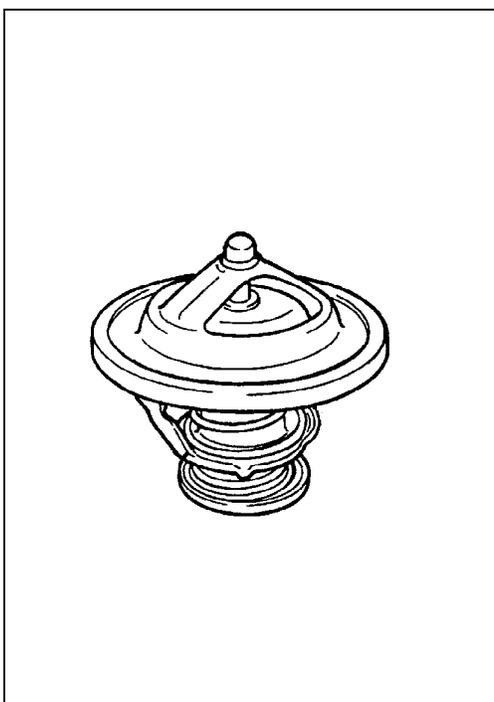
Coolant should be added only to the degassing tank as necessary.



## WATER PUMP

The water pump (1) is driven by timing belt (2).

The water pump can not be disassembled.



## THERMOSTAT

A wax pellet type thermostat is used in the coolant outlet passage to control the flow of engine coolant, to provide fast engine warm up and to regulate coolant temperatures.

A wax pellet element is hermetically contained in a metal case, and expands when heated and contracts when cooled.

When the pellet is heated and expands, the metal case pushed down the valve to open it.

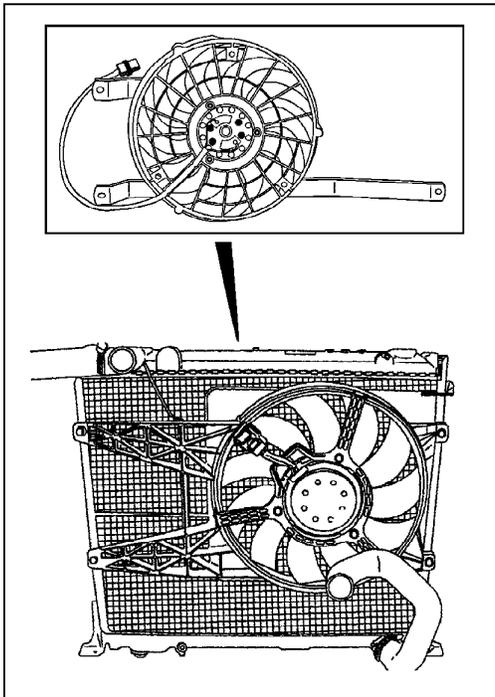
As the pellet is cooled, the contraction allows the spring to close the valve.

Thus, the valve remains closed while the coolant is cold, preventing circulation of coolant through the radiator.

At this point, coolant is allowed to circulate only throughout the engine to warm it quickly and evenly.

As the engine warms, the pellet expands and the thermostat valve opens, permitting coolant to flow through the radiator.

Thermostat functional spec. $\pm 1.5^{\circ}\text{C}$ ( $2.7^{\circ}\text{F}$ )	
Temp. at which valve begins to open	$83^{\circ}\text{C}$ ( $181^{\circ}\text{F}$ )
Temp. at which valve becomes fully open	$95^{\circ}\text{C}$ ( $203^{\circ}\text{F}$ )



### COOLING FAN

The cooling fan is driven by electric motor, and the motor is activated by ECM (and ECT sensor).

**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 relays with the ignition switch in the "ON" position.

ANTI-FREEZE PROPORTIONING CHART			
Freezing temperature	°C	-16	-36
Antifreeze/ Anticorrosion coolant concentration	%	30	50
Ratio of compound to cooling water	ltr.	2.5/6.0	4.25/4.25
	US pt.	5.4/12.5	8.95/8.95
	Imp. pt.	4.5/10.5	7.5/7.5

COOLANT CAPACITY	
Engine, radiator, heater and de- gassing tank, etc.	8.5 liters (17.9/15 US/Imp.p.)

### COOLANT

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

This 50/50 mixture coolant solution provides freezing protection to -36 °C (-33 °F).

- Maintain cooling system freeze protection at -36 °C (-33 °F) to ensure protection against corrosion and loss of coolant from boiling.

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

- Add ethylene glycol base coolant when coolant has to be added because of coolant loss or to provide added protection against freezing at temperature lower than -36 °C (-33 °F).

**NOTE:**

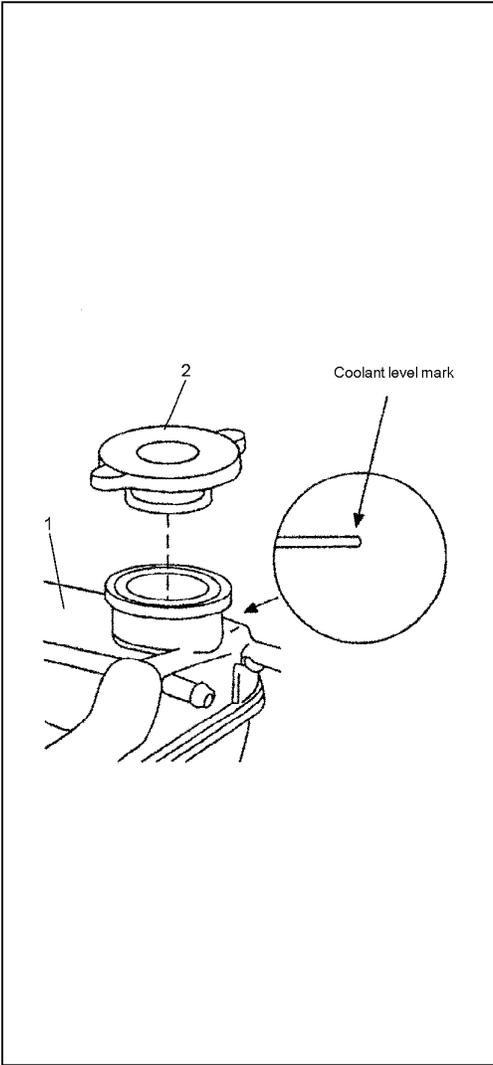
- Alcohol or methanol base coolant or plain water alone should not be used in cooling system at any time as damage to cooling system could occur.

- Even in a market where no freezing temperature is anticipated, mixture 70% water and 30% ethylene glycol anti-freeze (Antifreeze/Anticorrosion coolant) should be used for the purpose of corrosion protection and lubrication.

- "Hard water", if used, will foul up the cooling circuit by scale formation. Tap water available from city water supply is the best available water, in a practical sense, for the cooling system. Distilled water is ideal but is a luxury in most cases.

**DIAGNOSIS**

Condition	Possible cause	Correction
Engine overheats	<ul style="list-style-type: none"> <li>• Not enough coolant</li> <li>• Faulty thermostat</li> <li>• Faulty water pump</li> <li>• Dirty or bent radiator fins</li> <li>• Coolant leakage on cooling system</li> <li>• Defective cooling fan motor</li> <li>• Faulty fan motor control circuit</li> <li>• Plugged radiator</li> <li>• Faulty degassing tank cap</li> <li>• Dragging brakes</li> <li>• Slipping clutch</li> </ul>	<p>Check coolant level and add as necessary.                      Replace.                      Replace.                      Clean or remedy.                      Repair.                      Check and replace as necessary.                      Repair or replace                      Check and replace radiator as necessary.                      Replace.                      Adjust brake.                      Adjust or replace.</p>



## MAINTENANCE

### COOLANT LEVEL

To check level, lift hood and look at degassing tank (1). It is necessary to remove degassing tank cap (2) to check coolant level.

**WARNING:**

To help avoid danger of being burned:

- Do not remove degassing tank cap while coolant is "boiling".
- Do not remove degassing tank 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.

When engine is cool, check coolant level in degassing tank. A normal coolant level should be in level mark on degassing tank. If coolant level is below level mark, add proper coolant to tank to bring coolant level up to level mark.

**NOTE:**

If proper quality antifreeze is used, there is no need to add extra inhibitors or additives that claim to improve system. They may be harmful to proper operation of system, and are unnecessary expense.

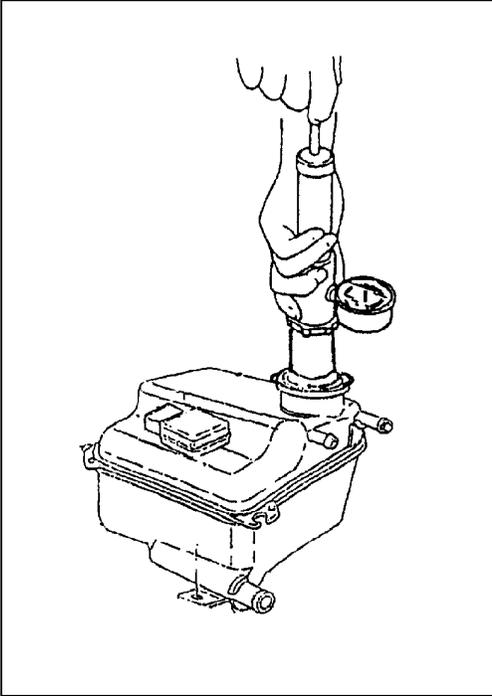
### COOLING SYSTEM SERVICE

**WARNING:**

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

Cooling system should be serviced as follows.

- 1) Check cooling system for leakage or damage.
- 2) Wash degassing tank cap and filler neck with clean water by removing degassing tank cap when engine is cold.
- 3) Check coolant for proper level and freeze protection.



- 4) Using a pressure tester, check system and degassing tank cap for proper pressure holding capacity 110 kpa (1.1 kg/ cm<sup>2</sup>, 15.6 psi). If replacement of cap is required, use proper cap specified for this vehicle.

**NOTE:**

**After installing degassing tank cap to degassing tank, make sure that it is closed certainly as shown in figure. If not, turn cap more as shown figure.**

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

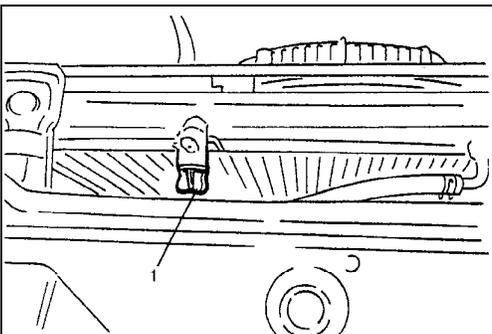
## COOLING SYSTEM FLUSH AND REFILL

- 1) Remove degassing tank cap when engine is cool.  
Turn cap slowly to the left until it reaches a "stop" (Do not press down while turning it).  
Wait until pressure is relieved (indicated by a hissing sound) then press down on cap and continue to turn it to the left.

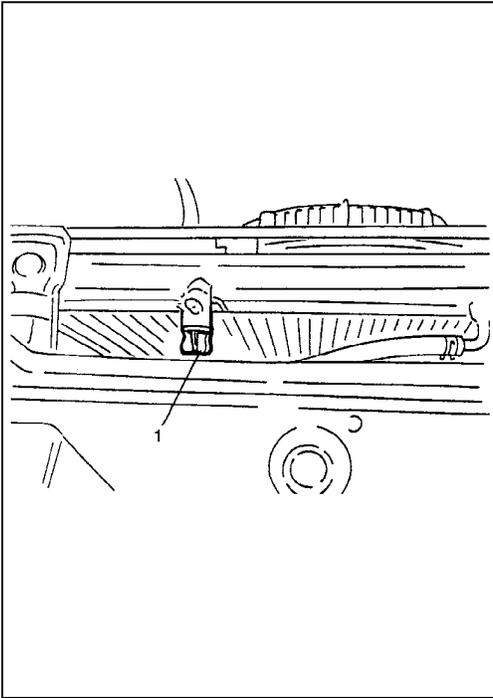
**WARNING:**

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

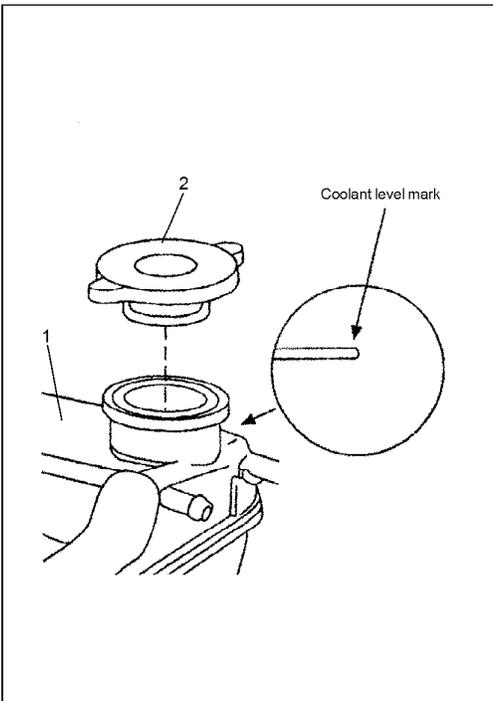
- 2) With degassing tank cap removed, run engine until upper radiator hose is hot (this shows that thermostat is open and coolant is flowing through system).



- 3) Stop engine and open radiator drain plug (1) to drain coolant.
- 4) Close drain plug.



- 5) Fill the circuit slowly with water.
- 6) Loosen bleed screw (1) to bleed air and tighten it after confirmation of overflow.
- 7) Run engine until upper radiator hose is hot again.
- 8) Repeat steps 3) and 7) several times until drained liquid is nearly colorless.
- 9) Drain cooling system and then close radiator drain plug tightly.

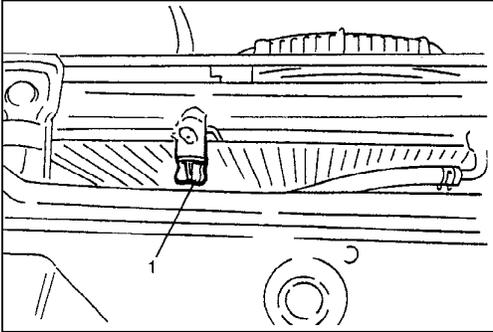


- 10) Disconnect hoses from degassing tank (1). Remove degassing tank and pour out any fluid. Scrub and clean inside of degassing tank with soap and water. Flush it well with clean water and drain.  
Reinstall degassing tank and hose.
- 11) Add 50/50 mixture of good quality ethylene glycol antifreeze and water to degassing tank.  
Fill to level mark. Loosen bleed screw to bleed air and tighten it after confirmation of overflow.
- 12) Run engine, with degassing tank cap removed, until radiator upper hose is hot.
- 13) With engine idling, add coolant to degassing tank until level reaches level mark.  
Install degassing tank cap (2).

## ON-VEHICLE SERVICE

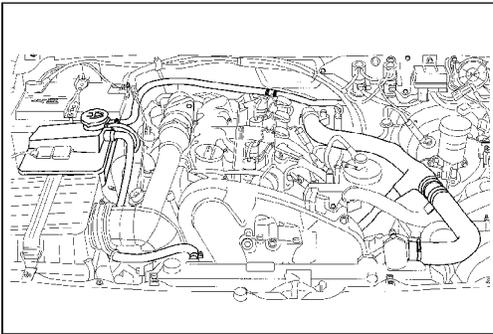
### WARNING:

- ✓ Check to make sure that engine coolant temperature is cold before removing any part of cooling system.
- ✓ Also be sure to disconnect negative cord from battery terminal before removing any part.



## COOLING SYSTEM DRAINING

- 1) Remove degassing tank cap.
- 2) Loosen drain plug (1) on radiator to drain coolant.
- 3) After draining coolant, be sure to tighten drain plug securely.
- 4) Fill cooling system. Refer to "COOLANT" and steps 8) to 10) of "COOLING SYSTEM FLUSH AND REFILL" in this section.



## COOLING WATER PIPES OR HOSES

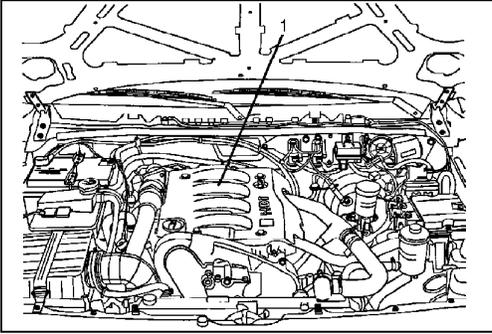
### REMOVAL

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

### INSTALLATION

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

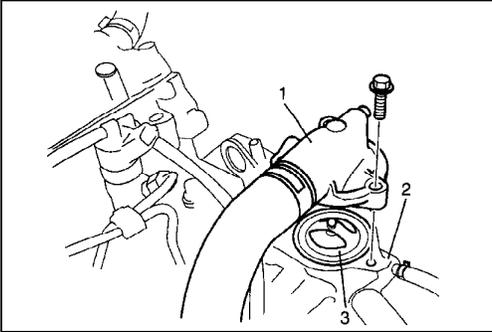
- ✓ Tighten each clamp securely.
- ✓ Refill cooling system with proper coolant, referring to description on "COOLANT" and steps 8) to 10) of "COOLING SYSTEM FLUSH AND REFILL" in this section.



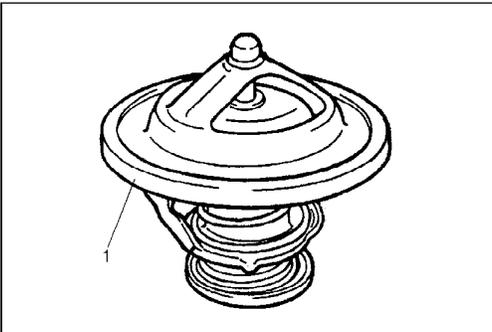
## THERMOSTAT

### REMOVAL

- 1) Disconnect negative cable at battery and remove engine cover (1).
- 2) Drain cooling system and tighten drain plug.

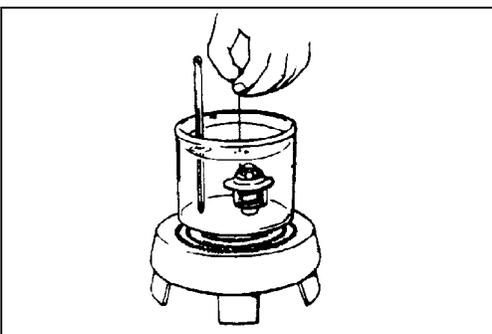


- 3) Remove thermostat cap (1) from water outlet box (2).
- 4) Remove thermostat (3).



### INSPECTION

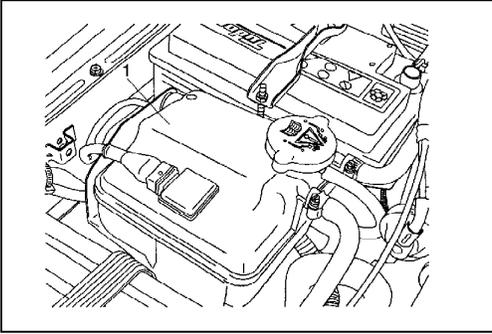
- 1) Check to make sure that valve seat is free from foreign matters which would prevent valve from seating tight.
- 2) Check thermostat seal (1) for breakage, deterioration or any other damage.



- 3) Check thermostatic movement of wax pellet as follows:
  - a) Immerse thermostat in water, and heat water gradually.
  - b) Check that valve starts to open at specific temperature.
  - c) 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.

### INSTALLATION

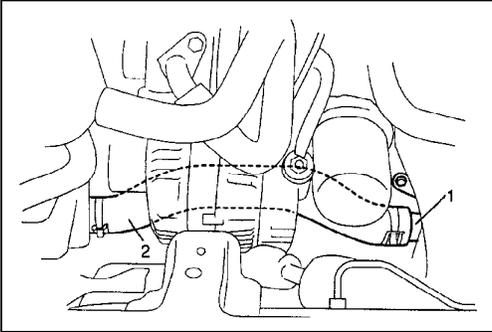
Reverse removal procedures.



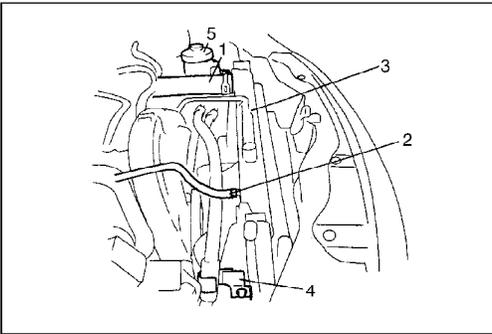
## RADIATOR

### REMOVAL

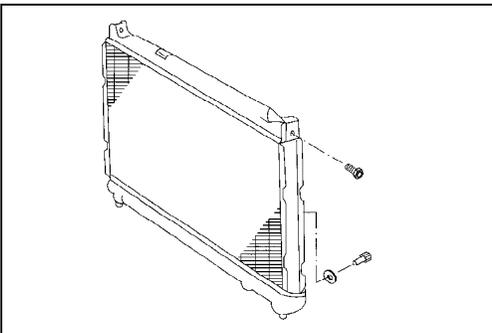
- 1) Disconnect negative cable at battery.
- 2) Drain cooling system by loosening drain plug of radiator.
- 3) Remove degassing tank (1) and its bracket.



- 4) Detach water outlet pipe (1) from engine mounting bracket and disconnect radiator outlet hose (2) from radiator.



- 5) Disconnect radiator inlet hose (1) and degassing tank hose (2) from radiator (3).
- 6) Remove P/S high pressure hose clamp (4) and detach P/S fluid reservoir (5). Remove MAF sensor bracket.



- 7) Disconnect radiator fan motor couplers and remove radiator with radiator fan motor assembly.
- 8) Remove radiator fan motor assembly from radiator.

**INSPECTION**

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

**CLEANING**

Clean frontal area of radiator cores.

**INSTALLATION**

Reverse removal procedures, noting the followings.

- ´ Refill cooling system with proper coolant referring to “COOLANT” and steps 8) to 10) of “COOLING SYSTEM FLUSH AND REFILL” in this section.
- ´ After installation, check each joint for leakage.

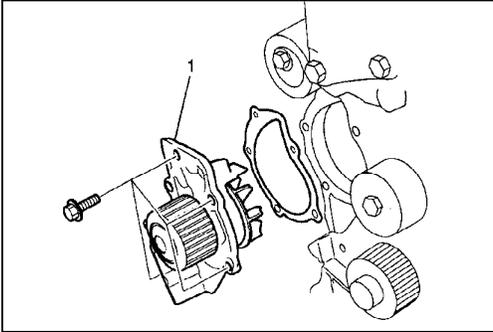
**RADIATOR FAN RELAY**

**INSPECTION**

Refer to “RADIATOR FAN CONTROL SYSTEM” in Section 6E3.

**WATER PUMP****REMOVAL**

- 1) Disconnect negative cable at battery.
- 2) Drain cooling system by loosening drain plug of radiator.
- 3) Remove timing belt referring to "TIMING BELT AND BELT TENSIONER" in Section 6A3.

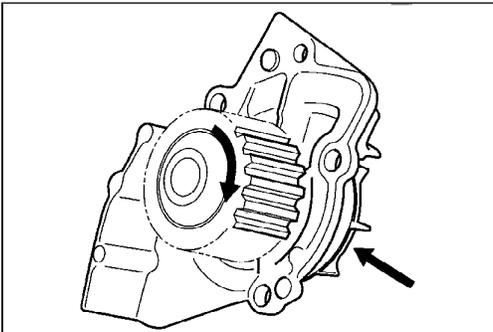


- 4) Remove water pump assembly (1).

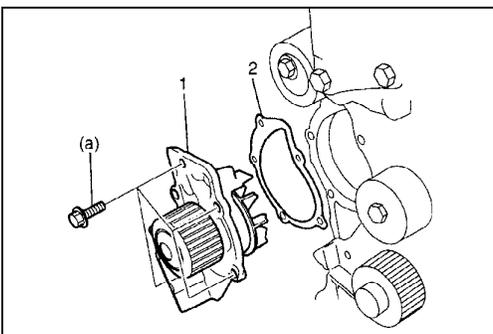
**CAUTION:**

**Do not disassemble water pump.**

**If any repair is required on pump, replace it as assembly.**

**INSPECTION**

- ˆ Rotate water pump by hand to check for smooth operation. If pump does not rotate smoothly or makes abnormal noise, replace it.
- ˆ Inspect water pump impeller for damage. Replace as necessary.

**INSTALLATION**

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

**Tightening torque**

**Water pump bolt (a): 15 N·m (1.5 kg·m, 11.0 lb-ft)**

- 3) Install timing belt and timing belt covers referring to "TIMING BELT AND BELT TENSIONER" in Section 6A3.
- 4) Connect negative cable at battery.
- 5) Fill coolant.
- 6) After installation, check each part for leakage.

### REQUIRED SERVICE MATERIALS

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

SECTION 6C

ENGINE FUEL

NOTE:

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

CONTENTS

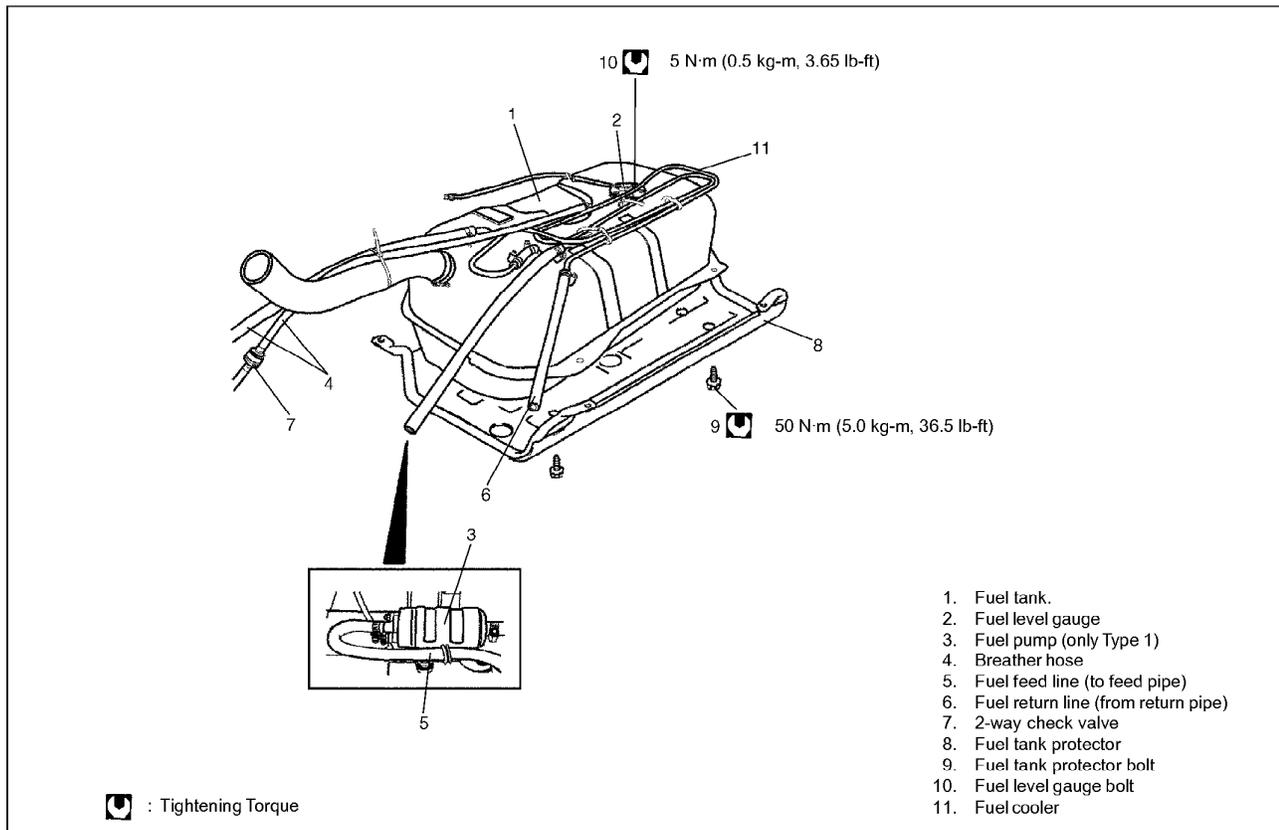
<b>GENERAL DESCRIPTION</b> .....	6C-1	Fuel Pump (Type 1) .....	6C-5
Fuel System .....	6C-1	Injection Pump .....	6C-6
<b>ON VEHICLE SERVICE</b> .....	6C-2	2-way Check Valve .....	6C-6
Water Draining of Fuel System .....	6C-2	Fuel Tank .....	6C-6
Air Bleeding of Fuel System .....	6C-2	Fuel Level Gauge .....	6C-8
Fuel Filter Element .....	6C-2	Fuel Heater .....	6C-8

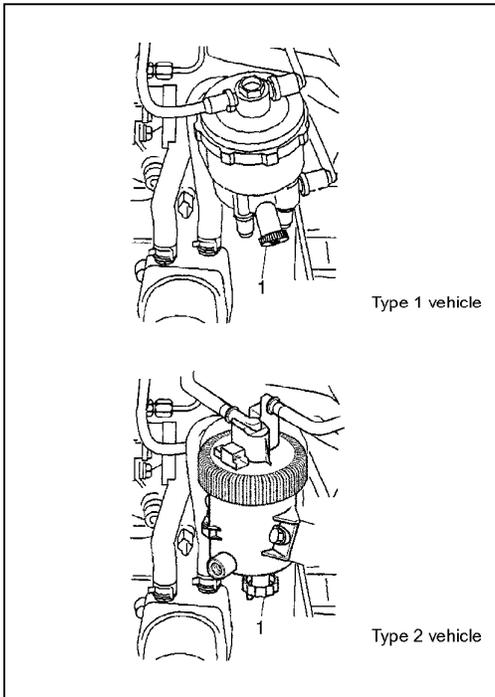
**6C**

GENERAL DESCRIPTION

FUEL SYSTEM

The main components of the fuel system are fuel tank, fuel pump (Type 1), high pressure fuel pump, fuel filter and fuel level gauge and it includes three lines and fuel feed line, fuel return line.





## ON-VEHICLE SERVICE

### WATER DRAINING OF FUEL FILTER

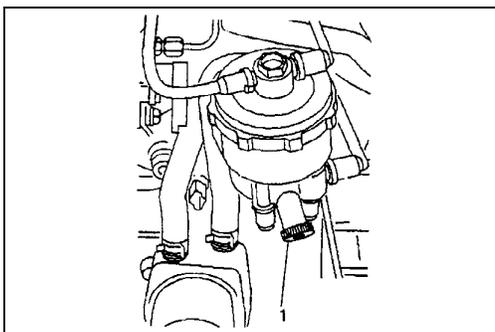
- 1) Loose bleed screw (1).
- 2) Drain water.
- 3) Tighten bleed screw.
- 4) Check for fuel leakage.

### AIR BLEEDING OF FUEL SYSTEM

Air bleeding must be carried out when fuel system has been disassembled or when vehicle ran out of fuel.

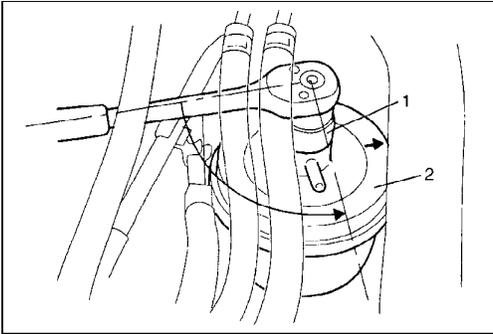
**For Type 1 vehicles**, turn ignition switch ON to operate fuel pump and after about 5 seconds turn it OFF. Repeat this 6 times and then check engine starts.

**For Type 2 vehicles**, squeeze the primer about 5 times and then turn ignition switch ON to operate high pressure fuel pump; after about 5 seconds turn it OFF. Repeat this 6 times and then check engine starts.

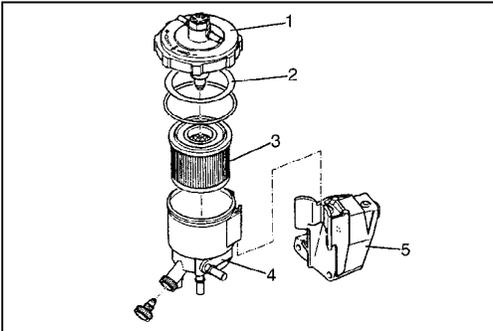


### FUEL FILTER ELEMENT REMOVAL (TYPE 1)

- 1) Disconnect negative cable at battery.
- 2) Loosen bleed screw (1) and drain fuel.

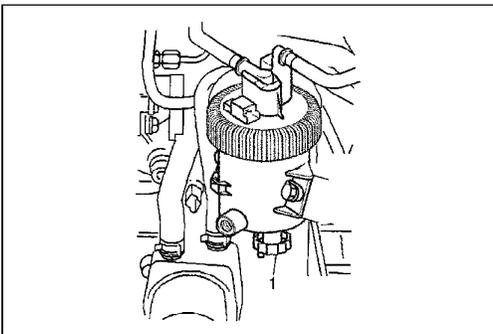


3) Turn cover (2) a quarter using a 22 mm socket (1).



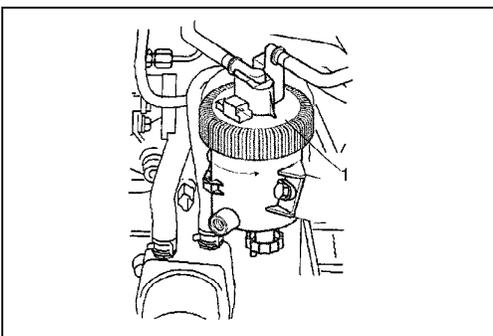
- 4) Remove cover (1), corrugated washer (2) and fuel filter element (3).
- 5) Remove fuel filter (4) from bracket (5) by unclipping and lifting fuel filter.
- 6) Clean fuel filter.

**CAUTION:**  
Do not use compressed air to fuel filter and its element.

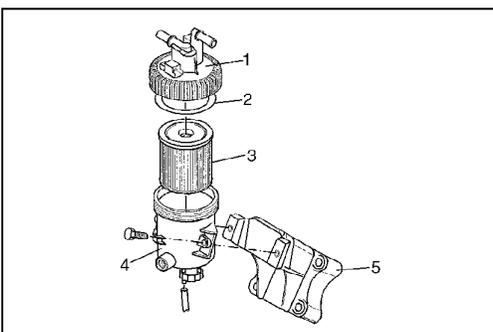


**REMOVAL (TYPE 2)**

- 1) Disconnect negative cable at battery.
- 2) Loosen bleed screw (1) and drain fuel.

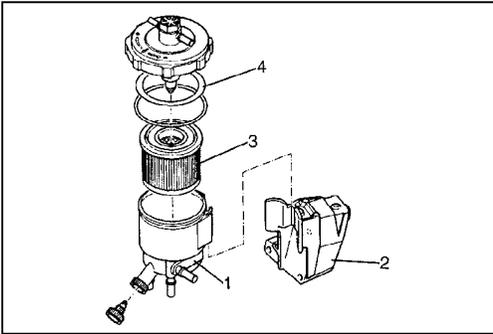


3) Loosen cover (1).



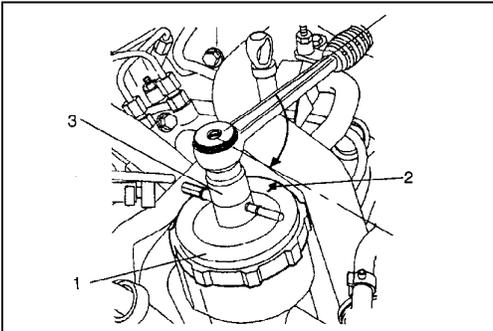
- 4) Remove cover (1), corrugated washer (2) and fuel filter element (3).
- 5) Remove fuel filter (4) from bracket (5) by unclipping and lifting fuel filter.
- 6) Clean fuel filter.

**CAUTION:**  
Do not use compressed air to fuel filter and its element.

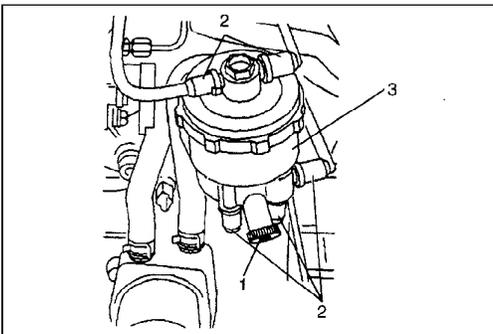


**INSTALLATION (TYPE 1)**

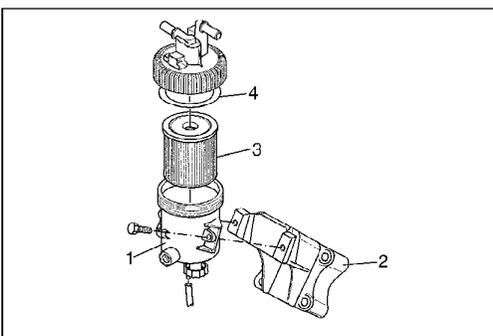
- 1) Install fuel filter (1) to bracket (2).
- 2) Set fuel filter element (3) and position it correctly.
- 3) Set corrugated washer (4) on fuel filter.



- 4) Set cover (1) so that arrow (2) on it is directed toward dash panel.
- 5) Tighten cover (1) a quarter turn using a 22 mm socket (3).

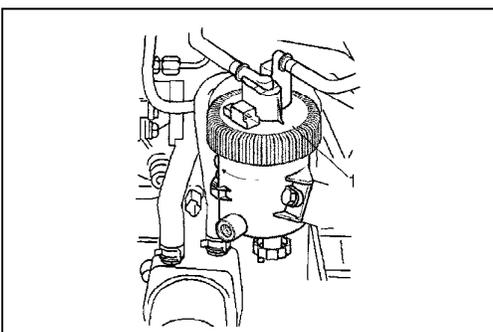


- 6) Connect fuel hoses (2) to fuel filter assembly (3).
- 7) Tighten bleed screw (1).
- 8) Connect negative cable at battery.
- 9) Bleed air in system referring to "AIR BLEEDING OF FUEL SYSTEM" in this section.
- 10) Start engine and check that there are no fuel leaks.

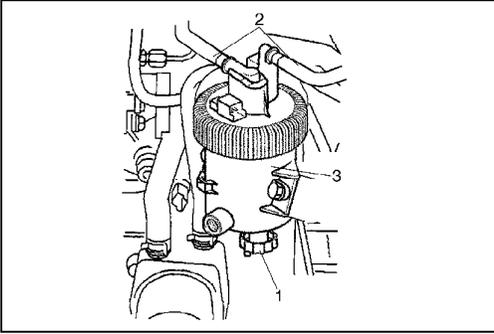


**INSTALLATION (TYPE 2)**

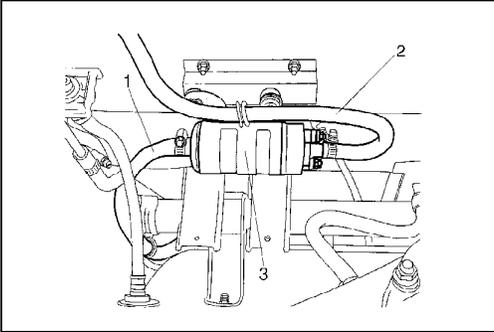
- 1) Install fuel filter (1) to bracket (2).
- 2) Set fuel filter element (3) and position it correctly.
- 3) Set corrugated washer (4) on fuel filter.



- 4) Set cover (1) so that arrow (2) on it is directed toward dash panel.
- 5) Tighten cover (1) a quarter turn using a 22 mm socket (3).



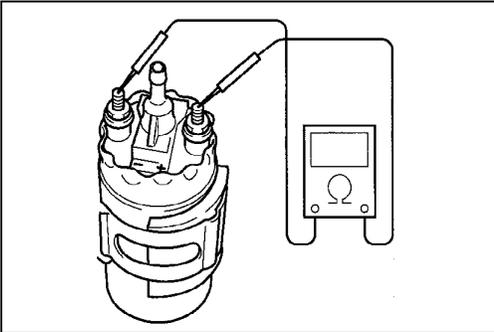
- 6) Connect fuel hoses (2) to fuel filter assembly (3).
- 7) Tighten bleed screw (1).
- 8) Connect negative cable at battery.
- 9) Bleed air in system referring to "AIR BLEEDING OF FUEL SYSTEM" in this section.
- 10) Start engine and check that there are no fuel leaks.



## FUEL PUMP (TYPE 1)

### REMOVAL

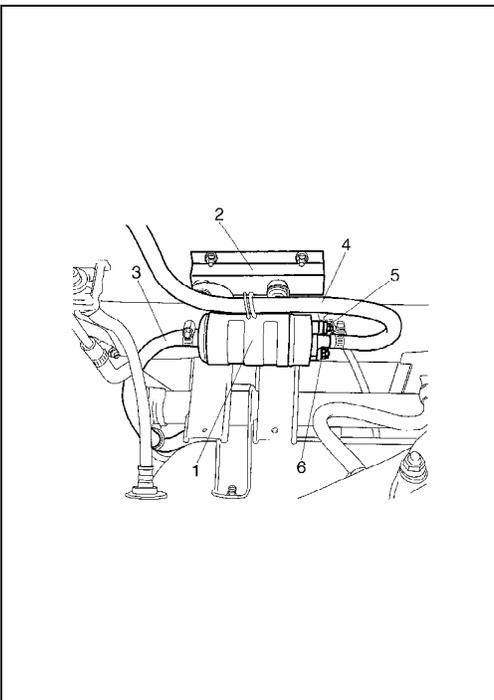
- 1) Remove fuel filler cap to release fuel pressure in fuel feed line.
- 2) Disconnect negative cable at battery.
- 3) Hoist vehicle.
- 4) Disconnect fuel pump wire harness.
- 5) Disconnect inlet hose (1) and outlet hose (2).
- 6) Remove fuel pump (3).



### INSPECTION

Measure resistance between terminals "+" and "-" of pump. If found defective, replace.

**Fuel pump resistance: About 2.1Ω.**

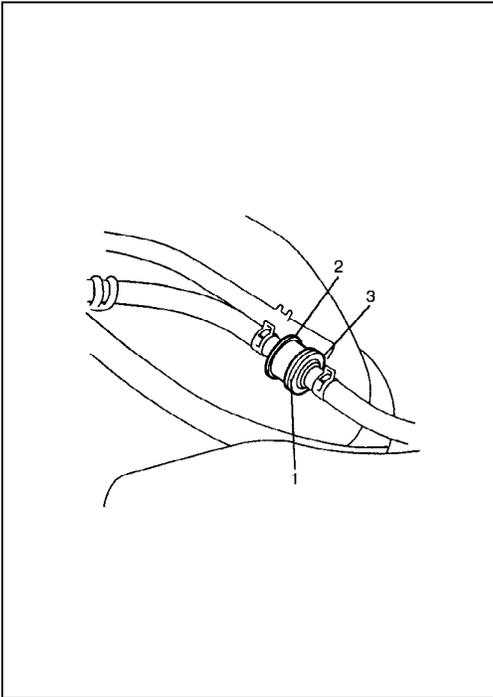


### INSTALLATION

- 1) Install fuel pump (1) with its bracket (2) to chassis frame.
- 2) Connect inlet hose (3) and outlet hose (4).
- 3) Connect "PB" wire terminal (5) and "B" wire terminal (6) to pump with nuts securely as shown in the left figure.
- 4) Lower hoist.
- 5) Connect negative cable at battery.
- 6) Install fuel filler cap.
- 7) Bleed air in system referring to "AIR BLEEDING OF FUEL SYSTEM" in this section.
- 8) Start engine and check that there are no fuel leaks.

## INJECTION PUMP

For removal and installation, refer to "INJECTION PUMP" in Section 6E3.



## 2-WAY CHECK VALVE (TANK PRESSURE CONTROL VALVE)

### INSPECTION

- 1) Air should pass through 2-way check valve (1) smoothly from fuel tank side (Black side (2) of 2-way check valve) to Orange side (3) when blown hard.
- 2) From Orange side, even when blown softly, air should come out of Black side.
- 3) If air doesn't pass through valve in step 1) or hard blow is required in step 2), replace 2-way check valve.

### WARNING:

**DO NOT SUCK** air through 2-way check valve. Fuel vapor inside the valve is harmful.

## FUEL TANK REMOVAL

### CAUTION:

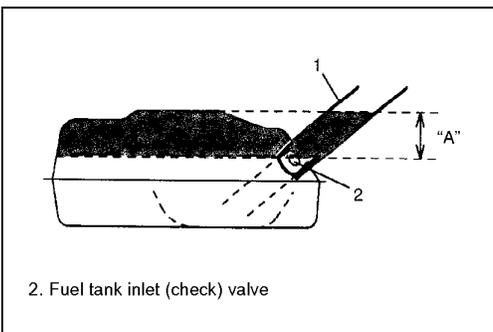
**This work must not be done when engine is hot. If done so, it may cause adverse effect to catalyst.**

- 1) Disconnect negative cable at battery.
- 2) Remove fuel filter cap.

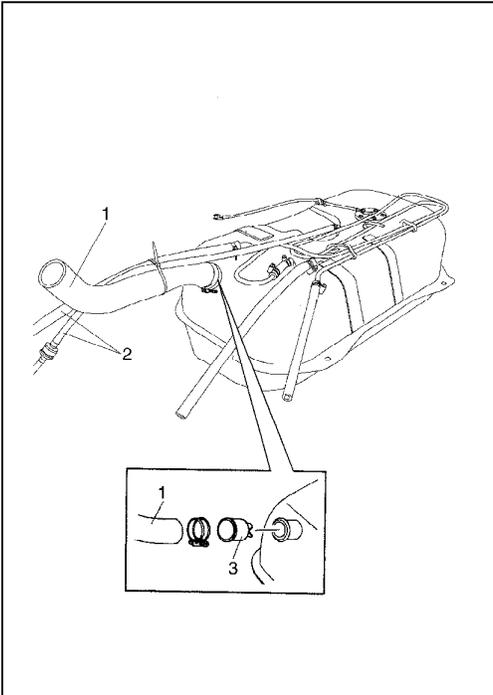
- 3) Insert hose of a hand operated pump into fuel filler hose (1) and drain fuel in space "A" in the figure (drain fuel through it till fuel stops).

### CAUTION:

**Do not force** hose of a hand operated pump into fuel tank. Doing so can damage inlet valve.

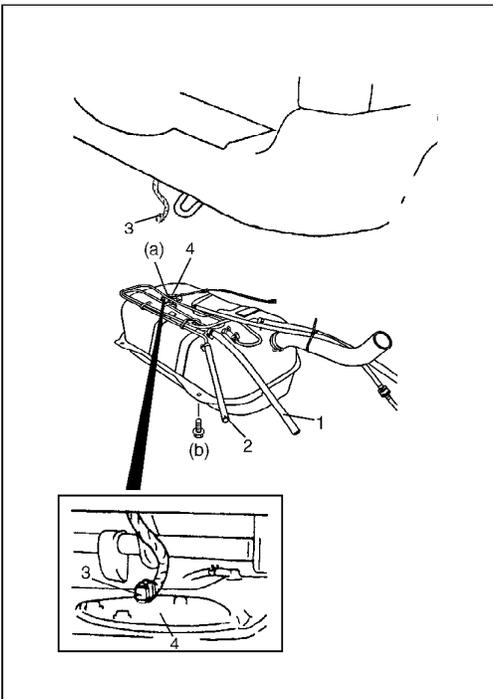


2. Fuel tank inlet (check) valve



- 4) Disconnect filler hose (1) from fuel tank and breather hoses (2) from fuel filler neck.
- 5) Remove fuel tank inlet valve (3).  
Use care not to damage inlet valve when removing.
- 6) Drain fuel tank by pumping fuel out through fuel tank filler.  
Use hand operated pump device to drain fuel tank.

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



- 7) Disconnect fuel pump inlet hose (1) from fuel pump and fuel return hose (2) from pipes.
- 8) Remove fuel tank protector (if equipped) from vehicle.
- 9) Lower fuel tank gradually while holding it horizontally and pull out coupler (3) at fuel level gauge (4).

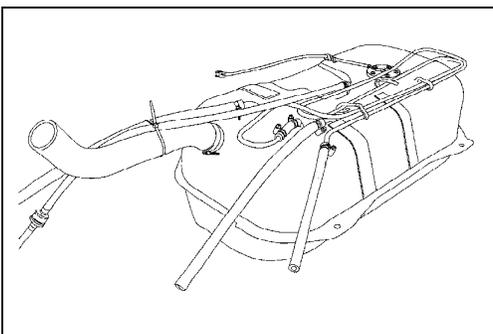
#### INSTALLATION

For installation, reverse removal procedure described above.  
Tighten each bolt to specified torque.

#### Tightening Torque

Fuel level gauge bolt (a): 5.0 N·m (0.5 kg-m, 3.5 lb-ft)

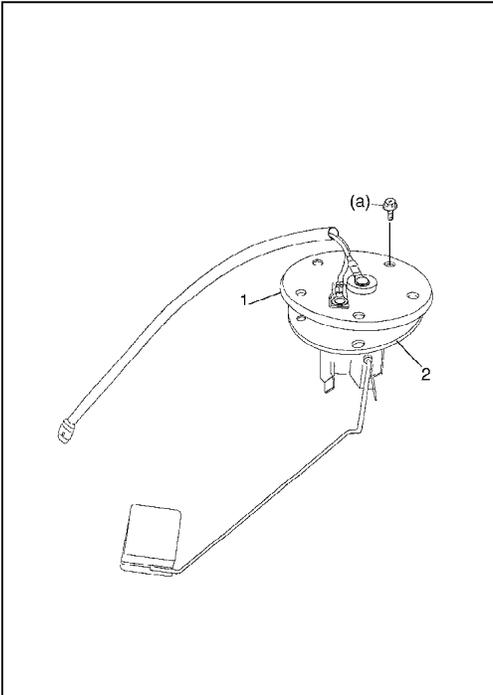
Fuel tank bolt (b): 50 N·m (5.0 kg-m, 36.0 lb-ft)



#### INSPECTION

After removing fuel tank, check hoses and pipes connected to fuel tank for leaks, loose connections, deterioration or damage. Also check fuel level gauge gaskets for leaks, visually inspect fuel tank for leaks and damage.

Replace any damaged or malfunctioned parts.



## FUEL LEVEL GAUGE

### REMOVAL

- 1) Remove fuel tank. Refer to "FUEL TANK" in this section.
- 2) Remove fuel level gauge (1) from fuel tank.

### INSPECTION

Check fuel level gauge (1) for evidence of dirt and contamination. If present, clean and check for presence of dirt in fuel tank.

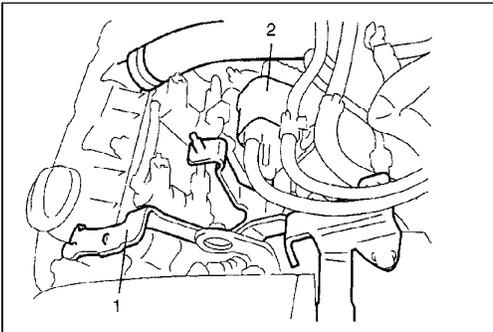
### INSTALLATION

Reverse removal procedure for installation noting the followings.

- Use new gasket (2).
- Tighten fuel level gauge bolts to specified torque.

### Tightening Torque

Fuel level gauge bolt (a): 5.0 N·m (0.5 kg-m, 3.5 lb-ft)

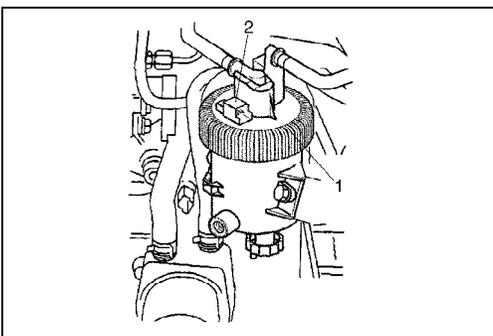


## FUEL HEATER

### REMOVAL

#### Type 1 vehicles:

- 1) Disconnect negative cable at battery and remove engine cover.
- 2) Disconnect fuel heater connector.
- 3) Disconnect fuel feed hose and inlet fuel hose from fuel heater.
- 4) Remove bracket (1) with fuel heater (2).



#### Type 2 vehicles:

- 1) Disconnect negative cable at battery and remove engine cover.
- 2) Disconnect fuel heater connector.
- 3) Disconnect fuel feed hose and inlet fuel hose from fuel heater.
- 4) Remove cover (1) with fuel heater (2).

### INSPECTION

Inspect for damage or deformation. If defective, replace.

### INSTALLATION

Reverse removal procedure for installation.

## SECTION 6E3

# ENGINE AND EMISSION CONTROL SYSTEM (HDI ENGINE)

**WARNING:**

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

Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to "Air Bag System Components and Wiring Location View" under "General Description" in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and "Service Precautions" under "On-Vehicle Service" in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either of these two conditions may result in severe injury.

Technical service work must be started at least 90 seconds after the ignition switch is turned to the "LOCK" position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

**6E3**

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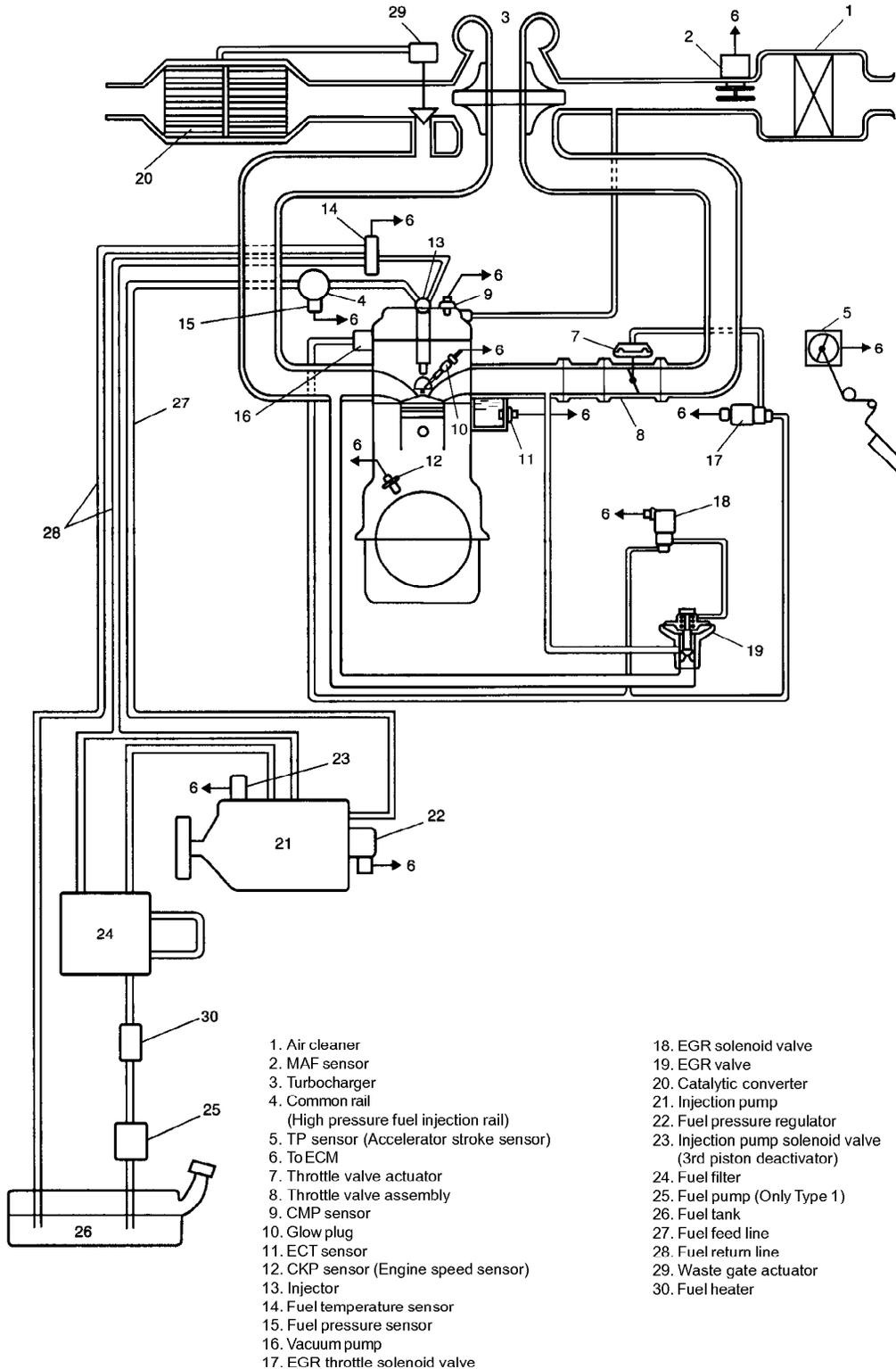
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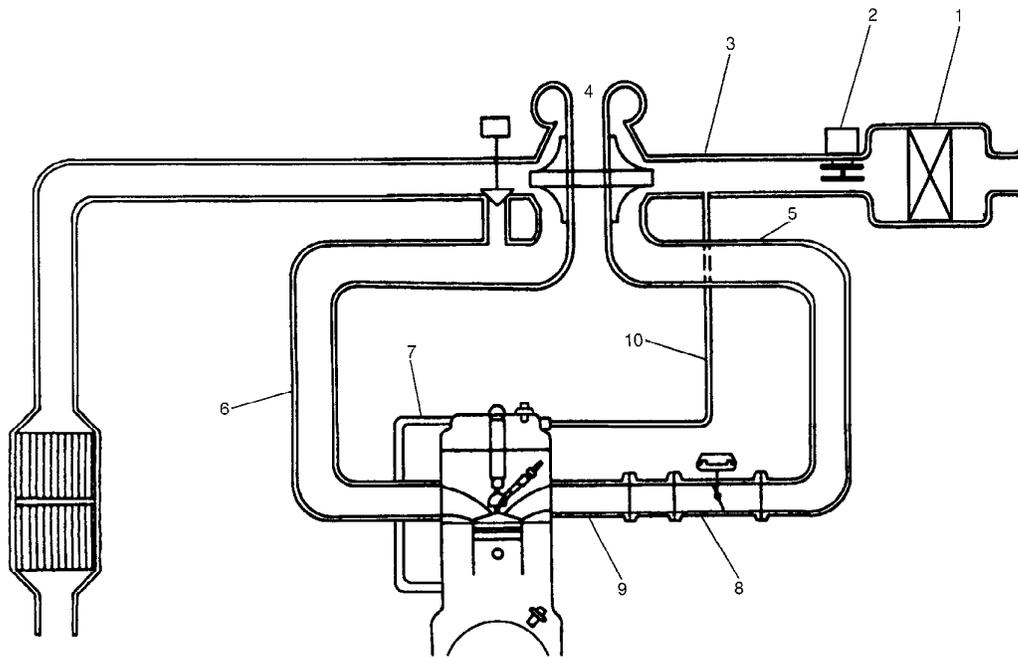
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## GENERAL DESCRIPTION

### SYSTEM DIAGRAM

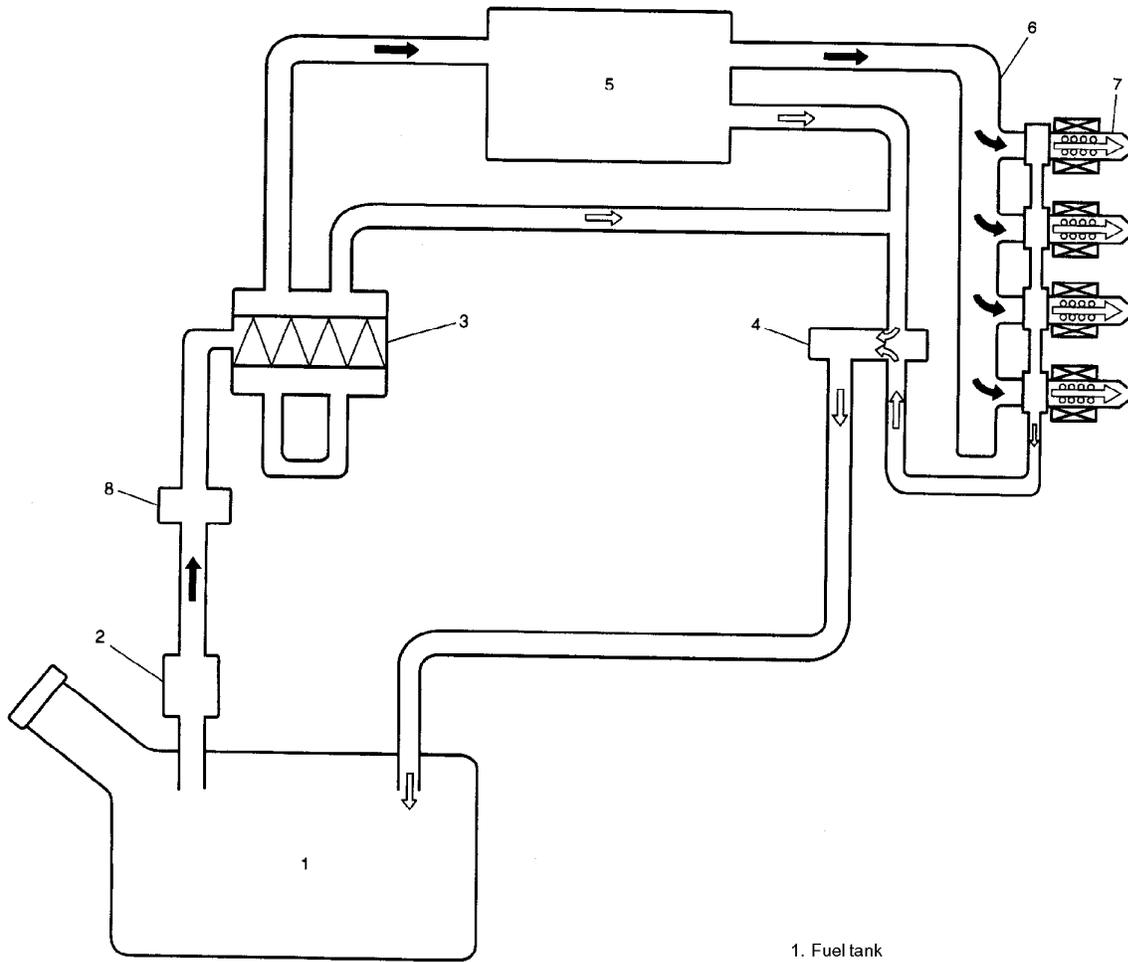


## AIR INTAKE SYSTEM



1. Air cleaner
2. MAF sensor
3. Air cleaner outlet hose
4. Turbocharger
5. Intake manifold inlet
6. Exhaust manifold
7. PCV hose
8. Throttle valve assembly
9. Intake manifold
10. Breather hose

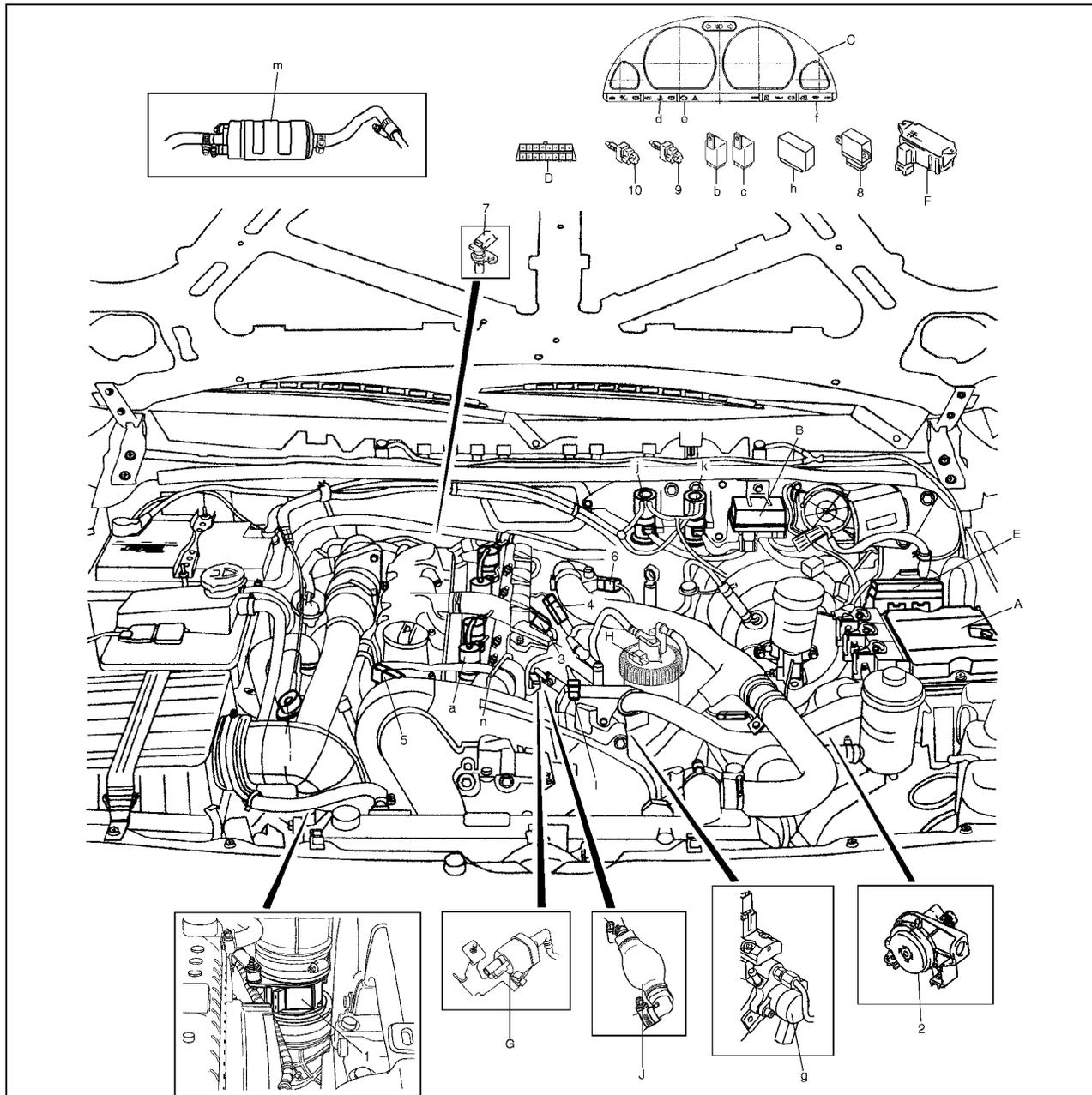
FUEL DELIVERY SYSTEM



- 1. Fuel tank
- 2. Fuel pump (Only Type 1)
- 3. Fuel filter
- 4. Fuel temperature sensor
- 5. Injection pump
- 6. Common rail  
(High pressure fuel injection rail)
- 7. Injector
- 8. Fuel heater

 : Fuel feed line  
 : Fuel return line

# ELECTRONIC CONTROL SYSTEM SYSTEM LOCATION DIAGRAM



**INFORMATION SENSORS**

- 1. MAF sensor (built-in intake air temp. sensor)
- 2. Accelerator stroke sensor
- 3. Fuel (rail) pressure sensor
- 4. Fuel temperature sensor
- 5. CMP sensor
- 6. ECT sensor
- 7. CKP sensor (Engine speed sensor)
- 8. Immobilizer control module
- 9. Brake lamp switch
- 10. Clutch switch

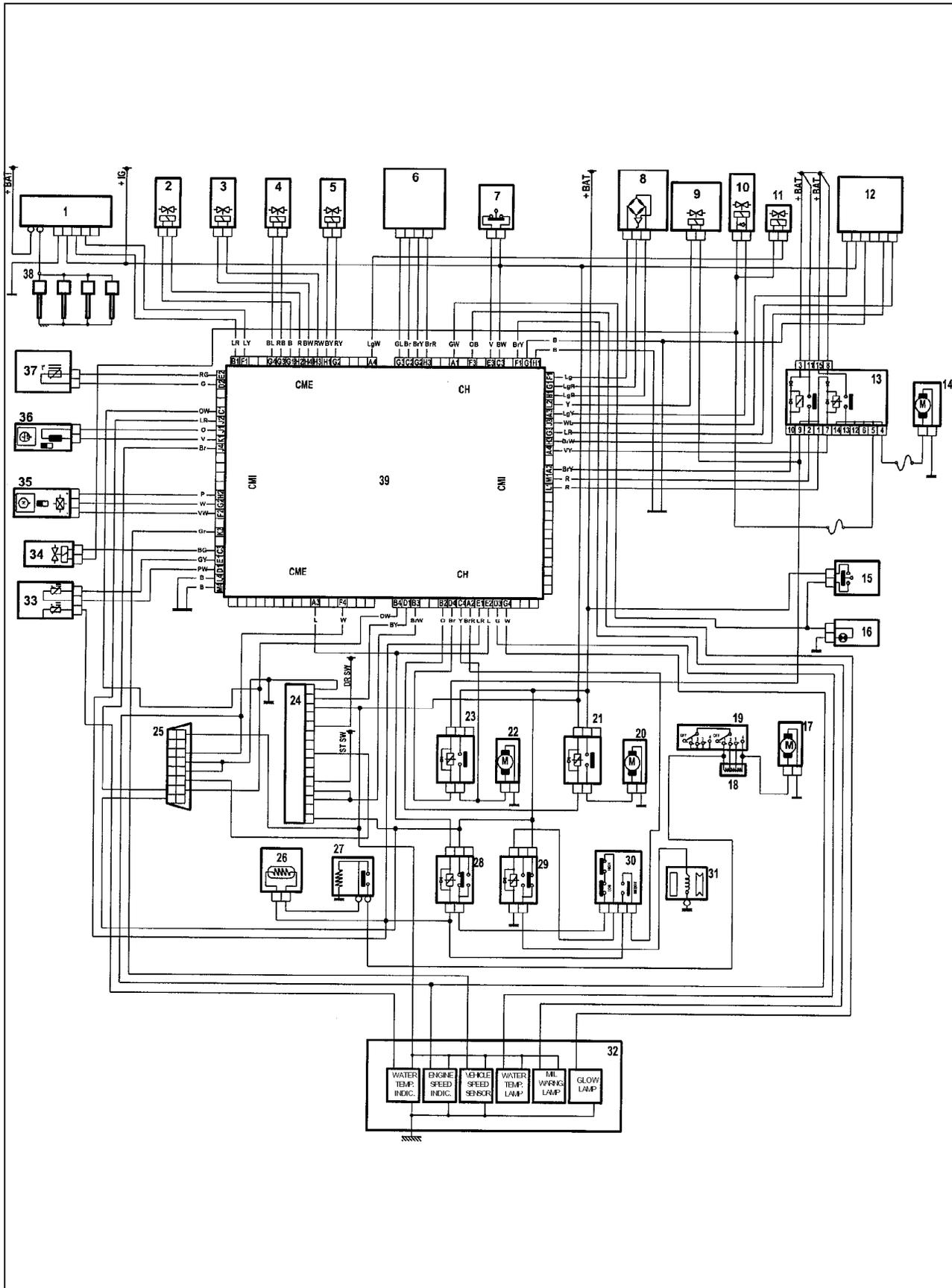
**CONTROLLED DEVICES**

- a: Injector
- b: Radiator fan relay 1 (High)
- c: Radiator fan relay 2 (Low)
- d: Engine coolant temperature warning lamp
- e: Malfunction indicator lamp
- f: Glow indicator lamp
- g: Fuel pressure regulator
- h: Double relay
- i: EGR valve
- j: EGR solenoid valve
- k: EGR throttle solenoid valve
- l: Injection pump solenoid valve (3rd piston deactivator)
- m: Fuel pump (only Type 1)
- n: Glow plug

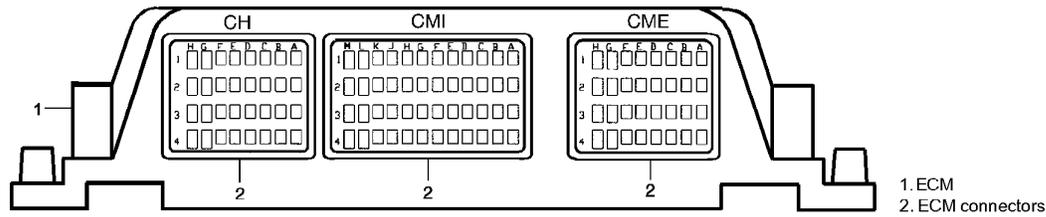
**OTHERS**

- A: ECM
- B: Pre post heating relay (control unit)
- C: Combination meter
- D: Data link connector
- E: Main fuse box
- F: Fuse box
- G: Fuel heater (Type 1)
- H: Fuel heater (Type 2)
- J: Primer (Type 2)

SYSTEM WIRING DIAGRAM (TYPE 1)



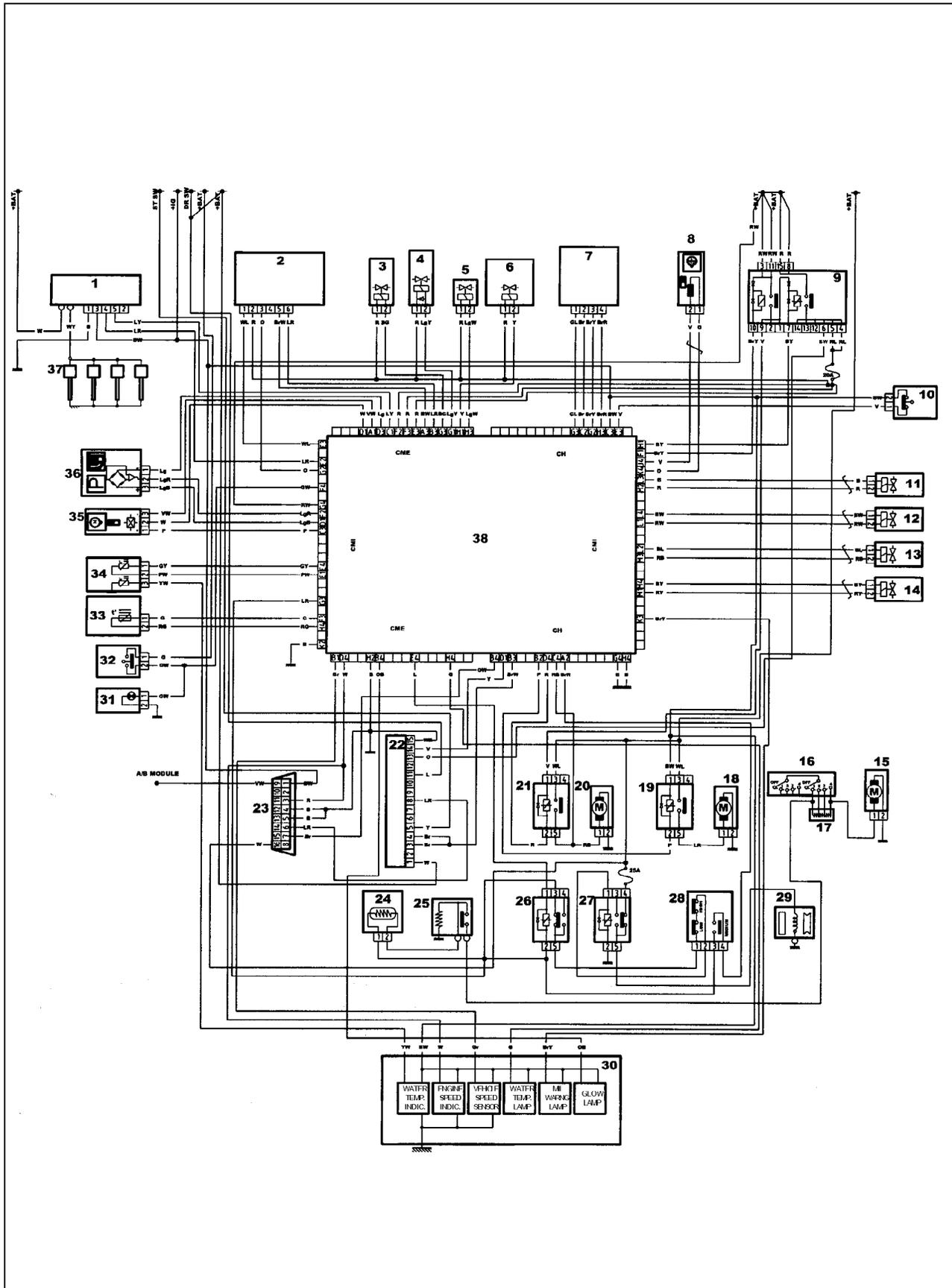
**TYPE 1 ECM CONNECTOR (TERMINAL ARRANGEMENT VIEWED FROM HARNESS SIDE)**



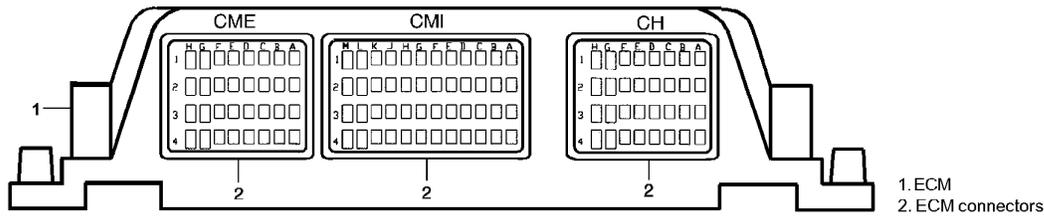
- |  |                                       |   |
|--|---------------------------------------|---|
| 1. Pre post heating relay (control unit)                       | 14. Fuel pump                         | 29. A/C compressor relay                                      |
| 2. Fuel injector No.1  | 15. Brake lamp switch                 | 30. A/C pressure switch                                       |
| 3. Fuel injector No.2  | 16. Brake lamp                        | 31. A/C compressor  |
| 4. Fuel injector No.3  | 17. Heater fan motor                  | 32. Combination meter   |
| 5. Fuel injector No.4  | 18. Heater regulation resistance      | 33. Engine coolant temperature sensor                         |
| 6. Throttle position sensor<br>(Accelerator stroke sensor)     | 19. Heater switch                     | 34. Injection pump solenoid valve<br>(3rd piston deactivator) |
| 7. Clutch switch regulator                                     | 20. Radiator fan motor 1 (Left side)  | 35. Camshaft position sensor                                  |
| 8. Fuel (rail) pressure sensor                                 | 21. Radiator fan relay 1 (Low)        | 36. Crankshaft position sensor<br>(Engine speed sensor)       |
| 9. Fuel pressure regulator                                     | 22. Radiator fan motor 2 (Right side) | 37. Fuel temperature sensor                                   |
| 10. EGR solenoid valve   | 23. Radiator fan relay 2 (High)       | 38. Glow plugs  |
| 11. EGR throttle solenoid valve                                | 24. Immobilizer control module        | 39. Engine control module (ECM)                               |
| 12. Mass air flow sensor<br>(built-in intake air temp. sensor) | 25. Data link connector               |   |
| 13. Double relay   | 26. Thermistor                        |   |
|  | 27. A/C switch                        |   |
|  | 28. A/C relay                         |   |

TERMINAL	CIRCUIT	TERMINAL	CIRCUIT	TERMINAL	CIRCUIT	TERMINAL	CIRCUIT
CH-A1	Brake lamp switch	CME-A1	-	CMI-A1	-	CMI-J1	Crankshaft position (Engine speed)sensor (-)
CH-A2	A/C pressure switch	CME-A2	-	CMI-A2	Double relay (Main relay)	CMI-J2	A/C control
CH-A3	-	CME-A3	A/C cut signal	CMI-A3	EGR solenoid valve	CMI-J3	Intake air temperature
CH-A4	-	CME-A4	EGR throttle solenoid valve	CMI-A4	Double relay (fuel pump relay)	CMI-J4	Data link connector 12V (L-line)
CH-B1	-	CME-B1	Pre post heating relay	CMI-B1	-	CMI-K1	Crankshaft position (Engine speed)sensor (+)
CH-B2	Radiator fan relay (low)	CME-B2	-	CMI-B2	-	CMI-K2	Vehicle speed signal
CH-B3	Immobilizer control module signal	CME-B3	-	CMI-B3	-	CMI-K3	-
CH-B4	Data link connector (K-line)	CME-B4	-	CMI-B4	-	CMI-K4	-
CH-C1	-	CME-C1	-	CMI-C1	Data link connector (K-line)	CMI-L1	Double relay (Main relay)
CH-C2	Throttle position sensor	CME-C2	-	CMI-C2	-	CMI-L2	Fuel pressure regulator (Accelerator stroke sensor)
CH-C3	Clutch regulator switch	CME-C3	-	CMI-C3	Injection pump solenoid valve (3rd piston deactivator)	CMI-L3	-
CH-C4	Radiator fan state	CME-C4	-	CMI-C4	-	CMI-L4	Ground
CH-D1	Immobilizer control module wake-up signal	CME-D1	-	CMI-D1	Engine coolant temperature sensor signal	CMI-M1	Power source
CH-D2	-	CME-D2	-	CMI-D2	Ground for fuel temperature sensor	CMI-M2	-
CH-D3	Engine coolant temp. warning lamp	CME-D3	-	CMI-D3	-	CMI-M3	-
CH-D4	Radiator fan relay (high)	CME-D4	-	CMI-D4	-	CMI-M4	Ground
CH-E1	A/C control	CME-E1	-	CMI-E1	Engine coolant temperature sensor		
CH-E2	A/C cut signal	CME-E2	-	CMI-E2	Fuel temperature sensor		
CH-E3	Clutch regulator switch	CME-E3	-	CMI-E3	-		
CH-E4	-	CME-E4	-	CMI-E4	-		
CH-F1	Malfunction indicator lamp	CME-F1	Pre heating diagnostic	CMI-F1	Ground for fuel pressure sensor		
CH-F2	-	CME-F2	-	CMI-F2	Camshaft position sensor (+)		
CH-F3	Glow indicator lamp	CME-F3	-	CMI-F3	-		
CH-F4	-	CME-F4	Engine speed signal	CMI-F4	-		
CH-G1	Ground	CME-G1	Fuel injector No.1 (-)	CMI-G1	Fuel (rail) pressure sensor signal		
CH-G2	Throttle position sensor (Accelerator stroke sensor)	CME-G2	Fuel injector No.4 (+)	CMI-G2	Camshaft position sensor		
CH-G3	Throttle position sensor (Accelerator stroke sensor)	CME-G3	Fuel injector No.3 (+)	CMI-G3	Mass air flow sensor		
CH-G4	Engine speed signal (Combination meter)	CME-G4	Fuel injector No.3 (-)	CMI-G4	-		
CH-H1	Ground	CME-H1	Fuel injector No.4 (-)	CMI-H1	Fuel (rail) pressure sensor		
CH-H2	-	CME-H2	Fuel injector No.1 (+)	CMI-H2	Ground for camshaft position sensor		
CH-H3	Throttle position sensor (Accelerator stroke sensor)	CME-H3	Fuel injector No.2 (+)	CMI-H3	Power source mass air flow sensor (Power source after ignition on)		
CH-H4	-	CME-H4	Fuel injector No.2 (-)	CMI-H4	-		

SYSTEM WIRING DIAGRAM (TYPE 2)



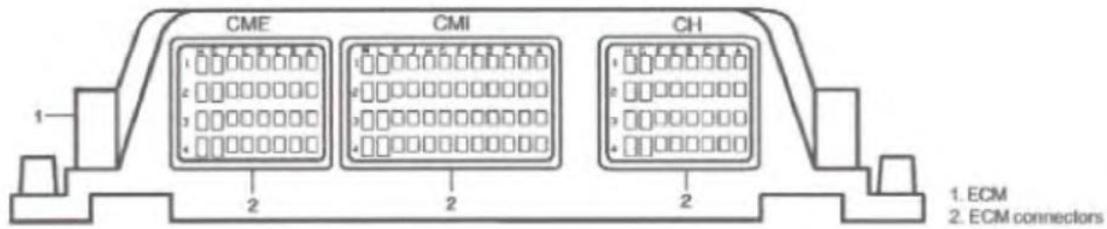
TYPE 2 ECM CONNECTOR (TERMINAL ARRANGEMENT VIEWED FROM HARNESS SIDE)



- |  |                                       |                                       |
|--|---------------------------------------|---------------------------------------|
| 1. Pre post heating relay (control unit)                   | 11. Fuel injector No.1                | 25. A/C switch                        |
| 2. Mass air flow sensor (built-in intake air temp. sensor) | 12. Fuel injector No.2                | 26. A/C relay                         |
| 3. Injection pump solenoid valve (3rd piston deactivator)  | 13. Fuel injector No.3                | 27. A/C compressor relay              |
| 4. EGR solenoid valve                                      | 14. Fuel injector No.4                | 28. A/C pressure switch               |
| 5. EGR throttle solenoid valve                             | 15. Heater fan motor                  | 29. A/C compressor                    |
| 6. Fuel pressure regulator                                 | 16. Heater switch                     | 30. Combination meter                 |
| 7. Throttle position sensor (Accelerator stroke sensor)    | 17. Heater regulation resistance      | 31. Brake lamp                        |
| 8. Crankshaft position sensor (Engine speed sensor)        | 18. Radiator fan motor 1 (Left side)  | 32. Brake lamp switch                 |
| 9. Double relay  | 19. Radiator fan relay 1 (Low)        | 33. Fuel temperature sensor           |
| 10. Clutch switch regulator                                | 20. Radiator fan motor 2 (Right side) | 34. Engine coolant temperature sensor |
|  | 21. Radiator fan relay 2 (High)       | 35. Camshaft position sensor          |
|  | 22. Immobilizer control module        | 36. Fuel (rail) pressure sensor       |
|  | 23. Data link connector               | 37. Glow plugs                        |
|  | 24. Thermistor                        | 38. Engine control module (ECM)       |

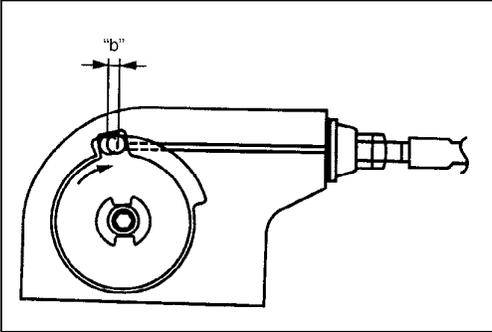
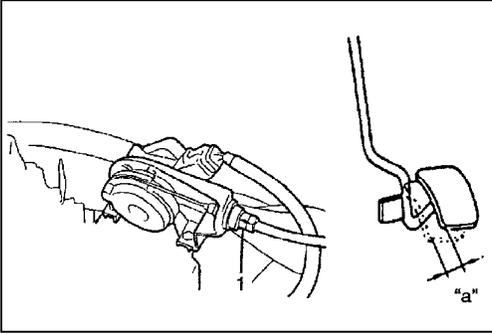
TERMINAL	CIRCUIT	TERMINAL	CIRCUIT	TERMINAL	CIRCUIT	TERMINAL	CIRCUIT
CH-A1	-	CME-A1	Camshaft position sensor ground	CMI-A1	-	CMI-J1	-
CH-A2	A/C pressure switch	CME-A2	-	CMI-A2	-	CMI-J2	-
CH-A3	-	CME-A3	Power source mass air flow sensor (Pwr. srce. after ig. on)	CMI-A3	-	CMI-J3	-
CH-A4	-	CME-A4	-	CMI-A4	-	CMI-J4	Crankshaft position (Engine speed)sensor (+)
CH-B1	-	CME-B1	Vehicle speed signal	CMI-B1	-	CMI-K1	-
CH-B2	Radiator fan relay (low)	CME-B2	-	CMI-B2	-	CMI-K2	Ground
CH-B3	Immobilizer control module signal	CME-B3	Mass air flow sensor	CMI-B3	-	CMI-K3	Malfunction indicator lamp
CH-B4	Data link connector (K-line)	CME-B4	Glow indicator lamp	CMI-B4	-	CMI-K4	Crankshaft position (Engine speed)sensor (-)
CH-C1	-	CME-C1	Pre heating diagnostic	CMI-C1	-	CMI-L1	Fuel injector No.2 (+)
CH-C2	Throttle position sensor (Accelerator stroke sensor)	CME-C2	-	CMI-C2	-	CMI-L2	Fuel injector No.3 (-)
CH-C3	Clutch regulator switch	CME-C3	-	CMI-C3	Camshaft position sensor (+)	CMI-L3	Fuel injector No.1 (-)
CH-C4	Radiator fan state	CME-C4	-	CMI-C4	-	CMI-L4	Fuel injector No.2 (-)
CH-D1	Immobilizer control module wake-up signal	CME-D1	Camshaft position sensor signal	CMI-D1	Fuel (rail) pressure sensor (+)	CMI-M1	Fuel injector No.4 (+)
CH-D2	-	CME-D2	-	CMI-D2	-	CMI-M2	Fuel injector No.1 (+)
CH-D3	-	CME-D3	Fuel (rail) pressure sensor (-)	CMI-D3	-	CMI-M3	Fuel injector No.3 (+)
CH-D4	Radiator fan relay (high)	CME-D4	Engine speed signal	CMI-D4	-	CMI-M4	Fuel injector No.4 (-)
CH-E1	-	CME-E1	-	CMI-E1	Engine coolant temperature sensor		
CH-E2	-	CME-E2	-	CMI-E2	Pre post heating relay		
CH-E3	Clutch regulator switch	CME-E3	Double relay (ECM supply)	CMI-E3	Intake air temperature		
CH-E4	-	CME-E4	A/C cut signal	CMI-E4	Engine coolant temperature sensor		
CH-F1	-	CME-F1	-	CMI-F1	Double relay (Main relay)		
CH-F2	-	CME-F2	Double relay (ECM supply)	CMI-F2	Fuel (rail) pressure sensor signal		
CH-F3	-	CME-F3	Double relay (ECM supply)	CMI-F3	Fuel temperature sensor (+)		
CH-F4	-	CME-F4	-	CMI-F4	Stop lamp switch		
CH-G1	-	CME-G1	EGR solenoid valve	CMI-G1	-		
CH-G2	Throttle position sensor (Accelerator stroke sensor)	CME-G2	-	CMI-G2	Mass air flow sensor (-)		
CH-G3	Throttle position sensor (Accelerator stroke sensor)	CME-G3	Injection pump solenoid valve (3rd piston deactivator)	CMI-G3	A/C control		
CH-G4	Ground	CME-G4	-	CMI-G4	Power supply		
CH-H1	-	CME-H1	Fuel pressure regulator	CMI-H1	Double relay		
CH-H2	-	CME-H2	Ground	CMI-H2	-		
CH-H3	Throttle position sensor (Accelerator stroke sensor)	CME-H3	EGR throttle solenoid valve	CMI-H3	-		
CH-H4	Ground	CME-H4	Engine coolant temp. signal	CMI-H4	Fuel temperature sensor (-)		

## TYPE 2 (OBD) CONNECTOR (TERMINAL ARRANGEMENT VIEWED FROM HARNESS SIDE)



- |   |                                       |                                       |
|---|---------------------------------------|---------------------------------------|
| 1. Pre Post heating Relay (Control Unit)                                | 10. Fuel Injector No.1                | 23. Thermistor                        |
| 2. Mass Air Flow Sensor<br>(Built-in Intake Air Temp. Sensor)           | 11. Fuel Injector No.2                | 24. A/C Switch                        |
| 3. Injector Pump Solenoid Valve<br>(3 <sup>rd</sup> Piston Deactivator) | 12. Fuel Injector No.3                | 25. A/C Relay                         |
| 4. EGR Solenoid Valve   | 13. Fuel Injector No. 4               | 26. A/C Compressor Relay              |
| 5. Fuel Pressure Regulator  | 14. Heater Fan Motor                  | 27. A/C Pressure Switch               |
| 6. Throttle Position Sensor<br>(Accelerator Stroke Sensor)              | 15. Heater Switch                     | 28. A/C Compressor                    |
| 7. Crankshaft position Sensor<br>(Engine Speed Sensor)                  | 16. Heater Regulator Resistance       | 29. Combination Meter                 |
| 8. Double Relay   | 17. Radiator Fan Motor 1 (Left Side)  | 30. Brake Lamp                        |
| 9. Clutch Switch Regulator  | 18. Radiator Fan Relay 1 (Low)        | 31. Brake Lamp Switch                 |
|   | 19. Radiator Fan Motor 2 (Right Side) | 32. Fuel Temperature Sensor           |
|   | 20. Radiator Fan Relay 2 (High)       | 33. Engine Coolant Temperature Sensor |
|   | 21. Immobilizer Control Module        | 34. Camshaft Position Sensor          |
|   | 22. Data Link Connector               | 35. Fuel (Rail) Pressure Sensor       |
|   |                                       | 36. Glow Plugs                        |

TERMINAL	CIRCUIT	TERMINAL	CIRCUIT	TERMINAL	CIRCUIT	TERMINAL	CIRCUIT
CH-A1	-	CME-A1	Camshaft Position Sensor	CMI-A1	-	CMI-J1	-
CH-A2	A/C Pressure Switch	CME-A2	-	CMI-A2	-	CMI-J2	-
CH-A3	-	CME-A3	Power Source Mass Air Flow Sensor (Pwr. Ssce. After Ig. On)	CMI-A3	-	CMI-J3	-
CH-A4	-	CME-A4	-	CMI-A4	-	CMI-J4	Crankshaft Position (Engine Speed) Sensor (+)
CH-B1	-	CME-B1	Vehicle Speed Signal	CMI-B1	-	CMI-K1	-
CH-B2	Radiator Fan Relay (Low)	CME-B2	-	CMI-B2	-	CMI-K2	Ground
CH-B3	Immobilizer Control Module Signal	CME-B3	Mass Air Flow Sensor	CMI-B3	-	CMI-K3	Malfunction Indicator Lamp
CH-B4	Data Link Connector (K-line)	CME-B4	Glow Indicator Lamp	CMI-B4	-	CMI-K4	Crankshaft Position (Engine Speed) Sensor (-)
CH-C1	-	CME-C1	Pre Heating Diagnostic	CMI-C1	-	CMI-L1	Fuel Injector No. 2(+)
CH-C2	Throttle Position Sensor (Accelerator Stroke Sensor)	CME-C2	-	CMI-C2	-	CMI-L2	Fuel Injector No. 3(-)
CH-C3	Clutch Regulator Switch	CME-C3	-	CMI-C3	Camshaft Position Sensor (+)	CMI-L3	Fuel Injector No. 1 (-)
CH-C4	Radiator Fan State	CME-C4	-	CMI-C4	-	CMI-L4	Fuel Injector No. 2(-)
CH-D1	Immobilizer Control Module Wake-up Signal	CME-D1	Camshaft Position Sensor Signal	CMI-D1	Fuel (Rail) Pressure Sensor (+)	CMI-M1	Fuel Injector No. 4 (+)
CH-D2	-	CME-D2	-	CMI-D2	-	CMI-M2	Fuel Injector No. 1 (+)
CH-D3	-	CME-D3	Fuel (Rail) Pressure Sensor(-)	CMI-D3	-	CMI-M3	Fuel Injector No. 3(+)
CH-D4	Radiator Fan Relay (High)	CME-D4	Engine Speed Signal	CMI-D4	-	CMI-M4	Fuel Injector No. 4(-)
CH-E1	-	CME-E1	-	CMI-E1	Engine Coolant Temperature Sensor		
CH-E2	-	CME-E2	-	CMI-E2	Pre Post Heating Relay		
CH-E3	Clutch Regulator Switch	CME-E3	Double Relay (ECM supply)	CMI-E3	Intake Air Temperature		
CH-E4	-	CME-E4	A/C Cut Signal	CMI-E4	Engine Coolant Temperature Sensor		
CH-F1	-	CME-F1	-	CMI-F1	Double Relay		
CH-F2	-	CME-F2	Double Relay (ECM Supply)	CMI-F2	Fuel (Rail) Pressure Sensor Signal		
CH-F3	-	CME-F3	Double Relay (ECM Supply)	CMI-F3	Fuel Temperature Sensor (+)		
CH-F4	-	CME-F4	-	CMI-F4	Stop Lamp Switch		
CH-G1	-	CME-G1	EGR Solenoid Valve	CMI-G1	-		
CH-G2	Throttle Position Sensor(Accelerator Stroke Sensor)	CME-G2	-	CMI-G2	Mass Air Flow Sensor (-)		
CH-G3	Throttle Position Sensor (Accelerator Stroke Sensor)	CME-G3	Injection Pump Solenoid Valve (3 <sup>rd</sup> Piston Deactivator)	CMI-G3	A/C Control		
CH-G4	Ground	CME-G4	-	CMI-G4	Power Supply		
CH-H1	-	CME-H1	Fuel Pressure Regulator	CMI-H1	Double Relay		
CH-H2	-	CME-H2	Ground	CMI-H2	-		
CH-H3	Throttle Position Sensor (Accelerator Stroke Sensor)	CME-H3	-	CMI-H3	-		
CH-H4	Ground	CME-H4	Engine Coolant Temp. Signal	CMI-H4	Fuel Temperature Sensor (-)		



## ON-VEHICLE SERVICE ACCELERATOR CABLE ADJUSTMENT

- 1) Check accelerator pedal play which should be within following specification.  
If measured value is out of specification, adjust it to specification with cable adjusting nut (1).

**Pedal play "a": 2 – 7 mm (0.08 – 0.27 in.)**

- 2) With accelerator pedal depressed fully, check clearance between throttle lever and lever stopper (throttle body) which should be within following specification.

**Clearance "b": 0.5 – 2.0 mm (0.02 – 0.07 in.)  
(With pedal depressed fully)**

If measured value is out of specification, adjust it to specification by changing height of pedal stopper bolt.

## IDLE SPEED INSPECTION

- 1) Shift transmission into Neutral.
- 2) Start engine and warm it up to normal operating temperature.
- 3) Turn all electrical loads off.
- 4) Using tachometer, verify that idle speed is within specification.

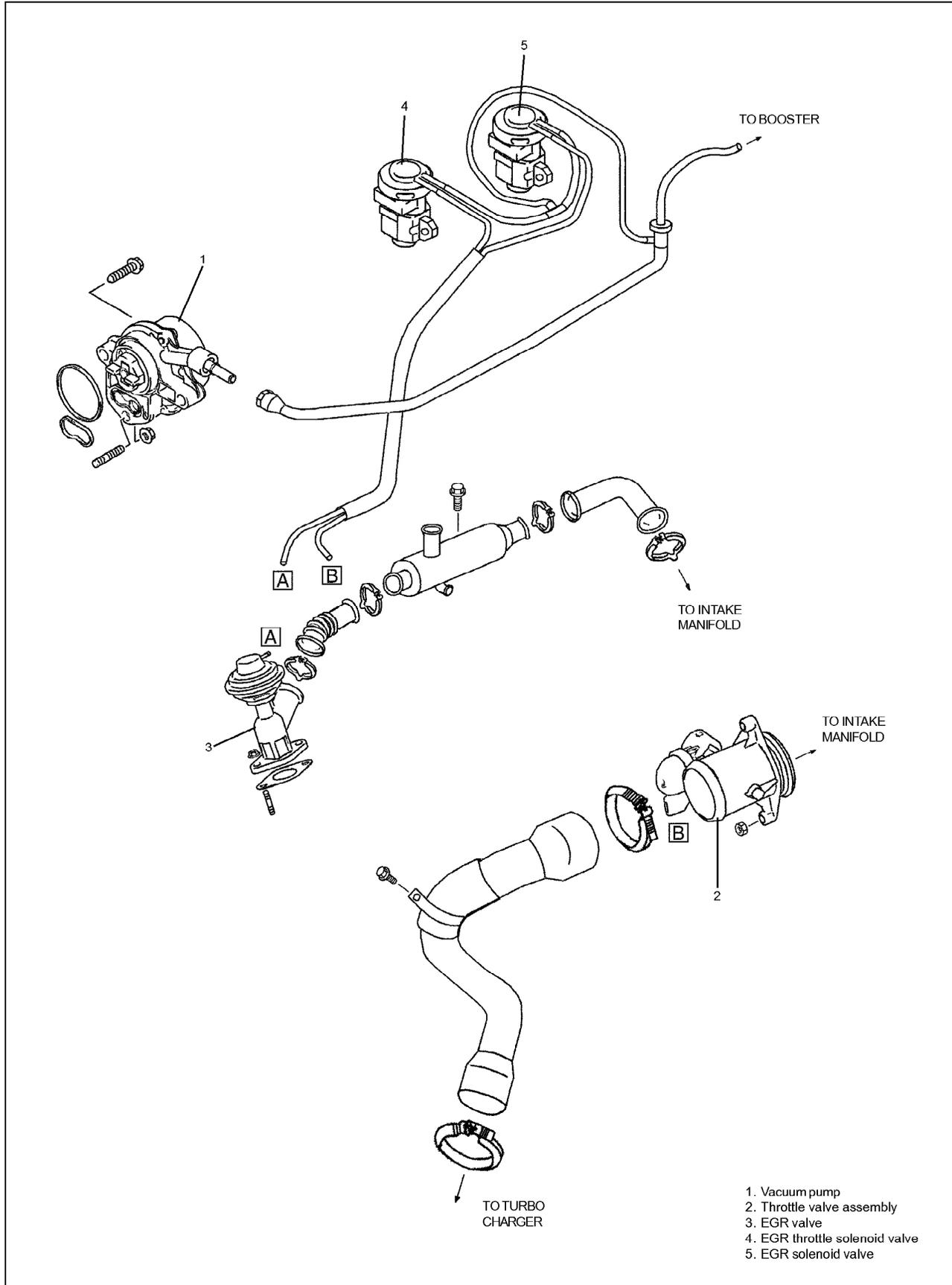
**Engine speed: 825 – 875 rpm**

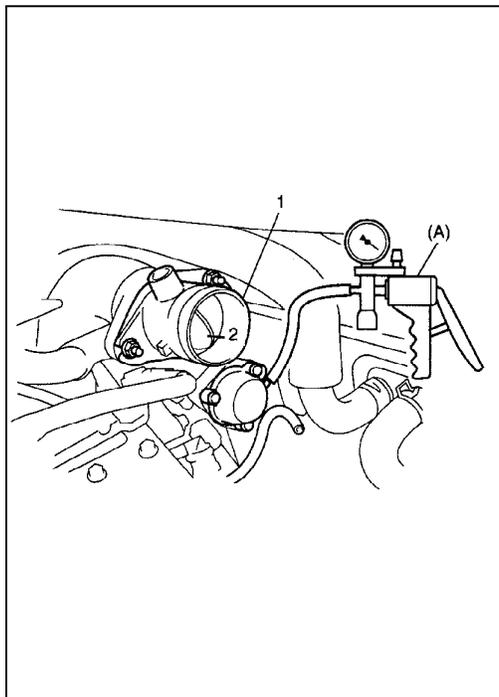
- 5) Operate A/C and verify that engine speed is within specification.

**Engine speed: 825 – 875 rpm**

- 6) If not, refer to troubleshooting "Improper engine idle" under "Engine Diagnosis Table" in Section 6.

# AIR INTAKE SYSTEM VACUUM HOSE ROUTING DIAGRAM





## THROTTLE VALVE ASSEMBLY

### INSPECTION

- 1) Remove outlet hose.
- 2) Connect a vacuum pump gauge (Special Tool) to throttle valve assembly (1).

#### Special Tool

(A): 09917-47910

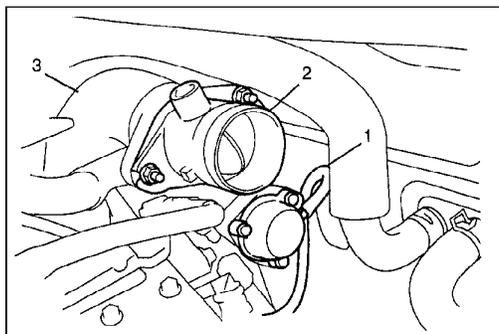
- 3) Gradually increase vacuum and check for throttle valve (2) operation.  
If not as specified, replace throttle valve assembly (1).

#### Valve operation starting vacuum:

0 – About 10.7 kPa (80 mmHg)

#### Valve operation completion vacuum:

About 50.6 kPa (380 mmHg)

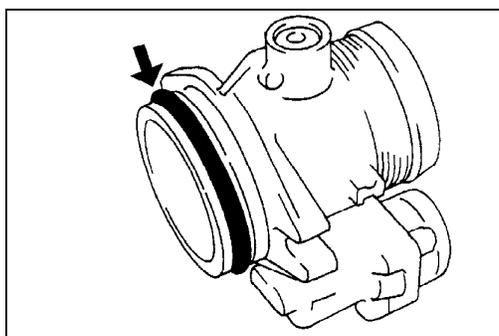


### REMOVAL

- 1) Remove outlet hose.
- 2) Disconnect vacuum hose (1) from throttle valve assembly (2).
- 3) Remove throttle valve assembly from elbow air divider (3).

#### CAUTION:

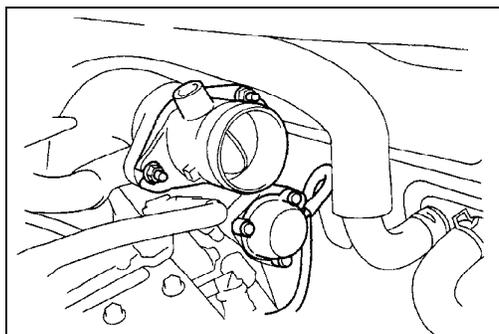
Don't disassemble throttle valve assembly.



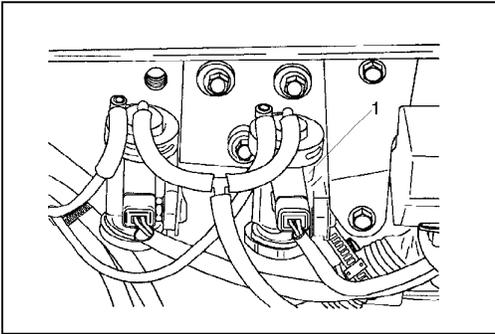
### INSTALLATION

Reverse removal procedure for installation noting the following.

- ˆ Clean mating surfaces of throttle valve assembly and elbow air divider.
- ˆ Check O-ring for damage and replace throttle valve assembly if necessary.



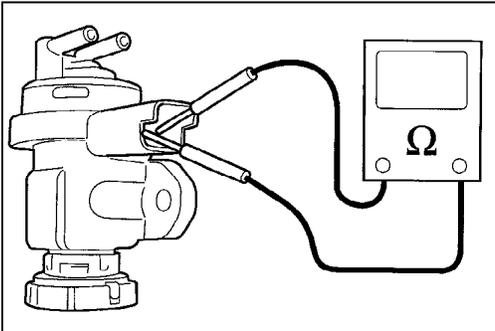
- ˆ Connect vacuum hose securely.



## EGR THROTTLE SOLENOID VALVE

### REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Disconnect connector from throttle solenoid valve (1).
- 3) Disconnect vacuum hoses from throttle solenoid valve.
- 4) Remove throttle solenoid valve from bracket.



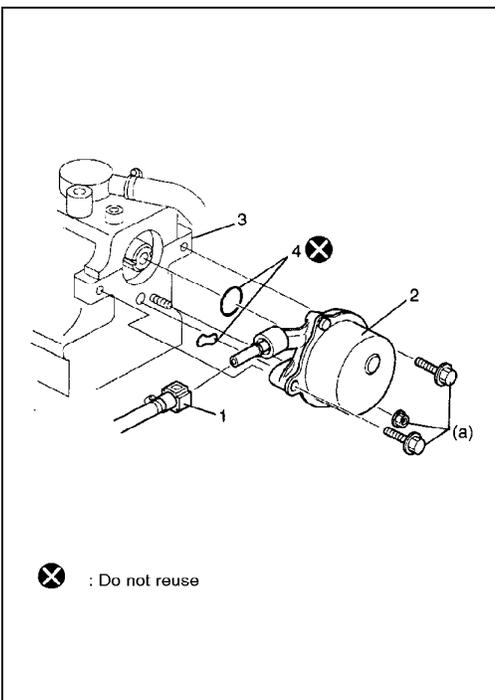
### INSPECTION

Measure resistance between each two terminals.  
If resistance is out of specification, replace throttle solenoid valve.

**Throttle solenoid valve resistance: 15 – 20 Ω.**

### INSTALLATION

For installation, reverse removal procedure.



## VACUUM PUMP

### REMOVAL

- 1) Remove throttle valve assembly referring to “THROTTLE VALVE ASSEMBLY” in this section.
- 2) Remove elbow air divider.
- 3) Disconnect hose (1) from vacuum pump (2).
- 4) Remove vacuum pump from cylinder head (3).

### INSTALLATION

For installation, reverse removal procedure noting the following.  
Fit the dogs of vacuum pump coupling into the slot of camshaft.

#### NOTE:

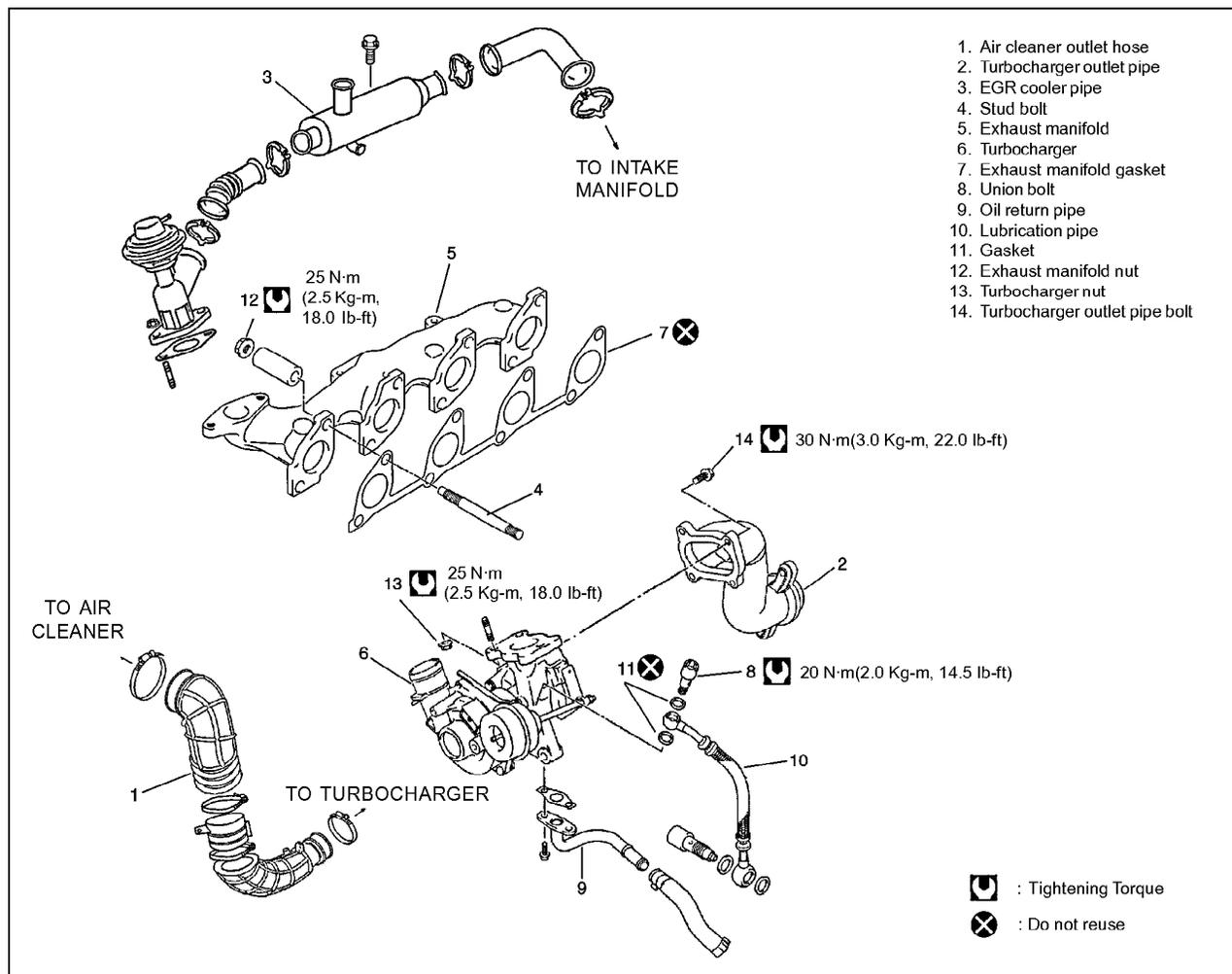
**Use new O-rings (4).**

Install vacuum pump and tighten bolts and nut to specified torque.

#### Tightening torque

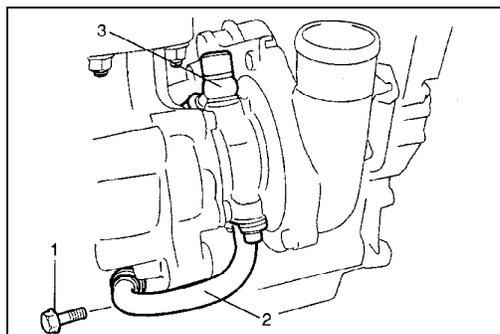
**Vacuum pump bolt and nut (a): 20 N·m (2.0 kg·m, 14.5 lb·ft)**

## TURBOCHARGER

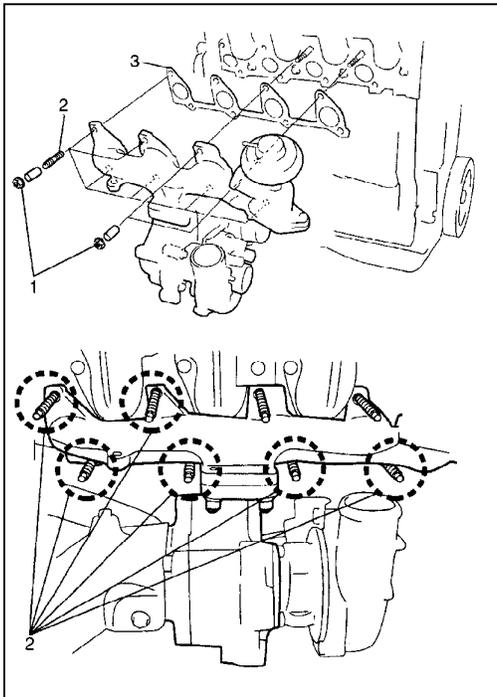


### REMOVAL

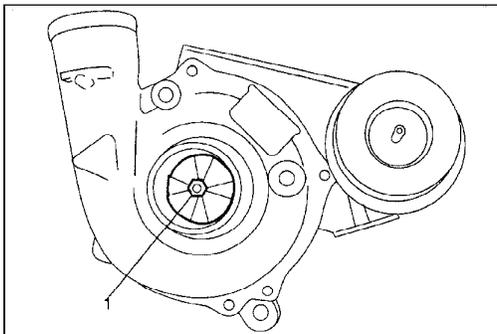
- 1) Disconnect negative cable at battery and remove engine cover.
- 2) Remove air cleaner outlet hose, MAF sensor and air cleaner case.
- 3) Disconnect vacuum hoses from waste gate actuator, EGR valve, EGR cooler pipe and water inlet and outlet hoses.



- 4) Remove turbocharger outlet pipe bolts and nuts.
- 5) Remove turbocharger bracket bolt (1).
- 6) Disconnect oil return pipe (2) and lubrication pipe (3) from turbocharger.
- 7) Remove EGR cooler pipe referring to "EGR VALVE" in this section.



- 8) Remove exhaust manifold nuts (1).
- 9) Remove 6 stud bolts (2) using stud bolt remover.
- 10) Remove turbocharger with exhaust manifold and manifold gasket (3).
- 11) Remove turbocharger from exhaust manifold.



#### INSPECTION

Rotate turbine shaft (1) by hand and verify that it turns smoothly without any abnormal noise and excessive runout. If not as specified, replace the turbocharger.

#### INSTALLATION

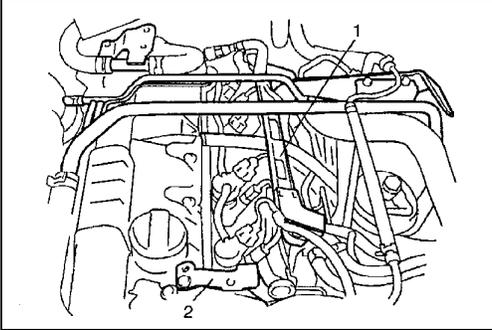
For installation, reverse removal procedure noting the following.

- ˆ Clean mating surfaces of turbocharger, turbocharger outlet pipe, exhaust manifold and cylinder head.
- ˆ Use new gaskets.
- ˆ Tighten each nuts and bolts to specified torque referring to "TURBOCHARGER" in this section.

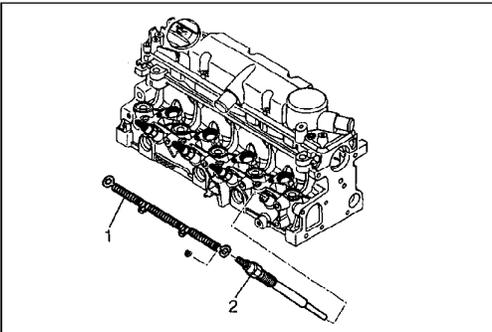
## GLOW PLUG REMOVAL

### CAUTION:

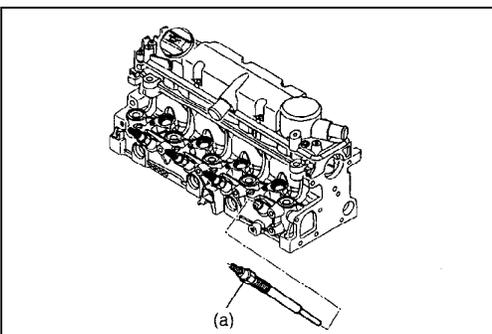
- ✓ Do not damage heating section of the glow plug.
- ✓ Do not use glow plug that has been dropped from height of over 10 cm (4 in.).
- ✓ When removing glow plug, first loosen it by using a tool so that one or more screw threads remain engaged, then loosen and remove by hand.



- 1) Disconnect negative cable at battery and remove engine cover.
- 2) Disconnect each coupler and install wire harness protector (1).
- 3) Remove bracket (2) with fuel heater.



- 4) Disconnect glow plug cable (1) from glow plug (2).
- 5) Remove glow plug from cylinder head.



## INSTALLATION

For installation, reverse removal procedure noting the following.

- ✓ Tighten glow plug to specified torque.

### Tightening Torque

Glow plug (a): 10 N·m (1.0 kg·m, 7.5 lb-ft)

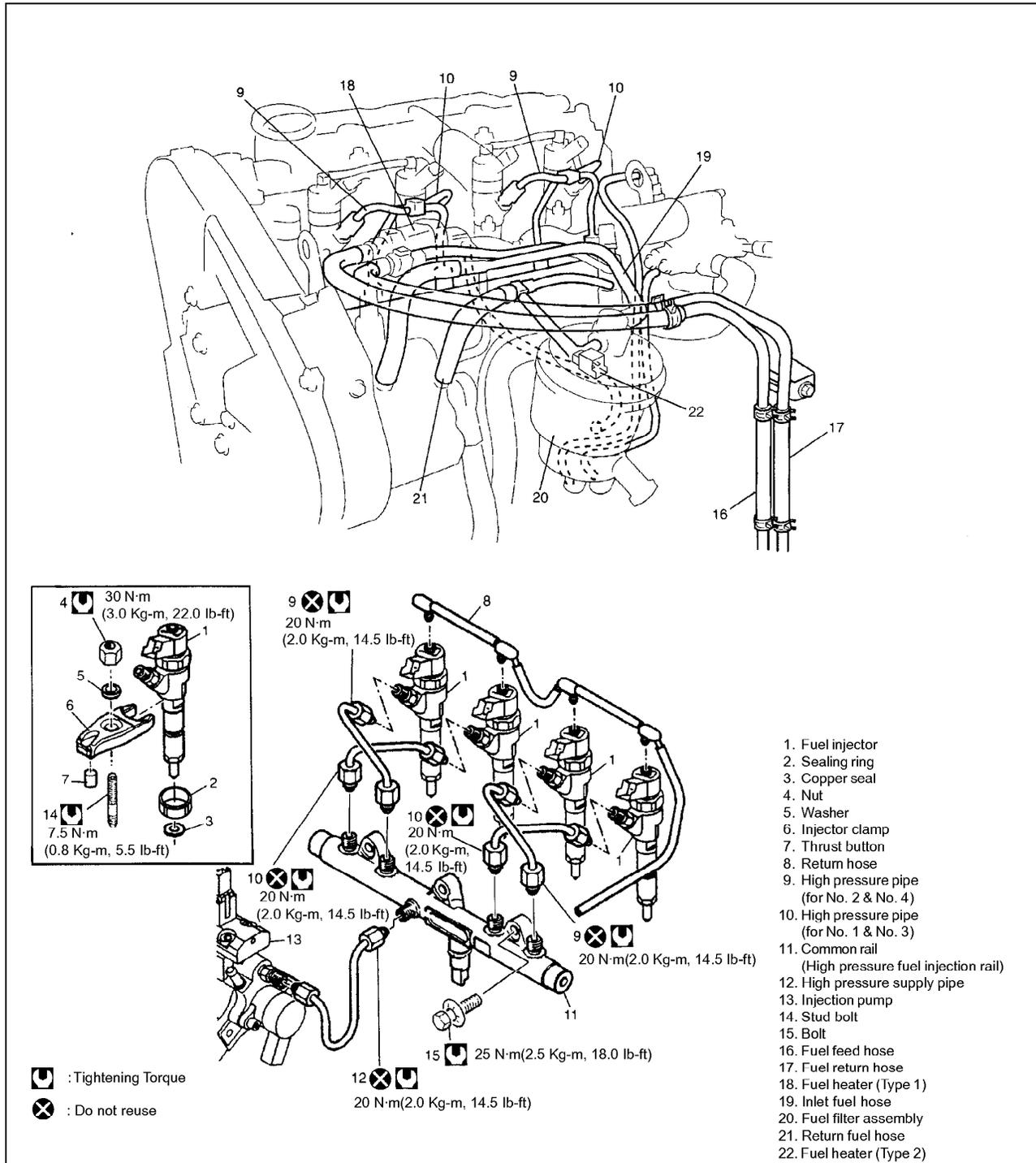
## FUEL DELIVERY SYSTEM

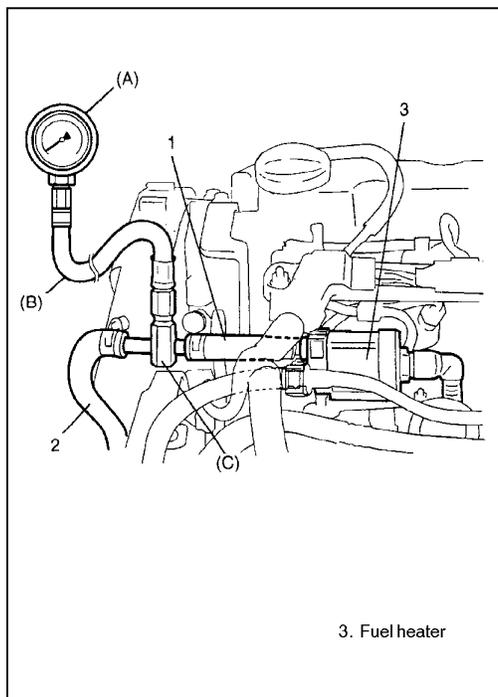
### WARNING

- Fuel vapor is hazardous. It can very easily ignite, causing serious injury and damage. Always keep sparks and flames away from fuel. Fuel line spills and leaks are dangerous. Fuel can ignite and cause serious injuries or death and damage.
- Fuel can also irritate skin and eyes. To prevent this, always complete following "Precautions".

### PRECAUTIONS

- When disconnecting a fuel hose or pipe, wrap rag around it to protect against fuel leakage. Plug disconnected hose.
- Before disconnecting a fuel hose or pipe, wait 30 seconds to release pressure in fuel system.





## LOW PRESSURE FUEL SUPPLY SYSTEM INSPECTION

- 1) Disconnect fuel feed hose (1) from fuel feed pipe.

### CAUTION:

A small amount of fuel may be released when fuel feed hose is removed. Place container under the fuel feed hose or fuel feed pipe with a shop cloth so that released fuel is caught in container or absorbed in cloth. Place that cloth in an approved container.

- 2) Connect special tools and hose (2) between fuel feed hose and fuel feed pipe as shown in figure, and clamp hose securely to ensure no leaks occurs during checking.

### Special Tool

(A): 09912-58441

(B): 09912-58431

(C): 09912-58490

- 3) Check that battery voltage is above 11 V.

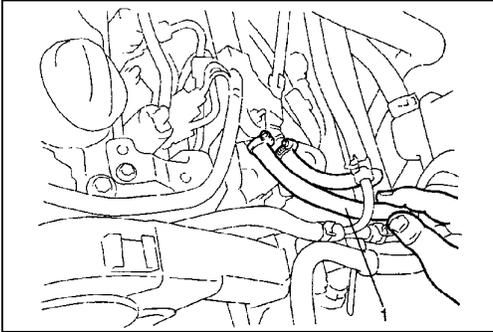
CONDITION	FUEL PRESSURE
With fuel pump operating and engine stopped (Within about 5 seconds after ignition switch ON)	about 220 kPa 2.2 kg/ cm <sup>2</sup> 31.3 psi
At specified idle speed	about 280 kPa 2.8 kg/ cm <sup>2</sup> 39.8 psi
With fuel pump stopped	0 kPa 0 kg/ cm <sup>2</sup> 0 psi

- 4) Turn ignition switch ON to operate fuel pump and after 5 seconds turn it OFF. Repeat this 6 times and then check fuel pressure.
- 5) Start engine.
- 6) Measure fuel pressure at idling.  
If measure pressure doesn't satisfy specification, refer to "Diagnostic Flow Table B-2" in Section 6 and check each possibly defective part. Replace if found defective.
- 7) After checking fuel pressure, remove special tools and hose from fuel feed pipe.
- 8) Connect fuel feed hose and clamp it securely.
- 9) With engine "OFF" and ignition switch "ON", check for fuel leaks.

## FUEL PUMP (TYPE 1)

### ON-VEHICLE INSPECTION

- 1) Check that fuel pump operating sound is heard from fuel pump for 5 seconds and then stop when turning on ignition switch. If above check result is not satisfactory, advance to "Diagnostic Flow Table B-1" in Section 6.



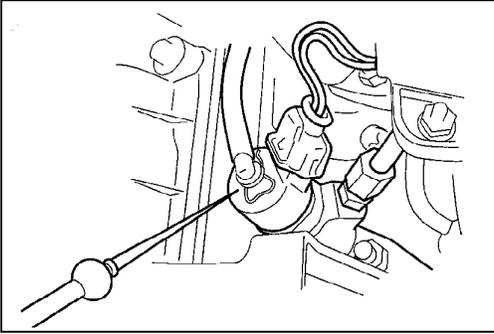
- 2) Check that fuel pressure is felt at fuel feed hose (1) for about 5 seconds after ignition switch ON. If fuel pressure is not felt, advance to "Diagnostic Flow Table B-2" in Section 6.

### REMOVAL/ INSPECTION/ INSTALLATION

Refer to "FUEL PUMP" in Section 6C.

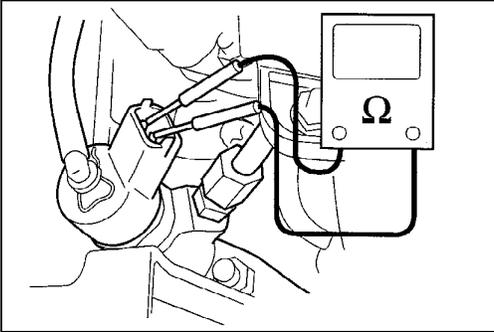
### FUEL HEATER

Refer to "FUEL HEATER" in Section 6C.



**FUEL INJECTOR**  
**ON-VEHICLE INSPECTION**

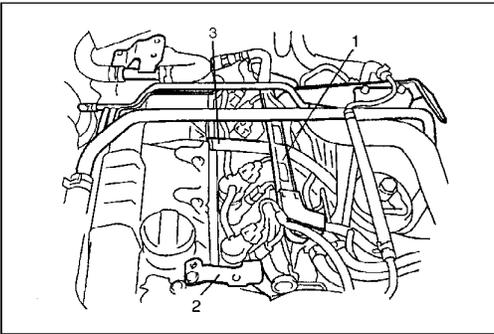
- 1) Using sound scope or such, check operating sound of injector when engine is running or cranking.  
Cycle of operating sound should vary according to engine speed.  
If no sound or an unusual sound is heard, check injector circuit (wire or coupler) or injector.



- 2) Disconnect coupler from injector, connect ohmmeter between terminals of injector and check resistance.  
If resistance is out of specification, replace.

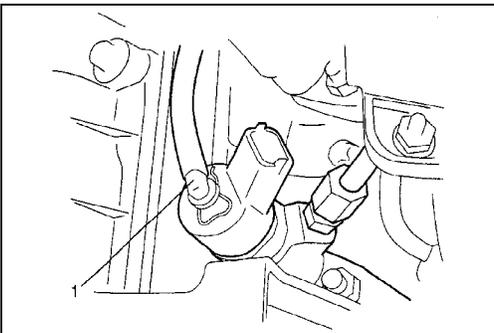
**Resistance of injector: 0.56  $\Omega$  (MAX.) (at 20 °C, 68 °F)**

- 3) Connect coupler to injector securely.

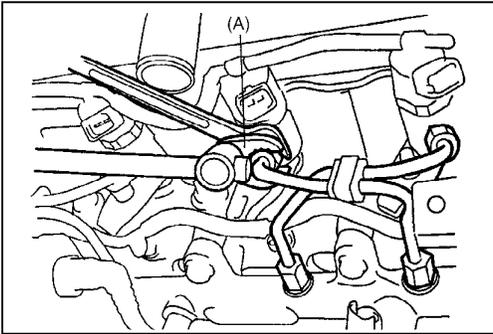


**REMOVAL**

- 1) Disconnect negative cable at battery and engine cover.
- 2) Disconnect fuel temperature sensor connector, injector connectors, CMP sensor connector and high pressure fuel pump solenoid valve connector. Then detach wire harness protector (1) and PCV hose (3).
- 3) Remove bracket (2) with fuel heater (Type 1 vehicle).



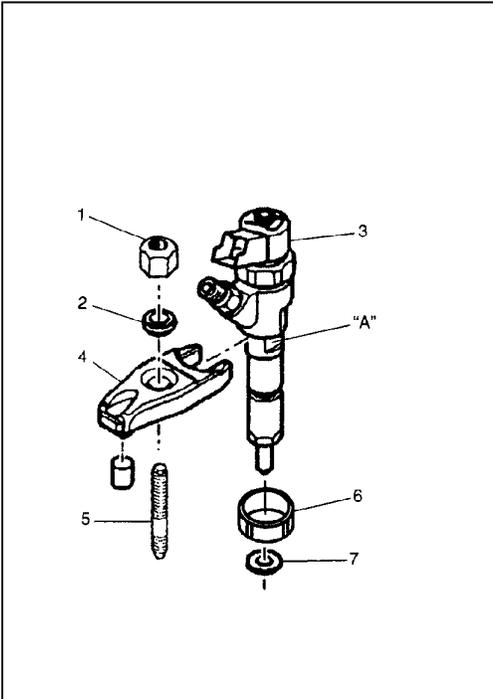
- 4) Disconnect return hose (1) from injector.



- 5) Remove high pressure pipe.  
When loosening union nut of high pressure pipe, hold union nut of injector with wrench as shown.

**Special Tool**

(A): 09950-76510/ OUT0000148

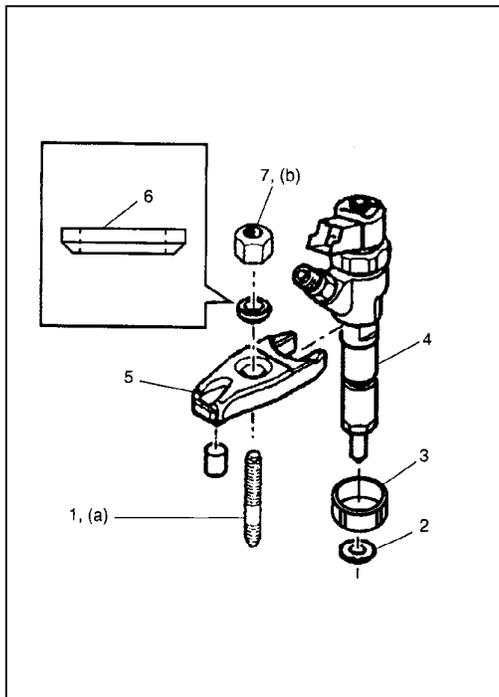


- 6) Remove nut (1) and washer (2), then remove injector (3) with its clamp (4).

**NOTE:**

If the injector cannot be removed, remove the stud bolt (5) by using stud bolt remover; then, using an opened spanner, turn the injector at "A".

- 7) Remove sealing ring (6) and copper seal (7).



**INSTALLATION**

- 1) Install stud bolt (1) to cylinder head, if removed.

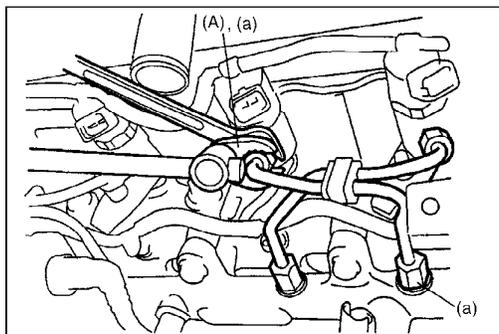
**Tightening Torque**

**Fuel injector stud bolt (a): 7.5 N·m (0.8 kg·m, 5.5 lb-ft)**

- 2) Install new copper seal (2) and new sealing ring (3).
- 3) Install injector (4) with its clamp (5) to cylinder head.
- 4) Install washer (6) in proper direction as shown in figure and then tighten nut (7) to specified torque.

**Tightening Torque**

**Fuel injector nut (b): 30 N·m (3.0 kg·m, 22.0 lb-ft)**



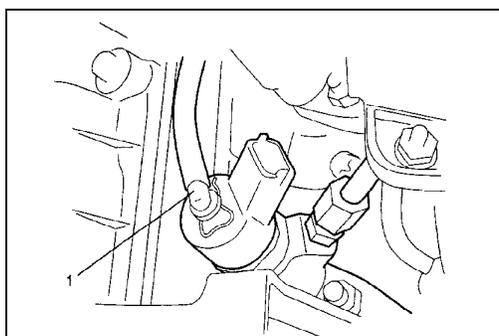
- 5) Install new high pressure pipe.  
When tightening union nuts of high pressure pipe, hold union nut of injector with wrench as shown.

**Special Tool**

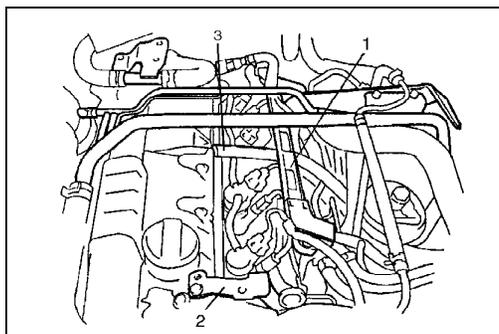
**(A): 09950-76510/OUT0000148**

**Tightening Torque**

**High pressure pipe union nut (a):  
20 N·m (2.0 kg·m, 14.5 lb-ft)**



- 6) Connect return hose (1) to injector.
- 7) Connect coupler to injector.



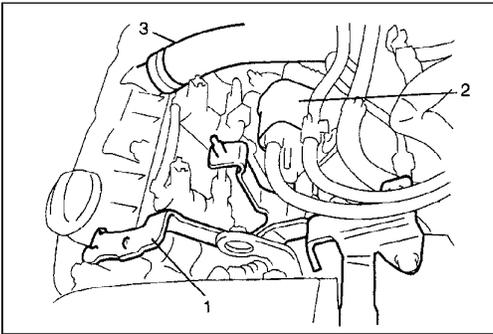
- 8) Install PCV hose (3) and wire harness protector (1), then connect each connector securely.
- 9) Install bracket (2) with fuel heater (Type 1 vehicles).

- 10) Connect negative cable at battery and install engine cover.
- 11) Check that fuel is not leaking by performing the procedure below.
  - (1) Start engine and warm up to normal operating temperature.
  - (2) Check fuel leakage after turning off ignition switch.
  - (3) Again, start engine and accelerate the vehicle up to 3,500 rpm with 1st gear. Then stop vehicle.
  - (4) Check fuel leakage after turning off ignition switch.

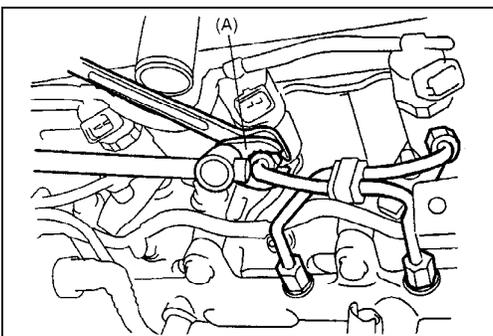
## COMMON RAIL (HIGH PRESSURE FUEL INJECTION RAIL)

### REMOVAL

- 1) Disconnect negative cable at battery and remove engine cover.
- 2) Remove fuel temperature sensor referring to "FUEL TEMPERATURE SENSOR" in this section.



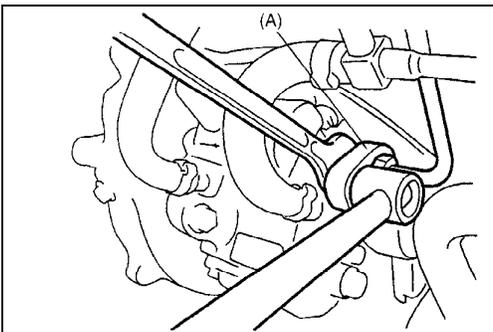
- 3) Remove bracket (1) with fuel heater (2) - only Type 1 vehicles- and detach PCV hose (3).



- 4) Remove high pressure pipes from injectors and common rail. When loosening union nut of high pressure pipe, hold union nut of injector with wrench as shown in figure.

#### Special Tool

(A): 09950-76510/OUT0000148

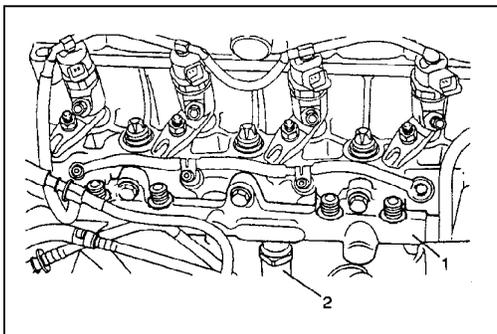


- 5) Remove high pressure supply pipe from injection pump and common rail. When loosening union nut of high pressure supply pipe, hold union nut of injection pump with wrench as shown in figure.

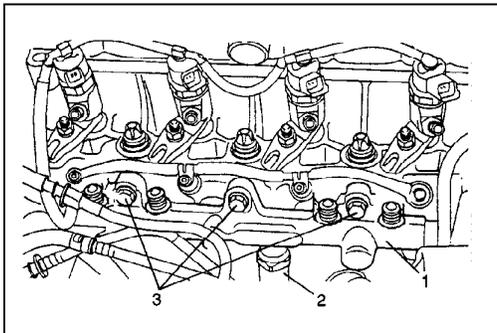
#### Special Tool

(A): 09950-76510/OUT0000148

- 6) Disconnect connector from fuel pressure sensor.

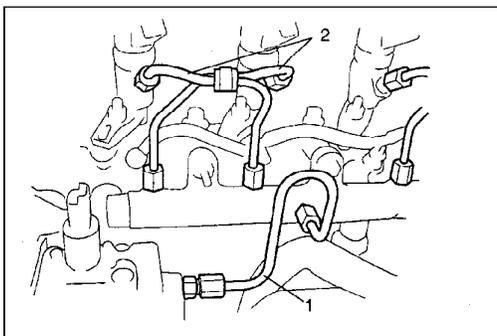


- 7) Remove common rail (1).
- 8) Remove fuel pressure sensor (2) from common rail.

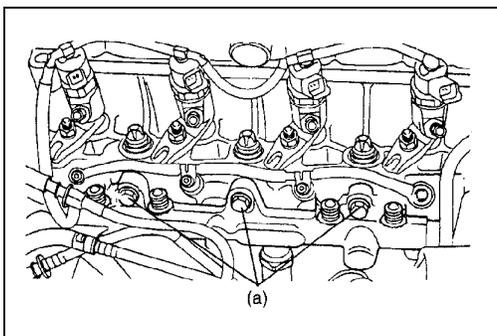


**INSTALLATION**

- 1) Install fuel pressure sensor (2) to common rail (1).  
Tighten fuel pressure sensor to specified torque referring to "FUEL PRESSURE SENSOR" in this section.
- 2) Install common rail (1) and tighten bolts (3) temporarily by hand.
- 3) Connect connector to fuel pressure sensor.



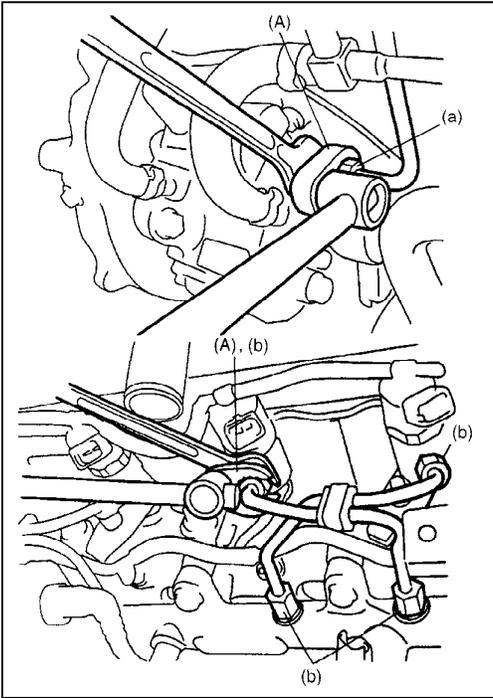
- 4) Install high pressure supply pipe (1) and high pressure pipes (2), tighten each union nuts temporarily by hand.



- 5) Tighten common rail bolts to specified torque.

**Tightening Torque**

**Common rail bolt (a): 25 N·m (2.5 kg-m, 18.0 lb-ft)**



- 6) Tighten union nuts of high pressure supply pipe and high pressure pipes to specified torque.  
When tightening each union nut, hold union nuts of injector and injection pump with wrench as shown.

**Special Tool**

(A): 09950-76510/OUT0000148

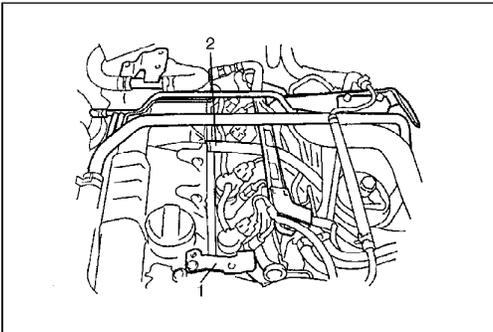
**Tightening Torque**

**High pressure supply pipe union nut**

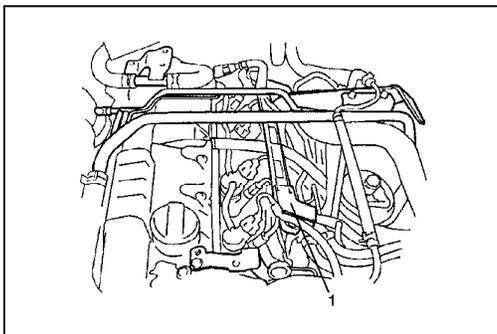
(a): 20 N·m (2.0 kg-m, 14.5 lb-ft)

**High pressure pipe union nut**

(b): 20 N·m (2.0 kg-m, 14.5 lb-ft)



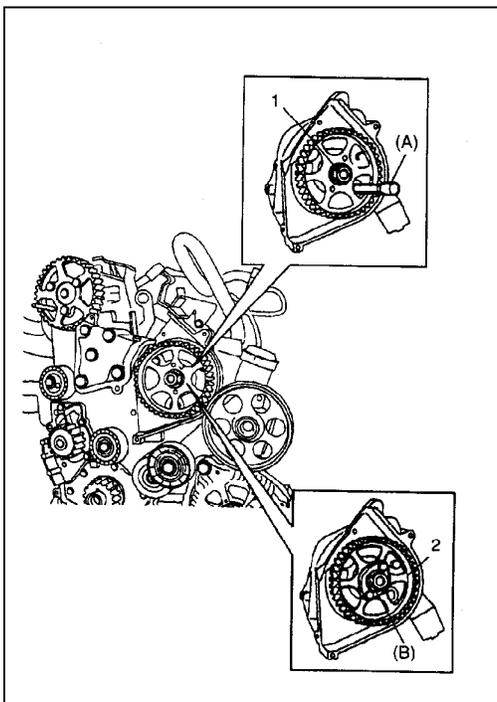
- 7) Install PCV hose (2) and, in Type 1 vehicles, bracket (1).
- 8) Install fuel temperature sensor referring to "FUEL TEMPERATURE SENSOR" in this section.
- 9) Install engine cover and connect negative cable at battery.
- 10) Check fuel leakage by performing step 10) described in "FUEL INJECTOR INSTALLATION" in this section.



## INJECTION PUMP

### REMOVAL

- 1) Disconnect negative cable at battery and remove engine cover.
- 2) Disconnect each connector and detach wire harness protector (1).
- 3) Remove timing belt referring to "TIMING BELT AND BELT TENSIONER" in Section 6A3.



- 4) Loosen injection pump pulley nut (1) with pulley locked by using special tool.

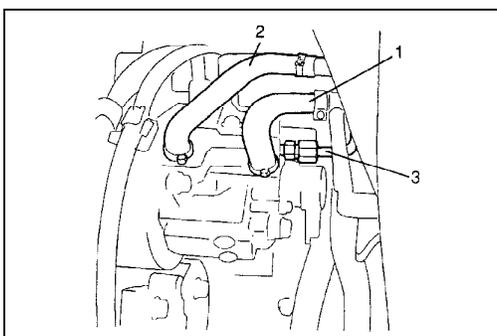
#### Special Tool

(A): 09919-56570/OUT0000157

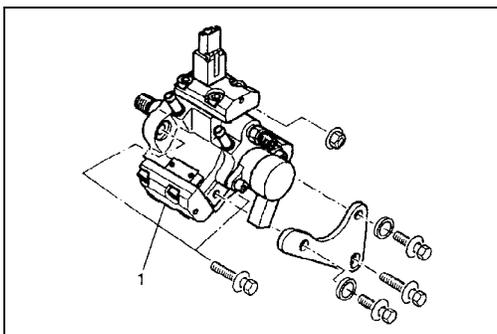
- 5) Remove injection pump pulley (2) by using special tool.

#### Special Tool

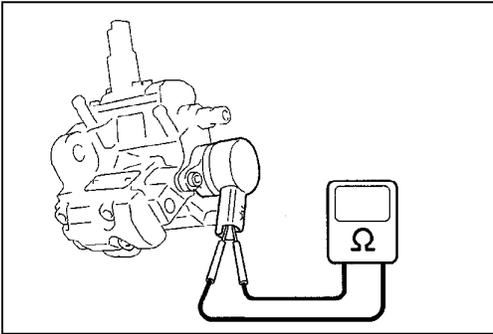
(B): 09919-56580/OUT0000158



- 6) Disconnect inlet fuel hose (2) and return fuel hose (1) from injection pump.
- 7) Remove high pressure supply pipe (3) from injection pump.



- 8) Remove injection pump (1).

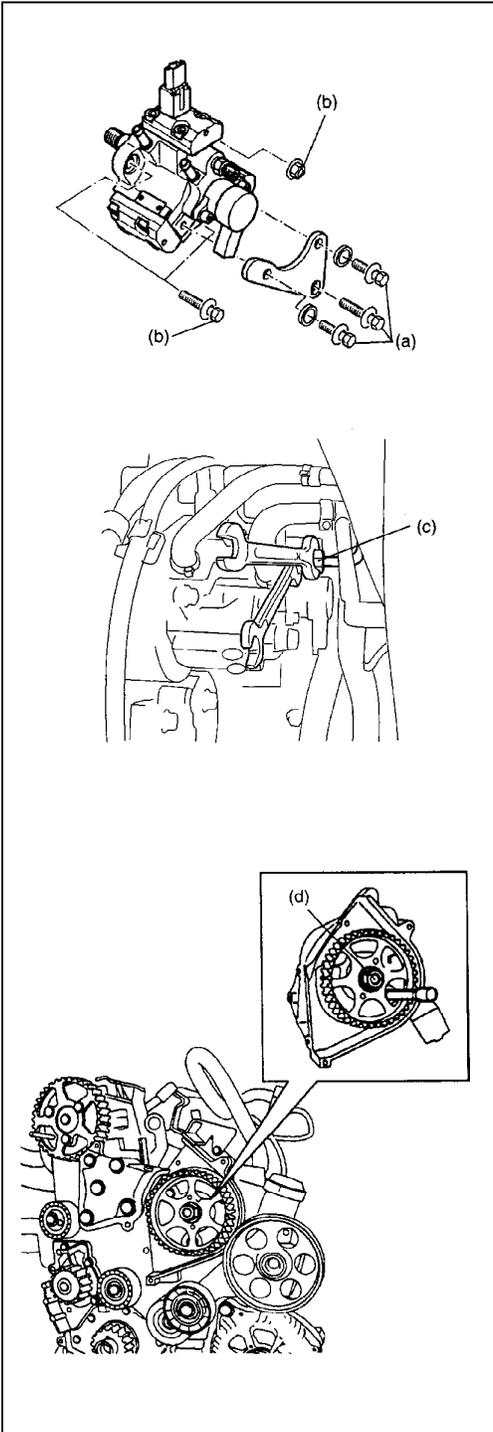


**INSPECTION**

**Fuel Pressure Regulator**

Check resistance between terminals of fuel pressure regulator. If found faulty, replace injection pump.

**Resistance of fuel pressure regulator: 2 – 3 Ω**



**INSTALLATION**

For installation reverse removal procedure noting the following.

- ˆ When tightening union nut of high pressure supply pipe, hold union nut of injection pump with wrench.

**Special Tool**

**(A): 09950-76510/OUT0000148**

- ˆ Tighten each bolt and nut to specified torque.

**Tightening Torque**

**Injection pump bracket bolt**

**(a): 20 N·m (2.0 kg-m, 14.5 lb-ft)**

**Injection pump nut and bolt**

**(b): 22.5 N·m (2.3 kg-m, 16.5 lb-ft)**

**High pressure supply pipe union nut**

**(c): 20 N·m (2.0 kg-m, 14.5 lb-ft)**

**Injection pump pulley nut**

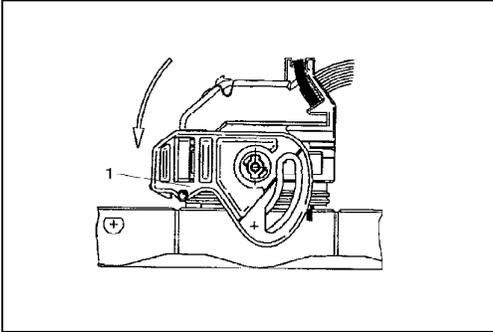
**(d): 50 N·m (5.0 kg-m, 36.5 lb-ft)**

- ˆ Install timing belt referring to “TIMING BELT AND BELT TENSIONER” in Section 6A3.
- ˆ Check fuel leakage by performing step 12) described in “FUEL INJECTION INSTALLATION” in this section.

## ELECTRONIC CONTROL SYSTEM ENGINE CONTROL MODULE (ECM)

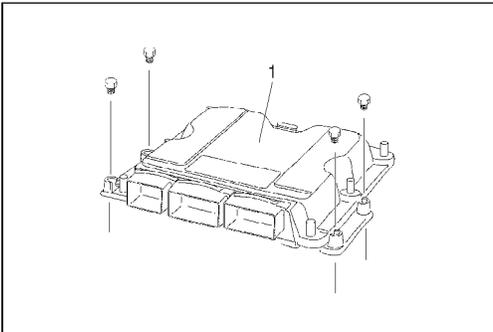
**CAUTION:**

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



### REMOVAL

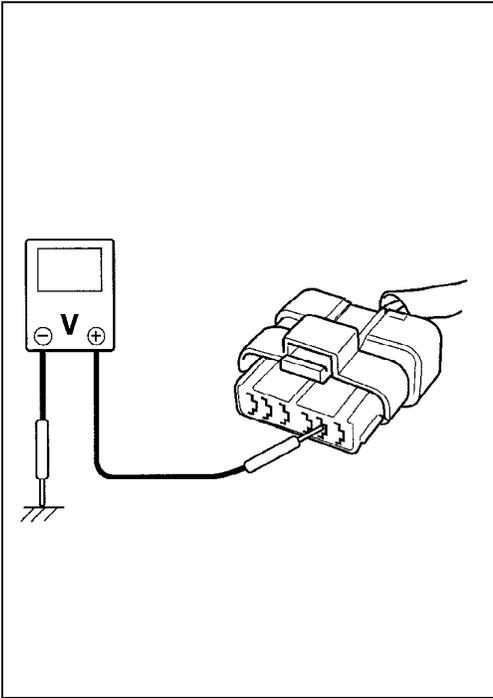
- 1) Disconnect negative cable at battery.
- 2) Disable air bag system (if equipped) referring to “Disabling the Air Bag System” in Air Bag System section.
- 3) Disconnect ECM connectors from ECM by pulling off locks (1).



- 4) Remove ECM (1) from bracket.

### INSTALLATION

- 1) Connect connectors to ECM securely.
- 2) Install ECM to bracket.
- 3) Enable air bag system (if equipped) referring to “Enabling Air Bag System” in Air Bag System section.
- 4) Connect negative cable to battery.



## MASS AIR FLOW SENSOR (MAF SENSOR)

### INSPECTION

#### NOTE:

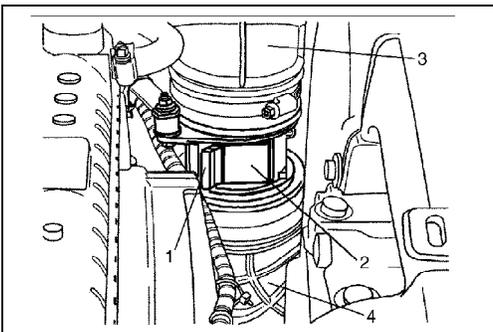
Use voltmeter with high-impedance (10 K $\Omega$ /V minimum) or digital type voltmeter.

- 1) Connect voltmeter to "BW" wire terminal of MAF sensor coupler disconnected and ground.
- 2) Turn ignition switch ON and check that voltage is battery voltage.  
If not, check if wire harness is open or connection is poor.

- 3) Connect MAF sensor coupler to MAF sensor.
- 4) Check voltage at MAF sensor output terminal "CMI-H3" referring to "VOLTAGE CHECK" in Section 6.

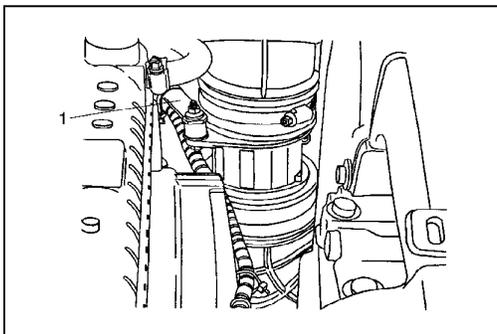
**Voltage: About 0.6 V**

- 5) Start engine and check that voltage is lower than 5 V and it rises as engine speed increases.  
(Reference data: about 2.6 V at specified idle speed)  
If check result is not as specified above, cause may lie in wire harness, coupler connection, MAF sensor or ECM.



### REMOVAL

- 1) Disconnect negative cable at battery and coupler (1) from MAF sensor (2).
- 2) Remove air cleaner outlet hose (3) and turbocharger inlet hose (4) from MAF sensor.



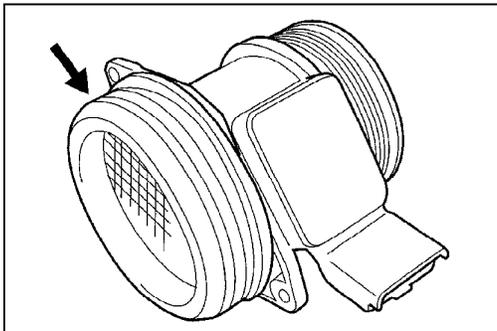
- 3) Remove MAF sensor from bracket.

**NOTE:**

**Don't disassemble MAF sensor.**

**CAUTION:**

- Do not expose MAF sensor to any shock.
- Do not blow compressed air by using air gun or the like.
- Do not put finger or any other object into MAF sensor. Malfunction may occur.



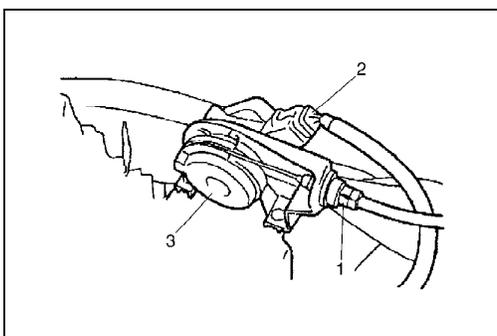
**INSTALLATION**

- 1) Check MAF sensor seal for deterioration and damage.
- 2) Install MAF sensor to bracket.
- 3) Install air cleaner outlet hose and turbocharger inlet hose.
- 4) Connect MAF sensor coupler securely.
- 5) Connect battery negative cable to battery.

**THROTTLE POSITION SENSOR (TP SENSOR)  
(ACCELERATOR STROKE SENSOR)**

**INSPECTION**

Refer to "DTCs P0121, P0221 and P0604" (Type 1 vehicles) or "DTCs P0221, P0222, P0223, P0226, P0227 and P0228" (Type 2 vehicles) in Section 6.



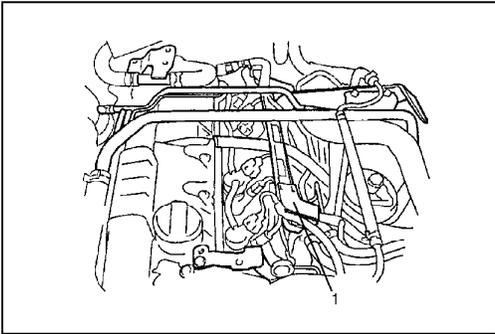
**REMOVAL**

- 1) Disconnect negative cable at battery.
- 2) Disconnect accelerator cable (1) from TP sensor (2).
- 3) Disconnect coupler (3) from TP sensor.
- 4) Remove TP sensor with its bracket.

**INSTALLATION**

For installation, reverse removal procedure noting the following.

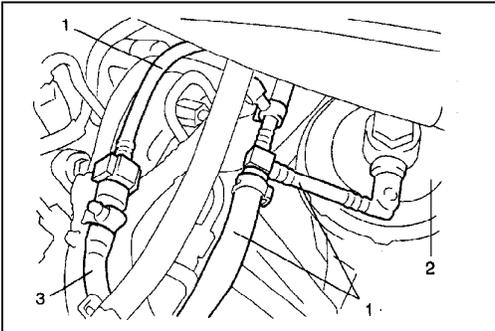
- Adjust accelerator cable play to specification referring to "ACCELERATOR CABLE ADJUSTMENT" in this section.



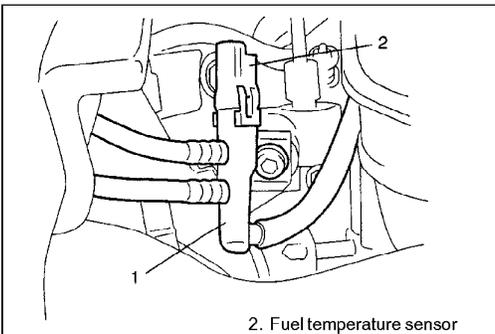
## FUEL TEMPERATURE SENSOR ASSEMBLY

### REMOVAL

- 1) Disconnect negative cable at battery and remove engine cover.
- 2) Disconnect fuel temperature sensor connector, injector connector, CMP sensor connector and injection pump solenoid valve connector. Then detach wire harness protector (1).

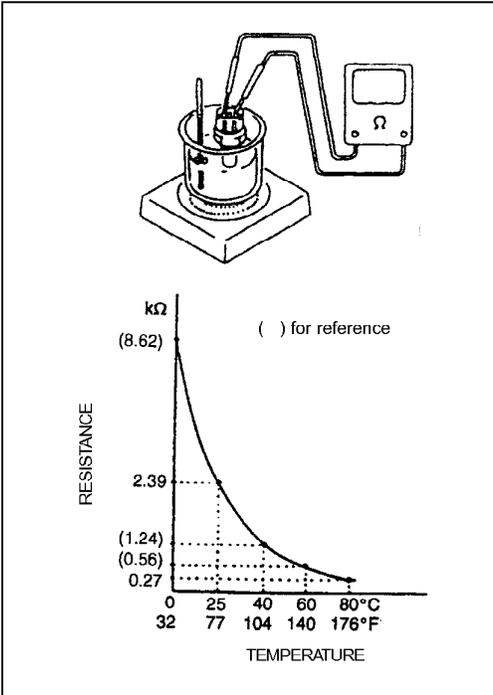


- 3) Disconnect fuel temperature sensor assembly (1) from fuel filter (2), injection pump and fuel return hose (3).



- 4) Remove fuel temperature sensor assembly (1) from common rail.

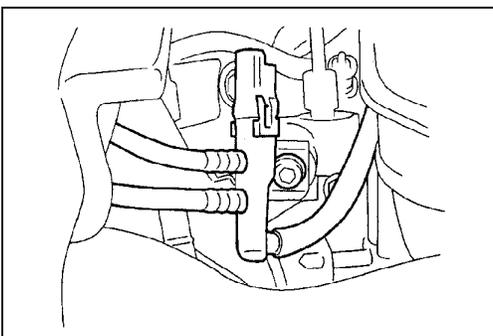
2. Fuel temperature sensor



### INSPECTION

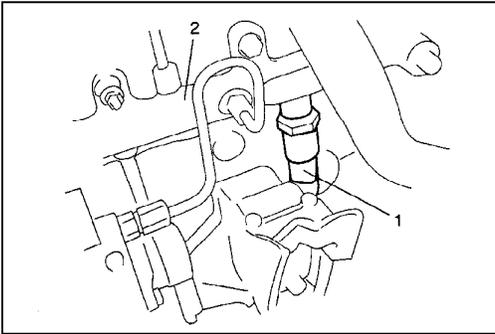
- 1) Disconnect negative cable at battery and remove engine cover.
- 2) Remove fuel temperature sensor from its assembly.
- 3) Place sensor and a thermometer in water. Heat water gradually and verify that resistance between fuel temperature sensor terminals at following temperatures is as specified.  
If not as specified, replace fuel temperature sensor assembly.

Water temperature °C (°F)	Resistance (KΩ)
-40 (-40)	93.63
-20 (-4)	25.76
0 (32)	8.62
25 (77)	2.39
40 (104)	1.24
60 (140)	0.56
80 (176)	0.27
100 (212)	0.14
120 (248)	0.08



### INSTALLATION

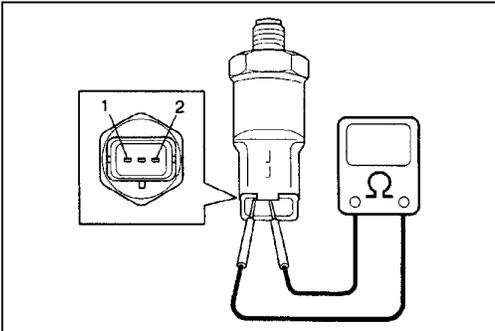
- For installation, reverse removal procedure noting the following.
- Connect each connector securely.



## FUEL (RAIL) PRESSURE SENSOR

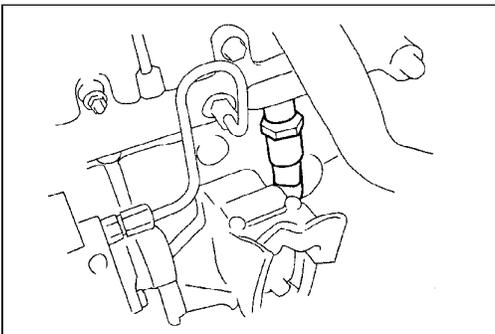
### REMOVAL

- 1) Disconnect negative cable at battery and remove engine cover.
- 2) Remove fuel filter assembly referring to Section 6C.
- 3) Disconnect connector from fuel pressure sensor (1).
- 4) Remove fuel pressure sensor from common rail (2).



### INSPECTION

Measure resistance between sensor terminals (1) and (2).  
If resistance is out of specification, replace fuel pressure sensor.  
Fuel pressure sensor resistance: about 970  $\Omega$  at 20 °C (68 °F).



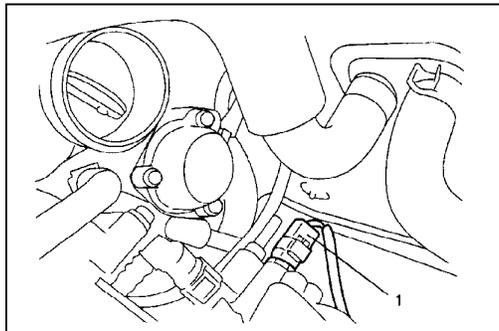
### INSTALLATION

Reverse removal procedure for installation.

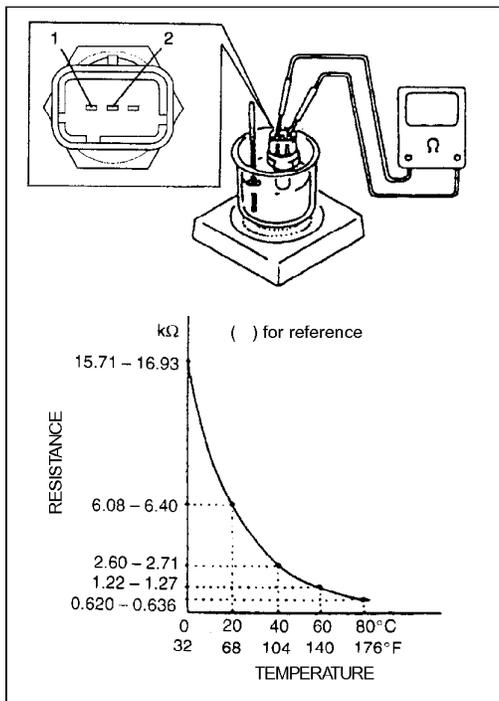
## ENGINE COOLANT TEMPERATURE SENSOR (ECT SENSOR)

### REMOVAL

- 1) Disconnect negative cable at battery and remove engine cover.
- 2) Drain cooling system.



- 3) Disconnect coupler (1) from ECT sensor.
- 4) Remove ECT sensor from water outlet box.



### INSPECTION

Immerse temperature sensing part of ECT sensor in water and measure resistance between sensor terminals (1) and (2) while heating water gradually.

If measured resistance doesn't show such characteristic as shown, replace ECT sensor.

### INSTALLATION

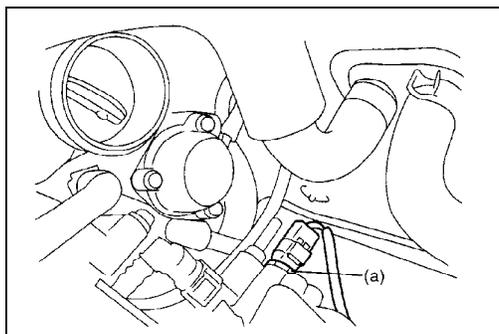
Reverse removal procedure noting the following.

- ✓ Clean mating surfaces of sensor and water outlet box.
- ✓ Check washer for damage and replace ECT sensor if necessary.
- ✓ Tighten ECT sensor to specified torque.

#### Tightening Torque

(a): 17 N·m (1.7 kg-m, 12.5 lb-ft)

- ✓ Connect coupler to sensor securely.
- ✓ Refill cooling system.

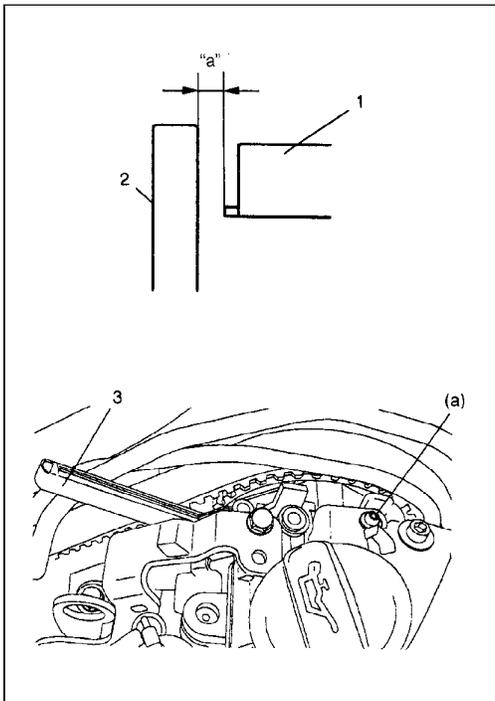


## CAMSHAFT POSITION SENSOR (CMP SENSOR)

### ON-VEHICLE INSPECTION

Check CMP sensor and its circuits referring to flow table of diagnostic trouble code P0340 in Section 6.

If malfunction is found, replace.



### AIR GAP INSPECTION/ADJUSTMENT

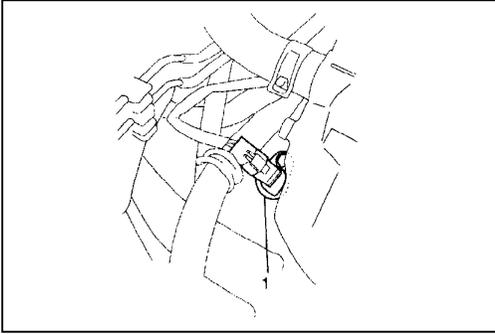
- 1) Remove upper timing belt cover.
- 2) Check clearance between CMP sensor (1) and camshaft hub (2), using thickness gauge (3).

**Clearance between CMP sensor and camshaft hub**  
"a": 1.2 mm (0.047 in.)

- 3) If clearance is out of specification, move the CMP sensor and adjust the clearance.

### Tightening Torque

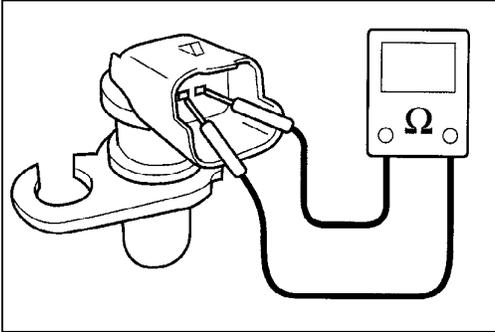
**CMP sensor bolt (a): 2 N·m (0.2 kg-m, 2.8 lb-ft)**



## CRANKSHAFT POSITION SENSOR (ENGINE SPEED SENSOR)

### REMOVAL

- 1) Remove battery.
- 2) Disconnect connector from crankshaft position sensor.
- 3) Remove crankshaft position sensor (1) from transmission case.

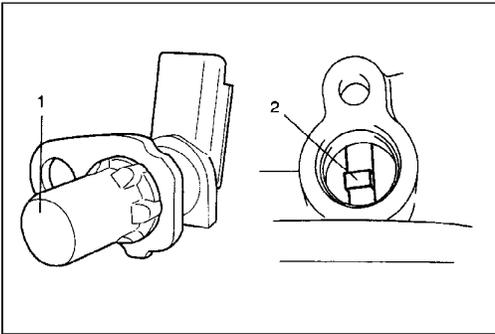


### INSPECTION

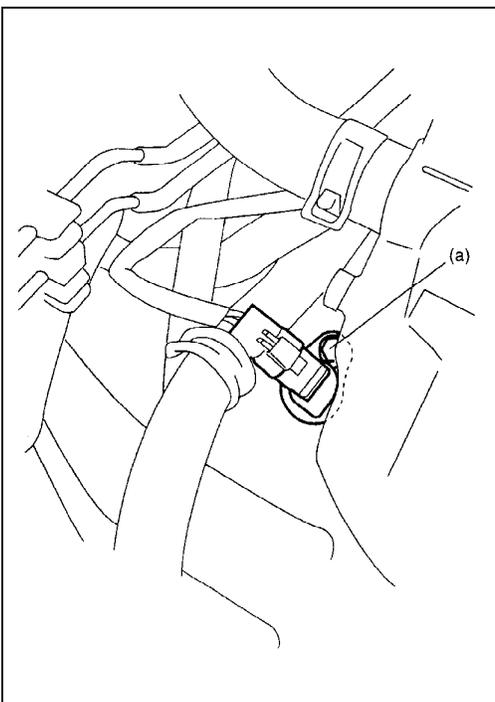
- ✓ Verify that resistance between terminals of CKP sensor is within specification.

**Resistance: 315 – 405  $\Omega$ .**

If not as specified, replace CKP sensor.



- ✓ Check to make sure that crankshaft position sensor (1) and sensor rotor tooth (2) is free from any metal particles and damage.



### INSTALLATION

- 1) Install crankshaft position sensor to transmission case.

#### CAUTION:

**Be sure to tighten to specified torque, CKP sensor will be deformed if over tightened and correct CKP sensor signal will not be fed if loosened.**

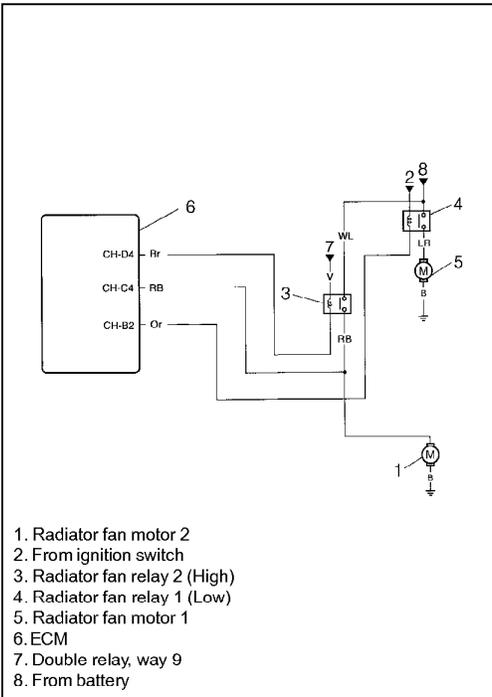
- 2) Connect connector to it securely.
- 3) Install battery.

## RADIATOR FAN CONTROL SYSTEM

### System Inspection

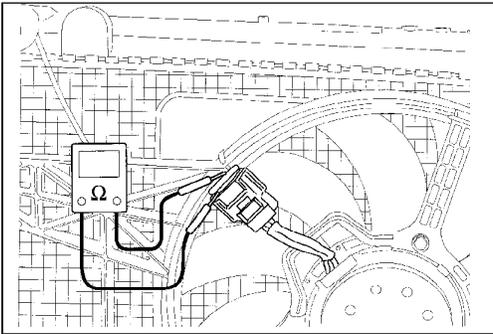
**WARNING:**

Keep hands, tools, and clothing away from engine cooling fan to help prevent personal injury. This fan is electric and can come on whether or not the engine is running. The fan can start automatically in response to the ECT sensor with the ignition switch in the "ON" position.

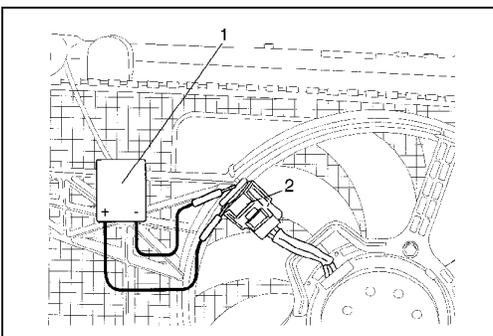


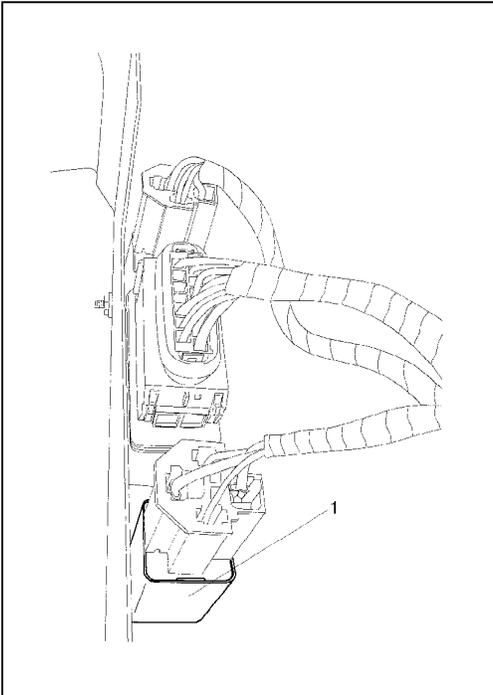
### Radiator Fan Inspection

- 1) Check continuity between each two terminals.  
 If there is no continuity, replace radiator fan motor.



- 2) Connect battery (1) to radiator fan motor coupler (2) (grey connector for radiator fan motor 1, black connector for radiator fan motor 2) as shown in figure, then check that the radiator fan motor operates smoothly.  
 If radiator fan motor does not operate smoothly, replace motor.

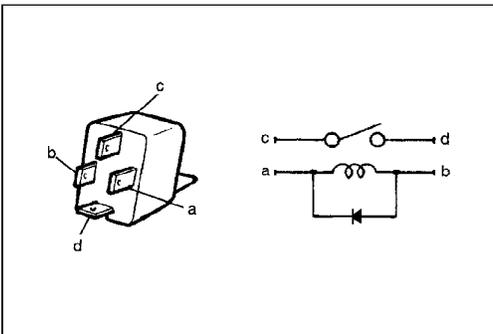




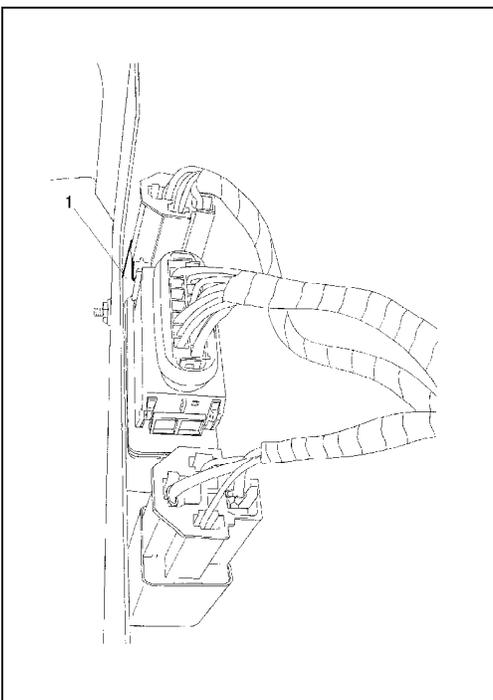
### RADIATOR FAN RELAY 1 (Low)

#### Inspection

- 1) Disconnect negative cable at battery.
- 2) Remove radiator fan relay 1 (1) from bracket by loosening nut.



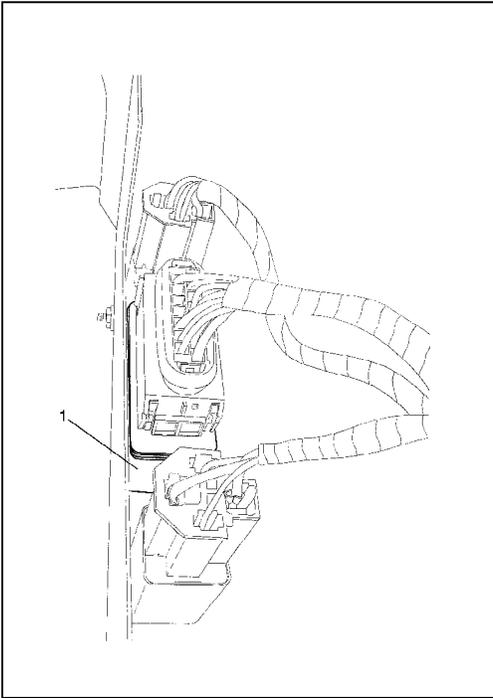
- 3) Check that there is no continuity between terminal "c" and "d". If there is continuity, replace relay.
- 4) Connect battery positive (+) terminal to terminal "b" of relay. Connect battery negative (-) terminal "a" of relay. Check continuity between terminal "c" and "d". If there is no continuity when relay is connected to the battery, replace relay.



### RADIATOR FAN RELAY 2 (High)

#### Inspection

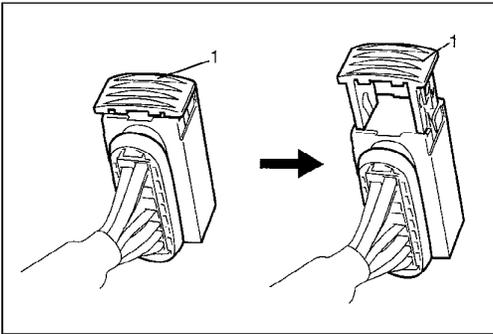
- 1) Disconnect negative cable at battery.
- 2) Remove radiator fan relay 2 (1) from bracket.
- 3) Repeat check process referring to RADIATOR FAN RELAY 1 (Low).



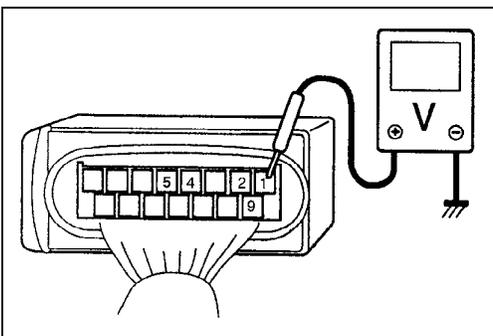
## DOUBLE RELAY

### REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Remove double relay (1) from bracket.



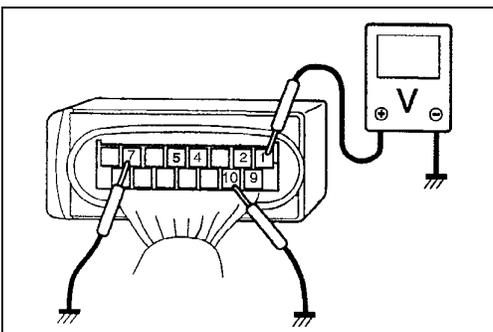
- 3) Disconnect connector from double relay by pulling off lock (1).



### INSPECTION

- 1) Connect connector to double relay.
- 2) Remove "FUEL PUMP" fuse (Type 1 vehicles) or "DOUBLE RELAY" fuse (Type 2 vehicles) from fuse box.
- 3) Disconnect ECM connectors.
- 4) Connect negative cable at battery.
- 5) Check voltage between each terminal and ground.  
If not as specified, replace double relay.

**Terminal "1", "2", "4", "5", "6" and "9" : 0 V**

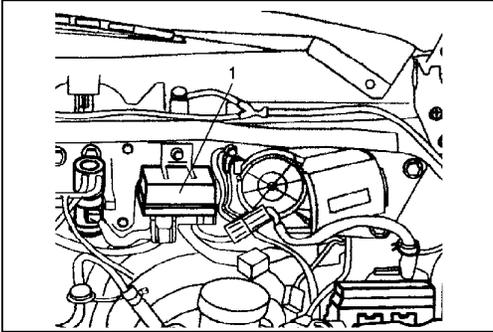


- 6) Using service wire, ground terminal "7" and terminal "10".
- 7) Check voltage between each terminal and ground.  
If not as specified, replace double relay.

**Terminal "1", "2", "4", "5", "6" and "9" : Battery voltage**

### INSTALLATION

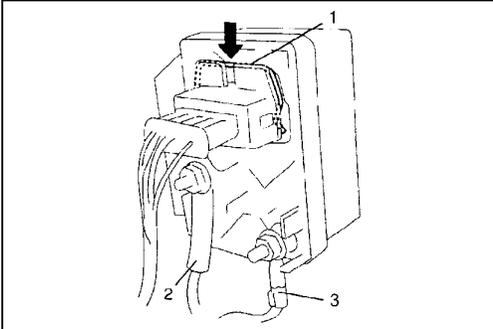
Reverse removal procedure for installation.



## PRE POST HEATING RELAY (CONTROL UNIT)

### REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Remove pre post heating control unit (1) from bracket.



- 3) Disconnect connector from pre post heating control unit by pushing lock (1).
- 4) Disconnect "W" wire terminal (2) and "WY" wire terminal (3).

### INSTALLATION

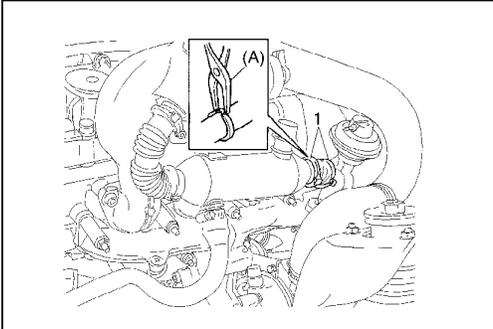
Reverse removal procedure for installation.

## EGR SYSTEM

### VACUUM HOSE

#### INSPECTION

Check hose for connection, leakage, clogs and deterioration. Replace as necessary.



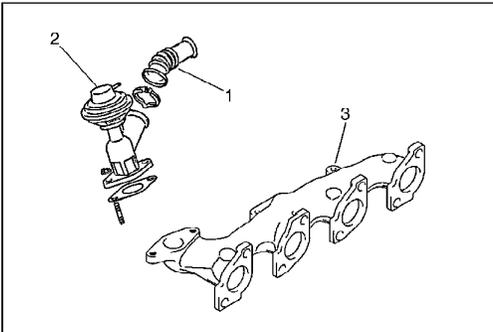
### EGR VALVE

#### REMOVAL

- 1) Remove outlet hose from turbocharger.
- 2) Remove EGR pipe clamps (1) by using special tool.

#### Special Tool

(A): 09919-46510/OUT0000110



- 3) Remove EGR pipe (1) from EGR valve (2) and EGR cooler pipe.
- 4) Remove EGR valve from exhaust manifold (3).

#### INSPECTION

- 1) Using a vacuum pump, apply vacuum to diaphragm chamber. Check for airflow between ports "A" and "B".

**Vacuum: About 24 kPa (180 mmHg) less than:**

**No airflow**

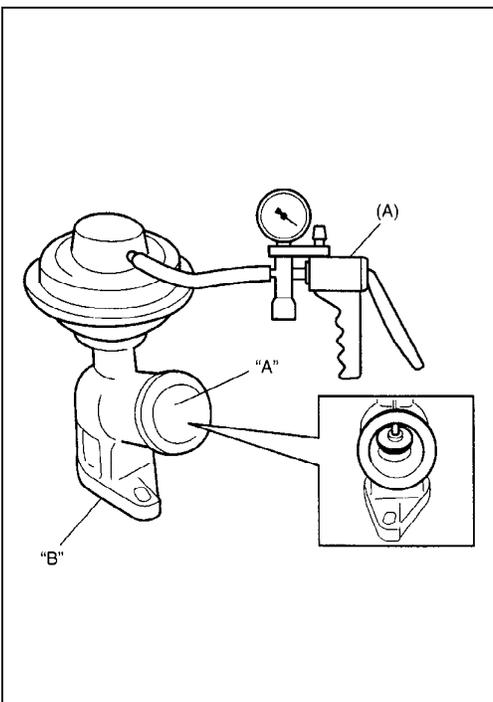
**Vacuum other than above:**

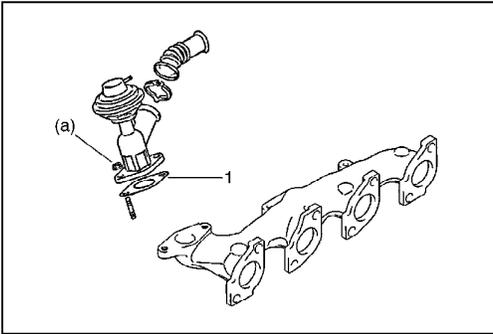
**Airflow**

#### Special Tool

(A): 09917-47910

If not as specified, replace EGR valve.





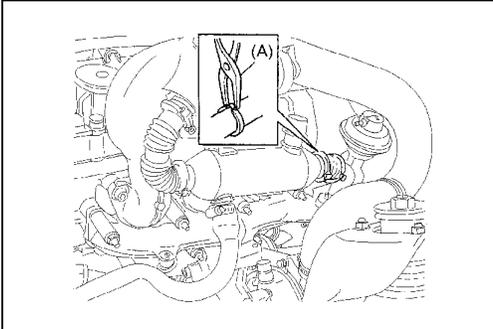
### INSTALLATION

For installation, reverse removal procedure noting the following.

- Clean mating surfaces of EGR valve and exhaust manifold.
- Use new gasket (1).
- Tighten EGR valve nuts to specified torque.

#### Tightening Torque

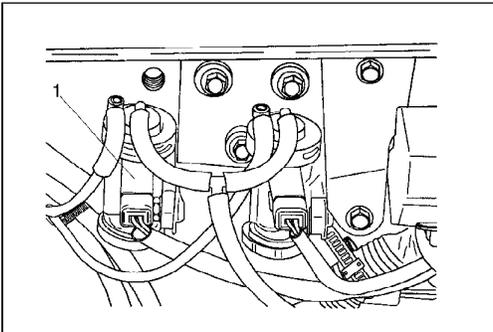
EGR valve nut (a): 10 N·m (1.0 kg·m, 7.5 lb·ft)



- Install EGR pipe clamps by using special tool.

#### Special Tool

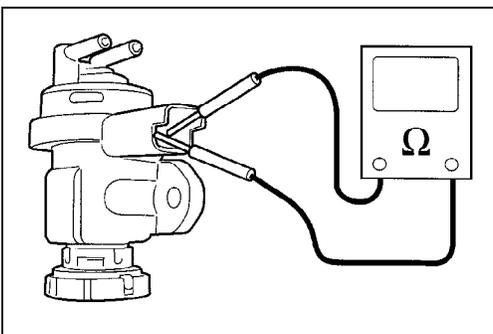
(A): 09919-46510/OUT0000110



### EGR SOLENOID VALVE

#### REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Disconnect connector from EGR solenoid valve (1).
- 3) Disconnect vacuum hoses from EGR solenoid valve.
- 4) Remove EGR solenoid valve from bracket.



#### INSPECTION

Measure resistance between each two terminals.

If resistance is out of specification, replace EGR solenoid valve.

EGR solenoid valve resistance: 15 – 20 Ω.

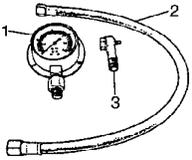
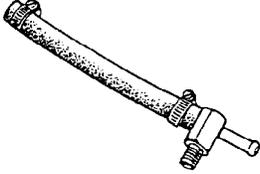
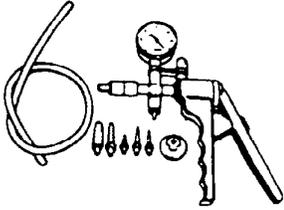
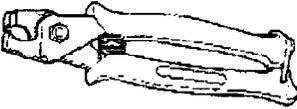
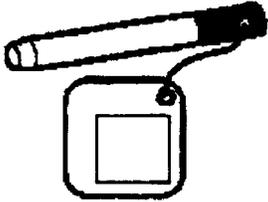
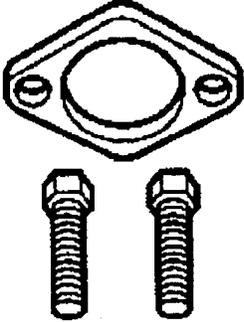
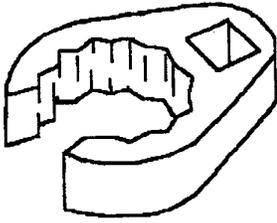
#### INSTALLATION

For installation, reverse removal procedure.

## TIGHTENING TORQUE SPECIFICATIONS

Fastening parts	Tightening torque		
	N·m	kg-m	lb-ft
Vacuum pump bolt and nut	20	2.0	14.5
Exhaust manifold nut	25	2.5	18.0
Turbocharger nut	25	2.5	18.0
Turbocharger outlet pipe bolt and nut	30	3.0	22.0
Lubrication pipe union bolt	20	2.0	14.5
Glow plug	10	1.0	7.5
Fuel injector clamp stud bolt	7.5	0.8	5.5
Fuel injector clamp nut	30	3.0	22.0
High pressure pipe union nut	20	2.0	14.5
Common rail bolt	25	2.5	18.0
High pressure supply pipe union nut	20	2.0	14.5
Injection pump bracket bolt	20	2.0	14.5
Injection pump nut and bolt	22.5	2.3	16.5
Injection pump pulley nut	50	5.0	36.5
ECT sensor	17	1.7	12.5
CMP sensor bolt	2	0.2	2.8
EGR valve nut	10	1.0	7.5

**SPECIAL TOOLS**

 <p>09912-58412 Fuel pressure gauge set</p>	<ol style="list-style-type: none"> <li>1. 09912-58411 Pressure gauge</li> <li>2. 09912-58431 Pressure hose</li> <li>3. 09912-58450 Attachment</li> </ol>	 <p>09912-58490 3 way joint and hose</p>	 <p>09917-47910 Vacuum pump gauge</p>
 <p>09919-46510 (OUT0000110) Clamp pliers</p>	 <p>09919-56570 (OUT0000157) Injection pump pulley lock</p>	 <p>09919-56580 (OUT0000158) Injection pump pulley remover</p>	 <p>09950-76510 (OUT0000148) Pipe spanner</p>

SECTION 6G

# CRANKING SYSTEM (2.0 kW Reduction Type)

**NOTE:**

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

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**6G**

## GENERAL DESCRIPTION

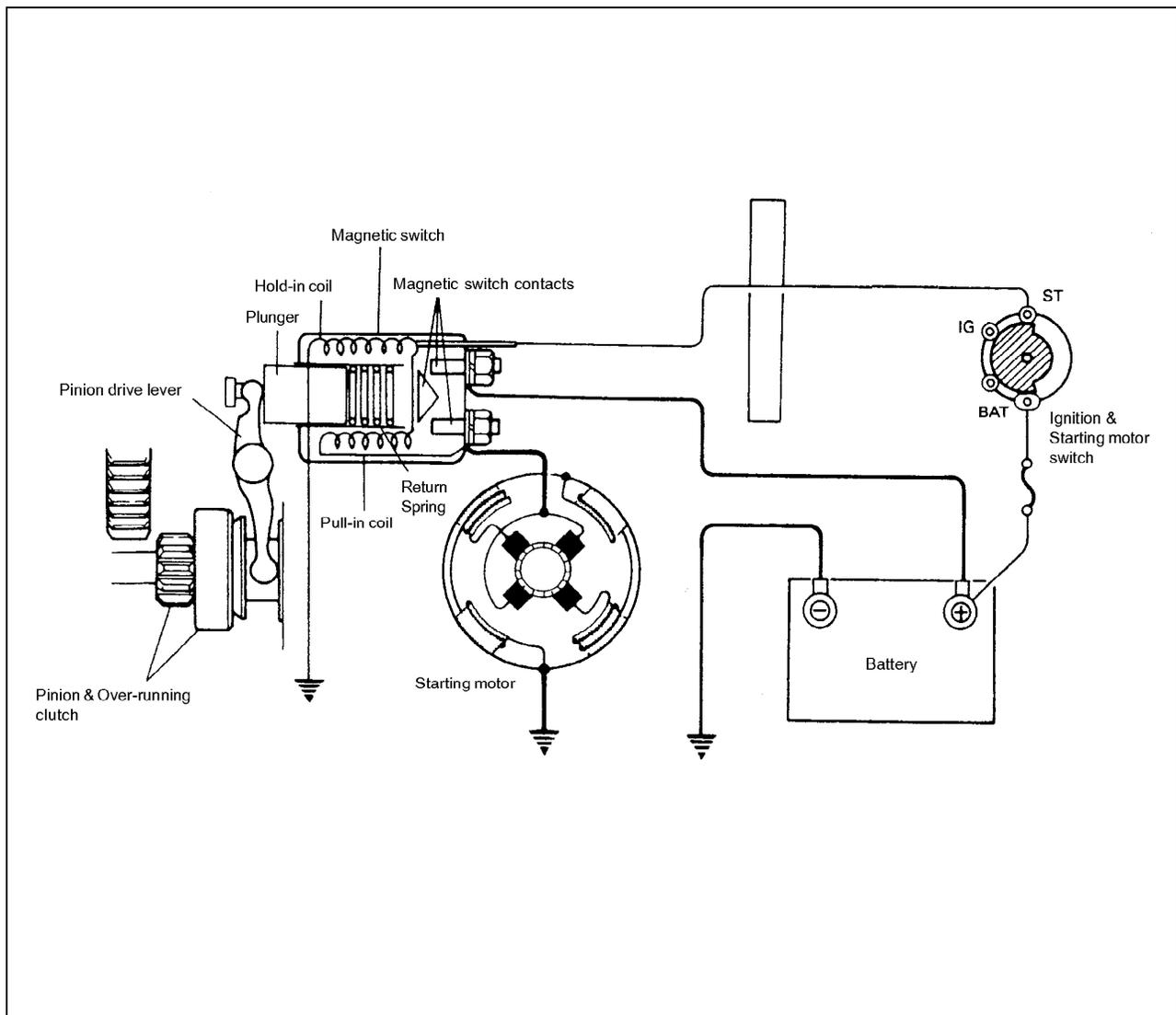
### CRANKING CIRCUIT

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring. These components are connected electrically.

Only the starting motor will be covered in this section.

### STARTING MOTOR CIRCUIT

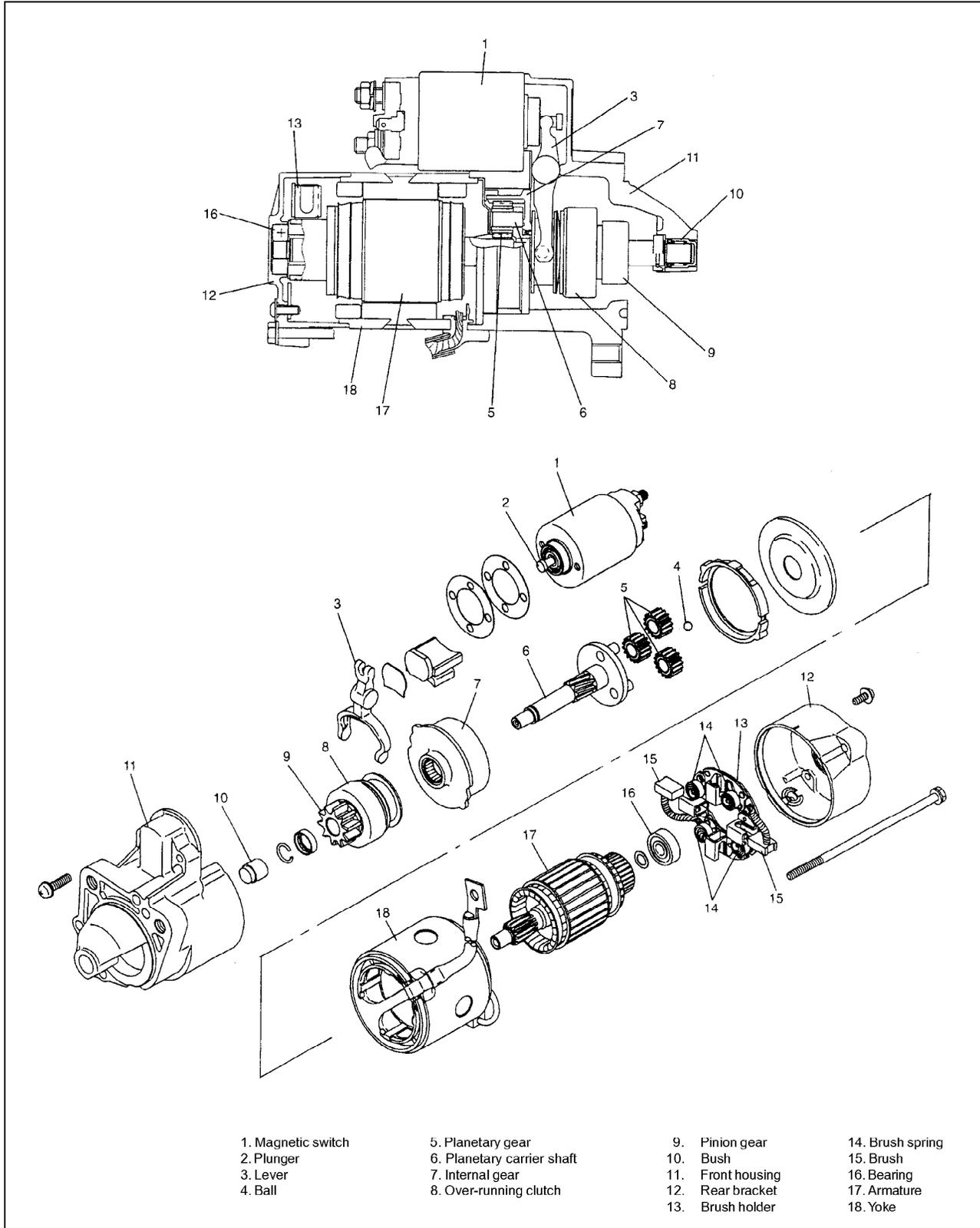
- ˆ The magnetic switch coils are magnetized when the ignition switch is closed.
- ˆ The resulting plunger and pinion drive lever movement causes the pinion to engage the engine flywheel gear and the magnetic switch main contacts to close, and cranking takes place.
- ˆ When the engine starts, the pinion over-running clutch protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage.



## STARTING MOTOR

The starting motor consists of parts shown in below.

The magnetic switch assembly and parts in the starting motor are enclosed in the housings so that they will be protected against possible dirt and water splash.



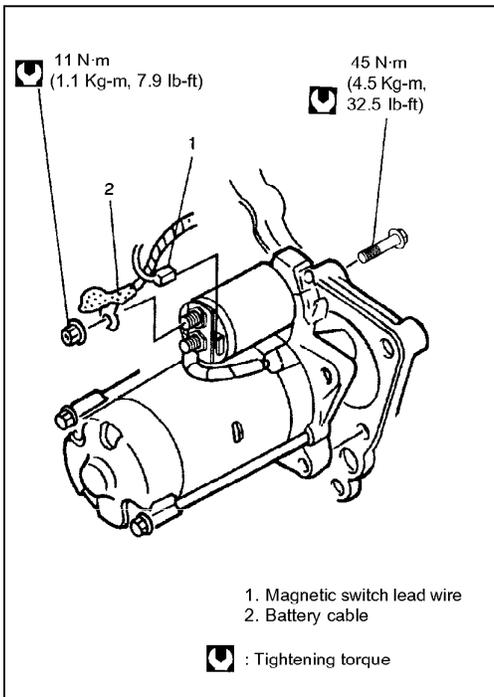
## DIAGNOSIS

Condition	Possible Cause	Correction
<b>Motor not running</b>	<b>Operating sound of magnetic switch heard</b> <ul style="list-style-type: none"> <li>' Battery run down</li> <li>' Battery voltage too low due to battery deterioration</li> <li>' Loose battery cable connections</li> <li>' Burnt main contact point, or poor contacting action of magnetic switch</li> <li>' Brushes are seating poorly or worn down</li> <li>' Weakened brush spring</li> <li>' Burnt commutator</li> <li>' Poor grounding of field coil</li> <li>' Layer short-circuit of armature</li> <li>' Crankshaft rotation obstructed</li> </ul>	<ul style="list-style-type: none"> <li>Recharge battery.</li> <li>Replace battery.</li> <li>Retighten.</li> <li>Replace magnetic switch.</li> <li>Repair or replace.</li> <li>Replace.</li> <li>Replace armature.</li> <li>Repair.</li> <li>Replace.</li> <li>Repair.</li> </ul>
<b>Starting motor running but too slow (small torque)</b>	<b>If battery and wiring are satisfactory, inspect starting motor</b> <ul style="list-style-type: none"> <li>' Insufficient contact of magnetic switch main contacts</li> <li>' Layer short-circuit of armature</li> <li>' Disconnected, burnt or worn commutator replace armature.</li> <li>' Poor grounding of field coil</li> <li>' Worn brushes</li> <li>' Weakened brush springs</li> <li>' Burnt or abnormally worn end bush</li> </ul>	<ul style="list-style-type: none"> <li>Replace magnetic switch.</li> <li>Replace.</li> <li>Repair commutator or</li> <li>Repair.</li> <li>Replace brush.</li> <li>Replace spring.</li> <li>Replace bush.</li> </ul>

## UNIT REPAIR OVERHAUL

### DISMOUNTING AND REMOUNTING

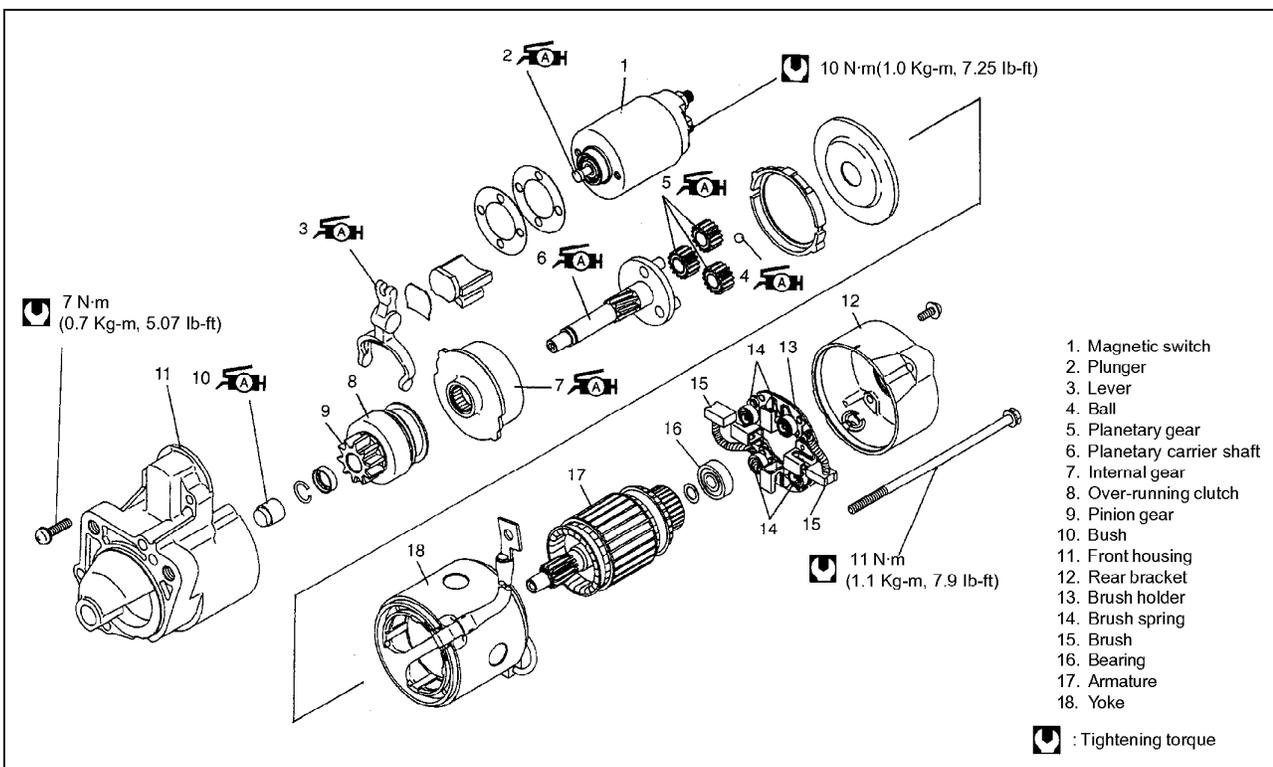
- 1) Disconnect negative cable at battery.
- 2) Disconnect magnetic switch lead wire ("S" terminal) and battery cable from starting motor terminal ("B" terminal).
- 3) Drain coolant.
- 4) Move engine wiring harness by loosening bolts in the plastic bracket.
- 5) Hoist vehicle.
- 6) Disconnect radiator outlet hose No.1 from water outlet box.
- 7) Remove starting motor mount bolts and remove starting motor.
- 8) To install, reverse the above procedure.

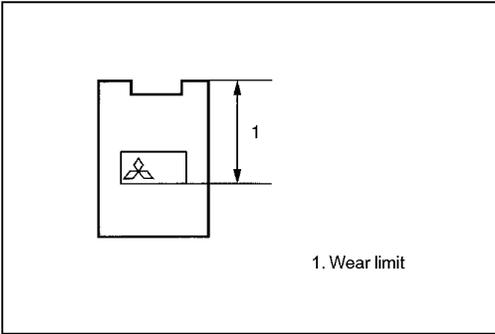


### DISASSEMBLY AND REASSEMBLY

**NOTE:**

- ✓ Disassemble in order shown in figure.
- ✓ For reassembly, reverse disassembly procedure.
- ✓ Tighten bolt and nut to specified torque.
- ✓ Upon completion of reassembly, carry out "Performance Test" later in this section.





## INSPECTION

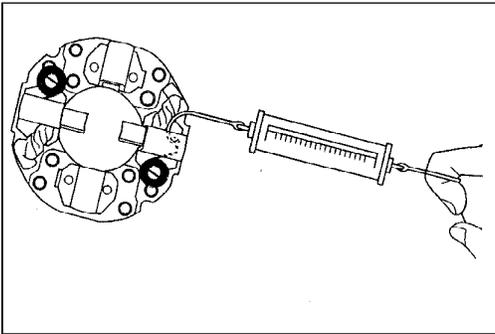
### 1. BRUSH

- Check brushes for wear. Measure length of brushes and if below limit, replace brush.

#### Brush length

Standard	18.0 mm (0.71 in.)
Limit	11.0 mm (0.43 in.)

- Install brushes to each brush holder and check for smooth movement.

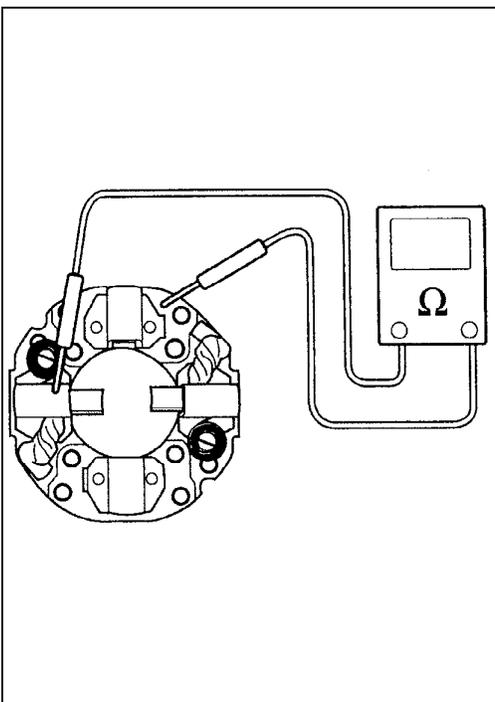


### 2. SPRING

- Inspect brush springs for wear, damage or other abnormal conditions. Replace if necessary.

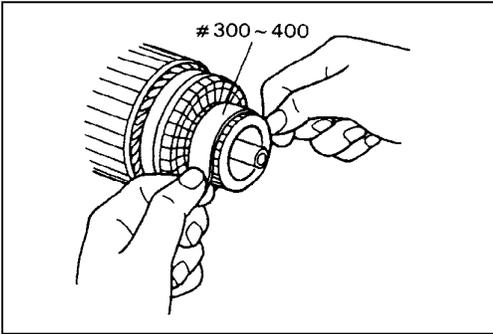
#### Brush spring tension

Standard	3.1 kg (6.8 lb)
Limit	1.5 kg (3.3 lb)



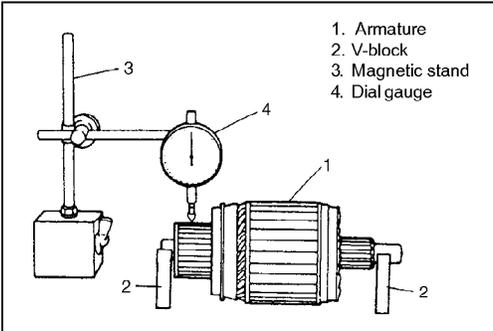
### 3. BRUSH HOLDER

- 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 between insulated brush holder and brush holder plate. Replace brush and brush holder if there is continuity.



**4. ARMATURE**

Inspect commutator for dirt or burn. Correct with sandpaper or lathe, if necessary.



Check commutator for uneven wear with armature supported on V-blocks. If deflection of dial gauge pointer exceeds limit, repair or replace.

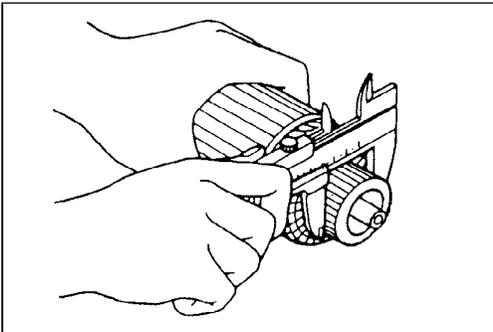
**NOTE:**

**Below specification presupposes that armature is free from bend. Bent armature must be replaced.**

**Commutator out of round**

**Standard: 0.05 mm (0.002 in.) or less**

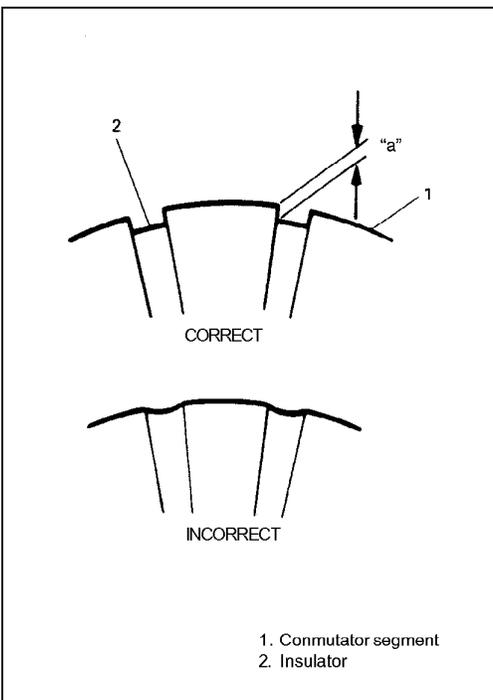
**Limit: 0.1 mm (0.004 in.)**



Inspect commutator for wear. If diameter is below limit, replace armature.

**Commutator outside diameter**

**Limit: 31.4 mm (1.24 in.)**

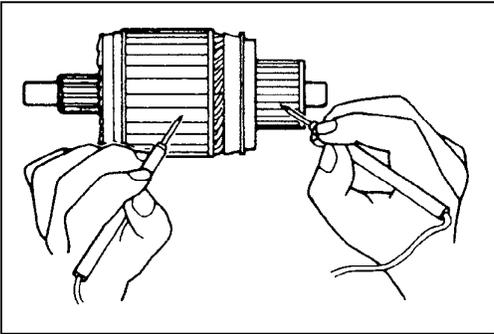


Inspect commutator for insulator depth. Correct or replace if below limit.

**Commutator insulator depth "a"**

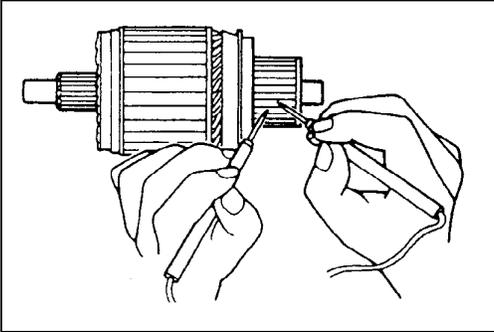
**Standard: 0.5 – 0.8 mm (0.02 – 0.031 in.)**

1. Commutator segment  
2. Insulator



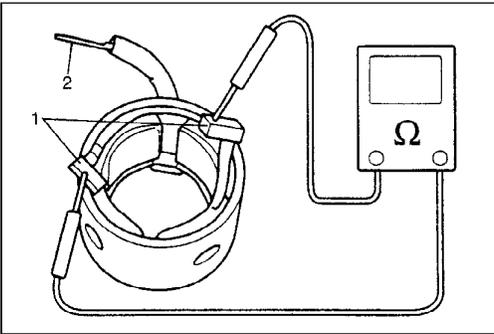
• **Ground Test**

Check commutator and armature core. If there is continuity, armature is grounded and must be replaced.



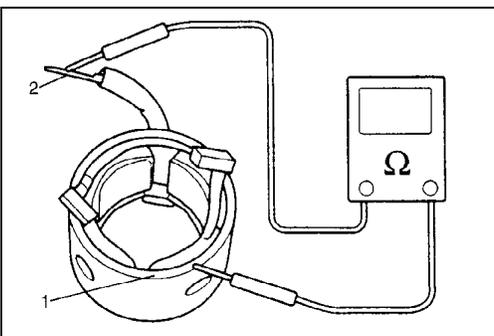
• **Open Circuit Test**

Check for continuity between segments. If there is no continuity at any test point, there is an open circuit and armature must be replaced.

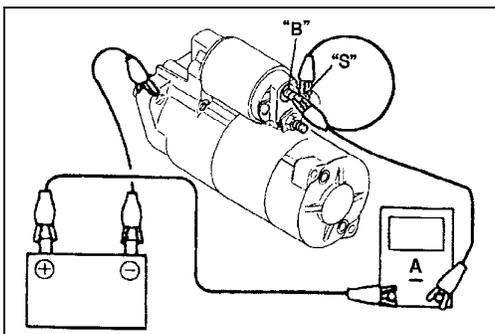
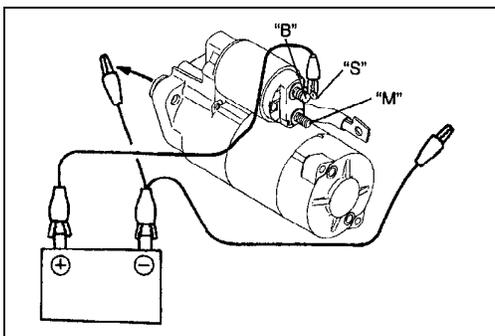
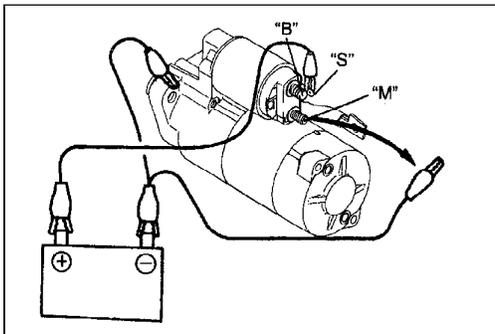
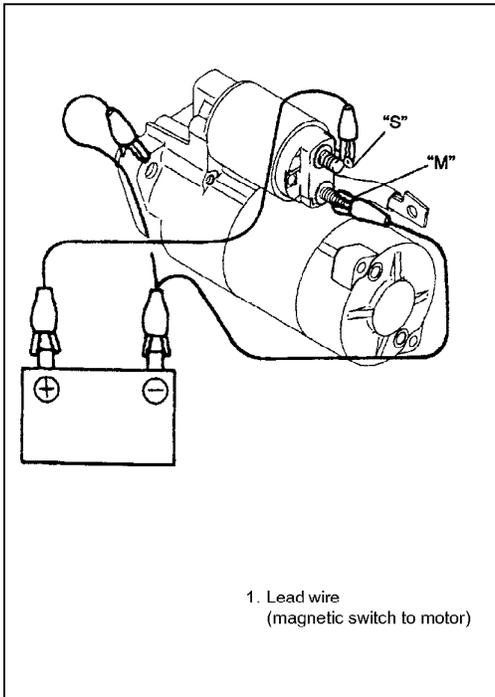


**5. FIELD COIL**

• Check for continuity between brushes (1) and between connector (2) and brush (1). Replace field coil if there is continuity.



• Check for continuity between connector (2) and yoke (1). Replace field coil if there is continuity.



## PERFORMANCE TEST

### CAUTION:

Each test must be performed within 3 – 5 seconds to avoid coil from burning.

#### 1) Pull-In Test

Connect battery to magnetic switch as shown. Check that plunger and pinion move outward. If plunger and pinion don't move, replace magnetic switch.

### NOTE:

Before testing, disconnect lead wire from terminal "M".

#### 2) Hold-In Test

While connected as above with plunger out, disconnect negative lead from terminal "M". Check that plunger and pinion remain out. If plunger and pinion return inward, replace magnetic switch.

#### 3) Plunger and Pinion Return Test

Disconnect negative lead from switch body. Check that plunger and pinion return inward. If plunger and pinion don't return, disassemble and inspect starting motor.

#### 4) No-Load Performance Test

- a) Connect battery and ammeter to starter as shown.
- b) Check that starter rotates smoothly and steadily with pinion moving out. Check that ammeter indicates specified current.

**Specified current: 130A MAX. at 11V**

### NOTE:

Use wires as thick as possible and tighten each terminal fully.

## SPECIFICATIONS

### 2.0 kW Reduction Type

Voltage		12 volts	
Output		2.0 kW	
Rating		30 seconds	
Direction of rotation		Clockwise as viewed from pinion side	
Brush length		18.0 mm (0.71 in.)	
Number of pinion teeth		10	
Performance		Condition	Guarantee
Around at 20 °C (68 °F)	No load characteristic	11.0 V	130 A maximum 3,600 rpm minimum
	Load characteristic	7.7 V 400 A	10.6 N·m (1.06 kg-m, 7.67 lb-ft) minimum 1,280 rpm minimum
	Locked characteristic	3.0 V	1,000 A maximum 29.4 N·m (2.94 kg-m, 21.3 lb-ft) minimum
	Magnetic switch operating voltage		8 volts maximum

## REQUIRED SERVICE MATERIAL

MATERIAL	RECOMMENDED SUZUKI PRODUCT	USE
Lithium grease	SUZUKI SUPER GREASE A (99000-25010)	<ul style="list-style-type: none"> <li>• Front bush</li> <li>• Plunger</li> <li>• Pinion drive lever</li> <li>• Internal gear</li> <li>• Planetary carrier shaft</li> <li>• Planetary gear</li> <li>• Ball</li> </ul>

## TIGHTENING TORQUE SPECIFICATIONS

Fastening parts	Tightening torque		
	N·m	kg-m	lb-ft
Starting motor mounting bolt	45	4.5	32.5
“B” terminal nut	11	1.1	8
Magnetic switch screw	7	0.7	5.0
Starting motor housing screw	11	1.1	8

SECTION 6H

**CHARGING SYSTEM**

**WARNING:**

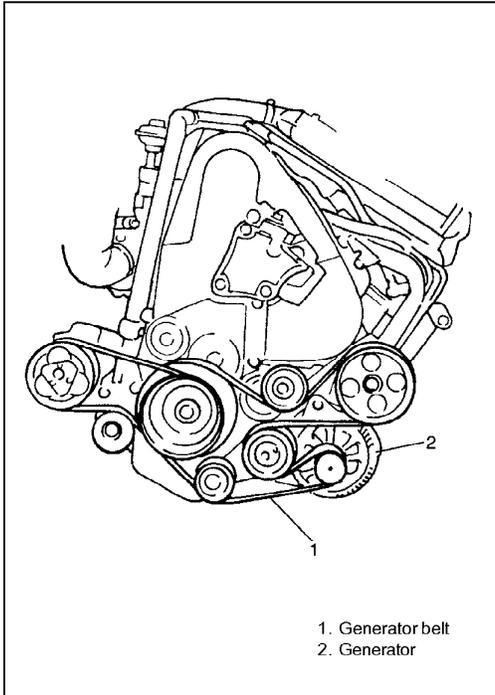
For vehicles equipped with Supplemental Restraint (Air Bag) System:

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

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<b>UNIT REPAIR OVERHAUL</b> .....	6H-4
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Dismounting and Remounting .....	6H-4
Disassembly and Reassembly .....	6H-5
<b>SPECIFICATIONS</b> .....	6H-6
Generator .....	6H-6
<b>SPECIAL TOOLS</b> .....	6H-6

**6H**



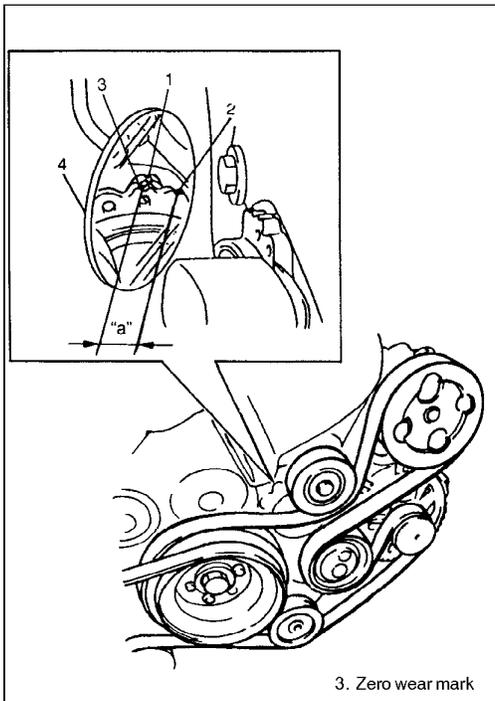
## ON-VEHICLE SERVICE GENERATOR BELT

### WARNING:

Disconnect negative cable at battery before inspection, removing and installing Generator belt.

### INSPECTION

- ✓ Verify that belt engages with pulley groove correctly.
- ✓ Visually check for wear and damage on belt and pulley contact surface and damage on pulley.



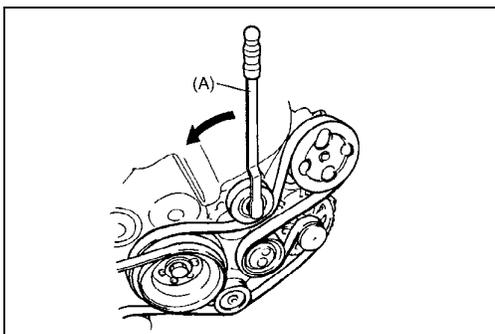
- ✓ Inspect belt for cracks, cuts, deformation, wear and cleanliness using mirror under enough lighting. If any defect exists, replace.
- ✓ Check that belt wear check mark (1) (tension indicator) is within range "a" using mirror (4) under enough lighting. If wear check mark (1) is aligned with maximum wear mark (2) or out of range "a", replace generator belt with a new one.

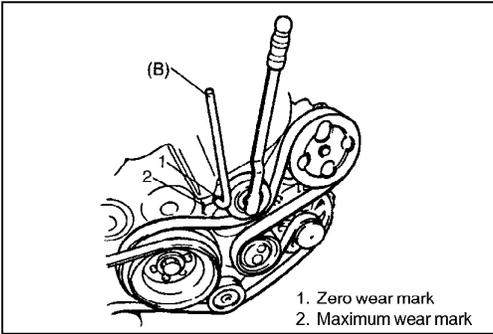
### REMOVAL

- 1) Using special tool (A) for dynamic roller tensioner, turn dynamic roller tensioner counterclockwise to loosen it.

### Special tool

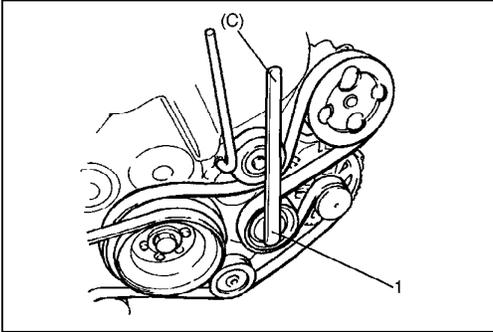
(A): 09919-56610/OUT0000143





- 2) With dynamic roller tensioner holes aligned by turning dynamic roller tensioner, insert special tool (B) into them.

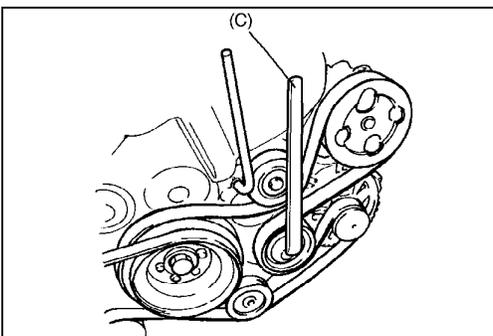
**Special tool**  
**(B): 09919-56590/OUT0000142**



- 3) Loosen roller tensioner bolt (1) using special tool (C).

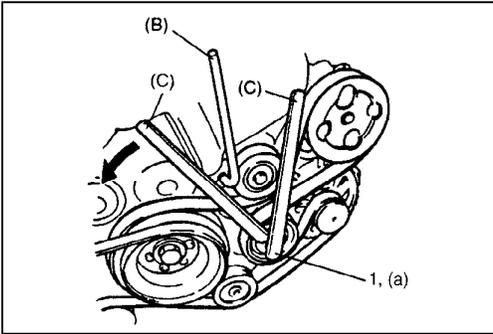
**Special tool**  
**(C): 09919-56620**

- 4) Remove generator belt.



**INSTALLATION**

- 1) Using special tool (C) for roller tensioner, turn roller tensioner clockwise to loosen it.
- 2) While holding the tensioner, install generator belt.



- 3) Using special tool (C), turn roller tensioner counterclockwise to until special tool (B) becomes free. With roller tensioner kept in that state, fix it by tightening roller tensioner bolt (1) to specified torque.

**Special tool**

(B): 09919-56590/OUT0000142

(C): 09919-56620

**Tightening torque**

(a): 50 N·m (5.0 kg·m, 36.5 lb·ft)

- 4) Remove special tool (B) and (C), turn crankshaft pulley 4 revolutions.
- 5) Using special tool (B), check that dynamic roller tensioner holes are aligned. If they are not aligned, repeat step 3) to 5).

## UNIT REPAIR OVERHAUL

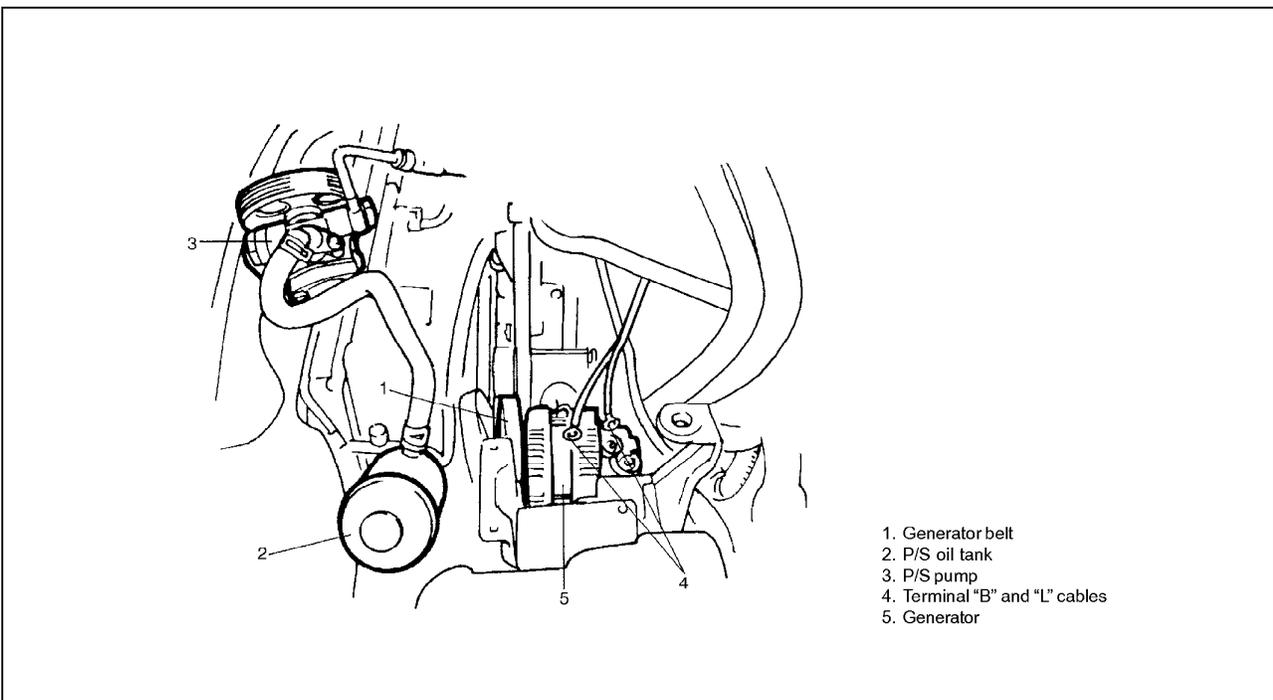
### GENERATOR

#### DISMOUNTING AND REMOUNTING

- ˆ Dismount in numerical order indicated in figure.
- ˆ For remounting, reverse dismounting procedure.
- ˆ Tighten bolt and nut to specified torque.

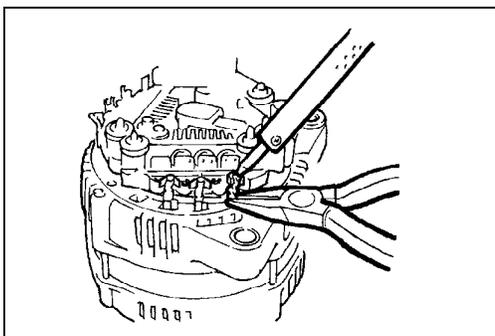
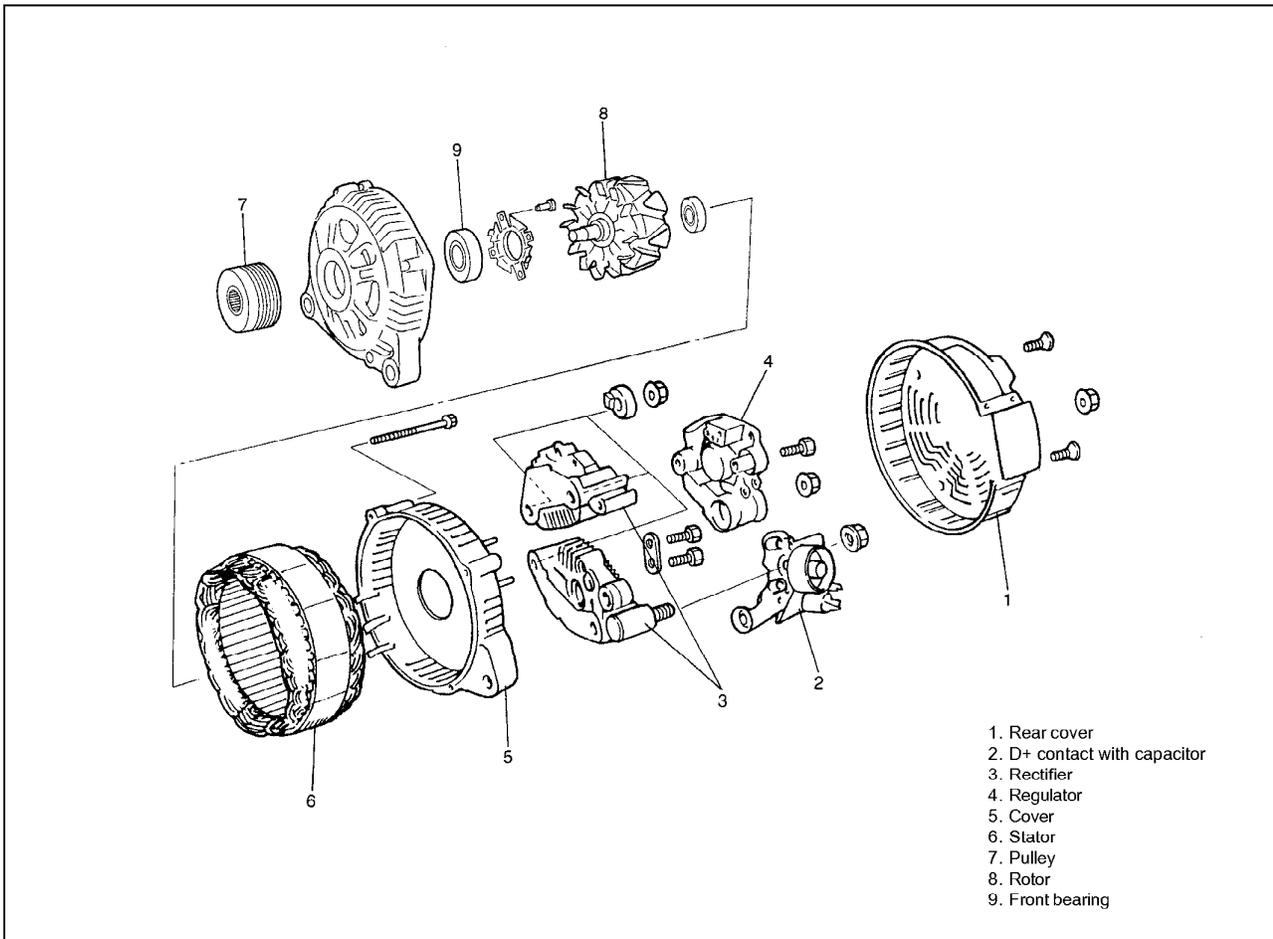
**Tightening Torque**

P/S pump mounting bolt: 25 N·m (2.5 kg·m, 18.0 lb·ft)



**DISASSEMBLY AND REASSEMBLY**

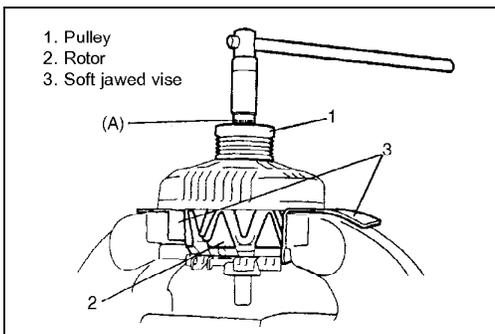
- Disassemble in numerical order shown in figure below and note the following.
- For reassembly, reverse disassembly procedure.



- When removing stator lead wire from rectifier, carry out soldering quickly.

**CAUTION:**  
 Overheating can damage semiconductor components such as regulator and rectifier.

**NOTE:**  
 Hold lead wire with pliers during soldering to prevent applying heat to rectifier.



- Hold rotor with soft jawed vise and remove pulley by using special tool.

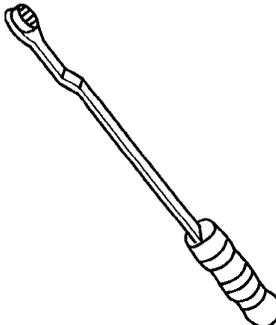
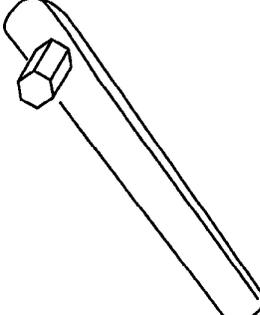
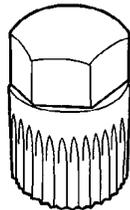
**Special tool**  
 (A): 09932-96510

## SPECIFICATIONS

### GENERATOR

Type	150 A type
Rated voltage	12 V
Nominal output	150 A

### SPECIAL TOOLS

 <p>09919-56610/OUT0000143 Belt tension lever</p>	 <p>09919-56590/OUT0000142 Belt tensioner pin</p>	 <p>09919-56620 Belt tension adjuster wrench</p>	 <p>09932-96510 Pulley remover attachment</p>
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SECTION 6K

EXHAUST SYSTEM

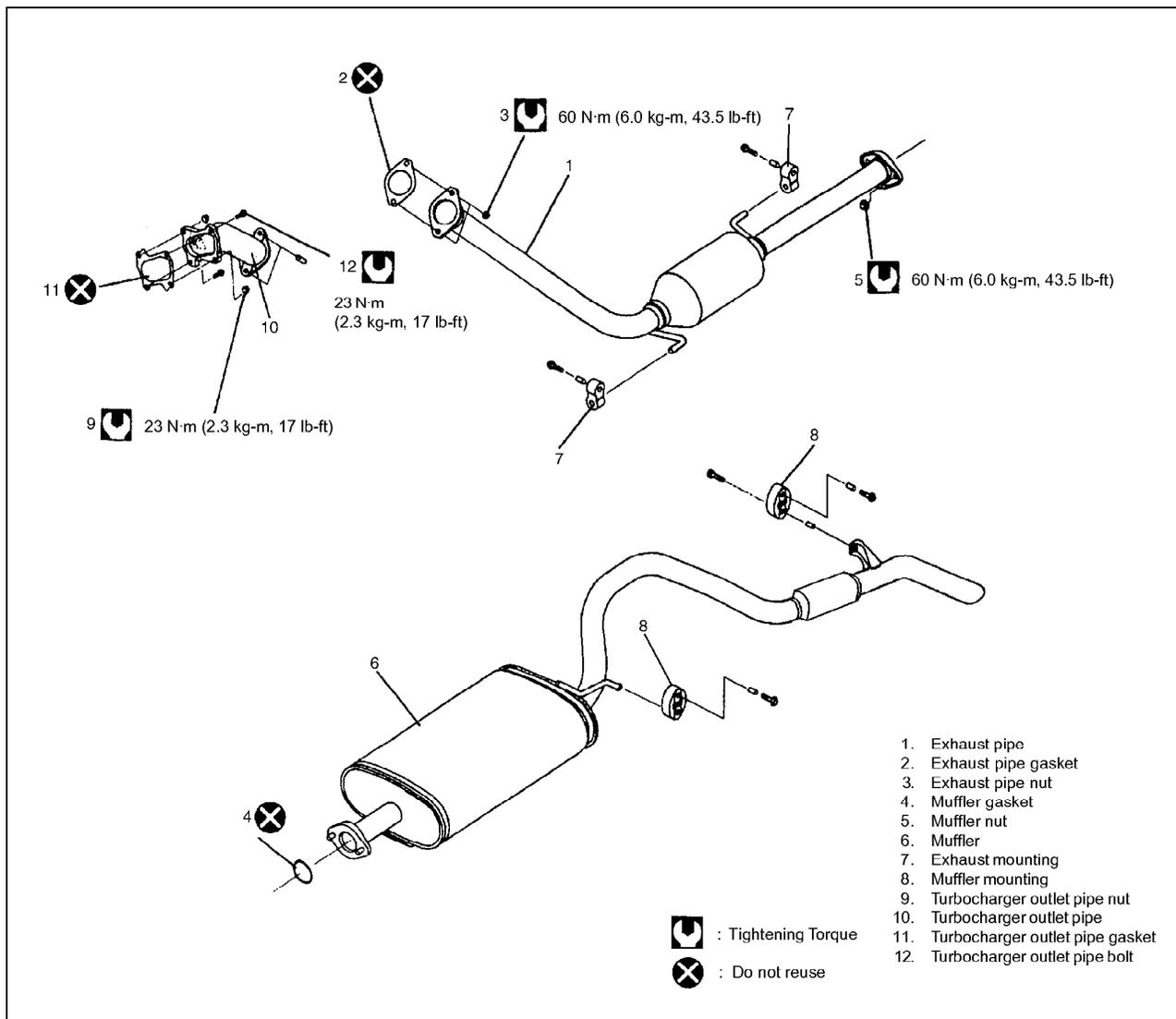
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GENERAL DESCRIPTION

The exhaust system consists of a exhaust manifold, a turbo charger, a turbocharger outlet pipe, an exhaust pipe, a muffler and seal, gaskets and etc., and the exhaust pipe has the catalytic converter for oxidation.

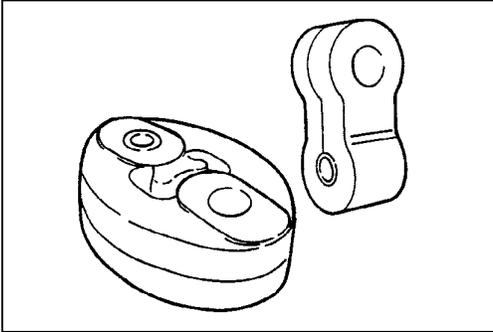
The catalytic converter for oxidation is an emission control device added to the exhaust system to lower the levels of Hydrocarbon (HC) and Carbon Monoxide (CO) pollutants in the exhaust gas.



## MAINTENANCE

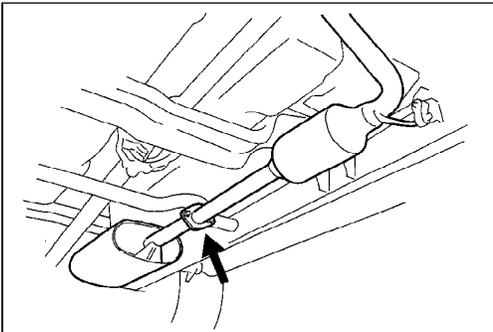
**WARNING:**

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



At every interval of periodic maintenance service, and when vehicle is raised for other service, check exhaust system as follows:

- Check rubber mountings for damage, deterioration, and out of position.



- Check exhaust system for leakage, loose connection, dent and damage.

If bolts or nuts are loosened, tighten them to specified torque.

Refer to "GENERAL DESCRIPTION" in this section for torque data.

- Check nearby body areas damaged, missing, or mispositioned part, open seam, hole connection or any other defect which could permit exhaust fumes to seep into vehicle.
- Make sure that exhaust system components have enough clearance from underbody to avoid overheating and possible damage to passenger compartment carpet.
- Any defect should be fixed at once.

## ON-VEHICLE SERVICE

**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.

**EXHAUST MANIFOLD**

Refer to "TURBOCHARGER" in Section 6E3 for removal and installation procedures. Before installation, check gasket and seal for deterioration or damage. Replace them as necessary.

**MUFFLER****CAUTION:**

As exhaust pipe has catalytic converter in it, it should not be exposed to any impulse. Be careful not to drop it or hit it against something.

- ˆ Tighten bolts and nuts to specified torque when reassembling. Refer to GENERAL DESCRIPTION in this section for location of bolts and nuts.
- ˆ After installation, start engine and check each joint of exhaust system for leakage.

SECTION 8B

CODED VEHICLE IMMOBILIZER

NOTE:

For points not covered in this section, please refer to the corresponding section in Service Manuals outlined in INTRODUCTION to this Manual.

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    Entering personal code for first time (Type 1) ..... 8B- 3

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    Modifying personal code (Type 1) ..... 8B- 3

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**8B**

## GENERAL OUTLINE

The code vehicle immobilizing system is a mechanism designed to lock the fuel injection system, as long as the access code established by the owner is not entered. It consists of the following component:

- **Coded immobilizing keypad**

It functions in the following way:

## STARTING UP ENGINE

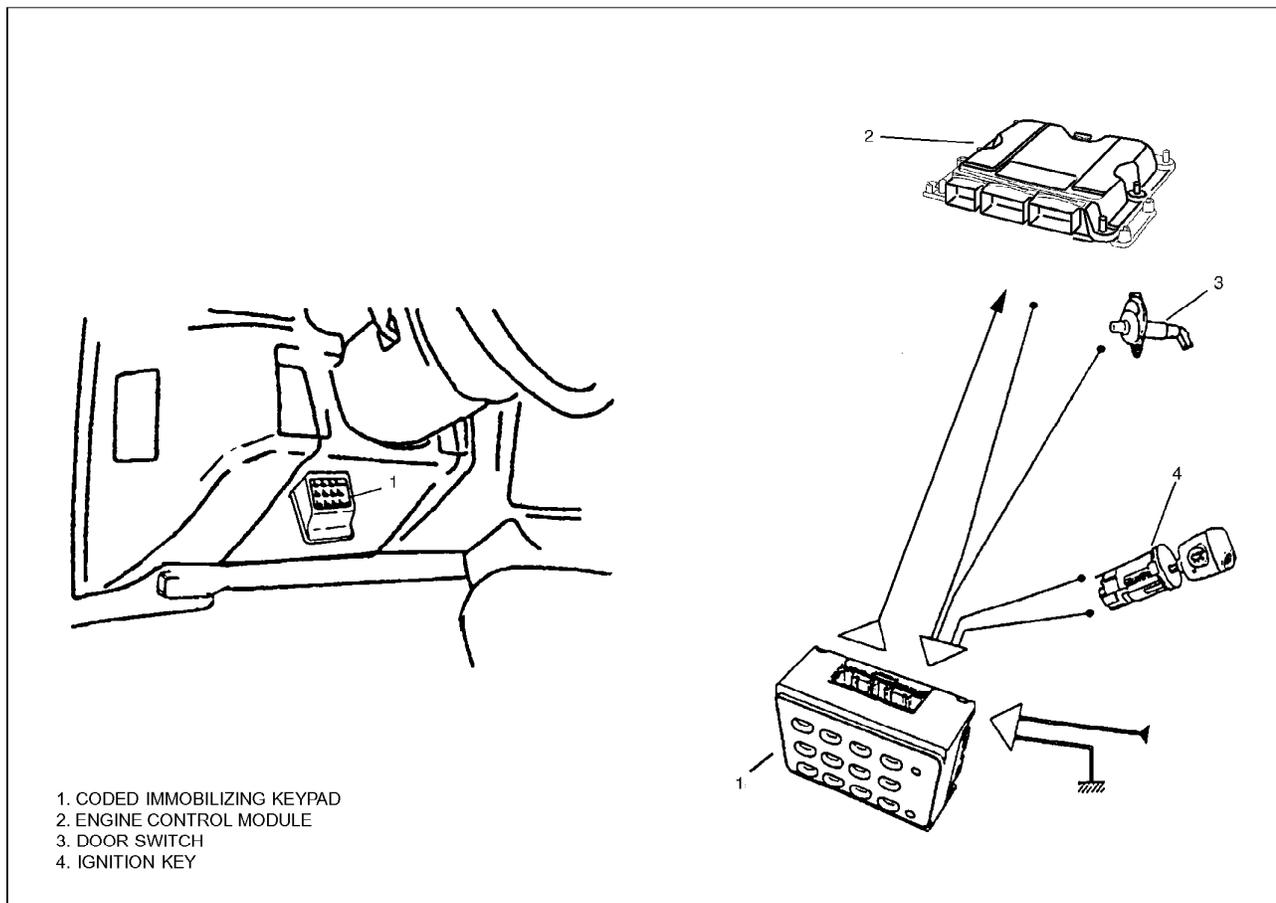
When the ignition key is entered and turned to ON position:

- If the green light on keypad comes on, the engine can be started directly.
- If the red light on keypad comes on, the immobilizing system is activated and it is necessary to enter the personal access code.

To start up the engine with the red light on, it is necessary to key in your personal four digit number. The green light will come on and the red light will go off. On leaving the Factory all vehicles have the code 1111 entered, which the customer may use if they do not wish to change it. If you key in the wrong number, key in the correct four digit code again. Each time a key is pressed a "beep" is heard. If an error is made on entering a code or in the process for changing a code, this is signalled by a two second warning sound. With the ignition on, a "beep" sound is made if an attempt is made to start the engine up with the immobilizing system activated, permanent if the engine continues running.

### NOTE

**If the incorrect code is entered three times in succession, the keypad is rendered immobilized for thirty minutes.**



### **ENTERING PERSONAL CODE FOR FIRST TIME (TYPE 1)**

This should be effected in the following way:

- 1) Turn ignition key to ON position.
- 2) Enter code 1111.
- 3) Press key C.
- 4) Enter a personal four digit code.
- 5) Press key C to validate operation. This operation is confirmed by four green flashes and four "beeps".

### **ENTERING PERSONAL CODE FOR FIRST TIME (TYPE 2)**

This should be effected in the following way:

- 1) Turn ignition key to ON position.
- 2) Enter code 1111.
- 3) Press key C.
- 4) Enter a personal four digit code.
- 5) Turn ignition key to OFF position.
- 6) Press key C to validate operation in nine seconds after turning the contact off. This operation is confirmed by four green flashes and four "beeps".

### **MODIFYING PERSONAL CODE (TYPE 1)**

This operation should be effected in the following way:

- 1) Turn the ignition key to ON position.
- 2) Enter memorized code.
- 3) Press key C.
- 4) Enter new four digit code.
- 5) Press key C to validate operation. This operation is confirmed by four green flashes and four "beeps".

### **MODIFYING PERSONAL CODE (TYPE 2)**

This operation should be effected in the following way:

- 1) Turn the ignition key to ON position.
- 2) Enter memorized code.
- 3) Press key C.
- 4) Enter new four digit code.
- 5) Turn ignition key to OFF position.
- 6) Press key C to validate operation in nine seconds after turn the contact off. This operation is confirmed by four green flashes and four "beeps".

### **SECURITY MEASURES**

The two codes (the old one preserved or new one validated) remain present until one of them is used, automatically annulling the other.

If the code is not confirmed, take out the key, enter once more and repeat the operation. Simultaneous flashing of red and green lights indicates an incorrect operation or a malfunction. If this occurs, wait for approximately a minute, switch off and then on again. If the problem persists, a diagnosis of the fault should be effected as indicated below.

### **SETTING IN SERVICE MODE (TYPE 1)**

This process allows the customer to let a garage or another person use the vehicle without knowing their personal code (four digits). This operation should be effected in the following way:

1. Turn ignition key to ON position.
2. Enter personal code and press S.
3. Enter service code (the code 1111 is recommended) and press S.

Six green flashes accompanied by six "beep" sounds confirm the operation. The service code is automatically annulled when the personal code is entered again, it being unnecessary to go through the code modification process again.

### **SETTING IN SERVICE MODE (TYPE 2)**

This process allows the customer to let a garage or another person use the vehicle without knowing their personal code (four digits). This operation should be effected in the following way:

1. Turn ignition key to ON position.
2. Enter personal code and press S.
3. Enter service code (the code 1111 is recommended).

4. Turn ignition key to OFF position.
  5. Press S in nine seconds after turn the contact off.
- Six green flashes accompanied by six "beep" sounds confirm the operation.  
The service code is automatically anulled when the personal code is entered again, it being unnecessary to go through the code modification process again.

## LOCKING SYSTEM

Locking is effected automatically on switching off in the following cases.

1. Thirty seconds after opening and closing of driver's door.
2. Ten minutes after switching off.

## SYSTEM IDENTIFICATION

System locking can be checked after thirty seconds by observing the red keypad light. This light comes on for ten seconds after system locking and then flashes until the starter motor is engaged again.

### NOTE

**In the event of a malfunction or the battery current being cut off, the personal code remains in the memory. In the event of the personal code being lost, it is necessary to replace the engine control module.**

## DIAGNOSIS

### INTRODUCTION

To effect a correct diagnosis and repair of the coded immobilizing mechanism the following steps should be taken:

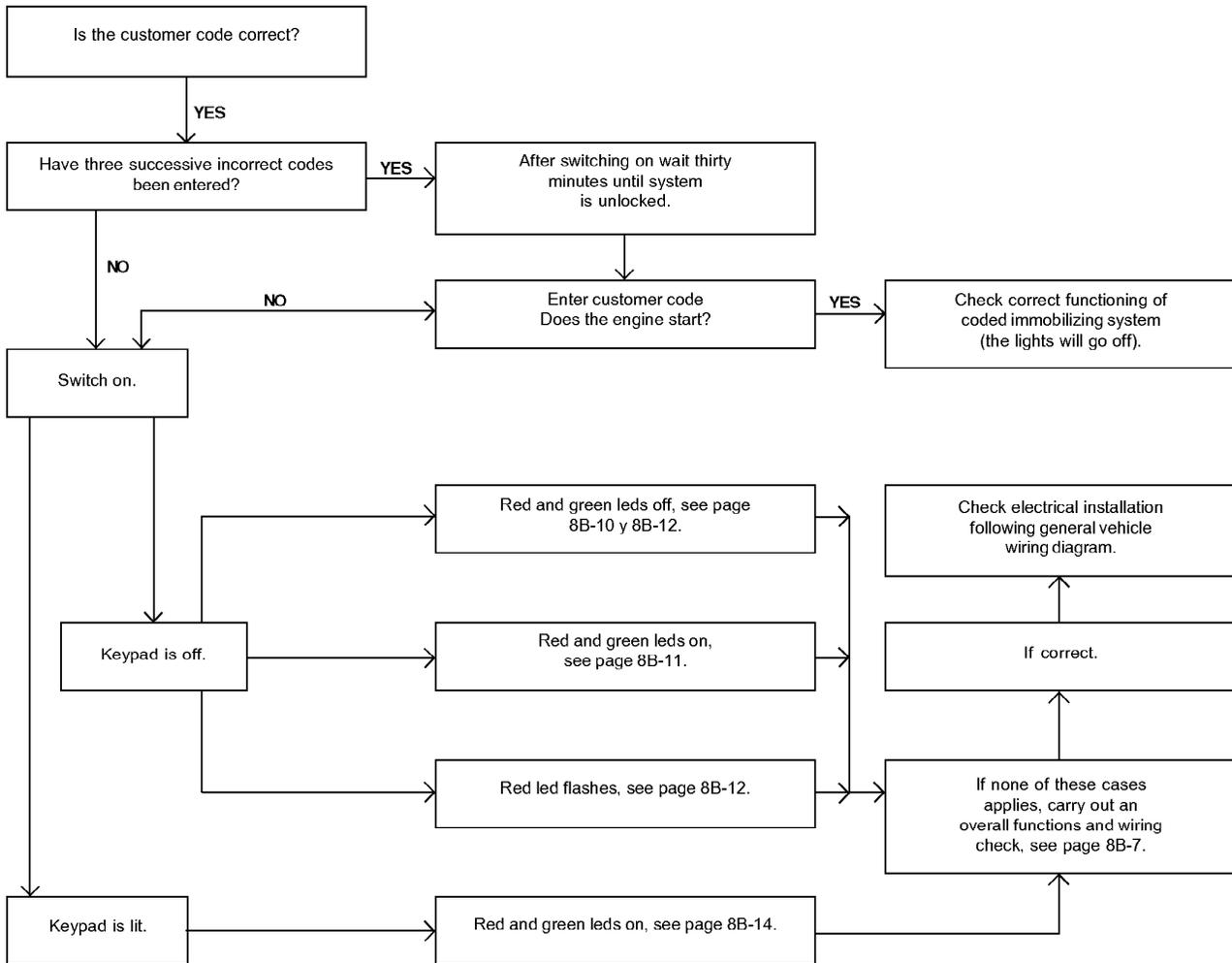
- 1) Dialogue with customer to know defective functioning symptoms of system and the conditions in which they have occurred.
- 2) Closely read the "General Outline" chapter in this section to gain thorough knowledge of the system.
- 3) Please refer to flow charts for each of the defects detected (see defect analysis).
- 4) Carry out repair to corresponding mechanism.
- 5) Perform test to confirm correct repair.

### PRECAUTIONS ON DIAGNOSING MALFUNCTIONS

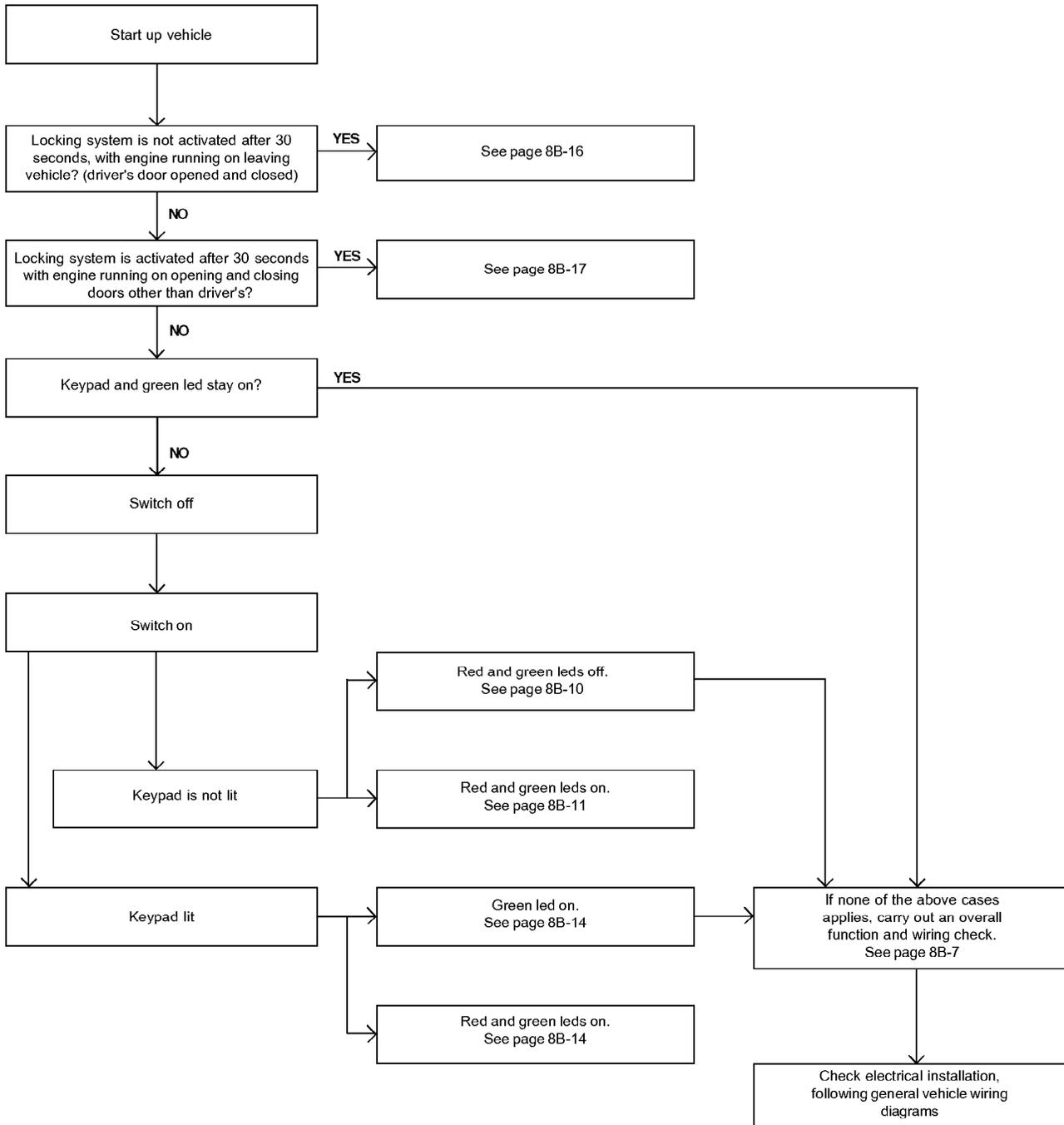
- 1) Do not disconnect
  - The battery with the engine running.
  - The engine control module or keypad after switching on.
- 2) Ensure that the battery is completely charged and that voltage is not lower than 12 V nor higher than 16 V.
- 3) The majority of intermittent problems are a result of:
  - Bad condition of cables or connections.
  - Incorrect power supply of terminals, or loose on lower part.
  - Terminals badly conformed or damaged.
  - Oxidized terminals.
  - Faulty connection between terminal and cable.Ensure these faults are repaired before continuing with diagnosis.
- 4) Do not use a pilot lamp or go over an electric arc with a wire to check continuity of a circuit.

# DEFECT ANALYSIS

## A-1 ENGINE DOES NOT START

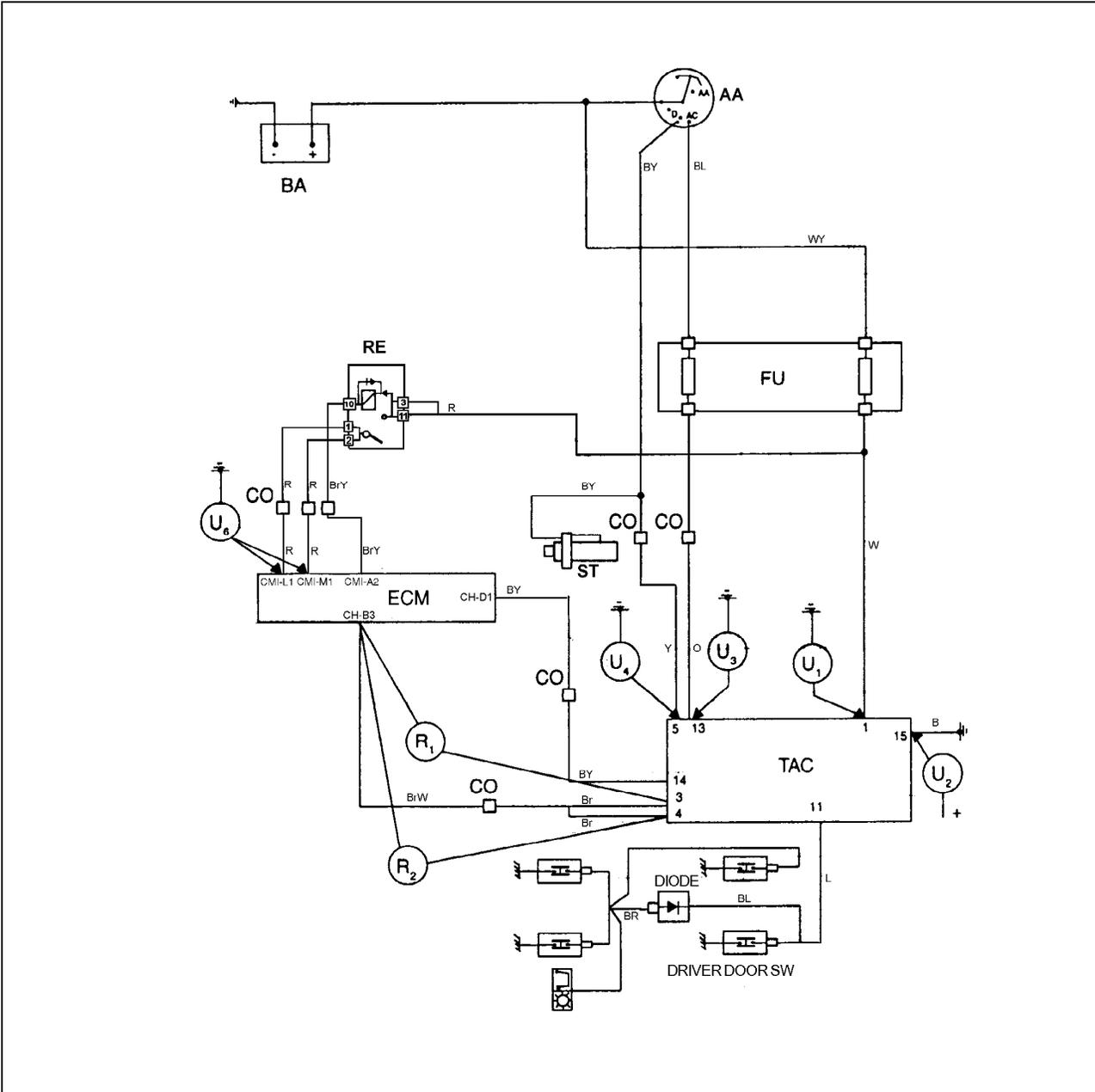


## A-2 ENGINE STARTS

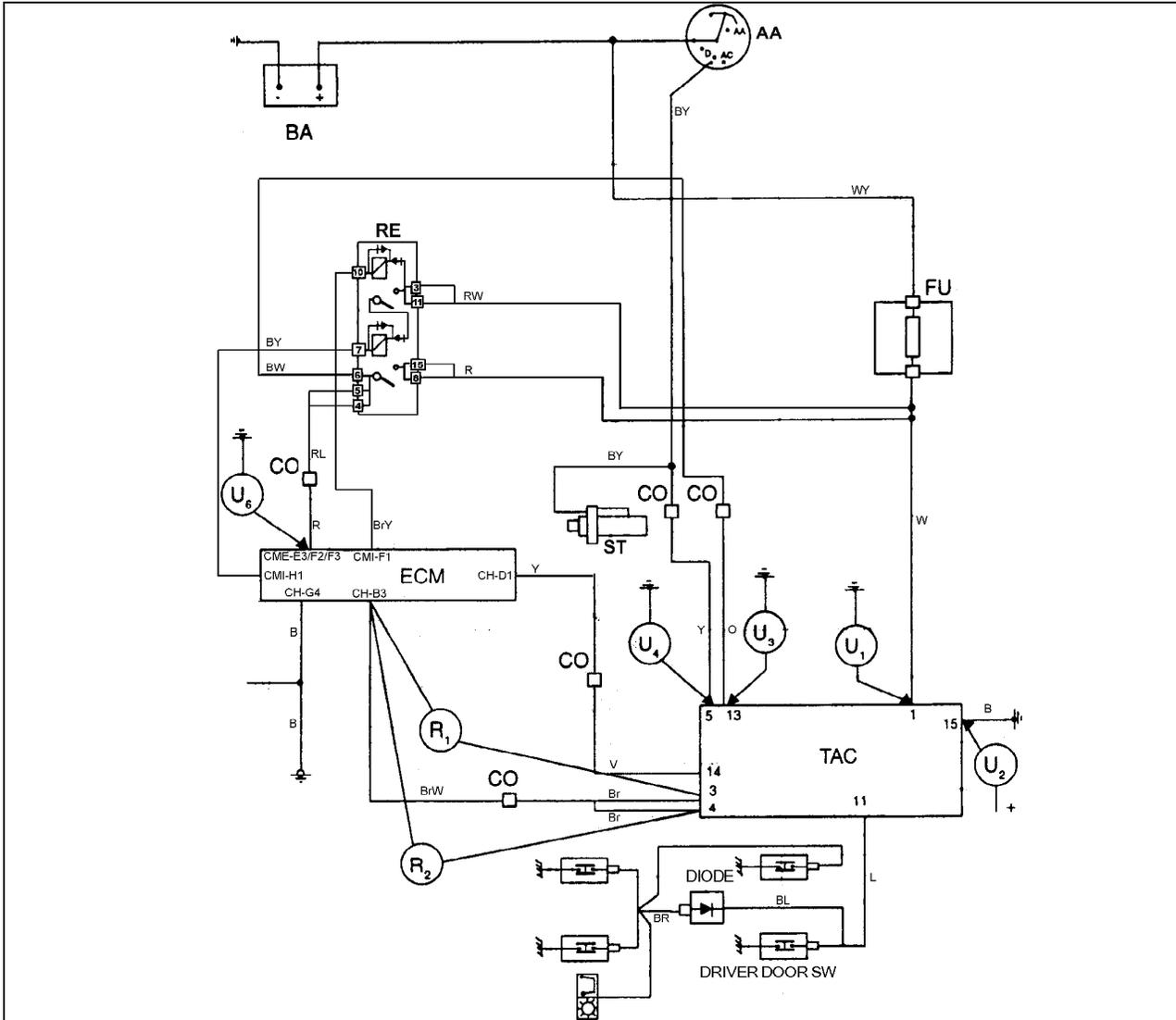


TESTING WIRING

TYPE 1 VEHICLE WIRING DIAGRAM:



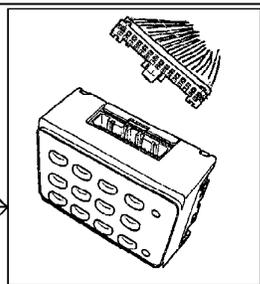
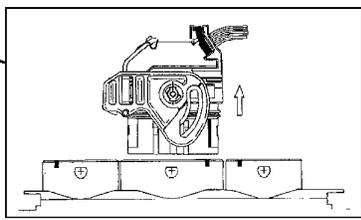
TYPE 2 VEHICLE WIRING DIAGRAM:



PRIOR CONDITIONS

- BATTERY VOLTAGE  $\approx 12V$
- ENGINE CONTROL MODULE DISCONNECTED
- KEYPAD CONNECTOR DISCONNECTED

Check keypad connector as follows:



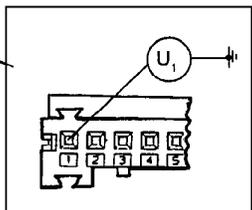
$U_1 \approx 12V$

NO

Check keypad feed, see page 8B-10

YES

$U_2 \approx 0V$

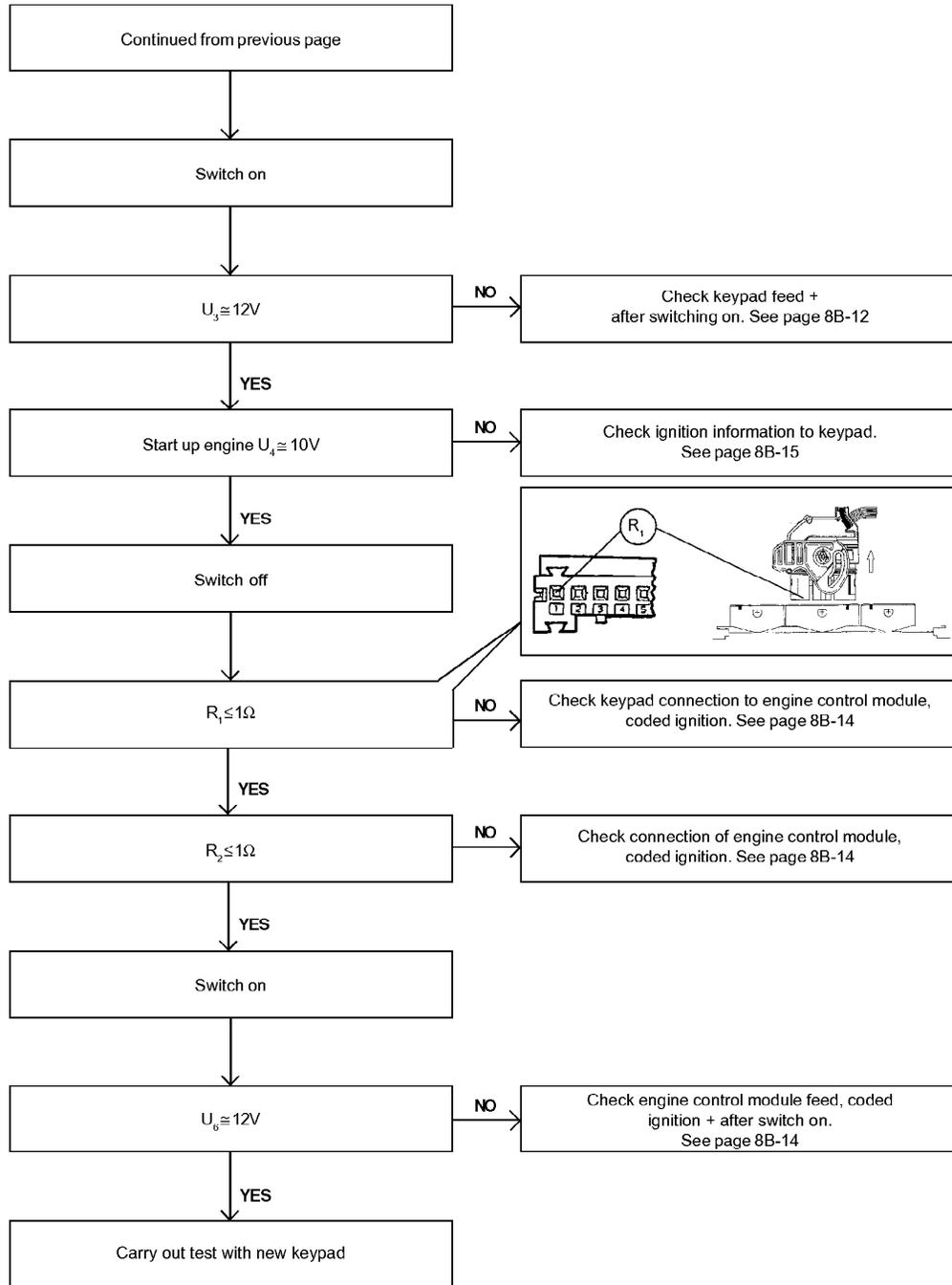


Check keypad ground, see page 8B-11

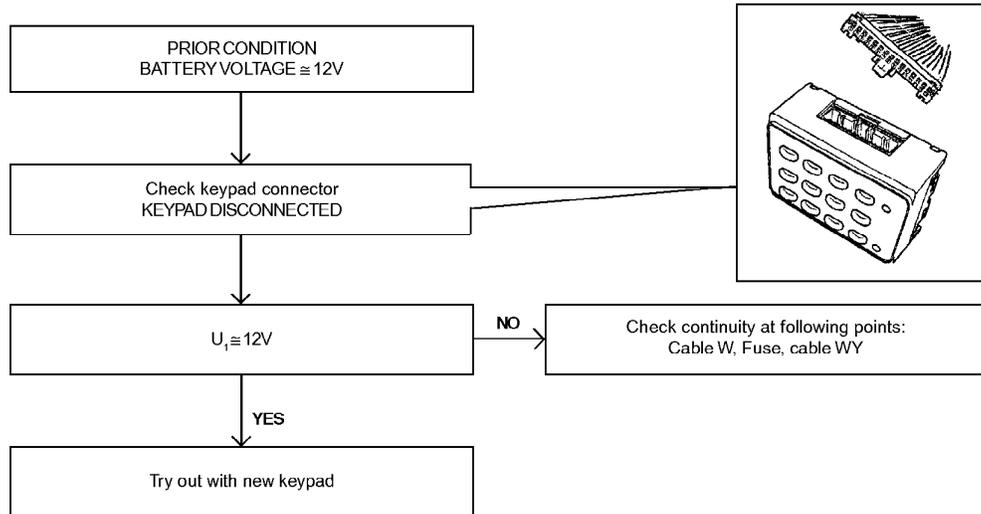
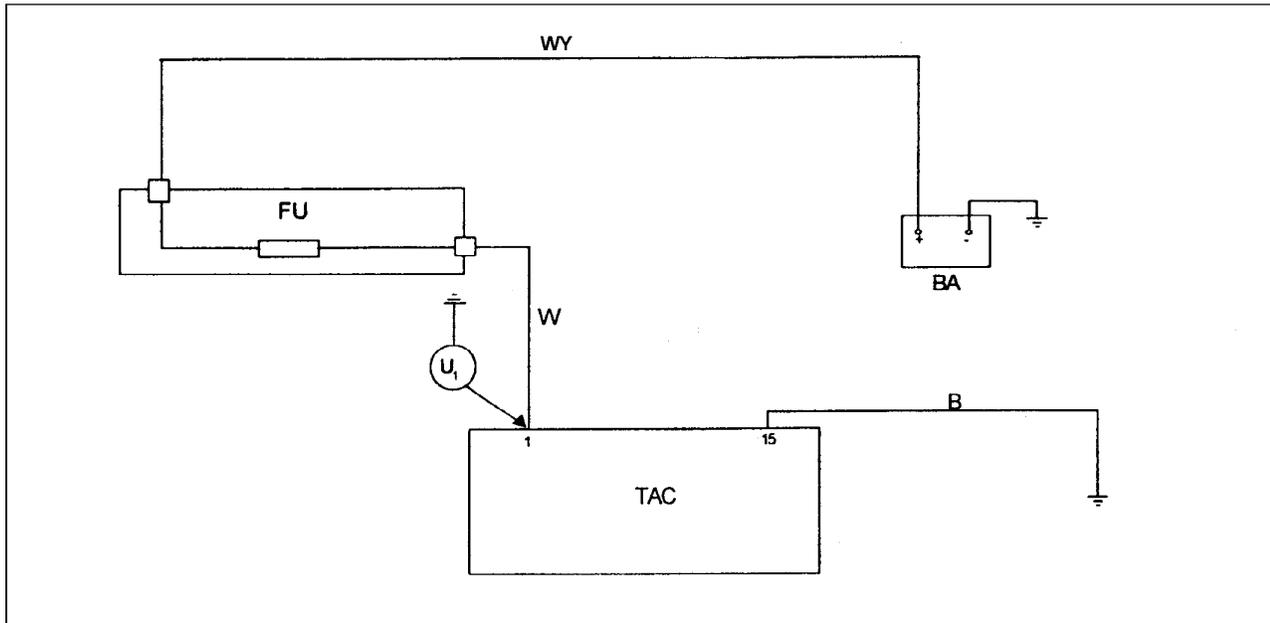
NO

YES

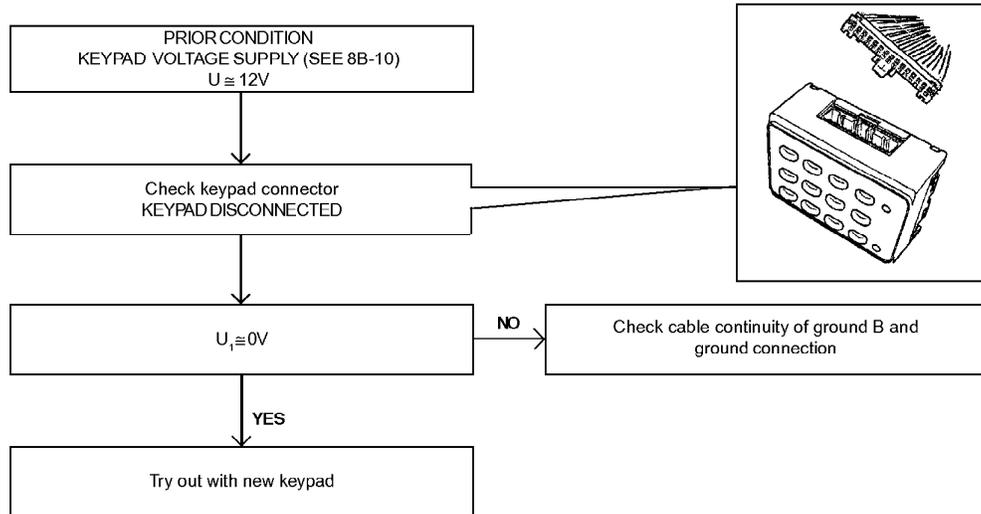
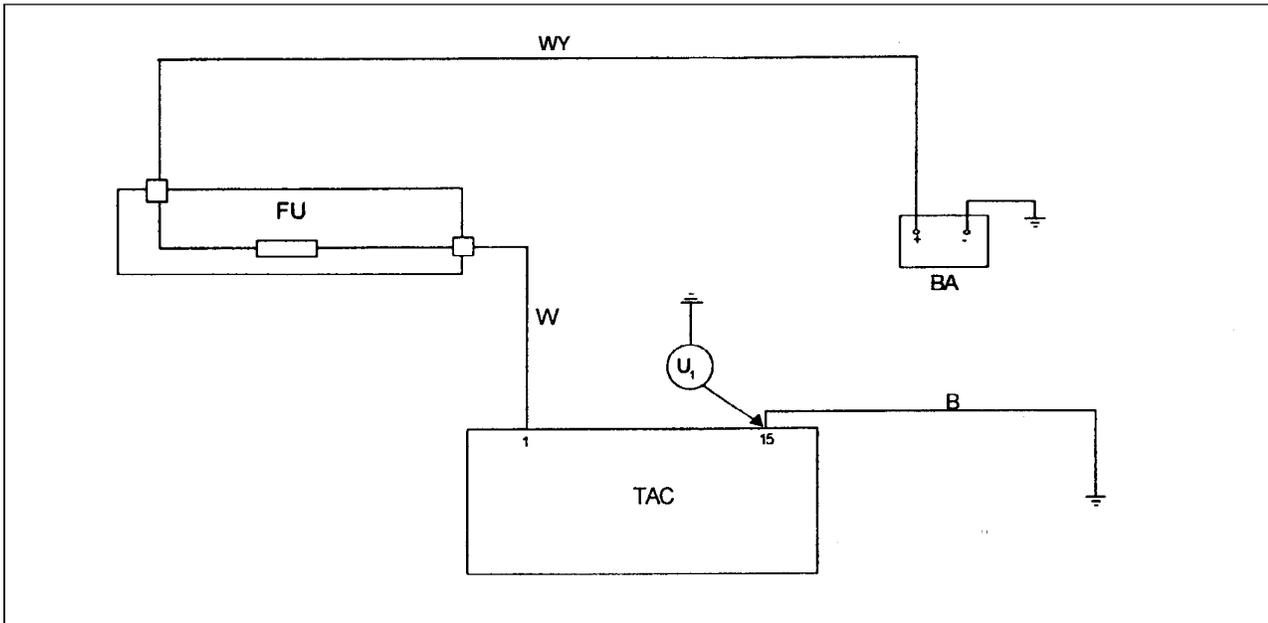
See following page



KEYPAD FEED CONTROL: + BATTERY

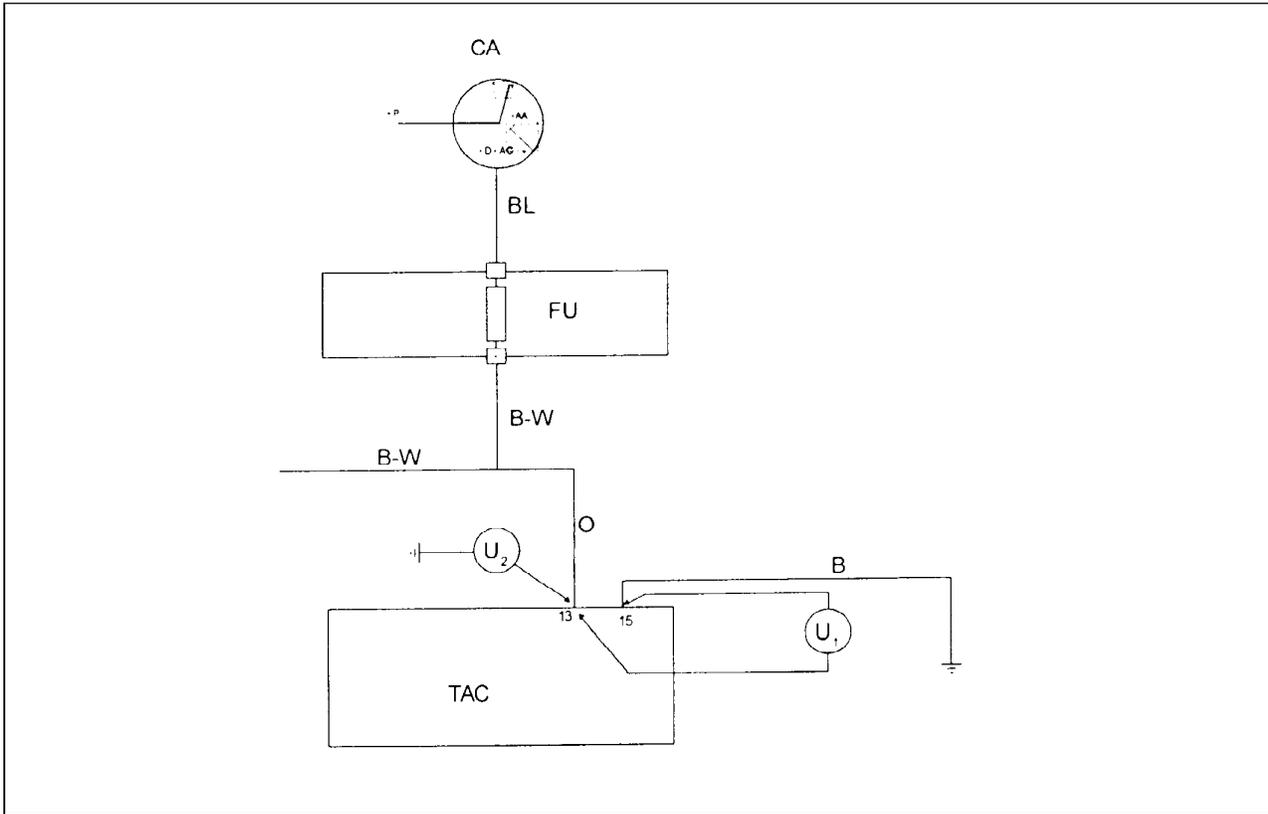


TESTING KEYPAD GROUND

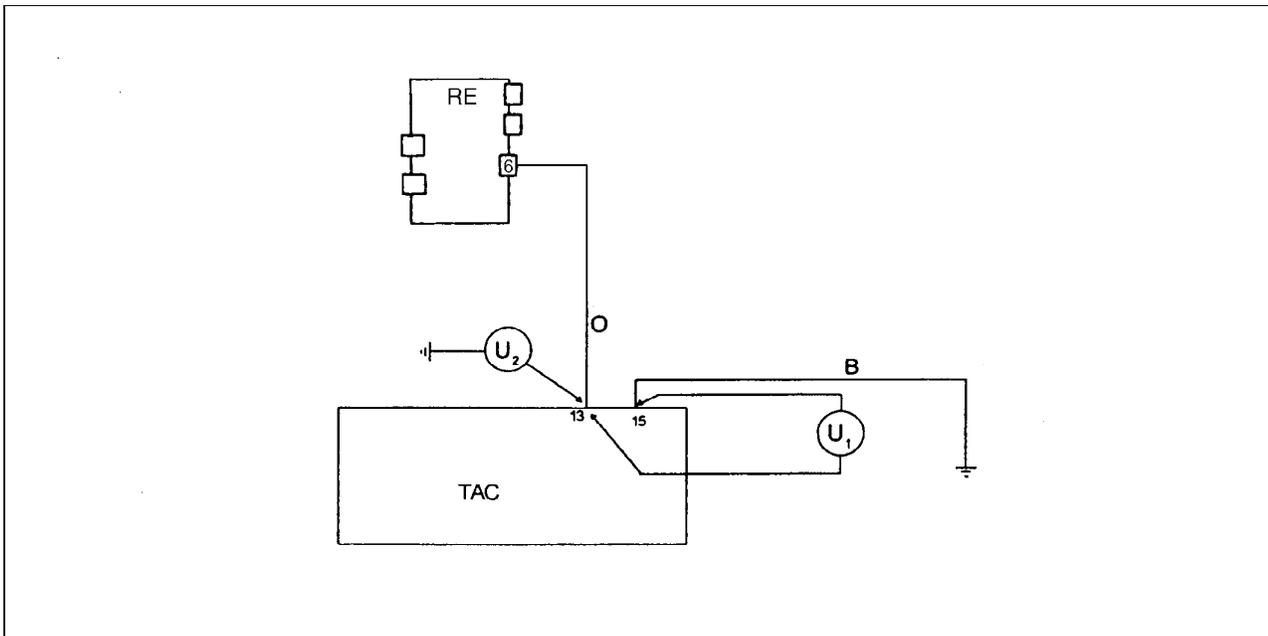


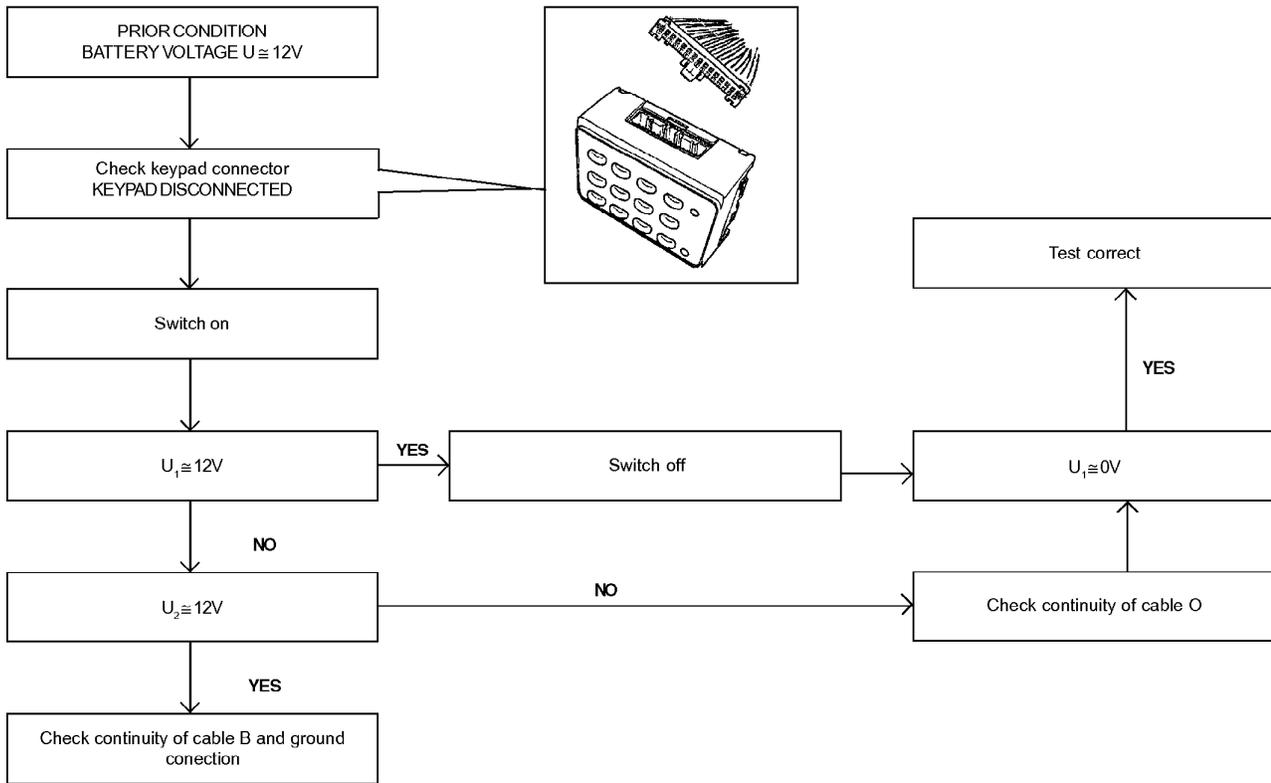
KEYPAD FEED CONTROL: + AFTER SWITCHING ON

TYPE 1 VEHICLE WIRING DIAGRAM

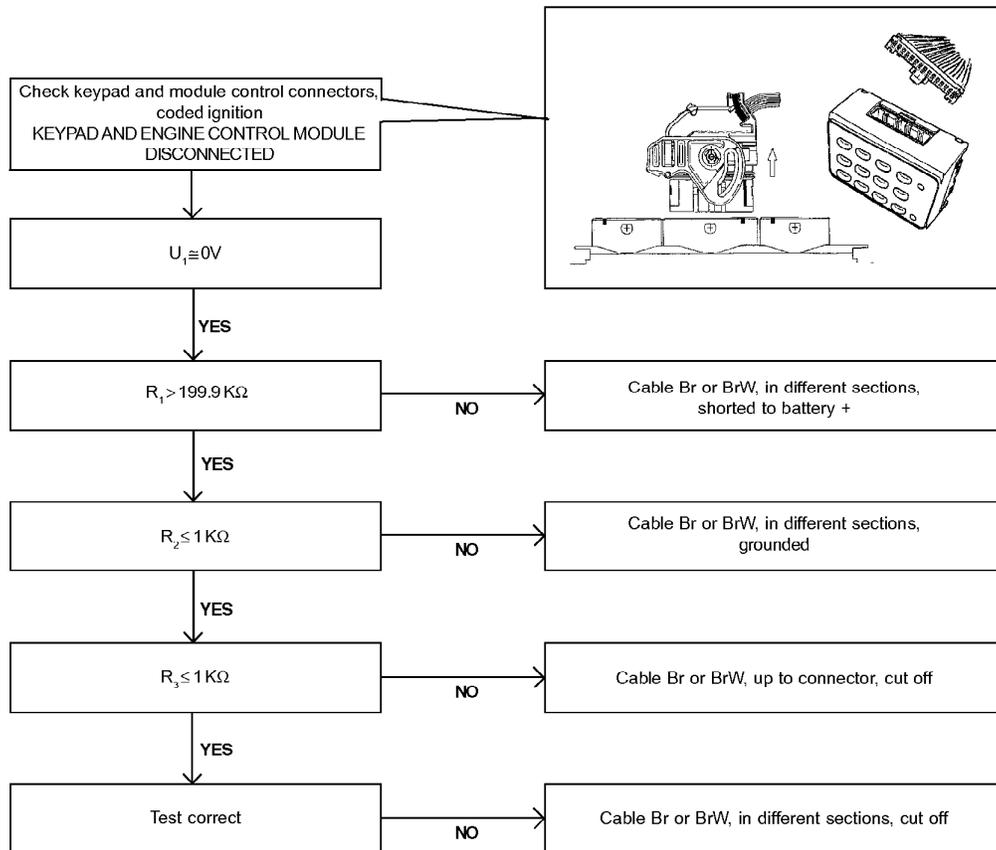
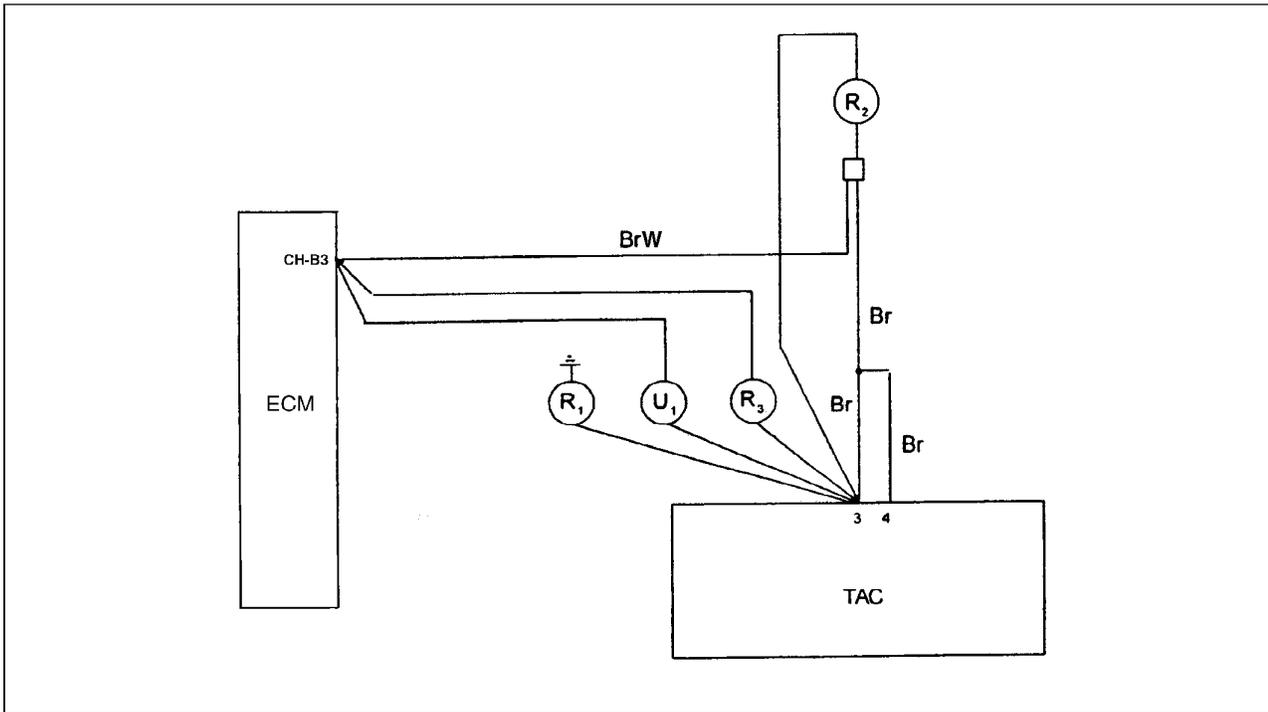


TYPE 2 VEHICLE WIRING DIAGRAM

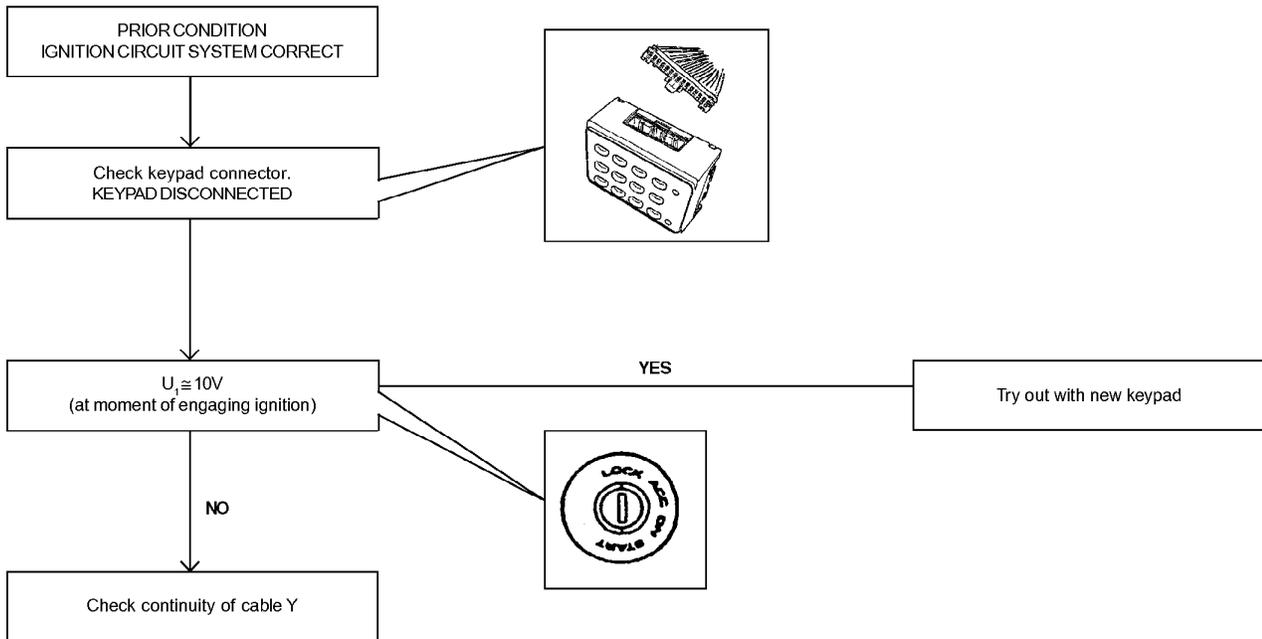
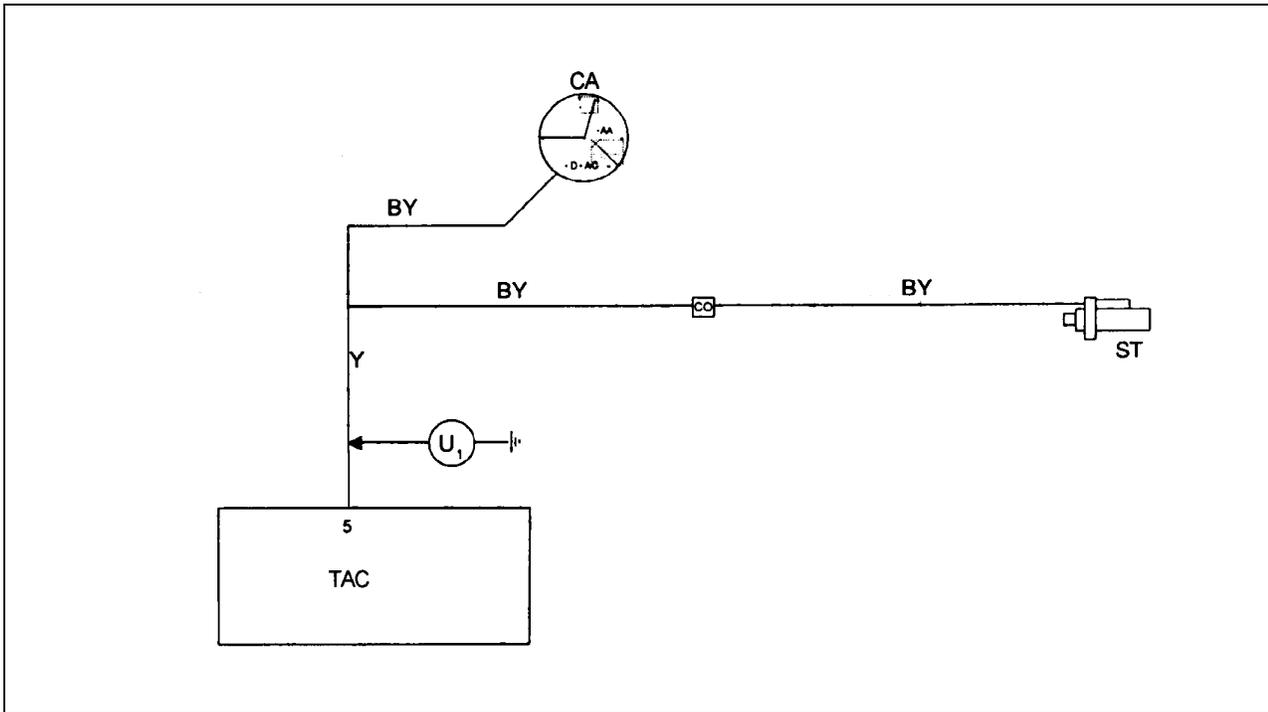




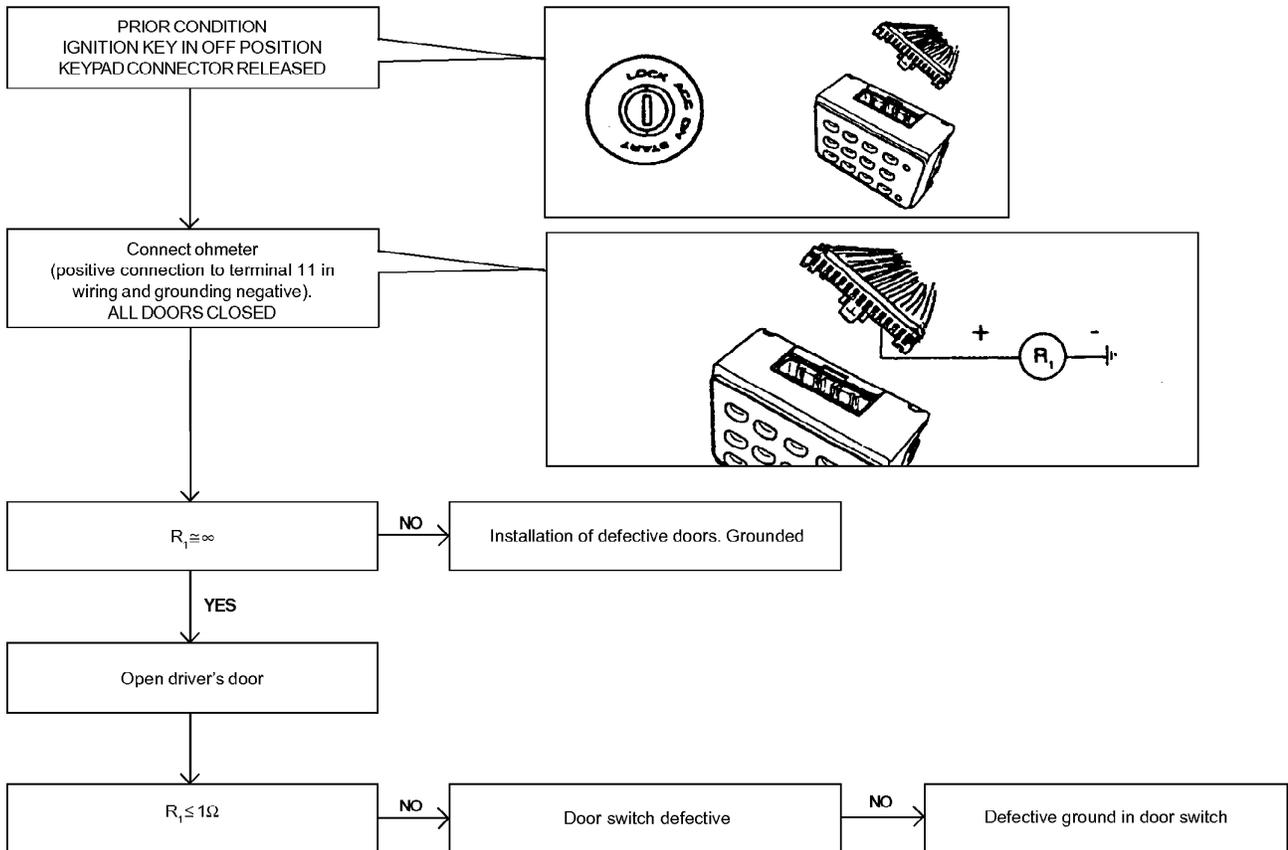
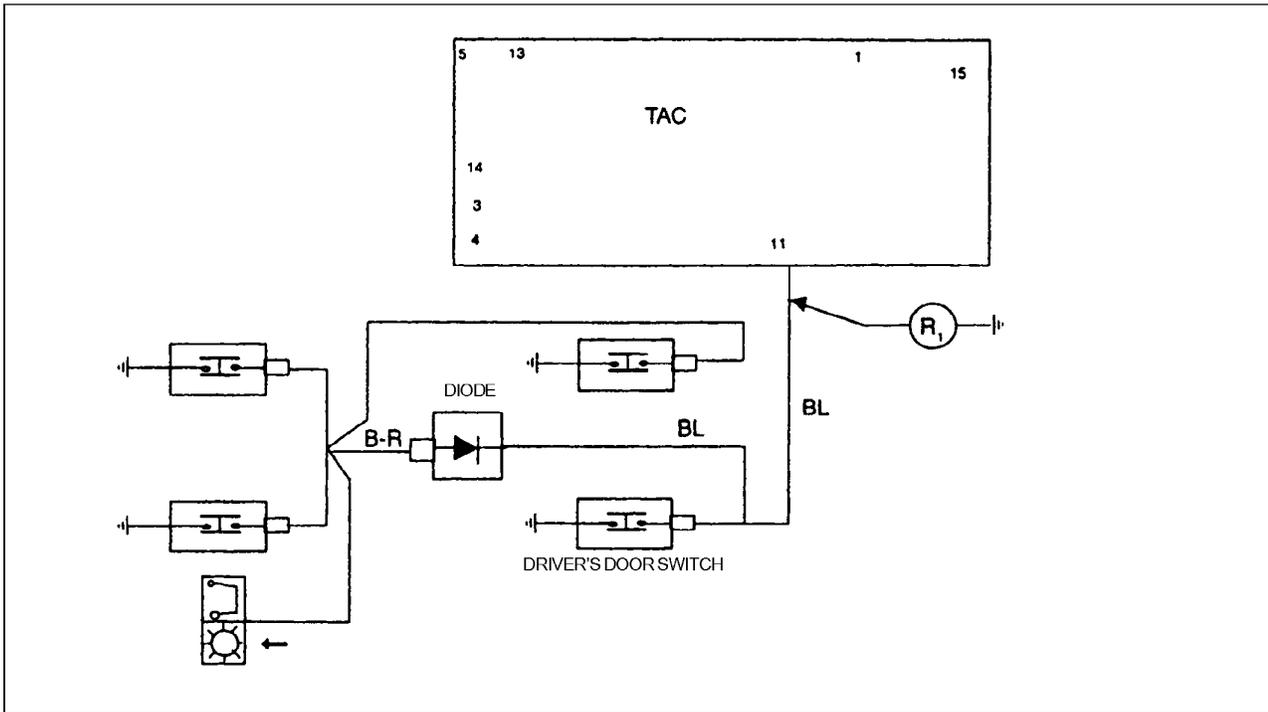
TESTING KEYPAD CONNECTION TO ENGINE CONTROL MODULE



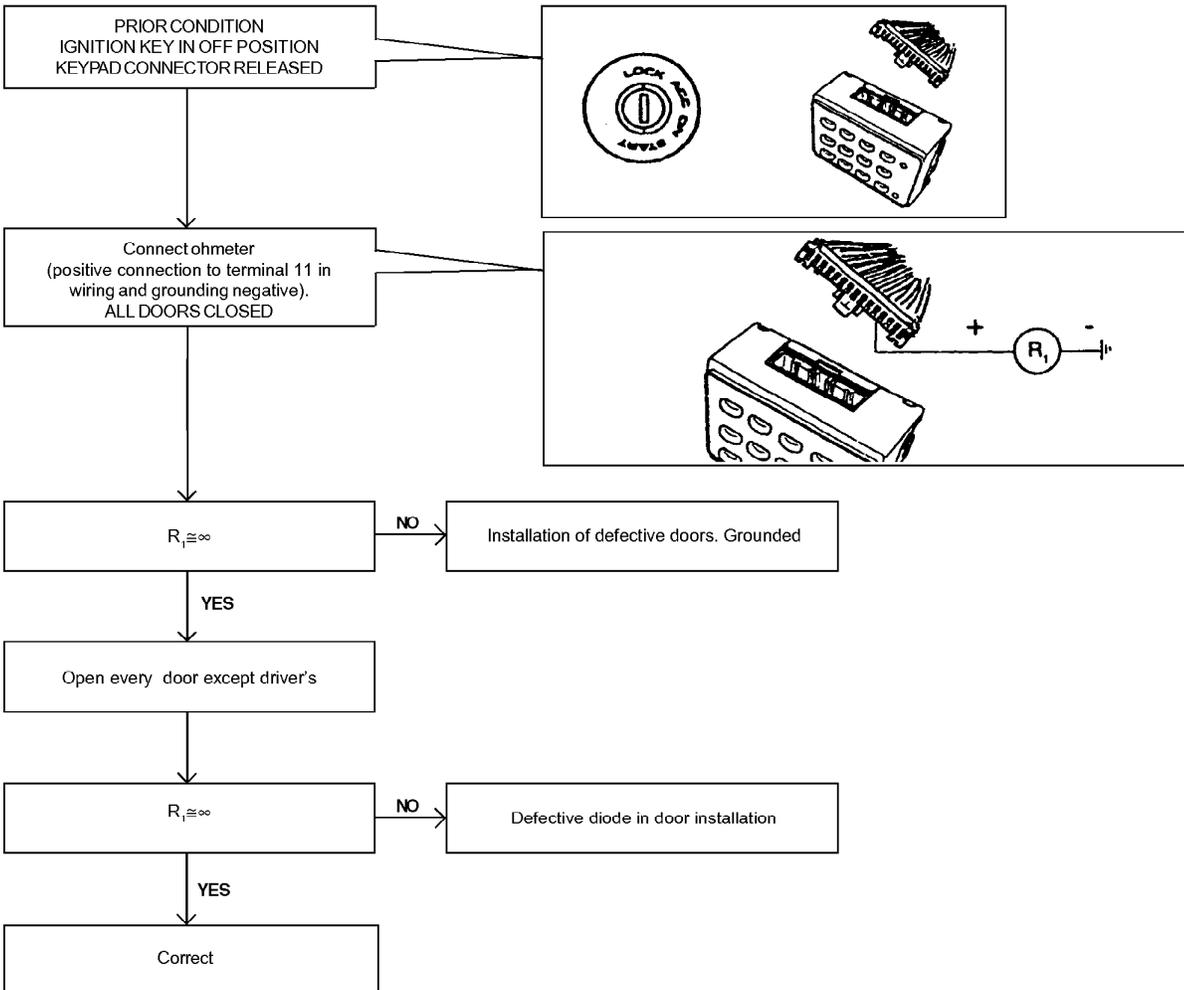
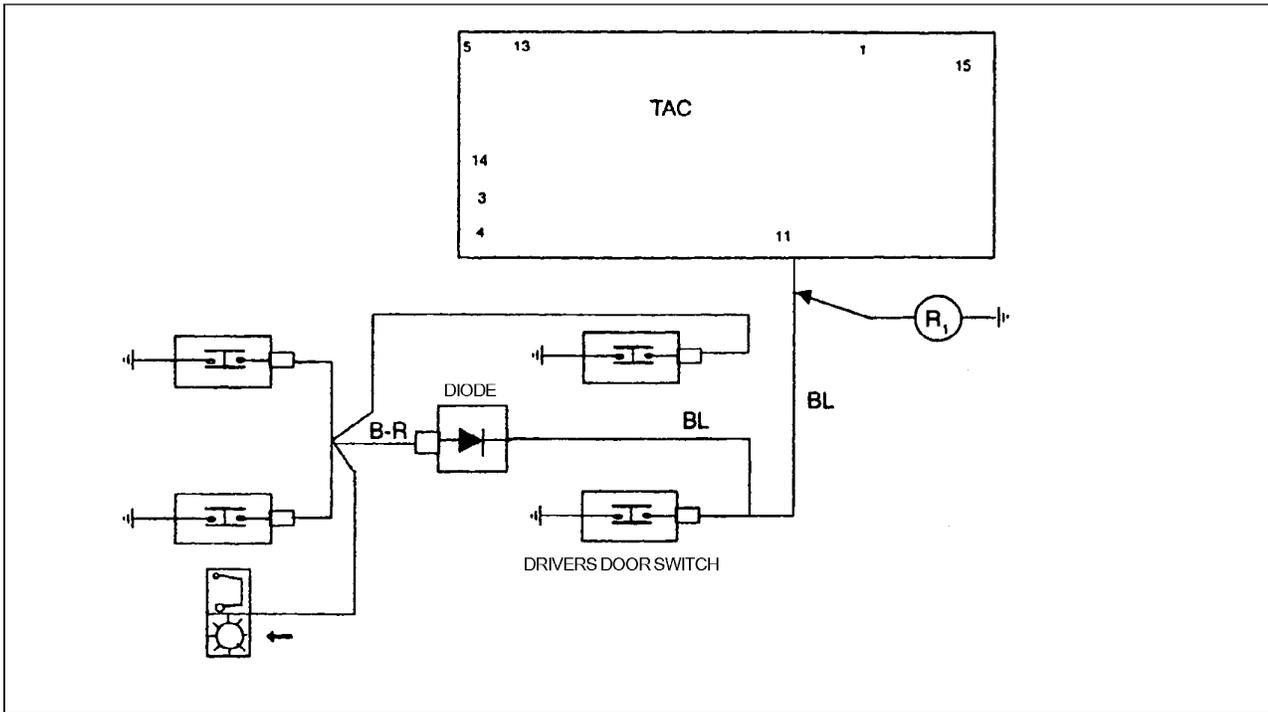
TESTING IGNITION INFORMATION TO KEYPAD



LOCK NOT ACTIVATED (ON OPENING AND CLOSING DRIVER'S DOOR)

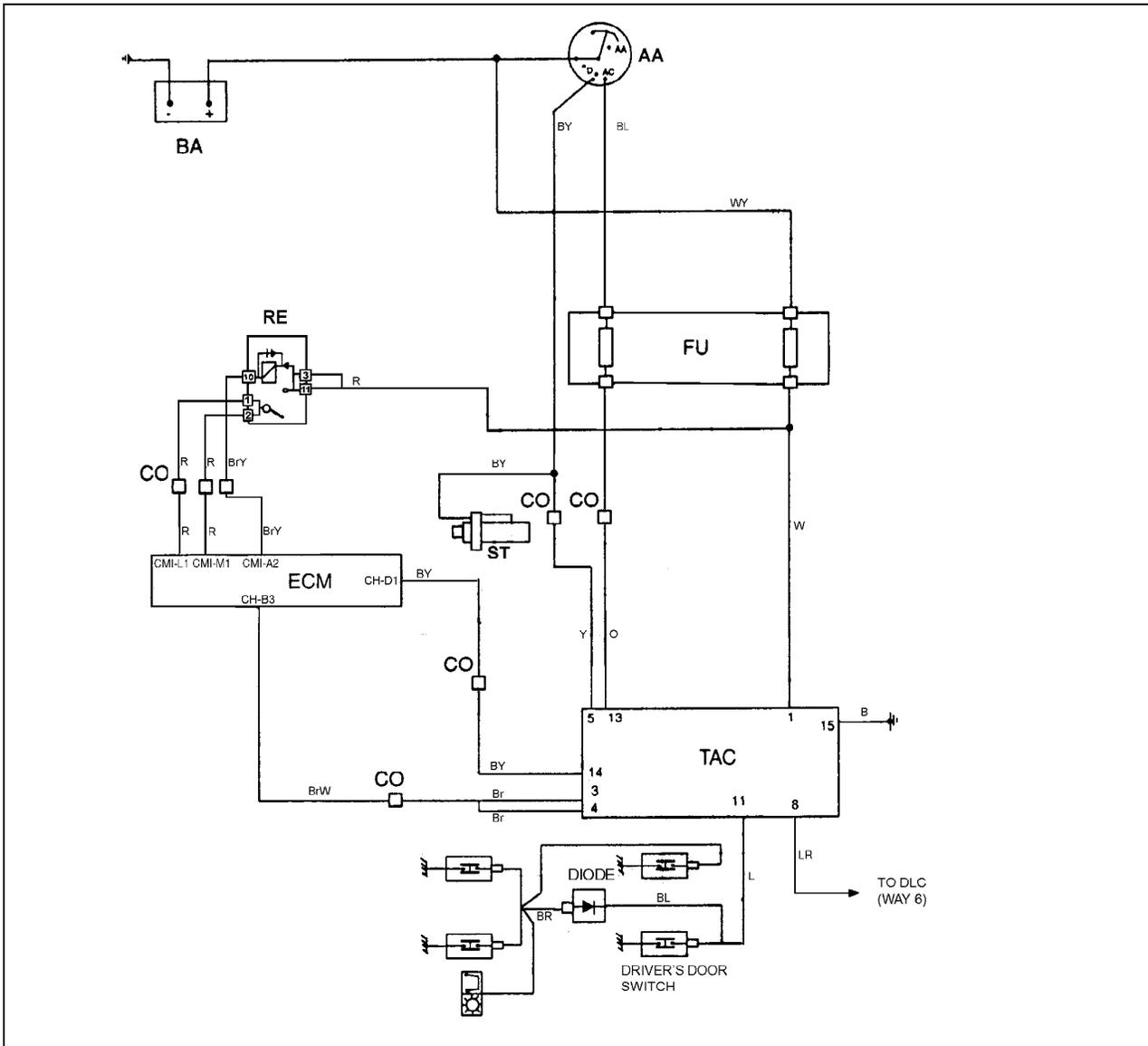


**LOCK ACTIVATED (ON OPENING AND CLOSING A DIFFERENT DOOR FROM DRIVER'S)**

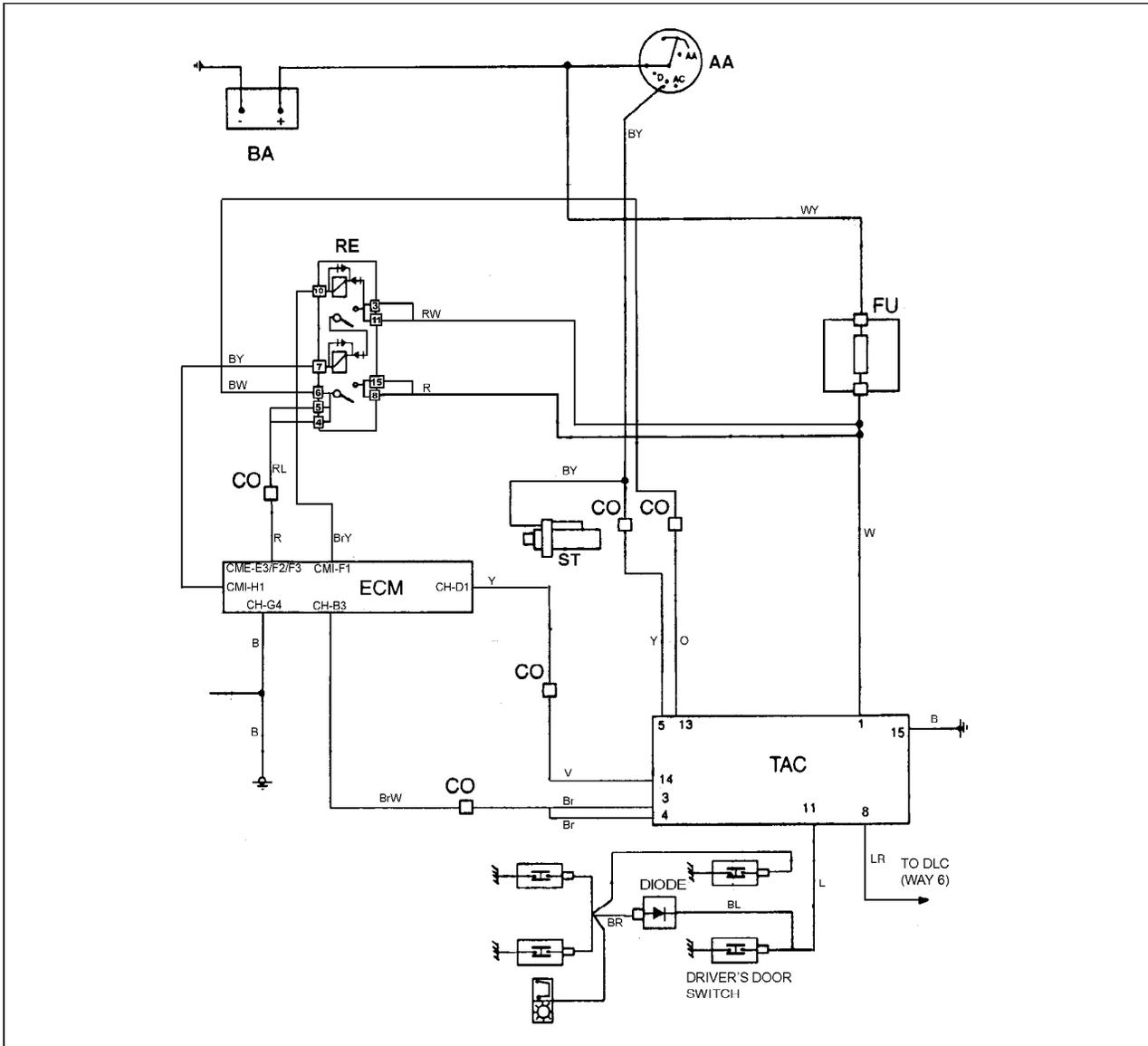


WIRING DIAGRAMS AND SYMBOLS IDENTIFICATION

Type 1 Vehicle Wire Diagram



Type 2 Vehicle Wire Diagram



COMPONENTS

- AA: ANTITHEFT ASSEMBLY (IGNITION KEY)
- BA: BATTERY
- CO: WIRING CONNECTOR
- DLC: DATA LINK CONNECTOR
- ECM: ENGINE CONTROL MODULE
- FU: FUSES
- RE: DOUBLE RELAY
- ST: STARTER MOTOR
- TAC: ANTITHEFT KEYPAD

WIRING COLOURS

- |                  |                  |
|------------------|------------------|
| B: BLACK         | O: ORANGE        |
| BL: BLACK/BLUE   | R: RED           |
| BR: BLACK/RED    | RL: RED/BLUE     |
| BW: BLACK/WHITE  | RW: RED/WHITE    |
| BY: BLACK/YELLOW | V: VIOLET        |
| Br: BROWN        | Y: YELLOW        |
| BrW: BROWN/WHITE | YB: YELLOW/BLACK |
| L: BLUE          | W: WHITE         |
| LR: BLUE/RED     |                  |

SECTION 10

TECHNICAL INFORMATION

NOTE:

For points not covered in this section, please refer to corresponding section in Service Manuals outlined in the FOREWORD to this manual.

CONTENTS

ENGINE .....	10-2
TRANSMISSION AND TRANSFER CASE .....	10-2
MEASUREMENTS .....	10-3
WEIGHTS.....	10-3

<b>ENGINE</b>				
			<b>Type 1 Vehicle</b>	<b>Type 2 Vehicle</b>
Number of cylinders and arrangement			4 in line	4 in line
Fuel firing order			1 - 3 - 4 - 2	1 - 3 - 4 - 2
Timing			OHC Actionated by belt	OHC Actionated by belt
Diameter and stroke			85 x 88	85 x 88
Cylinder capacity			1,997 cm <sup>3</sup>	1,997 cm <sup>3</sup>
Compression ratio			17.6:1	17.6:1
Compression engine warmed up	Pressure		30 ± 5 Kg/cm <sup>2</sup>	30 ± 5 Kg/cm <sup>2</sup>
	Máx. Difference		5 Kg/cm <sup>2</sup>	5 Kg/cm <sup>2</sup>
Maximum Power (C.E.E.)			66 Kw (4,000 r.p.m.)	64 Kw (4,000 r.p.m.)
Maximum Torque			205 Nm (1,750 r.p.m.)	160 Nm (1,700 r.p.m.)
Maximum rotation			4,500 r.p.m. ± 160 r.p.m.	5,000 r.p.m. ± 200 r.p.m.
Injection type			Direct at high pressure	Direct at high pressure
Intake type			Turbo compressor	Turbo compressor
Injectors Resistance			0.56 Ω (Máx.)	0.56 Ω (Máx.)
Maximum thermostat aperture			95°	95°
Oil system pressure	Idling		2 Kg/cm <sup>2</sup>	2 Kg/cm <sup>2</sup>
	to 4,000 r.p.m.		4 Kg/cm <sup>2</sup>	4 Kg/cm <sup>2</sup>
Pressure switch measurement			0.8 Kg/cm <sup>2</sup>	0.8 Kg/cm <sup>2</sup>
<b>TRANSMISSION AND TRANSFER CASE</b>				
			<b>Type 1 Vehicle</b>	<b>Type 2 Vehicle</b>
Type			Manual Transmission	Manual Transmission
Transmission rate	1 <sup>st</sup> Gear		3.704	3.652
	2 <sup>nd</sup> Gear		2.020	1.947
	3 <sup>rd</sup> Gear		1.369	1.379
	4 <sup>th</sup> Gear		1.000	1.000
	5 <sup>th</sup> Gear		0.802	0.795
	Rev.		4.473	3.670
Transfer case transmission rate	High		1.000	1.000
	Low		1.816	1.816
Differential groups			4.300	4.300

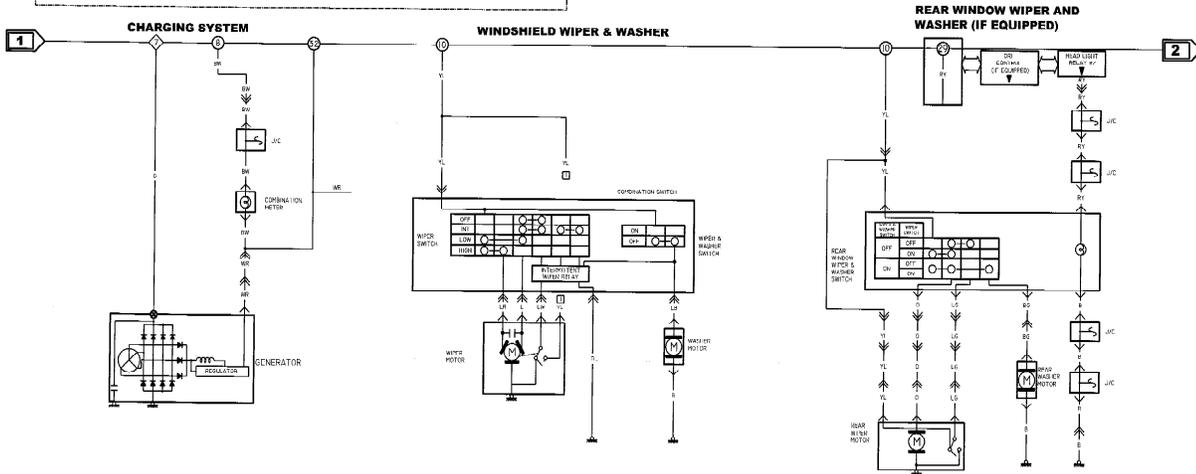
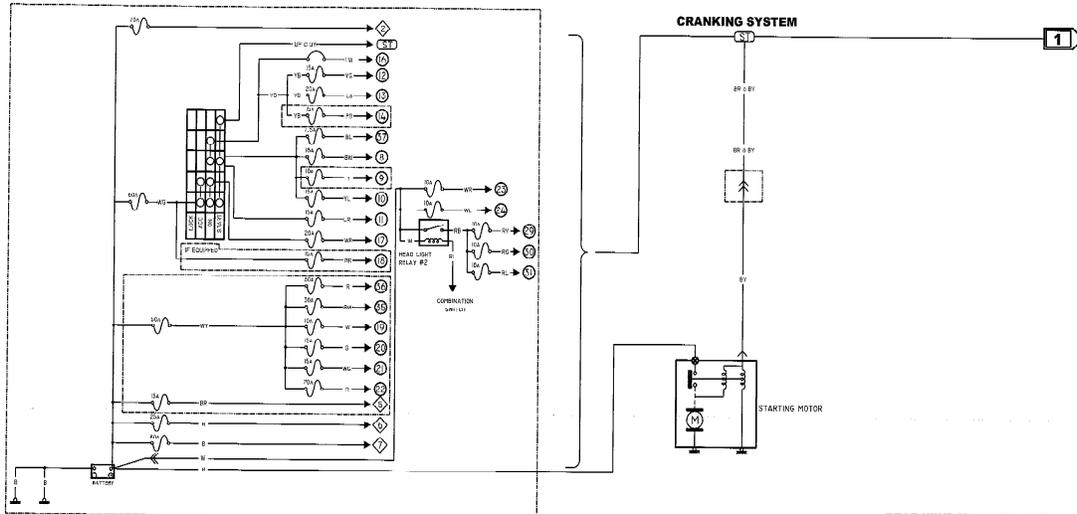
<b>MEASUREMENTS</b>	5 Doors Metal roof
Length(mm)	4,030
Width (mm)	1,635
Height (mm)	1,700
Distance between axles (mm)	2,480
Front track width (mm)	1,395
Rear track width (mm)	1,400
Headroom (mm)	200
Turning radius (m)	5.4
<b>WEIGHTS</b>	
Kg. empty	1,342
Kg. with max. load	1,850



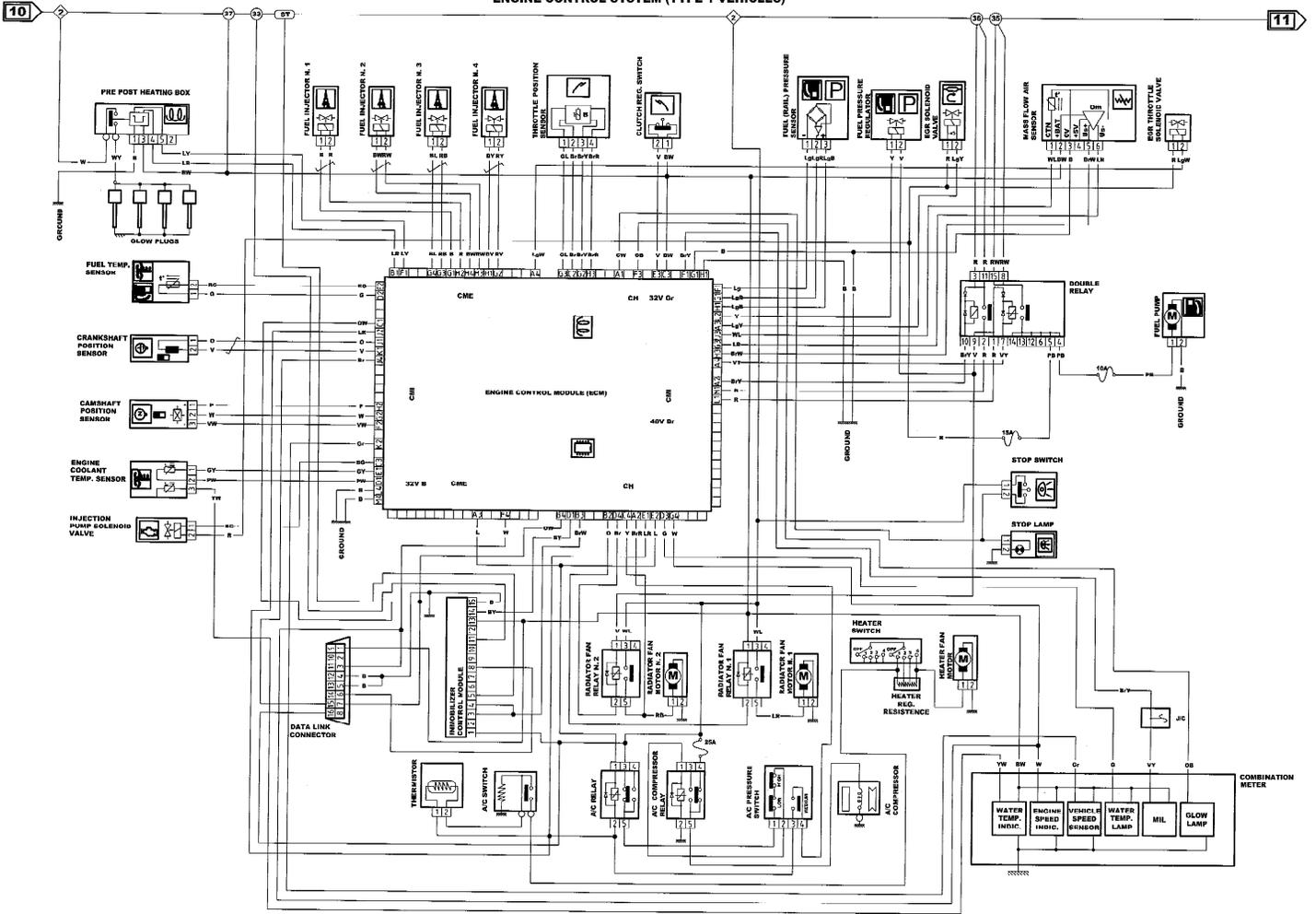
## **WIRING DIAGRAMS**

**NOTE:**

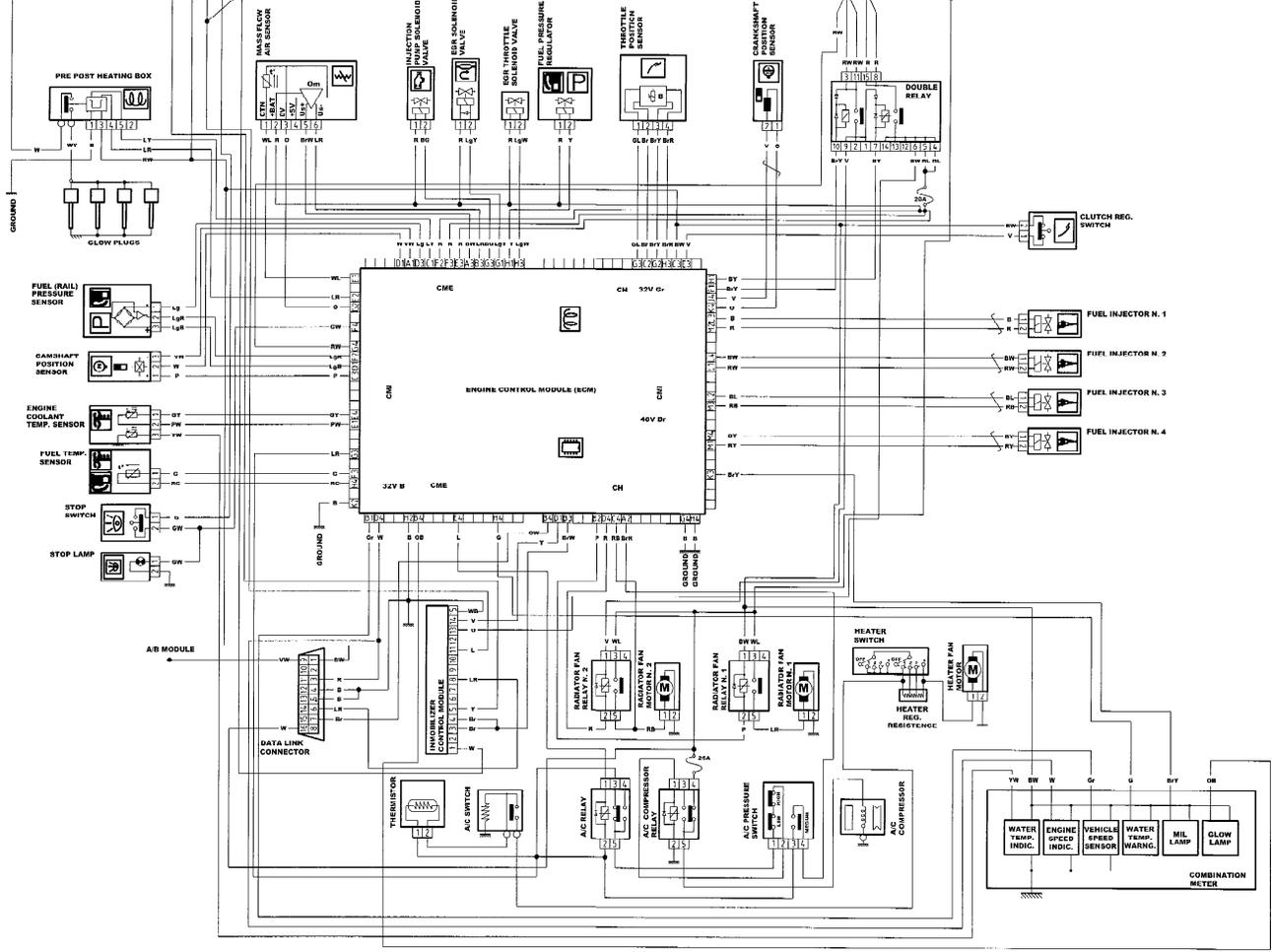
**For points not covered in this section, please refer to corresponding section in Service Manuals outlined in the FOREWORD to this manual.**



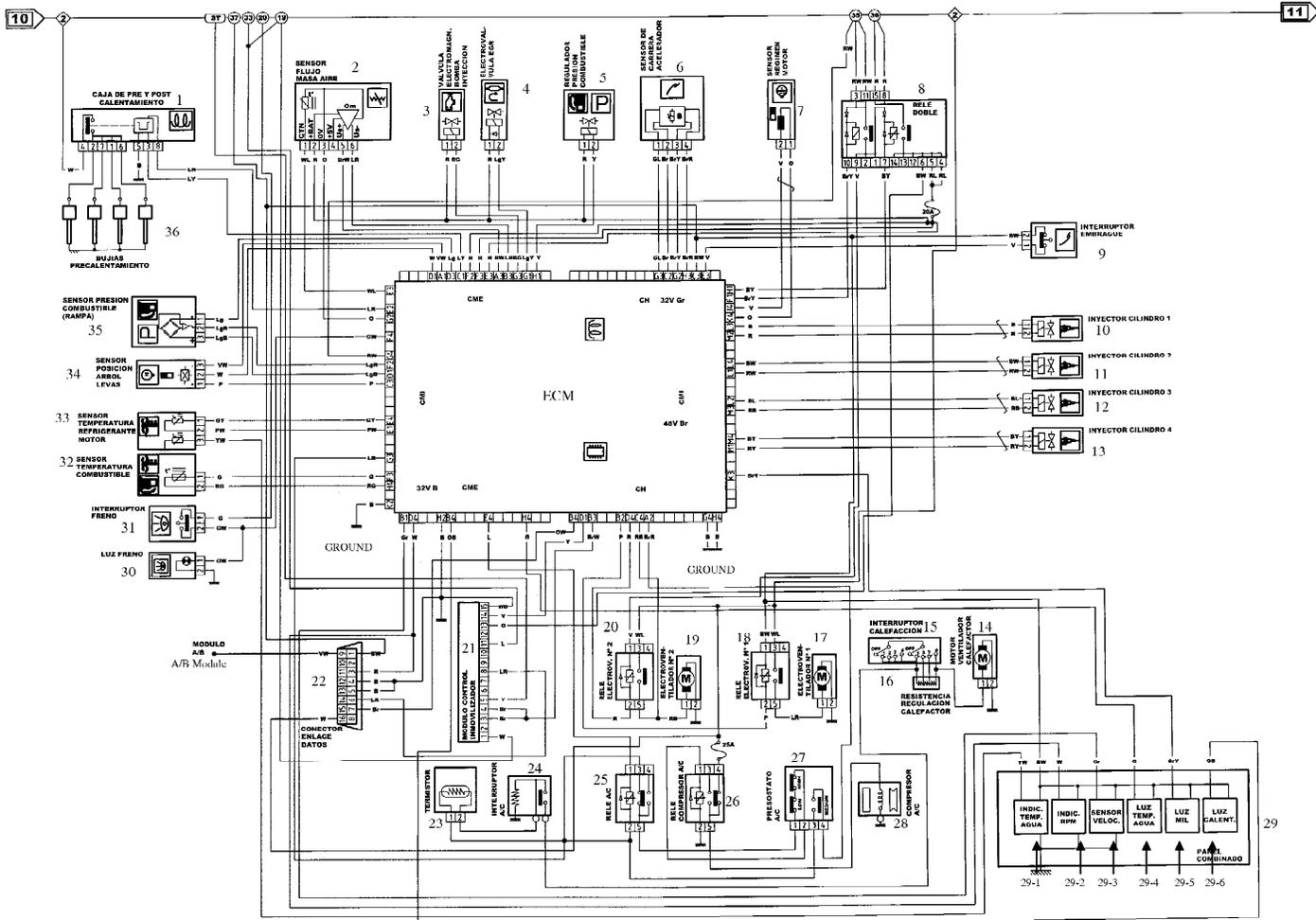
ENGINE CONTROL SYSTEM (TYPE 1 VEHICLES)



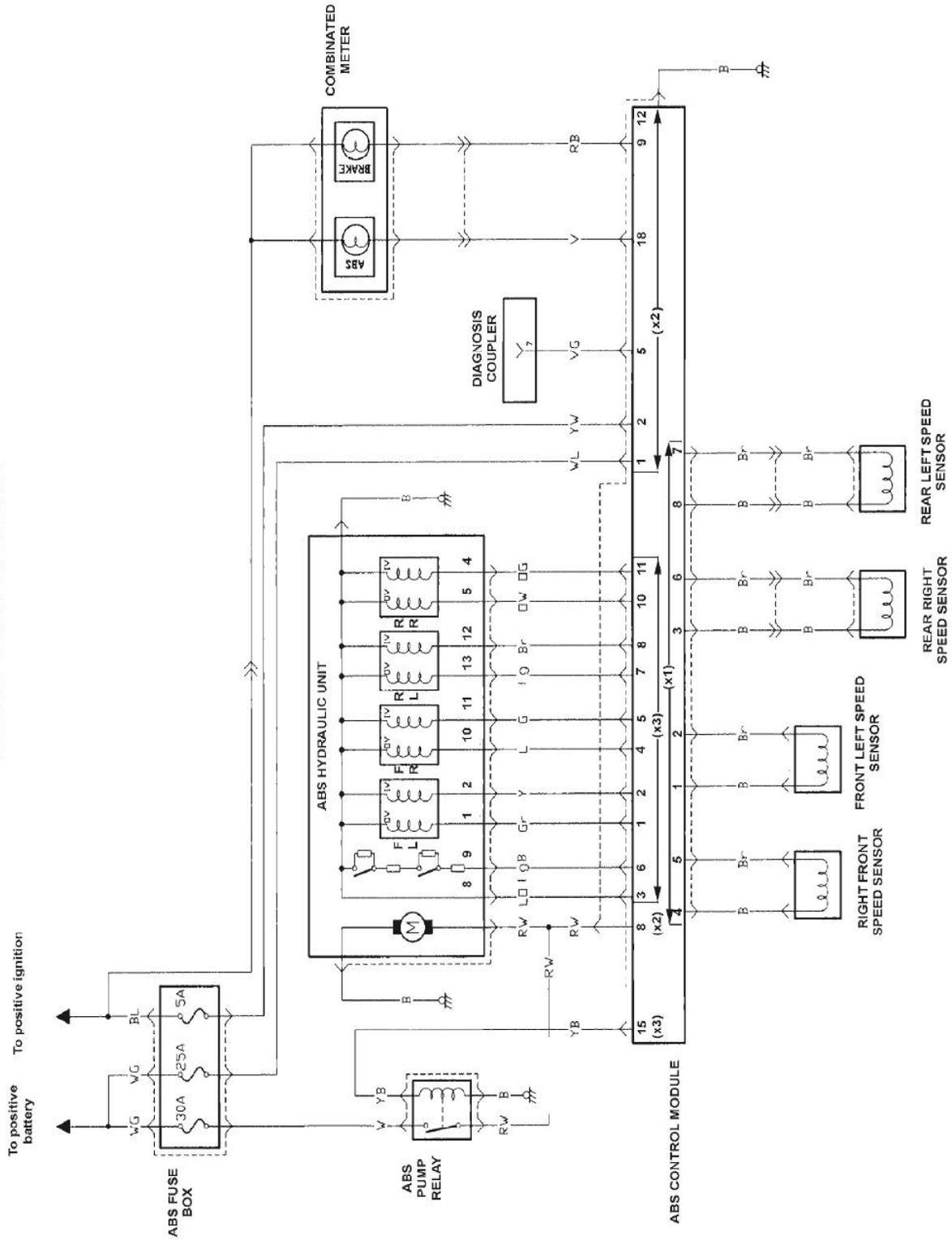
10 ENGINE CONTROL SYSTEM (TYPE 2 VEHICLES) 11



SYSTEM WIRING DIAGRAM (TYPE 2 WITH OBD)



### 1.1 ABS SYSTEM WIRING



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**SANTANA MOTOR, S.A.**

**After Sales Department**

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