ENGINE

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ENGINE MECHANICAL

CONTENTS

Service Precaution

WARNING: IF SO EQUIPPED WITH 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 skint. 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 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 is 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 seze 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 Lubrication

The oil discharged by a trochoid–type oil pump driven by the crankshaft is fed through full–flow oil filter and to the oil gallery provided under the crankshaft bearing cap. The oil is then led to the crankshaft journals and cylinder head. The crank pins are lubricated with oil from crankshaft journals through oil holes. Also, an oil jet is fed to each cylinder from crankshaft juornals on the connecting rod for piston cleaning. The oil pan flange is dealed with liquid packing only; do not deform or damage the flange surface during removal or installation.

Engine Diagnosis

Hard Starting

1. Starting Motor Does Not Turn Over

Troubleshooting Procedure

Turn on headlights and starter switch.

Condition	Possible cause	Correction
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 igniton coil from any spark plug. Connect the spark plug tester 5–8840–0607–0, 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 igniton coil is broken while the engine is running.

Condition	Possible cause	Correction
Spark jumps across gap	Spark plug defective	Clean, adjust spark gap 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
	Powertrain Control Module cable disconnected or defective	Correct or replace

3. Trouble In Fuel System

Condition	Possible cause	Correction
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

Condition	Possible cause	Correction
Engine lacks compression	Spark plug loosely fitted or spark plug gasket defective	Tighten to specified torque or replace gasket
	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

Condition	Possible cause	Correction
Trouble in fuel injection system	Idle air control valve defective	Replace
	Throttle shutting off incomplete	Correct or 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
	Manifold Absolute Pressure Sensor circuit open or poor connections	Correct or replace
	Manifold Absolute Pressure 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
	Knock Sensor (KS) cable broken or poor connections	Correct or replace
	KS defective	Replace
	KS Module circuits open or ground	Correct or replace
	KS Module defective	Replace
	Vehicle Speed Sensor circuit open or shorted	Correct or replace
	Vehicle Speed Sensor defective	Replace
Trouble in emission control system	Powertrain Control Module defective	Replace
	Exhaust Gas Recirculation Valve circuit open or poor connections	Correct or replace
	Exhaust Gas Recirculation Valve faulty	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”

Condition	Possible cause	Correction
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

Condition	Possible cause	Correction
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
	Powertrain control module faulty	Replace
Engine knocks periodically	Spark plugs running too hot	Install colder type spark plugs
	Powertrain 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
	Manifold Absolute Pressure (MAP) Sensor or Manifold Absolute Pressure Sensor circuit defective	Correct or replace
	Engine Coolant Temperature Sensor or Engine Coolant Temperature Sensor circuit defective	Correct or replace
	Powertrain 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
	Knock Sensor or Knock Sensor circuits defective	Correct or replace
	Knock Sensor Module or Knock Sensor Module circuits defective	Correct or replace

Hesitation

Condition	Possible cause	Correction
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
	Manifold Absolute Pressure (MAP) Sensor circuit open or shorted	Correct or replace
	MAP Sensor defective	Replace
	Intake Air Temperature (IAT) Sensor circuit open or shorted	Correct or replace
	Knock Sensor (KS) Circuit open or poor connections	Correct or replace
	KS defective	Replace
	KS Module circuits open or shorted	Correct or replace
	KS Module defective	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

Condition	Possible cause	Correction
Hesitation at high speeds	Powertrain 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
	MAP Sensor cable broken or poor connections	Correct or replace
	MAP Sensor defective	Replace
	IAT Sensor circuit open or poor connections	Correct or replace
	IAT Sensor defective	Replace
	KS circuit open or poor connections	Correct or replace
	KS defective	Replace
	KS Module circuit open or shorted	Correct or replace
	KS Module 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

Condition	Possible cause	Correction
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
	Powertrain 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
	Powertrain 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
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

Condition	Possible cause	Correction
Engine overheating	Level of Engine Coolant too low	Replenish
	Fan clutch defective	Replace
	Incorrect fan installed	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
	Exhaust Gas Recirculation 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.

Condition	Possible cause	Correction
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.

Condition	Possible cause	Correction
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.

Condition	Possible cause	Correction
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.

Condition	Possible cause	Correction
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 assy

Troubleshooting Procedure

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

Condition	Possible cause	Correction
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

Condition	Possible cause	Correction
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

Condition	Possible cause	Correction
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
	Manifold Absolute Pressure Sensor circuit open or shorted	Correct or replace
	Manifold Absolute Pressure 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
	Powertrain Control Module cable poor connections or defective	Correct or replace

Condition	Possible cause	Correction
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
	Exhaust Gas Recirculation 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

Condition	Possible cause	Correction
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 cooler adapter cracked	Replace
	Oil cooler center bolt loose	Retighten
	Oil cooler O–ring broken	Replace
	Oil cooler piping loose or broken	Retighten or replace
	Oil filter adapter cracked	Replace
	Oil filter attaching 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

Condition	Possible cause	Correction
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

Condition	Possible cause	Correction
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 Idle Air Control Valve
	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
	Excessive Exhaust Gas Recirculation flow due to trouble in Exhaust Gas Recirculation system	Refer to “Abnormal Combustion”

Lubrication Problems

Condition	Possible cause	Correction
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, gasoline or water in the engine oil.
   a. Check the viscosity of the oil.
   b. Change the oil if the viscosity is outside the specified standard.
   c. 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

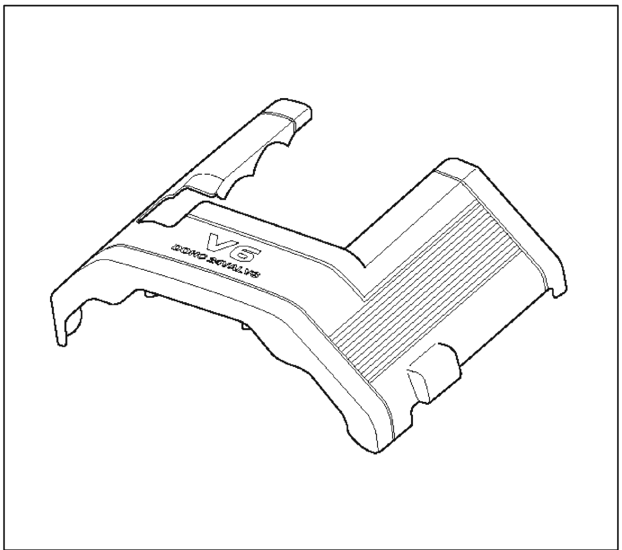
The instrument panel “CHECK ENGINE” Malfunction Indicator Lamp (MIL) illuminates by self diagnostic system when the system checks the starting of engine, or senses malfunctions.

Condition	Possible cause	Correction
“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 (PCM) cable loosely connected, disconnected or defective	Correct or replace
	PCM 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
	Manifold absolute pressure sensor circuit open or shorted	Correct or replace
	Intake air temperature sensor circuit open or shorted	Correct or replace
	Fuel injector circuit open or shorted	Correct or replace
	PCM driver transistor defective	Replace PCM
	Malfunctioning of PCM RAM (Random Access Memory) or ROM (Read Only Memory)	Replace PCM

Cylinder Head Cover LH

Removal

1. Disconnect battery ground cable.
2. Drain engine coolant from faucet bottom of radiator.
3. Remove engine cover from the dowels on the common chamber.



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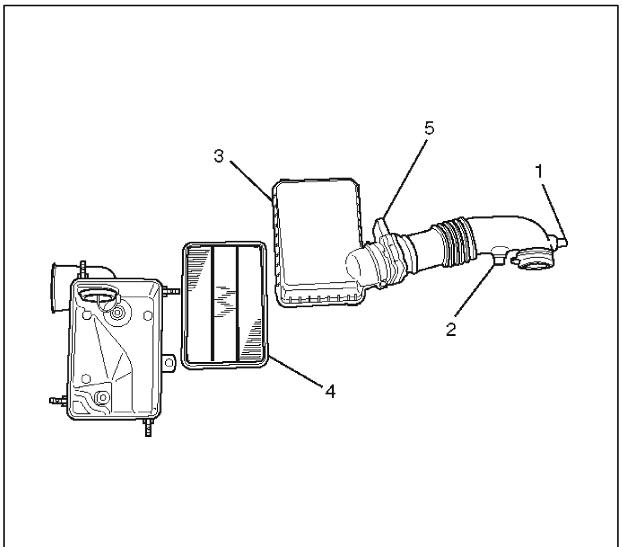
4. Remove air cleaner duct assembly (3) and air cleaner element (4).



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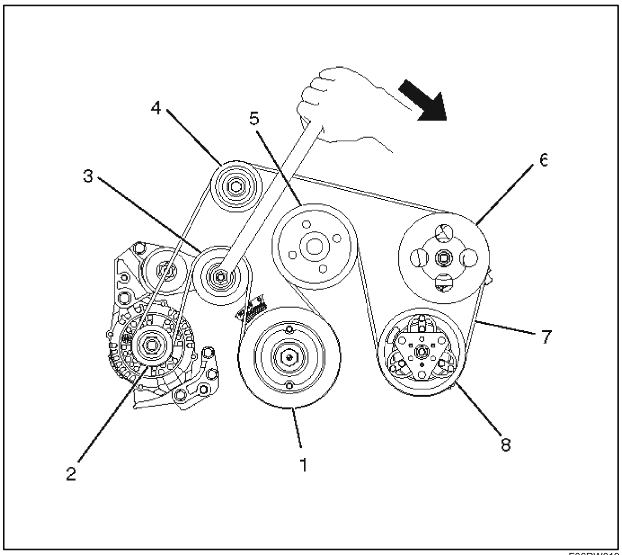
Legend

(1) Positive Crankcase Ventilation Hose Connector
(2) Intake Air Temperature Sensor
(3) Air Cleaner Duct Assembly
(4) Air Cleaner Element
(5) Mass Air Flow Sensor

NOTE: Disconnect the mass air flow (MAF) sensor connector, intake air temperature (IAT) sensor connector, and positive crankcase ventilation (PCV) hose before hand the air cleaner duct assembly is removed.

5. Disconnect following wiring connectors and bonding cable:
   - Manifold Absolute Pressure (MAP) sensor
   - Vacuum Switching Valve (VSV) for Induction Air Control Valve (IACV) actuator
   - Ignition coils for left bank
   - Fuel injectors for left bank
   - Idle air control (IAC) valve
   - Throttle position sensor (TPS)
   - Bonding cable
   - Others as necessitated
6. Disconnect following vacuum hoses:
   - Brake master VAC
   - Canister
   - VSV for IACV actuator
   - Duty solenoid valve
   - PCV
7. Disconnect radiator upper and lower hoses
8. Remove engine harness from the cylinder head cover.
9. Remove the upper fan guide.
10. Remove cooling fan and clutch assembly.
11. Remove drive belt by pushing down the auto tensioner using spanner as illustrated.



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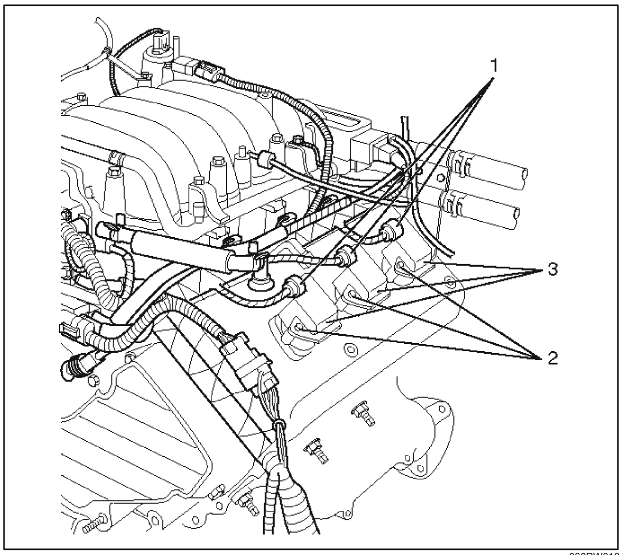
Legend

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

12. Remove power steering oil pump pulley.
13. Remove fan pulley and bracket assembly.
14. Remove idle pulley assembly.
15. Remove auto tensioner assembly.
16. Remove crankshaft pulley using 5–8840–0133–0 crankshaft holder.
17. Remove timing belt covers from the right bank side to the left bank side in order.
18. Remove ignition coil assemblies for the left side bank.



060RW018

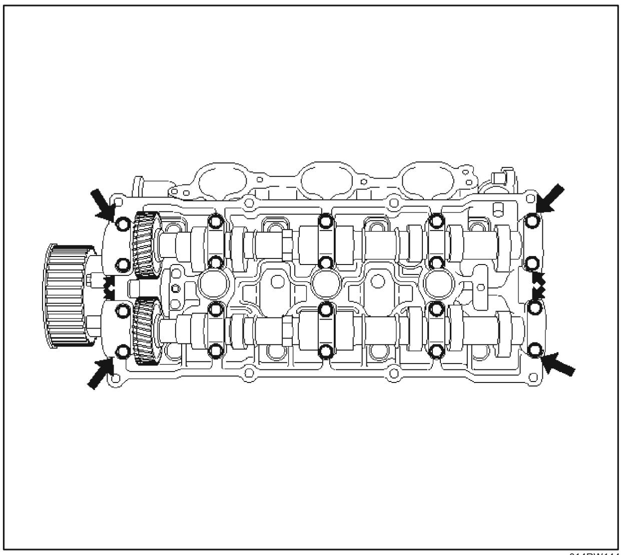
Legend

(1) Ignition Coil Connectors
(2) Bolts
(3) Ignition Coil Assemblies

19. Remove cylinder head cover assembly.

Installation

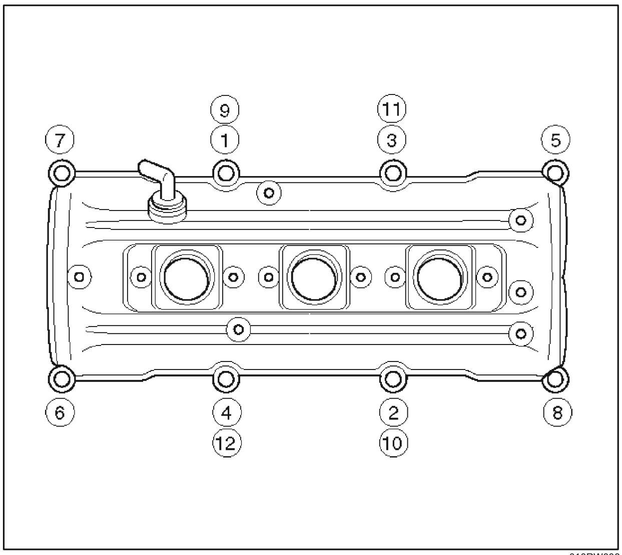
1. Install cylinder head cover.
   - Clean the sealing surface of cylinder head and cylinder head cover to remove oil and sealing materials completely.
   - Apply sealant (TB-1207B or equivalent) of bead diameter 2-3 mm at eight place of arched area of camshaft bracket on front and rear sides.
   - The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



014RW144

   - Tighten bolts to the specified torque.

Torque : 9 N·m (0.9 Kg·m/78 lb in)



010RW008

2. Install ignition coil assemblies and tighten the fixing bolts to the specified torque.

Torque : 4 N·m (0.4 Kg·m/35 lb in)

3. Install timing belt covers from left bank side to right bank side, and tighten the fixing bolts and nut to the specified torque.

Torque : 19 N·m (1.9 Kg·m/14 lb ft)

4. Install crankshaft pulley and tighten the fixing bolt using 5–8840–0133–0 crankshaft holder to the specified torque.

Torque : 167 N·m (17.0 Kg·m/123 lb ft)

5. Install auto tensioner assembly and tighten the fixing bolts to the specified torque.

   Torque :

   Shorter Bolt : 20 N·m (2.0 Kg·m/14 lb ft)

   Longer Bolt : 39 N·m (4.0 Kg·m/29 lb ft)
6. Install idle pulley and bracket assembly and tighten the fixing bolt to the specified torque.

   Torque : 52 N·m (5.3 Kg·m/38 lb ft)
7. Install fan pulley and bracket assembly and tighten the fixing bolts and nut to the specified torque.

   Torque : 22 N·m (2.2 Kg·m/16 lb ft)
8. Install power steering oil pump pulley and tighten the fixing bolt to the specified torque.

   Torque : 78 N·m (8.0 Kg·m/58 lb ft)
9. Install drive belt by pushing down the auto tensioner using spanner as shown in the removal step of drive belt.
10. Install cooling fan and clutch assembly and tighten the fixing bolts to the specified torque.

    Torque : 10 N·m (1.0 Kg·m/87 lb in)
11. Install upper fan guide and clip both side and tighten the fixing bolts to the specified torque.

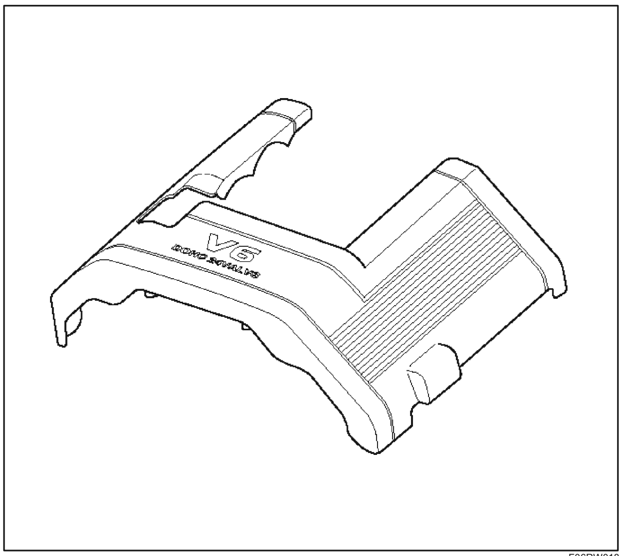
    Torque : 4 N·m (0.4 Kg·m/35 lb in)
12. Install engine harness and tighten the fixing bolts of the retaining clip and bracket to the specified torque.

    Torque : 4 N·m (0.4 Kg·m/35 lb in)
13. Connect radiator upper and lower hoses and clip them securely.
14. Connect vacuum hoses of those which were disconnected in the removal step.
15. Connect wiring connectors and bonding cable of those which were disconnected in the removal step.
16. Install air cleaner element and air cleaner duct assembly, and clip the both end securely.
17. Connect MAF sensor connector, IAT sensor connector and PCV hose.
18. Install engine cover mating with the dowels.

Cylinder Head Cover RH

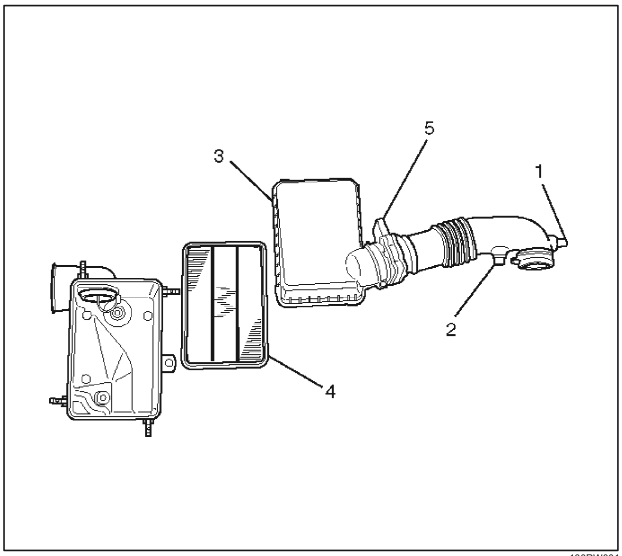
Removal

1. Disconnect battery ground cable.
2. Remove battery from the vehicle.
3. Drain engine coolant from faucet bottom of radiator.
4. Remove engine cover from the dowels on the common chamber.



F06RW018

5. Remove air cleaner duct assembly (3) and air cleaner element (4).



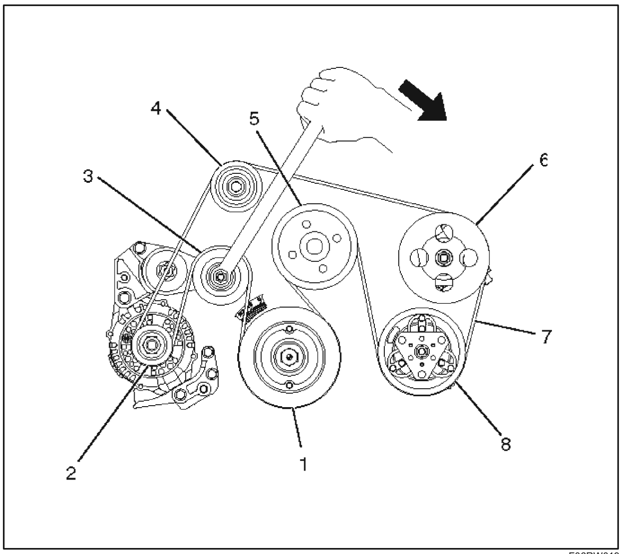
130RW001

Legend

(1) Positive Crankcase Ventilation Hose Connector
(2) Intake Air Temperature Sensor
(3) Air Cleaner Duct Assembly
(4) Air Cleaner Element
(5) Mass Air Flow Sensor

NOTE: Disconnect the mass air flow (MAF) sensor connector, intake air temperature (IAT) sensor connector, and positive crankcase ventilation (PCV) hose before hand the air cleaner duct assembly is removed.

6. Disconnect following wiring connectors and bonding cable:
   - Exhaust Gas Recirculation (EGR) valve
   - Fuel injectors for right bank
   - Ignition coils for right bank
   - Bonding cable
   - Othres as necessitated
7. Disconnect radiator upper and lower hoses.
8. Remove engine harness from the cylinder head cover.
9. Remove the upper fan guide.
10. Remove cooling fan and clutch assembly.
11. Remove drive belt by pushing down the auto tensioner using spanner as illustrated.



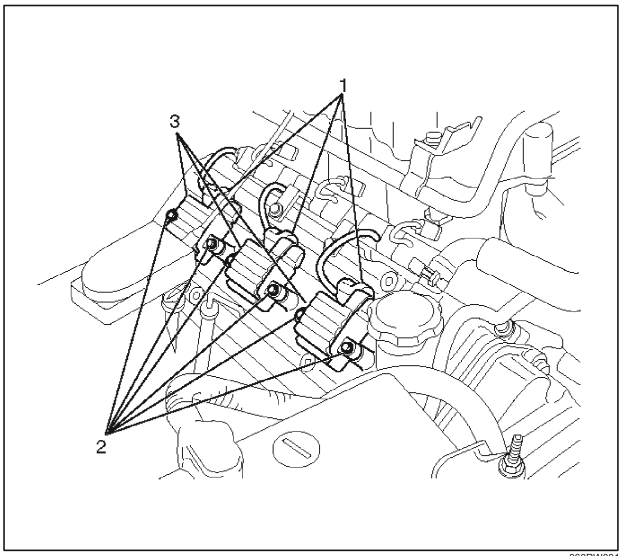
F06RW019

Legend

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

12. Remove fan pulley and bracket assembly.
13. Remove idle pulley assembly.
14. Remove auto tensioner assembly.
15. Remove crankshaft pulley using 5–8840–0133–0 crankshaft holder.

16. Remove timing belt covers for right bank side.
17. Reomve timing belt covers for right bank side.



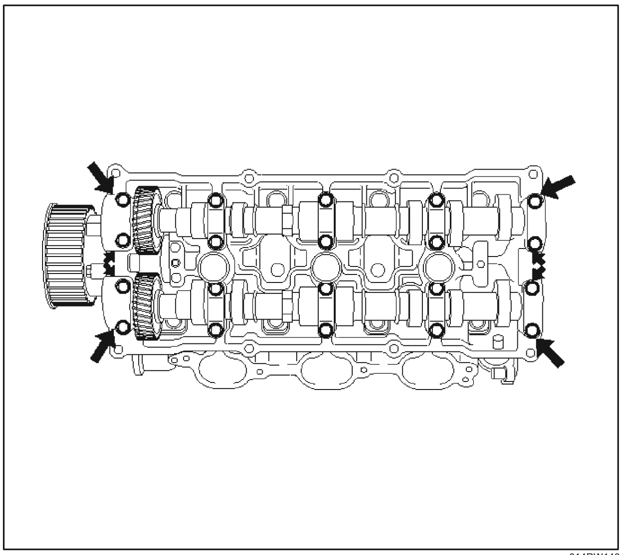
060RW001

Legend
- (1) Ignition Coil Connectors
- (2) Bolts
- (3) Ignition Coil Assemblies

18. Remove ignition coil assemblies for the right side bank.
19. Remove cylinder head cover assembly.

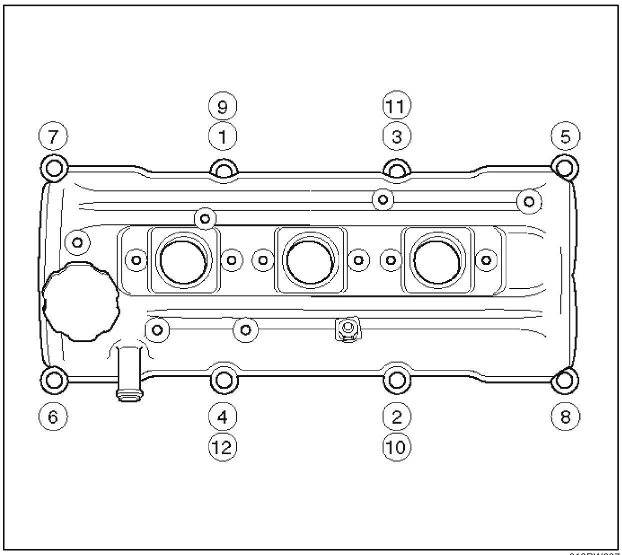
Installation

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 before the sealant hardens.


014RW143

- Tighten bolts in turn to the specified torque.

Torque : 8.8 N·m (0.9 Kg·m/78 lb in)



010RW007

2. Install ignition coil assemblies and tighten the fixing bolts to the specified torque.

   Torque : 4 N·m (0.4 Kg·m/35 lb in)
3. Install timing belt cover and tighten the fixing bolts and nut to the specified torque.

   Torque : 19 N·m (1.9 Kg·m/14 lb ft)
4. Install crankshaft pulley and tighten the fixing bolt using 5–8840–0133–0 crankshaft holder to the specified torque.

   Torque : 167 N·m (17 Kg·m/123 lb ft)
5. Install auto tensioner assembly and tighten the fixing bolts to the specified torque.

   Torque :

   Shorter Bolt : 20 N·m (2.0 Kg·m/14.8 lb ft)

   Longer Bolt : 39 N·m (4.0 Kg·m/28.8 lb ft)

6. Install idle pulley assembly and tighten the fixing bolt to the specified torque.

   Torque : 52 N·m (5.3 Kg·m/38.4 lb ft)

7. Install fan pulley and bracket assembly and tighten the fixing bolts and nut to the specified torque.

   Torque : 22 N·m (2.2 Kg·m/16.2 lb ft)

8. Install drive belt by pushing down the auto tensioner using spanner as shown in the removal step of drive belt.
9. Install cooling fan clutch assembly and tighten the fixing bolts to the specified torque.

   Torque : 10 N·m (1.0 Kg·m/88.5 lb in)

10. Install upper fan guide and clip both side and tighten the fixing bolts to the specified torque.

    Torque : 4 N·m (0.4 Kg·m/35.4 lb in)

11. Install engine harness and tighten the fixing bolts of the retaining clip and brackets to the specified torque.

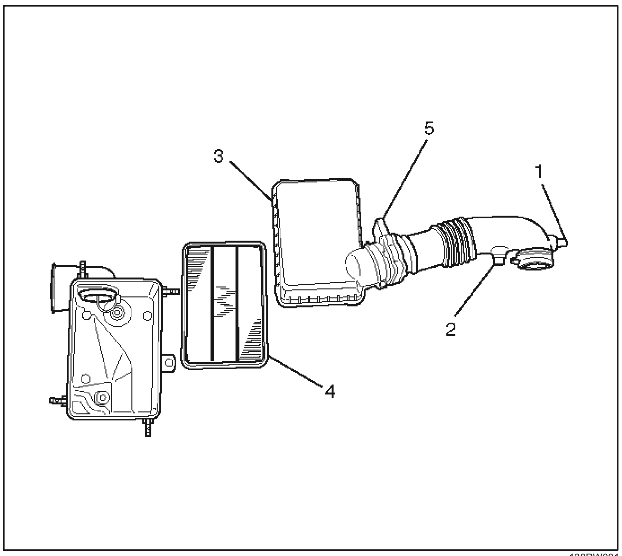
    Torque : 4 N·m (0.4 Kg·m/35.4 lb in)

12. Connect radiator upper and lower hoses and clip them securely.
13. Connect wiring connectors and bonding cable of those which were disconnected in the removal step.
14. Install air cleaner element and air cleaner duct assembly, and the clip both end securely.
15. Connect MAF sensor connector, IAT sensor connector and PCV hose.
16. Install engine cover mating with the dowels.

Common Chamber

Removal

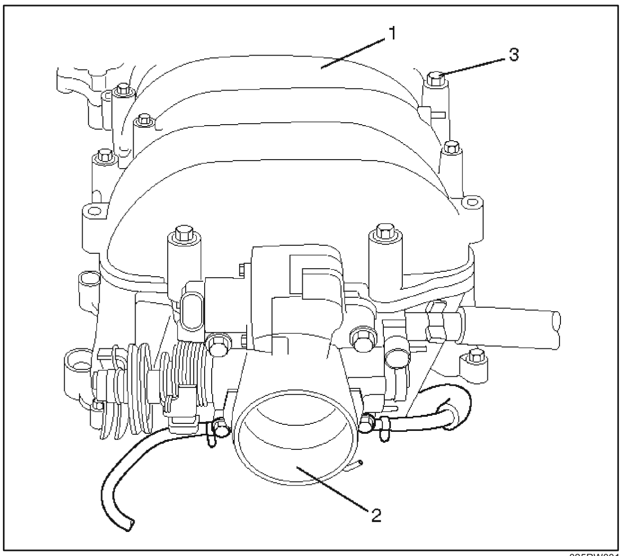
1. Disconnect battery ground cable.
2. Remove air cleaner duct assembly.



Legend

(1) Positive Crankcase Ventilation Hose Connector
(2) Intake Air Temperature Sensor
(3) Air Cleaner Duct Assembly
(4) Air Cleaner Element
(5) Air Flow Sensor

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



Legend

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

Installation

1. Install common chamber and tighten bolts and nuts to the specified torque.

   Torque :

   Bolt : 25 N·m (2.5 Kg·m/18 lb ft)

   Nut : 25 N·m (2.5 Kg·m/18 lb ft)
2. Install fuel hose bracket and tighten bolts to specified torque.

   Torque : 10 N·m (1.0 Kg·m/89 lb in)
3. Install exhaust gas recirculation valve assembly and tighten bolt and nut to the specified torque.

   Torque : 25 N·m (2.5 Kg·m/18 lb ft)
4. Install throttle body and tighten bolts to the specified torque.

   Torque : 25 N·m (2.5 Kg·m/18 lb ft)
5. Install ventilating hose to throttle valve and intake duct.
6. Connect vacuum hoses on canister VSV and positive crankcase ventilation hose. Tighten bolts for fuel rail assembly with pressure control valve bracket.

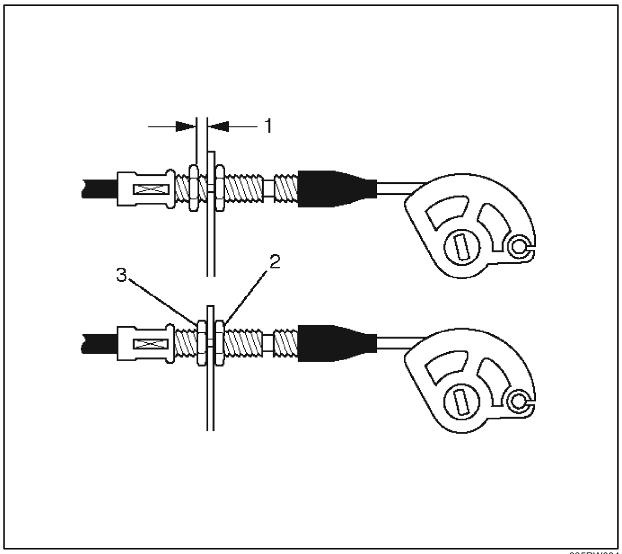
   Torque : 25 N·m (2.5 Kg·m/18 lb ft)
7. Connect each connector without fail.
8. Connect vacuum booster hose.
9. Connect accelerator pedal cable.

   Accelerator pedal cable adjustment

   1. Loosen the adjusting nut and screw cap.
   2. Pull outer cable while fully closing the throttle valve.

3. Tighten adjusting nut and lock nut temporarily.
4. Loosen adjusting nut by three turns and tighten lock nut.

   Then manually operating the throttle valve, make sure that the valve lever returns up to the stopper screw.
   If it does not reach the stopper screw, repeat from step 1.

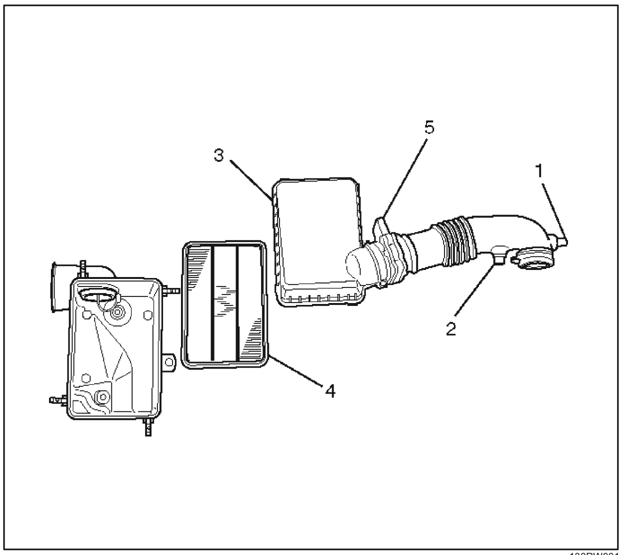


035RW004

Legend

(1) Clearance
(2) Lock Nut
(3) Adjusting Nut

10. Install air cleaner duct assembly.



130RW001

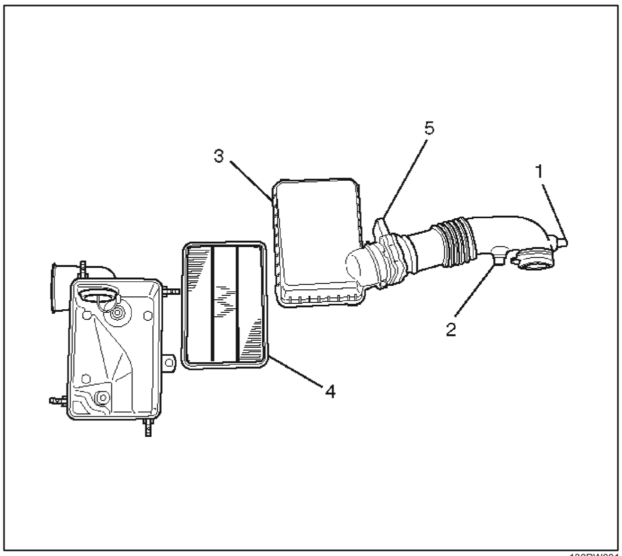
Legend

(1) Positive Crankcase Ventilation Hose Connector
(2) Intake Air Temperature Sensor
(3) Air Cleaner Duct Assembly
(4) Air Cleaner Element.
(5) Mass Air Flow Sensor

Exhaust Manifold LH

Removal

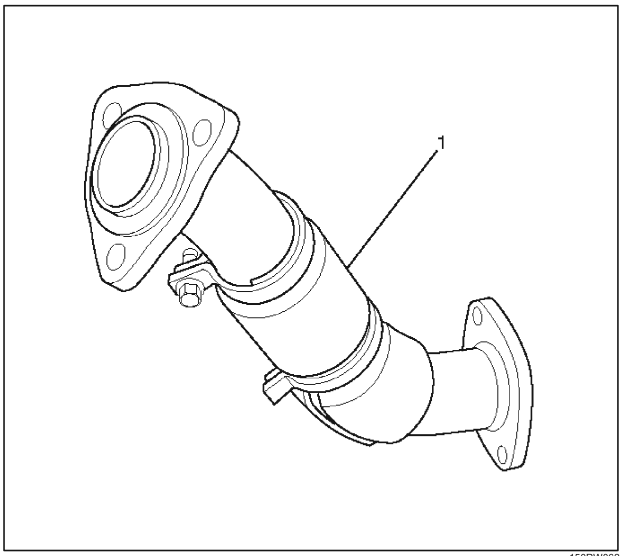
1. Disconnect battery ground cable.
2. Remove air cleaner duct assembly.



Legend

(1) Positive Crankcase Ventilation Hose Connector
(2) Intake Air Temperature Sensor
(3) Air Cleaner Duct Assembly
(4) Air Cleaner Element
(5) Mass Air Flow Sensor

3. Remove exhaust front pipe three stud nuts from exhaust side and two nuts from rear end of exhaust front pipe.



Legend

(1) Exhaust Front Pipe LH

4. Remove heat protector two fixing bolts then the heat protector.
5. 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.
6. Remove exhaust manifold eight fixing nuts and remove exhaust manifold from the engine.

Installation

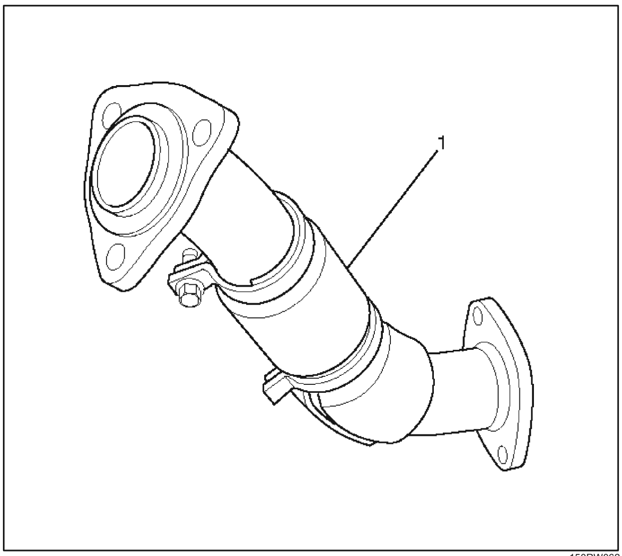
1. Install exhaust manifold and tighten exhaust manifold fixing nuts to the specified torque with new nuts.

   Torque: 57 N·m (5.8 Kg·m/42 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)



Legend

(1) Exhaust Front Pipe LH

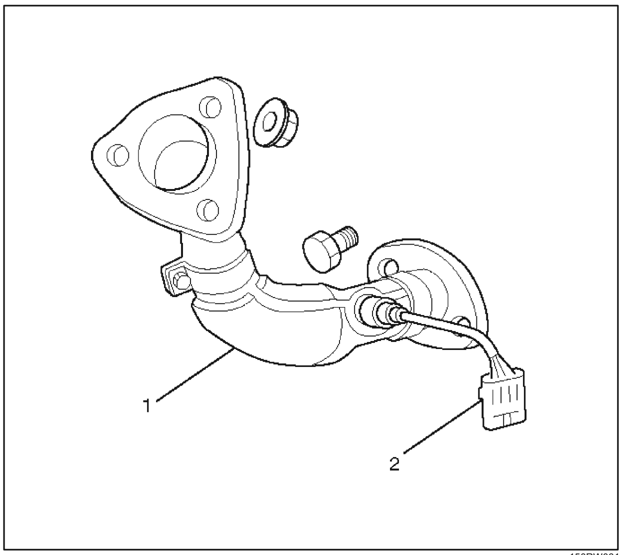
4. Set A/C compressor to normal position and tighten two bolts and a bolt to the specified torque.

   Torque : 40 N·m (4.1 Kg·m/30 lb ft)
5. Install air cleaner duct assembly.

Exhaust Manifold RH

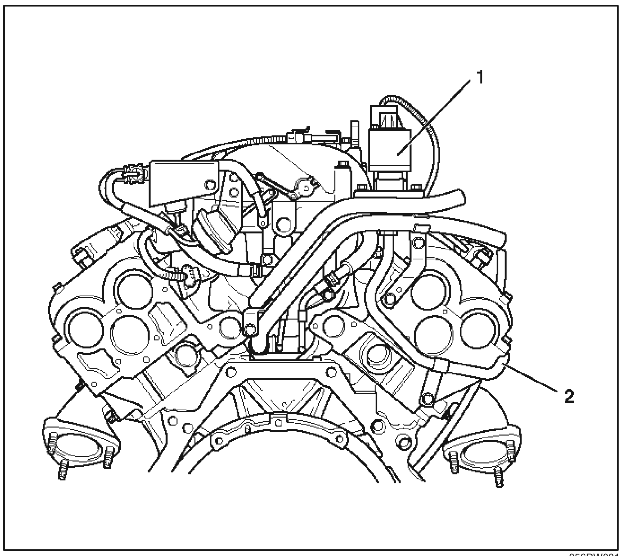
Removal

1. Disconnect battery ground cable.
2. Remove torsion bar. Refer to removal procedure in Front Suspension section.
3. Remove exhaust front pipe three stud nuts and two nuts then disconnect exhaust front pipe.



Legend
(1) Exhaust Front Pipe RH
(2) O_2 Sensor (for IGM)

4. Remove heat protector two fixing bolts then the heat protector.
5. Remove exhaust gas recirculation (EGR) pipe fixing bolt and nut from exhaust manifold, remove a nut from EGR valve and a bolt from rear side of cylinder head for bracket of EGR pipe then remove the EGR pipe.



Legend
(1) Exhaust Gas Recirculation (EGR) Valve
(2) 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 : 57 N·m (5.8 Kg·m/42 lb ft)
2. Install the EGR pipe, tighten bolt and nut on exhaust manifold to specified torque.

   Torque : 28 N·m (2.9 Kg·m/21 lb ft)

   Tighten nut to EGR valve to the specified torque.

   Torque : 44 N·m (4.5 Kg·m/33 lb ft)

   Tighten the bolt for EGR pipe bracket to specified torque.

   Torque : 25 N·m (2.5 Kg·m/18 lb ft)
3. Install heat protector
4. Install exhaust front pipe and tighten three stud nuts and two nuts to the specified torque.

   Torque:

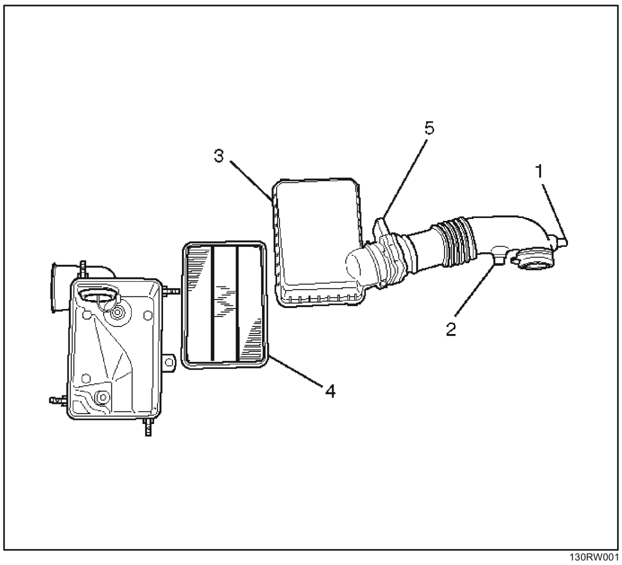
   Stud nuts: 67 N·m (6.8 Kg·m/49 lb ft)

   Nuts: 43 N·m (4.4 Kg·m/32 lb ft)
5. Install the torsion bar and readjust the vehicle height. Refer to installation and vehicle height adjustment procedure for Front Suspension.

Crankshaft Pulley

Removal

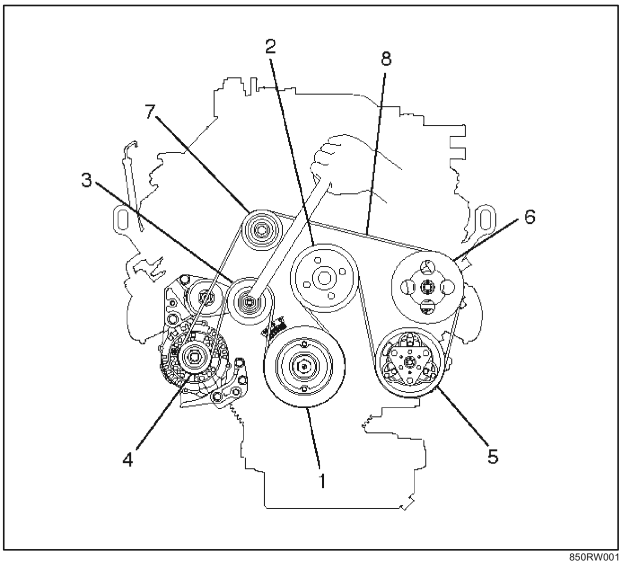
1. Disconnect battery ground cable.
2. Remove air cleaner assembly.



Legend

(1) Positive Crankcase Ventilation Hose Connector
(2) Intake Air Temperature Sensor
(3) Air Cleaner Duct Assembly
(4) Air Cleaner Element
(5) Mass Air Flow Sensor

3. Remove radiator upper fan shroud from radiator.
4. Move serpentine belt tensioner to loose side using wrench then remove serpentine belt.



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 J-8614-01 crankshaft holder, hold crankshaft pulley then remove center bolt and pulley.

Installation

1. Install crankshaft pulley using J-8614-01 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 : 22 N·m (2.2 Kg·m/16 lb ft) for fan pulley and fan bracket.

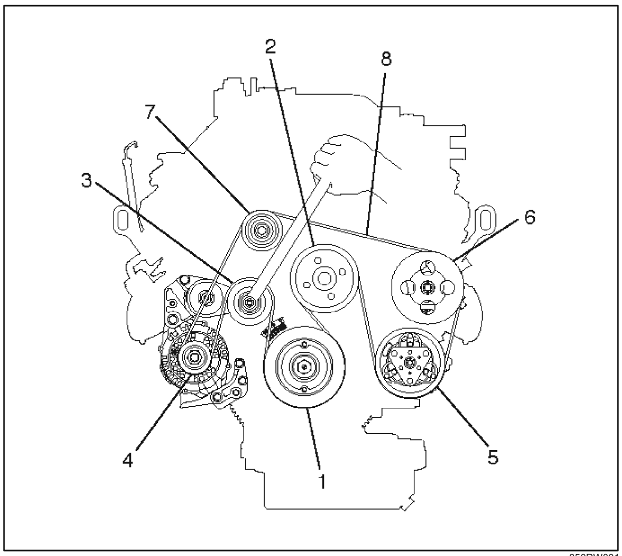
   Torque : 10 N·m (1.0 Kg·m/88.5 lb in) for fan and clutch assembly.

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.



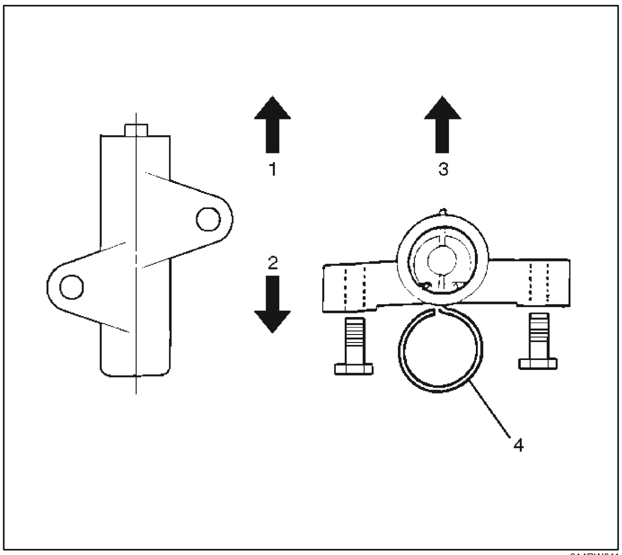
850RW001

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

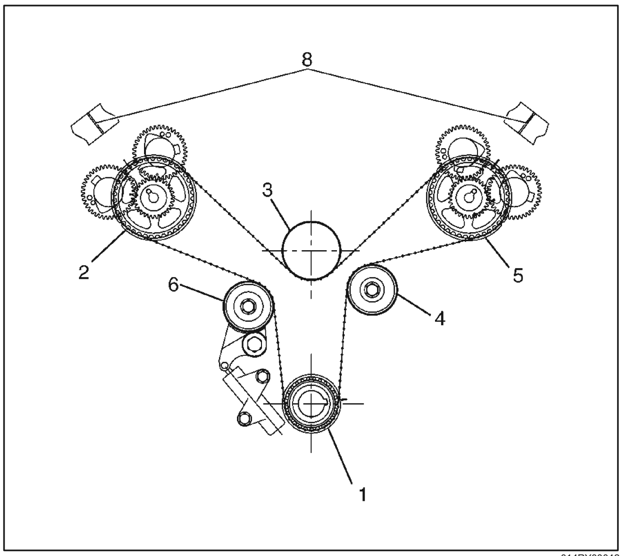
14. Remove timing belt.

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.**

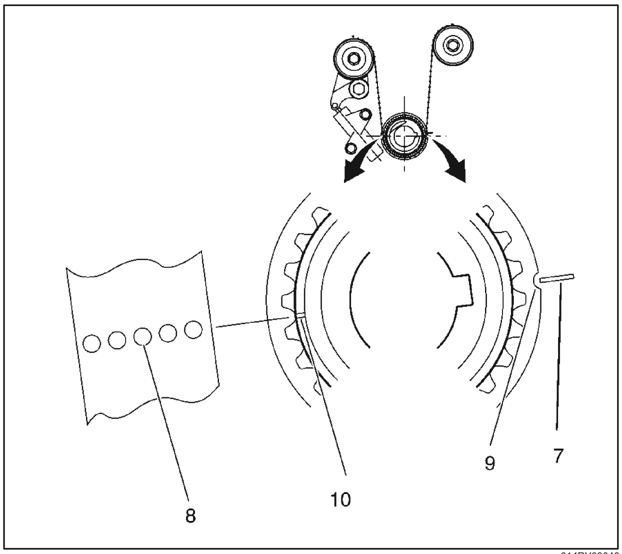
Installation

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



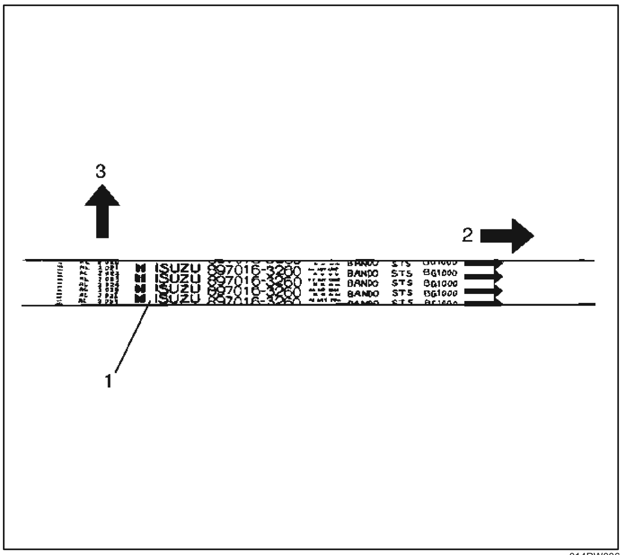
014RY00042

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.

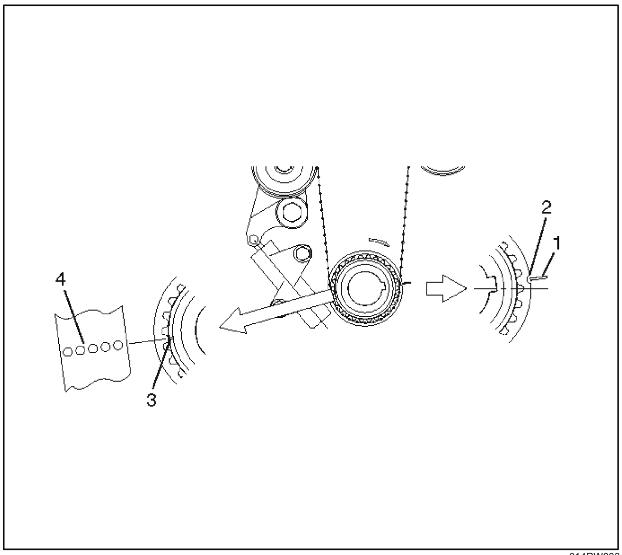


014RW006

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.

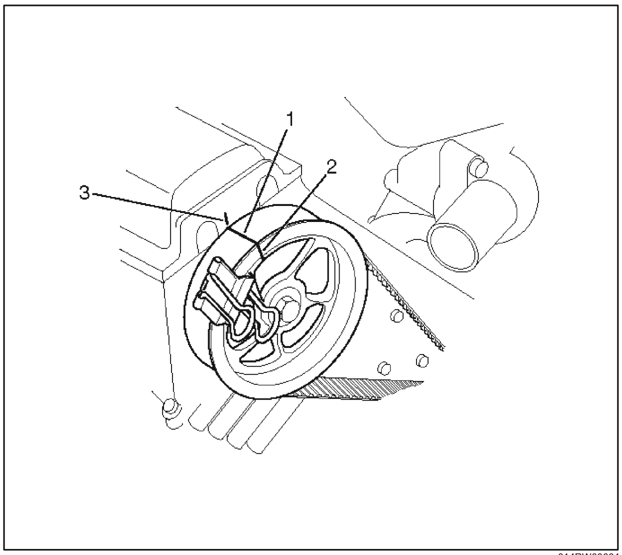


014RW003

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.



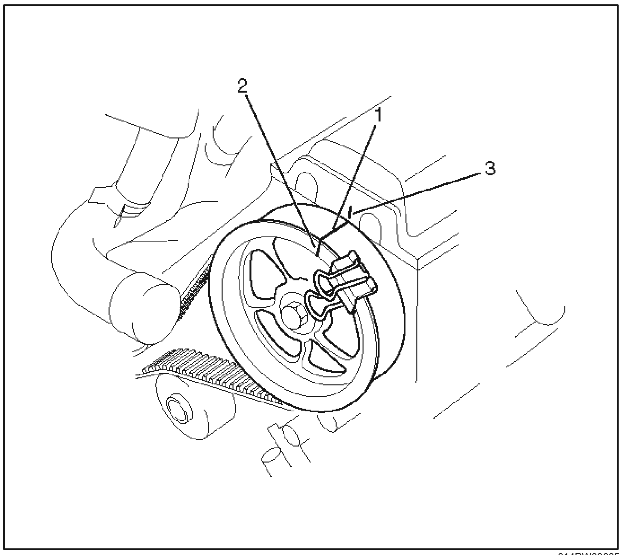
Legend

(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.



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).

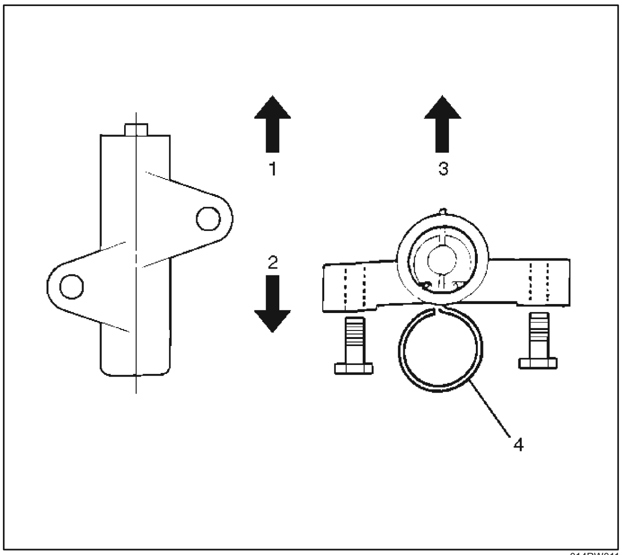
   Turn the crankshaft pulley clockwise to give some belt slack between the crankshaft timing pulley and the RH bank camshaft drive gear pulley.

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).

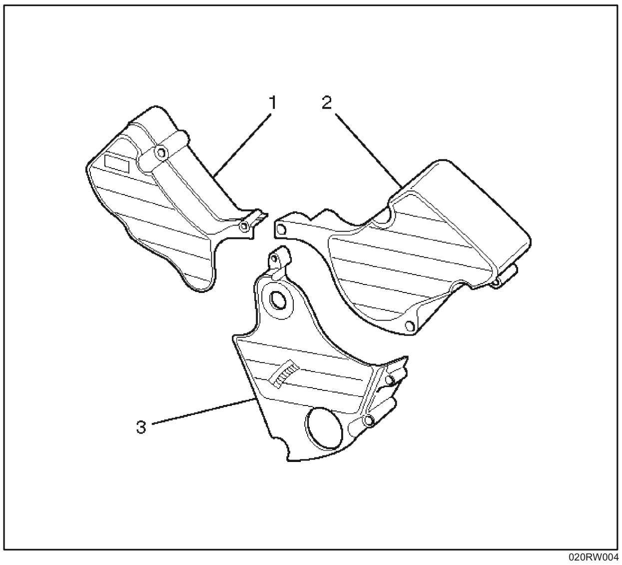


Legend

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

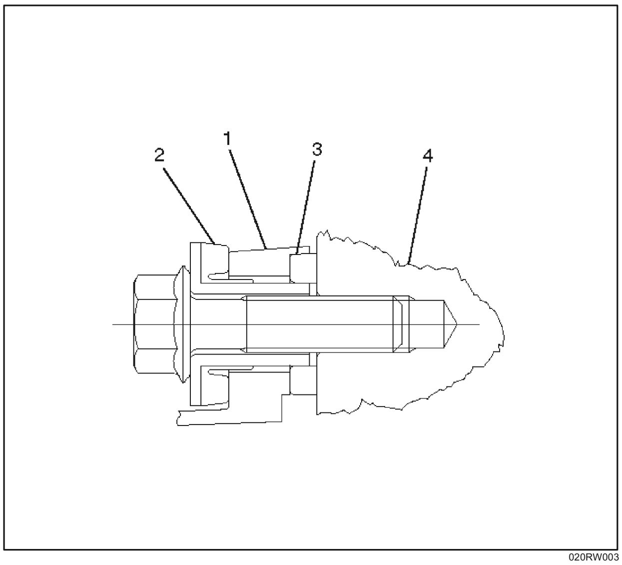
3. Remove double clips or equivalent clips, from timing belt pulleys.
   Turn the crankshaft pulley clockwise by two turns.
3. Install timing belt cover.
   Remove crankshaft pulley that was installed in step 1 item 5.
   Tighten bolts to the specified torque.

Torque: 19 N·m (1.9 Kg·m/14 lb ft)



Legend

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



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 : 22 N·m (2.2 Kg·m/16 lb ft)

6. Install power steering pump assembly and tighten to the specified torque.

Torque :

M8 bolt : 22 N·m (2.2 Kg·m/16 lb ft)

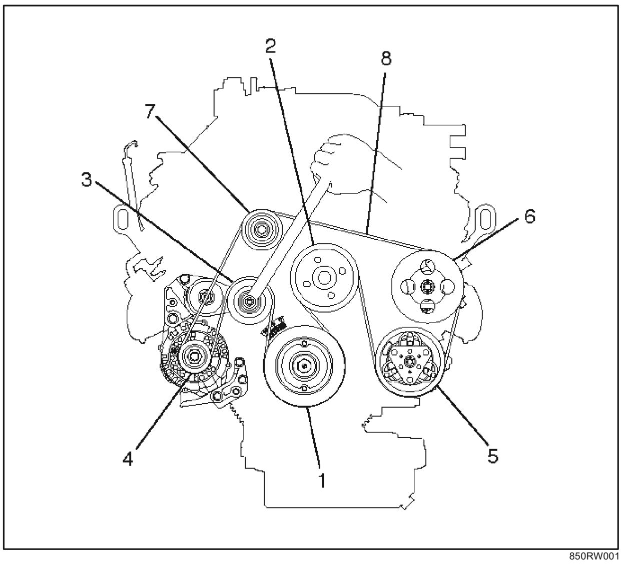
M10 bolt : 46 N·m (4.7 Kg·m/34 lb ft)

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

Torque : 22 N·m (2.2 Kg·m/16 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.

8. Move drive belt tensioner to loose side using wrench, then install drive belt to normal position.



Legend

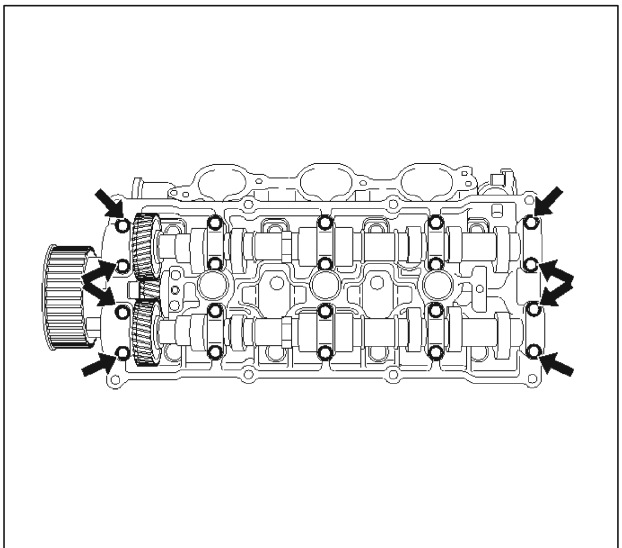
(1) Crankshaft Pulley
(2) Cooling Fan Pulley
(3) Auto Tensioner
(4) Generator
(5) Air Conditioner Compressor
(6) Power Steering Oil Pump
(7) Idle Pulley
(8) Drive Belt

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

Camshaft

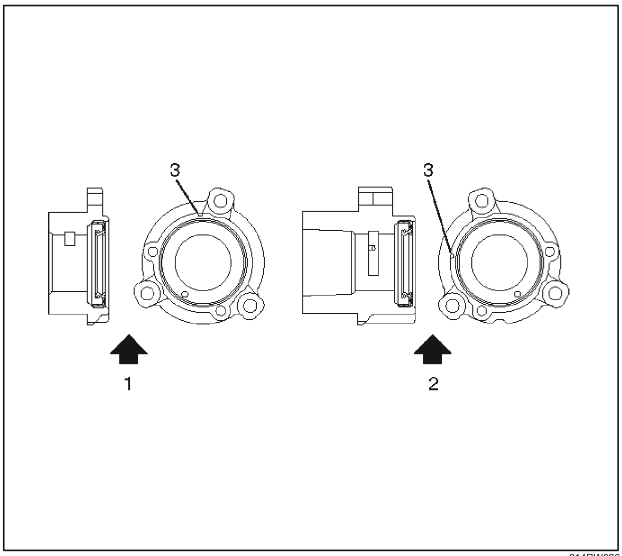
Removal

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

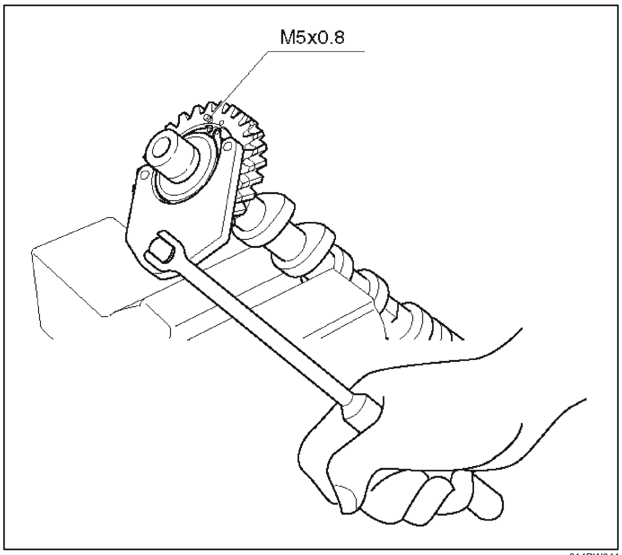
1. Install camshaft drive gear assembly and tighten three bolts to the specified torque.

   Torque : 10 N·m (1.0 Kg·m/89 lb in)

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

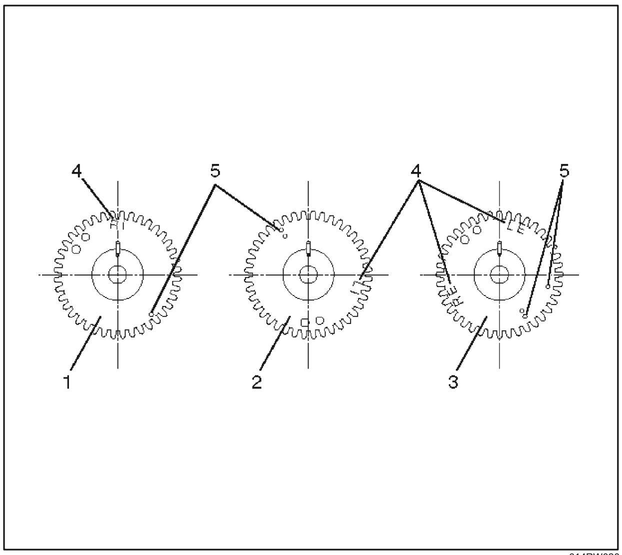
   Torque : 98 N·m (10.0 Kg·m/72 lb ft)

3. Tighten sub gear setting bolt.
   1. Use the 5–8840–2443–0 gear spring lever 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.



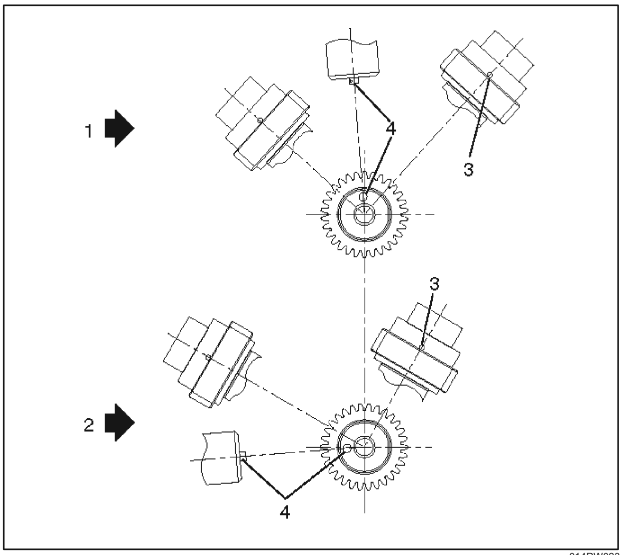
014RW041

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).



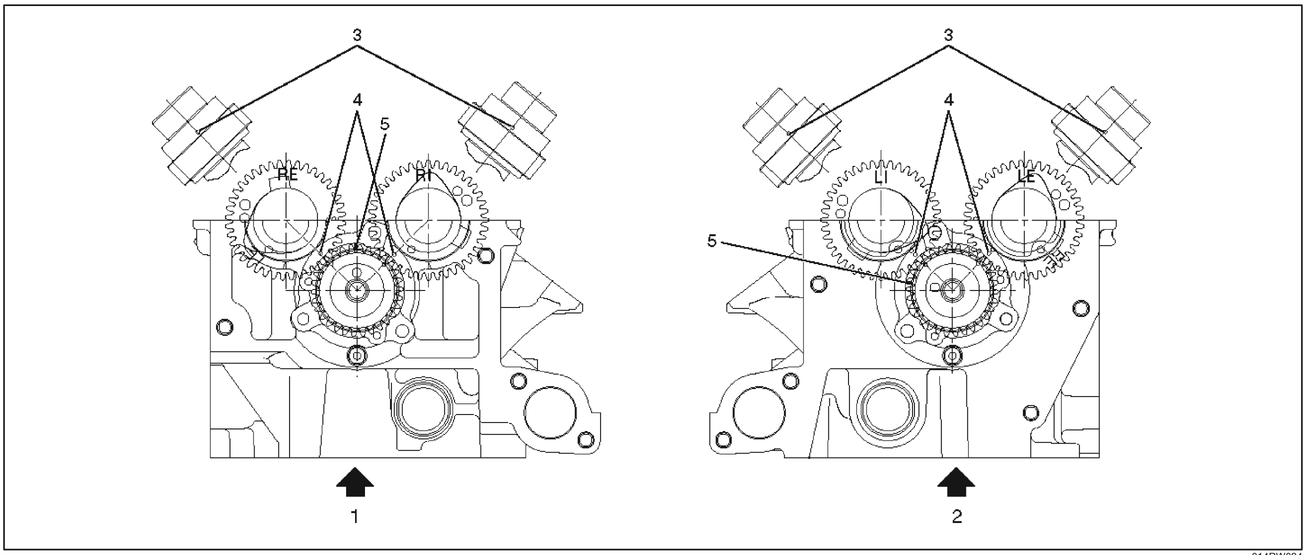
014RW020

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

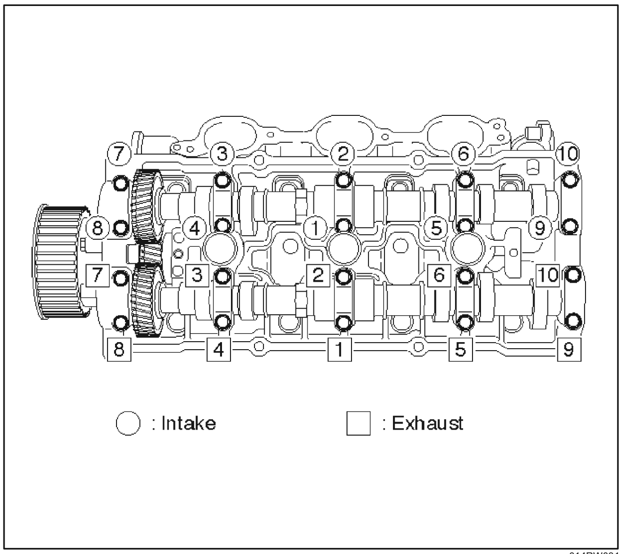


Legend

(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/89 lb in)



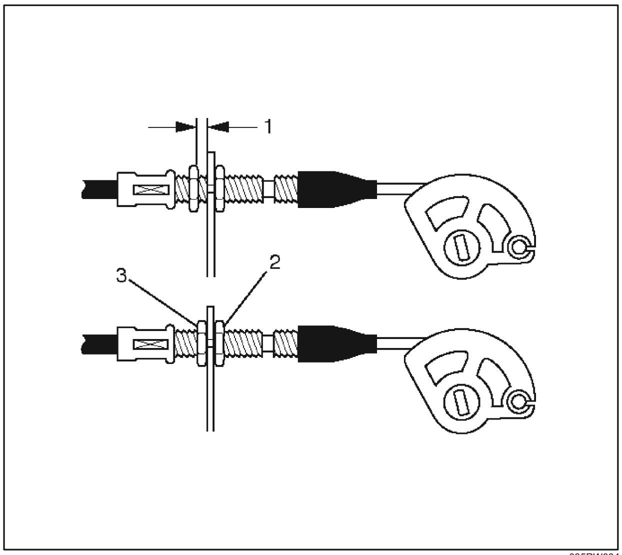
5. Install cylinder head cover RH.
   - Refer to installation procedure for CYLINDER HEAD COVER RH in this manual.
6. Install cylinder head cover LH.
   - Refer to installation procedure for CYLINDER HEAD COVER LH in this manual.
7. Install timing belt.
   - Refer to installation procedure for TIMING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

Accelerator pedal cable adjustment

1. Loosen adjusting nut and lock nut.
2. Pull outer cable while closing fully the throttle valve.
3. Tighten adjusting nut and lock nut temporarily.

4. Loosen adjusting nut by three turns and tighten lock nut.

   Then, manually operating the throttle valve, make sure that the valve lever returns up to the stopper screw.
   If it does not reach the stopper screw, repeat from step 1.

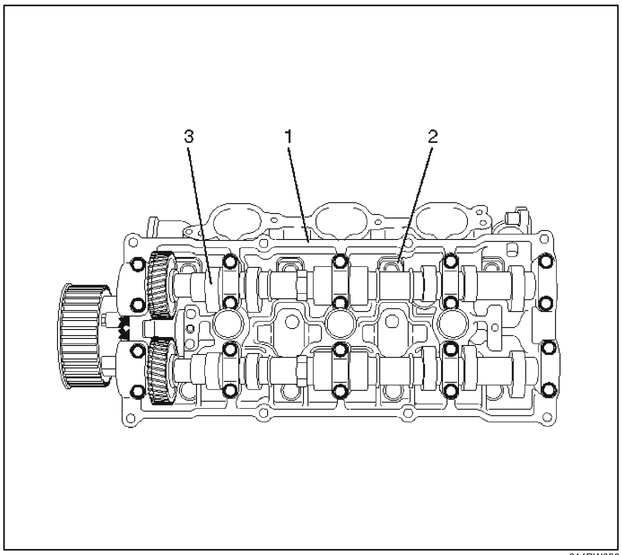


Legend
(1) Clearance
(2) Lock Nut
(3) Adjusting Nut

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

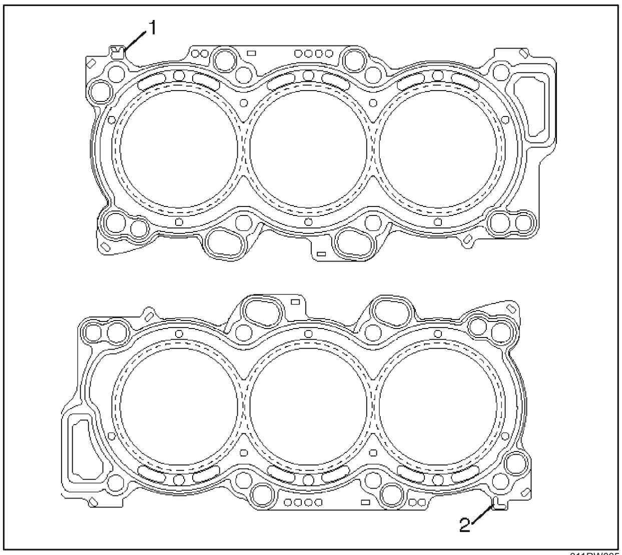
(1) Cylinder Head
(2) Cylinder Head Bolt
(3) Camshaft

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.

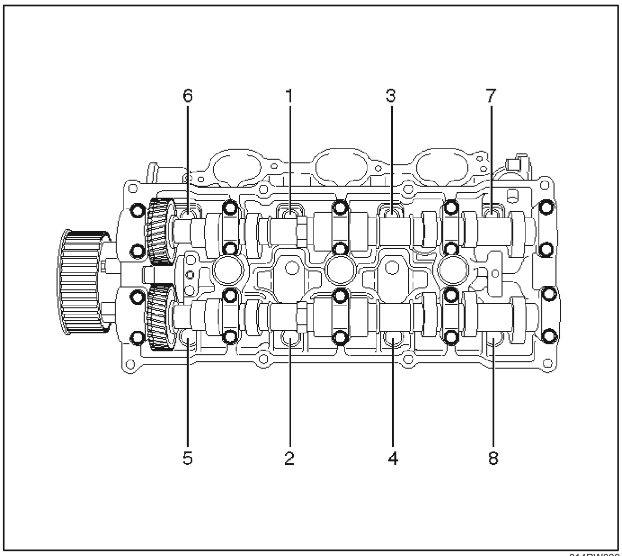
NOTE: Do not reuse cylinder head bolts.

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)



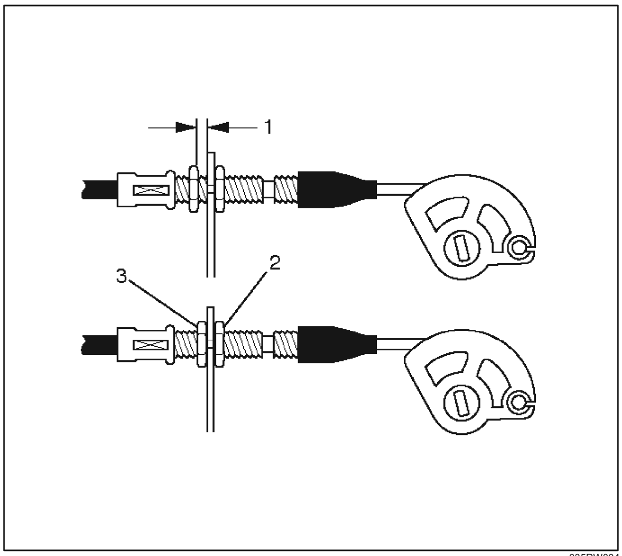
014RW029

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.

Accelerator pedal cable adjustment

1. Loosen adjusting nut and lock nut.
2. Pull outer cable while closing fully the throttle valve.
3. Tighten adjusting nut and lock nut temporarily.
4. Loosen adjusting nut by three turns and tighten lock nut.

   Then, manually operating the throttle valve, make sure that the valve lever returns up to the stopper screw.
   If it does not reach the stopper screw, repeat from step 1.



035RW004

Legend

(1) Clearance
(2) Lock Nut
(3) Adjusting Nut

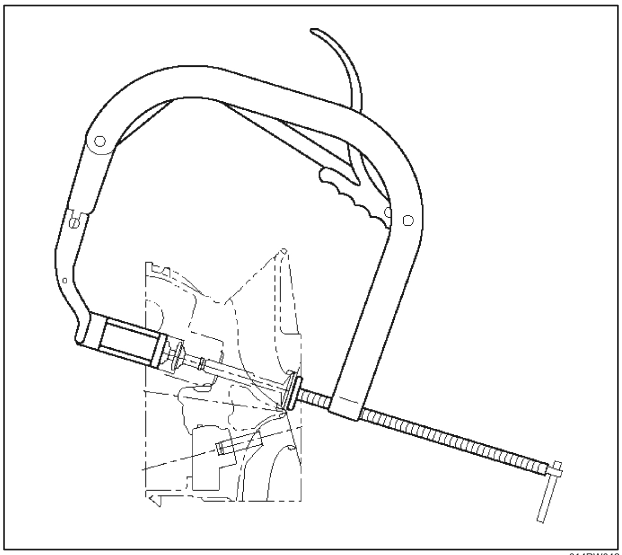
Valve Stem Oil Controller , Valve Spring and Valve Guide

Removal

1. Disconnect battery ground cable.
2. Drain engine oil.
   - 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.

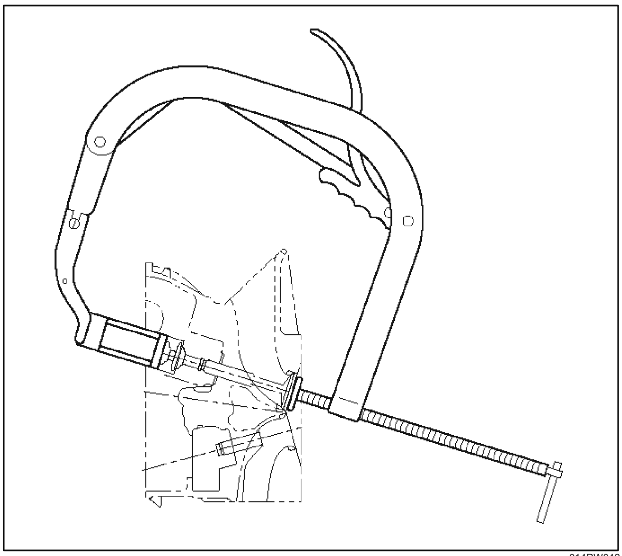


014RW042

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 5–8840–2446–0 valve spring compressor and 5–8840–2547–0 valve spring compressor adapter to install the split collars.

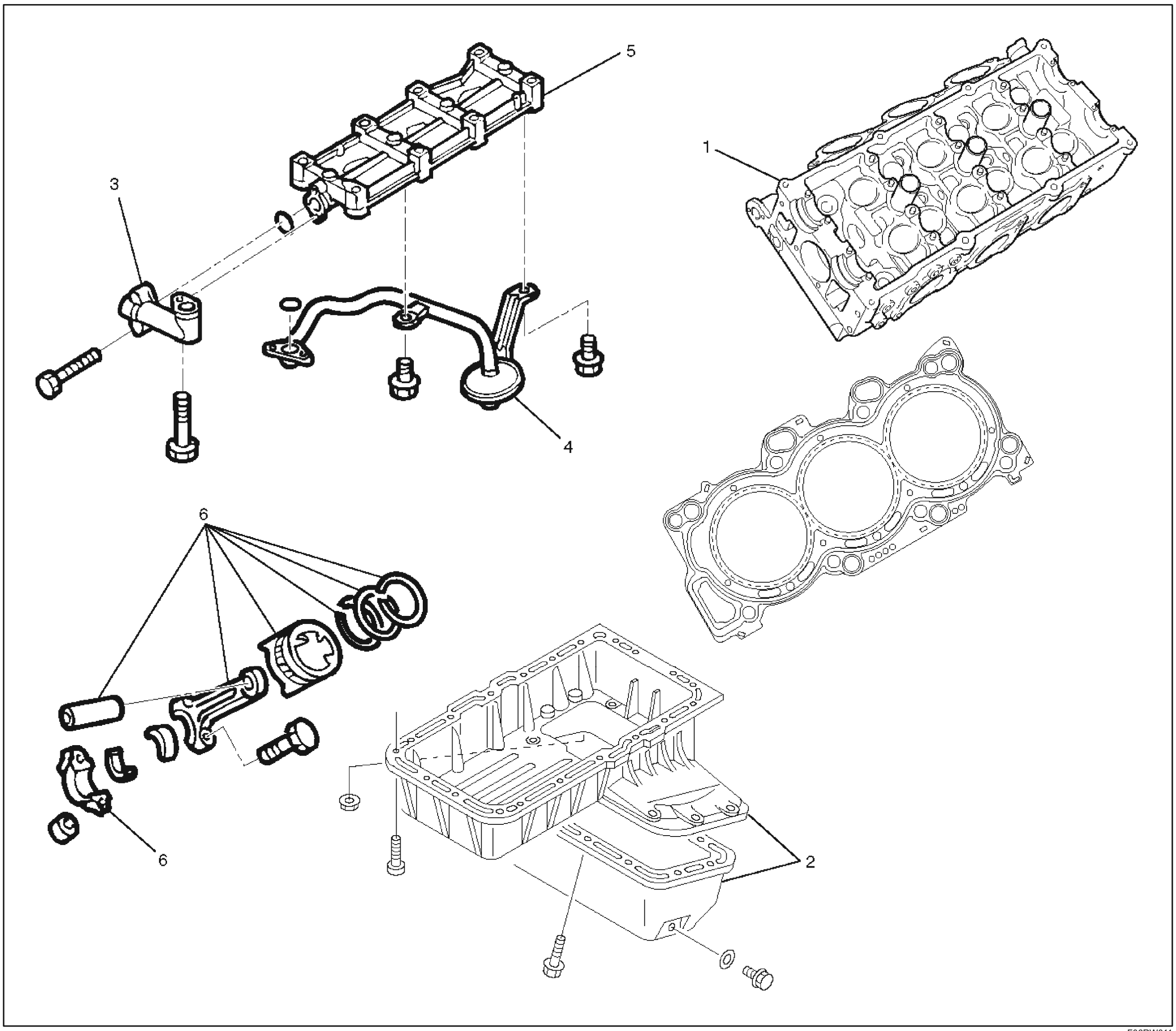


014RW042

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



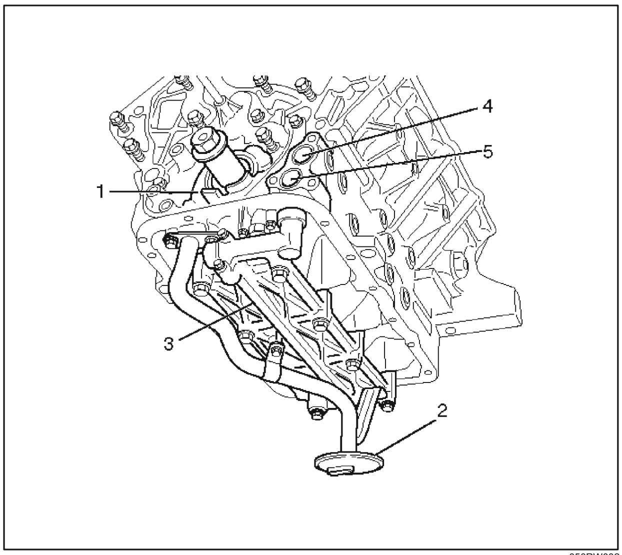
F06RW011

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.

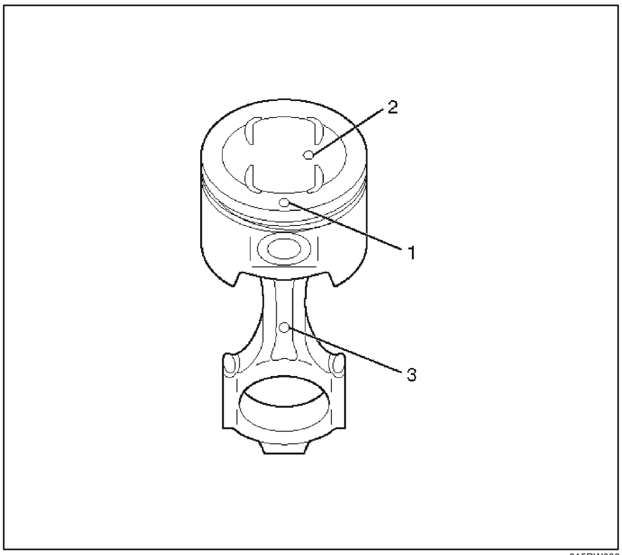
Installation

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

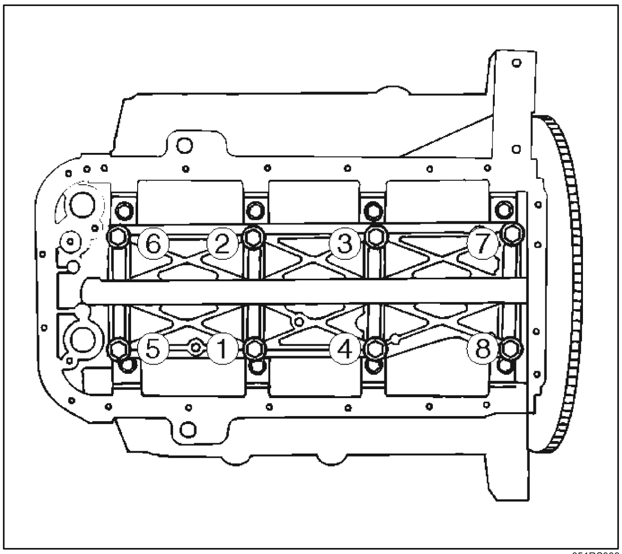
(1) Piston Front Mark
(2) Piston Grade
(3) Connecting Rod Front Mark

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/89 lb in)

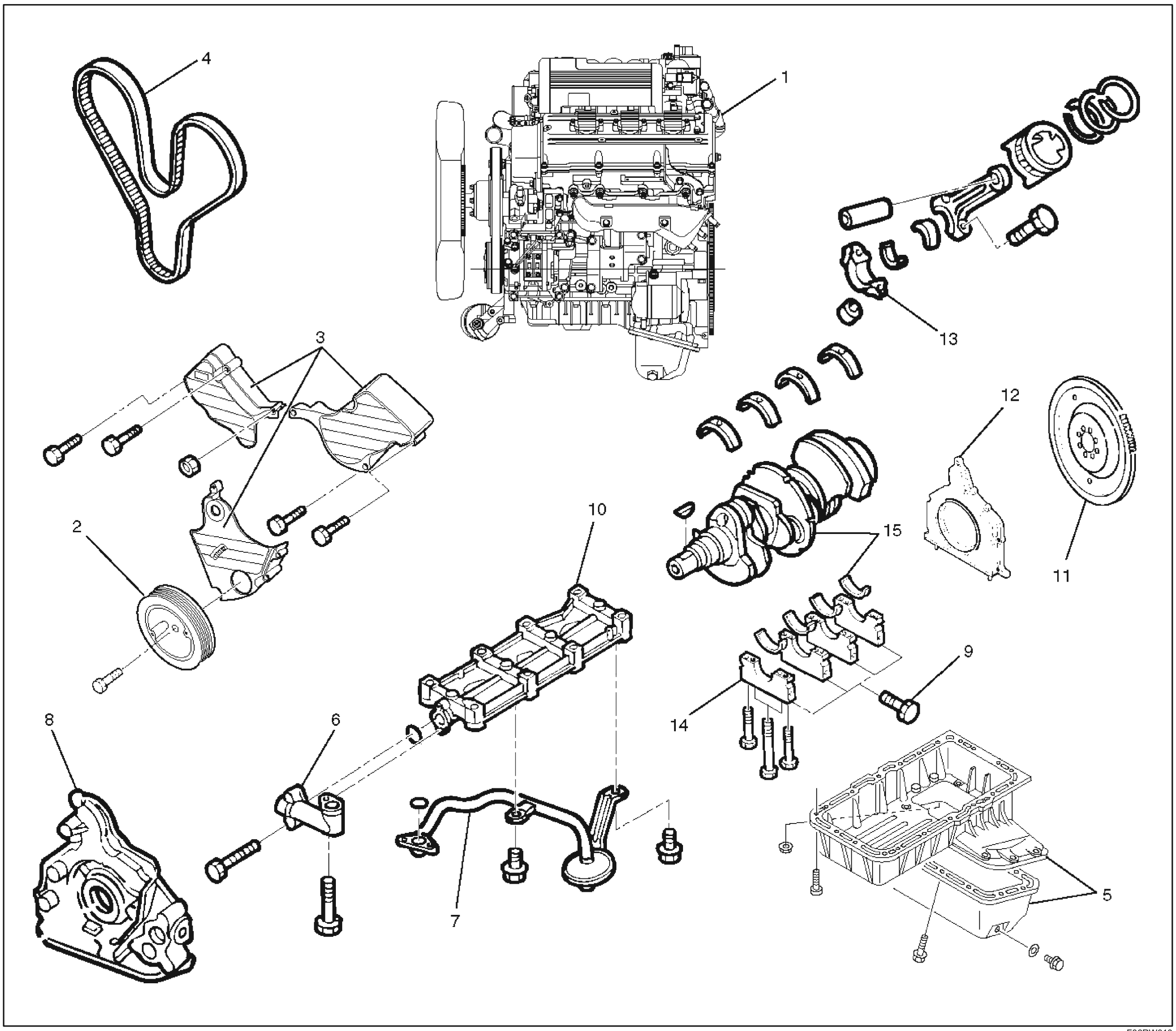
4. Install oil strainer assembly with O-ring.

   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



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.

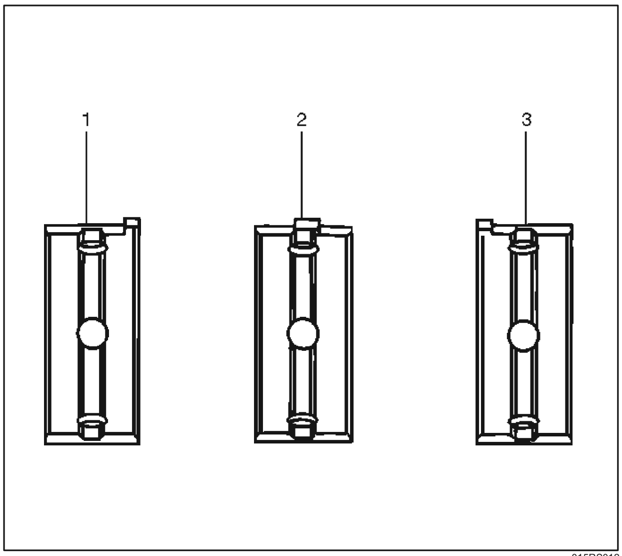
6. Remove oil pump assembly.
   - Refer to removal procedure for Oil Pump in this manual.
7. Remove cylinder body side bolts.
8. Remove oil gallery.
9. Remove flywheel.
10. Remove rear oil seal retainer.
    - Refer to removal procedure for Rear Oil Seal in this manual.
11. Remove connecting rod caps.
12. Remove crankshaft main bearing caps.
13. Remove crankshaft and main bearings.

Installation

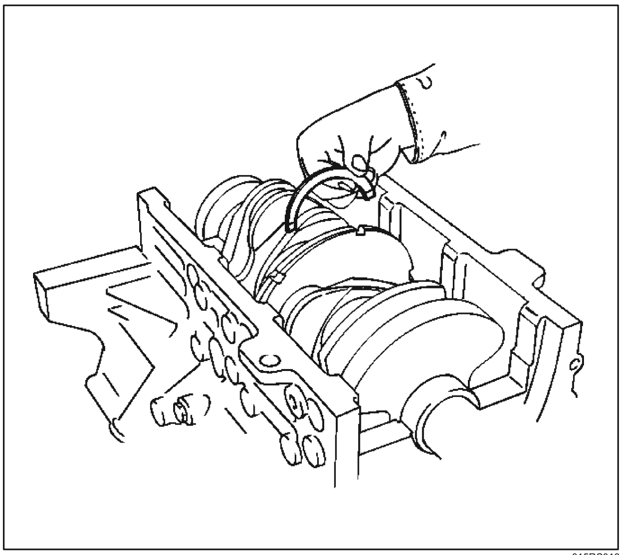
1. Install crankshaft and main bearings.
   - Install main bearing in the cylinder block and main bearing cap respectively.
     Apply new engine oil to upper and lower main bearings.

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.

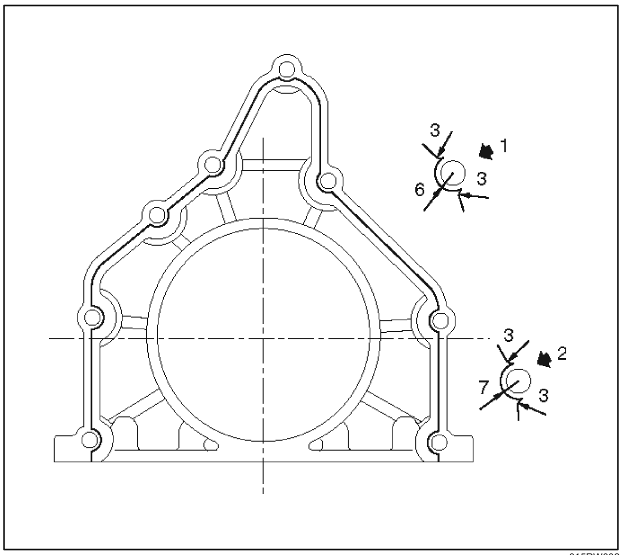
3. Install connecting rod caps.
   - The cap number must be same as connecting rod number.
   - Apply engine oil to the thread and seating surface of each nut.
   - Tighten nuts to the specified torque.

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 before the sealant hardens.



015RW002

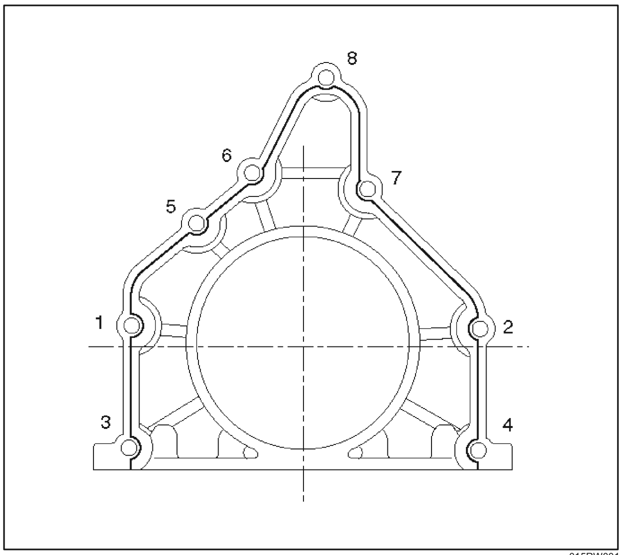
Legend

(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 : 18 N·m (1.8 Kg·m/13 lb ft)



015RW001

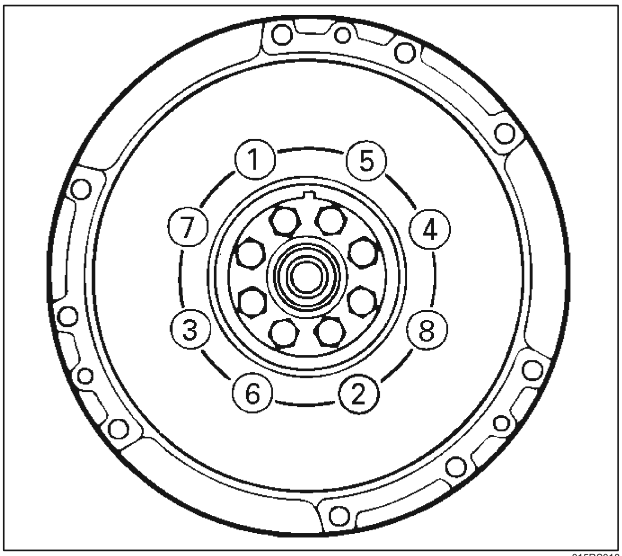
5. Install flywheel.
   - Clean tapped holes in the crankshaft.
   - Remove oil on crankshaft and flywheel fitting surface.

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 in illustration.

Torque :

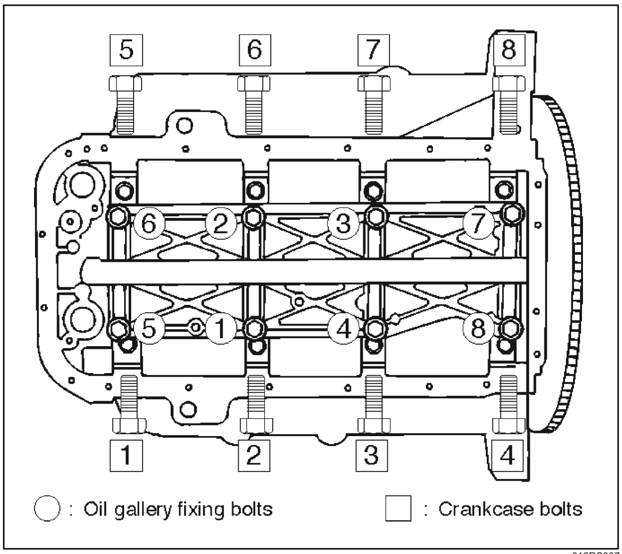
1st step : 29 N·m (3.0 Kg·m/21 lb ft)

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.

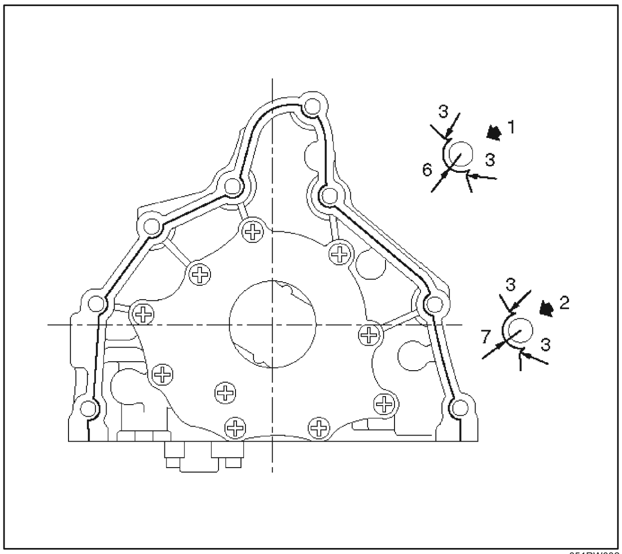


012RS007

8. Install oil pump assembly.
   - Remove oil on cylinder block and oil pump mounting surface.

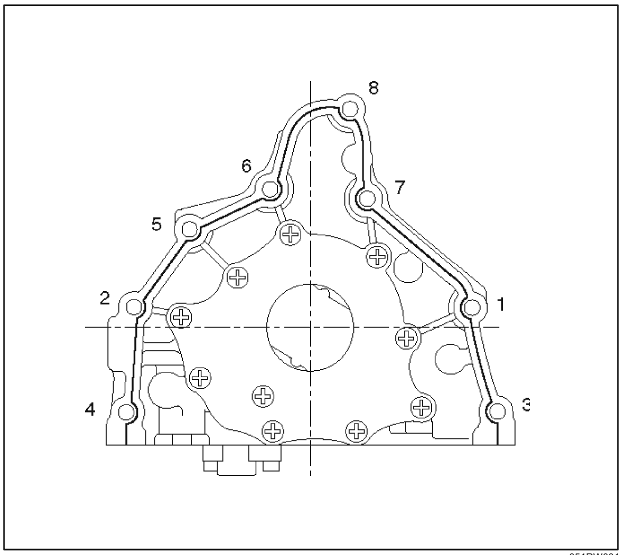
- Apply sealant (TB1207B or equivalent) to the oil pump mounting surface.
- The oil pump assembly must be installed within 5 minutes after sealant application before the sealant hardens.
- Apply engine oil to oil seal lip.
- Install oil pump in the cylinder block and tighten fixing bolts to the specified 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.

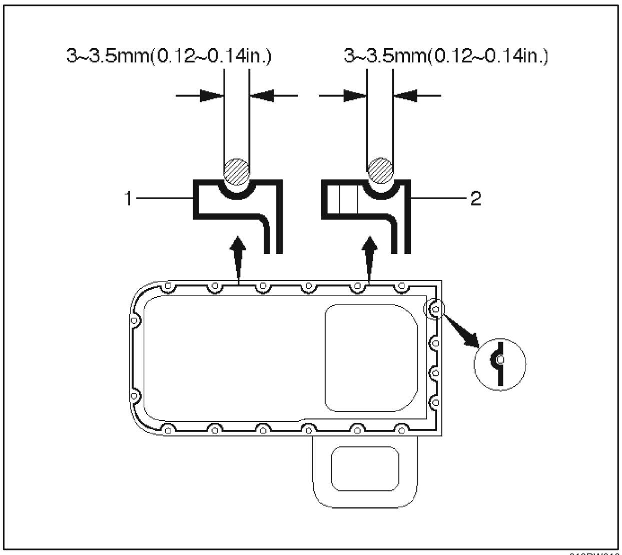
Torque : 25 N·m (2.5 Kg·m/18 lb ft)

10. Install oil pipe with O-ring, tighten fixing bolts to the specified torque.

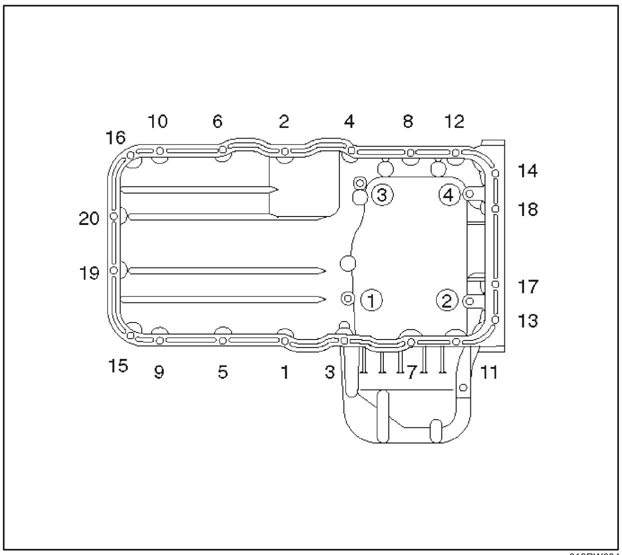
Torque : 25 N·m (2.5 Kg·m/18 lb ft)

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 before the sealant hardens.
    - Tighten fixing bolts to the specified torque.

Torque : 10 N·m (1.0 Kg·m/89 lb in)



013RW010

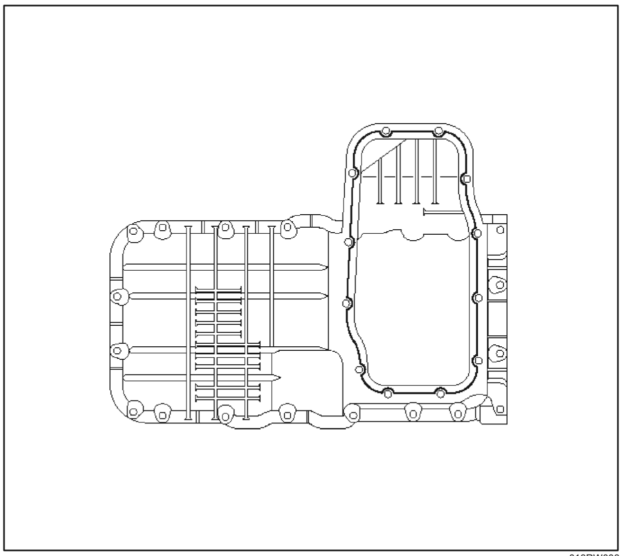


013RW004

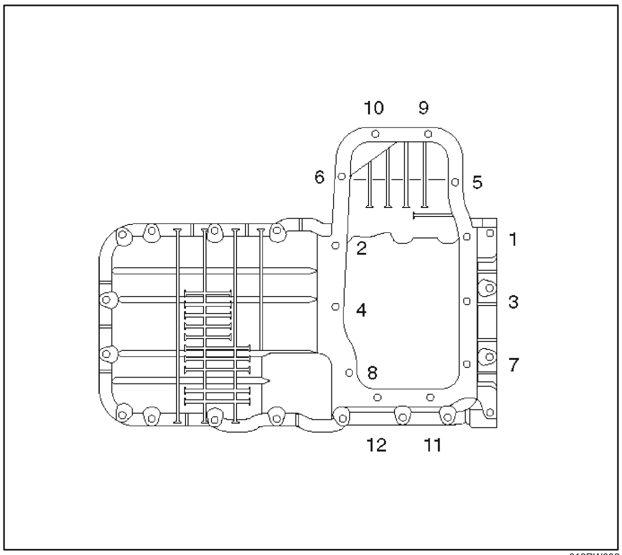
12. Install oil pan
    - Remove oil on oil pan mounting surface and dry the surface.
    - Properly apply a 4.5 mm (0.7 in) wide bead of sealant (TB1207C or equivalent) to the oil pan mounting surface. The bead must be continuous.
    - The oil pan must be installed within 5 minutes after sealant application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

Rear Oil Seal

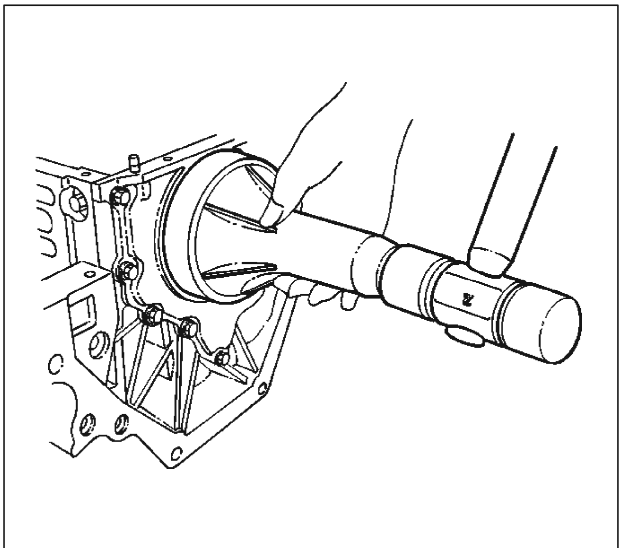
Removal

1. Remove transmission assembly.
   - Refer to removal procedure for 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.

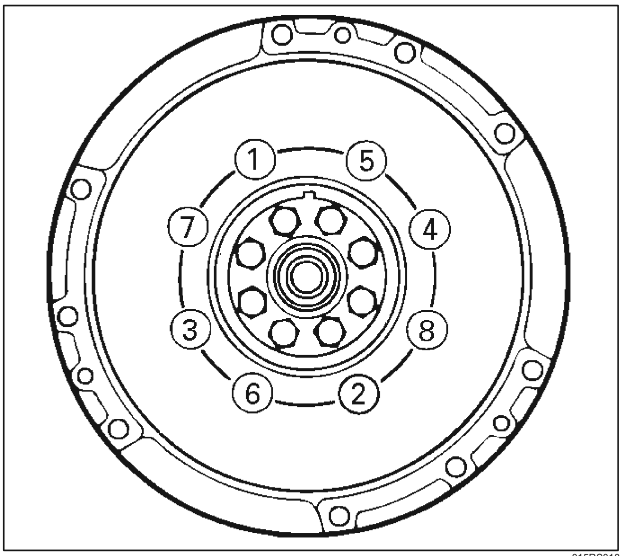


015RS017

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.

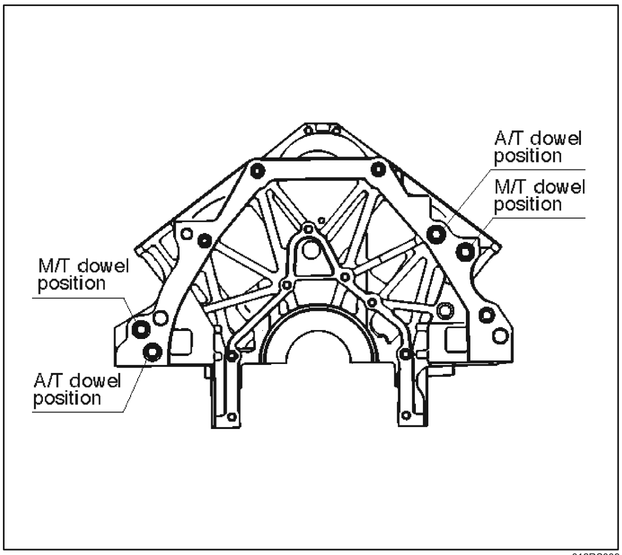
Torque : 54 N·m (5.5 Kg·m/40 lb ft)



015RS018

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

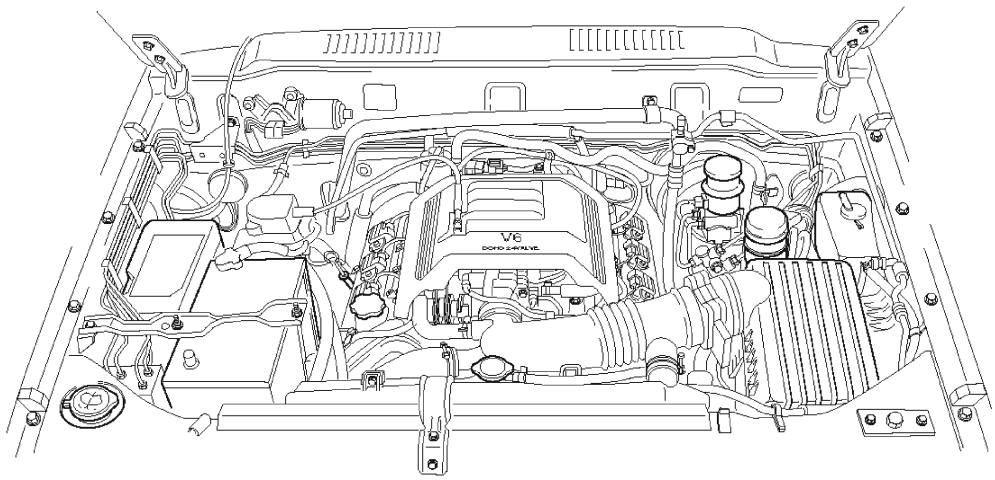
CAUTION: When assembling the engine and transmission, confirm that dowels have been mounted in the specified positions at the engine side. Take care that dowel positions are different between the manual transmission and the automatic transmission.
Otherwise, the transmission may be damaged.



012RS009

Engine Assembly

Removal



035RW027

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. Disconnect air duct with air cleaner cover.
8. Remove air cleaner assembly.
9. Disconnect canister vacuum hose.
10. Disconnect vacuum booster hose.
11. Disconnect three engine harness connectors.
12. 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.
13. Disconnect ground cable between engine and frame.
14. Disconnect bonding cable connector on the back of right dash panel.
15. Disconnect bonding cable terminal on the left bank.
16. Disconnect starter harness connector from starter.
17. Disconnect generator harness connector from generator.
18. Disconnect coolant reserve tank hose from radiator.
19. Remove radiator upper and lower hoses.
20. Remove upper fan shroud.
21. Remove cooling fan assembly four fixing nuts, then the cooling fan assembly.
22. Move drive belt tensioner to loose side using wrench then remove drive belt.
23. Remove power steering pump fixing bolts, then power steering pump. Place the power steering pump along with piping on the body side.
24. Remove air conditioning compressor fixing bolts from bracket and place the compressor along with piping on the body side.
25. Remove O_2 sensor harness connectors from exhaust front pipe.
26. Remove three exhaust pipe fixing nuts from each bank.
27. Remove two exhaust pipe fixing nuts from each exhaust pipe, then move exhaust pipe to rear side of vehicle.
28. Remove flywheel dust covers.
29. Disconnect two heater hoses from engine.
30. Disconnect fuel hoses from right side of transmission.

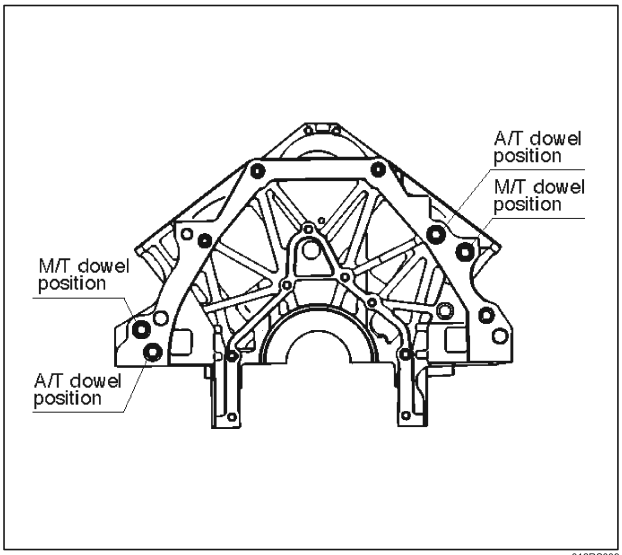
CAUTION: Plug fuel pipes on engine side and fuel hoses from fuel tank.

31. Remove transmission assembly. Refer to Transmission section in this manual.
32. Support the engine by engine hoist.
33. Remove two left side engine mount fixing bolts from engine mount on chassis side.
34. Remove two right side engine mount fixing bolts from engine mount on chassis side.
35. 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. Take care that dowel positions are different between the manual transmission and the automatic transmission.

If the engine is assembled in the condition that the dowels have not been mounted in the specified positions, the transmission may be damaged the transmission.



012RS009

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

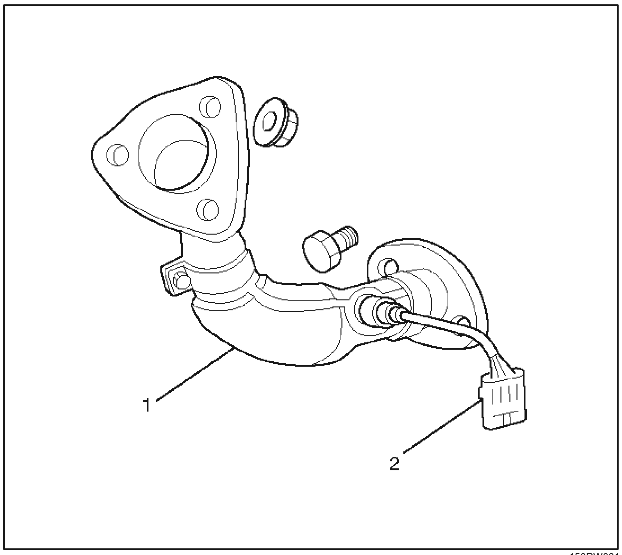
   Torque: 41 N·m (4.2 Kg·m/30 lb ft)

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 nuts to the specified torque.

   Torque:

   Nuts: 43 N·m (4.4 Kg·m/32 lb ft)

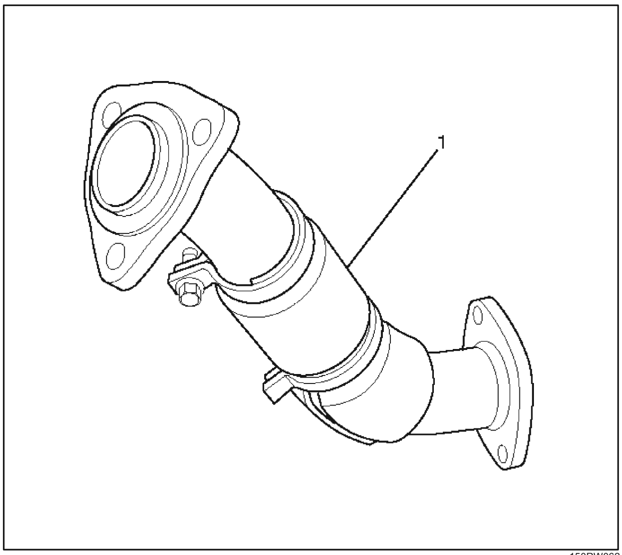
   Stud nuts: 67 N·m (6.8 Kg·m/49 lb ft)



150RW061

Legend

(1) Exhaust Front Pipe RH
(2) O_2 Sensor (for IGM)



150RW062

Legend

(1) Exhaust Front Pipe LH

7. Reconnect O_2 sensor connector.
8. Install cooling fan assembly and tighten bolts/nuts to the specified torque.

   Torque : 22 N·m (2.2 Kg·m/16 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.

9. Install air conditioner compressor to engine and tighten to the specified torque.

   Torque :

   M8 bolts : 22 N·m (2.2 Kg·m/16 lb ft)

   M10 bolts : 43 N·m (4.4 Kg·m/32 lb ft)

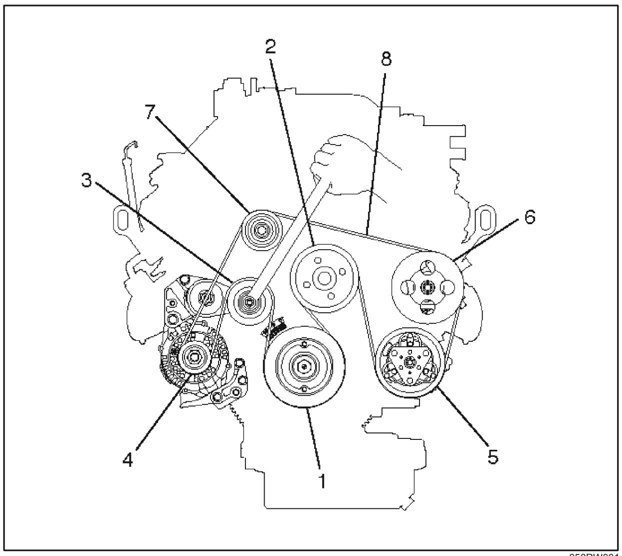
10. Install power steering pump, tighten fixing bolt to the specified torque.

    Torque :

    M8 bolts : 22N·m (2.2 Kg·m/16 lb ft)

    M10 bolts : 46 N·m (4.7 Kg·m/34 lb ft)

11. Move drive belt tensioner to loose side using wrench, then install drive belt to normal position.

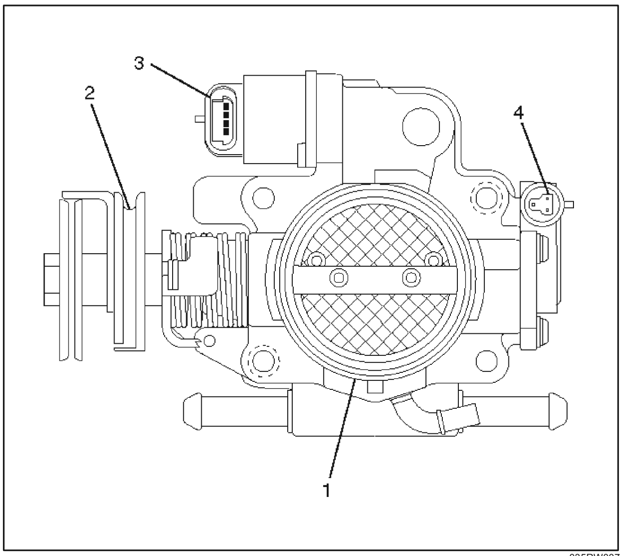


850RW001

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 and automatic cruise control cable to throttle valve on common chamber.



035RW007

Legend

(1) Throttle Valve Assembly
(2) Throttle Lever
(3) Idle Air Control Valve
(4) Throttle Position Sensor

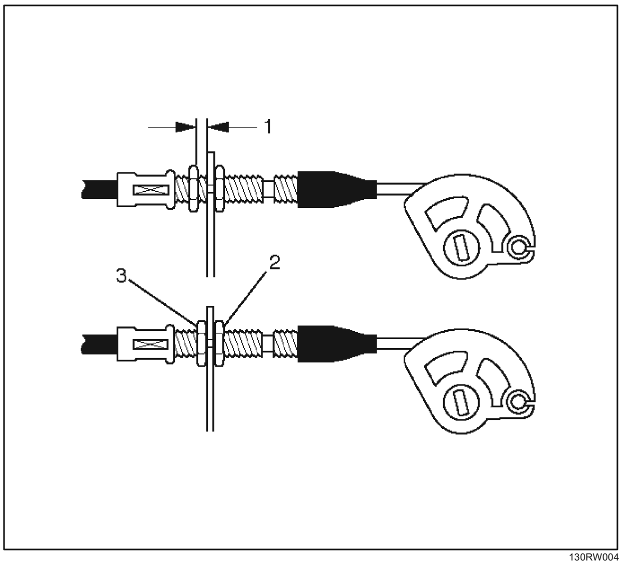
27. Install engine hood to the original position.
    - Refer to installation procedure for Body section in this manual.

    Accelerator pedal cable adjustment

    1. Loosen adjusting nut and lock nut.
    2. Pull outer cable while fully closing the throttle valve.
    3. Tighten adjusting nut and lock nut temporarily.
    4. Loosen adjusting nut by three turns and tighten lock nut.

       Then, manually operating the throttle valve, make sure that the valve lever returns up to the stopper screw.

If it does not reach the stopper screw, repeat from step 1.

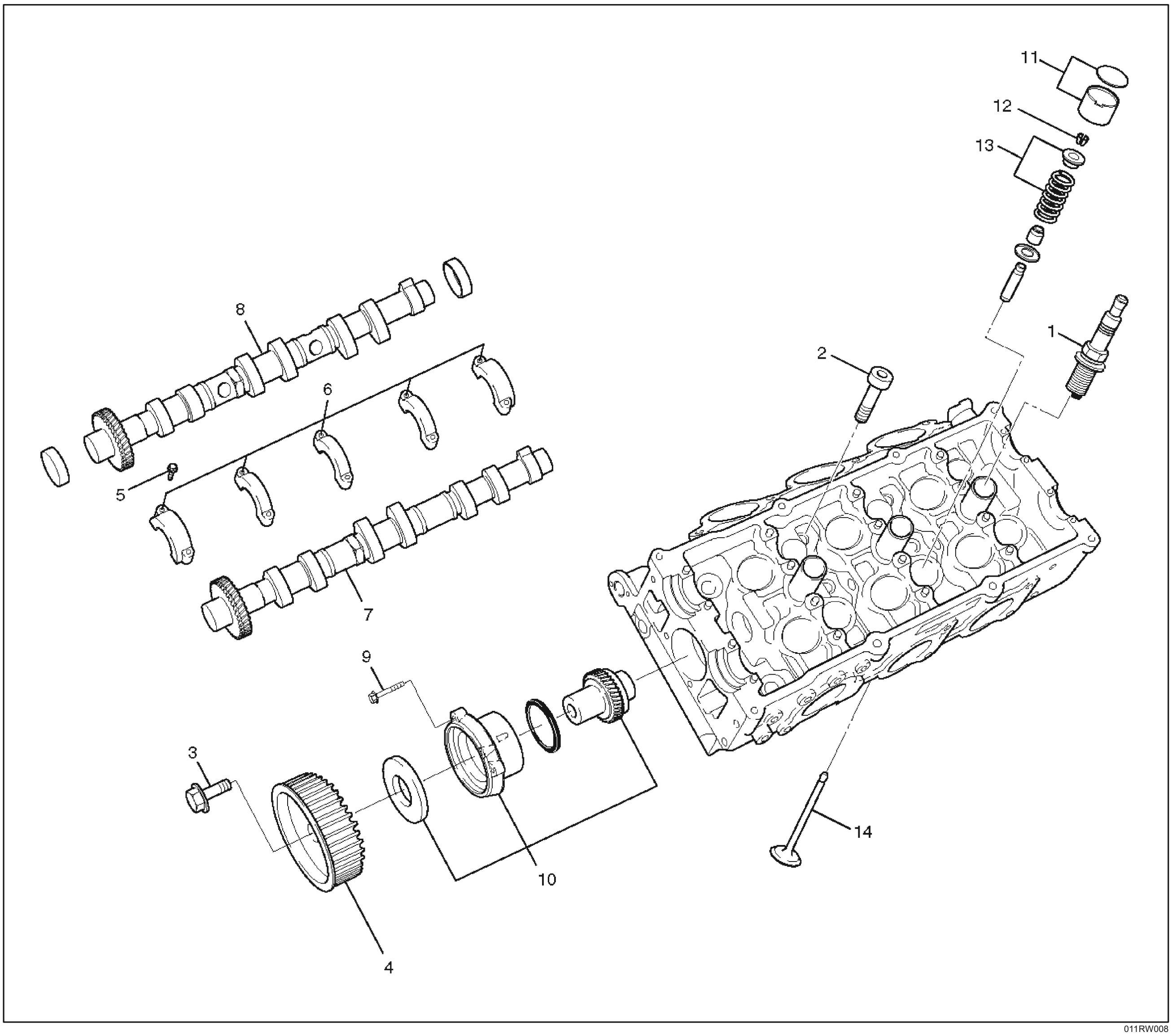


Legend

(1) Clearance
(2) Lock Nut
(3) Adjusting Nut

Cylinder Head

Cylinder Head and Associated Parts



Legend
- (1) Spark Plug
- (2) Cylinder Head Bolt
- (3) Camshaft Drive Gear Pulley Fixing Bolt
- (4) Camshaft Drive Gear Pulley
- (5) Camshaft Bracket Fixing Bolt
- (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

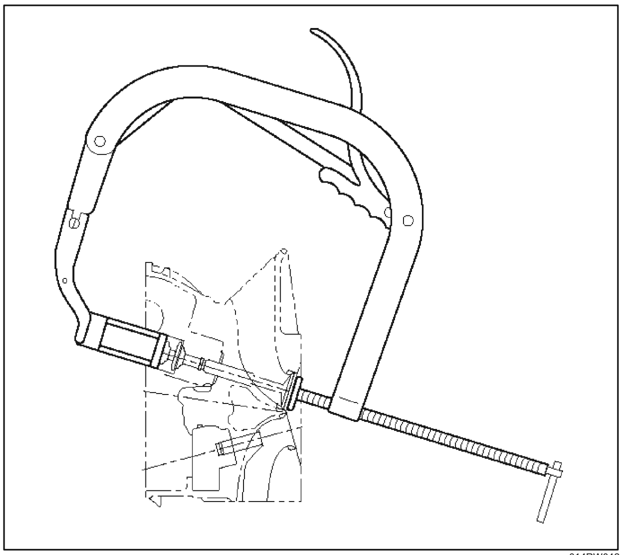
Disassembly

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)

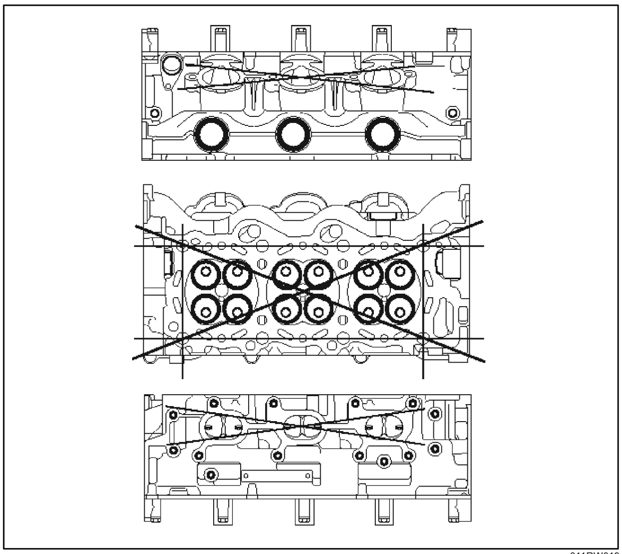
Maximum Repairable limit: 0.2 mm (0.0079 in)

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.

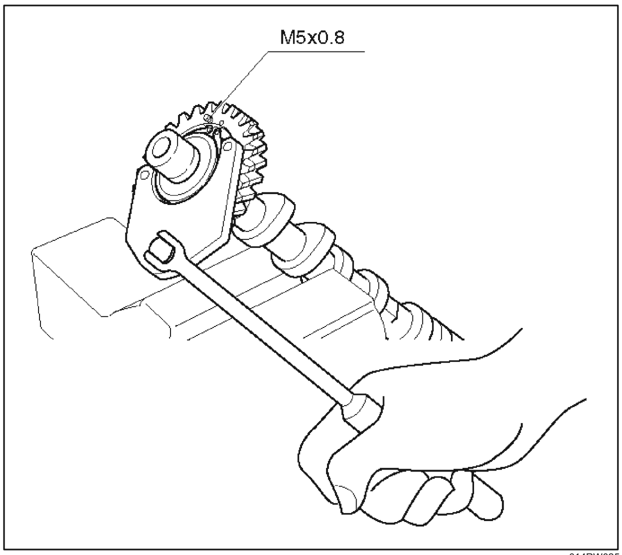
Reassembly

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

   Torque: 18 N·m (1.8 Kg·m/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 .

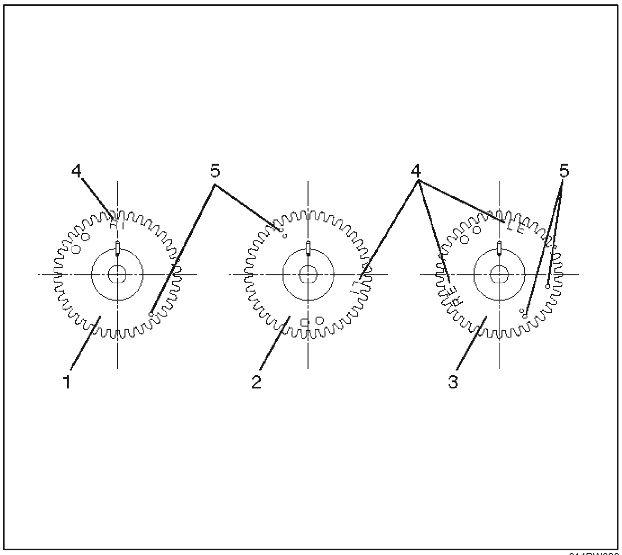


014RW025

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

Torque: 10 N·m (1.0 Kg·m/89 lb in)

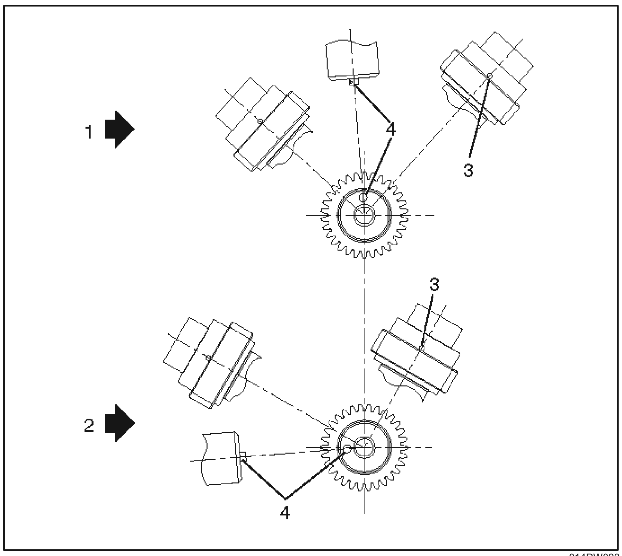
4. Install camshaft assembly and camshaft brackets, tighten twenty bolts on one side bank to the specified torque.
   1. Apply engine oil to camshaft journal and bearing surface of camshaft bracket.
   2. Align timing mark on intake camshaft (one dot for right bank, two dots for left bank) and exhaust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



014RW020

Legend

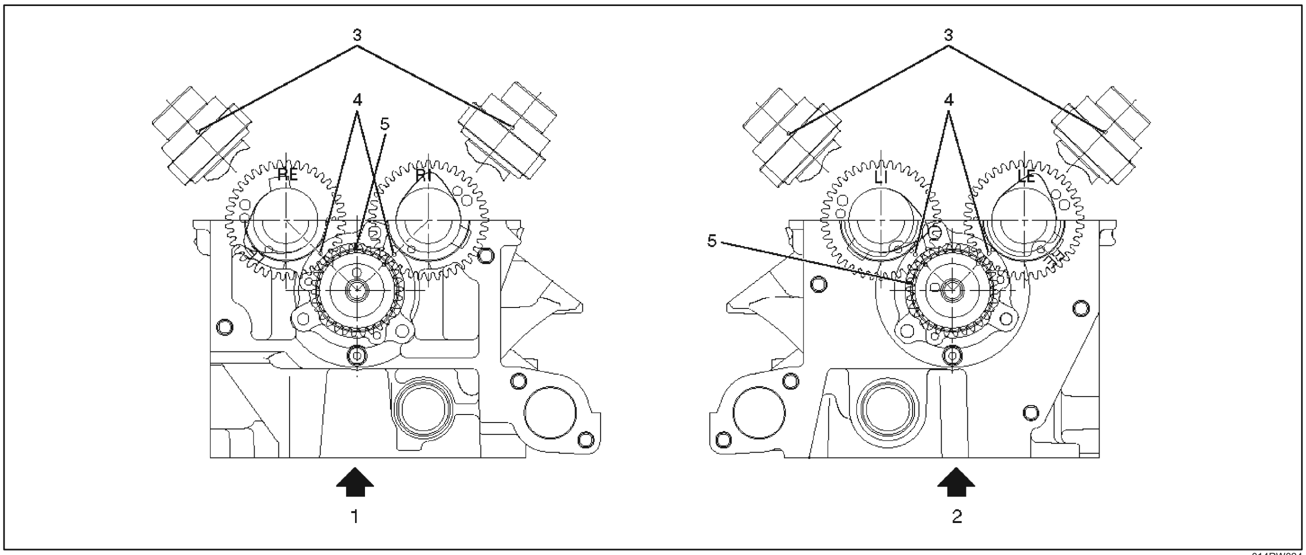
(1) Intake Camshaft Timing Gear for Right Bank
(2) Intake Camshaft Timing Gear for Left Bank
(3) Exhaust Camshaft Timing Gear
(4) Discrimination Mark
LI: Left Bank Intake
RI: Right Bank Intake
LE: Left Bank Exhaust
RE: Right Bank Exhaust



014RW023

Legend

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



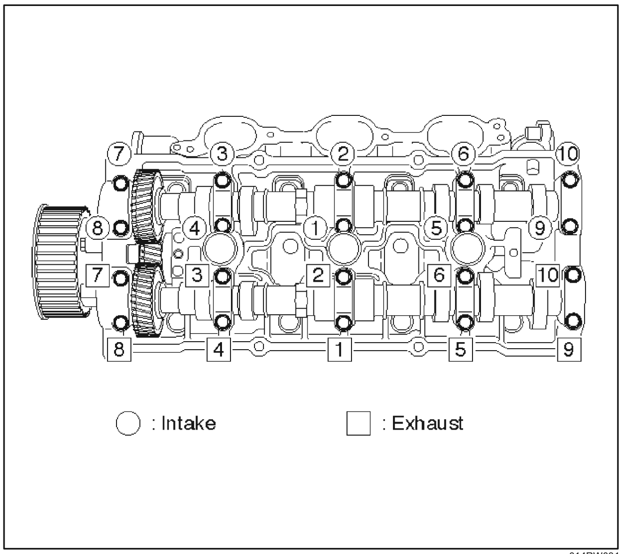
014RW024

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 one side bank as shown in the illustration.

Torque: 10 N·m (1.0 Kg·m/89 lb in)



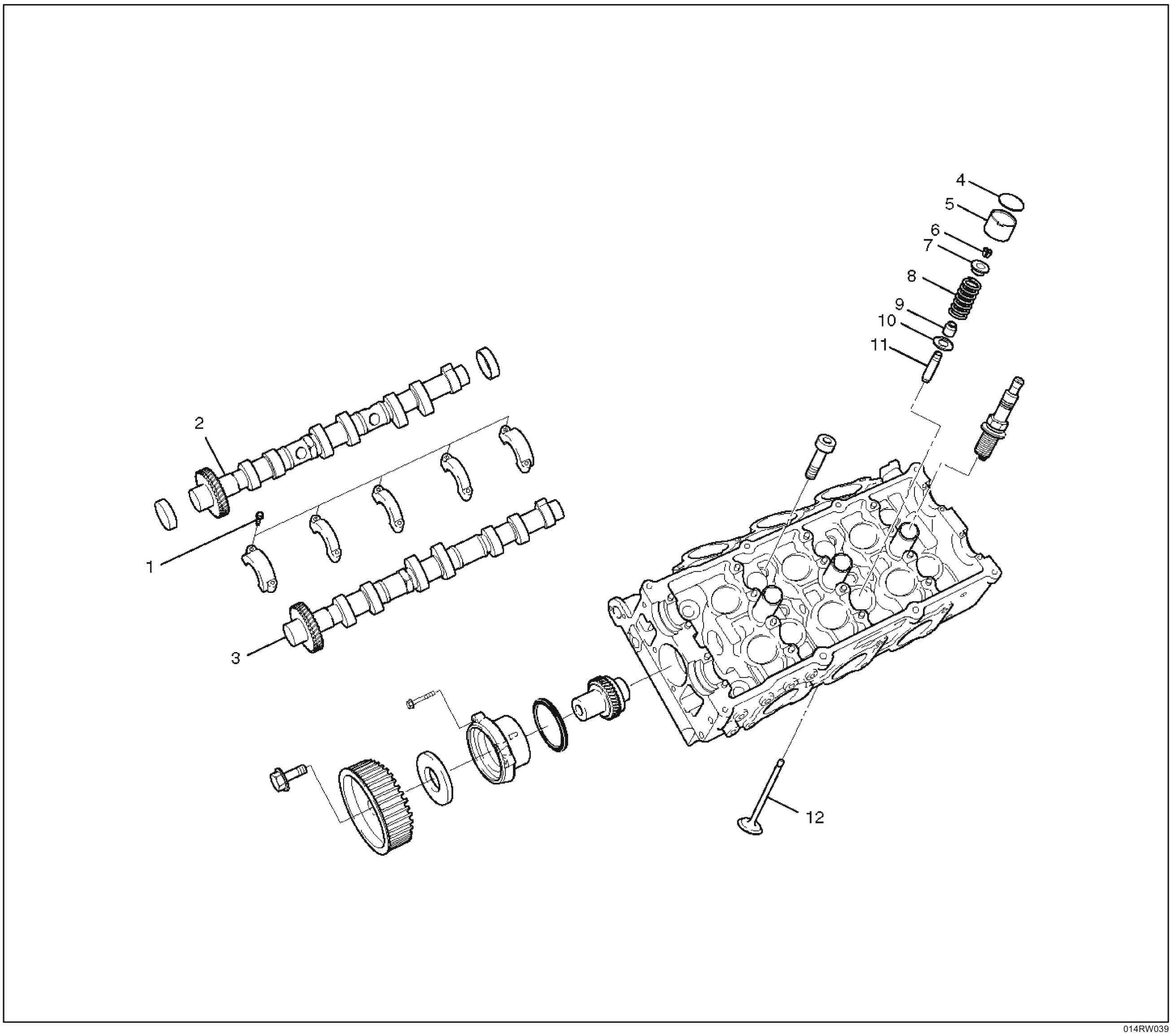
014RW031

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



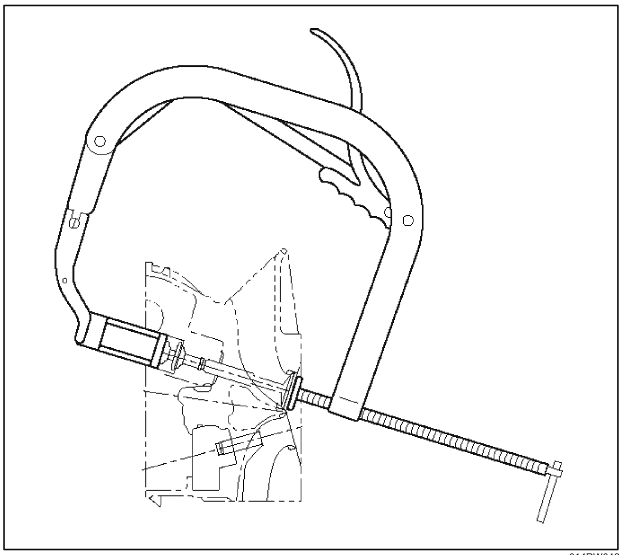
Legend

(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 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

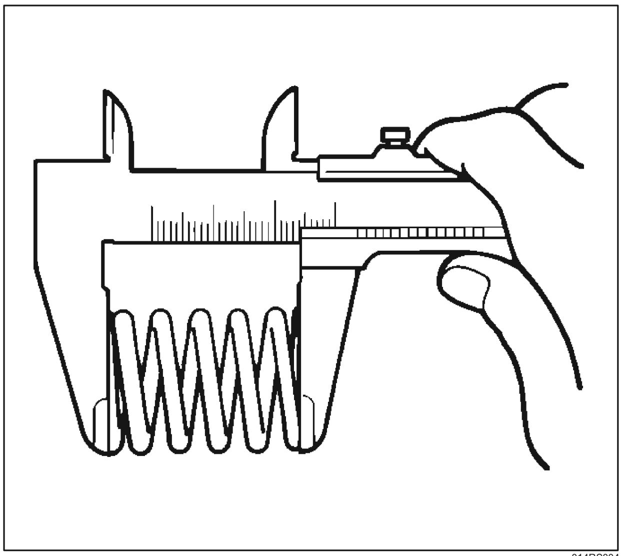
Valve Spring

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 (1.7559 in)

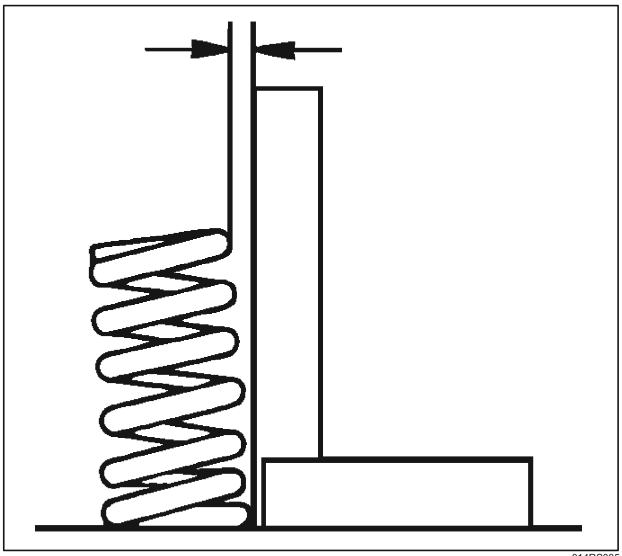
   Limit : 43.6 mm (1.7165 in)



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 (0.0787 in)



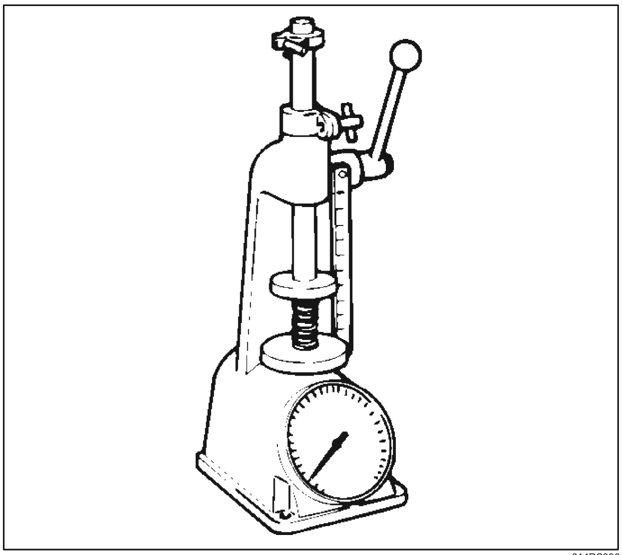
014RS005

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)



014RS006

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

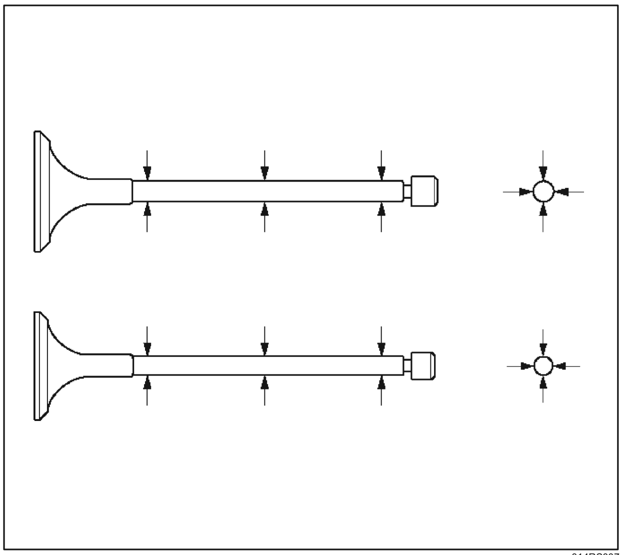
Standard : 5.977 mm–5.959 mm (0.2353 in–0.2346 in)

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)



014RS007

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)

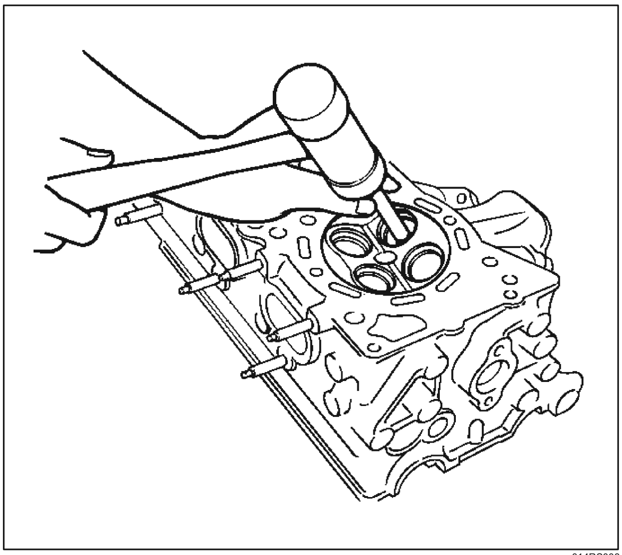
Exhaust clearance

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.

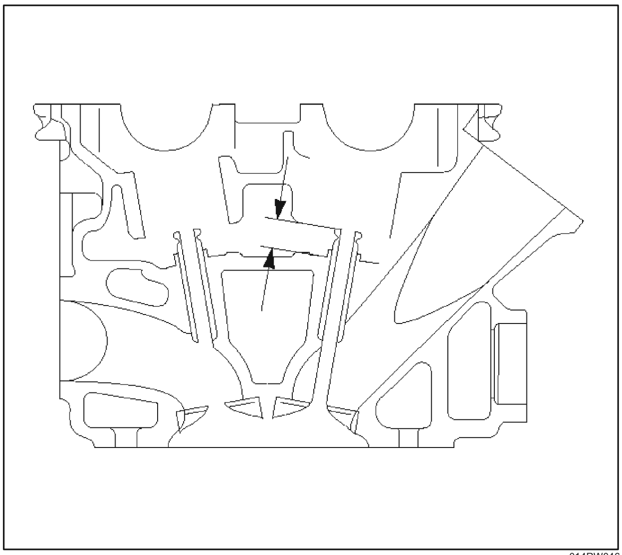


014RS008

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

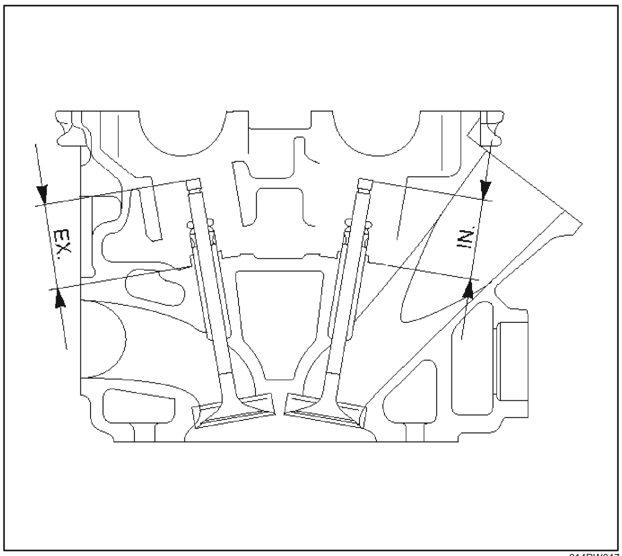
Standard: 39.32 mm (1.5480 in)

Limit: 39.47 mm (1.5539 in)

Exhaust

Standard: 39.30 mm (1.5472 in)

Limit: 39.45 mm (1.5531 in)



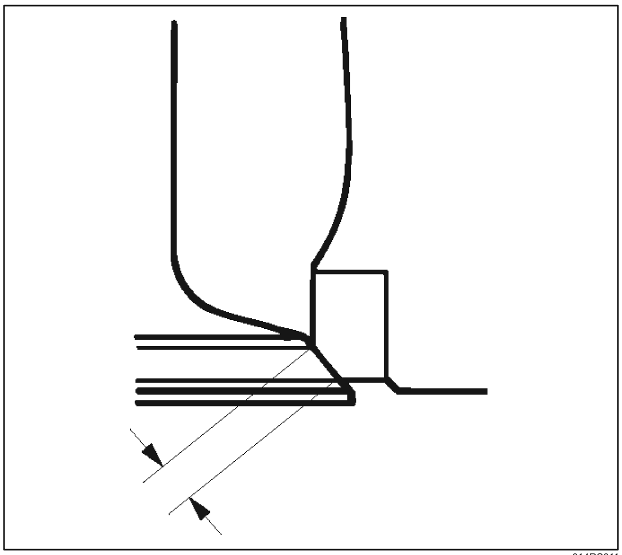
014RW047

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)



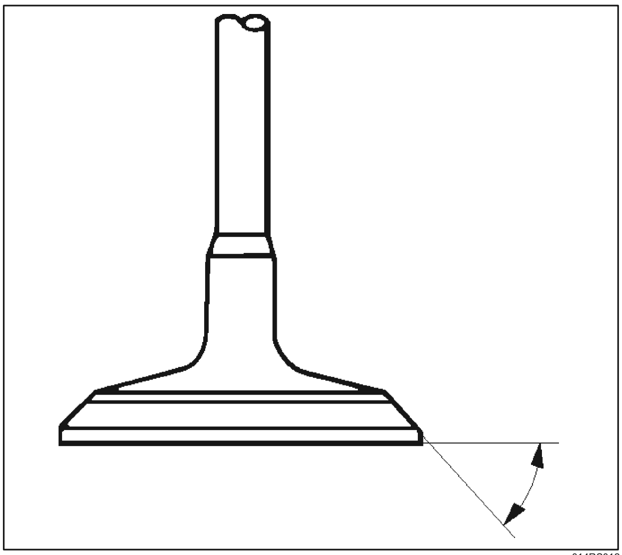
014RS011

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°

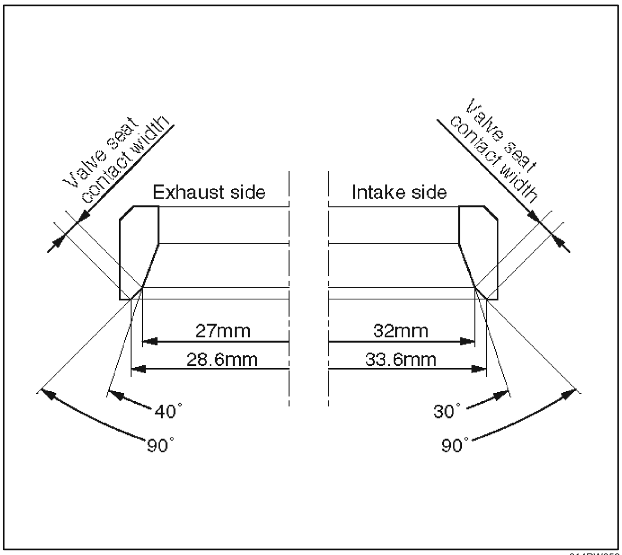


014RS012

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.

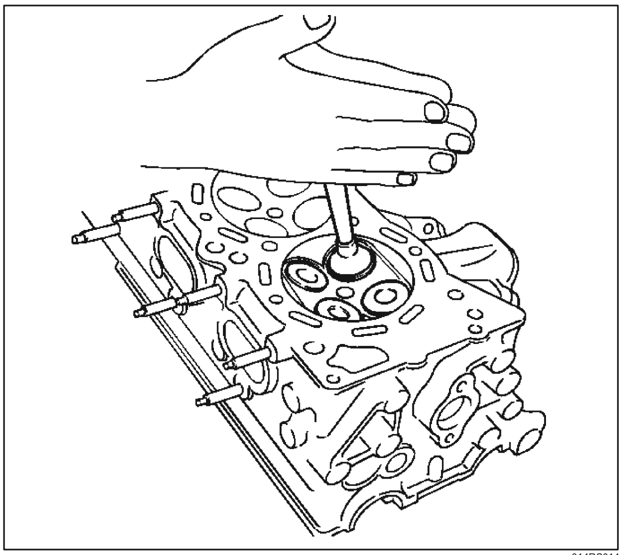
Valve seat angle degree: 90°



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.

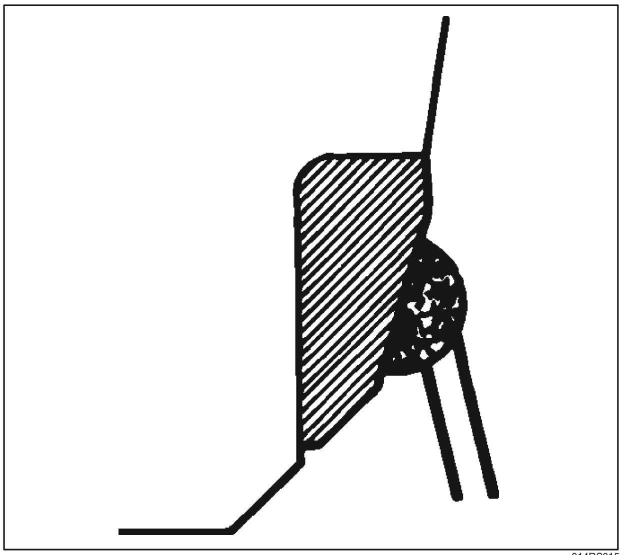
6. Check that the valve contact width is correct.
7. Check that the valve seat insert surface is in contact with the entire circumference of the valve.



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

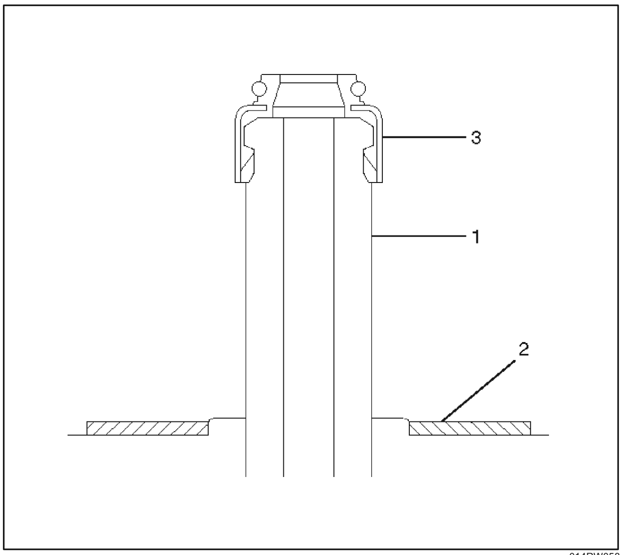
4. Carefully clean the valve seat press–fit section on the cylinder head side.
5. Heat the press–fit section with steam or some other means to cause expansion. Cool the valve seat with dry ice or some other means.
6. Insert the press–fit section into the valve seat horizontally.

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.

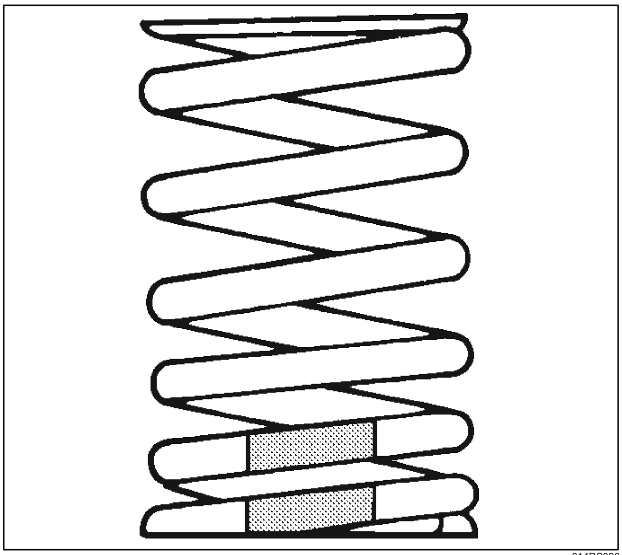
Reassembly

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.



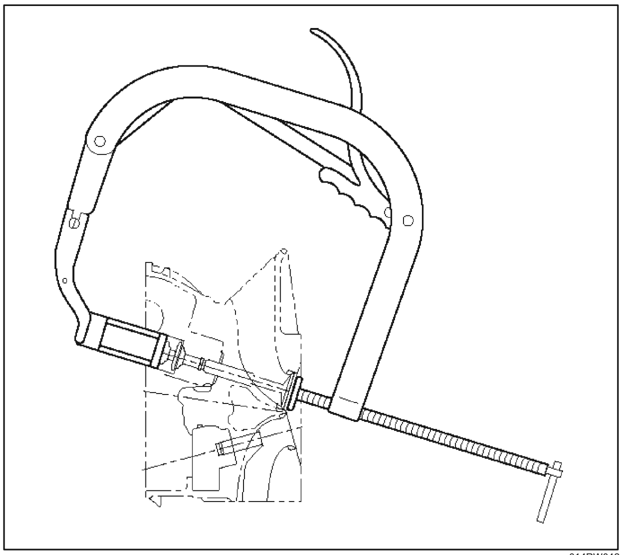
014RW058

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 compressor and 5–8840–2547–0 valve spring compressor adapter to install the split collars.

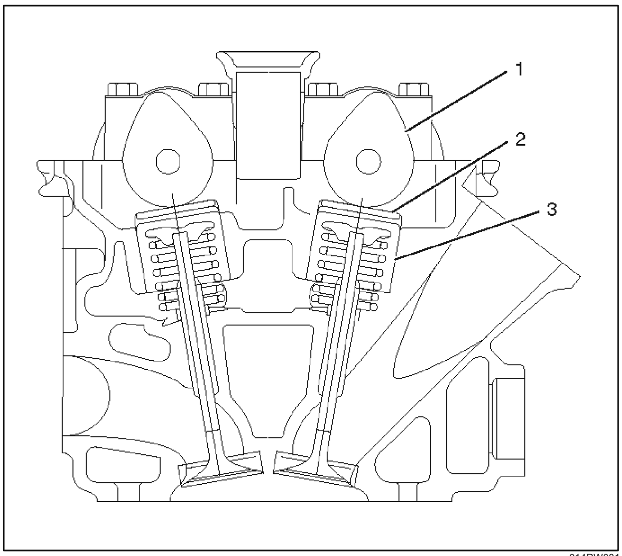


014RW042

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)

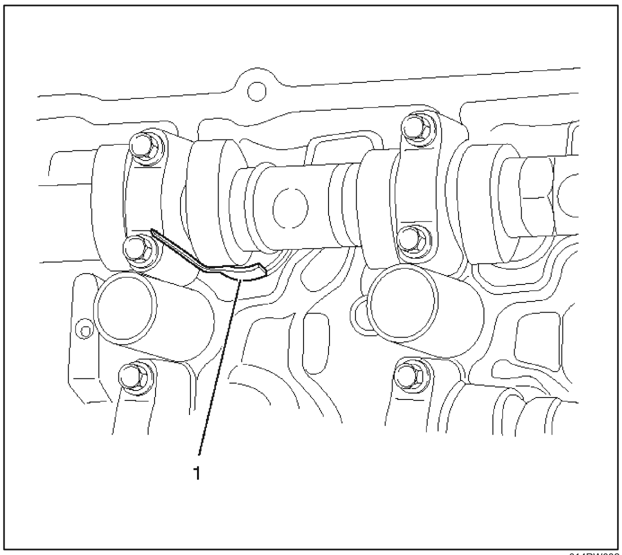
Exhaust: 0.25 mm–0.35 mm (0.0098 in–0.0138 in)

Selection of Adjusting Shim

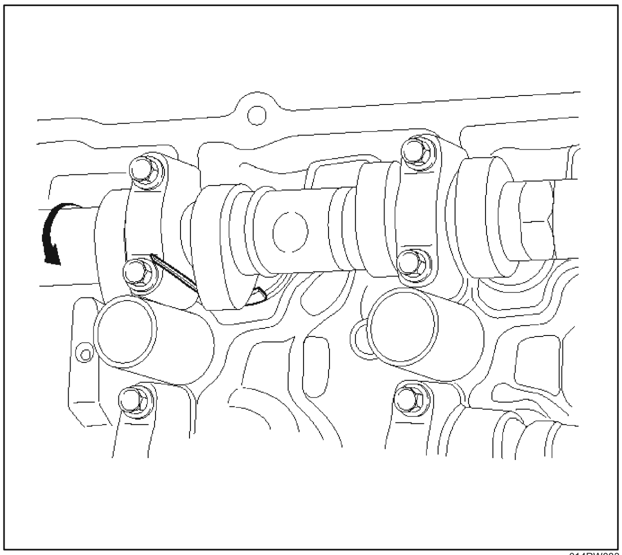
Shim to be selected = (Thickness of removed shim) + (Valve clearance measurement – Standard valve)
Based on the above formula, the best suited shim should be selected from 41 sorts of shim (differently thick at 0.02mm (0.0008 in) intervals from 2.40mm (0.0945 in) through 3.2mm (0.1260 in) thick). Install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

Replacement of Shim

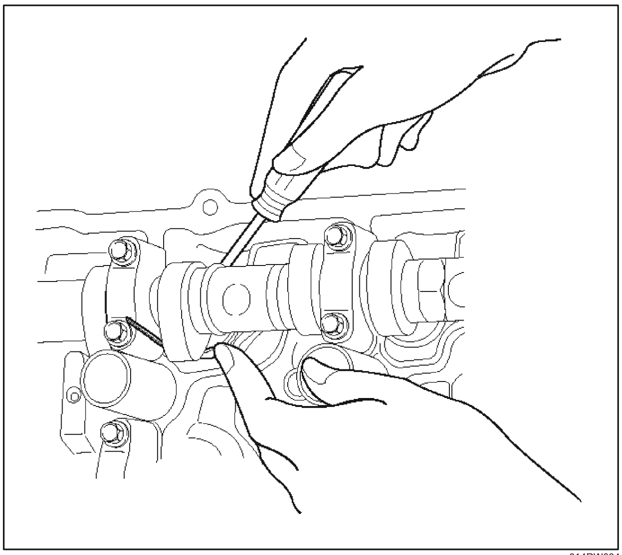
Let the cam push down the edge of tappet by using 5–8840–2444–0 valve clearance adjusting tool and push out the shim with a flat blade screw driver as shown in illustrations below.



014RW082



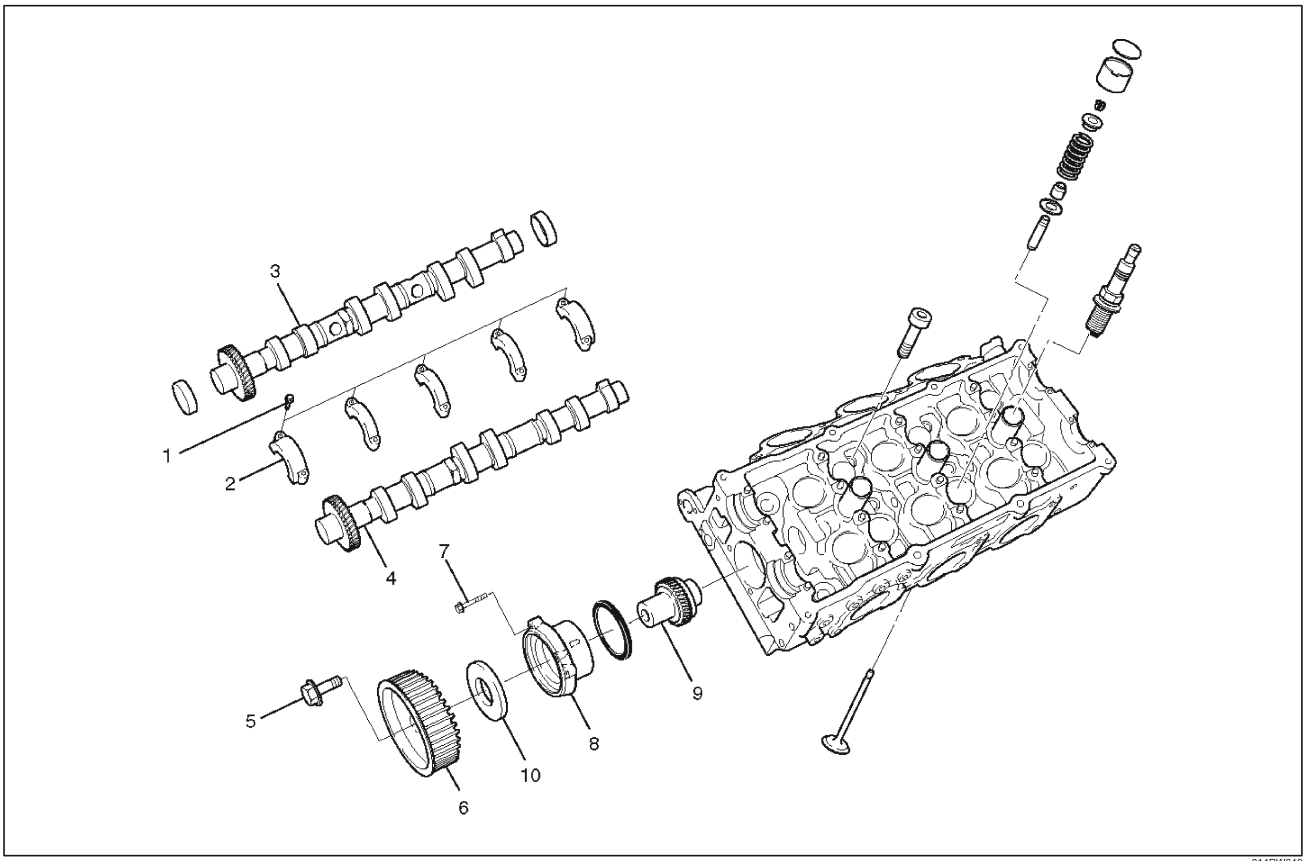
014RW083



014RW084

Camshaft

Camshaft and Associated Parts

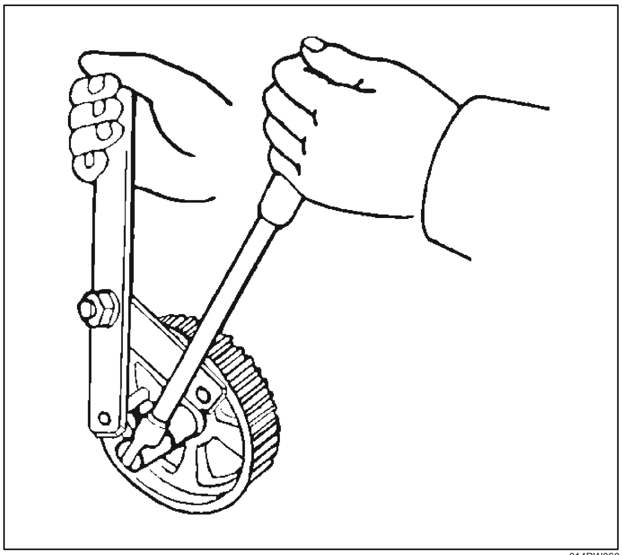


Legend

(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

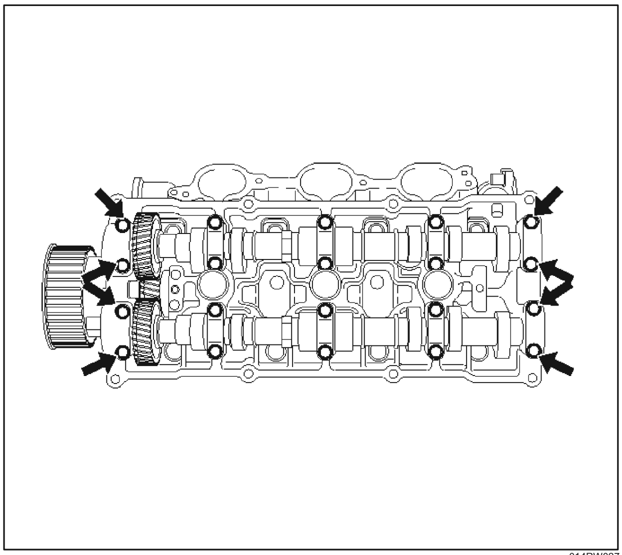
Disassembly

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



014RW060

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



014RW027

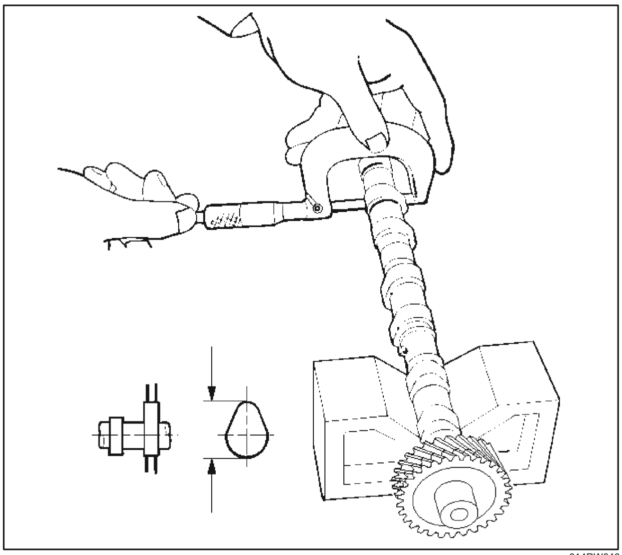
3. Remove camshaft assembly (3), (4).
4. Remove three fixing bolts (7) from camshaft drive gear retainer (8), then camshaft drive gear assembly.

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.

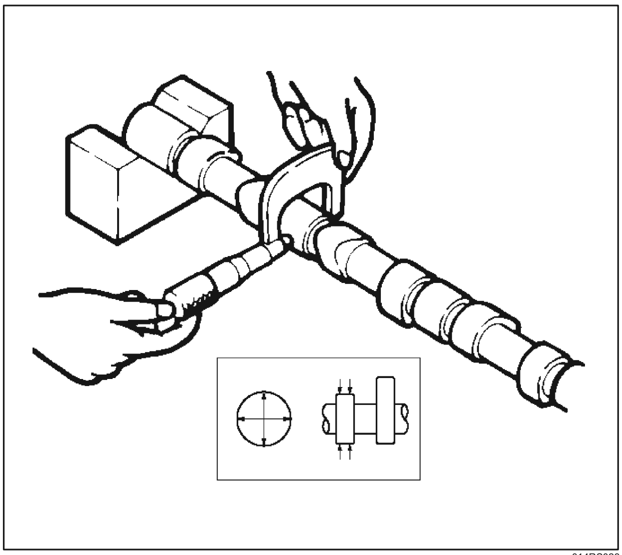
   Replace the camshaft if the diameter or the uneven wear exceeds the specified limit.

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

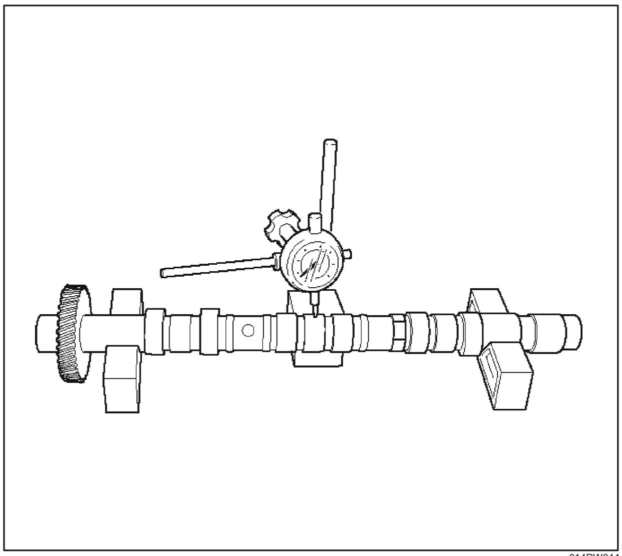
3. Place the camshaft on V–blocks.

   Slowly rotate the camshaft and measure the runout with a dial indicator.

   Replace the camshaft if the runout exceeds the specified limit.

Runout

Limit : 0.1 mm (0.0039 in)

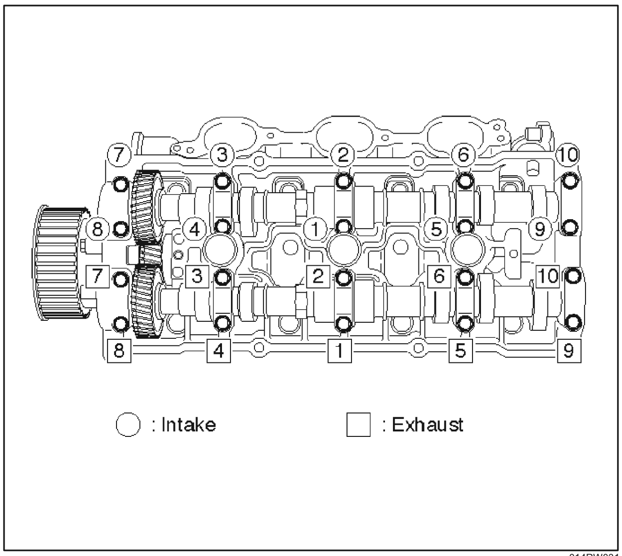


014RW044

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/89 lb in)



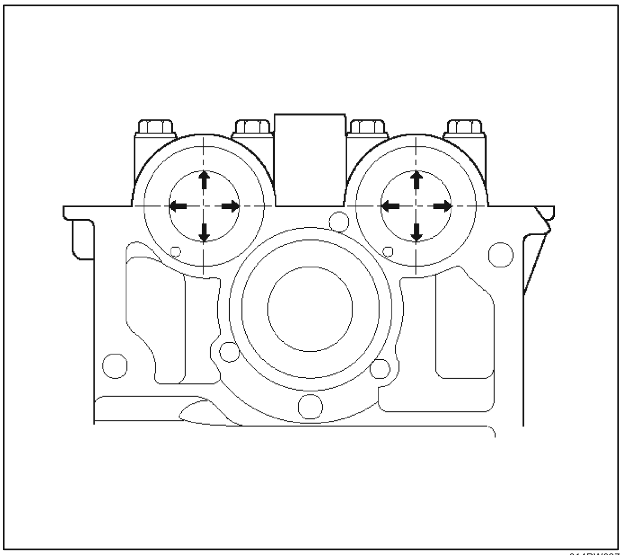
014RW031

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)

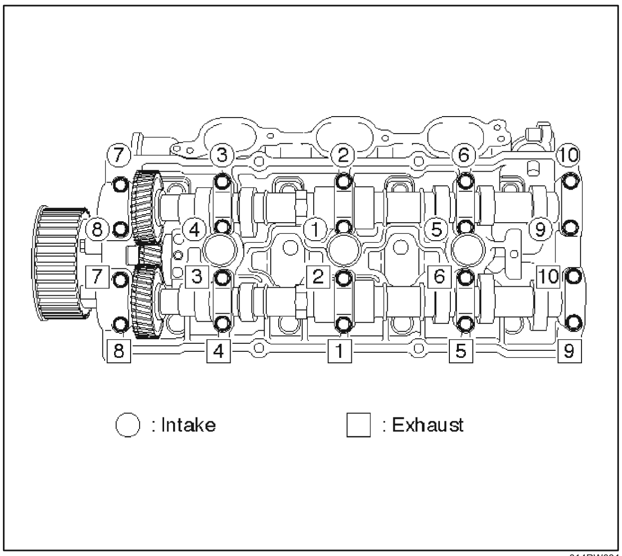
Limit : 0.11 mm (0.0043 in)



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/89 lb in)



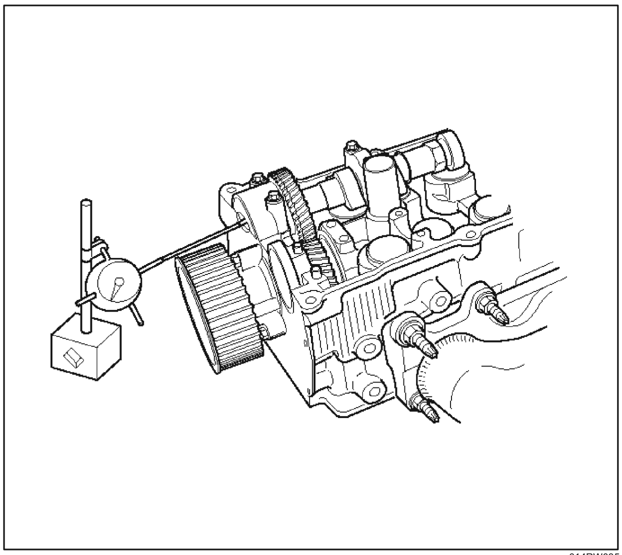
014RW031

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)



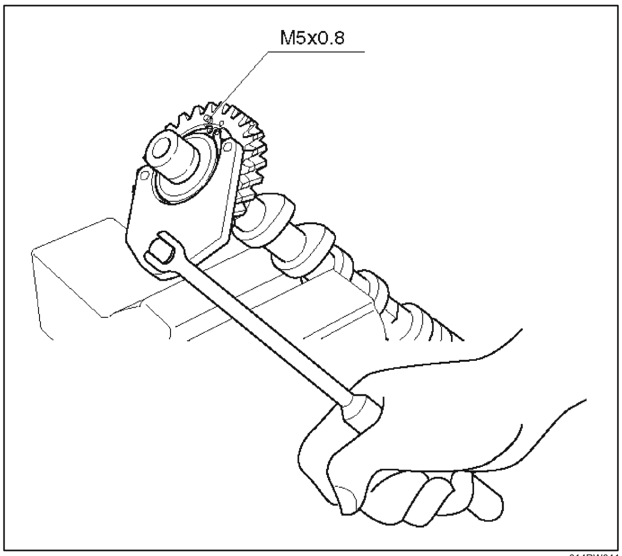
014RW035

Reassembly

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

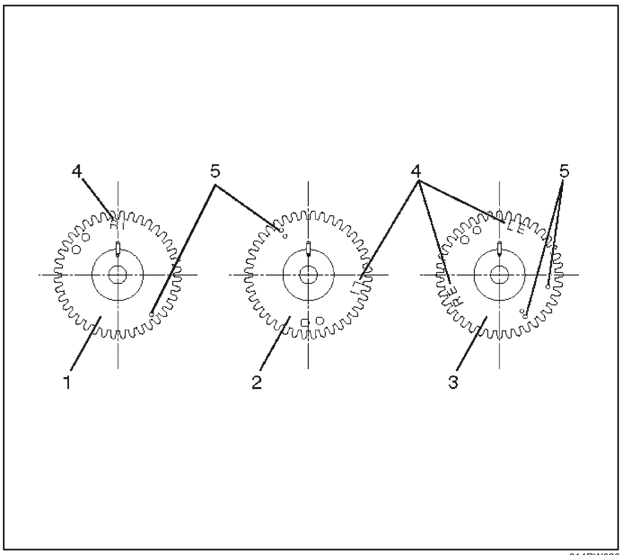
   Torque: 10 N·m (1.0 Kg·m/89 lb in)

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

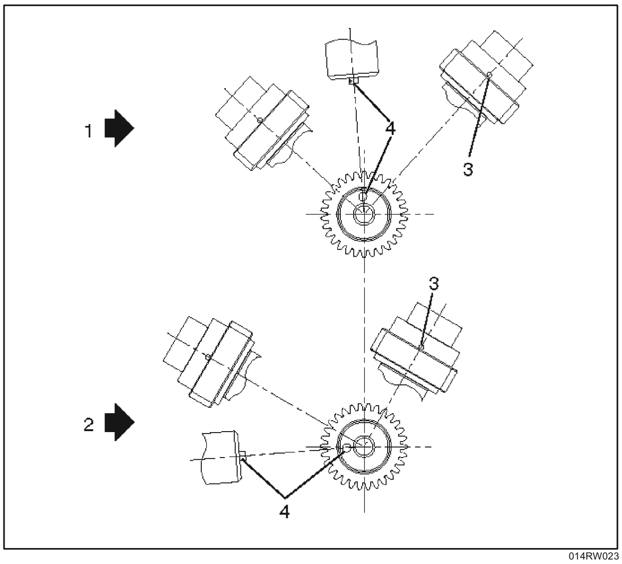
3. Install camshaft assembly and camshaft brackets, tighten twenty bolts on one side bank to the specified torque.
   1. Apply engine oil to camshaft journal and bearing surface of camshaft bracket.
   2. Align timing mark on intake camshaft (one dot for right bank, two dots for left bank) and exhaust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



014RW020

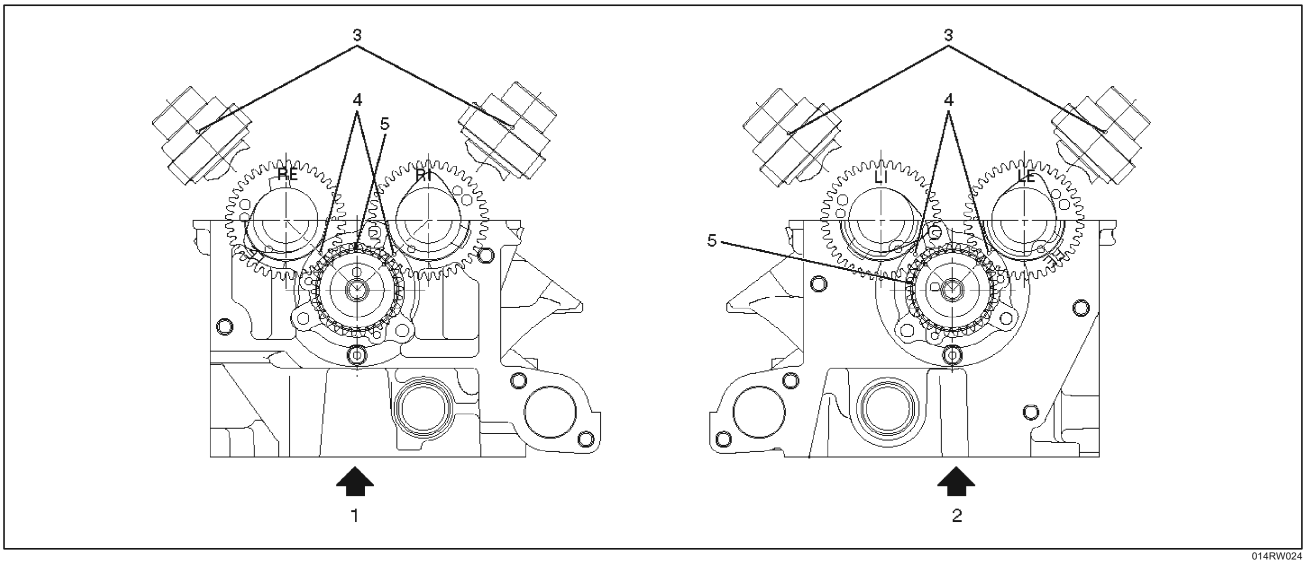
Legend

(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



Legend

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

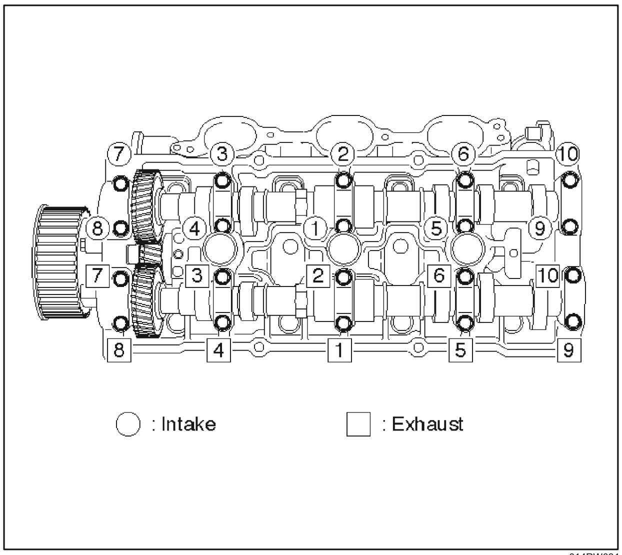


Legend

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

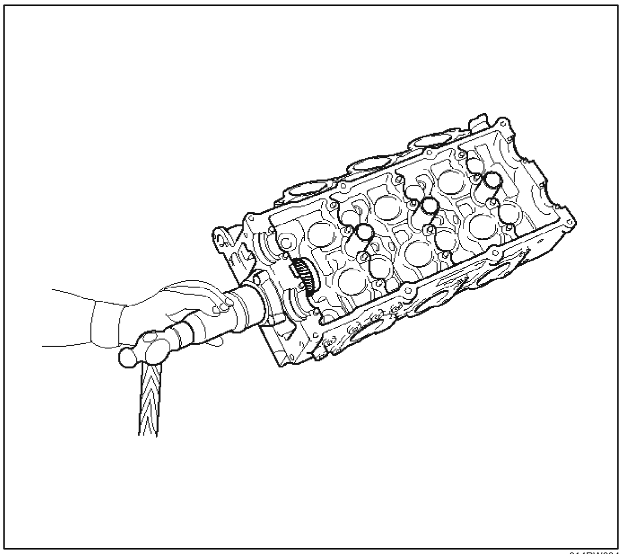
3. Tighten twenty bolts in numerical order on one side bank as shown in the illustration.

Torque: 10 N·m (1.0 Kg·m/89 lb in)



014RW031

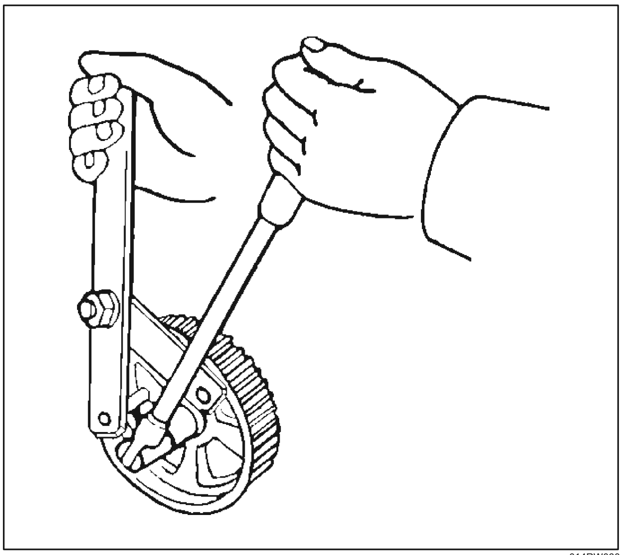
4. If the oil seal requires replacement, use the 5–8840–2445–0 to install the oil seal.



014RW034

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

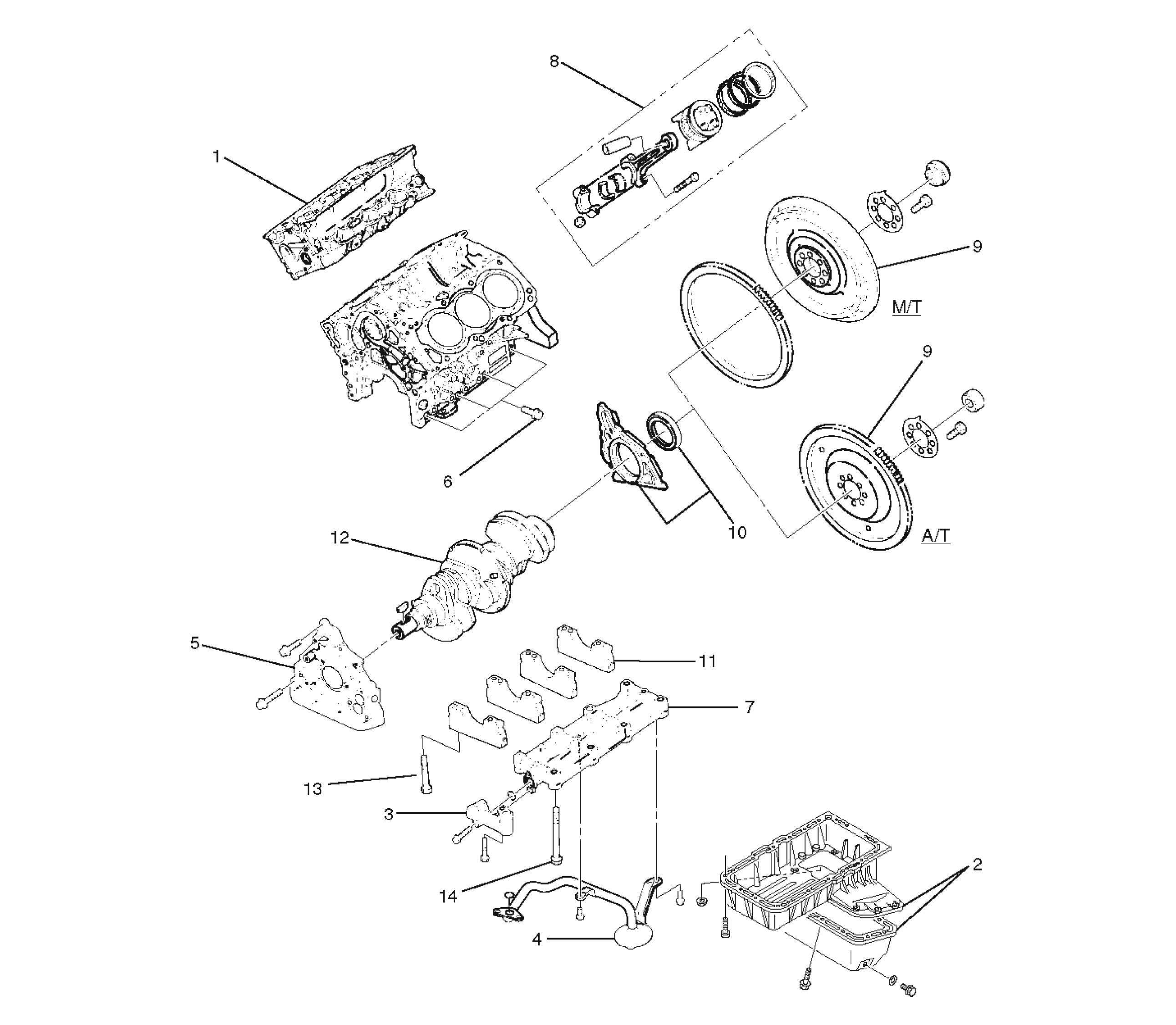
Torque: 98 N·m (10.0 Kg·m/72 lb ft)



014RW060

Crankshaft

Crankshaft and Associated Parts



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 “Cylinder 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).

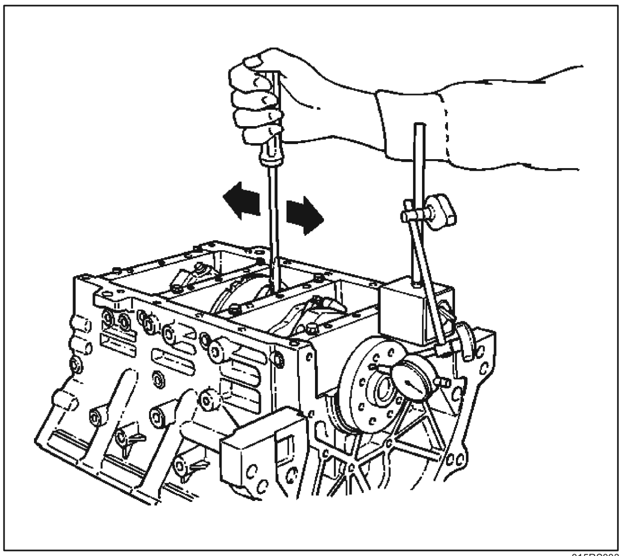
Inspection and Repair

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)

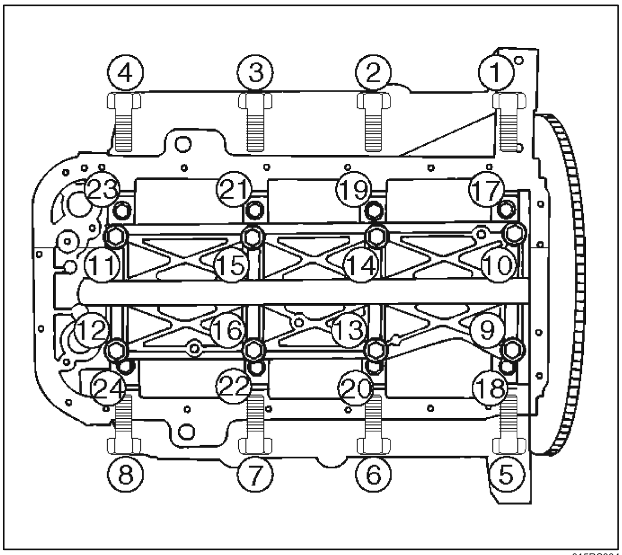
Limit : 0.30 mm (0.0118 in)



015RS003

Main Bearing Clearance

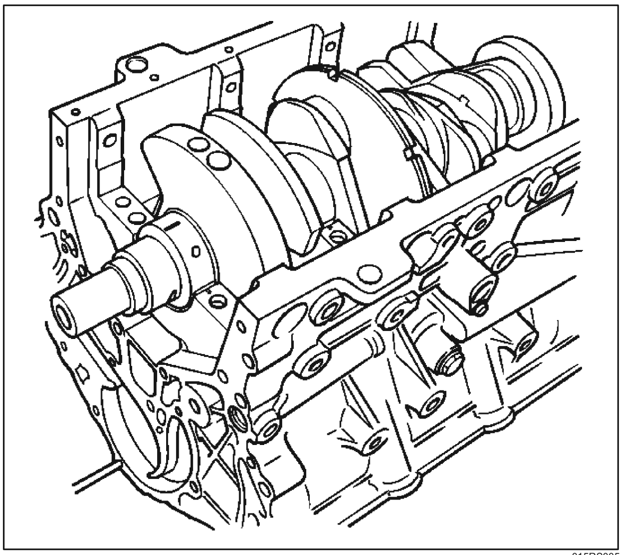
1. Remove the bearing caps and measure the oil clearance.
2. Remove the main bearing cap fixing bolts in the sequence shown in the illustration.
   Arrange the removed main bearing caps in the cylinder number order.
   Remove the main bearings.



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.



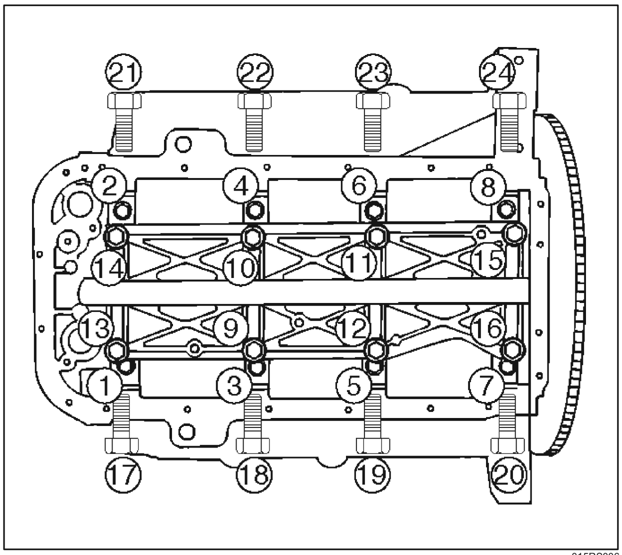
015RS005

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.

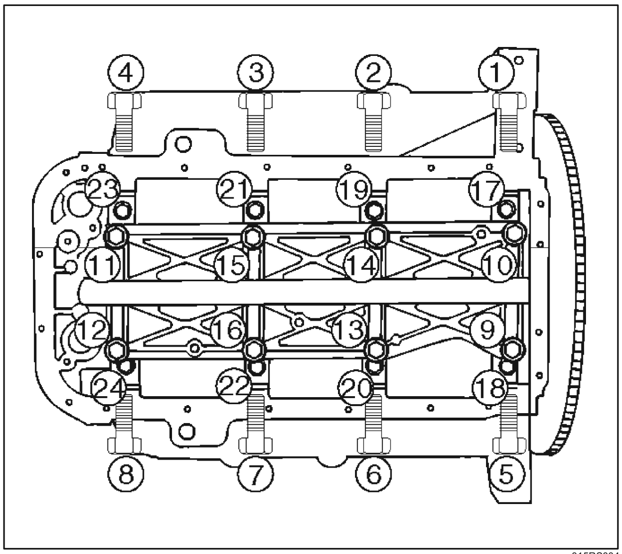
Main bearing cap bolts.
Torque: 39 N·m (4.0 Kg·m/29 lb ft)
Oil gallery fixing bolts.
Torque:
1st step: 29 N·m (3.0 Kg·m/21 lb ft)
2nd step 55°~ 65°
Crank case side bolts
Torque : 39 N·m (4.0 Kg·m/29 lb ft)

NOTE: Do not allow the crankshaft to rotate.



015RS006

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

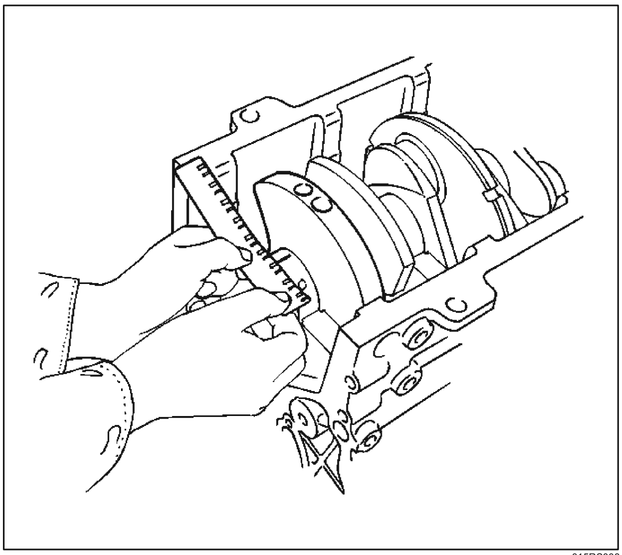


015RS004

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.

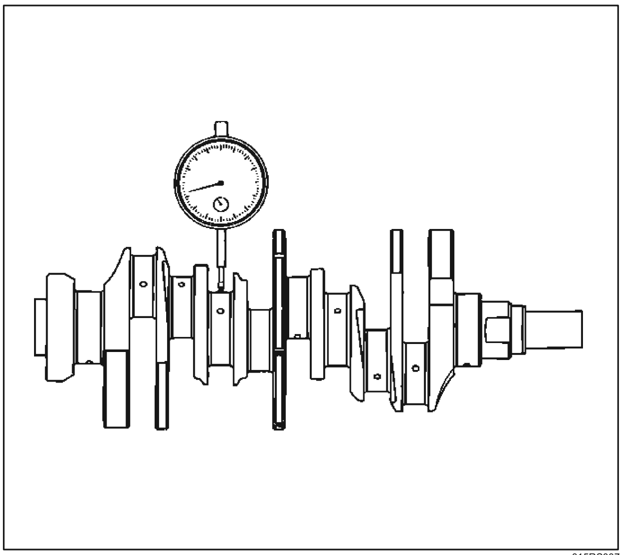
Crankshaft (12) Inspection

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)

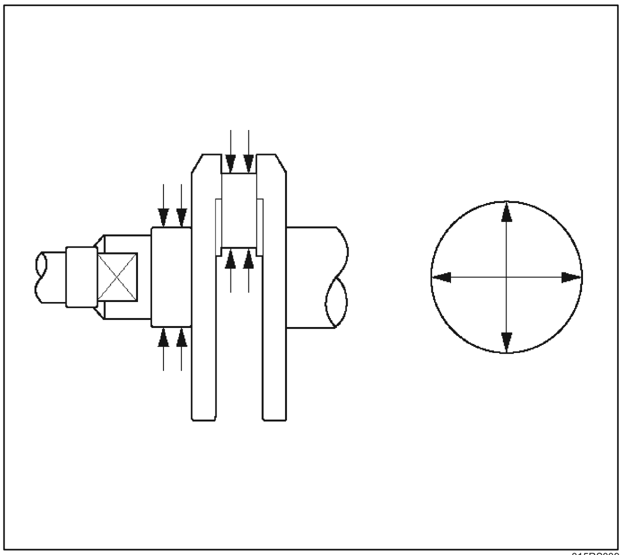

015RS007

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)

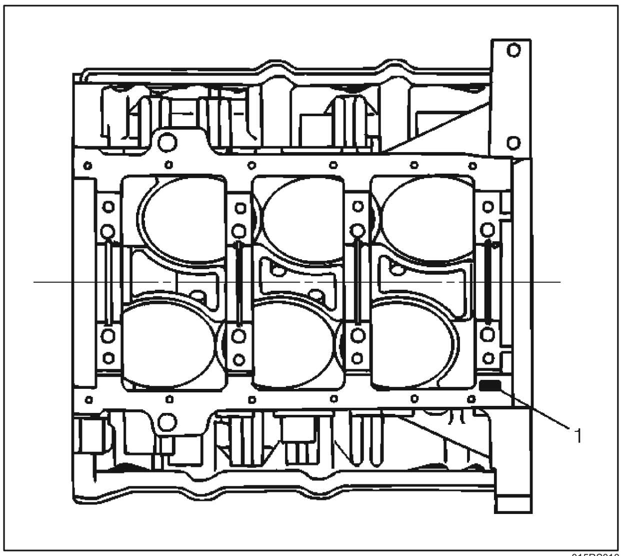


015RS009

Crankshaft Bearing Selection

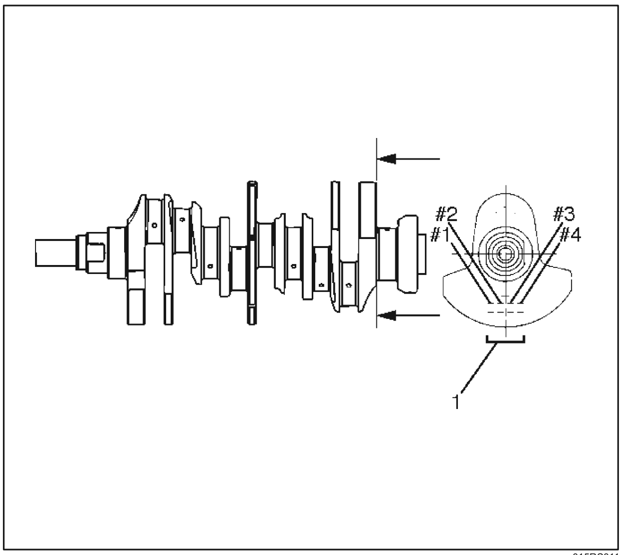
When installing new crankshaft bearings or replacing bearings, refer to the selection table below. Select and install the new crankshaft bearings, paying close attention to the cylinder block journal hole.

1. Diameter size mark (1) and the crankshaft journal.



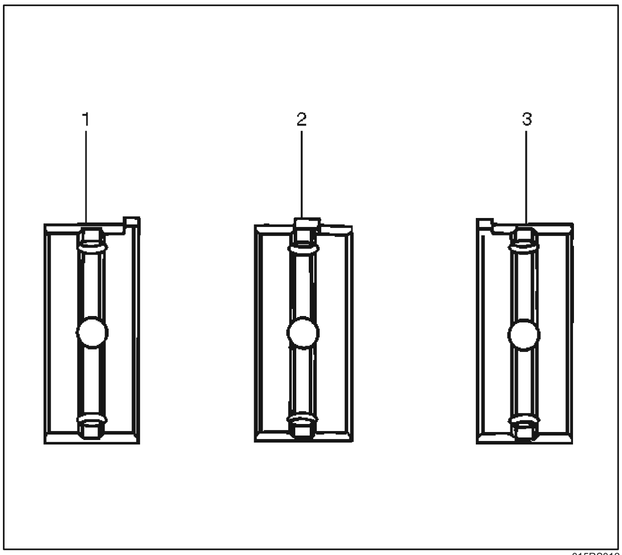
015RS010

2. Diameter size mark (1).
   The diameter size marks are stamped on the No.1 crankshaft balancer as shown in the illustration.



015RS011

NOTE: Take care to ensure the bearings are positioned correctly.



015RS012

Legend

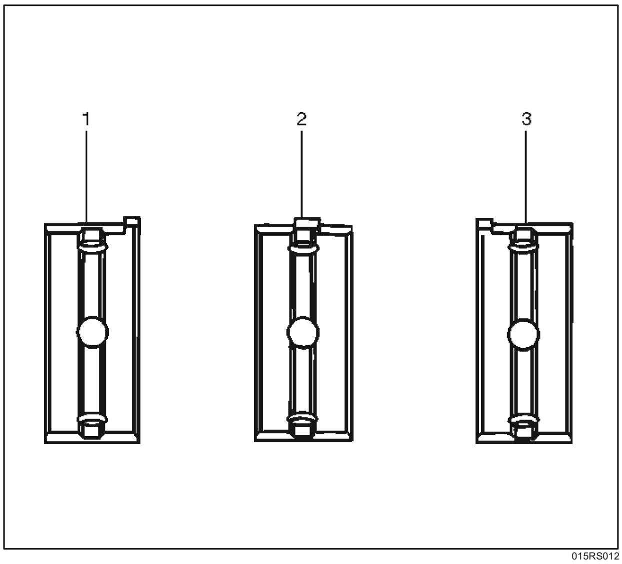
(1) Number 1 and 4 main bearing upper and lower
(2) Number 2 and 3 main bearing upper
(3) Number 2 and 3 main bearing lower

1 Size Mark	Main Bearing Bore Diameter	Crank Shaft Main Journal Diameter	2 Size Mark	Crank Shaft Bearing Size Mark (Upper Side)	Crank Shaft Bearing Size Mark (Lower Side)	Oil Clearance (Reference)
1	68.994-69.000 (2.7163-2.7165)	63.918-63.925 (2.5165-2.5167)	2	Blue	Blue	0.030-0.049 (0.0012-0.0019)
		63.926-63.933 (2.5168-2.5170)	1	Brown	Brown	0.028-0.047 (0.0011-0.0019)
2	68.987-68.993 (2.7160-2.7163)	63.918-63.925 (2.5165-2.5167)	2			0.029-0.048 (0.0011-0.0019)
		63.926-63.933 (2.5168-2.5170)	1	Green	Green	0.027-0.046 (0.0011-0.0018)
3	68.980-68.986 (2.7157-2.7160)	63.918-63.925 (2.5165-2.5167)	2			0.028-0.047 (0.0011-0.0019)
		63.926-63.933 (2.5168-2.5170)	1	Yellow	Yellow	0.026-0.045 (0.0010-0.0018)

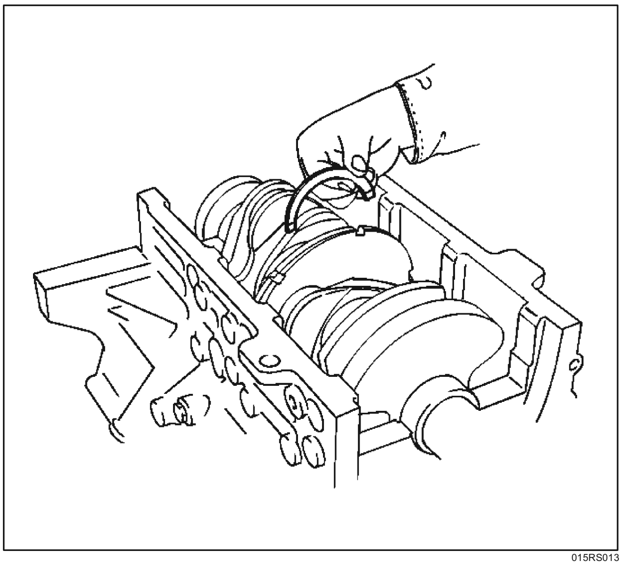
Reassembly

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.

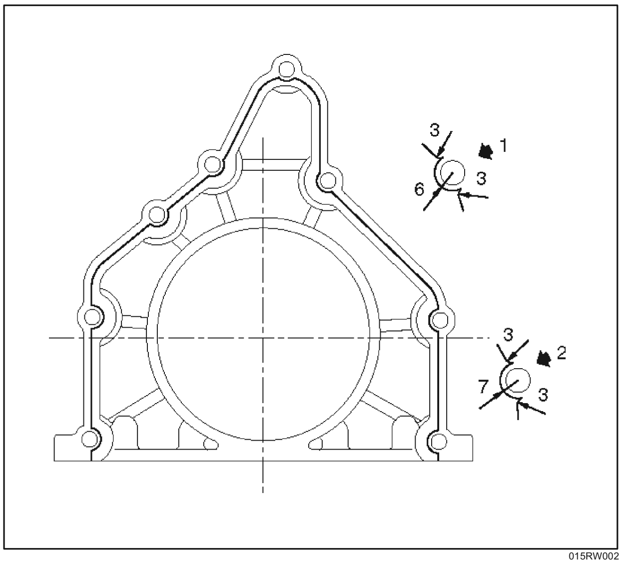


   - Carefully mount the crankshaft.
   - Apply engine oil to the thrust washer.
   - Assemble the thrust washer to the No.3 bearing journal. The oil grooves must face the crankshaft.



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 befor the sealant hardens.



Legend

(1) Around Bolt Holes

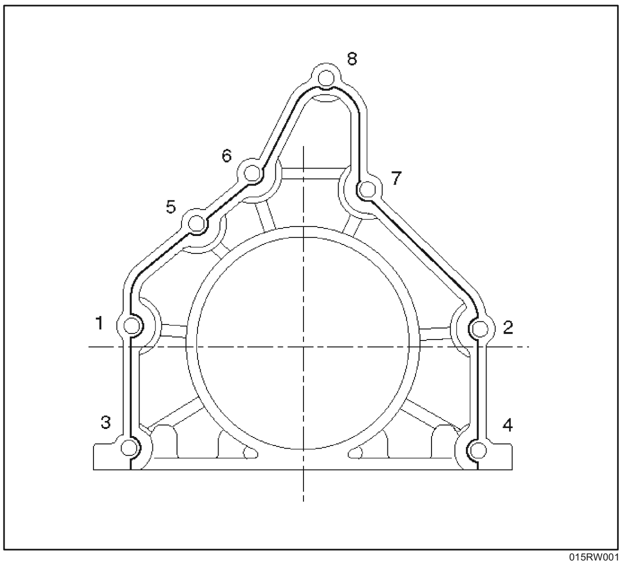
(2) Around Dowel Pin

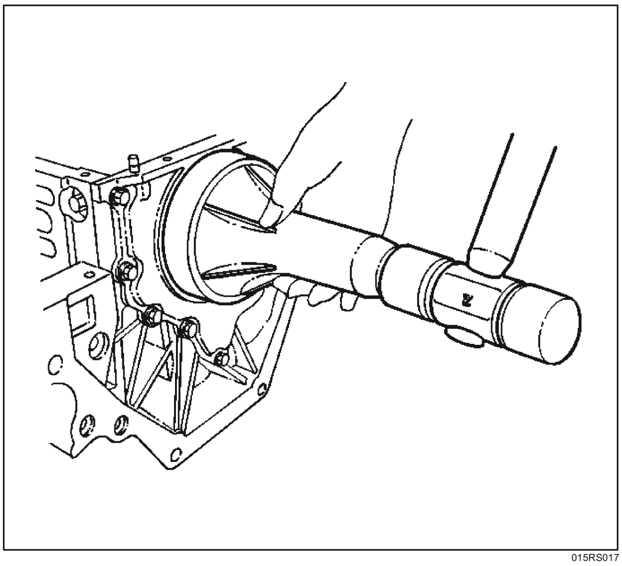
- Apply engine oil to the oil seal lip.
- Align the cylinder block dowel pin holes with the rear retainer dowel pins.
- Tighten the rear retainer fixing bolts. New bolts should be used when installing rear retainer.

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.

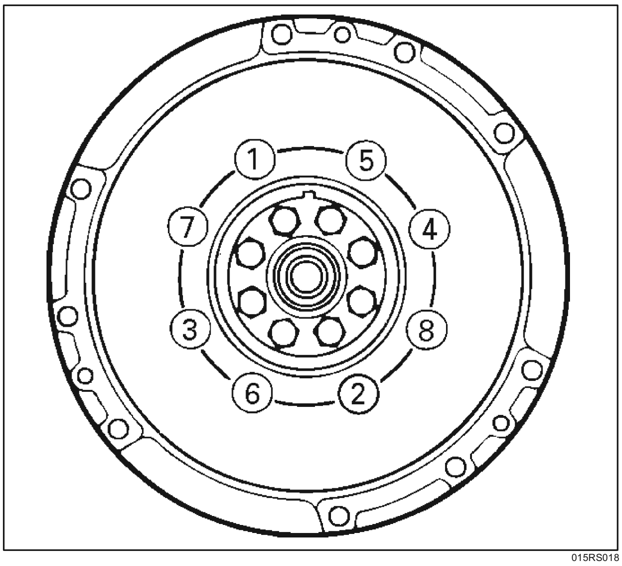




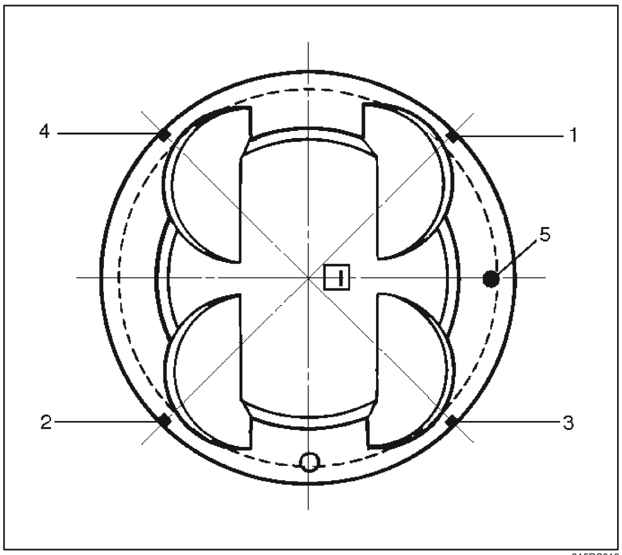
3. Flywheel (9)
   1. Thoroughly clean and remove the oil from the threads of crankshaft.
   2. Remove the oil from the crankshaft and flywheel mounting faces.
   3. Mount the flywheel on the crankshaft and then install the washer.
   4. Hold the crankshaft to prevent from rotating then install the bolts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



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

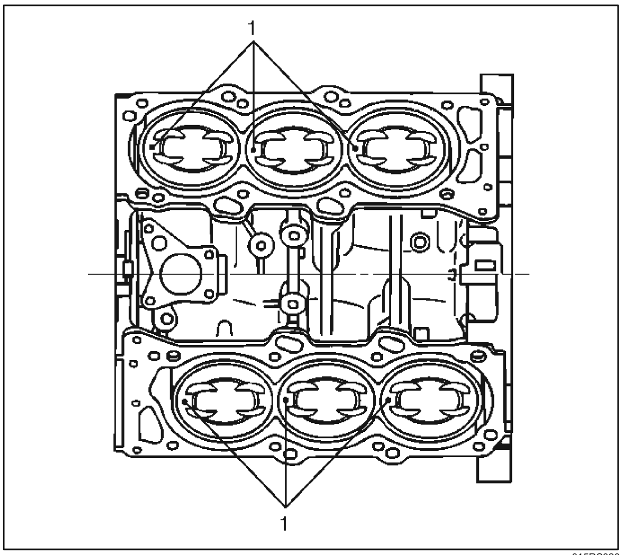
(1) No.1 Compression Ring
(2) No.2 Compression Ring
(3) Oil Ring Side Rail Upper
(4) Oil Ring Side Rail Lower
(5) Piston Front Mark

- 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.

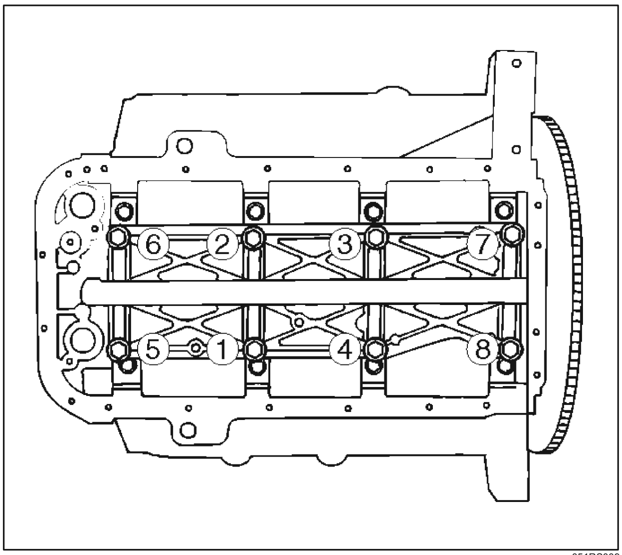


015RS020

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°

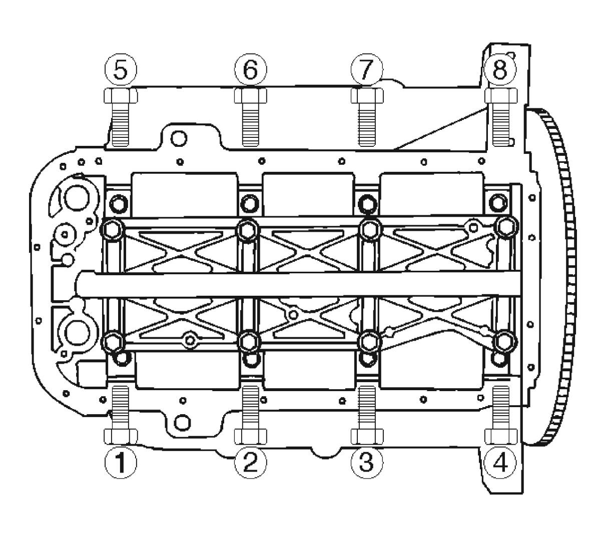


051RS009

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)



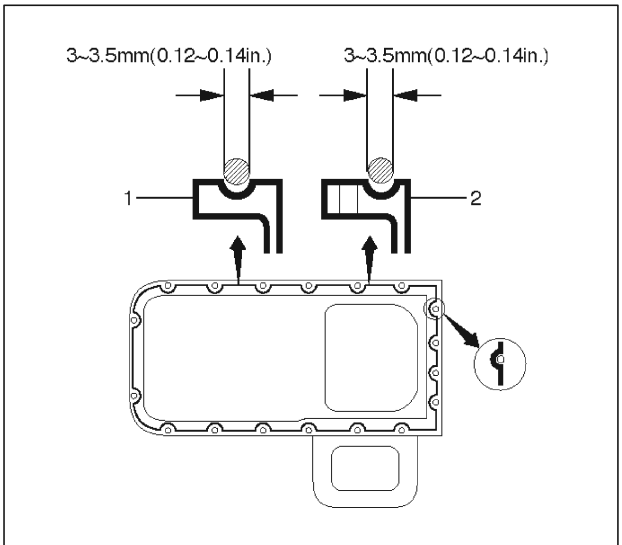
012RS001

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/89 lb in)



013RW010

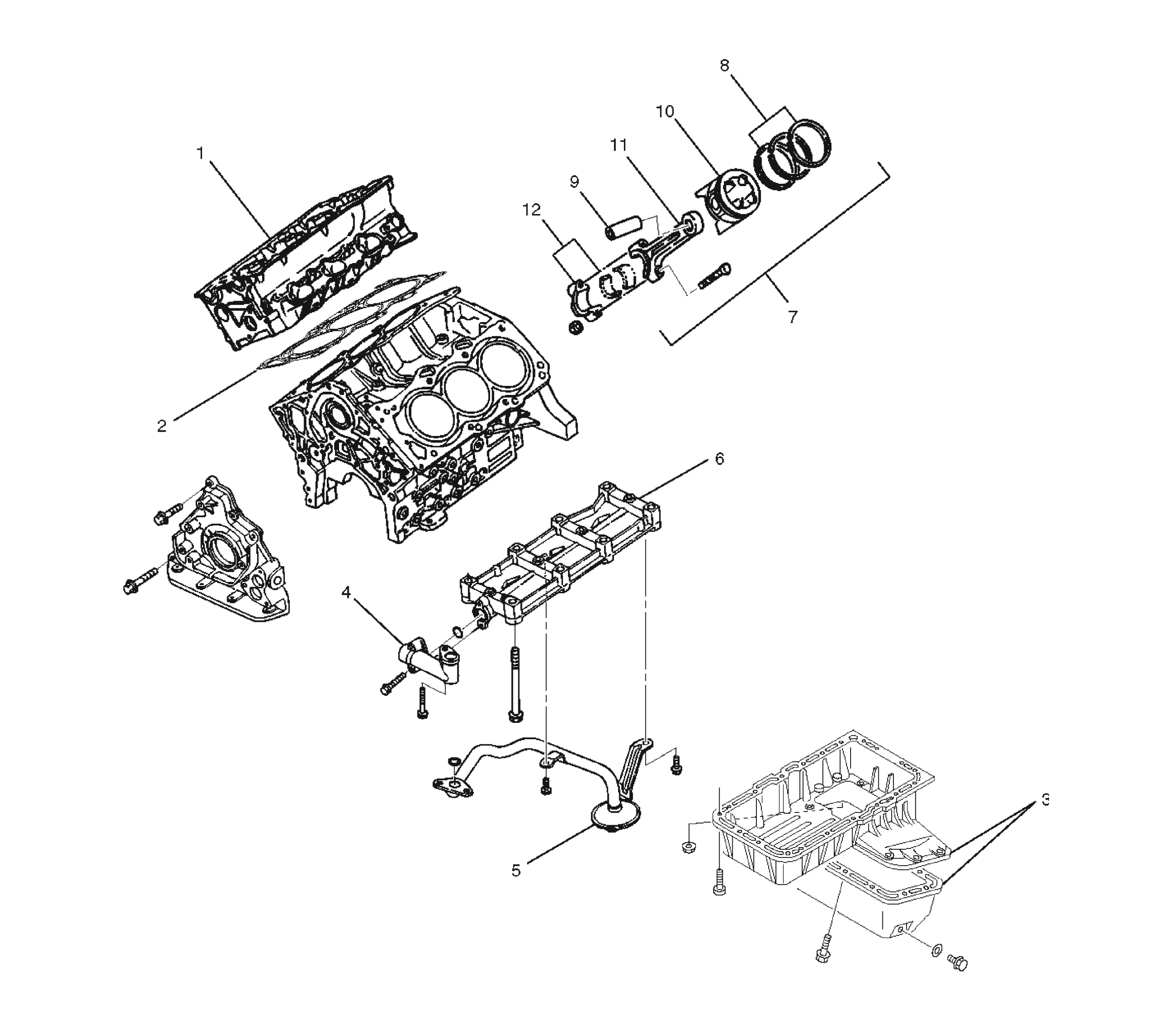
Legend

(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



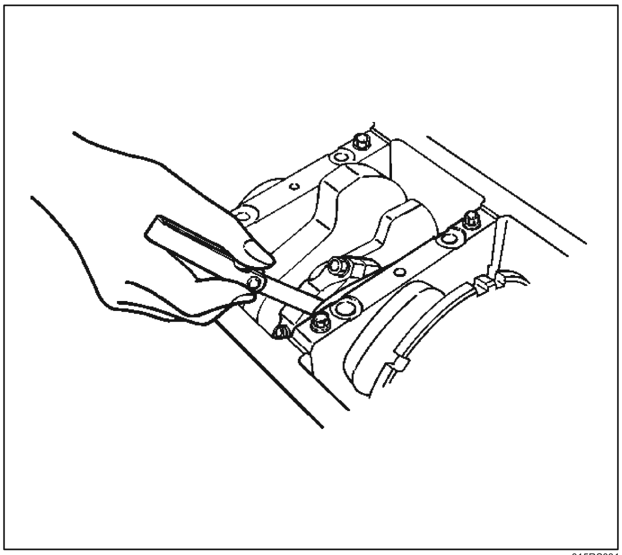
Legend

(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).

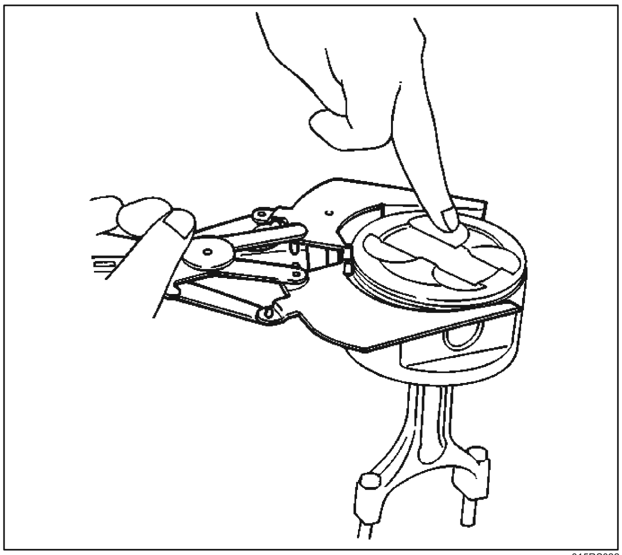
NOTE: Before removing piston and connecting rod assembly, measure thrust clearance.



015RS031

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

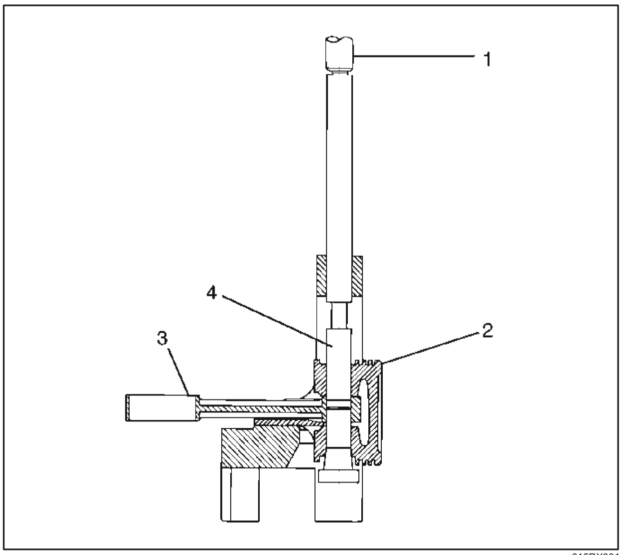
9. Remove the piston rings (8) with a piston ring expander. Arrange the removed piston rings in the cylinder number order.



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)

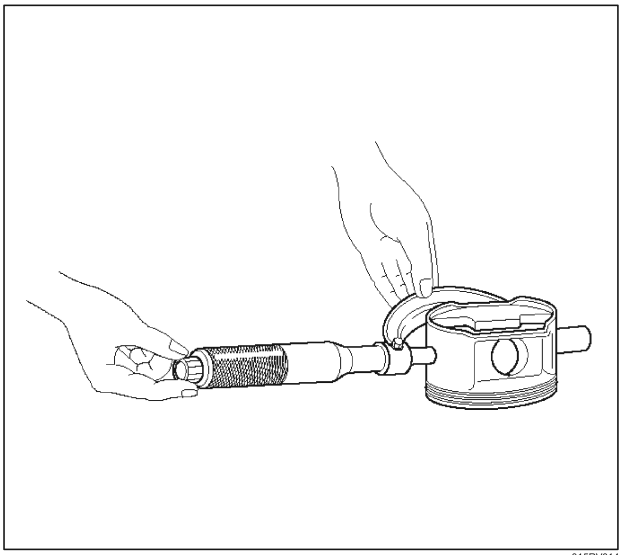
Carefully clean away all the carbon adhering to the piston head and the piston ring grooves.

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

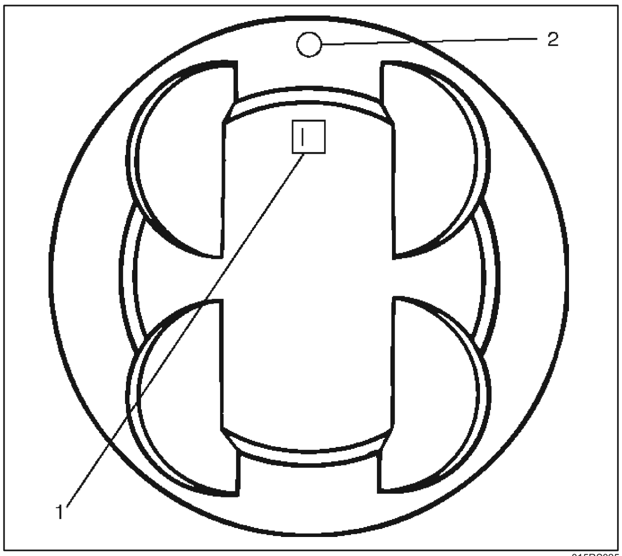
The size mark (1) for piston outside diameter is represented as shown in illustration below.

Outside Diameter

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

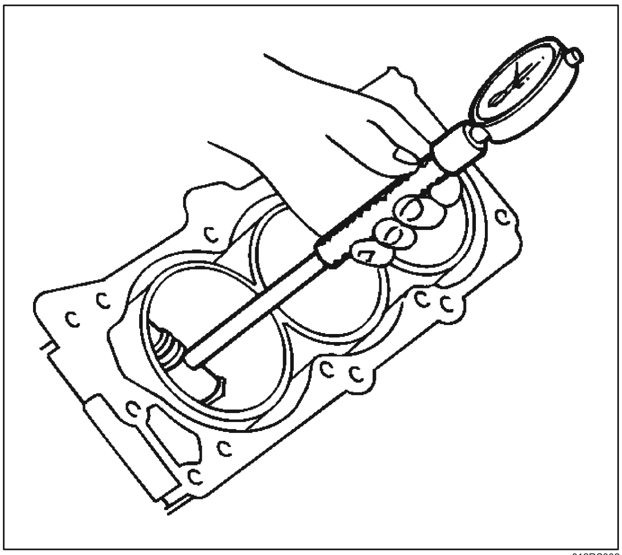
Size Mark B : 93.371 mm–93.380 mm (3.6760 in–3.6764 in)

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

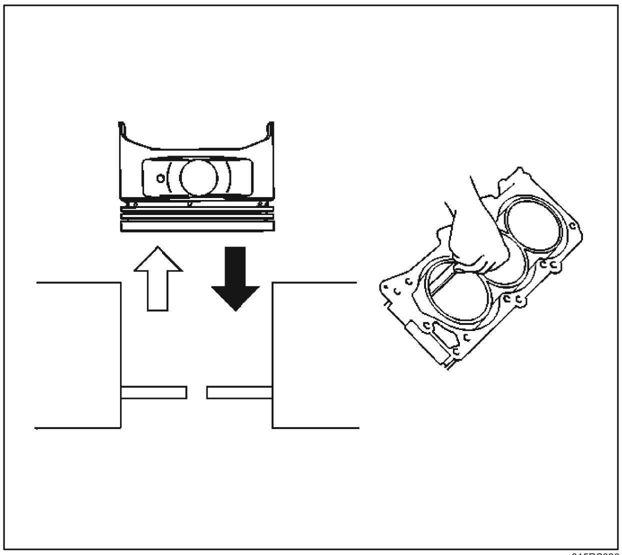
Standard:	**0.300 mm–0.400 mm (0.0118 in–0.0157 in)**
Limit:	**1.0 mm (0.0394 in)**

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)**

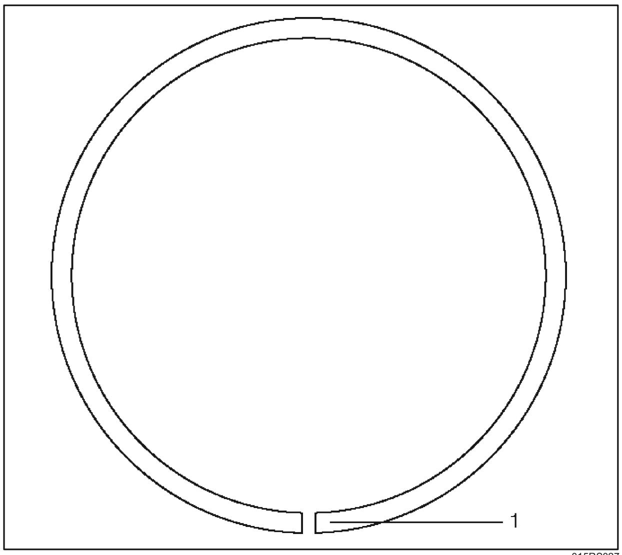


015RS026

- Positioning mark (1) is painted as shown in the illustration.

Marked T : No.1 Compression ring

Marked T2 : No.2 Compression ring



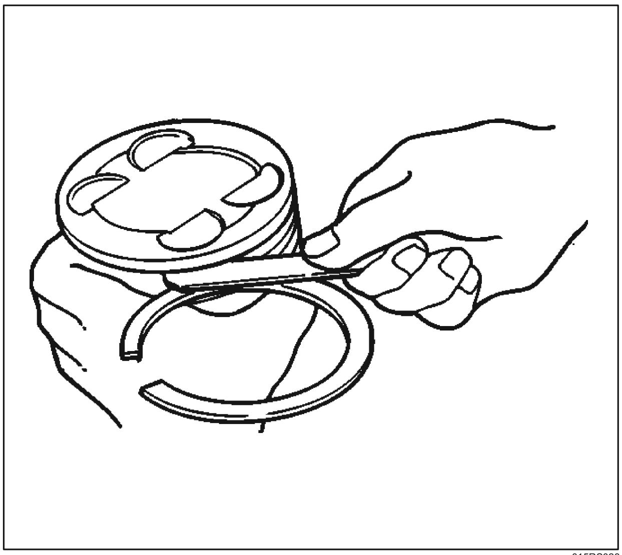
015RS027

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)



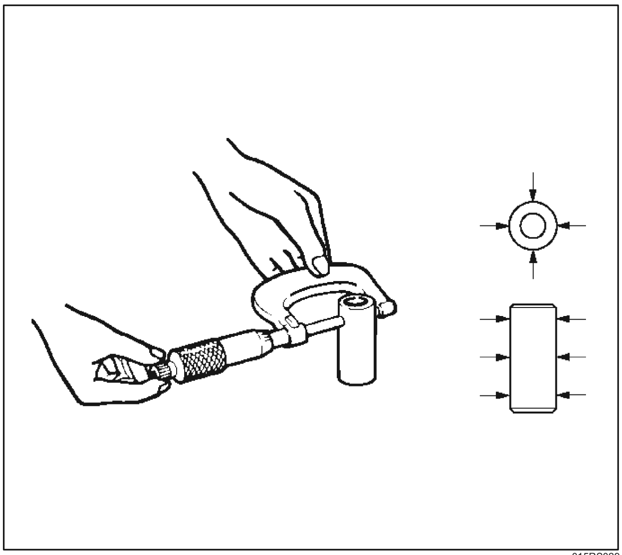
015RS028

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)

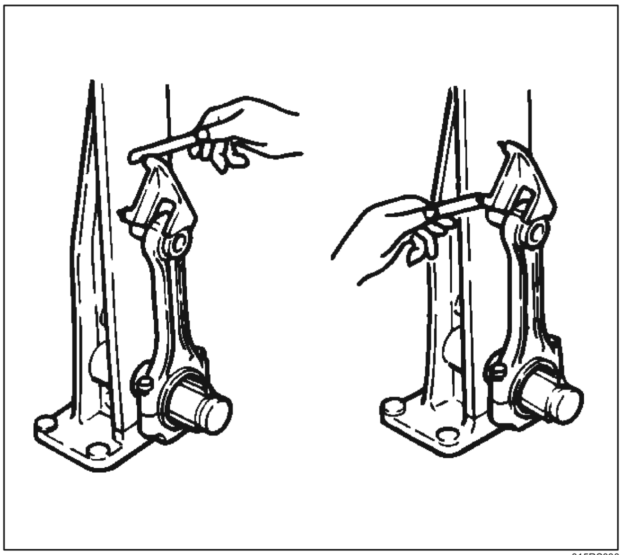
1. Check the connecting rod alignment If either the bend or the twist exceeds the specified limit, the connecting rod must be replaced.

Bend per 100 mm (3.937 in)

Limit: 0.15 (0.0059)

Twist per 100 mm (3.937 in)

Limit: 0.20 (0.0078)

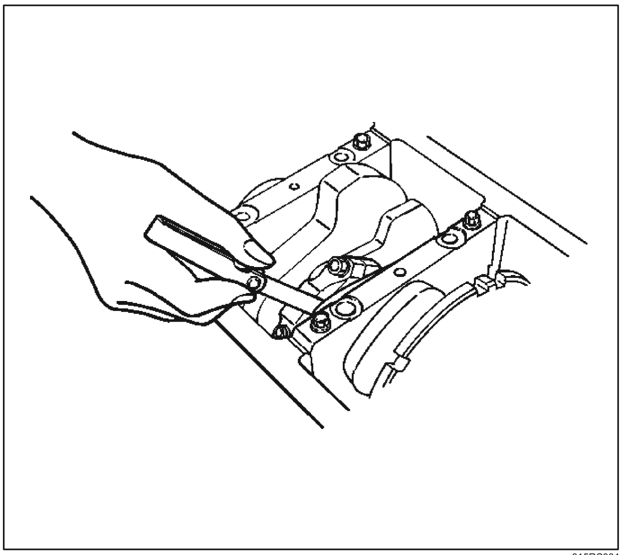


015RS030

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.

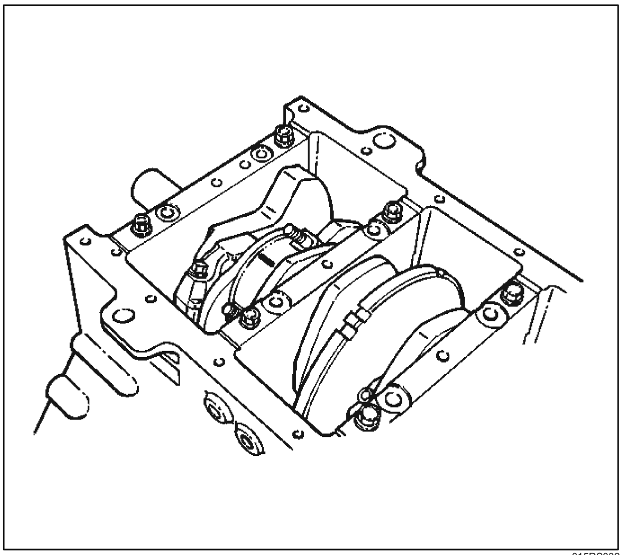
Standard : 0.16 mm–0.35 mm (0.0063 in.–0.0138 in)

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.

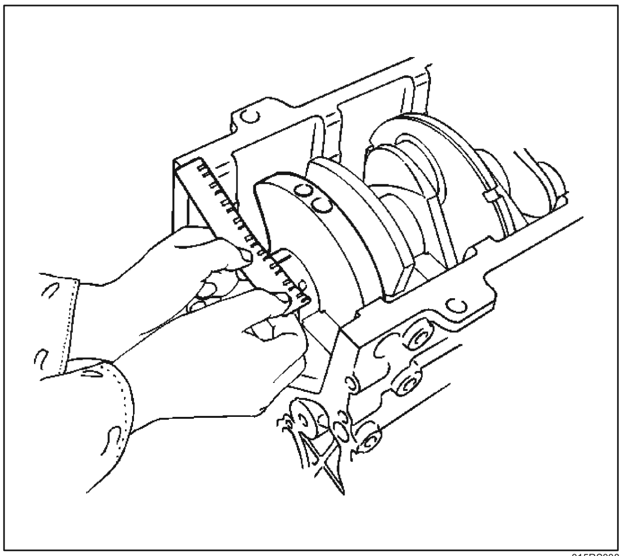
Torque: 54 N·m (5.5 Kg·m/40 lb ft)

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)



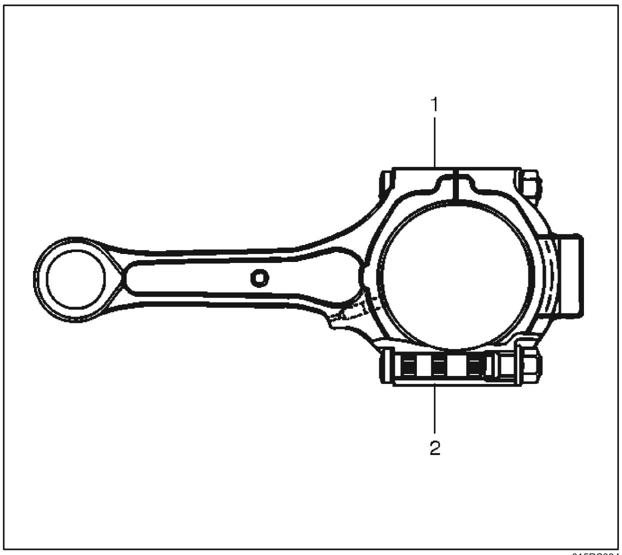
015RS008

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

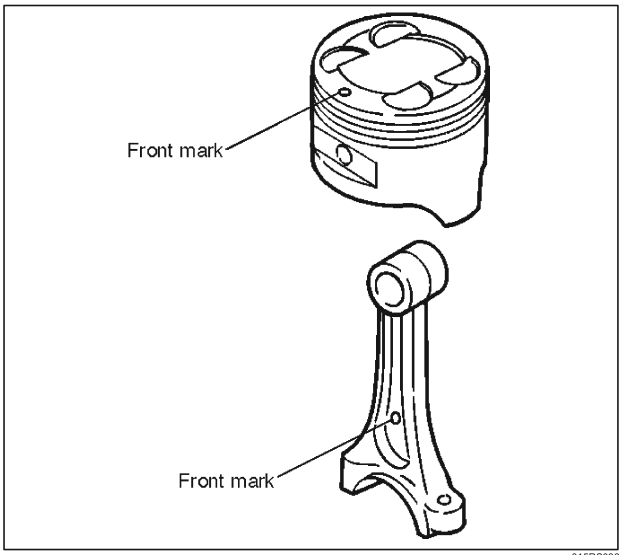
1 Size Mark	Big end Bore Diameter	Crankshaft Pin Diameter	Connecting Rod Bearing Thickness (Reference)	Color of Size Mark	Oil Clearance (Reference)
A	56.994-57.000 (2.2439-2.2441)	53.922-53.937 (2.1229-2.1235)	1.512-1.516 (0.0595-0.0597)	Yellow	0.025-0.054 (0.0010-0.0021)
B	56.988-56.994 (2.2436-2.2439)		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.

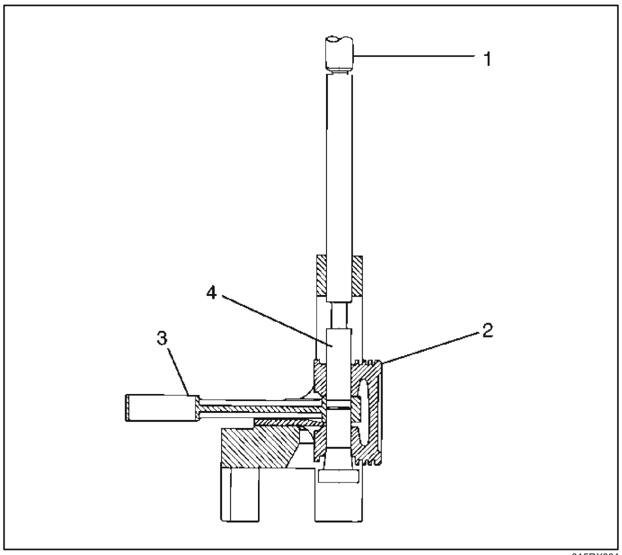
- Attach the piston to the connecting rod with the piston front mark and the connecting rod front mark on the same side.



015RS036

- 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

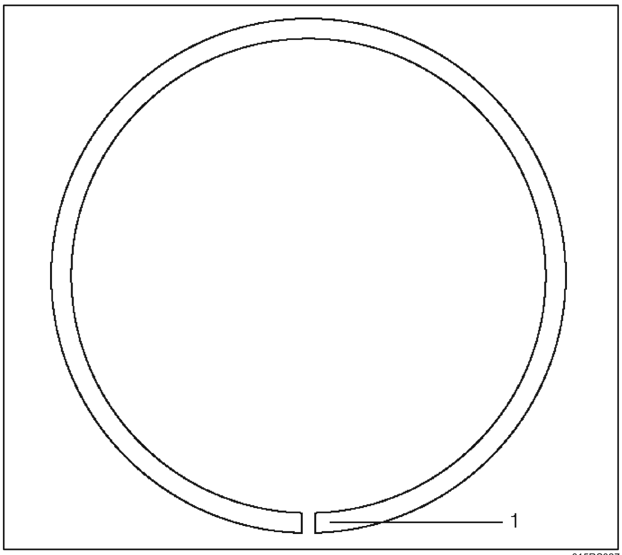
Legend

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

4. Install piston ring with the piston ring expander. The compression ring must be set with the T mark (1) facing up.

Marked T : No.1 Compression ring

Marked T2 : No.2 Compression ring



015RS027

- Install piston rings in the following sequence.

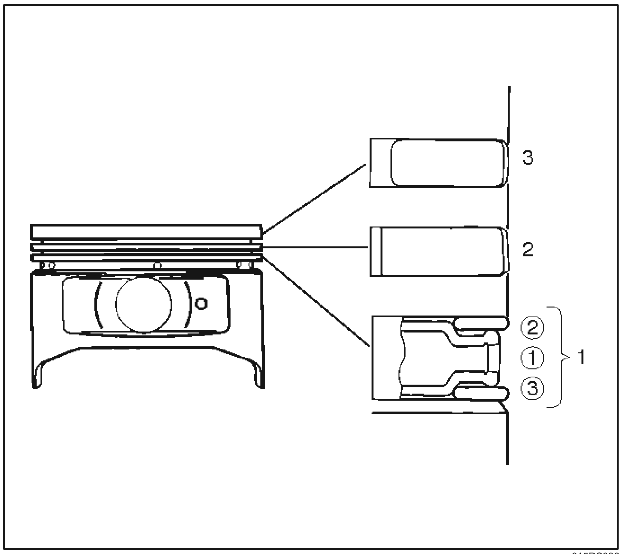
1. Oil ring
    1. Expander ring
    2. Upper side rail
    3. Lower side rail
2. 2nd compression ring
3. 1st compression ring

- The compression rings must be set with the T or T2 mark facing up.

Marked T : No.1 Compression ring

Marked T2 : No.2 Compression ring

- 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

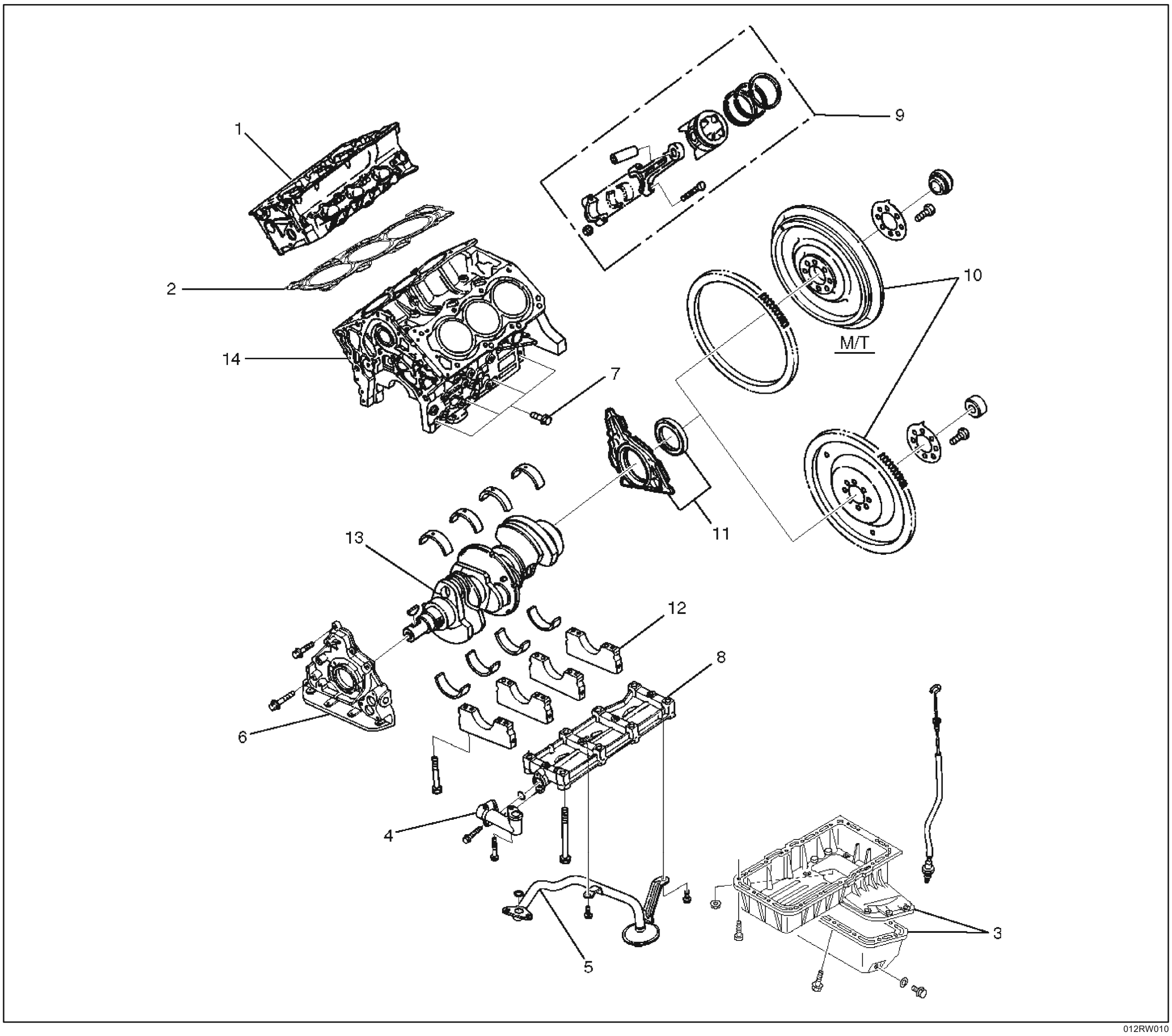
Torque : 54 N·m (5.5 Kg·m/40 lb ft)

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



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.

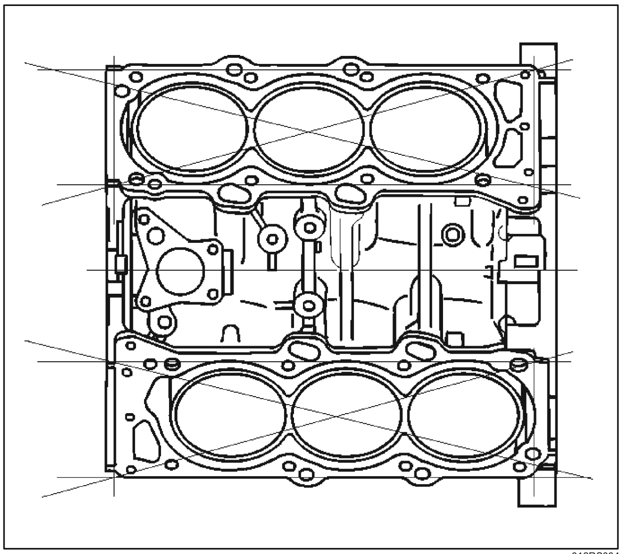
CAUTION: Be very careful not to allow any material to accidentally drop into the upper surface of the cylinder block. Be very careful not to scratch the upper surface of the cylinder block.

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 (3.6823)

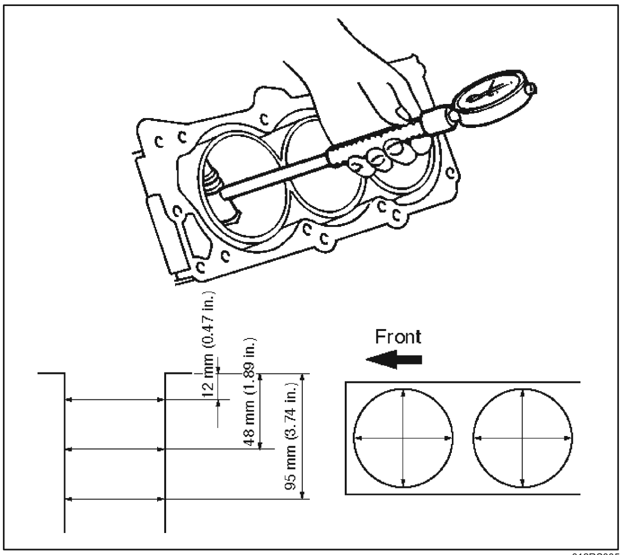
If the measurement exceed the specified limit, the cylinder block must be replaced.

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)

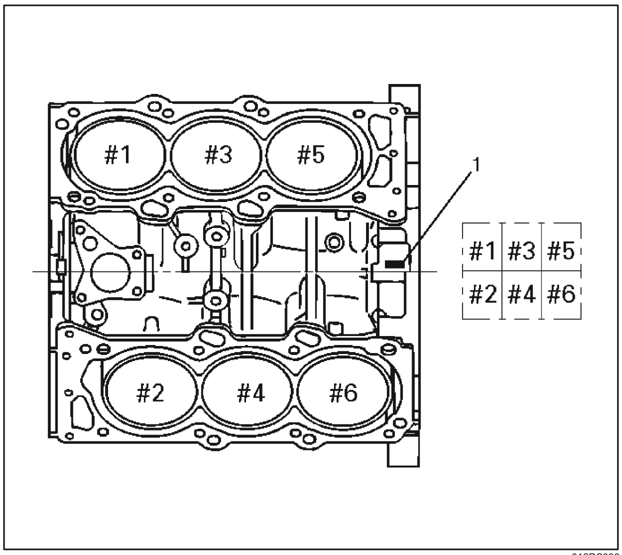
Grade C : 93.421 mm–93.430 mm (3.6780 in–3.6783 in)



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.

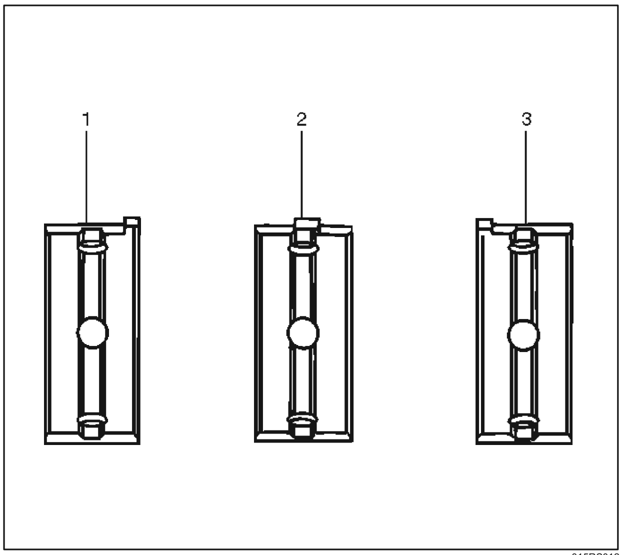


012RS006

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.

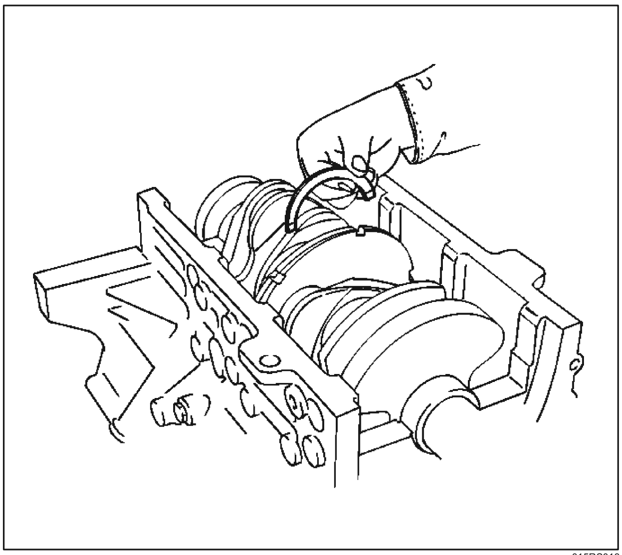


015RS012

Legend

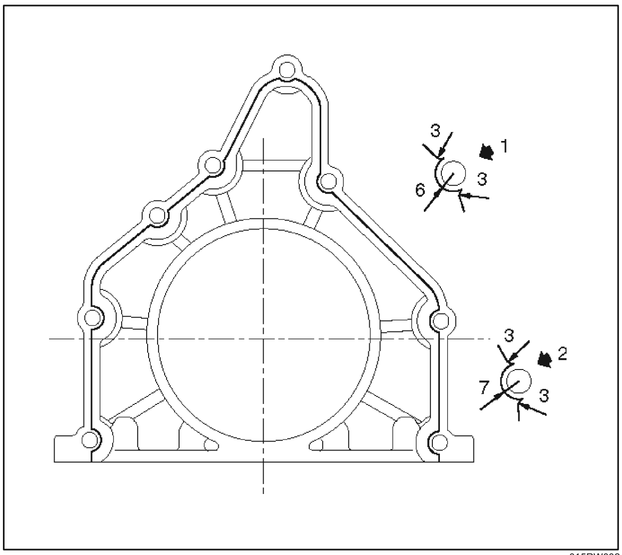
(1) Number 1 and 4 main bearing upper and lower.
(2) Number 2 and 3 main bearing upper.
(3) Number 2 and 3 main bearing lower.

- 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.



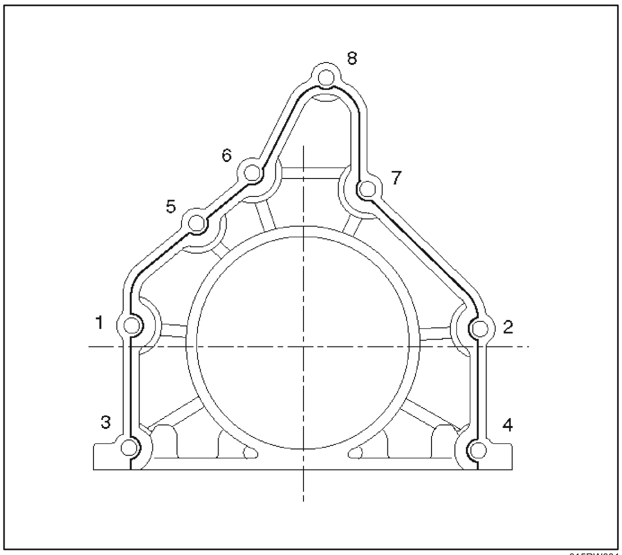
015RW002

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)

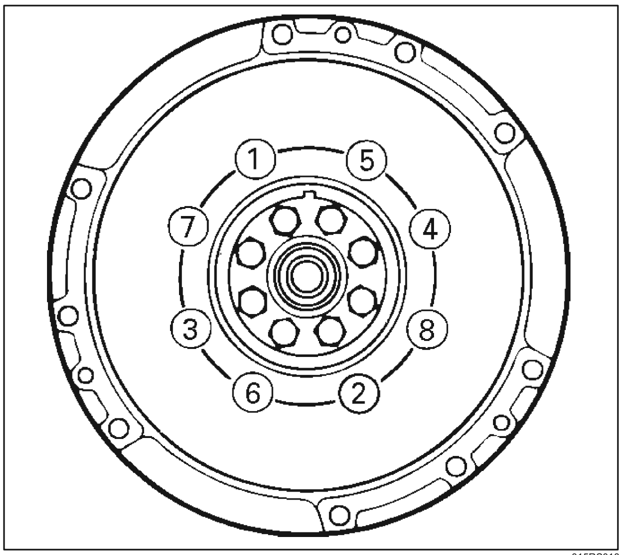


015RW001

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.

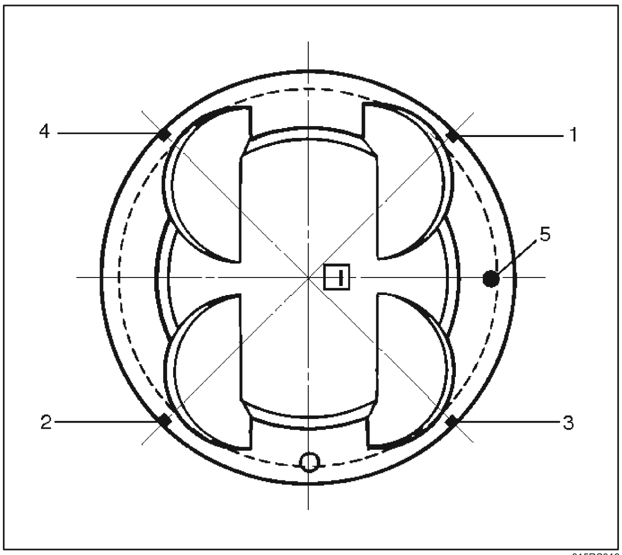


015RS018

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.

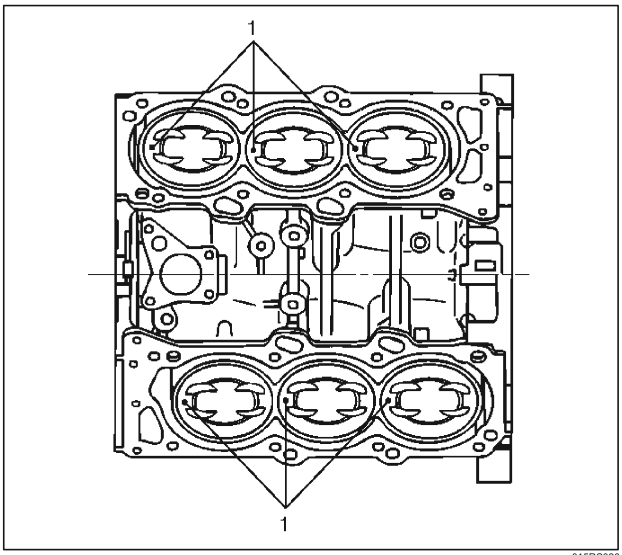


015RS019

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.

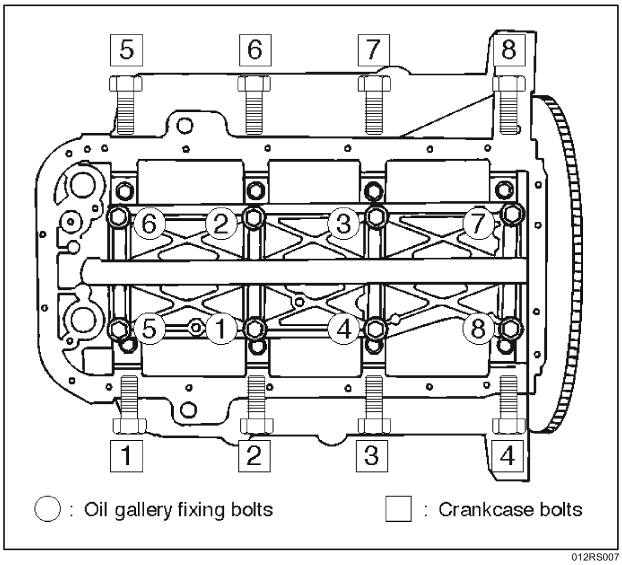


015RS020

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

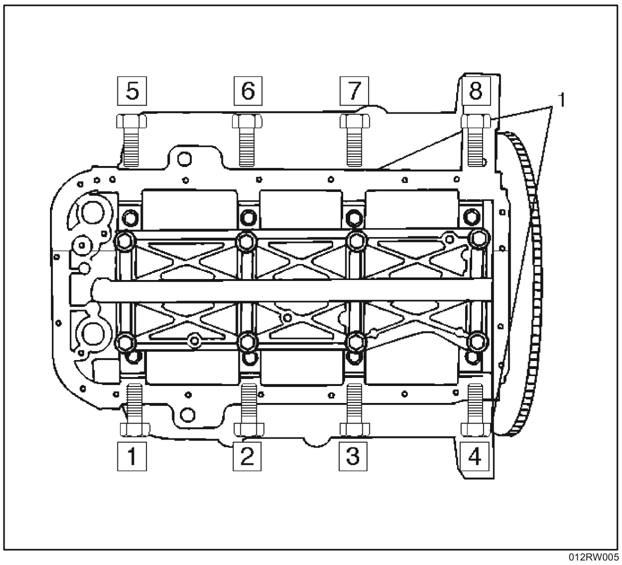
1st step : 29 N·m (3.0 Kg·m/22 lb ft)

2nd step : 55°~ 65°



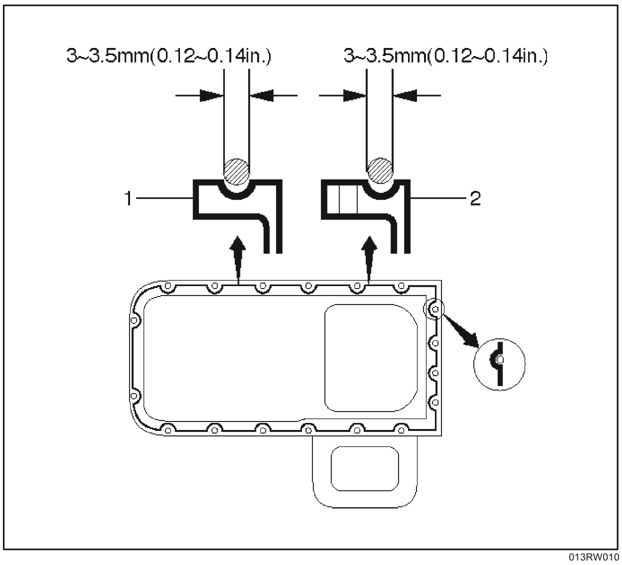
7. Install cylinder block side bolts (1) and tighten crankcase bolts in sequence shown in the illustration.

Torque : 39 N·m (4.0 Kg·m/29 lb ft)



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/89 lb in)



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

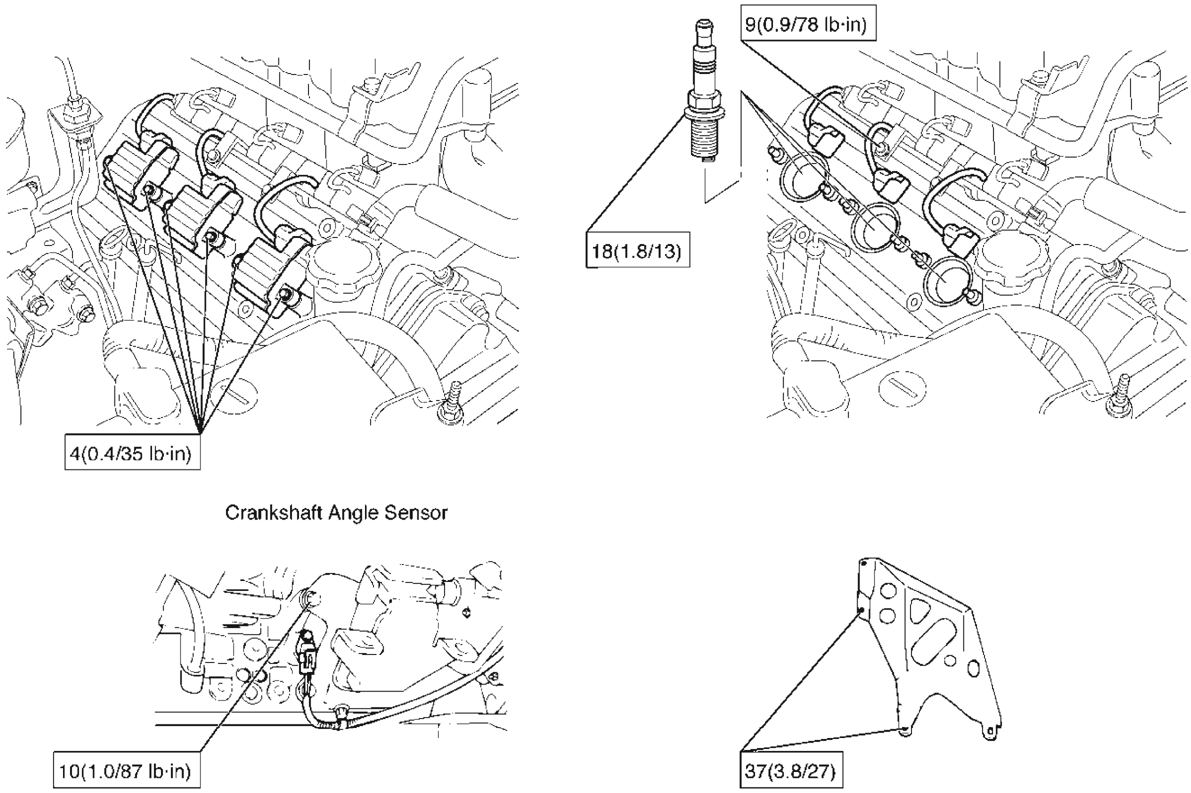
General Specification

Item	Specifications	
	6VD1	6VE1
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 drive	
Total piston displacement	3165 cc	3494 cc
Cylinder bore x stroke	93.4mm x 77.0mm (3.6772 in x 3.0315 in)	93.4mm x 85.0mm (3.6772 in x 3.3465 in)
Compression ratio	9.1 : 1	
Compression pressure at 300rpm	14.0 Kg/cm^2	
Engine idling speed rpm	Non adjustable (750)	
Valve clearance	Intake: 0.28 mm (0.11 in)	
	Exhaust: 0.30mm (0.12in)	
Oil capacity	5.3 liters	
Ignition timing	Non adjustable 16° BTDC at idle rpm)	Non adjustable (20° BTDC at idle rpm)
Spark plug	K16PR–P11, PK16PR11, RC10PYP4	
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

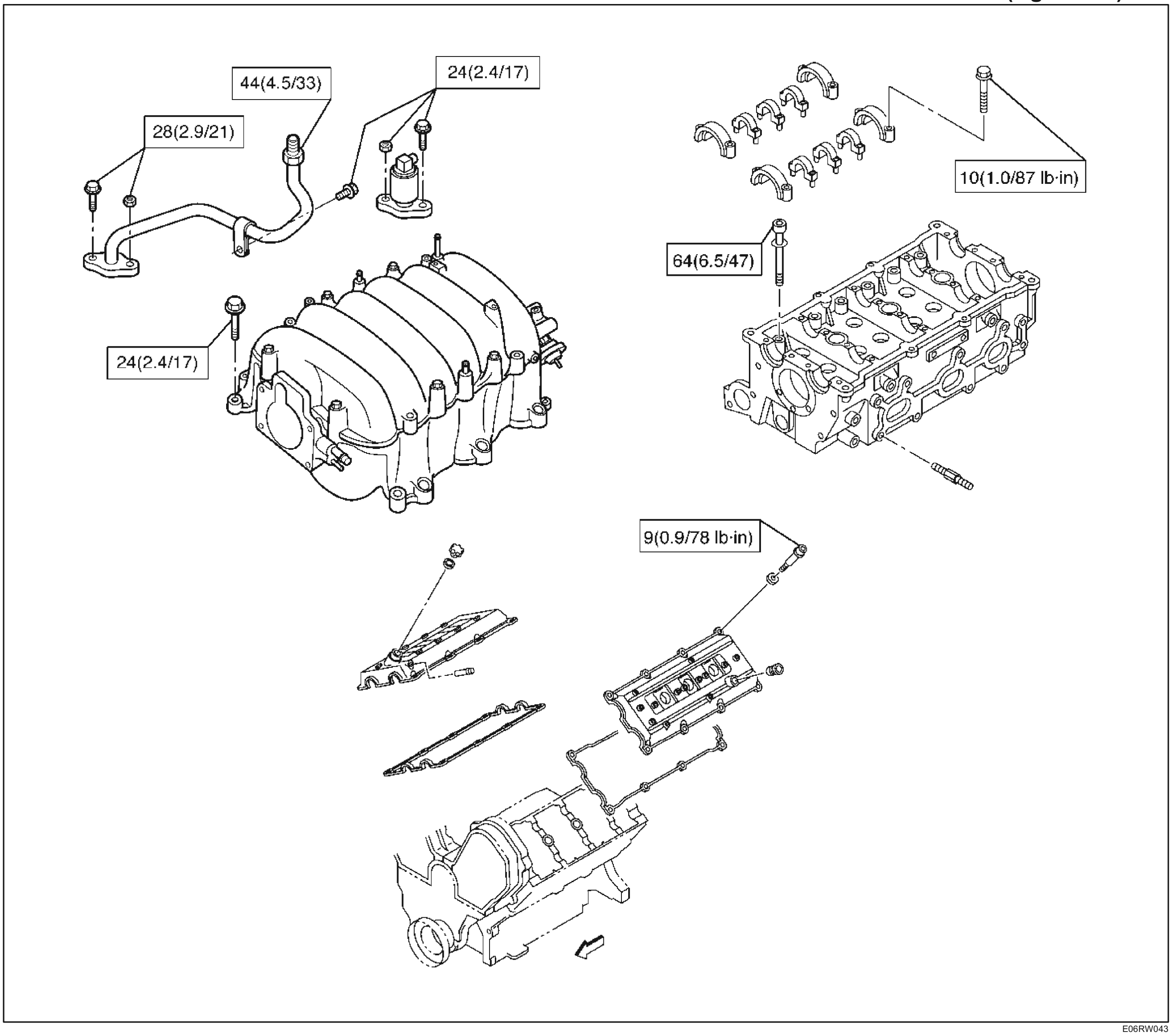
N·m (Kg·m/lb ft)



E06RW038

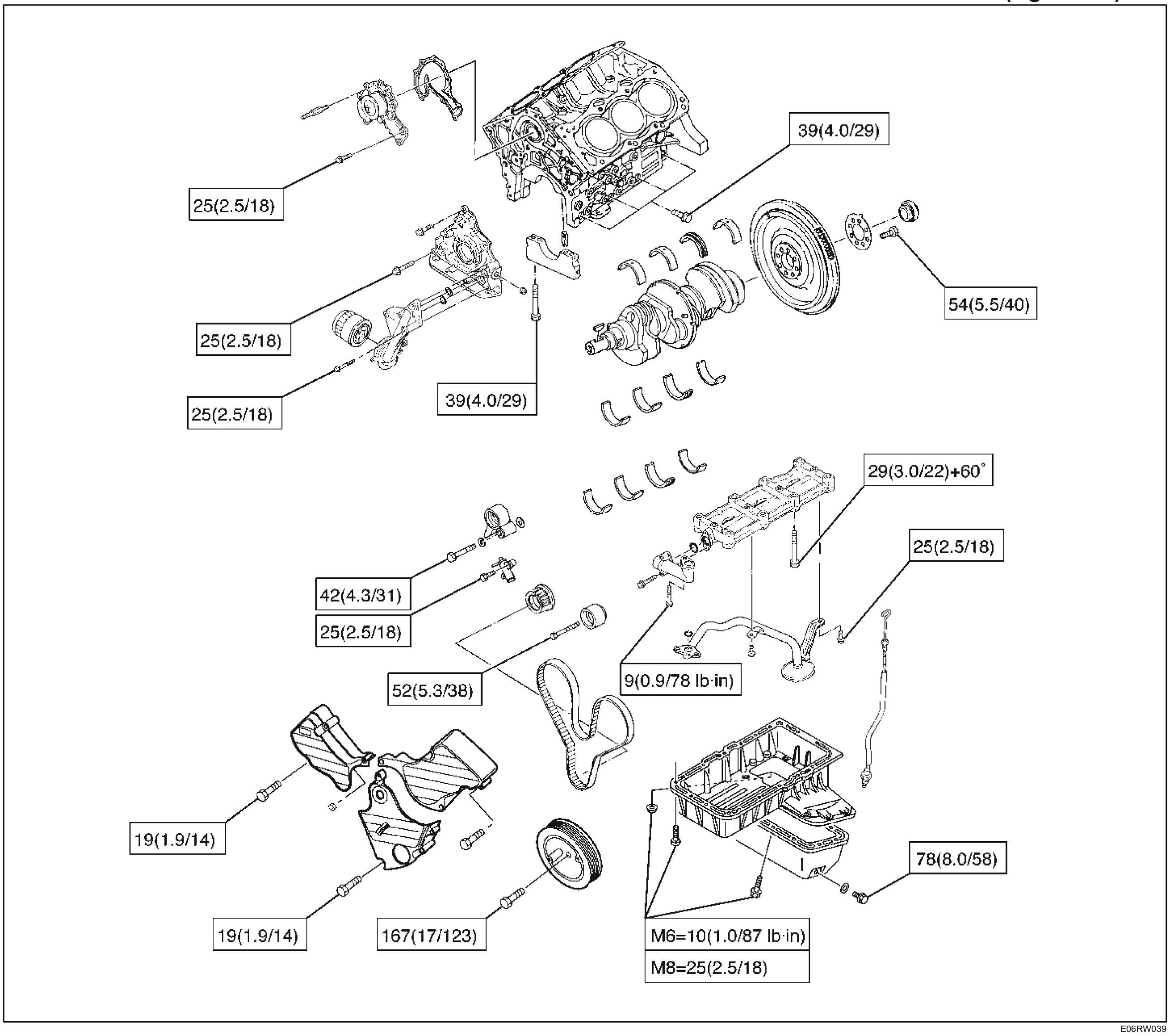
Cylinder head cover, Cylinder head, Camshaft bracket, Common chamber, EGR valve and EGR pipe

N·m (Kg·m/lb ft)



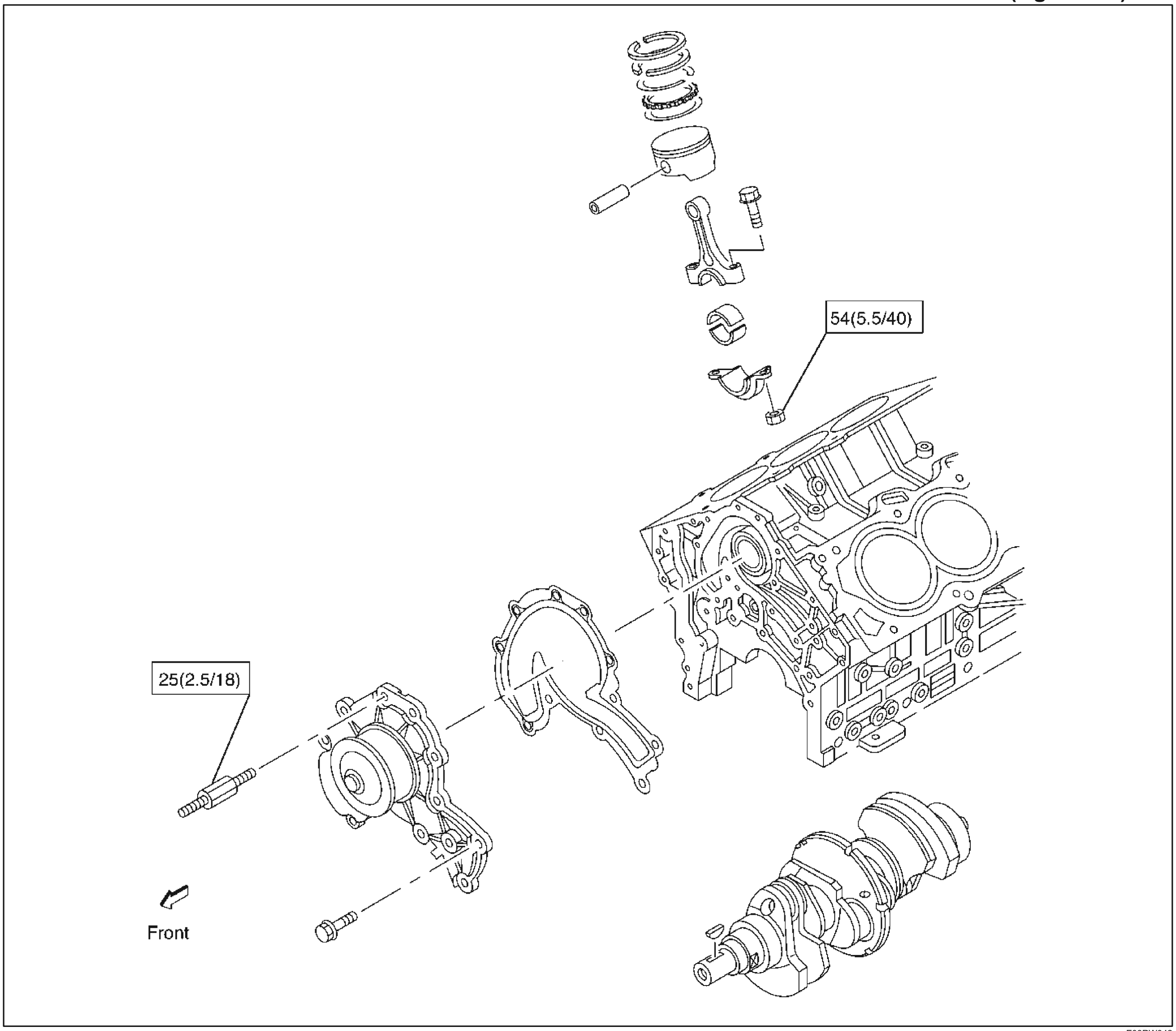
Crankshaft main bearing, Flywheel, Crankcase, Oil pan, Timing belt tensioner, Timing pulley, Timing belt cover, Oil pump, Oil gallery, Oil strainer and Water pump

N·m (Kg·m/lb ft)



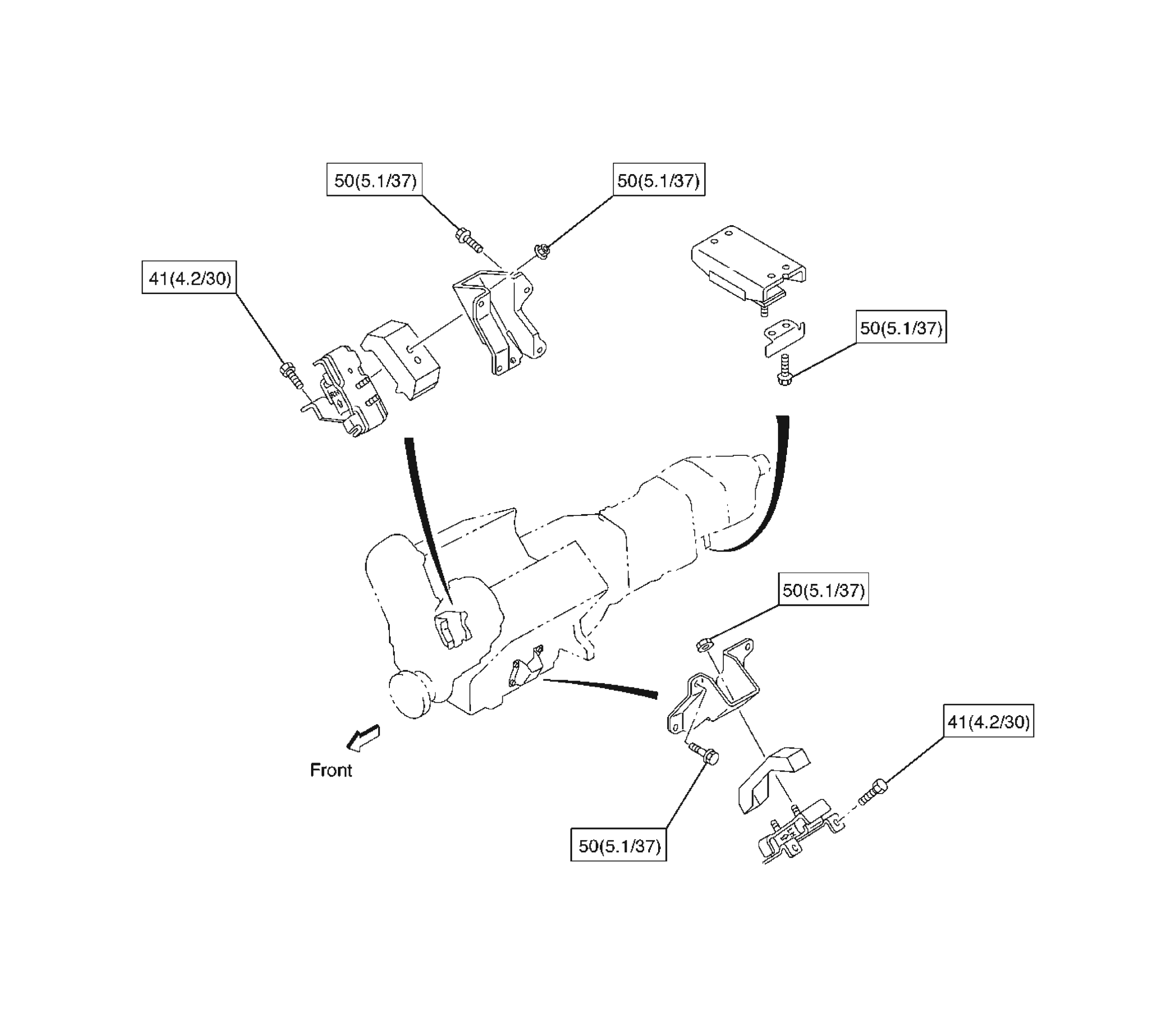
Connecting rod and Water pump

N·m (Kg·m/lb ft)



Engine mount

N·m (Kg·m/lb ft)



E06RW040

Special Tool

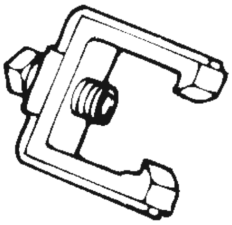
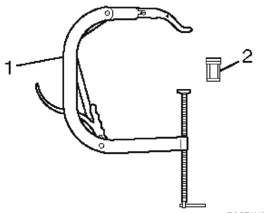
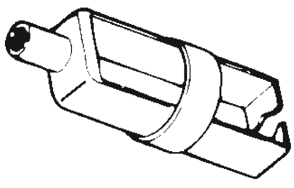
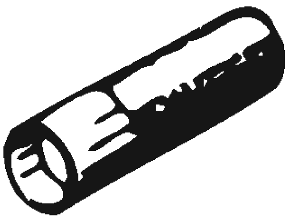
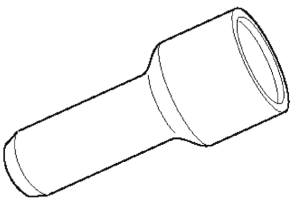
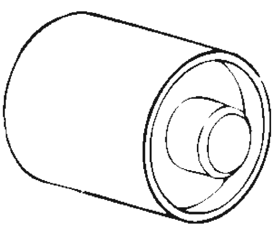
ILLUSTRATION	**TOOL NO.** TOOL NAME
	**5–8840–0011–0** **(J–21687–02)** Remover; tie rod end
	**5–8840–2441–0** Set Number of Valve Compressor **5–8840–2446–0** **(J–8062)** Compressor; Valve Spring (1) **5–8840–2547–0** **(J–42898)** Adapter; Compressor Valve Spring (2)
	**5–8840–0623–0** **(J–37281)** Remover; Oil controller
	**5–8840–0624–0** **(J–38537)** Installer; Oil controller
	**5–8840–2445–0** **(J–42985)** Installer; Camshaft oil seal
	**5–8840–2545–0** **(J–39206)** Installer; Pilot bearing

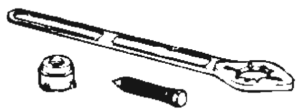
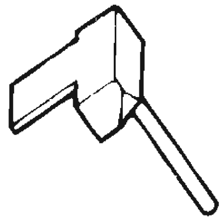
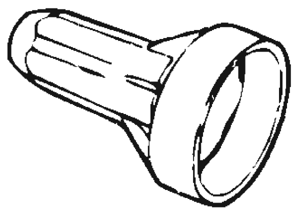
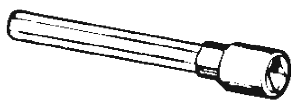
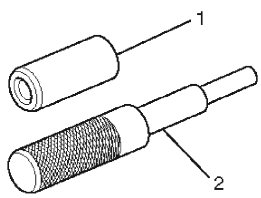
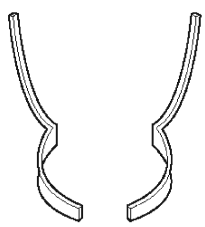
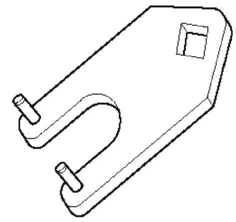
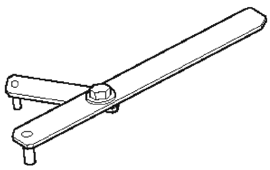
ILLUSTRATION	**TOOL NO.** TOOL NAME
	**5–8840–0133–0** **(J–8614–01)** Holder; Crankshaft
	**5–8840–2153–0** **(J–37228)** Seal cutter
	**5–8840–2286–0** **(J–39201)** Installer; Real oil seal
	**9–8511–4209–0** **(J–24239–1)** Cylinder head bolt wrench
	**5–8840–2442–0** **(J–42899)** Replacer; Valve guide (set) (1,2) **5–8840–2548–0** **(J–42687)** Installer; Valve guide (1) **5–8840–2549–0** **(J–37985–1)** Remover; Valve guide (2)
	**5–8840–2444–0** **(J–42689)** Adjusting Tool: Valve clearance

ILLUSTRATION	**TOOL NO.** TOOL NAME
 901RW110	**5–8840–2443–0** **(J–42686)** Lever; Gear spring
 901RW115	**5–8840–2447–0** **(J–43041)** Holder; Universal

ENGINE

ENGINE COOLING

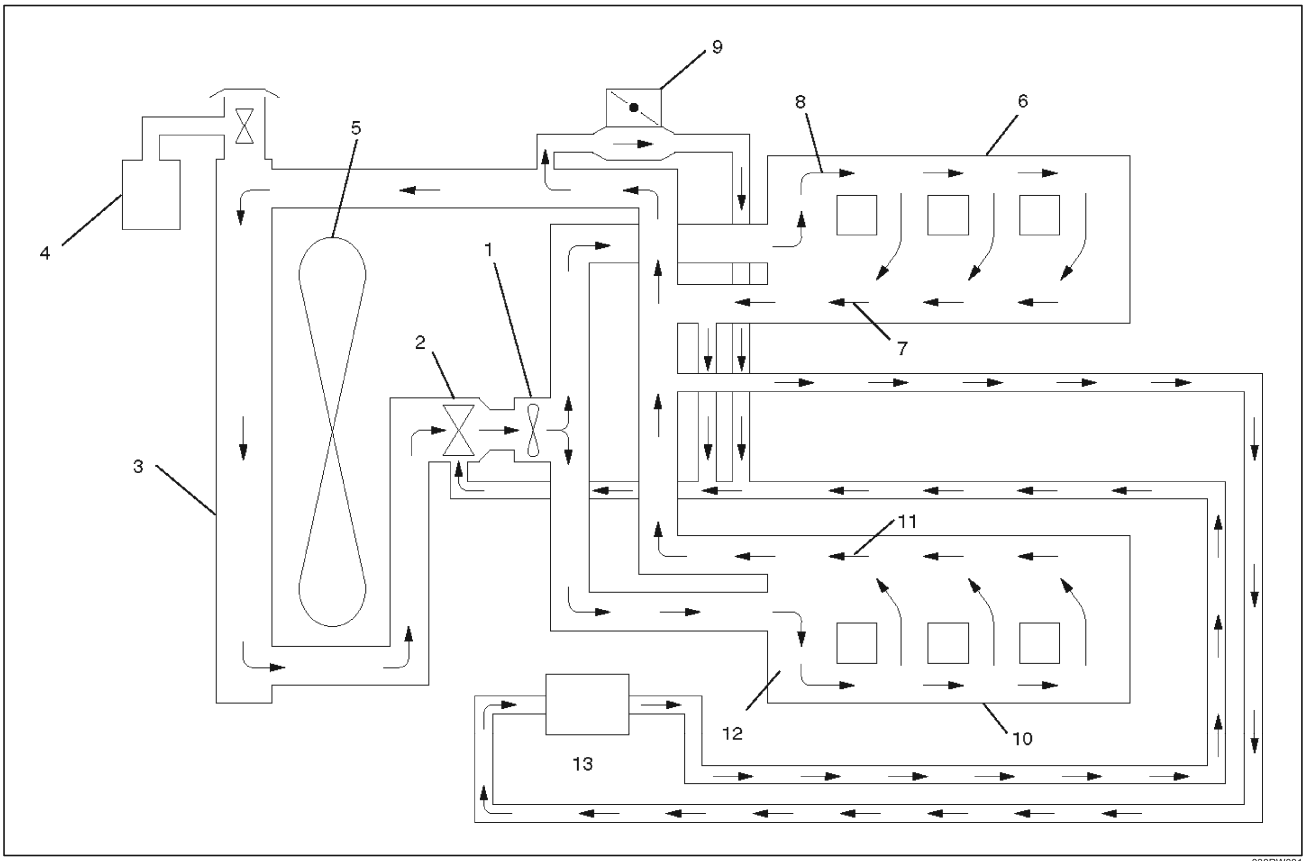
CONTENTS

Service Precaution

WARNING: IF SO EQUIPPED WITH 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

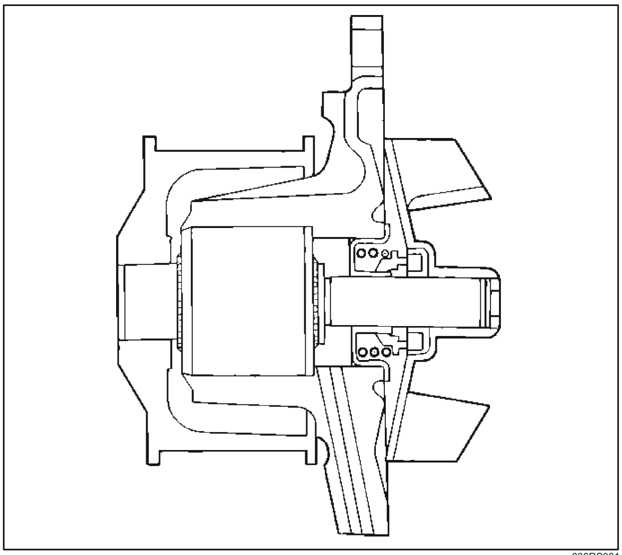
Legend

(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 cooling system is a pressurized Engine Coolant (EC) forced circulation type which consists of a water pump, thermostat cooling fan, radiator and other components. The automatic transmission fluid is cooled by the EC in radiator.

Water Pump

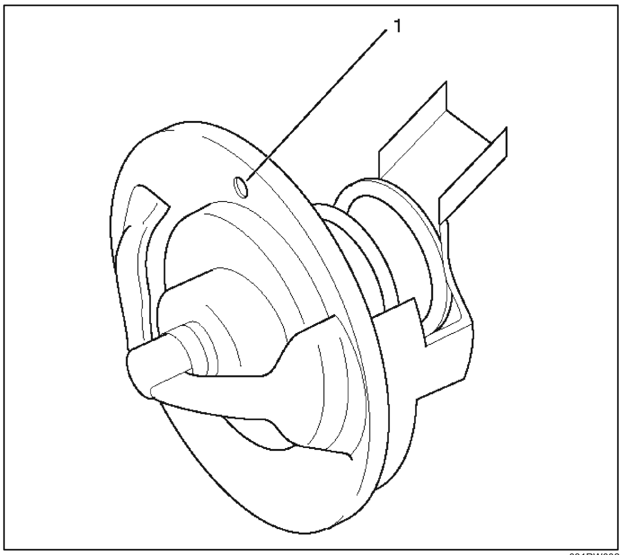
The EC pump is a centrifugal impeller type and is driven by a timing belt.



030RS001

Thermostat

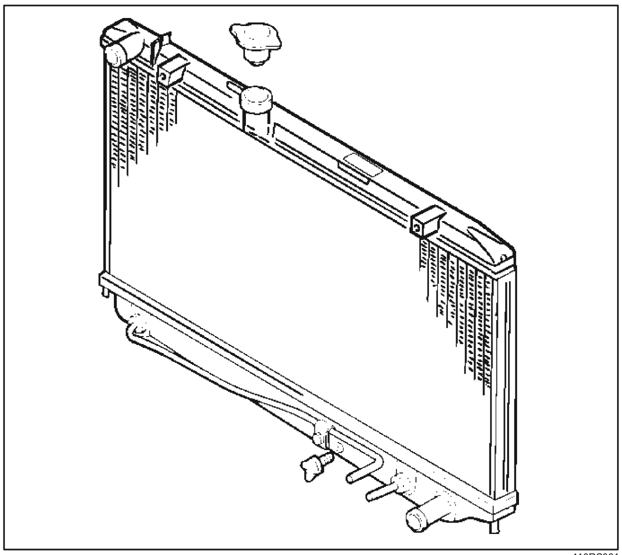
The thermostat is a wax pellet type with a air hole(1) and is installed in the thermostat housing.



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 88.2 ~ 117.6 kPa (12.8 ~ 17.0 psi) pressure. (No oil cooler provided for M/T)



110RS001

Anti Freeze Solution

- Relation between the mixing ratio and freezing temperature of the EC varies with the ratio of anti–freeze solution in water. Proper mixing ratio can be determined by referring to the chart. Supplemental inhibitors or additives claiming to increase cooling capability that have not been specifically approved by Isuzu are not recommended for addition to the cooling system.
- Calculating mixing ratio

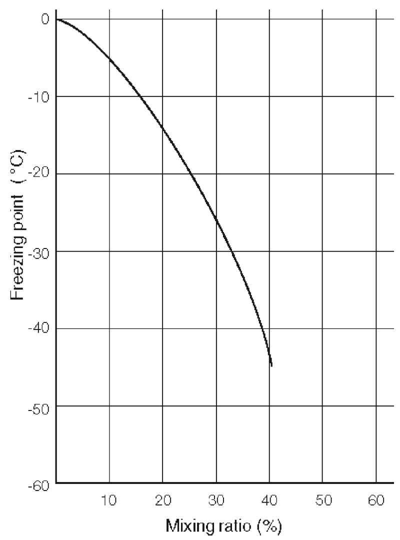
Mixing ratio

$$= \frac{\text{Anti freeze solution (Lit/gal.)}}{\text{Anti freeze solution (Lit/gal.)} + \text{Water (Lit/gal.)}}$$

F06RW005

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

- **Total Cooling System Capacity**
- **M/T 8.8Lit (2.32Us gal)**
- **A/T 8.4Lit (2.22Us gal)**



B06RW002

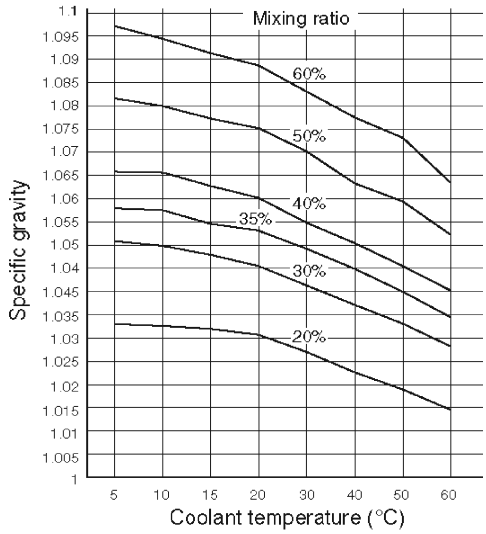
- Mixing ratio

  Check the specific gravity of engine coolant in the cooling system temperature ranges from 0°C to 50°C using a suction type hydrometer, then determine the density of the engine coolant by referring to the table.

NOTE:

1. Even in the areas where the atmospheric temperature is higher than 0°C, be sure not to use antifreeze solution at a mixing ratio lower than 20% so that the inside of the engine may not be corroded.
2. If antifreeze solution is used at a mixing ratio higher than 60%, the specific heat of the coolant falls and the engine may be overheated. Moreover, antifreeze performance drop and the coolant may be frozen. The density of the solution must be adjusted as occasion calls.

Antifreeze solution lower than 20% may not have sufficient anticorrosive performance, and therefore, please never fail to adjust as occasion demands within the range of 20% to 60%.



B06RW003

Diagnosis

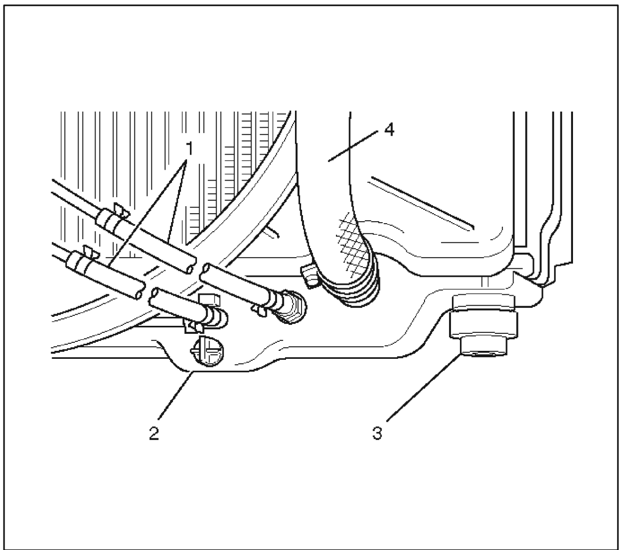
Engine Cooling Trouble

Condition	Possible cause	Correction
Engine overheating	Low Engine Coolant level	Replenish
	Incorrect fan installed	Replace
	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 (2) at the bottom of the radiator.



110RW002

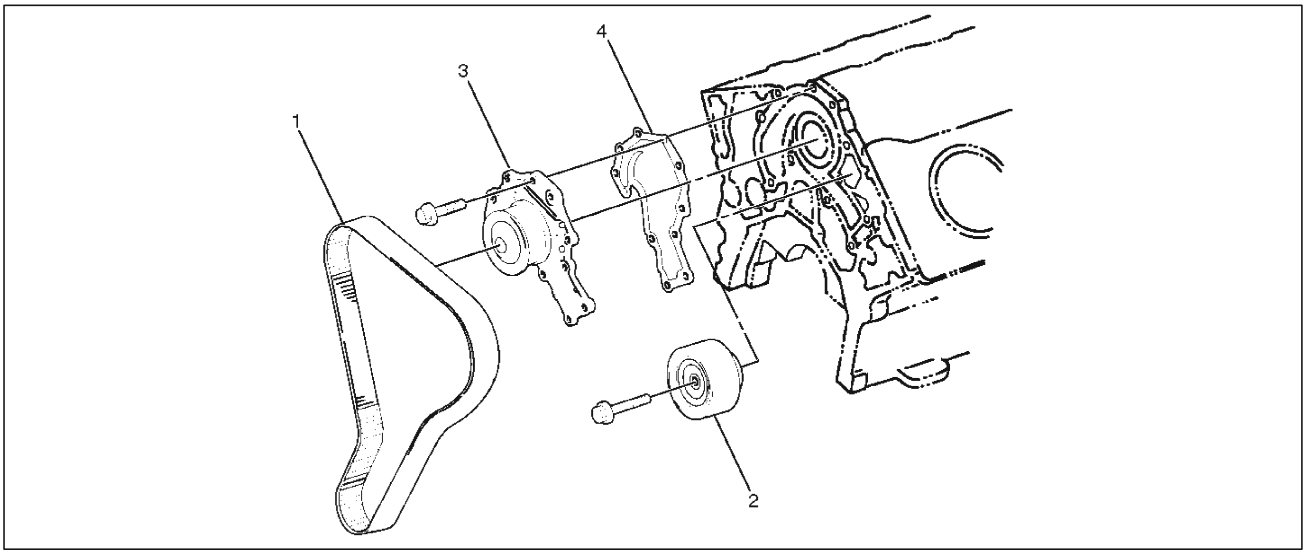
2. Remove the radiator cap.

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 at least 50 percent antifreeze but no more than 70 percent antifreeze.
5. Fill the radiator to the base of the filler neck.
   Fill the EC reserve tank to “MAX” line when the engine is cold.
6. Block the drive wheels and firmly apply the parking brake. Shift an automatic transmission to “P” (Park) or a manual transmission to neutral.
7. Remove the radiator cap. Start the engine and warm it up at 2,500 ~ 3,000 rpm for about 30 minutes.
8. When the air comes out from the radiator filler neck and the EC level has gone down, replenish with the EC. Repeat this procedure until the EC level does not go down. Then stop the engine and install the radiator cap. Let the engine cool down.
9. After the engine has cooled, replenish with EC up to the “MAX” line of the reserve tank.
10. Start the engine. With the engine running at 3,000 rpm, make sure there is no running water sound from the heater core (behind the center console).
11. If the running water sound is heard, repeat steps 8 to 10.

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.

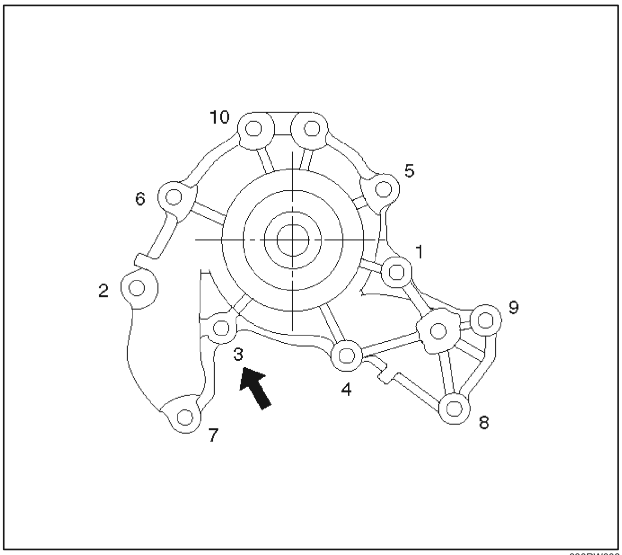
Installation

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

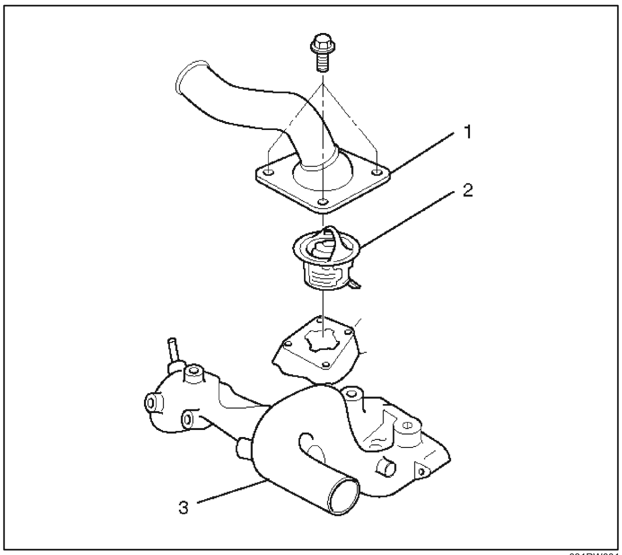
3. Idle pulley
   - Install idle pulley and tighten bolt to the specified torque.

   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

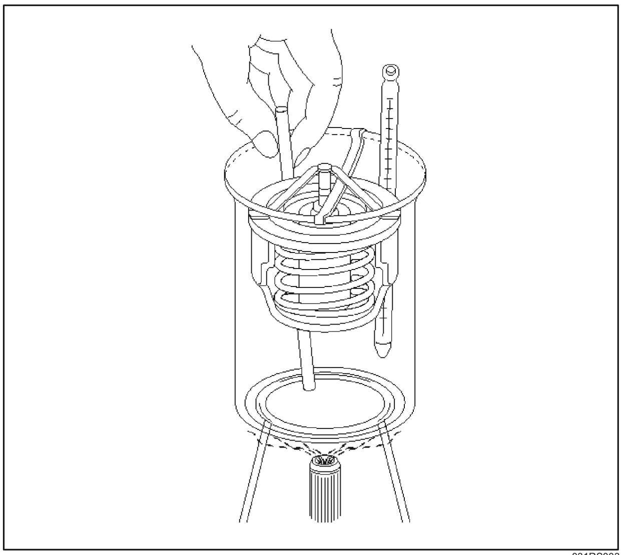
(1) Thermostat Housing
(2) Thermostat
(3) Outlet Pipe

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 74.5C ~ 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

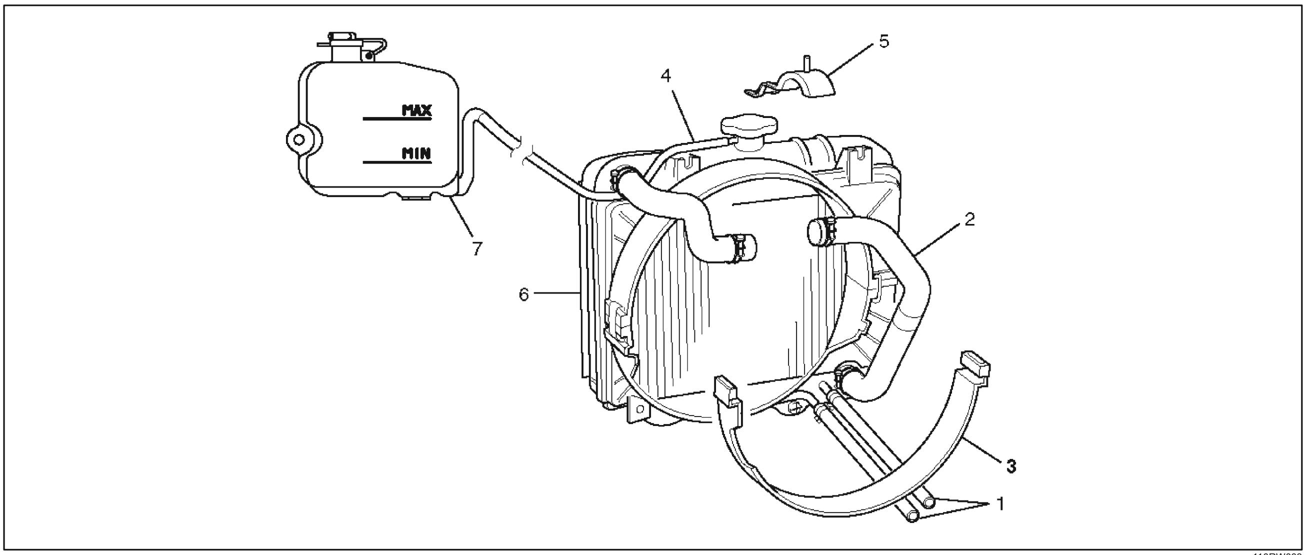
1. Install thermostat into the outlet pipe(4) making sure that the air hole is in the up position.
2. Install thermostat housing and tighten bolts to the specified torque.

   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



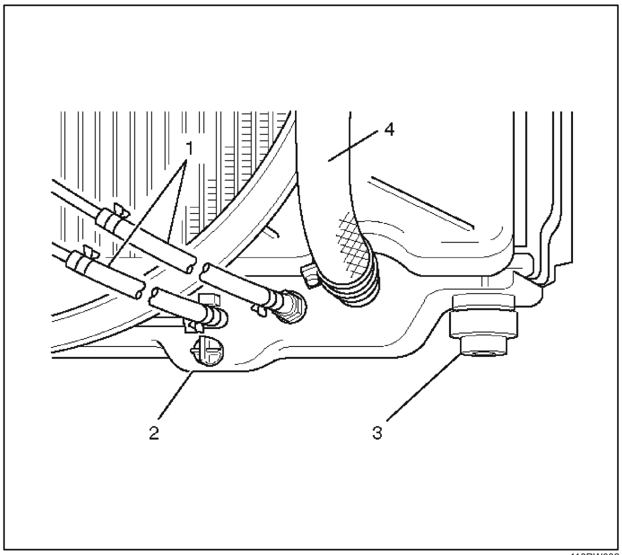
110RW003

Legend

(1) Oil Cooler Hose For Automatic Transmission
(2) Radiator Hose
(3) Fan Guide, Lower
(4) Reserve Tank Hose
(5) Bracket
(6) Radiator Assembly
(7) Reserve Tank

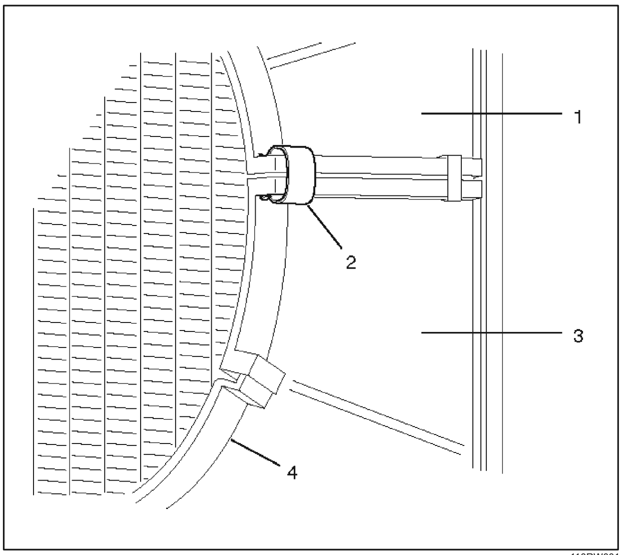
Removal

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



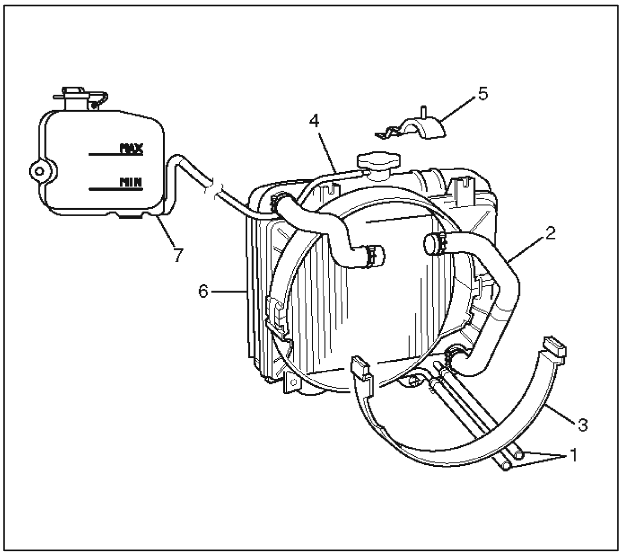
110RW002

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



110RW001

6. Disconnect the reserve tank hose(4) 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.
9. Remove rubber cushions on both sides at the bottom.

Inspection

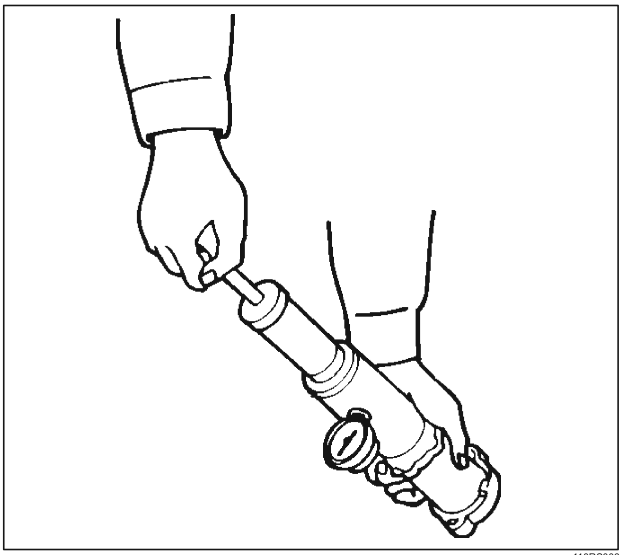
Radiator Cap

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) 88.3 ~ 117.7 (12.8 ~17.1)

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

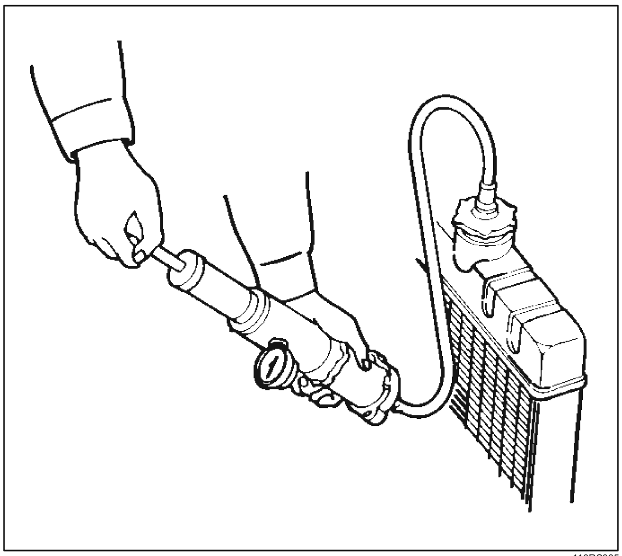
Thoroughly wash the inside of the radiator and the engine coolant passages with cold water and mild detergent. Remove all signs of scale and rust.

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.

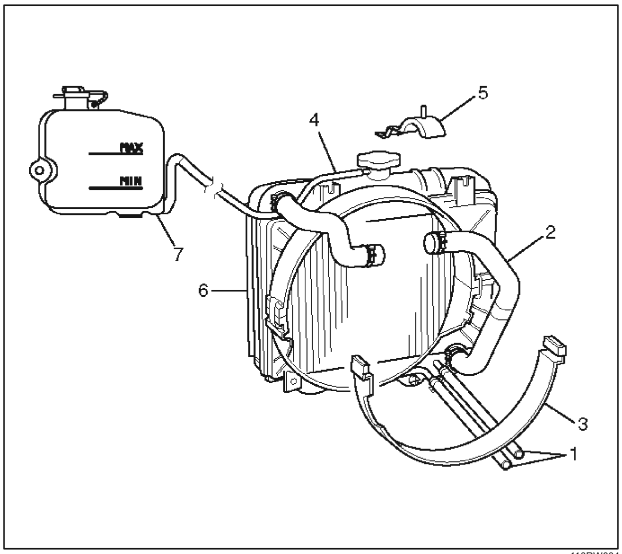
Cap tester: 5–8840–0277–0
Adapter: 5–8840–2603–0



110RS005

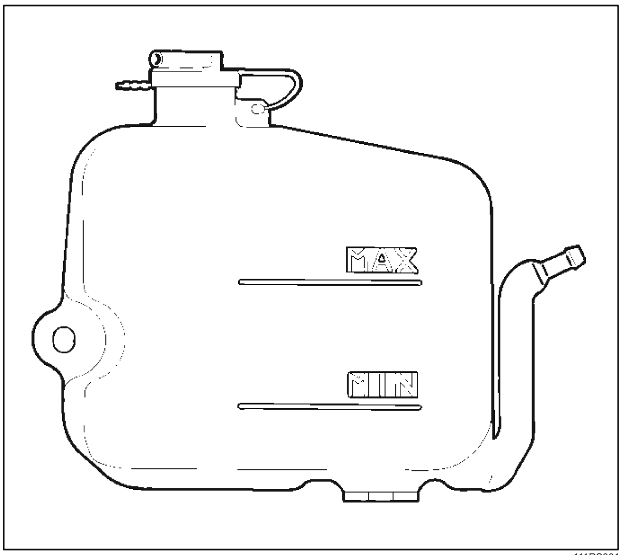
Installation

1. Install rubber cushions on both sides of radiator bottom.
2. Install radiator assembly with hose, taking care not to damage the radiator core with a fan blade.
3. Install bracket (6) and support the radiator upper tank with the bracket (5) and secure the radiator.
4. Connect reserve tank hose (4).
5. Install lower fan guide (3).
6. Connect radiator inlet hose and outlet hose to the engine.
7. Connect oil cooler hose (1) to automatic transmission.



110RW004

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



111RS001

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

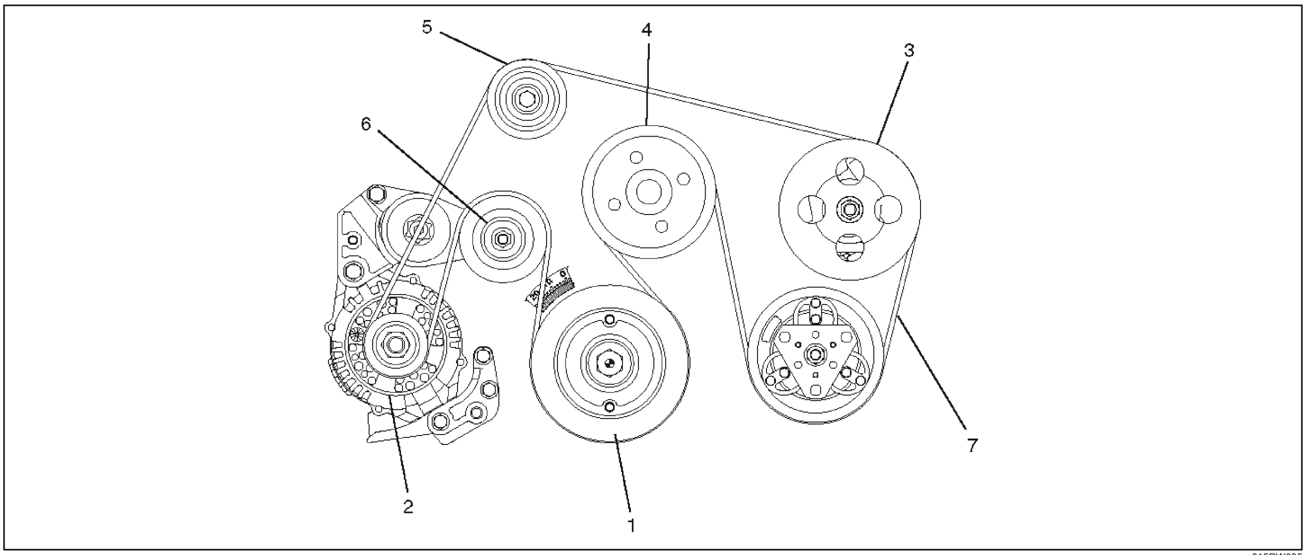
1. Make sure that the engine is cool.
2. Open radiator cap pour coolant up to filler neck.
3. Pour coolant into reservoir tank up to “MAX” line.
4. Tighten radiator cap and start the engine. After idling for 2 to 3 minutes, stop the engine and reopen radiator cap. If the water level is lower, replenish.

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.

5. 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.
6. Check to see the thermostat has opened through the needle position of water thermometer, conduct a 5–minute idling again and stop the engine.
7. 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.
8. Pour coolant into reservoir tank up tp “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 : 22 N·m (2.2 Kg·m/16 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.

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.

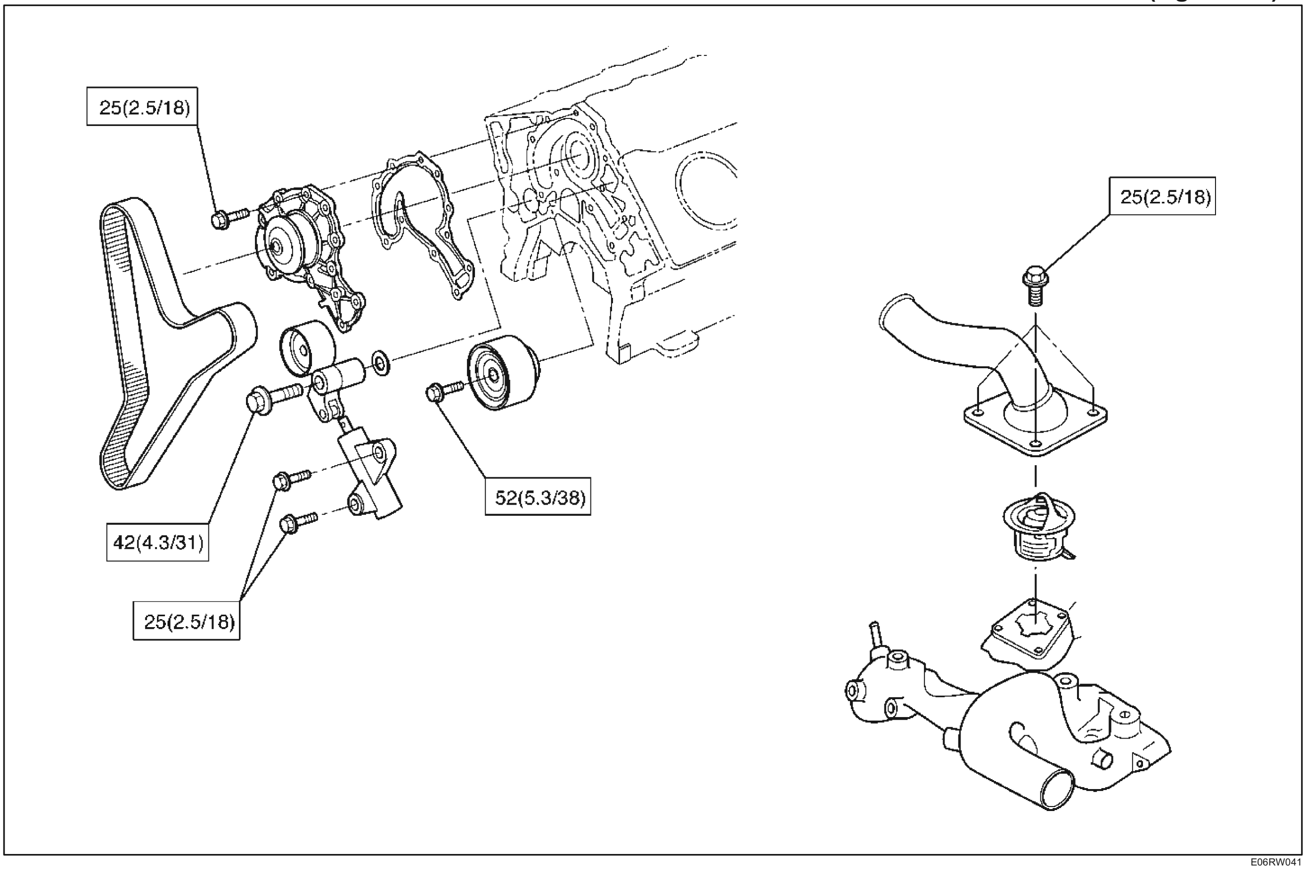
Main Data and Specifications

General Specifications

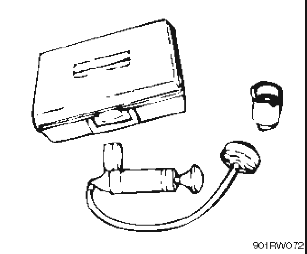
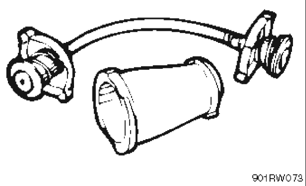
	M/T	A/T
Cooling system	Engine coolant forced circulation	
Radiator	(1 tube in row) Tube type corrugated (2 tube in row)	
Heat radiation capacity	68,000 kcal/h	77,000 kcal/h
Heat radiation area	9.445m^2 (0.878ft^2)	11.21m^2 (1.04ft^2)
Radiator front area	0.302m^2 (0.028ft^2)	
Radiator dry weight	39N (8.8lb)	44N (9.9lb)
Radiator cap valve opening pressure	93.3 ~ 122.7kpa (13.5 ~ 17.8psi)	
Engine coolant capacity	2.5lit (2.6U.S q.t.)	2.4lit (2.5U.S q.t.)
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	10.4lit (11.0U.S qt)	10.5lit (11.1U.S qt)

Torque Specifications

N·m (Kg·m/lb ft)



Special Tool

ILLUSTRATION	**TOOL NO.** TOOL NAME
	**5–8840–0277–0** **(J–24460–01)** Tester; radiator cap
	**5–8840–2603–0** **(J–33984–A)** Adapter; radiator cap

ENGINE

ENGINE FUEL

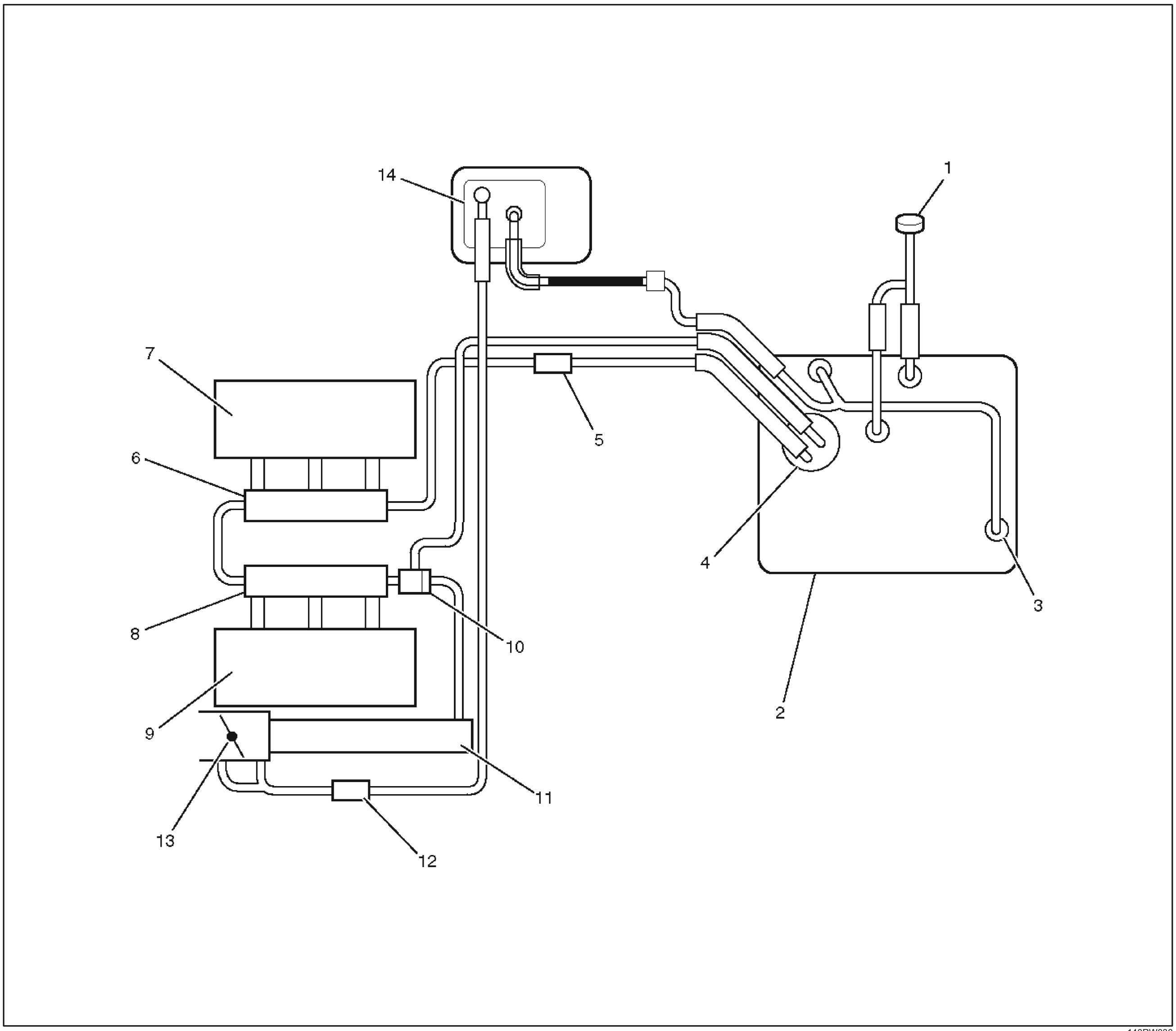
CONTENTS

Service Precaution

WARNING: IF SO EQUIPPED WITH 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



Legend

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

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.

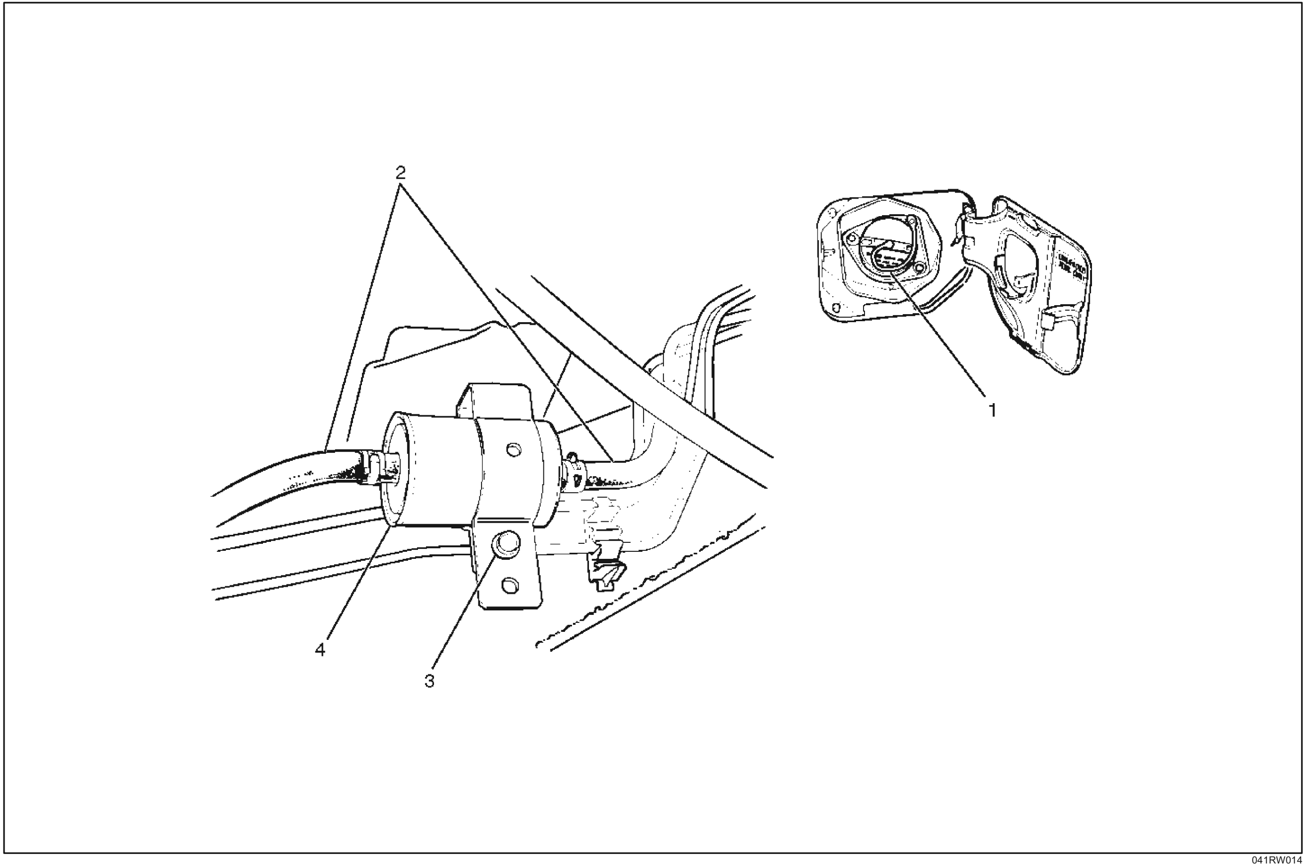
All gasoline engines are designed to use only unleaded gasoline. Unleaded gasoline must be used for proper emission control system operation.
Its use will also minimize spark plug fouling and extend engine oil life. Using leaded gasoline can damage the emission control system and could result in loss 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.

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 Manifold Absolute Pressure (MAP) sensor measures the changes in the intake manifold pressure which result from engine load and speed changes, which the MAP 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 MAP 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

Fuel Filter and Associated Parts



Legend

(1) Fuel Filler Cap
(2) Fuel Hose
(3) Fuel Filter Fixing Bolt
(4) 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".

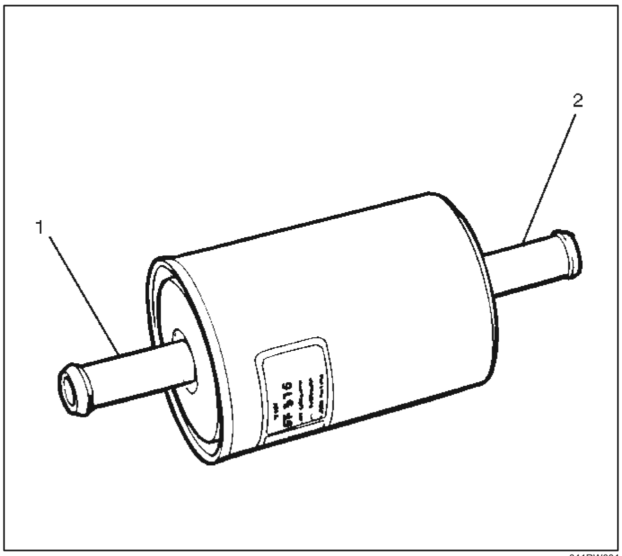
1. Disconnect battery ground cable.
2. Remove Fuel filler cap(1).
3. Disconnect fuel hoses(2) from fuel filter on both engine side and fuel tank side.
4. Fuel filter fixing bolt(3).
   - Remove the fuel filter fixing bolt(3) on fuel filter holder.
5. Remove fuel filter(4).

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.
3. Check the drain of receive rubber and if it is clogged with dust, clean it up with air.

Installation

1. Install the fuel filter in the proper direction.
2. Install fuel filter holder fixing bolt.
3. Connect fuel hoses on engine side(1) and fuel tank side(2).



041RW001

4. Install fuel filler cap
5. Connect the battery ground cable.

Inspection

After installation, start engine and check for fuel leakage.

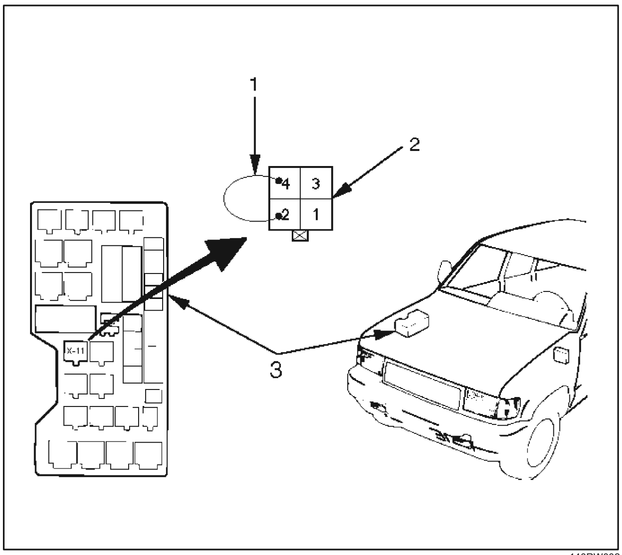
In–Tank Fuel Filter

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 self cleaning 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 with a jumper wire(1) as shown and start the fuel pump to measure delivery.



140RW002

CAUTION: Never generate sparks when connecting a jumper wire.

Delivery	Delivery
15 seconds	0.38 liters minimum

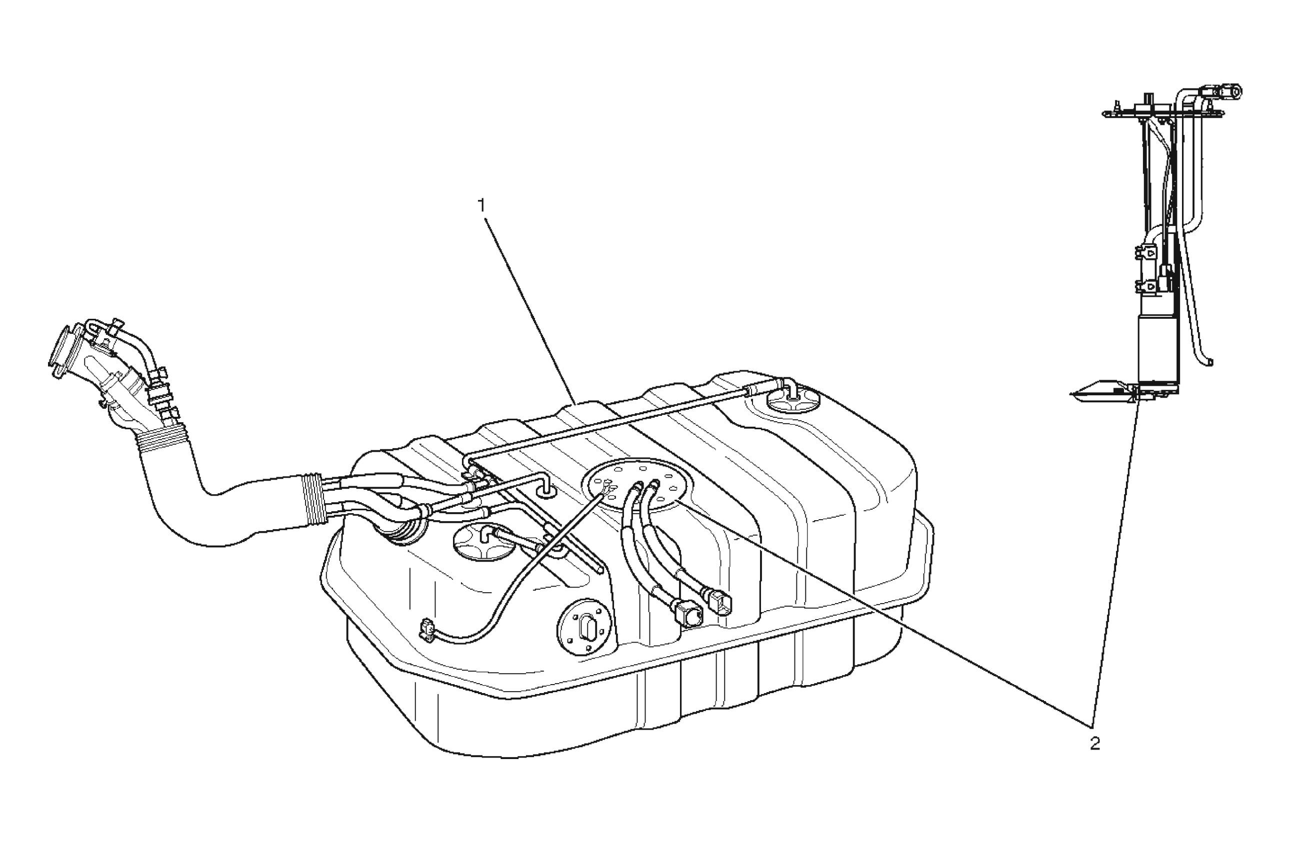
If the measure value is out of standard, conduct the pressure test.

Pressure test

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

Fuel Pump

Fuel Pump and Associated Parts



035RW047

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 fuel filler cap.
3. Drain fuel.
   Tighten drain plug to the specified torque after draining fuel.

   Torque: 20 N·m (2.0 Kg·m/14 lb ft) — M8
4. Remove fuel tank assembly(1). Refer to "Fuel Tank Removal" in this section.
5. Remove fuel pump (FP) assembly(2) fixing screws and remove the FP assembly.

NOTE: After removing FP, cover fuel tank to prevent any dust entering.

Installation

1. Install FP assembly(2).
2. Install fuel tank assembly(1). Refer to "Fuel Tank Installation".
3. Fill the tank with fuel and tighten fuel filler cap.
4. Connect battery ground cable.

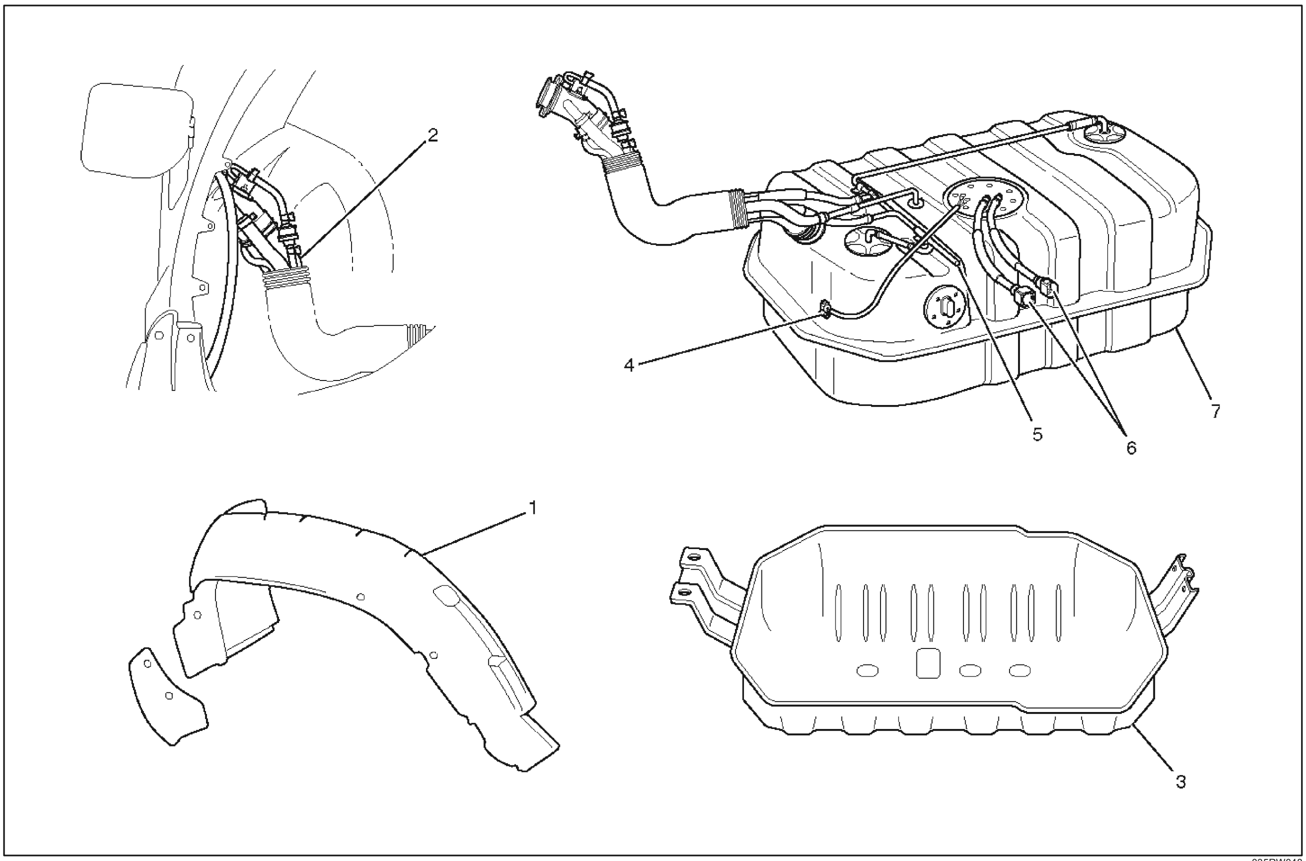
Fuel Pump Relay

General Description

In order to control the FP operation, the FP relay is provided. When the starter switch is turned to “ON” position, the FP relay operates the FP for 2 seconds. When it is turned to “START” position, the Power Train Control Module (PCM) receives the reference pulse from the Ignition Control Module and it operates the relay, again causing the FP to feed fuel.

Fuel Tank

Fuel Tank and Associated Parts



Legend

(1) Fender Liner
(2) Fuel Filler Hose and Air Breather Hose and Evapo Hose
(3) Undercover
(4) Fuel Tank Wiring Connector
(5) Evapo Fuel Hose
(6) Fuel Feed Tube and Fuel Return Tube/Quick–Connect Fittings
(7) Fuel Tank

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 fuel filler cap.
3. Drain fuel.
   Tighten drain plug to the specified torque after draining fuel.

   Torque: 20 N·m (2.0 Kg·m/14 lb ft) — M8
4. Remove fender liner (1) of wheel well on rear right side.
5. Fuel filler hose, air breather hose and evapo hose (2).
6. Remove undercover fixing bolts on both sides and remove under cover(3).

7. Disconnect two fuel tank wiring connectors(4) on front right side of tank.
8. Disconnect evapo fuel hose(5).
9. Disconnect fuel feed tube and fuel return tube(6).

NOTE: Handling of the fuel tube, be sure to refer “Fuel Tube/Quick–Connect Fittings” in this section.

10. Remove fuel tank fixing bolts on both sides and remove fuel tank(7).

Installation

1. Install fuel tank(7).
   - Place a flange on right side of tank on the bracket.
   - Install a flange on left side on the bracket from the bottom, and tighten bolts to the specified torque.

Torque: 36 N·m (3.7 Kg·m/27 lb ft)

2. Connect fuel feed tube and fuel return tube(6).
3. Connect evapo fuel hose(5).
4. Connect fuel tank wiring connector(4).
5. Install undercover(3).
6. Connect fuel filler hose, air breather hose and evapo hose(2).
7. Install fender liner(1).
   - Mount fender liner to the wheel well.
   - Fill the tank with fuel and tighten fuel filler cap.
   - Connect battery ground cable.

Fuel Tube / Quick – Connect Fittings

Precautions

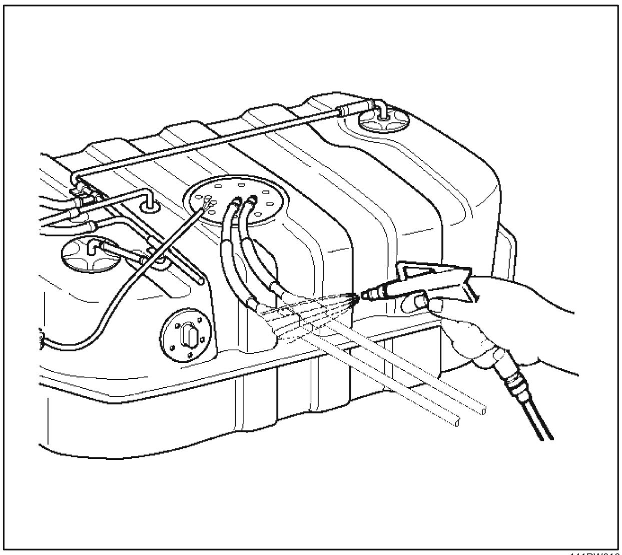
- Lighting of Fires Prohibited.
- Keep flames away from your work area to prevent the inflammable from catching fire.
- Disconnect the battery negative cable to prevent shorting during work.
- When welding or conducting other heat-generating work on other parts, be sure to provide pretreatment to protect the piping system from thermal damage or spattering.

Cautions During Work

Do not expose the assembly to battery electrolyte or do not wipe the assembly with a cloth used to wipe off spilt battery electorolyte.
The piping wet with battery electrolyte cannot be used.
Be careful not to give a bending or twisting force to the piping during the work. If deformed, replace with a new piping.

Removal

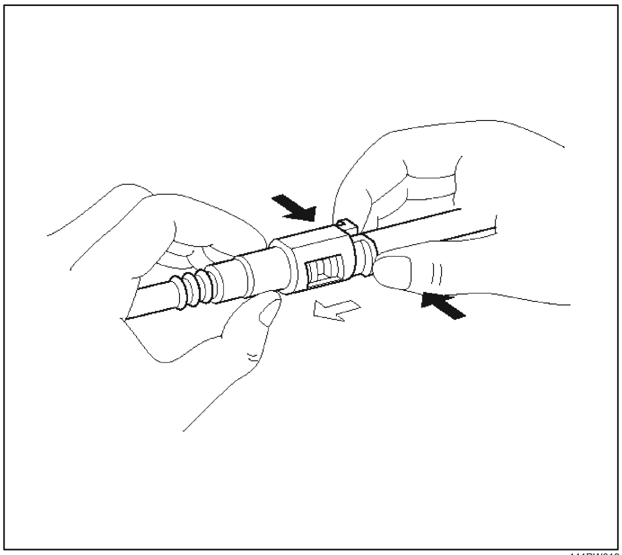
1. Open the fuel cap to relieve the fuel pressure in the tank.
   If the fuel quick-connect fittings are dusty, clean with an air blower, etc. and then remove it.



141RW016

As some pressure may remain in the piping, cover the connector with a cloth, etc. to prevent the splashing of fuel in the first disconnection of the piping.

2. For removal of the delivery pipe (feeding fuel to the engine), hold the connector in one hand, and hold the retainer tab with the other hand and pull out the connector, as illustrated. The pipe can be removed with the retainer attached.



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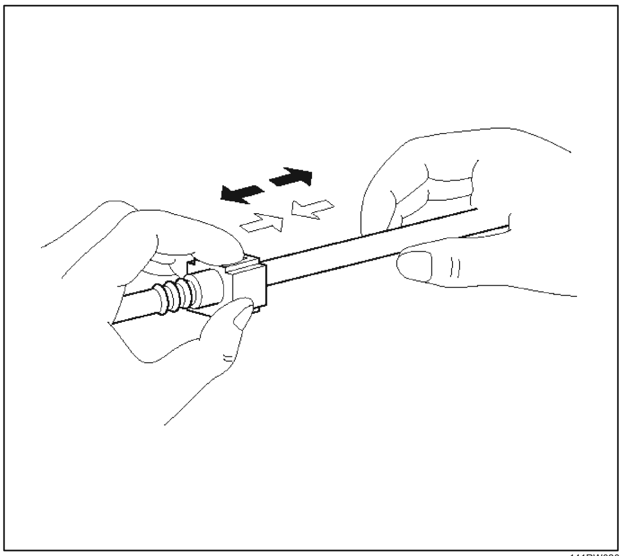
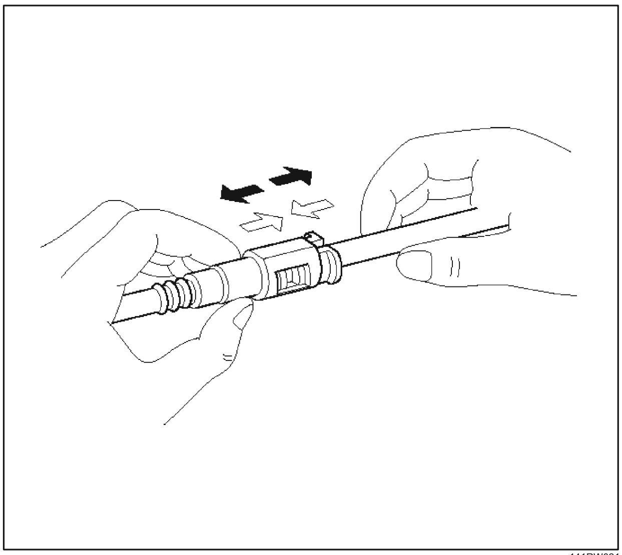
3. For removal of the return pipe (returning fuel to the tank), hold the pipe in one hand, and pull out the connentor with the other hand while pressing the square relieve button of the retainer, as illustrated.



141RW020

NOTE: This work should be done by hands. Do not use any tools. Should the pipe can hardly be removed from the connector, use a lubricant (light oil) and/or push and pull the connector longitudinally until the pipe is removed.



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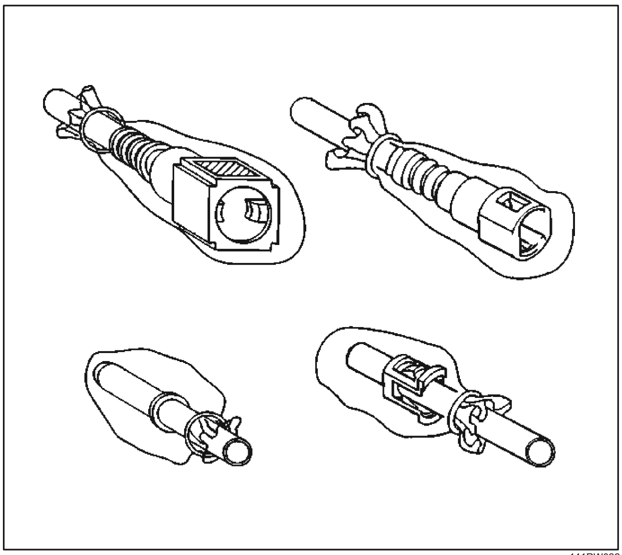
When reusing the delivery pipe retainer, reuse without removing the retainer from the pipe. If the retainer is damaged or deformed, however, replace with a new retainer.

Cover the connectors removed with a plastic bag, etc. to prevent the entry of dust or rain water.



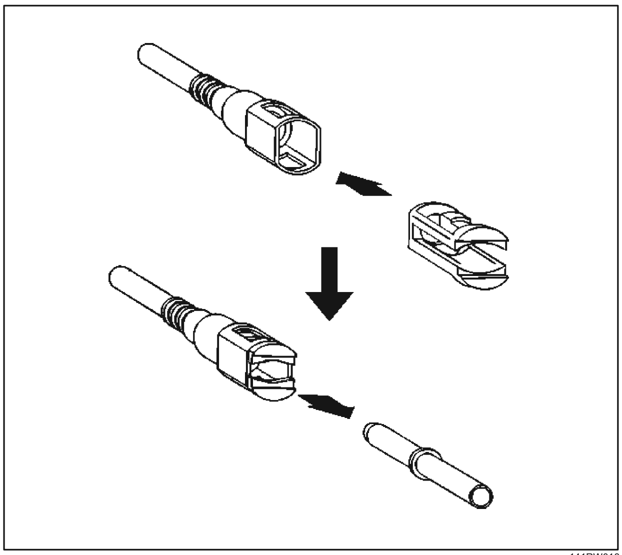
141RW022

Reuse of Quick–Connector

(Delivery Pipe)

- Replace the pipe and connector if scratch, dent or crack is found.
- Remove mud and dust from the pipe and make sure that the end including spool is free of defects, such as scratch, rust, and dent, which may cause poor sealability. If defective, replace with a new pipe.
- If the retainer removed according to the removal step above is attached to the pipe, clean and insert it straight into the quick-connector till it clicks. After it clicks, try pulling it out to make sure that it is not drawn and is securely locked.

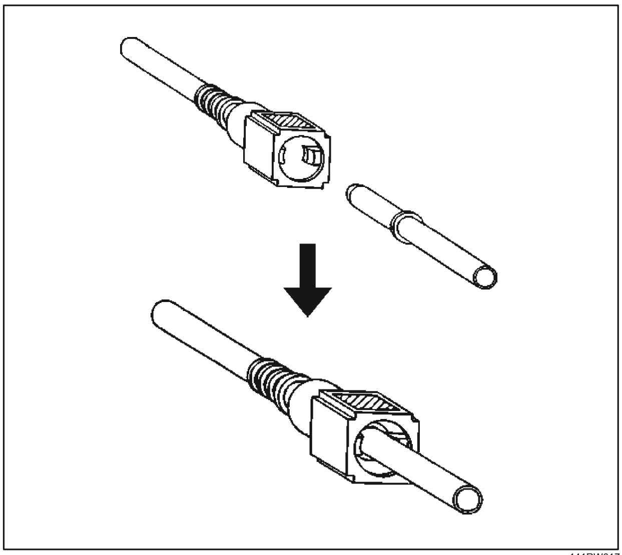
NOTE: The retainer, once removed from the pipe, cannot be reused. Just replace with a new retainer. Insert the new retainer into the connector side until it clicks, and connect the pipe as inserting it into the retainer until it clicks.



141RW018

(Return Pipe)

- Replace the pipe and connector if scratch, dent or crack is found.
- Remove mud or dust from the pipe and make sure that the end including spool is free from defects, such as scratch, rust, and dent, which may cause poor sealability. If defective, replace with a new pipe.
- After cleaning the pipe, insert it straight into the connector until it clicks. After it clicks, try pulling it out to make sure that it is not drawn and is securely locked.



141RW017

Assembling Advice

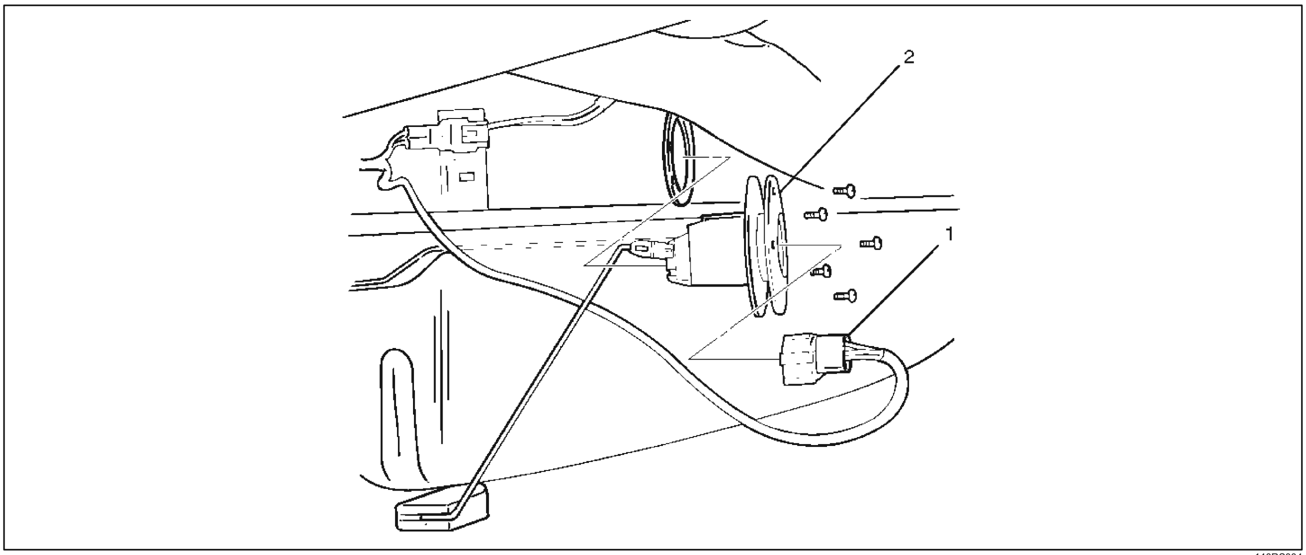
Application of engine oil or light oil to the pipe facilitates connecting work. The work should be started immediately after lubrication, since dust may stick to the pipe surface to cause poor sealability if a long time passes after lubrication.

Test/Inspection After Assembling

1. Reconnect the battery negative cable.
2. Turn the ignition key to the “ON” position and check pump startup sound. As the pump is actuated to raise fuel pressure, check and see fuel leak from the piping system.
3. Make sure of no fuel leakage by conducting the above fuel leak check a few times.
4. Start the engine and make sure of stable idling speed and normal vehicle run.The entry of dust during the work may sometimes affect the fuel injection system.

Fuel Gauge Unit

Fuel Gauge Unit and Associated Parts



Legend

(1) Wiring Connector
(2) Fuel Gauge Unit

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 fuel filler cap.
3. Drain fuel.
   Tighten drain plug to the specified torque after draining fuel.

   Torque: 20 N·m (2.0 Kg·m/14 lb ft) — M8
4. Wiring connector
   - Disconnect wiring connector(1) from the unit.
5. Fuel gauge unit
   - Remove the fixing screws, then the fuel gauge unit(2).

NOTE: After removing fuel gauge unit, cover fuel tank to prevent any dust entering

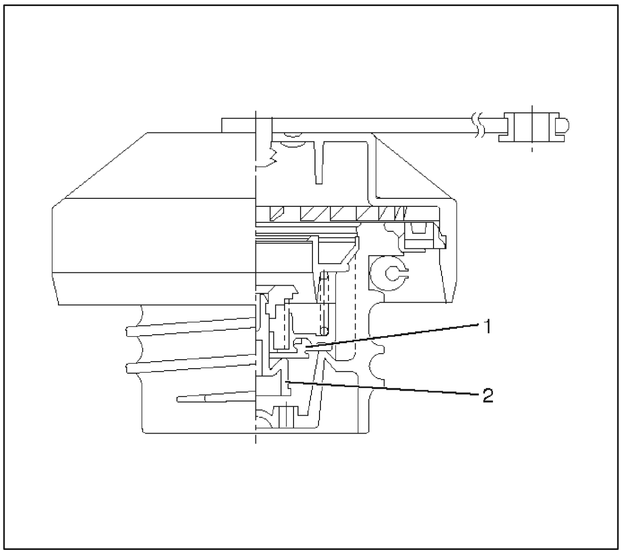
Installation

1. Fuel gauge unit(2).
2. Wiring connector(1).
   - Connect the wiring connector to the fuel gauge unit.
   - Fill the tank with fuel and tighten fuel filler cap.
   - Connect battery ground cable.

Fuel Filler Cap

General Description

Fuel filler cap includes vacuum valve and pressure valve. In case any high vacuum and any high pressure happen in tank, each valve works to adjust the pressure to prevent the tank from being damaged.



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Legend

(1) Vacuum Valve
(2) Pressure Valve

Inspection

Check the seal ring in the filler cap for presence of any abnormality and for seal condition.
Replace the filler cap, if abnormal.

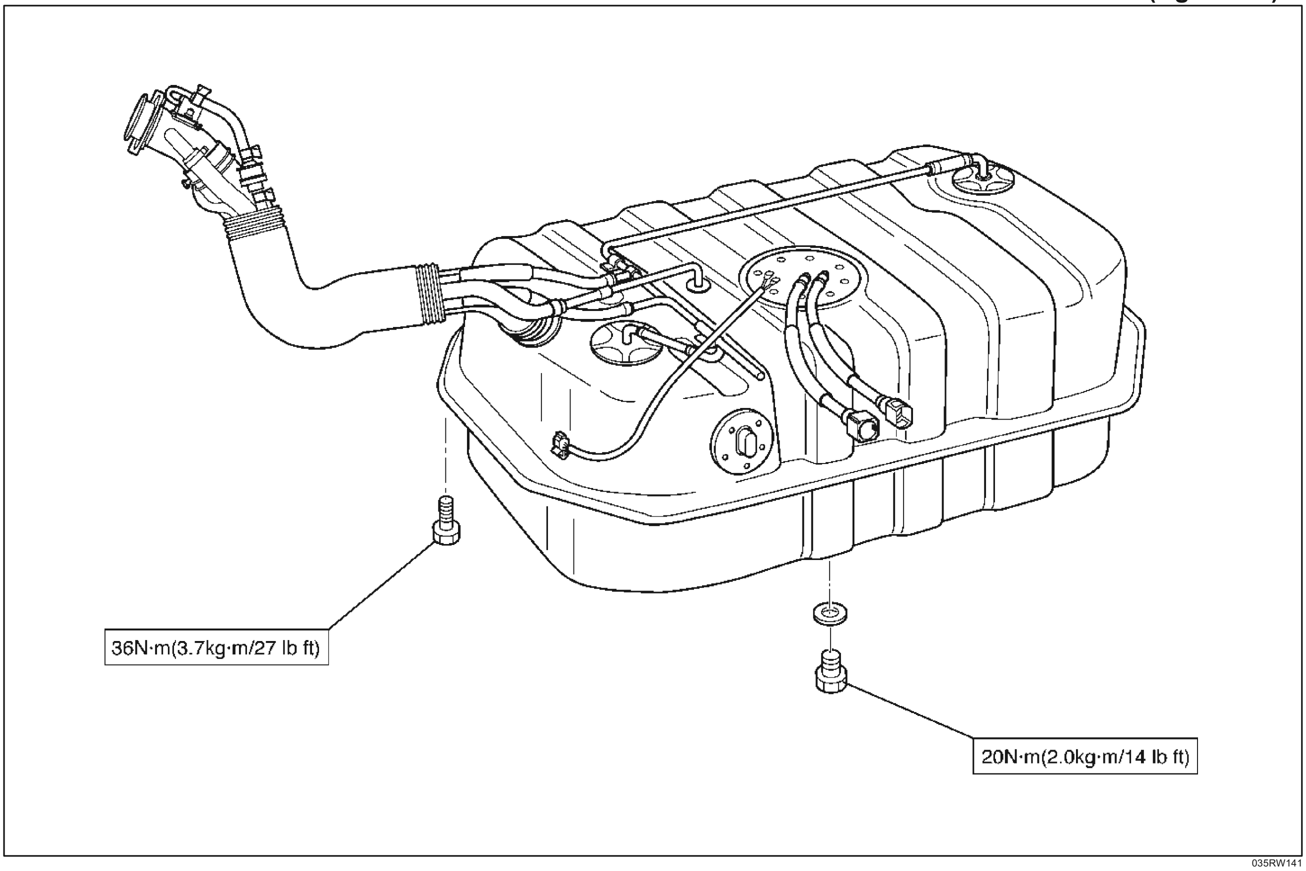
CAUTION: The fuel filler cap valves have characteristics.

A defective valve, no valve at all or a valve with the wrong characteristics will do a lot of harm to engine operating characteristics; be sure to use the same fuel filler cap as installed in this vehicle.

Main Data and Specifications

Torque Specification

N·m (Kg·m/lb ft)



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ENGINE

ENGINE ELECTRICAL

CONTENTS

Service Precaution

WARNING: IF SO EQUIPPED WITH 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 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

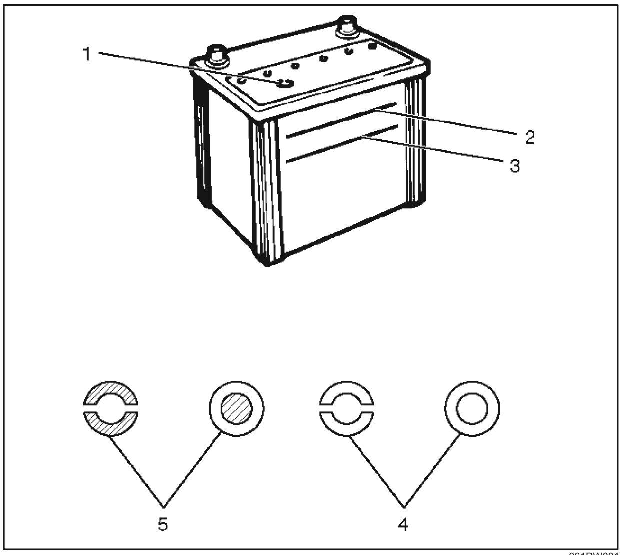
1. Visual Inspection

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. Hydrometer Check

There is a built–in hydrometer (Charge test indicator(1)) at the top of the battery. It is designed to be used during diagnostic procedures.
Before trying to read the hydrometer, carefully clean the upper battery surface.
If your work area is poorly lit, additional light may be necessary to read the hydrometer.

a. BLUE RING OR DOT VISIBLE(5) – Go to Step 4.
b. BLUE RING OR DOT NOT VISIBLE(4) – Go to Step 3.



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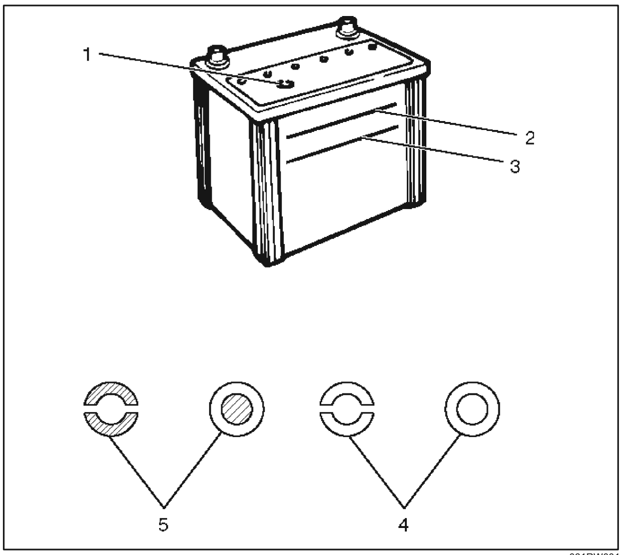
3. Fluid Level Check

The fluid level should be between the upper level line(2) and lower level line(3) on side of battery.

a. CORRECT FLUID LEVEL – Charge the battery.
b. BELOW LOWER LEVEL – Replace battery.



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4. 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.

5. 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. Serious 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

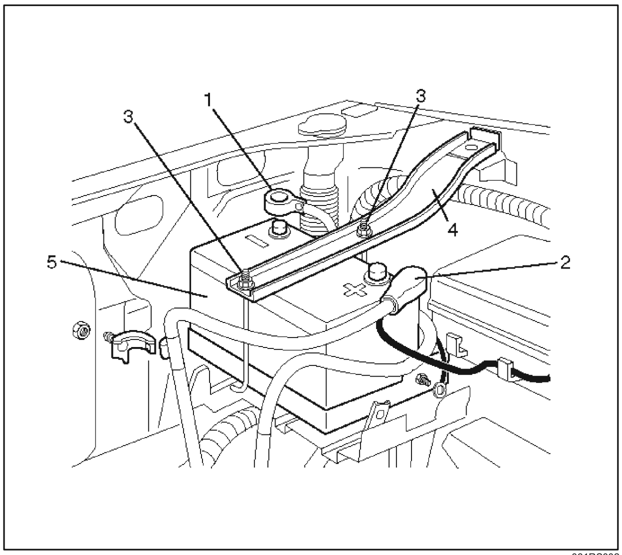
1. Set the vehicle parking brake.
   If the vehicle is equipped with an automatic transmission, place the selector level in the “PARK” position.
   If the vehicle is equipped with a manual transmission, place the shift lever in the “NEUTRAL” position.
   Turn “OFF” the ignition.
   Turn “OFF” all lights 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



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

Battery Installation

1. Install battery (5).
2. Install retainer (4).
3. Instal retainer screw and rods (3).

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

4. Install positive cable (2).
5. Install negative cable (1).

Main Data and Specifications

General Specifications

Model (JIS)	95D31R–MF	80D26R–MF	75D26R–MF
Voltage (V)	12	12	12
Cold Cranking Performance (Amp)	622	582	490
Reserve Capacity (Min)	159	133	123
Load Test (Amp)	310	290	245
Fast Charge Maximum Amperage (Amp)	20	20	20
BCI Group No.	27	24	24

MEMO

ENGINE

IGNITION SYSTEM

CONTENTS

Service Precaution

WARNING: IF SO EQUIPPED WITH 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.

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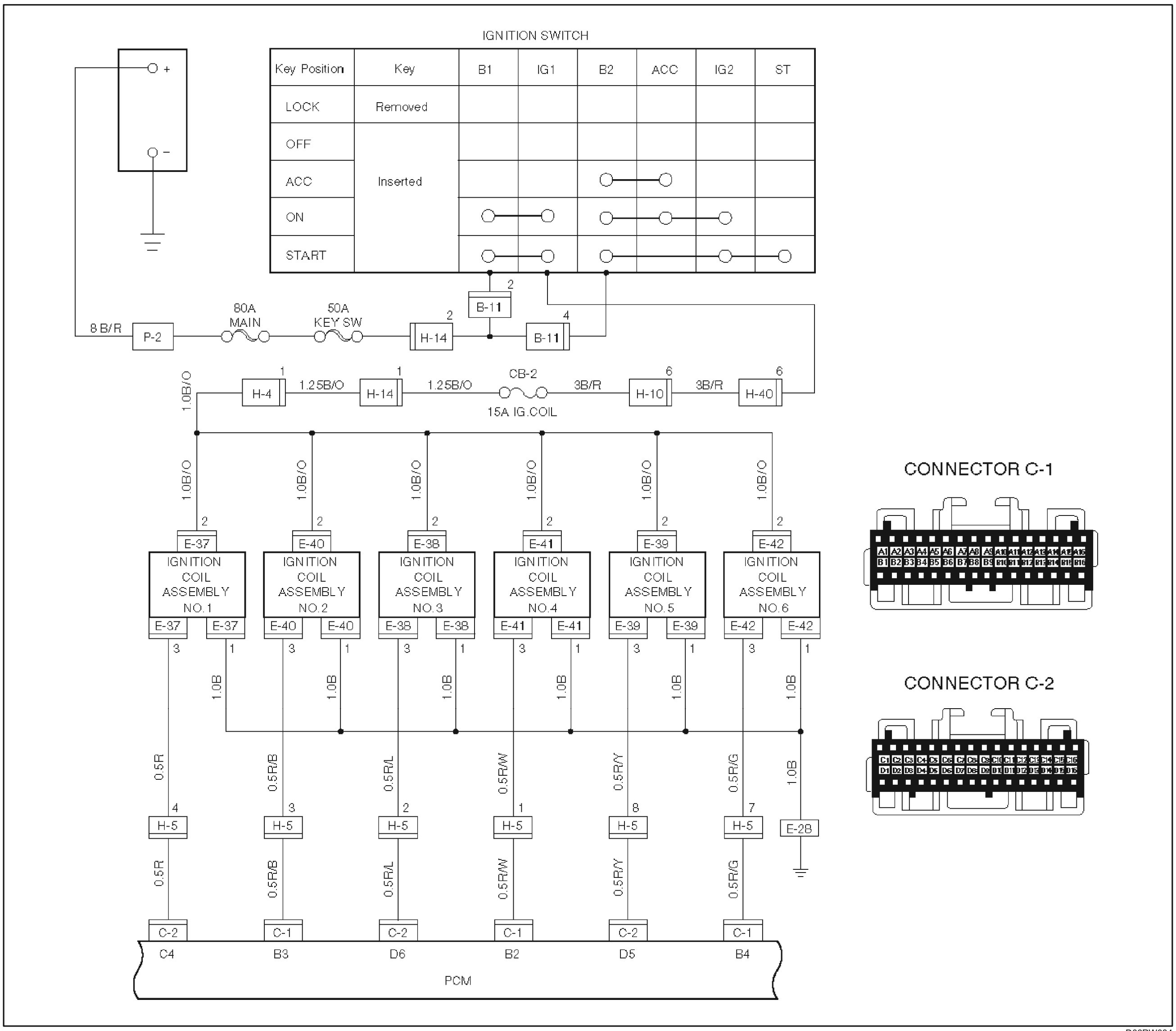
General Description

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,ignition control module, crank angle sensor, powertrain control module (PCM) and other components.
The ignition coils are connected with the PCM by means of a 32 pin connector.
The ignition control module turns on/off the primary circuit of ignition coils, and also it controls the ignition timing at the engine speed below 538 rpm.
A notch in the timing disc on the crankshaft activates the crank angle sensor which then sends information such as firing order and starting timing of each ignition coil to the PCM.
Further, the EI employs ignition control (IC) to control similar to a distributor system.
By receiving signals such as crank position,engine speed, water temperature and Manifold Absolute Pressure (MAP), the PCM controls the ignition timing.



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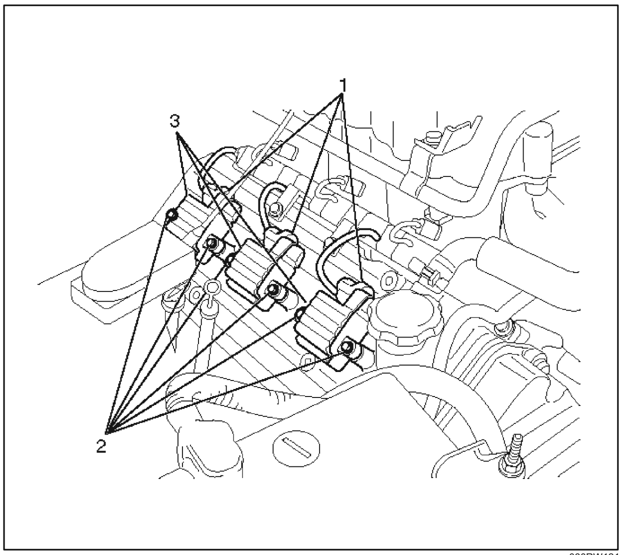
Diagnosis

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

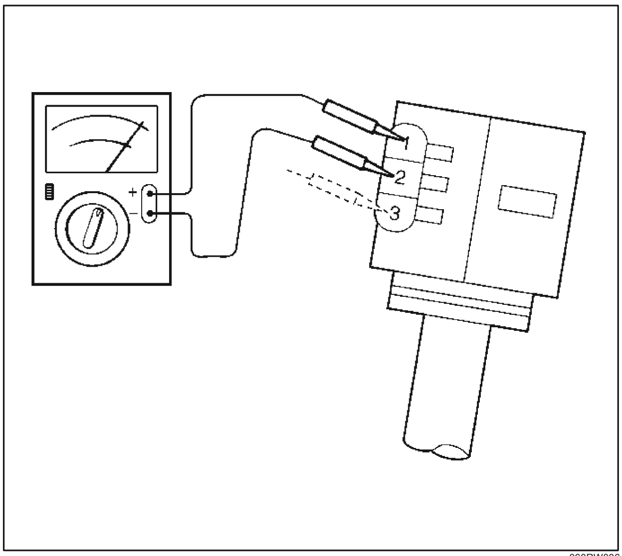
(1) Ignition Coil Connector
(2) Bolt
(3) Ignition Coil Assembly

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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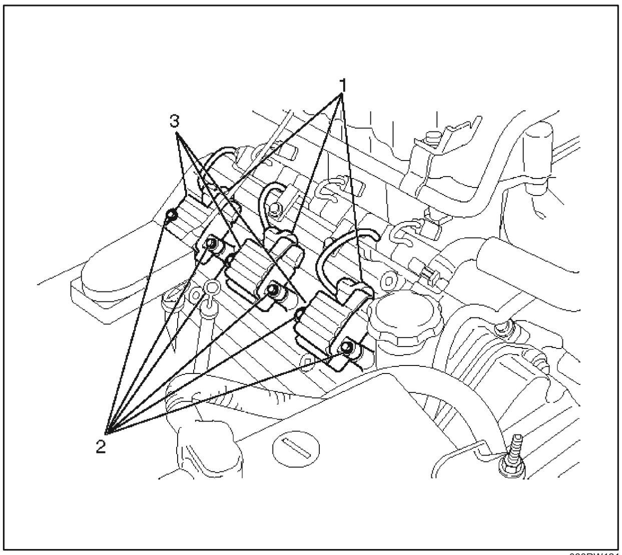
Installation

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/35 lb in)



060RW121

2. Connect battery ground cable.

Spark Plug

Removal

1. Remove spark plugs.

Inspection and Repair

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.

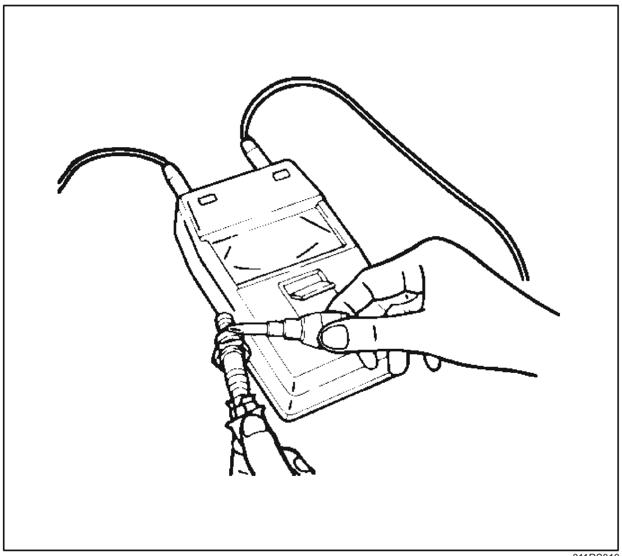
Possible causes:

- 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 Mδ or more



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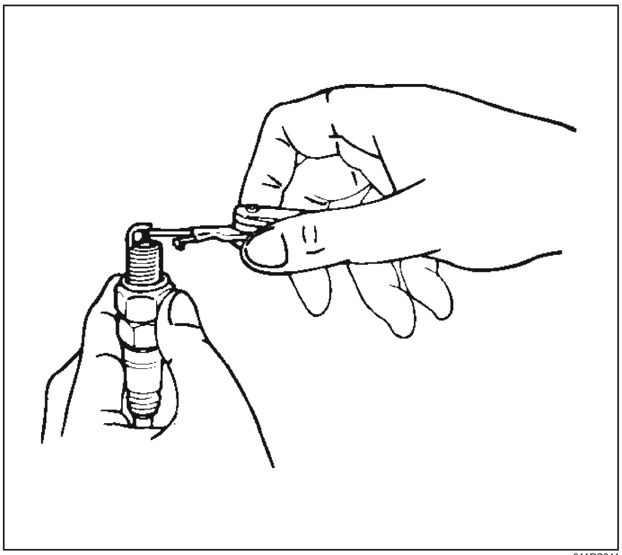
Cleaning Spark Plugs

- 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

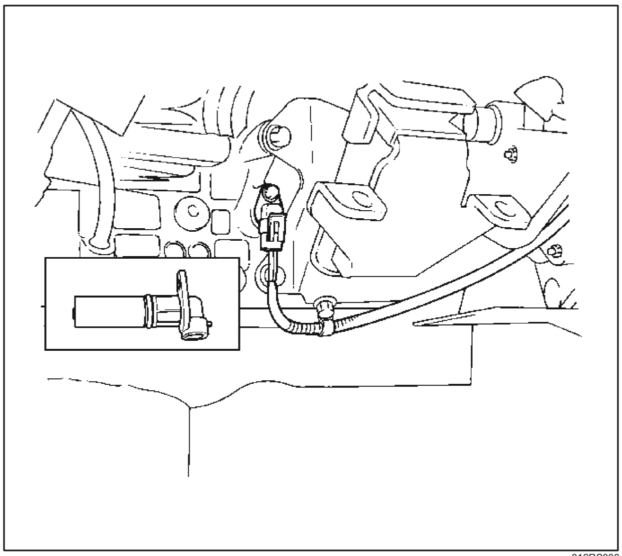
1. Spark plugs
   - Tighten spark plugs to the specified torque.

Torque: 18 N·m (1.8 Kg·m/13 lb ft)

Crankshaft Angle Sensor

Removal

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



012RS008

Installation

1. Install crankshaft angle 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/89 lb in)

2. Reconnect wiring connector to crankshaft angle sensor.

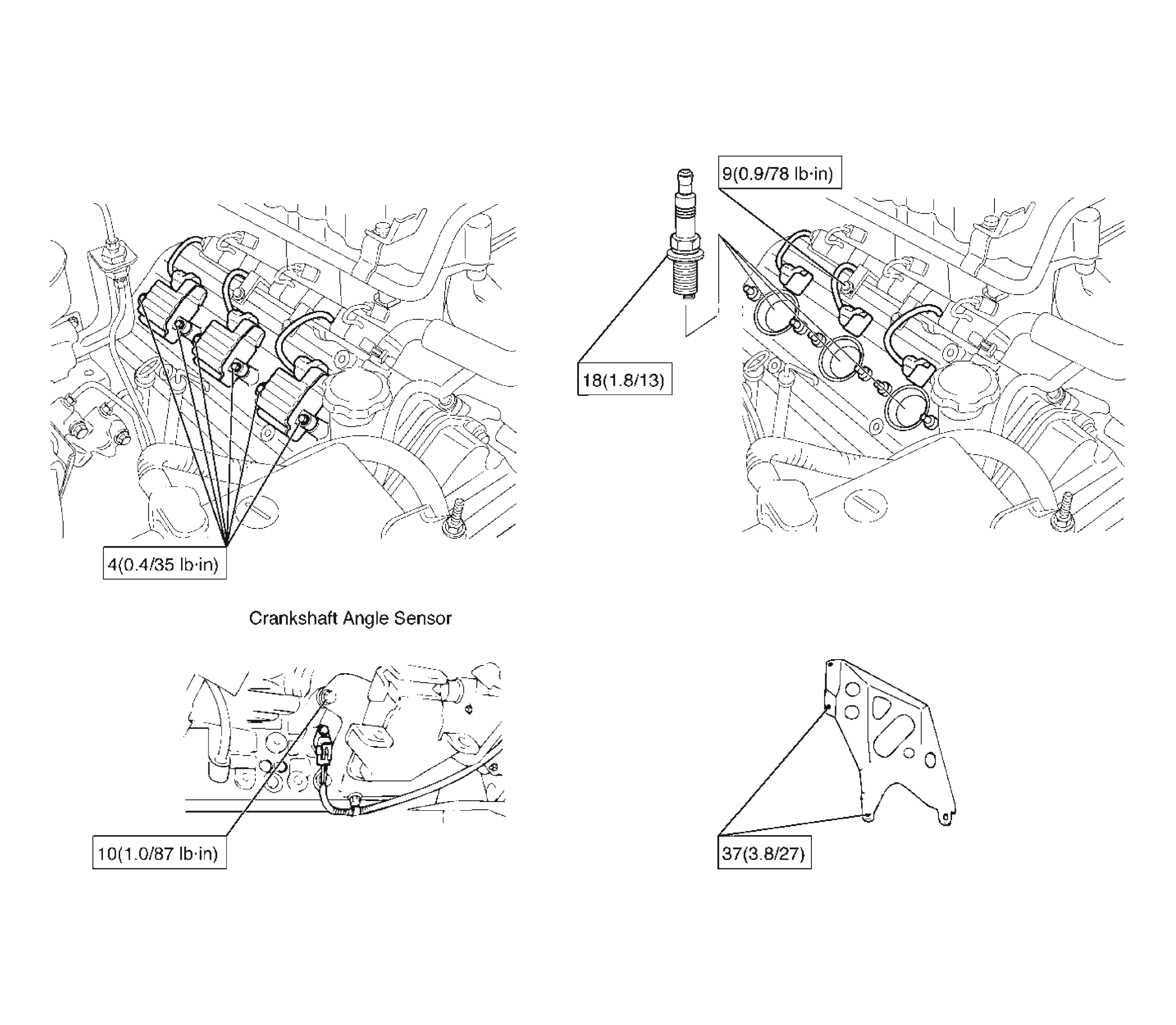
Main Data and Specifications

General Specifications

Ignition System	
Ignition Form	Electronic Ignition System (EI system) with Crankshaft angle Sensor
Spark Plug	
Type	K16PR–P11 RC10PYP4 PK16PR11
Plug gap	1.0 mm (0.04 in) – 1.1 mm (0.043 in)
Torque	18 N·m (1.8 Kg·m/13 lb ft)

Torque Specifications

N·m (Kg·m/lb ft)



E06RW038

ENGINE

STARTING AND CHARGING SYSTEM

CONTENTS

Service Precaution

WARNING: IF SO EQUIPPED WITH 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

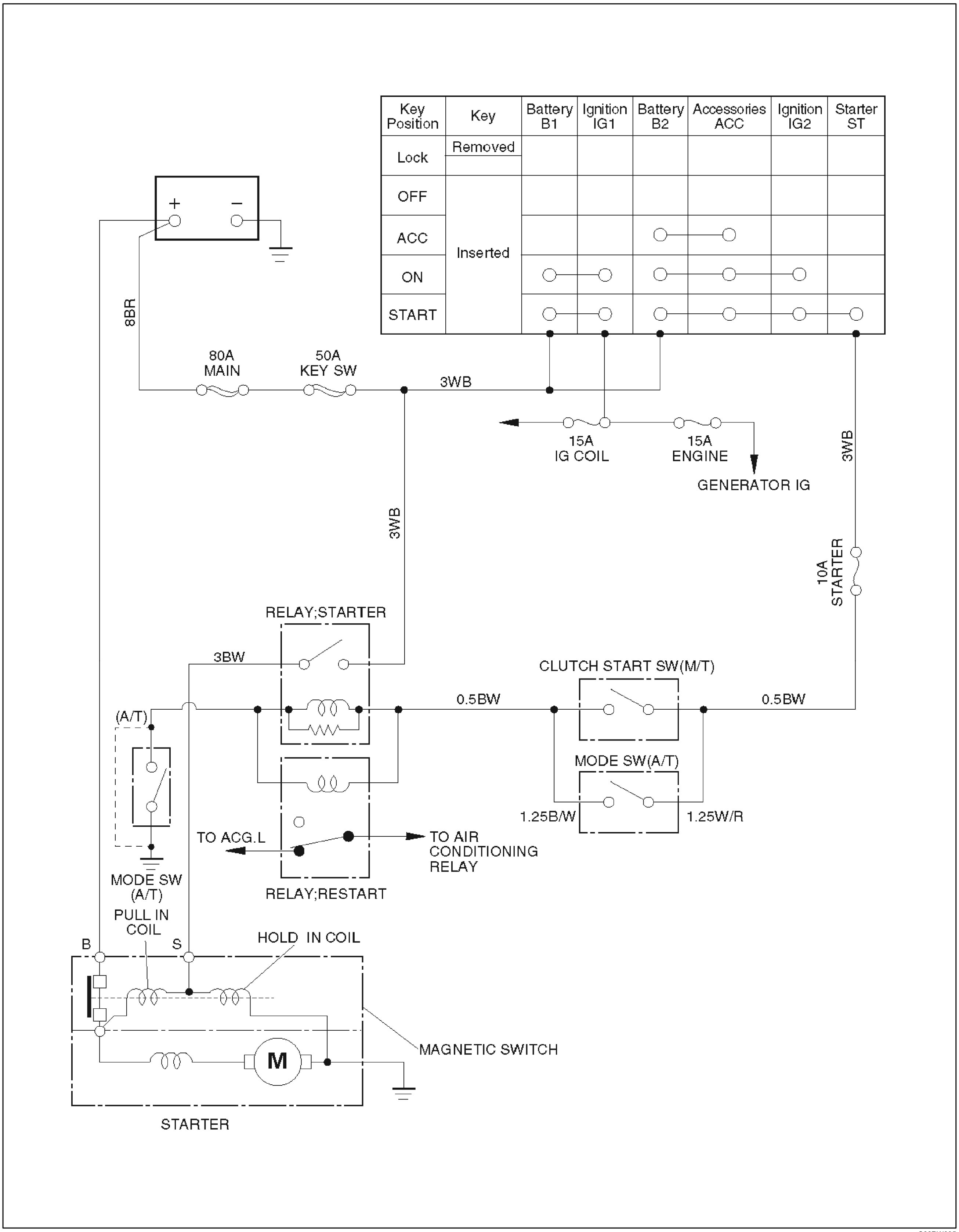
Cranking Circuit

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.



Key Position	Key	Battery B1	Ignition IG1	Battery B2	Accessories ACC	Ignition IG2	Starter ST
Lock	Removed						
OFF	Inserted						
ACC	Inserted			○	○		
ON	Inserted	○	○	○	○	○	
START	Inserted	○	○	○	○	○	○

C06RW005

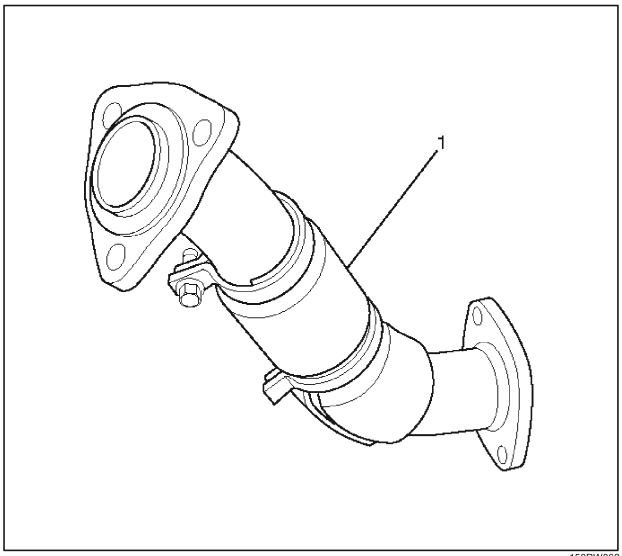
Diagnosis

Condition	Possible cause	Correction
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

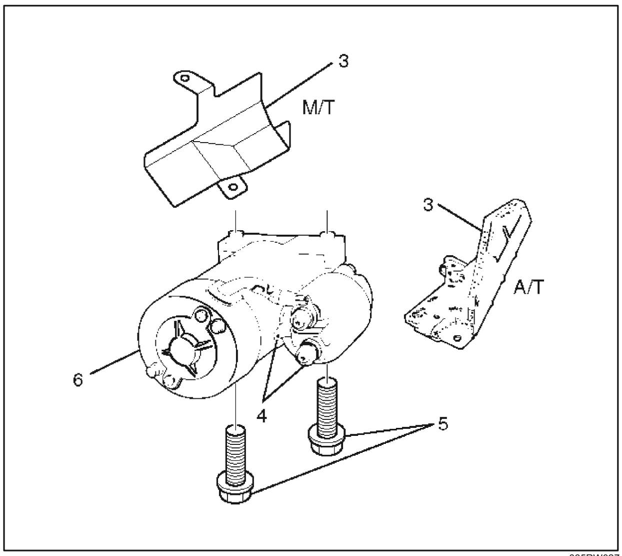
Removal

1. Battery ground cable.
2. Remove exhaust front left pipe(1).



150RW062

3. Remove heat protector(3).
4. Disconnect starter wiring connector from terminals "B" and "S"(4).
5. Remove starter assembly mounting bolts on inside and outside(5).
6. Remove starter assembly toward the bottom of engine(6).



065RW027

Installation

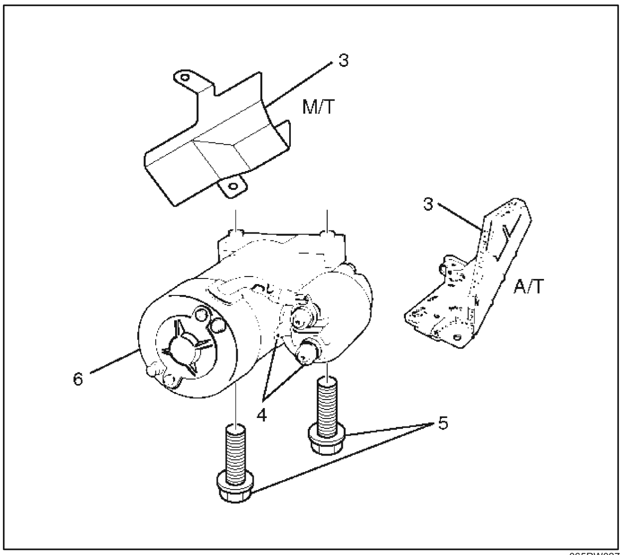
1. Install starter assembly(6).
2. Install mounting bolts and tighten bolts to specified torque(5).

Torque: 40 N·m (4.1 Kg·m/30 lb ft)

3. Reconnect the connectors to terminals "B" and "S" and tighten Terminals "B" to specified torque.

Torque: 9 N·m (0.9 Kg·m/80 lb in)

4. Install heat protector(3).



065RW027

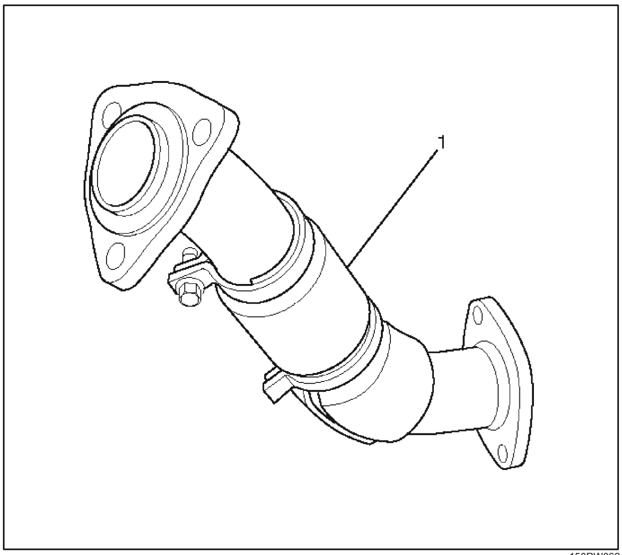
5. Install exhaust front left pipe and tighten bolts and nuts to specified torque(2).

Stud Nuts

Torque: 67 N·m (6.8 Kg·m/49 lb ft)

Nuts

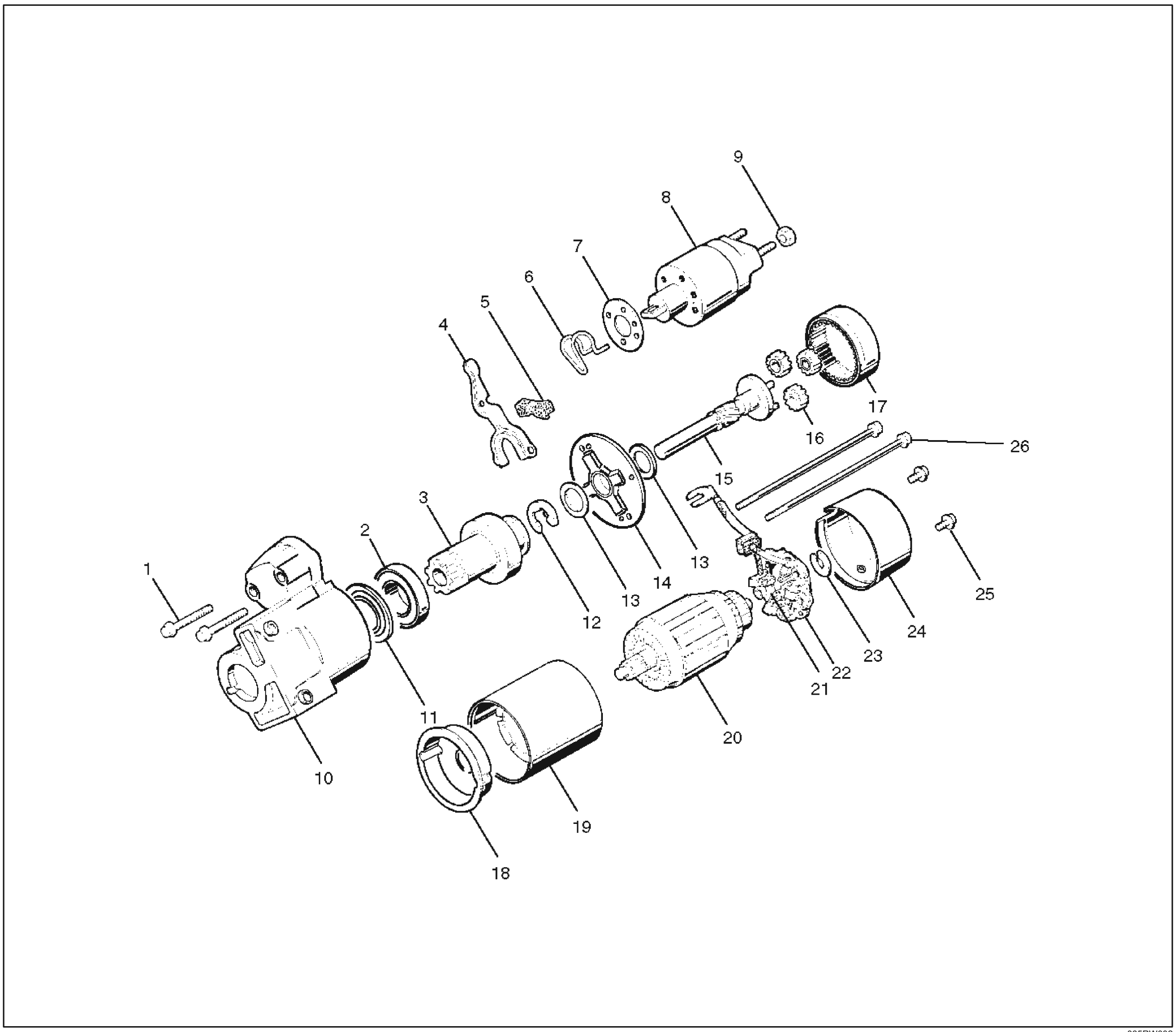
Torque: 43 N·m (4.4 Kg·m/32 lb ft)



150RW062

6. Reconnect the battery ground cable.

Disassembled View

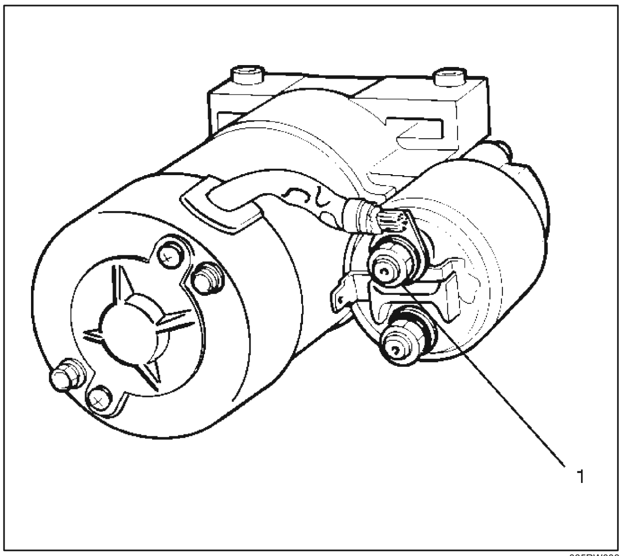


Legend

(1) Bolt (2 pcs)
(2) Ball Bearing
(3) Pinion
(4) Shift Lever
(5) Dust Cover
(6) Torsion Spring
(7) Dust Cover
(8) Magnetic Switch
(9) Nut
(10) Gear Case
(11) Bearing Cover
(12) E–Ring
(13) Thrust Washer (2)
(14) Center Bracket
(15) Pinion Shaft
(16) Planet Gear (3)
(17) Internal Gear
(18) Center Bracket (A)
(19) Yoke Assembly
(20) Armature
(21) Brush
(22) Brush Holder
(23) Thrust Washer
(24) Rear Cover
(25) Screw (2 pcs)
(26) Through Bolt (2 pcs)

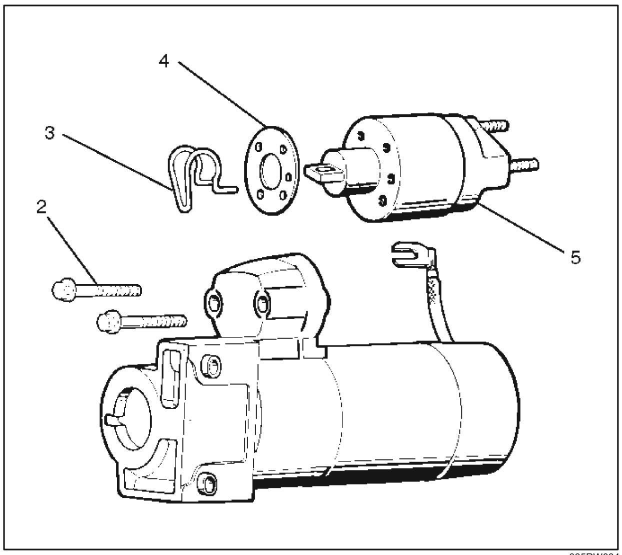
Disassembly

1. Loosen the nut(1) on terminal “M” of magnetic switch and disconnect the connector cable.
2. Remove bolt (2 pcs) (2).



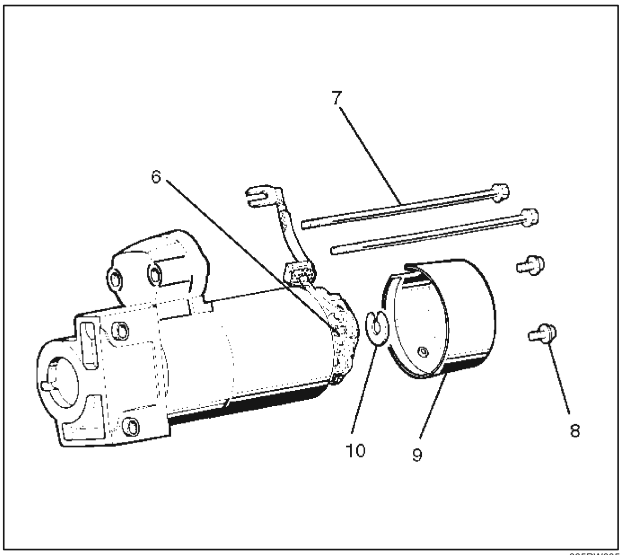
065RW003

3. Remove magnetic switch(5).
4. Remove dust cover(4).
5. Remove torsion spring bolts, then the magnetic switch assembly.
6. Remove torsion spring(3) from magnetic switch assembly(5).



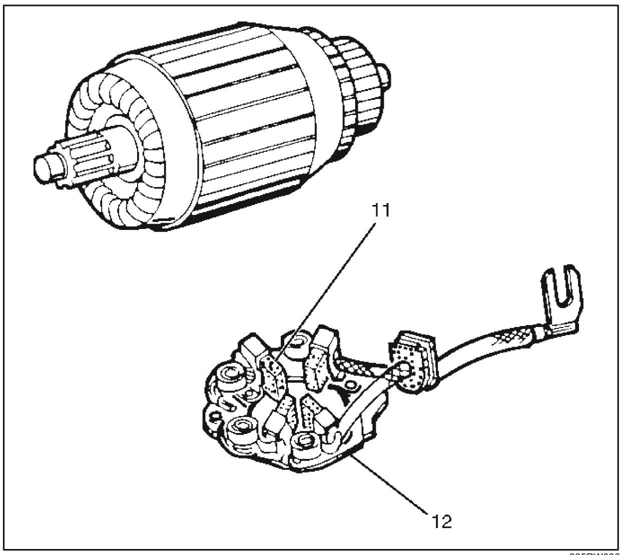
065RW004

7. Remove screw (2 pcs) (8).
8. Remove through bolt (2 pcs) (7).
9. Remove screws and through bolts, then the rear cover(9) then remove thrust washer(10).
10. Remove brush holder(6).



065RW005

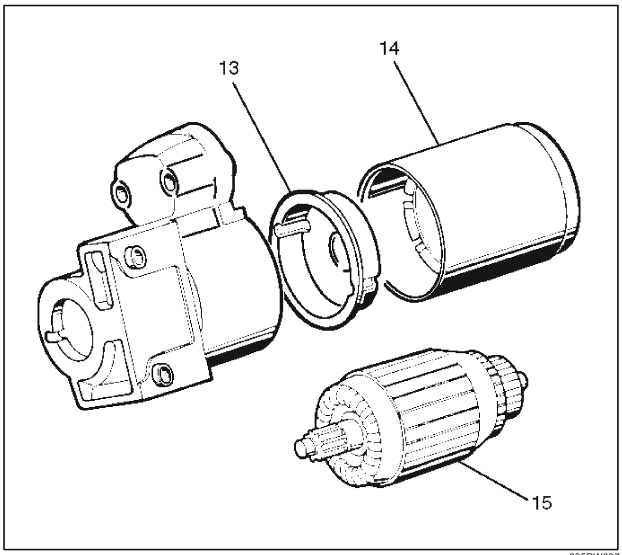
11. Raise a brush spring to detach brushes (4 pcs) from the commutator face and pull off the brush holder(12) and brush(11).



065RW006

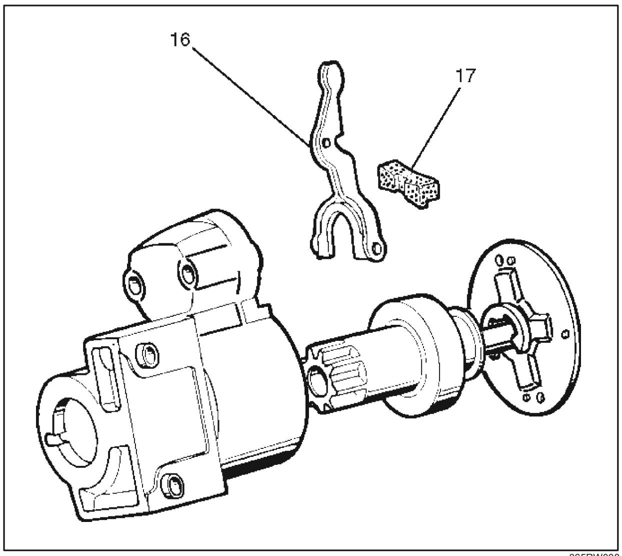
12. Remove yoke assembly(14).
13. Remove armature(15).
14. Pull off the yoke assembly, then remove armature, washer and center bracket.(A) (13).

NOTE: In disassembling the yoke assembly, hold the armature and pull off slowly the yoke assembly. Because of strong magnetic force, avoid placing a metallic part near armature.



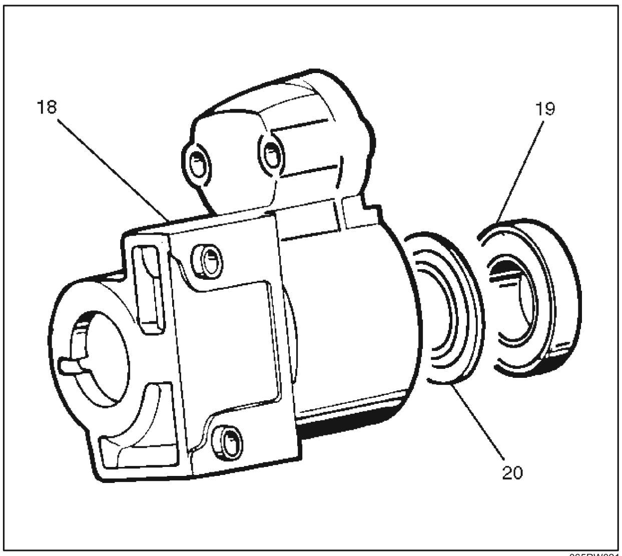
065RW007

15. Remove dust cover(17).
16. Remove a dust cover and shift lever(16) from the gear case.



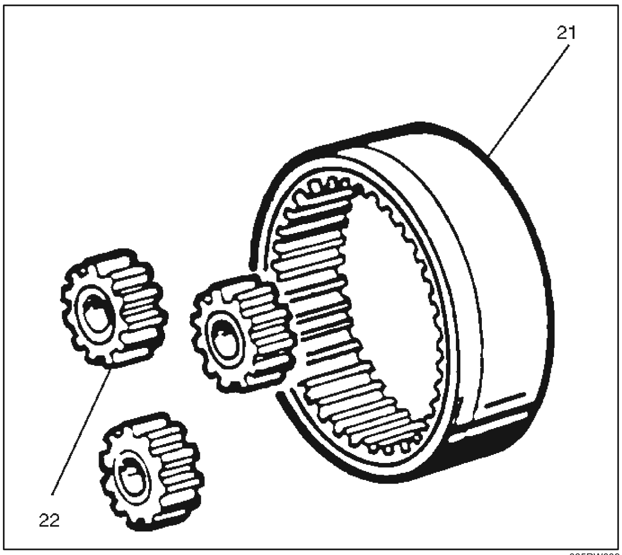
065RW008

17. Remove ball bearing(19).
18. Remove bearing cover(20).
19. Remove a ball bearing and bearing cover from the gear case(18).



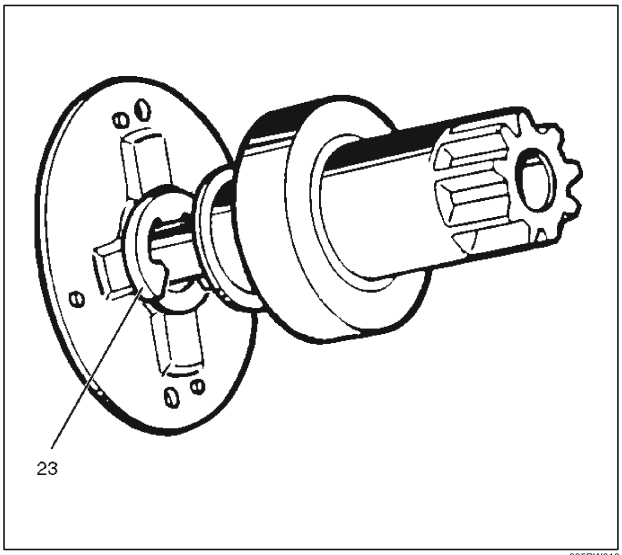
065RW021

20. Internal gear(21).
21. Remove internal gear and planet gear(3) (22).



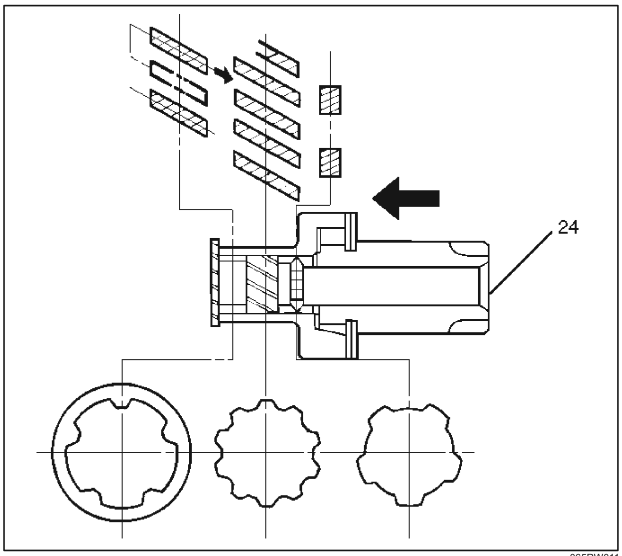
065RW009

22. Remove an E–ring(23) from the pinion shaft using a flat blade screwdriver.



065RW010

23. Holding the pinion shaft, push pinion toward the center bracket. and turn the pinion clockwise or counterclockwise by one tooth of spline, then pull off the pinion.
24. Remove thrust washer(24).
25. Remove center bracket
26. Remove pinion shaft.



065RW011

Inspection and Repair

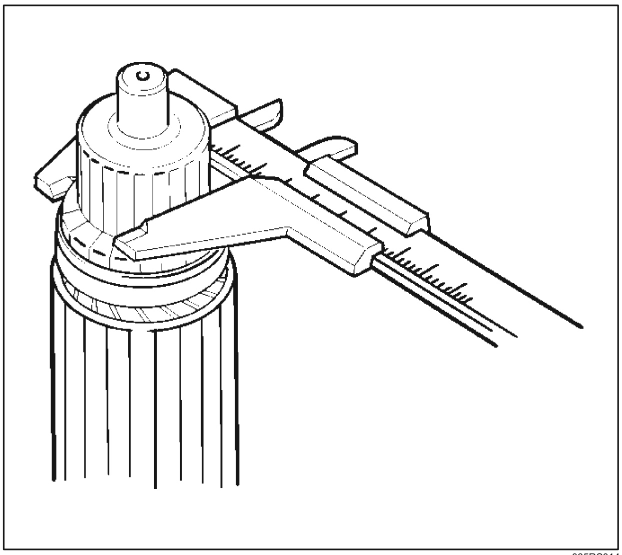
Repair or replace necessary parts if extreme wear or damage is found during inspection.

Armature

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

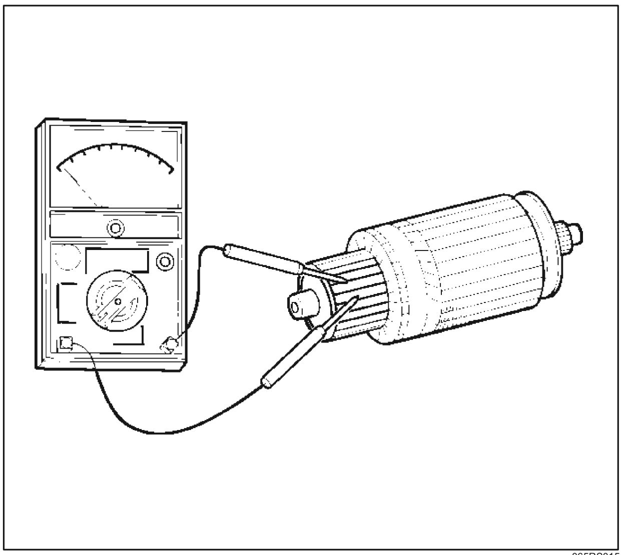
Standard: 33.0 mm (1.30 in)

Limit: 32.0 mm (1.26 in)



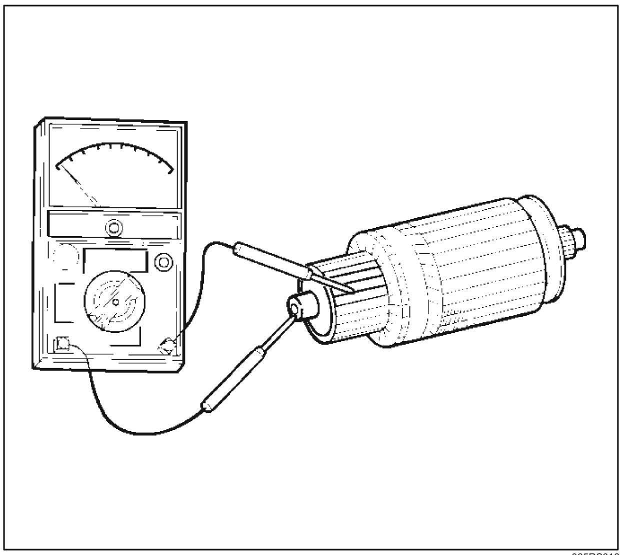
065RS014

Check for continuity between commutator and segment. 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 armature core and commutator with a dial gauge. Repair or replace, if it exceeds the limit.

Armature

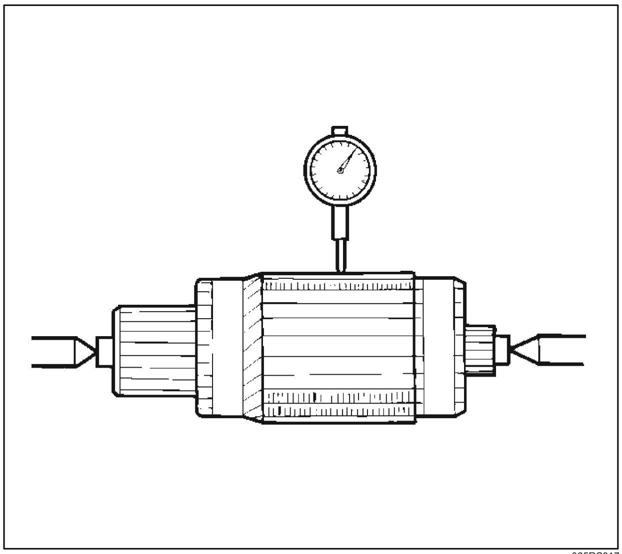
Standard: 0.05 mm (0.002 in) Max.

Limit: 0.10 mm (0.004 in)

Commutator

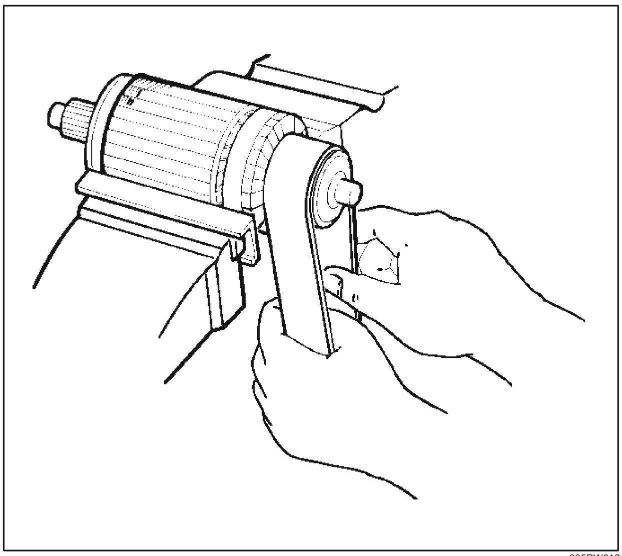
Standard: 0.05 mm (0.002 in) Max.

Limit: 0.10 mm (0.004 in)



065RS017

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

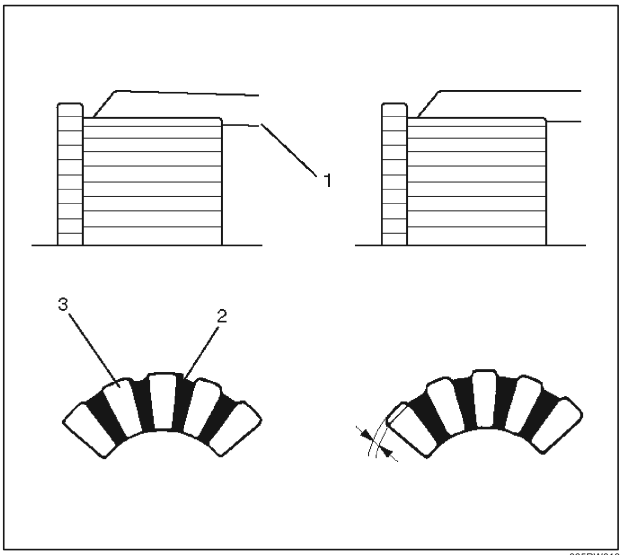


065RW012

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

Standard: 0.05 mm to 0.8 mm (0.02 in to 0.03 in)

Limit: 0.2 mm (0.008 in)



065RW013

Legend

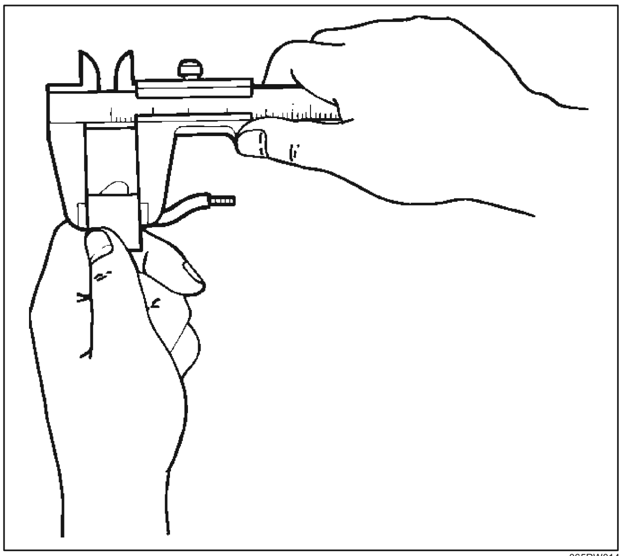
(1) Steel Saw
(2) Insulator
(3) Commutator Segments

Brush

Measure the length of brush.
Replace with a new one, if it is below the limit.

Standard: 16 mm (0.63 in)

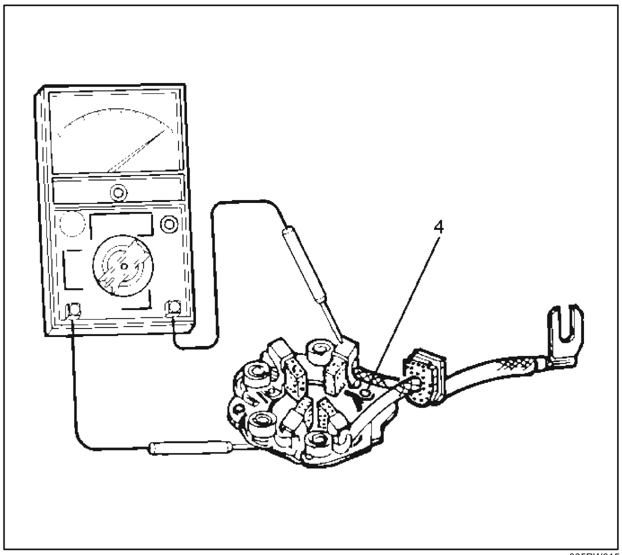
Limit: 11 mm (0.43 in)



065RW014

Brush Holder

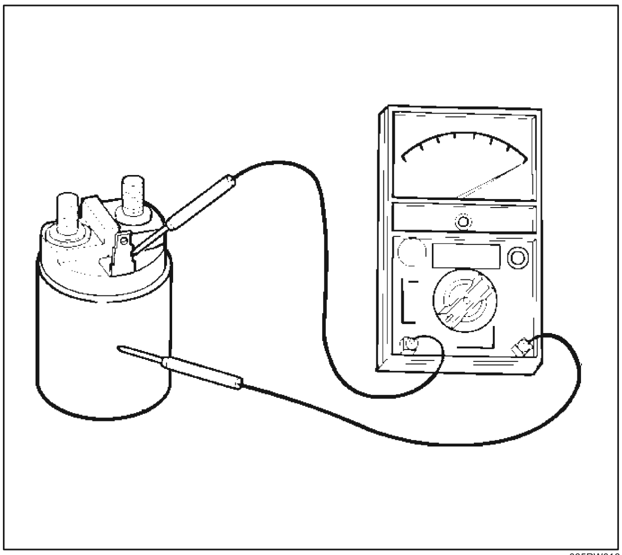
Check for continuity between brush holder (+) (4) and base (–). Replace, if there is continuity (i.e., insulation is broken).



065RW015

Magnetic Switch

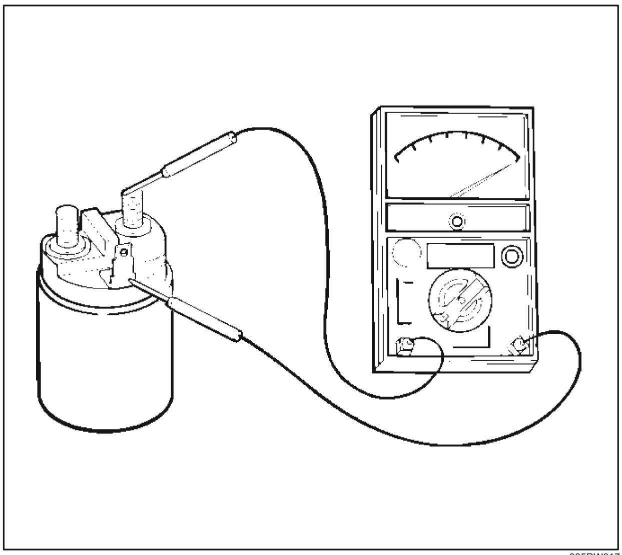
Check for continuity of shunt coil between terminals S and M.
Replace, if there is no continuity (i.e., coil is disconnected).



065RW016

Continuity of Series Coil

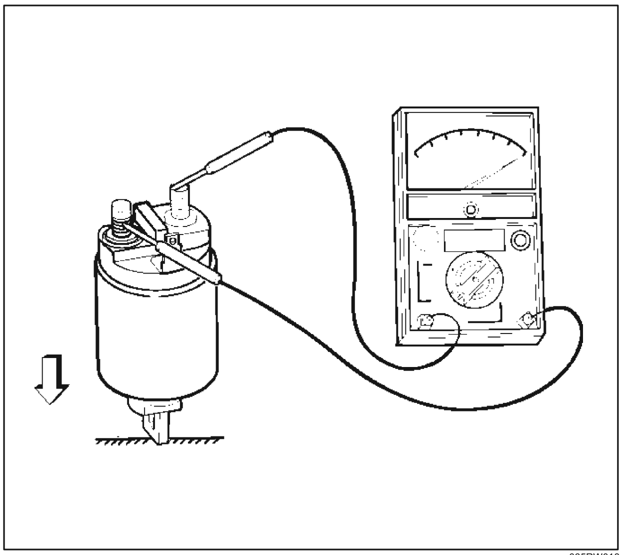
Check for continuity between terminals S and M.
Replace, if there is no continuity (i.e., coil is disconnected).



065RW017

Continuity of Contacts

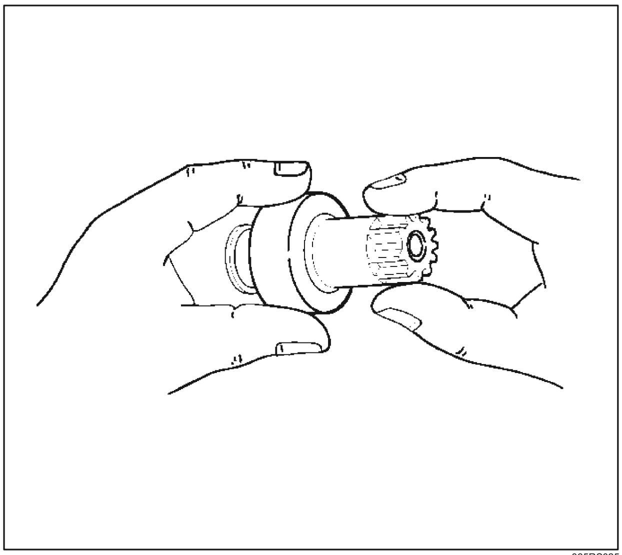
With the plunger faced downward, push down the magnetic switch. In this state, check for continuity between terminals B and M. Replace, if there is no continuity (i.e., contacts are faulty).



065RW018

Pinion

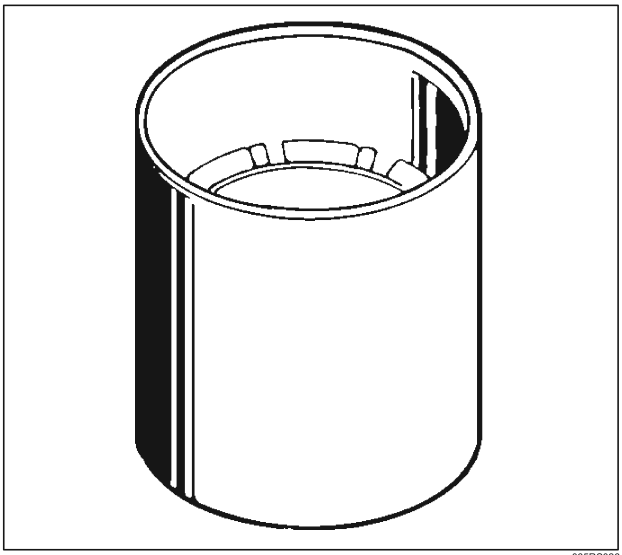
Check if the pinion rotates smoothly in drive direction by hand, or if it is locked when it is rotated in reverse. If not, replace the pinion.



065RS025

Yoke Assembly

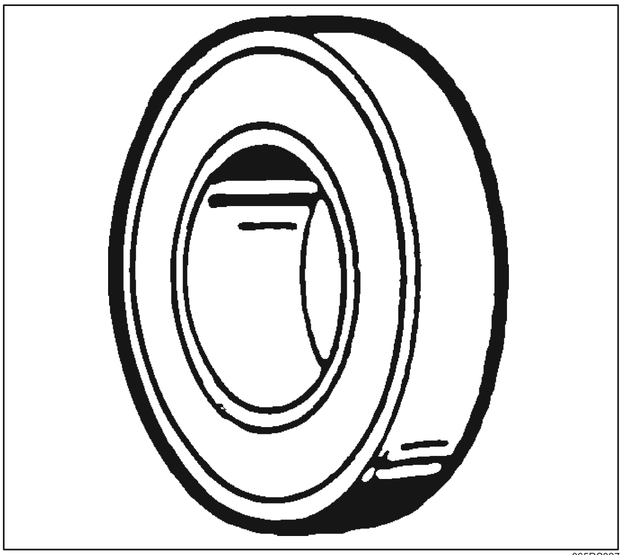
Check a magnet inside the yoke.
Replace the yoke assembly if it is broken.



065RS026

Ball Bearing

Clamp the inner race of the ball bearing with your finger, and check for sticking or play when rotating the outer race.
Replace, if abnormality is found.

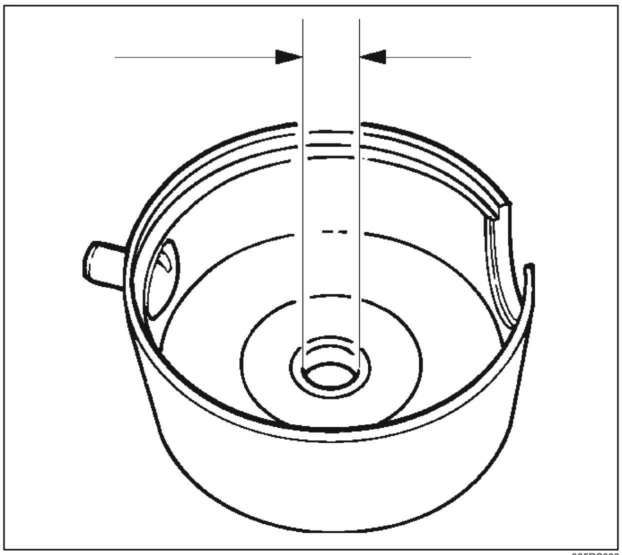


065RS027

Measure inner diameter of bushing in the rear cover, and replace if it exceeds the limit.

Standard: 12.50 mm to 12.527 mm (0.492 in to 0.4932 in)

Limit: 12.60 mm (0.4961 in)

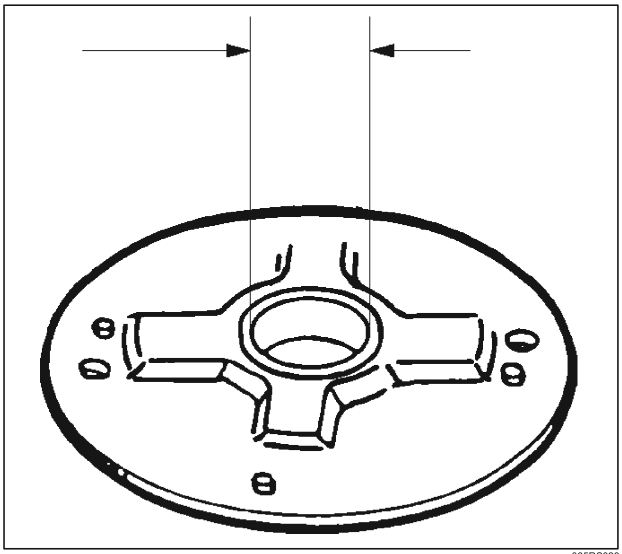


065RS028

Measure inner diameter of bushing in the center bracket (P), and replace if it exceeds the limit.

Standard: 18.01 mm to 18.127 mm (0.7091 in to 0.7137 in)

Limit: 18.15 mm (0.7146 in)



065RS029

Reassembly

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

Grease application places

- Bushing in rear cover and center bracket
- Gears in reduction gear
- Shift lever operating portion
- Sliding portion of pinion
- Plunger sliding portion of magnetic switch

Reassembling Yoke Assembly

Before reassembly, make sure that no metallic parts attach to the yoke assembly. Because of strong magnetic force, hold the yoke assembly and insert it slowly into the armature.

Torque

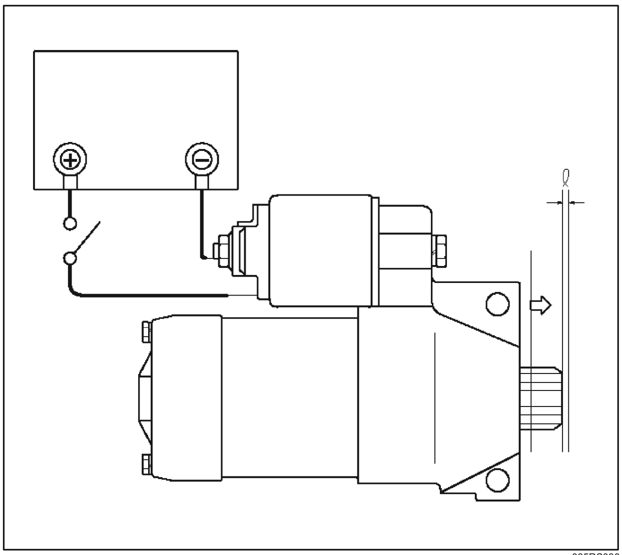
Torque for each part (See Torque Specifications in this section)

Pinion Jump–out Dimension

Connect the “+” cable of battery to terminal S and the “–” cable to terminal M. Turn the switch on, and measure pinion travel dimension in thrust direction from the jump–out position.

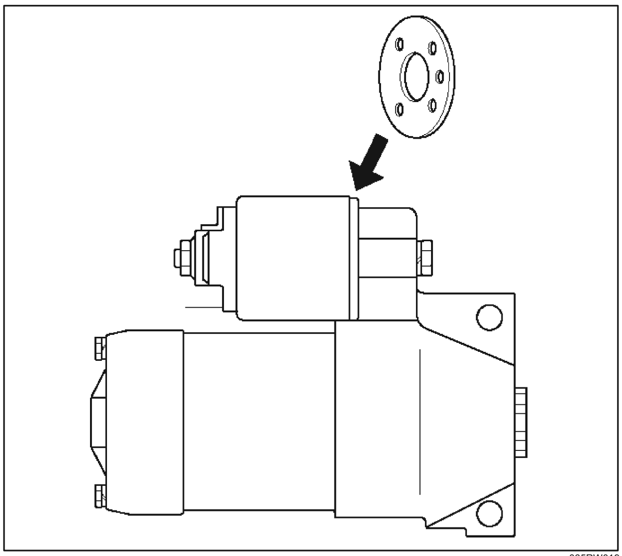
In measuring the dimension, pull the pinion out a little in the arrow direction.

Dimension(L): 0.05 mm to 1.5 mm (0.002 in to 0.06 in)



065RS030

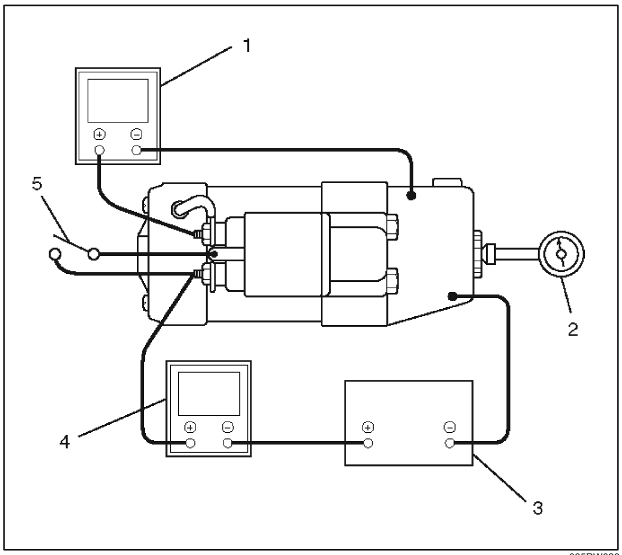
If the measured value is out of standard, insert dust cover, or disassemble and adjust.



065RW019

Characteristic Test

For easily confirming the characteristics, conduct the no load test as follows:
Rating as short as 30 seconds requires rapid testing.
Fix the starter on the test bench, and wire as shown in illustration. When the switch is closed, the current flows and the starter runs under no load. At this time, measure current, voltage and speed to check if they satisfy the standard.



065RW020

Legend

(1) Volt Meter
(2) Tachometer
(3) Battery
(4) Ammeter
(5) Switch

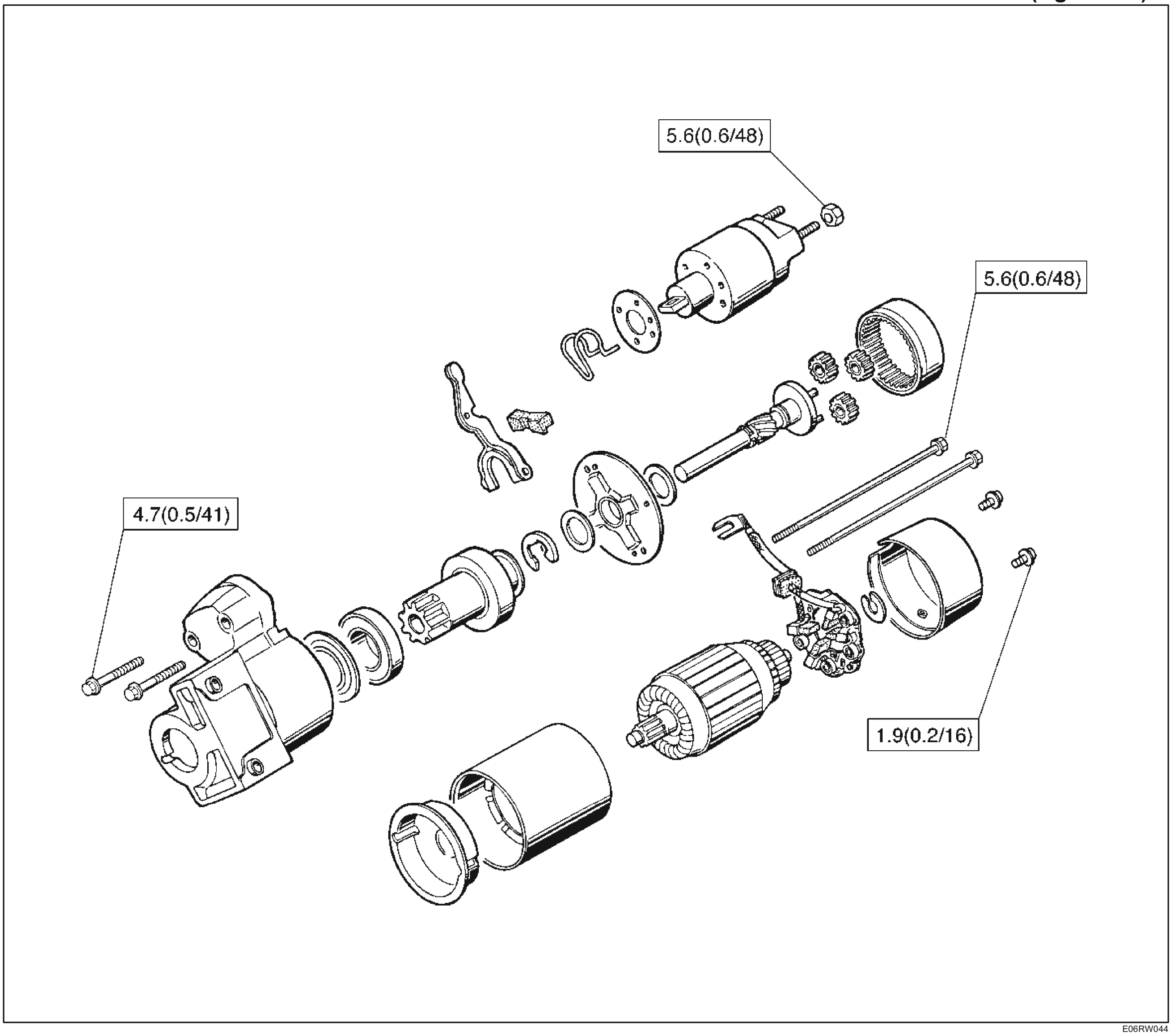
Main Data and Specifications

General Specifications

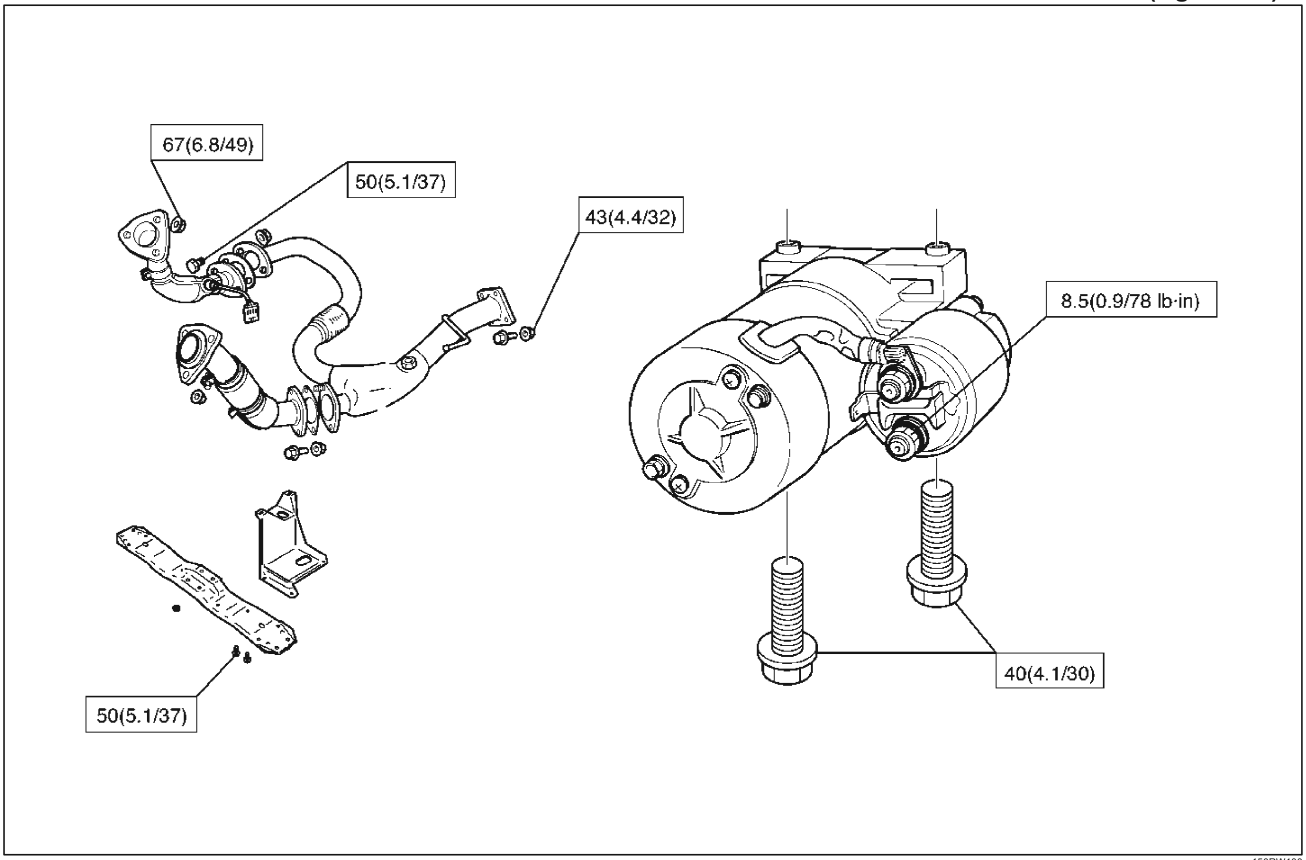
Model	HITACHI GD002350
Rating	
Voltage	12 V
Output	1.4 Kw
Time	30 sec
Number of teeth of pinion	9
Rotating direction(as viewed from pinion)	Clockwise
Weight(approx.)	34 N
No load characteristics	
Voltage /Current	11V/90A or less
Speed	2700rpm or more
Load characteristics	
Voltage/current	8.4V/250A
Torque	7.3N·m(64lb·in.) or more
Speed	1200rpm or more
Locking characteristics	
Voltage/current	3V/750A or less
Torque	19N·m(14lb·in) or more

Torque Specifications

N·m (Kg·m/lb ft)



N·m (Kg·m/lb ft)



150RW100

Charging System

General Description

The IC integral regulator charging system and its main components are connected as shown in the 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:

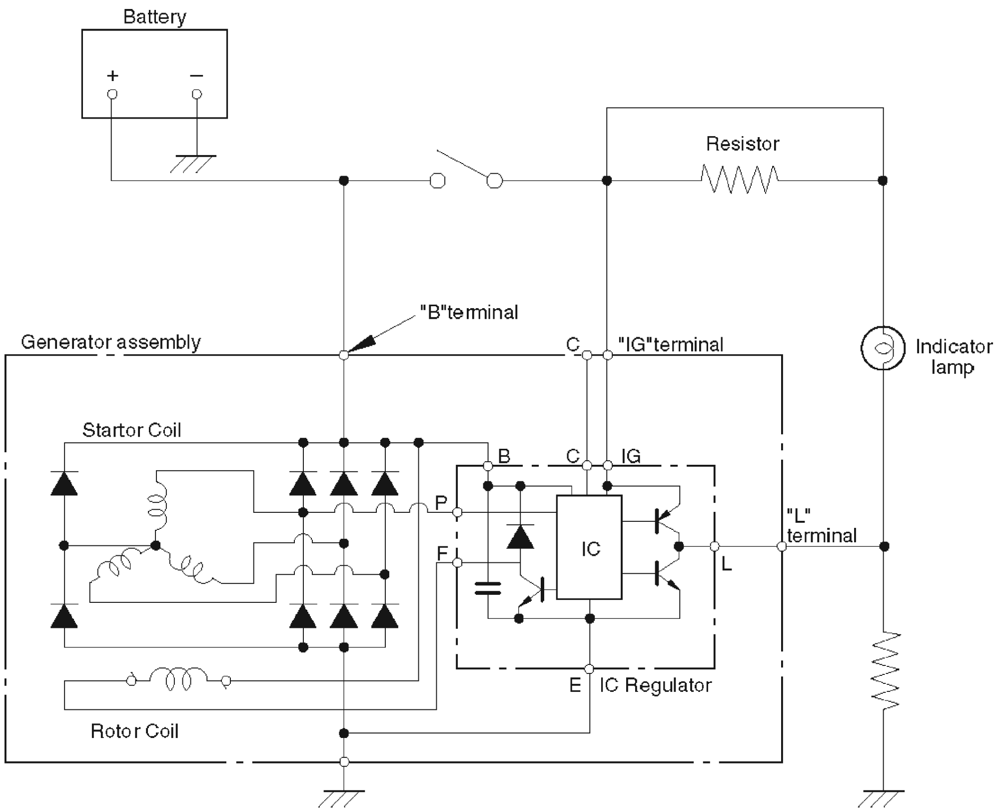
1. Check visually the belt and wiring connector.
2. With the engine stopped, turn the stator switch to “ON” position and observe the warning lamp.

   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.

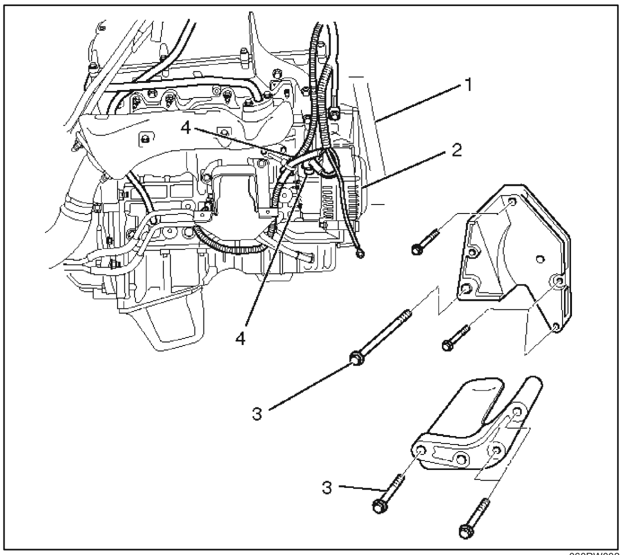


F06RW009

Generator

Removal

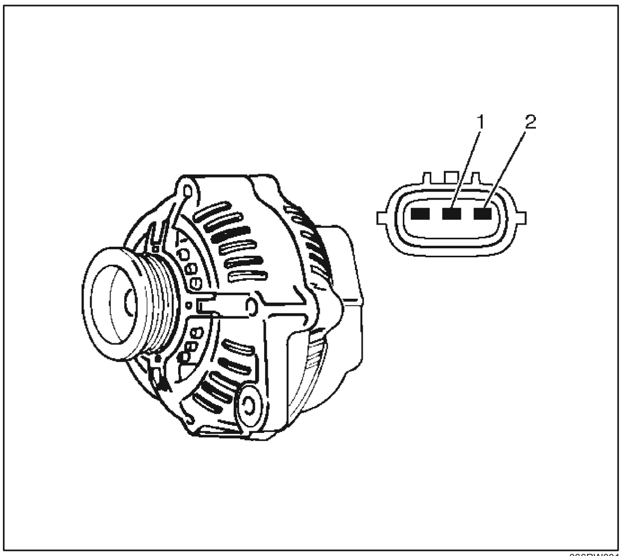
1. Disconnect battery ground cable.
2. Move drive belt tensioner to loose side using wrench then remove drive belt (1).
3. Disconnect the wire from terminal “B” and disconnect the connector (4).
4. Remove generator fixing bolt (3).
5. Remove generator assembly (2).



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., head lights). 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.

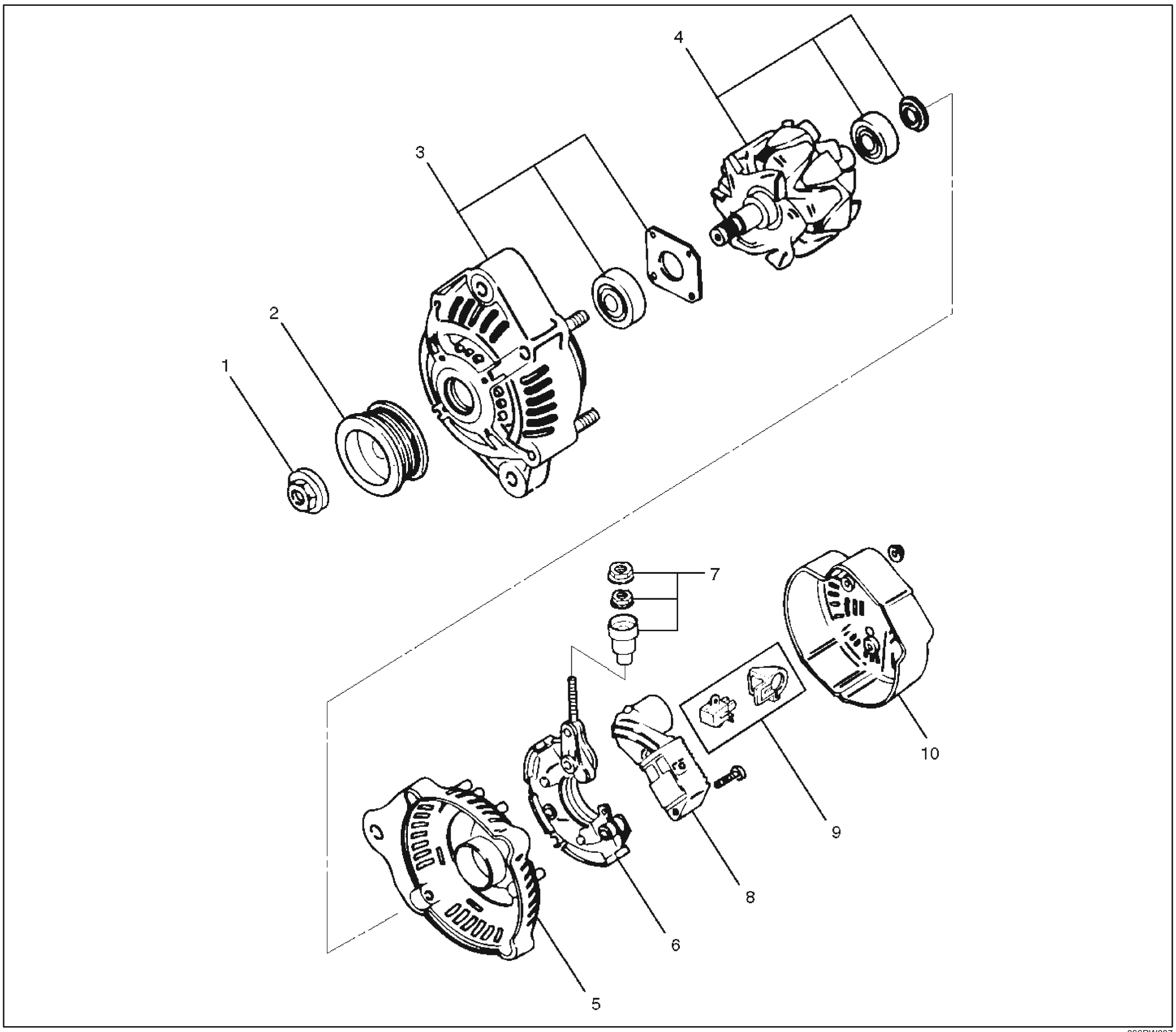
Torque:

M10 bolt: 41 N·m (4.2 Kg·m/30 lb ft)

M8 bolt: 21 N·m (2.1 Kg·m/15 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

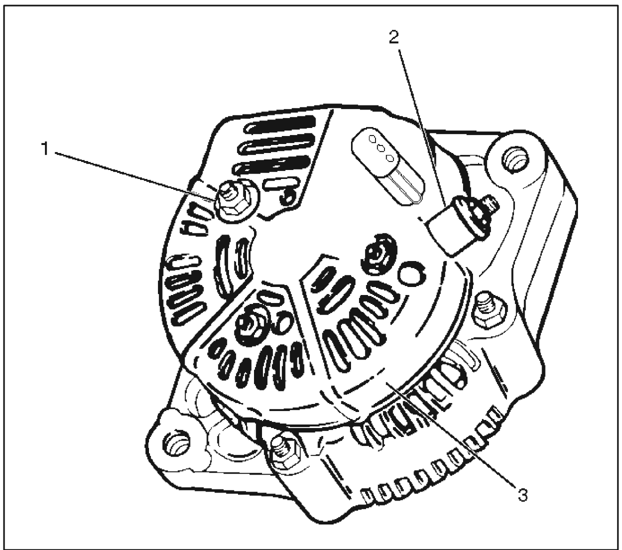


Legend

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

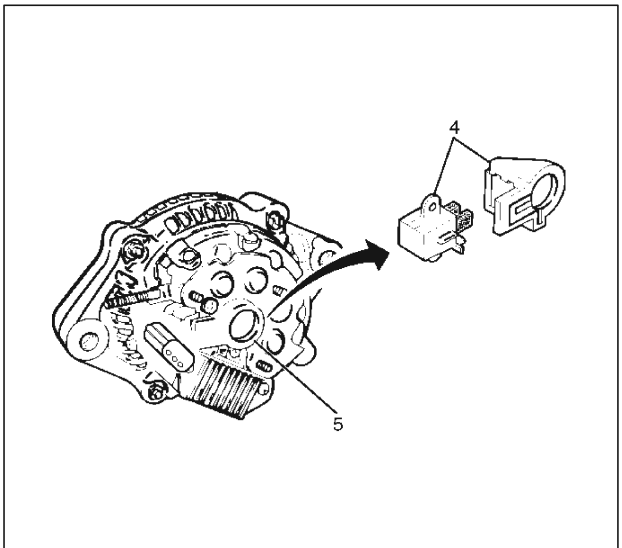
Disassembly

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).



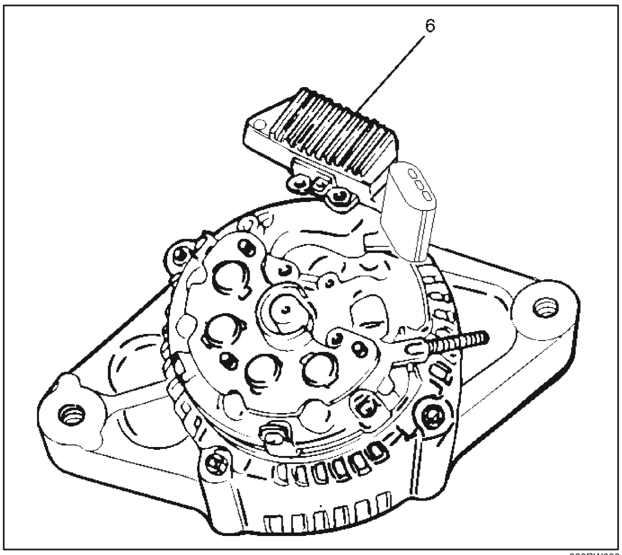
060RW005

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



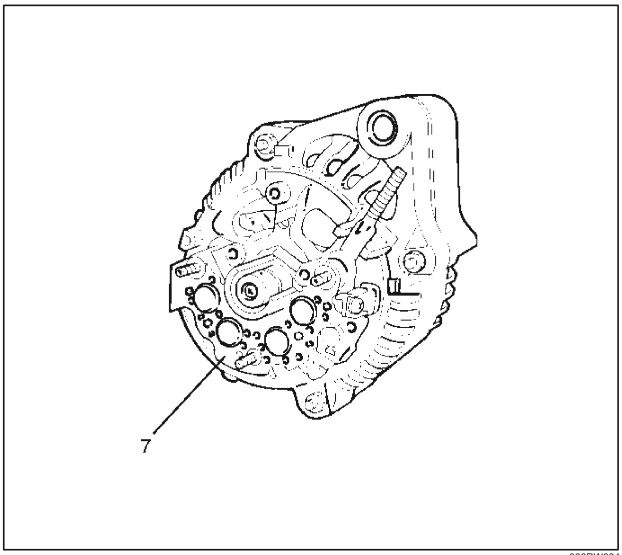
060RW004

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



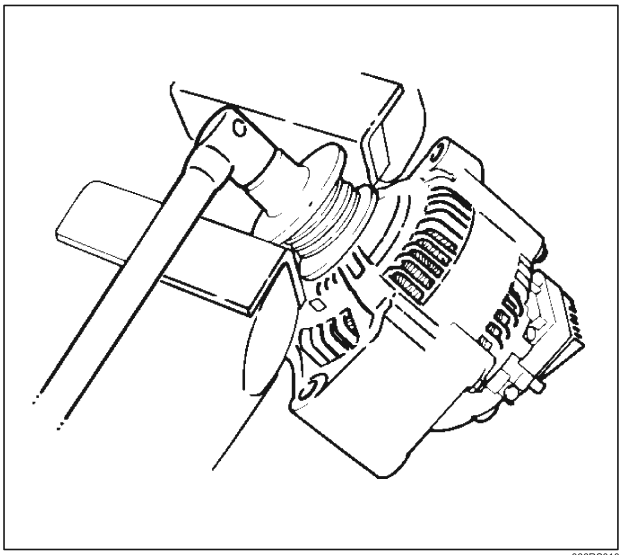
060RW003

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



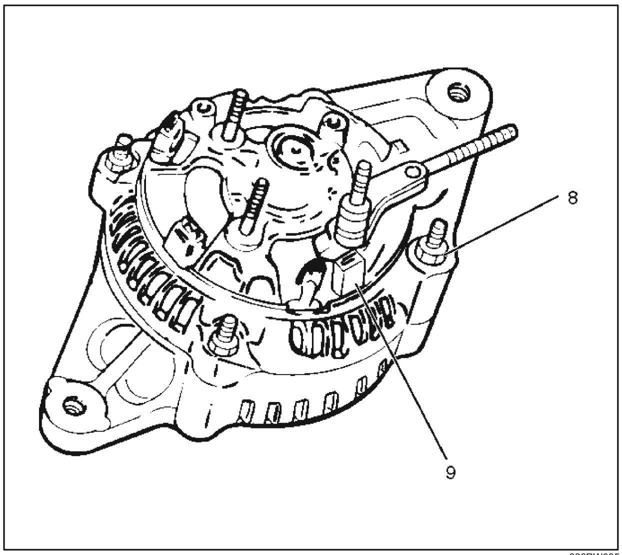
066RW004

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



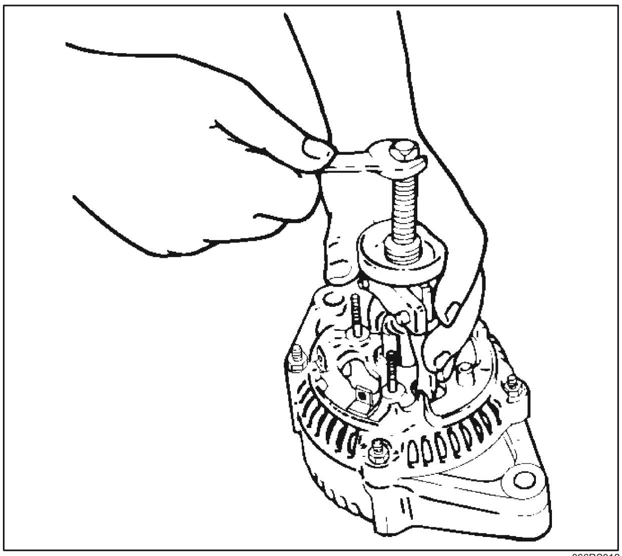
066RS010

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



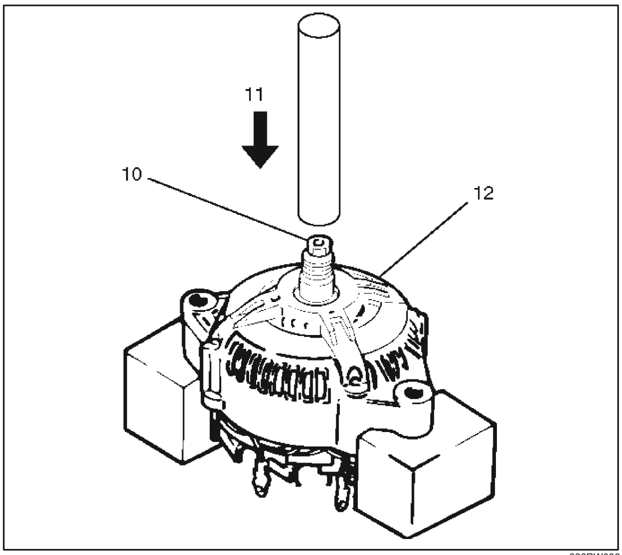
066RW005

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).



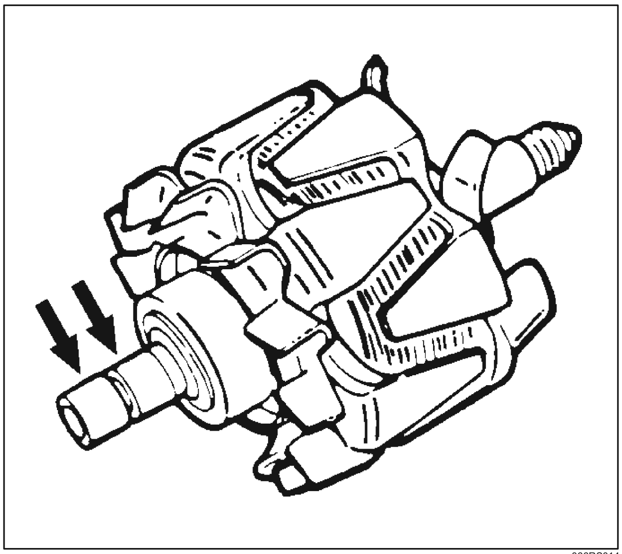
066RW006

Inspection and Repair

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

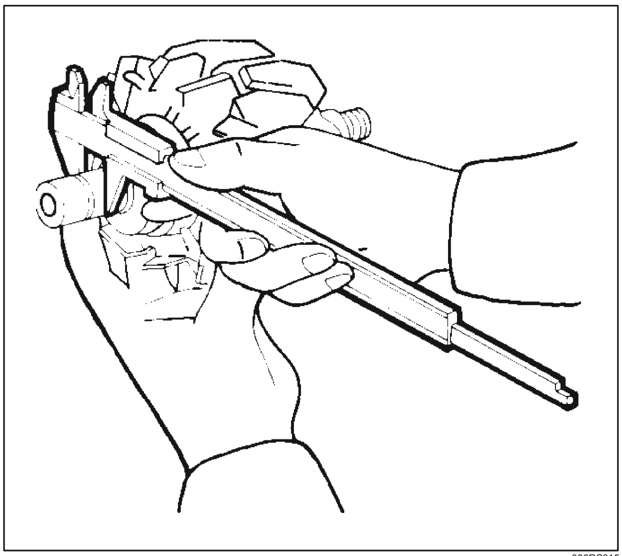
Rotor Assembly

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



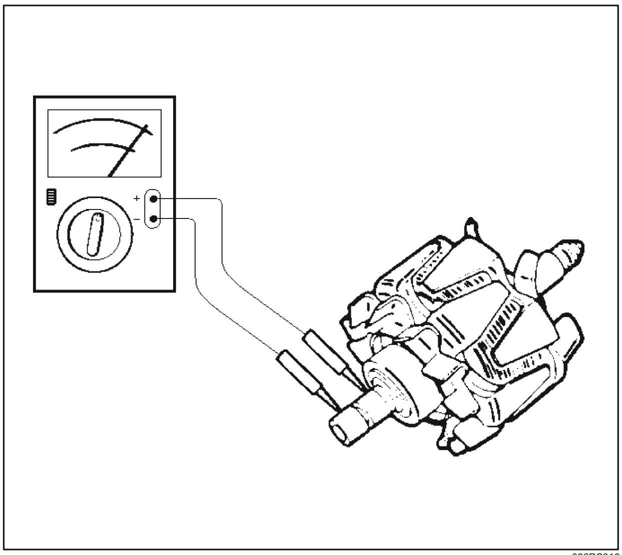
066RS014

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



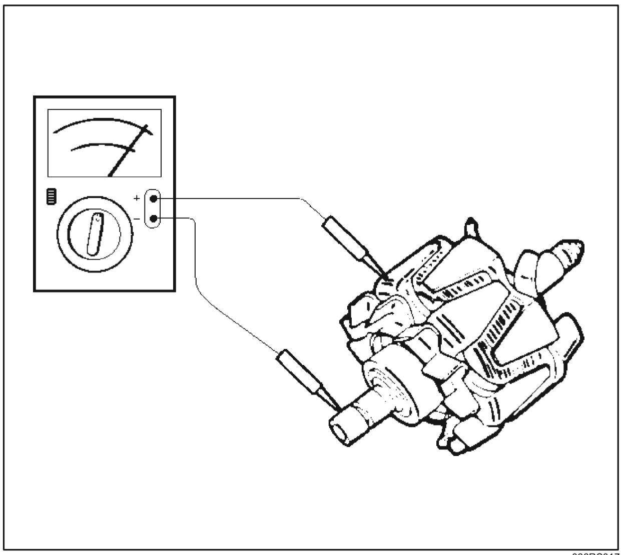
066RS015

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



066RS016

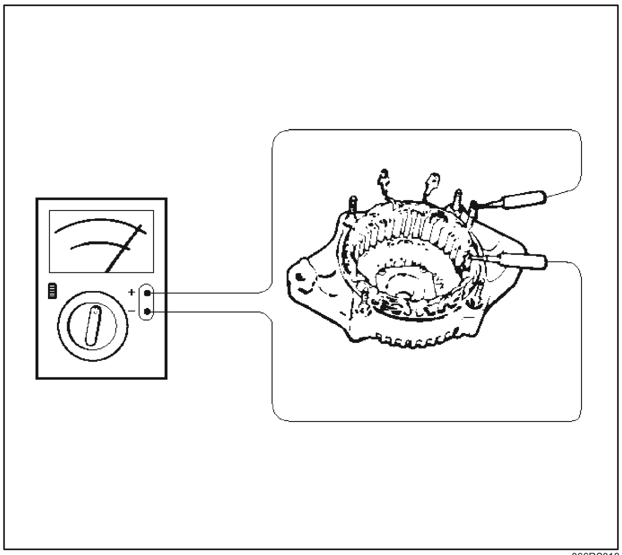
4. Check for continuity between slip ring and rotor core. In case of continuity, replace the rotor assembly.



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.



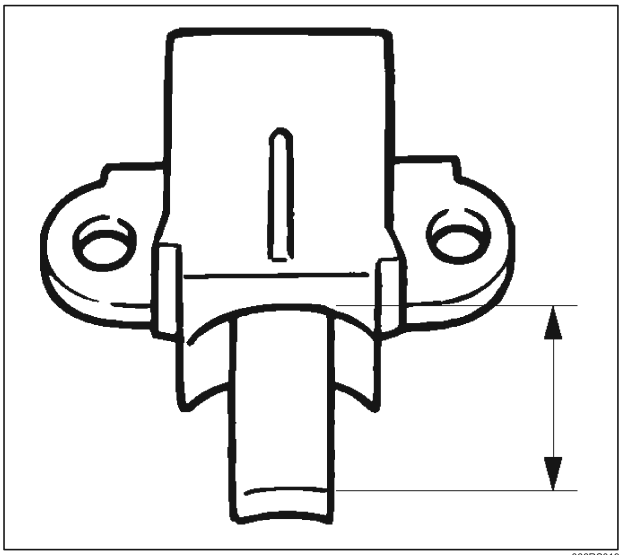
066RS018

Brush

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

Standard: 10.mm (0.4134 in)

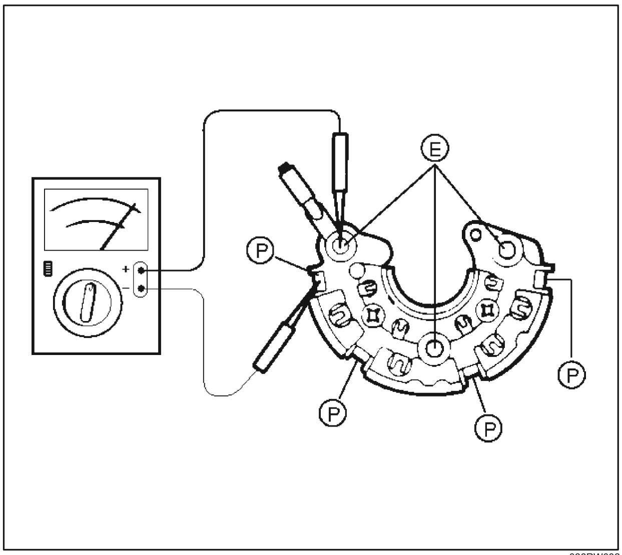
Limit: 8.4.mm (0.3307 in)



066RS019

Rectifier Assembly

Check for continuity across “P” and “E” in the $\times$ 100W range of multimeter.

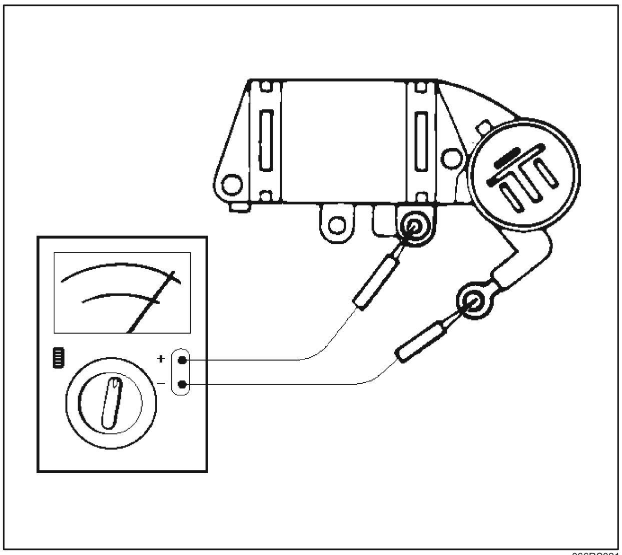


066RW002

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 $\times$ 100W range of multimeter.



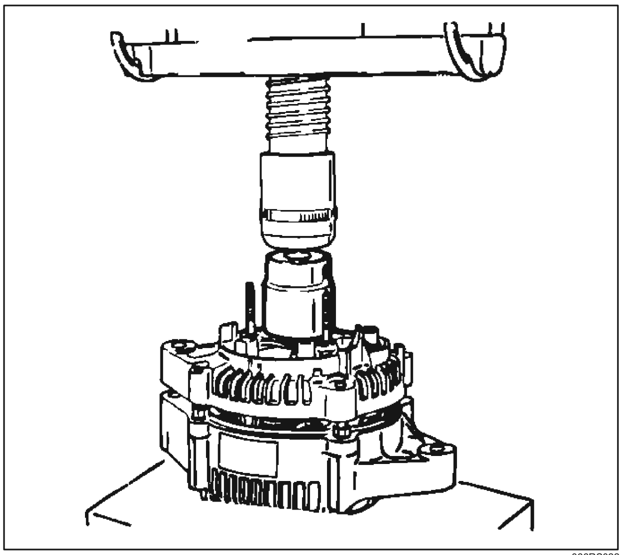
066RS021

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:

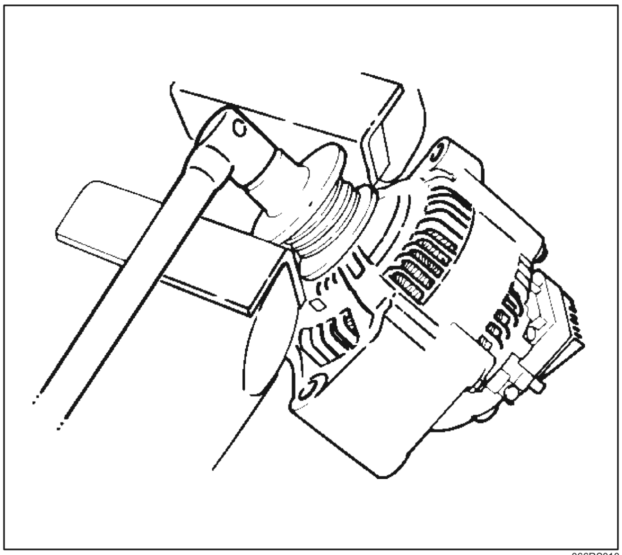
1. Using a press with a socket wrench attached, reassemble rotor and rear end cover assembly in the front cover.



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.

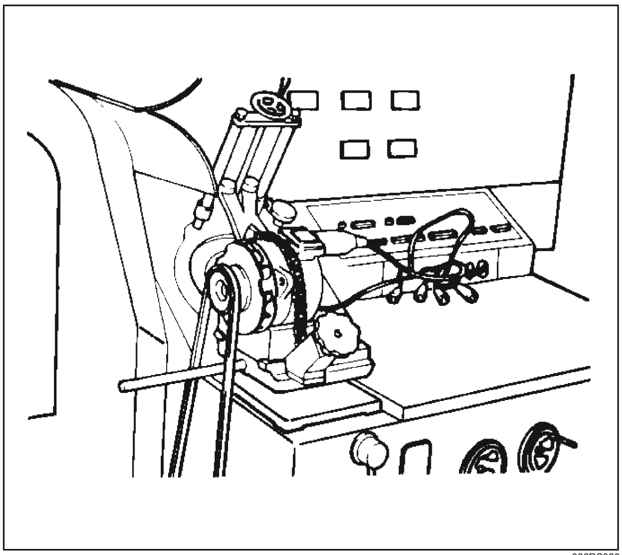
Torque: 111 N·m (11.3 Kg·m/82 lb ft)



066RS010

Bench Test

Conduct a bench test of the generator.

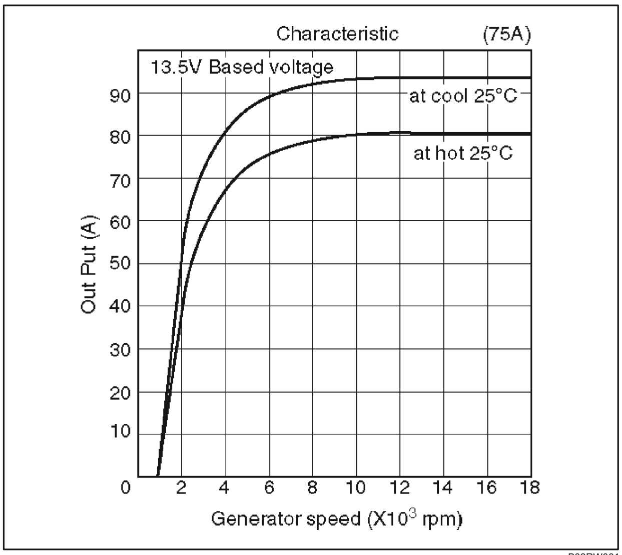


066RS023

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 (Nippon denso)	102211—5030
Model	ACHD04
Rated voltage	12 V
Rated output	75 A
Rotating direction (As viewed from pulley)	Clockwise
Pulley effective diameter	50 mm (1.97 in)
Weight	44 N (33 lb)

ENGINE

ENGINE DRIVEABILITY AND EMISSIONS

CONTENTS

Specifications

Tightening Specifications

Application	N·m	Lb Ft.	Lb In.
Camshaft Position Sensor Retaining Screw	9	—	78
Crankshaft Position Sensor Mounting Bolt	10	—	87
EGR Bolt	28	21	—
EGR Nut	28	21	—
Engine Coolant Temperature Sensor	20	7.7	—
Fuel Drain Plug	29	22	—
Fuel Pressure Regulator Attaching Screw	6.5	—	60
Fuel Rail Bolts	25	18	—
Fuel Tank Undercover Retaining Bolts	36	27	—
Heated Oxygen Sensor	42	31	—
Lower Intake Manifold to Engine Block Bolts	25	18	—
Lower Intake Manifold to Engine Block Nuts	25	18	—
Spark Plugs	18	13	—
Throttle Body Mounting Bolts	25	18	—
Upper Intake Manifold to Lower Intake Manifold Bolts	25	18	—
VSS Retaining Bolt	13	—	120

Vehicle Type Specifications

EC		AUSTRALIA		THAILAND SOUTH-EA ST-ASIA LATIN AMERICA		GULF CONTRIES SAUDI CHINA		SOU TH AFRI CA	EXPORT		Specifications			
UBS		UBS		UBS		UBS		UBS	UBS		OBD	O_2 SEN SOR	CAT A	EGR
MT	AT	MT	AT	MT	AT	MT	AT	MT	MT	AT				
•											I	2	1	●
	•										I	2	1	●
		•										1	1	●
			•									1	1	●
				•								1	1	●
					•							1	1	●
						•						1		●
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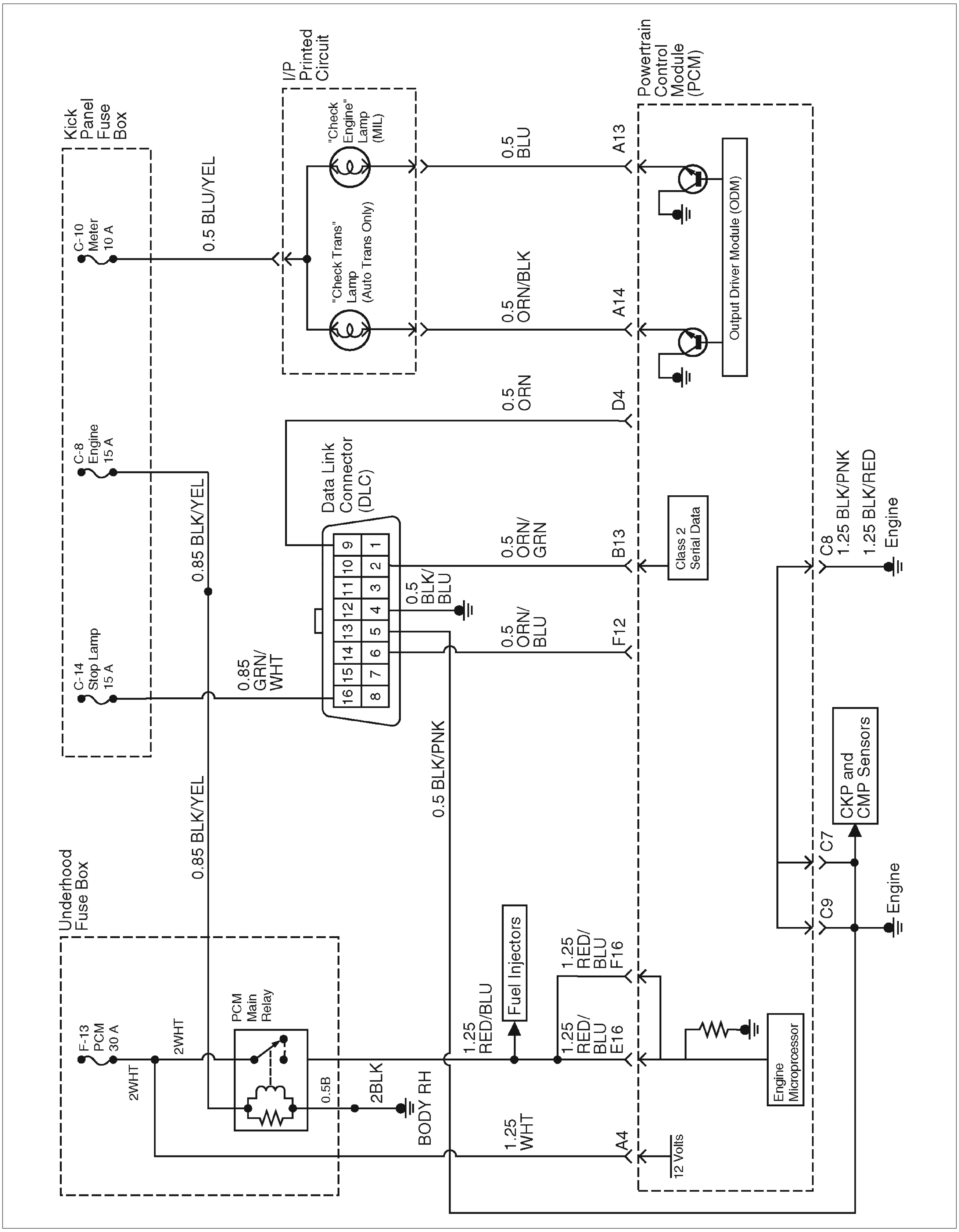
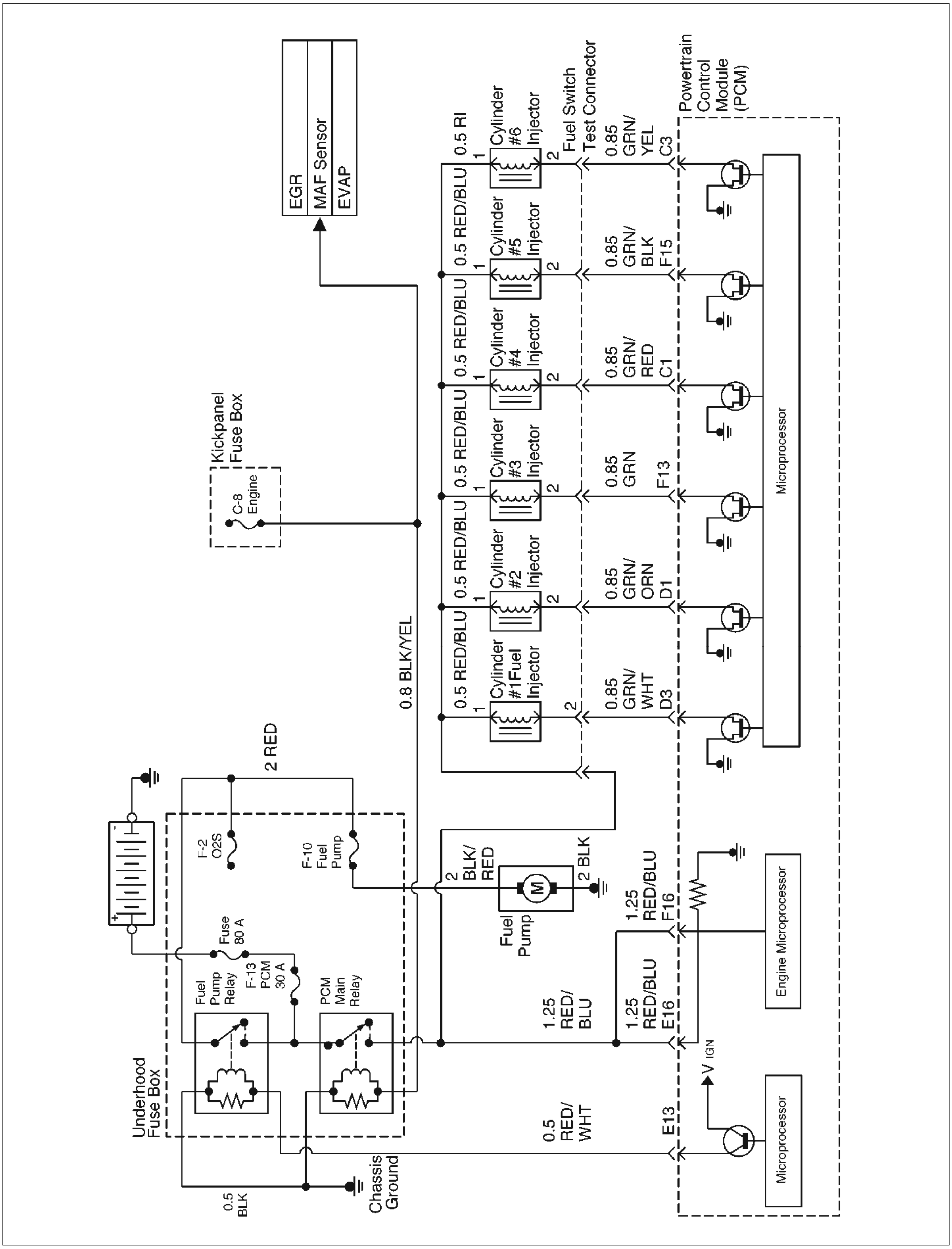
Diagrams and Schematics

PCM Wiring Diagram (1 of 11)



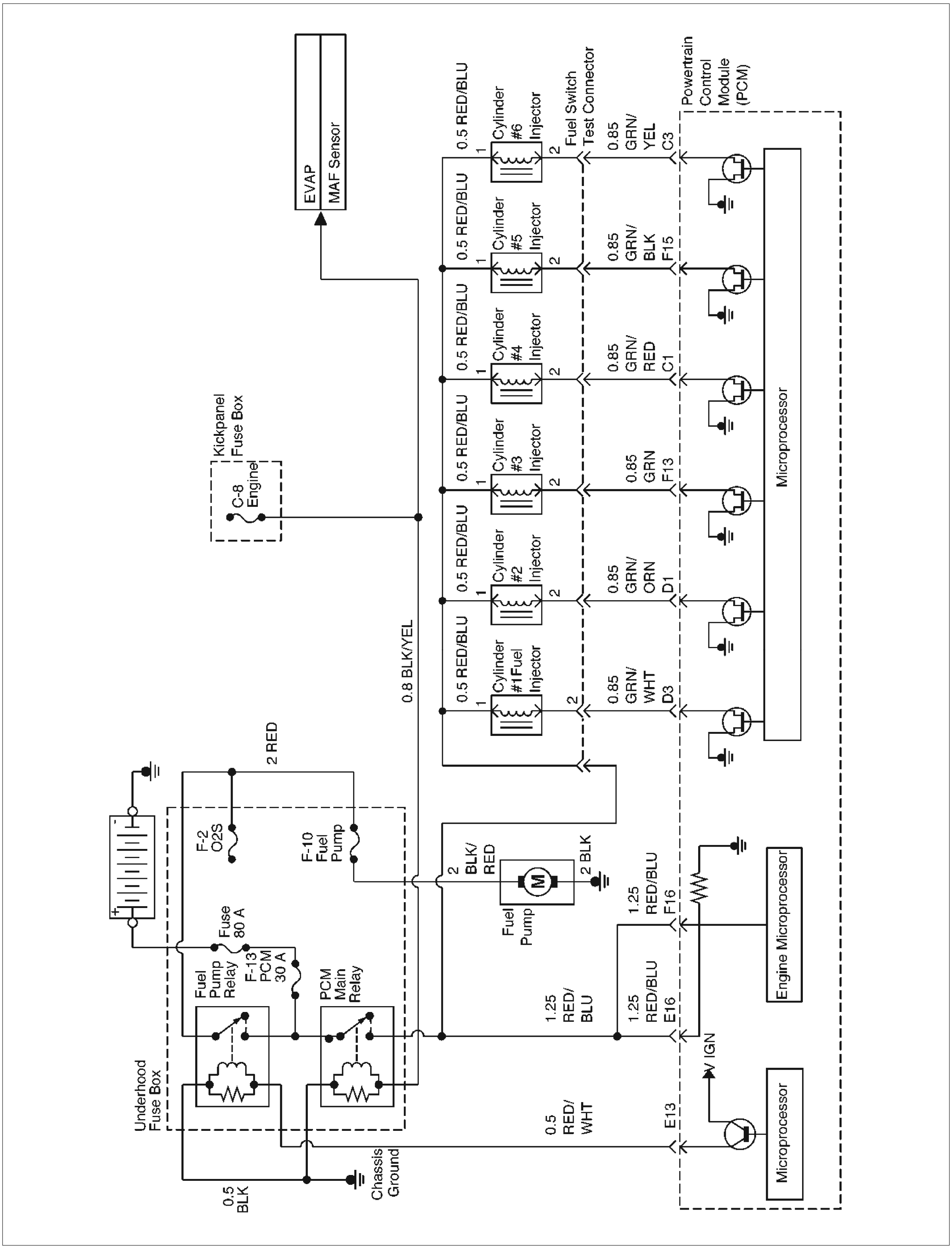
D06RW00005

PCM Wiring Diagram (2 of 11) For EC, THAILAND, SOUTH EAST ASIA, LATIN AMERICA, GULF, SAUDI, CHINA.



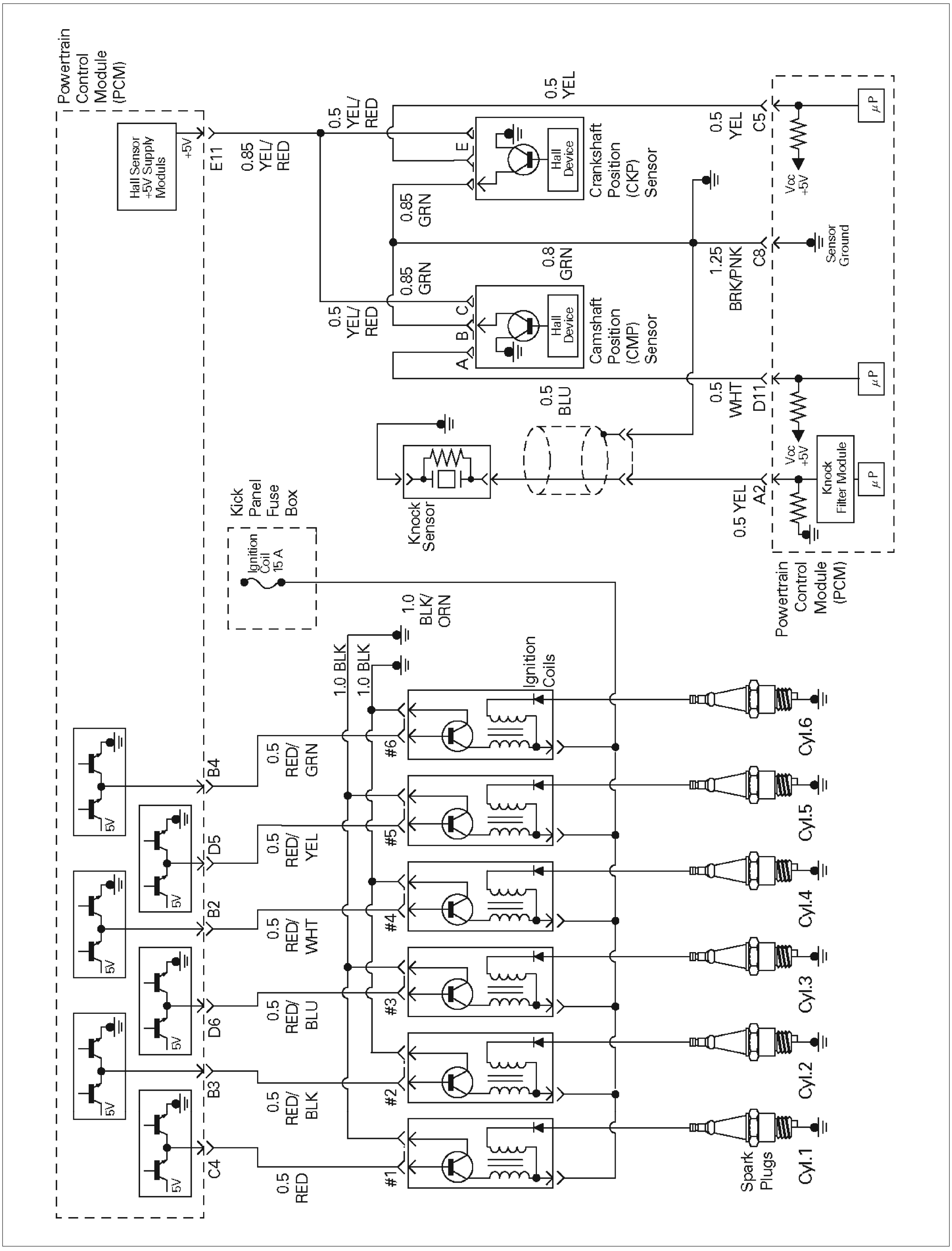
D06RW134

PCM Wiring Diagram (3 of 11) For SOUTH AFRICA and EXP.



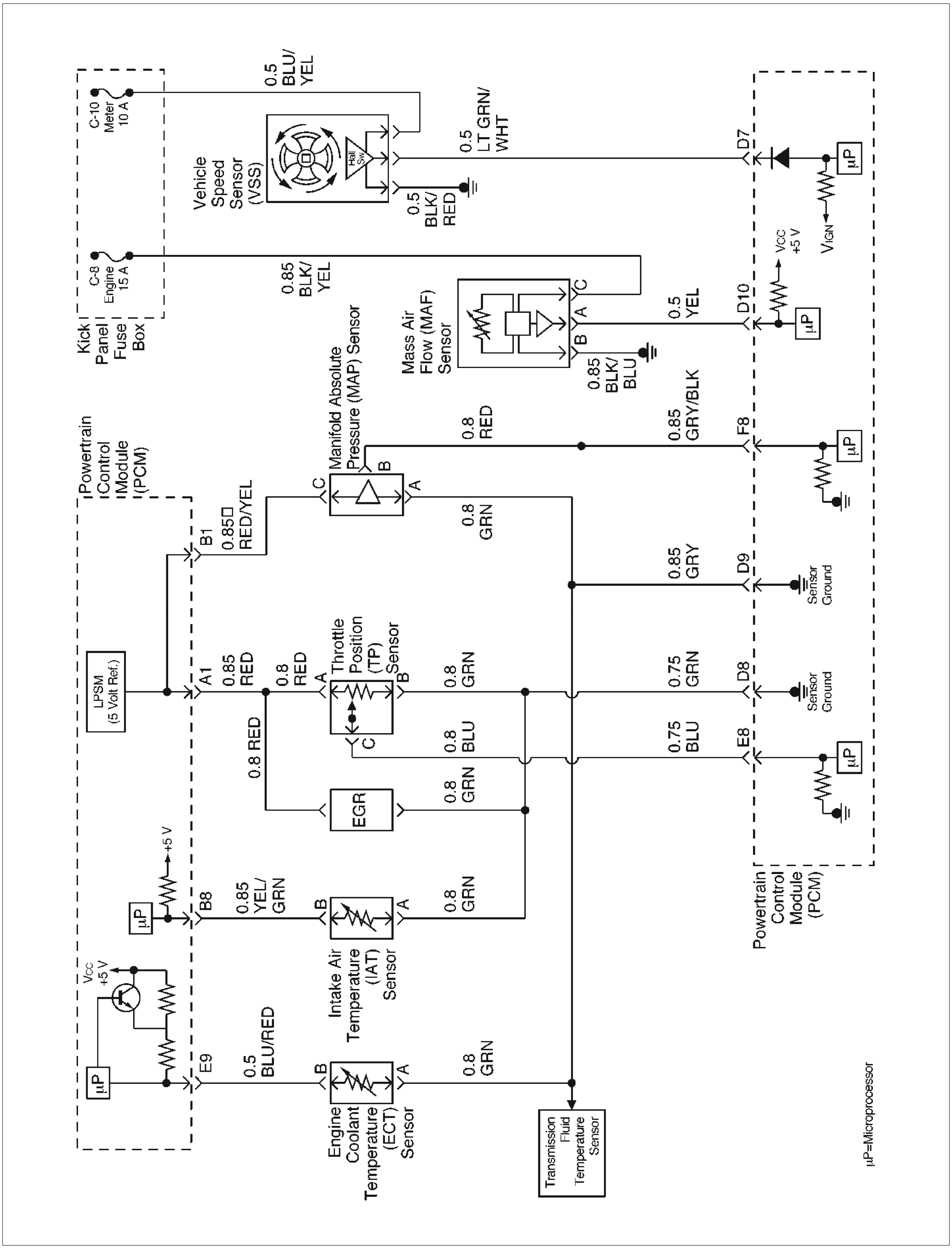
D06RW140

PCM Wiring Diagram (4 of 11)



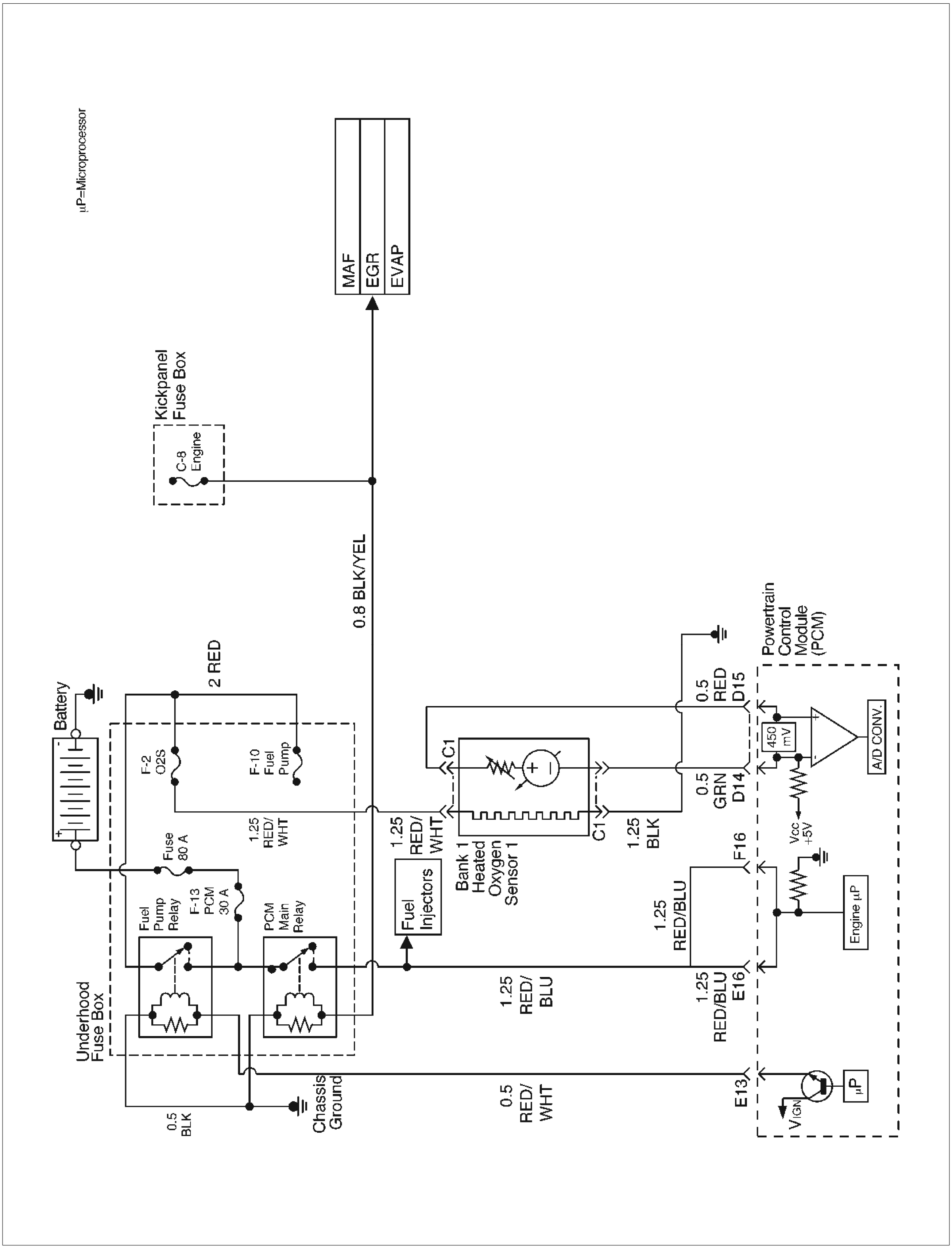
D06RX00003

PCM Wiring Diagram (5 of 11)



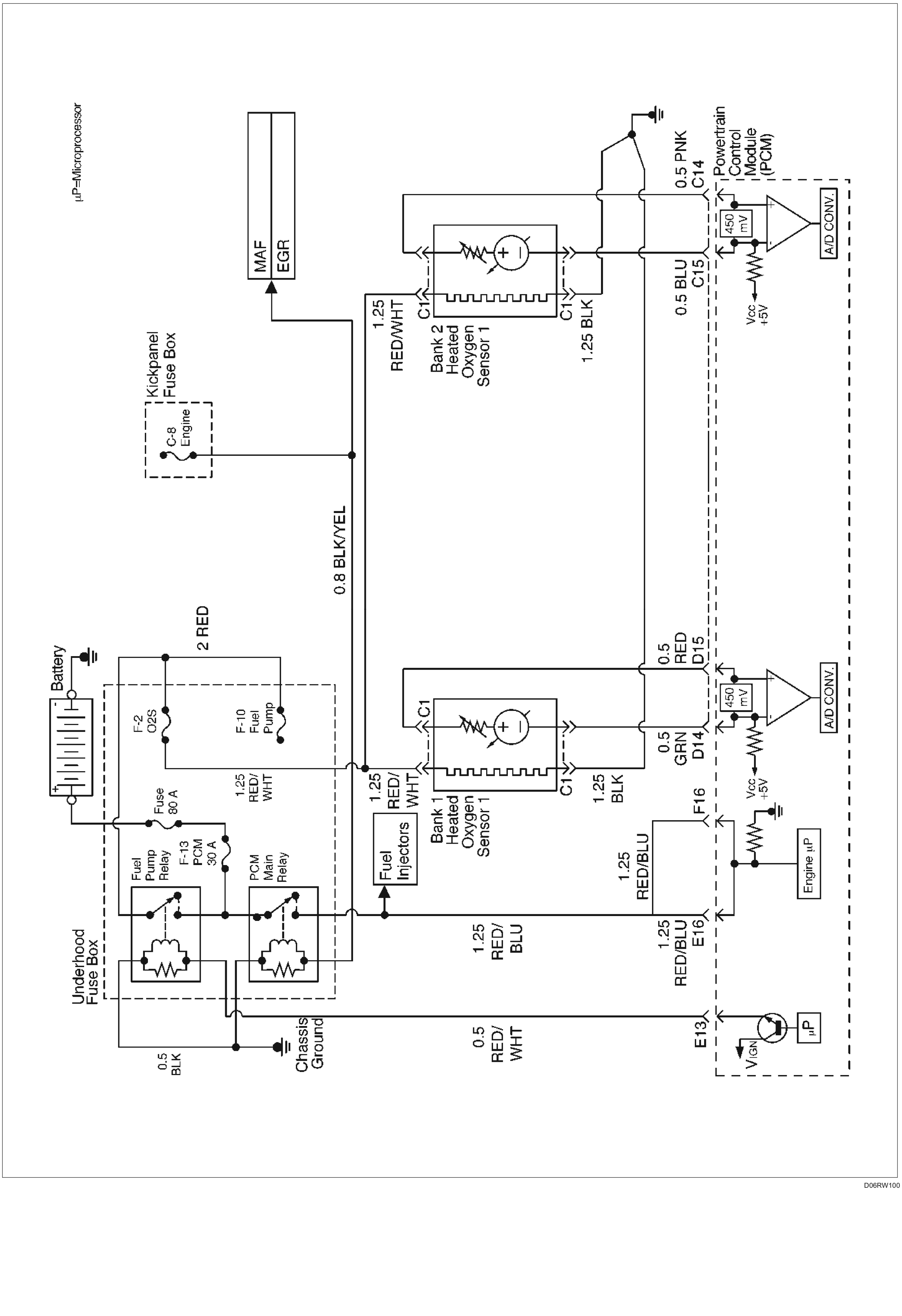
D06RW138

PCM Wiring Diagram (6 of 11) For AUSTRALIA, THAILAND, SOUTH EAST ASIA, LATIN AMERICA, GULF, SAUDI, LATIN AMERICA.



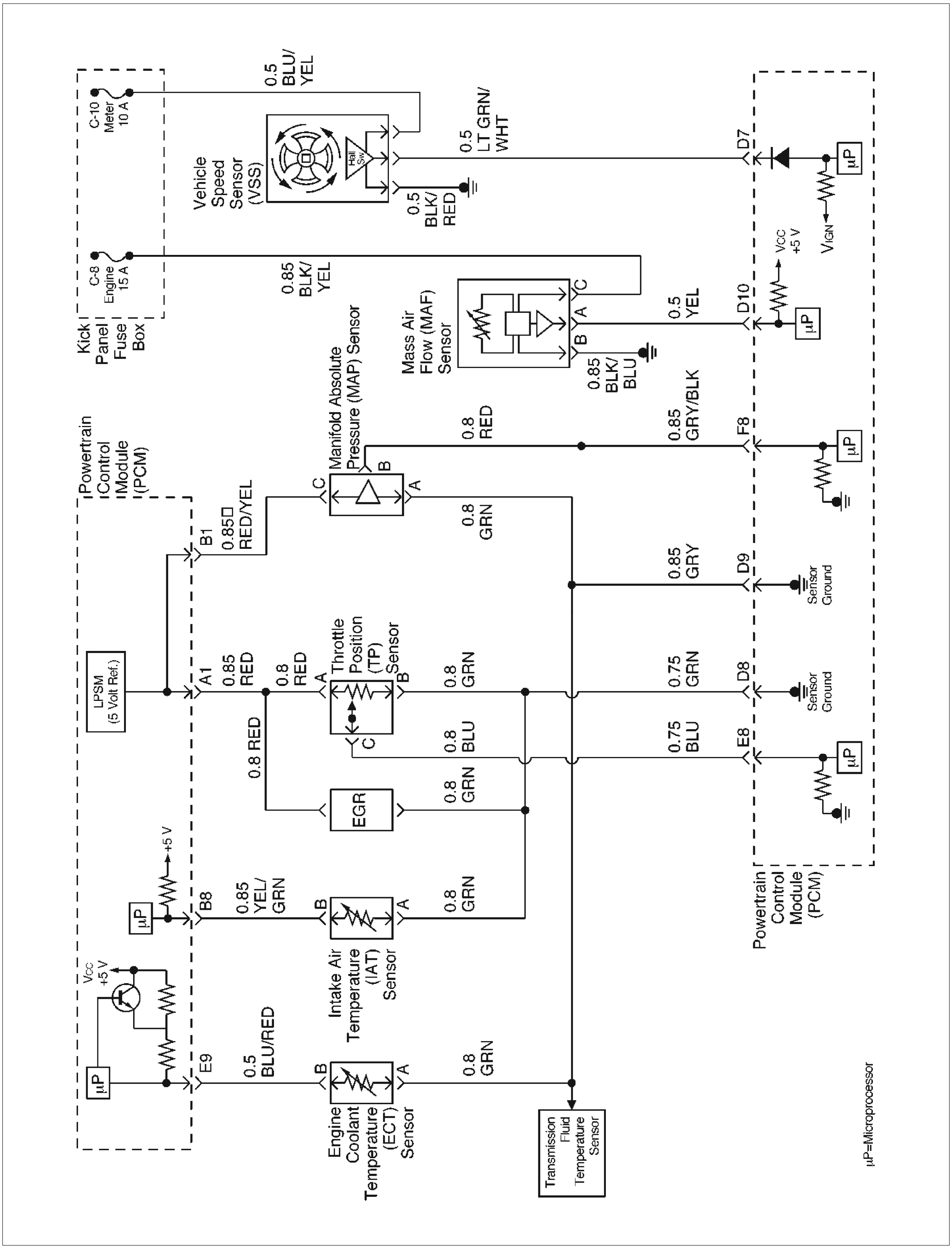
D06RW137

PCM Wiring Diagram (7 of 11) For EC.



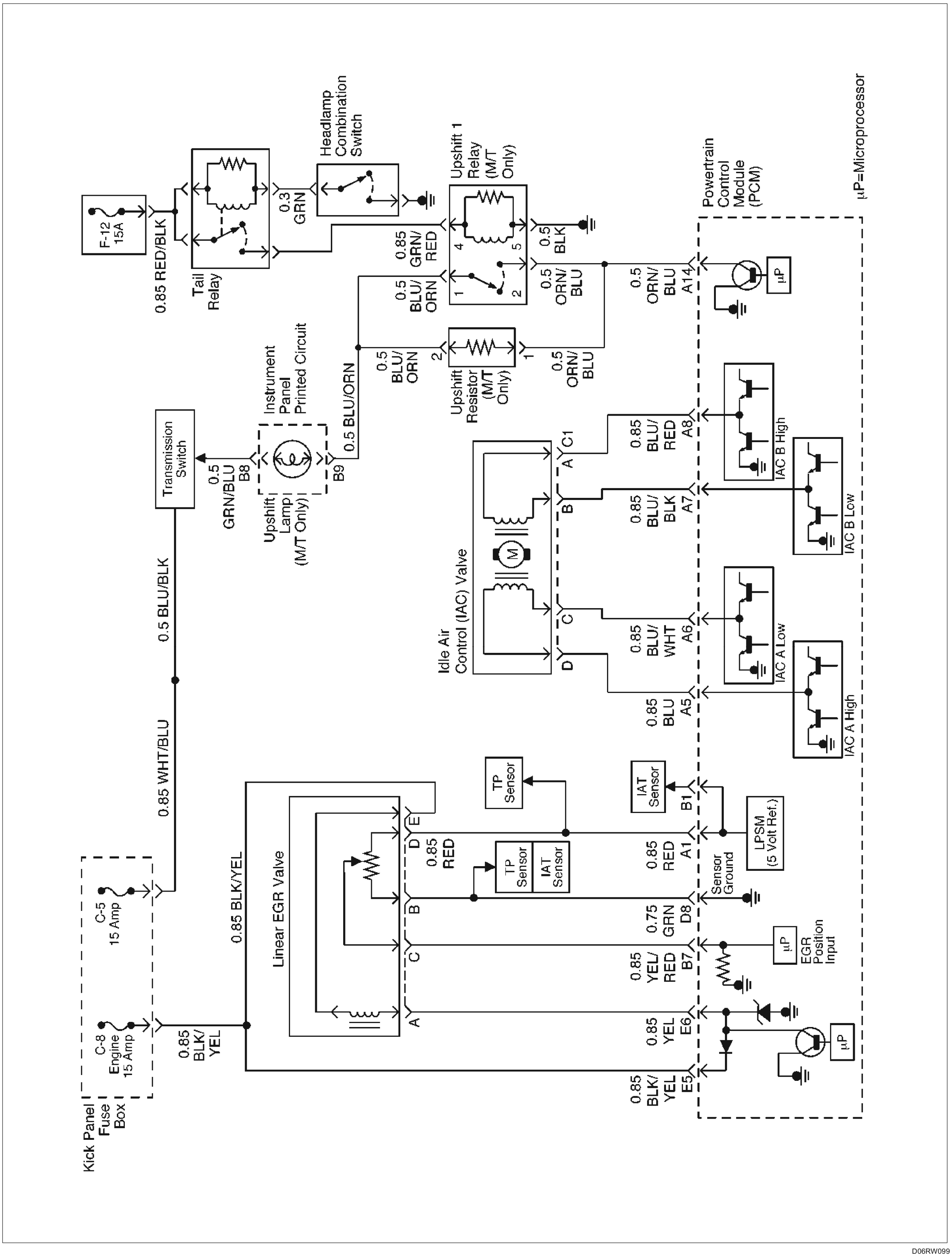
D06RW100

PCM Wiring Diagram (8 of 11) For EXPORT and SOUTH AFRICA.



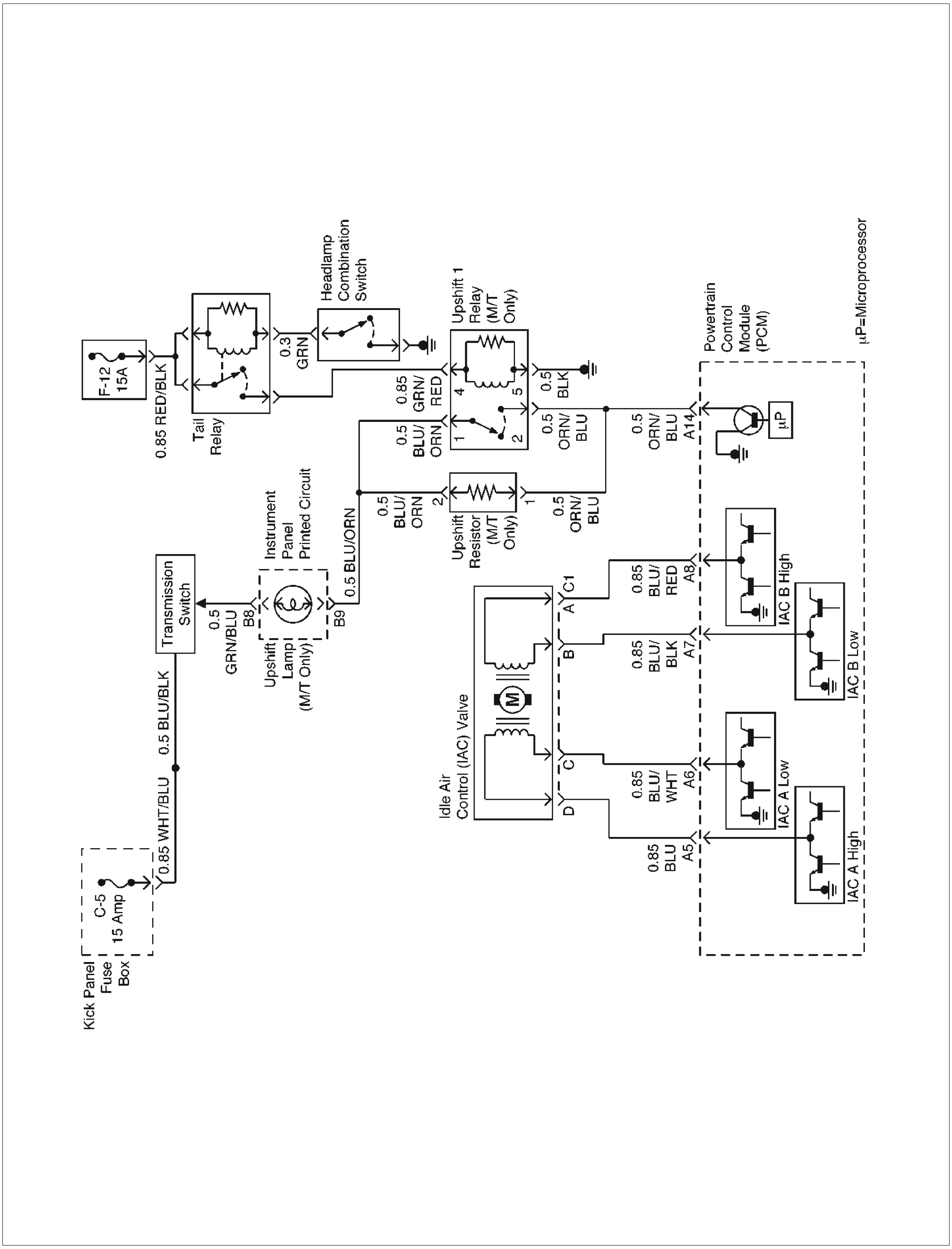
D06RW138

PCM Wiring Diagram (9 of 11) Except EXP and SOUTH AFRICA



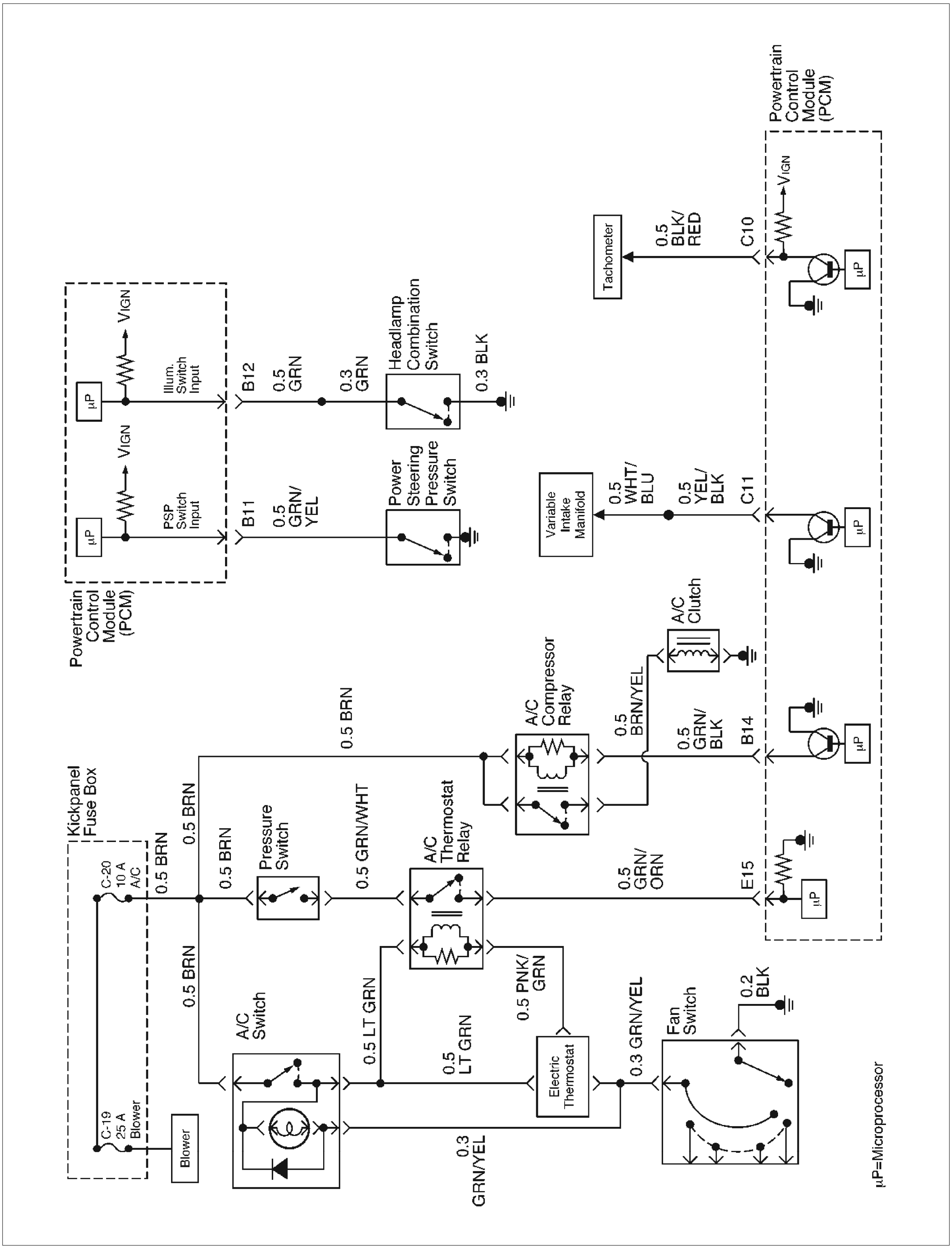
D06RW099

PCM Wiring Diagram (10 of 11) For EXPORT and SOUTH AFRICA



D06RW141

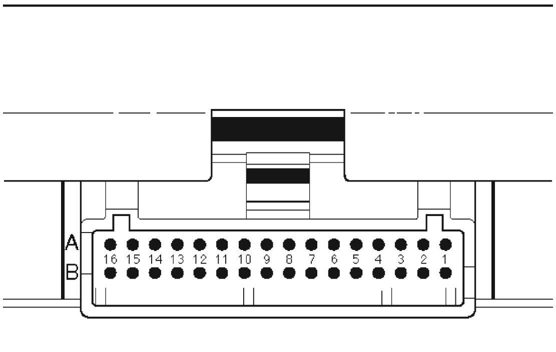
PCM Wiring Diagram (11 of 11)



D06RW136

PCM Pinouts

PCM Pinout Table, 32-Way Red Connector – Row “A”

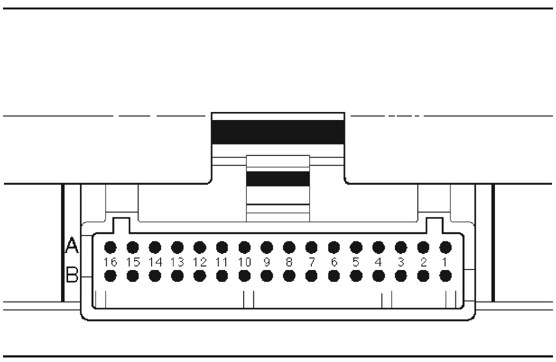


TS23344

PIN	PIN Function	Wire Color	IGN ON	ENG RUN	Refer To
A1	5 Volt Reference “A”	RED	5.0 V	5.0 V	Appropriate Sensor
A2	Knock Sensor	YEL	0.0 V DC 2mV AC	0.0 V DC 18mV AC (at idle)	General Description and Operation, Knock Sensor
A3	Not Used	—	—	—	—
A4	Battery Feed	WHT	B+	B+	Chassis Electrical
A5	Idle Air Control (IAC) “A” High	BLU	B+/0.8 V	B+/0.8 V	General Description and Operation, IAC
A6	IAC “A” Low	BLU/WHT	B+/0.8 V	B+/0.8 V	General Description and Operation, IAC
A7	IAC “B” Low	BLU/BLK	B+/0.8 V	B+/0.8 V	General Description and Operation, IAC
A8	IAC “B” High	BLU/RED	B+/0.8 V	B+/0.8 V	General Description and Operation, IAC
A9	Automatic Transmission Fluid (ATF) Lamp	ORN/BLU	B+	B+	Automatic Transmission (4L30E)
A10	Winter Lamp	PNK/GRN	B+	B+	Automatic Transmission (4L30E)
A11	Power Lamp	GRY/WHT	B+	B+	Automatic Transmission (4L30E)
A12	Antilock Brake System (ABS)	GRY	B+	B+	Antilock Brake System
A13	Malfunction Indicator (Check Engine or MIL) Lamp	BLU	0.0 V	B+	Chassis Electrical
A14	“Check Transmission” Lamp Driver (AT) Up Shift Lamp Driver (MT)	ORN/BLK ORN/BLU	B+	B+	Chassis Electrical

PIN	PIN Function	Wire Color	IGN ON	ENG RUN	Refer To
A15	EVAP	RED/BLU	B+	5.0 V	—
A16	Band Apply (AT) Air Pump (MT)	BRN/YEL	B+	B+	Automatic Transmission (4L30E)

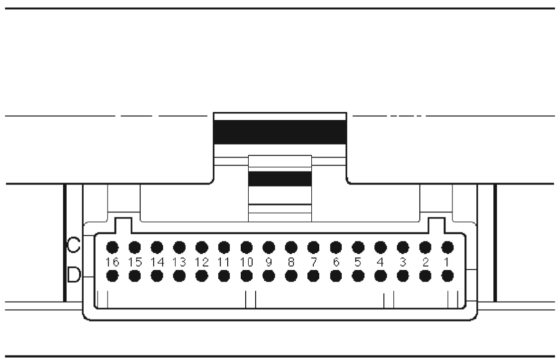
PCM Pinout Table, 32-Way Red Connector – Row “B”



TS23344

PIN	PIN Function	Wire Color	IGN ON	ENG RUN	Refer To
B1	5 Volt Reference “B”	RED/YEL	5.0 V	5.0 V	Appropriate Sensor
B2	Ignition coil	RED/WHT	0.0 V	0.1 V	General Description and Operation
B3	Ignition coil	RED/BLK	0.0 V	0.1 V	General Description and Operation
B4	Ignition coil	RED/GRN	0.0 V	0.1 V	General Description and Operation
B5	Not Used	—	—	—	—
B6	Not Used	—	—	—	—
B7	Exhaust Gas Recirculation (EGR)	YEL/RED	0.6 V	0.6 V	General Description and Operation, Linear EGR Control
B8	Intake Air Temperature (IAT) Sensor	YEL/GRN	0.5-4.9 V (depends on temperature)	0.5-4.9 V (depends on temperature)	General Description and Operation, IAT
B9	Not Used	—	—	—	—
B10	Not Used	—	—	—	—
B11	Power Steering Pressure (PSP) Switch	GRN/YEL	B+	B+	General Description and Operation, PSP
B12	Illuminated Switch	GRN	B+	B+	Chassis Electrical
B13	Class 2 Data	ORN/GRN	0.0 V	0.0 V	Diagnosis, Class 2 Serial Data
B14	A/C Clutch	GRN/BLK	B+ (A/C OFF)	B+ (A/C OFF)	General Description and Operation, A/C Clutch Circuit Operation
B15	ECM to ECU Communication	Violet	0.0 V	0.1 V	—
B16	Not Used	—	—	—	—

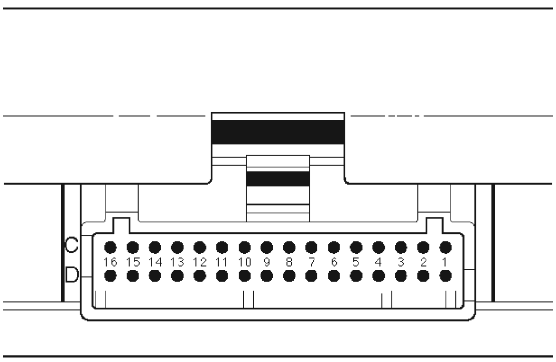
PCM Pinout Table, 32-Way White Connector – Row “C” (For EC)



TS23345

PIN	PIN Function	Wire Color	IGN ON	ENG RUN	Refer To
C1	Injector Cylinder #4	GRN/RED	B+	B+	General Description and Operation, Fuel Injector
C2	Shift “B” Solenoid	BRN/BLK	0.0 V	0.0 V	Automatic Transmission (4L30E)
C3	Injector Cylinder #6	GRN/YEL	B+	B+	General Description and Operation, Fuel Injector
C4	Ignition Control (IC) Cylinder #1	RED	0.0 V	0.1 V	General Description and Operation, Fuel Injector
C5	Crankshaft Position Sensor, “A” Circuit	YEL	0.3 V to 5 V	2.2 V	General Description and Operation, Crankshaft Position Sensor
C6	Not Used	—	—	—	—
C7	PCM Ground	YEL	0.0 V	0.0 V	Chassis Electrical
C8	PCM Ground	BLK/PNK	0.0 V	0.0 V	Chassis Electrical
C9	PCM Ground	BLK/BLU	0.0 V	0.0 V	Chassis Electrical
C10	Tachometer	BLK/RED	8.8 V	10.0 V (at idle)	Chassis Electrical
C11	Variable Intake Manifold	YEL/BLK	0.0 V	B+ (rpm 3600 over)	Manual Transmission
C12	Alternator Control Gain	WHT/BLU	10.5 V	B+	Chassis Electrical
C13	Fuel PWM	BLU/PNK	B+	B+	—
C14	Bank 2 HO2S 1 High	PNK	0.4 V	0.1-0.9 V	General Description and Operation, Fuel HO2S 1
C15	Bank 2 HO2S 1 Low	BLU	0.0 V	0.1 V	General Description and Operation, Fuel HO2S 1
C16	Not Used	—	—	—	—

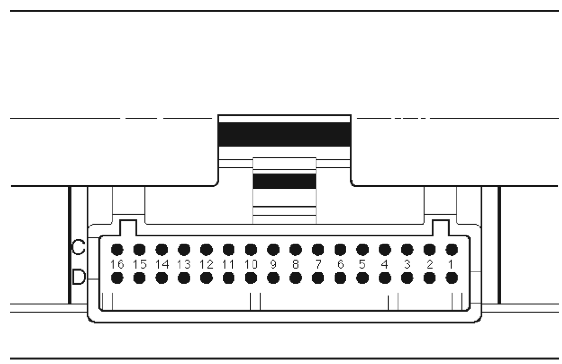
PCM Pinout Table, 32-Way White Connector – Row “C” (For except EC)



TS23345

PIN	PIN Function	Wire Color	IGN ON	ENG RUN	Refer To
C1	Injector Cylinder #4	GRN/RED	B+	B+	General Description and Operation, Fuel Injector
C2	Shift “B” Solenoid	BRN/BLK	0.0 V	0.0 V	Automatic Transmission (4L30E)
C3	Injector Cylinder #6	GRN/YEL	B+	B+	General Description and Operation, Fuel Injector
C4	Ignition Control (IC) Cylinder #1	RED	0.0 V	0.1 V	General Description and Operation, Fuel Injector
C5	Crankshaft Position Sensor, “A” Circuit	YEL	0.3 V to 5 V	2.2 V	General Description and Operation, Crankshaft Position Sensor
C6	Not Used	—	—	—	—
C7	PCM Ground	BLK/BLU	0.0 V	0.0 V	Chassis Electrical
C8	PCM Ground	BLK/PNK	0.0 V	0.0 V	Chassis Electrical
C9	PCM Ground	BLK/BLU	0.0 V	0.0 V	Chassis Electrical
C10	Tachometer	BLK/RED	8.8 V	10.0 V (at idle)	Chassis Electrical
C11	Variable Intake Manifold	YEL/BLK	0.0 V	B+ (rpm 3600 over)	Manual Transmission
C12	Not Used	—	—	—	—
C13	Not Used	—	—	—	—
C14	Not Used	—	—	—	—
C15	Not Used	—	—	—	—
C16	Not Used	—	—	—	—

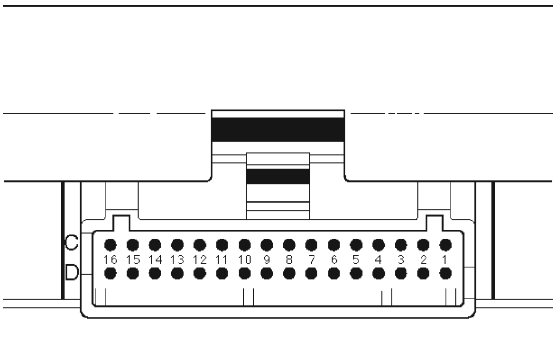
PCM Pinout Table, 32-Way White Connector – Row “D” (For except EXPORT and SOUTH AFRICA)



TS23345

PIN	PIN Function	Wire Color	IGN ON	ENG RUN	Refer To
D1	Injector Cylinder #2	GRN/ORN	B+	B+	General Description and Operation, Fuel Injector
D2	Torque Converter Clutch (TCC)	BRN/BLU	0.0 V	0.0 V	On-Vehicle Service, Torque Converter Clutch
D3	Injector Cylinder #1	GRN/WHT	B+	B+	General Description and Operation, Fuel Injector
D4	Serial Data (8192)	ORN	5.0 V	5.0 V	Chassis Electrical
D5	Ignition Control, Cylinder #5	RED/YEL	0.0 V	0.1 V	General Description and Operation, Ignition Coil
D6	Ignition Control, Cylinder #3	RED/BLUE	0.0 V	0.0 V	General Description and Operation, Ignition Coil
D7	VSS Input / IMOB Response	WHT/BLK	0.0 V	0.1 V (at rest)	Chassis Electrical
D8	Sensor Ground 5V Reference A Return	GRN	0.0 V	0.0 V	Appropriate Sensor
D9	Sensor Ground 5 V Reference B Return	GRY	0.0 V	0.0 V	Appropriate Sensor
D10	Mass Air Flow (MAF)	YEL	4.9 V	4.2 V	General Description, Mass Air Flow Sensor
D11	Camshaft Position Sensor	WHT	5.0 V or less than 1.0 V	4.6 V	General Description and Operation, Camshaft Position Sensor
D12	Not Used	—	—	—	—
D13	Not Used	—	—	—	—
D14	Bank 1 HO2S 1 Low	GRN	0.0 V	0.1 V	General Description and Operation, Fuel HO2S 1
D15	Bank 1 HO2S 1 Signal	RED	0.4 V	0.1-0.9 V	General Description and Operation, Fuel HO2S 1
D16	Not Used	—	—	—	—

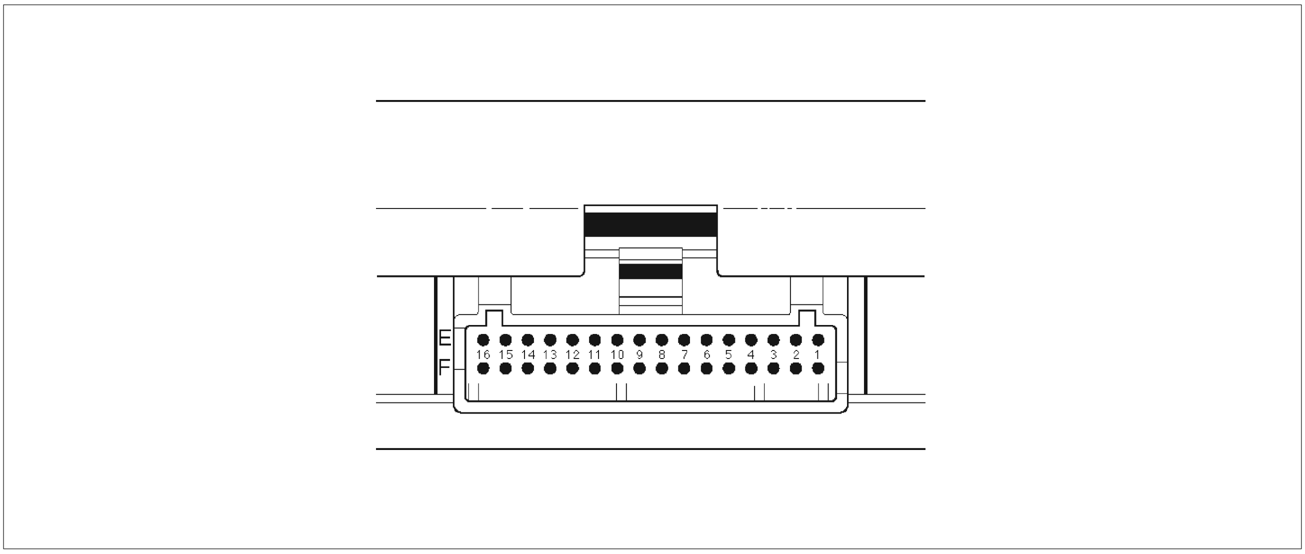
PCM Pinout Table, 32-Way White Connector – Row “D” (For EXPORT and SOUTH AFRICA)



TS23345

PIN	PIN Function	Wire Color	IGN ON	ENG RUN	Refer To
D1	Injector Cylinder #2	GRN/ORN	B+	B+	General Description and Operation, Fuel Injector
D2	Torque Converter Clutch (TCC)	BRN/BLU	0.0 V	0.0 V	On-Vehicle Service, Torque Converter Clutch
D3	Injector Cylinder #1	GRN/WHT	B+	B+	General Description and Operation, Fuel Injector
D4	Serial Data (8192)	ORN	5.0 V	5.0 V	Chassis Electrical
D5	Ignition Control, Cylinder #5	RED/YEL	0.0 V	0.1 V	General Description and Operation, Ignition Coil
D6	Ignition Control, Cylinder #3	RED/BLUE	0.0 V	0.0 V	General Description and Operation, Ignition Coil
D7	VSS Input / IMOB Response	LIGHT GRN/WHT	0.0 V	0.1 V (at rest)	Chassis Electrical
D8	Sensor Ground 5V Reference A Return	GRN	0.0 V	0.0 V	Appropriate Sensor
D9	Sensor Ground 5 V Reference B Return	GRY	0.0 V	0.0 V	Appropriate Sensor
D10	Mass Air Flow (MAF)	YEL	4.9 V	4.2 V	General Description, Mass Air Flow Sensor
D11	Camshaft Position Sensor	WHT	5.0 V or less than 1.0 V	4.6 V	General Description and Operation, Camshaft Position Sensor
D12	Not Used	—	—	—	—
D13	Not Used	—	—	—	—
D14	Not Used	—	—	—	—
D15	Not Used	—	—	—	—
D16	Not Used	—	—	—	—

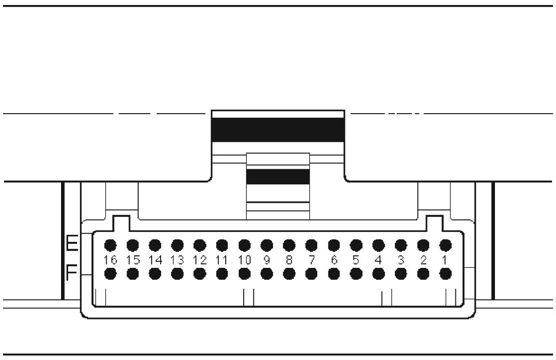
PCM Pinout Table, 32-Way Blue Connector – Row "E" (For except EXPORT and SOUTH AFRICA)



PIN	PIN Function	Wire Color	IGN ON	ENG RUN	Refer To
E1	Transmission Output Shaft Sensor (TOSS) High	RED	0.0 V	0.1 V	Automatic Transmission (4L30E)
E2	Transmission Output Shaft Sensor (TOSS) Low	WHT	0.0 V	0.0 V	Automatic Transmission (4L30E)
E3	Pressure Control Solenoid Low	PPL/RED	0.0 V	1.1 V	Automatic Transmission (4L30E)
E4	Pressure Control Solenoid High	PPL/WHT	0.0 V	4.9 V	Automatic Transmission (4L30E)
E5	Exhaust Gas Recirculation (EGR) Control High	BLK/YEL	B+	B+	General Description and Operation, EGR Control
E6	Exhaust Gas Recirculation (EGR) Control Low	YEL	B+	B+	General Description and Operation, EGR Control
E7	Transmission Range Signal "B"	BLU/YEL	0.0 V	0.0 V	Automatic Transmission (4L30E)
E8	Throttle Position (TP) Sensor	BLU	0.5-0.8 V	0.5-0.8 V (at idle)	General Description and Operation, Throttle Position Sensor
E9	Engine Coolant Temperature (ECT) Sensor	BLU/RED	0.5-4.9 V (depends on temperature)	0.5-4.9 V (depends on temperature)	General Description and Operation, Engine Coolant Temperature (ECT) Sensor
E10	Not Used	—	—	—	—
E11	Crankshaft Position (CKP) Sensor +5 Volt Reference	YEL/RED	5.0 V or less than 1.0 V	5.0 V	General Description and Operation, Crankshaft Position Sensor
E12	Transmission Range Signal "A"	BLU/WHT	B+	B+	Automatic Transmission (4L30E)
E13	Fuel Pump (FP) Relay	RED/WHT	0.0 V	B+	On-Vehicle Service, Fuel Pump Relay
E14	Shift High (BAND APPLY)	BRN/WHT	B+	B+	Automatic Transmission (4L30E)

PIN	PIN Function	Wire Color	IGN ON	ENG RUN	Refer To
E15	A/C Request	GRN/ORN	0.0 V	0.0 V	Electric Cooling Fans
E16	Ignition Feed (1 of 2 F16)	RED/BLU	B+	B+	—

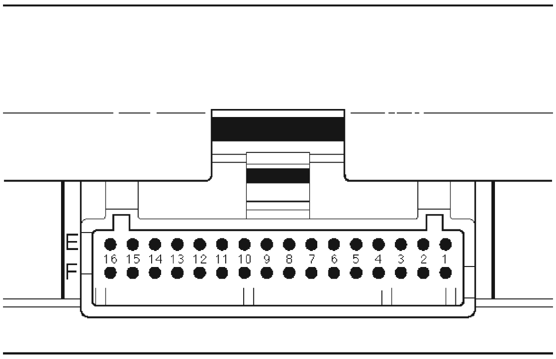
PCM Pinout Table, 32-Way Blue Connector – Row “E” (For EXPORT and SOUTH AFRICA)



TS23346

PIN	PIN Function	Wire Color	IGN ON	ENG RUN	Refer To
E1	Transmission Output Shaft Sensor (TOSS) High	RED	0.0 V	0.1 V	Automatic Transmission (4L30E)
E2	Transmission Output Shaft Sensor (TOSS) Low	WHT	0.0 V	0.0 V	Automatic Transmission (4L30E)
E3	Pressure Control Solenoid Low	PPL/RED	0.0 V	1.1 V	Automatic Transmission (4L30E)
E4	Pressure Control Solenoid High	PPL/WHT	0.0 V	4.9 V	Automatic Transmission (4L30E)
E5	Not Used	—	—	—	—
E6	Not Used	—	—	—	—
E7	Transmission Range Signal “B”	BLU/YEL	0.0 V	0.0 V	Automatic Transmission (4L30E)
E8	Throttle Position (TP) Sensor	BLU	0.5-0.8 V	0.5-0.8 V (at idle)	General Description and Operation, Throttle Position Sensor
E9	Engine Coolant Temperature (ECT) Sensor	BLU/RED	0.5-4.9 V (depends on temperature)	0.5-4.9 V (depends on temperature)	General Description and Operation, Engine Coolant Temperature (ECT) Sensor
E10	Not Used	—	—	—	—
E11	Crankshaft Position (CKP) Sensor +5 Volt Reference	YEL/RED	5.0 V or less than 1.0 V	5.0 V	General Description and Operation, Crankshaft Position Sensor
E12	Transmission Range Signal “A”	BLU/WHT	B+	B+	Automatic Transmission (4L30E)
E13	Fuel Pump (FP) Relay	RED/WHT	0.0 V	B+	On-Vehicle Service, Fuel Pump Relay
E14	Shift High (BAND APPLY)	BRN/WHT	B+	B+	Automatic Transmission (4L30E)
E15	A/C Request	GRN/ORN	0.0 V	0.0 V	Electric Cooling Fans
E16	Ignition Feed (1 of 2 F16)	RED/BLU	B+	B+	—

PCM Pinout Table, 32-Way Blue Connector – Row “F”

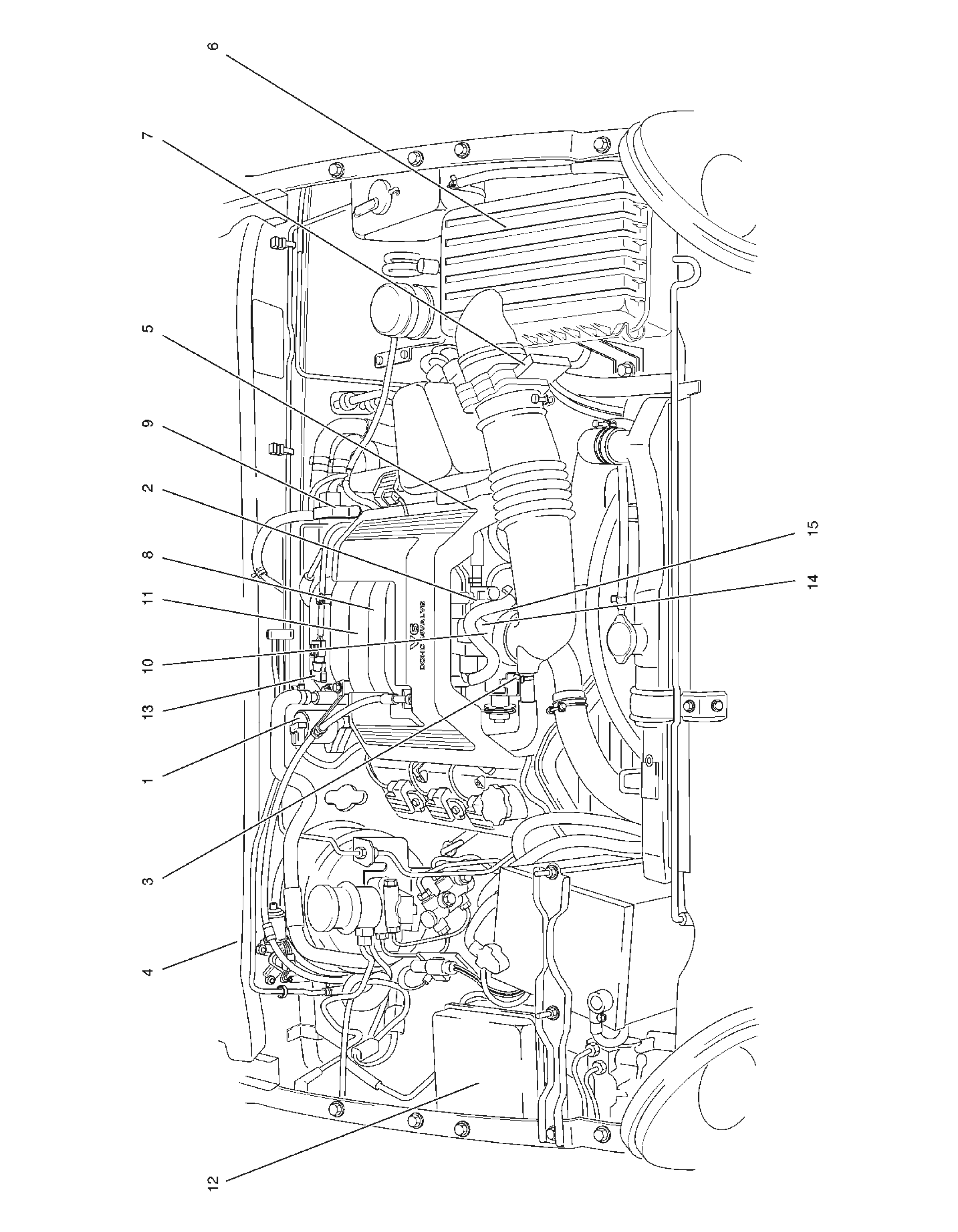


TS23346

PIN	PIN Function	Wire Color	IGN ON	ENG RUN	Refer To
F1	Not Used	—	—	—	—
F2	Transmission Range Signal “C”	BLU/BLK	0.0 V	0.0 V	Automatic Transmission (4L30E)
F3	Transmission Range Signal “P”	YEL/GRN	B+	0.0 V	Automatic transmission (4L30E)
F4	Brake Switch	GRN/YEL	0.0 V	0.0 V	Automatic transmission (4L30E)
F5	Power Switch	PPL/RED	B+	B+	Automatic Transmission (4L30E)
F6	Winter Switch	PPL/GRN	B+	B+	Automatic Transmission (4L30E)
F7	Transmission Fluid Temperature	RED/BLK	0.5-4.9 V (depends on temperature)	0.5-4.9 V (depends on temperature)	Automatic Transmission (4L30E)
F8	Manifold Absolute Pressure (MAP)	GRY/BLK	3.5-4.9 V (depends on altitude and barometric pressure)	0.6-1.3 V	General Description and Operation, Manifold Absolute Pressure
F9	Not Used	—	—	—	—
F10	Cruise Control	GRY/BLU	B+	B+	Automatic transmission (4L30E)
F11	Kickdown Switch	LT BLU	B+	B+	Automatic Transmission (4L30E)
F12	DIAG	ORN/BLU	B+	B+	—
F13	Injector “C” Cylinder #3	GRN	B+	B+	General Description and Operation, Fuel Injector
F14	Shift “A” Solenoid	BRN/RED	B+	B+	Automatic Transmission (4L30E)
F15	Injector Cylinder #5	GRN/BLK	B+	B+	General Description and Operation, Fuel Injector
F16	Ignition Feed (1 of 2 E16)	RED/BLU	B+	B+	—

Component Locators

Engine Component Locator (This illustration is based on RHD model.)

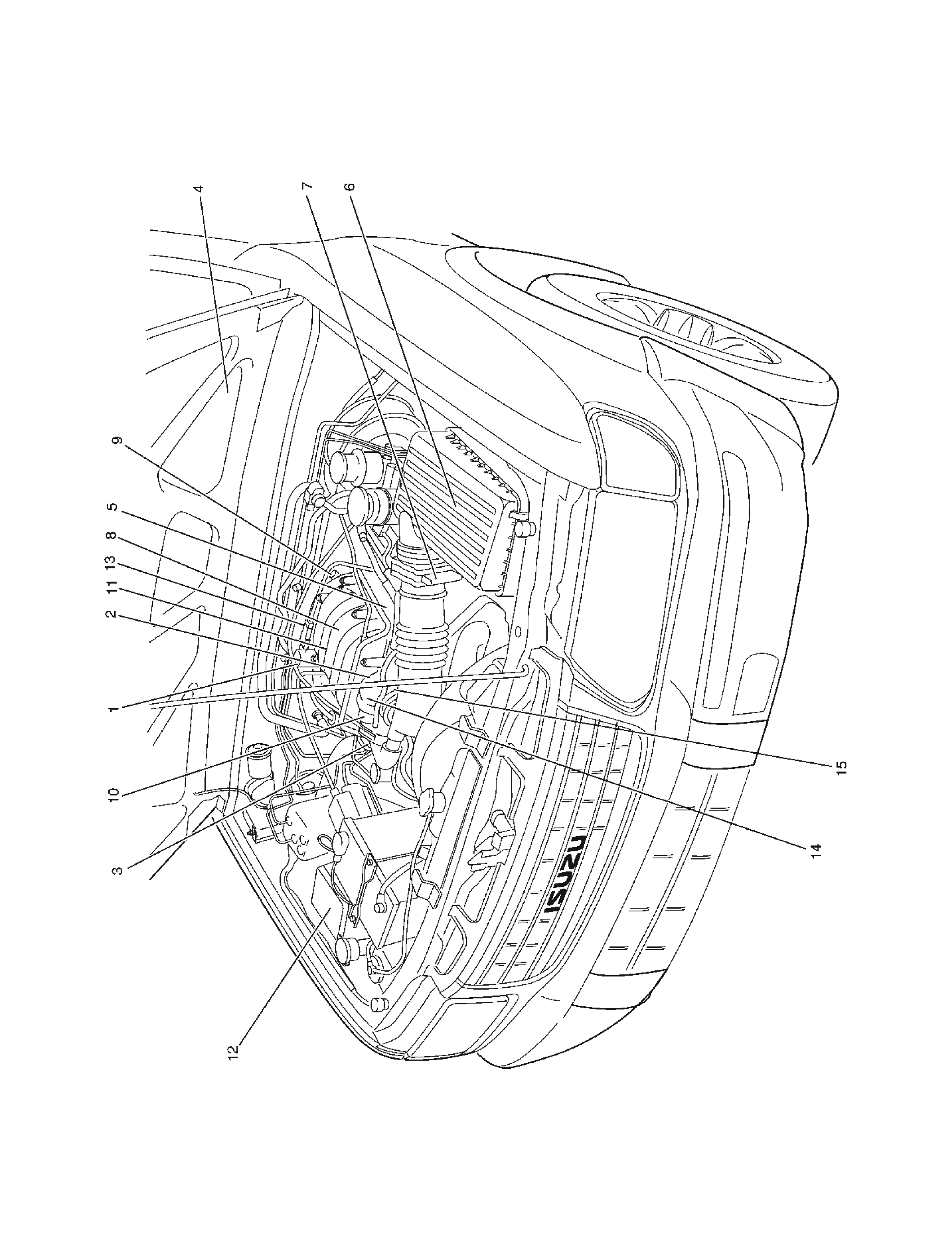


060RW210

Engine Component Locator Table

Number	Name	Location
1	Linear Exhaust Gas Recirculation (EGR) Valve	Rear right side of the engine
2	Throttle Position (TP) Sensor	On the rear of the throttle body
3	Intake Air Temperature (IAT) Sensor	On the intake air duct near the throttle body
4	Check Engine (MIL) Light	On the instrument panel beneath the tachometer
5	Positive Crankcase Ventilation (PCV) Valve	On the left of the cylinder head cover
6	Air Cleaner	Left front of the engine bay
7	Mass Air Flow (MAF) Sensor	Attached to the air filter box
8	Camshaft Position (CMP) Sensor	On the rear right side at the left of the cylinder head cover
9	Fuel Pressure Regulator	Rear right side of the engine
10	Idle Air Control (IAC) Valve	On the left of the throttle body
11	Upper Intake Manifold	Top of the engine
12	Fuse/Relay Box	Along the inside of the right fender
13	Manifold Absolute Pressure (MAP) Sensor	Bolted to the top of the upper intake manifold
14	Throttle Body	Between the intake air duct and the upper intake manifold
15	Engine Coolant Temperature Sensor	On the coolant crossover pipe at the front of the engine, near the throttle body

Engine Component Locator (This illustration is based on LHD model.)

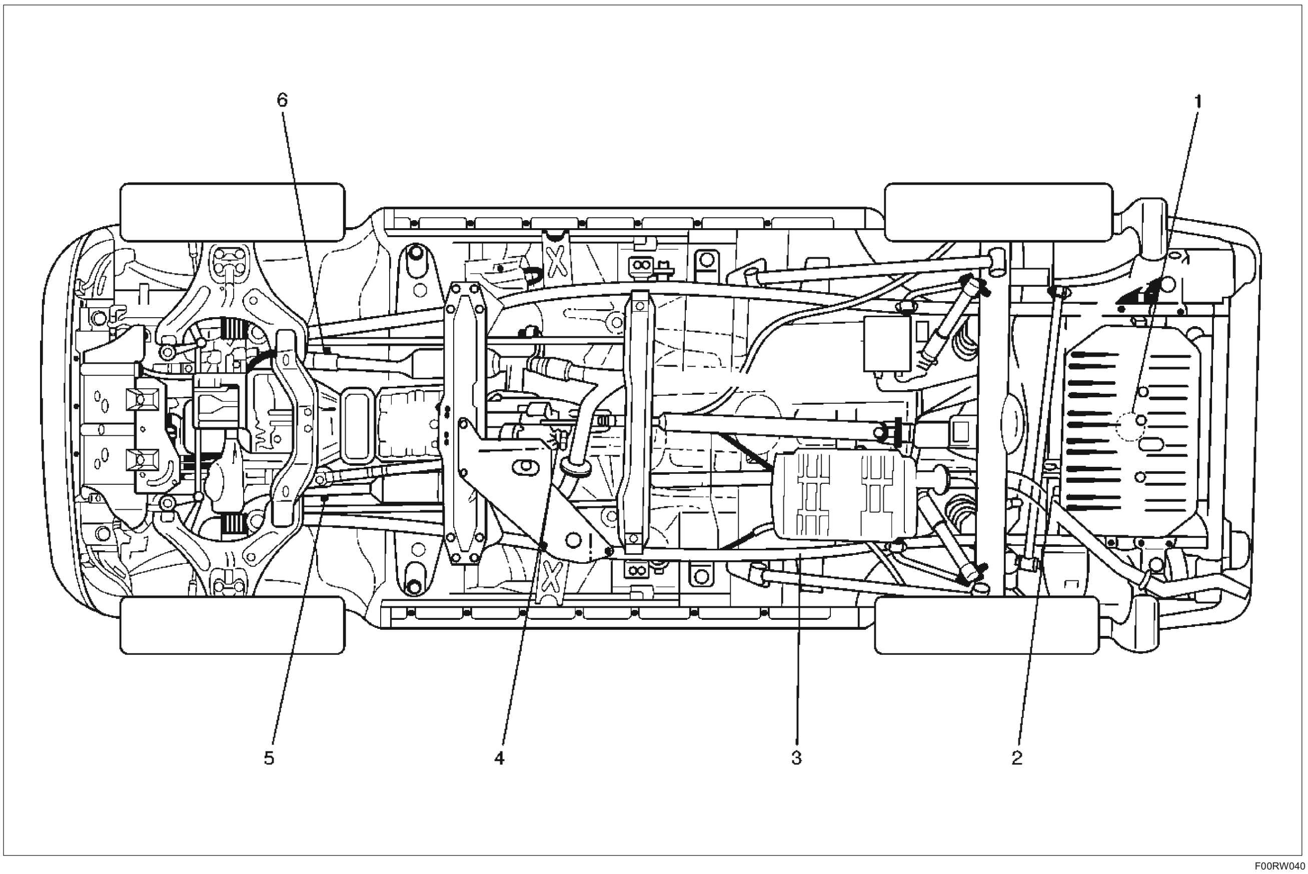


755RW062

Engine Component Locator Table

Number	Name	Location
1	Linear Exhaust Gas Recirculation (EGR) Valve	Rear right side of the engine
2	Throttle Position (TP) Sensor	On the rear of the throttle body
3	Intake Air Temperature (IAT) Sensor	On the intake air duct near the throttle body
4	Check Engine (MIL) Light	On the instrument panel beneath the tachometer
5	Positive Crankcase Ventilation (PCV) Valve	On the left of the cylinder head cover
6	Air Cleaner	Left front of the engine bay
7	Mass Air Flow (MAF) Sensor	Attached to the air filter box
8	Camshaft Position (CMP) Sensor	On the rear right side at the left of the cylinder head cover
9	Fuel Pressure Regulator	Rear right side of the engine
10	Idle Air Control (IAC) Valve	On the left of the throttle body
11	Upper Intake Manifold	Top of the engine
12	Fuse/Relay Box	Along the inside of the right fender
13	Manifold Absolute Pressure (MAP) Sensor	Bolted to the top of the upper intake manifold
14	Throttle Body	Between the intake air duct and the upper intake manifold
15	Engine Coolant Temperature Sensor	On the coolant crossover pipe at the front of the engine, near the throttle body

Undercarriage Component Locator



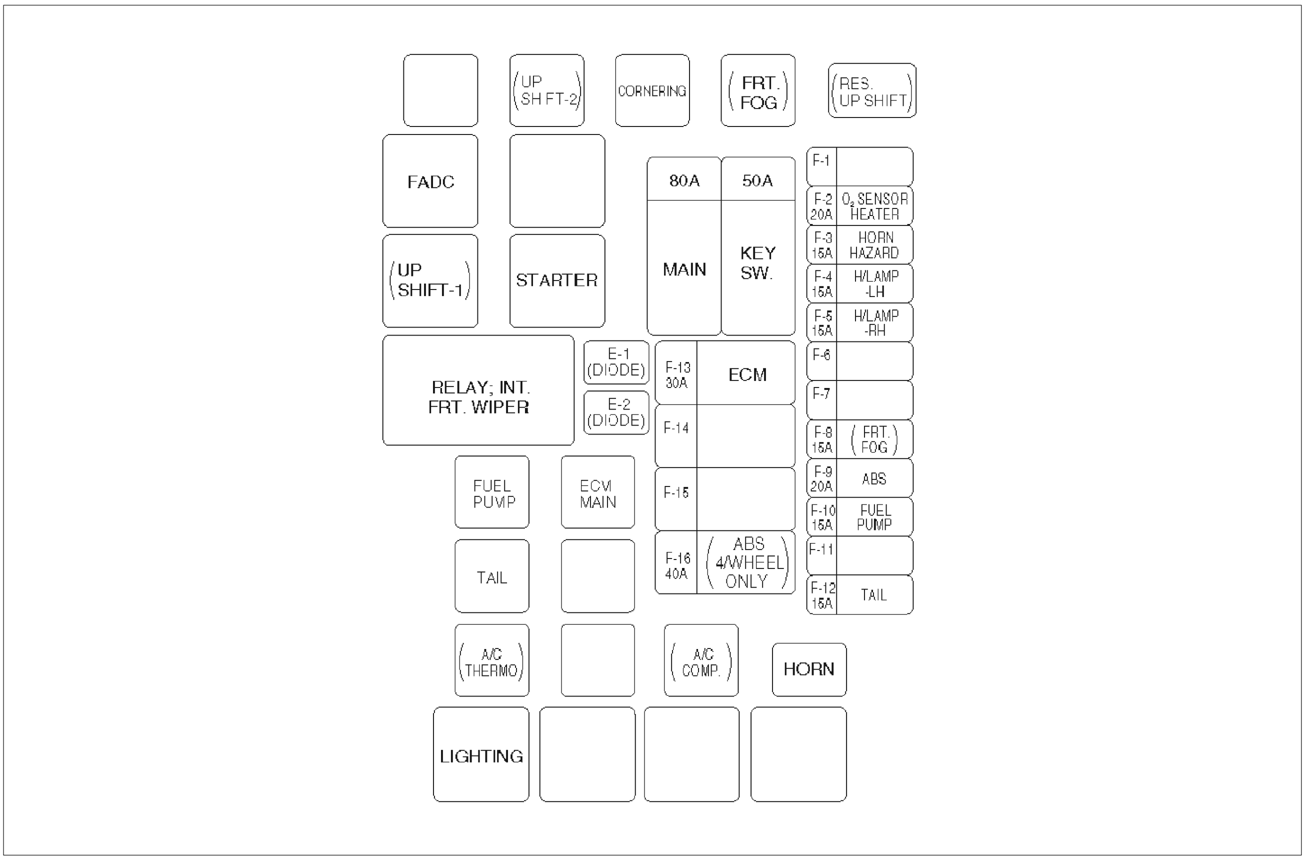
Undercarriage Component Locator Table (Automatic Transmission)

Number	Name	Location
1	Fuel Pump Assembly	Installed in the top of the fuel tank
2	Fuel Gauge Unit	Installed in the front edge of the fuel tank, on the right side
3	Fuel Filter	Located along the inside of the right frame rail, ahead of the rear axle
4	Vehicle Speed Sensor (VSS)	2WD: Protrudes from the transmission housing, just ahead of the propeller shaft. 4WD: Protrudes from the rear output shaft housing of the transfer case.
5	Heated Oxygen Sensor (Bank 1, HO2S 1)	Threaded into the exhaust pipe ahead of the right-hand catalytic converter
6	Heated Oxygen Sensor (Bank 2, HO2S 1)	Threaded into the exhaust pipe ahead the left-hand catalytic converter

Undercarriage Component Locator Table (Manual Transmission)

Number	Name	Location
1	Fuel Pump Assembly	Installed in the top of the fuel tank
2	Fuel Gauge Unit	Installed in the front edge of the right frame rail, ahead of the rear axle
3	Fuel Filter	Located along the inside of the right frame rail, ahead of the rear axle
4	Vehicle Speed Sensor (VSS)	2WD: Protrudes from the transmission housing, just ahead of the propeller shaft. 4WD: Protrudes from the rear output shaft housing of the transfer case.
5	Heated Oxygen Sensor (Bank 1, HO2S 1)	Threaded into the exhaust pipe ahead of the right-hand catalytic converter
6	Heated Oxygen Sensor (Bank 2, HO2S 1)	Threaded into the exhaust pipe ahead of the left-hand catalytic converter

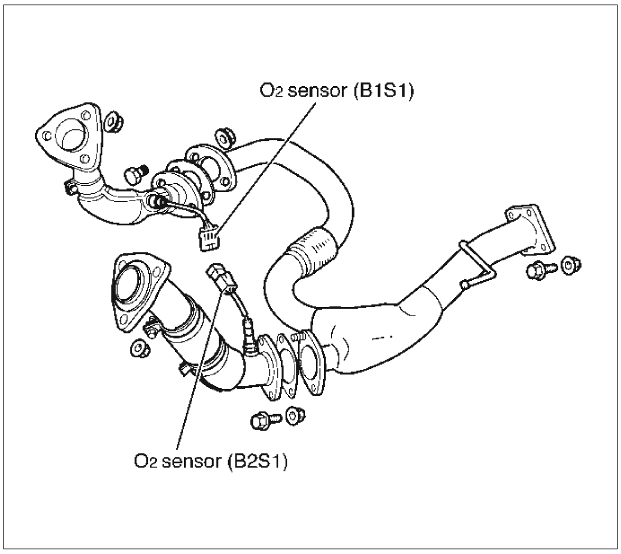
Fuse and Relay Panel (Underhood Electrical Center)



TS23336

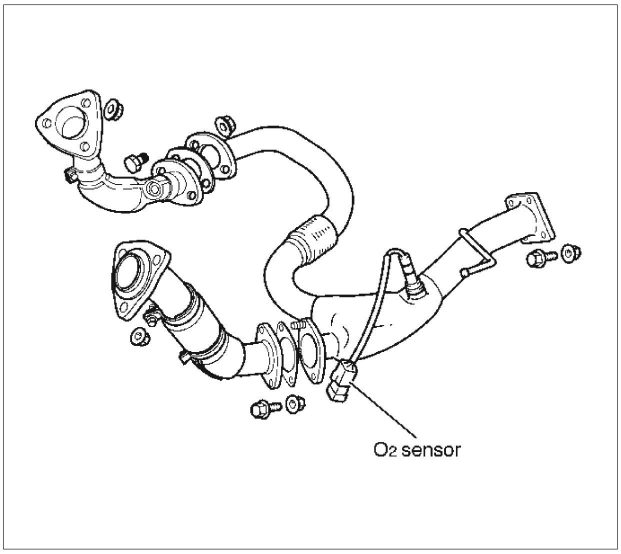
Sensors and Miscellaneous Component Locators

- **For EC.**

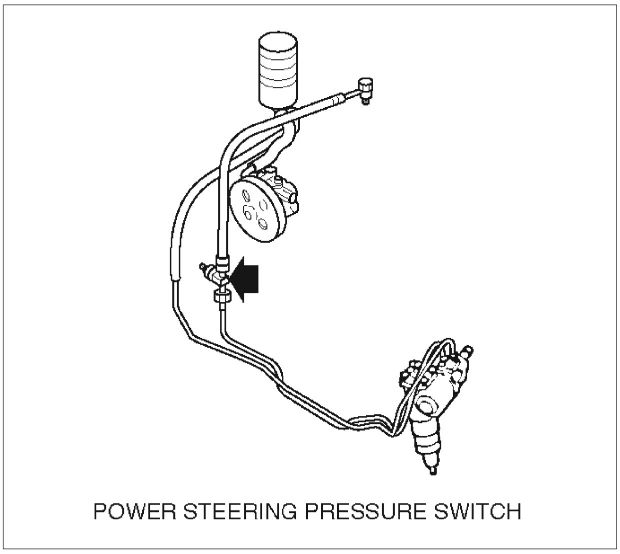


060RW194

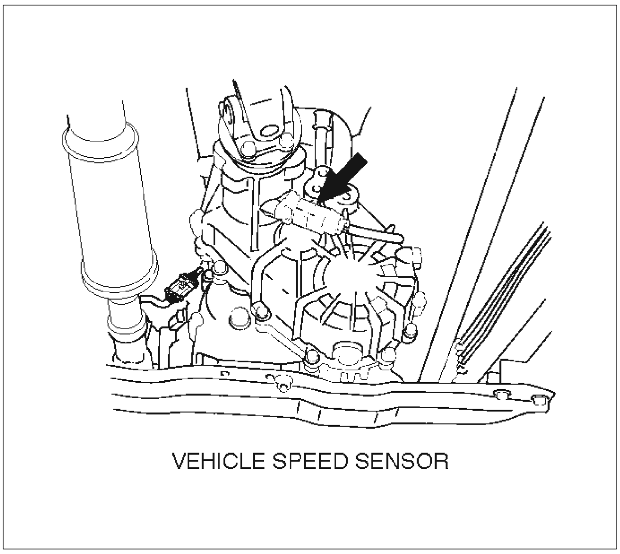
- **For AUSTRALIA, THAILAND, SOUTH EAST ASIA, LATIN AMERICA, GULF, SAUDI, CHINA.**



150RW101



T321066



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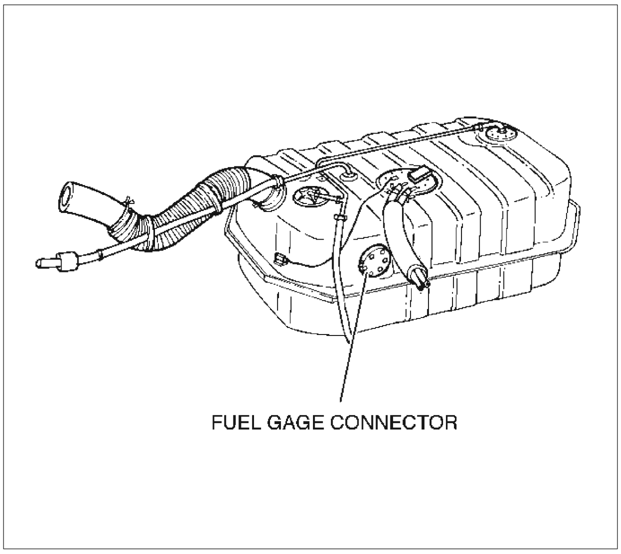
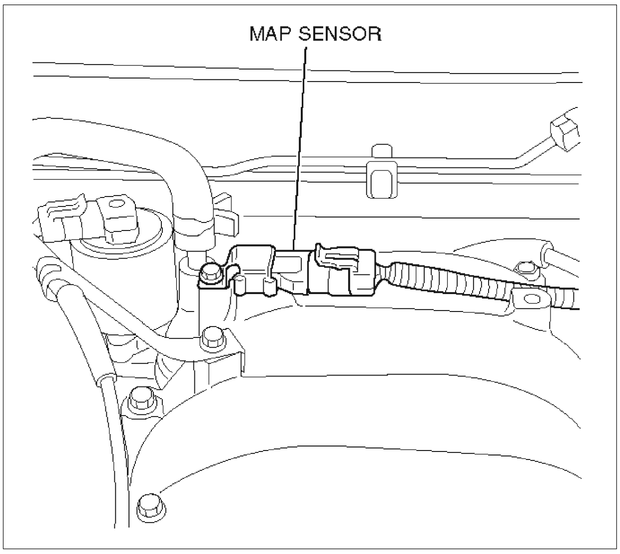


140RW032



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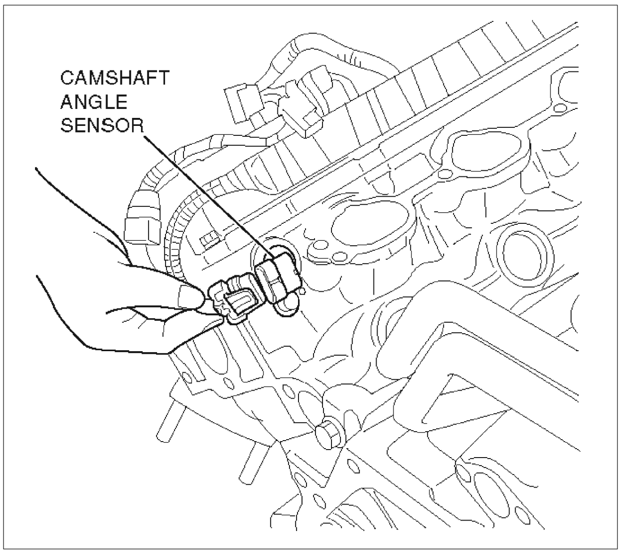
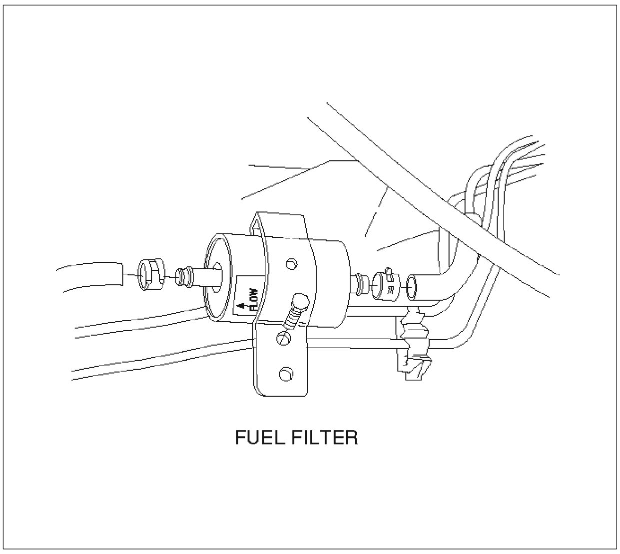


014RW125



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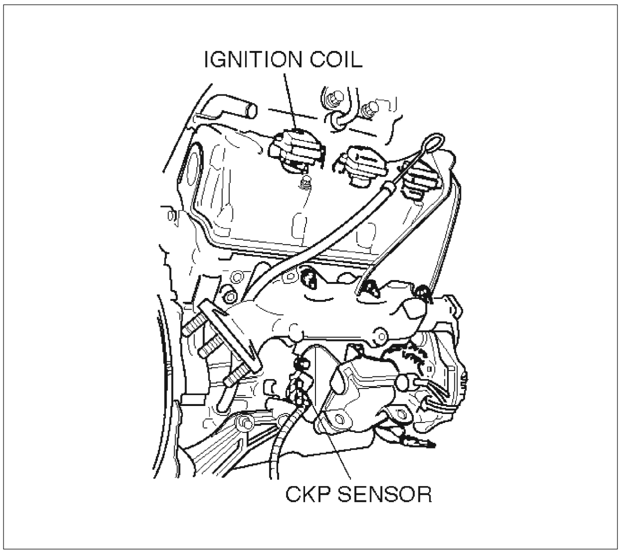
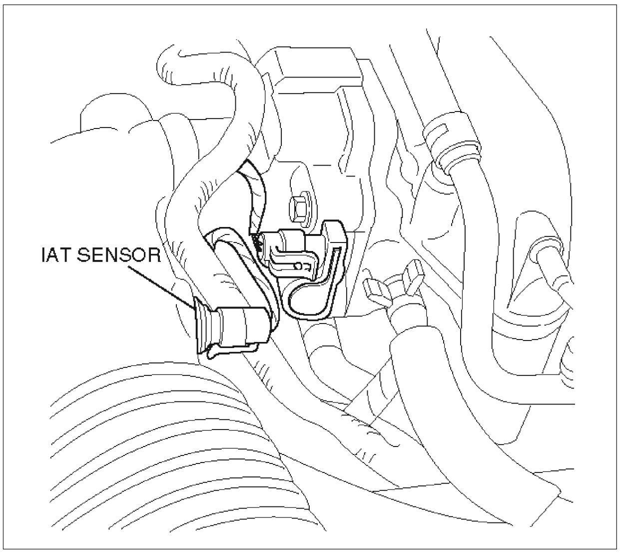
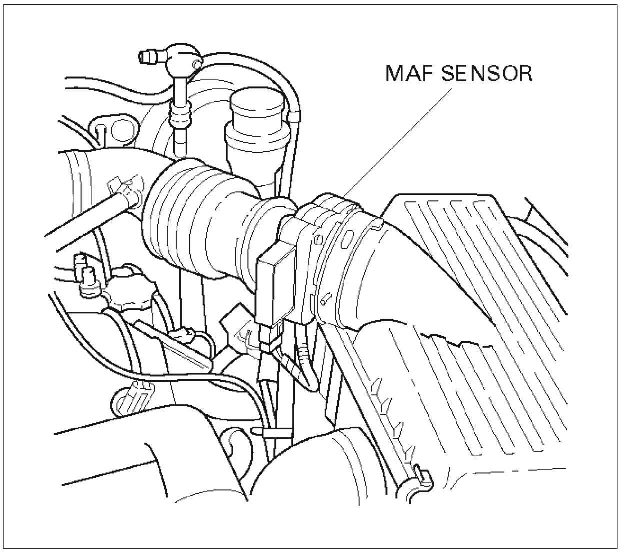


T321070



025RW005



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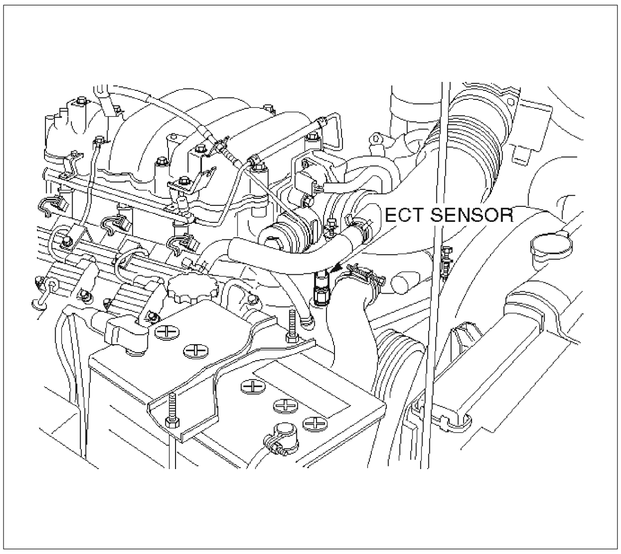
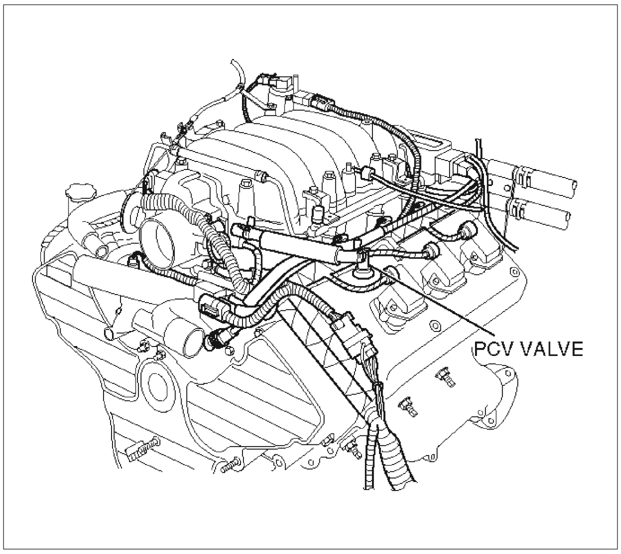


060RW007



028RW001

Diagnosis

Strategy-Based Diagnostics

Strategy-Based Diagnostics

The strategy-based diagnostic is a uniform approach to repair all Electrical/Electronic (E/E) systems. The diagnostic flow can always be used to resolve an E/E system problem and is a starting point when repairs are necessary. The following steps will instruct the technician how to proceed with a diagnosis:

1. Verify the customer complaint.
   - To verify the customer complaint, the technician should know the normal operation of the system.
2. Perform preliminary checks.
   - Conduct a thorough visual inspection.
   - Review the service history.
   - Detect unusual sounds or odors.
   - Gather diagnostic trouble code information to achieve an effective repair.
3. Check bulletins and other service information.
   - This includes videos, newsletters, etc.
4. Refer to service information (manual) system check(s).
   - “System checks” contain information on a system that may not be supported by one or more DTCs. System checks verify proper operation of the system. This will lead the technician in an organized approach to diagnostics.
5. Refer to service diagnostics.

DTC Stored

Follow the designated DTC chart exactly to make an effective repair.

No DTC

Select the symptom from the symptom tables. Follow the diagnostic paths or suggestions to complete the repair. You may refer to the applicable component/system check in the system checks.

No Matching Symptom

1. Analyze the complaint.
2. Develop a plan for diagnostics.
3. Utilize the wiring diagrams and the theory of operation.

Call technical assistance for similar cases where repair history may be available. Combine technician knowledge with efficient use of the available service information.

Intermittents

Conditions that are not always present are called intermittents. To resolve intermittents, perform the following steps:

1. Observe history DTCs, DTC modes, and freezeframe data.
2. Evaluate the symptoms and the conditions described by the customer.
3. Use a check sheet or other method to identify the circuit or electrical system component.
4. Follow the suggestions for intermittent diagnosis found in the service documentation.

Most Tech 2s, such as the Tech II and the 5–8840–0285–0 (Fluke model 87 DVOM), have data-capturing capabilities that can assist in detecting intermittents.

No Trouble Found

This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Verify the customer complaint against another vehicle that is operating normally. The condition may be intermittent. Verify the complaint under the conditions described by the customer before releasing the vehicle.

1. Re-examine the complaint.

   When the Complaint cannot be successfully found or isolated, a re-evaluation is necessary. The complaint should be re-verified and could be intermittent as defined in *Intermittents*, or could be normal.
2. Repair and verify.

   After isolating the cause, the repairs should be made. Validate for proper operation and verify that the symptom has been corrected. This may involve road testing or other methods to verify that the complaint has been resolved under the following conditions:
   - Conditions noted by the customer.
   - If a DTC was diagnosed, verify a repair by duplicating conditions present when the DTC was set as noted in the Failure Records or Freeze Frame data.

Verifying Vehicle Repair

Verification of the vehicle repair will be more comprehensive for vehicles with OBD system diagnostics. Following a repair, the technician should perform the following steps:

IMPORTANT: Follow the steps below when you verify repairs on OBD systems. Failure to follow these steps could result in unnecessary repairs.

1. Review and record the Failure Records and the 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(”Check Engine” lamp) has been requested).
2. Clear the DTC(S).
3. Operate the vehicle within conditions noted in the Failure Records and 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.

General Service Information

OBD Serviceablity Issues

The list of non-vehicle faults that could affect the performance of the OBD system has been compiled. These non-vehicle faults vary from environmental conditions to the quality of fuel used.

The illumination of the MIL ("Check Engine" lamp) due to a non-vehicle fault could lead to misdiagnosis of the vehicle, increased warranty expense and customer dissatisfaction. The following list of non-vehicle faults does not include every possible fault and may not apply equally to all product lines.

Fuel Quality

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. Something as simple as a high-performance exhaust system that affects exhaust system back pressure could potentially interfere with the operation of the EGR valve and thereby turn on the MIL ("Check Engine" lamp). Small leaks in the exhaust system near the post catalyst oxygen sensor can also cause the MIL ("Check Engine" lamp) to turn on.

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).

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.

Related System Faults

Many of the OBD system diagnostics will not run if the PCM detects a fault on a related system or component. One example would be that if the PCM 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

NOTE: 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 Tech 2s 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 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 (TP) sensor that indicates high throttle position at low engine loads or MAP voltage. Input components may include, but are not limited to the following sensors:

- Vehicle Speed Sensor (VSS)
- Crankshaft Position (CKP) sensor
- Knock Sensor (KS)
- Throttle Position (TP) sensor
- Engine Coolant Temperature (ECT) sensor
- Camshaft Position (CMP) sensor
- Manifold Absolute Pressure (MAP) 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 circuits:

- Idle Air Control (IAC) Motor
- Electronic Transmission controls
- A/C relays
- Cooling fan relay
- VSS output
- MIL control
- Cruise control inhibit

Refer to PCM 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. For example, the EGR diagnostic active test will force the EGR valve open during closed throttle decel and/or force the EGR valve closed during a steady state. Either action should result in a change in manifold pressure.

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.

Freeze Frame

Freeze Frame is an element of the Diagnostic Management System which stores various vehicle information at the moment an emissions-related fault is stored in memory and when the MIL is commanded on. These data can help to identify the cause of a fault. Refer to *Storing And Erasing Freeze Fame Data* for more detailed information.

Failure Records

Failure Records data is an enhancement of the OBD Freeze Frame feature. Failure Records store the same vehicle information as does Freeze Frame, but it will store that information for any fault which is stored in on-board memory, while Freeze Frame stores information only for emission-related faults that command the MIL on.

Common OBD Terms

Diagnostic

When used as a noun, the word diagnostic refers to any on-board test run by the vehicle's Diagnostic Management System. A diagnostic is simply a test run on a system or component to determine if the system or component is operating according to specification. There are many diagnostics, shown in the following list:

- Oxygen sensors
- Oxygen sensor heaters
- EGR
- Catalyst monitoring

Enable Criteria

The term "enable criteria" is engineering language for the conditions necessary for a given diagnostic test to run. Each diagnostic has a specific list of conditions which must be met before the diagnostic will run. "Enable criteria" is another way of saying "conditions required".
The enable criteria for each diagnostic is listed on the first page of the DTC description under the heading "Conditions for Setting the DTC". Enable criteria varies with each diagnostic, and typically includes, but is not limited to the following items:

- engine speed
- vehicle speed
- ECT
- MAF/MAP
- barometric pressure
- IAT
- TP
- fuel trim
- TCC enabled
- A/C on

Trip

Technically, a trip is a key on-run-key off cycle in which all the enable criteria for a given diagnostic are met, allowing the diagnostic to run. Unfortunately, this concept is not quite that simple. A trip is official when all the enable criteria for a given diagnostic are met. But because the enable criteria vary from one diagnostic to another, the definition of trip varies as well. Some diagnostic are run when the vehicle is at operating temperature, some when the vehicle first start up; some require that the vehicle be cruising at a steady highway speed, some run only when the vehicle is idle; some diagnostics function with the TCC disables. Some run only immediately following a cold engine start-up.
A trip then, is defined as a key on-run-key off cycle in which the vehicle was operated in such a way as to satisfy the enables criteria for a given diagnostic, and this diagnostic will consider this cycle to be one trip. However, another diagnostic with a different set of enable criteria (which were not met) during this driving event, would not consider it a trip. No trip will occur for that particular diagnostic until the vehicle is driven in such a way as to meet all the enable criteria.

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 following:

- Commanding the MIL ("Check Engine" lamp) on and off
- DTC logging and clearing
- Freeze Frame data for the first emission related DTC recorded
- Non-emission related Service Lamp (future)
- Operating conditions Failure Records buffer, (the number of records will vary)
- 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 Malfunction Indicator Lamp (MIL) ("Check Engine" lamp) is illuminated.

Malfunction Indicator Lamp (MIL)

The Malfunction Indicator Lamp (MIL) looks the same as the MIL you are already familiar with ("Check Engine" lamp). However, OBD requires that the it illuminate under a strict set of guide lines.
Basically, the MIL is turned on when the PCM 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 PCM 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 function:

- It informs the driver that a fault 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 II) 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.

DTC Types

Each DTC is directly related to a diagnostic test. The Diagnostic Management System sets DTC based on the failure of the tests during a trip or trips. Certain tests must fail two (2) consecutive trips before the DTC is set. The following are the four (4) types of DTCs and the characteristics of those codes:

- Type A
  - Emissions related
  - Requests illumination of the MIL 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
- Type B
  - Emissions related
  - "Armed" after one (1) trip with a fail
  - "Disarmed" after one (1) trip with a pass
  - Requests illumination of the MIL on the *second consecutive trip* with a fail
  - Stores 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* fails)
  - Updates the Fail Record each time the diagnostic test fails
- Type C (if the vehicle is so equipped)
  - Non-Emissions related
  - Requests illumination of the Service Lamp or the service message on the Drive Information Center (DIC) on the *first trip* with a fail
  - 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
- Type D (*Type D* non-emissions related are not utilized on certain vehicle applications).
  - Non-Emissions related
  - Dose 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

IMPORTANT: Only four Fail Records can be stored. Each Fail Record is for a different DTC. It is possible that there will not be Fail Records for every DTC if multiple DTCs are set.

Storing and Erasing Freeze Frame Data and Failure Records

The data captured is called Freeze Frame data. The Freeze Frame data is very similar to a single record of operating conditions. Whenever the MIL is illuminated, the corresponding record of operating conditions is recorded to the Freeze Frame buffer.

Data from these faults take precedence over data associated with any other fault. The Freeze Frame data will not be erased unless the associated history DTC is cleared.

Each time a diagnostic test reports a failure, the current engine operating conditions are recorded in the *Failure Records* buffer. A subsequent failure will update the recorded operating conditions. The following operating conditions for the diagnostic test which failed *typically* include the following parameters:

- Air Fuel Ratio
- Air Flow Rate
- Fuel Trim
- Engine Speed
- Engine Load
- Engine Coolant Temperature
- Vehicle Speed
- TP Angle
- MAP/BARO
- Injector Base Pulse Width
- Loop Status

Intermittent Malfunction Indicator Lamp

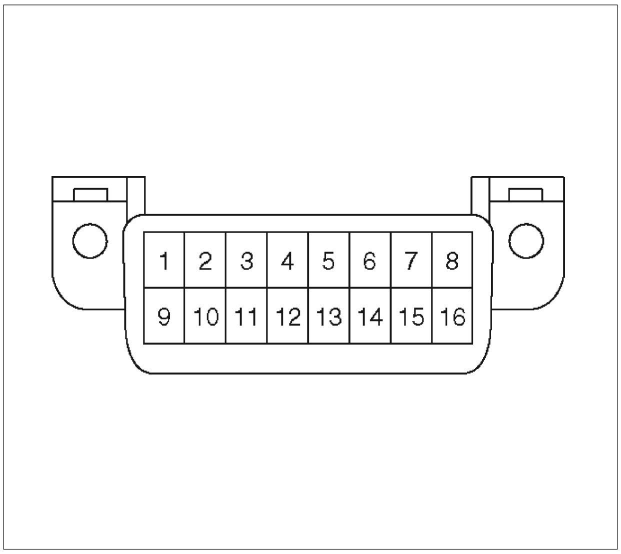
In the case of an “intermittent” fault, the MIL (“Check Engine” lamp) may illuminate and then (after three trips) go “OFF”. However, the corresponding diagnostic trouble code will be stored in the memory. When unexpected diagnostic trouble codes appear, check for an intermittent malfunction.

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 Tech 2. Some common uses of Tech 2 are listed below:

- Identifying stored Diagnostic Trouble Codes (DTCs).
- Clearing DTCs.
- Performing output 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 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.

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 PCM memory.

To clear Diagnostic Trouble Codes (DTCs), use the diagnostic Tech 2 “clear DTCs”. When clearing DTCs follow instructions supplied by the tool manufacturer.

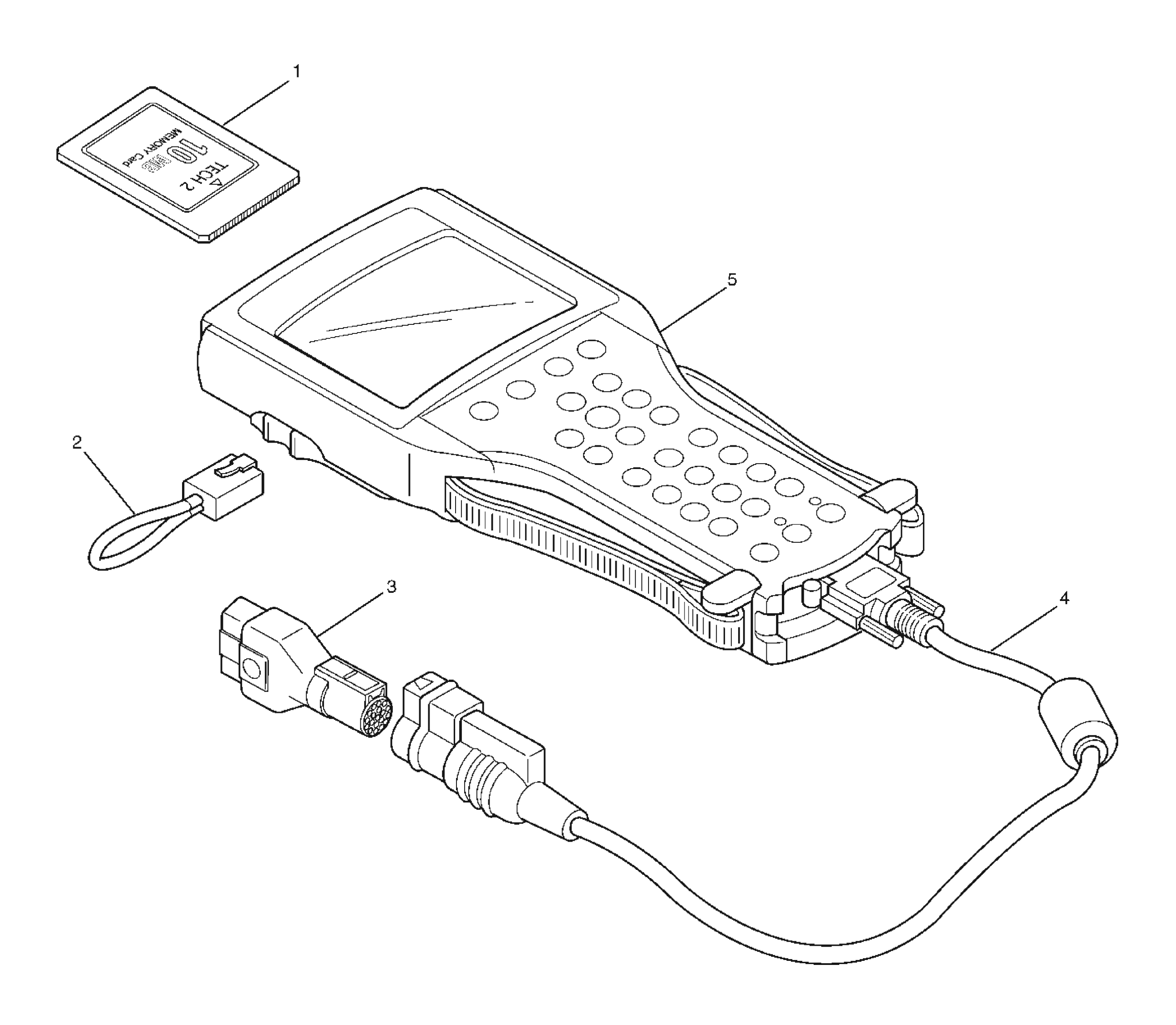
When Tech 2 is not available, DTCs can also be cleared by disconnecting *one* of the following sources for at least thirty (30) seconds.

NOTE: 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 PCM 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).

Tech 2

From 98 MY, Isuzu dealer service departments are recommended to use Tech 2. Please refer to Tech 2 Tech 2 user guide.



Legend

(1) PCMCIA Card
(2) RS 232 Loop Back Connector
(3) SAE 16/19 Adaptor
(4) DLC Cable
(5) Tech–2

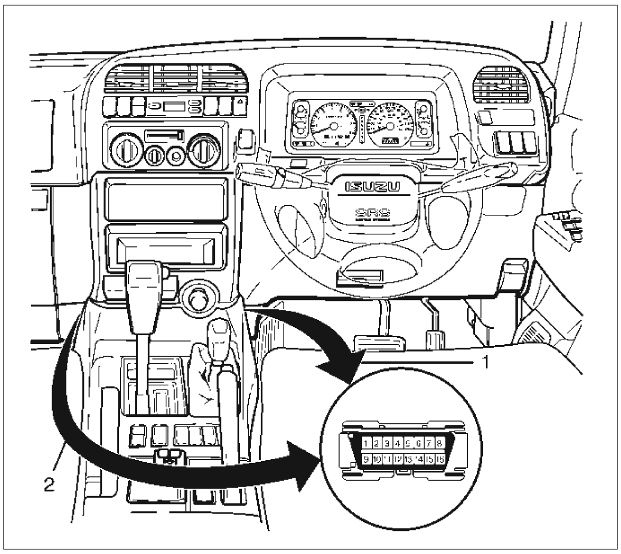
Tech 2 Features

1. Tech 2 is 12 volt system. Do not apply 24 volt.
2. After connect and/or install Tech 2 body, Vehicle Communications Interface (VCI) module, PCMCIA card and DLC connector, connect them to the vehicle DLC.
3. After power off to the Tech 2, remove and reinstall the PCMCIA card.
4. The PCMCIA card has a capacity of 10 Megabytes which is 10 times greater than the memory of the Tech 1 Mass Storage Cartridge.
5. The Tech 2 has the capability of two snapshots.
6. The PCMCIA card is sensitive to magnetism and static electricity, so care should be taken in the handling of the card.
7. The Tech 2 can plot a graph when replaying a snapshot.
8. Always return to the Main Menu to press EXIT key several times before shutting down.
9. To clear Diagnostic Trouble Codes (DTCs), open Application Menu and press “F1: Clear DTC Info”.

Getting Started

- Before operating the Isuzu PCMCIA card with the Tech 2, the following steps must be performed:

1. The Isuzu 98 System PCMCIA card (1) inserts into the Tech 2 (5).
2. Connect the SAE 16/19 adapter (3) to the DLC cable (4).
3. Connect the DLC cable to the Tech 2 (5)
4. Make sure the vehicle ignition is off.
5. Connect the Tech 2 SAE 16/19 adapter to the vehicle DLC.
    1. For RHD model: Right front side in the console box.
    2. For LHD model: Left front side in the console box.



060RW220

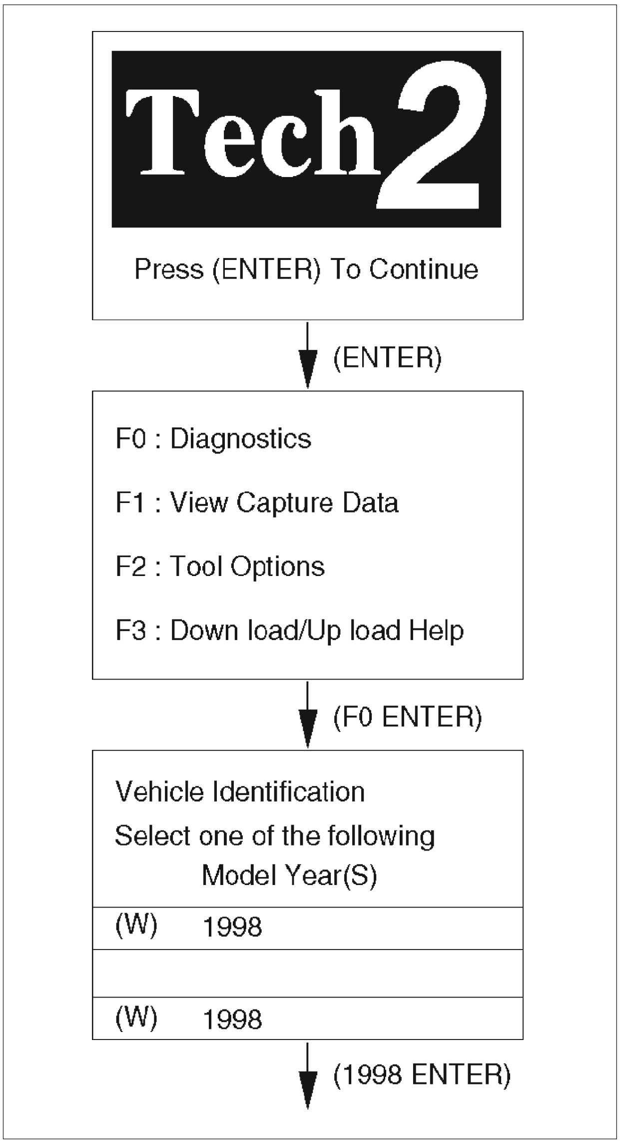
6. The vehicle ignition turns on.
7. Verify the Tech 2 power up display.

060RW009

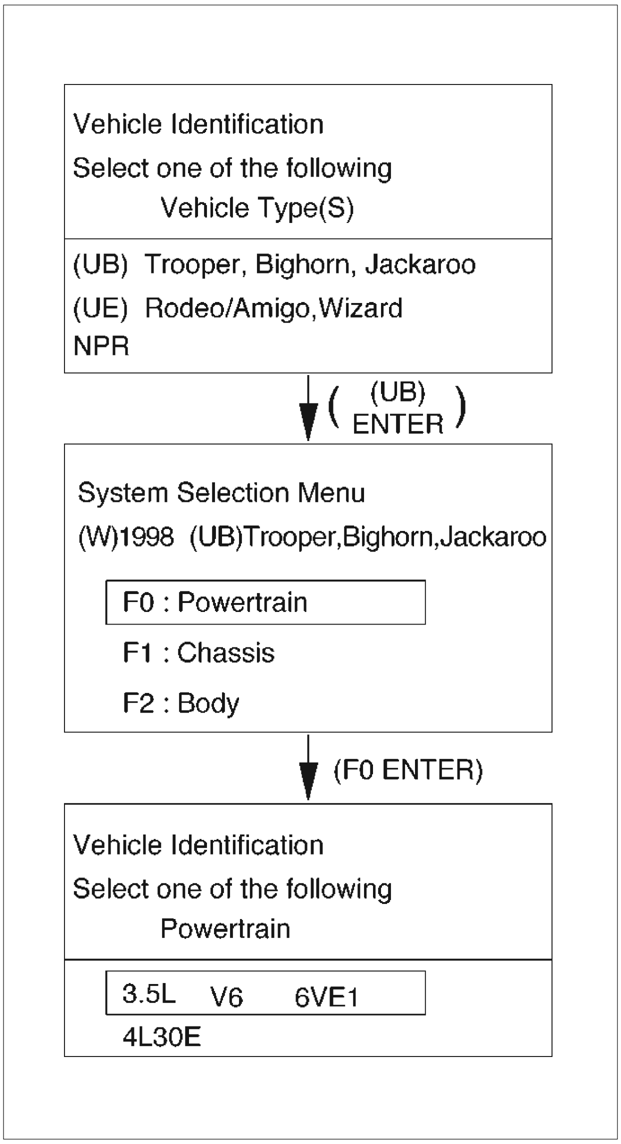
NOTE: The RS232 Loop back connector is only to use for diagnosis of Tech 2 and refer to user guide of the Tech 2.

Operating Procedure (For Example)

The power up screen is displayed when you power up the tester with the Isuzu systems PCMCIA card. Follow the operating procedure below. (Ver. 5.471)



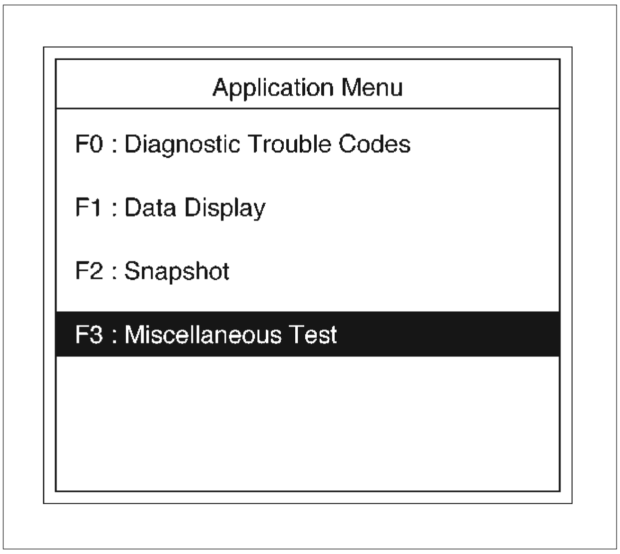
060RW014



060RW218

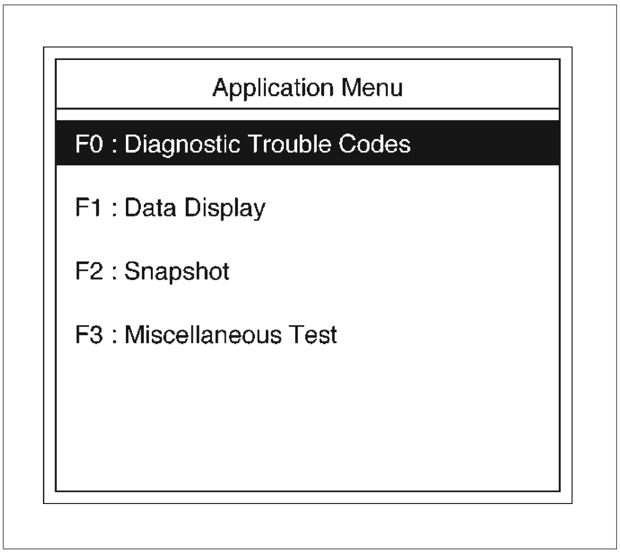
Menu

- The following table shows, which functions are used the available equipment versions.



060RW228

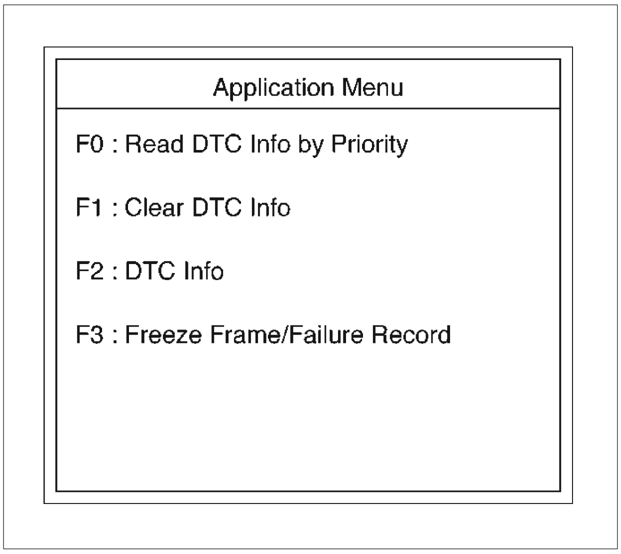
DTC Modes



060RW229

On OBD passenger cars there are five options available in Tech 2 DTC mode to display the enhanced information available. A description of the new modes, DTC Info follows. After selecting DTC, the following menu appears:

- DTC Info
- Freeze Frame
- Fail Records (not all applications)
- Clear Info



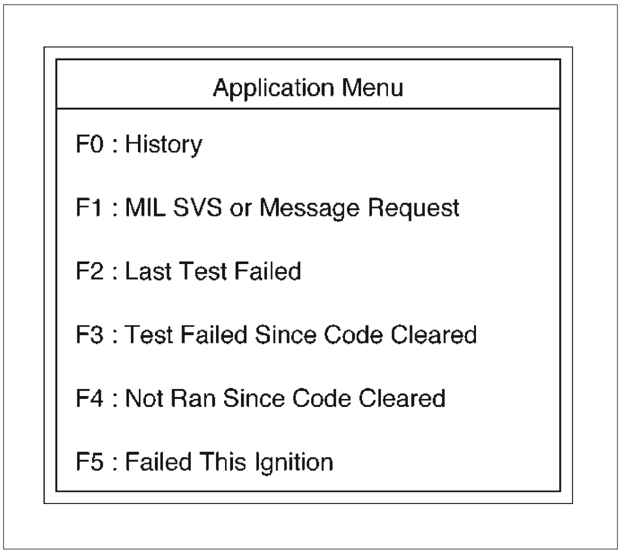
060RW223

The following is a brief description of each of the sub menus in DTC Info and Specific DTC. The order in which they appear here is alphabetical and not necessarily the way they will appear on the Tech 2.

DTC Information Mode

Use the DTC info mode to search for a specific type of stored DTC information. There are seven choices. The service manual may instruct the technician to test for DTCs in a certain manner. Always follow published service procedures.

To get a complete description of any status, press the “Enter” key before pressing the desired F-key. For example, pressing “Enter” then an F-key will display a definition of the abbreviated Tech 2 status.



060RW221

DTC Status

This selection will display any DTCs that have not run during the current ignition cycle or have reported a test failure during this ignition up to a maximum of 33 DTCs. DTC tests which run and pass will cause that DTC number to be removed from Tech 2 screen.

Fail This Ignition

This selection will display all DTCs that have failed during the present ignition cycle.

History

This selection will display only DTCs that are stored in the PCM’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 have requested the MIL and have failed within the last 40 warm-up cycles. In addition, it will display all type C and type D DTCs that have failed within the last 40 warm-up cycles.

Last Test Failed

This selection will display only DTCs that have failed the last time the test ran. The last test may have run during a previous ignition cycle if 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.

MILSVC or Message Requested

This selection will display only DTCs that are requesting the MIL. Type C and type D DTCs cannot be displayed using this option. This selection will report type B DTCs only after the MIL has been requested.

Not Run Since Code Clear

This option will display up to 33 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.

Test Failed Since Code Clear

This 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 than 40 warm-up cycles before this option is selected will not be displayed.

Injector Balance Test

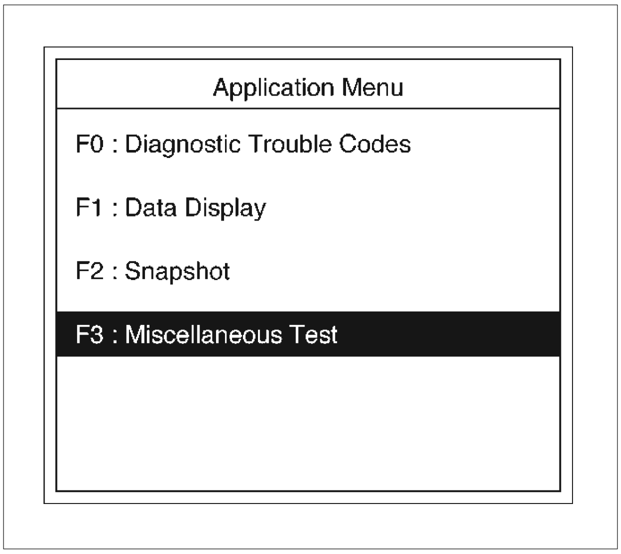
This test is conducted to make it sure that appropriate electric signals are being sent to injectors Nos. 1–6.

Tech 2 must be used for this test.

Test Procedure:

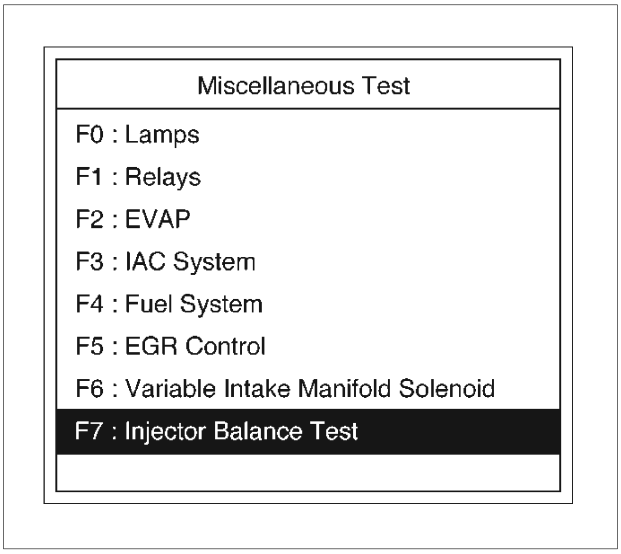
1. Connect Tech 2 to the vehicle DLC.
2. Run the Engine at idle.

3. Select F3: Miscellaneous Test in the Application Menu.



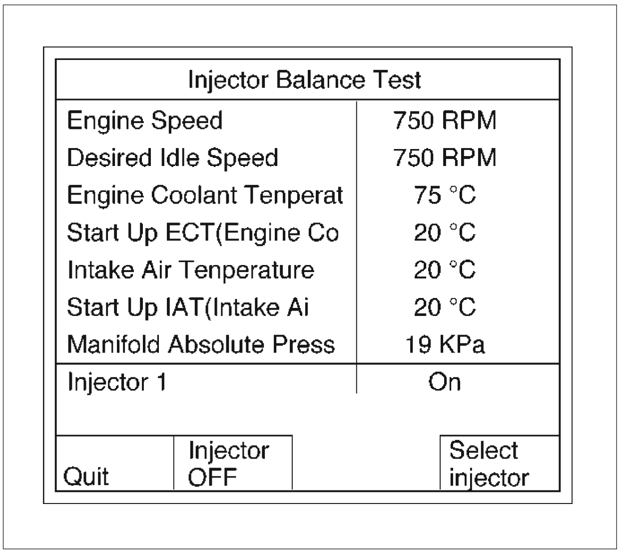
060RW228

4. Select F7: Injector Balance Test in the Miscellaneous Test.



060RX006

5. Select injector number and push “injector off” of soft key.



060RW230

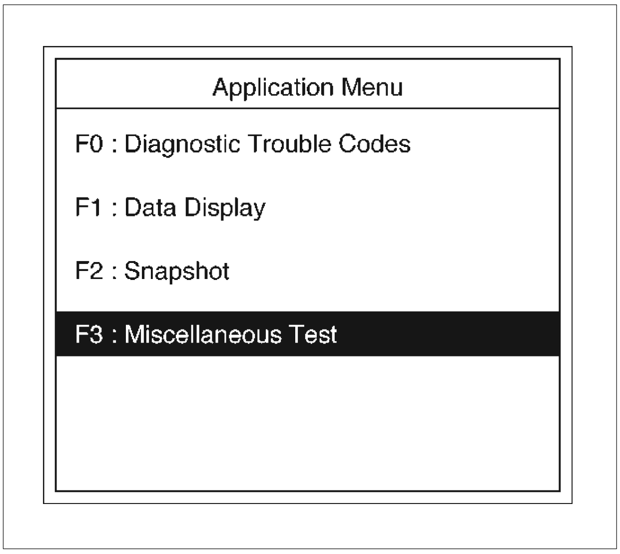
6. Make sure of engine speed change.
7. In the engine speed whose change has been confirmed, the injector electric circuit can be regard as normal.

   As for the engine speed whose change has not been confirmed, the injector electric circuit or the injector proper is faulty.

EGR Control Test

This test is conducted check EGR valve for its working.
Tech 2 must be used for this test.
Test Procedure:

1. Connect Tech 2 to the vehicle DLC.
2. Run the Engine at idle.
3. Select F3: Miscellaneous Test in the Application Menu.



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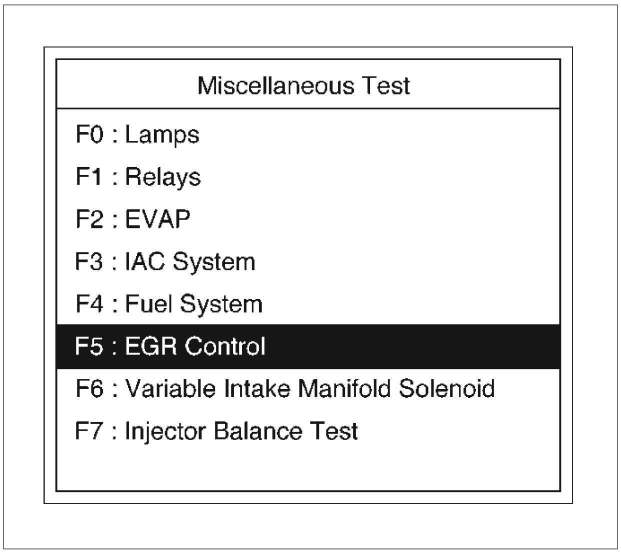
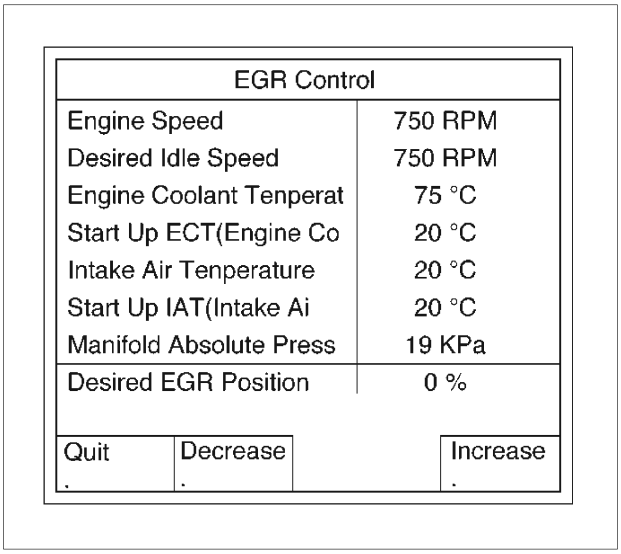
4. Select F5: EGR Control Test in the Miscellaneous Test.



060RX008

5. Instruct EGR Valve to check a data list.



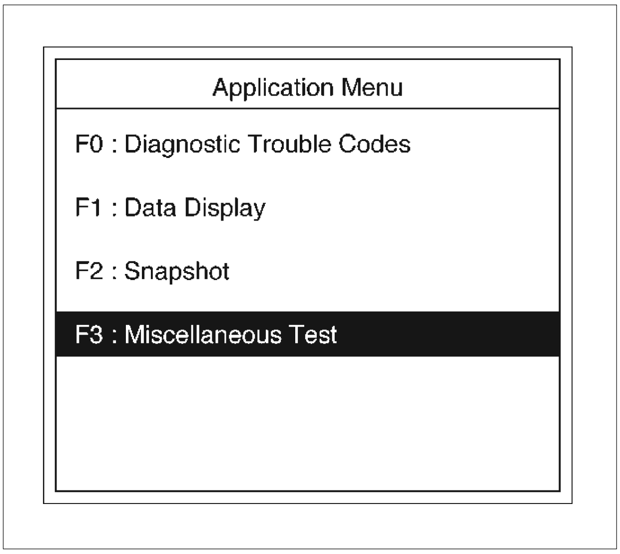
060RW234

6. If change in the data list shows a normal valve.

Idle Air Control System Test

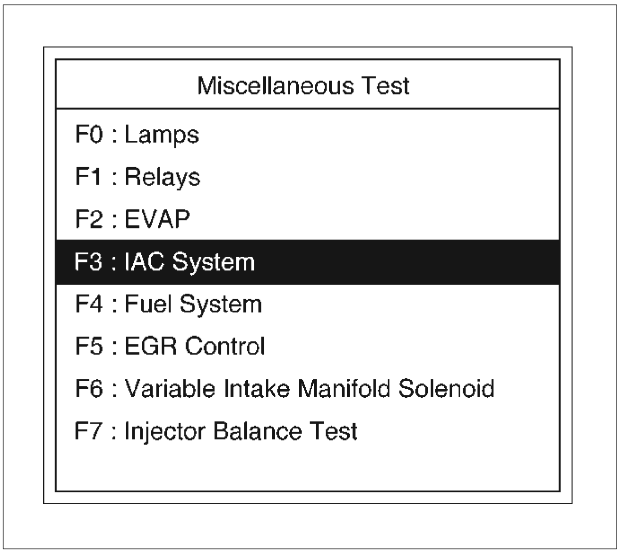
This test is conducted check IAC system for its working.
Tech 2 must be used for this test.
Test Procedure:

1. Connect Tech 2 to the vehicle DLC.
2. Run the Engine at idle.
3. Select F3: Miscellaneous Test in the Application Menu.



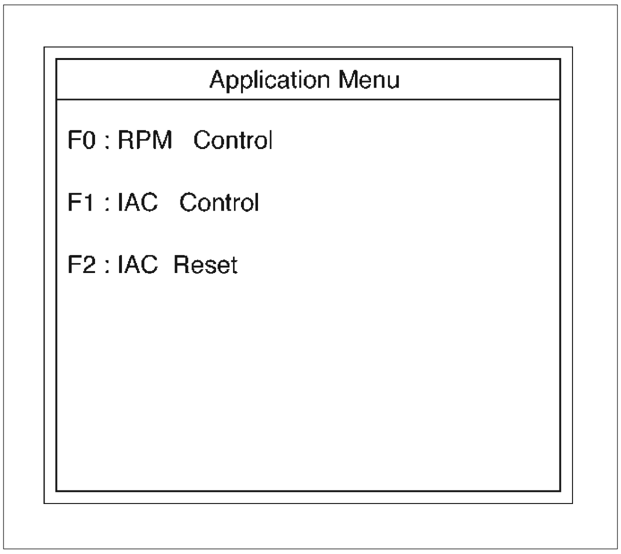
060RW228

4. Select F3: IAC System Test in the Miscellaneous Test.



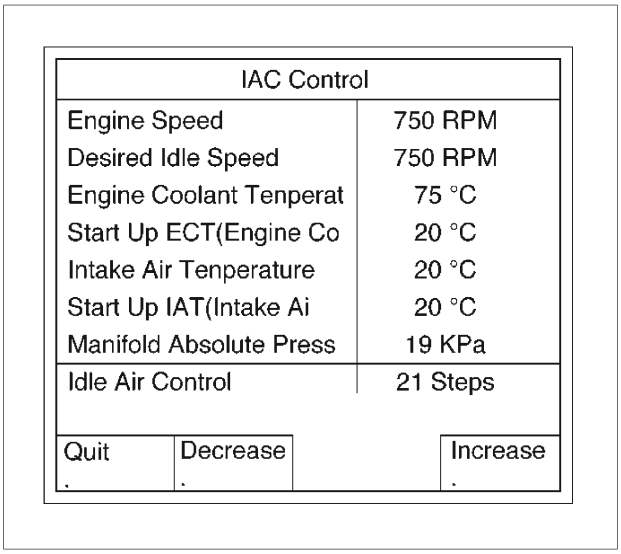
060RX007

5. Select F1: IAC Control Test.



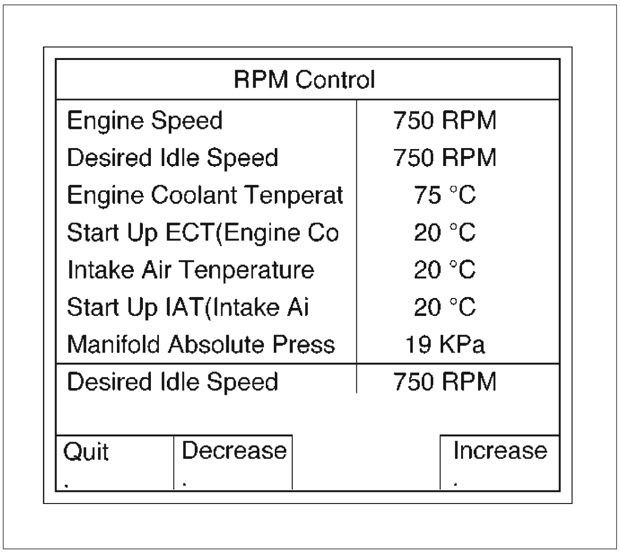
060RW235

6. Instruct IAC system to check a data list.



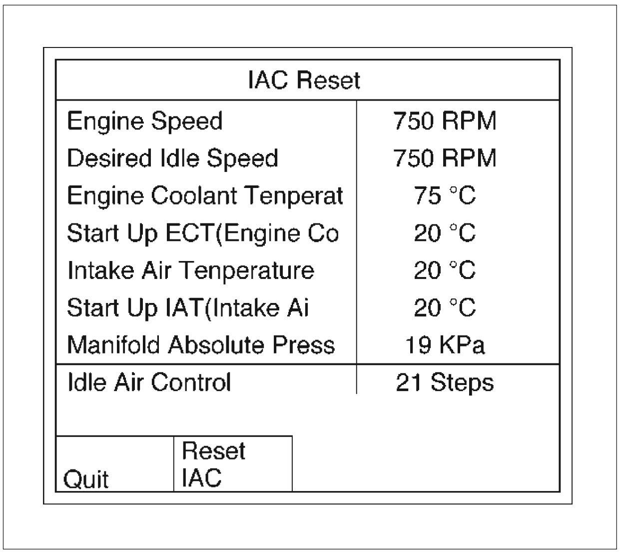
060RW233

- F0: RPM Control



060RW232

- F2: IAC Reset



060RW231

7. If change in the data list shows a normal IAC.

Primary System-Based Diagnostic

Primary System-Based Diagnostic

There are primary system-based diagnostics which evaluate system operation and its effect on vehicle emissions. The primary system-based diagnostics are listed below with a brief description of the diagnostic function:

Oxygen Sensor Diagnosis

The fuel control heated oxygen sensors (Bank 1 HO2S 1 and Bank 2 HO2S 1) are diagnosed for the following conditions:

- Inactive signal (output steady at bias voltage – approx. 450 mV)
- Signal fixed high
- Signal fixed low

If the oxygen sensor pigtail wiring, connector or terminal are damaged, the entire oxygen sensor assembly must be replaced. DO NOT attempt to repair the wiring, connector or terminals. In order for the sensor to function properly, it must have clean reference air provided to it. This clean air reference is obtained by way of the oxygen sensor wire(s). Any attempt to repair the wires, connector or terminals could result in the obstruction of the reference air and degrade oxygen sensor performance. Refer to *On-Vehicle Service, Heated Oxygen Sensors.*

Fuel Control Heated Oxygen Sensor

The main function of the fuel control heated oxygen sensors is to provide the control module with exhaust stream oxygen content information to allow proper fueling and maintain emissions within mandated levels. After it reaches operating temperature, the sensor will generate a voltage, inversely proportional to the amount of oxygen present in the exhaust gases. The control module uses the signal voltage from the fuel control heated oxygen sensors while in closed loop to adjust fuel injector pulse width. While in closed loop, the PCM can adjust fuel delivery to maintain an air/fuel ratio which allows the best combination of emission control and driveability.

HO2S Heater

Heated oxygen sensors are used to minimize the amount of time required for closed loop fuel control to begin operation and to allow accurate catalyst monitoring. The oxygen sensor heater greatly decreases the amount of time required for fuel control sensors (Bank 1 HO2S 1 and Bank2 HO2S 1) to become active. Oxygen sensor heaters are required to maintain a sufficiently high temperature which allows accurate exhaust oxygen content readings further away from the engine.

Fuel Trim System Monitor Diagnostic Operation

Fuel Trim System Monitor Diagnostic Operation

This system monitors the averages of short-term and long-term fuel trim values. If these fuel trim values stay at their limits for a calibrated period of time, a malfunction is indicated. The fuel trim diagnostic compares the averages of short-term fuel trim values and long-term fuel trim values to rich and lean thresholds. If either value is within the thresholds, a pass is recorded. If both values are outside their thresholds, a rich or lean DTC will be recorded.

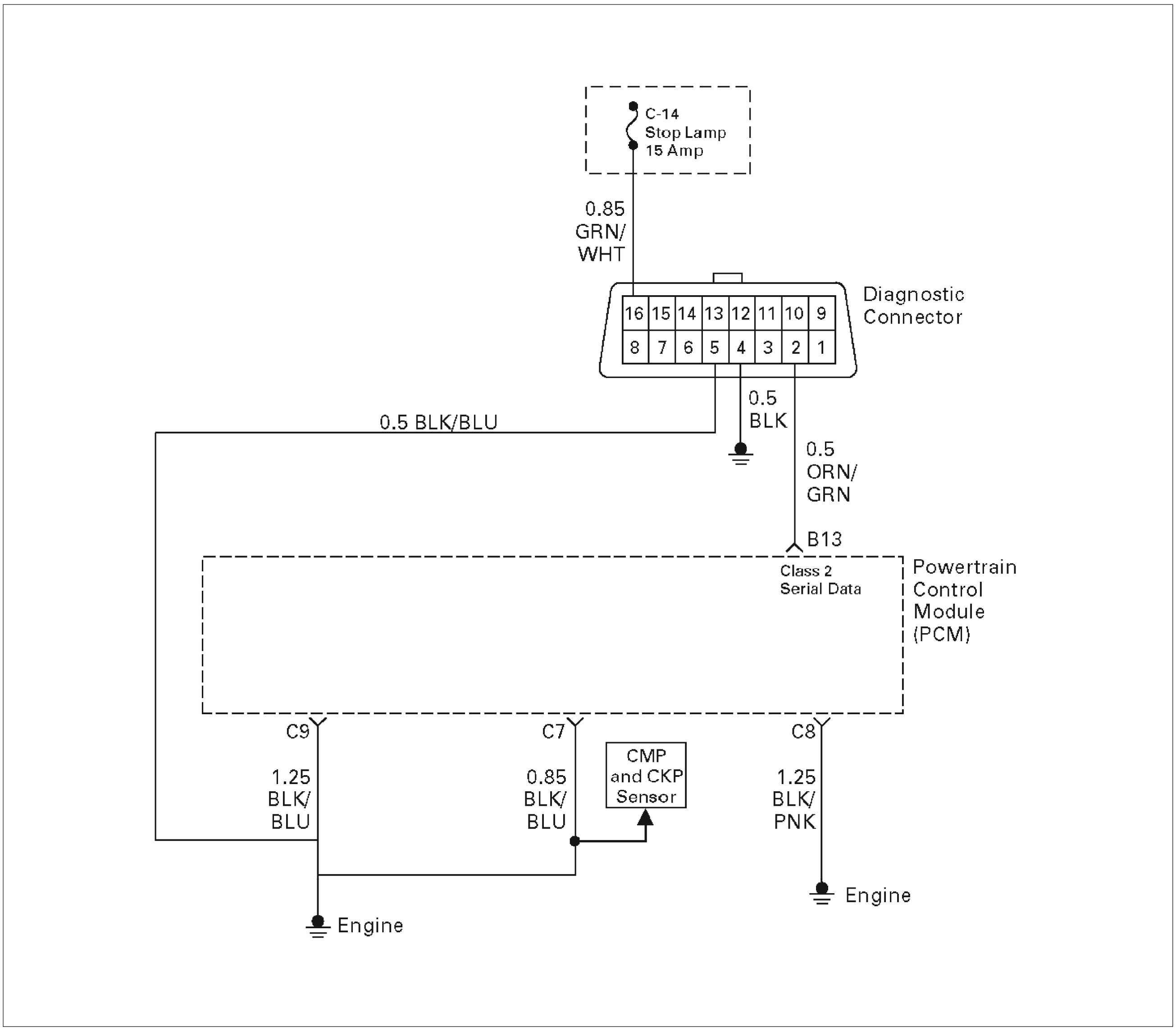
The fuel trim system diagnostic also conducts an intrusive test. This test determines if a rich condition is being caused by excessive fuel vapor from the EVAP canister. In order to meet OBD requirements, the control module uses weighted fuel trim cells to determine the need to set a fuel trim DTC. A fuel trim DTC can only be set if fuel trim counts in the weighted fuel trim cells exceed specifications. This means that the vehicle could have a fuel trim problem which is causing a problem under certain conditions (i.e., engine idle high due to a small vacuum leak or rough idle due to a large vacuum leak) while it operates fine at other times. No fuel trim DTC would set (although an engine idle speed DTC or HO2S DTC may set). Use a Tech 2 to observe fuel trim counts while the problem is occurring.

A fuel trim DTC may be triggered by a number of vehicle faults. Make use of all information available (other DTCs stored, rich or lean condition, etc.) when diagnosing a fuel trim fault.

Fuel Trim Cell Diagnostic Weights

No fuel trim DTC will set regardless of the fuel trim counts in cell 0 unless the fuel trim counts in the weighted cells are also outside specifications. This means that the vehicle could have a fuel trim problem which is causing a problem under certain conditions (i.e. engine idle high due to a small vacuum leak or rough due to a large vacuum leak) while it operates fine at other times. No fuel trim DTC would set (although an engine idle speed DTC or HO2S DTC may set). Use a Tech 2 to observe fuel trim counts while the problem is occurring.

On-Board Diagnostic (OBD) System Check



TS321119

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 PCM 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 PCM 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 to the step number(s) on the Diagnostic Chart:

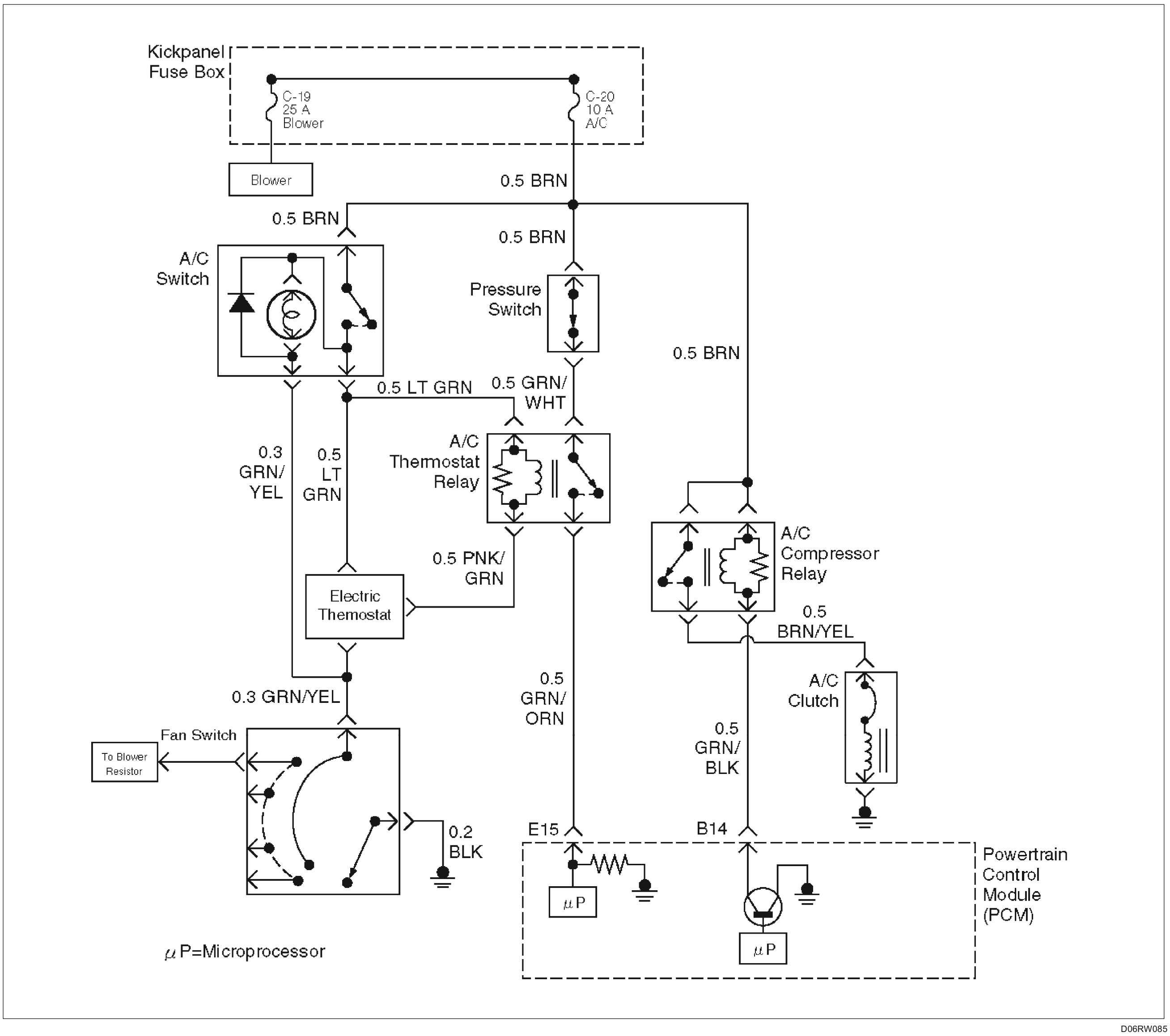
1. The MIL (“Check Engine” lamp) should be “ON” steady with the ignition “ON”/engine “OFF.” If not, Chart A-1 should be used to isolate the malfunction.
2. Checks the Class 2 data circuit and ensures that the PCM is able to transmit serial data.
3. This test ensures that the PCM is capable of controlling the MIL (“Check Engine” lamp) and the MIL (“Check Engine” lamp) driver circuit is not shorted to ground.
4. If the engine will not start, the *Cranks But Will Not Run* chart should be used to diagnose the condition.
7. A Tech 2 parameter which is not within the typical range may help to isolate the area which is causing the problem.

10. This vehicle is equipped with a PCM which utilizes an electrically erasable programmable read only memory (EEPROM). When the PCM is replaced, the new PCM must be programmed. *Refer to UBS 98 model year Immobilizer Workshop Manual.*

On-Board Diagnostic (OBD) System Check

Step	Action	Value(s)	Yes	No
1	1. Ignition “ON,” engine “OFF.” 2. Observe the malfunction indicator lamp (MIL or “Check Engine” lamp). Is the MIL (“Check Engine” lamp)“ON?”	—	Go to *Step 2*	Go to *No MIL (“Check Engine” lamp)*
2	1. Ignition “OFF.” 2. Install a Tech 2. 3. Ignition “ON.” 4. Attempt to display PCM engine data with the Tech 2. Does the Tech 2 display PCM data?	—	Go to *Step 3*	Go to *Step 8*
3	1. Using the Tech 2 output tests function, select MIL (“Check Engine” lamp) dash lamp control and command the MIL (“Check Engine” lamp) “OFF.” 2. Observe the MIL (“Check Engine” lamp). Did the MIL (“Check Engine” lamp) turn “OFF?”	—	Go to *Step 4*	Go to *MIL (“Check Engine” lamp) On Steady*
4	Attempt to start the engine. Did the engine start and continue to run?	—	Go to *Step 5*	Go to *Cranks But Will Not Run*
5	Select “Display DTCs” with the Tech 2. Are any DTCs stored?	—	Go to *Step 6*	Go to *Step 7*
6	Are two or more of the following DTCs stored? P0107, P0108, P0113, P0118, P0122, P0123, P0712.?	—	Go to *“Multiple PCM Information Sensor DTCs Set”*	Go to applicable DTC table
7	Compare PCM data values displayed on the Tech 2 to the typical engine scan data values. Are the displayed values normal or close to the typical values?	—	Refer to *Typical scan data value*	Refer to indicated *Component System Checks*
8	1. Ignition “OFF,” disconnect the PCM. 2. Ignition “ON,” engine “OFF.” 3. Check the Class 2 data circuit for an open, short to ground, or short to voltage. Also, check the DLC ignition feed circuit for an open or short to ground and the DLC ground circuit for an open. 4. If a problem is found, repair as necessary. Was a problem found?	—	Go to *Step 2*	Go to *Step 9*
9	Attempt to display PCM data with the Tech 2. Does the Tech 2 display PCM engine data?	—	Go to *Step 2*	Go to *Step 10*
10	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *Powertrain Control Module (PCM) in On-Vehicle Service.* Is the action complete?	—	Go to *Step 2*	—

A/C Clutch Control Circuit Diagnosis



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 powertrain control module (PCM). 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 PCM, the PCM 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 PCM 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 throttle is greater than 90%.
- The ignition voltage is below 10.5 volts.
- The engine speed is greater than 4500 RPM for 5 seconds or 5400 RPM.
- The engine coolant temperature (ECT) is greater than 125 °C (257 °F).
- The intake air temperature (IAT) is less than 5°C (41°F).
- The power steering pressure switch signals a cramped position.

Diagnostic Aids

To diagnose an the intermittent fault, check for the following conditions:

- Poor connection at the PCM–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 PCM. The Tech 2 can display when the PCM 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.

Test Description

IMPORTANT: Do not engage the A/C compressor clutch with the engine running if an A/C mode is not selected at the A/C control switch.

The numbers below refer to the step numbers on the Diagnostic Chart:

3. This a test determine is the problem is with the refrigerant system. If the switch is open, A/C pressure gauges will be used to determine if the pressure switch is faulty or if the system is partially discharged or empty.
4. Although the normal complaint will be the A/C clutch failing to engage, it is possible for a short circuit to cause the clutch to run when A/C has not been selected. This step is a test for that condition.
7. There is an extremely low probability that both relays will fail at the same time, so the substitution process is one way to check the A/C Thermostat relay. Use a known good relay to do a substitution check.
9. The blower system furnishes a ground for the A/C control circuit, and it also shares a power source through the Heater and A/C Relay. The blower must be "ON" in order to test the A/C system.

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 *OBD System Check*
2	Are any other DTCs stored?	—	Go to the other DTC chart(s) first	Go to *Step 3*
3	1. Disconnect the electrical connector at the pressure switch located on the receiver/drier. 2. Use an ohmmeter to check continuity across the pressure switch. Is the pressure switch open?	—	Go to Air *Conditioning* to diagnose the cause of the open pressure switch	Go to *Step 4*
4	**IMPORTANT:** Before continuing with the diagnosis, the following conditions must be met: • The intake air temperature must be greater than 15°C. (60°F). • The engine coolant temperature must be less than 119°C (246°F). 1. A/C "OFF." 2. Start the engine and idle for 1 minute. 3. Observe the A/C compressor. Is the A/C compressor clutch engaged even though A/C has not been requested?	—	Go to *Step 45*	Go to *Step 5*
5	1. Idle the engine. 2. A/C "ON". 3. Blower "ON". 4. Observe the A/C compressor. Is the A/C compressor magnetic clutch engaged?	—	Refer to *Diagnostic Aids*	Go to *Step 6*

A/C Clutch Control Circuit Diagnosis (Cont'd)

Step	Action	Value(s)	Yes	No
6	1. Engine idling. 2. A/C "ON". 3. Blower "ON". 4. Observe the "A/C Request" display on the Tech 2. Does the tool "A/C Request" display indicate "Yes?"	—	Go to *Step 34*	Go to *Step 7*
7	Temporarily substitute the A/C compressor relay in place of the A/C thermostat relay, then repeat Step 5. Did the "A/C Request" display indicate "Yes?"	—	Go to *Step 8*	Go to *Step 9*
8	Replace the original A/C thermostat relay. Is the action complete?	—	Verify repair	—
9	Dose the blower operate?	—	Go to *Step 10*	Go to *Step 11*
10	Repair the blower. Is the action complete?	—	Verify repair	—
11	Check for a faulty 10a A/C fuse in the underdash fuse panel. Was the 10A fuse OK?	—	Go to *Step 13*	Go to *Step 12*
12	Check for short circuit and make repairs if necessary. Replace the 10A A/C fuse. Is the action complete?	—	Verify repair	—
13	1. Ignition "ON." 2. Use a DVM to check voltage at the positive A/C switch wire (BRN). Was voltage equal to the specified value?	+B	Go to *Step 15*	Go to *Step 14*
14	Repair the open wire (BRN) between the A/C switch and the A/C fuse. Is the action complete?	—	Verify repair	—
15	1. Remove the glove box to gain access to the A/C thermostat. 2. Disconnect the thermostat connector. 3. Attach a fused jumper between ground and the PNK/GRN wire at the thermostat. 4. A/C "ON." 5. Blower "ON." Dose A/C request indicate "YES" on the Tech 2?	—	Go to *Step 16*	Go to *Step 23*
16	1. Ignition "ON." 2. Use a DVM to check voltage at the electronic A/C thermostat. Was voltage equal to the specified value?	+B	Go to *Step 20*	Go to *Step 17*
17	Check for an open (LT GRN) between the thermostat and the A/C switch. Was the wire open?	—	Go to *Step 18*	Go to *Step 19*
18	Repair the open wire (LT GRN) between the thermostat and the A/C switch. Is the action complete?	—	Verify repair	—

A/C Clutch Control Circuit Diagnosis (Cont'd)

Step	Action	Value(s)	Yes	No
19	Replace the A/C switch. Is the action complete?	—	Verify repair	—
20	Use an ohmmeter to check continuity between the electronic A/C thermostat and the blower switch. Was there an open circuit?	—	Go to *Step 21*	Go to *Step 22*
21	Repair the open wire (GRN/YEL) between the thermostat and the blower switch. Is the action complete?	—	Verify repair	—
22	Replace the electronic A/C thermostat. Is the an action complete?	—	Verify repair	—
23	Check for an open circuit between A/C thermostat relay and PCM A/C request terminal (E-15). Was there an open circuit?	—	Go to *Step 24*	Go to *Step 25*
24	Repair the open circuit between the PCM and A/C thermostat relay. Is the action complete?	—	Verify repair	—
25	Check for an open circuit between the A/C switch (LT GRN) and the A/C thermostat relay (LT GRN). Was there an open circuit?	—	Go to *Step 26*	Go to *Step 27*
26	Repair the open circuit between the A/C switch and the A/C thermostat relay. Is the action complete?	—	Verify repair	—
27	1. Ignition "ON." 2. Use a DVM to check voltage at the A/C pressure switch (BRN). Was voltage equal to the specified value?	+B	Go to *Step 29*	Go to *Step 28*
28	Repair the open circuit between the 10A A/C fuse and the pressure switch. Is the action complete?	—	Verify repair	—
29	Use an ohmmeter to check continuity between the pressure switch (GRN/WHT) and the A/C thermostat relay (GRN/WHT). Was the circuit open?	—	Go to *Step 30*	Go to *Step 31*
30	Repair the open circuit between the pressure switch and the A/C thermostat relay. Is the action complete?	—	Verify repair	—
31	Check for damaged pin or terminal at E-15 of the PCM. Was a damaged pin or terminal found?	—	Go to *Step 32*	Go to *Step 33*
32	Repair the damaged pin or terminal. Is the action complete?	—	Verify repair	—
33	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

A/C Clutch Control Circuit Diagnosis (Cont'd)

Step	Action	Value(s)	Yes	No
34	1. Remove the A/C compressor relay. 2. Ignition "ON." 3. Use a DVM to check voltage at both of the BRN wires at the A/C compressor relay socket. Is the voltage equal to the specified value?	+B	Go to *Step 36*	Go to *Step 35*
35	Repair the faulty BRN wire between the A/C fuse and the A/C compressor relay . Is the action complete?	—	Verify repair	—
36	1. A/C compressor relay removed. 2. Engine idling. 3. A/C "ON." 4. Blower "ON." 5. Use a DVM to measure voltage between the GRN/BLK wire at the A/C compressor relay socket and battery±. Did the DVM indicate the specified value?	+B	Go to *Step 40*	Go to *Step 37*
37	Check for an open GRN/BLK wire between PCM terminal B-14 and the A/C compressor relay. Was the wire open?	—	Go to *Step 38*	Go to *Step 39*
38	Repair the open GRN/BLK wire between the PCM and the A/C compressor relay. Is the action complete?	—	Verify repair	—
39	Check for a damaged pin or terminal at B-14 of the PCM. Was a damaged pin or a terminal found?	—	Go to *Step 32*	Go to *Step 33*
40	1. A/C compressor relay removed. 2. Connect a fused jumper at the A/C compressor relay socket between either BRN wire and the BRN/YEL wire. 3. Engine idling. 4. A/C "ON." 5. Blower "ON." Did the compressor magnetic clutch engage?	—	Go to *Step 41*	Go to *Step 42*
41	Repair the A/C compressor relay. Is the action complete?	—	Verify repair	—
42	Check for an open circuit between the A/C compressor relay and the A/C clutch. Was an open circuit found?	—	Go to *Step 43*	Go to *Step 44*
43	Repair the open circuit between the compressor Clutch and the A/C compressor relay. Is the action complete?	—	Verify repair	—
44	Service the compressor clutch or replace the compressor due to a faulty internal overheat switch. Is the action complete?	—	Verify repair	—

A/C Clutch Control Circuit Diagnosis (Cont'd)

Step	Action	Value(s)	Yes	No
45	1. Remove the A/C compressor relay. 2. Idle the engine. Is the compressor clutch still engaged when A/C is not selected?	—	Go to *Step 46*	Go to *Step 47*
46	Repair the short to voltage between the A/C clutch and A/C compressor relay. Is the action complete?	—	Verify repair	—
47	1. Reinstall the A/C compressor relay. 2. Remove the A/C thermostat relay. 3. Engine idling. Is the compressor clutch still engaged when A/C is not selected?	—	Go to *Step 48*	Go to *Step 50*
48	Use a DVM to check for a short to ground between the A/C compressor relay and B-14 of the PCM. Was a short detected?	—	Go to *Step 49*	Go to *Step 33*
49	Repair the short to ground between the PCM and A/C compressor relay. Is the action complete?	—	Verify repair	—
50	Repair the short to ground between the A/C thermostat relay and the electronic thermostat. Is the action complete?	—	Verify repair	—

Electronic Ignition System Diagnosis

If the engine cranks but will not run or immediately stalls, the Engine Cranks But Will Not Start chart must be used to determine if the failure is the ignition system or the fuel system. If DTC P0341, or P0336 is set, the appropriate diagnostic trouble code chart must be used for diagnosis. If a misfire is being experienced with no DTC set, refer to the *Symptoms* section for diagnosis.

Fuel Metering System Check

Some failures of the fuel metering system will result in an “Engine Cranks But Will Not Run” symptom. If this condition exists, refer to the *Cranks But Will Not Run* chart. This chart will determine if the problem is caused by the ignition system, the PCM, or the fuel pump electrical circuit.

Refer to *Fuel System Electrical Test* for the fuel system wiring schematic.

If there is a fuel delivery problem, refer to *Fuel System Diagnosis*, which diagnoses the fuel injectors, the fuel pressure regulator, and the fuel pump. If a malfunction occurs in the fuel metering system, it usually results in either a rich HO2S signal or a lean HO2S signal. This condition is indicated by the HO2S voltage, which causes the PCM to change the fuel calculation (fuel injector pulse width) based on the HO2S reading. Changes made to the fuel calculation will be indicated by a change in the long term fuel trim values which can be monitored with a Tech 2. Ideal long term fuel trim values are around 0%; for a lean HO2S signal, the PCM will add fuel, resulting in a fuel trim value above 0%. Some variations in fuel trim values are normal because all engines are not exactly the same. If the fuel trim values are greater than +23%, refer to *DTC P0131, DTC P0151, DTC P0171, and DTC 1171* for items which can cause a lean HO2S signal.

Idle Air Control (IAC) Valve

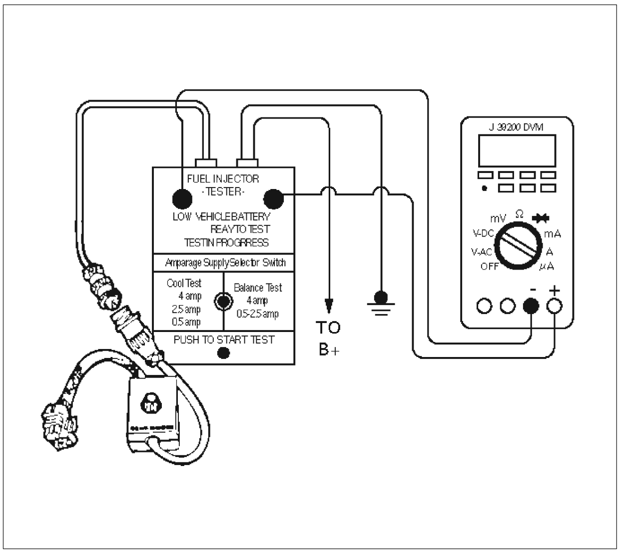
The Tech 2 displays the IAC pintle position in counts. A count of “0” indicates the PCM is commanding the IAC pintle to be driven all the way into a fully-seated position. This is usually caused by a large vacuum leak.

The higher the number of counts, the more air is being commanded to bypass the throttle blade. Refer to IAC System Check in order to diagnose the IAC system. Refer to *Rough, Unstable, or Incorrect Idle, Stalling* in *Symptoms* for other possible causes of idle problems.

Fuel System Pressure Test

A fuel system pressure test is part of several of the diagnostic charts and symptom checks. To perform this test, refer to *Fuel Systems Diagnosis.*

Fuel Injector Coil Test Procedure and Fuel Injector Balance Test Procedure



T32003

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.

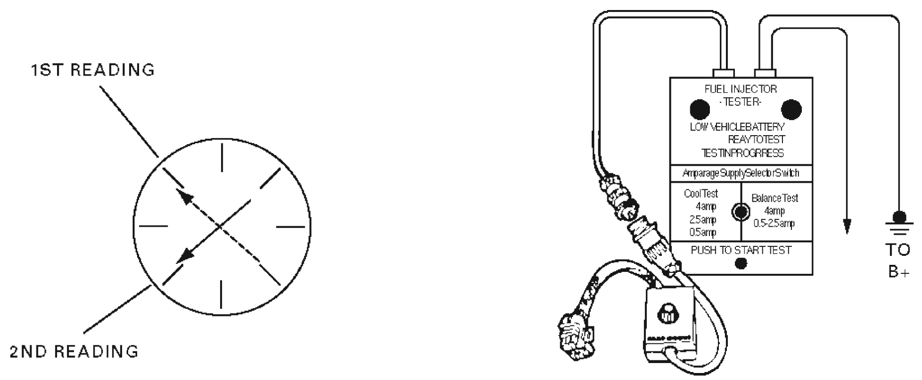
- An erratic voltage reading (large fluctuations in voltage that do not stabilize) indicates an intermittent connection within the fuel injector.

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)



R262001

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.” NOTE: 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 5-8840-2638-0 Fuel Injector Tester to B+ and ground, and to the 5-8840-2619-0 Injector Switch Box. 4. Connect the injector switch box to the grey fuel injector harness connector located on the front of the EVAP canister bracket. 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 5-8840-0285-0 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*	—

Injector Coil Test Procedure (Steps 1-6) and Injector Balance Test Procedure (Steps 7-11) (Cont'd)

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 scan tool. 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?	296-376 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*

Injector Coil Test Procedure (Steps 1-6) and Injector Balance Test Procedure (Steps 7-11) (Cont'd)

Step	Action	Value(s)	Yes	No
9	1. Connect the 5-8840-2638-0 Fuel Injector Tester and 5-8840-2619-0 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 scan tool 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. NOTE: 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	—

Knock Sensor Diagnosis

The Tech 2 has two data displays available for diagnosing the knock sensor (KS) system. The two displays are described as follows:

- “Knock Retard” indicates the number of degrees that the spark timing is being retarded due to a knock condition.
- “KS Noise Channel” indicates the current voltage level being monitored on the noise channel.

DTCs P0325 and P0327 are designed to diagnose the KS module, the knock sensor, and the related wiring. The problems encountered with the KS system should set a DTC. However, if no DTC was set but the KS system is suspect because of a detonation complaint, refer to *Detonation/Spark Knock in Symptoms.*

Powertrain Control Module (PCM) Diagnosis

To read and clear diagnostic trouble codes, use a Tech 2.

IMPORTANT: Use of a Tech 2 is recommended to clear diagnostic trouble codes from the PCM memory. Diagnostic trouble codes can also be cleared by turning the ignition “OFF” and disconnecting the battery power from the PCM for 30 seconds. Turning off the ignition and disconnecting the battery power from the PCM will cause all diagnostic information in the PCM memory to be cleared. Therefore, all the diagnostic tests will have to be re-run.

Since the PCM can have a failure which may affect only one circuit, following the diagnostic procedures in this section will determine which circuit has a problem and where it is.

If a diagnostic chart indicates that the PCM connections or the PCM is the cause of a problem, and the PCM is replaced, but this does not correct the problem, one of the following may be the reason:

- There is a problem with the PCM terminal connections. The terminals may have to be removed from the connector in order to check them properly.
- The problem is intermittent. This means that the problem is not present at the time the system is being checked. In this case, refer to the *Symptoms* portion of the manual and make a careful physical inspection of all component and wiring associated with the affected system.
- There is a shorted solenoid, relay coil, or harness. Solenoids and relays are turned “ON” and “OFF” by the PCM using internal electronic switches called drivers. A shorted solenoid, relay coil, or harness will not damage the PCM but will cause the solenoid or relay to be inoperative.

Multiple PCM Information Sensor DTCS Set

Circuit Description

The powertrain control module (PCM) monitors various sensors to determine the engine operating conditions. The PCM controls fuel delivery, spark advance, transmission operation, and emission control device operation based on the sensor inputs.

The PCM provides a sensor ground to all of the sensors. The PCM applies 5 volts through a pull-up resistor, and determines the status of the following sensors by monitoring the voltage present between the 5-volt supply and the resistor:

- The engine coolant temperature (ETC) sensor
- The intake air temperature (IAT) sensor
- The transmission fluid temperature (TFT) sensor

The PCM provides the following sensors with a 5-volt reference and a sensor ground signal:

- The exhaust gas recirculating (EGR) pintle position sensor
- The throttle position (TP) sensor
- The manifold absolute pressure (MAP) sensor

The PCM monitors the separate feedback signals from these sensors in order to determine their operating status.

Diagnostic Aids

IMPORTANT: Be sure to inspect PCM and engine grounds for being secure and clean.

A short to voltage in one of the sensor input circuits may cause one or more of the following DTCs to be set:

- P0108
- P0113
- P0118
- P0123
- P0560
- P0712
- P0406

IMPORTANT: If a sensor input circuit has been shorted to voltage, ensure that the sensor is not damaged. A damaged sensor will continue to indicate a high or low voltage after the affected circuit has been repaired. If the sensor has been damaged, replace it.

An open in the sensor ground circuit between the PCM and the splice will cause one or more of the following DTCs to be set:

- P0108
- P0113
- P0118
- P0123
- P0712
- P0406

A short to ground in the 5-volt reference A or B circuit will cause one or more of the following DTCs to be set:

- P0107
- P0122

In the 5-volt reference circuit A, between the PCM and the splice, will cause one or more of the following DTCs to be set:

- P0122

In the 5-volt reference circuit B, between the PCM and the splice, will cause one or more of the following DTCs to be set:

- P0107

Check for the following conditions:

- **Poor connection at PCM.** Inspect the harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damage terminals, and a poor terminal-to-wire connection.
- **Damaged harness.** Inspect the wiring harness for damage. If the harness is not damaged, observe an affected sensor's displayed value on the Tech 2 with the ignition "ON" and the engine "OFF" while you move the connectors and the wiring harnesses related to the following sensors:
- IAT
- ECT
- TP
- MAP
- EGR
- TFT

Multiple PCM Information Sensor DTCs Set

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," disconnect the PCM. 2. Turn the ignition "ON," check the 5 volt reference A circuit for the following conditions: • A poor connection at the PCM. • An open between the PCM connector and the splice. • A short to ground. • A short to voltage. Is there an open or short?	—	Go to *Step 3*	Go to *Step 4*
3	Repair the open or short. Is the action complete?	—	Verify repair	—
4	Check the sensor ground circuit for the following conditions: • A poor connection at the PCM or the affected sensors. • An open between the PCM connector and the affected sensors. Is there an open or a poor connection?	—	Go to *Step 5*	Go to *Step 6*
5	Repair the open or the poor connection. Is the action complete?	—	Verify repair	—
6	Measure the voltage between the EGR pintle position sensor signal circuit at the PCM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 7*	Go to *Step 12*
7	Measure the voltage between the MAP sensor signal circuit at the PCM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 8*	Go to *Step 15*
8	Measure the voltage between the TP sensor signal circuit at the PCM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 9*	Go to *Step 16*
9	Measure the voltage between the IAT sensor signal circuit at the PCM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 10*	Go to *Step 17*
10	Measure the voltage between the ECT sensor signal circuit at the PCM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 11*	Go to *Step 18*

Multiple PCM Information Sensor DTCs Set (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Disconnect the EGR valve. 2. Measure the voltage between the EGR pintle position sensor signal circuit at the PCM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 13*	Go to *Step 18*
12	Measure the voltage between the TFT sensor signal circuit at the PCM harness connector and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 20*	Go to *Step 19*
13	Replace the EGR valve. Is the action complete?	—	Verify repair	—
14	Locate and repair the short to voltage in the MAP sensor signal circuit. Is the action complete?	—	Verify repair	—
15	Locate and repair the short to voltage in the TP sensor signal circuit. Is the action complete?	—	Verify repair	—
16	Locate and repair the short to voltage in the IAT sensor signal circuit. Is the action complete?	—	Verify repair	—
17	Locate and repair the short to voltage in the ECT sensor signal circuit. Is the action complete?	—	Verify repair	—
18	Locate and repair the short to voltage in the EGR pintle position sensor signal circuit. Is the action complete?	—	Verify repair	—
19	Locate and repair the short to voltage in the TFT sensor signal circuit. Is the action complete?	—	Verify repair	—
20	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Go to *OBD System Check*	—

Exhaust Gas Recirculation (EGR) Diagnosis (For except EXPORT and SOUTH AFRICA)

Pintle position error diagnosis is covered by DTC P0402, P0404, P1404, P0405, P0406. If EGR diagnostic trouble codes P0402, P0404, P1404, P0405, P0406 are encountered, refer to the DTC charts.

Engine Tech 2 Data Definitions and Ranges

A/C CLUTCH – Tech 2 Displays ON or OFF –
Indicates whether the PCM has commanded the A/C clutch ON. Used in A/C system diagnostic.

A/C REQUEST — Tech 2 Displays YES or NO —
Indicates the state of the A/C request input circuit from the HVAC controls. The PCM uses the A/C request signal to determine whether A/C compressor operation is being requested.

AIR/FUEL RATIO — Tech 2 Range 0.0-25.5 —
Air/fuel ratio indicates the PCM commanded value. In closed loop, the air/fuel ratio should normally be displayed around "14.2-14.7." A lower air/fuel ratio indicates a richer commanded mixture, which may be seen during power enrichment or TWC protection modes. A higher air/fuel ratio indicates a leaner commanded mixture. This can be seen during deceleration fuel mode.

BAROMETRIC PRESSURE — Tech 2 Range 10-105 kPa/0.00-5.00 Volts —
The barometric pressure reading is determined from the MAP sensor signal monitored during key up and wide open throttle (WOT) conditions. The barometric pressure is used to compensate for altitude differences and is normally displayed around "61-104" depending on altitude and barometric pressure.

CHECK TRANS LAMP — AUTO TRANSMISSION —
Indicates the need to check for a DTC with the Tech 2 when the lamp is flashing 0.2 seconds ON and 0.2 seconds OFF.

CMP ACT. COUNTER – Cam Position Activity

DECEL FUEL MODE — Tech 2 Display ACTIVE or INACTIVE —
"ACTIVE" displayed indicates that the PCM has detected conditions appropriate to operate in deceleration fuel mode. The PCM will command the deceleration fuel mode when it detects a closed throttle position while the vehicle is traveling over 20 mph. While in the deceleration fuel delivered by entering open loop and decreasing the injector pulse width.

DESIRED EGR POS. — Tech 2 Range 0%-100% —
Represents the EGR pintle position that the PCM is commanding.

DESIRED IDLE — Tech 2 Range 0-3187 RPM —
The idle speed that the PCM is commanding. The PCM will compensate for various engine loads based on engine coolant temperature, to keep the engine at the desired speed.

ECT — (Engine Coolant Temperature) Tech 2 Range –40°C to 151°C (–40°F to 304°F) —
The engine coolant temperature (ECT) is mounted in the coolant stream and sends engine temperature information to the PCM. The PCM applies 5 volts to the ECT sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold (high resistance), the PCM monitors a high signal voltage and interprets that as a cold engine. As the sensor warms (decreasing resistance), the voltage signal will decrease and the PCM will interpret the lower voltage as a warm engine.

EGR DUTY CYCLE — Tech 2 Range 0%-100% —
Represents the EGR valve driver PWM signal from the PCM. A duty cycle of 0% indicates that no EGR flow is being commanded; a 100% duty cycle indicates maximum EGR flow commanded.

EGR FEEDBACK — Tech 2 Range 0.00-5.00 Volts —
Indicates the EGR pintle position sensor signal voltage being monitored by the PCM. A low voltage indicates a fully extended pintle (closed valve); a voltage near 5 volts indicates a retracted pintle (open valve).

ENGINE LOAD — Tech 2 Range 0%-100% —
Engine load is calculated by the PCM from engine speed and MAF sensor readings. Engine load should increase with an increase in RPM or air flow.

ENGINE RUN TIME — Tech 2 Range 00:00:00-99:99:99 Hrs:Min:Sec —
Indicates the time elapsed since the engine was started. If the engine is stopped, engine run time will be reset to 00:00:00.

ENGINE SPEED — Range 0-9999 RPM —
Engine speed is computed by the PCM from the 58X reference input. It should remain close to desired idle under various engine loads with engine idling.

FUEL PUMP — Tech 2 Displays ON or OFF —
Indicates the PCM commanded state of the fuel pump relay driver circuit.

FUEL TRIM CELL — Tech 2 Range 0-21 —
The fuel trim cell is dependent upon engine speed and MAF sensor readings. A plot of RPM vs. MAF is divided into 22 cells. Fuel trim cell indicates which cell is currently active.

FUEL TRIM LEARN — Tech 2 Displays NO or 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 learn displays "NO," then long term fuel trim will not respond to changes in short term fuel trim.

HO2S BANK 1, SEN. 1 — Tech 2 Range 0-1132 mV —
Represents the fuel control exhaust oxygen sensor output voltage. Should fluctuate constantly within a range between 10 mV (lean exhaust) and 1000 mV (rich exhaust) while operating in closed loop.

HO2S BANK2, SEN. 1—Tech 2 Range 0-1132 mV—
Represents the fuel control exhaust oxygen sensor output voltage. Should fluctuate constantly within a range between 10mV (lean exhaust) and 1000 mV (rich exhaust) while operating in closed loop.

HO2S BANK 1, SEN. 1—Tech 2 Displays NOT READY or READY—
Indicates the status of the exhaust oxygen sensor. The Tech 2 will indicate that the exhaust oxygen sensor is ready when the PCM detects a fluctuating HO2S voltage sufficient to allow closed loop operation. This will not occur unless the exhaust oxygen sensor is warmed up.

HO2S BANK 2, SEN. 1 — Tech 2 Displays NOT READY or READY —
Indicates the status of the exhaust oxygen sensor. The Tech 2 will indicate that the exhaust oxygen sensor is ready when the PCM detects a fluctuating HO2S voltage sufficient to allow closed loop operation. This will not occur unless the exhaust oxygen sensor is warmed up.

HO2S WARM UP TIME BANK 1, SEN. 1/BANK 2 SEN. 1 — Tech 2 Range 00:00:00-99:99:99 HRS:MIN:SEC —
Indicates warm-up time for each HO2S. The HO2S warm-up time is used for the HO2S heater test. The PCM will run the heater test only after a cold start (determined by engine coolant and intake air temperature at the time of start-up) and only once during an ignition cycle. When the engine is started the PCM will monitor the HO2S voltage. When the HO2S voltage indicates a sufficiently active sensor, the PCM looks at how much time has elapsed since start-up. If the PCM determines that too much time was required for the HO2S to become active, a DTC will set. If the engine was warm when started, HO2S warm-up will the display “00:00:00”.

IAC POSITION — Tech 2 Range 0-255 Counts —
Displays the commanded position of the idle air control pintle in counts. A larger number of counts means that more air is being commanded through the idle air passage. Idle air control should respond fairly quickly to changes in engine load to maintain desired idle RPM.

IAT (INTAKE AIR TEMPERATURE) — Tech 2 Range –40°C to 151°C (–40°F to 304°F) —
The PCM converts the resistance of the intake air temperature sensor to degrees. Intake air temperature (IAT) is used by the PCM to adjust fuel delivery and spark timing according to incoming air density.

IGNITION 1 — Tech 2 Range 0-25.5 Volts —
This represents the system voltage measured by the PCM at its ignition feed.

INJ. PULSE BANK 1/INJ. PULSE BANK 2 — Tech 2 Range 0-1000 msec. —
Indicates the amount of time the PCM 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.

KS NOISE CHANNEL (Knock Sensor) —
Indicates the output from the KS noise channel. There is always some electrical noise in an engine compartment and to avoid mistaking this as engine knock, the output from the knock sensor is compared to the output from the noise channel. A knock condition is not set unless the knock sensor output is greater than the noise channel output.

LONG TERM FUEL TRIM BANK 1/BANK 2 —
The long term fuel trim is derived from the short term fuel trim values and represents a long term correction of fuel delivery for the bank in question. A value of 0% indicates that fuel delivery requires no compensation to maintain the PCM commanded air/fuel ratio. A negative value significantly below 0% indicates that the fuel system is rich and fuel delivery is being reduced (decreased injector pulse width). A positive value significantly greater than 0% indicates that a lean condition exists and the PCM is compensating by adding 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. Fuel trim values at maximum authority may indicate an excessively rich or lean system.

LOOP STATUS — Tech 2 Displays OPEN or CLOSED —
“CLOSED” indicates that the PCM is controlling fuel delivery according to oxygen sensor voltage. In “OPEN” the PCM ignores the oxygen sensor voltage and bases the amount of fuel to be delivered on TP sensor, engine coolant, and MAF sensor inputs only.

MAF — Tech 2 Range 0.0-512 gm/s —
MAF (mass air flow) is the MAF input frequency converted to grams of air per second. This indicates the amount of air entering the engine.

MAP — Tech 2 Range 10-105 kPa (0.00-4.97 Volts) —
The manifold absolute pressure (MAP) sensor measures the change in the intake manifold pressure from engine load, EGR flow, and speed changes. As intake manifold pressure increases, intake vacuum decreases, resulting in a higher MAP sensor voltage and kPa reading. The MAP sensor signal is used to monitor intake manifold pressure changes during the EGR flow test, to update the BARO reading, and as an enabling factor for several of the diagnostics.

MIL — Tech 2 Displays ON or OFF —
Indicates the PCM commanded state of the malfunction indicator lamp.

POWER ENRICHMENT — Tech 2 Displays ACTIVE or INACTIVE —
“ACTIVE” displayed indicates that the PCM has detected conditions appropriate to operate in power enrichment mode. The PCM will command power enrichment mode when a large increase in throttle position and load is detected. While in power enrichment mode, the PCM will increase the amount of fuel delivered by entering open loop and increasing the injector pulse width. This is done to prevent a possible sag or hesitation from occurring during acceleration.

SPARK — Tech 2 Range –64° to 64° —
Displays the amount of spark advance being commanded by the PCM on the IC circuit.

START-UP ECT — Tech 2 Range –40°C to 151°C (–40°F to 304°F) —
Indicates the engine coolant temperature at the time that the vehicle was started. Used by the HO2S diagnostic to determine if the last start-up was a cold start.

START-UP IAT — Tech 2 Range –40°C to 151°C (–40°F to 304°F) —
Indicates the intake air temperature at the time that the vehicle was started. Used by the HO2S diagnostic to determine if the last start-up was a cold start.

TP — Tech 2 Range 0%-100% —
TP (throttle position) angle is computed by the PCM from the TP sensor voltage. TP angle should display "0%" at idle and "100%" at wide open throttle.

TP SENSOR — Tech 2 Range 0.00-5.00 Volts —
The voltage being monitored by the PCM on the TP sensor signal circuit.

CATALYST PROTECTION MODE — Tech 2 Displays YES or NO —
"YES" displayed indicates that the PCM has detected conditions appropriate to operate in TWC protection mode. The PCM will decrease the air/fuel ratio to a value that depends on mass air flow (higher mass air flow = lower air/fuel ratio).

UPSHIFT LAMP (MANUAL TRANSMISSION)
VEHICLE SPEED — Tech 2 Range 0-255 km/h (0-155 mph) —
The vehicle speed sensor signal is converted into km/h and mph for display.

WEAK CYLINDER — Tech 2 Displays Cylinder Number —
This indicates that the PCM has detected crankshaft speed variations that indicate 2% or more cylinder firing events are misfires.

Typical Scan Data Values

Use the Typical Scan Data 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 diagnostics are functioning properly. Tech 2 values from a properly-running engine may be used for comparison with the engine you are diagnosing. The typical scan data values represent values that would be seen on a normally-running engine.

NOTE: A Tech 2 that displays faulty data should not be used, and the problem should be reported to the Tech 2 manufacturer. Use of a faulty Tech 2 can result in misdiagnosis and unnecessary replacement of parts.

Only the parameters listed below are referred to in this service manual for use in diagnosis. For further information on using the Tech 2 to diagnose the PCM and related sensors, refer to the applicable reference section listed below. If all values are within the typical range described below, refer to the *Symptoms* section for diagnosis.

Test Conditions

Engine running, lower radiator hose hot, transmission in park or neutral, closed loop, accessaries off, brake not applied and air conditioning off.

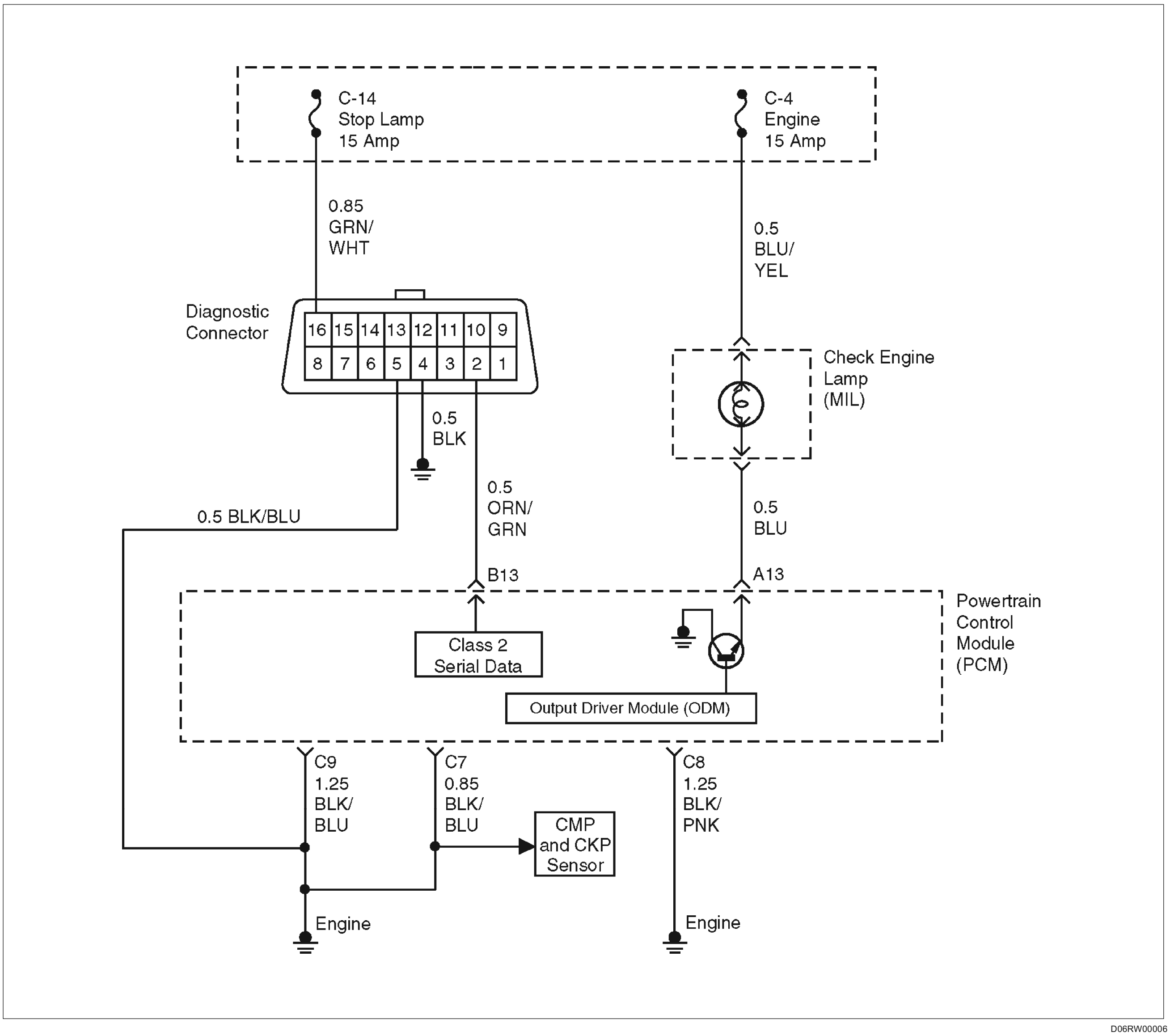
3.2/3.5L V-6 Engine

Tech 2 Parameter	Data List	Units Displayed	Typical Data Values (IDLE)	Typical Data Values (2500 RPM)	Refer To
A/C Clutch	Engine	On/Off	Off	Off	General Description and Operation, A/C Clutch Circuit Operation
A/C Request	Engine	Yes/No	No	No	General Description and Operation, A/C Request Signal
Air/Fuel Ratio	Engine	Ratio: _ to 1	14.7	14.7	General Description and Operation, Fuel System Metering Purpose
Barometric Pressure	Engine	kPa	61-104 (depends on altitude and barometric)	61-104 (depends on altitude and barometric)	General Description and Operation
CMP Act. Counter (Cam Position Activity)	Engine	Counts	0-255, always increasing	0-255, always increasing	DTC P0341 and P0342
Decel Fuel Mode	Engine	Active/Inactive	Inactive	Inactive	General Description and Operation, Deceleration Mode
Desired EGR Position	Engine	Percent	0%	0%	General Description and Operation, EGR Pintle Position Sensor
Desired Idle	Engine	RPM	750	—	General Description and Operation, Idle Air Control (IAC) Valve
ECT (Engine Coolant Temp)	Engine	Degrees C, Degrees F	80-100°C (176-212°F)	80-100°C (176-212°F)	General Description and Operation, Engine Coolant Temperature (ECT) Sensor
EGR Closed Valve Pintle Position	Engine	Steps	20-40	20-40	General Description and Operation, EGR Pintle Position Sensor
EGR Duty Cycle	Engine	Percent	0%	0%	General Description and Operation, Linear EGR Operation and Results of Incorrect Operation
EGR Feedback	Engine	Volts	0.45-0.80	0.45-0.80	—
EGR Normalized	Engine	Percent	0%	0%	—
Engine Load	Engine	Percent	2.0% - 5.5%	8.0% - 16.0%	General Description and Operation, Mass Air Flow (MAF) Sensor
Time From Start	Engine	Sec	Varies. Resets at each engine start.	Varies. Resets at each engine start.	—
Engine Speed	Engine	RPM	Within –50 to +100 of “Desired Idle”	Actual engine speed	DTCs: P1508, P1509
Fuel Pump	Engine	On/Off	On	On	Engine Fuel
HO2S Bank 1 Sen.1 (millivolts)	O2 Sensor Data	Millivolts	50-950 changing quickly	50-950, always changing quickly	General Description and Operation, Fuel control HO2S

Tech 2 Parameter	Data List	Units Displayed	Typical Data Values (IDLE)	Typical Data Values (2500 RPM)	Refer To
HO2S Bank 2 Sen.1 (millivolts)	O2 Sensor Data	Millivolts	50-950 changing quickly	50-950 changing quickly	General Description and Operation, Fuel Control HO2S
HO2S Bank 1 Sen.1 (ready/not ready)	O2 Sensor Data	Ready Yes/No	Ready Yes	Ready Yes	General Description and Operation, Fuel Control HO2S; DTC: P0135
HO2S Bank 2 Sen.1 (ready/not ready)	O2 Sensor Data	Ready Yes/No	Ready Yes	Ready Yes	General Description and Operation, Fuel Control HO2S
HO2S Warm-Up Time Bank 1 Sen.1	O2 Sensor Data	Seconds	25-45	25-45	General Description and Operation, Fuel Control HO2S
HO2S Warm-Up Time Bank 2 Sen.1	O2 Sensor Data	Seconds	25-45	25-45	General Description and Operation, Fuel Control HO2S
IAT (Intake Air Temp)	Engine	Degrees C, Degrees F	0-100°C, depends on underhood	0-80°C, depends on underhood	General Description and Operation, Intake Air Temperature (IAT) Sensor
Ignition Voltage	Engine	Volts	12.8-14.1	12.8-14.1	General Description and Operation, Electronic Ignition System
Inj. Pulse Bank 1	Engine	Millisecond s	2.0-4.0	2.5-4.0	General Description, Fuel Metering, Fuel Injector
Inj. Pulse Bank 2	Engine	Millisecond s	2.0-4.0	2.5-4.0	General Description, Fuel Metering, Fuel Injector
KS Noise Channel (Knock Sensor)	Engine	Volts	0.10-0.40	0.50-1.75	General Description and Operation, Knock Sensor Purpose and Operation; DTCs: P0352, P0327
Loop Status	Engine	Open/Clos ed	Closed	Closed	General Description and Operation, Fuel Metering System; DTCs: P0125-P0155
MAF (Mass Air Flow)	Engine	Grams per second	2.85-6.65	9.5-16.5	General Description and Operation, MAF; DTCs: P101, P0102, P0103
MAP kPa (Manifold Absolute Pressure)	Engine	Kilopascals	—	—	General Description and Operation, Manifold Absolute Pressure (MAP) Sensor; DTCs: P0106, P0107, P0108
MIL	Engine	On/Off	Off	Off	On-Board Diagnostic System Check
Power Enrichment	Engine	Inactive/Ac tive	Inactive	Inactive	General Description and Operation, Acceleration Mode
Spark (Advance)	Engine	Degrees Before Top Dead Center	15-22	34-44	General Description and Operation, Electronic Ignition System

Tech 2 Parameter	Data List	Units Displayed	Typical Data Values (IDLE)	Typical Data Values (2500 RPM)	Refer To
Start-Up ECT (Engine Coolant Temp)	Engine	Degrees C, Degrees F	Depends on engine coolant temperature at time of start-up	Depends on engine coolant temperature at time of start-up	General Description and Operation, Engine Coolant Temperature (ECT) Sensor
Start-Up IAT (Intake Air Temp)	Engine	Degrees C, Degrees F	Depends on intake air temperature at time of start-up	Depends on intake air temperature at time of start-up	General Description and Operation, Intake Air Temperature (IAT) Sensor
TP (Throttle Position)	Engine	Percent	0	—	General Description and Operation, Throttle Position (TP) Sensor; DTCs: P0121, P0122,P0123
TP Sensor (Throttle Position)	Engine	Volts	0.50-0.82	0.60-1.00	General Description and Operation, Throttle Position (TP) Sensor; DTCs: P0121, P0122,P0123
Catalyst Protection Mode	Engine	No/Yes	No	No	General Description, Fuel Metering, catalytic Converter Protection Mode
Vehicle Speed	Engine	MPH / km/h	0	0	4L30-E Automatic Transmission Diagnosis
EVAP Purge Solenoid	Engine	Percent	65	99	General Description
VIM Solenoid	Engine	On/Off	On	On	General Description
Security Wait Time	Engine	Active/Inactive	Inactive	Inactive	—

No Malfunction Indicator Lamp (MIL)



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 powertrain control module (PCM) 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 PCM 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 PCM ignition or battery feed, or a poor PCM to engine ground.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. A "No MIL" condition accompanied by a no-start condition suggests a faulty PCM ignition feed or battery feed circuit.
9. Using a test light connected to B+, probe each of the PCM ground terminals to ensure that a good ground is present. Refer to *PCM Terminal End View* for terminal locations of the PCM ground circuits.
12. In this step, temporarily substitute a known good relay for the PCM relay. The horn relay is nearby, and it can be verified as "good" simply by honking the horn. Replace the horn relay after completing this step.

17. This vehicle is equipped with a PCM which utilizes an electrically erasable programmable read only memory (EEPROM). When the PCM is replaced, the new PCM must be programmed. Refer to *UBS 98 model year Immobilizer Workshop Manual.*

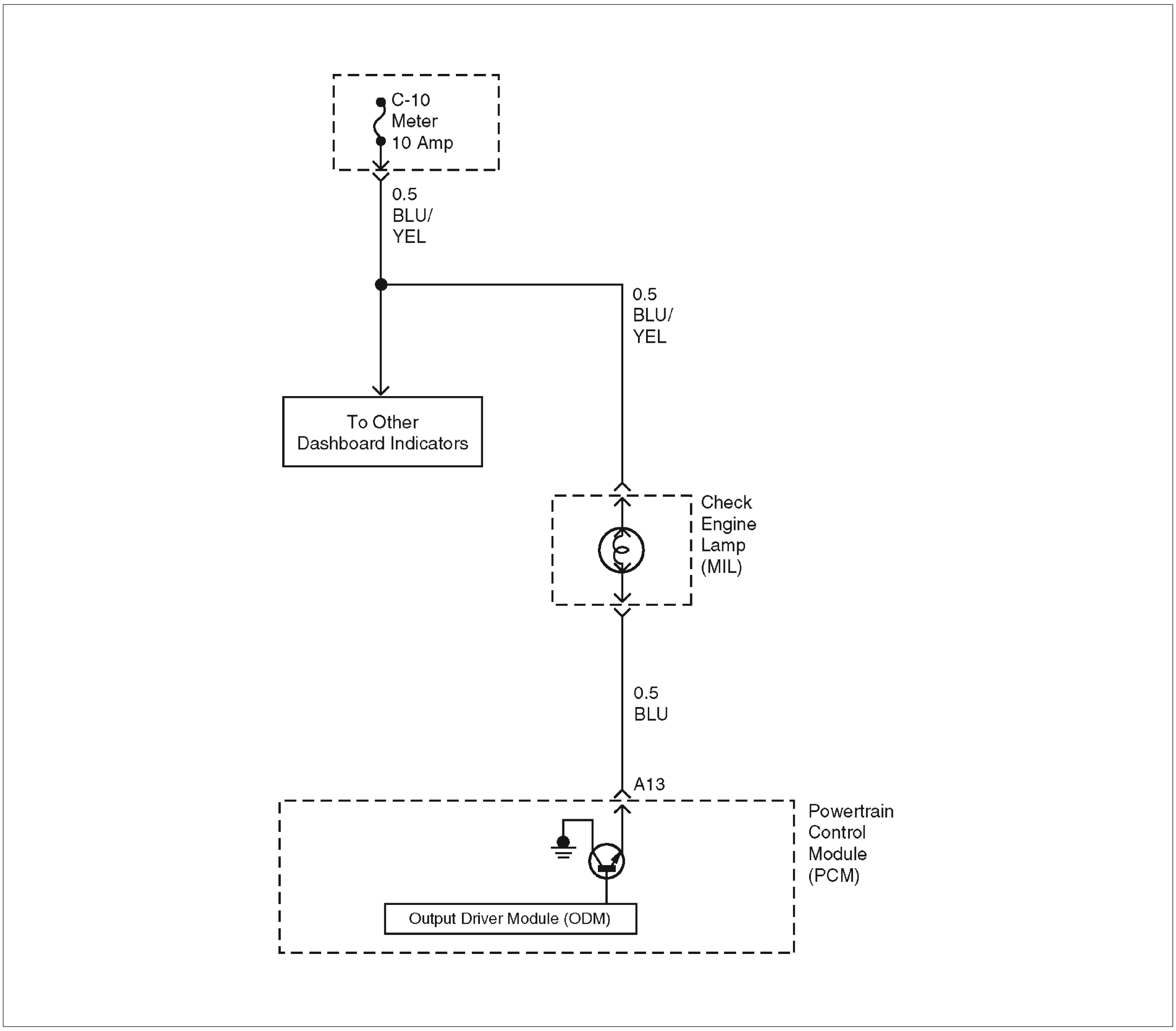
No Malfunction Indicator Lamp (MIL)

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	Attempt to start the engine. Does the engine start?	—	Go to *Step 3*	Go to *Step 6*
3	Check the meter fuse for the instrument cluster ignition feed circuit. Is the fuse OK?	—	Go to *Step 4*	Go to *Step 16*
4	Ignition "ON," probe the ignition feed circuit at the cluster connector with a test light to ground. Is the test light "ON?"	—	Go to *Step 5*	Go to *Step 13*
5	1. Ignition "OFF." 2. Disconnect the PCM. 3. Jumper the MIL driver circuit at the PCM connector to ground. 4. Ignition "ON." Is the MIL "ON?"	—	Go to *Step 10*	Go to *Step 11*
6	Check the PCM ignition feed and battery feed fuses (15 A engine fuse and 15 A PCM fuse). Are both fuses OK?	—	Go to *Step 7*	Go to *Step 15*
7	1. Ignition "OFF." 2. Disconnect the PCM. 3. Ignition "ON." 4. Probe the ignition feed circuit at the PCM harness connector with a test light to ground. Is the test light "ON?"	—	Go to *Step 8*	Go to *Step 12*
8	Probe the battery feed circuit at the PCM harness connector with a test light to ground. Is the test light "ON?"	—	Go to *Step 9*	Go to *Step 14*
9	Check for a faulty PCM ground connection. Was a problem found?	—	Verify repair	Go to *Step 10*
10	Check for damaged terminals at the PCM. Was a problem found?	—	Verify repair	Go to *Step 17*
11	Check for an open MIL driver circuit between the PCM and the MIL. Was a problem found?	—	Verify repair	Go to *Step 18*
12	Substitute a known "good" relay for the PCM main relay. Was the malfunction fixed?	—	Verify repair	Go to *Step 13*
13	Repair the open in the ignition feed circuit. Is the action complete?	—	Verify repair	—

No Malfunction Indicator Lamp (MIL) (Cont'd)

Step	Action	Value(s)	Yes	No
14	Locate and repair the open PCM battery feed circuit. Is the action complete?	—	Verify repair	—
15	Locate and repair the short to ground in the PCM ignition feed circuit or PCM battery feed circuit. Is the action complete?	—	Verify repair	—
16	Locate and repair the short to ground in the ignition feed circuit to the instrument cluster, and replace the fuse. Is the action complete?	—	Verify repair	—
17	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *PCM* in *ON-Vehicle Service* for procedures. Is the action complete?	—	Verify repair	—
18	Check the MIL driver circuit for a poor connection at the instrument panel connector. Was a problem found?	—	Verify repair	Go to *Instrument Panel* in *Electrical Diagnosis*

Malfunction Indicator Lamp (MIL) “ON” Steady



D06RW00007

Circuit description

The malfunction indicator 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 powertrain control module (PCM) 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 PCM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Test Description

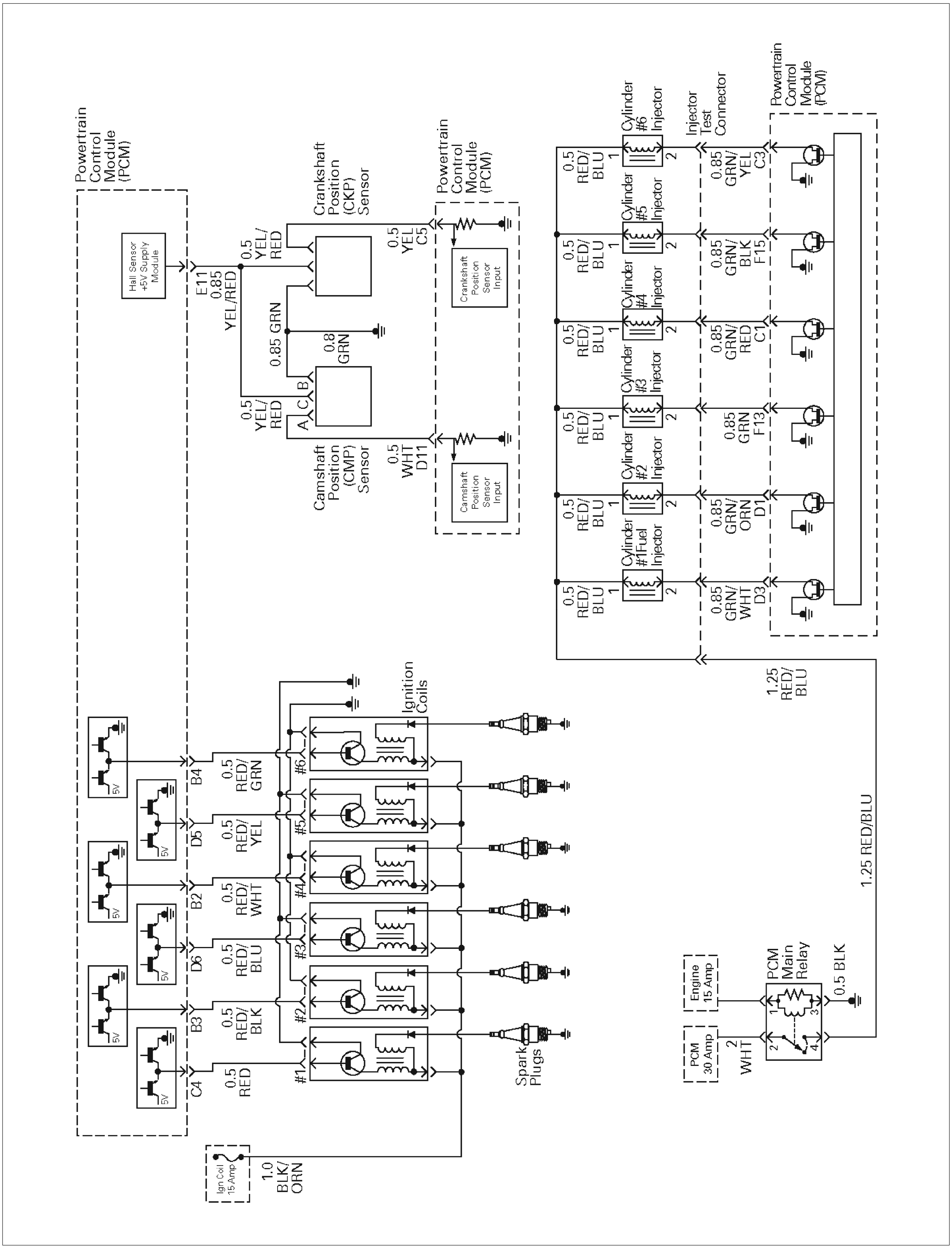
Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. If the MIL does not remain “ON” when the PCM is disconnected, the MIL driver wiring is not faulty.
3. If the MIL driver circuit is OK, the instrument panel cluster is faulty.
6. This vehicle is equipped with a PCM which utilizes an electrically erasable programmable read only memory (EEPROM). When the PCM is replaced, the new PCM must be programmed. Refer to *UBS 98 model year Immobilizer Workshop Manual.*

Malfunction Indicator Lamp (MIL) “ON” Steady

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. Ignition “OFF,” disconnect PCM. 2. Ignition “ON,” observe the MIL (Service Engine Soon lamp). Is the MIL “ON?”	—	Go to *Step 3*	Go to *Step 5*
3	1. Ignition “OFF,” disconnect the instrument panel cluster. 2. Check the MIL driver circuit between the PCM and the instrument panel cluster for a short to ground. 3. If a problem is found, repair as necessary. Was the MIL driver circuit shorted to ground?	—	Go to *OBD System Check*	Go to *Step 4*
4	Replace the instrument panel cluster. Is the action complete?	—	Go to *OBD System Check*	—
5	1. Ignition “OFF,” reconnect the PCM. 2. Using Tech 2, select “Output Miscellaneous Test” and command the MIL “OFF.” Did the MIL turn “OFF?”	—	Go to *OBD System Check*	Go to *Step 6*
6	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Go to *OBD System Check*	—

Engine Cranks But Will Not Run



D06RX00004

Circuit Description

The electronic Ignition system uses a coil-at-plug method of spark distribution. In this type of ignition system, the powertrain control module (PCM) triggers the correct driver inside the ignition coil, which then triggers the correct ignition coil based on the 58X signal received from the crankshaft position sensor (CKP). The spark plug connected to the coil fires when the ICM opens the ground circuit for the coil's primary circuit.

During crank, the PCM monitors the CKP 58X signal. The CKP signal is used to determine which cylinder will fire first. After the CKP 58X signal has been processed by the PCM, it will command all six injectors to allow a priming shot of fuel for all the cylinders. After the priming, the injectors are left "OFF" during the next six 58X reference pulses from the CKP. This allows each cylinder a chance to use the fuel from the priming shot. During this waiting period, a camshaft position (CMP) signal pulse will have been received by the PCM. The CMP signal allows the PCM to operate the injectors sequentially based on camshaft position. If the camshaft position signal is not present at start-up, the PCM will begin sequential fuel delivery with a 1-in-6 chance that fuel delivery is correct. The engine will run without a CMP signal, but will set a DTC code.

Diagnostic Aids

An intermittent problem 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 PCM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.
- Faulty engine coolant temperature sensor – Using Tech 2, compare engine coolant temperature with intake air temperature on a completely cool engine. Engine coolant temperature should be within 10°C of intake air temperature. If not, replace the ECT sensor.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

5. An obvious cause of low fuel pressure would be an empty fuel tank.
6. The engine will easily start and run if a few injectors are disabled. It is not necessary to test all injectors at this time since this step is only a test to verify that all of the injectors have not been disabled by fuel contamination.
7. A blinking test light verifies that the PCM is monitoring the 58X crankshaft reference signal and is capable of activating the injectors. If there is an open or shorted driver circuit, DTCs 201-206 should be set.
19. By using a spark tester, each ignition coil's ability to produce 25,000 volts is verified.
25. If there is an open or shorted driver circuit, DTCs 201-206 should be set. All six injector driver circuits can be checked at one time without removing the intake manifold if a 5-8840-2636-0 test light is available. This is the alternative procedure:
    - With the ignition "OFF," disconnect the gray connector located at the rear of the air filter, attached to a bracket on the purge canister.
    - Connect test light 5-8840-2636-0 to the connector. Do any of the light constantly illuminate or fail to blink when the engine is cranked? If so, repair the short or open circuit, or replace the PCM if indicated.

This procedure only tests the driver circuit as far as the test connection, so step 31 is added to test the circuit all the way to the injector.

Engine Cranks But Will Not Run

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	Check the 15 A ignition coil fuse, the 15 A engine fuse, and the 30 A PCM fuse. Was a fuse blown?	—	Go to *Step 3*	Go to *Step 4*
3	Check for a short to ground and replace the fuse. Is the action complete?	—	Verify repair	—
4	1. Ignition “OFF,” install a fuel pressure gauge at the test fitting on the fuel supply line in the engine compartment. (Use a shop cloth to absorb any fuel leakage while making the connection.) 2. Ignition “ON,” observe the fuel pressure. Is the fuel pressure within the specified values, and does it hold steady?	285-376 kPa (43-55 psi)	Go to *Step 6*	Go to *Step 5*
5	Is any fuel pressure indicated?	—	Go to *Fuel System Electrical Test*	Go to *Fuel System Diagnosis*
6	Install an injector switch box to the injector test connector, and attempt to operate the injector. Did the fuel pressure drop when the injector is operated?	—	Go to *Step 7*	Go to *Step 12*
7	Install an injector test light at the #2 cylinder injector harness connector. Does the light blink when the engine is cranked?	—	Go to *Step 8*	Go to *Step 18*
8	1. Ignition “ON.” 2. While the coil connectors are disconnected, touch each coil connector’s ignition feed terminal with a grounded test light (the ignition feed wire is black with orange tracer). Did the test light illuminate?	—	Go to *Step 10*	Go to *Step 9*
9	Repair the open ignition feed circuit. Is the action complete?	—	Verify repair	—
10	While the coil connectors are disconnected, touch each connector’s secondary ground terminal with a test light to B+. (The ground wires are black.) Did the test light illuminate at each coil connector?	—	Go to *Step 12*	Go to *Step 11*
11	Repair the open secondary ground circuit. Is the action complete?	—	Verify repair	—
12	1. Test the fuel for contamination. 2. If a problem is found, clean the fuel system and correct the contaminated fuel condition as necessary. Replace the fuel filter and replace any injectors that are not delivering fuel (see Injector Balance Test). Was a problem found?	—	Verify repair	Go to *Step 13*

Engine Cranks But Will Not Run (Cont'd)

Step	Action	Value(s)	Yes	No
13	1. Remove any ignition coil and install a spark tester at the spark plug end of the coil. 2. Observe the tester while the engine is cranking. Was a crisp, blue spark observed? Only one or two sparks followed by no result is considered the same as "No Spark."	—	Go to *Step 15*	Go to *Step 14*
14	Replace the ignition coil, and return to Step 13 to test the remaining coils. Is the action complete?	—	Verify repair	—
15	Repeat Step 13 for each coil. Remove only one coil at a time, and reinstall each coil on its spark plug after testing, but do not refasten coils with screws at this time. After all coils have passed the spark test, does the engine start?	—	Refasten all coils with their screws	Go to *Step 16*
16	1. Remove the spark plugs from all cylinders. 2. Visually inspect the spark plug electrodes. 3. Replace any spark plugs with loose or missing electrodes or cracked insulators. Did your inspection reveal any spark plugs exhibiting excessive fouling?	—	Correct the fouling condition	Go to *Step 17*
17	Refer to *Engine Mechanical Diagnosis* to diagnose the following conditions: ● Faulty or incorrect camshaft drive belts ● Leaking or sticky valves or rings ● Excessive valve deposits ● Loose or worn rocker arms ● Weak valve springs ● Incorrect valve timing ● Leaking head gasket Is the action complete?	—	Verify repair	Go to *Step 19*
18	Observe the "Engine Speed" data display on the scan tool while cranking the engine. Is the engine RPM indicated? (If the scan tool is normally powered from the cigarette lighter socket, and if the scan tool display goes blank while cranking the engine, it will be necessary to power the scan tool directly from the vehicle battery.)	—	Go to *Step 19*	Go to *Step 28*
19	1. Disconnect the 7-pin gray connector at the rear of the air filter beneath the point where the air duct attaches to the MAF sensor. 2. Ignition "ON." 3. Using a test light connected to ground, probe the ignition terminal at the PCM (female) side of the 7-pin connector. Is the test light "ON?"	—	Go to *Step 20*	Go to *Step 26*

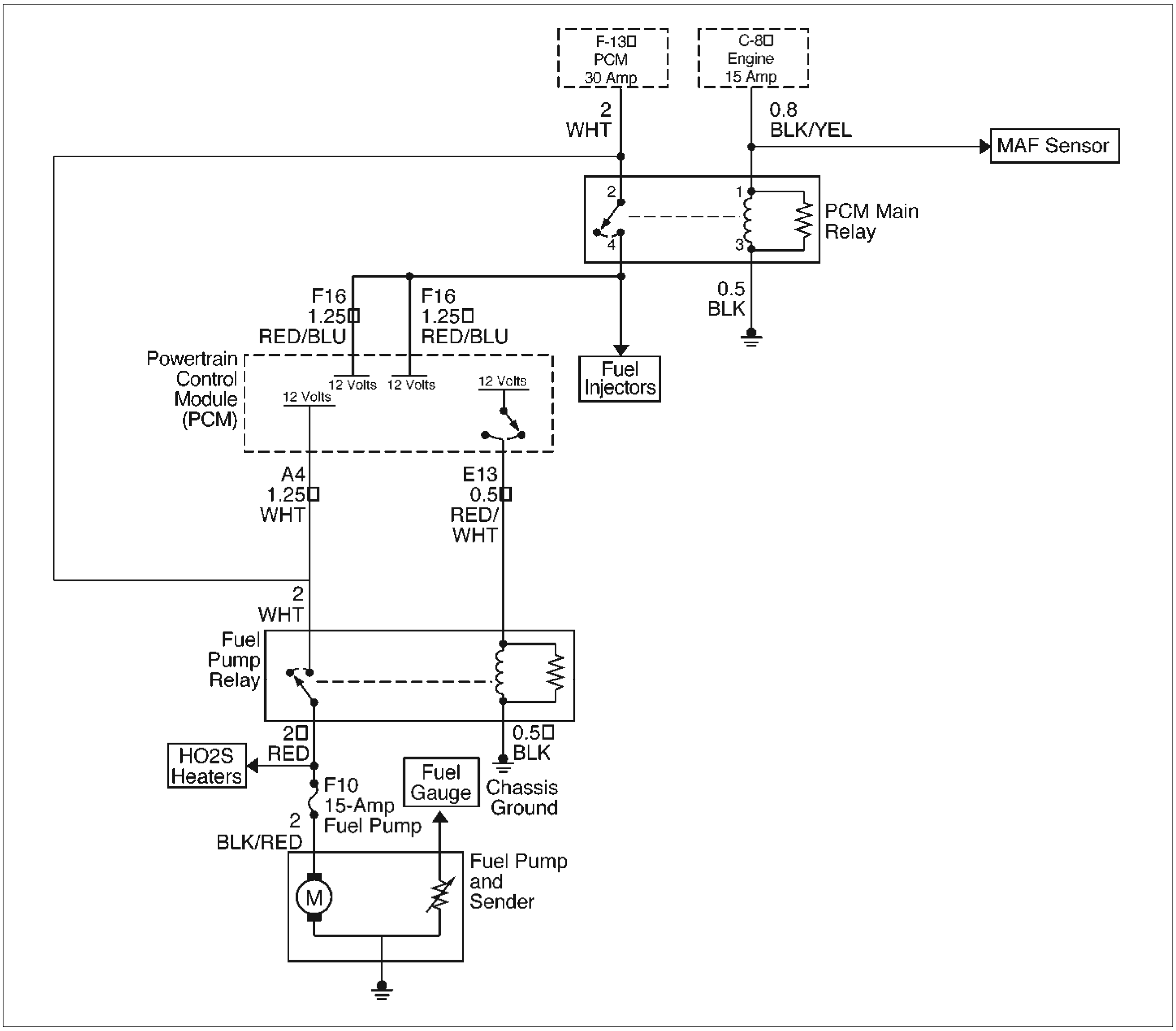
Engine Cranks But Will Not Run (Cont'd)

Step	Action	Value(s)	Yes	No
20	1. At the PCM (female) side of the connector, connect a test light between the ignition + terminal and one of the injector driver circuits at the same connector. 2. Ignition "ON." 3. Observe the test light, and repeat the test for each injector driver circuit. Did the test light stay on when checking any of the 6 injector driver circuits?	—	Go to *Step 21*	Go to *Step 23*
21	1. Ignition "OFF," disconnect the PCM. 2. Ignition "ON," observe the test light. Is the test light "ON?"	—	Go to *Step 22*	Go to *Step 27*
22	Locate and repair the short to ground in the injector driver circuit. Is the action complete?	—	Verify repair	—
23	1. Using the same test location as in step 20, connect a test light between the ignition terminal and one of the driver circuits. 2. Crank the engine and observe the test light. 3. Repeat for each injector driver circuit. Did the light blink during the test for each circuit?	—	Go to *Step 25*	Go to *Step 24*
24	Check for an open injector driver circuit. Was a problem found?	—	Verify repair	Go to *Step 27*
25	1. At the injector (male) side of the gray connector, connect an ohmmeter between the ignition pin and one of the driver circuit pins. 2. Check for continuity in the circuit. 3. Repeat for each injector circuit. The readings should be approximately equal to the specified value for injector resistance. Was a problem found?	12.5 ohms	Verify repair	Go to *Step 8*
26	Repair the ignition feed circuit. Is the action complete?	—	Verify repair	—
27	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—
28	1. Raise the vehicle and disconnect the CKP sensor harness. 2. Ignition "ON." 3. With a test light to ground, probe the harness ignition feed terminal. Did the light illuminate?	—	Go to *Step 30*	Go to *Step 29*
29	Check the ignition feed wire between the sensor and the PCM for a short to ground or open circuit. Is the action complete?	—	Verify repair	—

Engine Cranks But Will Not Run (Cont'd)

Step	Action	Value(s)	Yes	No
30	1. Ignition "ON." 2. At the CKP harness connector, connect a test light between the ignition and ground terminals. Did the light illuminate?	—	Go to *Step 32*	Go to *Step 31*
31	Check the sensor ground circuit for an open or short to voltage. Is the action complete?	—	Verify repair	—
32	Check the signal circuit between the sensor and the PCM for a short to ground, short to voltage, or an open. Was a problem found?	—	Verify repair	Go to *Step 33*
33	Replace the CKP sensor. Is the action complete?	—	Verify repair	Go to *Step 27*

Fuel System Electrical Test



D06RW101

Circuit Description

When the ignition switch is first turned "ON," the powertrain control module (PCM) 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 PCM is receiving 58X crankshaft position pulses. If no 58X crankshaft position pulses are present, the PCM 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 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 PCM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. If the fuel pump is operating but incorrect pressure is noted, the fuel pump wiring is OK and the "Fuel System Pressure Test" chart should be used for diagnosis.

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 shoulder 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 train cover .
3. Reinstall the fuel pump relay.

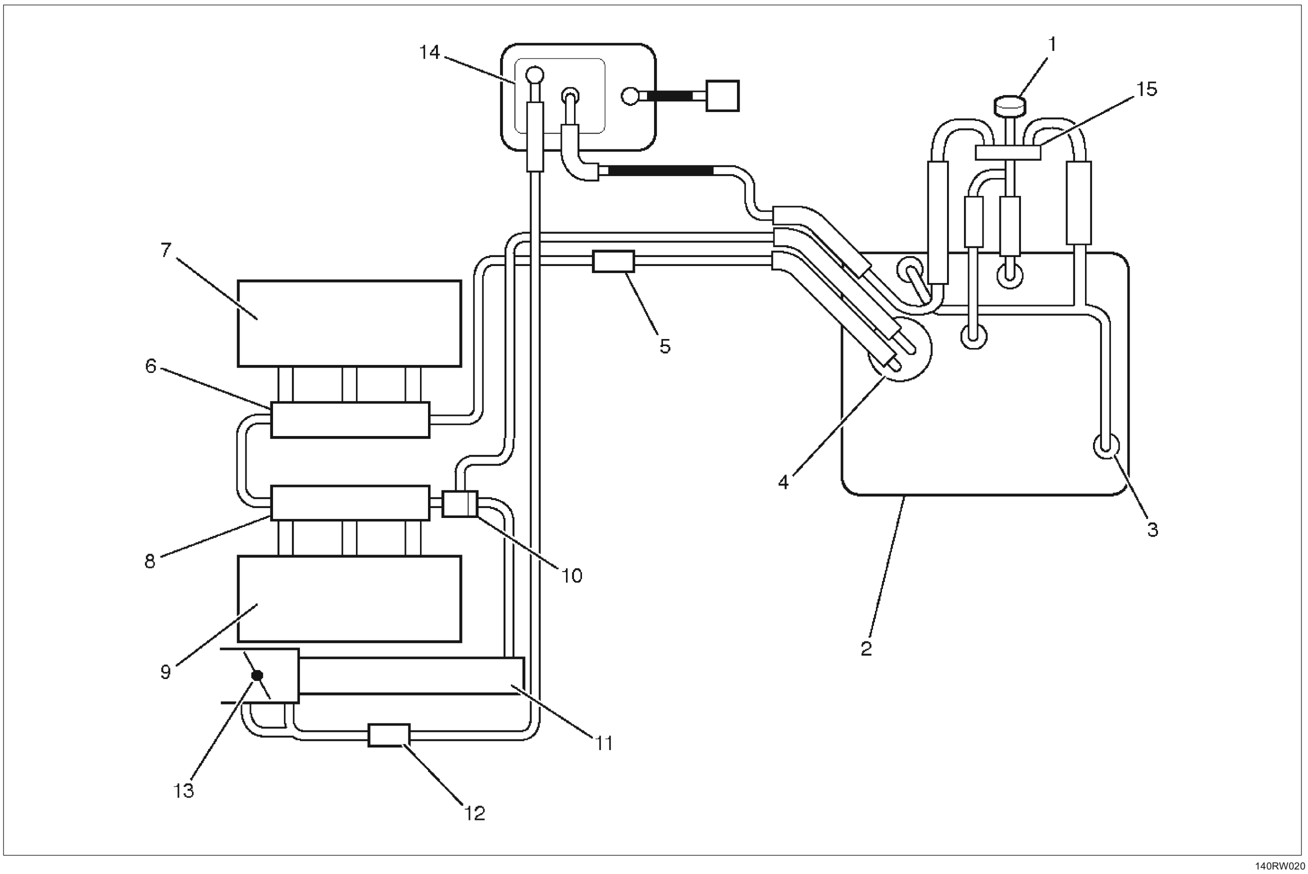
Fuel System Electrical Test

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Read the “Caution” above. 2. Relieve the fuel system pressure and install the fuel pump pressure gauge to the test fitting. 3. Use Tech 2 to command the fuel pump “ON.” Is there an immediate pressure build-up which indicates the pump is running?	—	Go to *Step 3*	Go to *Step 4*
3	1. Verify that the pump is not running by removing the fuel filler cap and listening. 2. Command the pump “ON” with Tech 2. Did the pump turn “OFF” after 2 seconds?	—	Test completed	Go to *Step 12*
4	1. Ignition “OFF.” 2. Remove the fuel pump relay. 3. Using a test light connected to ground, probe the battery feed to the relay. Did the light illuminate?	—	Go to *Step 6*	Go to *Step 5*
5	Repair short or open battery feed to fuel pump relay. Is the action complete?	—	Verify repair	—
6	1. Connect a test light between the two wires that connect to the fuel pump relay pull-in coil. 2. Ignition “ON.” Did the test light illuminate for 2 seconds and then turn off?	—	Go to *Step 12*	Go to *Step 7*
7	1. With a test light connected to battery (–), probe the fuel pump relay connector at the wire which runs from the relay pull-in coil to the PCM. 2. Ignition “ON.” Did the test light illuminate for 2 seconds and then turn off?	—	Go to *Step 8*	Go to *Step 9*
8	Locate and repair open in the fuel pump relay ground circuit. Is the action complete?	—	Verify repair	—

Fuel System Electrical Test (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check for short or open between the PCM and the fuel pump relay. Was a problem found?	—	Verify repair	Go to *Step 10*
10	1. Check the fuel pump relay circuit for a poor terminal connection at the PCM. 2. If a problem is found, replace terminal as necessary. Was a problem found?	—	Verify repair	Go to *Step 11*
11	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—
12	1. Reconnect the fuel pump relay. 2. Disconnect the fuel pump electrical connector at the fuel tank. 3. Using a test light connected to ground, probe the fuel pump feed wire (harness side). 4. Command the fuel pump “ON” with Tech 2. Did the light illuminate for 2 seconds?	—	Go to *Step 15*	Go to *Step 13*
13	1. Honk the horn to verify that the horn relay is functioning. 2. Substitute the horn relay for the fuel pump relay. 3. Leave the test light connected as in step 12. 4. Command the fuel pump “ON” with Tech 2. Did the test light illuminate for 2 seconds when the fuel pump was commanded “ON?”	—	Go to *Step 17*	Go to *Step 14*
14	1. Re-connect the horn relay in its proper location. 2. Check for a short circuit, blown fuse or open circuit between the relay and the fuel tank. Is the action complete?	—	Verify repair	—
15	1. With the fuel pump electrical connector at the fuel tank disconnected, connect a test light between the feed wire and the ground wire (harness side). 2. Command the fuel pump “ON” with Tech 2. Did the test light illuminate for 2 seconds?	—	Go to *Step 18*	Go to *Step 16*
16	Repair the open circuit in the fuel pump ground wire. Is the action complete?	—	Verify repair	—
17	1. Re-connect the horn relay in its proper location. 2. Replace the fuel pump relay. Is the action complete?	—	Verify repair	—
18	Replace the fuel pump. Is the action complete?	—	Verify repair	—

Fuel System Diagnosis



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) Right Bank
- (8) Fuel Rail Left
- (9) Left Bank
- (10) Fuel Pressure Control Valve
- (11) Common Chamber
- (12) Duty Solenoid Valve
- (13) Throttle Valve
- (14) Canister
- (15) Evapo Shut Off Valve

Circuit Description

When the ignition switch is turned "ON," the powertrain control module (PCM) 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 PCM is receiving 58X crankshaft position pulses. If there are no 58X crankshaft position pulses, the PCM 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 (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 II 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 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 shoulder 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 train 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. 4. Turn the ignition “ON.” NOTE: The fuel pump will run for approximately 2 seconds. Use 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	NOTE: 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-pipe 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*
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*

Fuel System Diagnosis (Cont'd)

Step	Action	Value(s)	Yes	No
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 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 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*
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 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*

Fuel System Diagnosis (Cont'd)

Step	Action	Value(s)	Yes	No
22	1. Command the fuel pump "ON" with 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 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*

Idle Air Control (IAC) System Check

Circuit Description

The powertrain control module (PCM) controls engine idle speed with the idle air control (IAC) valve. To increase idle speed, the PCM retracts the IAC valve pintle away from its seat, allowing more air to bypass the throttle bore. To decrease idle speed, it extends the IAC valve pintle towards its seat, reducing by pass air flow. Tech 2 will read the PCM commands to the IAC valve in counts. Higher counts indicate more air bypass (higher idle). Lower counts indicate less air is allowed to bypass (lower idle).

Diagnostic Aids

A slow, unstable, or fast idle may be caused by a non-IAC system problem that cannot be overcome by the IAC valve. Out of control range IAC Tech 2 counts will be above 60 if idle is too low, and zero counts if idle is too high. The following checks should be made to repair a non-IAC system problem:

- Vacuum leak (high idle) – If idle is too high, stop the engine. Fully extend (low) IAC with the Tech 2. Start the engine. If idle speed is above 800 RPM, locate and correct the vacuum leak, including the PCV system. Check for binding of the throttle blade or linkage.
- Lean heated oxygen sensor signal (high air/fuel ratio) – The idle speed may be too high or too low. Engine speed may vary up and down, and disconnecting the IAC valve does not help. Diagnostic trouble codes P0131, P0151, P0171, or P0174 may be set. Tech 2 oxygen (O2) voltage will be less than 100 mV (0.1 V). Check for low regulated fuel pressure, water in fuel, or a restricted injector.
- Rich heated oxygen sensor signal (low air/fuel ratio) – The idle speed will be too low. Tech 2 IAC counts will usually be above 80. The system is obviously rich and may exhibit black smoke in the exhaust.

  Tech 2 O2 voltage will be fixed at about 750 mV (0.75 V). Check for high fuel pressure, or a leaking or sticking injector. A silicon-contaminated heated oxygen sensor will show an O2 voltage slow to respond on Tech 2.
- Throttle body – Remove the IAC valve and inspect the bore for foreign material.
- IAC valve electrical connections – IAC valve connections should be carefully checked for proper contact.
- PCV valve – An incorrect or faulty PCV valve may result in an incorrect idle speed. Refer to *Diagnosis, Rough Idle, Stalling*. If intermittent poor driveability or idle symptoms are resolved by disconnecting the IAC, carefully recheck the connections and valve terminal resistance, or replace the IAC.

Test Description

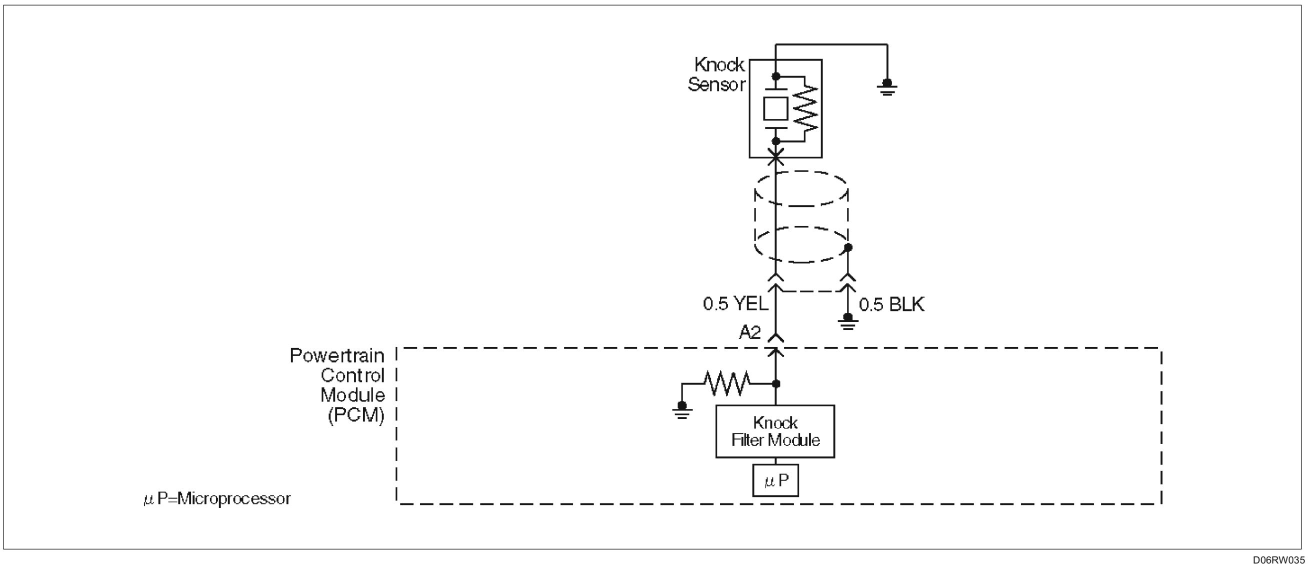
Number(s) below refer to the step number(s) on the Diagnostic Chart.

1. The Tech 2 is used to extend and retract the IAC valve. Valve movement is verified by an engine speed change. If no change in engine speed occurs, the valve can be resettled when removed from the throttle body.
2. This step checks the quality of the IAC movement in step 1. Between 700 revolutions per minute (RPM) and about 1500 RPM, the engine speed should change smoothly with each flash of the tester light in both extend and retract. If the IAC valve is retracted beyond the control range (about 1500 RPM), it may take many flashes to extend the IAC valve before engine speed will begin to drop. This is normal on certain engines. Fully extending the IAC may cause engine stall. This may be normal.

Idle Air Control (IAC) System Check

Step	Action	Value(s)	Yes	No
1	1. Ignition "OFF." 2. Connect the Tech 2. 3. Set the parking brake. 4. Block the wheels. 5. Turn the air conditioning "OFF." 6. Idle the engine in Park (A/T) or Neutral (M/T). 7. Operate the IAC test. 8. The engine speed should decrease and increase as the IAC is cycled. Does the RPM change?	—	Go to *Step 2*	Go to *Step 3*
2	RPM should change smoothly. Does the RPM change within the range specified?	700-1500 RPM	—	Go to *Step 3*
3	Check the IAC passages. Are the IAC passages OK?	—	Go to *Step 4*	Go to *Step 5*
4	Clear any obstruction from the IAC passages. Is the action complete?	—	Verify repair	—
5	Replace the IAC. Refer to *On-Vehicle Service, Idle Air Control Valve.* Is the action complete?	—	Verify repair	—

Knock Sensor (KS) System Check (Engine Knock, Poor Performance, or Poor Economy)



Circuit Description

The knock sensor (KS) sends an AC voltage signal to the powertrain control module (PCM). As the KS detects engine knock, the signal to the PCM changes in amplitude and frequency. The PCM retards timing if the engine speed is over 900 RPM.

Diagnostic Aids

If the KS system checks OK, but detonation is the complaint, refer to *Diagnosis, Detonation/Spark Knock.*

Test Description

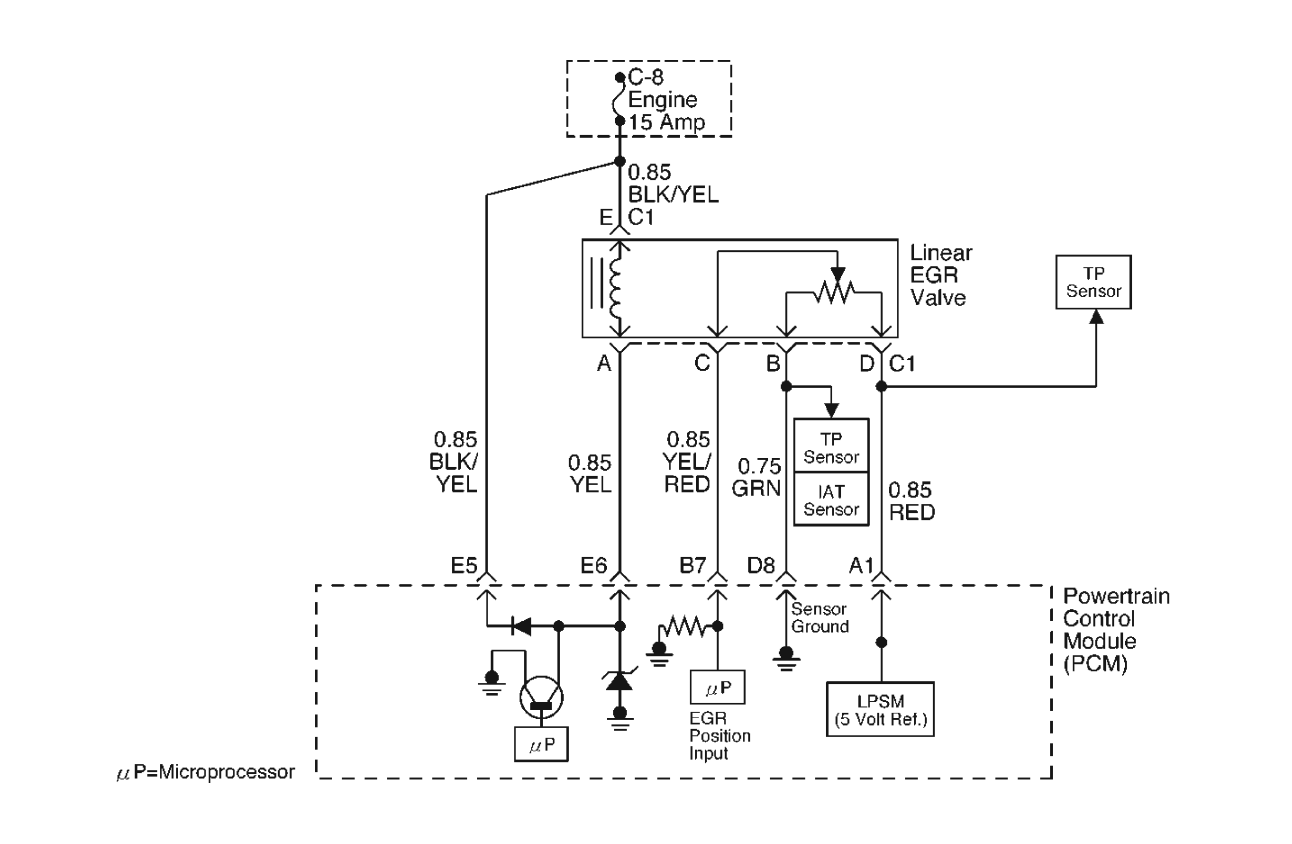
The numbers below refer to the step numbers on the Diagnostic Chart.

9. The change in signal speed depends on how hard the tapping is done. Normally there is about 1.5 to 10 mV at PCM pin A2 with the engine off. Loud tapping should be able to make the reading jump to 20-25 mV AC.

Knock Sensor (KS) System Check (Engine Knock, Poor Performance, or Poor Economy)

Step	Action	Value(s)	Yes	No
1	Is DTC P0325 or P0327 set?	—	Go to *DTC P0325 or DTC P0327*	Go to *Step 2*
2	Run the engine at 1500 RPM. Is there an internal engine knock?	—	Go to *Step 3*	Go to *Step 4*
3	Repair the mechanical problem. Is the action complete?	—	Verify repair	—
4	1. Install Tech 2. 2. Turn the ignition "ON." 3. Cycle through the list until "Knock Retard" is displayed. Is knock retard at the specified value?	0°	Go to *Step 6*	Go to *Step 7*
5	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—
6	1. Start the engine. 2. Monitor the knock retard display on Tech 2 while changing the throttle setting to place different loads on the engine. Is knock retard at the specified value? (Turn the ignition "OFF.")	0°	Go to *Step 9*	Go to *Step 7*
7	1. At the rear of the engine, behind the rear fuel injector on the lift side, disconnect the 2-wire knock sensor harness connector. 2. Attach the positive lead of DVM to B+. 3. On the main harness side of the connector, use the negative lead of the DVM to probe the connector pin that is connected to the black wire. Dose the DVM indicate the specified value? (Reconnect the knock sensor harness.)	B+	Go to *Step 9*	Go to *Step 8*
8	Repair the open black wire ground for the shield which prevents stray electromagnetic pulses from affecting the knock signal. Is the action complete?	—	Verify repair	—
9	1. Reconnect the wire harness. 2. Set a DVM to AC voltage. 3. With the DVM, backprobe the PCM connector at A2. 4. Tap the engine lift brackprobe with a socket extension. Did the DVM show an increase in AC voltage while tapping on the lift bracket?	—	System OK	Go to *Step 10*
10	Replace the knock sensor. Is the action complete?	—	Verify repair	—

Exhaust Gas Recirculation (EGR) System Check



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Circuit Description

A properly operation exhaust gas recirculation (EGR) system will directly affect the air/fuel requirements of the engine. Since the exhaust gas introduced into the air/fuel mixture is an inert gas (contains very little or no oxygen), less fuel is required to maintain a correct air/fuel ratio. Introducing exhaust gas into the combustion chamber lowers combustion temperatures and reduces the formation of oxides of nitrogen (NOx) in the exhaust gas. Lower combustion temperatures also prevent detonation. If the EGR pintle were to stay closed, the inert exhaust gas would be replaced with air and the air/fuel mixture would be leaner. The powertrain control module (PCM) would compensate for the lean condition by adding fuel, resulting in higher long term fuel trim values.

Diagnostic Aids

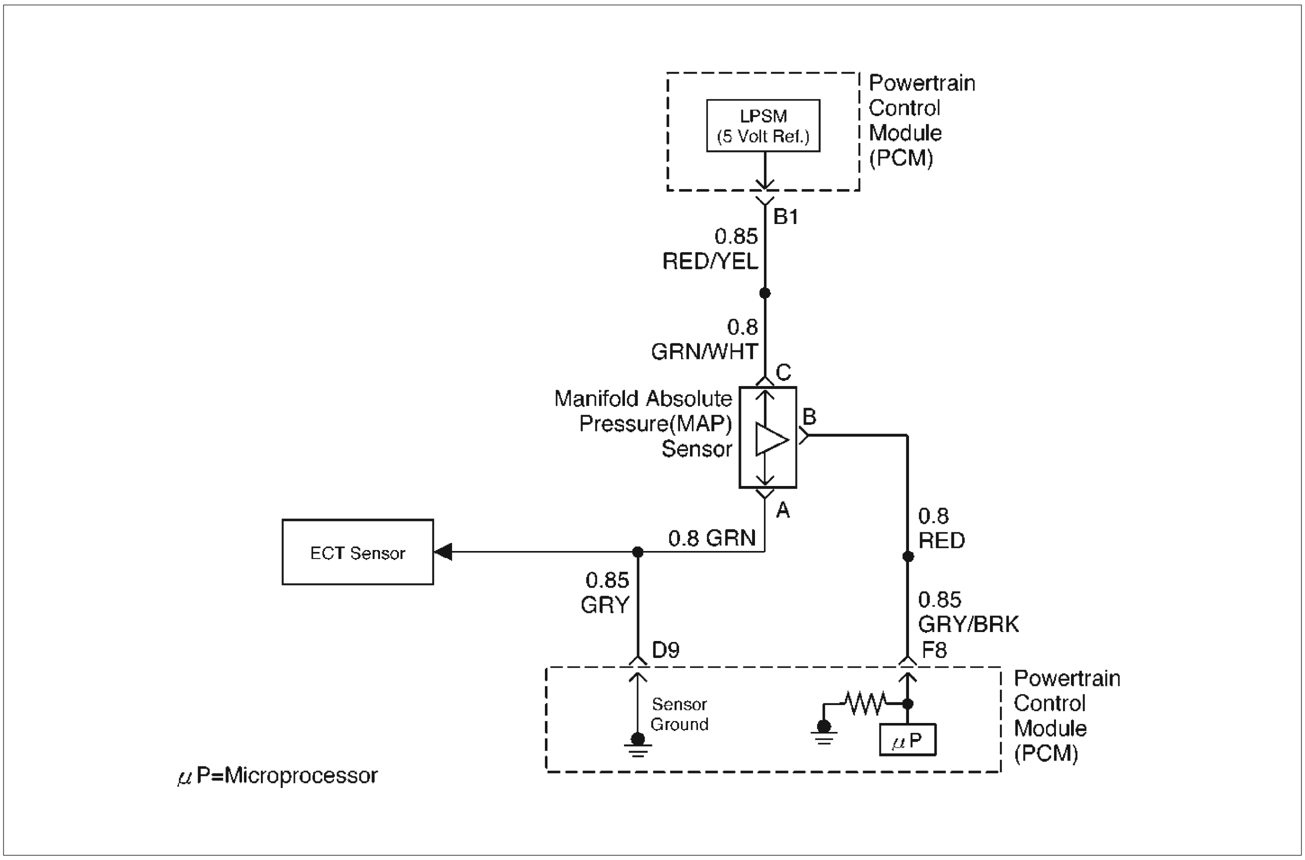
The EGR valve chart is a check of the EGR system. An EGR pintle constantly in the closed position could cause detonation and high emissions of NOx. It could also result in high long term fuel trim values in the open throttle cell, but not in the closed throttle cell. An EGR pintle constantly in the open position would cause a rough idle. Also, an EGR mounted incorrectly (rotated 180°) could cause rough idle. Check for the following items:

- EGR passages – Check for restricted or blocked EGR passages.
- Manifold absolute pressure sensor – A manifold absolute pressure sensor may shift in calibration enough to affect fuel delivery. Refer to *Manifold Absolute Pressure Output Check.*

Exhaust Gas Recirculation (EGR) System Check

Step	Action	Value(s)	Yes	No
1	Check the EGR valve for looseness. Is the EGR valve Loose?	—	Go to *Step 2*	Go to *Step 3*
2	Tighten the EGR valve. Is the action complete?	—	Verify repair	—
3	1. Place the transmission selector in Park or Neutral. 2. Start the engine and idle until warm. 3. Using Tech 2, command EGR “50% ON.” Does the engine idle rough and lose RPMs?	—	EGR system working properly. No problem found.	Go to *Step 4*
4	1. Engine “OFF.” 2. Ignition “ON.” 3. Using a test light to ground, check the EGR harness between the EGR valve and the ignition feed. Does the test light illuminate?	—	Go to *Step 6*	Go to *Step 5*
5	Repair the EGR harness ignition feed. Was the problem corrected?	—	Verify repair	Go to *Step 6*
6	1. Remove the EGR valve. 2. Visually and physically inspect the EGR valve pintle, valve passages and adapter for excessive deposits, obstructions or any restrictions. Does the EGR valve have excessive deposits, obstructions or any restrictions?	—	Go to *Step 7*	Go to *Step 8*
7	Clean or replace EGR system components as necessary. Was the problem corrected?	—	Verify repair	Go to *Step 8*
8	1. Ground the EGR valve metal case to battery (–). 2. Using Tech 2, command EGR “ON” and observe the EGR valve pintle for movement. Does the EGR valve pintle move according to command?	—	Go to *Step 9*	Go to *DTC P1406 chart*
9	1. Remove the EGR inlet and outlet pipes from the intake and exhaust manifolds. 2. Visually and physically inspect manifold EGR ports and EGR inlet and outlet pipes for blockage or restriction caused by excessive deposits or other damage. Do the manifold EGR ports or inlet and outlet pipes have excessive deposits, obstructions, or any restrictions?	—	Go to *Step 10*	EGR system working properly. No problem found.
10	Clean or replace EGR system components as necessary. Is the action complete?	—	Verify repair	—

Manifold Absolute Pressure (MAP) Output Check



Circuit Description

The manifold absolute pressure (MAP) sensor measures the changes in the intake MAP which result from engine load (intake manifold vacuum) and engine speed changes; and converts these into a voltage output. The powertrain control module (PCM) sends a 5-volt reference voltage to the MAP sensor. As the MAP changes, the output voltage of the sensor also changes. By monitoring the the sensor output voltage, the PCM knows the MAP. A lower pressure (low voltage) output voltage will be about 1-2 volts at idle. Higher pressure (high voltage) output voltage will be about 4-4.8 volts at wide open throttle. The MAP sensor is also used, under certain conditions, to measure barometric pressure, allowing the PCM to make adjustments for different altitudes. The PCM uses the MAP sensor to diagnose proper operation of the EGR system, in addition to other functions.

Test Description

IMPORTANT: Be sure to used the same diagnostic test equipment for all measurements.

The number(s) below refer to the step number(s) on the Diagnostic Chart.

2. Applying 34 kPa (10 Hg) vacuum to the MAP sensor should cause the voltage to be 1.5-2.1 volts less than the voltage at step 1. Upon applying vacuum to the sensor, the change in voltage should be instantaneous. A slow voltage change indicates a faulty sensor.
3. Check the vacuum hose to the sensor for leaking or restriction, Be sure that no other vacuum devices are connected to the MAP hose.

IMPORTANT: Make sure the electrical connector remains securely fastened.

4. Disconnect the sensor from the bracket. Twist the sensor with your hand to check for an intermittent connection. Output changes greater than 0.10 volt indicate a bad sensor.

Manifold Absolute Pressure (MAP) Output Check

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition "OFF"and leave it "OFF" for 15 seconds. 2. Ignition "ON." Don't crank engine. 3. Tech 2 should indicate a manifold absolute pressure (MAP) sensor voltage. 4. Compare this scan reading to scan reading of a known good vehicle obtained using the exact same procedure as in Steps 1-4. Is the voltage reading the same +/–0.40 volt?	—	Go to *Step 2*	Go to *Step 5*
2	1. Disconnect the vacuum hose at the MAP sensor and plug the hose. 2. Connect a hand vacuum pump to the MAP sensor. 3. Start the engine. 4. Apply 34 kPa (10 Hg) of vacuum and note the voltage change. Is the voltage change 1.5-2.1 volts less than Step 1?	—	Go to *Step 3*	Go to *Step 4*
3	No trouble found. Check the sensor cover for leakage or restriction. Does the hose supply vacuum to the MAP sensor only?	—	Go to *Step 5*	Go to *Step 4*
4	Repair the material to block. Is the action complete?	—	Verify repair	—
5	Check the sensor connection. Is the sensor connection good?	—	Go to *Step 6*	Go to *Step 7*
6	Replace the sensor. Refer to *On-Vehicle Service, MAP Sensor.* Is the action complete?	—	Verify repair	—
7	Repair the poor connection. Is the action complete?	—	Verify repair	—

PCM Diagnostic Trouble Codes

The following table lists the diagnostic trouble codes supported by this vehicle application. If any DTCs not listed here are displayed by a Tech 2, the Tech 2 data may be faulty; notify the Tech 2 manufacturer of any DTCs displayed that are not included in the following table.

A - Emission related P-code, check engine light on as soon as a failure detected.

B - Emission related P-code, check engine light on if a failure detected in two consecutive trips.

C - Non emission related P-code, check engine light on if a failure detected in one trip.

D - Non emission related P-code, no check engine light, but P-code will be set if a failure detected.

X - Do not check.

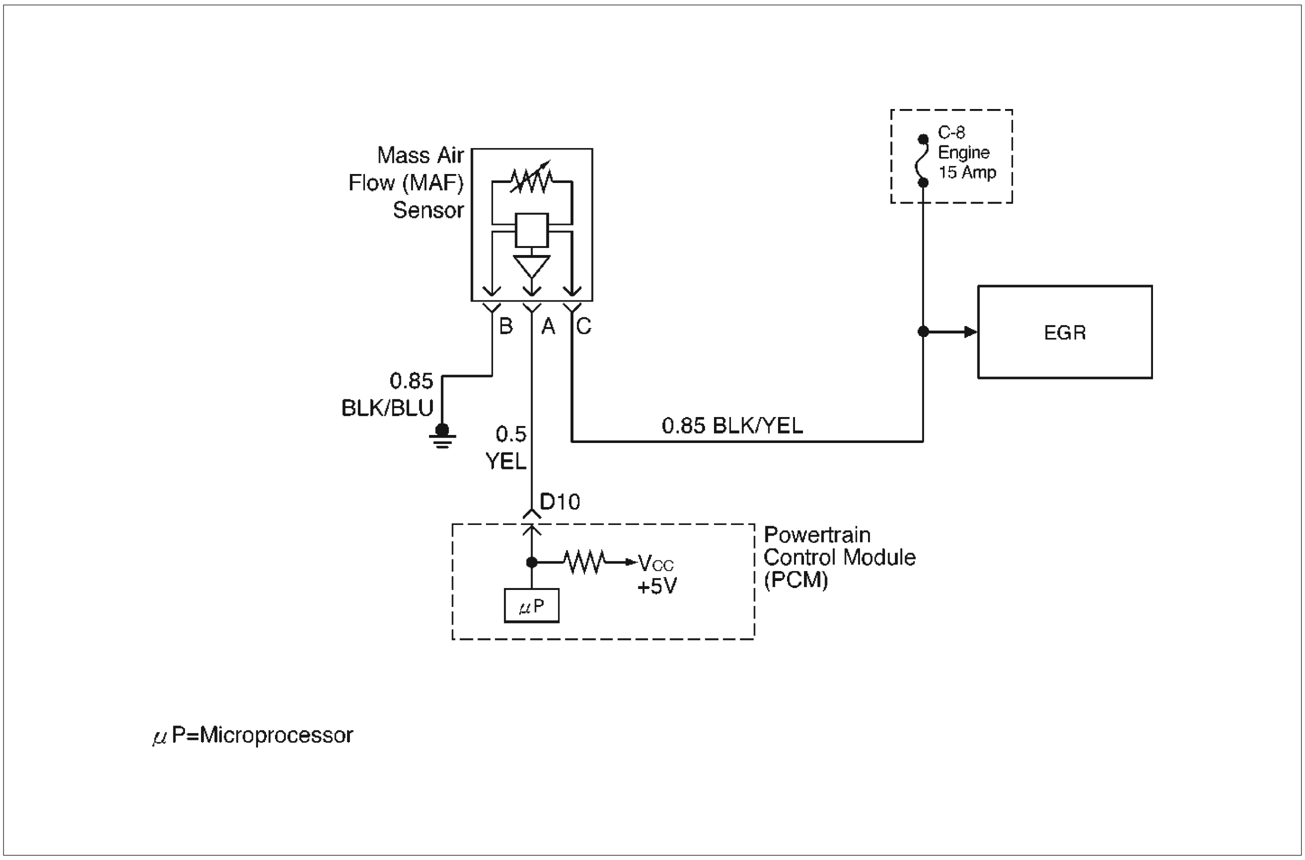
PCM Diagnostic Trouble Codes

DTC	Description / Countries	G. EXP A/T w/o immobi	G. EXP M/T w/o immobi	EC A/T w/ immobi	EC A/T w/o immobi	EC M/T w/ immobi	EC M/T w/o immobi	AUST A/T w/ immobi	AUST M/T w/ immobi
P0101	MAF system performance	B	B	B	B	B	B	B	B
P0102	MAF sensor circuit low frequency	A	A	A	A	A	A	A	A
P0103	MAF sensor circuit high frequency	A	A	A	A	A	A	A	A
P0107	MAP sensor circuit low voltage	A	A	A	A	A	A	A	A
P0108	MAP sensor circuit high voltage	A	A	A	A	A	A	A	A
P0112	ITA sensor circuit low voltage	A	A	A	A	A	A	A	A
P0113	ITA sensor circuit high voltage	A	A	A	A	A	A	A	A
P0117	ETC sensor circuit low voltage	A	A	A	A	A	A	A	A
P0118	ETC sensor circuit high voltage	A	A	A	A	A	A	A	A
P0121	TP system performance	A	A	A	A	A	A	A	A
P0122	TP sensor circuit low voltage	A	A	A	A	A	A	A	A
P0123	TP sensor circuit high voltage	A	A	A	A	A	A	A	A
P0131	HO2S circuit low voltage bank 1 sensor 1	X	X	A	A	A	A	A	A
P0132	HO2S circuit high voltage bank 1 sensor 1	X	X	A	A	A	A	A	A
P0134	HO2S circuit insufficient activity bank 1 sensor 1	X	X	X	X	X	X	A	A
P0151	HO2S circuit low voltage bank 2 sensor 1	X	X	A	A	A	A	X	X
P0152	HO2S circuit high voltage bank 2 sensor 1	X	X	A	A	A	A	X	X
P0171	Fuel trim system lean bank 1	X	X	B	B	B	B	B	B
P0172	Fuel trim system rich bank 1	X	X	B	B	B	B	B	B
P0174	Fuel trim system lean bank 2	X	X	B	B	B	B	X	X
P0175	Fuel trim system rich bank 2	X	X	B	B	B	B	X	X
P0201	Injector 1 control circuit	A	A	A	A	A	A	A	A
P0202	Injector 2 control circuit	A	A	A	A	A	A	A	A
P0203	Injector 3 control circuit	A	A	A	A	A	A	A	A
P0204	Injector 4 control circuit	A	A	A	A	A	A	A	A
P0205	Injector 5 control circuit	A	A	A	A	A	A	A	A
P0206	Injector 6 control circuit	A	A	A	A	A	A	A	A
P0218	T overtemp	D	X	D	D	X	X	D	X
P0325	KS sensor circuit	B	B	B	B	B	B	B	B
P0327	KS sensor circuit	B	B	B	B	B	B	B	B
P0336	58X reference signal circuit	B	B	B	B	B	B	B	B
P0337	CKP sensor circuit low frequency	B	B	B	B	B	B	B	B
P0341	CMP sensor circuit performance	B	B	B	B	B	B	B	B
P0342	CMP sensor circuit low	B	B	B	B	B	B	B	B
P0351	Injector 1 control circuit	A	A	A	A	A	A	A	A
P0352	Injector 2 control circuit	A	A	A	A	A	A	A	A
P0353	Injector 3 control circuit	A	A	A	A	A	A	A	A
P0354	Injector 4 control circuit	A	A	A	A	A	A	A	A
P0355	Injector 5 control circuit	A	A	A	A	A	A	A	A
P0356	Injector 6 control circuit	A	A	A	A	A	A	A	A
P0402	EGR pintle crank error	X	X	B	B	B	B	A	A
P0404	EGR open stuck	X	X	B	B	B	B	A	A
P0405	EGR low voltage	X	X	A	A	A	A	A	A
P0406	EGR high voltage	X	X	A	A	A	A	A	A
P0502	VSS circuit low input	B	B	B	B	B	B	B	B
P0560	T voltage	C	X	C	C	X	X	C	X
P0562	System voltage low	D	D	D	D	D	D	D	D
P0563	System voltage high	B	B	B	B	B	B	B	B
P0601	PCM memory	A	A	A	A	A	A	A	A
P0705	T range circuit	D	X	D	D	X	X	D	X
P0706	T range rat	D	X	D	D	X	X	D	X
P0712	T temp LO	D	X	D	D	X	X	D	X
P0713	T temp HI	D	X	D	D	X	X	D	X
P0719	T switch B LO	D	X	D	D	X	X	D	X
P0722	T shaft speed no signal	C	X	C	C	X	X	C	X
P0723	T shaft speed rat	C	X	C	C	X	X	C	X
P0730	T gear ratio	C	X	C	C	X	X	C	X
P0748	press solenoid circuit	C	X	C	C	X	X	C	X
P0753	T solenoid A circuit	C	X	C	C	X	X	C	X
P0758	T solenoid B circuit	C	X	C	C	X	X	C	X
P1127	CO ADJUST ERROR	A	A	X	X	X	X	X	X
P1154	HO2S circuit transition time ratio bank 2 sensor 1	X	X	A	A	A	A	X	X
P1171	Fuel system lean during acceleration	X	X	A	A	A	A	A	A
P1380	ABS rough road ABS system fault	X	X	X	X	X	X	A	A
P1404	EGR closed stuck	X	X	B	B	B	B	A	A
P1508	IAC system low RPM	B	B	B	B	B	B	B	B
P1509	IAC system high RPM	B	B	B	B	B	B	B	B
P1618	Serial peripheral interface(SPI)	C	X	C	C	X	X	C	X
P1625	PCM unexpected reset	D	D	D	D	D	D	D	D
P1626	immobi no response	X	X	D	X	D	X	D	D
P1631	immobi incorrect response	X	X	D	X	D	X	D	D
P1640	Driver 1 input high voltage	D	D	D	D	D	D	D	D
P1648	immobi wrong key	X	X	D	X	D	X	D	D
P1649	immobi no key	X	X	D	X	D	X	D	D
P1790	T ROM checksum	C	X	C	C	X	X	C	X
P1792	EEPROM checksum	C	X	C	C	X	X	C	X
P1835	T kick down switch	D	X	D	D	X	X	D	X
P1850	brake band solenoid	D	X	D	D	X	X	D	X
P1860	TCC PWM circuit	D	X	D	D	X	X	D	X

PCM Diagnostic Trouble Codes (Cont'd)

DTC	Description / Countries	LAO A/T w/o immobi	LAO M/T w/o immobi	S.A. M/T w/ ommobi	SAUD/CHINA A/T w/o immobi	SAUD/CHINA M/T w/o immobi
P0101	MAF system performance	B	B	B	B	B
P0102	MAF sensor circuit low frequency	A	A	A	A	A
P0103	MAF sensor circuit high frequency	A	A	A	A	A
P0107	MAP sensor circuit low voltage	A	A	A	A	A
P0108	MAP sensor circuit high voltage	A	A	A	A	A
P0112	ITA sensor circuit low voltage	A	A	A	A	A
P0113	ITA sensor circuit high voltage	A	A	A	A	A
P0117	ETC sensor circuit low voltage	A	A	A	A	A
P0118	ETC sensor circuit high voltage	A	A	A	A	A
P0121	TP system performance	A	A	A	A	A
P0122	TP sensor circuit low voltage	A	A	A	A	A
P0123	TP sensor circuit high voltage	A	A	A	A	A
P0131	HO2S circuit low voltage bank 1 sensor 1	A	A	X	A	A
P0132	HO2S circuit high voltage bank 1 sensor 1	A	A	X	A	A
P0134	HO2S circuit insufficient activity bank 1 sensor 1	A	A	X	X	X
P0151	HO2S circuit low voltage bank 2 sensor 1	X	X	X	A	A
P0152	HO2S circuit high voltage bank 2 sensor 1	X	X	X	A	A
P0171	Fuel trim system lean bank 1	B	B	X	B	B
P0172	Fuel trim system rich bank 1	B	B	X	B	B
P0174	Fuel trim system lean bank 2	X	X	X	B	B
P0175	Fuel trim system rich bank 2	X	X	X	B	B
P0201	Injector 1 control circuit	A	A	A	A	A
P0202	Injector 2 control circuit	A	A	A	A	A
P0203	Injector 3 control circuit	A	A	A	A	A
P0204	Injector 4 control circuit	A	A	A	A	A
P0205	Injector 5 control circuit	A	A	A	A	A
P0206	Injector 6 control circuit	A	A	A	A	A
P0218	T overtemp	D	X	X	D	X
P0325	KS sensor circuit	B	B	B	B	B
P0327	KS sensor circuit	B	B	B	B	B
P0336	58X reference signal circuit	B	B	B	B	B
P0337	CKP sensor circuit low frequency	B	B	B	B	B
P0341	CMP sensor circuit performance	B	B	B	B	B
P0342	CMP sensor circuit low	B	B	B	B	B
P0351	Injector 1 control circuit	A	A	A	A	A
P0352	Injector 2 control circuit	A	A	A	A	A
P0353	Injector 3 control circuit	A	A	A	A	A
P0354	Injector 4 control circuit	A	A	A	A	A
P0355	Injector 5 control circuit	A	A	A	A	A
P0356	Injector 6 control circuit	A	A	A	A	A
P0402	EGR pintle crank error	A	A	X	B	B
P0404	EGR open stuck	A	A	X	B	B
P0405	EGR low voltage	A	A	X	A	A
P0406	EGR high voltage	A	A	X	A	A
P0502	VSS circuit low input	B	B	B	B	B
P0560	T voltage	C	X	X	C	X
P0562	System voltage low	D	D	D	D	D
P0563	System voltage high	B	B	B	B	B
P0601	PCM memory	A	A	A	A	A
P0705	T range circuit	D	X	X	D	X
P0706	T range rat	D	X	X	D	X
P0712	T temp LO	D	X	X	D	X
P0713	T temp HI	D	X	X	D	X
P0719	T switch B LO	D	X	X	D	X
P0722	T shaft speed no signal	C	X	X	C	X
P0723	T shaft speed rat	C	X	X	C	X
P0730	T gear ratio	C	X	X	C	X
P0748	press solenoid circuit	C	X	X	C	X
P0753	T solenoid A circuit	C	X	X	C	X
P0758	T solenoid B circuit	C	X	X	C	X
P1127	CO ADJUST ERROR	X	X	A	X	X
P1154	HO2S circuit transition time ratio bank 2 sensor 1	X	X	X	A	A
P1171	Fuel system lean during acceleration	A	A	X	A	A
P1380	ABS rough road ABS system fault	A	A	X	X	X
P1404	EGR closed stuck	A	A	X	B	B
P1508	IAC system low RPM	B	B	B	B	B
P1509	IAC system high RPM	B	B	B	B	B
P1618	Serial peripheral interface(SPI)	C	X	X	C	X
P1625	PCM unexpected reset	D	D	D	D	D
P1626	immobi no response	X	X	D	X	X
P1631	immobi incorrect response	X	X	D	X	X
P1640	Driver 1 input high voltage	D	D	D	D	D
P1648	immobi wrong key	X	X	D	X	X
P1649	immobi no key	X	X	D	X	X
P1790	T ROM checksum	C	X	X	C	X
P1792	EEPROM checksum	C	X	X	C	X
P1835	T kick down switch	D	X	X	D	X
P1850	brake band solenoid	D	X	X	D	X
P1860	TCC PWM circuit	D	X	X	D	X

Diagnostic Trouble Code (DTC) P0101 MAF System Performance



D06RW103

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 powertrain control module (PCM) 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. 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.

Conditions for Setting the DTC

- The engine is running.
- No TP sensor or MAP sensor DTCs are set.
- The throttle is steady, TP angle doesn't change by more than 1%.
- System voltage is between 11.5 volts and 16 volts.
- Calculated air flow is between 25 g/second and 40 g/second.
- Above conditions present for at least 1 second.
- MAF signal frequency indicates an airflow significantly higher or lower than a predicted value based on throttle position and engine RPM for a total of 12.5 seconds over a 25-second period of time.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the fault is detected.
- The PCM calculates an airflow value based on idle air control valve position, throttle position, RPM and barometric pressure.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0101 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. The MAF system performance or “rationality” diagnostic uses the MAP sensor signal along with other input to calculate an expected airflow rate that is then compared to the actual measured airflow from the MAF sensor. The first few steps of this table verify that the MAP sensor is working properly.

6. Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate the vehicle within the same Freeze Frame conditions (RPM, load, vehicle speed , temperature, etc.) that were noted. This will isolate when the DTC failed.
   For any test that requires back probing the PCM or component harness connectors, use the Connector Test Adapter Kit J 35616-A. Using this kit will prevent any damage to the harness connector terminals.

7. Any un-metered air may cause this DTC to set. Check the PVC system for vacuum leaks. Also inspect the dip stick for being pulled out. Check the oil fill cap for being loose.

8. Verifies the signal circuit from the MAF sensor electrical connector to the PCM.

9. Verifies whether a ground and B+ circuit is available.

10. Checks a signal circuit for an open.

11. Checks for a signal circuit shorted to B+.

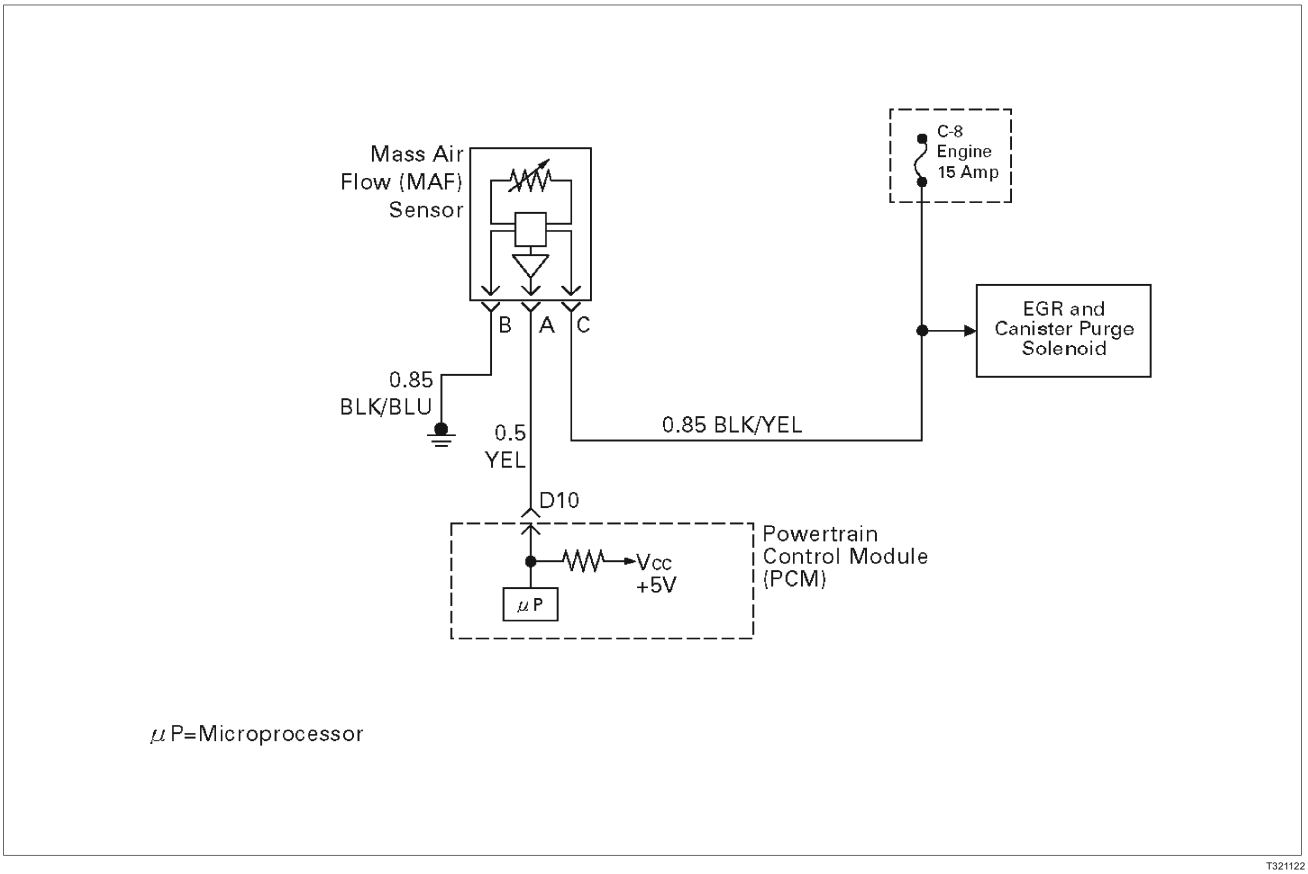
DTC P0101 – MAF System Performance

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. Ignition “ON,” engine “OFF.” 2. Using a Tech 2, select “MAP” from the Engine 1 Data List. Is the value displayed greater than the value shown?	85 kPa	Go to *Step 3*	Go to*Step 13*
3	1. Remove the MAP sensor from the intake manifold but leave the electrical harness connected. 2. Connect a hand operated vacuum pump to the MAP sensor. 3. Observe the MAP display while slowly applying vacuum up to 20” Hg as indicated on the pump gauge. Each 1” of vacuum applied should result in a 3 to 4 kPa drop in the MAP sensor value on the Tech 2 and the value should change smoothly with each increase in vacuum. Did the MAP value change smoothly through the entire range of the test without any erratic readings?	—	Go to *Step 13*	Go to *Step 4*
4	With 20” Hg vacuum applied to the MAP sensor, is the MAF sensor reading the same or less than the value shown?	34 kPa	Go to *Step 5*	Go to *Step 13*
5	Disconnect the vacuum source from the MAP sensor. Does the MAP sensor reading return to its original value?	—	Go to *Step 6*	Go to *Step 13*

DTC P0101 – MAF System Performance (Cont'd)

Step	Action	Value(s)	Yes	No
6	1. Ignition "ON," engine "OFF." 2. Review the Freeze Frame and/or Failure Records data for this DTC and note parameters. 3. Ignition "OFF" for 15 seconds. 4. Start the engine and operate the vehicle within the conditions required for this diagnostic to run, and as close to the conditions recorded in Freeze Frame /Failure Records possible. (Special operating conditions that need to be met before the PCM will run this diagnostic (where applicable) are listed in "Conditions for Setting the DTC"). 5. Using the Tech 2, select "DTC," then enter the DTC number which was set. Does the Tech 2 indicate that this diagnostic failed this ignition?	—	Go to *Step 7*	Refer to *Diagnostic Aids*
7	1. Check for the following conditions: • Objects blocking the MAF sensor inlet screen; • Intake manifold vacuum leaks; • Vacuum leaks at throttle body; • Vacuum leaks EGR value flange and pipes. • Crankcase ventilation valve faulty, missing, or incorrectly installed. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to*Step 8*
8	1. Ignition "OFF." 2. Disconnect the MAF sensor connector. 3. Ignition "ON," engine "OFF." 4. Using DVM 5-8840-0285-0, measure voltage between the MAF sensor signal circuit and chassis ground. Is the voltage near the specified value?	5 V	Go to *Step 9*	Go to*Step 10*
9	Connect a test light (5-8840-0607-0) between the MAF sensor ignition feed and ground circuits at the MAF sensor harness connector. Is the test light "ON?"	—	Go to *Step 13*	Go to*Step 12*
10	Is the voltage less than the specified value?	4.5 V	Go to *Step 13*	Go to*Step 11*
11	1. Ignition "OFF," disconnect the PCM. 2. Ignition "ON," engine "OFF." 3. Measure voltage between the MAF signal circuit and ground. Does the voltage measure near the specified value?	0 V	Go to *Step 13*	Go to*Step 12*
12	Connect a test light (5-8840-0607-0) between the MAF sensor ignition feed circuit and chassis ground. Is the test light "ON?"	—	Go to *Step 13*	Go to*Step 7*
13	1. Check for a poor connection at the MAF sensor. 2. If a poor connection is found, replace faulty terminal(s). Refer to *Repair Procedures in Electrical Diagnosis (8A Cell 5).* Was a poor connection found?	—	Verify repair	Solved

Diagnostic Trouble Code (DTC) P0102 MAF Sensor Circuit Low Frequency



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 powertrain control module (PCM) 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 2500 Hz at idle to around 1900 Hz 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.

Conditions for Setting the DTC

- The engine is running above 500 RPM for greater than 10 seconds.
- System voltage is above 11.5 volts.
- MAF signal frequency is below 1000 Hz for a total of 50-percent of the last 1000 samples monitored. A sample is taken every cylinder event.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM calculates an air flow value based on idle air control valve position, throttle position, RPM and barometric pressure.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0102 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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.
- Plugged intake air duct or filter element – A wide-open throttle acceleration from a stop should cause the mass air flow displayed on a Tech 2 to increase from about 3-6 g/second at idle to 100 g/second or greater at the time of the 1-2 shift. If not, check for a restriction.

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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. This step verifies that the problem is present at idle.
4. A voltage reading of less than 4 or over 5 volts at the MAF sensor signal circuit indicates a fault in the wiring or a poor connection.
5. This verifies that ignition feed voltage and a good ground are available at the MAF sensor.

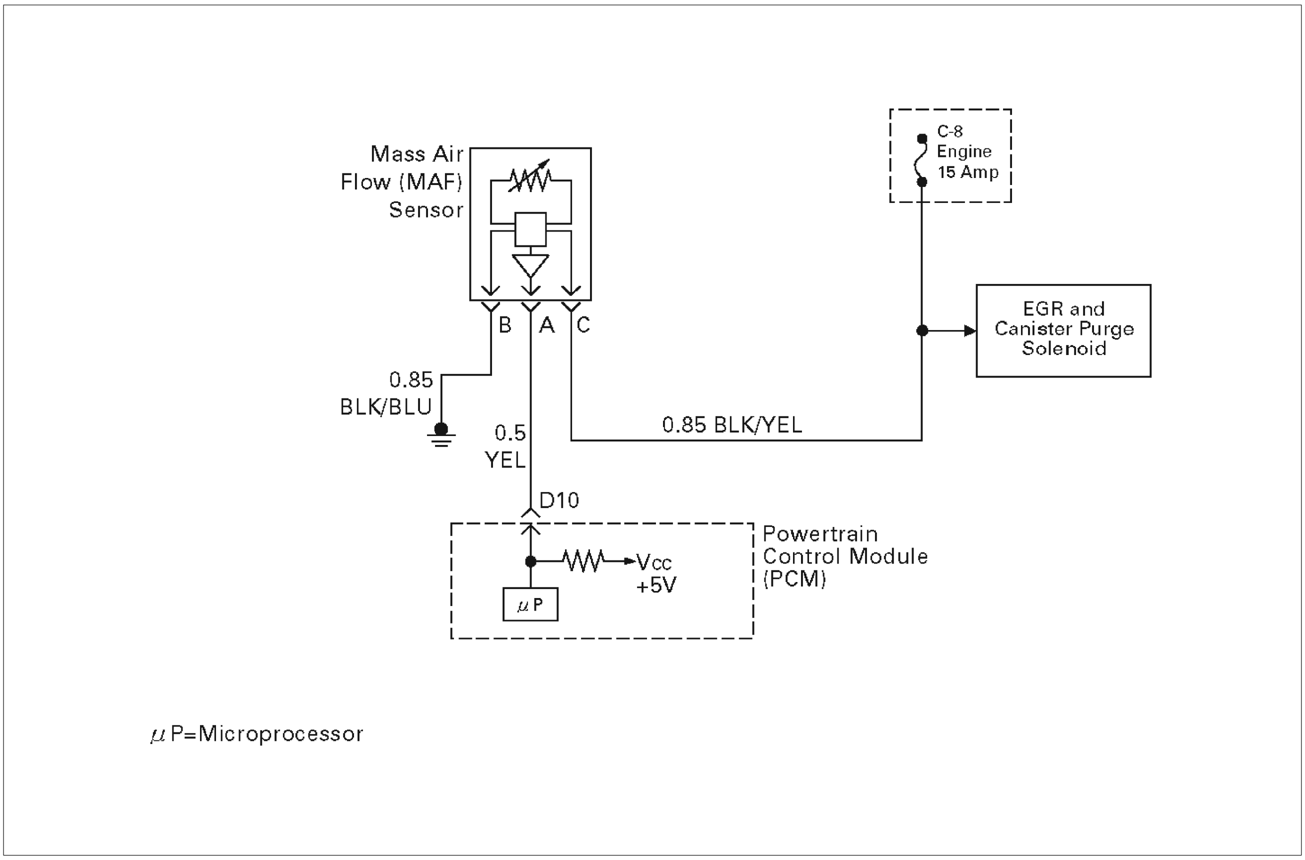
DTC P0102 – MAF Sensor Circuit Low Frequency

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. Start the engine. 2. With the engine idling, monitor “MAF Frequency” display on the Tech 2. Is the “MAF Frequency” below the specified value?	3 g/Sec	Go to *Step 4*	Go to *Step 5*
3	1. Ignition “ON,” engine “OFF.” 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using a Tech 2, monitor “DTC” info for DTC P0102. Does the Tech 2 indicate DTC P0102 failed this ignition?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	1. Ignition “OFF.” 2. Disconnect the MAF sensor connector. 3. Ignition “ON,” engine “OFF.” 4. Using a DVM, measure voltage between the MAF sensor signal circuit and battery ground. Is the voltage near the specified value?	5 V	Go to *Step 5*	Go to *Step 8*
5	Connect a test light between the MAF sensor ignition feed and ground circuits at the MAF sensor harness connector. Is the test light “ON?”	—	Go to *Step 13*	Go to *Step 6*
6	Connect a test light between the MAF sensor ignition feed circuit and battery ground. Is the test light “ON?”	—	Go to *Step 12*	Go to *Step 7*
7	1. Check for a poor connection at the MAF sensor. 2. If a poor connection is found, replace the faulty terminal(s). Was a poor connection found?	—	Verify repair	Go to *Step 11*
8	1. Ignition “OFF.” 2. Disconnect the MAF sensor. 3. Disconnect the PCM connector for the MAF signal circuit. 4. Ignition “ON,” engine “OFF.” 5. With the DVM, measure the voltage between the MAF signal terminal at the PCM and battery ground. Is the voltage under the specified value?	4 V	Go to *Step 9*	Go to *Step 10*

DTC P0102 – MAF Sensor Circuit Low Frequency (Cont'd)

Step	Action	Value(s)	Yes	No
9	1. Ignition "OFF." 2. Disconnect the PCM white connector. 3. Ignition "ON." 4. Check the MAF sensor signal circuit for a short to 5 volts. Is the action complete?	—	Verify repair	—
10	1. Ignition "OFF." 2. Disconnect the PCM white connector. 3. Ignition "ON." 4. Check the MAF sensor signal circuit between the PCM and the MAF sensor for an open, short to ground, or short to the MAF ground circuit. Is the action complete?	—	Verify repair	Go to *Step 13*
11	Locate and repair the open in the ground circuit to the MAF sensor. Is the action complete?	—	Verify repair	—
12	Locate and repair the open in the ignition feed circuit to the MAF sensor. Is the action complete?	—	Verify repair	—
13	Replace the MAF sensor. Is the action complete?	—	Verify repair	Go to *Step 14*
14	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0103 MAF Sensor Circuit High Frequency



T321122

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 powertrain control module (PCM) 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 2500 Hz at idle to around 9000 Hz 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.

Conditions for Setting the DTC

- The engine is running above 500 RPM for more than 10 seconds.
- System voltage is above 11.5 volts.
- MAF signal frequency is above 10,000 Hz (10.0 kHz) for a total of 50 percent of the last 200 samples monitored. A sample is taken every cylinder event.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM calculates an airflow value based on idle air control valve position, throttle position, RPM and barometric pressure.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for clearing the MIL/DTC

- DTC P0103 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

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.

Test Description

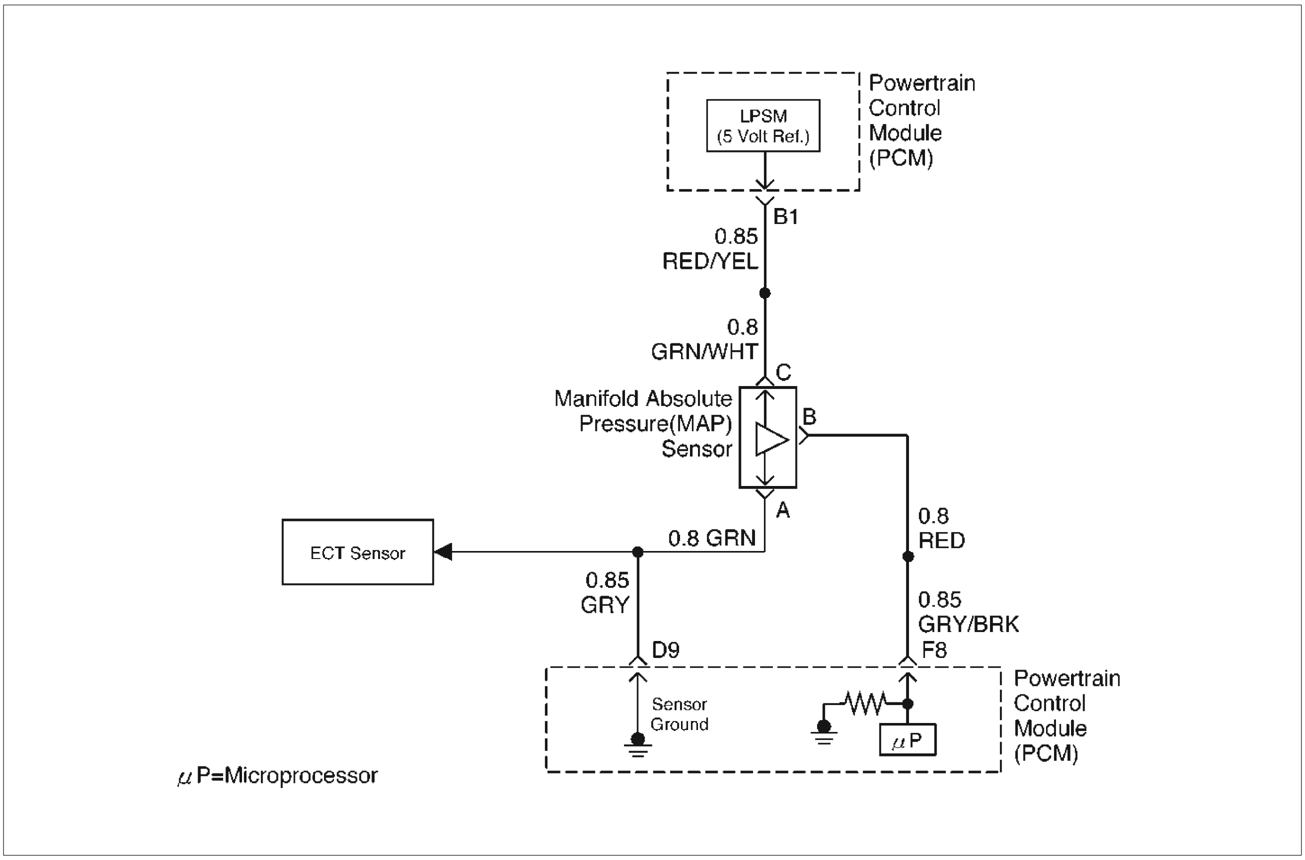
Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. This step verifies that the problem is present at idle.
4. A frequency reading with the MAF sensor connector disconnected indicates an electromagnetic interfernce (EMI) related fault.

DTC P0103 – MAF Sensor Circuit High Frequency

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. Ignition “ON,” engine “OFF.” 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using a Tech 2, monitor “DTC” info for DTC P0103. Does the Tech 2 indicate DTC P0103 failed this ignition?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	1. Start the engine. 2. With the engine idling, monitor “MAF Frequency” display on the Tech 2. Is “MAF Frequency” above the specified value?	219 g/Sec	Go to *Step 4*	Go to *Step 7*
4	1. Ignition “OFF.” 2. Disconnect the MAF sensor connector. 3. Ignition “ON,” engine idling. 4. Using a Tech 2, monitor “MAF Frequency.” Does the Tech 2 indicate a “MAF Frequency” at the specified value?	0.0 g/Sec	Go to *Step 5*	Go to *Step 6*
5	Replace the MAF sensor. Is the action complete?	—	Verify repair	Go to *Step 8*
6	1. Check the MAF harness for incorrect routing near high voltage components (solenoids, relays, motors). 2. If incorrect routing is found, correct the harness routing. Was a problem found?	—	Verify repair	Go to *Step 7*
7	1. With the engine idling, monitor “MAF Frequency” display on the Tech 2. 2. Quickly snap open throttle to wide open throttle while under a road load and record value. Does the Tech 2 indicate “MAF Frequency” above the specified value?	219 g/Sec	Go to *Step 5*	Go to *Step 8*
8	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0107 MAP Sensor Circuit Low Voltage



Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in intake manifold pressure (vacuum). The MAP sensor signal voltage to the powertrain control module (PCM) varies from below 2 volts at idle (high vacuum) to above 4 volts with the ignition "ON," engine not running or at wide-open throttle (low vacuum).

The MAP sensor is used to determine manifold pressure changes while the exhaust gas recirculation (EGR) flow test diagnostic is being run (refer to *DTC P0401*), to determine engine vacuum level for some other diagnostics and to determine barometric pressure (BARO). The PCM monitors the MAP signals for voltages outside the normal range of the MAP sensor. If the PCM detects a MAP signal voltage that is excessively low, DTC P0107 will be set.

Conditions for Setting the DTC

- No TP sensor DTCs present.
- Engine is running.
- Throttle angle is above 1% if engine speed is less than 1000 RPM.
- Throttle angle is above 2% if engine speed is above 1000 RPM.
- The MAP sensor indicates manifold absolute pressure at or below 11 kPa for a total of approximately 10 seconds over a 16-second period.
- Ignition voltage more than 11 volts.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will default to a BARO value of 79.3 kPa.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0107 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Check for intermittent codes.
- The MAP sensor shares a 5 Volt reference with the Rough Road Sensor. If these codes are also set, it could indicate a problem with the 5 Volt reference circuit .
- The MAP sensor shares a ground with the Rough Road Sensor, the ECT sensor, and the Transmission Fluid Temperature sensor.
- Poor connection at PCM – 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 MAP 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 P0107 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, performing the DTC P0107 Diagnostic Chart may isolate the cause of the fault.

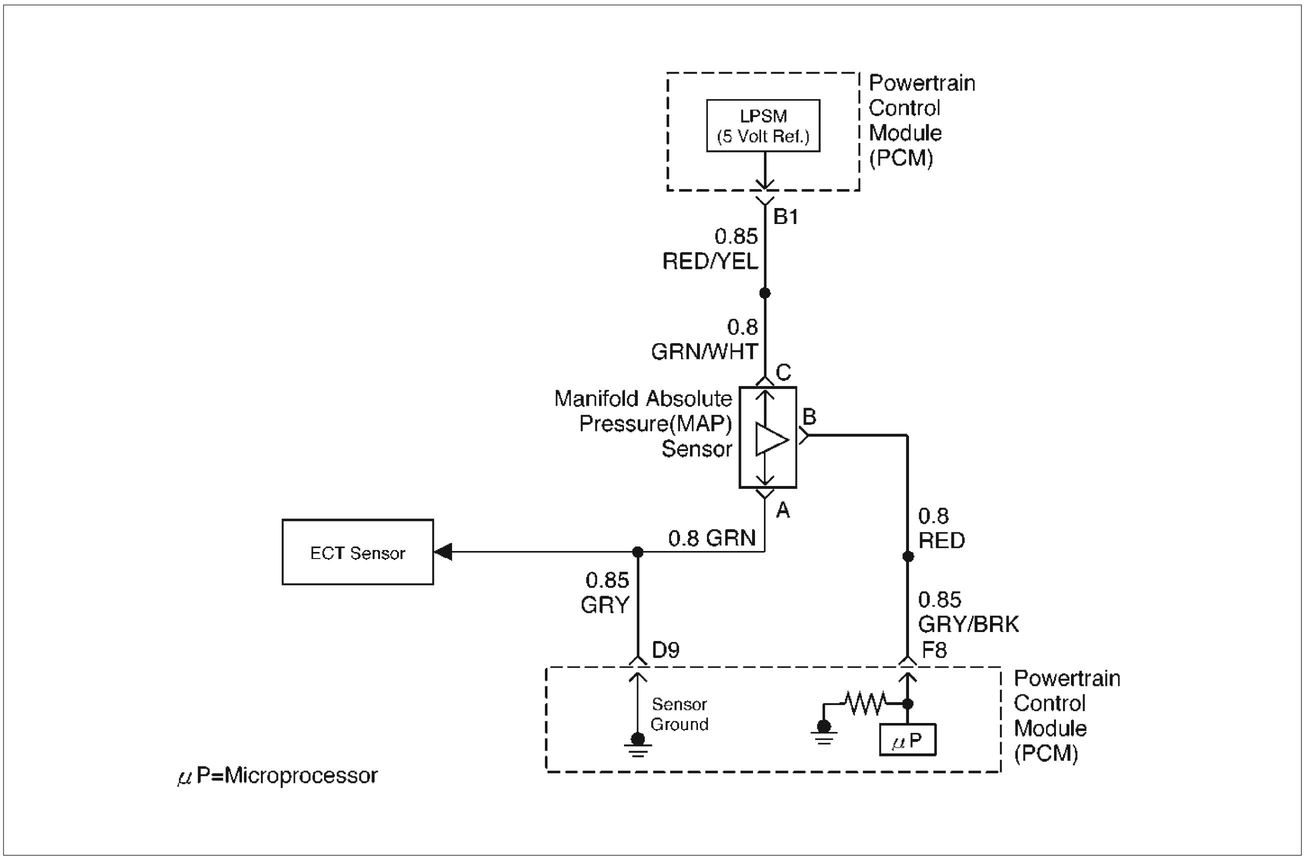
DTC P0107 – MAP Sensor Circuit Low Voltage

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. Ignition "ON," engine "OFF." 2. With the throttle closed, observe the MAP value displayed on the Tech 2. Is the MAP value near the specified value?	11 kPa at sea level	Go to *Step 4*	Go to *Step 3*
3	1. Ignition "ON," engine "OFF." 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using a Tech 2, monitor "Specific DTC" info for DTC P0107. Does the Tech 2 indicate DTC P0107 failed?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	1. Ignition "OFF." 2. Disconnect the MAP sensor electrical connector. 3. Jumper the 5 volt reference "A" circuit and the MAP signal together at the MAP sensor harness connector. 4. Ignition "ON." 5. Observe the MAP value displayed on the Tech 2. Is the MAP value near the specified value?	5 V 104 kPa	Go to *Step 10*	Go to *Step 5*
5	1. Disconnect the jumper. 2. Connect a test light between B+ and the MAP sensor signal circuit at the MAP sensor harness connector. 3. Observe the MAP value displayed on the Tech 2. Is the MAP value near the specified value.	5 V 104 kPa	Go to *Step 6*	Go to *Step 8*
6	1. Ignition "OFF." 2. Disconnect the PCM and check the 5 volt reference "A" circuit for an open or short to ground. 3. If the 5 volt reference "A" circuit is open or shorted to ground, repair it as necessary. Was the 5 volt reference "A" circuit open or shorted to ground?	—	Verify repair	Go to *Step 7*
7	Check the 5 volt reference "A" circuit for a poor connection at the PCM and replace the terminal if necessary. Did the terminal require replacement?	—	Verify repair	Go to *Step 11*
8	1. Ignition "OFF." 2. Disconnect the PCM, and check the MAP signal circuit for an open, short to ground, or short to the sensor ground circuit. 3. If the MAP sensor signal circuit is open or shorted to ground, repair it as necessary. Was the MAP signal circuit open or shorted to ground?	—	Verify repair	Go to *Step 9*

DTC P0107 – MAP Sensor Circuit Low Voltage (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check the MAP sensor signal circuit for a poor connection at the PCM and the MAP sensor; replace the terminal if necessary. Did the terminal require replacement?	—	Verify repair	Go to *Step 11*
10	Replace the MAP sensor. Is the action complete?	—	Verify repair	—
11	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0108 MAP Sensor Circuit High Voltage



Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in intake manifold pressure (vacuum). The MAP sensor signal voltage to the powertrain control module (PCM) varies from below 2 volts at idle (high vacuum) to above 4 volts with the key "ON," engine not running or at wide-open throttle (low vacuum).

The MAP sensor is used to determine manifold pressure changes while the linear EGR flow test diagnostic is being run (refer to *DTC P0401*), to determine engine vacuum level for some other diagnostics and to determine barometric pressure (BARO). The PCM monitors the MAP signals for voltages outside the normal range of the MAP sensor. If the PCM detects a MAP signal voltage that is excessively high, DTC P0108 will be set.

Conditions for Setting the DTC

- No TP sensor DTCs present.
- Engine is running for more than 10 seconds.
- Throttle position is below 3% if engine speed is below 1000 RPM.
- Throttle position is below 10% if engine speed is above 1000 RPM.
- The MAP sensor indicates an intermittent manifold absolute pressure above 80 kPa for a total of approximately 10 seconds over a 16-second period.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will default to a BARO value of 79.3 kPa.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0108 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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 MAP 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 P0108 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, performing the DTC P1108 Diagnostic Chart may isolate the cause of the fault.

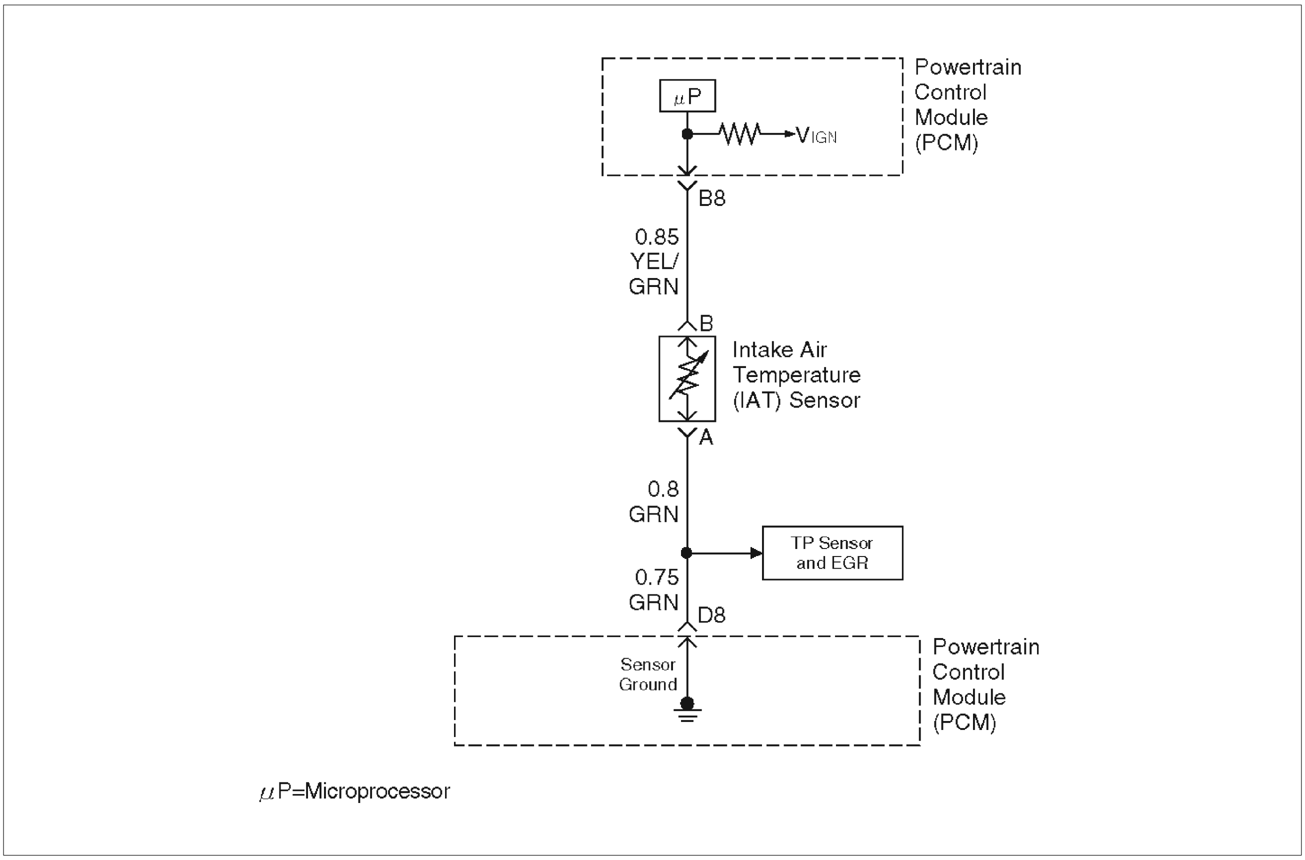
DTC P0108 – MAP Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. If the engine idle is rough, unstable or incorrect, repair the idle problem before using this chart. Refer to *Symptoms* section. 2. With the engine idling, note the MAP value on the Tech 2. Is the MAP reading above the specified value?	90 kPa	Go to *Step 4*	Go to *Step 3*
3	1. Ignition "ON," engine "OFF." 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using a Tech 2, monitor "Specific DTC" info for DTC P0108. Does the Tech 2 indicate DTC P0108 failed this ignition?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	1. Ignition "OFF." 2. Disconnected the MAP sensor electrical connector. 3. Ignition "ON." 4. Note the MAP sensor voltage displayed on the Tech 2. Is the MAP sensor voltage at the specified value?	0.0 V 11 kPa	Go to *Step 5*	Go to *Step 6*
5	Probe the sensor ground circuit with a test light to B+. Is the test light "ON?"	—	Go to *Step 7*	Go to *Step 9*
6	1. Check the MAP signal circuit for a short to voltage or a short to the 5 volt reference "A" circuit. 2. If the MAP sensor signal circuit is shorted, repair circuit as necessary. Was the MAP sensor signal circuit shorted?	—	Verify repair	Go to *Step 11*
7	1. Check for a poor sensor ground terminal connection at the MAP sensor electrical connector. 2. If a problem if found, replace the faulty terminal. Did the terminal require replacement?	—	Verify repair	Go to *Step 8*
8	Check for a plugged or leaking vacuum supply to the MAP sensor. Is the vacuum supply plugged or leaking?	—	Verify repair	Go to *Step 12*
9	1. Check for a poor sensor ground terminal connection at the PCM. 2. If a problem is found, replace the faulty terminal. Did the terminal require replacement?	—	Verify repair	Go to *Step 10*
10	1. Check the continuity of the MAP sensor ground circuit. 2. If the MAP sensor ground circuit measures over 5 ohms, repair open or poor connection. Was a condition found and corrected?	—	Verify repair	Go to *Step 11*

DTC P0108 – MAP Sensor Circuit High Voltage (Cont'd)

Step	Action	Value(s)	Yes	No
11	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify Repair	—
12	Replace the MAP sensor. Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0112 IAT Sensor Circuit Low Voltage



D06RW026

Circuit Description

The intake air temperature (IAT) sensor is a thermistor which measures the temperature of the air entering the engine. The powertrain control module (PCM) 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 PCM will monitor a high signal voltage on the IAT signal circuit. If the intake air is warm, the sensor resistance is lower, causing the PCM to monitor a lower voltage. DTC P0112 will set when the PCM detects an excessively low signal voltage on the intake air temperature sensor signal circuit.

Conditions for Setting the DTC

- The engine has been running for over 2 minutes.
- Vehicle speed is greater than 30 mph (48 km/h) .
- IAT signal voltage indicates and intake air temperature greater than 148°C (298°F) (about 5 volts) for a total of 12.5 seconds over a 25-second period of time.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0112 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – Inspect harness connectors for backed-bout 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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart:

2. Verifies that the fault is present.

3. If DTC P0112 can be repeated only by duplicating the Failure Records condition, refer to the *Temperature vs. Resistance Value* table. The table may be used to test the IAT sensor at various temperatures to evaluate the possibility of a “shifted” sensor that may be stored above or below a certain temperature. If this is the case, replace the IAT sensor. If the IAT sensor appears to be OK, the fault is intermittent; refer to *Diagnostic Aids*.

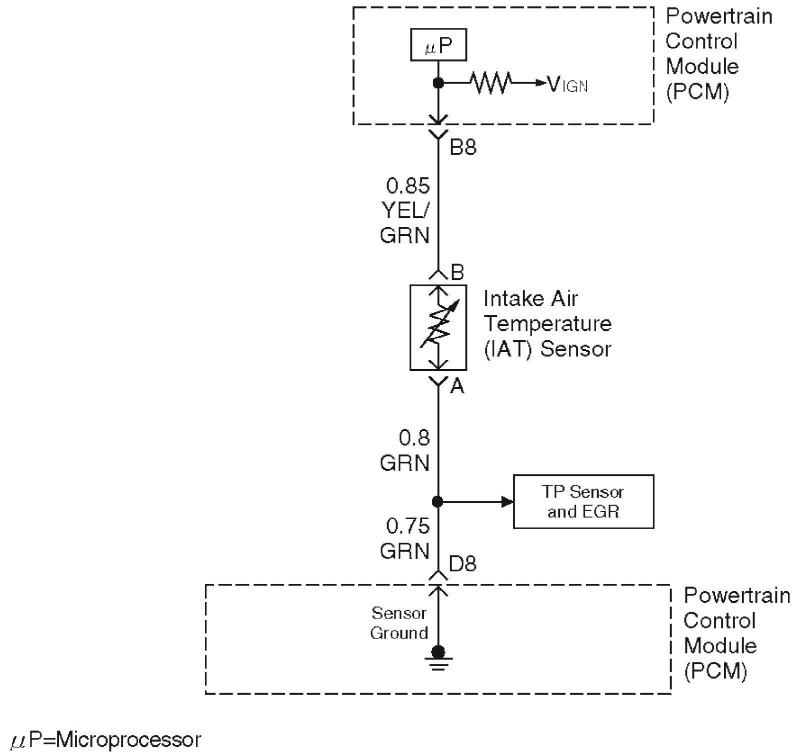
Intake Air Temperature Sensor

˚C	˚F	OHMS
Temperature vs. Resistance Values (approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
–5	23	12300
–15	5	21450
–30	–22	52700
–40	–40	100700

DTC P0112–IAT Sensor Circuit Low Voltage

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. Ignition “ON,” engine “OFF.” 2. Using a Tech 2, monitor the intake air temperature (IAT). Is the intake air temperature greater than the specified value?	148°C (283°F)	Go to *Step 4*	Go to *Step 3*
3	1. Ignition “ON,” engine “OFF.” Review and record Tech 2 Failure Records data. 2. Operate the vehicle within Failure Records conditions as noted. 3. Using a Tech 2, monitor the “Specific DTC” info for DTC P0112. Does the Tech 2 indicate DTC P0112 failed this ignition?	—	Refer to *Test Description*	Refer to *Diagnostic Aids*
4	1. Ignition “OFF.” 2. Disconnect the IAT sensor electrical connector. 3. Ignition “ON.” 4. Observe the intake air temperature on the Tech 2. Is the intake air temperature below the specified value?	–38°C (–36°F)	Go to *Step 6*	Go to *Step 5*
5	1. Ignition “OFF.” 2. Disconnect the PCM electrical connectors. 3. Check the IAT sensor signal circuit for a short to ground. Is the IAT sensor signal circuit shorted to ground?	—	Verify repair	Go to *Step 7*
6	Replace the IAT sensor. Is the action complete?	—	Verify repair	—
7	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0113 IAT Sensor Circuit High Voltage



D06RW026

Circuit Description

The intake air temperature (IAT) sensor is a thermistor which measures the temperature of the air entering the engine. The powertrain control module (PCM) 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 PCM will monitor a high signal voltage on the IAT signal circuit. If the intake air is warm, the sensor resistance is lower causing the PCM to monitor a lower voltage. DTC P0113 will set when the PCM detects an excessively high signal voltage on the intake air temperature sensor signal circuit.

Conditions for Setting the DTC

- The engine has been running for over 4 minutes.
- Vehicle speed is less than 20 mph (32 km/h).
- ECT signal temperature is above 60°C (140°F).
- Mass air flow is less then 20 g/second.
- IAT signal voltage indicates an intake air temperature less than –39°C (–38°F) for total of 12.5 seconds over a 25-second period.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0113 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- The IAT sensor shares a ground with the EGR position sensor and the TP sensor. Check the ground if these DTC’s are set.
- Poor connection at PCM – 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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart:

2. Verifies that the fault is present.

3. If DTC P0113 can be repeated only by duplicating the Failure Records conditions, refer to the “Temperature vs. Resistance Values” table. The table may be used to test the IAT sensor at various temperatures to evaluate the possibility of a “shifted” sensor that may be open above or below a certain temperature. If this is the case, replace the IAT sensor. If the IAT sensor appears to be OK, the fault is intermittent; refer to *Diagnostic Aids.*

Intake Air Temperature Sensor

°C	°F	OHMS
Temperature vs. Resistance Values (approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
–5	23	12300
–15	5	21450
–30	–22	52700
–40	–40	100700

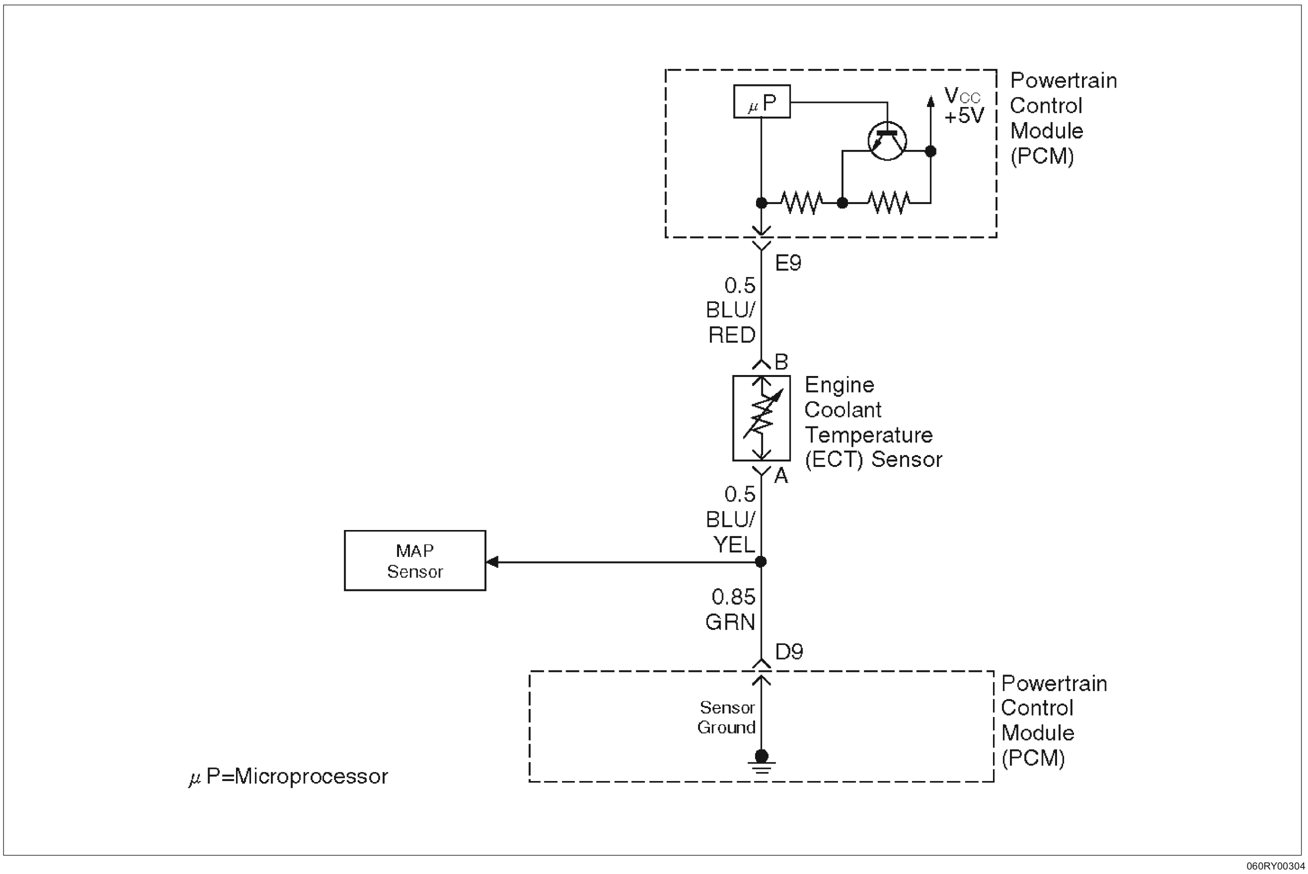
DTC P0113 –IAT Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	Ignition “ON,” engine “OFF.” Observe the “Intake Air Temp” display on the Tech 2. Is the “Intake Air Temp” below the specified value?	–38°C (–36°F)	Go to *Step 4*	Go to *Step 3*
3	1. Ignition “ON,” engine “OFF.” 2. Review and record Tech 2 Failure Records data parameters. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using a Tech 2, monitor “Specific DTC” info for DTC P0113. Does the Tech 2 indicate DTC P0113 failed?	—	Refer to *Test Description*	Refer to *Diagnostic Aids*
4	1. Ignition “OFF.” 2. Disconnect the IAT sensor electrical connector. 3. Jumper the IAT signal circuit and the sensor ground circuit together at the IAT sensor harness connector. 4. Ignition “ON.” 5. Observe the “Intake Air Temp” display on the Tech 2. Is the “Intake Air Temp” at the specified value?	140°C (284°F)	Go to *Step 6*	Go to *Step 5*
5	1. Jumper the IAT signal circuit at the IAT sensor harness connector to chassis ground. 2. Observe the “Intake Air Temp” display on the Tech 2. Is the “Intake Air Temp” at the specified value?	140°C (284°F)	Go to *Step 7*	Go to *Step 8*

DTC P0113 –IAT Sensor Circuit High Voltage (Cont'd)

Step	Action	Value(s)	Yes	No
6	Check for poor connections at the IAT sensor and replace terminals if necessary. Did any terminals require replacement?	—	Verify repair	Go to *Step 10*
7	1. Ignition "OFF." 2. Disconnect the PCM, and check the IAT sensor ground circuit for an open. 3. If the IAT sensor ground circuit is open, repair it as necessary. Was the IAT sensor ground circuit open?	—	Verify repair	Go to *Step 9*
8	1. Ignition "OFF." 2. Disconnect the PCM, and check the IAT signal circuit for an open. 3. If the IAT sensor signal circuit is open, repair it as necessary. Was the IAT signal circuit open?	—	Verify repair	Go to *Step 9*
9	Check for a poor sensor ground or IAT signal circuit terminal connection at the PCM and replace terminal(s) if necessary. Did any of the terminals need to be replaced?	—	Verify repair	Go to *Step 11*
10	Replace the IAT sensor. Is the action complete?	—	Verify repair	—
11	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0117 ECT Sensor Circuit Low Voltage



Circuit Description

The engine coolant temperature (ETC) sensor is a thermistor mounted on a coolant crossover pipe at the rear of the engine. The powertrain control module (PCM) 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 PCM will measure a high signal voltage. As the engine coolant warms, the sensor resistance becomes lower, and the ECT signal voltage measured at the PCM drops. With a fully warmed-up engine, the ECT signal voltage should measure about 1.5 to 2.0 volts.

Conditions for Setting the DTC

- Engine running time is longer than one minute.
- The ECT sensor signal indicates an engine coolant temperature greater than 150°C (302°F) (about 0.10 V) for a total of 50 seconds over a 100–second period.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will substitute the ECT reading with a default engine coolant temperature value. The default value is based on start-up intake air temperature and running time.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0117 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. Verifies that the fault is present.
3. If DTC P0117 can be repeated only by duplicating the Failure Records conditions, refer to the "Temperature vs. Resistance Values" table. The table may be used to test the ECT sensor at various temperatures to evaluate the possibility of a "shifted" sensor that may be shorted above or below a certain temperature. If this is the case, replace the ECT sensor. If the ECT sensor appears to be OK, the fault is intermittent; refer to *Diagnostic Aids*.

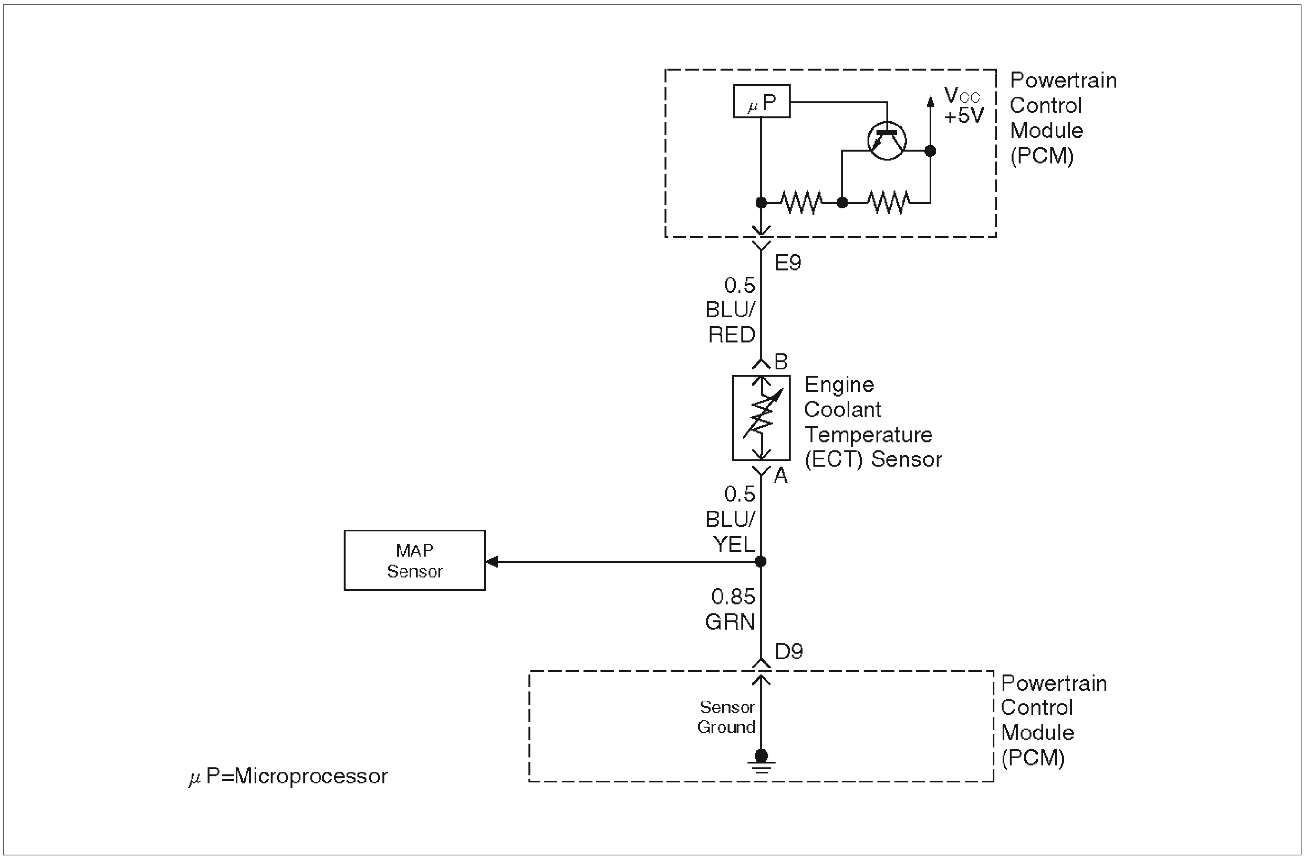
Engine Coolant Temperature Sensor

°C	°F	OHMS
Temperature vs. Resistance Values (approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
–5	23	12300
–15	5	21450
–30	–22	52700
–40	–40	100700

DTC P0117 – ECT Sensor Low Voltage

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. Ignition “ON,” engine “OFF.” 2. Observe the “Eng Cool Temp” display on the Tech 2. Is the “Eng Cool Temp” below the specified value?	139°C (282°F)	Go to *Step 4*	Go to *Step 3*
3	1. Ignition “ON,” engine “OFF.” 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using a Tech 2, monitor “Specific DTC” info for DTC P0117. Does the Tech 2 indicate DTC P0117 failed this ignition?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	1. Disconnect the ECT sensor electrical connector. 2. Observe the “Eng Cool Temp” display on the Tech 2. Is the “Eng Cool Temp” at the specified value?	–39°C (–38°F)	Go to *Step 6*	Go to *Step 5*
5	1. Ignition “OFF.” 2. Disconnect the PCM and check the ECT signal circuit for a short to ground or a short to the sensor ground circuit. 3. If the ECT signal circuit is shorted. repair it as necessary. Was the ECT signal circuit shorted to ground?	—	Verify repair	Go to *Step 7*
6	Replace the ECT sensor. Is the action complete?	—	Verify repair	—
7	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0118 ECT Sensor Circuit High Voltage



Circuit Description

The engine coolant temperature (ETC) sensor is a thermistor mounted in on a coolant crossover pipe at the rear of the engine. The powertrain control module (PCM) 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 PCM will measure a high signal voltage. As the engine coolant warms, the sensor resistance becomes less, and the ECT signal voltage measured at the PCM drops. With a fully warmed-up engine, the ECT signal voltage should measure about 1.5 to 2.0 volts.

Conditions for Setting the DTC

- Engine running time is longer than 1.5 minutes.
- The ECT sensor signal indicates an engine coolant temperature of –39°C (–38°F) or less (about 5 volts) for a total of 50 seconds over a 100-second period.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will substitute the ECT reading with a default engine coolant temperature value. The default value is based on start-up intake air temperature and running time.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0118 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:
The ECT shares a ground with the Transmission Fluid Temperature sensor, the Rough Road sensor, and the MAP sensor.
Check the ground if these DTCs are also set.

- Poor connection at PCM – 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. If it is determined that the DTC occurs intermittently, performing the DTC P1115 Diagnostic Chart may isolate the cause of the fault.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. Verifies that the fault is present.
3. If DTC P0118 can be repeated only by duplicating the Failure Records conditions, refer to the "Temperature vs. Resistance Value" table. The table may be used to test the ECT sensor at various temperatures to evaluate the possibility of a "shifted" sensor that may be shorted above or below a certain temperature. If this is the case, replace the ECT sensor. If the ECT sensor appears to be OK, the fault is intermittent; refer to *Diagnostic Aids*.

Engine Coolant Temperature Sensor

°C	°F	OHMS
Temperature vs. Resistance Values (approximate)		
100	212	177
80	176	332
60	140	667
45	113	1188
35	95	1802
25	77	2796
15	59	4450
5	41	7280
–5	23	12300
–15	5	21450
–30	–22	52700
–40	–40	100700

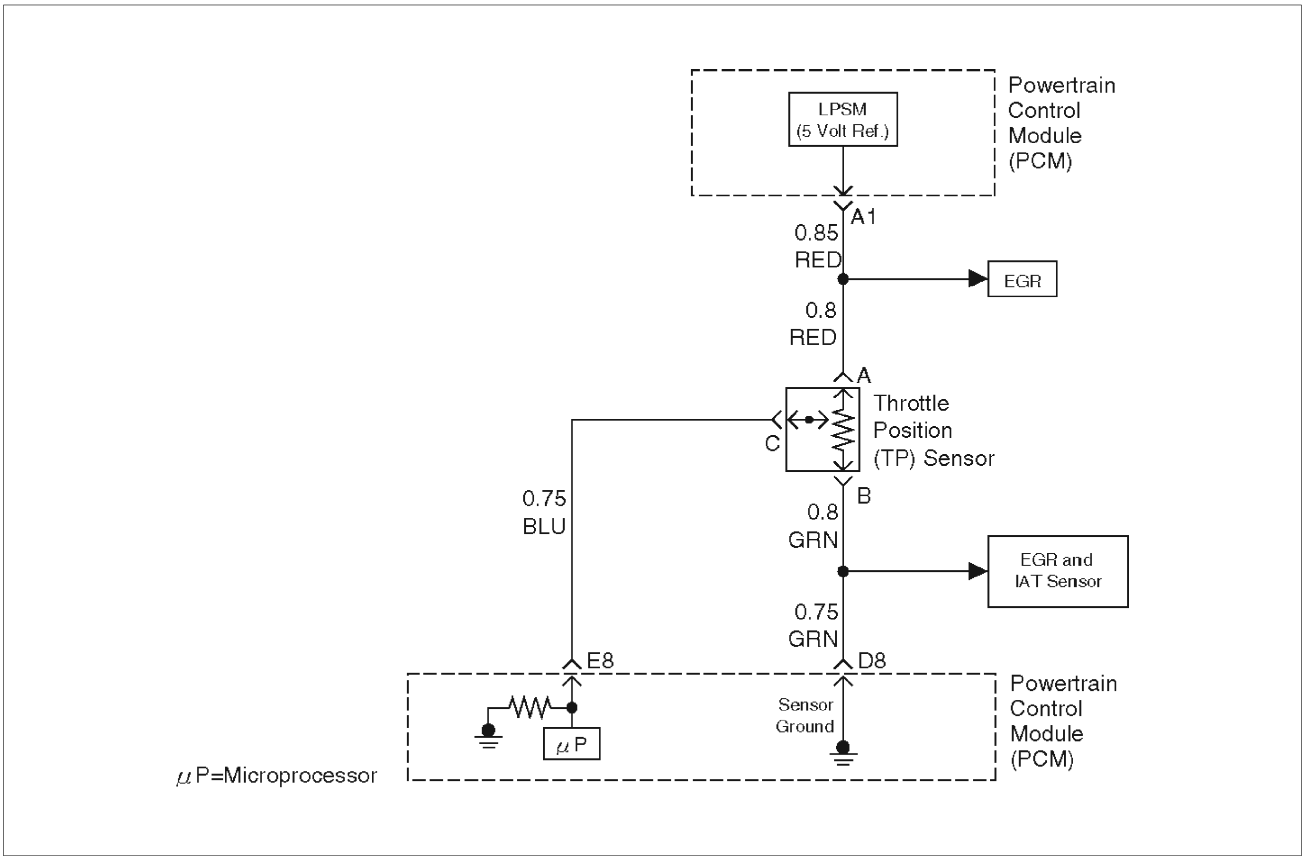
DTC P0118 – ECT Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Ignition "ON," engine "OFF." 2. Observe the "Eng Cool Temp" display on the Tech 2. Is the "Eng Cool Temp" below the specified value?	–39°C (–38°F)	Go to *Step 4*	Go to *Step 3*
3	1. Ignition "ON," engine "OFF." 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using a Tech 2, monitor the "Specific DTC" info for DTC P0118. Does the Tech 2 indicate DTC P0118 failed?	—	Refer to *Test Description*	Refer to *Diagnostic Aids*
4	1. Disconnect the ECT sensor electrical connector. 2. Jumper the ECT signal circuit and the sensor ground circuit together at the ECT sensor harness connector. 3. Observe the "Eng Cool Temp" display on the Tech 2. Is the "Eng Cool Temp" at the specified value?	140°C (284°F)	Go to *Step 6*	Go to *Step 5*
5	1. Jumper the ECT signal circuit at the ECT sensor harness connector to chassis ground. 2. Observe the "Eng Cool Temp" display on the Tech 2. Is the "Eng Cool Temp" at the specified value?	140°C (284°F)	Go to *Step 7*	Go to *Step 8*
6	Check for poor connections at the ECT sensor and replace terminals if necessary. Did any terminals require replacement?	—	Verify repair	Go to *Step 10*

DTC P0118 – ECT Sensor Circuit High Voltage (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Ignition "OFF." 2. Disconnect the PCM, and check the ECT sensor ground circuit for an open. 3. If the ECT sensor ground circuit is open, repair it as necessary. Was the ECT sensor ground circuit open?	—	Verify repair	Go to *Step 9*
8	1. Ignition "OFF." 2. Disconnect the PCM, and check the ECT signal circuit for an open. 3. If the ECT sensor signal circuit is open, repair it as necessary. Was the ECT signal circuit open?	—	Verify repair	Go to *Step 9*
9	Check for a poor sensor ground or ECT signal circuit terminal connection at the PCM and replace terminal(s) if necessary. Did any of the terminals need to be replaced?	—	Verify repair	Go to *Step 11*
10	Replace the ECT sensor. Is the action complete?	—	Verify repair	—
11	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0121 TP System Performance



D06RW028

Circuit Description

The throttle position (TP) sensor 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 TP signal is used by the powertrain control module (PCM) for fuel control and many of the PCM-controlled outputs. The PCM monitors throttle position and compares actual throttle position from the TP sensor to a predicted TP value calculated from engine speed. If the PCM detects an out-of-range condition, DTC P0121 will set.

Conditions for Setting the DTC

- The engine is running.
- No MAP DTCs, or P0121, P0122, P0123 are set.
- MAP reading is below 55 kPa.
- Throttle is steady, throttle angle is changing less than 1%.
- Predicted throttle angle is not close to actual throttle angle.
- Above conditions are present for a total of 12.5 seconds over a 25-second period of time.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.
- The PCM will use a default throttle position based on mass air flow and RPM.

Conditions for Clearing the MIL/DTC

- DTC P0121 can be cleared by using the Tech 2 “Clear info ” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Skewed MAP signal or faulty Map sensor – An incorrect MAP signal may cause the PCM to incorrectly calculate the predicted TP sensor value during high engine load situations. Check for an unusually low MAP reading. This condition can cause DTC P0121 to be set.
- Poor connection at PCM – 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.

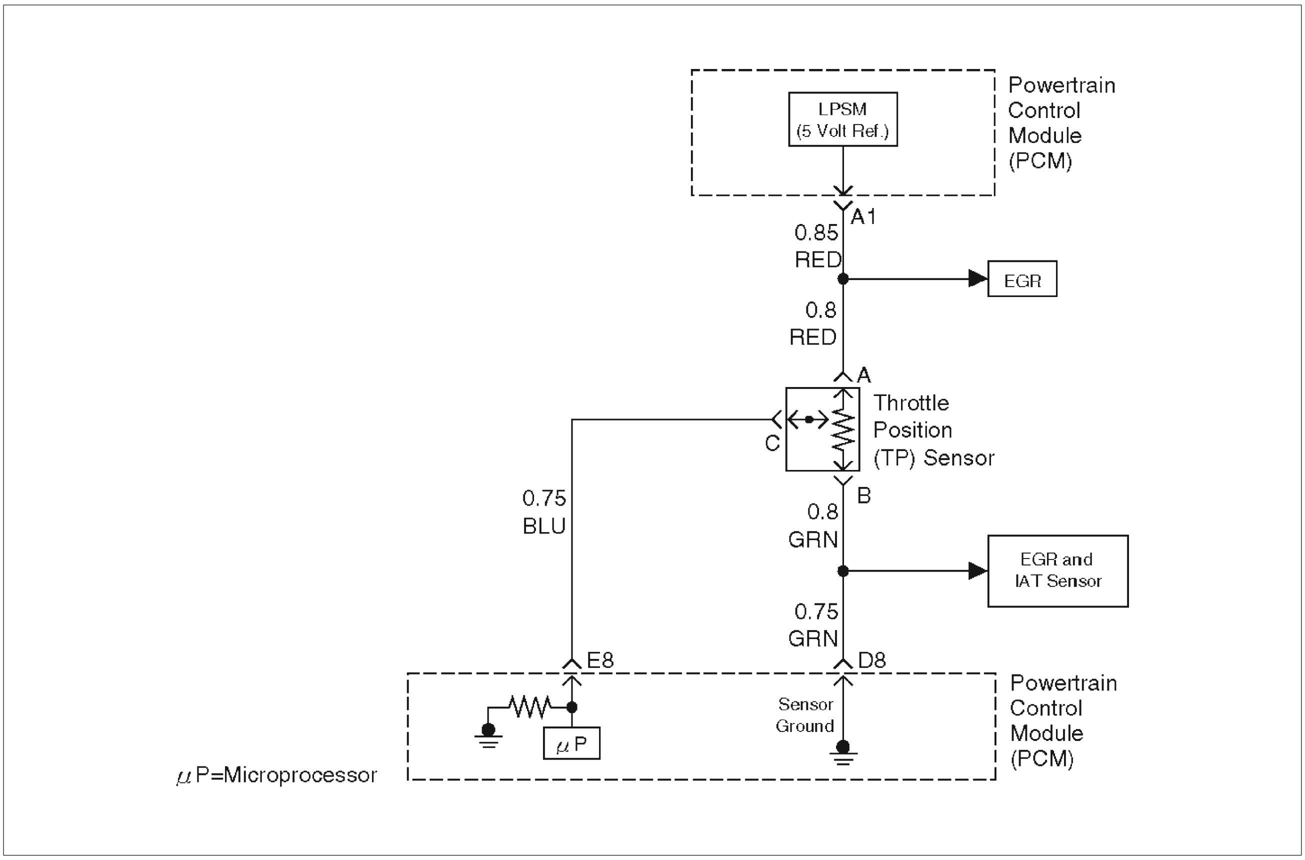
DTC P0121 –TP System Performance

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. Ignition “ON,” engine not running. 2. Observe the MAP reading on the Tech 2. Is the MAP reading less than the specified value?	65 kPa	Go to *Step 3*	Go to *Step 6*
3	1. Disconnected the MAP sensor. 2. Connect a test light between the 5 volt reference “A” circuit and the MAP signal circuit at the MAP sensor harness connector. 3. Observe the MAP reading on the Tech 2. Is the MAP reading less than the specified value?	65 kPa	Go to *Step 5*	Go to *Step 4*
4	1. Check the MAP signal circuit between the PCM and the MAP sensor for an open, short to ground, or short to the MAP ground circuit. 2. If the MAP signal circuit is open or shorted, repair it as necessary. Was the MAP signal circuit open or shorted?	—	Verify repair	Go to *Step 12*
5	Replace the MAP sensor. Is the action complete?	—	Verify repair	—
6	Observe the TP angle reading on the Tech 2 while slowly opening the throttle. Does the TP angle increase steadily and evenly from the closed throttle value to the wide open throttle value?	Closed throttle = 0% Wide open throttle = 100%	Refer to *Diagnostic Aids*	Go to *Step 7*
7	1. Disconnect the TP sensor. 2. Observe the TP sensor reading on the Tech 2. Is the TP sensor reading near the specified value?	0 V	Go to *Step 8*	Go to *Step 9*
8	1. Connect a test light between the 5 volt reference “A” circuit and the TP sensor signal circuit at the TP sensor harness connector. 2. Observe the TP sensor reading on the Tech 2. Is the TP sensor reading at the specified value?	5 V	Go to *Step 11*	Go to *Step 10*
9	Check the following items: 1. TP signal circuit for a short to voltage. 2. TP sensor ground circuit for high resistance between the PCM and the TP sensor. 3. TP sensor ground circuit for a poor connection. 4. If a problem is found, repair wiring harness as necessary. Was a problem found?	—	Verify repair	Go to *Step 12*

DTC P0121 –TP System Performance (Cont'd)

Step	Action	Value(s)	Yes	No
10	Check the following items: 1. TP signal circuit or 5 volt reference "A" circuit for a poor connection. 2. TP signal circuit or 5 volt reference "A" circuit for high resistance between the PCM and the TP sensor. 3. If a problem is found, repair wiring harness as necessary. Was a problem found?	—	Verify repair	Go to *Step 12*
11	Replace the TP sensor. Is the action complete?	—	Verify repair	—
12	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0122 TP Sensor Circuit Low Voltage



Circuit Description

The throttle position (TP) sensor 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 TP signal is used by the powertrain control module (PCM) for fuel control and many of the PCM–controlled outputs.

Conditions for Setting the DTC

- The ignition is "ON."
- TP sensor signal voltage is less than 0.22 volt for a total of 0.78 second over a 1.5-second period.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.
- The PCM will use a default throttle position based on mass air flow and RPM.

Conditions for Clearing the MIL/DTC

- DTC P0122 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Check intermittent codes.
- The TP sensor shares a 5 Volt reference with the EGR position sensor. Check the 5 Volt reference if these DTCs are also set.
- The TP sensor shares a ground with the IAT sensor, the EGR position sensor.
- Poor connection at PCM – 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 TP sensor. 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.

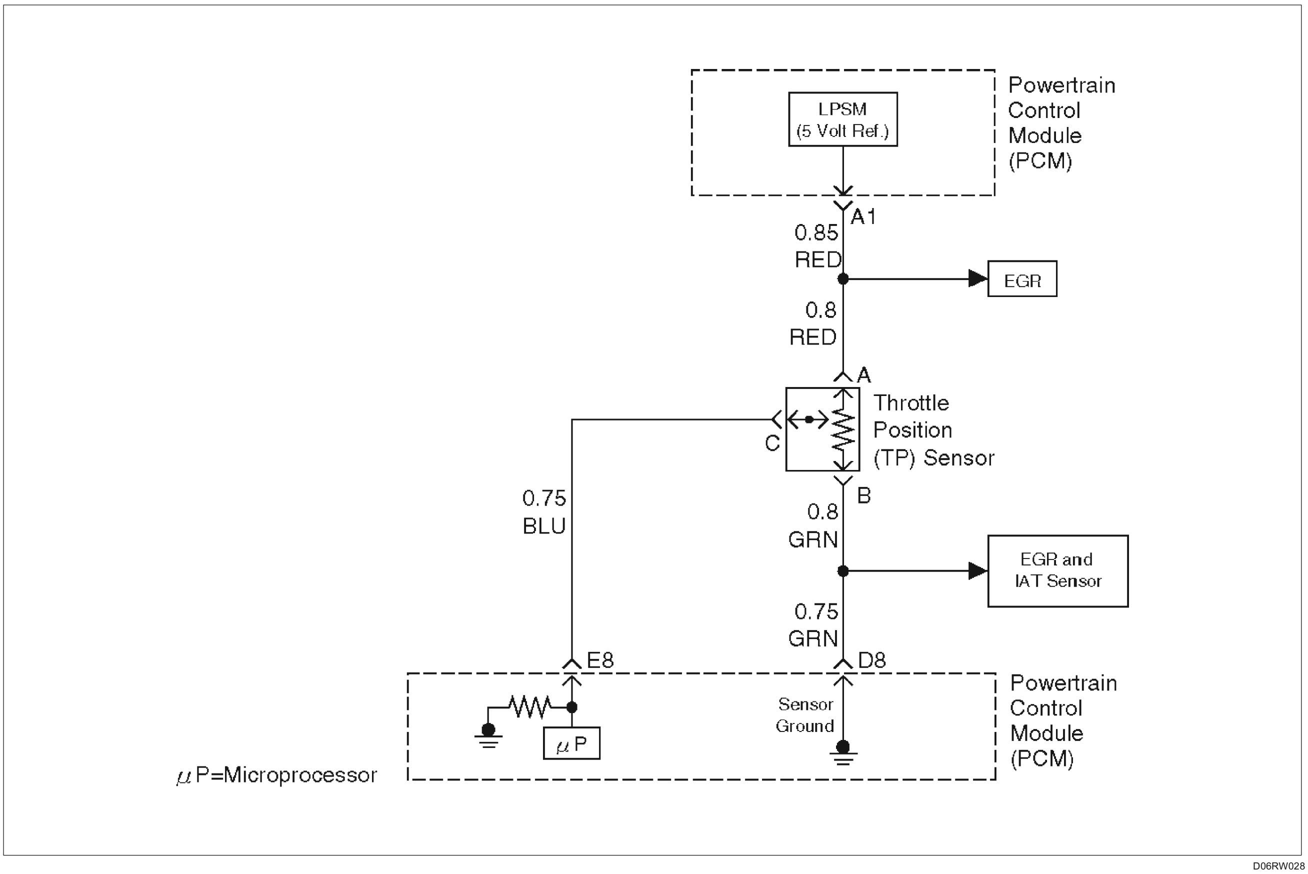
DTC P0122 –TP Sensor Circuit Low Voltage

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. Ignition “ON,” engine “OFF.” 2. With the throttle closed, observe the “TP Sensor” display on the Tech 2. Is the “TP Sensor” below the specified value?	0.22 V	Go to *Step 4*	Go to *Step 3*
3	1. Ignition “ON,” engine “OFF.” 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using a Tech 2, monitor the “DTC” info for DTC P0122. Does the Tech 2 indicate DTC P0122 failed?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	1. Ignition “OFF.” 2. Disconnect the TP sensor electrical connector. 3. Jumper the 5 volt reference “A” circuit and the TP signal together at the TP sensor harness connector. 4. Ignition “ON.” Observe the “TP Sensor” display on the Tech 2. Is the “TP Sensor” at the specified value?	5 V	Go to *Step 10*	Go to *Step 5*
5	1. Disconnect jumper. 2. Connect a test light between B+ and the TP sensor signal circuit at the TP sensor harness connector. Observe the “TP Sensor” display on the Tech 2. Is the “TP Sensor” at the specified value?	5 V	Go to *Step 6*	Go to *Step 8*
6	1. Ignition “OFF.” 2. Disconnect the PCM and check the 5 volt reference “A” circuit for an open or short to ground. 3. If the 5 volt reference “A” circuit is open or shorted to ground, repair it as necessary. Was the 5 volt reference “A” circuit open or shorted to ground?	—	Verify repair	Go to *Step 7*
7	Check the 5 volt reference “A” circuit for a poor connection at the PCM and replace the terminal if necessary. Did the terminal require replacement?	—	Verify repair	Go to *Step 12*
8	1. Ignition “OFF.” 2. Disconnect the PCM, and check the TP signal circuit for an open, short to ground, or short to the sensor ground circuit. 3. If the TP sensor signal circuit is open or shorted to ground, repair it as necessary. Was the TP signal circuit open or shorted to ground?	—	Verify repair	Go to *Step 9*
9	Check the TP sensor signal circuit for a poor connection at the PCM and replace the terminal if necessary. Did the terminal require replacement?	—	Verify repair	Go to *Step 12*

DTC P0122 –TP Sensor Circuit Low Voltage (Cont'd)

Step	Action	Value(s)	Yes	No
10	Check the TP sensor signal circuit for a poor connection at the TP sensor and replace the terminal if necessary. Did the terminal require replacement?	—	Verify repair	Go to *Step 11*
11	Replace the TP sensor. Is the action complete?	—	Verify repair	—
12	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0123 TP Sensor Circuit High Voltage



Circuit Description

The throttle position (TP) sensor 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 TP signal is one of the most important inputs used by the powertrain control module (PCM) for fuel control and many of the PCM-controlled outputs.

Conditions for Setting the DTC

- The ignition is "ON."
- TP sensor signal voltage is greater than 4.88 volts for a total of 0.78 second over a 1.5-second period.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.
- The PCM will use a default throttle position based on mass air flow and RPM.

Conditions for Clearing the MIL/DTC

- DTC P0123 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Check intermittent codes.
- The TP sensor shares a 5 Volt reference with the EGR position sensor. Check the 5 Volt reference if these DTCs are also set.
- The TP sensor shares a ground with the IAT sensor and the EGR position sensor. Check the ground if these other DTCs are also set.
- Poor connection at PCM – 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 TP sensor 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 TP sensor – With the ignition key "ON," engine "OFF," observe the TP sensor display on the Tech 2 while slowly depressing the accelerator to wide open throttle. If a voltage over 4.88 volts is seen at any point in normal accelerator travel, replace the TP sensor.

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.

Test Description

Number (s) below refer to the step number(s) on the Diagnostic Chart.
7. Components that share the TP sensor 5 volt reference "A" circuit include the following device:

- EGR valve

Disconnect the component while observing the TP sensor display on the Tech 2. If the reading changes drastically when this component is disconnected, replace the component that affected the reading.

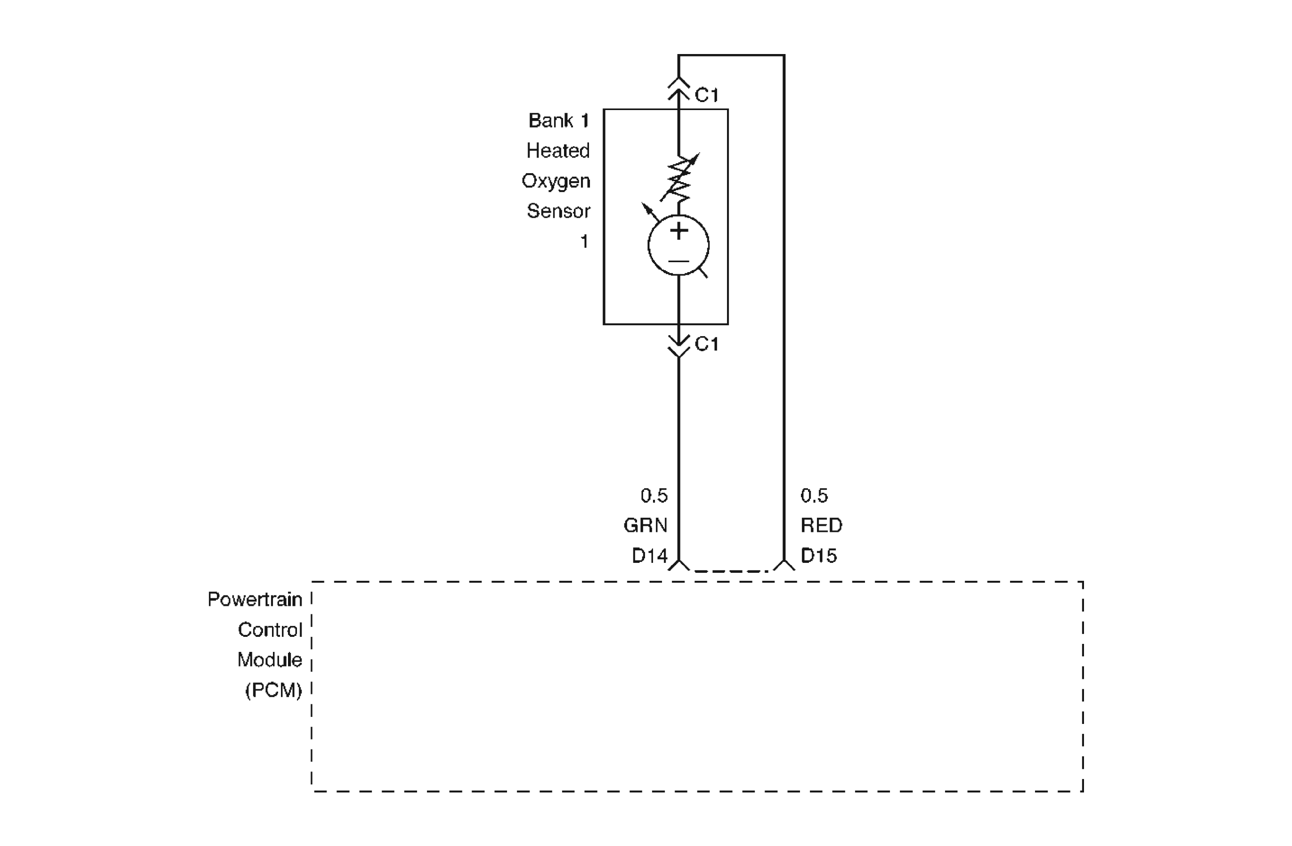
DTC P0123 – TP Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Ignition "ON," engine "OFF." 2. With the throttle closed, observe the "TP Sensor" display on the Tech 2. Is the "TP Sensor" above the specified value?	4.88 V	Go to *Step 4*	Go to *Step 3*
3	1. Ignition "ON," engine "OFF." 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using a Tech 2, monitor "Specific DTC" info for DTC P0123. Does the Tech 2 indicate DTC P0123 failed.	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	1. Disconnect the TP sensor electrical connector. 2. Observe the "TP Sensor" display on the Tech 2. Is the "TP Sensor" near the specified value?	0 V	Go to *Step 5*	Go to *Step 6*
5	Probe the sensor ground circuit at the TP sensor harness connector with a test light connected to B+. Is the test light "ON?"	—	Go to *Step 7*	Go to *Step 10*
6	1. Ignition "OFF," disconnect the PCM. 2. Ignition "ON," engine "OFF." 3. Check for a short to voltage on the TP sensor signal circuit. 4. If the TP sensor signal circuit is shorted, repair it as necessary. Was the TP sensor signal circuit shorted?	—	Verify repair	Go to *Step 12*
7	1. Ignition "ON." 2. Monitor the "TP Sensor" Tech 2 display while disconnecting each of the components that share the 5 volt reference "A" circuit (one at a time). 3. If the "TP Sensor" Tech 2 display changes, replace the component that caused the display to change when disconnected. Does disconnecting any of these components cause the "TP Sensor" display to change?	—	Verify repair	Go to *Step 8*
8	1. Ignition "OFF," disconnect the PCM. 2. Ignition "ON," engine "OFF." 3. Check for a short to B+ on the 5 volt reference "A" circuit. 4. If the 5 volt reference "A" circuit is shorted, repair it as necessary. Was the 5 volt reference "A" circuit shorted?	—	Verify repair	Go to *Step 9*
9	Check for poor electrical connections at the TP sensor and replace terminals if necessary. Did any terminals require replacement?	—	Verify repair	Go to *Step 11*

DTC P0123 – TP Sensor Circuit High Voltage (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Ignition "OFF." 2. Disconnect the PCM, and check for an open sensor ground circuit to the TP sensor. 3. If a problem is found, repair it as necessary. Was the sensor ground circuit to the TP sensor open?	—	Verify repair	Go to *Step 12*
11	Replace the TP sensor. Is the action complete?	—	Verify repair	—
12	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0131 HO2S Circuit Low Voltage Bank 1 Sensor 1



060RW236

Circuit Description

The powertrain control module (PCM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO2S) signal high and signal low circuits. When measured with a 10 megaohm digital voltmeter, this may display as low as 350 mV. The oxygen sensor varies the voltage within a range of about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean. The PCM 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 Bank 1 HO2S 1 voltage remains excessively low for an extended period of time, DTC P0131 will be set.

Conditions for Setting the DTC

- No related DTCs.
- Vehicle is operating in "closed loop."
- Engine coolant temperature is above 60°C (140°F).
- "Closed loop" commanded air/fuel ratio is between 14.5 and 14.8.
- Throttle angle is between 3% and 19%.
- Bank 1 HO2S 1 signal voltage remains below 22 mV during normal "closed loop" operation for a total of 77 seconds over a 90-second period of time.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.
- "Open loop" fuel control will be in effect.

Conditions for Clearing the MIL/DTC

- DTC P0131 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Heated oxygen sensor wiring – The sensor pigtail may be routed incorrectly and contacting the exhaust system.
- Poor PCM to engine block grounds.
- Fuel pressure – The system will go lean if pressure is too low. The PCM can compensate for some decrease. However, If fuel pressure is too low, a DTC P0131 may be set. Refer to *Fuel System Diagnosis*.
- Lean injector(s) – Perform "Injector Balance Test."
- Vacuum leaks – Check for disconnected or damaged vacuum hoses and for vacuum leaks at the intake manifold, throttle body, EGR system, and PCV system.
- 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 *Fuel System Diagnosis* for the procedure to check for fuel contamination.
- If none of the above conditions are present, replace the affected HO2S.

Test Description

Number(s) below refer to step numbers on the diagnostic chart.

3. DTC P0131 failing during operation may indicate a condition described in the “Diagnostic Aids” above. If the DTC P0131 test passes while the Failure Records conditions are being duplicated, an intermittent condition is indicated.

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.

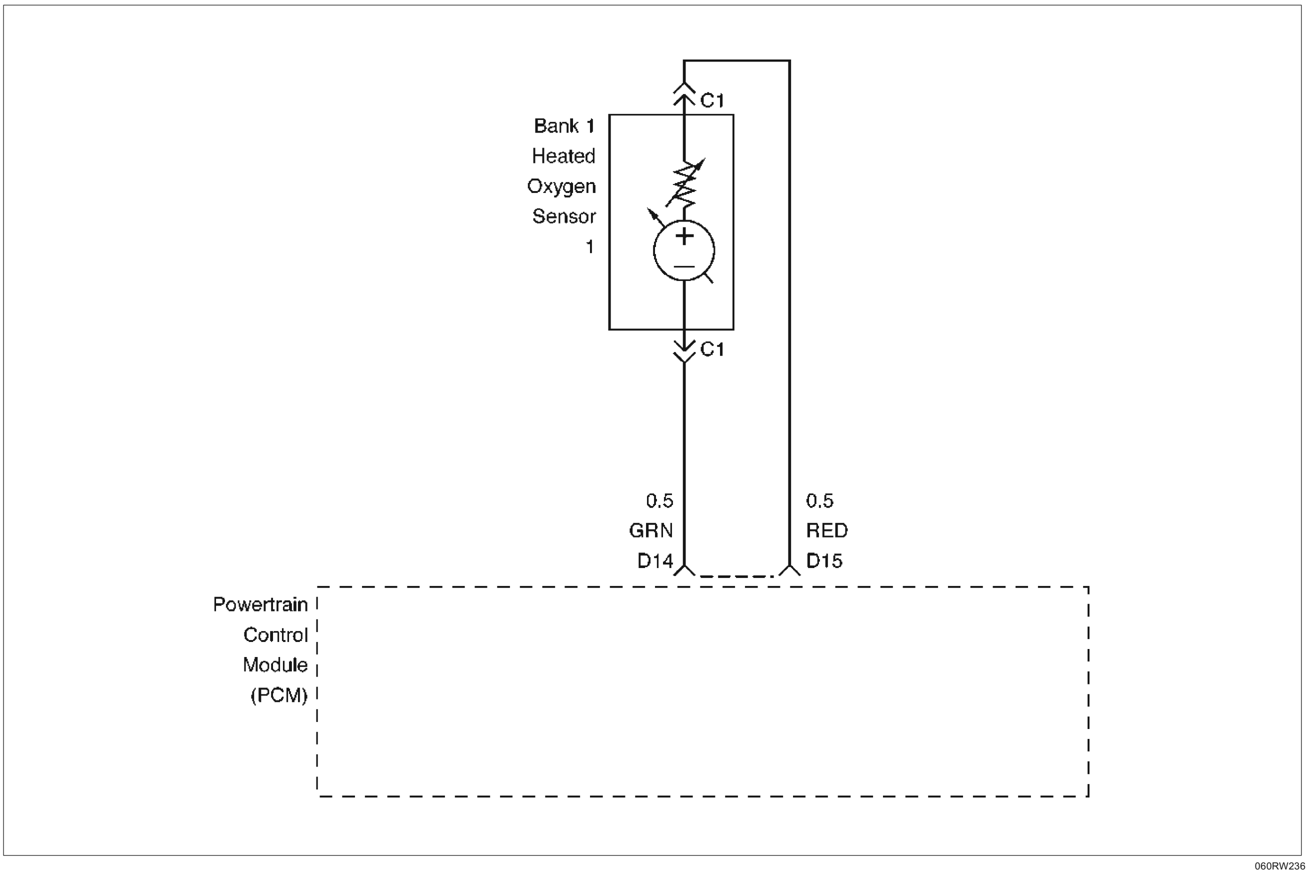
DTC P0131 –HO2S Circuit Low Voltage Bank 1 Sensor 1

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. Install the Tech 2. 2. Run the engine at operating temperature. 3. Operate the vehicle within the parameters specified under “Conditions for Setting the DTC” criteria included in Diagnostic Support. 4. Using a Tech 2, monitor Bank 1 HO2S 1 voltage. Does the Bank 1 HO2S 1 voltage remain below the specified value?	22 mV	Go to *Step 4*	Go to *Step 3*
3	1. Ignition “ON,” engine “OFF,” review and record Tech 2 Failure Records data and note parameters. 2. Operate the vehicle within Failure Records conditions as noted. 3. Using a Tech 2, monitor “Specific DTC” info for DTC P0131 until the DTC P0131 test runs. Note test result. Does Tech 2 indicate DTC P0131 failed this ignition?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	1. Turn the ignition “OFF.” 2. Disconnect the PCM. 3. Check the Bank 1 HO2S 1 high and low circuits for a short to ground or a short to the heater ground circuit. Are the Bank 1 HO2S 1 signal circuits shorted to ground?	—	Go to *Step 5*	Go to *Step 6*
5	Repair the Bank 1 HO2S 1 signal circuit. Is the action complete?	—	Verify repair	—
6	1. Turn the ignition “OFF,” HO2S 1 and PCM disconnected. 2. Check for continuity between the high and low signal circuits. Was there continuity between the high and low circuits?	—	Go to *Step 7*	Go to *Step 8*
7	Repair the short between the high and low circuits. Is the action complete?	—	Verify repair	—

DTC P0131 –HO2S Circuit Low Voltage Bank 1 Sensor 1 (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Ignition "OFF." 2. Reconnect the PCM, leave the sensor disconnected. 3. Ignition "ON." Does the Tech 2 indicate Bank 1 HO2S 1 voltage between the specified values?	425-475 mV	Refer to *Diagnostic Aids*	Go to *Step 9*
9	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0132 HO2S Circuit High Voltage Bank 1 Sensor 1



Circuit Description

The powertrain control module (PCM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO2S) signal and low circuits. When measured with a 10 megaohm digital voltmeter, this may display as low as 320 mV. The oxygen sensor varies the voltage within a range of about 1000 mV when exhaust is rich, down through about 10 mV when exhaust is lean. The PCM 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 Bank 1 HO2S 1 voltage remains excessively high for an extended period of time, DTC P0132 will be set.

Conditions for Setting the DTC

- No related DTCs.
- Engine coolant temperature is above 60°C (140°F)
- “Closed loop” commanded air/fuel ratio is between 14.5 and 14.8.
- Throttle angle is between 3% and 19%.
- Bank 1 HO2S 1 signal voltage remains above 952 mV during normal “closed loop” operation for a total of 77 seconds over a 90-second period.

OR

- Bank 1 HO2S 1 signal voltage remains above 500 mV during “deceleration fuel cutoff mode” operation for 3 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.
- “Open loop” fuel control will be in effect.

Conditions for Clearing the MIL/DTC

- DTC P0132 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check the following items:

- Fuel pressure – The system will go rich if pressure is too high. The PCM can compensate for some increase. However, if fuel pressure is too high, a DTC P0132 may be set. Refer to *Fuel System Diagnosis*.
- Perform “Injector Balance Test” – Refer to *Fuel System Diagnosis*.
- 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 TP 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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

3. DTC P0132 failing during "deceleration fuel cutoff mode" operation may indicate a condition described in the "Diagnostic Aids" above. If the DTC P0132 test passes while the Failure Records conditions are being duplicated, an intermittent condition is indicated.

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.

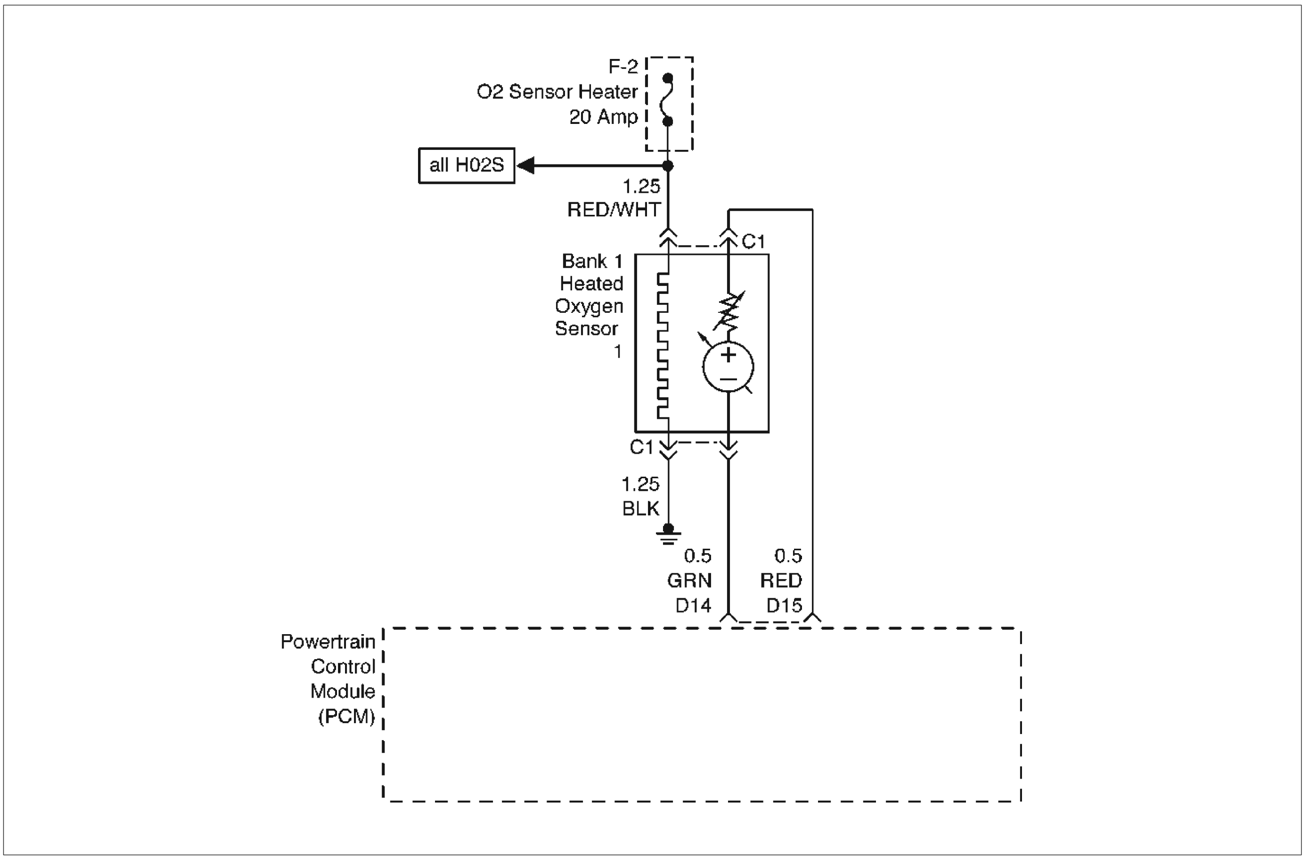
DTC P0132 – HO2S Circuit High Voltage Bank 1 Sensor 1

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. Install the Tech 2. 2. Run the engine at operating temperature. 3. Operate the vehicle within parameters specified under "Conditions for Setting the DTC" included in Diagnostic Support. 4. Using a Tech 2, monitor Bank 1 HO2S 1 voltage. Does the Bank 1 HO2S 1 voltage remain above the specified value?	952 mV (500 mV in deceleration fuel cutoff mode)	Go to *Step 4*	Go to *Step 3*
3	1. Ignition "ON," review and record Tech 2 Failure Records data. 2. Operate the vehicle within Failure Records conditions as noted. 3. Using a Tech 2, monitor "Specific DTC" info for DTC P0132 until the DTC P0132 test runs. 4. Note the test result. Does the Tech 2 indicate DTC P0132 failed this ignition?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	1. Ignition "OFF." 2. Disconnect Bank 1 HO2S 1. 3. Ignition "ON." 4. At HO2S Bank 1 Sensor 1 connector (PCM side) use a DVM to measure voltages at the high and low signal terminals. Are the voltages in the specified range?	3-4 V	Go to *Step 5*	Go to *Step 6*
5	Repair short to voltage in signal circuit. Is the action complete?	—	Verify repair	—

DTC P0132 – HO2S Circuit High Voltage Bank 1 Sensor 1 (Cont'd)

Step	Action	Value(s)	Yes	No
6	1. Ignition "ON," engine"OFF." 2. At Bank 1 HO2S 1 connector (PCM side) jumper both the HO2S high and low signal circuits (PCM side) to ground. 3. Using a Tech 2, monitor Bank 1 HO2S 1 voltage. Is Bank 1 HO2S 1 voltage below the specified value?	10 mV	Go to *Step 7*	Go to *Step 8*
7	1. Disconnect the jumpers to ground from Bank 1 HO2S 1 PCM-side connector. 2. With the HO2S 1 connector disconnected, monitor Bank 1 HO2S 1 voltage. Is Bank 1 HO2S 1 voltage between the specified values?	425-475 mV	Refer to *Diagnostic Aids*	Go to *Step 8*
8	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0134 HO2S Circuit Insufficient Activity Bank 1 Sensor 1



060RW237

Circuit Description

- The powertrain control module (PCM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO2S) high and low circuits. When measured with a 10 megaohm digital voltmeter, this may display as low as 320 mV. The oxygen sensor varies the voltage within a range of about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean. The PCM 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 Bank 1 HO2S 1 voltage remains at or near the 450 mV bias for an extended period of time, DTC P0134 will be set, indicating an open sensor signal or sensor low circuit.
- Heated oxygen sensors are used to minimize the amount of time required for "closed loop" fuel control operation and to allow accurate catalyst monitoring. The oxygen sensor heater greatly decreases the amount of time required for fuel control sensors Bank 1 HO2S 1 and Bank 2 HO2S 1 to become active.
- Oxygen sensor heaters are required by post-catalyst monitor sensors to maintain a sufficiently high temperature for accurate exhaust oxygen content readings further from the engine.

Conditions for Setting the DTC

- No related DTCs.
- Battery voltage is above 10 volts.
- Engine run time is longer than 40 seconds.
- Oxygen sensor heater has been determined to be functioning properly.
- Bank 1 HO2S 1 signal voltage remains between 400 mV and 500 mV for a total of 77 seconds over a 90-second period of time.

Action Take When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.
- "Open loop" fuel control will be in effect.

Conditions for Clearing the MIL/DTC

- DTC P0134 can be cleared by using Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

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 1 voltage displayed on 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. Disconnect the HO2S and connect a test light between the HO2S ignition feed and heater ground circuits. If the test light does not light for 2 seconds when the ignition is turned on, repair the open ignition feed or sensor ground circuit as necessary. If the test light lights and the HO2S signal and low circuits are OK, replace the HO2S.

- 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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

3. If the DTC P0134 test passes while the Failure Records conditions are being duplicated, an intermittent conditions is indicated.

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.

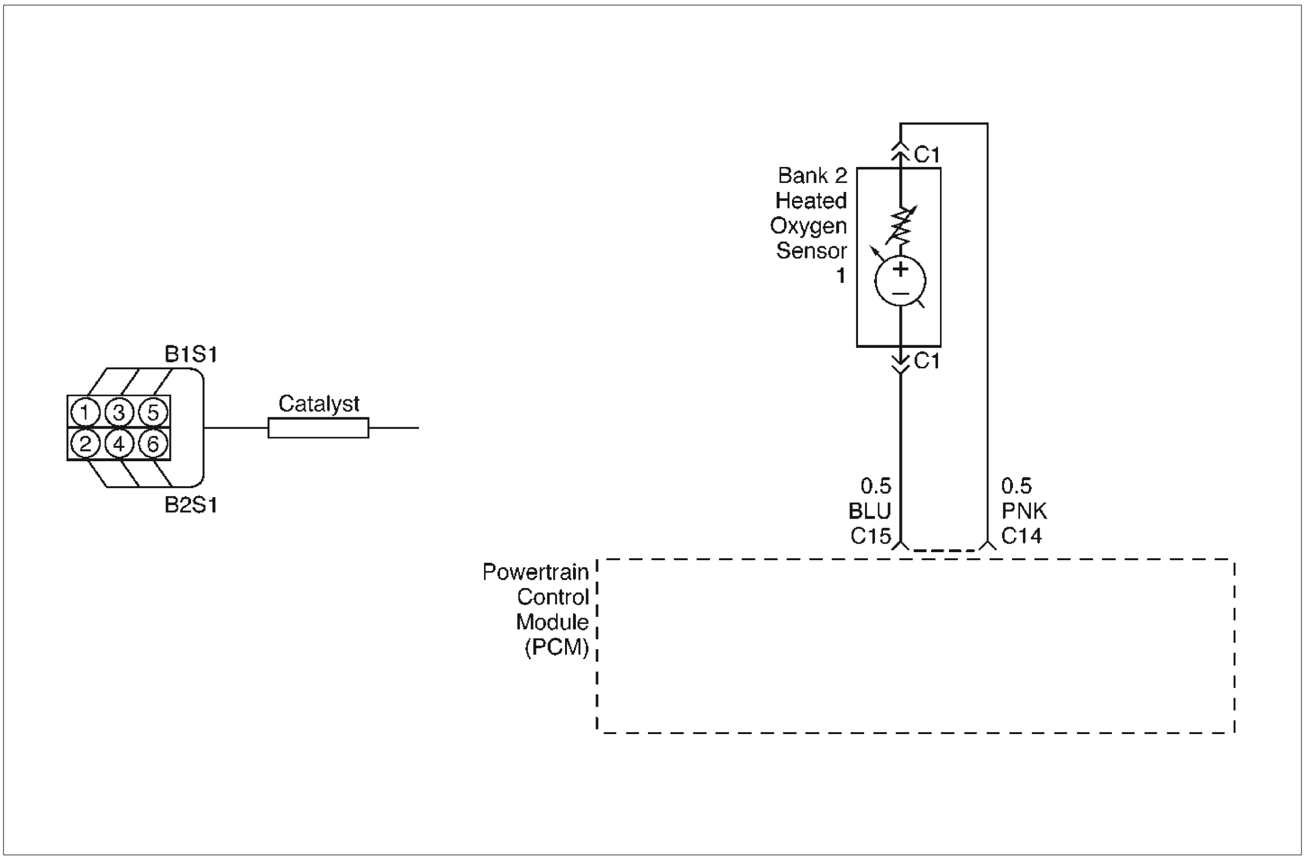
DTC P0134 –HO2S Circuit Insufficient Activity Bank 1 Sensor 1

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. Install Tech 2. 2. Run the engine at operating temperature. 3. Operate the engine above 1200 RPM for two minutes. Does Tech 2 indicate Bank 1 HO2S 1 voltage varying outside the specified values?	400-500 mV	Go to *Step 3*	Go to *Step 4*
3	1. Ignition "ON," engine "OFF," review and record Tech 2 Failure Records data and note parameters. 2. Operate the vehicle within Failure Records conditions as noted. 3. Using Tech 2, monitor "Specific DTC" info for DTC P0134 until the DTC P0134 test runs. 4. Note the test result. Does Tech 2 indicate DTC P0134 failed this ignition?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	Check for a damaged harness. Was a problem found?	—	Verify repair	Go to *Step 5*
5	Check for poor Bank 1 HO2S 1 high and low circuit terminal connections at the Bank 1 HO2S 1 harness connector and replace terminal(s) if necessary. Did any terminals require replacement?	—	Verify repair	Go to *Step 6*
6	Check for poor Bank 1 HO2S 1 high and low circuit terminal connections at the PCM and replace terminals if necessary. Did any terminals require replacement?	—	Verify repair	Go to *Step 7*
7	1. Ignition "OFF." 2. With the PCM disconnected, check continuity of the Bank 1 HO2S 1 high circuit. 3. If the Bank 1 HO2S 1 high circuit measures over 5.0 ohms, repair open or poor connection as necessary. Was a Bank 1 HO2S 1 high circuit problem found and corrected?	—	Verify repair	Go to *Step 8*

DTC P0134 –HO2S Circuit Insufficient Activity Bank 1 Sensor 1 (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Ignition "OFF." 2. With the PCM disconnected, check continuity of the Bank 1 HO2S 1 low circuit. 3. If the Bank 1 HO2S 1 low circuit measures over 5 ohms, repair open or poor connection as necessary. Was a Bank 1 HO2S 1 low circuit problem found and corrected?	—	Verify repair	Go to *Step 9*
9	1. Ignition "ON," engine "OFF." 2. Disconnect Bank 1 HO2S 1 and jumper the HO2S high and low circuits (PCM side) to ground. 3. Using Tech 2, monitor Bank 1 HO2S 1 voltage. Is Bank 1 HO2S 1 voltage in the specified range?	0-10 mV	Go to *Step 10*	Go to *Step 11*
10	Replace Bank 1 HO2S 1. Is the action complete?	—	Verify repair	—
11	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0151 HO2S Circuit Low Voltage Bank 2 Sensor 1



060RW190

Circuit Description

The powertrain control module (PCM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO2S) signal high and signal low circuits. When measured with a 10 megaohm digital voltmeter, this may display as low as 320 mV. The oxygen sensor varies the voltage within a range of about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean. The PCM 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 Bank 2 HO2S 1 voltage remains excessively low for an extended period of time, DTC P0151 will be set.

Conditions for Setting the DTC

- No related DTCs.
- The engine is operating in "closed loop."
- Engine coolant temperature is above 60°C (140°F).
- "Closed loop" commanded air/fuel ratio is between 14.5 and 14.8.
- Throttle angle is between 3% and 19%.
- Bank 2 HO2S 1 signal voltage remains below 22 mV during normal "closed loop" operation for a total of 77 seconds over a 90-second period of time.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.
- "Open loop" fuel control will be in effect.

Conditions for Clearing the MIL/DTC

- DTC P0151 can be cleared by using Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Heated oxygen sensor wiring – The sensor pigtail may be mispositioned and contacting the exhaust system.
- Poor PCM to engine block grounds.
- Fuel pressure – The system will go lean if pressure is too low. The PCM can compensate for some decrease. However, if fuel pressure is too low, a DTC P0151 may be set. Refer to *Fuel System Diagnosis*.
- Lean injector(s) – Perform "Injector Balance Test."
- Vacuum leaks – Check for disconnected or damaged vacuum hoses and for vacuum leaks at the intake manifold, throttle body, EGR system, and PCV system.
- 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 *Fuel System Diagnosis* for the procedure to check for fuel contamination.
- If none of the above conditions are present, replace the affected HO2S.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

3. DTC P0151 failing during operation may indicate a condition described in the “Diagnostic Aids” above. If the DTC P0151 test passes while the Failure Records conditions are being duplicated, an intermittent condition is indicate.

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.

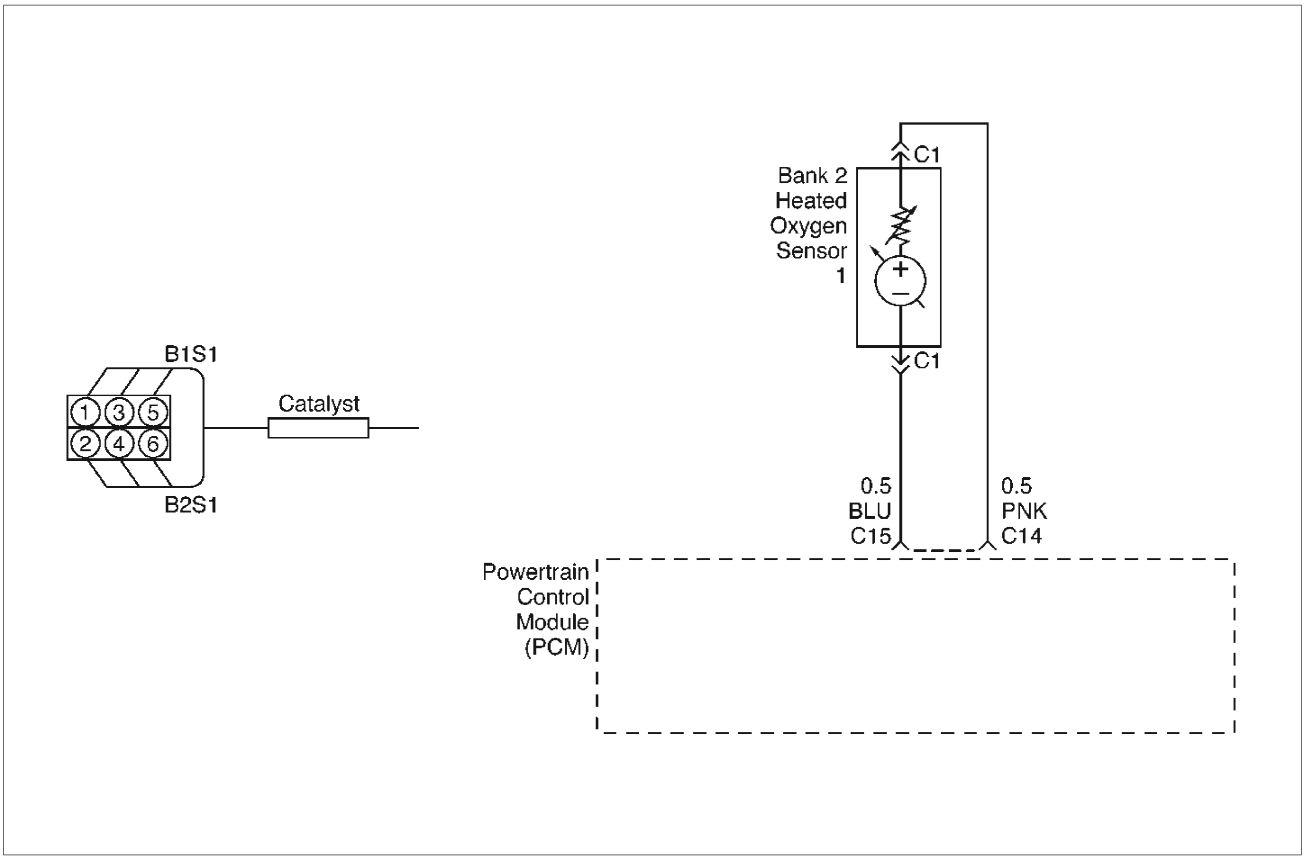
DTC P0151 – HO2S Circuit Low Voltage Bank 2 Sensor 1

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install Tech 2. 2. Run the engine at operating temperature. 3. Operate the vehicle within the parameters specified under “Conditions for Setting the DTC” criteria included in Diagnostic Support. 4. Using Tech 2, monitor Bank 2 HO2S 1 voltage. Does the Bank 2 HO2S 1 voltage remain below the specified value?	22 mV	Go to *Step 4*	Go to *Step 3*
3	1. Ignition “ON,” engine “OFF,” review and record Tech 2 Failure Records data and note parameters. 2. Operate the vehicle within Failure Records conditions as noted. 3. Using Tech 2, monitor “Specific DTC” info for DTC P0151 until the DTC P0151 test runs. 4. Note test result. Does Tech 2 indicate DTC P0151 failed this ignition?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	1. Turn ignition “OFF.” 2. Disconnect the PCM. 3. Check the Bank 2 HO2S 1 high and low signal circuits for a short to ground or a short to the heater ground circuit. Were Bank 2 HO2S 1 signal circuits shorted?	—	Go to *Step 5*	Go to *Step 6*
5	Repair the Bank 2 HO2S 1 signal circuit. Is the action complete?	—	Verify repair	—
6	1. Ignition “OFF.” 2. Leave the PCM and HO2S 1 disconnected. 3. Check for continuity between the high and low signal circuits. Was there continuity between the high and low circuits?	—	Go to *Step 7*	Go to *Step 8*
7	Repair the short between the high and low circuits. Is the action complete?	—	Verify repair	—

DTC P0151 – HO2S Circuit Low Voltage Bank 2 Sensor 1 (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Ignition "OFF." 2. Reconnect the PCM, leave HO2S 2 disconnected. 3. Ignition "ON." Does Tech 2 indicate Bank 2 HO2S 1 voltage near the specified value?	425-475 mV	Refer to *Diagnostic Aids*	Go to *Step 9*
9	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0152 HO2S Circuit HIGH Voltage Bank 2 Sensor 1



060RW190

Circuit Description

The powertrain control module (PCM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO2S) signal high and signal low circuits. When measured with a 10 megaohm digital voltmeter, this may display as low as 320 mV. The oxygen sensor varies the voltage within a range of about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean. The PCM constantly monitors the HO2S signal during "closed loop" operation and compensates for a rich or lean condition by decreasing or increasing the injector pulse width as necessary. If the Bank 2 HO2S 1 voltage remains excessively high for an extended period of time, DTC P0152 will be set.

Conditions for Setting the DTC

- No related DTCs.
- The engine is operating in "closed loop."
- The engine coolant temperature is above 60°C (140°F).
- "Closed loop" commanded air/fuel ratio between 14.5 and 14.8.
- Throttle angle between 3% and 19%.
- Bank 2 HO2S 1 signal voltage remains above 952 mV during normal "closed loop" operation for a total of 77 seconds over a 90-second period.

OR

- Bank 2 HO2S 1 signal voltage remains above 500 mV during deceleration fuel cutoff mode operation for up to 3 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.
- "Open loop" fuel control will be in effect.

Conditions for Clearing the MIL/DTC

- DTC P0152 can be cleared by using Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Fuel pressure – The system will go rich if pressure is too high. The PCM can compensate for some increase. However, if fuel pressure is too high, a DTC P0152 may be set. Refer to *Fuel System Diagnosis*.
- Rich injector(s) – Perform "Injector Balance Test."
- Leaking injector – Refer to *Fuel System Diagnosis*.
- Evaporative emissions (EVAP) system – Check the canister for fuel saturation. If the canister is full of fuel, check EVAP control system components and hoses. Refer to *Evaporative Emission (EVAP) Control System*.

- MAF sensor – The system can go rich if the MAF sensor signal indicates an engine airflow measurement that is not correct. Disconnect the MAF sensor to see if rich condition is corrected. If so, replace MAF sensor.
- Check for leaking fuel pressure regulator diaphragm by checking vacuum line to regulator for the presence of fuel. There should be no fuel in the vacuum line.
- TP sensor – An intermittent TP 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 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 cause a high HO2S voltage to be indicated. This condition is indicated by 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 of 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 switch between the rich and lean thresholds can also cause the condition. Operate the vehicle while monitoring the HO2S voltage with Tech 2. If the HO2S is limited within a range between 300 mV to 600 mV, check the HO2S signal circuit wiring and associated terminal connections.
- If none of the above conditions are present, replace the affected HO2S.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

3. DTC P0152 failing during deceleration fuel cutoff mode operation may indicate a condition described in the “Diagnostic Aids” above. If the DTC P0152 test passes while the Failure Records conditions are being duplicated, an intermittent condition is indicated.

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.

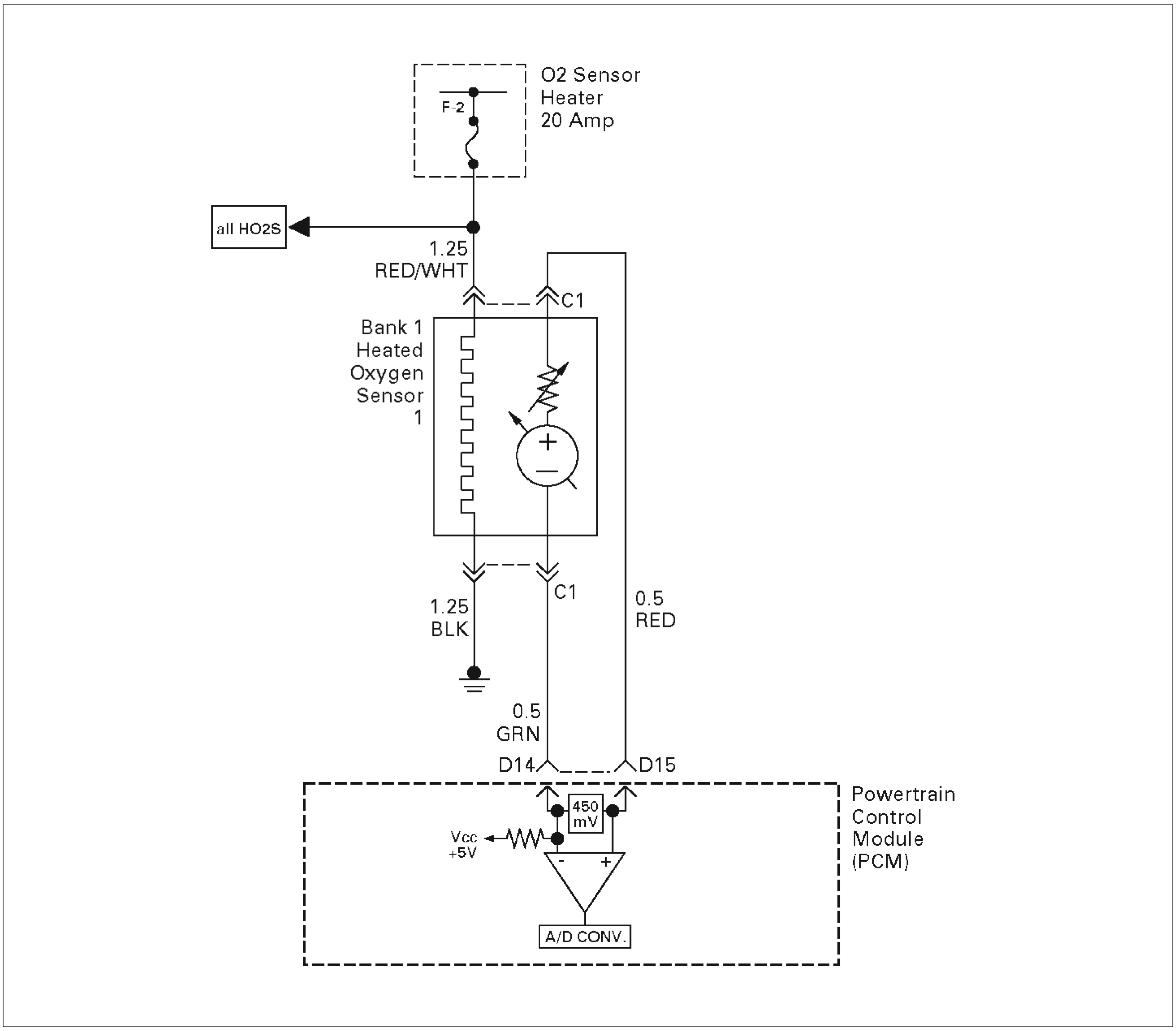
DTC P0152 – HO2S Circuit High Voltage Bank 2 Sensor 1

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install Tech 2. 2. Engine is at operating temperature. 3. Operate the vehicle within the parameters specified under “Conditions for Setting the DTC” criteria included in Diagnostic Support. 4. Using Tech 2, monitor Bank 2 HO2S 1 voltage. Does the Bank 2 HO2S 1 voltage remain above the specified value?	952 mV (500 mV in deceleration fuel cut-off mode)	Go to *Step 4*	Go to *Step 3*
3	1. Ignition “ON.” 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using Tech 2, monitor “Specific DTC” info for DTC P0152 until the DTC P0152 test runs. 5. Note the test result. Does Tech 2 indicate DTC P0152 failed this ignition?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	1. Ignition “OFF.” 2. Disconnect Bank 2 HO2S 1. 3. Ignition “ON.” 4. At HO2S Bank 2 Sensor 1 connector (PCM side) use a DVM to measure voltages at the high and low signal terminals. Are the voltages in the specified range?	3-4 V	Go to *Step 5*	Go to *Step 6*
5	Repair short to voltage in signal circuit. Is the action complete?	—	Verify repair	—

DTC P0152 – HO2S Circuit High Voltage Bank 2 Sensor 1 (Cont'd)

Step	Action	Value(s)	Yes	No
6	1. Ignition "ON," engine"OFF." 2. At Bank 2 HO2S 1 connector (PCM side) jumper both the HO2S high and low signal circuits (PCM side) to ground. 3. Using Tech 2, monitor Bank 2 HO2S 1 voltage. Is Bank 2 HO2S 1 voltage below the specified value?	10 mV	Go to *Step 7*	Go to *Step 8*
7	1. Disconnect the jumpers to ground from Bank 2 HO2S 1 PCM-side connector. 2. With the HO2S 1 connector disconnected, monitor Bank 2 HO2S 1 voltage. Is the Bank 2 HO2S 1 voltage between the specified values?	425-475 mV	Refer to *Diagnostic Aids*	Go to *Step 8*
8	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0171 Fuel Trim System Lean Bank 1



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 powertrain control module (PCM) monitors the Bank 1 HO2S 1 and Bank 2 HO2S 1 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 PCM 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 PCM is reducing the amount of fuel delivered. If an excessively lean condition is detected on Bank 1, the PCM will set DTC P0171.

The PCM's maximum authority to control long term fuel trim allows a range between –15% (automatic transmission) or –12% (manual transmission) and +20%. The PCM monitors fuel trim under various engine speed/load fuel trim cells before determining the status of the fuel trim diagnostic.

Conditions for Setting the DTC

- No Tech 2 test is being run.
- None of the following: EGR DTCs, HO2S DTCs, (response, transition, open, low volts, no activity), MAF DTCs, TP sensor DTCs, MAP DTCs, IAT DTCs, canister purge DTCs, EVAP DTCs, injector circuit DTCs, or misfire DTCs.
- Engine coolant temperature is between 25°C (77°F) and 100°C (212°F).
- Intake air temperature is between –40°C (–40°F) and 120°C (248°F).
- Manifold absolute pressure is between 24 kPa and 99 kPa.
- Throttle angle is steady below 95%.
- Vehicle speed is below 136 km/h (85 mph).
- Engine speed is between 400 and 6,000 RPM.
- Barometric pressure is greater than 72.5 kPa.

- Mass air flow is between 2 g/second and 200 g/second.
- Ignition voltage is above 9.5 volts.
- Fuel system is in “closed loop.”

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0171 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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 Bank 1 HO2S 1 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.

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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. DTCs other than P0171 and P0174 may indicate a condition present which may cause a lean condition. If this is the case, repairing the condition which caused the other DTC will most likely correct the DTC P0171/P0174.
4. If the DTC P0171 test passes while the Failure Records conditions are being duplicated, the lean condition is intermittent. Refer to *Diagnostic Aids* or *Symptoms* for additional information on diagnosing intermittent problems.

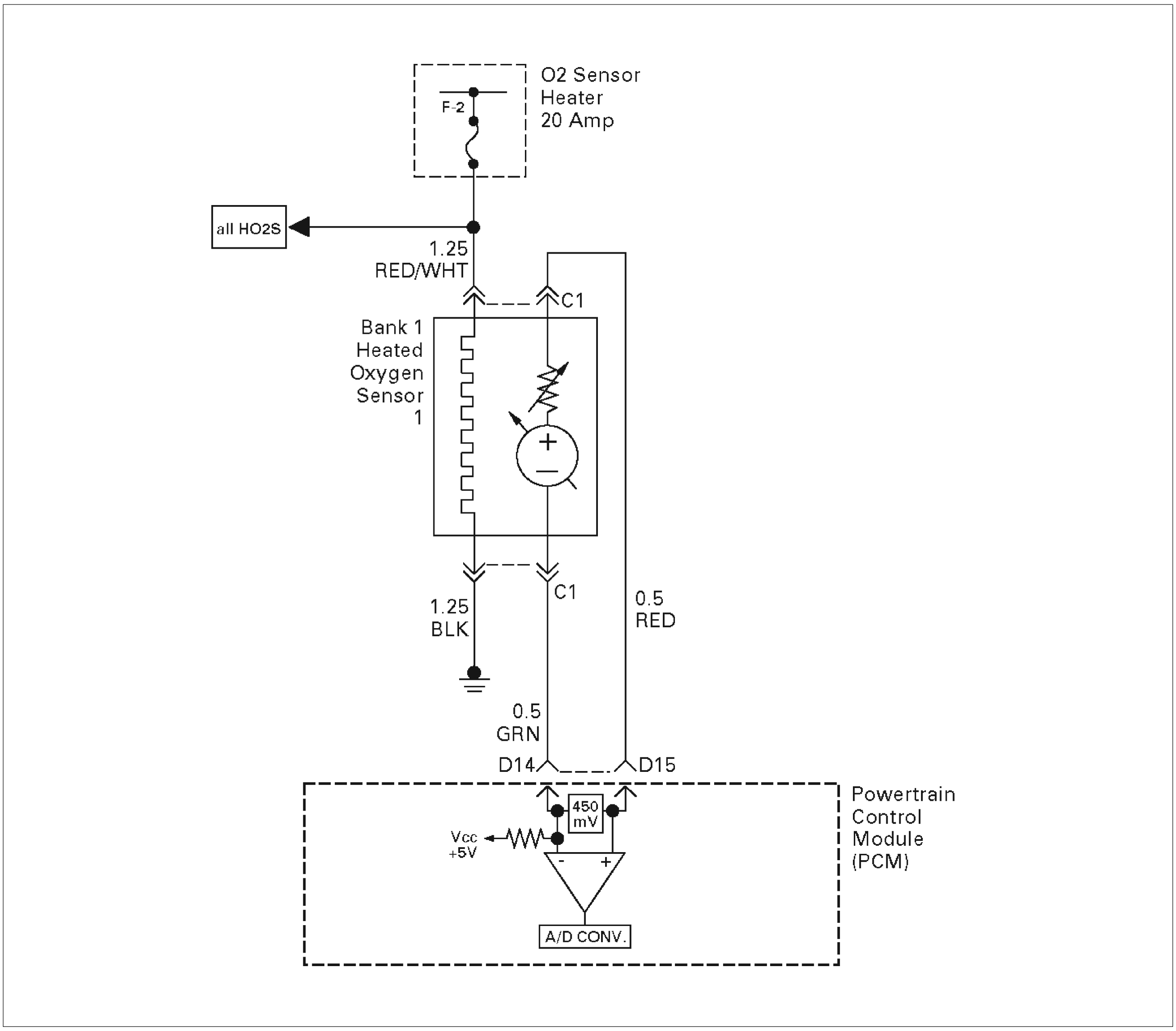
DTC P0171 – Fuel Trim System Lean Bank 1

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	Are any DTCs set other than P0171 and P0174?	—	Go to the applicable DTC charts and repair the other DTCs before proceeding with this chart	Go to *Step 3*
3	1. Start the engine and operate the vehicle in "closed loop." 2. Observe the "BANK 1 L.T. FUEL TRIM" display on the Tech 2. Is the displayed value greater than the specified value?	L.T. Fuel Trim: +20%	Go to *Step 5*	Go to *Step 4*
4	1. Review and record the Tech 2 Failure Records data. 2. Clear the DTC P0171/P0174 and operate the vehicle to duplicate the Failure Records conditions. 3. Monitor the Tech 2 "Specific DTC" info for DTC P0171 while operating the vehicle to duplicate the Failure Records conditions. 4. Continue operating the vehicle until the DTC P0171 test runs and note the test result. Does the Tech 2 indicate DTC P0171 failed this ignition?	—	Go to *Step 5*	The lean condition is not present. If a driveability symptom still exists, refer to *Symptoms* section.
5	Was DTC P0174 also set?	—	Go to *Step 6*	Go to *Step 15*
6	Visually and physically inspect the vacuum hoses for disconnects, splits, kinks, improper routing and improper connections and repair any problem found. Did your inspection reveal a problem requiring repair?	—	Verify repair	Go to *Step 7*
7	Visually and physically inspect the crankcase ventilation valve for proper installation and repair any problem found (refer to *Crankcase Ventilation System*). Did your inspection reveal a problem requiring repair?	—	Verify repair	Go to *Step 8*
8	1. Inspect the MAF sensor inlet screen for damage or for the presence of foreign objects which may partially block the air flow sample through the MAF sensor. 2. Correct any problem that is found as necessary. Did your inspection of the MAF sensor reveal a condition requiring repair?	—	Verify repair	Go to *Step 9*
9	Start the engine and note the idle quality. Is a high or unsteady idle being experienced?	—	Go to *Step 10*	Go to *Step11*
10	1. Visually and physically inspect the throttle body, intake manifold, EGR valve and the EGR feed pipe for vacuum leaks. 2. Repair any vacuum leaks as necessary. Did your inspection reveal a vacuum leak?	—	Verify repair	Go to *Step 11*

DTC P0171 – Fuel Trim System Lean Bank 1 (Cont'd)

Step	Action	Value(s)	Yes	No
11	Check the fuel for excessive water, alcohol, or other contaminants (see *Diagnosis* in *Engine Fuel* for the procedure) and correct the contaminated fuel condition if present (see *Engine Fuel*). Was the fuel contaminated?	—	Verify repair	Go to *Step 12*
12	1. Visually and physically inspect the PCM injector grounds, power grounds and sensor grounds to ensure that they are clean, tight, and in their proper locations. 2. If a faulty ground condition is present, correct it as necessary. Did your inspection reveal a condition requiring repair?	—	Verify repair	Go to *Step 13*
13	1. Disconnect the MAF sensor electrical connector. 2. Operate the vehicle in "closed loop" while monitoring the "BANK 1 S.T. FUEL TRIM" displayed on the Tech 2. Does "BANK 1 S.T. FUEL TRIM" value decrease to near the specified value?	0%	Go to *Step 19*	Go to *Step 14*
14	Perform the procedure in the "Fuel System Pressure Test" and repair fuel system problem if necessary. Did Fuel System Pressure Test isolate a condition requiring repair?	—	Verify repair	Go to *Step 15*
15	1. Visually and physically inspect the intake manifold, injector O-rings, EGR adapter, EGR valve and the EGR feed pipes for vacuum leaks. 2. Repair any problem that is found. Did your inspection reveal a problem?	—	Verify repair	Go to *Step 16*
16	Visually and physically inspect the Bank 1 exhaust manifold for leaks and loose or missing hardware and correct any problem found. Did your inspection reveal a problem?	—	Verify repair	Go to *Step 17*
17	Perform the "Injector Balance Test," and correct any problem found (refer to *Fuel Metering System*). Did Injector Balance Test isolate a problem?	—	Verify repair	Go to *Step 18*
18	1. Visually and physically inspect the Bank 1 HO2S 1 to ensure that it is installed securely and that the Bank 1 HO2S 1 pigtail and wiring harness are not contacting the exhaust or otherwise damaged. 2. If a problem is found, correct it as necessary. Did your inspection reveal a problem?	—	Verify repair	Refer to *Diagnostic Aids*
19	Replace the MAF sensor. Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0172 Fuel Trim System Rich Bank 1



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 powertrain control module (PCM) monitors the Bank 1 heated oxygen sensors (HO2S) 1 and Bank 2 HO2S 1 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 PCM 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 PCM is reducing the amount of fuel delivered. If an excessively rich condition is detected on Bank 1, the PCM will set DTC P0172.

The PCM's maximum authority to control long term fuel trim allows a range between –15% (automatic transmission) or –12 (manual transmission) and +20%. The PCM's maximum authority to control short term fuel trim allows a range between –11% and +20%. The PCM monitors fuel trim under various engine speed/load fuel trim cells before determining the status of the fuel trim diagnostic.

Conditions for Setting the DTC

- No Tech 2 test is being run.
- None of the following was set: EGR DTCs, HO2S DTCs, (response, transition, open, low volts, no activity), MAF DTCs, TPS DTCs, MAP DTCs, IAT DTCs, canister purge DTCs, EVAP DTCs, injector circuit DTCs, or misfire DTCs.
- Engine coolant temperature is between 25°C (77°F) and 100°C (212°F).
- Intake air temperature is between –40°C (–40°F) and 120°C (248°F).
- Manifold absolute pressure is between 24 kPa and 99 kPa.
- Throttle angle is steady below 95%.

- Vehicle speed is below 136 km/h (85 mph).
- Engine speed is between 400 and 6,000 RPM.
- Barometric pressure is greater than 72.5 kPa.
- Mass air flow is between 2 g/second and 200 g/second.
- Ignition voltage is above 9.5 volts.
- Fuel system is in “closed loop.”

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0172 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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 Bank 1 HO2S 1 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.

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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. DTCs other than P0172 and P0175 may indicate a condition present which may cause a lean condition. If this is the case, repairing the condition which caused the other DTC will most likely correct the DTC P0172/P0175.

4. If the DTC P0172 test passes while the Failure Records conditions are being duplicated, the rich condition is intermittent. Refer to *Diagnostic Aids* or *Symptoms* for additional information on diagnosing intermittent problems.

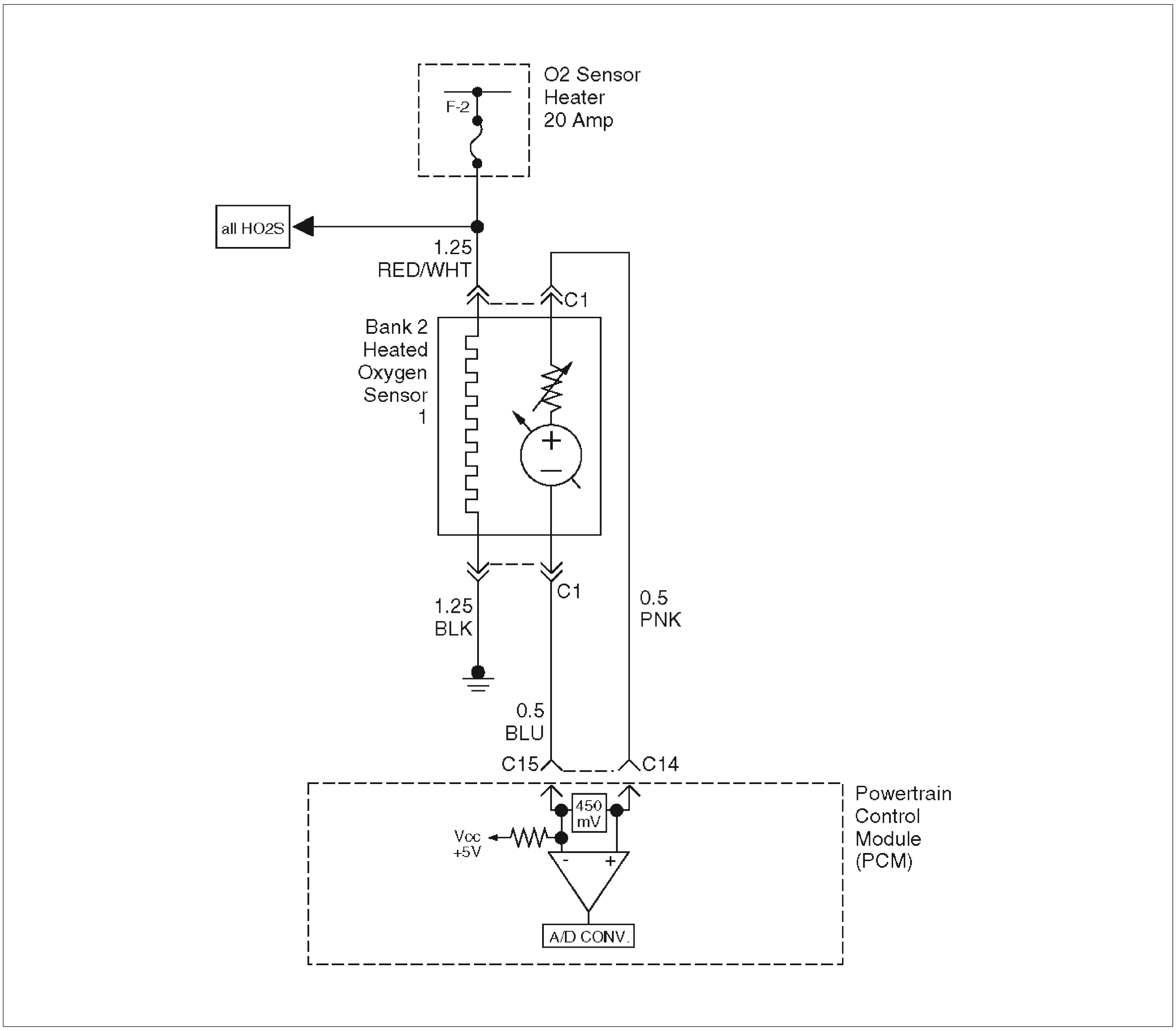
DTC P0172 – Fuel Trim System Rich Bank 1

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	Are any DTCs set other than P0172 and P0175?	—	Go to the applicable DTC charts and repair the other DTCs before proceeding with this chart	Go to *Step 3*
3	1. Start the engine and operate the vehicle in “closed loop.” 2. Observe “B1 Long Term Fuel Trim” display on the Tech 2. Is the displayed value more negative than the specified value?	L.T. Fuel Trim: –15% (auto. trans.) OR –12% (man. trans.)	Go to *Step 5*	Go to *Step 4*
4	1. Review and record the Tech 2 Failure Records data. 2. Clear the DTC P0172/P0175 and operate the vehicle to duplicate the Failure Records conditions. 3. Monitor the Tech 2 “DTC” info for DTC P0172 while operating the vehicle to duplicate the Failure Records conditions. 4. Continue operating the vehicle until the DTC P0172 test runs and note test result. Does the Tech 2 indicate DTC P0172 failed this ignition?	—	Go to *Step 5*	The rich condition is not present. If a driveability symptom still exists, refer to *Symptoms*.
5	Is DTC P0175 also set?	—	Go to *Step 6*	Go to *Step 15*
6	Visually and physically inspect the air filter element and replace it if necessary. Did the air filter require replacement?	—	Verify repair	Go to *Step 7*
7	Visually and physically inspect the air intake duct for collapse or restriction and repair if necessary. Did your inspection reveal a condition requiring repair?	—	Verify repair	Go to *Step 8*
8	Inspect the MAF sensor inlet screen for damage or for the presence of foreign objects which may partially block air flow through the screen and correct any problem found. Did your inspection of the MAF sensor reveal a condition requiring repair or replacement?	—	Verify repair	Go to *Step 9*
9	Start the engine and note the idle quality. Is a low or unsteady idle being experienced?	—	Go to *Step 10*	Go to *Step 11*
10	1. Ignition “OFF.” 2. Physically inspect the throttle body bore, throttle plate, and IAC passages for coking and foreign objects. 3. If a problem was found, repair as necessary. Did your inspection reveal a condition requiring repair?	—	Verify repair	Go to *Step 11*

DTC P0172 – Fuel Trim System Rich Bank 1 (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Disconnect the vacuum hose from the fuel pressure regulator and inspect the hose for the presence of fuel. 2. If fuel is present in the vacuum hose, replace the fuel pressure regulator (refer to *Fuel Metering System*). Did the fuel pressure regulator require replacement?	—	Verify repair	Go to *Step 12*
12	Ignition "ON," engine "OFF," monitor the TP Angle display on the Tech 2 while slowly depressing the accelerator pedal. Does the TP Angle display increase steadily and evenly from minimum value at closed throttle to maximum value at wide-open throttle?	Minimum 0% Maximum 100%	Go to *Step 13*	Go to *Step 18*
13	1. Disconnect the MAF sensor electrical connector. 2. Operate the vehicle in "closed loop" while monitoring the "BANK 1 L.T. FUEL TRIM" and "BANK 1 S. T. FUEL TRIM" display on the Tech 2. Did both values change to near the specified value?	0%	Go to *Step 19*	Go to *Step 14*
14	1. Perform "Fuel System Pressure Test." 2. If Fuel System Pressure Test isolates a problem, repair as necessary (refer to *Engine Fuel* or *Fuel Metering System*). Did the Fuel System Pressure Test isolate a problem requiring repair?	—	Verify repair	Go to *Step 16*
15	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—
16	1. Perform the "Injector Balance Test." 2. If Injector Balance Test isolates a problem, repair as necessary (refer to *Fuel Metering System*). Did the Injector Balance Test isolate a problem requiring repair?	—	Verify repair	Go to *Step 17*
17	1. Remove and visually/physically inspect the Bank 1 HO2S 1 for silicon contamination. This will be indicated by a powdery white deposit on the portion of the HO2S that is exposed to the exhaust stream. 2. If contamination is evident on the Bank 1 HO2S 1, replace the contaminated sensors. Did the sensor require replacement?	—	Verify repair	Refer to *Diagnostic Aids*
18	1. Check the TP sensor mounting screws and tighten or replace them as necessary if they are loose or missing. 2. If the screws are OK, replace the TP sensor. Is the action complete?	—	Verify repair	—
19	Replace the MAF sensor. Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0174 Fuel Trim System Lean Bank 2



D06RW031

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 powertrain control module (PCM) monitors the Bank 1 HO2S 1 and Bank 2 HO2S 1 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 PCM 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 PCM is reducing the amount of fuel delivered. If an excessively lean condition is detected on Bank 2, the PCM will set DTC P0174.

The PCM's maximum authority to control long term fuel trim allows a range between –15%(automatic transmission) or –12%(manual transmission) and +20%. The PCM monitors fuel trim under various engine speed/load fuel trim cells before determining the status of the fuel trim diagnostic.

Conditions for Setting the DTC

- No Tech 2 test is being run.
- None of the following DTCs are set: idle system, EGR, HO2S, (response, transition, open, low volts, no activity), MAF, TP sensor, MAP, IAT, canister purge, EVAP, injector circuit, or misfire.
- Engine coolant temperature is between 25°C (77°F) and 100°C (212°F).
- Intake air temperature is between –40°C (–40°F) and 120°C (248°F).
- Manifold absolute pressure is between 24 kPa and 99 kPa.
- Throttle angle is steady below 95%.
- Vehicle speed is below 136 km/h (85 mph).
- Engine speed is between 400 and 6,000 RPM.
- Barometric pressure is greater than 72.5 kPa.
- Mass air flow is between 2 g/second and 200 g/second.

- Ignition voltage is above 9.5 volts.
- Fuel system is in “closed loop.”

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the failure is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0174 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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 Bank 2 HO2S 1 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.

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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. DTCs other than P0171 and P0174 may indicate a condition present which may cause a lean condition. If this is the case, repairing the condition which caused the other DTC will most likely correct the DTC P0171/P0174.

4. If the DTC P0174 test passes while the Failure Records conditions are being duplicated, the lean condition is intermittent. Refer to *Diagnostic Aids* or *Symptoms* for additional information on diagnosing intermittent problems.

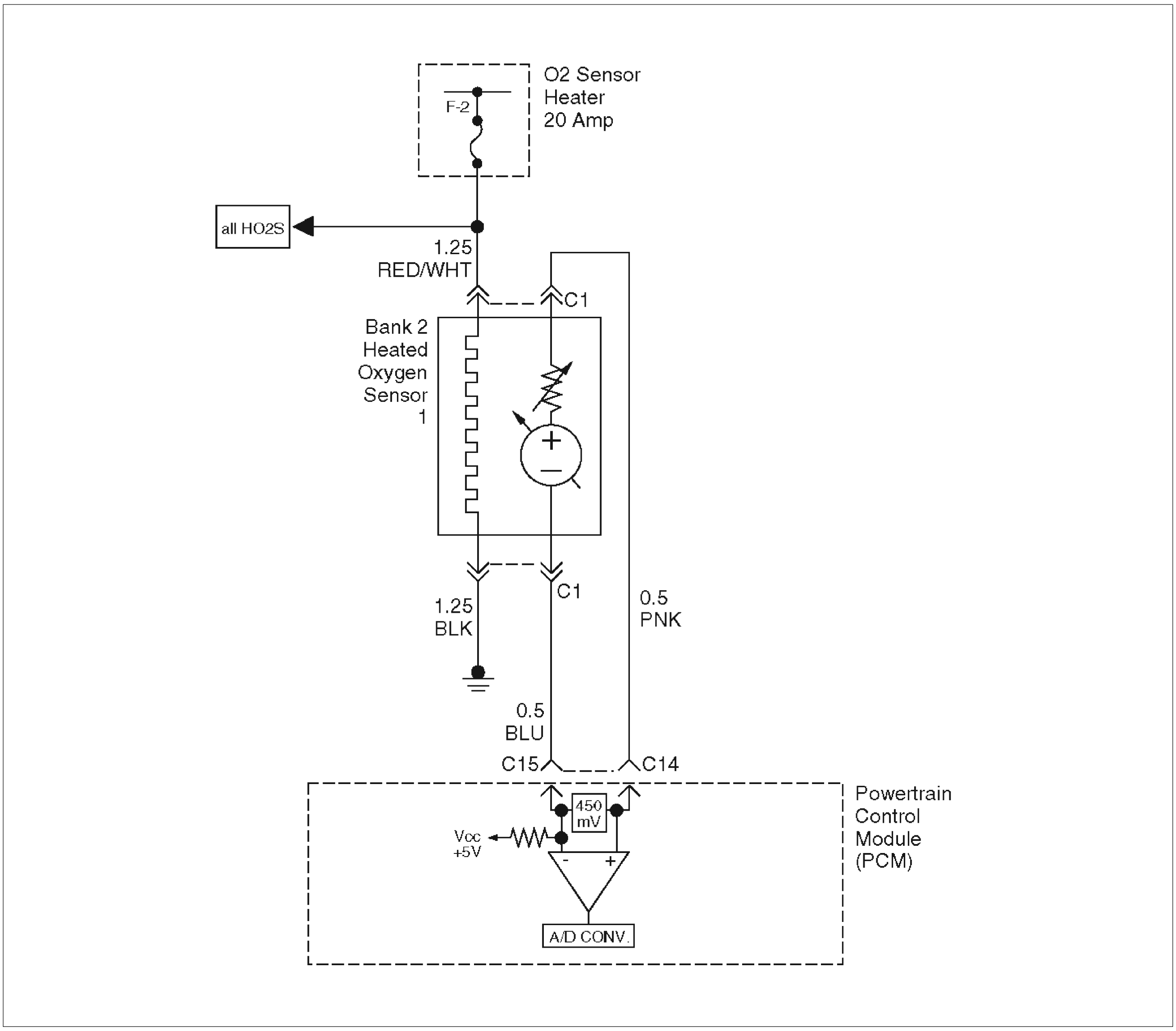
DTC P0174 – Fuel Trim System Lean Bank 2

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	Are any DTCs set other than P0174 and P0171?	—	Go to the applicable DTC charts and repair the other DTCs before proceeding with this chart.	Go to *Step 3*
3	1. Start the engine and operate the vehicle in “closed loop.” 2. Observe the “BANK 2 L.T. FUEL TRIM” display on the Tech 2. Is the displayed values greater than the specified values?	L.T. Fuel Trim: +20%	Go to *Step 5*	Go to *Step 4*
4	1. Review and record Tech 2 Failure Records data. 2. Clear the DTC P0171/P0174 and operate the vehicle to duplicate the Failure Records conditions. 3. Monitor the Tech 2 “DTC” info for DTC P0174 while operating the vehicle to duplicate the Failure Records conditions. 4. Continue operating the vehicle until the DTC P0174 test runs. 5. Note the test result. Does the Tech 2 indicate DTC P0174 failed this ignition?	—	Go to *Step 5*	The lean condition is not present. If a driveability symptom still exists, refer to *Symptoms* section.
5	Was DTC P0171 also set?	—	Go to *Step 6*	Go to *Step 15*
6	Visually and physically inspect the vacuum hoses for disconnects, splits, kinks, improper routing and improper connections and repair any problem found. Did your inspection reveal a problem requiring repair?	—	Verify repair	Go to *Step 7*
7	Visually and physically inspect the crankcase ventilation valve for proper installation and repair any problem found (refer to *Crankcase Ventilation System*). Did your inspection reveal a problem requiring repair?	—	Verify repair	Go to *Step 8*
8	1. Inspect the MAF sensor inlet screen for damage or for the presence of foreign objects which may partially block the air flow sample through the MAF sensor. 2. Correct any problem that is found as necessary. Did your inspection of the MAF sensor reveal a condition requiring repair?	—	Verify repair	Go to *Step 9*
9	Start the engine and note the idle quality. Is a high or unsteady idle being experienced?	—	Go to *Step 10*	Go to *Step 11*

DTC P0174 – Fuel Trim System Lean Bank 2 (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Visually and physically inspect the throttle body, intake manifold, EGR valve and the EGR feed pipe for vacuum leaks. 2. Repair any vacuum leaks as necessary. Did your inspection reveal a vacuum leak?	—	Verify repair	Go to *Step 11*
11	Check the fuel for excessive water, alcohol, or other contaminants (see *Diagnosis* in *Engine Fuel* for procedure) and correct the contaminated fuel condition is present (see *Engine Fuel*). Was the fuel contaminated?	—	Verify repair	Go to *Step 12*
12	1. Visually and physically inspect the PCM injector grounds, power grounds and sensor grounds to ensure that they are clean, tight, and in their proper locations. 2. If a faulty ground condition is present, correct it as necessary. Did your inspection reveal a condition requiring repair?	—	Verify repair	Go to *Step 13*
13	1. Disconnect the MAF sensor electrical connector. 2. Operate the vehicle in "closed loop" while monitoring the "BANK 1 S.T. FUEL TRIM" displayed on the Tech 2. Does the "BANK 1 S.T. FUEL TRIM" value decrease to near the specified value?	0%	Go to *Step 19*	Go to *Step 14*
14	Perform the procedure in the "Fuel System Pressure Test" and repair fuel system problem if necessary. Did the Fuel System Pressure Test isolate a condition requiring repair?	—	Verify repair	Go to *Step 15*
15	1. Visually and physically inspect the intake manifold, injector O-rings, EGR adapter, EGR valve and the EGR feed pipes for vacuum leaks. 2. Repair any problem that is found. Did your inspection reveal a problem?	—	Verify repair	Go to *Step 16*
16	Visually and physically inspect the Bank 2 exhaust manifold for leaks and loose or missing hardware and correct any problem found. Did your inspection reveal a problem?	—	Verify repair	Go to *Step 17*
17	Perform the "Injector Balance Test," and correct any problem found (refer to *Fuel Metering System*). Did the Injector Balance Test isolate a problem?	—	Verify repair	Go to *Step 18*
18	1. Visually and physically inspect the Bank 2 HO2S 1 to ensure that it is installed securely and that the Bank 2 HO2S 1 pigtail and wiring harness are not contacting the exhaust or otherwise damaged. 2. If a problem is found, correct it as necessary. Did your inspection reveal a problem?	—	Verify repair	Refer to *Diagnostic Aids*
19	Replace the MAF sensor. Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0175 Fuel Trim System Rich Bank 2



D06RW031

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 powertrain control module (PCM) monitors the Bank 1 HO2S 1 and Bank 2 HO2S 1 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 PCM 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 PCM is reducing the amount of fuel delivered. If an excessively rich condition is detected on Bank 2, the PCM will set DTC P0175.

The PCM's maximum authority to control long term fuel trim allows a range between –15%(automatic transmission) or –12%(manual transmission) and +20%. The PCM's maximum authority to control short term fuel trim allows a range between –11% and +20%. The PCM monitors fuel trim under various engine speed/load fuel trim cells before determining the status of the fuel trim diagnostic.

Conditions for Setting the DTC

- No Tech 2 test is being run.
- None of the following DTCs are set: idle system, EGR, HO2S, (response, transition, open, low volts, no activity), MAF, TPS, MAP, IAT, canister purge, EVAP, injector circuit, or misfire.
- Engine coolant temperature is between 25°C (77°F) and 100°C (212°F).
- Intake air temperature is between –40°C (–40°F) and 120°C (248°F).
- Manifold absolute pressure is between 24 kPa and 99 kPa.
- Throttle angle is steady below 95%.
- Vehicle speed is below 136 km/h (85 mph).
- Engine speed is between 400 and 6,000 RPM.

- Barometric pressure is greater than 72.5 kPa.
- Mass air flow is between 2 g/second and 200 g/second.
- Ignition voltage is above 9.5 volts.
- Fuel system is in “closed loop.”

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the failure is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0175 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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 Bank 2 HO2S 1 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.

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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. DTCs other than P0172 and P0175 may indicate a condition present which may cause a lean condition. If this is the case, repairing the condition which caused the other DTC will most likely correct the DTC P0172/P0175.
4. If the DTC P0175 test passes while the Failure Records conditions are being duplicated, the rich condition is intermittent. Refer to *Diagnostic Aids* or *Symptoms* for additional information on diagnosing intermittent problems.

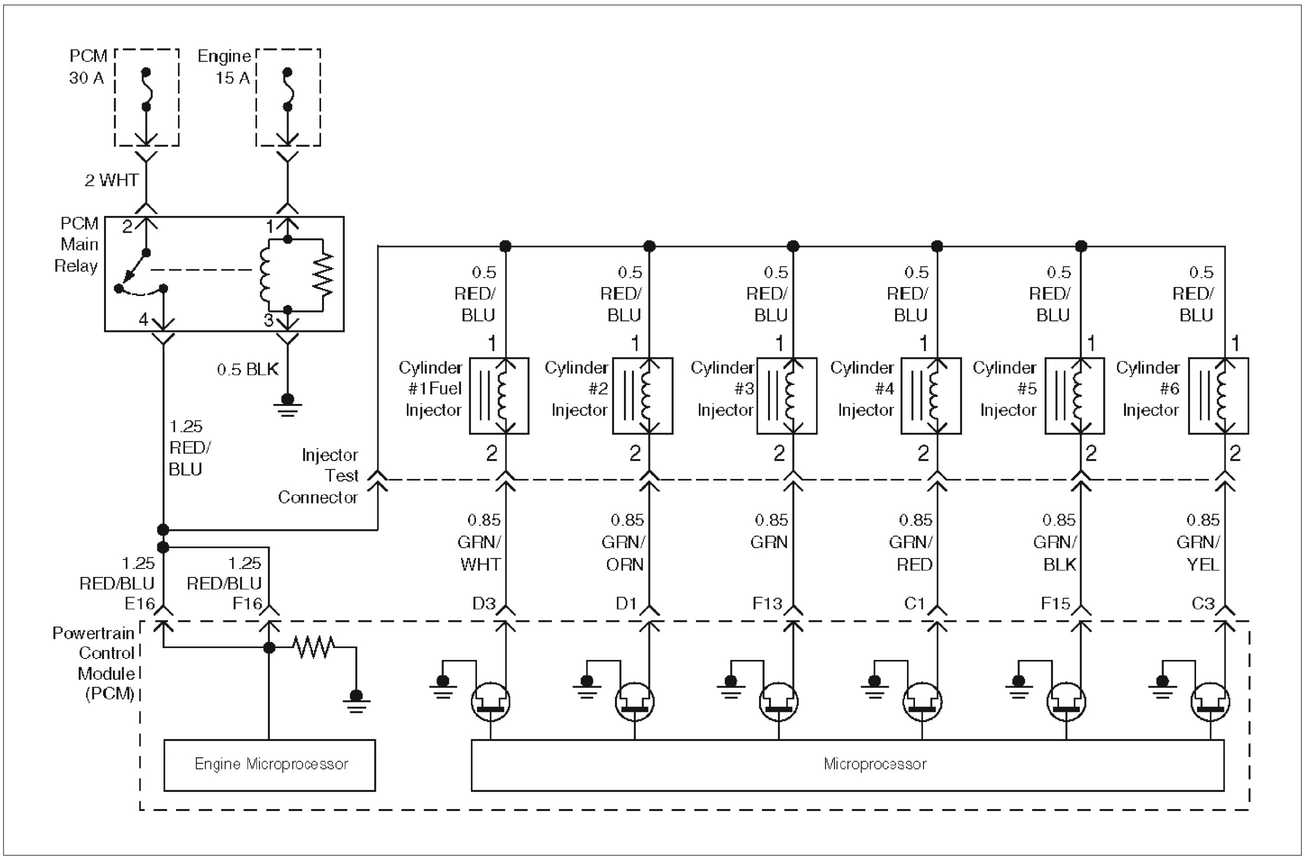
DTC P0175 – Fuel Trim System Rich Bank 2

Step	Action	Value(s)	Yes	No
1	Was the ”On-Board Diagnostic (OBD) System Check” performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any DTCs set other than P0172 and P0175?	—	Go to the applicable DTC charts and repair the other DTCs before proceeding with this chart.	Go to *Step 3*
3	1. Start the engine and operate the vehicle in “closed loop.” 2. Observe the “BANK 2 L.T. FUEL TRIM” display on the Tech 2. Is the displayed value more negative than the specified value?	L.T. Fuel Trim: –15% (auto. trans.) OR –12% (man. trans.)	Go to *Step 5*	Go to *Step 4*
4	1. Review and record the Tech 2 Failure Records data. 2. Clear the DTC P0172/P0175 and operate the vehicle to duplicate the Failure Records conditions. 3. Monitor the Tech 2 “DTC” info for DTC P0175 while operating the vehicle to duplicate the Failure Records conditions. 4. Continue operating the vehicle until the DTC P0175 test runs. 5. Note the test result. Does the Tech 2 indicate DTC P0175 failed this ignition?	—	Go to *Step 5*	The rich condition is not present. If a driveability symptom still exists, refer to *Symptoms*.
5	Was DTC P0172 also set?	—	Go to *Step 6*	Go to *Step 15*
6	Visually and physically inspect the air filter element and replace it if necessary. Did the air filter require replacement?	—	Verify repair	Go to *Step 7*
7	Visually and physically inspect the air intake duct for collapse or restriction and repair if necessary. Did your inspection reveal a problem requiring repair?	—	Verify repair	Go to *Step 8*
8	Inspect the MAF sensor inlet screen for damage or for the presence of foreign objects which may partially block air flow through the screen and correct any problem found. Did your inspection of the MAF sensor reveal a condition requiring repair or replacement?	—	Verify repair	Go to *Step 9*
9	Start the engine and note the idle quality. Is a low or unsteady idle being experienced?	—	Go to *Step 10*	Go to *Step 11*
10	1. Turn the ignition off and physically inspect the throttle body bore, throttle plate, and IAC passages for coking and foreign objects. 2. If a problem was found, repair as necessary. Did your inspection reveal a condition requiring repair?	—	Verify repair	Go to *Step 11*

DTC P0175 – Fuel Trim System Rich Bank 2 (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Disconnect the vacuum hose from the fuel pressure regulator and inspect the hose for the presence of fuel. 2. If fuel is present in the vacuum hose, replace the fuel pressure regulator (refer to *Fuel Metering System*). Did the fuel pressure regulator require replacement?	—	Verify repair	Go to *Step 12*
12	1. Ignition “ON,” engine “OFF.” 2. Monitor the TP Angle display on the Tech 2 while slowly depressing the accelerator pedal. Does the TP Angle display increase steadily and evenly from minimum value at closed throttle to maximum value at wide-open throttle?	Minimum 0% Maximum 100%	Go to *Step 13*	Go to *Step 18*
13	1. Disconnect the MAF sensor electrical connector. 2. Operate the vehicle in “closed loop” while monitoring the “BANK 1 L.T. FUEL TRIM” and “BANK 1 S.T. FUEL TRIM” display on the Tech 2. Did both values change to near the specified value?	0%	Go to *Step 19*	Go to *Step 14*
14	1. Perform the “Fuel System Pressure Test.” 2. If Fuel System Pressure Test isolates a problem, repair as necessary (refer to *Engine Fuel* or *Fuel Metering System*). Did the Fuel System Pressure Test isolate a condition requiring repair?	—	Verify repair	Go to *Step 16*
15	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—
16	1. Perform the “Injector Balance Test.” 2. If the Injector Balance Test isolates a problem, repair as necessary (refer to *Fuel Metering System*). Did the Injector Balance Test isolate a problem requiring repair?	—	Verify repair	Go to *Step 17*
17	1. Remove and visually/physically inspect the Bank 2 HO2S 1 for silicon contamination. This will be indicated by a powdery white deposit on the portion of the HO2S that is exposed to the exhaust stream. 2. If contamination is evident on the Bank 2 HO2S 1, replace the contaminated sensor. Did the sensor require replacement?	—	Verify repair	Refer to *Diagnostic Aids*
18	1. Check the TP sensor mounting screws and tighten or replace them as necessary if they are loose or missing. 2. If the screws are OK, replace the TP sensor. Is the action complete?	—	Verify repair	—
19	Replace the MAF sensor. Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0201 Injector 1 Control Circuit



D06RW034

Circuit Description

The powertrain control module (PCM) has six individual injector driver circuits. Each controls an injector. When a driver circuit is grounded by the PCM, the injector is activated. The PCM 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 PCM 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.

Conditions for Setting the DTC

- The battery voltage is more than 9 volts.
- The engine is turning, determined by 58X crankshaft position input signal.
- The injector voltage does not equal the ignition voltage when the injector is commanded “OFF” or the injector voltage does not equal 0 volts when the injector is commanded “ON.”
- The above conditions are met for 15 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0201 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

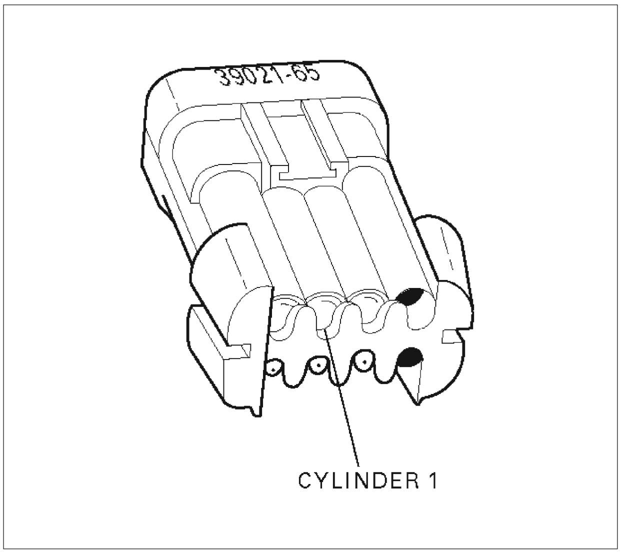
An injector driver circuit that is open or shorted to voltage will cause a DTC P0201 to set. It will also cause a misfire due to an inoperative injector. A misfire DTC will also be set indicating which cylinder is inoperative.
Long term and short term fuel trims that are excessively high or low are a good indication that an injector is faulty. Use Fuel Injector Coil Test Procedure to check for faulty injectors.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Chart.

3. This step determines if DTC P0201 is the result of a hard failure or an intermittent condition.
5. A special injector test connector is provided so that the injectors can be electrically tested without removal of the manifold. On the Trooper, the special 7-way gray connector is located at the front of the charcoal canister. The test connector can be identified by the blue connector lock which is tethered to the wiring harness. If the light for cylinder 1 is “ON” steady before cranking the engine as well as while cranking the engine, then the injector driver circuit is shorted to ground.

If the test light blinks while cranking, the PCM and the wiring to the injectors are OK. The Fuel Injector Coil Test Procedure will check if the injectors are faulty.



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7. Because the test light was “ON” steady, voltage to the injector is OK, but the driver circuit is grounded at all times. This step determines if the circuit is shorted to ground or the PCM is faulty.

9. The reading should be about 12-14δ .

10. Locating the open in the harness or in the injector will require removal of the manifold to provide access.

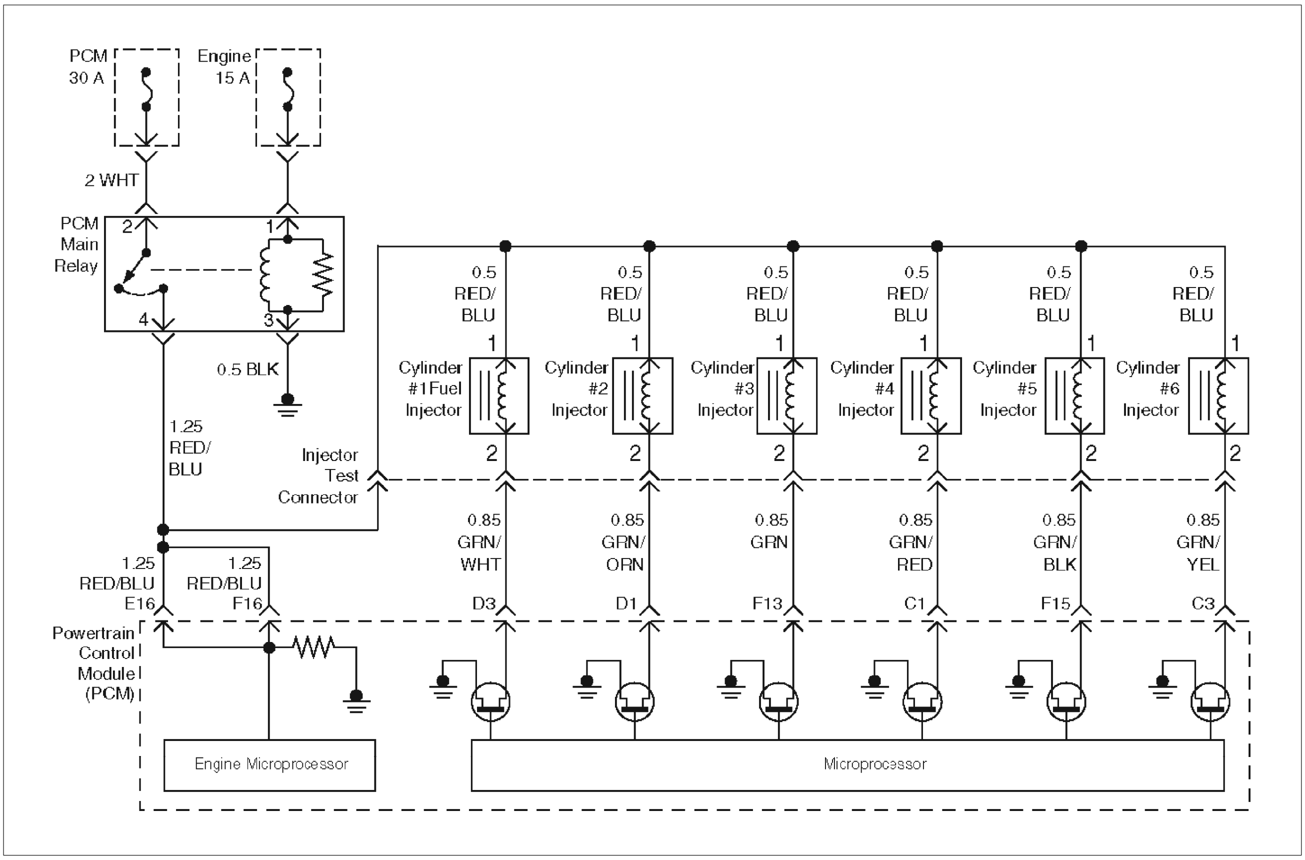
DTC P0201 – Injector 1 Control Circuit

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	Will the engine start?	—	Go to *Step 3*	Go to *Engine Cranks But Will Not Run* chart
3	1. Install the Tech 2. Clear the DTC. 2. Idle the engine for one minute. Does DTC P0201 reset?	—	Go to *Step 5*	Go to *Step 4*
4	1. Review the Freeze Frame data with the ignition “ON” and the engine “OFF” and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions as noted. Does P0201 reset?	—	Go to *Step 5*	Go to *Diagnostic Aids*
5	1. Engine “OFF.” 2. Disconnect the injector connector. 3. Install an injector test light 5-8840-2636-0 on the injector test connector. 4. Crank the engine and note the light. Does the injector test light blink?	—	Go to *Fuel Injector Coil Test Procedure*	Go to *Step 6*
6	Note whether the injector test light for cylinder 1 was “OFF” or “ON” steady in step 5. Was the test light “ON” steady while cranking the engine?	—	Go to *Step 7*	Go to *Step 9*

DTC P0201 – Injector 1 Control Circuit (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Disconnect the PCM connector for the affected injectors. 2. With a test light connected to B+, probe the affected injector driver circuit. Does the test light illuminate?	—	Go to *Step 8*	Go to *Step 15*
8	Repair short to ground in the injector driver circuit. Is the action complete?	—	Go to *OBD System Check*	—
9	1. Disconnect the injector test connector. 2. At the injector side of the harness, connect an ohmmeter between the positive wire (red with blue tracer) and the wire for cylinder 1 (green with white tracer). Does the ohmmeter indicate continuity?	—	Go to *Step 11*	Go to *Step 10*
10	Repair the open injector harness wire or open injector. Is the action complete?	—	Verify repair	—
11	At the PCM side of the injector test connector, check the green/white wire for a short to voltage. Was there a short to voltage?	—	Go to *Step 12*	Go to *Step 13*
12	Repair the short to voltage. Is the action complete?	—	Verify repair	—
13	Check for an open circuit between the injector test connector and the PCM. Was there an open circuit?	—	Go to *Step 14*	Go to *Step 15*
14	Repair the open circuit. Is the action complete?	—	Verify repair	—
15	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0202 Injector 2 Control Circuit



Circuit Description

The powertrain control module (PCM) has six individual injector driver circuits. Each controls an injector. When a driver circuit is grounded by the PCM, the injector is activated. The PCM 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 PCM 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.

Conditions for Setting the DTC

- The battery voltage is more than 9 volts.
- The engine is turning, determined by 58X crankshaft position input signal.
- The injector voltage does not equal the ignition voltage when the injector is commanded “OFF” or the injector voltage does not equal 0 volts when the injector is commanded “ON.”
- The above conditions are met for 15 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0202 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

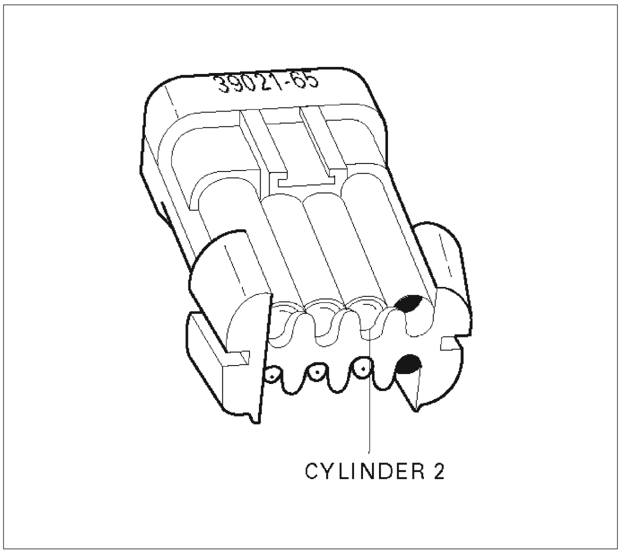
An injector driver circuit that is open or shorted to voltage will cause a DTC P0202 to set. It will also cause a misfire due to an inoperative injector. A misfire DTC will also be set indicating which cylinder is inoperative.
Long term and short term fuel trims that are excessively high or low are a good indication that an injector is faulty. Use Fuel Injector Coil Test Procedure to check for faulty injectors.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Chart.

3. This step determines if DTC P0202 is the result of a hard failure or an intermittent condition.
5. A special injector test connector is provided so that the injectors can be electrically tested without removal of the manifold. On the Trooper, the special 7-way gray connector is located at the front of the charcoal canister. The test connector can be identified by the blue connector lock which is tethered to the wiring harness. If the light for cylinder 2 is “ON” steady before cranking the engine as well as while cranking the engine, then the injector driver circuit is shorted to ground.

If the test light blinks while cranking, the PCM and the wiring to the injectors are OK. The Fuel Injector Coil Test Procedure will check if the injectors are faulty.



R321055

7. Because the test light was “ON” steady, voltage to the injector is OK, but the driver circuit is grounded at all times. This step determines if the circuit is shorted to ground or the PCM is faulty.

9.The reading should be about 12-14δ .

10.Locating the open in the harness or in the injector will require removal of the manifold to provide access.

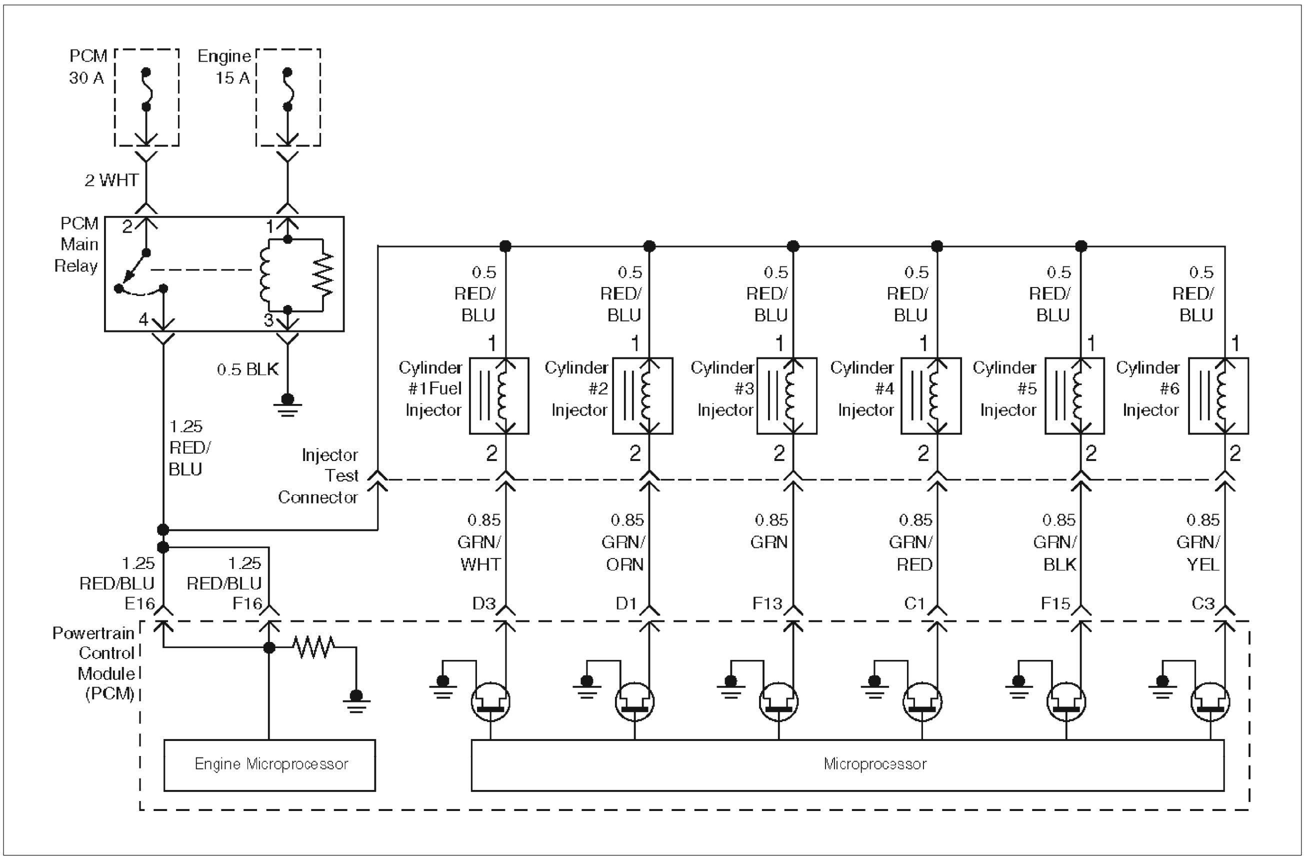
DTC P0202 – Injector 2 Control Circuit

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	Will the engine start?	—	Go to *Step 3*	Go to *Engine Cranks But Will Not Run* chart
3	1. Install the Tech 2. Clear the DTC. 2. Idle the engine for one minute. Does DTC P0202 reset?	—	Go to *Step 5*	Go to *Step 4*
4	1. Review the Freeze Frame data with the ignition “ON” and the engine “OFF” and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions as noted. Does P0202 reset?	—	Go to *Step 5*	Go to *Diagnostic Aids*
5	1. Engine “OFF.” 2. Disconnect the injector test connector. 3. Install an injector test light 5-8840-2636-0 on injector connector. 4. Crank the engine and note the light. Does the cylinder 2 test light blink?	—	Go to *Fuel Injector Coil Test Procedure*	Go to *Step 6*
6	Note whether the injector test light for cylinder 2 was “OFF” or “ON” steady in step 5. Was the test light “ON” steady while cranking the engine?	—	Go to *Step 7*	Go to *Step 9*

DTC P0202 – Injector 2 Control Circuit (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Disconnect the PCM connector for the affected injectors. 2. With a test light connected to B+, probe the affected injector driver circuit. Does the test light illuminate?	—	Go to *Step 8*	Go to *Step 15*
8	Repair short to ground in the injector driver circuit. Is the action complete?	—	Go to *OBD System Check*	—
9	1. Disconnect the injector test connector. 2. At the injector side of the harness, connect an ohmmeter between the positive wire (red with blue tracer) and the wire for cylinder 2 (green with orange tracer). Does the ohmmeter indicate continuity?	—	Go to *Step 11*	Go to *Step 10*
10	Repair the open injector harness wire or open injector. Is the action complete?	—	Verify repair	—
11	At the PCM side of the injector test connector, check the green/orange wire for a short to voltage. Was there a short to voltage?	—	Go to *Step 12*	Go to *Step 13*
12	Repair the short to voltage. Is the action complete?	—	Verify repair	—
13	Check for an open circuit between the injector test connector and the PCM. Was there an open circuit?	—	Go to *Step 14*	Go to *Step 15*
14	Repair the open circuit. Is the action complete?	—	Verify repair	—
15	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0203 Injector 3 Control Circuit



Circuit Description

The powertrain control module (PCM) has six individual injector driver circuits. Each controls an injector. When the driver circuit is grounded by the PCM, the injector is activated. The PCM 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 PCM 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.

Conditions for Setting the DTC

- The battery voltage is more than 9 volts.
- The engine is turning, determined by the 58X crankshaft position input signal.
- The injector voltage does not equal the ignition voltage when the injector is commanded “OFF” or the injector voltage does not equal 0 volts when the injector is commanded “ON.”
- The above conditions are met for 15 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0203 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

An injector driver circuit that is open or shorted to voltage will cause a DTC P0203 to set. It will also cause a misfire due to an inoperative injector. A misfire DTC will also be set indicating which cylinder is inoperative.

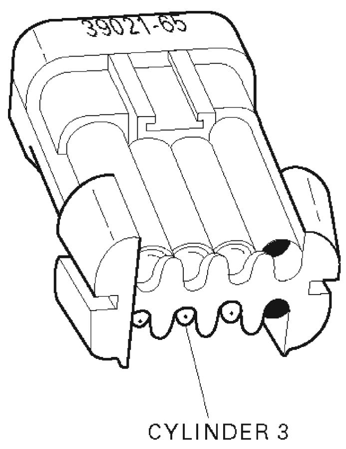
Long term and short term fuel trims that are excessively high or low are a good indication that an injector is faulty. Use Fuel Injector Coil Test Procedure to check for faulty injectors.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Chart.

3. This step determines if DTC P0203 is the result of a hard failure or an intermittent condition.
5. A special injector test connector is provided so that the injectors can be electrically tested without removal of the manifold. On the Trooper, the special 7-way gray connector is located at the front of the charcoal canister. The test connector can be identified by the blue connector lock which is tethered to the wiring harness. If the light for cylinder 3 is “ON” steady before cranking the engine as well as while cranking the engine, then the injector driver circuit is shorted to ground.

If the test light blinks while cranking, the PCM and the wiring to the injectors are OK. The Fuel Injector Coil Test Procedure will check if the injectors are faulty.



R321056

7. Because the test light was “ON” steady, voltage to the injector is OK, but the driver circuit is grounded at all times. This step determines if the circuit is shorted to ground or the PCM is faulty.

9. The reading should be about 12-14δ .

10. Locating the open in the harness or in the injector will require removal of the manifold to provide access.

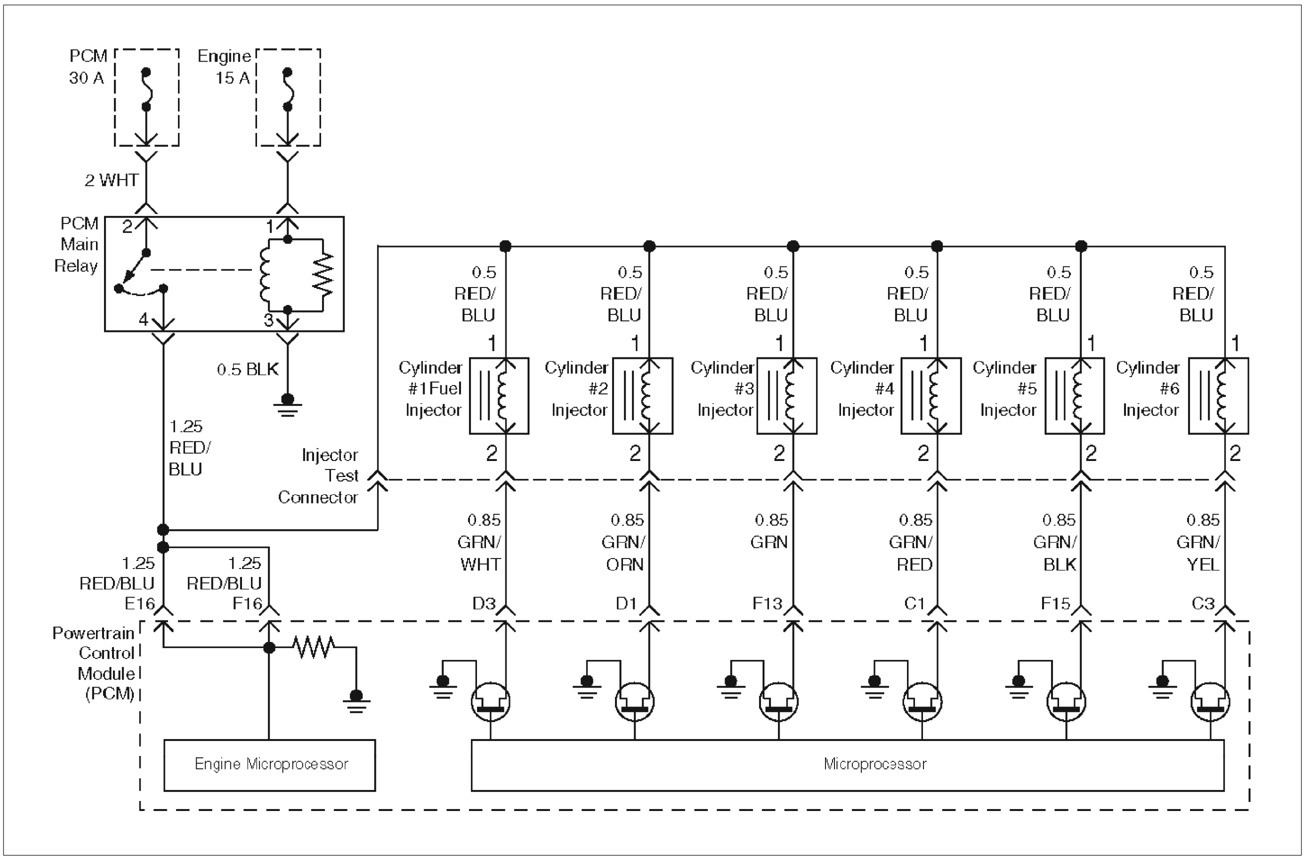
DTC P0203 – Injector 3 Control Circuit

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	Will the engine start?	—	Go to *Step 3*	Go to *Engine Cranks But Will Not Run* chart
3	1. Install the Tech 2. Clear the DTC. 2. Idle the engine for one minute. Does DTC P0203 reset?	—	Go to *Step 5*	Go to *Step 4*
4	1. Review the Freeze Frame data with the ignition “ON” and the engine “OFF” and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions as noted. Does P0203 reset?	—	Go to *Step 5*	Go to *Diagnostic Aids*
5	1. Engine “OFF.” 2. Disconnect the injector test connector . 3. Install an injector test light 5-8840-2636-0 on injector connector. 4. Crank the engine and note the light. Does the cylinder 3 test light blink?	—	Go to *Fuel Injector Coil Test Procedure*	Go to *Step 6*
6	Note whether the injector test light for cylinder 3 was “OFF” or “ON” steady in step 5. Was the test light “ON” steady while cranking the engine?	—	Go to *Step 7*	Go to *Step 9*

DTC P0203 – Injector 3 Control Circuit (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Disconnect the PCM connector for the affected injectors. 2. With a test light connected to B+, probe the affected injector driver circuit. Does the test light illuminate?	—	Go to *Step 8*	Go to *Step 15*
8	Repair short to ground in the injector driver circuit. Is the action complete?	—	Go to *OBD System Check*	—
9	1. Disconnect the injector test connector. 2. At the injector side of the harness, connect an ohmmeter between the positive wire (red with blue tracer) and the wire for cylinder 3 (green). Does the ohmmeter indicate continuity?	—	Go to *Step 11*	Go to *Step 10*
10	Repair the open injector harness wire or open injector. Is the action complete?	—	Verify repair	—
11	At the PCM side of the injector test connector, check the green wire for a short to voltage. Was there a short to voltage?	—	Go to *Step 12*	Go to *Step 13*
12	Repair the short to voltage. Is the action complete?	—	Verify repair	—
13	Check for an open circuit between the injector test connector and the PCM. Was there an open circuit?	—	Go to *Step 14*	Go to *Step 15*
14	Repair the open circuit. Is the action complete?	—	Verify repair	—
15	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0204 Injector 4 Control Circuit



D06RW034

Circuit Description

The powertrain control module (PCM) has six individual injector driver circuits. Each controls an injector. When the driver circuit is grounded by the PCM, the injector is activated. The PCM 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 PCM 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.

Conditions for Setting the DTC

- The battery voltage is more than 9 volts.
- The engine is turning, determined by the 58X crankshaft position input signal.
- The injector voltage does not equal the ignition voltage when the injector is commanded “OFF” or the injector voltage does not equal 0 volts when the injector is commanded “ON.”
- The above conditions are met for 15 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0204 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

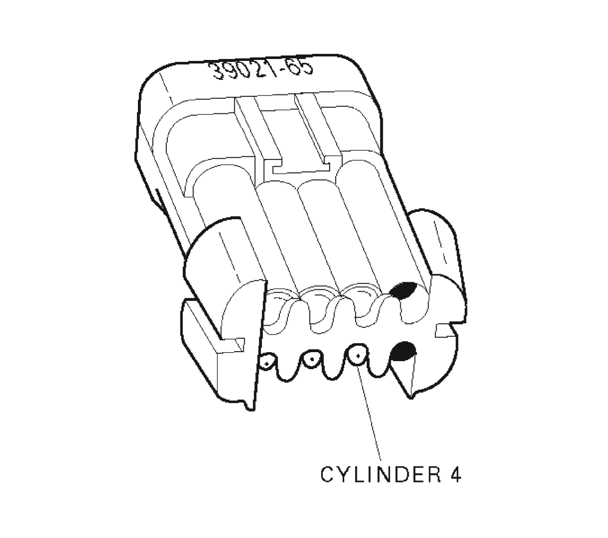
An injector driver circuit that is open or shorted to voltage will cause a DTC P0204 to set. It will also cause a misfire due to an inoperative injector. A misfire DTC will also be set indicating which cylinder is inoperative.
Long term and short term fuel trims that are excessively high or low are a good indication that an injector is faulty. Use Fuel Injector Coil Test Procedure to check for faulty injectors.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Chart.

3. This step determines if DTC P0204 is the result of a hard failure or an intermittent condition.
5. A special injector test connector is provided so that the injectors can be electrically tested without removal of the manifold. On the Trooper, the special 7-way gray connector is located at the front of the charcoal canister. The test connector can be identified by the blue connector lock which is tethered to the wiring harness. If the light for cylinder 4 is “ON” steady before cranking the engine as well as while cranking the engine, then the injector driver circuit is shorted to ground.

If the test light blinks while cranking, the PCM and the wiring to the injectors are OK. The Fuel Injector Coil Test Procedure will check if the injectors are faulty.



R321057

7. Because the test light was “ON” steady, voltage to the injector is OK, but the driver circuit is grounded at all times. This step determines if the circuit is shorted to ground or the PCM is faulty.
9. The reading should be about 12-14δ .
10. Locating the open in the harness or in the injector will require removal of the manifold to provide access.

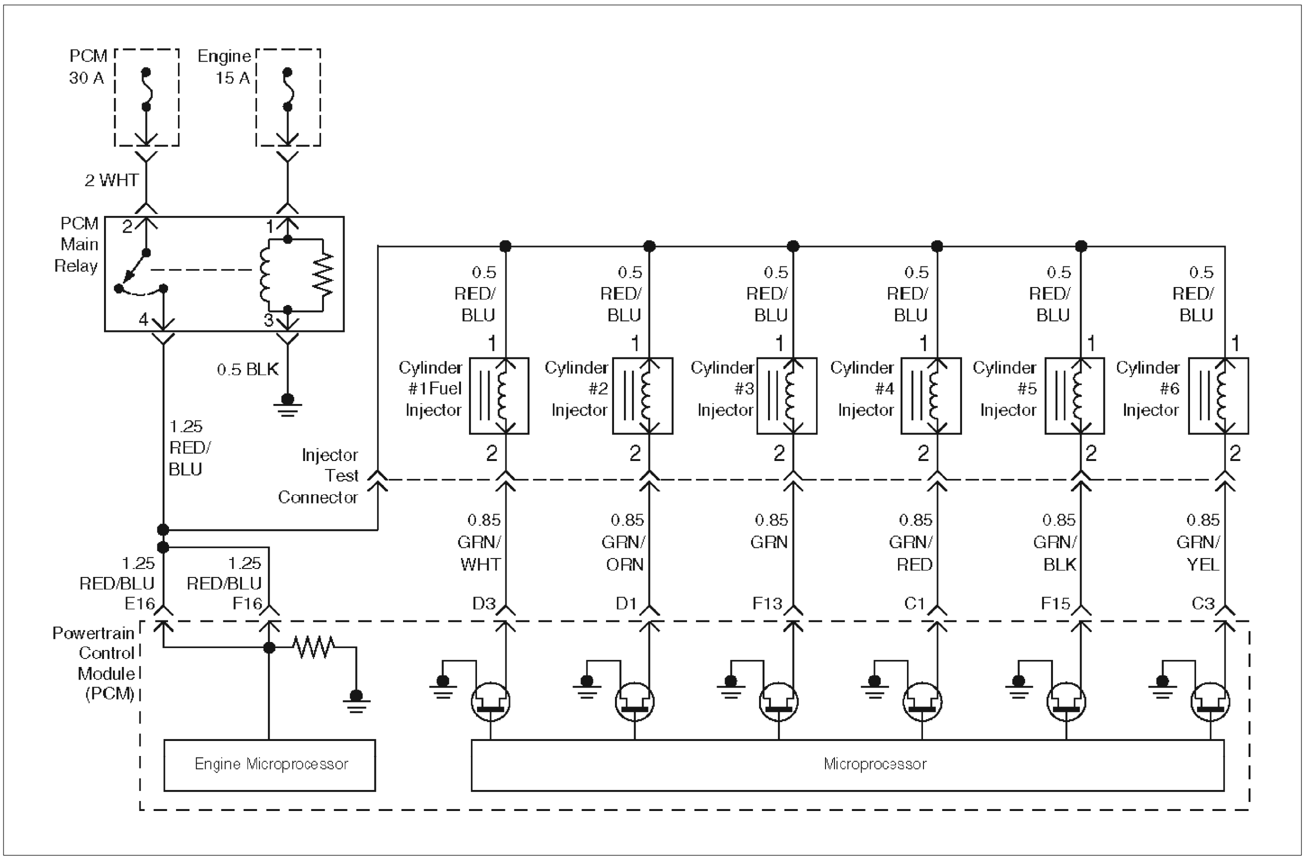
DTC P0204 – Injector 4 Control Circuit

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	Will the engine start?	—	Go to *Step 3*	Go to *Engine Cranks But Will Not Run* chart
3	1. Install the Tech 2. Clear the DTC. 2. Idle the engine for one minute. Does DTC P0204 reset?	—	Go to *Step 5*	Go to *Step 4*
4	1. Review the Freeze Frame data with the ignition “ON” and the engine “OFF” and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions as noted. Does P0204 reset?	—	Go to *Step 5*	Go to *Diagnostic Aids*
5	1. Engine “OFF.” 2. Disconnect the injector test connector. 3. Install an injector test light 5-8840-2636-0 on injector connector. 4. Crank the engine and note the light. Does the cylinder 4 test light blink?	—	Go to *Fuel Injector Coil Test Procedure*	Go to Step 6
6	Note whether the injector test light for cylinder 4 was “OFF” or “ON” steady in step 5. Was the test light “ON” steady while cranking the engine?	—	Go to *Step 7*	Go to *Step 9*

DTC P0204 – Injector 4 Control Circuit (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Disconnect the PCM connector for the affected injectors. 2. With a test light connected to B+, probe the affected injector driver circuit. Does the test light illuminate?	—	Go to *Step 8*	Go to *Step 15*
8	Repair short to ground in the injector driver circuit. Is the action complete?	—	Go to *OBD System Check*	—
9	1. Disconnect the injector test connector. 2. At the injector side of the harness, connect an ohmmeter between the positive wire (red with blue tracer) and the wire for cylinder 4 (green/red). Does the ohmmeter indicate continuity?	—	Go to *Step 11*	Go to *Step 10*
10	Repair the open injector harness wire or open injector. Is the action complete?	—	Verify repair	—
11	At the PCM side of the injector test connector, check the green/red wire for a short to voltage. Was there a short to voltage?	—	Go to *Step 12*	Go to *Step 13*
12	Repair the short to voltage. Is the action complete?	—	Verify repair	—
13	Check for an open circuit between the injector test connector and the PCM. Was there an open circuit?	—	Go to *Step 14*	Go to *Step 15*
14	Repair the open circuit. Is the action complete?	—	Verify repair	—
15	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0205 Injector 5 Control Circuit



D06RW034

Circuit Description

The powertrain control module (PCM) has six individual injector driver circuits. Each controls an injector. When the driver circuit is grounded by the PCM, the injector is activated. The PCM monitors the current in each driver circuit. If the voltage is not what the PCM 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.

Conditions for Setting the DTC

- The battery voltage is more than 9 volts.
- The engine is turning, determined by the 58X crankshaft position input signal.
- The injector voltage does not equal the ignition voltage when the injector is commanded “OFF” or the injector voltage does not equal 0 volts when the injector is commanded “ON.”
- The above conditions are met for 15 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0205 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

An injector driver circuit that is open or shorted to voltage will cause a DTC P0205 to set. It will also cause a misfire due to an inoperative injector. A misfire DTC will also be set indicating which cylinder is inoperative.

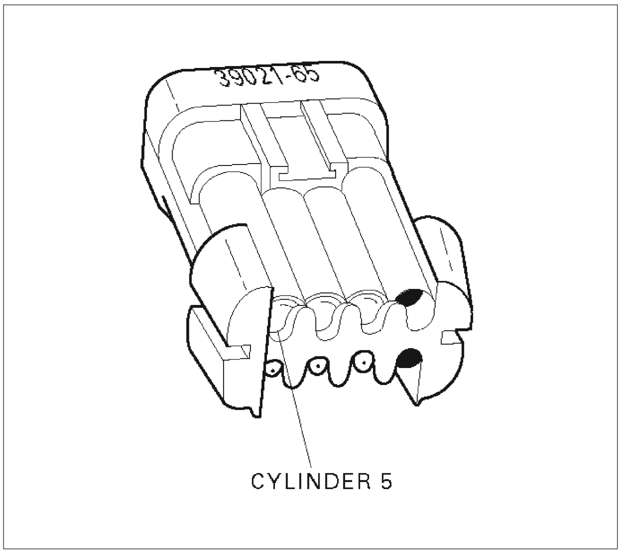
Long term and short term fuel trims that are excessively high or low are a good indication that an injector is faulty. Use Fuel Injector Coil Test Procedure to check for faulty injectors.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Chart.

3. This step determines if DTC P0205 is the result of a hard failure or an intermittent condition.
5. A special injector test connector is provided so that the injectors can be electrically tested without removal of the manifold. On the Trooper, the special 7-way gray connector is located at the front of the charcoal canister. The test connector can be identified by the blue connector lock which is tethered to the wiring harness. If the light for cylinder 5 is “ON” steady before cranking the engine as well as while cranking the engine, then the injector driver circuit is shorted to ground.

If the test light blinks while cranking, the PCM and the wiring to the injectors are OK. The Fuel Injector Coil Test Procedure will check if the injectors are faulty.



R321058

7. Because the test light was “ON” steady, voltage to the injector is OK, but the driver circuit is grounded at all times. This step determines if the circuit is shorted to ground or the PCM is faulty.

9. The reading should be about 12-14δ .

10. Locating the open in the harness or in the injector will require removal of the manifold to provide access.

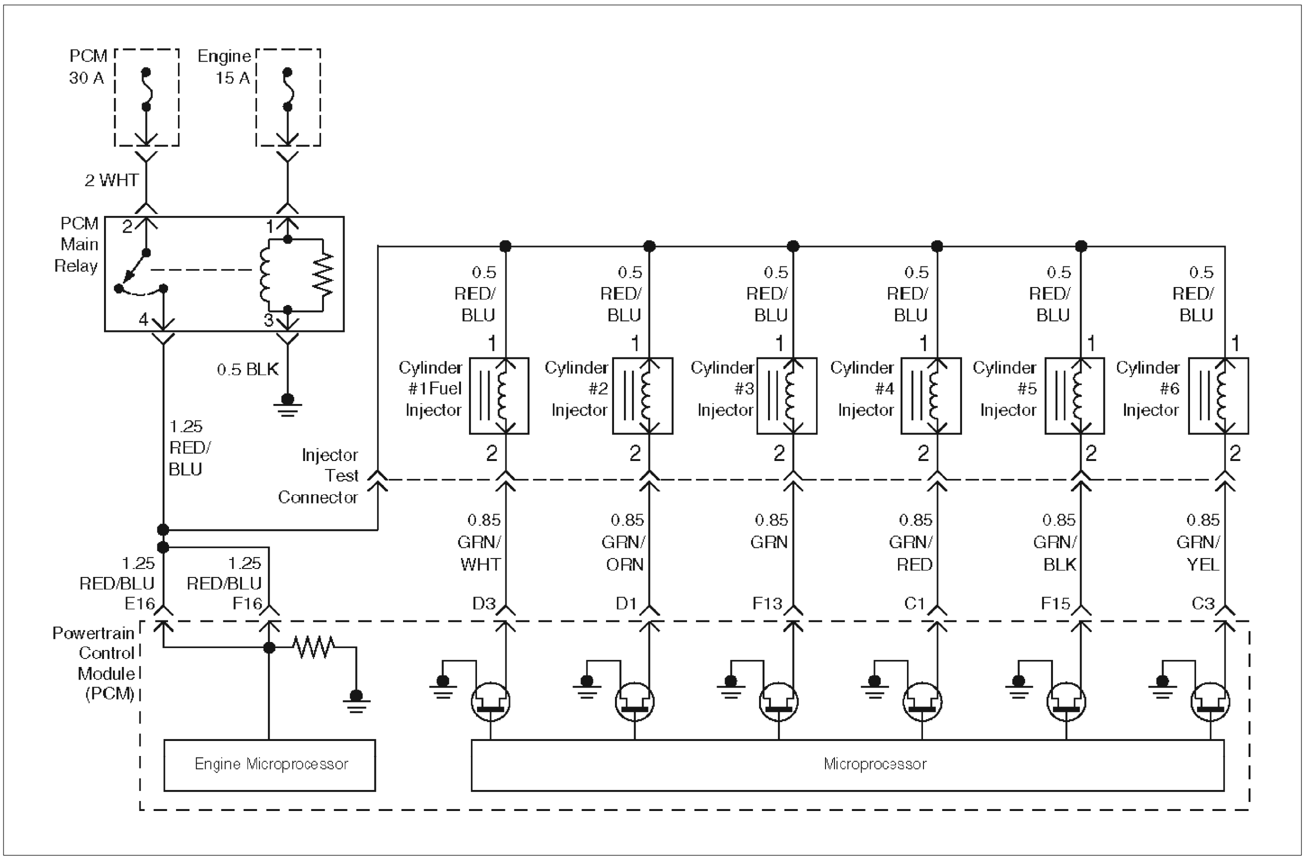
DTC P0205 – Injector 5 Control Circuit

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	Will the engine start?	—	Go to *Step 3*	Go to *Engine Cranks But Will Not Run* chart
3	1. Install the Tech 2. Clear the DTC. 2. Idle the engine for one minute. Does DTC P0205 reset?	—	Go to *Step 5*	Go to *Step 4*
4	1. Review the Freeze Frame data with the ignition “ON” and the engine “OFF” and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions as noted. Does P0205 reset?	—	Go to *Step 5*	Go to *Diagnostic Aids*
5	1. Engine “OFF.” 2. Disconnect the injector test connector. 3. Install an injector test light 5-8840-2636-0 on injector connector. 4. Crank the engine and note the light. Does the cylinder 5 test light blink?	—	Go to *Fuel Injector Coil Test Procedure*	Go to *Step 6*
6	Note whether the injector test light for cylinder 5 was “OFF” or “ON” steady in step 5. Was the test light “ON” steady while cranking the engine?	—	Go to *Step 7*	Go to *Step 9*

DTC P0205 – Injector 5 Control Circuit (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Disconnect the PCM connector for the affected injectors. 2. With a test light connected to B+, probe the affected injector driver circuit. Does the test light illuminate?	—	Go to *Step 8*	Go to *Step 15*
8	Repair short to ground in the injector driver circuit. Is the action complete?	—	Go to *OBD System Check*	—
9	1. Disconnect the injector test connector. 2. At the injector side of the harness, connect an ohmmeter between the positive wire (red with blue tracer) and the wire for cylinder 5 (green with black tracer). Does the ohmmeter indicate continuity?	—	Go to *Step 11*	Go to *Step 10*
10	Repair the open injector harness wire or open injector. Is the action complete?	—	Verify repair	—
11	At the PCM side of the injector test connector, check the green/black wire for a short to voltage. Was there a short to voltage?	—	Go to *Step 12*	Go to *Step 13*
12	Repair the short to voltage. Is the action complete?	—	Verify repair	—
13	Check for an open circuit between the injector test connector and the PCM. Was there an open circuit?	—	Go to *Step 14*	Go to *Step 15*
14	Repair the open circuit. Is the action complete?	—	Verify repair	—
15	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0206 Injector 6 Control Circuit



D06RW034

Circuit Description

The powertrain control module (PCM) has six individual injector driver circuits. Each controls an injector. When the driver circuit is grounded by the PCM, the injector is activated. The PCM 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 PCM 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.

Conditions for Setting the DTC

- The battery voltage is more than 9 volts.
- The engine is turning, determined by 58X crankshaft position input signal.
- The injector voltage does not equal the ignition voltage when the injector is commanded “OFF” or the injector voltage does not equal 0 volts when the injector is commanded “ON.”
- The above conditions are met for 15 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0206 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

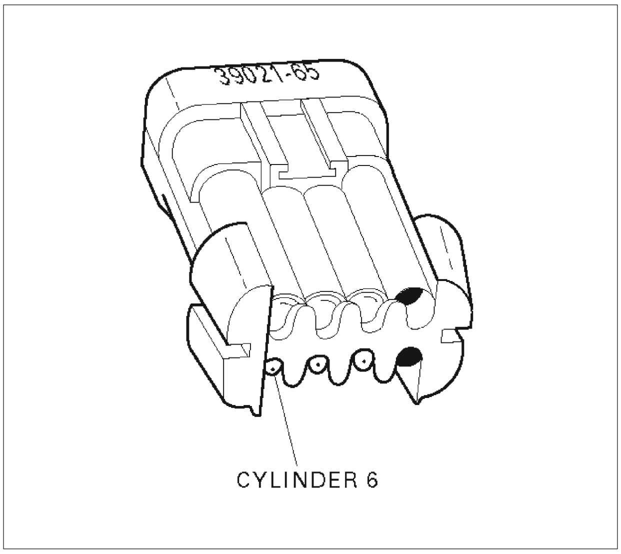
An injector driver circuit that is open or shorted to voltage will cause a DTC P0206 to set. It will also cause a misfire due to an inoperative injector. A misfire DTC will also be set indicating which cylinder is inoperative.
Long term and short term fuel trims that are excessively high or low are a good indication that an injector is faulty. Use Fuel Injector Coil Test Procedure to check for faulty injectors.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Chart.

3. This step determines if DTC P0206 is the result of a hard failure or an intermittent condition.
5. A special injector test connector is provided so that the injectors can be electrically tested without removal of the manifold. On the Trooper, the special 7-way gray connector is located at the front of the charcoal canister. The test connector can be identified by the blue connector lock which is tethered to the wiring harness. If the light for cylinder 6 is “ON” steady before cranking the engine as well as while cranking the engine, then the injector driver circuit is shorted to ground.

If the test light blinks while cranking, the PCM and the wiring to the injectors are OK. The Fuel Injector Coil Test Procedure will check if the injectors are faulty.



R321059

7. Because the test light was “ON” steady, voltage to the injector is OK, but the driver circuit is grounded at all times. This step determines if the circuit is shorted to ground or the PCM is faulty.
9. The reading should be about 12-14δ .
10. Locating the open in the harness or in the injector will require removal of the manifold to provide access.

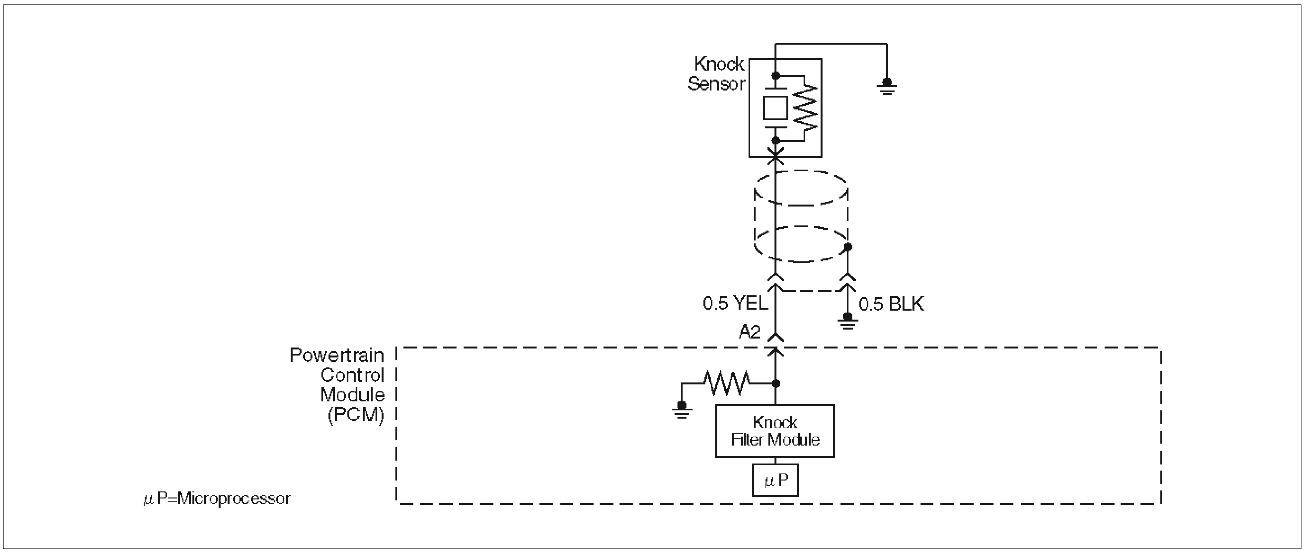
DTC P0206 – Injector 6 Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	Will the engine start?	—	Go to *Step 3*	Go to *Engine Cranks But Will Not Run* chart
3	1. Install the Tech 2. Clear the DTC. 2. Idle the engine for one minute. Does DTC P0206 reset?	—	Go to *Step 5*	Go to *Step 4*
4	1. Review the Freeze Frame data with the ignition “ON” and the engine “OFF” and note the parameters. 2. Operate the vehicle within the Freeze Frame conditions as noted. Does P0206 reset?	—	Go to *Step 5*	Go to *Diagnostic Aids*
5	1. Engine “OFF.” 2. Disconnect the injector test connector. 3. Install an injector test light 5-8840-2636-0 on injector connector. 4. Crank the engine and note the light. Does the cylinder 6 test light blink?	—	Go to *Fuel Injector Coil Test Procedure*	Go to *Step 6*
6	Note whether the injector test light for cylinder 6 was “OFF” or “ON” steady in step 5. Was the test light “ON” steady while cranking the engine?	—	Go to *Step 7*	Go to *Step 9*

DTC P0206 – Injector 6 Control Circuit (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Disconnect the PCM connector for the affected injectors. 2. With a test light connected to B+, probe the affected injector driver circuit. Does the test light illuminate?	—	Go to *Step 8*	Go to *Step 15*
8	Repair short to ground in the injector driver circuit. Is the action complete?	—	Go to *OBD System Check*	—
9	1. Disconnect the injector test connector. 2. At the injector side of the harness, connect an ohmmeter between the positive wire (red with blue tracer) and the wire for cylinder 6 (green with yellow tracer). Does the ohmmeter indicate continuity?	—	Go to *Step 11*	Go to *Step 10*
10	Repair the open injector harness wire or open injector Is the action complete?	—	Verify repair	—
11	At the PCM side of the injector test connector, check the green/yellow wire for a short to voltage. Was there a short to voltage?	—	Go to *Step 12*	Go to *Step 13*
12	Repair the short to voltage. Is the action complete?	—	Verify repair	—
13	Check for an open circuit between the injector test connector and the PCM. Was there an open circuit?	—	Go to *Step 14*	Go to *Step 15*
14	Repair the open circuit. Is the action complete?	—	Verify repair	—
15	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0325 KS Module Circuit



D06RW035

Circuit Description

The knock sensor is used to detect engine detonation, allowing the powertrain control module (PCM) to retard ignition control (IC) spark timing based on the knock sensor (KS) signal being received. The knock sensor produces an AC signal so that under a no knock condition the signal on the KS circuit measures about 0.007 V AC. The KS signal's amplitude and frequency depend upon the amount of knock being experienced. The PCM contains a non-replaceable knock filter module called a signal-to-noise enhancement filter (SNEF) module. This filter module in the PCM determines whether knock is occurring by comparing the signal level on the KS circuit with the voltage level on the noise channel. The noise channel allows the PCM to reject any false knock signal by knowing the amount of normal engine mechanical noise present. Normal engine noise varies depending on engine speed and load. When the PCM determines that an abnormally low noise channel voltage level is being experienced, a DTC P0325 will set.

Conditions for Setting the DTC

- Engine has been running for at least 30 seconds.
- The PCM determines that its internal signal from its knock filter module indicates a continuous knocking condition for more than 10 seconds.

Action Taken When the DTC Sets

- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.
- The PCM will use a "substitute" default spark retard value of 6 degrees to minimize knock during conditions when knock is likely to occur.

Conditions for Clearing the MIL/DTC

- DTC P0325 can be cleared by using Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – Inspect the knock sensor and PCM connectors for backed-out terminals, broken locks, and improperly formed or damaged terminals.
- Misrouted harness – Inspect the knock sensor harness to ensure that it is not routed too close to high voltage wires such as spark plug leads.

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.

Test Description

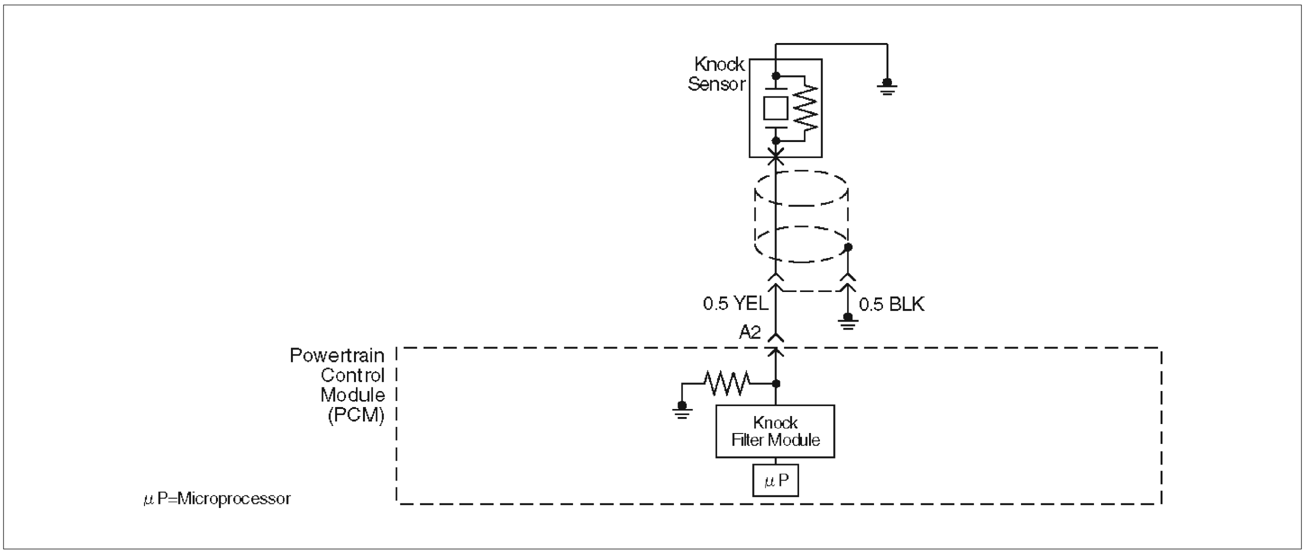
Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. Ensures that the fault is present.

DTC P0325 – KS Module Circuit

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	**IMPORTANT:** If an engine knock can be heard, repair the engine mechanical problem before proceeding with this diagnostic. 1. Operate the vehicle within parameters specified under criteria included in "Conditions for Setting the DTC." 2. Using Tech 2, monitor "Specific DTC" info for DTC P0325 until the DTC P0325 test runs. 3. Note the test result. Does Tech 2 indicate DTC P0325 failed this ignition?	—	Go to *Step 4*	Go to *Step 3*
3	1. Ignition "ON," engine "OFF." 2. Review and record Tech 2 Failure Records data for DTC P0325. 3. Operate the vehicle within Failure Records conditions. 4. Using Tech 2, monitor "Specific DTC" info for DTC P0325 until the DTC P0325 test runs. Does Tech 2 indicate DTC P0325 test failed this ignition?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0327 KS Sensor Circuit



D06RW035

Circuit Description

The powertrain control module (PCM) uses the knock sensor to detect engine detonation, allowing the PCM to retard ignition control (IC) spark timing based on the knock sensor (KS) signal being received. The knock sensor produces an AC signal so that under a no knock condition the signal on the KS circuit measures about 0.007 V AC. The signal amplitude and frequency are dependent upon the amount of knock being experienced. The PCM monitors the KS signal and can diagnose the KS sensor and circuitry.

Conditions for Setting the DTC

- Engine running for at least 10 seconds.
- The TP sensor is greater than 5%.
- The ECT sensor is greater than 60°C (140°F).
- Engine speed is between 2000 and 4000 RPM.
- The knock sensor signal voltage is less than 0.20 volts, or greater than 4.8 volts.
- All conditions are present for more than 15 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.
- The PCM will use a calculated spark retard value to minimize knock during conditions when knock is likely to occur. The calculated value will vary based on engine speed and load.

Conditions for Clearing the MIL/DTC

- DTC P0327 can be cleared by using Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. Ensures that the fault is present.
4. The knock sensor is attached to a short jumper harness, so it can be tested without removing the intake manifold. A 2-wire connector for the knock sensor is accessible behind the left rear fuel injector.

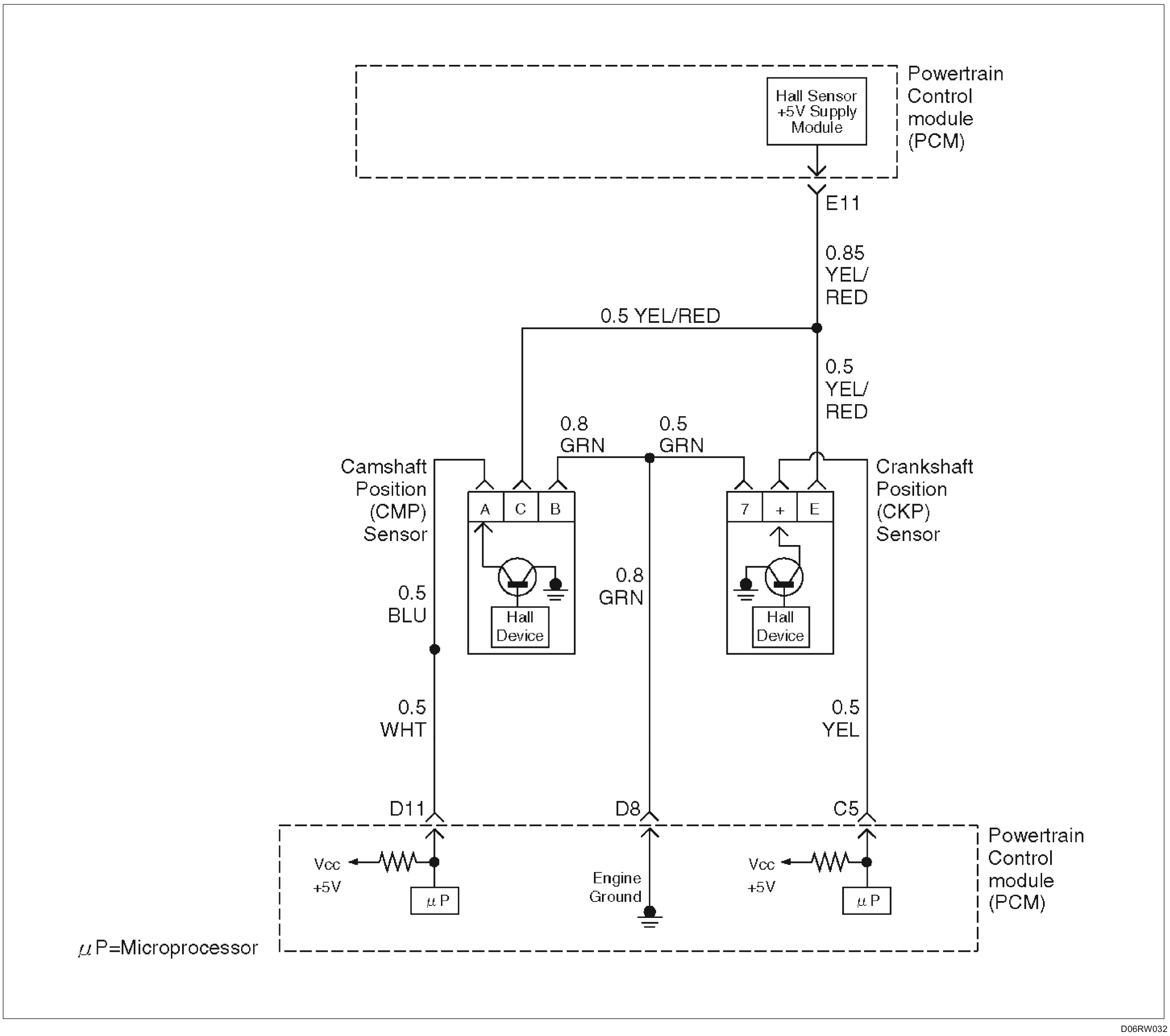
DTC P0327 – KS Sensor Circuit

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	**IMPORTANT:** If an engine knock can be heard, repair the engine mechanical problem before proceeding with this diagnostic. 1. Operate the engine within the conditions specified in diagnostic support "Conditions for Setting the DTC." 2. Using Tech 2, monitor "Specific DTC" info for DTC P0327 until the DTC P0327 test runs. 3. Note the test result. Does Tech 2 indicate DTC P0327 failed this ignition?	—	Go to *Step 4*	Go to *Step 3*
3	1. Ignition "ON," engine "OFF." 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Records conditions. 4. Using Tech 2, monitor "Specific DTC" info for DTC P0327 until the DTC P0327 test runs. 5. Note the test result. Does Tech 2 indicate DTC P0327 failed this ignition?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	1. Check for a damaged terminal at the knock sensor connector. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 5*
5	Using a test light to battery +, check the black/blue wire (PCM side) to verify that the shield connection is good. Did the test light illuminate?	—	Go to *Step 7*	Go to *Step 6*
6	Repair the open shield ground. Is the action complete?	—	Verify repair	—
7	1. Ignition "OFF," disconnect the PCM. 2. Check the KS signal circuit for a poor terminal connection at the PCM. 3. If a problem is found, replace the faulty terminal. Was a problem found?	—	Verify repair	Go to *Step 8*
8	1. Ignition "OFF," PCM disconnected. 2. Check the KS signal circuit between the PCM and the knock sensor connector for an open, a short to voltage, or a short to ground. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 9*
9	1. Ignition "OFF," PCM disconnected. 2. Knock sensor connected. 3. Measure the resistance of the knock sensor by connecting the DVM between the PCM connector and the engine block. Is the resistance of each knock sensor near the specified value?	100K ohms	Go to *Step 10*	Go to *Step 11*

DTC P0327 – KS Sensor Circuit (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Ignition "OFF," PCM disconnected. 2. Connect the DVM to monitor AC voltage between the PCM connector and engine ground. 3. Tap on the engine lift bracket with a socket extension while observing the signal indicated on the DVM. Is any signal indicated on the DVM while tapping on the engine lift bracket?	—	Go to *Step 12*	Go to *Step 11*
11	Replace the knock sensor. Is the action complete?	—	Verify repair	—
12	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0336 58X Reference Signal Circuit



Circuit Description

The 58X reference signal is produced by the crankshaft position (CKP) sensor. During one crankshaft revolution, 58 crankshaft pulses will be produced. The powertrain control module (PCM) uses the 58X reference signal to calculate engine RPM and crankshaft position. The PCM constantly monitors the number of pulses on the 58X reference circuit and compares them to the number of camshaft position (CMP) signal pulses being received. If the PCM receives an incorrect number of pulses on the 58X reference circuit, DTC P0336 will set.

Conditions for Setting the DTC

- Engine is running.
- Extra or missing pulse is detected between consecutive 58X reference pulses.
- Above condition is detected in 10 of 100 crankshaft rotations.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0336 can be cleared by using Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

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 PCM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

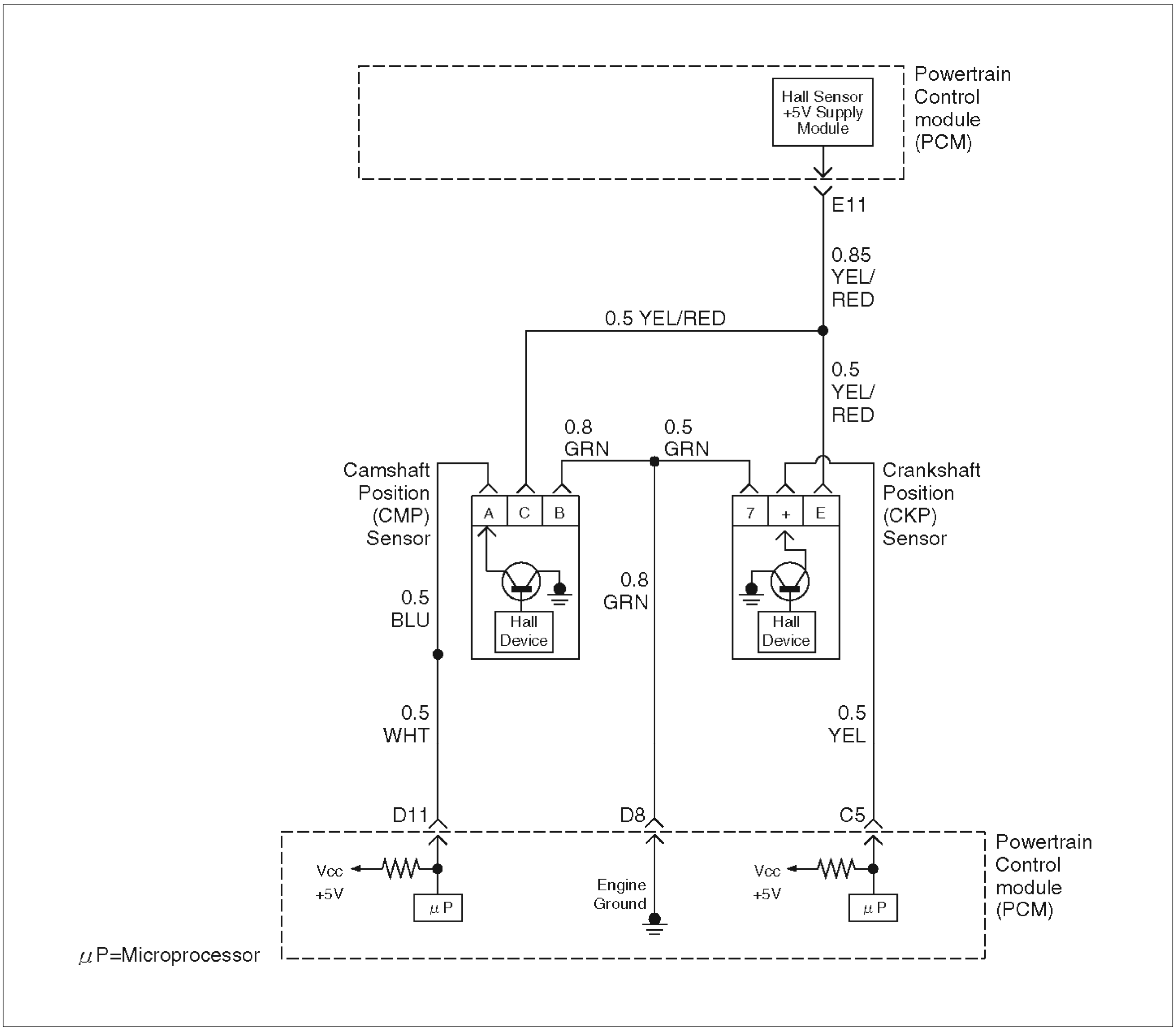
- Damaged harness – Inspect the wiring harness for damage. If the harness appears to be OK, disconnect the PCM, turn the ignition on and observe a voltmeter connected to the 58X reference circuit at the PCM harness connector while moving connectors and wiring harnesses related to the ICM. A change in voltage 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.

DTC P0336 – 58X Reference Signal Circuit

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	Attempt to start the engine. Does the engine start?	—	Go to *Step 3*	Go to *"Engine Cranks But Will Not Run"* chart
3	1. Review and record Failure Records information. 2. Clear DTC P0336. 3. Start the engine and idle for 1 minute. 4. Observe DTCs. Is DTC P0336 set?	—	Go to *Step 4*	Refer to Diagnostic Aids
4	1. Disconnect the PCM and CKP sensor. 2. Check for an open or a short to ground in the 58X reference circuit between the CKP sensor connector and the PCM harness connector. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 5*
5	1. Reconnect the PCM and CKP sensor. 2. Connect a DVM to measure voltage on the 58X reference circuit at the PCM connector. 3. Observe the voltage while cranking the engine. Is the voltage near the specified value?	2.5 V	Go to *Step 8*	Go to *Step 6*
6	Check the connections at the CKP sensor and replace the terminals if necessary. Did any terminals require replacement?	—	Verify repair	Go to *Step 7*
7	Replace the CKP sensor. Use caution to avoid any hot oil that may drip out. Is the action complete?	—	Verify repair	—
8	Check connections at the PCM and replace the terminals if necessary. Did any terminals require replacement?	—	Verify repair	Go to *Step 9*
9	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0337 CKP Sensor Circuit Low Frequency



D06RW032

Circuit Description

The 58X reference signal is produced by the crankshaft position (CKP) sensor. During one crankshaft revolution, 58 crankshaft reference pulses will be produced. The powertrain control module (PCM) uses the 58X reference signal to calculate engine RPM and crankshaft position. The PCM constantly monitors the number of pulses on the 58X reference circuit and compares them to the number of camshaft position (CMP) signal pulses being received. If the PCM does not receive pulses on the 58X reference circuit, DTC P0337 will set.

Conditions for Setting the DTC

- No camshaft position (CMP) sensor DTCs are set.
- Engine cranking.
- Crankshaft position (CKP) sensor signal is not present between two cam pulses.
- CKP reference pulse is not detected within 8 CMP pulses.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0337 can be cleared by using Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

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 PCM 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. If the harness appears to be OK, disconnect the PCM, turn the ignition on and observe a voltmeter connected to the 58X reference circuit at the PCM harness connector while moving connectors and wiring harnesses related to the ICM. A change in voltage 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.

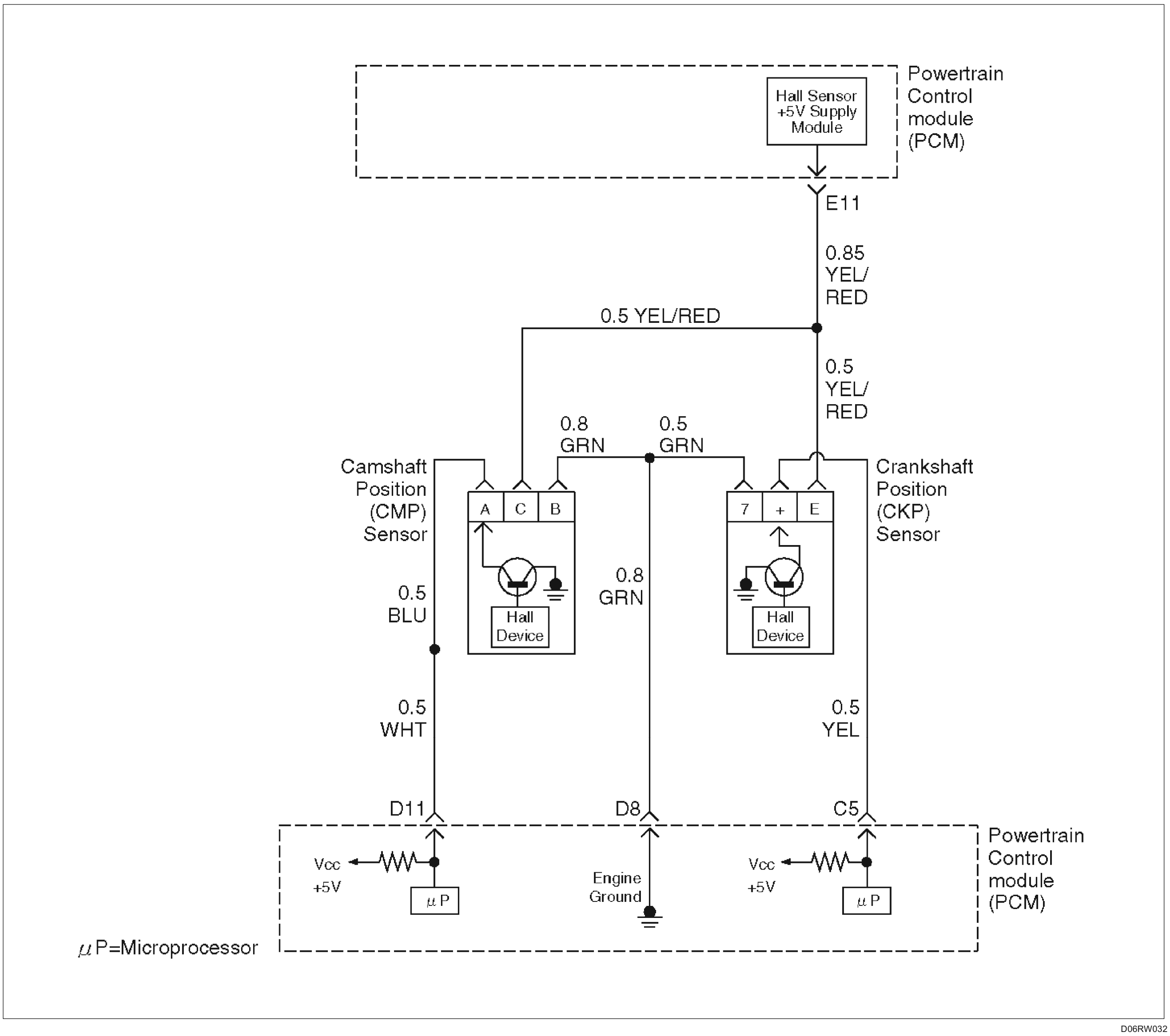
DTC P0337 – CKP Sensor Circuit Low Frequency

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	Attempt to start the engine. Does the engine start?	—	Go to *Step 3*	Go to *Chart 3*
3	1. Review and record Failure Records information. 2. Clear DTC P0337. 3. Start the engine and idle for 1 minute. 4. Observe DTCs. Is DTC P0337 set?	—	Go to *Step 4*	Refer to *Diagnostic Aid*
4	1. Disconnect the CKP sensor. 2. Ignition "ON." 3. Using a DVM, verify that 5 V reference and ground are being supplied at the sensor connector (PCM side). Are 4-6 volts and ground available at the sensor?	—	Go to *Step 7*	Go to *Step 5*
5	1. Ignition "ON." 2. With a DVM, backprobe the PCM connector 5 V reference and ground connections. Are 5 V reference and ground available at the PCM?	—	Go to *Step 6*	Go to *Step 11*
6	Check 5 V reference or ground between the CKP sensor and PCM and repair the open circuit, short to ground or short to voltage. Is the action complete?	—	Verify repair	—
7	1. Ignition "OFF." 2. Disconnect the PCM and CKP sensor. 3. Check for an open or a short to ground in the 58X reference circuit between the CKP sensor connector and the PCM harness connector. 4. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 8*
8	1. Reconnect the PCM and CKP sensor. 2. Connect a DVM to measure voltage on the 58X reference circuit at the PCM connector. 3. Observe the voltage while cranking the engine. Is the voltage near the specified value?	2.5 V	Go to *Step 11*	Go to *Step 9*
9	Check the connections at the CKP sensor and replace the terminals if necessary. Did any terminals require replacement?	—	Verify repair	Go to *Step 10*
10	Replace the CKP sensor. Use caution and avoid hot oil that may drip out. Is the action complete?	—	Verify repair	—

DTC P0337 – CKP Sensor Circuit Low Frequency (Cont'd)

Step	Action	Value(s)	Yes	No
11	Check the connections at the PCM and replace the terminals if necessary. Did any terminals require replacement?	—	Verify repair	Go to *Step 12*
12	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0341 CMP Sensor Circuit Performance



Circuit Description

The CMP signal is produced by the camshaft position (CMP) sensor pulses when the engine is running and crankshaft position (CKP) sync pulses are also being received. The powertrain control module (PCM) uses the CMP signal pulses to initiate sequential fuel injection. The PCM constantly monitors the number of pulses on the CMP signal circuit and compares the number of CMP pulses to the number of 58X reference pulses received. If the PCM receives an incorrect number of pulses on the CMP reference circuit, DTC P0341 will set and the PCM will initiate injector sequence without the CMP signal with a one in six chance that injector sequence is correct. The engine will continue to start and run normally, although the misfire diagnostic will be affected if a misfiring condition occurs.

Conditions for Setting the DTC

- The engine is running (1X CMP reference pulses are being received).
- The CMP sensor signal is not detected at the correct interval every 6 cylinders.
- Above condition fails for 100 occurrences within 200 test samples.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the fault is detected.
- The PCM will initiate the injector sequence without the CMP signal with a one in six chance that the injector sequence is correct.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0341 can be cleared by using Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

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 PCM 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. If the harness appears to be OK, disconnect the PCM, turn the ignition on and observe a voltmeter connected to the CMP signal circuit at the PCM harness connector while moving connectors and wiring harnesses related to the ICM and the CMP sensor. A change in voltage 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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. Ensures that the fault is present.

12. Determines whether the fault is being caused by a missing camshaft magnet or a faulty sensor. The voltage measured in this step should read around 4 volts, toggling to near 0 volts when the CMP sensor interfaces with the camshaft magnet.

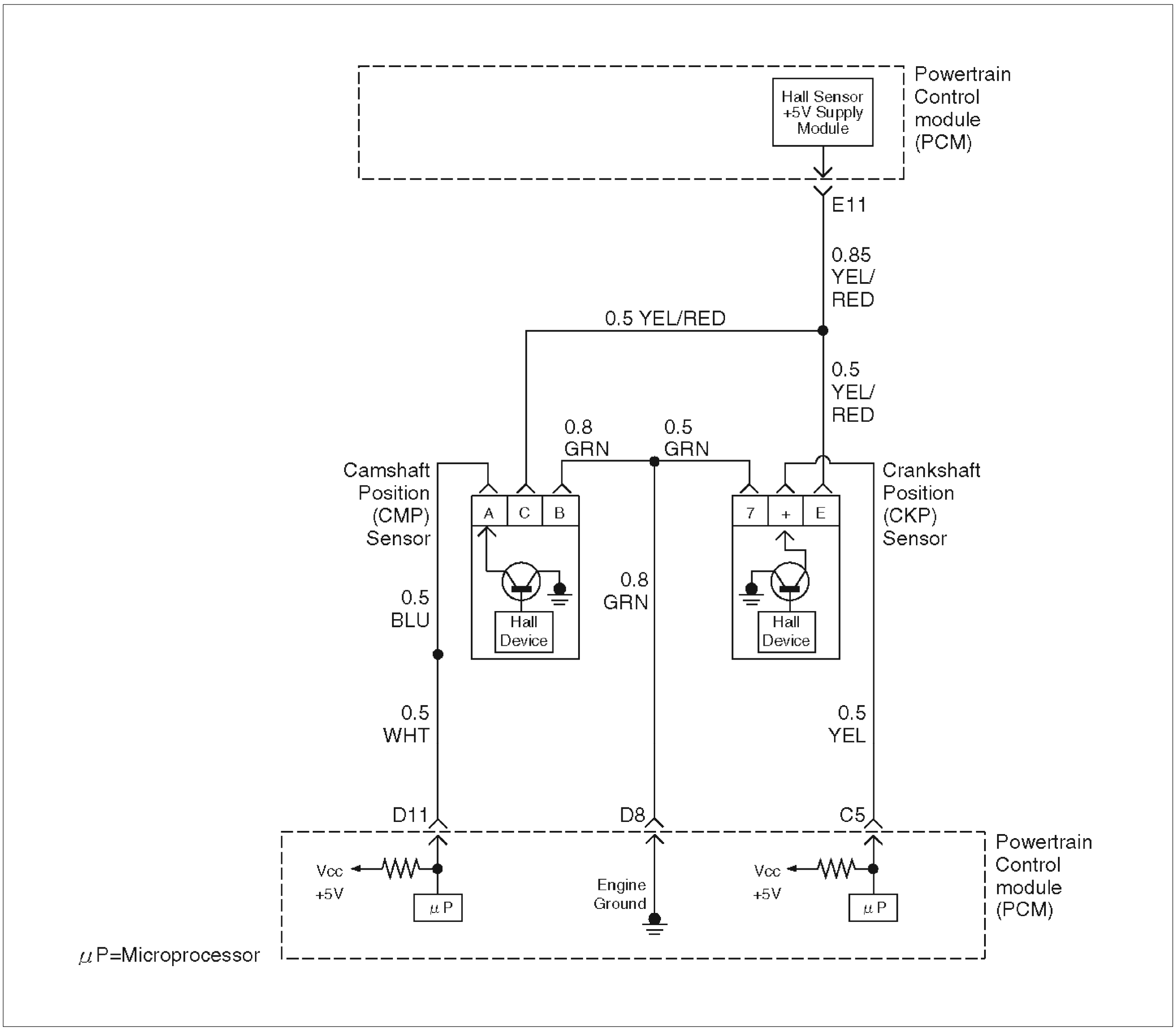
DTC P0341 – CMP Sensor Circuit Performance

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. Ignition "ON." 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using Tech 2, monitor "Specific DTC" info for DTC P0341 until the DTC P0341 test runs. 5. Note the test result. Does Tech 2 indicate DTC P0341 failed this ignition?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	1. Disconnect the CMP sensor. 2. Measure the voltage between the sensor feed circuit and the sensor ground circuit at the CMP sensor harness connector. Does the voltage measure near the specified value?	4-6 V	Go to *Step 4*	Go to *Step 5*
4	Measure the voltage between the CMP sensor signal circuit and the sensor ground circuit at the CMP sensor harness connector. Does the voltage measure near the specified value?	4-6 V	Go to *Step 11*	Go to *Step 8*
5	If the voltage measured in step 3 was less than 4-6 volts, proceed directly to step 6 without completing this step. If the voltage in step 3 was greater than 4-6 V, repair the short to voltage in the CMP feed circuit. Is the action complete?	—	Verify repair	—
6	1. Check for poor connections at the camshaft position sensor. 2. If a problem is found, repair it as necessary. Was a problem found?	—	Verify repair	Go to *Step 7*
7	1. Ignition "OFF," disconnect the PCM and the CMP sensor. 2. Check the following circuits for an open between the ignition coil and the CMP sensor: ● The sensor feed circuit. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 9*
8	1. Ignition "OFF," disconnect the PCM (leave the CMP sensor disconnected). 2. Ignition "ON," check the following circuits: ● The CMP sensor signal circuit for an open or a short to voltage. ● The CMP sensor input signal circuit for a short to ground. 3. If a problem is found, repair it as necessary. Was a problem found?	—	Verify repair	Go to *Step 9*
9	Check for a short or open in the sensor ground circuit. Was a problem found?	—	Verify repair	Go to *Step 10*

DTC P0341 – CMP Sensor Circuit Performance (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Check for poor connections at the PCM. 2. If a problem is found, repair it as necessary. Was a problem found?	—	Verify repair	Go to *Step 11*
11	Backprobe the PCM connector with a DVM to monitor voltage on the camshaft position input signal circuit while cranking the engine with the sensor connected. (Use rubber band, tape, or an assistant to keep the DVM lead in contact with the sensor terminal during this test.) Does the voltage toggle between the specified values?	4-0 V	Go to *Step 15*	Go to *Step 12*
12	1. Remove the CMP sensor from the engine front cover (leave the sensor wiring connected). 2. Place a magnet on the CMP sensor. (If you use a magnet that is too small to cover the face of the sensor, test on every part of the sensor face because only a small area will respond to this test.) Does the DVM display a voltage near the specified value?	0 V	Go to *Step 13*	Go to *Step 14*
13	Replace the faulty or missing camshaft position sensor magnet. Is the action complete?	—	Verify repair	—
14	Replace the camshaft position sensor. Is the action complete?	—	Verify repair	—
15	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0342 CMP Sensor Circuit Low



D06RW032

Circuit Description

The CMP signal produced by the camshaft position (CMP) sensor pulses when the engine is running and crankshaft position (CKP) sync pulses are also being received. The hall type CMP sensor and the CKP sensor share 5 V and ground connections at the powertrain control module (PCM). The third wire at the sensor is a signal circuit to the PCM. The PCM uses the CMP signal pulses to initiate sequential fuel injection. The PCM constantly monitors the number of pulses on the CMP signal circuit and compares the number of CMP pulses to the number of 58X reference pulses received. If the PCM does not receive pulses on the CMP reference circuit, DTC P0342 will set and the PCM will initiate injector sequence without the CMP signal with a one in six chance that injector sequence is correct. The engine will continue to start and run normally, although the misfire diagnostic will be affected if a misfiring condition occurs.

Conditions for Setting the DTC

- The engine is running.
- The CMP sensor signal is not received by the PCM once every 6 cylinders.
- The above condition occurs for 10 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the fault is detected.
- The PCM will initiate injector sequence without the CMP signal with a one in six chance that the injector sequence is correct.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0342 can be cleared by using Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

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 PCM 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. If the harness appears to be OK, disconnect the PCM, turn the ignition on and observe a voltmeter connected to the CMP signal circuit at the PCM harness connector while moving connectors and wiring harnesses related to the ICM and the CMP sensor. A change in voltage will indicate the location of the fault.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. Ensures that the fault is present.

14. Determines whether the fault is being caused by a missing camshaft magnet or a faulty PCM. The voltage measured in this step should read around 4 volts, toggling to near 0 volts when the CMP sensor interfaces with the camshaft magnet.

DTC P0342 – CMP Sensor Circuit Low

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. Ignition "ON." 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Records conditions as noted. 4. Using Tech 2, monitor "Specific DTC" information for DTC P0342 until the DTC P0342 test runs. 5. Note test result. Does Tech 2 indicate DTC P0342 failed this ignition?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	1. Ignition "ON." 2. Disconnect the CMP sensor. 3. Measure the voltage between the sensor feed circuit and the sensor ground circuit at the CMP sensor harness connector. Does the voltage measure near the specified value?	4-6 V	Go to *Step 7*	Go to *Step 4*
4	1. Ignition "OFF," disconnect the PCM and the CMP sensor. 2. Check for poor connections at the camshaft position sensor. 3. If a problem is found, repair it as necessary. Was a problem found?	—	Verify repair	Go to *Step 5*
5	1. Check for poor connections at the PCM. 2. If a problem is found, repair it as necessary. Was a problem found?	—	Verify repair	Go to *Step 6*
6	1. Check the following circuits between the PCM and the CMP sensor: • The sensor feed circuit. Open or short to ground? • The sensor ground circuit. Open or short to voltage? 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	—

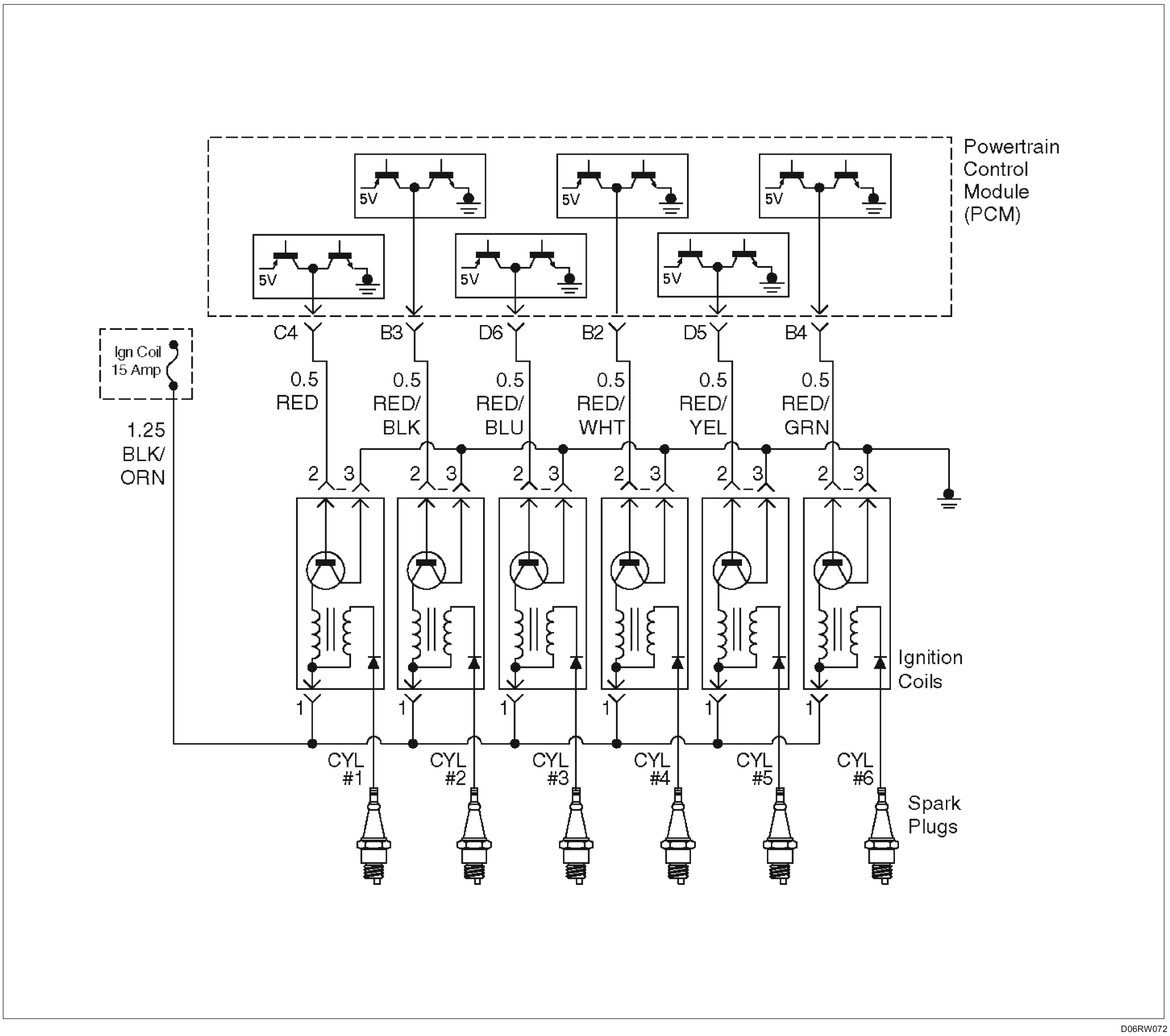
DTC P0342 – CMP Sensor Circuit Low (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Ignition "ON," engine "OFF." 2. Measure the voltage between the CMP sensor signal circuit and the sensor ground circuit at the CMP sensor harness connector. Does the voltage measure near the specified value?	4-6 V	Go to *Step 8*	Go to *Step 9*
8	1. Turn the ignition "OFF." 2. Disconnect the PCM and connect a DVM to monitor voltage on the camshaft position signal circuit at the PCM connector. 3. Ignition "ON." 4. Monitor the voltage display on the DVM while repeatedly touching the CMP sensor signal circuit at the CMP sensor connector with a test light to ground. Does the DVM voltage display switch between 0 and approximately 5 volts when the test light is touched to the CMP sensor signal circuit?	—	Go to *Step 12*	Go to *Step 9*
9	1. Ignition "OFF." 2. Leave the PCM disconnected. 3. Ignition "ON." 4. Probe the camshaft position signal circuit at the PCM connector with a test light to B+. 5. If the test light is "ON," locate and repair the short to ground in the camshaft position input signal circuit. Was either circuit shorted to ground?	—	Verify repair	Go to *Step 10*
10	1. Ignition "OFF." 2. Leave the PCM disconnected. 3. Ignition "ON." 4. Probe the camshaft position signal circuit with a test light to ground. 5. If the test light is "ON," locate and repair the short to voltage in the camshaft position input signal circuit. Was the test light "ON"?	—	Verify repair	Go to *Step 11*
11	1. Ignition "OFF," disconnect the PCM (leave the CMP sensor disconnected). 2. Ignition "ON," check the following circuit: • The CMP sensor signal circuit for an open. 3. If a problem is found, repair it as necessary. Was a problem found?	—	Verify repair	—
12	1. Ignition "ON." 2. Remove the CMP sensor from the engine front cover (leave the sensor wiring connected). 3. Place a magnet on the CMP sensor. If you use a magnet that is too small to cover the face of the sensor, test on every part of the sensor face because only a small area will respond to this test. Does the DVM display a voltage near the specified value?	0 V	Go to *Step 14*	Go to *Step 13*
13	Replace the camshaft position sensor. Is the action complete?	—	Verify repair	—

DTC P0342 – CMP Sensor Circuit Low (Cont'd)

Step	Action	Value(s)	Yes	No
14	1. Reinstall the CMP sensor to the engine front cover. 2. Observe the DVM connected to monitor voltage on the camshaft position signal circuit while cranking the engine. Does the voltage toggle between the specified values?	4-0 V	Go to *Step 15*	Go to *Step 16*
15	Replace the PCM. NOTE: The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—
16	Replace faulty or missing camshaft magnet. Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0351 Ignition 1 Control Circuit



Circuit Description

The powertrain control module's (PCM) 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 PCM, it provides a ground path for the B+ supply to the primary side of the number 1 ignition coil. When the PCM 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 PCM and ignition coil is monitored for an open circuit, short to voltage, and short to ground. When the PCM detects a problem on ignition control circuit 1, it will set a DTC P0351.

Conditions for Setting the DTC

- The ignition is "ON."
- The engine is turning, determined by the 58X crankshaft position input signal.
- The output voltage is not equal to 5 volts when output is "ON."
- The output voltage is not equal to 0 volts when output is "OFF."
- Twenty test failures occur within 40 samples of continuous spark events.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0351 can be cleared by using Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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 Tech 2 display related to DTC P0351 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.

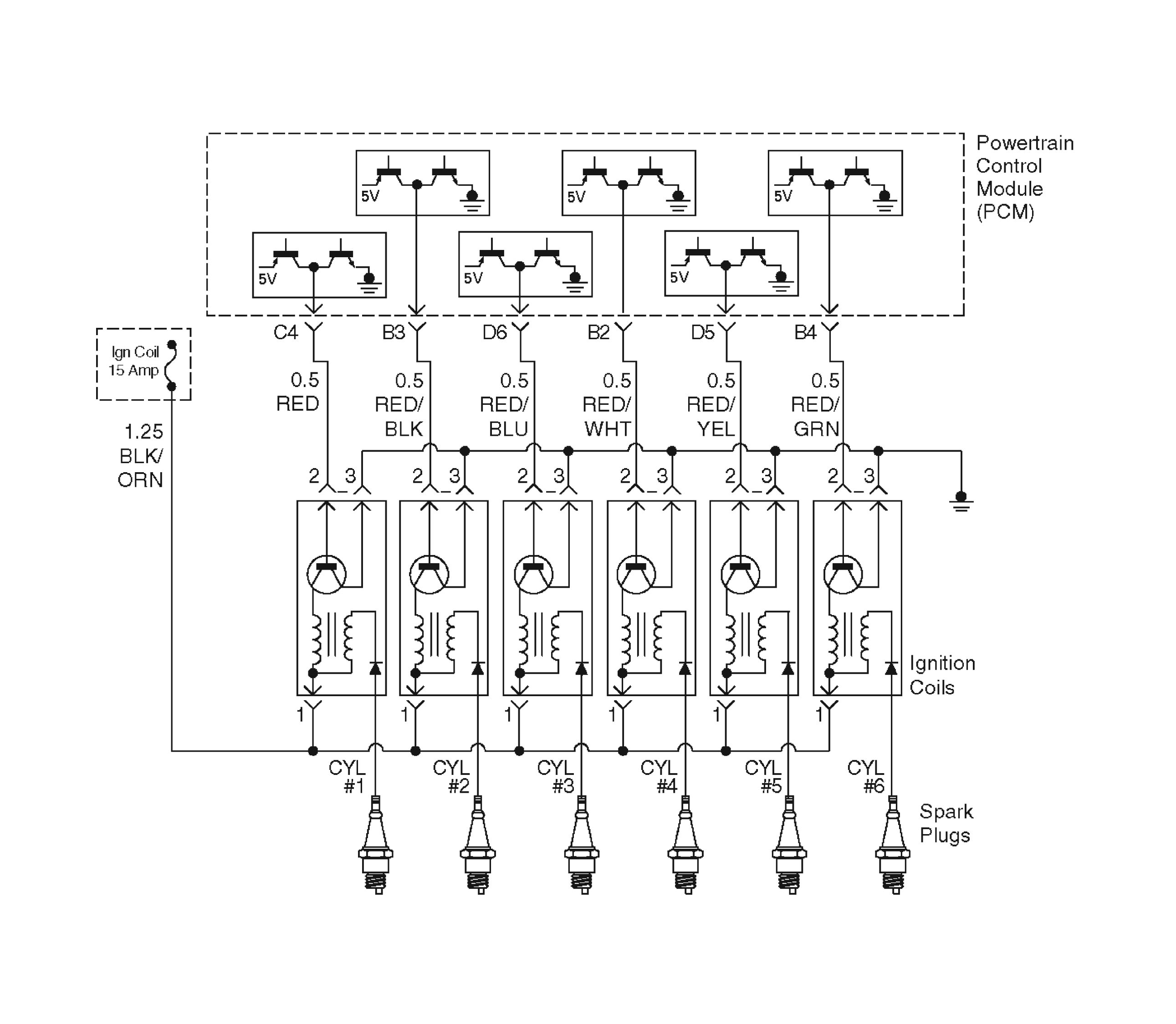
DTC P0351 – Ignition 1 Control Circuit

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. Ignition “ON,” engine “OFF.” 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Record conditions as noted. 4. Use Tech 2 to monitor the “Specific DTC” information for DTC P0351 until the DTC P0351 test runs. 5. Note the test result. Does Tech 2 indicate DTC P0351 failed this ignition cycle?	—	Go to *Step 3*	Go to *Diagnostic Aids*
3	Check for faulty connection at ignition coil. Was a problem found?	—	Verify repair	Go to *Step 4*
4	Check for faulty connection at PCM connector. Was a problem found?	—	Verify repair	Go to *Step 5*
5	1. Ignition “ON,” engine “OFF.” 2. Back probe the ignition control circuit 1 at the PCM with a DVM. Is the voltage near the specified value?	25-55 mV	Go to *Step 6*	Go to *Step 9*
6	1. Ignition “ON,” engine running. 2. Back probe the ignition control circuit at the PCM for the cylinder being tested. Is the voltage in the specified range, rapidly toggling back and forth to a reading 20-50 mV higher?	100-180 mV	Go to *Step 7*	Go to *Step 13*
7	1. Ignition “OFF.” 2. Disconnect the 3-pin and 5-pin connectors at the ignition coil. 3. Check ignition control circuit 1 voltage at the ignition coil connector while cranking the engine. Does the voltage measure between the specified values?	200-1200 mV	Go to *Step 8*	Go to *Step 11*
8	Replace the ignition coil. Is the action complete?	—	Verify repair	—
9	1. Ignition “OFF.” 2. Disconnect the PCM and the ignition coil. 3. Check ignition control circuit 1 for short to ground. Was a problem found?	—	Verify repair	Go to *Step 10*
10	Check ignition control circuit 1 for short to voltage. Was a problem found?	—	Verify repair	Go to *Step 13*

DTC P0351 – Ignition 1 Control Circuit (Cont’d)

Step	Action	Value(s)	Yes	No
11	Check for an open ignition control circuit 1. Was the ignition control circuit open?	—	Go to *Step 12*	Go to *Step 13*
12	Repair the open ignition control circuit. Is the action complete?	—	Verify repair	—
13	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0352 Ignition 2 Control Circuit



D06RW072

Circuit Description

The powertrain control module's (PCM) control circuit 2 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 PCM, it provides a ground path for the B+ supply to the primary side of the number 2 ignition coil. When the PCM 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 PCM and ignition coil is monitored for an open circuit, short to voltage, and short to ground. When the PCM detects a problem on ignition control circuit 2, it will set a DTC P0352.

Conditions for Setting the DTC

- The ignition is "ON."
- The engine is turning, determined by the 58 X crankshaft position input signal.
- The output voltage is not equal to 5 volts when output is "ON."
- The output voltage is not equal to 0 volts when output is "OFF."
- Twenty test failures occur within 40 samples of continuous spark events.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0352 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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 P0352 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.

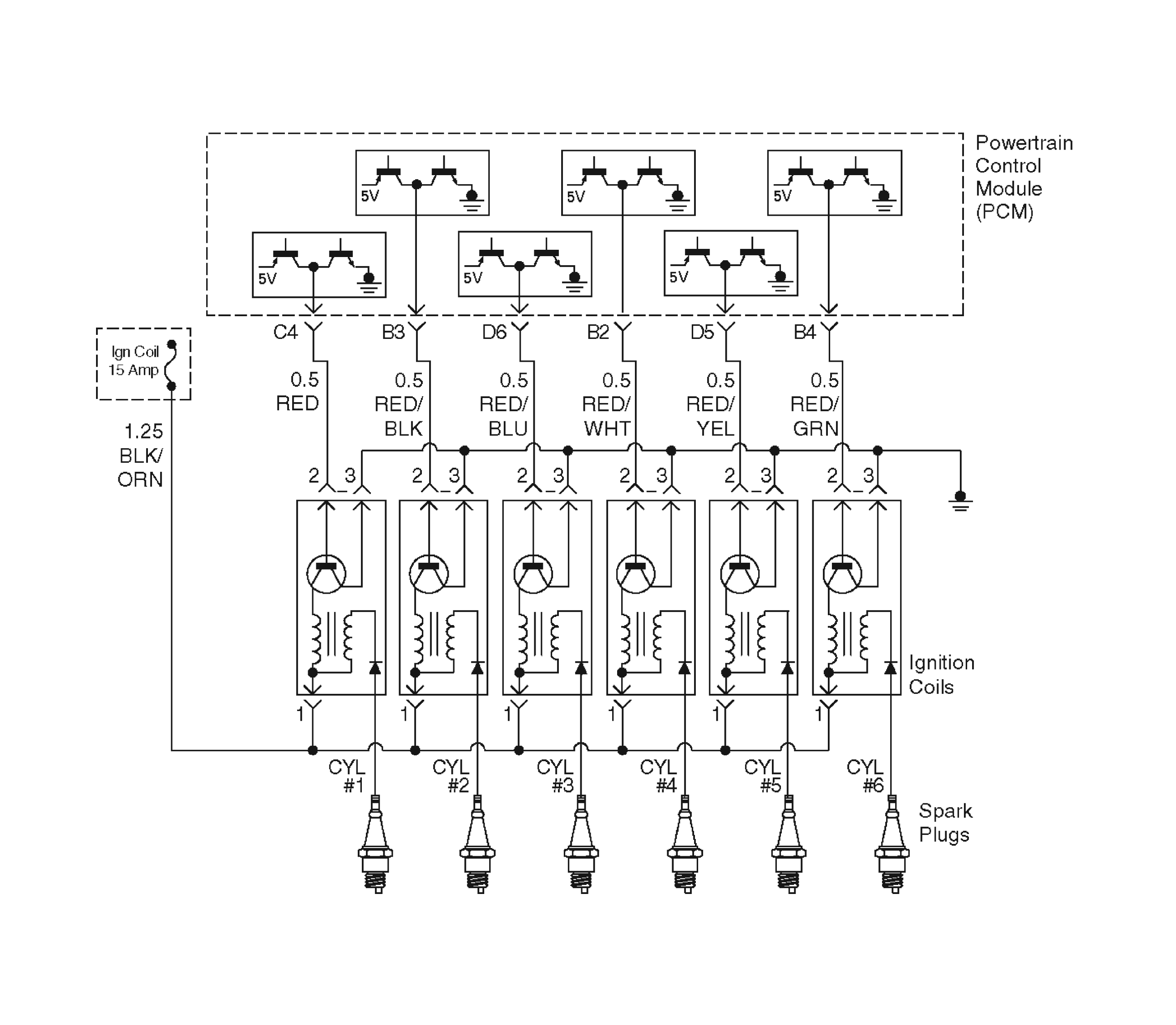
DTC P0352 – Ignition 2 Control Circuit

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. Ignition "ON," engine "OFF." 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Record conditions as noted. 4. Use a Tech 2 to monitor the "Specific DTC" information for DTC P0352 until the DTC P0352 test runs. 5. Note the test result. Does the Tech 2 indicate DTC P0352 failed this ignition cycle?	—	Go to *Step 3*	Go to *Diagnostic Aids*
3	Check for faulty connection at ignition coil. Was a problem found?	—	Verify repair	Go to *Step 4*
4	Check for faulty connection at PCM connector. Was a problem found?	—	Verify repair	Go to *Step 5*
5	1. Ignition "ON," engine "OFF." 2. Back probe the ignition control circuit 2 at the PCM with a DVM . Is the voltage near the specified value?	25-55 mV	Go to *Step 6*	Go to *Step 9*
6	1. Ignition "ON," engine running. 2. Back probe the ignition control circuit at the PCM for the cylinder being tested. Is the voltage in the specified range, rapidly toggling back and forth to a reading 20-50 mV higher?	100-180 mV	Go to *Step 7*	Go to *Step 13*
7	1. Ignition "OFF." 2. Disconnect the 3-pin and 5-pin connectors at the ignition coil. 3. Check ignition control circuit 2 voltage at the ignition coil connector while cranking the engine connector. Does the voltage measure between the specified values?	200-1200 mV	Go to *Step 8*	Go to *Step 11*
8	Replace the ignition coil. Is the action complete?	—	Verify repair	—
9	1. Ignition "OFF." 2. Disconnect the PCM and the ignition coil. 3. Check ignition control circuit 2 for short to ground. Was a problem found?	—	Verify repair	Go to *Step 10*
10	Check ignition control circuit 2 for short to voltage. Was a problem found?	—	Verify repair	Go to *Step 13*

DTC P0352 – Ignition 2 Control Circuit (Cont'd)

Step	Action	Value(s)	Yes	No
11	Check for an open ignition control circuit 1. Was the ignition control circuit open?	—	Go to *Step 12*	Go to *Step 13*
12	Repair the open ignition control circuit. Is the action complete?	—	Verify repair	—
13	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0353 Ignition 3 Control Circuit



Circuit Description

The powertrain control module's (PCM) control circuit 3 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 PCM, it provides a ground path for the B+ supply to the primary side of the number 3 ignition coil. When the PCM 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 PCM and ignition coil is monitored for an open circuit, short to voltage, and short to ground. When the PCM detects a problem on ignition control circuit 3, it will set a DTC P0353.

Conditions for Setting the DTC

- The ignition is "ON."
- The engine is turning, determined by the 58X crankshaft position input signal.
- The output voltage is not equal to 5 volts when output is "ON."
- The output voltage is not equal to 0 volts when output is "OFF."
- Twenty test failures occur within 40 samples of continuous spark events.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0353 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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 P0353 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.

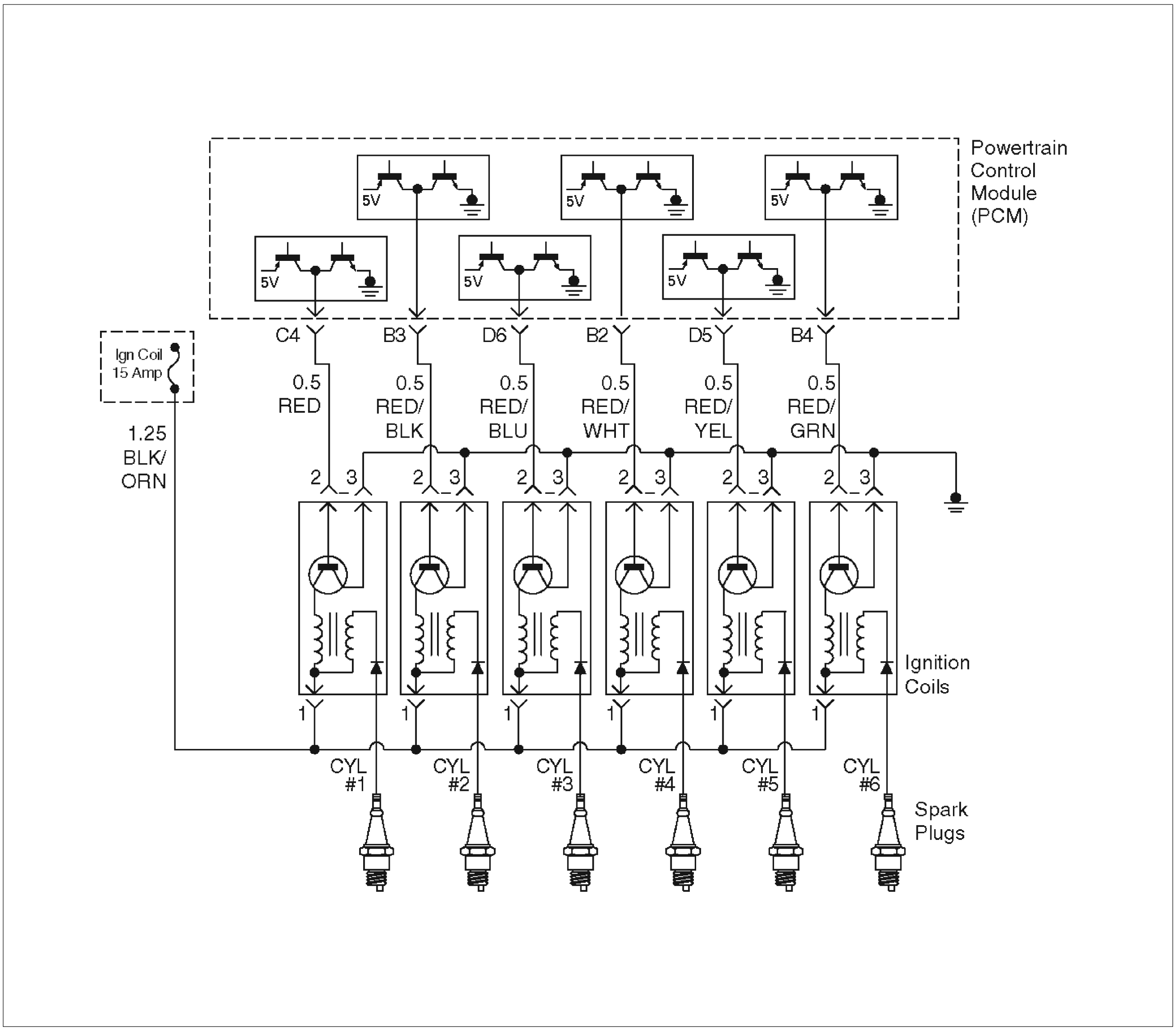
DTC P0353 – Ignition 3 Control Circuit

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. Ignition “ON,” engine “OFF.” 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Record conditions as noted. 4. Use a Tech 2 to monitor the “Specific DTC” information for DTC P0353 until the DTC P0353 test runs. 5. Note the test result. Does the Tech 2 indicate DTC P0353 failed this ignition cycle?	—	Go to *Step 3*	Go to *Diagnostic Aids*
3	Check for faulty connection at ignition coil. Was a problem found?	—	Verify repair	Go to *Step 4*
4	Check for faulty connection at PCM connector. Was a problem found?	—	Verify repair	Go to *Step 5*
5	1. Ignition “ON,” engine “OFF.” 2. Back probe the ignition control circuit 3 at the PCM with a DVM positive lead with the negative lead to ground. Is the voltage near the specified value?	25-55 mV	Go to *Step 6*	Go to *Step 9*
6	1. Ignition “ON,” engine running. 2. Back probe the ignition control circuit at the PCM for the cylinder being tested. Is the voltage in the specified range, rapidly toggling back and forth to a reading 20-50 mV higher?	100-180 mV	Go to *Step 7*	Go to *Step 13*
7	1. Ignition “OFF.” 2. Disconnect the 3-pin and 5-pin connectors at the ignition coil. 3. Check ignition control circuit 3 voltage at the ignition coil connector while cranking the engine. Does the voltage measure between the specified values?	200-1200 mV	Go to *Step 8*	Go to *Step 11*
8	Replace the ignition coil. Is the action complete?	—	Verify repair	—
9	1. Ignition “OFF.” 2. Disconnect the PCM and the ignition coil. 3. Check ignition control circuit 3 for short to ground. Was a problem found?	—	Verify repair	Go to *Step 10*
10	Check ignition control circuit 3 for short to voltage. Was a problem found?	—	Verify repair	Go to *Step 13*

DTC P0353 – Ignition 3 Control Circuit (Cont'd)

Step	Action	Value(s)	Yes	No
11	Check for an open ignition control circuit 1. Was the ignition control circuit open?	—	Go to *Step 12*	Go to *Step 13*
12	Repair the open ignition control circuit. Is the action complete?	—	Verify repair	—
13	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0354 Ignition 4 Control Circuit



D06RW072

Circuit Description

The powertrain control module's (PCM) control circuit 4 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 PCM, it provides a ground path for the B+ supply to the primary side of the number 4 ignition coil. When the PCM 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 PCM and ignition coil is monitored for an open circuit, short to voltage, and short to ground. When the PCM detects a problem on ignition control circuit 4, it will set a DTC P0354.

Conditions for Setting the DTC

- The ignition is "ON."
- The engine is turning, determined by the 58X crankshaft position input signal.
- The output voltage is not equal to 5 volts when output is "ON."
- The output voltage is not equal to 0 volts when output is "OFF."
- Twenty test failures occur within 40 samples of continuous spark events.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0354 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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 P0354 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.

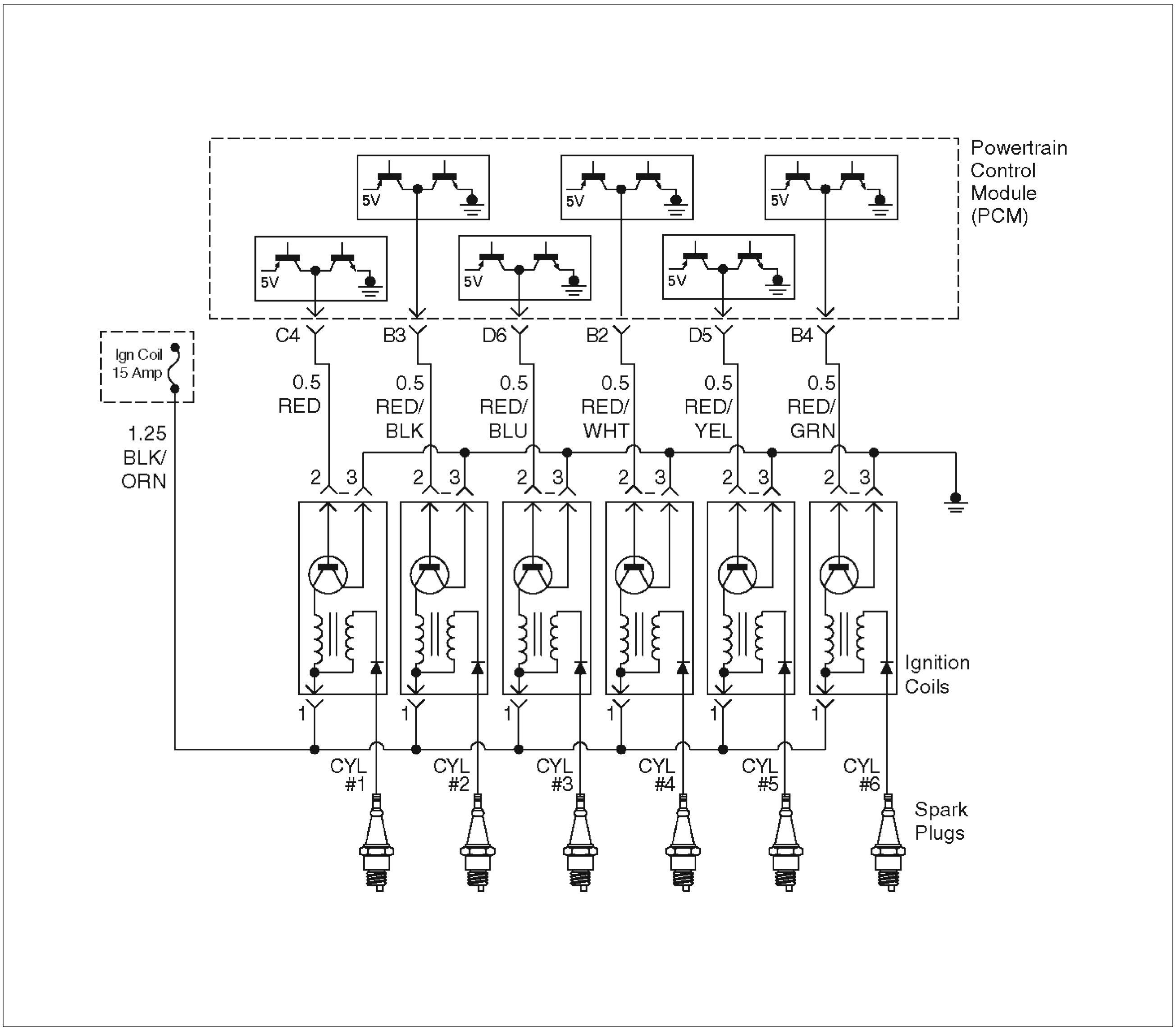
DTC P0354 – Ignition 4 Control Circuit

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. Ignition “ON,” engine “OFF.” 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Record conditions as noted. 4. Use a Tech 2 to monitor the “Specific DTC” information for DTC P0354 until the DTC P0354 test runs. 5. Note the test result. Does the Tech 2 indicate DTC P0354 failed this ignition cycle?	—	Go to *Step 3*	Go to *Diagnostic Aids*
3	Check for faulty connection at ignition coil. Was a problem found?	—	Verify repair	Go to *Step 4*
4	Check for faulty connection at PCM connector. Was a problem found?	—	Verify repair	Go to *Step 5*
5	1. Ignition “ON,” engine “OFF.” 2. Back probe the ignition control circuit 4 at the PCM with a DVM positive lead with the negative lead to ground. Is the voltage near the specified value?	25-55 mV	Go to *Step 6*	Go to *Step 9*
6	1. Ignition “ON,” engine running. 2. Back probe the ignition control circuit at the PCM for the cylinder being tested. Is the voltage in the specified range, rapidly toggling back and forth to a reading 20-50 mV higher?	100-180 mV	Go to *Step 7*	Go to *Step 13*
7	1. Ignition “OFF.” 2. Disconnect the 3-pin and 5-pin connectors at the ignition coil. 3. Check ignition control circuit 4 voltage at the ignition coil connector while cranking the engine. Does the voltage measure between the specified values?	200-1200 mV	Go to *Step 8*	Go to *Step 11*
8	Replace the ignition coil. Is the action complete?	—	Verify repair	—
9	1. Ignition “OFF.” 2. Disconnect the PCM and the ignition coil. 3. Check ignition control circuit 4 for short to ground. Was a problem found?	—	Verify repair	Go to *Step 10*
10	Check ignition control circuit 4 for short to voltage. Was a problem found?	—	Verify repair	Go to *Step 13*

DTC P0354 – Ignition 4 Control Circuit (Cont'd)

Step	Action	Value(s)	Yes	No
11	Check for an open ignition control circuit 1. Was the ignition control circuit open?	—	Go to *Step 12*	Go to *Step 13*
12	Repair the open in ignition control circuit. Is the action complete?	—	Verify repair	—
13	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0355 Ignition 5 Control Circuit



Circuit Description

The powertrain control module's (PCM) control circuit 5 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 PCM, it provides a ground path for the B+ supply to the primary side of the number 5 ignition coil. When the PCM 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 PCM and ignition coil is monitored for an open circuit, short to voltage, and short to ground. When the PCM detects a problem on ignition control circuit 5, it will set a DTC P0355.

Conditions for Setting the DTC

- The ignition is "ON."
- The engine is turning, determined by the 58X crankshaft position input signal.
- The output voltage is not equal to 5 volts when output is "ON."
- The output voltage is not equal to 0 volts when output is "OFF."
- Twenty test failures occur within 40 samples of continuous spark events.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0355 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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 P0355 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.

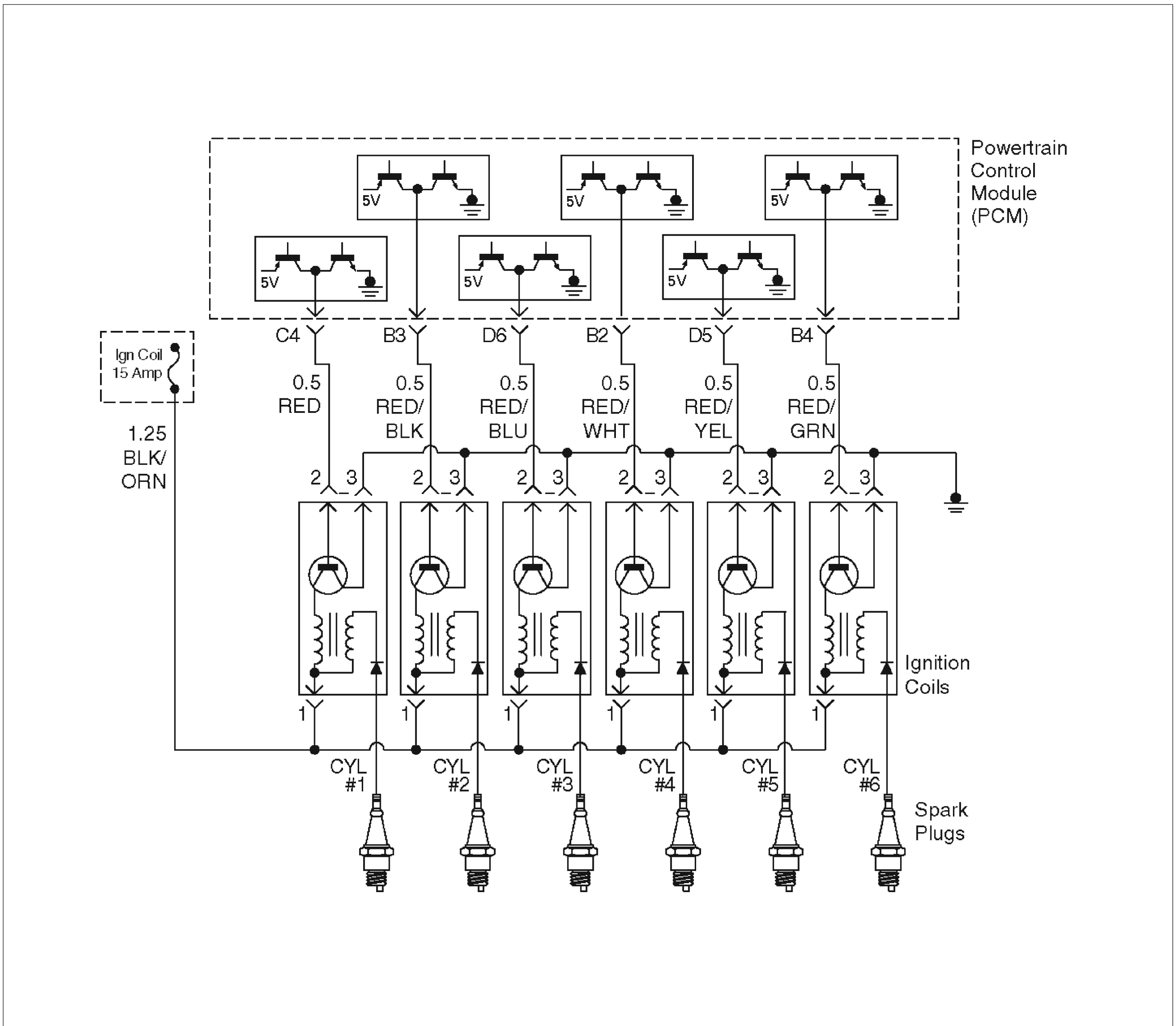
DTC P0355 – Ignition 5 Control Circuit

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. Ignition "ON," engine "OFF." 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Record conditions as noted. 4. Use a Tech 2 to monitor the "Specific DTC" information for DTC P0355 until the DTC P0355 test runs. 5. Note the test result. Does the Tech 2 indicate DTC P0355 failed this ignition cycle?	—	Go to *Step 3*	Go to *Diagnostic Aids*
3	Check for faulty connection at ignition coil. Was a problem found?	—	Verify repair	Go to *Step 4*
4	Check for faulty connection at PCM connector. Was a problem found?	—	Verify repair	Go to *Step 5*
5	1. Ignition "ON," engine "OFF." 2. Back probe the ignition control circuit 5 at the PCM with a DVM positive lead with the negative lead to ground. Is the voltage near the specified value?	25-55 mV	Go to *Step 6*	Go to *Step 9*
6	1. Ignition "ON," engine running. 2. Back probe the ignition control circuit at the PCM for the cylinder being tested. Is the voltage in the specified range, rapidly toggling back and forth to a reading 20-50 mV higher?	100-180 mV	Go to *Step 7*	Go to *Step 13*
7	1. Ignition "OFF." 2. Disconnect the 3-pin and 5-pin connectors at the ignition coil. 3. Check ignition control circuit 5 voltage at the ignition coil connector while cranking the engine. Does the voltage measure between the specified values?	200-1200 mV	Go to *Step 8*	Go to *Step 11*
8	Replace the ignition coil. Is the action complete?	—	Verify repair	—
9	1. Ignition "OFF." 2. Disconnect the PCM and the ignition coil. 3. Check ignition control circuit 5 for short to ground. Was a problem found?	—	Verify repair	Go to *Step 10*
10	Check ignition control circuit 5 for short to voltage. Was a problem found?	—	Verify repair	Go to *Step 13*

DTC P0355 – Ignition 5 Control Circuit (Cont'd)

Step	Action	Value(s)	Yes	No
11	Check for an open ignition control circuit 1. Was the ignition control circuit open?	—	Go to *Step 12*	Go to *Step 13*
12	Repair the open ignition control circuit. Is the action complete?	—	Verify repair	—
13	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0356 Ignition 6 Control Circuit



D06RW072

Circuit Description

The powertrain control module's (PCM) control circuit 6 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 PCM, it provides a ground path for the B+ supply to the primary side of the number 6 ignition coil. When the PCM 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 PCM and ignition coil is monitored for an open circuit, short to voltage, and short to ground. When the PCM detects a problem on ignition control circuit 6, it will set a DTC P0356.

Conditions for Setting the DTC

- The ignition is "ON."
- The engine is turning, determined by the 58X crankshaft position input signal.
- The output voltage is not equal to 5 volts when output is "ON."
- The output voltage is not equal to 0 volts when output is "OFF."
- Twenty test failures occur within 40 samples of continuous circuit monitoring.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0356 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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 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.

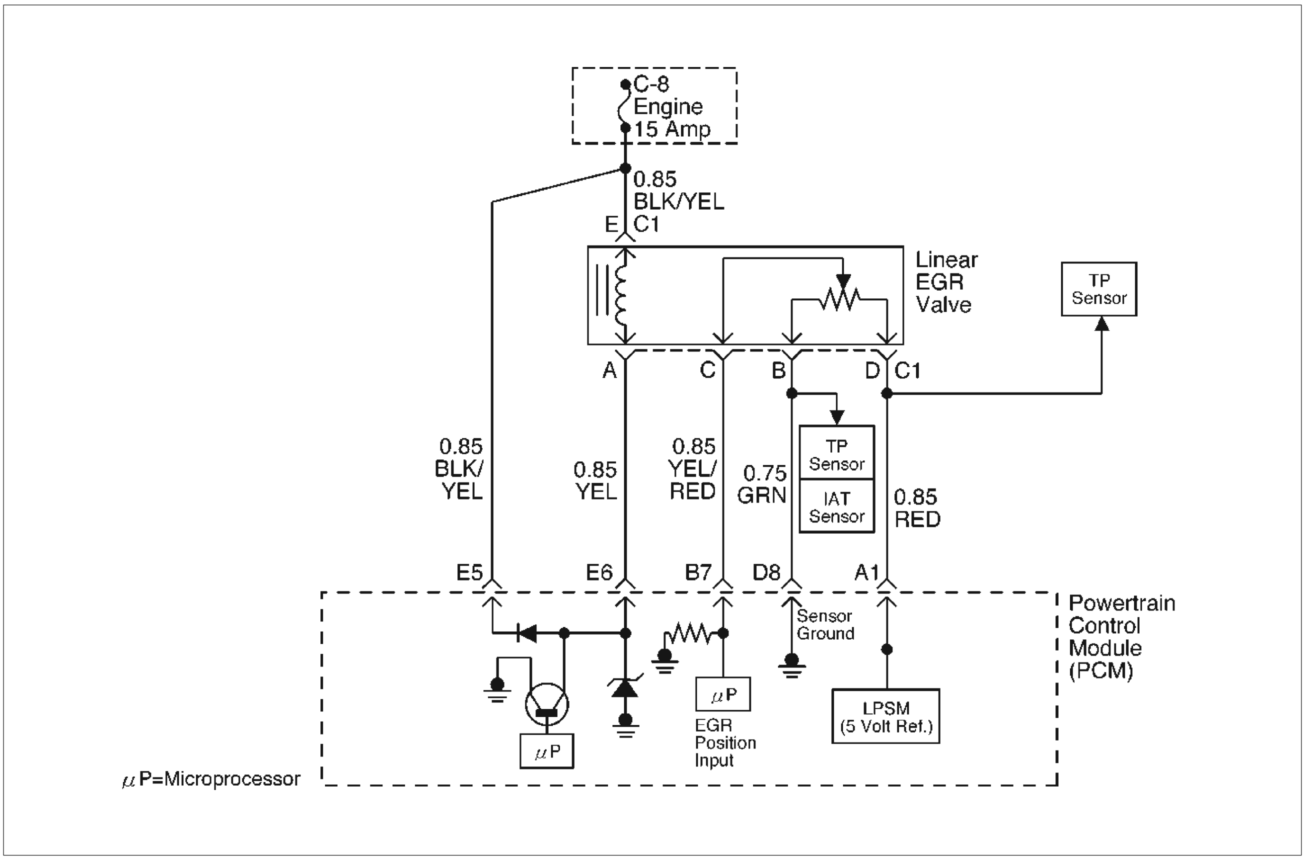
DTC P0356 – Ignition 6 Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Ignition “ON,” engine “OFF.” 2. Review and record Tech 2 Failure Records data. 3. Operate the vehicle within Failure Record conditions as noted. 4. Use a Tech 2 to monitor the “Specific DTC” information for DTC P0356 until the DTC P0356 test runs. 5. Note the test result. Does the Tech 2 indicate DTC P0356 failed this ignition cycle?	—	Go to *Step 3*	Go to *Diagnostic Aids*
3	Check for faulty connection at ignition coil. Was a problem found?	—	Verify repair	Go to *Step 4*
4	Check for faulty connection at PCM connector. Was a problem found?	—	Verify repair	Go to *Step 5*
5	1. Ignition “ON,” engine “OFF.” 2. Back probe the ignition control circuit 6 at the PCM with a DVM positive lead with the negative lead to ground. Is the voltage near the specified value?	25-55 mV	Go to *Step 6*	Go to *Step 9*
6	1. Ignition “ON,” engine running. 2. Back probe the ignition control circuit at the PCM for the cylinder being tested. Is the voltage in the specified range, rapidly toggling back and forth to a reading 20-50 mV higher?	100-180 mV	Go to *Step 7*	Go to *Step 13*
7	1. Ignition “OFF.” 2. Disconnect the 3-pin and 5-pin connectors at the ignition coil. 3. Check ignition control circuit 6 voltage at the ignition coil connector while cranking the engine. Does the voltage measure between the specified values?	200-1200 mV	Go to *Step 8*	Go to *Step 11*
8	Replace the ignition coil. Is the action complete?	—	Verify repair	—
9	1. Ignition “OFF.” 2. Disconnect the PCM and the ignition coil. 3. Check ignition control circuit 6 for short to ground. Was a problem found?	—	Verify repair	Go to *Step 10*
10	Check ignition control circuit 6 for short to voltage. Was a problem found?	—	Verify repair	Go to *Step 13*

DTC P0356 – Ignition 6 Control Circuit (Cont'd)

Step	Action	Value(s)	Yes	No
11	Check for an open ignition control circuit 1. Was the ignition control circuit open?	—	Go to *Step 12*	Go to *Step 13*
12	Repair the open ignition control circuit. Is the action complete?	—	Verify repair	—
13	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0402 EGR Pintle Crank Error



Circuit Description

The powertrain control module (PCM) 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 stuck open. If the PCM detects a pintle position signal indicates more than 21.5% and more than for 625 msec during cranking, the PCM will set DTC P0402.

Conditions for Setting the DTC

- Ignition voltage is between 11 and 16 volts.
- Intake Air temp is more than 3°C
- At Engine revolution less than 600 RPM, EGR pintle position indicates more than 21.5% and more than for 625 msecs.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0402 can be cleared by using Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

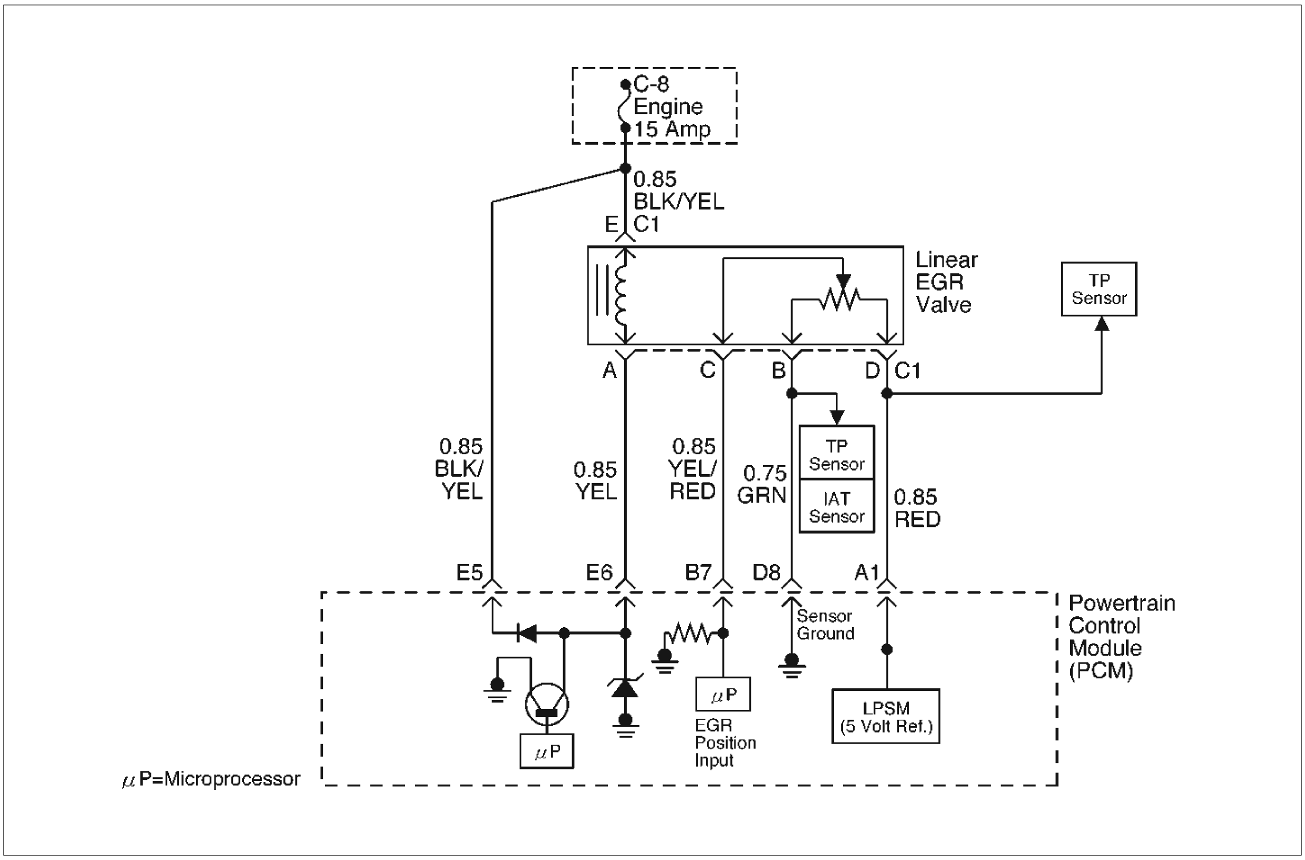
- Foreign material on EGR valve between pintle and seat may cause EGR stuck open. Inspect foreign material in EGR valve.
- Excessive carbon deposit may cause unsmooth operation of EGR valve shaft. Inspect carbon deposit and clean up inside of carbon deposit.
- Poor connection or damaged harness–inspect the wiring harness for damage If the harness appears to be OK, observe the EGR actual position display on Tech 2 while moving connectors and wiring harnesses related to EGR valve. A change in the display will indicate the location of the fault.

NOTE: If the EGR valve shows signs of excessive heat, check the exhaust system for blockage (possibly a plugged catalytic converter) using the “Restricted Exhaust System Check”.

DTC P0402 – EGR Pintle Crank Open Error

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. Ignition “ON”, engine “OFF”, review and record Tech 2 Failure Records data. 2. Operate the vehicle within Failure Records conditions as noted. 3. Using Tech 2, monitor “Specific DTC” info for DTC P0402 until the DTC P0402 test runs. Note the result. Does Tech 2 indicates DTC P0402 failed this ignition?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	1. Disconnect the EGR valve harness connector. 2. Inspect the EGR valve and connectors for damaged pin or terminals. Were there any damaged pins or terminals?	—	Go to *Step 4*	Go to *Step 5*
4	Repair the damaged pin or terminal. Is the action complete?	—	Verify repair	—
5	1. Remove EGR valve from Engine. 2. Inspect EGR valve whether there is any foreign material between seat and pintle. Was any foreign material in EGR valve?	—	Go to *Step 6*	Go to *Step 7*
6	1. Remove EGR valve foreign material from EGR valve and clean up inside. 2. Visually inspect damage of pintle and seat, which leakage may occur. Was there any severe damage which affects function?	—	Go to *Step 7*	Verify repair Go to *Step 8*
7	1. Reconnect. 2. Ignition “OFF”. 3. Install Tech 2. 4. Run the engine at idle. 5. On Tech-II, select special function for EGR. 6. Use the “UP” arrow to increase the EGR from 0% to 40%. Did EGR work properly?	—	—	Go to *Step 8*
8	Replace the EGR valve. Does DTC P0402 still fail “DTC” test on Tech 2?	—	Go to *Step 9*	Verify repair
9	Replace the EGR valve. Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0404 EGR Open Stuck



D06RW106

Circuit Description

The powertrain control module (PCM) 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 from commanded position. If the PCM detects a pintle position signal indicates more than 15 points different between current and commanded and more than 15 seconds, the PCM will set DTC P0404.

Conditions for Setting the DTC

- Ignition voltage is between 11 and 16 volts.
- Intake Air temp is more than 3°C.
- Desire EGR position is more than 0.
- The difference between desired EGR and current EGR is less than 3%.
- Difference EGR pintle position between current and commanded position becomes more than 15% and last more than 15 seconds, and this condition meets three times in a trip. Then it trigger, the PCM lights on.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) as soon as failure detected after consecutive 2nd trip in which the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0404 can be cleared by using Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

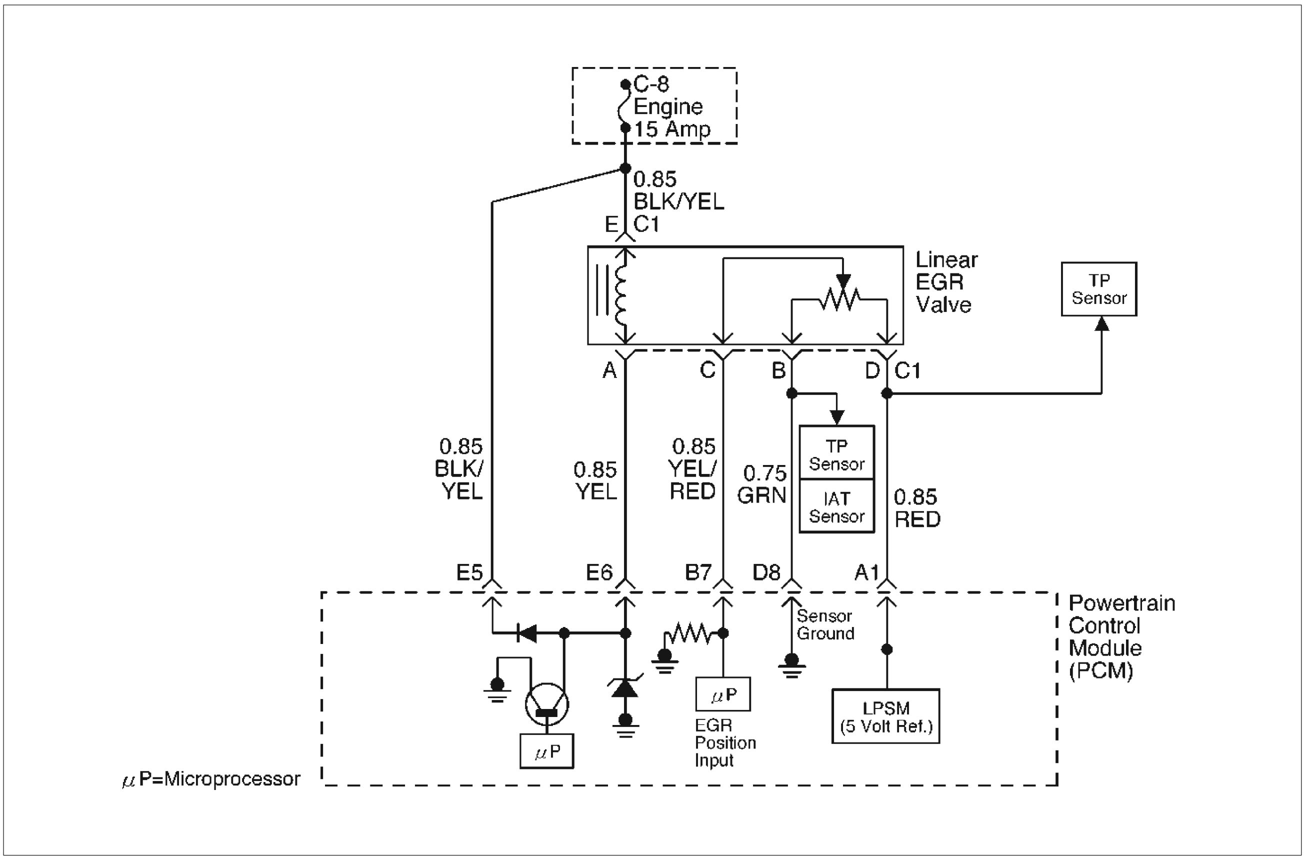
Check for the following conditions:

- Excessive carbon deposit on EGR valve shaft may cause EGR stuck open or unsmooth operation. Those carbon deposit may occur by unusual port operation. Clean up carbon may make smooth function of EGR valve.
- 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 Tech 2 while moving connectors and wiring harnesses related to EGR valve. A change in the display will indicate the location of the fault.

DTC P0404 – EGR Open Stuck

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. Ignition "ON," engine "OFF", review and record Tech 2 Failure Records Data. 2. Operate the vehicle within Failure Records conditions as noted. 3. Using Tech 2, monitor "Specific DTC" info for DTC P0404 until the DTC P0404 test runs. Note the result. Does Tech 2 indicates DTC P0404 failed this ignition?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	1. Disconnect the EGR valve harness connector. 2. Inspect the EGR valve and connectors for damaged pin or terminals. Were there any damaged pins or terminals?	—	Go to *Step 4*	Go to *Step 5*
4	Repair the damaged pin or terminal.	—	Verify repair	Is the action complete?
5	1. Remove EGR valve from Engine. 2. Inspect EGR valve whether there is any excessive carbon deposit on EGR shaft. Was excessive carbon deposit 0n EGR valve shaft?	—	Go to *Step 6*	Go to *Step 7*
6	1. Clean up EGR valve shaft and inside of EGR valve. 2. Visually inspect damage of pintle and seat whether there is bent, leakage may occur. Was there any severe damage which affects function?	—	Go to *Step 8*	Verify repair Go to *Step 7*
7	1. Reconnect. 2. Ignition "OFF". 3. Install Tech 2. 4. Run the engine at idle. 5. On Tech 2, select F3:Misc. Test; F2:EGR. 6. Use the "UP" arrow to increase the EGR from 0% to 40%. Did EGR work properly?	—	—	Go to *Step 8*
8	Replace the EGR valve. Does DTC P0404 still fail "DTC" test on Tech 2?	—	Go to *Step 9*	Verify repair
9	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0405 EGR Low Voltage



D06RW106

Circuit Description

The powertrain control module (PCM) monitors the EGR valve pintle position input to ensure that the valve responds properly to command from the PCM. If current pintle position voltage indicates less than 0.1 V and last more than 10 seconds, then the PCM will set DTC P0405.

Conditions for Setting the DTC

- Ignition voltage is between 11 and 16 volts.
- EGR pintle position output voltage is less than 0.1 volt and last more than 10 sec. Action taken when the DTC sets.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) as soon as failure detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0405 can be cleared by using Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

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 Tech 2 while moving connectors and wiring harnesses related to EGR valve. A change in the display will indicate the location of the fault.

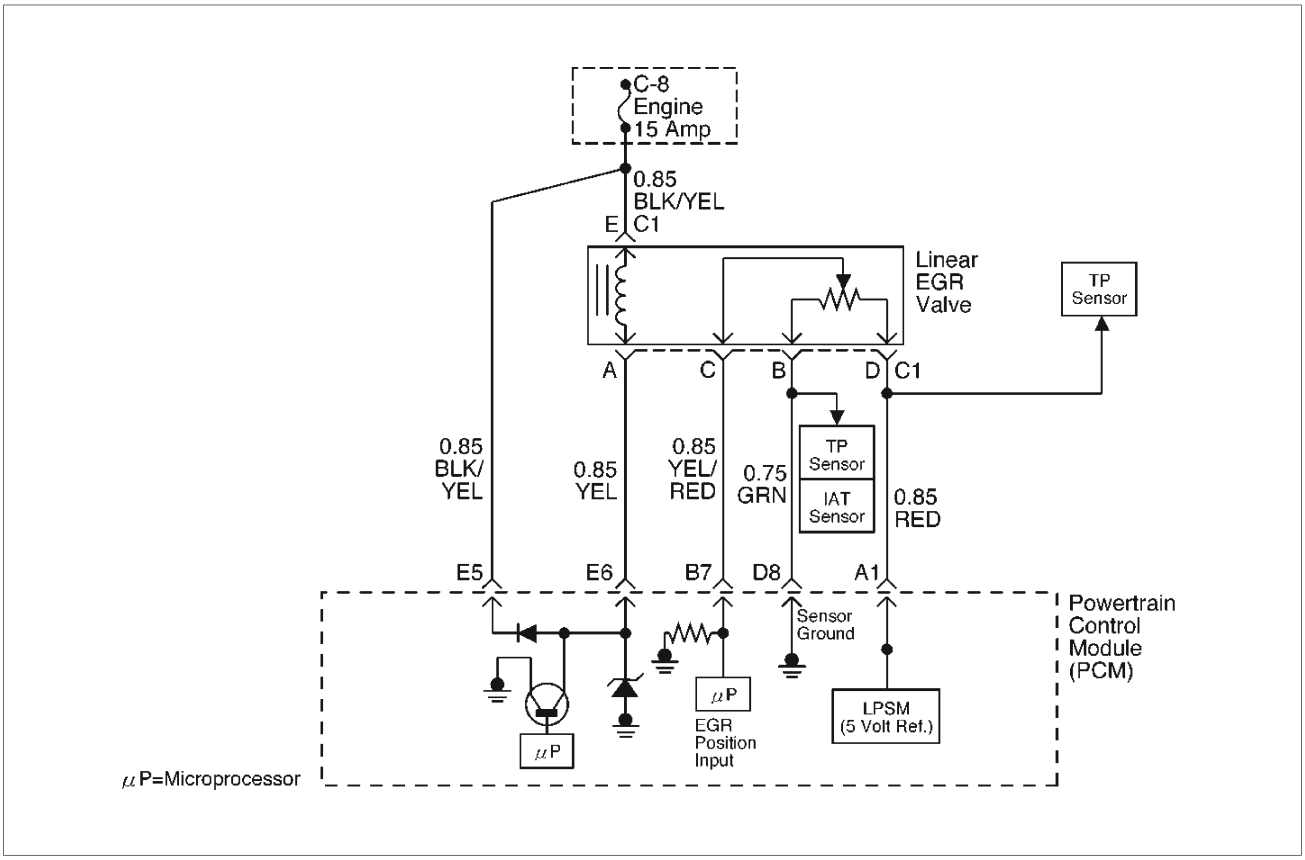
DTC P0405 – EGR Low Volt

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. Ignition "ON," engine "OFF", review and record Tech 2 Failure Records Data. 2. Operate the vehicle within Failure Records conditions as noted. 3. Using Tech 2, monitor "DTC" info for DTC P0405 until the DTC P0405 test runs. Note the result. Does Tech 2 indicates DTC P0405 failed this ignition?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	1. Disconnect the EGR valve harness connector. 2. Inspect the EGR valve and connectors for damaged pin or terminals. Were there any damaged pins or terminals?	—	Go to *Step 4*	Go to *Step 5*
4	Repair the damaged pin or terminal. Is the action complete?	—	Verify repair	—
5	1. Disconnect the EGR harness connector. 2. Ignition "ON". 3. At the EGR valve, use a DVM to check the voltage at the 5 volt reference wire (RED) and ground (B). Did the DVM indicate the specified value?	4–6 V	Go to *Step 6*	Go to *Step 7*
6	1. Disconnect the EGR harness connector. 2. Measure resistance between terminal B and D. Was resistance in range?	5–5.5 Kδ	Go to *Step 10*	Go to *Step 17*
7	1. Ignition "ON". 2. At the PCM connector, backprobe with a DVM at the 5 volt reference for the EGR valve. Did the DVM indicate the specified value?	4–6 V	Go to *Step 8*	Go to *Step 9*
8	Repair the open 5 volt reference circuit. Is the action complete?	—	Verify repair	—
9	Repair the damaged sensor ground wire. Is the action complete?	—	Verify repair	—
10	1. Disconnect the EGR harness 2. Use an ohmmeter to measure between the pintle position pin and the sensor ground pin on the EGR valve. NOTE: J-35616 Connector Test Adapter Kit may be useful for gaining access to the recessed pins on the valve. Was the ohmmeter reading approximately equal to the specified value?	1 to 1.25 Kδ	Go to *Step 11*	Go to *Step 17*
11	1. Ignition "ON". 2. Backprobe with a DVM to measure voltage at EGR valve pintle position pin and sensor ground pin. Was voltage in range?	Less than 0.1 V	Go to *Step 17*	Go to *Step 12*

DTC P0405 – EGR Low Volt (Cont'd)

Step	Action	Value(s)	Yes	No
12	1. Ignition "ON". 2. Backprobe with a DVM to measure voltage at PCM sensor ground pin and pintle position pin. Was voltage in range?	Less than 0.1 V	Go to *Step 13*	Go to *Step 18*
13	1. Ignition "OFF". 2. Disconnect the EGR harness. 3. Check short circuit between EGR pintle position circuit and EGR ground circuit. Was any short circuit?	—	Go to *Step 14*	Go to *Step 18*
14	Locate and repair the short to ground in the pintle position circuit Is the action complete?	—	Verify repair	—
15	1. Ignition "OFF". 2. Disconnect the PCM. 3. Ignition "ON". 4. Measure the voltage between the EGR pintle position circuit and ground. Is the measured voltage near the specified value?	Less than 0.1 V	Go to *Step 17*	Go to *Step 16*
16	Check for a short circuit between other wires and the pintle position circuit Was any short circuit?	—	Repair short circuit Verify repair	Go to *Step 17*
17	Replace the EGR valve. Does DTC P1404 still fail "specific DTC test on Tech 2?	—	Go to *Step 18*	Verify repair
18	Examine the PCM pin and terminal connection. Was there a damaged terminal?	—	Go to *Step 4*	Go to *Step 19*
19	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0406 EGR High Voltage



D06RW106

Circuit Description

The powertrain control module (PCM) monitors the EGR valve pintle position input to ensure that the valve responds properly to command from the PCM. If current pintle position voltage indicates more than 4.8 V and last more than 10 seconds, then the PCM will set DTC P0406.

Conditions for Setting the DTC

- Ignition voltage is between 11 and 16 volts.
- EGR pintle position output voltage is more than 4.8 volt and last more than 10 sec.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) as soon as failure detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0404 can be cleared by using Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

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 Tech 2 while moving connectors and wiring harnesses related to EGR valve. A change in the display will indicate the location of the fault.

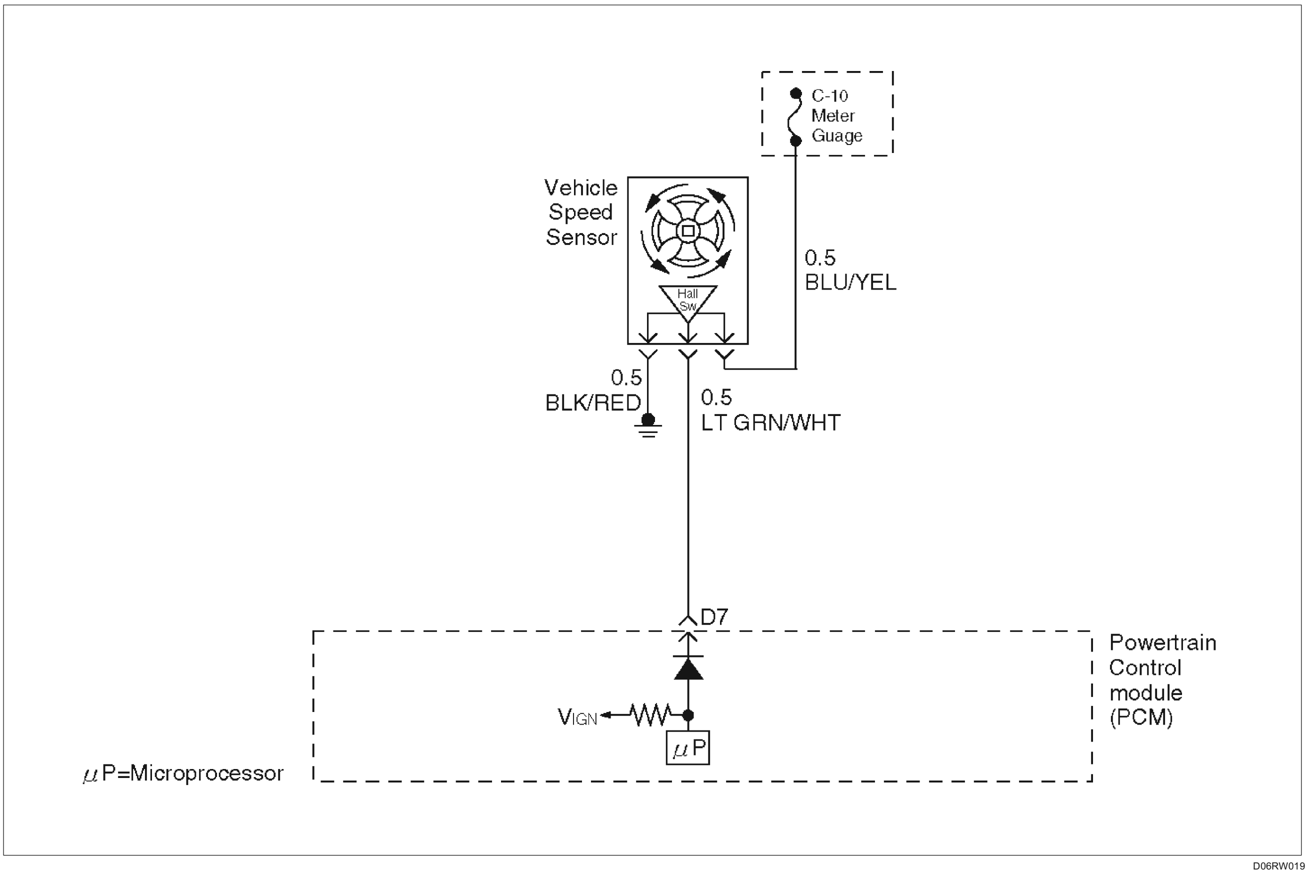
DTC P0406 – EGR High Voltage

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. Ignition “ON,” engine “OFF”, review and record Tech 2 Failure Records Data. 2. Operate the vehicle within Failure Records conditions as noted. 3. Using Tech 2, monitor “DTC” info for DTC P0406 until the DTC P0406 test runs. Note the result. Does Tech 2 indicates DTC P0406 failed this ignition?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	1. Disconnect the EGR valve harness connector. 2. Inspect the EGR valve and connectors for damaged pin or terminals. Were there any damaged pins or terminals?	—	Go to *Step 4*	Go to *Step 5*
4	Repair the damaged pin or terminal. Is the action complete?	—	Verify repair	Is the action complete?
5	1. Disconnect the EGR harness connector. 2. Ignition “ON”. 3. At the EGR valve, use a DVM to check the voltage at the 5 volt reference wire (RED). Did the DVM indicate the specified value?	4–6 V	Go to *Step 8*	Go to *Step 6*
6	1. Ignition “ON”. 2. At the PCM connector, backprobe with a DVM at the 5 volt reference for the EGR valve. Did the DVM indicate the specified value?	4–6 V	Go to *Step 7*	Go to *Step 16*
7	Repair the open 5 volt reference circuit Is the action complete?	—	Verify repair	—
8	1. Ignition “OFF” 2. Disconnect the EGR harness. 3. Use a DVM to check for an resistance between D (5 V reference) and B (Sensor Ground) at EGR sensor terminals. NOTE: J-35616 Connector Test Adapter Kit may be useful for gaining access to the recessed pins on the valve. Was there measured resistance in range?	5 to 5 Kδ	Go to *Step 9*	Go to *Step 15*
9	1. Ignition “OFF”. 2. Disconnect the EGR harness. 3. Use a DVM to check for an resistance between B and C at EGR sensor terminal. Was there open circuit?	—	Go to *Step 15*	Go to *Step 10*
10	1. Ignition “OFF”. 2. Disconnect the EGR harness at PCM connector. 3. Use a DVM to check for shorted wire between A1 and B7. Was there shorted wire?	—	Go to *Step 14*	Go to *Step 11*

DTC P0406 – EGR High Voltage (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Ignition "ON". 2. Use a DVM to backprobe at terminal C of EGR valve for voltage. Was measured voltage more than 4.8 V?	more than 4.8 V	Go to *Step 12*	Go to *Step 12*
12	1. Ignition "ON". 2. Stay the EGR harness connected. 3. Check voltage by backproving at PCM B7 terminal. Was voltage more than 4.8 V?	4.8 V	Go to *Step 16*	Go to *Step 13*
13	1. Locate short circuit at EGR harness between RED to RED or GREEN, RED to YEL. 2. Replace EGR harness. Is the action complete?	—	Verify repair	—
14	Replace EGR harness. Is the action complete?	—	Verify repair	—
15	Replace the EGR valve. Does DTC P1404 still fail "specific DTC test on Tech 2?	—	Go to *Step 16*	Verify repair
16	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0502 VSS Circuit Low Input



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 powertrain control module (PCM) on the reference circuit. The PCM interprets vehicle speed by the number of pulses to ground per second on the reference circuit.

Conditions for Setting the DTC

- Engine is running.
- Engine coolant temperature is above 60°C (140°F).
- Engine speed is between 1800 RPM and 2500 RPM.
- Throttle angle is between 10% and 40%.
- Engine load is greater than 50 kPa.
- MAP sensor indicates greater than 50 kPa manifold pressure.
- PCM detects no VSS signal for 12.5 seconds over a period of 25 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P0502 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

10. To avoid backprobing the VSS and possibly damaging a seal or terminal, the VSS output can be tested at the point where the transmission harness connects to the engine harness. Power and ground are applied by jumpers to the VSS through the connectors which are located just in front of the air cleaner assembly. The VSS signal is monitored with a DVM as the rear driveshaft turns. The wheels can be turned to rotate the driveshaft, or in 2-wheels-drive vehicles the driveshaft can be turned directly.
12. The speedometer-to-PCM VSS signal wire is spliced to a wire leading to the cruise control module. If a short to ground or voltage is indicated between the PCM and speedometer, it could be on the cruise control circuit if the vehicle is equipped with cruise control.

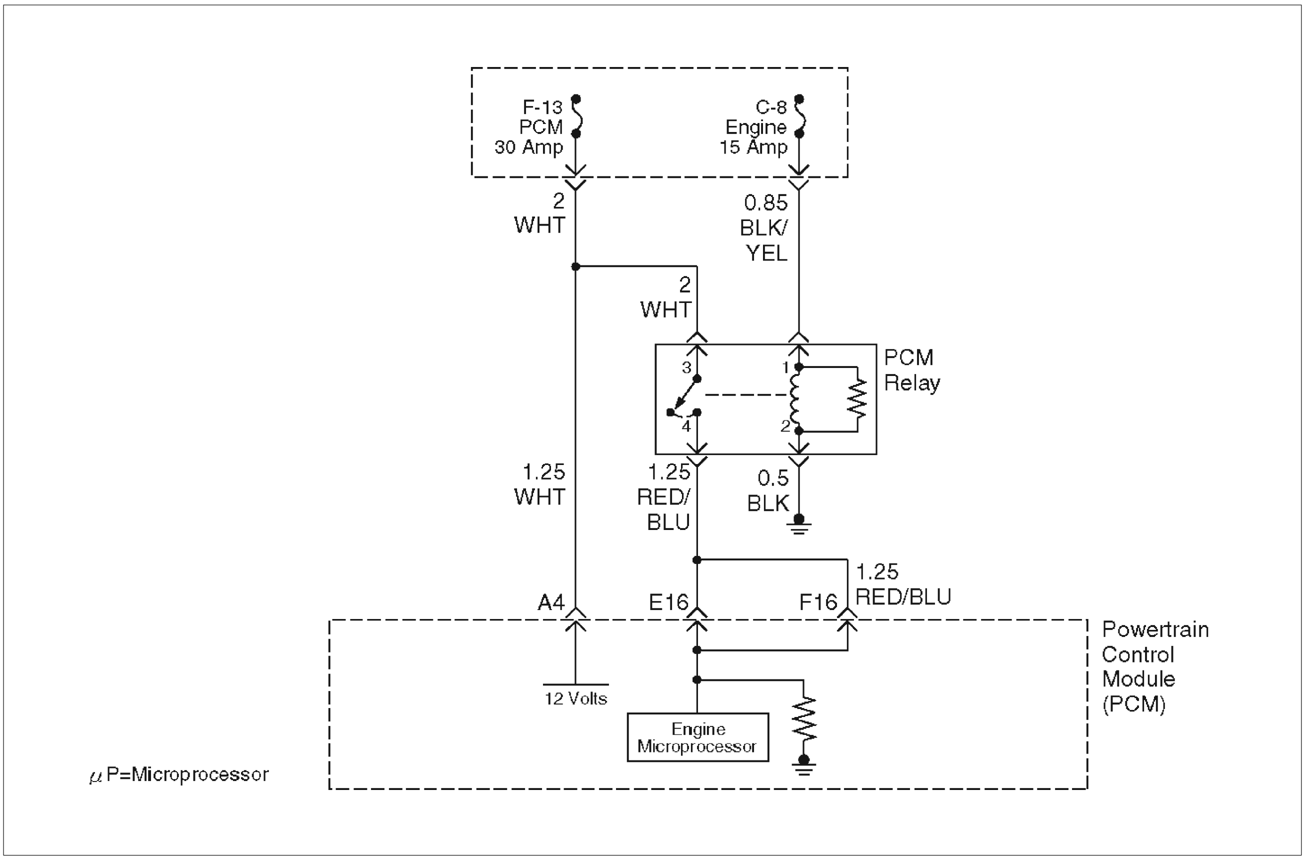
DTC P0502 – VSS Circuit Low Input

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	Does the speedometer work?	—	Go to *Step 10*	Go to *Step 3*
3	1. Disconnect the VSS connector. 2. Ignition "ON." 3. Using a test light to battery +, probe the connector ground wire. Did the light illuminate?	—	Go to *Step 5*	Go to *Step 4*
4	Repair the sensor ground. Is the action complete?	—	Verify repair	—
5	1. Ignition "ON," sensor disconnected. 2. Using a DVM, measure at the VSS connector between ground and voltage supply. Was the measurement near the specified value?	Battery voltage	Go to *Step 7*	Go to *Step 6*
6	Repair the open or short to ground which may have blown the meter fuse. Is the action complete?	—	Verify repair	—
7	1. Ignition "ON," VSS disconnected. 2. Using a DVM, measure at the VSS connector between ground and the wire from the speedometer. Was the measurement near the specified value?	7.5-8 V	Go to *Step 9*	Go to *Step 8*
8	Check for an open or short circuit between the speedometer and the VSS. Was an open or short circuit located?	—	Verify repair	Go to *Step 9*
9	Replace the speedometer. Is the action complete?	—	Verify repair	—

DTC P0502 – VSS Circuit Low Input (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Ignition "OFF." 2. Disconnect the MAF sensor and remove the air cleaner assembly and filter element to gain access to the 16-way black connector located immediately to the rear of the left front headlamp. The connector attaches the VSS wires from the transmission harness to the left-side engine harness. 3. Disconnect the black 16-way connector. 4. Select a terminal adapter from kit J 35616 that can be used with a jumper to supply B+ to the blue wire with a yellow tracer (transmission side of the connector). 5. Use another terminal adapter to attach a voltmeter to the light-green wire with a while tracer (next to the wire in the previous step.) 6. Disconnect the blue connector next to the black 16-way connector, and locate the black/red tracer wire at one corner of the blue connector. The black/red wire is the VSS ground. Use a terminal adapter to attach a jumper to ground to the black/red VSS ground wire at the transmission side of the blue connector. 7. Raise the rear wheels off the ground with transmission in neutral. Does the DVM toggle back and forth between 0.6 V and 10 V as the wheels (and driveshaft) are rotated?	—	Go to *Step 11*	Go to *Step 12*
11	Replace the VSS. Is the action complete?	—	Verify repair	—
12	Check for an open or short between the PCM and the speedometer. Was a problem found?	—	Verify repair	Go to *Step 13*
13	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0562 System Voltage Low



D06RW020

Circuit Description

The powertrain control module (PCM) monitors the system voltage on the ignition feed terminal to the PCM. A system voltage DTC will set whenever the voltage is below a calibrated value.

Conditions for Setting the DTC

- Ignition "ON."
- System voltage is below 11.5 volts for 15 minutes.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM will store as Failure Records conditions which were present when the DTC was set. This information will not be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- A history DTC P0562 will clear after 40 consecutive warm-up cycles have occurred without a fault.
- DTC P0562 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

If the DTC sets when an accessory is operated, check for a poor connection or excessive current draw.

DTC P0562 – 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 *OBD System Check*
2	Using a Tech 2, measure the battery voltage at the battery. Is the battery voltage greater than the specified value?	11.5 V	Go to *Step 3*	Charge battery, then go to *Step 3*
3	1. Using a Tech 2. 2. Select “Ignition Volts” on the Tech 2. 3. Start the engine and raise the engine speed to the specified value. 4. Load the electrical system by turning on the headlights, high blower, etc. Is the ignition voltage approximately equal to the specified value?	2000 RPM 12.8-14.1 V	Go to *Step 4*	Go to *Starting/Charging*
4	1. Ignition “OFF.” 2. Disconnect the PCM connector at the PCM. 3. Using a DVM, measure the battery voltage at the PCM connector A-4. Is it approximately equal to battery voltage?	—	Check for excessive current draw with ignition “OFF,” engine “OFF.”	Go to *Step 5*
5	1. Check for faulty connections at the PCM harness terminals. 2. Repair as necessary. Was a repair necessary?	—	Verify repair	Go to *Step 6*
6	Check for an open battery feed circuit to the PCM. Is the action complete?	—	Verify repair	Go to *Step 7*
7	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0563 System Voltage High

Circuit Description

The powertrain control module (PCM) monitors the system voltage on the ignition feed terminals to the PCM. A system voltage DTC will set whenever the voltage is above a calibrated value.

Conditions for Setting the DTC

- Ignition “ON.”
- System voltage is above 16 volts for 15 minutes.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM will store as Failure Records only conditions which were present when the DTC was set. This information will not be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- A history DTC P0563 will clear after 40 consecutive warm-up cycles have occurred without a fault.
- DTC P0563 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

If the DTC sets when an accessory is operated, check for a poor connection or excessive current draw.

DTC P0563 – 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 *OBD System Check*
2	Using a Tech 2, measure the battery voltage at the battery. Is the battery voltage less than the specified value?	11.5 V	Go to *Step 3*	Go to *Step 4*
3	1. Charge the battery and clean the battery terminals. 2. Clean the battery ground cable connection if corrosion is indicated. Is the battery voltage less than the specified value?	11.5 V	Replace battery	Go to *Step 4*
4	1. Turn “OFF” all the accessories. 2. Install a Tech 2. 3. Select the ignition voltage parameter on the Tech 2. 4. Start the engine and raise the engine RPM to the specified value. Is the voltage more than 2.5 volts greater than the measurement taken in step 2 or 3?	2000 RPM	Go to *Starting/Charging*	Go to *Step 5*
5	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98 model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P0601 PCM Memory

Circuit Description

The powertrain control module (PCM) 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 powertrain diagnostics operation.
Unlike the PROM used in past applications, the EEPROM is not replaceable.

Conditions for Setting the DTC

- The PCM detects an internal program fault (check sum error).

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM will store conditions which were present when the DTC was set in the Failure Records data only.

Conditions for Clearing the MIL/DTC

- DTC P0601 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

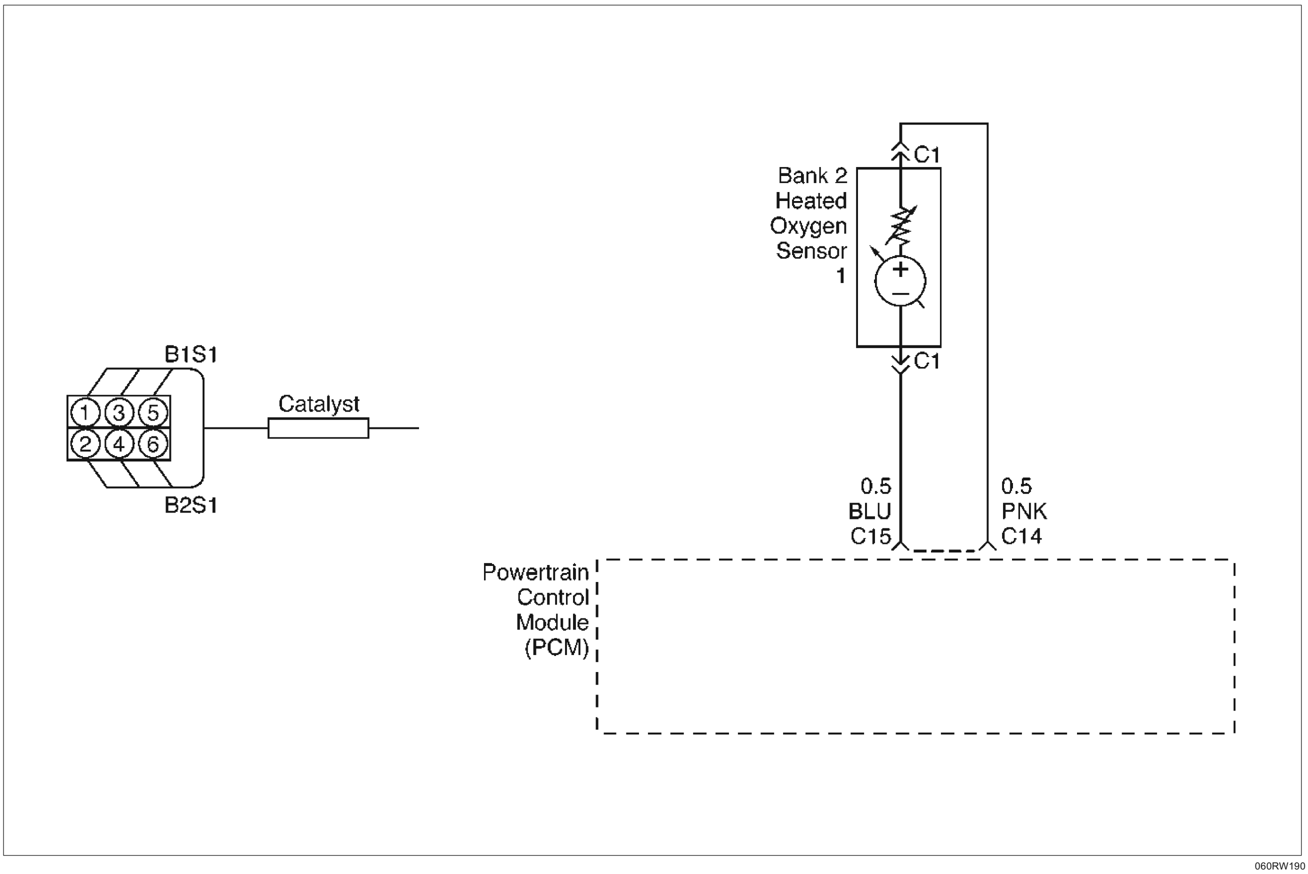
Diagnostic Aids

- DTC P0601 indicates that the contents of the EEPROM have changed since the PCM was programmed. The only possible repair is PCM replacement.

DTC P0601 – PCM Memory

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	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P1154 HO2S Circuit Transition Time Ratio Bank 2 Sensor 1



Circuit Description

The powertrain control module (PCM) monitors the heated oxygen sensor (HO2S) activity for 90 seconds after "closed loop" and stoichiometric operation have been enabled. During the monitor period the PCM counts the number of times that the HO2S responds from rich-to-lean and from lean-to-rich and adds the amount of time it took to complete all transitions. With this information, an average time for all transitions can be determined. The PCM then divides the rich-to-lean average by the lean-to-rich average to obtain a ratio. If the HO2S transition time ratio is not within this range, DTC P1154 will be set, indicating that the oxygen sensor is not responding as expected to changes in exhaust oxygen content.

Conditions for Setting the DTC

- No related DTCs.
- Engine coolant temperature (ETC) is above 50°C (122°F) for automatic transmission; 75°C (167°F) for manual transmission.
- The engine is operating in "closed loop."
- The engine has been running at least one minute.
- Canister purge duty cycle is greater than 2%.
- Engine speed is between 1500 RPM and 3000 RPM.
- Mass air flow is between 9 g/second and 42 g/second.
- Above conditions are present for a 3-second monitoring period.
- 90 seconds after "closed loop" and stoichiometric operation have been enabled, Bank 2 HO2S 1 transition ratio between lean to rich and rich to lean is less than 0.44 or greater than 3.8.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the fault is detected.
- "Open loop" fuel control will be in effect.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P1154 can be cleared by using Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

A multifunction in the HO2S heater ignition feed or ground circuit may cause a DTC P1154 to set. Check HO2S heater circuitry for intermittent faults or poor connections. If connections and wiring are OK and DTC P1154 continues to set, replace the Bank 2 HO2S 1.

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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

3. A condition that affects other heated oxygen sensors indicates probable contamination. To avoid damaging replacement sensors, correct the condition which caused the contamination before replacing the affected sensors.

5. This step checks for conditions which may cause the heated oxygen sensor to appear faulty. Correct any of the described conditions if present.

8. To avoid damaging replacement sensors, correct the condition which caused the contamination before replacing the affected sensors.

DTC P1154 – HO2S Transition Time Ratio 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 *OBD System Check*
2	**IMPORTANT:** If any other DTCs are set (except P1133 and/or P1134), refer to those DTCs before proceeding with this diagnostic chart. 1. Idle the engine at operating temperature. 2. Operate the vehicle within parameters specified under “Conditions for Setting the DTC” criteria included in Diagnostic Support. 3. Using a Tech 2, monitor “Specific DTC” info for DTC P1154 until the DTC P1154 test runs. Note the test result. Does Tech 2 indicate DTC failed this ignition?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Did Tech 2 also indicate P1133, and/or P1134 test failed?	—	Go to *Step 17*	Go to *Step 4*
4	Check for leaks at the pipe joints. Are the joints leaking?	—	Go to *Step 5*	Go to *Step 6*
5	Tighten the U-bolt nuts at the leaking joints. Is your action complete?	—	Go to *Step 2*	—
6	Check for gaskets that are damaged or improperly installed. Are there damaged or misaligned gaskets?	—	Go to *Step 7*	Go to *Step 8*
7	1. Replace the damaged gaskets. 2. Align the connections. 3. Tighten the connections. Is your action complete?	—	Go to *Step 2*	—
8	Check for loose exhaust flange connections. Are the flange connections loose?	—	Go to *Step 9*	Go to *Step 10*
9	Tighten the stud nuts or bolts to specifications. Is your action complete?	—	Go to *Step 2*	—
10	Check for burned or corroded exhaust pipes. Are the exhaust pipes burned or corroded?	—	Go to *Step 11*	Go to *Step 12*
11	Replace the exhaust pipes, as required. Is your action complete?	—	Go to *Step 2*	—

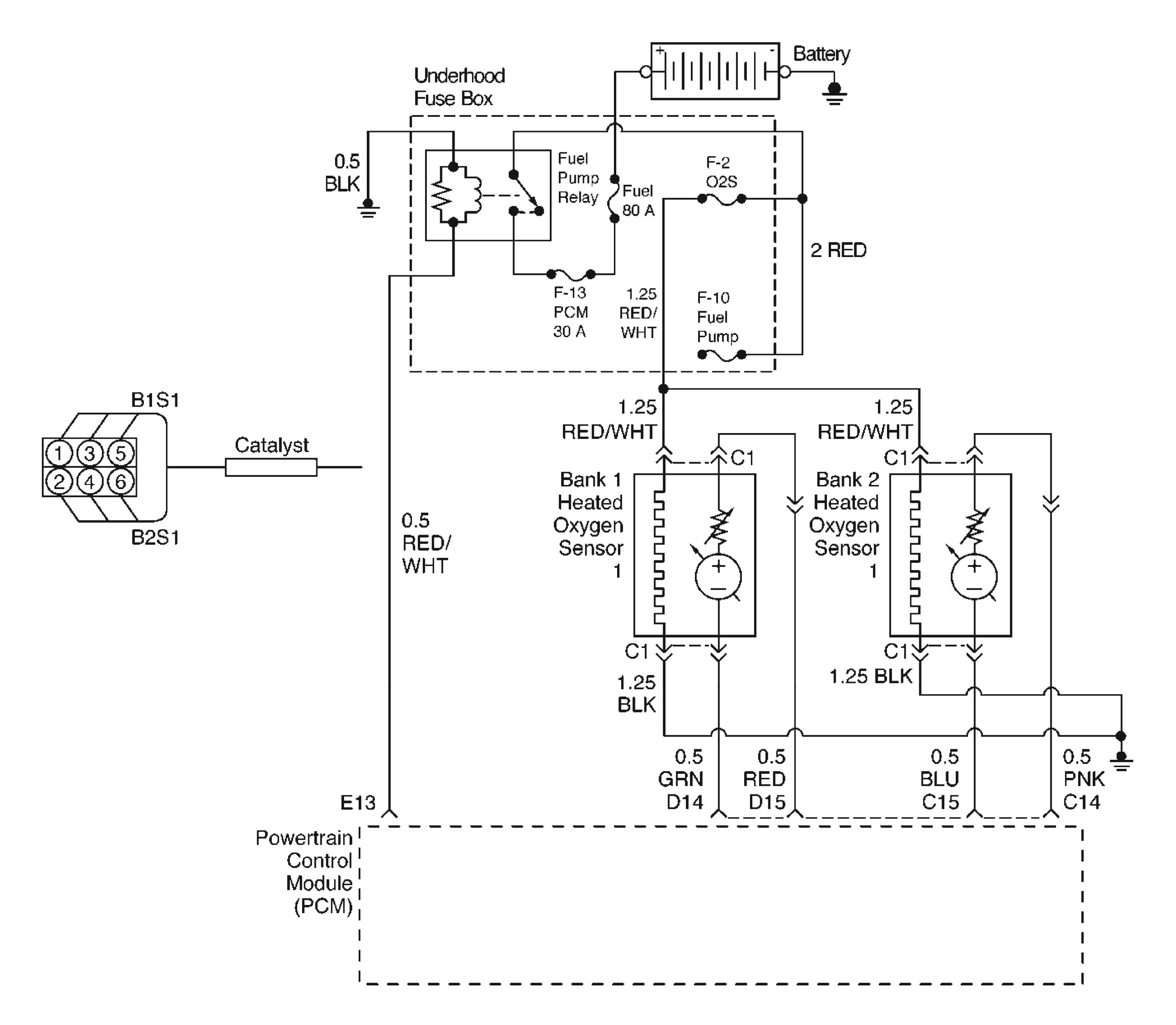
DTC P1154 – HO2S Transition Time Ratio Bank 2 Sensor 1 (Cont'd)

Step	Action	Value(s)	Yes	No
12	Check for leaks at the exhaust manifold. Are there leaks at the exhaust manifold?	—	Go to *Step 13*	Go to *Step 14*
13	Tighten the bolts to specifications or replace the manifold if necessary. Is your action complete?	—	Go to *Step 2*	—
14	Visually/physically inspect the following items: ● Ensure that the Bank 2 HO2S 1 is securely installed. ● Check for corrosion on terminals. ● Check terminal tension (at Bank 2 HO2S 1 and at the PCM). ● Check for damaged wiring. Was a problem found in any of the above areas?	—	Go to *Step 18*	Go to *Step 15*
15	1. Disconnect Bank 1 HO2S 1. 2. Ignition "ON." 3. Using a DVM at the PCM side of the HO2S 1 connector, measure the voltage between the high signal circuit and ground. Also measure the voltage between the low signal circuit and ground. Are both voltages in the specified range?	3-4 V	Go to *Step 16*	Go to *Step 19*
16	1. With Bank 1 HO2S 1 disconnected, jumper the high and low (PCM side) signal circuits to ground. 2. Ignition "ON." 3. Using Tech 2, monitor the Bank 2 HO2S 1 voltage. Does the scan too indicate less than 10 mV and immediately return to about 450 mV when the jumper is removed?	—	Go to *Step 21*	Go to *Step 22*
17	Replace affected heated oxygen sensors. NOTE: Before replacing sensors, the cause of the contamination must be determined and corrected. ● Fuel contamination. ● Use of improper RTV sealant. ● Engine oil/coolant consumption. Is the action complete?	—	Verify repair	—
18	Repair condition as necessary. Is the action complete?	—	Verify repair	—
19	Check for faulty PCM connections or terminal damage. Is the action complete?	—	Verify repair	Go to *Step 20*
20	Repair open, short or grounded signal circuit. Is the action complete?	—	Verify repair	—

DTC P1154 – HO2S Transition Time Ratio Bank 2 Sensor 1 (Cont'd)

Step	Action	Value(s)	Yes	No
21	Replace Bank 2 HO2S 1. Is the action complete?	—	Verify repair	—
22	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P1171 Fuel System Lean During Acceleration



060RW193–1

Circuit Description

The powertrain control module (PCM) internal circuitry can identify if the vehicle fuel system is capable of supplying adequate amounts of fuel during heavy acceleration (power enrichment). The PCM 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 PCM will provide more fuel to the engine. Under these conditions the PCM should detect a “rich” condition (high oxygen sensor voltage). If this “rich” exhaust is not detected at this time, a DTC P1171 will set. A plugged fuel filter, restricted fuel line, restricted in-tank filter or defective fuel pump can prevent adequate amounts of fuel from being supplied during power enrichment mode.

Conditions for Setting the DTC

- No related DTCs.
- Engine is operating in “closed loop power enrichment” mode for 3 seconds.
- Engine coolant temperature is above 60°C (140°F).
- While in “power enrichment” mode the oxygen sensor voltage remains below 400 mV for 3 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) the first the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P1171 can be cleared by using Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

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.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

4. When the engine is idling or at steady cruise, the HO2S voltage should vary from between approximately 100 mV to 900 mV. It is possible to measure a satisfactory fuel pressure at idle even though the pressure may drop at high flow requirements. It may be necessary to watch fuel pressure at high engine load.
5. Wrap a shop towel around the fuel pressure connector to absorb any small amount of fuel leakage that may occur when installing gauge. Ignition "ON," pump pressure should be 280-320 kPa.

DTC P1171 – Fuel System Lean During Acceleration

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	Are any component-related DTCs set?	—	Go to component DTC charts	Go to *Step 3*
3	1. Check the vehicle's fuel tank for an adequate amount of fuel. 2. Add fuel to the vehicle's fuel tank if the tank is almost empty. Was fuel added to the vehicle's fuel tank?	—	Go to *Step 4*	Go to *Step 5*
4	1. Place the transmission in park. 2. Using Tech 2, observe HO2S 1 voltage while running warm engine 75°C-95°C (167°F-203°F) at 1200 RPM. 3. HO2S 1 voltage should vary within the specified range. 4. Quickly open the throttle halfway for a few seconds. Did the voltage suddenly rise toward the high end of the specified range?	100-900 mV	Go to Chart A-7	Go to *Step 5*
5	1. Disconnect the fuel pump relay and crank the engine to relieve the fuel pressure. 2. Install the fuel pressure gauge. 3. Start the engine and idle at normal operating temperature. 4. Disconnect the vacuum line going to the fuel pressure regulator. With the engine running, is the fuel pressure within the specified range?	280-325 kPa (41-46 psi)	Go to *OBD System Check*	Go to *Step 6*
6	Check for restricted fuel lines or restricted in-line filter. Was a problem found?	—	Verify repair	Go to *Step 7*

DTC P1171 – Fuel System Lean During Acceleration (Cont'd)

Step	Action	Value(s)	Yes	No
7	1. Ignition "OFF." 2. Remove the fuel pump relay and replace it with a fused jumper which will connect the relay's battery terminal to the terminal leading to the fuel pump fuse. 3. While the fuel pump is operating, use pliers to slowly close the return line (do not exceed the first specified value). Using the pliers to restrict the return line, can the fuel pressure be manipulated to exceed the second specified value?	414 kPa (60 psi) 325 kPa (46 psi)	Go to *Diagnostic Aids*	Go to *Step 8*
8	Check for: • Faulty fuel pump • Restricted fuel pump strainer (sock) • Incorrect fuel pump • Incorrect fuel being used • Hot fuel Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P1380 ABS Rough Road ABS System Fault

Circuit Description

The powertrain control module (PCM) monitors ABS fault signal. When PCM receives fault signal, PCM will set DTC P1380.

Conditions for Setting the DTC

- Vehicle speed is more than 5 mph.
- Load is less than 99%.
- Engine revolution is less than 6250 rpm.
- PCM receives ABS fault signals from ABS unit.
- Ignition on.
- Misfire DTCs exist.
- 100 test failures within 120 test samples.

Action Taken When the DTC Sets

- The PCM will store DTC 1380 only, no MIL turn on.

Conditions for Clearing the MIL/DTC

- A history DTC P1380 will clear after 40 consecutive warm-up cycles have occurred without a fault.
- DTC 1380 can be cleared by using Tech-2 or disconnecting the PCM battery feed.

Diagnostic Aids

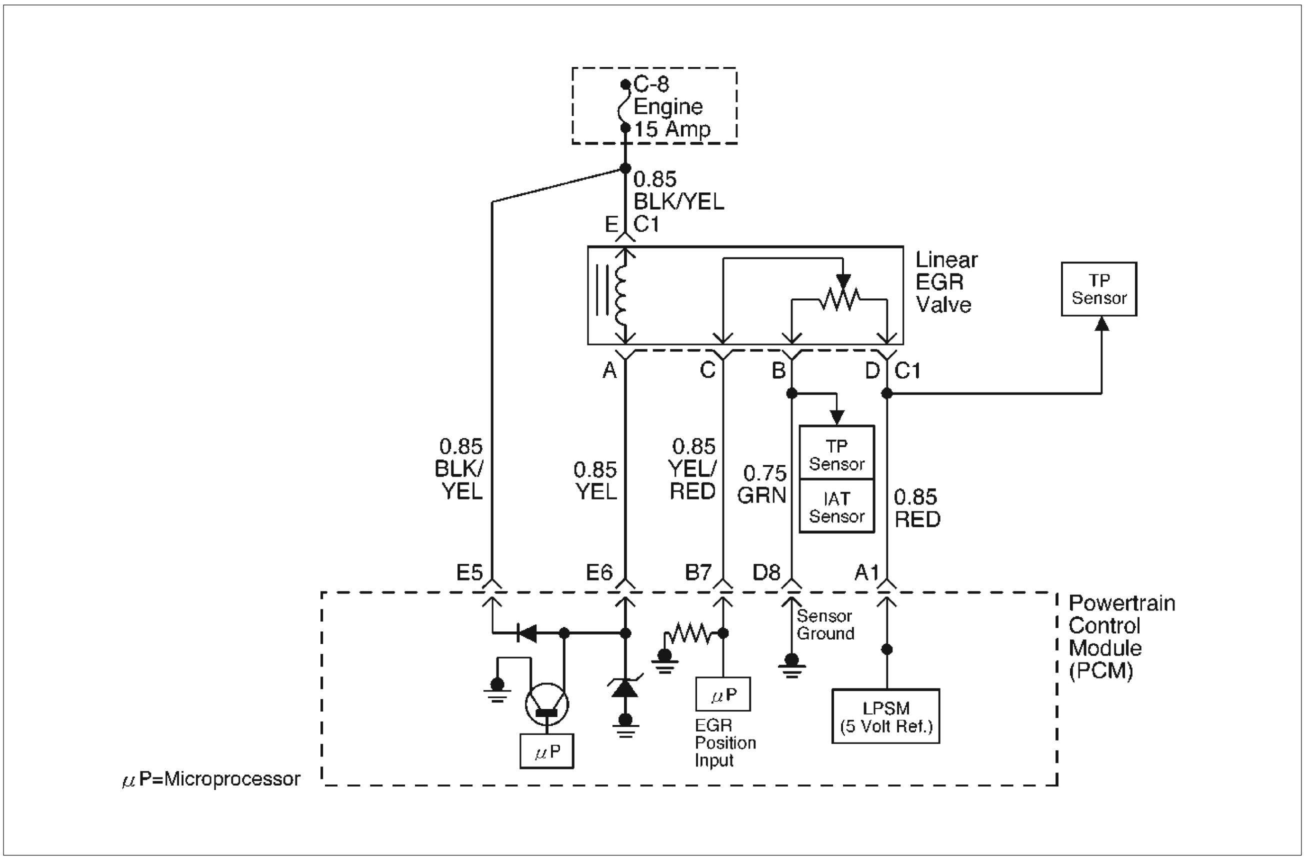
Check for the following conditions:

- PCM and ABS communication line short circuit to other line may cause faulty signal. Inspect communication line.
- Follow ABS ECU diagnosis procedure, refer to ABS procedure page.

DTC P1380 – ABS Rough Road ABS System Fault

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. Ignition “ON,” engine “OFF”, review and record Tech 2 Failure Records Data. 2. Operate the vehicle within Failure Records conditions as noted. 3. Using a Tech 2, monitor “Specific DTC” info for DTC P1380 and Misfire DTCs until the DTC P1380 and Misfire DTCs test runs. Note the result. Does the Tech 2 indicates DTC P1380 and Misfire DTCs failed this ignition?	—	Refer to ABS diagnosis After inspect ABS, unit re-peat *Step 2* Still problem exists, go to *Step 3*	Clear DTC by Tech 2
3	Check short circuit among communication line of PCM/ABS and others. Was short circuit?	—	Repair wiring Verify repair	Go to *Step 4*
4	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P1404 EGR Closed Stuck



D06RW106

Circuit Description

The powertrain control module (PCM) 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 current pintle zero position is different from the learned zero position. If the PCM detects a pintle position signal indicates more than 30 % different between current zero position and the learned zero position and more than 5 seconds, and this condition meet 3 times during trip, then the PCM will set DTC P1404.

Conditions for Setting the DTC

- Ignition voltage is between 11 and 16 volts.
- Intake Air temp is more than 3°C.
- Desire EGR position is 0.
- Difference EGR pintle position between current and the learned zero is more than 30 % last more than 5 seconds, and meet three time to the above condition during a trip. Then it trigger the PCM lights on.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after consecutive 2nd trip in which the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P1404 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

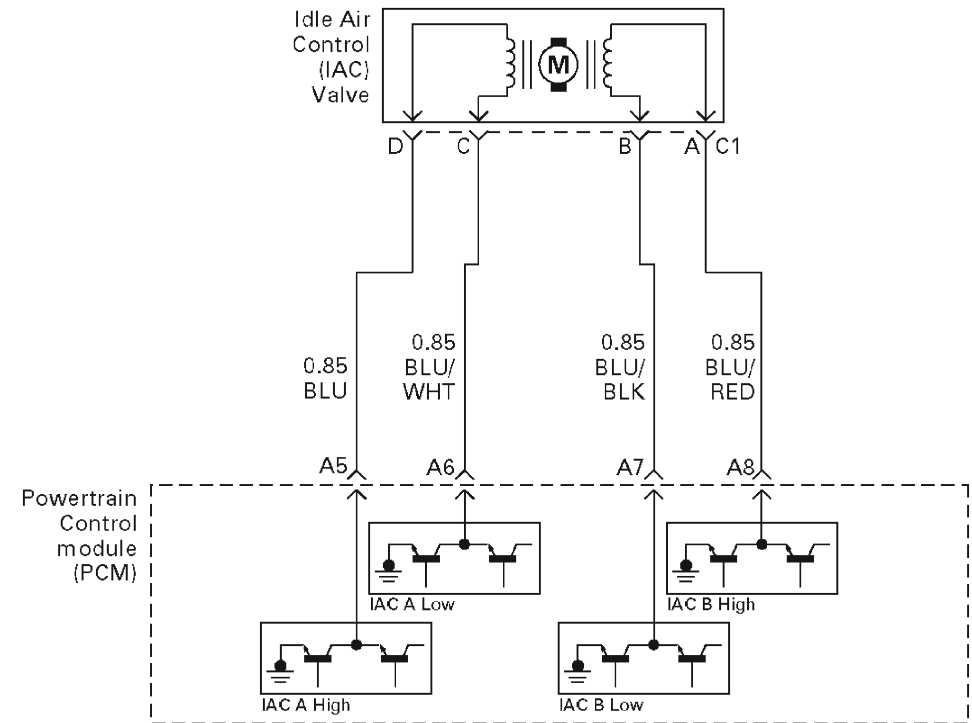
- Excessive carbon deposit on EGR valve shaft or/and foreign material may cause no return to EGR valve fully seated. Those carbon deposit may occur by unusual port operation. Remove foreign material or/and excessive carbon deposit on EGR valve shaft may make return to EGR valve fully seated.
- Poor connection or damaged harness – Inspect the wiring harness for damage. Same as P1406 description

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.

DTC P1404 – EGR Closed Stuck

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. Ignition "ON," engine "OFF", review and record Tech 2 Failure Records Data. 2. Operate the vehicle within Failure Records conditions as noted. 3. Using a Tech 2, monitor "DTC inf. for DTC P1404 until the DTC P1404 test runs. Note the result. Does the Tech 2 indicates DTC P1404 failed this ignition?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	1. Disconnect the EGR valve harness connector. 2. Inspect the EGR valve and connectors for damaged pin or terminals. Were there any damaged pins or terminals?	—	Go to *Step 4*	Go to *Step 5*
4	Repair the damaged pin or terminal. Is the action complete?	—	Verify repair	—
5	1. Remove EGR valve from Engine. 2. Inspect EGR valve whether there is any excessive carbon deposit on EGR shaft. 3. Inspect any foreign material inside of EGR valve. Was excessive carbon deposit on EGR valve shaft or/and foreign material in EGR valve ?	—	Go to *Step 6*	Go to *Step 7*
6	1. Clean up EGR valve shaft and inside of EGR valve. 2. Remove foreign material from EGR valve. 3. Visually inspect damage of pintle and seat whether there is bent, leakage may occur. Was there any severe damage which affects function?	3–6 ohms	Go to *Step 8*	Verify repair Go to *Step 7*
7	1. Reconnect. 2. Ignition "OFF". 3. Install the Tech 2. 4. Run the engine at idle. 5. On the Tech 2, select F3:Misc. Test F5:EGR. 6. Use the "UP" arrow to increase the EGR from 0% to 40%. Did EGR work properly?	—	—	Go to *Step 8*
8	1. Reset the learned zero EGR valve position. 2. Repeat step 7. Did EGR work properly?	—	Verify repair	Go to *Step 9*
9	Replace the EGR valve. Replace the EGR valve. Does DTC P1404 still fail "specific DTC" test on the Tech 2?	—	Go to *Step 10*	Verify repair
10	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P1508 IAC System Low RPM



T321115

Circuit Description

The powertrain control module (PCM) 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 PCM 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 PCM 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 PCM detects a condition where too low of an idle speed is present and the PCM is unable to adjust idle speed by increasing the IAC counts, DTC P1508 will set, indicating a problem with the idle control system.

Conditions for Setting the DTC

- No Tech 2 test is being run.
- None of these DTCs are set: TP sensor, VSS, ECT, EGR, fuel system, MAF, MAP, IAT, canister purge, injector control or ignition control.
- Barometric pressure is above 75 kPa.
- Engine coolant temperature (ECT) is above 50°C (120°F).
- Engine speed is more than 100-200 RPM lower than desired idle, based upon coolant temperature.
- The engine has been running for at least 125 seconds.
- Vehicle speed is less than 1 mph.
- Canister purge duty cycle is above 10%.
- Ignition voltage is between 9.5 volts and 16.7 volts.
- The throttle is closed.
- Engine speed is lower than desired idle.
- All of the above conditions are met for 10 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P1508 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM 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.
- Throttle body – Check for objects blocking the IAC passage or throttle bore, excessive deposits in the IAC

passage and on the IAC pintle, and excessive deposits in the throttle bore and on the throttle plate.

- Large vacuum leak – Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty PCV valve or a disconnected brake booster hose.

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.

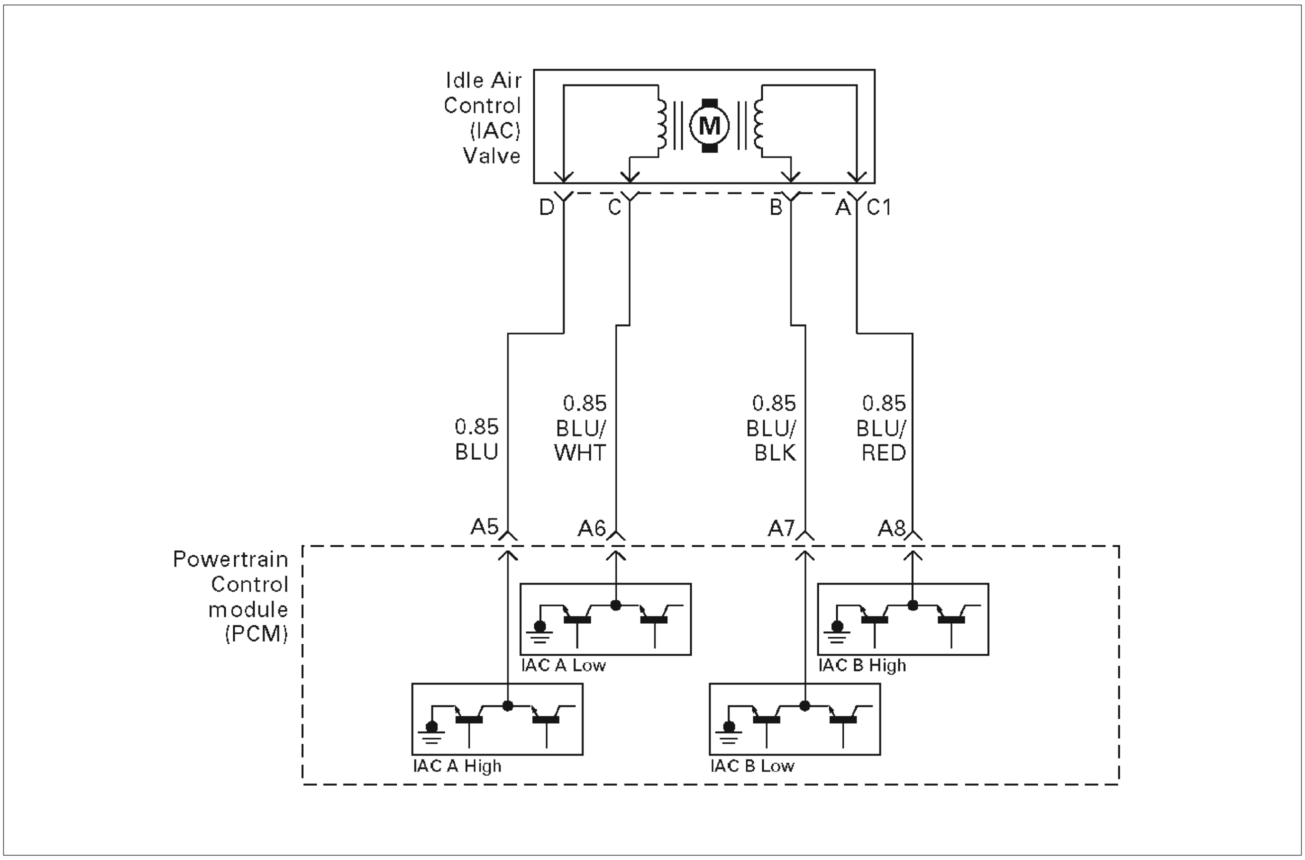
DTC P1508 – IAC System Low RPM

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. Start the engine. 2. Turn all accessories "OFF"(A/C, rear defroster, etc). 3. Using a Tech 2, command RPM up to 1500, down to 500, and the up to 1500 while monitoring the "Engine Speed" on the Tech 2. NOTE: This Tech 2 command may cause the engine to "cut out" when RPM goes above 1500. If this occurs, the "cutting out" will stop when the Tech 2 command for the test is discontinued, or if the Tech 2 command is changed to less than 1500 RPM. Does the "Engine Speed" remain within the specified value of the "Desired Idle" for each RPM command?	± 50 RPM	No trouble found. Go to *Diagnostic Aids*	Go to *Step 3*
3	1. Disconnect the IAC. 2. Install IAC Node Light 5-8840-2312-0 or equivalent. 3. With the engine running, command RPM up to 1500, down to 500, and then up to 1500 while observing the node light. NOTE: This Tech 2 command may cause the engine to "cut out" when RPM goes above 1500. If this occurs, the "cutting out" will stop when the Tech 2 command for the test is discontinued, or if the Tech 2 command is changed to less than 1500 RPM. Does each node light cycle red and green (never "OFF")?	—	Go to *Step 5*	Go to *Step 4*
4	1. Check the following circuits for an open, short to voltage, short ground, or poor connections at the PCM: • IAC "A" Low. • IAC "A" High. • IAC "B" Low. • IAC "B" High. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 8*

DTC P1508 – IAC System Low RPM (Cont'd)

Step	Action	Value(s)	Yes	No
5	Visually/physically inspect for following conditions: • Restricted air intake system. Check for a possible collapsed air intake duct, restricted air filter element, or foreign objects blocking the air intake system. • Throttle body. Check for objects blocking the IAC passage or throttle bore, excessive deposits in the IAC passage and on the IAC pintle, and excessive deposits in the throttle bore and on the throttle plate. Do any of the above require a repair?	—	Refer to appropriate section for on-vehicle service	Go to *Step 6*
6	1. Check for a poor connection at the IAC harness connector. 2. If a problem is found, replace faulty terminals as necessary. Was a problem found?	—	Verify repair	Go to *Step 7*
7	Replace the IAC valve. Is the action complete?	—	Verify repair	—
8	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P1509 IAC System High RPM



T321115

Circuit Description

The powertrain control module (PCM) 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 PCM 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 PCM 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 PCM detect a condition where too high of an idle speed is present and the PCM is unable to adjust idle speed by increasing the IAC counts, DTC P1509 will set, indicating a problem with the idle control system.

Conditions for Setting the DTC

- No Tech 2 test is being run.
- None of these DTCs are set: TP sensor, VSS, ECT, EGR, fuel system, MAF, MAP, IAT, canister purge, injector control or ignition control.
- Barometric pressure is above 75 kPa.
- Engine coolant temperature is above 50°C (120°F).
- Engine speed is more than 100-200 RPM lower than desired idle, based upon coolant temperature.
- The engine has been running for at least 125 seconds.
- Vehicle speed is less than 1 mph.
- Canister purge duty cycle is above 10%.
- Ignition voltage is between 9.5 volts and 16.7 volts.
- Engine speed is lower than desired idle.
- All of the above conditions are met for 5 seconds.

Action Taken When the DTC Sets

- The PCM will illuminate the malfunction indicator lamp (MIL) after the second consecutive trip in which the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.

Conditions for Clearing the MIL/DTC

- DTC P1509 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM 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.
- Vacuum leak – Check for a condition that causes a vacuum leak, such as disconnected or damaged hoses, leaks at the EGR valve and the EGR pipe to the intake manifold, leaks at the throttle body, faulty or incorrectly installed PCV valve, leaks at the intake manifold, etc.

- Throttle body – Check for sticking throttle plate. Also inspect the IAC passage for deposits or objects which keep the IAC pintle from fully extending.

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.

DTC P1509 – IAC System High RPM

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. Start the engine. 2. Turn all accessories "OFF" (A/C, rear defroster, etc.). 3. Using a Tech 2, command RPM up to 1500, down to 500, and then up to 1500 while monitoring "Engine Speed" on the Tech 2. NOTE: This Tech 2 command may cause the engine to "cut out" when RPM goes above 1500. If this occurs, the "cutting out" will stop when the Tech 2 command for the test is discontinued, or if the Tech 2 command is changed to less than 1500 RPM. Does the "Engine Speed" remain within the specified value of "Desired Idle" for each RPM command?	± 50 RPM	No trouble found. Go to *Diagnostic Aids*	Go to *Step 3*
3	1. Disconnect the IAC. 2. Install IAC Node Light 5-8840-2312-0 or equivalent. 3. With the engine running, command RPM up to 1500, down to 500, and then up to 1500 while observing the node light. NOTE: This Tech 2 command may cause the engine to "cut out" when RPM goes above 1500. If this occurs, the "cutting out" will stop when the Tech 2 command for the test is discontinued, or if the Tech 2 command is changed to less than 1500 RPM. Does each node light cycle red and green (never "OFF")?	—	Go to *Step 5*	Go to *Step 4*
4	1. Check the following circuits for an open, short to voltage, short ground, or poor connections at the PCM: • IAC "A" Low • IAC "A" High • IAC "B" Low • IAC "B" High 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 8*
5	Visually/physically inspect for following conditions: • Vacuum leaks. • Throttle plate or throttle shaft for binding. • Accelerator and cruise control cables for being misadjusted or for binding. • Faulty, missing, or incorrectly installed PCV valve. Do any of the above require a repair?	—	Refer to appropriate section for on-vehicle service	Go to *Step 6*

DTC P1509 – IAC System High RPM (Cont’d)

Step	Action	Value(s)	Yes	No
6	1. Check for a poor connection at the IAC harness connector. 2. If a problem is found, replace faulty terminals as necessary. Was a problem found?	—	Verify repair	Go to *Step 7*
7	Replace the IAC valve. Is the action complete?	—	Verify repair	—
8	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed, Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P1618 Serial Peripheral Interface (SPI) PCM Interprocessor Communication Error

Circuit Description

The serial peripheral interface (SPI) communication is used internally by the PCM to send messages between the engine processor and the automatic transmission processor. Included in each message sent between the two-processors is a checksum of the message. Both the engine processor and automatic transmission processor will compare this check sum value with the calculated value. If the checksums don't match, the processor will view the new data as being corrupted and ignore the values. The processor will then use the previous message. The receiving processor will then send a message to the sending processor informing it that it's last message was corrupted.

Conditions for Setting the DTC

- Battery voltage is above 9.0 V for 2 seconds.
- The PCM detects an internal program fault (check sum of data communications error).
- Check sum fault present for 3 out 6 seconds.
- No TCM resets for 2 seconds.

Action Taken When the DTC Sets

- The PCM will flash the "Check Trans" lamp the first time the fault is detected.
- The PCM will store conditions which were present when the DTC was set as Freeze Frame and in the Failure Records data.
- The automatic transmission will operate in the "safety mode" to protect the mechanical parts of the transmission. Shift quality and/or gear changes may not be normal.

Conditions for Clearing the MIL/DTC

- DTC P1618 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

DTC P1618 – Serial Peripheral Interface (SPI) PCM Interprocessor Communication Error

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	Is the EEPROM calibration the latest version available?	—	Go to *Step 4*	Go to *Step 3*
3	Reprogram the PCM with the latest available calibrations. Does DTC 1618 re-appear when the *OBD System Check* is repeated?	—	Go to *Step 4*	Repair completed
4	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	Verify repair	—

Diagnostic Trouble Code (DTC) P1625 PCM Unexpected Reset

Circuit Description

The powertrain control module (PCM) monitors unexpected PCM reset. This will not turn on MIL light on, only records code DTC P1625.

Conditions for Setting the DTC

- Clock or COP reset.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM will store conditions which were present when the DTC was set as Failure Records only. This information will not be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- DTC P1625 can be cleared by using the Tech 2 “Clear Info” function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- P1625 alone stored does not need diagnosis. Clear DTC code.

Diagnostic Trouble Code (DTC) P1640 Driver-1-Input High Voltage

Circuit Description

Output driver modules (ODMs) are used by the powertrain control module (PCM) to turn "ON" many of the current-driven devices that are needed to control various engine and transmission functions. Each ODM is capable of controlling up to 7 separate outputs by applying ground to the device which the PCM is commanding "ON."

Unlike the Quad Driver Modules (QDMs) used in prior model years, ODMs have the capability of diagnosing each output circuit individually. DTC P1640 set indicates an improper voltage level has been detected on an ODM output.

Since A/C is an option, No A/C will cause the air conditioning clutch relay output to always fault. If a fault is seen on the air conditioning clutch relay output, it will not be logged as a fault until the A/C request input interrupts a high voltage, indicating that A/C has been installed.

Conditions for Setting the DTC

- Ignition "ON."
- Engine running.
- No DTC 1618.
- Ignition voltage is above 13.2 volts for 4 seconds.
- Output voltage does not equal ignition voltage when output is "OFF" or output voltage is not less than 1 volt when output is "ON."
- Above conditions occur for at least 1 second.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM will store conditions which were present when the DTC was set as Failure Records only. This information will not be stored as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- DTC P1640 can be cleared by using the Tech 2 "Clear Info" function or by disconnecting the PCM battery feed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM – 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 PCM, turn the ignition "ON" and observe a voltmeter connected to the suspect driver circuit at the PCM harness connector while moving connectors and wiring harnesses relates to the MIL. A change in voltage will indicate the location of the fault.
- Poor connection at component – Examine for damaged connectors, unplugged connector, or damaged terminals at the following locations: Instrument cluster harness, canister purge solenoid, A/C clutch relay. An open ignition feed circuit at any of these components will cause DTC P1640 to be set.

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.

The following PCM pins are controlled by output driver modules (ODMs):

- A13 – "Check Engine Lamp"
- A14 – SVS ("Check Trans")
- B14 – A/C Clutch

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

6. The Tech 2 Driver Module Status indicates the PCM pin that is affected.

11. The Tech 2 may indicate "short circuit" even when the problem is an open circuit. The cause of an open circuit may be in the component itself-lamp, purge, solenoid, or A/C compressor relay.

13. A short to ground on the ignition side of the component will blow the fuse. Since the fuse was checked in Step 4, a short to ground would be between the affected component and the PCM.

DTC P1640 – Driver-1-Input High Voltage

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. Ignition "ON,"engine "OFF." 2. Install the Tech 2. 3. Review and record Tech 2 Failure Records data. 4. Operate the vehicle within Failure Records conditions as noted. 5. Use the Tech 2 to indicate DTC P1640. Does the Tech 2 indicate DTC P1640?	—	Go to *Step 3*	—
3	Check the fuse for the driver circuit that was shown as faulty. Was the fuse blown?	—	Go to *Step 4*	Go to *Step 5*
4	1. Check for a short to ground between the fuse and the affected component. 2. Replace the fuse after making any necessary repairs. Is the action complete?	—	Verify repair	—
5	Disconnect the PCM connector for the affected driver circuit. Is there any damage to the PCM pin or connector?	—	Go to *Step 6*	Go to *Step 7*
6	Repair the damaged pin or terminal. Is the action complete?	—	Verify repair	—
7	Were either of the lamp circuits for "Check Engine" or "Check Trans." indicated as faulty by the Tech 2?	—	Go to *Step 8*	Go to *Step 14*
8	1. Leave the PCM connector for the lamp driver circuit disconnected. 2. Ignition "ON." 3. Using a DVM, check the voltage at the PCM connector for the affected lamp driver circuit. Was the voltage equal to the specified value?	B+	Go to *Step 16*	Go to *Step 9*
9	1. Ignition "ON." 2. Check for battery voltage at the fuse for the affected lamp circuit. Was battery voltage available at the fuse?	—	Go to *Step 11*	Go to *Step 10*
10	Repair the open circuit between the ignition switch and the fuse. Is the action complete?	—	Verify repair	—
11	1. Ignition "OFF." 2. Disconnect the PCM connector for the affected driver terminal. 3. Connect an ohmmeter between a good ground and the PCM connector for the affected driver. Did the ohmmeter indicate continuity?	—	Go to *Step 12*	Go to *Step 13*
12	Repair the short to ground between the affected component and is PCM driver terminal. Is the action complete?	—	Verify repair	—

DTC P1640 – Driver-1-Input High Voltage (Cont'd)

Step	Action	Value(s)	Yes	No
13	Repair the open circuit between the fuse and the PCM driver terminal for the affected circuit. Is the action complete?	—	Verify repair	—
14	1. Connect the PCM. 2. Start the engine and let it idle. 3. Backprobe the affected terminal at the PCM with a DVM. Was the voltage equal to the specified value?	+B	Go to *Step 16*	Go to *Step 15*
15	1. Run the engine at idle. 2. Check for battery voltage at the fuse for the affected circuit. Was battery voltage available at the fuse?	—	Go to *Step 11*	Go to *Step 10*
16	Replace the PCM. **IMPORTANT:** The replacement PCM must be programmed. Refer to *UBS 98model year Immobilizer Workshop Manual.* Is the action complete?	—	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 powertrain control module (PCM) and malfunction indicator lamp (MIL) (Service Engine Soon lamp) are operating correctly.
- There are no DTC(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:

- PCM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connections, as shown on the "Vehicle Emission Control Information" label. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Air leaks at throttle body mounting area, mass air flow (MAF) sensor and intake manifold sealing surfaces.
- Ignition wires for cracking, hardness, and carbon tracking.
- Wiring for proper connections, pinches and cuts.

Intermittents

IMPORTANT: An intermittent problem may or may not turn on the malfunction indicator lamp (MIL) or store a DTC. 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 caused 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 from the connector body to check.

Road test the vehicle with a J 39200 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.

Use Tech 2 to help detect intermittent conditions. Tech 2s have several features that can be used to locate an intermittent condition. Use the following feature to find intermittent faults:

- Using Tech 2's "Freeze Frame" buffer or "Failure Records" buffer can aid in locating an intermittent condition. Review and record the information in the freeze frame or failure record associated with the intermittent DTC being diagnosed. The vehicle can be driven within the conditions that were present when the DTC originally set.

To check for loss of diagnostic code memory, disconnect the MAP sensor and idle the engine until the MIL (Service Engine Soon lamp) comes on. DTC P0107 should be stored and kept in memory when the ignition is turned "OFF." If not, the PCM is faulty. When this test is completed, make sure that you clear the DTC P0107 from memory.

An intermittent MIL (Service Engine Soon lamp) with no stored DTC may be caused by the following:

- Ignition coil shorted to ground and arcing at ignition wires or plugs.
- MIL (Service Engine Soon lamp) wire to PCM shorted to ground.
- Poor PCM grounds. Refer to the PCM wiring diagrams.

Check for improper installation of electrical options such as lights, cellular phones, etc. Route ignition coil wiring away from the ignition coils. Check all wires from the PCM to the ignition coil 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 *PCM Connector Symptom* tables.

Hard Start Symptom

Step	Action	Value(s)	Yes	No
1	**DEFINITION:** Engine cranks, but does not start for a long time. Does eventually run, or may start but immediately stalls. Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *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 visual/physical check performed?	—	Go to *Step 4*	Go to *Visual/Physical Check*
4	Check engine coolant temperature (ECT) sensor for shift in value. After 8 hours with the hood up and the engine not running, connect Tech 2. With the ignition "ON" and the engine not running, compare engine coolant temperature to intake air temperature. Are ECT and IAT within the specified value of each other?	± 5°C (± 9°F)	Go to *Step 8*	Go to *Step 5*
5	1. Using Tech 2, display the engine coolant temperature and note the value. 2. Check the resistance of the engine coolant temperature sensor. 3. Refer to *Engine Coolant Temperature Sensor Temperature vs. Resistance* chart on *DTC P0118 Diagnostic Support* for resistance specifications. Is the resistance value near the resistance for the temperature noted?	—	Go to *Step 7*	Go to *Step 6*
6	Replace the ECT sensor. Is the action complete?	—	Verify repair	—
7	Locate and repair high resistance or poor connection in the ECT signal circuit or the ECT sensor ground. Is the action complete?	—	Verify repair	—
8	1. Check for a faulty, plugged, or incorrectly installed PCV valve. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 9*
9	1. Check for water- or alcohol-contaminated fuel. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 10*
10	1. Perform the procedure in *Fuel System Pressure Test*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 11*
11	1. Check for proper ignition voltage output with spark tester J 26792 (ST-125). Refer to *Electric Ignition System* for procedure. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 12*

Hard Start Symptom (Cont'd)

Step	Action	Value(s)	Yes	No
12	1. Remove spark plugs. Check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Refer to *Electronic Ignition System*. NOTE: If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 13*
13	1. Check for a loose ignition coil ground. Refer to *Electronic Ignition System*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 14*
14	1. Remove the ignition coils and check the ignition coils for cracks or carbon tracking. 2. If a problem is found, replace affected coil(s) as necessary. Was a problem found?	—	Verify repair	Go to *Step 15*
15	1. Check IAC operation. Perform the procedure in the *DTC P0506, Step 6* diagnostic table. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 16*
16	1. Check for the following engine mechanical problems (refer to *Engine Mechanical*): • Low compression • Leaking cylinder head gaskets • Worn or incorrect camshaft • Camshaft drive belt slipped or stripped 2. If a problem is found, repair as necessary. 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 • Freeze Frame data/Failure Records buffer • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Contact Technical Assistance

Surges and/or Chuggles Symptom

Step	Action	Value(s)	Yes	No
1	**DEFINITION:** Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal. Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *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 visual/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 TCC and the A/C clutch operate. Is the customer experiencing a normal condition?	—	System OK	Go to *Step 5*
5	1. Check the the fuel control heated oxygen sensors (HO2S, B1S1 and B2S1). The fuel control heated oxygen sensors (HO2S) should respond quickly to different throttle positions. If they don't, check them for silicon or other contaminants from fuel or use of improper RTV sealant. The sensors may have a white powdery coating. Silicon contamination causes a high but false HO2S signal voltage (rich exhaust indication). The PCM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem. For more information, refer to *Powertrain Control Module (PCM) and Sensors*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 6*
6	1. Check the fuel pressure. Refer to *Fuel System Pressure Test*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 7*
7	Monitor the long term fuel trim on Tech 2. Is the long term fuel trim significantly in the negative range (rich condition)?	—	Go to *Step 8*	Go to *Step 9*
8	1. Check items that can cause the engine to run rich. Refer to *Diagnostic Aids* in *DTC P0172 Diagnostic Support*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to *Step 10*	Verify repair
9	1. Check items that can cause the engine to run lean. Refer to *Diagnostic Aids* in *DTC P0171*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to *Step 10*	Verify repair

Surges and/or Chuggles Symptom (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Check for proper ignition voltage output with spark tester J 26792 (ST-125). Refer to *Electric Ignition System* for procedure. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 11*
11	1. Check for a loose ignition coil ground. Refer to *Electric Ignition System*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 12*
12	1. Check the ignition coils for cracks or carbon tracking. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 13*
13	1. Remove the spark plugs and check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Refer to *Electronic Ignition System*. NOTE: If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 14*
14	1. Check the injector connections. 2. If any of the injector connectors are connected to an incorrect cylinder, correct as necessary. Was a problem found?	—	Verify repair	Go to *Step 15*
15	1. Check PCM grounds for the cleanliness, tightness and proper locations. Refer to the PCM wiring diagrams in *Electrical Diagnosis*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 16*
16	1. Check MAF sensor connections. 2. If a problem is found, replace the faulty terminals as necessary. Refer to *Electrical Diagnosis* for wiring repair procedures. Was a problem found?	—	Verify repair	Go to *Step 17*
17	1. Visually/physically check vacuum hoses for splits, kinks, and proper connections and routing as shown on the "Vehicle Emission Control Information" label. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 18*

Surges and/or Chuggles Symptom (Cont'd)

Step	Action	Value(s)	Yes	No
18	1. Check the exhaust system for possible restriction: • Inspect the exhaust system for damaged or collapsed pipes. • Inspect the muffler for heat distress or possible internal failure. • Check for a possible plugged three-way catalytic converter by checking the exhaust system back pressure. Refer to *Restricted Exhaust System Check*. 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 • Freeze Frame data/Failure Records buffer • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Contact Technical Assistance

Lack of Power, Sluggish or Spongy Symptom

Step	Action	Value(s)	Yes	No
1	**DEFINITION:** Engine delivers less than expected power. Little or no increase in speed when accelerator pedal is pushed down part-way. Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *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 visual/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. Refer to *Air Intake System* in *ON-Vehicle Service*. 2. Replace the air filter element if necessary. Was a repair required?	—	Verify repair	Go to *Step 5*
5	1. Check for low fuel pressure. Refer to *Fuel System Pressure Test*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 6*
6	1. Check for water- or alcohol-contaminated fuel. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 7*
7	1. Using Tech 2, monitor the knock sensor (KS) system for excessive spark retard activity. Refer to *Knock Sensor (KS) System*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 8*
8	1. Check for proper ignition voltage output with spark tester J 26792 (ST-125). Refer to *Electronic Ignition System* for procedure. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 9*
9	1. Remove the spark plugs and check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Refer to *Electronic Ignition System*. NOTE: If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 10*
10	1. Check the ignition coils for cracks or carbon tracking. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 11*

Lack of Power, Sluggish or Spongy Symptom (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Check the PCM grounds for the cleanliness, tightness and proper locations. Refer to the PCM wiring diagrams in *Electrical Diagnosis*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 12*
12	1. Check the exhaust system for possible restriction: • Inspect the exhaust system for damaged or collapsed pipes. • Inspect the muffler for heat distress or possible internal failure. • Check for a possible plugged three-way catalytic converter by checking the exhaust system back pressure. Refer to *Restricted Exhaust System Check*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 13*
13	1. Check the torque converter clutch (TCC) for proper operation. Refer to *4L30-E Transmission Diagnosis*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 14*
14	1. Check for an engine mechanical problem. Check for low compression, incorrect or worn camshaft, loose timing belt, etc. Refer to *Engine Mechanical*. 2. If a problem is found, repair as necessary. 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 • Freeze Frame data/Failure Records buffer • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Contact Technical Assistance

Detonation/Spark Knock Symptom

Step	Action	Value(s)	Yes	No
1	**DEFINITION:** A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening. Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *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 visual/physical check performed?	—	Go to *Step 4*	Go to *Visual/Physical Check*
4	If Tech 2 readings are normal (refer to *Typical Scan Values*) and there are no engine mechanical faults, fill the fuel tank with a known quality gasoline that has a minimum octane rating of 87 and re-evaluate the vehicle performance. Is detonation present?	—	Go to *Step 5*	Verify repair
5	1. Check the transmission range switch circuit. Use Tech 2 and be sure Tech 2 indicates that the vehicle is in drive with the gear selector in drive or overdrive. 2. If a problem is found, diagnose and repair the transmission range switch as necessary (refer to *4L30-E Automatic Transmission Diagnosis*). Was a problem found?	—	Verify repair	Go to *Step 6*
6	1. Check TCC operation. Refer to *4L30-E Transmission Diagnosis*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 7*
7	1. Check for obvious overheating problems: • Low engine coolant. • Restricted air flow to radiator, or restricted water flow through radiator. • Correct coolant solution should be a 50/50 mix of approved antifreeze/coolant and water. Refer to *Engine Cooling*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 8*
8	1. Check fuel pressure. Refer to Chart Fuel System Pressure Test. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 9*
9	1. Check items that can cause an engine to run lean (long term fuel trim significantly in the positive range). For a lean condition, refer to *Diagnostic Aids* in *DTC P0171 Diagnostic Support*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 10*

Detonation/Spark Knock Symptom (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Spark plugs for proper heat range. Refer to *General Information*. 2. If incorrect spark plugs are installed, replace spark plugs as necessary. Did any spark plugs require replacement?	—	Verify repair	Go to *Step 11*
11	1. Remove excessive carbon buildup with a top engine cleaner. Refer to instructions on the top engine cleaner can. 2. Re-evaluate vehicle performance. Is detonation still present?	—	Go to *Step 12*	Verify repair
12	1. Check for an engine mechanical problem. Perform a cylinder compression check. Refer to *Engine Mechanical*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 13*
13	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 • Freeze Frame data/Failure Records buffer • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Contact Technical Assistance

Rough, Unstable, or Incorrect Idle, Stalling Symptom

Step	Action	Value(s)	Yes	No
1	**DEFINITION:** 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. Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *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?	—	Go to *Step 13*	Go to *Step 3*
3	Was a visual/physical check performed?	—	Go to *Step 4*	Go to *Visual/Physical Check*
4	1. Check the PCM grounds for cleanliness, tightness and proper routing. Refer to the PCM wiring diagrams in *Electrical Diagnosis*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 5*
5	Observe the long term fuel trim on Tech 2. Is the long term fuel trim significantly in the negative range (rich condition)?	—	Go to *Step 6*	Go to *Step 7*
6	1. Check items that can cause the engine to run rich. Refer to *Diagnostic Aids* in *DTC P0172 Diagnostic Support*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 9*
7	Is the long term fuel trim significantly in the positive range (lean condition)?	—	Go to *Step 8*	Go to *Step 9*
8	1. Check items that can cause the engine to run lean. Refer to *Diagnostic Aids* in *DTC P0171 Diagnostic Support*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 9*
9	1. Check for incorrect idle speed. Ensure that the following conditions are present: • The engine is fully warm. • The accessories are "OFF." 2. Using Tech 2, monitor the IAC position. Is the IAC position within the specified values?	Between 10 and 50 counts	Go to *Step 11*	Go to *Step 10*

Rough, Unstable, or Incorrect Idle, Stalling Symptom (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Visually/physically inspect for the following conditions: • Restricted air intake system. Check for a possible collapsed air intake duct, restricted air filter element, or foreign objects blocking the air intake system. • Throttle body. Check for objects blocking the IAC passage or throttle bore, excessive deposits in the IAC passage and on the IAC pintle, and excessive deposits in the throttle bore and on the throttle plate. • Large vacuum leak. Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty crankcase ventilation valve or a disconnected brake booster hose. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 8*
11	Check the injector connections. If any of the injectors are connected to an incorrect cylinder, correct as necessary. Was a problem found?	—	Verify repair	Go to *Step 12*
12	1. Perform the "Injector Coil/Balance Test" in *Fuel Metering System*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 13*
13	1. Check for fuel in the pressure regulator vacuum hose. 2. If fuel is present, replace the fuel pressure regulator assembly. Refer to *Fuel Metering System*. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 14*
14	1. Check for proper ignition voltage output with spark tester J 26792 (ST-125). Refer to *Electronic Ignition System* for the procedure. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 15*
15	1. Remove spark plugs. Check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Refer to *Electronic Ignition System*. NOTE: If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 16*
16	1. Check for a loose ignition coil ground. Refer to *Electrical Ignition System*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 17*

Rough, Unstable, or Incorrect Idle, Stalling Symptom (Cont'd)

Step	Action	Value(s)	Yes	No
17	1. Check ignition coils for cracks or carbon tracking. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 18*
18	Using Tech 2, monitor the throttle position (TP) angle with the engine idling. Is the TP angle at the specified value and steady?	0%	Go to *Step 19*	Refer to *DTC P0123* for further diagnosis
19	1. Check the positive crankcase ventilation (PCV) valve for proper operation. Refer to *Crankcase Ventilation System*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 20*
20	1. Check the transmission range switch circuit. Use Tech 2 and be sure Tech 2 indicates that the vehicle is in drive with the gear selector in drive or overdrive. 2. If a problem is found, diagnose and repair the transmission range switch as necessary (refer to *4L30-E Automatic Transmission Diagnosis*). Was a problem found?	—	Verify repair	Go to *Step 21*
21	1. Check for the following engine mechanical items. Refer to *Engine Mechanical* for diagnosis procedures: • EGR valve mounted backward. Compare with a known-good vehicle. • Low compression • Sticking or leaking valves • Worn camshaft lobe(s) • Camshaft drive belt slipped or stripped • Incorrect valve timing • Worn rocker arms • Broken valve springs 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 22*
22	1. Check for faulty motor mounts. Refer to *Engine Mechanical* for inspection of mounts. 2. If a problem is found, repair as necessary. 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 • Freeze Frame data/Failure Records buffer • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Contact Technical Assistance

Poor Fuel Economy Symptom

Step	Action	Value(s)	Yes	No
1	**DEFINITION:** 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 previously shown by an actual road test. (Non-standard tires will cause odometer readings to be incorrect, and that may cause fuel economy to appear poor when it is actually normal.) Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *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 visual/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? Was a problem found?	—	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	1. Visually/physically check: Vacuum hoses for splits, kinks, and improper connections and routing as shown on the "Vehicle Emission Control Information" label. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 7*
7	1. Remove and check the air filter element for dirt or for restrictions. Refer to *Air Intake System*. 2. Replace the air filter element if necessary. Was a repair required?	—	Verify repair	Go to *Step 8*
8	1. Remove spark plugs and check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Refer to *Spark Plug Replacement*. NOTE: If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 9*
9	1. Check for low engine coolant level. Refer to *Engine Cooling*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 10*

Poor Fuel Economy Symptom (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Check for an incorrect or faulty engine thermostat. Refer to *Engine Cooling*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 11*
11	1. Check for low engine compression. Refer to *Engine Mechanical*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 12*
12	1. Check the TCC operation. Refer to *4L30-E Transmission Diagnosis*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 13*
13	1. Check the exhaust system for possible restriction: ● Inspect the exhaust system for damaged or collapsed pipes. ● Inspect the muffler for heat distress or possible internal failure. ● Check for a possible plugged three-way catalytic converter by checking the exhaust system back pressure. Refer to *Restricted Exhaust System Check*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 14*
14	Check for proper calibration of the speedometer. Does the speed indicated on the speedometer closely match the vehicle speed displayed on Tech 2?	—	Go to *Step 16*	Go to *Step 15*
15	Diagnose and repair an inaccurate speedometer condition as necessary. Refer to *Vehicle Speed Sensor* in *Electrical Diagnosis*. Was a problem found?	—	Verify repair	—
16	1. Check the air intake system and the crankcase for air leaks. Refer to *Air Intake System* and *Crankcase Ventilation System*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 17*
17	1. Review all diagnostic procedures within this table. 2. When all procedures have been completed and no malfunctions have been found, review/inspect the following: ● Visual/physical inspection ● Tech 2 data ● Freeze Frame data/Failure Records buffer ● All connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 18*
18	Perform the procedure in *Fuel System Pressure Test*. Was the fuel pressure normal?	—	Contact Technical Assistance	Verify repair

Excessive Exhaust Emissions or Odors Symptom

Step	Action	Value(s)	Yes	No
1	**DEFINITION:** Vehicle fails an emission test. Vehicle has excessive "rotten egg" smell. (Excessive odors do not necessarily indicate excessive emissions.) Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *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?	—	Go to *Step 12*	Go to *Step 3*
3	Was a thorough visual/physical check performed?	—	Go to *Step 4*	Go to *Visual/Physical Check*
4	1. Check for vacuum leaks. Check vacuum lines, intake manifold, throttle body, etc. 2. If a problem is found, repair as necessary. Were any vacuum leaks located?	—	Go to *Step 12*	Go to *Step 5*
5	1. Check the fuel cap for proper installation. 2. Secure the fuel cap if necessary. Was the fuel cap installed properly?	—	Go to *Step 6*	Go to *Step 12*
6	1. Check the fuel pressure. Perform the procedure in *Fuel System Pressure Test*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to *Step 12*	Go to *Step 7*
7	1. Check for a faulty, plugged, or incorrectly installed crankcase ventilation valve; also check the crankcase ventilation system for plugging. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to *Step 12*	Go to *Step 8*
8	1. Check the injector connections. 2. If any of the injectors are connected to an incorrect cylinder, correct as necessary. Was a problem found?	—	Go to *Step 12*	Go to *Step 9*
9	1. Perform the "Injector Coil/Balance Test" in *Fuel Metering System*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to *Step 12*	Go to *Step 10*
10	1. Refer to *Engine Cooling* for cooling system diagnosis. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to *Step 12*	Go to *Step 11*
11	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 13*
12	Perform the exhaust emission test. Does the vehicle pass the test?	—	System OK	Go to *Step 13*

Excessive Exhaust Emissions or Odors Symptom (Cont'd)

Step	Action	Value(s)	Yes	No
13	Does the exhaust emission test indicate excessive CO and HC levels or is long term fuel trim significantly in the negative range (rich condition)?	—	Go to *Step 14*	Go to *Step 15*
14	1. Check items that can cause the engine to run rich. Refer to *Diagnostic Aids* in *DTC P0172 Diagnostic Support*. Make any necessary repairs. 2. Perform the exhaust emission test. Does the vehicle pass the test?	—	System OK	Go to *Step 16*
15	1. Check items that can cause the engine to run lean. Refer to *Diagnostic Aids* in *DTC P0171 Diagnostic Support*. Make any necessary repairs. 2. Perform the exhaust emission test. Does the vehicle pass the test?	—	System OK	Go to *Step 16*
16	1. Check the EGR system. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to *Step 12*	Go to *Step 17*
17	1. Check for an engine mechanical problem. Perform a cylinder compression check (refer to *Engine Mechanical*). 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to *Step 12*	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 • Freeze Frame data/Failure Records butter • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Contact Technical Assistance

Dieseling, Run-On Symptom

Step	Action	Value(s)	Yes	No
1	**DEFINITION:** Engine continues to run after key is turned “OFF,” but runs very rough. If engine runs smooth, check ignition switch and adjustment. Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *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 visual/physical check performed?	—	Go to *Step 4*	Go to *Visual/Physical Check*
4	1. Check for a short between B+ and any of the ignition feed circuits. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 5*
5	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 ● Freeze Frame data/Failure Records butter ● All electrical connections within a suspected circuit and/or system 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Contact Technical Assistance

Backfire Symptom

Step	Action	Value(s)	Yes	No
1	**DEFINITION:** Fuel ignites in the intake manifold, or in the exhaust system, making a loud popping noise. Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *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 visual/physical check performed?	—	Go to *Step 4*	Go to *Visual/Physical Check*
4	1. Check for proper ignition voltage coil output with spark tester 5-8840-0383-0. Refer to *Electric Ignition System* for procedure. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 5*
5	1. Remove spark plugs and check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Refer to *Electronic Ignition System*. NOTE: If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to *DTC P0172* to determine the cause of a rich condition or *Engine Mechanical* for an oil fouling condition. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 6*
6	1. Visually/physically inspect the ignition coils for cracks. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 7*
7	1. Check for an intermittent ignition system malfunction: ● Intermittent CKP 58X signal. ● Intermittent ignition feed circuit or sensor ground circuit to the crankshaft position sensor. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 8*
8	1. Check the fuel pressure. Refer to *Fuel System Pressure Test*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 9*

Backfire Symptom (Cont'd)

Step	Action	Value(s)	Yes	No
9	1. Check for the following engine mechanical conditions. Refer to *Engine Mechanical* for diagnosis procedures: • Low compression • Sticking or leaking valves • Worn camshaft lobe(s) • Camshaft drive belt slipped or stripped • Incorrect valve timing 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 10*
10	1. Check the intake and exhaust manifold(s) for casting flash. Refer to *Engine Mechanical*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 11*
11	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 • Freeze Frame data/Failure Records butter • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Contact Technical Assistance

Cuts Out, Misses Symptom

Step	Action	Value(s)	Yes	No
1	**DEFINITION:** Steady pulsation or jerking that follows engine speed; usually more pronounced as engine load increases. Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *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?	—	Go to *Step 13*	Go to *Step 3*
3	Was a visual/physical check performed?	—	Go to *Step 4*	Go to *Visual/Physical Check*
4	1. Check the PCM grounds for clearness, tightness and proper routing. Refer to the PCM wiring diagrams in *Electrical Diagnosis*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 5*
5	Observe the long term fuel trim on Tech 2. Is the long term fuel trim significantly in the negative range (rich condition)?	—	Go to *Step 6*	Go to *Step 7*
6	1. Check items that can cause the engine to run rich. Refer to *Diagnostic Aids* in *DTC P0172 Diagnostic Support*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 9*
7	Is the long term fuel trim significantly in the positive range (lean condition)?	—	Go to *Step 8*	Go to *Step 9*
8	1. Check items that can cause the engine to run lean. Refer to *Diagnostic Aids* in *DTC P0171 Diagnostic Support*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 9*
9	1. Check for incorrect idle speed. Ensure that the following conditions are present: • The engine is fully warm. • The accessories are "off." 2. Using Tech 2, monitor the IAC position. Is the IAC position within the specified values?	Between 5 and 50 counts	Go to *Step 11*	Go to *Step 10*

Cuts Out, Misses Symptom (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Visually/physically inspect for the following conditions: • Restricted air intake system. Check for a possible collapsed air intake duct, restricted air filter element, or foreign objects blocking the air intake system. • Throttle body. Check for objects blocking the IAC passage or throttle bore, excessive deposits in the IAC passage and on the IAC pintle, and excessive deposits in the throttle bore and on the throttle plate. • Large vacuum leak. Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty PCV valve or brake booster hose disconnected . 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 8*
11	Check the injector connections. If any of the injectors are connected to an incorrect cylinder, correct as necessary. Was a problem found?	—	Verify repair	Go to *Step 12*
12	1. Perform the "Injector Coil/Balance Test" in *Fuel Metering System*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 13*
13	1. Check for fuel in the pressure regulator vacuum hose. 2. If fuel is present, replace the fuel pressure regulator assembly. Refer to *Fuel Metering System*. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 14*
14	1. Check for proper ignition voltage output with spark tester J 26792 (ST-125). Refer to *Electronic Ignition System* for the procedure. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 15*
15	1. Remove spark plugs. Check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Refer to *Electronic Ignition System*. NOTE: If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 16*
16	1. Check for a loose ignition coil ground. Refer to *Electronic Ignition System*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 17*

Cuts Out, Misses Symptom (Cont'd)

Step	Action	Value(s)	Yes	No
17	1. Check ignition coils for cracks or carbon tracking. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 18*
18	Using Tech 2, monitor the TP angle with the engine idling. Is the TP angle at the specified value and steady?	0%	Go to *Step 19*	Refer to *DTC P0123* for further diagnosis
19	1. Check the PCV valve for proper operation. Refer to *Crankcase Ventilation System*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 20*
20	1. Check the transmission range switch circuit. Use Tech 2 and be sure Tech 2 indicates that the vehicle is in drive with the gear selector in drive or overdrive. 2. If a problem is found, diagnose and repair the transmission range switch as necessary (refer to *4L30-E Automatic Transmission Diagnosis*). Was a problem found?	—	Verify repair	Go to *Step 21*
21	1. Check the following engine mechanical items. Refer to *Engine Mechanical* for diagnosis procedures: • Low compression • Sticking or leaking valves • Worn camshaft lobe(s) • Camshaft drive belt slipped or stripped • Incorrect valve timing • Worn rocker arms • Broken valve springs 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 22*
22	1. Check for faulty motor mounts. Refer to *Engine Mechanical* for inspection of mounts. 2. If a problem is found, repair as necessary. 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 • Freeze Frame data/Failure Records butter • All electrical connections within a suspected circuit and/or system 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Contact Technical Assistance

Hesitation, Sag, Stumble Symptom

Step	Action	Value(s)	Yes	No
1	**DEFINITION:** 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. Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *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 visual/physical check performed?	—	Go to *Step 4*	Go to *Visual/Physical Check*
4	1. Check the fuel control heated oxygen sensors (HO2S, B1S1 and B2S1). The fuel control heated oxygen sensors (HO2S) should respond quickly to different throttle positions. If they don't, check them for silicon or other contaminants from fuel or use of improper RTV sealant. The sensors may have a white powdery coating. Silicon contamination causes a high but false HO2S signal voltage (rich exhaust indication). The PCM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem. For more information, refer to *Powertrain Control Module (PCM) and Sensors*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 5*
5	1. Check the fuel pressure. Refer to *Fuel System Pressure Test.* 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 6*
6	Observe the TP angle display on Tech 2 while slowly increasing throttle pedal. Does the TP angle display steadily increase from 0% at closed throttle to 100% at WOT?	—	Go to *Step 7*	Go to *Step 18*
7	Monitor the long term fuel trim on Tech 2. Is the long term fuel trim significantly in the negative range (rich condition)?	—	Go to *Step 8*	Go to *Step 9*
8	1. Check items that can cause the engine to run rich. Refer to *Diagnostic Aids* in *DTC P0172 Diagnostic Support*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 10*
9	1. Check items that can cause the engine to run lean. Refer to *Diagnostic Aids* in *DTC P0171 Diagnostic Support*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 10*

Hesitation, Sag, Stumble Symptom (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Check for proper ignition voltage output with spark tester J 26792 (ST-125). Refer to *Electronic Ignition System* for the procedure. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 11*
11	1. Check for a loose ignition coil ground. Refer to *Electronic Ignition System*. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 12*
12	1. Check the ignition coils for cracks or carbon tracking. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 13*
13	1. Remove spark plugs and check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Refer to *Electronic Ignition System*. NOTE: If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 14*
14	1. Check the PCM grounds for clearness, tightness and proper routing. Refer to the PCM wiring diagrams in Electrical Diagnosis. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 15*
15	1. Check the MAF sensor connections. 2. If a problem is found, replace the faulty terminals as necessary. Refer to *Electrical Diagnosis* for wiring repair procedures. Was a problem found?	—	Verify repair	Go to *Step 16*
16	1. Visually/physically check vacuum hoses for splits, kinks, and proper connections and routing as shown on the "Vehicle Emission Control Information" label. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 17*

Hesitation, Sag, Stumble Symptom (Cont'd)

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 • Freeze Frame data/Failure Records butter • All electrical connections within a suspected circuit and/or system 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Contact Technical Assistance
18	Replace the TP sensor. Is the action complete?	—	Verify repair	—

Default Matrix Table

Service Procedure Default Strategy

A referral strategy has been established to assist the technician with additional information when the cause of the failure cannot be determined. If no problem is found after performing diagnostics, then refer to the default matrix table for further diagnostic information.

Default Matrix Table

Strategy Based Diagnostic Charts	Initial Diagnosis	Default Section(s)
On-Board Diagnostic (OBD) System Check	Vehicle does not enter diagnostics.	Chassis Electrical
On-Board Diagnostic (OBD) System Check	Vehicle enters diagnostics and communicates with Tech 2. MIL is "ON" in diagnostics. Engine does not start and run.	Ignition System Check
On-Board Diagnostic (OBD) System Check	Engine starts and runs, no PCM codes set. Customer complains of vibration.	—
On-Board Diagnostic (OBD) System Check	Engine starts and runs, no PCM codes set. Customer complains of harsh or soft shift, poor performance, delayed or no engagement into drive or reverse, transmission fluid leak, transmission noise or vibration, or improper TCC operation.	Automatic Transmission
PCM Power and Ground Check	On-Board Diagnostic (OBD) System Check.	Chassis Electrical
PCM Power and Ground Check	On-Board Diagnostic (OBD) System Check. PCM power and ground circuits OK. Data link voltage incorrect.	Chassis Electrical
On-Board Diagnostic (OBD) System Check	Engine starts and runs, no PCM codes set. Customer complains of harsh or soft shift, poor performance, delayed or no engagement into drive or reverse, transmission fluid leak, transmission noise or vibration, or improper TCC operation.	Automatic Transmission

Symptoms	Initial Diagnosis	Default Section(s)
Intermittents	1. On-board Diagnostic (OBD) system check. 2. Careful visual/physical inspections.	Chassis Electrical
Hard Starts	1. OBD system check. 2. Sensors (ECT, MAP, MAF, TP) ; MAP output chart. 3. Fuel system electrical test, fuel system diagnosis. 4. Ignition system. 5. IAC system check.	Engine Mechanical, Ignition System Check, Exhaust System Diagnosis
Surges and/or Chuggles	1. OBD system check. 2. Heated oxygen sensors. 3. Fuel system diagnosis. 4. Ignition system.	Calibration ID "Broadcast Code"/Service Bulletins, Ignition System Check, Generator Output, Exhaust System Diagnosis, 4L30-E System Test

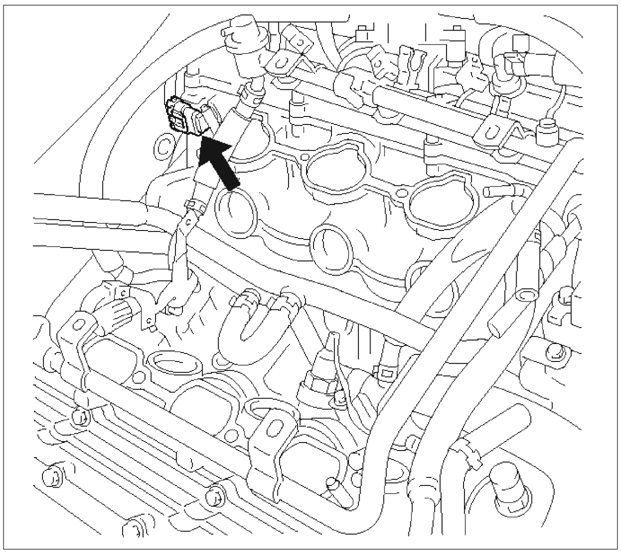
Symptoms	Initial Diagnosis	Default Section(s)
Lack of Power, Sluggish or Spongy	1. OBD system check. 2. Fuel system diagnosis. 3. Ignition system. 4. Knock sensor. 5. EGR operation. 6. EGR system check.	Refer to *Exhaust System* in *Engine Exhaust*, TCC Operation, Calibration ID/Service Bulletins
Detonation/Spark Knock	1. OBD system check. 2. Transmission range switch. 3. EGR operation. 4. EGR system check. 5. TCC operation. 6. Fuel system diagnosis. 7. Ignition system. 8. Knock sensor.	TCC operation, Cooling System, Ignition System Check, Calibration ID/Service Bulletins
Hesitation, Sag, Stumble	1. OBD system check. 2. TP. 3. MAP output check. 4. Fuel system diagnosis. 5. Fuel injector and fuel injector balance test. 6. Ignition system.	EGR Operation, EGR System Check, Generator Output Voltage (refer to *Chassis Electrical*), Calibration ID/Service Bulletins, Ignition System Check
Cuts Out, Misses	1. OBD system check. 2. Cylinder balance test.	Ignition System Check
Rough, Unstable, or Incorrect Idle, Stalling	1. OBD system check. 2. Fuel injector and fuel injector balance test. 3. Ignition system. 4. IAC operation. 5. EGR operation.	MAP Output Check, Throttle Linkage, IAC System Check, EGR System Check, A/C Clutch Control Circuit Diagnosis, Crankcase Ventilation System, Calibration ID/Service Bulletins, Generator Output Voltage (refer to *Chassis Electrical*), Exhaust Diagnosis
Poor Fuel Economy	1. OBD system check. 2. Careful visual/physical inspection. 3. Ignition system. 4. Cooling system.	TCC Operation, Exhaust System (refer to *Engine Exhaust*)
Engine Cranks But Will Not Run	1. OBD system check.	Fuel System Electrical Diagnosis, Fuel System Diagnosis, Fuel Injector and Fuel Injector Balance Test.
Excessive Exhaust Emissions or Odors	1. OBD system check. 2. Emission test. 3. Cooling system. 4. Fuel system diagnosis. 5. Fuel injector and fuel injector balance test. 6. Crankcase ventilation system. 7. Ignition system. 8. MAP output check.	EGR System Check, Exhaust Diagnosis, Calibration ID/Service Bulletins
Dieseling, Run-On	1. OBD system check. 2. Careful visual/physical inspection. 3. Fuel system diagnosis.	—

Symptoms	Initial Diagnosis	Default Section(s)
Backfire	1. OBD system check. 2. Ignition system. 3. Fuel system diagnosis. 4. Fuel injector and fuel injector balance test. 5. EGR operation, EGR system check.	Exhaust System Diagnosis, Intake Casting Flash, Ignition System Check
Catalyst Monitor	1. OBD system check. 2. Careful visual/physical inspection. 3. Heated oxygen sensors.	Exhaust System
Fuel Trim	1. OBD system check. 2. Careful visual/physical inspection. 3. Fuel system diagnosis. 4. Heated oxygen sensors, MAF sensors.	Exhaust System Intake Air System
Evaporative Emissions	1. OBD system check. 2. Careful visual/physical inspection. 3. Fuel system diagnosis.	—
Heated Oxygen Sensors	1. OBD system check. 2. Careful visual/physical inspection.	Exhaust System

Camshaft Position (CMP) Sensor

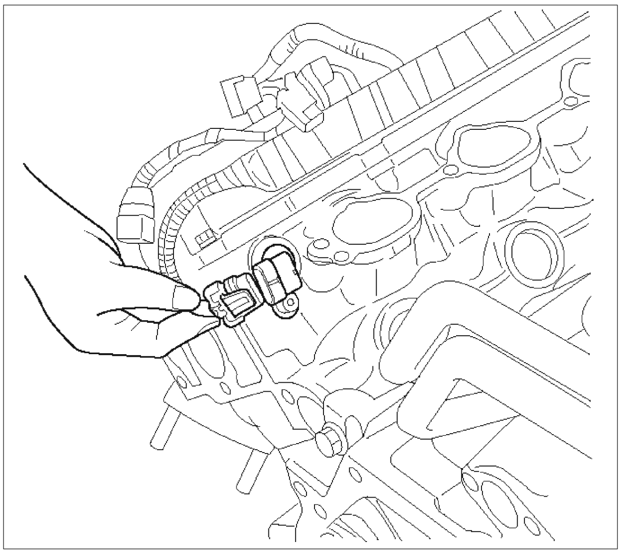
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Remove the common chamber assembly.
   Refer to Common Chamber in Engine Mechanical.



014RW120

4. Disconnect the electrical connector to the CMP sensor.



014RV053

5. Remove the CMP retaining bolt from the side of left cylinder head.
6. Remove the CMP sensor from the cylinder head.

Inspection Procedure

1. Inspect the sensor O-ring for cracks or leaks.
2. Replace the O-ring if it is worn or damaged.
3. Lubricate the new O-ring with engine oil.
4. Install the lubricated O-ring.

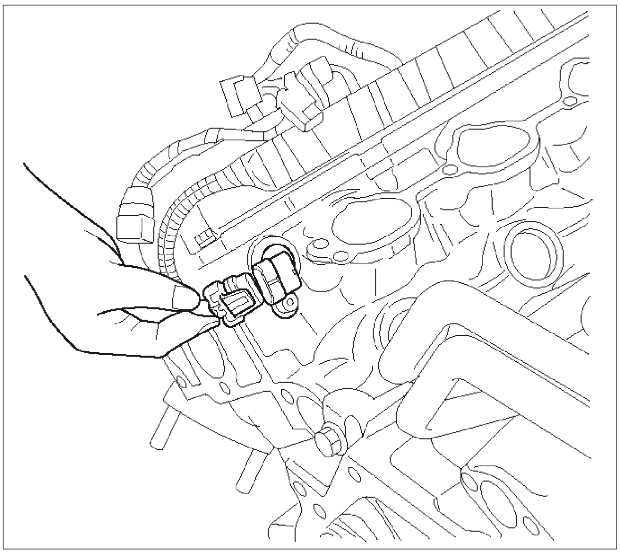
Installation Procedure

1. Install the CMP sensor in the cylinder head.
2. Install the CMP sensor retaining bolt.

Tighten

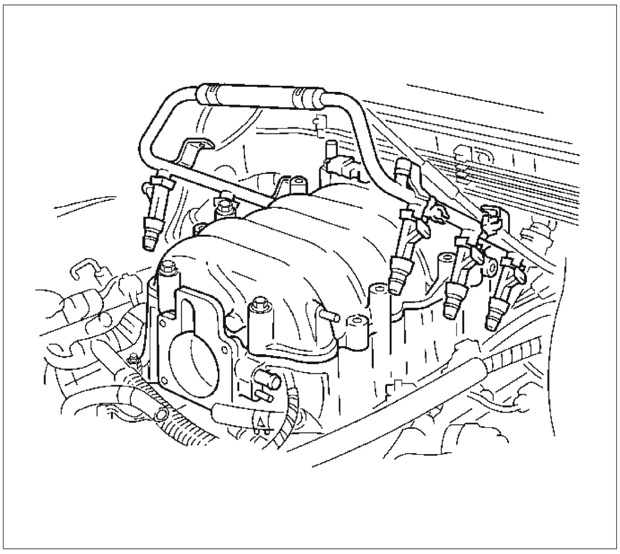
- Tighten the retaining screw to 9 N·m (78 lb in.).

3. Connect the electrical connector to the CMP sensor.



014RV053

4. Install the common chamber assembly.
   Refer to Common Chamber in Engine Mechanical.



014RW106

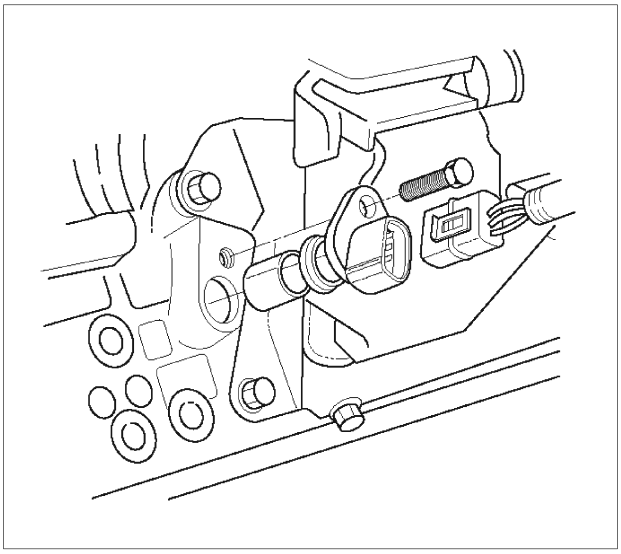
5. Install the engine cover.
6. Connect the negative battery cable.

Crankshaft Position (CKP) Sensor

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector to the CKP sensor.
3. Remove one bolt and the CKP sensor from the right side of the engine block, just behind the mount.

NOTE: Use caution to avoid any hot oil that might drip out.



TS22909

Inspection Procedure

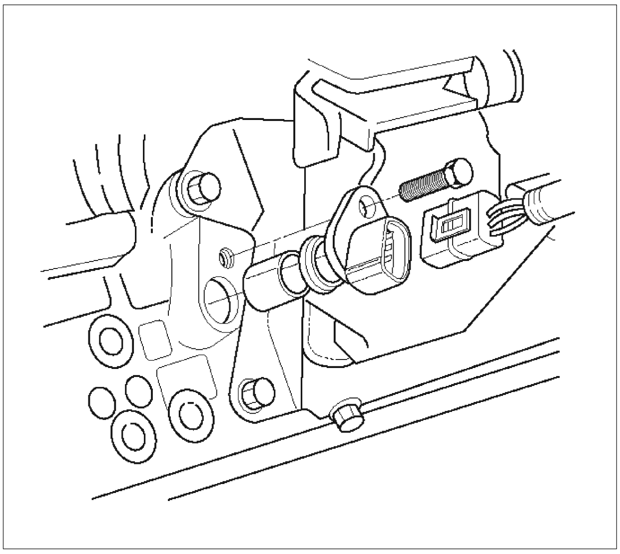
1. Inspect the sensor O-ring for cracks or leaks.
2. Replace the O-ring if it is worn or damaged.
3. Lubricate the new O-ring with engine oil.
4. Install the lubricated O-ring.

Installation Procedure

1. Install the CKP sensor in the engine block.
2. Install the CKP sensor mounting bolt.

Tighten

- Tighten the mounting bolt to 9 N·m (78 lb in.).



TS22909

3. Connect the electrical connector to the CKP sensor.
4. Connect the negative battery cable.

Engine Coolant Temperature (ECT) Sensor

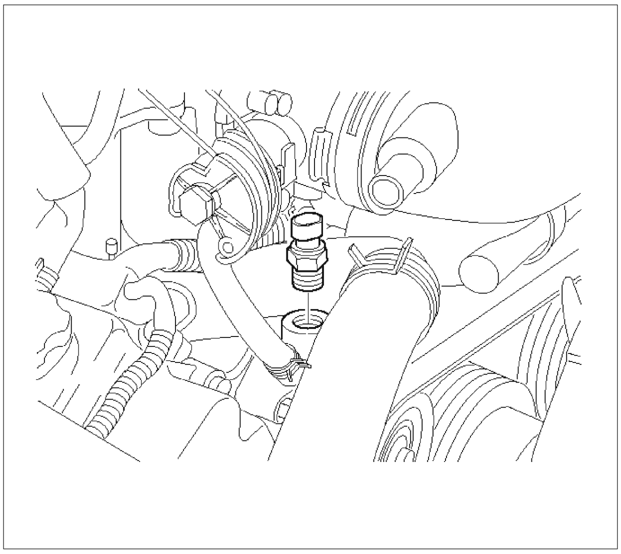
Removal Procedure

NOTE: Care must be taken when handling the engine coolant temperature (ECT) sensor. Damage to the ECT sensor will affect proper operation of the fuel injection system.

1. Disconnect the negative battery cable.
2. Drain the radiator coolant. Refer to *Draining and Refilling Cooling System* in *Engine Cooling*.
3. Disconnect the electrical connector.

014RW127

4. Remove the ECT sensor from the coolant crossover.



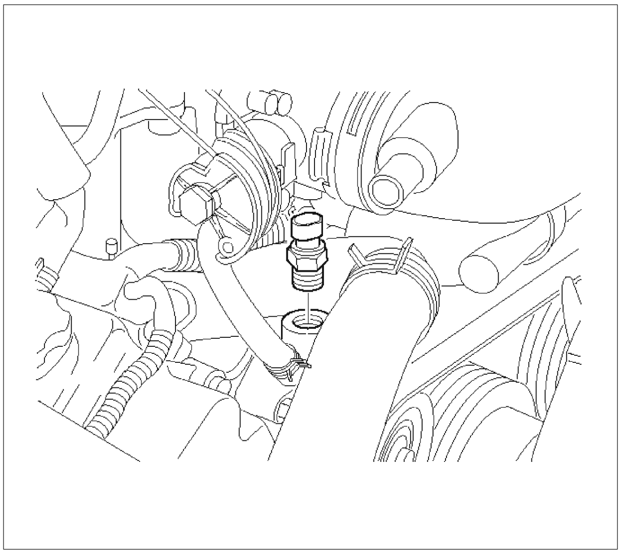
014RW086

Installation Procedure

1. Apply sealer or the equivalent to the threads of the ECT sensor.
2. Install the ECT sensor in the coolant crossover.

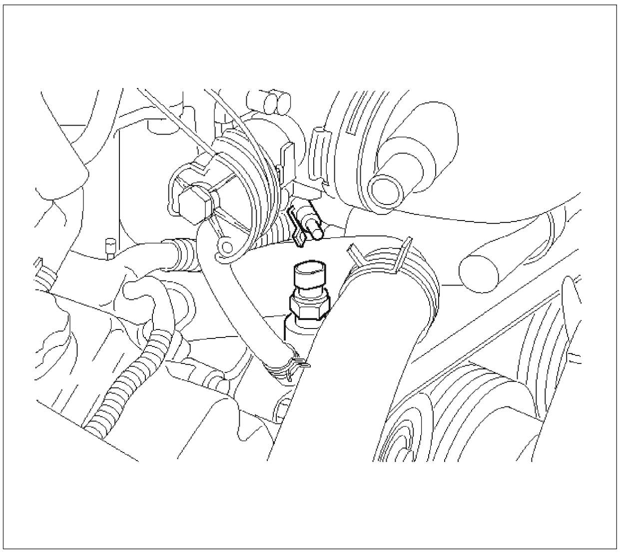
Tighten

- Tighten the ECT sensor to 30 N·m (22 lb ft.).



014RW086

3. Connect the electrical connector.



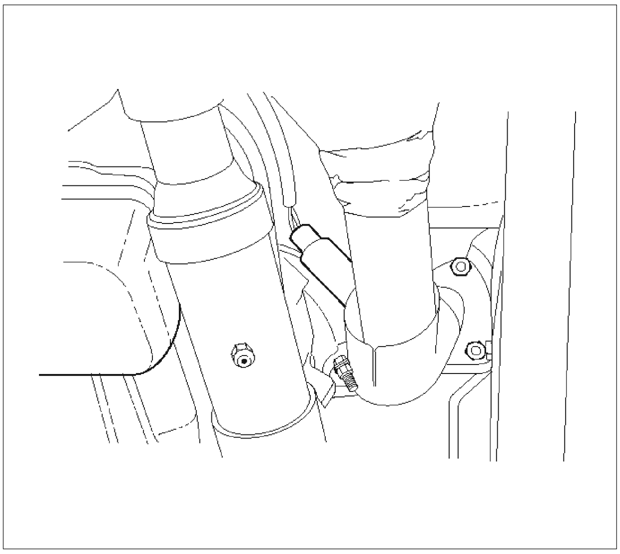
014RW085

4. Fill the radiator with coolant. Refer to *Draining and Refilling Cooling System* in *Engine Cooling*.
5. Connect the negative battery cable.

Heated Oxygen Sensor (HO2S)

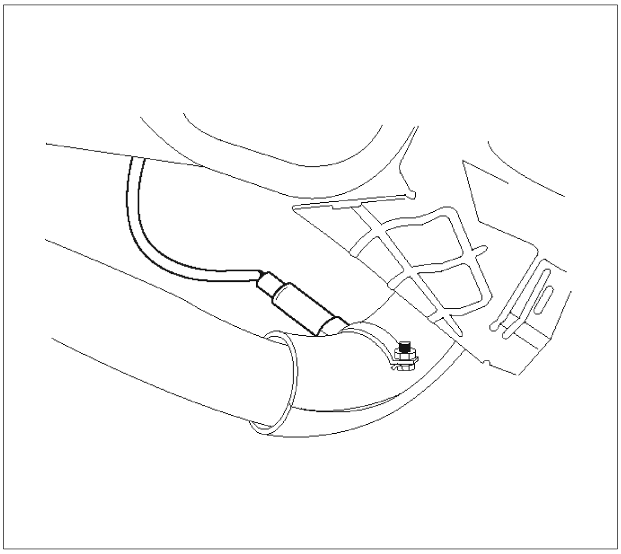
Removal Procedure

1. Disconnect the negative battery cable.
2. Locate the oxygen sensors.
   - Bank 1 sensor 1 is mounted on the right-hand front exhaust pipe.



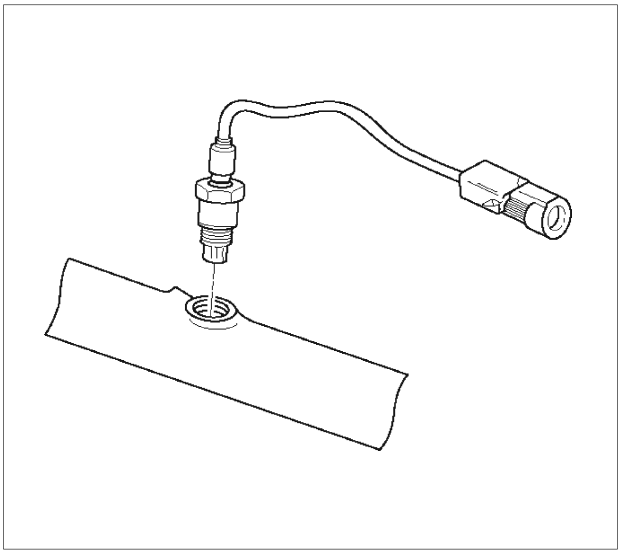
TS22912

- Bank 2 sensor 1 is mounted on the exhaust pipe ahead of the catalytic converter.



TS22914

3. Disconnect the pigtail from the wiring harness.

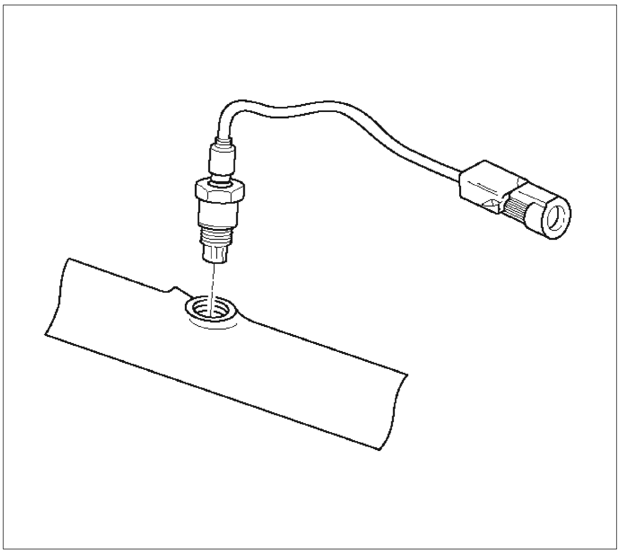


TS23739

IMPORTANT: The pigtail is permanently attached to the sensor. Be careful not to pull the wires out.

NOTE: Do not use a torch to remove an HO2S unless the sensor is being replaced. Using a torch could damage the sensor.

4. Remove the sensor from the exhaust pipe.
   - Because of the expansion and contraction of the metal in the exhaust system over time, this may be difficult if the engine temperature is below 48°C (120°F).

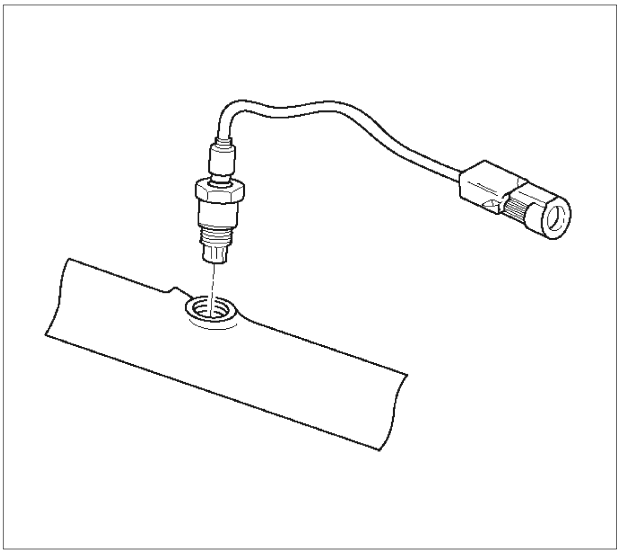


TS23739

Inspection Procedure

All two sensors are identical. Inspect each in the same way.

1. Inspect the pigtail and the electrical connector for grease, dirt, corrosion, and bare wires or worn insulation.
2. Inspect the louvered end of the sensor for grease, dirt, or other contaminations.



TS23739

Installation Procedure

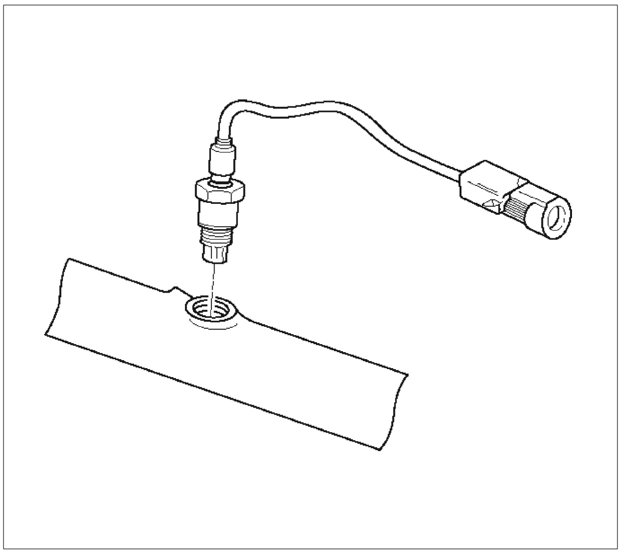
IMPORTANT:

- A special anti-seize compound, P/N 5613695, is used on the HO2S threads. This compound consists of glass beads suspended in a liquid graphite solution. The graphite burns away with engine heat, but the glass beads will remain, making 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.

1. Apply anti-seize compound or the equivalent to the threads of the oxygen sensor, if necessary.
2. Install the oxygen sensor on the exhaust pipe in its original position.

Tighten

- Tighten the oxygen sensor to 55 N·m (40 lb in.).

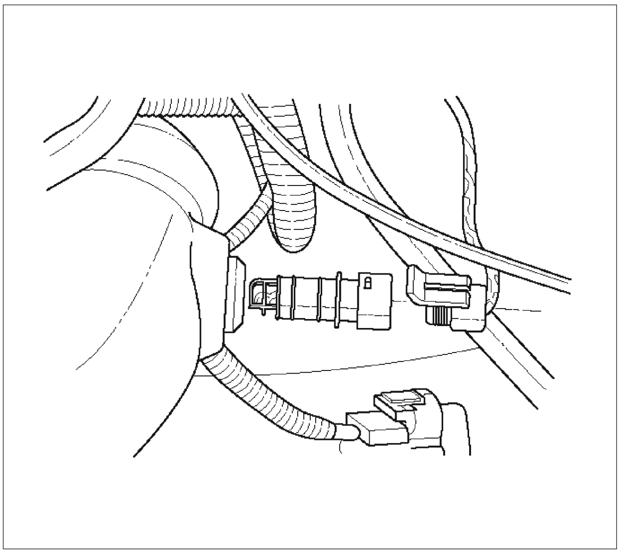

TS23739

3. Connect the pigtail to the wiring harness.
4. Connect the negative battery cable.

Intake Air Temperature (IAT) Sensor

Removal Procedure

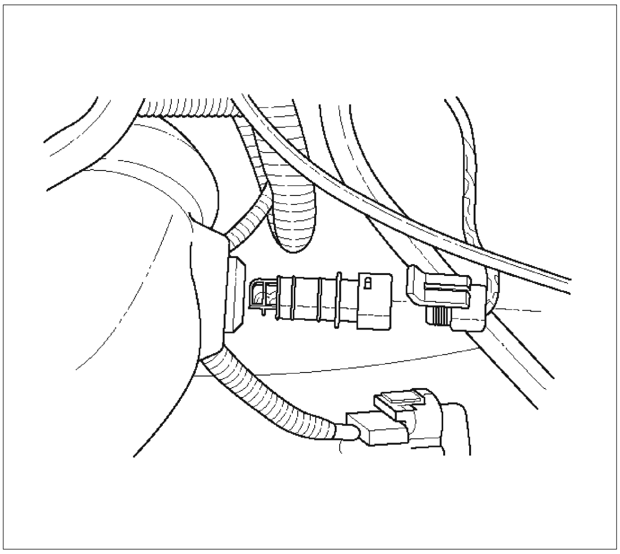
1. Disconnect the negative battery cable.
2. Remove the engine cover
3. The IAT sensor is located in the intake air duct, behind the throttle body.
4. Disconnect the electrical connector from the IAT sensor.


TS23741

5. Remove the IAT sensor from the intake air duct by using a rocking motion while pulling the sensor.

Installation Procedure

1. Install the IAT sensor into the grommet in the intake air duct.
2. Correct the IAT electrical connector.


TS23741

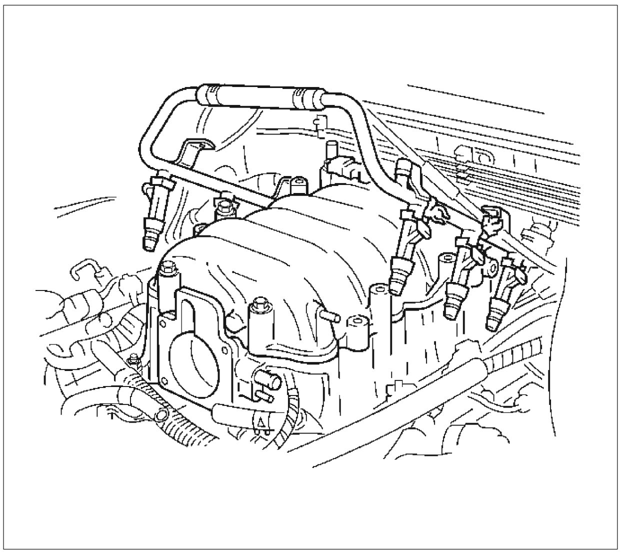
3. Install the engine cover.
4. Connect the negative battery cable.

Knock Sensor (KS)

Removal Procedure

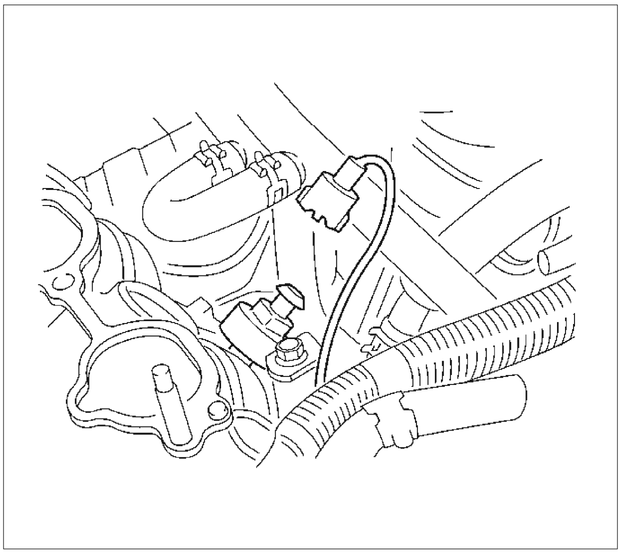
1. Disconnect the negative battery cable.
2. Drain the cooling system. Refer to *Draining and Filling the Cooling System* in *Engine Cooling*.
3. Remove the engine cover.
4. Remove the common chamber assembly.

   Refer to Common Chamber in Engine Mechanical.



014RW106

5. Disconnect the electrical connector from the knock sensor.



014RW103

6. Unscrew the knock sensor from the engine block.

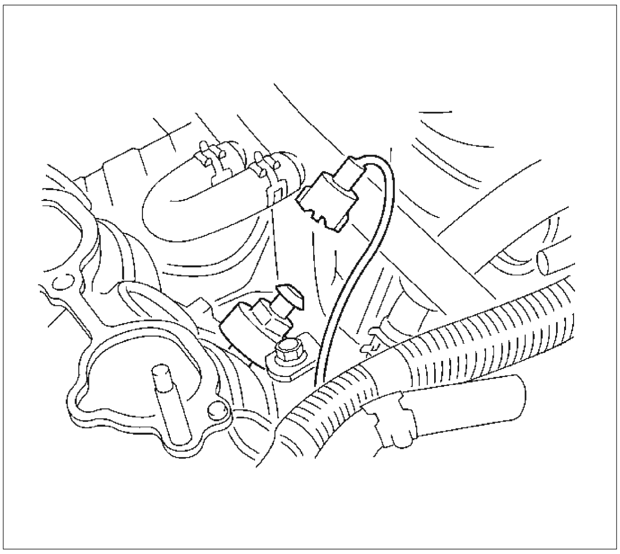
Installation Procedure

NOTE: Do not apply thread sealant to the sensor threads. The sensor is coated at the factory and applying additional sealant will affect the sensor's ability to detect detonation.

1. Screw the knock sensor into the engine block.

Tighten

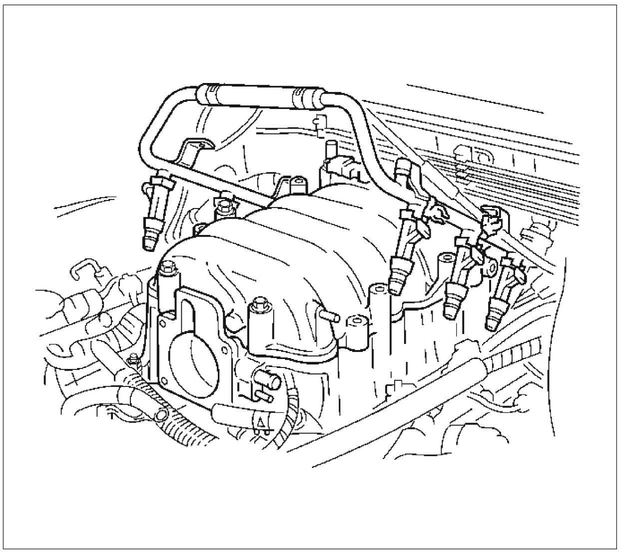
- Tighten the knock sensor to 20 N·m (177 lb in.).



014RW103

2. Connect the electrical connector to the knock sensor.
3. Install the common chamber assembly.

   Refer to Common Chamber in Engine Mechanical.



014RW106

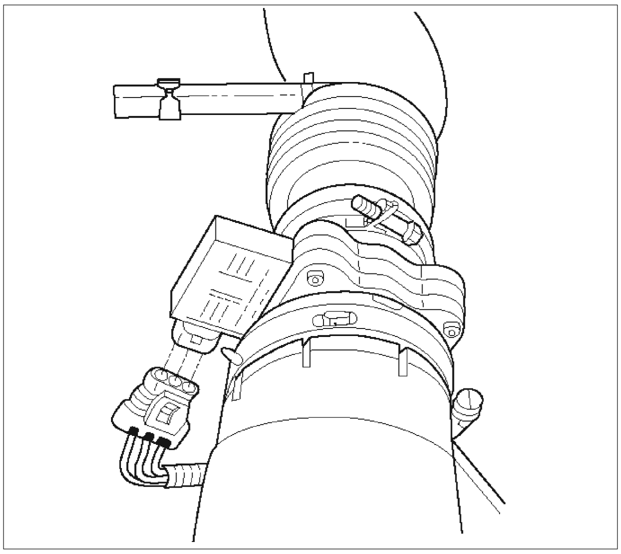
4. Install the engine cover.
5. Fill the cooling system.

   Refer to Draining and Filling the Cooling System in Engine Cooling.
6. Connect the negative battery cable.

Mass Air Flow (MAF) Sensor

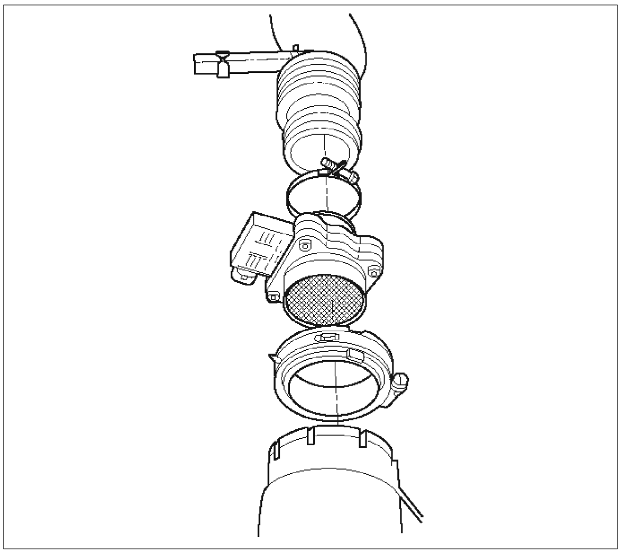
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector from the MAF sensor.



TS23740

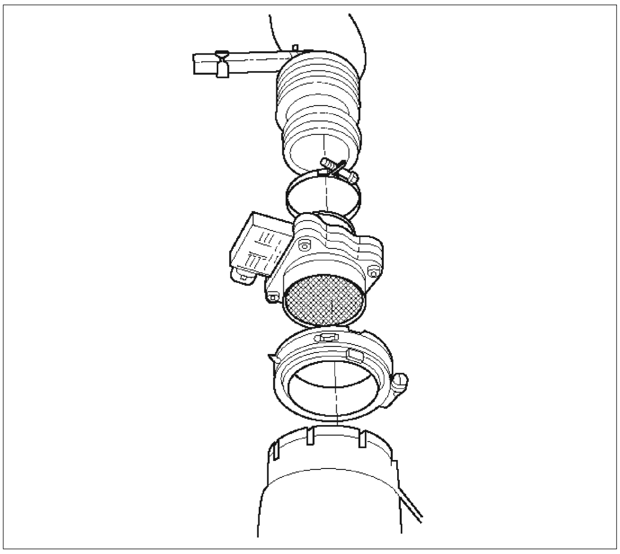
3. Loosen the clamps which secure the intake air duct and the air cleaner to the MAF sensor.
4. Remove the intake air duct from the MAF sensor.
5. Remove the MAF sensor from the air cleaner.



TS23781

Installation Procedure

1. Install the MAF sensor on the air cleaner with the clamp.
2. Install the intake air duct and the clamp on the MAF sensor.



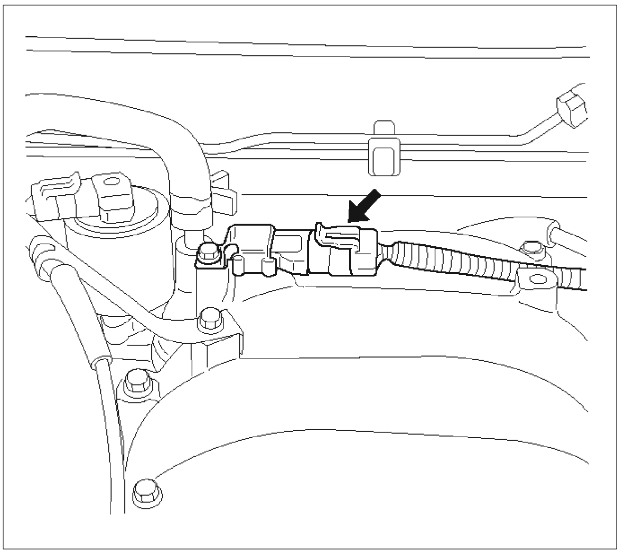
TS23781

3. Tighten the clamps to secure the MAF sensor to the intake air duct and the air cleaner.
4. Connect the MAF electrical connector.
5. Connect the negative battery cable.

Manifold Absolute Pressure (MAP) Sensor

Removal Procedure

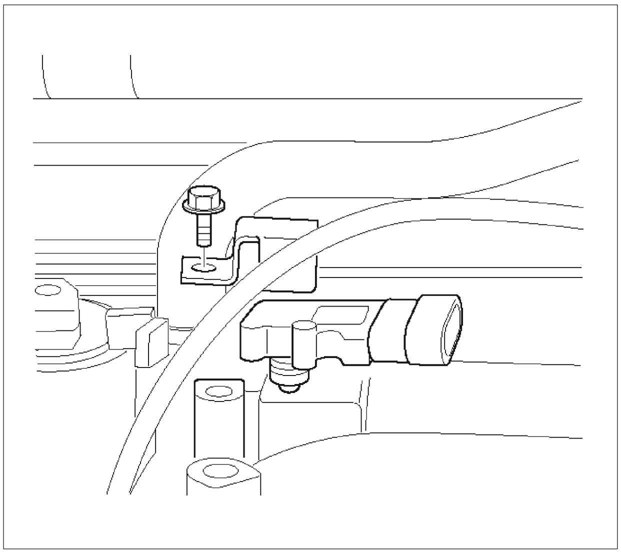
1. Disconnect the negative battery cable.
2. Disconnect the electrical connector from the MAP sensor.



055RW005

3. Remove the bolt securing the MAP sensor to the mounting bracket on the common chamber.

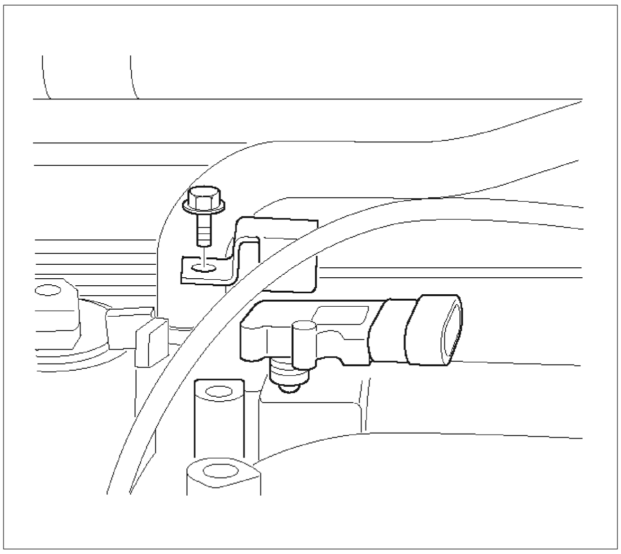
4. Remove the MAP sensor from the mounting bracket.



055RW002

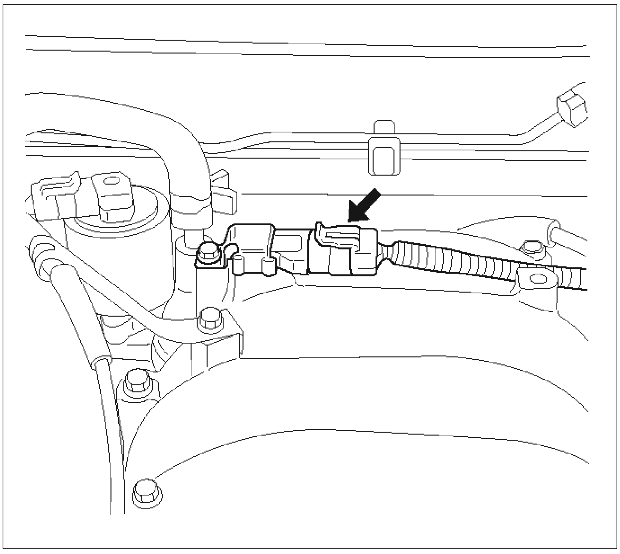
Installation Procedure

1. Install the MAP sensor in the mounting bracket.



055RW002

2. Install the mounting bracket retaining bolt on the common chamber.
3. Connect the MAP electrical connector.



055RW005

4. Connect the negative battery cable.

Malfunction Indicator Lamp (MIL)

Removal and Installation Procedure

Refer to Warning light bulb, indicator light valve, illumination light bulb, A/T indicator light bulb in Meter and Gauge.

Powertrain Control Module (PCM)

Service Precaution

NOTE: To prevent possible electrostatic discharge damage to the PCM, do not touch the connector pins or soldered components on the circuit board.

Electrostatic Discharge (ESD) Damage

Electronic components used in the control systems 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 4,000 volts for a person to even feel the zap of a static discharge.

There are several ways for a person to become statically charged. The most common methods of charging are by friction and by induction. An example of charging by friction is a person sliding across a car seat.

Charging by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily 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 control module connector pins or soldered components on the control module 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, 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 PCM damage, the ignition must be in the “OFF” position in order to disconnect or reconnect power to the PCM (for example: battery cable, PCM pigtail, PCM fuse, jumper cables, etc.).

IMPORTANT: When replacing the production PCM with a service PCM, it is important to transfer the broadcast code and production PCM number to the service PCM label. This will allow positive identification of PCM parts throughout the service life of the vehicle. Do not record this information on the metal PCM cover.

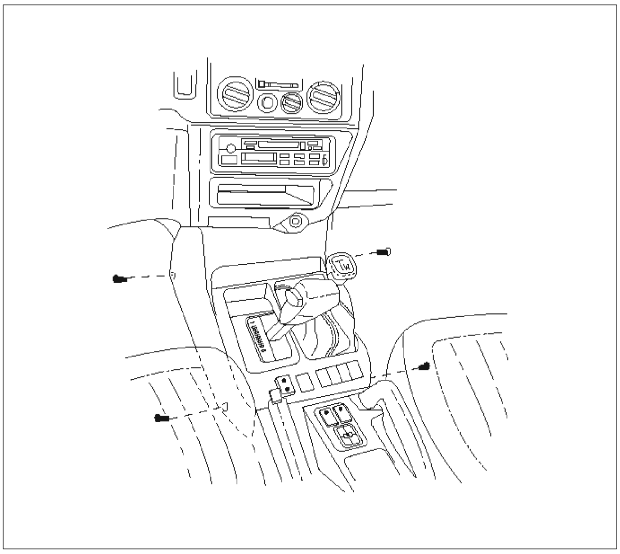
IMPORTANT: The ignition should always be in the “OFF” position in order to install or remove the PCM connectors.

Service of the PCM should normally consist of either replacement of the PCM or EEPROM programming. If the diagnostic procedures call for the PCM to be replaced, the PCM should be checked first to ensure it is the correct part. If it is, remove the faulty PCM and install the new service PCM.

The service PCM EEPROM will not be programmed. DTC P0601 indicates the check sum error.

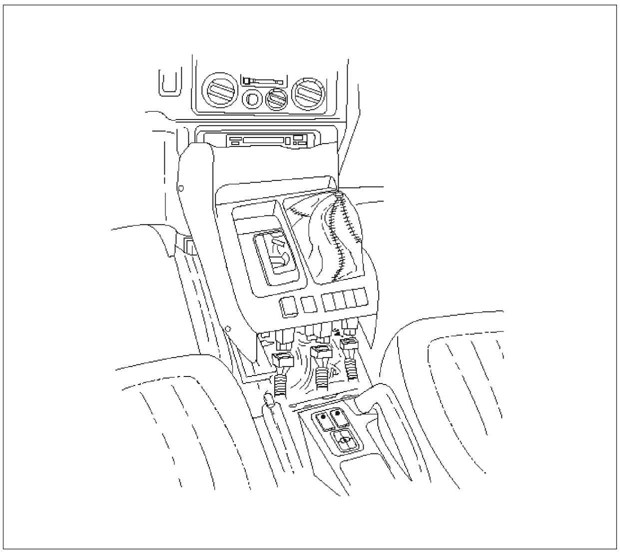
Removal Procedure

1. Disconnect the negative battery cable.
2. Block the wheels.
3. Remove the front console assembly.
    1. Remove the four screws.



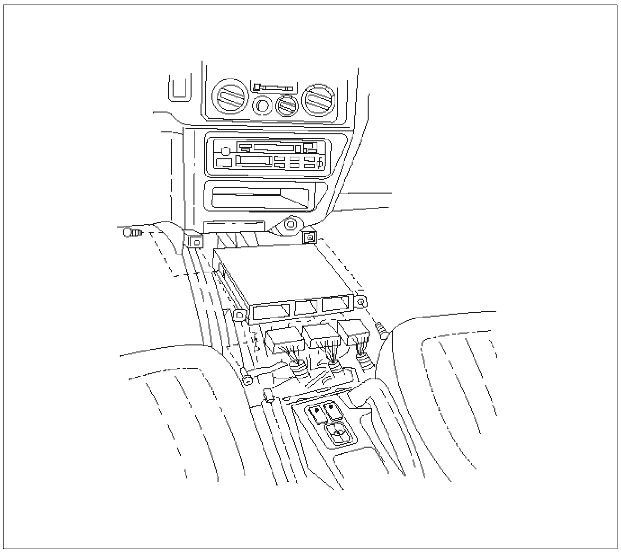
TS23755

2. Remove the transfer shift lever knob by unscrewing the knob.
3. Move the transmission gear selector out of the park position.
4. Lift up sharply on the back edge of the assembly.
5. Disconnect the seat heater switch connectors (if equipped).
6. Disconnect the POWER and WINTER switch connectors.
7. Lift out the front console assembly.



TS23756

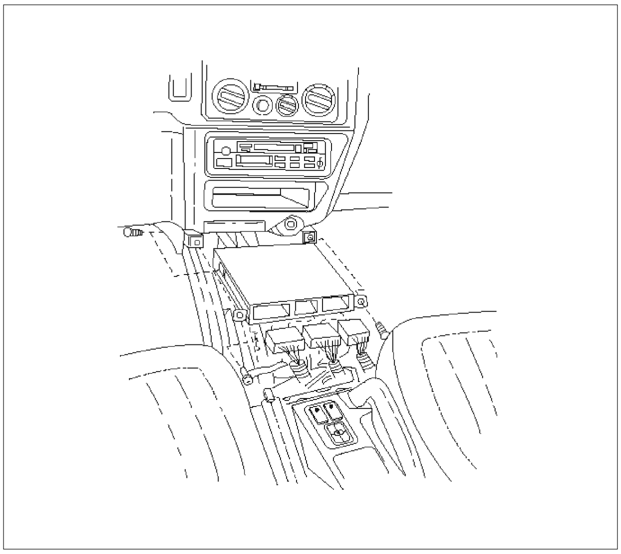
4. Disconnect the red, white, and blue electrical connectors at the PCM.
5. Remove the two screws in the front of the PCM.
6. Remove the one screw at the left rear of the PCM.
7. Pull the PCM straight out from the dashboard.



TS23757

Installation Procedure

1. Insert the PCM into the dashboard.
   - Line up the holes in front for the mounting screws.
2. Install the PCM with two screws in the front and one screw at the left rear.
3. Plug the red, white, and blue connectors into the appropriate sockets.



TS23757

EEPROM

General Description

The Electronically Erasable Programmable Read Only Memory (EEPROM) is a permanent memory that is physically soldered within the PCM. The EEPROM contains program and calibration information that the PCM needs to control powertrain operation.

EEPROM Programming

1. Step-up – Ensure that the following conditions have been met:
   - The battery is fully charged.
   - The ignition is “ON.”
   - The Vehicle Interface Module cable connection at the DLC is secure.
2. Program the PCM using the latest software matching the vehicle. Refer to up-to-date Techline equipment user’s instructions.
3. If the PCM fails to program, Refer to *UBS 98 model year Immobilizer Workshop Manual.*

Functional Check

1. Perform the On-Board Diagnostic System Check.
2. Start the engine and run for one minute.
3. Scan for DTCs using the Tech 2.

Power Steering Pressure (PSP) Switch

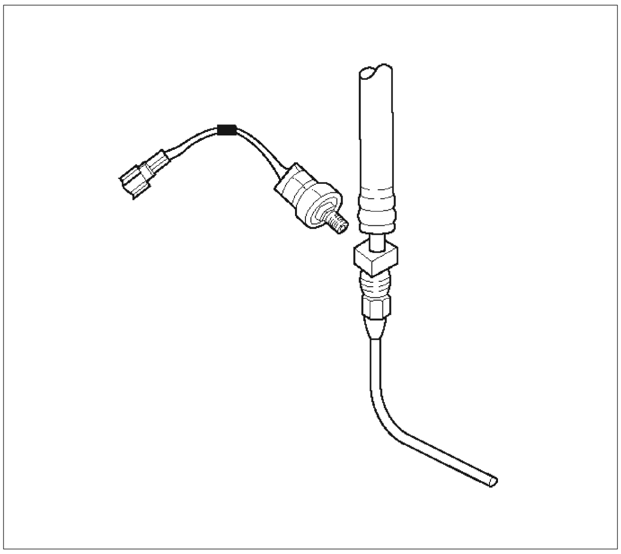
General Description

The Power Steering Pressure (PSP) switch closes when the hydraulic pressure reaches 3920 ± 690 kPa (570 ± 100 psi). This causes the PCM to actuate the idle air control valve in order to prevent the additional load from slowing down the engine. The switch opens when the hydraulic pressure drops to 2970 ± 560 kPa (430 ± 80 psi).

Removal Procedure

1. Disconnect the PSP switch pigtail from the wiring harness.
   - The pigtail is permanently attached to the switch. Do not attempt to remove the wires from the sensor.
   - Have a container ready to catch the power steering fluid that leaks out of the line when the switch is removed.

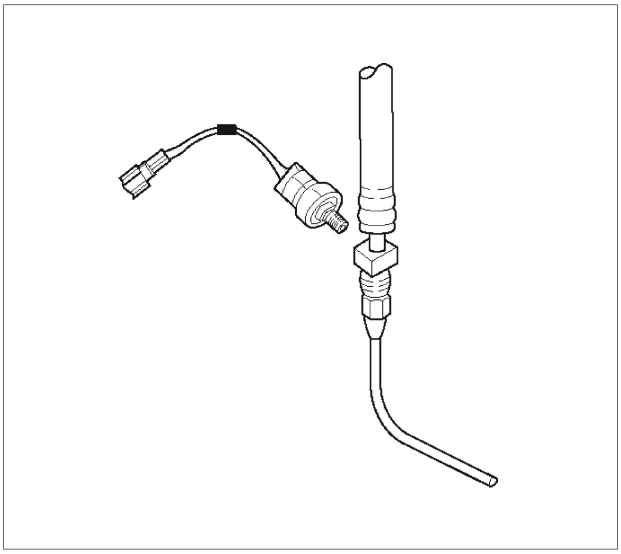
2. Remove the PSP switch from the power steering line.
   - Plug the line to prevent excessive loss of fluid and possible contamination of the power steering system.



TS23760

Installation Procedure

1. Install the PSP switch in the power steering line.



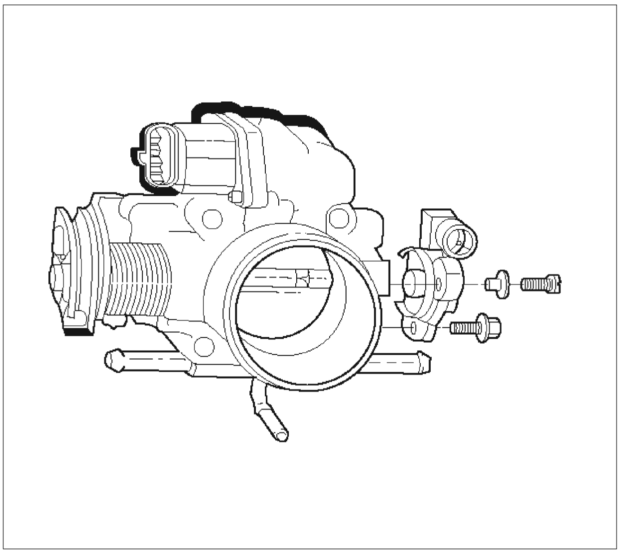
TS23760

2. Connect the PSP switch pigtail to the wiring harness.
3. Check the power steering fluid level. Refer to *Power Steering*.
4. Start the engine. Watch the PSP switch for signs of fluid leakage.

Throttle Position (TP) Sensor

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the TPS electrical connector.
3. Remove the bolts and the TP sensor from the throttle body.



TS23747

NOTE: Do not clean the TP sensor by soaking it in solvent. The sensor will be damaged as a result.

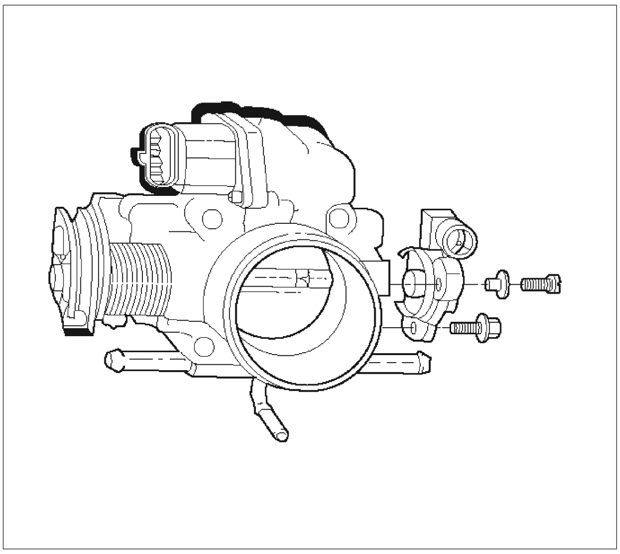
Function Check

Use a Tech 2 to check the TP sensor output voltage at closed throttle.

- The voltage should be under 0.85 volt.
- If the reading is greater than 0.85 volt, check the throttle shaft to see if it is binding. Check that the throttle cable is properly adjusted, also. Refer to *Throttle Cable Adjustment*.
- If the throttle shaft is not binding and the throttle cable is properly adjusted, install a new TP sensor.

Installation Procedure

1. Install the TP sensor on the throttle body with the bolts.



TS23747

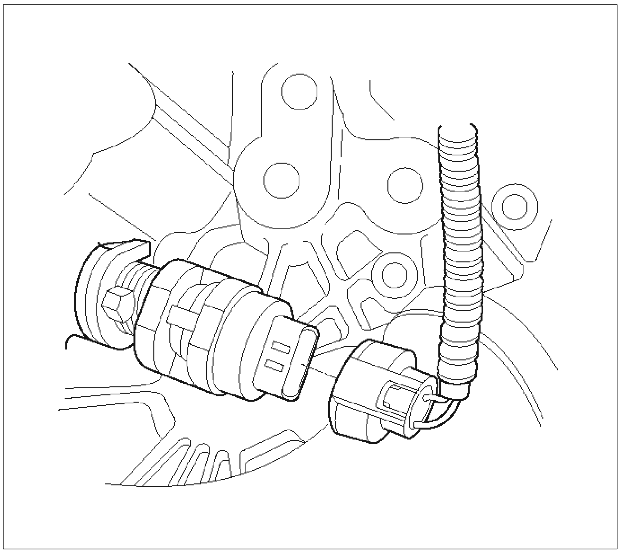
2. Connect the TP electrical connector.
3. Install the negative battery cable.

Vehicle Speed Sensor (VSS)

Removal Procedure

CAUTION: The VSS is located on the right side of the transfer case just ahead of the rear propeller shaft and very close to the exhaust pipes. Be sure that the exhaust pipes are cool enough to touch before trying to remove the VSS. If the pipes are hot, you could be burned.

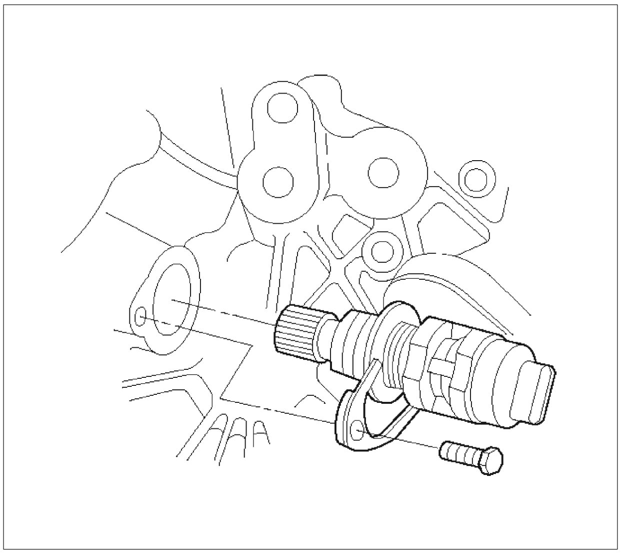
1. Disconnect the negative battery cable.
2. Disconnect the VSS electrical connector.



TS23748

3. Remove the bolt and the clamp securing the VSS in place.

IMPORTANT: Have a container ready to catch any fluid that leaks out when the VSS is removed from the transfer case.



TS23780

4. Remove the VSS from the transfer case by wiggling it slightly and pulling it straight out.

Inspection Procedure

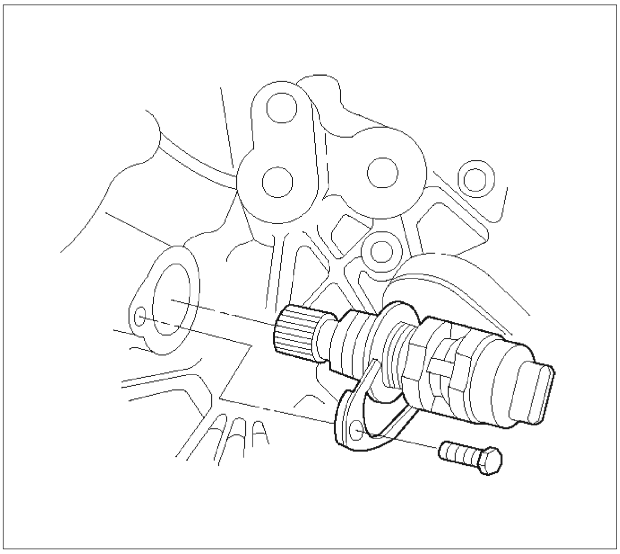
1. Inspect the electrical connector for signs of corrosion or warping. Replace the VSS if the electrical connector is corroded or warped.
2. Inspect the VSS driven gear for chips, breaks, or worn condition. Replace the VSS if the driven gear is chipped, broken or worn.
3. Inspect the O-ring for wear, nicks, tears, or looseness. Replace the O-ring if necessary.

Installation Procedure

1. Install the VSS in the transfer case with the notch for the connector facing the rear.
2. Secure the VSS in place with the clamp and the bolt.

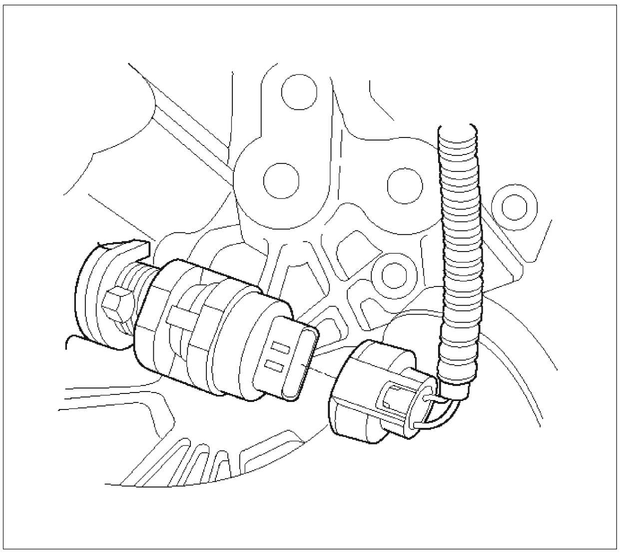
Tighten

- Tighten the bolt to 16 N·m (12 lb ft.).



TS23780

3. Connect the VSS electrical connector.



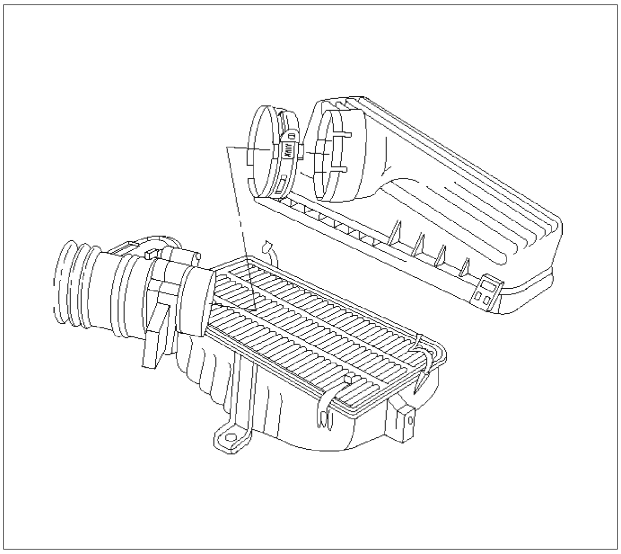
TS23748

4. Check the transfer case oil level. Add fluid if necessary.
5. Connect the negative battery cable.

Air Cleaner/Air Filter

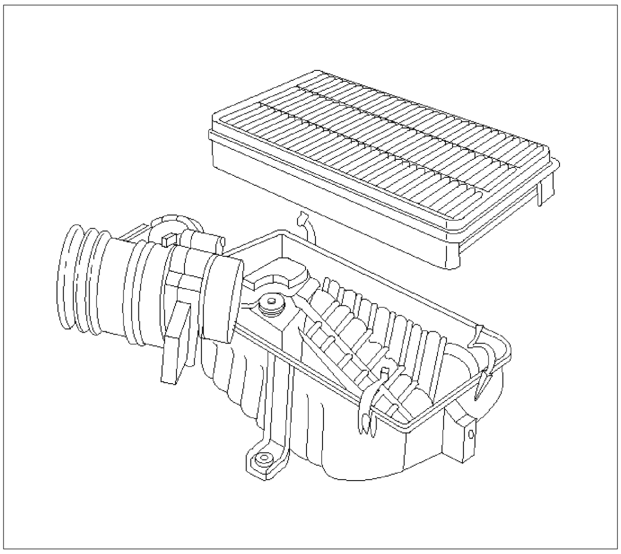
Removal Procedure

1. Loosen the clamp between the air cleaner lid and the mass air flow sensor.
2. Release the four latches securing the lid to the air cleaner housing.
3. Remove the air cleaner lid.



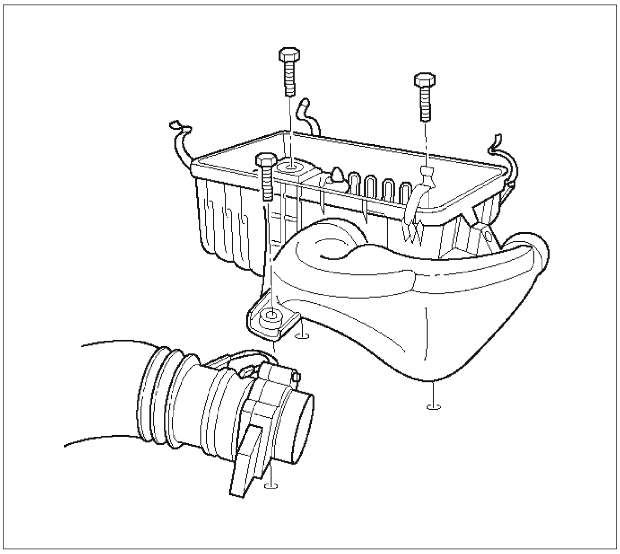
TS23973

4. Remove the air filter element.



TS23794

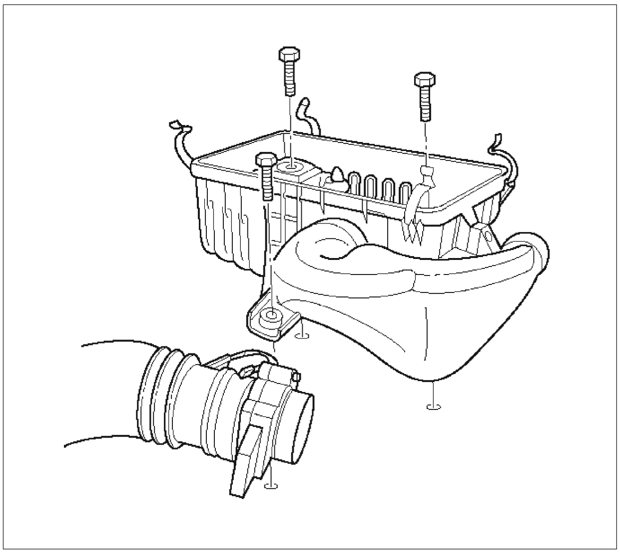
5. Remove the retaining bolts and the air cleaner housing from the vehicle.



130RT002

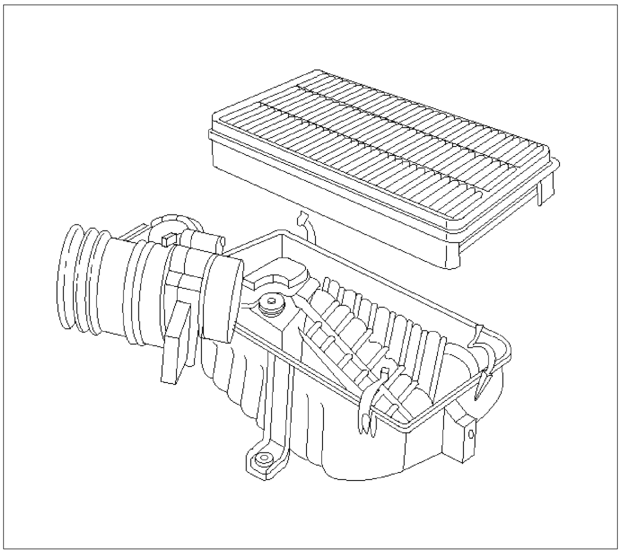
Installation Procedure

1. Install the air cleaner housing in the vehicle with the retaining bolts.



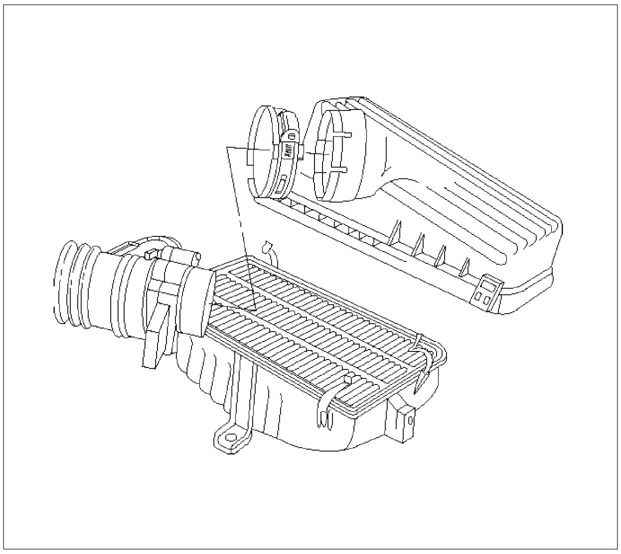
130RT002

2. Install the air filter element in the air cleaner housing.



TS23794

3. Install the air cleaner lid on the MAF sensor and the air cleaner housing.



TS23973

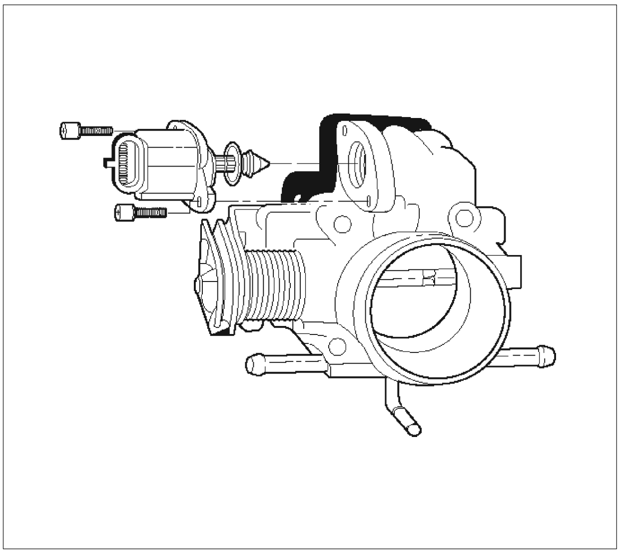
4. Tighten the clamp and secure the four latches between the lid and the air cleaner housing.

Idle Air Control (IAC) Valve

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the IAC electrical connector.
3. Remove the bolts and the IAC valve from the throttle body.

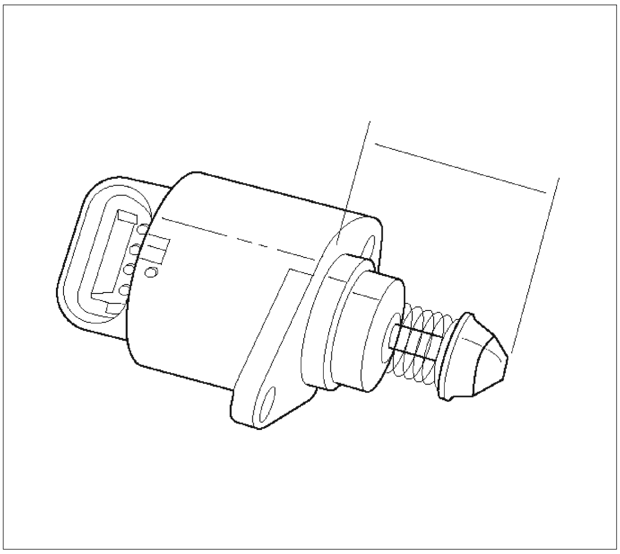
NOTE: Do not clean the IAC valve by soaking it in solvent. The valve will be damaged as a result.



TS23745

Cleaning, Inspection, and Measurement Procedure

- Clean the IAC valve O-ring sealing surface, pintle valve seat and air passage.
  – Use carburetor cleaner and a parts cleaning brush to remove carbon deposits. Do not use a cleaner that contains methyl ethyl ketone. This is an extremely strong solvent and not necessary for this type of deposit.
  – Shiny spots on the pintle are normal and do not indicate misalignment or a bent pintle shaft.
  – If the air passage has heavy deposits, remove the throttle body for complete cleaning.



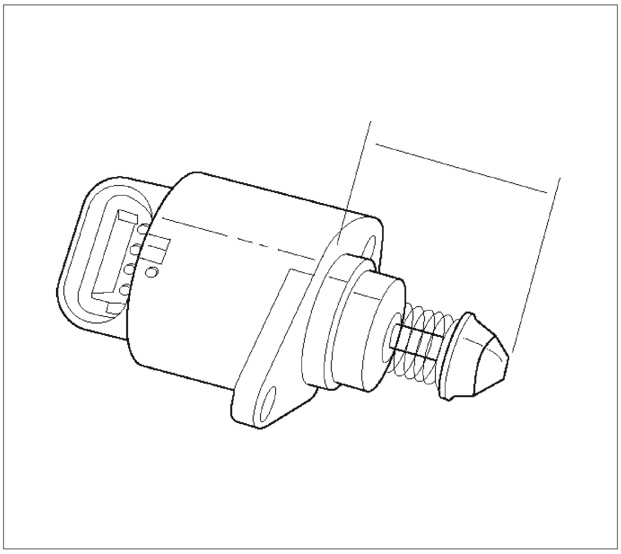
TS23746

- Inspect the IAC valve O-ring for cuts, cracks, or distortion. Replace the O-ring if damaged.

- In order to install a new IAC valve, measure the distance between the tip of the pintle and the mounting flange. If that measurement is 28 mm (1.1 in.) or less, the valve needs no adjustment. If the measurement is greater than 28 mm (1.1 in.), 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.

NOTE: Do not push or pull on the IAC valve pintle on IAC valves that have been in service. The force required to move the pintle may damage it.

IMPORTANT: Use an identical replacement part in order to replace a valve. IAC valve pintle shape and diameter are designed for the specific application.



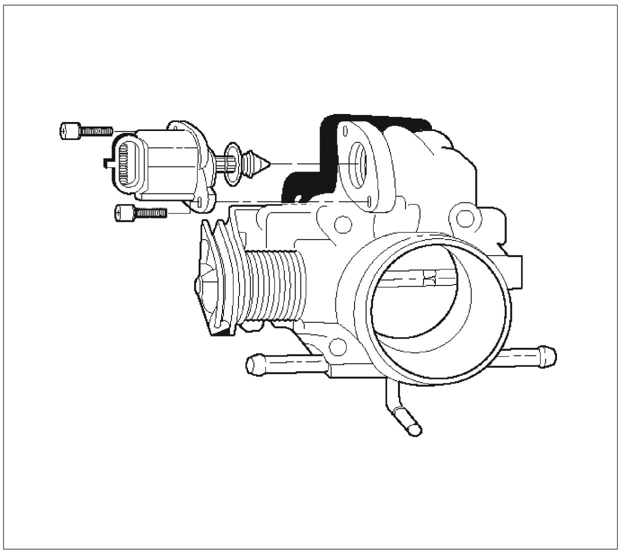
TS23746

Installation Procedure

1. Install the IAC valve on the throttle body with the bolts.

Tighten

- Tighten the bolts to 1 N·m (9 lb in.).



TS23745

2. Connect the IAC valve electrical connector.
3. Install the negative battery cable.

Common Chamber

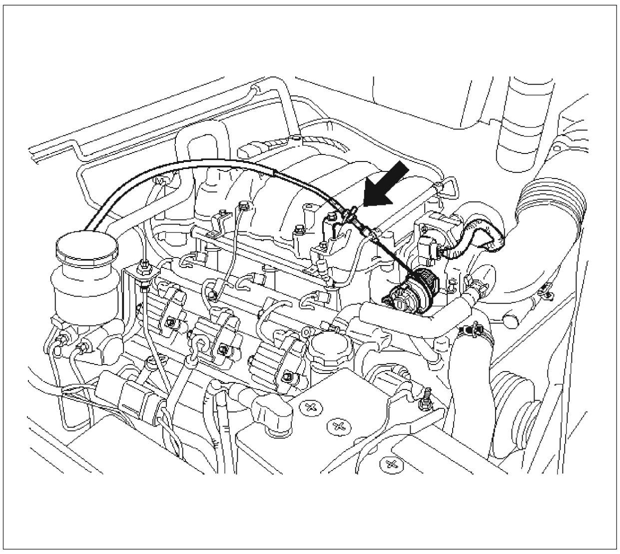
Removal and Installation Procedure

Refer to Common Chamber in Engine Mechanical.

Accelerator Cable Assembly

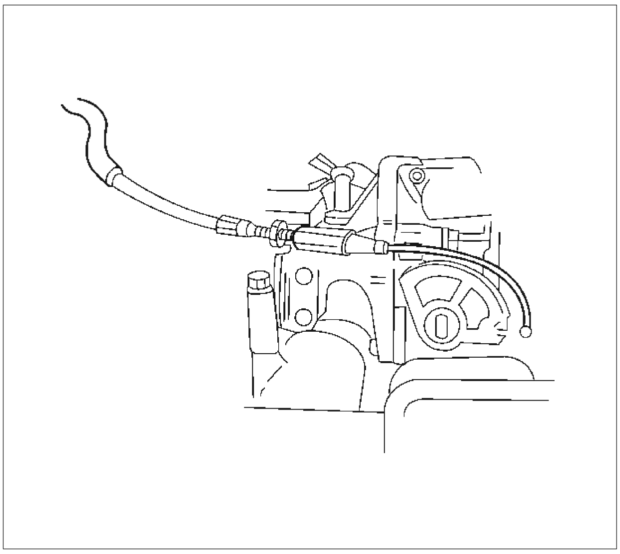
Removal Procedure

1. Remove the engine cover.
2. Loosen the adjusting nut on the cable bracket mounting on the common chamber.



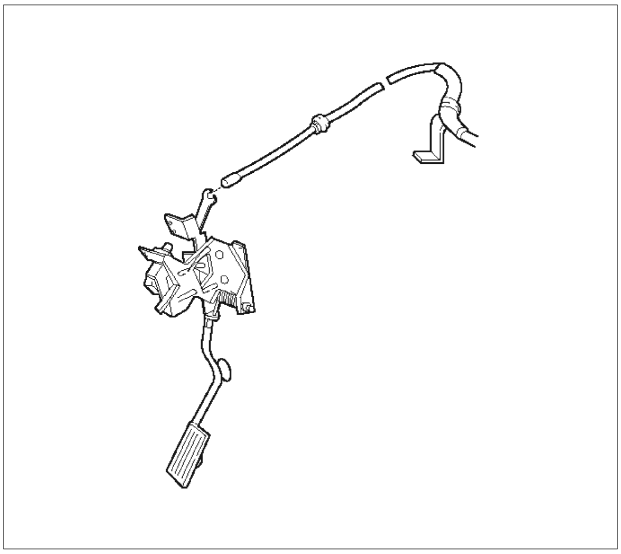
101RW005

3. Remove the accelerator control cable (on the throttle valve end).



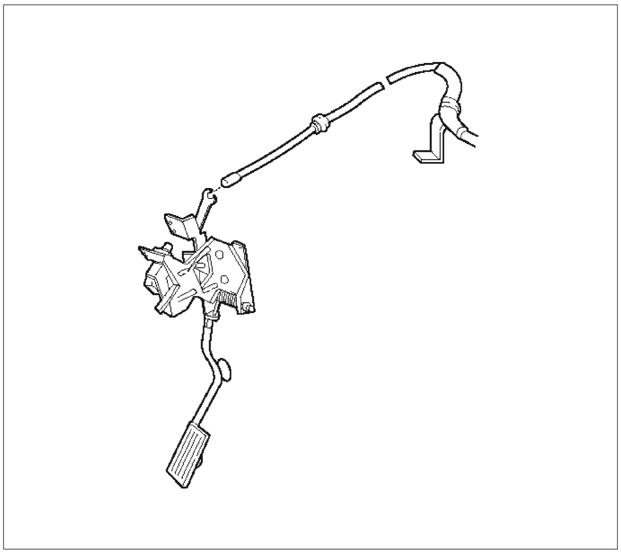
101RW006

4. Remove the accelerator control cable (on the accelerator pedal end).



TS23982

5. Remove the grommet.
6. Remove the accelerator control cable.



TS23983

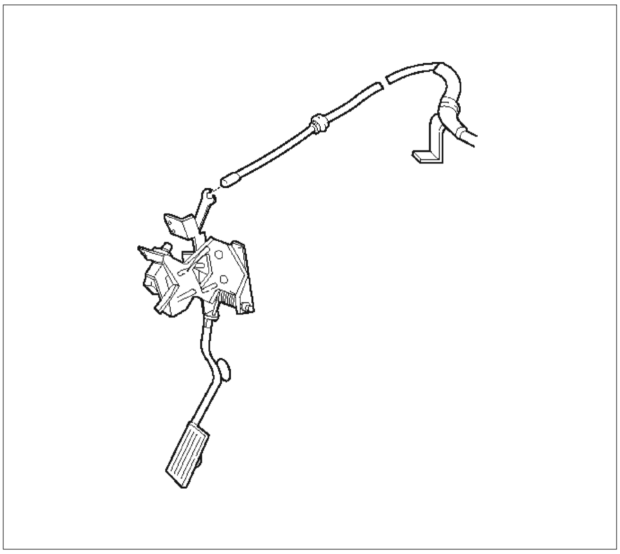
Inspection Procedure

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 be free of damage and corrosion.

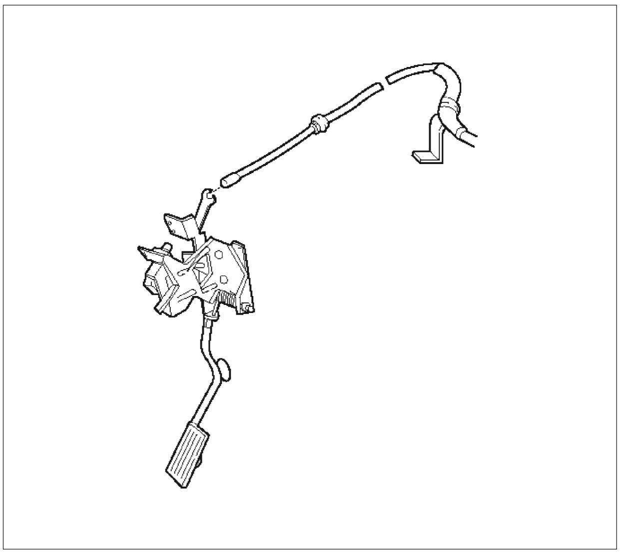
Installation Procedure

1. Install the accelerator control cable.



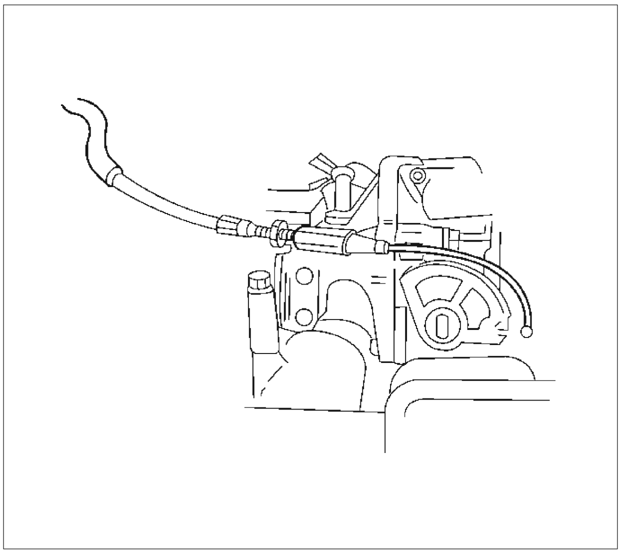
TS23983

2. Install the grommet.
3. Install the accelerator control cable (on the accelerator pedal end).



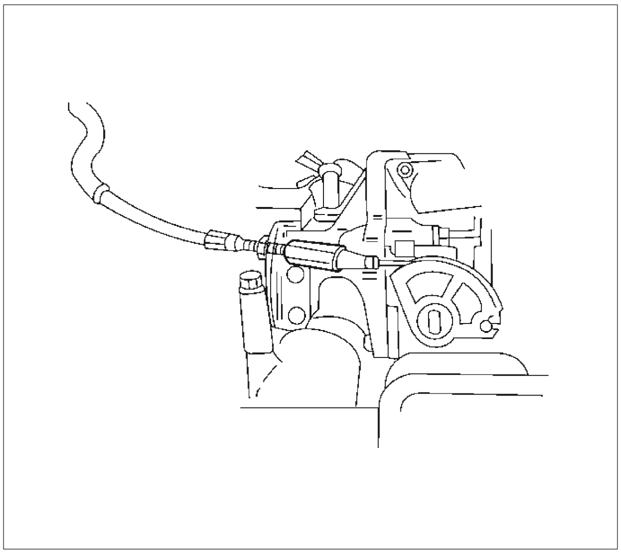
TS23982

4. Install the accelerator control cable (on the throttle valve end).



101RW006

5. Install the adjusting nut.

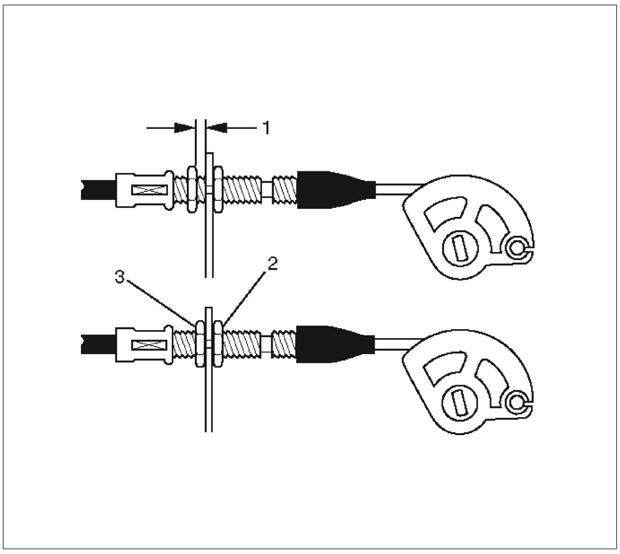


101RW007

6. Adjust the accelerator cable at the throttle body. Refer to *Accelerator Cable Adjustment*.
7. Install the engine cover.

Adjustment Procedure

1. Loosen the adjusting nut and lock nut.
2. Pull outer cable closing fully the throttle valve.
3. Tighten adjusting nut and lock nut temporarily.

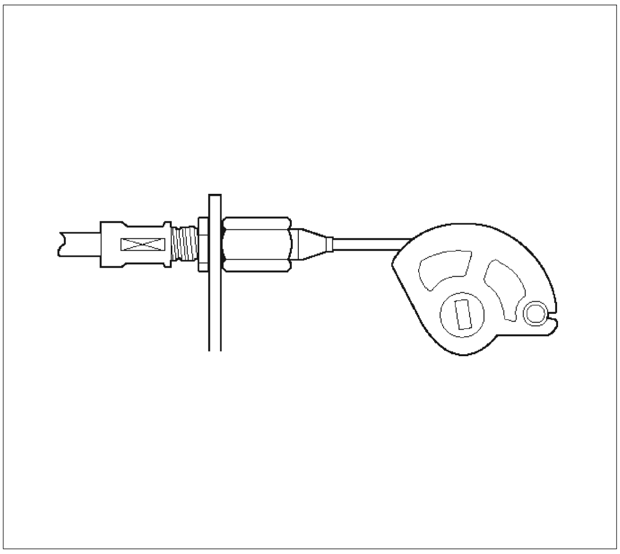


035RW004

4. Loosen adjusting nut by three turns and tighten lock nut. Then, manually operating the throttle valve, make sure that the valve lever returns up to the stopper screw.

IMPORTANT: The valve lever must return up to the stopper screw. If the valve lever does not reach the stopper screw, repeat the procedure again from step 1.

5. It does not reach the stopper screw, repeat from step 1.

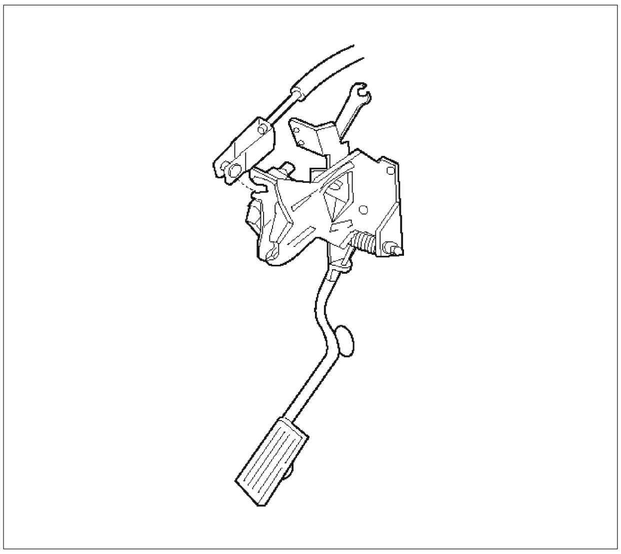


TS23782

Accelerator Pedal Replacement

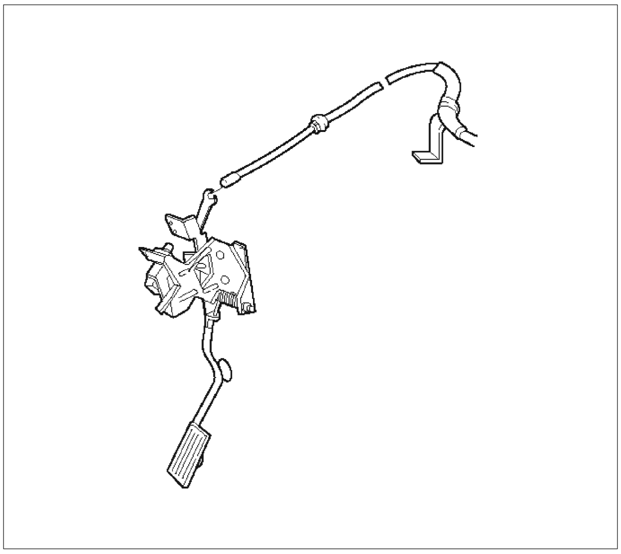
Removal Procedure

1. Disconnect the cruise control cable from the accelerator pedal assembly.



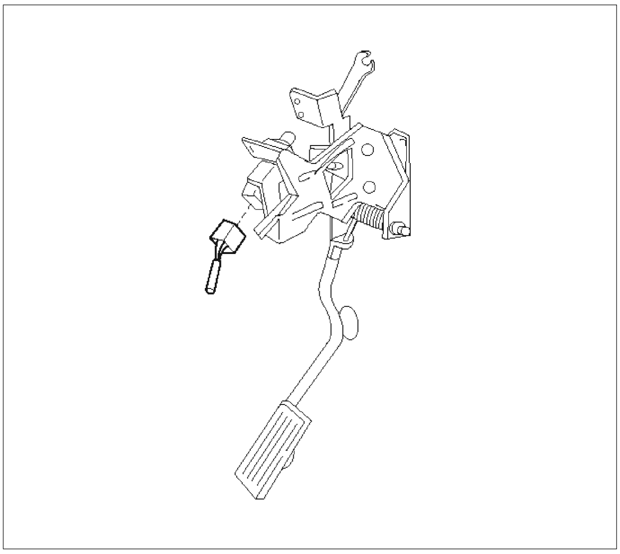
TS24053

2. Disconnect the accelerator pedal control cable from the accelerator pedal assembly.



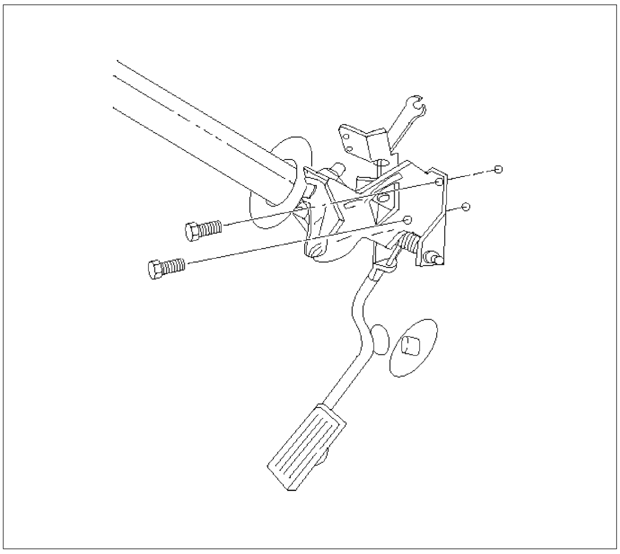
TS24054

3. Disconnect the wiring harness from the kick-down switch.



TS24038

4. Remove the two screws from the accelerator pedal assembly.

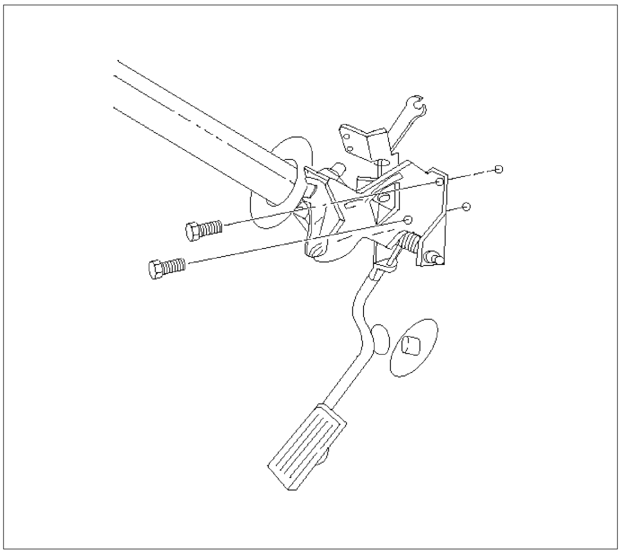


TS24055

5. Remove the accelerator pedal assembly from the bulkhead.

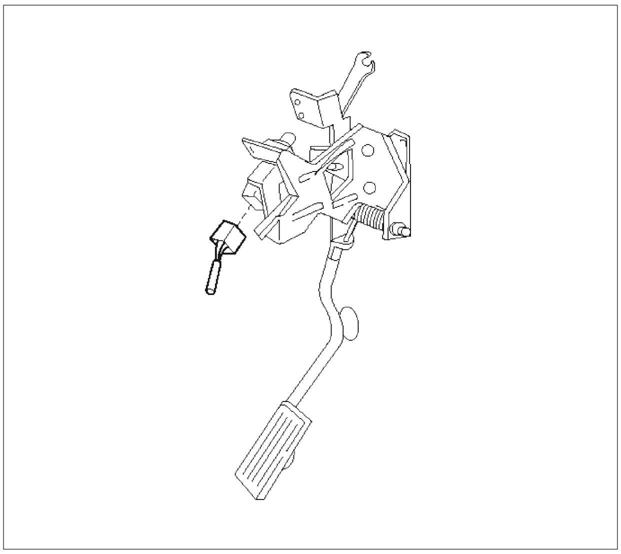
Installation Procedure

1. Install the accelerator pedal assembly on the bulkhead.
2. Install the two screws to the accelerator pedal assembly.



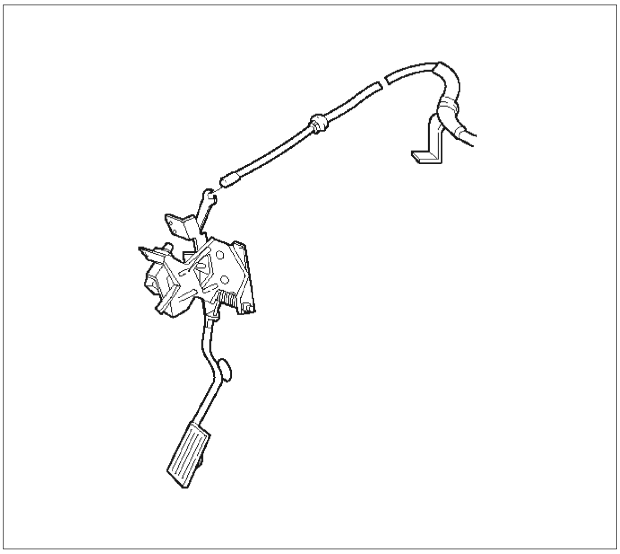
TS24055

3. Connect the wiring harness to the kick-down switch.



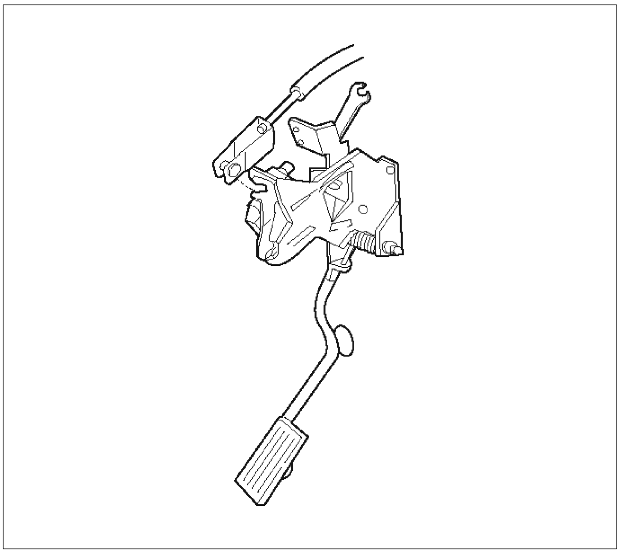
TS24038

4. Connect the accelerator pedal control cable to the accelerator pedal assembly.



TS24054

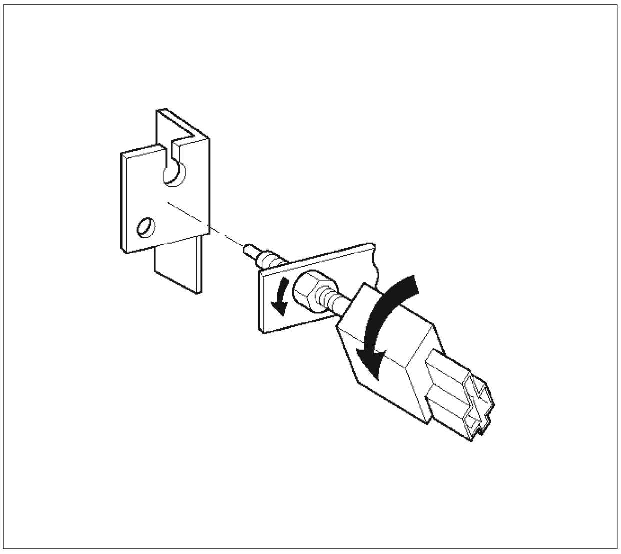
5. Connect the cruise control cable to the accelerator pedal assembly.



TS24053

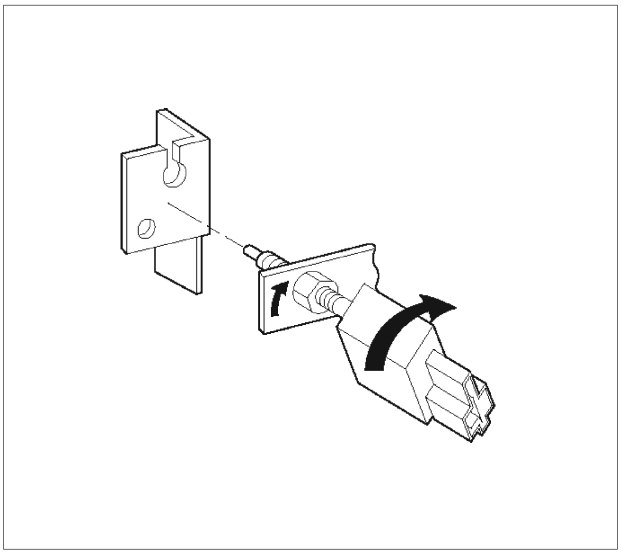
Pedal Stroke Adjustment Procedure

1. Loosen the jam nut and rotate the kick-down switch counterclockwise.



TS24039

2. Fully depress the pedal and hold it by hand. Rotate the switch clockwise until the switch clicks.
3. Rotate the switch 1/2 turn further and lock it in this position by tightening the jam nut.



TS24040

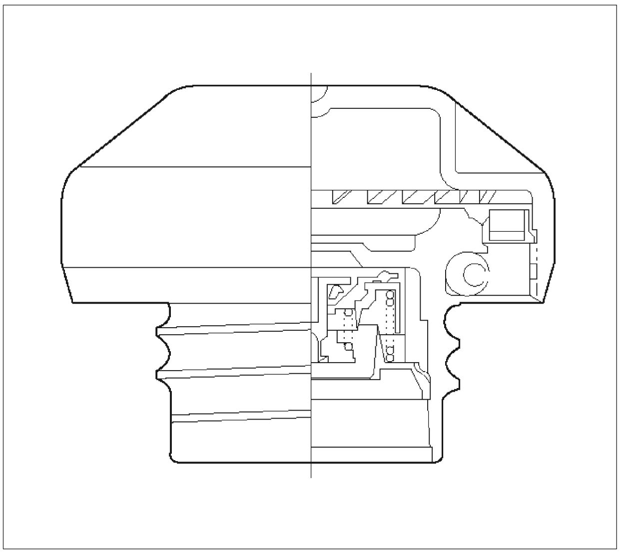
4. Step on the accelerator pedal and make sure there is a clicking sound at the full-stroke position.

Fuel Filter Cap

General Description

The fuel filler cap includes a vacuum valve and a pressure valve.

If high vacuum or high pressure occurs in the fuel tank, each valve works to adjust the pressure in order to prevent damage to the tank at the EGR valve.



TS23767

Inspection Procedure

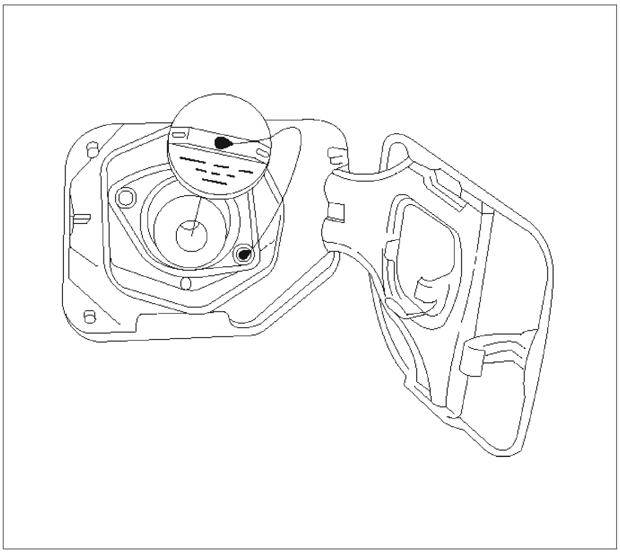
NOTE: Replace the fuel filler cap with the same type of filler cap that was originally installed on the vehicle.

- Check the seal ring in the filler cap for any abnormality and for seal condition.
- Replace the filler cap if any abnormality is found.

Fuel Filter

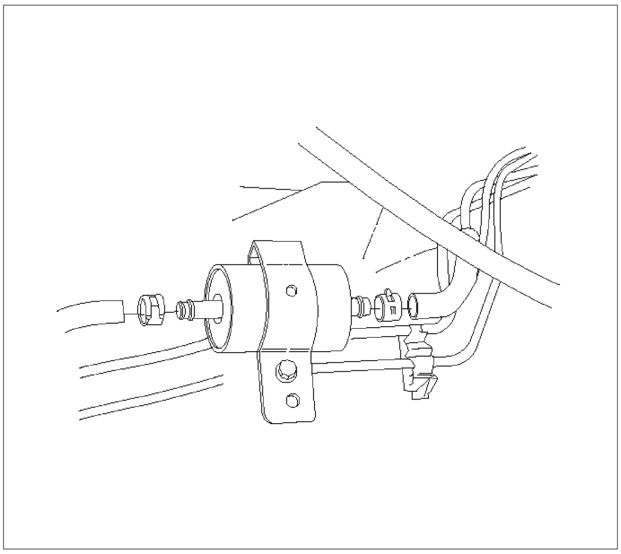
Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the fuel filler cap.



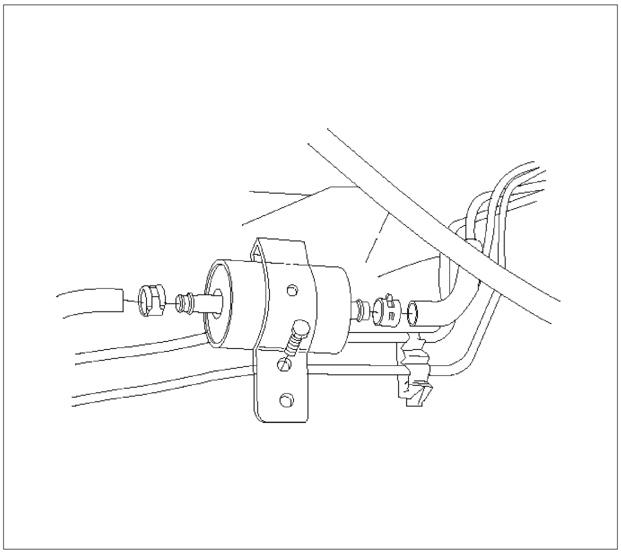
041RW005

3. Disconnect the fuel line from the fuel filter on the engine side.
4. Disconnect the fuel line from the fuel filter on the fuel tank side.



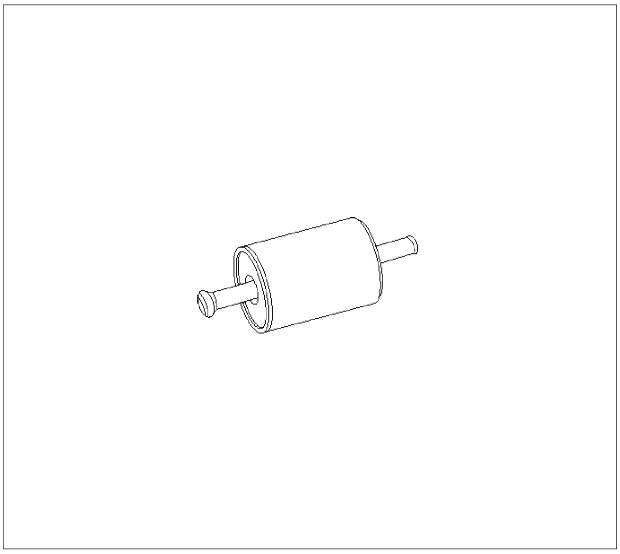
041RW006

5. Remove the bolt on the fuel filter holder.



041RW007

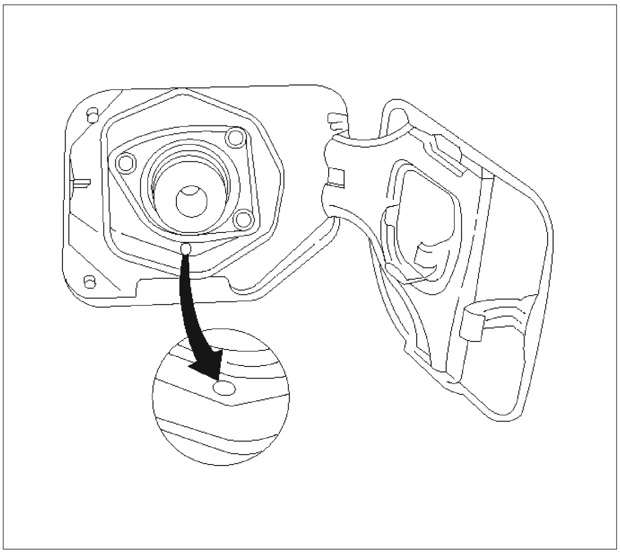
6. Remove the fuel filter.



041RW008

Inspection Procedure

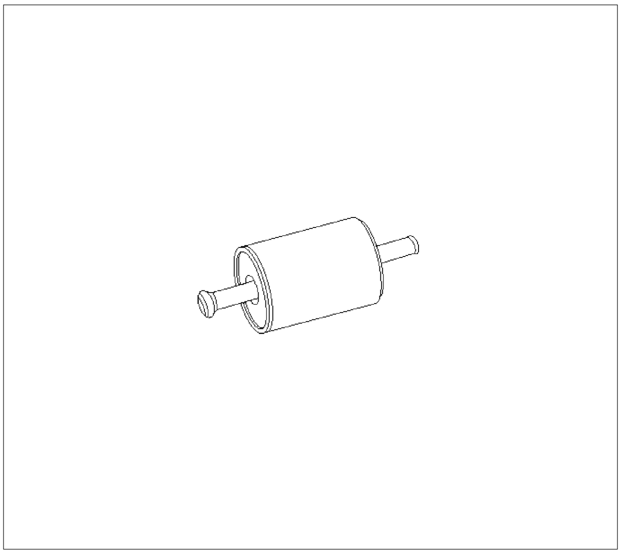
1. Replace the fuel filter when the following occur:
   - Fuel leaks from the fuel filter body.
   - The fuel filter body is damaged.
   - The fuel filter is clogged with dirt or sediment.
2. If the drain hole is clogged, clean the drain.



041RW009

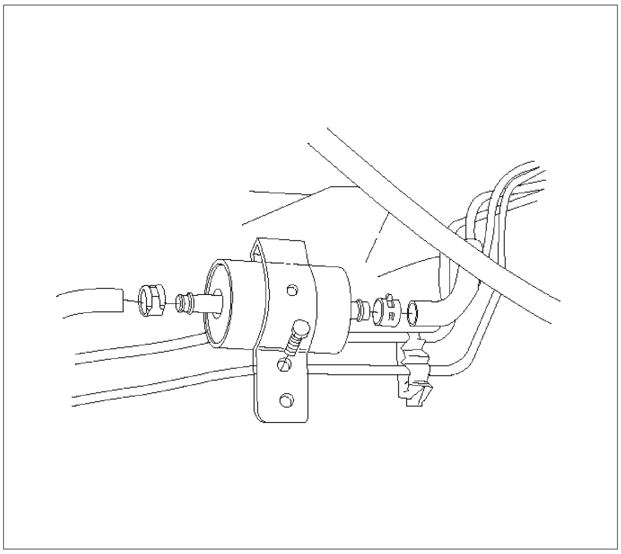
Installation Procedure

1. Install the fuel filter in the correct direction.



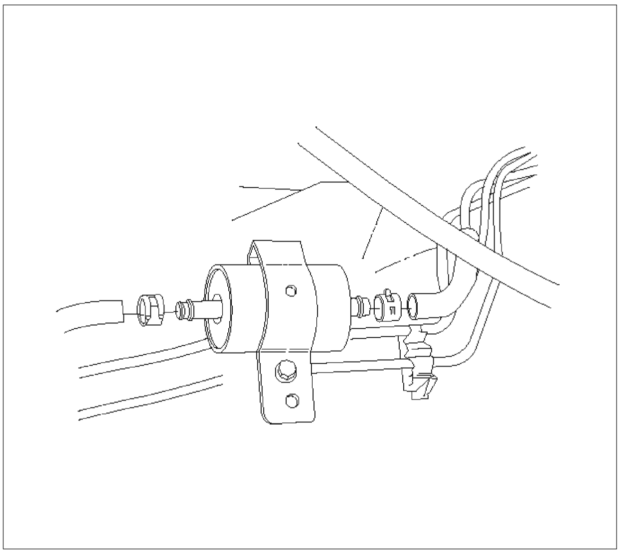
041RW008

2. Install the bolt on the fuel filter holder.



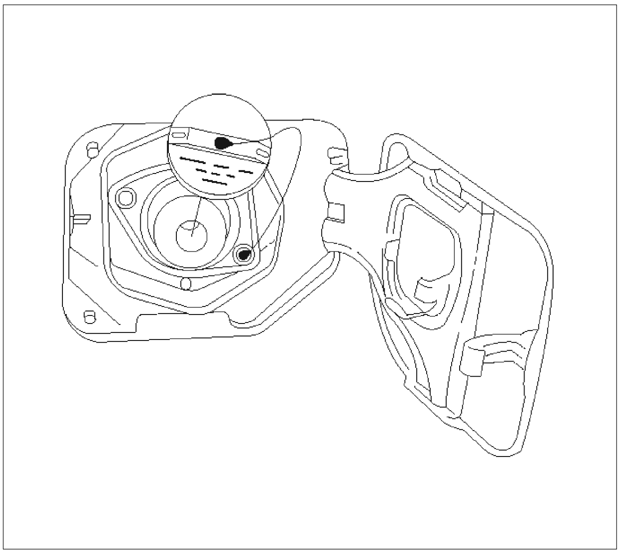
041RW007

3. Connect the fuel line on the engine side.
4. Connect the fuel line on the fuel tank side.



041RW006

5. Install the fuel filler cap.



041RW005

6. Connect the negative battery cable.

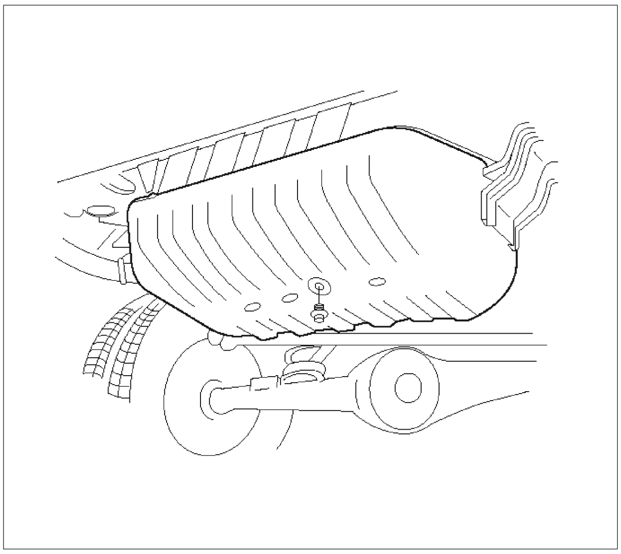
Fuel Gauge Unit

Removal Procedure

1. Disconnect the negative battery cable.
2. Loosen the fuel filler cap.
3. Drain the fuel from the tank.

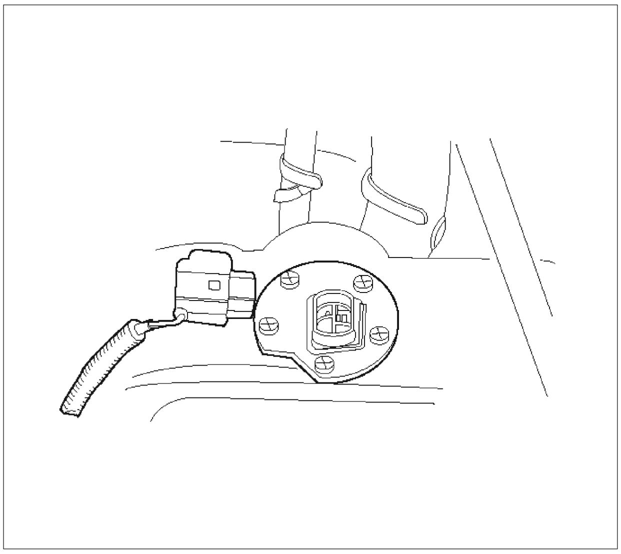
Tighten

- Tighten the drain plug to 20 N·m (14 lb ft.).



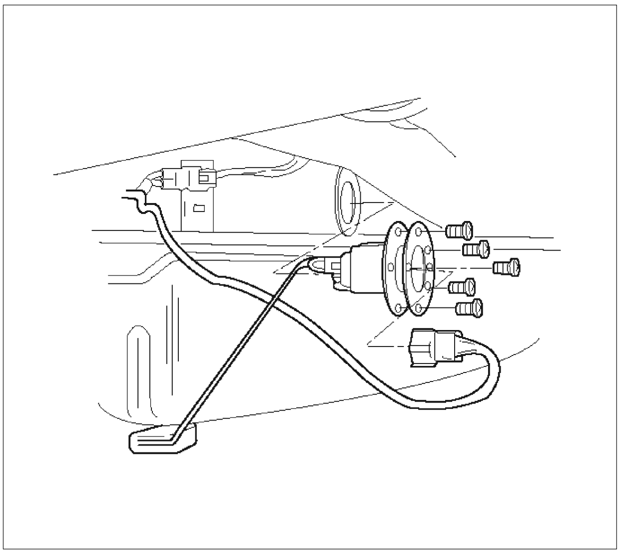
TS22907

4. Disconnect the wiring connector from the fuel gauge unit.



TS23771

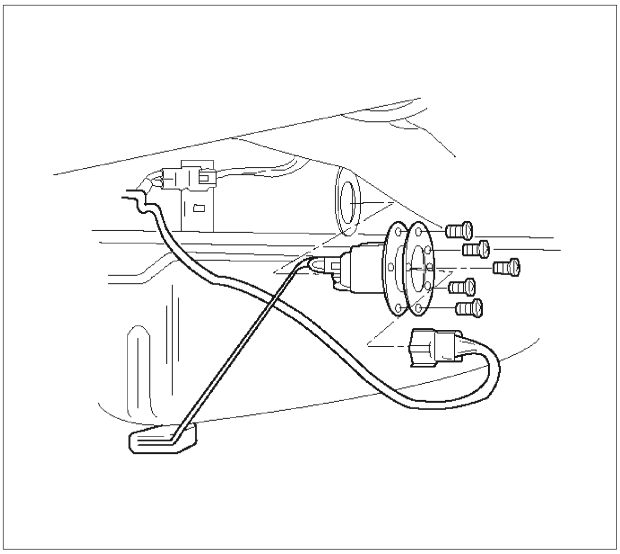
5. Remove the fuel gauge unit retaining screws.
6. Remove the fuel gauge unit.
   - Cover or plug the fuel tank to prevent dust, dirt, or debris from entering the tank.



TS22911

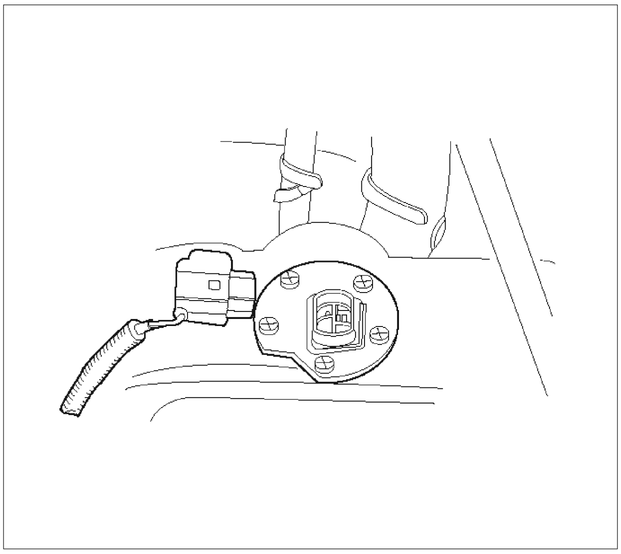
Installation Procedure

1. Install the fuel gauge unit.
2. Install the fuel gauge unit retaining screws.



TS22911

3. Connect the wiring connector to the fuel gauge unit.



TS23771

4. Fill the fuel tank with fuel.
   - Tighten the fuel filler cap.
   - Check for leaks at the fuel gauge unit gasket.
5. Connect the negative battery cable.

Fuel Injectors

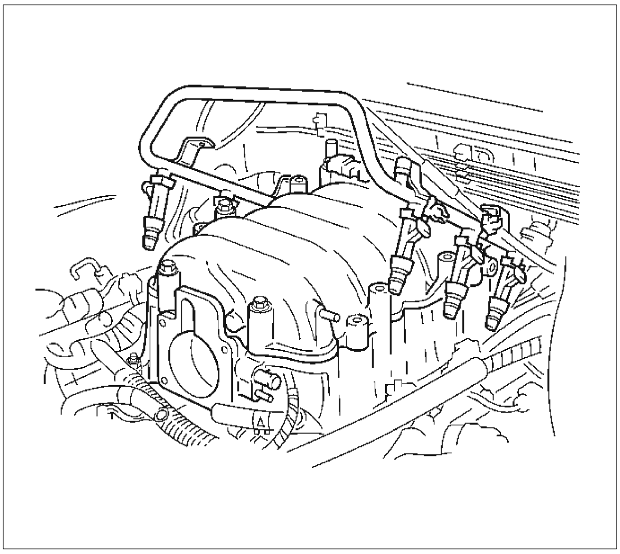
Removal Procedure

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.

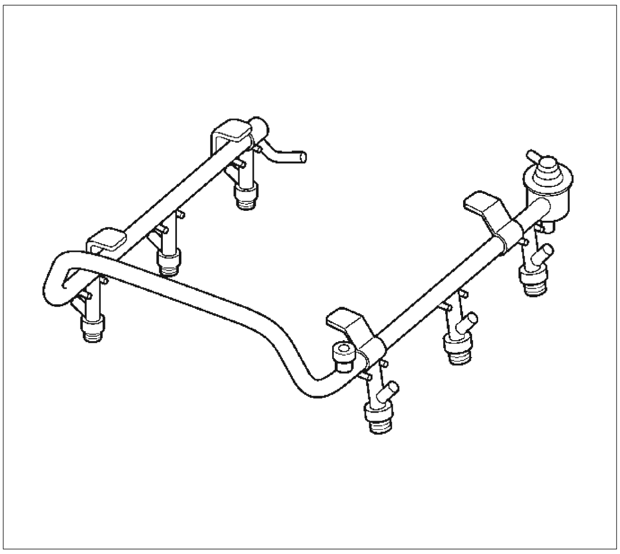
IMPORTANT: Fuel injectors are serviced as a complete assembly only.

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*.



014RW164

4. Remove the injector retainer clip.



055RW009

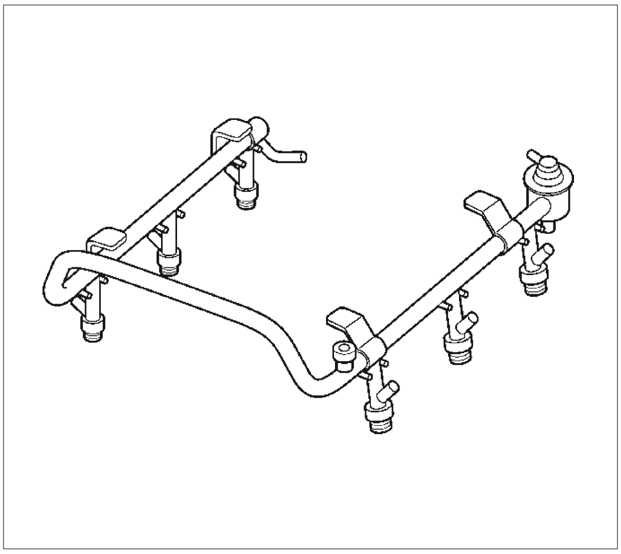
5. Remove the fuel injector assembly.
6. Remove the O-ring from the fuel injector.
7. Remove the O-ring backup from the fuel injector .

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.

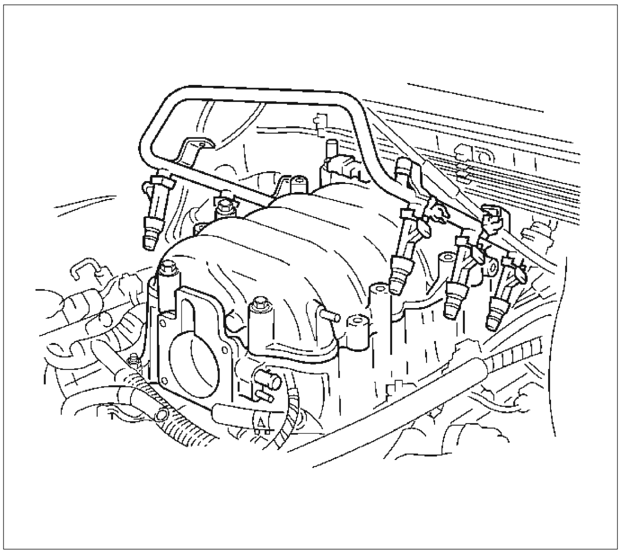
Installation Procedure

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.



055RW009

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*.



014RW164

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

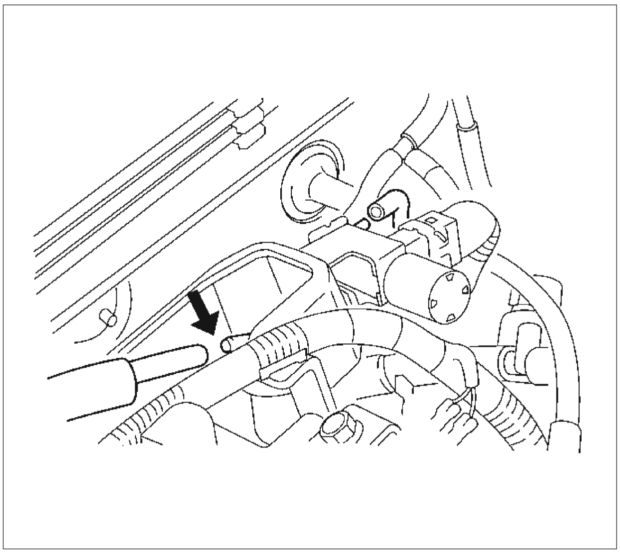
CAUTION: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing the fuel system components.

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.

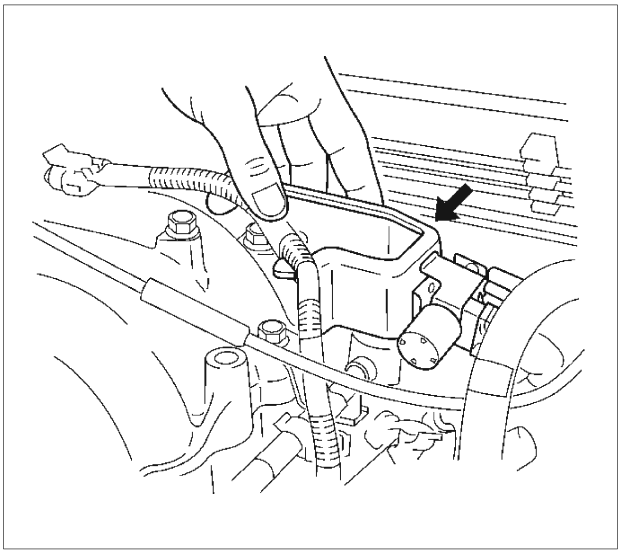
NOTE: To prevent damage to the fuel pressure regulator, do not immerse the pressure regulator in solvent.

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.



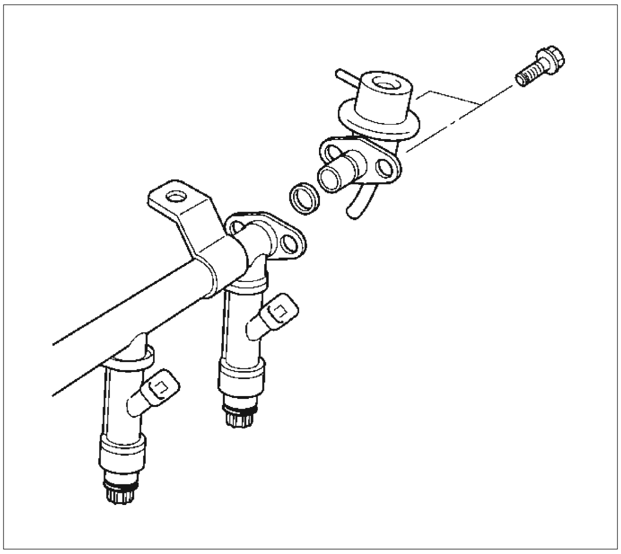
014RW110

5. Remove the two bolts from the protector that secures the common chamber.



014RW109

6. Remove the fuel pressure regulator attaching screw.

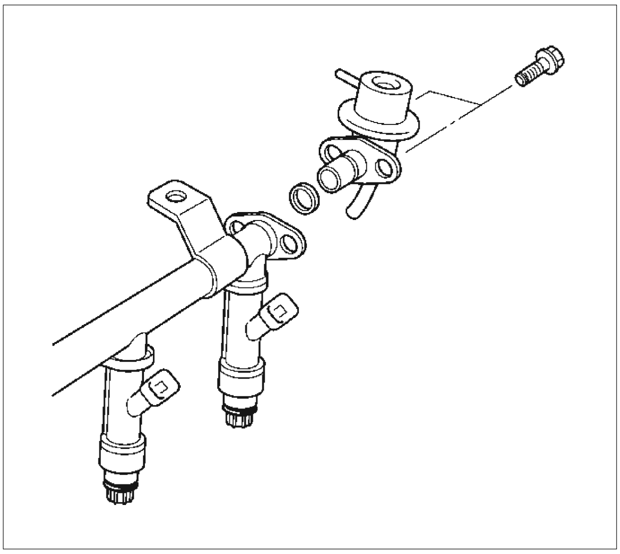


F06RW043

7. Remove the fuel pressure regulator from the fuel rail.

Disassembly Procedure

1. Remove the O-ring from the fuel pressure regulator.
2. Loosen the swivel nut.
3. Remove the fuel return line from the fuel pressure regulator.
4. 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.



F06RW043

Assembly Procedure

1. Install a new O-ring on the fuel return line.
2. Install the fuel return line on the fuel pressure regulator.

NOTE: 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.

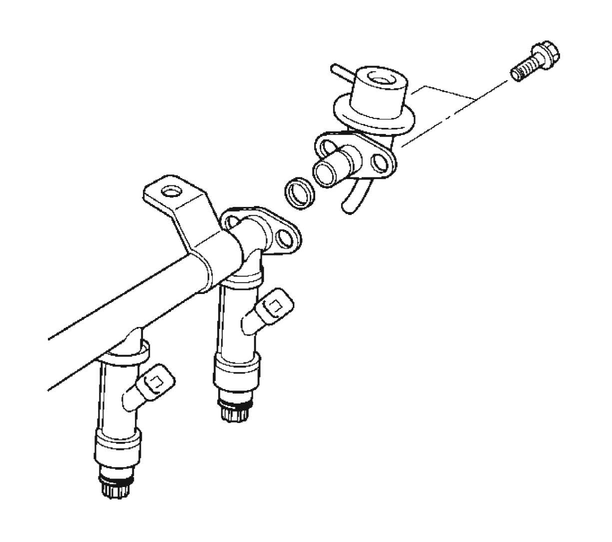
3. Tighten the swivel nut.
4. Install a new O-ring on the fuel pressure regulator.

Installation Procedure

1. Install the fuel pressure regulator attaching screw.

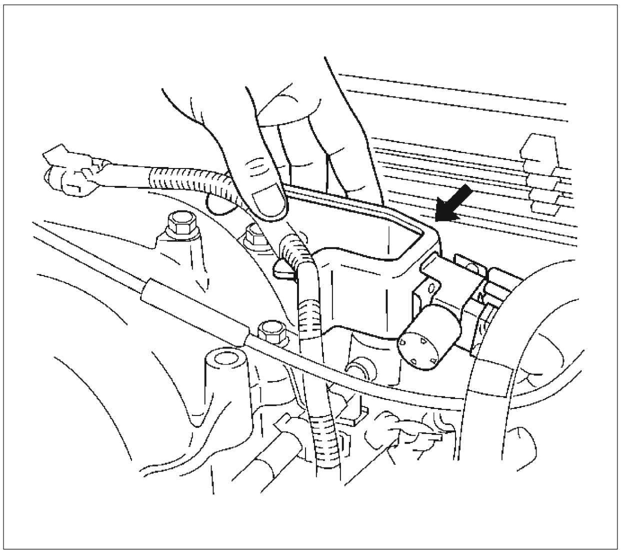
Tighten

- Tighten the fuel pressure regulator attaching screw to 3 N·m (26 lb in.).



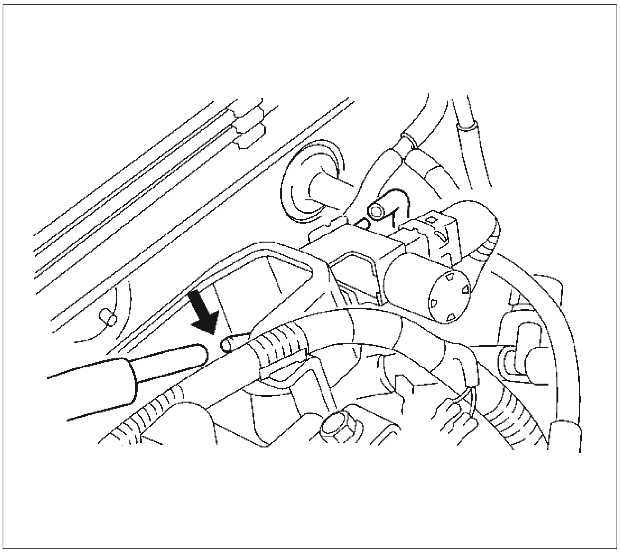
F06RW043

2. Install the fuel pressure regulator on the fuel rail.
3. Install the two bolts to the protector that secures the common chamber.



014RW109

4. Install the pressure regulator hose to the fuel pressure regulator.



014RW110

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.

Fuel Metering System

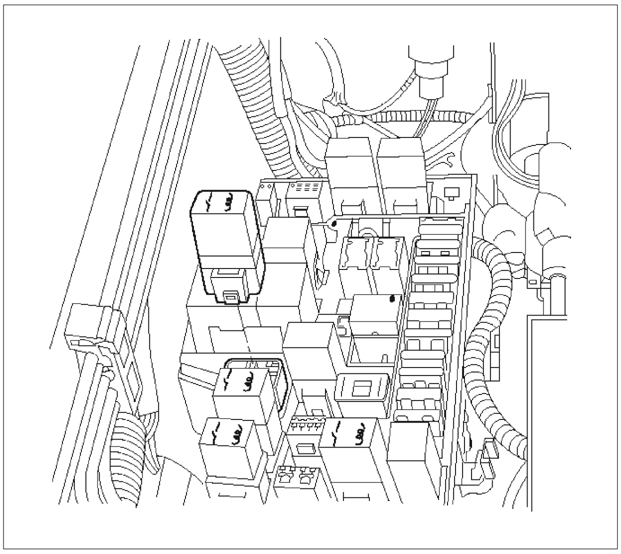
Fuel Pressure Relief Procedure

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 you disconnect the fittings. The towels will absorb any fuel that may leak out. When the disconnect is completed, place the towel in an approved container.

1. Remove the fuel cap.

2. Remove the fuel pump relay from the underhood relay box. Refer to *Fuel Pump Relay*.



TS23976R

3. Start the engine and allow it to stall.
4. Crank the engine for 30 seconds.
5. Disconnect the negative battery cable.

Fuel Pump Assembly

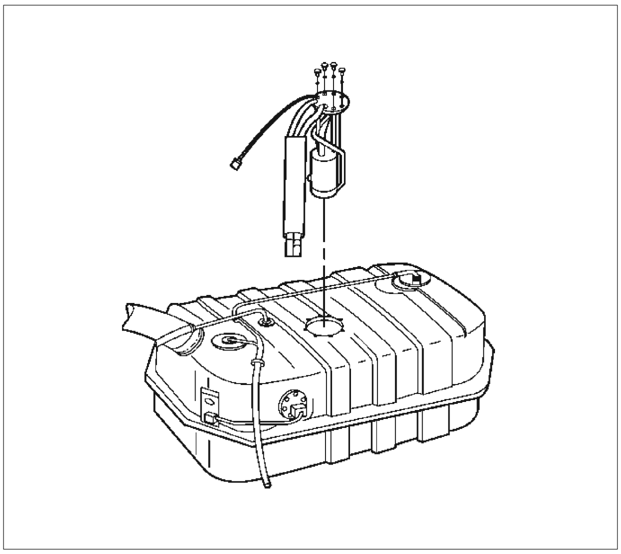
Removal Procedure

1. Disconnect the negative battery cable.
2. Drain all the fuel from the tank.
3. Install and tighten the drain plug.

Tighten

- Tighten the drain plug to 20 N·m (14 lb ft.).

4. Remove the fuel tank. Refer to *Fuel Tank*.
5. Remove the retaining screws from the fuel tank.
6. Remove the fuel pump assembly from the fuel tank.
   - Cover the fuel pump opening in order to prevent dust, dirt, or debris from entering the fuel tank.



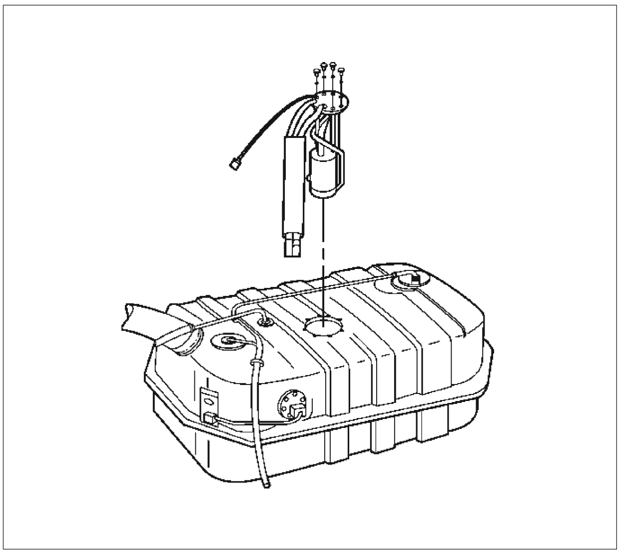
TS23795

Inspection Procedure

1. Inspect the fuel pump gasket for tears, cracks, stretching, or rotting. If any of these conditions are found, replace the fuel pump gasket.
2. Inspect the in-tank fuel filter for tears or evidence of dirt, debris, or water in the fuel. If any of these conditions are found, replace the in-tank fuel filter.

Installation Procedure

1. Install the fuel pump assembly.
2. Install the fuel pump assembly retaining screws.
3. Install the fuel tank assembly. Refer to *Fuel Tank*.
4. Fill the tank with fuel.
5. Tighten the fuel filler cap.
6. Connect the negative battery cable.

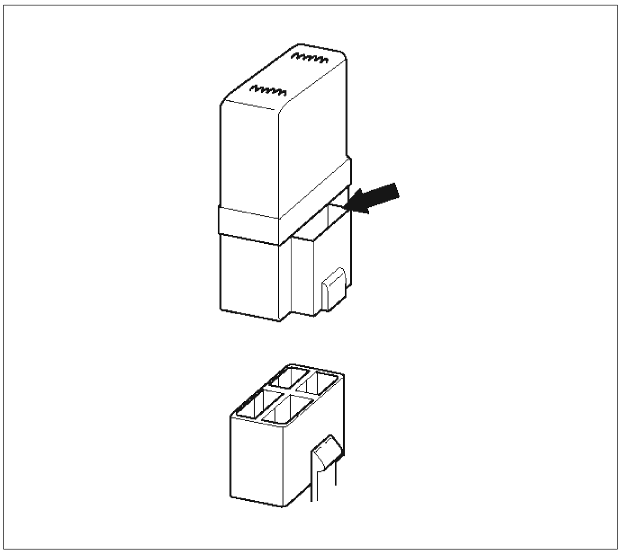


TS23795

Fuel Pump Relay

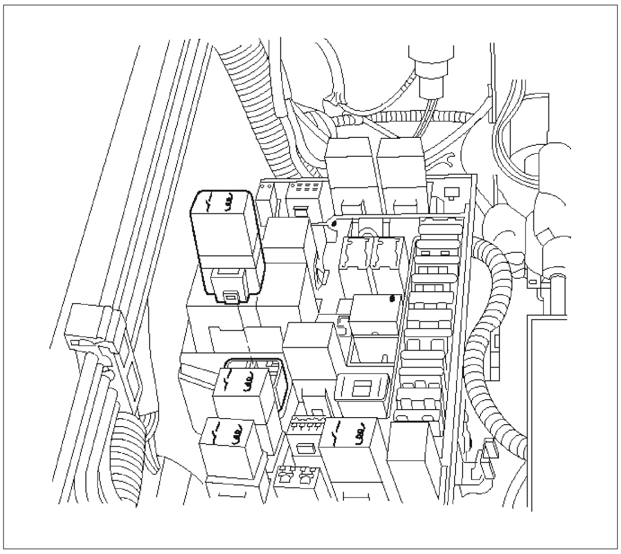
Removal Procedure

1. Remove the fuse and relay box cover from under the hood.
2. Consult the diagram on the cover to determine which is the correct relay.
3. Insert a small screwdriver into the catch slot on the forward side of the fuel pump relay.
   - The screwdriver blade will release the catch inside.



T321092

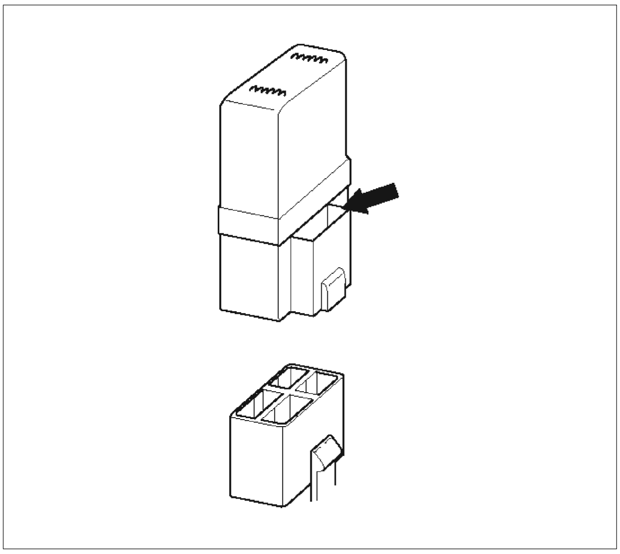
4. Pull the relay straight up and out of the fuse and relay box.



TS23976R

Installation Procedure

1. Insert the relay into the correct place in the fuse and relay box with the catch slot facing forward.
2. Press down until the catch engages.
   - An audible “click” will be heard.



T321092

3. Install the fuse and relay box cover.

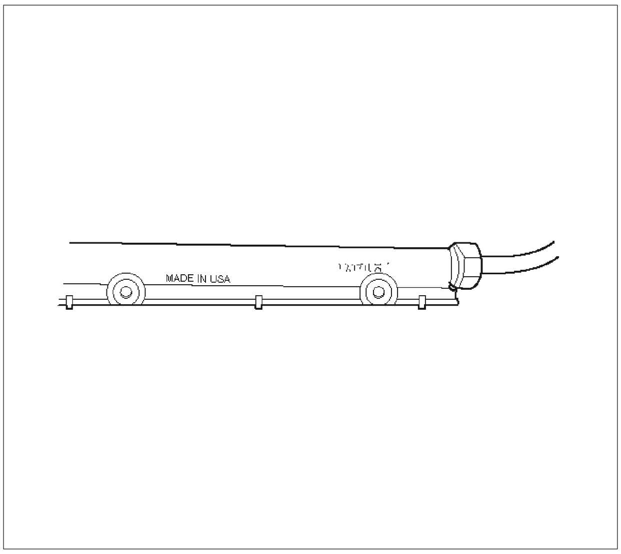
Fuel Rail Assembly

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.

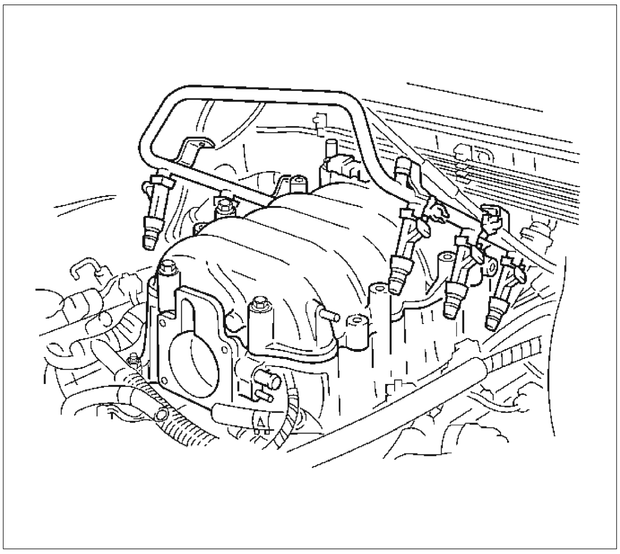
IMPORTANT: An eight-digit identification number is stamped on the side of the fuel rail. Refer to this number when you service the fuel rail or when a replacement part is required.



TS24022

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 manifold absolute pressure sensor, solenoid valve, electric vacuum sensing valve.
6. Disconnect the vacuum hose on canister VSV 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.

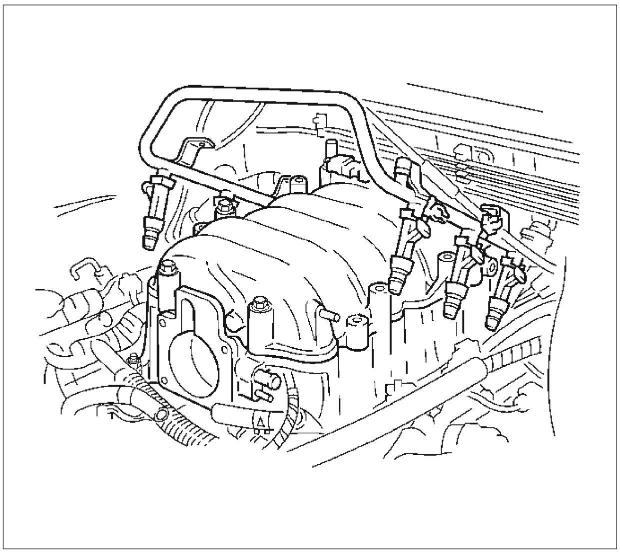


014RW164

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.



014RW164

4. Connect the vacuum hose on Canister VSV and positive crankcase ventilation hose.
5. Connect the connectors to manifold absolute pressure sensor, solenoid valve, electric vacuum sensing 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 Tank

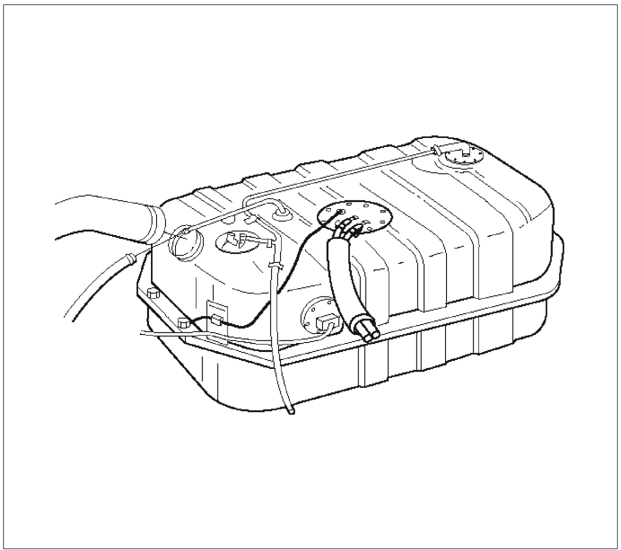
Removal Procedure

1. Disconnect the negative battery cable.
2. Loosen the fuel filler cap.
3. Drain the fuel from the tank into an approved container.
4. Install and tighten the drain plug.

Tighten

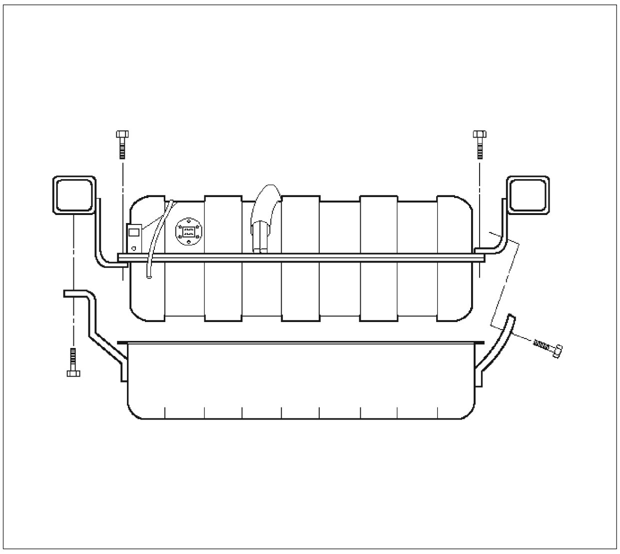
- Tighten the drain plug to 20 N·m (14 lb ft.).

5. Disconnect the fuel filler hose at the fuel tank.
6. Disconnect the air breather hose at the fuel tank.



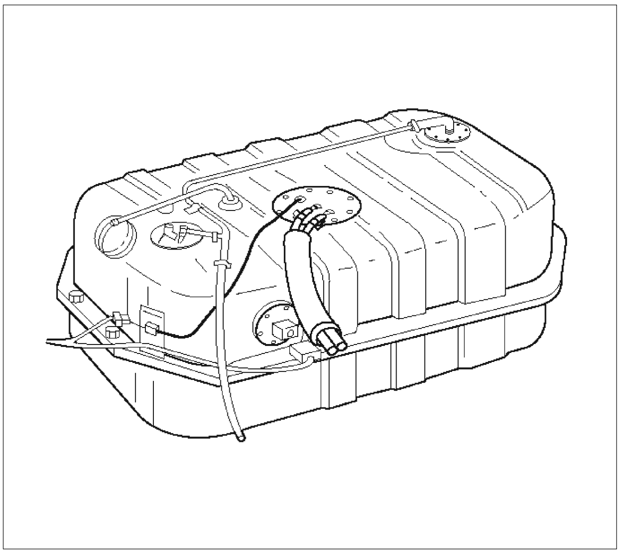
TS23796

7. Remove the undercover retaining bolts.
8. Remove the undercover.



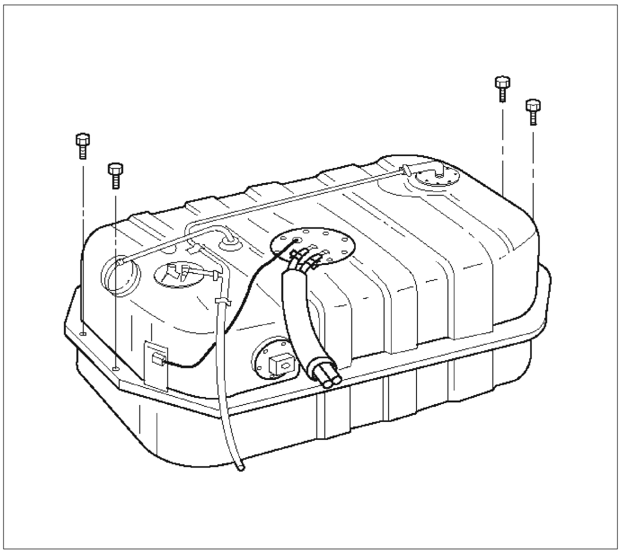
TS23797

9. Disconnect the wiring connector to the fuel pump.
10. Disconnect the wiring connector to the fuel gauge unit.
11. Remove the fuel gauge unit connector from the bracket.
12. Disconnect the EVAP vapor hose.
13. Disconnect the fuel supply hose.
14. Disconnect the fuel return hose.
    - Plug the hoses to prevent dust from entering the hoses.



TS23769

15. Remove the fuel tank retaining bolts on both sides.
16. Remove the fuel tank.



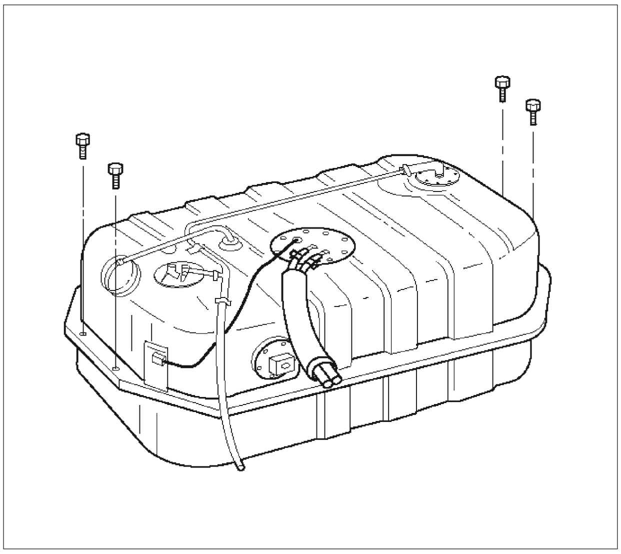
TS23770

Installation Procedure

1. Install the fuel tank.
   - Place the flanges on the left and right side of the tank on the bracket.
2. Install the fuel tank retaining bolts.

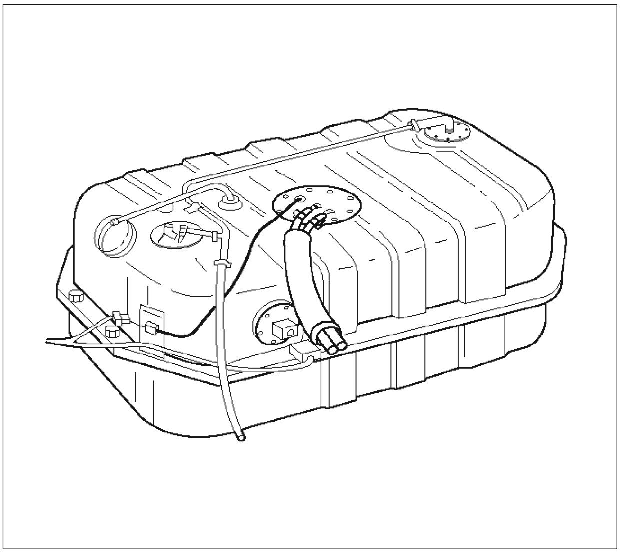
Tighten

- Tighten the fuel tank retaining bolts to 36 N·m (27 lb ft.).



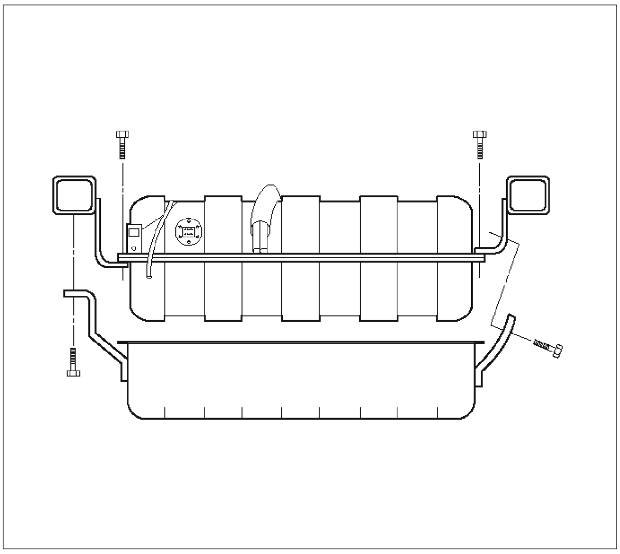
TS23770

3. Connect the fuel return hose.
4. Connect the fuel supply hose.
5. Connect the EVAP vapor hose.
6. Connect the wiring connector for the fuel gauge unit.
7. Connect the fuel gauge wiring connector to the bracket.
8. Connect the wiring connector for the fuel pump.



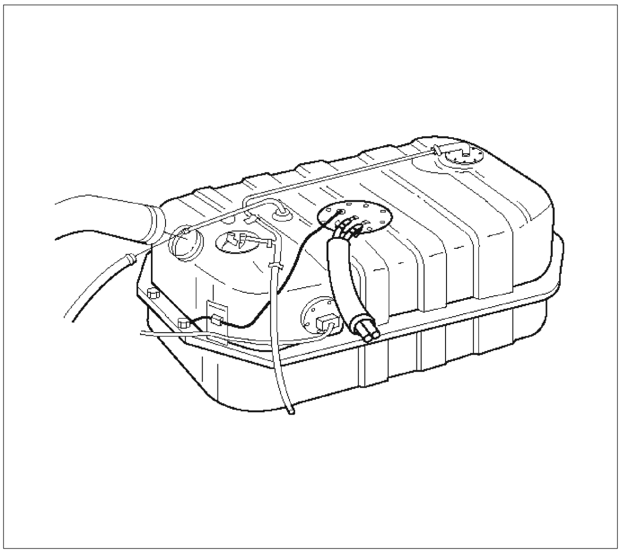
TS23769

9. Install the undercover.
10. Secure the undercover with the retaining bolts.



TS23797

11. Connect the fuel filler fuse at the tank.
12. Connect the air breather hose at the tank.



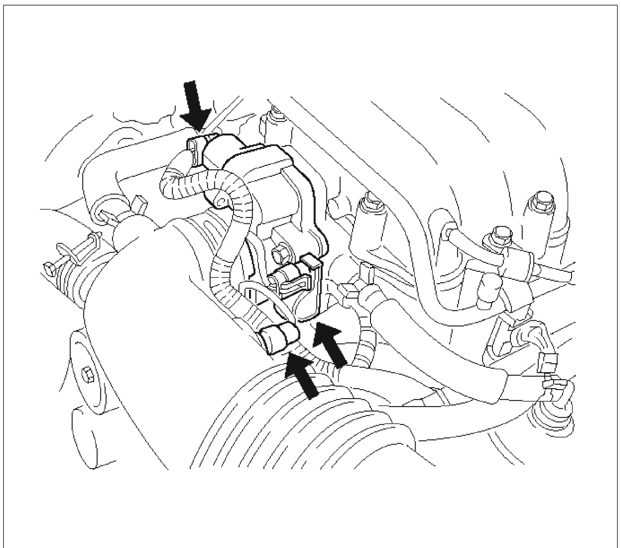
TS23796

13. Fill the fuel tank with fuel.
14. Tighten the fuel filler cap.
15. Connect the negative battery cable.

Throttle Body (TB)

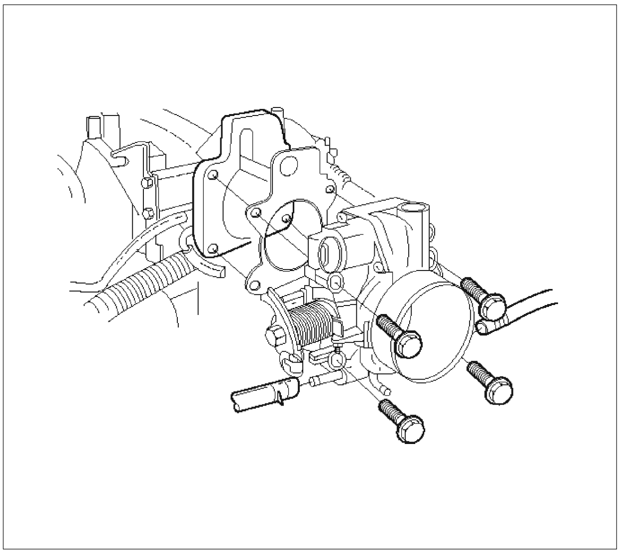
Removal Procedure

1. Disconnect the negative battery cable.
2. Drain the cooling system. Refer to *Cooling System*.
3. Remove the accelerator cable assembly. Refer to *Accelerator Cable in Engine Speed Control System.*.
4. Disconnect the electrical connectors:
   - Throttle position (TP) sensor.
   - Idle air control (IAC) solenoid.
   - Intake air temperature (IAT) sensor. Refer to *Intake Air Temperature Sensor*.



035RW023

5. Disconnect the vacuum hose below the air horn.
6. Remove the intake air duct clamp.
7. Disconnect the intake air duct.
8. Disconnect the coolant lines from the throttle body.
9. Remove the bolts from the common chamber.
10. Remove the throttle body from the common chamber.
11. Remove the gasket from the upper intake manifold.



035RW024

12. Remove the IAC. Refer to *Idle Air Control (IAC) Solenoid*.
13. Remove the TP sensor. Refer to *Throttle Position (TP) Sensor*.

Inspection Procedure

NOTE: Do not use solvent of any type when you clean the gasket surfaces on the intake manifold and the throttle body assembly. The gasket surfaces and the throttle body assembly may be damaged as a result.

- If the throttle body gasket needs to be replaced, remove any gasket material that may be stuck to the mating surfaces of the manifold.
- Do not leave any scratches in the aluminum casting.

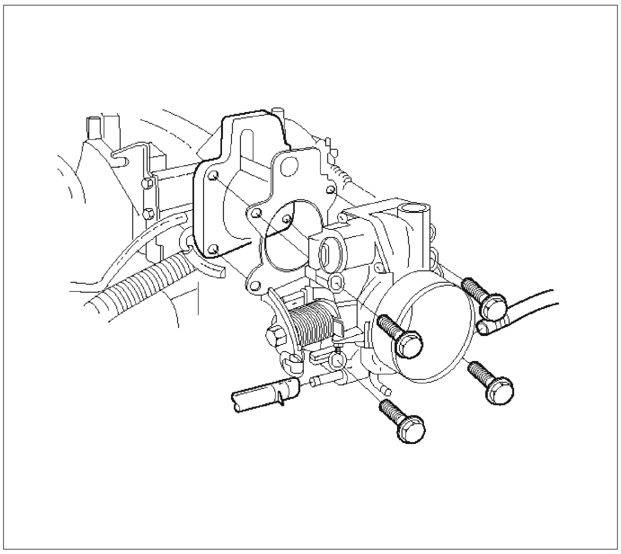
Installation Procedure

1. Install the TP sensor. Refer to *Throttle Position (TP) Sensor*.
2. Install the IAC. Refer to *Idle Air Control (IAC) Solenoid*.
3. Install the gasket on the common chamber.
4. Install the throttle body on the common chamber.

5. Secure the gasket and the throttle body with the four bolts.
   - The vacuum lines must be properly routed under the throttle body before tightening the mounting bolts.

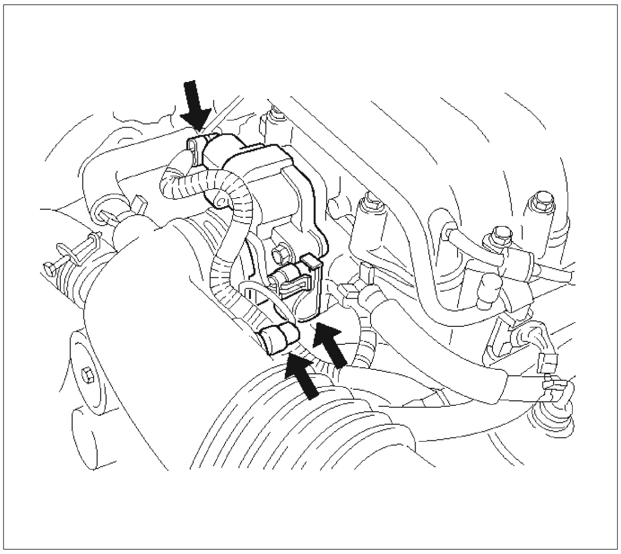
Tighten

- Tighten the throttle body mounting bolts to 24 N·m (17 lb ft.).



035RW024

6. Install the coolant lines.
7. Connect all the vacuum lines.
8. Install the intake air duct.
9. Tighten the intake air duct clamp.
10. Connect all the electrical connectors:
    - Throttle position (TP) sensor.
    - Idle air control (IAC) solenoid.
    - Intake air temperature (IAT) sensor. Refer to *Intake Air Temperature Sensor*.



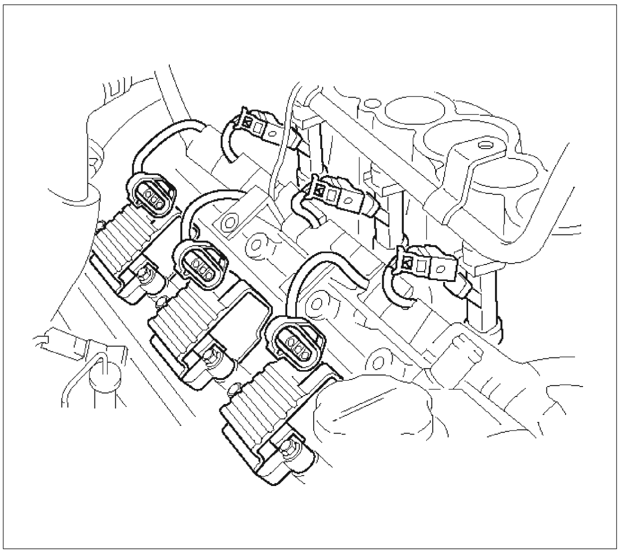
035RW023

11. Install the accelerator cable assembly. Refer to *Accelerator Cable in Engine Speed Control System.*.
12. Fill the cooling system. Refer to *Cooling System*.
13. Install the negative battery cable.

Electronic Ignition System

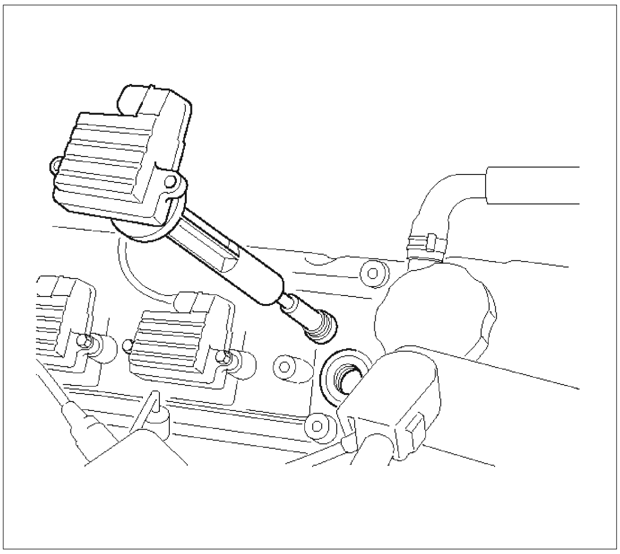
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector at the ignition coil.
3. Remove the two screws that secure the ignition coil to the rocker cover.



014RW108

4. Remove the ignition coil and the spark plug boot from the spark plug.
   - Twist the ignition coil while pulling it straight up.



014RW091

5. Use the spark plug socket in order to remove the spark plug from the engine.

Spark Plug Gap Check

- Check the gap of all spark plugs before installation.
- Use a round wire feeler gauge to ensure an accurate check.
- Plugs installed with the wrong gap can cause poor engine performance and excessive emissions.

Installation Procedure

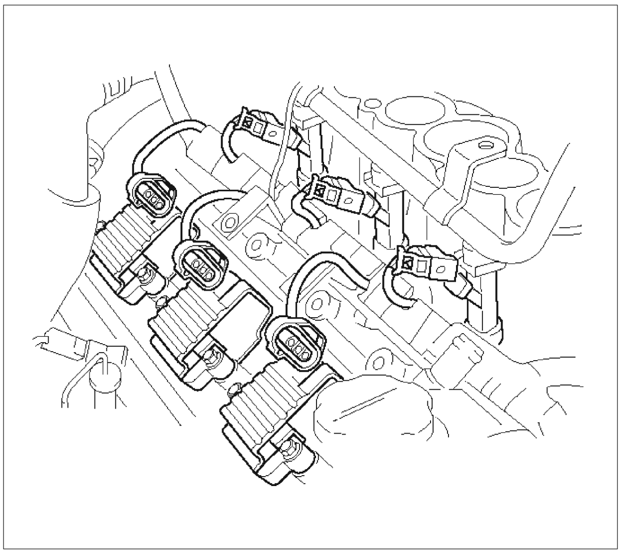
NOTE: The plug must thread smoothly into the cylinder head and be fully seated. Use a thread chaser if necessary to clean the threads in the cylinder head. Cross-threading or failure to fully seat the spark plug can cause plug overheating, exhaust blow-by gas, or thread damage. Do not overtighten the spark plugs. Over tightening can cause aluminum threads to strip.

1. Install the spark plug in the engine. Use the appropriate spark plug socket.

Tighten

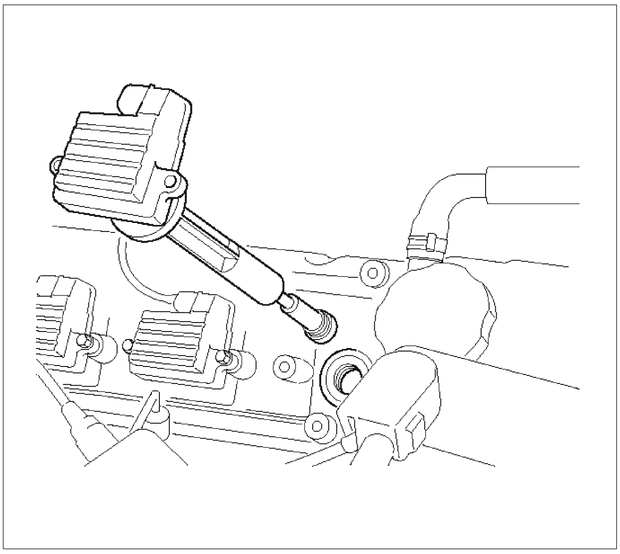
- Tighten the spark plug to 18 N·m (13 lb ft.).

2. Install the ignition coil and spark plug boot over the spark plug.



014RW108

3. Secure the ignition coil to the rocker cover with two screws.



014RW091

4. Connect the electrical connector at the ignition coil.
5. Connect the negative battery cable.

Catalytic Converter

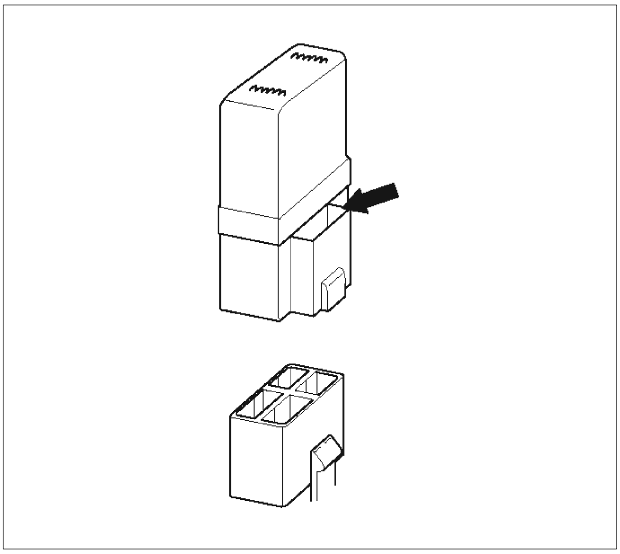
Removal and Installation Procedure

Refer to *Engine Exhaust in Engine*.

Air Conditioning Relay

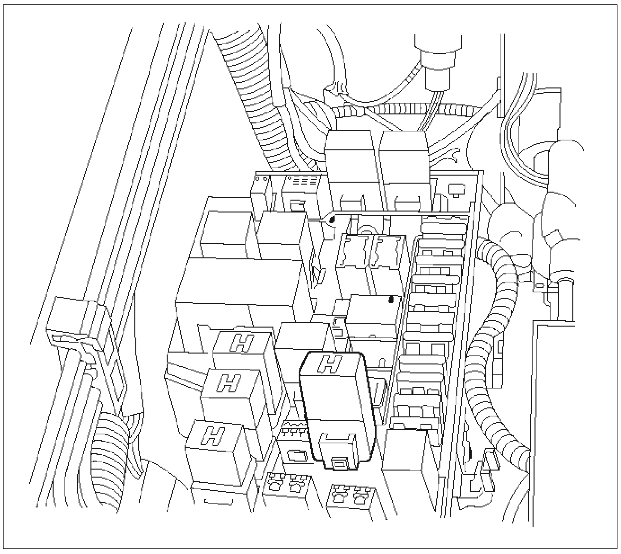
Removal Procedure

1. Remove the fuse and relay box cover from under the hood.
2. Consult the diagram on the cover to determine which is the correct relay.
3. Insert a small screwdriver into the catch slot on the forward side of the fuel pump relay.
   - The screwdriver blade will release the catch inside.



T321092

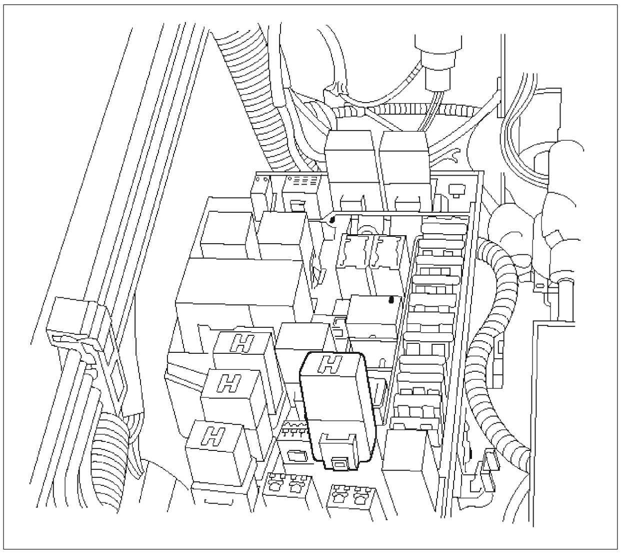
4. Pull the relay straight up and out of the fuse and relay box.



TS23986

Installation Procedure

1. Insert the relay into the correct place in the fuse and relay box with the catch slot facing forward.
2. Press down until the catch engages.
   - An audible “click” will be heard.
3. Install the fuse and relay box cover.



TS23986

EVAP Canister Hoses

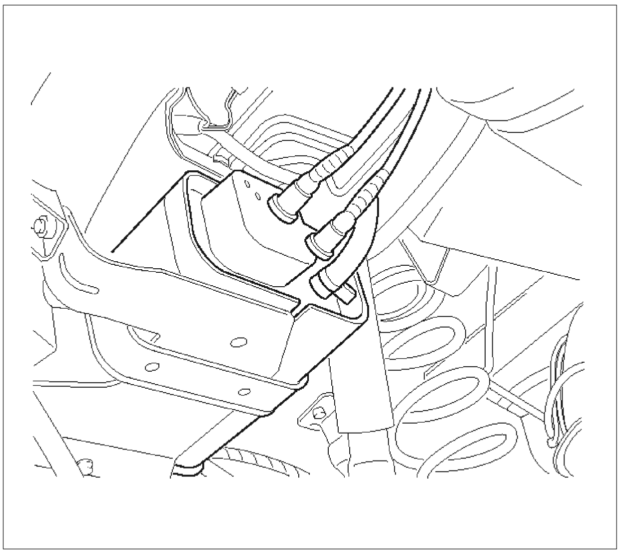
Service Information

To view the routing of the EVAP canister hoses, refer to *Vehicle Emission Control Information* in *Diagnosis*. Use 6148M or equivalent when you replace the EVAP canister hoses.

EVAP Canister

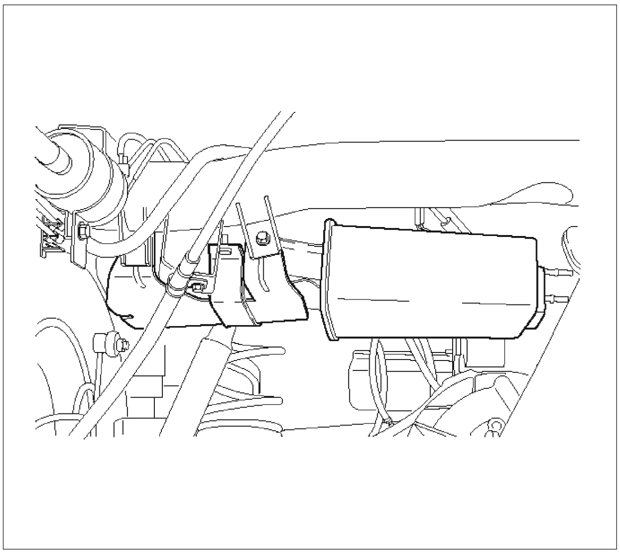
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the three hoses from the EVAP canister.



014RW145

3. Remove the retaining two bolts on the mounting bracket and slide the canister out of mounting bracket.



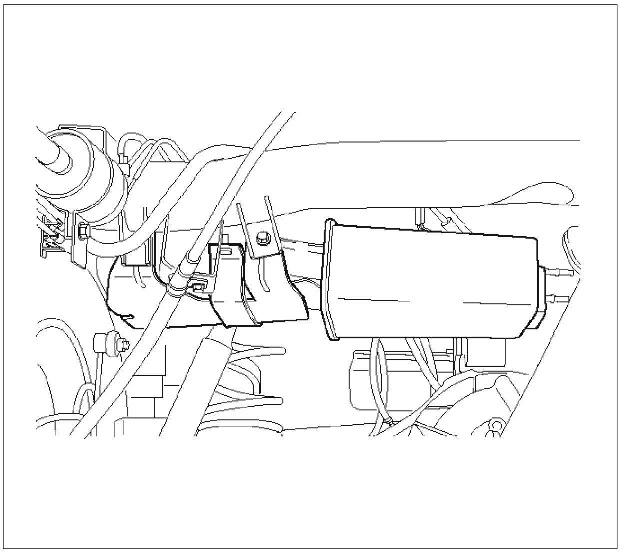
014RW146

Inspection Procedure

1. Inspect the hoses for cracks and leaks.
2. Inspect the canister for a damaged case.

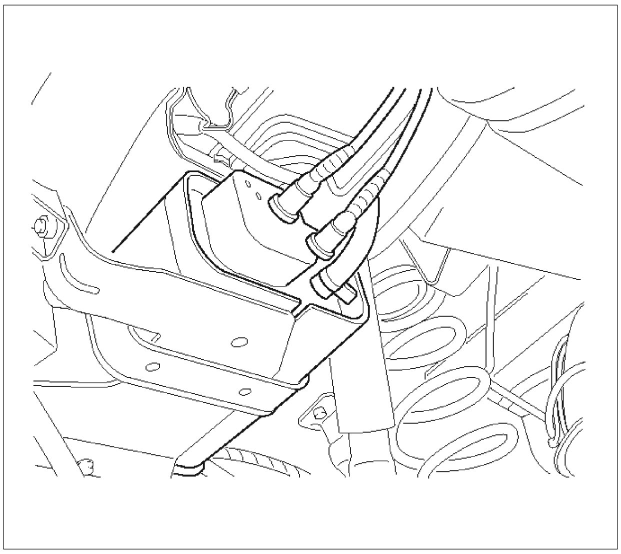
Installation Procedure

1. Slide the canister into mounting bracket and install the mounting bracket two bolts.



014RW146

2. Connect the three hoses to the EVAP canister.



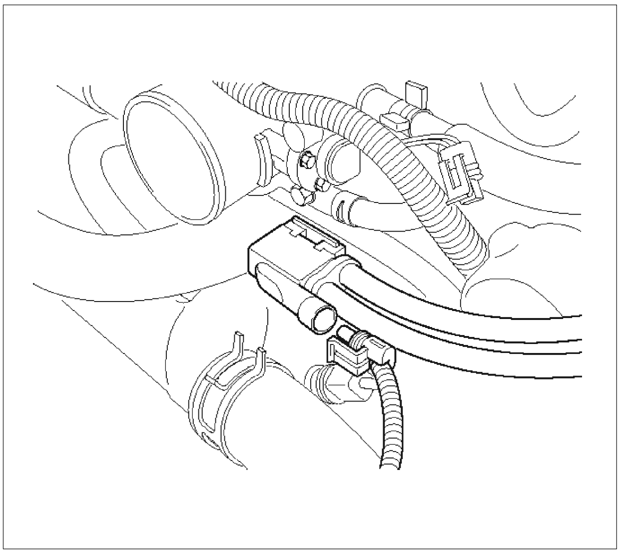
014RW145

3. Disconnect the negative battery cable.

EVAP Canister Purge Solenoid

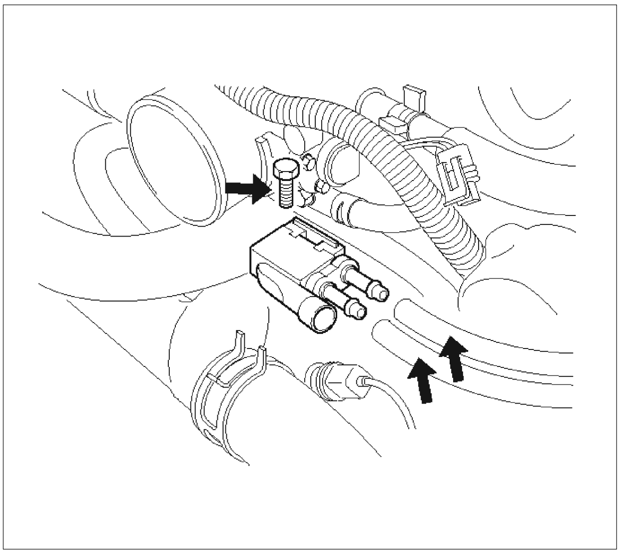
Removal Procedure

1. Disconnect the electrical connector from the EVAP canister purge solenoid.
2. Disconnect the vacuum hoses from the EVAP canister purge solenoid.



014RW136

3. Remove the EVAP canister purge solenoid retaining bolt from the upper intake manifold.
4. Remove the EVAP canister purge solenoid.

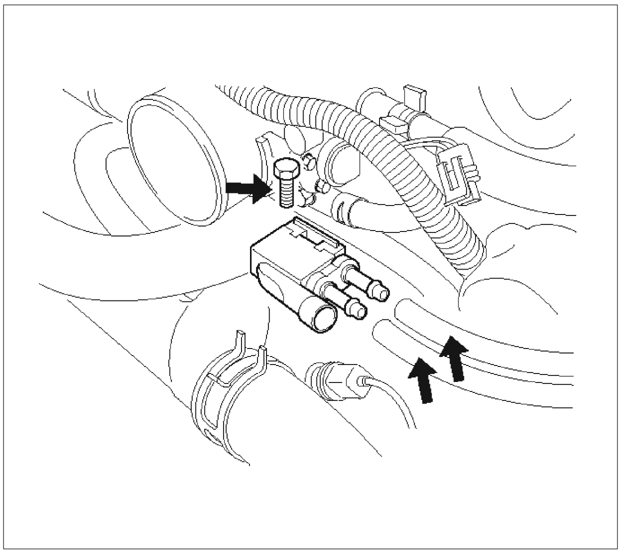


014RW137

Installation Procedure

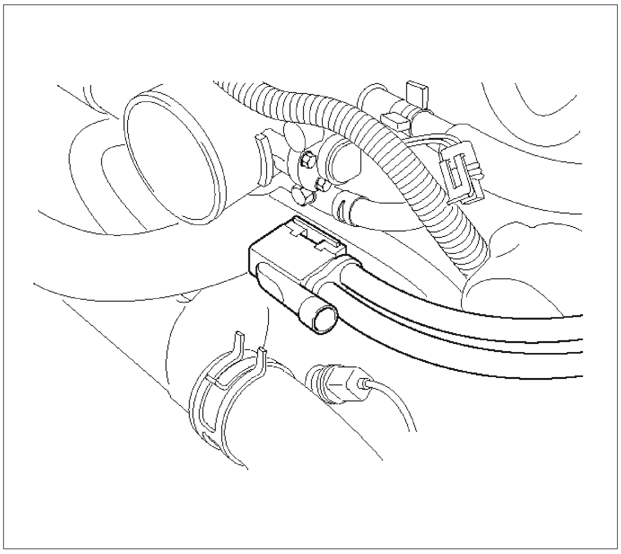
1. Install the EVAP canister purge solenoid on the upper intake manifold.
2. Install the EVAP canister purge solenoid retaining bolt.

3. Connect the vacuum hoses to the EVAP canister purge solenoid.



014RW137

4. Connect the electrical connector to the EVAP canister purge solenoid.



014RW138

Fuel Tank Vent Valve

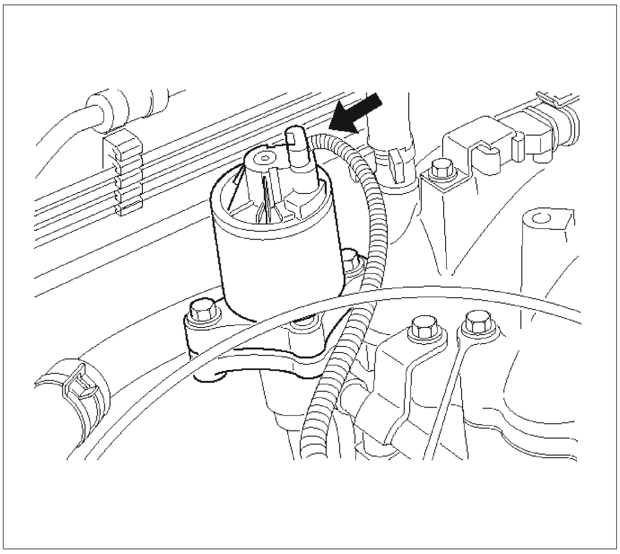
Removal and Installation Procedure

Refer to *Fuel Pump*

Linear Exhaust Gas Recirculation (EGR) Valve

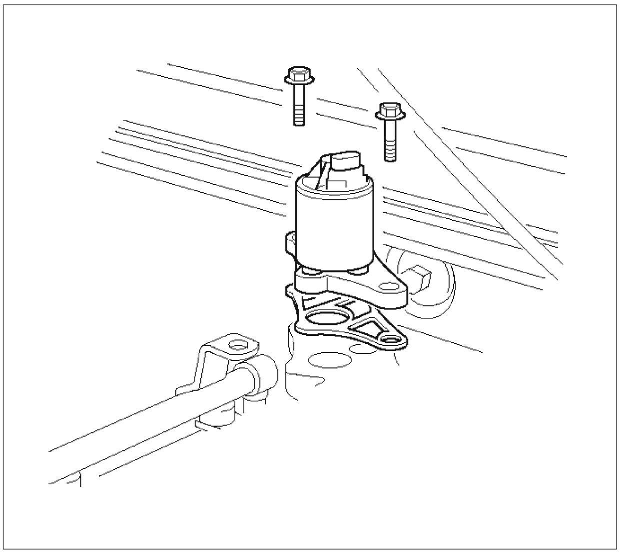
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector at the EGR valve.



014RW139

3. Remove the bolt and the nut from the upper intake manifold.



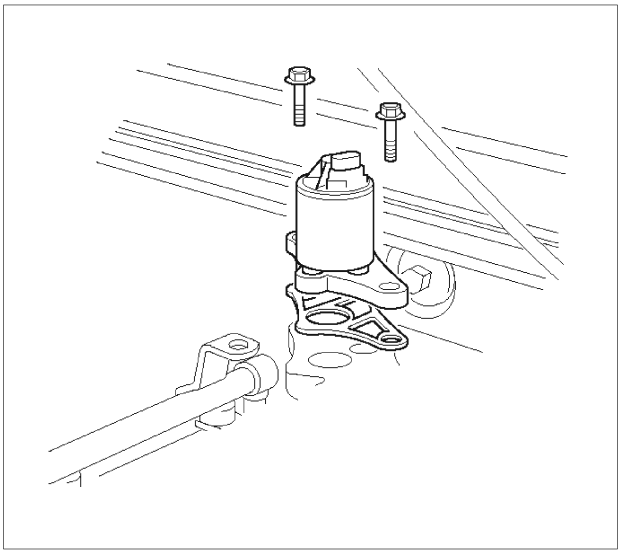
014RW098

4. Remove the EGR valve from the upper intake manifold.
5. Remove the gasket from the upper intake manifold.

Installation Procedure

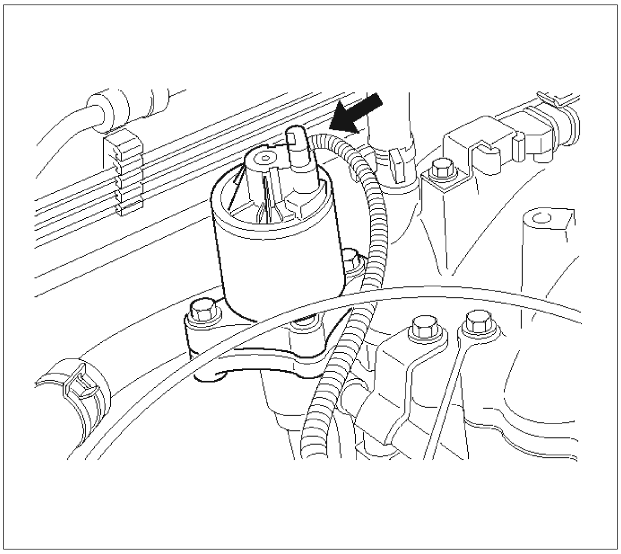
1. Install the gasket on the upper intake manifold.
2. Install the EGR valve on the upper intake manifold.
3. Secure the EGR valve and the gasket with the bolt and the nut.

NOTE: It is possible to install the EGR valve rotated 180° from the correct position. Make sure that the base of the valve is placed so that it aligns with the mounting flange.



014RW098

4. Connect the electrical connector at the EGR valve.



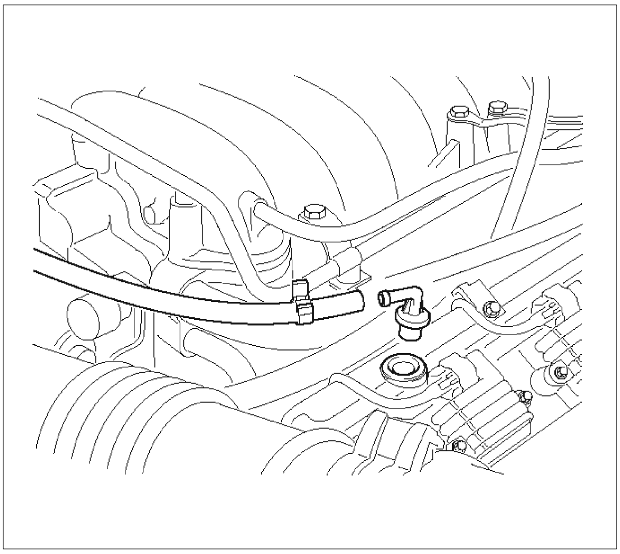
014RW139

5. Connect the negative battery cable.

Positive Crankcase Ventilation (PCV) Valve

Removal Procedure

1. Remove the vacuum hose at the PCV valve.
   - Slide the clamp back to release the hose.
2. Pull the PCV valve from the rubber grommet in the right valve cover.



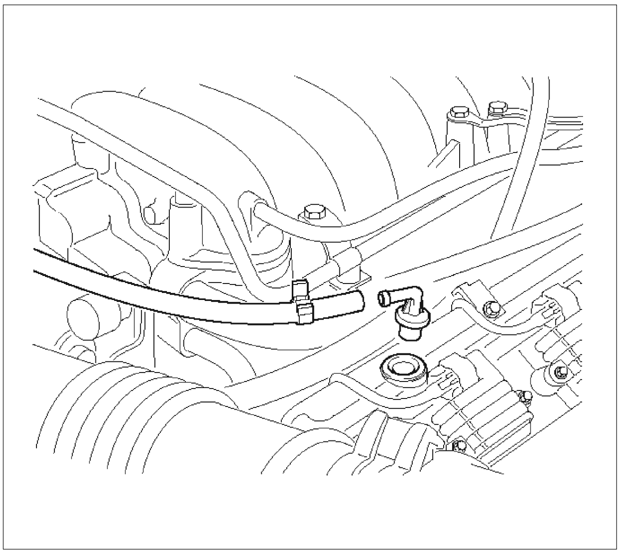
014RW097

Inspection Procedure

1. Shake the valve and listen for the rattle of the needle inside the valve.
2. If the valve does not rattle, replace the valve.

Installation Procedure

1. Push the PCV valve into the rubber grommet in the left valve cover.
2. Install the vacuum hose on the PCV valve and secure the vacuum hose with the clamp.



014RW097

Wiring and Connectors

Wiring Harness Service

The control module harness electrically connects the control module to the various solenoids, switches and sensors in the vehicle engine compartment and passenger compartment.

Replace wire harnesses with the proper part number replacement.

Because of the low amperage and voltage levels utilized in powertrain control systems, it is essential that all wiring in environmentally exposed areas be repaired with crimp and seal splice sleeves.

The following wire harness repair information is intended as a general guideline only. Refer to *Chassis Electrical* for all wire harness repair procedures.

Connectors and Terminals

Use care when probing a connector and when replacing terminals. It is possible to short between opposite terminals. Damage to components could result. Always use jumper wires between connectors for circuit checking. NEVER probe through Weather-Pack seals. Use an appropriate connector test adapter kit which contains an assortment of flexible connectors used to probe terminals during diagnosis. Use an appropriate fuse remover and test tool for removing a fuse and to adapt the fuse holder to a meter for diagnosis.

Open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor, or in the wiring harness, may temporarily correct the open circuit. Intermittent problems may also be caused by oxidized or loose connections.

Be certain of the type of connector/terminal before making any connector or terminal repair. Weather-Pack and Com-Pack III terminals look similar, but are serviced differently.

PCM Connectors and Terminals

Removal Procedure

1. Remove the connector terminal retainer.
2. Push the wire connected to the affected terminal through the connector face so that the terminal is exposed.
3. Service the terminal as necessary.

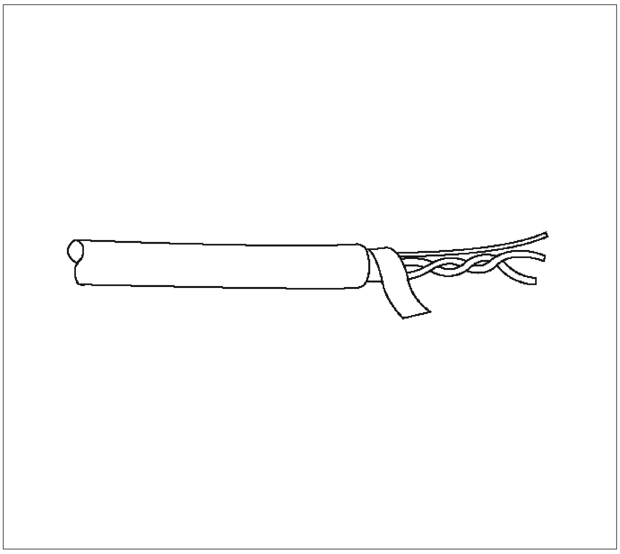
Installation Procedure

1. Bend the tab on the connector to allow the terminal to be pulled into position within the connector.
2. Pull carefully on the wire to install the connector terminal retainer.

Wire Harness Repair: Twisted Shielded Cable

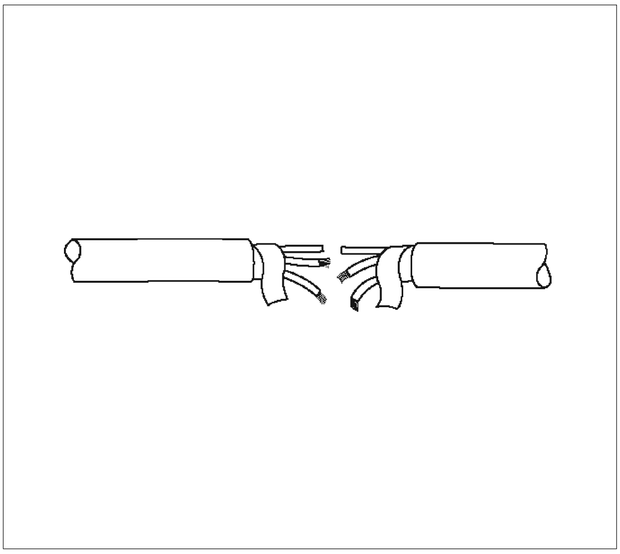
Removal Procedure

1. Remove the outer jacket.
2. Unwrap the aluminum/mylar tape. Do not remove the mylar.



047

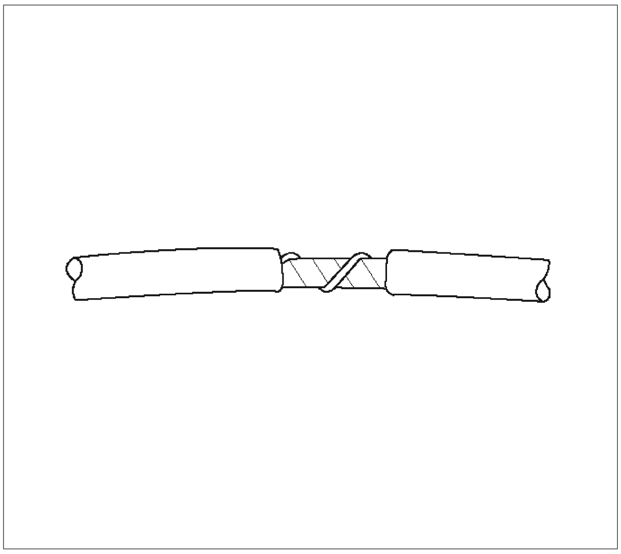
3. Untwist the conductors.
4. Strip the insulation as necessary.



048

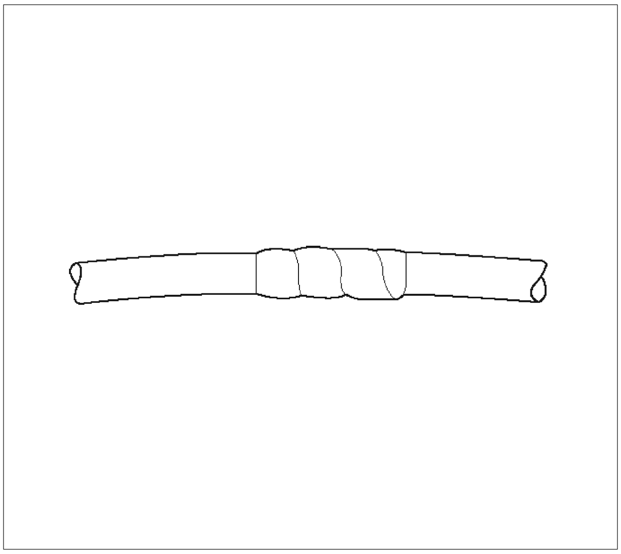
Installation Procedure

1. Splice the wires using splice clips and rosin core solder.
2. Wrap each splice to insulate.
3. Wrap the splice with mylar and with the drain (uninsulated) wire.



049

4. Tape over the whole bundle to secure.

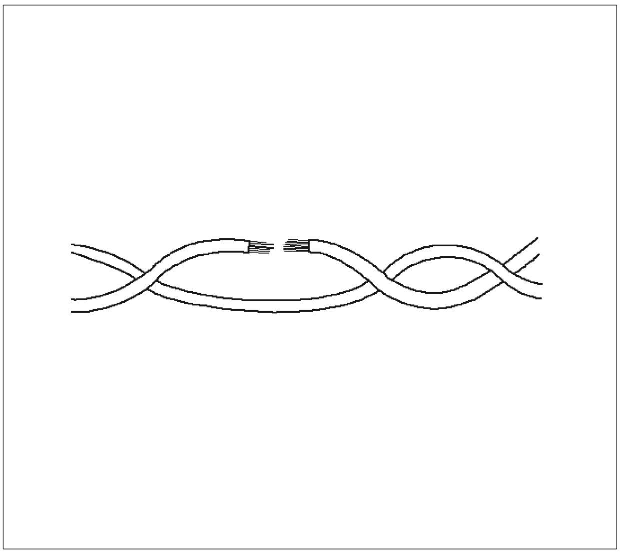


050

Twisted Leads

Removal Procedure

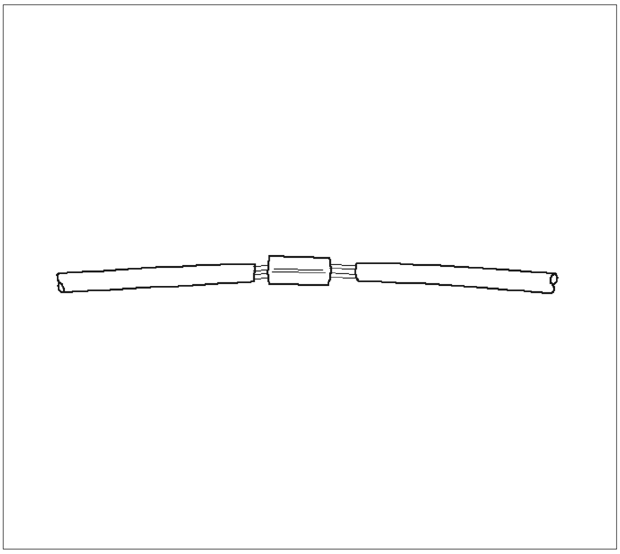
1. Locate the damaged wire.
2. Remove the insulation as required.



051

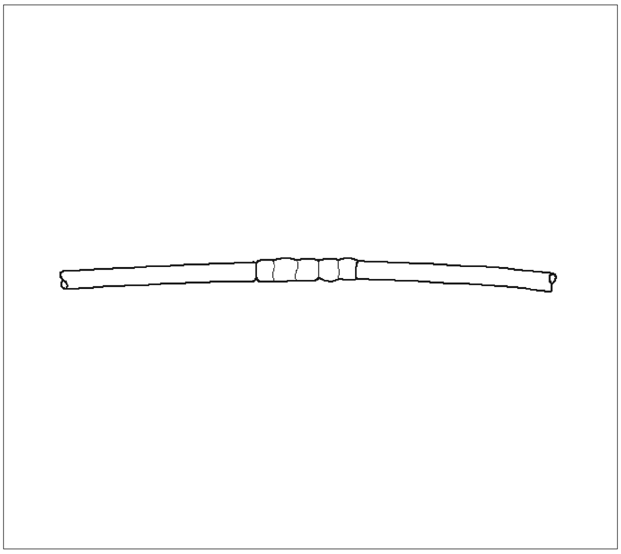
Installation Procedure

1. Use splice clips and rosin core solder in order to splice the two wires together.



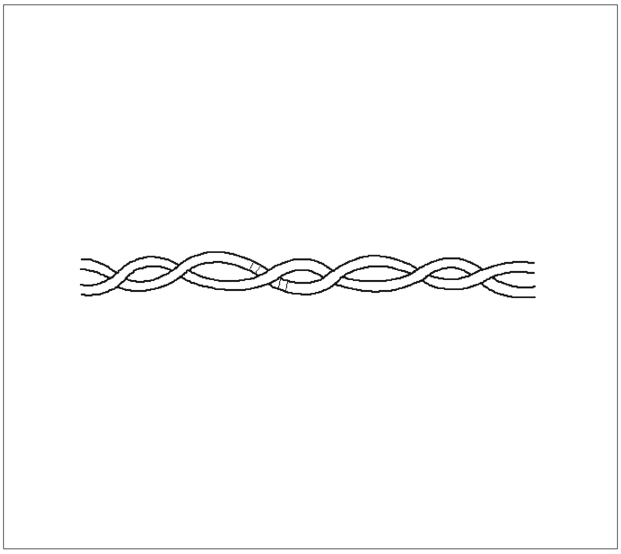
052

2. Cover the splice with tape in order to insulate it from the other wires.



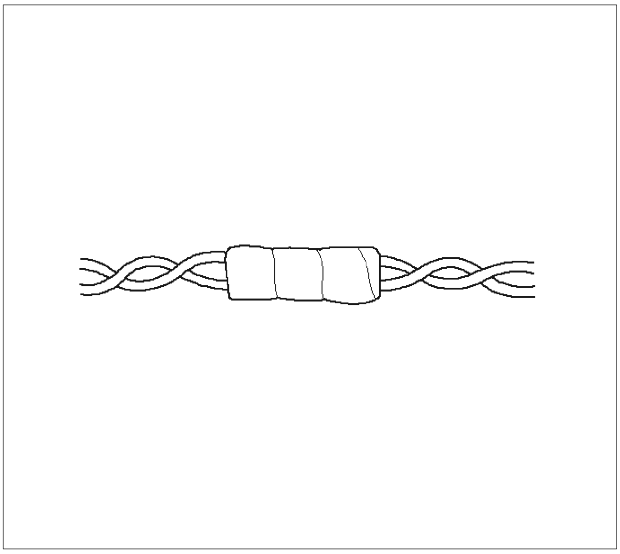
053

3. Twist the wires as they were before starting this procedure.



054

4. Tape the wires with electrical tape. Hold in place.



055

Weather-Pack Connector

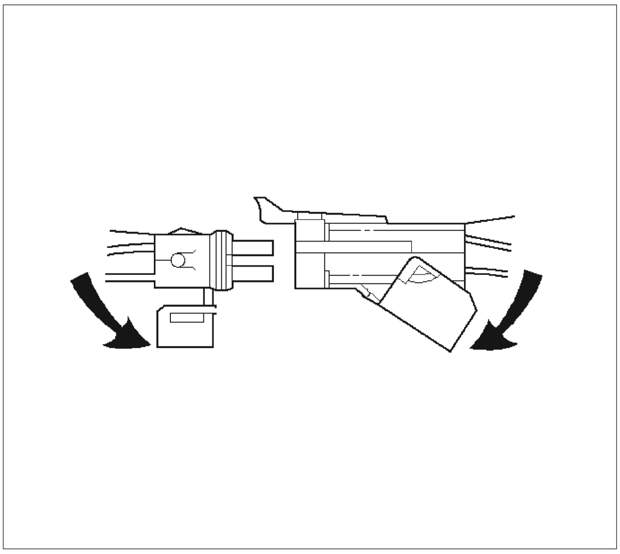
Tools Required

J 28742-A Weather-Pack II Terminal Remover

Removal Procedure

A Weather-Pack connector can be identified by a rubber seal at the rear of the connector. This engine room connector protects against moisture and dirt, which could from oxidation and deposits on the terminals. This protection is important, because of the low voltage and the low amperage found in the electronic systems.

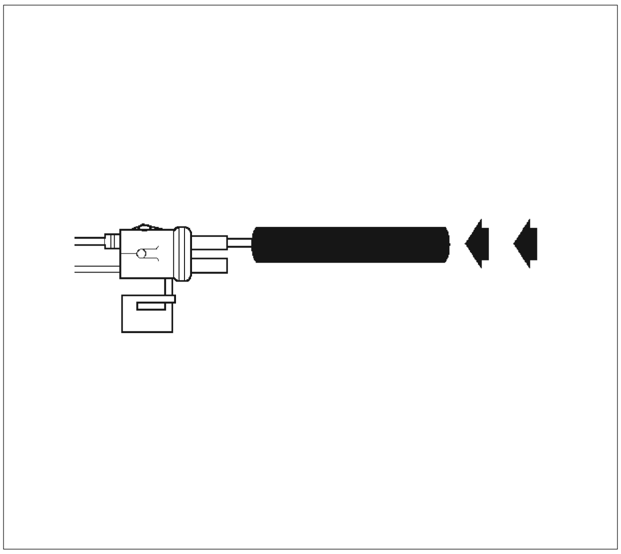
1. Open the secondary lock hinge on the connector.



070

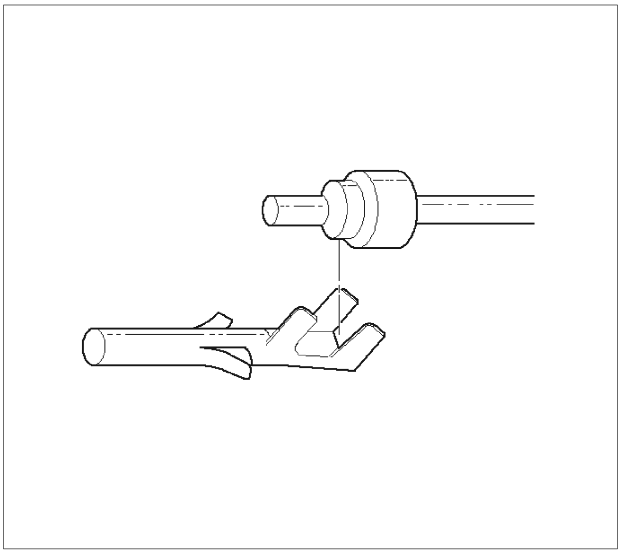
2. Use tool J 28742-A or the equivalent to remove the pin and the sleeve terminals. Push on J 28742-A to release.

NOTE: Do the use an ordinary pick or the terminal may be bent or deformed. Unlike standard blade terminals, these terminals cannot be straightened after they have been improperly bent.



071

3. Cut the wire immediately behind the cable seal.



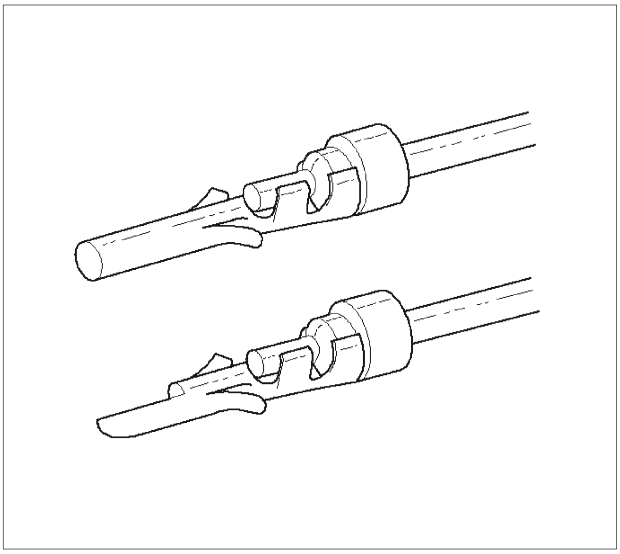
072

Installation Procedure

Make certain the connectors are properly seated and all of the sealing rings are in place when you reconnect the leads. The secondary lock hinge provides a backup locking feature for the connector. The secondary lock hinge is used for added reliability. This flap should retain the terminals even if the small terminal lock tangs are not positioned properly.

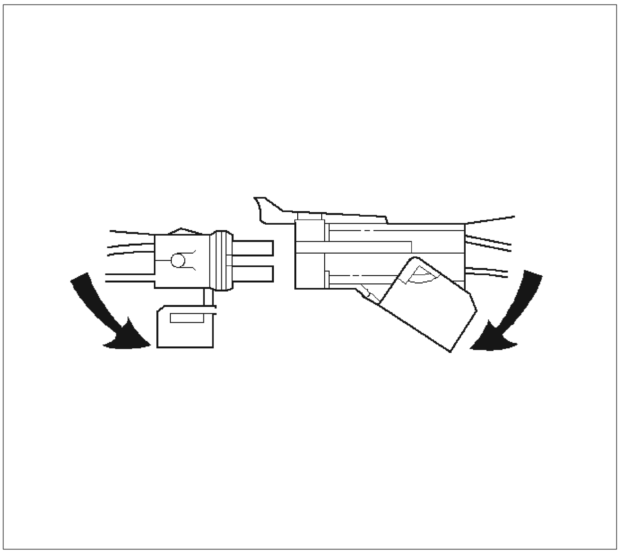
Do not replace the Weather-Pack connections with standard connections. Read the instructions provided with the Weather-Pack connector and terminal packages.

1. Replace the terminal.
2. Slip the new seal onto the wire.
3. Strip 5 mm (0.2”) of insulation from the wire.
4. Crimp the terminal over the wire and the seal.



073

5. Push the terminal and the connector to engage the locking tangs.



070

6. Close the secondary locking hinge.

Com-Pack III

General Information

The Com-Pack III terminal looks similar to some Weather-Pack terminals. This terminal is not sealed and is used where resistance to the environment is not required. Use the standard method when repairing a terminal. Do not use the Weather-Pack terminal tool J 28742-A or equivalent. These will damage the terminals.

Metri-Pack

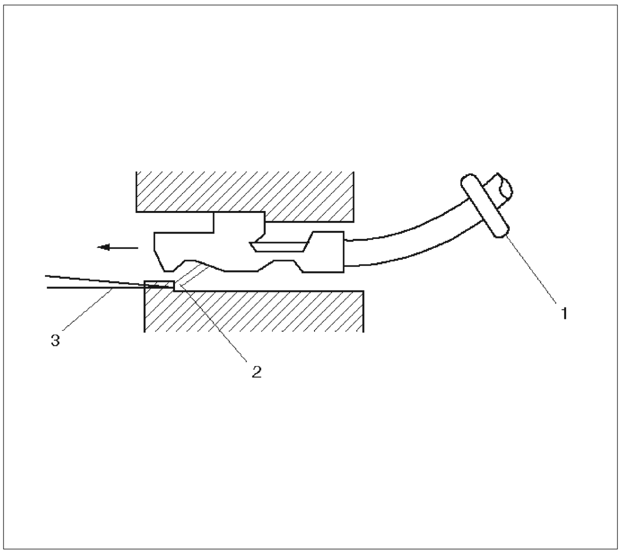
Tools Required

J 35689 Terminal Remover

Removal Procedure

Some connectors use terminals called Metri-Pack Series 150. These may be used at the engine coolant temperature (ECT) sensor.

1. Slide the seal (1) back on the wire.
2. Insert the J 35689 tool or equivalent (3) in order to release the terminal locking tang (2).



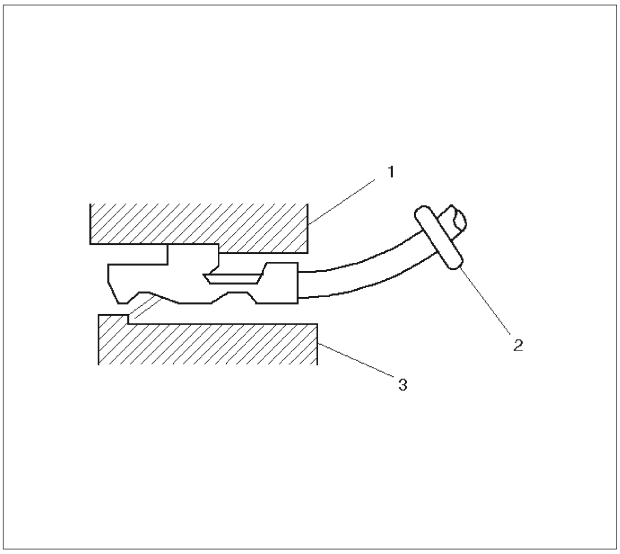
060

3. Push the wire and the terminal out through the connector. If you reuse the terminal, reshape the locking tang.

Installation Procedure

Metri-Pack terminals are also referred to as “pull-to-seat” terminals.

1. In order to install a terminal on a wire, the wire must be inserted through the seal (2) and through the connector (3).
2. The terminal (1) is then crimped onto the wire.



061

3. Then the terminal is pulled back into the connector to seat it in place.

General Description

General Description (PCM and Sensors)

58X Reference PCM Input

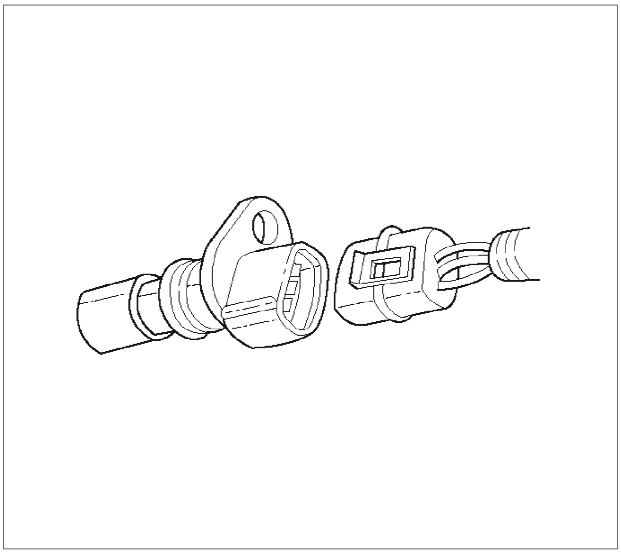
The powertrain control module (PCM) uses this signal from the crankshaft position (CKP) sensor to calculate engine RPM and crankshaft position at all engine speeds. The PCM also uses the pulses on this circuit to initiate injector pulses. If the PCM receives no pulses on this circuit, DTC P0337 will set. The engine will not start and run without using the 58X reference signal.

A/C Request Signal

This signal tells the PCM when the A/C mode is selected at the A/C control head. The PCM uses this to adjust the idle speed before turning "ON" the A/C clutch. The A/C compressor will be inoperative if this signal is not available to the PCM.
Refer to *A/C Clutch Circuit Diagnosis* for A/C wiring diagrams and diagnosis for the A/C electrical system.

Crankshaft Position (CKP) Sensor

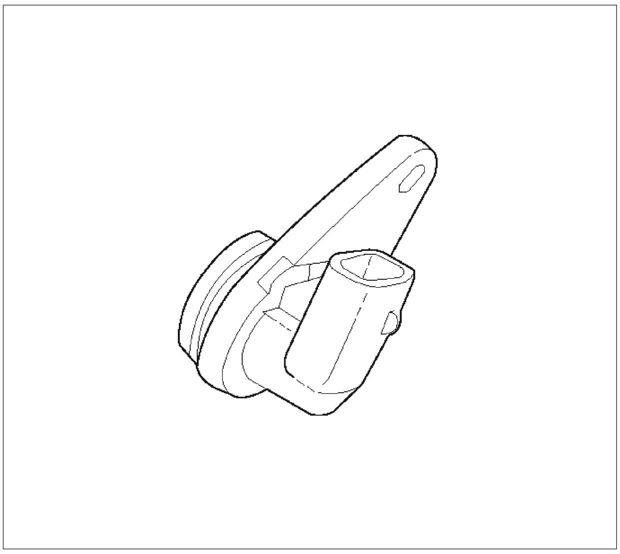
The crankshaft position (CKP) sensor provides a signal used by the powertrain control module (PCM) to calculate the ignition sequence. The CKP sensor initiates the 58X reference pulses which the PCM uses to calculate RPM and crankshaft position.
Refer to *Electronic Ignition System* for additional information.



0013

Camshaft Position (CMP) Sensor and Signal

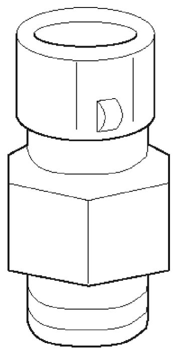
The camshaft position (CMP) sensor sends a CMP signal to the PCM. The PCM uses this signal as a "sync pulse" to trigger the injectors in the proper sequence. The PCM uses the CMP signal to indicate the position of the #1 piston during its power stroke. This allows the PCM to calculate true sequential fuel injection (SFI) mode of operation. If the PCM detects an incorrect CMP signal while the engine is running, DTC P0341 will set. If the CMP signal is lost while the engine is running, the fuel injection system will shift to a calculated sequential fuel injection mode based on the last fuel injection pulse, and the engine will continue to run. As long as the fault is present, the engine can be restarted. It will run in the calculated sequential mode with a 1-in-6 chance of the injector sequence being correct.
Refer to *DTC P0341* for further information.



0014

Engine Coolant Temperature (ECT) Sensor

The engine coolant temperature (ECT) sensor is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance of 100,000 ohms at –40°C (–40°F). High temperature causes a low resistance of 70 ohms at 130°C (266°F). The PCM supplies a 5-volt signal to the ECT sensor through resistors in the PCM and measures the voltage. The signal voltage will be high when the engine is cold and low when the engine is hot. By measuring the voltage, the PCM calculates the engine coolant temperature. Engine coolant temperature affects most of the systems that the PCM controls.
Tech 2 displays engine coolant temperature in degrees. After engine start-up, the temperature should rise steadily to about 85°C (185°F). It then stabilizes when the thermostat opens. If the engine has not been run for several hours (overnight), the engine coolant temperature and intake air temperature displays should be close to each other. A hard fault in the engine coolant sensor circuit will set DTC P0177 or DTC P0118. An intermittent fault will set a DTC P1114 or P1115.



0016

Electrically Erasable Programmable Read Only Memory (EEPROM)

The electrically erasable programmable read only memory (EEPROM) is a permanent memory chip that is physically soldered within the PCM. The EEPROM contains the program and the calibration information that the PCM needs to control powertrain operation.

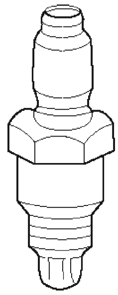
Unlike the PROM used in past applications, the EEPROM is not replaceable. If the PCM is replaced, the new PCM will need to be programmed. Equipment containing the correct program and calibration for the vehicle is required to program the PCM.

Fuel Control Heated Oxygen Sensors

The fuel control heated oxygen sensors (Bank 1 HO2S 1 and Bank 2 HO2S 1) are mounted in the exhaust stream where they can monitor the oxygen content of the exhaust gas. The oxygen present in the exhaust gas reacts with the sensor to produce a voltage output. This voltage should constantly fluctuate from approximately 100 mV to 900 mV. The heated oxygen sensor voltage can be monitored with Tech 2. By monitoring the voltage output of the oxygen sensor, the PCM calculates the pulse width command for the injectors to produce the proper combustion chamber mixture.

- Low HO2S voltage is a lean mixture which will result in a rich command to compensate.
- High HO2S voltage is a rich mixture which will result in a lean command to compensate.

An open Bank 1 HO2S 1 signal circuit will set a DTC P0134 and Tech 2 will display a constant voltage between 400-500 mV. A constant voltage below 300 mV in the sensor circuit (circuit grounded) will set DTC P0131. A constant voltage above 800 mV in the circuit will set DTC P0132. Faults in the Bank 2 HO2S 1 signal circuit will cause DTC 0154 (open circuit), DTC P0151 (grounded circuit), or DTC P0152 (signal voltage high) to set.

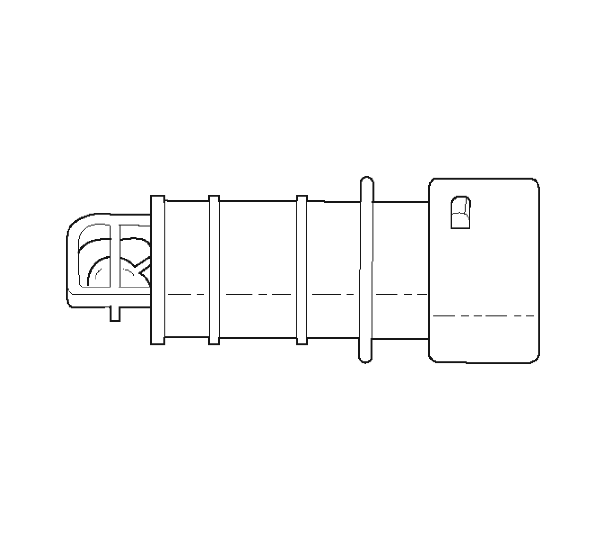


0012

Intake Air Temperature (IAT) Sensor

The intake air temperature (IAT) sensor is a thermistor which changes its resistance based on the temperature of air entering the engine. Low temperature produces a high resistance of 100,000 ohms at –40°C (–40°F). High temperature causes low resistance of 70 ohms at 130°C (266°F). The PCM supplies a 5-volt signal to the sensor through a resistor in the PCM and monitors the signal voltage. The voltage will be high when the incoming air is cold. The voltage will be low when the incoming air is hot. By measuring the voltage, the PCM calculates the incoming air temperature. The IAT sensor signal is used to adjust spark timing according to the incoming air density.

Tech 2 displays the temperature of the air entering the engine. The temperature should read close to the ambient air temperature when the engine is cold and rise as underhood temperature increases. If the engine has not been run for several hours (overnight), the IAT sensor temperature and engine coolant temperature should read close to each other. A fault in the IAT sensor circuit will set DTC P0112 or DTC P0113.



0018

Knock Sensor

Insufficient gasoline octane levels may cause detonation in some engines. Detonation is an uncontrolled explosion (burn) in the combustion chamber. This uncontrolled explosion results from a flame front opposite that of the normal flame front produced by the spark plug. The rattling sound normally associated with detonation is the result of two or more opposing pressures (flame fronts) colliding within the combustion chamber. Light detonation is sometimes considered normal, but heavy detonation could result in engine damage.

A knock sensor system is used to control detonation. This system is designed to retard spark timing up to 20 degrees to reduce detonation in the engine. This allows the engine to use maximum spark advance to improve driveability and fuel economy.

The knock sensor system has two major components:

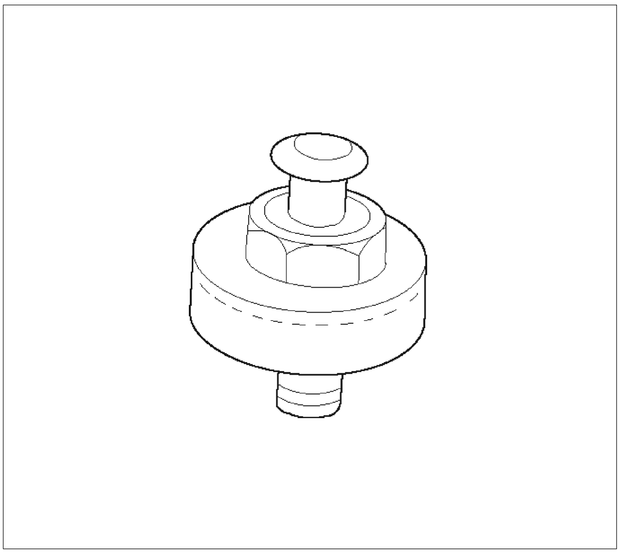
- The knock sensor (KS) module.
- The knock sensor.

The knock sensor, mounted in the engine block near the cylinders, detects abnormal vibration in the engine. The sensor produces an AC output signal of about 10 millivolts. The signal amplitude and frequency are dependent on the amount of knock being experienced. The signal voltage increases with the severity of the knock. This signal voltage is input to the PCM. The PCM then retards the ignition control (IC) spark timing based on the KS signal being received.

The PCM determines whether knock is occurring by comparing the signal level on the KS circuit with the voltage level on the noise channel. The noise channel allows the PCM to reject any false knock signal by indicating the amount of normal engine mechanical noise present. Normal engine noise varies depending on the engine speed and load. If the voltage level on the KS noise channel circuit is below the range considered normal, DTC P0327 will set, indicating a fault in the KS circuit or the knock sensor. If the PCM determines that an abnormal minimum or maximum noise level is being experienced, DTC P0325 will set.

The PCM contains a knock sensor (KS) module. The KS module contains the circuitry which allows the PCM to utilize the KS signal and diagnose the KS sensor and the KS circuitry. If the KS module is missing or faulty, a continuous knock condition will be indicated, and the PCM will set DTC P0325.

Although it is a plug-in device, the KS module is not replaceable. If the KS module is faulty, the entire PCM must be replaced.



0009

Linear Exhaust Gas Recirculation (EGR) Control

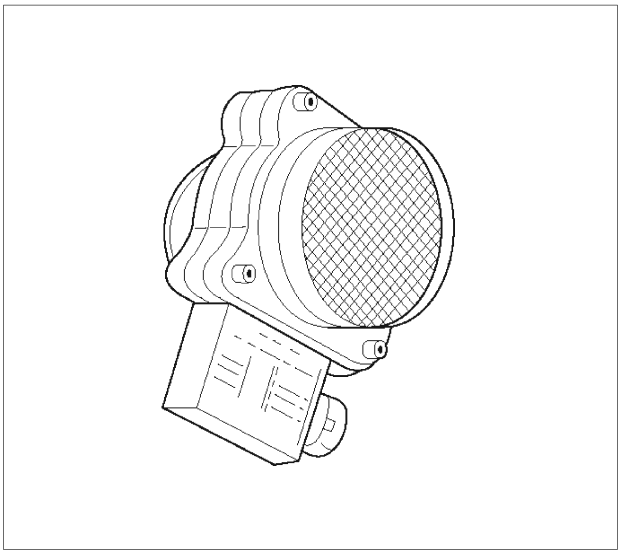
The PCM monitors the exhaust gas recirculation (EGR) actual position and adjusts the pintle position accordingly. The PCM uses information from the following sensors to control the pintle position:

- Engine coolant temperature (ECT) sensor.
- Throttle position (TP) sensor.
- Mass air flow (MAF) sensor.

Mass Air Flow (MAF) Sensor

The mass air flow (MAF) sensor measures the difference between the volume and the quantity of air that enters the engine. “Volume” means the size of the space to be filled. “Quantity” means the number of air molecules that will fit into the space. This information is important to the PCM because heavier, denser air will hold more fuel than lighter, thinner air. The PCM adjusts the air/fuel ratio as needed depending on the MAF value. Tech 2 reads the MAF value and displays it in terms of grams per second (gm/s). At idle, Tech 2 should read between 4-7 gm/s on a fully warmed up engine. Values should change quickly on acceleration. Values should remain stable at any given

RPM. A failure in the MAF sensor or circuit will set DTC P0101, DTC P0102, or DTC P0103.



0007

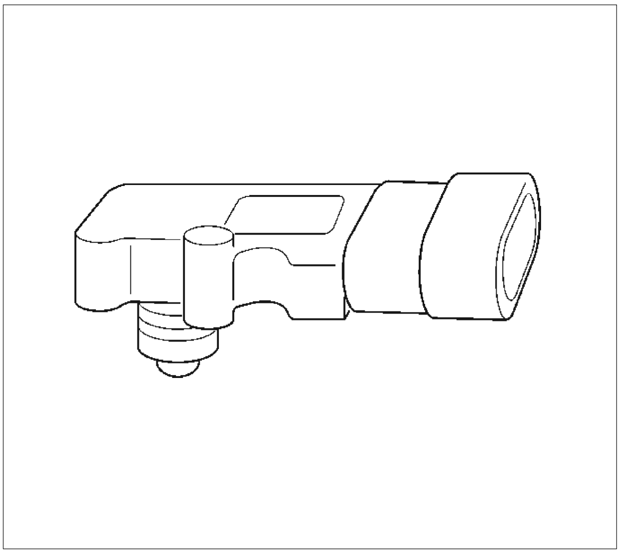
Manifold Absolute Pressure (MAP) Sensor

The manifold absolute pressure (MAP) sensor responds to changes in intake manifold pressure (vacuum). The MAP sensor signal voltage to the PCM varies from below 2 volts at idle (high vacuum) to above 4 volts with the ignition ON, engine not running or at wide-open throttle (low vacuum).

The MAP sensor is used to determine the following:

- Manifold pressure changes while the linear EGR flow test diagnostic is being run. Refer to *DTC P0401*.
- Engine vacuum level for other diagnostics.
- Barometric pressure (BARO).

If the PCM detects a voltage that is lower than the possible range of the MAP sensor, DTC P0107 will be set. A signal voltage higher than the possible range of the sensor will set DTC P0108. An intermittent low or high voltage will set DTC P1107 or DTC P1106, respectively. The PCM can detect a shifted MAP sensor. The PCM compares the MAP sensor signal to a calculated MAP based on throttle position and various engine load factors. If the PCM detects a MAP signal that varies excessively above or below the calculated value, DTC P0106 will set.



055RW004

Powertrain Control Module (PCM)

The powertrain control module (PCM) is located in the passenger compartment below the center console. The PCM controls the following:

- Fuel metering system.
- Transmission shifting (automatic transmission only).
- Ignition timing.
- On-board diagnostics for powertrain functions.

The PCM constantly observes the information from various sensors. The PCM controls the systems that affect vehicle performance. The PCM performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the MIL (Service Engine Soon lamp), and store diagnostic trouble codes (DTCs). DTCs identify the problem areas to aid the technician in making repairs.

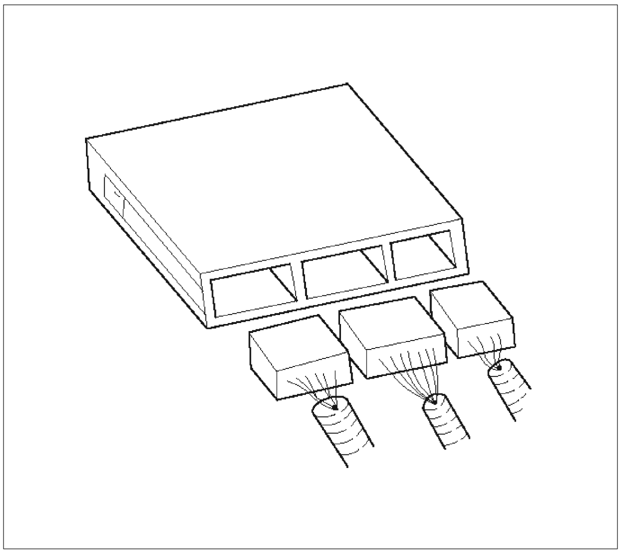
This engine uses 2 different control modules:

- IPCM-6KT for automatic transmission-equipped vehicles.
- ISFI-6 for manual transmission-equipped vehicles.

PCM Function

The PCM supplies either 5 or 12 volts to power various sensors or switches. The power is supplied through resistances in the PCM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, a digital voltmeter with at least 10 megohms input impedance is required to ensure accurate voltage readings. Tool J 39200 meets this requirement. The PCM controls output circuits such as the injectors, IAC, cooling fan relays, etc., by controlling the ground or the power feed circuit through transistors of following device.

- Output Driver Module (ODM)



0005

PCM Components

The PCM is designed to maintain exhaust emission levels to government mandated standards while providing excellent driveability and fuel efficiency. The PCM monitors numerous engine and vehicle functions via electronic sensors such as the throttle position (TP) sensor, heated oxygen sensor (HO2S), and vehicle speed sensor (VSS). The PCM also controls certain engine operations through the following:

- Fuel injector control
- Ignition control module
- Knock sensor
- Automatic transmission shift functions
- Cruise control
- A/C clutch control

PCM Voltage Description

The PCM supplies a buffered voltage to various switches and sensors. It can do this because resistance in the PCM is so high in value that a test light may not illuminate when connected to the circuit. An ordinary shop voltmeter may not give an accurate reading because the voltmeter input impedance is too low. Use a 10-megohm input impedance digital voltmeter (such as J 39200) to assure accurate voltage readings.

The input/output devices in the PCM include analog-to-digital converters, signal buffers, counters, and special drivers. The PCM controls most components with electronic switches which complete a ground circuit when turned “ON.” These switches are arranged in groups of 4 and 7, called either a surface-mounted quad driver module (QDM), which can independently control up to 4 output terminals, or QDMs which can independently control up to 7 outputs. Not all outputs are always used.

PCM Input/Outputs

Inputs – Operating Conditions Read

- Air Conditioning “ON” or “OFF”
- Engine Coolant Temperature
- Crankshaft Position
- Exhaust Oxygen Content
- Electronic Ignition
- Manifold Absolute Pressure
- Battery Voltage
- Throttle Position
- Vehicle Speed
- Fuel Pump Voltage
- Power Steering Pressure
- Intake Air Temperature
- Mass Air Flow
- Engine Knock
- Camshaft Position

Outputs – Systems Controlled

- Exhaust Gas Recirculation (EGR)
- Ignition Control
- Fuel Control
- Idle Air Control
- Electric Fuel Pump
- Air Conditioning
- Diagnostics
  - Malfunction Indicator Lamp (Service Engine Soon lamp)
  - Data Link Connector (DLC)
  - Data Output
- Transmission Control Module
- Alternator Gain Control

PCM Service Precautions

The PCM is designed to withstand normal current draws associated with vehicle operation. Avoid overloading any circuit. When testing for opens and shorts, do not ground or apply voltage to any of the PCM’s circuits unless instructed to do so. These circuits should only be tested Tech-2. The PCM should remain connected to the PCM or to a recommended breakout box.

Reprogramming The PCM

The Trooper allow reprogramming of the PCM without removing it from the vehicle . This provides a flexible and cost-effective method of making changes in software calibrations.

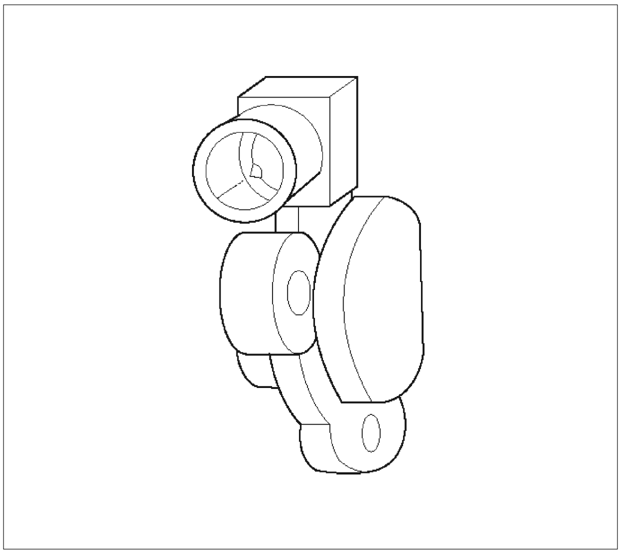
The service programming system (SPS) will not allow incorrect software programming or incorrect calibration changes.

Refer to the UBS 98model year Immobilizer Workshop Manual.

Throttle Position (TP) Sensor

The throttle position (TP) sensor is a potentiometer connected to the throttle shaft on the throttle body. The PCM monitors the voltage on the signal line and calculates throttle position. As the throttle valve angle is changed (accelerator pedal moved), the TP sensor signal also changes. At a closed throttle position, the output of the TP sensor is low. As the throttle valve opens, the output increases so that at wide open throttle (WOT), the output voltage should be above 4 volts.

The PCM calculates fuel delivery based on throttle valve angle (driver demand). A broken or loose TP sensor may cause intermittent bursts of fuel from an injector and unstable idle because the PCM thinks the throttle is moving. A hard failure in the TP sensor 5-volt reference or signal circuits will set a DTC P0123. A hard failure with the TP sensor ground circuit may set DTC P0123. Once a DTC is set, the PCM will use an artificial default value based on engine RPM and mass air flow for the throttle position, and some vehicle performance will return. A high idle may result when DTC P0123 is set. The PCM can also detect a shifted TP sensor. The PCM monitors throttle position and compares the actual TP sensor reading to a predicted TP value calculated from engine speed. If the PCM detects an out-of-range condition, DTC P0121 will be set.



0021

Transmission Fluid Temperature (TFT) Sensor

The transmission fluid temperature sensor is a thermistor which changes its resistance based on the temperature of the transmission fluid. For a complete description of the TFT sensor, refer to *4L30-E Automatic Transmission Diagnosis*.

A failure in the TFT sensor or associated wiring will cause DTC P0712 or DTC P0713 to set. In this case, engine coolant temperature will be substituted for the TFT sensor value and the transmission will operate normally.

Transmission Range Switch

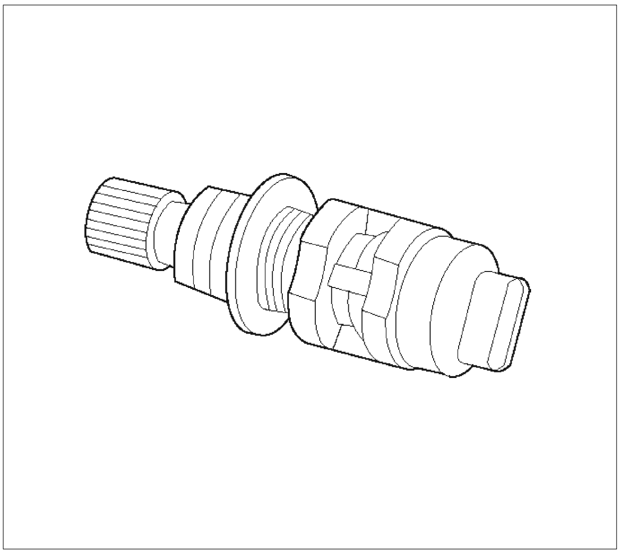
IMPORTANT: The vehicle should not be driven with the transmission range switch disconnected; idle quality will be affected.

The four inputs from the transmission range switch indicate to the PCM which position is selected by the transmission selector lever. This information is used for ignition timing, EVAP canister purge, EGR and IAC valve operation.

For more information on the transmission on the transmission range switch, refer to *4L30-E Automatic Transmission*.

Vehicle Speed Sensor (VSS)

The PCM determines the speed of the vehicle by converting a plusing voltage signal from the vehicle speed sensor (VSS) into miles per hour. The PCM uses this signal to operate the cruise control, speedometer, and the TCC and shift solenoids in the transmission. For more information on the TCC and shift solenoids, refer to *4L30-E Automatic Transmission*.



0008

Use of Circuit Testing Tools

Do not use a test light to diagnose the powertrain electrical systems unless specifically instructed by the diagnostic procedures. Use Connector Test Adapter Kit J 35616 whenever diagnostic procedures call for probing connectors.

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.

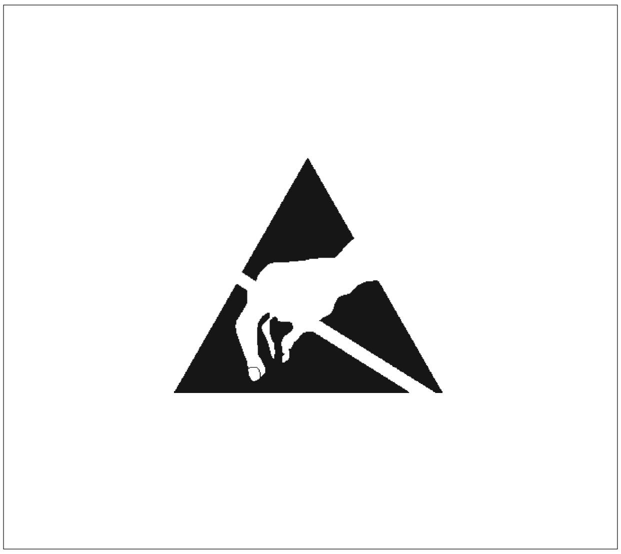
NOTE: No add-on vacuum equipment should be added to this vehicle.

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 PCM 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.



TS23793

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 PCM connector pins or soldered components on the PCM circuit board.
- Do not touch the knock sensor module component leads.
- 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.

Upshift Lamp

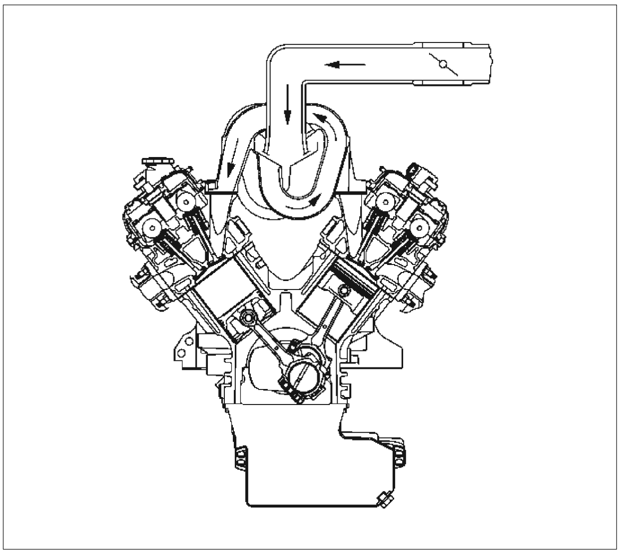
Refer to *Manual Transmission*.

General Description (Air Induction)

Air Induction System

The air induction system filters contaminants from the outside air, and directs the progress of the air as it is drawn into the engine. A remote-mounted air cleaner prevents dirt and debris in the air from entering the engine. The air duct assembly routes filtered air to the throttle body. Air enters the engine by to following steps:

1. Through the throttle body.
2. Into the common chamber.
3. Through the cylinder head intake ports.
4. Into the cylinders.



055RV010

General Description (Fuel Metering)

Acceleration Mode

The PCM provides extra fuel when it detects a rapid increase in the throttle position and the air flow.

Accelerator Controls

The accelerator control system is a cable-type system with specific linkage adjustments.
Refer to *Cable Adjustment*.

Battery Voltage Correction Mode

When battery voltage is low, the PCM will compensate for the weak spark by increasing the following:

- The amount of fuel delivered.
- The idle RPM.
- Ignition dwell time.

CMP Signal

The PCM uses this signal to determine the position of the number 1 piston during its power stroke, allowing the

PCM to calculate true sequential multiport fuel injection (SFI). 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.

Clear Flood Mode

Clear a flooded engine by pushing the accelerator pedal down all the way. The PCM then de-energizes the fuel injectors. The PCM 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 PCM again begins to pulse the injectors “ON” and “OFF,” allowing fuel into the cylinders.

Deceleration Mode

The PCM 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 PCM may cut off fuel completely for short periods.

Engine Speed/Vehicle Speed/Fuel Disable Mode

The PCM 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

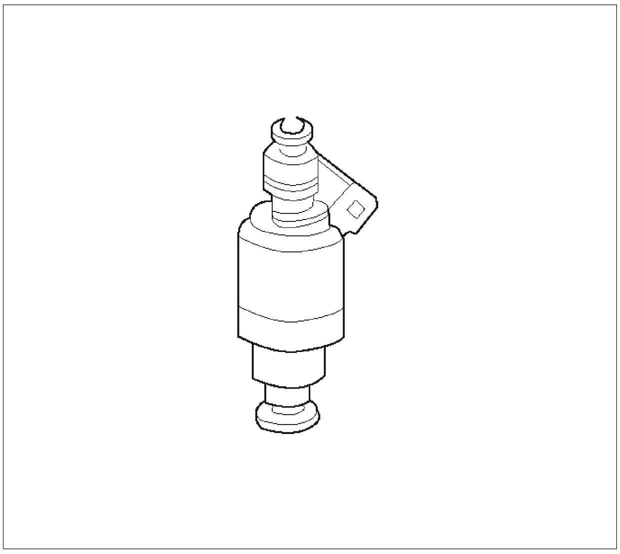
No fuel is delivered by the fuel injectors when the ignition is “OFF.” This prevents engine run-on. In addition, the PCM suspends fuel delivery if no reference pulses are detected (engine not running) to prevent engine flooding.

Fuel Injector

The sequential multiport fuel injection (SFI) fuel injector is a solenoid-operated device controlled by the PCM. The PCM 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.

A fuel injector which is stuck partly open will cause a loss of fuel pressure after engine shut down, causing long crank times.



0003

Fuel Metering System Components

The fuel metering system is made up of the following parts:

- The fuel injectors.
- The throttle body.
- The fuel rail.
- The fuel pressure regulator.
- The PCM.
- The crankshaft position (CKP) sensor.
- The camshaft position (CMP) sensor.
- The idle air control (IAC) valve.
- The fuel pump.
- The fuel pump relay.

Basic System Operation

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. Refer to *Section 6C* for further information on the fuel tank, line filter, and fuel pipes.

Fuel Metering System Purpose

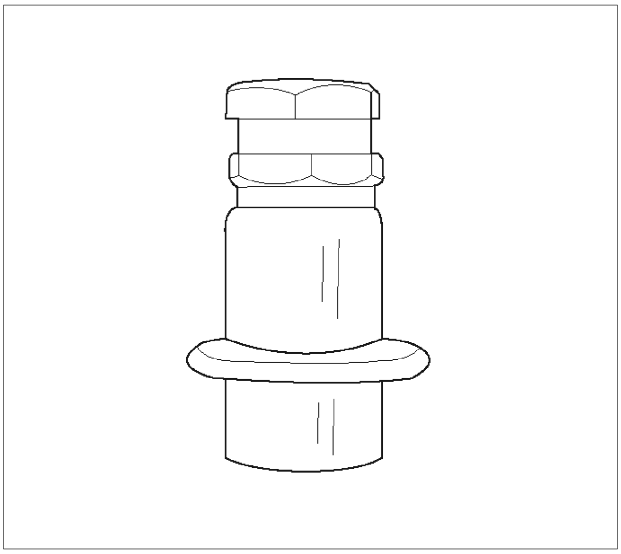
The basic function of the air/fuel metering system is to control the air/fuel delivery to the engine. Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold near each intake valve.

The main control sensor is the heated oxygen sensor (HO2S) located in the exhaust system. The HO2S tells the PCM how much oxygen is in the exhaust gas. The PCM 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 PCM monitors signals from several sensors in order to determine the fuel needs of the engine. Fuel is delivered under one of several conditions called “modes.” All modes are controlled by the PCM.

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, DTC P0151,DTC P0171 or DTC P1171 will be the result. If the pressure is too high, excessive odor and/or a DTC P0132, DTC P0152,DTC P0172 or DTC P0175 will be the result. Refer to *Fuel System Diagnosis* for information on diagnosing fuel pressure conditions.



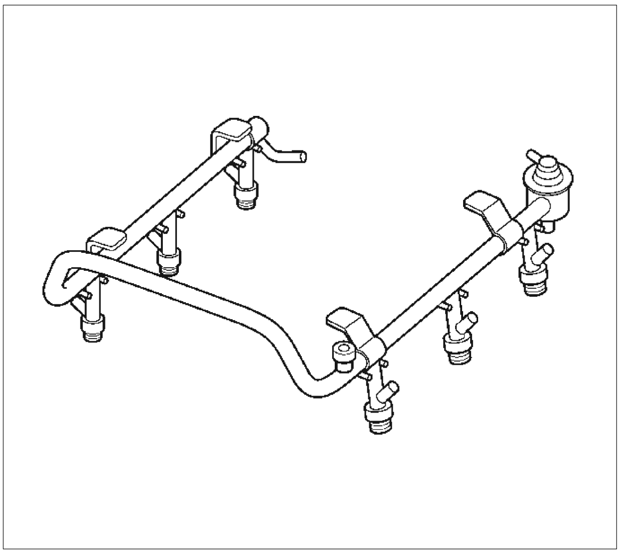
0011

Fuel Pump Electrical Circuit

When the key is first turned “ON,” the PCM 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 PCM 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 PCM, the PCM 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.

Fuel Rail

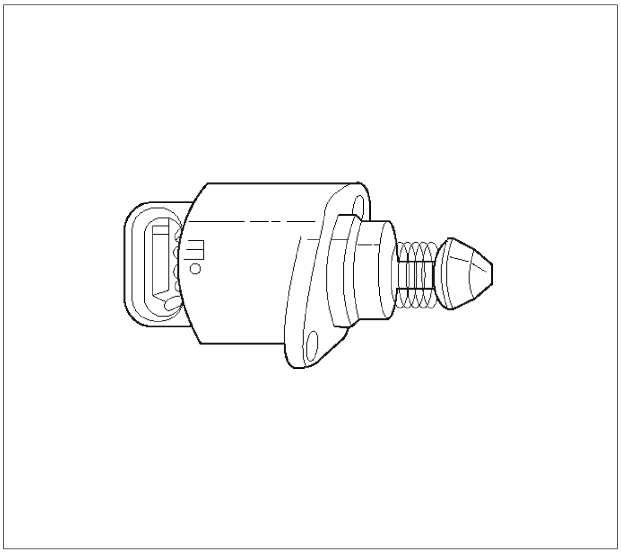
The fuel rail is mounted to the top of the engine and distributes fuel to the individual injectors. Fuel is delivered to the fuel inlet tube of the fuel rail by the fuel lines. The fuel goes through the fuel rail to the fuel pressure regulator. The fuel pressure regulator maintains a constant fuel pressure at the injectors. Remaining fuel is then returned to the fuel tank.



055RW009

Idle Air Control (IAC) Valve

The purpose of the idle air control (IAC) valve is to control engine idle speed, while preventing stalls due to changes in engine load. The IAC valve, mounted in the throttle body, controls bypass air around the throttle plate. By moving the conical valve (pintle) in (to decrease air flow) or out (to increase air flow), a controlled amount of air can move around the throttle plate. If the RPM is too low, the PCM will retract the IAC pintle, resulting in more air moving past the throttle plate to increase the RPM. If the RPM is too high, the PCM will extend the IAC pintle, allowing less air to move past the throttle plate, decreasing the RPM.
The IAC pintle valve moves in small steps called counts. During idle, the proper position of the IAC pintle is calculated by the PCM based on battery voltage, coolant temperature, engine load, and engine RPM. If the RPM drops below a specified value, and the throttle plate is closed, the PCM senses a near-stall condition. The PCM 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 RPM 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 characteristics 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 a lean air/fuel ratio. DTC P0507 or DTC P1509 may set. If the IAC pintle is stuck closed, too little air will be allowed in the manifold. This results in a low idle speed, along with possible hard starting and a rich air/fuel ratio. DTC P0506 or DTC P1508 may set. If the IAC pintle is stuck part-way open, the idle may be high or low and will not respond to changes in the engine load.



0006

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 PCM 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 PCM 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

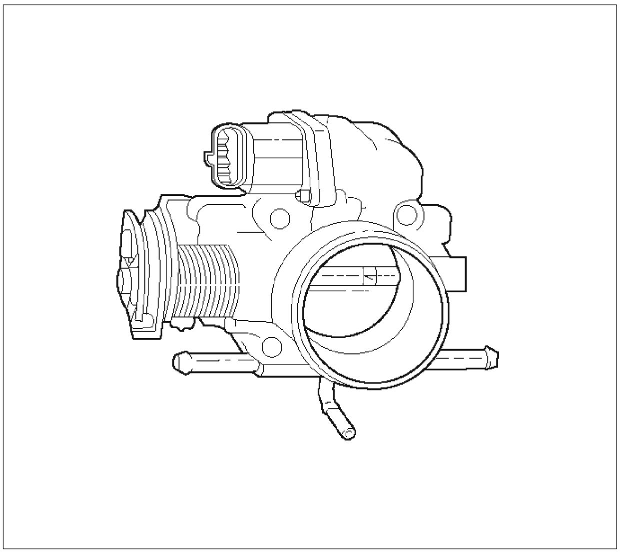
When the ignition is first turned “ON,” the PCM energizes the fuel pump relay for two seconds to allow the fuel pump to build up pressure. The PCM then checks the engine coolant temperature (ECT) sensor and the throttle position (TP) sensor to determine the proper air/fuel ratio for starting.

The PCM 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.

Throttle Body Unit

The throttle body has a throttle plate to control the amount of air delivered to the engine. The TP sensor and IAC valve are also mounted on the throttle body. Vacuum ports located behind the throttle plate provide the vacuum signals needed by various components.

Engine coolant is directed through a coolant cavity in the throttle body to warm the throttle valve and to prevent icing.

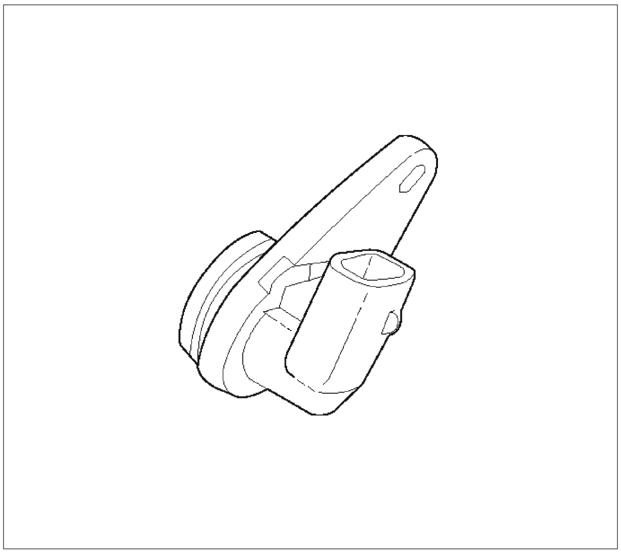


0019

General Description (Electronic Ignition System)

Camshaft Position (CMP) Sensor

As the camshaft sprocket turns, a magnet in the sprocket activates the Hall-effect switch in the CMP sensor. When the Hall-effect switch is activated, it grounds the signal line to the PCM, pulling the camshaft position sensor signal circuit’s applied voltage low. This is a CMP signal. The CMP signals is created as piston #1 is approximately 25° after top dead counter on the power stroke. If the correct CMP signal is not received by the PCM, DTC P0341 will be set.



0014

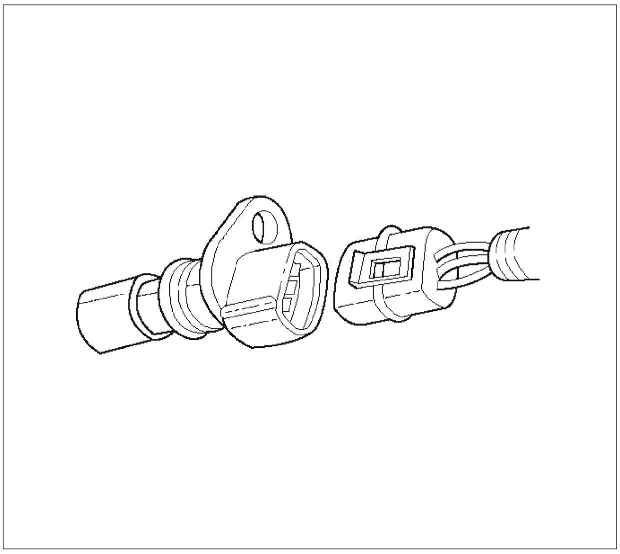
Crankshaft Position (CKP) Sensor

The crankshaft position (CKP) sensor provides a signal used by the powertrain control module (PCM) to calculate the ignition sequence. The sensor initiates the 58X reference pulses which the PCM uses to calculate RPM and crankshaft position. Refer to *Electronic Ignition System* for additional information.

Electronic Ignition

The electronic ignition system controls fuel combustion by providing a spark to ignite the compressed air/fuel mixture at the correct time. To provide optimum engine performance, fuel economy, and control of exhaust emissions, the PCM controls the spark advance of the ignition system. Electronic ignition has the following advantages over a mechanical distributor system:

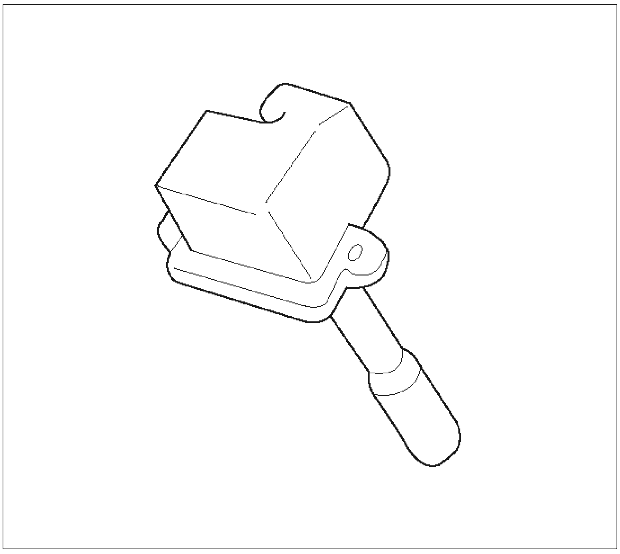
- No moving parts.
- Less maintenance.
- Remote mounting capability.
- No mechanical load on the engine.
- More coil cooldown time between firing events.
- Elimination of mechanical timing adjustments.
- Increased available ignition coil saturation time.



0013

Ignition Coils

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-volt primary supply from the 15-amp ignition fuse, a ground-switching trigger line from the PCM, and a ground.



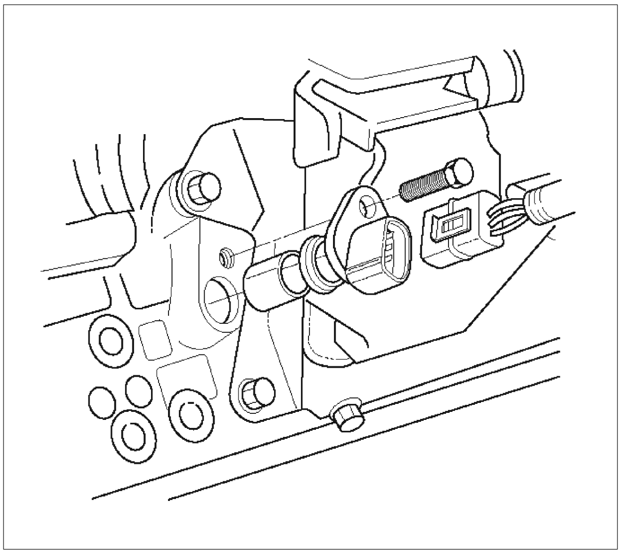
0001

Ignition Control

The ignition control (IC) spark timing is the PCM's method of controlling the spark advance and the ignition dwell. The IC spark advance and the ignition dwell are calculated by the PCM using the following inputs:

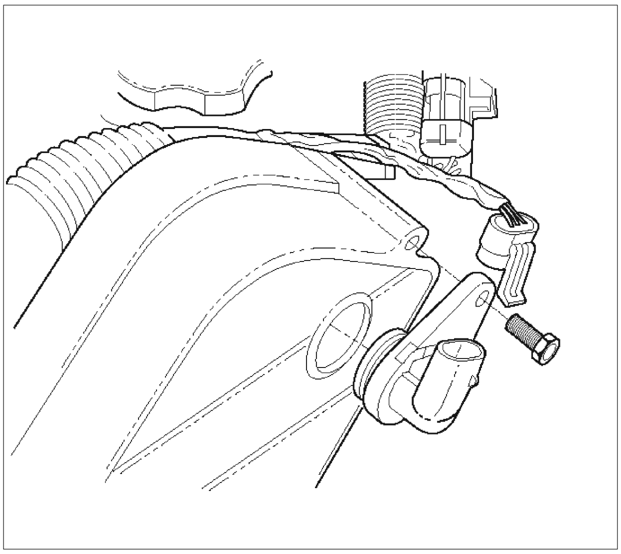
- Engine speed.

- Crankshaft position (58X reference).
- Camshaft position (CMP) sensor.
- Engine coolant temperature (ECT) sensor.
- Throttle position (TP) sensor.
- Knock signal (knock sensor).
- Park/Neutral position (PRNDL input).
- Vehicle speed (vehicle speed sensor).
- PCM and ignition system supply voltage.
- The crankshaft positron (CKP) sensor sends the PCM a 58X signal related to the exact position of the crankshaft.



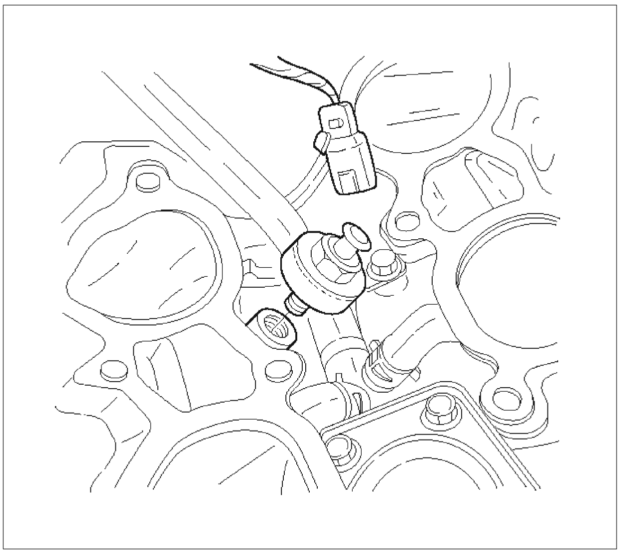
TS22909

- The camshaft position (CMP) sensor sends a signal related to the position of the camshaft.



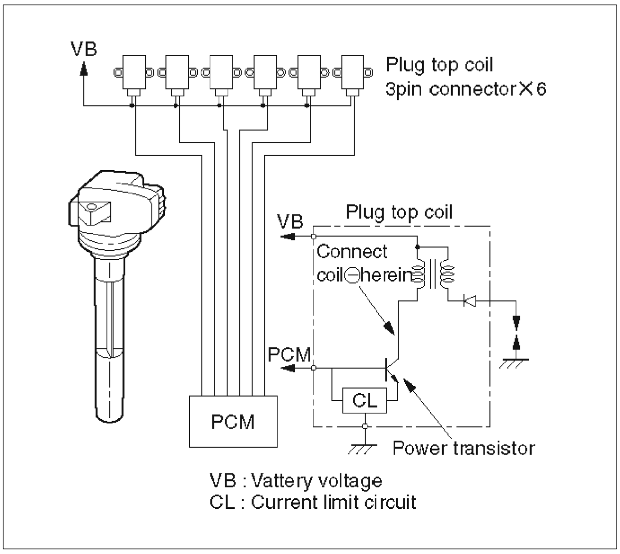
TS22910

- The knock sensor tells the PCM if there is any problem with pre-ignition or detonation. This information allows the PCM to retard timing, if necessary.



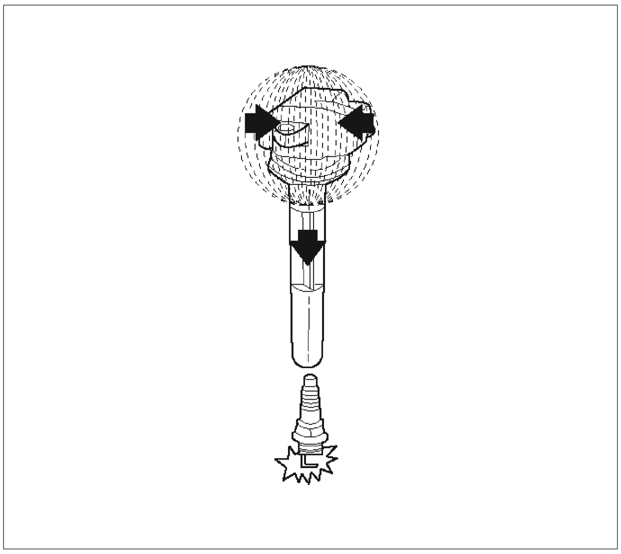
TS24037

Based on these sensor signals and engine load information, the PCM sends 5V to each ignition coil.



060RW015

The PCM applies 5V signal voltage to the ignition coil requiring ignition. This signal sets on 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 PCM 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.



TS24047

Ignition Control PCM Output

The PCM 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 PCM, 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 PCM 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 PCM and the ignition coil is monitored for open circuits, shorts to voltage, and shorts to ground. If the PCM 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

Knock Sensor (KS) PCM Input

The knock sensor (KS) system is comprised of a knock sensor and the PCM. The PCM monitors the KS signals to determine when engine detonation occurs. When a knock sensor detects detonation, the PCM retards the spark timing to reduce detonation. Timing may also be retarded because of excessive mechanical engine or transmission noise.

Powertrain Control Module (PCM)

The PCM is responsible for maintaining proper spark and fuel injection timing for all driving conditions. To provide optimum driveability and emissions, the PCM monitors the input signals from the following components in order to calculate spark timing:

- Engine coolant temperature (ECT) sensor.
- Intake air temperature (IAT) sensor.
- Mass air flow (MAF) sensor.
- PRNDL input from transmission range switch.
- Throttle position (TP) sensor.
- Vehicle speed sensor (VSS) .
- Crankshaft position (CKP) sensor.

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.*

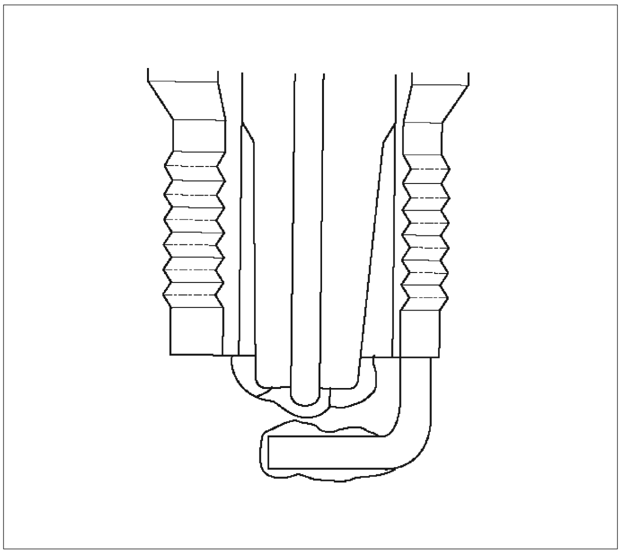
Normal spark plug operation will result in brown to grayish-tan deposits appearing on the insulator portion of the spark plug. A small amount of red-brown, yellow, and white powdery material may also be present on the insulator tip around the center electrode. These deposits are normal combustion by-products 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. While other ignition and fuel system causes must also be considered, possible causes include ignition system conditions which allow the spark voltage to reach ground in some other manner than by jumping across the air gap at the tip of the spark plug, leaving the air/fuel mixture unburned. Misfiring may also occur when the tip of the spark plug becomes overheated and ignites the mixture before the spark jumps. This is referred to as “pre-ignition.”

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.

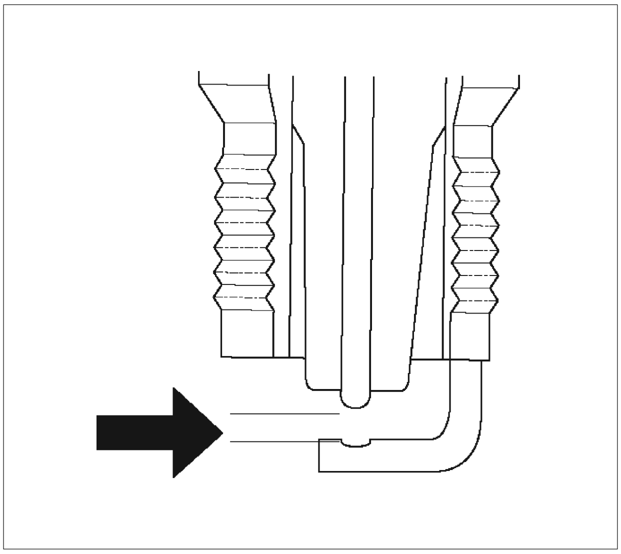
Oil fouling of the spark plug is indicated by wet oily deposits on the portion of the spark plug in the cylinder, usually with little electrode wear. This may be caused by oil during break-in of new or newly overhauled engines.

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

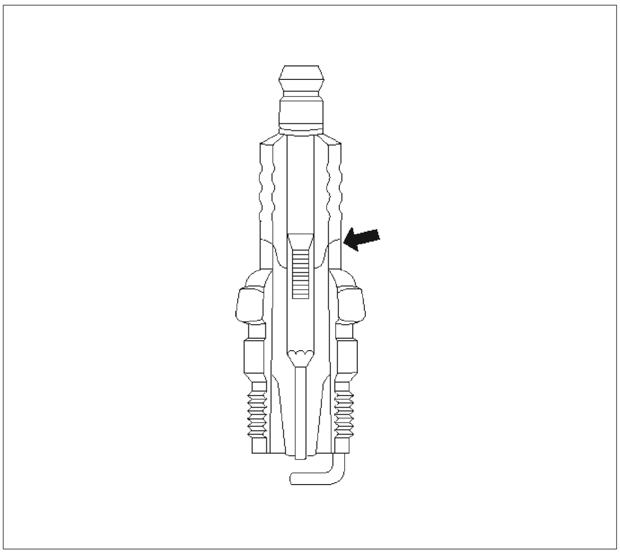
Excessive gap means that the air space between the center and the side electrodes at the bottom of the spark plug is too wide for consistent firing. This may be due to improper gap adjustment or to excessive wear of the electrode during use. A check of the gap size and comparison to the gap specified 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

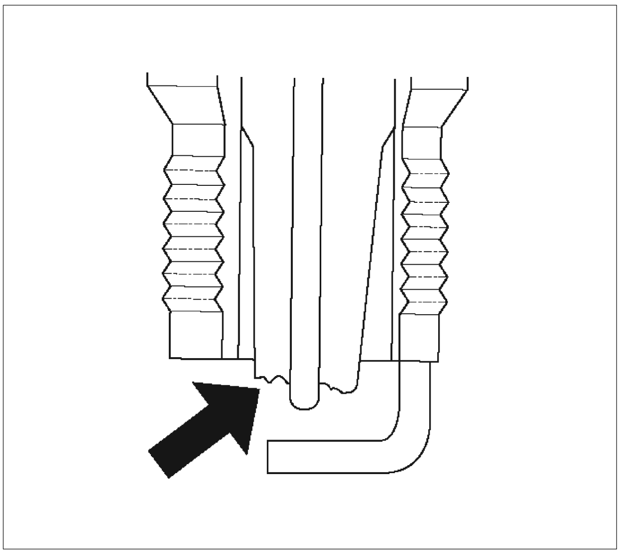
Low or high spark plug installation torque or improper seating can result in the spark plug running too hot and can cause excessive center electrode wear. The plug and the cylinder head seats must be in good contact for proper heat transfer and spark plug cooling. Dirty or damaged threads in the head 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. Overtightening 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 re-gapping, or 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.



TS23994

A broken or cracked lower insulator tip (around the center electrode) may result from damage during re-gapping or from “heat shock” (spark plug suddenly operating too hot).



TS23993

- Damage during re-gapping can happen if the gapping tool is pushed against the center electrode or the insulator around it, causing the insulator to crack. When re-gapping a spark plug, make the adjustment by bending only the ground side terminal, keeping the tool clear of other parts.
- ”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.

Spark plugs with less than the recommended amount of service can sometimes be cleaned and re-gapped , then returned to service. However, 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.

A/C Clutch Diagnosis

A/C Clutch Circuit Operation

A 12-volt signal is supplied to the A/C request input of the PCM when the A/C is selected through the A/C control switch.

The A/C compressor clutch relay is controlled through the PCM. This allows the PCM to modify the idle air control position prior to the A/C clutch engagement for better idle quality. If the engine operating conditions are within their specified calibrated acceptable ranges, the PCM will enable the A/C compressor relay. This is done by providing a ground path for the A/C relay coil within the PCM. When the A/C compressor relay is enabled, battery voltage is supplied to the compressor clutch coil. The PCM will enable the A/C compressor clutch whenever the engine is running and the A/C has been requested. The PCM will not enable the A/C compressor clutch if any of the following conditions are met:

- The throttle is greater than 90%.
- The engine speed is greater than 6315 RPM.
- The ECT is greater than 119°C (246°F).
- The IAT is less than 5°C (41°F).
- The throttle is more than 80% open.

A/C Clutch Circuit Purpose

The A/C compressor operation is controlled by the powertrain control module (PCM) for the following reasons:

- It improvises idle quality during compressor clutch engagement.
- It improvises wide open throttle (WOT) performance.
- It provides A/C compressor protection from operation with incorrect refrigerant pressures.

The A/C electrical system consists of the following components:

- The A/C control head.
- The A/C refrigerant pressure switches.
- The A/C compressor clutch.
- The A/C compressor clutch relay.
- The PCM.

A/C Request Signal

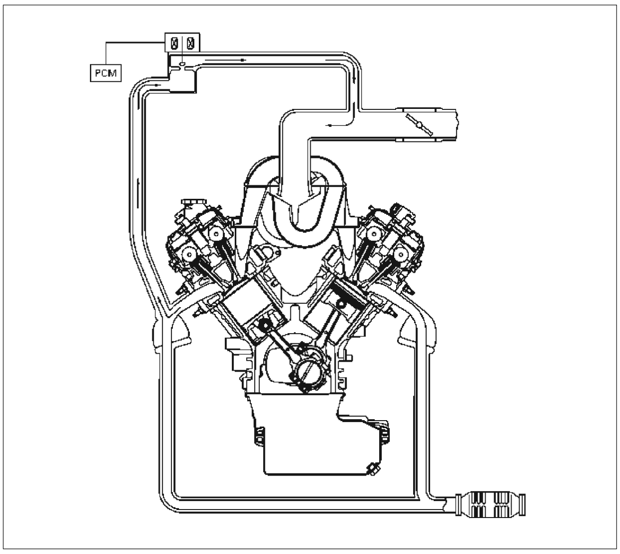
This signal tells the PCM when the A/C mode is selected at the A/C control head. The PCM uses this to adjust the idle speed before turning on the A/C clutch. The A/C compressor will be inoperative if this signal is not available to the PCM.

Refer to *A/C Clutch Circuit Diagnosis* for A/C wiring diagrams and diagnosis for A/C electrical system.

General Description (Exhaust Gas Recirculation (EGR) System)

EGR Purpose

The exhaust gas recirculation (EGR) system is use to reduce emission levels of oxides of nitrogen (NOx). NOx emission levels are caused by a high combustion temperature. The EGR system lowers the NOx emission levels by decreasing the combustion temperature.



057RW002

Linear EGR Valve

The main element of the system is the linear EGR valve. The EGR valve feeds small amounts of exhaust gas back into the combustion chamber. The fuel/air mixture will be diluted and combustion temperatures reduced.

Linear EGR Control

The PCM monitors the EGR actual positron and adjusts the pintle position accordingly. The uses information from the following sensors to control the pintle position:

- Engine coolant temperature (ECT) sensor.
- Throttle position (TP) sensor.
- Mass air flow (MAF) sensor.

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 PCM controlled pintle. During operation, the PCM controls pintle position by monitoring the pintle position feedback signal. The feedback signal can be monitored with Tech 2 as “Actual EGR Pos.” “Actual EGR Pos.” should always be near the commanded EGR position (”Desired EGR Pos.”). If a problem with the EGR system will not allow the PCM to control the pintle position properly, DTC P1406 will set. The PCM also tests for EGR flow. If incorrect flow is detected, DTC P0401 will set. If DTCs P0401 and/or P1406 are set, refer to the DTC charts.

The linear EGR valve is usually activated under the following conditions:

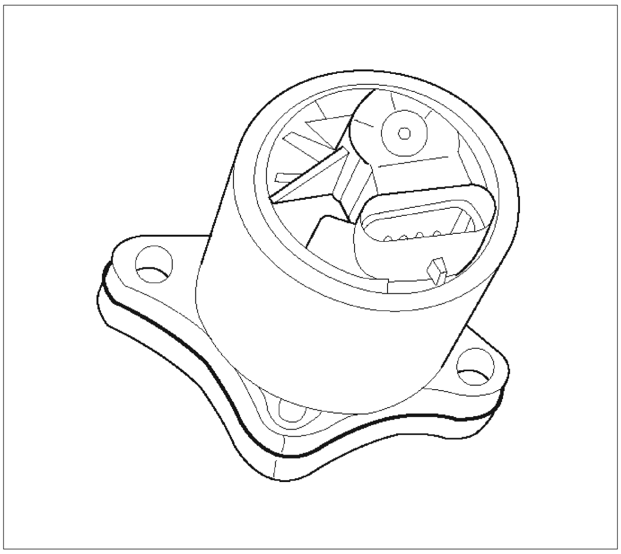
- Warm engine operation.
- Above-idle speed.

Too much 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).
- Engine overheating.
- Emission test failure.
- DTC P0401 (EGR flow test).
- Poor fuel economy.



0017

EGR Pintle Position Sensor

The PCM monitors the EGR valve pintle position input to endure that the valve responds properly to commands from the PCM and to detect a fault if the pintle position sensor and control circuits are open or shorted. If the PCM detects a pintle position signal voltage outside the normal range of the pintle position sensor, or a signal voltage that is not within a tolerance considered acceptable for proper EGR system operation, the PCM will set DTC P1406.

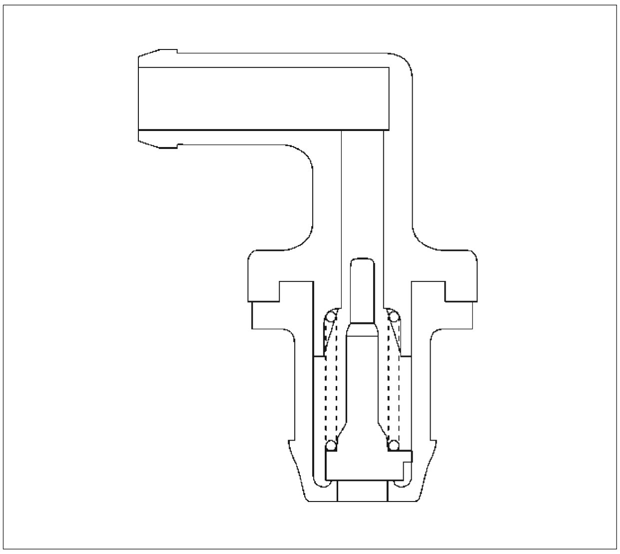
General Description (Positive Crankcase Ventilation (PCV) System)

Crankcase Ventilation System Purpose

The crankcase ventilation system is use to consume crankcase vapors in the combustion process instead of venting them to the atmosphere. Fresh air from the throttle body is supplied to the crankcase and mixed with blow-by gases. This mixture is then passed through the positive crankcase ventilation (PCV) valve into the common chamber.

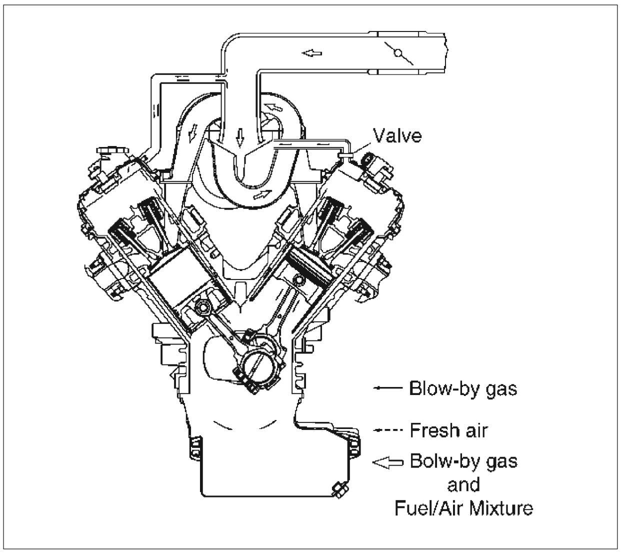
Crankcase Ventilation System Operation

The primary control is through the positive crankcase ventilation (PCV) valve. The PCV valve meters the flow at a rate that depends on the intake vacuum. The PCV valve restricts the flow when the inlet vacuum is highest. In addition, the PCV valve can seal the common chamber off in case of sudden high pressure in the crankcase.



028RV002

While the engine is running, exhaust fuses and small amounts of the fuel/air mixture escape past the piston rings and enter the crankcase. These gases are mixed with clean air entering through a tube from the air intake duct.



028RW002

During normal, part-throttle operation, the system is designed to allow crankcase gases to flow through the PCV valve into the throttle body to be consumed by normal combustion.

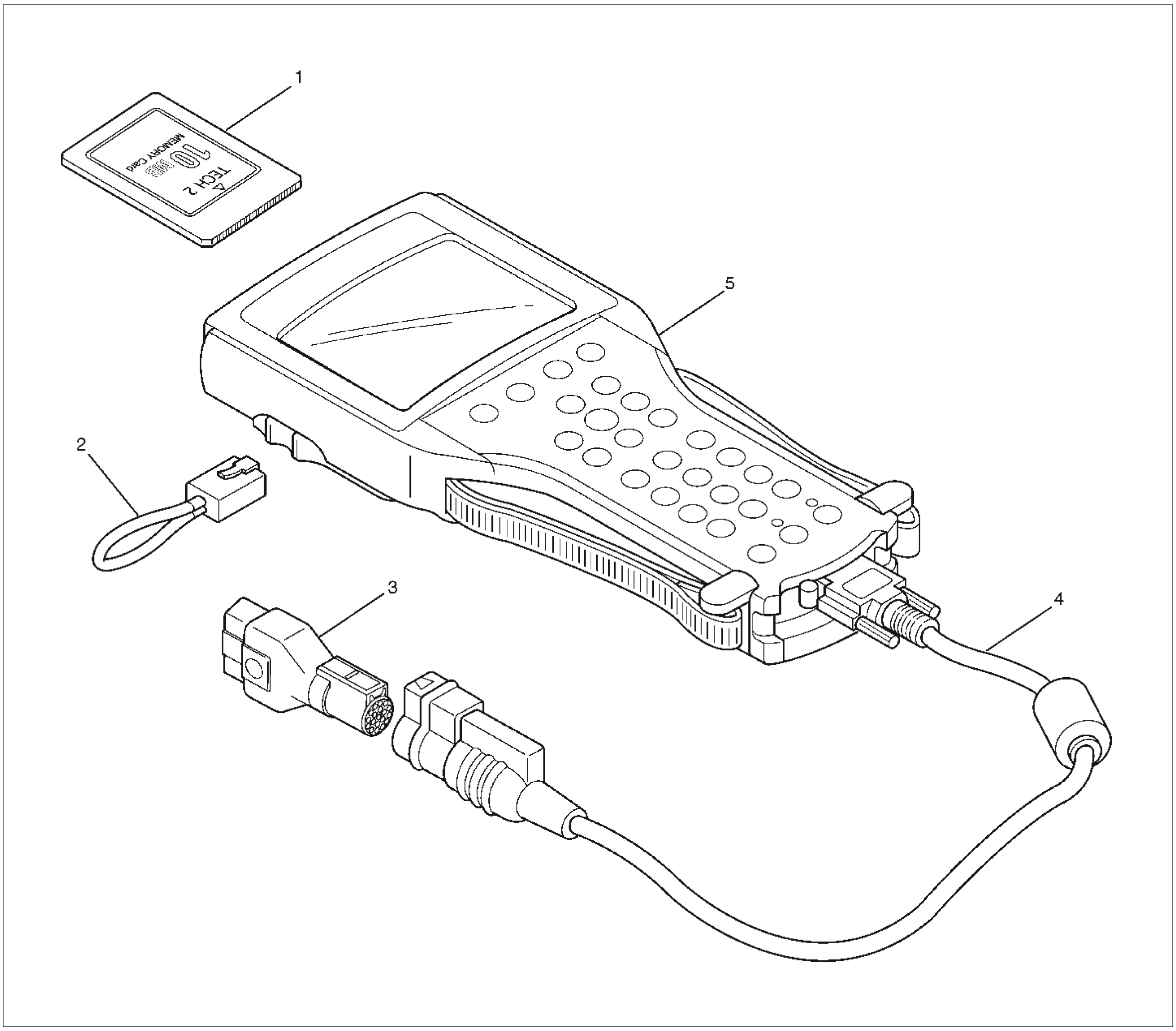
A plugged valve or PCV hose may cause the following conditions:

- Rough idle.
- Stalling of slow idle speed.
- Oil leaks.
- Sludge in the engine.

A leaking PCV hose would cause:

- Rough idle.
- Stalling.
- High idle speed.

Special Tools



901RW180

Legend

(1) PCMCIA Card
(2) RS232 Loop Back Connector
(3) SAE 16/19 Adapter
(4) DLC Cable
(5) TECH–2

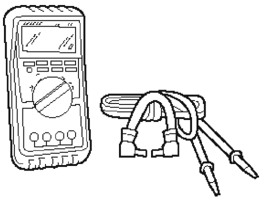
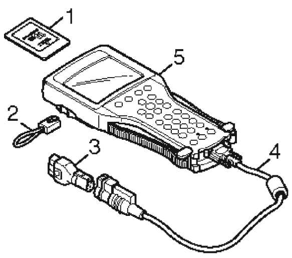
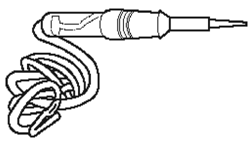
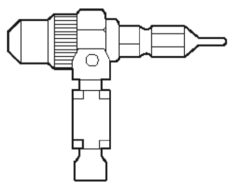
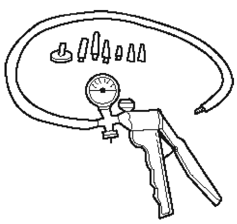
ILLUSTRATION	**TOOL NO.** TOOL NAME
	5-8840-0285-0 **(J 39200)** High Impedance Multimeter (Digital Voltmeter – DVM)
	(1) PCMCIA Card (2) RS232 Loop Back Connector (3) SAE 16/19 Adapter (4) DLC Cable (5) TECH–2
	5-8840-0607-0 **(J 34142-B)** Unpowered Test Light
	5-8840-0385-0 **(J 35616-A/BT-8637)** Connector Test Adapter Kit
	5-8840-0383-0 **(J 26792/BT-7220-1)** Spark Tester
	5-8840-0279-0 **(J 23738-A)** Vacuum Pump with Gauge common tool

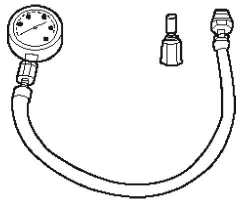
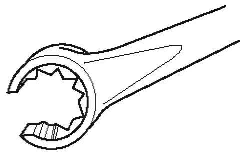
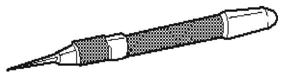
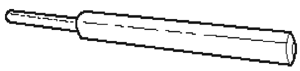
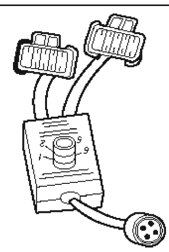
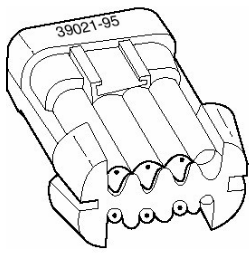
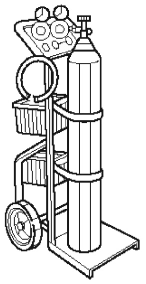
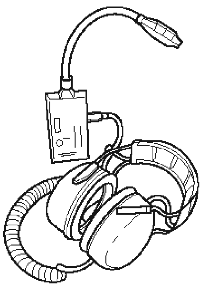
ILLUSTRATION	**TOOL NO.** TOOL NAME
	**BT-8515** Exhaust Back Pressure Tester or common tool
	5-8840-2640-0 **(J 39194-B)** Heated Oxygen Sensor Wrench
	5-8840-0632-0 **(J 35689-A)** Terminal Remover
	5-8840-0388-0 **(J 28742-A)** Weather Pack II Terminal Remover
	5-8840-2635-0 **(J 39021-90)** Injector Switch Box
	5-8840-2636-0 **(J 39021-65)** Injector Test Light

ILLUSTRATION	**TOOL NO.** TOOL NAME
	5-8840-2607-0 **(J 41413)** EVAP Pressure/Purge Diagnostic Station
	5-8840-2608-0 **(J 41416)** Ultrasonic Leak Detector

1. 5-8840-2607-0 (J-41413)EVAP Pressure/Purge Diagnostic Station is a multipurpose tool which is used to perform several diagnostic procedures for enhanced emission testing. The station will accommodate a nitrogen gas filled cylinder which is used to pressurize the vehicle EVAP system for a leakdown test and leak location test when a vehicle is repaired for leakage in the enhanced evaporative emission control system. It also has two additional gauges (inches of mercury and inches of water) which are used to measure both source vacuum and EVAP canister purge vacuum to verify correct operation and vapor flow within the canister purge circuit.
2. 5-8840-2608-0 (J-41416) Ultrasonic Leak Detector is a microprocessor-based device used to detect leaks in the enhanced evaporative emission control system. The evaporative system is pressurized to 30 inches of water using the 5-8840-2607-0 (J-41413) EVAP Pressure/Purge Diagnostic System. Small leaks in the EVAP system will emit sound at a high frequency undetectable by a human ear but detectable with the 5-8840-2608-0 (J-41416). The technician traces along the evaporative system and can pinpoint leaks due to corroded lines, cracked hoses, or a damaged EVAP component. The detector includes a high quality set of headphones to block out surrounding shop noise and the LED sensitivity meter allows a visual reference for locating leaks in conjunction with the audio output heard through the headphones. Powered by (1) nine volt battery.

ENGINE

ENGINE EXHAUST

CONTENTS

Service Precaution

WARNING: IF SO EQUIPPED WITH 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.

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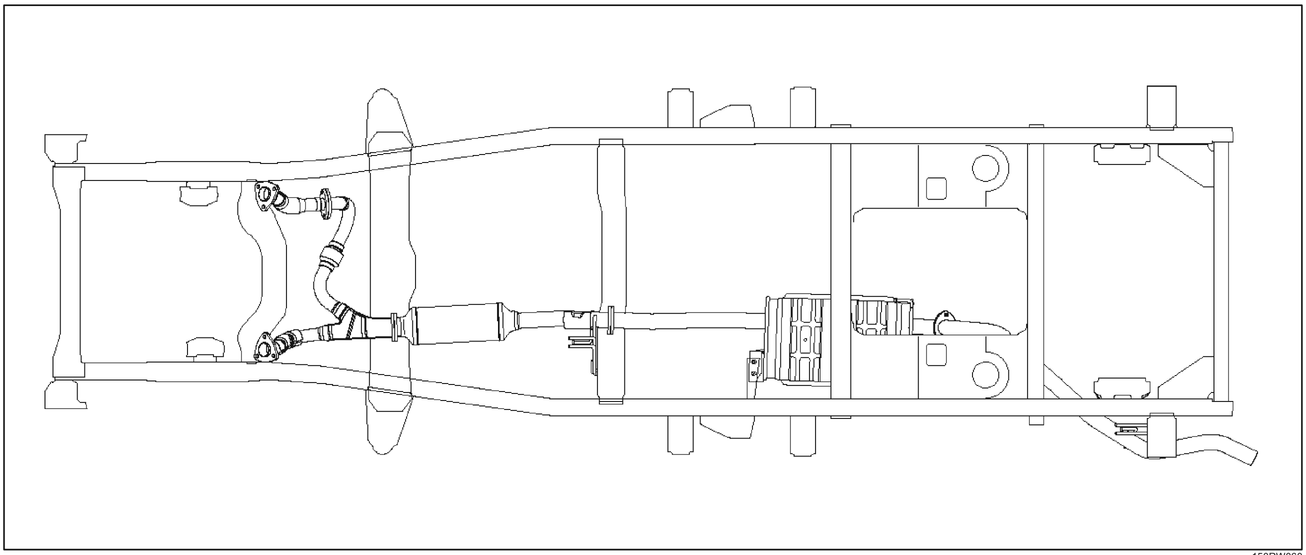
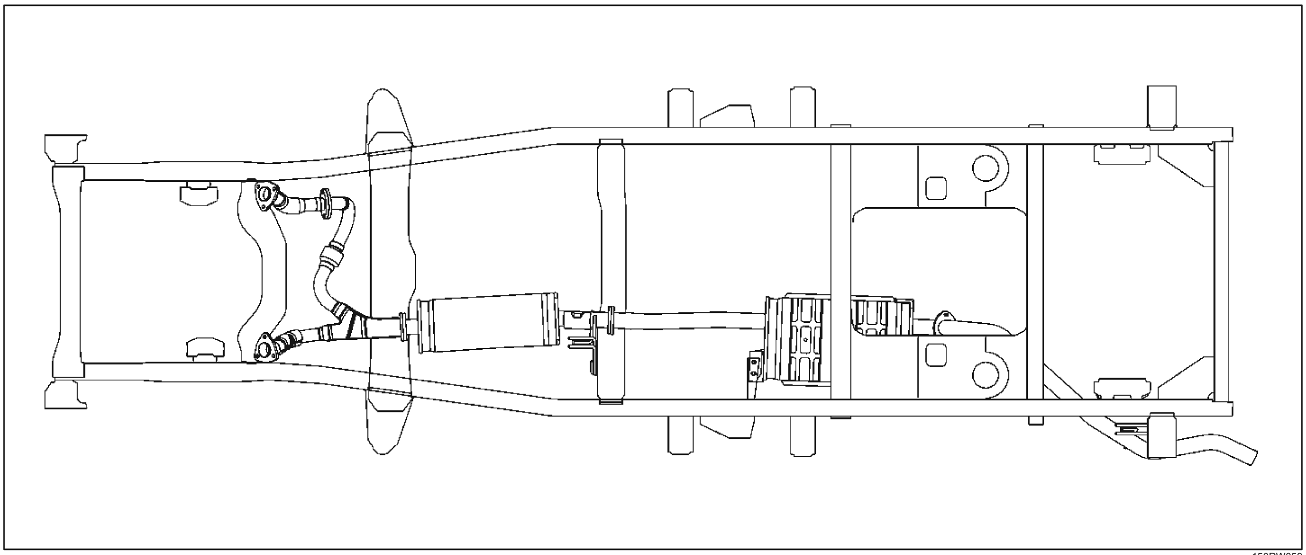
General Description

General export with three way catalytic converter model



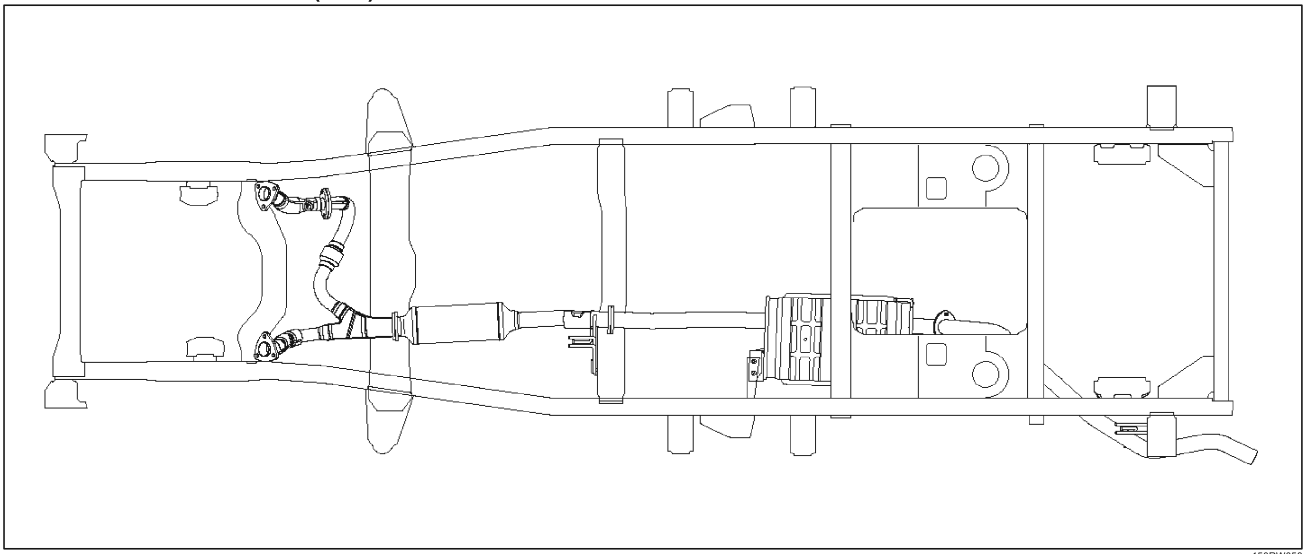
150RW060

General export with out three way catalytic converter model



150RW059

For Isuzu General Motors (IGM)



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 Types:

Three way (Reduction/Oxidation) catalyst

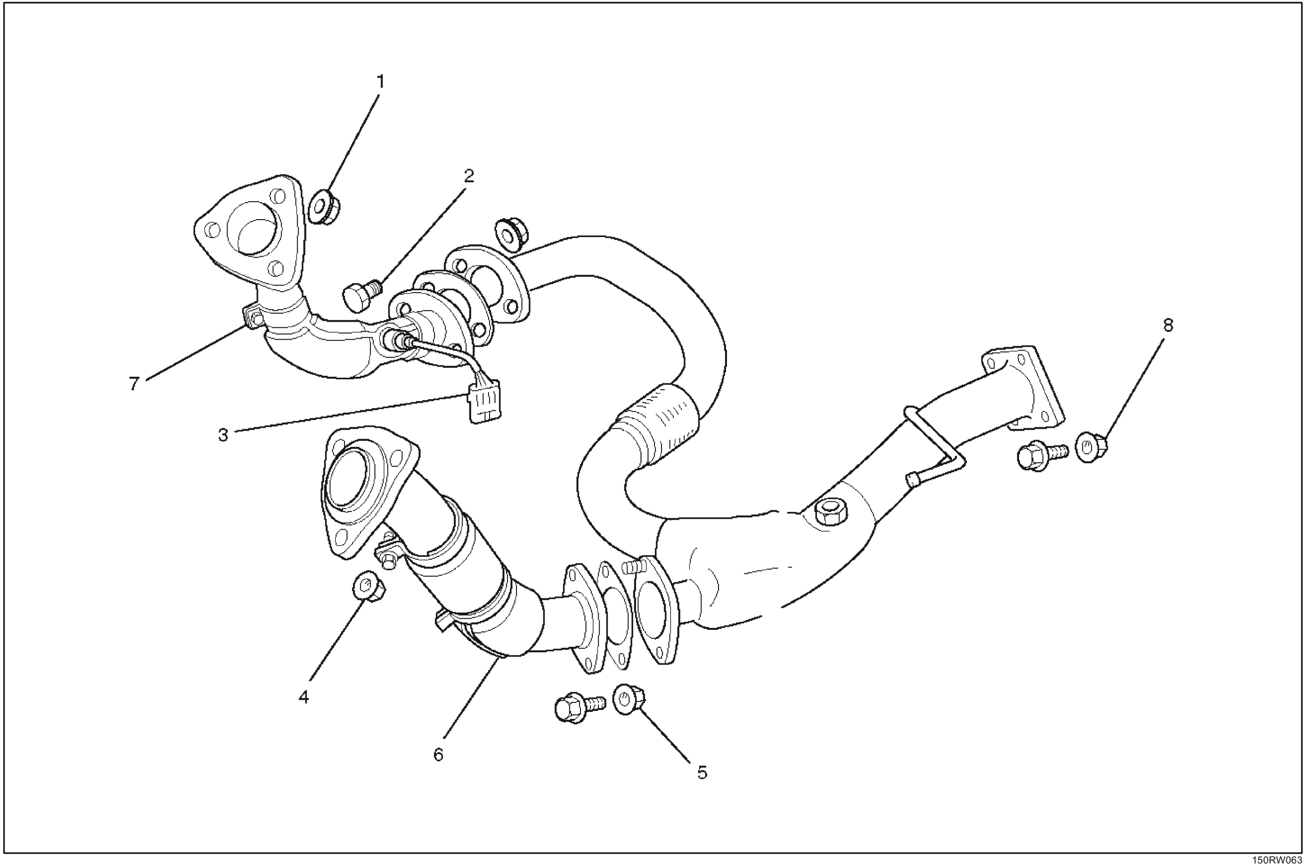
The catalyst coating on the three way (reduction) converter contains platinum and rhodium which lowers the levels of nitrous oxide (NOx) as well as hydrocarbons (HC) and carbon monoxide (Co).

Gasket

The gasket must be replaced whenever a new exhaust pipe, muffler or catalytic converter is installed.

Front Exhaust Pipe

Front Exhaust Pipe and Associated Parts



Legend

(1) Front Exhaust Pipe RH Fixing Nuts
(2) Front Exhaust Pipe RH Fixing Bolts and Nuts
(3) O_2 Sensor Terminal Connector (for IGM)
(4) Front Exhaust Pipe LH Fixing Nuts
(5) Front Exhaust Pipe LH Fixing Bolts and Nuts
(6) Front Exhaust Pipe LH
(7) Front Exhaust Pipe RH
(8) Three way Exhaust Pipe Fixing Bolts and Nuts

Removal

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Disconnect O_2 sensor harness connector (3).
4. Remove front exhaust pipe fixing nuts and three way Exhaust Pipe Fixing Bolts and Nuts (2)(5)(8).
5. Remove front exhaust pipe fixing three stud nuts from exhaust manifold (1)(4).
6. Remove front exhaust pipe (6)(7).

Installation

1. Install front exhaust pipe (6)(7) and tighten three stud nuts (1)(4) and nuts (2)(5)(8) to the specified torque.

   Torque

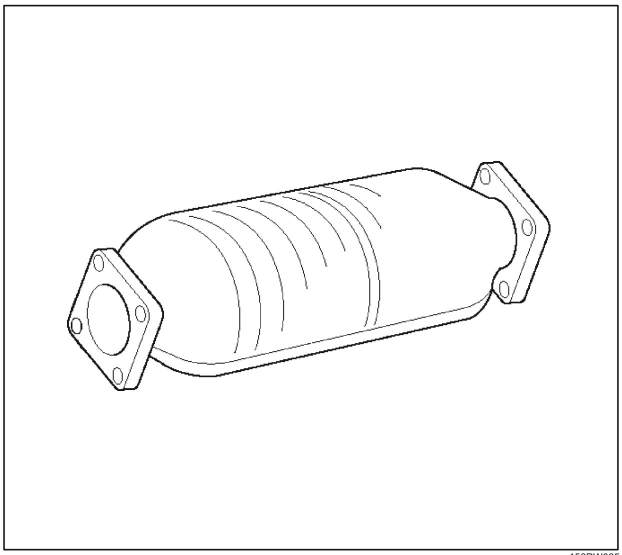
   Stud Nuts : 67 N·m (6.8 Kg·m/49 lb ft)

   Nuts : 43 N·m (4.3 Kg·m/32 lb ft)
2. Reconnect O_2 sensor harness connector (3).

Three Way Catalytic Converter

Removal

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove three way exhaust pipe fixing bolts and nuts.



150RW065

Installation

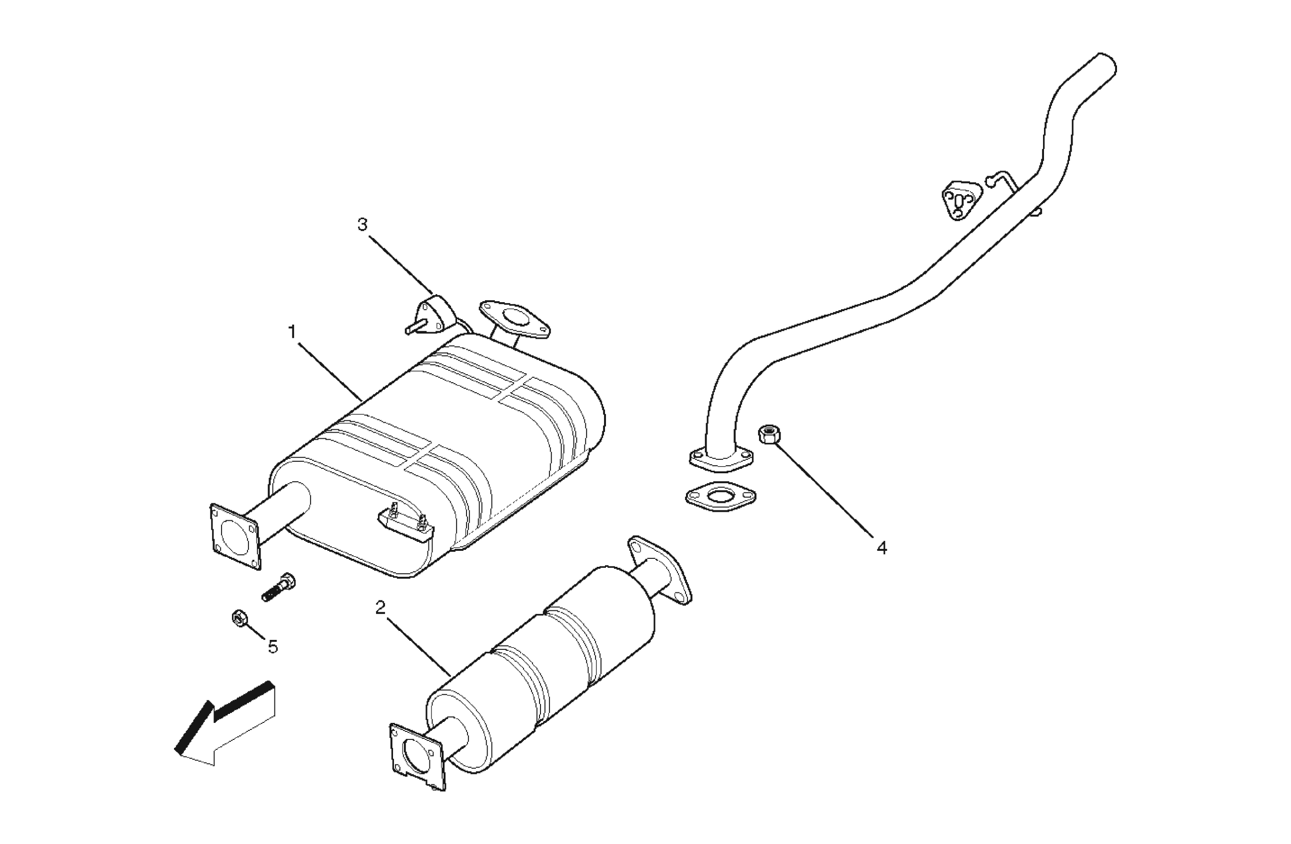
1. Install three way catalytic converter between three way exhaust pipe and silencer.
2. Tighten nuts to the specified torque.

Torque

Nuts : 43 N·m (4.4 Kg·m/32 lb ft)

Exhaust Silencer

Exhaust Silencer and Associated Parts



E06RW031

Legend

(1) Exhaust Silencer
(2) Exhaust Silencer
(3) Mounting Rubber
(4) Exhaust Silencer Fixing Nuts
(5) Exhaust Silencer Fixing Bolts

Removal

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove exhaust silencer fixing nuts (4) then disconnect rear exhaust pipe from exhaust silencer.
4. Remove exhaust silencer fixing nuts (5) then disconnect exhaust silencer from three way exhaust pipe.
5. Remove exhaust silencer mounting nuts from chassis side then remove exhaust silencer (1)(2).

Installation

1. Install the exhaust silencer (1)(2) chassis side and tighten nuts to the specified torque.

   Nuts: 16 N·m (1.6 Kg·m/12 lb ft)

2. Install the exhaust silencer and tighten nuts (5) on front exhaust pipe to specified torque.

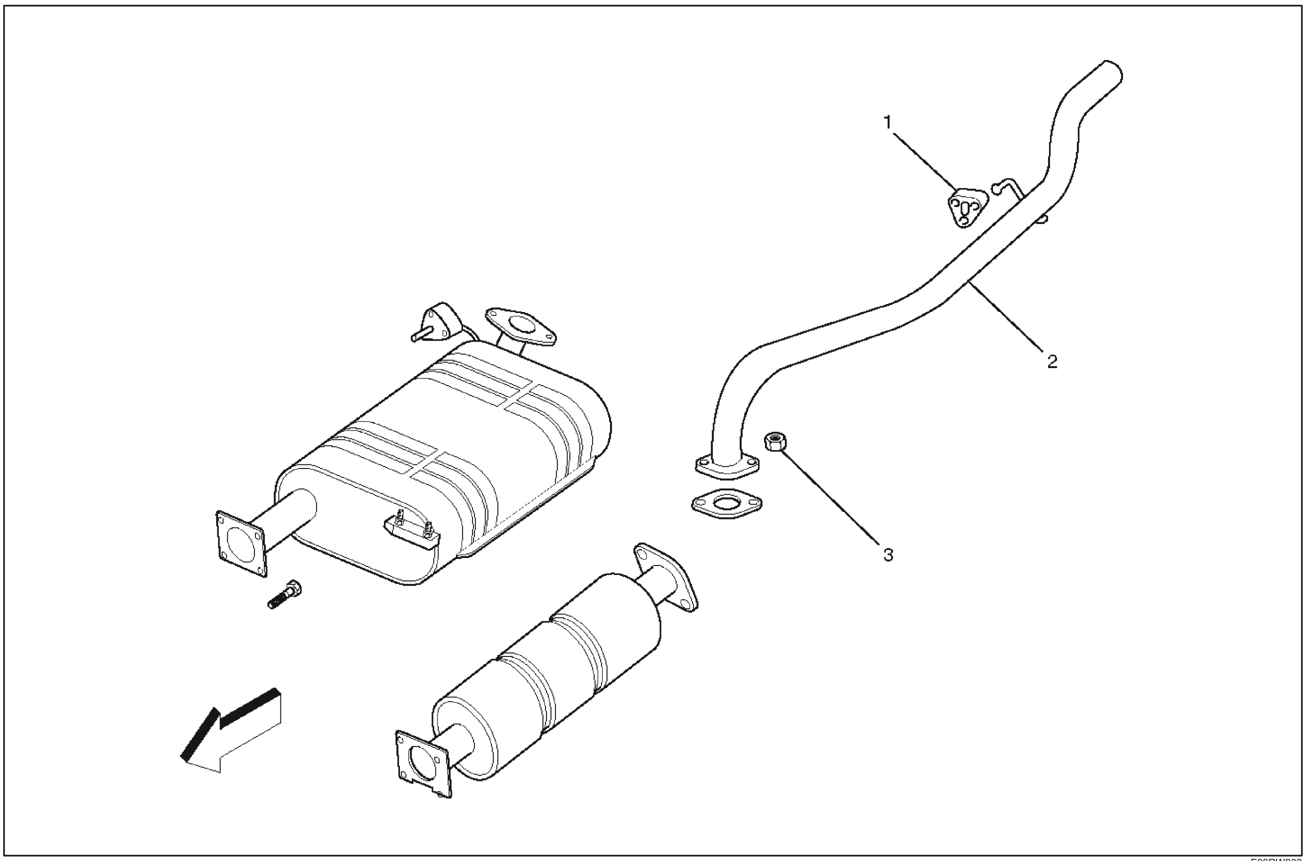
   Nuts: 43 N·m (4.4 Kg·m/32 lb ft)

3. Install the rear exhaust pipe and tighten fixing nuts on exhaust silencer to specified torque.

   Nuts: 43 N·m (4.4 Kg·m/32 lb ft)

Rear Exhaust pipe

Rear Exhaust pipe and Associated Parts



Legend

(1) Mounting Rubber

(2) Rear Exhaust Pipe

(3) Rear Exhaust Pipe Fixing Nuts

Removal

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove rear exhaust pipe fixing nuts (3), then disconnect rear exhaust pipe from exhaust silencer.
4. Remove mounting rubber (1).
5. Remove rear exhaust pipe (2).

Installation

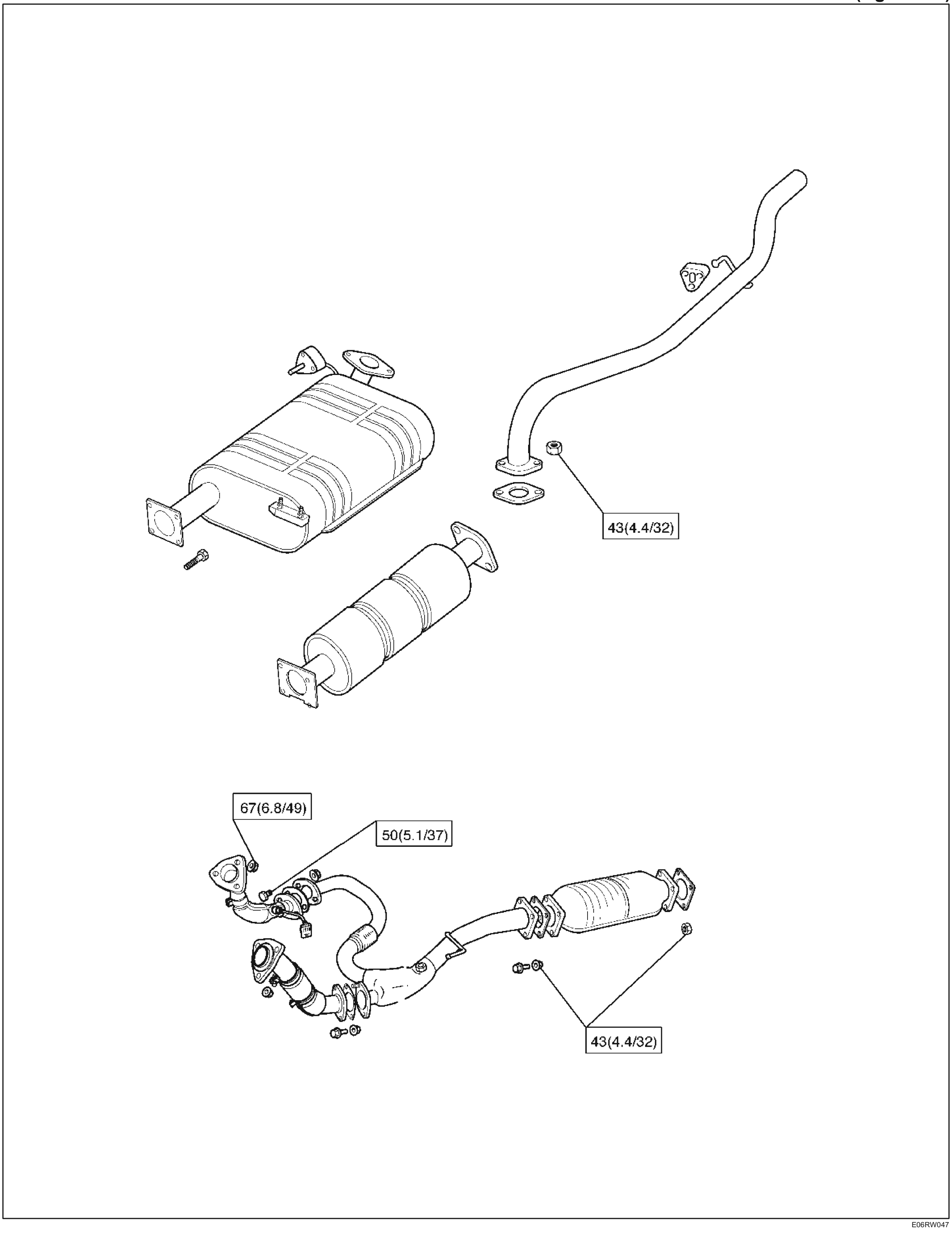
1. Install the mounting rubber (1).
2. Install the exhaust pipe (2) and tighten two nuts (3) on exhaust silencer to specified torque.

Nuts: 43 N·m (4.4 Kg·m/32 lb ft)

Main Data and Specifications

Torque Specifications

N·m (Kg·m/lb ft)



ENGINE

ENGINE LUBRICATION

CONTENTS

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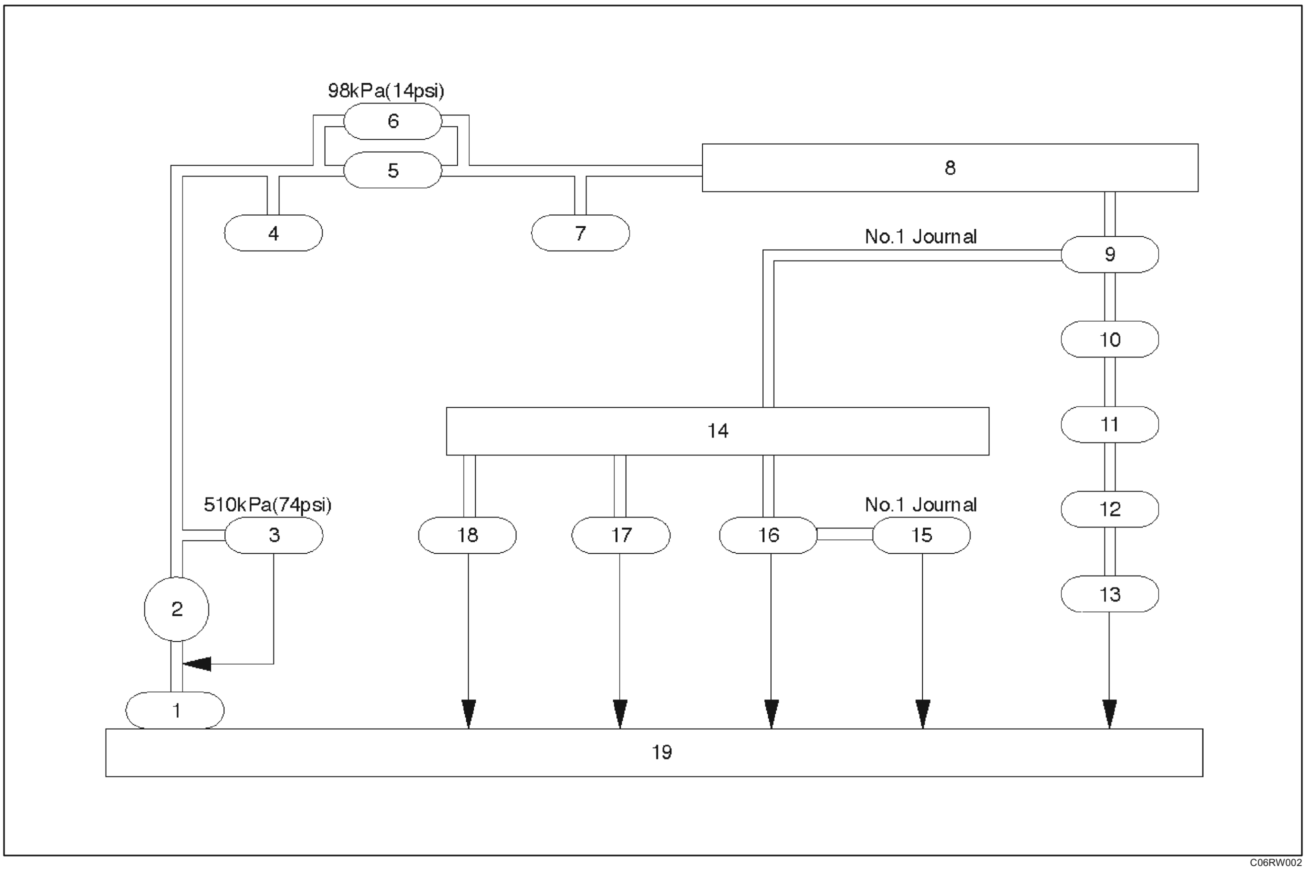
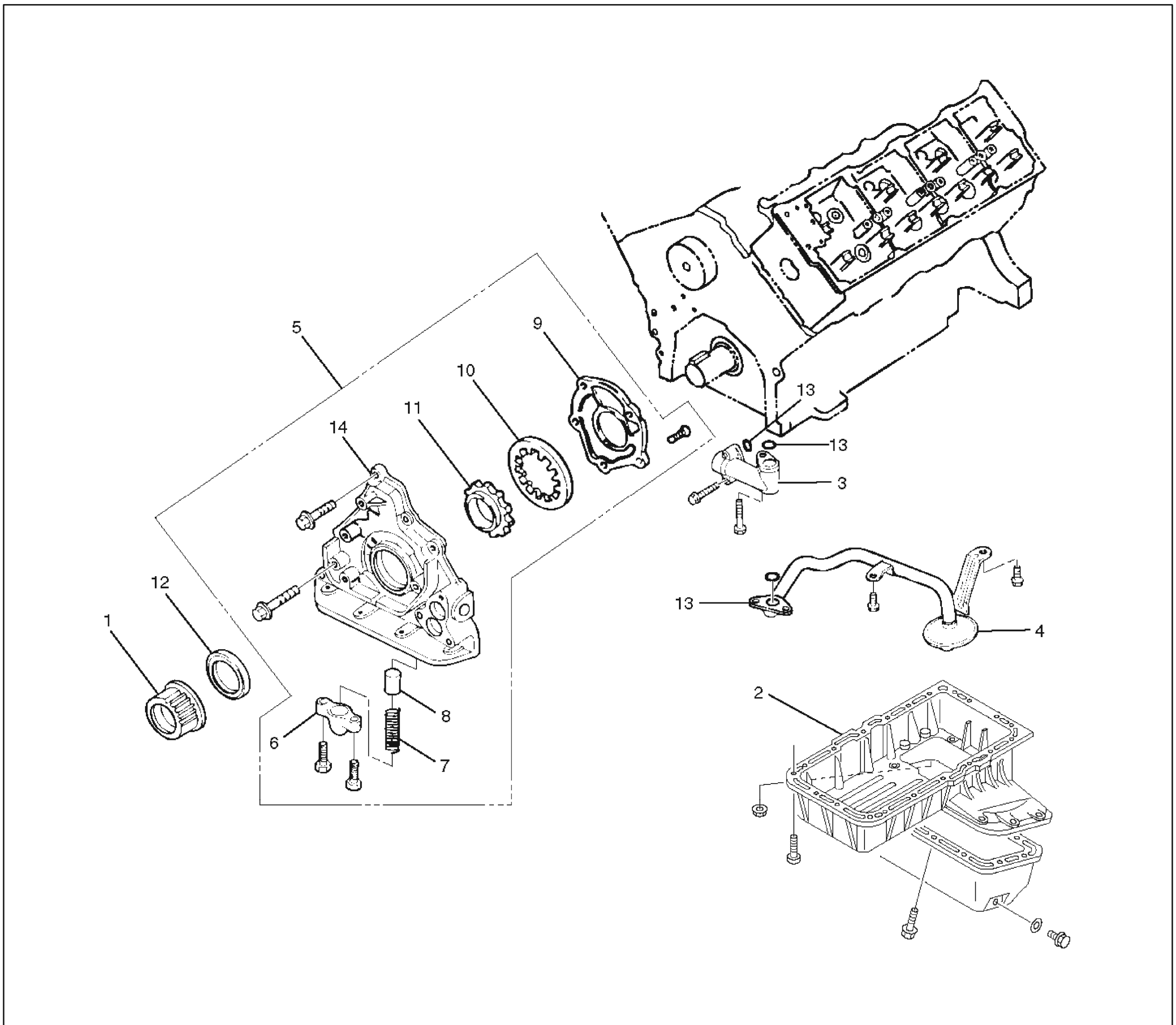


Legend

(1) Oil Strainer
(2) Oil Pump
(3) Relief Valve
(4) Oil Pressure Switch
(5) Oil Filter
(6) Safety Valve
(7) Oil Pressure Unit
(8) Oil Gallery
(9) Crankshaft Bearing
(10) Crankshaft
(11) Connecting Rod Bearing
(12) Connecting Rod
(13) Piston
(14) Oil Gallery; Cylinder Head
(15) Camshaft
(16) Camshaft Journal
(17) Front Journal; Camshaft Drive Gear
(18) Rear Journal; Camshaft Drive Gear
(19) 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
(7) Spring
(8) Relief Valve
(9) Oil Pump Cover
(10) Driven Gear
(11) Drive Gear
(12) Oil Seal
(13) O-ring
(14) Oil Pump Body

Oil Pump and Associated Parts

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.

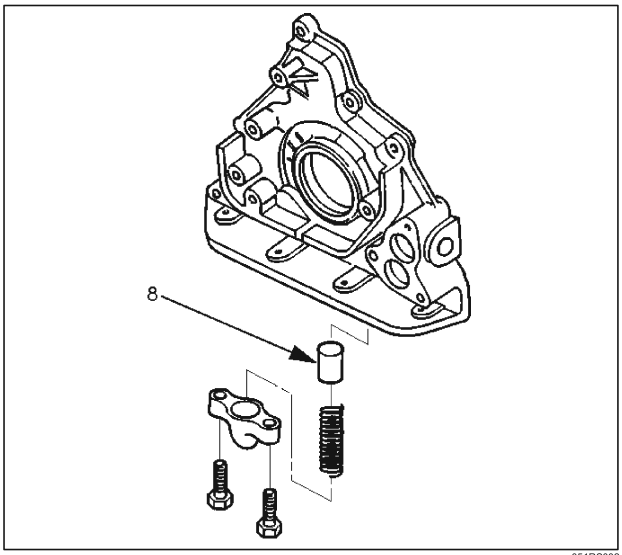
11. Remove drive gear.
12. Remove oil seal.
13. Remove O-ring.

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)

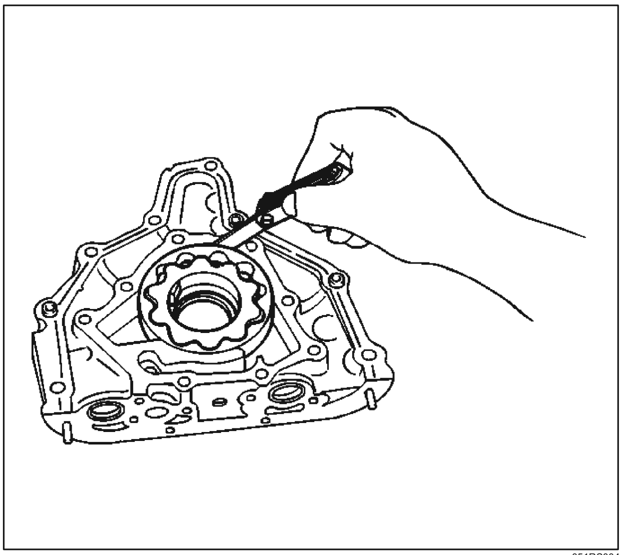
The pump assembly must be replaced if one or more of the conditions below is discovered during inspection.

- 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)

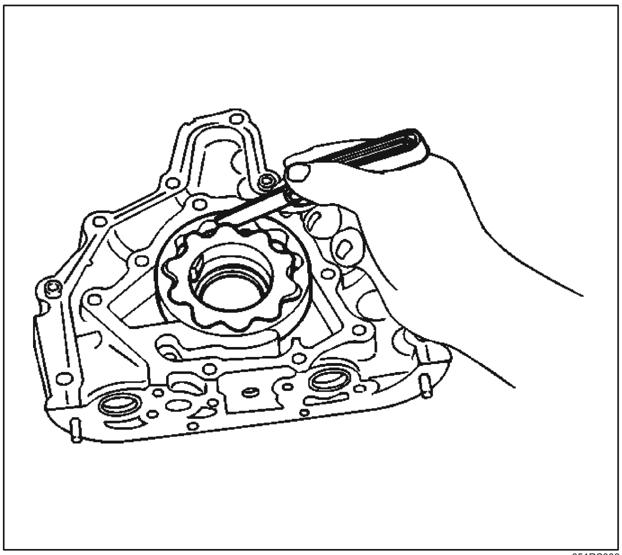


051RS004

- 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)



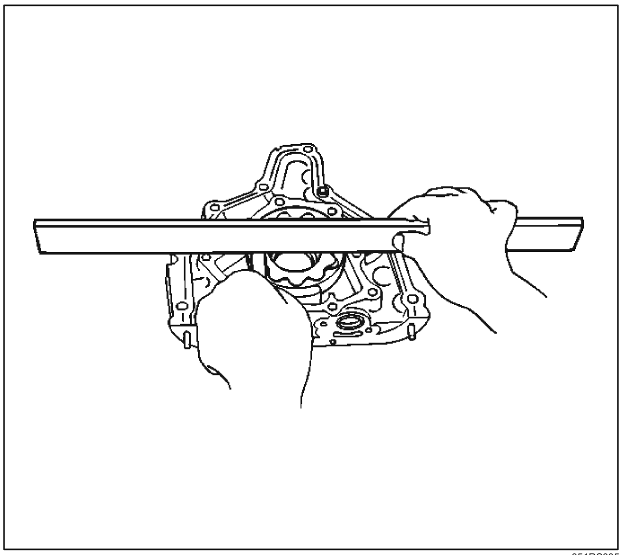
051RS003

- Measure the side clearance with a precision straight edge and a feeler gauge.

Clearance

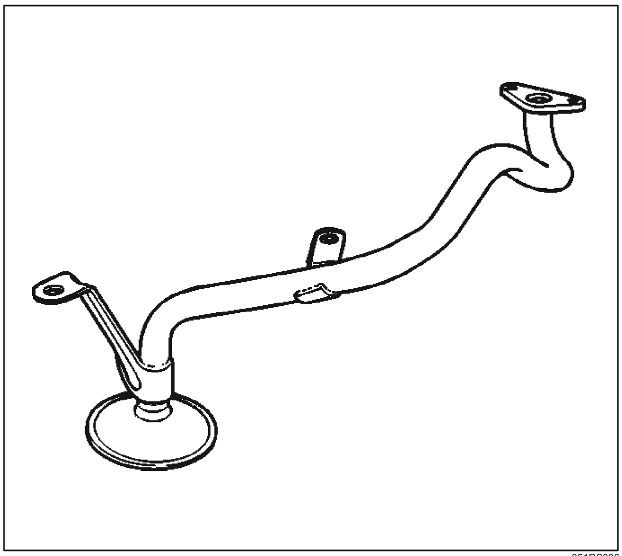
Standard : 0.03 mm–0.09 mm (0.0011 in–0.0035 in)

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

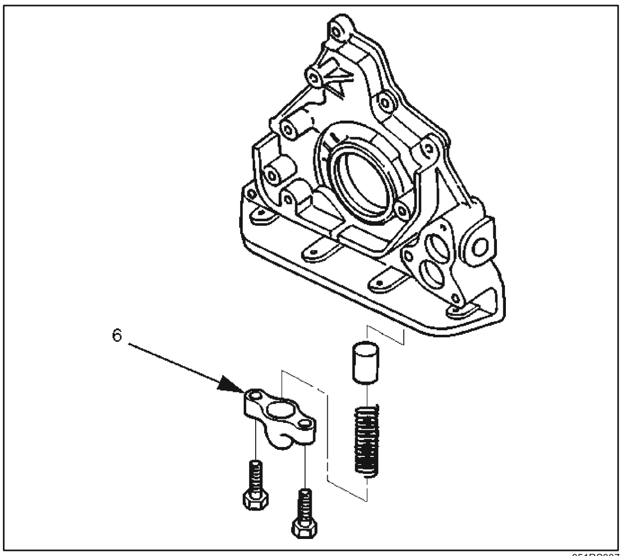
Reassembly

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/89 lb in)

   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/69 lb in)



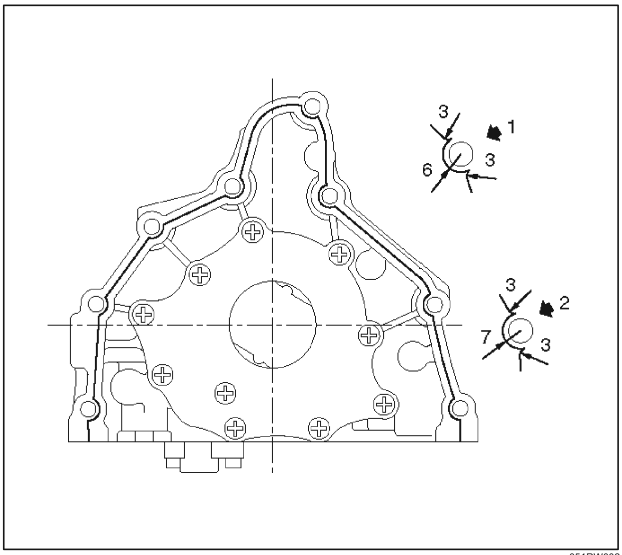
051RS007

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 before the sealant hardens.

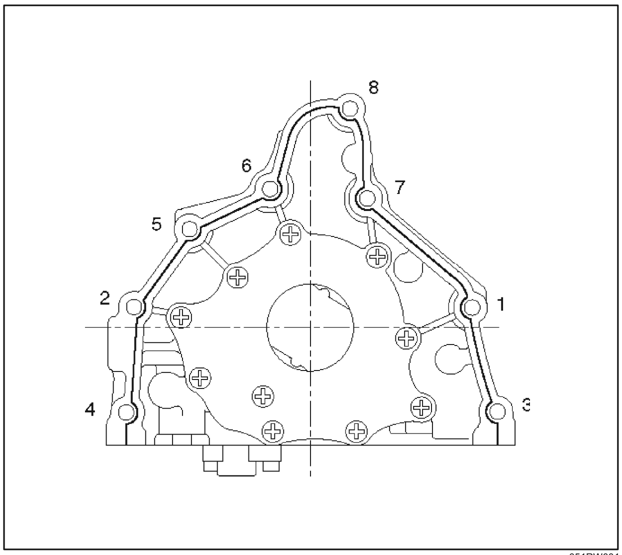
CAUTION: Do not apply an excessive amount of sealant to the contact surface. Applying too much sealant will overflow the contact surfaces. This could cause serious damage to the engine.

- **Attach oil pump assembly to cylinder body.**
- **Tighten the oil pump fixing bolts.**

  Torque : 25 N·m (2.5 Kg·m/18 lb·ft)



051RW002



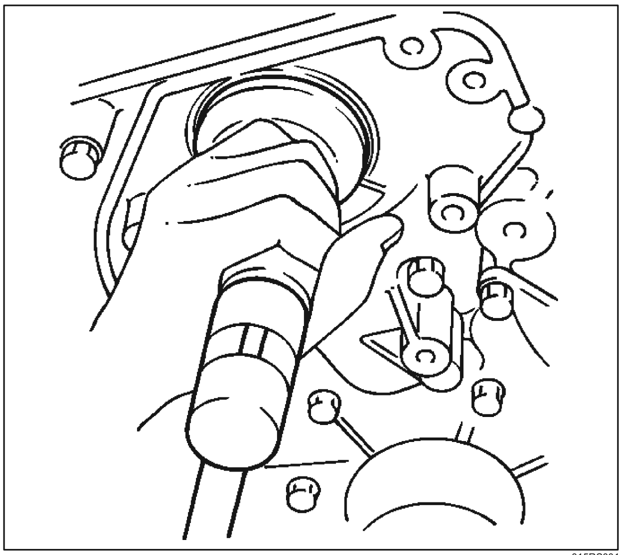
051RW001

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).

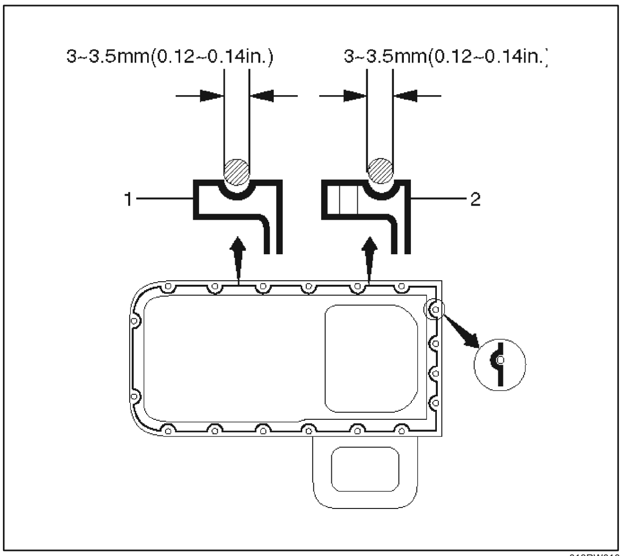
Torque: 25 N·m (2.5 Kg·m/18 lb ft)

10. Install oil pipe (3) with O-ring (13).

Torque: 25 N·m (2.5 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 before the sealant hardens.
    - Tighten fixing bolts to the specified torque.

Torque : 10 N·m (1.0 Kg·m/89 lb in)



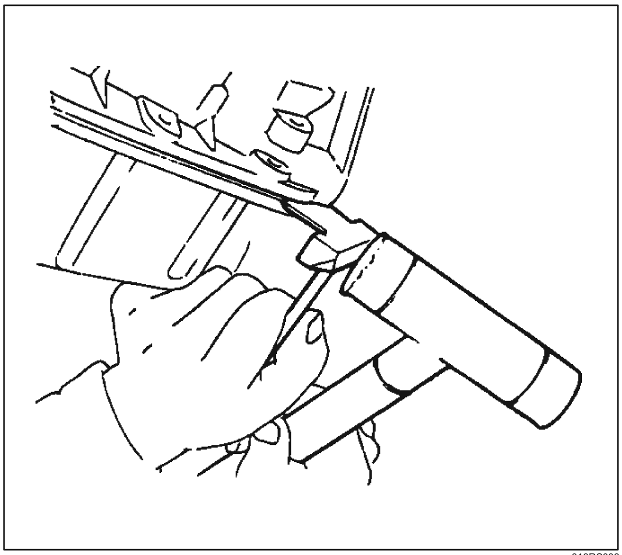
013RW010

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.
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.

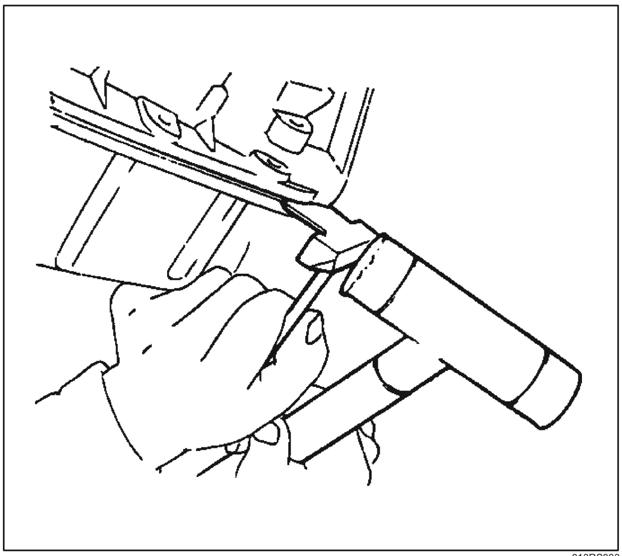


013RS003

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.



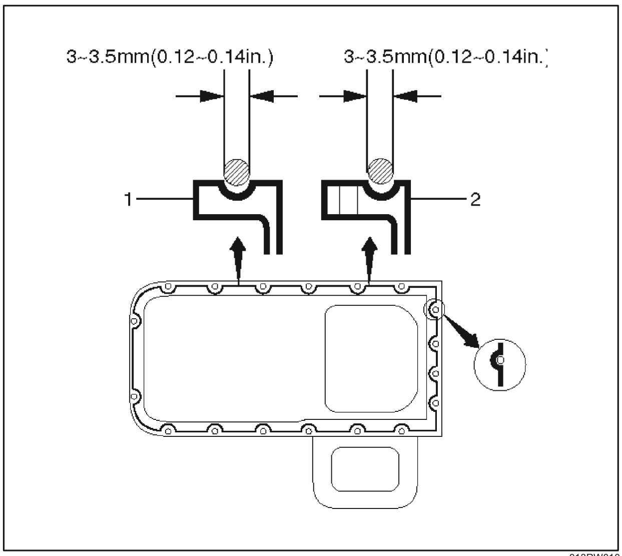
013RS003

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.

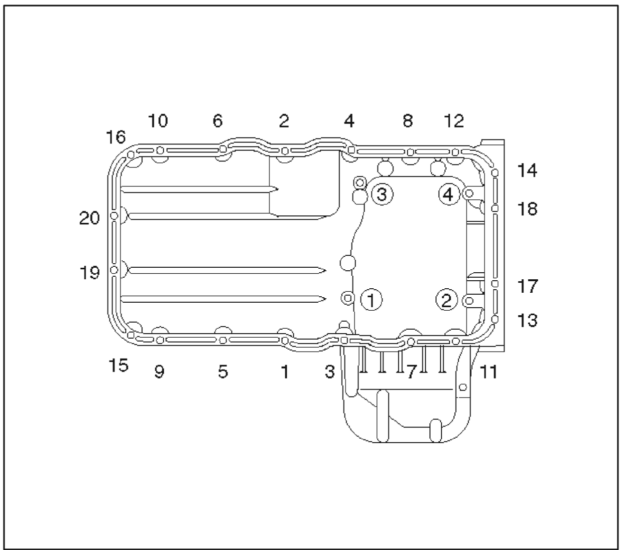
      - The crankcase must be installed within 5 minutes after sealant application before the sealant hardens.



013RW010

3. Install crankcase, tighten crankcase fixing bolts to the specified torque.

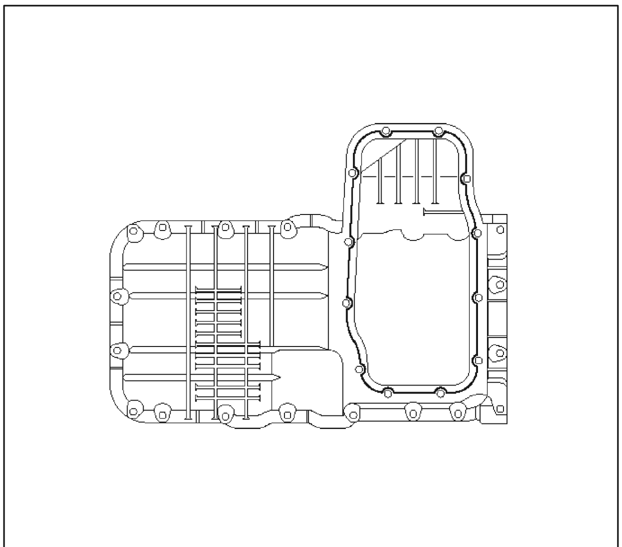
Torque : 10 N·m (1.0 Kg·m/89 lb in)



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 (07 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 befor 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)

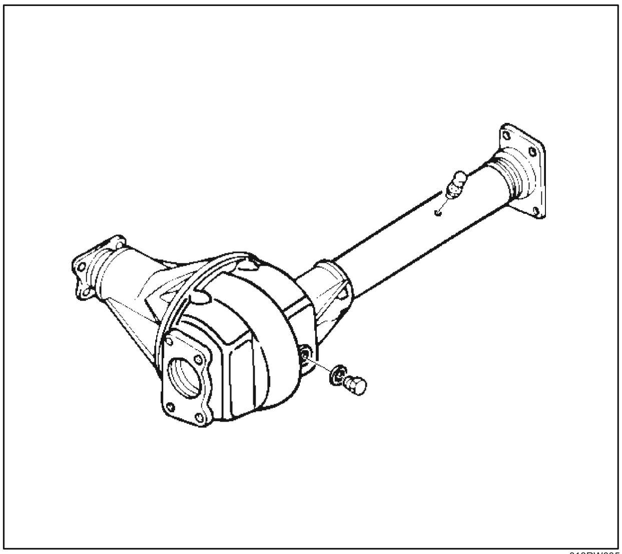
3. Install axle housing assembly and tighten fixing bolts to the specified torque.

Axle case bolts

Torque : 82 N·m (8.4 Kg·m/60 lb ft)

Mounting bolts

Torque : 152 N·m (15.5 Kg·m/112 lb ft)



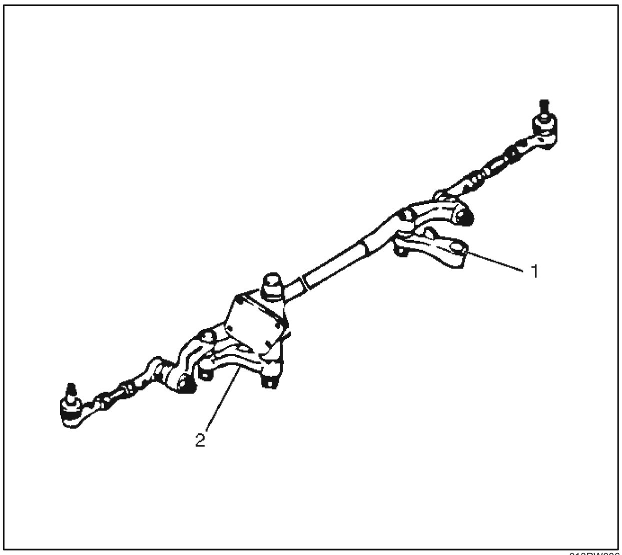
013RW005

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)



013RW006

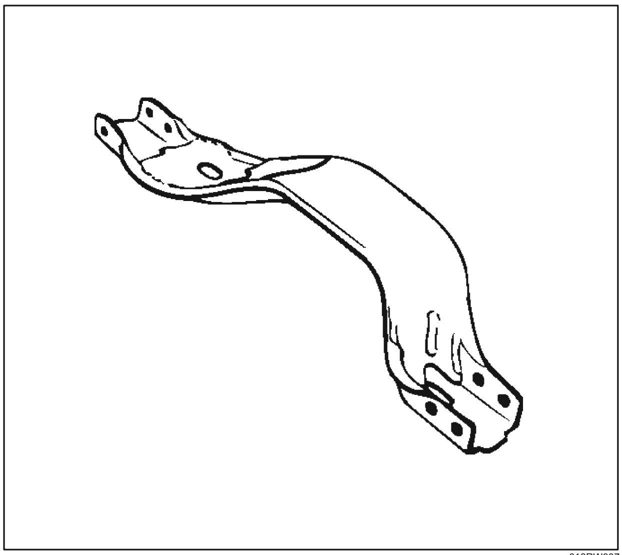
Legend

(1) Pitman Arm

(2) Relay Lever

6. Install suspension cross member and tighten fixing bolts to the specified torque.

Torque : 78 N·m (8.0 Kg·m/58 lb ft)



013RW007

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

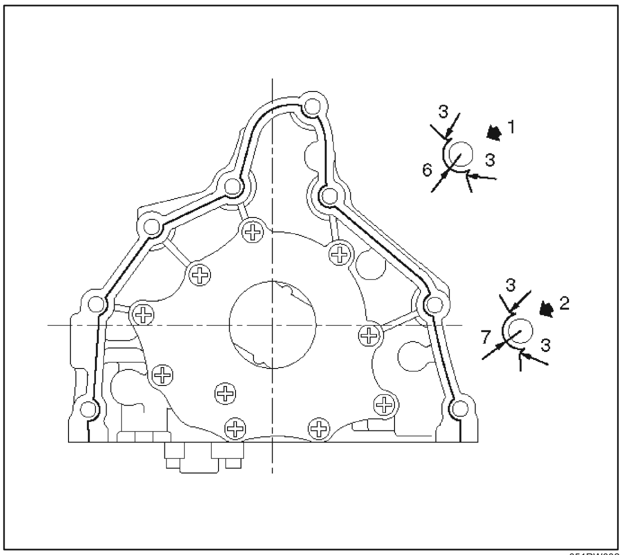
Removal

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.

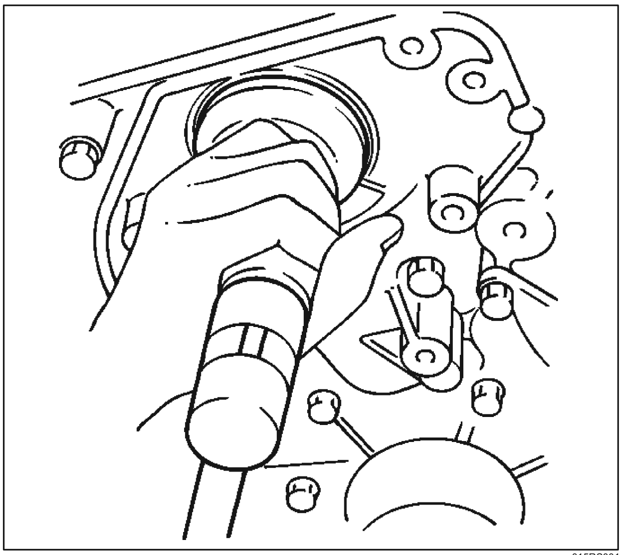
NOTE: Do not apply sealant to the oil ports.



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.

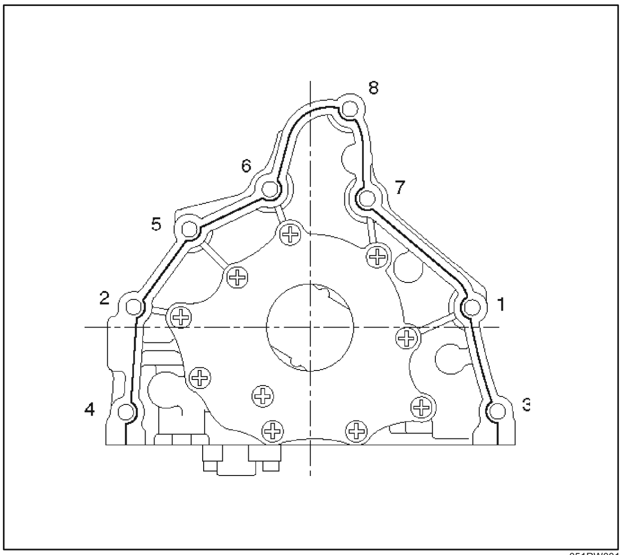
NOTE: Do not damage oil seal during installation of oil pump assembly.



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.

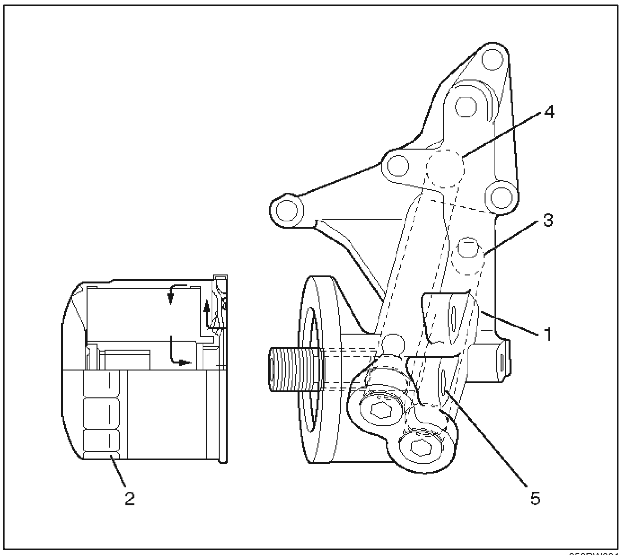
Torque : 10 N·m (1.0 Kg·m/89 lb in)

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)



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

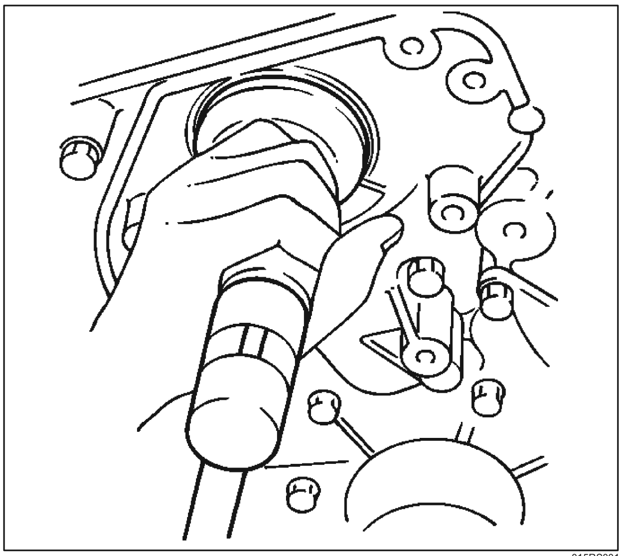
Removal

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.

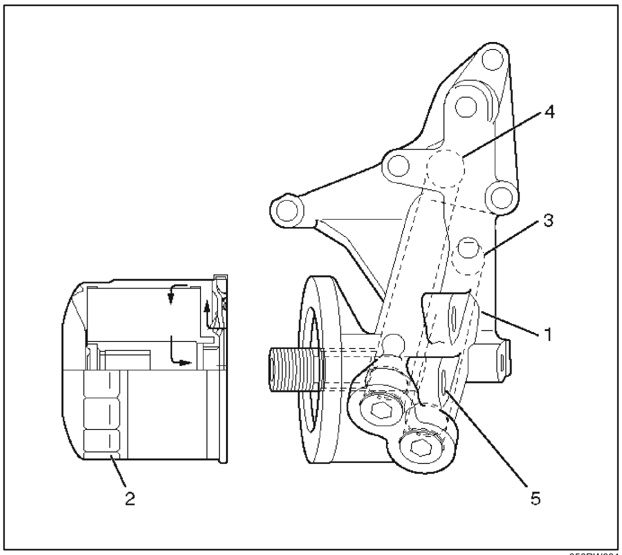
Oil Filter

Removal

1. Disconnect battery ground cable.
2. Drain engine oil.
3. Remove oil filter using 5-8840-0203-0 filter wrench.

Installation

1. Clean filter fitting surface and apply small amount of engine oil to sealing surface.
2. Install oil filter cartridge by hand until it comes in contact with sealing surface then rotate additional 2/3 turn to tighten using 5-8840-0203-0 filter wrench.



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

3. Fill engine oil until full level on dipstick.
4. Reconnect battery ground cable.

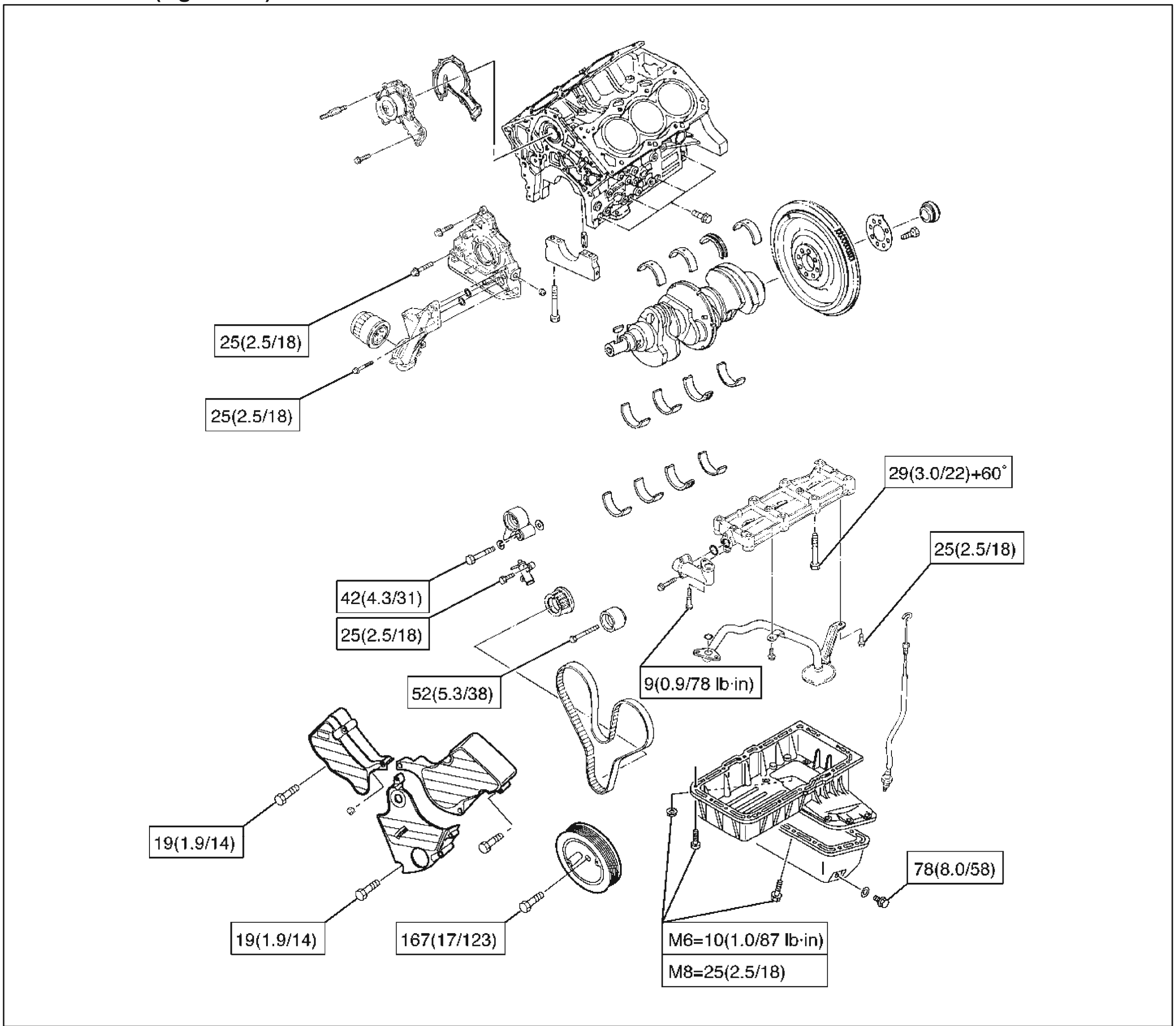
Main Data and Specification

General Specification

Item	Specifications	
	6VD1	6VE1
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)



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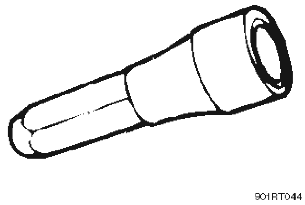
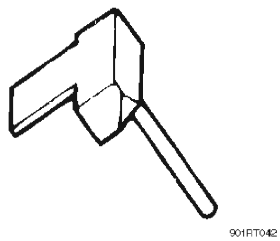
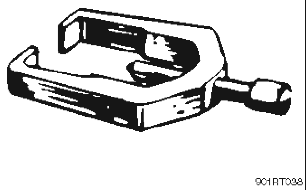
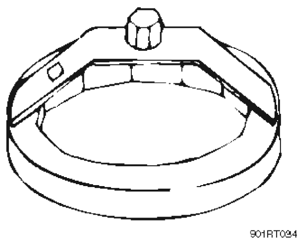
Special Tool

ILLUSTRATION	**TOOL NO.** TOOL NAME
	**5–8840–2287–0** **(J–39202)** Installer; Oil pump oil seal
	**5–8840–2153–0** **(J–37228)** Seal cutter
	**5–8840–2005–0** **(J–29107)** Universal pitman arm puller
	**5–8840–0203–0** **(J–36390)** Wrench; Oil filter

ENGINE

ENGINE SPEED CONTROL SYSTEM

CONTENTS

Service Precaution

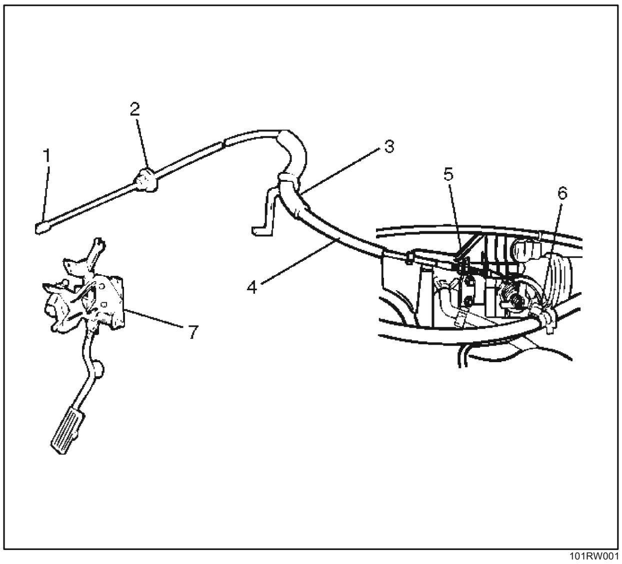
WARNING: IF SO EQUIPPED WITH A SUPPLEMENTAL RESTRAINT SYSTEM (SRS), REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, 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

Removal

1. Loosen the adjusting nut(5) on the cable bracket mounted on the common chamber.
2. Remove cable clip(3).
3. Disconnect accelerator pedal (AP) control cable(6). (on throttle valve side)
4. Disconnect AP control cable(1). (on AP pedal(7) side)
5. Remove molding cap(2).
6. Remove AP control cable(4).



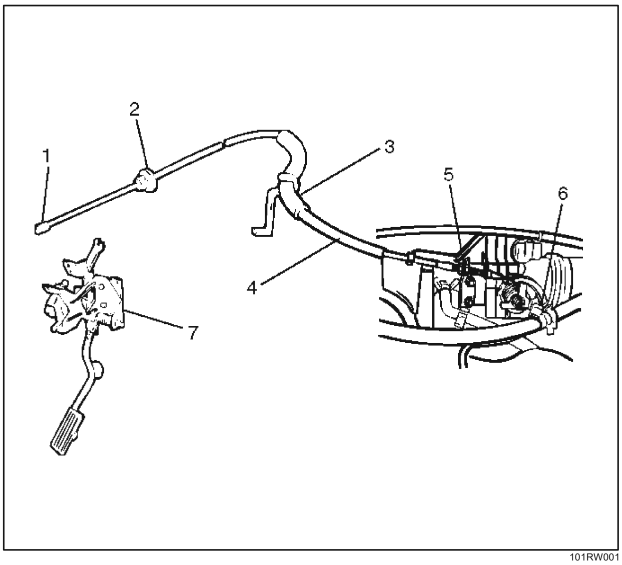
Inspection

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 be free of damage and corrosion.

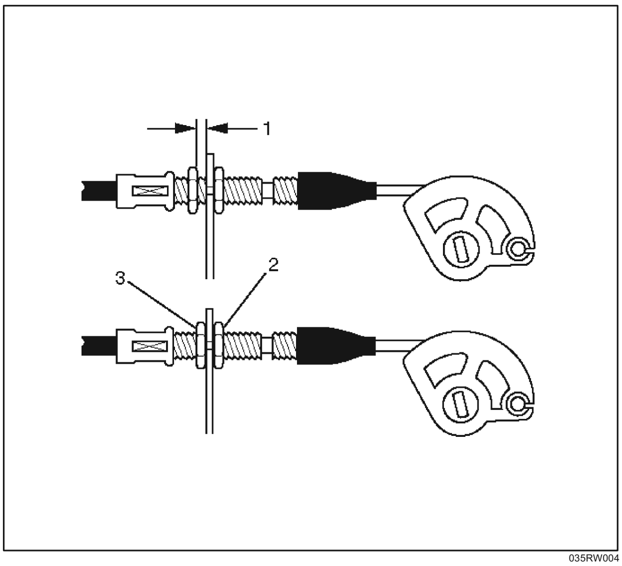
Installation

1. Install AP control cable(4).
2. Install molding cap(2).
3. Connect AP control cable(1). (on AP side)
4. Connect AP control cable(6). (on throttle valve side)
5. Install cable clip(3).
6. Install adjusting nut(5).



Adjustment

1. Loosen adjusting nut and lock nut.
2. Pull outer cable while closing fully the throttle valve.
3. Tighten adjusting nut and lock nut temporarily.
4. Loosen adjusting nut by three turns and tighten lock nut.
   Then, manually operating the throttle valve, make sure that the valve lever returns up to the stopper screw.
   If it does not reach the stopper screw, repeat from step 1.

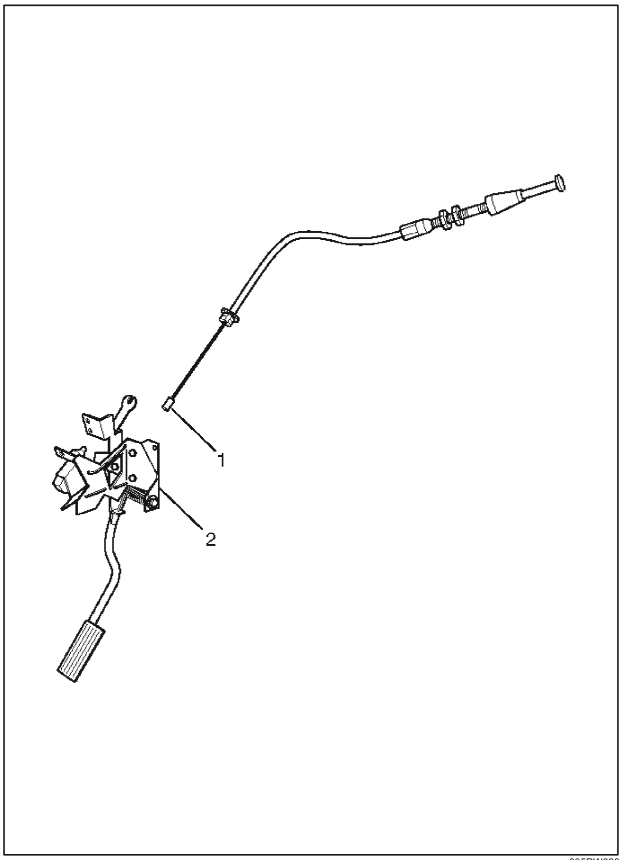


Legend

(1) Clearance
(2) Lock Nut
(3) Adjusting Nut

Accelerator Pedal

Accelerator Pedal and Associated Parts



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Legend

(1) Accelerator Pedal Control Cable
(2) Accelerator Pedal Assembly

Removal

1. Accelerator Pedal control cable(1).
2. Accelerator Pedal assembly(2).

Installation

1. Accelerator pedal assembly(2).
2. Accelerator pedal control cable(1).

Adjustment

Manual Transmission:

- Rotate counterclockwise to loosen the lock nut and screw the stopper bolt in sufficiently.
- Fully depress the pedal and hold it there with your hand. Next, rotate the stopper bolt until it hits the stopper of pedal bracket. Then, lock the stopper bolt there.

Automatic Transmission:

- Rotate counterclockwise to loosen the kickdown switch sufficiently.
- Fully depress the pedal and hold it there with your hand. Rotate the switch clockwise and then rotate further by 1/2 turn from the position where the switch clicks. Lock the switch there.
- Step on the accelerator pedal and make sure that you can hear a clicking sound at the full stroke position.

MEMO

ENGINE

INDUCTION

CONTENTS

Service Precaution

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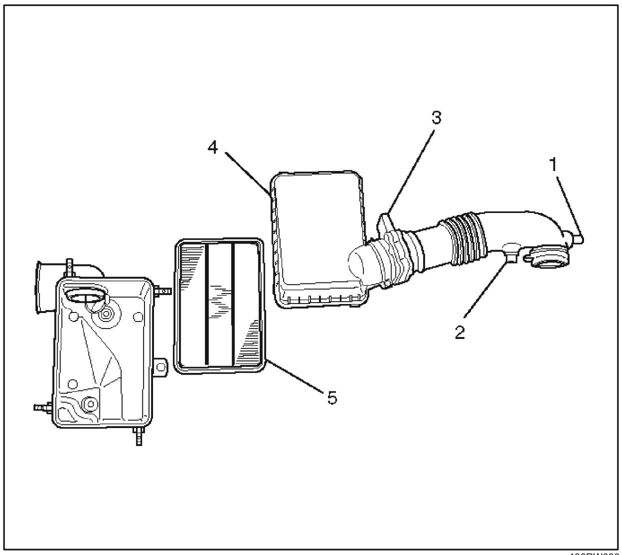
Air Cleaner Element

Removal

1. Remove positive ventilation hose from connector(1).
2. Remove intake air temperature sensor(2).
3. Remove air flow sensor(3).
4. Remove air cleaner duct cover(4).
5. Remove air cleaner element(5).



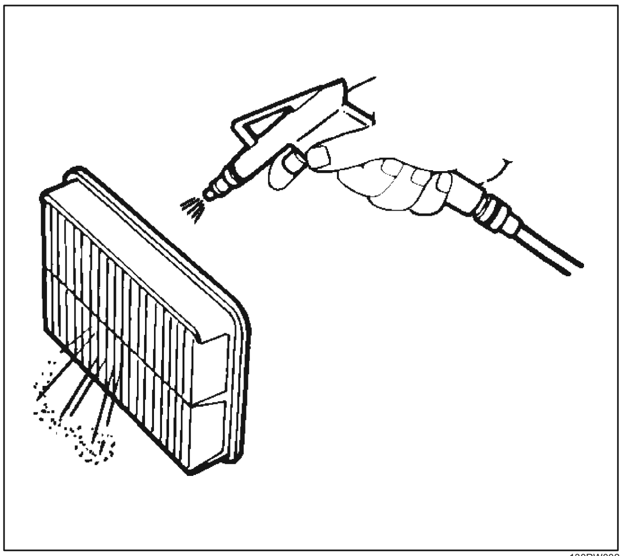
130RW003

Inspection

Check the air cleaner element for damage or dust clogging. Replace if it is damaged, or clean if it is clogged.

Cleaning Method

Tap the air cleaner element gently so as not to damage the paper element, or clean the element by blowing with compressed air of about 490 kPa (71 psi) from the clean side if it is extremely dirty.

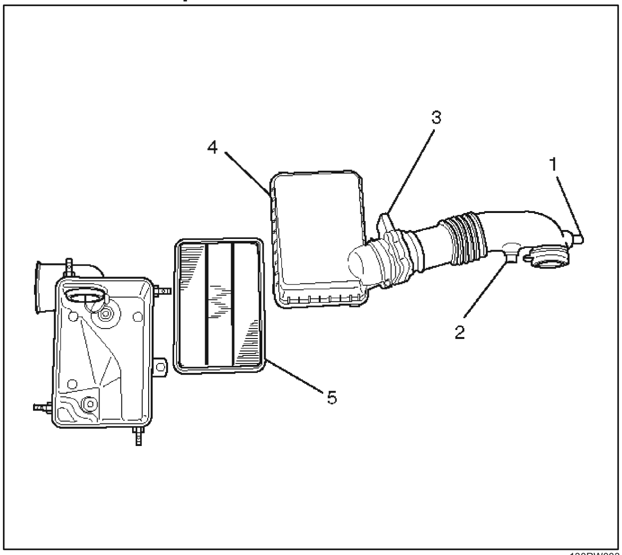


130RW002

Installation

1. Install air cleaner element(5).
2. Attach the air cleaner duct cover (4) to the body completely, then clamp it with the clip.
3. Install mass air flow sensor(3).
4. Install air temperature sensor(2).
5. Connect positive crankcase ventilation hose to connector(1).

For General Export Model



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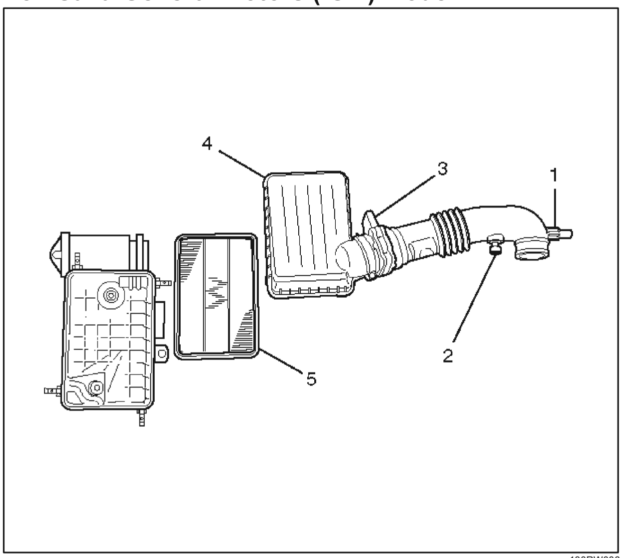
For Isuzu General Motors (IGM) Model



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