WORKSHOP MANUAL

TF SERIES

ENGINE
6VE1

SECTION 6

ISUZU

ISUZU

International Service & Parts

Tokyo, Japan

ENGINE

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ENGINE MECHANICAL (6VE1 3.5L)

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Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

General Description

Engine Cleanliness And Care

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

- A liberal coating of engine oil should be applied to all friction areas during assembly to protect and lubricate the surfaces on initial operation.
- Whenever valve train components, pistons, piston rings, connecting rods, rod bearings, and crankshaft journal bearings are removed for service, they should be retained in order.
- At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.
- Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.
- The six cylinders of this engine are identified by numbers; Right side cylinders 1, 3 and 5, Left side cylinders 2, 4 and 6, as counted from crankshaft pulley side to flywheel side.

General Information on Engine Service

The following information on engine service should be noted carefully, as it is important in preventing damage and contributing to reliable engine performance.

- When raising or supporting the engine for any reason, do not use a jack under the oil pan. Due to the small clearance between the oil pan and the oil pump strainer, jacking against the oil pan may cause damage to the oil pick-up unit.
- The 12-volt electrical system is capable of damaging circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected at the battery.
- Any time the intake air duct or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material into the cylinder which could cause extensive damage when the engine is started.

Cylinder Block

The cylinder block is made of aluminum die-cast casting for 75°V–type six cylinders. It has a rear plate integrated structure and employs a deep skirt. The cylinder liner is cast and the liner inner diameter and crankshaft journal diameter are classified into grades. The crankshaft is supported by four bearings of which width is different between No.2, No.3 and No.1, No.4; the width of No.3 bearing on the body side is different in order to support the thrust bearing. The bearing cap is made of nodular cast iron and each bearing cap uses four bolts and two side bolts.

Cylinder Head

The cylinder head, made of aluminum alloy casting employs a pent-roof type combustion chamber with a spark plug in the center. The intake and exhaust valves are placed in V-type design. The ports are cross-flow type.

Valve Train

Intake and exhaust camshaft on the both side of banks are driven through an camshaft drive gear by timing belt. The valves are operated by the camshaft and the valve clearance is adjusted to select suitable thickness shim.

Intake Manifold

The intake manifold system is composed of the aluminum cast common chamber and intake manifold attached with six fuel injectors.

Exhaust Manifold

The exhaust manifold is made of nodular cast iron.

Pistons and Connecting Rods

Aluminum pistons are used after selecting the grade that meets the cylinder bore diameter. Each piston has two compression rings and one oil ring. The piston pin made of chromium steel is offset 1mm toward the thrust side, and the thrust pressure of piston to the cylinder wall varies gradually as the piston travels. The connecting rods are made of forged steel. The connecting rod bearings are graded for correct size selection.

Crankshaft and Bearings

The crankshaft is made of Ductile cast-iron. Pins and journals are graded for correct size selection for their bearing.

Engine Control Module (ECM)

The ECM location is on the common charmber.

Engine Diagnosis

Hard Starting

1. Starting Motor Does Not Turn Over

Troubleshooting Procedure

Turn on headlights and starter switch.

Symptom	Possible Cause	Action
Headlights go out or dim considerably	Battery run down or under charged	*Recharge or replace battery*
	Terminals poorly connected	*Clean battery posts and terminals and connect properly*
	Starting motor coil circuit shorted	*Overhaul or replace*
	Starting motor defective	*Overhaul or replace*

2. Ignition Trouble – Starting Motor Turns Over But Engine Does Not Start Spark Test

Disconnect an ignition coil from any spark plug. Connect the spark plug tester 5–8840–0383–0, start the engine, and check if a spark is generated in the spark plug tester. Before starting the engine, make sure that the spark plug tester is properly grounded. To avoid electrical shock, do not touch the part where insulation of the ignition coil is broken while the engine is running.

Symptom	Possible Cause	Action
Spark jumps across gap	Spark plug defective	*Clean or replace*
	Ignition timing incorrect	*Refer to Ignition System*
	Fuel not reaching fuel injector(s) or engine	*Refer to item 3 (Trouble in fuel system)*
	Valve timing incorrect	*Adjust*
	Engine lacks compression	*Refer to item 4 (Engine lacks compression)*
No sparking takes place	Ignition coil disconnected or broken	*Connect properly or replace*
	Electronic Ignition System with module	*Replace*
	Poor connections in engine harness	*Correct*
	Engine Control Module cable disconnected or defective	*Correct or replace*

3. Trouble In Fuel System

Symptom	Possible Cause	Action
Starting motor turns over and spark occurs but engine does not start.	Fuel tank empty	*Fill*
	Water in fuel system	*Clean*
	Fuel filter clogged	*Replace filter*
	Fuel pipe clogged	*Clean or replace*
	Fuel pump defective	*Replace*
	Fuel pump circuit open	*Correct or replace*
	Evaporative Emission Control System circuit clogged	*Correct or replace*
	Multiport Fuel Injection System faulty	*Refer to "Electronic Fuel Injection" section*

4. Engine Lacks Compression

Symptom	Possible Cause	Action
Engine lacks compression	Spark plug loosely fitted	*Tighten to specified torque*
	Valve timing incorrect	*Adjust*
	Cylinder head gasket defective	*Replace gasket*
	Valve incorrectly seated	*Lap valve*
	Valve stem seized	*Replace valve and valve guide*
	Valve spring weakened or broken	*Replace*
	Cylinder or piston rings worn	*Overhaul engine*
	Piston ring seized	*Overhaul engine.*

Engine Compression Test Procedure

1. Start and run the engine until the engine reaches normal operating temperature.
2. Turn the engine off.
3. Remove all the spark plugs.
4. Remove ignition coil fuse (15A) and disable the ignition system.
5. Remove the fuel pump relay from the relay and fuse box.
6. Engage the starter and check that the cranking speed is approximately 300 rpm.
7. Install cylinder compression gauge into spark plug hole.
8. With the throttle valve opened fully, keep the starter engaged until the compression gage needle reaches the maximum level. Note the reading.
9. Repeat the test with each cylinder.

   If the compression pressure obtained falls below the limit, engine overhaul is necessary.

   Limit; 1000 kPa (145 psi)

Rough Engine Idling or Engine Stalling

Symptom	Possible Cause	Action
Trouble in fuel injection system	Idle air control valve defective	*Replace*
	Throttle shutting off incomplete	*Replace*
	Throttle position sensor circuit open or shorted	*Correct or replace*
	Fuel injector circuits open or shorted	*Correct or replace*
	Fuel injectors damaged	*Replace*
	Fuel pump relay defective	*Replace*
	Mass Airflow Sensor circuit open or poor connections	*Correct or replace*
	Mass Airflow Sensor defective	*Replace*
	Engine Coolant Temperature Sensor circuit open or poor connections	*Correct or replace*
	Engine Coolant Temperature Sensor defective	*Replace*
	Intake Air Temperature sensor circuit open or poor connections	*Correct or replace*
	Intake Air Temperature sensor defective	*Replace*
	Vehicle Speed Sensor circuit open or shorted	*Correct or replace*
	Vehicle Speed Sensor defective	*Replace*
Trouble in emission control system	EGR valve defective	*Replace*
	EGR valve circuit open or poor connection	*Correct or replace*
	Engine Control Module defective	*Replace*
	Canister purge valve circuit open or poor connections	*Correct or replace*
	Canister purge valve defective	*Replace*
	Evaporative Emission Canister Purge control valve defective	*Replace*
	Trouble in ignition system	*Refer to “Hard Start"*
Others	Engine lacks compression	*Refer to “Hard Start"*
	Valve incorrectly seated	*Lap valve*
	Air Cleaner Filter clogged	*Replace filter element*
	Valve timing incorrect	*Readjust*
	Idle air control valve broken	*Replace*
	Fast idle solenoid defective	*Replace*
	Positive Crankcase Ventilation valve defective or clogged	*Replace*

Rough Engine Running

Symptom	Possible Cause	Action
Engine misfires periodically	Ignition coil layer shorted	*Replace*
	Spark plugs fouling	*Clean or install hotter type plug*
	Spark plug(s) insulator nose leaking	*Replace*
	Fuel injector(s) defective	*Replace*
	Engine control module faulty	*Replace*
Engine knocks periodically	Spark plugs running too hot	*Install colder type spark plugs*
	Engine control module faulty	*Replace*
Engine lacks power	Spark plugs fouled	*Clean*
	Fuel injectors defective	*Replace*
	Mass Airflow Sensor or Intake Airflow Sensor circuit defective	*Correct or replace*
	Engine Coolant Temperature Sensor or Engine Coolant Temperature Sensor circuit defective	*Correct or replace*
	Engine Control Module faulty	*Replace*
	Intake Air Temperature Sensor or Intake Air Temperature Sensor circuit defective	*Correct or replace*
	Throttle Position Sensor or Throttle Position Sensor circuit defective	*Correct or replace*

Hesitation

Symptom	Possible Cause	Action
Hesitation on acceleration	Throttle Position Sensor adjustment incorrect	*Replace throttle valve assembly*
	Throttle Position Sensor circuit open or shorted	*Correct or replace*
	Excessive play in accelerator linkage	*Adjust or replace*
	Mass Airflow Sensor circuit open or poor connections	*Correct or replace*
	Mass Airflow Sensor defective	*Replace*
	Intake Air Temperature (IAT) Sensor circuit open or poor connections	*Correct or replace*
	IAT Sensor defective	*Replace*
Hesitation at high speeds (Fuel pressure too low)	Fuel tank strainer clogged	*Clean or replace*
	Fuel pipe clogged	*Clean or replace*
	Fuel filter clogged	*Replace*
	Defective fuel pump system	*Check and replace*
	Fuel Pressure Control Valve leaking	*Replace*
Hesitation at high speeds (Fuel injector not working normally)	Power supply or ground circuit for Multiport Fuel Injection System shorted or open	*Check and correct or replace*
	Fuel Injector defective	*Replace*
	Cable of Multiport Fuel Injection System circuit open or poor connections	*Correct or replace*

Symptom	Possible Cause	Action
Hesitation at high speeds	Engine Control Module defective	*Replace*
	Throttle Position Sensor cable broken or poor connections	*Correct or replace*
	Throttle Position Sensor defective	*Replace*
	Engine Coolant Temperature Sensor circuit open or shorted	*Correct or replace*
	Engine Coolant Temperature Sensor defective	*Replace*
	Mass Airflow Sensor circuit open or poor connections	*Correct or replace*
	Mass Airflow Sensor defective	*Replace*
	IAT Sensor circuit open or poor connections	*Correct or replace*
	IAT Sensor defective	*Replace*
	Throttle valve not fully opened	*Check and correct or replace*
	Air Cleaner Filter clogged	*Replace filter element*
	Power supply voltage too low	*Check and correct or replace*

Engine Lacks Power

Symptom	Possible Cause	Action
Trouble in fuel system	Fuel Pressure Control Valve not working normally	*Replace*
	Fuel injector clogged	*Clean or replace*
	Fuel pipe clogged	*Clean*
	Fuel filter clogged or fouled	*Replace*
	Fuel pump drive circuit not working normally	*Correct or replace*
	Fuel tank not sufficiently breathing due to clogged Evaporative Emission Control System circuit	*Clean or replace*
	Water in fuel system	*Clean*
	Inferior quality fuel in fuel system	*Use fuel of specified octane rating*
	Engine Control Module supplied poor voltage	*Correct circuit*
	Throttle Position Sensor cable broken or poor connections	*Correct or replace*
	Throttle Position Sensor defective	*Replace*
	Mass Airflow Sensor not working normally	*Replace*
	Manifold Absolute Pressure Sensor not working normally	*Replace*
	Intake Air Temperature Sensor not working normally	*Replace*
	Engine Coolant Temperature Sensor circuit open or shorted	*Correct or replace*
	Engine Coolant Temperature Sensor defective	*Replace*
	Engine Control Module defective	*Replace*
Trouble in intake or exhaust system	Air Cleaner Filter clogged	*Replace filter element*
	Air duct kinked or flattened	*Correct or replace*
	Exhaust system clogged	*Correct or replace*
Ignition failure	———	*Refer to Hard Start Troubleshooting Guide*
	Heat range of spark plug inadequate	*Install spark plugs of adequate heat range*
	Ignition coil defective	*Replace*

Symptom	Possible Cause	Action
Engine overheating	Level of Engine Coolant too low	*Replenish*
	Fan clutch defective	*Replace*
	Thermostat defective	*Replace*
	Engine Coolant pump defective	*Correct or replace*
	Radiator clogged	*Clean or replace*
	Radiator filler cap defective	*Replace*
	Level of oil in engine crankcase too low or wrong engine oil	*Change or replenish*
	Resistance in exhaust system increased	*Clean exhaust system or replace defective parts*
	Throttle Position Sensor adjustment incorrect	*Replace with Throttle Valve ASM*
	Throttle Position Sensor circuit open or shorted	*Correct or replace*
	Cylinder head gasket damaged	*Replace*
Engine overcooling	Thermostat defective	*Replace (Use a thermostat set to open at 82°C (180°F))*
Engine lacks compression	———	*Refer to Hard Start*
Others	Tire inflation pressure abnormal	*Adjust to recommended pressures*
	Brake drag	*Adjust*
	Clutch slipping	*Adjust or replace*
	Level of oil in engine crankcase too high	*Correct level of engine oil*
	EGR valve defective	*Replace*

Engine Noisy

Abnormal engine noise often consists of various noises originating in rotating parts, sliding parts and other moving parts of the engine. It is, therefore, advisable to locate the source of noise systematically.

Symptom	Possible Cause	Action
Noise from crank journals or from crank bearings (Faulty crank journals and crank bearings usually make dull noise that becomes more evident when accelerating)	Oil clearance increased due to worn crank journals or crank bearings	*Replace crank bearings and crankshaft or regrind crankshaft and install the undersize bearing*
	Crankshaft out of round	*Replace crank bearings and crankshaft or regrind crankshaft and install the undersize bearing*
	Crank bearing seized	*Crank bearing seized Replace crank bearings and crankshaft or regrind crankshaft and install the undersize bearing*

Troubleshooting Procedure

Short out each spark plug in sequence using insulated spark plug wire removers. Locate cylinder with defective bearing by listening for abnormal noise that stops when spark plug is shorted out.

Symptom	Possible Cause	Action
Noise from connecting rods or from connecting rod bearings (Faulty connecting rods or connecting rod bearings usually make an abnormal noise slightly higher than the crank bearing noise, which becomes more evident when engine is accelerated)	Bearing or crankshaft pin worn	*Replace connecting rod bearings and crankshaft or regrind crankshaft pin and install the undersize bearing*
	Crankpin out of round	*Replace connecting rod bearings and crankshaft or regrind crankshaft pin and install the undersize bearing*
	Connecting rod bent	*Correct or replace*
	Connecting rod bearing seized	*Replace connecting rod bearings and crankshaft or regrind crankshaft pin and install the undersize bearing*

Troubleshooting Procedure

Abnormal noise stops when the spark plug on the cylinder with defective part is shorted out.

Symptom	Possible Cause	Action
Piston and cylinder noise (Faulty piston or cylinder usually makes a combined mechanical thumping noise which increases when engine is suddenly accelerated but diminishes gradually as the engine warms up)	Piston clearance increased due to cylinder wear	*Replace piston and cylinder body*
	Piston seized	*Replace piston and cylinder body*
	Piston ring broken	*Replace piston and cylinder body*
	Piston defective	*Replace pistons and others*

Troubleshooting Procedure

Short out each spark plug and listen for change in engine noise.

Symptom	Possible Cause	Action
Piston pin noise (Piston makes noise each time it goes up and down)	Piston pin or piston pin hole worn	*Replace piston, piston pin and connecting rod assembly*

Troubleshooting Procedure

The slapping sound stops when spark plug on bad cylinder is shorted out.

Symptom	Possible Cause	Action
Timing belt noise	Timing belt tension is incorrect	*Replace pusher or adjust the tension pulley or replace timing belt*
	Tensioner bearing defective	*Replace*
	Timing belt defective	*Replace*
	Timing pulley defective	*Replace*
	Timing belt comes in contact with timing cover	*Replace timing belt and timing cover*
Valve noise	Valve clearance incorrect	*Replace adjusting shim*
	Valve and valve guide seized	*Replace valve and valve guide*
	Valve spring broken or weakened	*Replace*
	Valve seat off–positioned	*Correct*
	Camshaft worn out	*Replace*
Crankshaft noise	Crankshaft end play excessive (noise occurs when clutch is engaged)	*Replace thrust bearing*
Engine knocking	Preignition due to use of spark plugs of inadequate heat range	*Install Spark Plugs of adequate heat range*
	Carbon deposits in combustion chambers	*Clean*
	Fuel too low in octane rating	*Replace fuel*
	Wide Open Throttle enrichment system failure	*Refer to Section 6E*
	Selection of transmission gear incorrect	*Caution operator of incorrect gear selection*
	Engine overheating	*Refer to “Engine Lacks Power"*
Others	Water pump defective	*Replace*
	Drive belt slipping	*Replace auto tentioner or drive belt*

Abnormal Combustion

Symptom	Possible Cause	Action
Trouble in fuel system	Fuel pressure control valve defective	*Replace*
	Fuel filter clogged	*Replace*
	Fuel pump clogged	*Clean or replace*
	Fuel tank or fuel pipe clogged	*Clean or replace*
	Fuel injector clogged	*Clean or replace*
	Fuel pump relay defective	*Replace*
	Power supply cable for fuel pump broken or poor connections	*Reconnect, correct or replace*
	Mass Airflow (MAF) Sensor circuit open or defective	*Correct or replace*
	MAF Sensor defective	*Replace*
	Engine Coolant Temperature (ECT) Sensor circuit open or shorted	*Correct or replace*
	ECT Sensor defective	*Replace*
	Throttle Position Sensor adjustment incorrect	*Readjust*
	Throttle Position Sensor defective	*Replace*
	Throttle Position Sensor connector poor connections	*Reconnect*
	Vehicle Speed Sensor cable poor connections or defective	*Correct or replace*
	Vehicle Speed Sensor loosely fixed	*Fix tightly*
	Vehicle Speed Sensor in wrong contact or defective	*Replace*
	Engine Control Module cable poor connections or defective	*Correct or replace*

Symptom	Possible Cause	Action
Trouble in emission control system	Heated Oxygen Sensor circuit open	*Correct or replace*
	Heated Oxygen Sensor defective	*Replace*
	Signal vacuum hose loosely fitted or defective	*Correct or replace*
	EGR Valve circuit open or shorted	*Correct or replace*
	EGR Valve defective	*Replace*
	ECT Sensor circuit open or shorted	*Correct or replace*
	Canister Purge Valve circuit open or shorted	*Correct or replace*
	Canister Purge Valve defective	*Replace*
	ECT Sensor defective	*Replace*
	Positive Crankcase Ventilation (PCV) valve and hose clogged	*Correct or replace*
	Evaporator system	*Refer to Section 6E*
Trouble in ignition system	———	*Refer to "Engine Lacks Power"*
Trouble in cylinder head parts	Carbon deposits in combustion chamber	*Remove carbon*
	Carbon deposit on valve, valve seat and valve guide	*Remove carbon*

Engine Oil Consumption Excessive

Symptom	Possible Cause	Action
Oil leaking	Oil pan drain plug loose	*Retighten or replace gasket*
	Crankcase fixing bolts loosened	*Retighten*
	Oil pan setting bolts loosened	*Retighten*
	Oil pan gasket broken	*Replace gasket*
	Front cover retaining bolts loose or gasket broken	*Retighten or replace gasket*
	Head cover fixing bolts loose or gasket broken	*Retighten or replace gasket*
	Oil filter adapter cracked	*Replace*
	Oil filter attachings bolt loose or rubber gasket broken	*Retighten or replace oil filter*
	Oil cooler broken	*Replace*
	Crankshaft front or rear oil seal defective	*Replace oil seal*
	Oil pressure unit loose or broken	*Retighten or replace*
	Blow–by gas hose broken	*Replace hose*
	Positive Crankcase Ventilation Valve clogged	*Clean*
	Engine/Transmission coupling failed	*Replace oil seal*
Oil leaking into combustion chambers due to poor seal in valve system	Valve stem oil seal defective	*Replace*
	Valve stem or valve guide worn	*Replace valve and valve guide*
Oil leaking into combustion chambers due to poor seal in cylinder parts	Cylinders and pistons worn excessively	*Replace cylinder body assembly and pistons*
	Piston ring gaps incorrectly positioned	*Correct*
	Piston rings set with wrong side up	*Correct*
	Piston ring sticking	*Replace cylinder body assembly and pistons*
	Piston ring and ring groove worn	*Replace pistons and others*
	Return ports in oil rings clogged	*Clean piston and replace rings*
Positive Crankcase Ventilation System malfunctioning	Positive Crankcase Ventilation Valve clogged	*Clean*
Others	Improper oil viscosity	*Use oil of recommended S.A.E. viscosity*
	Continuous high speed driving and/or severe usage such as trailer towing	*Continuous high speed operation and/or severe usage will normally cause increased oil consumption*

Fuel Consumption Excessive

Symptom	Possible Cause	Action
Trouble in fuel system	Mixture too rich or too lean due to trouble in fuel injection system	*Refer to "Abnormal Combustion"*
	Fuel cut function does not work	*Refer to "Abnormal Combustion"*
Trouble in ignition system	Misfiring or abnormal combustion due to trouble in ignition system	*Refer to "Hard Start" or "Abnormal Combustion"*
Others	Engine idle speed too high	*Reset to Section 6E*
	Returning of accelerator control sluggish	*Correct*
	Fuel system leakage	*Correct or replace*
	Clutch slipping	*Correct*
	Brake drag	*Correct*
	Selection of transmission gear incorrect	*Caution operator of incorrect gear selection*

Lubrication Problems

Symptom	Possible Cause	Action
Oil pressure too low	Wrong oil in use	*Replace with correct engine oil*
	Relief valve sticking	*Replace*
	Oil pump not operating properly	*Correct or replace*
	Oil pump strainer clogged	*Clean or replace strainer*
	Oil pump worn	*Replace*
	Oil pressure gauge defective	*Correct or replace*
	Crankshaft bearing or connecting rod bearing worn	*Replace*
Oil contamination	Wrong oil in use	*Replace with correct engine oil*
	Oil filter clogged	*Replace oil filter*
	Cylinder head gasket damage	*Replace gasket*
	Burned gases leaking	*Replace piston and piston rings or cylinder body assembly*
Oil not reaching valve system	Oil passage in cylinder head or cylinder body clogged	*Clean or correct*

Engine Oil Pressure Check

1. Check for dirt, Fuel or water in the engine oil.
   a. Check the viscosity of the oil.
   b. Check the viscosity of the oil.
   c. Change the oil if the viscosity is outside the specified standard.
   d. Refer to the “Maintenance and Lubrication" section of this manual.
2. Check the engine oil level.

   The level should fall somewhere between the “ADD" and the “FULL" marks on the oil level dipstick.

   If the oil level does not reach the “ADD" mark on the oil level dipstick, engine oil must be added.
3. Remove the oil pressure unit.
4. Install an oil pressure gauge.
5. Start the engine and allow the engine to reach normal operating temperature (About 80°C).
6. Measure the oil pressure.

   Oil pressure should be:

   392–550 kPa (56.9–80.4 psi) at 3000 rpm.
7. Stop the engine.
8. Remove the oil pressure gauge.
9. Install the oil pressure unit.
10. Start the engine and check for leaks.

Malfunction Indicator Lamp

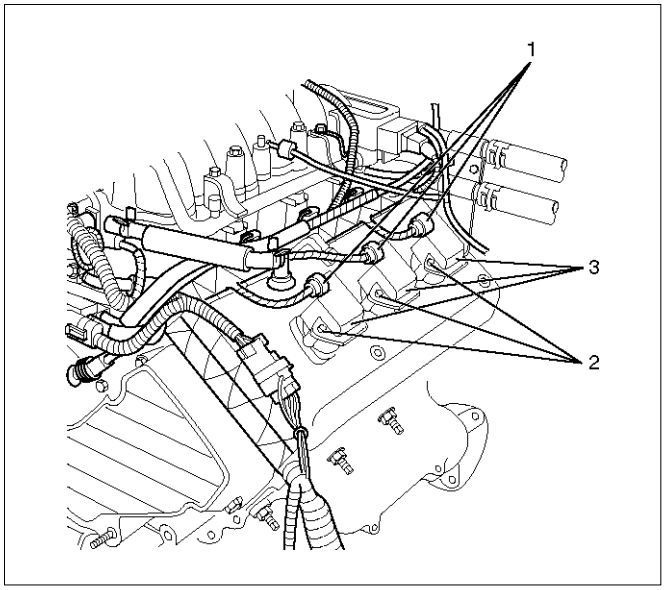
The instrument panel “CHECK ENGINE" Malfunction Indicator Lamp (MIL) illuminates by self diagnostic system when the system checks the starting of engine, or senses malfunctions. ”CHECK ENGINE" MIL does not illuminate at the starting of engine

Symptom	Possible Cause	Action
“CHECK ENGINE" MIL does not illuminate at the starting of engine	Bulb defective	*Replace*
	MIL circuit open	*Correct or replace*
	Command signal circuit to operate self diagnostic system shorted	*Correct or replace*
	Engine Control Module (ECM) cable loosely connected, disconnected or defective	*Correct or replace*
	ECM defective	*Replace*
“CHECK ENGINE" MIL illuminates, and stays on	Deterioration of heated oxygen sensor internal element	*Replace*
	Heated oxygen sensor connector terminal improper contact	*Reconnect properly*
	Heated oxygen sensor lead wire shorted	*Correct*
	Heated oxygen sensor circuit open	*Correct or replace*
	Deterioration of engine coolant temperature sensor internal element	*Replace*
	Engine coolant temperature sensor connector terminal improper contact	*Reconnect properly*
	Engine coolant temperature sensor lead wire shorted	*Correct*
	Engine coolant temperature sensor circuit open	*Correct or replace*
	Throttle position sensor open or shorted circuits	*Correct or replace*
	Deterioration of crankshaft position sensor	*Replace*
	Crankshaft position sensor circuit open or shorted	*Correct or replace*
	Vehicle speed sensor circuit open	*Correct or replace*
	Intake air temperature sensor circuit open or shorted	*Correct or replace*
	Fuel injector circuit open or shorted	*Correct or replace*
	ECM driver transistor defective	*Replace ECM*
	Malfunctioning of ECM RAM (Random Access Memory) or ROM (Read Only Memory)	*Replace ECM*

Cylinder Head Cover LH

Removal

1. Disconnect battery ground cable.
2. Disconnect positive crankcase ventilation hose.
3. Remove camshaft angle sensor connector.
4. Remove ground cable fixing bolt on cylinder head cover.
5. Ignition coil connector and ignition coil.
   - Disconnect the three connectors from the ignition coils.
   - Remove harness bracket bolt on cylinder head cover.
   - Remove fixing bolts on ignition coils.

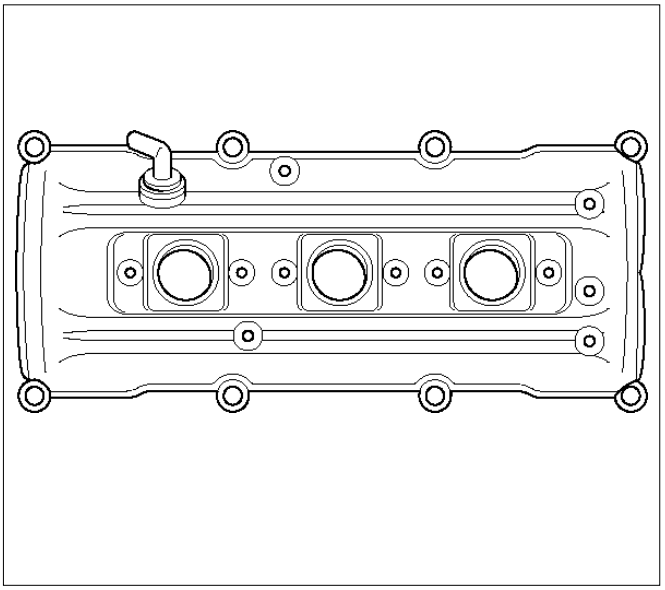


060RW078

Legend

(1) Ignition Coil Connector
(2) Bolt
(3) Ignition Coil Assemblies

6. Remove fixing bolt for fuel injector harness bracket.
7. Remove eight fixing bolts, then the cylinder head cover.

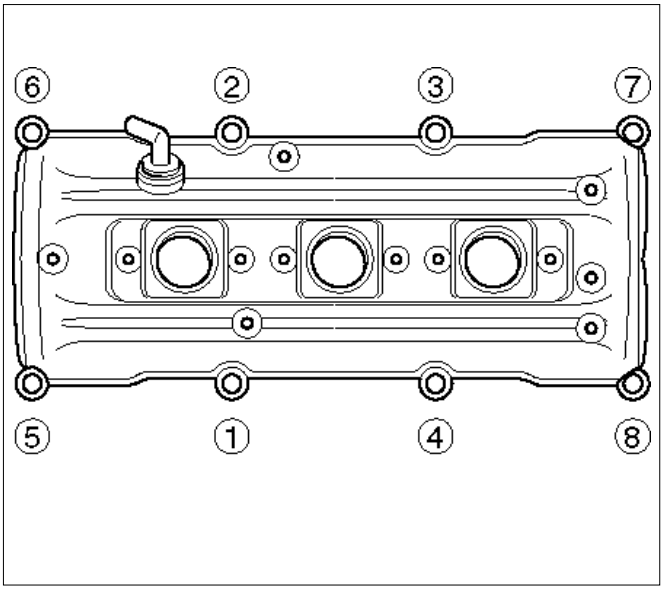


010RW001

Installation

1. Install cylinder head cover.
   - Clean the sealing surface of cylinder head and cylinder head cover to remove oil and sealing materials completely.
   - Apply sealant (TB-1207B or equivalent) of bead diameter 2-3 mm at eight place of arched area of camshaft bracket on front and rear sides.
   - The cylinder head cover must be installed with in 5 minutes after sealant application to prevent hardening of sealant.
   - Tighten bolts to the specified torque.

Torque : 9 N·m (0.9 kg·m/7 lb ft)



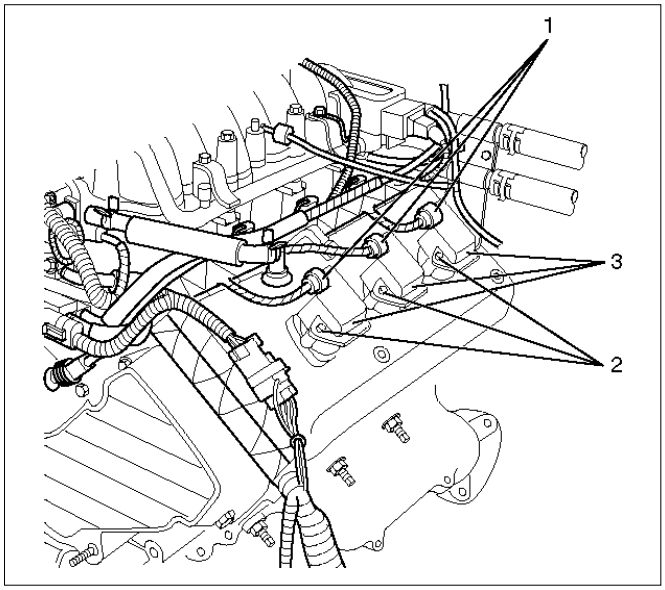
010RW006

2. Install fuel injection harness bracket and tighten bolt to the specified torque.

Torque : 8 N·m (0.8 kg·m/8 lb ft)

3. Connect ignition coil connector and ignition coil, then tighten bolt to the specified torque.

Torque : 4 N·m (0.4 kg·m/3 lb ft)



060RW078

Legend

(1) Ignition Coil Connector
(2) Bolt
(3) Ignition Coil Assembly

4. Connect ground cable and tighten bolts to the specified torque.

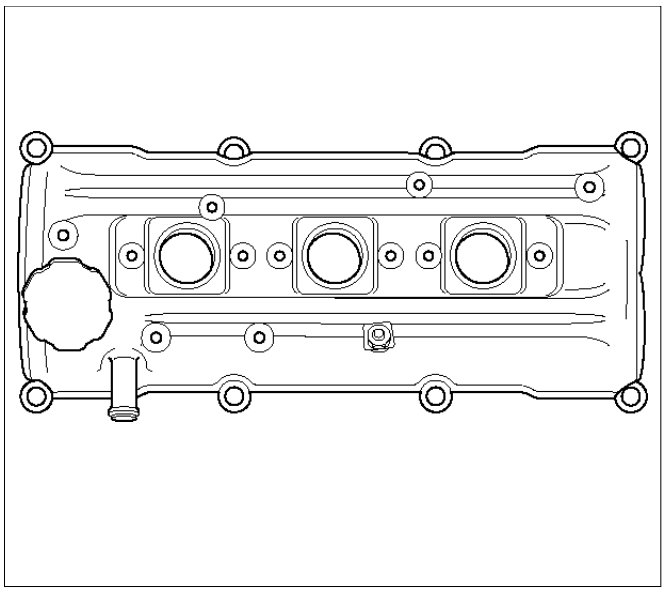
Torque : 8 N·m (0.8 kg·m/6 lb ft)

5. Connect camshaft angle sensor connector.
6. Install positive crankcase ventilation hose.

Cylinder Head Cover RH

Removal

1. Disconnect battery ground cable.
2. Remove air cleaner duct assembly.
3. Disconnect ventilation hose from cylinder head cover.
4. Disconnect three ignition coil connectors from ignition coils and remove harness bracket bolts on cylinder head cover then remove ignition coil fixing bolts on ignition coils and remove ignition coils.
5. Remove heater pipe fixing bolts from the bracket.
6. Disconnect fuel injector harness connector then remove fuel injector harness bracket bolt.
7. Remove eight fixing bolts then the cylinder head cover.

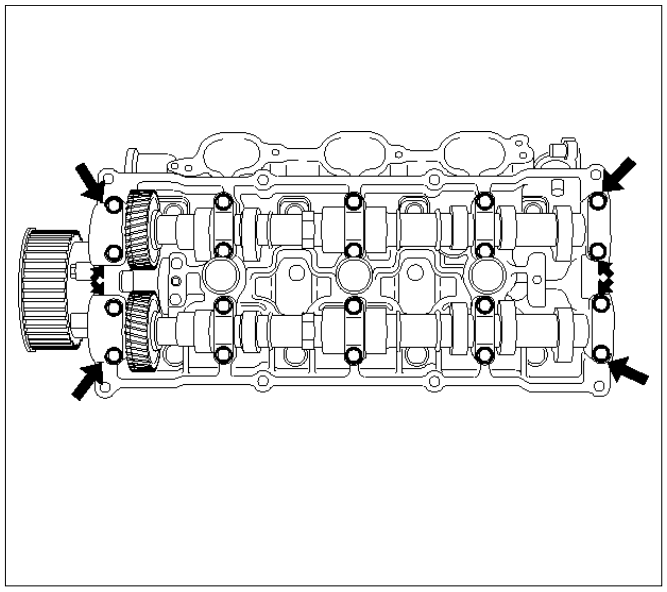


010RW002

Installation

1. Install cylinder head cover.
   - Clean the sealing surface of cylinder head and cylinder head cover to remove oil and sealing materials completely.
   - Apply sealant (TB-1207B or equivalent) of bead diameter 2‐3 mm at eight place of arched area of camshaft bracket on front and rear sides.
   - The cylinder head cover must be installed within 5 minutes after sealant application to prevent premature hardening of sealant.
   - Tighten bolts to the specified torque.

   Torque : 9 N·m (0.9 kg·m/7 lb ft)



014RW019

2. Install exhaust gas recirculation pipe and tighten to specified torque.

   Torque :

   Exhaust manifold side: 29 N·m (3.0 kg·m/21 lb ft)

   Flare nut: 44 N·m (4.5 kg·m/33 lb ft)

   Cylinder head side: 20 N·m (2.0 kg·m/14 lb ft)
3. Tighten fuel injector harness bracket bolts to specified torque then reconnect fuel injector harness connector.

   Torque : 8 N·m (0.8 kg·m/5.7 lb ft)
4. Install heater pipe bolt to the specified torque.

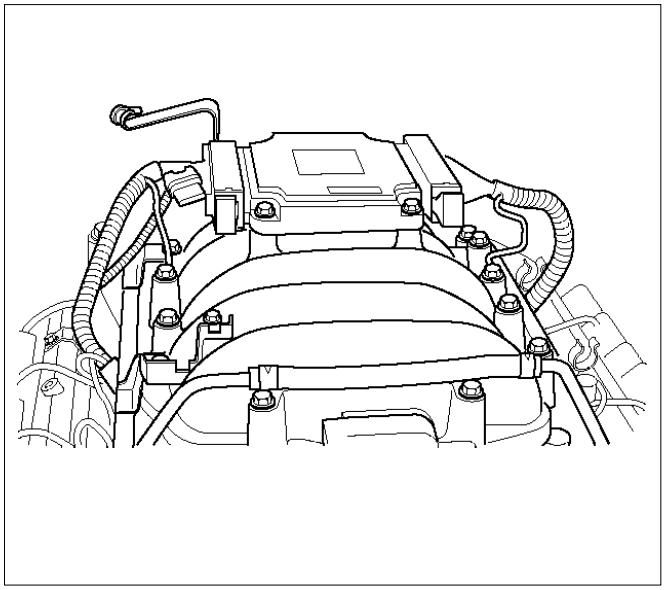
   Torque : 20 N·m (2.0 kg·m/14 lb ft)
5. Connect ignition coil connector and tighten ignition coil fixing bolts to specified torque.

   Torque : 4 N·m (0.4 kg·m/3 lb ft)
6. Connect ventilation hose to cylinder head.
7. Install air cleaner duct assembly.

Common Chamber

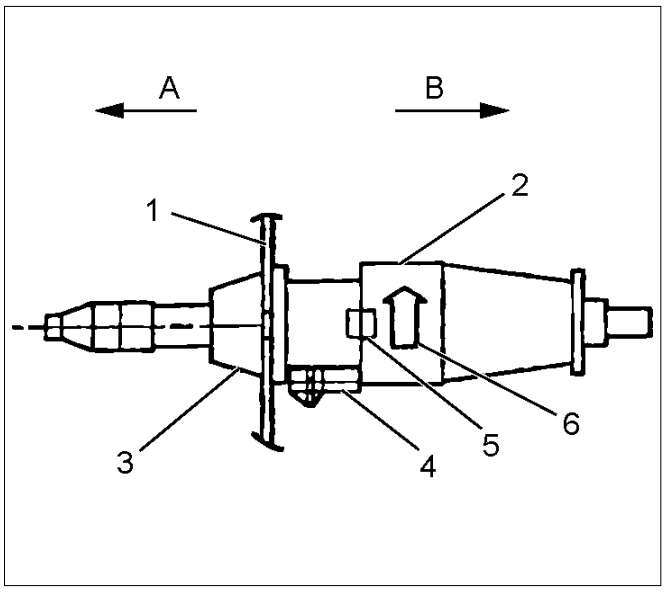
Removal

1. Disconnect battery ground cable.
2. Remove air cleaner duct assembly.
3. Remove the ECM.
   - Disconnect the two connectors from the ECM.
   - Remove fixing bolts on the common chamber.
   - Remove fixing bolts for ground cable.



060RW025

4. Remove the accelerator control cable from accelerator control cable bracket.
   - Slide the lock in direction A
   - Rotate the ratchet ring in indirection an arrow 90°

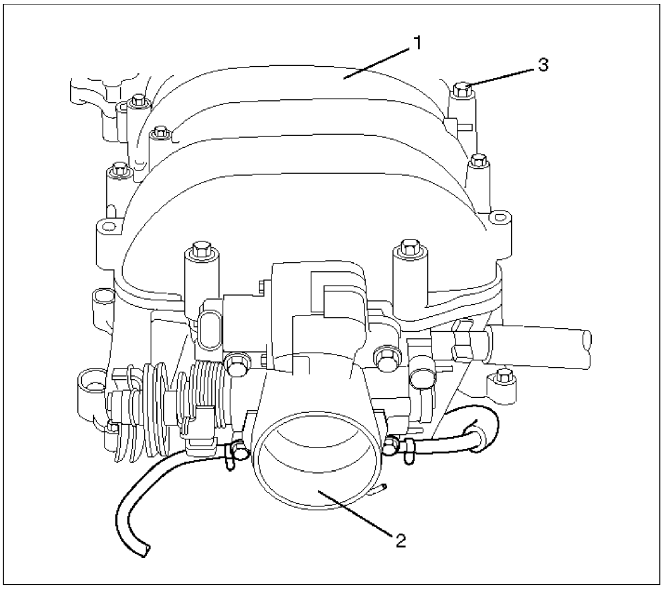


RTW46ASH000201

Legend

(1) Cable Bracket
(2) Ratchet ring
(3) Outer Cap
(4) Lock
(5) Paint Mark
(6) Arrow Mark

5. Remove the accelerator control cable from the throttle.
6. Disconnect vacuum booster hose from common chamber.
7. Disconnect connector from manifold absolute pressure sensor, idle air control valve, throttle position sensor, solenoid valve, electric vacuum sensing valve.
8. Disconnect vacuum hose on canister VSV and positive crankcase ventilation hose, fuel rail assembly with pressure control valve bracket.
9. Remove ventilation hose from throttle valve and intake duct and remove water hose.
10. Remove exhaust gas recirculation valve assembly fixing bolt and nut on common chamber.
11. Remove two bolts from common chamber rear side for remove fuel hose bracket.
12. Remove common chamber four bolts and four nuts then remove the common chamber.



025RW001

Legend

(1) Common Chamber
(2) Throttle Valve Assembly
(3) Bolt

13. Remove the four throttle body fixing bolts.

Installation

1. Install throttle body and tighten bolts to the specified torque.

   Torque : 25 N·m (2.5 kg·m/18 lb ft)
2. Install common chamber and tighten bolts and nuts to the specified torque.

   Torque :

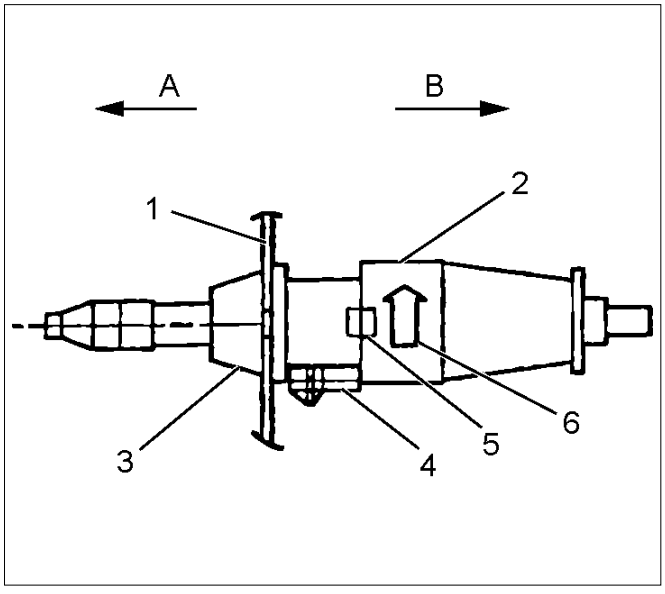
   Bolt : 18 N·m (1.8 kg·m/13 lb ft)

   Nut : 18 N·m (1.8 kg·m/13 lb ft)
3. Install fuel hose bracket and tighten bolts to specified torque.

   Torque : 10 N·m (1.0 kg·m/89 lb in)
4. Install ventilating hose to throttle valve and intake duct.
5. Connect vacuum hoses on canister VSV and positive crankcase ventilation hose. Tighten bolts for fuel rail assembly with pressure control valve bracket.

   Torque : 25 N·m (2.5 kg·m/18 lb ft)
6. Connect each connector without fail.
7. Connect vacuum booster hose.
8. Install the ECM.
   - Tighten the four bolts.

   Torque : 10 N·m (1.0 kg·m/7 lb ft)
   - Connect the two connectors.
   - Tighten the two ground cable bolts.
9. Install accelerator control cable to accelerator cable bracket.
   - Rotate the ratchet ring in direction an arrow 90°
   - Confirm marking of outer cap must be upper side.
   - Slider the lock of outer cap must be upper side.
   - Confirm ratchet ring is locked.



060RW093

Legend

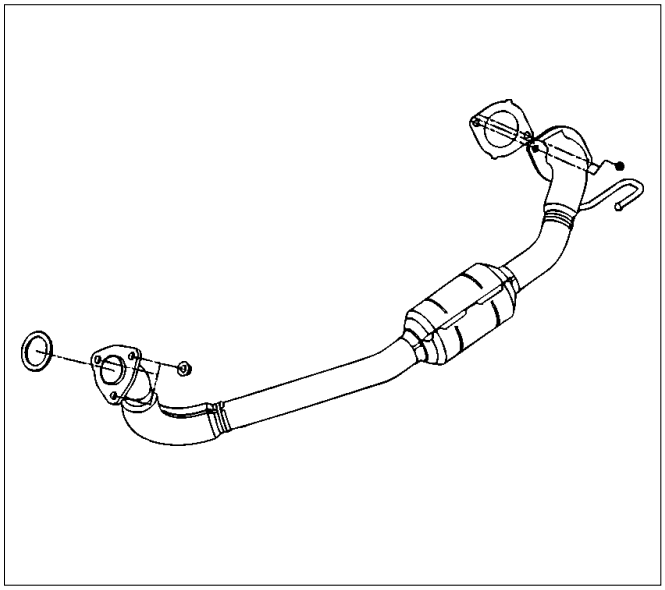
(1) Cable Bracket
(2) Ratchet ring
(3) Outer Cap
(4) Lock
(5) Paint Mark
(6) Arrow Mark

10. Install the cable clips to accelerator control cable.
11. Install air cleaner duct assembly.

Exhaust Manifold LH

Removal

1. Disconnect battery ground cable.
2. Disconnect O_2 sensor connector.
3. Remove torsion bar. Refer to removal procedure in Front Suspension section.
4. Remove exhaust front pipe three stud nuts from exhaust side and two nuts from rear end of exhaust front pipe.



RTW36FSH000201

5. Remove heat protector two fixing bolts then the heat protector.
6. Remove a bolt on engine LH side for air conditioner (A/C) compressor bracket and loosen two bolts for A/C compressor then move A/C compressor to front side.
7. Remove exhaust manifold eight fixing nuts and remove exhaust manifold from the engine.

Installation

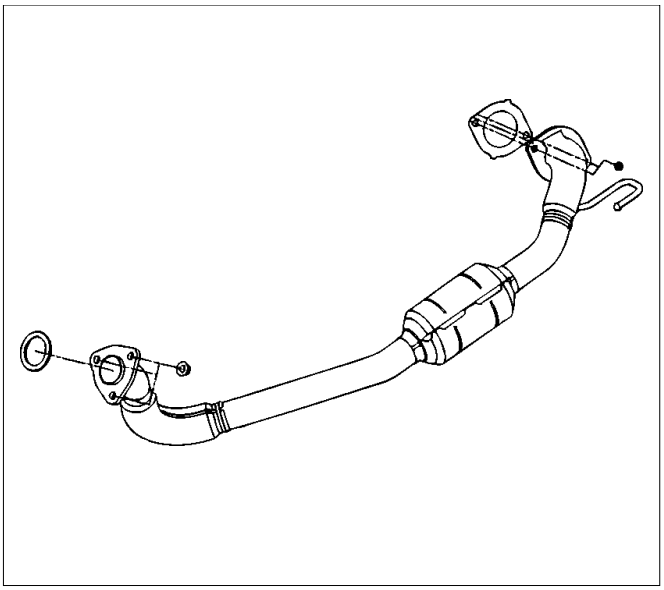
1. Install exhaust manifold and tighten exhaust manifold fixing nuts to the specified torque with new nuts.

   Torque: 52 N·m (5.3 kg·m/38 lb ft)
2. Install heat protector.
3. Install exhaust front pipe and tighten three stud nuts and two nuts to the specified torque.

   Torque:

   Stud nuts: 67 N·m (6.8 kg·m/49 lb ft)

   Nuts: 43 N·m (4.4 kg·m/32 lb ft)



RTW36FSH000201

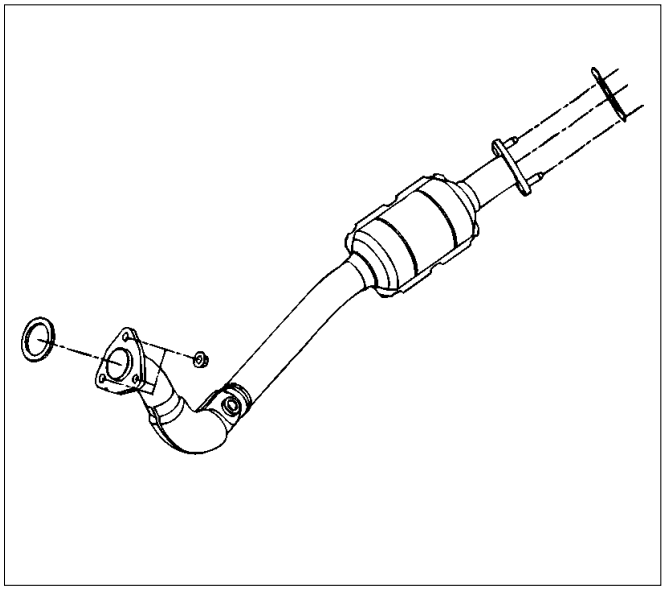
4. Install the torsion bar and readjust the vehicle height. Refer to installation and vehicle height adjustment procedure for front suspension.
5. Set A/C compressor to normal position and tighten two bolts and a bolt to the specified torque.

   Torque : 40 N·m (4.1 kg·m/30 lb ft)
6. Reconnect O_2 sensor connector.
7. Install air cleaner duct assembly.

Exhaust Manifold RH

Removal

1. Disconnect battery ground cable.
2. Remove exhaust front pipe three stud nuts and two nuts then disconnect exhaust front pipe.



RTW36FSH000101

3. Remove steering shaft. Refer to removal procedure in Steering section.
4. Remove heat protector two fixing bolts then the heat protector.
5. Remove EGR pipe.
6. Remove exhaust manifold eight fixing nuts then the exhaust manifold.

Installation

1. Install exhaust manifold and tighten bolts to the specified torque.

   Torque: 52 N·m (5.3 kg·m/38 lb ft)
2. Install EGR pipe.

   Torque: 29 N·m (3.0 kg·m/22 lb ft)
3. Install heat protector
4. Install exhaust front pipe and tighten three stud nuts and two nuts to the specified torque.

   Torque:

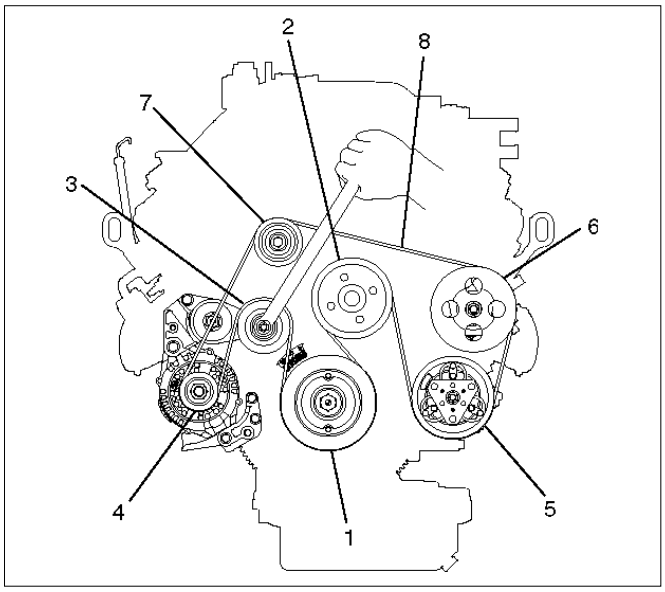
   Stud nuts: 67 N·m (6.8 kg·m/49 lb ft)

   Nuts: 43 N·m (4.4 kg·m/32 lb ft)
5. Install steering shaft. Refer to installation procedure in Steering section.

Crankshaft Pulley

Removal

1. Disconnect battery ground cable.
2. Remove air cleaner assembly.
3. Remove radiator upper fan shroud from radiator.
4. Move serpentine belt tensioner to loose side using wrench then remove serpentine belt.



850RW001

Legend

(1) Crankshaft Pulley
(2) Cooling Fan Pulley
(3) Tensioner
(4) Generator
(5) Air Conditioner Compressor
(6) Power Steering Oil Pump
(7) Serpentine Belt

5. Remove cooling fan assembly four fixing nuts, then the cooling fan assembly.
6. Remove crankshaft pulley assembly using 5−8840−0133−0 crankshaft holder, hold crankshaft pulley then remove center bolt and pulley.

Installation

1. Install crankshaft pulley using 5−8840−0133−0 crankshaft holder, hold the crankshaft pulley and tighten center bolt to the specified torque.

   Torque: 167 N·m (17.0 kg·m/123 lb ft)
2. Install cooling fan assembly and tighten bolts/nuts to the specified torque.

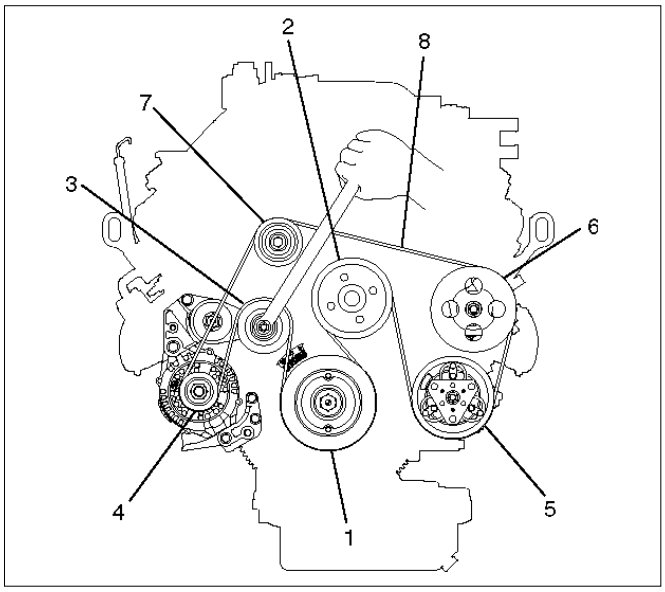
   Torque: 25 N·m (2.5 kg·m/18 lb ft) for fan pulley and fan bracket.

   Torque: 10 N·m (1.0 kg·m/88.5 lb in) for fan and clutch assembly.
3. Move serpentine belt tensioner to loose side using wrench, then install serpentine belt to normal position.
4. Install radiator upper fan shroud.
5. Install air cleaner assembly.

Timing Belt

Removal

1. Disconnect battery ground cable.
2. Remove air cleaner assembly.
3. Remove radiator upper fan shroud from radiator.
4. Move drive belt tensioner to loose side using wrench then remove drive belt.



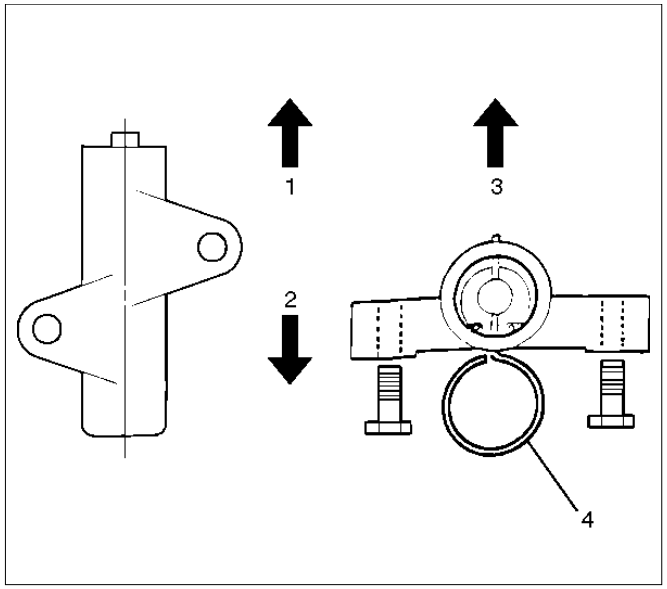
850RW001

Legend

(1) Crankshaft Pulley
(2) Cooling Fan Pulley
(3) Tensioner
(4) Generator
(5) Air Conditioner Compressor
(6) Power Steering Oil Pump
(7) Drive Belt

5. Remove cooling fan assembly four nuts, then the cooling fan assembly.
6. Remove cooling fan drive pulley assembly.
7. Remove idle pulley assembly.
8. Remove serpentine belt tensioner assembly.
9. Remove power steering pump assembly.
10. Remove crankshaft pulley assembly using 5−8840−0133−0 crankshaft holder, hold crankshaft pulley remove center bolt, then the pulley.
11. Remove right side timing belt cover then left side timing belt cover.
12. Remove lower timing belt cover
13. Remove pusher.

CAUTION: The pusher prevents air from entering the oil chamber. Its rod must always be facing upward.



014RW011

Legend

(1) Up Side
(2) Down Side
(3) Direction For Installation
(4) Locking Pin

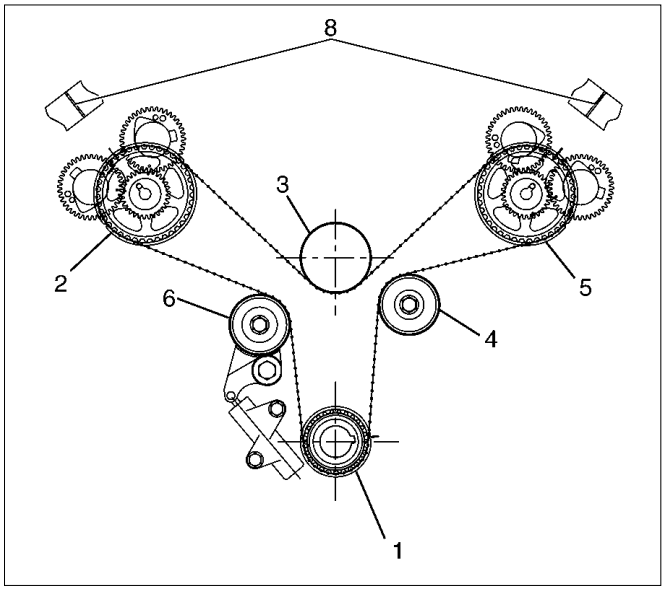
14. Remove timing belt.

CAUTION:

1. **Do not bend or twist the belt, otherwise its core could be damaged. The belt should not be bent at a radius less than 30 mm.**
2. **Do not allow oil or other chemical substances to come in contact with the belt. They will shorten the life.**
3. **Do not attempt to pry or stretch the belt with a screw driver or any other tool during installation.**
4. **Store timing belt in a cool and dark place. Never expose the belt direct sunlight or heat.**

Installation

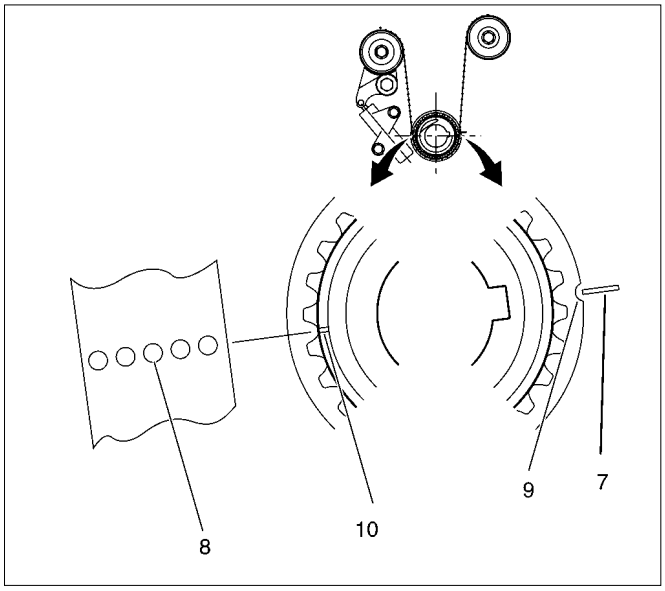
For correct belt installation, the letter on the belt must be able to be read as viewed from the front of the vehicle.



014RY00042

Legend

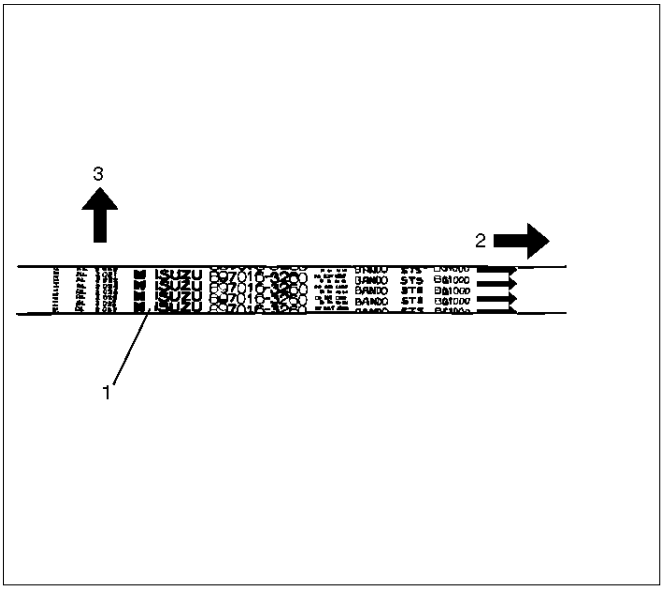
(1) Crankshaft Timing Pulley
(2) RH Bank Camshaft Drive Gear Pulley
(3) Water Pump Pulley
(4) Idle Pulley
(5) LH Bank Camshaft Drive Gear Pulley
(6) Tension Pulley



014RY00043

Legend

(7) Alignment Mark on Oil Pump.
(8) Alignment Mark on Timing Belt
(9) Alignment Mark (notch) on Crankshaft Timing Pulley
(10) Alignment Mark (groove) on Crankshaft Timing Pulley.



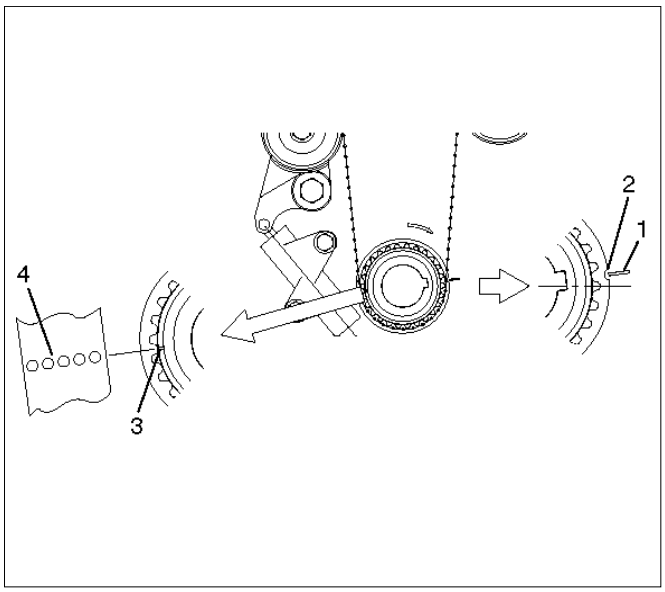
014RW006

Legend

(1) Timing Belt
(2) Engine Rotation Direction
(3) Cylinder Head Side

1. Install timing belt.
   1. Align the mark (notch) of crankshaft timing pulley (2) with mark on oil pump (1).
      Align the mark (groove) on the crankshaft timing pulley (3) with alignment mark (white dots line) on the timing belt (4).

NOTE: When timing marks are aligned, No.2 piston will be on Top Dead Center.



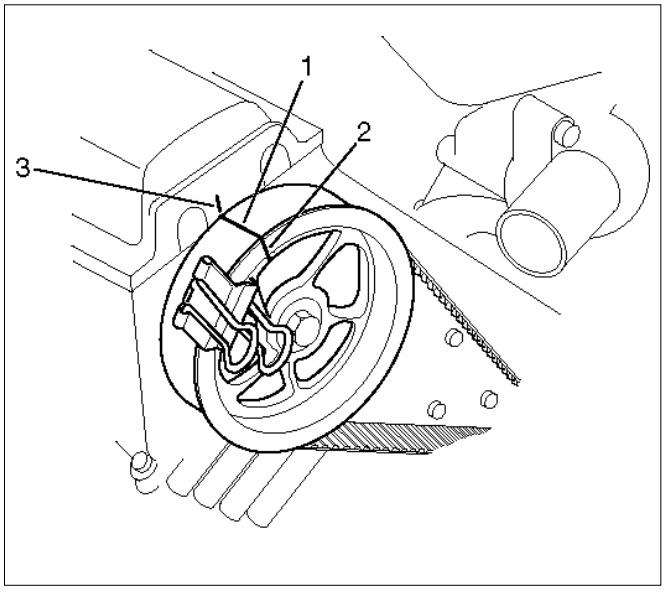
014RW003

Legend

(1) Alignment Mark on Oil Pump
(2) Groove on Crankshaft Timing Pulley
(3) Alignment Mark on Crankshaft Timing Pulley
(4) Alignment Mark on Timing Belt

2. Align the alignment mark on the RH bank camshaft drive gear pulley (2) to the alignment mark of the cylinder head cover RH (3).
3. Align the alignment mark (white line) on the timing belt (1) with alignment mark on the RH bank camshaft drive gear pulley (2) (on the left side as viewed from the front of the vehicle) and put the timing belt on the camshaft drive gear pulley.

   Secure the belt with a double clip or equivalent clip.



014RW00004

Legend

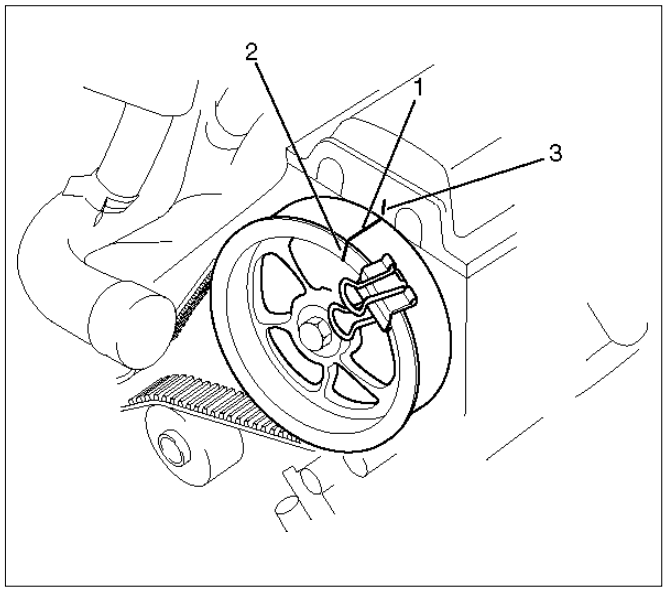
(1) Alignment Mark on Timing Belt (White line).
(2) Alignment Mark on Camshaft Drive Gear Pulley.
(3) Alignemnt Mark on Cylinder Head Cover RH.

4. Align the alignment mark on the LH bank camshaft drive gear pulley (2) to the alignment mark of the cylinder head cover LH (3).
5. Align the alignment mark (white line) on the timing belt (1) with the alignment mark on the LH bank camshaft drive gear pulley (2).

   When aligning the timing marks, use a wrench to turn the camshaft drive gear pulley, then set the timing mark between timing belt and camshaft drive gear pulley and put the timing belt on the camshaft drive gear pulley.

   Secure the belt with a double clip or equivalent clip.

NOTE: It is recommended for easy installation that the belt be secured with a double clip or equivalent clip after it is installed the timing belt to each pulley.



014RW00005

Legend

(1) Alignment Mark on Timing Belt (White line).
(2) Alignment Mark on Camshaft Drive Gear Pulley.
(3) Alignemnt Mark on Cylinder Head Cover LH.

6. Install crankshaft pulley temporarily and tighten center bolt by hand (do not use a wrench).

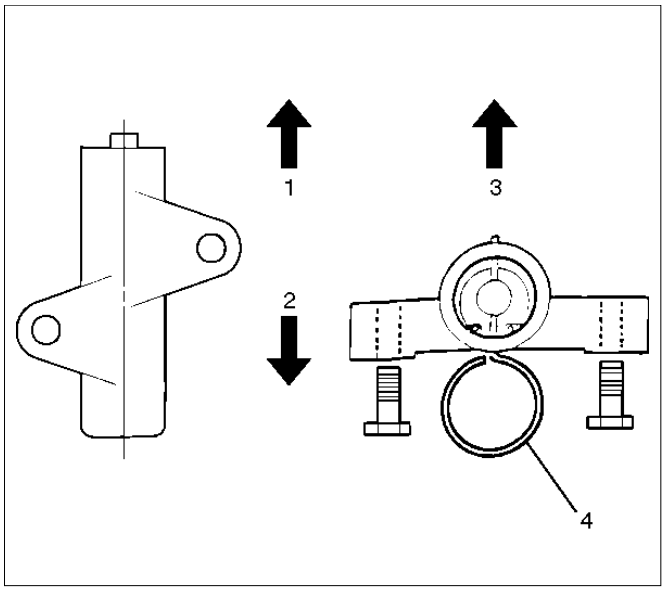
   Turn the crankshaft pulley clockwise to give some belt slack between the crankshaft timing pulley and the RH bank camshaft drive gear pulley.

2. Install pusher and tighten bolt to the specified torque.

Torque: 25 N·m (2.5 Kg·m/18 lb ft)

1. Install the pusher while pushing the tension pulley to the belt.
2. Pull out pin from the pusher.

NOTE: When reusing the pusher, press the pusher with approximately 100Kg to retract the rod, and insert a pin (1.4 mm piano wire).



014RW011

Legend

(1) Up Side
(2) Down Side
(3) Direction for Installation
(4) Locking Pin

3. Remove double clips or equivalent clips, from timing belt pulleys.

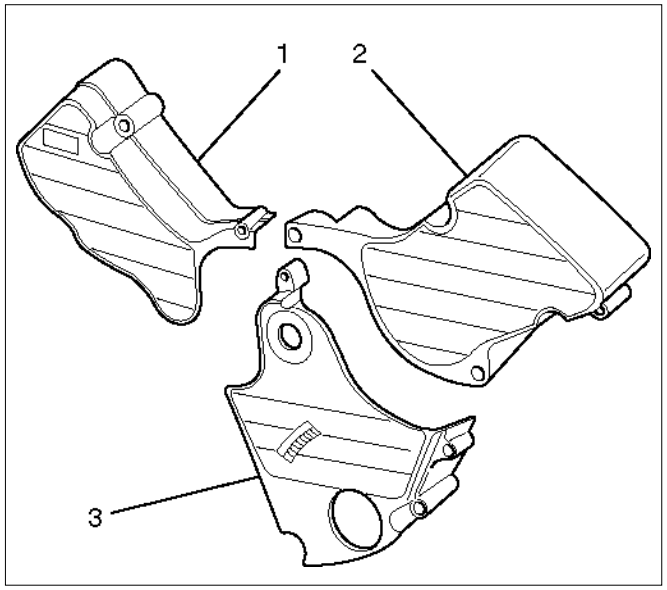
Turn the crankshaft pulley clockwise by two turns.

3. Install timing belt cover.

Remove crankshaft pulley that was installed in step 1 item 5.

Tighten bolts to the specified torque.

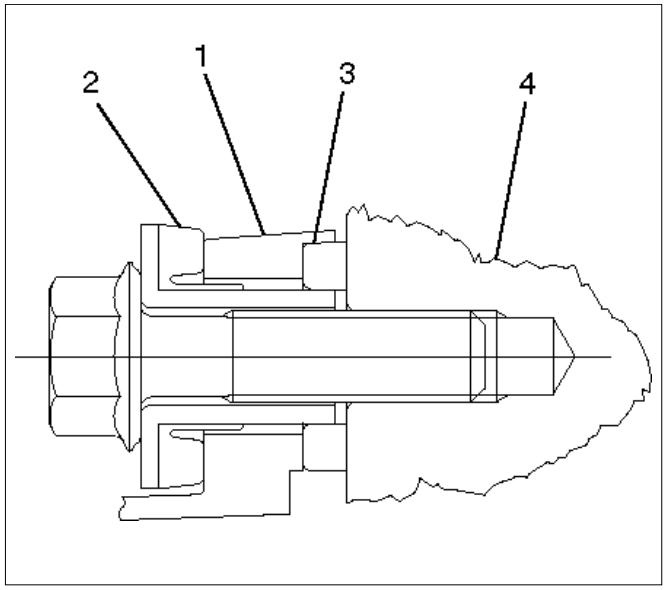
Torque: 18 N·m (1.8 kg·m/13 lb ft)



020RW004

Legend

(1) Timing Belt Cover RH
(2) Timing Belt Cover LH
(3) Timing Belt Cover Lower



020RW003

Legend

(1) Timing Belt Cover
(2) Rubber Bushing
(3) Sealing Rubber
(4) Cylinder Body

4. Install crankshaft pulley using 5-8840-0133-0, hold the crankshaft pulley and tighten center bolt to the specified torque.

   Torque: 167 N·m (17.0 kg·m/123 lb ft)
5. Install fan pulley bracket and tighten fixing bolts to the specified torque.

   Torque: 25 N·m (2.5 kg·m/18 lb ft)
6. Install power steering pump assembly and tighten to the specified torque.

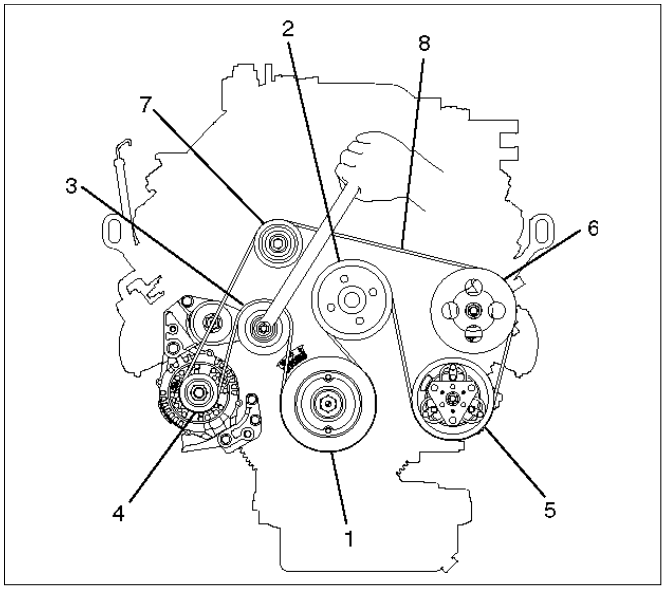
   Torque:

   M8 bolt: 25 N·m (2.5 kg·m/18 lb ft)

   M10 bolt: 43 N·m (4.4 kg·m/32 lb ft)
7. Install cooling fan assembly and tighten bolts/nuts to the specified torque.

   Torque: 25 N·m (2.5 kg·m/18 lb ft) for fan pulley and fan bracket.

   Torque: 10 N·m (1.0 kg·m/7 lb ft) for fan and clutch assembly.
8. Move drive belt tensioner to loose side using wrench, then install drive belt to normal position.



850RW001

Legend

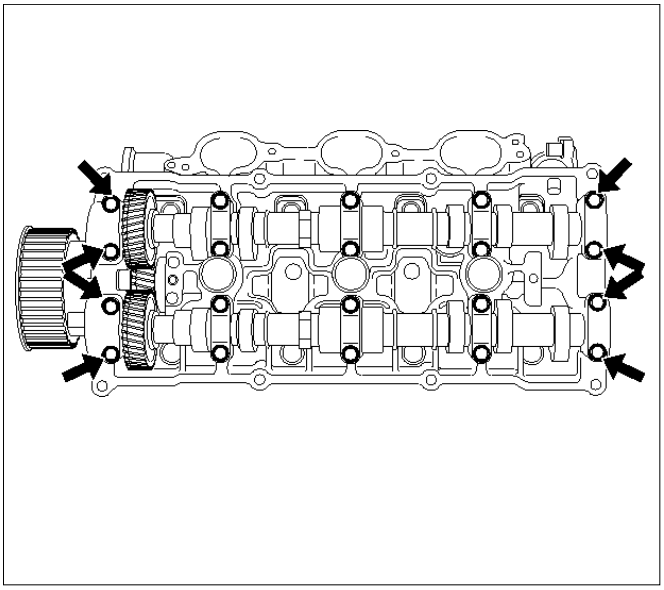
(1) Crankshaft Pulley
(2) Cooling Fan Pulley
(3) Tensioner
(4) Generator
(5) Air Conditioner Compressor
(6) Power Steering Oil Pump
(7) Drive Belt

9. Install radiator upper fan shroud.
10. Install air cleaner assembly.

Camshaft

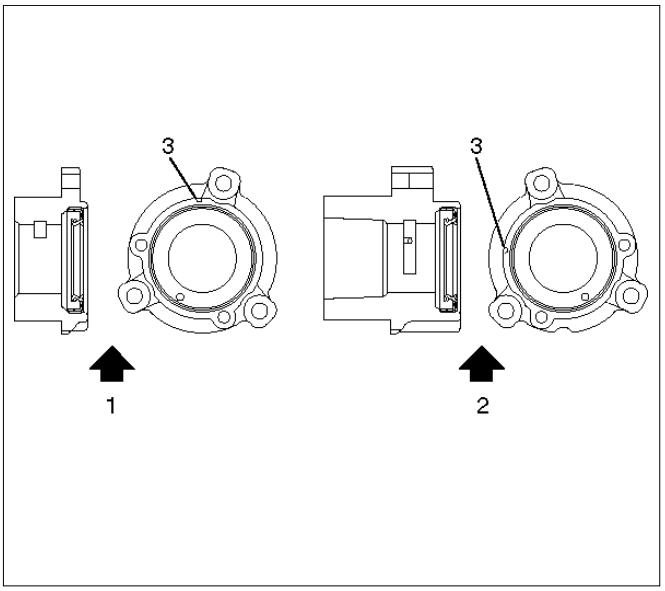
Removal

1. Disconnect battery ground cable.
2. Remove crankshaft pulley.
   - Refer to removal procedure for Crankshaft Pulley in this manual.
3. Remove timing belt.
   - Refer to removal procedure for Timing Belt in this manual.
4. Remove cylinder head cover LH.
   - Refer to removal procedure for Cylinder Head Cover LH in this manual.
5. Remove cylinder head cover RH.
   - Refer to removal procedure for Cylinder Head Cover RH in this manual.
6. Remove twenty fixing bolts from inlet and exhaust camshaft bracket on one side bank, then camshaft brackets.



014RW027

7. Remove camshaft assembly.
8. Remove fixing bolt for camshaft drive gear pulley.
9. Remove three fixing bolts from camshaft drive gear retainer, then camshaft drive gear assembly.



014RW026

Legend

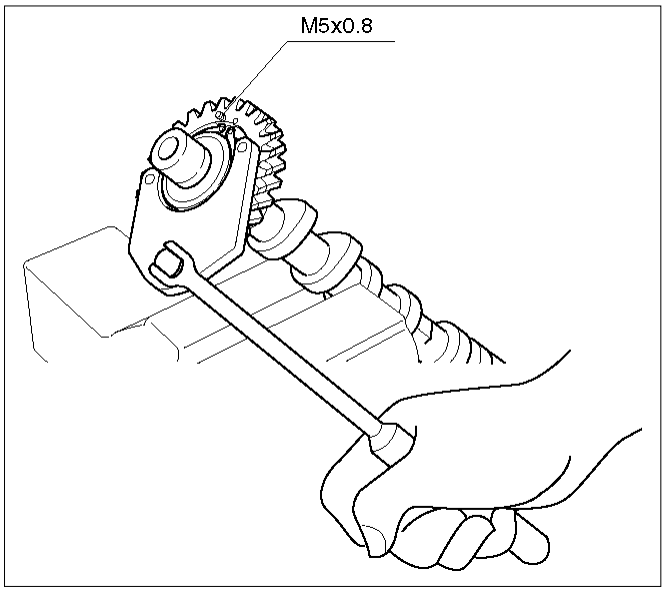
(1) Right Bank
(2) Left Bank
(3) Timing Mark on Retainer

Installation

1. Install camshaft drive gear assembly and tighten three bolts to the specified torque.

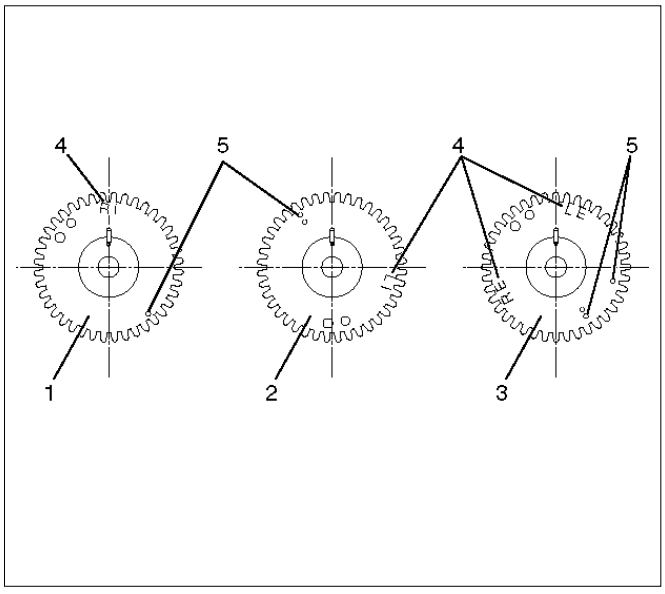
   Torque: 10 N·m (1.0 kg·m/7 lb ft)
2. Tighten bolt for camshaft drive gear assembly pulley to the specified torque.

   Torque: 98 N·m (10.0 kg·m/72 lb ft)
3. Tighten sub gear setting bolt.
   1. Use 5–8840–2443–0 to turn sub gear to right direction until it aligns with the M5 bolt hole between camshaft driven gear and sub gear.
   2. Tighten the M5 bolt to a suitable torque to prevent the sub gear from moving.



014RW041

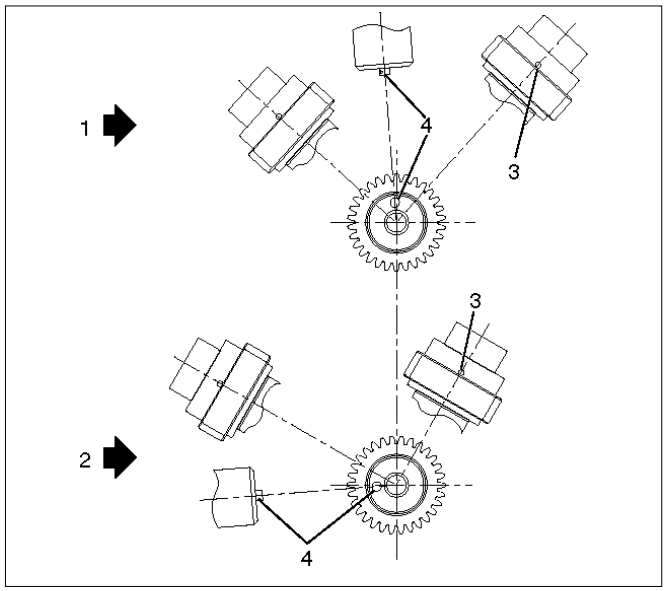
4. Install camshaft assembly and camshaft brackets, tighten twenty bolts on one side bank to the specified torque.
   1. Apply engine oil to camshaft journal and bearing surface of camshaft bracket.
   2. Align timing mark on intake camshaft (one dot for right bank, two dot for left bank) and exhaust camshaft (one dot for right bank, two dots for left bank) to timing mark on camshaft drive gear (one dot).



014RW020

Legend

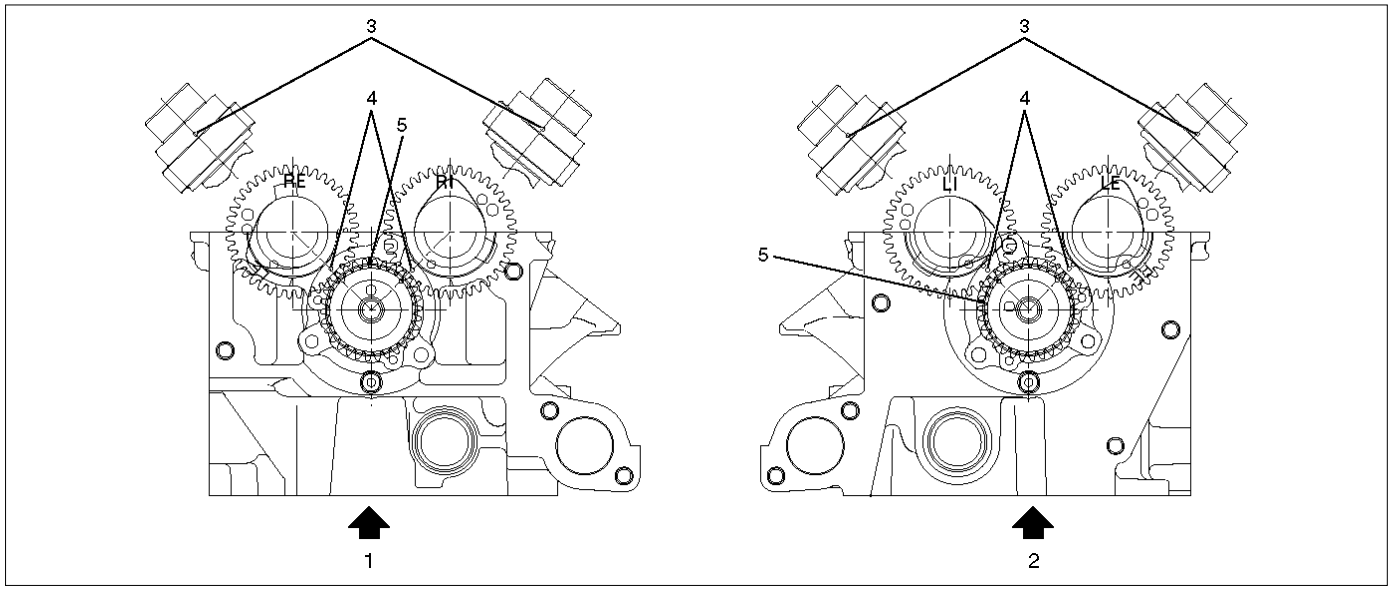
(1) Intake Camshaft Timing Gear for Right Bank
(2) Intake Camshaft Timing Gear for Left Bank
(3) Exhaust Camshaft Timing Gear
(4) Discrimination Mark
(LI: Left bank intake, RI: Right bank intake)
(LE: Left bank exhaust, RE: Right bank exhaust)



014RW023

Legend

(1) Right Bank Camshaft Drive Gear
(2) Left Bank Camshaft Drive Gear
(3) Timing Mark on Drive Gear
(4) Dowel Pin



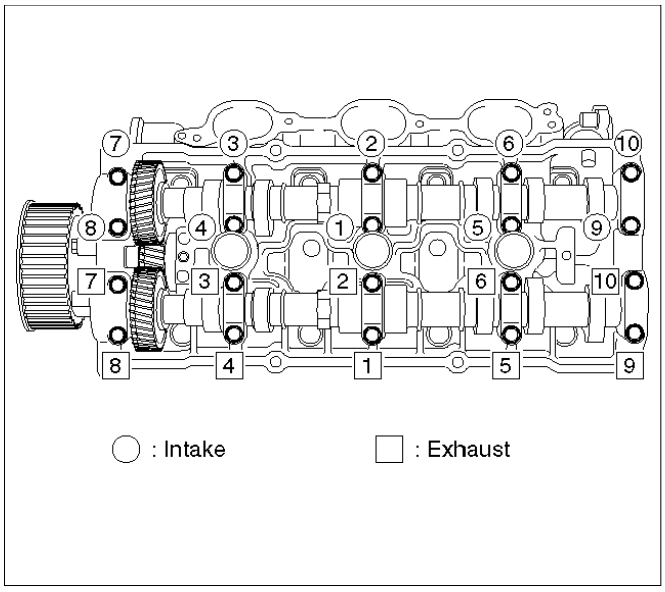
014RW024

Legend

(1) Right Bank
(2) Left Bank
(3) Alignment Mark on Camshaft Drive Gear
(4) Alignment Mark on Camshaft
(5) Alignment Mark on Retainer

3. Tighten twenty bolts on numerical order an one side bank as shown in the illustration.

Torque : 10 N·m (1.0 kg·m/7 lb ft)



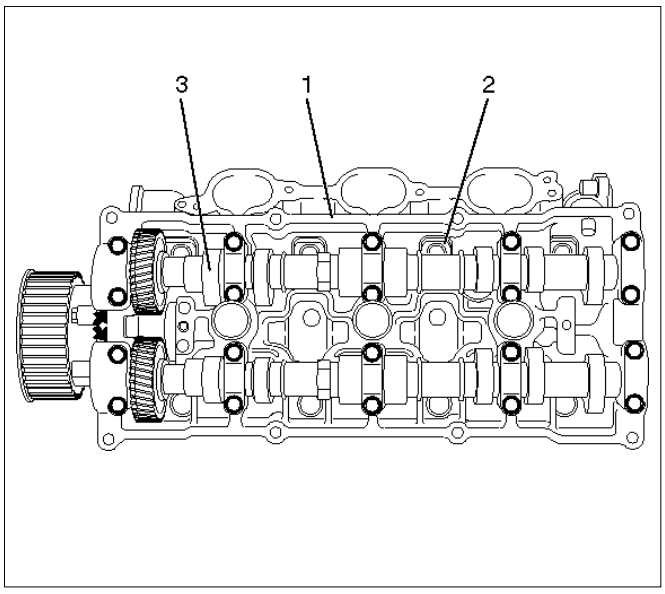
014RW031

5. Install cylinder head cover RH.
   - Refer to installation procedure for CYLINDER HEAD COVER RH in this manual.
6. Install cylinder head cover LH.
   - Refer to installation procedure for CYLINDER HEAD COVER LH in this manual.
7. Install timing belt.
   - Refer to installation procedure for TIMING BELT in this manual.
8. Install crankshaft pulley.
   - Refer to installation procedure for CRANKSHAFT PULLEY in this manual.

Cylinder Head

Removal

1. Remove engine hood.
2. Disconnect battery ground cable.
3. Drain radiator coolant.
4. Drain engine oil.
5. Remove crankshaft pulley.
   - Refer to removal procedure for Crankshaft Pulley in this manual.
6. Remove timing belt.
   - Refer to removal procedure for Timing Belt in this manual.
7. Remove cylinder head cover LH.
   - Refer to removal procedure for Cylinder Head Cover LH in this manual.
8. Remove cylinder head cover RH.
   - Refer to removal procedure for Cylinder Head Cover RH in this manual.
9. Remove common chamber.
   - Refer to removal procedure for Common Chamber in this manual.
10. Remove cylinder head assembly.
    1. Loosen eights bolts for tight cylinder head.
    2. Remove cylinder head assembly.



014RW028

Legend

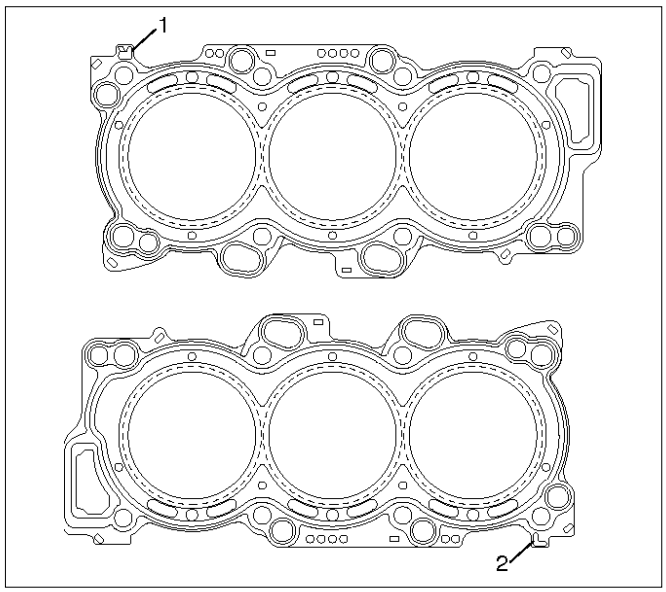
(1) Cylinder Head
(2) Cylinder Head Bolt
(3) Camshaft

Installation

1. Install cylinder head assembly to cylinder block.
   1. Put cylinder head gasket on the cylinder block.

NOTE: There is discrimination mark “R" for right bank and “L" for left bank on the cylinder head gasket as shown in the illustration.

Do not reuse cylinder head gasket.



011RW005

2. Align dowel pin hole to dowel pin on the cylinder block.
3. Tighten two bolts temporarily by hand to prevent the cylinder head assembly from moving.
4. Using 9−8511−4209−0 cylinder head bolt wrench, tighten bolts in numerical order as shown in the illustration to the specified torque.

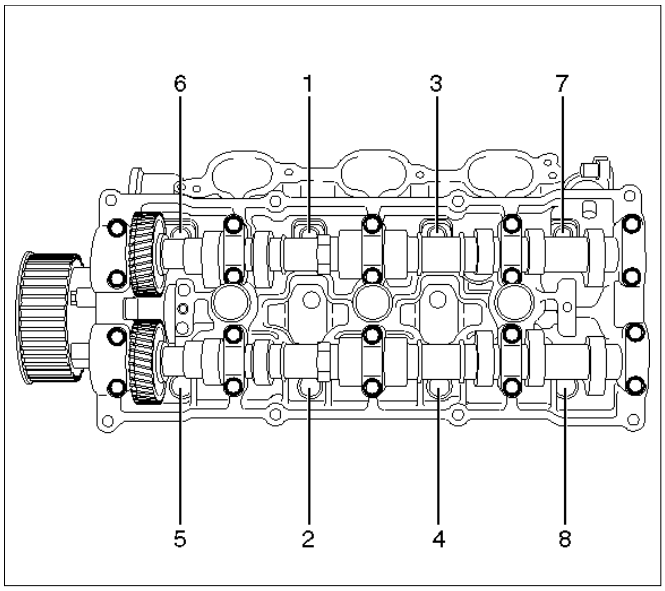
NOTE: Do not reuse cylinder head bolts.

Do not apply any lubricant to the cylinder head bolts.

Torque:

Temporary: 29 N·m (3.0 kg·m/21 lb ft)

Final: 64 N·m (6.5 kg·m/47 lb ft)



014RW029

2. Install common chamber.
   - Refer to installation procedure for Common Chamber in this manual.
3. Install cylinder head cover RH.
   - Refer to installation procedure for Cylinder Head Cover RH in this manual.
4. Install cylinder head cover LH.
   - Refer to installation procedure for Cylinder Head Cover LH in this manual.
5. Install timing belt.
   - Refer to installation procedure for Timing Belt in this manual.
6. Install crankshaft pulley.
   - Refer to installation procedure for Crankshaft Pulley in this manual.

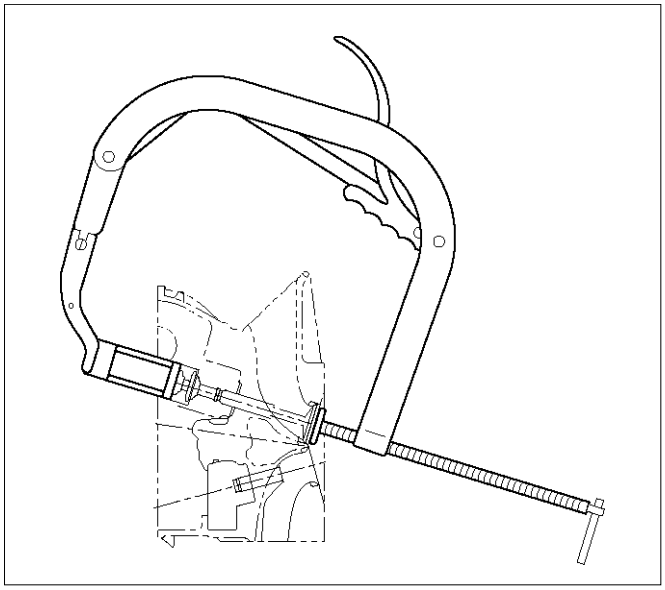
Valve Stem Oil Controller, Valve Spring and Valve Guide

Removal

1. Disconnect battery ground cable.
   - Drain engine oil.
2. Drain engine coolant.
3. Remove cylinder head assembly.
   - Refer to removal procedure for Cylinder Head in this manual.
4. Remove camshaft.
   - Refer to removal procedure for Camshaft in this manual.
5. Remove tappets with shim.

NOTE: Do not damage shim surface.

6. Remove valve springs using 5−8840−2446−0 valve spring compressor and 5−8840−2547−0 valve spring compressor adapter then remove upper valve spring seat and lower seat.

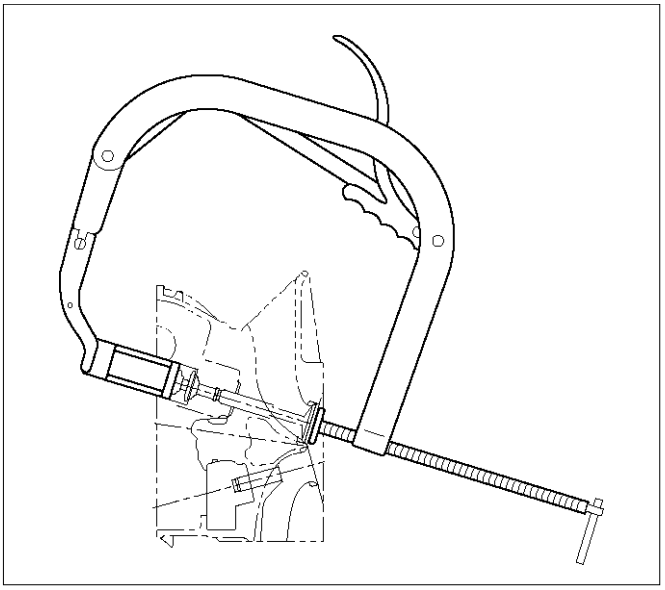


014RW042

7. Remove oil controller using 5−8840−0623−0 oil controller remover, remove each valve stem oil controller.
8. Remove valve guide using 5−8840−2549−0 valve guide replacer.

Installation

1. Install valve guide using 5−8840−2442−0 valve guide installer.
2. Install oil controller using 5−8840−0624−0 oil controller installer.
3. Install lower valve spring seat, valve spring and upper valve spring seat then put split collars on the upper spring seat, using 5−8840−2442−0 valve spring compressor and 5−8840−0624−0 valve spring compressor adapter to install the split collars.

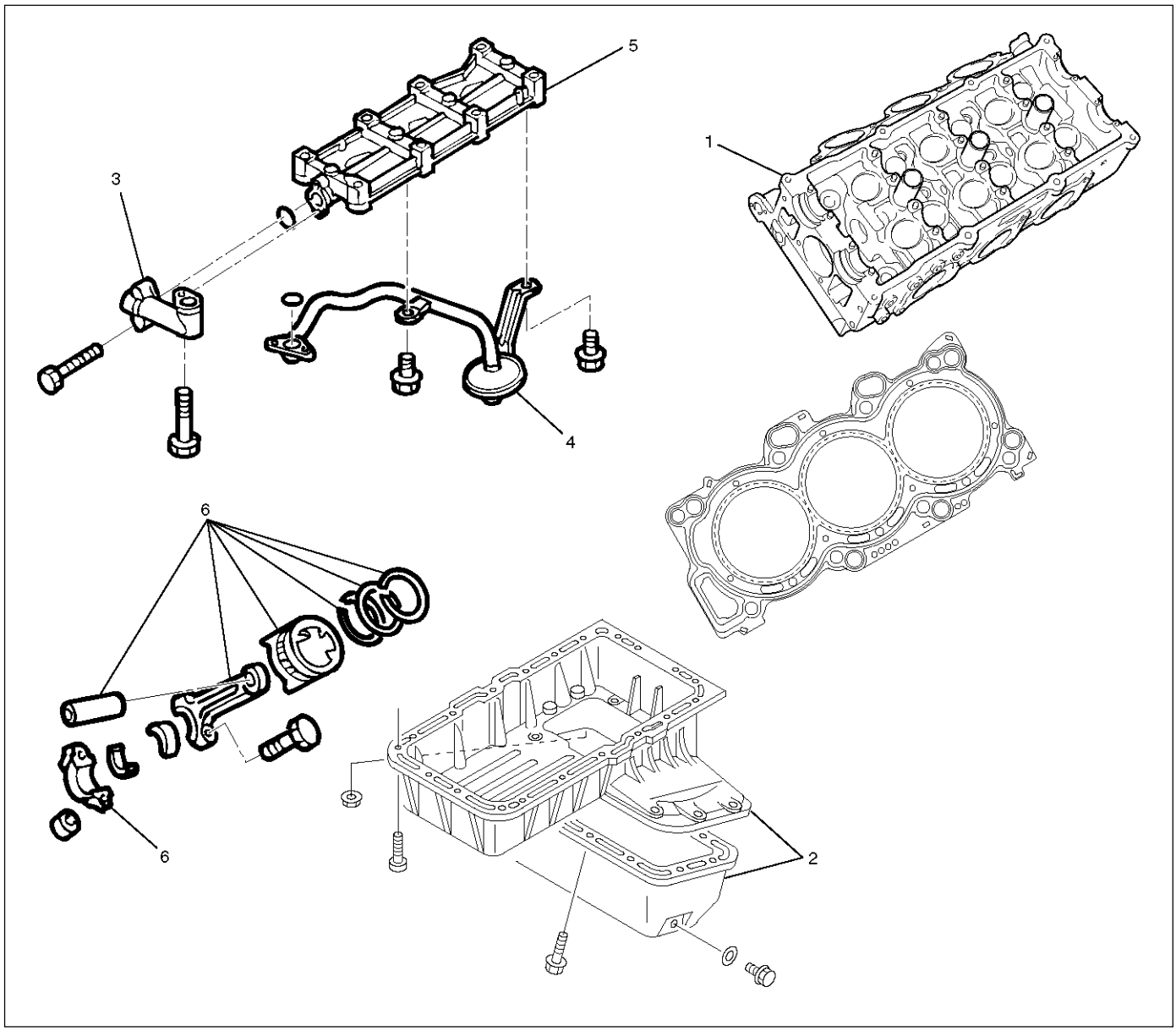


014RW042

4. Install tappet with shim.
5. Install camshaft assembly.
   - Refer to installation procedure for Camshaft in this manual.
6. Install cylinder head assembly.
   - Refer to installation procedure for Cylinder Head in this manual.
7. Fill engine oil until full level.
8. Fill engine coolant.

Piston, Piston Ring and Connecting Rod

Removal



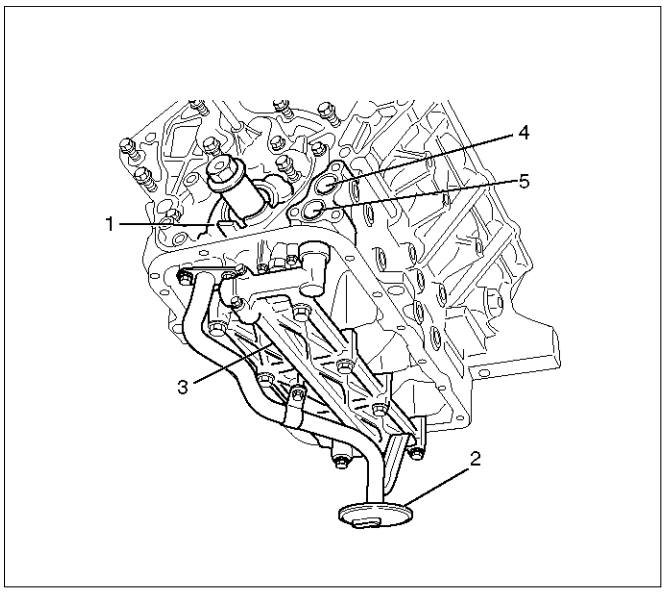
F06RW011

Legend

(1) Cylinder Head
(2) Crankcase with Oil Pan
(3) Oil Pipe
(4) Oil Strainer
(5) Oil Gallery
(6) Piston with Connecting Rod Assembly

1. Remove cylinder head assembly.
   - Refer to removal procedure for Cylinder Head in this manual.
2. Remove crankcase with oil pan.
   - Refer to removal procedure for Oil Pan and Crankcase in this manual.

3. Remove oil strainer fixing bolts, remove oil strainer assembly with O-ring.



050RW002

Legend

(1) Oil Pump
(2) Oil Strainer
(3) Oil Gallery
(4) From Oil Filter
(5) To Oil Filter

4. Remove three fixing bolts, oil pipe with O-ring.
5. Remove eight fixing bolts, oil gallery.
6. Remove piston with connecting rod assembly, before removing the bearing cap, remove carbon on the top of cylinder bore and push piston with connecting rod out from the top of cylinder bore.

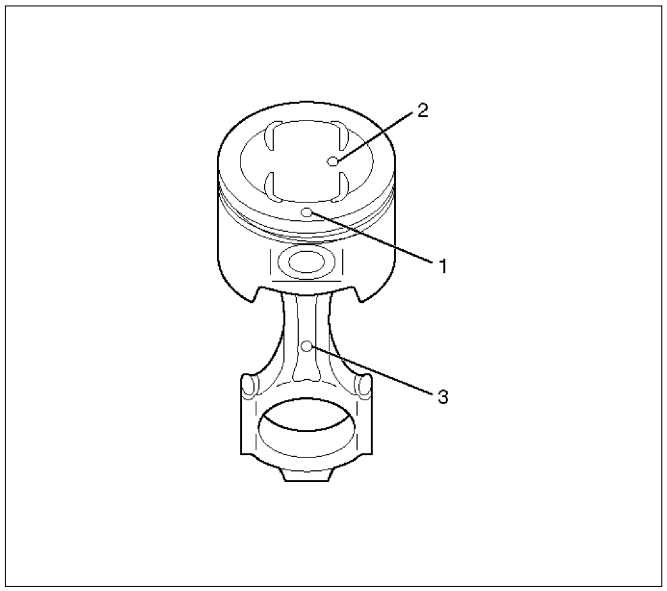
Installation

1. Install piston with connecting rod assembly.
   - Apply engine oil to cylinder bore, connecting rod bearing and crank pin.
   - When installing the piston, its front mark must face the engine front side.
   - The bearing cap number must be the same as connecting rod number.
   - Apply engine oil to the thread and seating surface of each nut.
   - Tighten nuts to the specified torque.

   Torque: 54 N·m (5.5 kg·m/40 lb ft)

   - After tightening the nuts, make sure that the crankshaft rotates smoothly.

NOTE: Do not apply engine oil to the bearing back faces and connecting rod bearing fitting surfaces.



015RW003

Legend

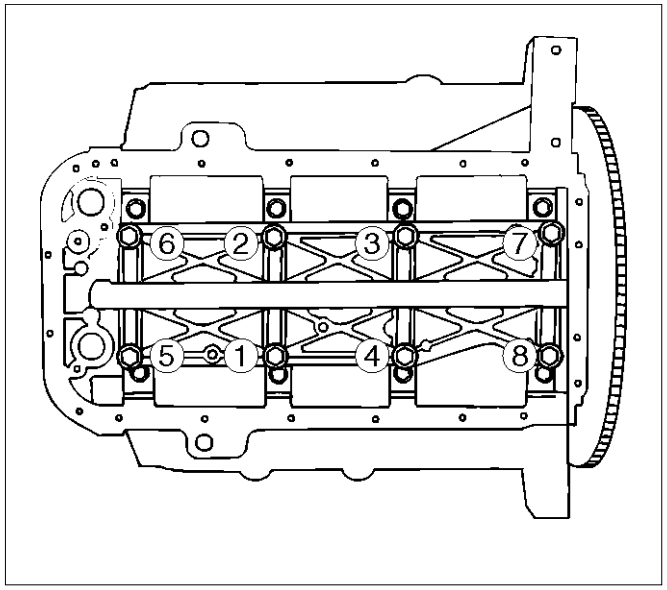
(1) Piston Front Mark
(2) Piston Grade
(3) Connecting Rod Front Mark

2. Install oil gallery and tighten the bolts in two steps, in the order shown in illustration.

   Torque:

   1st step: 29 N·m (3.0 kg·m/21 lb ft)

   2nd step: 55°–65°



051RS009

3. Install oil pipe with O-ring.

   Torque: 10 N·m (1.0 kg·m/7 lb ft)

4. Install oil strainer assembly with O-ring.

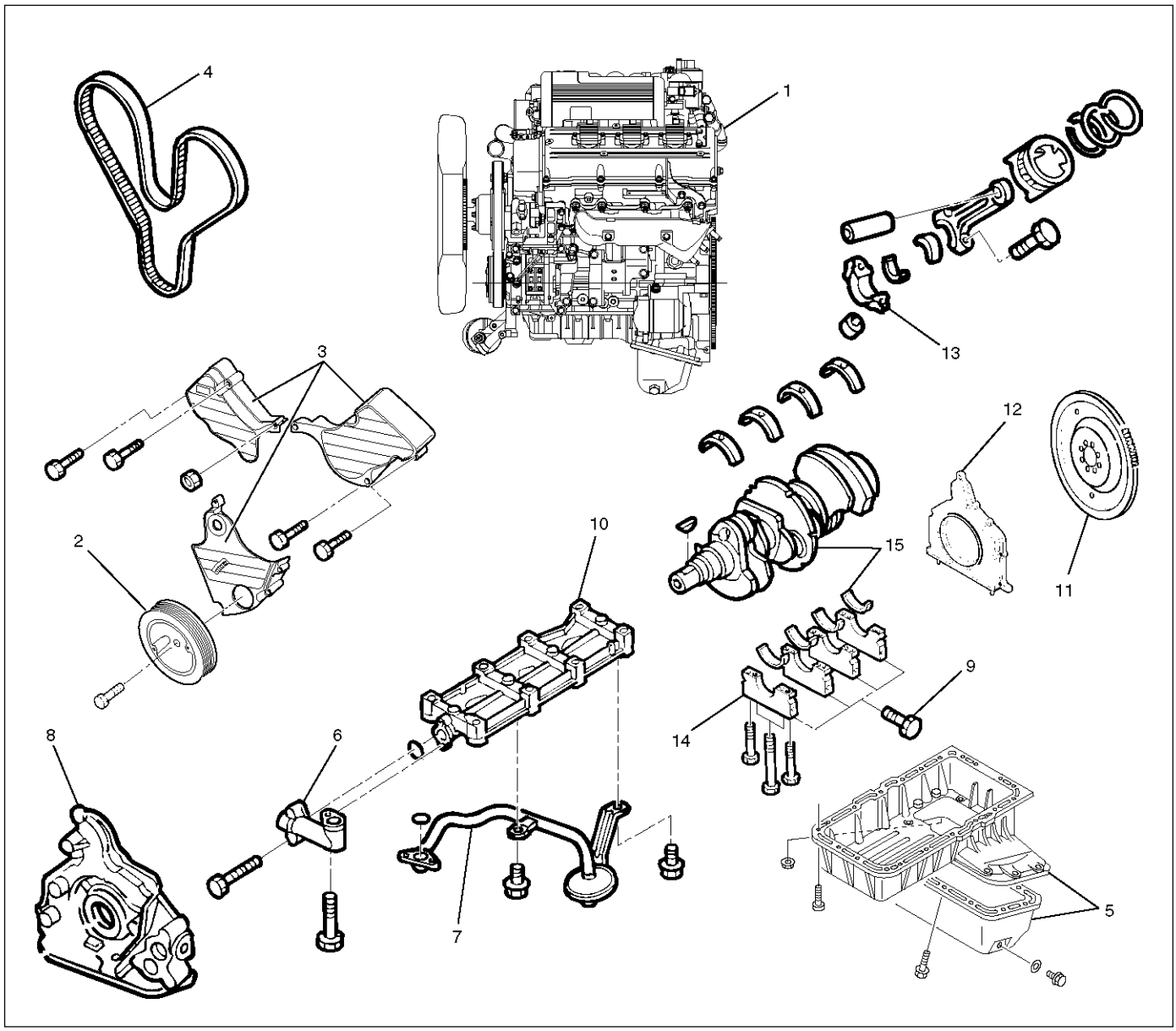
   Torque: 25 N·m (2.5 kg·m/18 lb ft)

5. Install crankcase with oil pan.
   - Refer to installation procedure for Oil Pan and Crankcase in this manual.

6. Install cylinder head assembly.
   - Refer to installation procedure for Cylinder Head in this manual.

Crankshaft and Main Bearings

Removal



F06RW010

Legend

(1) Engine Assembly
(2) Crankshaft Pulley
(3) Timing Belt Cover
(4) Timing Belt
(5) Crankcase with Oil Pan
(6) Oil Pipe
(7) Oil Strainer
(8) Oil Pump Assembly
(9) Cylinder Body Side Bolt
(10) Oil Gallery
(11) Flywheel
(12) Rear Oil Seal Retainer
(13) Connecting Rod Cap
(14) Crankshaft Main Bearing Cap
(15) Crankshaft and Main Bearing

1. Remove engine assembly.
   - Refer to removal procedure for Engine Assembly in this manual.
2. Remove timing belt.
   - Refer to removal procedure for Timing Belt in this manual.
3. Remove oil pan and crankcase.
   - Refer to removal procedure for Oil Pan and Crankcase in this manual.
4. Remove oil pipe with O-ring.
5. Remove oil strainer assembly with O-ring.
6. Remove oil pump assembly.
   - Refer to removal procedure for Oil Pump in this manual.
7. Remove cylinder body side bolts.
8. Remove oil gallery.
9. Remove flywheel.
10. Remove rear oil seal retainer.
    - Refer to removal procedure for Rear Oil Seal in this manual.
11. Remove connecting rod caps.
12. Remove crankshaft main bearing caps.
13. Remove crankshaft and main bearings.

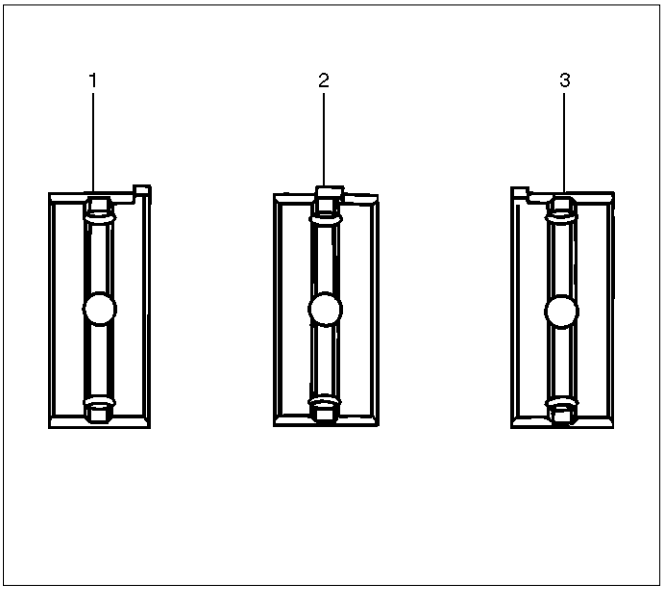
Installation

1. Install crankshaft and main bearings.
   - Install main bearing in the cylinder block and main bearing cap respectively.

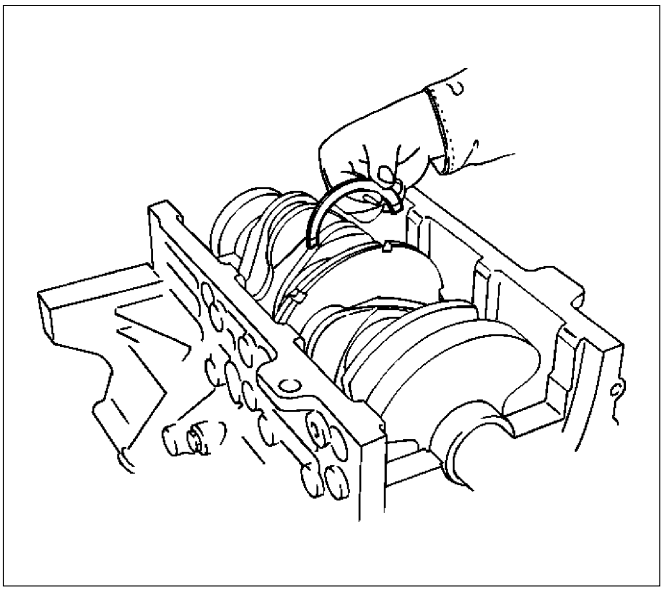
     Apply new engine oil to upper and lower main bearings.

NOTE:

- Do not apply engine oil to the bearing back faces.
- Make sure that main bearings are in correct position.
- Install crankshaft with care.
- Apply engine oil to the thrust washer.
- Install thrust washer on No.3 journal.
- Oil grooves in thrust washer must face the crankshaft.



015RS012



015RS013

2. Install crankshaft main bearing caps.
   - Apply engine oil to the thread and seating surface of each bearing cap fixing bolt.

NOTE:

- Do not apply engine oil to the bearing back faces.
- Install bearing caps in the order of numbers, starting with cylinder block front side.
- Tighten main bearing fixing bolts to the specified torque.

  Torque: 39 N·m (4.0 kg·m/29 lb ft)
- After tightening the bolts, make sure that the crankshaft rotates smoothly.

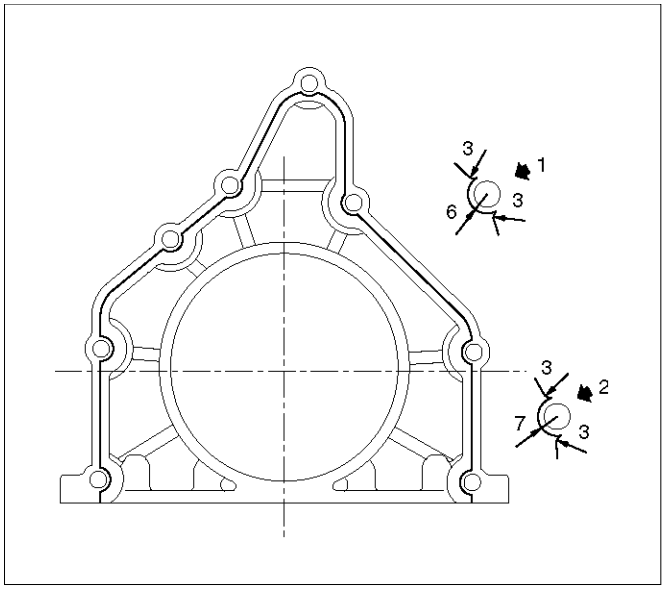
3. Install connecting rod caps.
   - The cap number must be same as connecting rod number.
   - Apply engine oil to the thread and seating surface of each nut.

- Tighten nuts to the specified torque.

Torque: 54 N·m (5.5 kg·m/40 lb ft)

- After tightening the nuts, make sure that the crankshaft rotates smoothly.

4. Install rear oil seal retainer.
   - Remove oil on cylinder block and retainer fitting surface.
   - Apply sealant (TB1207B or equivalent) to retainer fitting surface as shown in illustration.
   - The oil seal retainer must be installed within 5 minutes after sealant application to prevent premature hardening of sealant.



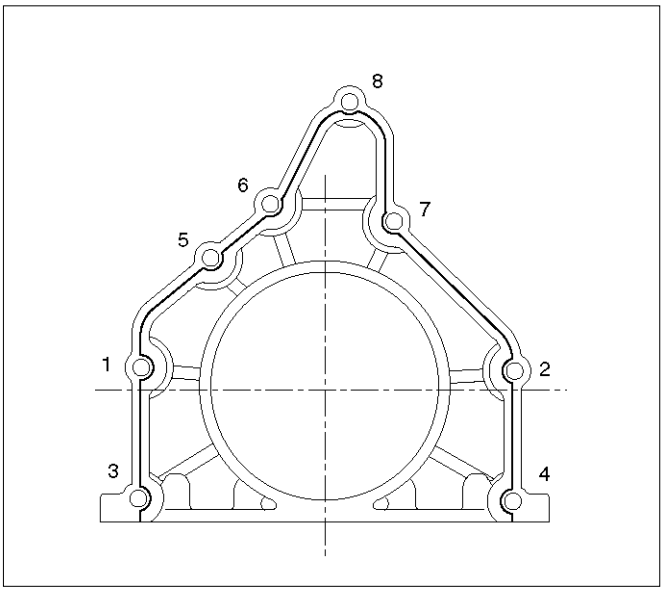
015RW002

Legend

(1) Around Bolt Holes
(2) Around Dowel Pin

- Apply engine oil to oil seal lip and align a dowel pin hole in the cylinder block with that in the retainer.
- Tighten retainer fixing bolts to the specified torque.

Torque: 18 N·m (1.8 kg·m/13 lb ft)



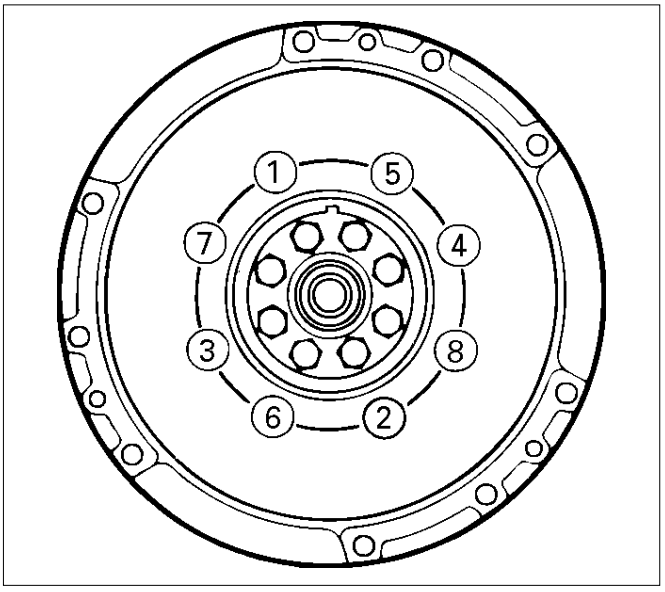
015RW001

5. Install flywheel.
   - Clean tapped holes in the crankshaft.
   - Remove oil on crankshaft and flywheel fitting surface.

NOTE:

- Do not reuse the bolts.
- Do not apply oil or thread lock to the bolts.
- Tighten fixing bolts to the specified torque.

Torque: 54 N·m (5.5 kg·m/40 lb ft)



015RS018

6. Install oil gallery.
   - Clean contact surface of oil gallery and main bearing cap.

     Apply engine oil to oil gallery fixing bolts and tighten the bolts in two steps, in the order shown.

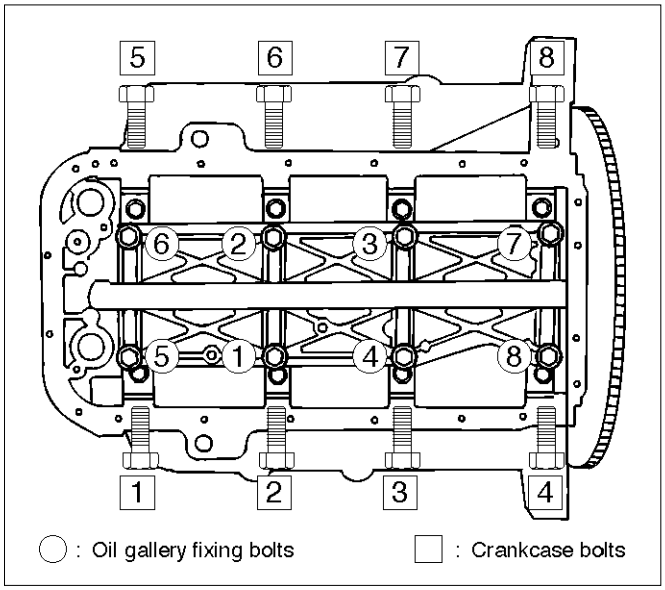
   Torque:

   1st step: 29 N·m (3.0 kg·m/21 lb ft)

   2nd step: 55°–65°
7. Install cylinder body side bolts and tighten bolts in order to the specified torque.

   Torque: 39 N·m (4.0 kg·m/29 lb ft)

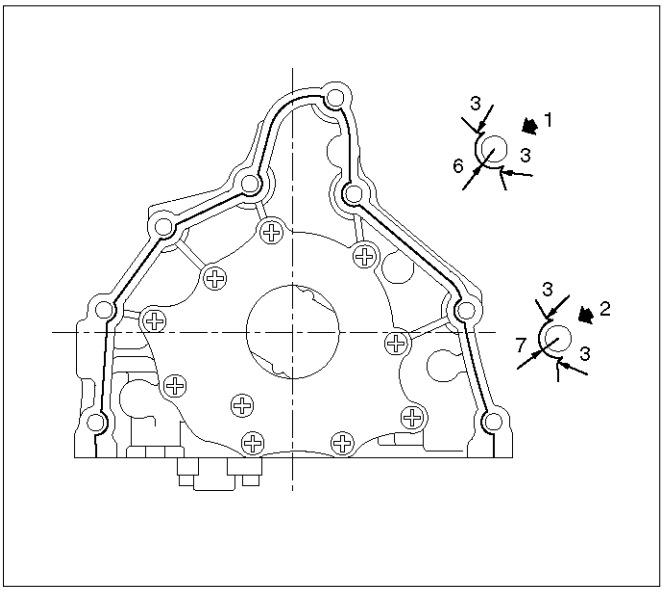
NOTE: Do not apply the oil to the bolts.



012RS007

8. Install oil pump assembly.
   - Remove oil on cylinder block and oil pump mounting surface.
   - Apply sealant (TB1207B or equivalent) to the oil pump mounting surface.
   - The oil pump assembly must be installed within 5 minutes after sealant application to prevent premature hardening of sealant.
   - Apply engine oil to oil seal lip.
   - Install oil pump in the cylinder block and tighten fixing bolts to the specified torque.

   Torque: 25 N·m (2.5 kg·m/18 lb ft)

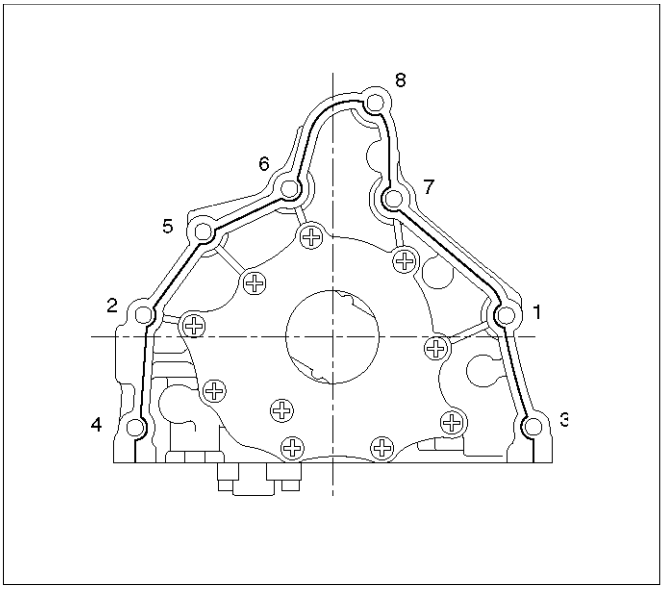


051RW002

Legend

(1) Around Bolt Holes

(2) Around Dowel Pin



051RW001

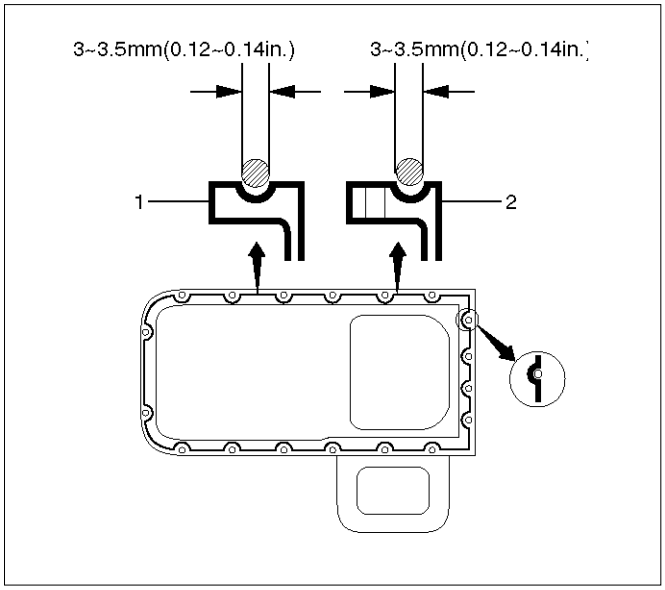
9. Install oil strainer with O-ring, tighten to the specified torque.

   Torque: 25 N·m (2.5 kg·m/18 lb ft)
10. Install oil pipe with O-ring, tighten fixing bolts to the specified torque.

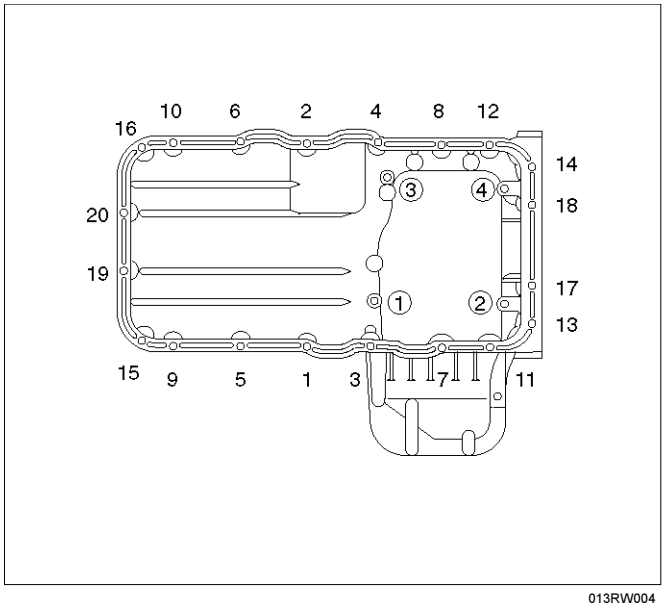
    Torque: 25 N·m (2.5 kg·m/18 lb ft)

11. Install crankcase.
    - Remove oil on crankcase mounting surface and dry the surface.
    - Properly apply a 4.5 mm (0.7 in) wide bead of sealant (TB1207C or equivalent) to the crankcase mounting surface. The bead must be continuous.
    - The crankcase must be installed within 5 minutes after sealant application to prevent premature hardening of sealant.
    - Tighten fixing bolts to the specified torque.

    Torque: 10 N·m (1.0 kg·m/1 lb ft)



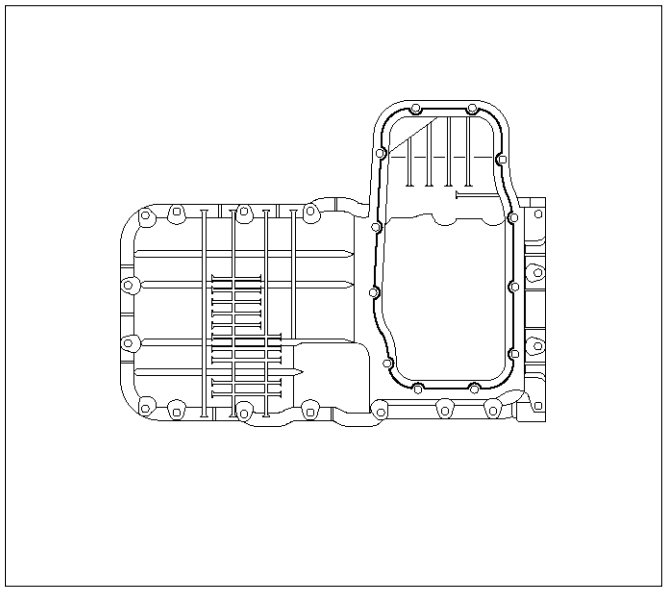
013RW010



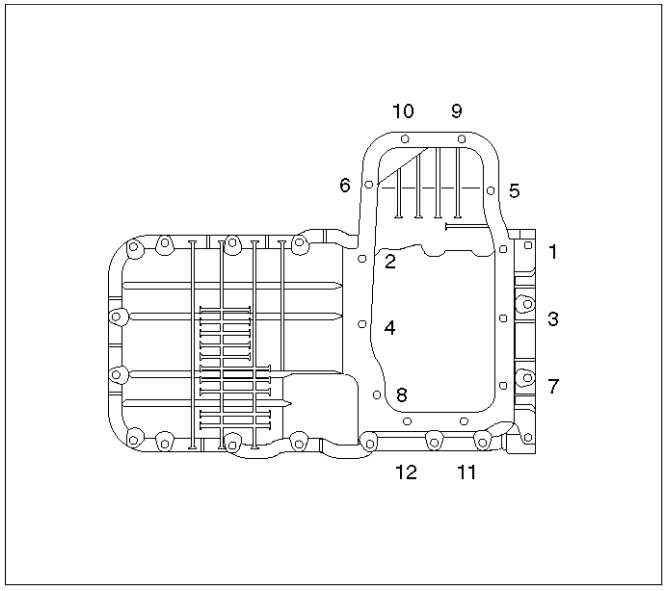
013RW004

12. Install oil pan
    - Remove oil on oil pan mounting surface and dry the surface.
    - Properly apply a 4.5 mm (0.7 in) wide bead of sealant (TB1207C or equivalent) to the oil pan mounting surface. The bead must be continuous.
    - The oil pan must be installed within 5 minutes after sealant application to prevent premature hardening of sealant.
    - Tighten fixing bolts to the specified torque.

    Torque: 25 N·m (2.5 kg·m/18 lb ft)



013RW003



013RW002

13. Install timing belt.
    - Refer to installation procedure for Timing Belt in this manual.
14. Install engine assembly.
    - Refer to installation procedure for Engine Assembly in this manual.

Rear Oil Seal

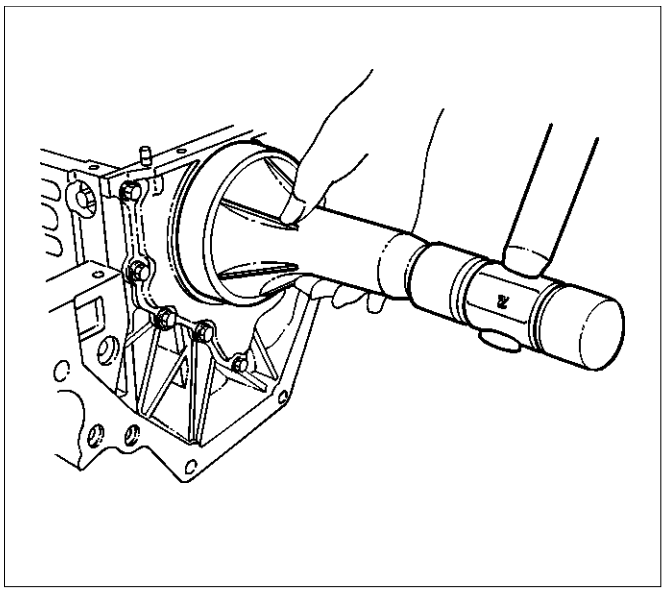
Removal

1. Remove transmission assembly.
   - See Transmission section in this manual.
2. Remove flywheel.
3. Remove rear oil seal using a seal remover.

NOTE: Take care not to damage the crankshaft or oil seal retainer when removing oil seal.

Installation

1. Apply engine oil to oil seal lip and install oil seal using 5−8840−2286−0.



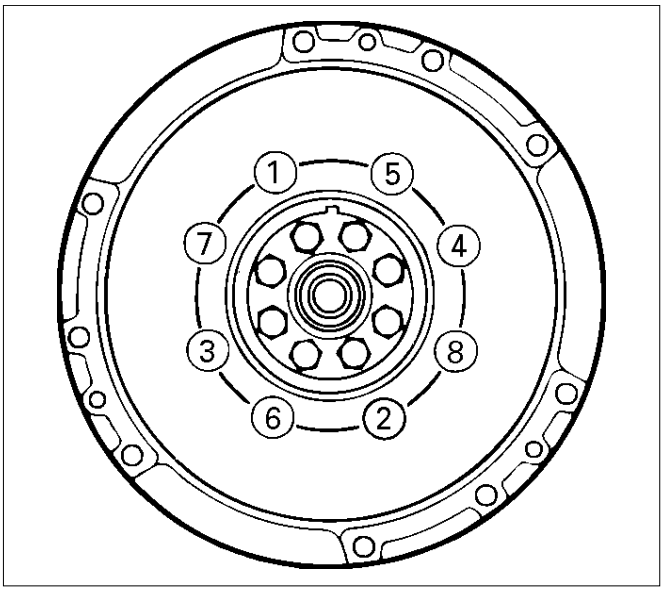
015RS017

2. Install flywheel.

- Clean tapped holes in the crankshaft.
- Remove oil on the crankshaft and flywheel mounting surface.
- Tighten fixing bolts to the specified torque.

NOTE: Do not reuse the bolts and do not apply oil or thread lock to the bolts.

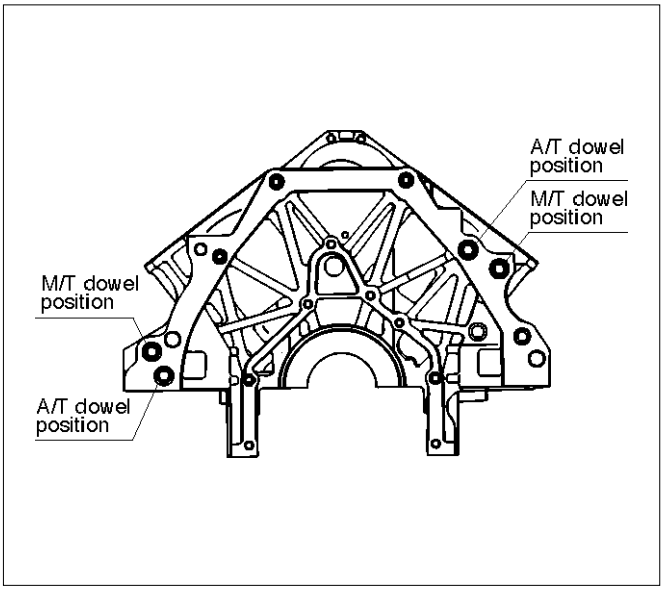
Torque: 54 N·m (5.5 kg·m/40 lb ft)



015RS018

3. Install transmission.
   - See Transmission section in this manual.

CAUTION: When assembling the engine and transmission, confirm that dowels have been mounted in the specified positions at the engine side. Take care that dowel positions are different between the manual transmission and the automatic transmission. Otherwise, the transmission may be damaged.



012RS009

Engine Assembly

Removal



P1010068

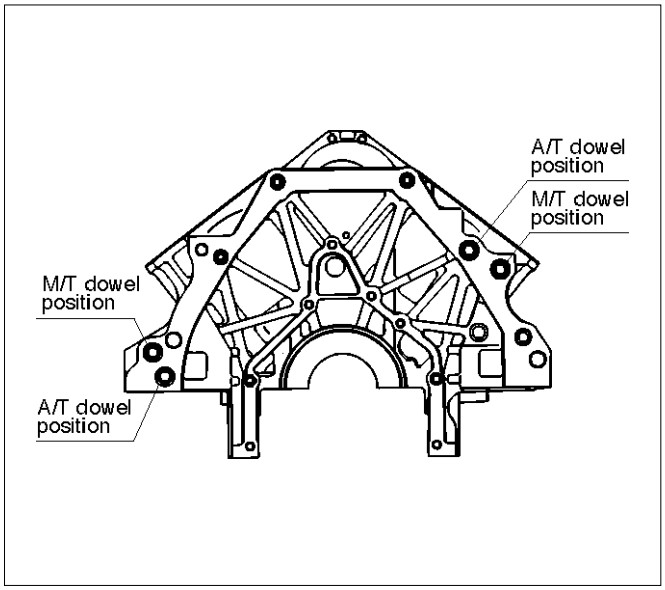
1. Disconnect battery ground and positive cable.
2. Remove battery.
3. Make alignment mark on the engine hood and hinges before removal in order to return the hood to original position exactly.
4. Remove engine hood.
5. Drain radiator coolant.
6. Disconnect accelerator cable and automatic cruise control cable from throttle valve on common chamber.
7. Remove the ECM.
   - Disconnect the two connectors from the ECM.
   - Remove fixing bolts on the common chamber.
   - Remove fixing bolts for ground cable.
8. Disconnect air duct with air cleaner cover.
9. Remove air cleaner assembly.
10. Disconnect canister vacuum hose.
11. Disconnect vacuum booster hose.
12. Disconnect three engine harness connectors.
13. Disconnect harness connector to transmission (left front side of engine compartment), disconnect shift on the fly harness connector from front side of front axle and remove transmission harness bracket from engine left side.
14. Disconnect ground cable between engine and frame.
15. Disconnect bonding cable connector on the back of right dash panel.
16. Disconnect bonding cable terminal on the left bank.
17. Disconnect starter harness connector from starter.
18. Disconnect generator harness connector from generator.
19. Disconnect coolant reserve tank hose from radiator.
20. Remove radiator upper and lower hoses.
21. Remove upper fan shroud.
22. Remove cooling fan assembly four fixing nuts, then the cooling fan assembly.
23. Move drive belt tensioner to loose side using wrench then remove drive belt.
24. Remove power steering pump fixing bolts, then power steering pump. Place the power steering pump along with piping on the body side.
25. Remove air conditioning compressor fixing bolts from bracket and place the compressor along with piping on the body side.
26. Remove four O2 sensor harness connectors (two each bank) from exhaust front pipe.
27. Remove three exhaust pipe fixing nuts from each bank.
28. Remove two exhaust pipe fixing nuts from each exhaust pipe, then move exhaust pipe to rear side of vehicle.
29. Remove flywheel dust covers.
30. Disconnect two heater hoses from engine.
31. Disconnect fuel hose from right side of transmission.

CAUTION: Plug fuel pipe on engine side and fuel hose from fuel tank.

32. Remove transmission assembly. Refer to Transmission section in this manual.
33. Support the engine by engine hoist.
34. Remove two left side engine mount fixing bolts from engine mount on chassis side.
35. Remove two right side engine mount fixing bolts from engine mount on chassis side.
36. Remove engine assembly.

Installation

CAUTION: When assembling the engine and transmission, confirm that dowels have been mounted in the specified positions at the engine side. Also take care that dowel positions are different between the manual transmission and the automatic transmission. Otherweise, the transmission may be damaged.

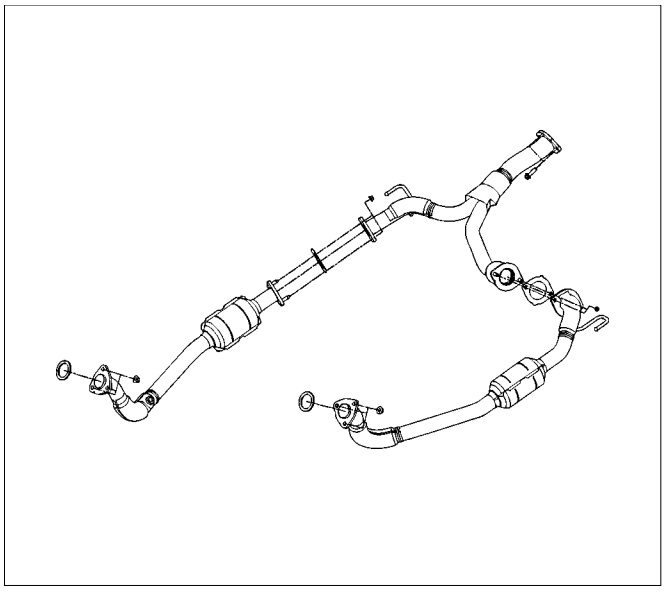


012RS009

1. Install engine assembly. Tighten engine mount fixing bolts to frame to the specified torque.

   Torque: 41 N·m (4.2 kg·m/30 lb ft)
2. Reconnect fuel hose to fuel pipe on engine.
3. Install transmission assembly. Refer to Transmission section in this manual.
4. Reconnect two heater hoses to engine.
5. Install flywheel dust covers.
6. Install exhaust pipe and temporally tighten two (each bank) rear exhaust flange nuts then tighten three stud nuts (each bank) between exhaust manifold and exhaust pipe, finally tighten rear side stud nuts to the specified torque.

   Torque: 67 N·m (6.8 kg·m/49 lb ft)



LTW36FSH000101

7. Reconnect O2 sensor connector.
8. Install cooling fan assembly and tighten bolts/nuts to the specified torque.

   Torque: 25 N·m (2.5 kg·m/18 lb ft) for fan pulley and fan bracket.

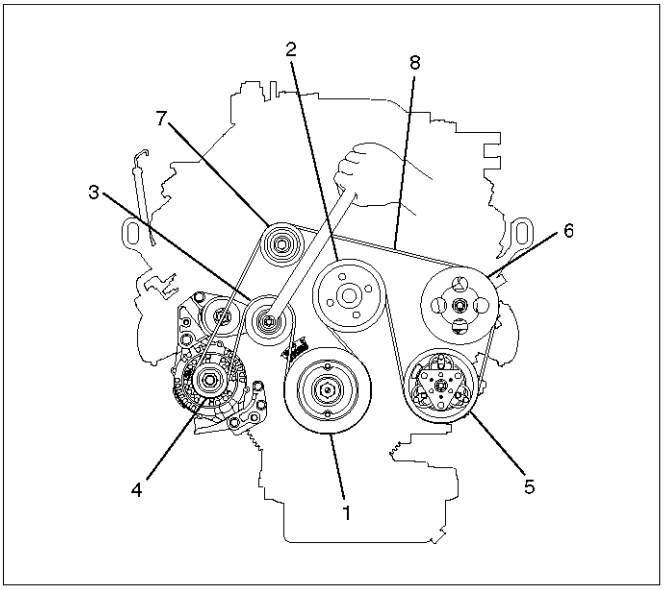
   Torque : 10 N·m (1.0 kg·m/7 lb ft) for fan and clutch assembly.
9. Install air conditioner compressor to engine and tighten to the specified torque.

   Torque : 43 N·m (4.4 kg·m/32 lb ft)
10. Install power steering pump, tighten fixing bolt to the specified torque.

    Torque :

    M8 bolts : 25 N·m (2.5 kg·m/18 lb ft)

    M10 bolts : 43 N·m (4.4 kg·m/32 lb ft)
11. Move drive belt tensioner to loose side using wrench, then install drive belt to normal position.



850RW001

Legend

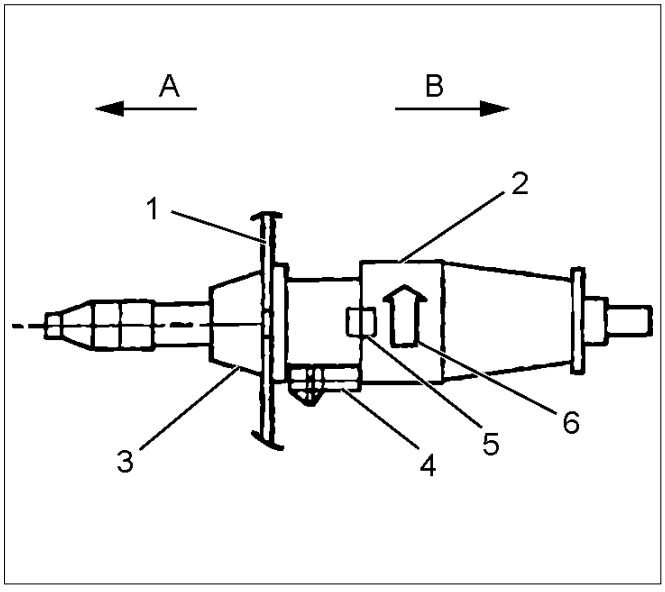
(1) Crankshaft Pulley
(2) Cooling Fan Pulley
(3) Tensioner
(4) Generator
(5) Air Conditioner Compressor
(6) Power Steering Oil Pump
(7) Drive Belt

12. Install upper fan shroud.
13. Reconnect radiator upper and lower hoses.
14. Reconnect coolant reserve tank hose to radiator.
15. Reconnect generator harness connector.
16. Reconnect starter harness connector.
17. Reconnect bonding cable terminal on left bank
18. Reconnect bonding cable terminal on the back of right dash panel.

19. Reconnect ground cable between engine and chassis.
20. Reconnect harness connector to transmission and install transmission harness bracket on engine left side.
21. Reconnect three engine harness connectors.
22. Reconnect vacuum booster hose.
23. Reconnect canister vacuum hose.
24. Install air cleaner assembly.
25. Reconnect air duct.
26. Reconnect accelerator cable to throttle valve on common chamber.
27. Install the ECM.
    - Tighten the four bolts.

    Torque : 10 N·m (1.0 kg·m/7 lb ft)

    - Connect the two connectors.
    - Tighten the two ground cable bolts.
28. Install engine hood to the origine position.
    - Refer to installation procedure for Body section in this manual.
    - Install accelerator control cable to accelerator cable bracket.
    - Rotate the ratchet ring in direction an arrow 90°
    - Confirm marking of outer cap must be upper side.
    - Slider the lock in direction B.
    - Confirm ratchet ring is locked.



RTW46ASH000201

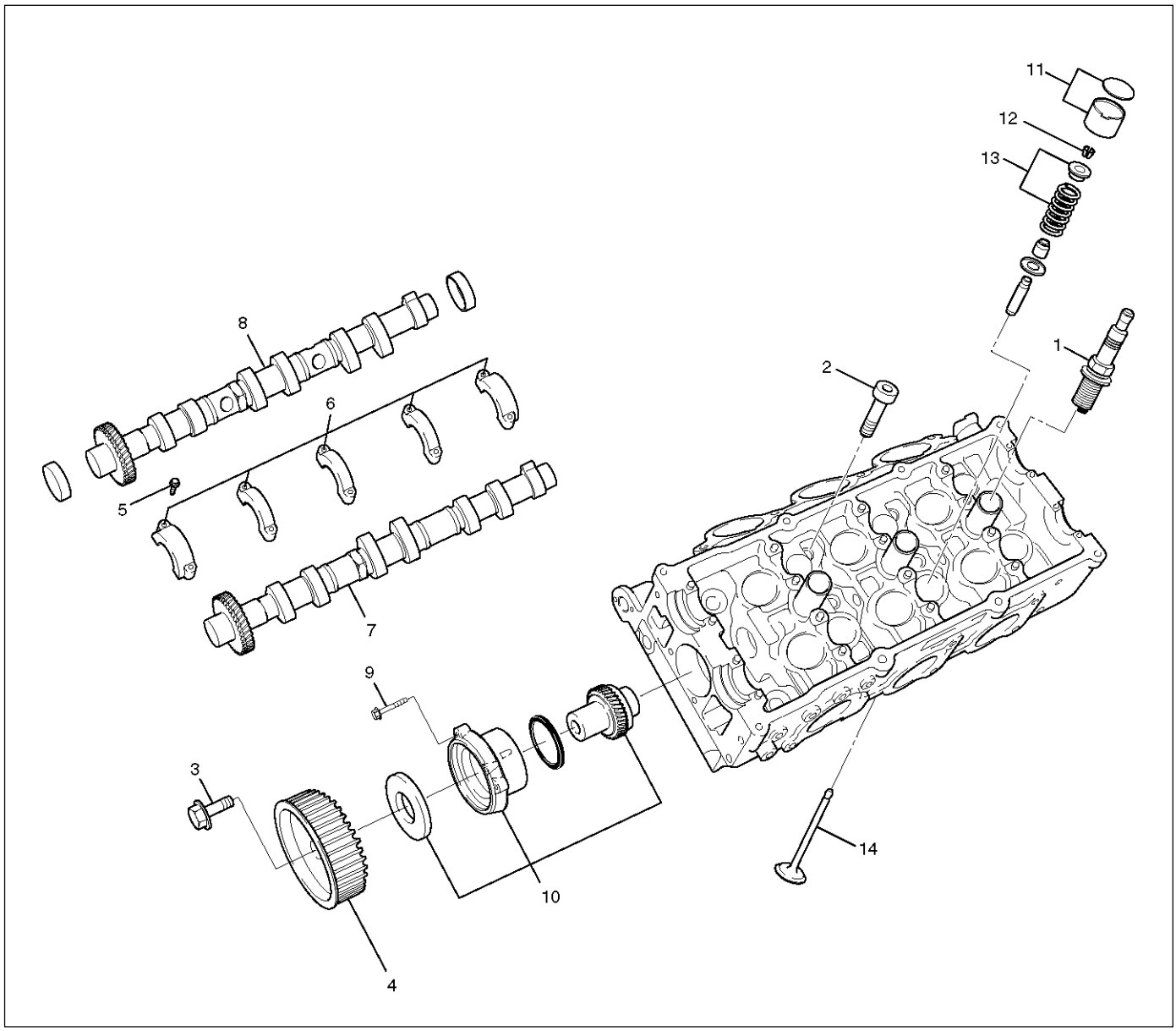
Legend

(1) Cable Bracket
(2) Ratchet ring
(3) Outer Cap
(4) Lock
(5) Paint Mark
(6) Arrow Mark

29. Install the cable clips to accelerator control cable.

Cylinder Head

Cylinder Head and Associated Parts



011RW008

Legend

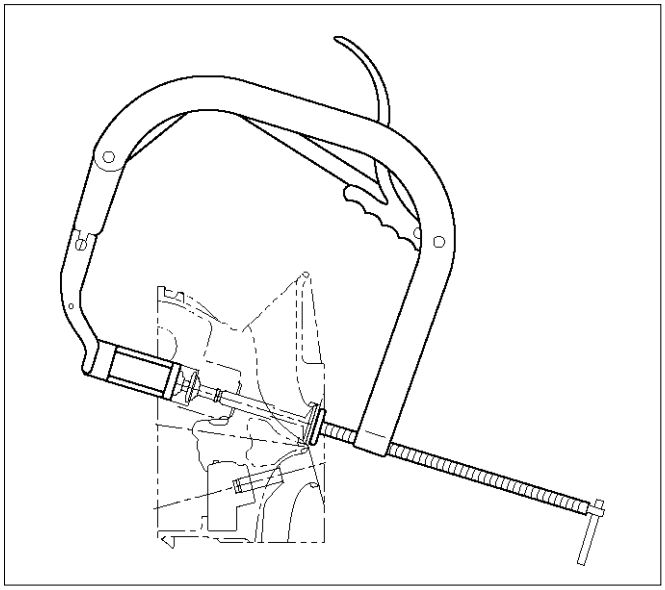
(1) Spark Plug
(2) Cylinder Head Bolt
(3) Camshaft Drive Gear Pulley Fixing Bolt
(4) Camshaft Drive Gear Pulley
(5) Camshaft Drive Gear Pulley
(6) Camshaft Bracket
(7) Camshaft Exhaust
(8) Camshaft Intake
(9) Retainer Fixing Bolt
(10) Retainer Assembly
(11) Tappet with Shim
(12) Split Collar
(13) Valve Spring and Spring Upper Seat
(14) Valve

Disassembly

NOTE:

- During disassembly, be sure that the valve train components are kept together and identified so that they can be reinstalled in their original locations.
- Before removing the cylinder head from the engine and before disassembling the valve mechanism, perform a compression test and note the results.

1. Remove camshaft drive gear pulley fixing bolt (3), then pulley (4).
2. Remove camshaft bracket fixing bolt (5), camshaft bracket (6), then camshaft exhaust (7), and intake side (8).
3. Remove tappet with shim (11).
4. Use the 5−8840−2446−0 valve spring compressor and 5−8840−2547−0 valve spring compressor adapter to remove the split collar (12), valve spring with upper seat (13) and valve (14).



014RW042

5. Remove spark plug (1).

CAUTION: Do not remove the spark plugs when the head and plugs are hot. Clean dirt and debris from spark plug recess areas before removal.

Clean

Cylinder head

Carefully remove all varnish, soot and carbon from the bare metal. Do not use a motorized wire brush on any gasket sealing surface.

Inspection and Repair

1. Cylinder head gasket and mating surfaces for leaks, corrosion and blow-by. If the gasket has failed, determine the cause.
   −Insufficient torque on head bolts
   −Improper installation
   −Loose or warped cylinder head
   −Missing dowel pins
   −Warped case surface
2. Cylinder head for cracks, especially between valve seats and in the exhaust ports.
3. Cylinder head deck for corrosion, sand particles in head and porosity.

CAUTION:

- **Do not attempt to weld the cylinder head. Replace it.**
- **Do not reuse cylinder head bolts.**

4. Cylinder head deck, common chamber and exhaust manifold mating surfaces for flatness. These surfaces may be reconditioned by milling. If the surfaces are “out of flat" by more than specification, the surface should be ground to within specifications. Replace the head if it requires machining beyond the repairable limit.

Head surface and manifold surface

Standard: 0.05 mm (0.002 in) or less

Warpage limit: 0.2 mm (0.0079 in)

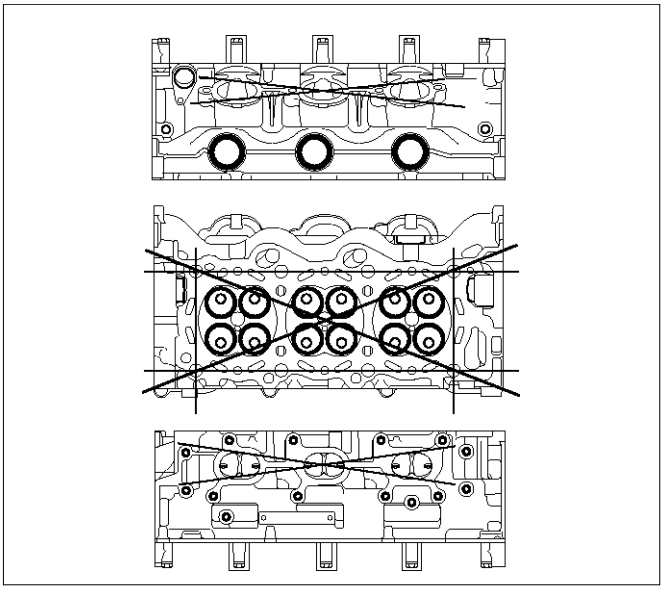
Maximum Repairable limit: 0.2 mm (0.0079 in)

Head height

Standard height : 133.2 mm (5.2441 in)

Warpage limit : 0.2 mm (0.0079 in)

Maximum Repairable limit : 133.0 mm (5.2362 in)



011RW019

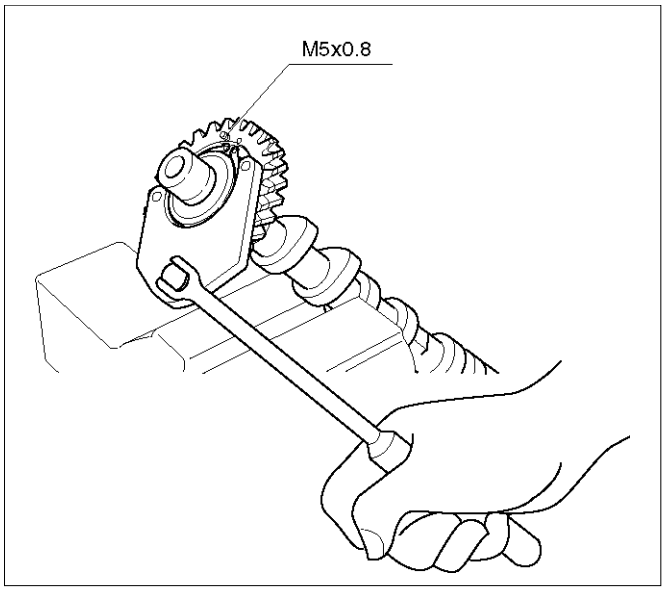
5. Water jacket sealing plugs seating surfaces.

Reassembly

1. Install spark plug and tighten all the spark plugs to specified torque.

   Torque: 18 Nm (1.8 kgm/13 lb ft)

2. Tighten sub gear setting bolt.
   1. Use 5−8840−2443−0 gear spring lever to turn sub gear to right direction until the M5 bolt aligns with the hole between camshaft driven gear and sub gear.
   2. Tighten the M5 bolt to a suitable torque to prevent the sub gear from moving.

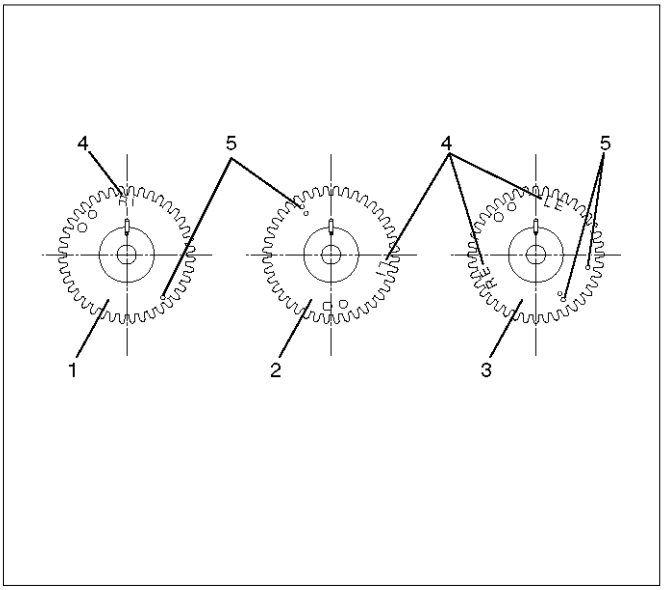


014RW041

3. Install camshaft drive gear assembly and tighten three bolts to the specified torque.

   Torque: 10 N·m (1.0 kg·m/7 lb ft)

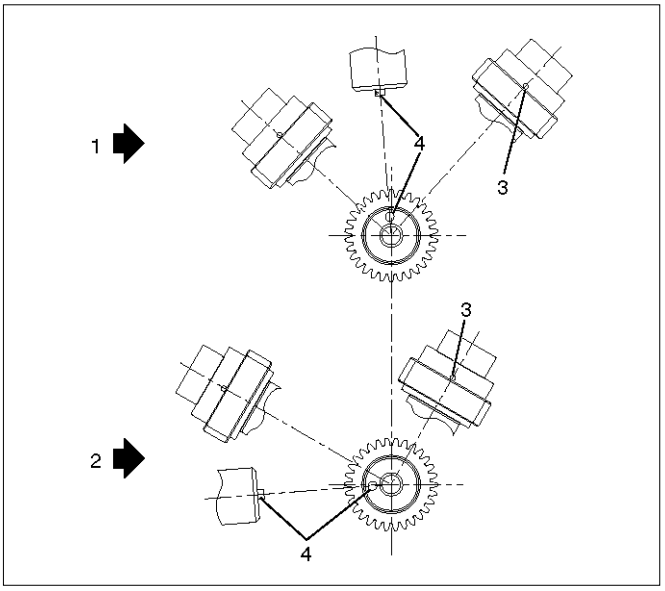
4. Install camshaft assembly and camshaft brackets, tighten twenty bolts on one side bank to the specified torque.
   1. Apply engine oil to camshaft journal and bearing surface of camshaft bracket.
   2. Align timing mark on intake camshaft (one dot for right bank, two dots for left bank) and exhaust camshaft (one dot for right bank, two dots for left bank) to timing mark on camshaft drive gear (one dot).



014RW020

Legend

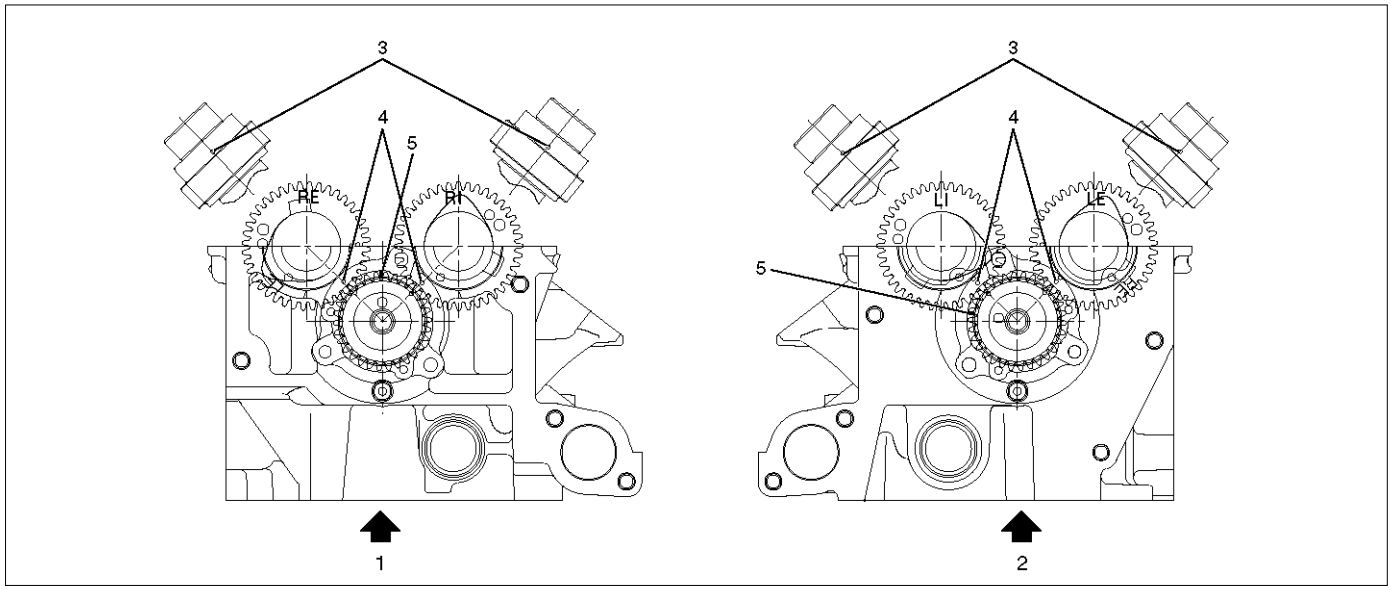
(1) Intake Camshaft Timing Gear for Right Bank
(2) Intake Camshaft Timing Gear for Left Bank
(3) Exhaust Camshaft Timing Gear
(4) Discrimination Mark
LI: Left Bank Intake
RI: Right Bank Intake
LE: Left Bank Exhaust
RE: Right Bank Exhaust



014RW023

Legend

(1) Right Bank Camshaft Drive Gear
(2) Left Bank Camshaft Drive Gear
(3) Timing Mark on Drive Gear
(4) Dowel Pin



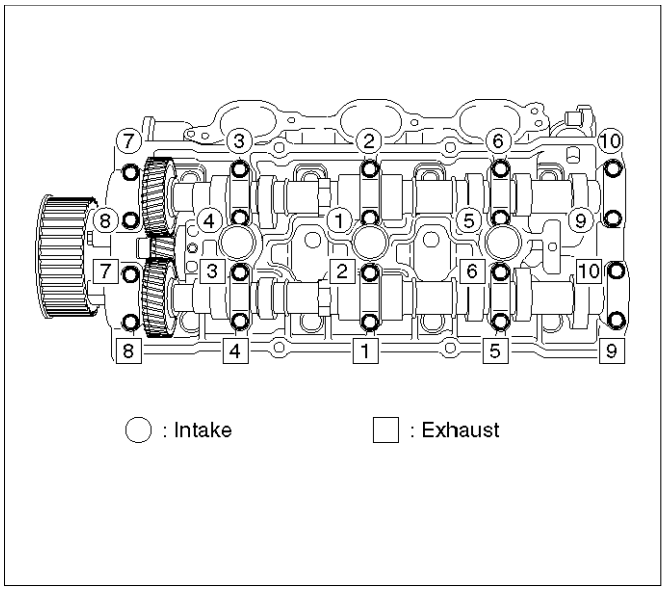
014RW024

Legend

(1) Right Bank
(2) Left Bank
(3) Alignment Mark on Camshaft Drive Gear
(4) Alignment Mark on Camshaft
(5) Alignment Mark on Retainer

3. Tighten twenty bolts in numerical order on each bank as shown in the illustration.

Torque: 10 N·m (1.0 kg·m/7 lb ft)



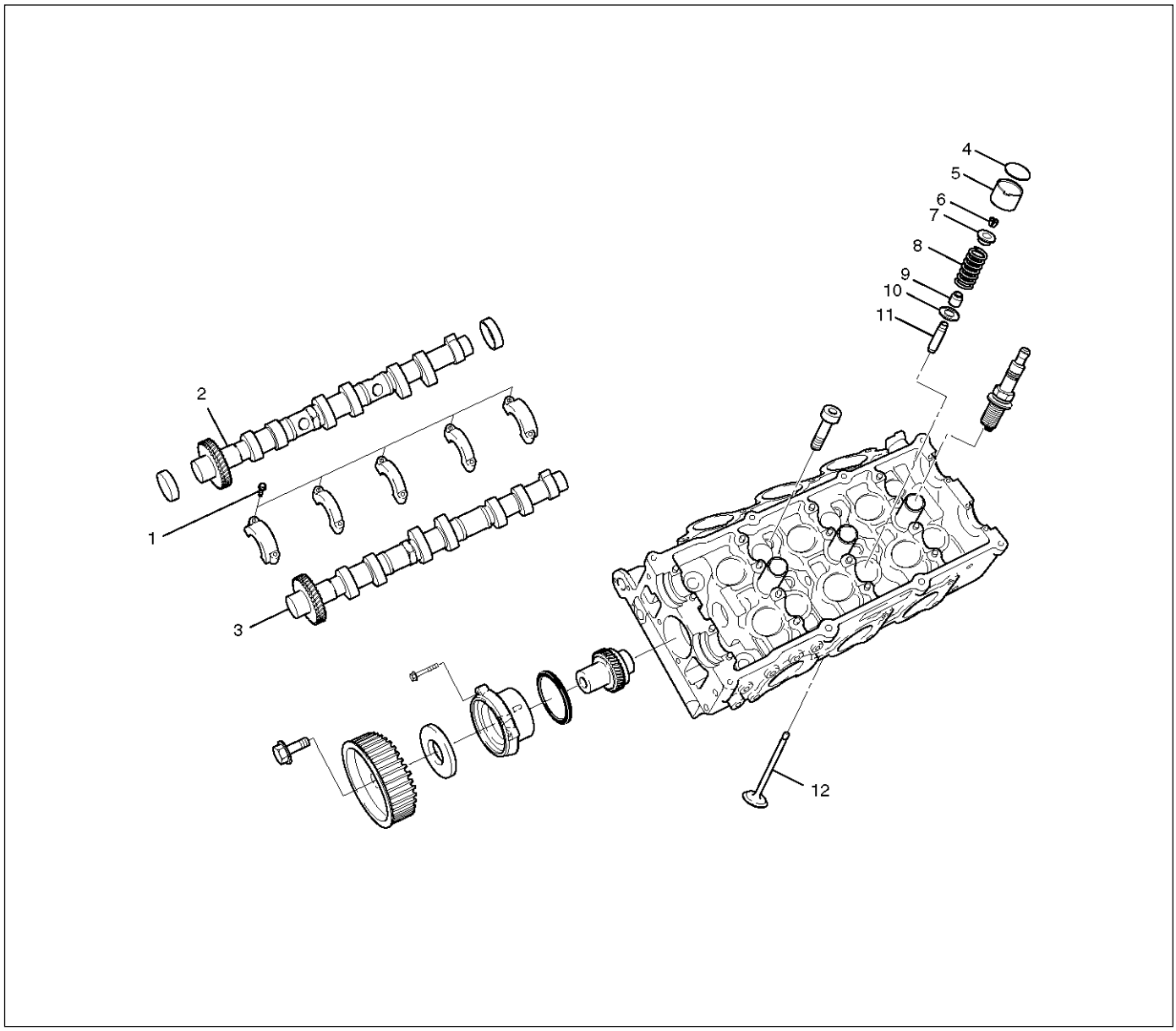
014RW031

5. Tighten bolt for camshaft drive gear assembly pulley to the specified torque.

Torque: 98 N·m (10.0 kg·m/72 lb ft)

Valve Spring, Oil Controller, Valve, Valve Guide

Valve Spring, Oil Controller, Valve, Valve Guide and Associated Parts



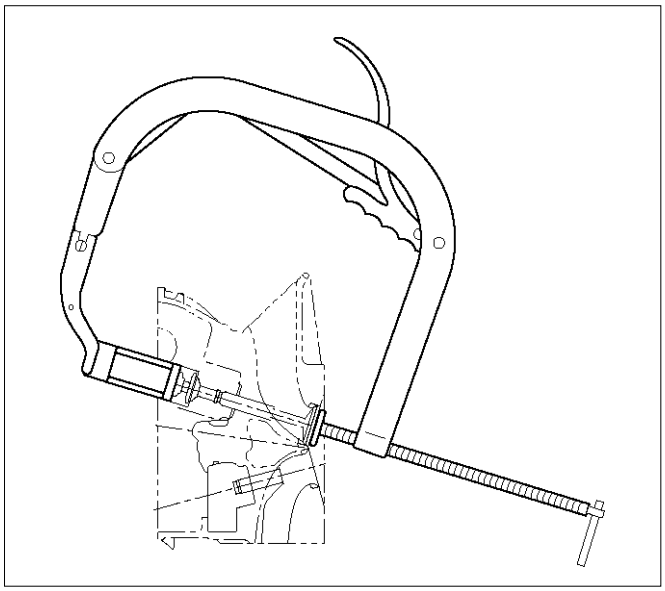
014RW039

Legend

(1) Camshaft Bracket Fixing Bolts
(2) Camshaft Assembly Inlet
(3) Camshaft Assembly Exhaust
(4) Shim
(5) Tappet
(6) Split Collar
(7) Spring Upper Seat
(8) Valve Spring
(9) Oil Controller
(10) Spring Lower Seat
(11) Valve Guide
(12) Valve

Disassembly

1. Remove camshaft bracket fixing bolts (1).
2. Remove camshaft assembly (intake).
3. Remove camshaft assembly (Exhaust side).
4. Remove shim (4) and tappet (5).
5. Use the 5−8840−2446−0 valve spring compressor and 5−8840−2547−0 valve spring compressor adapter to remove split collar.



014RW042

6. Remove valve spring.
7. Remove valve.
8. Remove oil controller and spring lower seat.
9. Remove the valve guide using the 5−8840−2442−0 valve guide replacer.

Inspection and Repair

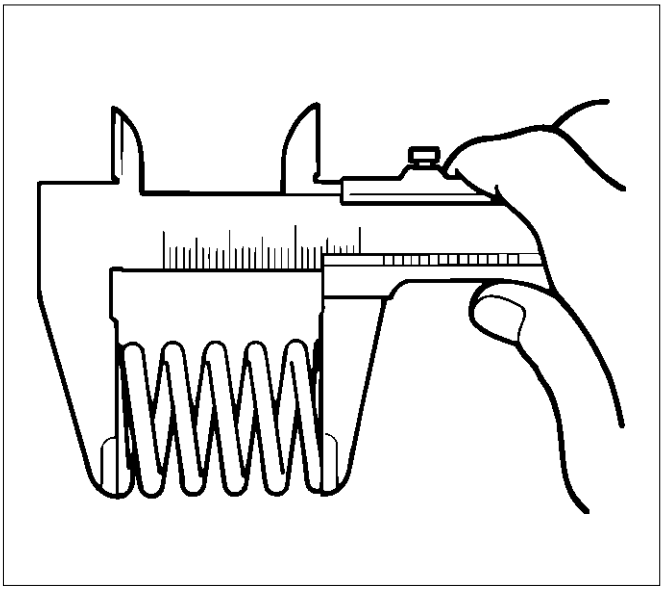
Valve Spring

CAUTION: Visually inspect the valve springs and replace them if damage or abnormal wear is evident.

1. Measure the free height of the springs. The springs must be replaced if the free height is below the specified limit.

Standard: 44.6 mm (1.756 in)

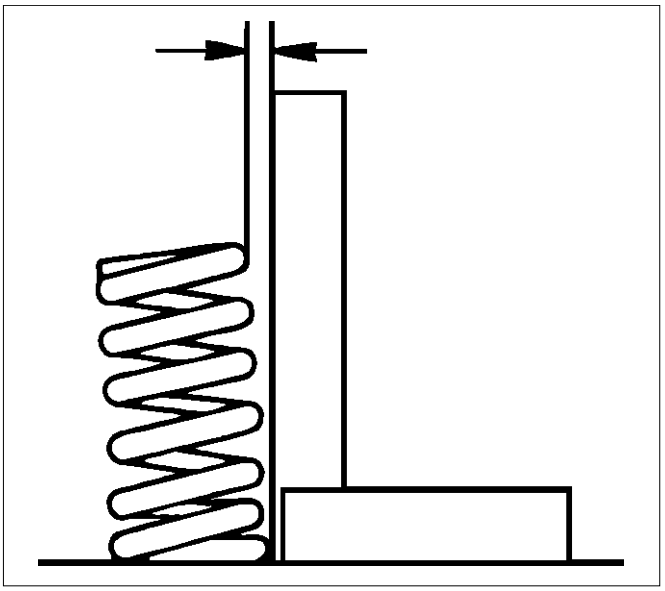
Limit: 43.6 mm (1.717 in)



014RS004

2. Measure the valve spring squareness with a steel square and replace the valve springs if the measured value exceeds the specified limit.

Limit: 2 mm (0.079 in)



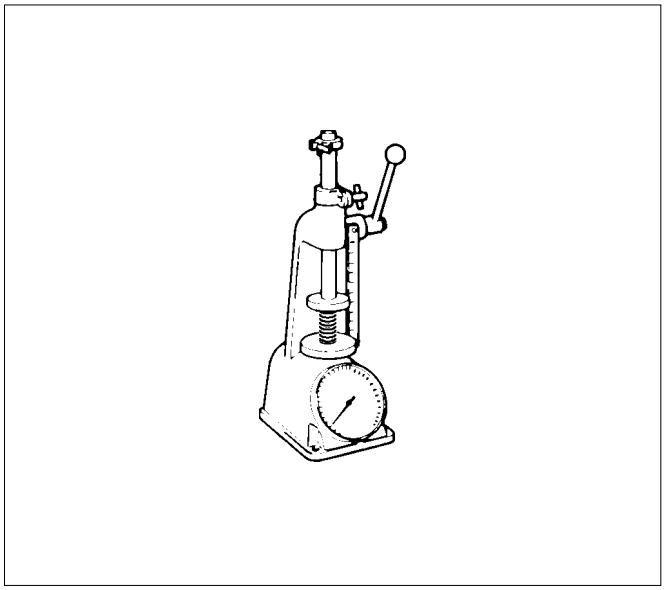
014RS005

3. Using a spring tester to compress the springs to the installed height, measure the compressed spring tension, and replace the springs if the measured tension is below the specified limit.

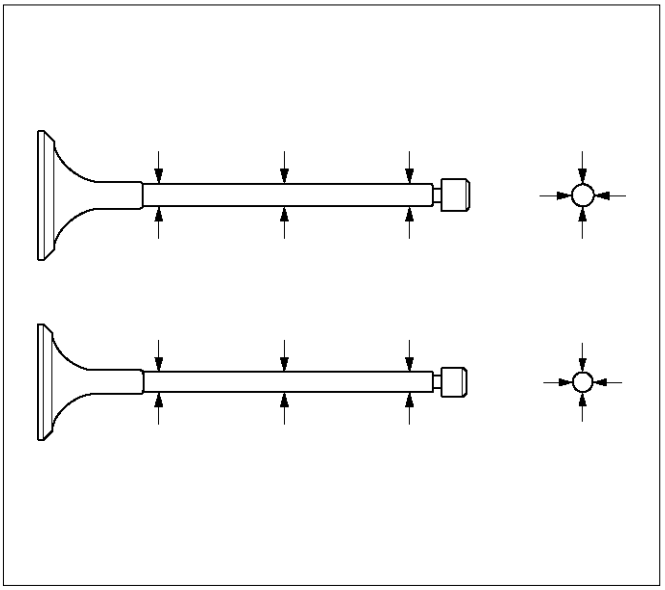
At installed height: 35.0 mm (1.38 in)

Standard: 196 N (44 lb)

Limit: Less than 181 N (41 lb)



LNW21BSH056701



014RS007

Valve Guide

CAUTION: Take care not to damage the valve seat contact surface, when removing carbon adhering to the valve head. Carefully inspect the valve stem for scratchs or abnormal wear. If these conditions are present, the valve and the valve guide must be replaced as a set.

1. Measure the valve stem diameter with a micrometer. If the valve stem diameter is less than the specified limit, the valve and the valve guide must be replaced as a set.

Diameter of Valve Stem

Intake

Standard: 5.977 mm–5.959 mm

(0.2353 in–0.2346 in)

Limit: 5.90 mm (0.2323 in)

Exhaust

Standard: 5.952 mm–5.970 mm

(0.2343 in–0.2350 in)

Limit: 5.90 mm (0.2323 in)

2. Measure the inside diameter of the valve guide with a micrometer. Subtract the measured outer diameter of the valve stem from the measured inner diameter of the valve guide. If the value exceeds the specified limit, the valve and the valve guide must be replaced as a set.

Inside Diameter of the Vale Guide

Inlet clearance

Standard : 0.023 mm–0.056 mm(0.0009 in–0.0002 in)

Limit : 0.20 mm (0.00787 in)

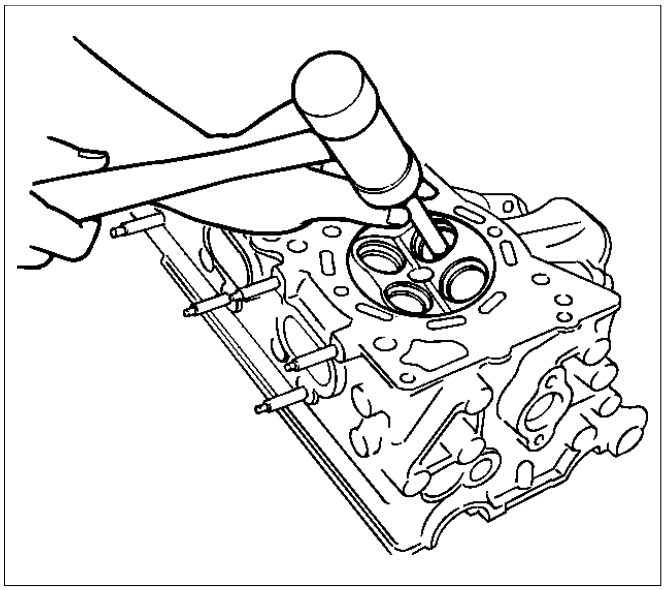
Exhaust clearance

Standard : 0.030 mm–0.063 mm(0.0012 in–0.0025 in)

Limit : 0.20 mm (0.00787 in)

Valve Guide Replacement

1. Using Valve guide replacer: 5]8840]2442]0, drive out the valve guide from the combustion chamber side.

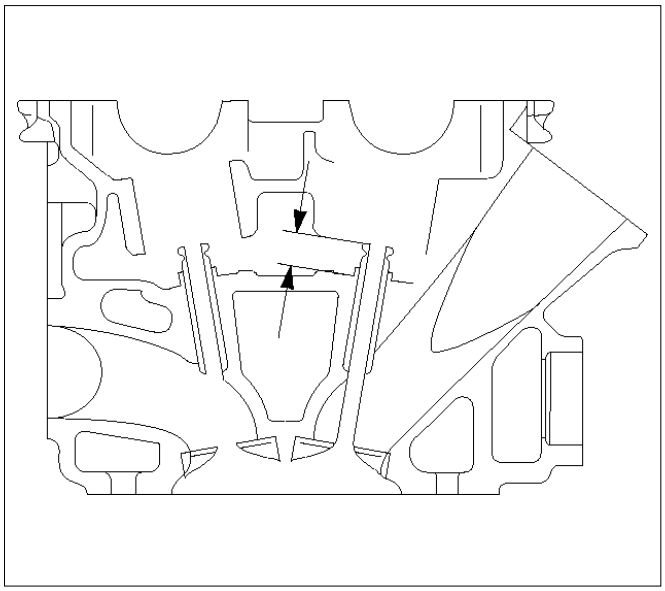


014RS008

2. Apply engine oil to the outside of the valve guide. Using valve guide replacer 5]8840]2442]0, drive in a new valve guide from the camshaft side, and check the valve guide height.

Valve guide upper end height: 13.0 mm (0.5118 in)

(Measured from the cylinder head upper face)



014RW046

3. Check the clearance. If the clearance is less than the specified value, ream the inside diameter of valve guide. Using a sharp 6 mm reamer, ream the valve guide to obtain the specified clearance.

Valve Seat

1. Measure the protrusion of the valve stem when a new valve is installed in the cylinder head. If the protrusion of the valve stem exceeds the limit, replace the valve seat insert or the cylinder head assembly.

Protrusion of valve stem

Intake

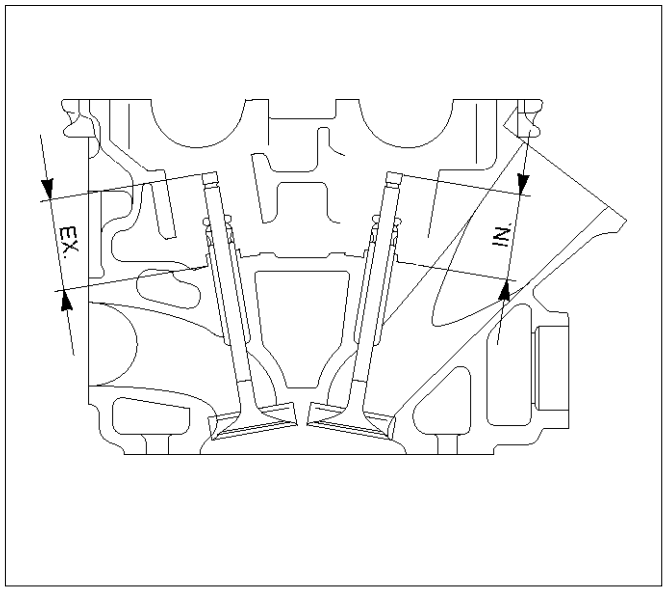
Standard: 39.32 mm (1.5480 in)

Limit: 39.47 mm (1.5539 in)

Exhaust

Standard: 39.30 mm (1.5472 in)

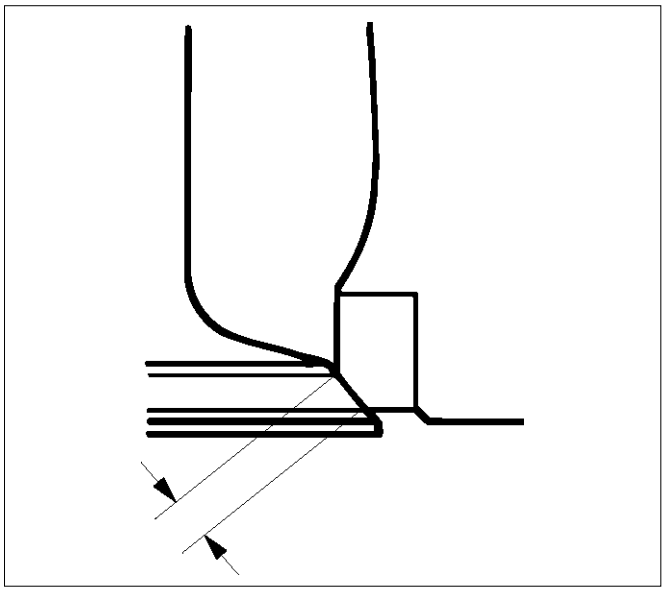
Limit: 39.45 mm (1.5531 in)



014RW047

2. Measure the valve seat contact width. Make the necessary corrections if the seat contact surface is damaged or rough or if the contact width wear exceeds the limit.

Valve seat contact width
Standard: 1.1 mm (0.0433 in)
Limit: 1.7 mm (0.0669 in)

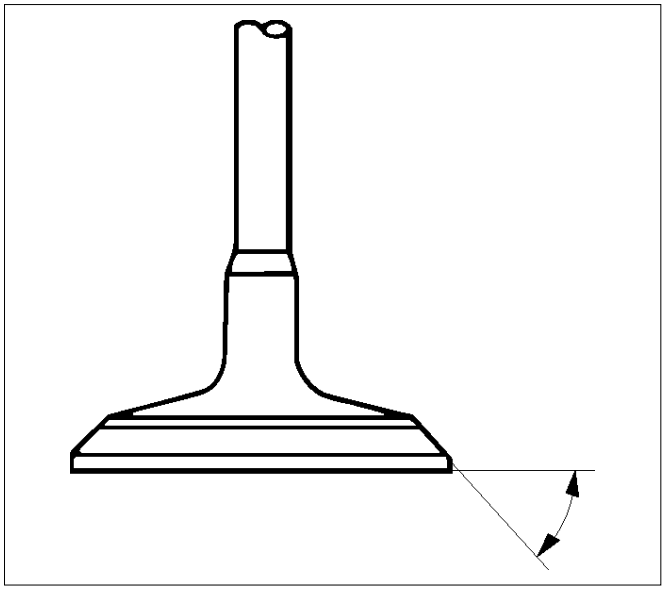


014RS011

Contact Surface Angle on Valve Seat on Valve

1. Measure contact surface angle on valve seat.
2. If the measured value exceeds the limit, replace valve, valve guide and valve seat as a set.

Valve contact surface angle: 45°

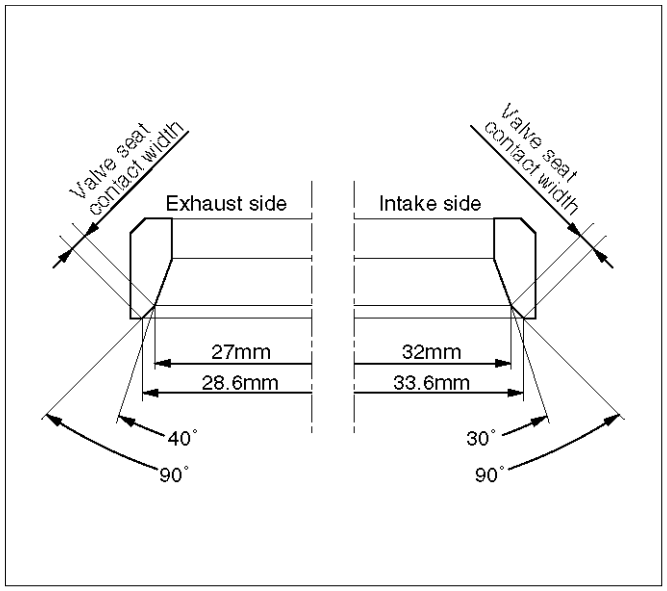


014RS012

Valve Seat Insert Correction

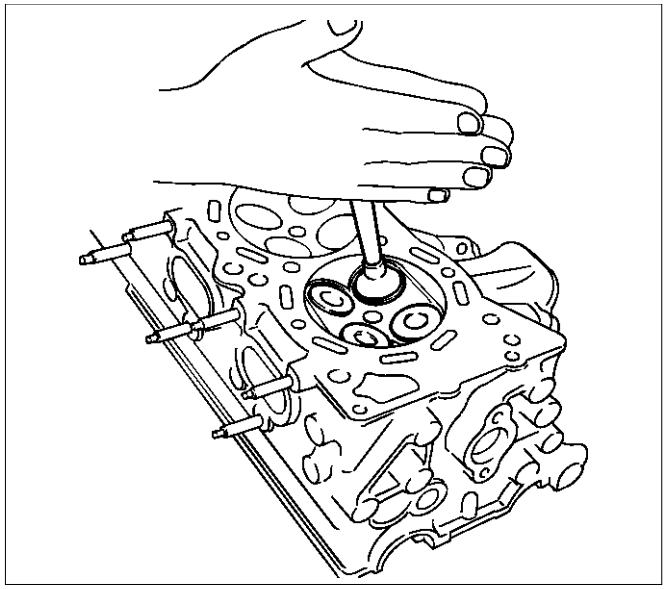
1. Remove the carbon from the valve seat insert surface.
2. Use a valve cutter to minimize scratches and other rough areas. This will bring the contact width back to the standard value. Remove only the scratches and rough areas. Do not cut away too much. Take care not to cut away unblemished areas of the valve seat surface.

Valve seat angle degree: 90°



014RW059

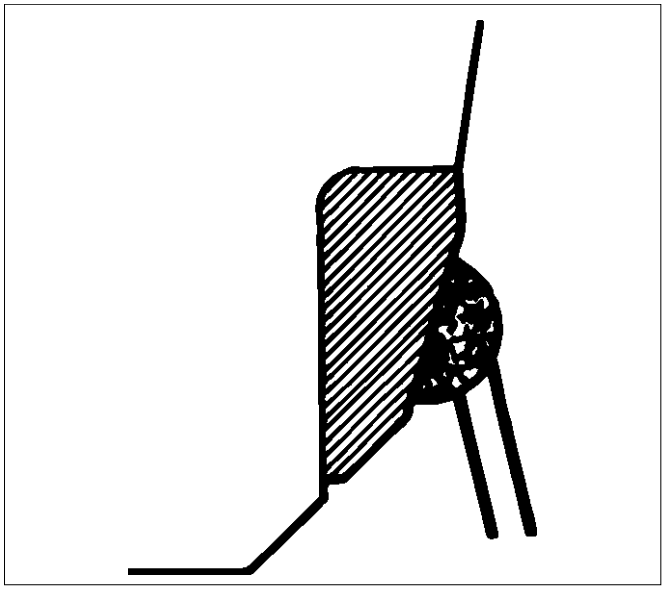
3. Apply abrasive compound to the valve seat insert surface.
4. Insert the valve into the valve guide.
5. Turn the valve while lapping it to fit the valve seat insert.
6. Check that the valve contact width is correct.
7. Check that the valve seat insert surface is in contact with the entire circumference of the valve.



014RS014

Valve Seat Insert Replacement

1. Arc weld the rod at several points. Be careful not to damage the aluminum section.
2. Allow the rod to cool for a few minutes. This will cause the valve seat to shrink.
3. Strike the rod and pull it out.



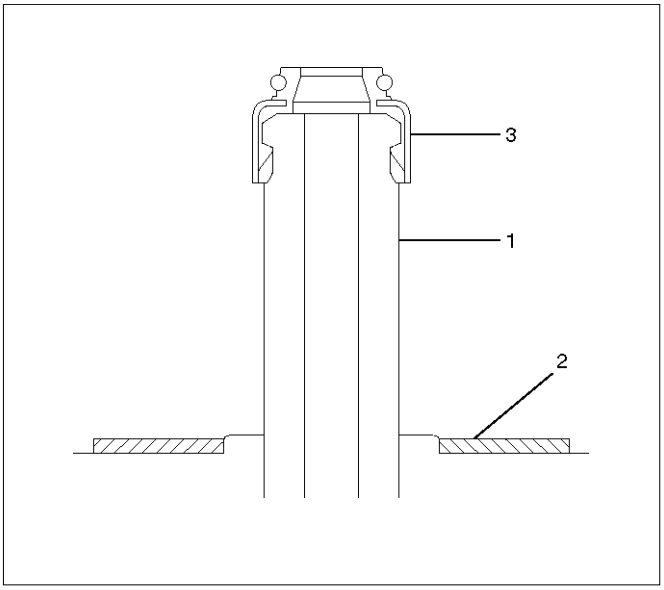
014RS015

4. Carefully clean the valve seat press−fit section on the cylinder head side.
5. Heat the press−fit section with steam or some other means to cause expansion. Cool the valve seat with dry ice or some other means.
6. Insert the press−fit section into the valve seat horizontally.

   Standard fitting interference: 0.14 mm–0.09 mm (0.0055 in–0.0035 in)
7. After insertion, use a seat grinder to grind finish the seating face. Carefully note the seating angle, the contact width, and the depression.
8. Lap the valve and the seat.

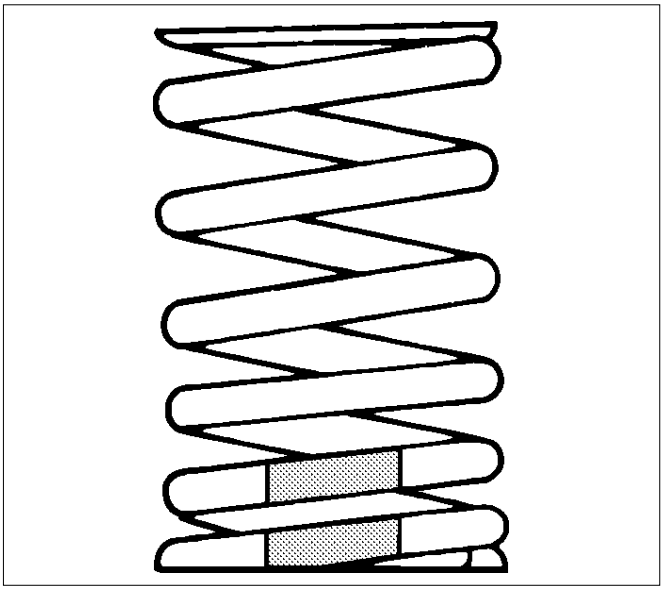
Reassembly

1. Install valve guide (1) to cylinder head. Apply engine oil to the outside of the valve guide. Using valve guide replacer 5−8840−2442−0, drive in a new valve guide from the camshaft side.
2. Install oil controller (3) and spring lower seat (2). Using oil controller replacer 5−8840−0623−0, drive in a new oil controller.



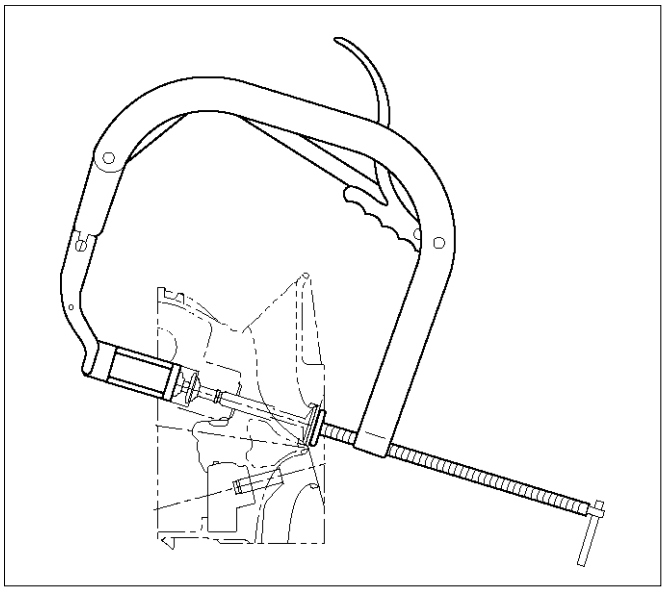
014RW058

3. Install valve to valve guide. Before install valve guide apply engine oil to the outside of the valve stem.
4. Install valve spring to cylinder head. Attach the valve spring to the lower spring seat. The painted area of the valve spring should be facing downward.



014RS020

5. Install lower valve spring seat, valve spring and upper valve spring seat then put split collars on the upper spring seat, using the 5−8840−2446−0 valve spring compresor and 5−8840−2547−0 valve spring compressor adapter to install the split collars.

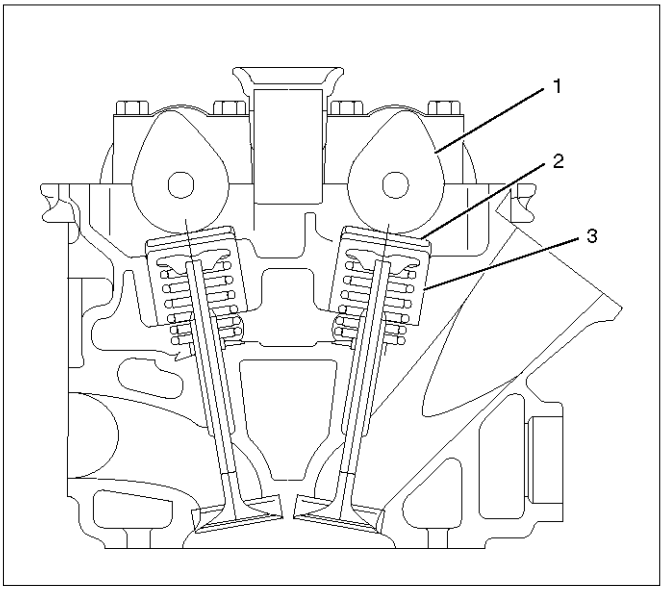


014RW042

6. Install tappet with shim.
7. Install camshaft assembly.
   - Refer to installation procedure for Camshaft in this manual.

Valve Clearance Adjustments

NOTE: To adjust valve clearance, apply engine oil to the cam as well as to the adjusting shim (2) with the cylinder head built on the cylinder block, give a few turns to the camshaft by means of timing pulley tightening bolt, and measure valve clearance when the nose of cam is just opposite to maximum cam lift (1) as shown in illustration below.



014RW081

Legend

(1) Cam
(2) Shim
(3) Tappet

Valve Clearance Standard Value (cold)

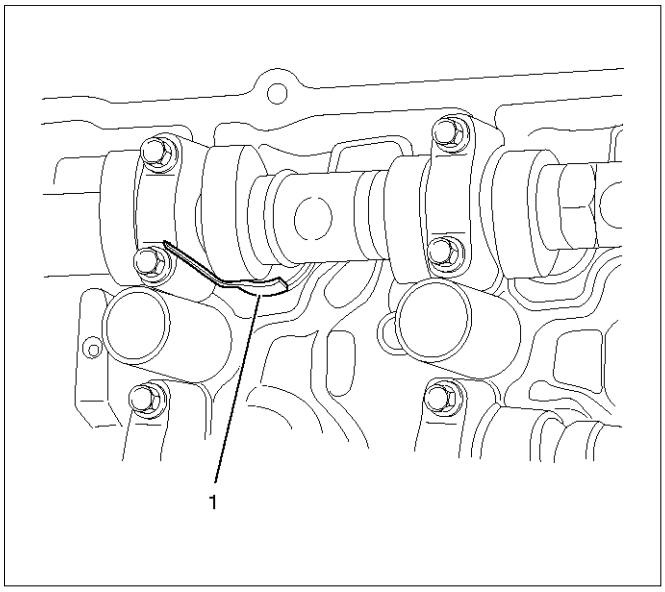
Intake: 0.23 mm–0.33 mm
(0.0091 in–0.0130 in)
Exhaust: 0.25 mm−0.35 mm
(0.0098 in–0.0138 in)

Selection of Adjusting Shim

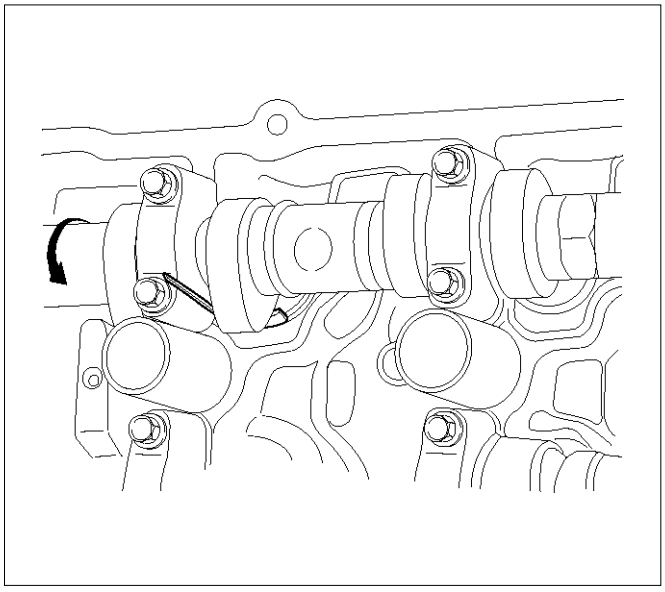
Shim to be selected = (Thickness of removed shim) + (Valve clearance measurement − Standard value) Based on the above formula, the best suited shim should be selected from 41 sorts of shim (differently thick at 0.02mm (0.0008 in) intervals from 2.40mm (0.0945 in) through 3.2mm (0.1260 in) thick). Install the shim and check valve clearance.

Replacement of Shim

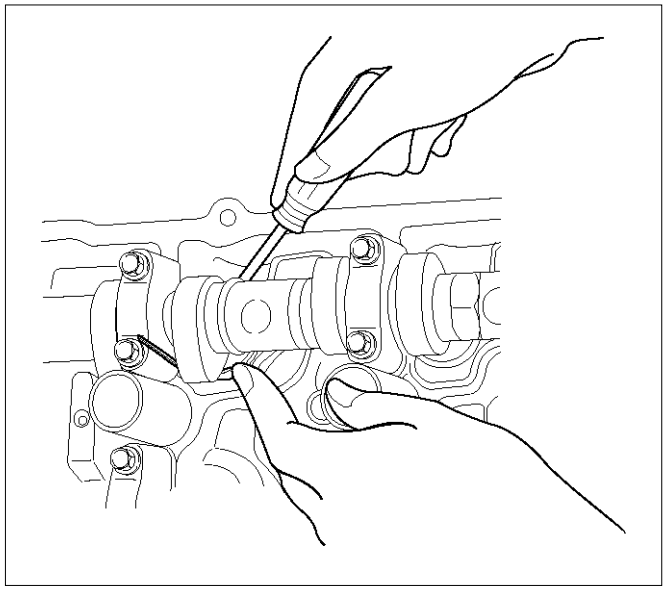
Let the cam push down the edge of tappet by using 5−8840−2444−0 valve clearance adjusting tool and push out the shim with a flat blade screw driver as shown in illustrations below.



014RW082



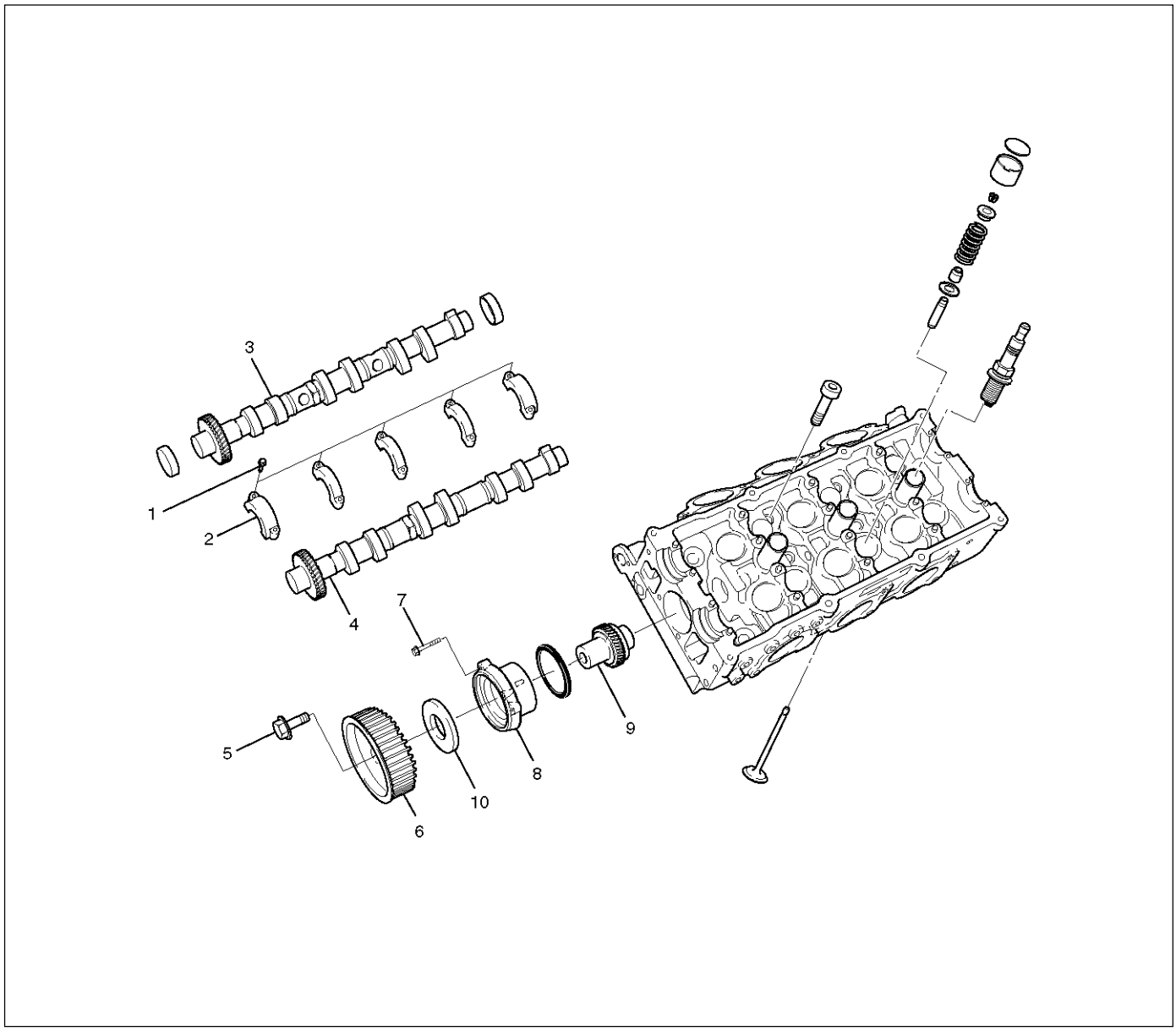
014RW083



014RW084

Camshaft

Camshaft and Associated Parts



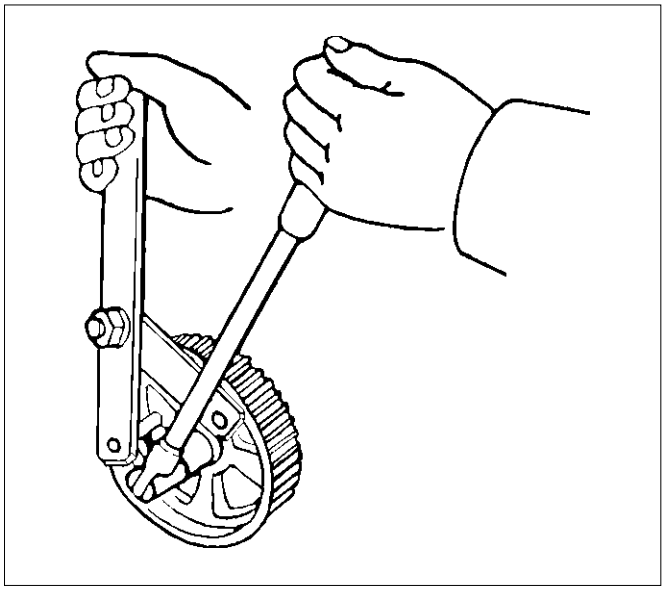
014RW040

Legend

(1) Camshaft Bracket Fixing Bolt
(2) Camshaft Bracket
(3) Camshaft Assembly Intake
(4) Camshaft Assembly Exhaust
(5) Pulley Fixing Bolt
(6) Camshaft Drive Gear Pulley
(7) Retainer Fixing Bolt
(8) Retainer
(9) Camshaft Drive Gear
(10) Oil Seal

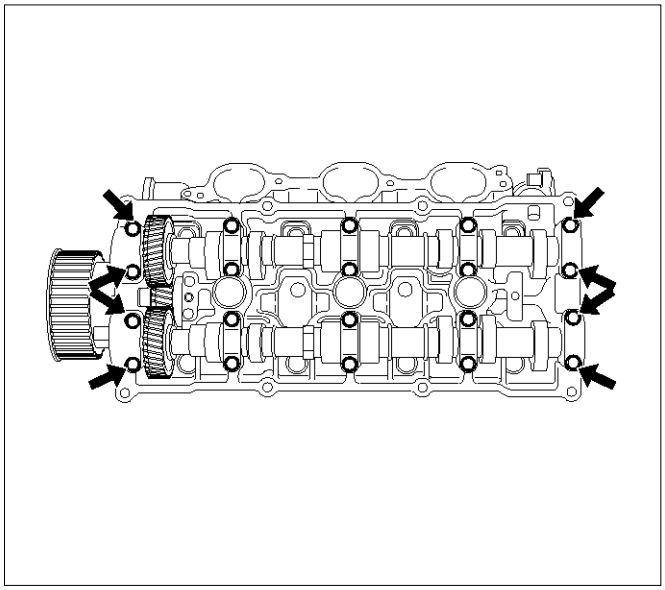
Disassembly

1. Remove fixing bolt (5) for camshaft drive gear pulley using 5–8840–2447&–ndash;0 universal holder.



014RW060

2. Remove twenty fixing bolts from inlet and exhaust camshaft bracket on one side bank, then camshaft brackets (2).



014RW027

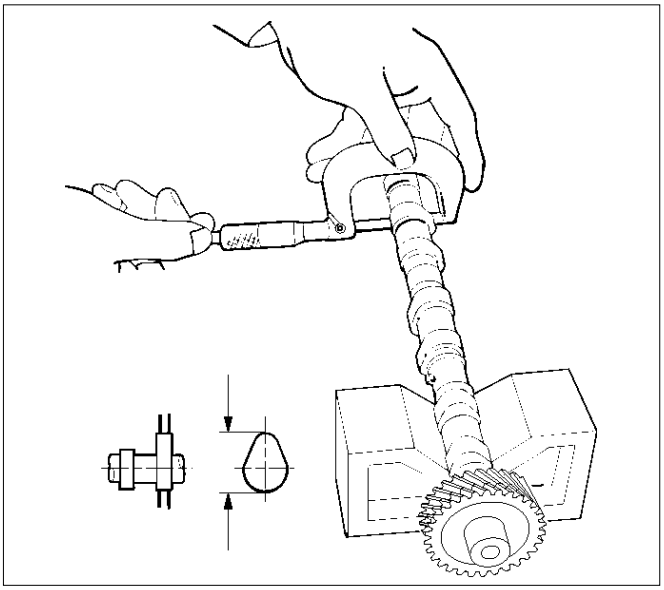
3. Remove camshaft assembly (3), (4).
4. Remove three fixing bolts (7) from camshaft drive gear retainer (8), then camshaft drive gear assembly.

Inspection and Repair

1. Use a micrometer to measure the cam lobe height and uneven wear. Replace the camshaft if either the lobe height or the uneven wear exceeds the specified limit.

   Lobe height: 44.709 mm (1.7602 in)

   Uneven wear: 0.05 mm (0.0020 in)



014RW043

2. Use a micrometer to measure the diameter and the uneven wear of the camshaft journals.

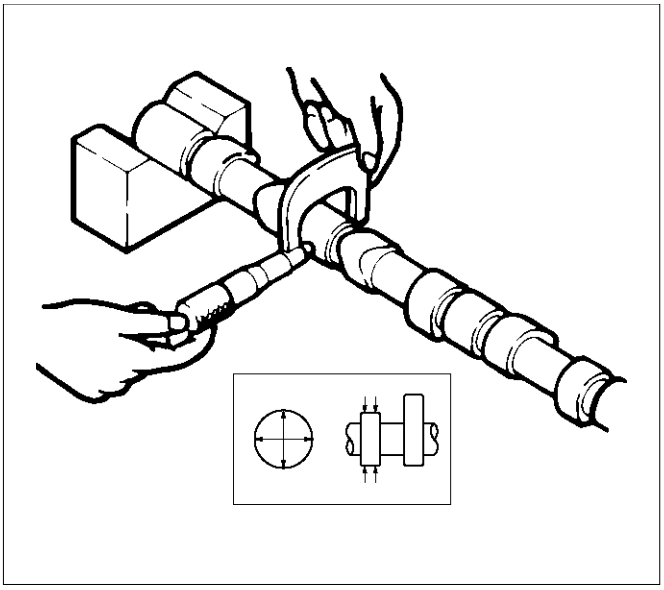
   Replace the camshaft if the diameter or the uneven wear exceeds the specified limit.

   Journal Diameter

   Standard: 25.972 mm–25.993 mm (1.0225 in–1.0233 in)

   Limit: 25.8 mm (1.0157 in)

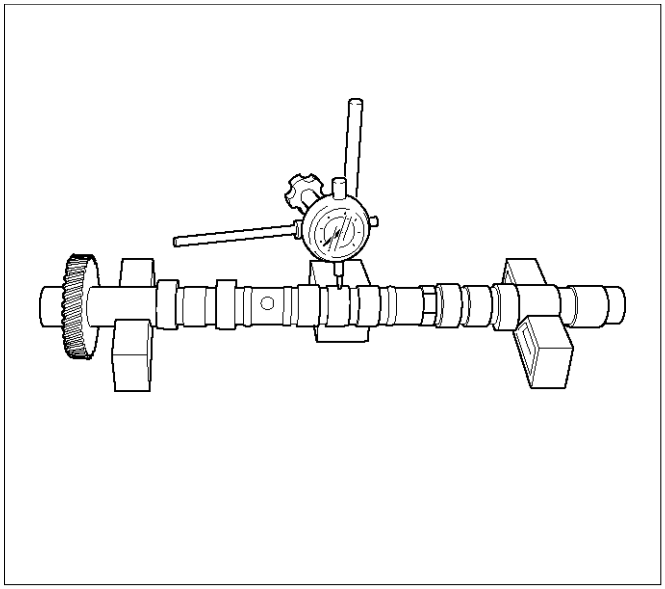
   Uneven wear: 0.05 mm (0.0020 in)



014RS023

3. Place the camshaft on V−blocks.
   Slowly rotate the camshaft and measure the runout with a dial indicator.
   Replace the camshaft if the runout exceeds the specified limit.

Run out
Limit: 0.1 mm (0.0039 in)

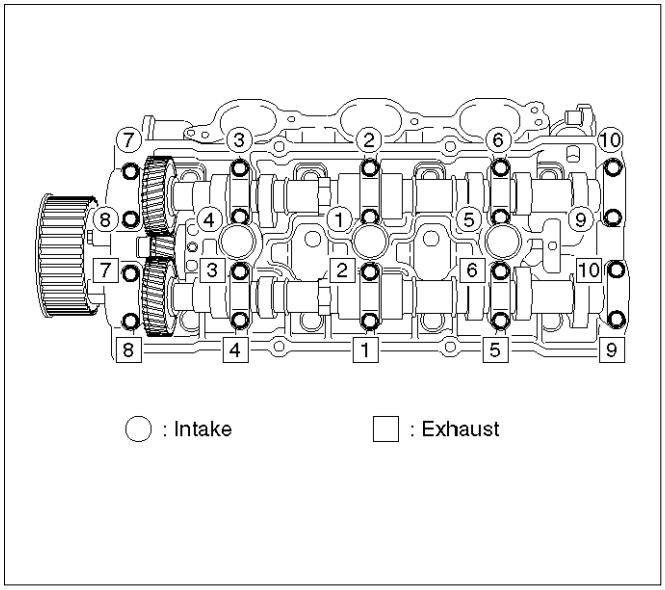


014RW044

4. Measure the camshaft journal oil clearance.
   1. Measure the camshaft bracket housing inside diameter.

NOTE: Tighten camshaft bracket (2) to specified torque before measuring the camshaft bracket inside diameter.

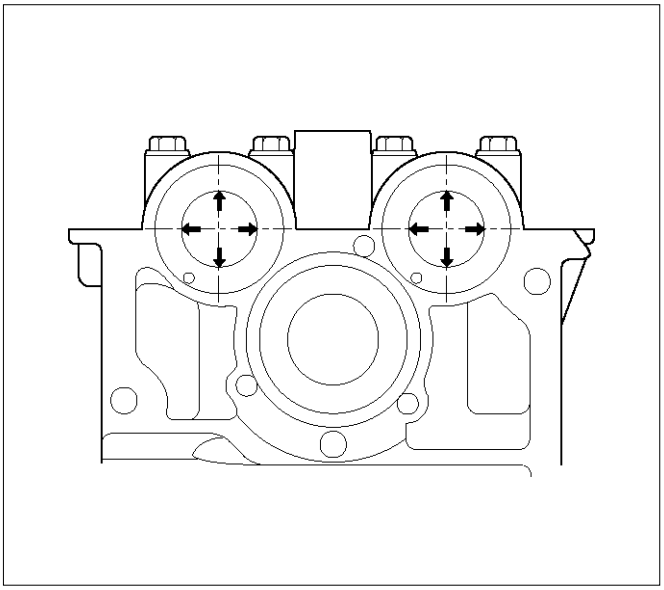
Torque : 10 N·m (1.0 kg·m/7 lb ft)



014RW031

2. Subtract the camshaft outside diameter from the camshaft bracket housing inside diameter.

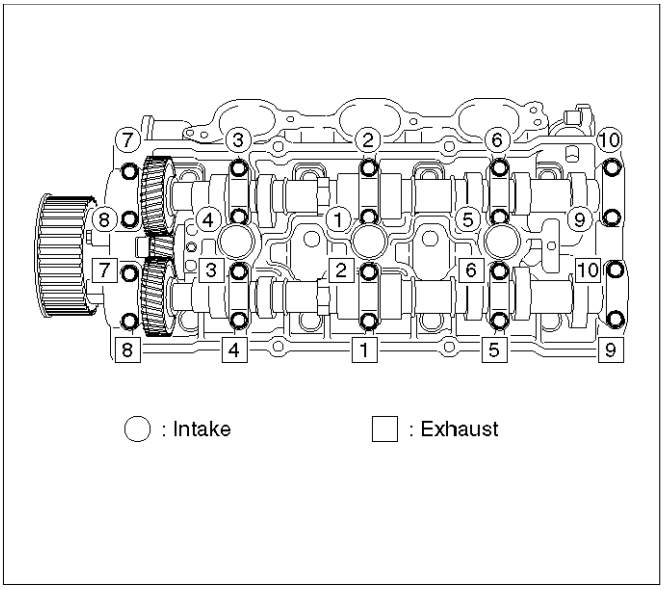
Oil Clearance
Standard : 0.027 mm–0.078 mm(0.0011 in–0.0031 in)
Limit : 0.11 mm (0.0043 in)



014RW037

5. Replace the cylinder head and/or camshaft if the measured oil clearance exceeds the specified limit.
   1. Carefully clean the camshaft journal, the camshaft bracket, and the cylinder head.
   2. Install camshaft assembly and camshaft brackets (2), tighten twenty bolts (1) on one side bank to the specified torque.

Torque: 10 N·m (1.0 kg·m/7 lb ft)



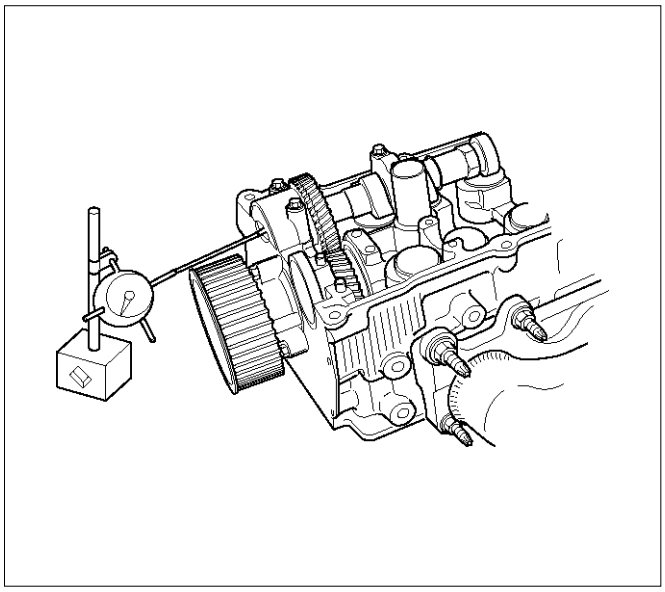
014RW031

3. Measure the camshaft thrust clearance with a dial indicator. Replace the camshaft and/or the cylinder head if the camshaft thrust clearance exceeds the specified limit.

Camshaft thrust Clearance

Standard : 0.03 mm–0.08 mm(0.0012 in –0.0031 in)

Limit : 0.12 mm (0.0047 mm)



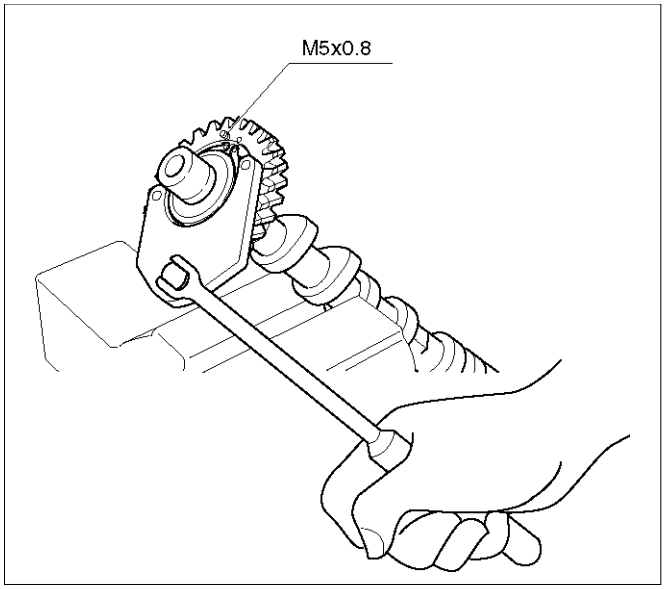
014RW035

Reassembly

1. Install camshaft drive gear assembly and tighten three bolts to specified torque.

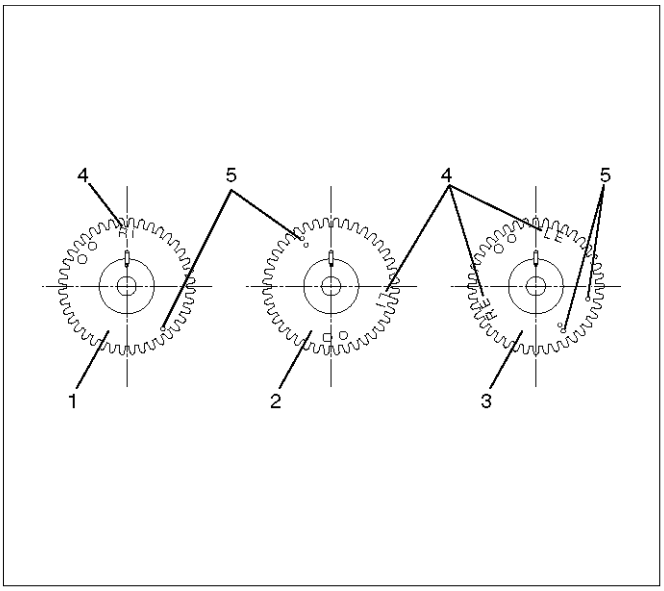
Torque: 10 N·m (1.0 kg·m/7 lb ft)

2. Tighten sub gear setting bolt.
   1. Use 5−8840−2443−0 to turn sub gear to right direction until the M5 bolt hole aligns between camshaft driven gear and sub gear.
   2. Tighten M5 bolt suitable torque for prevent moving the sub gear.



014RW041

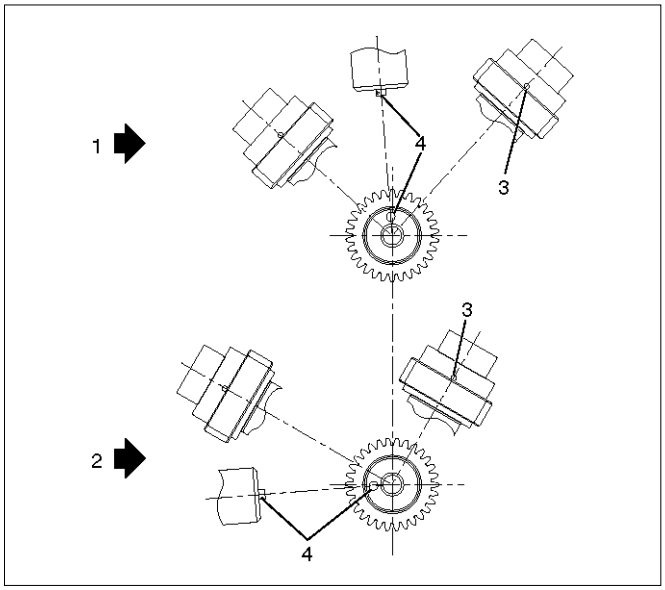
3. Install camshaft assembly and camshaft brackets, tighten twenty bolts on one side bank to the specified torque.
   1. Apply engine oil to camshaft journal and bearing surface of camshaft bracket.
   2. Align timing mark on intake camshaft (one dot for right bank, two dots for left bank) and exhaust camshaft (one dot for right bank, two dots for left bank) to timing mark on camshaft drive gear (one dot).



014RW020

Legend

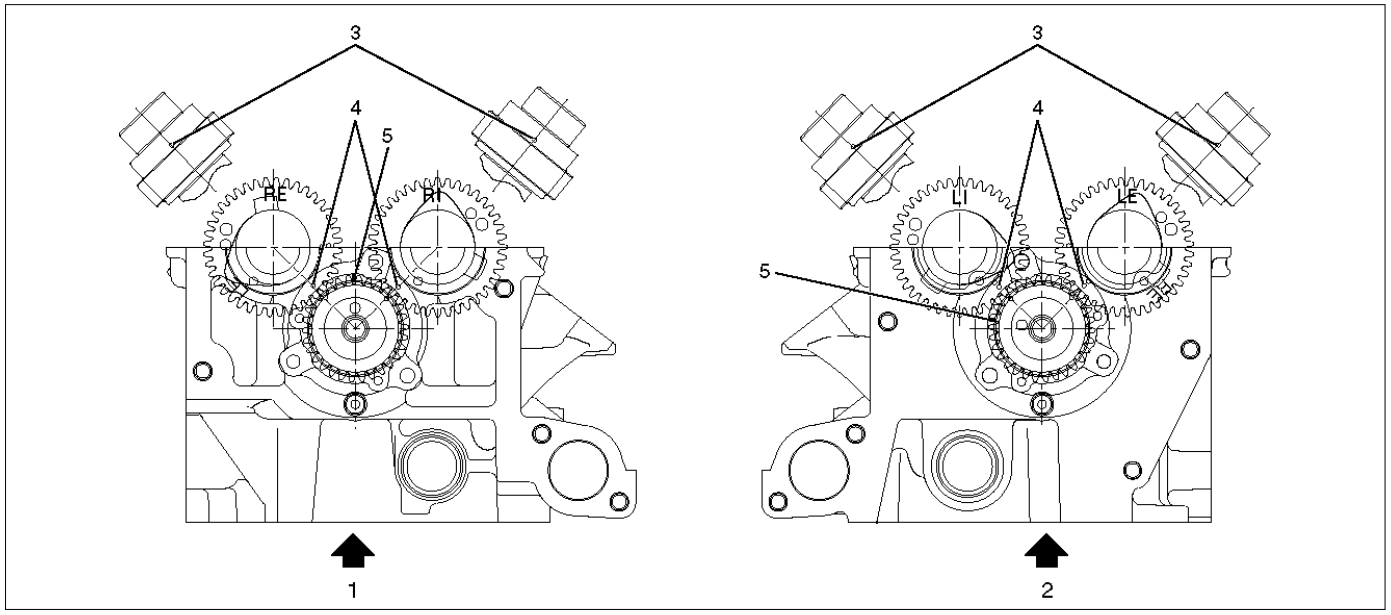
(1) Intake Camshaft Timing Gear for Right Bank
(2) Intake Camshaft Timing Gear for Left Bank
(3) Exhaust Camshaft Timing Gear
(4) Discerning Mark
LI: Left Bank Intake
RI: Right Bank Intake
LE: Left Bank Exhaust
RE: Right Bank Exhaust



014RW023

Legend

(1) Right Bank Camshaft Drive Gear
(2) Left Bank Camshaft Drive Gear
(3) Timing Mark on Drive Gear
(4) Dowel Pin



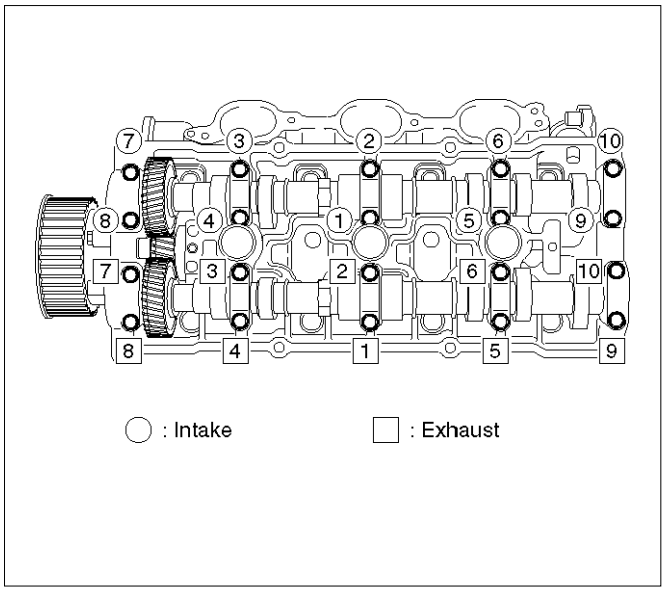
014RW024

Legend

(1) Right Bank
(2) Left Bank
(3) Alignment Mark on Camshaft Drive Gear
(4) Alignment Mark on Camshaft
(5) Alignment Mark on Retainer

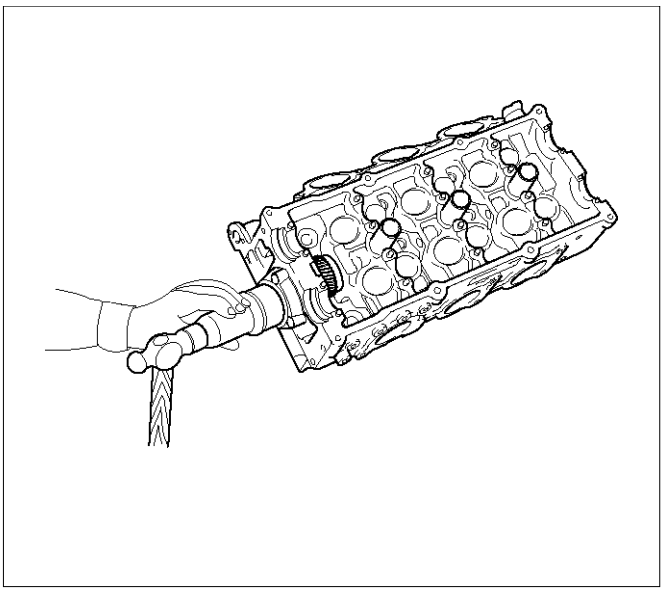
3. Tighten twenty bolts in numerical order on one side bank as shown in the illustration.

Torque: 10 N·m (1.0 kg·m/7 lb ft)



014RW031

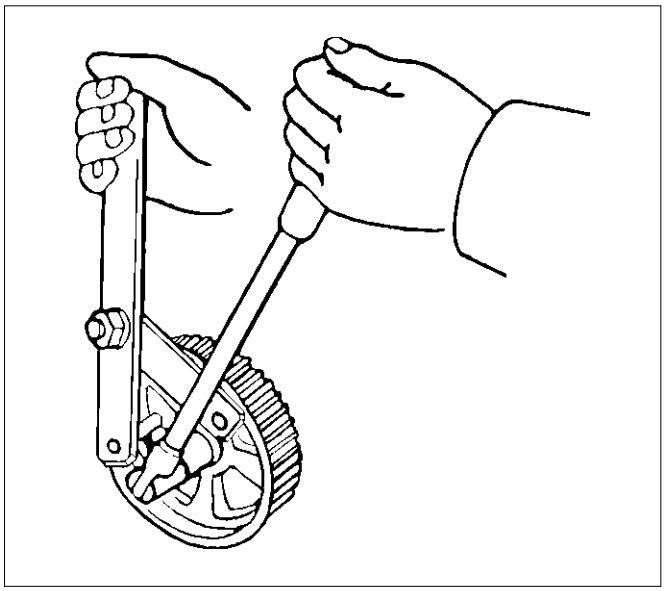
4. If the oil seal requires replacement, use the 5−8840−2445−0 to install the oil seal.



014RW034

5. Tighten bolt for camshaft drive gear assembly pulley to the specified torque using the 5−8840−2447−0 universal holder.

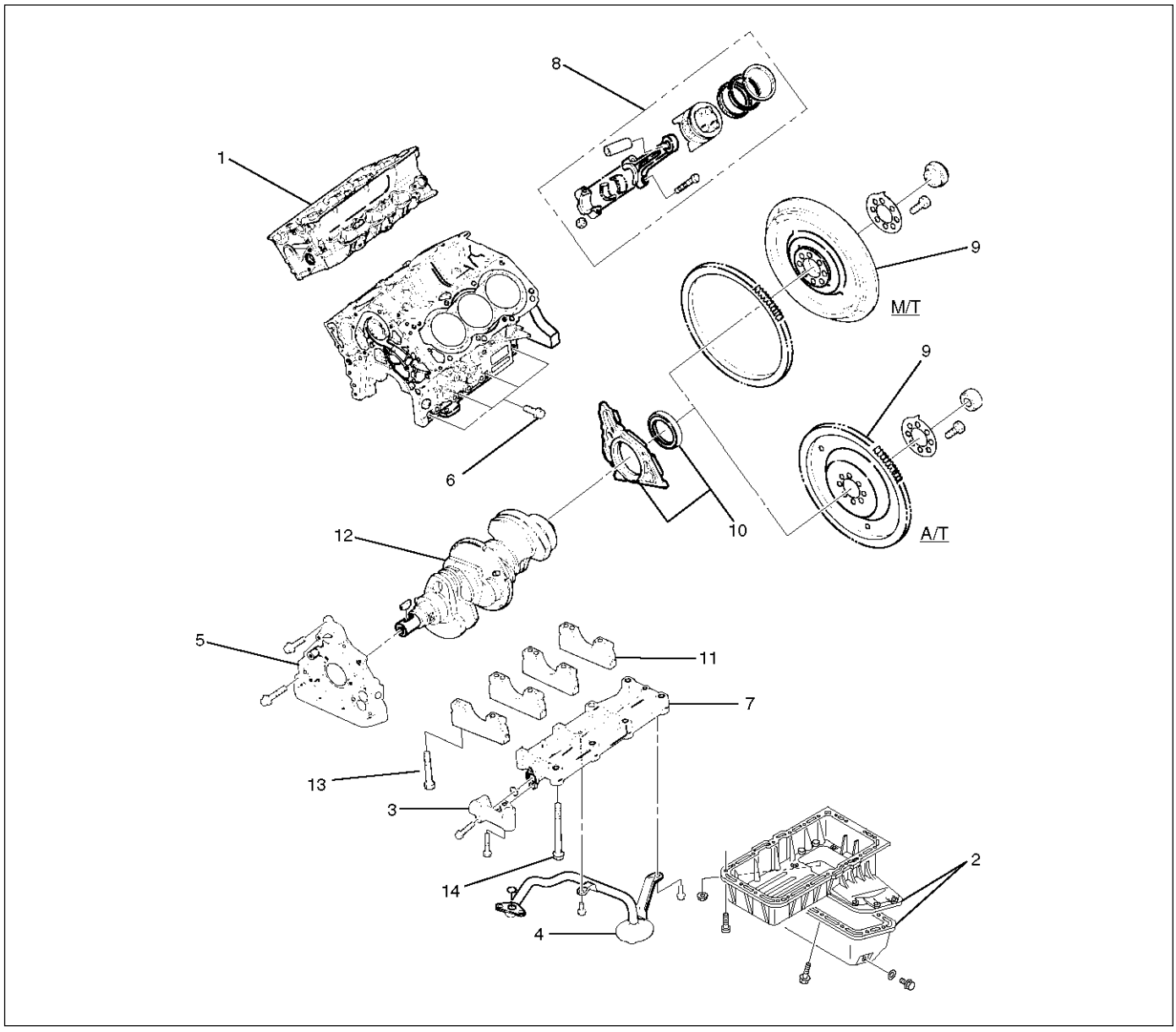
Torque: 98 N·m (10.0 kg·m/72 lb ft)



014RW060

Crankshaft

Crankshaft and Associated Parts



013RW009

Legend

(1) Cylinder Head Assembly
(2) Crankcase with Oil Pan
(3) Oil Pipe and O-Ring
(4) Oil Strainer and O-Ring
(5) Oil Pump Assembly
(6) Cylinder Block Side Bolts
(7) Oil Gallery
(8) Piston and Connecting Rod Assembly
(9) Flywheel
(10) Rear Oil Seal Retainer and Oil Seal
(11) Main Bearing Cap
(12) Crankshaft
(13) Main Bearing Cap Fixing Bolts
(14) Oil Gallery Fixing Bolts

Disassembly

1. Remove cylinder head assembly (1). Refer to “Head" in this manual.
2. Remove crankcase with oil pan (2). Refer to “Oil Pan and Crankcase" in this manual.

CAUTION: Take care not to damage or deform the sealing flange surface of crankcase.

3. Remove oil pipe and O-ring (3).
4. Remove oil strainer and O-ring (4).
5. Remove oil pump assembly (5).
6. Remove crankcase side bolts (6).
7. Remove oil gallery (7).
8. Remove piston and connecting rod assembly (8). Refer to “Piston, Piston Ring and Connecting Rod" in this manual.
9. Remove flywheel (9).
10. Remove rear oil seal retainer (10).
11. Remove main bearing cap (11).
12. Remove crankshaft (12).

Inspection and Repair

1. Crankshaft

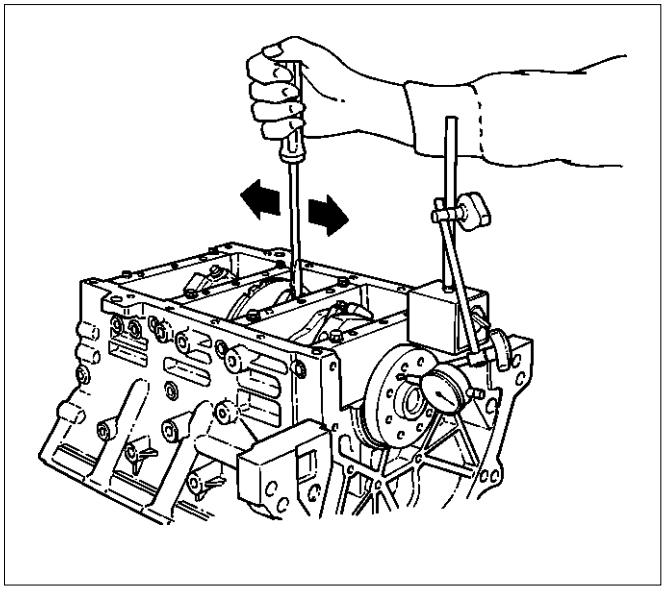
   Set the dial indicator as shown in the illustration and measure the crankshaft thrust clearance. If the thrust clearance exceeds the specified limit, replace the thrust bearings as a set.

   Thrust Clearance

   Standard : 0.06 mm–0.24 mm

   (0.0024 in–0.0094 in)

   Limit : 0.30 mm (0.0118 in)



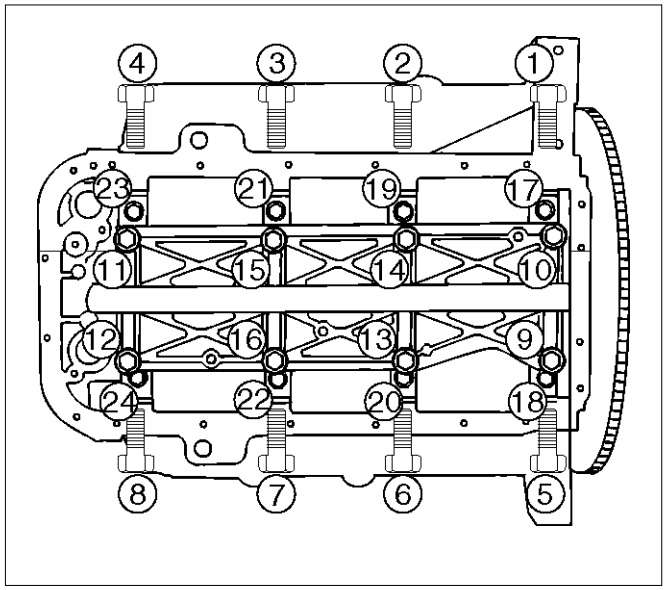
015RS003

Main Bearing Clearance

1. Remove the bearing caps and measure the oil clearance.
2. Remove the main bearing cap fixing bolts in the sequence shown in the illustration.

   Arrange the removed main bearing caps in the cylinder number order.

   Remove the main bearings.



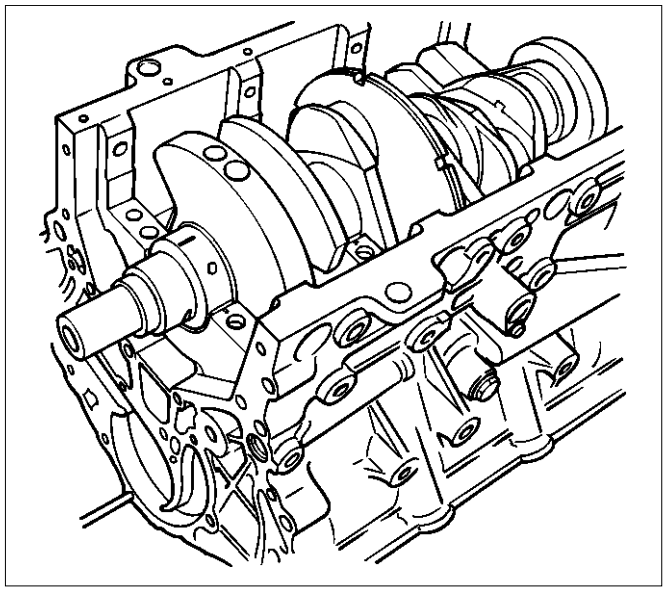
015RS004

3. Remove the crankshaft. Remove the main bearings.
4. Clean the upper and lower bearings as well as the crankshaft main journal.
5. Check the bearings for damage or excessive wear.

   The bearings must be replaced as a set if damage or excessive wear is discovered during inspection.
6. Set the upper bearings and the thrust washers to their original positions.

   Carefully install the crankshaft.
7. Set the lower bearings to the bearing cap original position.
8. Apply plastigage to the crankshaft journal unit as shown in the illustration.

NOTE: Do not set the plastigage on the oil hole.



015RS005

9. Install main bearing caps, oil gallery and crank case bolts in the order shown, and tighten each bolt to the specified torque.

NOTE: Do not apply engine oil to the crank case side

bolts.

Main bearing cap bolts.

Torque: 39 N·m (4.0 Kg·m/29 lb ft)

Oil gallery fixing bolts.

Torque:

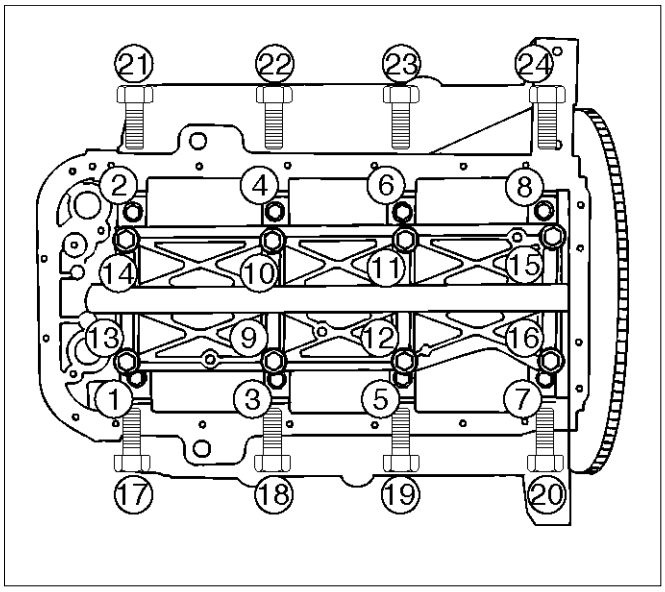
1st step: 29 N·m (3.0 Kg·m/21 lb ft)

2nd step 55° ~ 65°

Crank case side bolts

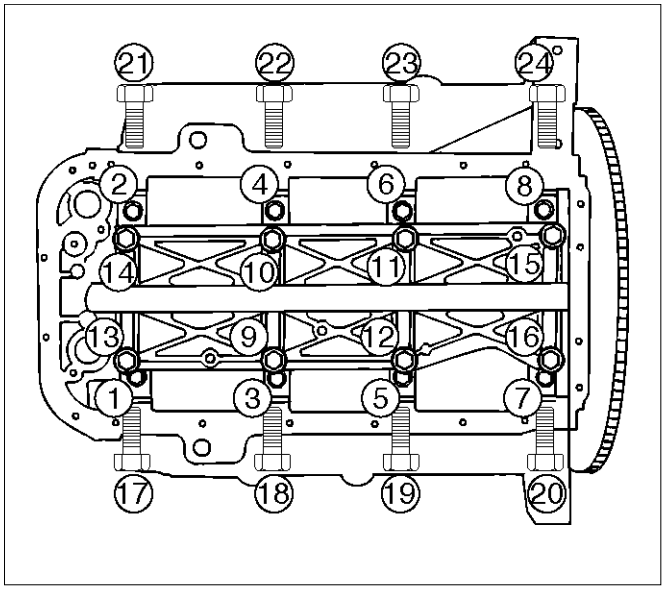
Torque : 39 N·m (4.0 Kg·m/29 lb ft)

NOTE: Do not allow the crankshaft to rotate.



015RS006

10. Remove the main bearing caps in the sequence shown in the illustration.



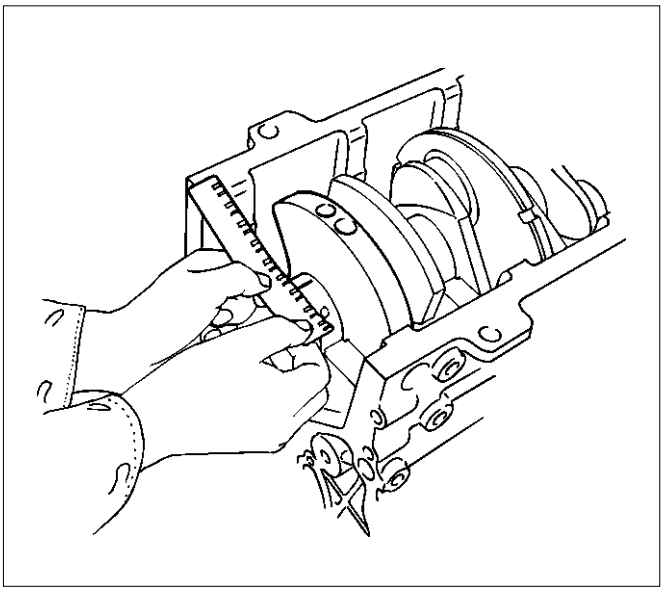
015RS004

11. Measure the plastigage width and determine the oil clearance. If the oil clearance exceeds the specified limit, replace the main bearings as a set and/or replace the crankshaft.

Standard : 0.019 mm–0.043 mm

(0.0007 in–0.0017 in)

Limit : 0.08 mm (0.0031 in)



015RS008

12. Clean the plastigage from the bearings and the crankshaft.

    Remove the crankshaft and the bearings.

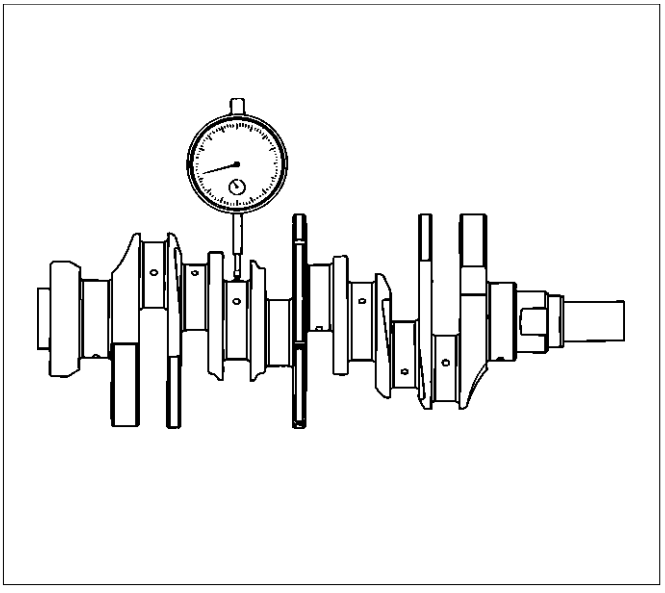
Crankshaft (12) Inspection

Inspect the surface of the crankshaft journal and crank pins for excessive wear and damage. Inspect the oil seal fitting surfaces for excessive wear and damage. Inspect the oil ports for obstructions.

Inspection and Repair

1. Carefully set the crankshaft on the V–blocks. Slowly rotate the crankshaft and measure the runout. If the crankshaft runout exceeds the specified limit, the crankshaft must be replaced.

Runout : 0.04 mm (0.0016 in)



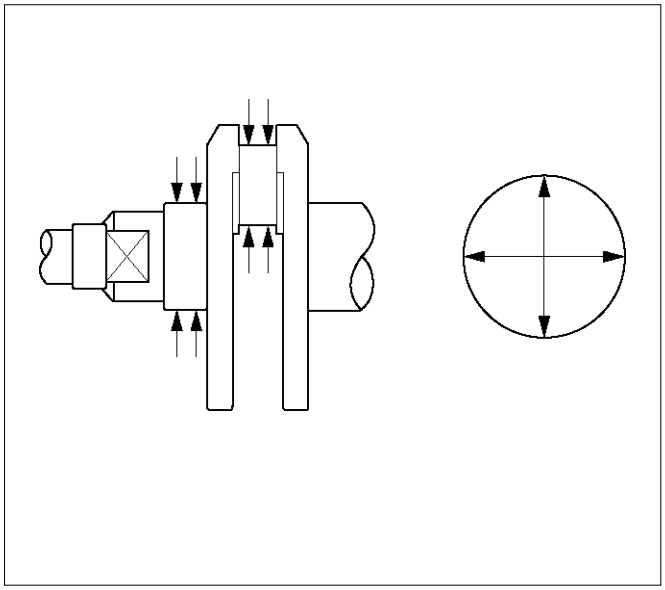
015RS007

2. Measure the diameter and the uneven wear of main journal and crank pin. If the crankshaft wear exceeds the specified limit, crankshaft must be replaced.

Main journal diameter : 63.918 mm–63.933 mm (2.5165 in.–2.5170 in.)

Crank pin diameter : 53.922 mm–53.937 mm (2.1229 in.–2.1235 in.)

Uneven wear limit : 0.005 mm (0.0002 in)

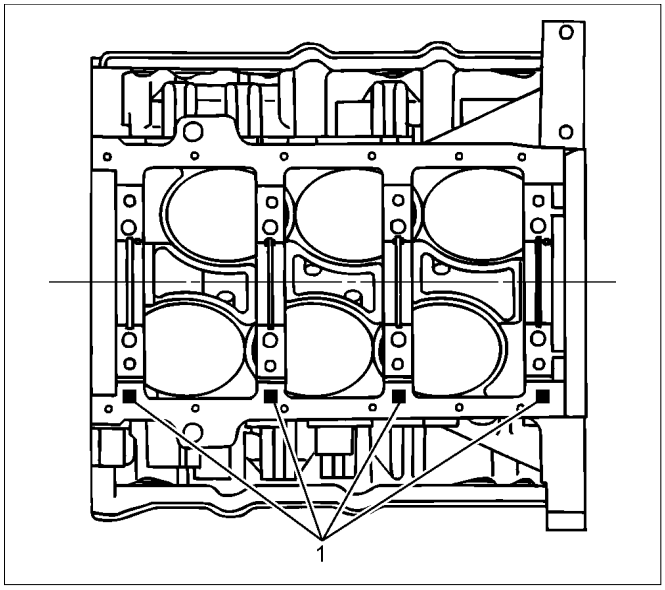


015RS009

Crankshaft Bearing Selection

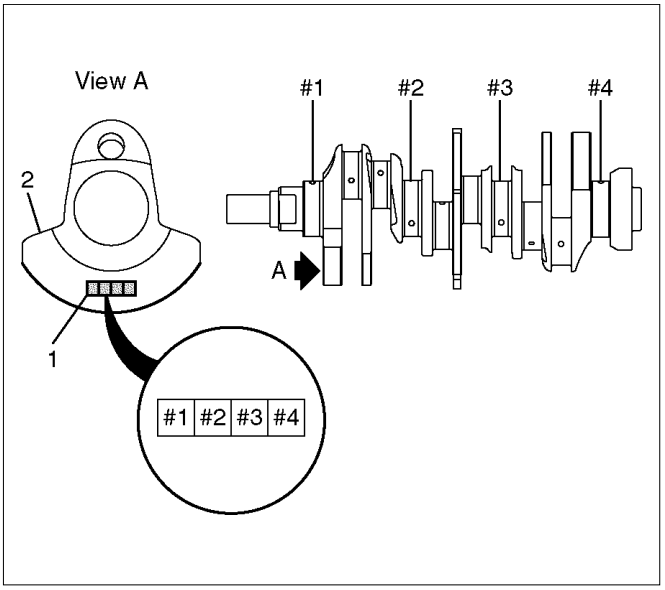
Crankshaft bearing selection is based on the measured diameters of the crankshaft journals and the bearing inserts.

1. The grade mark (1) for cylinder block journal are stamped on the lower face of cylinder block as shown in the illustration.



RTW31BSH000701

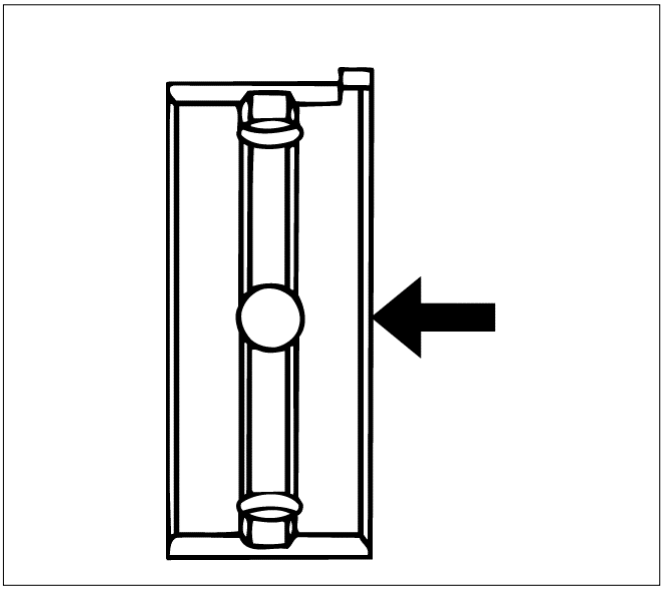
2. The crankshaft journal diameter grade mark (1) are stamped on the No.1 crankshaft balancer (2) as shown in the illustration.



015R200005

3. Match the cylinder block journal grade marks and the crankshaft journal grade marks in the table below to determine the correct crankshaft bearing size.

   The size color code is painted to side of the crankshaft bearings.



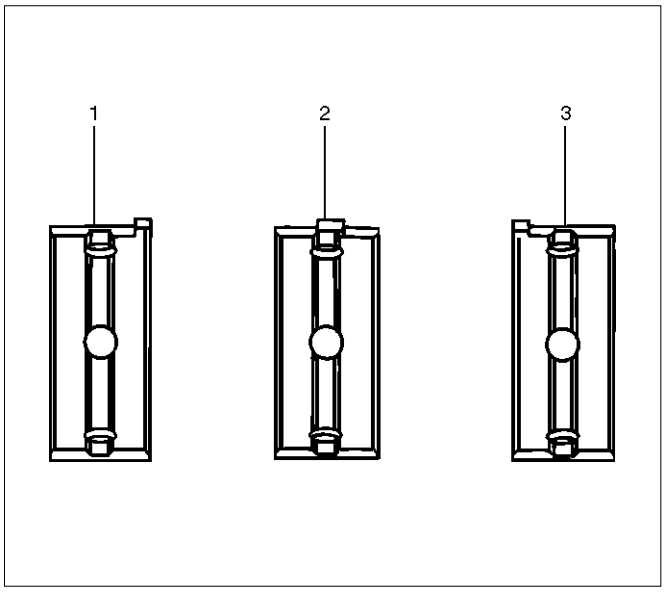
RTW31BSH000601

Grade Mark	Cylinder Block Journal	Crank Shaft Journal Diameter	Grade Mark	Color Code	Oil Clearance (Reference)
1	68.994-69.000 (2.7163-2.7165)	63.918-63.925 (2.5165-2.5167)	2	Blue	0.024-0.043 (0.0009-0.0017)
		63.926-63.933 (2.5168-2.5170)	1	Brown	0.022-0.041 (0.0009-0.0016)
2	68.987-68.993 (2.7160-2.7163)	63.918-63.925 (2.5165-2.5167)	2		0.023-0.042 (0.0009-0.0016)
		63.926-63.933 (2.5168-2.5170)	1	Green	0.021-0.040 (0.0008-0.0016)
3	68.980-68.986 (2.7157-2.7160)	63.918-63.925 (2.5165-2.5167)	2		0.022-0.041 (0.0009-0.0016)
		63.926-63.933 (2.5168-2.5170)	1	Yellow	0.020-0.039 (0.0008-0.0015)

Reassembly

1. Crankshaft (12)
   - Install the main bearings to the cylinder block and the main bearing caps.
   - Be sure that they are positioned correctly.
   - Apply new engine oil to the upper and lower main bearing faces.

NOTE: Do not apply engine oil to the main bearing back faces.

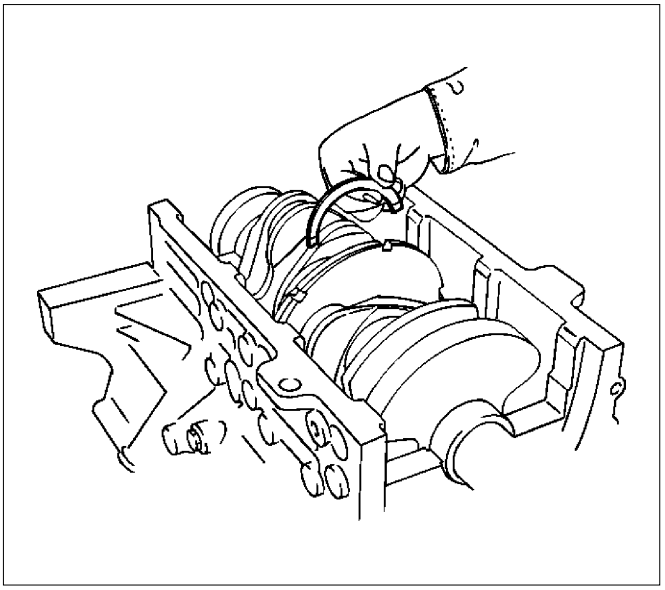


015RS012

Legend

(1) Numver 1 and 4 main bearing upper and lower
(2) Numver 2 and 3 main bearing upper
(3) Numver 2 and 3 main bearing lower

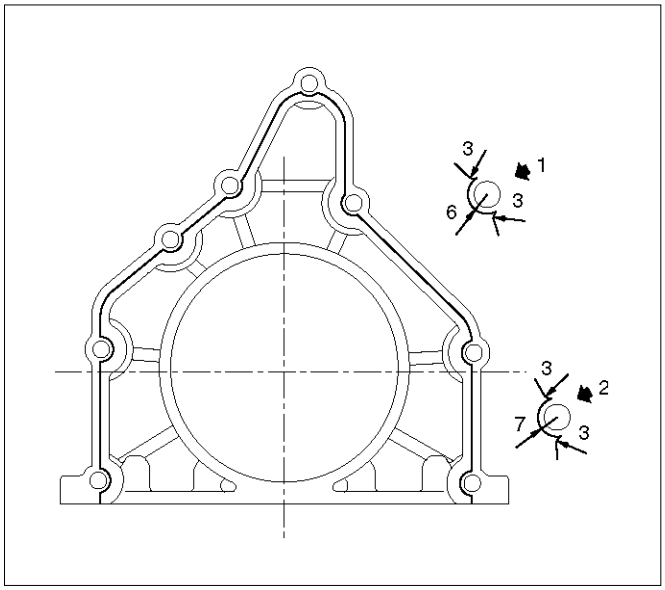
- Carefully mount the crankshaft.
- Apply engine oil to the thrust washer.
- Assemble the thrust washer to the No.3 bearing journal. The oil grooves must face the crankshaft.



015RS013

2. Rear oil seal (10)
   - Remove the oil from the cylinder block and the retainer mounting surface.
   - Apply sealant (TB−1207B or equivalent) to the retainer mounting surface, following the pattern shown in the illustration.

     The retainer must be installed within 5 minutes after sealant application before the sealant hardens.



015RW002

Legend

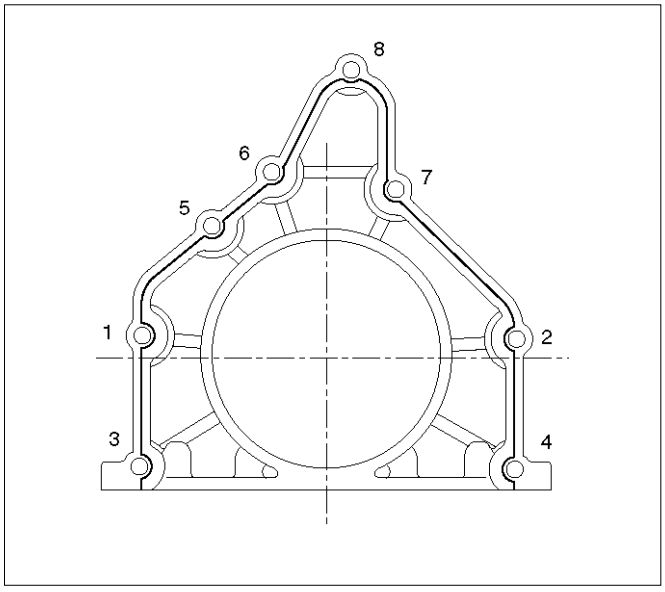
(1) Around Bolt Holes
(2) Around Dowel Pin

- Apply engine oil to the oil seal lip.
- Align the cylinder block dowel pin holes with the rear retainer dowel pins.
- Tighten the rear retainer fixing bolts. New bolts should be used when installing rear retainer.

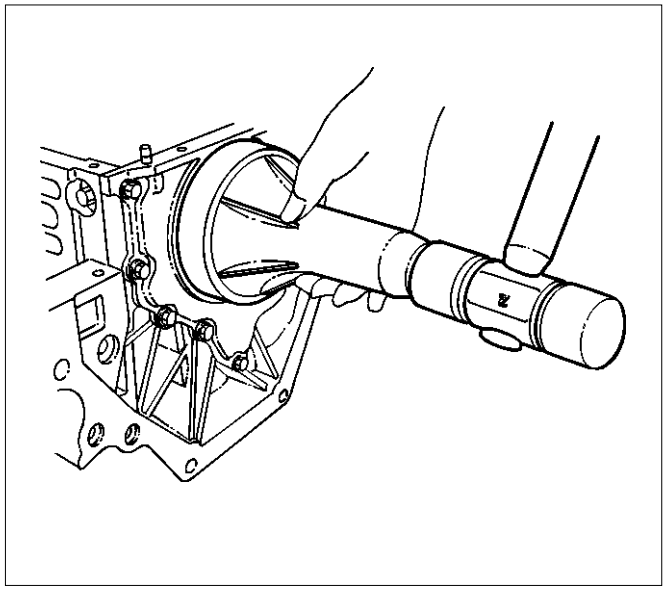
Torque: 18 N·m (1.8 Kg·m/13 lb ft)

NOTE: Be very careful not to disengage the oil seal garter spring during installation of the rear retainer.

If the seal was removed from retainer for replacement, apply engine oil to the oil seal lip and install the oil seal using 5−8840−2286−0 oil seal installer.



015RW001

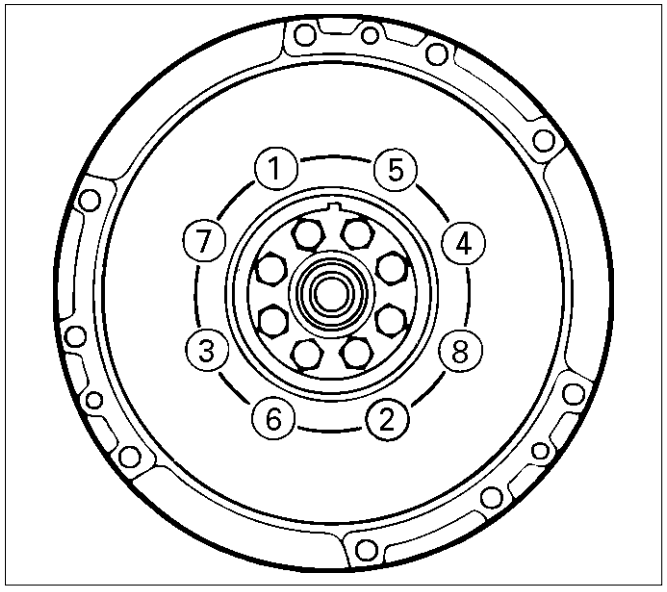


015RS017

3. Flywheel (9)
   1. Thoroughly clean and remove the oil from the threads of crankshaft.
   2. Remove the oil from the crankshaft and flywheel mounting faces.
   3. Mount the flywheel on the crankshaft and then install the washer.
   4. Hold the crankshaft to prevent from rotating then install the bolts in the order shown to the specified torque.

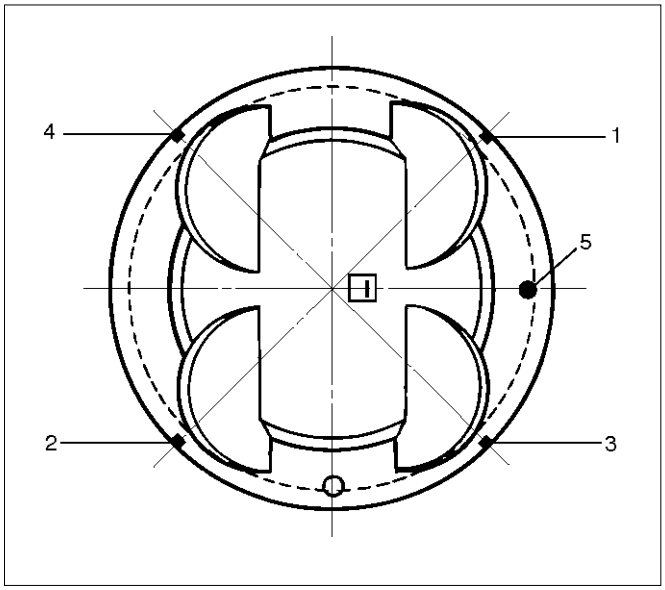
Torque: 54 N·m (5.5 Kg·m/40 lb ft)

NOTE: Do not reuse the bolt and do not apply oil or thread lock to the bolt.



015RS018

4. Piston and connecting rod assembly (8)
   - Apply engine oil to the cylinder bores, the connecting rod bearings and the crankshaft pins. Check to see that the piston ring end gaps are correctly positioned.



015RS019

Legend

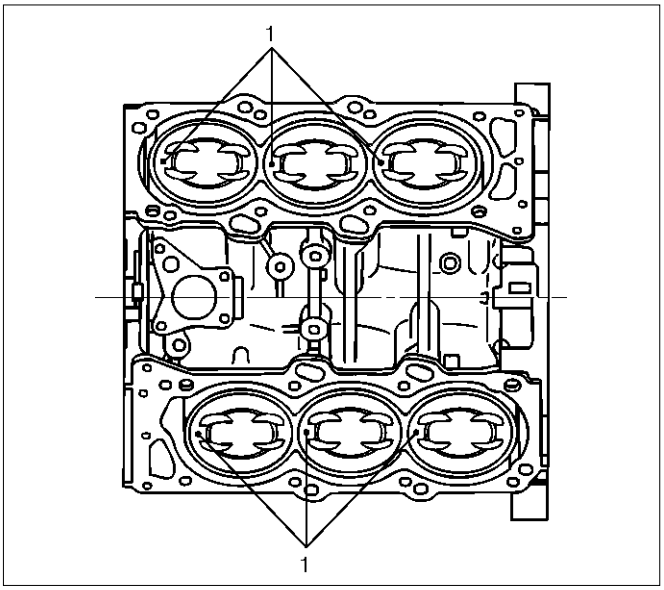
(1) No.1 Compression Ring
(2) No.2 Compression Ring
(3) Oil Ring Side Rail Upper
(4) Oil Ring Side Rail Lower
(5) Piston Front Mark

- Insert the piston/connecting rod assemblies into each cylinder with the piston ring compressor. The front marks must be facing the front of the engine.
- Match the numbered caps with the numbers on the connecting rods. Align the punched marks on the connecting rods and caps.
- Apply engine oil to the threads and seating faces of the nuts.
- Tighten the nuts.

Torque: 54 N·m (5.5 Kg·m/40 lb ft)

After tightening the cap nuts, check to see that the crankshaft rotates smoothly.

NOTE: Do not apply engine oil to the bearing back faces.

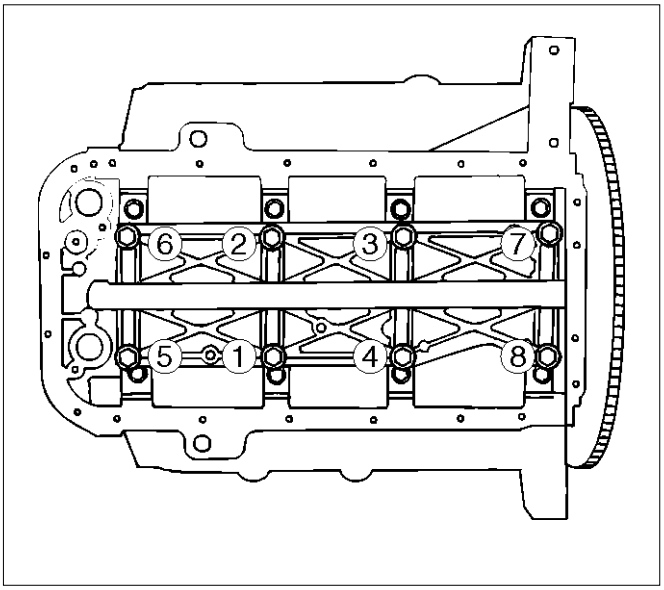


015RS020

5. Install oil gallery (7) and tighten the bolts in 2 steps, in the order shown.

1st step: 29 N·m (3.0 Kg·m/22 lb ft)

2nd step: 55° ~ 65°

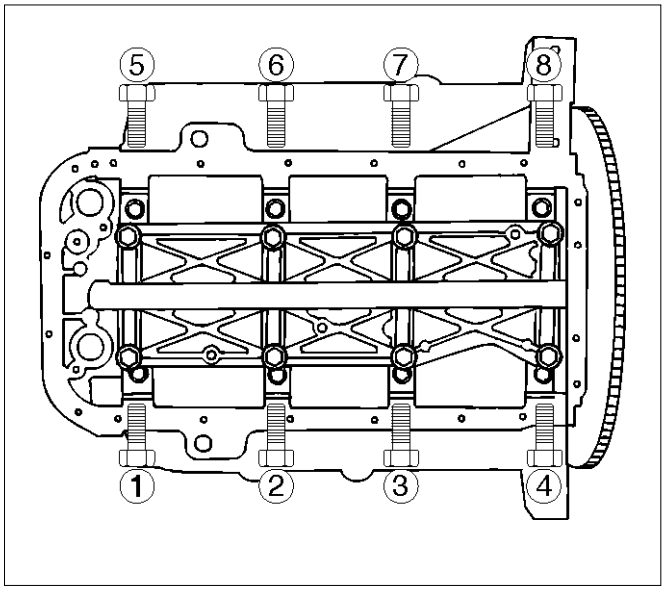


051RS009

6. Cylinder block side bolts (6)
   - Tighten all the bolts to the specified torque in the order shown.

NOTE: Do not apply engine oil to the crank case side bolts.

Torque: 39 N·m (4.0 Kg·m/29 lb ft)



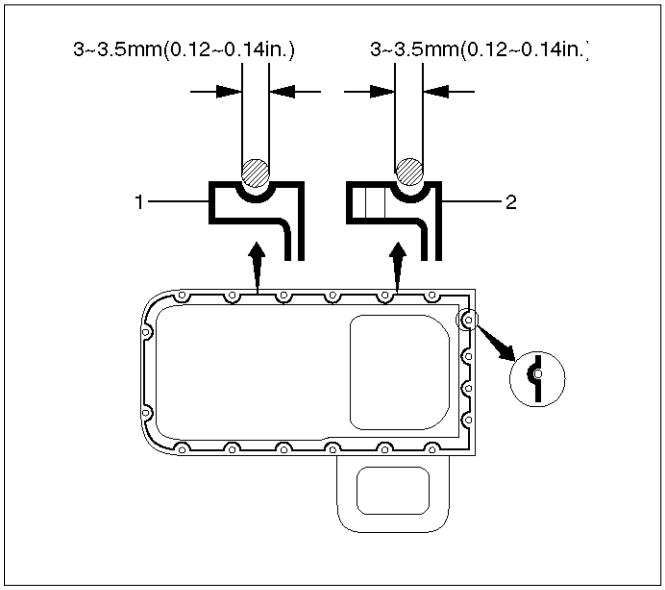
012RS001

7. Install oil pump assembly (5), refer to “Oil pump" in this manual.
8. Install oil strainer and O-ring (4).
9. Install oil pipe and O-ring (3) and tighten the bolts.

Torque: 25 N·m (2.5 Kg·m/18 lb ft)

10. Install crankcase with oil pan (2).
    1. Completely remove all residual sealant, lubricant and moisture from the sealing surfaces. The surfaces must be perfectly dry.
    2. Apply a correct width bead of sealant (TB—1207C or its equivalent) to the contact surfaces of the oil pan. There must be no gaps in the bead.
    3. The crankcase assembly must be installed within 5 minutes after sealant application to prevent premature hardening of the sealant.
    4. Tighten the bolts and nuts to the specified torque.

Torque : 10 N·m (1.0 Kg·m/7 lb ft)



013RW010

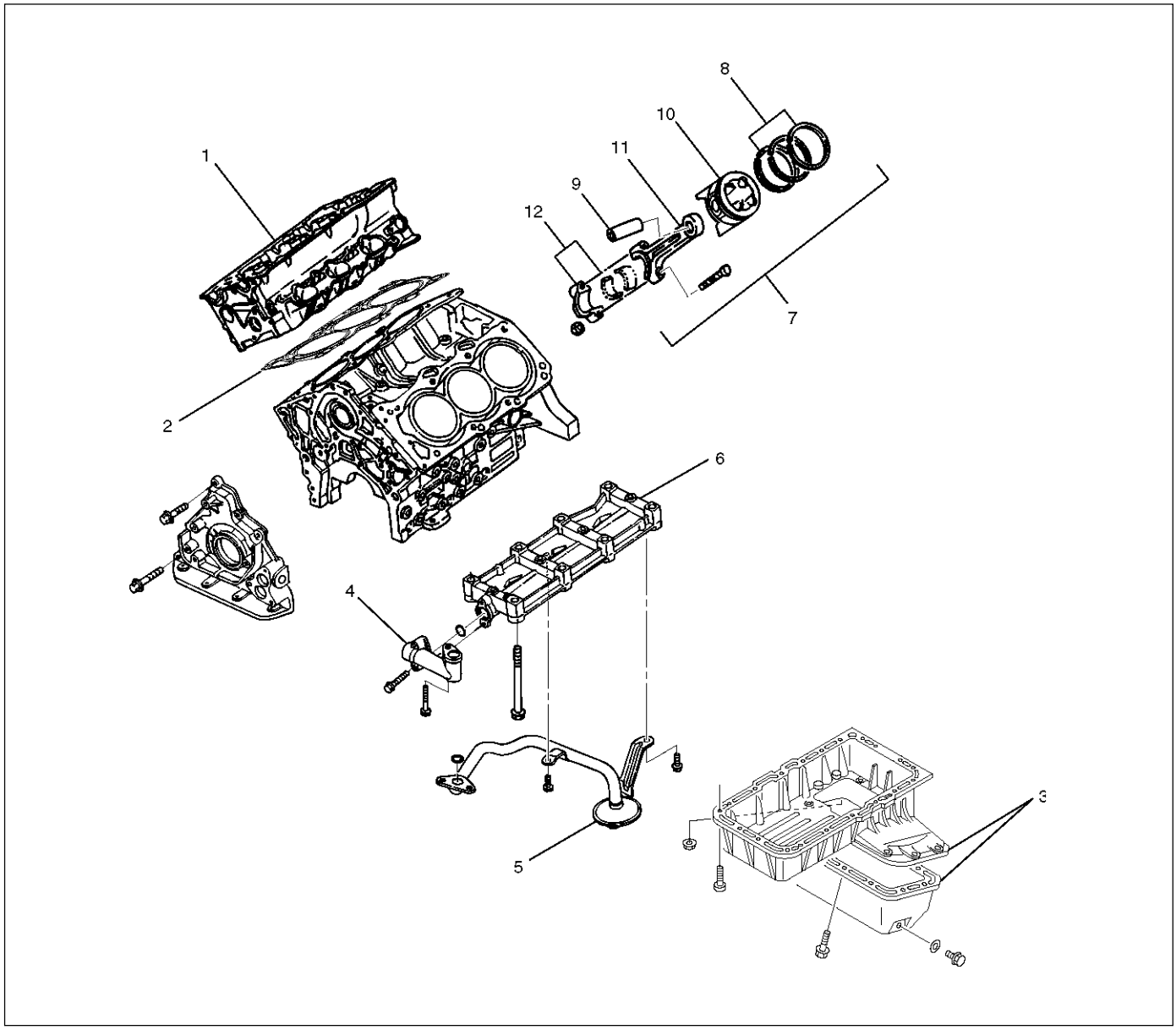
Legend

(1) Portion Between Bolt Holes
(2) Bolt Hole Portion

11. Install cylinder head assembly, refer to “Cylinder head" in this manual.

Piston and Connecting Rod

Piston, Connecting Rod and Associate Parts



015RW019

Legend

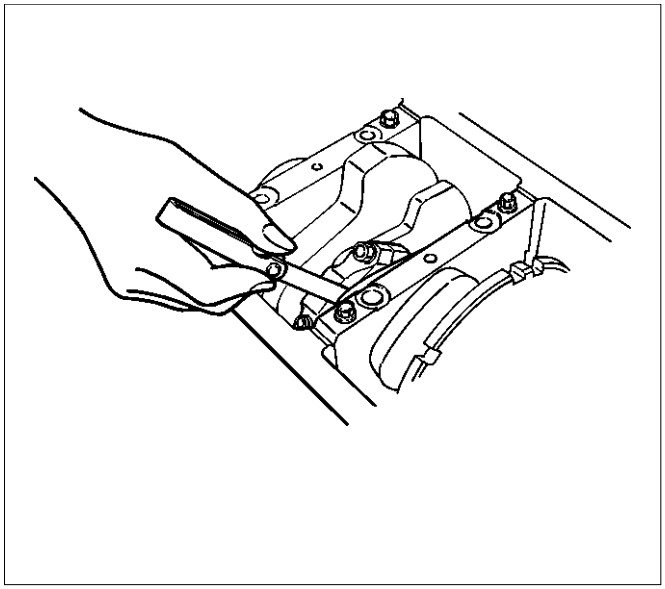
(1) Cylinder Head Assembly
(2) Cylinder Head Gasket
(3) Crankcase with Oil Pan
(4) Oil Pipe and O-Ring
(5) Oil Strainer and O-Ring
(6) Oil Gallery
(7) Piston and Connecting Rod Assembly
(8) Piston Ring
(9) Piston Pin
(10) Piston
(11) Connecting Rod
(12) Connecting Rod Cap

Disassembly

1. Remove cylinder head assembly (1). Refer to “Cylinder Head Removal" in this manual.
2. Remove cylinder head gasket (2).
3. Remove crankcase with oil pan (3). Refer to ”Oil Pan and Crankcase" in this manual.
4. Remove oil pipe and O-ring (4).

5. Remove oil strainer and O-ring (5).
6. Remove oil gallery (6).
7. Remove connecting rod cap with connecting rod lower bearing (12).
8. Remove piston and connecting rod assembly (7).

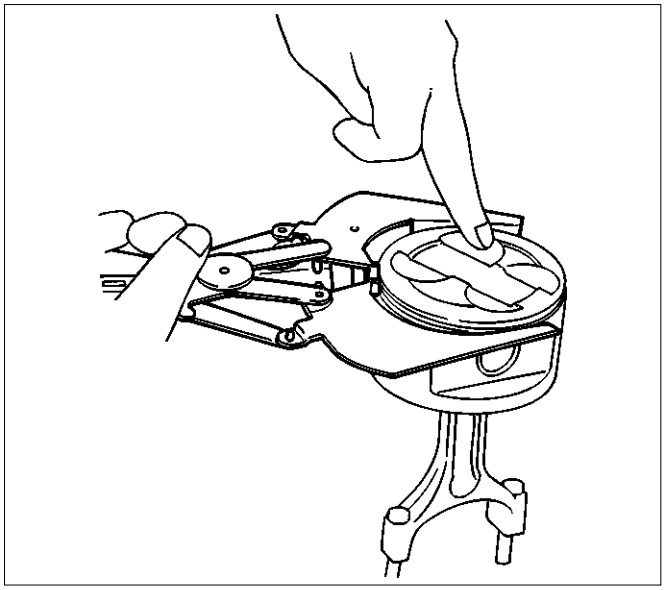
NOTE: Before removing piston and connecting rod assembly, measure thrust clearance.



015RS031

- Remove any ridge or carbon build up from the top end of the cylinder.

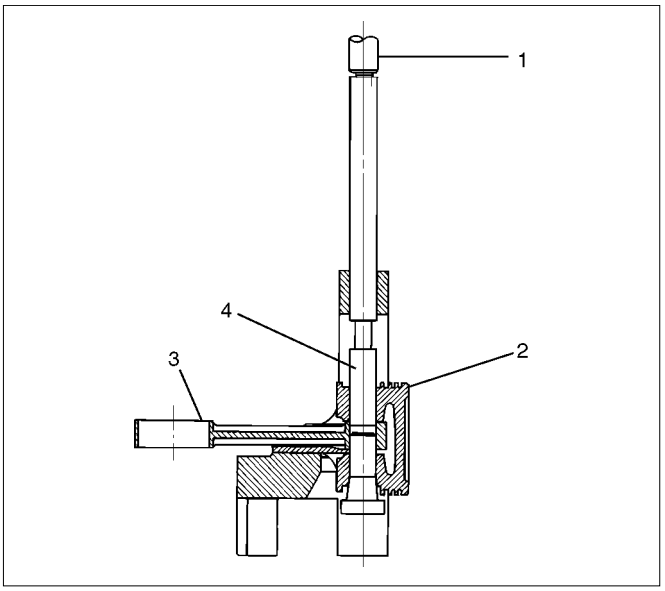
9. Remove the piston rings (8) with a piston ring expander. Arrange the removed piston rings in the cylinder number order.



015RS022

10. Remove the piston pin (9) using 5−8840−0551−0 piston pin service set and piston support with a press.

NOTE: Keep the parts removed from each cylinder separate. All parts must be reinstalled in their original positions. Heating the connecting rod will permit easy removal of the piston pin.



015RX001

Legend

(1) Press Ram
(2) Piston
(3) Connecting Rod
(4) Piston Pin

11. Piston (10)
12. Connecting rod (11)

Inspection and Repair

Pistons (10)

Carefully clean away all the carbon adhering to the piston head and the piston ring grooves.

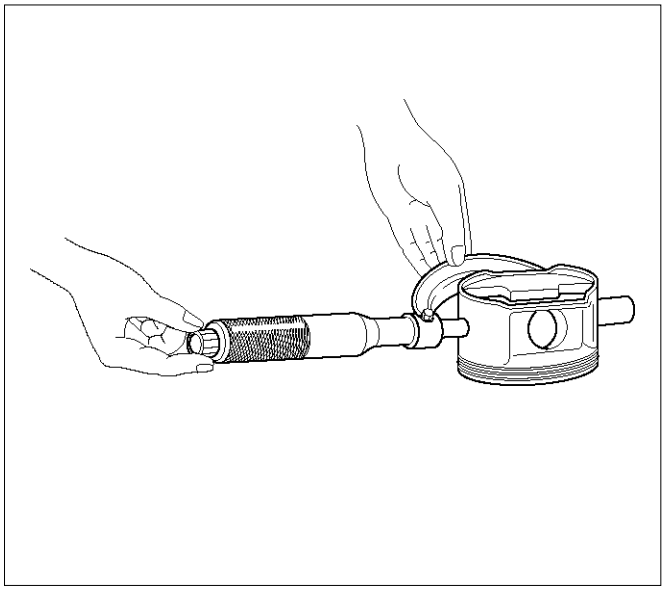
NOTE: Never use a wire brush to clean the pistons. Damage will result. Visually check each piston for cracking, scoring, and other signs of excessive wear. If any of the above conditions are found, the piston must be replaced.

Piston Diameter

1. Measure the piston outside diameter with micrometer at the piston grading position and a right angle to the piston pin.

   Piston grading position (from piston head)

   Piston grading position : 43.0 mm (1.6929 in)



015RV014

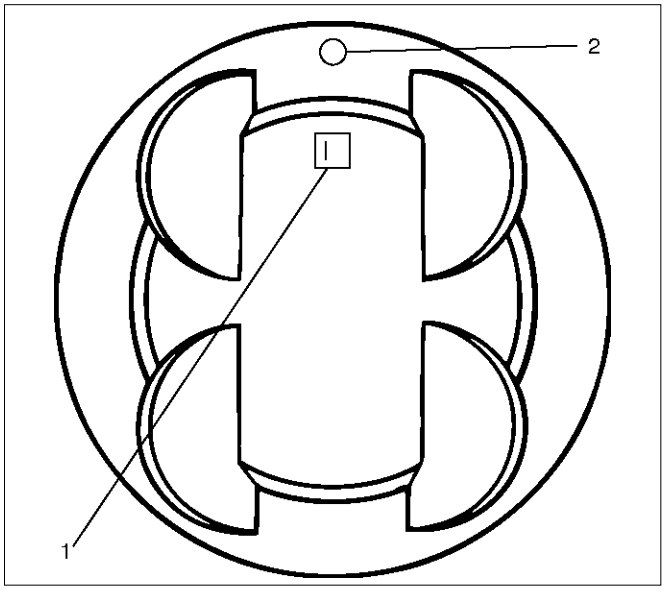
The size mark (1) for piston outside diameter is represented as shown in illustration below.

Outside Diameter

Size Mark A : 93.360 mm–93.370 mm (3.6756 in–3.6760 in)

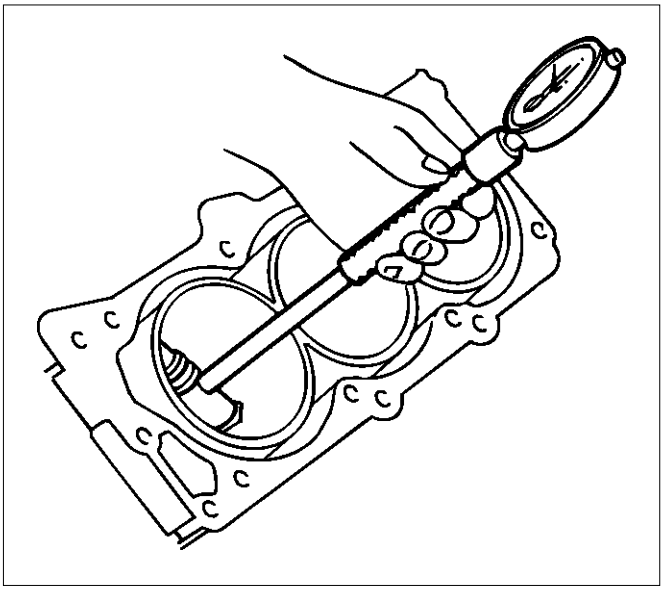
Size Mark B : 93.371 mm–93.380 mm (3.6760 in–3.6764 in)

Size Mark C : 93.381 mm–93.390 mm (3.6764 in–3.6768 in)



015RS025

Measure the cylinder bore inside diameter (refer to ”Cylinder Block" in this manual).



012RS002

Piston Rings (8)

Any worn or damaged part discovered during engine overhaul must be replaced with a new one.

1. Ring end gap measurement
   - Insert the piston ring into the bore.
   - Push the ring by the piston, at a right angle to the wall, into the point at which the cylinder bore diameter is the smallest.
   - Measure the ring end gap.

Compression Ring

1st ring

Standard: 0.300 mm–0.400 mm (0.0118 in–0.0157 in)

Limit: 1.0 mm (0.0394 in)

2nd ring

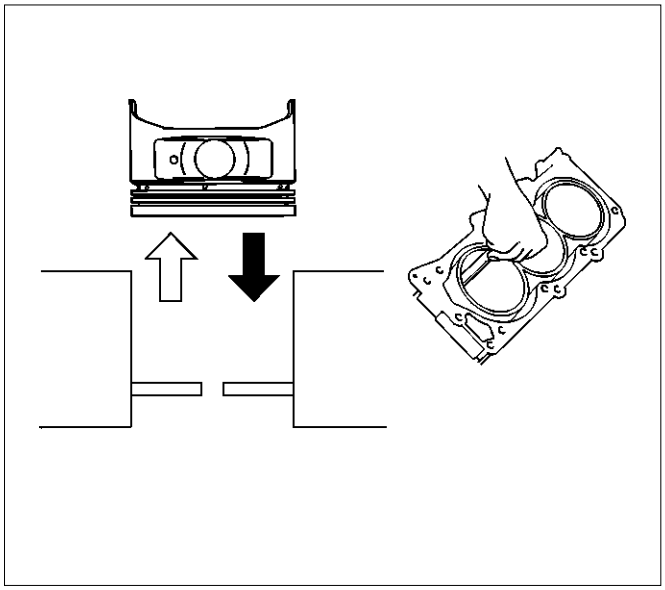
Standard: 0.450 mm–0.600 mm (0.0177 in–0.0236 in)

Limit: 1.2 mm (0.0472 in)

Oil ring

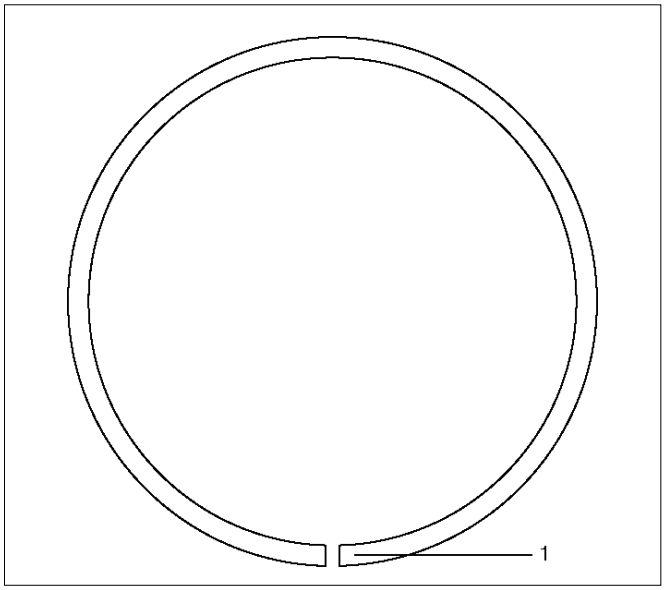
Standard: 0.150 mm–0.450 mm (0.0059 in–0.0177 in)

Limit: 1.05 mm (0.0413 in)



015RS026

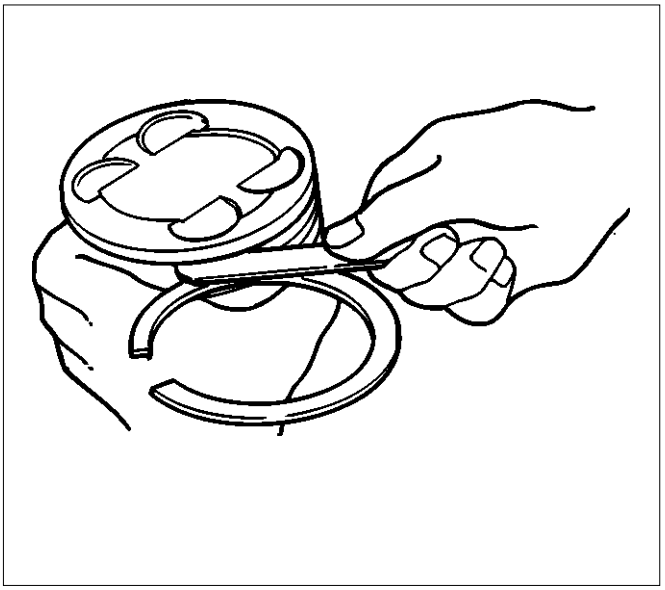
- The No.1 compression ring must be set with direction of origin.
- No.2 compression ring: Positioning mark (1) is painted as shown in the illustration.



015RS027

2. Measure the clearance between the piston ring groove and the piston ring with a feeler gauge. If the piston ring groove / piston ring clearance exceeds the specified limit, the piston must be replaced.

Compression Ring Clearance
Standard : 0.016 mm–0.038 mm
(0.0006 in. –0.0015 in)
Limit : 0.15mm (0.0059 in)



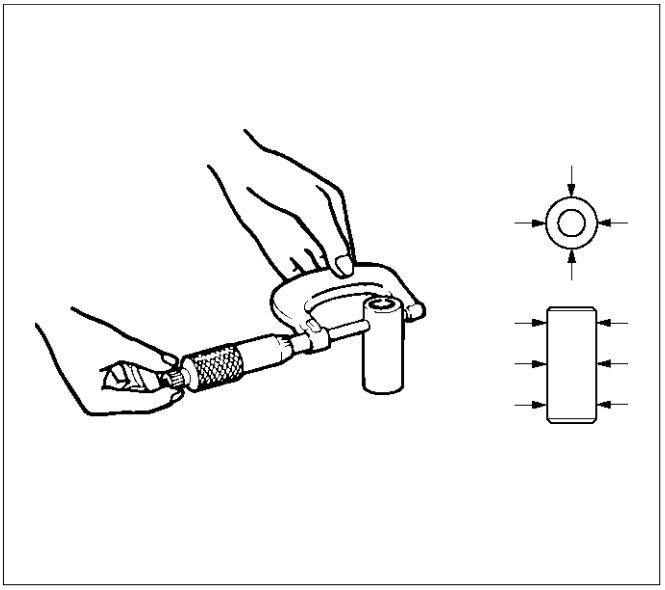
015RS028

Piston Pin (9)

NOTE: Do not reuse the old piston pin.

1. Use a micrometer to measure the new piston pin outside diameter in both directions at three different positions.
2. Measure the inside diameter of the connecting rod small end. If the fitting interference between the small end and pin does not conform to the specified value, the connecting rod must be replaced.

Standard : 0.023 mm–0.038 mm
(0.0009 in–0.0015 in)



015RS029

3. Insert the new pin into the piston and rotate it. If the pin rotates smoothly with no backlash, the clearance is normal. If there is backlash or roughness, measure the clearance. If the clearance exceeds the specified limit, the piston must be replaced.

Clearance

Standard : 0.010 mm–0.017 mm (0.0004 in. –0.0007 in)

Limit : 0.040 mm (0.0016 in)

Connecting Rods (11)

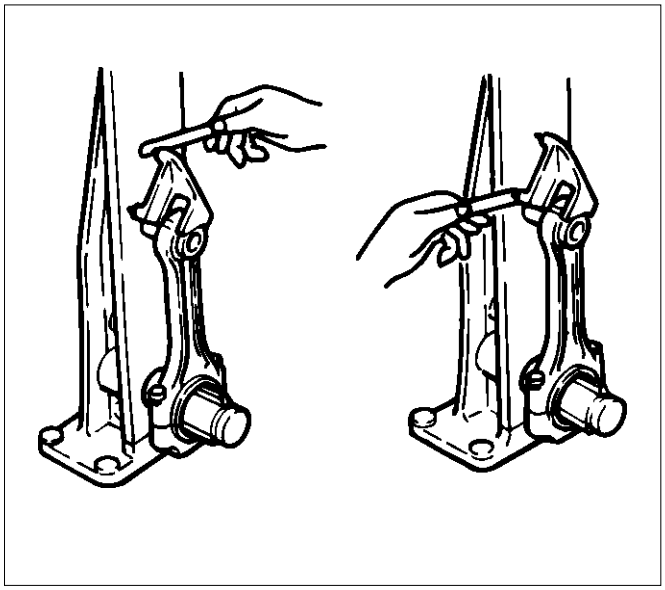
1. Check the connecting rod alignment If either the bend or the twist exceeds the specified limit, the connecting rod must be replaced.

Bend per 100 mm (3.937 in)

Limit: 0.15 (0.0059)

Twist per 100 mm (3.937 in)

Limit: 0.20 (0.0078)

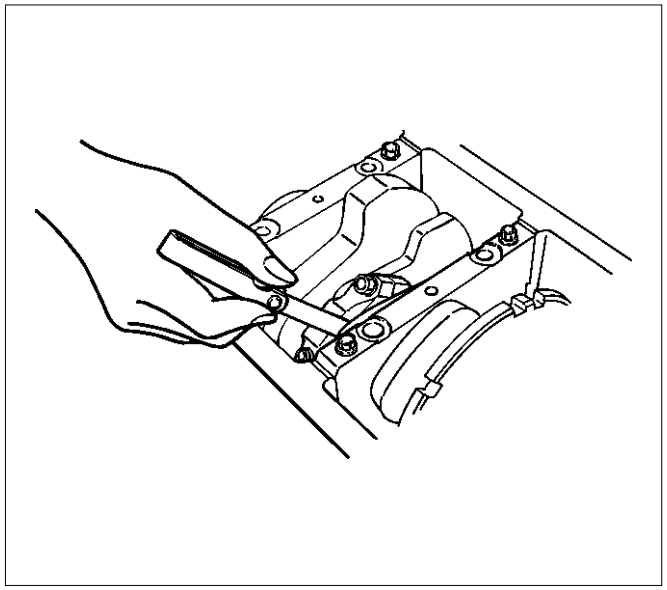


015RS030

2. Measure the connecting rod thrust clearance. Use a feeler gauge to measure the thrust clearance at the large end of the connecting rod If the clearance exceeds the specified limit, the connecting rod must be replaced.

Standard : 0.16 mm–0.35 mm (0.0063 in. –0.0138 in)

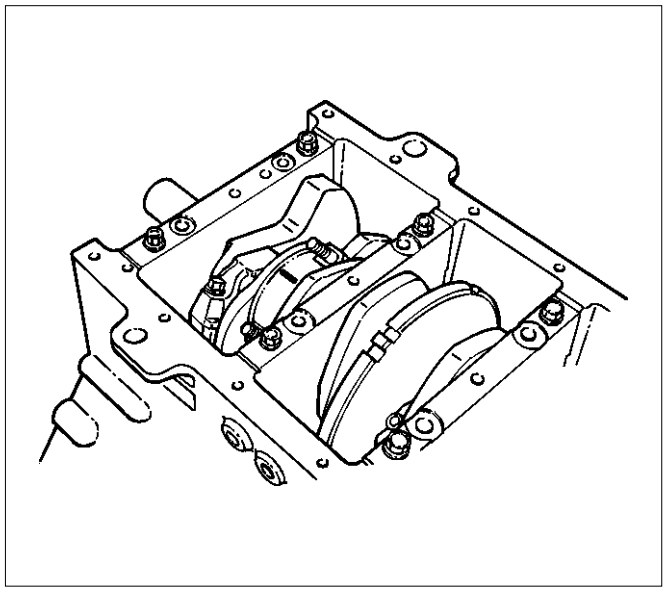
Limit : 0.40 mm (0.0157 in)



015RS031

3. Measure the oil clearance between the connecting rod and the crankshaft.
   1. Remove the connecting rod cap nuts and the rod caps (12).

      Arrange the removed rod caps in the cylinder number order.
   2. Clean the rod bearings and the crankshaft pins.
   3. Carefully check the rod bearings. If even one bearing is found to be damaged or badly worn, the entire bearing assembly must be replaced as a set. Reinstall the bearings in their original positions. Apply plastigage to the crank pin.



015RS032

4. Reinstall the rod caps (12) to their original positions.

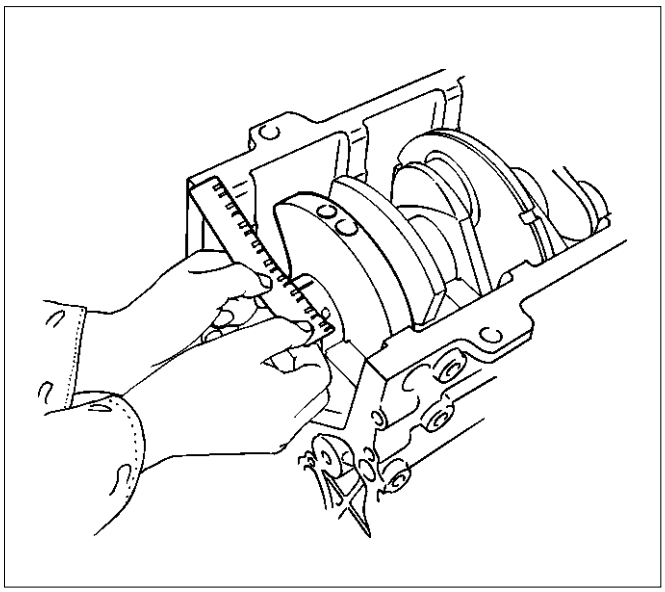
   Tighten the rod cap nuts.

Torque: 54 N·m (5.5 kg·m/40 lb ft)

NOTE: Do not allow the crankshaft to rotate.

5. Remove the rod caps.
6. Measure the width of the plastigage and determine the oil clearance. If the oil clearance exceeds the limit, replace the rod bearing as a set.

Standard : 0.019 mm–0.043 mm
(0.0007 in–0.0017 in)
Limit : 0.08 mm (0.003 in)



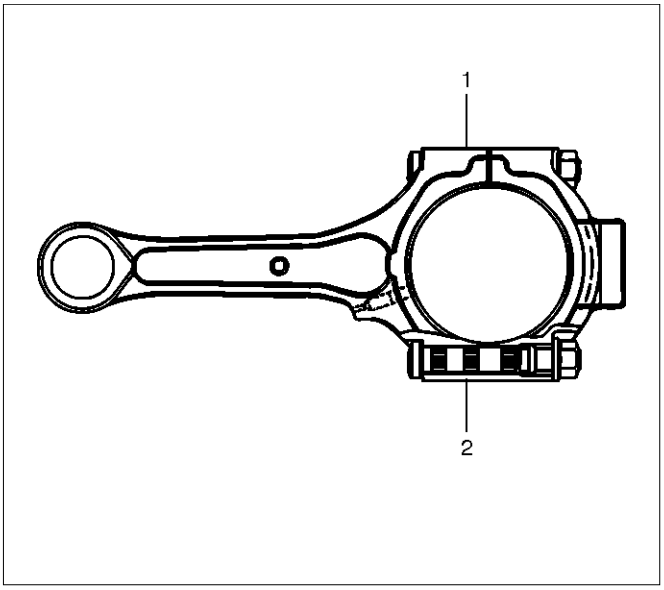
015RS008

7. Clean the plastigage from the bearings and the crankshaft pins.

Con–rod Bearing Selection

Select and install the new connecting rod bearings, paying close attention to the connecting rod big end diameter size mark (1).

NOTE: Take care not to confuse the alignment mark (2) and the size mark (1) during the installation procedure.



015RS034

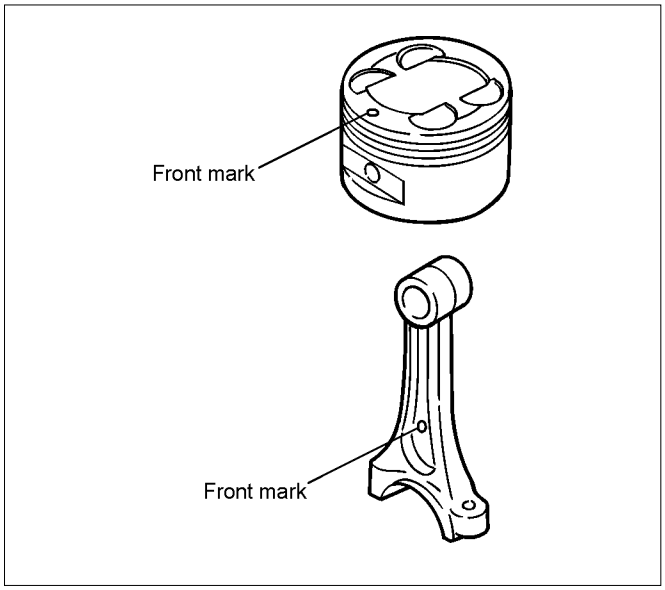
1 Size Mark	Big end Bore Diameter	Crankshaft Pin Diameter	Connecting Rod Bearing Thickness (Reference)	Color of Size Mark	Oil Clearance (Reference)
A	56.994-57.000 (2.2439-2.2441)	53.922-53.937 (2.1229-2.1235)	1.512-1.516 (0.0595-0.0597)	Yellow	0.025-0.054 (0.0010-0.0021)
B	56.988-56.994 (2.2436-2.2439)		1.508-1.512 (0.0594-0.0595)	Green	0.027-0.056 (0.0011-0.0022)
C	56.982-56.988 (2.2434-2.2436)		1.504-1.508 (0.0592-0.0594)	Pink	0.029-0.058 (0.0011-0.0023)

Reassembly

1. Install connecting rod
2. Install piston
3. Install piston pin
   - Apply a thin coat of engine oil to the piston pin. Try to insert the piston pin into the piston pin hole with normal finger pressure.

NOTE: When changing piston / connecting rod combinations, do not change the piston / piston pin combination and do not reuse the old piston pin.

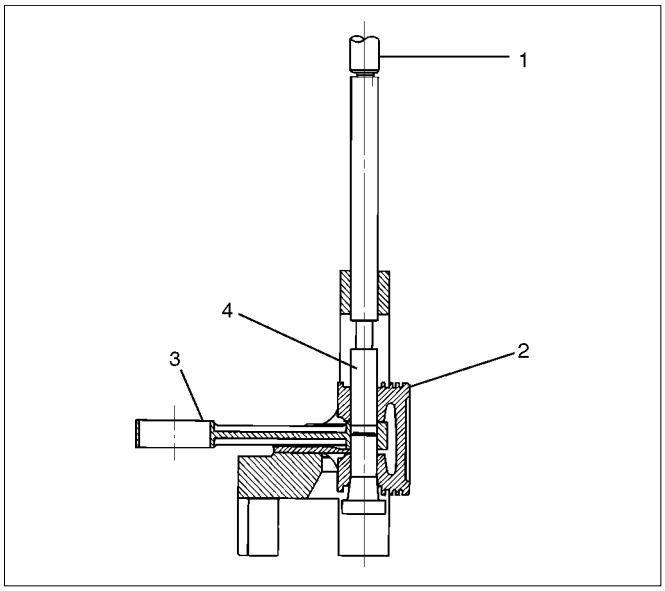
- Attach the piston to the connecting rod with the piston front mark and the connecting rod front mark on the same side.



RUW36ASH000501

- With 5−8840−0551−0 Piston pin service set and a press, press fit the piston pin.

NOTE: Heat the connecting rod small end to a suitable temperature to ensure smooth installation.

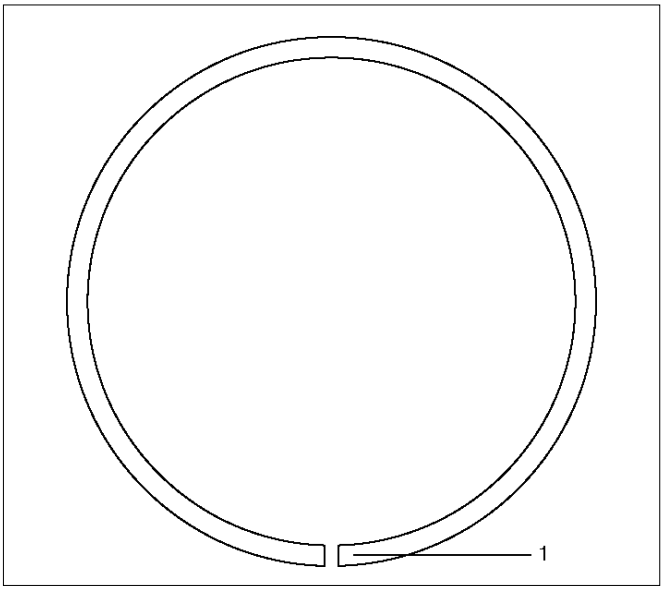


015RX001

Legend

(1) Press Ram
(2) Piston
(3) Connecting Rod
(4) Piston Pin

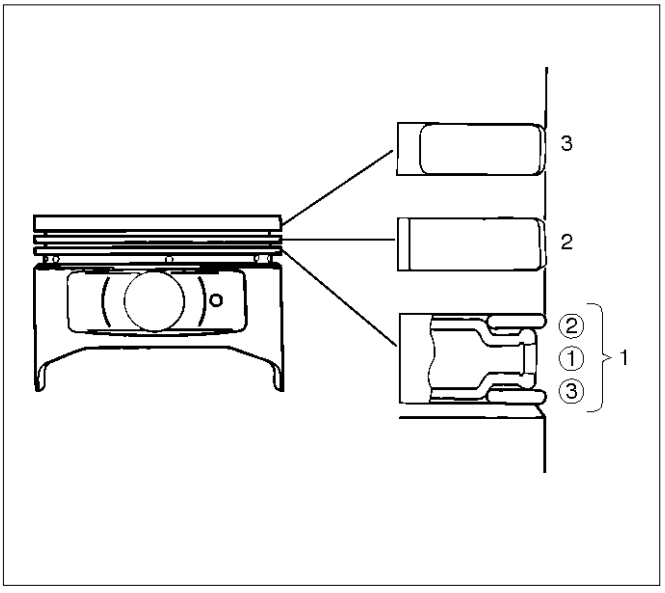
4. Install piston ring with the piston ring expander.
   The No.2 compression ring must be set with the T2 mark (1) facing up.



015RS027

- Install piston rings in the following sequence.

1. Oil ring
   1. Expander ring
   2. Upper side rail
   3. Lower side rail
2. 2nd compression ring
   - The 2nd compression ring must be set with the T2 mark facing up.
3. 1st compression ring
   - The compression ring must be set with direction of origin.
   - After installation, apply engine oil to the entire circumference of the piston rings. Check to see that all the rings rotate smoothly.



015RS038

5. Install piston and connecting rod assembly.
   - Insert the bearings into the connecting rods and caps. Apply new engine oil to the bearing faces and nuts.
   - Tighten the connecting rod cap nuts

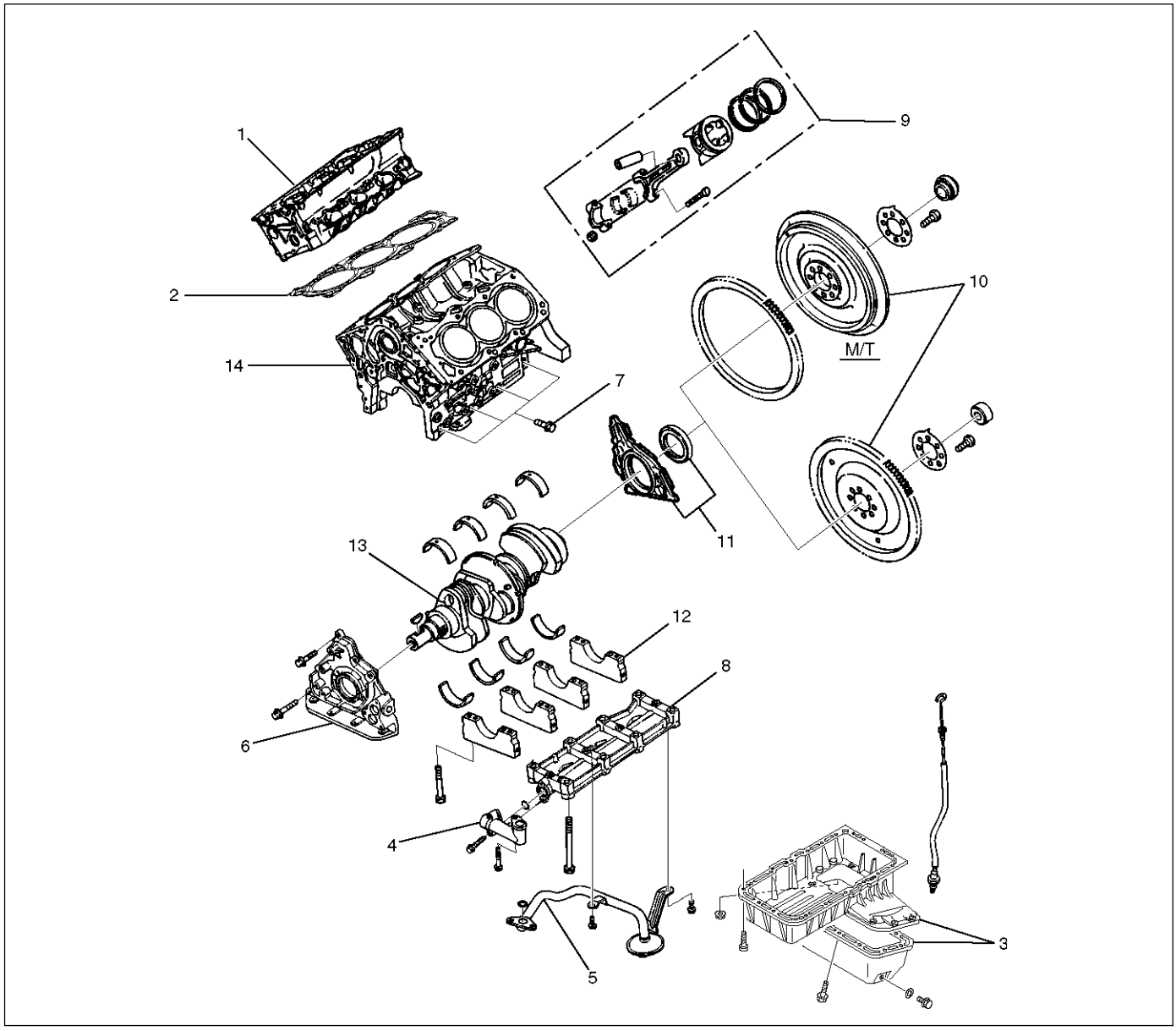
Torque : 54 N·m (5.5 kg·m/40 lb ft)

NOTE: Do not apply engine oil to the bearing back faces.

6. Oil gallery, refer to “Crankshaft and main bearing" in this manual.
7. Oil strainer and O-ring.
8. Oil pipe and O-ring.
9. Install crankcase with oil pan, refer to “Oil pan and Crankcase" in this manual.
10. Install cylinder head gasket.
11. Install Cylinder head assembly.
    - Refer to “Cylinder head" in this manual.

Cylinder Block

Cylinder Block and Associated Parts



012RW010

Legend

(1) Cylinder Head Assembly
(2) Cylinder Head Gasket
(3) Crankcase with Oil Pan
(4) Oil Pipe and O-Ring
(5) Oil Strainer and O-Ring
(6) Oil Pump Assembly
(7) Cylinder Block Side Bolts
(8) Oil Gallery
(9) Piston and Connecting Rod Assembly
(10) Flywheel
(11) Rear Oil Seal Retainer Assembly
(12) Main Bearing Cap
(13) Crankshaft
(14) Cylinder Block

Disassembly

1. Remove cylinder head assembly.
2. Remove cylinder head gasket.
3. Remove crankcase with oil pan.
4. Remove oil pipe and O-ring.
5. Remove oil strainer and O-ring.
6. Remove oil pump assembly.
7. Remove crankcase side bolts.
8. Remove oil gallery.
9. Remove piston and connecting rod assembly.
10. Remove flywheel.
11. Remove rear oil seal retainer assembly.
12. Remove main bearing cap.
13. Remove crankshaft.
14. Remove cylinder block.

Inspection and Repair

1. Remove the cylinder head gasket and any other material adhering to the upper surface of the cylinder block. Be very careful not to allow any material to accidentally drop into the cylinder block. Be very careful not to scratch the cylinder block.
2. Carefully remove the oil pump, rear oil seal retainer, and crankcase assembly installation surface seal.
3. Wipe the cylinder block clean.
4. Visually inspect the cylinder block. If necessary, use a flaw detector to perform a dye penetrate and hydraulic (or air pressure) test. If cracking or other damage is discovered, the cylinder block must either be repaired or replaced.

Flatness

1. Using a straight−edge and feeler gauge, check that the upper surface of the cylinder block is not warped.

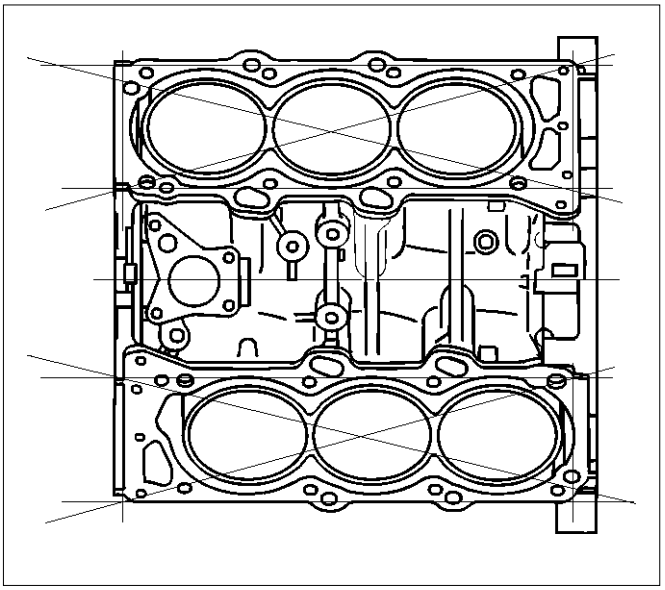
NOTE: Be very careful not to allow any material to accidentally drop into the upper surface of the cylinder block. Be very careful not to scratch the upper surface of the cylinder block.

2. The cylinder block must be reground or replaced if the warpage exceeds the limit.

Warpage

Limit : 0.15 mm (0.0059 in)

Maximum repairable limit: 0.15 mm (0.0059 in)



012RS004

Cylinder Bore

Use a cylinder gauge to measure the cylinder bore diameter in both the axial and thrust directions. Each measurement should be made at six points.

CAUTION: Be very careful not to allow any material to accidentally drop into the upper surface of the cylinder block. Be very careful not to scratch the upper surface of the cylinder block.

Cylinder Bore Inside Diameter

Limit : 93.530 mm (3.6823 in)

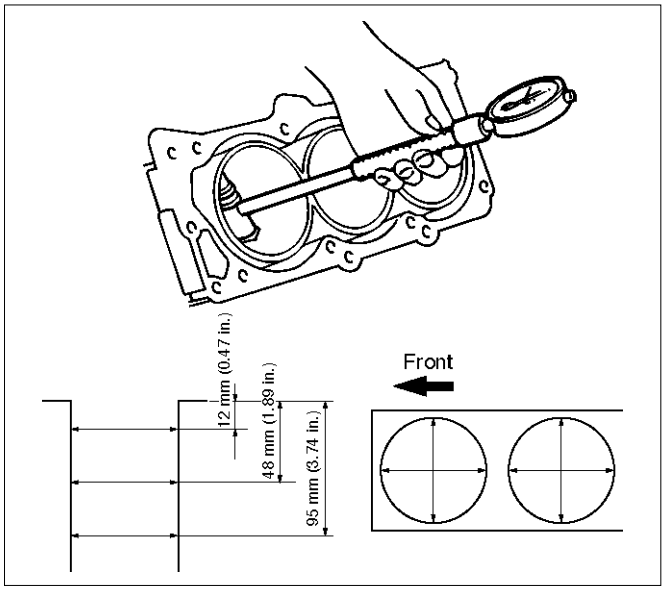
If the measurement exceed the specified limit, the cylinder block must be replaced.

Diameter

Grade A : 93.400 mm−93.410 mm (3.6772 in−3.6776 in)

Grade B : 93.411 mm−93.420 mm (3.6776 in−3.6779 in)

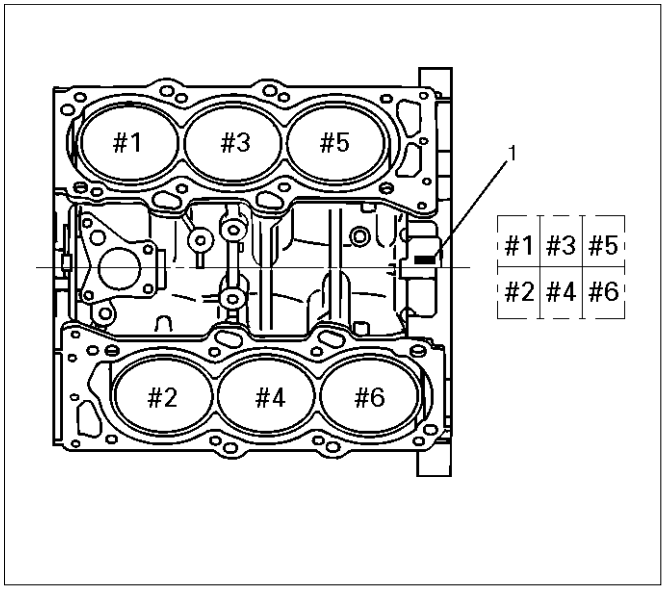
Grade C : 93.421 mm−93.430 mm (3.6780 in−3.6783 in)



012RS005

NOTE: For information on piston diameter, please refer to the section "Inspection of the Piston and Connecting Rod Assembly" in this manual.

- The "Grade" mark (1) is stamped at the position illustrated.

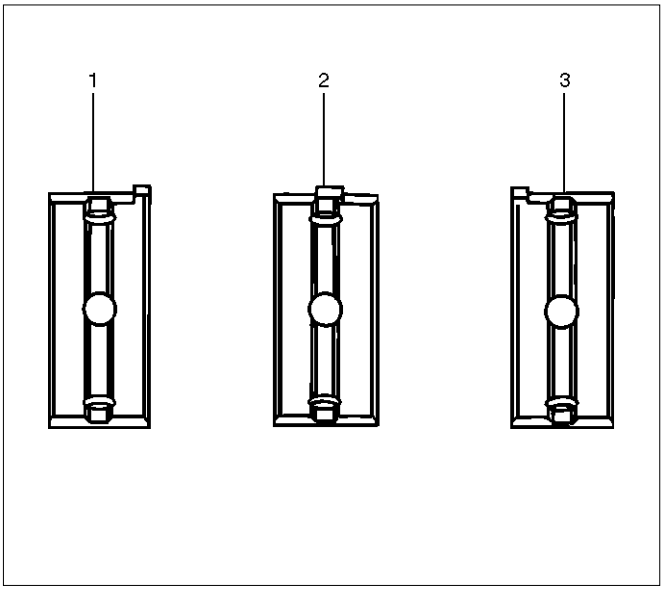


012RS006

Reassembly

1. Install cylinder block.
2. Install crankshaft.
   - Install the main bearings to the cylinder block and the main bearing caps.
   - Be sure that they are positioned correctly.
   - Apply new engine oil to the upper and lower main bearing faces.

NOTE: Do not apply engine oil to the bearing back faces.

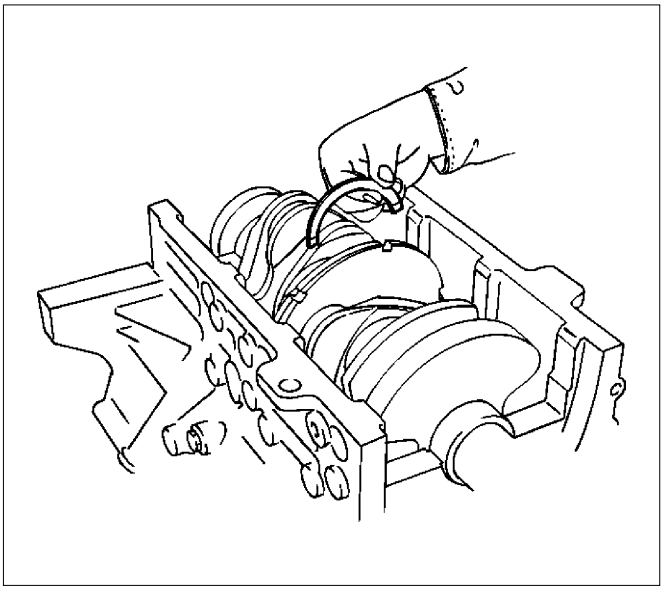


015RS012

Legend

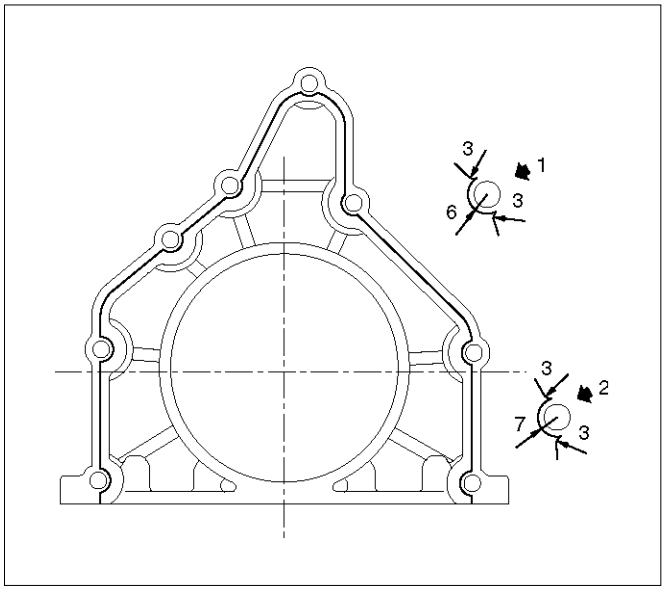
(1) Number 1 and 4 main bearing upper and lower.
(2) Number 2 and 3 main bearing upper.
(3) Number 2 and 3 main bearing lower.

- Carefully mount the crankshaft.
- Apply engine oil to the thrust washer.
- Assemble the thrust washer to the No. 3 bearing journal. The oil grooves must face the crankshaft.



015RS013

3. Install rear oil seal retainer.
   - Remove oil on cylinder block and retainer fitting surface.
   - Apply sealant (TB1207B or equivalent) to retainer fitting surface as shown in illustration.
   - The oil seal retainer must be installed within 5 minutes after sealant application before the sealant hardens.



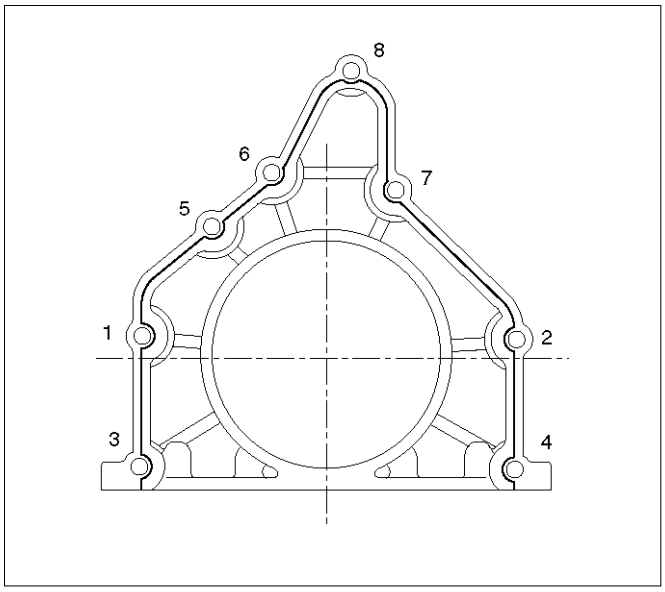
015RW002

Legend

(1) Around Bolt Holes
(2) Around Dowel Pin

- Apply engine oil to oil seal lip and align a dowel pin hole in the cylinder block with that in the retainer.
- Tighten retainer fixing bolts to the specified torque.

Torque: 25 N·m (2.5 kg·m/18.4 lb ft)

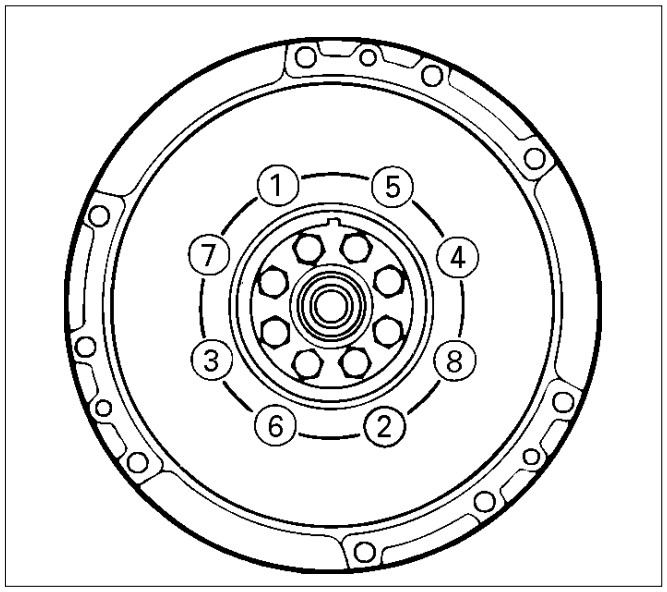


015RW001

4. Install flywheel
   1. Thoroughly clean and remove the oil from the threads of crankshaft.
   2. Remove the oil from the crankshaft and flywheel mounting faces.
   3. Mount the flywheel on the crankshaft and then install the washer.
   4. Holding the crankshaft stationary, tighten the flywheel bolts in the order shown.

Torque: 54 N·m (5.5 kg·m/40 lb ft)

NOTE: Do not reuse the bolts and do not apply oil or thread lock to the bolts.

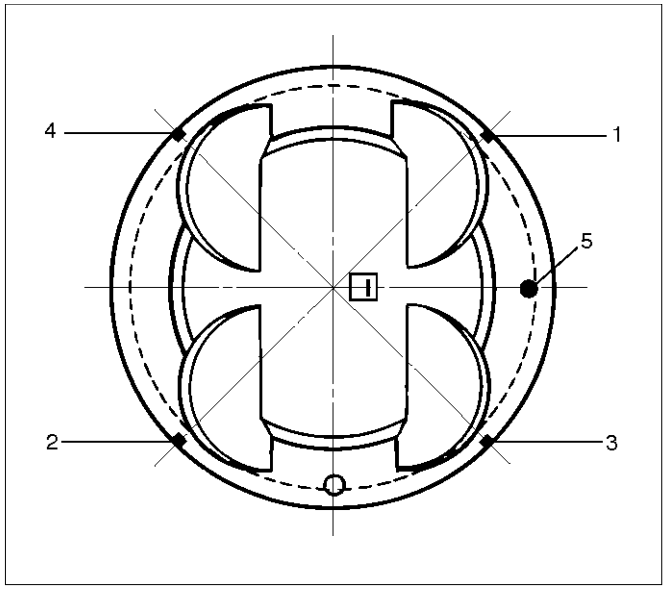


015RS018

5. Install piston and connecting rod assembly.
   - Apply engine oil to the cylinder bores, the connecting rod bearings and the crankshaft pins.

NOTE: Do not apply engine oil to the bearing back faces.

- Check to see that the piston ring end gaps are correctly positioned.

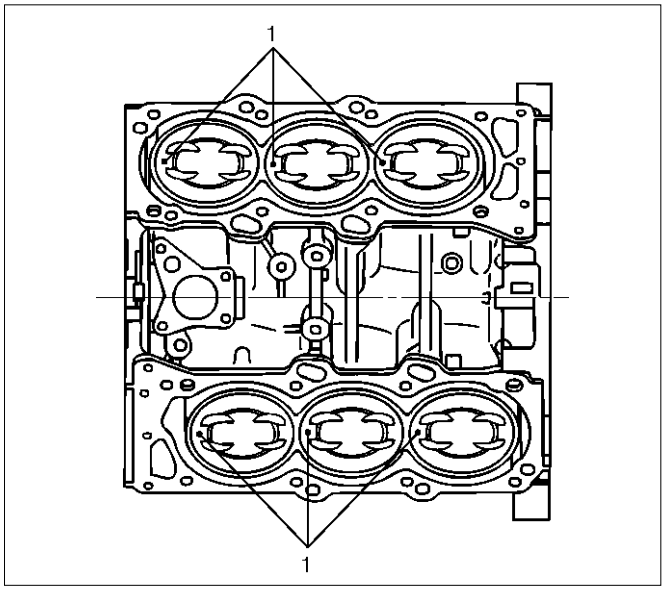


015RS019

Legend

(1) No.1 Compression Ring
(2) No.2 Compression Ring
(3) Oil Ring Side Rail Upper
(4) Oil Ring Side Rail Lower
(5) Piston Front Mark

- Insert the piston/connecting rod assemblies into each cylinder with the piston ring compressor.
- The front marks (1) must be facing the front of the engine.

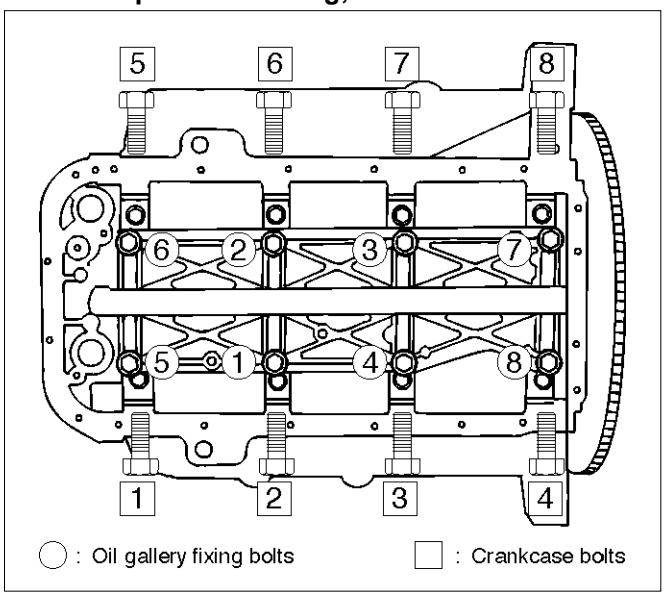


015RS020

6. Install oil gallery and tighten the bolts in 2 steps in the order shown.

1st step : 29 N·m (3.0 kg·m/22 lb ft)

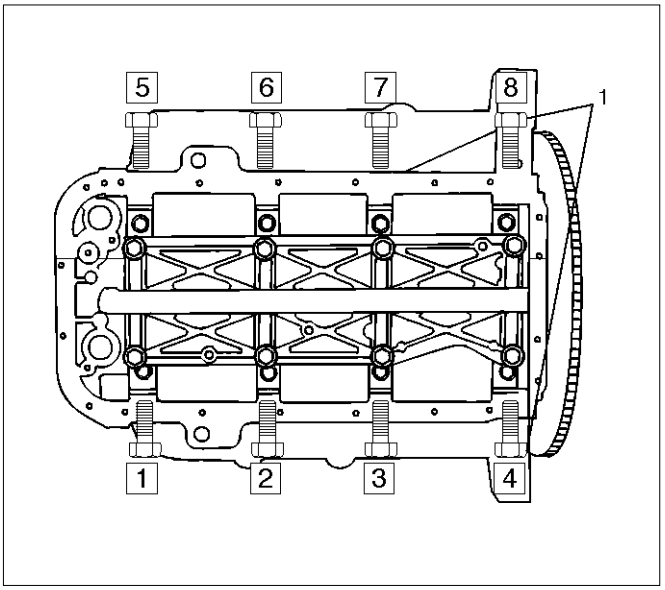
2nd step : 55° ~ 65°



012RS007

7. Install cylinder block side bolts (1) and tighten crankcase bolts in sequence shown in the illustration.

Torque : 39 N·m (4.0 kg·m/29 lb ft)

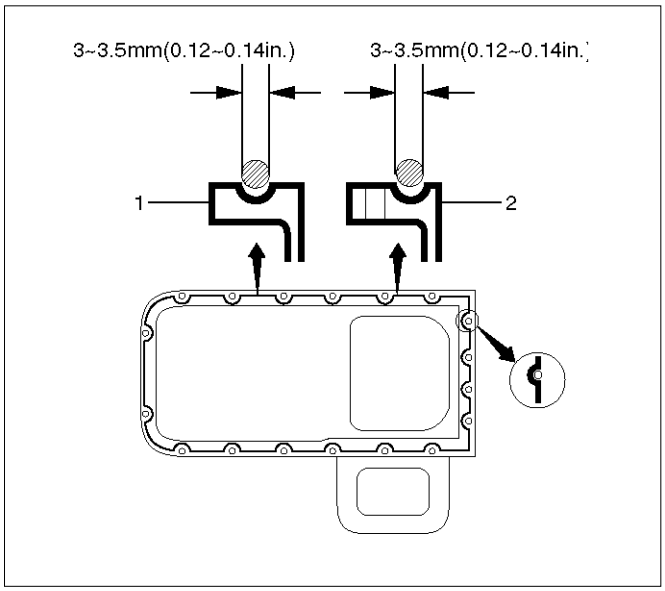


012RW005

8. Install oil pump assembly. Refer to “Oil Pump" in this manual.
9. Install oil strainer and O-ring.
10. Install oil pipe and O-ring.
11. Install crankcase with oil pan.
    1. Completely remove all residual sealant, lubricant and moisture from the sealing surfaces. The surfaces must be perfectly dry.
    2. Apply a correct width bead of sealant (TB–1207C or its equivalent) to the contact surfaces of the crankcase. There must be no gaps in the bead.
    3. The oil pan must be installed within 5 minutes after sealant application to prevent premature hardening of sealant.

4. Tighten the bolts and nuts to the specified torque.

Torque : 10 N·m (1.0 kg·m/7 lb ft)



013RW010

Legend

(1) Portion Between Both Holes
(2) Bolt Hole Portions

12. Install cylinder head gasket.
13. Install cylinder head assembly. Refer to “Cylinder Head" in this manual.

Main Data and Specification

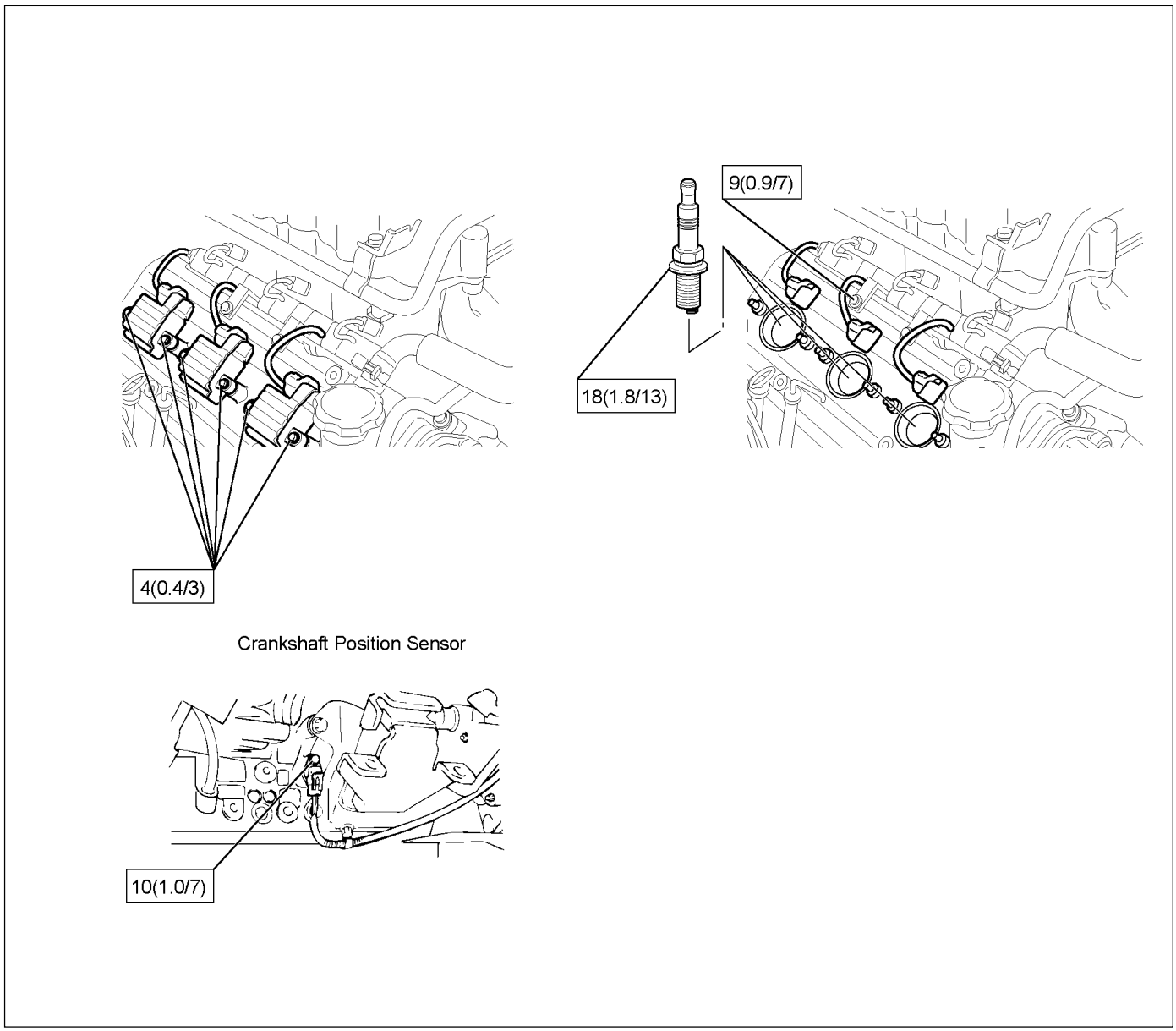
General Specification

Item	Specifications
Engine type, number of cylinders and arrangement	Water cooled, four cycle V6
Form of combustion chamber	Pent-roof type
Valve mechanism	4-Cams, 4-Valves, DOHC Gear & Belt Drive
Cylinder liner type	Casted in cylinder block
Total piston displacement	3494 cc
Cylinder bore x stroke	93.4mm x 85.0mm
	(3.6772 in × 3.3465 in)
Compression ratio	8.6
Compression pressure at 300rpm	1.37 MPa (14.0 Kg/cm^2)
Engine idling speed rpm	Non adjustable (750)
Valve clearance	Intake: 0.28 mm (0.11 in)
	Exhaust: 0.30mm (0.12 in)
Oil capacity	5.3 liters
Ignition timing	Non adjustable (12° BTDC at idle rpm)
Spark plug	PK16PR11, RC10PYP4, K16PR-P11
Plug gap	1.0 mm – 1.1 mm (0.0394 in – 0.0433 in)

Torque Specifications

Ignition coil, Spark plug, Crankshaft angle sensor and Under cover

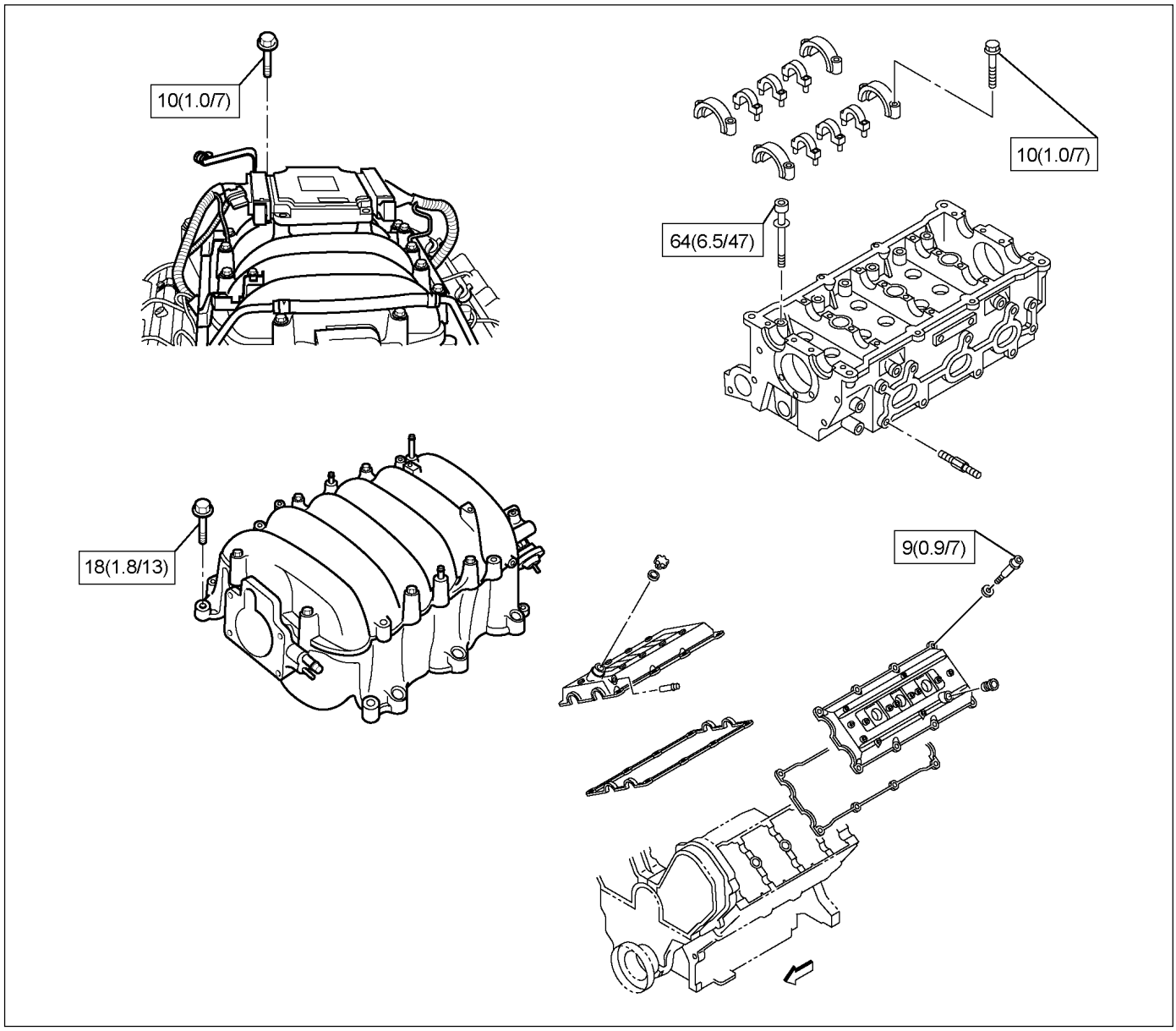
N·m (kg·m/ lb ft)



RTW460LF000101

Cylinder head cover, Cylinder head, Camshaft bracket, Common chamber, ECM

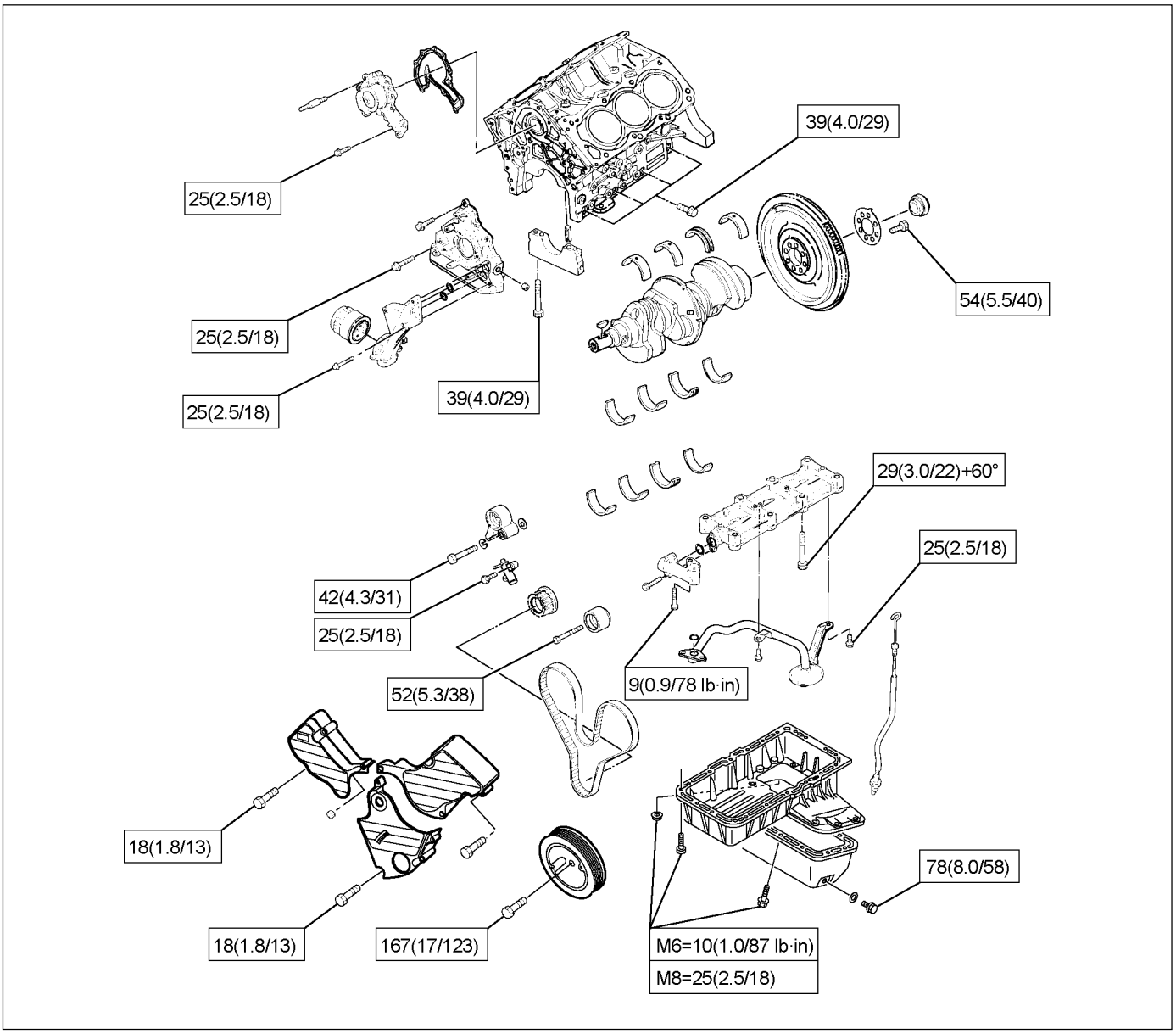
N·m (kg·m/ lb ft)



RTW46ALF000601

Crankshaft main bearing, Flywheel, Crankcase, Oil pan, Timing belt tensioner, Timing pulley, timing belt cover, Oil pump, Oil gallery, Oil strainer and water pump

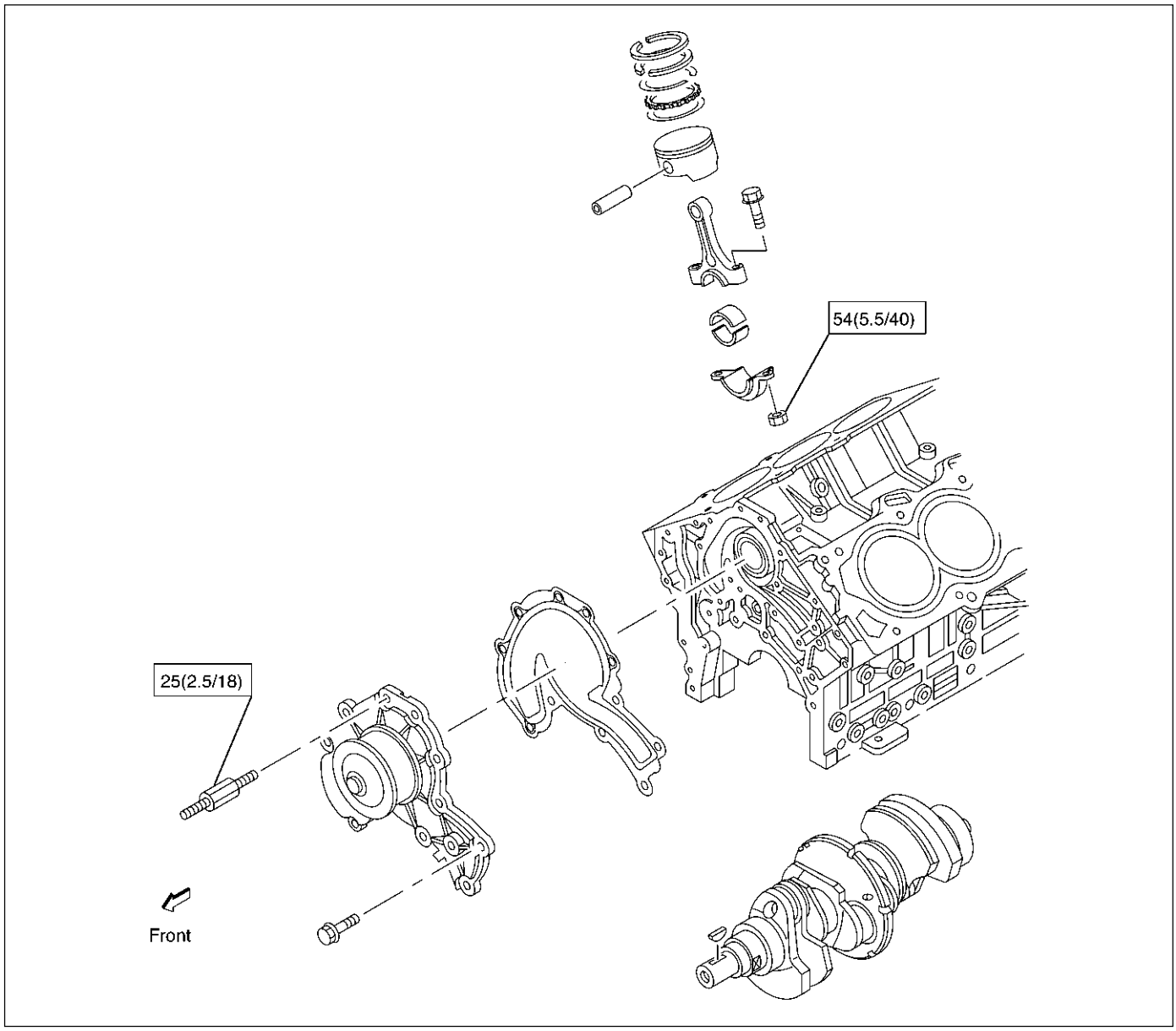
N·m (kg·m/ lb ft)



RTW46ALF000701

Connecting rod and Water pump

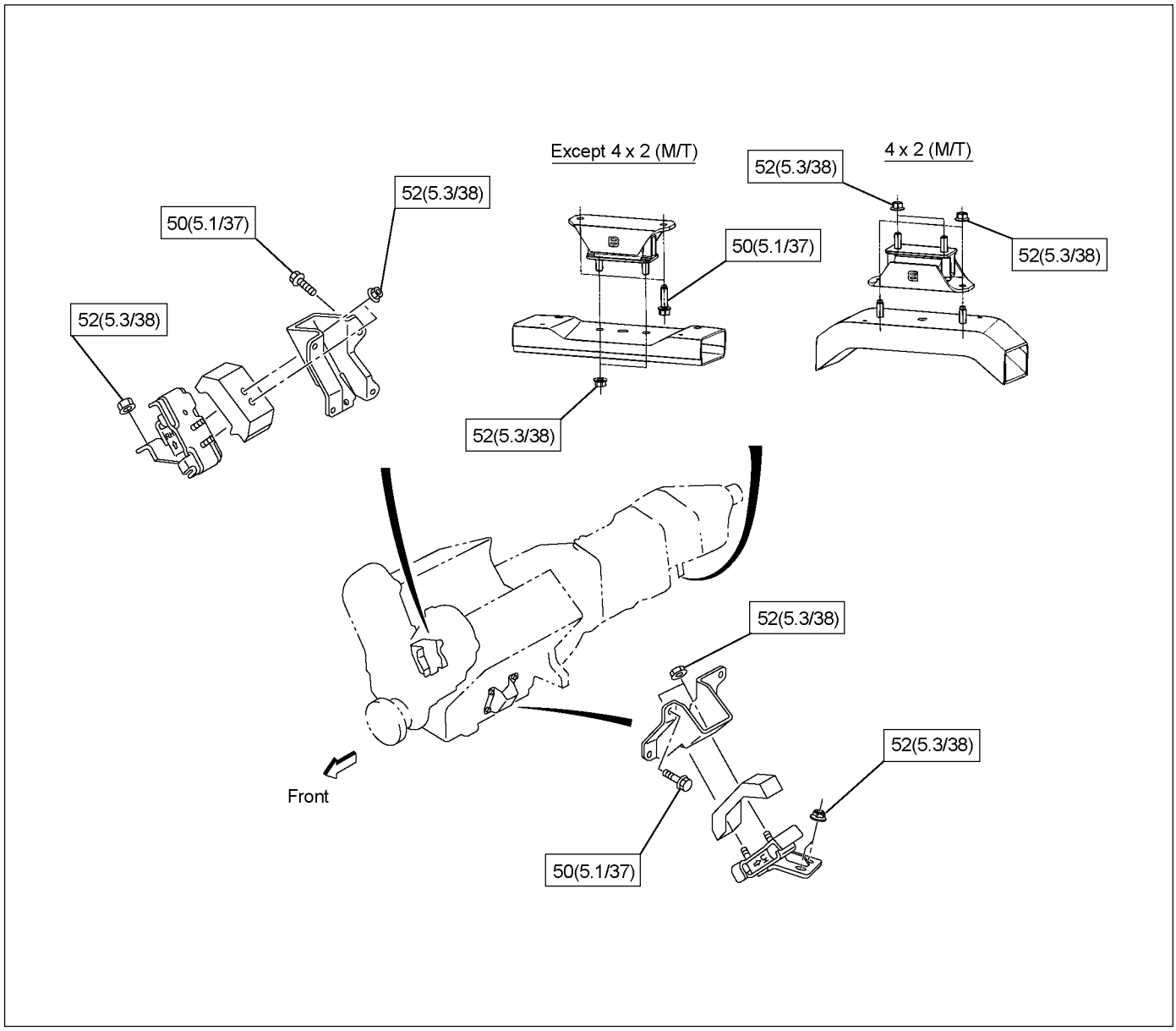
N·m (kg·m/ lb ft)



E06RW042

Engine mount

N·m (kg·m/ lb ft)



RTW36ALF000101

Special Tool

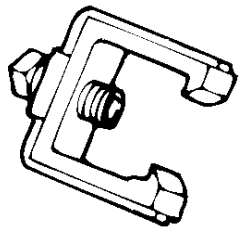
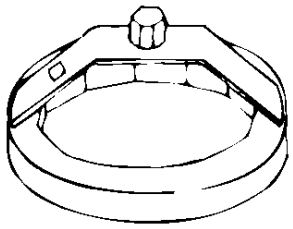
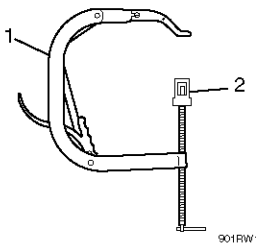
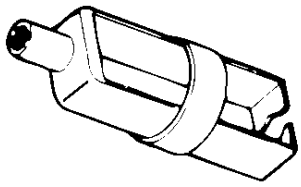
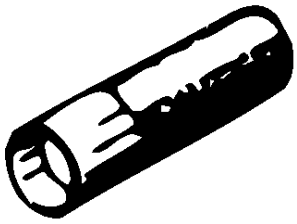
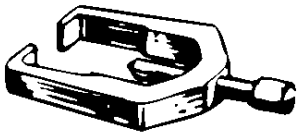
ILLUSTRATION	PART NO. PART NAME
 901RT033	**5-8840-0011-0** **(J-21687-02)** Remover; tie rod end
 901RT034	**5-8840-0203-0** **(J-36390)** Wrench; Oil filter (79ϕ)
 901RW108	**5-8840-2446-0** **(J-8062)** Compressor; Valve spring (1) **5-8840-2547-0** **(J-42898)** Adapter; Compressor, Valve spring (2)
 901RT036	**5-8840-0623-0** **(J-37281)** Remover; Oil controller
 901RT037	**5-8840-0624-0** **(J-38537)** Installer; Oil controller
 901RT038	**5-8840-2005-0** **(J-29107)** Universal pitman arm remover

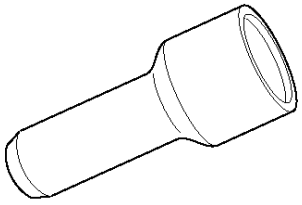
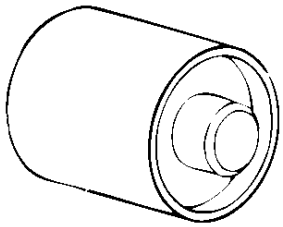
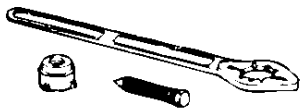
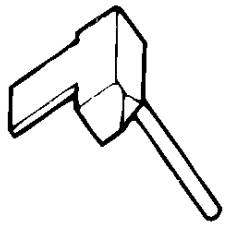
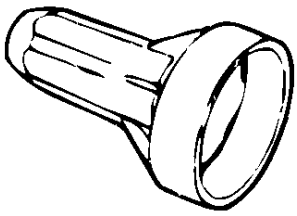
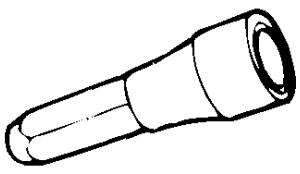
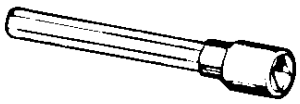
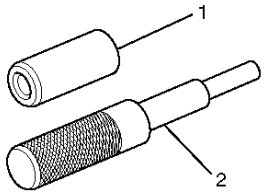
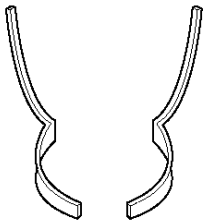
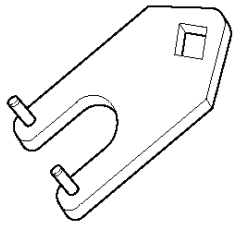
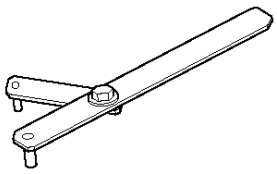
ILLUSTRATION	PART NO. PART NAME
 901RW171	**5-8840-2445-0** **(J-42985)** Installer; Camshaft oil seal
 901RT040	**5-8840-2545-0** **(J-39206)** Installer; Pilot bearing
 901RT041	**5-8840-0133-0** **(J-8614-01)** Holder; Crankshaft
 901RT042	**5-8840-2153-0** **(J-37228)** Seal cutter
 901RT043	**5-8840-2286-0** **(J-39201)** Installer; Real oil seal
 901RT044	**5-8840-2287-0** **(J-39202)** Installer; Oil pump oil seal

ILLUSTRATION	PART NO. PART NAME
 901RT046	**9-8511-4209-0** **(J-24239-1)** Cylinder head bolt wrench
 901RW182	**5-8840-2442-0** **(J-42899)** Replacer; Valve guide (1,2) **5-8840-2548-0** **(J-42687)** Installer; Valve guide (1) **5-8840-2549-0** **(J-37985-1)** Remover; Valve guide (2)
 901RW109	**5-8840-2444-0** **(J-42689)** Adjusting Tool; Valve clearance
 901RW110	**5-8840-2443-0** **(J-42686)** Lever; Gear spring
 901RW115	**5-8840-2447-1** **(J-43041)** Holder; Universal

ENGINE

ENGINE COOLING (6VE1 3.5L)

CONTENTS

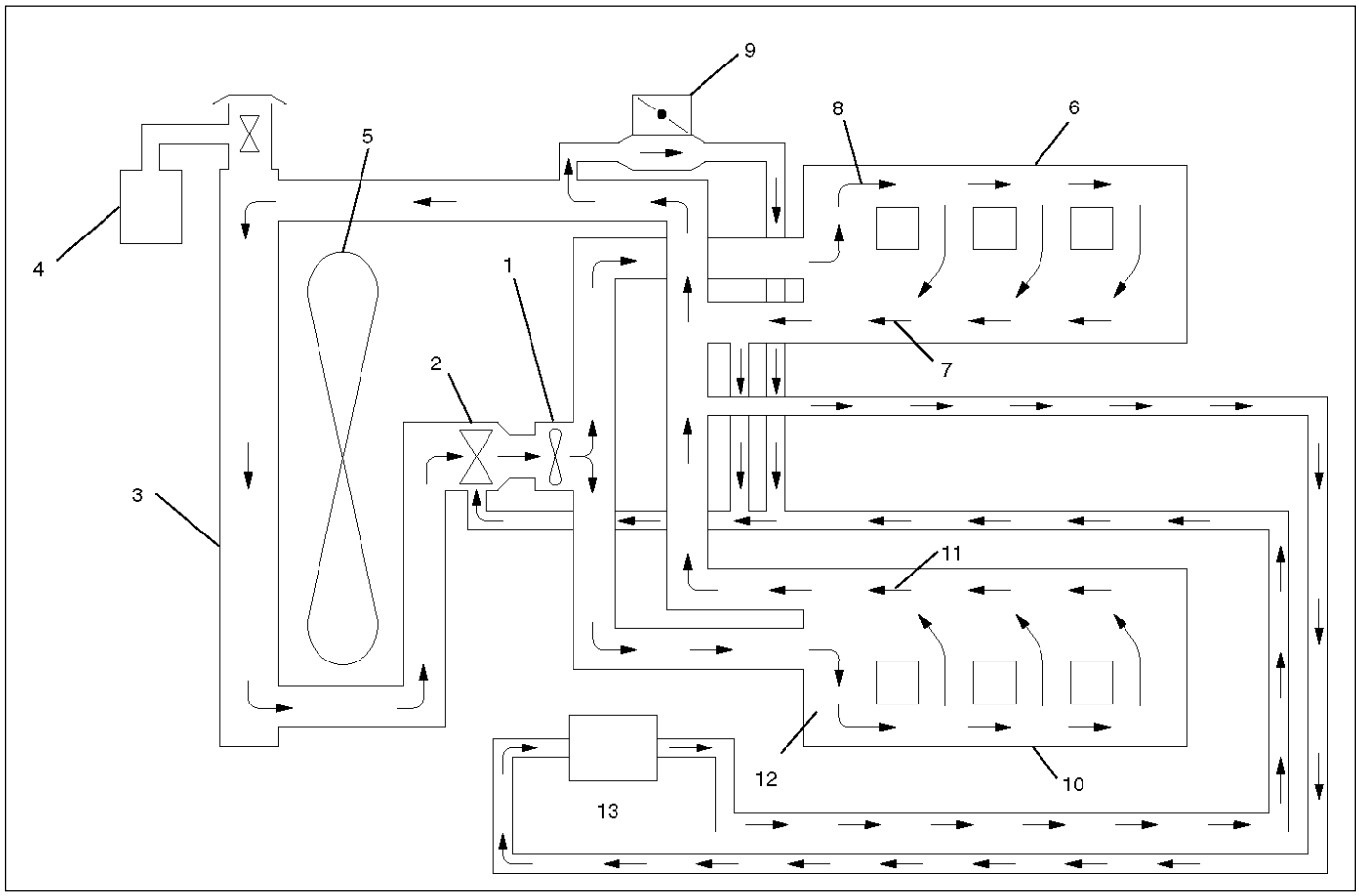
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Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

General Description



030RW001

Legend

(1) Water Pump
(2) Thermostat
(3) Radiator
(4) Reserve Tank
(5) Cooling Fan
(6) Cylinder Block
(7) Cylinder Head
(8) Right Bank
(9) Throttle Body
(10) Cylinder Block
(11) Cylinder Head
(12) Left Bank
(13) Heater

The engine cooling system consists of the radiator, the water pump, the cooling fan, and the thermostat.

To quickly increase cold engine coolant temperature for smooth engine operation, the coolant is circulated by the water pump and thermostat through the bypass hose and back to the cylinder body.

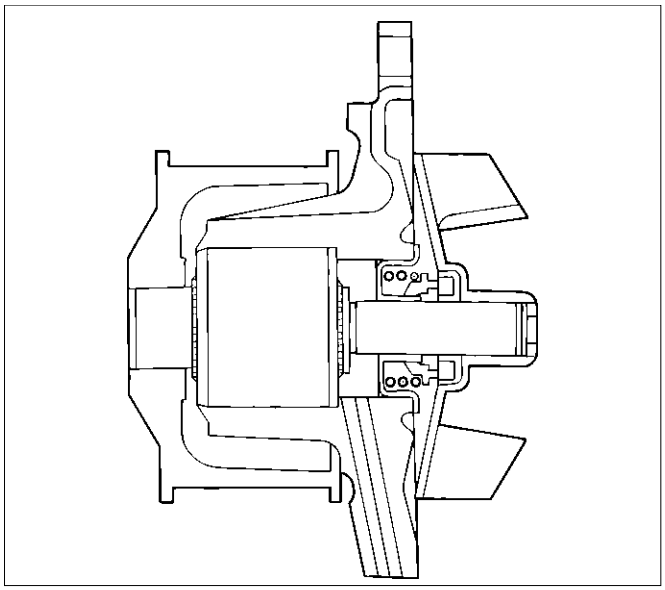
The coolant does not circulate through the radiator.

When the coolant temperature reaches specified value, the thermostat will begin to open and a gradually increasing amount of coolant will circulate through the radiator.

The thermostat will be fully open when the coolant temperature reaches specified value. All of the coolant is now circulating through the radiator for effective engine cooling.

Water Pump

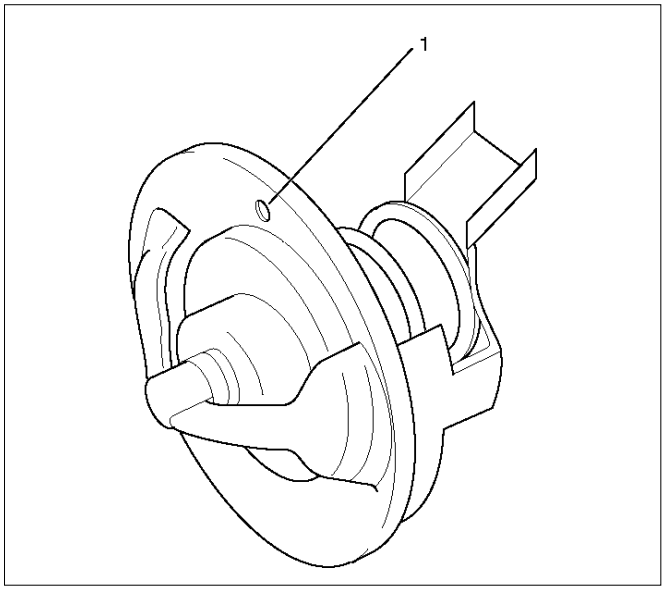
The EC pump is a centrifugal impeller type and is driven by a timing belt.



030RS001

Thermostat

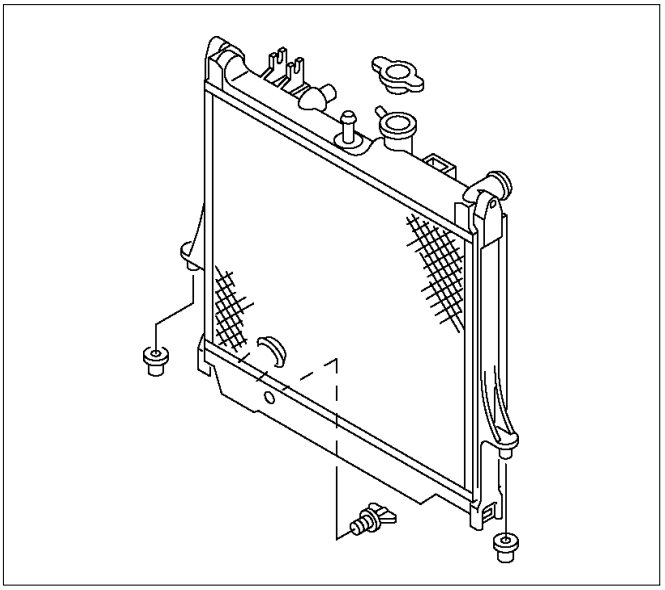
The thermostat is a wax pellet type with a air hole(1) and is installed in the thermostat housing.



031RW002

Radiator

The radiator is a tube type with corrugated fins. In order to raise the boiling point of the coolant, the radiator is fitted with a cap in which the valve is operated at 93.3 ~ 122.7 kPa (13.5 ~ 17.8 psi) pressure. (No oil cooler provided for M/T)



110RS001

Antifreeze Solution

- Calculating mixing ratio

$$\text{Mixing ratio} = \frac{\text{Antifreeze solution (Lit/gal.)}}{\text{Antifreeze solution (Lit/gal.) + Water (Lit/gal.)}}$$

F06RW005

NOTE: Antifreeze solution + Water = Total cooling system capacity.

Total Cooling System Capacity

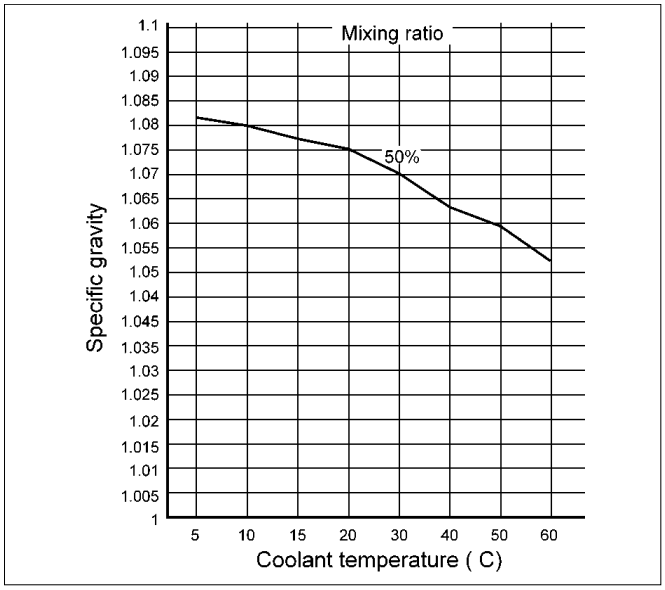
M/T 12.3Lit (13.0Us qt)

A/T 12.2Lit (12.9Us qt)

See section 0B *MAINTENACE AND LUBRICATION*.

- Mixing ratio

NOTE: To maintain the corrosion resistance of the aluminum radiator, water and antifreeze must be combined in a 1:1 solution (50% antifreeze and 50% water).



RTW46BSH000201

Diagnosis

Engine Cooling Trouble

Symptom	Possible Cause	Action
Engine overheating	Low Engine Coolant level	*Replenish*
	Thermo meter unit faulty	*Replace*
	Faulty thermostat	*Replace*
	Faulty Engine Coolant temperature sensor	*Repair or replace*
	Clogged radiator	*Clean or replace*
	Faulty radiator cap	*Replace*
	Low engine oil level or use of improper engine oil	*Replenish or change oil*
	Clogged exhaust system	*Clean exhaust system or replace faulty parts*
	Faulty Throttle Position sensor	*Replace throttle valve assembly*
	Open or shorted Throttle Position sensor circuit	*Repair or replace*
	Damaged cylinder head gasket	*Replace*
Engine overcooling	Faulty thermostat	*Replace*
Engine slow to warm–up	Faulty thermostat	*Replace*
	Thermo unit faulty	*Replace*

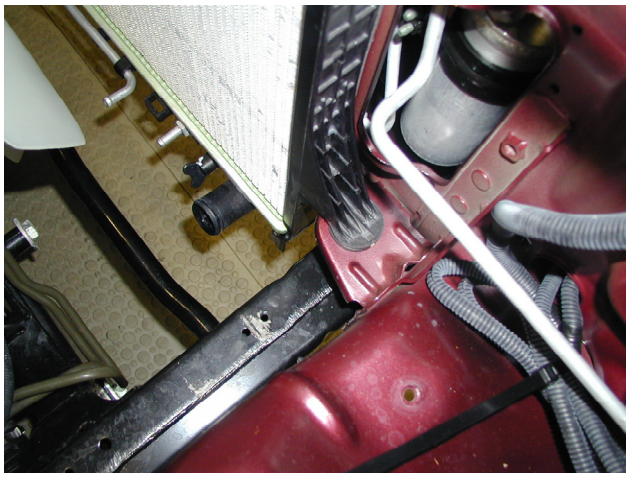
Draining and Refilling Cooling System

Before draining the cooling system, inspect the system and perform any necessary service to ensure that it is clean, does not leak and is in proper working order. The engine coolant (EC) level should be between the “MIN" and “MAX" lines of reserve tank when the engine is cold. If low, check for leakage and add EC up to the “MAX" line.

There should not be any excessive deposit of rust or scales around the radiator cap or radiator filler hole, and the EC should also be free from oil.

Replace the EC if excessively dirty.

1. Completely drain the cooling system by opening the drain plug at the bottom of the radiator.



P1010064

2. Remove the radiator cap.

WARNING: To avoid the danger of being burned, do not remove the cap while the engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure.

3. Disconnect all hoses from the EC reserve tank.
   Scrub and clean the inside of the reserve tank with soap and water. Flush it well with clean water, then drain it. Install the reserve tank and hoses.
4. Refill the cooling system with the EC using a solution that is 50 percent antifreeze.

Procedure for filling with coolant (in case of full change)

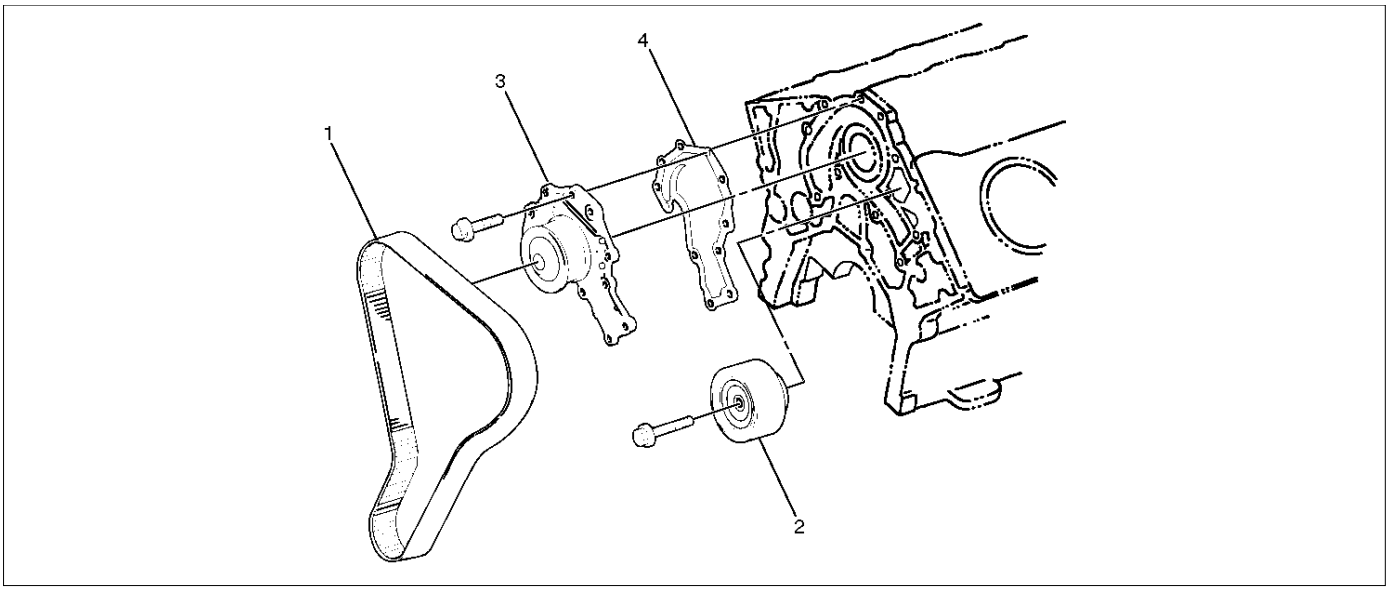
- Make sure that the engine is cool.
- Open radiator cap pour coolant up to filler neck.
- Pour coolant into reservoir tank up to “MAX" line.
- Tighten radiator cap and start the engine. After idling for 2 to 3 minutes, stop the engine and reopen radiator cap. If the water level is lower, replenish.

WARNING: When the coolant is heated to a high temperature, be sure not to loosen or remove the radiator cap. Otherwise you might get scalded by not vapor or boiling water. To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

- After tightening radiator cap, warm up the engine at about 2000 rpm. Set heater adjustment to the highest temperature position, and let the coolant circulate also into heater water system.
- Check to see the thermostat has opened through the needle position of water thermometer, conduct a 5–minute idling again and stop the engine.
- When the engine has been cooled, check filler neck for water level and replenish if required. Should extreme shortage of coolant is found, check the cooling system and reservoir tank hose for leakage.
- Pour coolant into the reservoir tank up to “MAX" line.

Water Pump

Water Pump and Associated Parts



030RS002

Legend

(1) Timing Belt
(2) Idle Pulley
(3) Water Pump Assembly
(4) Gasket

Removal

1. Disconnect battery ground cable.
2. Drain coolant.
3. Radiator hose (on inlet pipe side).
4. Remove timing belt. Refer to “Timing Belt" in this manual.
5. Remove Idle pulley.
6. Remove water pump assembly.
7. Remove gasket.

Inspection

Make necessary repair and parts replacement if extreme wear or damage is found during inspection. Should any of the following problems occur, the entire water pump assembly must be replaced:

- Crack in the water pump body
- EC leakage from the seal unit
- Play or abnormal noise in the bearing
- Cracks or corrosion in the impeller.

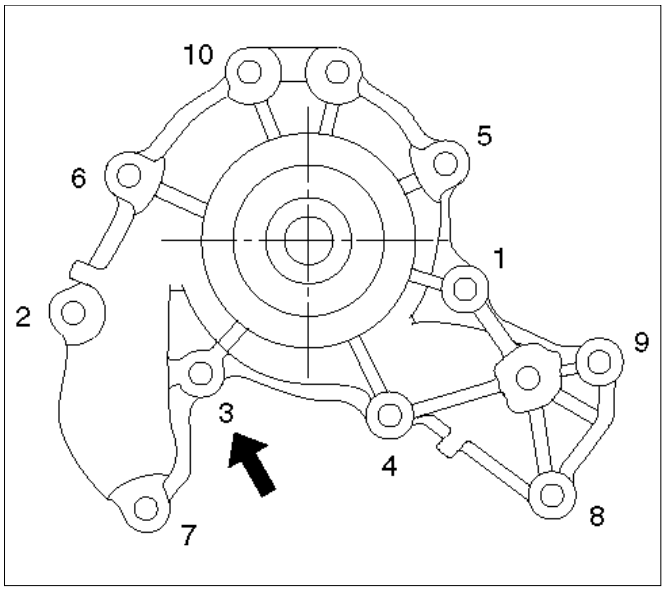
Installation

1. Install gasket, clean the mating surface of gasket before installation.
2. Install water pump assembly and tighten bolts to the specified torque.

Torque: 25 N·m (2.5 kg·m/18 lb ft)

- Tightening order
  The tightening order are in the illustrate.

NOTE: To prevent the oil leakage, apply the LOCTITE 262 or an equivalent, to the arrow marked fixing bolt thread.



030RW008

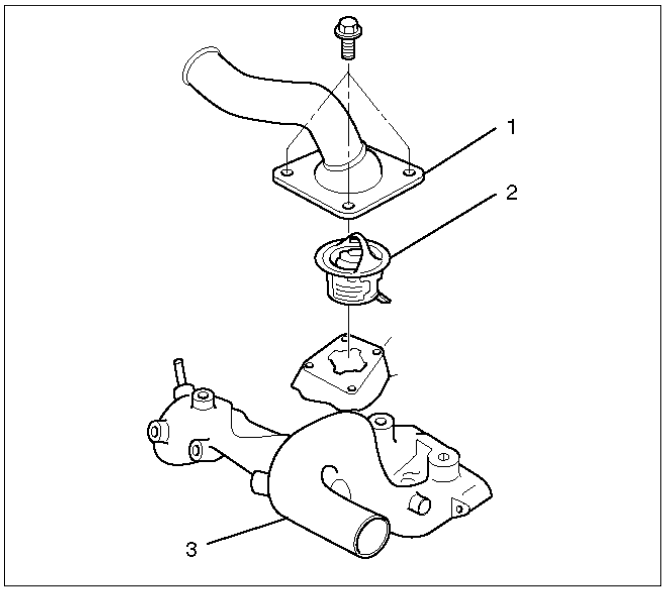
3. Idle pulley
   - Install idle pulley and tighten bolt to the specified torque.

Torque: 52 N·m (5.3 kg·m/38 lb ft)

4. Timing belt
   - Install timing belt. Refer to timing belt installation step in “Timing Belt" in this manual.
5. Connect radiator inlet hose and replenish EC.
6. Connect battery ground cable.

Thermostat

Thermostat and Associated Parts



031RW001

Legend

(1) Thermostat Housing
(2) Thermostat
(3) Outlet Pipe

Removal

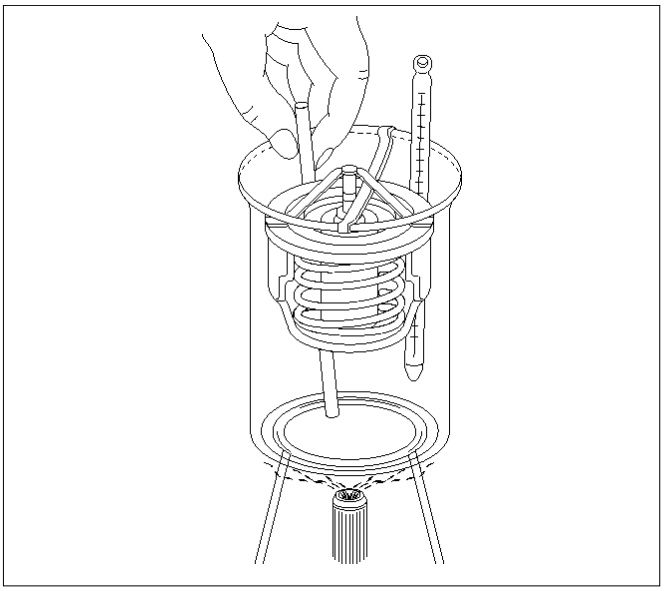
1. Disconnect battery ground cable.
2. Drain engine coolant from the radiator and engine.
3. Disconnect radiator hose from the inlet pipe.
4. Remove thermostat housing.
5. Remove thermostat(2).

Inspection

Suspend the thermostat in a water–filled container using thin wire. Place a thermometer next to the thermostat.

Do not directly heat the thermostat.

Gradually increase the water temperature. Stir the water so that the entire water is same temperature.



031RS003

Confirm the temperature when the valve first begins to open.

Valve opening temperature 74.5°C ~ 78.5°C (166.1°F ~ 173.3°F)

Confirm the temperature when the valve is fully opened.

Valve full open temperature and lift More than 8.5mm (0.33 in) at 90°C (194°F)

Make necessary repair and parts replacement if extreme wear or damage is found during inspection.

Installation

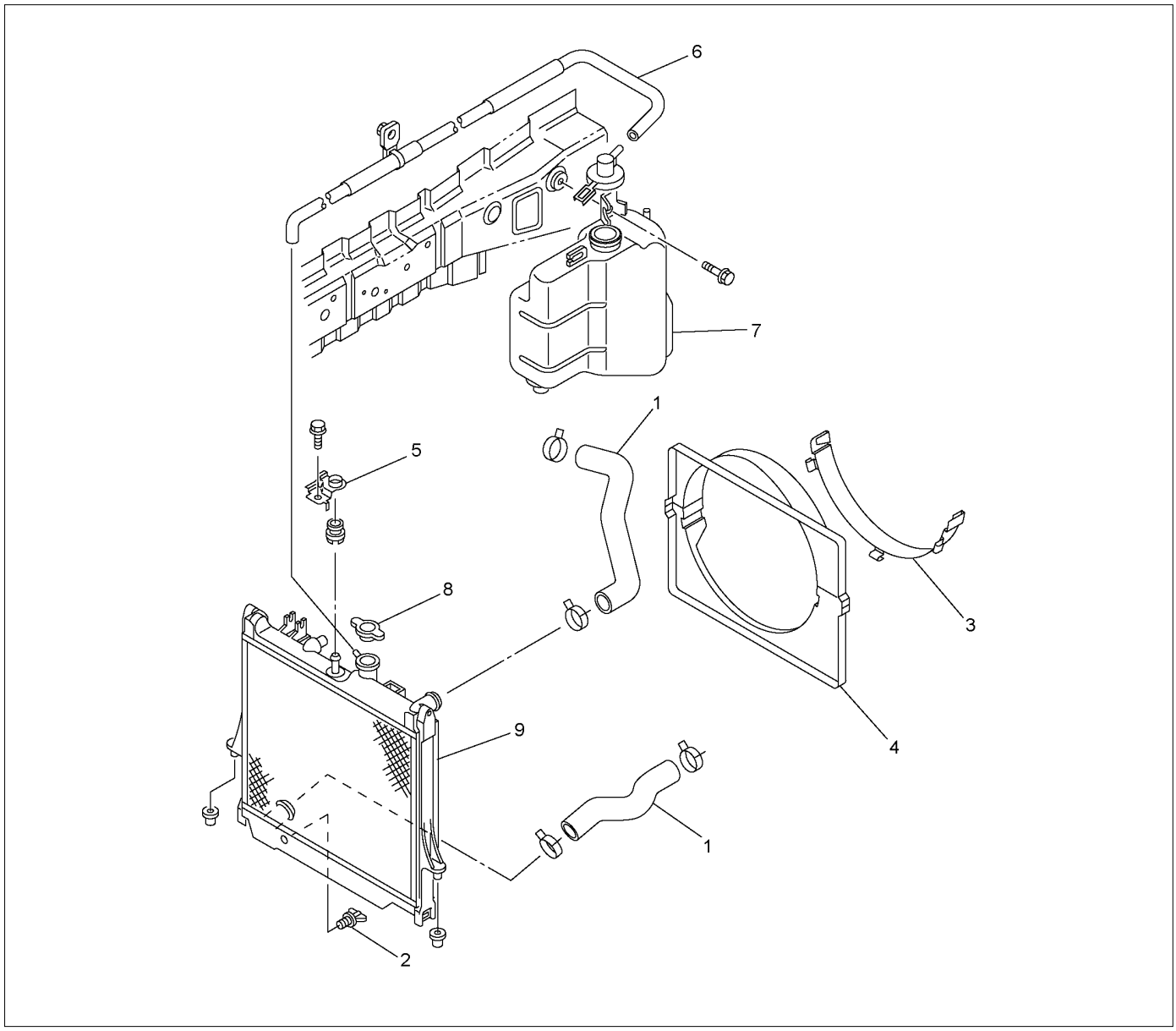
1. Install thermostat into the outlet pipe(4) making sure that the air hole is in the up position.
2. Install thermostat housing and tighten bolts to the specified torque.

Torque: 25 N·m (2.5 kg·m/18 lb ft)

3. Installation rubber hose.
4. Replenish engine coolant (EC).
5. Start engine and check for EC leakage.

Radiator

Radiator and Associated Parts



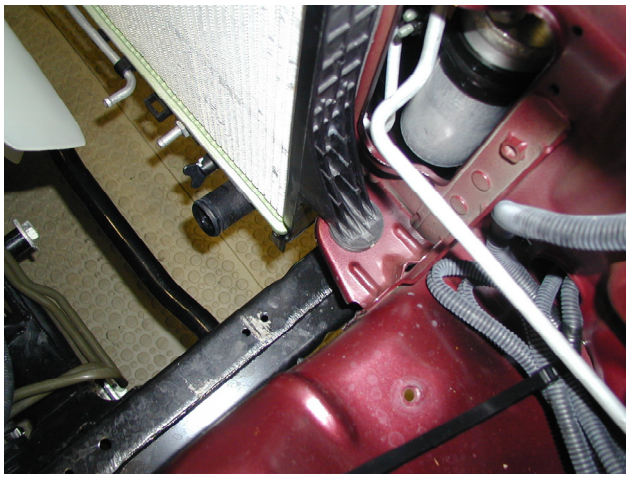
RTW36BLF000101

Legend

(1) Radiator Hose
(2) Drain Plug
(3) Fan Guide, Lower
(4) Fan Guide
(5) Bracket
(6) Reserve Tank Hose
(7) Reserve Tank
(8) Radiator Cap
(9) Radiator Assembly

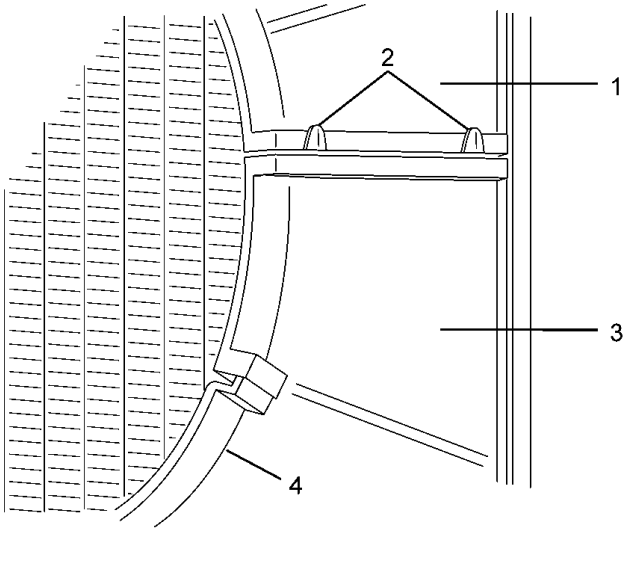
Removal

1. Disconnect battery ground cable.
2. Loosen a drain plug to drain EC.
3. Disconnect oil cooler hose on automatic transmission (A/T).
4. Disconnect radiator inlet hose and outlet hose from the engine.



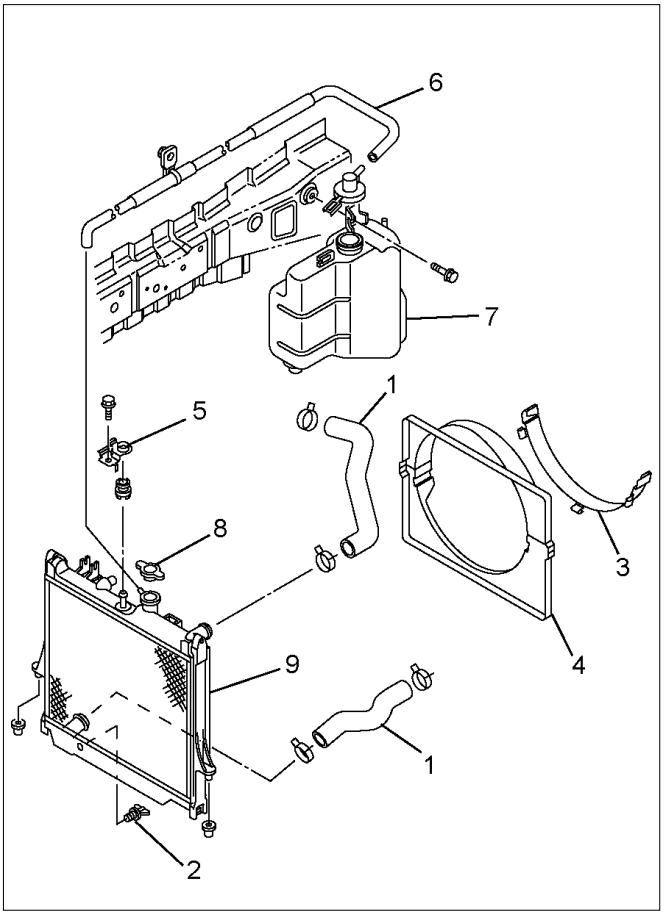
P1010064

5. Remove fan guide(1), clips(2) on both sides and the bottom lock, then remove lower fan guide(3) with fan shroud(4).



RTW46BSH000101

6. Disconnect the reserve tank hose(6) from radiator.
7. Remove bracket(5).



110RW004

8. Lift up and remove the radiator assembly with hose, taking care not to damage the radiator core with a fan blade.

Inspection

Radiator Cap

Measure the valve opening pressure of the pressurizing valve with a radiator filler cap tester.

Replace the cap if the valve opening pressure is outside the standard range.

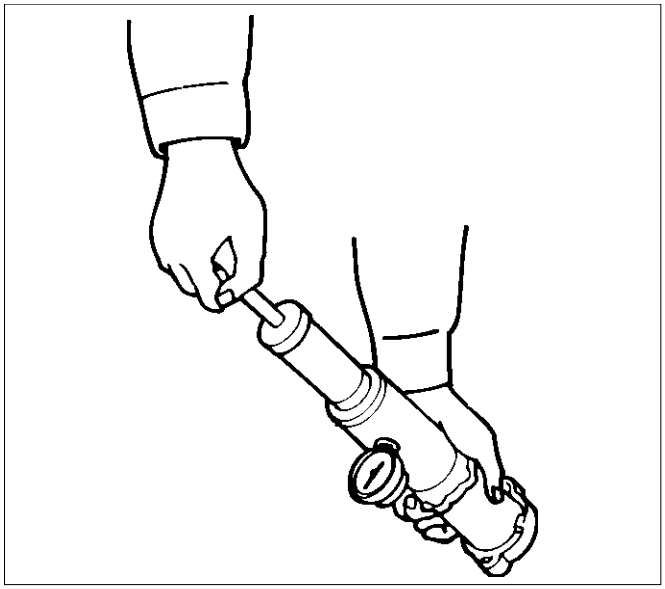
Valve opening pressure kPa (psi) 93.3 ~ 122.7 (13.5 ~17.8)

Cap tester: 5–8840–0277–0

Adapter: 5–8840–2603–0

Check the condition of the vacuum valve in the center of the valve seat side of the cap. If considerable rust or dirt is found, or if the valve seat cannot be moved by hand, clean or replace the cap.

Valve opening vacuum kPa (psi) 1.96 ~ 4.91 (0.28 ~ 0.71)



110RS006

Radiator Core

1. A bent fin may result in reduced ventilation and overheating may occur. All bent fins must be straightened. Pay close attention to the base of the fin when it is being straightened.
2. Remove all dust, bugs and other foreign material.

Flushing the Radiator

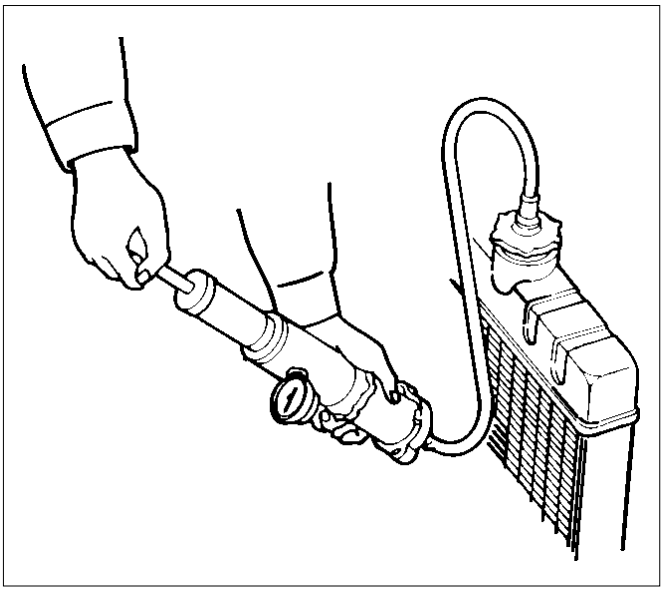
Thoroughly wash the inside of the radiator and the engine coolant passages with cold water and mild detergent. Remove all signs of scale and rust.

Cooling System Leakage Check

Use a radiator cap tester to force air into the radiator through the filler neck at the specified pressure of 196 kPa (28.5 psi) with a cap tester:

- Leakage from the radiator
- Leakage from the coolant pump
- Leakage from the water hoses
- Check the rubber hoses for swelling.

Cap tester: 5–8840–0277–0
Adapter: 5–8840–2603–0

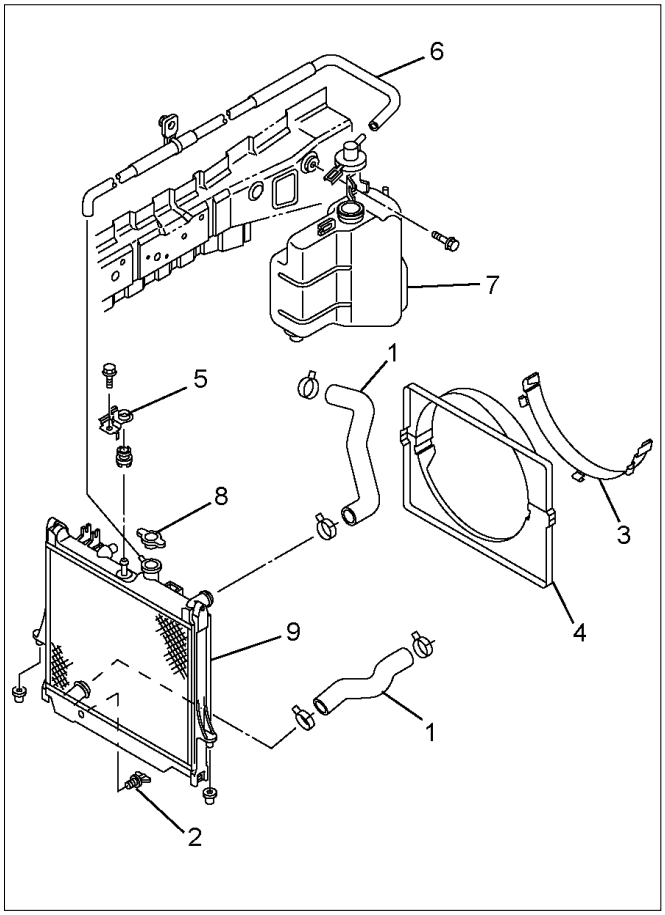


110RS005

Installation

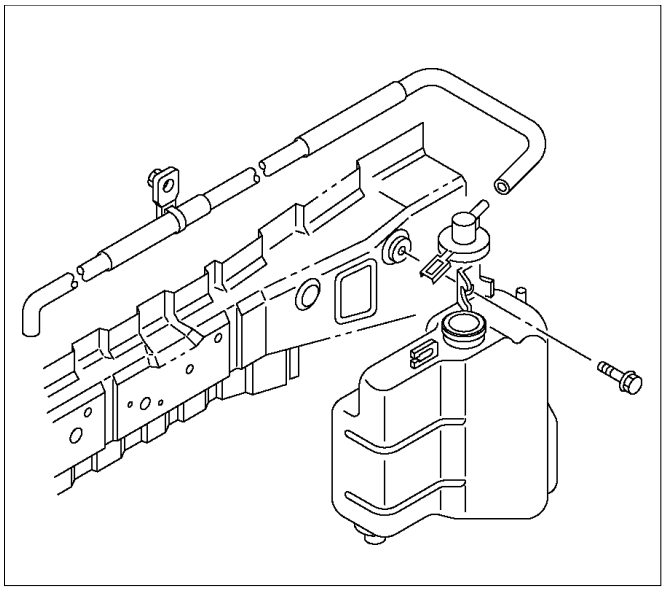
1. Install radiator assembly (9) with hose, taking care not to damage the radiator core with a fan blade.
2. Support the radiator upper tank with the bracket (5) and secure the radiator.
3. Connect reserve tank hose (6).
4. Install lower fan guide (3).
5. Connect radiator inlet hose and outlet hose (1) to the engine.

6. Connect oil cooler hose to automatic transmission.



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7. Connect battery ground cable.
8. Pour engine coolant up to filler neck of radiator, and up to MAX mark of reserve tank.



RTW36BSH000101

Important operation (in case of 100% engine coolant change) procedure for filling with engine coolant.

Engine coolant change

1. To change engine coolant, make sure that the engine is cool.

WARNING: When the coolant is heated to a high temperature, be sure not to loosen or remove the radiator cap. Otherwise you might get scalded by hot vapor or boiling water. To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

2. Open radiator cap and drain the cooling system by loosening the drain valve on the radiator and on the cylinder body.

NOTE: For best result it is suggested that the engine cooling system be flushed at least once a year. It is advisable to flash the interior of the cooling system including the radiator before using anti-freeze (ethylene-glycol based).

Replace damaged rubber hoses as the engine anti-freeze coolant is liable to leak out even minor cracks.

Isuzu recommends to use Isuzu genuine anti-freeze (ethylen-glycol based) or equivalent, for the cooling system and not add any inhibitors or additives.

CAUTION: A failure to correctly fill the engine cooling system in changing or topping up coolant may sometimes cause the coolant to overflow from the filler neck even before the engine and radiator are completely full.

If the engine runs under this condition, shortage of coolant may possibly result in engine overheating. To avoid such trouble, the following precautions should be taken in filling the system.

3. To refill engine coolant, pour coolant up to filler neck using a filling hose which is smaller in outside diameter of the filler neck. Otherwise air between the filler neck and the filling hose will block entry, preventing the system from completely filling up.
4. Keep a filling rate of 9 liter/min. or less. Filling over this maximum rate may force air inside the engine and radiator.

   And also, the coolant overflow will increase, making it difficult to determine whether or not the system is completely full.
5. After filling the system to the full, pull out the filling hose and check to see if air trapped in the system is disclodged and the coolant level goes down. Should the coolant level go down, repeat topping-up until there is no more drop in the coolant level.

6. After directly filling the radiator, fill the reservoir to the maximum level.
7. Install and tighten radiator cap and start the engine. After idling for 2 to 3 minutes, stop the engine and reopen radiator cap. If the water level is lower, replenish.

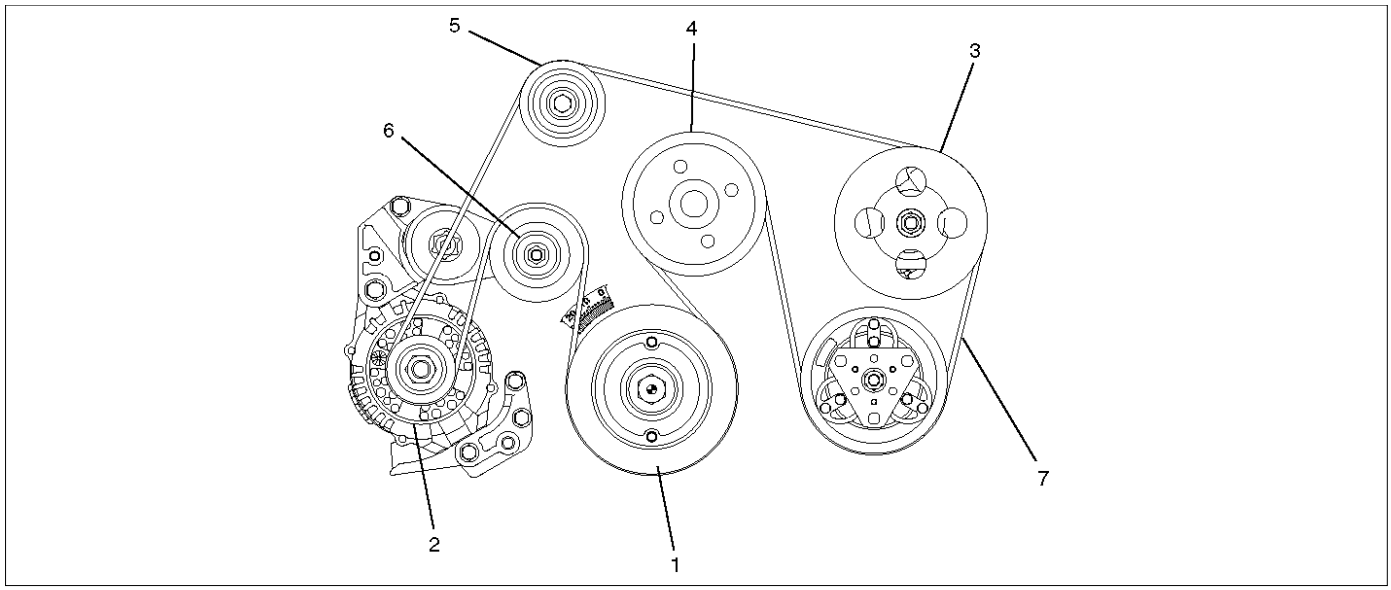
WARNING: When the coolant is heated to a high temperature, be sure not to loosen or remove the radiator cap. Otherwise you might get scalded by hot vapor or boiling water. To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

8. After tightening radiator cap, warm up the engine at about 2,000 rpm.

   Set heater adjustment to the highest temperature position, and let the coolant circulate also into heater water system.
9. Check to see the thermostat has opened through the needle position of water thermometer, conduct a 5-minute idling again and stop the engine.
10. When the engine has been cooled, check filler neck for water level and replenish if required. Should extreme shortage of coolant is found, check the coolant system and reservoir tank hose for leakage.
11. Fill the coolant into the reservoir tank up to “MAX" line.

Drive Belt and Cooling Fan

Drive Belt and Associated Parts



015RW005

Legend

(1) Crankshaft Pulley
(2) Generator
(3) Power Steering Pump
(4) Water Pump and Cooling Fan Pulley
(5) Idle Pulley
(6) Tension Pulley
(7) Drive Belt

The drive belt adjustment is not required as automatic drive belt tensioner is equipped.

Inspection

Check drive belt for wear or damage, and replace with a new one as necessary.

Installation

Install cooling fan assembly and tighten bolts/nuts to the specified torque.

Torque : 25 N·m (2.5 kg·m/18 lb ft) for fan pulley and fan bracket.

Torque : 10 N·m (1.0 kg·m/7 lb ft) for fan and clutch assembly.

NOTE: Fan belts for 6VE1 Gasoline Engine mounted on 98MY (UX) have been brought into one. As a result, the rotating direction of a fan belt is opposite to the direction of cooling fan for 92 to 97MY 6VD1 with no interchangeability.

Therefore, incorrect installation of a fan may cause the air for cooling to flow in the opposite direction, this resulting in the poor performance of the air-conditioner and a rise temperature in engine cooling water.

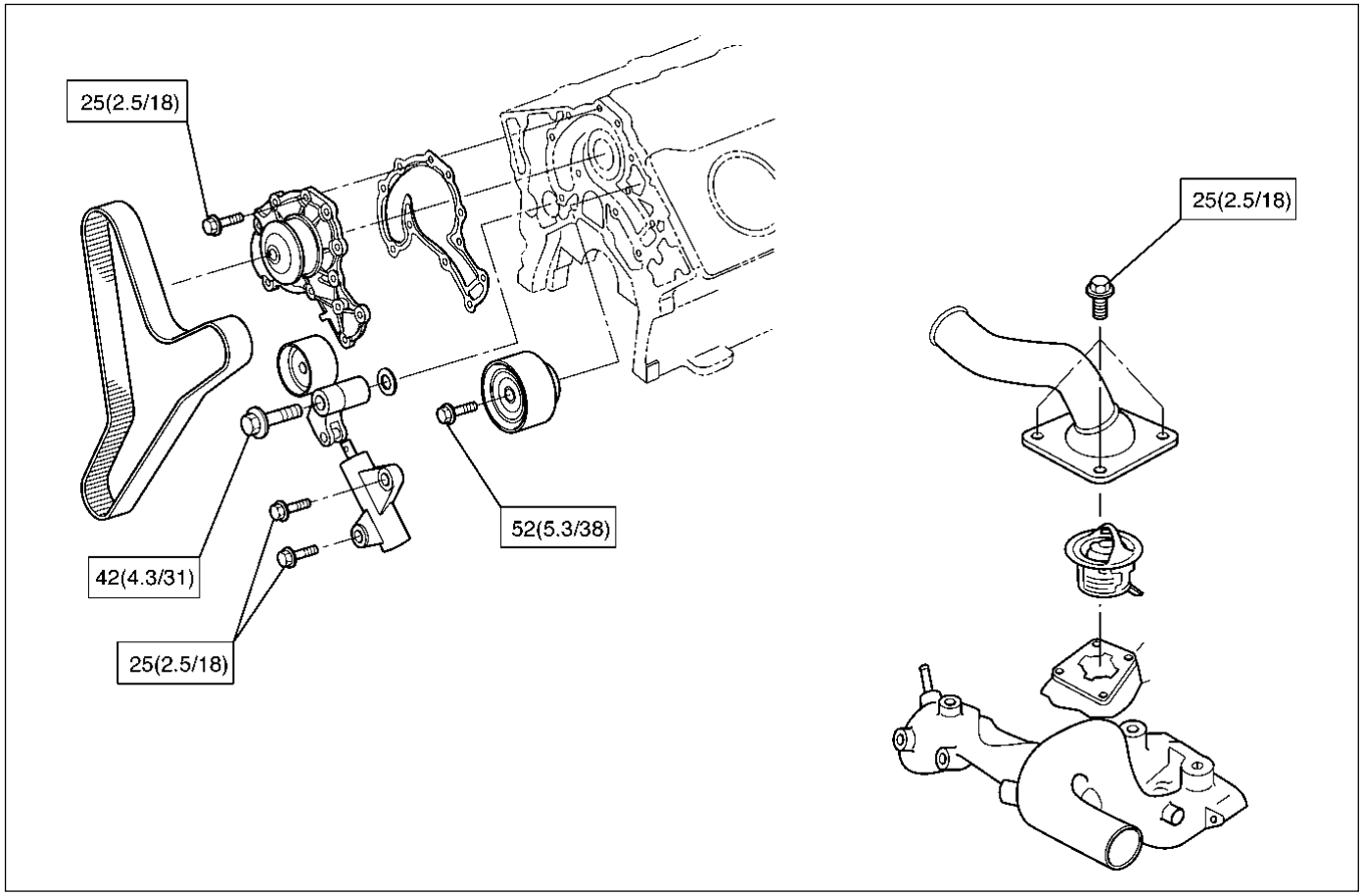
Main Data and Specifications

General Specifications

	M/T	A/T
Cooling system	Engine coolant forced circulation	
Radiator	Tube type corrugated	
Heat radiation capacity	81.4 kw (70.004 kcal/h)	
Heat radiation area	9.42m^2 (0.875ft^2)	
Radiator front area	0.28m^2 (0.026ft^2)	
Radiator dry weight	5.0kg (11.0lb)	5.2kg (11.4lb)
Radiator cap valve opening pressure	93.3 ~ 122.7kpa (13.5 ~ 17.8psi)	
Engine coolant pump	Centrifugal impeller type	
Delivery	300 (317) or more	
Pump speed	5000 ± 50 rpm	
Thermostat	Wax pellet type with air hole	
Valve opening temperature	74.5 ~ 78.5°C (166.1 ~ 173.3°F)	
Engine coolant total capacity	12.3lit (13.0U.S qt)	12.2lit (12.9U.S qt)

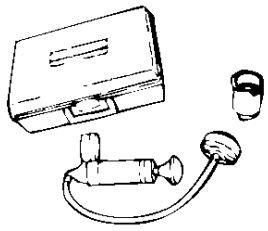
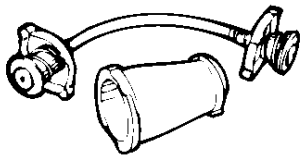
Torque Specifications

N·m (kg·m/ lb ft)



E06RW041

Special Tools

ILLUSTRATION	PART NO. PART NAME
 901RW072	**5–8840–277–0** **(J–24460–01)** Tester; radiator cap
 901RW073	**5-8840-2603-0** **(J–33984–A)** Adapter; radiator cap

ENGINE

ENGINE FUEL (6VE1 3.5L)

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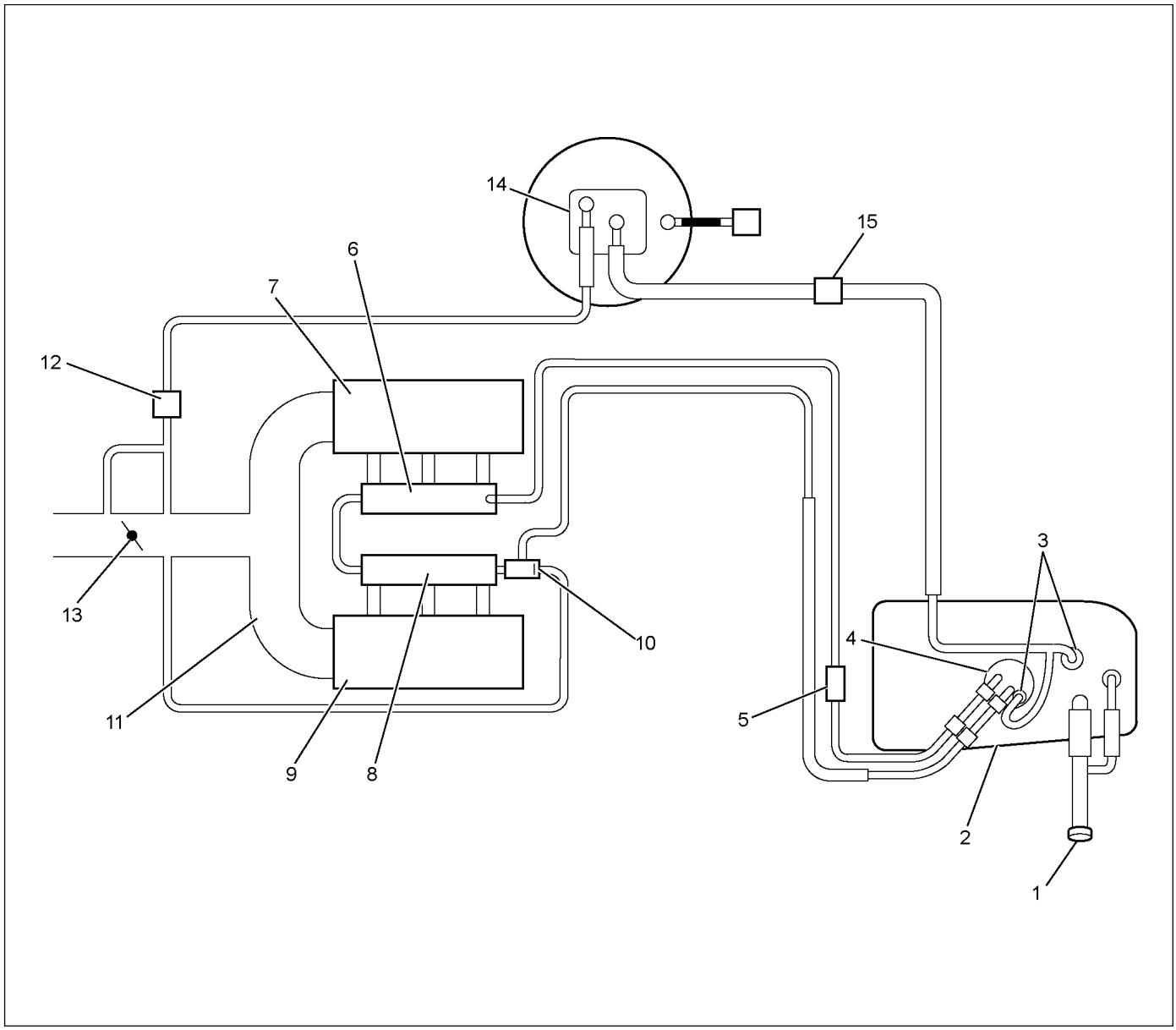
Service Precaution

When working on the fuel system, there are several things to keep in mind:

- **Any time the fuel system is being worked on, disconnect the negative battery cable except for those tests where battery voltage is required.**
- **Always keep a dry chemical (Class B) fire extinguisher near the work area.**
- **Replace all pipes with the same pipe and fittings that were removed.**
- **Clean and inspect “O" rings. Replace if required.**
- **Always relieve the line pressure before servicing any fuel system components.**
- **Do not attempt repairs on the fuel system until you have read the instructions and checked the pictures relating to that repair.**
- **Adhere to all Notices and Cautions.**

All gasoline engines are designed to use only unleaded gasoline. Unleaded gasoline must be used for proper emission control system operation. Its use will also minimize spark plug fouling and extend engine oil life. Using leaded gasoline can damage the emission control system and could result in loss of emission warranty coverage. All cars are equipped with an Evaporative Emission Control System. The purpose of the system is to minimize the escape of fuel vapors to the atmosphere.

General Description



RTW36CLF000301

Legend

(1) Fuel Filler Cap
(2) Fuel Tank
(3) Rollover Valve
(4) Fuel Pump and Sender Assembly
(5) Fuel Filter
(6) Fuel Rail Right
(7) Intake Air Port Right Bank
(8) Fuel Rail Left
(9) Intake Air Port Left Bank
(10) Fuel Pressure Control Valve
(11) Common Chamber
(12) Duty Solenoid Valve
(13) Throttle Valve
(14) Canister
(15) Evapo Control Valve

Fuel Metering

The Engine Control Module (ECM) is in complete control of this fuel delivery system during normal driving conditions.

The intake manifold function, like that of a diesel, is used only to let air into the engine. The fuel is injected by separate injectors that are mounted over the intake manifold.

The Barometric Pressure (BARO) sensor measures the changes in the barometric pressure which result from engine load and speed changes, which the BARO sensor converts to a voltage output.

This sensor generates the voltage to change corresponding to the flow of the air drawn into the engine.

The changing voltage is transformed into an electric signal and provided to the ECM.

With receipt of the signals sent from the BARO sensor, Intake Air Temperature sensor and others, the ECM determines an appropriate fuel injection pulse width feeding such information to the fuel injector valves to effect an appropriate air/fuel ratio.

The Multiport Fuel Injection system utilizes an injection system where the injectors turn on at every crankshaft revolution. The ECM controls the injector on time so that the correct amount of fuel is metered depending on driving conditions.

Two interchangeable “O" rings are used on the injector that must be replaced when the injectors are removed.

The fuel rail is attached to the top of the intake manifold and supplies fuel to all the injectors.

Fuel is recirculated through the rail continually while the engine is running. This removes air and vapors from the fuel as well as keeping the fuel cool during hot weather operation.

The fuel pressure control valve that is mounted on the fuel rail maintains a pressure differential across the injectors under all operating conditions. It is accomplished by controlling the amount of fuel that is recirculated back to the fuel tank based on engine demand.

See Section “Driveability and Emission" for more information and diagnosis.

Fuel Filter

Removal

CAUTION: When repair to the fuel system has been completed, start engine and check the fuel system for loose connection or leakage. For the fuel system diagnosis, see Section "Driveability and Emission".

1. Disconnect the battery ground cable.
2. Loosen slowly the fuel filler cap.

NOTE: To prevent spouting out fuel to change the pressure in the fuel tank.

NOTE: Cover opening of the filler neck to prevent any dust entering.

3. Disconnect the quick connector into the fuel tube from the fuel filter.

NOTE: Cover the quick connector to prevent any dust entering and fuel leaking.

NOTE: Refer to "Fuel Tube/Quick Connector Fittings" in this section when performing any repairs.

4. Pull off fuel filter from holder to side member side.

Inspection

1. Replace the fuel filter if the fuel leaks from fuel filter body or if the fuel filter body itself is damaged.
2. Replace the filter if it is clogged with dirt or sediment.

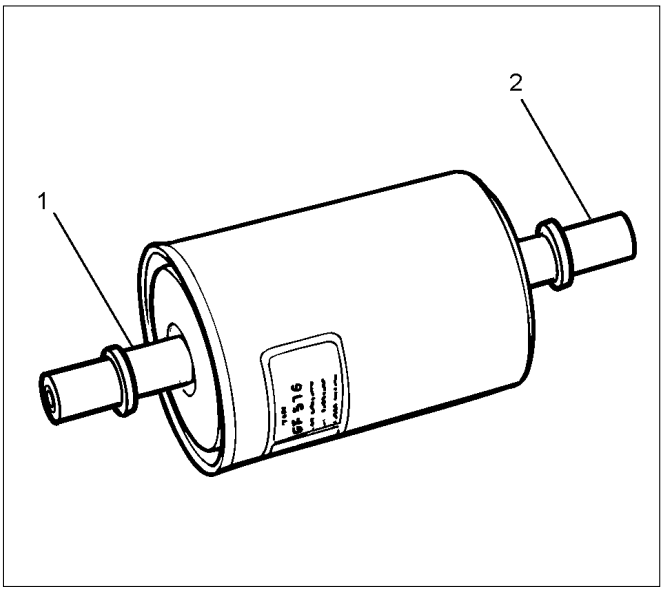
Installation

1. Install the filter to holder from side member side.

NOTE: Attend direction of fuel filter. (1) to engine side (2) to fuel tank side.

NOTE: Verify to hang holder hook to fuel filter.

NOTE: Verify to hang holder hook to fuel filter.



RTW36CSH000301

2. Connect the quick connector from the fuel tube to the fuel filter.

NOTE: Pull of the left checker into the fuel pipe.

NOTE: Refer to "Fuel Tube/Quick Connector Fittings" in this section when performing any repairs.

3. Tighten fuel filler cap until at least one click are heard.
4. Connect the battery ground cable.

Inspection

After installation, start engine and check for fuel leakage.

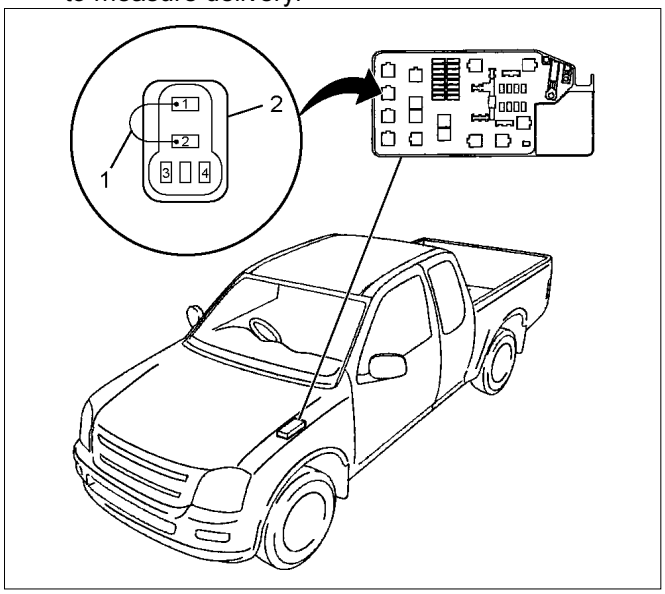
In–Tank Fuel Filter

The filter is located on the lower end of fuel pickup tube in the fuel tank. It prevents dirt from entering the fuel pipe and also stops water unless the filter is completely submerged in the water. It is a selfcleaning type, not requiring scheduled maintenance. Excess water and sediment in the tank restricts fuel supply to the engine, resulting in engine stoppage. In such a case, the tank must be cleaned thoroughly.

Fuel Pump Flow Test

If reduction of fuel supply is suspected, perform the following checks.

1. Make sure that there is fuel in the tank.
2. With the engine running, check the fuel feed pipe and hose from fuel tank to injector for evidence of leakage. Retighten, if pipe or hose connection is loose. Also, check pipes and hoses for squashing or clogging.
3. Insert the hose from fuel feed pipe into a clean container, and check for fuel pump flow rate.
4. Connect the pump relay terminals (2) with a jumper wire (1) as shown and start the fuel pump to measure delivery.



RTW36CSH000201

CAUTION: Never generate sparks when connecting a jumper wire.

Delivery	Delivery
15 seconds	0.38 liters minimum

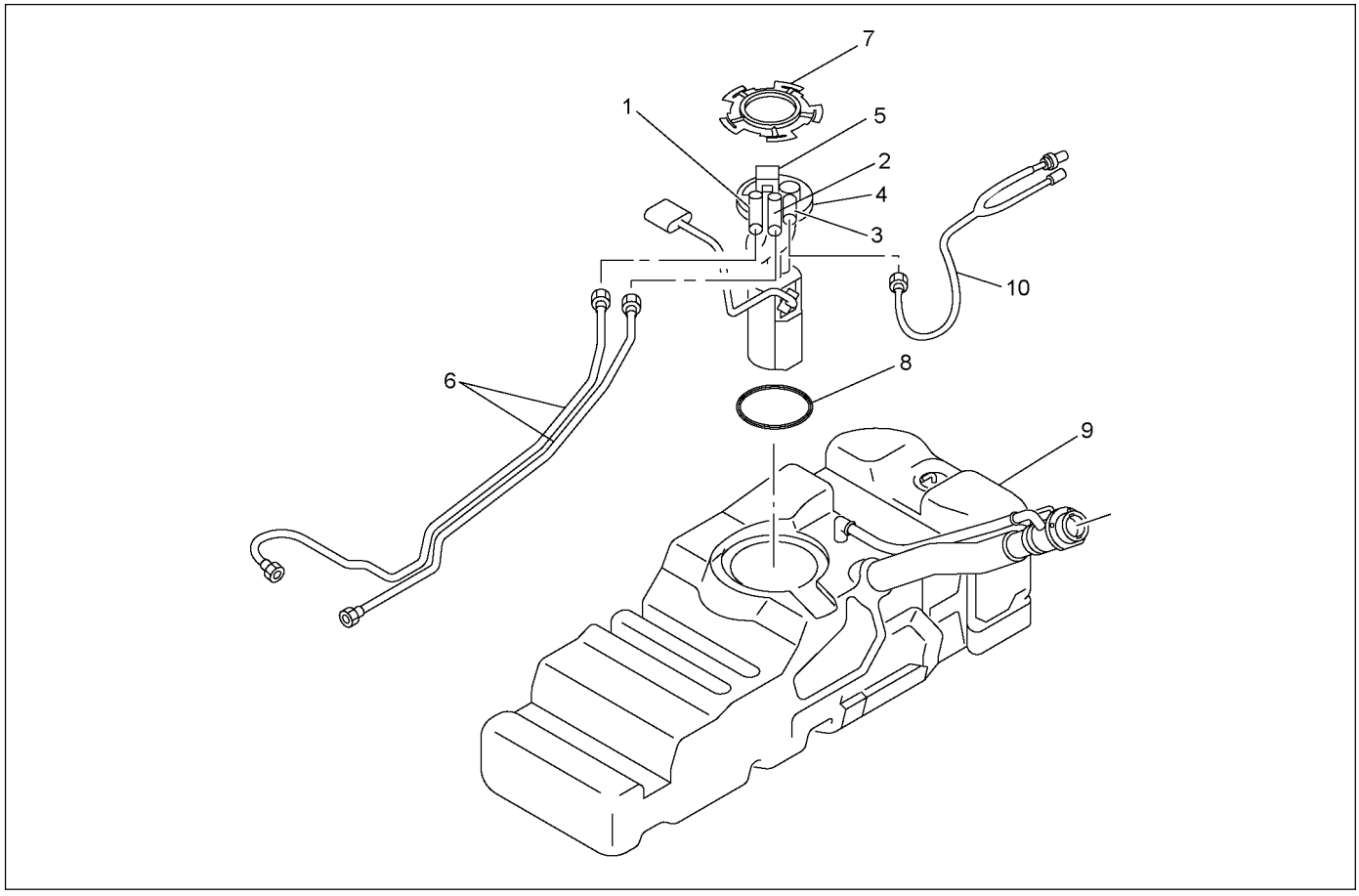
If the measure value is out of standard, conduct the pressure test.

Pressure test

For the pressure test to the fuel system, see Section 6E “Fuel Control System".

Fuel Pump

Fuel Pump and Associated Parts



RTW46FMF000401

Legend

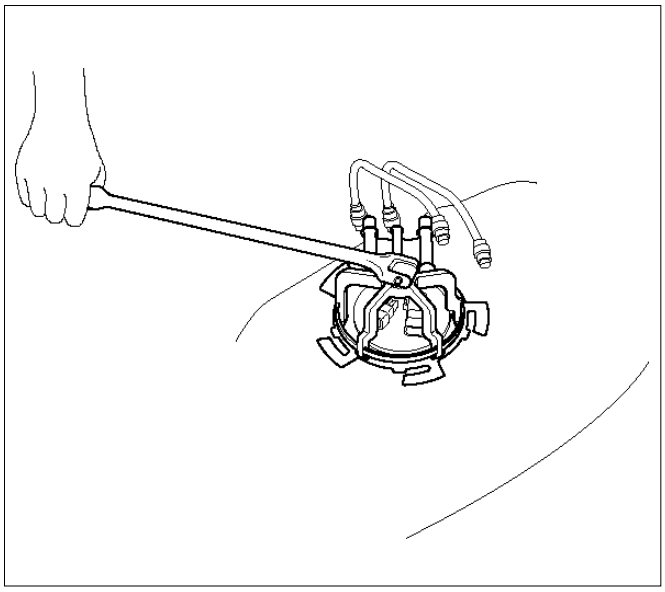
(1) Fuel Feed Port
(2) Fuel Return Port
(3) Fuel Emission Port
(4) Fuel Pump and Sender Assembly
(5) Connector; Fuel Feed Pump & Sender
(6) Fuel Tube/Quick Connector
(7) Retainer Ring (Fuel Pump Lock)
(8) Seal; Fuel Pump
(9) Fuel Tank Assembly
(10) Evapo Tube/Quick Connector

Removal

CAUTION: When repair to the fuel system has been completed, start engine and check the fuel system for loose connection or leakage. For the fuel system diagnosis, see Section “Driveability and Emission".

1. Remove fuel tank assembly (9). Refer to “Fuel Tank Removal" in this section.
2. Disconnect the quick connector (6) into the fuel tube from fuel pump.
3. Disconnect the quick connector (10) into the evapo tube from fuel pump.

3. Remove the retainer ring (7) from the fuel tank with the removal tool 5-8840-2602-0.



140R100035

4. Remove slowly the fuel pump (4) from the fuel tank as no bend float arm.

NOTE: Cover opening for the fuel pump on fuel tank to prevent any dust enthering.

5. Discard fuel pump seal (8) because it cannot be reusable.

Installation

1. Clean the seal surface of the fuel tank and the fuel pump.

NOTE: If there is dust on the seal surface, it becomes cause of fuel leak.

2. Install the new fuel pump seal (8) to opening of the fuel tank as along the groove.
3. Install slowly the fuel pump (4) into the fuel tank as no bend float arm.
4. Set flange of the fuel pump on fuel pump seal as mating convexity of the fuel pump and reentrant of the fuel tank.
5. Lock slowly the retainer ring (7) to the fuel tank with the remover tool 5-8840-2602-0.
6. Connect the quick connector (10) into the evapo tube to fuel pump.
7. Connect the quick connector (6) into the fuel tube to fuel pump.

NOTE: Pull off the left ckecker into the fuel pipe.

NOTE: Refer to “Fuel Tube/Quick Connector Fittings” in this section when performing any repairs.

8. Check leak.

Methed of leak check.

(1) Plug end of quick connector and breather hose (Pull off the breather hose from fuel tank) and tighten fuel filler cap until at least one click are heard.
(2) Apply water soap around the fuel pump seal area.
(3) Pressure air into the fuel tank from end of breather pipe at 5psi (34.3 kPa/2.8kgf/cm^2) over 15 seconds.
(4) Verify no bubbles around the fuel pump seal area.

8. Install the fuel tank assembly (9).

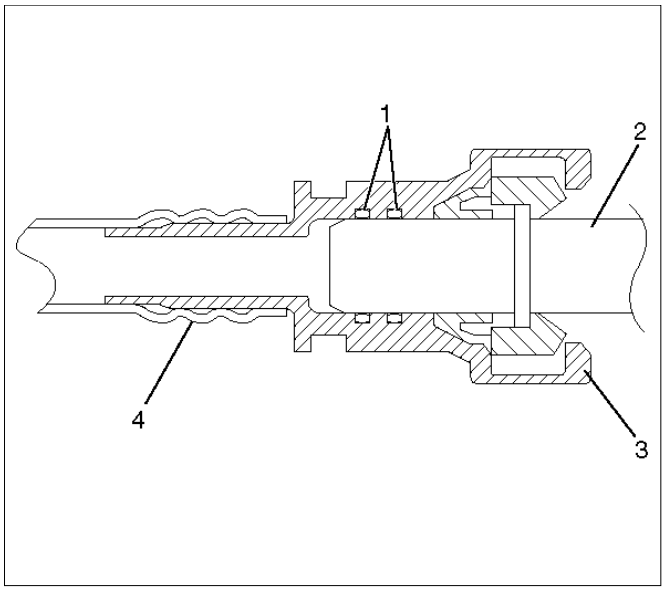
NOTE: Refer to “Install the fuel tank” in this section.

Fuel Tube / Quick – Connector Fittings

Precautions

- Do not light a match or create a flame.
- Keep flames away from your work area to prevent flammable materials from catching fire.
- Disconnect battery ground cable to prevent electrical shorts.
- Pre-treat piping system or associated parts from thermal damage or from spattering when welding or similar heat-generating work.

Cautions During Work



140R100032

Legend

(1) O-ring
(2) Port
(3) Connector
(4) Plastic Tube

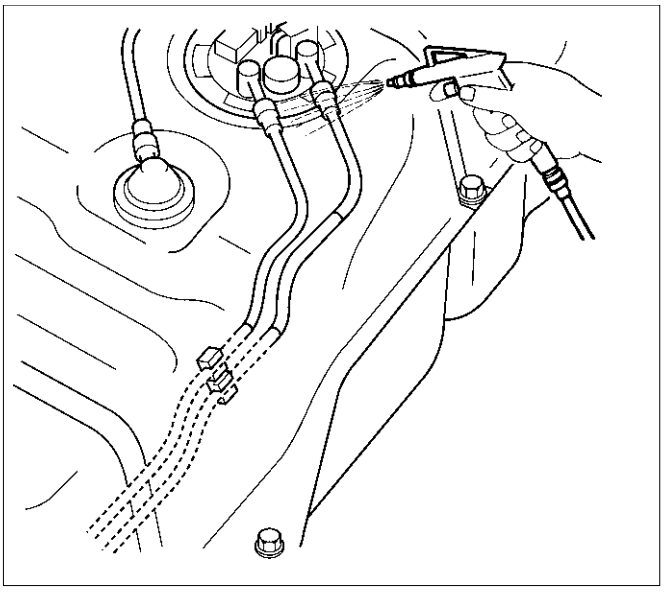
Do not expose the assembly to battery electrolyte or do not wipe the assembly with a cloth used to wipe off spilt battery electorolyte.

Piping that has been splattered with battery electrolyte or battery electrolyte soaked cloth that was wiped on the piping cannot be used.

Removal

1. Open the fuel cap to relieve the fuel pressure in the tank.

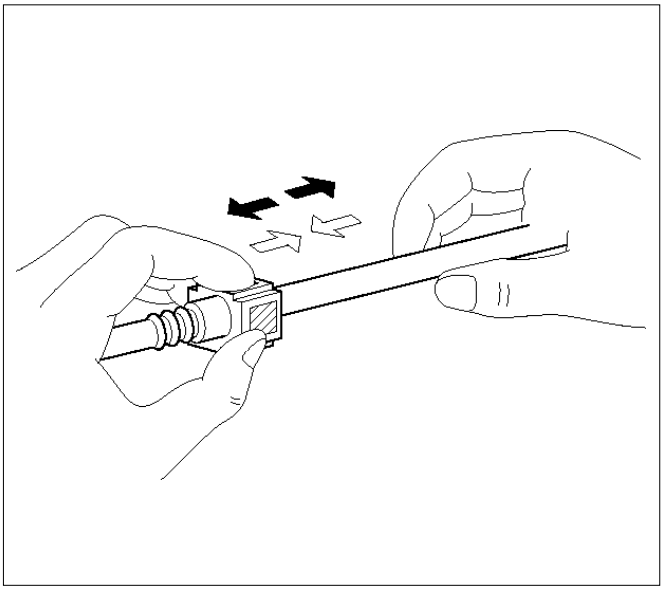
   Use compressed air to remove any dirt on the fuel quick connect fittings prior to disconnecting the fittings.



141R100002

   When disconnecting the fuel pipe, cover the area with a cloth to prevent fuel from splashing as the fuel pipe may still have some pressure in it.

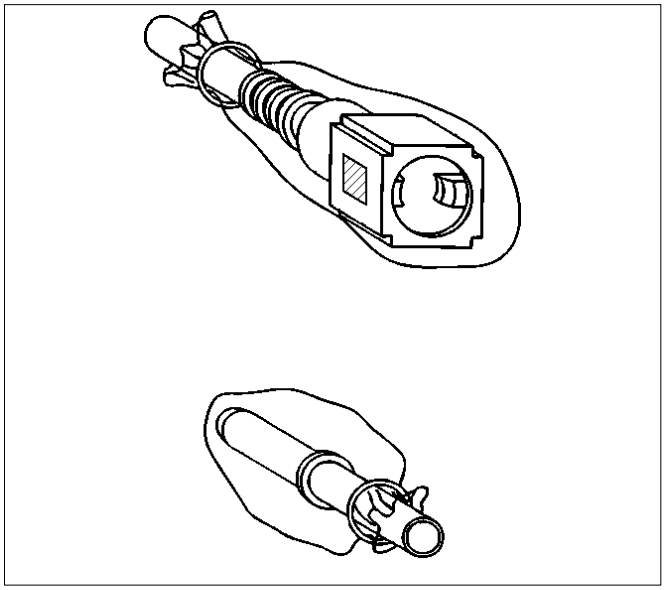
2. For removal of the quick connector, hold the quick connector in one hand, and pull out the connentor with the other hand while pressing the square relieve button of the connector, as illustrated.



140R100037

NOTE: Do not use tools of any kind. Only use bare hands when disconnecting the connector. Use a lubricant (light oil) and/or push and pull the connector until the pipe is disconnected.

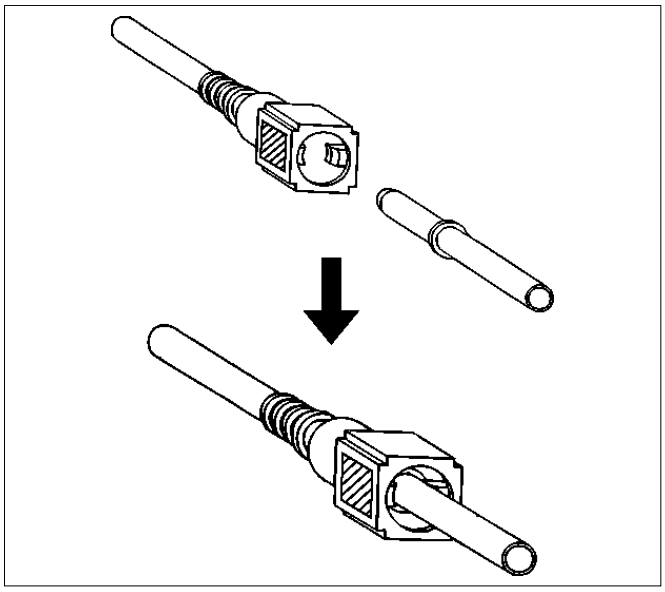
   Cover the connectors that was removed with a plastic bag, to prevent dust or rain water from entering.



140R100028

Reuse of Quick–Connector

- Replace the port and connector if scratch, dent or crack is found.
- Remove any dirt build up on the port when installing the connector. Replace the connector, if there is any forms of rust, dent, scratch.
- After cleaning the port, insert it straight into the connector until it clicks. After it clicks, try pulling at 49N (5kgf) it out to make sure that it is not drawn and is securely locked.



140R100036

Assembling Advice

By applying engine oil or light oil to the pipe, port makes pipe assembly easier. The pipe assembly should take place immediately after applying oil (to prevent dust from sticking to the pipe surface – which may decrease sealing ability).

Test/Inspection After Assembling

1. Reconnect the battery negative cable.
2. Turn the ignition key to the “ON" position and listen for pump start-up sound. Inspect for leaks, the fuel pressure will increase as the fuel pump is actuated.
3. Perform leak inspection (step 2) several times.
4. Start the engine and observe the engine idle speed. The presence of dirt in the fuel system may affect the fuel injection system.

Fuel Pump Relay

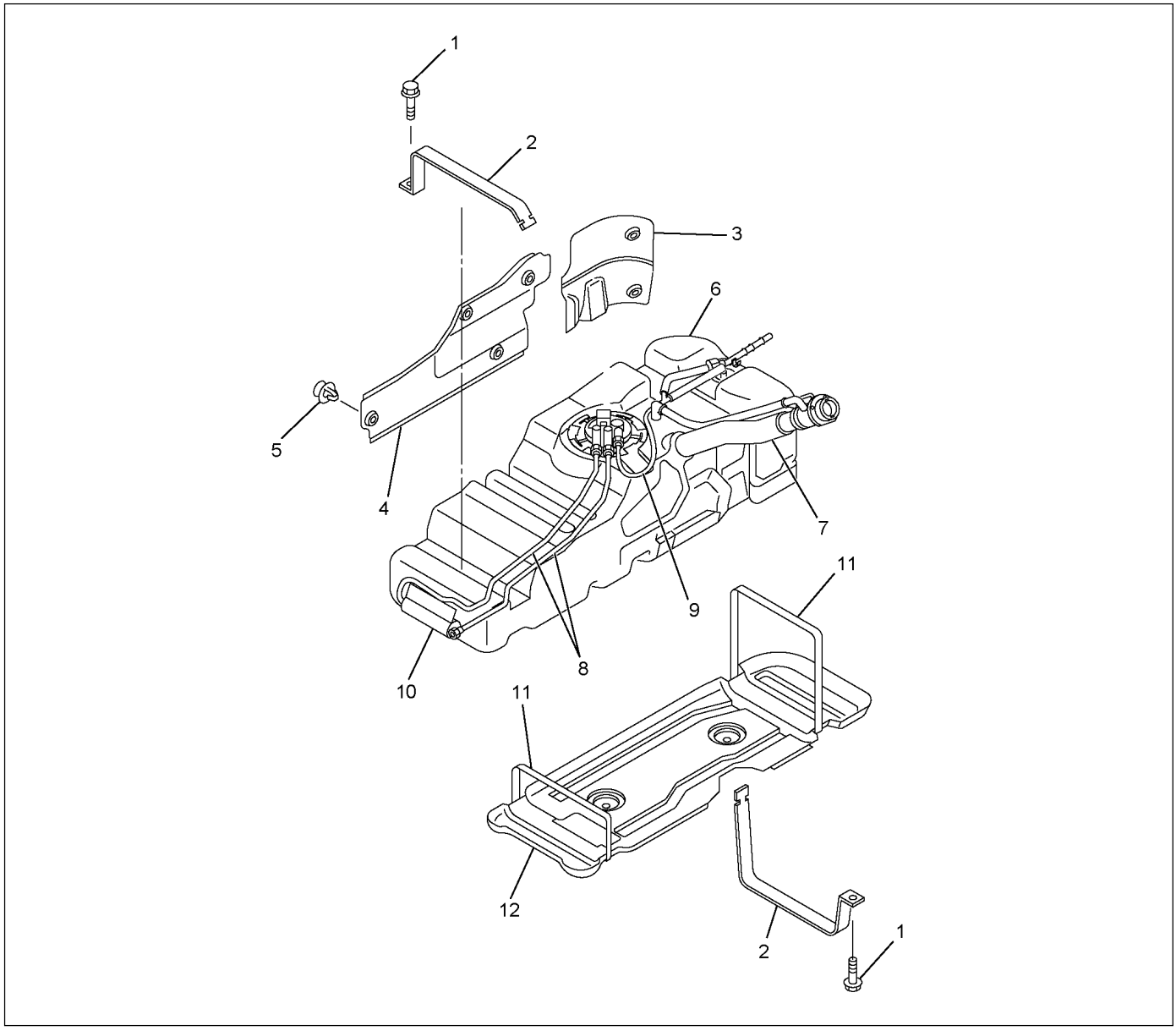
General Description

In order to control the fuel pump and sender assembly (FPAS) operation, the FPAS relay is provided. When the starter switch is turned to “ON" position, the FPAS relay operates the FPAS for 2 seconds.

When it is turned to “START" position, the Engine Control Module receives the reference pulse from the Ignition Control Module and it operates the relay, again causing the FPAS to feed fuel.

Fuel Tank

Fuel Tank and Associated Parts



RTW46FLF000301

Legend

(1) Bolt; Fuel Tank
(2) Fuel Tank Band
(3) Rear Side Shield
(4) Side Shield
(5) Retainer
(6) Fuel Tank
(7) Fuel Filler Hose
(8) Fuel Tube/Quick Connector
(9) Evapo Tube / Quick Connector – Only Specified Model
(10) Fuel Filter
(11) Band; Under Shield
(12) Under Shield

Removal

CAUTION: When repair to the fuel system has been completed, start engine and check the fuel system for loose connection or leakage. For the fuel system diagnosis, see Section "Driveability and Emission".

1. Disconnect battery ground cable.
2. Loosen slowly the fuel filler cap.

NOTE: To prevent spouting out fuel to change the pressure in the fuel tank.

NOTE: Cover opening of the filler neck to prevent any dust entering.

3. Jack up the vehicle.
4. Support underneath of the fuel tank with a lifter.
5. Remove the inner liner of the wheel house on rear left side.
6. Remove fasten bolt to the filler neck from the body.
7. Disconnect the quick connector (8) into the fuel tube from the fuel pipe and the evapo tube from evapo joint connector.

NOTE: Cover the quick connector to prevent any dust entering and fuel leaking.

NOTE: Refer to "Fuel Tube/Quick Connector Fittings" in this section when performing any repairs.

8. Remove fasten bolt (1) to the tank band and the tank band (2).
9. Disconnect the pump and sender connector on the fuel pump and remove the harness from weld clip on the fuel tank.
10. Lower the fuel tank (6).

NOTE: When the fuel tank is lowered from the vehicle, don't scratch each hose and tube by around other pars.

Installation

1. Rise the fuel tank into position.

NOTE: Ensure hoses and tubes do not foul on other component.

2. Connect the pump and sender connector to the fuel pump and install harness to into the plastic clip welded to the top of the fuel tank..

NOTE: The connector must be certainly connected against stopper.

Ensure tank band anchor mates with guide hole on frame.

3. Install the tank band to fasten bolt.

Torque: 68 N·m (6.9kg·m/50 lb ft)

NOTE: The anchor of the tank band must be certainly installed to guide hole on frame.

4. Connect the quick connector from the fuel tube to the fuel pipe and the evapo tube from evapo joint connector.

NOTE: Pull off the left checker into the fuel pipe.

NOTE: Refer to "Fuel Tube/Quick Connector Fittings" in this section when performing any repairs.

5. Install the filler neck to the body by bolt.
6. Install the inner liner of the wheel house on rear side.
7. Remove lifter to support underneath of the fuel tank.
8. Put back the vehicle.
9. Tigten the filler cap until at least three clicks are heard.
10. Connect the battery ground cable.

Filler Neck

Removal

1. Remove the fuel tank.

NOTE: Refer to "Fuel Tank" in this section.

2. Put a marking the following point as the filler neck assembly is restored.
   - Each joint area of the hose (to restore axial direction and insertion length of the hose)
   - Each fasten area of the clamp (to restore axial direction and position of the clamp)
   - Each bolt in the clamp (to restore fasten length of bolt in the clamp)
   - The band clip (to restore position and fasten length of the band clip)

NOTE: Cover end of each hose and pipe to prevent any dust entering.

Installation

1. Align each marking and restore the following point.
   - Each joint area of the hose (Restore axial direction and insertion length of the hose)
   - Each fasten area of the clamp (Restore axial direction and position of the clamp)
   - Each bolt in the clamp (Restore fasten length of bolt in the clamp)

   Torque: 2.5 N·m (0.25 kg·m / 2 lb ft) … filler neck side except flat deck model.
   - The band clip (Restore position and fasten length of the band clip)
2. Install the fuel tank.

NOTE: Refer to "Fuel Tank" in this section.

Fuel Gauge Unit

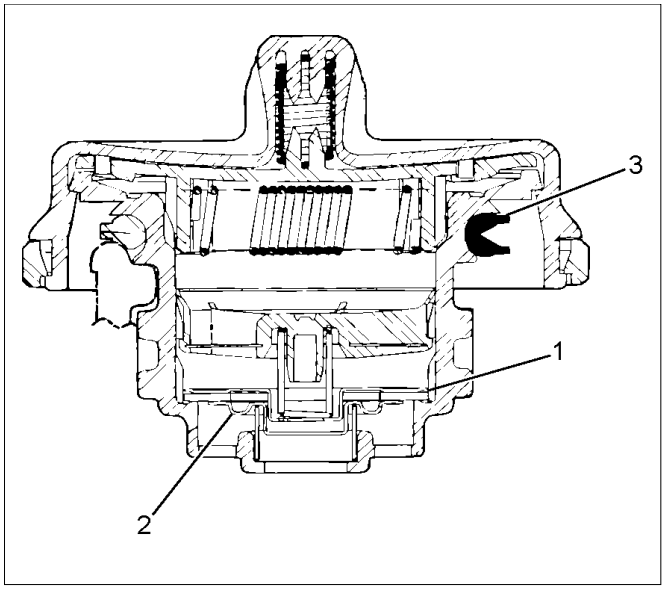
Removal and Installation

As for removal and installation of the Fuel Gauge Unit, refer to “Fuel Tank" of this section 6C as the fuel gauge unit is combined with the fuel pump and sender assembly.

Fuel Filler Cap

General Description

A vacuum valve and pressure valve are built into the fuel filler cap which adjusts the fuel pressure in the fuel tank to prevent fuel tank damage.



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Legend

(1) Pressure Valve
(2) Vacuum Valve
(3) Seal Ring

Inspection

The fuel filler cap must be inspected for seal condition.

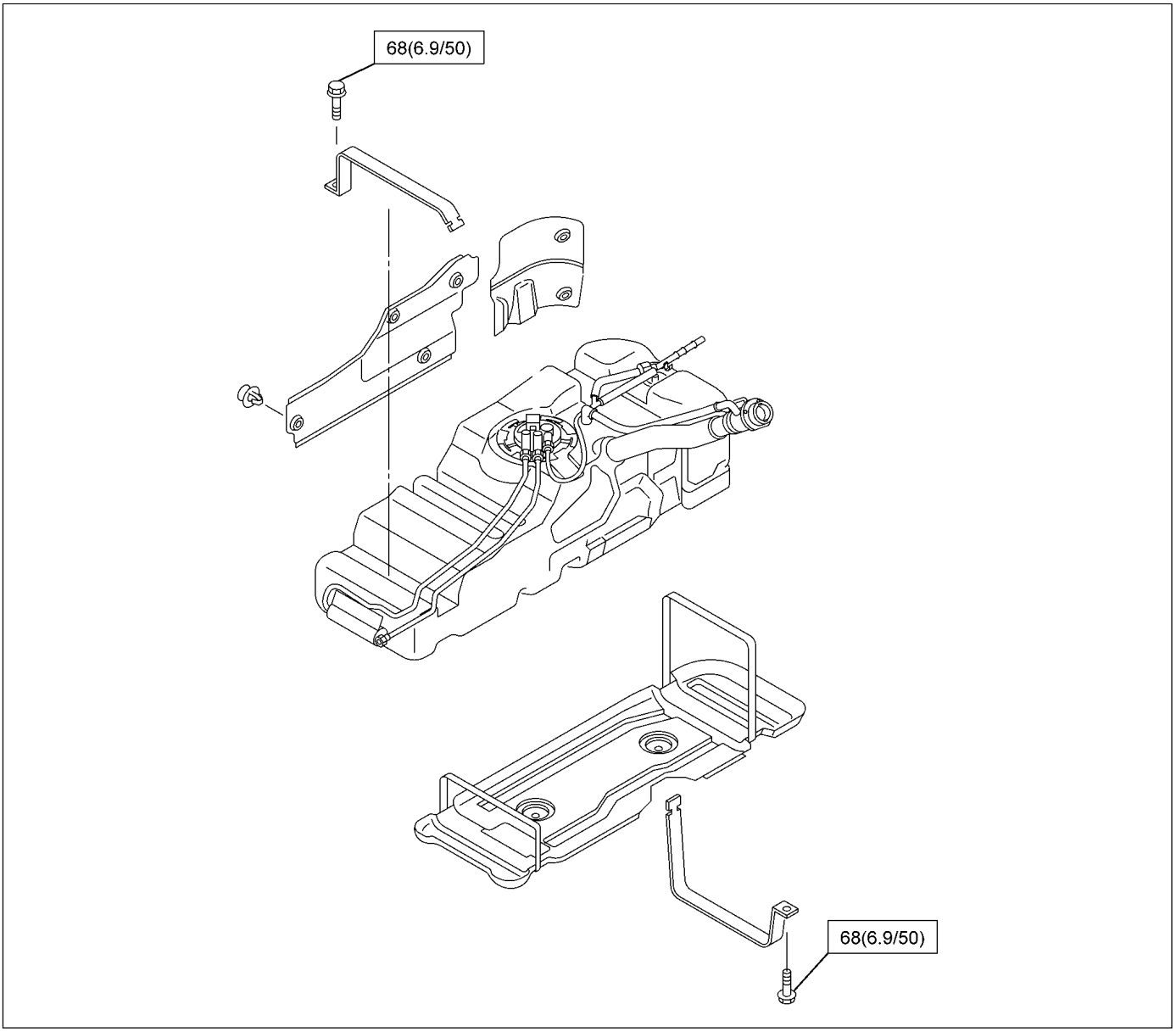
The fuel filler cap must be replaced if found defective

CAUTION: A replacement fuel filler cap must be the same as the original. The fuel filler cap valve was designed primarily for this application and must be replaced with the same type or decreased engine performance may occur.

Main Data and Specifications

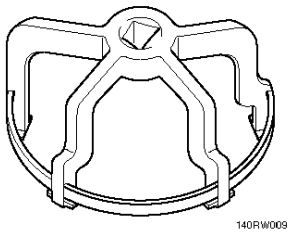
Torque Specification

N·m (kg·m/ lb ft)



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Special Tools

ILLUSTRATION	PART NO. PART NAME
 140RW009	**5–8840–2602–0** **(J–39765)** Remover; fuel pump retainer

ENGINE

ENGINE ELECTRICAL (6VE1 3.5L)

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Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Battery

General Description

There are six battery fluid caps on the top of the battery. These are covered by a paper label.

The battery is completely sealed except for the six small vent holes on the side. These vent holes permit the escape of small amounts of gas generated by the battery.

This type of battery has the following advantages over conventional batteries:

1. There is no need to add water during the entire service life of the battery.
2. The battery protects itself against overcharging.

   The battery will refuse to accept an extensive charge.

   (A conventional battery will accept an excessive charge, resulting in gassing and loss of battery fluid.)
3. The battery is much less vulnerable to self discharge than a conventional type battery.

Diagnosis

1. Visual Inspection

Inspect the battery for obvious physical damage, such as a cracked or broken case, which would permit electrolyte loss.

Replace the battery if obvious physical damage is discovered during inspection.

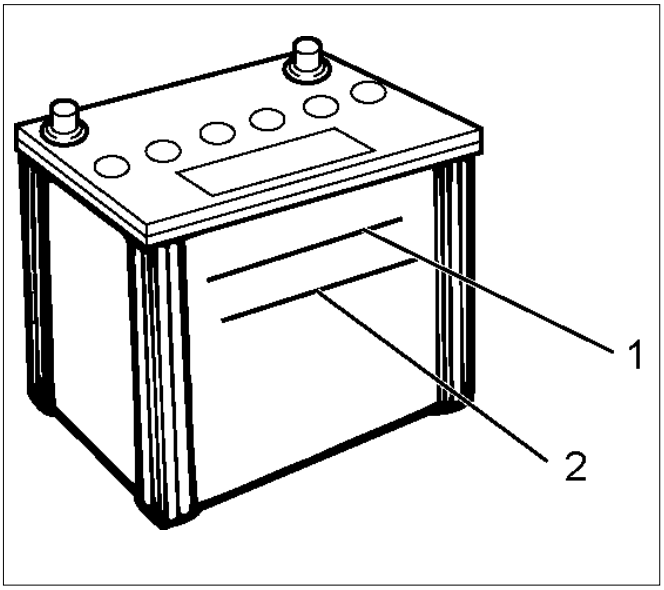
Check for any other physical damage and correct it as necessary.

2. Fluid Level Check

The fluid level should be between the upper level line(1) and lower level line(2) on side of battery.

a. CORRECT FLUID LEVEL – Charge the battery.

b. BELOW LOWER LEVEL – Replace battery.



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3. Voltage Check

1. Put voltmeter test leads to battery terminals.
   a. VOLTAGE IS 12.4V OR ABOVE – Go to Step 5.
   b. VOLTAGE IS UNDER 12.4V – Go to procedure (2) below.
2. Determine fast charge amperage from specification. (See Main Data and Specifications in this section).

   Fast charge battery for 30 minutes at amperage rate no higher than specified value.

   Take voltage and amperage readings after charge.
   a. VOLTAGE IS ABOVE 16V AT BELOW 1/3 OF AMPERAGE RATE – Replace battery.
   b. VOLTAGE IS ABOVE 16V AT ABOVE 1/3 OF AMPERAGE RATE – Drop charging voltage to 15V and charge for 10 – 15 hours. Then go to Step 5.
   c. VOLTAGE IS BETWEEN 12V AND 16V – Continue charging at the same rate for an additional 3–1/2 hours. Then go to Step 5.
   d. VOLTAGE BELOW 12V – Replace Battery.

4. Load Test

1. Connect a voltmeter and a battery load tester across the battery terminals.
2. Apply 300 ampere load for 15 seconds to remove surface charge from the battery. Remove load.
3. Wait 15 seconds to let battery recover. Then apply specified load from specifications (See Main Data and Specifications in this section).

   Read voltage after 15 seconds, then remove load.

   a. VOLTAGE DOES NOT DROP BELOW THE MINIMUM LISTED IN THE TABLE – The battery is good and should be returned to service.

   b. VOLTAGE IS LESS THAN MINIMUM LISTED – Replace battery.

ESTIMATED TEMPERATURE		MINIMUM VOLTAGE
°F	°C	V
70	21	9.6
60	16	9.5
50	10	9.4
40	4	9.3
30	–1	9.1
20	–7	8.9
10	–12	8.7
0	–18	8.5
The battery temperature must be estimated by feel and by the temperature the battery has been exposed to for the preceding few hours.		

Battery Charging

Observe the following safety precautions when charging the battery:

1. Never attempt to charge the battery when the fluid level is below the lower level line on the side of the battery. In this case, the battery must be replaced.
2. Pay close attention to the battery during charging procedure.

   Battery charging should be discontinued or the rate of charge reduced if the battery feels hot to the touch.

   Battery charging should be discontinued or the rate of charge reduced if the battery begins to gas or spew electrolyte from the vent holes.
3. In order to more easily view the hydrometer blue dot or ring, it may be necessary to jiggle or tilt the battery.
4. Battery temperature can have a great effect on battery charging capacity.
5. The sealed battery used on this vehicle may be either quick charged or slow charged in the same manner as other batteries.

   Whichever method you decide to use, be sure that you completely charge the battery. Never partially charge the battery.

Jump Starting

Jump Starting with an Auxiliary (Booster) Battery

CAUTION: Never push or tow the vehicle in an attempt to start it. Serious damage to the emission system as well as other vehicle parts will result.

Treat both the discharged battery and the booster battery with great care when using jumper cables. Carefully follow the jump starting procedure, being careful at all times to avoid sparking.

WARNING: FAILURE TO CAREFULLY FOLLOW THE JUMP STARTING PROCEDURE COULD RESULT IN THE FOLLOWING:

1. **Serous personal injury, particularly to your eyes.**
2. **Property damage from a battery explosion, battery acid, or an electrical fire.**
3. **Damage to the electronic components of one or both vehicles particularly.**

Never expose the battery to an open flame or electrical spark. Gas generated by the battery may catch fire or explode.

Remove any rings, watches, or other jewelry before working around the battery. Protect your eyes by wearing an approved set of goggles.

Never allow battery fluid to come in contact with your eyes or skin.

Never allow battery fluid to come in contact with fabrics or painted surfaces.

Battery fluid is a highly corrosive acid.

Should battery fluid come in contact with your eyes, skin, fabric, or a painted surface, immediately and thoroughly rinse the affected area with clean tap water.

Never allow metal tools or jumper cables to come in contact with the positive battery terminal, or any other metal surface of the vehicle. This will protect against a short circuit.

Always keep batteries out of reach of young children.

Jump Starting Procedure

1. Set the vehicle parking brake.
   If the vehicle is equipped with an automatic transmission, place the selector level in the “PARK" position.
   If the vehicle is equipped with a manual transmission, place the shift lever in the “NEUTRAL" position.
   Turn “OFF" the ignition.
   Turn “OFF" all lights and any other accessory requiring electrical power.
2. Look at the built–in hydrometer.
   If the indication area of the built–in hydrometer is completely clear, do not try to jump start.
3. Attach the end of one jumper cable to the positive terminal of the booster battery.
   Attach the other end of the same cable to the positive terminal of the discharged battery.
   Do not allow the vehicles to touch each other. This will cause a ground connection, effectively neutralizing the charging procedure.
   Be sure that the booster battery has a 12 volt rating.
4. Attach one end of the remaining cable to the negative terminal of the booster battery.
   Attach the other end of the same cable to a solid engine ground (such as the air conditioning compressor bracket or the generator mounting bracket) of the vehicle with the discharged battery.
   The ground connection must be at least 450 mm (18 in.) from the battery of the vehicle whose battery is being charged.

WARNING: NEVER ATTACH THE END OF THE JUMPER CABLE DIRECTLY TO THE NEGATIVE TERMINAL OF THE DEAD BATTERY.

5. Start the engine of the vehicle with the good battery.
   Make sure that all unnecessary electrical accessories have been turned “OFF".
6. Start the engine of the vehicle with the dead battery.
7. To remove the jumper cables, follow the above directions in reverse order.
   Be sure to first disconnect the negative cable from the vehicle with the discharged battery.

Battery Removal



P1010001

1. Remove negative cable.
2. Remove positive cable (2).
3. Remove retainer screw and rods.
4. Remove retainer.
5. Remove battery.

Battery Installation

1. Install battery.
2. Install retainer.
3. Install retainer screw and rods.

NOTE: Make sure that the rod is hooked on the body side.

4. Install positive cable.
5. Install negative cable.

Main Data and Specifications

General Specifications

Model (JIS)	55D23L–MF
Voltage (V)	12

MEMO

ENGINE

IGNITION SYSTEM (6VE1 3.5L)

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Service Precaution

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General Description

Ignition is done by the electronic ignition (EI) that directly fires the spark plugs from ignition coils through spark plug wires without using a distributor. A pair of ignition coils for the cylinders having different phases by 360° (No.1 and No.4, No.2 and No.5, No.3 and No.6) are fired simultaneously.

Since the cylinder on exhaust stroke requires less energy to fire its ignition plug, energy from the ignition coils can be utilized to fire the mating cylinder on compression stroke. After additional 360° rotation, respective cylinder strokes are reversed.

The EI consists of six ignition coils, crankshaft position sensor, engine control module (ECM) and other components.

The ignition coils are connected with the ECM.

The ECM turns on/off the primary circuit of ignition coils, and also it controls the ignition timing.

A notch in the timing disc on the crankshaft activates the crankshaft position sensor which then sends information such as firing order and starting timing of each ignition coil to the ECM.

Further, the EI employs ignition control (IC) to control similar to a distributor system.

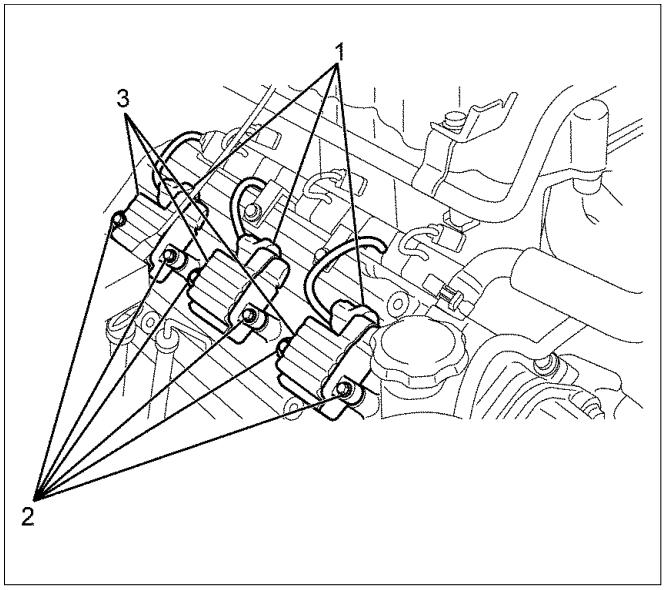
Diagnosis

Refer to Section Drivability and Emissions for the diagnosis to electronic ignition system (EI system).

Ignition Coil

Removal

1. Disconnect battery ground cable.
2. Ignition coil connector and ignition coil.
   - Disconnect three connector from ignition coil.
   - Remove harness bracket bolt on cylinder head cover.
   - Remove fixing bolts on ignition coil.



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Legend

(1) Ignition Coil Connector
(2) Bolt
(3) Ignition Coil Assembly

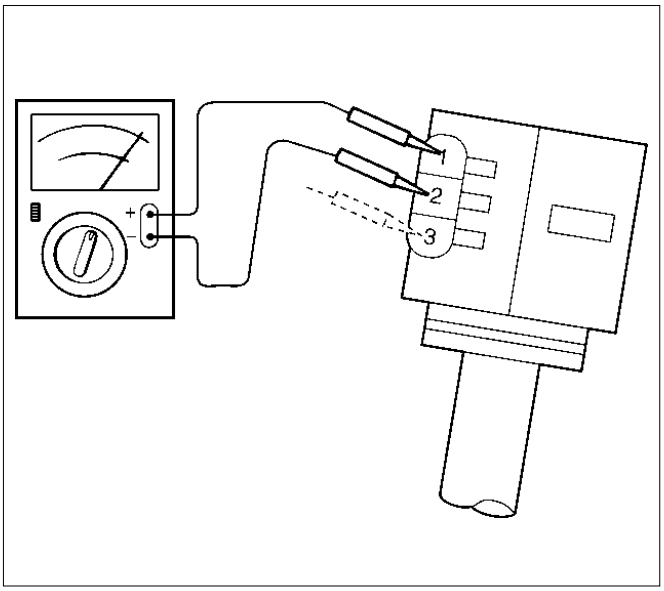
Inspection and Repair

Check the ignition coil assembly for insulation. Check terminals for corrosion or damage, and replace as necessary.

Measuring resistance of ignition coil assembly.

Terminal No.	Limit
1 to 2	Without 0 ohm or infinity maximum ohm.
1 to 3	Same as above
2 to 3	Same as above

Measure resistance of ignition coil assembly, and replace the ignition coil assembly if its value exceeds the standard.

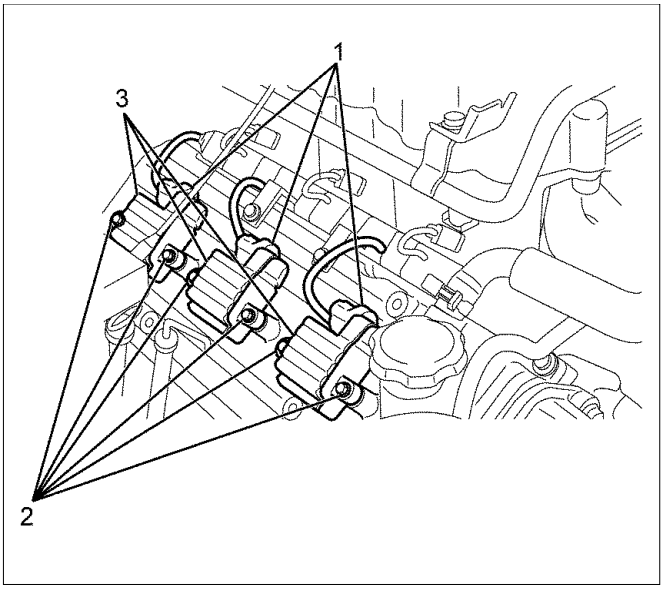


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Installation

1. Install the ignition coil assembly (3).
   Connect ignition coil connector (1) and ignition coil (3), then tighten bolt (2) to the specified torque.

Torque: 4 N·m (0.4 kg·m/3 lb ft)



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2. Connect battery ground cable.

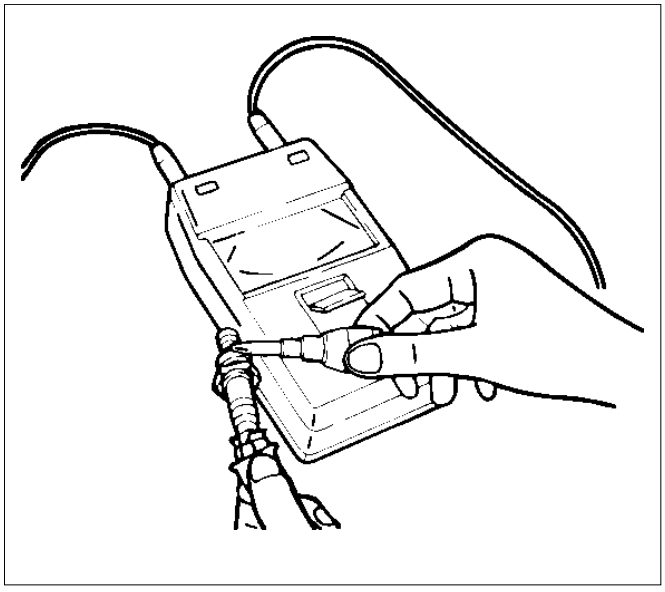
Spark Plug

Inspection

Poor spark plug condition adversely affects engine performance. Carefully inspect each spark plug following the procedure outlined below.

1. Remove the spark plug.
2. Check the plug for dirt and other foreign material.
   If the plug is extremely dirty, the fuel and electrical systems must be checked.
3. If necessary, clean the spark plugs by placing them in a spark plug cleaning machine for no more than 20 seconds.
4. Check the electrode and insulator for wear and/or cracking. If there is significant wear or cracking, the plug must be replaced.
5. Check the gasket for damage. Replace the gasket if necessary.
6. Measure the insulation resistance with a 500-volt megaohm meter. Replace the plug if the resistance is less than the specified value.

Insulation resistance: 50 MΩ or more

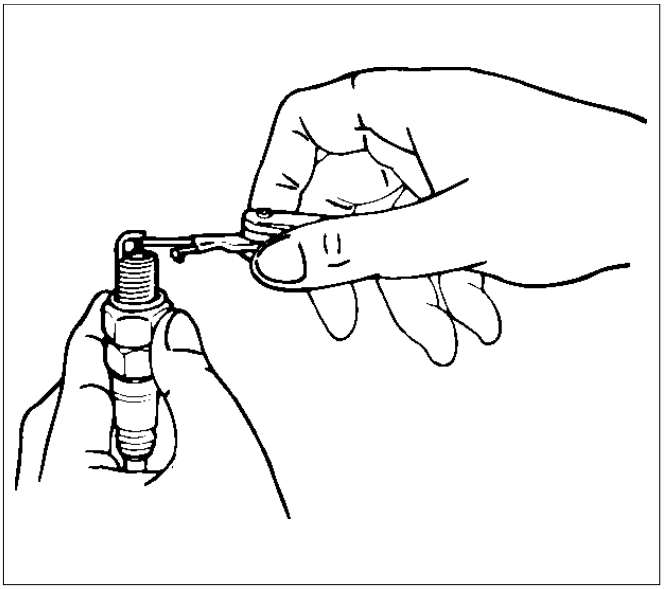


011RS010

7. Check the spark plug gap. Replace the spark plug the if gap is not as specified.

Standard: 1.0–1.1 mm (0.04–0.043 in)

Limit: 1.3 mm (0.05 in)



011RS011

- Do not attempt to adjust the gap of an old spark plug. Replace the plug and adjust the gap of the new plug if required.
- Take care not to damage the spark plug tip during handling.

8. Tighten the spark plugs to the specified torque.

Torque: 18 N·m (1.8 kg·m/13 lb ft)

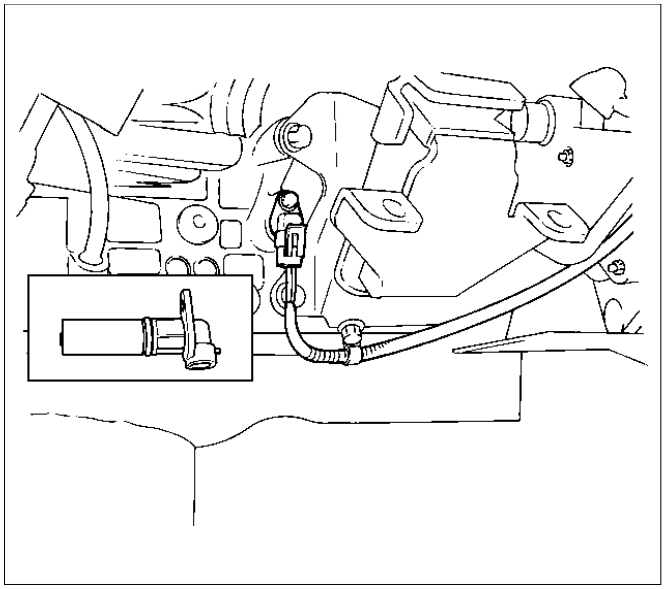
Replacement spark plugs

- Under normal conditions (no problem with the fuel and/or electrical systems), use replacement spark plugs with a low heat value (hot-type plug).
- If insulator and electrode scorching is significant, use replacement spark plugs with a high heat value (cold-type plug).

Crankshaft Position Sensor

Removal

1. Disconnect battery ground cable
2. Wiring connector from crankshaft position sensor.
3. Remove crankshaft position sensor from cylinder block.



012RS008

Installation

1. Install crankshaft position sensor into the cylinder block.
   Before installation, apply small amount of engine oil to the O–ring.

Torque: 10 N·m (1.0 kg·m/7 lb ft)

2. Reconnect wiring connector to crankshaft position sensor.

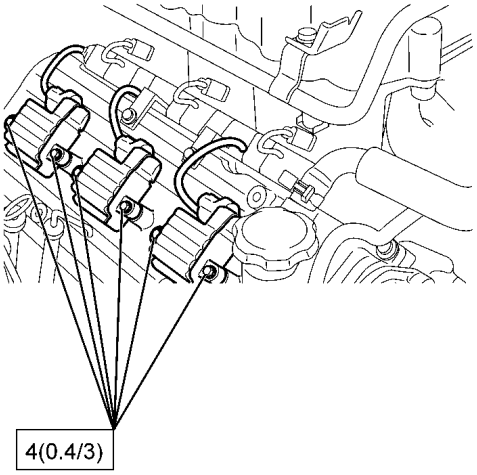
Main Data and Specifications

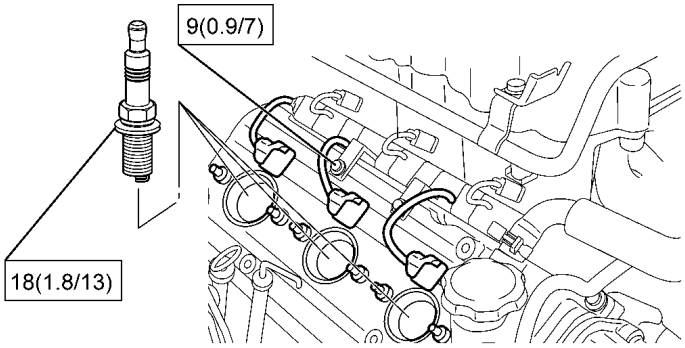
General Specifications

Ignition System	
Ignition Form	Electronic Ignition System (EI system) with Crankshaft position sensor
Spark Plug	
Type	K16PR-P11 RC10PYP4 RK16PR11
Plug gap	1.0 mm (0.04 in) – 1.1 mm (0.043 in)
Torque	18 N·m (13lb ft)

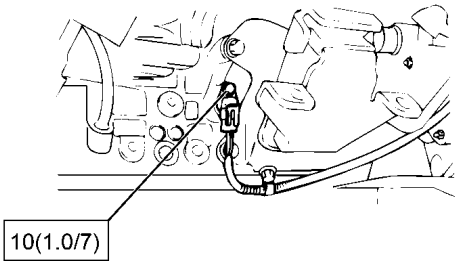
Torque Specifications

N·m (kg·m/lb ft)





Crankshaft Position Sensor



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MEMO

ENGINE

STARTING AND CHARGING SYSTEM (6VE1 3.5L)

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Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Starting System

General Description

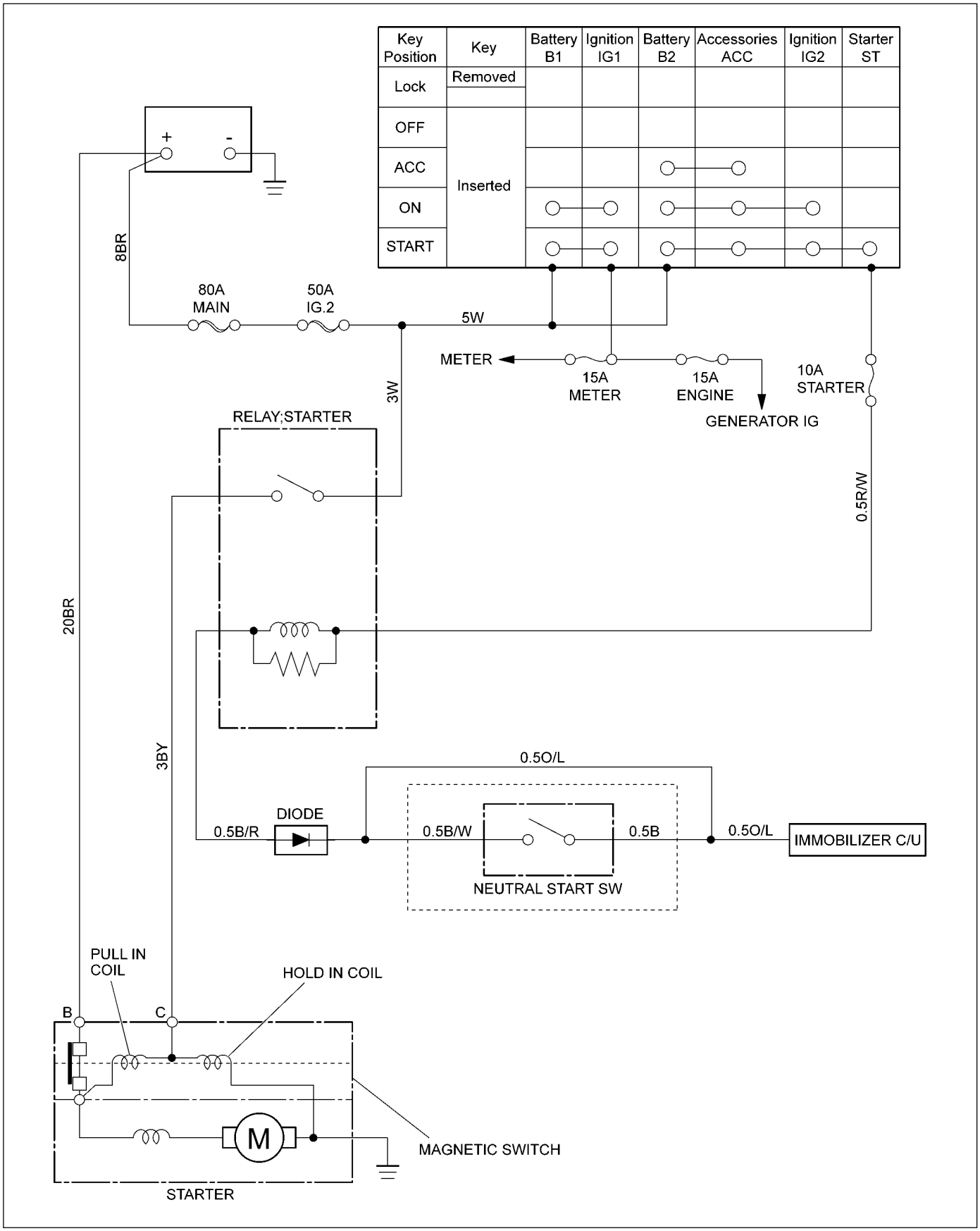
Cranking Circuit

The cranking system consists of a battery, starter, starter switch, starter relay, etc. These main components are connected.

Starter

The cranking system employs a magnetic type reduction starter in which the motor shaft is also used as a pinion shaft. When the starter switch is turned on, the contacts of magnetic switch are closed, and the armature rotates. At the same time, the plunger is attracted, and the pinion is pushed forward by the shift lever to mesh with the ring gear.

Then, the ring gear runs to start the engine. When the engine starts and the starter switch is turned off, the plunger returns, the pinion is disengaged from the ring gear, and the armature stops rotation. When the engine speed is higher than the pinion, the pinion idles, so that the armature is not driven.



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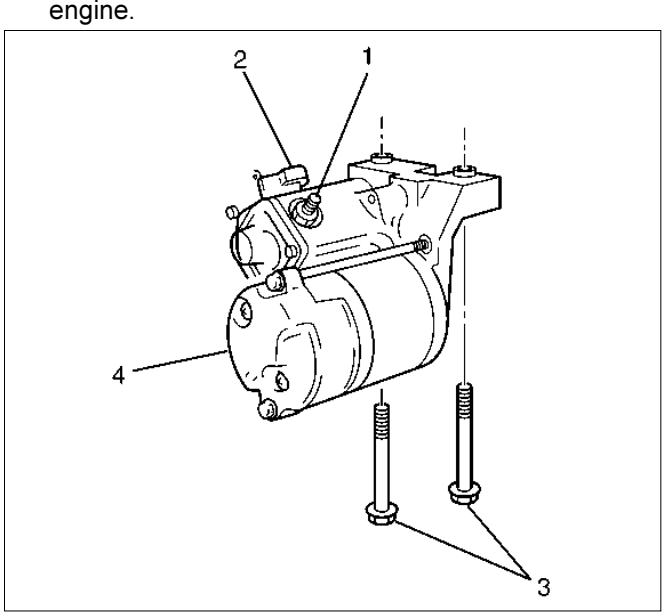
Diagnosis

Symptom	Possible Cause	Action
Starter does not run	Charging failure	*Repair charging system*
	Battery Failure	*Replace Battery*
	Terminal connection failure	*Repair or replace terminal connector and/or wiring harness*
	Starter switch failure	*Repair or replace starter switch*
	Starter failure	*Repair or replace starter*

Starter

Removal

1. Battery ground cable.
2. Disconnect left heated O_2 sensor connector.
3. Remove exhaust front left pipe.
4. Remove dust cover.
5. Disconnect starter wiring connector from terminals “30" and “50".
6. Remove starter assembly mounting bolts on inside and outside.
7. Remove starter assembly toward the bottom of engine.



065RY00050

Legend

(1) Terminal "30"
(2) Terminal "50"
(3) Fixing Bolts
(4) Starter Assembly

Installation

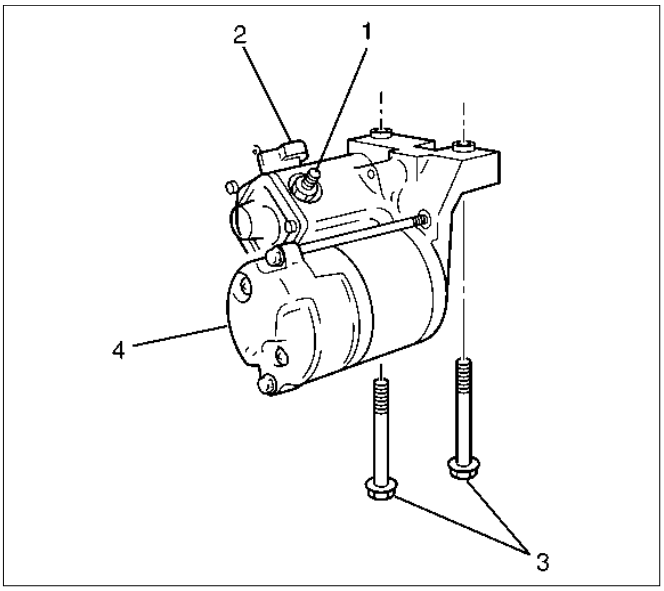
1. Install starter assembly.
2. Install mounting bolts and tighten bolts to specified torque.

   Torque: 40 N·m (4.1 kg·m/30 lb ft)

3. Reconnect the connectors to terminals “30" and “50" and tighten Terminals “30" to specified torque.

   Torque: 9 N·m (0.9 kg·m/7 lb ft)

4. Install dust cover.



065RY00050

Legend

(1) Terminal "30"
(2) Terminal "50"
(3) Fixing Bolts
(4) Starter Assembly

5. Install exhaust front left pipe and tighten bolts and nuts to specified torque(2).

   Stud Nuts

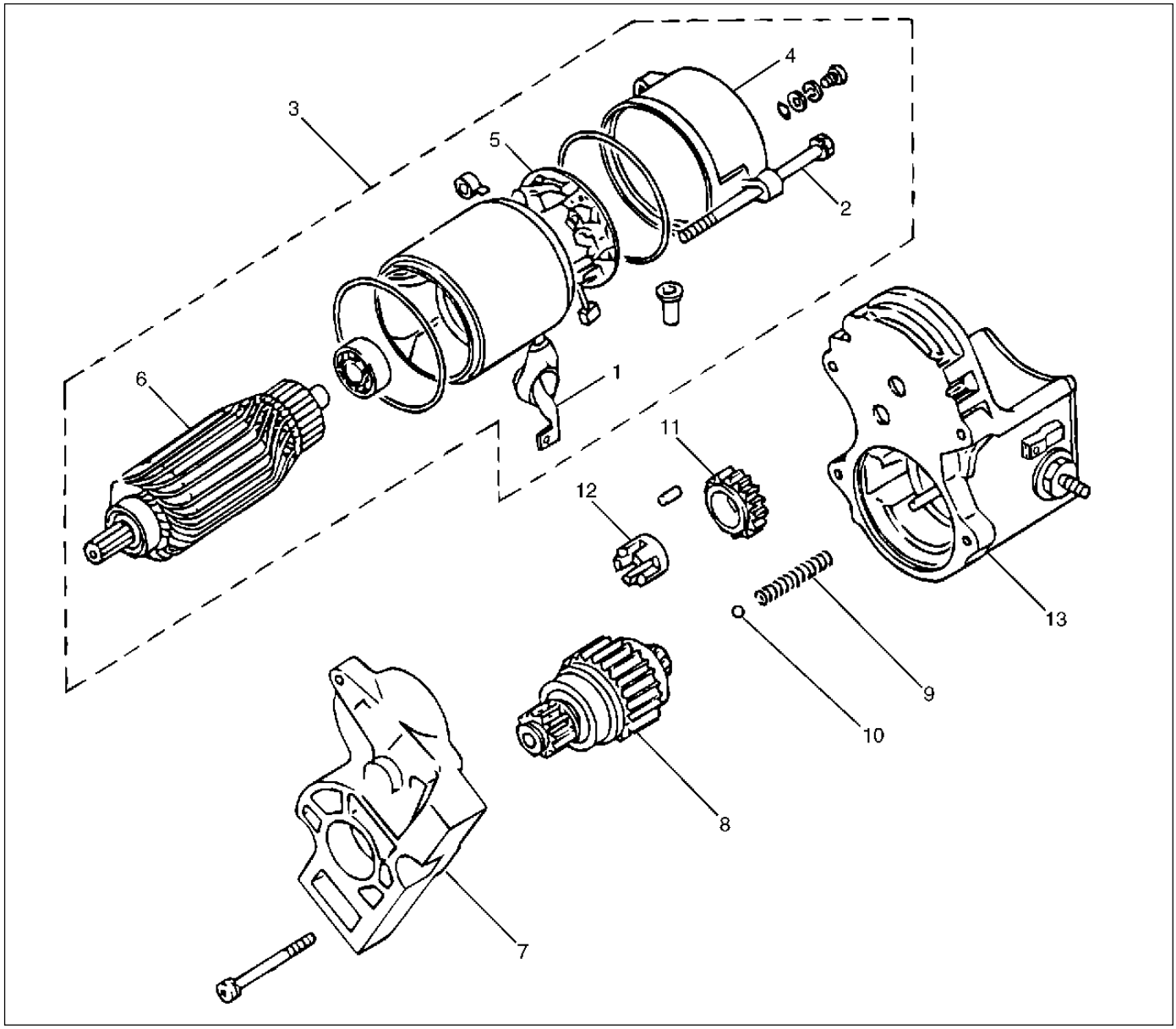
   Torque: 67 N·m (6.8 kg·m/49 lb ft)

   Nuts

   Torque: 43 N·m (4.4 kg·m/32 lb ft)

6. Connect heated O_2 sensor connector.
7. Reconnect the battery ground cable.

Disassembled View



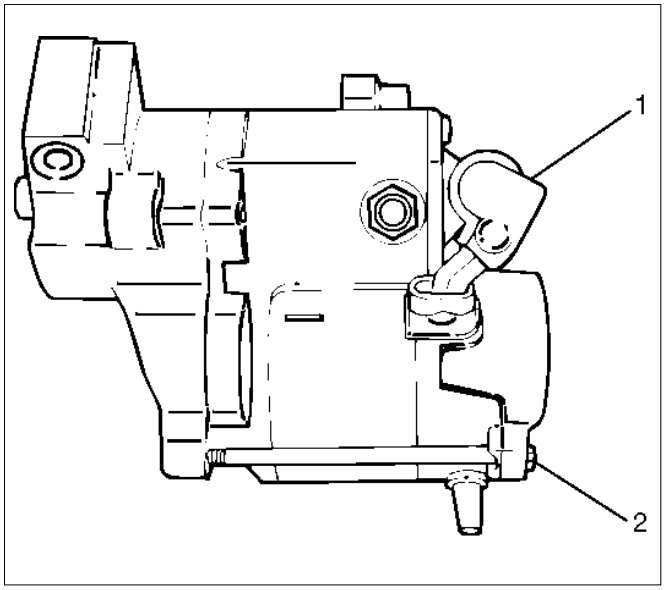
065R100012

Legend

(1) Lead Wire
(2) Through Bolt
(3) Yoke Assembly
(4) Yoke Cover
(5) Brush and Brush Holder
(6) Armature
(7) Housing
(8) Over Running Clutch
(9) Return Spring
(10) Steel Ball
(11) Idle Pinion
(12) Retainer
(13) Magnetic Switch

Disassembly

1. Remove the lead wire (1) from the magnetic switch.
2. Remove the through bolts (2).

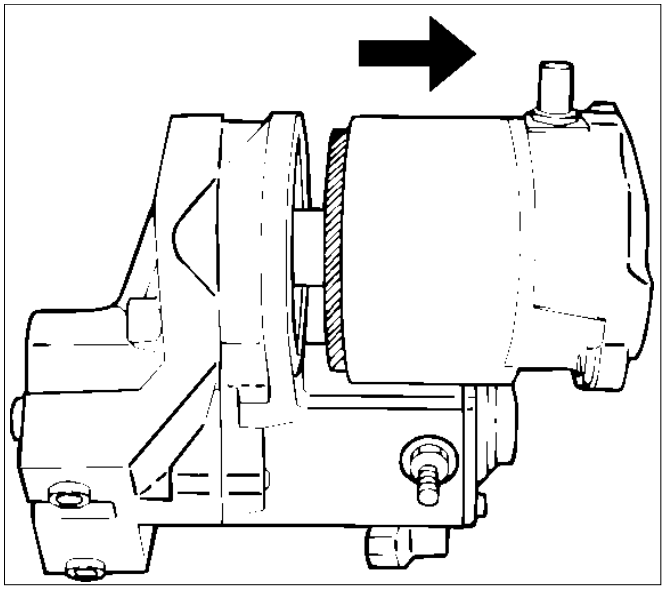


065RY00053

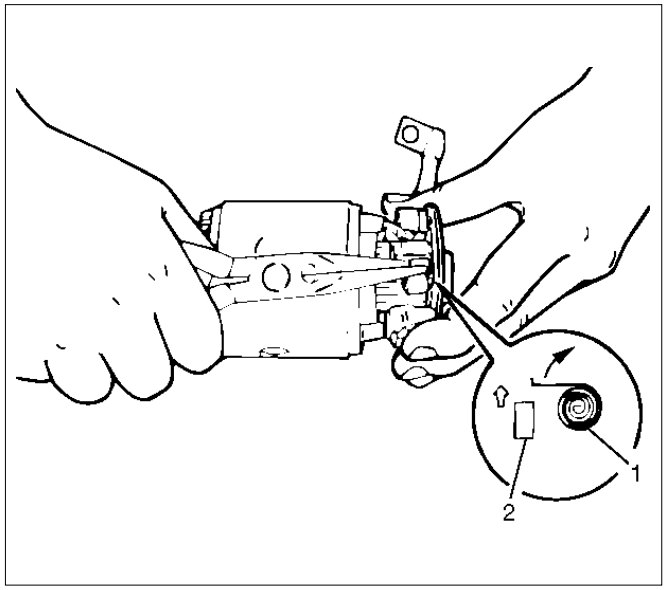
Legend

(1) Lead Wire
(2) Through Bolt

3. Remove the yoke from the magnetic.
4. Remove the yoke cover.
5. Use the long nose pliers to remove the brush and brush holder.



065RY00054

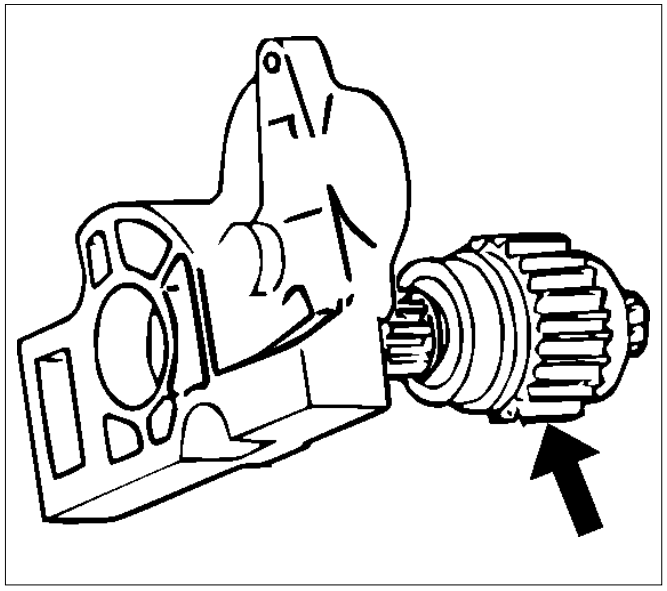


065RY00055

Legend

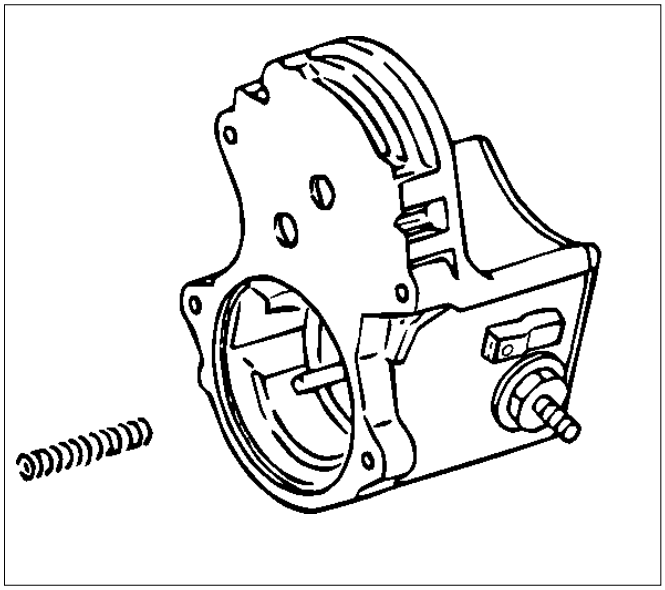
(1) Spring
(2) Brush

6. Remove the armature.
7. Remove the housing.
8. Remove the overrunning clutch from the housing.



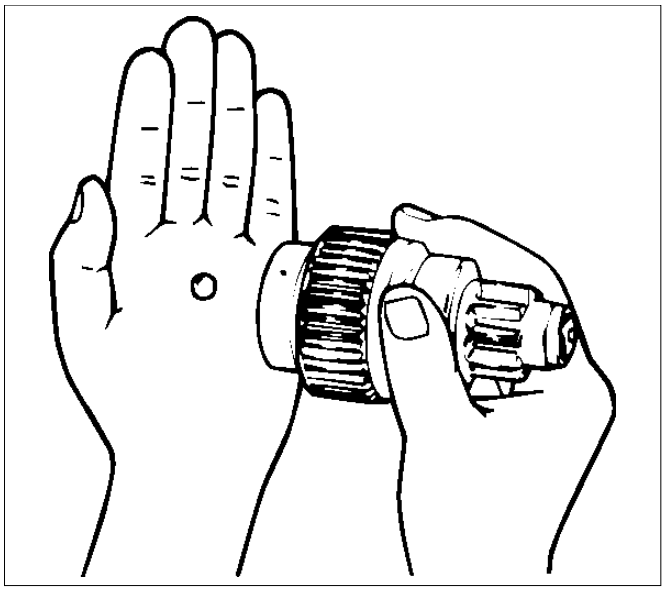
065RY00056

9. Remove the return spring from the magnetic switch.



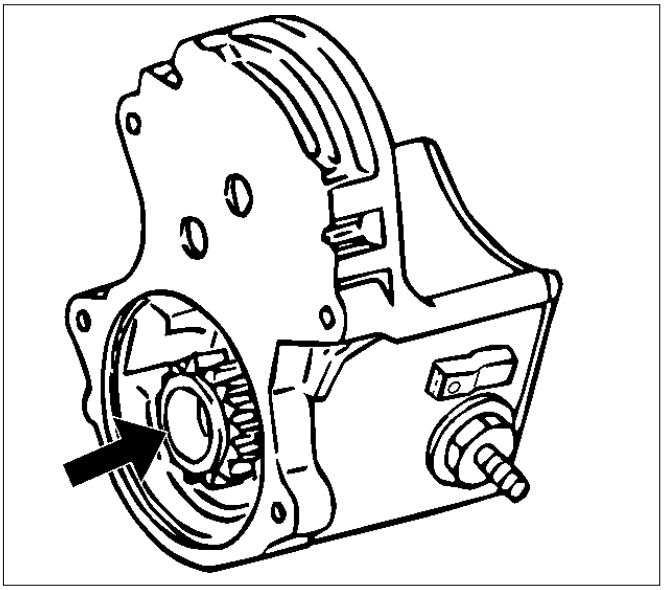
065R100014

10. Remove the steel ball from the overrunning clutch.



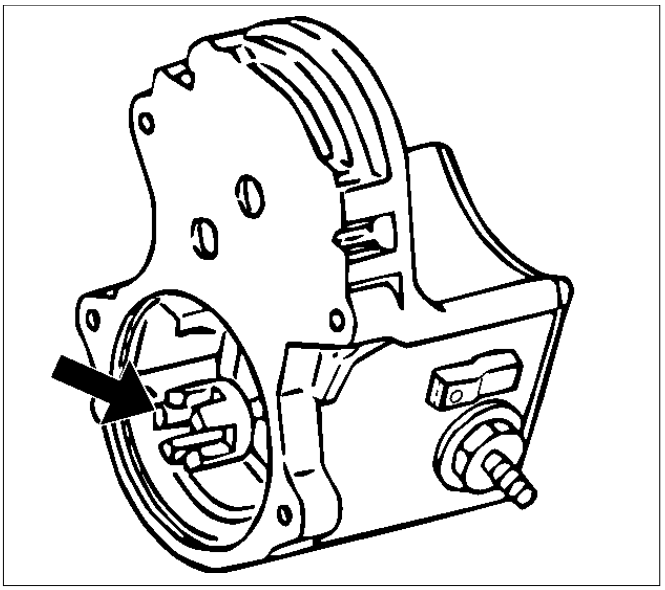
065RY00058

11.Remove the idle pinion from the magnetic switch.



065R100015

12. Remove the retainer from the magnetic switch.



065R100016

13. Remove the magnetic switch.

Inspection and Repair

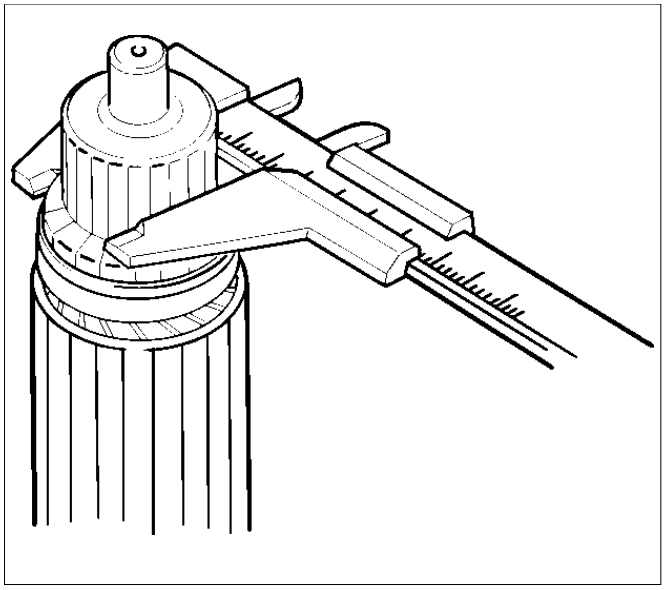
Repair or replace necessary parts if extreme wear or damage is found during inspection.

Armature

Measure the outer diameter of commutator, and replace with a new one if it is out of the limit.

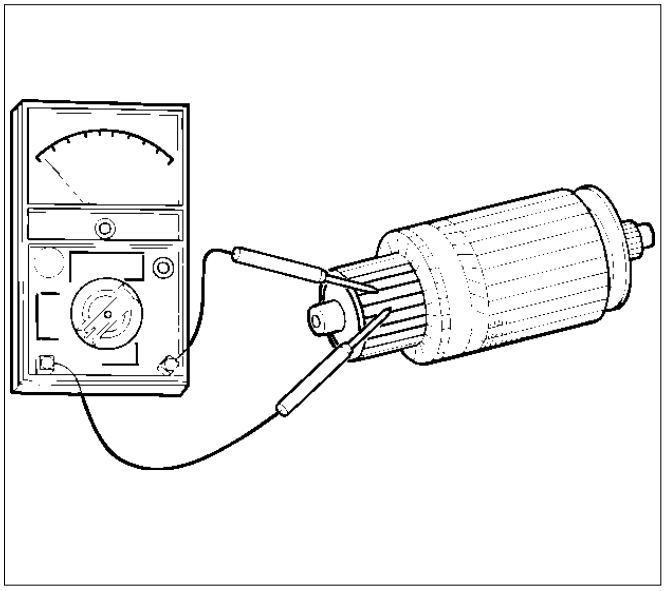
Standard: 30 mm (1.1811 in)

Limit: 29 mm (1.1417 in)



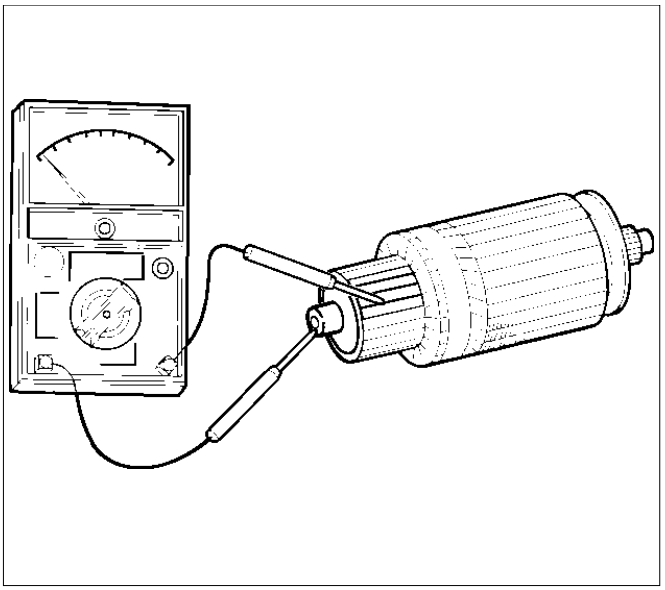
065RS014

Check for continuity between segment and segment on the commutator. Replace commutator if there is no continuity (i.e., disconnected).



065RS015

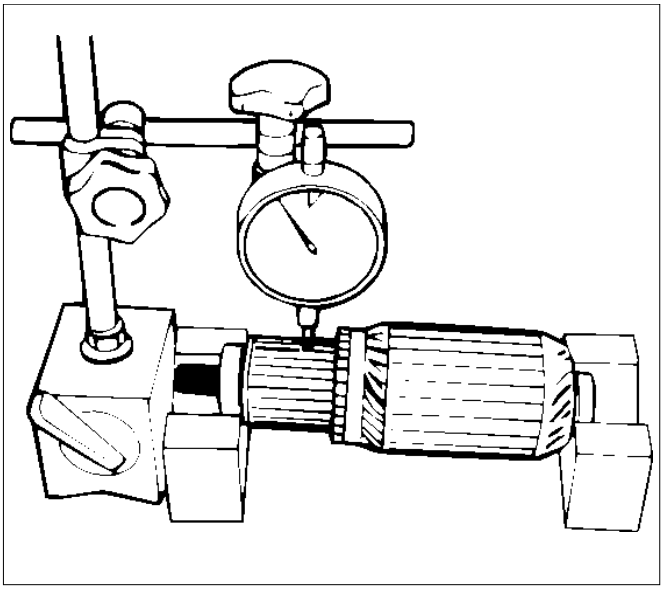
Check for continuity between commutator and shaft. Also, check for continuity between commutator and armature core, armature core and shaft. Replace commutator if there is continuity (i.e., internally grounded).



065RS016

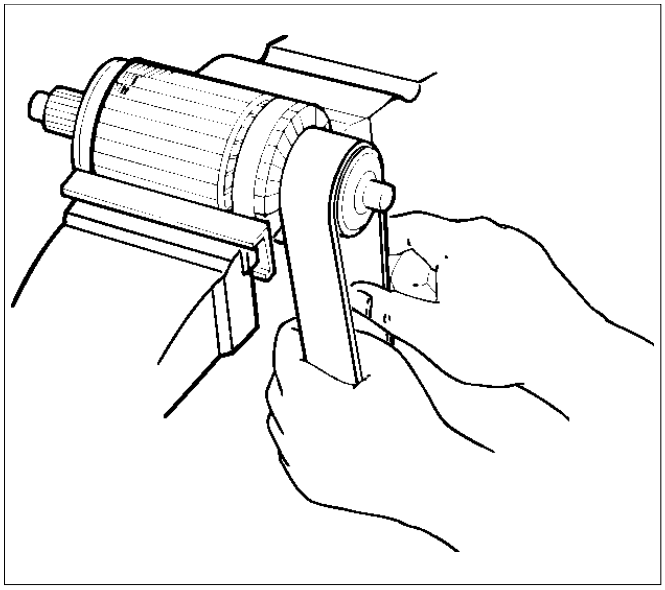
Measure runout of the commutator with a dial gauge. Repair or replace, if it exceeds the limit.

Limit: 0.4 mm (0.0157 in)



065RY00061

Polish the commutator surface with sandpaper #500 to #600 if it is rough.

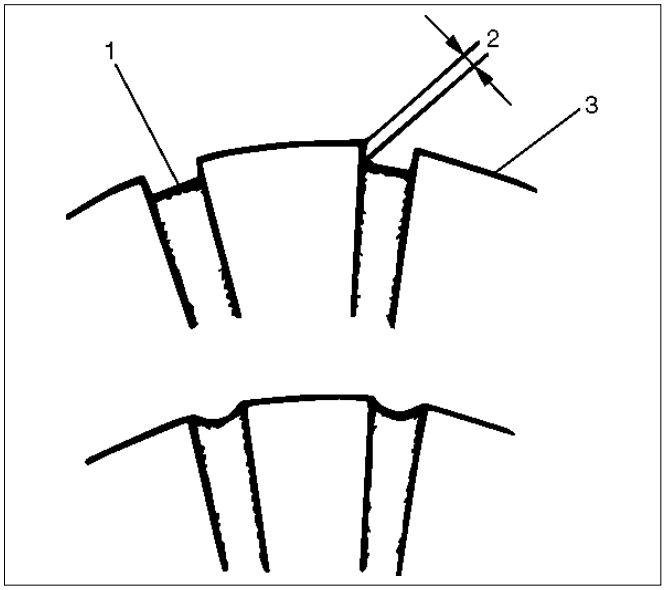


065RW012

Measure the depth of insulator in commutator. Replace, if it is below the limit.

Standard: 0.45 mm to 0.75 mm (0.0177 in to 0.0295 in)

Limit: 0.2 mm (0.008 in)



065RY00070

Legend

(1) Insulator
(2) Depth of Insulator
(3) Commutator Segments

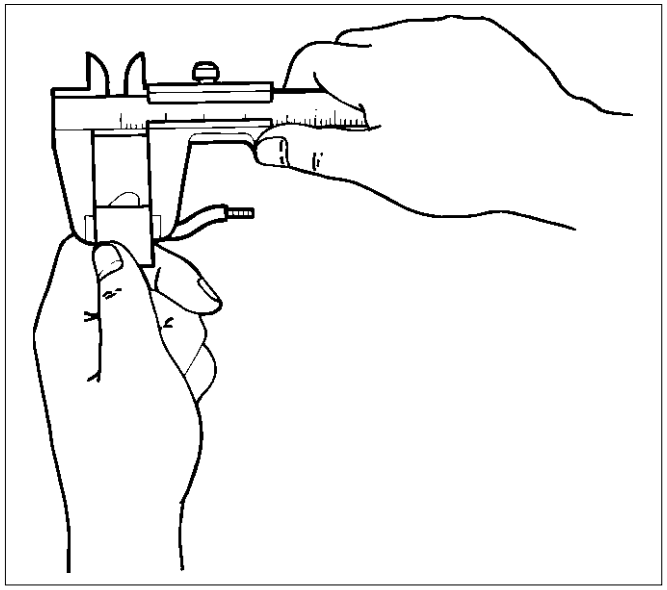
Brush

Measure the length of brush.

Replace with a new one, if it is below the limit.

Standard: 15 mm (0.5906 in)

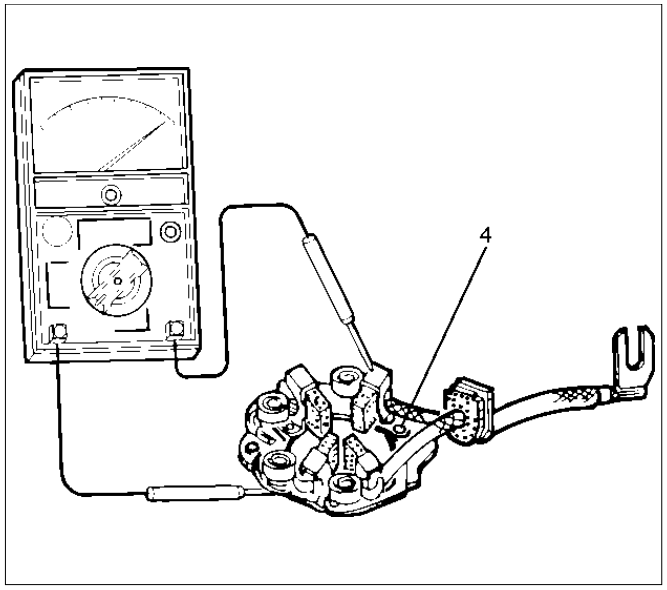
Limit: 11 mm (0.43 in)



065RW014

Brush Holder

Check for continuity between brush holder (+) (4) and base (–). Replace, if there is continuity (i.e., insulation is broken).



065RW015

Brush Spring

Use spring balancer to measure the spring setting force when remove the spring from the brush.

Standard: 17.65–23.54 N (38.9–51.9 lb)
Limit: 11.77 N (25.9 lb)

Magnetic Switch

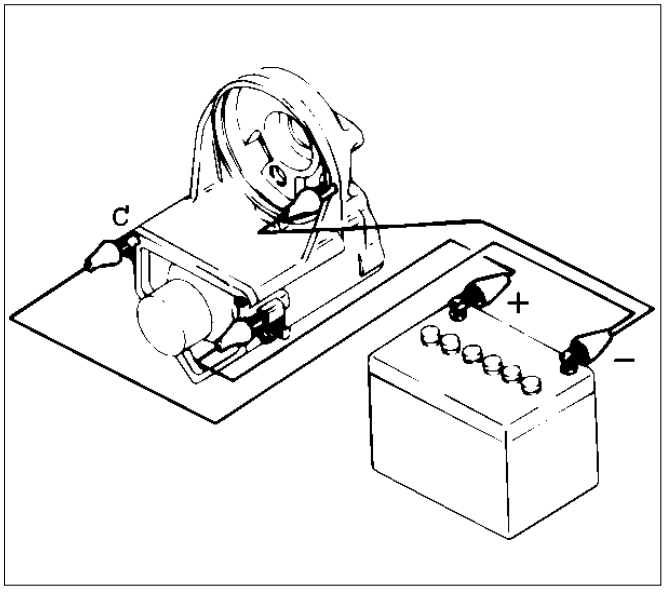
Temporarilly connect the magnetic switch between the overrunning clutch and housing.

Perform the steps described below in 3 to 5 seconds.

1. Pull in test

   Connect the ground (-) to terminal C and magnetic switch body.

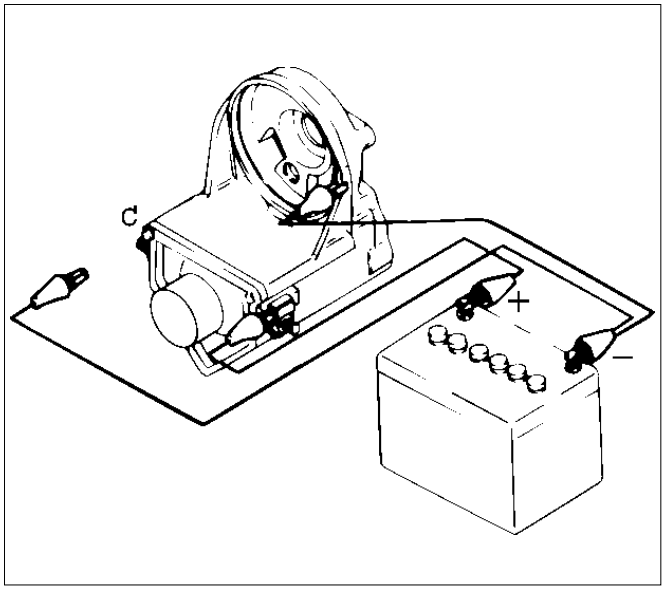
   Verify that the pinion pulls out when the battery (+) pole is connected to terminal 50.



065R100017

2. Hold in test

   Observe that the pinion stays when the lead wire is disconnected from terminal C.

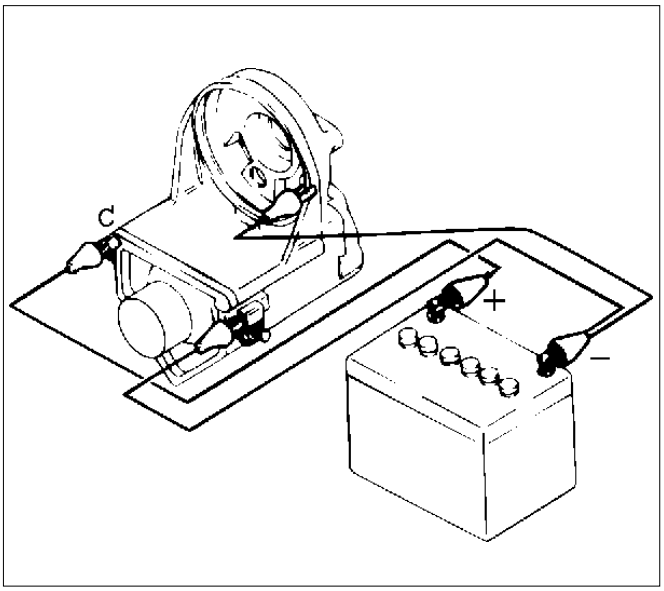


065R100018

3. Return test

   Connect the ground (-) to terminal 50 and magnetic switch body.

   Verify that the pinion pulls out when the battery (+) pole is connected to terminal C and the pinion pulls away when the lead wire is disconnected from terminal 50.

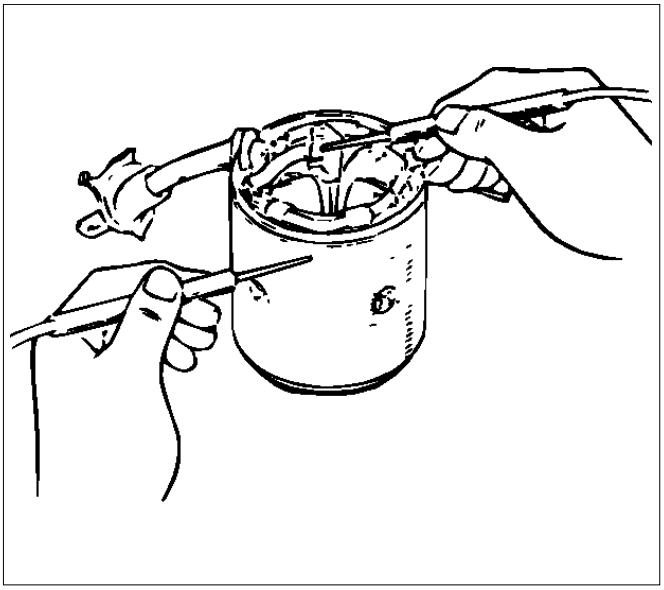


065R100019

Field Coil

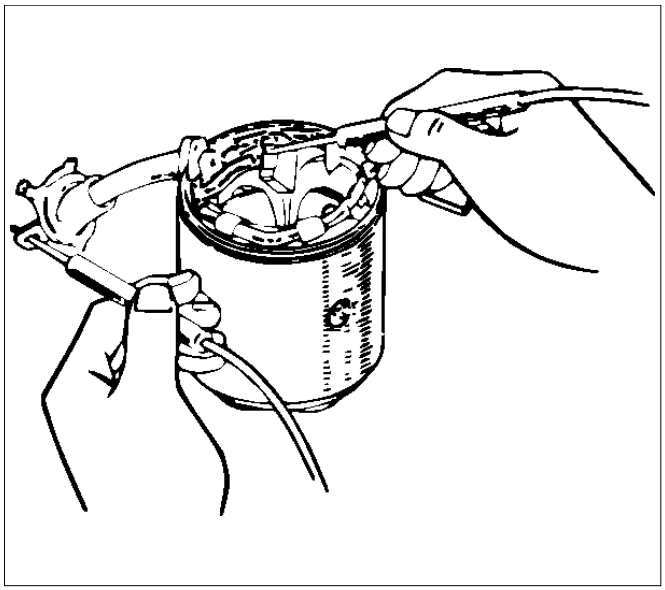
1. Check for continuity between the end of the field coil and yoke body.

   Replace the field coil, if there is continuity.



065RY00065

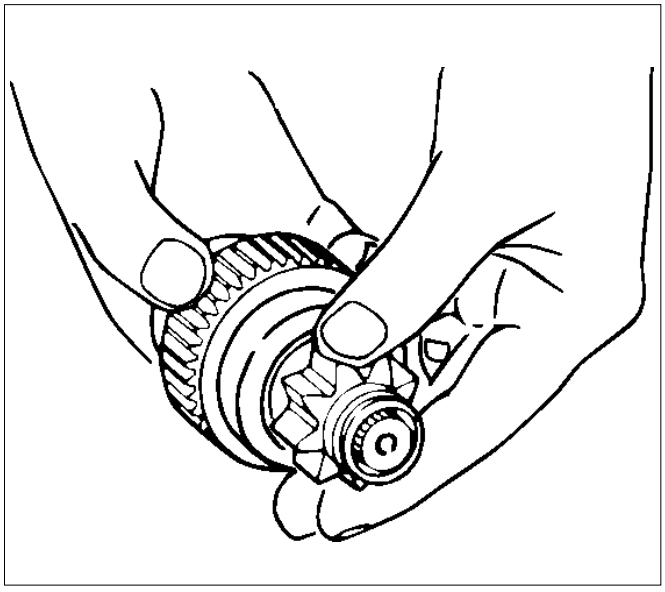
2. Check continuity between the lead wire of terminal C and brush.
   Replace the yoke assembly, if there is no continuity.



065RY00066

Overrunning Clutch

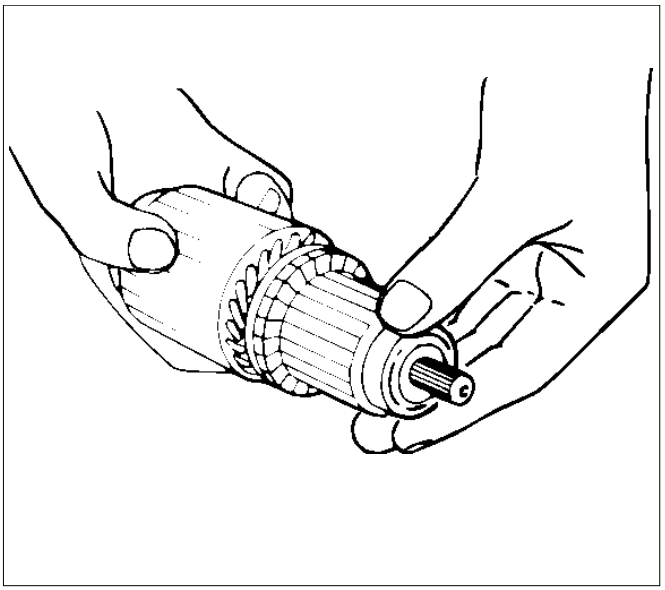
1. Visual check for excessive wear or damage.
2. Test the pinion rotation, it must rotate smoothly when rotated clockwise and it shouldn't rotate when turned counterclockwise.



065RY00067

Bearing

1. Inspect excessive wear or damage.
   Replace the bearing if an abnormal noise is heard under normal operating condition.



065RY00068

Reassembly

To install, follow the removal steps in the reverse order, noting the following points:

Grease application places

- Bearing in rear cover
- Gears in reduction gear
- Sliding portion of pinion

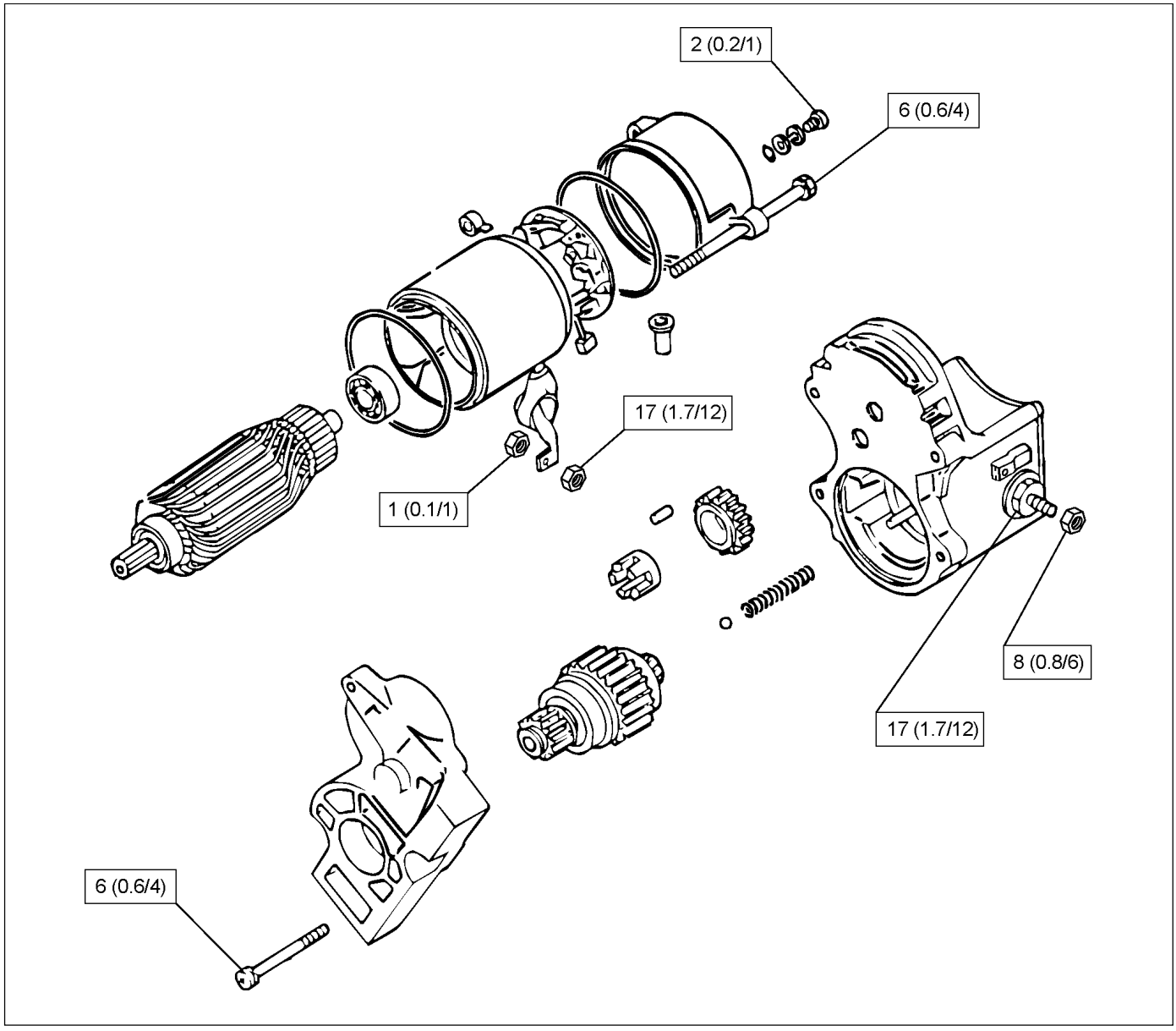
Main Data and Specifications

General Specifications

Model	ADX4IH
Rating	
Voltage	12 V
Output	1.4 Kw
Time	30 sec
Number of teeth of pinion	9
Rotating direction(as viewed from pinion)	Clockwise
Weight(approx.)	3.8kg (8.4lb)
No–load characteristics	
Voltage /Current	11.5V/90A or less
Speed	3000rpm or more
Load characteristics	
Voltage/current	8.5V/350A or less
Torque	13.2Nm (1.35kgm/9.77lb in.) or more
Speed	1000rpm or more
Locking characteristics	
Voltage/current	2.4V/500A or less
Torque	11.8N·m (1.2kg·m/8.68lb in) or more

Torque Specifications

N·m (kg·m/lb ft)



RTW46DLF000101

Charging System

General Description

The IC integral regulator charging system and its main components are connected as shown in illustration.

The regulator is a solid state type and it is mounted along with the brush holder assembly inside the generator installed on the rear end cover.

The generator does not require particular maintenance such as voltage adjustment.

The rectifier connected to the stator coil has eight diodes to transform AC voltage into DC voltage.

This DC voltage is connected to the output terminal of generator.

General On–Vehicle Inspection

The operating condition of charging system is indicated by the charge warning lamp. The warning lamp comes on when the starter switch is turned to “ON" position. The charging system operates normally if the lamp goes off when the engine starts.

If the warning lamp shows abnormality or if undercharged or overcharged battery condition is suspected, perform diagnosis by checking the charging system as follows:

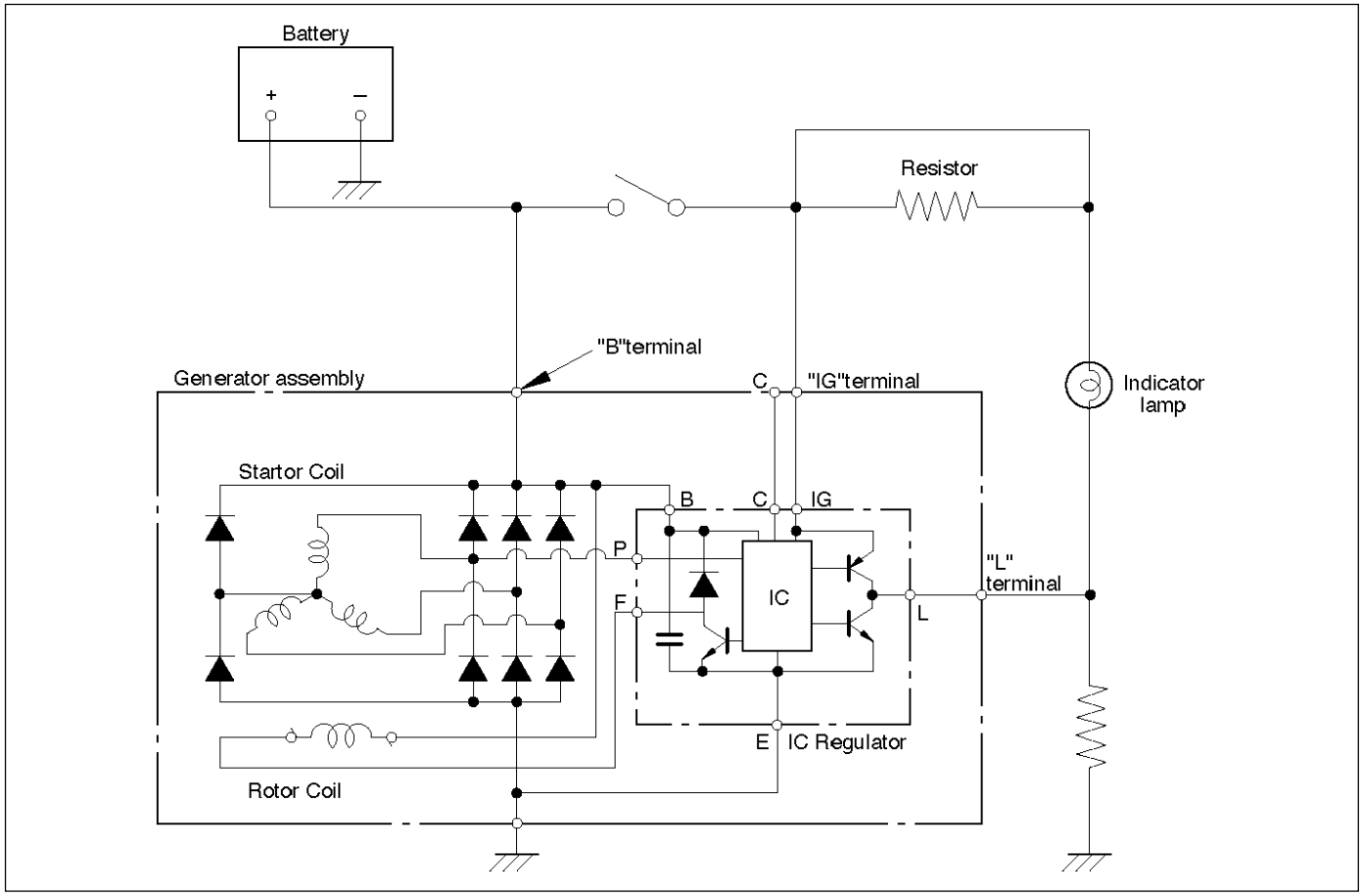
1. Check visually the belt and wiring connector.
2. With the engine stopped, turn the stator switch to “ON" position and observe the warning lamp.

   If lamp does not come on:

   Disconnect wiring connector from generator, and ground the terminal “L" on connector side.

   If lamp comes on:

   Repair or replace the generator.

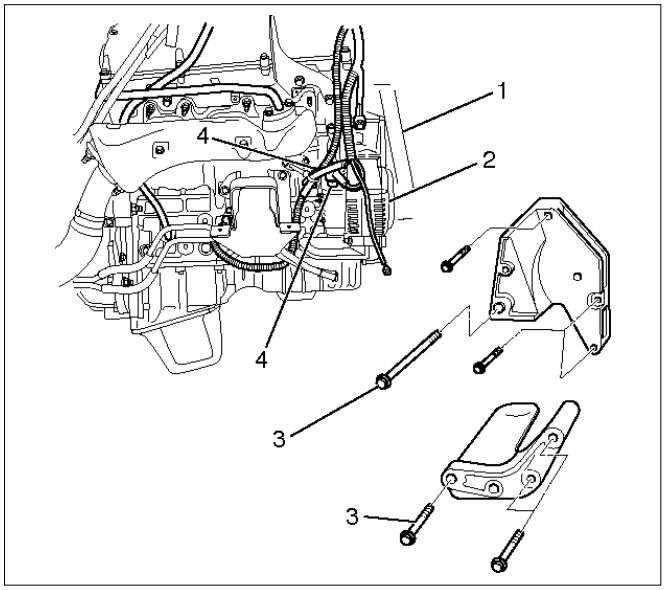


F06RW009

Generator

Removal

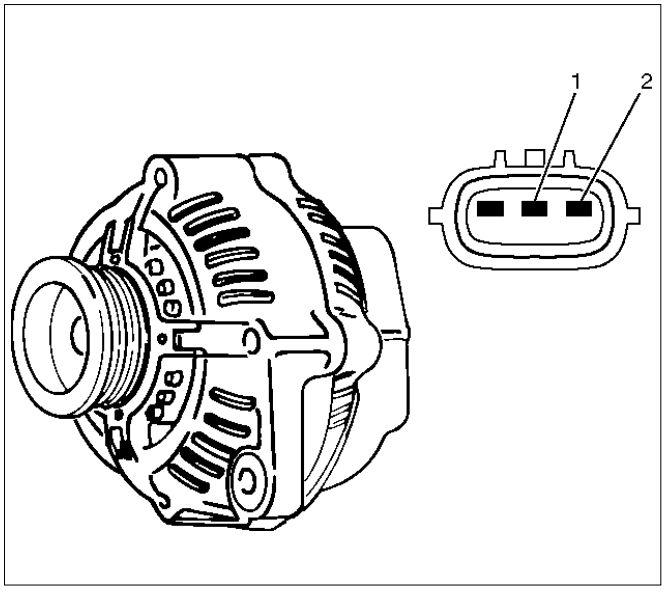
1. Disconnect battery ground cable.
2. Move drive belt tensioner to loose side using wrench then remove drive belt (1).
3. Disconnect the wire from terminal “B" and disconnect the connector (4).
4. Remove generator fixing bolt (3).
5. Remove generator assembly (2).



060RW002

Inspection

1. Disconnect the wiring connector from generator.
2. With the engine stopped, turn starter switch to “ON" and connect a voltmeter between connector terminal L (2) and ground or between terminal IG (1) and ground.



066RW001

If voltage is not present, the line between battery and connector is disconnected and so requires repair.

3. Reconnect the wiring connector to the generator, run the engine at middle speed, and turn off all electrical devices other than engine.
4. Measure battery voltage. If it exceeds 16V, repair or replace the generator.
5. Connect an ammeter to output terminal of generator, and measure output current under load by turning on the other electrical devices (eg., headlights). At this time, the voltage must not be less than 13V.

Installation

1. Install generator assembly to the position to be installed.
2. Install generator assembly and tighten the fixing bolts to the specified torque.

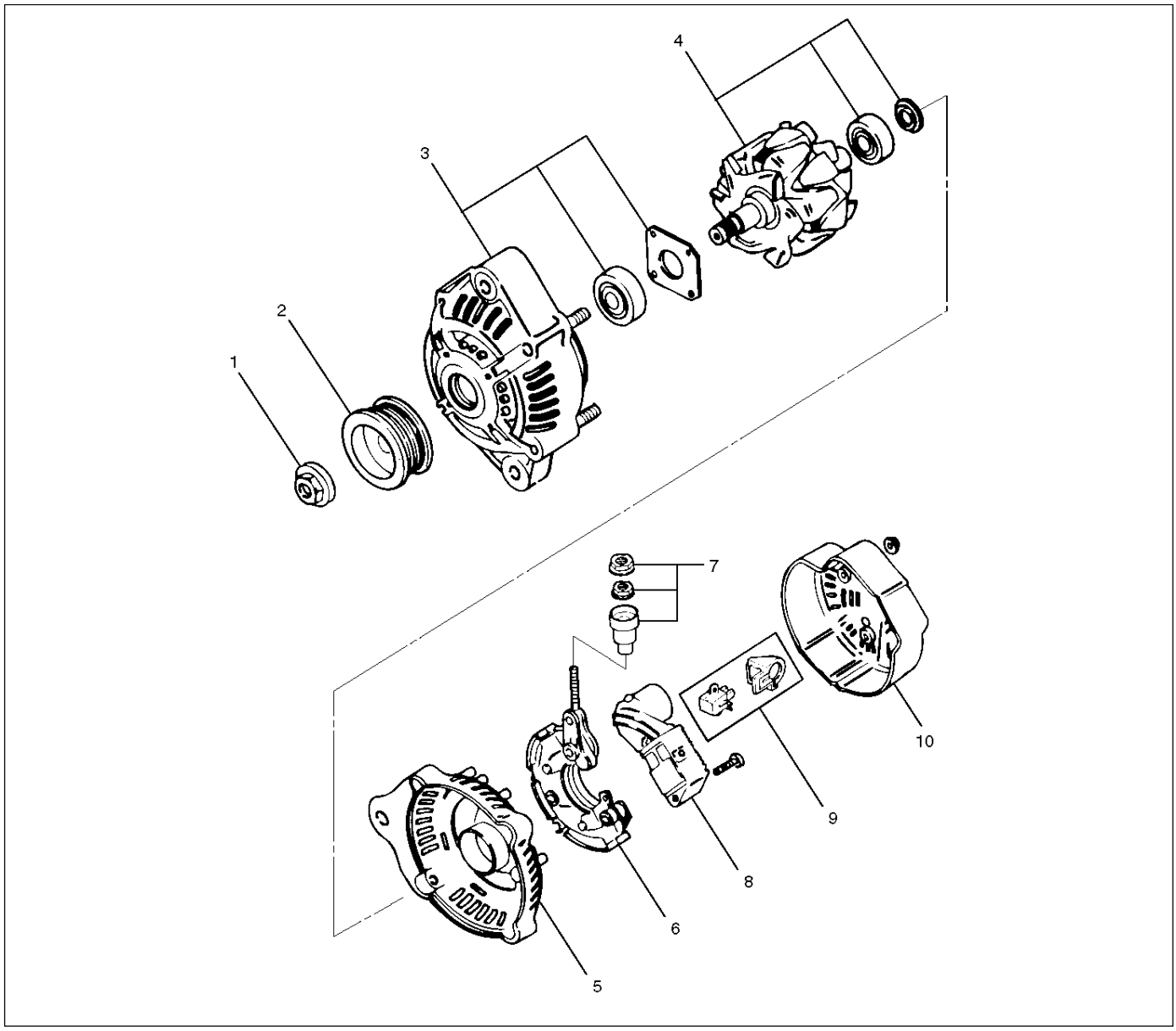
   Torque:

   M10 bolt: 52 N·m (5.3 kg·m/38 lb ft)

   M8 bolt: 25 N·m (2.5 kg·m/18 lb ft)

3. Connect wiring harness connector and direct terminal “B".
4. Move drive belt tensioner to loose side using wrench, then install drive belt to normal position.
5. Reconnect battery ground cable.

Disassembled View



066RW007

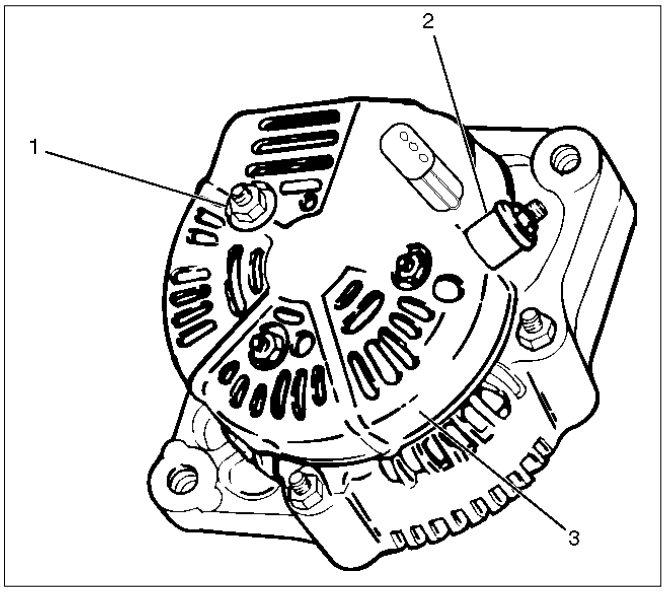
Legend

(1) Pulley Nut
(2) Pulley
(3) Front Cover Assembly
(4) Rotor Assembly
(6) Rectifier
(7) Terminal Insulator and Nut
(8) Regulator Assembly
(9) Brush Holder Assembly
(10) Rear Cover

Disassembly

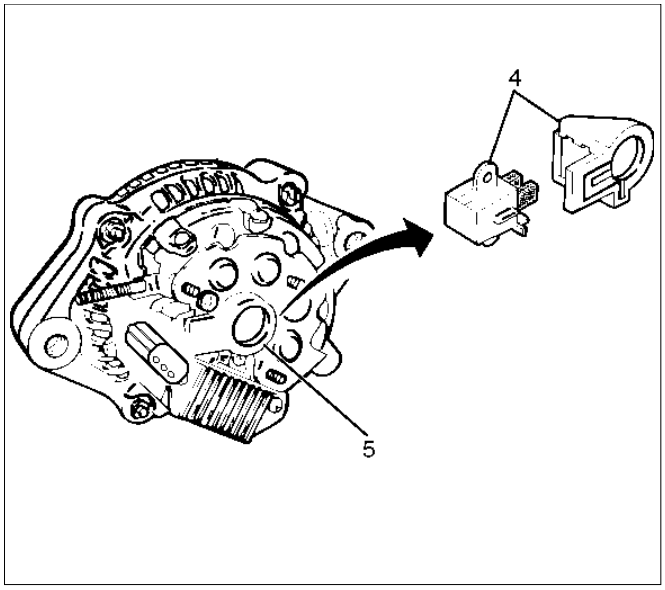
1. Terminal insulator and nut (2).

2. Remove three nuts(1) on the rear cover and a nut on terminal B and insulator, then remove the rear cover(3).



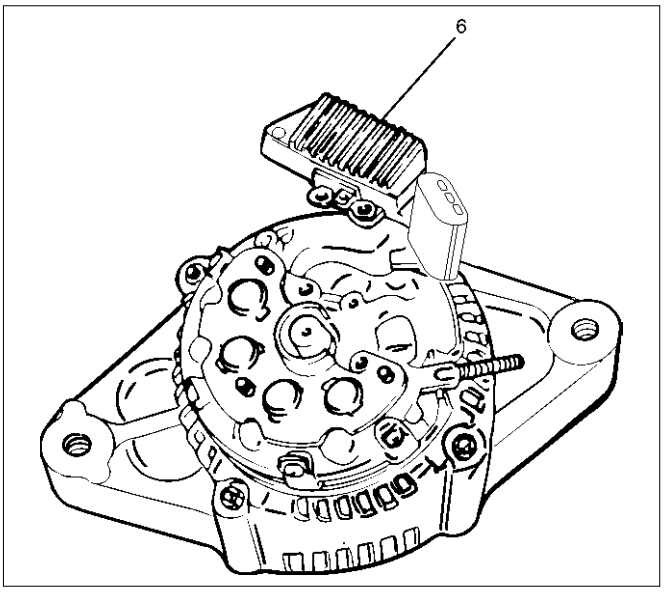
060RW005

3. Remove two screws that fix the brush holder(5) and rectifier, then remove the brush holder assembly(4).



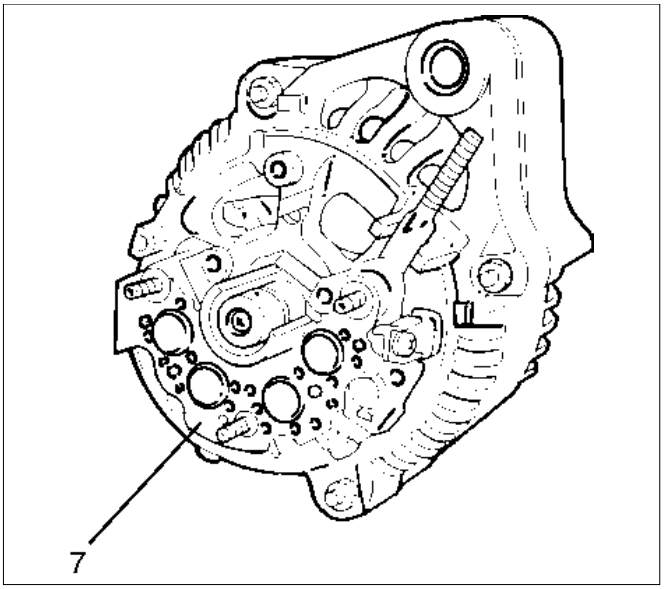
060RW004

4. Remove three screws on the IC regulator, then the IC regulator assembly(6).



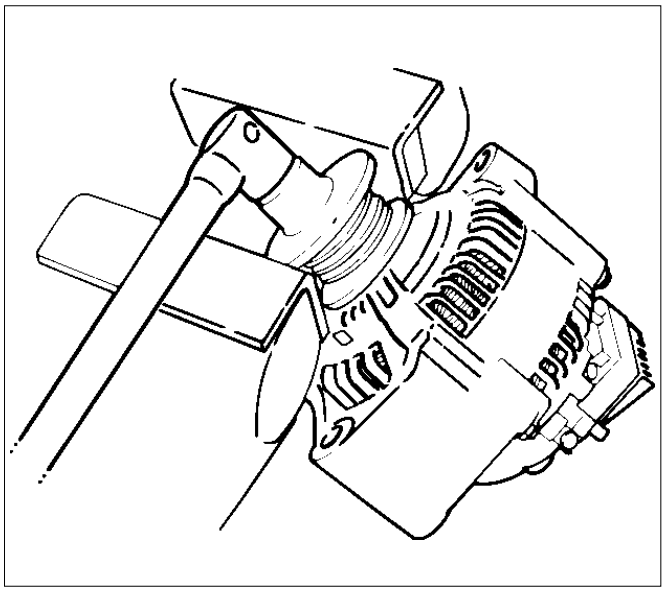
060RW003

5. Remove four screws that fix rectifier(7) and stator lead wires.



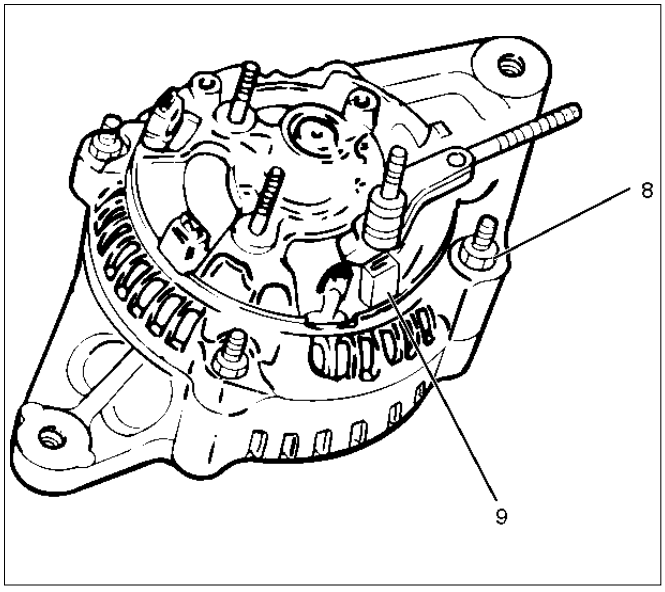
066RW004

6. Secure the pulley directly in the vise between two copper plates, and remove the nut and pulley.



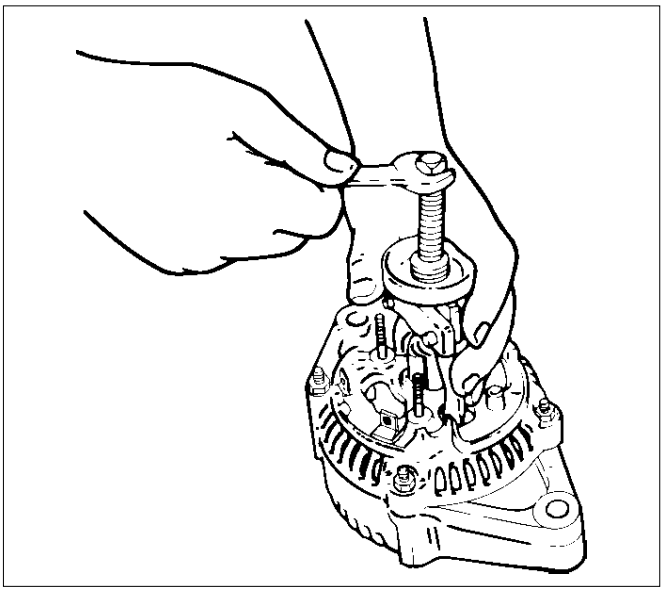
066RS010

7. Remove four nuts(8) that secure the front cover assembly and rear end cover, and an insulator(9).



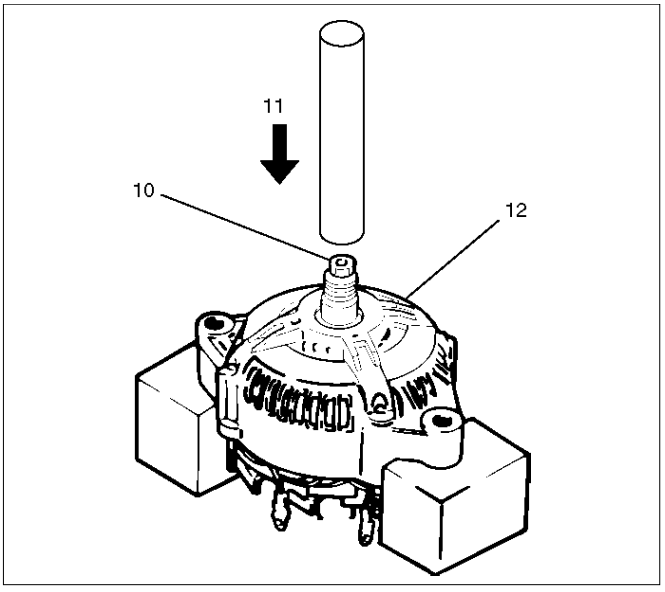
066RW005

8. Use the puller to remove the rear end cover.
9. Rotor assembly



066RS012

10. Pull the rotor assembly(10) off the front cover assembly(12) using a bench press(11).



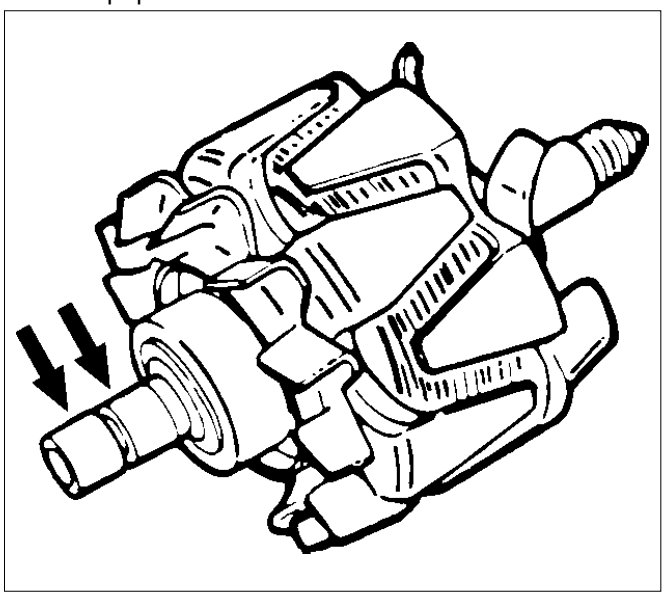
066RW006

Inspection and Repair

Repair or replace necessary parts if extreme wear or damage is found during inspection.

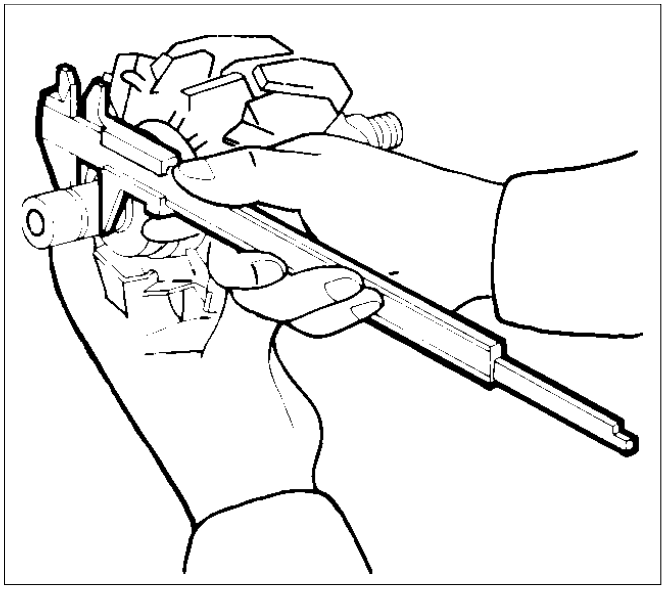
Rotor Assembly

1. Check the rotor slip ring surfaces for contamination and roughness. If rough, polish with #500—600 sandpaper.



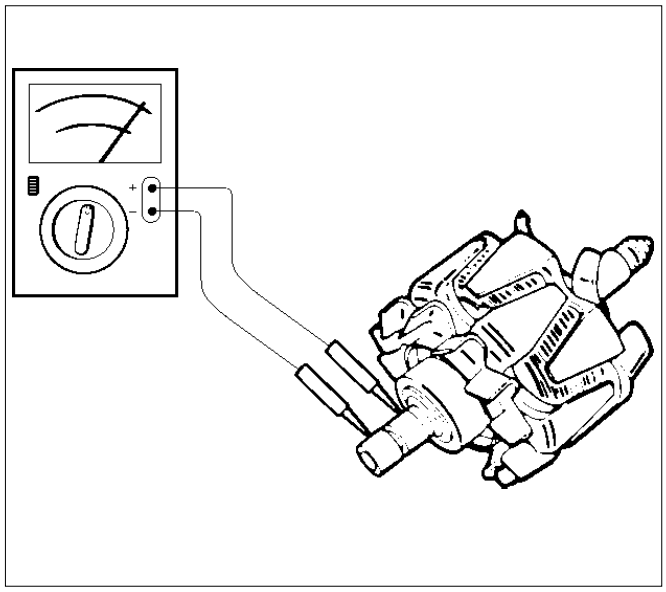
066RS014

2. Measure the slip ring diameter, and replace if it exceeds the limit.



066RS015

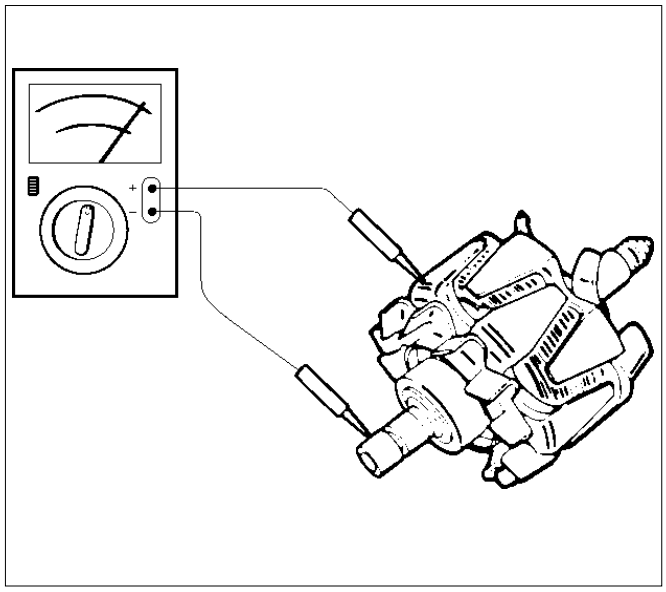
3. Check resistance between slip rings, and replace if there is no continuity.



066RS016

4. Check for continuity between slip ring and rotor core.

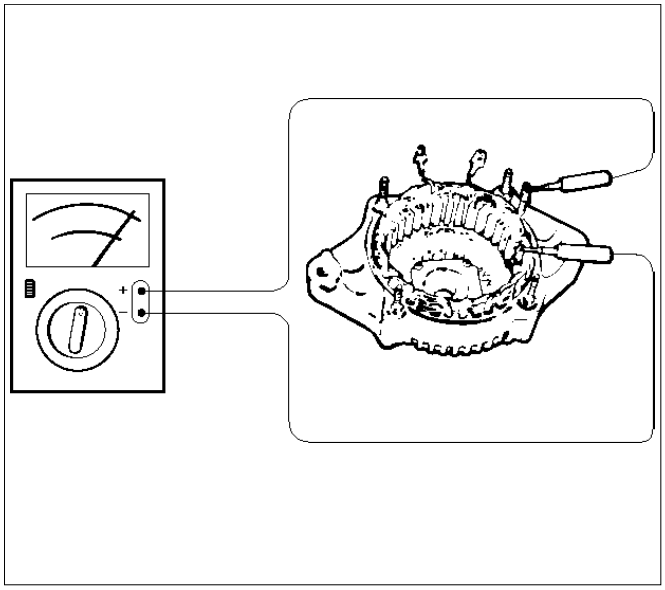
   In case of continuity, replace the rotor assembly.



066RS017

Stator Coil

1. Measure resistance between respective phases.
2. Measure insulation resistance between stator coil and core with a mega–ohmmeter.
   If less than standard, replace the coil.



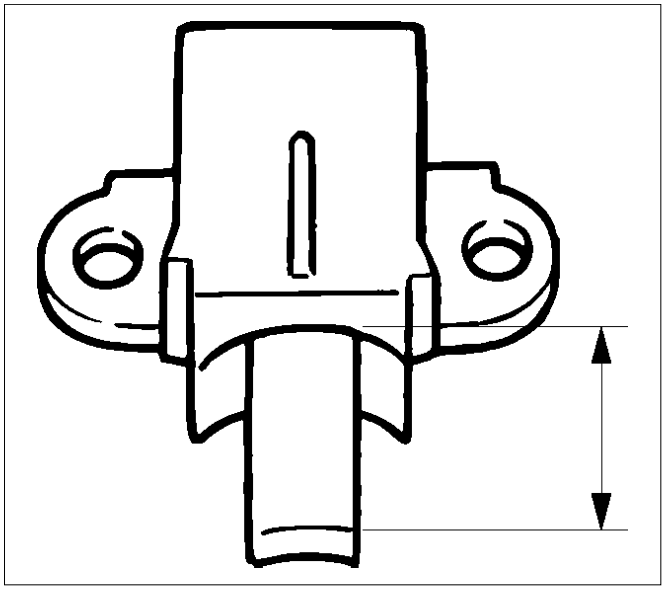
066RS018

Brush

Measure the brush length.
If more than limit, replace the brush.

Standard: 10.mm (0.4134 in)

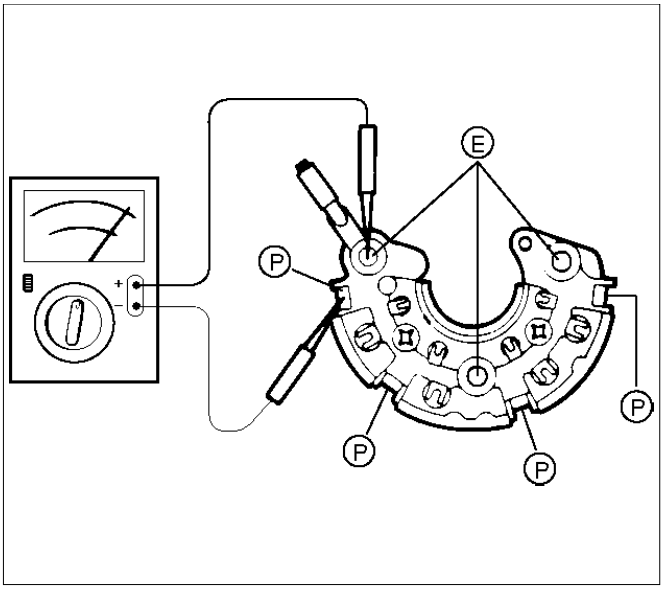
Limit: 8.4.mm (0.3307 in)



066RS019

Rectifier Assembly

Check for continuity across “P" and “E" in the ∴ 100W range of multimeter.

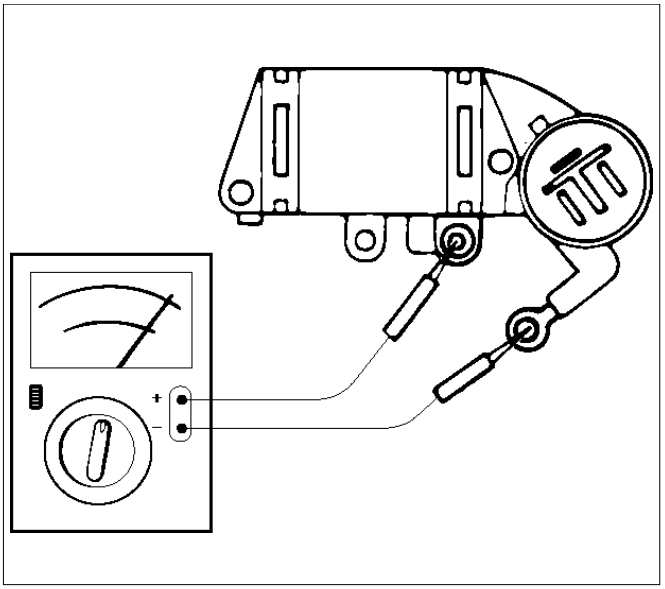


066RW002

Change polarity, and make sure that there is continuity in one direction, and not in the reverse direction. In case of continuity in both directions, replace the rectifier assembly.

IC Regulator Assembly

Check for continuity across “B" and “F" in the ∴ 100W range of multimeter.



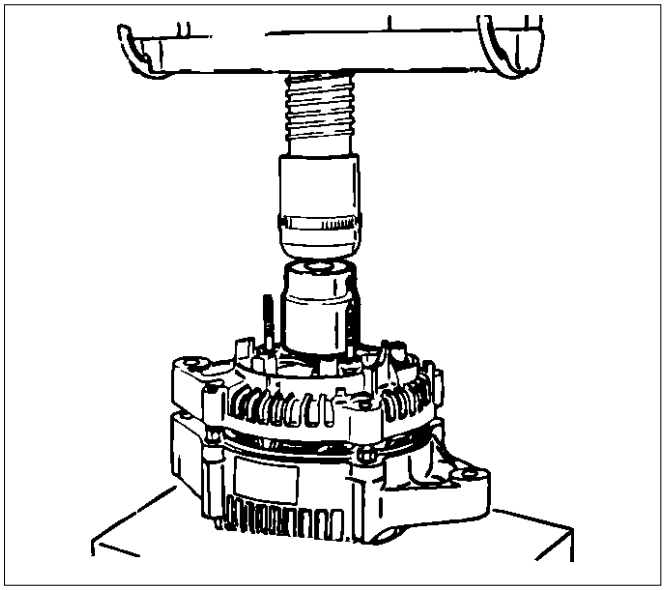
066RS021

Change polarity, and make sure that there is continuity in one direction, and not in the reverse direction. In case of continuity in both directions, replace the IC regulator assembly.

Reassembly

To reassemble, follow the disassembly steps in the reverse order, noting the following points:

1. Using a press with a socket wrench attached, reassemble rotor and rear end cover assembly in the front cover.

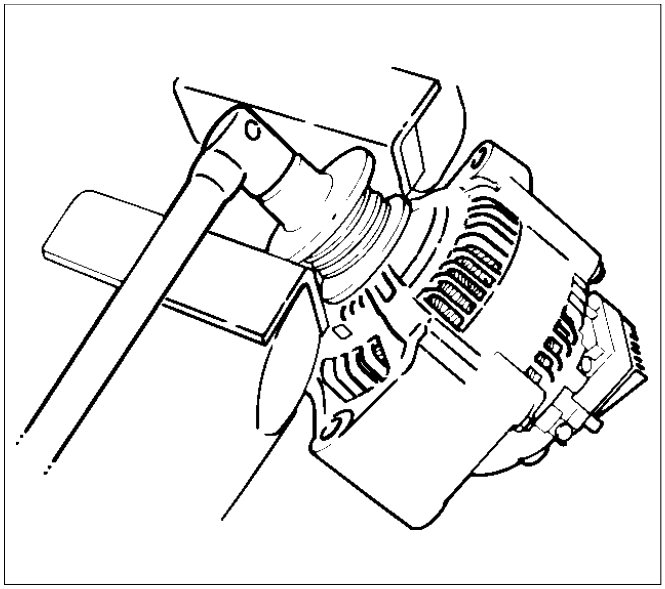


066RS022

2. Install pulley on the rotor.

   Secure the pulley directly in the vise between two copper plates, and tighten nut to the specified torque.

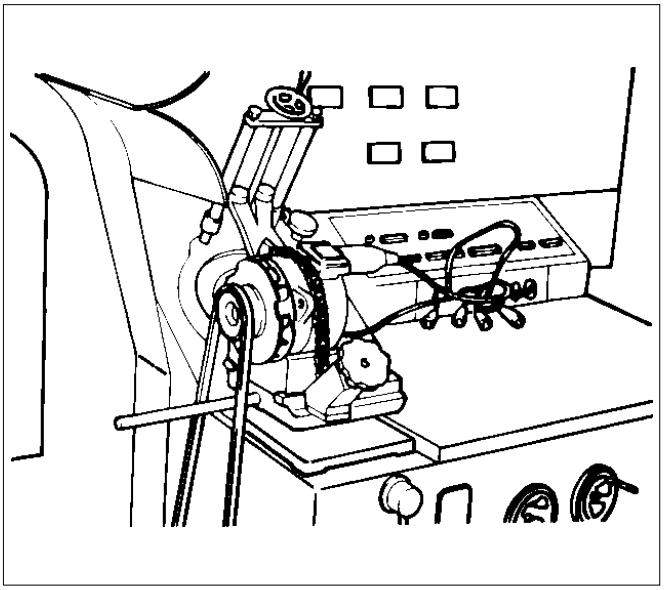
   Torque: 111 N·m (11.3 kg·m/82 lb ft)



066RS010

Bench Test

Conduct a bench test of the generator.



066RS023

Preparation

Remove generator from the vehicle (see “Generator removal").

1. Secure generator to the bench test equipment and connect wires.

   Terminal “IG" for energization

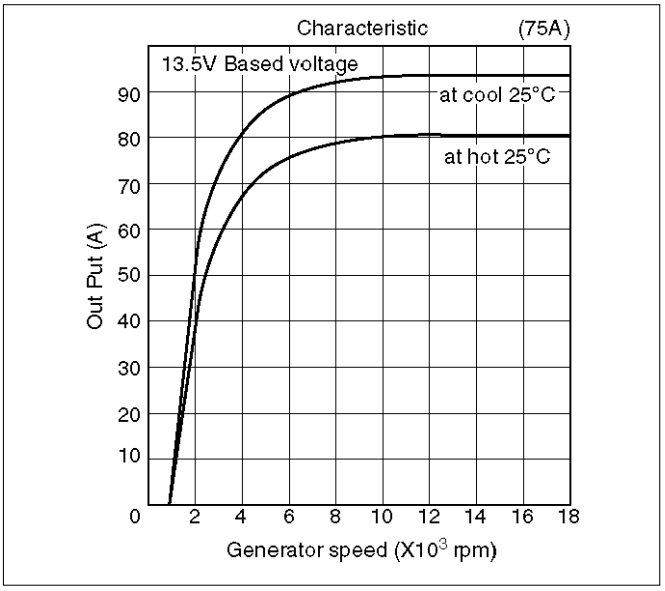
   Terminal “L" for neutral (warning lamp)

   Terminal “B" for output

2. Conduct the generator characteristic test.

   Characteristics of generator are shown in illustration.

   Repair or replace the generator if its outputs are abnormal.



B06RW001

Main Data and Specifications

General Specifications

Parts Number	102211-1740
Model	ACJV74
Rated voltage	12 V
Rated output	90 A
Rotating direction (As viewed from pulled)	Clockwise
Pulley effective diameter	57.5 mm (2.26 in)
Weight	5.1 kg (11 lb)

MEMO

ENGINE

3.5L ENGINE DRIVEABILITY AND EMISSIONS

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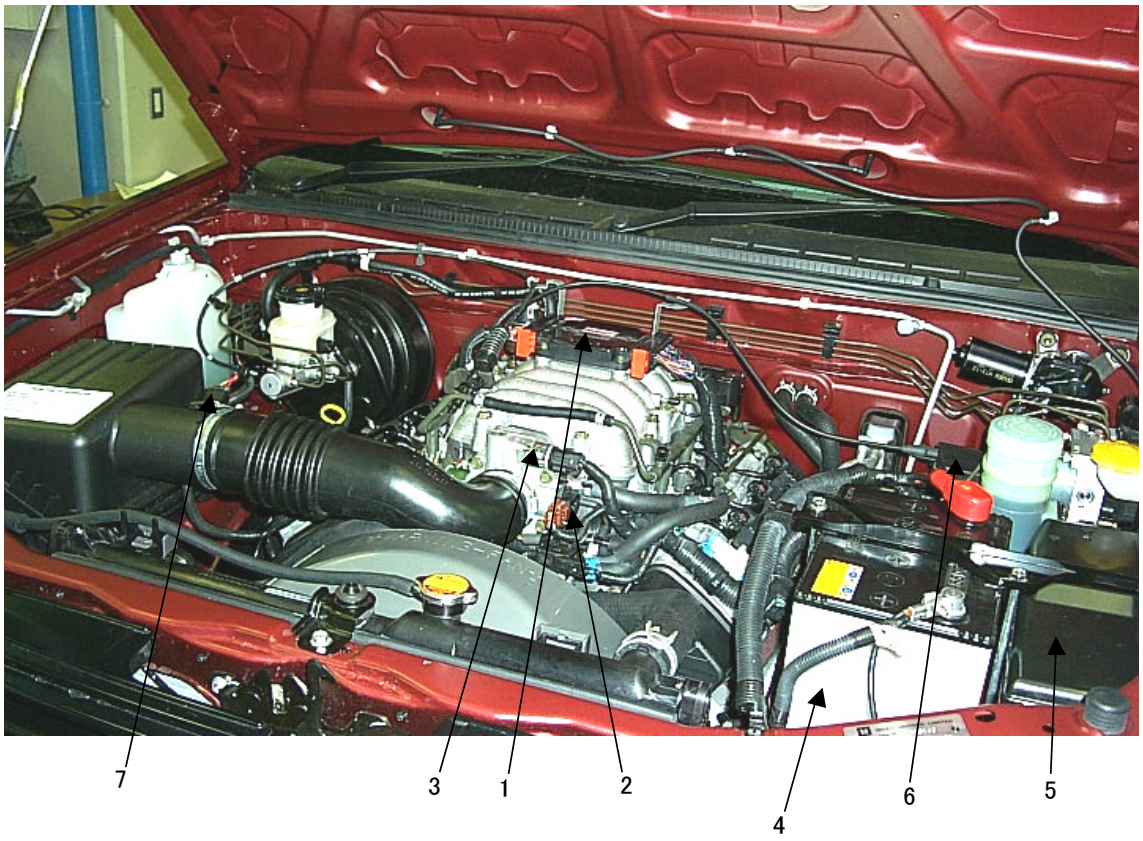
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ABBREVIATION CHARTS

Abbreviations	Appellation
A/C	Air conditioner
A/T	Automatic transmission
ACC	Accessory
BLK	Black
BLU	Blue
BRN	Brown
CAN	Controller Area Network
CEL	Check engine lamp
CKP	Crankshaft position
CMP	Camshaft position
DLC	Data link connector
DTC	Diagnosis trouble code
DVM	Digital voltage meter
ECM	Engine control module
ECT	Engine coolant temperature
EEPROM	Electrically erasable & programmable read only memory
EGR	Exhaust gas recalculation
GND	Ground
GRY	Gray
HO2S	Heated Oxygen Sensor
IAT	Intake air temperature
IAC	Idle air control
IG	Ignition
M/T	Manual transmission
MAF	Mass air flow
MIL	Malfunction indicator lamp
OBD	On-board diagnostic
ORN	Orange
PNK	Pink
PROM	Programmable read only memory
RED	Red
SW	Switch
TPS	Throttle position sensor
TCM	Transmission control module
VCC	Voltage Constant Control
VIO	Violet
VSS	Vehicle speed sensor
WHT	White
WOT	Wide open throttle
YEL	Yellow

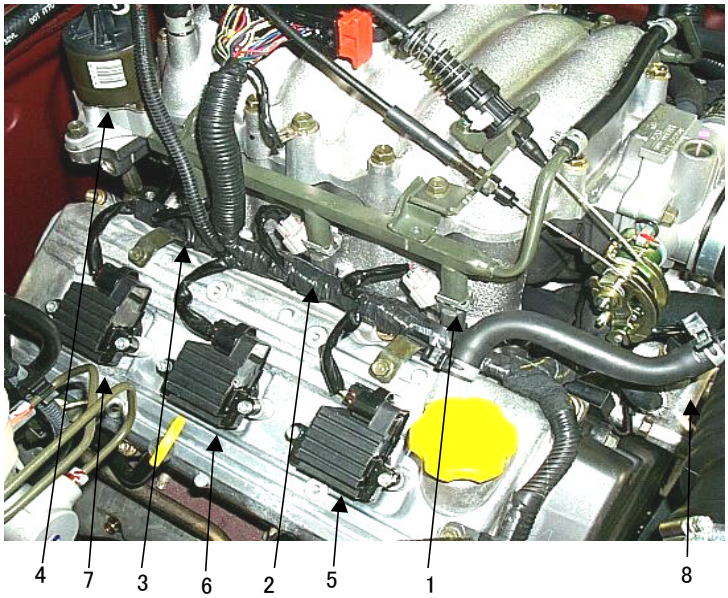
COMPONENT LOCATOR

ENGINE COMPONENT LOCATOR TABLE



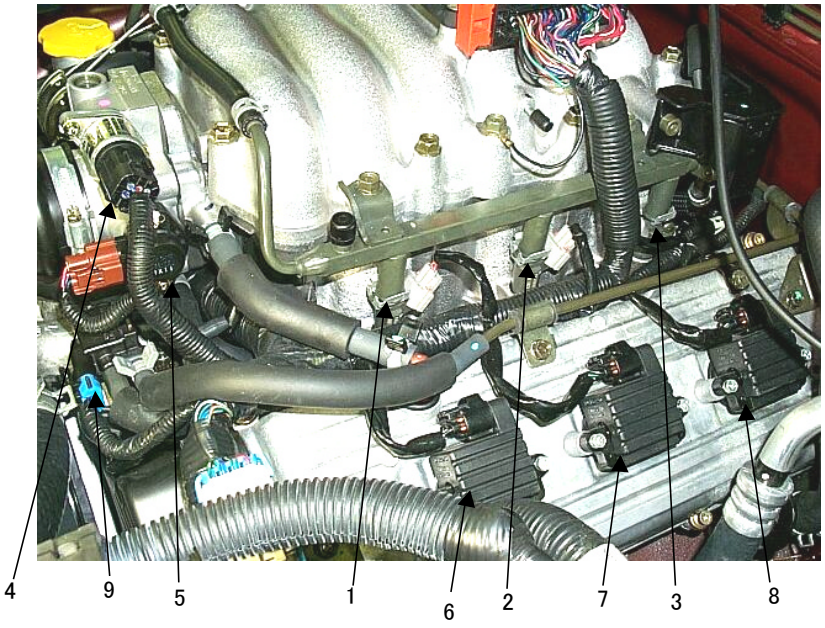
Legend

(1) Engine Control Module (ECM)
(2) Throttle Position Sensor (TPS)
(3) Idle Air Control (IAC) Valve
(4) Battery
(5) Relay & Fuse Box
(6) Auto Cruise Actuator
(7) Mass Air Flow (MAF) & Intake Air Temperature (IAT) Sensor Assembly



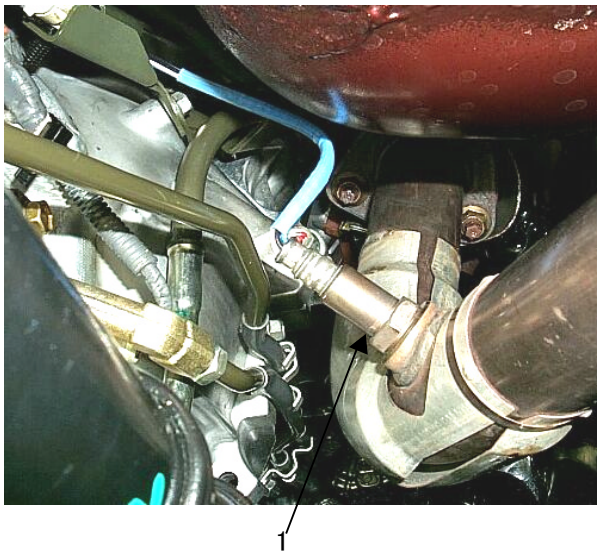
Legend

(1) Injector #1 Cylinder
(2) Injector #3 Cylinder
(3) Injector #5 Cylinder
(4) EGR Valve
(5) Ignition Coil #1 Cylinder
(6) Ignition Coil #3 Cylinder
(7) Ignition Coil #5 Cylinder
(8) Engine Coolant Temperature (ECT) Sensor

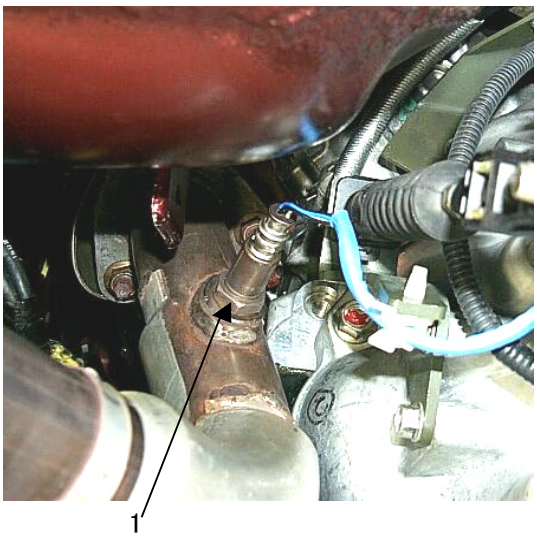


Legend

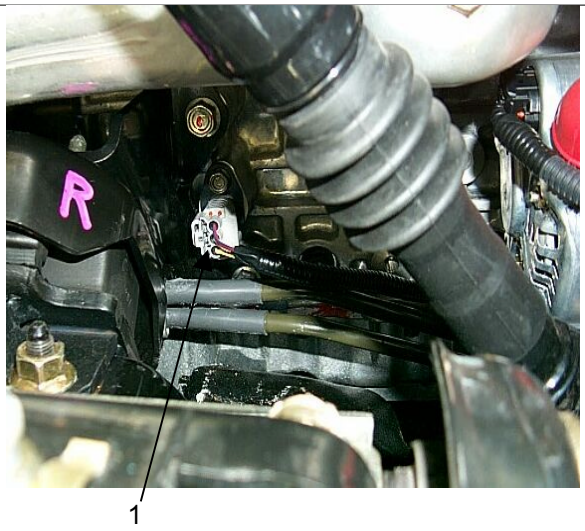
(1) Injector #2 Cylinder
(2) Injector #4 Cylinder
(3) Injector #6 Cylinder
(4) Idle Air Control (IAC) Valve
(5) Throttle Position Sensor
(6) Ignition Coil #2 Cylinder
(7) Ignition Coil #4 Cylinder
(8) Ignition Coil #6 Cylinder
(9) Canister Purge Solenoid Valve



(1) Bank 1 Heated Oxygen Sensor (RH)



(1) Bank 2 Heated Oxygen Sensor (LH)



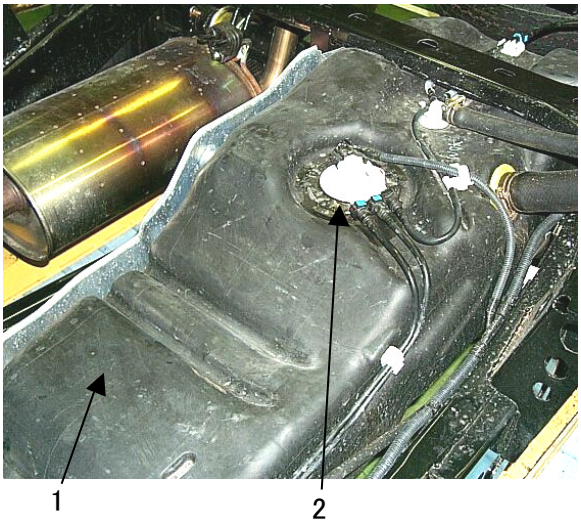
(1) Crankshaft Position (CKP) Sensor



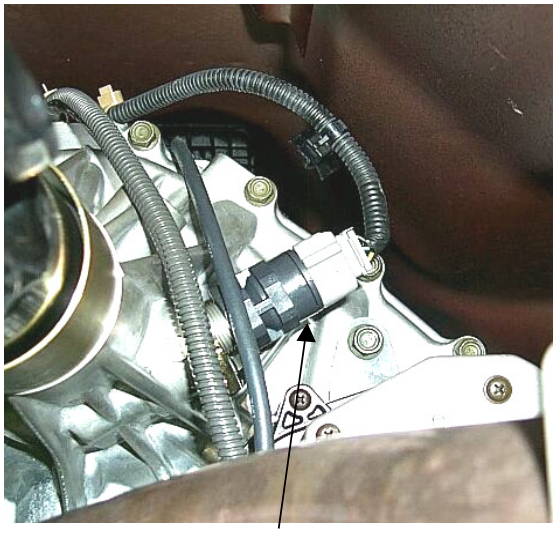
(1) Camshaft Position Sensor (CMS)
(2) EGR Valve



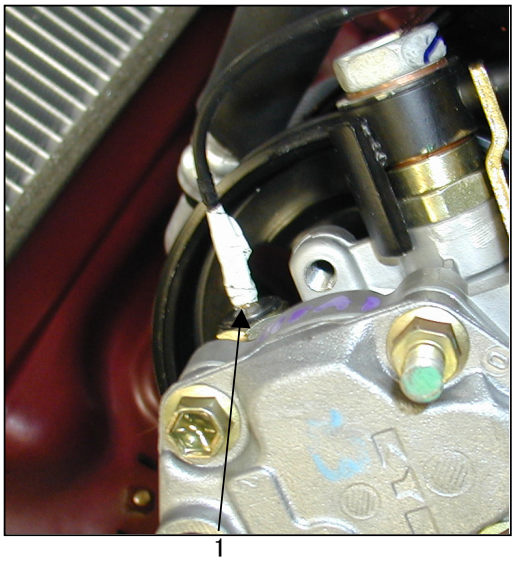
(1) Canister



(1) Fuel Tank
(2) Fuel Pump

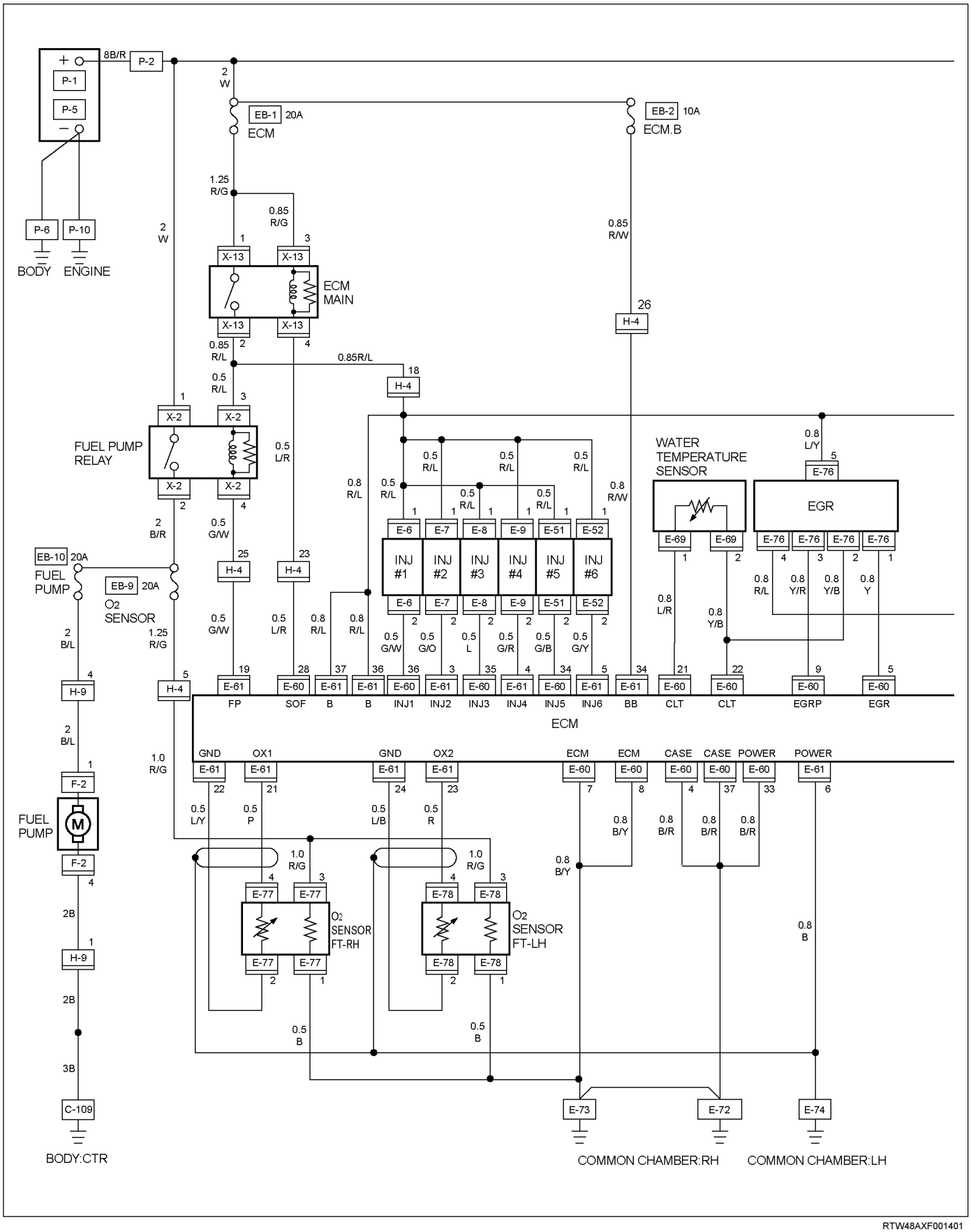


(1) Vehicle Speed Sensor (VSS)

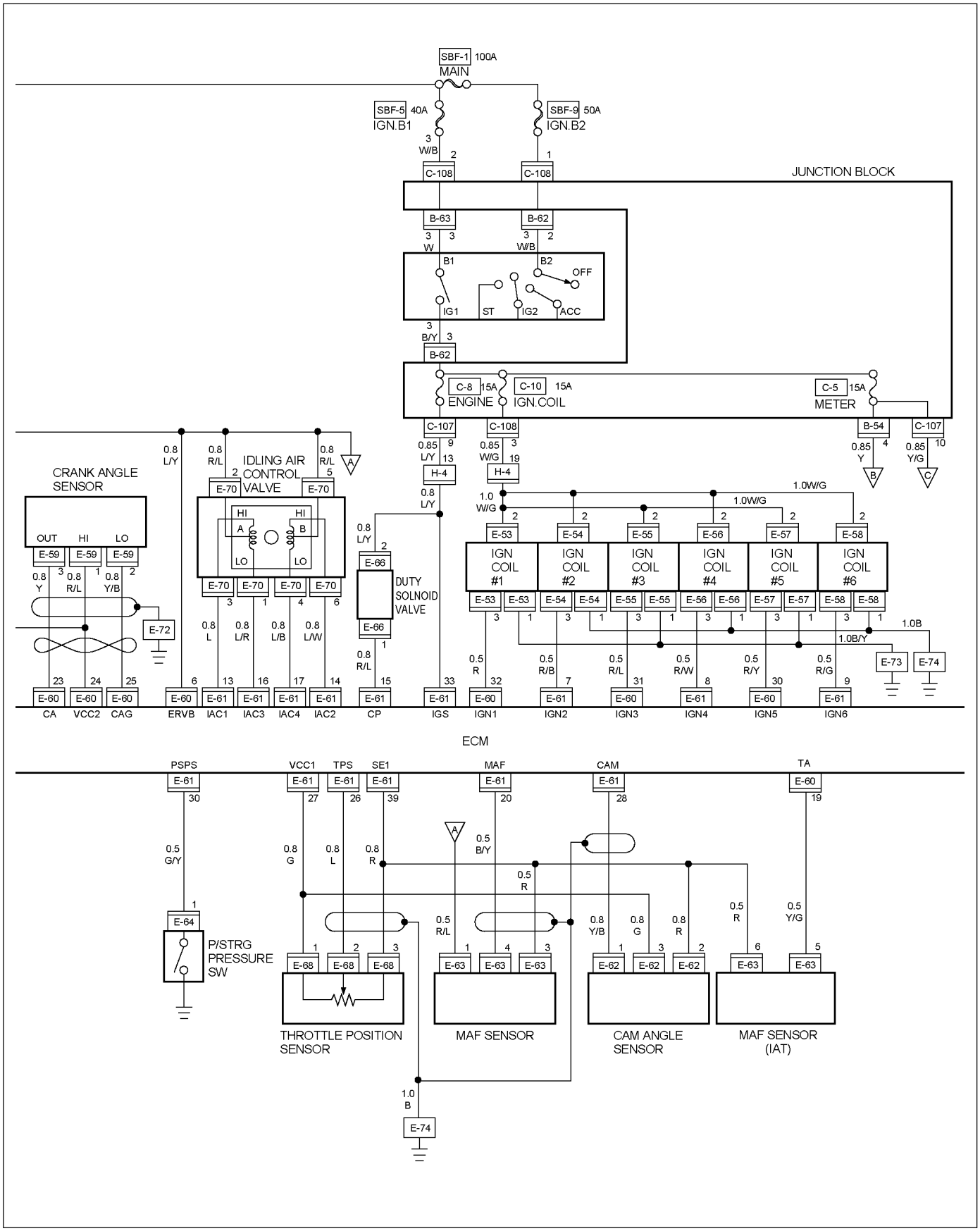


(1) Power Steering Pressure Switch

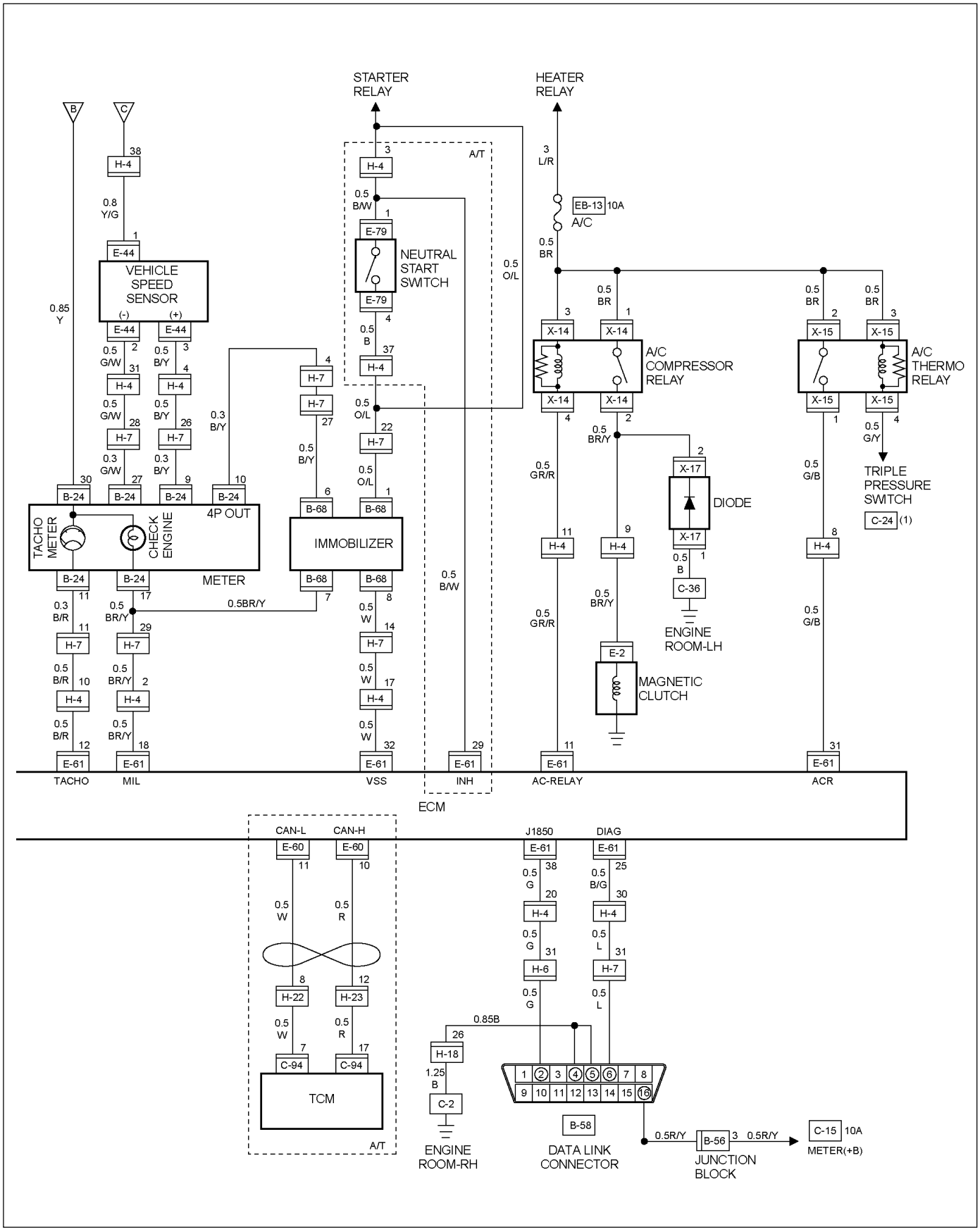
ECM CIRCUIT DIAGRAM



RTW48AXF001401

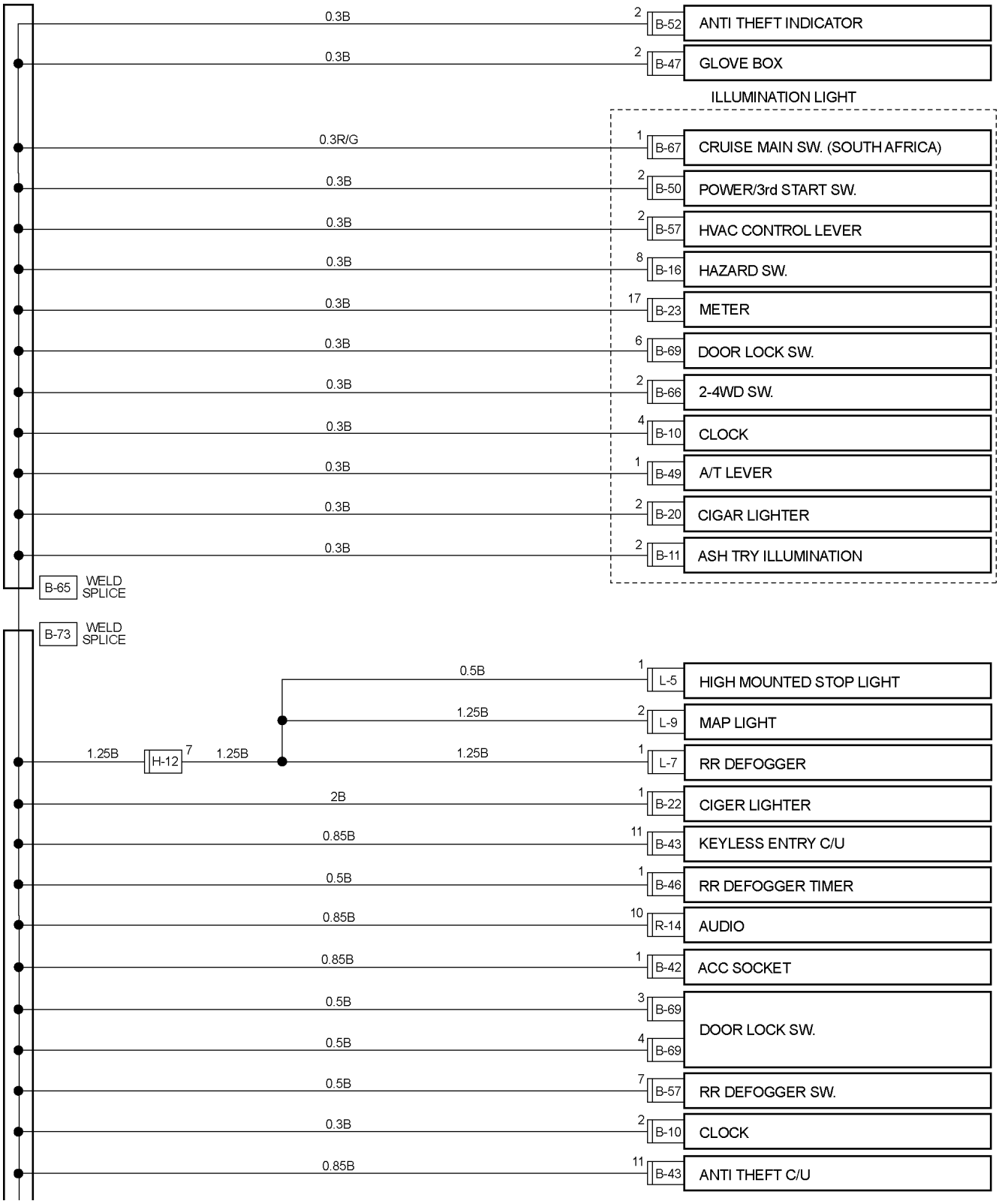


RTW48AXF027601



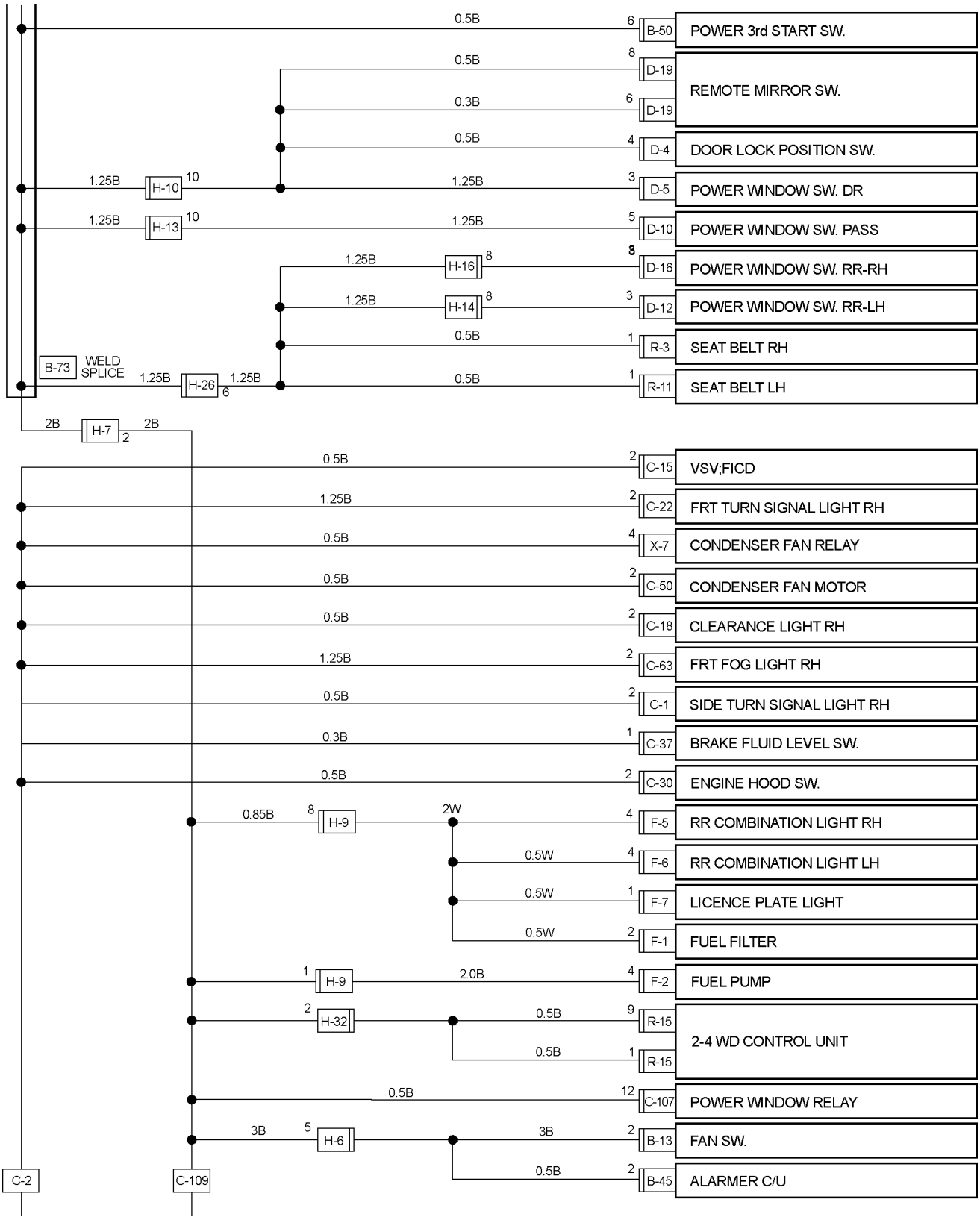
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GROUND POINT CHART GENERAL EXPORT (LHD) (1/4)



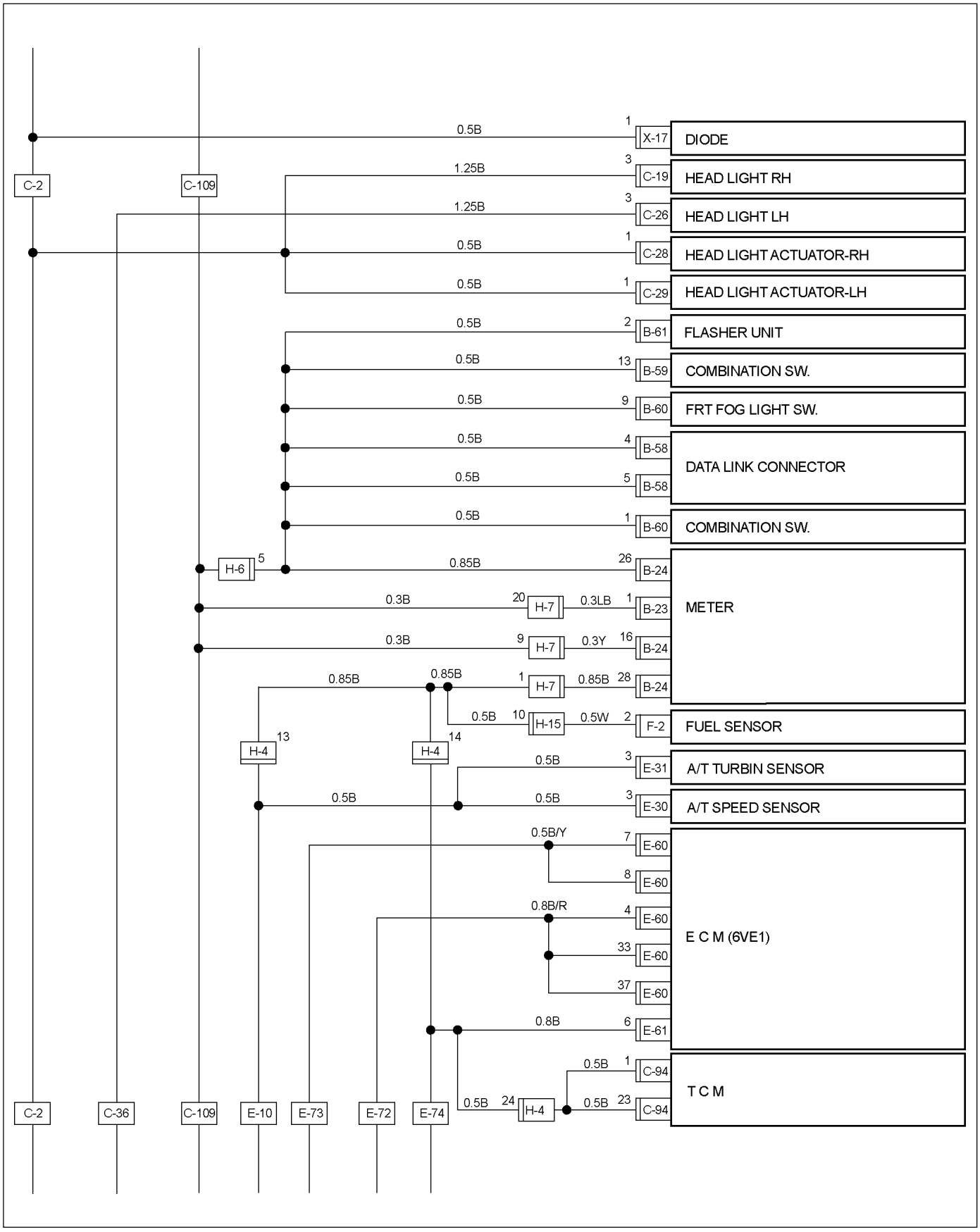
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GROUND POINT CHART GENERAL EXPORT (LHD) (2/4)



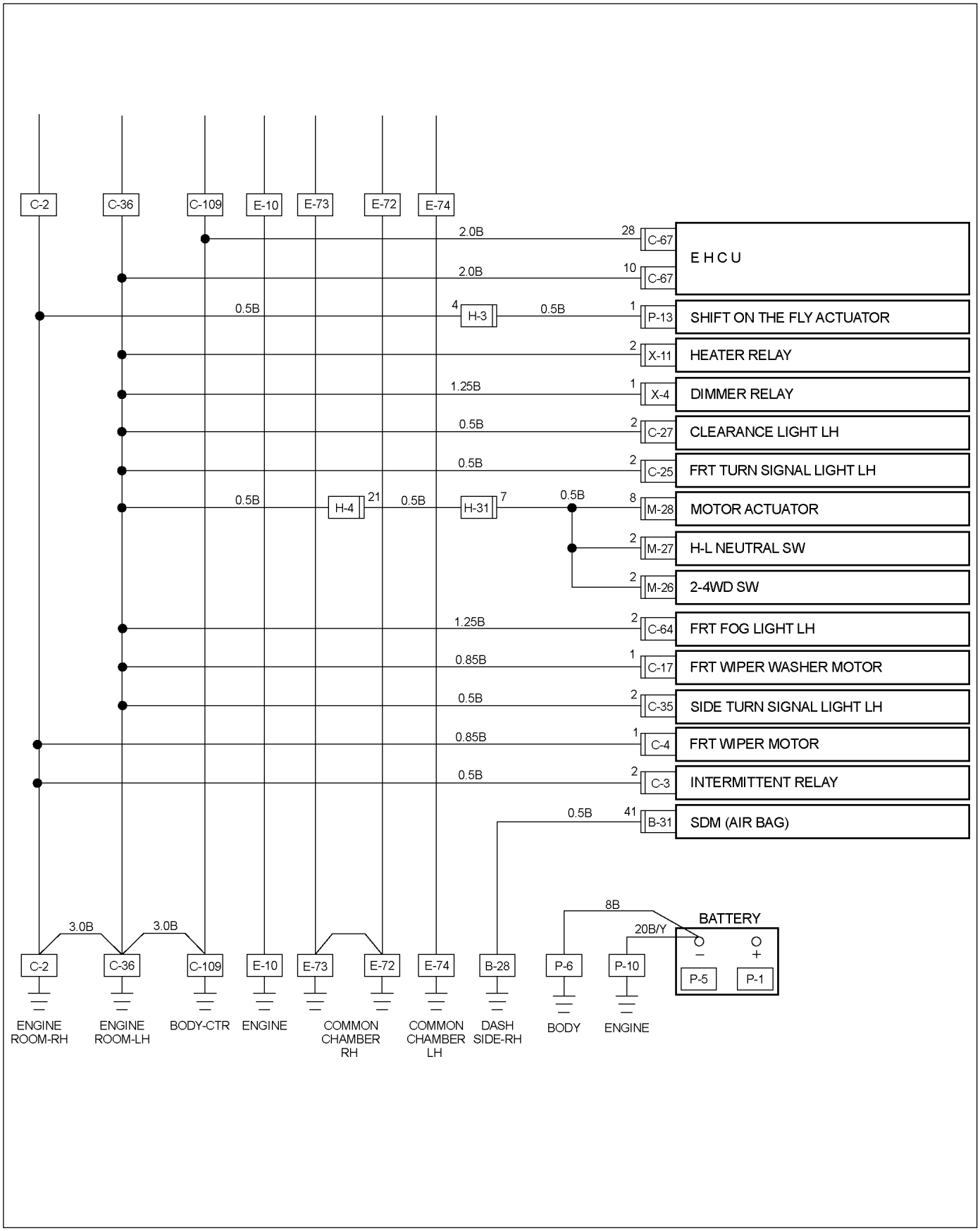
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GROUND POINT CHART GENERAL EXPORT (LHD) (3/4)



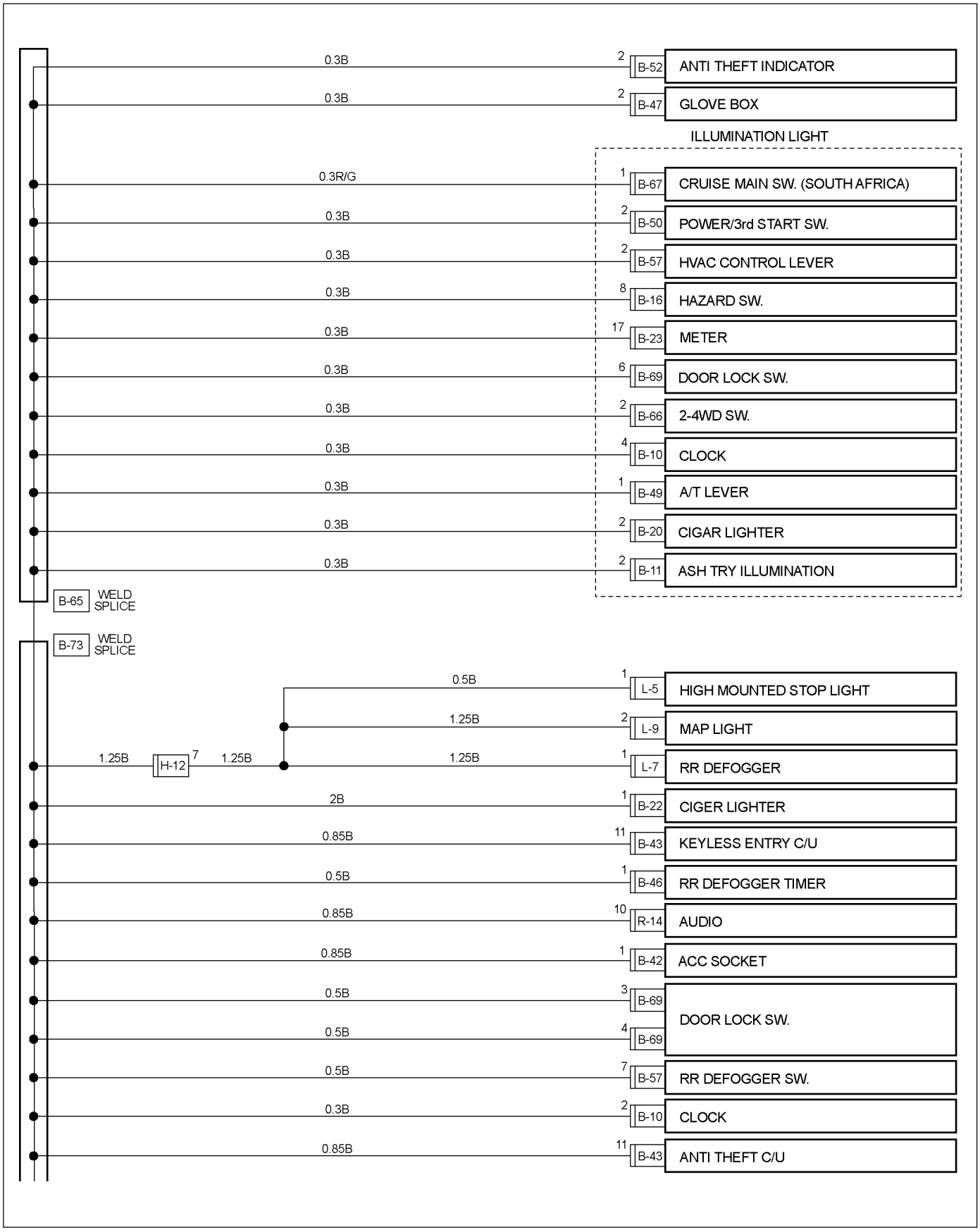
RTW48AXF030101

GROUND POINT CHART GENERAL EXPORT (LHD) (4/4)



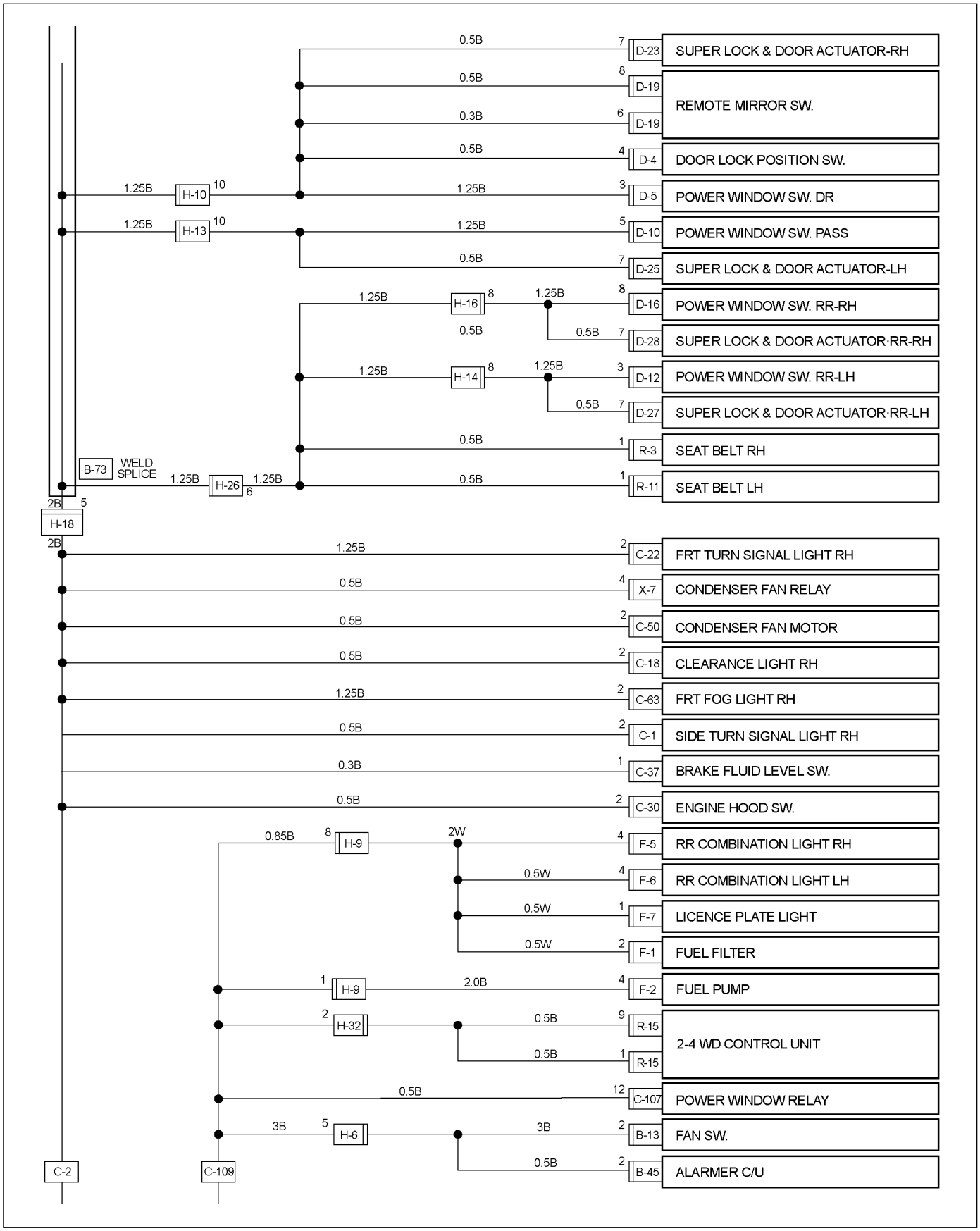
RTW48AXF030201

GROUND POINT CHART GENERAL EXPORT (RHD) (1/4)



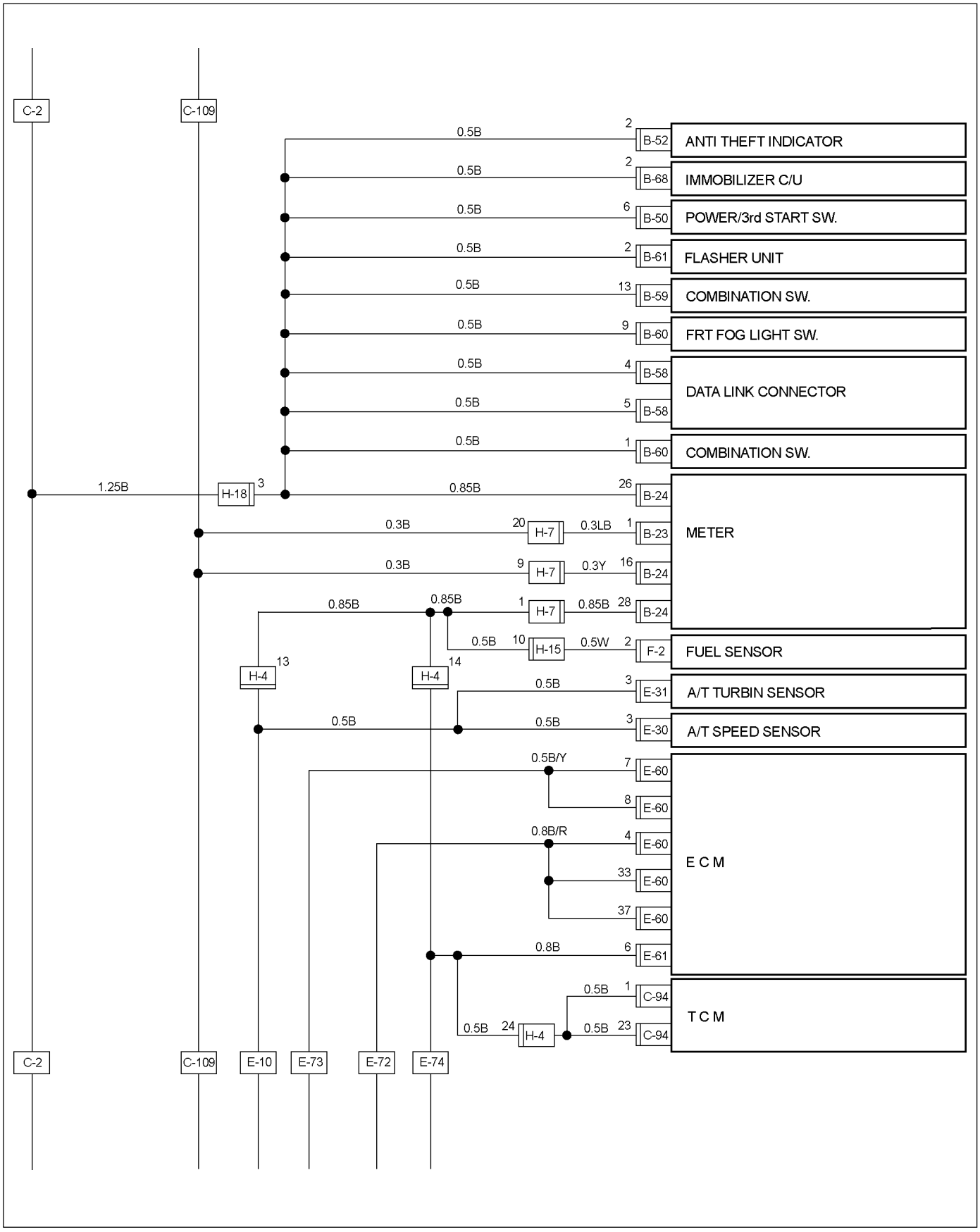
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GROUND POINT CHART GENERAL EXPORT (RHD) (2/4)



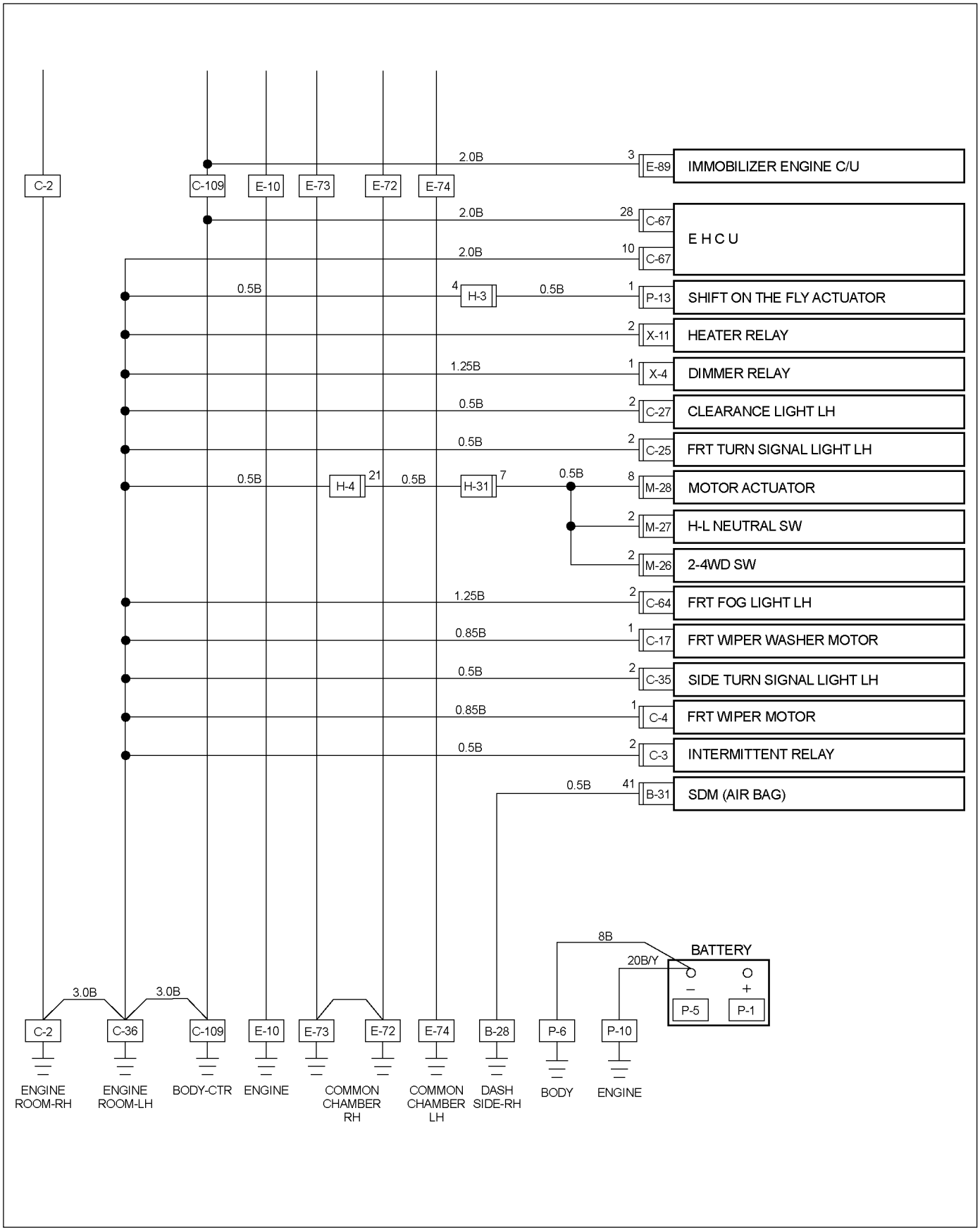
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GROUND POINT CHART GENERAL EXPORT (RHD) (3/4)



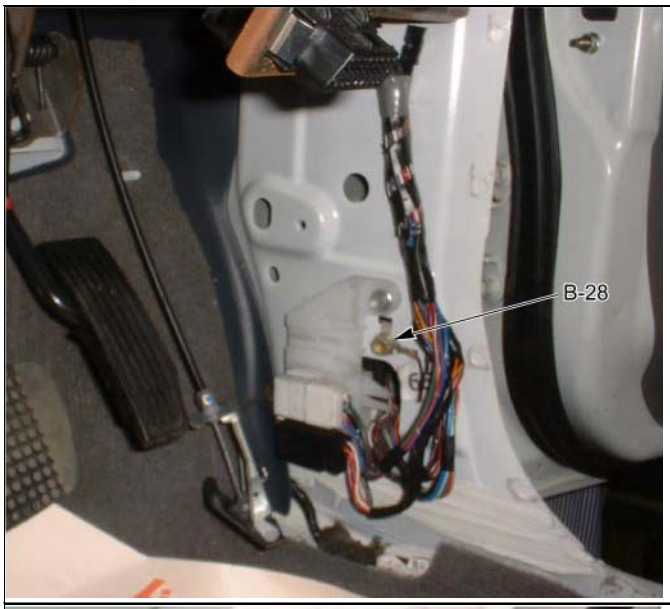
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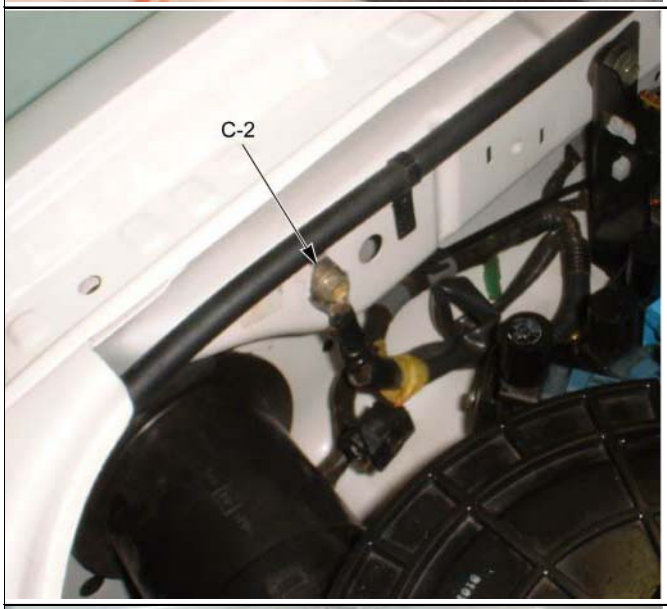


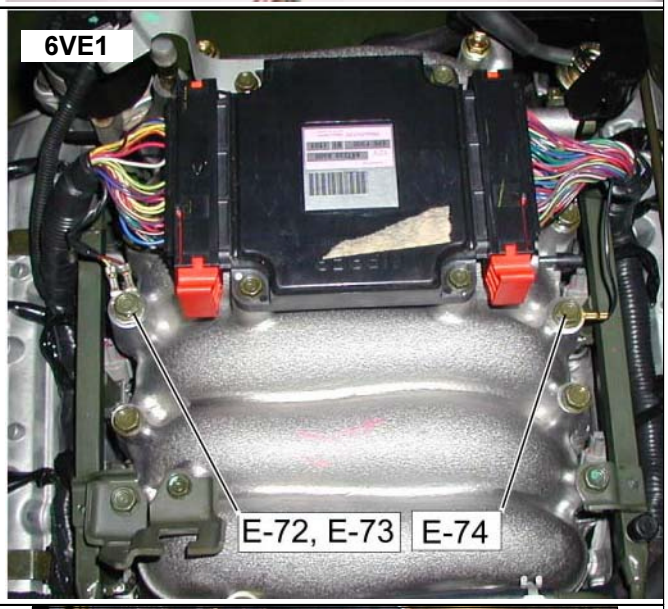
RTW48AXF030601

LOCATION

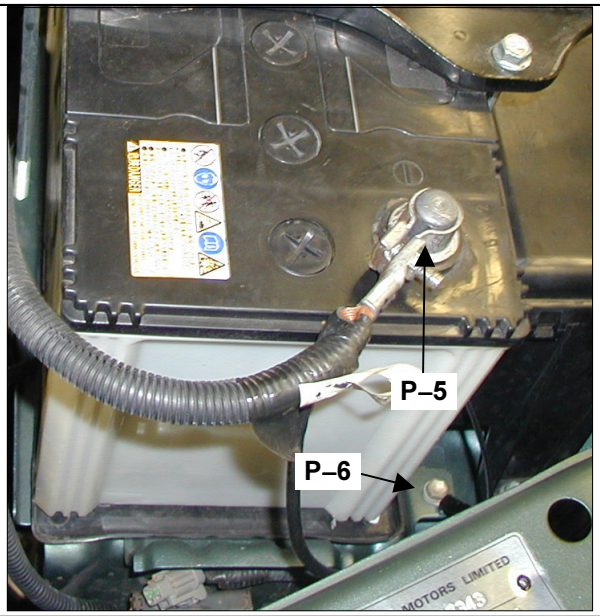




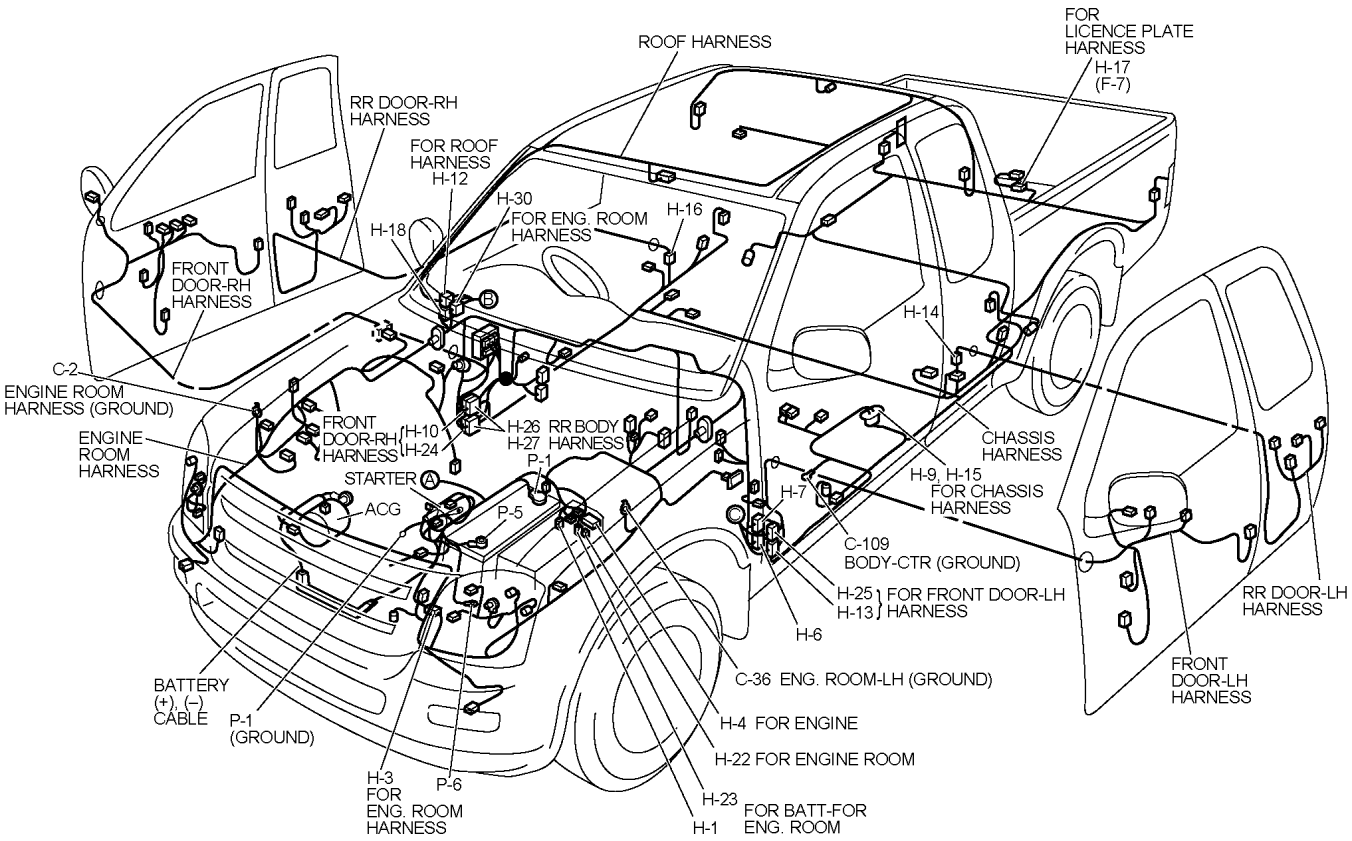






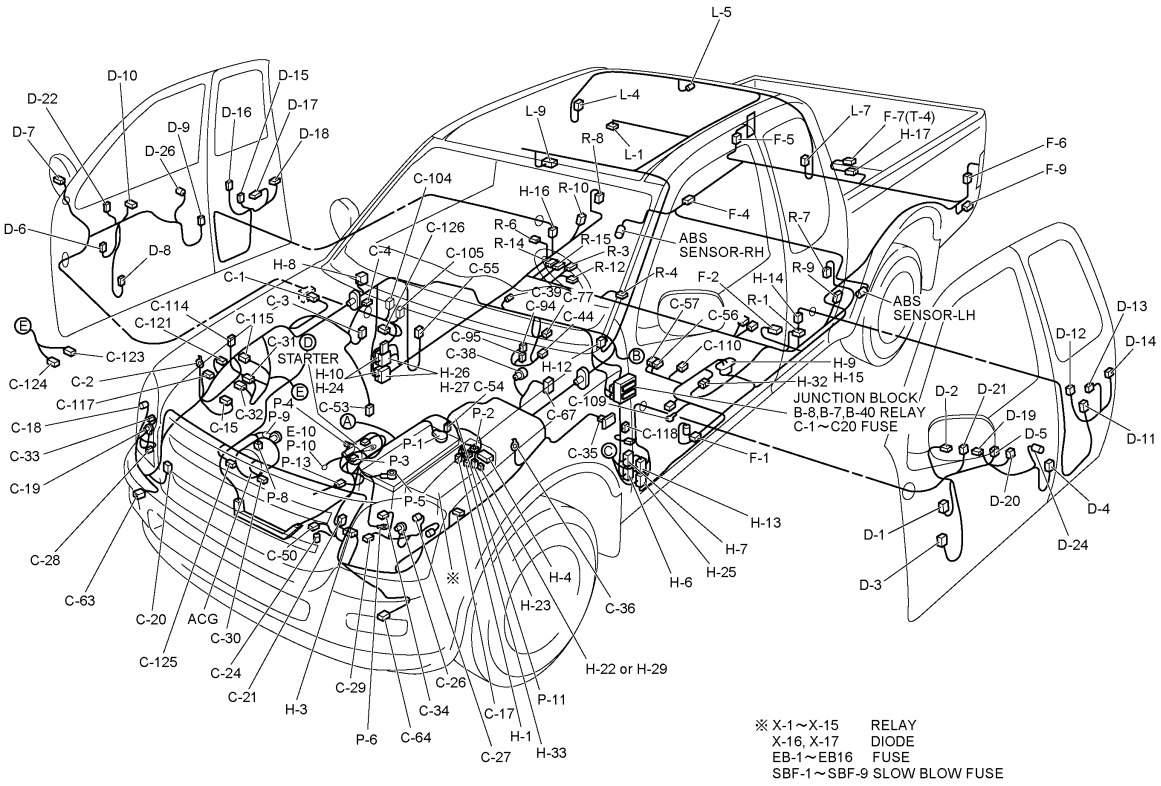


CABLE HARNESS & CONNECTOR LOCATION

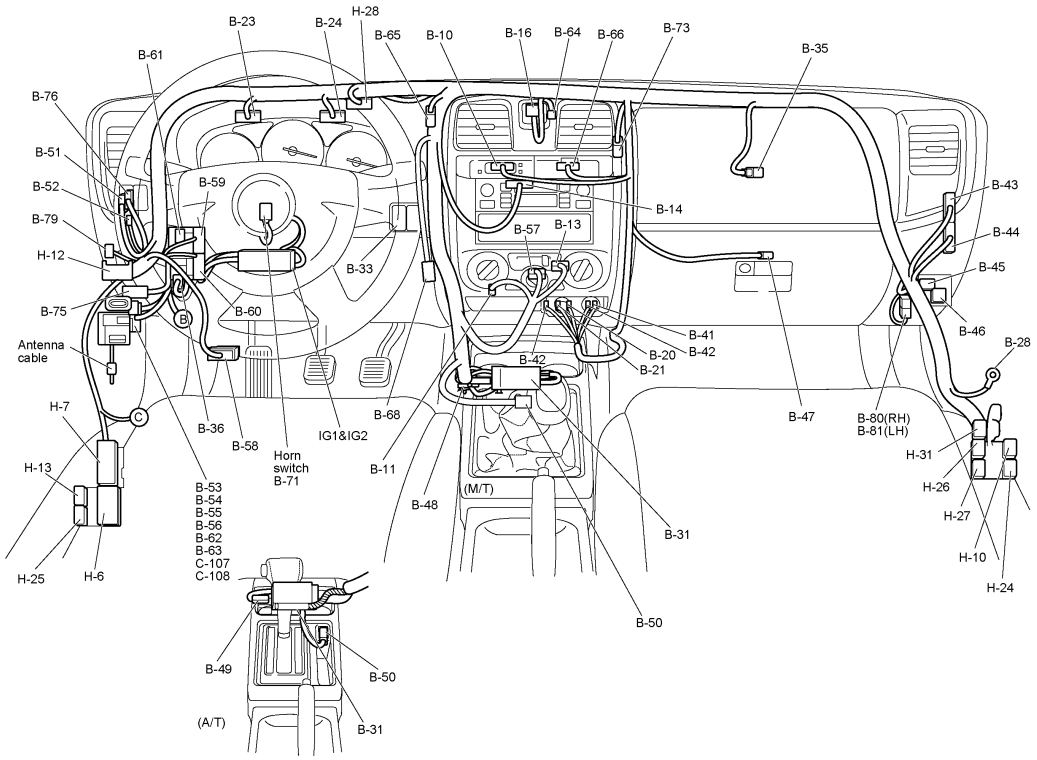


RTW46EXF000101

(General Export - LHD)

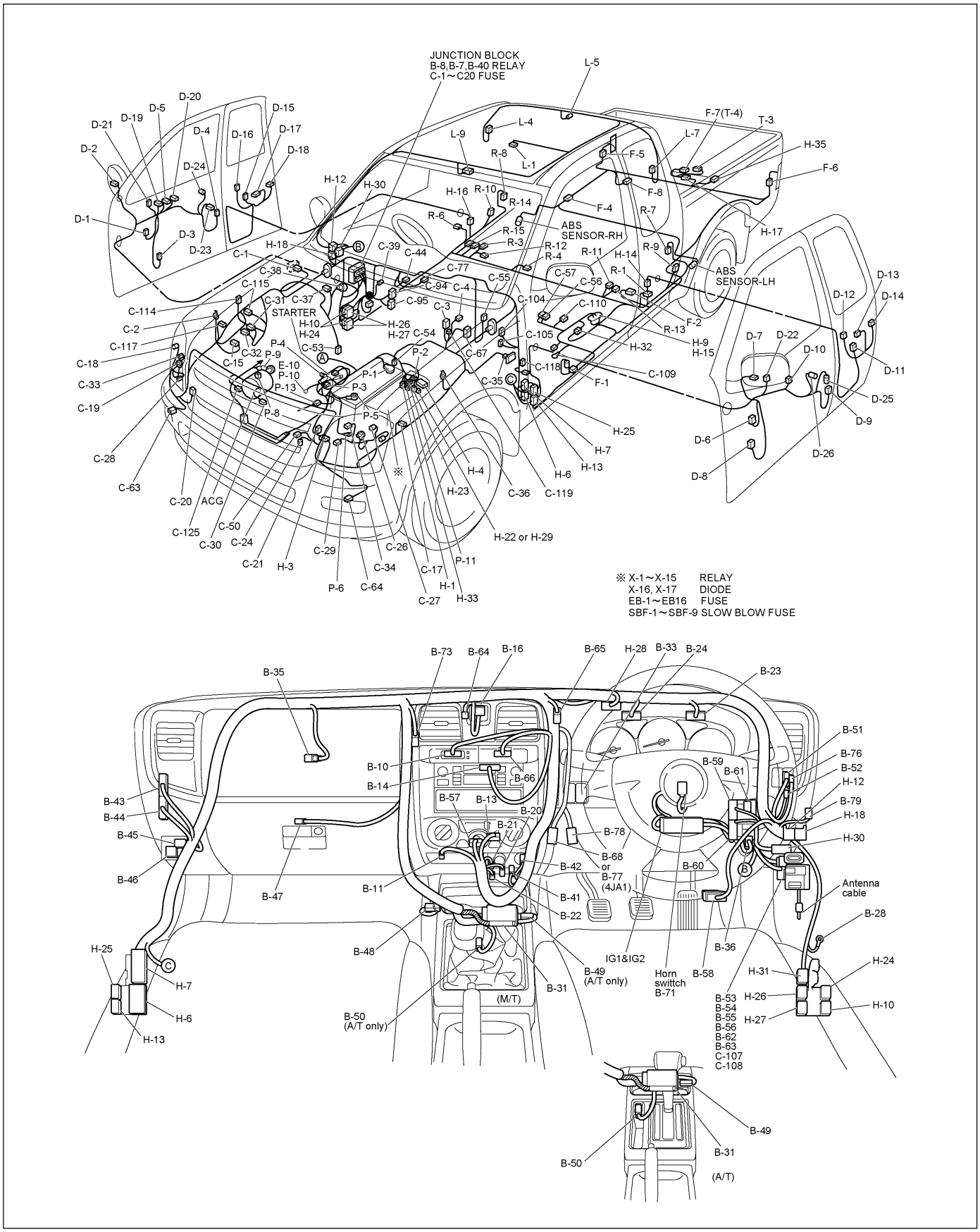


※ X-1～X-15 RELAY
X-16, X-17 DIODE
EB-1～EB16 FUSE
SBF-1～SBF-9 SLOW BLOW FUSE



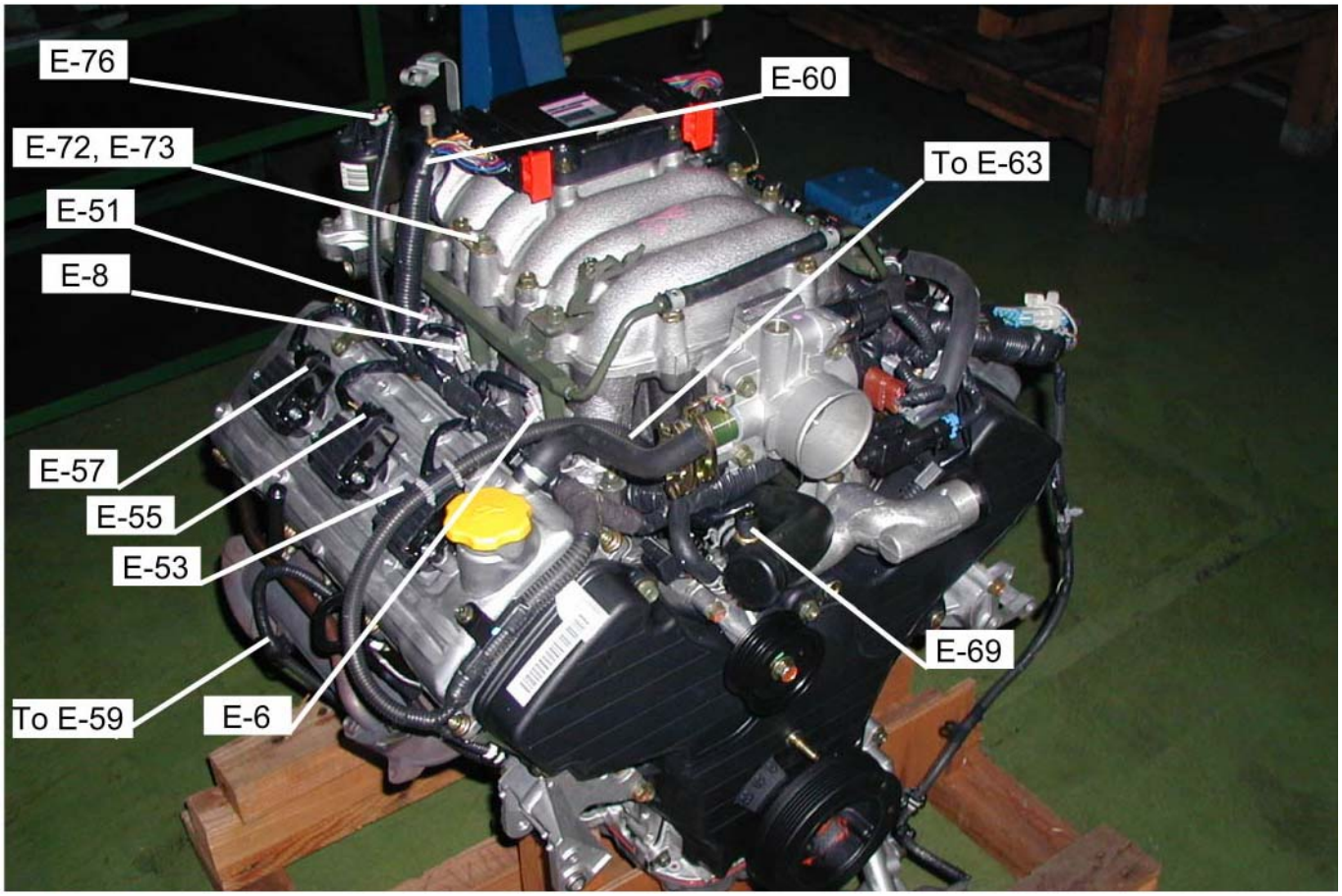
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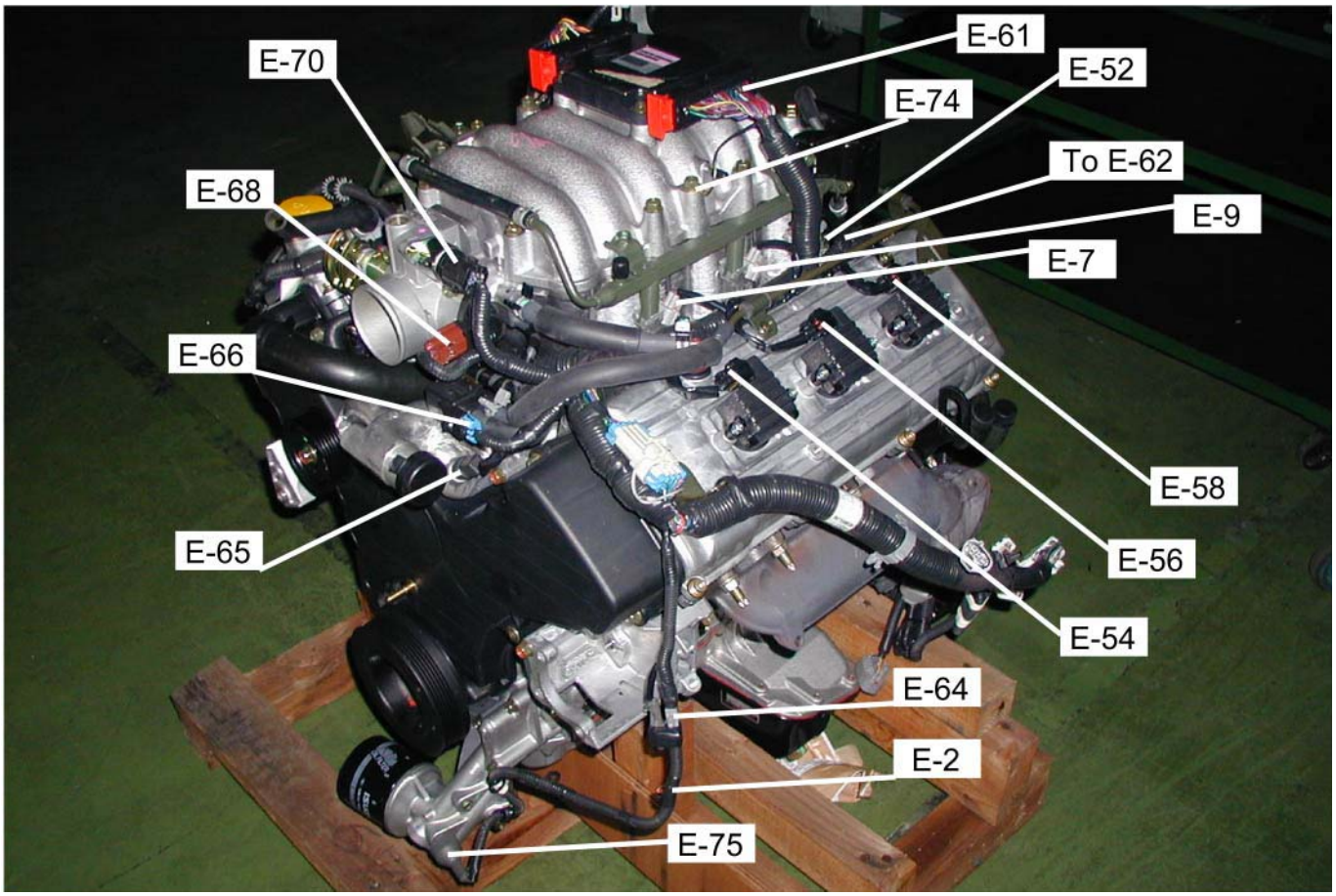
General Export - RHD

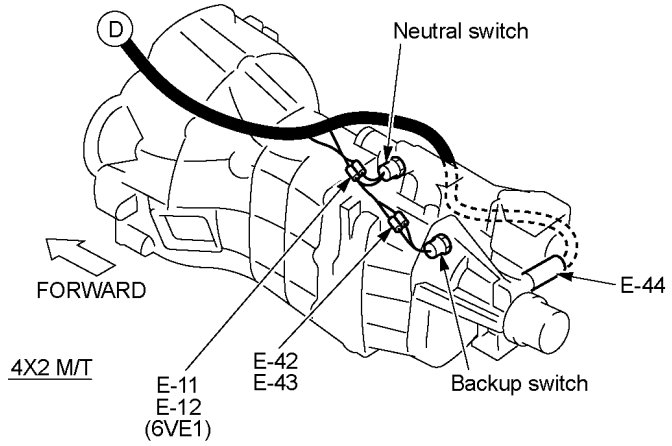


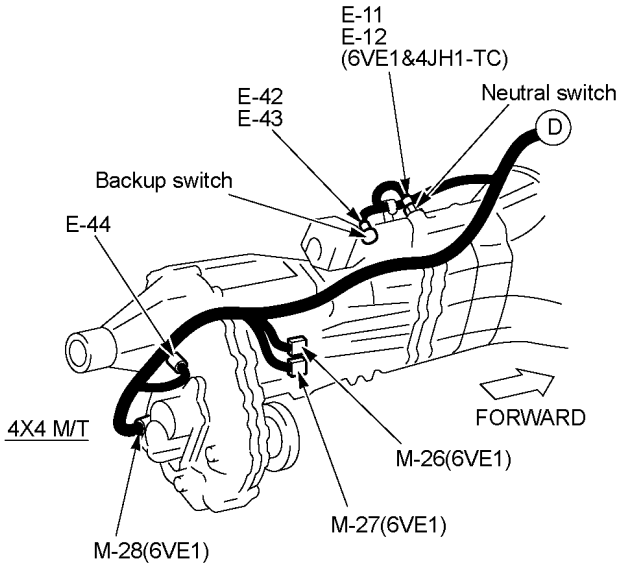
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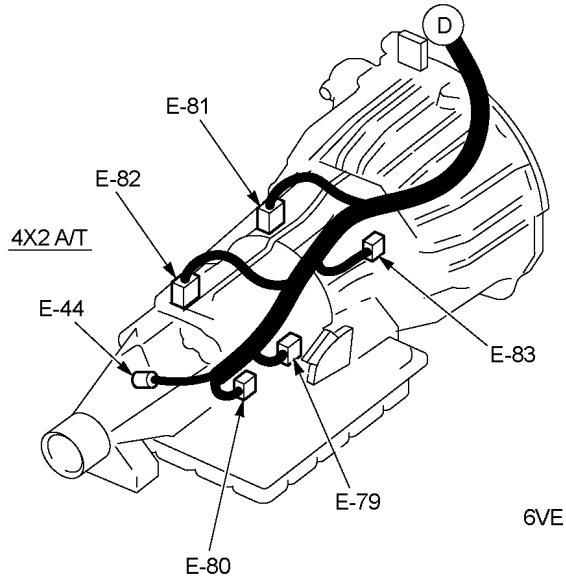
6VE1 ENGINE


E-76
E-60
E-72, E-73
To E-63
E-51
E-8
E-57
E-55
E-53
E-69
To E-59
E-6

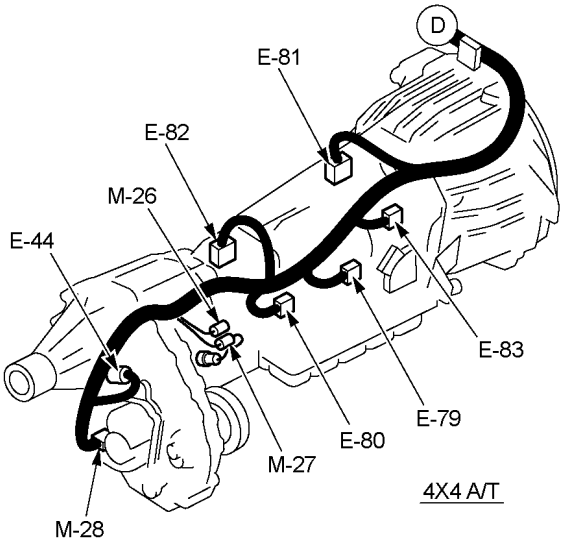

E-70
E-61
E-52
E-74
To E-62
E-68
E-9
E-7
E-66
E-58
E-56
E-65
E-54
E-64
E-2
E-75





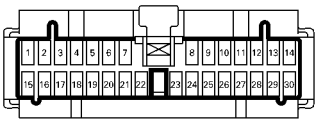
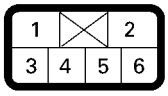
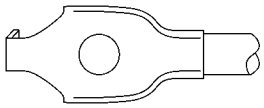
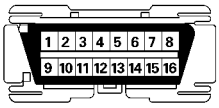
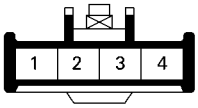
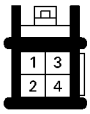
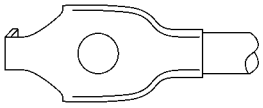
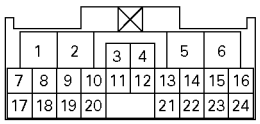


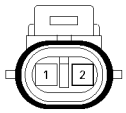
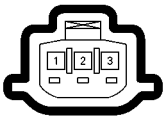
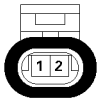
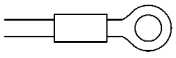
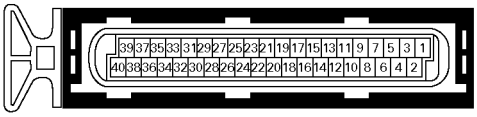
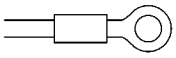
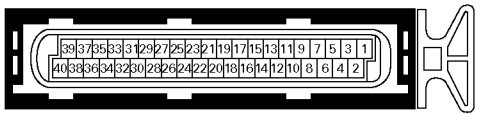
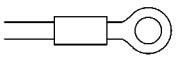
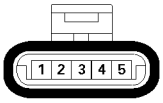
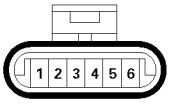
6VE1 (AISIN)

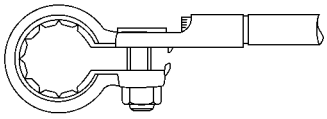
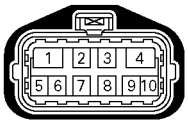
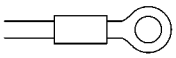
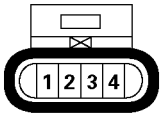
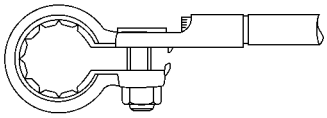
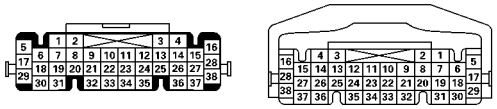
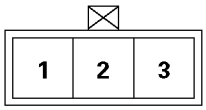
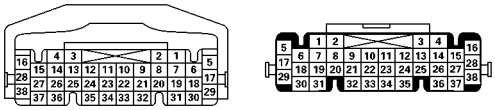
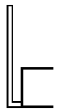
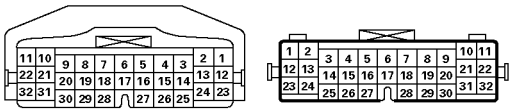
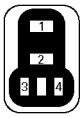
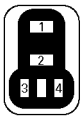
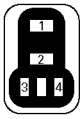
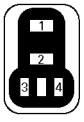
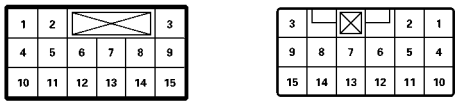
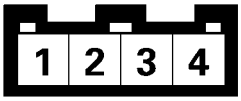


RTW36ELF000301

CONNECTOR LIST

No.	Connector face	No.	Connector face
B-24 Green	 Meter-B	C-108 White	 J/B E1
B-56 White	 J/B I4	C-109 Silver	 Body-LH ; ground
B-58 Black	 Check connector	E-2	 Magnetic clutch
B-62 White	 Ignition switch (IGSUB : G1)	E-6	 Fuel injector
B-63 White	 Ignition switch (IGSUB : G2)	E-7	 Fuel injector
B-68	 Immobilizer	E-8	 Fuel injector
C-2 Silver	 Engine room-RH ground	E-9	 Fuel injector
C-24	 Triple pressure switch	E-51	 Fuel injector
C-94 Gray	 TCM-(A)	E-52	 Fuel injector
C-107 White	 J/B E2	E-53	 Ignition coil

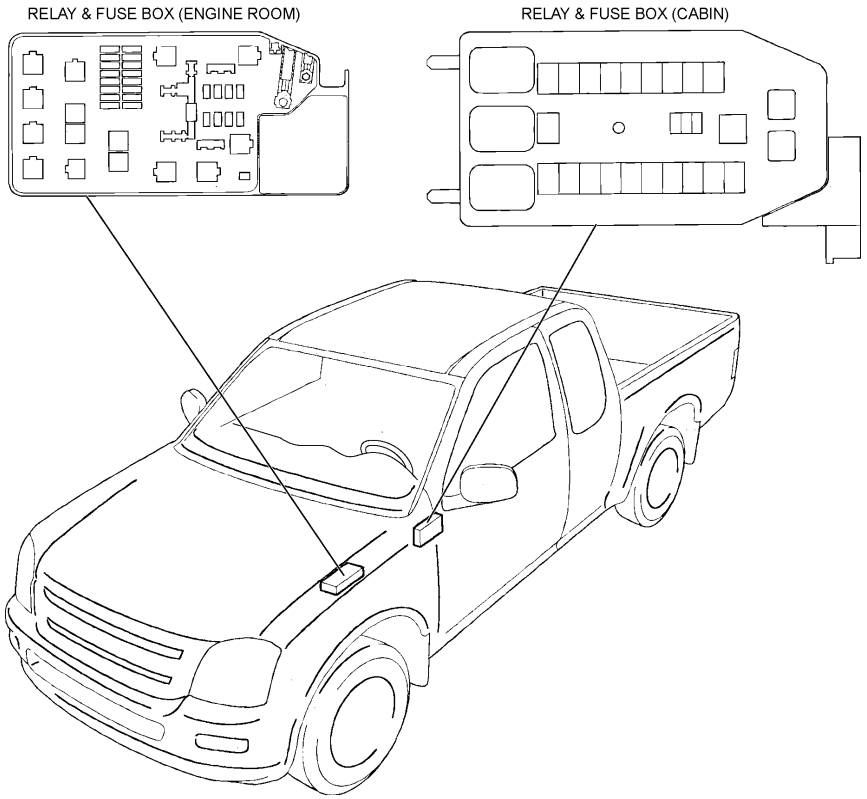
No.	Connector face	No.	Connector face
E-54	 Ignition coil	E-64	 Oil pressure switch (P/STRG)
E-55	 Ignition coil	E-66	 Duty solenoid
E-56	 Ignition coil	E-68	 Throttle position sensor
E-57	 Ignition coil	E-69	 Temperature sensor
E-58	 Ignition coil	E-70	 IACV
E-59	 Crank position sensor	E-72	 Engine earth-A
E-60	 ECM-A	E-73	 Engine earth-A
E-61	 ECM-B	E-74	 Engine earth-B
E-62	 Cam position sensor	E-76	 EGR valve
E-63	 MAF sensor	E-77	 O_2 sensor RH-Front

No.	Connector face	No.	Connector face
E-78	 O_2 sensor LH-Front	P-1 Silver	 Battery (+)
E-79	 Neutral start switch	P-2 Silver	 Relay & Fuse box
F-2 White	 Fuel pump & sensor	P-5 Silver	 Battery (-)
H-4 White	 Engine ~ Engine room	P-8 White	 ACG (L)
H-6 White	 Engine room ~ INST	P-10 Silver	 Engine ground
H-7 White	 Engine room ~ INST	X-2 Black	 Relay ; Fuel pump
H-9 Blue	 Engine room ~ Chassis	X-13 Black	 Relay ; ECM MAIN
H-18 White	 Engine room ~ INST	X-14 Black	 Relay ; A/C Compressor
H-22 White	 Engine ~ Engine room C	X-15 Black	 Relay ; Thermo
H-23 White	 Engine ~ Engine room B	X-17 Black	 DIODE

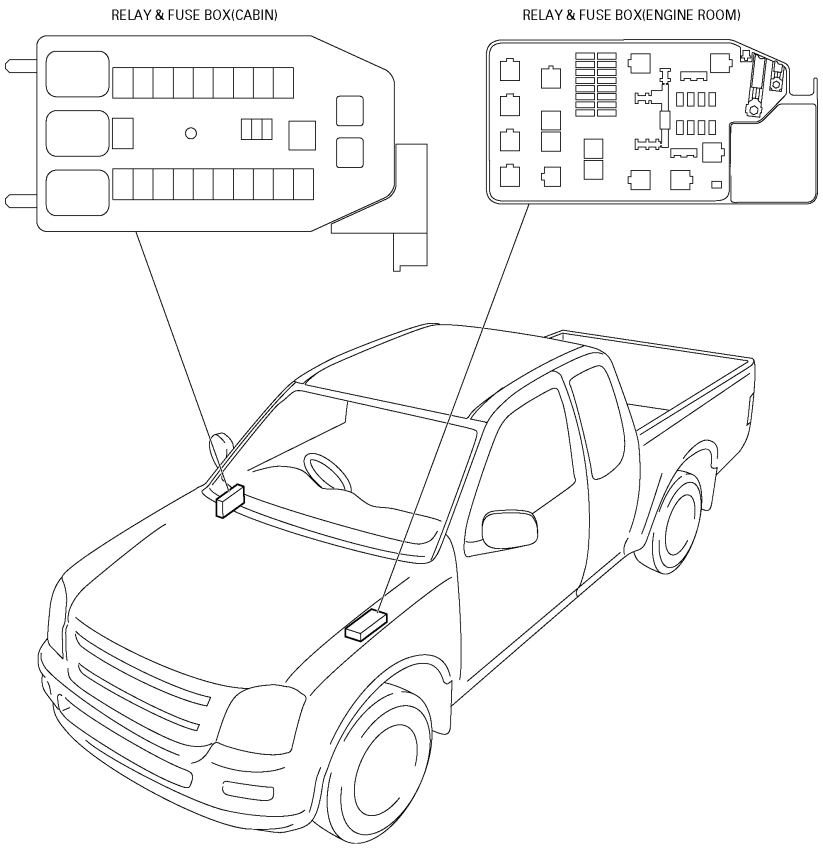
RELAY AND FUSE

RELAY AND FUSE BOX LOCATION (LHD & RHD)

LHD

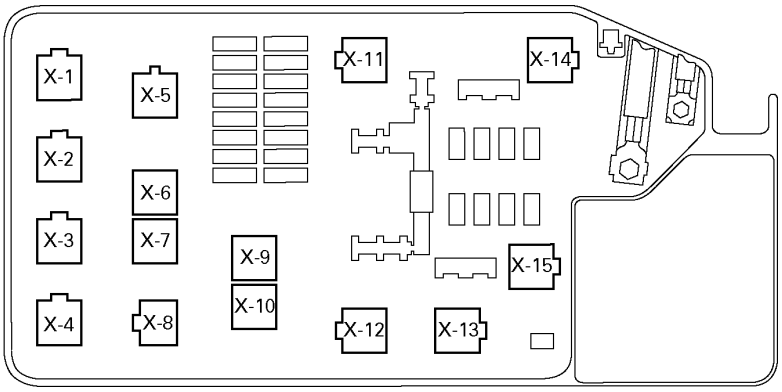


RHD



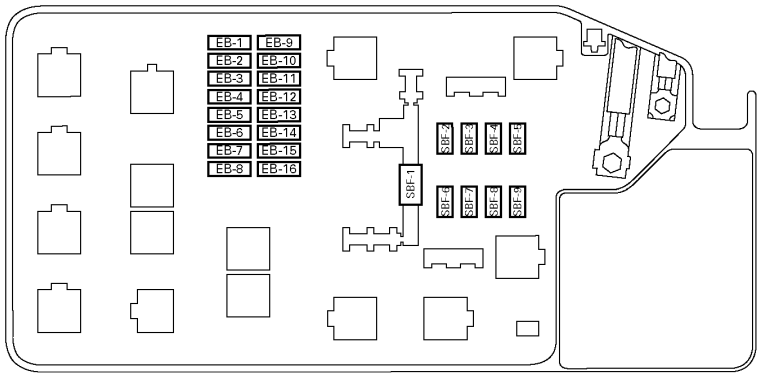
RELAY AND FUSE BOX LOCATION (LHD & RHD)

RELAY & FUSE BOX



RELAY

NO.	Relay name
X-1	RELAY; TAIL LIGHT
X-2	RELAY; FUEL PUMP
X-3	RELAY; HORN
X-4	RELAY; DIMMER
X-5	RELAY; FOG LIGHT
X-6	RELAY; STARTER
X-7	RELAY; COND, FAN
X-8	RELAY; —
X-9	RELAY; HAZARD-RH
X-10	RELAY; HAZARD-LH
X-11	RELAY; HEATER
X-12	RELAY; HEAD LIGHT
X-13	RELAY; ECM MAIN
X-14	RELAY; A/C COMP
X-15	RELAY; THERMO



FUSE

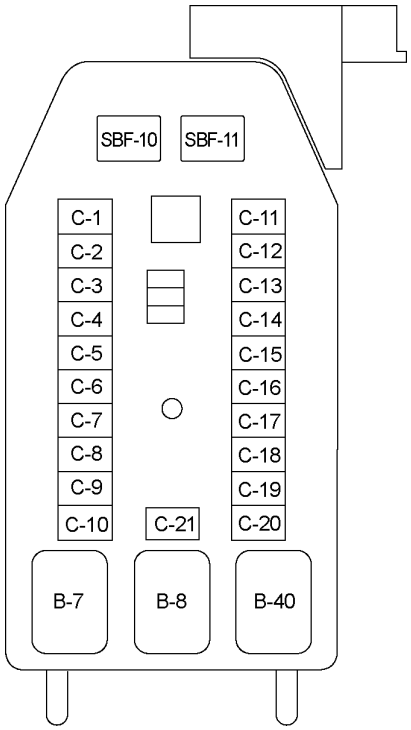
FUSE NO.	Fuse name
EB-1	20A ECM
EB-2	10A ECM (B)
EB-3	10A TCM
EB-4	15A FRT FOG
EB-5	10A ILLUMI
EB-6	10A TAIL
EB-7	10A H/LIGHT-RH-LOW (LHD)
	10A H/LIGHT-RH (RHD)
EB-8	10A H/LIGHT-LH-LOW (LHD)
	10A H/LIGHT-LH (RHD)
EB-9	10A O_2 SENSOR
EB-10	20A FUEL PUMP
EB-11	—
EB-12	—
EB-13	10A A/C
EB-14	10A 4WD
EB-15	10A HORN
EB-16	10A HAZARD

SLOW BLOW FUSE

FUSE NO.	Slow Blow Fuse name
SBF-1	100A MAIN
SBF-2	—
SBF-3	—
SBF-4	20A COND, FAN
SBF-5	40A IG 1
SBF-6	40A ABS-1
SBF-7	30A ABS-2
SBF-8	30A BLOWER
SBF-9	50A IG 2

FUSE & RELAY LOCATION (LHD & RHD)

FUSE BOX



RTW46EMF001001

FUSE

NO.	Capacity	Indication on label	NO.	Capacity	Indication on label
C-1	—	—	C-12	15A	CIGER
C-2	10A	ABS	C-13	15A	AUDIO (+B)
C-3	10A	TRAILER	C-14	20A	DOOR LOCK
C-4	15A	BACK UP	C-15	10A	METER (+B)
C-5	15A	METER	C-16	10A	ROOM
C-6	10A	TURN	C-17	10A	ANTI THEFT
C-7	15A	ELEC.IG	C-18	15A	STOP
C-8	15A	ENGINE	C-19	15A	ACC SOCKET
C-9	20A	FRT WIPER	C-20	10A	STARTER
C-10	15A	IG. COIL	C-21	10A	SRS
C-11	10A	AUDIO			

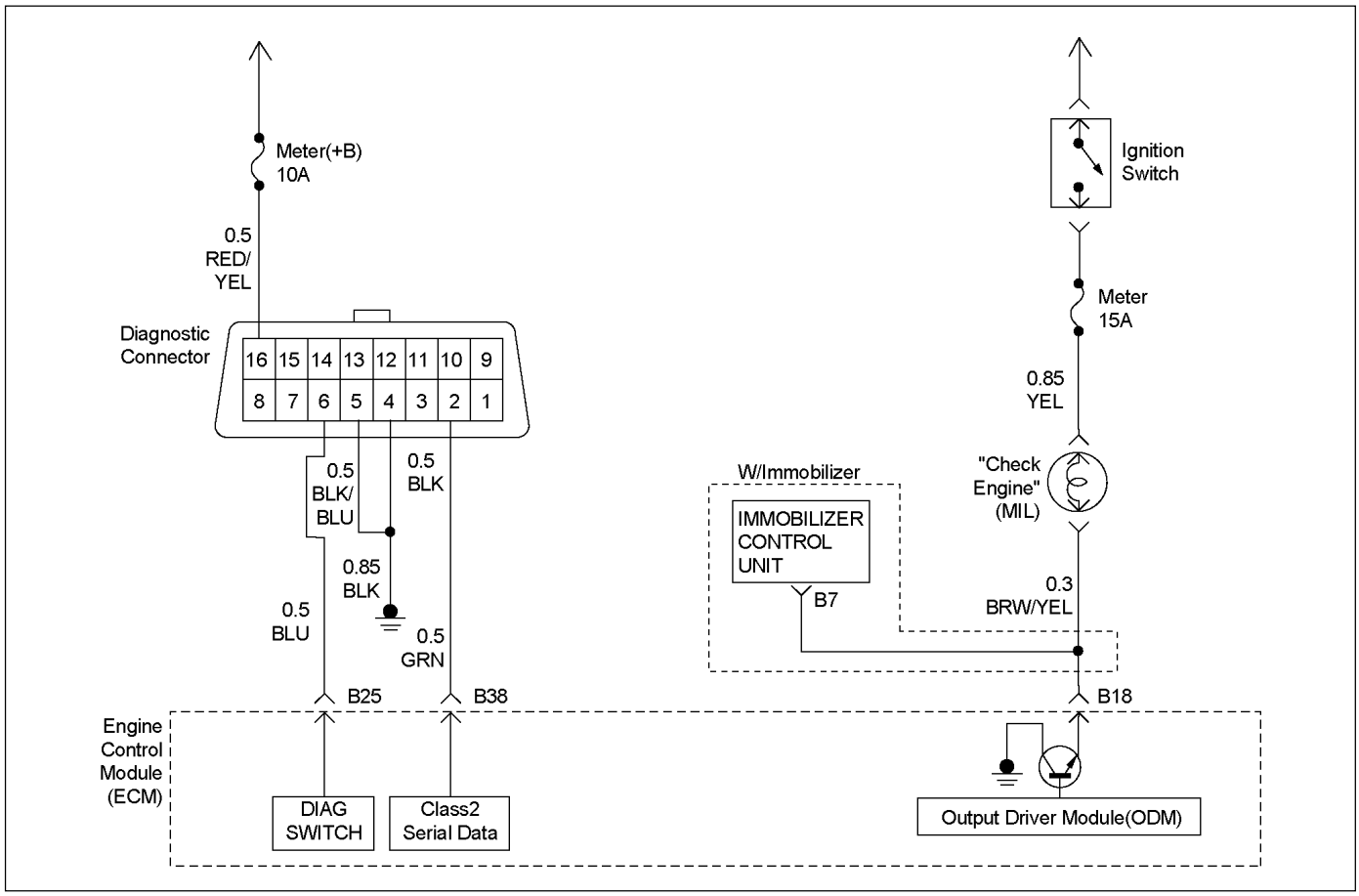
SLOW BLOW FUSE

NO.	Capacity	Indication on label
SBF-10	20A	RR DEF
SBF-11	30A	POWER WINDOW

RELAY

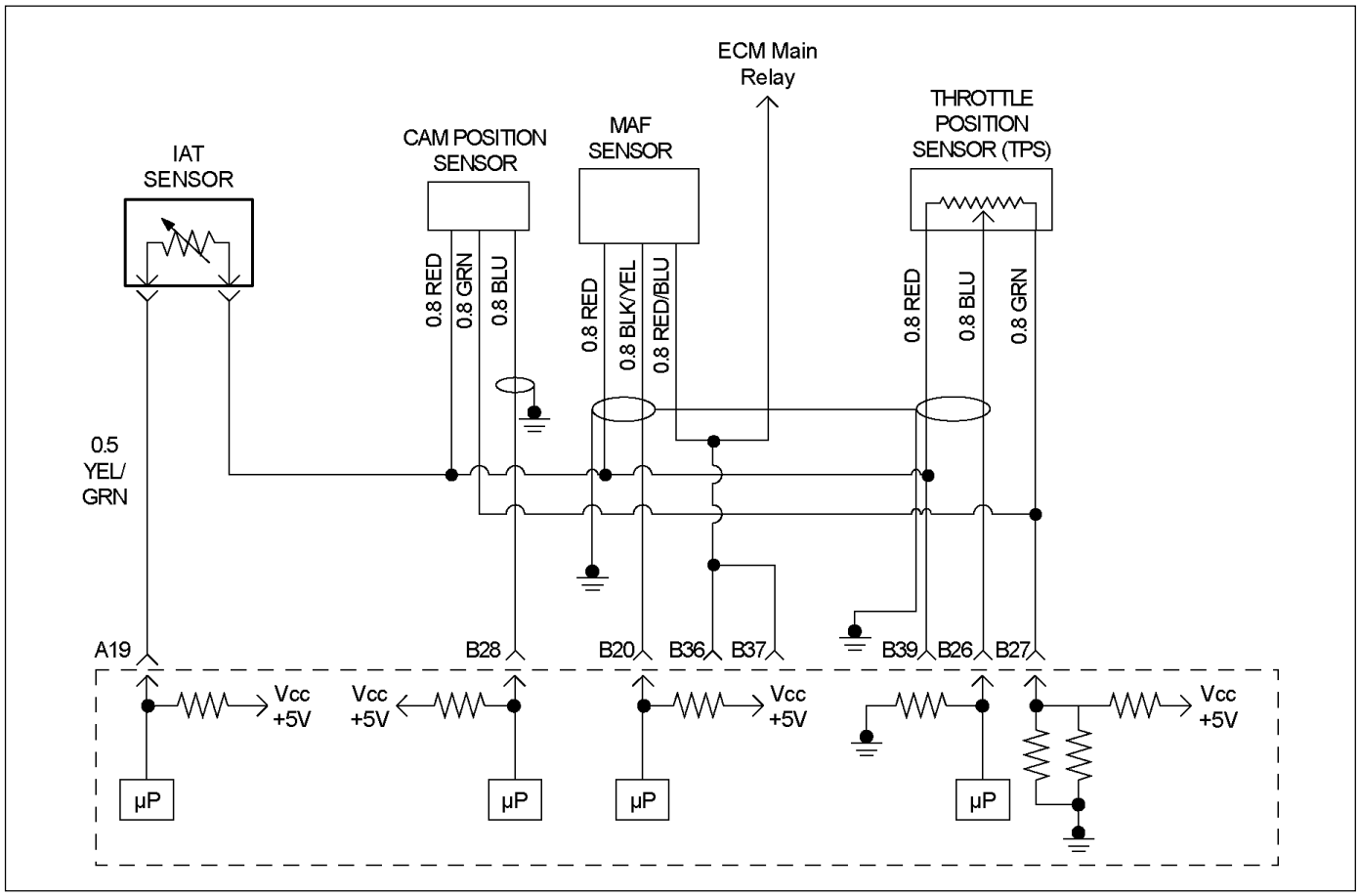
Connector No.	B-7	B-8	B-40
6VE1	REAR DEFOGGER	POWER WINDOW	ACC SOCKET

ECM WIRING DIAGRAM (1/10)



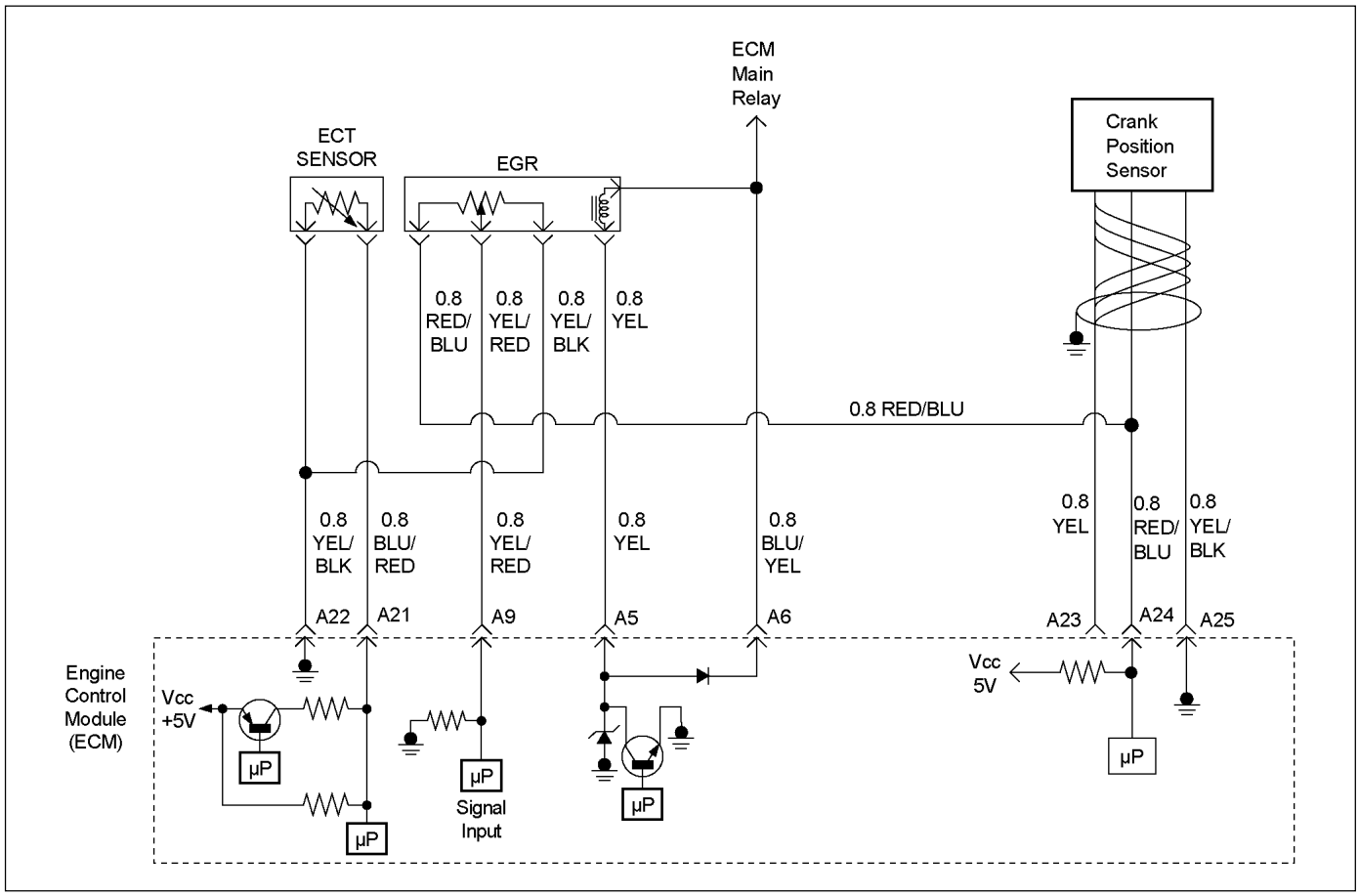
RTW46EMF000401

ECM WIRING DIAGRAM (2/10)



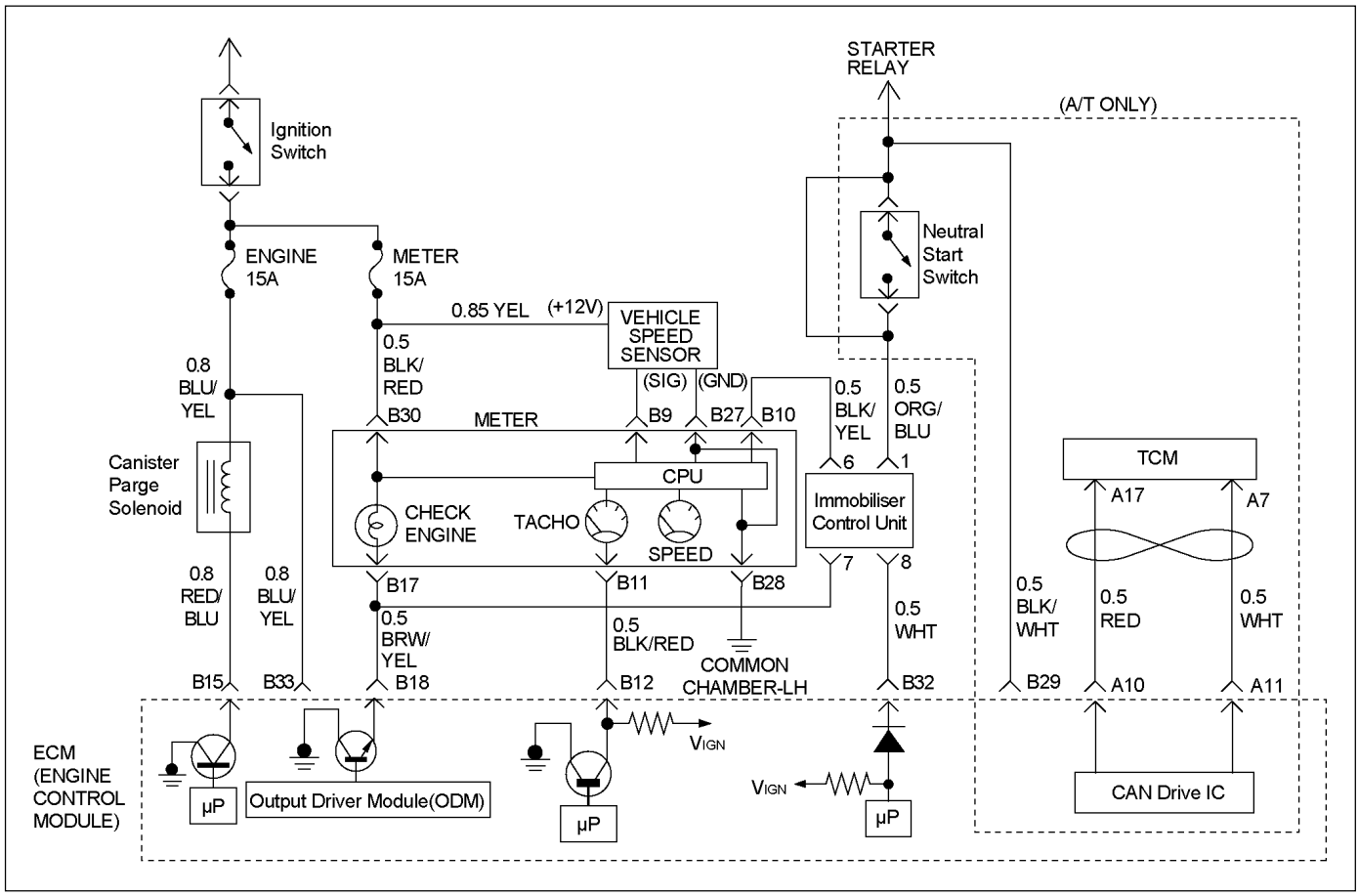
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ECM WIRING DIAGRAM (3/10)



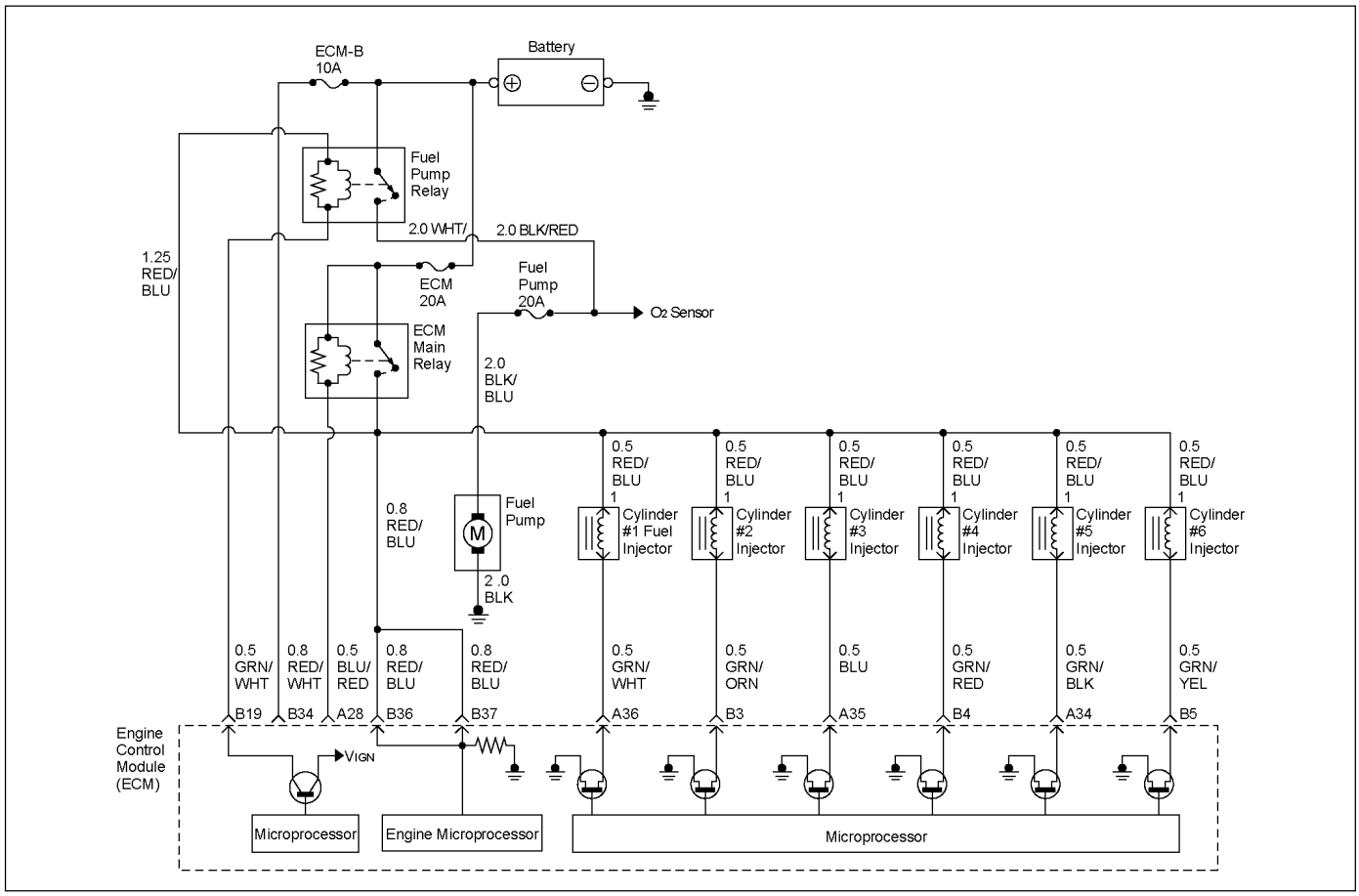
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ECM WIRING DIAGRAM (4/10)



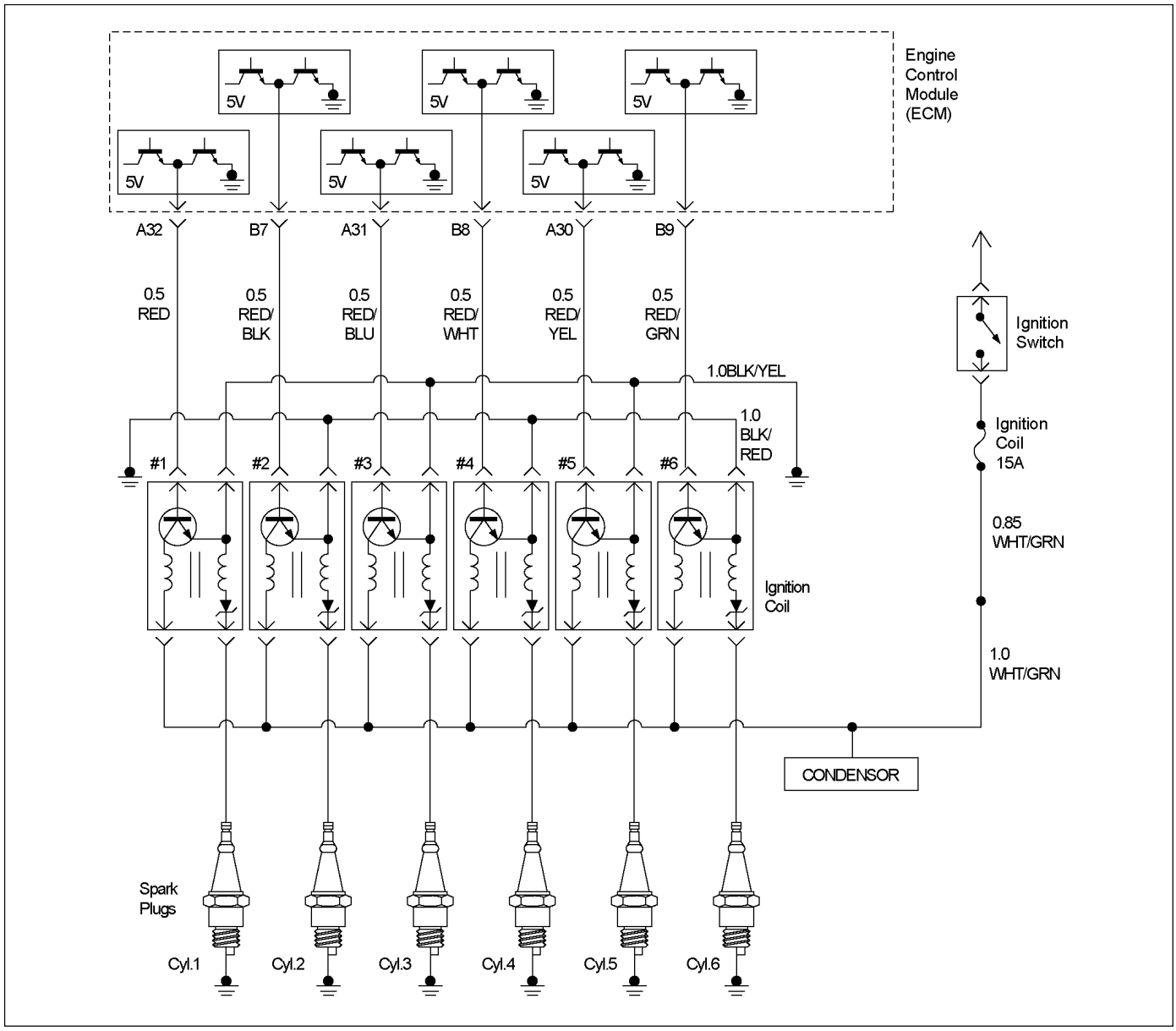
RTW46EMF000301

ECM WIRING DIAGRAM (5/10)



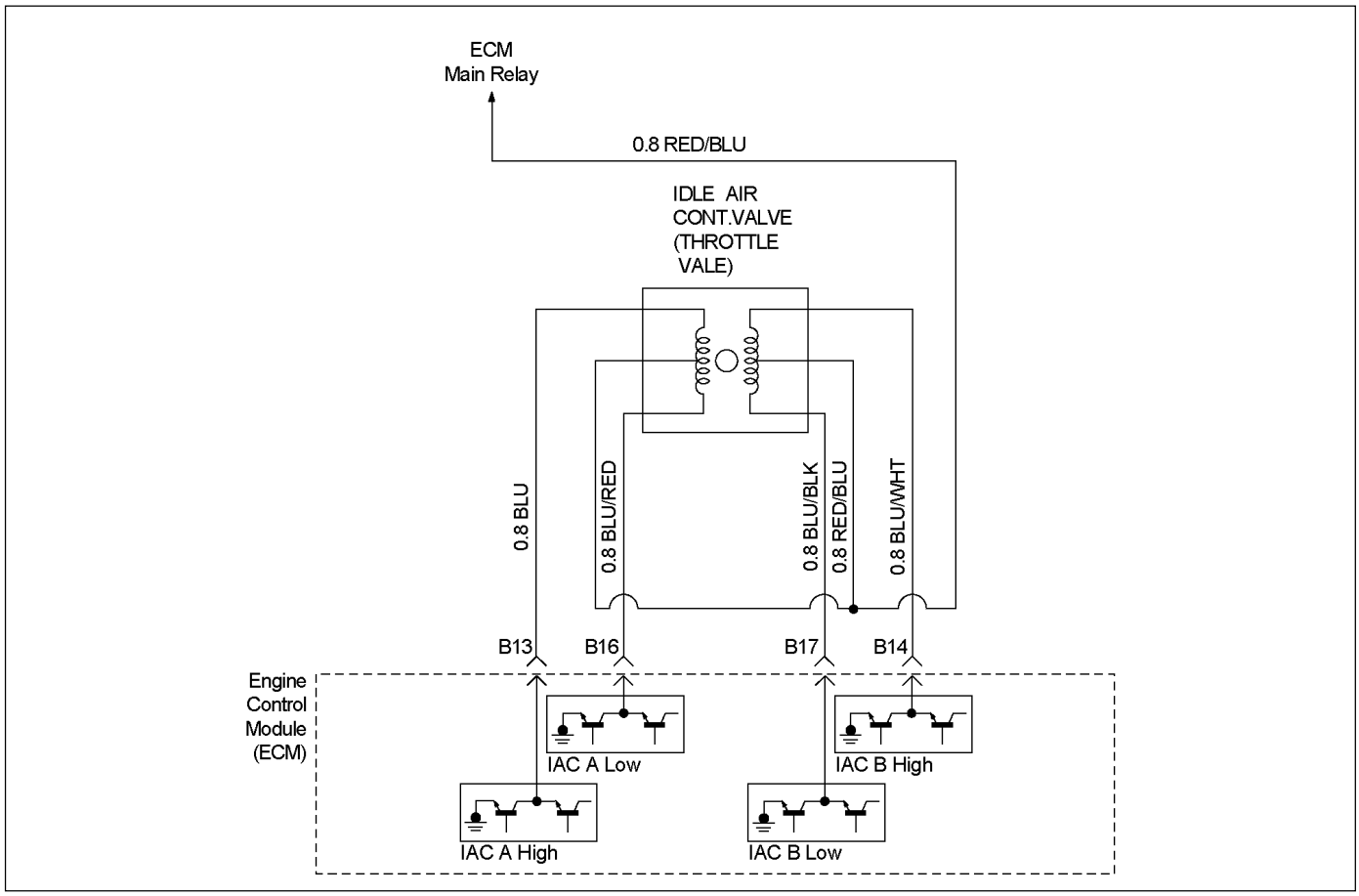
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ECM WIRING DIAGRAM (6/10)



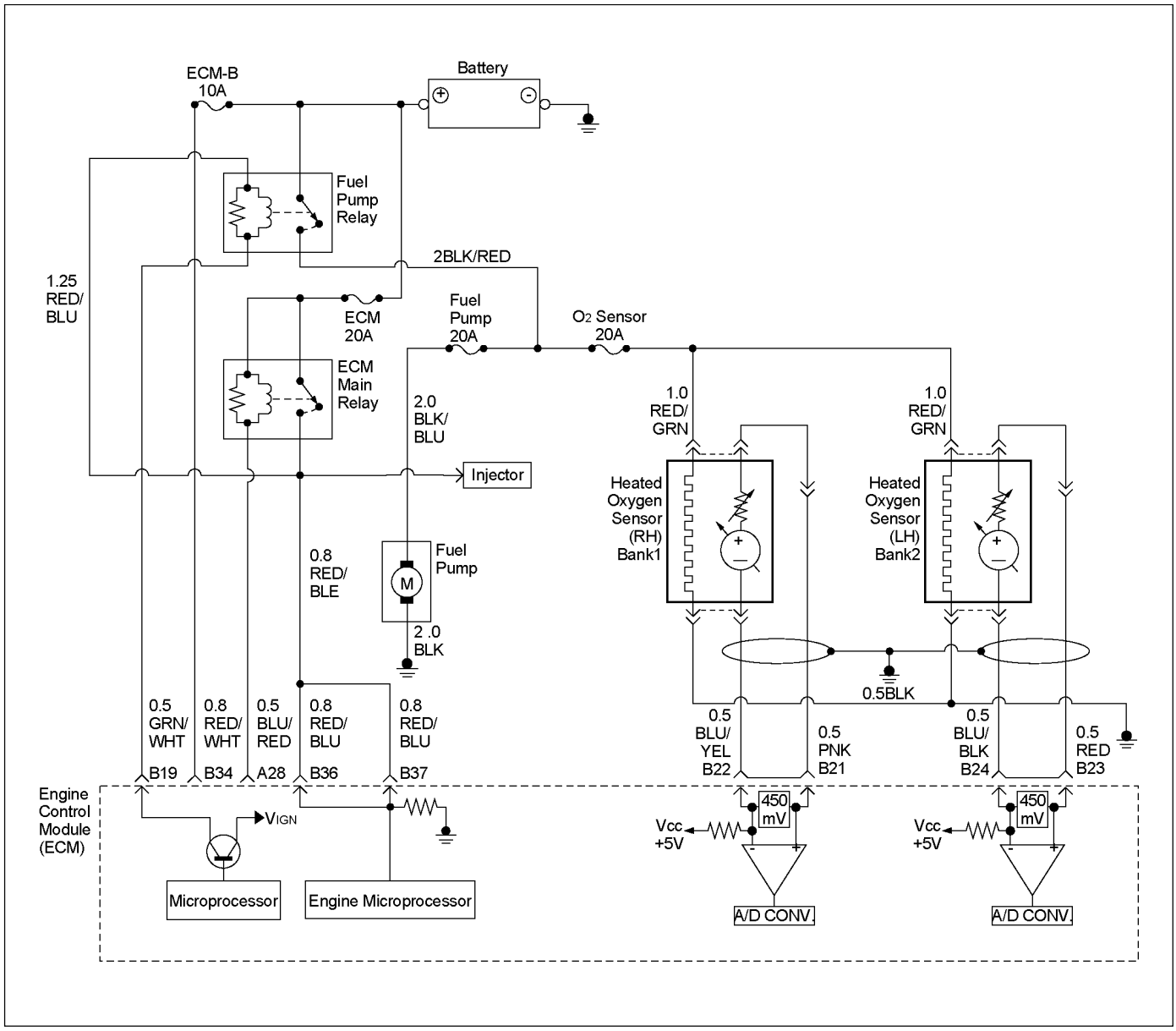
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ECM WIRING DIAGRAM (7/10)



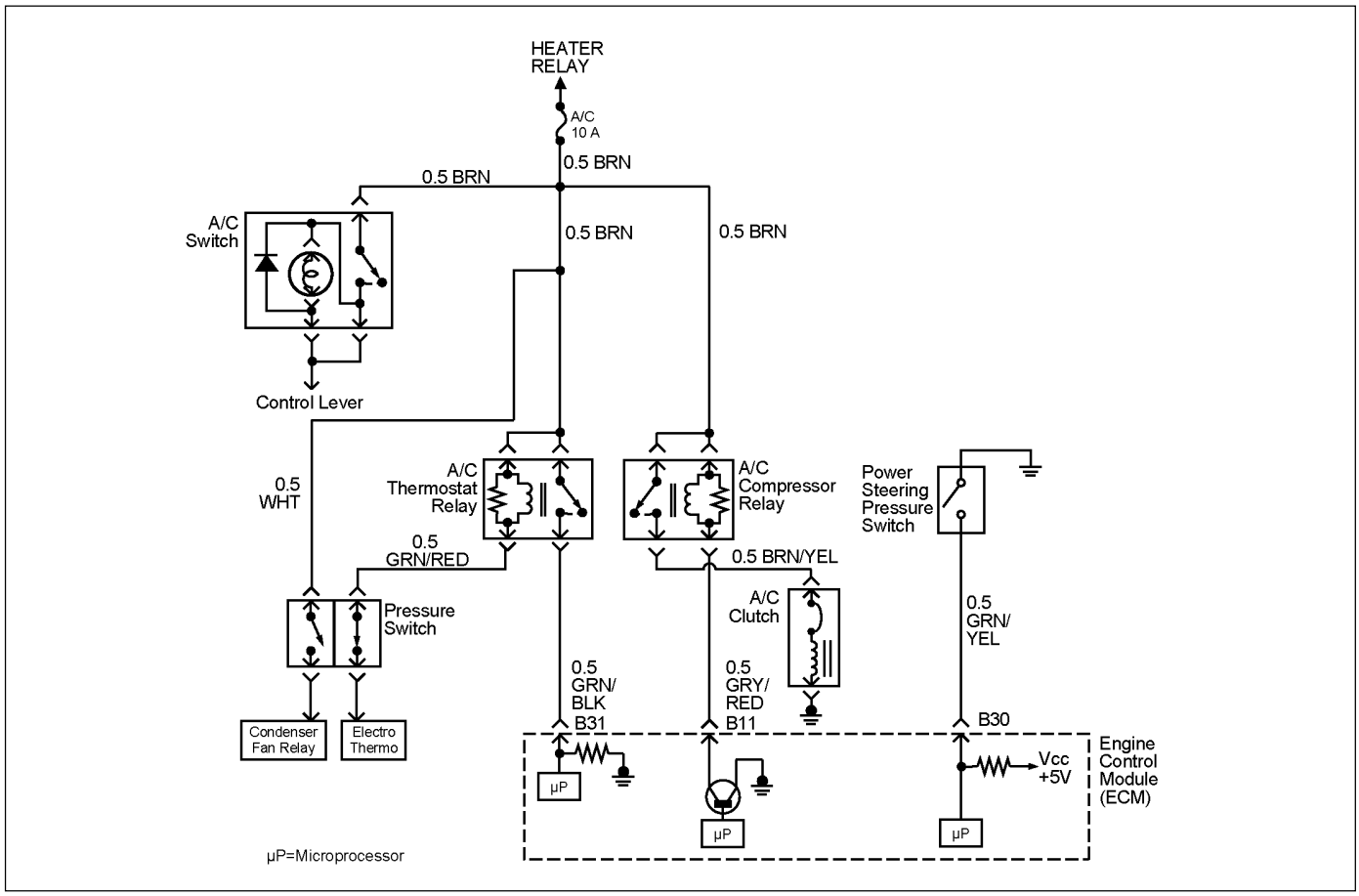
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ECM WIRING DIAGRAM (8/10)



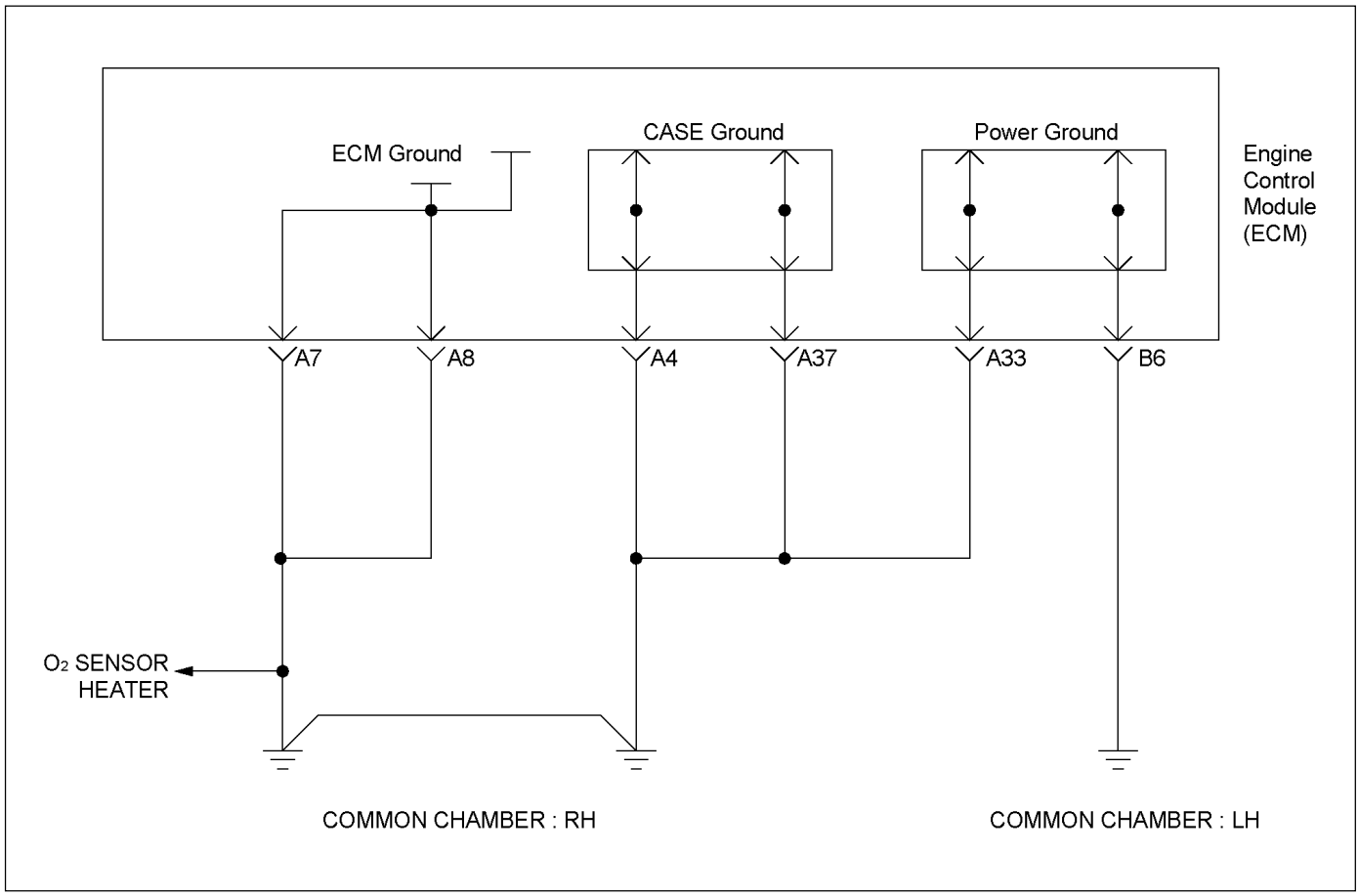
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ECM WIRING DIAGRAM (9/10)



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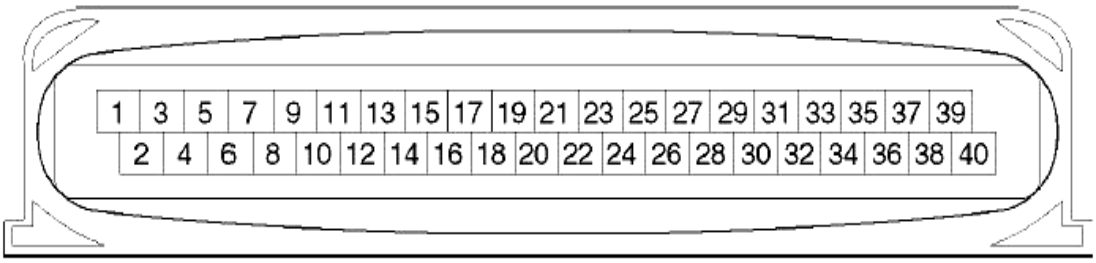
ECM WIRING DIAGRAM (10/10)



RTW36EMF000801

ECM CONNECTOR PIN ASSIGNMENT & OUTPUT SIGNAL

Connector A Port: View Looking Into ECM Case

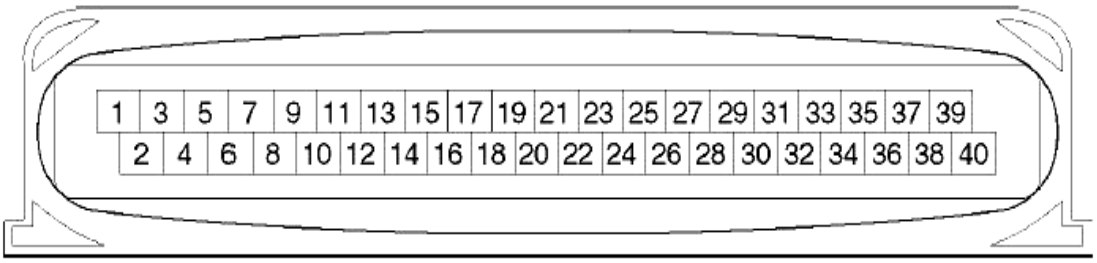


Pin No.	B/Box No.	Pin Function	Wire Color	Signal or Continuity				ECM Connection	Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm		Range	(+)	(-)
A1	A1	No Connection	-	-	-	-	-	-	-	-	-
A2	A2	No Connection	-	-	-	-	-	-	-	-	-
A3	A3	No Connection	-	-	-	-	-	-	-	-	-
A4	A4	Ground (Case)	BLK/ RED	Continuity with ground	-	-	-	Disconnect	Ohm	A4	GND
A5	A5	EGR Valve Control Duty Signal	YEL	Less than 1V	10-14V		Wave form	Connect	DC V	A5	GND
A6	A6	ECM Main Relay	BLU/ YEL	While main relay is activated: 10-14V Main relay is not activated: Less than 1V	10-14V			Connect	DC V	A6	GND
A7	A7	Ground	BLK/ YEL	Continuity with ground	-	-	-	Disconnect	Ohm	A7	GND
A8	A8	Ground	BLK/ YEL	Continuity with ground	-	-	-	Disconnect	Ohm	A8	GND
A9	A9	EGR Valve Position Signal	YEL/ RED	Less than 1V	0.5-0.8V			Connect	DC V	A9	GND
A10	A10	CAN (Controller Area Network) to TCM A17	RED	-	-	-	-	-	-	-	-
A11	A11	CAN (Controller Area Network) to TCM A7	WHT	-	-	-	-	-	-	-	-
A12	A12	No Connection	-	-	-	-	-	-	-	-	-
A13	A13	No Connection	-	-	-	-	-	-	-	-	-

Pin No.	B/Box No.	Pin Function	Wire Color	Signal or Continuity				ECM Connection	Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm		Range	(+)	(-)
A14	A14	No Connection	-	-	-	-	-	-	-	-	-
A15	A15	No Connection	-	-	-	-	-	-	-	-	-
A16	A16	No Connection	-	-	-	-	-	-	-	-	-
A17	A17	No Connection	-	-	-	-	-	-	-	-	-
A18	A18	No Connection	-	-	-	-	-	-	-	-	-
A19	A19	Intake Air Temperature (IAT) Sensor Signal	YEL/ GRN	Less than 1V	0 deg. C: Approx. 3.5V / 20 deg. C: Approx. 2.5V / 40 deg. C: Approx. 1.6V / 60 deg. C: 0.9V / 80 deg. C: 0.6V			Connect	DC V	A19	B39
A20	A20	No Connection	-	-	-	-	-	-	-	-	-
A21	A21	Engine Coolant Temperature (ECT) Sensor Signal	BLU/ RED	Less than 1V	0 deg. C: Approx. 3.6V / 20 deg. C: Approx. 2.4V / 40 deg. C: Approx. 1.4V / 60 deg. C: 3.4V / 80 deg. C: 2.6V			Connect	DC V	A21	A22
A22	A22	EGR Valve & ECT Sensor Ground	YEL/ BLK	Continuity with ground	-	-	-	Connect	Ohm	A22	GND
A23	A23	Crank Position (CKP) Sensor Signal	YEL	-	-	Wave form or approx. 1.9V		Connect	AC V	A23	A25
A24	A24	Crank Position (CKP) Sensor & EGR Valve +5V Supply	RED/ BLU	Less than 1V	Approx. 5V			Connect	DC V	A24	A25
A25	A25	Crank Position (CKP) Sensor Ground	YEL/ BLK	Continuity with ground	-	-	-	Connect	Ohm	A25	GND
A26	A26	No Connection	-	-	-	-	-	-	-	-	-
A27	A27	No Connection	-	-	-	-	-	-	-	-	-
A28	A28	ECM Main Relay	BLU/ RED	While main relay is activated: Less than 1V Main relay is not activated: 10-14V	Less than 1V			Connect	DC V	A28	GND
A29	A29	No Connection	-	-	-	-	-	-	-	-	-
A30	A30	No. 5 Ignition Coil	RED/ YEL	-	-	Wave form		-	-	-	-

Pin No.	B/Box No.	Pin Function	Wire Color	Signal or Continuity				ECM Connection	Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm		Range	(+)	(-)
A31	A31	No. 3 Ignition Coil	RED/ BLU	-	-	Wave form		-	-	-	-
A32	A32	No. 1 Ignition Coil	RED	-	-	Wave form		-	-	-	-
A33	A33	Ground (Power)	BLK/ RED	Continuity with ground	-	-	-	Disconnect	Ohm	A33	GND
A34	A34	No. 5 Injector	GRN/ BLK	Less than 1V	Wave form or 12-14V			Connect	DC V	A34	GND
A35	A35	No. 3 Injector	BLU	Less than 1V	Wave form or 12-14V			Connect	DC V	A35	GND
A36	A36	No. 1 Injector	GRN/ WHT	Less than 1V	Wave form or 12-14V			Connect	DC V	A36	GND
A37	A37	Ground (Case)	BLK/ RED	Continuity with ground	-	-	-	Disconnect	Ohm	A37	GND
A38	A38	No Connection	-	-	-	-	-	-	-	-	-
A39	A39	No Connection	-	-	-	-	-	-	-	-	-
A40	A40	No Connection	-	-	-	-	-	-	-	-	-

Connector B Port: View Looking Into ECM Cace

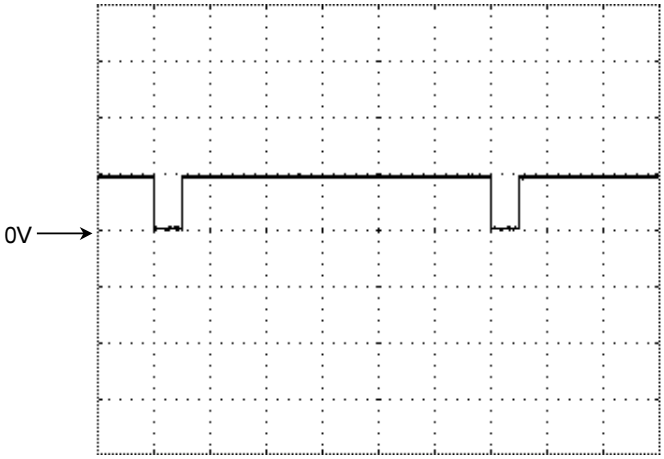


Pin No.	B/Box No.	Pin Function	Wire Color	Signal or Continuity					Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm	ECM Connection	Range	(+)	(-)
B1	B1	No Connection	-	-	-	-	-	-	-	-	-
B2	B2	No Connection	-	-	-	-	-	-	-	-	-
B3	B3	No. 2 Injector	GRN/ ORG	Less than 1V	Wave form or 12-14V			Connect	DC V	B3	GND
B4	B4	No. 4 Injector	GRN/ RED	Less than 1V	Wave form or 12-14V			Connect	DC V	B4	GND
B5	B5	No. 6 Injector	GRN/ YEL	Less than 1V	Wave form or 12-14V			Connect	DC V	B5	GND
B6	B6	Ground (Power)	BLK	Continuity with ground	-	-	-	Disconnect	Ohm	B6	GND
B7	B7	No. 2 Ignition Coil	RED/ BLK	-	-	Wave form		-	-	-	-
B8	B8	No. 4 Ignition Coil	RED/ WHT	-	-	Wave form		-	-	-	-
B9	B9	No. 6 Ignition Coil	RED/ GRN	-	-	Wave form		-	-	-	-
B10	B10	No Connection	-	-	-	-	-	-	-	-	-
B11	B11	A/C Compressor Relay	GRY/ RED	Less than 1V	A/C comp. is operated: Less than 1V A/C comp. is not operated: 10-14V			Connect	DC V	B11	GND
B12	B12	Tachometer Output Signal	BLK/ RED	-	-	Wave form or 6.2V	Wave form or 6.2V	Connect	AC V	B12	GND
B13	B13	Idle Air Control (IAC) Valve Coil A High	BLU	Less than 1V	Less than 1V / 10-14V			Connect	DC V	B13	GND
B14	B14	Idle Air Control (IAC) Valve Coil B High	BLU/ WHT	Less than 1V	Less than 1V / 10-14V			Connect	DC V	B14	GND
B15	B15	Canister Purge Solenoid Valve	RED/ BLU	Less than 1V	Wave form or 12-14V			Connect	AC V	B15	GND

Pin No.	B/Box No.	Pin Function	Wire Color	Signal or Continuity					Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm	ECM Connection	Range	(+)	(-)
B16	B16	Idle Air Control (IAC) Valve Coil A Low	BLU/ RED	Less than 1V	Less than 1V / 10-14V			Connect	DC V	B16	GND
B17	B17	Idle Air Control (IAC) Valve Coil B Low	BLU/ BLK	Less than 1V	Less than 1V / 10-14V			Connect	DC V	B17	GND
B18	B18	Check Engine Lamp (Immobilizer Control Unit Terminal B7)	BRN/ YEL	Less than 1V	Less than 1V	Lamp is turned on: Less than 1V Lamp is turned off: 10-14V		Connect	DC V	B18	GND
B19	B19	Fuel Pump Relay	GRN/ WHT	Less than 1V	While relay is activated: 10-14V Relay is not activated: Less than 1V	10-14V		Connect	DC V	B19	GND
B20	B20	Mass Air Flow (MAF) Sensor	BLK/ YEL	Less than 1V	Approx. 0.47V	Approx. 1.5V at 750 rpm	Approx. 2V	Connect	DC V	B20	GND
B21	B21	Bank 1 Oxygen Sensor Signal	PNK	Less than 1V	Approx. 0.4V	0.1 - 0.9V		Connect	DC V	B21	B22
B22	B22	Bank 1 Oxygen Sensor Ground	BLU/ YEL	Continuity with ground	-	-	-	Connect	Ohm	B22	GND
B23	B23	Bank 2 Oxygen Sensor Signal	RED	Less than 1V	Approx. 0.4V	0.1 - 0.9V		Connect	DC V	B23	B24
B24	B24	Bank 2 Oxygen Sensor Ground	BLU/ BLK	Continuity with ground	-	-	-	Connect	Ohm	B24	GND
B25	B25	To Data Link Connector No.6	BLK/ GRN	-	-	-	-	-	-	-	-
B26	B26	Throttle Position Sensor (TPS) Signal	BLU	Less than 1V	Approx. 0.5V		Approx. 0.6V	Connect	DC V	B26	B39
B27	B27	TPS & Cam Position Sensor +5V Supply	GRN	Less than 1V	Approx. 5V			Connect	DC V	B27	B39
B28	B28	Camshaft Position (CMP) Sensor Signal	BLU	-	-	Wave form		-	-	-	-
B29	B29	Inhibitor Switch (AT Only)	BLK	Less than 1V	P or N range: Less than 1V Other than P or N range: 10-14V			Connect	DC V	B29	GND
B30	B30	Power Steering Pressure Switch	GRN/ YEL	Less than 1V	Pressure switch is turned on: Less than 1V Pressure Switch is turned off: 10-14V			Connect	DC V	B30	GND
B31	B31	A/C Thermo Relay	GRN/ BLK	Less than 1V	A/C request is activated: 10-14V A/C request is not activated: Less than 1V			Connect	DC V	B31	GND

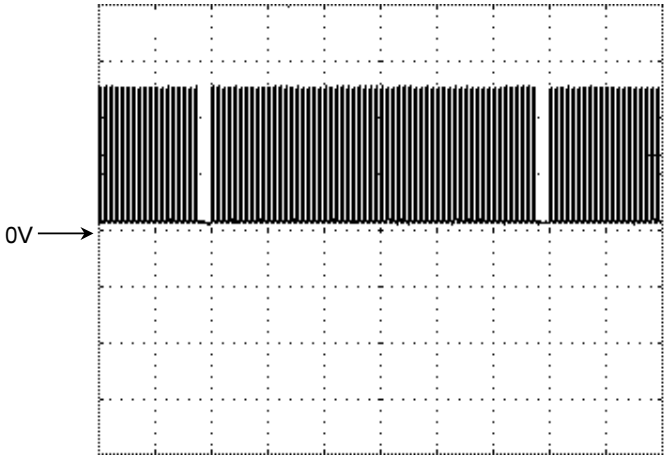
Pin No.	B/Box No.	Pin Function	Wire Color	Signal or Continuity					Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm	ECM Connection	Range	(+)	(-)
B32	B32	Vehicle Speed Signal (Immobilizer Control Unit Terminal B8)	WHT	-	-	Wave form or approx. 6.5V at 20km/h		Connect	AC V	B32	GND
B33	B33	Ignition Switch	BLU/ YEL	Less than 1V	10-14V			Connect	DC V	B33	GND
B34	B34	Back Up Power Supply	RED/ WHT	10-14V				Connect	DC V	B34	GND
B35	B35	No Connection	-	-	-	-	-	-	-	-	-
B36	B36	ECM Main Relay	RED/ BLU	While main relay is activated: 10-14V Main relay is not activated: Less than 1V	10-14V			Connect	DC V	B36	GND
B37	B37	ECM Main Relay	RED/ BLU	While main relay is activated: 10-14V Main relay is not activated: Less than 1V	10-14V			Connect	DC V	B37	GND
B38	B38	To Data Link Connect to No. 2	GRN	-	-	-	-	-	-	-	-
B39	B39	TPS, MAF, IAT & CMP Sensor Ground	RED	Continuity with ground	-	-	-	Connect	Ohm	B39	GND
B40	B40	No Connection	-	-	-	-	-	-	-	-	-

Camshaft Position (CMP) Sensor Reference Wave Form



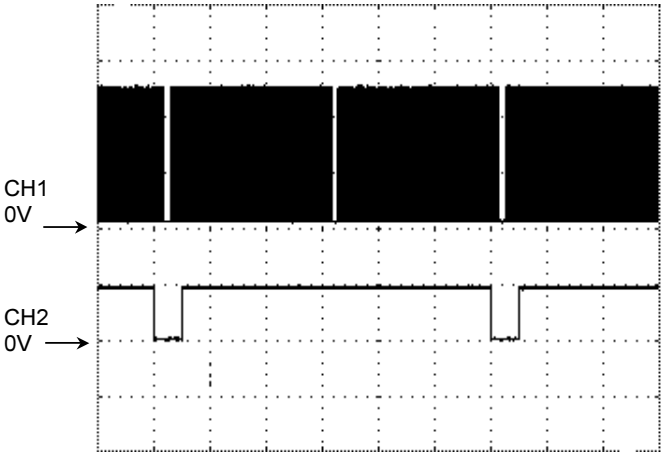
Measurement Terminal: B28(+) B39(-)
Measurement Scale: 5V/div 10ms/div
Measurement Condition: Approximately 2000rpm

Crankshaft Position (CKP) Sensor Reference Wave Form



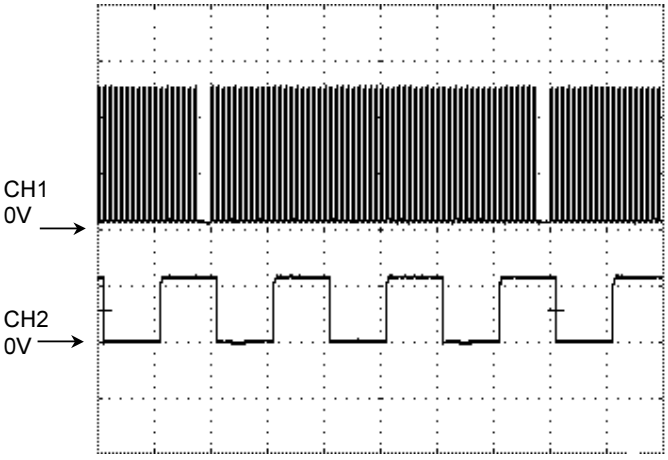
Measurement Terminal: A23(+) A25(-)
Measurement Scale: 2.0V/div 5ms/div
Measurement Condition: Approximately 2000rpm

Crankshaft Position (CKP) Sensor & Camshaft Position (CMP) Sensor Reference Wave Form



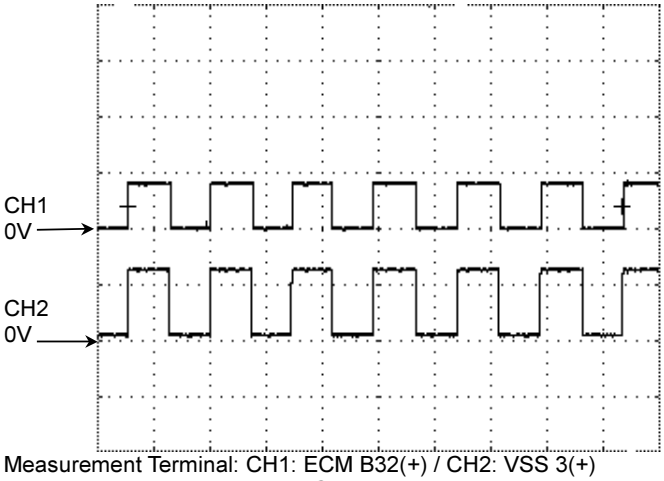
Measurement Terminal: CH1: A23(+) / CH2: B28(+) GND(-)
Measurement Scale: 2V/div / CH2: 5V/div 10ms/div
Measurement Condition: Approximately 2000rpm

Crankshaft Position (CKP) Sensor & Tacho Output Signal Reference Wave Form



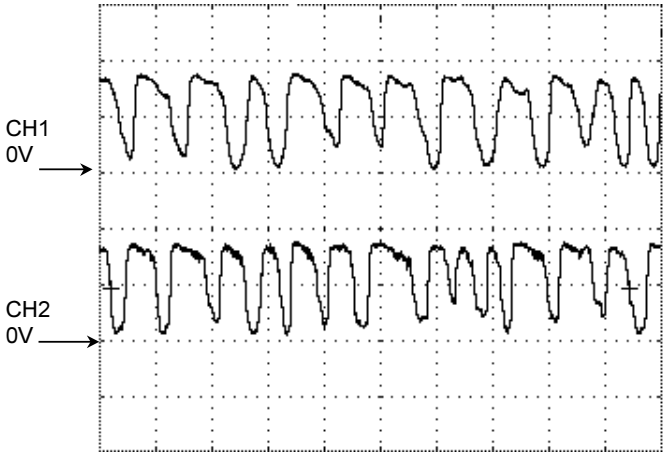
Measurement Terminal: CH1: A23(+) / CH2: B12(+) GND(-)
Measurement Scale: CH1: 2V/div / CH2: 10V/div 5ms/div
Measurement Condition: Approximately 2000rpm

Vehicle Speed Sensor (VSS) Reference Wave Form



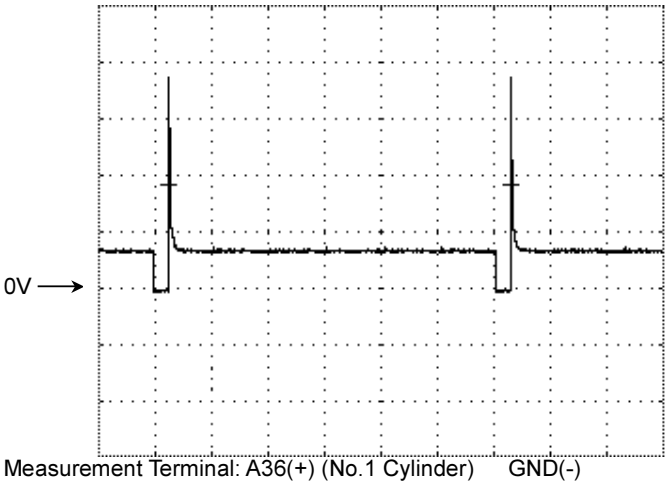
Measurement Terminal: CH1: ECM B32(+) / CH2: VSS 3(+)
GND(-)
Measurement Scale: CH1: 10V/div / CH2: 10V/div 50ms/div
Measurement Condition: Approximately 20km/h
Note: The vehicle is without immobilizer system,
CH1 signal is same as CH2.

Heated Oxygen Sensor (HO2S) Reference Wave Form



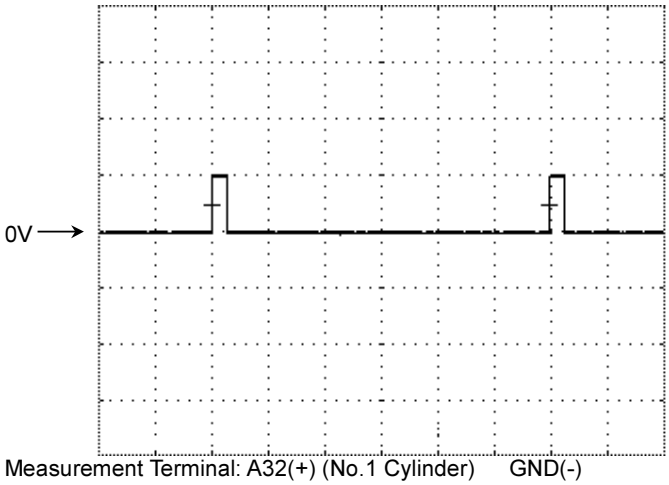
Measurement Terminal: CH1: B21(+) / CH2: B23(+) GND(-)
Measurement Scale: CH1: 500mV/div / CH2: 500mV/div 1s/div
Measurement Condition: Approximately 2000rpm in Closed Loop

Injector Control Signal Reference Wave Form



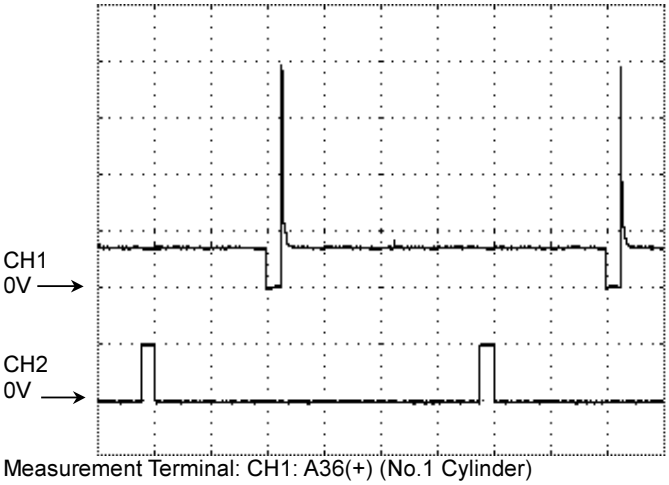
Measurement Terminal: A36(+) (No.1 Cylinder) GND(-)
Measurement Scale: 20V/div 10ms/div
Measurement Condition: Approximately 2000rpm

Ignition Coil Control Signal Reference Wave Form



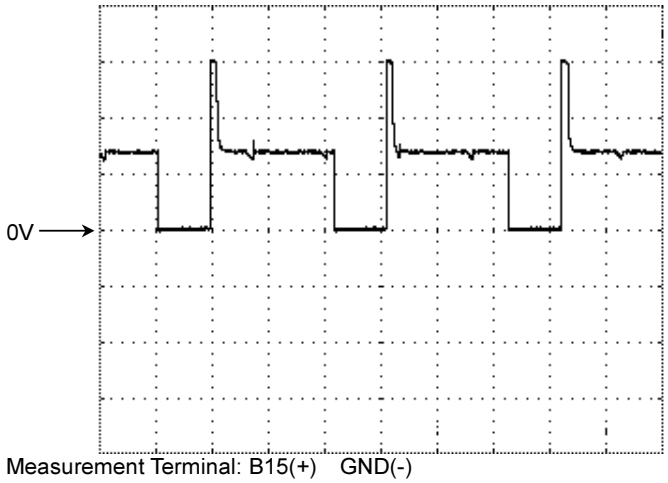
Measurement Terminal: A32(+) (No.1 Cylinder) GND(-)
Measurement Scale: 5V/div 10ms/div
Measurement Condition: Approximately 2000rpm

Injector & Ignition Coil Control Signal Reference Wave Form



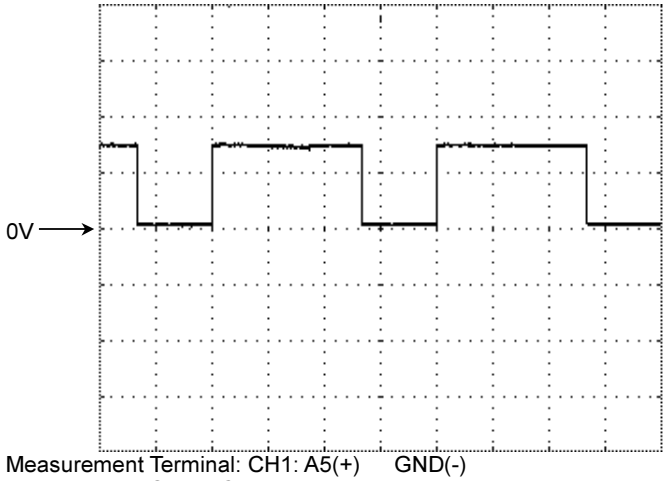
Measurement Terminal: CH1: A36(+) (No.1 Cylinder)
CH2: A32(+) (No.1 Cylinder) GND(-)
Measurement Scale: CH1: 20V/div / CH2: 5V/div 10ms/div
Measurement Condition: Approximately 2000rpm

EVAP Canistor Purge Solenoid Reference Wave Form



Measurement Terminal: B15(+) GND(-)
Measurement Scale: 10V/div 20ms/div
Frequency: Approximately 16Hz

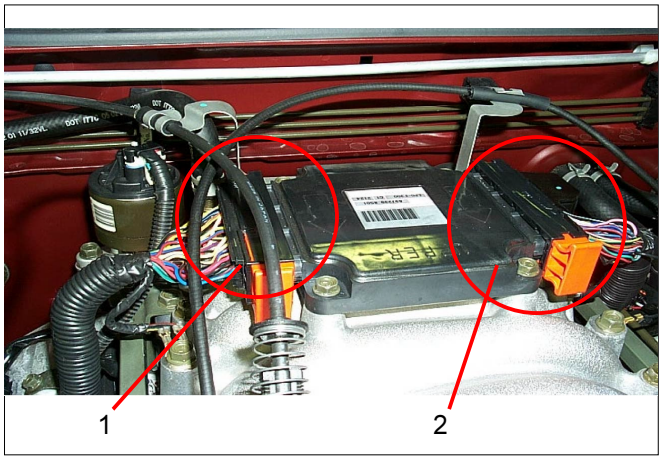
EGR Solenoid Reference Wave Form



Measurement Terminal: CH1: A5(+) GND(-)
Measurement Scale: CH1: 10V/div 2ms/div
Frequency: Approximately 128Hz

GENERAL DESCRIPTION FOR ECM AND SENSORS

Engine Control Module (ECM)



(1) A Port
(2) B Port

The engine control module (ECM) is located on the common chamber. The ECM controls the following.

- Fuel metering system
- Ignition timing
- On-board diagnostics for powertrain functions.

The ECM constantly observes the information from various sensors. The ECM controls the systems that affect vehicle performance. And it performs the diagnostic function of the system.

The function can recognize operational problems, and warn to the driver through the check engine lamp, and store diagnostic trouble code (DTC). DTCs identify the problem areas to aid the technician in marking repairs.

The input / output devices in the ECM include analog to digital converts, signal buffers, counters and drivers. The ECM controls most components with electronic switches which complete a ground circuit when turned on.

Inputs (Operating condition read):

- Battery voltage
- Electrical ignition
- Exhaust oxygen content
- Mass air flow
- Intake air temperature
- Engine coolant temperature
- Crankshaft position
- Camshaft position
- Throttle position
- Vehicle speed
- Power steering pressure
- Air conditioning request on or off
- EGR valve position

Outputs (Systems controlled):

- Ignition control
- Fuel control
- Idle air control
- Fuel pump
- EVAP canister purge
- Air conditioning
- Diagnostics functions

The vehicle with automatic transmission, the interchange of data between the engine control module (ECM) and the transmission control module (TCM) is performed via a CAN-bus system.

The following signals are exchanged via the CAN-bus:

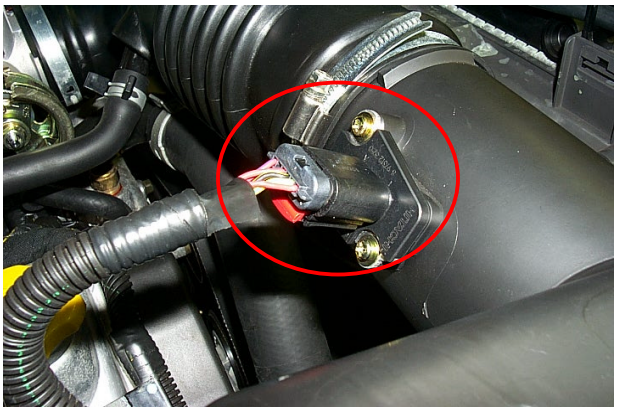
ECM to TCM:

- ECM CAN signal status
- Engine torque
- Coolant temperature
- Throttle position
- Engine speed
- A/C status
- CAN valid counter

TCM to ECM:

- Ignition timing retard request
- Garage shift status
- CAN valid counter

Mass Air Flow (MAF) Sensor & Intake Air Temperature (IAT) Sensor



The MAF sensor is part of the intake air system.

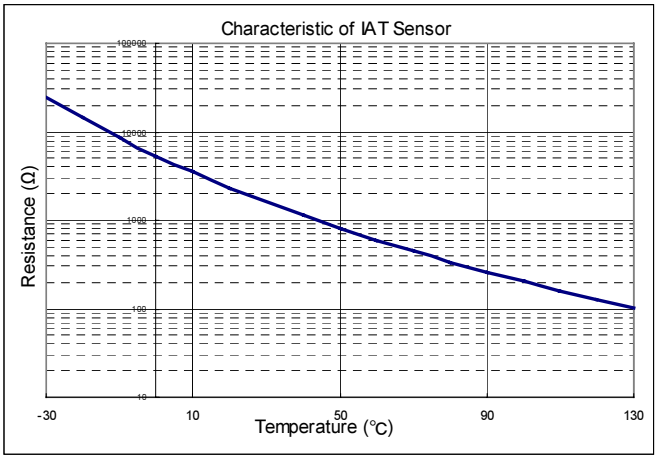
It is fitted between the air cleaner & throttle body and measure the mass air flowing into the engine.

The MAF sensor uses a hot wire element to determine the amount of air flowing into the engine. (The wire temperature reaches to 170 - 300°C)

The MAF sensor assembly consist of a MAF sensor element and an intake air temperature sensor that are both exposed to the air flow to be measured.

The MAF sensor element measures the partial air mass through a measurement duct on the sensor housing.

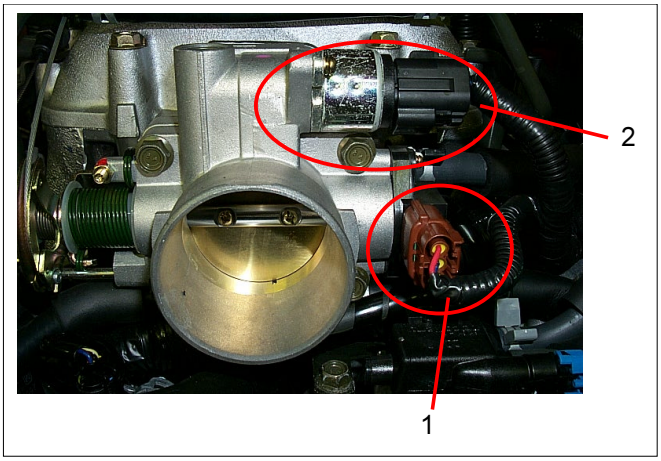
Using calibration, there is an extrapolation to the entire mass air flow to the engine.



The IAT sensor is a thermistor. A temperature changes the resistance value. And it changes voltage. In other words it measures a temperature value. Low air temperature produces a high resistance.

The ECM supplies 5 volts signal to the IAT sensor through resisters in the ECM and measures the voltage. The signal voltage will be high when the air temperature is cold, and it will be low when the air temperature is hot.

Throttle Position Sensor (TPS)



(1) Throttle Position Sensor (TPS)
(2) Idle Air Control Valve (IACValve)

The TPS is a potentiometer connected to throttle shaft on the throttle body.

The engine control module (ECM) monitors the voltage on the signal line and calculates throttle position. As the throttle valve angle is changed when accelerator pedal moved. The TPS signal also changed at a moved throttle valve. As the throttle valve opens, the output increases so that the output voltage should be high.

The throttle body has a throttle plate to control the amount of air delivered to the engine. Engine coolant is directed through a coolant cavity in the throttle body to warm the throttle valve and to prevent icing.

Idle Air Control (IAC) Valve



Step / Coil	A	B	C	D
Coil A High (ECM B13)	On			On
Coil A Low (ECM B16)		On	On	
Coil B High (ECM B14)	On	On		
Coil B Low (ECM B17)			On	On

(IAC Valve Close Direction)

(IAC Valve Open Direction)

The idle air control valve (IAC) valve is two directional and gives 2-way control. It has a stepping motor capable of 256 steps, and also has 2 coils. With power supply to the coils controlled steps by the engine control module (ECM), the IAC valve's pintle is moved to adjust idle speed, raising it for fast idle when cold or there is extra load from the air conditioning or power steering.

By moving the pintle in (to decrease air flow) or out (to increase air flow), a controlled amount of the air can move around the throttle plate. If the engine speed is too low, the engine control module (ECM) will retract the IAC pintle, resulting in more air moving past the throttle plate to increase the engine speed.

If the engine speed is too high, the engine control module (ECM) will extend the IAC pintle, allowing less air to move past the throttle plate, decreasing the engine speed.

The IAC pintle valve moves in small step called counts. During idle, the proper position of the IAC pintle is calculated by the engine control module (ECM) based on battery voltage, coolant temperature, engine load, and engine speed.

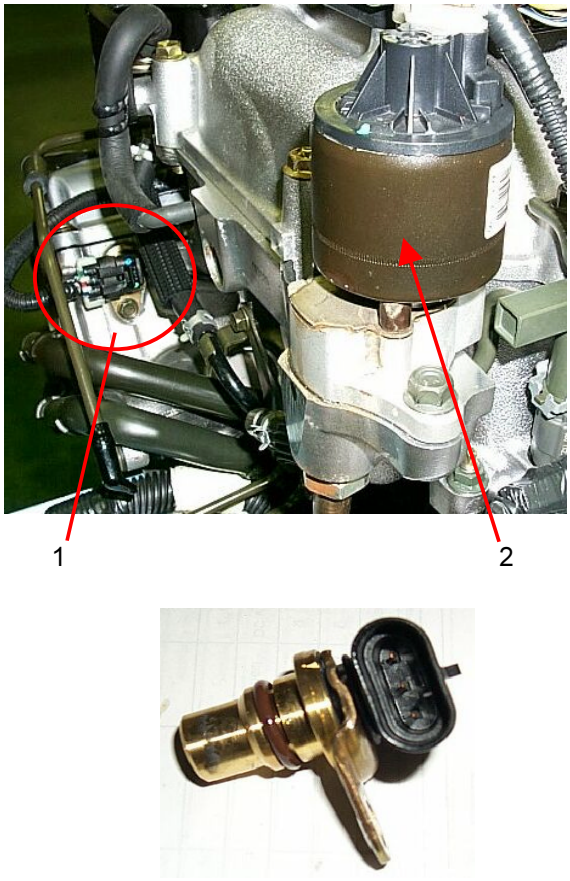
If the engine speed drops below a specified value, and the throttle plate is closed, the engine control module (ECM) senses a near-stall condition. The engine control module (ECM) will then calculate a new IAC pintle valve position to prevent stalls.

If the IAC valve is disconnected and reconnected with the engine running, the idle speed will be wrong. In this case, the IAC must be reset. The IAC resets when the key is cycled "On" then "Off". When servicing the IAC, it should only be disconnected or connected with the ignition "Off".

The position of the IAC pintle valve affects engine start-up and the idle characteristic of the vehicle.

If the IAC pintle is fully open, too much air will be allowed into the manifold. This results in high idle speed, along with possible hard starting and lean air/fuel ratio.

Camshaft Position (CMP) Sensor

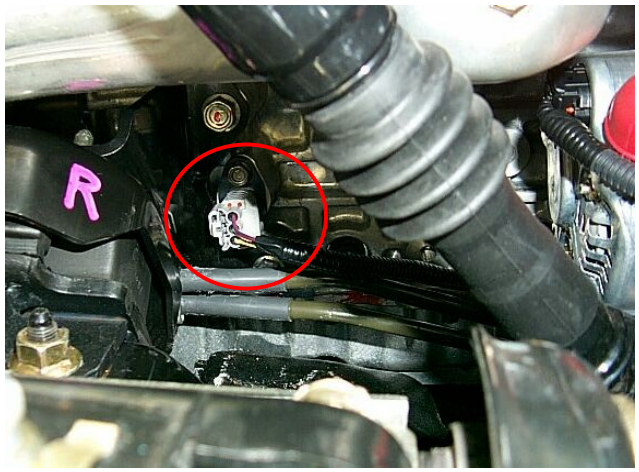


(1) Camshaft Position (CMP) Sensor
(2) EGR Valve

With the use of sequential multi-point fuel injection, a hall element type camshaft position (CMP) is adopted to provide information to be used in making decisions on injection timing to each cylinder. It is mounted on the rear of the left-hand cylinder head and sends signals to the ECM.

One pulse is generated per two rotations of crankshaft.

Crankshaft Position (CKP) Sensor





The crankshaft position (CKP) sensor, which sends a signal necessary for deciding on injection timing to the ECM, is mounted on the right-hand side of the cylinder block.

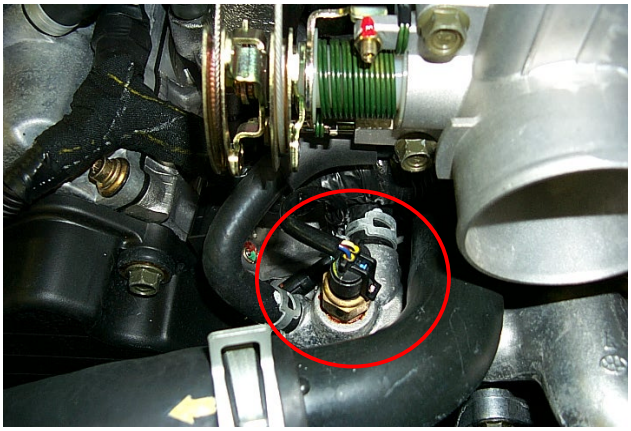
The crankshaft has a 58 teeth press-fit timing disc, from which the CKP sensor reads the position of the crankshaft at all the times. It converts this to an electrical signal, which it sends to the ECM.

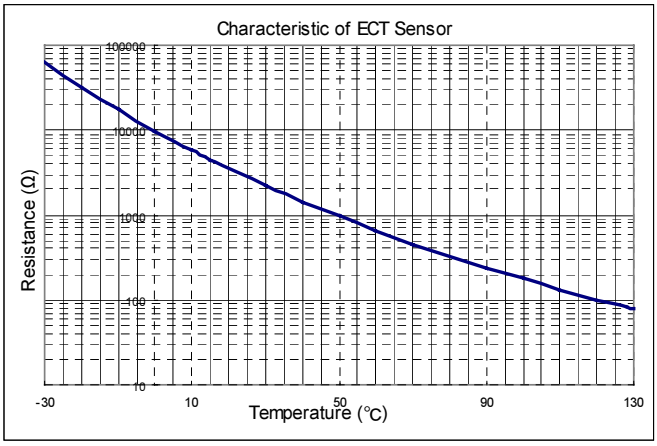
Of the 58 teeth, 57 have a base with of 3°, and are evenly spaced, but tooth No. 58 is 15° wide at its based to serve as a timing mark, allowing the sensor to report the standard crankshaft position.

Using the 58 X signals per rotation and the timing-mark signal sent by the CKP sensor, the ECM is able to accurately calculate engine speed and crank position. Also, the position of each cylinder is precisely known by the ECM from signals sent by the camshaft position (CMP) sensor, so the sequential multi-point fuel injection can be controlled with accuracy.

The 58 X signals are converted by the ECM into a retangle wave signal. This converted signal is sent from the ECM terminal B12 to the tachometer and transfer case control module (TCCM) terminal 15 (if 4WD model).

Engine Coolant Temperature (ECT) Sensor

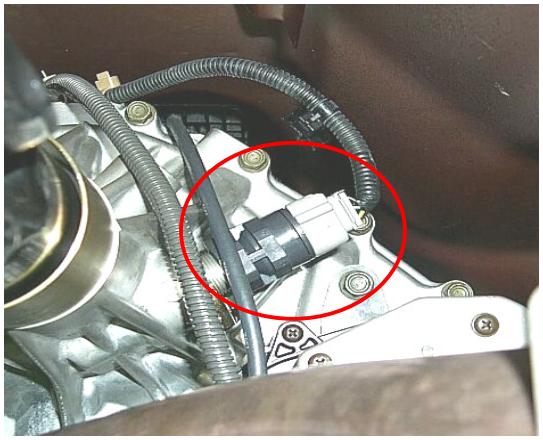




The ECT sensor is a thermistor. A temperature changes the resistance value. And it changes voltage. In other words it measures a temperature value. It is installed on the coolant stream. Low coolant temperature produces a high resistance.

The ECM supplies 5 volts signal to the ECT sensor through resisters in the ECM and measures the voltage. The signal voltage will be high when the engine temperature is cold, and it will be low when the engine temperature is hot.

Vehicle Speed Sensor (VSS)

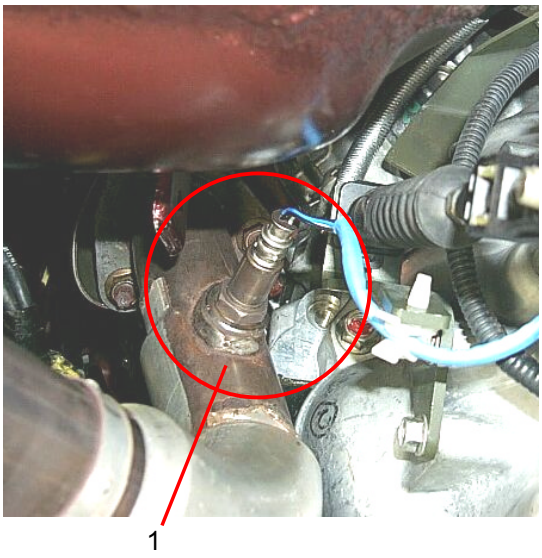


The VSS is a magnet rotated by the transmission output shaft. The VSS uses a hall element. It interacts with the magnetic field treated by the rotating magnet. It outputs pulse signal. The 12 volts operating supply from the meter fuse.

Heated Oxygen (O2) Sensor



(1) Bank 1 Heated Oxygen Sensor (RH)



(1) Bank 2 Heated Oxygen Sensor (LH)

Each oxygen sensor consists of a 4-wire low temperature activated zirconia oxygen analyzer element with heater for operating temperature of 315°C, and there is one mounted on each exhaust pipe.

A constant 450millivolt is supplied by the ECM between the two supply terminals, and oxygen concentration in the exhaust gas is reported to the ECM as returned signal voltage.

The oxygen present in the exhaust gas reacts with the sensor to produce a voltage output. This voltage should constantly fluctuate from approximately 100mV to 1000mV and the ECM calculates the pulse width commanded for the injectors to produce the proper combustion chamber mixture.

Low oxygen sensor output voltage is a lean mixture which will result in a rich commanded to compensate.

High oxygen sensor output voltage is a rich mixture which result in a lean commanded to compensate.

When the engine is first started the system is in "Open Loop" operation. In "Open Loop", the ECM ignores the signal from the oxygen sensors. When various conditions (ECT, time from start, engine speed & oxygen sensor output) are met, the system enters "Closed Loop" operation. In "Closed Loop", the ECM calculates the air fuel ratio based on the signal from the oxygen sensors.

Heated oxygen sensors are used to minimize the amount of time required for closed loop fuel control to begin operation and allow accurate catalyst monitoring.

The oxygen sensor heater greatly decreases the amount of time required for fuel control sensors to become active.

Oxygen sensor heaters are required by catalyst monitor and sensors to maintain a sufficiently high temperature which allows accurate exhaust oxygen content readings further away from the engine.

GENERAL DESCRIPTION FOR FUEL METERING

The fuel metering system starts with the fuel in the fuel tank. An electric fuel pump, located in the fuel tank, pumps fuel to the fuel rail through an in-line fuel filter.

The pump is designed to provide fuel at a pressure above the pressure needed by the injectors.

A fuel pressure regulator in the fuel rail keeps fuel available to the fuel injectors at a constant pressure.

A return line delivers unused fuel back to the fuel tank.

The basic function of the air/fuel metering system is to control the air/fuel delivery to the engine. Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold.

The main control sensor is the heated oxygen sensor located in the exhaust system. The heated oxygen sensor reports to the ECM how much oxygen is in the exhaust gas. The ECM changes the air/fuel ratio to the engine by controlling the amount of time that fuel injector is "On".

The best mixture to minimize exhaust emissions is 14.7 parts of air to 1 part of gasoline by weight, which allows the catalytic converter to operate most efficiently.

Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a "closed loop" system.

The ECM monitors signals from several sensors in order to determine the fuel needs of the engine. Fuel is delivered under one of several conditions called "mode". All modes are controlled by the ECM.

Acceleration Mode

The ECM provides extra fuel when it detects a rapid increase in the throttle position and the air flow.

Battery Voltage Correction Mode

When battery voltage is low, the ECM will compensate for the weak spark by increasing the following:

- The amount of fuel delivered.
- The idle RPM.
- Ignition dwell time.

Clear Flood Mode

Clear a flooded engine by pushing the accelerator pedal down all the way. The ECM then de-energizes the fuel injectors. The ECM holds the fuel injectors de-energized as long as the throttle remains above 80% and the engine speed is below 800 RPM. If the throttle position becomes less than 80%, the ECM again begins to pulse the injectors "ON" and "OFF," allowing fuel into the cylinders.

Deceleration Mode

The ECM reduces the amount of fuel injected when it detects a decrease in the throttle position and the air flow. When deceleration is very fast, the ECM may cut off fuel completely for short periods.

Engine Speed/Vehicle Speed/Fuel Disable Mode

The ECM monitors engine speed. It turns off the fuel injectors when the engine speed increase above 6400 RPM. The fuel injectors are turned back on when engine speed decreases below 6150 RPM.

Fuel Cutoff Mode

No fuel is delivered by the fuel injectors when the ignition is "OFF." This prevents engine run-on. In addition, the ECM suspends fuel delivery if no reference pulses are detected (engine not running) to prevent engine flooding.

Run Mode

The run mode has the following two conditions:

- Open loop
- Closed loop

When the engine is first started the system is in "open loop" operation. In "open loop," the ECM ignores the signal from the heated oxygen sensor (HO2S). It calculates the air/fuel ratio based on inputs from the TP, ECT, and MAF sensors.

The system remains in "open loop" until the following conditions are met:

- The HO2S has a varying voltage output showing that it is hot enough to operate properly (this depends on temperature).
- The ECT has reached a specified temperature.
- A specific amount of time has elapsed since starting the engine.
- Engine speed has been greater than a specified RPM since start-up.

The specific values for the above conditions vary with different engines and are stored in the programmable read only memory (PROM). When these conditions are met, the system enters "closed loop" operation. In "closed loop," the ECM calculates the air/fuel ratio (injector on-time) based on the signal from the HO2S. This allows the air/fuel ratio to stay very close to 14.7:1.

Starting Mode

When the ignition is first turned "ON," the ECM energizes the fuel pump relay for two seconds to allow the fuel pump to build up pressure. The ECM then checks the engine coolant temperature (ECT) sensor and the throttle position sensor to determine the proper air/fuel ratio for starting.

The ECM controls the amount of fuel delivered in the starting mode by adjusting how long the fuel injectors are energized by pulsing the injectors for very short times.

Fuel Metering System Components

The fuel metering system is made up of the following parts.

- Fuel injector
- Throttle Body
- Fuel Rail
- Fuel Pressure regulator
- ECM
- Crankshaft position (CKP) sensor
- Camshaft position (CMP) sensor
- Idle air control valve
- Fuel pump

Fuel Injector

The sequential multi-port fuel injection fuel injector is a solenoid operated device controlled by the ECM. The ECM energizes the solenoid, which opens a valve to allow fuel delivery.

The fuel is injected under pressure in a conical spray pattern at the opening of the intake valve. Excess fuel not used by the injectors passes through the fuel pressure regulator before being returned to the fuel tank.

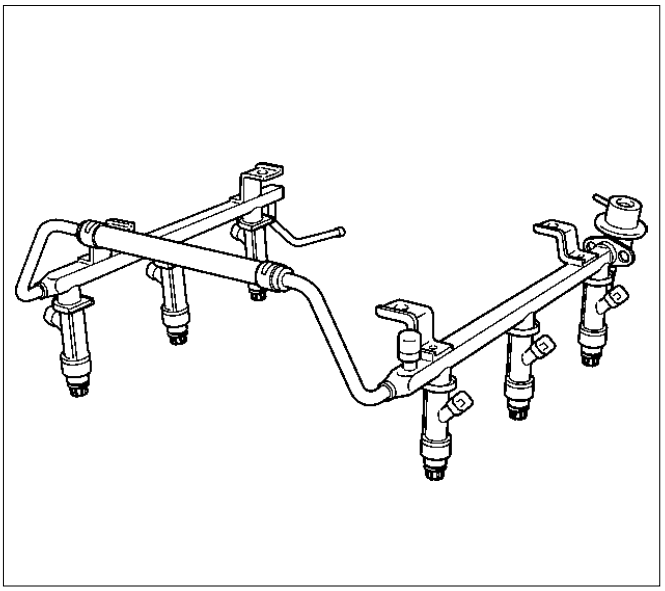
Fuel Pressure Regulator

The fuel pressure regulator is a diaphragm-operated relief valve mounted on the fuel rail with fuel pump pressure on one side and manifold pressure on the other side. The fuel pressure regulator maintains the fuel pressure available to the injector at three times barometric pressure adjusted for engine load. It may be serviced separate.

If the pressure is too low, poor performance and a DTC P0131, P0151, P0171, P0174, P1171 or P1174 will be the result. If the pressure is too high, excessive odor and/or a DTC P0132, P0152, P0172 or P0175 will be the result. Refer to *Fuel System Diagnosis* for information on diagnosing fuel pressure conditions.

Fuel Rail

The fuel rail is mounted to the top of the engine and distributes fuel to the individual injectors. Fuel is delivered to the fuel inlet tube of the fuel rail by the fuel lines. The fuel goes through the fuel rail to the fuel pressure regulator. The fuel pressure regulator maintains a constant fuel pressure at the injectors. Remaining fuel is then returned to the fuel tank.



055RV009

Fuel Pump Electrical Circuit

When the key is first turned "ON," the ECM energizes the fuel pump relay for two seconds to build up the fuel pressure quickly. If the engine is not started within two seconds, the ECM shuts the fuel pump off and waits until the engine is cranked. When the engine is cranked and the 58 X crankshaft position signal has been detected by the ECM, the ECM supplies 12 volts to the fuel pump relay to energize the electric in-tank fuel pump.

An inoperative fuel pump will cause a "no-start" condition. A fuel pump which does not provide enough pressure will result in poor performance.

Camshaft Position (CMP) Sensor Signal

The ECM uses this signal to determine the position of the number 1 piston during its power stroke, allowing the ECM to calculate true sequential multiport fuel injection. Loss of this signal will set a DTC P0341. If the CMP signal is lost while the engine is running, the fuel injection system will shift to a calculated sequential fuel injection based on the last fuel injection pulse, and the engine will continue to run. The engine can be restarted and will run in the calculated sequential mode as long as the fault is present, with a 1-in-6 chance of being correct.

GENERAL DESCRIPTION FOR ELECTRONIC IGNITION SYSTEM IGNITION COILS & CONTROL

A separate coil-at-plug module is located at each spark plug.

The coil-at-plug module is attached to the engine with two screws. It is installed directly to the spark plug by an electrical contact inside a rubber boot.

A three way connector provides 12 volts primary supply from the ignition coil fuse, a ground switching trigger line from the ECM, and ground.

The ignition control spark timing is the ECM's method of controlling the spark advance and the ignition dwell.

The ignition control spark advance and the ignition dwell are calculated by the ECM using the following inputs.

- Engine speed
- Crankshaft position (CKP) sensor
- Camshaft position (CMP) sensor
- Engine coolant temperature (ECT) sensor
- Throttle position sensor
- Park or neutral position switch
- Vehicle speed sensor
- ECM and ignition system supply voltage

Based on these sensor signal and engine load information, the ECM sends 5V to each ignition coil requiring ignition. This signal sets in the power transistor of the ignition coil to establish a grounding circuit for the primary coil, applying battery voltage to the primary coil.

At the ignition timing, the ECM stops sending the 5V signal voltage. Under this condition the power transistor of the ignition coil is set off to cut the battery voltage to the primary coil, thereby causing a magnetic field generated in the primary coil to collapse.

On this moment a line of magnetic force flows to the secondary coil, and when this magnetic line crosses the coil, high voltage induced by the secondary ignition circuit to flow through the spark plug to the ground.

Ignition Control ECM Output

The ECM provides a zero volt (actually about 100 mV to 200 mV) or a 5-volt output signal to the ignition control (IC) module. Each spark plug has its own primary and secondary coil module ("coil-at-plug") located at the spark plug itself. When the ignition coil receives the 5-volt signal from the ECM, it provides a ground path for the B+ supply to the primary side of the coil-at -plug module. This energizes the primary coil and creates a magnetic field in the coil-at-plug module. When the ECM shuts off the 5-volt signal to the ignition control module, the ground path for the primary coil is broken. The magnetic field collapses and induces a high voltage secondary impulse which fires the spark plug and ignites the air/fuel mixture.

The circuit between the ECM and the ignition coil is monitored for open circuits, shorts to voltage, and shorts to ground. If the ECM detects one of these events, it will set one of the following DTCs:

- P0351: Ignition coil Fault on Cylinder #1
- P0352: Ignition coil Fault on Cylinder #2
- P0353: Ignition coil Fault on Cylinder #3
- P0354: Ignition coil Fault on Cylinder #4
- P0355: Ignition coil Fault on Cylinder #5
- P0356: Ignition coil Fault on Cylinder #6

Spark Plug

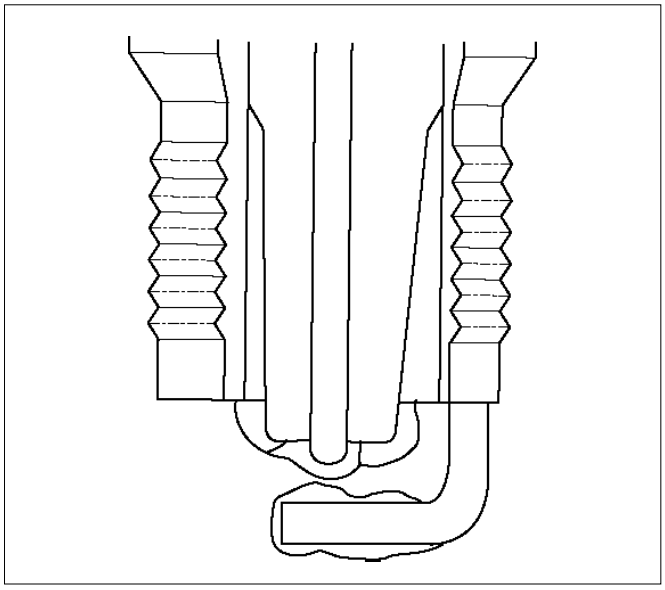
Although worn or dirty spark plugs may give satisfactory operation at idling speed, they frequency fail at higher engine speeds. Faulty spark plugs may cause poor fuel economy, power loss, loss of speed, hard starting and generally poor engine performance. Follow the scheduled maintenance service recommendations to ensure satisfactory spark plug performance. Refer to *Maintenance and Lubrication*.

Normal spark plug operation will result in brown to grayish-tan deposits appearing on the insulator portion of the spark plug. A small amount of red-brown, yellow, and white powdery material may also be present on the insulator tip around the center electrode. These deposits are normal combustion by-products of fuels and lubricating oils with additives. Some electrode wear will also occur. Engines which are not running properly are often referred to as “misfiring." This means the ignition spark is not igniting the air/fuel mixture at the proper time.

Spark plugs may also misfire due to fouling, excessive gap, or a cracked or broken insulator. If misfiring occurs before the recommended replacement interval, locate and correct the cause.

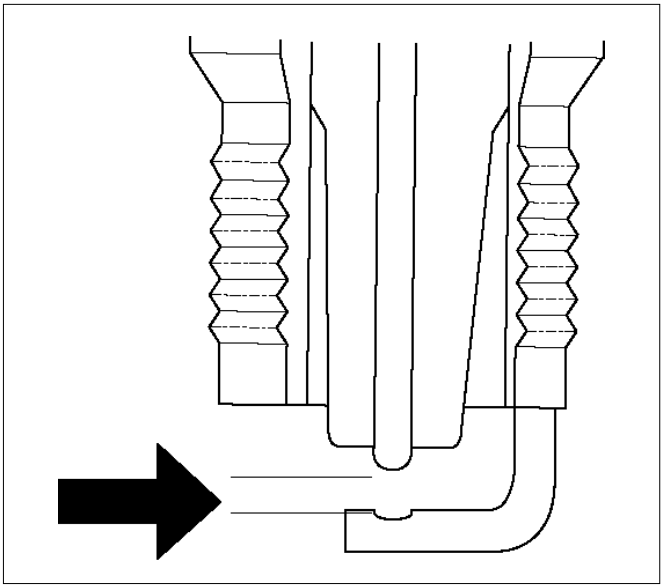
Carbon fouling of the spark plug is indicated by dry, black carbon (soot) deposits on the portion of the spark plug in the cylinder. Excessive idling and slow speeds under light engine loads can keep the spark plug temperatures so low that these deposits are not burned off. Very rich fuel mixtures or poor ignition system output may also be the cause. Refer to DTC P0172.

Oil fouling of the spark plug is indicated by wet oily deposits on the portion of the spark plug in the cylinder, usually with little electrode wear. This may be caused by oil during break-in of new or newly overhauled engines. Deposit fouling of the spark plug occurs when the normal red-brown, yellow or white deposits of combustion by products become sufficient to cause misfiring. In some cases, these deposits may melt and form a shiny glaze on the insulator around the center electrode. If the fouling is found in only one or two cylinders, valve stem clearances or intake valve seals may be allowing excess lubricating oil to enter the cylinder, particularly if the deposits are heavier on the side of the spark plug facing the intake valve.



TS23995

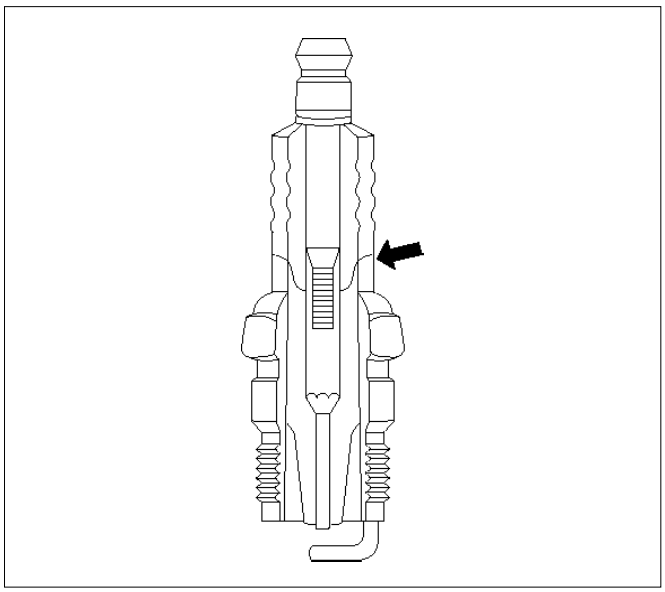
Excessive gap means that the air space between the center and the side electrodes at the bottom of the spark plug is too wide for consistent firing. This may be due to excessive wear of the electrode during use. A check of the gap size and comparison to the gap specified for the vehicle in *Maintenance and Lubrication* will tell if the gap is too wide. A spark plug gap that is too small may cause an unstable idle condition. Excessive gap wear can be an indication of continuous operation at high speeds or with engine loads, causing the spark to run too hot. Another possible cause is an excessively lean fuel mixture.



TS23992

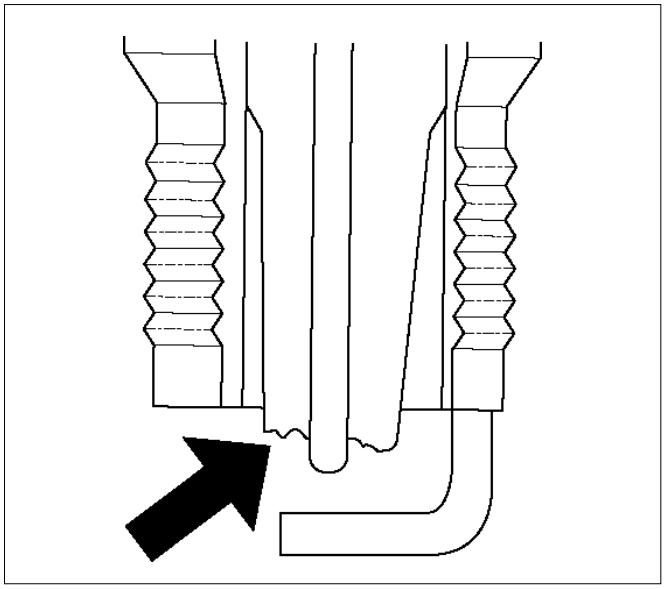
Low or high spark plug installation torque or improper seating can result in the spark plug running too hot and can cause excessive center electrode wear. The plug and the cylinder head seats must be in good contact for proper heat transfer and spark plug cooling. Dirty or damaged threads in the head or on the spark plug can keep it from seating even though the proper torque is applied. Once spark plugs are properly seated, tighten them to the torque shown in the Specifications Table. Low torque may result in poor contact of the seats due to a loose spark plug. Over tightening may cause the spark plug shell to be stretched and will result in poor contact between the seats. In extreme cases, exhaust blow-by and damage beyond simple gap wear may occur.

Cracked or broken insulators may be the result of improper installation, damage during spark plug heat shock to the insulator material. Upper insulators can be broken when a poorly fitting tool is used during installation or removal, when the spark plug is hit from the outside, or is dropped on a hard surface. Cracks in the upper insulator may be inside the shell and not visible. Also, the breakage may not cause problems until oil or moisture penetrates the crack later.



TS2394

A broken or cracked lower insulator tip (around the center electrode) may result from “heat shock" (spark plug suddenly operating too hot).

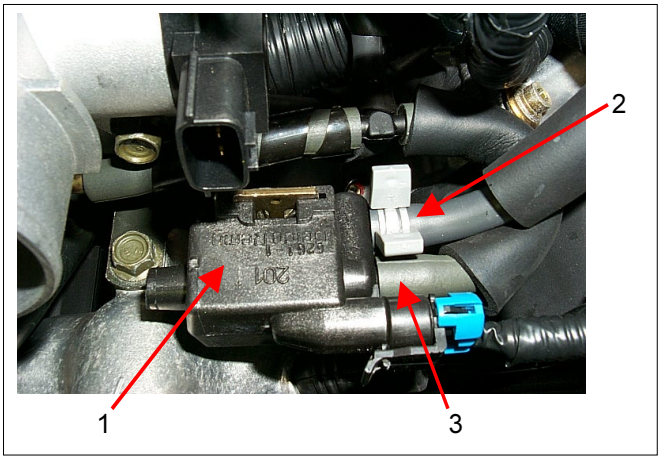


TS23993

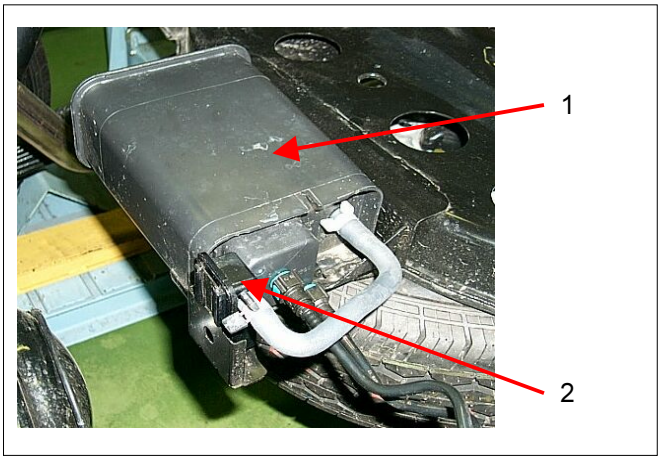
- "Heat shock" breakage in the lower insulator tip generally occurs during several engine operating conditions (high speeds or heavy loading) and may be caused by over-advanced timing or low grade fuels. Heat shock refers to a rapid increase in the tip temperature that causes the insulator material to crack.

If there is any doubt about the serviceability of a spark plug, replace it. Spark plugs with cracked or broken insulators should always be replaced.

GENERAL DESCRIPTION FOR EVAPORATIVE EMISSION SYSTEM



(1) Purge Solenoid Valve
(2) From Canistor to Purge Solenoid
(3) From Purge Solenoid to Intake



(1) Canistor
(2) Air Separator

The basic evaporative emission control system used on the charcoal canister storage method. The method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) storage devise to hold the vapors when the vehicle is not operating.

The canister is located on the rear axle housing by the frame cross-member.

When the engine is running, the fuel vapor is purged from the carbon element by intake air flow and consumed in the normal combustion process.

EVAP Control System

The evaporate emission canister purge is controlled by a duty solenoid valve that allows manifold to purge the canister when following operating conditions are met.

Purge solenoid valve operating condition at idle condition:

- Engine speed is below 1000rpm.
- Vehicle speed is below 3km/h.
- Engine coolant temperature is more than 80°C.
- Intake air temperature is more than 10°C.
- In closed loop operation.

All above conditions are met for 4 seconds.

Purge solenoid valve operating condition at other than idle condition:

- Engine speed is below 6375rpm.
- Vehicle speed is more than 14km/h.
- Engine coolant temperature is more than 60°C.

All above conditions are met for 4 seconds.

Results of Incorrect Operation

Poor idle, stalling and poor driveability can be caused by:

- Inoperative purge solenoid.
- Damaged canister.
- Hoses split, cracked and/or not connected to the proper tubes.

Evidence of fuel loss or fuel vapor odor can be caused by:

- Liquid fuel leaking from fuel lines, or fuel pump.
- Cracked or damaged canister.
- Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses, or control hoses.

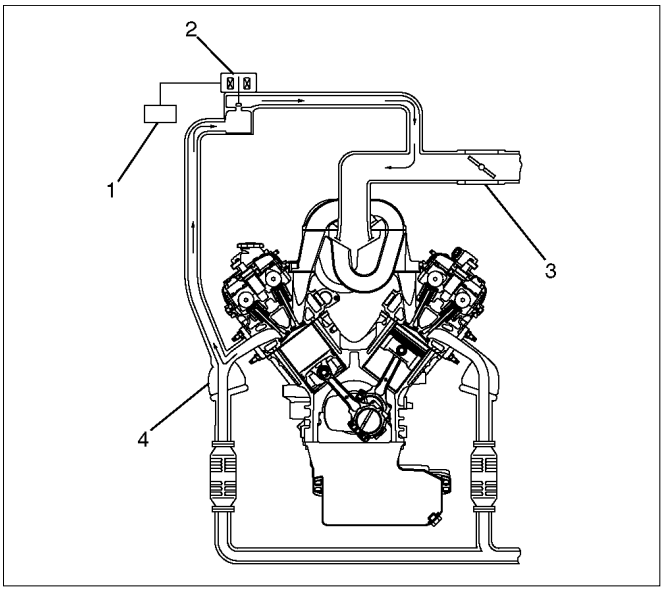
If the solenoid is always open, the canister can purge to the intake manifold at all times. This can allow extra fuel at idle or during warm-up, which can cause rough or unstable idle, or too rich operation.

If the solenoid is always closed, the canister can become over-loaded, resulting in fuel odor.

GENERAL DESCRIPTION FOR EXHAUST GAS RECIRCULATION (EGR) SYSTEM

Linear EGR Valve





060R200237

Legend

(1) ECM
(2) Linear EGR Valve
(3) Throttle
(4) Exhaust Manifold

The exhaust gas re-circulation (EGR) system is used to reduce emission levels of oxides of nitrogen (NOx). NOx emission levels are caused by a high combustion levels by decreasing the combustion temperature.

The EGR valve feeds small amount of exhaust gas back into the combustion chamber. The fuel/air mixture will be diluted and combustion temperatures reduced.

Linear EGR valve Operation and Results of Incorrect Operation

The linear EGR valve is designed to accurately supply EGR to the engine independent of intake manifold vacuum. The valve controls EGR flow from the exhaust to the intake manifold through an orifice with a ECM controlled pintle. During operation, the ECM controls pintle position by monitoring the pintle position feedback signal.

The linear EGR valve is activated under the following conditions:

- No DTC relating to the EGR.
- Engine speed is between 1200 and 4375rpm.
- Engine coolant temperature is between 20 and 100℃.
- Throttle position sensor output voltage is below 3V.

Too mach EGR flow at idle, cruise or cold operation may cause any of the following conditions to occur:

- Engine stalls after a cold start.
- Engine stalls at idle after deceleration.
- Vehicle surges during cruise.
- Rough idle.

Too little or no EGR flow may allow combustion temperatures to get too high. This could cause:

- Spark knock (detonation).
- Emission test failure.
- Poor fuel economy.

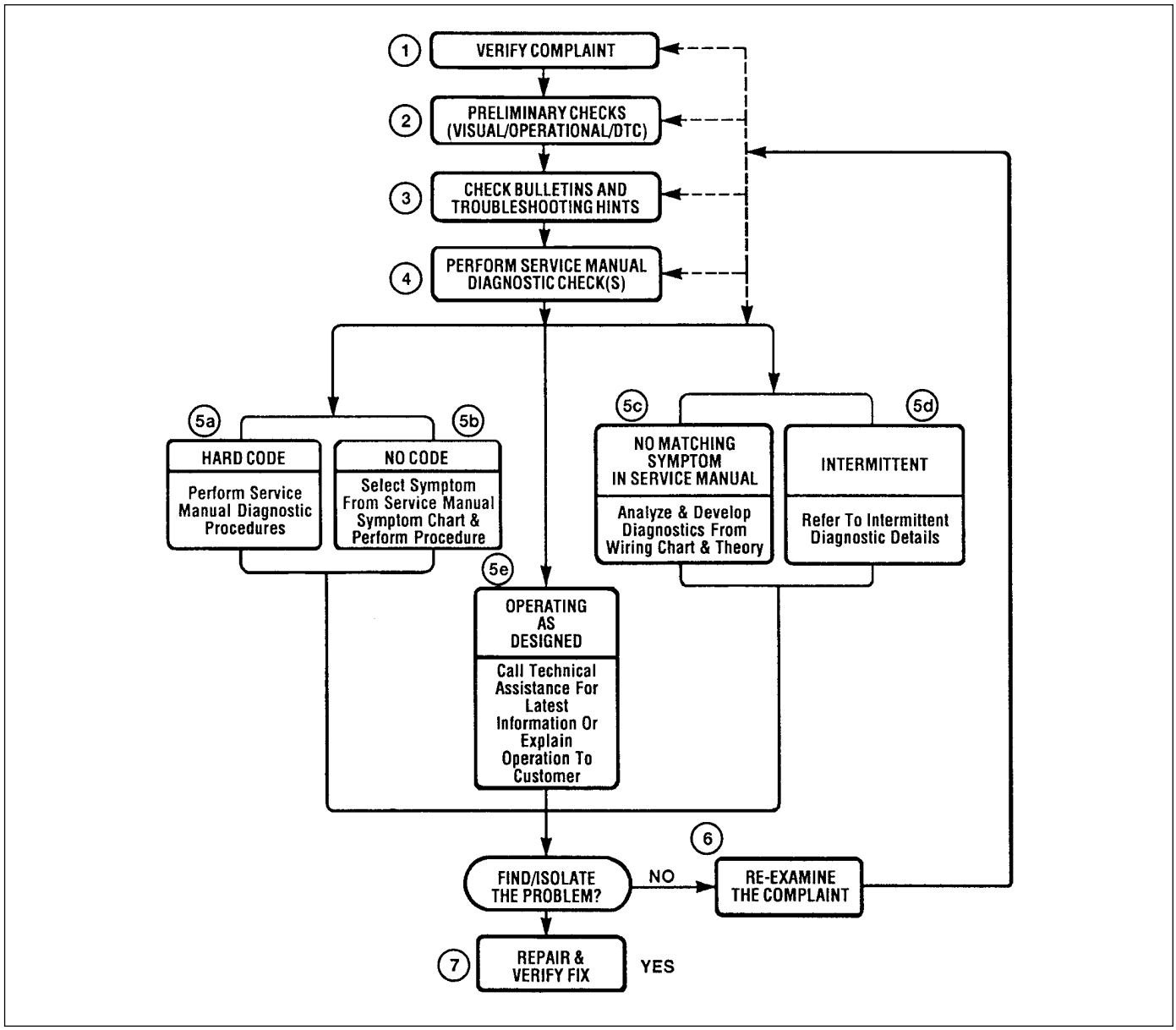
ISUZU STRATEGY BASED DIAGNOSTICS

Overview

As a retail service technician, you are part of the ISUZU service team. The team goal is FIX IT RIGHT THE FIRST TIME for the satisfaction of every customer. You are a very important member of the team as you diagnose and repair customer vehicles.

You have maximum efficiency in diagnosis when you have an effective, organized plan for your work. Strategy Based Diagnostics (refer to Figure 1) provides you with guidance as you create and follow a plan of action for each specific diagnostic situation.

STRATEGY BASED DIAGNOSTICS CHART



Diagnostic Thought Process

As you follow a diagnostic plan, every box on the Strategy Based Diagnostics chart requires you to use the diagnostic thought process. This method of thinking optimizes your diagnosis in the following ways:

- Improves your understanding and definition of the customer complaint
- Saves time by avoiding testing and/or replacing good parts
- Allows you to look at the problem from different perspectives
- Guides you to determine what level of understanding about system operation is needed:
  - Owner's manual level
  - Service manual level
  - In-depth (engineering) level

1. Verify the Complaint

What you should do

To verify the customer complaint, you need to know the correct (normal) operating behavior of the system and verify that the customer complaint is a valid failure of the system.

The following information will help you verify the complaint:

- WHAT the vehicle model/options are
- WHAT aftermarket and dealer-installed accessories exist
- WHAT related system(s) operate properly
- WHEN the problem occurs
- WHERE the problem occurs
- HOW the problem occurs
- HOW LONG the condition has existed (and if the system ever worked correctly)
- HOW OFTEN the problem occurs
- Whether the severity of the problem has increased, decreased or stayed the same

What resources you should use

Whenever possible, you should use the following resources to assist you in verifying the complaint:

Service manual Theory or Circuit Description sections

- Service manual "System Performance Check"
- Owner manual operational description
- Technician experience
- Identical vehicle for comparison
- Circuit testing tools
- Vehicle road tests
- Complaint check sheet
- Contact with the customer

2. Perform Preliminary Checks

NOTE: An estimated 10 percent of successful vehicle repairs are diagnosed with this step!

What you should do

You perform preliminary checks for several reasons:

- To detect if the cause of the complaint is VISUALLY OBVIOUS
- To identify parts of the system that work correctly
- To accumulate enough data to correctly and accurately search for a ISUZU Service Bulletin.

The initial checks may vary depending on the complexity of the system and may include the following actions:

- Operate the suspect system
- Make a visual inspection of harness routing and accessible/visible power and ground circuits
- Check for blown fuses
- Make a visual inspection for separated connectors
- Make a visual inspection of connectors (includes checking terminals for damage and tightness)
- Check for any DTCs stored by the on-board computers
- Sense unusual noises, smells, vibrations or movements
- Investigate the vehicle service history (call other dealerships, if appropriate)

What resources you should use

Whenever appropriate, you should use the following resources for assistance in performing preliminary checks:

- Tech 2 or other technical equipment for viewing DTCs
- Service manual information:
  - Component locations
  - Harness routing
  - Wiring schematics
  - Procedures for viewing DTCs
- Dealership service history file
- Vehicle road test
- Identical vehicle or system for comparison

3. Check Bulletins and Troubleshooting Hints

NOTE: As estimated 30 percent of successful vehicle repairs are diagnosed with this step!

What you should do

You should have enough information gained from preliminary checks to accurately search for a bulletin and other related service information. Some service manual sections provide troubleshooting hints that match symptoms with specific complaints.

What resources you should use

You should use the following resources for assistance in checking for bulletins and troubleshooting hints:

- Printed bulletins
- Access ISUZU Bulletin Web site
- Videotapes
- Service manual

4. Perform Service Manual Diagnostic Checks

What you should do

The “System Checks” in most service manual sections and in most cells of section 8A (electrical) provide you with:

- A systematic approach to narrowing down the possible causes of a system fault
- Direction to specific diagnostic procedures in the service manual
- Assistance to identify what systems work correctly

What resources you should use

Whenever possible, you should use the following resources to perform service manual checks:

- Service manual
- Technical equipment (for viewing DTCs and analyzing data)
- Digital multimeter and circuit testing tools
- Other tools as needed

5a and 5b. Perform Service Manual Diagnostic Procedures

NOTE: An estimated 40 percent of successful vehicle repairs are diagnosed with these steps!

What you should do

When directed by service manual diagnostic checks, you must then carefully and accurately perform the steps of diagnostic procedures to locate the fault related to the customer complaint.

What resources you should use

Whenever appropriate, you should use the following resources to perform service manual diagnostic procedures:

- Service manual
- Technical equipment (for analyzing diagnostic data)
- Digital multimeter and circuit testing tools
- Essential and special tools

5c. Technician Self Diagnoses

When there is no DTC stored and no matching symptom for the condition identified in the service manual, you must begin with a thorough understanding of how the system(s) operates. Efficient use of the service manual combined with you experience and a good process of elimination will result in accurate diagnosis of the condition.

What you should do

Step 1: Identify and understand the suspect circuit(s)

Having completed steps 1 through 4 of the Strategy Based Diagnostics chart, you should have enough information to identify the system(s) or sub-system(s) involved. Using the service manual, you should determine and investigate the following circuit characteristics:

- Electrical:
  - How is the circuit powered (power distribution charts and/or fuse block details)?
  - How is the circuit grounded (ground distribution charts)?
  - How is the circuit controlled or sensed (theory of operation):
    - If it is a switched circuit, is it normally open or normally closed?
    - Is the power switched or is the ground switched?
    - Is it a variable resistance circuit (ECT sensor or TPS, for example)?
    - Is it a signal generating device (MAF sensor of VSS, for example)?

  - Does it rely on some mechanical/vacuum device to operate?
- Physical:
  - Where are the circuit components (component locators and wire harness routing diagrams):
    - Are there areas where wires could be chafed or pinched (brackets or frames)?
    - Are there areas subjected to extreme temperatures?
    - Are there areas subjected to vibration or movement (engine, transmission or suspension)?
    - Are there areas exposed to moisture, road salt or other corrosives (battery acid, oil or other fluids)?
    - Are there common mounting areas with other systems/components?
  - Have previous repairs been performed to wiring, connectors, components or mounting areas (causing pinched wires between panels and drivetrain or suspension components without causing and immediate problem)?
  - Does the vehicle have aftermarket or dealer-installed equipment (radios, telephone, etc.)

Step 2: Isolate the problem

At this point, you should have a good idea of what could cause the present condition, as well as could not cause the condition. Actions to take include the following:

- Divide (and separate, where possible) the system or circuit into smaller sections
- Confine the problem to a smaller area of the vehicle (start with main harness connections while removing panels and trim as necessary in order to eliminate large vehicle sections from further investigation)
- For two or more circuits that do not share a common power or ground, concentrate on areas where harnesses are routed together or connectors are shared (refer to the following hints)

Hints

Though the symptoms may vary, basic electrical failures are generally caused by:

- Loose connections:
  - Open/high resistance in terminals, splices, connectors or grounds
- Incorrect connector/harness routing (usually in new vehicles or after a repair has been made):
  - Open/high resistance in terminals, splices, connectors of grounds
- Corrosion and wire damage:
  - Open/high resistance in terminals, splices, connectors of grounds
- Component failure:
  - Opens/short and high resistance in relays, modules, switches or loads
- Aftermarket equipment affecting normal operation of other systems You may isolate circuits by:
- Unplugging connectors or removing a fuse to separate one part of the circuit from another part
- Operating shared circuits and eliminating those that function normally from the suspect circuit
- If only one component fails to operate, begin testing at the component
- If a number of components do no operate, begin tests at the area of commonality (such as power sources, ground circuits, switches or major connectors)

What resources you should use

Whenever appropriate, you should use the following resources to assist in the diagnostic process:

- Service manual
- Technical equipment (for data analysis)
- Experience
- Technical Assistance
- Circuit testing tools

5d. Intermittent Diagnosis

By definition, an intermittent problem is one that does not occur continuously and will occur when certain conditions are met. All these conditions, however, may not be obvious or currently known. Generally, intermittents are caused by:

- Faulty electrical connections and wiring
- Malfunctioning components (such as sticking relays, solenoids, etc.)
- EMI/RFI (Electromagnetic/radio frequency interference)
- Aftermarket equipment

Intermittent diagnosis requires careful analysis of suspected systems to help prevent replacing good parts. This may involve using creativity and ingenuity to interpret customer complaints and simulating all external and internal system conditions to duplicate the problem.

What you should do

Step 1: Acquire information

A thorough and comprehensive customer check sheet is critical to intermittent problem diagnosis. You should require this, since it will dictate the diagnostic starting point. The vehicle service history file is another source for accumulating information about the complaint.

Step 2: Analyze the intermittent problem

Analyze the customer check sheet and service history file to determine conditions relevant to the suspect system(s).

Using service manual information, you must identify, trace and locate all electrical circuits related to the malfunctioning system(s). If there is more than one system failure, you should identify, trace and locate areas of commonality shared by the suspect circuits.

Step 3: Simulate the symptom and isolate the problem

Simulate the symptom and isolate the system by reproducing all possible conditions suggested in Step 1 while monitoring suspected circuits/components/ systems to isolate the problem symptom. Begin with the most logical circuit/component.

Isolate the circuit by dividing the suspect system into simpler circuits. Next, confine the problem into a smaller area of the system. Begin at the most logical point (or point of easiest access) and thoroughly check the isolated circuit for the fault, using basic circuit tests.

Hints

You can isolate a circuit by:

- Unplugging connectors or removing a fuse to separate one part of the circuit from another
- If only component fails to operate, begin testing the component
- If a number of components do not operate, begin test at areas of commonality (such as power sources, ground circuits, switches, main connectors or major components)
- Substitute a known good part from the parts department or the vehicle system
- Try the suspect part in a known good vehicle See *Symptom Simulation Tests* on the next page for problem simulation procedures. Refer to service manual sections 6E and 8A for information about intermittent diagnosis. Follow procedures for basic circuit testing in service manual section 8A.

What resources you should use

Whenever appropriate, you should use the following resources to assist in the diagnostic process:

- Service manual
- Bulletins
- Digital multimeter (with a MIN/MAX feature)
- Tech 2 and Tech 2 upload function
- Circuit testing tools (including connector kits/harnesses and jumper wires)
- Experience
- Intermittent problem solving simulation methods
- Customer complaint check sheet

Symptom Simulation Tests

1. Vibration

This method is useful when the customer complaint analysis indicates that the problem occurs when the vehicle/system undergoes some form of vibration.

For connectors and wire harness, slightly shake vertically and horizontally. Inspect the connector joint and body for damage. Also, tapping lightly along a suspected circuit may be helpful.

For parts and sensors, apply slight vibration to the part with a light tap of the finger while monitoring the system for a malfunction.

2. Heat

This method is important when the complaint suggests that the problem occurs in a heated environment. Apply moderate heat to the component with a hair drier or similar tool while monitoring the system for a malfunction.

CAUTION: Care must be take to avoid overheating the component.

3. Water and Moisture

This method may be used when the complaint suggests that the malfunction occurs on a rainy day or under conditions of high humidity. In this case, apply water in a light spray on the vehicle to duplicate the problem.

CAUTION: Care must be take to avoid directly exposing electrical connections to water.

4. Electrical loads

This method involves turning systems ON (such as the blower, lights or rear window defogger) to create a load on the vehicle electrical system at the same time you are monitoring the suspect circuit/component.

5e. Vehicle Operates as Designed

This condition refers to instances where a system operating as designed is perceived to be unsatisfactory or undesirable. In general, this is due to:

- A lack of understanding by the customer
- A conflict between customer expectations and vehicle design intent
- A system performance that is unacceptable to the customer

What you should do

You can verify that a system is operating as designed by:

- Reviewing service manual functional/diagnostic checks
- Examining bulletins and other service information for supplementary information
- Compare system operation to an identical vehicle

If the condition is due to a customer misunderstanding or a conflict between customer expectation and system operation, you should explain the system operation to the customer.

If the complaint is due to a case of unsatisfactory system performance, you should contact Technical Assistance for the latest information.

What resources you should use

Whenever possible, you should use the following resources to facilitate the diagnostic process:

- Vehicle service information (service manual, etc.)
- ISUZU field support
- Experience
- Identical vehicle or system for comparison

6. Re-examine the complaint

When you do not successfully find/isolate the problem after executing a diagnostic path, you should re-examine the complaint.

What you should do

In this case, you will need to backtrack and review information accumulated from step 1 through 4 of Strategy Based Diagnostics. You also should repeat any procedures that require additional attention.

A previous path may be eliminated from consideration only if you are certain that all steps were executed as directed. You must then select another diagnostic path (step 5a, 5b, 5c or 5d). If all possible options have been explored, you may call or seek ISUZU field support.

What resources you should use

Whenever possible, you should use the following resources to facilitate the diagnostic process:

- Service manual
- Accumulated information form a previous diagnostic path
- Service information and publications
- ISUZU field support

7. Repair and Verify Fix

What you should do

After you have located the cause of the problem, you must execute a repair by following recommended service manual procedures.

When the repair is completed, you should verify the fix by performing the system checks under the conditions listed in the customer complaint.

If applicable, you should carry out preventive measures to avoid a repeat complaint.

What resources you should use

Whenever possible, you should use the following resources to facilitate the repair process:

- Electrical repair procedures
- Service manual information and publications

GENERAL SERVICE INFORMATION

Aftermarket Electrical and Vacuum Equipment

Aftermarket (add-on) electrical and vacuum equipment is defined as any equipment which connects to the vehicle's electrical or vacuum systems that is installed on a vehicle after it leaves the factory. No allowances have been made in the vehicle design for this type of equipment.

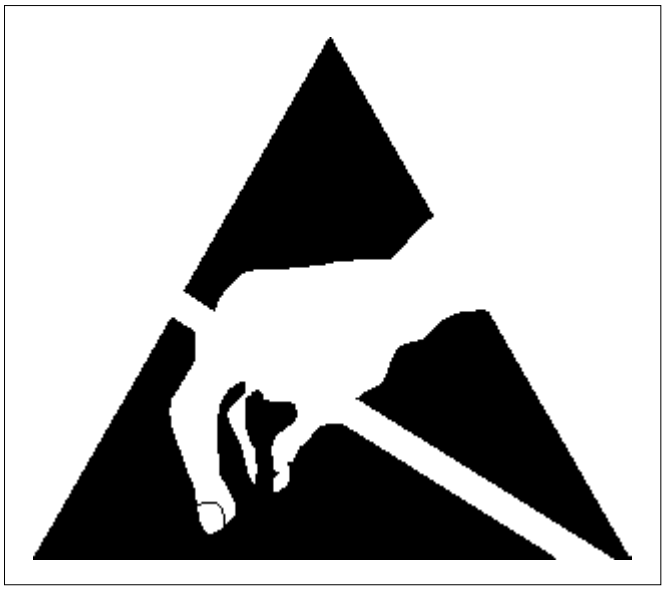
NOTE: No add-on vacuum equipment should be added to this vehicle.

NOTE: Add-on electrical equipment must only be connected to the vehicle's electrical system at the battery (power and ground).

Add-on electrical equipment, even when installed to these guidelines, may still cause the powertrain system to malfunction. This may also include equipment not connected to the vehicle electrical system such as portable telephones and radios. Therefore, the first step in diagnosing any powertrain problem is to eliminate all aftermarket electrical equipment from the vehicle. After this is done, if the problem still exists, it may be diagnosed in the normal manner.

Electrostatic Discharge Damage

Electronic components used in the ECM are often designed to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. Less than 100 volts of static electricity can cause damage to some electronic components. By comparison, it takes as much as 4000 volts for a person to feel even the zap of a static discharge.



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There are several ways for a person to become statically charged. The most common methods of charging are by friction and induction.

- An example of charging by friction is a person sliding across a vehicle seat.
- Charge by induction occurs when a person with well insulated shoes stands near a highly charged object and momentary touches ground. Charges of the same polarity are drained off leaving the person highly charged with the opposite polarity. Static charges can cause damage, therefore it is important to use care when handling and testing electronic components.

NOTE: To prevent possible electrostatic discharge damage, follow these guidelines:

- **Do not touch the ECM connector pins or soldered components on the ECM circuit board.**
- **Do not open the replacement part package until the part is ready to be installed.**
- **Before removing the part from the package, ground the package to a known good ground on the vehicle.**
- **If the part has been handled while sliding across the seat, while sitting down from a standing position, or while walking a distance, touch a known good ground before installing the part.**

Fuel Quality

Fuel quality is not a new issue for the automotive industry, but its potential for turning on the MIL (“Check Engine" lamp) with OBD systems is new.

Fuel additives such as “dry gas" and “octane enhancers" may affect the performance of the fuel. The Reed Vapor Pressure of the fuel can also create problems in the fuel system, especially during the spring and fall months when severe ambient temperature swings occur. A high Reed Vapor Pressure could show up as a Fuel Trim DTC due to excessive canister loading. High vapor pressures generated in the fuel tank can also affect the Evaporative Emission diagnostic as well.

Using fuel with the wrong octane rating for your vehicle may cause driveability problems. Many of the major fuel companies advertise that using “premium" gasoline will improve the performance of your vehicle. Most premium fuels use alcohol to increase the octane rating of the fuel. Although alcohol-enhanced fuels may raise the octane rating, the fuel's ability to turn into vapor in cold temperatures deteriorates. This may affect the starting ability and cold driveability of the engine.

Low fuel levels can lead to fuel starvation, lean engine operation, and eventually engine misfire.

Non-OEM Parts

All of the OBD diagnostics have been calibrated to run with OEM parts.

Aftermarket electronics, such as cellular phones, stereos, and anti-theft devices, may radiate EMI into the control system if they are improperly installed. This may cause a false sensor reading and turn on the MIL (“Check Engine" lamp).

Environment

Temporary environmental conditions, such as localized flooding, will have an effect on the vehicle ignition system. If the ignition system is rain-soaked, it can temporarily cause engine misfire and turn on the MIL (“Check Engine" lamp).

Vehicle Marshaling

The transportation of new vehicles from the assembly plant to the dealership can involve as many as 60 key cycles within 5Km miles of driving. This type of operation contributes to the fuel fouling of the spark plugs and will turn on the MIL (“Check Engine" lamp).

Poor Vehicle Maintenance

The sensitivity of OBD diagnostics will cause the MIL (“Check Engine" lamp) to turn on if the vehicle is not maintained properly. Restricted air filters, fuel filters, and crankcase deposits due to lack of oil changes or improper oil viscosity can trigger actual vehicle faults that were not previously monitored prior to OBD. Poor vehicle maintenance can not be classified as a “non-vehicle fault", but with the sensitivity of OBD diagnostics, vehicle maintenance schedules must be more closely followed.

Severe Vibration

The Misfire diagnostic measures small changes in the rotational speed of the crankshaft. Severe driveline vibrations in the vehicle, such as caused by an excessive amount of mud on the wheels, can have the same effect on crankshaft speed as misfire.

Related System Faults

Many of the OBD system diagnostics will not run if the ECM detects a fault on a related system or component. One example would be that if the ECM detected a Misfire fault, the diagnostics on the catalytic converter would be suspended until Misfire fault was repaired. If the Misfire fault was severe enough, the catalytic converter could be damaged due to overheating and would never set a Catalyst DTC until the Misfire fault was repaired and the Catalyst diagnostic was allowed to run to completion. If this happens, the customer may have to make two trips to the dealership in order to repair the vehicle.

Maintenance Schedule

Refer to the *Maintenance Schedule*.

Visual/Physical Engine Compartment Inspection

Perform a careful visual and physical engine compartment inspection when performing any diagnostic procedure or diagnosing the cause of an emission test failure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual/physical inspection:

- Inspect all vacuum hoses for punches, cuts, disconnects, and correct routing.
- Inspect hoses that are difficult to see behind other components.
- Inspect all wires in the engine compartment for proper connections, burned or chafed spots, pinched wires, contact with sharp edges or contact with hot exhaust manifolds or pipes.

Basic Knowledge of Tools Required

Lack of basic knowledge of this powertrain when performing diagnostic procedures could result in an incorrect diagnosis or damage to powertrain components. Do not attempt to diagnose a powertrain problem without this basic knowledge.

A basic understanding of hand tools is necessary to effectively use this section of the Service Manual.

Serial Data Communications

Class II Serial Data Communications

This vehicle utilizes the “Class II" communication system. Each bit of information can have one of two lengths: long or short. This allows vehicle wiring to be reduced by transmitting and receiving multiple signals over a single wire. The messages carried on Class II data streams are also prioritized. If two messages attempt to establish communications on the data line at the same time, only the message with higher priority will continue. The device with the lower priority message must wait. The most significant result of this regulation is that it provides Tech 2 manufacturers with the capability to access data from any make or model vehicle that is sold.

The data displayed on the other Tech 2 will appear the same, with some exceptions. Some scan tools will only be able to display certain vehicle parameters as values that are a coded representation of the true or actual value. For more information on this system of coding, refer to *Decimal/Binary/Hexadecimal Conversions.* On this vehicle the Tech 2 displays the actual values for vehicle parameters. It will not be necessary to perform any conversions from coded values to actual values.

On-Board Diagnostic (OBD)

On-Board Diagnostic Tests

A diagnostic test is a series of steps, the result of which is a pass or fail reported to the diagnostic executive. When a diagnostic test reports a pass result, the diagnostic executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.
- The diagnostic test has passed during the current ignition cycle.
- The fault identified by the diagnostic test is not currently active.

When a diagnostic test reports a fail result, the diagnostic executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.
- The fault identified by the diagnostic test is currently active.
- The fault has been active during this ignition cycle.
- The operating conditions at the time of the failure.

Remember, a fuel trim DTC may be triggered by a list of vehicle faults. Make use of all information available (other DTCs stored, rich or lean condition, etc.) when diagnosing a fuel trim fault.

Comprehensive Component Monitor Diagnostic Operation

Input Components:

Input components are monitored for circuit continuity and out-of-range values. This includes rationality checking. Rationality checking refers to indicating a fault when the signal from a sensor does not seem reasonable, i.e.throttle position sensor that indicates high throttle position at low engine loads. Input components may include, but are not limited to the following sensors:

- Vehicle Speed Sensor (VSS)
- Inlet Air Temperature (IAT) Sensor
- Crankshaft Position (CKP) Sensor
- Throttle Position Sensor (TPS)
- Engine Coolant Temperature (ECT) Sensor
- Camshaft Position (CMP) Sensor
- Mass Air Flow (MAF) Sensor

In addition to the circuit continuity and rationality check the ECT sensor is monitored for its ability to achieve a steady state temperature to enable closed loop fuel control.

Output Components:

Output components are diagnosed for proper response to control module commands. Components where functional monitoring is not feasible will be monitored for circuit continuity and out-of-range values if applicable.

Output components to be monitored include, but are not limited to, the following circuit:

- Idle Air Control (IAC) Valve
- Control module controlled EVAP Canister Purge Valve
- Electronic Transmission controls
- A/C relays
- VSS output
- MIL control

Refer to ECM and Sensors in General Descriptions.

Passive and Active Diagnostic Tests

A passive test is a diagnostic test which simply monitors a vehicle system or component. Conversely, an active test, actually takes some sort of action when performing diagnostic functions, often in response to a failed passive test.

Intrusive Diagnostic Tests

This is any on-board test run by the Diagnostic Management System which may have an effect on vehicle performance or emission levels.

Warm-Up Cycle

A warm-up cycle means that engine at temperature must reach a minimum of 70°C (160°F) *and* rise at least 22°C (40°F) over the course of a trip.

The Diagnostic Executive

The Diagnostic Executive is a unique segment of software which is designed to coordinate and prioritize the diagnostic procedures as well as define the protocol for recording and displaying their results. The main responsibilities of the Diagnostic Executive are listed as follows:

- Commanding the MIL (“Check Engine" lamp) on and off
- DTC logging and clearing
- Freeze Frame data for the first emission related DTC recorded
- Current status information on each diagnostic

The Diagnostic Executive records DTCs and turns on the MIL when emission-related faults occur. It can also turn off the MIL if the conditions cease which caused the DTC to set.

Diagnostic Information

The diagnostic charts and functional checks are designed to locate a faulty circuit or component through a process of logical decisions. The charts are prepared with the requirement that the vehicle functioned correctly at the time of assembly and that there are not multiple faults present.

There is a continuous self-diagnosis on certain control functions. This diagnostic capability is complemented by the diagnostic procedures contained in this manual. The language of communicating the source of the malfunction is a system of diagnostic trouble codes. When a malfunction is detected by the control module, a diagnostic trouble code is set and the MIL (“Check Engine" lamp) is illuminated.

Check Engine Lamp (MIL)

The Check Engine Lamp (MIL) looks the same as the MIL you are already familiar with (“Check Engine" lamp).

Basically, the MIL is turned on when the ECM detects a DTC that will impact the vehicle emissions.

The MIL is under the control of the Diagnostic Executive. The MIL will be turned on if an emissions-related diagnostic test indicates a malfunction has occurred. It will stay on until the system or component passes the same test, for three consecutive trips, with no emissionsrelated faults.

Extinguishing the MIL

When the MIL is on, the Diagnostic Executive will turn off the MIL after *three consecutive* trips that a “test passed" has been reported for the diagnostic test that originally caused the MIL to illuminate.

Although the MIL has been turned off, the DTC will remain in the ECM memory (both Freeze Frame and Failure Records) until *forty(40) warm-up cycles after no faults* have been completed.

If the MIL was set by either a fuel trim or misfire-related DTC, additional requirements must be met. In addition to the requirements stated in the previous paragraph, these requirements are as follows:

- The diagnostic tests that are passed must occur with 375 RPM of the RPM data stored at the time the last test failed.
- Plus or minus ten (10) percent of the engine load that was stored at the time the last failed.
- Similar engine temperature conditions (warmed up or warming up) as those stored at the time the last test failed.

Meeting these requirements ensures that the fault which turned on the MIL has been corrected.

The MIL (“Check Engine" lamp) is on the instrument panel and has the following functions:

- It informs the driver that a fault that affects vehicle emission levels has occurred and that the vehicle should be taken for service as soon as possible.
- As a bulb and system check, the MIL will come “ON" with the key “ON" and the engine not running. When the engine is started, the MIL will turn “OFF."
- When the MIL remains “ON" while the engine is running, or when a malfunction is suspected due to a driveability or emissions problem, a Powertrain On-Board Diagnostic (OBD) System Check must be performed. The procedures for these checks are given in On-Board Diagnostic (OBD) System Check. These checks will expose faults which may not be detected if other diagnostics are performed first.

Intermittent Check Engine Lamp

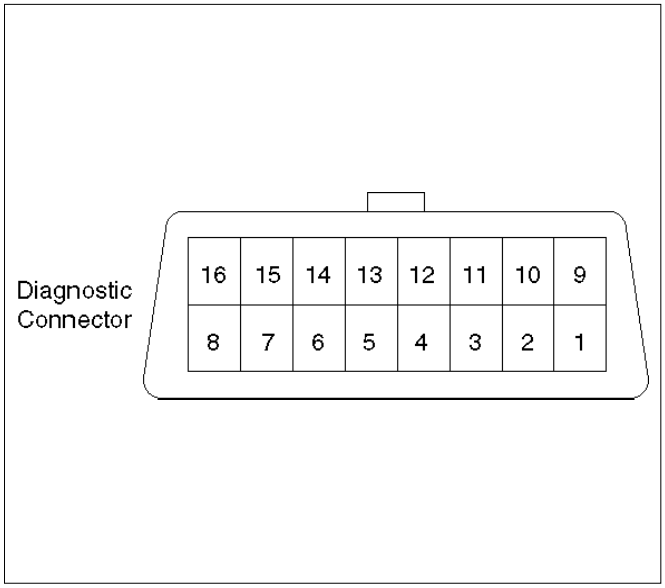
In the case of an “intermittent" fault, the MIL (“Check Engine" lamp) may illuminate and then (after three trips) go “OFF". However, the corresponding diagnostic trouble code will be stored in the memory. When unexpected diagnostic trouble codes appear, check for an intermittent malfunction.

A diagnostic trouble code may reset. Consult the “Diagnostic Aids" associated with the diagnostic trouble code. A physical inspection of the applicable sub–system most often will resolve the problem.

Data Link Connector (DLC)

The provision for communication with the control module is the Data Link Connector (DLC). The DLC is used to connect to a Tech 2. Some common uses of the Tech 2 are listed below:

- Identifying stored Diagnostic Trouble Codes (DTCs).
- Clearing DTCs.
- Performing out put control tests.
- Reading serial data.



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Verifying Vehicle Repair

Verification of vehicle repair will be more comprehensive for vehicles with OBD system diagnostic. Following a repair, the technician should perform the following steps:

1. Review and record the Fail Records and/or Freeze Frame data for the DTC which has been diagnosed (Freeze Frame data will only be stored for an A or B type diagnostic and only if the MIL has been requested).
2. Clear DTC(s).
3. Operate the vehicle within conditions noted in the Fail Records and/or Freeze Frame data.
4. Monitor the DTC status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

Following these steps are very important in verifying repairs on OBD systems. Failure to follow these steps could result in unnecessary repairs.

Reading Flash Diagnostic Trouble Codes

The provision for communicating with the Engine Control Module (ECM) is the Data Link Connector (DLC). The DLC is located behind the lower front instrument panel. It is used in the assembly plant to receive information in checking that the engine is operating properly before it leaves the plant.

The diagnostic trouble code(s) (DTCs) stored in the ECM's memory can be read either through a hand-held diagnostic scanner plugged into the DLC or by counting the number of flashes of the Check Engine Lamp (MIL) when the diagnostic test terminal of the DLC is grounded. The DLC terminal “6" (diagnostic request) is pulled “Low" (grounded) by jumpering to DLC terminal “4", which is a ground wire.

This will signal the ECM that you want to “flash" DTC(s), if any are present. Once terminals “4" and “6" have been connected, the ignition switch must be moved to the “ON" position, with the engine not running. At this point, the “Check Engine" MIL should flash DTC12 three times consecutively.

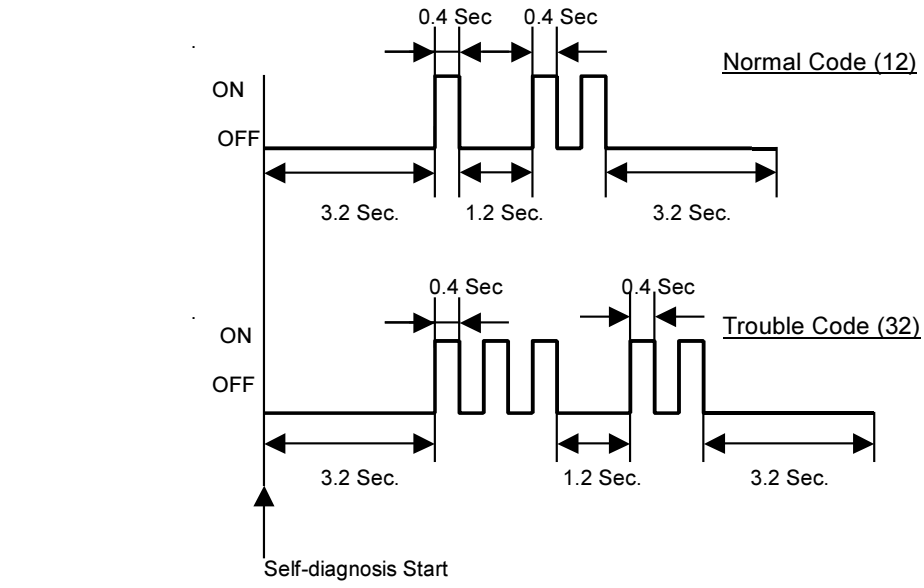
This would be the following flash, sequence: "flash, pause, flash?flash, long pause, flash, pause, flash?flash, long pause, flash, pause, flash?flash". DTC 12 indicates that the ECM's diagnostic system is operating. If DTC 12 is not indicated, a problem is present within the diagnostic system itself, and should be addressed by consulting the appropriate diagnostic chart in DRIVEABILITY AND EMISSIONS.

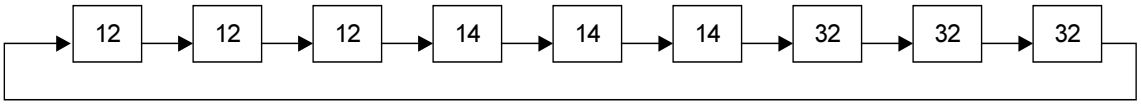
Following the output of DTC 12, the “Check Engine" MIL will indicate a DTC three times if a DTC is present, or it will simply continue to output DTC12. If more than one DTC three has been stored in the ECM's memory, the DTC(s) will be output from the lowest to the highest, with each DTC being displayed three times.

Reading Diagnostic Trouble Codes Using a TECH 2

The procedure for reading diagnostic trouble code(s) is to used a diagnostic Tech 2. When reading DTC(s), follow instructions supplied by Tech 2 manufacturer.

For the 1998 model year, Isuzu dealer service departments will continue to use Tech 2.





In case DTC 14 & 32 are stored

Clearing Diagnostic Trouble Codes

Important: Do not clear DTCs unless directed to do so by the service information provided for each diagnostic procedure. When DTCs are cleared, the Freeze Frame and Failure Record data which may help diagnose an intermittent fault will also be erased from memory.

If the fault that caused the DTC to be stored into memory has been corrected, the Diagnostic Executive will begin to count the “warm-up" cycles with no further faults detected, the DTC will automatically be cleared from the ECM memory.

To clear Diagnostic Trouble Codes (DTCs), use the Tech 2 “clear DTCs" or “clear information" function. When clearing DTCs follow instructions supplied by the Tech 2 manufacturer.

When a Tech 2 is not available, DTCs can also be cleared by disconnecting *one* of the following sources for at least thirty (30) seconds.

To prevent system damage, the ignition key must be “OFF" when disconnecting or reconnecting battery power.

- The power source to the control module. Examples: fuse, pigtail at battery ECM connectors etc.
- The negative battery cable. (Disconnecting the negative battery cable will result in the loss of other on-board memory data, such as preset radio tuning).

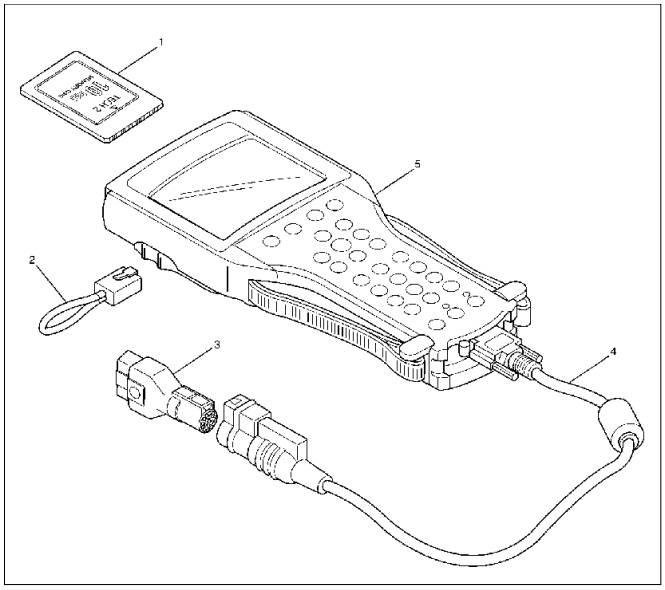
On-Board Diagnosis (Self-Diagnosis)

1. The Engine Control Module (ECM) conducts a self-test of most of the wiring and components in the system each time the key is turned to ON, and can detect faults in the system while the key is ON. If a fault is detected, the ECM will store a trouble code in memory and flash the CHECK ENGINE indicator to alert the driver.
2. The Diagnostic Trouble Codes (DTC) can be displayed by shorting together terminals and the Data Link Connector (DLC) located below Instrument Panel of drivers side.

   The CHECK ENGINE indicator will flash DTC 12 three times, followed by any DTC.If several DTC are stored, each DTC will be displayed three times. The DTC will be displayed in numerical order. The DTC display will continue as long as the DLC is shorted.

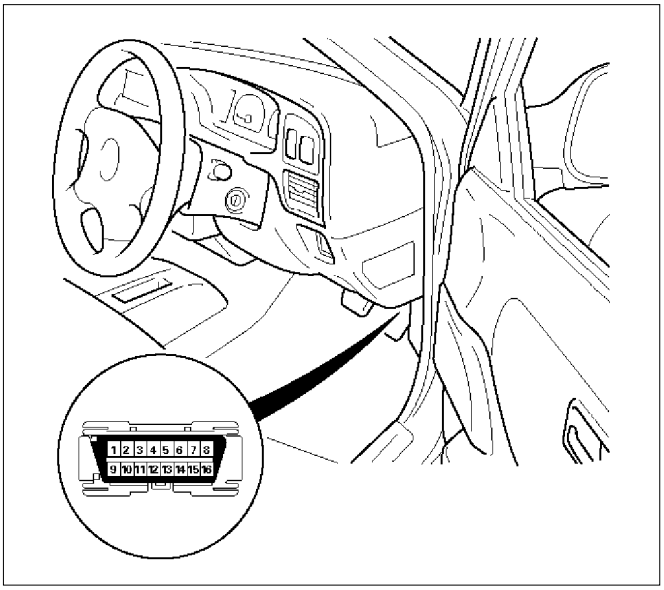
   Some DTC can cause other DTC to be stored, It is important to diagnose and repair the lowest numbered DTC first before going on to the higher numbered DTC.

TECH 2 CONNECTION



Tech 2 scan tool is used to electrically diagnose the automatic transmission system and to check the system. The Tech 2 enhances the diagnosis efficiency though all the troubleshooting can be done without the Te c h 2 .

1. Configuration of Tech 2
   - Tech 2 scan tool kit (No. 7000086), Tech 2 scan tool (No. 7000057) and DLC cable (No. 3000095).
   - SAE 16/19 adapter (No. 3000098) (3), RS232 loop back connector (No. 3000112) (2) and PCMCIA card (No. 3000117) (1).
2. Tech 2 Connection
   - Check the key switch is turn OFF.
   - Insert the PCMCIA card (1) into the Tech 2 (5).
   - Connect the SAE 16/19 adapter (3) to the DLC



- Turn the key switch of the vehicle ON and press the “PWR” key of the Tech 2.
- Check the display of the Tech 2.

NOTE: Be sure to check that the power is not supplied to the Tech 2 when attaching or removing the PCMCIA card.

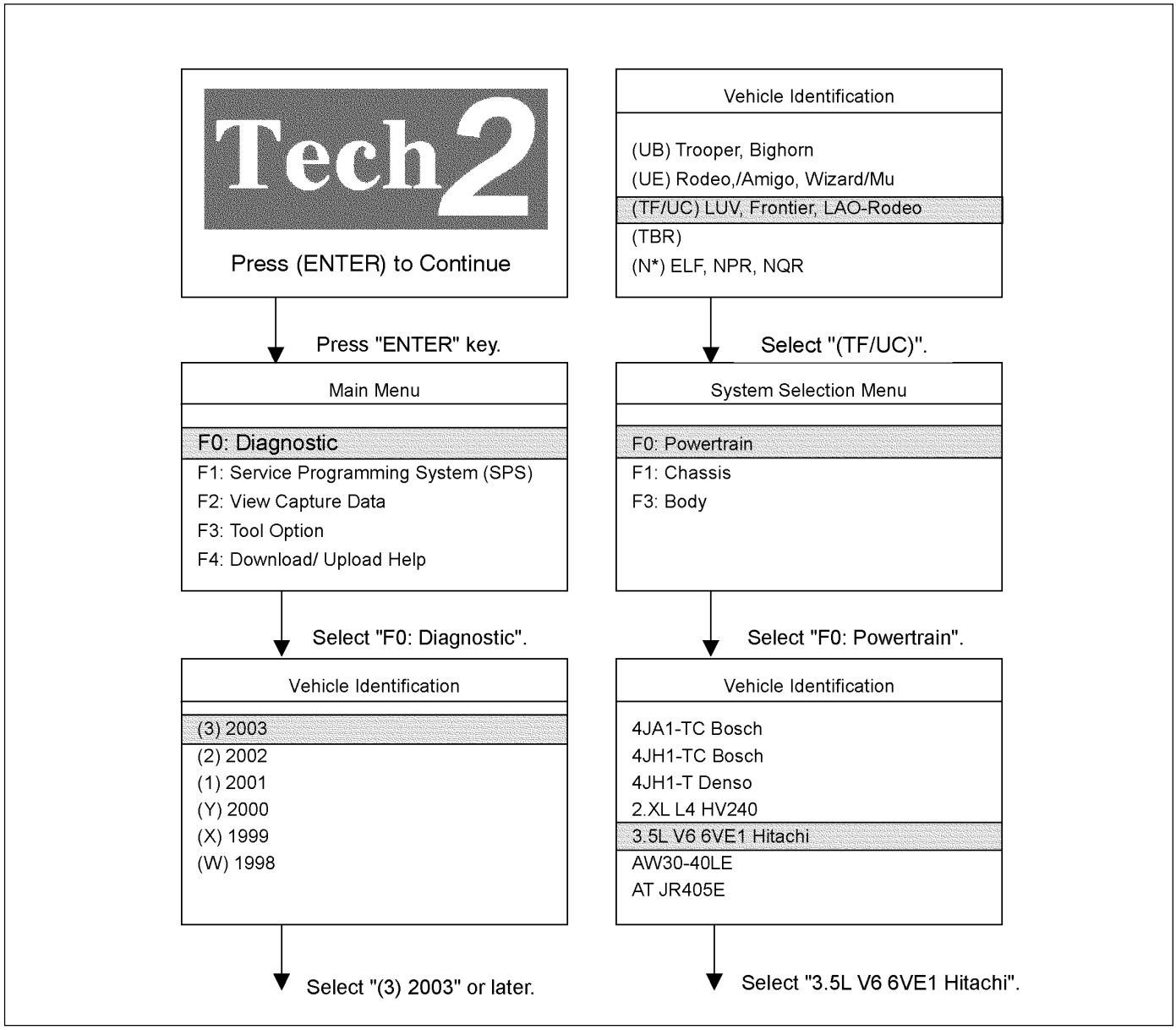
Diagnosis with TECH 2

If No Codes are Set

- Refer to *F1: Data Display* and identify the electrical faults that are not indicated by trouble code.
- Refer to *"SYMPTOM DIAGNOSIS"*.

If Codes are Set

1. Record all trouble codes displayed by Tech 2 and check id the codes are intermittent.
2. Clear the codes.
3. Drive the vehicle for a test to reproduce the faulty status.
4. Check trouble codes again using the Tech 2.
5. If no codes is displayed by test driving, the fault is intermittent. In this case, refer to *"DIAGNOSIS AIDS"*.
6. If a code is present, refer to *DTC Chart* for diagnosis.
7. Check trouble codes again using the Tech 2.



Select "3.5L V6 6VE1 Hitachi" in Vehicle Identification menu and the following table is shown in the Tech 2 screen.

F0: Diagnostic Trouble Code
- F0: Read DTC Infor By Priority
- F1: Clear DTC Information
- F2: DTC Information
  - F0: History
  - F1: MIL SVS or Message Requested
  - F2: Last Test Failed
  - F3: Test Failed Since Code Cleared
  - F4: Not Run Since Code Cleared
  - F5: Failed This Ignition
- F3: Freeze Frame/Failure Record

F1: Data Display
- F0: Engine Data
- F1: O2 Sensor Data

F2: Snapshot

F3: Miscellaneous Test
- F0: Lamps
  - F0: Malfunction Indicator Lamps
- F1: Relays
  - F0: Fuel Pump Relay
  - F1: A/C Clutch Relay
- F2: EVAP
  - F0: Purge Solenoid
- F3: IAC System
  - F0: RPM Control
  - F1: IAC Control
- F4: Fuel System
  - F0: Fuel Trim Reset

F4: System Information
- F0: MIL/System Status

F0: Diagnostic Trouble Code

The purpose of the "Diagnostic Trouble Codes" mode is to display stored trouble code in the

ECM.

When "Clear DTC Information" is selected, a "Clear DTC Information", warning screen appears.

This screen informs you that by cleaning DTC's "all stored DTC information in the ECM will be erased".

After clearing codes, confirm system operation by test driving the vehicle.

Use the "DTC Information" mode to search for a specific type of stored DTC information.

History

This selection will display only DTCs that are stored in the ECM's history memory. It will not display Type B DTCs that have not requested the MIL ("Check Engine Lamp"). It will display all type A and B DTCs that requested the MIL and have failed within the last 40 warm-up cycles. In addition, it will display all type C and D DTCs that have failed within the last 40 warm-up cycles.

MIL SVC or Message Request

This selection will display only DTCs that are requesting the MIL. Type C and Type D DTCs cannot be displayed using the MIL. Type C and D DTCs cannot be displayed using this option.

This selection will report type B DTCs only after the MIL has been requested.

Last Test Failed

This selection will display only DTCs that have failed the last time the test run. The last test may have run during a previous ignition cycle of a type A or type B DTC is displayed. For type C and type D DTCs, the last failure must have occurred during the current ignition cycle to appear as last test fail.

Test Failed Since Code Cleared

The selection will display all active and history DTCs that have reported a test failure since the last time DTCs were cleared. DTCs that last failed more that 40 warm-up cycles before this option is selected will not be displayed.

Not Run Since Code Cleared

This selection will display up to DTCs that have not run since the DTCs were last cleared. Since any displayed DTCs have not run, their condition (passing or failing) is unknown.

Failed This Ignition

This selection will display all DTCs that have failed during the present ignition cycle.

Freeze Frame/Failure Record

This selection will display stored various vehicle information at the moment an emission related fault when the MIL ("Check Engine Lamp") is commanded on.

The Freeze Frame data will not be erased unless the associated history DTC is cleared.

F1: Data Display

The purpose of the "Data Display" mode is to continuously monitor data parameters.

The current actual values of all important sensors and signals in the system are display through F1 mode.

See the *"Typical Scan Data"* section.

TYPICAL SCAN DATA & DEFINITIONS (ENGINE DATA)

Use the typical values table only after the On-Board Diagnostic System check has been completed, no DTC(s) were noted, and you have determined that the On-Board Diagnostic are functioning properly.

Tech2 values from a properly running engine may be used for comparison with the engine you are diagnosing.

Condition : Vehicle stopping, engine running, air conditioning off & after warm-up (Coolant temperature approximately 80°C)

	Tech 2 Parameter	Units	Idle	2000rpm	Definitions
1	Ignition Voltage	V	10.0 – 14.5	10.0 – 14.5	This displays the system voltage measured by the ECM at ignition feed.
2	Engine Speed	rpm	710 – 860	1950 – 2050	The actual engine speed is measured by ECM from the CKP sensor 58X signal.
3	Desired Idle Speed	rpm	750 – 770	750 – 770	The desired engine idle speed that the ECM commanding. The ECM compensates for various engine loads.
4	Engine Coolant Temperature	°C or °F	80 – 90 (°C)	80 – 90 (°C)	The ECT is measured by ECM from ECT sensor output voltage. When the engine is normally warm upped, this data displays approximately 80 °C or more.
5	Start Up ECT (Engine Coolant Temperature)	°C or °F	Depends on ECT at start-up	Depends on ECT at start-up	Start-up ECT is measured by ECM from ECT sensor output voltage when engine is started.
6	Intake Air Temperature	°C or °F	Depends on ambient temp.	Depends on ambient temp.	The IAT is measured by ECM from IAT sensor output voltage. This data is changing by intake air temperature.
7	Throttle Position	%	0	4 – 6	Throttle position operating angle is measured by the ECM from throttle position output voltage. This should display 0% at idle and 99 – 100% at full throttle.
8	Throttle Position Sensor	V	0.4 – 0.7	0.6 – 0.8	The TPS output voltage is displayed. This data is changing by accelerator operating angle.
9	Mass Air Flow	g/s	5.0 – 8.0	13.0 – 16.0	This displays intake air amount. The mass air flow is measured by ECM from the MAF sensor output voltage.
10	Air Fuel Ratio		14.7:1	14.7:1	This displays the ECM commanded value. In closed loop, this should normally be displayed around 14.2:1 – 14.7:1.
11	Idle Air Control	Steps	10 – 20	20 – 30	This displays the ECM commanded position of the idle air control valve pintle. A larger number means that more air is being commanded through the idle air passage.
12	EGR Valve	V	0.00	0.00 – 0.10	The EGR position sensor output voltage is displayed. This data is changing by EGR valve solenoid operating position.
13	Desired EGR Opening	V	0.00	0.05 – 1.10	The ECM commanded EGR position sensor voltage is displayed. According to the current position, ECM changes EGR valve solenoid operating position to meet the desired position.
14	EGR Valve On Duty	%	0	32 – 38	This displays the duty signal from the ECM to control the EGR valve.
15	Engine Load	%	2 – 7	8 – 15	This displays is calculated by the ECM form engine speed and MAF sensor reading. Engine load should increase with an increase in engine speed or air flow amount.
16	B1 Fuel System Status	Open Loop/ Close Loop	Close Loop	Close Loop	When the engine is first started the system is in "Open Loop" operation. In "Open Loop", the ECM ignores the signal from the oxygen sensors. When various conditions (ECT, time from start, engine speed & oxygen sensor output) are met, the system enters "Closed Loop" operation. In "Closed Loop", the ECM calculates the air fuel ratio based on the signal from the oxygen sensors.
17	B2 Fuel System Status	Open Loop/ Close Loop	Close Loop	Close Loop	
18	Fuel Trim Learned (Bank 1)	Yes/No	Yes	Yes	When conditions are appropriate for enabling long term fuel trim corrections, fuel trim learn will display "Yes". This indicates that the long term fuel trim is responding to the short term fuel trim. If the fuel trim lean displays "No", then long term fuel trim will not respond to changes in short term fuel trim.
19	Fuel Trim Learned (Bank 2)	Yes/No	Yes	Yes	
20	Injection Pulse Bank 1	ms	2.0 – 4.0	2.0 – 4.0	This displays the amount of time the ECM is commanding each injector On during each engine cycle. A longer injector pulse width will cause more fuel to be delivered. Injector pulse width should increase with increased engine load.
21	Injection Pulse Bank 2	ms	2.0 – 4.0	2.0 – 4.0	
22	Spark Advance	°CA	10 – 15	35 – 42	This displays the amount of spark advance being commanded by the ECM.

	Tech 2 Parameter	Units	Idle	2000rpm	Definitions
23	A/C Request (Air Conditioning)	On/Off	Off	Off	This displays the air conditioner request signal. This should display "On" when the air conditioner switch is switched on.
24	A/C Clutch	On/Off	Off	Off	This displays whether the ECM has commanded the A/C compressor clutch "On" or "Off".
25	EVAP Purge Solenoid (Evaporative Emission)	%	50 – 80	0	This displays the duty signal from the ECM to control the canister purge solenoid valve.
26	Fuel Trim Cell		49 – 52	13 – 17	This displays dependent on engine speed and MAF sensor reading. A plot of engine speed versus MAF amount is divided into the cells. Fuel trim cell indicates which cell is currently active.
27	Fuel Pump	On/Off	On	On	This displays operating status for the fuel pump main relay. This should display "On" when the key switch is turned on and while engine is running.
28	Deceleration Fuel Cutoff	Active/ Inactive	Inactive	Inactive	The ECM will command the deceleration fuel mode when it detects a closed throttle position while the vehicle is traveling. While in decreasing fuel mode, the ECM will decrease the amount of fuel delivered by entering open loop and decreasing the injector pulse width.
29	Power Enrichment	Yes/No	No	No	The ECM will command power enrichment mode "Yes" when a large increase in throttle position and load is detected. While in power enrichment mode, the ECM will increase the amount of fuel delivered by entering open loop and increasing the injector pulse width.
30	Vehicle Speed	km/h or mph	0	0	This displays vehicle speed. The vehicle speed is measured by ECM from the vehicle speed sensor.
31	Cam Signal	Present/ Missing	Present	Present	This displays input signal from the camshaft position sensor. When the correct pulse is generated, signal is received.
32	PSP Switch (Power Steering Pressure)	Normal Pressure / High Pressure	Normal Pressure	Normal Pressure	This displays the power steering pressure signal. This should display "High Pressure" when the steering is steered.
33	Security Code Status	Programmable/ Not Programmable	Programmable	Programmable	This should display "Programmable" when the correct security code & secret code are programmed.
34	Security Code	Okay/ Not Okay	Okay	Okay	This should display "Okay" when the security code is correctly accepted.
35	Immobilizer System	Normal / Abnormal	Normal	Normal	This should display "Normal" when the immobilizer is correctly operated.
36	Malfunction Indicator Lamp	On/Off	Off	Off	This displays operating status for the Check Engine Lamp. This should display "On" when the Check Engine Lamp is turned on.
37	Time From Start		—	—	This displays the engine time elapsed since the engine was started. If the engine is stopped, engine run time will be reset to 00:00:00

TYPICAL SCAN DATA & DEFINITIONS (O2 SENSOR DATA)

Use the typical values table only after the On-Board Diagnostic System check has been completed, no DTC(s) were noted, and you have determined that the On-Board Diagnostic are functioning properly.

Tech2 values from a properly running engine may be used for comparison with the engine you are diagnosing.

Condition : Vehicle stopping, engine running, air conditioning off & after warm-up (Coolant temperature approximately 80 °C)

	Tech 2 Parameter	Units	Idle	2000rpm	Definitions
1	Ignition Voltage	V	10.0 – 14.5	10.0 – 14.5	This displays the system voltage measured by the ECM at ignition feed.
2	Engine Speed	rpm	710 – 860	1950 – 2050	The actual engine speed is measured by ECM from the CKP sensor 58X signal.
3	Desired Idle Speed	rpm	750 – 770	750 – 770	The desired engine idle speed that the ECM commanding. The ECM compensates for various engine loads.
4	Engine Coolant Temperature	°C or °F	80 – 90 (°C)	80 – 90 (°C)	The ECT is measured by ECM from ECT sensor output voltage. When the engine is normally warm upped, this data displays approximately 80 °C or more.
5	Start Up ECT (Engine Coolant Temperature)	°C or °F	Depends on ECT at start-up	Depends on ECT at start-up	Start-up ECT is measured by ECM from ECT sensor output voltage when engine is started.
6	Throttle Position	%	0	4 – 6	Throttle position operating angle is measured by the ECM from throttle position output voltage. This should display 0% at idle and 99 – 100% at full throttle.
7	Throttle Position Sensor	V	0.4 – 0.7	0.6 – 0.8	The TPS output voltage is displayed. This data is changing by accelerator operating angle.
8	Mass Air Flow	g/s	5.0 – 8.0	13.0 – 16.0	This displays intake air amount. The mass air flow is measured by ECM from the MAF sensor output voltage.
9	Air Fuel Ratio		14.7:1	14.7:1	This displays the ECM commanded value. In closed loop, this should normally be displayed around 14.2:1 – 14.7:1.
10	Engine Load	%	2 – 7	8 – 15	This displays is calculated by the ECM form engine speed and MAF sensor reading. Engine load should increase with an increase in engine speed or air flow amount.
11	B1 Fuel System Status	Open Loop/ Close Loop	Close Loop	Close Loop	When the engine is first started the system is in "Open Loop" operation. In "Open Loop", the ECM ignores the signal from the oxygen sensors. When various conditions (ECT, time from start, engine speed & oxygen sensor output) are met, the system enters "Closed Loop" operation. In "Closed Loop", the ECM calculates the air fuel ratio based on the signal from the oxygen sensors.
12	B2 Fuel System Status	Open Loop/ Close Loop	Close Loop	Close Loop	
13	B1S1 O2 Sensor (Bank1 Sensor 1)	mV	50 – 950	50 –950	This displays the exhaust oxygen sensor output voltage. Should fluctuate constantly within a range between 10mV (lean exhaust) and 1000mV (rich exhaust) while operating in closed loop.
14	B2S1 O2 Sensor (Bank2 Sensor 1)	mV	50 – 950	50 – 950	
15	B1 O2 Sensor Ready (Bank 1)	Yes/No	Yes	Yes	This displays the status of the exhaust oxygen sensor. This display will indicate "Yes" when the ECM detects a fluctuating oxygen sensor output voltage sufficient to allow closed loop operation. This will not occur unless the oxygen sensor is warmed up.
16	B2 O2 Sensor Ready (Bank 2)	Yes/No	Yes	Yes	
17	B1 Long Term Fuel Trim (Bank 1)	%	-10 – 20	-10 – 20	The long term fuel trim is delivered from the short term fuel term values and represents a long term correction of fuel delivery for bank in question. A value of 0% indicates that fuel delivery requires no compensation to maintain the ECM commanded air fuel ratio. A negative value indicates that the fuel system is rich and fuel delivery is being reduced (decreased injector pulse width). A positive value indicates that a lean condition exists and the ECM is compensating by add fuel (increased injector pulse width). Because long term fuel trim tends to follow short term fuel trim, a value in the negative range due to canister purge at idle should not be considered unusual. Excessive long term fuel trim values may indicate an rich or lean condition.
18	B2 Long Term Fuel Trim (Bank 2)	%	-10 – 20	-10 – 20	

	Tech 2 Parameter	Units	Idle	2000rpm	Definitions
19	B1 Short Term Fuel Trim (Bank 1)	%	-10 – 20	-10 – 20	The short term fuel trim to a bank represents a short term correction to the bank fuel delivery by the ECM in response to the amount of time the bank fuel control oxygen sensor voltage spends above or below the 450mV threshold. If the oxygen sensor voltage has mainly remained less than 450mV, indicating a lean air/fuel, short term fuel trim will increase into the positive range above 0% and the ECM will pass fuel. If the oxygen sensor voltage stays mainly above the threshold, short term fuel trim will decrease below 0% into the negative range while the ECM reduces fuel delivery to compensate for the indicated rich condition. Under certain conditions such as extended idle and high ambient temperatures, canister purge may cause short term fuel trim to read in the negative range during normal operation. Excessive short term fuel trim values may indicate an rich or lean condition.
20	B2 Short Term Fuel Trim (Bank 2)	%	-10 – 20	-10 – 20	
21	Fuel Trim Cell		49 – 52	13 – 17	This displays dependent on engine speed and MAF sensor reading. A plot of engine speed versus MAF amount is divided into the cells. Fuel trim cell indicates which cell is currently active.
22	Fuel Trim Learned (Bank 1)	Yes/No	Yes	Yes	When conditions are appropriate for enabling long term fuel trim corrections, fuel trim learn will display "Yes". This indicates that the long term fuel trim is responding to the short term fuel trim. If the fuel trim lean displays "No", then long term fuel trim will not respond to changes in short term fuel trim.
23	Fuel Trim Learned (Bank 2)	Yes/No	Yes	Yes	
24	B1S1 Status (Bank 1 Sensor 1)	Rich / Lean	Rich / Lean	Rich / Lean	This displays dependent on the exhaust oxygen sensor output voltage. Should fluctuate constantly "Rich" and "Lean" in closed loop.
25	B2S1 Status (Bank 2 Sensor 1)	Rich / Lean	Rich / Lean	Rich / Lean	

MISCELLANEOUS TEST

The state of each circuit can be tested by using miscellaneous test menus. Especially when DTC cannot be detected, a faulty circuit can be diagnosed by testing each circuit by means of these menus.

Even DTC has been detected, the circuit tests using these menus could help discriminate between a mechanical trouble and an electrical trouble.

Connect Tech 2 and select "Powertrain", "3.5L V6 6VE1 Hitachi" & "Miscellaneous Test".

F0: Lamps

F0: Malfunction Indicator Lamp

When the Tech 2 is operated, "Malfunction Indicator Lamp (Check Engine Lamp)" is turned on or off.

The circuit is normal if the "Malfunction Indicator Lamp (Check Engine Lamp)" in the instrument panel is turned on or off in accordance with this operation.

F1: Relays

F0: Fuel Pump Relay

When the Tech 2 is operated, fuel pump relay signal turns ON or OFF.

The circuit is normal if fuel pump sound is generated in accordance with this operation when key switch is turned ON.

"F1: A/C Clutch Relay"

When the Tech 2 is operated, A/C clutch relay signal turns ON or OFF.

The circuit is normal if A/C compressor clutch is energized in accordance with this operation when the engine is running.

F2: EVAP

F0: Purge Solenoid

When the Tech 2 is operated, duty ratio of EVAP purge solenoid is changed 10%-by-10%.

Purge Solenoid	
Engine Speed	800 RPM
Desired Idle Speed	762 RPM
Engine Coolant Temperature	80 °C
Start Up ECT	50 °C
Intake Air Temperature	30 °C
Throttle Position	0 %
EVAP Purge Solenoid	10 %

- Press "Increase" key.
  Then, EVAP Purge Solenoid increases 10%-by-10%.
- Press "Quit" Key.

F3: IAC System

F0: RPM Control

When the Tech 2 is operated, "Desired Idle Speed" increases 50rpm-by-50rpm up to 1550rpm.

The circuit is normal if engine speed is changed in accordance with this operation.

RPM Control	
Engine Speed	850 RPM
Desired Idle Speed	850 RPM
Engine Coolant Temperature	80 °C
Start Up ECT	50 °C
Intake Air Temperature	30 °C
Throttle Position	0 %
Desired Idle Speed	850 RPM

- Press "Increase" key.
  Then, Desired Idle speed increases 50rpm-by-50rpm up to 1550rpm. Engine speed is also changed by this operation.
- Press "Quit" Key.

F0: IAC Control

When the Tech 2 is operated, "Idle Air Control" increases or decreases 10steps-by-10steps up to 160steps.

The circuit is normal if idle engine speed is changed in accordance with this operation.

IAC Control	
Engine Speed	875 RPM
Desired Idle Speed	762 RPM
Engine Coolant Temperature	80 ℃
Start Up ECT	50 ℃
Intake Air Temperature	30 ℃
Throttle Position	0 %
Idle Air Control	30 Steps

- Press "Increase" key.
  Then, Idle Air Control increases 10steps-by-10steps up to 160steps.
  Engine speed is also changed by this operation.
- Press "Quit" Key.

F4: Fuel System

F0: Fuel Trim Reset

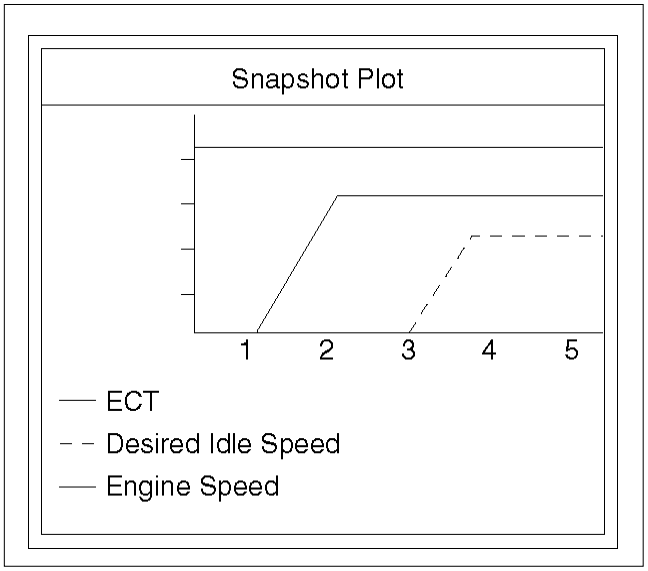
When the Tech 2 is operated, "Long Term Fuel Trim" is reset to 0%.

Fuel Trim Reset	
B1 Long Term Fuel Trim (Bank 1)	3 %
B2 Long Term Fuel Trim (Bank 2)	3 %
B1 Short Term Fuel Trim (Bank 1)	−1 %
B2 Short Term Fuel Trim (Bank 2)	−2 %
Fuel Trim Cell	53
Fuel Trim Learned (Bank 1)	Yes
Fuel Trim Learned (Bank 2)	Yes
B1 Long Term Fuel Trim	0%

- Press "Reset" key.
  Then, B1 & B2 Long Term Fuel Trim is reseted to 0%.
- Press "Quit" Key.

PLOTTING SNAPSHOT GRAPH

This test selects several necessary items from the data list to plot graphs and makes data comparison on a long term basis. It is an effective test particularly in emission related evaluations.

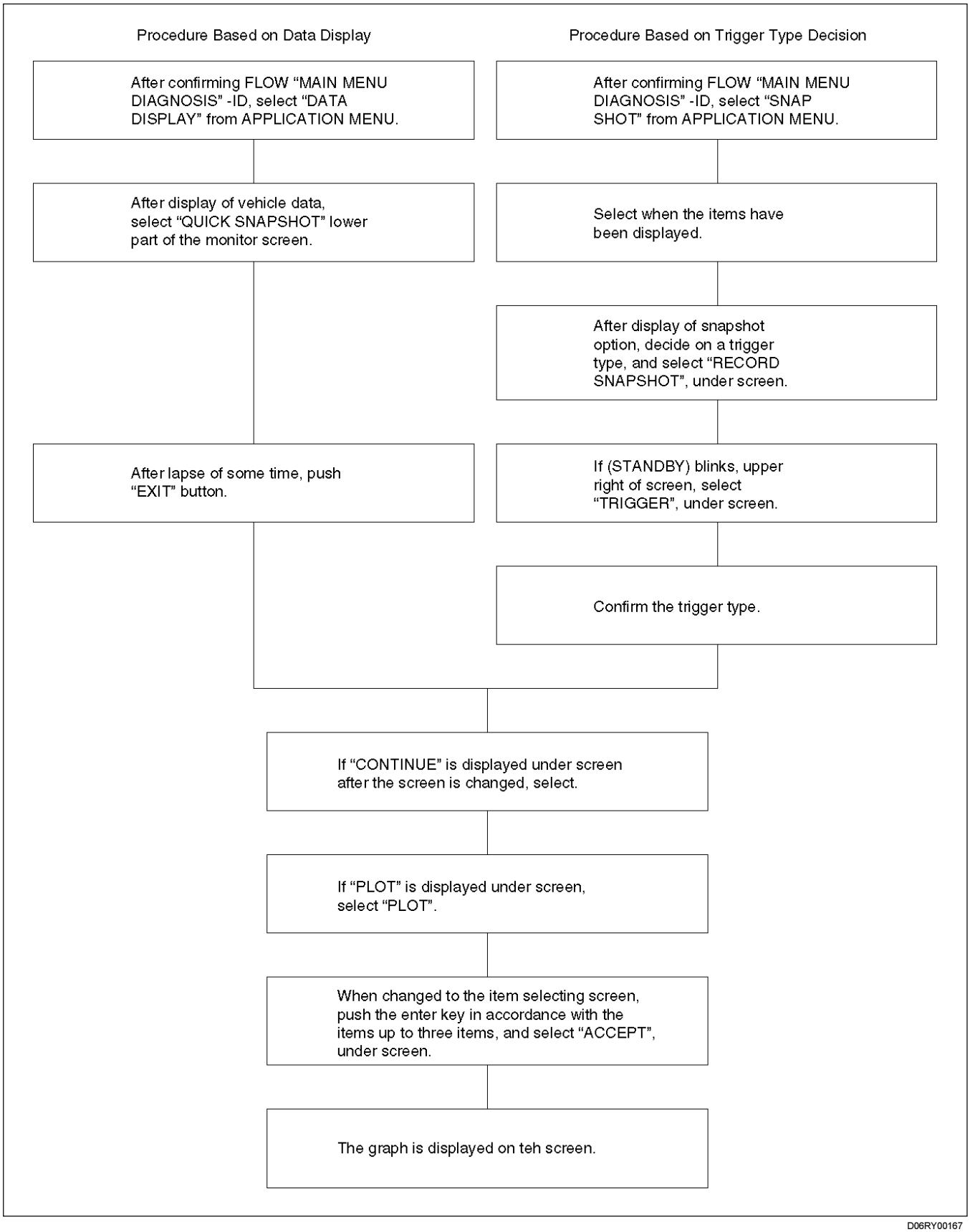


060RX037

For trouble diagnosis, you can collect graphic data (snap shot) directly from the vehicle.

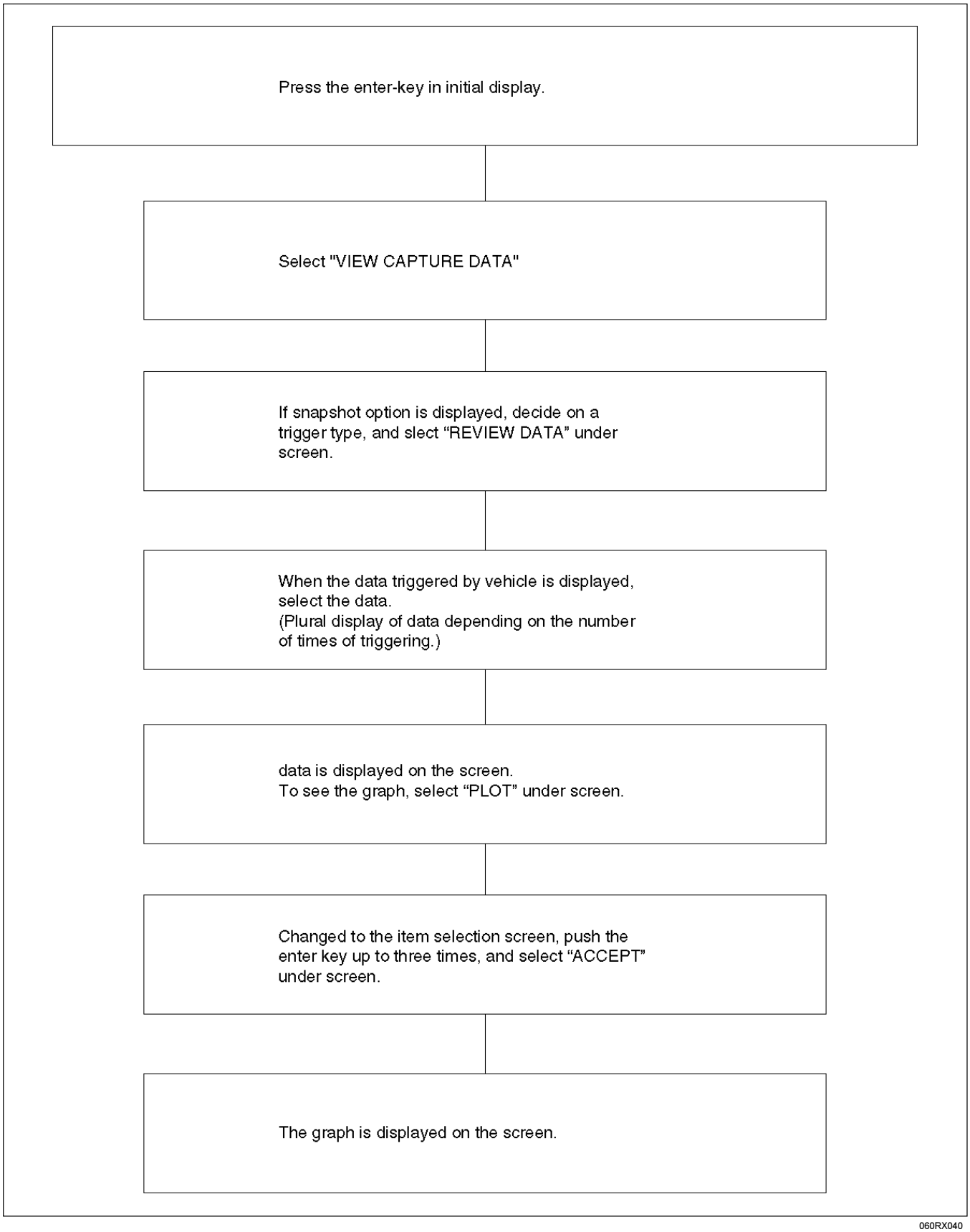
You can replay the snapshot data as needed. Therefore, accurate diagnosis is possible, even though the vehicle is not available.

Plotting Graph Flow Chart (Plotting graph after obtaining vehicle information)



D06RY00167

Flow Chart for Snapshot Replay (Plotting Graph)



060RX040

SNAPSHOT DISPLAY WITH TIS2000



Procedures for transferring and displaying Tech2 snapshot data by using TIS2000 [Snapshot Upload] function is described below.

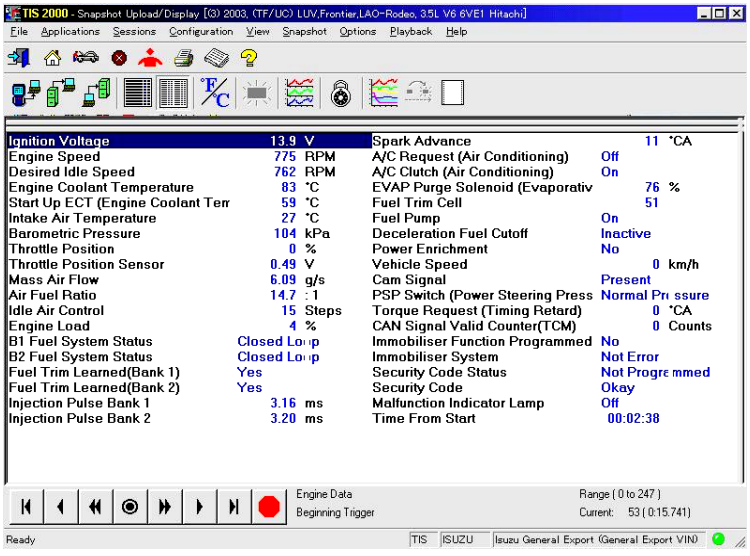
Snapshot data can be displayed with [Snapshot Upload] function included in TIS2000.

By analyzing these data in various methods, trouble conditions can be checked.

Snapshot data is displayed by executing the three steps below shown:

1. Record the snapshot data, in Tech2.

2. Transfer the snapshot data to PC.



After recording the snapshot in Tech2, transfer the data from Tech2 to PC by the below procedures.

1. Start TIS2000.
2. Select [Snapshot Upload] on the TIS2000 start screen.
3. Select [Upload from trouble diagnosis tool (transfer from diagnosis tester)] or click the corresponding icon of the tool bar.
4. Select Tech2, and transfer the recorded snapshot information.
5. Select the transferred snapshot.
6. After ending transfer of the snapshot, data parameter list is displayed on the screen.

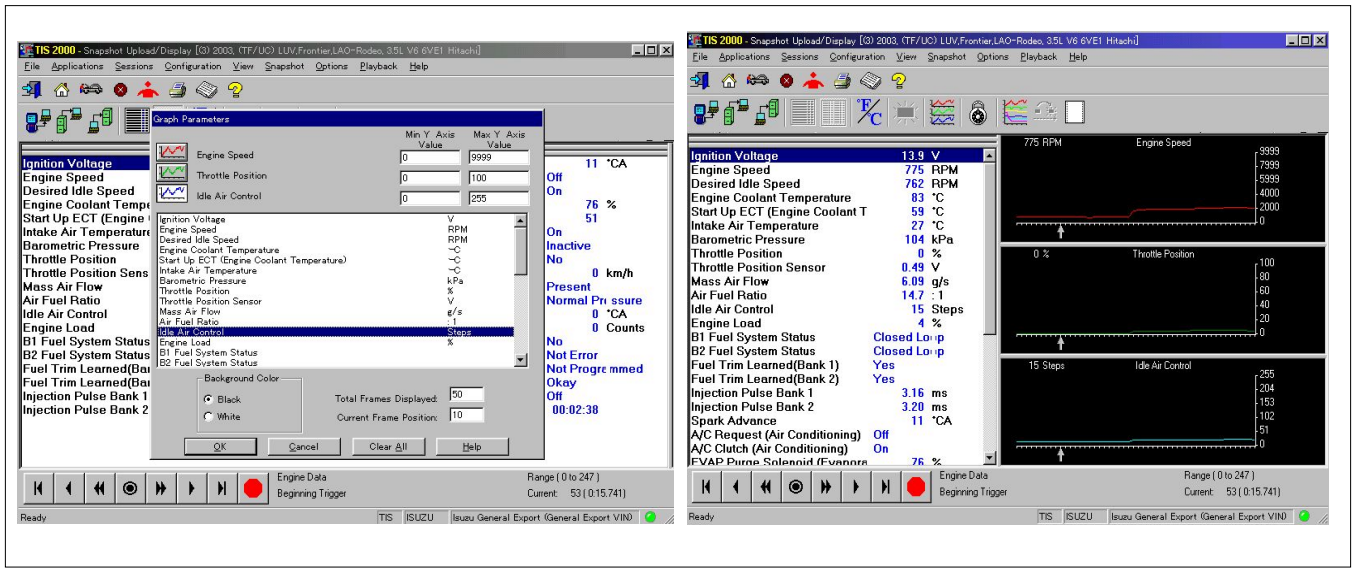
3. Snapshot data is displayed with TIS2000 [Snapshot Upload] function.

Snapshot is stored in the PC hard disk or floppy disk, and can be displayed any time.

Stored snapshot can be displayed by the below procedures.

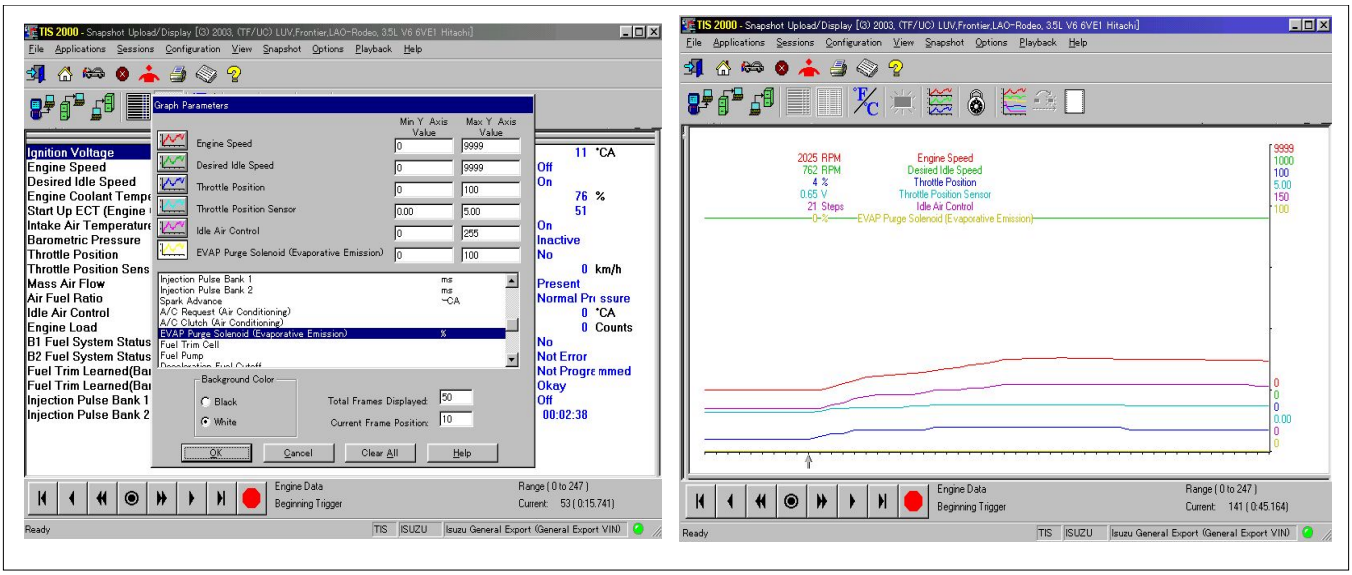
1. Start TIS2000.
2. Select [Snapshot Upload] on the TIS2000 start screen.
3. Select [Open the existing files] or click the corresponding icon of the tool bar.
4. Select the transferred snapshot.
5. Open the snapshot, to display the data parameter list on the screen.

Graph display Values and graphs (Max. 3 graphs):



1. Click the icon for graph display. [Graph Parameter] window opens.
2. Click the first graph icon of the window upper part, and select one parameter from the list of the window lower part. Selected parameter is displayed nest to the graph icon. Graph division can be selected in the field on the parameter right side.
3. Repeat the same procedures with the 2nd and 3rd icons.
4. After selecting all parameters to be displayed (Max. 3 parameters), click [OK] button.
5. Parameter selected is displayed in graph form on the right of the data parameter on the screen.
6. Graph display can be moved with the navigation icon.
7. For displaying another parameter by graph, click the parameter of the list, drug the mouse to the display screen while pressing the mouse button and release the mouse button. New parameter is displayed at the position of the previous parameter. For displaying the graph display screen in full size, move the cursor upward on the screen. When the cursor is changed to the magnifying glass form, click the screen. Graph screen is displayed on the whole screen.

Display of graphs on one screen (Max. 6 graphs):



1. Click the 6 graph icon. [Graph Parameter] window opens.
2. Click the graph icon, select the parameter to be displayed from the list and change divisions according to necessity.
3. Repeat the same procedures with the graph icons, from the 2nd to 6th.
4. Click the [OK] button to display.
5. In this case, parameters are displayed only in graph form. All parameters are displayed in one graph.
6. The graph display screen can be moved with the navigation icon.

SERVICE PROGRAMMING SYSTEM (SPS)

The procedure to program the control unit by using the Service Programming System (SPS) software contained in TIS2000 is explained below.

NOTE:

- **If the Engine Control Module (ECM) was programmed, the Immobilizer System must be linked to the ECM: Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.**
- **Should Tech2 display "SPS Procedure was not successful", engine will not start, but no DTCs are present, low battery voltage or poor electrical connections should be the primary suspects. Perform the SPS procedure again after rectifying the fault/s.**

IMPORTANT:

Perform the following checks before attempting to program the control unit:

- **The Tech2 PCMCIA card is programmed with the latest software release.**
- **The latest release of TIS2000 is loaded on the PC.**
- **The vehicle battery is fully charged.**
- **The control unit to be programmed is connected to the vehicle.**

1. Preparations of TIS 2000

1. Connect Tech 2 to P/C.
2. Check to see if Hardware Key is plugged into Port.
3. Activate TIS 2000 by P/C.
4. On the activating screen of TIS2000, choose "Service Programming System"



5. On the screen of "Diagnostic Tester and Processing Program Selection", choose the one that will comply with the following.

- Diagnostic Tech 2 in use
- New programming by the existing module or new programming by the replaced/new module.
- Fixing position of the control unit.

6. Upon completion of the selection, push the button of "Next".

2.Demand of Data

1. Connect Tech-2 to the vehicle. When activated by turning on the power of Tech-2, push the "Enter" switch.
2. Turn on the ignition switch (without starting the engine)
3. In the main menu of Tech 2, push "F1: Service Programming System (SPS)".
4. Push "F0: Request Info" of Tech-2.
5. Where vehicle data has been already saved in Tech-2, the existing data come on display. In this instance, as Tech-2 starts asking whether to keep the data or to continue obtaining anew data from the control unit, choose either of them.



6. If you select “continue”, you have to select “Model Year”, “Vehicle Type”.
7. After that. then push button and turn Ignition switch tuned on, off, on following Tech-2 display. Tech-2 will read information from controller after this procedure.
8. During obtaining information, Tech-2 is receiving information from the control unit ECM and TCM (A/T only) at the same time. With VIN not being programmed into the new control unit at the time of shipment, "obtaining information" is not complete (because the vehicle model, engine model and model year are specified from VIN). For the procedure get additional information on vehicles, instruction will be provided in dialog form, when TIS2000 is in operation.
9. Following instructions by Tech-2, push the "Exit" switch of Tech-2, turn off the ignition of the vehicle and turn off the power of Tech-2, thereby removing from the vehicle.

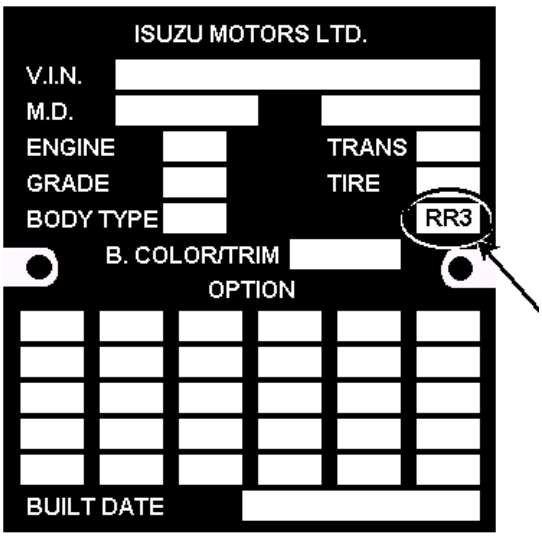
3.Data Exchange

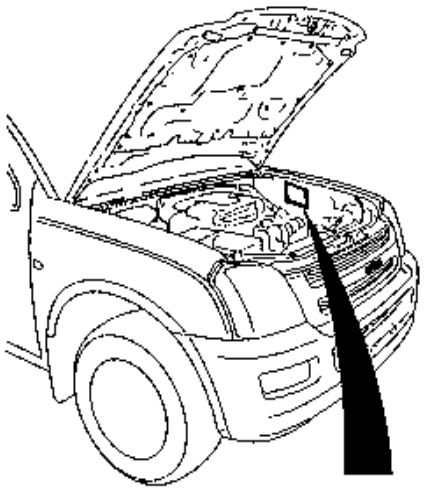
1. Connect Tech-2 to P/C, turn on the power and click the "Next" button of P/C.
2. Check VIN of the vehicle and choose "Next".
3. Select “System Type” for required control unit.
   - Engine (Programming for ECM or PCM)
   - Transmission (Programming for TCM)
4. When a lack of data is asked from among the following menu, enter accordingly.
   Select following Menu
   - Model Year
   - Model
   - Engine type
   - Transmission type
   - Destination code (vehicles for general export)*1
   - Immobilizer

   Etc.

* 1: How to read the destination code

"Destination code can be read from service ID Plate affixed on vehicles, while on service ID plate the destination code is described at the right-hand edge of Body Type line. In the figure, the destination code can be read as "RR3" (Australia).



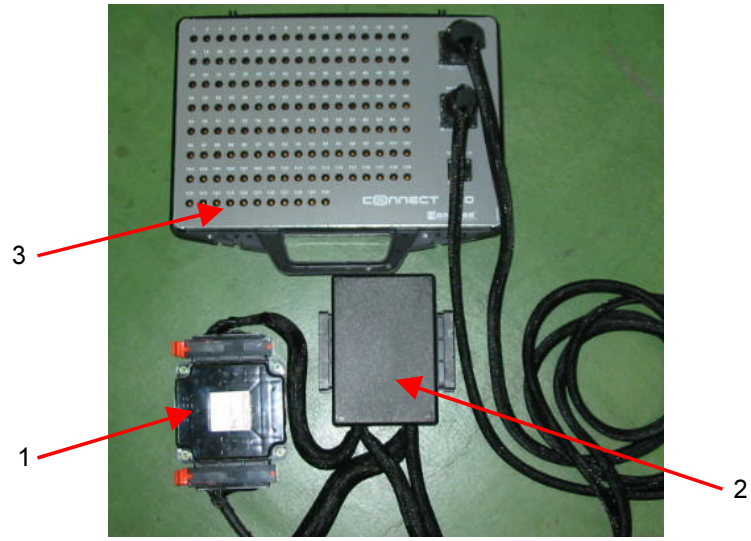


5. After choosing the data, click the "Next" button.
6. When all the necessary information is entered, the "details" of software within the database that match the entered data will appear for confirmation. Click the "Program" switch and then download the new software onto Tech-2.
7. "Data Transfer" comes on display. The progress of downloading will be displayed on the screen in the form of bar graph.
8. Upon finishing the data transfer, turn off the power of Tech-2, removing from P/C.

4. Programming of ECM

1. Check to see if batteries are fully charged, while ABS connectors shall be removed from the vehicle.
2. Connect Tech-2 to Vehicle Diagnostic Connectors.
3. Turn on the power of Tech-2 and the title screen comes on display.
4. Turn on the ignition (without allowing the engine to start)
5. On the title screen of Tech-2, push the "Enter" button.
6. Choose "F1: Service Programming System" on the main screen and then choose "F1: Program ECU".
7. While data is being transferred, "Programing in Progress" will be displayed on the Tech-2 screen.
8. Upon finishing the data transfer, Tech-2 will display "Reprogramming was Successful". Push the "Exit" button to bring program to completion.
9. Following "Procedure 2: Demand of Data", try over again "Information Obtaining" and check to confirm if the data has been correctly re-loaded.
10. Upon finishing confirmation, turn off the ignition of the vehicle and then turn off the power of Tech-2, removing from the vehicle.

HOW TO USE BREAKER BOX



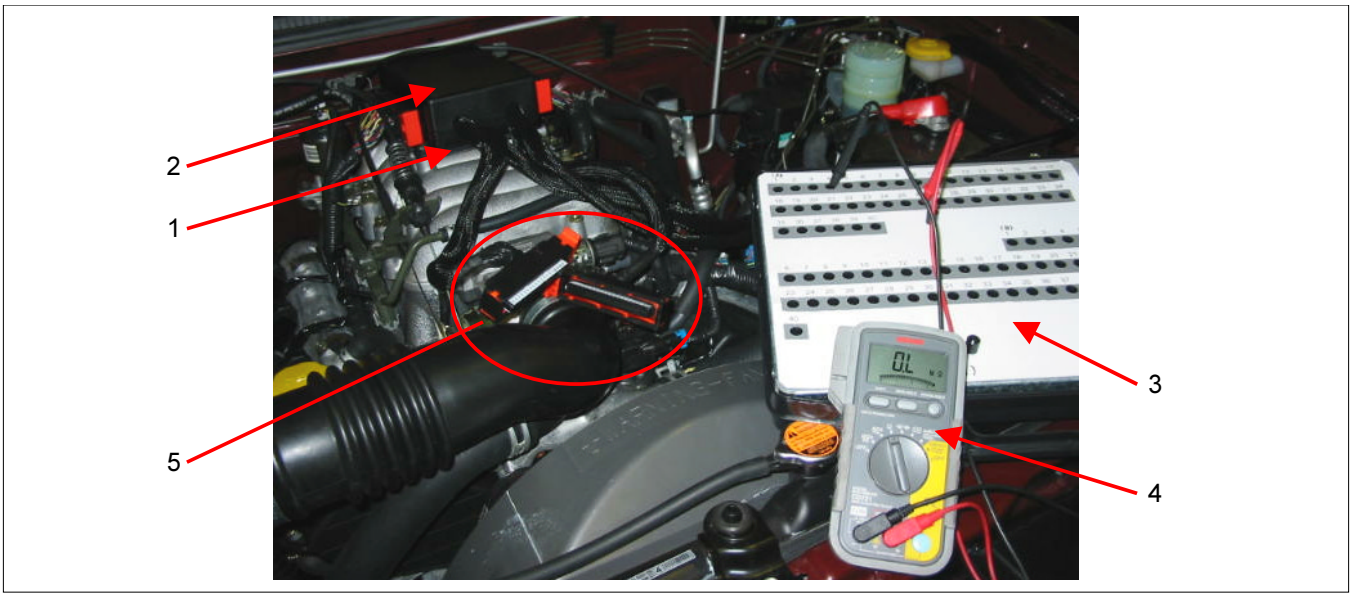
Legend

(1) Engine Control Module (ECM)
(2) Harness Adapter
(3) Breaker Box

The engine control module (ECM) and other connectors have water proof connector and special terminal. Water proof terminal does not allow to use back prove. In addition, the ECM special terminal can not let regular digital voltage meter prove to access, because terminal shape is very fin pin type.

In order to prevent damage of female terminal and connector itself, the breaker box and adapter is the most suitable special tool.

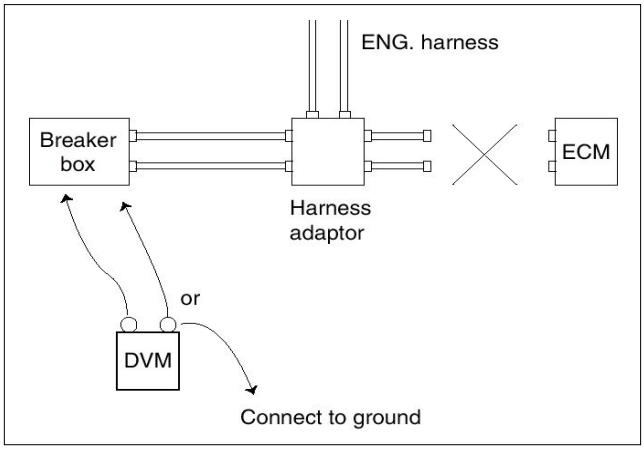
Breaker Box Connection Type A



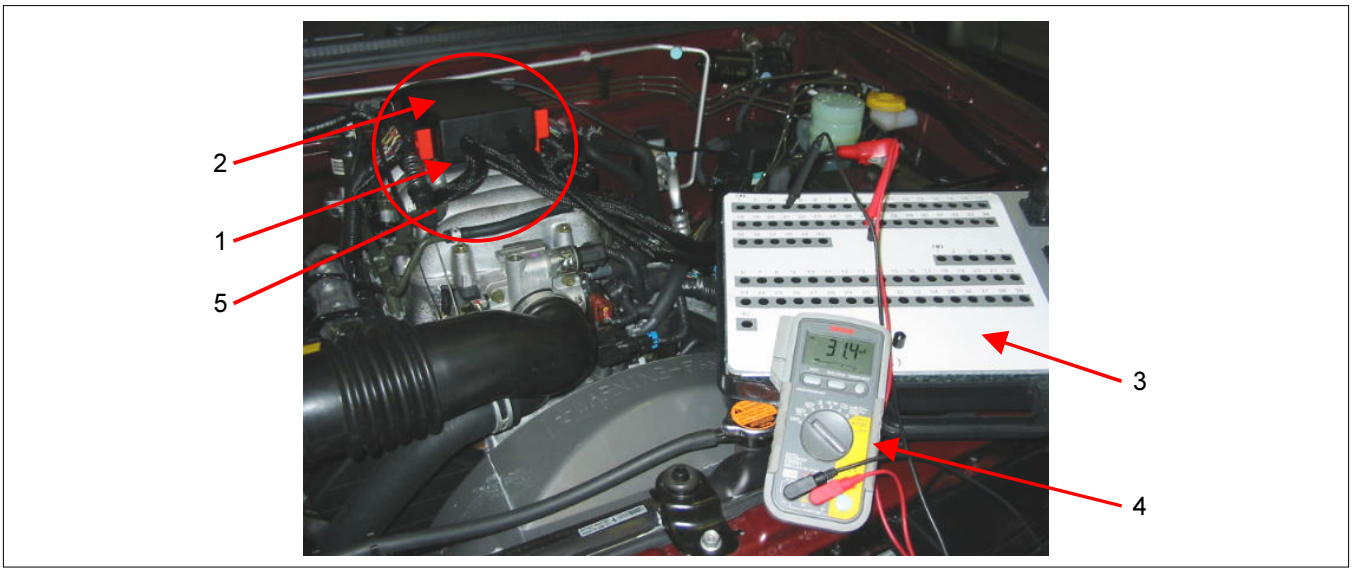
Legend

(1) Engine Control Module (ECM) (Under the harness adaptoer)
(2) Harness Adapter
(3) Breaker Box
(4) Digital Voltage Meter
(5) ECM - Harness Adapter Disconnection

Breaker box connection type A, check for "open circuit" and "short to ground circuit".



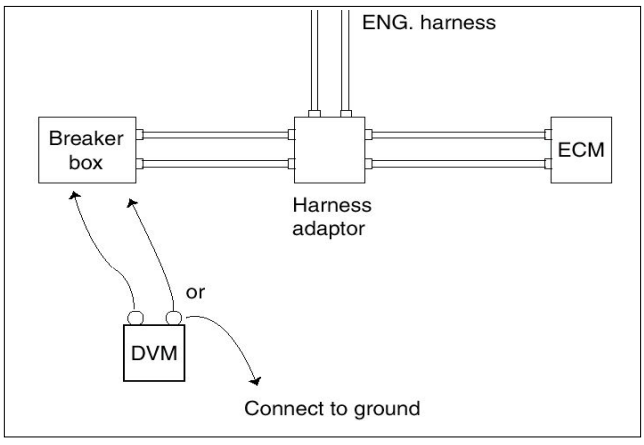
Breaker Box Connection Type B



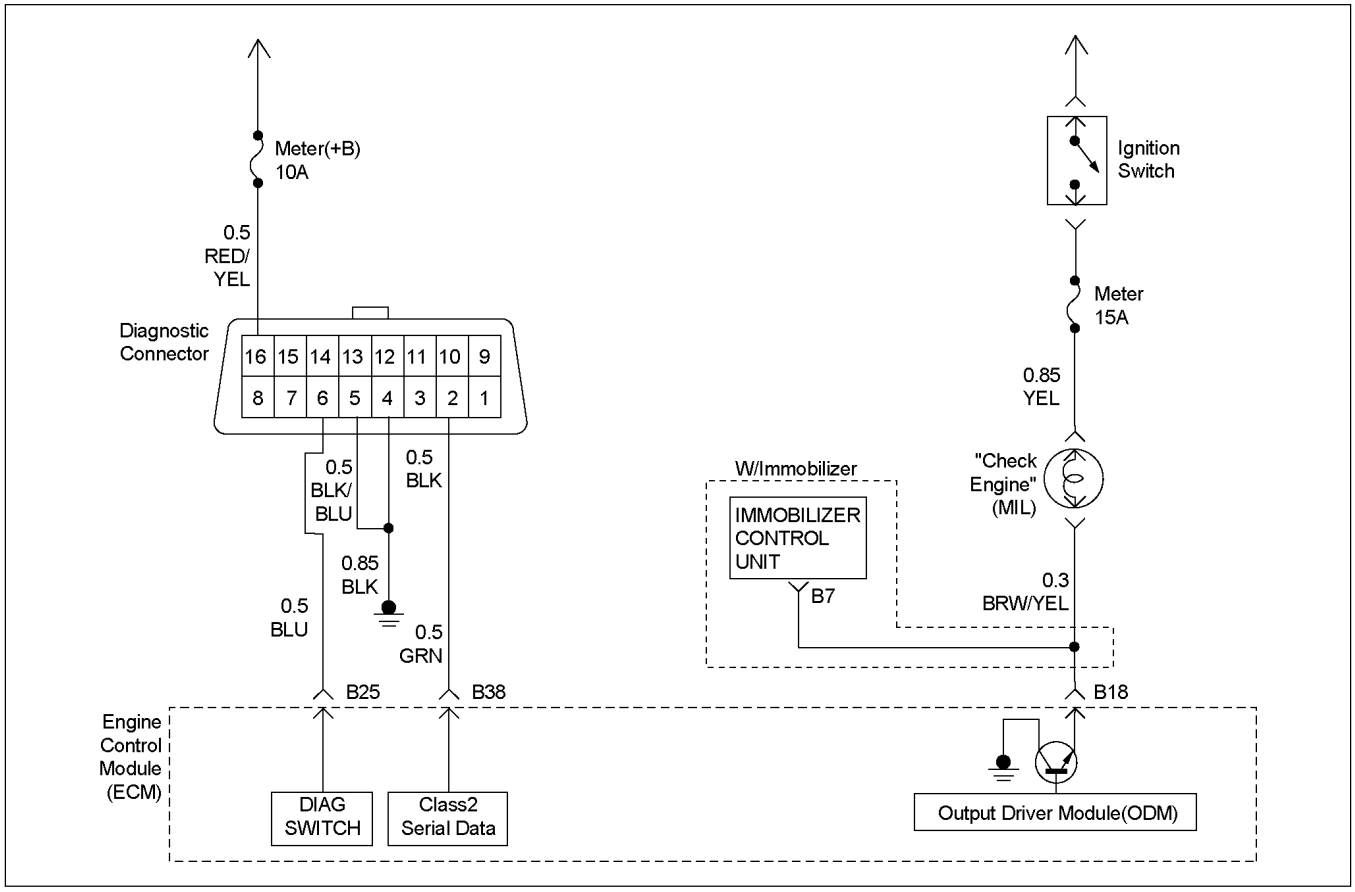
Legend

(1) Engine Control Module (ECM) (Under the harness adapter)
(2) Harness Adapter
(3) Breaker Box
(4) Digital Voltage Meter
(5) ECM - Harness Adapter Connection

Breaker box connection type B, check for "short to power supply circuit" and "power, signal voltage check" between the engine control module (ECM) and electrical components.



ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK



RTW46EMF000401

CIRCUIT DESCRIPTION

The on-board diagnostic system check is the starting point for any driveability complaint diagnosis. Before using this procedure, perform a careful visual/physical check of the ECM and engine grounds for cleanliness and tightness.

The on-board diagnostic system check is an organized approach to identifying a problem created by an electronic engine control system malfunction.

DIAGNOSTIC AIDS

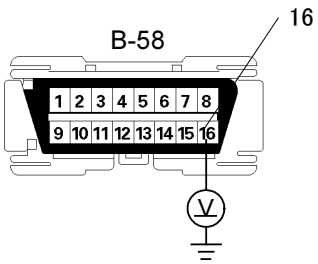
An intermittent may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

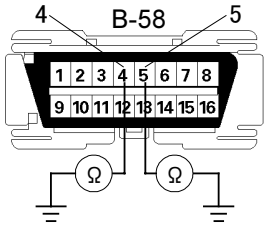
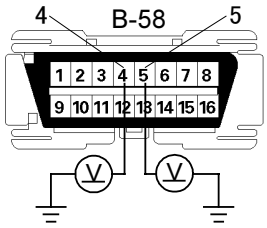
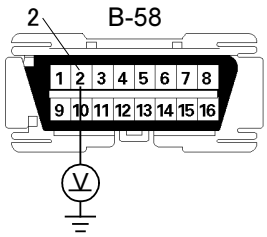
TEST DESCRIPTION

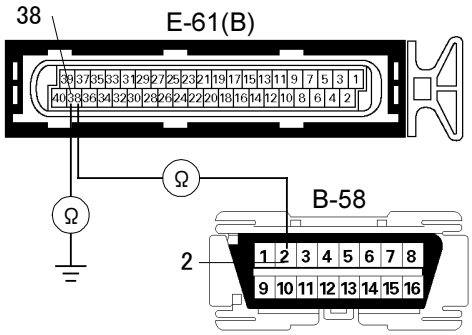
Number(s) below refer the step number(s) on the Diagnostic Chart:

1. The Check Engine Lamp (MIL) should be ON steady with the ignition "On", engine "Off". If not, "No Check Engine Lamp (MIL)" chart should be used to isolate the malfunction.
2. Checks the Class 2 data circuit and ensures that the ECM is able to transmit serial data.
3. This test ensures that the ECM is capable of controlling the Check Engine Lamp (MIL) and the Check Engine Lamp (MIL) driver circuit is not shorted to ground circuit.
4. If the engine will not start, "Engine Cranks But Will Not Run" chart should be used to diagnose the fault.
6. The Tech2 parameters which is not within the typical range may help to isolate the area which is causing the problem.
12. This vehicle is equipped with ECM which utilizes an electrically erasable programmable read only memory (EEPROM).

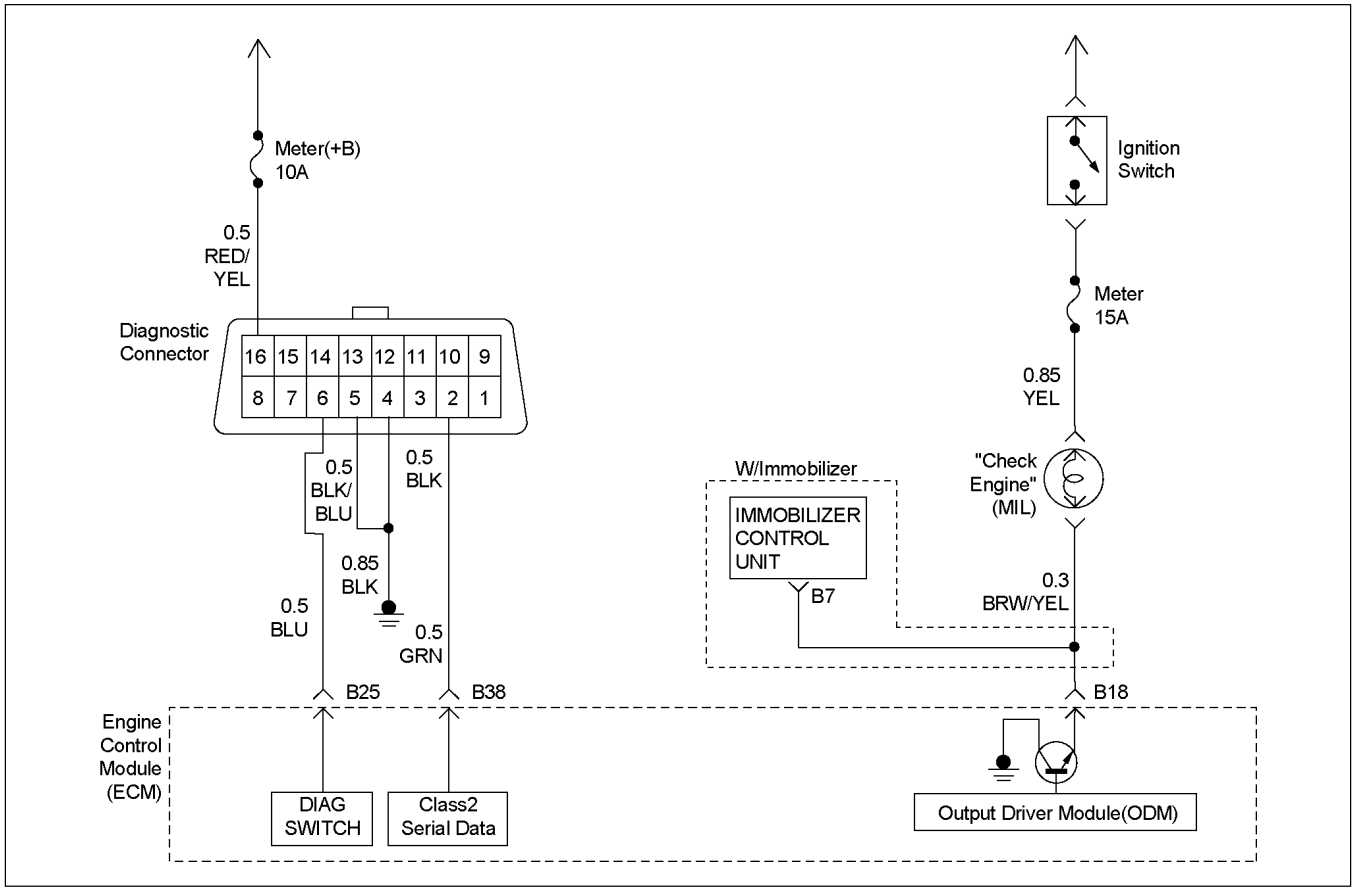
On-Board Diagnostic (OBD) System Check

Step	Action	Value (s)	Yes	No
1	1. Ignition "On", engine "Off". 2. Check the "CHECK ENGINE" lamp (MIL). Does the "CHECK ENGINE" lamp turn "On"?	-	Go to *Step 2*	Go to *No CHECK ENGINE Lamp*
2	1. Using the Tech 2, ignition "On" and engine "Off". 2. Attempt to display "Engine Data" with the Tech 2. Does the Tech 2 display "Engine Data" and "O2 Sensor Data"?	-	Go to *Step 3*	Go to *Step 7*
3	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select the "Miscellaneous Test" and perform the "Malfunction Indicator Lamp" in "Lamps". 3. Operate the Tech 2 in accordance with the Tech 2 instructions. Does the "CHECK ENGINE" lamp turn "Off"?	-	Go to *Step 4*	Go to *CHECK ENGINE LAMP On Steady*
4	Attempt to start the engine. Does the engine start and continue to "Run"?	-	Go to *Step 5*	Go to *Engine Cranks But Will Not Run*
5	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select the "Read DTC In for By Priority" in "Diagnostic Trouble Code". Are any DTCs stored?	-	Go to *DTC Chart*	Go to *Step 6*
6	Compare typical scan data values displayed on the Tech 2 "Engine Data" and "O2 Sensor Data". Are the displayed values within the range?	-	Refer to *SYMPTOM DIAGNOSIS*	Refer to *TYPICAL SCAN DATA*
7	Using the DVM and check the data link connector power supply circuit. 1. Ignition "Off", engine "Off". 2. Check the circuit for open circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 8*

Step	Action	Value (s)	Yes	No
8	Using the DVM and check the data link connector ground circuit. 1. Ignition "Off", engine "Off". 2. Check the circuit for open circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 9*
9	Using the DVM and check the data link connector ground circuit. 1. Ignition "On", engine "Off". 2. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 10*	Repair faulty harness and verify repair
10	Using the DVM and check the data link connector communication circuit. 1. Ignition "On", engine "Off". 2. Check the circuit for short to power supply circuit. Was the DVM indicated battery voltage? 	-	Repair faulty harness and verify repair	Go to *Step 11*

Step	Action	Value (s)	Yes	No
11	Using the DVM and check the data link connector communication circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 12*
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 13*
13	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the Immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

NO CHECK ENGINE LAMP (MIL)



RTW46EMF000401

CIRCUIT DESCRIPTION

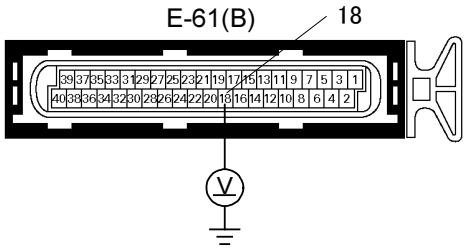
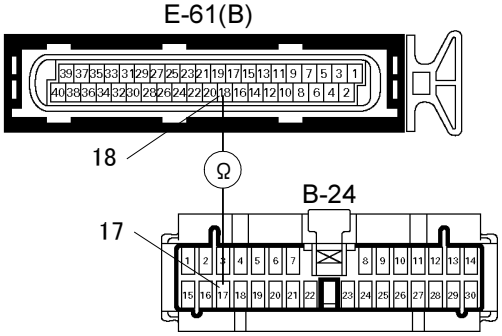
The “Check Engine" lamp (MIL) should always be illuminated and steady with the ignition “ON" and the engine stopped. Ignition feed voltage is supplied to the MIL bulb through the meter fuse. The Engine Control Module (ECM) turns the MIL “ON" by grounding the MIL driver circuit.

DIAGNOSTIC AIDS

An intermittent MIL may be cased by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check for the following items:

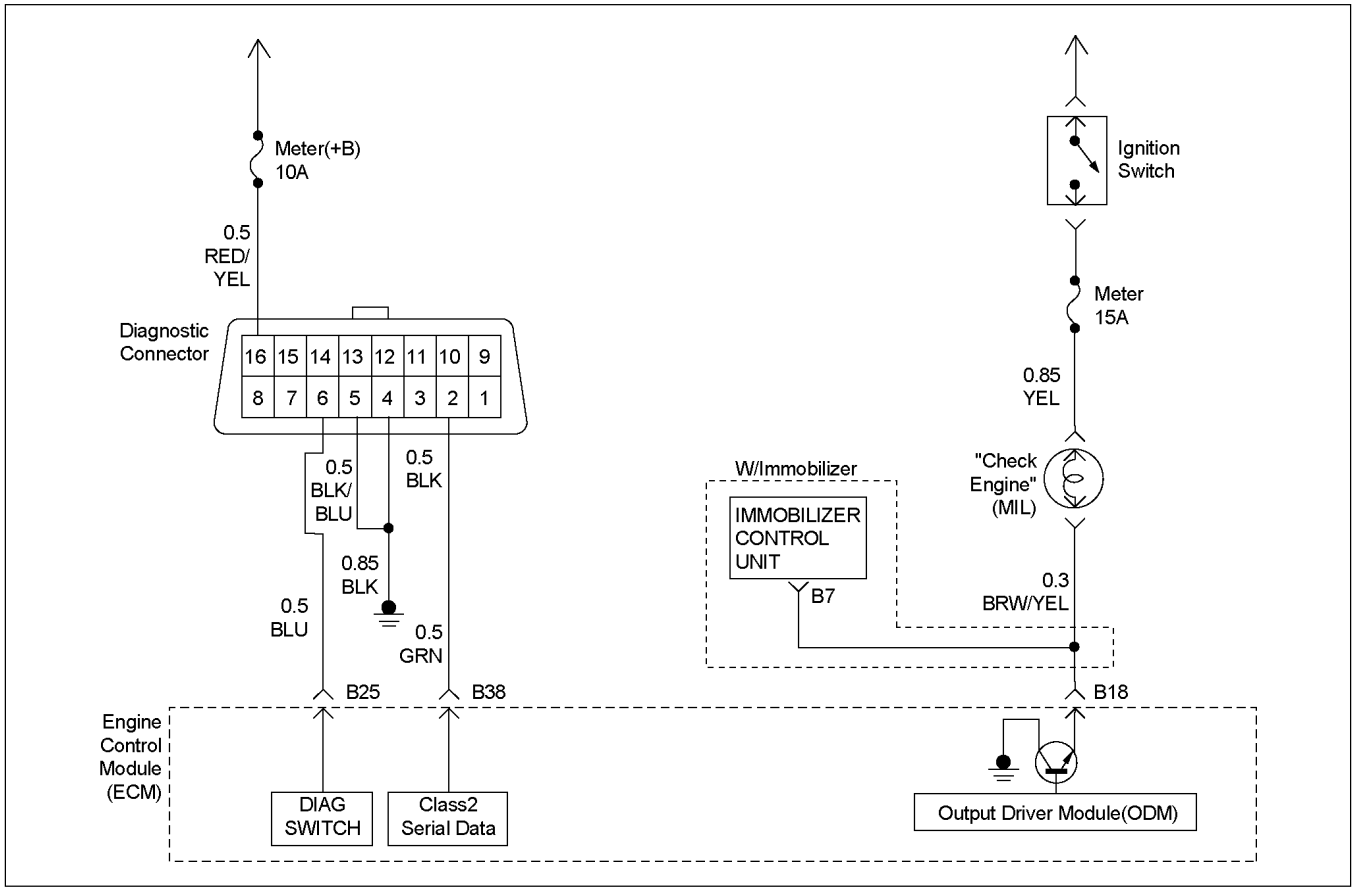
- Inspect the ECM harness and connections for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.
- If the engine runs OK, check for a faulty light bulb, an open in the MIL driver circuit, or an open in the instrument cluster ignition feed.
- If the engine cranks but will not run, check for an open ECM ignition or battery feed, or a poor ECM to engine ground.

No Check Engine Lamp (MIL)

Step	Action	Value (s)	Yes	No
1	Check the meter fuse (15A). If the fuse is burnt out, repair as necessary. Was the problem found?	-	Verify repair	Go to *Step 2*
2	Using the DVM and check the "CHECK ENGINE" lamp circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the ECM connector. 3. Ignition "On". 4. Check the circuit for open circuit. Was the DVM indicated specified value? 	10 – 14.5V	Go to *Step 5*	Go to *Step 3*
3	Check the "CHECK ENGINE" lamp bulb. If the bulb is burnt out, repair as necessary. Was the problem found?	-	Verify repair	Go to *Step 4*
4	Using the DVM and check the "CHECK ENGINE" lamp circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the meter connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	-	Verify repair	Go to *Step 5*
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 6*

Step	Action	Value (s)	Yes	No
6	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the Immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

CHECK ENGINE LAMP (MIL) “ON" STEADY



RTW46EMF000401

CIRCUIT DESCRIPTION

The “Check Engine" lamp (MIL) should always be illuminated and steady with ignition “ON" and the engine stopped. Ignition feed voltage is supplied directly to the MIL indicator. The Engine Control Module (ECM) turns the MIL “ON" by grounding the MIL driver circuit.

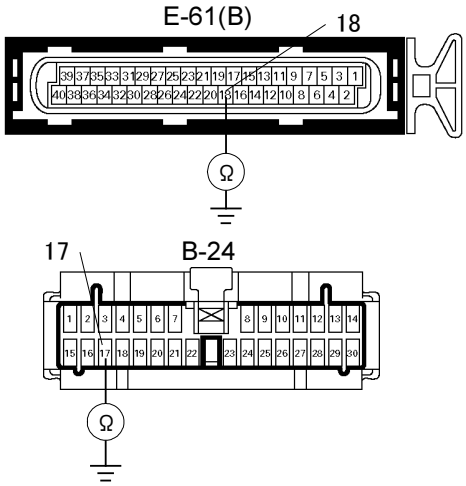
The MIL should not remain “ON" with the engine running and no DTC(s) set. A steady MIL with the engine running and no DTC(s) suggests a short to ground in the MIL driver circuit.

DIAGNOSTIC AIDS

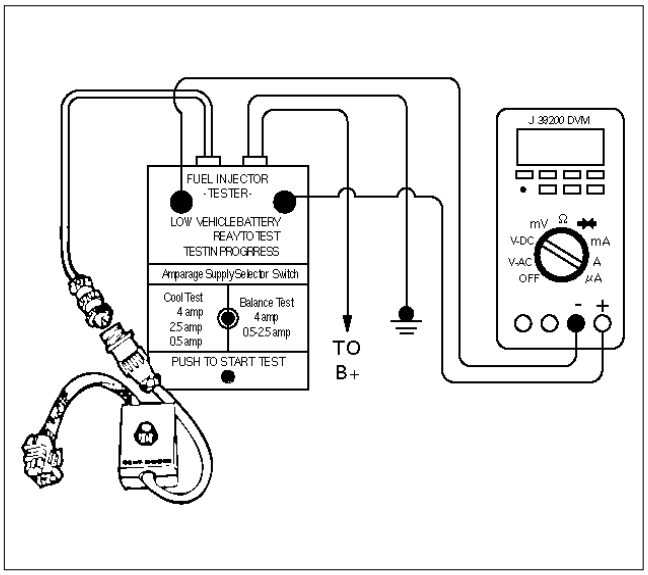
An intermittent may be caused by a poor connection, rubbed–through wire insulation, or a wire broken inside the insulation. Check for the following items:

- Poor connection or damaged harness – Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Check Engine Lamp (MIL) “ON" Steady

Step	Action	Value (s)	Yes	No
1	1. Ignition "Off", engine "Off". 2. Disconnect the ECM connector. 3. Ignition "On". Was the "CHECK ENGINE" lamp turned on?	-	Go to *Step 2*	Go to *Step 4*
2	Using the DVM and check the "CHECK ENGINE" lamp circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the meter connector and ECM connector. 3. Check the circuit for short to ground circuit. Was the problem found? 	-	Verify repair	Go to *Step 3*
3	Replace the meter assembly. Is the action complete?	-	Verify repair	-
4	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 5*
5	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the Immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **“Immobilizer System-ECM replacement”** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

FUEL INJECTOR COIL TEST PROCEDURE AND FUEL INJECTOR BALANCE TEST PROCEDURE



Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart:

2. Relieve the fuel pressure by connecting the 5–8840–0378–0 Fuel Pressure Gauge to the fuel pressure connection on the fuel rail.

CAUTION: In order to reduce the risk of fire and personal injury, wrap a shop towel around the fuel pressure connection. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.

Place the fuel pressure gauge bleed hose in an approved gasoline container.
With the ignition switch “OFF," open the valve on the fuel pressure gauge.

3. Record the lowest voltage displayed by the DVM after the first second of the test. (During the first second, voltage displayed by the DVM may be inaccurate due to the initial current surge.)
   Injector Specifications:

Resistance Ohms	Voltage Specification at 10°C–35°C (50°F–95°F)
11.8 – 12.6	5.7 – 6.6

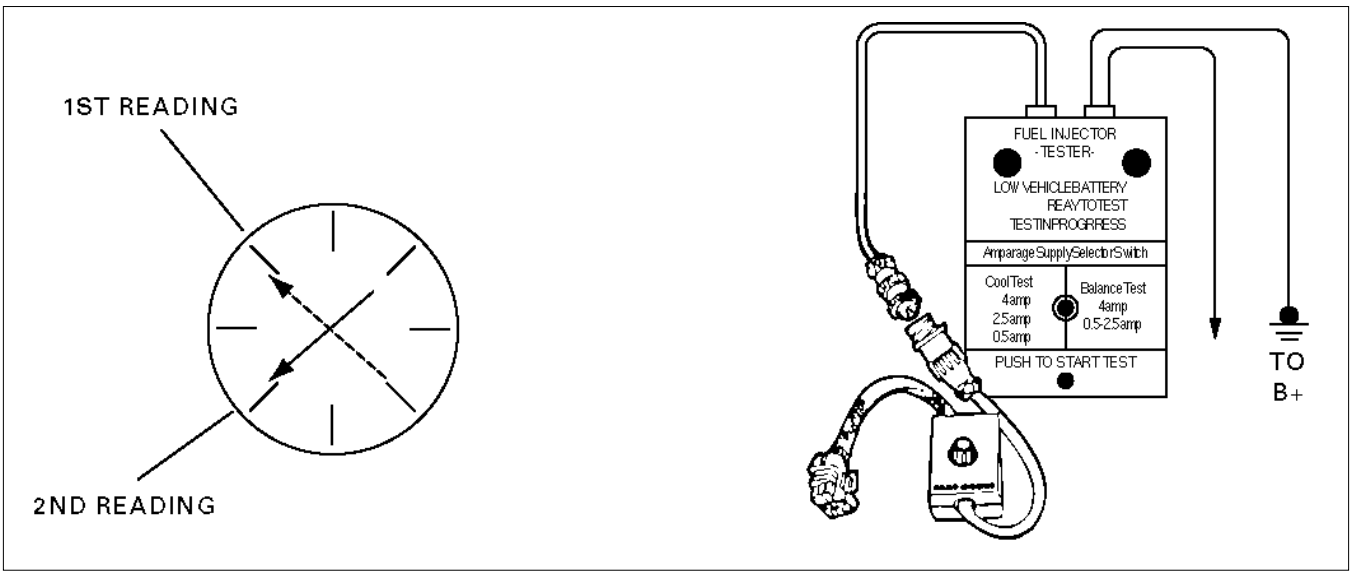
- The voltage displayed by the DVM should be within the specified range.
- The voltage displayed by the DVM may increase throughout the test as the fuel injector windings warm and the resistance of the fuel injector windings changes.
- An erratic voltage reading (large fluctuations in voltage that do not stabilize) indicates an intermittent connection within the fuel injector.

5. Injector Specifications:

Highest Acceptable Voltage Reading Above/Below 35°C/10°C (95°F/50°F)	Acceptable Subtracted Value
9.5 Volts	0.6 Volts

7. The Fuel Injector Balance Test portion of this chart (Step 7 through Step 11) checks the mechanical (fuel delivery) portion of the fuel injector. An engine cool-down period of 10 minutes is necessary in order to avoid irregular fuel pressure readings due to “Hot Soak" fuel boiling.

Injector Coil Test Procedure (Steps 1-6) and Injector Balance Test Procedure (Steps 7-11)



CYLINDER	1	2	3	4	5	6
1st Reading (1)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)
2nd Reading (2)	131 kPa (19 psi)	117 kPa (17 psi)	124 kPa (18 psi)	145 kPa (21 psi)	131 kPa (19 psi)	130 kPa (19 psi)
Amount of Drop (1st Reading–2nd Reading)	165 kPa (24 psi)	179 kPa (26 psi)	172 kPa (25 psi)	151 kPa (22 psi)	165 kPa (24 psi)	166 kPa (24 psi)
Av.drop = 166 kPa/24 psi ± 10 kPa/1.5 psi = 156- 176 kPa or 22.5- 25.5 psi	OK	Faulty, Rich (Too Much Fuel Drop)	OK	Faulty, Lean (Too Little Fuel Drop)	OK	OK

NOTE: These figures are examples only.

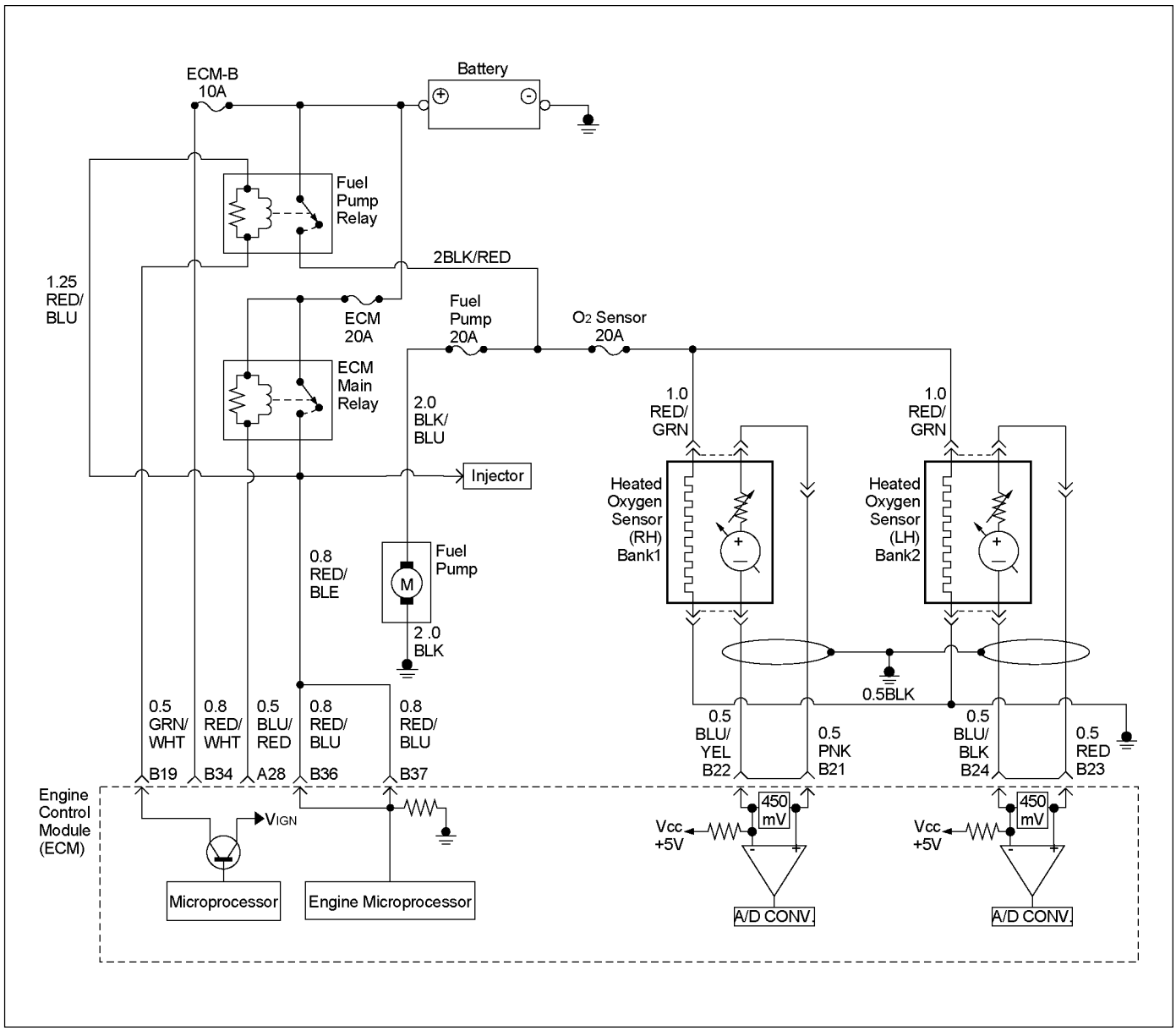
Injector Coil Test Procedure (Steps 1-6) and Injector Balance Test Procedure (Steps 7-11)

Step	Action	Value(s)	YES	NO
1	Was the “On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Turn the engine “OFF." In order to prevent flooding of a single cylinder and possible engine damage, relieve the fuel pressure before performing the fuel injector coil test procedure. 2. Relieve the fuel pressure. Refer to Test Description Number 2. 3. Connect the 5–8840–2618–0 Fuel Injector Tester to B+ and ground, and to the 5–8840–2635–0 Injector Switch Box. 4. Connect the injector switch box to the gray fuel injector harness connector located at the rear of the air cleaner assembly. 5. Set the amperage supply selector switch on the fuel injector tester to the “Coil Test" 0.5 amp position. 6. Connect the leads from the Digital Voltmeter (DVM) to the injector tester. Refer to the illustrations associated with the test description. 7. Set the DVM to the tenths scale (0.0). 8. Observe the engine coolant temperature. Is the engine coolant temperature within the specified values?	10°C (50°F) to 35°C (95°F)	Go to *Step 3*	Go to *Step 5*
3	1. Set injector switch box injector #1. 2. Press the “Push to Start Test" button on the fuel injector tester. 3. Observe the voltage reading on the DVM. **Important:** The voltage reading may rise during the test. 4. Record the lowest voltage observed after the first second of the test. 5. Set the injector switch box to the next injector and repeat steps 2, 3, and 4. Did any fuel injector have an erratic voltage reading (large fluctuations in voltage that did not stabilize) or a voltage reading outside of the specified values?	5.7-6.6 V	Go to *Step 4*	Go to *Step 7*
4	Replace the faulty fuel injector(s). Refer to *Fuel Injector.* Is the action complete?	—	Go to *Step 7*	—

Step	Action	Value(s)	YES	NO
5	1. Set injector switch box injector #1. 2. Press the “Push to Start Test" button on the fuel injector tester. 3. Observe the voltage reading on the DVM. **Important:** The voltage reading may rise during the test. 4. Record the lowest voltage observed after the first second of the test. 5. Set the injector switch box to the next injector and repeat steps 2, 3, and 4. Did any fuel injector have an erratic voltage reading (large fluctuations in voltage that did not stabilize) or a voltage reading above the specified value?	9.5 V	Go to *Step 4*	Go to *Step 6*
6	1. Identify the highest voltage reading recorded (other than those above 9.5 V). 2. Subtract the voltage reading of each injector from the highest voltage selected in step 1. Repeat until you have a subtracted value for each injector. For any injector, is the subtracted Value in step 2 greater than the specified value?	0.6 V	Go to *Step 4*	Go to *Step 7*
7	**CAUTION: In order to reduce the risk of fire and personal injury, wrap a shop towel around the fuel pressure connection. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.** 1. Connect the 5–8840–0378–0 Fuel Pressure Gauge to the fuel pressure test port. 2. Energize the fuel pump using the Tech 2. 3. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 4. Bleed the air out of the fuel pressure gauge. 5. With the fuel pump running, observe the reading on the fuel pressure gauge. Is the fuel pressure within the specified values?	296 kPa-376 kPa (43-55 psi)	Go to *Step 8*	Go to *Fuel System Diagnosis*
8	Turn the fuel pump “OFF." Does the fuel pressure remain constant?	—	Go to *Step 9*	Go to *Fuel System Diagnosis*

Step	Action	Value(s)	YES	NO
9	1. Connect the 5–8840–2618–0 Fuel Injector Tester and 5–8840–2635–0 Injector Switch Box the fuel injector harness connector. 2. Set the amperage supply selector switch on the fuel injector tester to the “Balance Test" 0.5-2.5 amp position. 3. Using the Tech 2 turn the fuel pump “ON" then “OFF" in order to pressurize the fuel system. 4. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure stabilizes. This is the first pressure reading. 5. Energize the fuel injector by depressing the “Push to Start Test" button on the fuel injector tester. 6. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure gauge needle has stopped moving. This is the second pressure reading. 7. Repeat steps 1 through 6 for each fuel injector. 8. Subtract the second pressure reading from the first pressure reading for one fuel injector. The result is the pressure drop value. 9. Obtain a pressure drop value for each fuel injector. 10. Add all of the individual pressure drop values. This is the total pressure drop. 11. Divide the total pressure drop by the number of fuel injectors. This is the average pressure drop. Does any fuel injector have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?	10 kPa (1.5 psi)	Go to *Step 10*	Go to *OBD System Check*
10	Re-test any fuel injector that does not meet the specification. Refer to the procedure in step 11. Do not repeat any portion of this test before running the engine in order to prevent the engine from flooding. Does any fuel injector still have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?	10 kPa (1.5 psi)	Go to *Step 11*	Go to *Symptoms*
11	Replace the faulty fuel injector(s). Refer to *Fuel Injector.* Is the action complete?	—	Verify repair	—

FUEL SYSTEM ELECTRICAL TEST



RTW36ELF000101

CIRCUIT DESCRIPTION

When the ignition switch is first turned “ON," the Engine Control Module (ECM) energizes the fuel pump relay which applies power to the in-tank fuel pump. The fuel pump relay will remain “ON" as long as the engine is running or cranking and the ECM is receiving 58X crankshaft position pulses. If no 58X crankshaft position pulses are present, the ECM de-energizes the fuel pump relay within 2 seconds after the ignition is turned “ON" or the engine is stopped.

The fuel pump delivers fuel to the fuel rail and injectors, then to the fuel pressure regulator. The fuel pressure regulator controls fuel pressure by allowing excess fuel to be returned to the fuel tank. With the engine stopped and ignition “ON," the fuel pump can be turned “ON" by using a command by the Tech 2.

DIAGNOSTIC AIDS

An intermittent may be caused by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check for the following items:

- Poor connection or damaged harness – Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

CAUTION: To reduce the risk of fire and personal injury:

- **It is necessary to relieve fuel system pressure before connecting a fuel pressure gauge. Refer to Fuel Pressure Relief Procedure, below.**
- **A small amount of fuel may be released when disconnecting the fuel lines. Cover fuel line fittings with a shop towel before disconnecting, to catch any fuel that may leak out. Place the towel in an approved container when the disconnect is completed.**

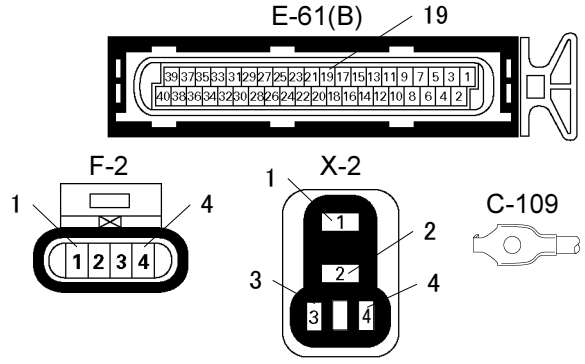
FUEL PRESSURE RELIEF PROCEDURE

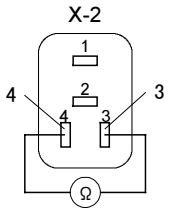
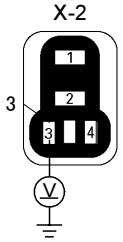
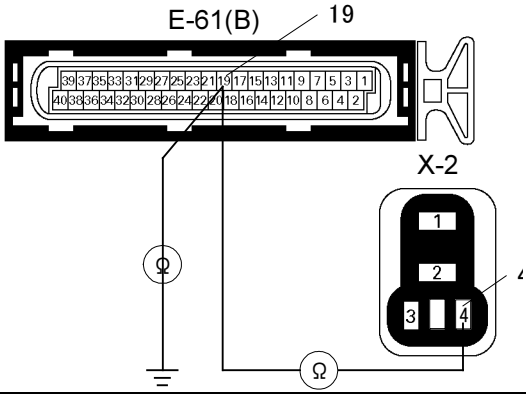
1. Remove the fuel cap.
2. Remove the fuel pump relay from the underhood relay center.
3. Start the engine and allow it to stall.
4. Crank the engine for an additional 3 seconds.

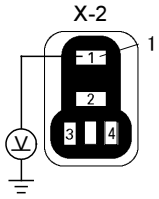
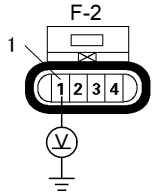
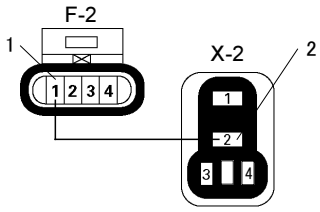
FUEL GAUGE INSTALLATION

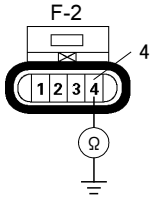
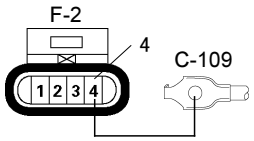
1. Remove the fuel pressure fitting cap.
2. Install fuel gauge 5-8840-0378-0 to the fuel feed line located in front of and above the right side valve cover.
3. Reinstall the fuel pump relay.

Fuel System Electrical Test

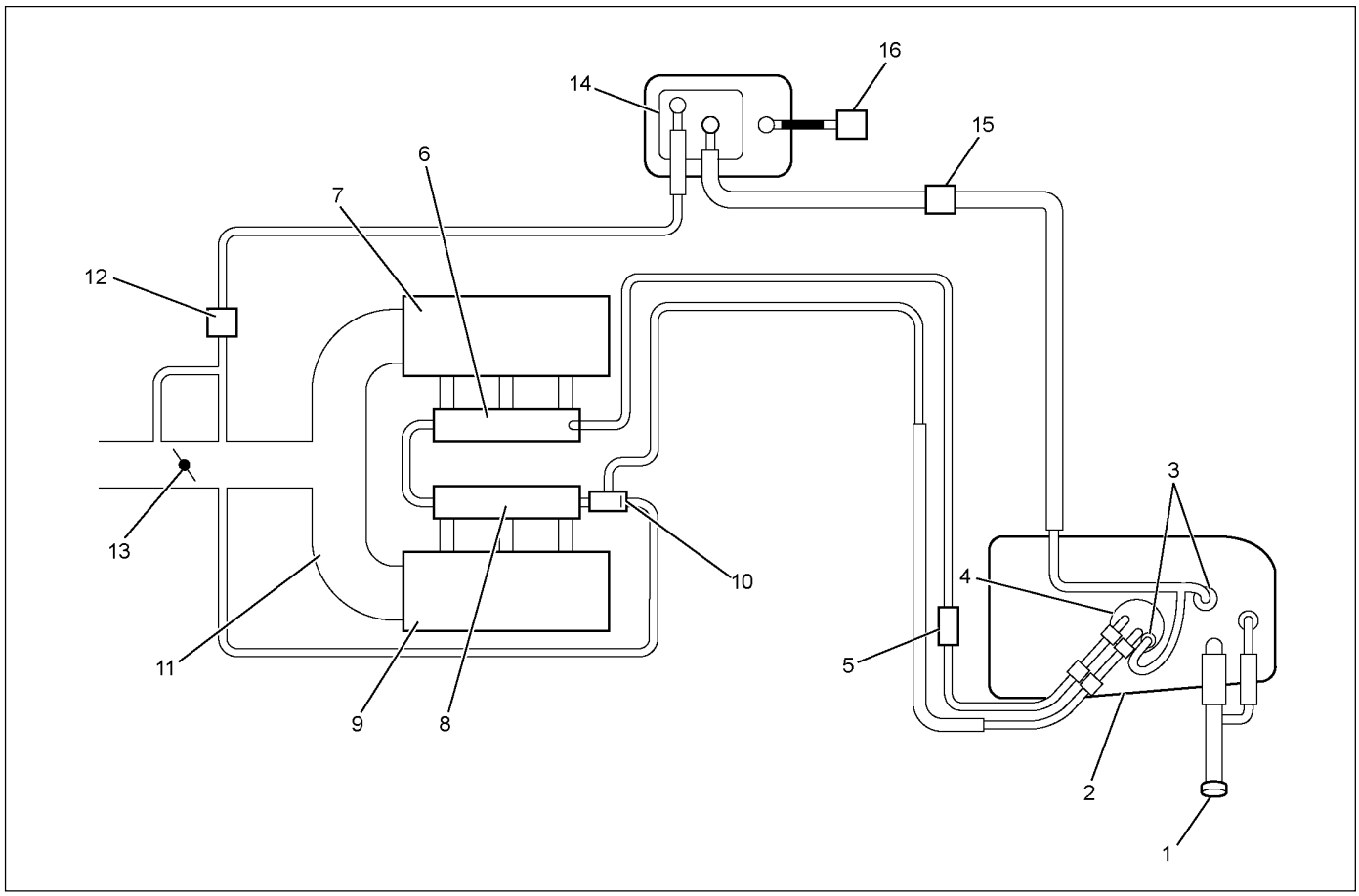
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Using the Tech 2, ignition "On" and engine "On". 2. Select the "Miscellaneous Test" and perform the "Fuel Pump Relay" in the "Relays". 3. Operate the Tech 2 in accordance with procedure. Was the fuel pump operated, when the Tech 2 is operated?	-	Test completed	Go to *Step 3*
3	Check the "Fuel Pump" fuse (20A). If the fuse is burnt out, repair as necessary. Was the problem found?	-	Verify repair	Go to *Step 4*
4	Check for poor/faulty connection at the fuel pump, fuel pump relay or ECM connector. If a poor/faulty connection is found, repair as necessary.  Was the problem found?	-	Verify repair	Go to *Step 5*

Step	Action	Value (s)	Yes	No
5	Using the DVM and check the fuel pump relay. 1. Ignition "Off", engine "Off". 2. Remove the fuel pump relay from the relay box. 3. Check the relay coil. Was the DVM indicated specified value? 	Approximately 140 Ω	Go to *Step 6*	Replace fuel pump relay and verify repair
6	Using the DVM and check the fuel pump relay power supply circuit. 1. Ignition "On", engine "Off". 2. Remove the fuel pump relay from the relay box. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	10 – 14.5V	Go to *Step 8*	Go to *Step 7*
7	Repair the open or short to ground circuit between the "ECM" fuse (15A) and fuel pump relay. Is the action complete?	-	Verify repair	-
8	Using the DVM and check the fuel pump relay ground circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the ECM connector. 3. Remove the fuel pump relay from the relay box. 4. Check the circuit for open or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 9*

Step	Action	Value (s)	Yes	No
9	Using the DVM and check the fuel pump relay power supply circuit. 1. Ignition "Off", engine "Off". 2. Remove the fuel pump relay from the relay box. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	10 – 14.5V	Go to *Step 11*	Go to *Step 10*
10	Repair the open circuit between the fuel pump relay and battery. Is the action complete?	-	Verify repair	-
11	Using the DVM and check the fuel pump power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the fuel pump connector. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	10 – 14.5V	Go to *Step 13*	Go to *Step 12*
12	Repair the open or short to ground circuit between the fuel pump relay and fuel pump. Is the action complete? 	-	Verify repair	-

Step	Action	Value (s)	Yes	No
13	Using the DVM and check the fuel pump ground circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the fuel pump connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	Continuity	Go to *Step 15*	Go to *Step 14*
14	Repair the open circuit between the fuel pump and body ground. Is the action complete? 	-	Verify repair	-
15	Replace the fuel pump. Was the problem solved?	-	Verify repair	Go to *Step 16*
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 17*
17	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

FUEL SYSTEM DIAGNOSIS



RTW36ELF000501

Legend

(1) Fuel Filler Cap
(2) Fuel Tank
(3) Rollover Valve
(4) Fuel Pump Assembly
(5) Fuel Filter
(6) Fuel Rail Right
(7) Intake Air Port Right Bank
(8) Fuel Rail Left
(9) Intake Air Port Left Bank
(10) Fuel Pressure Control Valve
(11) Common Chamber
(12) Duty Solenoid Valve
(13) Throttle Valve
(14) Canister
(15) Check Valve
(16) Air Separator

CIRCUIT DESCRIPTION

When the ignition switch is turned “ON," the Engine Control Module (ECM) will turn “ON" the in-tank fuel pump. The in-tank fuel pump will remain “ON" as long as the engine is cranking or running and the ECM is receiving 58X crankshaft position pulses. If there are no 58X crankshaft position pulses, the ECM will turn the in-tank fuel pump “OFF" 2 seconds after the ignition switch is turned “ON" or 2 seconds after the engine stops running.

The in-tank fuel pump is an electric pump within an integral reservoir. The in-tank fuel pump supplies fuel through an in-line fuel filter to the fuel rail assembly. The fuel pump is designed to provide fuel at a pressure above the pressure needed by the fuel injectors. A fuel pressure regulator, attached to the fuel rail, keeps the fuel available to the fuel injectors at a regulated pressure. Unused fuel is returned to the fuel tank by a separate fuel return line.

TEST DESCRIPTION

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. Connect the fuel pressure gauge to the fuel feed line as shown in the fuel system illustration. Wrap a shop towel around the fuel pressure connection in order to absorb any fuel leakage that may occur when installing the fuel pressure gauge. With the ignition switch “ON" and the fuel pump running, the fuel pressure indicated by the fuel pressure gauge should be 333-376 kPa (3.4-3.8 kg/cm^2 / 48-55 psi). This pressure is controlled by the amount of pressure the spring inside the fuel pressure regulator can provide.
3. A fuel system that cannot maintain a constant fuel pressure has a leak in one or more of the following areas:
   - The fuel pump check valve.
   - The fuel pump flex line.
   - The valve or valve seat within the fuel pressure regulator.
   - The fuel injector(s).
4. Fuel pressure that drops off during acceleration, cruise, or hard cornering may case a lean condition. A lean condition can cause a loss of power, surging, or misfire. A lean condition can be diagnosed using a Tech 1 Tech 2. If an extremely lean condition occurs, the oxygen sensor(s) will stop toggling. The oxygen sensor output voltage(s) will drop below 500 mV. Also, the fuel injector pulse width will increase.

Important: Make sure the fuel system is not operating in the “Fuel Cut-Off Mode."

When the engine is at idle, the manifold pressure is low (high vacuum). This low pressure (high vacuum) is applied to the fuel pressure regulator diaphragm. The low pressure (high vacuum) will offset the pressure being applied to the fuel pressure regulator diaphragm by the spring inside the fuel pressure regulator. When this happens, the result is lower fuel pressure. The fuel pressure at idle will vary slightly as the barometric pressure changes, but the fuel pressure at idle should always be less than the fuel pressure noted in step 2 with the engine “OFF."

16. Check the spark plug associated with a particular fuel injector for fouling or saturation in order to determine if that particular fuel injector is leaking. If checking the spark plug associated with a particular fuel injector for fouling or saturation does not determine that a particular fuel injector is leaking, use the following procedure:
    - Remove the fuel rail, but leave the fuel lines and injectors connected to the fuel rail. Refer to *Fuel Rail Assembly* in *On-Vehicle Service*.
    - Lift the fuel rail just enough to leave the fuel injector nozzles in the fuel injector ports.

CAUTION: In order to reduce the risk of fire and personal injury that may result from fuel spraying on the engine, verify that the fuel rail is positioned over the fuel injector ports and verify that the fuel injector retaining clips are intact.

- **Pressurize the fuel system by connecting a 10 amp fused jumper between B+ and the fuel pump relay connector.**
- **Visually and physically inspect the fuel injector nozzles for leaks.**

17. A rich condition may result from the fuel pressure being above 376 kPa (55 psi). A rich condition may cause a DTC P0132 or a DTC P0172 to set. Driveability conditions associated with rich conditions can include hard starting (followed by black smoke) and a strong sulfur smell in the exhaust.
20. This test determines if the high fuel pressure is due to a restricted fuel return line or if the high fuel pressure is due to a faulty fuel pressure regulator.
21. A lean condition may result from fuel pressure below 333 kPa (48 psi). A lean condition may cause a DTC P0131 or a DTC P0171 to set. Driveability conditions associated with lean conditions can include hard starting (when the engine is cold), hesitation, poor driveability, lack of power, surging , and misfiring.

22. Restricting the fuel return line causes the fuel pressure to rise above the regulated fuel pressure. Command the fuel pump “ON" with the Tech 2. The fuel pressure should rise above 376 kPa (55 psi) as the fuel return line becomes partially closed.

NOTE: Do not allow the fuel pressure to exceed 414 kPa (60 psi). Fuel pressure in excess of 414 kPa (60 psi) may damage the fuel pressure regulator.

CAUTION: To reduce the risk of fire and personal injury:

- **It is necessary to relieve fuel system pressure before connecting a fuel pressure gauge. Refer to Fuel Pressure Relief Procedure, below.**
- **A small amount of fuel may be released when disconnecting the fuel lines. Cover fuel line fittings with a shop towel before disconnecting, to catch any fuel that may leak out. Place the towel in an approved container when the disconnect is completed.**

FUEL PRESSURE RELIEF PROCEDURE

1. Remove the fuel cap.
2. Remove the fuel pump relay from the underhood relay center.
3. Start the engine and allow it to stall.
4. Crank the engine for an additional 3 seconds.

FUEL GAUGE INSTALLATION

1. Remove the fuel pressure fitting cap.
2. Install fuel gauge 5-8840-0378-0 to the fuel supply line located in front of and above the right side valve cover.
3. Reinstall the fuel pump relay.

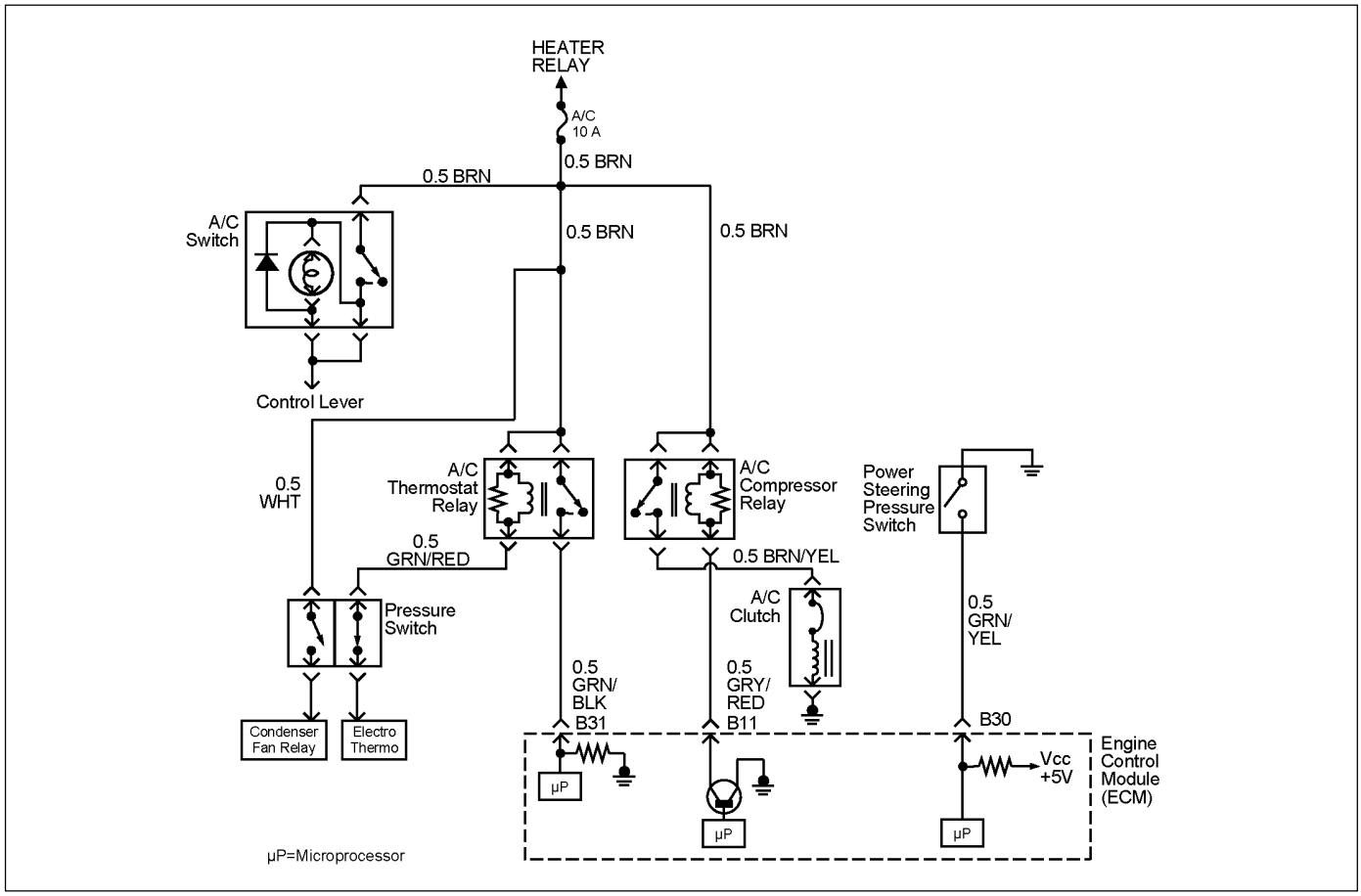
Fuel System Diagnosis

Step	Action	Value(s)	YES	NO
1	Was the “On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Turn the ignition “OFF." 2. Turn the air conditioning system “OFF." 3. Relieve fuel system pressure and install the fuel pressure gauge. Refer to 6E-118 FUEL GAUGE INSTALLATION 4. Turn the ignition “ON." **NOTE: The fuel pump will run for approximately 2 seconds. Use the Tech 2 to command the fuel pump “ON".** 5. Observe the fuel pressure indicated by the fuel pressure gauge with the fuel pump running. Is the fuel pressure within the specified limits?	290-376 kPa (42-55 psi)	Go to *Step 3*	Go to *Step 17*
3	The fuel pressure will drop when the fuel pump stops running, then it should stabilize and remain constant. Does the fuel pressure indicated by the fuel pressure gauge remain constant?	—	Go to *Step 4*	Go to *Step 12*
4	1. When the vehicle is at normal operation temperature, turn the ignition “ON" to build fuel pressure and observe the measurement on the gauge. 2. Start the engine and observe the fuel pressure gauge. Did the reading drop by the amount specified after the engine was started?	21-105 kPa (3-15 psi)	Go to *Step 5*	Go to *Step 9*
5	Is fuel pressure dropping off during acceleration, cruise, or hard cornering?	—	Go to *Step 6*	Check for improper fuel
6	Visually and physically inspect the following items for a restriction: • The in-line fuel filter. • The fuel feed line. Was a restriction found?	—	Verify repair	Go to *Step 7*
7	Remove the fuel tank and visually and physically inspect the following items: • The fuel pump strainer for a restriction. • The fuel line for a leak. • Verify that the correct fuel pump is in the vehicle. Was a problem found in any of these areas?	—	Verify repair	Go to *Step 8*

Step	Action	Value(s)	YES	NO
8	Replace the fuel pump. Is the action complete?	—	Verify repair	—
9	1. Disconnect the vacuum hose from the fuel pressure regulator. 2. With the engine idling, apply 12-14 inches of vacuum to the fuel pressure regulator. Does the fuel pressure indicated by the fuel pressure gauge drop by the amount specified?	21-105 kPa (3-15 psi)	Go to *Step 10*	Go to *Step 11*
10	Locate and repair the loss of vacuum to the fuel pressure regulator. Is the action complete?	—	Verify repair	—
11	Replace the fuel pressure regulator. Is the action complete?	—	Verify repair	—
12	1. Run the fuel pump with the Tech 2. 2. After pressure has built up, turn off the pump and clamp the supply hose shut with suitable locking pliers. Does the fuel pressure indicated by the fuel pressure gauge remain constant?	—	Go to *Step 13*	Go to *Step 15*
13	Visually inspect the fuel supply line and repair any leaks. Was a problem found?	—	Verify repair	Go to *Step 14*
14	Remove the fuel tank and inspect for leaky hose or in-tank fuel line. Was a problem found?	—	Verify repair	Go to *Step 8*
15	1. If the pliers are still clamped to the fuel supply hose, remove the locking pliers. 2. With suitable locking pliers, clamp the fuel return line to prevent fuel from returning to the fuel tank. 3. Run the fuel pump with the Tech 2. 4. After pressure has built up, remove power to the pump. Does the fuel pressure indicated by the fuel pressure gauge remain constant?	—	Go to *Step 11*	Go to *Step 16*
16	Locate and replace any leaking fuel injector(s). Is the action complete?	—	Verify repair	—
17	Is the fuel pressure indicated by the fuel pressure gauge above the specified limit?	376 kPa (55 psi)	Go to *Step 18*	Go to *Step 21*

Step	Action	Value(s)	YES	NO
18	1. Relieve the fuel pressure. Refer to the *Fuel Pressure Relief.* 2. Disconnect the fuel return line from the fuel rail. 3. Attach a length of flexible hose to the fuel rail return outlet passage. 4. Place the open end of the flexible hose into an approved gasoline container. 5. Run the fuel pump with the Tech 2. 6. Observe the fuel pressure indicated by the fuel pressure gauge with the fuel pump running. Is the fuel pressure within the specified limits?	290-376 kPa (42-55 psi)	Go to *Step 19*	Go to *Step 20*
19	Locate and correct the restriction in the fuel return line. Is the action complete?	—	Verify repair	—
20	Visually and physically inspect the fuel rail outlet passages for a restriction. Was a restriction found?	—	Verify repair	Go to *Step 11*
21	Is the fuel pressure indicated by the fuel pressure gauge above the specified value?	0 kPa (0 psi)	Go to *Step 22*	Go to *Step 23*
22	1. Command the fuel pump “ON" with the Tech 2. 2. Using suitable pliers which will not damage the fuel hose, gradually apply pressure with the pliers to pinch the flexible fuel return hose closed. **CAUTION: Do not let the fuel pressure exceed the second specified value.** Does the fuel pressure indicated by the fuel pressure gauge rise above the first specified value?	376 kPa (55 psi). 414 kPa (60 psi).	Go to *Step 11*	Go to *Step 7*
23	1. Command the fuel pump “ON" with the Tech 2. 2. Remove the fuel filler cap and listen for the sound of the fuel pump running. 3. Turn the pump off. Was the fuel pump running?	—	Go to *Step 7*	Go to *Fuel System Electrical Test Chart*

A/C SYSTEM CIRCUIT DIAGNOSIS



RTW36EMF000101

CIRCUIT DESCRIPTION

When air conditioning and blower fan are selected, and if the system has a sufficient refrigerant charge, a 12-volt signal is supplied to the A/C request input of the Engine Control Module (ECM). The A/C request signal may be temporarily canceled during system operation by the electronic thermostat in the evaporator case. The electronic thermostat may intermittently remove the control circuit ground for the A/C thermostat relay to prevent the evaporator from forming ice. When the A/C request signal is received by the ECM, the ECM supplies a ground from the compressor clutch relay if the engine operating conditions are within acceptable ranges. With the A/C compressor relay energized, voltage is supplied to the compressor clutch coil.

The ECM will enable the compressor clutch to engage whenever A/C has been selected with the engine running, unless any of the following conditions are present:

- The A/C request switch is "Off".
- The engine speed is lower than 550rpm or greater than 6375rpm.
- The engine coolant temperature is greater than 120℃.

DIAGNOSTIC AIDS

To diagnose an the intermittent fault, check for the following conditions:

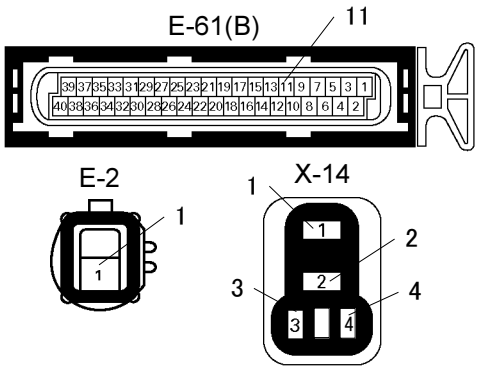
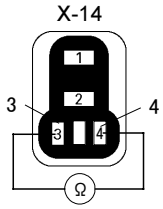
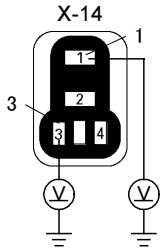
- Poor connection at the ECM–Inspect connections for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness–Inspect the wiring harness for damage. If the harness appears to OK, observe the A/C clutch while moving connectors and wiring harnesses related to the A/C. A sudden clutch malfunction will indicate the source of the intermittent fault.

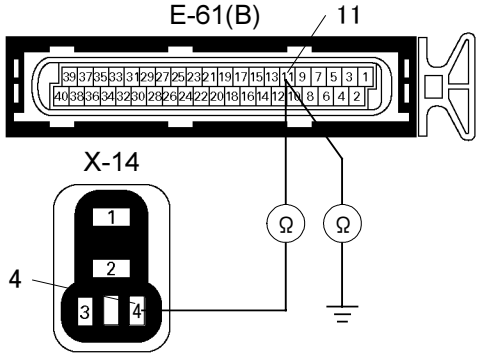
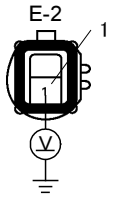
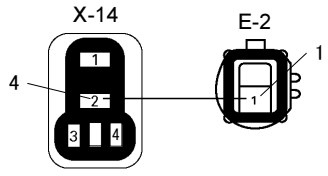
A/C CLUTCH DIAGNOSIS

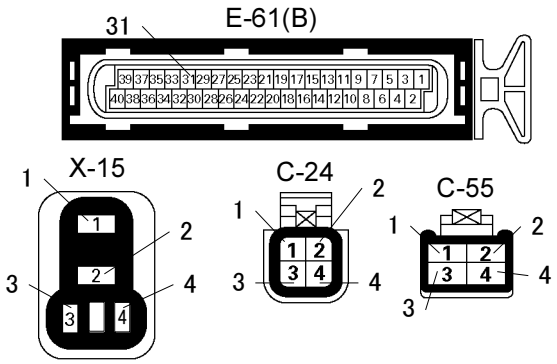
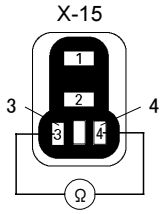
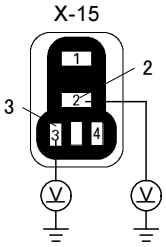
This chart should be used for diagnosing the electrical portion of the A/C compressor clutch circuit. A Tech 2 will be used in diagnosing the system. The Tech 2 has the ability to read the A/C request input to the ECM. The Tech 2 can display when the ECM has commanded the A/C clutch “ON." The Tech 2 should have the ability to override the A/C request signal and energize the A/C compressor relay.

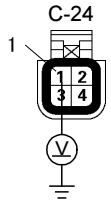
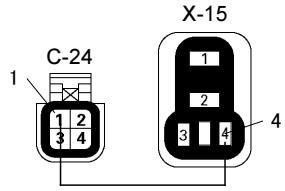
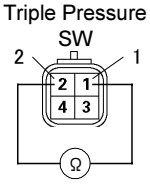
A/C Clutch Control Circuit Diagnosis

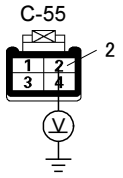
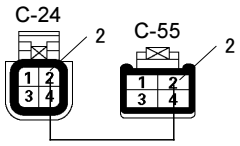
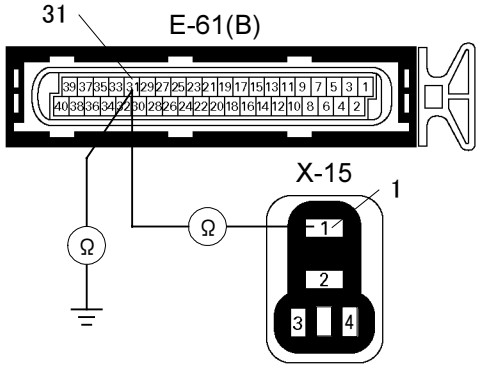
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	Are the A/C setting conditions met?	-	Go to *Step 3*	Set the setting condition and Go to *Step 3*
3	Is the A/C compressor worked properly?	-	Diagnosis completed	Go to *Step 4*
4	Does the blower motor operate?	-	Go to *Step 6*	Go to *Step 5*
5	Repair the blower motor circuit. Is the action complete?	-	Verify repair	-
6	1. Using the Tech 2, ignition "On" and engine "On". 2. Select the "Miscellaneous Test" and perform the "A/C Clutch Relay" in the "Relays". 3. Operate the Tech 2 in accordance with procedure. Was the A/C compressor magnet clutch engaged, when the Tech 2 is operated?	-	Go to *Step 15*	Go to *Step 7*
7	Check the "A/C" fuse (10A). If the fuse is burnt out, repair as necessary. Was the problem found?	-	Verify repair	Go to *Step 8*

Step	Action	Value (s)	Yes	No
8	Check for poor/faulty connection at the A/C compressor, A/C compressor relay or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 9*
9	Using the DVM and check the A/C compressor relay. 1. Ignition "Off", engine "Off". 2. Remove the A/C compressor relay from the relay box. 3. Check the relay coil. Was the DVM indicated specified value? 	Approximately 140 Ω	Go to *Step 10*	Replace A/C compressor relay and verify repair
10	Using the DVM and check the A/C compressor relay power supply circuit. 1. Ignition "On", engine "Off". 2. Remove the A/C compressor relay from the relay box. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	10 – 14.5V	Go to *Step 12*	Go to *Step 11*
11	Repair the open or short to ground circuit between the "A/C" fuse (10A) and A/C compressor relay. Is the action complete?	-	Verify repair	-

Step	Action	Value (s)	Yes	No
12	Using the DVM and check the A/C compressor relay ground circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the ECM connector. 3. Remove the A/C compressor relay from the relay box. 4. Check the circuit for open or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 13*
13	Using the DVM and check the A/C magnet clutch power supply circuit. 1. Using the Tech 2, ignition "On" and engine "Off". 2. Select the "Miscellaneous Test" and perform the "A/C Clutch Relay" in the "Relays". 3. Operate the Tech 2 in accordance with procedure. 4. Disconnect the A/C clutch connector. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	10 – 14.5V	Go to *Step 27*	Go to *Step 14*
14	Repair the open or short to ground circuit between the A/C compressor relay and A/C magnet clutch. Is the action complete? 	-	Verify repair	-

Step	Action	Value (s)	Yes	No
15	Check for poor/faulty connection at the thermo relay, triple pressure switch, thermostat or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 16*
16	Using the DVM and check the thermo relay. 1. Ignition "Off", engine "Off". 2. Remove the thermo relay from the relay box. 3. Check the relay coil. Was the DVM indicated specified value? 	Approximately 140 Ω	Go to *Step 17*	Replace thermo relay and verify repair
17	Using the DVM and check the thermo relay power supply circuit. 1. Ignition "On", engine "Off". 2. Remove the thermo relay from the relay box. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	10 – 14.5V	Go to *Step 19*	Go to *Step 18*
18	Repair the open or short to ground circuit between the "A/C" fuse (10A) and thermo relay. Is the action complete?	-	Verify repair	-

Step	Action	Value (s)	Yes	No
19	Using the DVM and check the triple pressure switch circuit. 1. Ignition "On", engine "Off". 2. Turn "On" blower motor. 3. Disconnect the triple pressure switch connector. 4. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	10 – 14.5V	Go to *Step 21*	Go to *Step 20*
20	Repair the open or short to ground circuit between the thermo relay and triple pressure switch. Is the action complete? 	-	Verify repair	-
21	Using the DVM and check the triple pressure switch. 1. Ignition "Off", engine "Off". 2. Disconnect the triple pressure switch connector. 3. Check the switch. Was the switch closed? 	-	Go to *Step 23*	Go to *Step 22*
22	Replace the triple pressure switch. Is the action complete?	-	Verify repair	-

Step	Action	Value (s)	Yes	No
23	Using the DVM and check the thermostat circuit. 1. Ignition "On", engine "Off". 2. Turn "On" blower motor. 3. Disconnect the triple pressure switch connector. 4. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	10 – 14.5V	Go to *Step 25*	Go to *Step 24*
24	Repair the open or short to ground circuit between the triple pressure switch and thermostat. Is the action complete? 	-	Verify repair	-
25	Replace the thermostat. Is the action complete?	-	Verify repair	-
26	Using the DVM and check the thermo relay input circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the ECM connector. 3. Remove the thermo relay from the relay box. 4. Check the circuit for open or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 28*
27	Replace the A/C compressor. Was the problem solved?	-	Verify repair	-

Step	Action	Value (s)	Yes	No
28	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 29*
29	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

ECM DIAGNOSTIC TROUBLE CODES (DTC)

DTC Type A

- Emission related.
- Requests illumination of the MIL (Malfunction Indicator Lamp = Check Engine Lamp) of the first trip with a fail.
- Stores a history DTC on the first trip with a fail.
- Stores a freeze frame (If empty).
- Stores a fail record.
- Updates the fail record each time the diagnostic test fails.

DTC Type B

- Emission related.
- "Armed" after one trip with fail.
- "Disarmed" after one trip with a pass.
- Requests illumination of the MIL on the second consecutive trip with a fail.
- Store a history DTC on the second consecutive trip with a fail. (The DTC will be armed after the first fail.)
- Stores a freeze frame on the second consecutive trip with a fail (If empty).
- Stores a fail record when the first test fails (not dependent on consecutive trip).
- Updates the fail record each time the diagnostic test fails.

DTC Type D

- Non emission related.
- Does not request illumination of any lamp.
- Stores a history DTC on the first trip with a fail.
- Does not store a freeze frame.
- Stores fail record when test fails.
- Updates the fail record each time the diagnostic test fails.

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
61	P0101	B	Mass Air Flow Sensor Circuit Range/Performance	1. No DTC relating to barometer sensor, TPS, CMP sensor, CKP sensor and MAF sensor (low input & high input). 2. Engine speed is between 2800rpm and 4500rpm. 3. Throttle position sensor output voltage is between 1V and 3V. 4. Intake air temperature is between -14°C and 70°C. 5. Air flow amount below 0.04g/s (small air) or more than 177g/s (large air). Above conditions are met for 3 seconds.	No fail-safe function.	Air flow amount is more than 0.04g/s or below 177g/s.	1. Air intake is obstructed. 2. Sensor signal circuit short to voltage circuit. 3. MAF sensor malfunction. 4. Electrical interference. 5. ECM malfunction.	B20/ B39	-
	P0102	A	Mass Air Flow Sensor Circuit Low Input	MAF sensor output voltage is below 0.3V.	The ECM uses default mass air flow value based on IAC valve position, throttle position, barometer pressure and engine speed.	MAF sensor output voltage is more than 0.3V.	1. Sensor power supply circuit open circuit. 2. Sensor signal circuit open or short to ground circuit. 3. Poor connector connection. 4. MAF sensor malfunction. 5. ECM malfunction.	B20	-
	P0103	A	Mass Air Flow Sensor Circuit High Input	MAF sensor output voltage is more than 4.9V.		MAF sensor output voltage is below 4.9V.	1. Sensor signal circuit short to voltage circuit. 2. Sensor ground circuit open or short to voltage circuit. 3. MAF sensor malfunction. 4. ECM malfunction.	B20/ B39	P0113/ P0123/ P0341/ P0342
23	P0112	A	Intake Air Temperature Sensor Low Input	IAT sensor output voltage is below 0.08V.	The ECM use 40°C conditions as substitute.	IAT sensor output voltage is more than 0.08V.	1. Sensor signal circuit short to ground circuit. 2. IAT sensor malfunction. 3. ECM malfunction.	A19	-
	P0113	A	Intake Air Temperature Sensor High Input	IAT sensor output voltage is more than 4.9V.		IAT sensor output voltage is below 4.9V.	1. Sensor signal circuit open or short to voltage circuit. 2. Sensor ground circuit open or short to voltage circuit. 3. Poor connector connection 4. IAT sensor malfunction. 5. ECM malfunction.	A19/ B39	P0103/ P0123/ P0341/ P0342

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
14	P0117	A	Engine Coolant Temperature Sensor Low Input	ECT sensor output voltage is below 0.08V.	The ECM uses default engine coolant temperature value based on start-up ECT and time from start.	ECT sensor output voltage is more than 0.08V.	1. Sensor signal circuit short to ground circuit. 2. ECT sensor malfunction. 3. ECM malfunction.	A21	-
	P0118	A	Engine Coolant Temperature Sensor High Input	ECT sensor output voltage is more than 4.8V.		ECT sensor output voltage is below 4.8V.	1. Sensor signal circuit open or short to voltage circuit. 2. Sensor ground circuit open or short to voltage circuit. 3. Poor connector connection 4. ECT sensor malfunction. 5. ECM malfunction.	A21/ A22	P0406
21	P0121	A	Throttle Position Sensor Range/Performance	1. No DTC relating to barometer sensor, ECT sensor, CMP sensor, CKP sensor, MAF sensor and TPS (low input & high input). 2. Engine speed is more than 2000rpm. 3. Engine coolant temperature is more than 75°C. 4. TPS output voltage is between 0.24V and 0.26V. Above conditions are met for 3 seconds. OR 1. No DTC relating to barometer sensor, ECT sensor, CMP sensor, CKP sensor, MAF sensor and TPS (low input & high input). 2. Engine speed is below 3200rpm. 3. Engine coolant temperature is more than 75°C. 4. TPS output voltage is between 4.54V and 4.56V. Above conditions are met for 3 seconds.	No fail-safe function.	TPS output voltage is below 0.24V or more than 0.26V. OR TPS output voltage is below 4.54V or more than 4.56V.	1. TPS malfunction. 2. Sensor signal circuit short to voltage circuit. 3. Electrical interference. 4. ECM malfunction.	B27/ B26/ B39	-
	P0122	A	Throttle Position Sensor Low Input	TPS output voltage is below 0.24V.	The ECM uses default throttle position value based on mass air flow and engine speed.	TPS output voltage is more than 0.24V.	1. Sensor power supply circuit open or short to ground circuit. 2. Sensor signal circuit open or short to ground circuit. 3. Poor connector connection. 4. TPS malfunction. 5. ECM malfunction.	B27/ B26	P0336/ P0337 or P0342
	P0123	A	Throttle Position Sensor High Input	TPS output voltage is more than 4.56V.		TPS output voltage is below 4.56V.	1. Sensor power supply circuit short to voltage circuit. 2. Sensor signal circuit short to voltage circuit. 3. Sensor ground circuit open or short to voltage circuit. 4. Poor connector connection. 5. TPS malfunction. 6. ECM malfunction.	B27/ B26/ B39	P0103/ P0113/ P0341/ P0342

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
15	P0131	A	O2 Sensor Circuit Low Voltage (Bank 1 Sensor 1)	1. No DTC relating to ECT sensor, CMP sensor, CKP sensor, VSS, injector control circuit, ignition control circuit and O2 sensor circuit no activity (bank 1 & 2). 2. Engine speed is between 1000rpm and 4000rpm. 3. Engine coolant temperature is between 70°C and 110°C. 4. Vehicle speed is between 0km/h and 120km/h. 5. Engine load is between 80% and 160%. 6. Throttle position fluctuation is below 0.28V. 7. O2 sensor bank 1 or bank 2 output voltage is more than 400mV for 50 seconds.	"Open Loop" fuel control.	O2 sensor bank 1 or bank 2 output voltage is below 400mV for 50 seconds.	1. Sensor harness open or short to ground circuit. 2. O2 sensor malfunction. 3. MAF sensor output is incorrect. 4. Air intake line malfunction. 5. IAC valve malfunction. 6. Low fuel pressure. 7. Injector malfunction. 8. ECM malfunction.	B21/ B22	P0171/ P1171/ P1172
	P0151	A	O2 Sensor Circuit Low Voltage (Bank 2 Sensor 1)					B23/ B24	P0174/ P1171/ P1172
	P0132	A	O2 Sensor Circuit High Voltage (Bank 1 Sensor 1)	1. No DTC relating to ECT sensor, CMP sensor, CKP sensor, VSS, injector control circuit, ignition control circuit and O2 sensor circuit no activity (bank 1 & 2). 2. Engine speed is between 1000rpm and 4000rpm. 3. Engine coolant temperature is between 70°C and 110°C. 4. Vehicle speed is between 0km/h and 120km/h. 5. Engine load is between 80% and 160%. 6. Throttle position fluctuation is below 0.28V. 7. O2 sensor bank 1 or bank 2 output voltage is below 600mV for 50 seconds.	"Open Loop" fuel control.	O2 sensor bank 1 or bank 2 output voltage is more than 600mV for 50 seconds.	1. Sensor harness open or short to ground circuit. 2. O2 sensor malfunction. 3. MAF sensor output is incorrect. 4. Air intake line malfunction. 5. AC valve malfunction. 6. Low fuel pressure. 7. Injector malfunction. 8. EVAP purge solenoid valve malfunction. 9. Ignition system malfunction. 10. Spark plug malfunction. 11. ECM malfunction.	B21/ B22	P0172
	P0152	A	O2 Sensor Circuit High Voltage (Bank 2 Sensor 1)					B23/ B24	P0175
	P0134	A	O2 Sensor Circuit No Activity Detected (Bank 1 Sensor 1)	1.No DTC relating to MAF sensor, ECT sensor, CMP sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 70°C. 3. Vehicle speed is more than 60km/h. 4. O2 sensor bank 1 or bank 2 output voltage is between 350mV and 600mV.	"Open Loop" fuel control.	O2 sensor bank 1 or bank 2 output voltage is below 0.35mV consecutively. OR O2 sensor bank 1 or bank 2 output voltage is more than 600mV consecutively.	1. O2 sensor malfunction. 2. ECM malfunction.	B21/ B22	-
	P0154	A	O2 Sensor Circuit No Activity Detected (Bank 2 Sensor 1)					B23/ B24	-

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
44	P0171	B	O2 Sensor System Too Lean (Bank 1)	1. No DTC relating to MAF sensor, IAT sensor, ECT sensor, TPS, CMP sensor, CKP sensor, VSS, injector control circuit, ignition control circuit, O2 sensor circuit low voltage & high voltage (bank 1 & 2) and O2 sensor circuit no activity (bank 1 & 2). 2. Engine speed is more than 600rpm. 3. Intake air temperature is more than 50°C. 4. Engine coolant temperature is between 35°C and 120°C. 5. Engine load is more than 20. 6. EVAP purge solenoid valve on-duty is below 100%. 7. Air-fuel ratio correction volume is more than 150% for 20 seconds.	No fail-safe function.	Air fuel ratio correction volume is between 50% and 150% for 5 seconds.	1. Sensor harness open or short to ground circuit. 2. O2 sensor malfunction. 3. MAF sensor output is incorrect. 4. Air intake line malfunction. 5. IAC valve malfunction. 6. Low fuel pressure. 7. Injector malfunction. 8. ECM malfunction.	-	-
	P0174	B	O2 Sensor System Too Lean (Bank 2)					-	-
45	P0172	B	O2 Sensor System Too Rich (Bank 1)	1. No DTC relating to MAF sensor, IAT sensor, ECT sensor, TPS, CMP sensor, CKP sensor, VSS, injector control circuit, ignition control circuit, O2 sensor circuit low voltage & high voltage (bank 1 & 2) and O2 sensor circuit no activity (bank 1 & 2). 2. Engine speed is more than 600rpm. 3. Intake air temperature is more than 50°C. 4. Engine coolant temperature is between 35°C and 120°C. 5. Engine load is more than 20. 6. EVAP purge solenoid valve on-duty is below 100%. 7. Air-fuel ratio correction volume is below 50% for 20 seconds.	No fail-safe function.	Air fuel ratio correction volume is between 50% and 150% for 5 seconds.	1. Sensor harness open or short to ground circuit. 2. O2 sensor malfunction. 3. MAF sensor output is incorrect. 4. Air intake line malfunction. 5. AC valve malfunction. 6. Low fuel pressure. 7. Injector malfunction. 8. EVAP purge solenoid valve malfunction. 9. Ignition system malfunction. 10. Spark plug malfunction. 11. ECM malfunction.	-	-
	P0175	B	O2 Sensor System Too Rich (Bank 2)					-	-

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
44	P1171	D	Fuel Supply System Lean During Power Enrichment (Bank 1)	1. No DTC relating to MAF sensor, IAT sensor, ECT sensor, TPS, CMP sensor, CKP sensor, VSS, injector control circuit, ignition control circuit, O2 sensor circuit low voltage & high voltage (bank 1 & 2) and O2 sensor circuit no activity (bank 1 & 2). 2. Engine speed is between 1000rpm and 6000rpm. 3. Intake air temperature is below 70°C. 4. Engine coolant temperature is between 30°C and 120°C. 5. Engine load is between 150 and 255. 6. Throttle position output is more than 2.22V and fluctuation is below 0.28V. 7. Except fuel cut operation. 8. O2 sensor output voltage below 250mV for 10 seconds.	No fail-safe function.	O2 sensor output voltage is more than 520mV for 5 seconds.	1. Sensor harness open or short to ground circuit. 2. O2 sensor malfunction. 3. MAF sensor output is incorrect. 4. Air intake line malfunction. 5. IAC valve malfunction. 6. Low fuel pressure. 7. Injector malfunction. 8. ECM malfunction.	B21/ B22/	-
	P1172	D	Fuel Supply System Lean During Power Enrichment (Bank 2)					B23/ B24	-
31	P0201	A	Injector 1 Control Circuit	1. No DTC relating to CMP sensor and CKP sensor. 2. Under sequential injection. 3. Injection pulse is between 2.5ms and 7.5 ms. 4. Except fuel cut operation. 5. Engine speed is between 600rpm and 2000rpm. 6. 30 injection signals are not detected consecutively.	No fail-safe function.	30 injection signals are detected consecutively.	1. Injector harness open circuit, short to ground or short to voltage. 2. Injector malfunction. 3. ECM malfunction.	A36	-
	P0202	A	Injector 2 Control Circuit					B3	-
	P0203	A	Injector 3 Control Circuit					A35	-
	P0204	A	Injector 4 Control Circuit					B4	-
	P0205	A	Injector 5 Control Circuit					A34	-
	P0206	A	Injector 6 Control Circuit					B5	-

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
29	P0336	B	Crankshaft Position Sensor Circuit Range/Performance (58X)	1. No DTC relating to CMP sensor. 2. Engine speed is below 2000rpm. 3. Extra or missing pulse is detected consecutively.	No fail-safe function.	Correct pulse is detected consecutively.	1. CKP sensor harness open circuit, short to ground or short to voltage. 2. Poor connector connection. 3. CKP sensor malfunction. 4. Pulse sensing gap incorrect. 5. Electrical interference. 6. Magnetic interference. 7. ECM malfunction.	A23/ A24/ A25	P0122/ P0337
	P0337	B	Crankshaft Position Sensor Circuit No Signal (58X)	1. No DTC relating to CKP sensor. 2. Engine speed is below 2000rpm. 3. Incorrect pulse is detected consecutively.			1. CKP sensor harness open circuit, short to ground or short to voltage. 2. CMP sensor signal circuit short to ground circuit. 3. TPS & CMP sensor power supply circuit short to ground. 4. Poor connector connection. 5. CKP sensor malfunction. 6. Pulse sensing gap incorrect. 7. Electrical interference. 8. Magnetic interference. 9. ECM malfunction.	A23/ A24/ A25	P0112/ P0336
41	P0341	B	Camshaft Position Sensor Circuit Range/Performance	1. Engine speed below 2000rpm. 2. No crankshaft position sensor DTC P0336 or P0337. 3. Incorrect pulse is detected consecutively.	Fuel cut is operated at high engine speed.	Correct pulse is detected consecutively.	1. CMP sensor harness open circuit, short to ground or short to voltage. 2. Poor connector connection. 3. CMP sensor malfunction. 4. Pulse sensing gap incorrect. 5. Electrical interference. 6. Magnetic interference. 7. ECM malfunction.	B27/ B28/ B39	P0103/ P0113/ P0123/ P0342
	P0342	B	Camshaft Position Sensor Circuit No Signal	1. No DTC relating to CKP sensor. 2. Engine speed is below 2000rpm. 3. No pulse is detected consecutively.			1. CMP sensor harness open circuit, short to ground or short to voltage. 2. Poor connector connection. 3. CMP sensor malfunction. 4. Pulse sensing gap incorrect. 5. Electrical interference. 6. Magnetic interference. 7. ECM malfunction.	B27/ B28/ B39	P0103/ P0113/ P0123/ P0341 or P0122

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
42	P0351	A	Ignition 1 Control Circuit	1. No DTC relating to CMP sensor and CKP sensor. 2. Engine speed is between 250rpm and 850 rpm. 3. 10 ignition signals are not detected consecutively.	Fuel cut is operated more than 2000rpm.	10 ignition signals are detected consecutively.	1. Ignition coil harness open circuit, short to ground or short to voltage. 2. Ignition coil malfunction. 3. ECM malfunction.	A32	-
	P0352	A	Ignition 2 Control Circuit					B7	-
	P0353	A	Ignition 3 Control Circuit					A31	-
	P0354	A	Ignition 4 Control Circuit					B8	-
	P0355	A	Ignition 5 Control Circuit					A30	-
	P0356	A	Ignition 6 Control Circuit					B9	-

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
32	P0404	B	EGR Circuit Range/Performance (Open Valve)	1. Engine is stopping. 2. No DTC relating to ECT sensor, CKP sensor and VSS. 3. Vehicle speed is below 4km/h. 4. Engine coolant temperature is more than 75°C. 5. EGR solenoid valve on-duty ratio is more than 100%. 6. EGR valve output monitoring signal high.	1. EGR operation is stopped. 2. EGR valve closed position learning operation is disabled. 3. EGR position feedback is disabled.	EGR valve output monitoring signal low.	1. EGR solenoid harness short to voltage circuit. 2. EGR valve sticking. 3. ECM malfunction.	A5	-
	P1404	B	EGR Circuit Range/Performance (Closed Valve)	1. Engine is running. 2. Engine speed is below 4000rpm. 3. No DTC relating to CKP sensor. 4. EGR solenoid valve on-duty ratio is 0%. 5. EGR valve output monitoring signal low.		EGR valve output monitoring signal high.	1. EGR solenoid harness open circuit or short to ground circuit. 2. EGR valve sticking. 3. ECM malfunction.	A5	-
	P0405	B	EGR Circuit Low	1. No DTC relating to EGR circuit range/performance. 2. EGR solenoid valve on-duty ratio is more than 40%. 3. EGR position sensor output voltage is below 0.3V.	No fail-safe function.	EGR position sensor output voltage is more than 0.3V.	1. EGR position sensor power supply circuit open or short to ground circuit. 2. EGR position sensor signal circuit open or short to ground circuit. 3. Poor connector connection. 4. EGR valve malfunction. 5. ECM malfunction.	A9/ A24	-
	P0406	B	EGR Circuit High	1. No DTC relating to EGR circuit range/performance. 2. EGR solenoid valve on-duty ratio is below 40%. 3. EGR position sensor output voltage is more than 4.6V.		EGR position sensor output voltage is below 4.6V.	1. EGR position sensor power supply circuit short to voltage circuit. 2. EGR position sensor signal circuit short to voltage circuit. 3. EGR position sensor ground circuit open or short to voltage circuit. 4. Poor connector connection. 5. EGR valve malfunction. 6. ECM malfunction.	A9/ A22/ A24	P0118
	P0444	A	EVAP Purge Solenoid Valve Circuit Low Voltage	1. No DTC relating to CKP sensor and system voltage. 2. Engine speed is below 4000rpm. 3. Purge solenoid valve on-duty ratio is below 48%. 4. Purge solenoid valve output monitoring signal low.	No fail-safe function.	Purge solenoid valve output monitoring signal high.	1. Solenoid harness open circuit or short to ground. 2. Solenoid malfunction. 3. ECM malfunction.	B15	-
	P0445	A	EVAP Purge Solenoid Valve Circuit High Voltage	1. No DTC relating to CKP sensor and system voltage. 2. Engine speed is below 4000rpm. 3. Purge solenoid valve on-duty ratio is more than 50%. 4. Purge solenoid valve output monitoring signal high.		Purge solenoid valve output monitoring signal low.	1. Solenoid harness short to voltage. 2. Solenoid malfunction. 3. ECM malfunction.	B15	-

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
24	P0500	B	Vehicle Speed Sensor Circuit Range/Performance	1. Engine speed is below 5000rpm. 2. Under fuel cut operation. 3. Vehicle speed sensor output is below 1km/h. Above conditions are met for 4 seconds.	The ECM use 10km/h condition as substitute.	Vehicle speed sensor output is more than 2km/h.	1. Sensor harness open circuit, short to ground circuit or short to voltage circuit. 2. Poor connector connection. 3. Electrical interference. 4. Magnetic interference. 5. VSS malfunction. 6. ECM malfunction.	B32	-
66	P0562	D	System Voltage Low	Battery voltage is below 6V for more than 20 seconds.	No fail-safe function.	Battery voltage is between 6V and 16V.	1. Battery power feed harness open circuit or short to ground circuit. 2. ECM ground harness open or poor connection. 3. Poor connector connection. 4. Battery malfunction. 5. Charge system malfunction. 6. ECM malfunction.	-	-
	P0563	A	System Voltage High	Battery voltage is above 16V for more than 20 seconds.			1. Charge system malfunction. 2. Battery jump start cable misconnect. 3. ECM malfunction.	-	-
51	P0601	A	Control Module Memory Checksum	ECM memory area error.	Engine control disabled.	Memory are is OK.	1. ECM malfunction.	-	-
	P0602	-	ECU Programming Error	ECM memory area error.	Engine control disabled.	Memory are is OK.	1. ECM is not programmed.	-	-

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
22	P1508	B	Idle Air Control System Low/Closed	1. No DTC relating to MAF sensor, IAT sensor, ECT sensor, TPS, CMP sensor, CKP sensor, VSS and system voltage. 2. Engine speed is between 675rpm and 6000rpm. 3. Engine coolant temperature is more than 75°C. 4. Intake air temperature is between -10°C and 80°C. 5. Vehicle is stopping. 6. Small amount of intake air through the idle air control valve. (Idle air control valve is sticking at close position.) Above conditions are met for 2 seconds.	Fuel cut is operated at high idle speed.	Correct amount of air intake through the idle air control valve. (Correct movement of the idle air control valve.)	1. IAC valve harness open circuit, short to ground circuit or short to voltage circuit. 2. Poor connector connection. 3. IAC valve malfunction. 4. IAC valve is sticking at close position. 5. ECM malfunction.	B13/ B14/ B16/ B17	-
	P1509	B	Idle Air Control System High/Open	1. No DTC relating to MAF sensor, IAT sensor, ECT sensor, TPS, CMP sensor, CKP sensor, VSS and system voltage. 2. Engine speed is between 675rpm and 6000rpm. 3. Engine coolant temperature more than 75°C. 4. Intake air temperature is between -10°C and 80°C. 5. Vehicle is stopping. 6. Large amount of intake air through the idle air control valve. (Idle air control valve is sticking at open position.) Above conditions are met for 2 seconds.			1. IAC valve harness open circuit, short to ground circuit or short to voltage circuit. 2. Poor connector connection. 3. IAC valve malfunction. 4. IAC valve is sticking at open position. 5. ECM malfunction.	B13/ B14/ B16/ B17	-
65	P1601	D	CAN BUS Off	CAN BUS off condition is detected consecutively.	Torque reduction control is disable.	CAN BUS on condition is detected consecutively for 2 seconds.	1. ECM and TCM communication circuit open, short to ground or short to voltage. 2. Electrical interference. 3. ECM malfunction. 4. TCM malfunction.	A10/ A11	-
67	U2104	D	CAN BUS Reset Counter Overrun	1. No DTC CAN BUS Off. 2. CAN valid counter does not change for 2 seconds.		CAN valid counter changes consecutively for 2 seconds.	1. ECM and TCM communication circuit open, short to ground or short to voltage. 2. Electrical interference. 3. ECM malfunction. 4. TCM malfunction.	A10/ A11	P1767/ U2104 (AT)

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
67	P1626	-	Immobilizer No Signal	No response from immobilizer control unit.	1. Engine does not start. 2. Check engine lamp flash.	No recovery	1. ECM and immobilizer control unit communication circuit open circuit, short to ground circuit or short to voltage circuit. 2. Electrical interference. 3. Magnetic interference. 4. ECM malfunction. 5. Immobilizer control unit malfunction. 6. Transponder key malfunction.	B18/ B32	B****
	P1631	-	Immobilizer Wrong Signal	Received response is not correct.			1. ECM malfunction. 2. Immobilizer control unit malfunction. 3. Transponder key malfunction.	-	B****
	P1648	-	Wrong Security Code Entered	Received incorrect security code.			1. ECM malfunction. 2. Immobilizer control unit malfunction. 3. Transponder key malfunction.	-	B****
	P1649	-	Immobilizer Function Not Programmed	Immobilizer function is not programmed in the ECM.			ECM malfunction.	-	B****

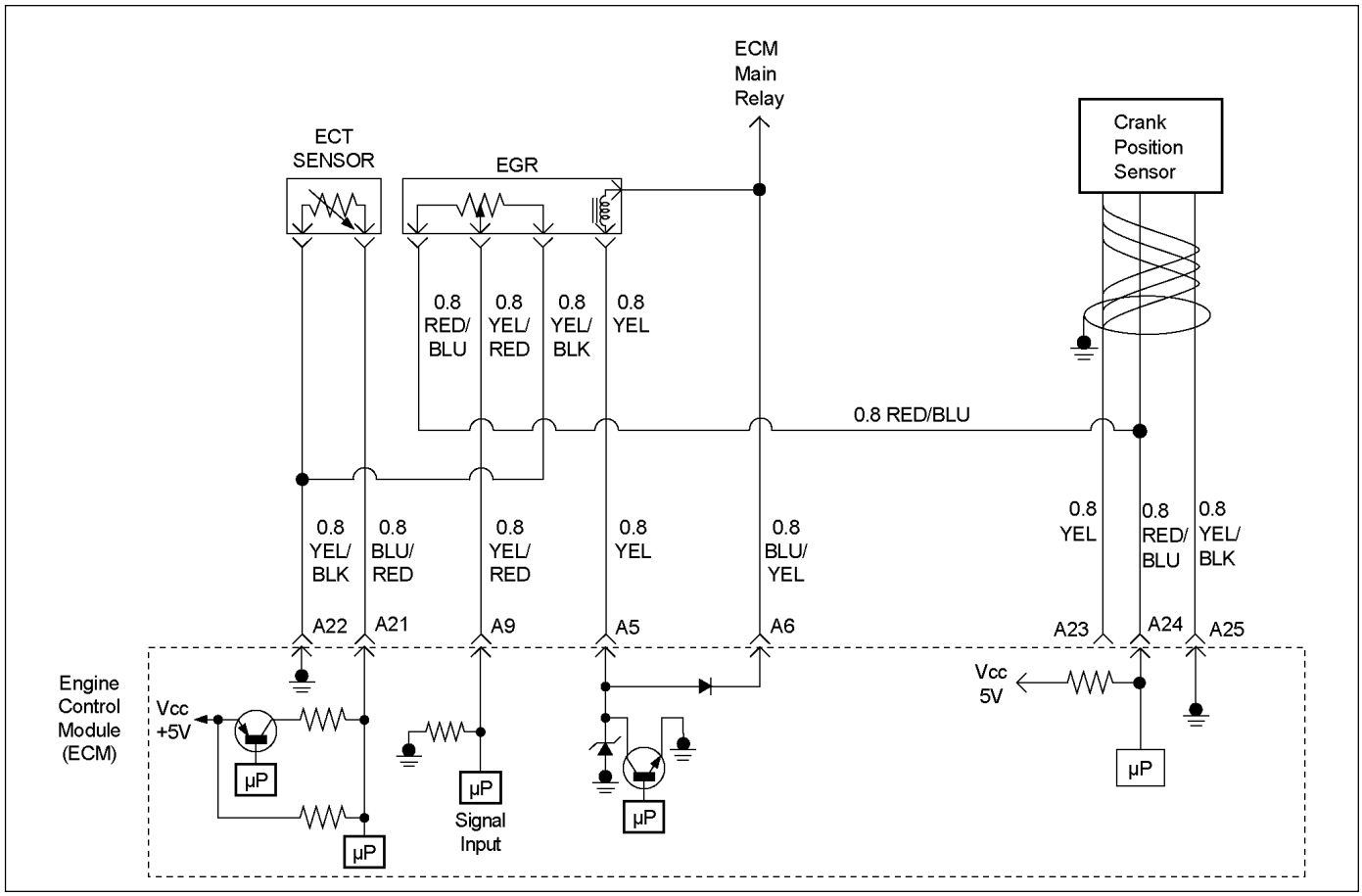
MULTIPLE DTC SETS TROUBLESHOOTING AIDS

An open or short to voltage circuit in the sensor ground circuit between the ECM terminal A22 and splice will cause one or more of following DTCs to be set:

- **P0406 (Flash Code 32): EGR Circuit High**
- **P0118 (Flash Code 14): Engine Coolant Temperature Sensor High Input**

A short to ground circuit in the sensor power supply circuit between the ECM terminal A24 and splice will cause one or more of following DTCs to be set:

- **P0122 (Flash Code 21): Throttle Position Sensor Low Input**
- **P0336 (Flash Code 29): Crankshaft Position Sensor Circuit Range/Performance (58X)**
- **P0337 (Flash Code 29): Crankshaft Position Sensor Circuit No Signal (58X)**



RTW46EMF000201

An open or short to voltage circuit in the sensor ground circuit between the ECM terminal B39 and splice will cause one or more of following DTCs to be set:

- **P0103 (Flash Code 61): Mass Air Flow Sensor Circuit High Input**
- **P0113 (Flash Code 23): Intake Air Temperature Sensor High Input**
- **P0123 (Flash Code 21): Throttle Position Sensor High Input**
- **P0341(Flash Code 41): Camshaft Position Sensor Circuit Range/Performance**
- **P0342 (Flash Code 41): Camshaft Position Sensor Circuit No Signal**

An open circuit in the sensor power supply circuit between the ECM terminal B27 and splice will cause one or more of following DTCs to be set:

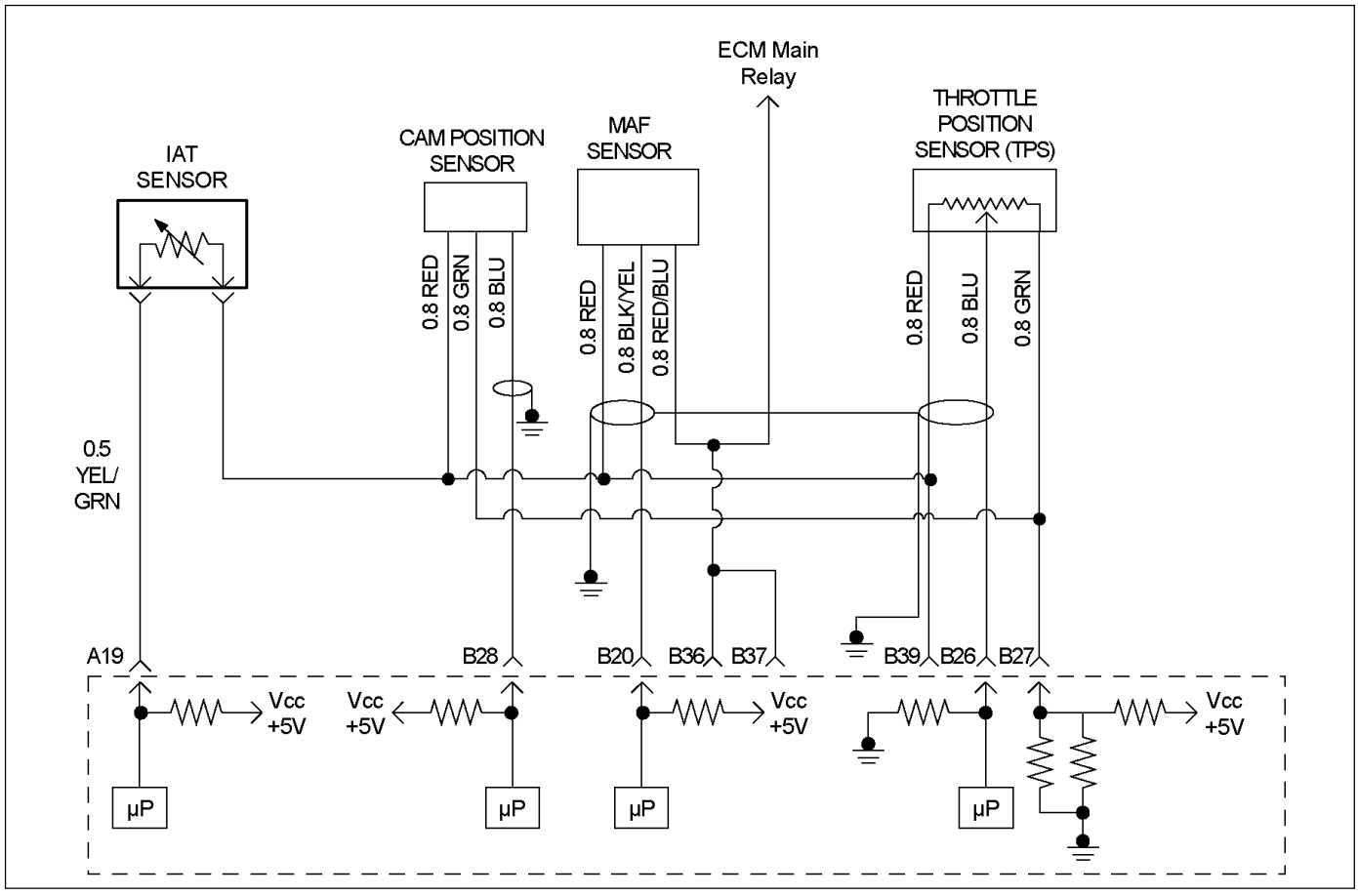
- **P0122 (Flash Code 21): Throttle Position Sensor Low Input**
- **P0342 (Flash Code 41): Camshaft Position Sensor Circuit No Signal**

A short to ground circuit in the sensor power supply circuit between the ECM terminal B27 and splice will cause one or more of following DTCs to be set:

- **P0122 (Flash Code 21): Throttle Position Sensor Low Input**
- **P0336 (Flash Code 29): Crankshaft Position Sensor Circuit Range/Performance (58X)**
- **P0337 (Flash Code 29): Crankshaft Position Sensor Circuit No Signal (58X)**

A short to ground circuit in the sensor signal circuit between the ECM terminal B28 and sensor will cause one of following DTC to be set:

- **P0337 (Flash Code 29): Crankshaft Position Sensor Circuit No Signal (58X)**



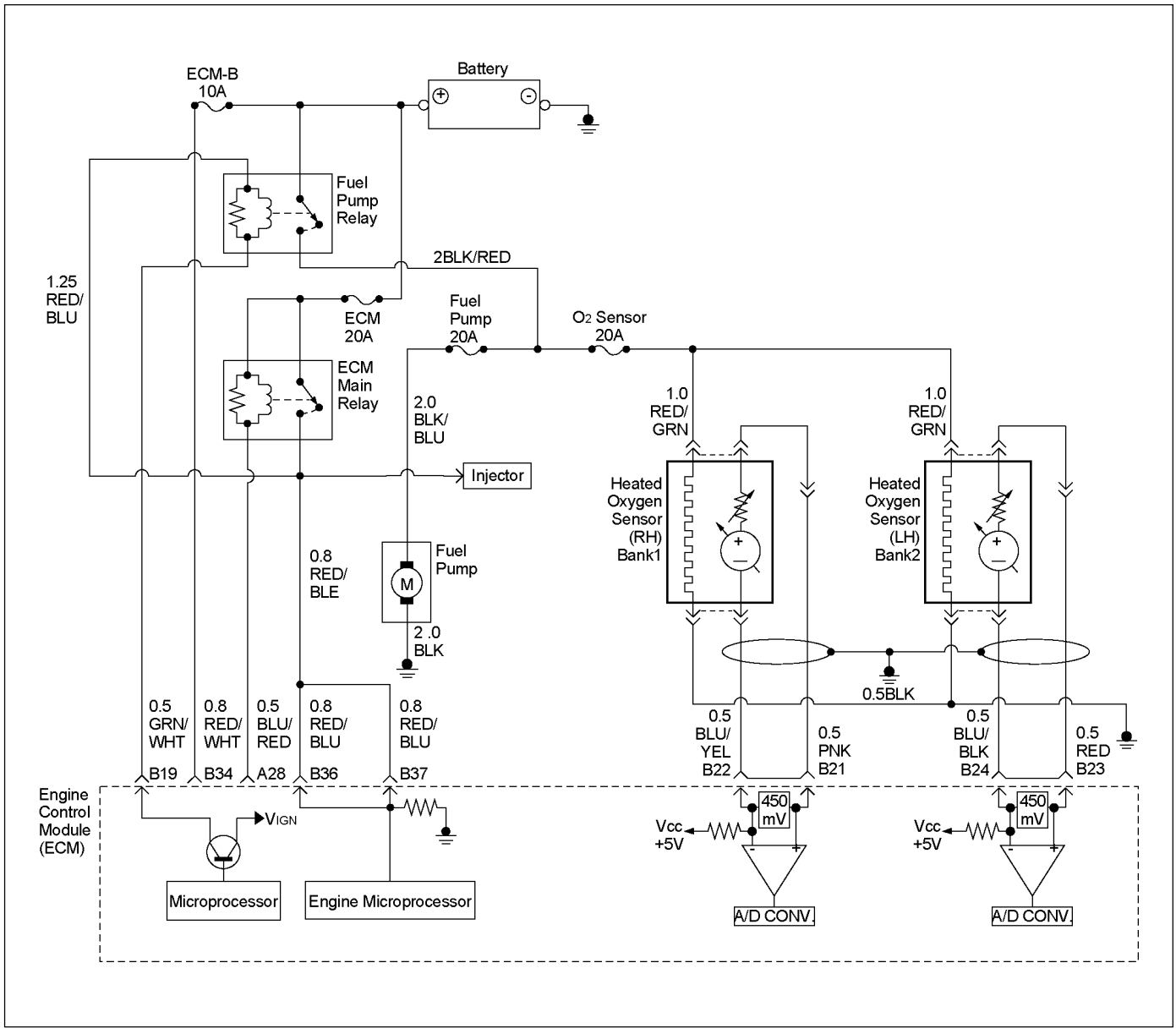
RUW46EMF000101

Too low fuel pressure (poor fuel) will cause one or more of following DTCs to be set.

- **P0131 (Flash Code 15): O2 Sensor Circuit Low Voltage (Bank 1 Sensor 1)**
- **P0151 (Flash Code 15): O2 Sensor Circuit Low Voltage (Bank 2 Sensor 1)**
- **P0171 (Flash Code 44): O2 Sensor System Too Lean (Bank 1)**
- **P0174 (Flash Code 44): O2 Sensor System Too Lean (Bank 2)**
- **P1171 (Flash Code 44): Fuel Supply System Lean During Power Enrichment (Bank 1)**
- **P1172 (Flash Code 44): Fuel Supply System Lean During Power Enrichment (Bank 2)**

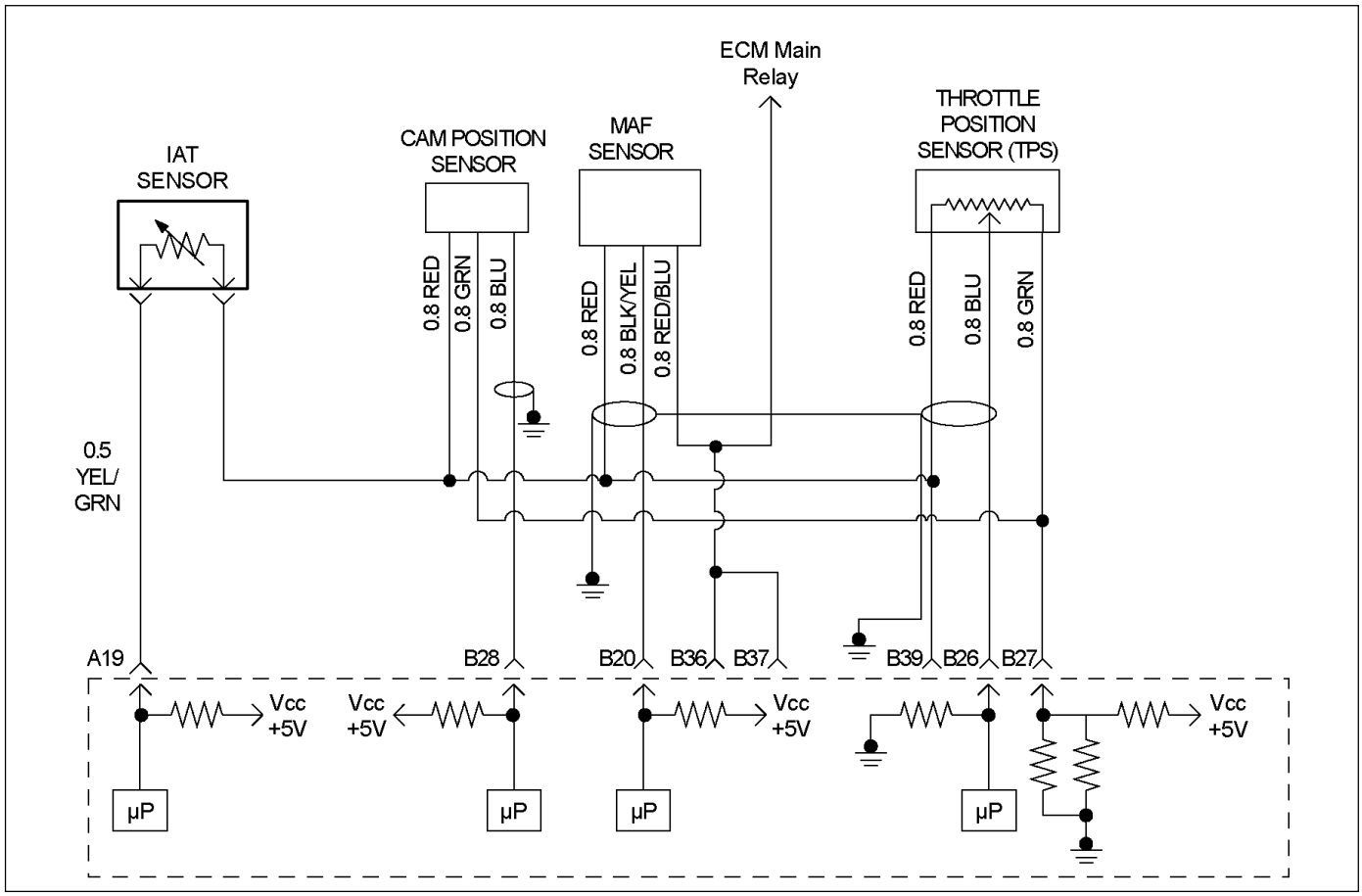
Too high fuel pressure (excessive fuel) will cause one or more of following DTCs to be set.

- **P0132 (Flash Code 15): O2 Sensor Circuit High Voltage (Bank1 Sensor 1)**
- **P0152 (Flash Code 15): O2 Sensor Circuit High Voltage (Bank 2 Sensor 1)**
- **P0172 (Flash Code 45): O2 Sensor System Too Rich (Bank 1)**
- **P0175 (Flash Code 45): O2 Sensor System Too Rich (Bank 2)**



RTW36ELF000101

DIAGNOSTIC TROUBLE CODE (DTC) P0101 (FLASH CODE 61) MASS AIR FLOW SENSOR CIRCUIT RANGE/PERFORMANCE



RUW46EMF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
61	P0101	B	Mass Air Flow Sensor Circuit Range/Performance	1. No DTC relating to barometer sensor, TPS, CMP sensor, CKP sensor and MAF sensor (low input & high input). 2. Engine speed is between 2800rpm and 4500rpm. 3. Throttle position sensor output voltage is between 1V and 3V. 4. Intake air temperature is between -14°C and 70°C. 5. Air flow amount below 0.04g/s (small air) or more than 177g/s (large air). Above conditions are met for 3 seconds.	No fail-safe function.

CIRCUIT DESCRIPTION

The mass air flow (MAF) sensor measures the amount of air which passes through it into the engine during a given time. The Engine Control Module (ECM) uses the mass air flow information to monitor engine operating conditions for fuel delivery calculations. A large quantity of air entering the engine indicates an acceleration or high load situation, while a small quantity or air indicates deceleration or idle.

The MAF sensor produces a frequency signal which can be monitored using a Tech 2. The frequency will vary within a range of around 4 to 7 g/s at idle to around 25 to 40 g/s at maximum engine load. DTC P0101 will be set if the signal from the MAF sensor does not match a predicted value based on throttle position and engine RPM.

DIAGNOSTIC AIDS

An intermittent may be caused by the following:

- Poor connections.
- Mis-routed harness.
- Rubbed through wire insulation.
- Broken wire inside the insulation.

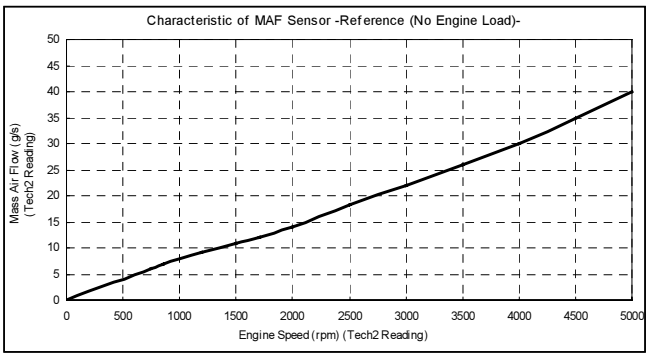
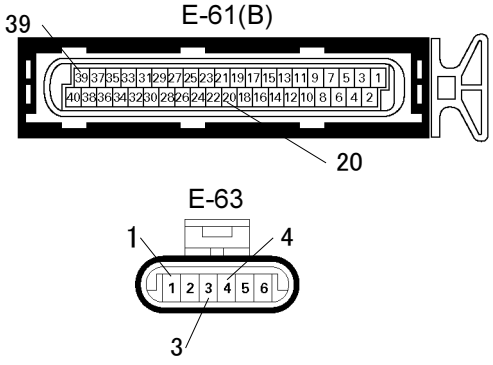
Refer to Intermittents under service category Symptoms.

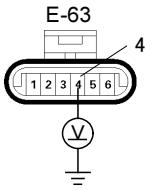
Any un-metered air may cause this DTC to set. Check for the following:

- The duct work at the MAF sensor for leaks.
- An engine vacuum leak.
- The PCV system for vacuum leaks.
- An incorrect PCV valve.
- The engine oil dip stick not fully seated.
- The engine oil fill cap loose or missing.

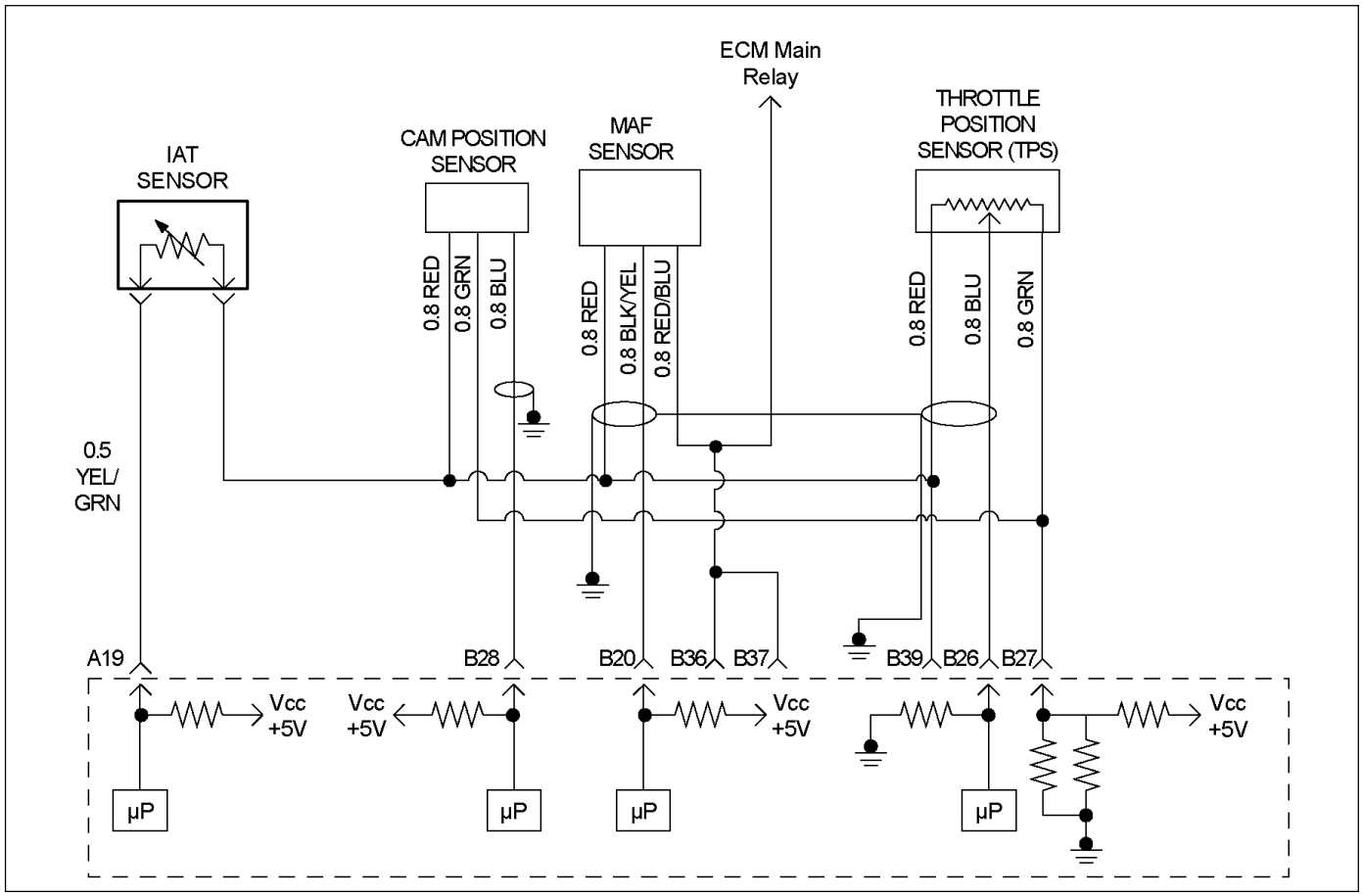
Diagnostic Trouble Code (DTC) P0101 (Flash Code 61) Mass Air Flow Sensor Circuit Range/Performance

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0101 stored as "Present Failure"?	-	Go to Step 3	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0101 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*

Step	Action	Value (s)	Yes	No
4	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Mass Air Flow" in the data display. Does the Tech 2 indicate correct "Mass Air Flow" as shown in the following graph, when engine speed is increasing little by little? 	-	Go to *Step 6*	Go to *Step 5*
5	Remove the MAF & IAT sensor assembly and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAF sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Go to Step 6
6	Check for poor/faulty connection at the MAF sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 7*
7	Remove the MAF & IAT sensor assembly and visually check. Was the problem found?	-	Go to Step 11	Go to Step 8

Step	Action	Value (s)	Yes	No
8	Using the DVM and check the MAF sensor signal circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the MAF sensor connector. 3. Ignition "On". 4. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 9*	Repair faulty harness and verify repair
9	Check any accessory parts which may cause electric interference.	-	Remove the accessory parts and verify repair	Go to *Step 10*
10	Check the shield wire for open or short circuit. Was the problem found?	-	Verify repair	Go to *Step 11*
11	Substitute a known good MAF & IAT sensor assembly and recheck. Was the problem solved?	-	Go to *Step 12*	Go to *Step 13*
12	Replace the MAF & IAT sensor assembly. Is the action complete?	-	Verify repair	
13	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 14*
14	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0102 (FLASH CODE 61) MASS AIR FLOW SENSOR CIRCUIT LOW INPUT



RUW46EMF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
61	P0102	A	Mass Air Flow Sensor Circuit Low Input	MAF sensor output voltage is below 0.3V.	The ECM uses default mass air flow value based on IAC valve position, throttle position, barometer pressure and engine speed.

CIRCUIT DESCRIPTION

The mass air flow (MAF) sensor measures the amount of air which passes through it into the engine during a given time. The Engine Control Module (ECM) uses the mass air flow information to monitor engine operating conditions for fuel delivery calculations. A large quantity of air entering the engine indicates an acceleration or high load situation, while a small quantity of air indicates deceleration or idle.

The MAF sensor produces a frequency signal which can be monitored using a Tech 2. The frequency will vary within a range of around 5 to 8 g/s at idle to around 25 to 40 g/s at maximum engine load. DTC P0102 will be set if the signal from the MAF sensor is below the possible range of a normally operating MAF sensor.

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DIAGNOSTIC AIDS

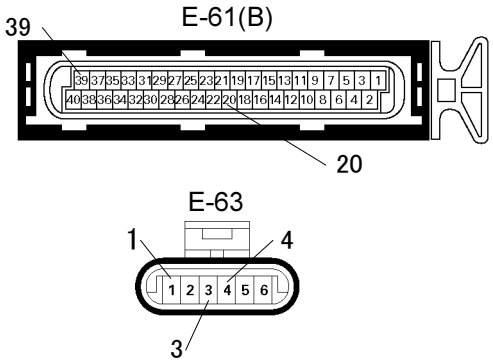
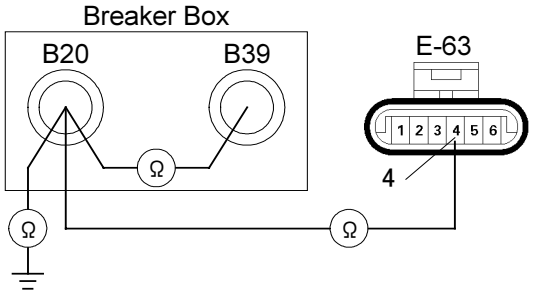
Check for the following conditions:

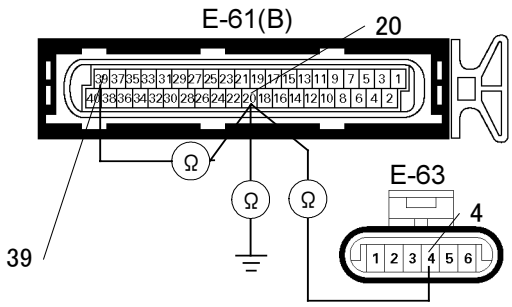
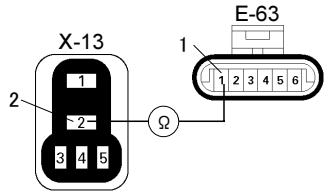
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Misrouted harness – Inspect the MAF sensor harness to ensure that it is not routed too close to high voltage wires.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the Tech 2 while moving connectors and wiring harnesses related to the MAF sensor. A change in the display will indicate the location of the fault.

If DTC P0102 cannot be duplicated, the information included in the Failure Records data can be useful in determining vehicle mileage since the DTC was last set

Diagnostic Trouble Code (DTC) P0102 (Flash Code 61) Mass Air Flow Sensor Circuit Low Input

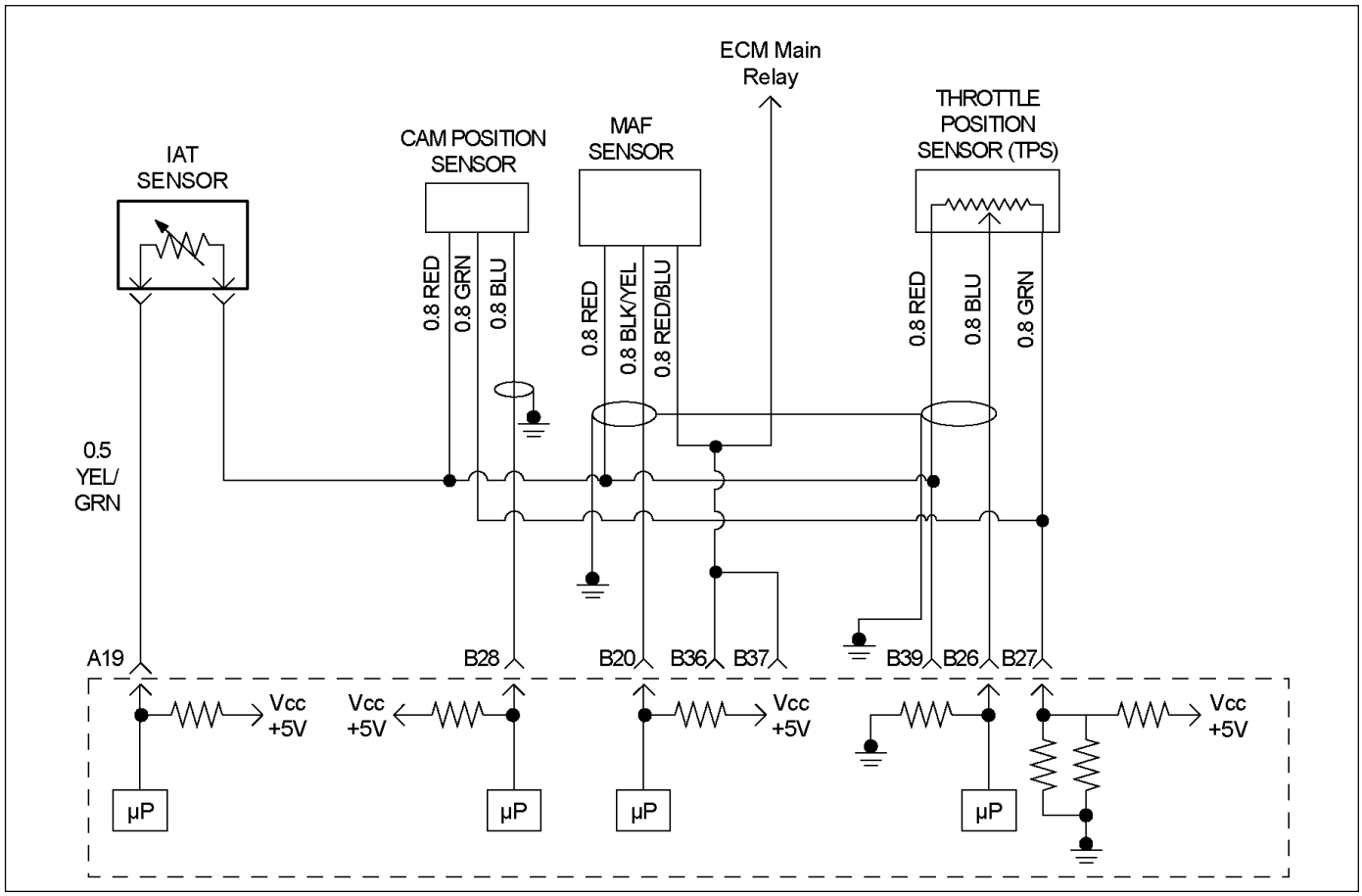
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0102 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0102 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*

Step	Action	Value (s)	Yes	No
4	Check for poor/faulty connection at the MAF sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 5*
5	Remove the MAF & IAT sensor assembly and visually check. Was the problem found?	-	Go to *Step 8*	Go to *Step 6*
6	Using the DVM and check the MAF sensor signal circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-99 page. 3. Disconnect the MAF sensor connector. 4. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found? 			

Step	Action	Value (s)	Yes	No
	Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the MAF sensor connector and ECM connector. 3. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 7*
7	Using the DVM and check the MAF sensor power supply circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the MAF sensor connector and ECM main relay. 3. Check the circuit for open circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 8*
8	Substitute a known good MAF & IAT sensor assembly and recheck. Was the problem solved?	-	Go to *Step 9*	Go to *Step 10*
9	Replace the MAF & IAT sensor assembly. Is the action complete?	-	Verify repair	-
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 11*

Step	Action	Value (s)	Yes	No
11	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0103 (FLASH CODE 61) MASS AIR FLOW SENSOR CIRCUIT HIGH INPUT



RUW46EMF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
61	P0103	A	Mass Air Flow Sensor Circuit High Input	MAF sensor output voltage is more than 4.9V.	The ECM uses default mass air flow value based on IAC valve position, throttle position, barometer pressure and engine speed.

CIRCUIT DESCRIPTION

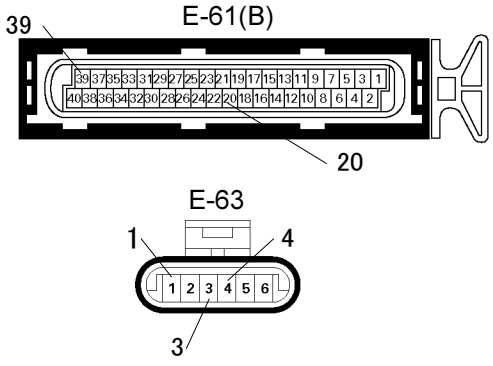
The mass air flow (MAF) sensor measures the amount of air which passes through it into the engine during a given time. The Engine Control Module (ECM) uses the mass air flow information to monitor engine operating conditions for fuel delivery calculations. A large quantity of air entering the engine indicates an acceleration or high load situation, while a small quantity of air indicates deceleration or idle.

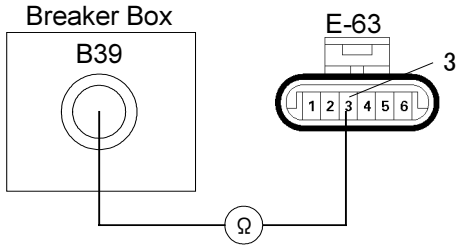
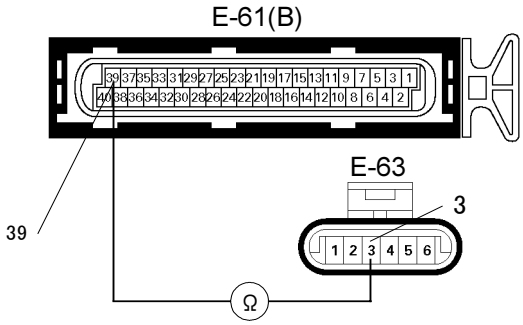
The MAF sensor produces a frequency signal which can be monitored using a Tech 2. The frequency will vary within a range of around 5 ~ 8 g/s at idle to around 25 to 40 g/s at maximum engine load. DTC P0103 will be set if the signal from the MAF sensor is above the possible range of a normally operating MAF sensor.

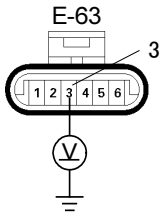
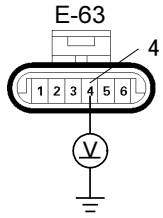
DIAGNOSTIC AIDS

If DTC P0103 cannot be duplicated, the information included in the Failure Records data can be useful in determining vehicle mileage since the DTC was last set.

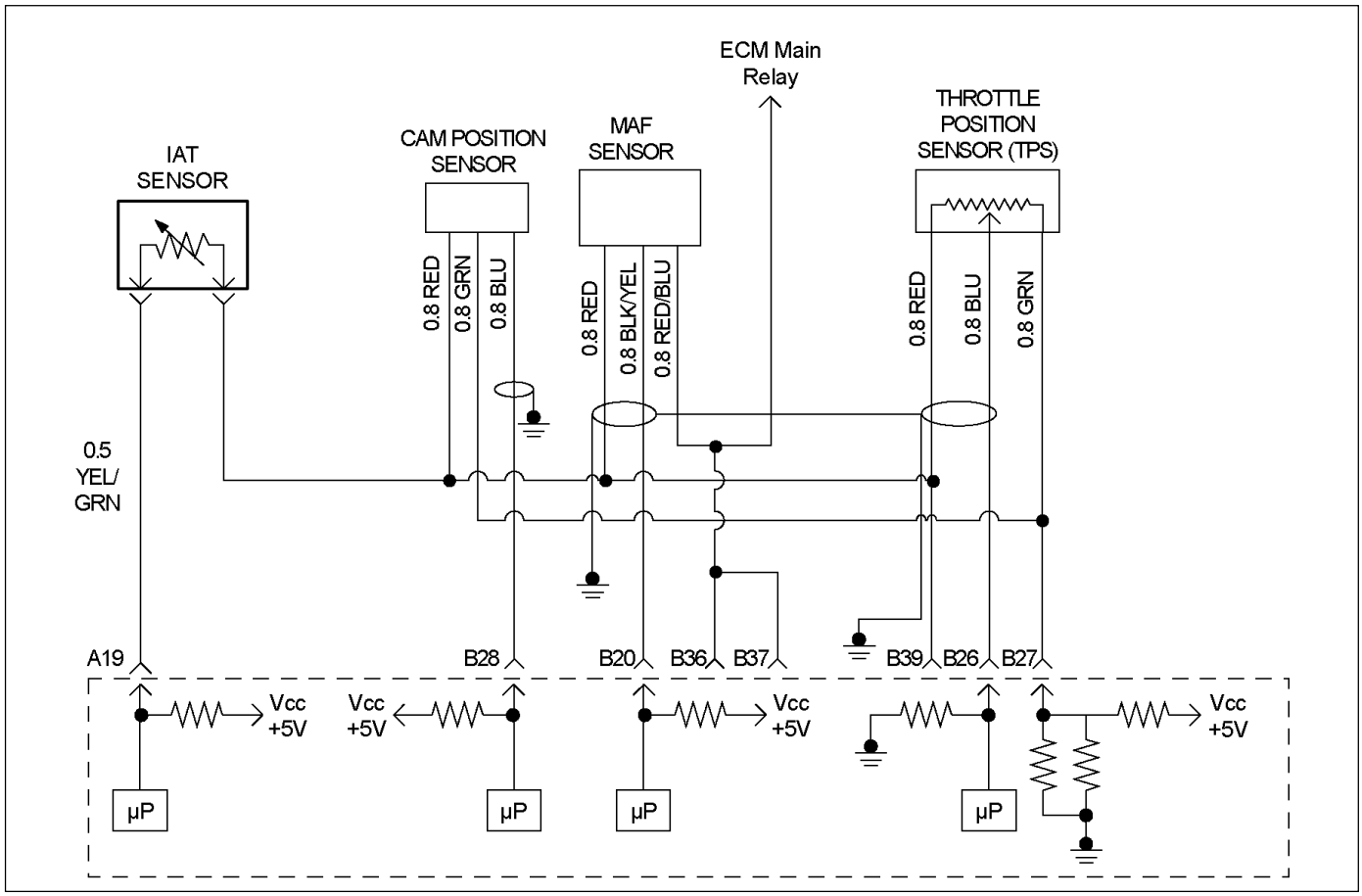
Diagnostic Trouble Code (DTC) P0103 (Flash Code 61) Mass Air Flow Sensor Circuit High Input

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0103 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0103 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the MAF sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 5*

Step	Action	Value (s)	Yes	No
5	Remove the MAF & IAT sensor assembly and visually check. Was the problem found?	-	Go to *Step 9*	Go to *Step 6*
6	Using the DVM and check the MAF sensor ground circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the MAF sensor connector. 4. Check the circuit for open circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the MAF sensor connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found?  	- -	Repair faulty harness and verify repair	Go to *Step 7*

Step	Action	Value (s)	Yes	No
7	Using the DVM and check the MAF sensor ground circuit. 1. Ignition "On", engine "Off". 2. Disconnect the MAF sensor connector . 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 8*	Repair faulty harness and verify repair
8	Using the DVM and check the MAF sensor signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the MAF sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 11*	Repair faulty harness and verify repair
9	Substitute a known good MAF & IAT sensor assembly and recheck. Was the problem solved?	-	Go to *Step 10*	Go to *Step 11*
10	Replace the MAF & IAT sensor assembly. Is the action complete?	-	Verify repair	-
11	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 12*
12	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0112 (FLASH CODE 23) INTAKE AIR TEMPERATURE (IAT) SENSOR LOW INPUT



RUW46EMF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
23	P0112	A	Intake Air Temperature Sensor Low Input	IAT sensor output voltage is below 0.08V.	The ECM use 40°C conditions as substitute.

CIRCUIT DESCRIPTION

The intake air temperature (IAT) sensor is a thermistor which measures the temperature of the air entering the engine. The Engine Control Module (ECM) applies 5 volts through a pull-up resistor to the IAT sensor. When the intake air is cold, the sensor resistance is high and the ECM will monitor a high signal voltage on the IAT signal circuit. If the intake air is warm, the sensor resistance is lower, causing the ECM to monitor a lower voltage. DTC P0112 will set when the ECM detects an excessively low signal voltage on the intake air temperature sensor signal circuit.

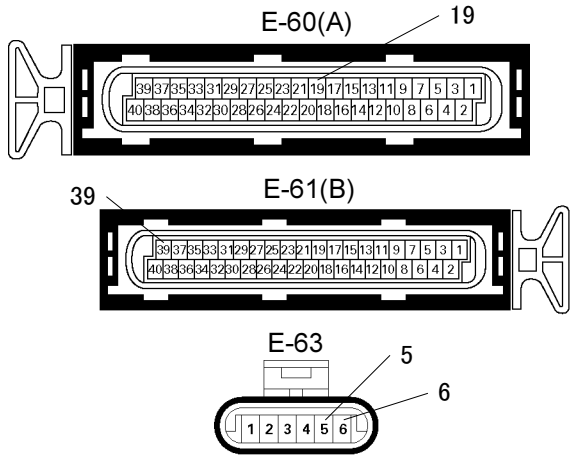
DIAGNOSTIC AIDS

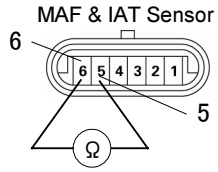
Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the Tech 2 while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.

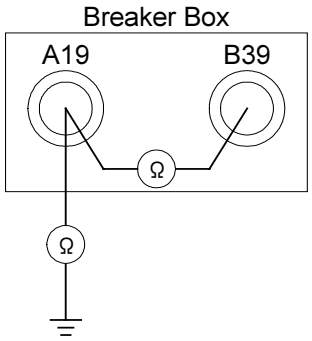
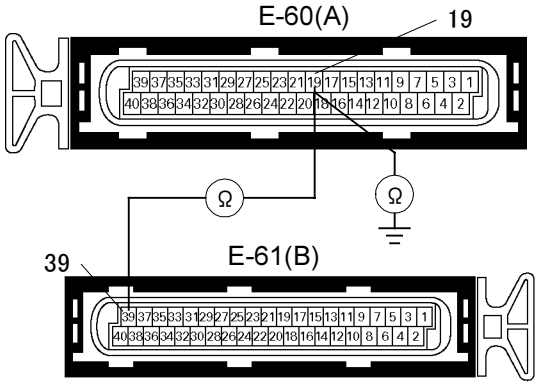
If DTC P0112 cannot be duplicated, the information included in the Failure Records data can be useful in determining vehicle mileage since the DTC was last set.

Diagnostic Trouble Code (DTC) P0112 (Flash Code 23) Intake Air Temperature (IAT) Sensor Low Input

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0112 stored as "Present Failure"?	-	Go to Step 3	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0112 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the IAT sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to Step 5
5	Remove the MAF & IAT sensor assembly and visually check. Was the problem found?	-	Go to *Step 8*	Go to *Step 6*

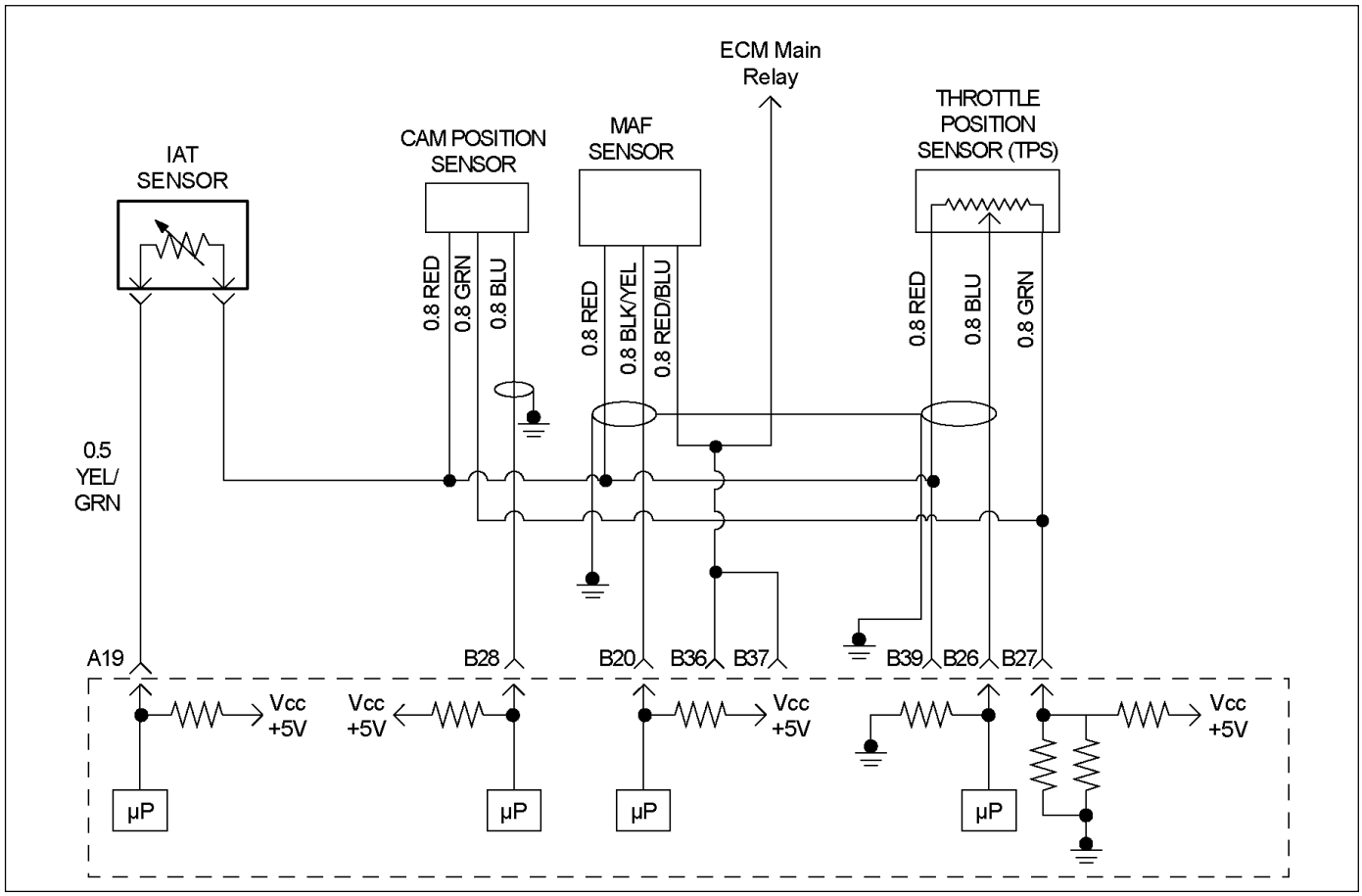
<table>
<tr><th>Step</th><th>Action</th><th>Value (s)</th><th>Yes</th><th>No</th></tr>
<tr><td>6</td><td>Using the DVM and check the IAT sensor.
1. Ignition "Off", engine "Off".
2. Disconnect IAT sensor connector.
3. Measure the resistance of IAT sensor.
Does the tester indicate standard resistance as shown in the following table?
 

<table>
<tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr>
<tr><td>-20</td><td>15230</td></tr>
<tr><td>0</td><td>5760</td></tr>
<tr><td>20</td><td>2480</td></tr>
<tr><td>40</td><td>1185</td></tr>
<tr><td>60</td><td>584</td></tr>
<tr><td>80</td><td>332</td></tr>
<tr><td>100</td><td>183</td></tr>
<tr><td>120</td><td>119</td></tr>
</table></td><td>Standard resistance</td><td>Go to Step 7</td><td>Go to Step 8</td></tr>
</table>

Step	Action	Value (s)	Yes	No
7	Using the DVM and check the IAT sensor signal circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the IAT sensor connector. 4. Check the circuit for short to sensor ground or ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the IAT sensor connector. 3. Check the circuit for short to sensor ground or ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 10*
8	Substitute a known good MAF & IAT sensor assembly and recheck. Was the problem solved?	-	Go to *Step 9*	Go to *Step 10*
9	Replace the MAF & IAT sensor assembly. Is the action complete?	-	Verify repair	-

Step	Action	Value (s)	Yes	No
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 11*
11	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0113 (FLASH CODE 23) INTAKE AIR TEMPERATURE (IAT) SENSOR HIGH INPUT



RUW46EMF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
23	P0113	A	Intake Air Temperature Sensor High Input	IAT sensor output voltage is more than 4.9V.	The ECM use 40°C conditions as substitute.

CIRCUIT DESCRIPTION

The intake air temperature (IAT) sensor is a thermistor which measures the temperature of the air entering the engine. The Engine Control Module (ECM) applies 5 volts through a pull-up resistor to the IAT sensor. When the intake air is cold, the sensor resistance is high and the ECM will monitor a high signal voltage on the IAT signal circuit. If the intake air is warm, the sensor resistance is lower causing the ECM to monitor a lower voltage. DTC P0113 will set when the ECM detects an excessively high signal voltage on the intake air temperature sensor signal circuit.

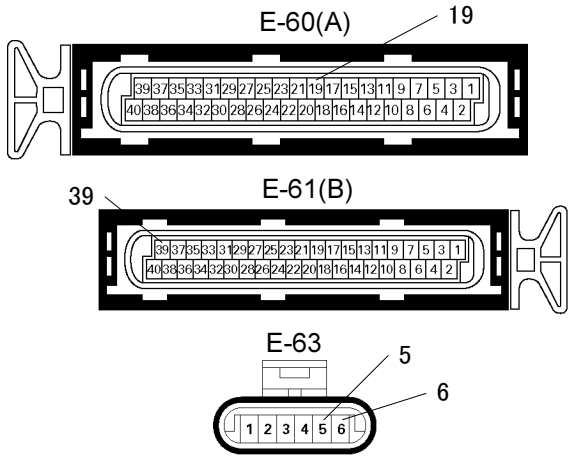
DIAGNOSTIC AIDS

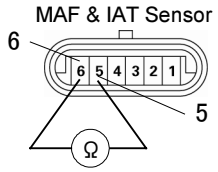
Check for the following conditions:

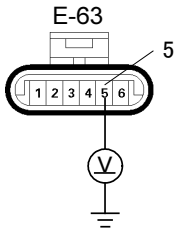
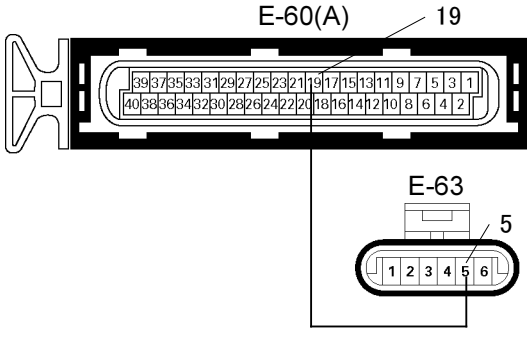
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the Tech 2 while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.

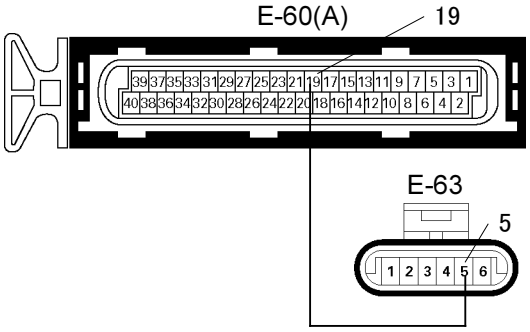
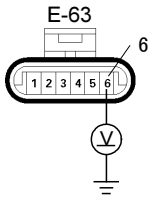
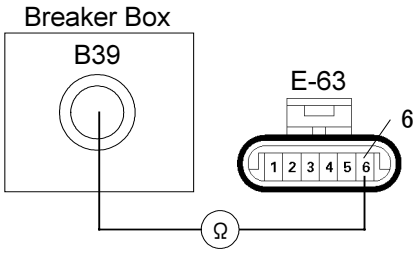
If DTC P0113 cannot be duplicated, the information included in the Failure Records data can be useful in determining vehicle mileage since the DTC was last set.

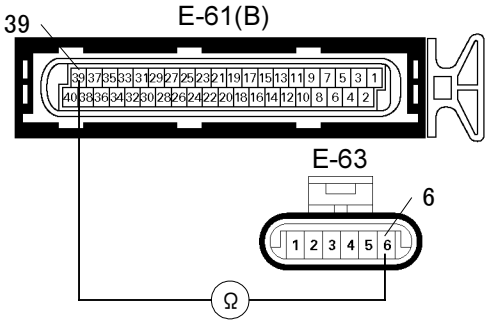
Diagnostic Trouble Code (DTC) P0113 (Flash Code 23) Intake Air Temperature (IAT) Sensor High Input

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0113 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0113 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the IAT sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to Step 5
5	Visually check the IAT sensor. Was the problem found?	-	Go to *Step 12*	Go to *Step 6*

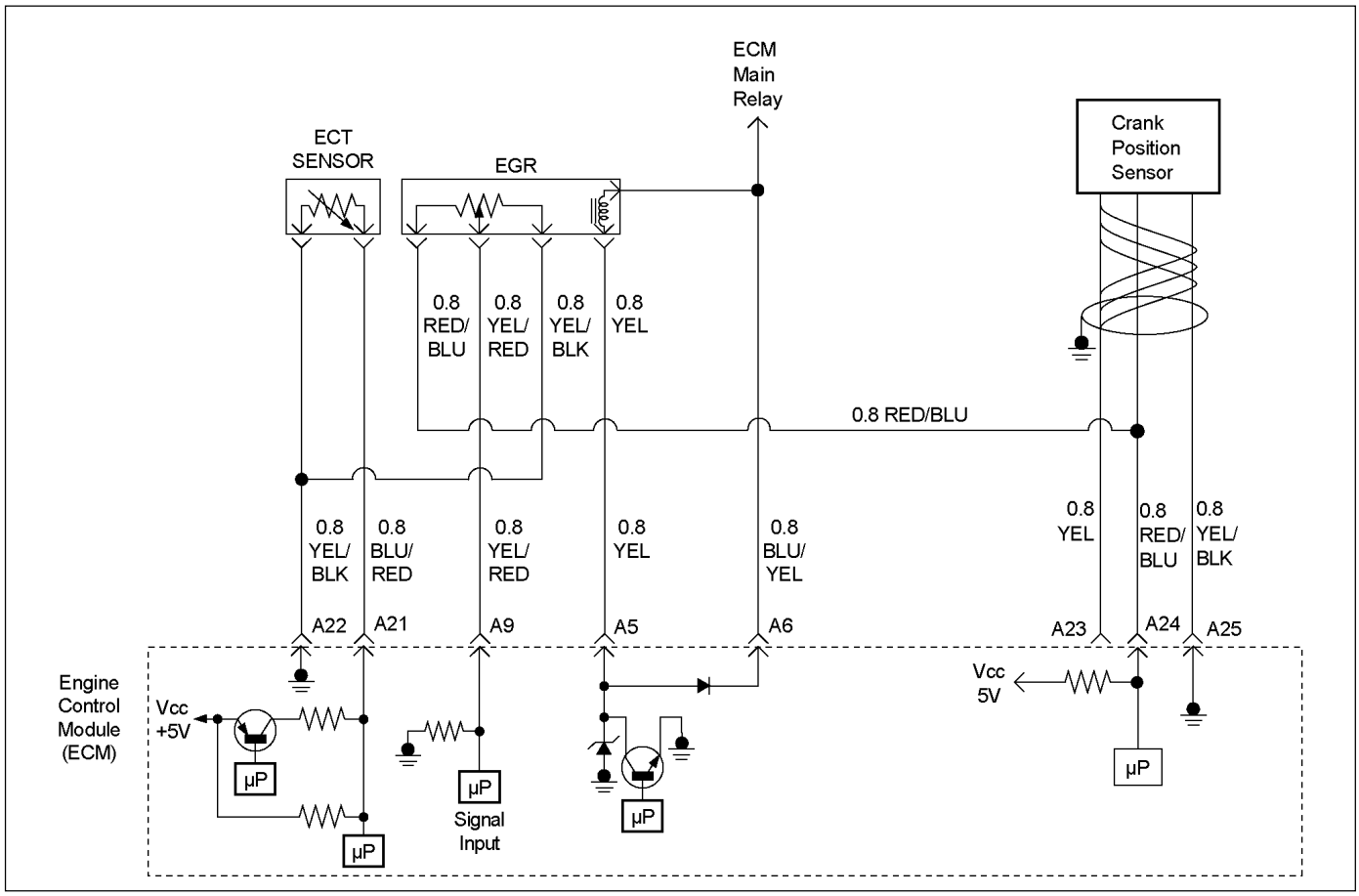
<table>
<tr><th>Step</th><th>Action</th><th>Value (s)</th><th>Yes</th><th>No</th></tr>
<tr><td>6</td><td>Using the DVM and check the IAT sensor.
1. Ignition "Off", engine "Off".
2. Disconnect IAT sensor connector.
3. Measure the resistance of IAT sensor.
Does the tester indicate standard resistance as shown in the following table?
 

<table>
<tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr>
<tr><td>-20</td><td>15230</td></tr>
<tr><td>0</td><td>5760</td></tr>
<tr><td>20</td><td>2480</td></tr>
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<tr><td>80</td><td>332</td></tr>
<tr><td>100</td><td>183</td></tr>
<tr><td>120</td><td>119</td></tr>
</table></td><td>Standard resistance</td><td>Go to Step 7</td><td>Go to Step 12</td></tr>
<tr><td>7</td><td>Using the DVM and check the IAT sensor signal circuit.
1. Ignition "On", engine "Off".
2. Disconnect the IAT sensor connector.
3. Check the circuit for open circuit.
Was the DVM indicated specified value?
 
</td><td>Approximately 5.0V</td><td>Go to Step 10</td><td>Less than 1V: Go to Step 8
More than specified value: Go to Step 9</td></tr>
<tr><td>8</td><td>Repair the open circuit between the ECM and IAT sensor.
Was the problem solved?
 
</td><td>-</td><td>Verify repair</td><td>Go to Step 14</td></tr>
</table>

Step	Action	Value (s)	Yes	No
9	Repair the short to voltage circuit between the ECM and IAT sensor. Was the problem solved? 	-	Verify repair	Go to *Step 14*
10	Using the DVM and check the IAT sensor ground circuit. 1. Ignition "On", engine "Off". 2. Disconnect the IAT sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 11*	Repair faulty harness and verify repair
11	Using the DVM and check the IAT sensor ground circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the IAT sensor connector. 4. Check the circuit for open circuit. Was the problem found? 			

Step	Action	Value (s)	Yes	No
	Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the IAT sensor connector. 3. Check the circuit for open circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 14*
12	Substitute a known good MAF & IAT sensor assembly and recheck. Was the problem solved?	-	Go to *Step 13*	Go to *Step 14*
13	Replace the MAF & IAT sensor assembly. Is the action complete?	-	Verify repair	-
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 15*
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0117 (FLASH CODE 14) ENGINE COOLANT TEMPERATURE (ECT) SENSOR LOW INPUT



RUW46EMF000201

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
14	P0117	A	Engine Coolant Temperature Sensor Low Input	ECT sensor output voltage is below 0.08V.	The ECM uses default engine coolant temperature value based on start-up ECT and time from start.

Circuit Description

The engine coolant temperature (ECT) sensor is a thermistor mounted on a coolant crossover pipe at the rear of the engine. The Engine Control Module (ECM) applies a voltage (about 5 volts) through a pull-up resistor to the ECT signal circuit. When the engine coolant is cold, the sensor (thermistor) resistance is high, therefore the ECM will measure a high signal voltage. As the engine coolant warms, the sensor resistance becomes lower, and the ECT signal voltage measured at the ECM drops.

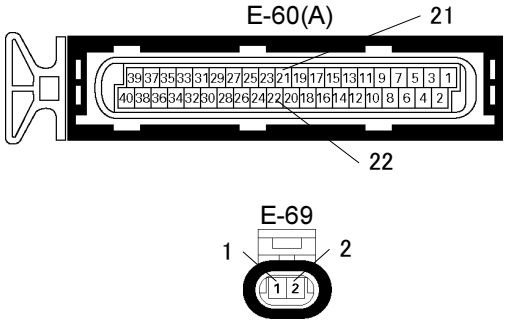
DIAGNOSTIC AIDS

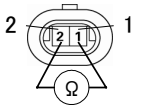
Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the Tech 2 while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.

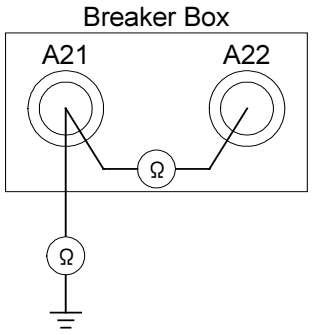
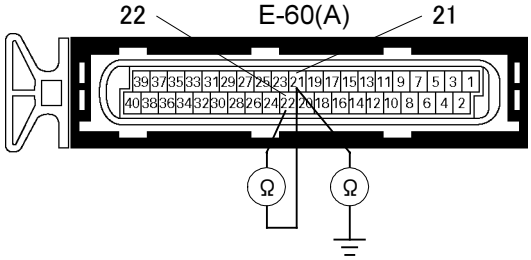
If DTC P0117 cannot be duplicated, the information included in the Failure Records data can be useful in determining vehicle mileage since the DTC was last set. If it is determined that the DTC occurs intermittently.

Diagnostic Trouble Code (DTC) P0117 (Flash Code 14) Engine Coolant Temperature (ECT) Sensor Low Input

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0117 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0117 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the ECT sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 5*
5	Visually check the ECT sensor. Was the problem found?	-	Go to *Step 8*	Go to *Step 6*

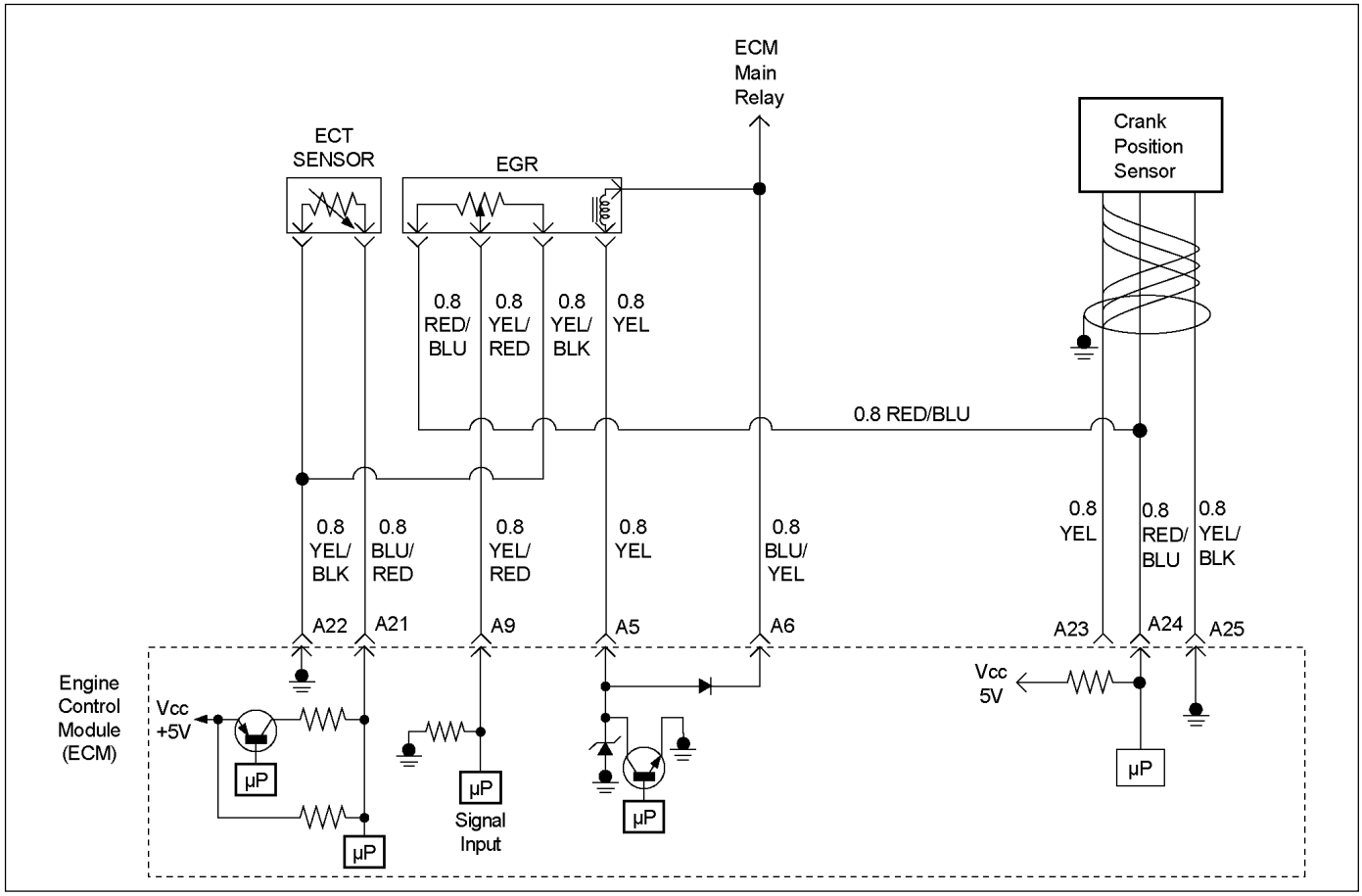
<table>
<tr><th>Step</th><th>Action</th><th>Value (s)</th><th>Yes</th><th>No</th></tr>
<tr><td>6</td><td>Using the DVM and check the ECT sensor.
1. Ignition "Off", engine "Off".
2. Disconnect ECT sensor connector.
3. Measure the resistance of ECT sensor.
Does the tester indicate standard resistance as shown in the following table?
ECT Sensor
 

<table><tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr><tr><td>-20</td><td>30300</td></tr><tr><td>0</td><td>9850</td></tr><tr><td>20</td><td>3650</td></tr><tr><td>40</td><td>1540</td></tr><tr><td>60</td><td>649</td></tr><tr><td>100</td><td>182</td></tr><tr><td>120</td><td>104</td></tr></table></td><td>Standard resistance</td><td>Go to Step 7</td><td>Go to Step 8</td></tr>
</table>

Step	Action	Value (s)	Yes	No
7	Using the DVM and check the ECT sensor signal circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the ECT sensor connector. 4. Check the circuit for short to sensor ground or ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the ECT sensor connector. 3. Check the circuit for short to sensor ground or ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 10*
8	Substitute a known good ECT sensor assembly and recheck. Was the problem solved?	-	Go to *Step 9*	Go to *Step 10*
9	Replace the ECT sensor. Is the action complete?	-	Verify repair	-
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 11*

Step	Action	Value (s)	Yes	No
11	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0118 (FLASH CODE 14) ENGINE COOLANT TEMPERATURE (ECT) SENSOR HIGH INPUT



RUW46EMF000201

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
14	P0118	A	Engine Coolant Temperature Sensor High Input	ECT sensor output voltage is more than 4.8V.	The ECM uses default engine coolant temperature value based on start-up ECT and time from start.

CIRCUIT DESCRIPTION

The engine coolant temperature (ECT) sensor is a thermistor mounted in on a coolant crossover pipe at the rear of the engine. The Engine Control Module (ECM) applies a voltage (about 5 volts) through a pull-up resistor to the ECT signal circuit. When the engine coolant is cold, the sensor (thermistor) resistance is high, therefore the ECM will measure a high signal voltage. As the engine coolant warms, the sensor resistance becomes less, and the ECT signal voltage measured at the ECM drops.

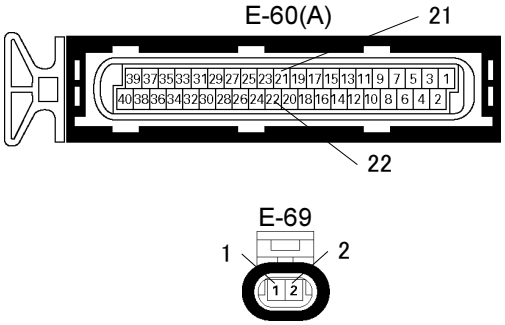
DIAGNOSTIC AIDS

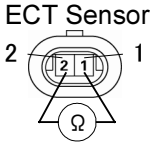
Check for the following conditions:

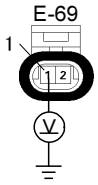
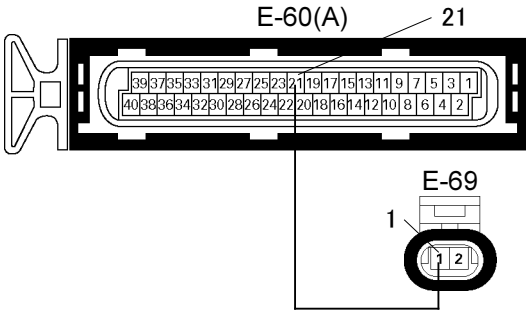
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the Tech 2 while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.

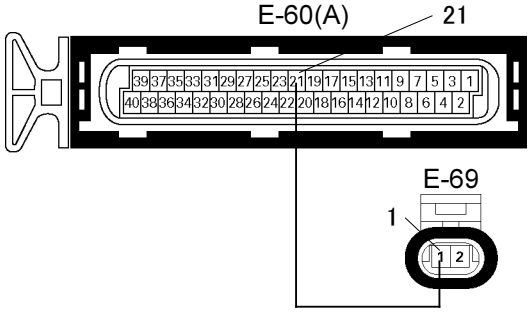
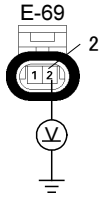
If DTC P0118 cannot be duplicated, the information included in the Failure Records data can be useful in determining vehicle mileage since the DTC was last set.

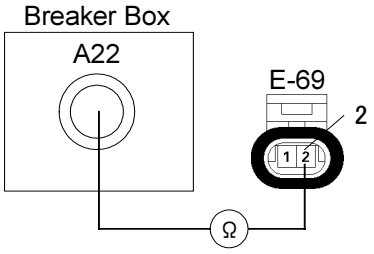
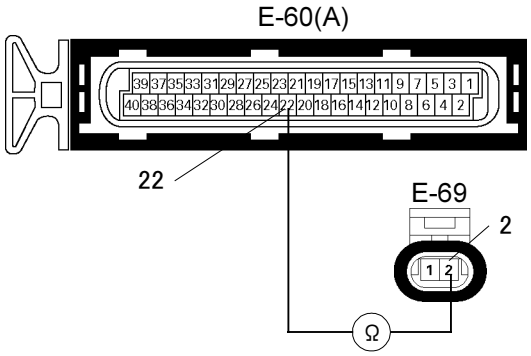
Diagnostic Trouble Code (DTC) P0118 (Flash Code 14) Engine Coolant Temperature (ECT) Sensor High Input

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0118 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0118 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the ECT sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 5*
5	Visually check the ECT sensor. Was the problem found?	-	Go to *Step 12*	Go to *Step 6*

<table>
<tr><th>Step</th><th>Action</th><th>Value (s)</th><th>Yes</th><th>No</th></tr>
<tr><td>6</td><td>Using the DVM and check the ECT sensor.
1. Ignition "Off", engine "Off".
2. Disconnect ECT sensor connector.
3. Measure the resistance of ECT sensor.
Does the tester indicate standard resistance as shown in the following table?
 

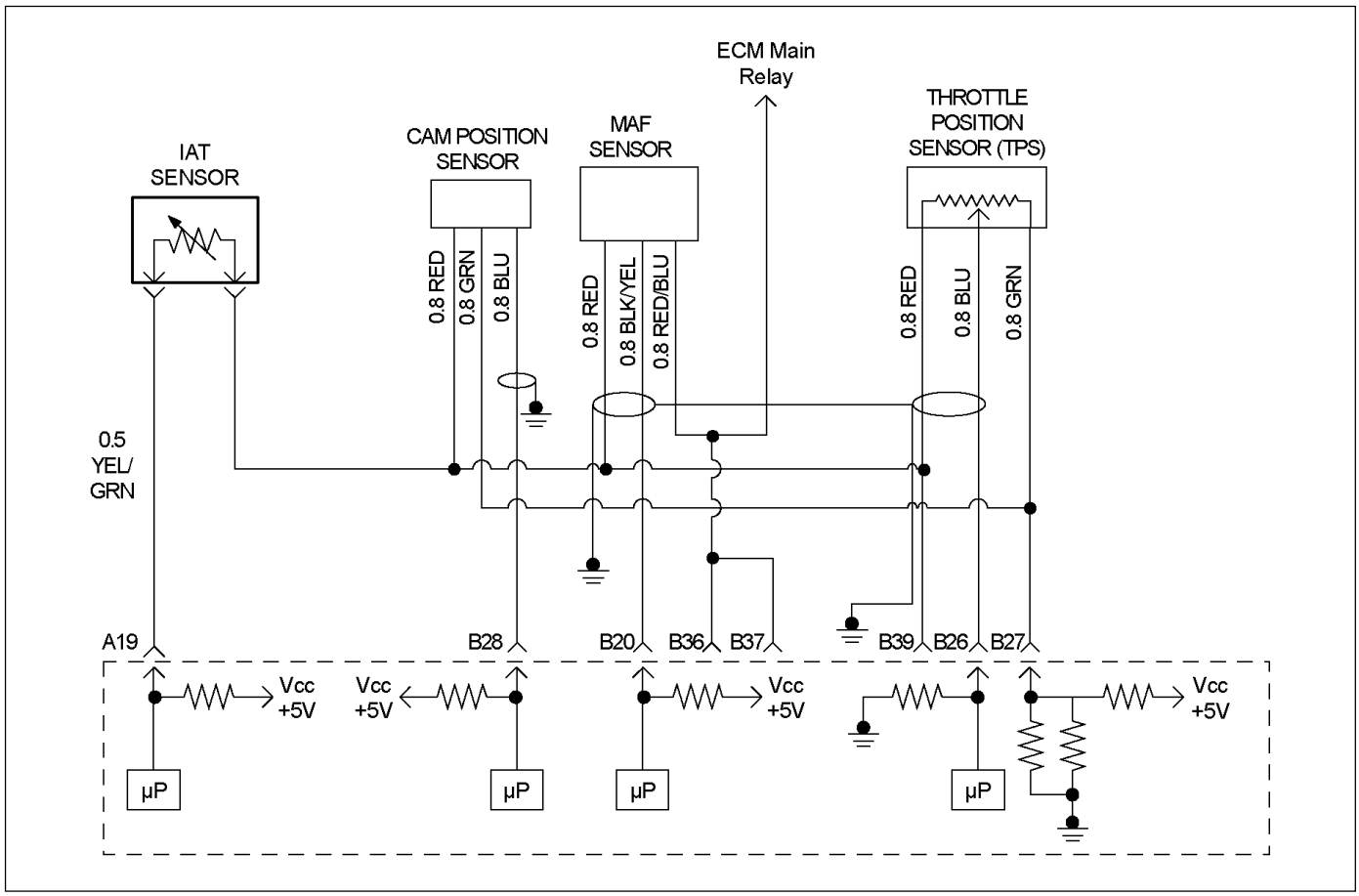
<table>
<tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr>
<tr><td>-20</td><td>30300</td></tr>
<tr><td>0</td><td>9850</td></tr>
<tr><td>20</td><td>3650</td></tr>
<tr><td>40</td><td>1540</td></tr>
<tr><td>60</td><td>649</td></tr>
<tr><td>100</td><td>182</td></tr>
<tr><td>120</td><td>104</td></tr>
</table></td><td>Standard resistance</td><td>Go to Step 7</td><td>Go to Step 12</td></tr>
<tr><td>7</td><td>Using the DVM and check the ECT sensor signal circuit.
1. Ignition "On", engine "Off".
2. Disconnect the ECT sensor connector.
3. Check the circuit for open circuit.
Was the DVM indicated specified value?
 
</td><td>Approximately 5.0V</td><td>Go to Step 10</td><td>Less than 1V: Go to Step 8
More than specified value: Go to Step 9</td></tr>
<tr><td>8</td><td>Repair the open circuit between the ECM and ECT sensor.
Was the problem solved?
 
</td><td>-</td><td>Verify repair</td><td>Go to Step 14</td></tr>
</table>

Step	Action	Value (s)	Yes	No
9	Repair the short to voltage circuit between the ECM and ECT sensor. Was the problem solved? 	-	Verify repair	Go to *Step 14*
10	Using the DVM and check the ECT sensor ground circuit. 1. Ignition "On", engine "Off". 2. Disconnect the ECT sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 11*	Repair faulty harness and verify repair

Step	Action	Value (s)	Yes	No
11	Using the DVM and check the ECT sensor ground circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected) Refer to 6E-95 page. 3. Disconnect the ECT sensor connector. 4. Check the circuit for open circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the ECT sensor connector. 3. Check the circuit for open circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 14*
12	Substitute a known good ECT sensor assembly and recheck. Was the problem solved?	-	Go to *Step 13*	Go to *Step 14*
13	Replace the ECT sensor. Is the action complete?	-	Verify repair	-
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 15*

Step	Action	Value (s)	Yes	No
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0121 (FLASH CODE 21) THROTTLE POSITION SENSOR (TPS) CIRCUIT RANGE/PERFORMANCE



RUW46EMF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
21	P0121	A	Throttle Position Sensor Range/Performance	1. No DTC relating to barometer sensor, ECT sensor, CMP sensor, CKP sensor, MAF sensor and TPS (low input & high input). 2. Engine speed is more than 2000rpm. 3. Engine coolant temperature is more than 75°C. 4. TPS output voltage is between 0.24V and 0.26V. Above conditions are met for 3 seconds. OR 1. No DTC relating to barometer sensor, ECT sensor, CMP sensor, CKP sensor, MAF sensor and TPS (low input & high input). 2. Engine speed is below 3200rpm. 3. Engine coolant temperature is more than 75°C. 4. TPS output voltage is between 4.54V and 4.56V. Above conditions are met for 3 seconds.	No fail-safe function.

CIRCUIT DESCRIPTION

The TPS circuit provides a voltage signal that changes relative to throttle blade angle. The signal voltage will vary from about 0.6 volts at closed throttle to about 4.5 volts at wide open throttle (WOT).

The TPS signal is one of the most important inputs used by the Engine Control Module (ECM) for fuel control and many of the ECM-controlled outputs. The ECM monitors throttle position and compares actual throttle position from the TPS to a predicted TPS value calculated from engine speed. If the ECM detects an out-of-range condition, DTC P0121 will set.

DIAGNOSTIC AIDS

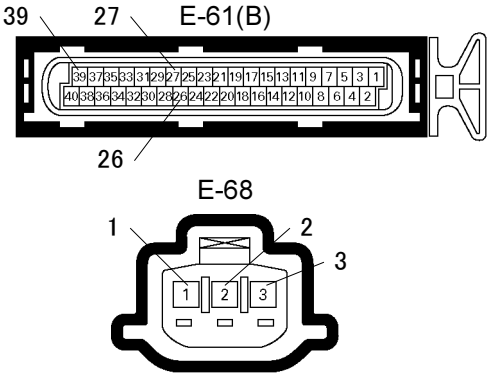
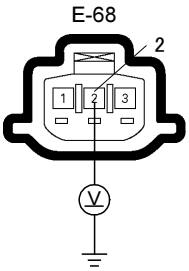
Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the Tech 2 while moving connectors and wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.

If DTC P0121 cannot be duplicated, the information included in the Failure Records data can be useful in determining vehicle mileage since the DTC was last set.

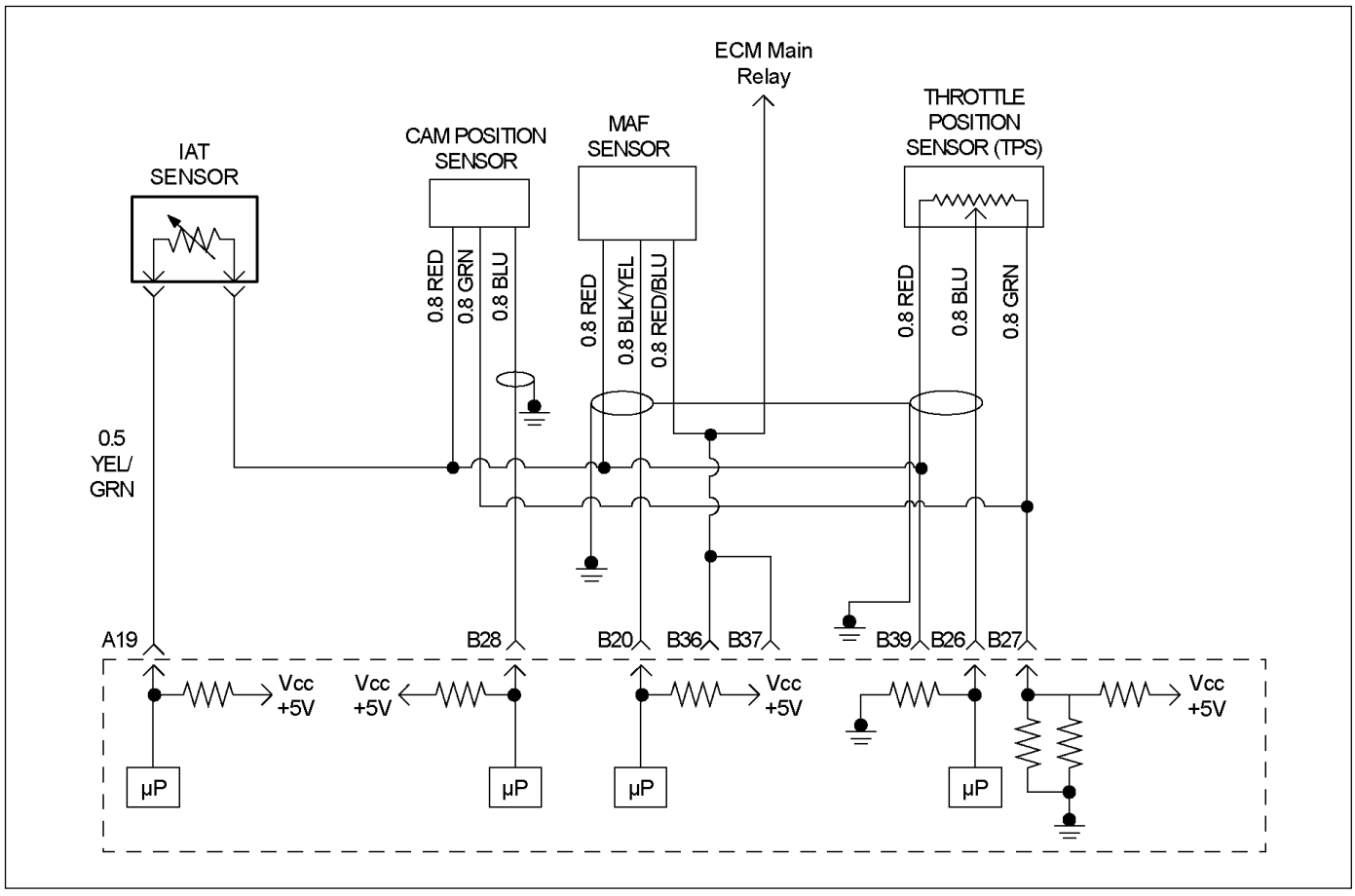
Diagnostic Trouble Code (DTC) P0121 (Flash Code 21) Throttle Position Sensor (TPS) Circuit Range/Performance

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0121 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0121 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" from 0% to 100% depending on accelerator pedal operation?	-	Go to *Step 6*	Go to *Step 5*
5	1. Using the Tech 2, ignition "On" and engine "Off 2. Monitor the "Throttle Position" in the data display. 3. Adjust the TPS within 0% to 100%. Was the problem solved?	-	Verify repair	Go to *Step 12*

Step	Action	Value (s)	Yes	No
6	Check for the following conditions. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Go to *Step 7*
7	Check for poor/faulty connection at the TPS or ECM connector. If a poor/faulty connection is found, repair the faulty terminal. Was the problem found? 	-	Verify repair	Go to *Step 8*
8	Visually check the TPS. Was the problem found?	-	Go to *Step 12*	Go to *Step 9*
9	Using the DVM and check the TPS signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the TPS connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 10*	Repair faulty harness and verify repair
10	Check any accessory parts which may cause electric interference. Was the problem found?	-	Remove the accessory parts and verify repair	Go to *Step 11*
11	Check the shield wire for open or short circuit. Was the problem found?	-	Verify repair	Go to *Step 12*
12	Substitute a known good TPS and recheck. Was the problem solved?	-	Go to *Step 13*	Go to *Step 14*
13	Replace the TPS. Is the action complete?	-	Verify repair	-

Step	Action	Value (s)	Yes	No
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 15*
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0122 (FLASH CODE 21) THROTTLE POSITION SENSOR CIRCUIT LOW INPUT



RUW46EMF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
21	P0122	A	Throttle Position Sensor Low Input	TPS output voltage is below 0.24V.	The ECM uses default throttle position value based on mass air flow and engine speed.

CIRCUIT DESCRIPTION

The TPS circuit provides a voltage signal that changes relative to throttle blade angle. The signal voltage will vary from below 0.6 volts at closed throttle to about 4.5 volts at wide open throttle (WOT).

The TPS signal is used by the Engine Control Module (ECM) for fuel control and many of the ECM-controlled outputs.

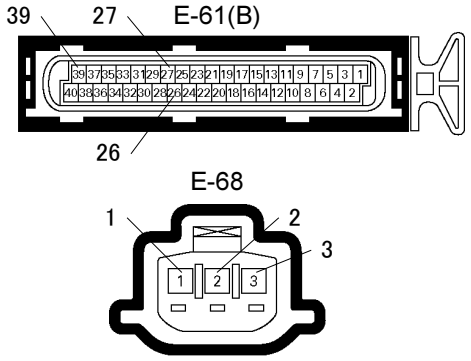
DIAGNOSTIC AIDS

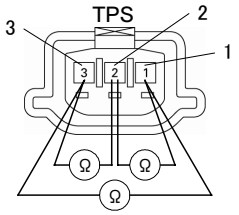
Check for the following conditions:

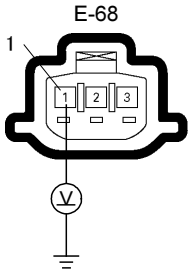
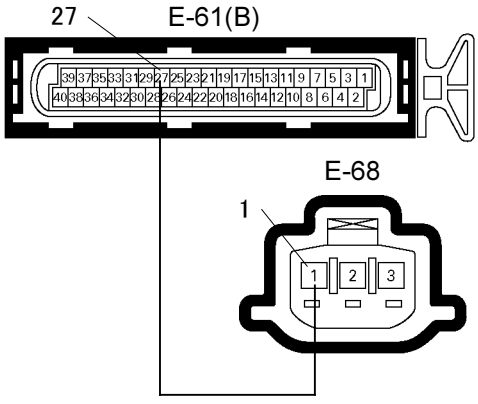
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the throttle position display on the Tech 2 while moving connectors and wiring harnesses related to the TPS. A change in the display will indicate the location of the fault.

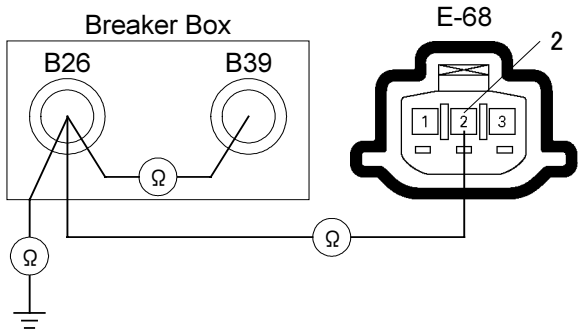
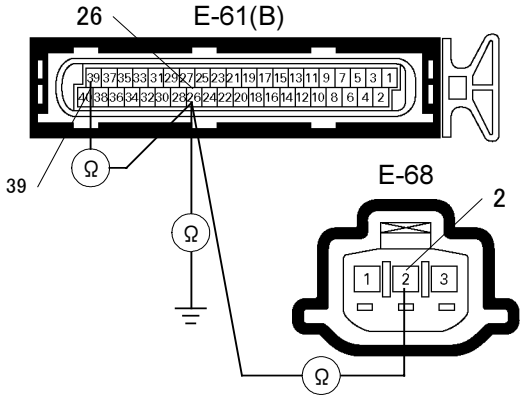
If DTC P0122 cannot be duplicated, the information included in the Failure Records data can be useful in determining vehicle mileage since the DTC was last set.

Diagnostic Trouble Code (DTC) P0122 (Flash Code 21) Throttle Position Sensor Circuit Low Input

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0122 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0122 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the TPS or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 5*
5	Visually check the TPS. Was the problem found?	-	Go to *Step 10*	Go to *Step 6*

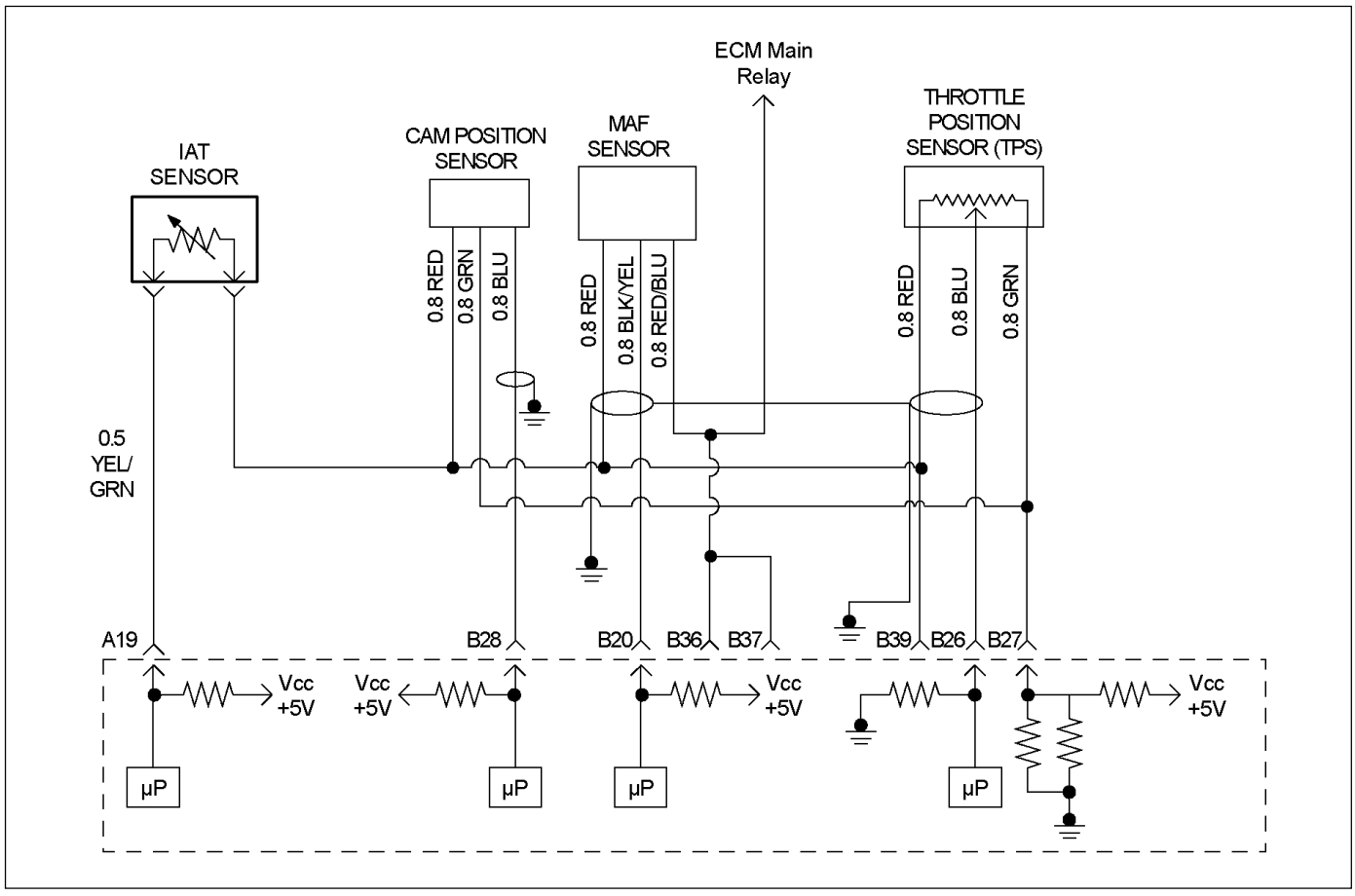
<table>
<tr><th>Step</th><th>Action</th><th>Value (s)</th><th>Yes</th><th>No</th></tr>
<tr><td>6</td><td>Using the DVM and check the TPS.
1. Ignition "Off", engine "Off".
2. Disconnect TPS connector.
3. Measure the resistance of TPS.
Does the tester indicate standard resistance as shown in the following table?
 

<table>
<tr><th>Measurement Terminal</th><th>Resistance (Ω)</th></tr>
<tr><td rowspan="2">1 - 2</td><td>Approximately 4.7kΩ at idle position</td></tr>
<tr><td>Approximately 1.0kΩ at WOT</td></tr>
<tr><td rowspan="2">2 – 3</td><td>Approximately 0.6kΩ at idle position</td></tr>
<tr><td>Approximately 4.3kΩ at WOT</td></tr>
<tr><td>1 – 3</td><td>Approximately 5.0kΩ at idle position & WOT</td></tr>
</table></td><td>Standard resistance</td><td>Go to Step 7</td><td>Go to Step 10</td></tr>
<tr><td>7</td><td>Using the DVM and check the TPS power supply circuit.
1. Ignition "On", engine "Off".
2. Disconnect the TPS connector.
3. Check the circuit for open or short to ground circuit.
Was the DVM indicated specified value?
 
</td><td>Approximately 5.0V</td><td>Go to Step 9</td><td>Go to Step 8</td></tr>
<tr><td>8</td><td>Repair the open or short to ground circuit between the ECM and TPS.
Was the problem solved?
 
</td><td>-</td><td>Verify repair</td><td>Go to Step 12</td></tr>
</table>

Step	Action	Value (s)	Yes	No
9	Using the DVM and check the TPS signal circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect TPS connector. 4. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the TPS connector and ECM connector. 3. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 12*
10	Substitute a known good TPS and recheck. Was the problem solved?	-	Go to *Step 11*	Go to *Step 12*
11	Replace the TPS. Is the action complete?	-	Verify repair	-
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 13*

Step	Action	Value (s)	Yes	No
13	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0123 (FLASH CODE 21) THROTTLE POSITION SENSOR CIRCUIT HIGH INPUT



RUW46EMF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
21	P0123	A	Throttle Position Sensor High Input	TPS output voltage is more than 4.56V.	The ECM uses default throttle position value based on mass air flow and engine speed.

CIRCUIT DESCRIPTION

The TPS circuit provides a voltage signal that changes relative to throttle blade angle. The signal voltage will vary from about 0.6 volts at closed throttle to about 4.5 volts at wide open throttle (WOT).

The TPS signal is one of the most important inputs used by the Engine Control Module (ECM) for fuel control and many of the ECM-controlled outputs.

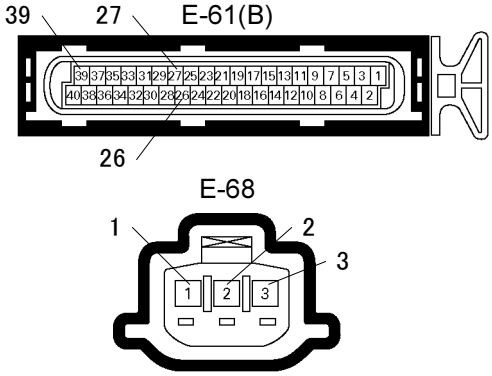
DIAGNOSTIC AIDS

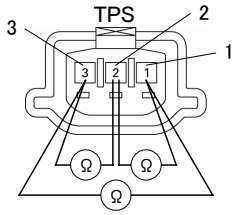
Check for the following conditions:

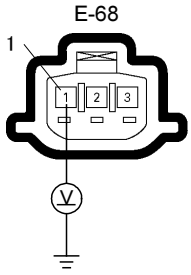
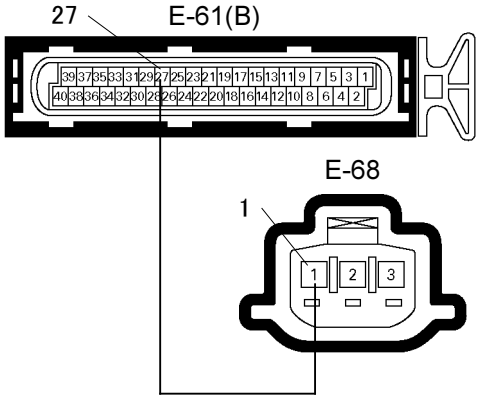
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the TPS display on the Tech 2 while moving connectors and wiring harnesses related to the TP sensor. A change in the display will indicate the location of the fault.
- Faulty TPS – With the ignition key “ON," engine “OFF," observe the TPS display on the Tech 2 while slowly depressing the accelerator to wide open throttle. If a voltage over 4.56 volts is seen at any point in normal accelerator travel, replace the TPS.

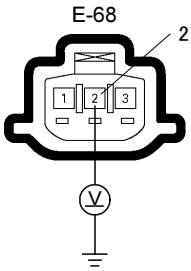
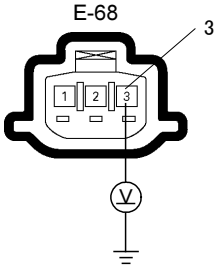
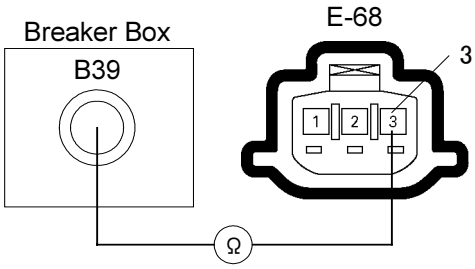
If DTC P0123 cannot be duplicated, the information included in the Failure Records data can be useful in determining vehicle mileage since the DTC was last set.

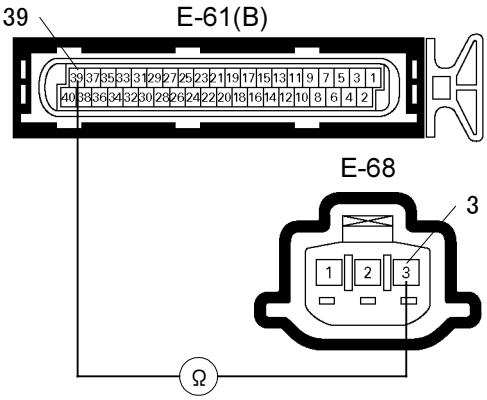
Diagnostic Trouble Code (DTC) P0123 (Flash Code 21) Throttle Position Sensor Circuit High Input

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0123 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0123 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the TPS or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 5*
5	Visually check the TPS. Was the problem found?	-	Go to *Step 12*	Go to *Step 6*

<table>
<tr><th>Step</th><th>Action</th><th>Value (s)</th><th>Yes</th><th>No</th></tr>
<tr><td>6</td><td>Using the DVM and check the TPS.
1. Ignition "Off", engine "Off".
2. Disconnect TPS connector.
3. Measure the resistance of TPS.
Does the tester indicate standard resistance as shown in the following table?
 

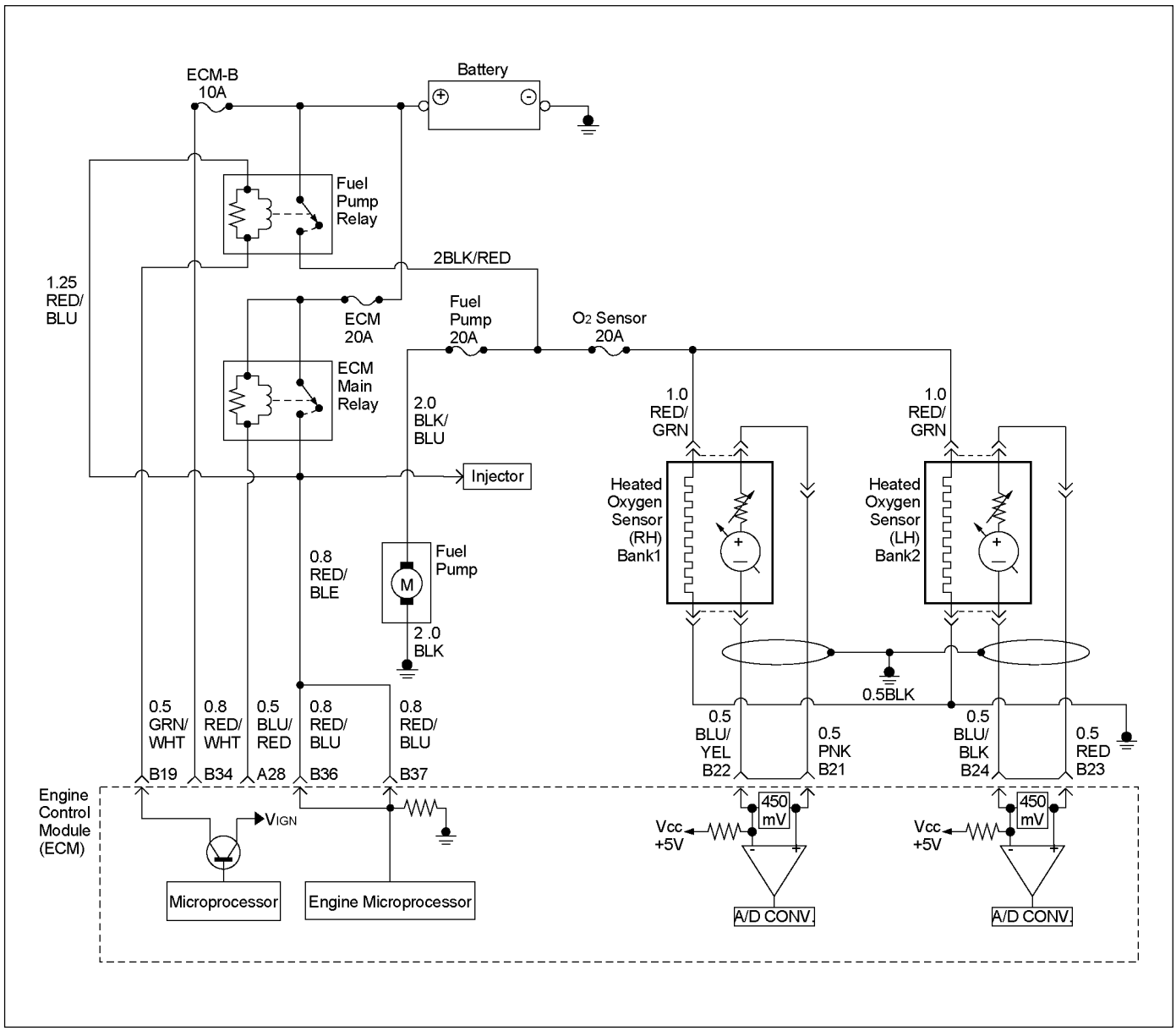
<table>
<tr><th>Measurement Terminal</th><th>Resistance (Ω)</th></tr>
<tr><td rowspan="2">1 - 2</td><td>Approximately 4.7kΩ at idle position</td></tr>
<tr><td>Approximately 1.0kΩ at WOT</td></tr>
<tr><td rowspan="2">2 – 3</td><td>Approximately 0.6kΩ at idle position</td></tr>
<tr><td>Approximately 4.3kΩ at WOT</td></tr>
<tr><td>1 – 3</td><td>Approximately 5.0kΩ at idle position & WOT</td></tr>
</table></td><td>Standard resistance</td><td>Go to Step 7</td><td>Go to Step 12</td></tr>
<tr><td>7</td><td>Using the DVM and check the TPS power supply circuit.
1. Ignition "On", engine "Off".
2. Disconnect the TPS connector.
3. Check the circuit for short to voltage circuit.
Was the DVM indicated specified value?
 
</td><td>Approximately 5.0V</td><td>Go to Step 9</td><td>Go to Step 8</td></tr>
<tr><td>8</td><td>Repair the short to voltage circuit between the ECM and TPS.
Was the problem solved?
 
</td><td>-</td><td>Verify repair</td><td>Go to Step 14</td></tr>
</table>

Step	Action	Value (s)	Yes	No
9	Using the DVM and check the TPS signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the TPS connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 10*	Repair faulty harness and verify repair
10	Using the DVM and check the TPS ground circuit. 1. Ignition "On", engine "Off". 2. Disconnect the TPS connector . 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 11*	Repair faulty harness and verify repair
11	Using the DVM and check the TPS ground circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the TPS connector. 4. Check the circuit for open circuit. Was the problem found? 			

Step	Action	Value (s)	Yes	No
	Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the TPS connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 14*
12	Substitute a known good TPS and recheck. Was the problem solved?	-	Go to *Step 13*	Go to *Step 14*
13	Replace the TPS. Is the action complete?	-	Verify repair	-
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 15*
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0131 (FLASH CODE 15) O_2 SENSOR CIRCUIT LOW VOLTAGE (BANK 1 SENSOR 1)

DIAGNOSTIC TROUBLE CODE (DTC) P0151 (FLASH CODE 15) O_2 SENSOR CIRCUIT LOW VOLTAGE (BANK 2 SENSOR 1)



RTW36ELF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
15	P0131	A	O2 Sensor Circuit Low Voltage (Bank 1 Sensor 1)	1. No DTC relating to ECT sensor, CMP sensor, CKP sensor, VSS, injector control circuit, ignition control circuit and O2 sensor circuit no activity (bank 1 & 2). 2. Engine speed is between 1000rpm and 4000rpm. 3. Engine coolant temperature is between 70°C and 110°C. 4. Vehicle speed is between 0km/h and 120km/h. 5. Engine load is between 80% and 160%. 6. Throttle position fluctuation is below 0.28V. 7. O2 sensor bank 1 or bank 2 output voltage is more than 400mV for 50 seconds.	"Open Loop" fuel control.
	P0151	A	O2 Sensor Circuit Low Voltage (Bank 2 Sensor 1)		

CIRCUIT DESCRIPTION

The Engine Control Module (ECM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO2S) signal high and signal low circuits. The ECM constantly monitors the HO2S signal during “closed loop" operation and compensates for a rich or lean condition by decreasing or increasing injector pulse width as necessary. If HO2S voltage remains excessively low for an extended period of time, DTC P0131 or P0151 will be set.

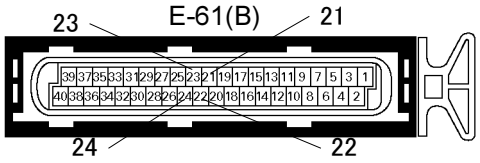
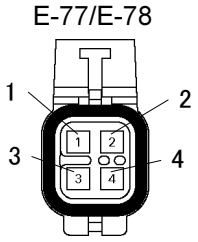
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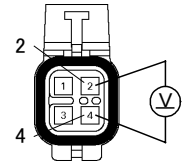
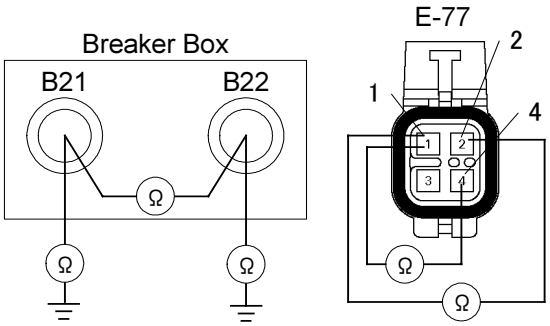
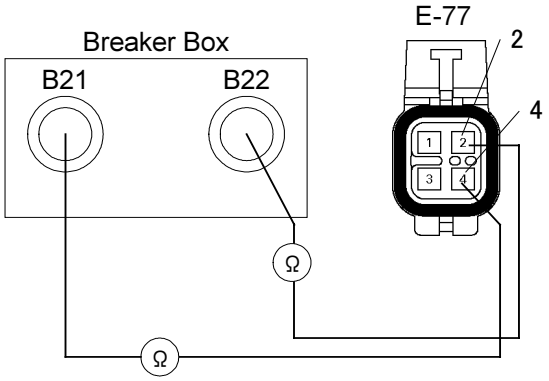
Check for the following conditions:

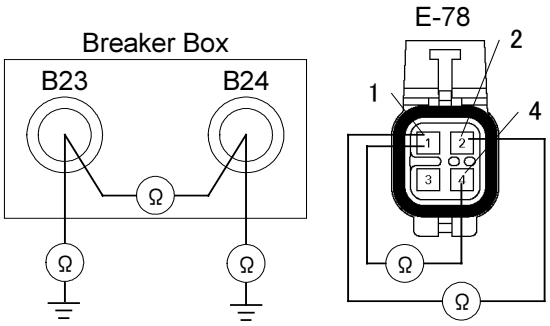
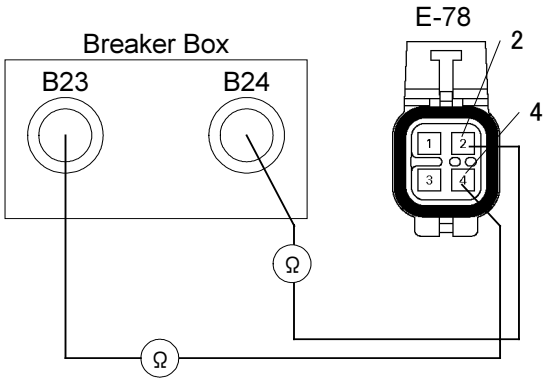
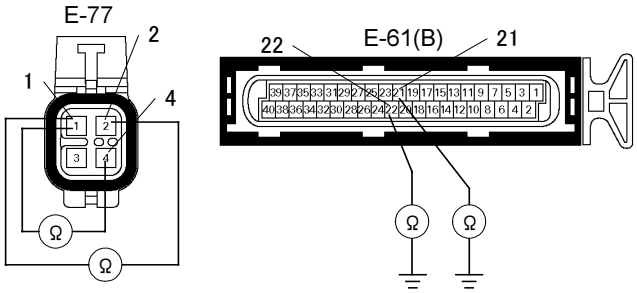
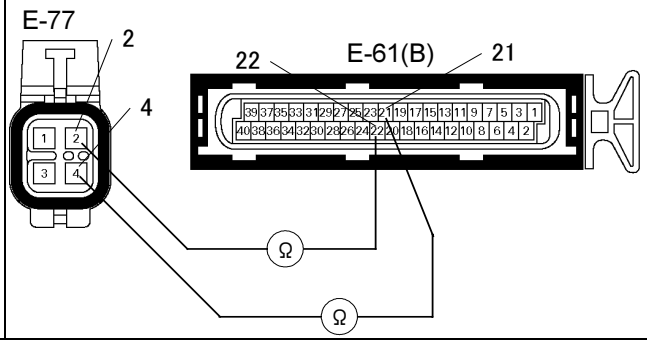
- Heated oxygen sensor wiring – The sensor pigtail may be routed incorrectly and contacting the exhaust system.
- Poor ECM to engine block grounds.
- Fuel pressure – The system will go lean if pressure is too low. The ECM can compensate for some decrease. However, If fuel pressure is too low, a DTC P0131 or P0151 may be set. Refer to 6E-116 *Fuel System Diagnosis*.
- Lean injector(s) – Perform “Injector Balance Test."
- Exhaust leaks – An exhaust leak may cause outside air to be pulled into the exhaust gas stream past the HO2S, causing the system to appear lean. Check for exhaust leaks that may cause a false lean condition to be indicated.
- MAF sensor – The system can go lean if the MAF sensor signal indicates an engine airflow measurement that is not correct. Disconnect the MAF sensor to see if the lean condition is corrected. If so, replace the MAF sensor.
- Fuel contamination – Water, even in small amounts, can be delivered to the fuel injectors. The water can cause a lean exhaust to be indicated. Excessive alcohol in the fuel can also cause this condition. Refer to 6E-116 *Fuel System Diagnosis* for the procedure to check for fuel contamination.
- If none of the above conditions are present, replace the affected HO2S.

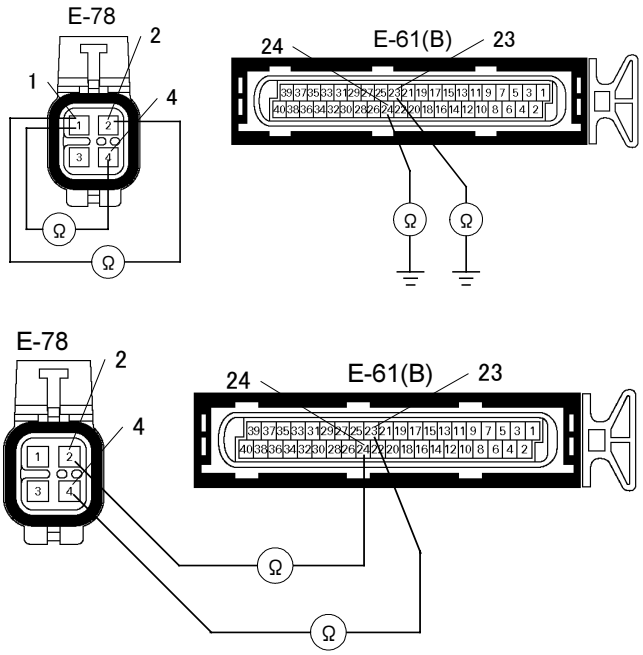
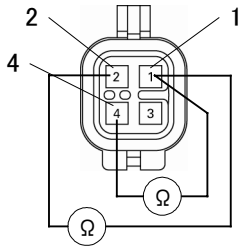
Diagnostic Trouble Code (DTC) P0131 (Flash Code 15) O_2 Sensor Circuit Low Voltage (Bank 1 Sensor 1)

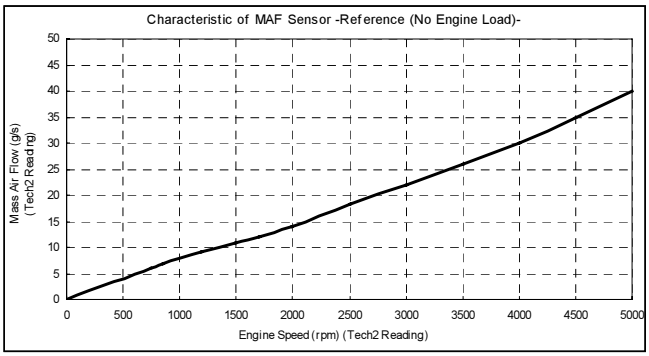
Diagnostic Trouble Code (DTC) P0151 (Flash Code 15) O_2 Sensor Circuit Low Voltage (Bank 2 Sensor 1)

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0131 or P0151 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0131 or P0151 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the O2 sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?  	-	Verify repair	Go to *Step 5*

Step	Action	Value (s)	Yes	No
5	Using the DVM and check the O2 sensor circuit for the affected bank. 1. Ignition "On", engine "Off". 2. Disconnect the O2 sensor connector for the affected bank. 3. Check the circuit for open, short to heater ground or ground circuit. Was the DVM indicated specified value? BANK1/BANK2 E-77/E-78 	Approximatly 450mV	Go to *Step 7*	Go to *Step 6*
6	Using the DVM and check the O2 sensor circuit for the affected bank. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the O2 sensor for the affected bank. 4. Check the circuit for open, short to heater ground or short to ground circuit. Was the problem found? BANK1  			

Step	Action	Value (s)	Yes	No
	BANK2   **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the O2 sensor connector for the affected bank and ECM connector. 3. Check the circuit for open, short to heater ground or short to ground circuit. Was the problem found? BANK1   	-	Repair faulty harness and verify repair	Go to *Step 15*

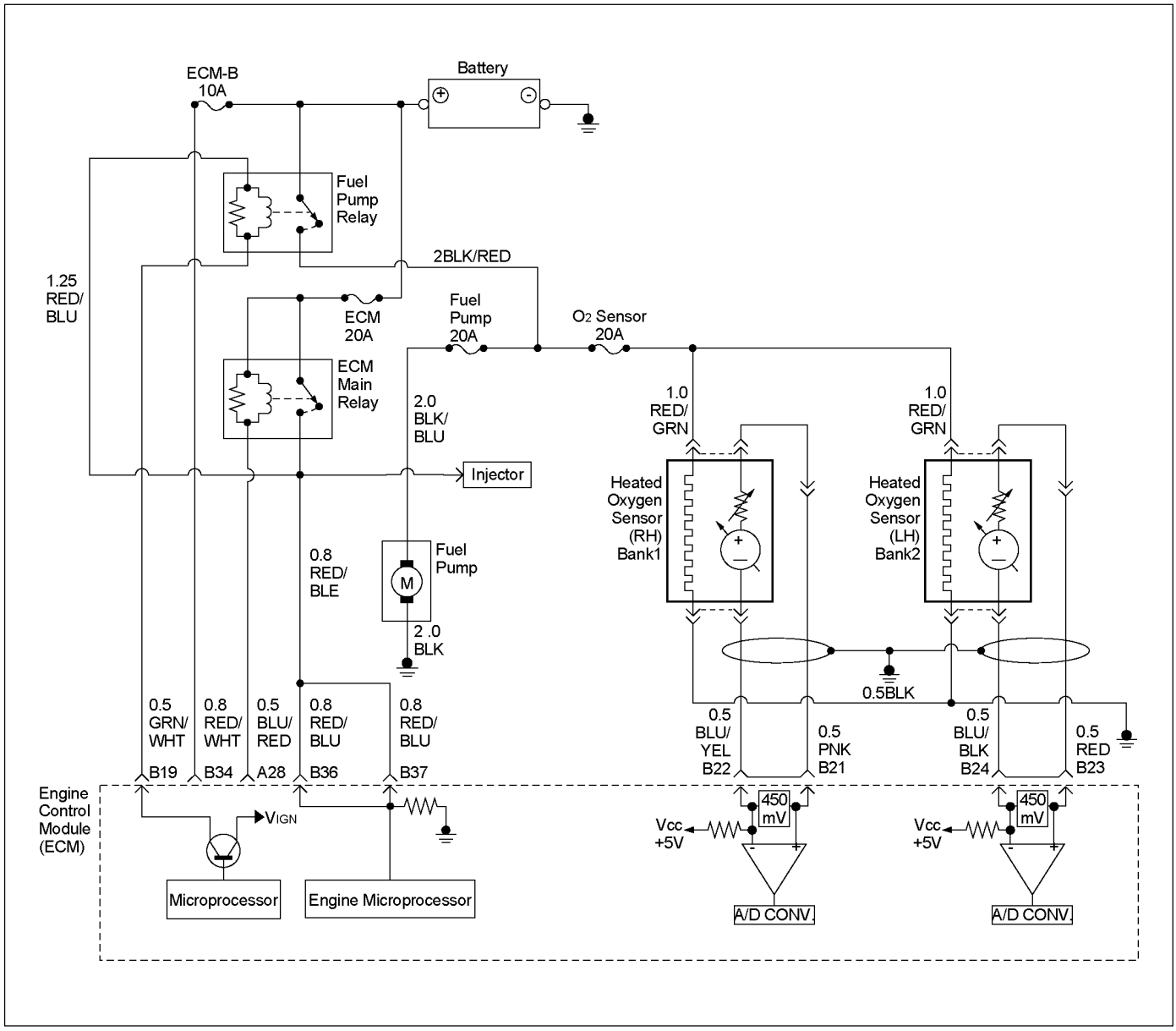
Step	Action	Value (s)	Yes	No
	BANK2  			
7	Using the DVM and check the O2 sensor circuit for the affected bank. 1. Ignition "Off", engine "Off". 2. Disconnect the O2 sensor connector for the affected bank. 3. Check the circuit for short to heater ground circuit. Was the DVM indicated specified value? BANK1/BANK2 O2 Sensor  	No continuity	Go to *Step 9*	Go to *Step 8*
8	Repair the short to heater ground circuit. Was the problem found?	-	Verify repair	Go to *Step 15*

Step	Action	Value (s)	Yes	No
9	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Mass Air Flow" in the data display. Does the Tech 2 indicate correct "Mass Air Flow" as shown in the following graph, when engine speed is increasing little by little? 	-	Go to *Step 11*	Go to *Step 10*
10	Remove the MAF & IAT sensor assembly and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAF sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P0101* and Go to *Step 11*
11	1. Using the Tech 2, ignition "On" and engine "On". 2. Select the "Miscellaneous Test" and perform the "IAC Control" in the "IAC System". 3. Operate the Tech 2 in accrodance with procedure. Was the engine speed changed, when the IAC Valve is operating step by step?	-	Go to *Step 13*	Go to *Step 12*
12	Check for the following conditions. • Objects blocking the IAC Valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P1508/P1509* and Go to *Step 13*
13	Check for injector for the affected bank. Refer to 6E-106 *"Injector Coil Test & Injector Balance Test Procedure"* Was the injector operation correct?	-	Go to *Step 14*	Refer to *Injector Coil Test & Injecotr Balance Test Procedure*
14	Check for fuel pressure. Refer to 6E-116 *"Fuel System Diagnosis".* Was the fuel pressure correct?	-	Go to *Step 15*	Refer to *Fuel System Diagnosis*
15	Replace the O2 sensor for the affected bank. Was the problem solved?	-	Verify repair	Go to *Step 16*

Step	Action	Value (s)	Yes	No
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	- -	Verify repair	Go to *Step 17*
17	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	- -	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0132 (FLASH CODE 15) O2 SENSOR CIRCUIT HIGH VOLTAGE (BANK 1 SENSOR 1)

DIAGNOSTIC TROUBLE CODE (DTC) P0152 (FLASH CODE 15) O2 SENSOR CIRCUIT HIGH VOLTAGE (BANK 2 SENSOR 1)



RTW36ELF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
15	P0132	A	O2 Sensor Circuit High Voltage (Bank 1 Sensor 1)	1. No DTC relating to ECT sensor, CMP sensor, CKP sensor, VSS, injector control circuit, ignition control circuit and O2 sensor circuit no activity (bank 1 & 2). 2. Engine speed is between 1000rpm and 4000rpm. 3. Engine coolant temperature is between 70℃ and 110℃. 4. Vehicle speed is between 0km/h and 120km/h. 5. Engine load is between 80% and 160%. 6. Throttle position fluctuation is below 0.28V. 7. O2 sensor bank 1 or bank 2 output voltage is below 600mV for 50 seconds.	"Open Loop" fuel control.
	P0152	A	O2 Sensor Circuit High Voltage (Bank 2 Sensor 1)		

CIRCUIT DESCRIPTION

The Engine Control Module (ECM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO2S) signal high and signal low circuits. The ECM constantly monitors the HO2S signal during “closed loop" operation and compensates for a rich or lean condition by decreasing or increasing injector pulse width as necessary. If the HO2S voltage remains excessively high for an extended period of time, DTC P0132 or P0152 will be set.

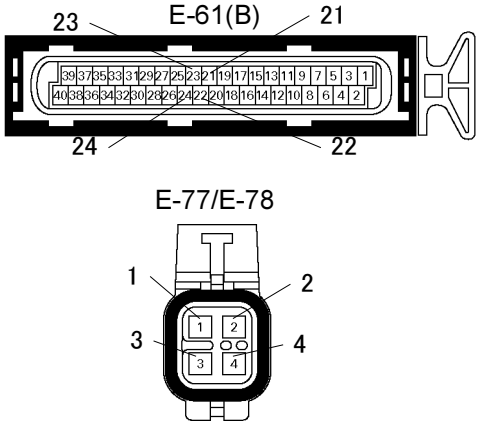
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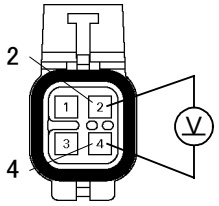
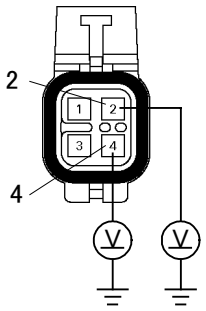
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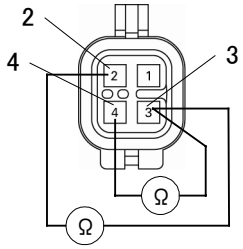
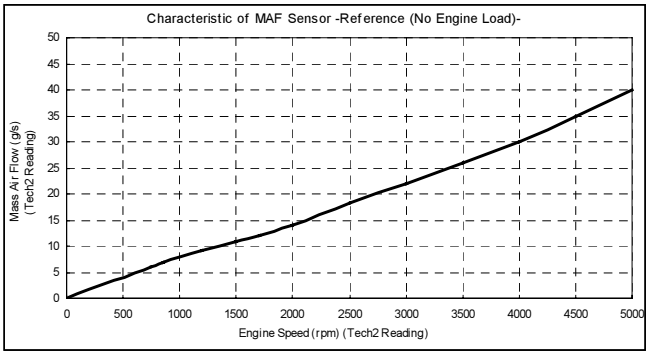
- Fuel pressure – The system will go rich if pressure is too high. The ECM can compensate for some increase. However, if fuel pressure is too high, a DTC P0132 or P0152 may be set. Refer to 6E-116 *Fuel System Diagnosis*.
- Perform “Injector Balance Test" – Refer to 6E-116 *Fuel System Diagnosis*.
- Check the canister for fuel saturation – If full of fuel, check canister control and hoses.
- MAF sensor –The system can go rich if MAF sensor signal indicates an engine airflow measurement that is not correct. Disconnect the MAF sensor to see it the rich condition is corrected. If so, replace the MAF sensor.
- Check for a leak in the fuel pressure regulator diaphragm by checking the vacuum line to the regulator for the presence of fuel. There should be no fuel in the vacuum line.
- An intermittent throttle position sensor output will cause the system to go rich due to a false indication of the engine accelerating.
- Shorted Heated Oxygen Sensor (HO2S) –If the HO2S is internally shorted, the HO2S voltage displayed on the Tech 2 will be over 1 volt. Try disconnecting the affected HO2S with the key “ON," engine “OFF." If the displayed HO2S voltage changes from over 1000 mV to around 450 mV, replace the HO2S. Silicon contamination of the HO2S can also cause a high HO2S voltage to be indicated. This condition is indicated by a powdery white deposit on the portion of the HO2S exposed to the exhaust stream. If contamination is noticed, replace the affected HO2S.
- Open HO2S Signal Circuit or Faulty HO2S–A poor connection or open in the HO2S signal circuit can cause the DTC to set during deceleration fuel mode. An HO2S which is faulty and not allowing a full voltage swing between the rich and lean thresholds can also cause this condition. Operate the vehicle by monitoring the HO2S voltage with a Tech 2. If the HO2S voltage is limited within a range between 300 mV to 600 mV, check the HO2S signal circuit wiring and associated terminal conditions.
- If none of the above conditions are present, replace the affected HO2S.

Diagnostic Trouble Code (DTC) P0132 (Flash Code 15) O2 Sensor Circuit High Voltage (Bank 1 Sensor 1)

Diagnostic Trouble Code (DTC) P0152 (Flash Code 15) O2 Sensor Circuit High Voltage (Bank 2 Sensor 1)

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0132 or P0152 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0132 or P0152 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the O2 sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 5*

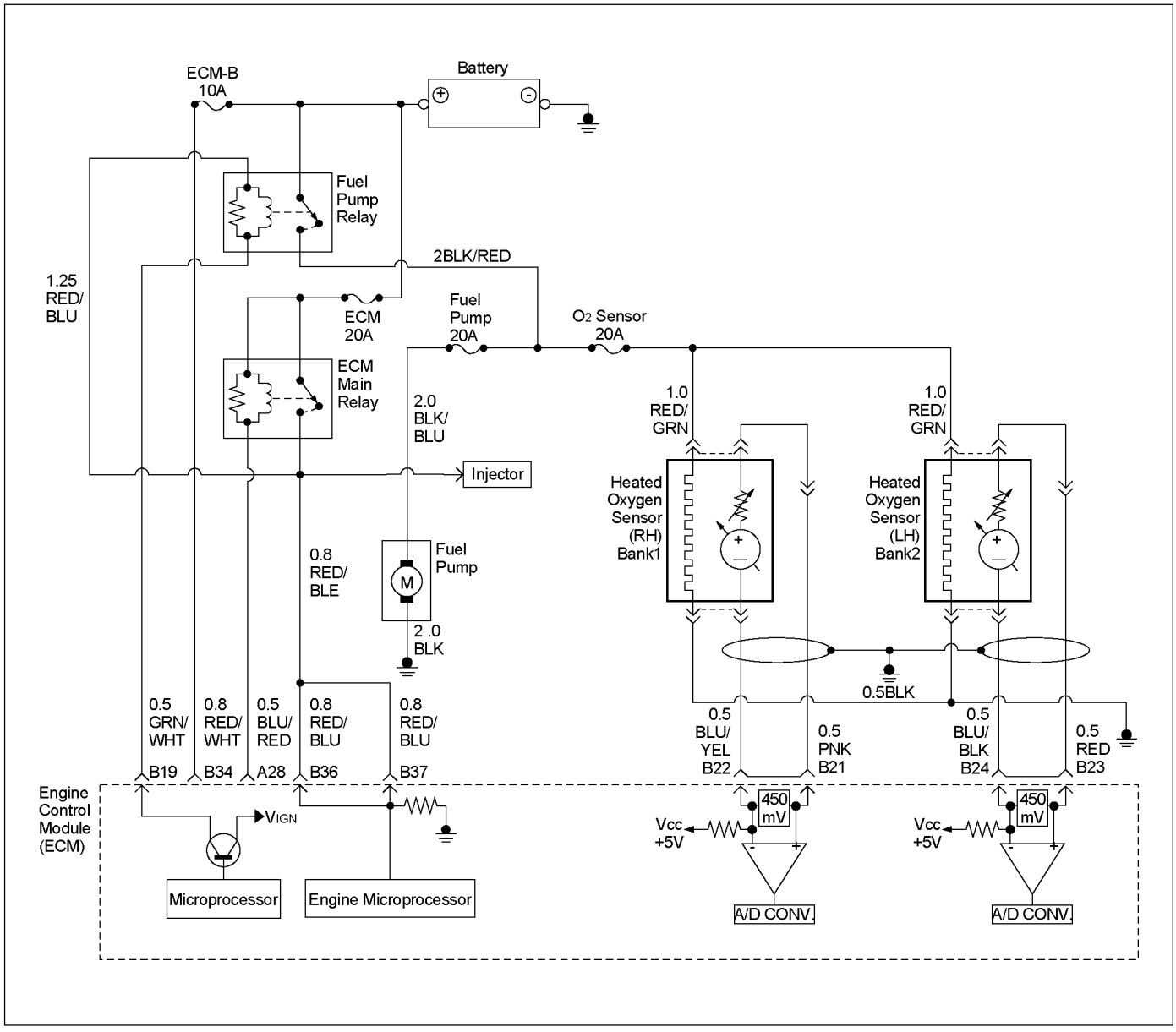
Step	Action	Value (s)	Yes	No
5	Using the DVM and check the O2 sensor circuit for the affected bank. 1. Ignition "On", engine "Off". 2. Disconnect the O2 sensor connector for the affected bank. 3. Check the circuit for open, short to heater ground or ground circuit. Was the DVM indicated specified value? BANK1/BANK2 E-77/E-78 	Approximatly 450mV	Go to *Step 7*	Go to *Step 6*
6	Using the DVM and check the O2 sensor circuit for the affected bank. 1. Ignition "On", engine "Off". 2. Disconnect the O2 sensor connector for the affected cylinder. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specifed value? BANK1/BANK2 E-77/E-78 	Less than 1V	Go to *Step 15*	Repair faulty harness and verify repair

Step	Action	Value (s)	Yes	No
7	Using the DVM and check the O2 sensor circuit for the affected bank. 1. Ignition "Off", engine "Off". 2. Disconnect the O2 sensor connector for the affected bank. 3. Check the circuit for short to heater power supply circuit. Was the DVM indicated specified value? BANK1/BANK2 O2 Sensor 	No continuity	Go to *Step 9*	Go to *Step 8*
8	Repair the short to heater power supply circuit. Was the problem found?	-	Verify repair	Go to *Step 15*
9	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Mass Air Flow" in the data display. Does the Tech 2 indicate correct "Mass Air Flow" as shown in the following graph, when engine speed is increasing little by little? 	-	Go to *Step 11*	Go to *Step 10*
10	Remove the MAF & IAT sensor assembly and check for the following conditions. • -Objects blocking the air cleaner. • Objects blocking the MAF sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P0101* and Go to *Step 11*

Step	Action	Value (s)	Yes	No
11	1. Using the Tech 2, ignition "On" and engine "On". 2. Select the "Miscellaneous Test" and perform the "IAC Control" in the "IAC System". 3. Operate the Tech 2 in accrodance with procedure. Was the engine speed changed, when the IAC Valve is operating step by step?	-	Go to *Step 13*	Go to *Step 12*
12	Check for the following conditions. • Objects blocking the IAC Valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P1508/P1509* and Go to *Step 13*
13	Check for injector for the affected bank. Refer to 6E-106 *"Injector Coil Test & Injector Balance Test Procedure".* Was the injector operation correct?	-	Go to *Step 14*	Refer to *Injector Coil Test & Injector Balance Test Procedure*
14	Check for fuel pressure. Refer to 6E-116 *"Fuel System Diagnosis".* Was the fuel pressure correct?	-	Go to *Step 15*	Refer to *Fuel System Diagnosis*
15	Replace the O2 sensor for the affected bank. Was the problem solved?	-	Verify repair	Go to *Step 16*
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 17*
17	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0134 (FLASH CODE 15) O2 SENSOR CIRCUIT NO ACTIVITY DETECTED (BANK 1 SENSOR 1)

DIAGNOSTIC TROUBLE CODE (DTC) P0154 (FLASH CODE 15) O2 SENSOR CIRCUIT NO ACTIVITY DETECTED (BANK 2 SENSOR 1)



RTW36ELF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
15	P0134	A	O2 Sensor Circuit No Activity Detected (Bank 1 Sensor 1)	1. No DTC relating to MAF sensor, ECT sensor, CMP sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 70°C. 3. Vehicle speed is more than 60km/h. 4. O2 sensor bank 1 or bank 2 output voltage is between 350mV and 600mV.	"Open Loop" fuel control.
	P0154	A	O2 Sensor Circuit No Activity Detected (Bank 2 Sensor 1)		

CIRCUIT DESCRIPTION

- The Engine Control Module (ECM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO2S) high and low circuits. The ECM constantly monitors the HO2S signal during “closed loop" operation and compensates for a rich or lean condition by decreasing or increasing injector pulse width as necessary. If the HO2S voltage remains at or near the 450 mV bias for an extended period of time, DTC P0134 or P0154 will be set, indicating an open sensor signal or sensor low circuit.

DIAGNOSTIC AIDS

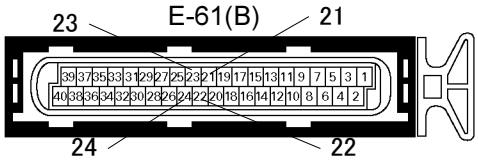
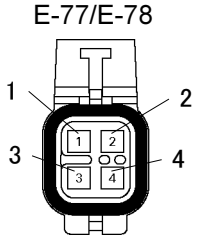
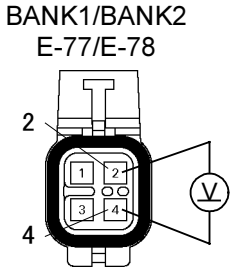
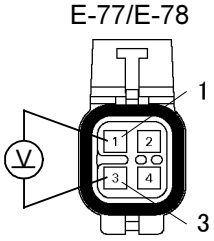
Check for the following conditions:

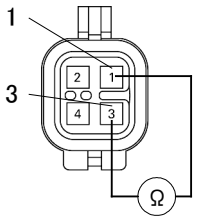
- Poor connection or damaged harness – Inspect the harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.
- Faulty HO2S heater or heater circuit – With the ignition “ON," engine “OFF," after a cool down period, the HO2S voltage displayed on the Tech 2 is normally 455-460 mV. A reading over 1000 mV indicates a signal line shorted to voltage. A reading under 5 mV indicates a signal line shorted to ground or signal lines shorted together.
- Intermittent test – With the Ignition “ON," monitor the HO2S signal voltage while moving the wiring harness and related connectors. If the fault is induced, the HO2S signal voltage will change. This may help isolate the location of the malfunction.

Diagnostic Trouble Code (DTC) P0134 (Flash Code 15) O2 Sensor Circuit No Activity Detected (Bank 1 Sensor 1)

Diagnostic Trouble Code (DTC) P0154 (Flash Code 15) O2 Sensor Circuit No Activity Detected (Bank 2 Sensor 1)

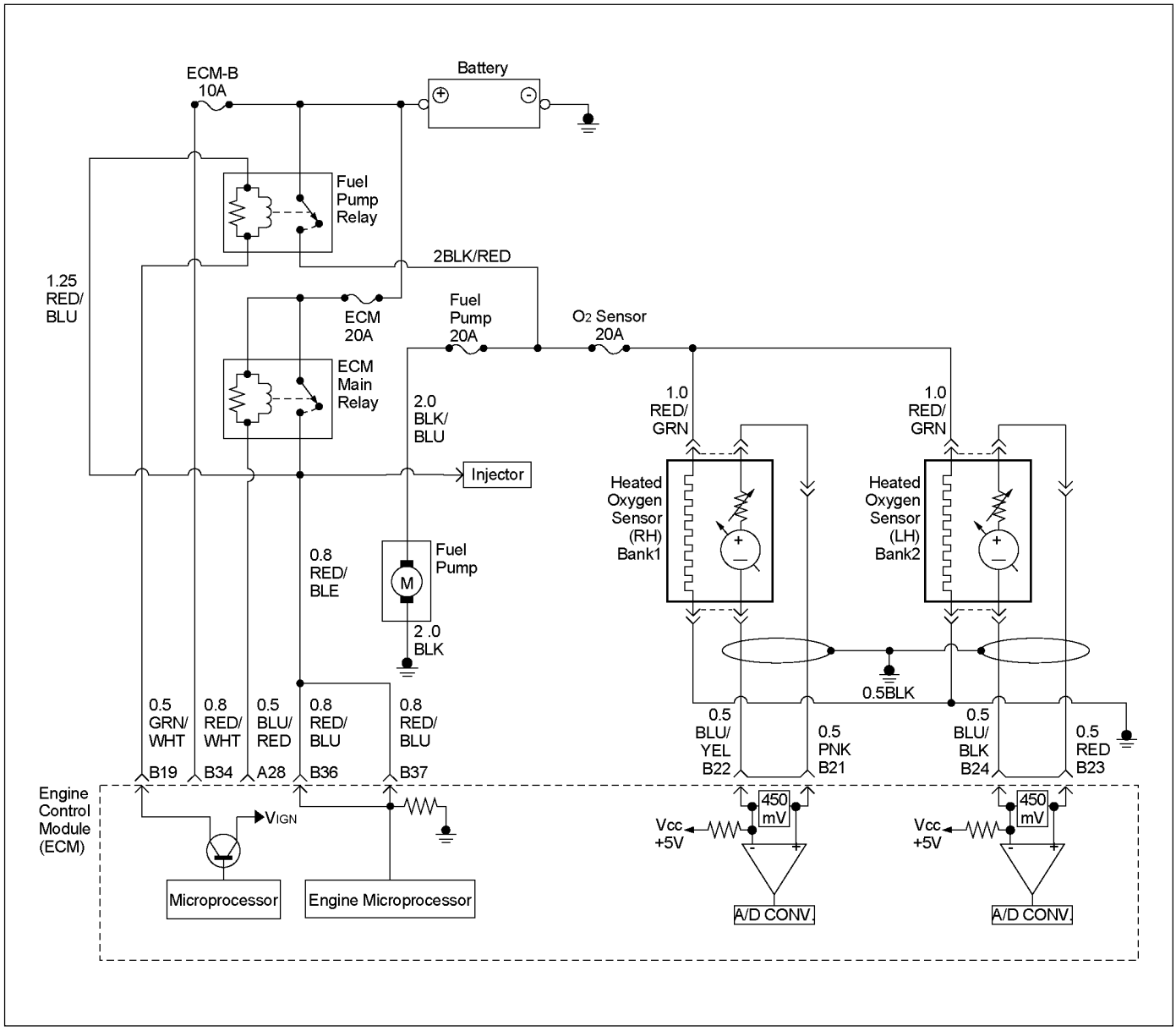
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0134 or P0154 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0134 or P0154 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*

Step	Action	Value (s)	Yes	No
4	Check for poor/faulty connection at the O2 sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?  	-	Verify repair	Go to *Step 5*
5	Using the DVM and check the O2 sensor circuit for the affected bank. 1. Ignition "On", engine "Off". 2. Disconnect the O2 sensor connector for the affected bank. 3. Check the circuit for open, short to heater ground or ground circuit. Was the DVM indicated specified value? 	Approximatly 450mV	Go to *Step 6*	Go to *Step 12*
6	Using the DVM and check the O2 sensor heater power supply circuit for the affected bank. 1. Ignition "On", engine "Off". 2. Disconnect the O2 sensor connector for the affected cylinder. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	10-14.5 V	Go to *Step 9*	Go to *Step 7*

Step	Action	Value (s)	Yes	No
7	Repair the open or short to ground circuit between the fuel pump relay and O2 sensor heater for the affected cylinder. Was the problem found?	-	Verify repair	Go to *Step 8*
8	Repair the open circuit between the O2 sensor heater and engine ground for the affected cylinder. Was the problem found?	-	Verify repair	Go to *Step 9*
9	Using the DVM and check the O2 sensor heater circuit for the affected bank. 1. Ignition "Off", engine "Off". 2. Disconnect the O2 sensor connector for the affected bank. 3. Check the circuit for short circuit. Was the tester indicated specified value? BANK1/BANK2 O2 Sensor  	Approximatly 16.5Ω at 20°C	Go to *Step 12*	Approximataly 0Ω: Go to *Step 10* No continuitly: Go to *Step 11*
10	Repair the short circuit between the O2 sensor heater power supply and ground circuit. Is the action complete?	-	Verify repair	-
11	Replace the O2 sensor for the affected bank. Was the problem solved?	-	Verify repair	Go to *Step 12*
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 13*
13	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0171 (FLASH CODE 44) O2 SENSOR SYSTEM TOO LEAN (BANK 1)

DIAGNOSTIC TROUBLE CODE (DTC) P0174 (FLASH CODE 44) O2 SENSOR SYSTEM TOO LEAN (BANK 2)



RTW36ELF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
44	P0171	B	O2 Sensor System Too Lean (Bank 1)	1. No DTC relating to MAF sensor, IAT sensor, ECT sensor, TPS, CMP sensor, CKP sensor, VSS, injector control circuit, ignition control circuit, O2 sensor circuit low voltage & high voltage (bank 1 & 2) and O2 sensor circuit no activity (bank 1 & 2). 2. Engine speed is more than 600rpm. 3. Intake air temperature is more than 50°C. 4. Engine coolant temperature is between 35°C and 120°C. 5. Engine load is more than 20%. 6. EVAP purge solenoid valve on-duty is below 100%. 7. Air-fuel ratio correction volume is more than 150% for 20 seconds.	No fail-safe function.
	P0174	B	O2 Sensor System Too Lean (Bank 2)		

CIRCUIT DESCRIPTION

To provide the best possible combination of driveability, fuel economy, and emission control, a “closed loop" air/fuel metering system is used. While in “closed loop," the Engine Control Module (ECM) monitors the HO2S signals and adjusts fuel delivery based upon the HO2S signal voltages. A change made to fuel delivery will be indicated by the long and short term fuel trim values which can be monitored with a Tech 2. Ideal fuel trim values are around 0%; if the HO2S signals are indicating a lean condition the ECM will add fuel, resulting in fuel trim values above 0%. If a rich condition is detected, the fuel trim values will be below 0%, indicating that the ECM is reducing the amount of fuel delivered. If an excessively lean condition is detected, the ECM will set DTC P0171 or P0174.

The ECM's maximum authority to control long term fuel trim allows a range between –15% (automatic transmission) or –12% (manual transmission) and +20%. The ECM monitors fuel trim under various engine speed/load fuel trim cells before determining the status the fuel trim diagnostic.

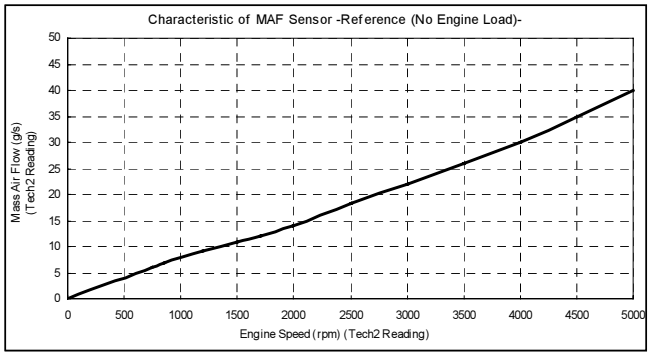
DIAGNOSTIC AIDS

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the HO2S display on the Tech 2 while moving connectors and wiring harnesses related to the engine harness. A change in the display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0171 (Flash Code 44) O2 Sensor System Too Lean (Bank 1)

Diagnostic Trouble Code (DTC) P0174 (Flash Code 44) O2 Sensor System Too Lean (Bank 2)

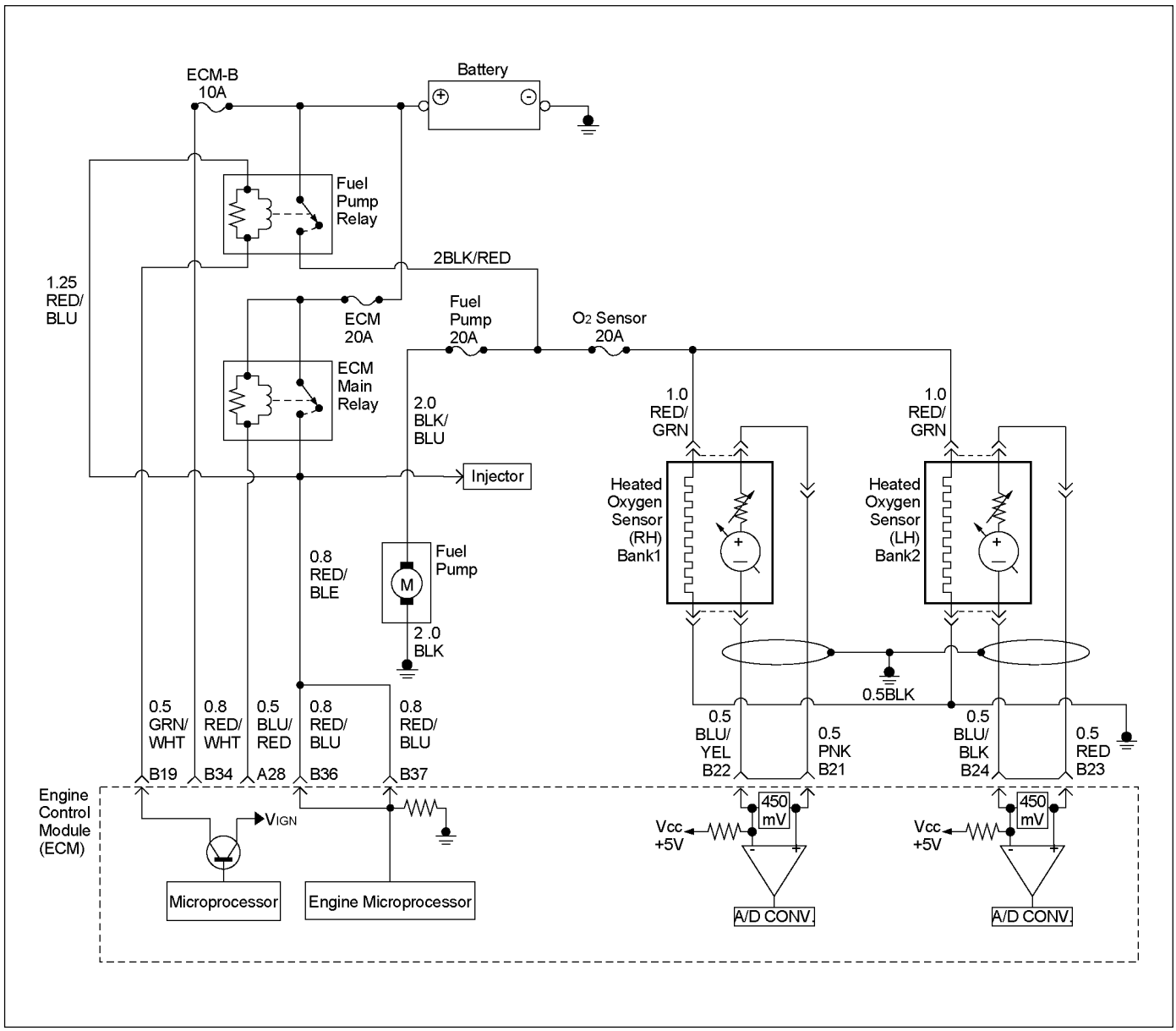
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0171 or P0174 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0171 or P0174 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Mass Air Flow" in the data display. Does the Tech 2 indicate correct "Mass Air Flow" as shown in the following graph, when engine speed is increasing little by little? 	-	Go to *Step 6*	Go to *Step 5*
5	Remove the MAF & IAT sensor assembly and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAF sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P0101* and Go to *Step 6*

Step	Action	Value (s)	Yes	No
6	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" from 0% to 100% depending on accelerator pedal operation?	-	Go to *Step 8*	Go to *Step 7*
7	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. 3. Adjust the TPS within 0% to 100%. Was the action complete?	-	Verify repair	-
8	Check for the following conditions. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P0121* and Go to *Step 9*
9	1. Using the Tech 2, ignition "On" and engine "On". 2. Select the "Miscellaneous Test" and perform the "IAC Control" in the "IAC System". 3. Operate the Tech 2 in accrodance with procedure. Was the engine speed changed, when the IAC Valve is operating step by step?	-	Go to *Step 11*	Go to *Step 10*
10	Check for the following conditions. • Objects blocking the IAC Valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P1508/P1509* and Go to *Step 11*
11	Check for injector for the affected bank. Refer to 6E-106 *"Injector Coil Test & Injector Balance Test Procedure".* Was the injector operation correct?	-	Go to *Step 12*	Refer to *Injector Coil Test & Injector Balance Test Procedure*
12	Check for fuel pressure. Refer to 6E-116 *"Fuel System Diagnosis".* Was the fuel pressure correct?	-	Go to *Step 13*	Refer to *Fuel System Diagnosis*
13	Replace the O2 sensor for the affected bank. Was the problem solved?	-	Verify repair	Go to *Step 14*
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 15*

Step	Action	Value (s)	Yes	No
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0172 (FLASH CODE 45) O2 SENSOR SYSTEM TOO RICH (BANK 1)

DIAGNOSTIC TROUBLE CODE (DTC) P0175 (FLASH CODE 44) O2 SENSOR SYSTEM TOO RICH (BANK 2)



RTW36ELF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
45	P0172	B	O2 Sensor System Too Rich (Bank 1)	1. No DTC relating to MAF sensor, IAT sensor, ECT sensor, TPS, CMP sensor, CKP sensor, VSS, injector control circuit, ignition control circuit, O2 sensor circuit low voltage & high voltage (bank 1 & 2) and O2 sensor circuit no activity (bank 1 & 2). 2. Engine speed is more than 600rpm. 3. Intake air temperature is more than 50°C. 4. Engine coolant temperature is between 35°C and 120°C. 5. Engine load is more than 20%. 6. EVAP purge solenoid valve on-duty is below 100%. 7. Air-fuel ratio correction volume is below 50% for 20 seconds.	No fail-safe function.
	P0175	B	O2 Sensor System Too Rich (Bank 2)		

CIRCUIT DESCRIPTION

To provide the best possible combination of driveability, fuel economy, and emission control, a “closed loop" air/fuel metering system is used. While in “closed loop," the Engine Control Module (ECM) monitors the heated oxygen sensors (HO2S) signals and adjusts fuel delivery based upon the HO2S signal voltages. A change made to fuel delivery will be indicated by the long and short term fuel trim values which can be monitored with a Tech 2. Ideal fuel trim values are around 0%; if the HO2S signals are indicating a lean condition the ECM will add fuel, resulting in fuel trim values above 0%. If a rich condition is detected, the fuel trim values will be below 0%, indicating that the ECM is reducing the amount of fuel delivered. If an excessively rich condition is detected on Bank 1, the ECM will set DTC P0172 or P0175.

The ECM's maximum authority to control long term fuel trim allows a range between –15% (automatic transmission) or –12 (manual transmission) and +20%. The ECM's maximum authority to control short term fuel trim allows a range between –11% and +20%. The ECM monitors fuel trim under various engine speed/load fuel trim cells before determining the status of the fuel trim diagnostic.

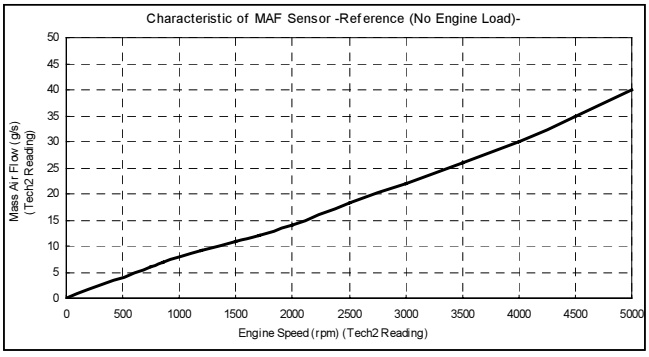
DIAGNOSTIC AIDS

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the HO2S display on the Tech 2 while moving connectors and wiring harnesses related to the engine harness. A change in the display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0172 (Flash Code 45) O2 Sensor System Too Rich (Bank 1)

Diagnostic Trouble Code (DTC) P0175 (Flash Code 44) O2 Sensor System Too Rich (Bank 2)

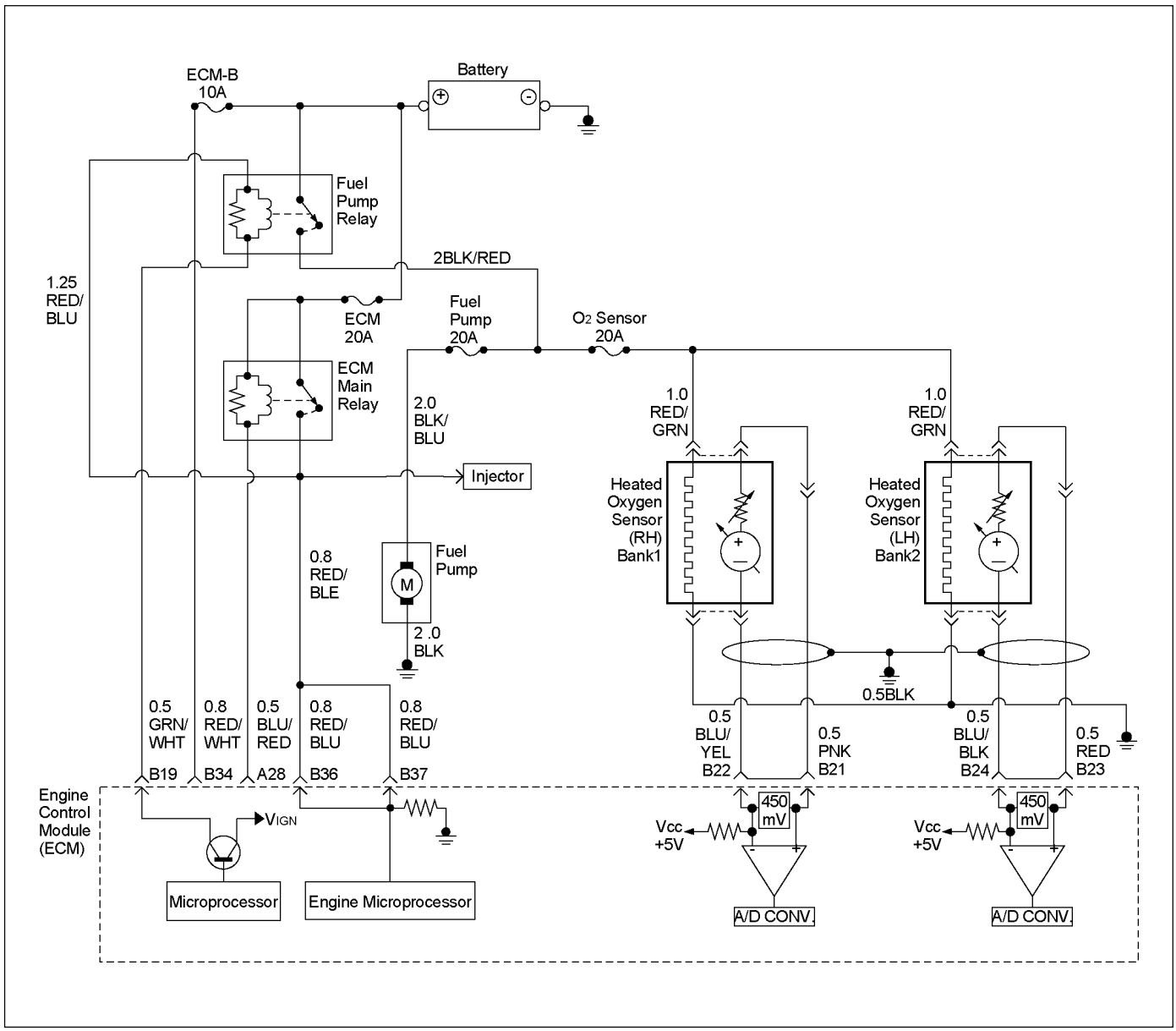
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0172 or P0175 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0172 or P0175 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Mass Air Flow" in the data display. Does the Tech 2 indicate correct "Mass Air Flow" as shown in the following graph, when engine speed is increasing little by little? 	-	Go to *Step 6*	Go to *Step 5*
5	Remove the MAF & IAT sensor assembly and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAF sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P0101* and Go to *Step 6*

Step	Action	Value (s)	Yes	No
6	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" from 0% to 100% depending on accelerator pedal operation?	-	Go to *Step 8*	Go to *Step 7*
7	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. 3. Adjust the TPS within 0% to 100%. Is the action complete?	-	Verify repair	-
8	Check for the following conditions. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P0121* and Go to *Step 9*
9	1. Using the Tech 2, ignition "On" and engine "On". 2. Select the "Miscellaneous Test" and perform the "IAC Control" in the "IAC System". 3. Operate the Tech 2 in accrodance with procedure. Was the engine speed changed, when the IAC Valve is operating step by step?	-	Go to *Step 11*	Go to *Step 10*
10	Check for the following conditions. • Objects blocking the IAC Valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P1508/P1509* and Go to *Step 11*
11	Check for injector for the affected bank. Refer to 6E-106 *"Injector Coil Test & Injector Balance Test Procedure".* Was the injector operation correct?	-	Go to *Step 12*	Refer to *Injector Coil Test & Injector Balance Test Procedure*
12	Check for fuel pressure. Refer to 6E-116 *"Fuel System Diagnosis".* Was the fuel pressure correct?	-	Go to *Step 13*	Refer to *Fuel System Diagnosis*
13	Replace the O2 sensor for the affected bank. Was the problem solved?	-	Verify repair	Go to *Step 14*
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	*Go to Step* 15

Step	Action	Value (s)	Yes	No
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P1171 (FLASH CODE 44) FUEL SUPPLY SYSTEM LEAN DURING POWER ENRICHMENT (Bank 1)

DIAGNOSTIC TROUBLE CODE (DTC) P1172 (FLASH CODE 44) FUEL SUPPLY SYSTEM LEAN DURING POWER ENRICHMENT (Bank 2)



RTW36ELF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
44	P1171	D	Fuel Supply System Lean During Power Enrichment (Bank 1)	1. No DTC relating to MAF sensor, IAT sensor, ECT sensor, TPS, CMP sensor, CKP sensor, VSS, injector control circuit, ignition control circuit, O2 sensor circuit low voltage & high voltage (bank 1 & 2) and O2 sensor circuit no activity (bank 1 & 2). 2. Engine speed is between 1000rpm and 6000rpm. 3. Intake air temperature is below 70°C. 4. Engine coolant temperature is between 30°C and 120°C. 5. Engine load is between 150 and 255. 6. Throttle position output is more than 2.22V and fluctuation is below 0.28V. 7. Except fuel cut operation. 8. O2 sensor output voltage below 250mV for 10 seconds.	No fail-safe function.
	P1172	D	Fuel Supply System Lean During Power Enrichment (Bank 2)		

CIRCUIT DESCRIPTION

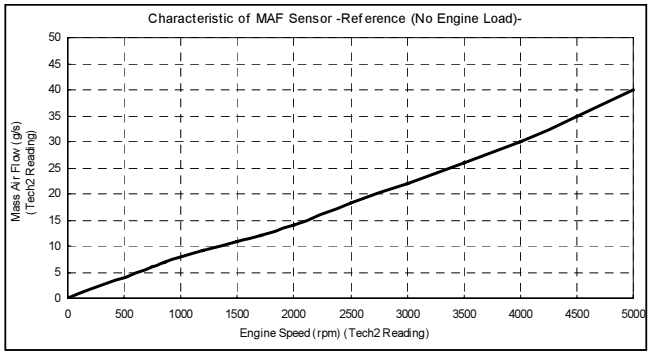
The engine control module (ECM) internal circuitry can identify if the vehicle fuel system is capable of supplying adequate amounts of fuel during heavy acceleration (power enrichment). The ECM monitors the voltage of the oxygen sensor during power enrichment. When a power enrichment mode of operation is requested during “closed loop" operation (by heavy acceleration), the ECM will provide more fuel to the engine. Under these conditions the ECM should detect a “rich" condition (high oxygen sensor voltage). If this “rich" exhaust is not detected at this time, a DTC P1171 or P1172 will set. A plugged fuel filter, restricted fuel line, restricted in-tank filter or defective fuel pump can prevent adequate amouts of fuel from being supplied during power enrichment mode.

DIAGNOSTIC AIDS

- A restricted fuel filter or fuel line, restricted in-tank filter, or a defective fuel pomp may supply adequate amounts of fuel at idle, but may not be able to supply enough fuel during heavy acceleration.
- Water or alcohol in the fuel may cause low HO2S voltage during acceleration.
- Check for faulty or plugged fuel injector(s).
- Check for low fuel.

Diagnostic Trouble Code (DTC) P1171 (Flash Code 44) Fuel Supply System Lean During Power Enrichment (Bank 1)

Diagnostic Trouble Code (DTC) P1172 (Flash Code 44) Fuel Supply System Lean During Power Enrichment (Bank 2)

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1171 or P1172 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P1171 or P1172 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Mass Air Flow" in the data display. Does the Tech 2 indicate correct "Mass Air Flow" as shown in the following graph, when engine speed is increasing little by little? 	-	Go to *Step 6*	Go to *Step 5*
5	Remove the MAF & IAT sensor assembly and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAF sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P0101* and Go to *Step 6*

Step	Action	Value (s)	Yes	No
6	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" from 0% to 100% depending on accelerator pedal operation?	-	Go to *Step 8*	Go to *Step 7*
7	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. 3. Adjust the TPS within 0% to 100%. Is the action complete?	-	Verify repair	-
8	Check for the following conditions. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P0121* and Go to *Step 9*
9	1. Using the Tech 2, ignition "On" and engine "On". 2. Select the "Miscellaneous Test" and perform the "IAC Control" in the "IAC System". 3. Operate the Tech 2 in accrodance with procedure. Was the engine speed changed, when the IAC Valve is operating step by step?	-	Go to *Step 10*	Go to *Step 10*
10	Check for the following conditions. • Objects blocking the IAC Valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P1508/P1509* and Go to *Step 11*
11	Check for injector for the affected bank. Refer to 6E-106 *"Injector Coil Test & Injector Balance Test Procedure".* Was the injector operation correct?	-	Go to *Step 12*	Refer to *Injector Coil Test & Injector Balance Test Procedure*
12	Check for fuel pressure. Refer to 6E-116 *"Fuel System Diagnosis".* Was the fuel pressure correct?	-	Go to *Step 13*	Refer to *Fuel System Diagnosis*
13	Replace the O2 sensor for the affected bank. Was the problem solved?	-	Verify repair	Go to *Step 14*
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 15*

Step	Action	Value (s)	Yes	No
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0201 (FLASH CODE 31) INJECTOR 1 CONTROL CIRCUIT

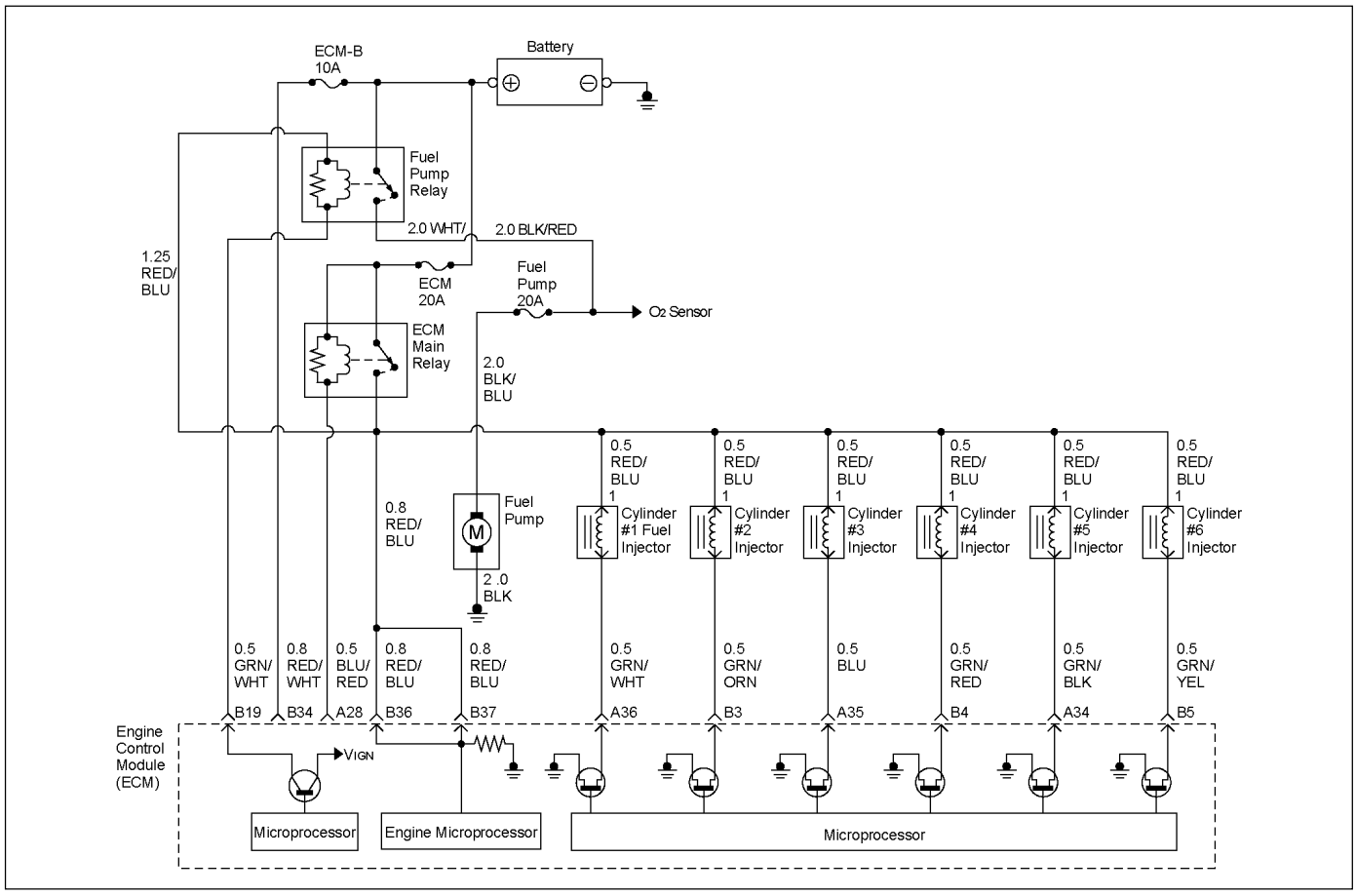
DIAGNOSTIC TROUBLE CODE (DTC) P0202 (FLASH CODE 31) INJECTOR 2 CONTROL CIRCUIT

DIAGNOSTIC TROUBLE CODE (DTC) P0203 (FLASH CODE 31) INJECTOR 3 CONTROL CIRCUIT

DIAGNOSTIC TROUBLE CODE (DTC) P0204 (FLASH CODE 31) INJECTOR 4 CONTROL CIRCUIT

DIAGNOSTIC TROUBLE CODE (DTC) P0205 (FLASH CODE 31) INJECTOR 5 CONTROL CIRCUIT

DIAGNOSTIC TROUBLE CODE (DTC) P0206 (FLASH CODE 31) INJECTOR 6 CONTROL CIRCUIT



RTW36EMF000901

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
31	P0201	A	Injector 1 Control Circuit	1. No DTC relating to CMP sensor and CKP sensor. 2. Under sequential injection. 3. Injection pulse is between 2.5ms and 7.5 ms. 4. Except fuel cut operation. 5. Engine speed is between 600rpm and 2000rpm. 6. 30 injection signals are not detected consecutively.	No fail-safe function.
	P0202	A	Injector 2 Control Circuit		
	P0203	A	Injector 3 Control Circuit		
	P0204	A	Injector 4 Control Circuit		
	P0205	A	Injector 5 Control Circuit		
	P0206	A	Injector 6 Control Circuit		

CIRCUIT DESCRIPTION

The Engine Control Module ECM has six individual injector driver circuits. Each controls an injector. When a driver circuit is grounded by the (ECM), the injector is activated. The ECM monitors the current in each driver circuit. The voltage on each driver is monitored to detect a fault. If the voltage is not what the ECM expects to monitor on the circuit, a DTC is set. This DTC is also set if an injector driver is shorted to voltage or if there is an open circuit.

DIAGNOSTIC AIDS

An injector driver circuit that is open or shorted to voltage will cause a DTC P0201, P0202, P0203, P0204, P0205 or P0206 to set. It will also cause a misfire due to an inoperative injector.

Long term and short term fuel trims that are excessively high or low are a good indication that an injector is faulty.

Diagnostic Trouble Code (DTC) P0201 (Flash Code 31) Injector 1 Control Circuit

Diagnostic Trouble Code (DTC) P0202 (Flash Code 31) Injector 2 Control Circuit

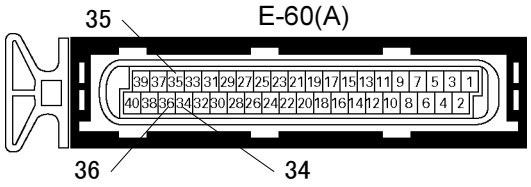
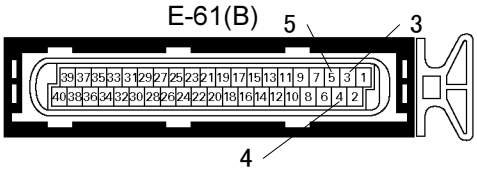
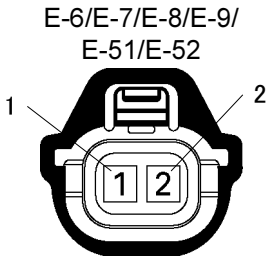
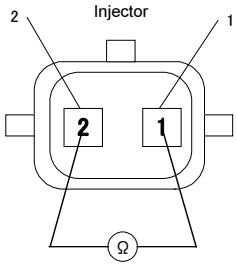
Diagnostic Trouble Code (DTC) P0203 (Flash Code 31) Injector 3 Control Circuit

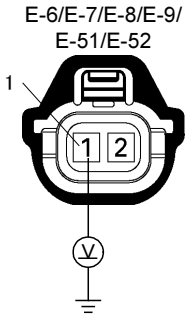
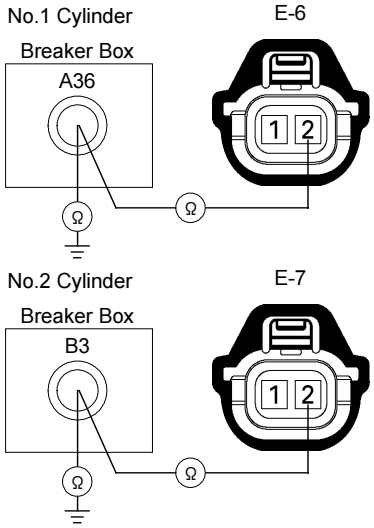
Diagnostic Trouble Code (DTC) P0204 (Flash Code 31) Injector 4 Control Circuit

Diagnostic Trouble Code (DTC) P0205 (Flash Code 31) Injector 5 Control Circuit

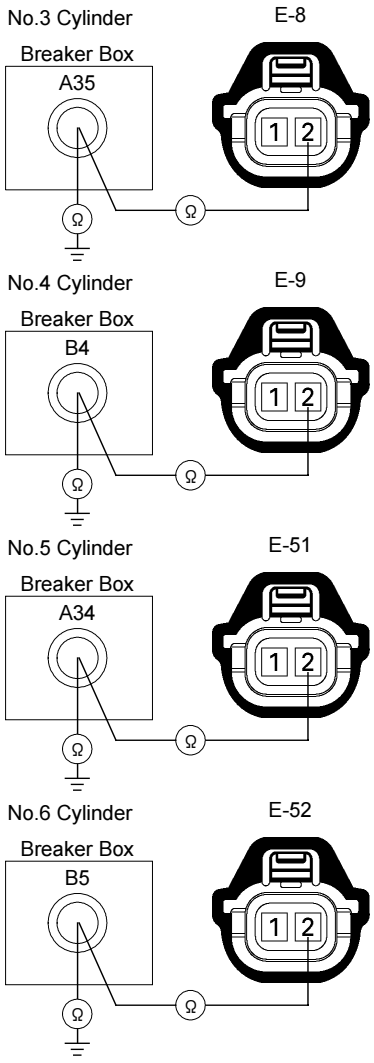
Diagnostic Trouble Code (DTC) P0206 (Flash Code 31) Injector 6 Control Circuit

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0201, P0202, P0203, P0204, P0205 or P0206 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0201, P0202, P0203, P0204, P0205 or P0206 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*

Step	Action	Value (s)	Yes	No
4	Check for poor/faulty connection at the injector or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?   	-	Verify repair	Go to *Step 5*
5	Visually check the injector for affected cylinder. Was the problem found?	-	Go to *Step 11*	Go to *Step 6*
6	Using the DVM and check the injector coil. 1. Ignition "Off", engine "Off". 2. Disconnect injector connector for the affected cylinder. 3. Measure the resistance of injector coil. Does the tester indicate standard resistance? 	Approximately 15Ω at 20°C	Go to *Step 7*	Go to *Step 11*

Step	Action	Value (s)	Yes	No
7	Using the DVM and check the injector power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the injector connector for the affected cylinder. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	Battery voltage	Go to *Step 9*	Go to *Step 8*
8	Repair the open or short to ground circuit between the ECM main relay and injector for the affected cylinder. Is the action complete?	-	Verify repair	-
9	Using the DVM and check the injector signal circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the injector connector for the affected cylinder. 4. Check the circuit for open or short to ground circuit. Was the problem found? 			

Step	Action	Value (s)	Yes	No

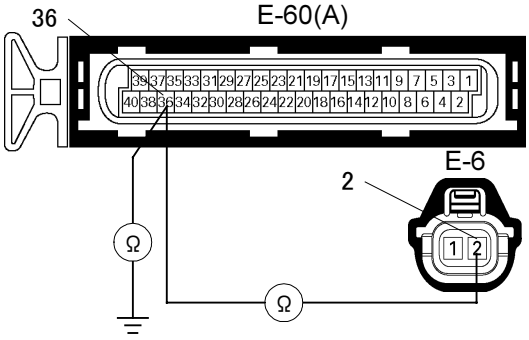


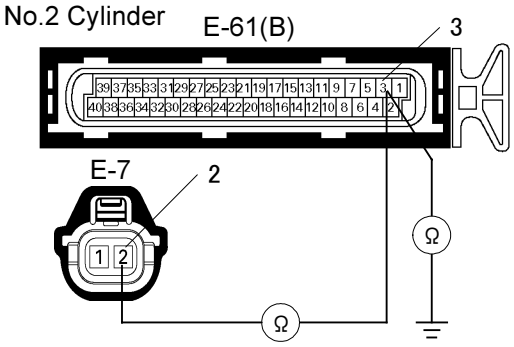
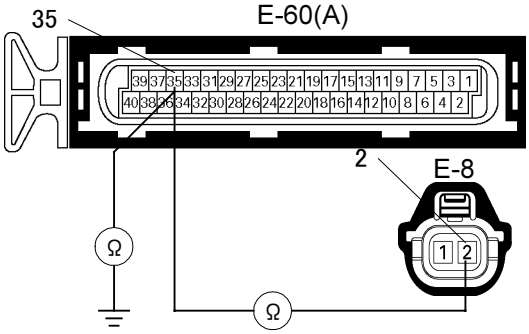
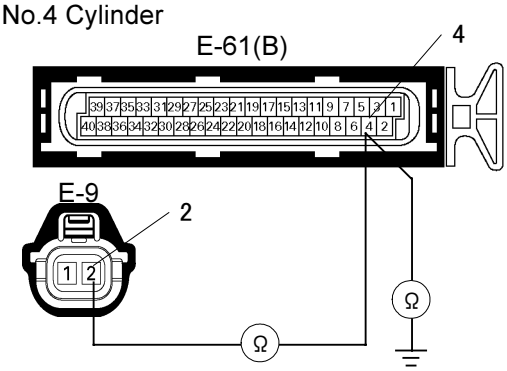
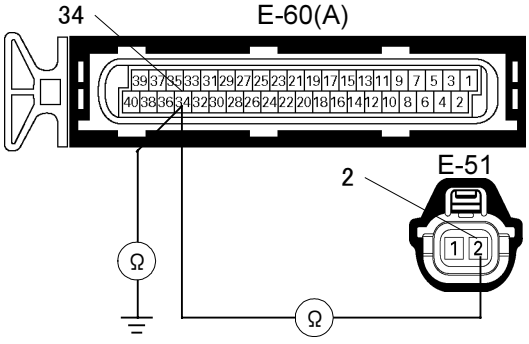
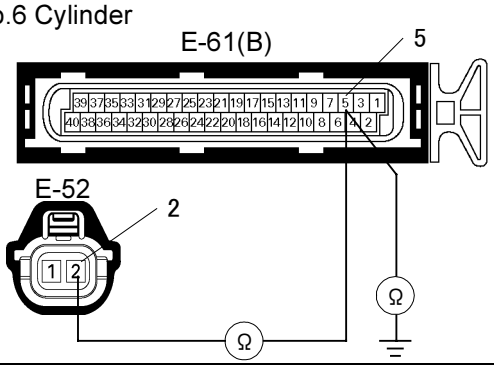
Breaker box is not available:

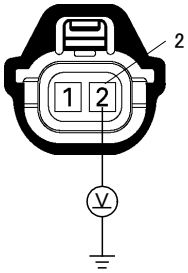
1. Ignition "Off", engine "Off".
2. Disconnect the injector connector for the affected cylinder and ECM connector.
3. Check the circuit for open or short to ground circuit.

Was the problem found?

No.1 Cylinder

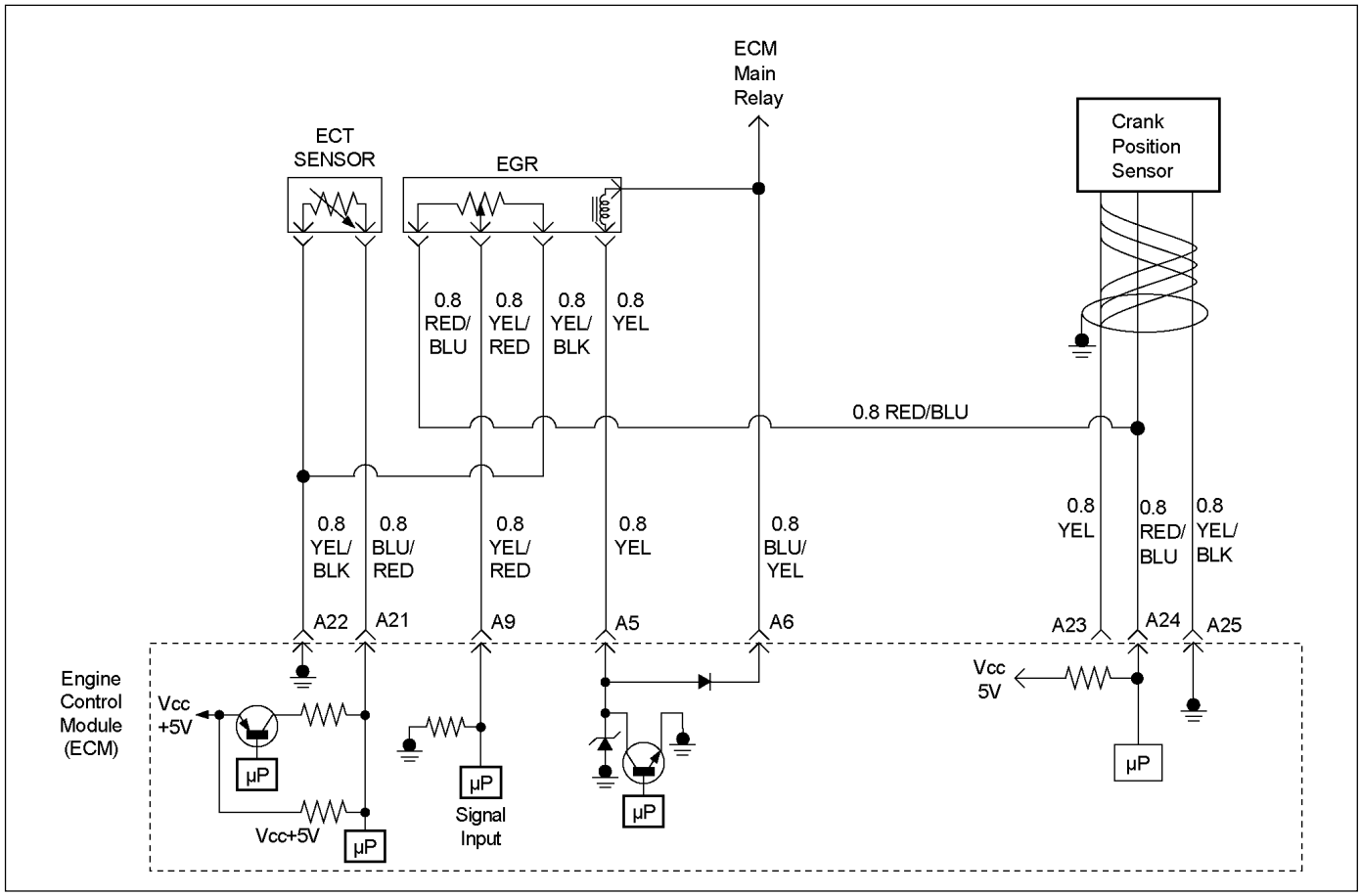


Step	Action	Value (s)	Yes	No
	No.2 Cylinder  No.3 Cylinder  No.4 Cylinder  No.5 Cylinder  No.6 Cylinder 	-	Repair faulty harness and verify repair	Go to *Step 10*

Step	Action	Value (s)	Yes	No
10	Using the DVM and check the injector signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the injector connector for the affected cylinder. 3. Check the circuit for short to battery voltage circuit. Was the DVM indicated battery voltage? E-6/E-7/E-8/E-9/ E-51/E-52 	-	Repair faulty harness and verify repair	Go to *Step 12*
11	Replace the injector for the affected cylinder. Was the problem solved?	-	Verify repair	Go to *Step 12*
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 13*
13	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0336 (FLASH CODE 29) CRANKSHAFT POSITION SENSOR CIRCUIT RANGE/PERFORMANCE (58X)

DIAGNOSTIC TROUBLE CODE (DTC) P0337 (FLASH CODE 29) CRANKSHAFT POSITION SENSOR CIRCUIT NO SIGNAL (58X)



RUW46EMF000201

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
29	P0336	B	Crankshaft Position Sensor Circuit Range/Performance (58X)	1. No DTC relating to CMP sensor. 2. Engine speed is below 2000rpm. 3. Extra or missing pulse is detected consecutively.	No fail-safe function.
	P0337	B	Crankshaft Position Sensor Circuit No Signal (58X)	1. No DTC relating to CKP sensor. 2. Engine speed is below 2000rpm. 3. Incorrect pulse is detected consecutively.	

CIRCUIT DESCRIPTION

The CKP reference signal is produced by the crankshaft position (CKP) sensor. During one crankshaft revolution, crankshaft pulses will be produced. The Engine Control Module (ECM) uses the CKP reference signal to calculate engine RPM and crankshaft position. The ECM constantly monitors the number of pulses on the CKP reference circuit and compares them to the number of camshaft position (CMP) signal pulses being received. If the ECM receives an incorrect number of pulses on the CKP reference circuit, DTC P0336 will set.

DIAGNOSTIC AIDS

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for:

- Poor connection – Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Diagnostic Trouble Code (DTC) P0336 (Flash Code 29) Crankshaft Position Sensor Circuit Range/Performance (58X)

Diagnostic Trouble Code (DTC) P0337 (Flash Code 29) Crankshaft Position Sensor Circuit No Signal (58X)

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0336 or P0337 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0336 or P0337 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check any accessory parts which may cause electric interference or magnetic interference. Was the problem found?	-	Remove the accessory parts and verify repair	Go to *Step 5*
5	Attempt to start the engine. Does the engine start and continue to "Run"?	-	Go to *Step 6*	Go to *Step 7*

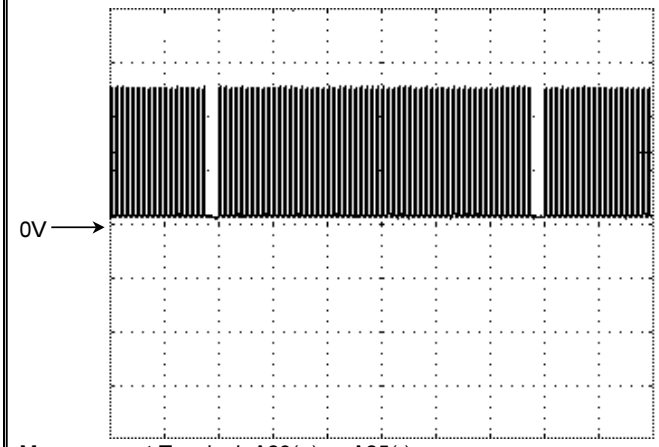
<table>
<tr><th>Step</th><th>Action</th><th>Value (s)</th><th>Yes</th><th>No</th></tr>
<tr><td>6</td><td>Using the DVM and check the CKP sensor signal.
1. Ignition "On", engine "On".
2. Measure the CKP output voltage at the sensor and ECM.

Does the tester indicate standard voltage?

<table>
<tr><th>Measurement Point</th><th>Voltage (V) (AC Range)</th></tr>
<tr><td>At CKP sensor terminal 3 & GND</td><td rowspan="2">Approximately 1.9 V at 2000rpm</td></tr>
<tr><td>At ECM E60 connector A23 & GND</td></tr>
</table>

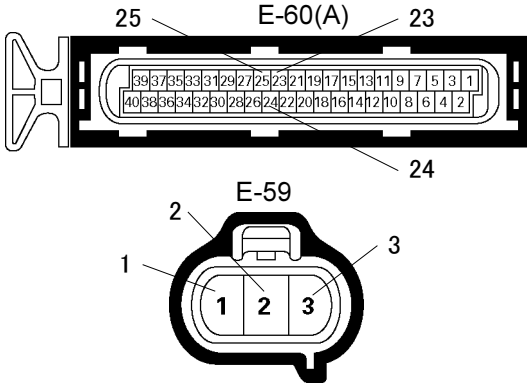
If a oscilloscope is available, monitor the CKP sensor signal.

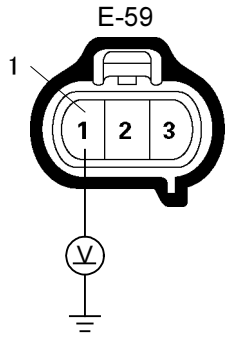
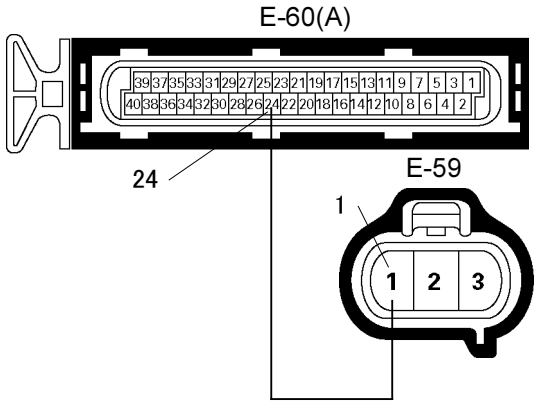
Does the oscilloscope indicate correct wave form?

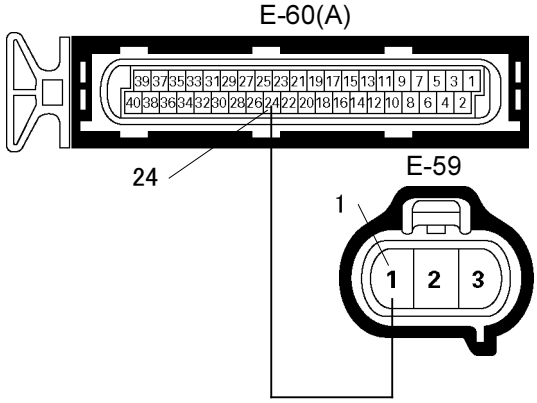
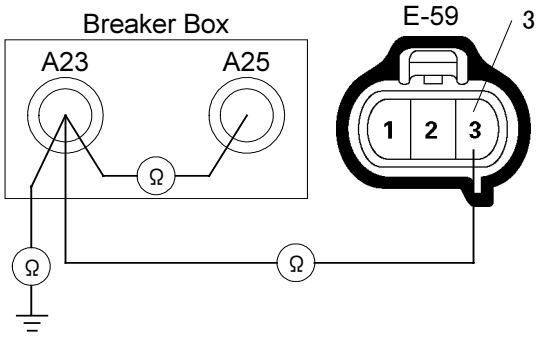
Crankshaft Position (CKP) Sensor Reference Wave Form
 

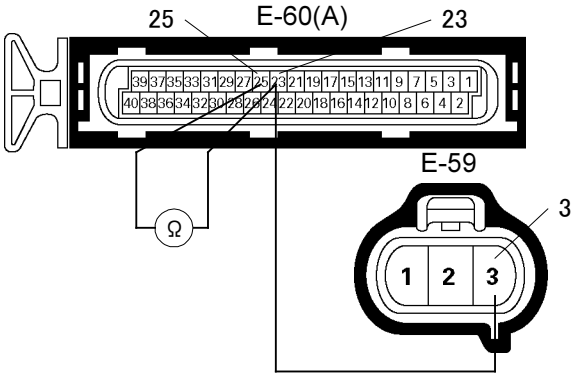
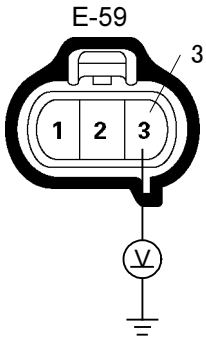
Measurement Terminal: A23(+) A25(-)
Measurement Scale: 2.0V/div 5ms/div
Measurement Condition: Approximately 2000rpm</td><td></td><td>Go to Step 17</td><td>Go to Step 7</td></tr>
<tr><td>7</td><td>Check for poor/faulty connection at the CKP sensor or ECM connector. If a poor/faulty connection is found, repair the faulty terminal.

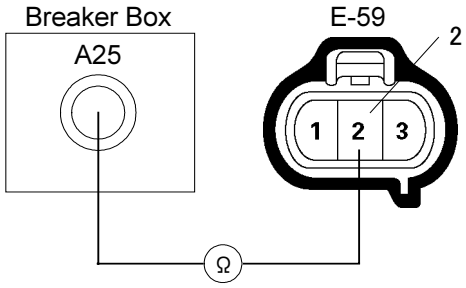
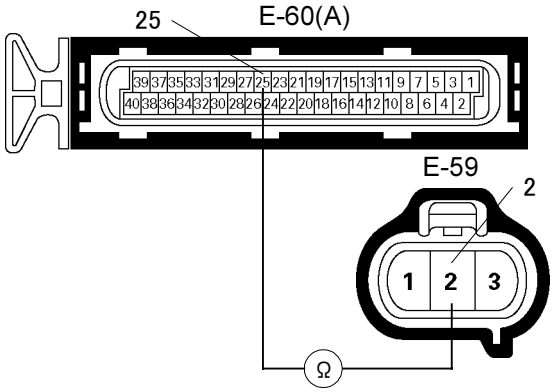
Was the problem found?

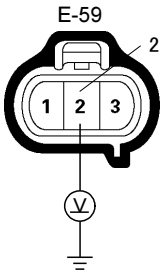
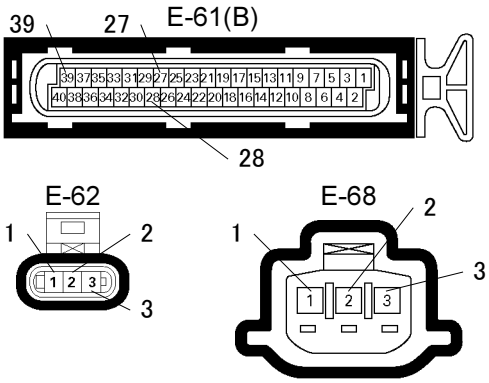
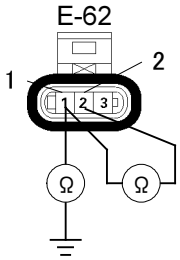
 
</td><td>-</td><td>Verify repair</td><td>Go to Step 8</td></tr>
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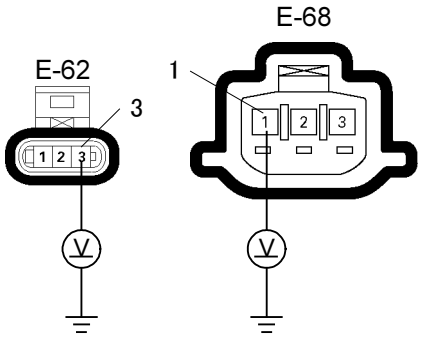
Step	Action	Value (s)	Yes	No
8	Remove the CKP sensor from the cylinder block and visually check. Check for the following conditions. • Objects sticking the CKP sensor. • Objects sticking the CKP sensor pluser. • Gear missing the CKP sensor pluser. Was the problem found?	-	Verify repair	Go to *Step 9*
9	Using the DVM and check the CKP sensor power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the CKP sensor connector. 3. Check the circuit for open, short to ground or short to battery voltage circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to *Step 12*	Less than 1V: Go to *Step 10* More than specified value: Go to *Step 11*
10	Repair the open or short to ground circuit between the ECM and CKP sensor. Was the problem solved? 	-	Verify repair	Go to *Step 21*

Step	Action	Value (s)	Yes	No
11	Repair the short to battery voltage circuit between the ECM and CKP sensor. Was the problem solved? 	-	Verify repair	Go to *Step 21*
12	Using the DVM and check the CKP sensor signal circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the CKP sensor connector. 4. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found? 			

Step	Action	Value (s)	Yes	No
	Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the CKP sensor connector and ECM connector. 3. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 13*
13	Using the DVM and check the CKP sensor signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the CKP sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 14*	Repair faulty harness and verify repair

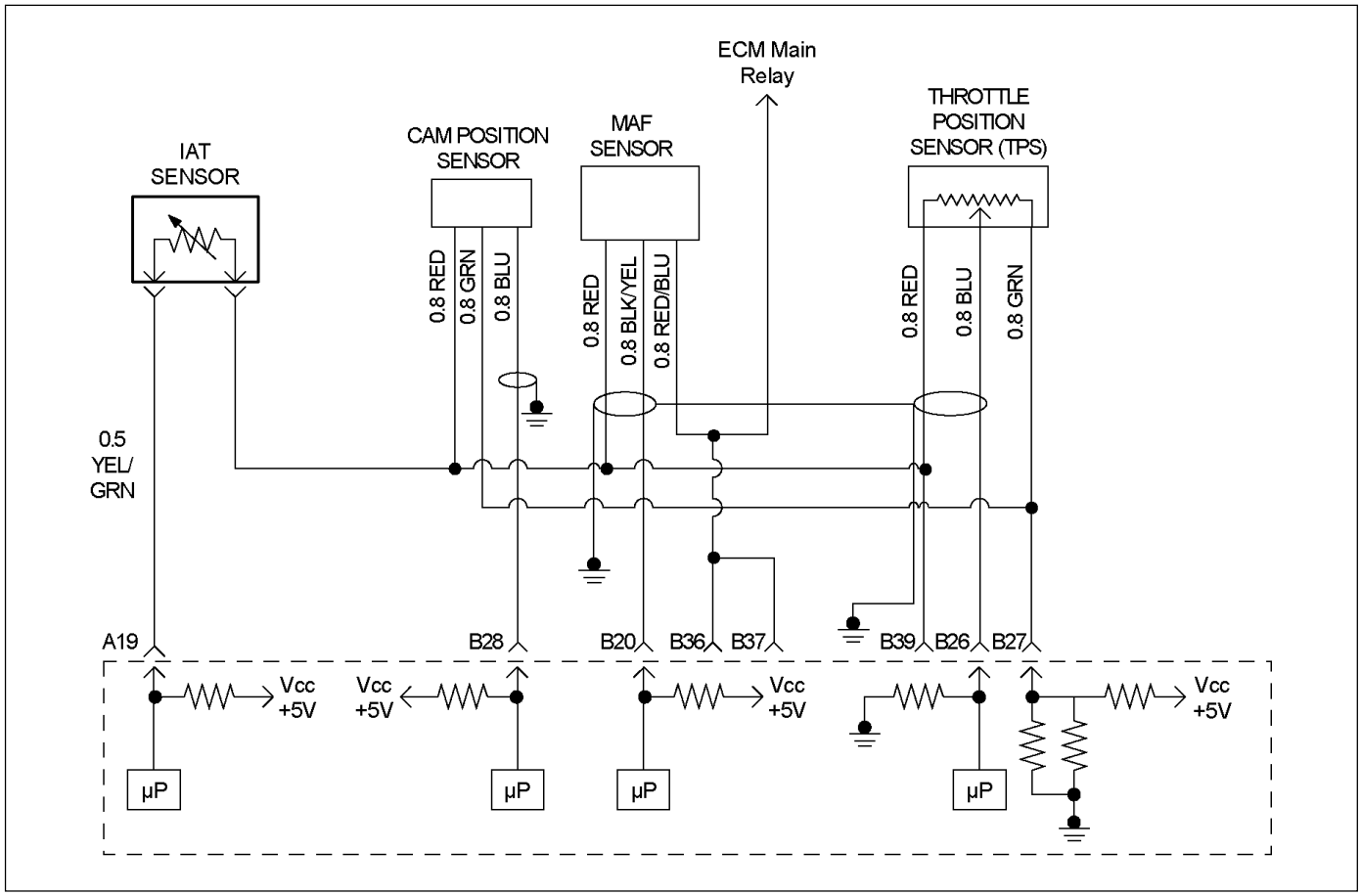
Step	Action	Value (s)	Yes	No
14	Using the DVM and check the CKP sensor ground circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect CKP sensor connector. 4. Check the circuit for open circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the CKP sensor connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 15*

Step	Action	Value (s)	Yes	No
15	Using the DVM and check the CKP ground circuit. 1. Ignition "On", engine "Off". 2. Disconnect the CKP sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 21*	Repair faulty harness and verify repair
16	Check the CKP sensor shield wire for open or short circuit. Was the problem found?	-	Verify repair	Go to *Step 17*
17	Check for poor/faulty connection at the TPS, CMP sensor or ECM connector. If a poor/faulty connection is found, repair the faulty terminal. Was the problem found? 	-	Verify repair	Go to *Step 18*
18	Using the DVM and check the CMP sensor signal circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the CMP sensor connector and ECM connector. 3. Check the circuit for short to sensor ground or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 19*

Step	Action	Value (s)	Yes	No
19	Using the DVM and check the TPS or CMP sensor power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the TPS or CMP sensor connector. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to *Step 23*	Go to *Step 20*
20	Repair the short to ground circuit between the ECM and TPS or CMP sensor. Was the problem solved?	-	Verify repair	Go to *Step 23*
21	Substitute a known good CKP sensor and recheck. Was the problem solved?	-	Go to *Step 21*	Go to *Step 23*
22	Replace the CKP sensor. Was the problem solved?	-	Verify repair	Go to *Step 23*
23	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 24*
24	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0341(FLASH CODE 41) CAMSHAFT POSITION SENSOR CIRCUIT RANGE/PERFORMANCE

DIAGNOSTIC TROUBLE CODE (DTC) P0342 (FLASH CODE 41) CAMSHAFT POSITION SENSOR CIRCUIT NO SIGNAL



RUW46EMF000101

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
41	P0341	B	Camshaft Position Sensor Circuit Range/Performance	1. Engine speed below 2000rpm. 2. No crankshaft position sensor DTC P0336 or P0337. 3. Incorrect pulse is detected consecutively.	Fuel cut is operated at high engine speed.
	P0342	B	Camshaft Position Sensor Circuit No Signal	1. No DTC relating to CKP sensor. 2. Engine speed is below 2000rpm. 3. No pulse is detected consecutively.	

CIRCUIT DESCRIPTION

If the ECM receives an incorrect number of pulses on the CMP reference circuit, DTC P0341 will set.

If the ECM does not receive pulses on the CMP reference circuit, DTC P0342 will set.

DIAGNOSTIC AIDS

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for:

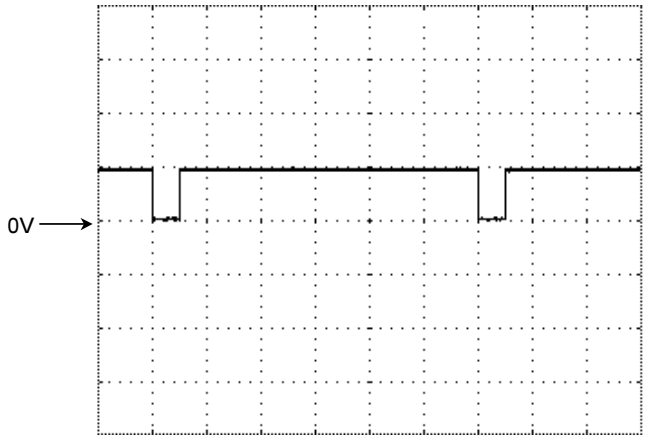
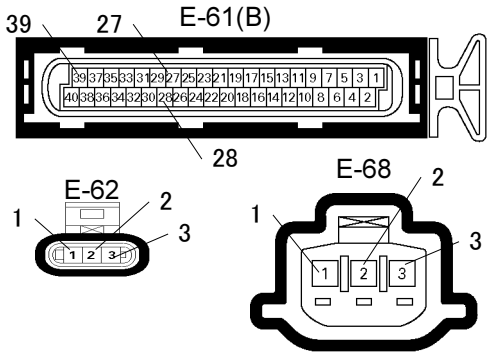
- Poor connection — Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness — Inspect the wiring harness for damage.

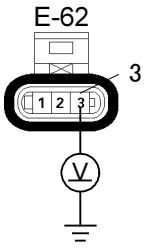
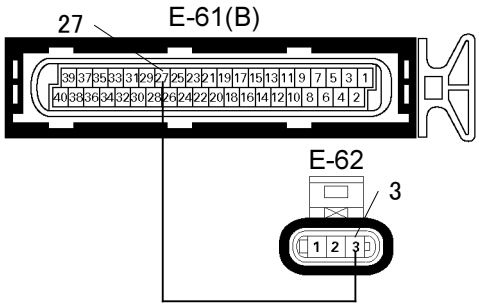
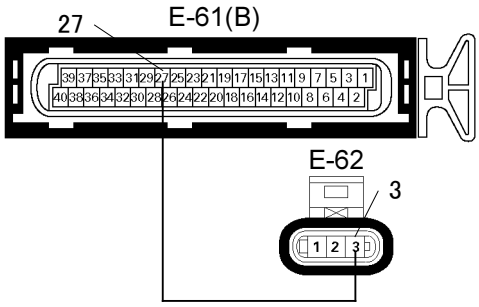
Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

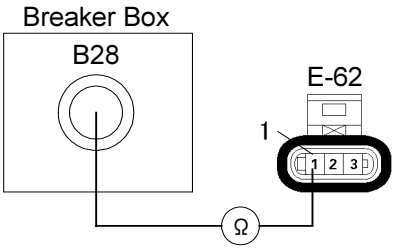
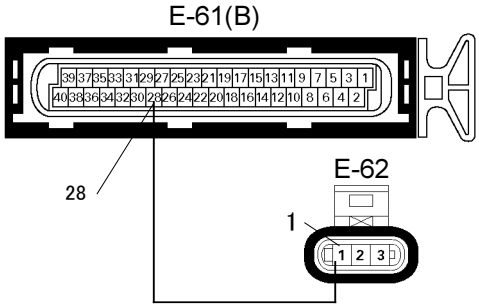
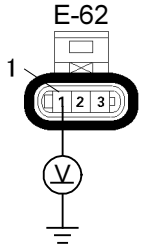
Diagnostic Trouble Code (DTC) P0341(Flash Code 41) Camshaft Position Sensor Circuit Range/Performance

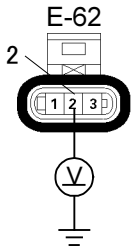
Diagnostic Trouble Code (DTC) P0342 (Flash Code 41) Camshaft Position Sensor Circuit No Signal

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0341 or P0342 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0341 or P0342 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check any accessory parts which may cause electric interference or magnetic interference. Was the problem found?	-	Remove the accessory parts and verify repair	Go to *Step 5*

Step	Action	Value (s)	Yes	No
5	If a oscilloscope is available, monitor the CMP sensor signal. Does the oscilloscope indicate correct wave form? Camshaft Position (CMP) Sensor Reference Wave Form  Measurement Terminal: B28(+) B39(-) Measurement Scale: 5V/div 10ms/div Measurement Condition: Approximately 2000rpm		Refer to *Diagnostic Aids* and Go to *Step 17*	Not available: Go to *Step 6* Fixed at low: Go to *Step 6* Fixed at High: Go to *Step 12*
6	Check for poor/faulty connection at the TPS, CMP sensor or ECM connector. If a poor/faulty connection is found, repair the faulty terminal. Was the problem found?  	-	Verify repair	Go to *Step 7*
7	Remove the CMP sensor from the cylinder head and visually check. • Objects sticking the CMP sensor. Was the problem found?	-	Verify repair	Go to *Step 8*

Step	Action	Value (s)	Yes	No
8	1. Ignition "On", engine "Off". 2. Disconnect the CMP sensor connector. 3. Check the circuit for open, short to ground or short to battery voltage circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to *Step 11*	Less than 1V: Go to *Step 9* More than specified value: Go to *Step 10*
9	Repair the open, short to sensor gorund or short to ground circuit between the ECM and CMP sensor. Was the problem solved? 	-	Verify repair	Go to *Step 15*
10	Repair the short to battery voltage circuit between the ECM and CMP sensor. Was the problem solved? 	-	Verify repair	Go to *Step 15*

Step	Action	Value (s)	Yes	No
11	Using the DVM and check the CMP sensor signal circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the CMP sensor connector. 4. Check the circuit for open circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the CMP sensor connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 12*
12	Using the DVM and check the CMP sensor signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the CMP sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 13*	Repair faulty harness and verify repair

Step	Action	Value (s)	Yes	No
13	Using the DVM and check the CMP sensor ground circuit. 1. Ignition "On", engine "Off". 2. Disconnect the CMP sensor connector . 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 14*	Repair faulty harness and verify repair
14	Check the shield wire for open or short circuit. Was the problem found?	-	Verify repair	Go to *Step 15*
15	Substitute a known good CMP sensor and recheck. Was the problem solved?	-	Go to *Step 16*	Go to *Step 17*
16	Replace the CMP sensor. Was the problem solved?	-	Verify repair	Go to *Step 17*
17	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 18*
18	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0351 (FLASH CODE 42) IGNITION 1 CONTROL CIRCUIT

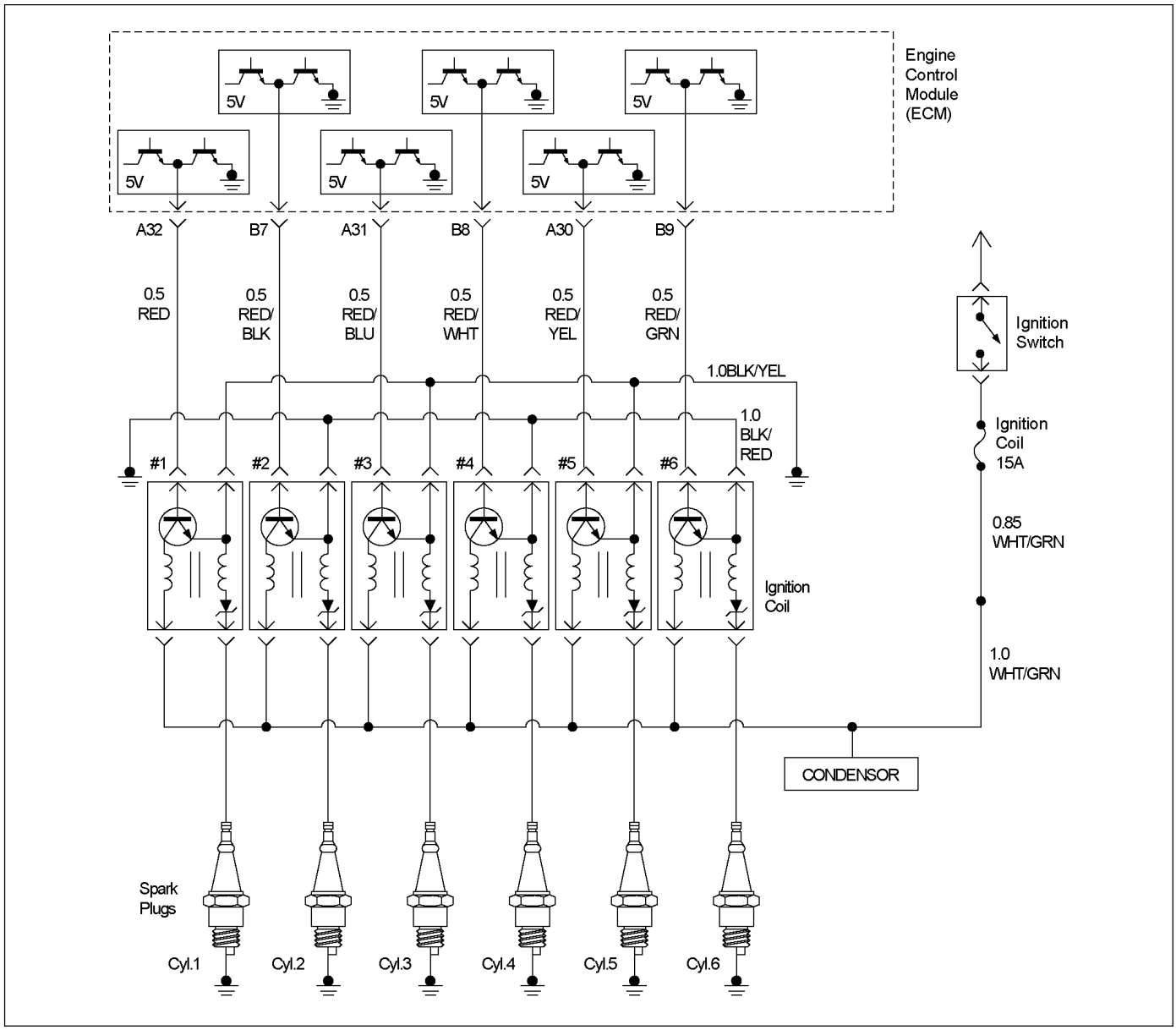
DIAGNOSTIC TROUBLE CODE (DTC) P0352 (FLASH CODE 42) IGNITION 2 CONTROL CIRCUIT

DIAGNOSTIC TROUBLE CODE (DTC) P0353 (FLASH CODE 42) IGNITION 3 CONTROL CIRCUIT

DIAGNOSTIC TROUBLE CODE (DTC) P0354 (FLASH CODE 42) IGNITION 4 CONTROL CIRCUIT

DIAGNOSTIC TROUBLE CODE (DTC) P0355 (FLASH CODE 42) IGNITION 5 CONTROL CIRCUIT

DIAGNOSTIC TROUBLE CODE (DTC) P0356 (FLASH CODE 42) IGNITION 6 CONTROL CIRCUIT



RTW46ELF001001

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
42	P0351	A	Ignition 1 Control Circuit	1. No DTC relating to CMP sensor and CKP sensor. 2. Engine speed is between 250rpm and 850 rpm. 3. 10 ignition signals are not detected consecutively.	Fuel cut is operated more than 2000rpm.
	P0352	A	Ignition 2 Control Circuit		
	P0353	A	Ignition 3 Control Circuit		
	P0354	A	Ignition 4 Control Circuit		
	P0355	A	Ignition 5 Control Circuit		
	P0356	A	Ignition 6 Control Circuit		

CIRCUIT DESCRIPTION

The Engine Control Module's (ECM) control circuit 1 provides a zero-volt or a 5-volt output signal to the ignition coil. The normal voltage on the circuit is zero volts. When the ignition coil receives the 5-volt signal from the ECM, it provides a ground path for the B+ supply to the primary side of the number 1 ignition coil. When the ECM shuts off the 5 volts to the ignition coil, the ignition coil turns “OFF." This causes the ignition coil primary magnetic field to collapse, producing a voltage in the secondary coil which fires the spark plug.

The circuit between the ECM and ignition coil is monitored for an open circuit, short to voltage, and short to ground. When the ECM detects a problem on ignition control circuit, it will set a DTC P0351, P0352, P0353, P0354, P0355 or P0356.

DIAGNOSTIC AIDS

Check for the following conditions:

- Poor connection at ECM – Inspect the harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connections.
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the Tech 2 display related to DTC P0351 or P0352, P0353, P0354, P0355 or P0356 while moving the connector and wiring related to the ignition system. A change in the display will indicate the location of the fault.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Diagnostic Trouble Code (DTC) P0351 (Flash Code 42) Ignition 1 Control Circuit

Diagnostic Trouble Code (DTC) P0352 (Flash Code 42) Ignition 2 Control Circuit

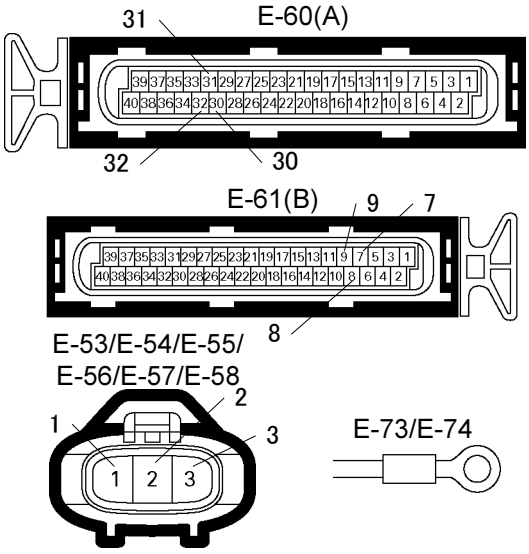
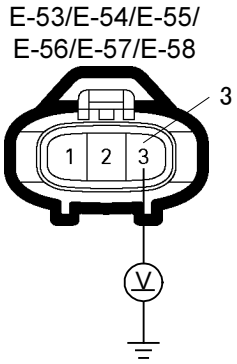
Diagnostic Trouble Code (DTC) P0353 (Flash Code 42) Ignition 3 Control Circuit

Diagnostic Trouble Code (DTC) P0354 (Flash Code 42) Ignition 4 Control Circuit

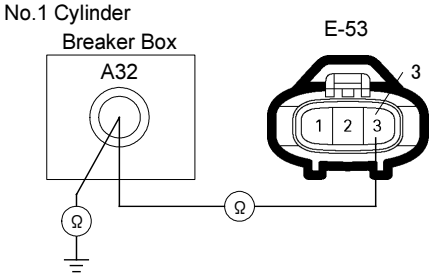
Diagnostic Trouble Code (DTC) P0355 (Flash Code 42) Ignition 5 Control Circuit

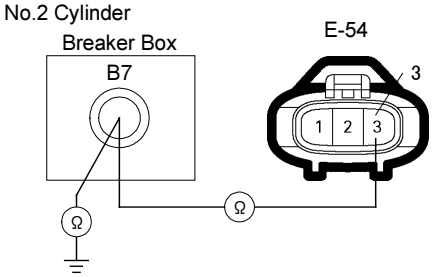
Diagnostic Trouble Code (DTC) P0356 (Flash Code 42) Ignition 6 Control Circuit

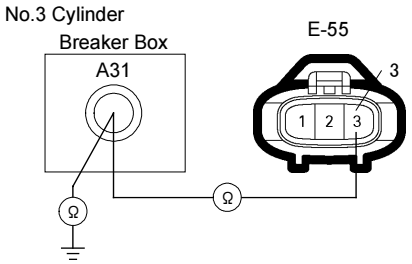
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0351, P0352, P0353, P0354, P0355 or P0356 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC DTC P0351, P0352, P0353, P0354, P0355 or P0356 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*

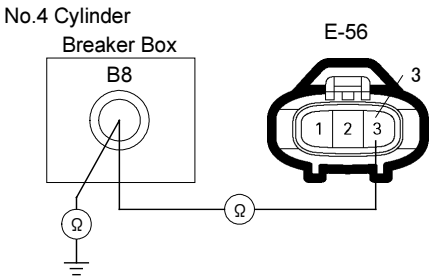
Step	Action	Value (s)	Yes	No
4	Check for poor/faulty connection at the ignition coil or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 5*
5	Visually check the ignition coil for the affected cylinder. Was the problem found?	-	Go to *Step 12*	Go to *Step 6*
6	Using the DVM and check the ignition coil signal circuit for the affected cylinder. 1. Ignition "On", engine "Off". 2. Disconnect the ignition coil connector for the affected cylinder. 3. Check the circuit for short to battery voltage circuit. Was the DVM indicated battery voltage? 	-	Repair faulty harness and verify repair	Go to *Step 7*

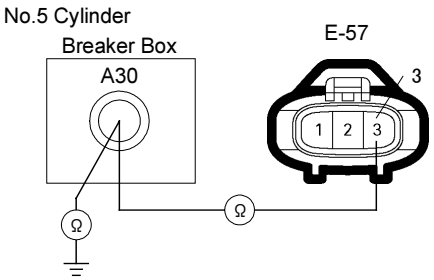
Step	Action	Value (s)	Yes	No
7	Using the DVM and check the ignition coil signal circuit for the affected cylinder. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the ignition coil connector for the affected cylinder. 4. Check the circuit for open or short to ground circuit. Was the problem found?			



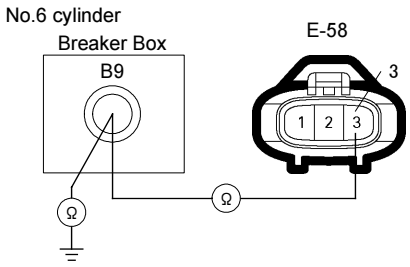








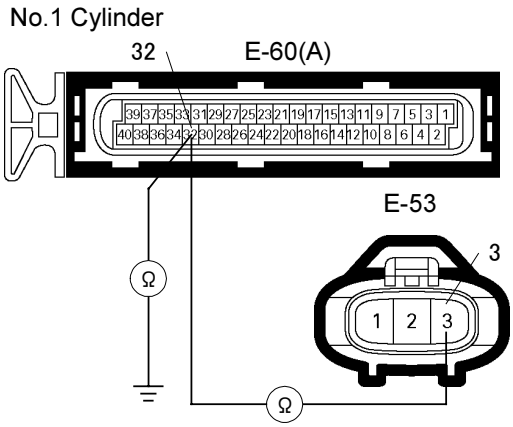
Step	Action	Value (s)	Yes	No

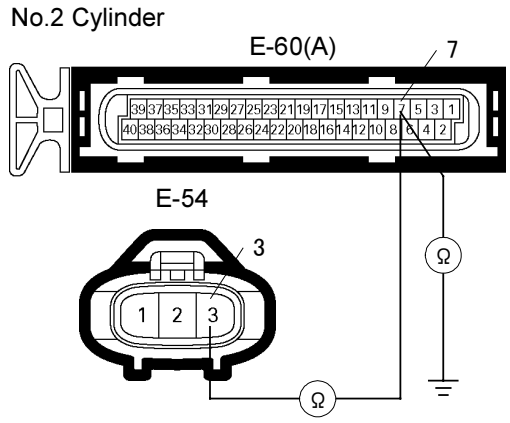


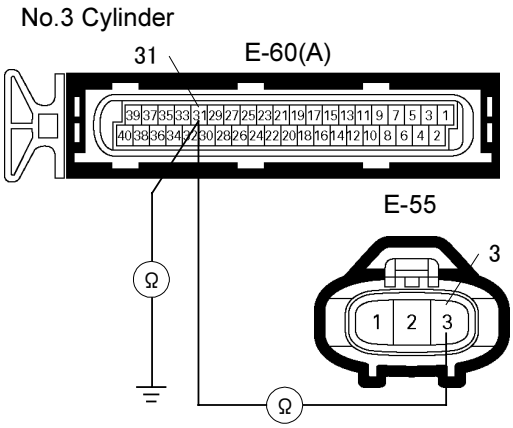
Breaker box is not available:

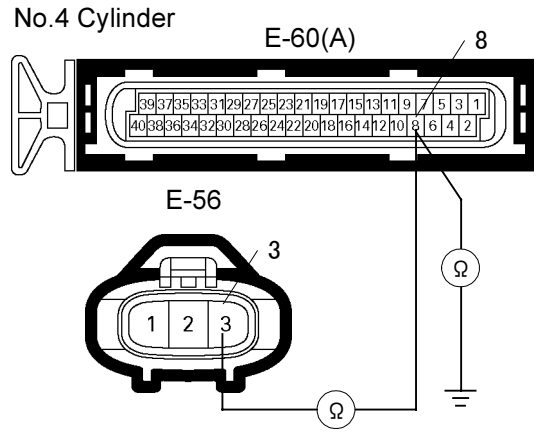
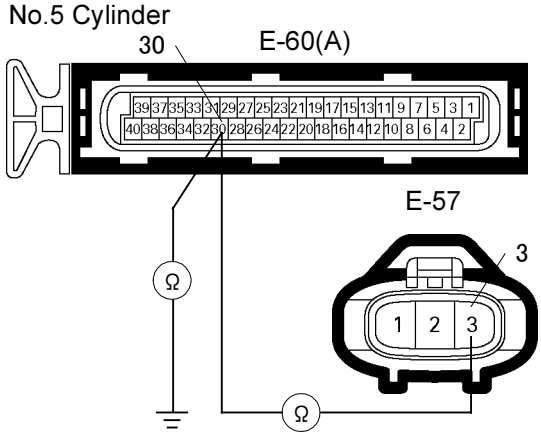
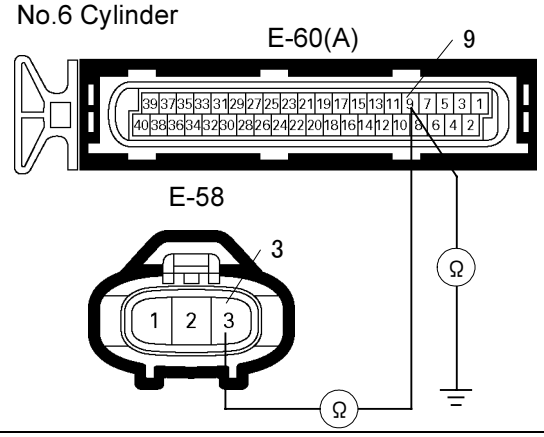
1. Ignition "Off", engine "Off".
2. Disconnect the ignition coil connector for the affected cylinder and ECM connector.
3. Check the circuit for open or short to ground circuit.

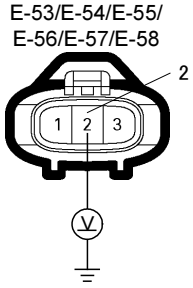
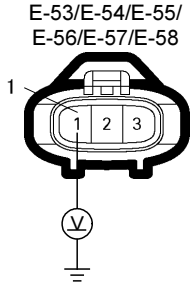
Was the problem found?

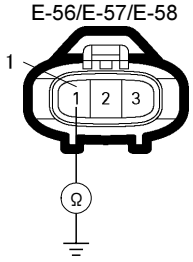






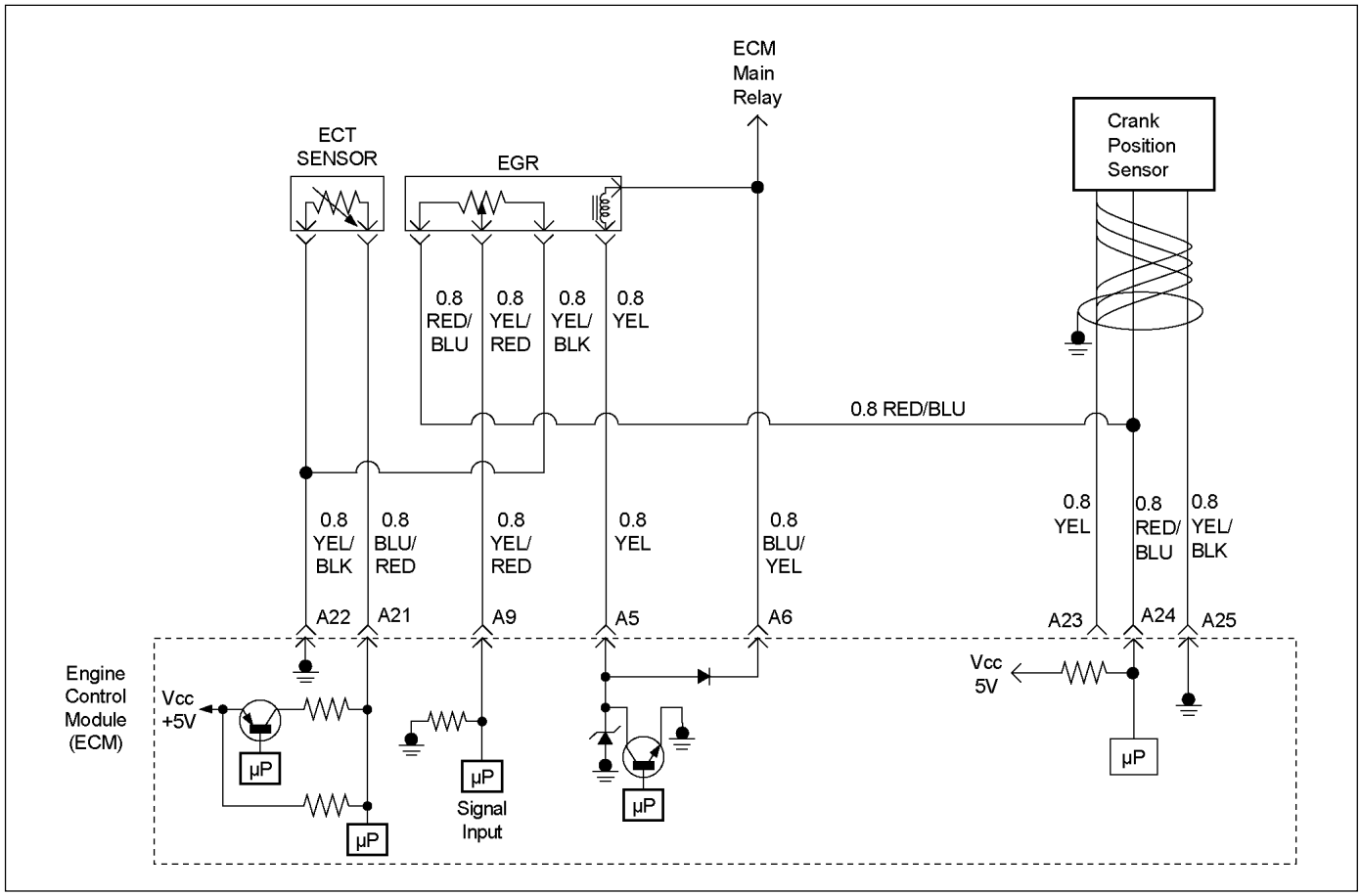
Step	Action	Value (s)	Yes	No
	No.4 Cylinder  No.5 Cylinder  No.6 Cylinder 	-	Repair faulty harness and verify repair	Go to *Step 8*

Step	Action	Value (s)	Yes	No
8	Using the DVM and check the ignition coil power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the ignition coil connector for the affected cylinder. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	10-14.5V	Go to *Step 10*	Go to *Step 9*
9	Repair the open or short to ground circuit between the "IGN. COIL" (15A) and ignition coil for the affected cylinder. Is the action complete?	-	Verify repair	-
10	Using the DVM and check the ignition coil ground circuit for the affected cylinder. 1. Ignition "On", engine "Off". 2. Disconnect the ignition coil connector for the affected cylinder. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 11*	Repair faulty harness and verify repair

Step	Action	Value (s)	Yes	No
11	Using the DVM and check the ignition coil ground circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the ignition coil connector for the affected cylinder and ECM connector. 3. Check the circuit for open circuit. Was the problem found? E-53/E-54/E-55/ E-56/E-57/E-58 	-	Repair faulty harness and verify repair	Go to *Step 12*
12	Replace the ignition coil for the affected cylinder. Was the problem solved?	-	Verify repair	Go to *Step 13*
13	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 14*
14	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0404 (FLASH CODE 32) EGR CIRCUIT RANGE/PERFOMANCE (OPEN VALVE)

DIAGNOSTIC TROUBLE CODE (DTC) P1404 (FLASH CODE 32) EGR CIRCUIT RANGE/PERFOMANCE (CLOSED VALVE)



RUW46EMF000201

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
32	P0404	B	EGR Circuit Range/Performance (Open Valve)	1. Engine is stopping. 2. No DTC relating to ECT sensor, CKP sensor and VSS. 3. Vehicle speed is below 4km/h. 4. Engine coolant temperature is more than 75°C. 5. EGR solenoid valve on-duty ratio is more than 100%. 6. EGR valve output monitoring signal high.	1. EGR operation is stopped. 2. EGR valve closed position learning operation is disabled. 3. EGR position feedback is disabled.
	P1404	B	EGR Circuit Range/Performance (Closed Valve)	1. Engine is running. 2. Engine speed is below 4000rpm. 3. No DTC relating to CKP sensor. 4. EGR solenoid valve on-duty ratio is 0%. 5. EGR valve output monitoring signal low.	

CIRCUIT DESCRIPTION

The engine control module (ECM) monitors the EGR valve pintle position input to ensure that the valve responds properly to commands from the PCM, and to detect a fault if pintle position is different fromcommanded position.

DIAGNOSTIC AIDS

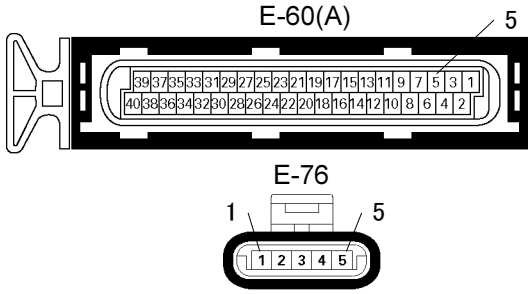
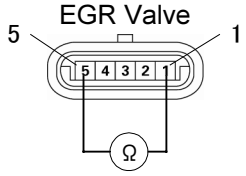
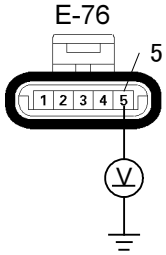
Check for the following conditions:

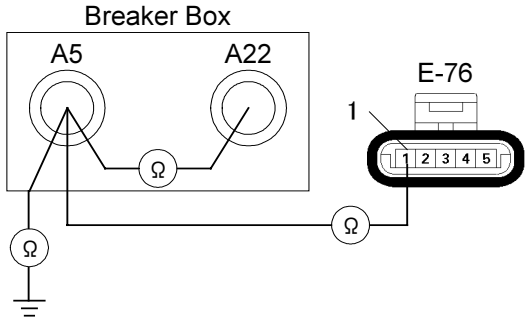
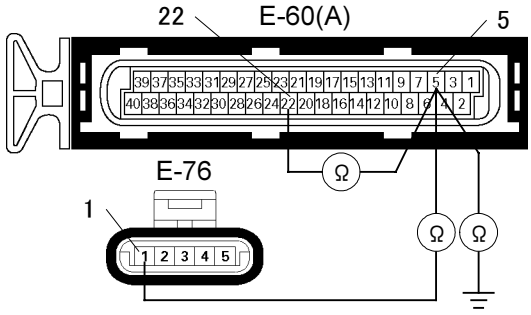
- Excessive carbon deposit on EGR valve shaft maycause EGR stuck open or unsmooth operation. Those carbon deposit may occur by unusual portoperation. Clean up carbon may make smoothfunction of EGR valve.
- Poor connection or damaged harness – Inspect thewiring harness for damage. If the harness appears to be OK, observe the EGR actual position display on the Tech 2 while moving connectors and wiring harnesses related to EGR valve. A change in the display will indicate the location of the fault.

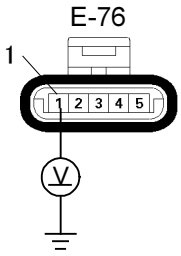
Diagnostic Trouble Code (DTC) P0404 (Flash Code 32) EGR Circuit Range/Perfomance (Open Valve)

Diagnostic Trouble Code (DTC) P1404 (Flash Code 32) EGR Circuit Range/Perfomance (Closed Valve)

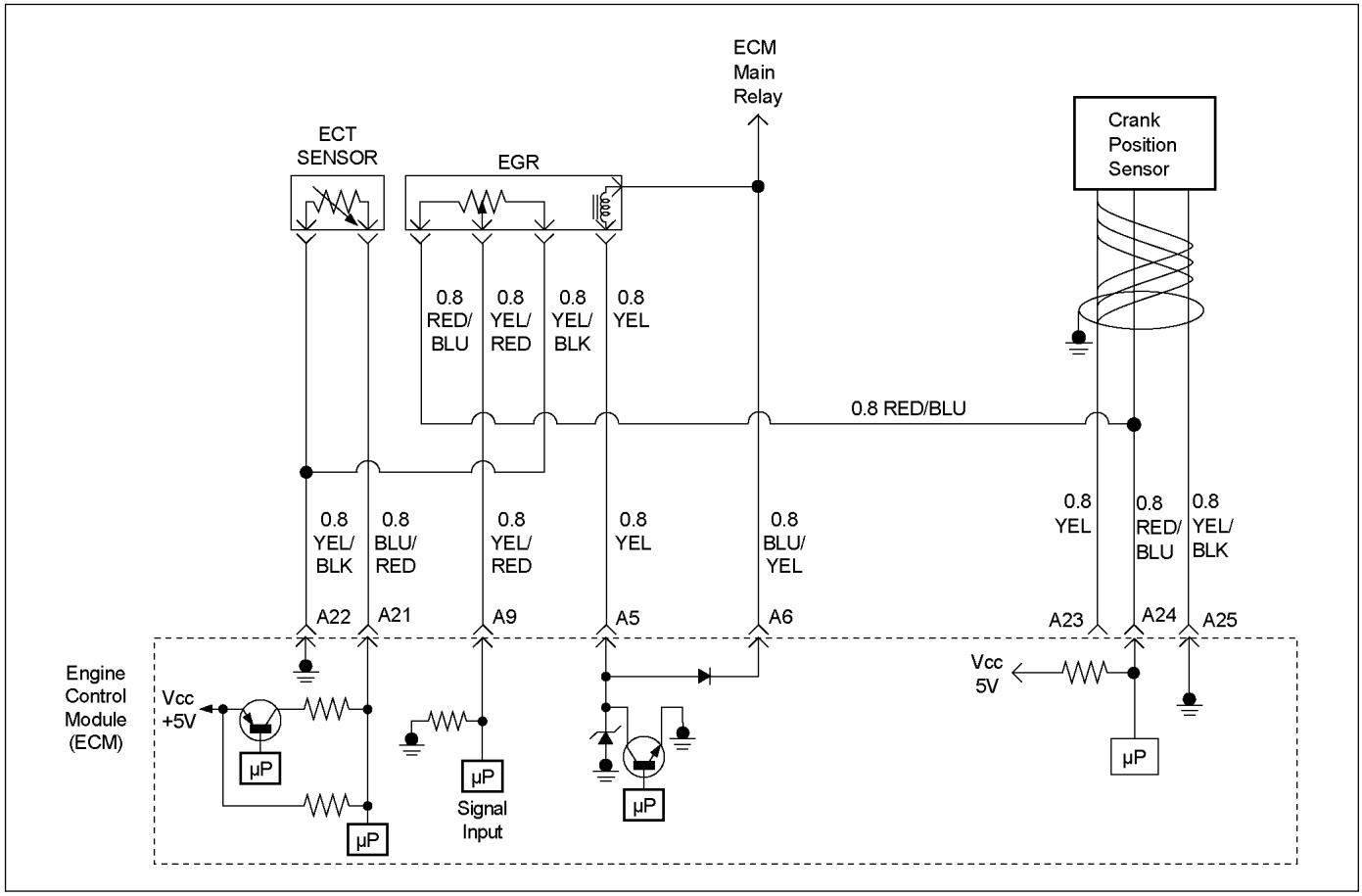
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0404 or P1404 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0404 or P1404 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*

Step	Action	Value (s)	Yes	No
4	Check for poor/faulty connection at the EGR valve or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 5*
5	Using the DVM and check the EGR valve. 1. Ignition "Off", engine "Off". 2. Disconnect EGR valve connector. 3. Measure the resistance of EGR valve solenoid coil. Does the tester indicate standard resistance? 	Apporoximately 8.3Ω at 20°C	Go to *Step 6*	Go to *Step 11*
6	Inspect the EGR valve. 1. Remove the EGR valve from the engine. 2. Inspect the EGR valve whether there is any carbon deposit on shaft. If excessive carbon deposit is found, clean up the EGR valve and inspect damage of the pintle and seat. Was the problem found?	-	Verify repair or Go to *Step 11*	Go to *Step 7*
7	Using the DVM and check the EGR valve solenoid power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the EGR valve connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	10-14.5 V	Go to *Step 9*	Go to *Step 8*

Step	Action	Value (s)	Yes	No
8	Repair the open or short to ground circuit between the ECM main relay and EGR valve. Is the action complete?	-	Verify repair	-
9	Using the DVM and check the EGR valve solenoid signal circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect EGR valve connector. 4. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the EGR valve connector and ECM connector. 3. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found? 	- -	Verify repair Repair faulty harness and verify repair	- Go to *Step 10*

Step	Action	Value (s)	Yes	No
10	Using the DVM and check the EGR valve solenoid signal circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the EGR valve connector. 3. Check the circuit for short to battery voltage circuit. Was the DVM indicated battery voltage? 	-	Repair faulty harness and verify repair	Go to *Step 11*
11	Substitute a known good EGR valve and recheck. Was the problem solved?	-	Go to *Step 12*	Go to *Step 13*
12	Replace the EGR valve. Was the problem solved?	-	Verify repair	Go to *Step 13*
13	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 14*
14	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0405 (FLASH CODE 32) EGR CIRCUIT LOW



RUW46EMF000201

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
32	P0405	B	EGR Circuit Low	1. No DTC relating to EGR circuit range/performance. 2. EGR solenoid valve on-duty ratio is more than 40%. 3. EGR position sensor output voltage is below 0.3V.	No fail-safe function.

CIRCUIT DESCRIPTION

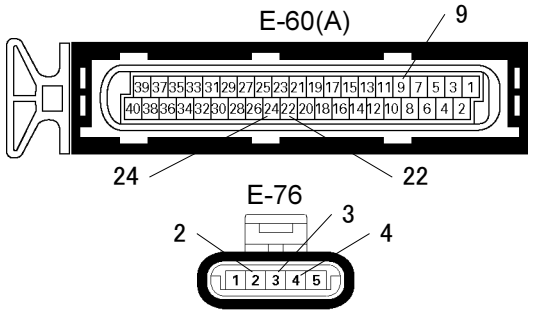
The engine control module (ECM) monitors the EGR valve pintle position input to ensure that the valve responds properly to command from the ECM. If current pintle position voltage indicates less than 0.3 V the ECM will set DTC P0405.

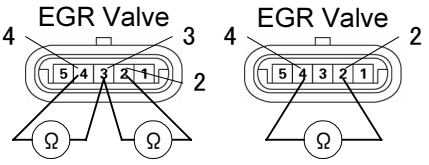
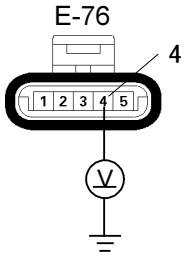
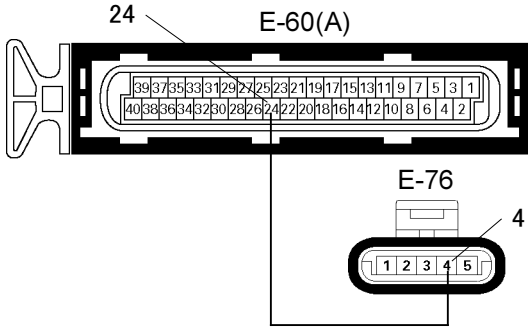
DIAGNOSTIC AIDS

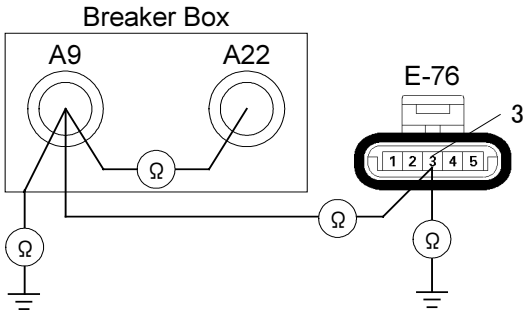
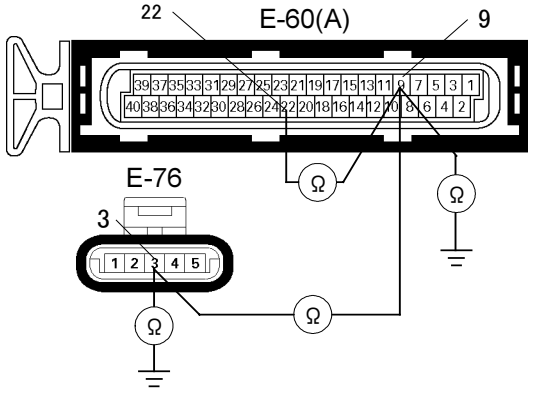
Check for the following conditions:

- Poor connection or damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the EGR actual position display on the Tech 2 while moving connectors and wiring harnesses related to EGR valve. A change in the display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0405 (Flash Code 32)
EGR Circuit Low

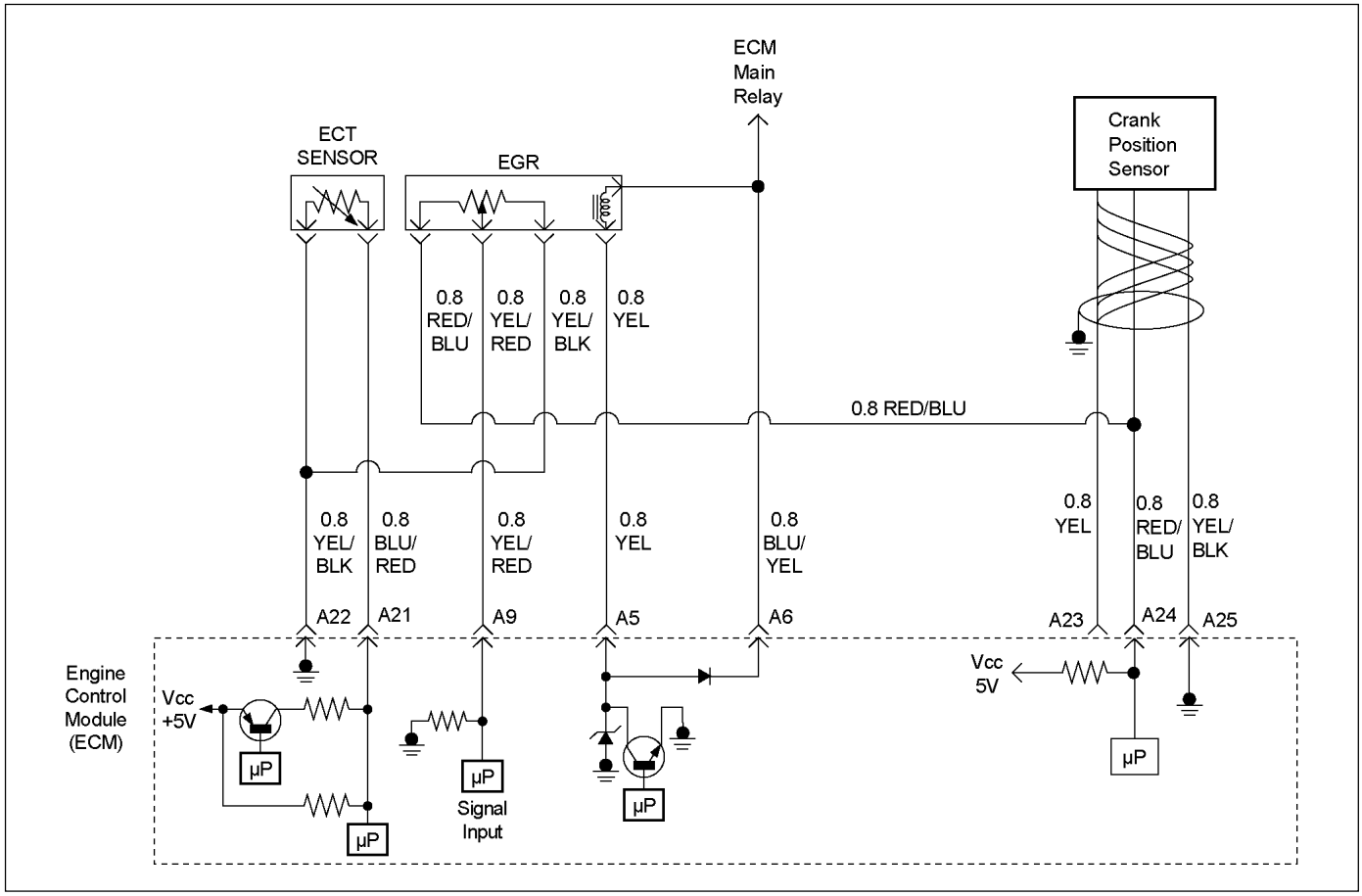
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0405 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0405 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the EGR valve or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 5*
5	Visually check the EGR valve. Was the problem found?	-	Go to *Step 10*	Go to *Step 6*

Step	Action	Value (s)	Yes	No
6	Using the DVM and check the EGR valve position sensor. 1. Ignition "Off", engine "Off". 2. Disconnect EGR valve connector. 3. Measure the resistance of EGR valve position sensor. Does the tester indicate standard resistance as shown in the following table?  Measurement Terminal / Resistance (Ω): 2 – 3: Approximately 1.1kΩ; 3 – 4: Approximately 4.5kΩ; 2 - 4: Approximately 4.7kΩ	Standard resistance	Go to *Step 7*	Go to *Step 10*
7	Using the DVM and check the EGR valve position sensor power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the EGR valve connector. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to *Step 9*	Go to *Step 8*
8	Repair the open or short to ground circuit between the ECM and EGR valve position sensor circuit. Was the problem solved? 	-	Verify repair	Go to *Step 12*

Step	Action	Value (s)	Yes	No
9	Using the DVM and check the EGR valve position sensor signal circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect EGR valve connector. 4. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the EGR valve connector and ECM connector. 3. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 10*
10	Substitute a known good EGR valve and recheck. Was the problem solved?	-	Go to *Step 11*	Go to *Step 12*
11	Replace the EGR valve. Is the action complete?	-	Verify repair	-

Step	Action	Value (s)	Yes	No
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 13*
13	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0406 (FLASH CODE 32) EGR CIRCUIT HIGH



RUW46EMF000201

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
32	P0406	B	EGR Circuit High	1. No DTC relating to EGR circuit range/performance. 2. EGR solenoid valve on-duty ratio is below 40%. 3. EGR position sensor output voltage is more than 4.6V.	No fail-safe function.

CIRCUIT DESCRIPTION

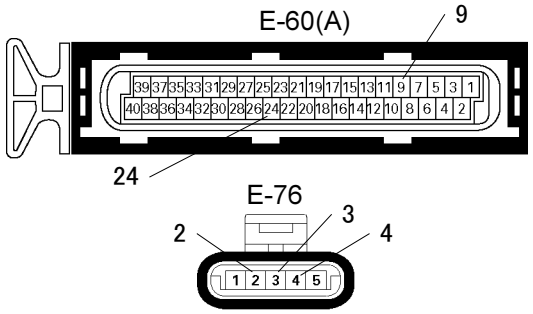
The engine control module (ECM) monitors the EGR valve pintle position input to ensure that the valve responds properly to command from the ECM. If current pintle position voltage indicates more than 4.6 V the ECM will set DTC P0406.

DIAGNOSTIC AIDS

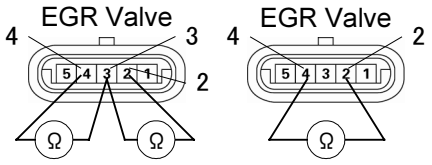
Check for the following conditions:

- Poor connection or damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, observe the EGR actual position display on the Tech 2 while moving connectors and wiring harnesses related to EGR valve. A change in the display will indicate the location of the fault.

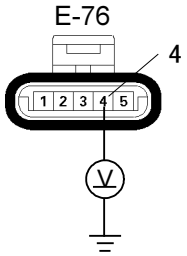
Diagnostic Trouble Code (DTC) P0406 (Flash Code 32)
EGR Circuit High

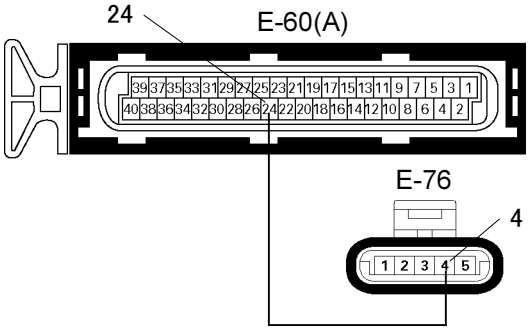
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0406 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0406 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the EGR valve or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 5*
5	Visually check the EGR valve. Was the problem found?	-	Go to *Step 12*	Go to *Step 6*

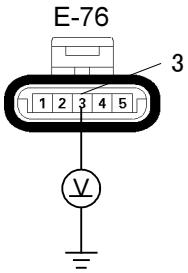
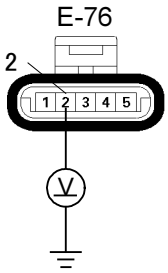
<table>
<tr><th>Step</th><th>Action</th><th>Value (s)</th><th>Yes</th><th>No</th></tr>
<tr><td>6</td><td>Using the DVM and check the EGR valve position sensor.
1. Ignition "Off", engine "Off".
2. Disconnect EGR valve connector.
3. Measure the resistance of EGR valve position sensor.

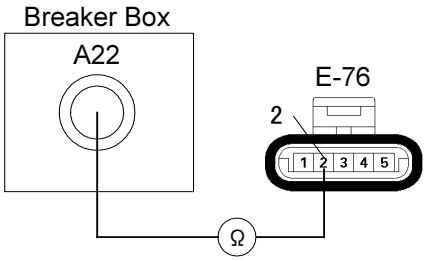
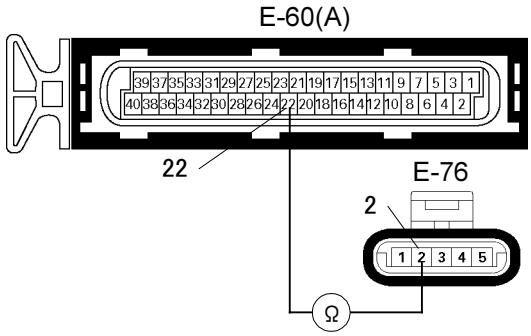
Does the tester indicate standard resistance as shown in the following table?
 

<table>
<tr><th>Measurement Terminal</th><th>Resistance (Ω)</th></tr>
<tr><td>2 – 3</td><td>Approximately 1.1kΩ</td></tr>
<tr><td>3 – 4</td><td>Approximately 4.5kΩ</td></tr>
<tr><td>2 - 4</td><td>Approximately 4.7kΩ</td></tr>
</table></td><td>Standard resistance</td><td>Go to Step 7</td><td>Go to Step 12</td></tr>
<tr><td>7</td><td>Using the DVM and check the EGR position sensor power supply circuit.
1. Ignition "On", engine "Off".
2. Disconnect the EGR valve connector.
3. Check the circuit for short to voltage circuit.

Was the DVM indicated specified value?
 
</td><td>Approximately 5.0V</td><td>Go to Step 9</td><td>Go to Step 8</td></tr>
<tr><td>8</td><td>Repair the short to voltage circuit between the ECM and EGR valve.

Was the problem solved?
 
</td><td>-</td><td>Verify repair</td><td>Go to Step 14</td></tr>
</table>

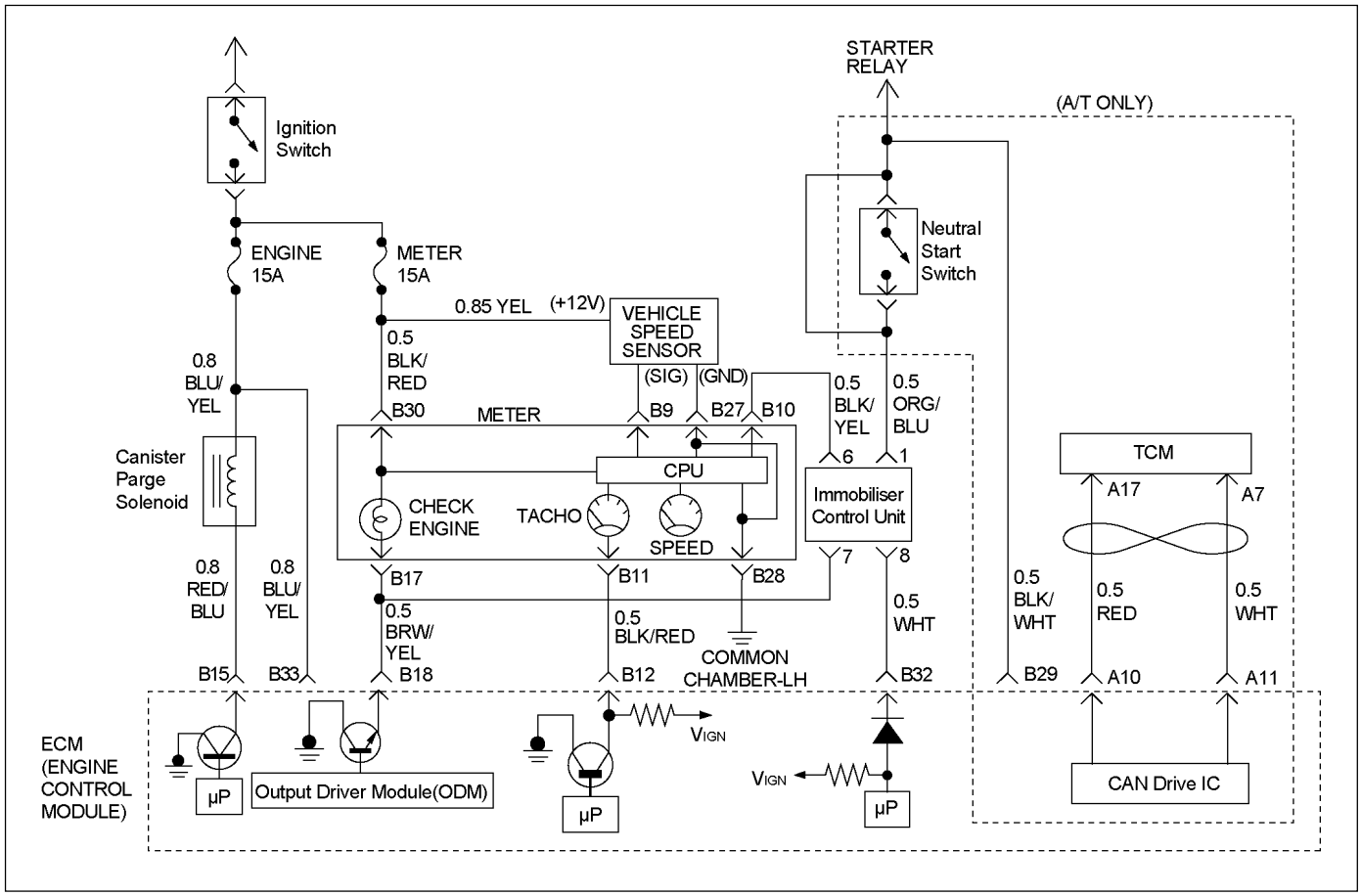
Step	Action	Value (s)	Yes	No
9	Using the DVM and check the EGR position sensor signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the EGR valve connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 10*	Repair faulty harness and verify repair
10	Using the DVM and check the EGR position sensor ground circuit. 1. Ignition "On", engine "Off". 2. Disconnect the EGR valve connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 11*	Repair faulty harness and verify repair

Step	Action	Value (s)	Yes	No
11	Using the DVM and check the EGR position sensor ground circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the EGR valve connector. 4. Check the circuit for open circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the EGR valve connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 12*
12	Substitute a known good EGR valve and recheck. Was the problem solved?	-	Go to *Step 13*	Go to *Step 14*
13	Replace the EGR valve. Is the action complete?	-	Verify repair	-
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 15*

Step	Action	Value (s)	Yes	No
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0444 EVAP PURGE SOLENOID VALVE CIRCUIT LOW VOLTAGE

DIAGNOSTIC TROUBLE CODE (DTC) P0445 EVAP PURGE SOLENOID VALVE CIRCUIT HIGH VOLTAGE



RTW46EMF000301

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
32	P0444	A	EVAP Purge Solenoid Valve Circuit Low Voltage	1. No DTC relating to CKP sensor and system voltage. 2. Engine speed is below 4000rpm. 3. Purge solenoid valve on-duty ratio is below 48%. 4. Purge solenoid valve output monitoring signal low.	No fail-safe function.
	P0445	A	EVAP Purge Solenoid Valve Circuit High Voltage	1. No DTC relating to CKP sensor and system voltage. 2. Engine speed is below 4000rpm. 3. Purge solenoid valve on-duty ratio is more than 50%. 4. Purge solenoid valve output monitoring signal high.	No fail-safe function.

CIRCUIT DESCRIPTION

The canister purge solenoid valve is controlled by the Engine Train Control Module (ECM).

At an appropriate time, the EVAP canister purge solenoid is “ON," allowing engine vacuum to draw a small vacuum on the entire evaporative emissions system.

DIAGNOSTIC AIDS

An intermittent may be caused by the following:

- Poor connections.
- Mis routed harness.
- Rubbed through wire insulation.
- Broken wire inside the insulation.

Check for the following conditions:

- Poor connection at ECM-Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Damaged harness-Inspect the wiring harness for damage. If the harness appears to be OK, observe the EVAP purge solenoid display on the Tech 2 while moving connectors and wiring harnesses related to the sensor.

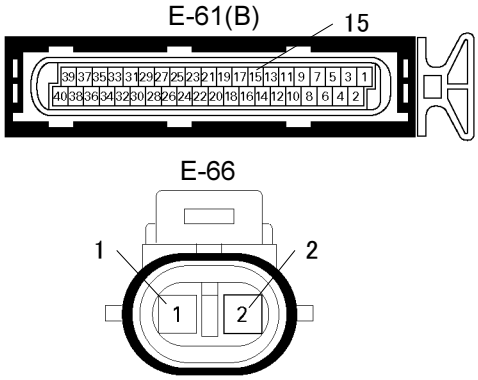
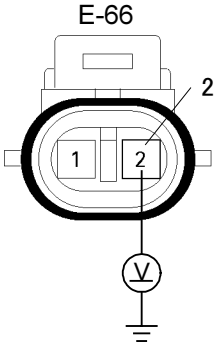
  A change in the display will indicate the location of the fault. If DTC P0444 or P0445 cannot be duplicated, the information included in the Failure Records data can be useful in determined vehicle mileage since the DTC was last set.

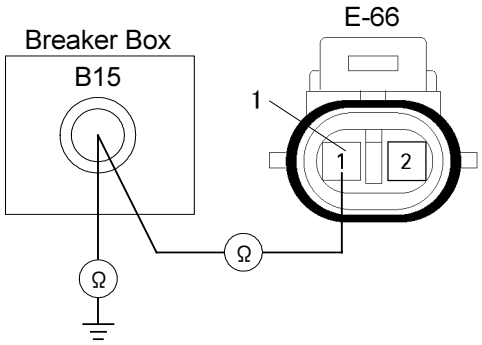
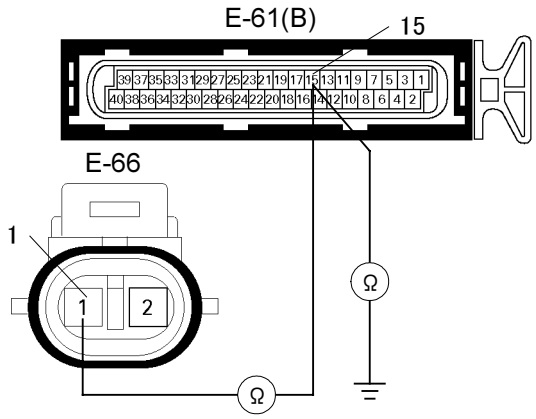
  If it is determined that the DTC occurs intermittently, performing the DTC P0444 or P0445 Diagnostic Chart may isolate the cause of the fault.

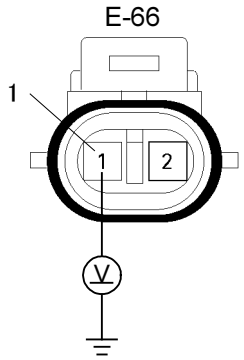
Diagnostic Trouble Code (DTC) P0444 EVAP Purge Solenoid Valve Circuit Low Voltage

Diagnostic Trouble Code (DTC) P0445 EVAP Purge Solenoid Valve Circuit High Voltage

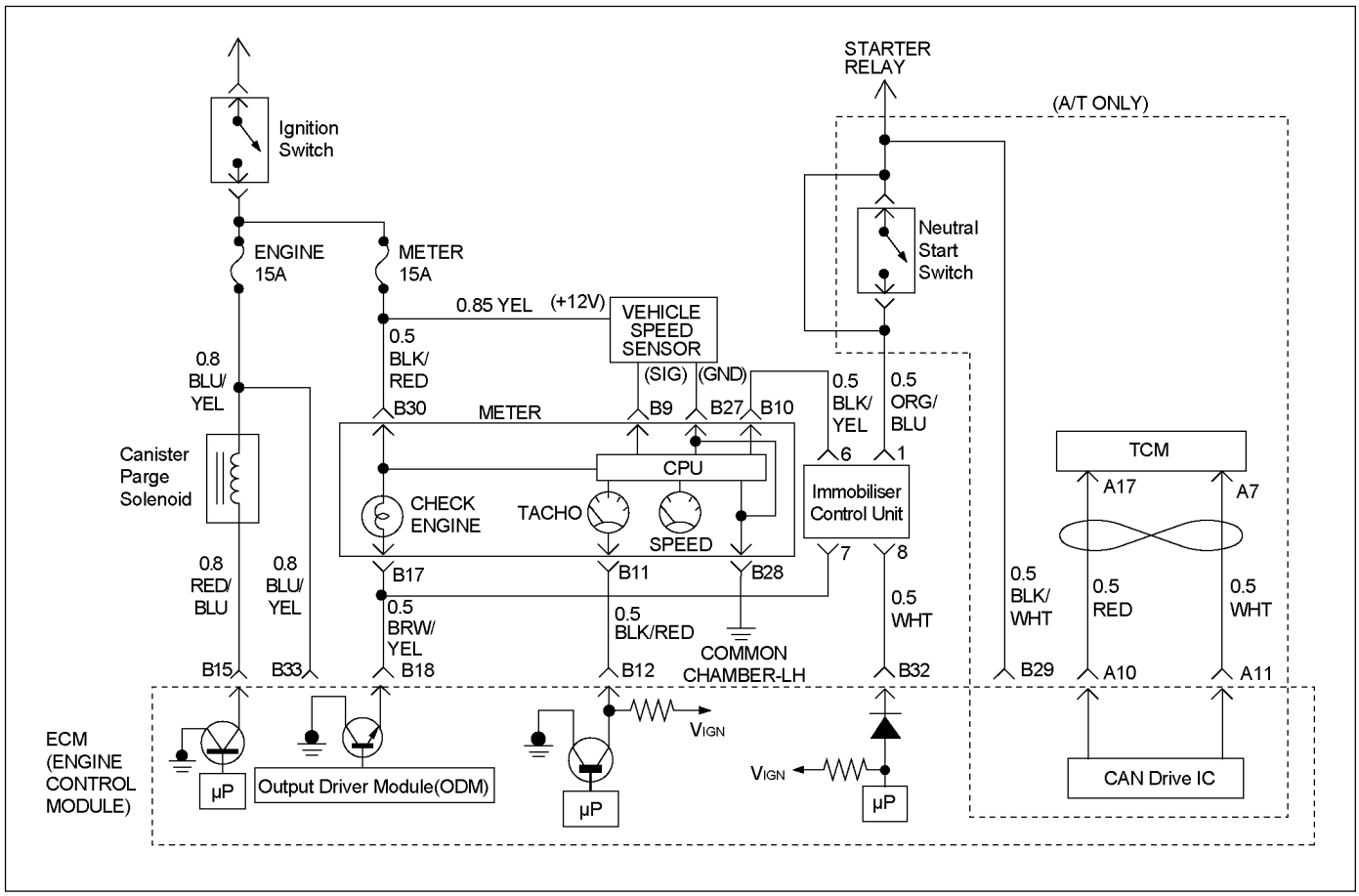
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0444 or P0445 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0444 or P0445 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*

Step	Action	Value (s)	Yes	No
4	Check for poor/faulty connection at the purge solenoid valve or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 5*
5	Using the DVM and check the purge solenoid valve. 1. Ignition "Off", engine "Off". 2. Disconnect purge solenoid valve connector. 3. Measure the resistance of purge solenoid valve coil. Does the tester indicate standard resistance?	25 - 30Ω at 20°C	Go to *Step 6*	Go to *Step 9*
6	Using the DVM and check the purge solenoid valve power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the purge solenoid valve connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	10-14.5V	Go to *Step 8*	Go to *Step 7*
7	Repair the open or short to ground circuit between the "Engine" fuse (15A) and purge solenoid valve. Is the action complete?	-	Verify repair	-

Step	Action	Value (s)	Yes	No
8	Using the DVM and check the purge solenoid valve solenoid signal circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the purge solenoid valve connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the purge solenoid valve connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 9*

Step	Action	Value (s)	Yes	No
9	Using the DVM and check the purge solenoid valve signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the purge solenoid valve connector. 3. Check the circuit for short to battery voltage circuit. Was the DVM indicated battery voltage? 	-	Repair faulty harness and verify repair	Go to *Step 10*
10	Substitute a known good purge solenoid valve and recheck. Was the problem solved?	-	Go to *Step 11*	Go to *Step 12*
11	Replace the purge solenoid valve. Was the problem solved?	-	Verify repair	Go to *Step 12*
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 13*
13	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0500 (FLASH CODE 24) VEHICLE SPEED SENSOR (VSS) CIRCUIT RANGE/PERFORMANCE



RTW46EMF000301

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
24	P0500	B	Vehicle Speed Sensor Circuit Range/Performance	1. Engine speed is below 5000rpm. 2. Under fuel cut operation. 3. Vehicle speed sensor output is below 1km/h. Above conditions are met for 4 seconds.	The ECM use 10km/h condition as substitute.

CIRCUIT DESCRIPTION

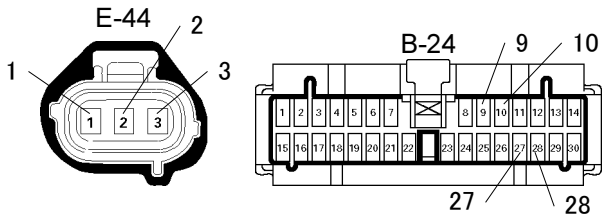
The vehicle speed sensor has a magnet rotated by the transmission output shaft. Attached to the sensor is a hall effect circuit the interacts with the magnetic field treated by the rotating magnet. A 12-volt operating supply for the speed sensor hall circuit is supplied from the meter fuse. The VSS pulses to ground the 9-volt signal sent from the Engine Control Module (ECM) on the reference circuit. The ECM interprets vehicle speed by the number of pulses to ground per second on the reference circuit.

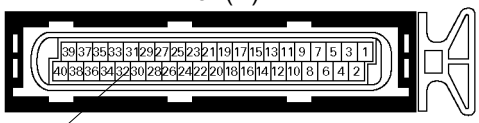
DIAGNOSTIC AIDS

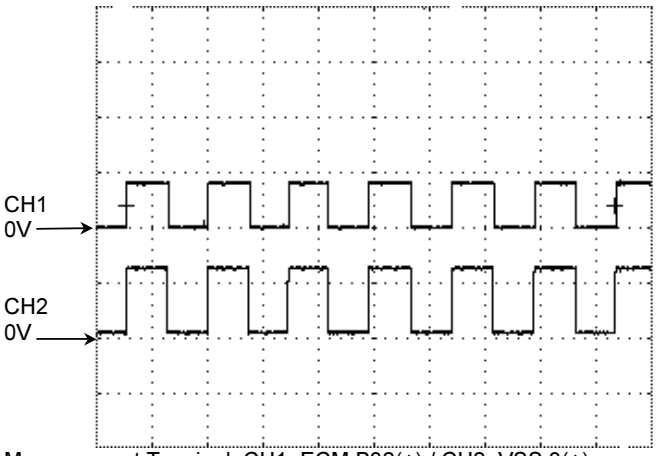
An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for:

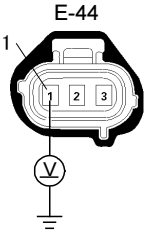
- Poor connection — Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness — Inspect the wiring harness for damage.

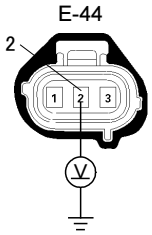
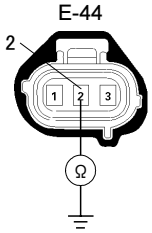
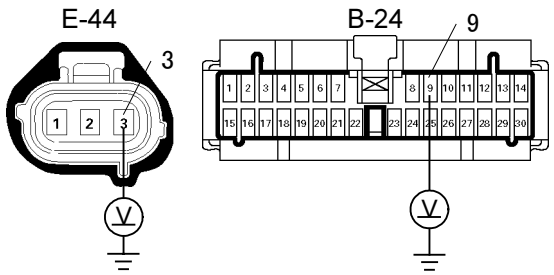
Diagnostic Trouble Code (DTC) P0500 (Flash Code 24) Vehicle Speed Sensor (VSS) Circuit Range/Performance

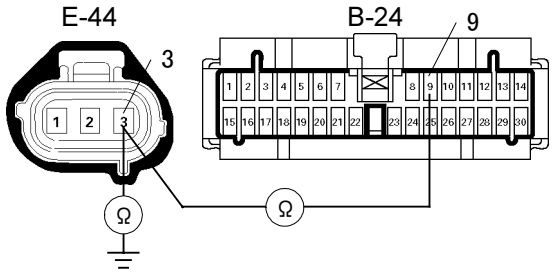
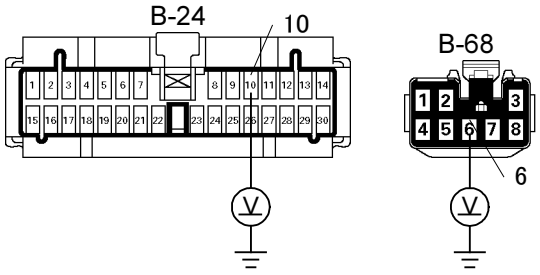
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0500 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0500 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check any accessory parts which may cause electric interference or magnetic interference. Was the problem found?	-	Remove the accessory parts and verify repair	Go to *Step 5*
5	Perform test drive and check the speed meter. Does the speed meter indicate correct vehicle speed.	-	Go to *Step 6*	Go to *Step 7*
6	Perform test drive and use the Tech 2. Monitor the "Vehicle Speed" in the data display. Does the Tech 2 indicate correct vehicle speed as same as the speed meter indication in the instrument panel?	-	Go to *Step 25*	Go to *Step 8*
7	Check for poor/faulty connection at the VSS and meter connectors. If a poor/faulty connection is found, repair the faulty terminal. Was the problem found? 	-	Verify repair	Go to *Step 9*

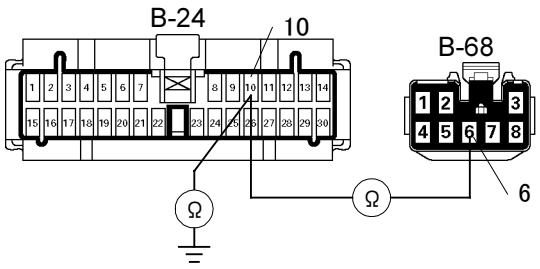
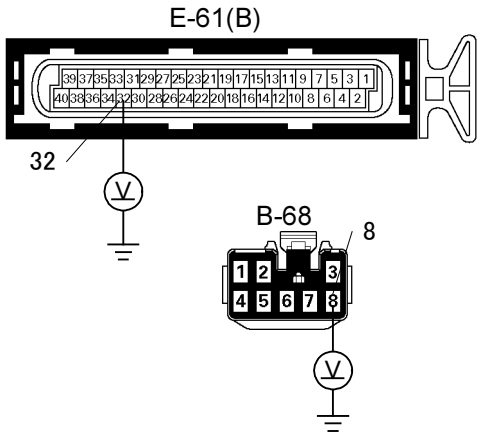
Step	Action	Value (s)	Yes	No
8	Check for poor/faulty connection at the immobilizer control unit (if equipped), ECM and other connectors. If a poor/faulty connection is found, repair the faulty terminal. Was the problem found? E-61(B)  B-68  	-	Verify repair	Go to *Step 10*
9	Remove the VSS from the housing case and visually check. Was the problem found?	-	Go to *Step 23*	Go to *Step 10*

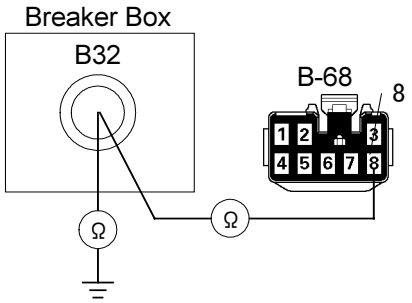
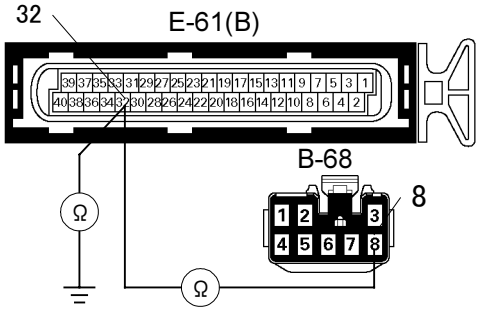
<table>
<tr><th>Step</th><th>Action</th><th>Value (s)</th><th>Yes</th><th>No</th></tr>
<tr><td>10</td><td>Using the DVM and check the VSS signal.
1. Ignition "On", vehicle "Run (lift up)".
2. Measure the VSS output voltage at sensor, meter, immobilizer control unit (if equipped) and ECM.
Does the tester indicate specified value?
<table>
<tr><th>Measurement Position</th><th>Voltage (V) (AC Range)</th><th>If No Good</th></tr>
<tr><td>VSS terminal 3 & GND</td><td rowspan="4">Approximately 6.0 V at 20km/h</td><td>Go to Step 11</td></tr>
<tr><td>Meter B24 connector 9 & GND</td><td>Go to Step 15</td></tr>
<tr><td>Meter B24 connector 10 & GND</td><td>Go to Step 17</td></tr>
<tr><td>Immobilizer control unit B68 connector 6 & GND</td><td>Go to Step 18</td></tr>
<tr><td>Immobilizer control unit B68 connector 8 & GND</td><td rowspan="2">Approximately 4.0 V at 20km/h</td><td>Go to Step 20</td></tr>
<tr><td>ECM E-61 connector 32 & GND</td><td>Go to Step 21</td></tr>
</table>
If a oscilloscope is available, monitor the VSS signal. Does the oscilloscope indicate correct wave form?
Vehicle Speed Sensor (VSS) Reference Wave Form
 

Measurement Terminal: CH1: ECM B32(+) / CH2: VSS 3(+)
GND(-)
Measurement Scale: CH1: 10V/div / CH2: 10V/div 50ms/div
Measurement Condition: Approximately 20km/h
Note: The vehicle is without immobilizer system,
CH1 signal is same as CH2.</td><td>-</td><td>Refer to Diagnostic Aids and Go to Step 25</td><td>Refer the table</td></tr>
<tr><td>11</td><td>Using the DVM and check the VSS power supply circuit.
1. Ignition "On", engine "Off".
2. Disconnect the VSS connector.
3. Check the circuit for open or short to ground circuit.
Was the DVM indicated specified value?
 
</td><td>10-14.5V</td><td>Go to Step 13</td><td>Go to Step 12</td></tr>
</table>

Step	Action	Value (s)	Yes	No
12	Repair the open circuit between the VSS and meter fuse. Is the action complete?	-	Verify repair	-
13	Using the DVM and check the VSS ground circuit. 1. Ignition "On", engine "Off". 2. Disconnect the VSS connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 14*	Repair faulty harness and verify repair
14	Using the DVM and check the VSS ground circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the VSS connector. 3. Check the circuit for open circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 23*
15	Using the DVM and check the VSS signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the VSS connector and meter connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 16*	Repair faulty harness and verify repair

Step	Action	Value (s)	Yes	No
16	Using the DVM and check the VSS signal circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the VSS connector and meter connector. 3. Check the circuit for open or short to ground circuit. If a open or short to ground circuit is found, repair the faulty harness and verify repair. Is the action complete? 	-	Verify repair	-
17	Replace the speed meter. Is the action complete?	-	Verify repair	-
18	Using the DVM and check the VSS signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the meter connector and immobilizer control unit connector (if equipped). 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 19*	Repair faulty harness and verify repair

Step	Action	Value (s)	Yes	No
19	Using the DVM and check the VSS signal circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the meter connector and immobilizer control unit connector (if equipped). 3. Check the circuit for open or short to ground circuit. If a open or short to ground circuit is found, repair the faulty harness and verify repair. Is the action complete? 	-	Verify repair	-
20	Replace the immobilizer control unit (if equipped). Is the action complete?	-	Verify repair	-
21	Using the DVM and check the VSS signal circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the immobilizer control unit connector (if equipped) and ECM connector. 3. Ignition "On". 4. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 22*	Repair faulty harness and verify repair

Step	Action	Value (s)	Yes	No
22	Using the DVM and check the VSS signal circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the immobilizer control unit connector (if equipped). 4. Check the circuit for open or shot to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the immobilizer control unit connector (if equipped) and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 25*
23	Substitute a known good VSS and recheck. Was the problem solved?	-	Go to *Step 24*	Go to *Step 25*
24	Replace the VSS. Was the problem solved?	-	Verify repair	Go to *Step 25*
25	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 26*

Step	Action	Value (s)	Yes	No
26	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0562 (FLASH CODE 66) SYSTEM VOLTAGE LOW

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
66	P0562	D	System Voltage Low	Battery voltage is below 6V for more than 20 seconds.	No fail-safe function.

CIRCUIT DESCRIPTION

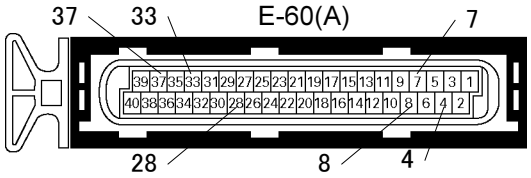
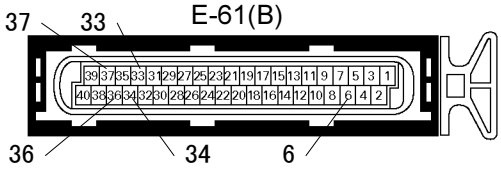
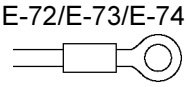
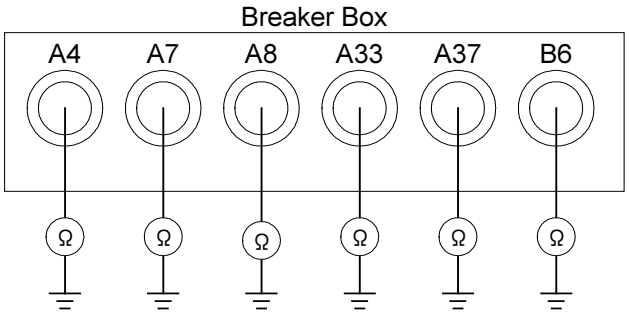
The engine control module (ECM) monitors the system voltage on the ignition feed terminals to the ECM. A system voltage DTC will set whenever the voltage is above a calibrated value.

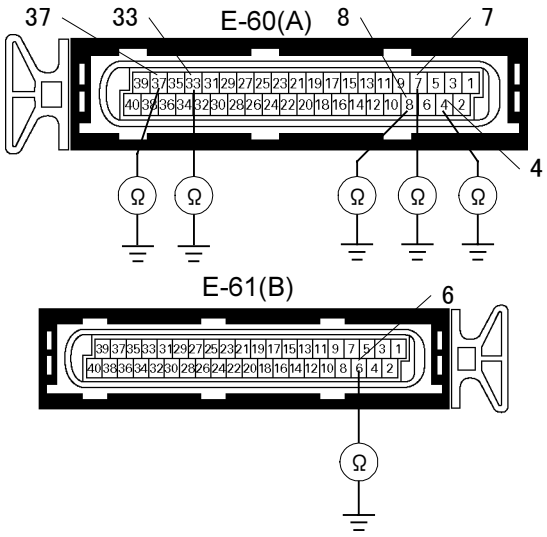
DIAGNOSTIC AIDS

If the DTC sets when an accessory is operated, check for a poor connection or defective accessory.

Diagnostic Trouble Code (DTC) P0562 (Flash Code 66) System Voltage Low

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0562 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0562 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Ignition Voltage" in the data display. 3. Load the electrical system by turning on the headlights, etc.. Does the Tech 2 indicate enough ignition voltage?	10 – 14.5V	Go to *Step 6*	Go to *Step 5*
5	Using the DVM and check the battery voltage at the battery terminal. Does the tester indicate enough battery voltage?	10 – 14.5V	Go to *Step 6*	Check the charging system, charge or replace the battery

Step	Action	Value (s)	Yes	No
6	Check for poor/faulty connection at the ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?  	-	Verify repair	Go to *Step 7*
7	Check for poor/faulty connection of the ECM ground at the common chamber right and left. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 8*
8	Using the DVM and check the ECM ground circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Check the circuit for open circuit. Was the problem found? 			

Step	Action	Value (s)	Yes	No
	Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 9*
9	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 10*
10	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0563 (FLASH CODE 66) SYSTEM VOLTAGE HIGH

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
66	P0563	A	System Voltage High	Battery voltage is above 16V for more than 20 seconds.	No fail-safe function.

CIRCUIT DESCRIPTION

The engine control module (ECM) monitors the system voltage on the ignition feed terminals to the ECM. A system voltage DTC will set whenever the voltage is above a calibrated value.

DIAGNOSTIC AIDS

If the DTC sets when an accessory is operated, check for a poor connection or defective accessory.

Diagnostic Trouble Code (DTC) P0563 (Flash Code 66) System Voltage High

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0563 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0563 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Ignition Voltage" in the data display. 3. Load the electrical system by turning on the headlights, etc.. Does the Tech 2 indicate correct ignition voltage?	Less than 16V	Go to *Step 5*	Check the charging system and Go to *Step 5*
5	Is the battery jamp start cable incorrectly connecting?	-	Verify procedure	Go to *Step 6*
6	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 7*

Step	Action	Value (s)	Yes	No
7	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0601 (FLASH CODE 51) CONTROL MODULE MEMORY CHECKSUM

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
51	P0601	A	Control Module Memory Checksum	ECM memory area error.	Engine control disabled.

CIRCUIT DESCRIPTION

The engine control module (ECM) used in this vehicle utilizes an electrically erasable programmable read-only memory (EEPROM). The EEPROM contains program information and the calibrations required for engine, transmission, and engine diagnostics operation.

Unlike the PROM used in past applications, the EEPROM is not replaceable.

DIAGNOSTIC AIDS

- DTC P0601 indicates that the contents of the EEPROM have changed since the ECM was programmed. The only possible repair is ECM replacement.

Diagnostic Trouble Code (DTC) P0601 (Flash Code 51) Control Module Memory Checksum

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0601 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P0601 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids*
4	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 5*

Step	Action	Value (s)	Yes	No
5	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P0602 ECU PROGRAMMING ERROR

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
51	P0602	-	ECU Programming Error	ECM memory area error.	Engine control disabled.

CIRCUIT DESCRIPTION

The engine control module (ECM) used in this vehicle utilizes an electrically erasable programmable read-only memory (EEPROM). The EEPROM contains program information and the calibrations required for engine, transmission, and engine diagnostics operation.

Unlike the PROM used in past applications, the EEPROM is not replaceable.

DIAGNOSTIC AIDS

Check for following conditions.

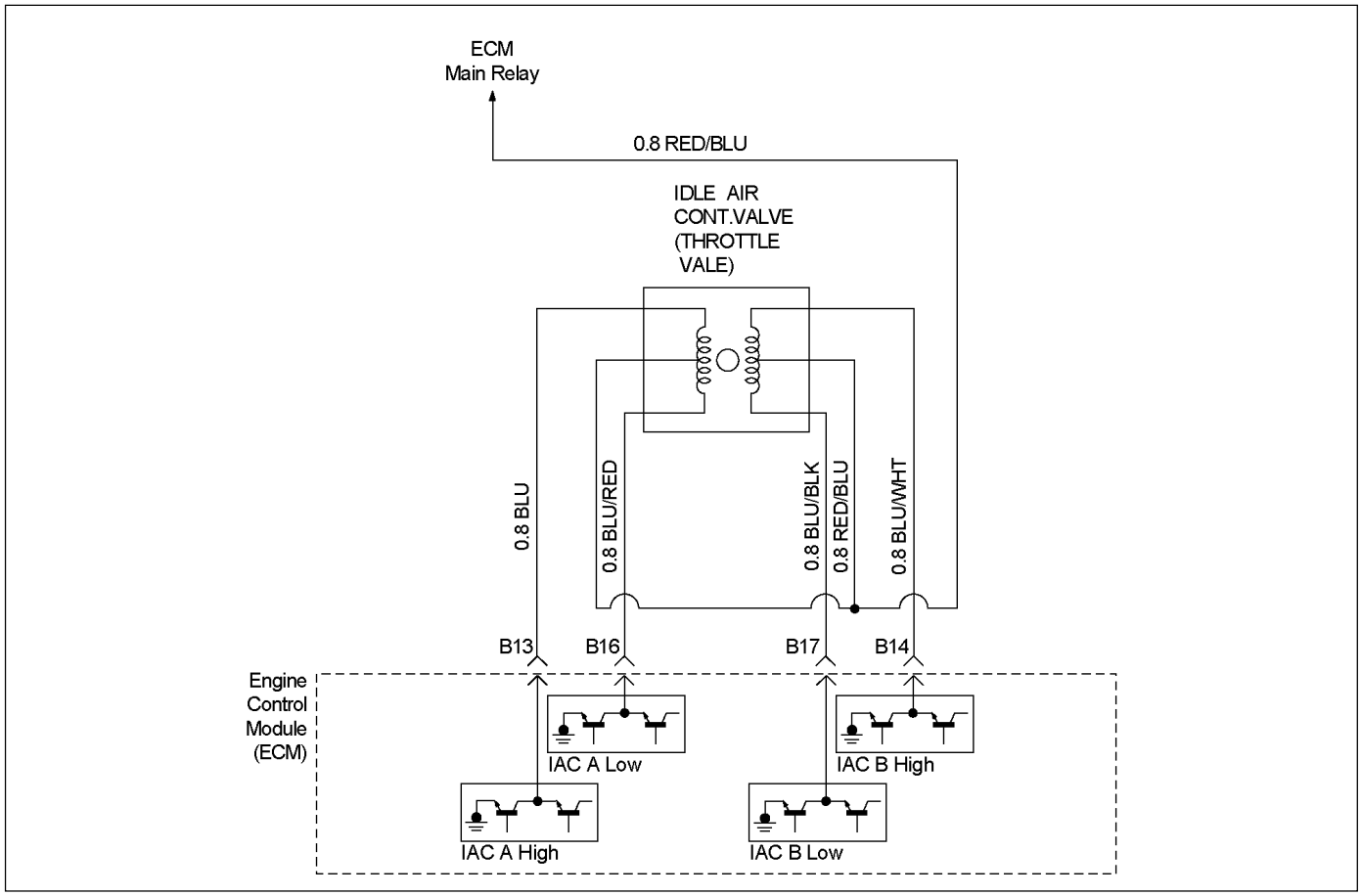
- When reprogramming operation is stopped under Service Programming System (SPS), DTC P0602 will be set.
- When non programmed ECM (service ECM) is used without Service Programming System (SPS), DTC P0602 will be set.

Diagnostic Trouble Code (DTC) P0602 ECU Programming Error

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0602 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Download the latest software to the ECM. ***"SPS (Service Programming System) is necessary."*** Is the action complete?	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P1508 (FLASH CODE 22) IDLE AIR CONTROL SYSTEM LOW/CLOSED

DIAGNOSTIC TROUBLE CODE (DTC) P1509 (FLASH CODE 22) IDLE AIR CONTROL SYSTEM HIGH/OPEN



RTW36EMF000201

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
22	P1508	B	Idle Air Control System Low/Closed	1. No DTC relating to MAF sensor, IAT sensor, ECT sensor, TPS, CMP sensor, CKP sensor, VSS and system voltage. 2. Engine speed is between 675rpm and 6000rpm. 3. Engine coolant temperature is more than 75°C. 4. Intake air temperature is between -10°C and 80°C. 5. Vehicle is stopping. 6. Small amount of intake air through the idle air control valve. (Idle air control valve is sticking at close position.) Above conditions are met for 2 seconds.	Fuel cut is operated at high idle speed.
	P1509	B	Idle Air Control System High/Open	1. No DTC relating to MAF sensor, IAT sensor, ECT sensor, TPS, CMP sensor, CKP sensor, VSS and system voltage. 2. Engine speed is between 675rpm and 6000rpm. 3. Engine coolant temperature more than 75°C. 4. Intake air temperature is between -10°C and 80°C. 5. Vehicle is stopping. 6. Large amount of intake air through the idle air control valve. (Idle air control valve is sticking at open position.) Above conditions are met for 2 seconds.	

CIRCUIT DESCRIPTION

The engine control module (ECM) controls engine idle speed by adjusting the position of the idle air control (IAC) motor pintle. The IAC is a bi-directional stepper motor driven by two coils. The ECM applies current to the IAC coils in steps (counts) to extend the IAC pintle into a passage in the throttle body to decrease air flow. The ECM reverses the current to retract the pintle, increasing air flow. This method allows highly accurate control of idle speed and quick response to changes in engine load. If the ECM detects a condition where too low of an idle speed is present and the ECM is unable to adjust idle speed by increasing the IAC counts, DTC P1508 or P1509 will set, indicating a problem with the idle control system.

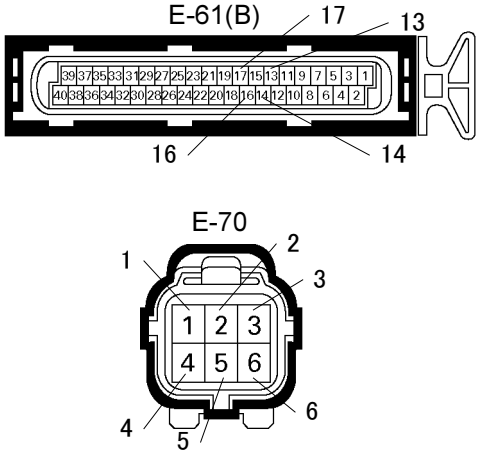
DIAGNOSTIC AIDS

Check for the following conditions:

- Poor connection at ECM or IAC motor – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring for damage.
- Restricted air intake system – Check for a possible collapsed air intake duct, restricted air filter element, or foreign objects blocking the air intake system.

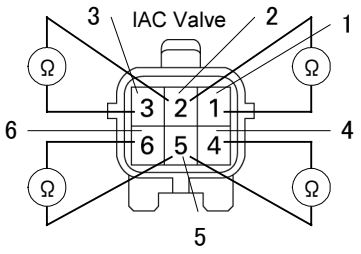
Diagnostic Trouble Code (DTC) P1508 (Flash Code 22) Idle Air Control System Low/Closed

Diagnostic Trouble Code (DTC) P1509 (Flash Code 22) Idle Air Control System High/Open

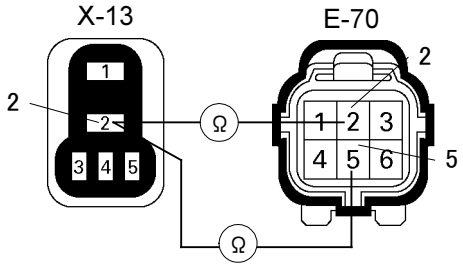
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1508 or P1509 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P1508 or P1509 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for the following conditions. • Objects blocking the Idle Air Control (IAC) Valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Go to *Step 5*
5	Check for poor/faulty connection at the IAC Valve or ECM connector. If a poor/faulty connection is found, repair the faulty terminal. Was the problem found? 	-	Verify repair	Go to *Step 6*

<table>
<tr><th>Step</th><th>Action</th><th>Value (s)</th><th>Yes</th><th>No</th></tr>
<tr><td>6</td><td>Remove the IAC Valve and visually check.

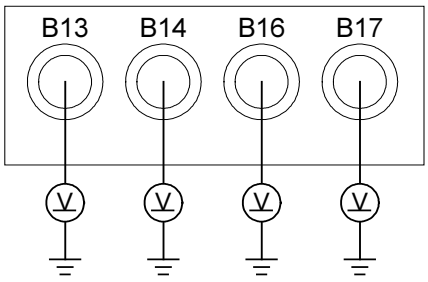
Was the problem found?</td><td>-</td><td>Go to Step 12</td><td>Go to Step 7</td></tr>
<tr><td>7</td><td>Using the DVM and check the IAC Valve coil at IAC Valve.
1. Ignition "Off", engine "Off".
2. Disconnect the IAC Valve connector.
3. Check the coil resistance.

Does the tester indicate standard resistance as shown in the following table?
 

<table>
<tr><th>Measurement Terminal</th><th>Resistance (Ω)</th></tr>
<tr><td>1 - 2</td><td>Approximately 50Ω</td></tr>
<tr><td>2 - 3</td><td>Approximately 50Ω</td></tr>
<tr><td>1 – 3</td><td>Approximately 100Ω</td></tr>
<tr><td>4 - 5</td><td>Approximately 50Ω</td></tr>
<tr><td>5 - 6</td><td>Approximately 50Ω</td></tr>
<tr><td>4 - 6</td><td>Approximately 100Ω</td></tr>
</table></td><td>-</td><td>Go to Step 8</td><td>Go to Step 12</td></tr>
<tr><td>8</td><td>Using the DVM and check the IAC Valve power supply circuit.
1. Ignition "Off", engine "Off".
2. Disconnect the IAC Valve connector and ECM main relay
3. Check the circuit for open circuit.

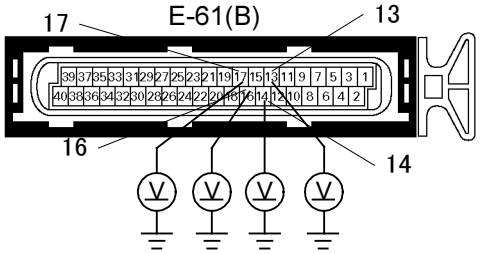
Was the problem found?
 
</td><td>-</td><td>Repair faulty harness and verify repair</td><td>Go to Step 9</td></tr>
</table>

<table>
<tr><th>Step</th><th>Action</th><th>Value (s)</th><th>Yes</th><th>No</th></tr>
<tr><td>9</td><td>
Using the DVM and check the IAC Valve circuit.
Breaker box is available:
1. Ignition "Off", engine "Off".
2. Install the breaker box as type B. (ECM connection)
3. Using the Tech 2, ignition "On" and engine "Off".
4. Select the "Miscellaneous Test" and perform the "IAC Control" in the "IAC System".
5. Operate the Tech 2 in accrodance with procedure.

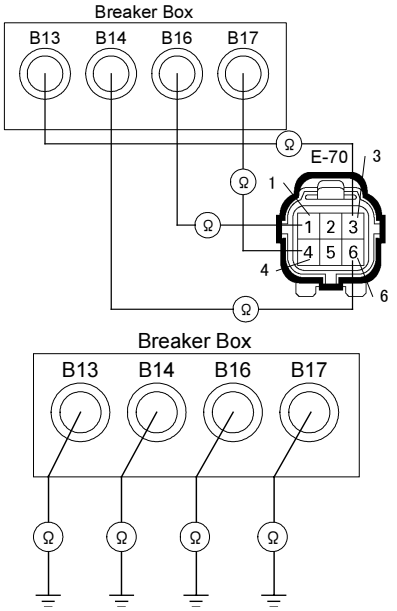
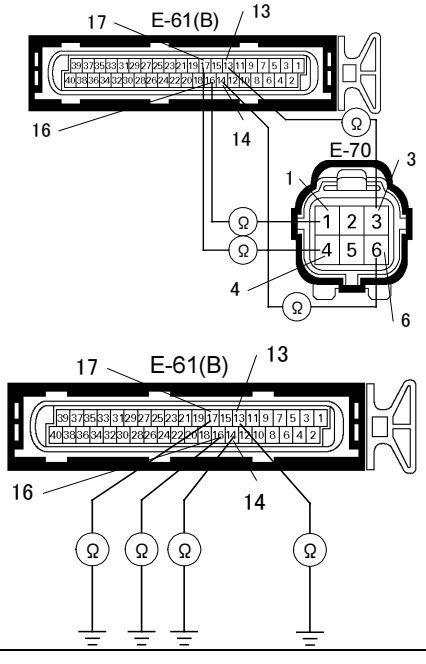
Does the DVM indicate correct characteristic as shown in the following table, when the IAC Valve is operating step by step?
Breaker Box


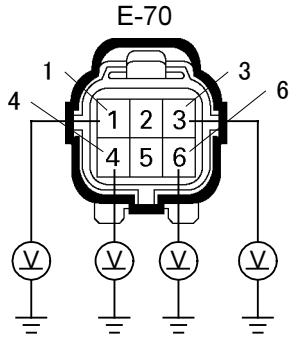
<table>
<tr><th>Measurement Point</th><th>IACV steps at 0, 20, 40, ··· 160</th><th>IACV steps at 10, 30, 50, ··· 150</th></tr>
<tr><td>Coil A High (Breaker Box 53 & GND)</td><td>Less than 1V</td><td>Battery voltage</td></tr>
<tr><td>Coil A Low (Breaker Box 56 & GND)</td><td>Battery voltage</td><td>Less than 1V</td></tr>
<tr><td>Coil B High (Breaker Box 54 & GND)</td><td>Less than 1V</td><td>Battery voltage</td></tr>
<tr><td>Coil B Low (Breaker Box 57 & GND)</td><td>Battery voltage</td><td>Less than 1V</td></tr>
</table>
</td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th>Step</th><th>Action</th><th>Value (s)</th><th>Yes</th><th>No</th></tr>
<tr>
<td></td>
<td>
Breaker box is not available:
1. Using the Tech 2, ignition "On" and engine "Off".
2. Select the "Miscellaneous Test" and perform the "IAC Control" in the "IAC System".
3. Operate the Tech 2 in accordance with procedure.

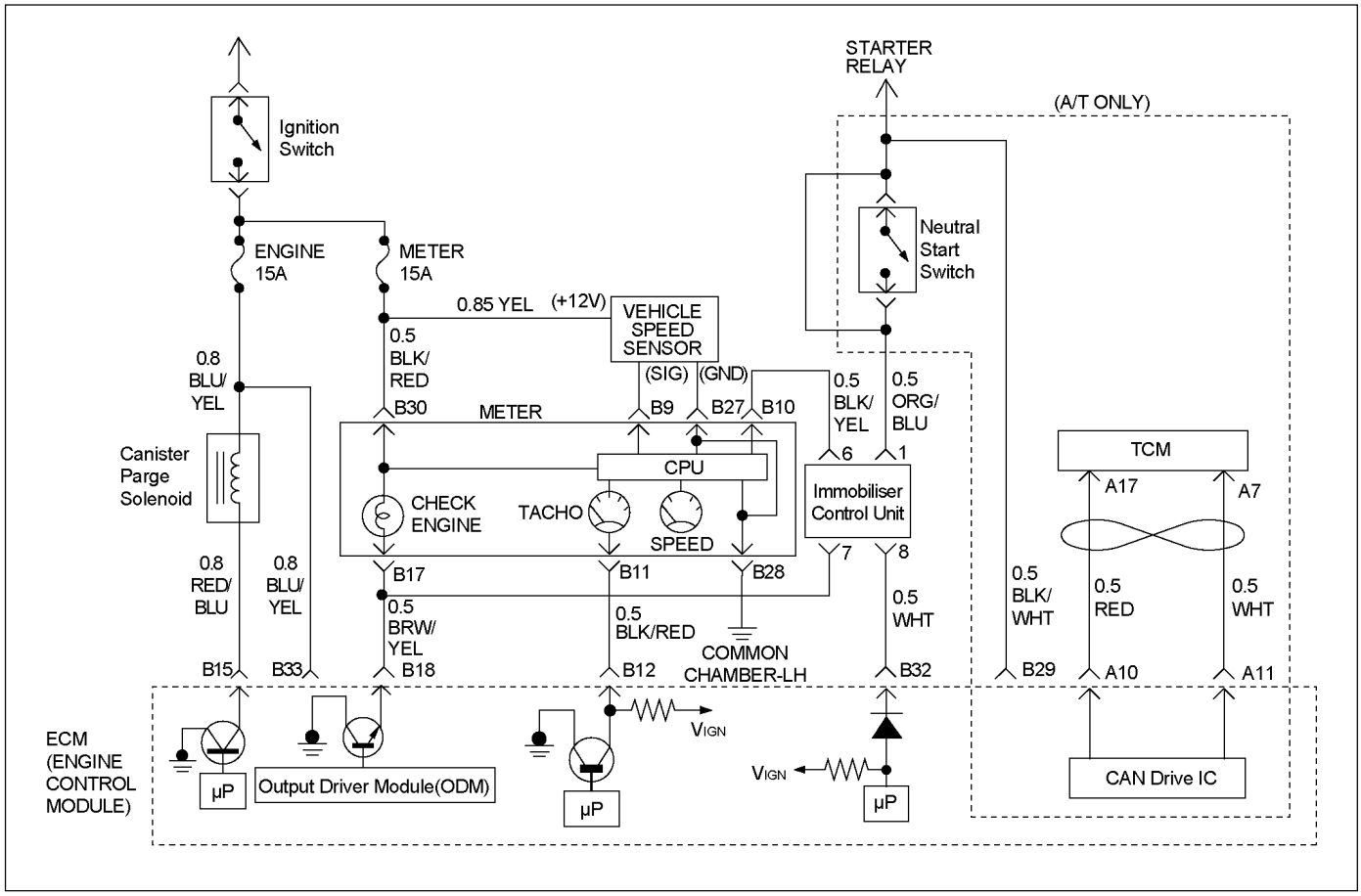
Does the DVM indicate correct characteristic as shown in the following table, when the IAC Valve is operating step by step?


<table>
<tr><th>Measurement Point</th><th>IACV steps at 0, 20, 40, ··· 160</th><th>IACV steps at 10, 30, 50, ··· 150</th></tr>
<tr><td>Coil A High (ECM E61 connector 13 & GND)</td><td>Less than 1V</td><td>10 - 14.5 V</td></tr>
<tr><td>Coil A Low (ECM E61 connector 16 & GND)</td><td>10 - 14.5 V</td><td>Less than 1V</td></tr>
<tr><td>Coil B High (ECM E61 connector 14 & GND)</td><td>Less than 1V</td><td>10 - 14.5 V</td></tr>
<tr><td>Coil B Low (ECM E61 connector 17 & GND)</td><td>10 - 14.5 V</td><td>Less than 1V</td></tr>
</table>
</td>
<td>-</td>
<td>Go to Step 14</td>
<td>Fixed at less than 1V: Go to Step 10
Fixed at battery voltage: Go to Step 11</td>
</tr>
</table>

Step	Action	Value (s)	Yes	No
10	Using the DVM and check the IAC Valve circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the IAC Valve connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the IAC Valve connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 14*

Step	Action	Value (s)	Yes	No
11	Using the DVM and check the IAC Valve circuit. 1. Ignition "On", engine "Off". 2. Disconnect the IAC Valve connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicate voltage? 	-	Repair faulty harness and verify repair	Go to *Step 14*
12	Substitute a known good IAC Valve and recheck. Was the problem solved?	-	Go to *Step 13*	Go to *Step 14*
13	Replace the IAC Valve. Was the problem solved?	-	Verify repair	Go to *Step 14*
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 15*
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P1601 (FLASH CODE 65) CAN BUS OFF



RTW46EMF000301

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
65	P1601	D	CAN BUS Off	CAN BUS off condition is detected consecutively.	Torque reduction control is disable.

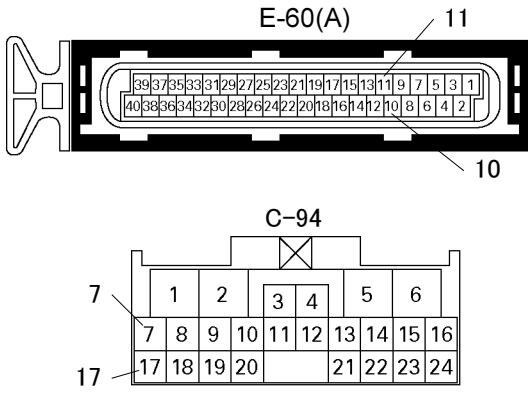
Circuit Description

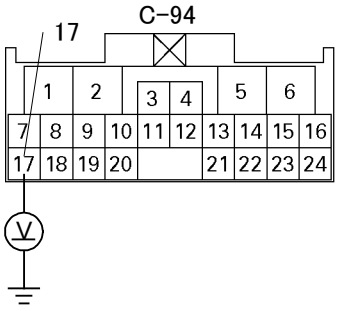
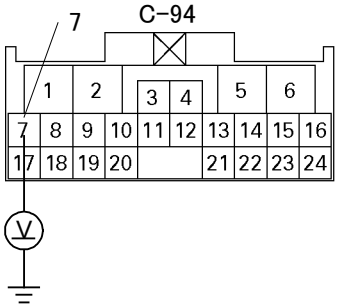
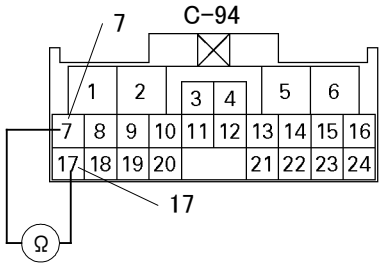
The engine control system in 6VE1 uses high speed CAN bus system. The individual CAN bus systems are connected via two interfaces and can exchange information and data. This allows control modules that are connected to different CAN bus systems to communicate. Engine control modules (ECM) in the vehicle that require continuous, rapid communication are connected to the high speed CAN bus. The engine is continuously notified of the current engine load status. Since the ECM has to react immediately to load status changes, rapid communication is required between the ECM and the automatic transmission control module. The high speed CAN bus in the 6VE1 is designed as a two-wire CAN bus (twisted pair). The wires are shielded and twisted. The engine rate is 500K band.

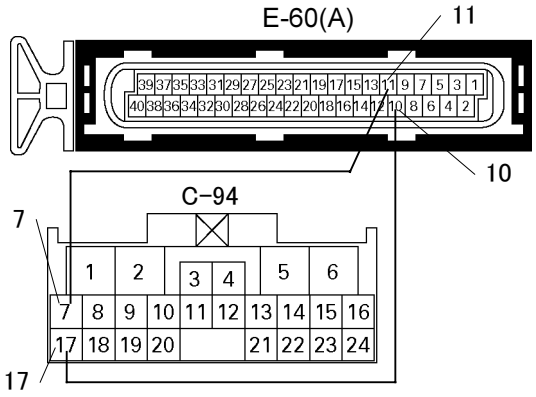
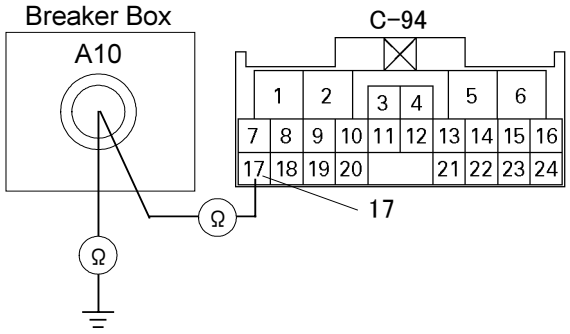
Diagnostic Aids

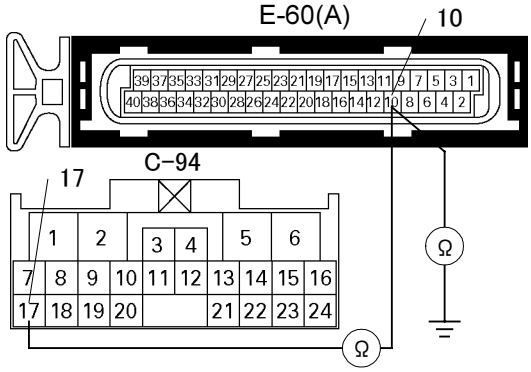
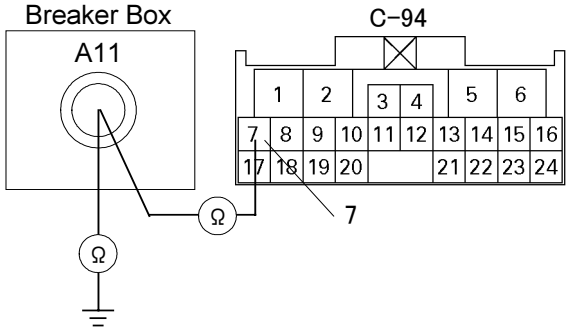
- Inspect the wiring for poor electrical connection at the ECM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring. Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.
- Inspect the wiring for EMI (Erectro-Magnetic Interference). Check that all wires are properly routed away from coil, and generator. Also check for improperly installed electrical options. When this test is performed, turn “OFF" on electronic autoparts switches to improperly for a noise preventing.

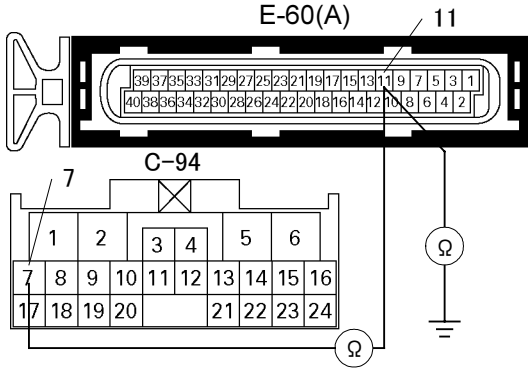
Diagnostic Trouble Code (DTC) P1601 (Flash Code 65) CAN Bus Off

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1601 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P1601 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check any accessory parts which may cause electric interference. Was the problem found?	-	Remove the accessory parts and verify repair	Go to *Step 5*
5	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select "AW30-40LE" in the system selection menu "Powertrain". 3. Select "Read DTC Info Ordered By Priority" in the "Diagnositic Trouble Code". Was the any DTC's P1767 or U2104 stored in this ignition cycle?	-	Refer to *"Automatic Transmission Workshop Manual" & Go to DTC Chart P1767 or U2104*	Go to *Step 6*
6	Check for poor/faulty connection at the TCM or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 7*

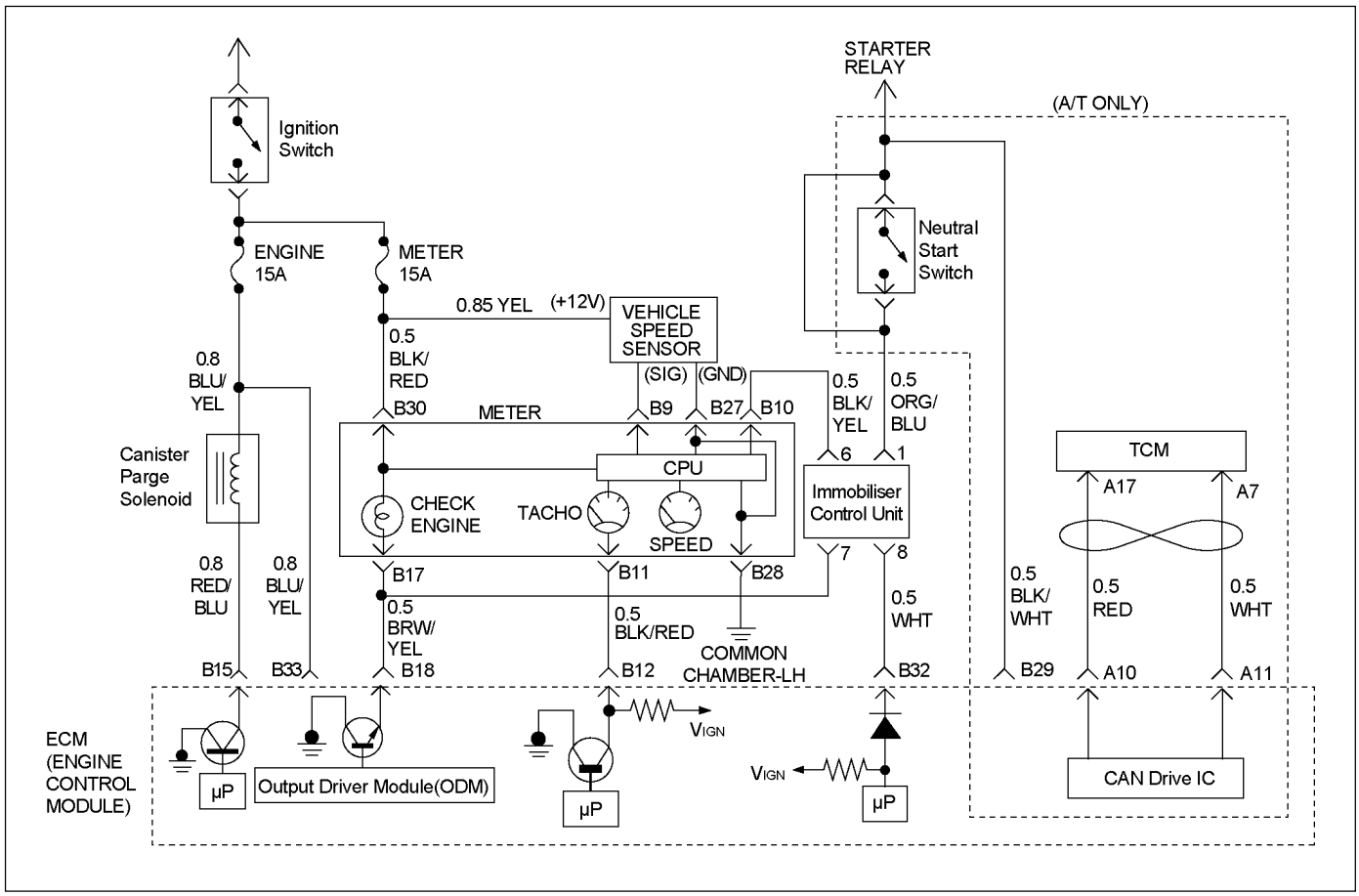
Step	Action	Value (s)	Yes	No
7	Using the DVM and check the CAN BUS high circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the TCM connector. 3. Ignition "On". 4. Check the circuit for short to power supply circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 8*
8	Using the DVM and check the CAN BUS low circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the TCM connector. 3. Ignition "On". 4. Check the circuit for short to power supply circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 9*
9	Using the DVM and check the ECM CAN BUS circuit. 1. Ignition "Off", engine "Off". 2. Disconnect TCM connector. 3. Measure the resistance of ECM CAN BUS circuit. Does the tester indicate standard resistance? 	Approximately 120Ω	Go to *Step 14*	Close to 0Ω: Go to *Step 10* No resistance: Go to *Step 11*

Step	Action	Value (s)	Yes	No
10	Repair the open circuit between the ECM CAN BUS high and low circuit. Was the problem solved? 	-	Verify repair	Go to *Step 15*
11	Using the DVM and check the CAN BUS high circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the TCM connector. 4. Check the circuit for open or short to ground circuit. Was the problem found? 			

Step	Action	Value (s)	Yes	No
	Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the TCM connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 12*
12	Using the DVM and check the CAN BUS low circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the TCM connector. 4. Check the circuit for open or short to ground circuit. Was the problem found? 			

Step	Action	Value (s)	Yes	No
	Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the TCM connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 13*
13	Is the ECM or TCM programmed with the latest software release? If not, download the latest software to the ECM or TCM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 14*
14	Replace the TCM. Was the problem solved? **IMPORTANT:** The replacement TCM must be programmed. **"SPS (Service Programming System) is necessary."**	-	Verify repair	Go to *Step 15*
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) U2104 (FLASH CODE 67) CAN BUS RESET COUNTER OVER-RUN



RTW46EMF000301

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
67	U2104	D	CAN BUS Reset Counter Overrun	1. No DTC CAN BUS Off. 2. CAN valid counter does not change for 2 seconds.	Torque reduction control is disable.

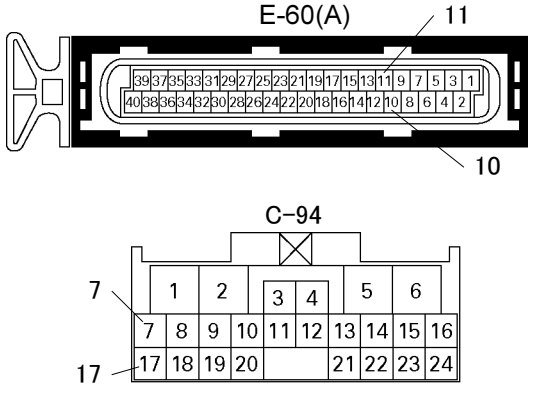
CIRCUIT DESCRIPTION

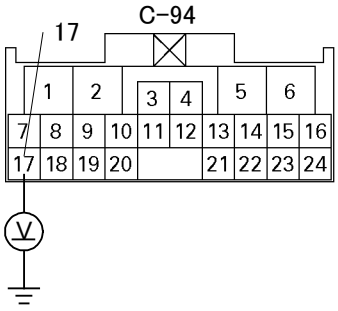
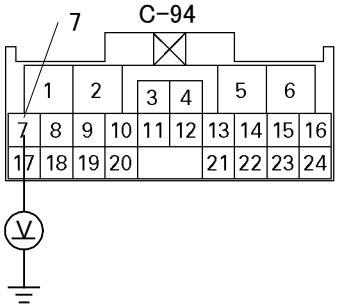
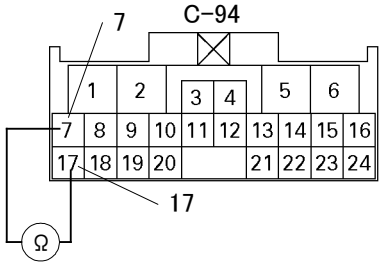
The engine control system in 6VE1 uses high speed CAN bus system. The individual CAN bus systems are connected via two interfaces and can exchange information and data. This allows control modules that are connected to different CAN bus systems to communicate. Engine control modules (ECM) in the vehicle that require continuous, rapid communication are connected to the high speed CAN bus. The engine is continuously notified of the current engine load status. Since the ECM has to react immediately to load status changes, rapid communication is required between the ECM and the automatic transmission control module. The high speed CAN bus in the 6VE1 is designed as a two-wire CAN bus (twisted pair). The wires are shielded and twisted. The engine rate is 500K band.

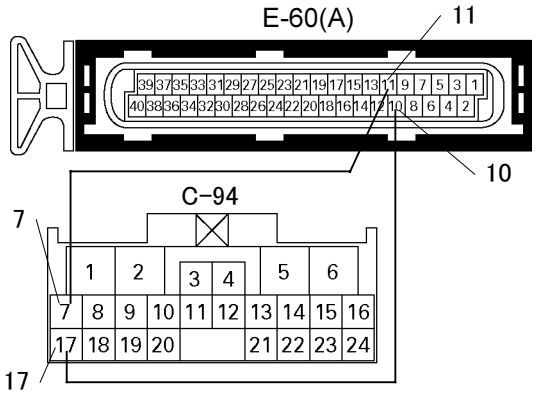
DIAGNOSTIC AIDS

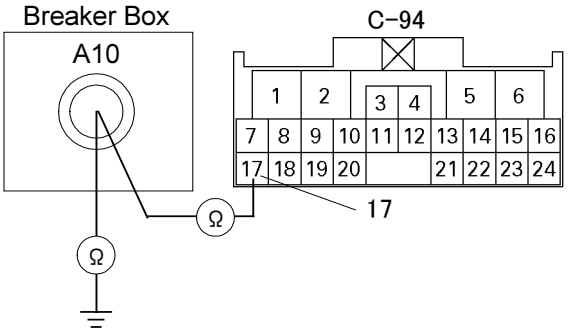
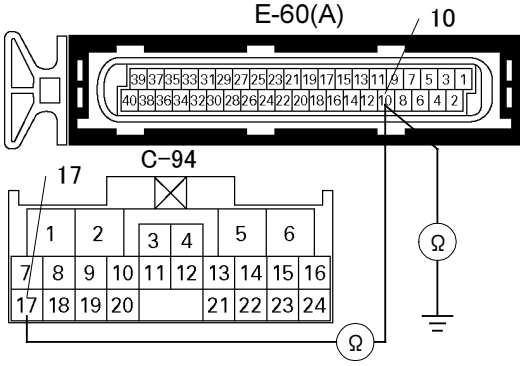
- Inspect the wiring for poor electrical connection at the ECM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring. Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.
- Inspect the wiring for EMI (Erectro-Magnetic Interference). Check that all wires are properly routed away from coil, and generator. Also check for improperly installed electrical options. When this test is performed, turn “OFF" on electronic auto parts switches to improperly for a noise preventing.

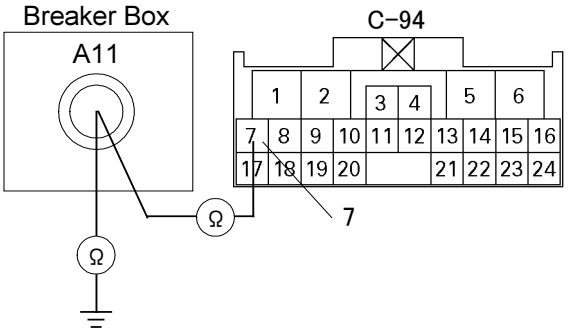
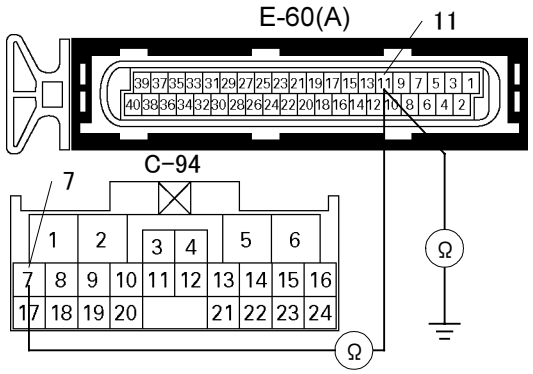
Diagnostic Trouble Code (DTC) U2104 (Flash Code 67) CAN Bus Reset Counter Over-Run

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC U2104 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC U2104 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select "AW30-40LE" in the system selection menu "Powertrain". 3. Select "Read DTC Info Ordered By Priority" in the "Diagnositic Trouble Code". Was the any DTC's P1767 or U2104 stored in this ignition cycle?	-	Refer to *"Automatic Transmission Workshop Manual" & Go to DTC Chart P1767 or U2104*	Go to *Step 5*
5	Check any accessory parts which may cause electric interference. Was the problem found?	-	Remove the accessory parts and verify repair	Go to *Step 6*
6	Check for poor/faulty connection at the TCM or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	-	Verify repair	Go to *Step 7*

Step	Action	Value (s)	Yes	No
7	Using the DVM and check the CAN BUS high circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the TCM connector. 3. Ignition "On". 4. Check the circuit for short to power supply circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 8*
8	Using the DVM and check the CAN BUS low circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the TCM connector. 3. Ignition "On". 4. Check the circuit for short to power supply circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 9*
9	Using the DVM and check the ECM CAN BUS circuit. 1. Ignition "Off", engine "Off". 2. Disconnect TCM connector. 3. Measure the resistance of ECM CAN BUS circuit. Does the tester indicate standard resistance? 	Approximately 120Ω	Go to *Step 14*	Close to 0Ω: Go to *Step 10* No resistance: Go to *Step 11*

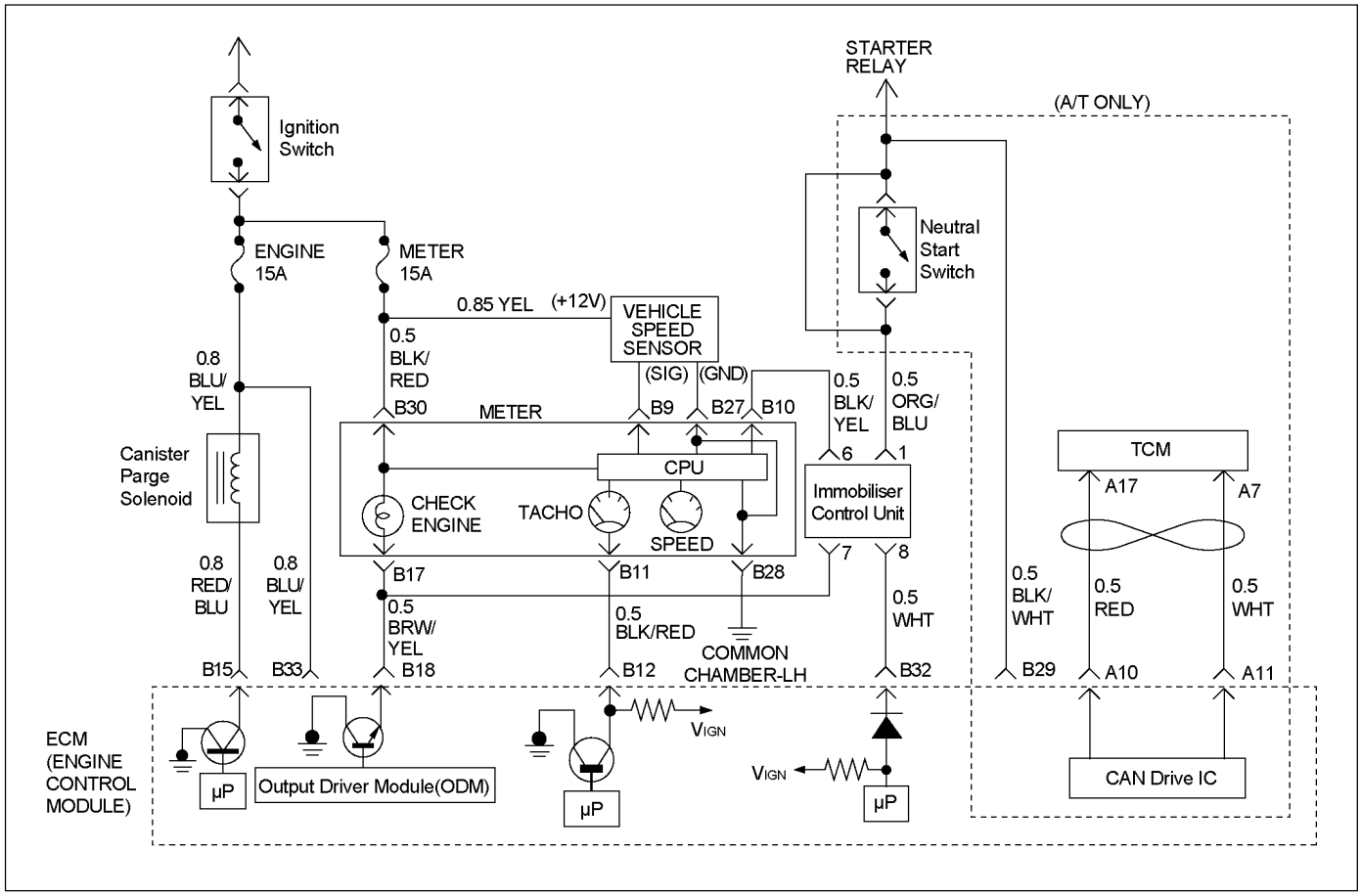
Step	Action	Value (s)	Yes	No
10	Repair the open circuit between the ECM CAN BUS high and low circuit. Was the problem solved? 	-	Verify repair	Go to *Step 15*

Step	Action	Value (s)	Yes	No
11	Using the DVM and check the CAN BUS high circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the TCM connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the TCM connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found?  	-	Repair faulty harness and verify repair	Go to *Step 12*

Step	Action	Value (s)	Yes	No
12	Using the DVM and check the CAN BUS low circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the TCM connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the TCM connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 13*
13	Is the ECM or TCM programmed with the latest software release? If not, download the latest software to the ECM or TCM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 14*
14	Replace the TCM. Was the problem solved? **IMPORTANT:** The replacement TCM must be programmed. ***"SPS (Service Programming System) and is necessary."***	-	Verify repair	Go to *Step 15*

Step	Action	Value (s)	Yes	No
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P1626 IMMOBILIZER NO SIGNAL



RTW46EMF000301

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
67	P1626	-	Immobilizer No Signal	No response from immobilizer control unit.	1. Engine does not start. 2. Check engine lamp flash.

CIRCUIT DESCRIPTION

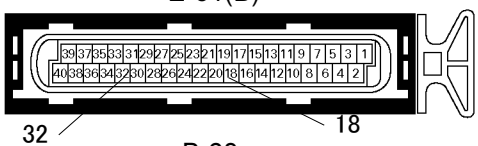
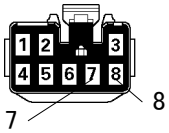
The Engine Control Module (ECM) decides whether that is an abnomality in the immobilizer control system. DTC P1626 is recorded by the ECM when no response from immoblizer.

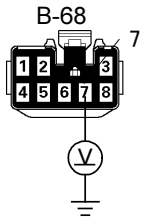
DIAGNOSTIC AIDS

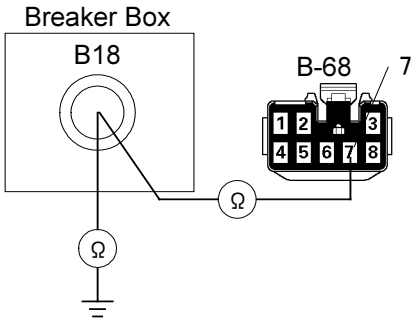
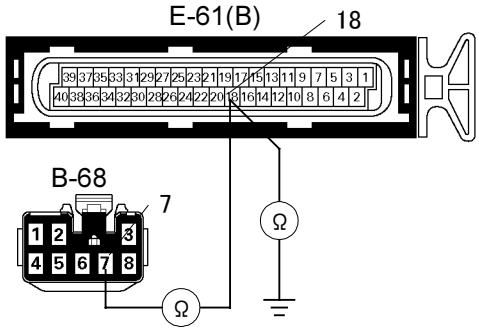
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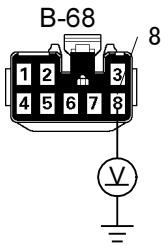
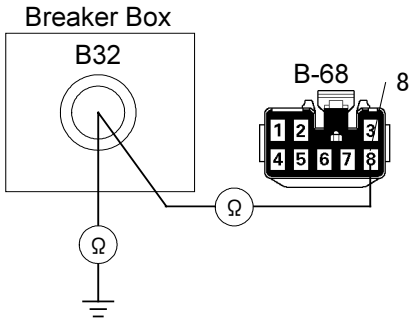
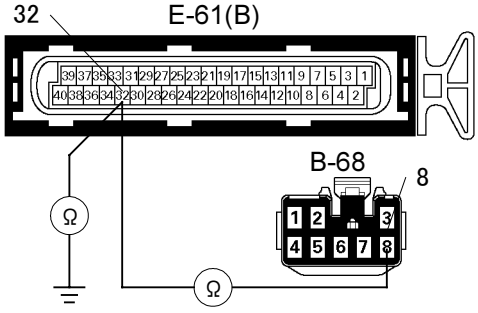
- Poor connection at Engine Control Module (ECM) and immobilizer inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Damaged harness-inspect the wiring harness for damage, if the harness appears to be OK, disconnect the ECM and immobilizer, turn the ignition "ON" and observe a voltmeter connected to the suspect driver circuit at the ECM and immobilizer harness connector while moving connectors and wiring harnesses relates to the Check Engine Lamp (MIL). A change in voltage will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P1626 Immobilizer No Signal

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1626 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P1626 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check any accessory parts which may cause electric interference. Was the problem found?	-	Remove the accessory parts and verify repair	Go to *Step 5*
5	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select "Immobilizer" in the system selection menu "Body". 3. Select "Read DTC Info Ordered By Priority" in the "Diagnositic Trouble Code". Was the DTC B0007 stored in this ignition cycle?	-	Refer to *"Immobilizer Workshop Manual" & Go to DTC Chart B0007*	Go to *Step 6*
6	Check for poor/faulty connection at the immobilizer control unit connector or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? E-61(B)  B-68  	-	Verify repair	Go to *Step 7*

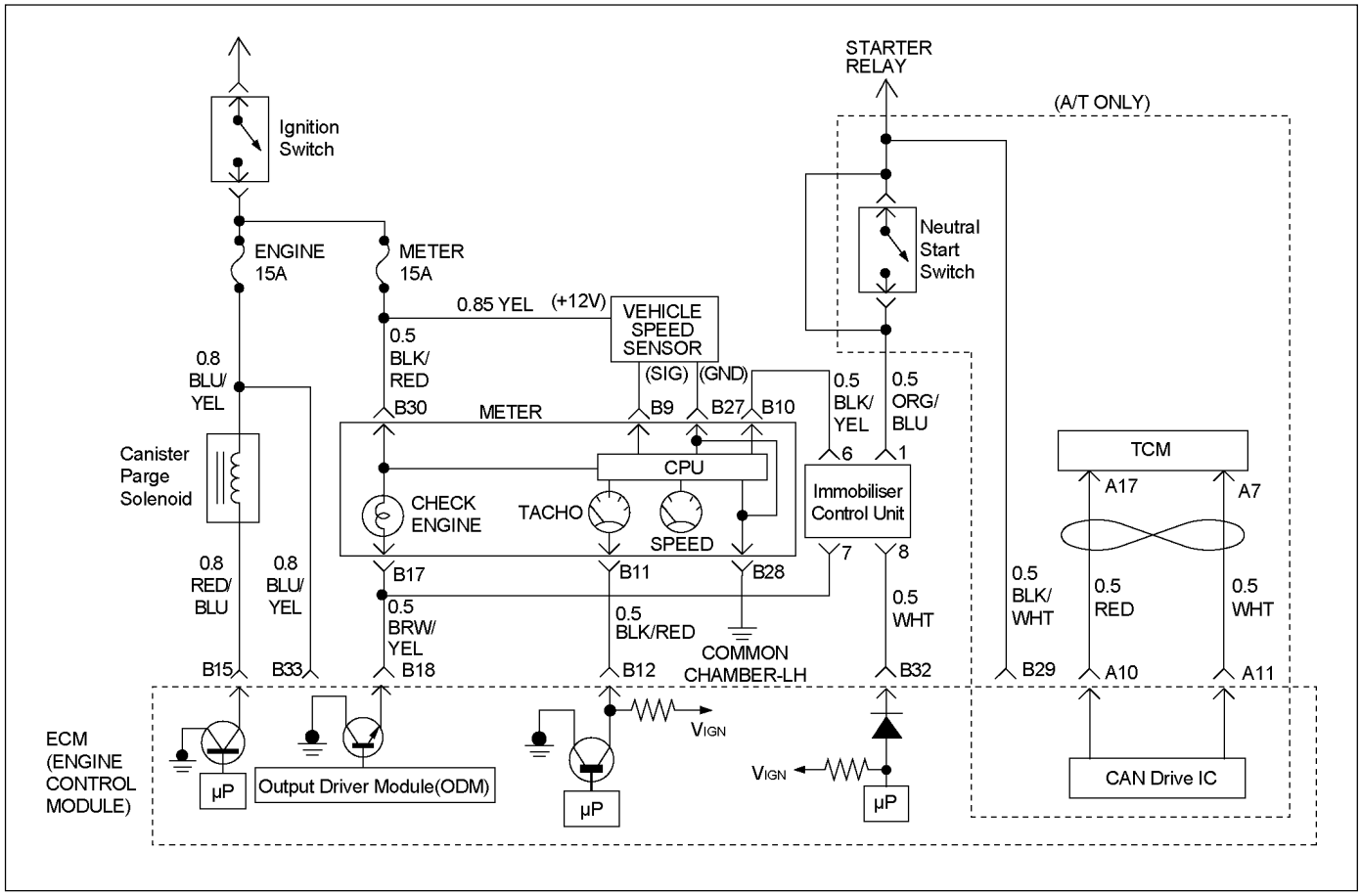
Step	Action	Value (s)	Yes	No
7	Using the DVM and check the "CHECK ENGINE" lamp circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the meter connector and immobilizer control unit connector. 3. Ignition "On". 4. Check the circuit for short to power supply circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 8*

Step	Action	Value (s)	Yes	No
8	Using the DVM and check the "CHECK ENGINE" lamp circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the immobilizer control unit connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the immobilizer control unit connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 9*

Step	Action	Value (s)	Yes	No
9	Using the DVM and check the VSS signal circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the immobilizer control unit connector and ECM connector. 3. Ignition "On". 4. Check the circuit for short to power supply circuit. Was the problem found? 	-	Repair faulty harness and verify repair	Go to *Step 10*
10	Using the DVM and check the VSS signal circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A (ECM disconnected). Refer to 6E-95 page. 3. Disconnect the immobilizer control unit connector . 4. Check the circuit for open or shot to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the immobilizer control unit connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	- -	Repair faulty harness and verify repair	Go to Srtep 11

Step	Action	Value (s)	Yes	No
11	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 12*
12	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P1631 IMMOBILIZER WRONG SIGNAL



RTW46EMF000301

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
67	P1631	-	Immobilizer Wrong Signal	Received response is not correct.	1. Engine does not start. 2. Check engine lamp flash.

CIRCUIT DESCRIPTION

The ECM decides whether that is an abnormality in the immobilizer control system. DTC P1631 is recorded by the ECM when received response was not correct.

DIAGNOSTIC AIDS

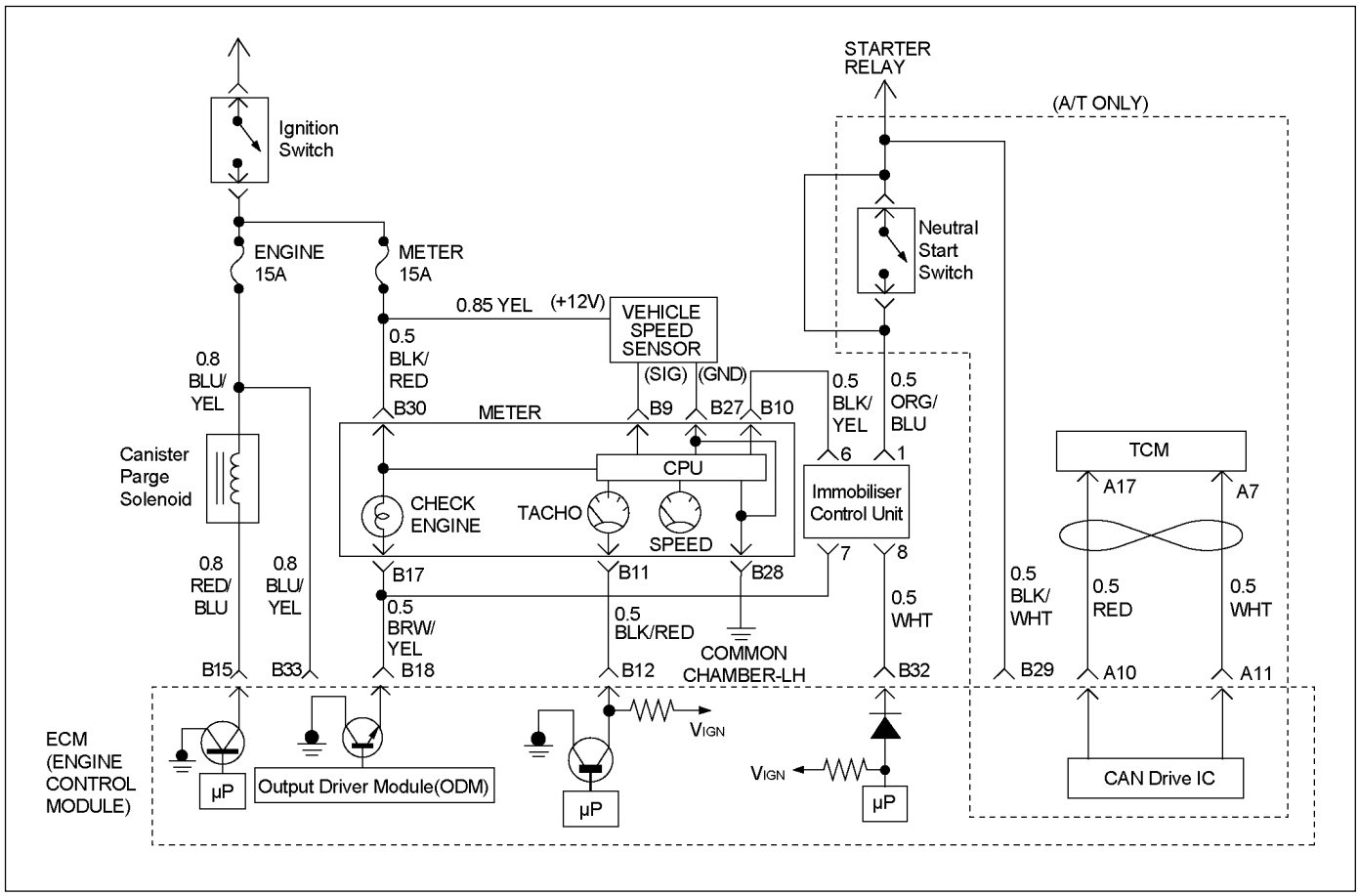
Check for the following conditions:

- Poor connection at Engine Control Module (ECM) and immobilizer inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Damaged harness-inspect the wiring harness for damage, if the harness appears to be OK, disconnect the ECM and immobilizer, turn the ignition "ON" and observe a voltmeter connected to the suspect driver circuit at the ECM and immobilizer harness connector while moving connectors and wiring harnesses relates to the Check Engine Lamp (MIL). A change in voltage will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P1631 Immobilizer Wrong Signal

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1631 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P1631 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select "Immobilizer" in the system selection menu "Body". 3. Select "Read DTC Info Ordered By Priority" in the "Diagnositic Trouble Code". Was the any DTC's B0005 or B0006 stored in this ignition cycle?	-	Refer to *"Immobilizer Workshop Manual" & Go to DTC Chart B0005 or B0006*	Go to *Step 5*
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 6*
6	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P1648 WRONG SECURITY CODE ENTERED



RTW46EMF000301

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
67	P1648	-	Wrong Security Code Entered	Received incorrect security code.	1. Engine does not start. 2. Check engine lamp flash.

CIRCUIT DESCRIPTION

The ECM decides whether that is an abnormality in the immobilizer control system. DTC P1648 is recorded by the ECM when received security code was not correct.

DIAGNOSTIC AIDS

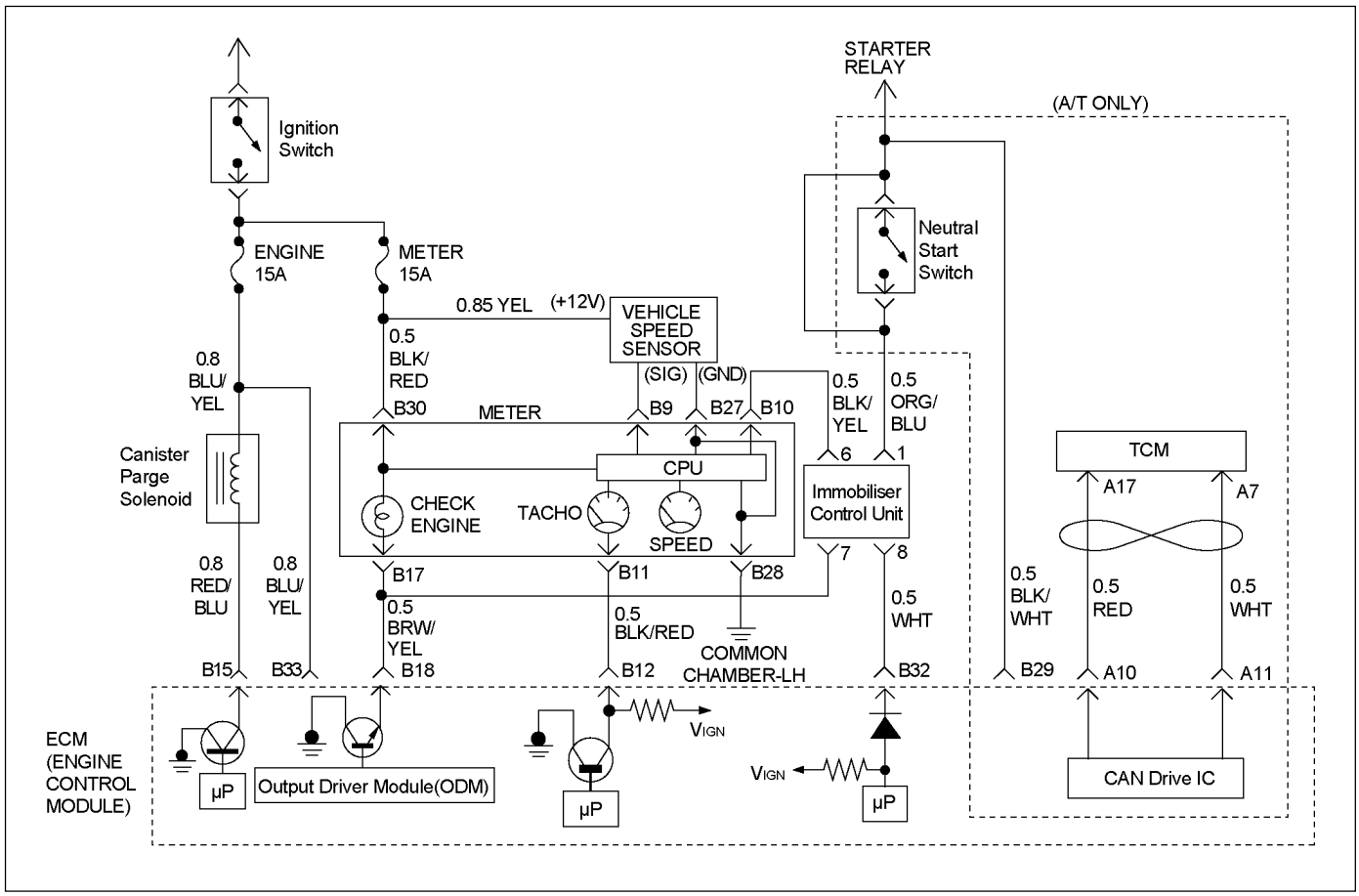
Check for the following conditions:

- Poor connection at Engine Control Module (ECM) and immobilizer inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Damaged harness-inspect the wiring harness for damage, if the harness appears to be OK, disconnect the ECM and immobilizer, turn the ignition "ON" and observe a voltmeter connected to the suspect driver circuit at the ECM and immobilizer harness connector while moving connectors and wiring harnesses relates to the Check Engine Lamp (MIL). A change in voltage will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P1648 Wrong Security Code Entered

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1648 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P1648 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select "Immobilizer" in the system selection menu "Body". 3. Select "Read DTC Info Ordered By Priority" in the "Diagnositic Trouble Code". Was the any DTC's B0002 or B0003 stored in this ignition cycle?	-	Refer to *"Immobilizer Workshop Manual" & Go to DTC Chart B0002 or B0003*	Go to *Step 5*
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 6*
6	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIAGNOSTIC TROUBLE CODE (DTC) P1649 IMMOBILIZER FUNCTION NOT PROGRAMMED



RTW46EMF000301

Condition For Setting The DTC and Action Taken When The DTC Sets

Flash Code	Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
67	P1649	-	Immobilizer Function Not Programmed	Immobilizer function is not programmed in the ECM.	1. Engine does not start. 2. Check engine lamp flash.

CIRCUIT DESCRIPTION

The ECM decides whether that is an abnormality in the immobilizer control system. DTC P1649 is recorded by the ECM when immobilizer function was not programmed in the ECM.

DIAGNOSTIC AIDS

Check for the following conditions:

- Poor connection at Engine Control Module (ECM) and immobilizer inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Damaged harness-inspect the wiring harness for damage, if the harness appears to be OK, disconnect the ECM and immobilizer, turn the ignition "ON" and observe a voltmeter connected to the suspect driver circuit at the ECM and immobilizer harness connector while moving connectors and wiring harnesses relates to the Check Engine Lamp (MIL). A change in voltage will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P1649 Immobilizer Function Not Programmed

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1649 stored as "Present Failure"?	-	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information" Was the DTC P1649 stored in this ignition cycle?	-	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select "Immobilizer" in the system selection menu "Body". 3. Select "Read DTC Info Ordered By Priority" in the "Diagnositic Trouble Code". Was the DTC B0007 stored in this ignition cycle?	-	Refer to *"Immobilizer Workshop Manual" & Go to DTC Chart B0007*	Go to *Step 5*
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 6*
6	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

SYMPTOM DIAGNOSIS

PRELIMINARY CHECKS

Before using this section, perform the "On-Board Diagnostic (OBD) System Check" and verify all of the following items:

- The engine control module (ECM) and check engine lamp (MIL=malfunction indicator lamp) are operating correctly.
- There are no Diagnostic Trouble Code(s) stored.
- Tech 2 data is within normal operating range. Refer to Typical Scan Data Values.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom chart.

VISUAL/PHYSICAL CHECK

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time. This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connection. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Air leaks at throttle body mounting area, manifold absolute pressure (MAP) sensor and intake manifold sealing surfaces.
- Ignition wires for cracking, harness, and carbon tracking.
- Wiring for proper connections, pinches and cuts.

INTERMITTENT

Important: An intermittent problem may or may not turn on the check engine lamp (MIL=malfunction indicator lamp) or store a Diagnostic Trouble Code. Do NOT use the Diagnostic Trouble Code (DTC) charts for intermittent problems.

The fault must be present to locate the problem.

Most intermittent problems are cased by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions.

- Poor mating of the connector halves or a terminal not fully seated in the connector (backed out).
- Improperly formed or damaged terminal.
- All connector terminals in the problem circuit should be carefully checked for proper contact tension.
- Poor terminal-to-wire connection. This requires removing the terminal form the connector body to check.
- Ignition coils shorted to ground and arcing at ignition wires or plugs.
- Check engine lamp (MIL=malfunction indicator lamp) wire to ECM shorted to ground.
- Poor ECM grounds. Refer to the ECM wiring diagrams.

Road test the vehicle with a Digital Multimeter connected to a suspected circuit. An abnormal voltage when the malfunction occurs is a good indication that there is a fault in the circuit being monitored.

Using Tech 2 to help detect intermittent conditions. The Tech 2 have several features that can be used to located an intermittent condition. Use the following features to find intermittent faults:

To check for loss of diagnostic code memory, disconnect the mass air flow (MAF) sensor and idle the engine until the check engine lamp (MIL=malfunction indicator lamp) comes on. Diagnostic Trouble Code P0102 should be stored and kept in memory when the ignition is turned OFF.

If not, the ECM is faulty. When this test is completed, make sure that you clear the Diagnostic Trouble Code P0102 from memory.

An intermittent check engine lamp (MIL=malfunction indicator lamp) with no stored Diagnostic Trouble Code may be caused by the following:

- Ignition coil shorted to ground and arcing at ignition wires or plugs.
- Check engine lamp (MIL=malfunction indicator lamp) wire to ECM short to ground.
- Poor ECM grounds. Refer to the ECM wiring diagrams.

Check for improper installation of electrical options such as light, cellular phones, etc. Check all wires from ECM to the ignition control module for poor connections.

Check for an open diode across the A/C compressor clutch and check for other open diodes (refer to wiring diagrams in Electrical Diagnosis).

If problem has not been found, refer to ECM connector symptom tables.

- Check the "Broadcast Code" of the ECM, and compare it with the latest Isuzu service bulletins and/or Isuzu EEPROM reprogramming equipment to determine if an update to the ECM's reprogrammable memory has been released.

To check the "Broadcast Code", connect the Tech 2, then look for "ID info." then select "Broadcast Code". This should display a 4 character code, such as "8501" (example only).

This identifies the contents of the reprogrammable software and calibration contained in the ECM.

If the "Broadcast Code" is not the most current available, it is advisable to reprogram the ECM's EEPROM memory, which may either help identify a hard-to find problem or may fix the problem.

The Service Programming System (SPS) will not allow incorrect software programming or incorrect calibration changes.

ENGINE CRANKS BUT WILL NOT RUN

DEFINITIONS: Engine cranks, but will not run. (The engine never start.)

NOTE: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.
Should Tech2 display "SPS Procedure was not successful", engine will not start, but no DTCs are present, low battery voltage or poor electrical connections should be the primary suspects.Perform the SPS procedure again after rectifying the fault/s.

NOTE: The vehicle with immobilizer system, this system may be activated. Check the immobilizer system diagnosis.

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to On Board Diagnostic (OBD) System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	-	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	-	Go to *Step 4*	Go to Visual / physical Check
4	Check the "Meter" fuse (15A), "Engine" fuse (15A), "IGN Coil" fuse (15A) and "Fuel Pump" fuse (20A). If the fuse is burnt out, repair as necessary. Was the problem found?	-	Verify repair	Go to *Step 5*
5	Check the ECM grounds to verify that they are clean and tight. Refer to the ECM wiring diagrams. Was a problem found?	-	Verify repair	Go to *Step 6*
6	Check the fuel quality. Is the customer using proper fuel?	-	Go to *Step 7*	Replace fuel
7	Visually/physically inspect for the following conditions: • Restrict air intake system. Check for a restricted air filter element, or foreign objects blocking the air intake system. • Check for objects blocking the IAC passage or throttle bore, excessive deposits in the throttle bore and on the throttle plate. • Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty crankcase ventilation hose/brake booster hose. Was a problem found?	-	Verify repair	Go to *Step 8*

Step	Action	Value (s)	Yes	No
8	1. Using a Tech 2, display the IAC value. 2. Check for a faulty, plugged, or sticking IAC operation. Was the problem found?	-	Verify repair	Go to *Step 9*
9	Check the CKP sensor signal or installation condition. Refer to DTC P0336 "Crankshaft Position Sensor Circuit Range/Performance" and DTC P0337 "Crankshaft Position Sensor Circuit No Signal". Was a problem found?	-	Verify repair	Go to *Step 10*
10	Check for proper ignition voltage output with the spark tester. Was a problem found?	-	Verify repair	Go to *Step 11*
11	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	-	Verify repair	Go to *Step 12*
12	Check the fuel pressure. Refer to Fuel System Diagnosis. Was a problem found?	-	Verify repair	Go to *Step 13*
13	Perform the procedure in Fuel System Pressure Test to determine if there is a problem with fuel delivery. Was a problem found?	-	Verify repair	Go to *Step 14*
14	Visually/physically check the vacuum hose for splits, kinks and proper connections and routing. Was a problem found?	-	Verify repair	Go to *Step 15*
15	Check the exhaust system for a possible restriction: • Damaged or collapsed pipes. • Internal muffler failure. Was a problem found?	-	Verify repair	Go to *Step 16*
16	Check for the following engine mechanical problems (refer to Engine Mechanical section): • Low compression. • Leaking cylinder head gaskets. • Worn camshaft. • Camshaft drive belt slipped or stripped. Was a problem found?	-	Verify repair	Go to *Step 17*

Step	Action	Value (s)	Yes	No
17	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Tech 2 data. • All electrical connections within a suspected circuit and/or system. Was a problem found?	-	Verify repair	Go to *Step 18*
18	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 19*
19	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

HARD START SYMPTOM

DEFINITIONS: Engine cranks, but does not start for a long time. Does eventually start, or may start and then immediately stall.

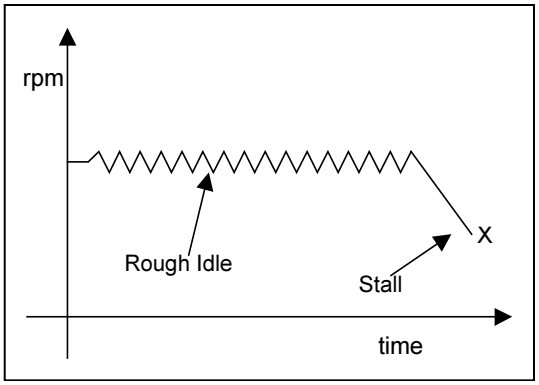
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to On Board Diagnostic (OBD) System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	-	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	-	Go to *Step 4*	Go to Visual / physical Check
4	1. Using a Tech 2, display the ECT sensor and IAT sensor value. 2. Check the specified value or wire. Was the problem found?	-	Verify repair	Go to *Step 5*
5	Check the ECM grounds to verify that they are clean and tight. Refer to the ECM wiring diagrams. Was a problem found?	-	Verify repair	Go to *Step 6*
6	Visually/physically inspect for the following conditions: • Restrict air intake system. Check for a restricted air filter element, or foreign objects blocking the air intake system. • Check for objects blocking the IAC passage or throttle bore, excessive deposits in the throttle bore and on the throttle plate. • Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty crankcase ventilation hose/brake booster hose. Was a problem found?	-	Verify repair	Go to *Step 7*
7	1. Using a Tech 2, display the IAC value. 2. Check for a faulty, plugged, or sticking IAC operation. Was the problem found?	-	Verify repair	Go to *Step 8*
8	Check the CKP sensor signal or installation condition. Refer to DTC P0336 "Crankshaft Position Sensor Circuit Range/Performance" and DTC P0337 "Crankshaft Position Sensor Circuit No Signal". Was a problem found?	-	Verify repair	Go to *Step 9*
9	Check for proper ignition voltage output with a spark tester. Was the problem found?	-	Verify repair	Go to *Step 10*

Step	Action	Value (s)	Yes	No
10	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	-	Verify repair	Go to *Step 11*
11	Check for water or alcohol contaminated fuel. Was a problem found?	-	Verify repair	Go to *Step 12*
12	Perform the procedure in Fuel System Pressure Test to determine if there is a problem with fuel delivery. Refer to 6E-116 page. Was a problem found?	-	Verify repair	Go to *Step 13*
13	1. Check the injector connectors. 2. If any of the connectors are connected at an improper cylinder, connect as necessary. Was a problem found?	-	Verify repair	Go to *Step 14*
14	Check for the following engine mechanical problems (refer to Engine Mechanical section): • Low compression. • Leaking cylinder head gaskets. • Worn camshaft. • Camshaft drive belt slipped or stripped. Was a problem found?	-	Verify repair	Go to *Step 15*
15	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Tech 2 data. • All electrical connections within a suspected circuit and/or system. Was a problem found?	-	Verify repair	Go to *Step 16*
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 17*

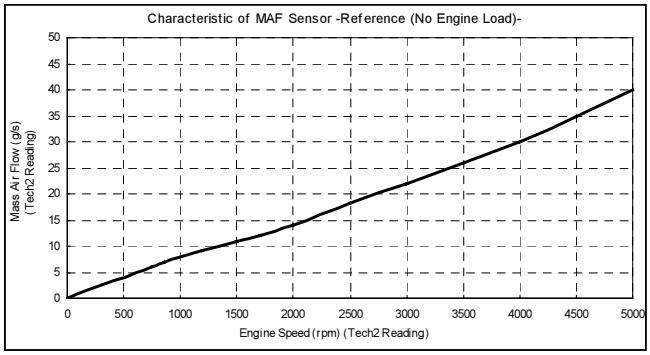
Step	Action	Value (s)	Yes	No
17	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING SYMPTOM

DEFINITIONS: Engine runs unevenly at idle. If severe, the engine or vehicle may shake. Engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.



Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to On Board Diagnostic (OBD) System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	-	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	-	Go to *Step 4*	Go to Visual / physical Check
4	1. Check for incorrect idle speed. Ensure that the following conditions are present. • Engine fully warm. • Accessories are OFF. 2. Using a Tech 2, monitor IAC position. Is the IAC position within the specified values?	10 - 20 Steps	Go to *Step 6*	Go to *Step 5*
5	Visually/physically inspect for the following conditions: • Restrict air intake system. Check for a restricted air filter element, or foreign objects blocking the air intake system. • Check for objects blocking the IAC passage or throttle bore, excessive deposits in the throttle bore and on the throttle plate. • Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty crankcase ventilation hose/brake booster hose. Was a problem found?	-	Verify repair	Go to *Step 6*
6	1. Using a Tech 2, display the ECT sensor and IAT sensor value. 2. Check the specified value or wire. Was the problem found?	-	Verify repair	Go to *Step 7*

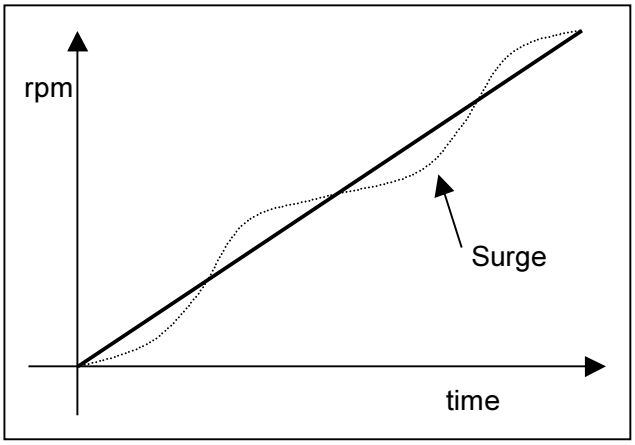
Step	Action	Value (s)	Yes	No
7	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Mass Air Flow" in the data display. Does the Tech 2 indicate correct "Mass Air Flow" as shown in the following graph, when engine speed is increasing little by little? 	-	Go to *Step 9*	Go to *Step 8*
8	Remove the MAF & IAT sensor assembly and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAF sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P0101* and Go to *Step 9*
9	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" from 0% to 100% depending on accelerator pedal operation?	-	Go to *Step 11*	Go to *Step 10*
10	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. 3. Adjust the accelerator cable or TPS within 0% to 100%. Is the action complete?	-	Verify repair	-
11	Check for the following conditions. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Go to *Step 12*

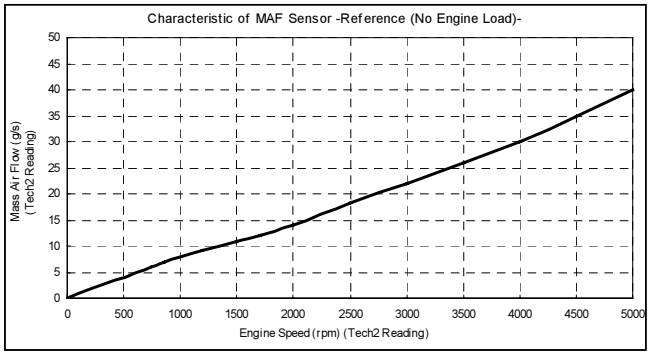
Step	Action	Value (s)	Yes	No
12	Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminates from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command and excessively lean air/fuel mixture. Was a problem found?	-	Verify repair	Go to *Step 13*
13	Check the fuel pressure. Refer to Fuel System Diagnosis. Was a problem found?	-	Verify repair	Go to *Step 14*
14	Perform the procedure in *Fuel System Pressure Test* to determine if there is a problem with fuel delivery. Refer to 6E-116 page. Was a problem found?	-	Verify repair	Go to *Step 15*
15	Monitor "B1S1 (Bank 1 Sensor 1) Status" and "B2S1 (Bank 2 Sensor 1) Status" on the Tech 2. Is the "B1S1 (Bank 1 Sensor 1) Status" or "B2S1 (Bank 2 Sensor 1) Status" in the rich condition?	-	Go to *Step 16*	Go to *Step 17*
16	Check items that can cause the engine to run rich. Refer to DTC P0172 "O2 Sensor System Too Rich (Bank 1)" or DTC P0175 "O2 Sensor System Too Rich (Bank 2)". Was a problem found?	-	Verify repair	Go to *Step 18*
17	Check items that can cause the engine to run lean. Refer to DTC P0171 "O2 Sensor System Too Lean (Bank 1)" or DTC P0174 "O2 Sensor System Tool Lean (Bank 2)". Was a problem found?	-	Verify repair	Go to *Step 18*
18	Check for proper ignition voltage output with the spark tester. Was a problem found?	-	Verify repair	Go to *Step 19*
19	Check the ignition coils for cracks or carbon tracking. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to *Step 20*
20	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	-	Verify repair	Go to *Step 21*
21	1. Check the injector connectors. 2. If any of the connectors are connected at an improper cylinder, connect as necessary. Was a problem found?	-	Verify repair	Go to *Step 22*

Step	Action	Value (s)	Yes	No
22	Check the ECM grounds to verify that they are clean and tight. Refer to the ECM wiring diagrams. Was a problem found?	-	Verify repair	Go to *Step 23*
23	1. Check for faulty engine mounts. 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to *Step 24*
24	Check for the following engine mechanical problems (refer to Engine Mechanical section): • Low compression. • Leaking cylinder head gaskets. • Worn camshaft. • Sticking or leaking valves. -Valve timing. • Broken valve springs. • Camshaft drive belt slipped or stripped. Was a problem found?	-	Verify repair	Go to *Step 25*
25	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Tech 2 data. • All electrical connections within a suspected circuit and/or system. Was a problem found?	-	Verify repair	Go to *Step 26*
26	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 27*
27	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	-	Verify repair	-

SURGES AND/OR CHUGS SYMPTOM

DEFINITIONS: Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no charge in the accelerator pedal.



Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to On Board Diagnostic (OBD) System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	-	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	-	Go to *Step 4*	Go to Visual / physical Check
4	Be sure that the driver understands transmission torque converter clutch and A/C compressor operation as explained in the owner's manual. Inform the customer how the torque converter clutch (TCC) (if A/T model) and the A/C clutch operate. Is the customer experiencing a normal condition?	-	System OK	Go to *Step 5*
5	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Mass Air Flow" in the data display. Does the Tech 2 indicate correct "Mass Air Flow" as shown in the following graph, when engine speed is increasing little by little?  	-	Go to *Step 7*	Go to *Step 6*

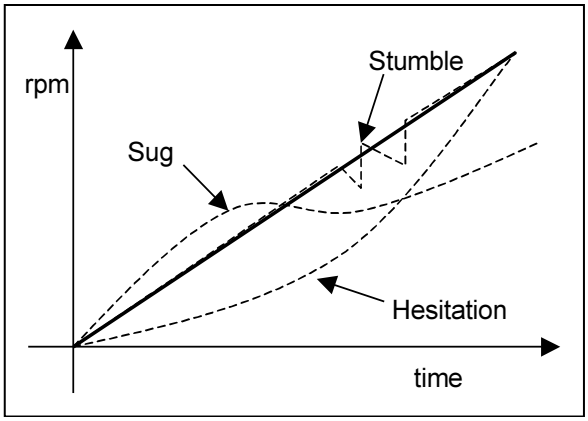
Step	Action	Value (s)	Yes	No
6	Remove the MAF & IAT sensor assembly and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAF sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P0101* and Go to *Step 7*
7	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" from 0% to 100% depending on accelerator pedal operation?	-	Go to *Step 9*	Go to *Step 8*
8	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. 3. Adjust the accelerator cable or TPS within 0% to 100%. Is the action complete?	-	Verify repair	-
9	Check for the following conditions. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Go to *Step 10*
10	Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminates from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command and excessively lean air/fuel mixture. Was a problem found?	-	Verify repair	Go to *Step 11*
11	Check the fuel pressure. Refer to 6E-116 Fuel System Diagnosis. Was a problem found?	-	Verify repair	Go to *Step 12*
12	Monitor "B1S1 (Bank 1 Sensor 1) Status" and "B2S1 (Bank 2 Sensor 1) Status" on the Tech 2. Is the "B1S1 (Bank 1 Sensor 1) Status" or "B2S1 (Bank 2 Sensor 1) Status" in the rich condition?	-	Go to *Step 13*	Go to *Step 14*

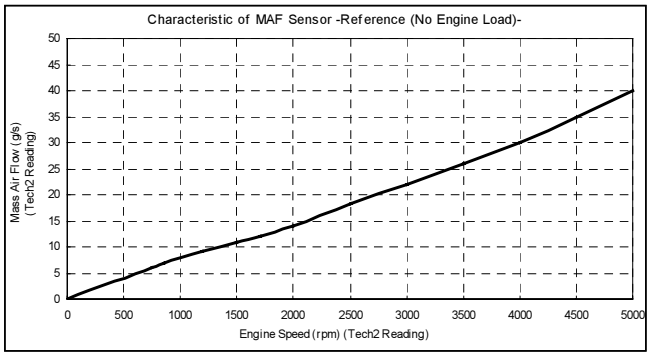
Step	Action	Value (s)	Yes	No
13	Check items that can cause the engine to run rich. Refer to DTC P0172 "O2 Sensor System Too Rich (Bank 1)" or DTC P0175 "O2 Sensor System Too Rich (Bank 2)". Was a problem found?	-	Verify repair	Go to *Step 15*
14	Check items that can cause the engine to run lean. Refer to DTC P0171 "O2 Sensor System Too Lean (Bank 1)" or DTC P0174 "O2 Sensor System Tool Lean (Bank 2)". Was a problem found?	-	Verify repair	Go to *Step 15*
15	Check for proper ignition voltage output with the spark tester. Was a problem found?	-	Verify repair	Go to *Step 16*
16	Check the ignition coils for cracks or carbon tracking. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to *Step 17*
17	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	-	Verify repair	Go to *Step 18*
18	1. Check the injector connectors. 2. If any of the connectors are connected at an improper cylinder, connect as necessary. Was a problem found?	-	Verify repair	Go to *Step 19*
19	Check the ECM grounds to verify that they are clean and tight. Refer to the ECM wiring diagrams. Was a problem found?	-	Verify repair	Go to *Step 20*
20	Visually/physically check the vacuum hose for splits, kinks and proper connections and routing. Was a problem found?	-	Verify repair	Go to *Step 21*
21	Check the exhaust system for a possible restriction: • Damaged or collapsed pipes. • Internal muffler failure. Was a problem found?	-	Verify repair	Go to *Step 22*

Step	Action	Value (s)	Yes	No
22	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Tech 2 data. • All electrical connections within a suspected circuit and/or system. Was a problem found?	-	Verify repair	Go to *Step 23*
23	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 24*
24	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

HESITATION, SAG, STUMBLE SYMPTOM

DEFINITIONS: Momentary lack of response as the accelerator is pushed down. Can occur at any vehicle speed. Usually most pronounced when first trying to make the vehicle move, as from a stop sign. May cause the engine to stall if severe enough.



Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to On Board Diagnostic (OBD) System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	-	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	-	Go to *Step 4*	Go to Visual / physical Check.
4	Check the fuel quality. Is the customer using improper fuel or degraded fuel?	-	Replace fuel	Go to *Step 5*
5	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Mass Air Flow" in the data display. Does the Tech 2 indicate correct "Mass Air Flow" as shown in the following graph, when engine speed is increasing little by little? 	-	Go to *Step 7*	Go to *Step 6*

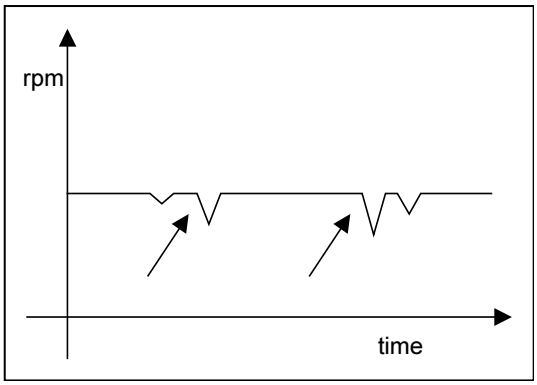
Step	Action	Value (s)	Yes	No
6	Remove the MAF & IAT sensor assembly and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAF sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P0101* and Go to *Step 7*
7	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" from 0% to 100% depending on accelerator pedal operation?	-	Go to *Step 9*	Go to *Step 8*
8	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. 3. Adjust the accelerator cable or TPS within 0% to 100%. Is the action complete?	-	Verify repair	-
9	Check for the following conditions. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Go to *Step 10*
10	Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminates from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command and excessively lean air/fuel mixture. Was a problem found?	-	Verify repair	Go to *Step 11*
11	Check the fuel pressure. Refer to Fuel System Diagnosis. Refer to 6E-116 page. Diagnosis. Was a problem found?	-	Verify repair	Go to *Step 12*
12	Monitor "B1S1 (Bank 1 Sensor 1) Status" and "B2S1 (Bank 2 Sensor 1) Status" on the Tech 2. Is the "B1S1 (Bank 1 Sensor 1) Status" or "B2S1 (Bank 2 Sensor 1) Status" in the rich condition?	-	Go to *Step 13*	Go to *Step 14*

Step	Action	Value (s)	Yes	No
13	Check items that can cause the engine to run rich. Refer to DTC P0172 "O2 Sensor System Too Rich (Bank 1)" or DTC P0175 "O2 Sensor System Too Rich (Bank 2)". Was a problem found?	-	Verify repair	Go to *Step 15*
14	Check items that can cause the engine to run lean. Refer to DTC P0171 "O2 Sensor System Too Lean (Bank 1)" or DTC P0174 "O2 Sensor System Tool Lean (Bank 2)". Was a problem found?	-	Verify repair	Go to *Step 15*
15	Check for proper ignition voltage output with the spark tester. Was a problem found?	-	Verify repair	Go to *Step 16*
16	Check the ignition coils for cracks or carbon tracking. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to *Step 17*
17	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	-	Verify repair	Go to *Step 18*
18	1. Check the injector connectors. 2. If any of the connectors are connected at an improper cylinder, connect as necessary. Was a problem found?	-	Verify repair	Go to *Step 19*
19	Check the ECM grounds to verify that they are clean and tight. Refer to the ECM wiring diagrams. Was a problem found?	-	Verify repair	Go to *Step 20*
20	Visually/physically check the vacuum hose for splits, kinks and proper connections and routing. Was a problem found?	-	Verify repair	Go to *Step 21*
21	Check the exhaust system for a possible restriction: • Damaged or collapsed pipes. • Internal muffler failure. Was a problem found?	-	Verify repair	Go to *Step 22*

Step	Action	Value (s)	Yes	No
22	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Tech 2 data. • All electrical connections within a suspected circuit and/or system. Was a problem found?	-	Verify repair	Go to *Step 23*
23	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 24*
24	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

CUTS OUT, MISSES SYMPTOM

DEFINITIONS: Steady pulsation or jerking that follows engine speed; usually more pronounced as engine load increases.



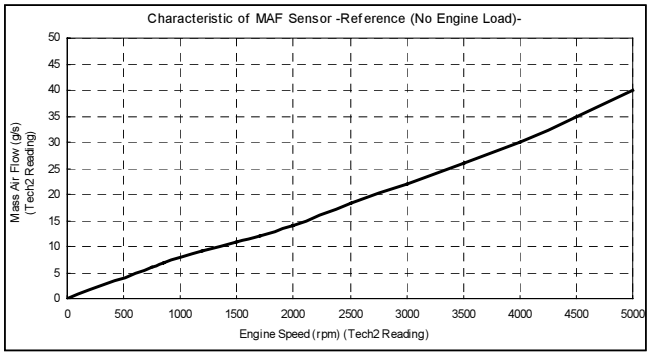
Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to On Board Diagnostic (OBD) System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	-	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	-	Go to *Step 4*	Go to Visual / physical Check.
4	Check the ECM grounds to verify that they are clean and tight. Refer to the ECM wiring diagrams. Was a problem found?	-	Verify repair	Go to *Step 5*
5	Check the CKP sensor signal or installation condition. Refer to DTC P0336 "Crankshaft Position Sensor Circuit Range/Performance" and DTC P0337 "Crankshaft Position Sensor Circuit No Signal". Was a problem found?	-	Verify repair	Go to *Step 6*
6	Monitor "B1S1 (Bank 1 Sensor 1) Status" and "B2S1 (Bank 2 Sensor 1) Status" on the Tech 2. Is the "B1S1 (Bank 1 Sensor 1) Status" or "B2S1 (Bank 2 Sensor 1) Status" in the rich condition?	-	Go to *Step 7*	Go to *Step 8*
7	Check items that can cause the engine to run rich. Refer to DTC P0172 "O2 Sensor System Too Rich (Bank 1)" or DTC P0175 "O2 Sensor System Too Rich (Bank 2)". Was a problem found?	-	Verify repair	Go to *Step 9*
8	Check items that can cause the engine to run lean. Refer to DTC P0171 "O2 Sensor System Too Lean (Bank 1)" or DTC P0174 "O2 Sensor System Tool Lean (Bank 2)". Was a problem found?	-	Verify repair	Go to *Step 9*

Step	Action	Value (s)	Yes	No
9	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" from 0% to 100% depending on accelerator pedal operation?	-	Go to *Step 11*	Go to *Step 10*
10	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. 3. Adjust the accelerator cable or TPS within 0% to 100%. Is the action complete?	-	Verify repair	-
11	Check for the following conditions. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Go to *Step 12*
12	Visually/physically inspect for the following conditions: • Restrict air intake system. Check for a restricted air filter element, or foreign objects blocking the air intake system. • Check for objects blocking the IAC passage or throttle bore, excessive deposits in the throttle bore and on the throttle plate. • Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty crankcase ventilation hose/brake booster hose. Was a problem found?	-	Verify repair	Go to *Step 13*
13	Perform the Injector Coil/Balance Test. Refer to 6E-106 page Was a problem found.	-	Verify repair	Go to *Step 14*
14	1. Check for fuel in the pressure regulator vacuum hose. 2. If fuel is present, replace the fuel pressure regulator assembly. Was a problem found?	-	Verify repair	Go to *Step 15*
15	Check for proper ignition voltage output with the spark tester. Was a problem found?	-	Verify repair	Go to *Step 16*
16	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	-	Verify repair	Go to *Step 17*

Step	Action	Value (s)	Yes	No
17	Check for the following engine mechanical problems (refer to Engine Mechanical Section): • Low compression. -Leaking cylinder head gaskets. • Worn camshaft. -Sticking or leaking valves. • Valve timing. -Broken valve springs. • Camshaft drive belt slipped or stripped. Was a problem found?	-	Verify repair	Go to *Step 18*
18	1. Check for faulty engine mounts. 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to *Step 19*
19	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Tech 2 data. • All electrical connections within a suspected circuit and/or system. Was a problem found?	-	Verify repair	Go to *Step 20*
20	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 21*
21	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

LACK OF POWER, SLUGGISH OR SPONGY SYMPTOM

DEFINITIONS: Engine delivers less than expected power. Attempting part-throttle acceleration results in little or no increase in vehicle speed.

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to On Board Diagnostic (OBD) System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	-	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	-	Go to *Step 4*	Go to Visual / physical Check.
4	1. Remove and check the air filter element for dirt or restrictions. 2. Replace the air filter element if necessary. Was a repair required?	-	Verify repair	Go to *Step 5*
5	Check the fuel quality. Is the customer using improper fuel or degraded fuel?	-	Replace fuel	Go to *Step 6*
6	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Mass Air Flow" in the data display. Does the Tech 2 indicate correct "Mass Air Flow" as shown in the following graph, when engine speed is increasing little by little? 	-	Go to *Step 8*	Go to *Step 7*

Step	Action	Value (s)	Yes	No
7	Remove the MAF & IAT sensor assembly and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAF sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P0101* and Go to *Step 8*
8	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" from 0% to 100% depending on accelerator pedal operation?	-	Go to *Step 10*	Go to *Step 9*
9	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. 3. Adjust the accelerator cable or TPS within 0% to 100%. Is the action complete?	-	Verify repair	-
10	Check for the following conditions. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Go to *Step 11*
11	Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminates from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command and excessively lean air/fuel mixture. Was a problem found?	-	Verify repair	Go to *Step 12*
12	Check the fuel pressure. Refer to 6E-116 Fuel System Diagnosis. Was a problem found?	-	Verify repair	Go to *Step 13*
13	Monitor "B1S1 (Bank 1 Sensor 1) Status" and "B2S1 (Bank 2 Sensor 1) Status" on the Tech 2. Is the "B1S1 (Bank 1 Sensor 1) Status" or "B2S1 (Bank 2 Sensor 1) Status" in the rich condition?	-	Go to *Step 14*	Go to *Step 15*
14	Check items that can cause the engine to run rich. Refer to DTC P0172 "O2 Sensor System Too Rich (Bank 1)" or DTC P0175 "O2 Sensor System Too Rich (Bank 2)". Was a problem found?	-	Verify repair	Go to *Step 16*

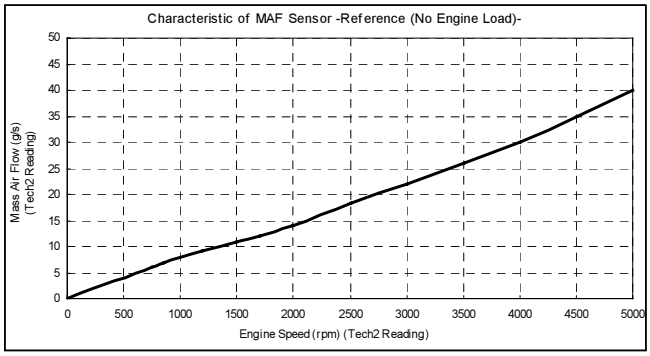
Step	Action	Value (s)	Yes	No
15	Check items that can cause the engine to run lean. Refer to DTC P0171 "O2 Sensor System Too Lean (Bank 1)" or DTC P0174 "O2 Sensor System Tool Lean (Bank 2)". Was a problem found?	-	Verify repair	Go to *Step 16*
16	Check for proper ignition voltage output with the spark tester. Was a problem found?	-	Verify repair	Go to *Step 17*
17	Check the ignition coils for cracks or carbon tracking. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to *Step 18*
18	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	-	Verify repair	Go to *Step 19*
19	Visually/physically check the vacuum hose for splits, kinks and proper connections and routing. Was a problem found?	-	Verify repair	Go to *Step 20*
20	Check the exhaust system for a possible restriction: • Damaged or collapsed pipes. • Internal muffler failure. Was a problem found?	-	Verify repair	Go to *Step 21*
21	Check the torque converter clutch (TCC) for proper operation (if A/T model). If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to *Step 22*
22	Check for the following engine mechanical problems (refer to Engine Mechanical Section): • Low compression. • Leaking cylinder head gaskets. • Worn camshaft. • Sticking or leaking valves. • Valve timing. • Broken valve springs. • Camshaft drive belt slipped or stripped. Was a problem found?	-	Verify repair	Go to *Step 23*
23	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Tech 2 data. • All electrical connections within a suspected circuit and/or system. Was a problem found?	-	Verify repair	Go to *Step 24*

Step	Action	Value (s)	Yes	No
24	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 25*
25	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DETONATION/SPARK KNOCK SYMPTOM

DEFINITIONS: A mild to sever ping, usually worse under acceleration. The engine makes a shape metallic knocking sound that changes with throttle opening. Prolonged detonation may lead to complete engine failure.

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to On Board Diagnostic (OBD) System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	-	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	-	Go to *Step 4*	Go to Visual / physical Check.
4	1. If Tech 2 readings are normal (refer to Typical Scan Data Values) and there are no engine mechanical faults, fill the fuel tank with a known quality gasoline. 2. Re-evaluate the vehicle performance. Is detonation present?	-	Go to *Step 5*	Verify repair
5	Check for obvious overheating problems: • Low engine coolant. • Restricted air flow to radiator. • Incorrect coolant solution. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to *Step 6*
6	1. Using a Tech 2, display the ECT sensor and IAT sensor value. 2. Check the specified value or wire. Was the problem found?	-	Verify repair	Go to *Step 7*

Step	Action	Value (s)	Yes	No
7	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Mass Air Flow" in the data display. Does the Tech 2 indicate correct "Mass Air Flow" as shown in the following graph, when engine speed is increasing little by little?  	-	Go to *Step 9*	Go to *Step 8*
8	Remove the MAF & IAT sensor assembly and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAF sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	-	Verify repair	Refer to *DTC P0101* and Go to *Step 9*
9	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" from 0% to 100% depending on accelerator pedal operation?	-	Go to *Step 11*	Go to *Step 10*
10	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. 3. Adjust the accelerator cable or TPS within 0% to 100%. Is the action complete?	-	Verify repair	-
11	Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminates from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command and excessively lean air/fuel mixture. Was a problem found?	-	Verify repair	Go to *Step 12*

Step	Action	Value (s)	Yes	No
12	Check the fuel pressure. Refer to Fuel System Diagnosis. Was a problem found?	-	Verify repair	Go to *Step 13*
13	Monitor "B1S1 (Bank 1 Sensor 1) Status" and "B2S1 (Bank 2 Sensor 1) Status" on the Tech 2. Is the "B1S1 (Bank 1 Sensor 1) Status" or "B2S1 (Bank 2 Sensor 1) Status" in the lean condition?	-	Go to *Step 14*	Go to *Step 15*
14	Check items that can cause the engine to run lean. Refer to DTC P0171 "O2 Sensor System Too Lean (Bank 1)" or DTC P0174 "O2 Sensor System Tool Lean (Bank 2)". Was a problem found?	-	Verify repair	Go to *Step 15*
15	Check spark plugs for proper heat range. Were incorrect spark plugs installed?	-	Verify repair	Go to *Step 16*
16	1. Remove excessive carbon buildup with a top engine cleaner. 2. Re-evaluate vehicle performance. Is detonation still present?	-	Verify repair	Go to *Step 17*
17	Check for an engine mechanical problem. Perform a cylinder compression check. Refer to Engine Mechanical. Was a problem found?	-	Verify repair	Go to *Step 18*
18	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Tech 2 data. • All electrical connections within a suspected circuit and/or system. Was a problem found?	-	Verify repair	Go to *Step 19*
19	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 20*
20	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

POOR FUEL ECONOMY SYMPTOM

DEFINITIONS: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, economy is noticeably lower than it was on this vehicle at one time, as previousl shown by an actual road test. (Larger than standard tires will cause odometer readings to be incorrect, and that may cause fuel economy to appear poor when it is actually normal.)

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to On Board Diagnostic (OBD) System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	-	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	-	Go to *Step 4*	Go to Visual / physical Check.
4	Check owner's driving habits. • Is the A/C On full time (defroster mode On)? • Are tires at the correct pressure? • Are excessively heavy loads being carried? • Is acceleration too much, too often?	-	Go to *Step 5*	Go to *Step 6*
5	Review the items in Step 4 with the customer and advise as necessary. Is the action complete?	-	System OK	-
6	Visually/physically check: Vacuum hoses for splits, kinks, and improper connections. Was a problem found?	-	Verify repair	Go to *Step 7*
7	Check for low engine coolant level. Was a problem found?	-	Verify repair	Go to *Step 8*
8	Check for incorrect or faulty engine thermostat. Refer to Engine Cooling. Was a problem found?	-	Verify repair	Go to *Step 9*
9	Remove and check the air filter element for dirt or for restrictions. Was a problem found?	-	Verify repair	Go to *Step 10*
10	Check the torque converter clutch (TCC) for proper operation (if A/T model). If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to *Step 11*

Step	Action	Value (s)	Yes	No
11	1. Using a Tech 2, display the ECT sensor and IAT sensor value. 2. Check the specified value or wire. Was the problem found?	-	Verify repair	Go to *Step 12*
12	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	-	Verify repair	Go to *Step 13*
13	Check for proper calibration of the speedometer. Does the speed indicated on the speed meter closely match the vehicle speed displayed on the Tech 2?	-	Go to *Step 15*	Go to *Step 14*
14	Diagnose and repair the inaccurate speedometer condition as necessary. Refer to Vehicle Speed Sensor in Electrical Diagnosis.	-	Verify repair	-
15	Check for proper calibration of the fuel gauge. Was a problem found?	-	Verify repair	Go to *Step 16*
16	Check for the following engine mechanical problems (refer to Engine Mechanical): • Low compression. • Worn camshaft. • Sticking or leaking valves. • Valve timing. Was a problem found?	-	Verify repair	Go to *Step 17*
17	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Tech 2 data. • All electrical connections within a suspected circuit and/or system. Was a problem found?	-	Verify repair	Go to *Step 18*
18	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 19*

Step	Action	Value (s)	Yes	No
19	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

EXCESSIVE EXHAUST EMISSIONS OR ODORS SYMPTOM

DEFINITIONS: Vehicle fails an emission test. There is excessive "rotten egg" smell. (Excessive odors do not necessarily indicate excessive emissions.)

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to On Board Diagnostic (OBD) System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	-	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	-	Go to *Step 4*	Go to Visual / physical Check.
4	Is the customer continual accelerated On/Off in cold condition?	-	System OK	Go to *Step 5*
5	Is the customer used lead fuel?	-	Replace to Unlead fuel	Go to *Step 6*
6	Check for vacuum leaks (vacuum lines, intake manifold, throttle body, etc.) Were any vacuum leaks found?	-	Verify repair & Go to *Step 17*	Go to *Step 7*
7	1. Check fuel cap for proper installation. 2. Secure the fuel cap if necessary. Was a problem found?	-	Verify repair & Go to *Step 17*	Go to *Step 8*
8	Check the fuel pressure. Refer to 6E-116 page Fuel System Pressure Test. Was a problem found?	-	Verify repair & Go to *Step 17*	Go to *Step 9*
9	1. Check for faulty, plugged or incorrectly installed PCV valve. 2. Verify that the PCV system is not plugged. Was a problem found?	-	Verify repair & Go to *Step 17*	Go to *Step 10*
10	Check the injector connectors, if any of the injectors are connected an incorrect cylinder, correct as necessary. Was a problem found?	-	Verify repair & Go to *Step 17*	Go to *Step 11*
11	Perform the Injector Coil/Balance Test. Was a problem found?	-	Verify repair & Go to *Step 17*	Go to *Step 12*
12	Check for a problem with the engine cooling system. Was a problem found?	-	Verify repair & Go to *Step 17*	Go to *Step 13*
13	Check EVAP canister for fuel loading. Refer to Evaporative Emission Control System. Was a problem found?	-	Verify repair & Go to *Step 17*	Go to *Step 14*

Step	Action	Value (s)	Yes	No
14	Check the EVAP purge solenoid valve operation. Is the valve operated normally?	-	Verify repair & Go to *Step 17*	Verify repair & Go to *Step 15*
15	Check the exhaust system for a possible restriction: • Damaged or collapsed pipes. • Internal catalytic converter failure. Was a problem found?	-	Verify repair & Go to *Step 17*	Go to *Step 16*
16	1. Remove excessive carbon buildup with a top engine cleaner. Refer to the instructions on the top engine cleaner can. 2. Perform the exhaust emission test. Does the vehicle pass the test?	-	System OK	Go to *Step 18*
17	Perform the exhaust emission test. Does the vehicle pass the test?	-	System OK	Go to *Step 18*
18	Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminates from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command and excessively lean air/fuel mixture. Was a problem found?	-	Verify repair	Go to *Step 19*
19	Monitor "B1S1 (Bank 1 Sensor 1) Status" and "B2S1 (Bank 2 Sensor 1) Status" on the Tech 2. Is the "B1S1 (Bank 1 Sensor 1) Status" or "B2S1 (Bank 2 Sensor 1) Status" in the rich condition?	-	Go to *Step 20*	Go to *Step 21*
20	Check items that can cause the engine to run rich. Refer to DTC P0172 "O2 Sensor System Too Rich (Bank 1)" or DTC P0175 "O2 Sensor System Too Rich (Bank 2)". Was a problem found?	-	Verify repair	Go to *Step 22*
21	Check items that can cause the engine to run lean. Refer to DTC P0171 "O2 Sensor System Too Lean (Bank 1)" or DTC P0174 "O2 Sensor System Tool Lean (Bank 2)". Was a problem found?	-	Verify repair	Go to *Step 22*
22	Check for the following engine mechanical problems (refer to Engine Mechanical): • Low compression. • Leaking cylinder head gaskets. • Worn camshaft. -Sticking or leaking valves. • Valve timing. -Broken valve springs. Was a problem found?	-	Verify repair	Go to *Step 23*

Step	Action	Value (s)	Yes	No
23	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Tech 2 data. • All electrical connections within a suspected circuit and/or system. Was a problem found?	-	Verify repair	Go to *Step 24*
24	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 25*
25	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

DIESELING, RUN-ON SYMPTOM

DEFINITIONS: Engine continues to run after key is turned OFF, but runs very rough. If engine runs smoothly, check the ignition switch and adjustment.

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to On Board Diagnostic (OBD) System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	-	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	-	Go to *Step 4*	Go to Visual / physical Check.
4	Check for a short between voltage circuit and the ignition feed circuit. Was a problem found?	-	Verify repair	Go to *Step 5*
5	Check the fuel leaking from injector. Perform the Injector Coil/Balance Test. Refer to 6E-106 page. Was a problem found?	-	Verify repair	Go to *Step 6*
6	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Tech 2 data. • All electrical connections within a suspected circuit and/or system. Was a problem found?	-	Verify repair	Go to *Step 7*
7	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 8*
8	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

BACKFIRE SYMPTOM

DEFINITIONS: Fuel ignites in the intake manifold, or in the exhaust system, making a loud popping noise.

Step	Action	Value (s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	-	Go to *Step 2*	Go to On Board Diagnostic (OBD) System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	-	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	-	Go to *Step 4*	Go to Visual / physical Check.
4	Check for proper ignition voltage output with the spark tester. Was a problem found?	-	Verify repair	Go to *Step 5*
5	Check the ignition coils for cracks or carbon tracking. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to *Step 6*
6	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	-	Verify repair	Go to *Step 7*
7	Check the fuel pressure. Refer to Fuel System Pressure Test. Was a problem found?	-	Verify repair	Go to *Step 8*
8	Refer to 6E-116 page Fuel System Diagnosis to determine if there is a problem with fuel delivery. Was a problem found?	-	Verify repair	Go to *Step 9*
9	Check the CKP sensor signal, shield wire, or installation condition. Refer to DTC P0336 "Crankshaft Position Sensor Circuit Range/Performance" and DTC P0337 "Crankshaft Position Sensor Circuit No Signal". Was a problem found?	-	Verify repair	Go to *Step 10*

Step	Action	Value (s)	Yes	No
10	Check for the following engine mechanical problems (refer to Engine Mechanical): • Low compression. • Leaking cylinder head gaskets. • Worn camshaft. • Sticking or leaking valves. • Valve timing. • Broken valve springs. • Camshaft drive belt slipped or stripped. Was a problem found?	-	Verify repair	Go to *Step 11*
11	Check the intake and exhaust manifold for casting flash. Refer to Engine Mechanical. Was a problem found?	-	Verify repair	Go to *Step 12*
12	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Tech 2 data. • All electrical connections within a suspected circuit and/or system. Was a problem found?	-	Verify repair	Go to *Step 13*
13	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the **"SPS (Service Programming System)"**. Was the problem solved?	-	Verify repair	Go to *Step 14*
14	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the Immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 **"Immobilizer System-ECM replacement"** for the ECM/Immobilizer linking procedure.	-	Verify repair	-

ON-VEHICLE SERVICE PROCEDURE

ENGINE CONTROL MODULE (ECM)

NOTE:

To prevent possible electrostatic discharge damage, follow these guidelines:

- **Do not touch the control module connector pins or soldered components on the control module circuit board.**
- **Do not open the replacement part package until the par is ready to be installed.**
- **Before removing the part from the package, ground the package to a known good ground on the vehicle.**
- **If the part has been handled while sliding across the seat, or while sitting down from a standing position, or while walking a distance, touch a known good ground before installing the part.**

NOTE:

To prevent internal ECM damage, the ignition must be in the "OFF" position in order to disconnect or reconnect power to the ECM (for example: battery cable, ECM pigtail, ECM fuse, jumper cables, etc.).

NOTE:

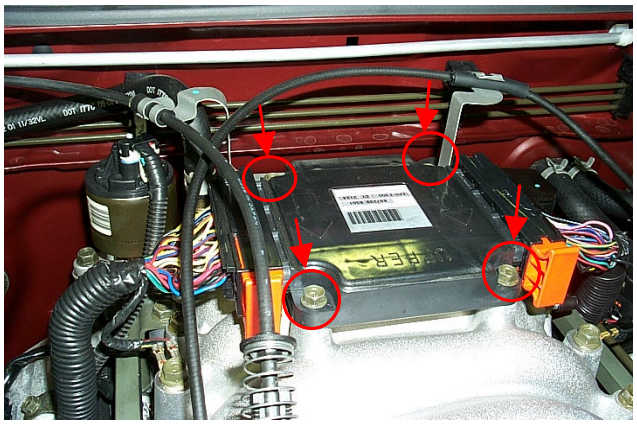
When replacing the production ECM with a service ECM, it is important to transfer the broadcast code and production ECM number to the service ECM label. This will allow positive identification of ECM parts throughout the service life of the vehicle.

Location

On the common chamber.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the two connectors from the ECM.
3. Remove four bolts.
4. Remove the ECM from common chamber.



Installation Procedure

1. Put on the ECM on the common chamber.
2. Tighten the ECM by four bolts.
3. Connect the two connectors to the ECM.
4. Connect the negative battery cable.

NOTE:

The replacement ECM must be programmed. Service Programming System (SPS) and Immobilizer programming (if equipped) is/are necessary. In case "SPS procedure does not succeed" or "engine does not run but No DTC after SPS", low vehicle battery voltage or disconnected electrical connector (e.g. poor connection of data link connector) are supposed. Perform the SPS procedure once again by correct conditions. The programming ECM will be recovered normally.

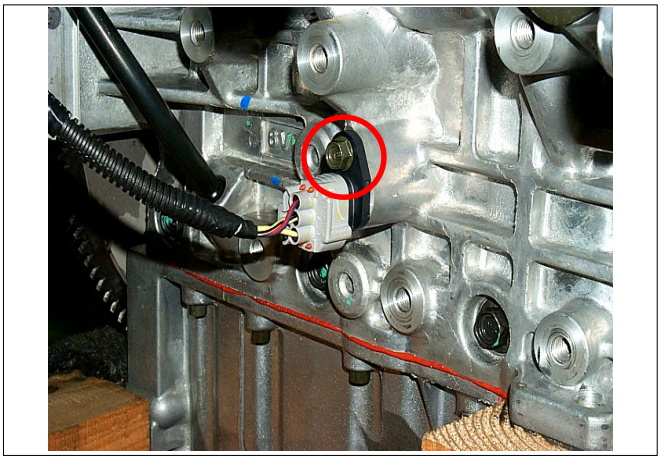
CRANKSHAFT POSITION (CKP) SENSOR

Location
Right-hand side of the cylinder block.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect connector from the CKP sensor.
3. Loosen a bolt and remove the CKP sensor from the cylinder block.

NOTE:
Use caution to avoid any hot oil that might drip out.



Installation Procedure

1. Install the CKP sensor to the cylinder block.
   Before installation, apply small amount of engine oil to the O-ring.
2. Tighten CKP sensor by a bolt with specified tightening torque.
   Tightening Torque
   - **Bolt: 10N·m (1.0kgf·m).**
3. Connect a sensor connector to the CKP sensor.
4. Connect the negative battery cable.

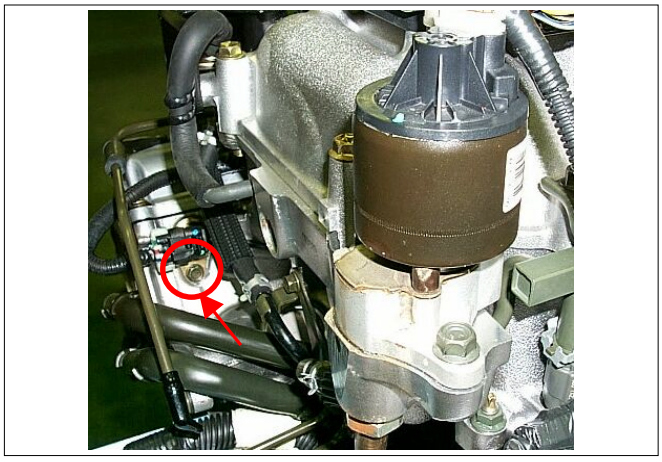
NOTE:
Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

CAMSHAFT POSITION (CMP) SENSOR

Location
The rear of right bank of the cylinder head.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect connector from the CMP sensor.
3. Loosen a bolt and remove the CMP sensor from the cylinder head.



Installation Procedure

1. Install the CMP sensor to the cylinder head.
   Before installation, apply small amount of engine oil to the O-ring.
2. Tighten CMP sensor by a bolt with specified tightening torque.
   Tightening Torque
   - **Bolt: 10N·m (1.0kgf·m)**
3. Connect a sensor connector to the CMP sensor.
4. Connect the negative battery cable.

NOTE:
Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

Location

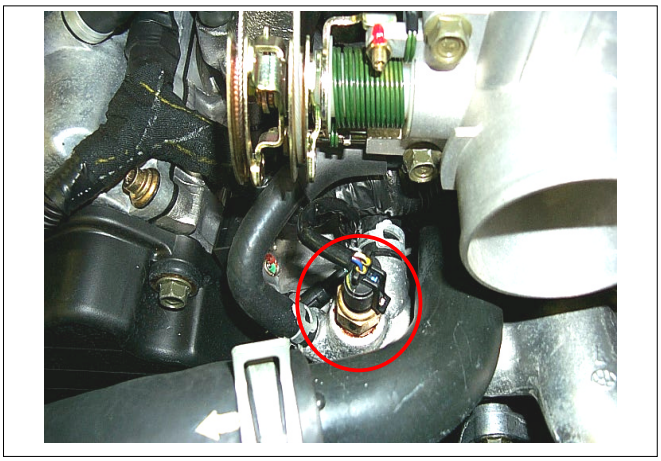
Installed to the thermostat housing.

Removal Procedure

1. Disconnect the negative battery cable.
2. Drain enough engine coolant so that the coolant level will be below the ECT sensor.
3. Disconnect connector from the ECT sensor.
4. Loosen and remove the ECT sensor from the thermostat housing.

NOTE:

Cool down the engine before above procedures are carried out.



Installation Procedure

1. Apply sealer to threads of screw at the ECT sensor.
2. Tighten the ECT sensor with specified tightening torque.

   Tightening Torque

   • 13N·m (1.3kgf·m)
3. Connect a ECT sensor connector to the ECT sensor.
4. Fill the engine coolant.
5. Connect the negative battery cable.

NOTE:

Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

Verify no engine coolant leaking from the sensor threads after replacement.

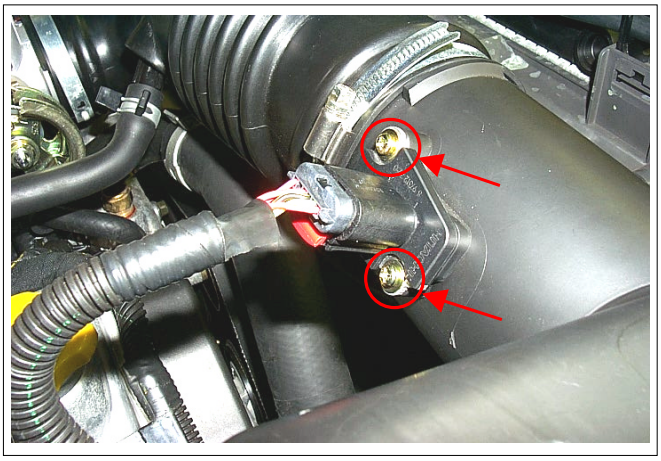
MASS AIR FLOW (MAF) SENSOR & INTAKE AIR TEMPERATURE (IAT) SENSOR

Location

Installed to the intake duct housing.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect a MAF & IAT sensor connector from the MAF & IAT sensor.
3. Loosen two screws and remove the MAF & IAT sensor from the intake duct.



Installation Procedure

1. Install the MAF & IAT sensor into intake air duct.
2. Tighten MAF & IAT sensor by two screws.

   Tightening Torque : 1.5 N·m (0.15 kgf·m)
3. Connect a sensor connector to the MAF & IAT sensor.
4. Connect the negative battery cable.

NOTE:

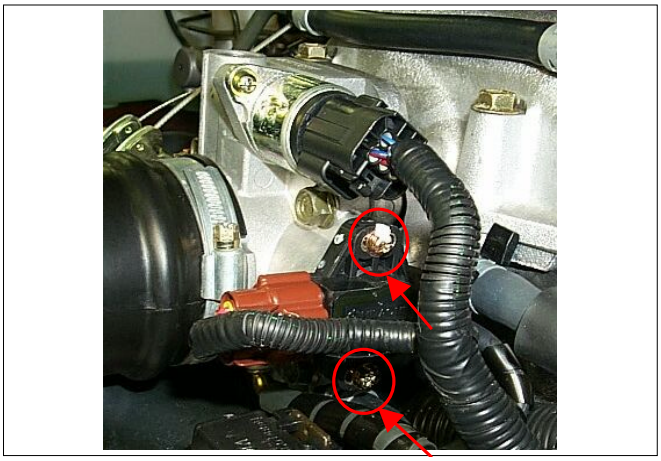
Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

THROTTLE POSITION SENSOR (TPS)

Location
Installed on the throttle body.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the TPS connector.
3. Loosen two screws and remove TPS from the throttle body.



Installation Procedure

1. Temporary tighten the TPS by two screws.
2. Connect a TPS connectors to the TPS.
3. Connect the Tech2 to the vehicle.
4. Connect the negative battery cable.
5. Select "Data Display" with the Tech2.
6. Check the throttle position data and adjust the TPS position.
7. Tighten two screws.

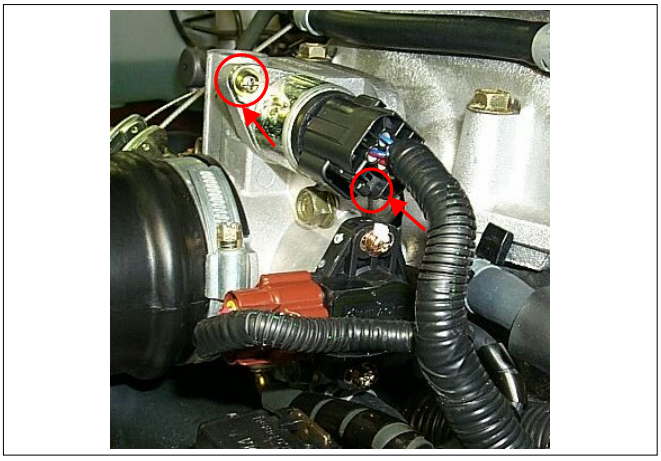
NOTE:
Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

IDLE AIR CONTROL (IAC) VALVE

Location
Installed on the throttle body.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the IAC valve connector.
3. Loosen two screws and remove IAC valve from the throttle body.

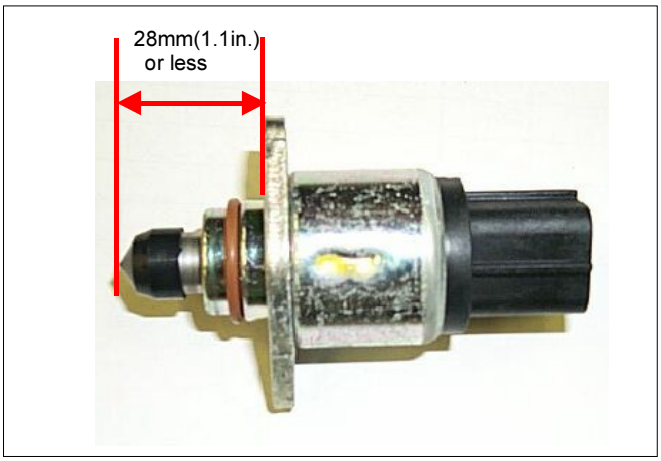


Cleaning and Inspection

1. Clean the IAC valve O-ring sealing surface, pintle valve seat and air passage.
2. Use carburetor cleaner and a parts cleaning brush to remove carbon deposit.
   Do not use a cleaner that contain methyl ethyl ketone. This is an extremely strong solvent and not necessary for this type of deposit.
3. Shiny spots on the pintle are normal and do not indicate misalignment or a bent pintle shaft.
4. Inspect the IAC valve O-ring for cuts, cracks or distortion.

Measurement

In order to install a new IAC valve, messier the distance between the tip of the pintle and the mounting flange. If that measurement is 28mm (1.1in.) or less, the valve need no adjustment. If the measurement is greater than 28mm (1.1in.), apply finger pressure and retract the valve. The force required to retract the pintle on a new valve will not damage the valve, shaft, or pintle.



Installation Procedure

1. Tighten the IAC valve by two screws.
2. Connect a IAC valve connector to the IAC valve.
3. Connect the negative battery cable.

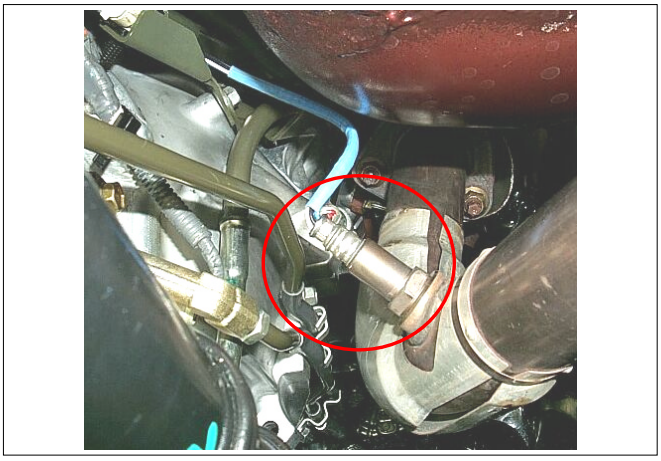
NOTE:
Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

HEATED OXYGEN SENSOR (HO2S)

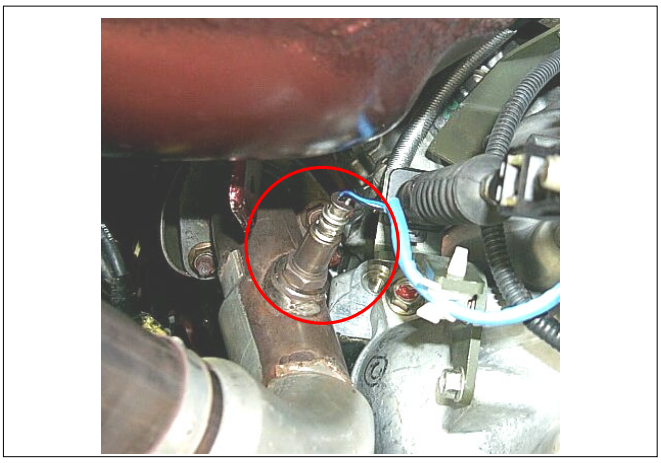
Location
Installed on the exhaust pipe for each bank.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the O2 sensor connector.
3. Loosen and remove the O2 sensor from the exhaust pipe.



Bank 1 Heated Oxygen Sensor (Right bank)



Bank 2 Heated Oxygen Sensor (Left bank)

Inspection

- Inspect the louvered end of the sensor for grease, dirt, excessive carbon build up or other contamination.
- A special anti-seize compound is used on the O2 sensor threads. This compound consists of glass breads suspended in a liquid graphite solution.
  The graphite burns away with engine heat, but the glass breads will remain, marking the sensor easier to remove.
- New or service sensors will already have the compound applied to the threads. If a sensor is removed and is to be reinstalled for any reason, the threads must have anti-seize compound applied.

Installation Procedure

1. Install the O2 sensor to the exhaust pipe.
   Apply anti-seize compound or the equivalent to the threads of the oxygen sensor, if necessary.
2. Tighten the O2 sensor with specified tightening torque.

Tightening Torque

- **Bolt: 42N·m (4.3kgf·m)**

3. Connect a sensor connector to the O2 sensor.
4. Connect the negative battery cable.

NOTE:

Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

Verify no exhaust gas leaking from the sensor threads after replacement.

EVAP CANISTER PURGE VALVE SOLENOID

Location

On the intake manifold.

Removal Procedure

1. Disconenct the negative battery cable.
2. Disconnect a purge solenoid connector from the purge solenoid.
3. Disconnect two hoses from the purge solenoid valve.
4. Loosen a bolt and remove the purge solenoid from the intake manifold.



Installation Procedure

1. Put on the purge solenoid on the intake manifold.
2. Tighten the purge solenoid by a bolt.
3. Connect a connector to the purge solenoid.
4. Connect two hoses to the purge solenoid valve.
5. Connect the negative battery cable.

NOTE:

Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

Verify proper connection of two hoses.

FUEL PRESSURE RELIEF

Caution:

To reduce the risk of the fire and personal injury, it is necessary to relive the fuel system pressure before servicing the fuel system components.

Caution:

After relieving the fuel system pressure, a small amount of fuel may be released when servicing fuel lines or connections. Reduce the chance of personal injury by covering the fuel line fitting with a short towel before disconnecting the fittings. The towel will absorb any fuel that may leak out. When the disconnect is completed, place the towel in an approved container.

1. Remove the fuel filler cap.
2. Remove the fuel pump relay.
3. Start the engine and allow it to stall.
4. Crank the engine for about 30 seconds.
5. Disconnect the negative battery cable.

FUEL RAIL ASSEMBLY

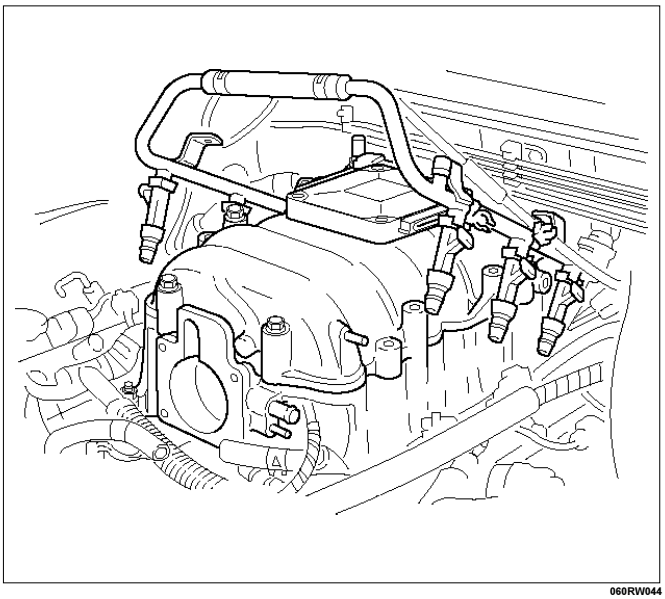
Removal Procedure

NOTE:

- **Do not attempt to remove the fuel inlet fitting on the fuel rail. It is staked in place. Removing the fuel inlet fitting will result in damage to the fuel rail or the internal O-ring seal.**
- **Use care when removing the fuel rail assembly in order to prevent damage to the injector electrical connector terminals and the injector spray tips.**
- **Fittings should be capped and holes plugged during servicing to prevent dirt and other contaminants from entering open lines and passages.**

Important: Before removal, the fuel rail assembly may be cleaned with a spray type engine cleaner. Follow the spray package instructions. Do not immerse the fuel rails in liquid cleaning solvent.

1. Depressurize the fuel system. Refer to Fuel Pressure Relief Procedure in this Section.
2. Disconnect the negative battery cable.
3. Remove the engine cover.
4. Disconnect the accelerator pedal cable from throttle body and cable bracket.
5. Disconnect the connectors from, solenoid valve, sensing valve.
6. Disconnect the vacuum hose on canister solenoid and positive crankcase ventilation hose.
7. Remove the common chamber Refer to the common chamber in Engine Mechanical.
    1. Lift up carefully on the fuel injectors. Do not separate the fuel injectors from the fuel rail.
    2. If an injector becomes separated from the fuel rail, the infector O-ring seals and the retainer clip must be replaced.
    3. Drain residual fuel into an approved container.



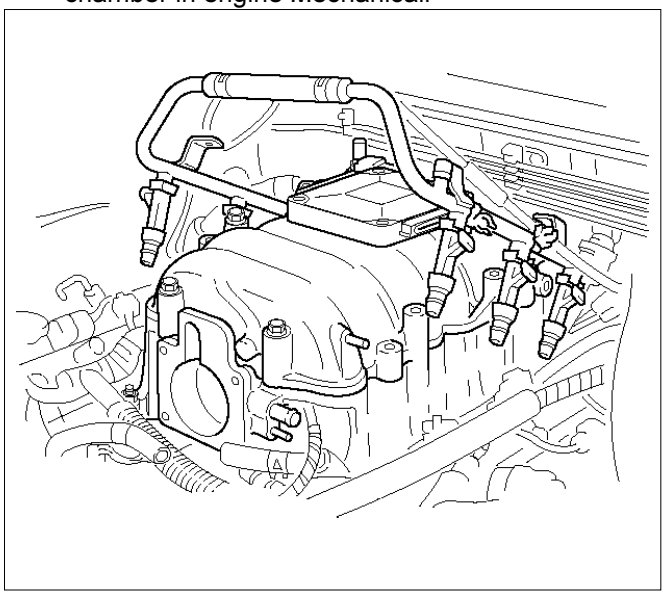
060RW044

8. If removal of the fuel pressure regulator is necessary, refer to *Fuel Pressure Regulator*.
9. If removal of the fuel injectors is necessary, refer to *Fuel Injectors*.

Installation Procedure

1. If the fuel injectors were removed, install them. Refer to *Fuel Injectors*.
2. If the fuel pressure regulator was removed, install it. Refer to *Fuel Pressure Regulator*.

3. Install the common chamber. Refer to common chamber in engine Mechanical.



060RW044

4. Connect the vacuum hose on Canister Solenoid and positive crankcase ventilation hose.
5. Connect the connectors to, solenoid valve.
6. Connect the accelerator pedal cable to throttle body and cable bracket.
7. Install the engine cover.
8. Connect the negative battery cable.
9. Crank the engine until it starts. Cranking the engine may take longer than usual due to trapped air in the fuel rail and in the injectors.

FUEL INJECTORS

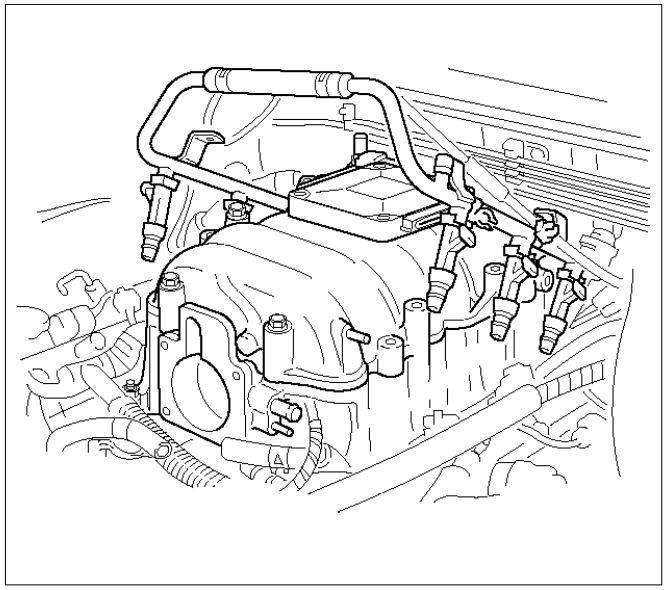
Removal Procedure

NOTE: If the fuel injectors are leaking, the engine oil may be contaminated with fuel. Check the oil for signs of contamination and change the oil and the filter if necessary.

NOTE: Use care in removing the fuel injectors in order to prevent damage to the fuel injector electrical connector pins or the fuel injector nozzles. The fuel injector is an electrical component and should not be immersed in any type of cleaner as this may damage the fuel injector.

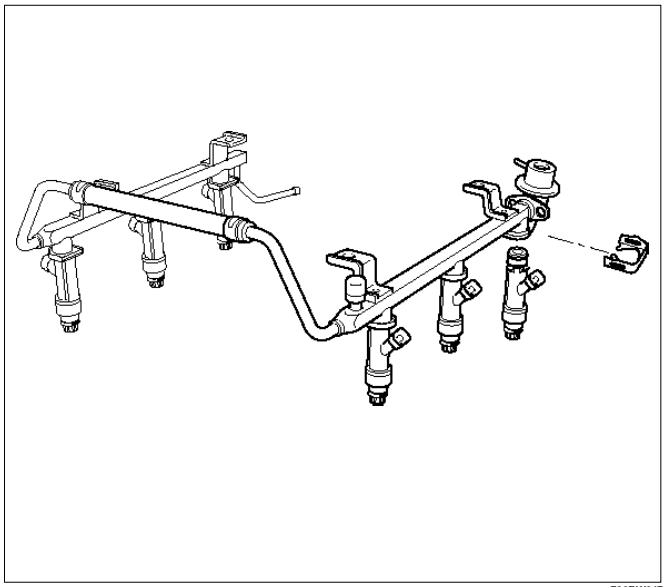
Important: Fuel injectors are serviced as a complete assembly only.

1. Disconnect the negative battery cable.
2. Remove the upper intake manifold. Refer to *Common Chamber in Engine Mechanical.*.
3. Remove the fuel rail. Refer to *Fuel Rail*.



060RW044

4. Remove the injector retainer clip.



F06RW017

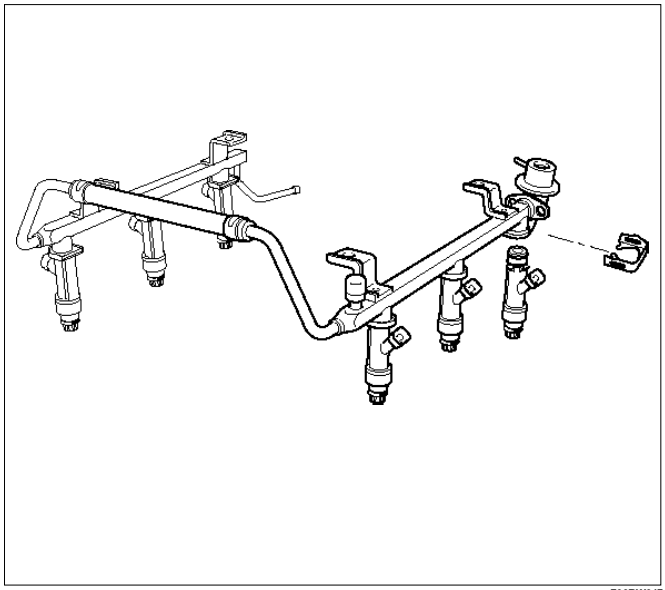
5. Remove the fuel injector assembly.
6. Remove the O-ring from the fuel injector.
7. Remove the O-ring backup from the fuel injector .

Inspection Procedure

1. Inspect the O-rings for cracks or leaks.
2. Replace worn or damaged O-rings.
3. Lubricate the new O-rings with engine oil before installation.

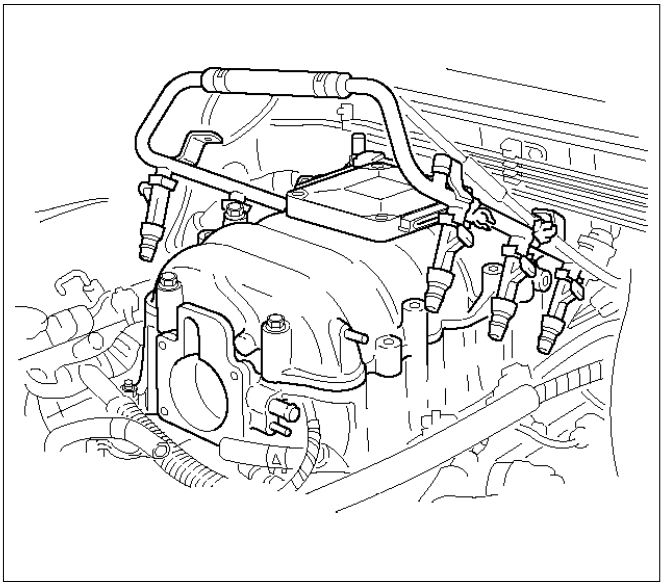
Installation Procedure

1. Install the O-ring backup on the fuel injector.
2. Install the new O-ring on the fuel injector.
3. Install the fuel injector on the fuel rail.



F06RW017

4. Use new fuel injector retainer clips to retain the fuel injector to the fuel rail.
5. Coat the end of the fuel injector with engine oil.
6. Install the fuel rail. Refer to *Fuel Rail*.



060RW044

7. Install the upper intake manifold. Refer to *Common Chamber in Engine Mechanical.*
8. Install the engine cover.
9. Connect the negative battery cable.

FUEL PRESSURE REGULATOR

Removal Procedure

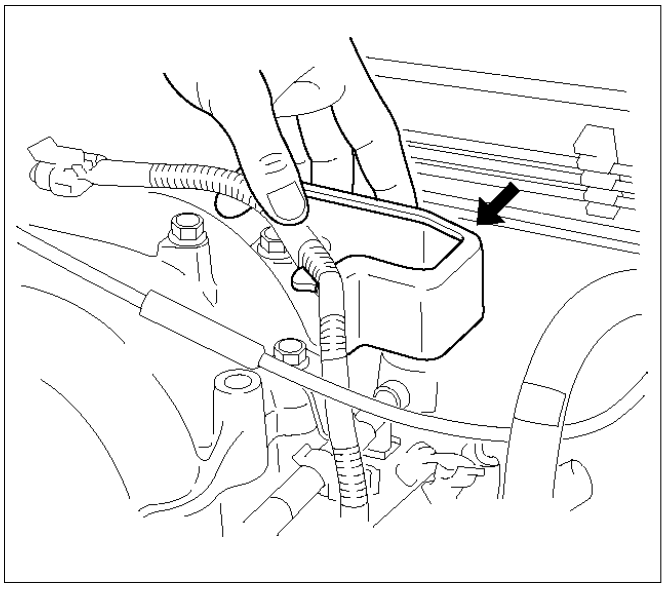
CAUTION: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing the fuel system components.

CAUTION: After relieving the system pressure, a small amount of fuel may be released when servicing fuel lines or connections. Reduce the chance of personal injury by covering the fuel line fittings with a shop towel before disconnecting the fittings. The towels will absorb any fuel that may leak out. When the disconnect is completed, place the towel in an approved container.

NOTE: Compressed air must never be used to test or clean a fuel pressure regulator, as damage to the fuel pressure regulator may result.

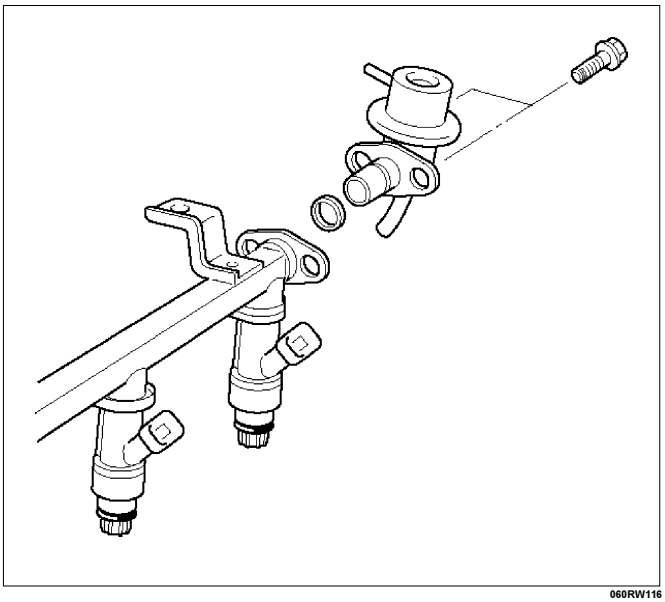
NOTE: To prevent damage to the fuel pressure regulator, do not immerse the pressure regulator in solvent.

1. Depressurize the fuel system. Refer to *Fuel Pressure Relief Procedure*.
2. Disconnect the negative battery cable.
3. Remove the fuel pump relay. Refer to *Fuel Pump Relay*.
4. Remove the pressure regulator hose from the fuel pressure regulator.
5. Remove the two bolts from the protector that secures the common chamber.



060RW066

6. Remove the fuel pressure regulator attaching screw.

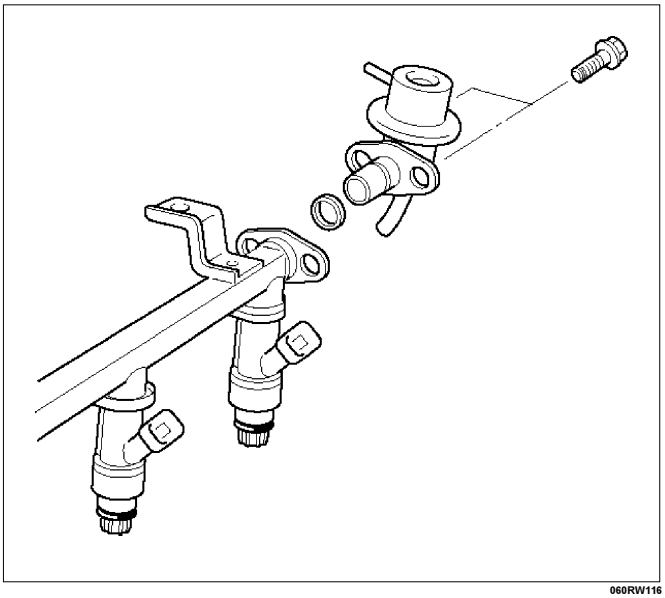


060RW116

7. Remove the fuel pressure regulator from the fuel rail.

Disassembly Procedure

1. Remove the O-ring from the fuel pressure regulator.
2. Remove the fuel return line from the fuel pressure regulator.
3. Remove the O-ring from the fuel return line.
   - The O-ring may be left inside the fuel pressure regulator instead of on the fuel return line.



060RW116

Assembly Procedure

1. Install a new O-ring on the fuel return line.
2. Install the fuel return line on the fuel pressure regulator.

Do not over-tighten the swivel nut on the fuel pressure regulator. The fuel pressure regulator can be damaged and fuel may leak if the swivel nut is over-tightened.

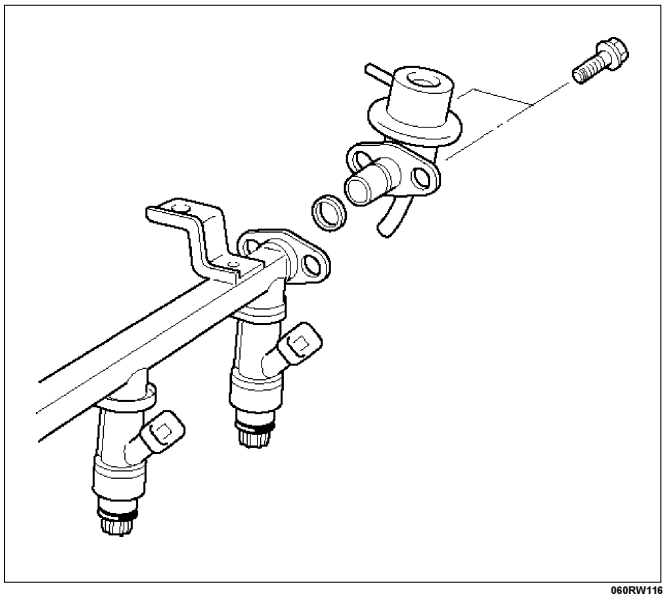
3. Tighten the swivel nut.
4. Install a new O-ring on the fuel pressure regulator.

Installation Procedure

1. Install the fuel pressure regulator attaching screw.

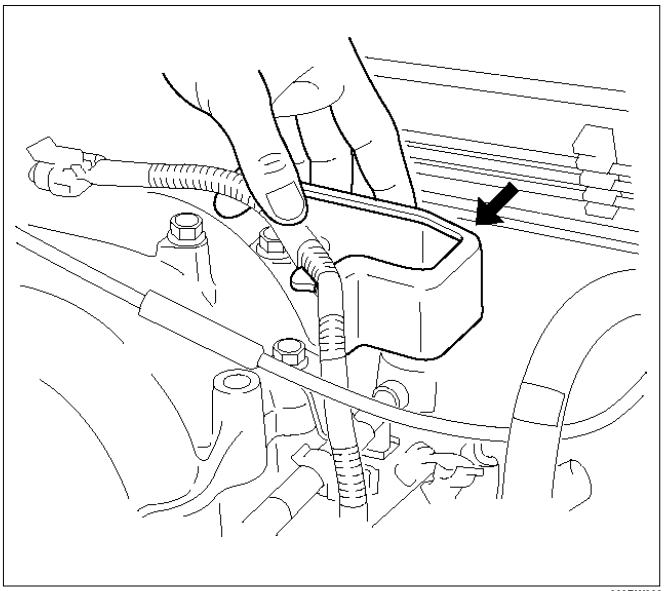
   Tighten

   - Tighten the fuel pressure regulator attaching screw to 3 N·m (0.3 kg·m/26 lb in.).



060RW116

2. Install the fuel pressure regulator on the fuel rail.
3. Install the two bolts to the protector that secures the common chamber.



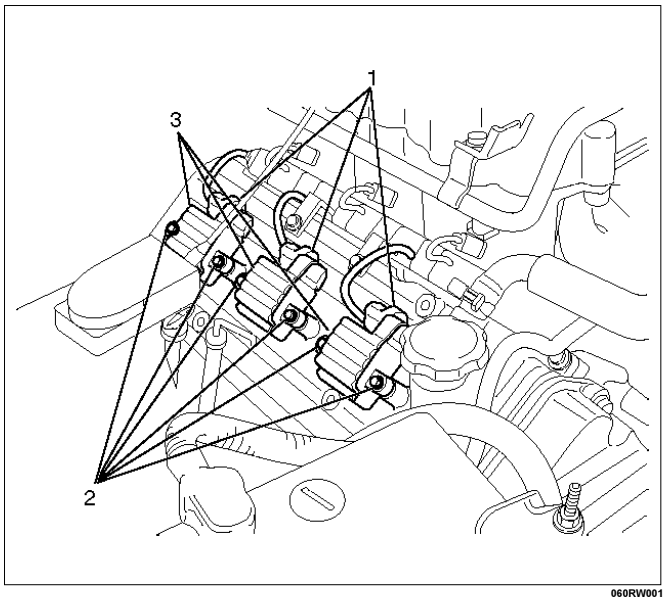
060RW066

4. Install the pressure regulator hose to the fuel pressure regulator.
5. Install the fuel pump relay. Refer to *Fuel Pump Relay*.
6. Connect the negative battery cable.
7. Crank the engine until it starts. Cranking the engine may take longer than usual due to trapped air in the fuel lines.

IGNITION COIL

Removal Procedure

1. Disconnect battery ground cable.
2. Ignition coil connector and ignition coil.
   - Disconnect three connector from ignition coil.
   - Remove harness bracket bolt on cylinder head cover.
   - Remove fixing bolts on ignition coil.



060RW001

Legend

(1) Ignition Coil Connector
(2) Bolt
(3) Ignition Coil Assembly

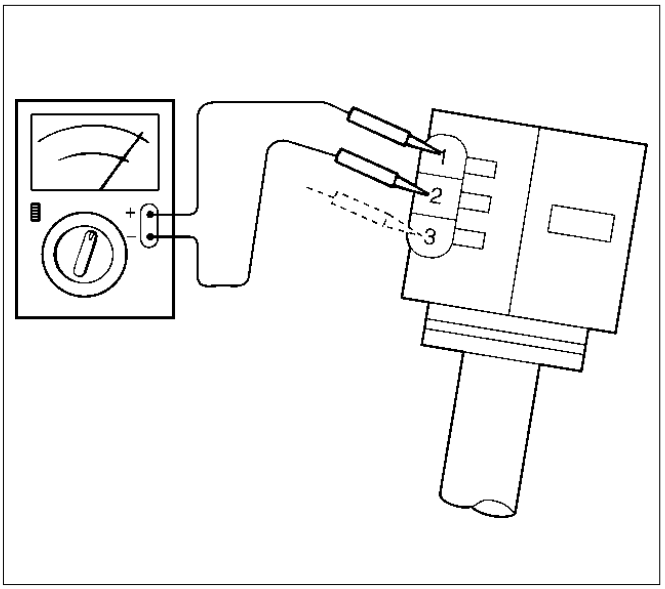
Inspection Procedure

Check the ignition coil assembly for insulation. Check terminals for corrosion or damage, and replace as necessary.

Measuring resistance of ignition coil assembly.

Terminal No.	Limit
1 to 2	Without 0 ohm or infinity maximum ohm.
1 to 3	Same as above
2 to 3	Same as above

Measure resistance of ignition coil assembly, and replace the ignition coil assembly if its value exceeds the standard.

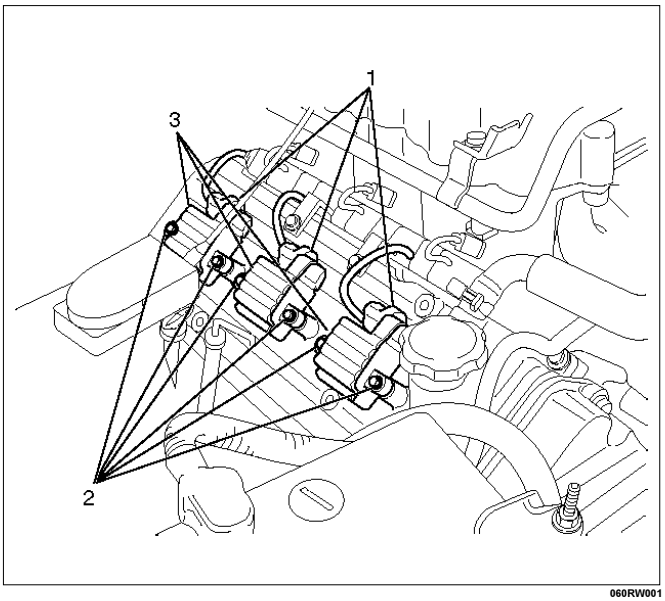


060RW006

Installation Procedure

1. Install the ignition coil assembly (3).
   Connect ignition coil connector (1) and ignition coil (3), then tighten bolt (2) to the specified torque.

   Torque: 4 N·m (0.4 kg·m/35 lb in)



060RW001

2. Connect battery ground cable.

SPARK PLUGS

Removal Procedure

1. Remove spark plugs.

Inspection Procedure

The spark plug affects entire engine performance and therefore its inspection is very important.

- Check electrode and insulator for presence of cracks, and replace if any.
- Check electrode for wear, and replace if necessary.
- Check gasket for damage, and replace if necessary.
- Measure insulation resistance with an ohmmeter, and replace if faulty.
- Adjust spark plug gap to 1.0 mm (0.04 in) ~ 1.1 mm (0.043 in).
- Check fuel and electrical systems if spark plug is extremely dirty.
- Use spark plugs having low heat value (hot type plug) if fuel and electrical systems are normal.
- Use spark plugs having high heat value (cold type plug) if insulator and electrode are extremely burned.

Sooty Spark Plugs

Much deposit of carbon or oil on the electrode and insulator of spark plug reduces the engine performance.

Possible causes:

- Too rich mixture
- Presence of oil in combustion chamber
- Incorrectly adjusted spark plug gap

Burning Electrodes

This fault is characterized by scorched or heavily oxidized electrode or blistered insulator nose.

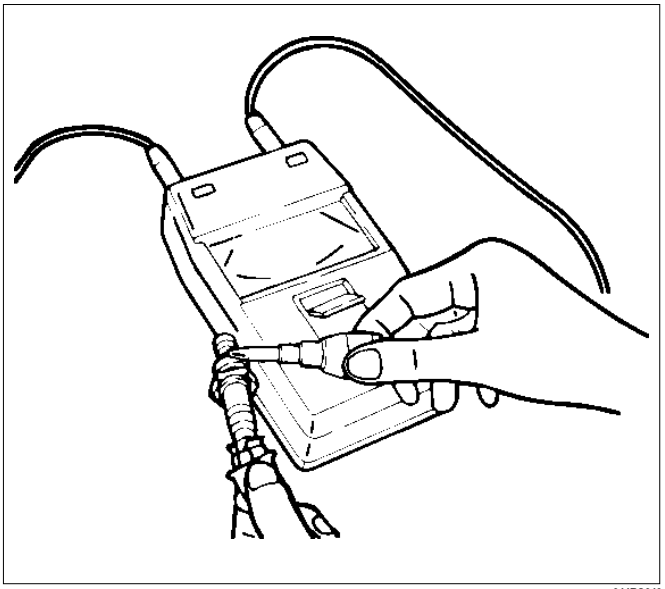
Possible causes:

- Too lean mixture
- Improper heat value

Measuring Insulation Resistance

- Measure insulation resistance using a 500 volt megaohm meter.
- Replace spark plugs if measured value is out of standard.

Insulation resistance: 50 MΩ or more

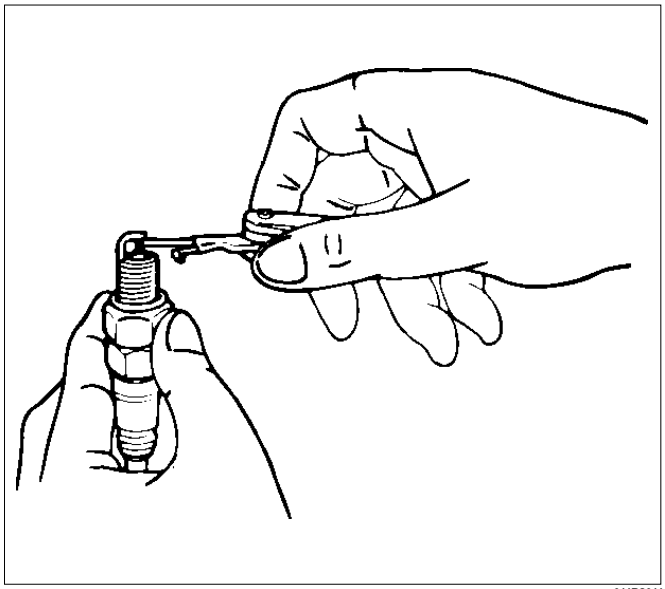


011RS010

Cleaning Spark Plugs

- Clean spark plugs with a spark plug cleaner.
- Raise the ground electrode to an angle of 45 to 60 degrees. If electrode is wet, dry it before cleaning.
- After spark plug is thoroughly cleaned, check insulator for presence of cracks.
- Clean threads and metal body with a wire brush.
- File the electrode tip if electrode is extremely worn.

- Bend the ground electrode to adjust the spark plug gap.



011RS011

Installation Procedure

1. Spark plugs
   - Tighten spark plugs to the specified torque.

Torque: 18 N·m (1.8 kg·m/13 lb ft)

Special Tools

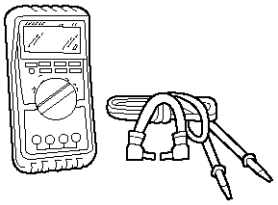
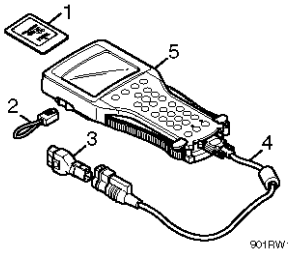
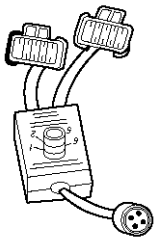
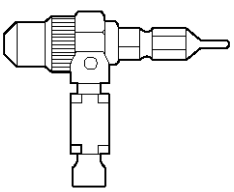
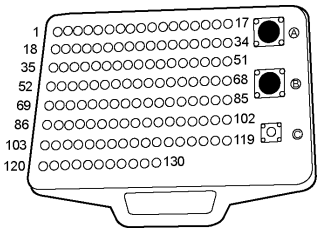
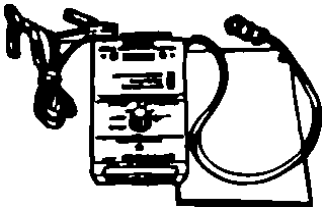
ILLUSTRATION	PART NO. PART NAME
	**5–8840–0285–0** **(J 39200)** High Impedance Multimeter (Digital Voltmeter – DVM)
	(1) PCMCIA Card (2) RS232 Loop Back Connector (3) SAE 16/19 Adapter (4) DLC Cable (5) TECH 2
	**5–8840–0385–0** **(J 35616-A/BT-8637)** Connector Test Adapter Kit
	**5–8840–0378–0** **(J 34730-E)** Port Fuel Injection Diagnostic Kit
	**5–8840–2635–0** **(J 39021-90)** Injector Switch Box
	**5–8840–0383–0** **(J 26792/BT-7220-1)** Spark Tester

ILLUSTRATION	PART NO. PART NAME
	Breaker Box
	**5–8840–2618–0** Fuel Injector Tester

ENGINE

ENGINE EXHAUST (6VE1 3.5L)

CONTENTS

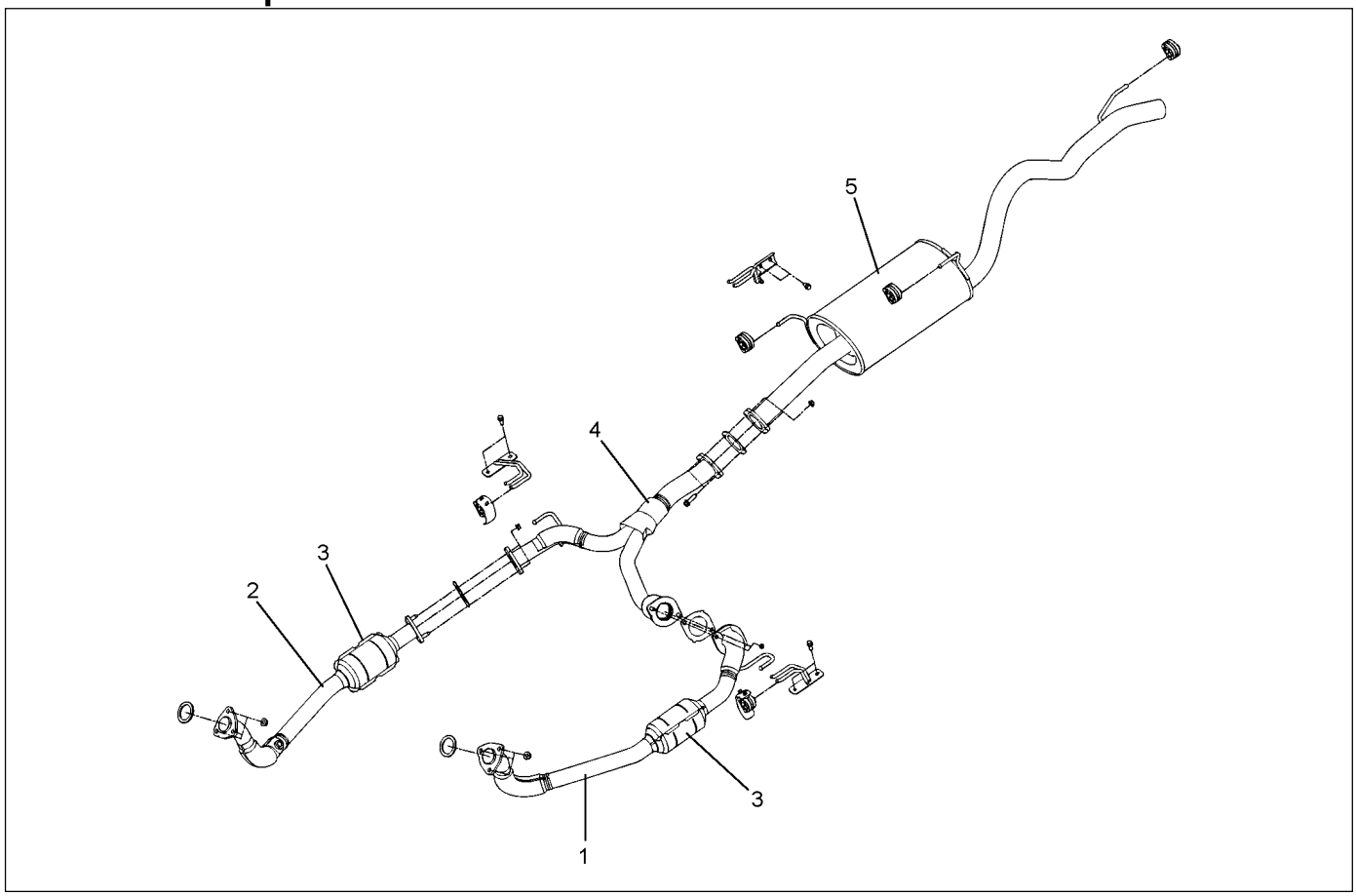
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Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

General Description



RTW46FLF000101

Legend

(1) Front Exhaust Pipe LH
(2) Front Exhaust Pipe RH
(3) Three Way Catalytic Converter
(4) Center Exhaust Pipe
(5) Exhaust Silencer & Tail Pipe

When inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to prevent overheating the floor pan and possible damage to the passenger compartment insulation and trim materials.

Check complete exhaust system and nearby body areas and rear compartment lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the rear compartment or passenger compartment. Dust or water in the rear compartment may be an indication of a problem in one of these areas. Any faulty areas should be corrected immediately.

Hangers

Various types of hangers are used to support exhaust system(s). These include conventional rubber straps, rubber rings, and rubber blocks.

The installation of exhaust system supports is very important, as improperly installed supports can cause annoying vibrations which can be difficult to diagnose.

Three Way Catalytic Converter

The three way catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust gas stream.

CAUTION: The catalytic converter requires the use of unleaded fuel only.

Periodic maintenance of the exhaust system is not required. If the vehicle is raised for other service, it is advisable to check the condition of the complete exhaust system.

A dual bed monolith catalytic converter is used in combination with three way catalytic converter.

Catalytic Converter Types:

Three way (Reduction/Oxidation) catalyst

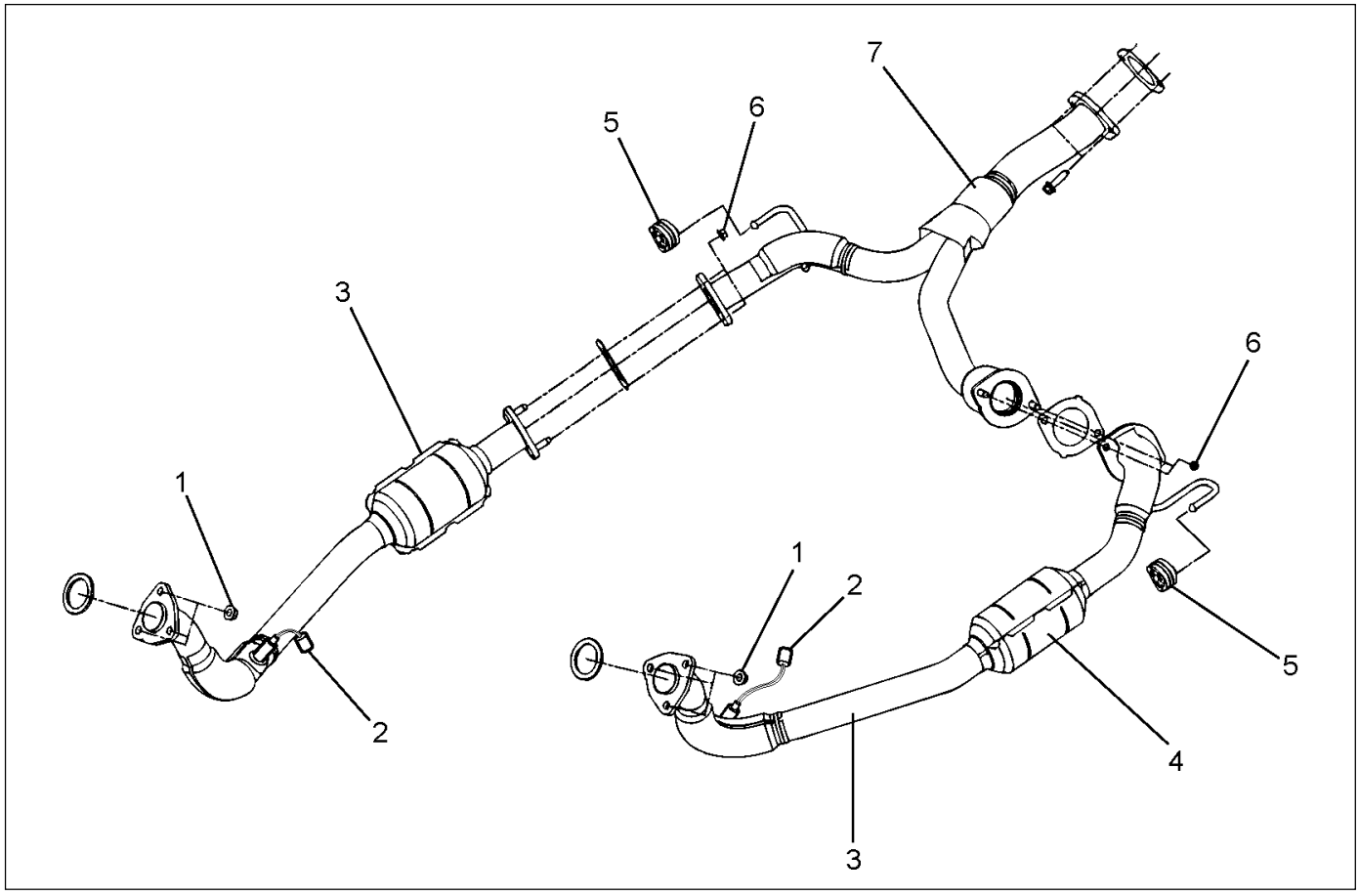
The catalyst coating on the three way (reduction) converter contains platinum and rhodium which lowers the levels of nitrous oxide (NOx) as well as hydrocarbons (HC) and carbon monoxide (Co).

Gasket

The gasket must be replaced whenever a new exhaust pipe, muffler or catalytic converter is installed.

Three Way Catalytic Converter and Center Exhaust Pipe

Three Way Catalytic Converter and Center Exhaust Pipe and Associated Parts



RTW46FMF000201

Legend

(1) Front Exhaust Pipe Fixing Nuts
(2) O_2 Sensor
(3) Three Way Catalytic Converter RH
(4) Three Way Catalytic Converter LH
(5) Mounting Rubber
(6) Exhaust Pipe Fixing Nuts
(7) Center Exhaust Pipe

Removal

1. Disconnect battery ground cable.
2. Lift up the vehicle and support with suitable safety stands.
3. Disconnect O_2 sensor harness connectors (2).
4. Remove the center exhaust pipe fixing nuts (6) and the exhaust silencer fixing bolts, then remove the center exhaust pipe and the mounting rubber.
5. Remove the front exhaust pipe fixing nuts (1) and the mounting rubber, then remove the three way catalytic converter (3) (4).

Installation

1. Install the three way catalytic converter (3) (4) and the mounting rubber, and tighten the fixing nuts (1) to the specified torque.

   Torque : 67 N·m (6.8 kg·m/49 lb ft)

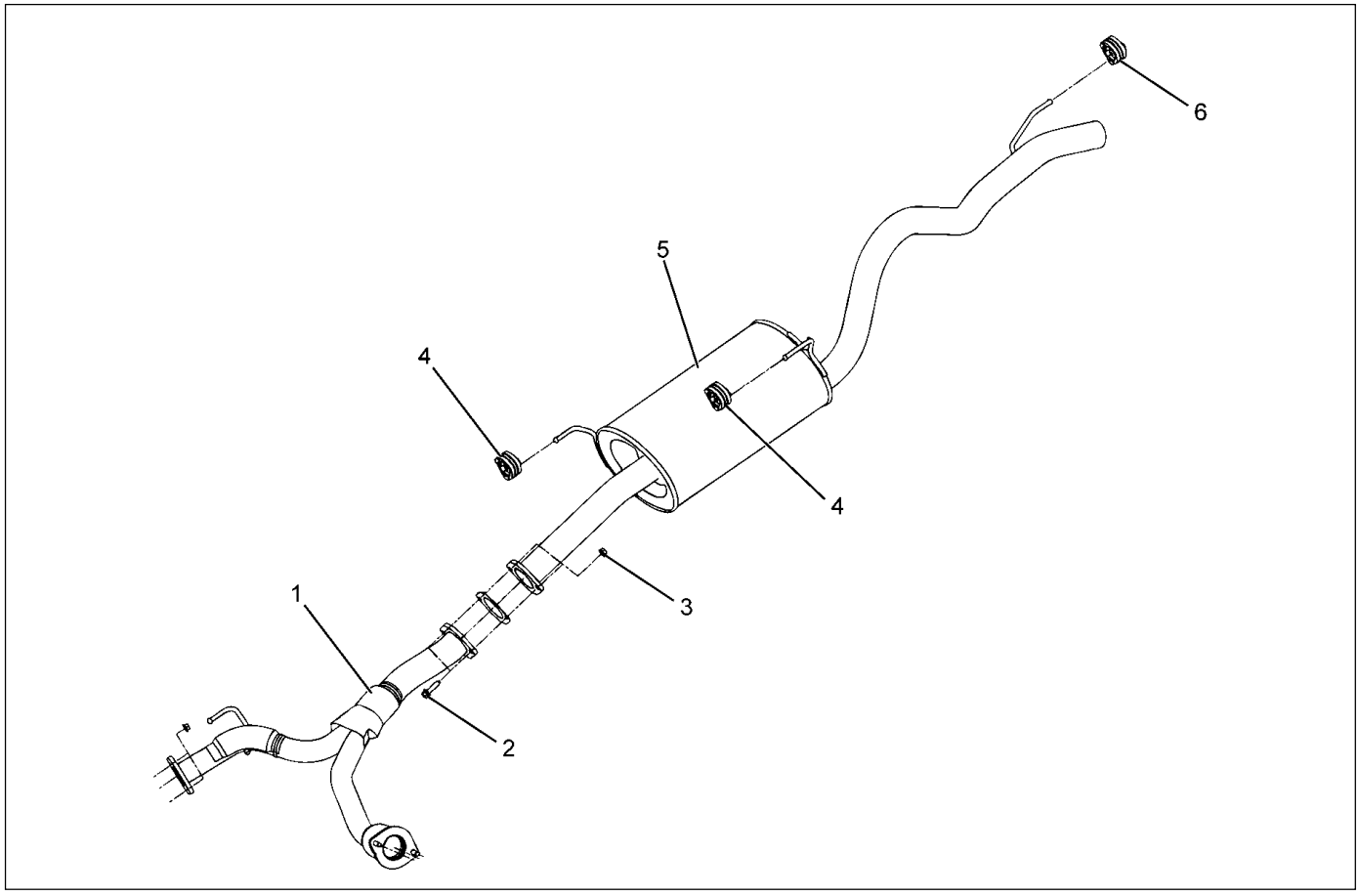
2. Install the center exhaust pipe and the mounting rubbler, and tighten the fixing nuts (6) and bolts to the specified torque.

   Torque : 43 N·m (4.4 kg·m/32 lb ft)

3. Connect the O_2 sensor connectors (2).

Exhaust Silencer and Rear Exhaust Pipe

Exhaust Silencer & Tail Pipe and Associated Parts



RTW46FMF000301

Legend

(1) Center Exhaust Pipe
(2) Exhaust Pipe Fixing Bolts
(3) Exhaust Pipe Fixing Nuts
(4) Exhaust Silencer Mounting Rubber
(5) Exhaust Silencer & Tail Pipe
(6) Rear Exhaust Pipe Mounting Rubber

Removal

1. Disconnect battery ground cable.
2. Lift up the vehicle and support with suitable safety stands.
3. Remove the exhaust pipe fixing nuts (3) and bolts (2).
4. Remove the silencer and rear exhaust pipe mounting rubber (4)(6), then remove the exhaust silencer (5) and rear exhaust pipe (6).

Installation

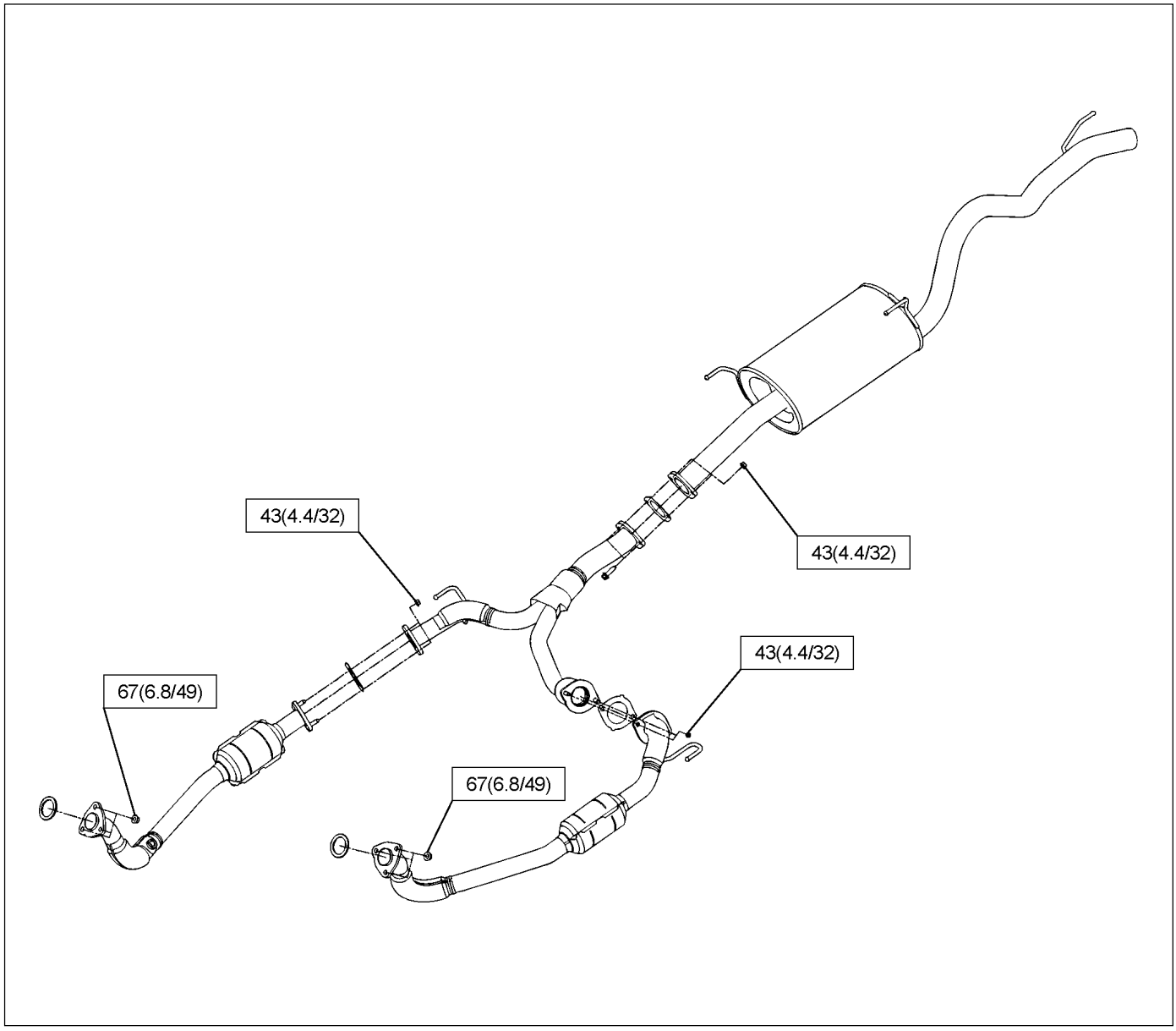
1. Install the exhaust silencer and pipe (5), then install the exhaust silencer and rear exhaust pipe mounting rubber (4)(6).
2. Tighten the exhaust pipe fixing nuts (3) and exhaust pipe fixing bolts (2).

Torque: 43 N·m (4.4 kg·m/32 lb ft)

Main Data and Specifications

Torque Specifications

N·m (kg·m/lb ft)



RTW36FLF000301

ENGINE

ENGINE LUBRICATION (6VE1 3.5L)

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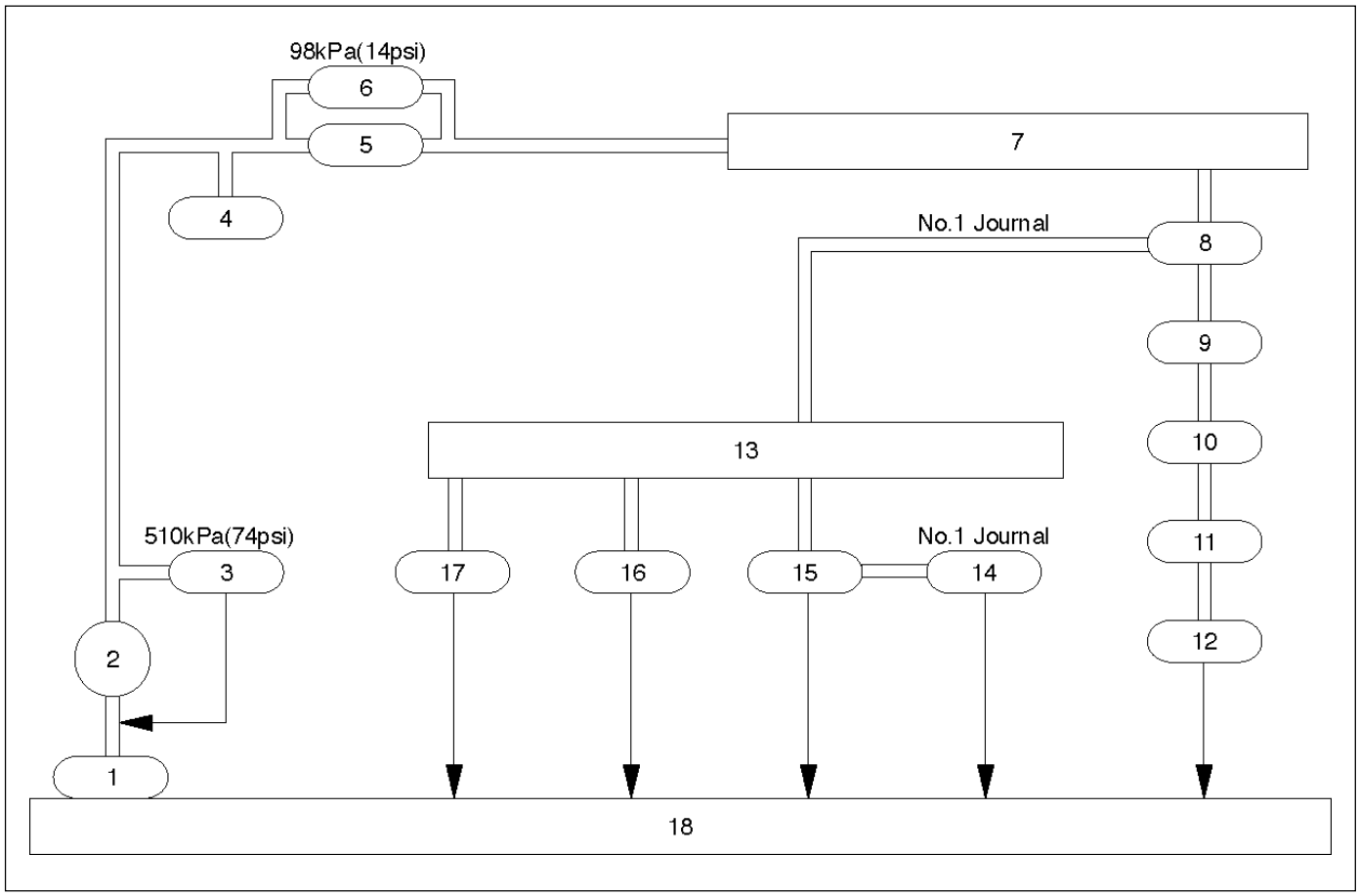
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General Description



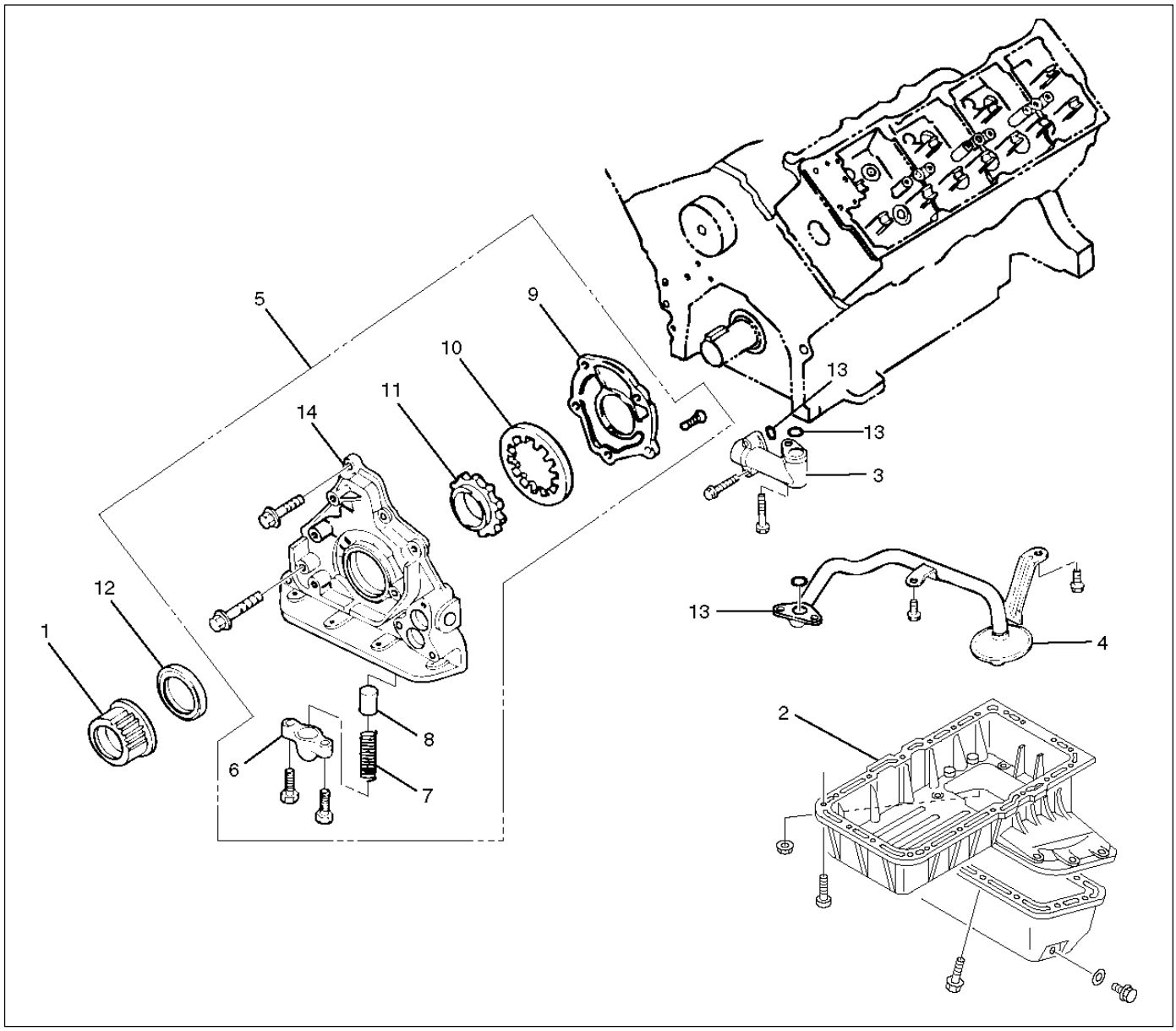
C06RW003

Legend

(1) Oil Strainer
(2) Oil Pump
(3) Relief Valve
(4) Oil Pressure Switch
(5) Oil Filter
(6) Safety Valve
(7) Oil Gallery
(8) Crankshaft Bearing
(10) Connecting Rod Bearing
(11) Connecting Rod
(12) Piston
(13) Oil Gallery; Cylinder Head
(14) Camshaft
(15) Camshaft Journal
(16) Front Journal; Camshaft Drive Gear
(17) Rear Journal; Camshaft Drive Gear
(18) Oil Pan

Oil Pump

Oil Pump and Associated Parts



051RW005

Legend

(1) Crankshaft Timing Pulley
(2) Crankcase with Oil Pan
(3) Oil Pipe
(4) Oil Strainer
(5) Oil Pump Assembly
(6) Plug
(8) Relief Valve
(9) Oil Pump Cover
(10) Driven Gear
(11) Drive Gear
(12) Oil Seal
(13) O-ring
(14) Oil Pump Body

Disassembly

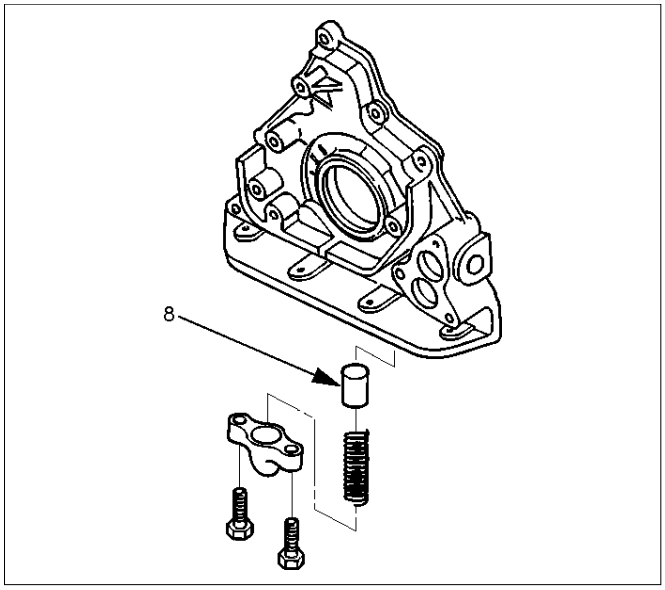
1. Remove crankshaft timing pulley.
2. Remove crankcase with oil pan.
3. Remove oil pipe.
4. Remove oil strainer.
5. Remove oil pump assembly.
6. Remove plug.
7. Remove spring.
8. Remove relief valve.
9. Remove oil pump cover.
10. Remove driven gear.
11. Remove drive gear.
12. Remove oil seal.
13. Remove O-ring.

Inspection and Repair

CAUTION: Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found during inspection.

Relief Valve (8)

- Check to see that the relief valve slides freely.
- The oil pump must be replaced if the relief valve does not slide freely.
- Replace the spring and/or the oil pump assembly (5) if the spring is damaged or badly worn.



051RS002

Body (14) and Gears (10, 11)

The pump assembly must be replaced if one or more of the conditions below is discovered during inspection.

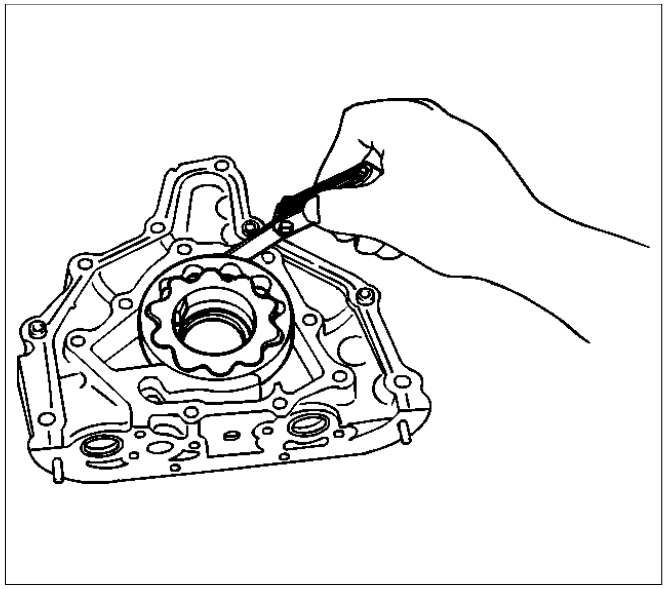
- Badly worn or damaged driven gear (10).
- Badly worn drive gear (11) driving face.
- Badly scratched or scored body sliding face (14) or driven gear (10).
- Badly worn or damaged gear teeth.

Measure the clearance between the body and the driven gear with a feeler gauge.

Standard : 0.10 mm–0.18 mm

(0.0039 in.–0.0070 in)

Limit : 0.20mm (0.0079 in)



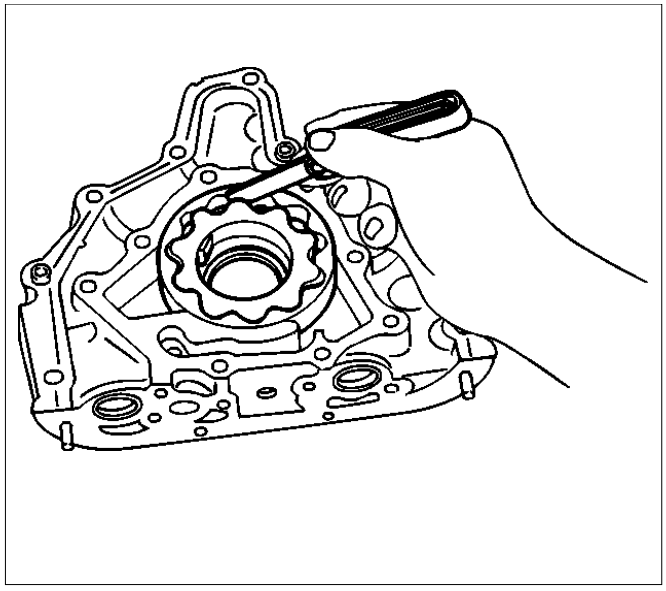
051RS004

- Measure the clearance between the drive gear and driven gear with a feeler gauge.

Standard : 0.11 mm–0.24 mm

(0.0043 in–0.0094 in)

Limit : 0.35mm (0.0138 in)



051RS003

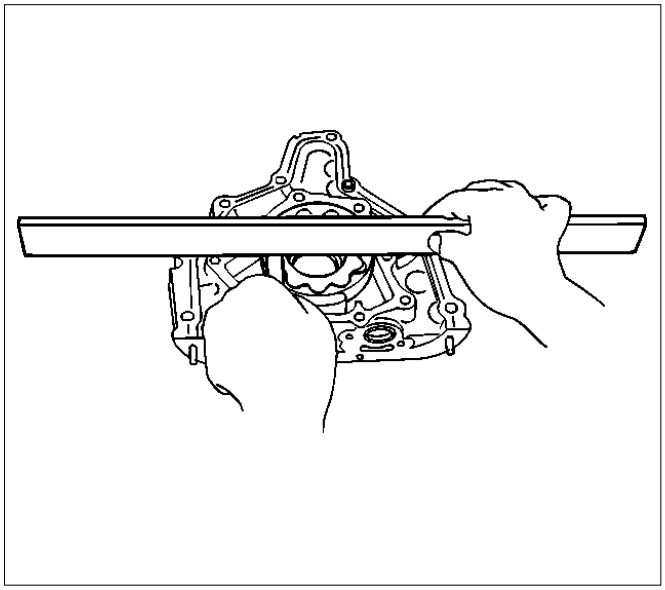
- Measure the side clearance with a precision straight edge and a feeler gauge.

Clearance

Standard : 0.03 mm–0.09 mm

(0.0011 in–0.0035 in)

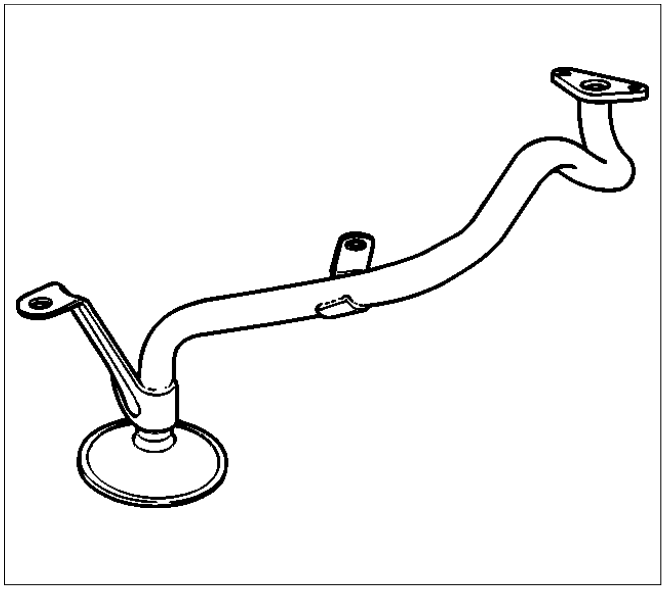
Limit : 0.15mm (0.0059 in)



051RS005

Oil Strainer

Check the oil strainer for cracking and scoring. If cracking and scoring are found, the oil strainer must be replaced.



051RS006

Reassembly

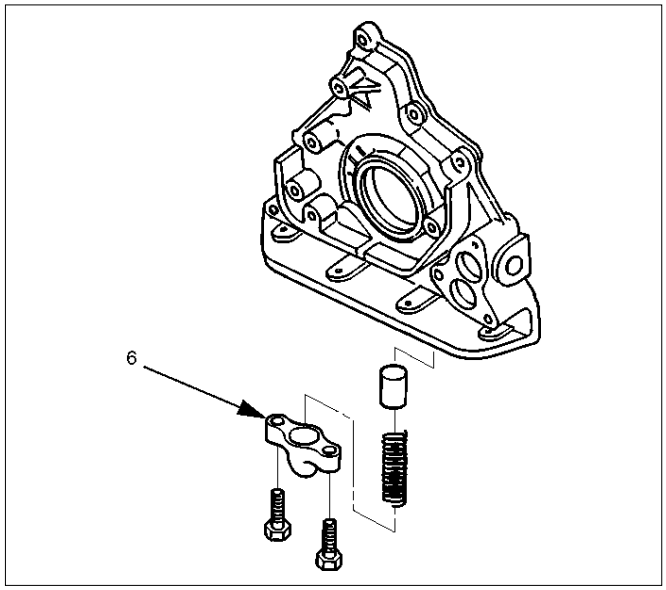
1. Install drive gear (11).
2. Install driven gear (10).
3. Install oil pump cover (9) and first, loosely tighten all of the attaching screws. Next, tighten the attaching screws to the specified torque.

Torque : 10 N·m (1.0 kg·m/7 lb ft)

After installation, check that the gear rotates smoothly.

4. Install relief valve (8) and apply engine oil to the relief valve and spring (7).
5. Install spring (7).
6. Install the plug (6).

Torque : 8 N·m (0.8 kg·m/6 lb ft)



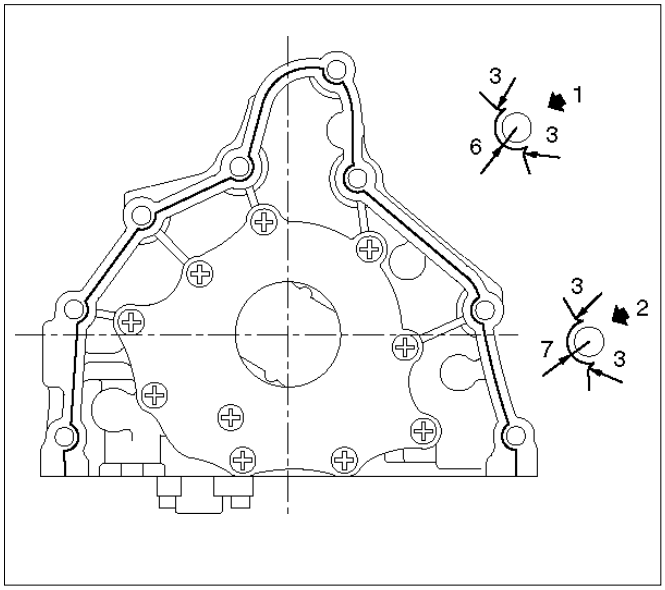
051RS007

7. Install oil pump assembly (5).
   - Carefully remove any oil from the cylinder body and the pump. Apply sealant (TB–1207B or equivalent) to the pump fitting face as shown in illustration. Take care that sealant is not applied to oil port surfaces. The oil pump assembly must be installed within 5 minutes after sealant application to prevent premature hardening of sealant.

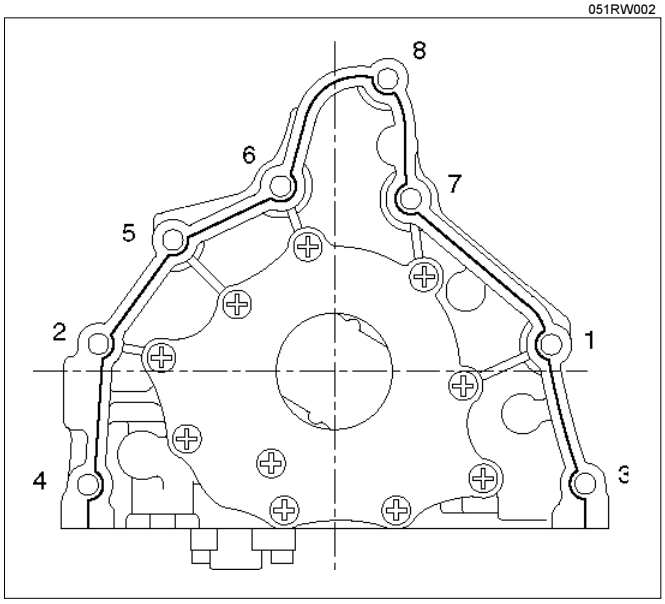
CAUTION: Do not apply an excessive amount of sealant to the contact surface. Applying too much sealant will overflow the contact surfaces. This could cause serious damage to the engine.

- **Attach oil pump assembly to cylinder body.**
- **Tighten the oil pump fixing bolts.**

Torque : 25 N·m (2.6 kg·m/18 lb ft)



051RW002

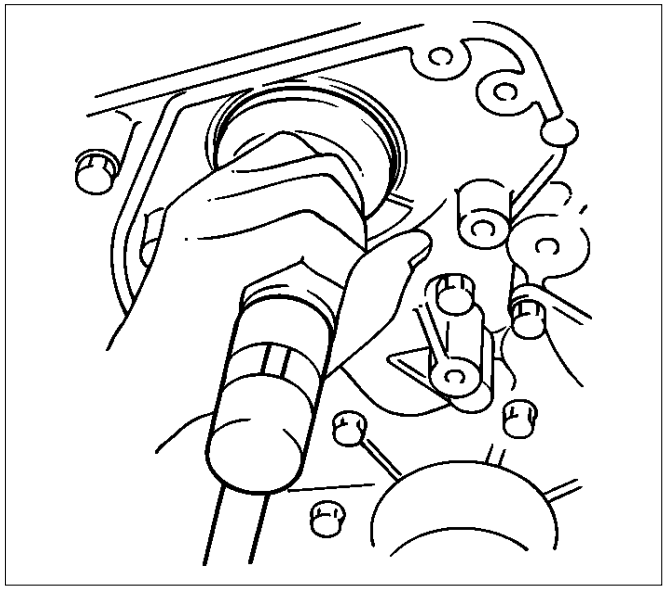


051RW001

Legend

(1) Around Bolt Holes
(2) Around Dowel Pin

8. Install the new oil seal (12). Apply engine oil to the oil seal lip before installation then use 5–8840–2287–0 oil seal Installer, install oil seal.



015RS001

9. Install oil strainer (4) with O-ring (13).

   Torque: 25 N·m (2.6 kg·m/18 lb ft)

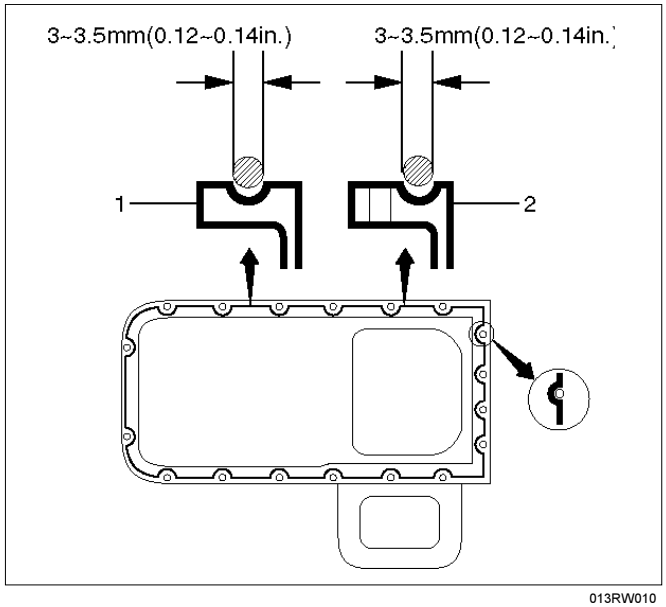
10. Install oil pipe (3) with O-ring (13).

    Torque: 25 N·m (2.6 kg·m/18 lb ft)

11. Install crankcase with oil pan (2).

    - Remove oil on crankcase mounting surface and dry the surface.
    - Apply a proper 4.5 mm (0.7 in) wide bead of sealant (TB1207C or equivalent) to the crankcase mounting surface. The bead must be continuous.
    - The crankcase must be installed within 5 minutes after sealant application to prevent premature hardening of sealant.
    - Tighten fixing bolts to the specified torque.

    Torque : 10 N·m (1.0 kg·m/7 lb ft)



013RW010

12. Install crankshaft timing pulley.

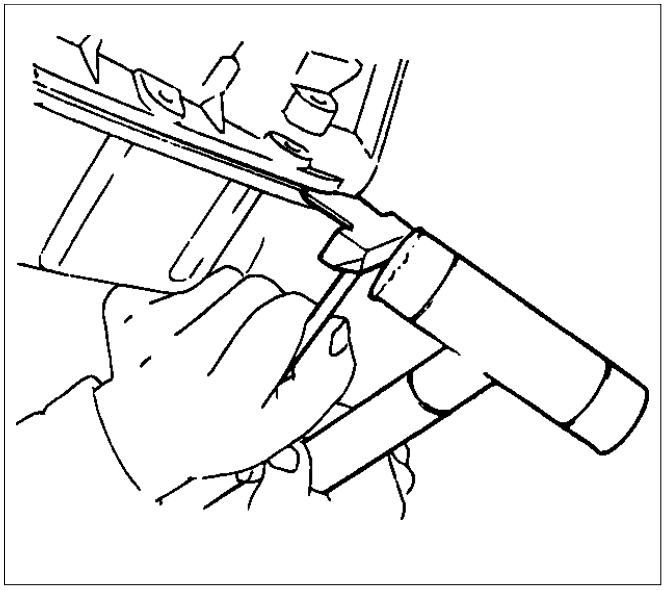
Oil Pan and Crankcase

Removal

1. Disconnect battery ground cable.
2. Drain engine oil.
3. Lift vehicle by supporting the frame.
4. Remove front wheels.
5. Remove oil level dipstick from level gauge tube.
6. Remove stone guard.
7. Remove radiator under fan shroud.

NOTE: For 4WD model, remove front axle housing assembly from chassis (steps 8 to 10).

8. Remove suspension cross member fixing bolts, 2 pcs each per side and remove suspension cross member.
9. Remove pitman arm and relay lever assembly, using the 5–8840–2005–0 remover, remove pitman arm from the steering unit and remove four fixing bolts for relay lever assembly.
10. Remove axle housing assembly four fixing bolts from housing isolator side and mounting bolts from wheel side. At this time support the axle with a garage jack and remove axle housing assembly.
11. Remove oil pan fixing bolts.
12. Remove oil pan, using 5–8840–2153–0 sealer cutter, remove oil pan.

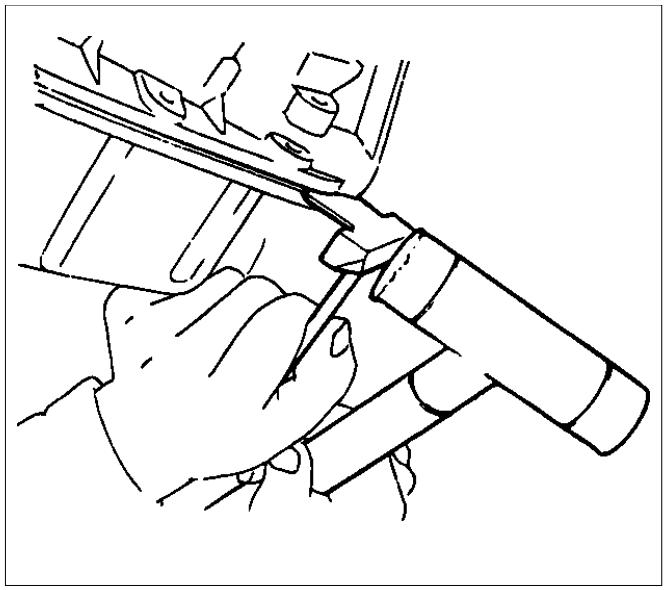


013RS003

13. Remove crankcase fixing bolts.
14. Remove crankcase, using 5–8840–2153–0 sealer cutter, remove crankcase.

NOTE: Do not deform or damage the flange of oil pan and crankcase.

Replace the oil pan and/or crankcase if deformed or damaged.



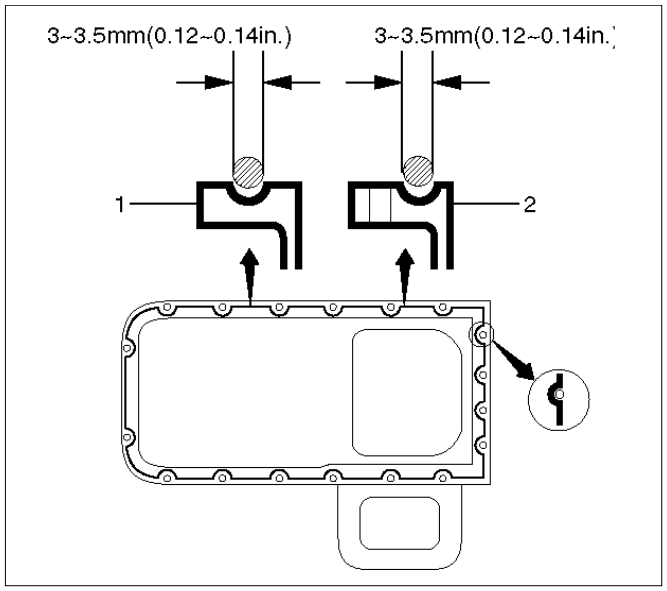
013RS003

Installation

1. Install crankcase.
   1. Remove residual sealant, lubricant and moisture from mounting surface, then dry thoroughly.
   2. Properly apply a 4.5 mm (0.7 in) wide bead of sealant (TB-1207C or equivalent) to mounting surface of crankcase.

      Sealant beat must be continuous.

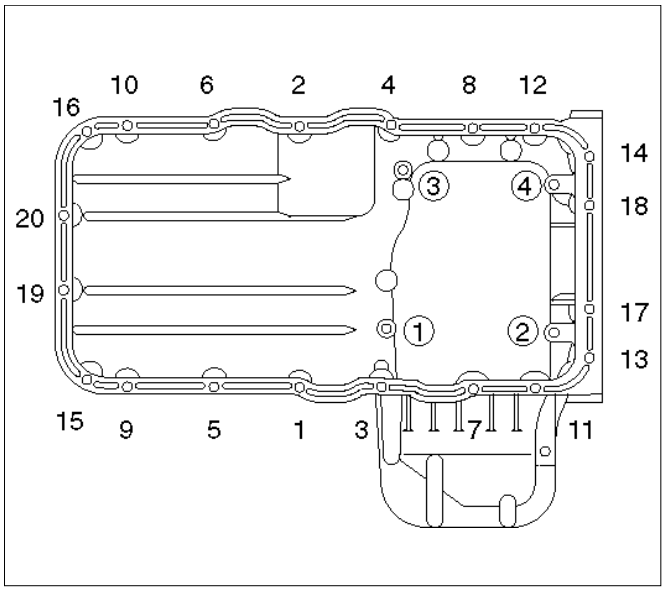
      - The crankcase must be installed within 5 minutes after sealant application before the sealant hardens.



013RW010

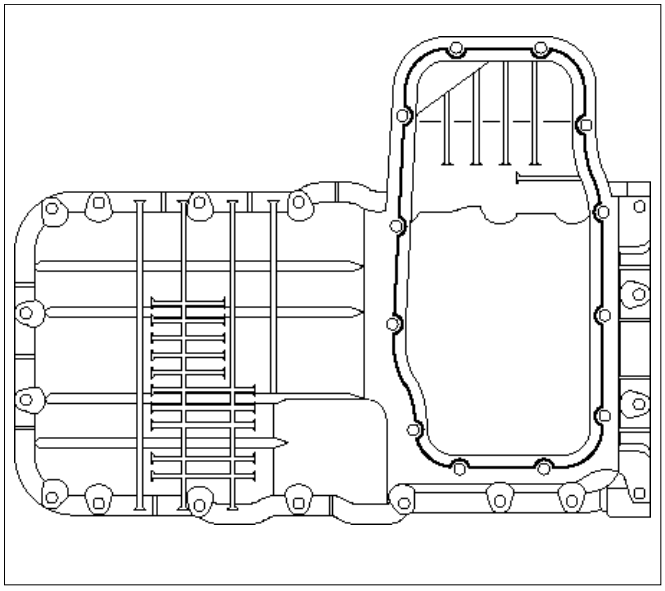
3. Install crankcase, tighten crankcase fixing bolts to the specified torque.

Torque : 10 N·m (1.0 kg·m/89 lb in)



013RW004

2. Install oil pan
   1. Remove residual sealant, lubricant and moisture from mounting surface, then dry thoroughly.
   2. Properly apply a 4.5 mm (0.17 in) wide bead of sealant (TB-1207C or equivalent) to mounting surface of oil pan.
      Sealant beat must be continuous.
      - The crankcase must be installed within 5 minutes after sealant application before the sealant hardens.



013RW003

3. Install oil pan, tighten oil pan fixing bolts to the specified torque.

Torque : 25 N·m (2.5 kg·m/18 lb ft)

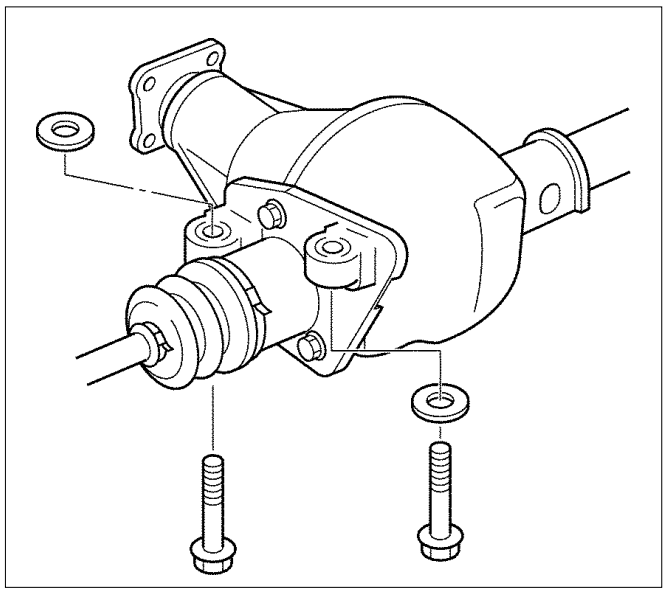
3. Install axle housing assembly and tighten fixing bolts to the specified torque (4WD model).

Axle case bolts

Torque : 116 N·m (11.8 kg·m/85 lb ft)

Mounting bolts

Torque : 168 N·m (17.2 kg·m/124 lb ft)



RTW34CSH000101

4. Install relay lever assembly and tighten fixing bolts.

Torque: 44 N·m (4.5 kg·m/32 lb ft)

5. Engage teeth of pitman arm and steering unit, and tighten nut to the specified torque.

Torque : 216 N·m (22.0 kg·m/159 lb ft)

6. Install suspension cross member and tighten fixing bolts to the specified torque.

Torque : 78 N·m (8.0 kg·m/58 lb ft)

7. Install radiator under fan shroud.
8. Install stone guard.
9. Install engine oil level dipstick.
10. Fill engine oil until full level on engine oil gauge dipstick.

Oil Pump

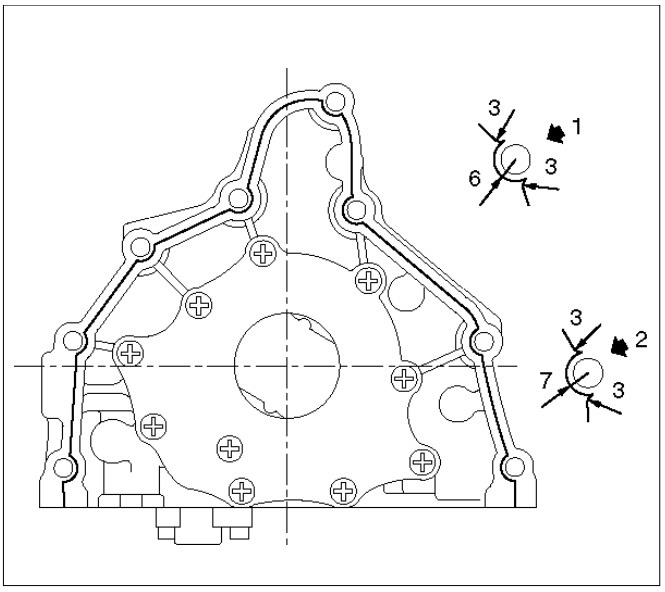
Removal

1. Disconnect battery ground cable.
2. Drain engine oil.
3. Remove crankcase assembly.
   - Refer to removal procedure for Oil Pan and Crankcase in this manual.
4. Remove crankshaft pulley.
   - Refer to removal procedure for Crankshaft Pulley in this manual.
5. Remove timing belt.
   - Refer to removal procedure for Timing Belt in this manual.
6. Remove timing pulley from crankshaft.
7. Remove four fixing bolts from oil filter assembly.
8. Remove oil strainer fixing bolts, remove oil strainer assembly with O-ring.
9. Remove three bolts from oil pipe and O-ring.
10. Remove eight oil pump fixing bolts, then oil pump assembly.
11. Remove sealant from mounting surface of oil pump assembly, cylinder block and take care not to damage mounting surfaces of oil pump and cylinder block.

Installation

1. Install oil pump assembly
   - Apply sealant (TB-1207B or equivalent) to the oil pump mounting surfaces as shown in the illustration.
   - The oil pump assembly must be installed within 5 minutes after sealant application before the sealant hardens.

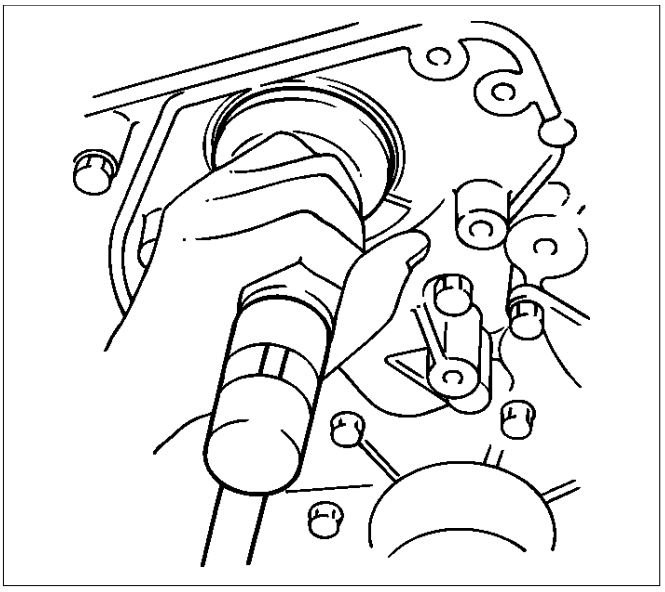
NOTE: Do not apply sealant to the oil ports.



051RW002

- Use 5–8840–2287–0 installer when installing new oil seal.
- Apply engine oil to oil seal lip.
- Install oil pump assembly to the cylinder block.

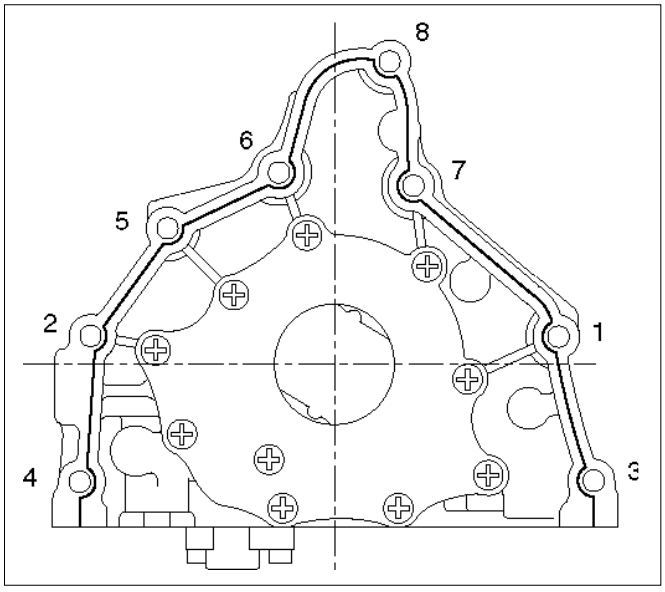
NOTE: Do not damage oil seal during installation of oil pump assembly.



015RS001

- Tighten fixing bolts to the specified torque.

Torque : 25 N·m (2.5 kg·m/18 lb ft)



051RW001

2. Install oil pipe with O-ring, tighten fixing bolt to the specified torque.

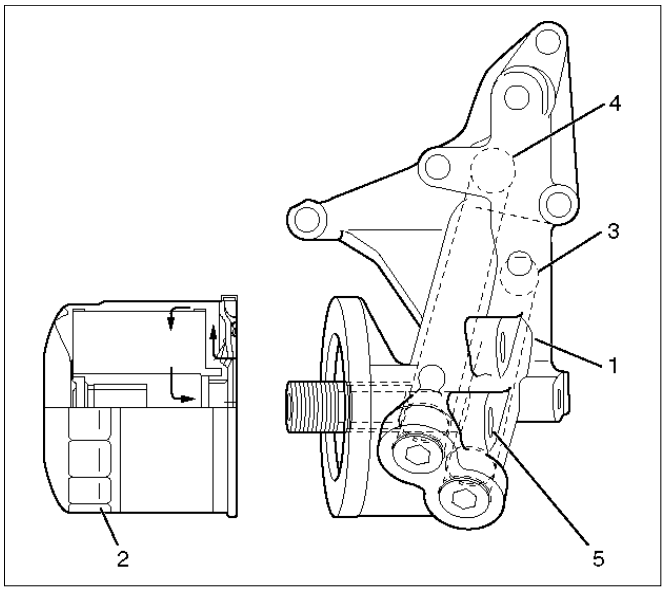
Torque : 10 N·m (1.0 kg·m/7 lb ft)

3. Install oil strainer with O-ring, tighten fixing bolt to the specified torque.

Torque : 25 N·m (2.5 kg·m/18 lb ft)

4. Install oil filter assembly and tighten bolts to the specified torque.

Torque : 25 N·m (2.5 kg·m/18 lb ft)



050RW001

Legend

(1) Oil Pump
(2) Oil Filter
(3) Oil Gallery
(4) From Oil Filter
(5) To Oil Filter

5. Install timing pulley on crankshaft.
   Install timing belt.
   - Refer to installation procedure for Timing Belt in this manual.
6. Install crankshaft pulley.
   - Refer to install procedure for Crankshaft Pulley in this manual.
7. Install crankcase assembly.
   - Refer to installation procedure for Oil Pan and Crankcase in this manual.
8. Refill engine oil until full level on engine oil dipstick.

Oil Pump Oil Seal

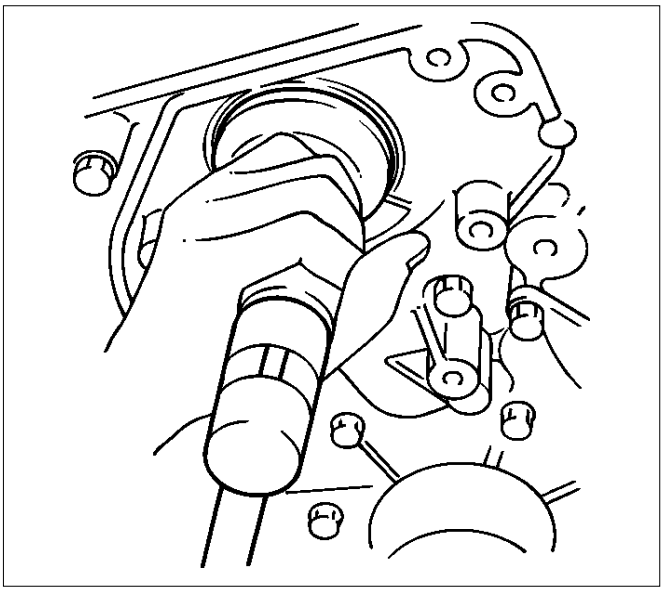
Removal

1. Disconnect battery ground cable.
2. Drain engine oil.
3. Remove crankshaft pulley.
   - Refer to removal procedure for Crankshaft Pulley in this manual.
4. Remove timing belt.
   - Refer to removal procedure for Timing Belt in this manual.
5. Remove timing pulley from crankshaft.
6. Remove oil pump oil seal using a sealer puller.

NOTE: Take care not to damage sealing surfaces of oil pump and crankshaft when removing oil seal.

Installation

1. Install oil pump oil seal, apply engine oil to oil seal lip, then install oil seal using 5–8840–2287–0 installer.



015RS001

2. Install timing pulley to crankshaft.
3. Install timing belt.
   - Refer to installation procedure for Timing Belt in this manual.
4. Install crankshaft pulley.
   - Refer to installation procedure for Crankshaft Pulley in this manual.
5. Refill engine oil until full level.

Main Data and Specifications

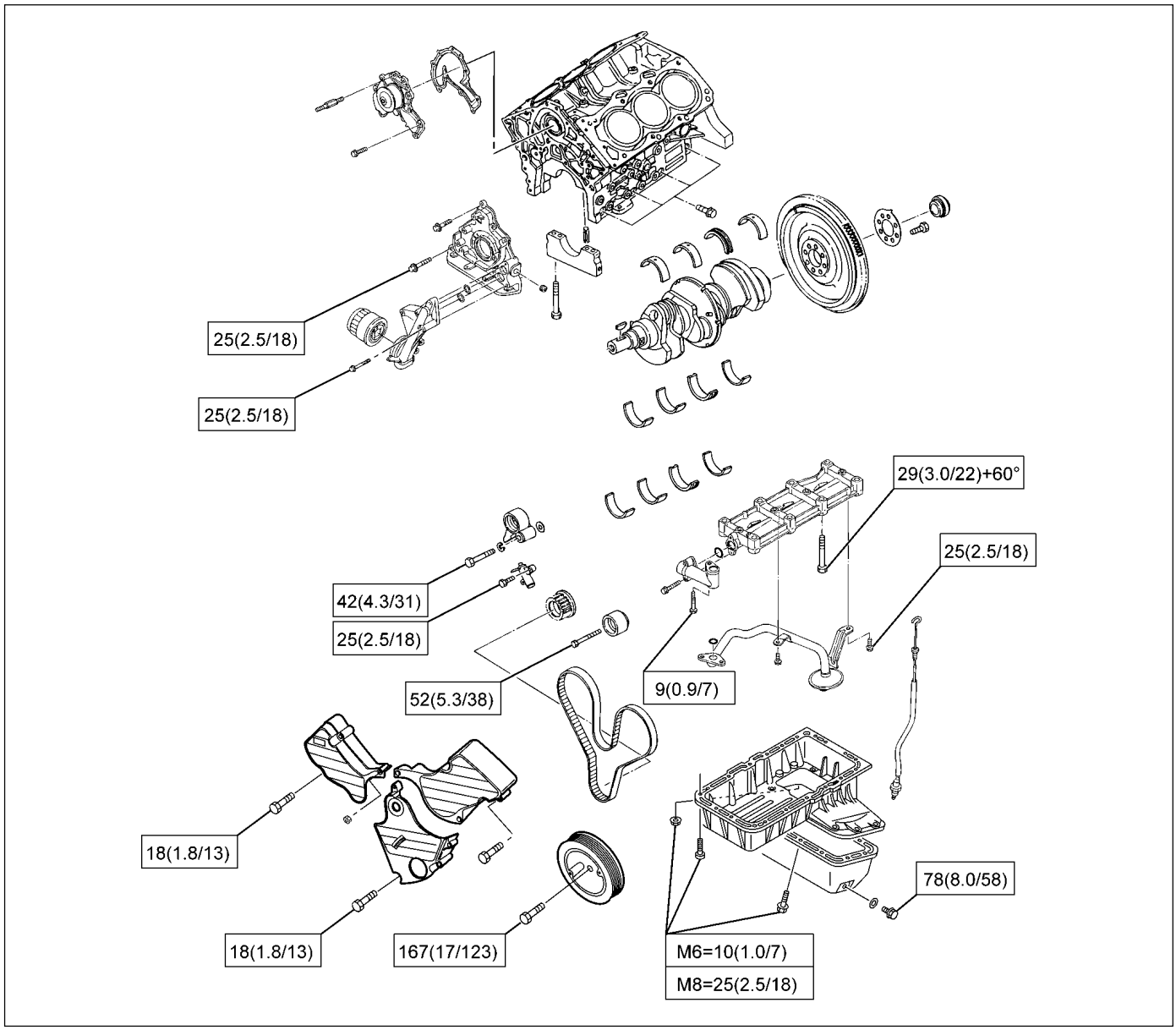
General Specifications

Item	Specifications
Oil capacity	5.3 liters

Torque Specifications

Crankcase, Oil pan, Timing belt tensioner, Timing pulley, timing belt cover, Oil pump, Oil gallery, Oil strainer

N·m (kg·m/lb ft)



RTW46GLF000101

ENGINE

ENGINE SPEED CONTROL SYSTEM (6VE1 3.5L)

CONTENTS

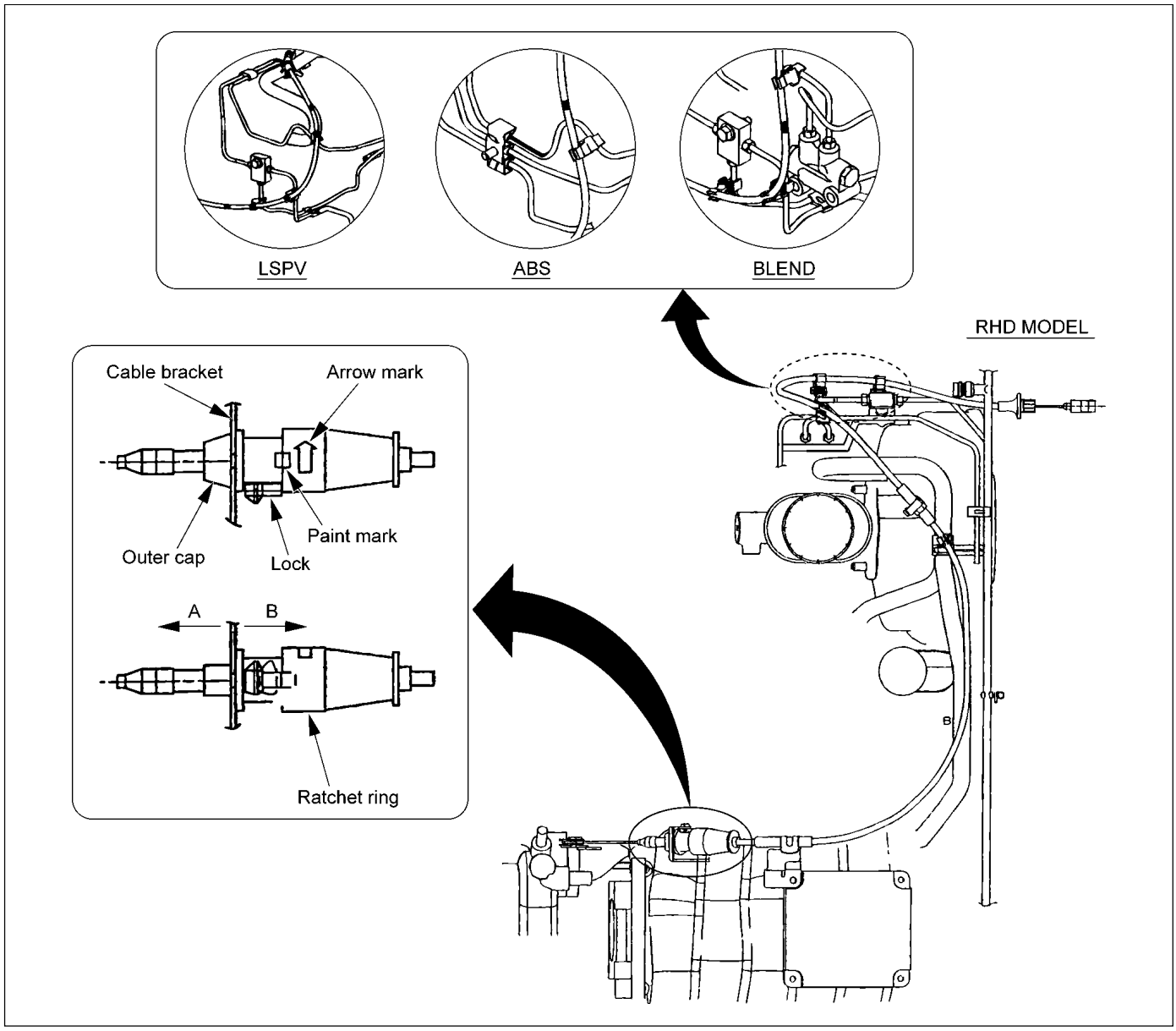
Service Precaution 6H-1
Accelerator Pedal Control Cable 6H-2
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Inspection 6H-2
Installation 6H-3

Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Accelerator Pedal Control Cable

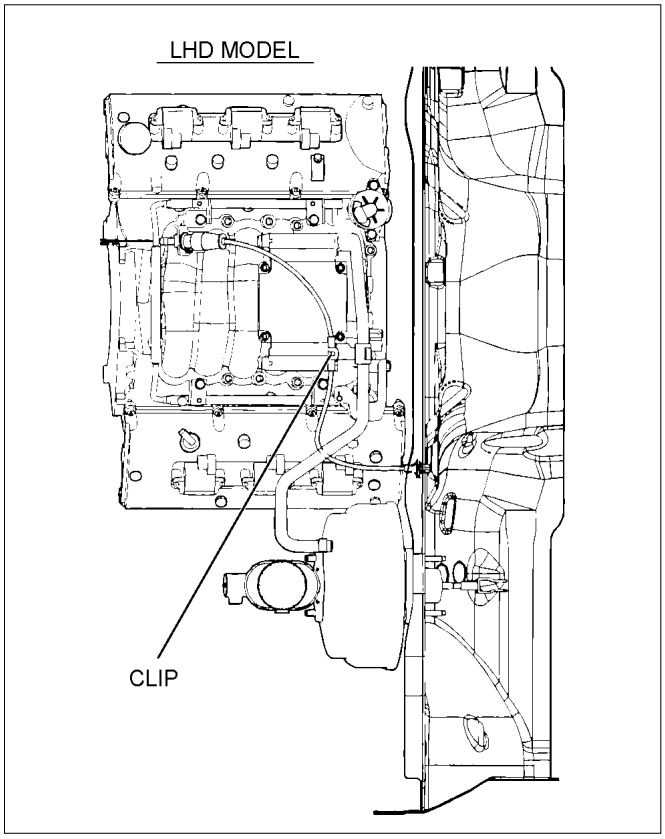


RTW46HLF000101

Removal

1. Disconnect the accelerator control cable from the accelerator pedal and dash panel.
2. Remove the cable clips.
3. Remove the accelerator control cable from accelerator control cable bracket.
   1) Slide the lock in direction A
   2) Rotate the ratchet ring in indirection an arrow 90°.

4. Remove the accelerator control cable from the throttle.



RTW46HMH000101

Inspection

Check the following items and replace the control cable if any abnormality is found.

- The control cable should move smoothly.
- The control cable should not be bent or kinked.
- The control cable should not be damage or corrosion.

Installation

1. Install the accelerator control cable to accelerator control pedal and dash panel.
2. Install the accelerator control cable to throttle.
   Attach T-END and inner cable to throttle cam of engine.
3. Install accelerator control cable to accelerator bracket.
   1) Rotate the ratchet ring in direction an arrow 90° until both white marking are aligned.
   2) Confirm marking of outer cap must be upper side.
   3) Slider the lock in direction B.
   4) Confirm ratchet ring is locked.

MEMO

ENGINE

INDUCTION (6VE1 3.5L)

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Air Cleaner Element 6J-2
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Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Air Cleaner

Removal

1. Remove positive ventilation hose connector.
2. Remove MAF and IAT sensor.
3. Remove air cleaner duct assembly.
4. Remove air cleaner housing.



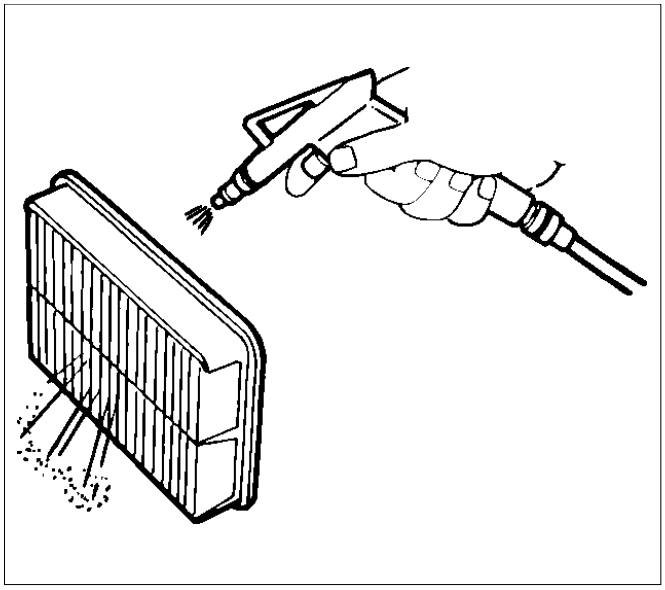
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Inspection

Check the air cleaner filter for damage or dust clogging. Replace if it is damaged, or clean if it is clogged.

Cleaning Method

Tap the air cleaner filter gently so as not to damage the paper filter, or clean the element by blowing with compressed air of about 490 kPa (71 psi) from the clean side if it is extremely dirty.

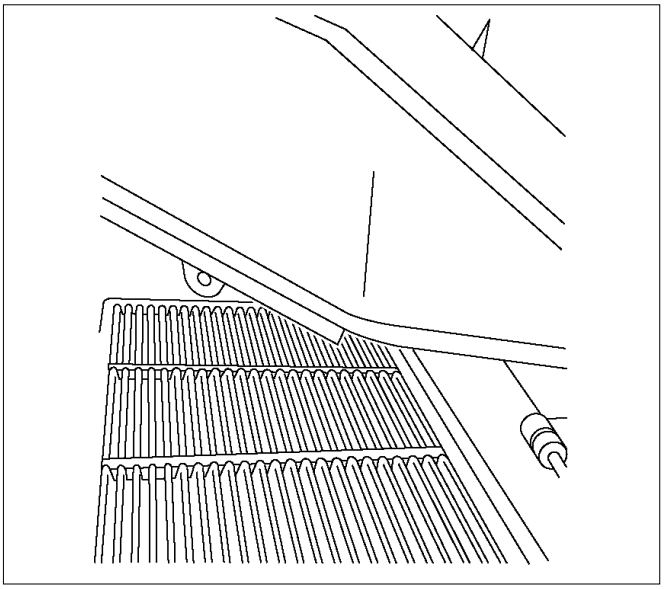


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Installation

1. Install air cleaner housing.

NOTE: The air cleaner filter is not damaged with the edge to an air cleaner housing.



RTW46JSH000101

2. Attach the mass air cleaner duct cover to the body completely, then clamp it with the clip.
3. Install MAF and IAT sensor.
4. Install positive crankcase ventilation hose connector.



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