MEFI 4 / 4B

DIAGNOSTIC MANUAL

5.0/5.7/6.0/8.1L

PCM marine engines

PLEASURECRAFT ENGINE GROUP

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Marine Electronic Fuel Injection (MEFI 4 / 4B)

Contents

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Marine Electronic Fuel Injection (MEFI)

Section 1

General Information

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General Description

Visual and Physical Inspection

Important: This visual and physical inspection is very important. Perform this inspection carefully and thoroughly. Perform a careful visual and physical inspection when performing any diagnostic procedure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual and physical inspection:

- Inspect all vacuum hoses for the following conditions:
  - Correct routing
  - Pinches
  - Cuts
  - Disconnects
- Inspect all wires in the engine compartment for the following conditions:
  - Proper connections
  - Burned or chafed spots
  - Pinched wires
  - Contact with sharp edges
  - Contact with hot exhaust manifolds

Basic Knowledge and Tools Required

To use this manual most effectively, a general understanding of basic electrical circuits and circuit testing tools is required. You should be familiar with wiring diagrams, the meaning of voltage, ohms, amps and the basic theories of electricity. You should also understand what happens if a circuit becomes open, shorted to ground or shorted to voltage.

To perform system diagnostics, several special tools and equipment are required. Please become acquainted with the tools and their use before attempting to diagnose the system. Special tools that are required for system service are illustrated in this section.

Electrostatic Discharge Damage

Electronic components used in control systems are often designed to carry very low voltage, and are very susceptible to damage caused by electrostatic discharge. It is possible for less than 100 volts of static electricity to cause damage to some electronic components. By comparison, it takes as much as 4,000 volts for a person to feel the zap of a static discharge.

There are several ways a person can 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 seat, in which a charge of as much as 25,000 volts can build up. 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 of either type can cause damage. Therefore, it is important to use care when handling and testing electronic components.

Engine Wiring

When it is necessary to move any of the wiring, whether to lift wires away from their harnesses or move harnesses to reach some component, take care that all wiring is replaced in its original position and all harnesses are routed correctly. If clips or retainers break, replace them. Electrical problems can result from wiring or harnesses becoming loose and moving from their original positions, or from being rerouted.

Engine Control Module (ECM) Self-Diagnostics

The Engine Control Module (ECM) performs a continuous self-diagnosis on certain control functions. This diagnostic capability is complemented by the diagnostic procedures contained in this manual. The ECM's language for communicating the source of a malfunction is a system of Diagnostic Trouble Codes (DTC's). The DTC's are two digit numbers that can range from 12 to 81. When a malfunction is detected by the ECM, a DTC is set and the Malfunction Indicator Lamp (MIL) is illuminated.

Malfunction Indicator Lamp (MIL)

The Malfunction Indicator Lamp (MIL) is part of the Marine Diagnostic Trouble Code (MDTC) tool, or it can be a dash mounted warning light on some boat models.

- If present, it informs the operator that a problem has occurred and that the boat should be taken for service as soon as reasonably possible.
- It displays DTC's stored by the ECM which help the technician diagnose system problems.

As a bulb and system check, the light will come "ON" with the key "ON," engine "OFF." When the engine is started, the light will turn "OFF." If the light remains "ON," the self-diagnostic system has detected a problem. If the problem goes away, the light may go out, but a DTC will remain stored in the ECM.

When the light remains "ON" while the engine is running, or when a malfunction is suspected due to a driveability problem, the MEFI "On-Board Diagnostic (OBD) System Check" must be performed as the first step. These checks will expose malfunctions which may not be detected if other diagnostics are performed prematurely.

Intermittent Malfunction Indicator Lamp (MIL)

In the case of an “intermittent” problem, the Malfunction Indicator Lamp (MIL) will light for 10 seconds, and then go out. However, the corresponding DTC will be stored in the memory of the ECM. When DTC’s are set by an intermittent malfunction, they could be helpful in diagnosing the system.

If an intermittent DTC is cleared, it may or may not reset. If it is an intermittent failure, consult the “Diagnostic Aids” on the facing page of the corresponding Diagnostic Procedure. Symptoms section also covers the topic of “Intermittents.” A physical inspection of the applicable sub-system most often will resolve the problem.

Reading Diagnostic Trouble Codes (DTC’s)

The provision for communicating with the ECM is the Data Link Connector (DLC) (Figure 1-1). It is part of the MEFI engine wiring harness, and is a 10-pin connector, which is electrically connected to the ECM. It is used in the assembly plant to receive information in checking that the engine is operating properly before it leaves the plant. The DTC(s) stored in the ECM’s memory can be retrieved two different ways. One way is with a Diagnostic Trouble Code (DTC) tool. The other way is through a scan tool,

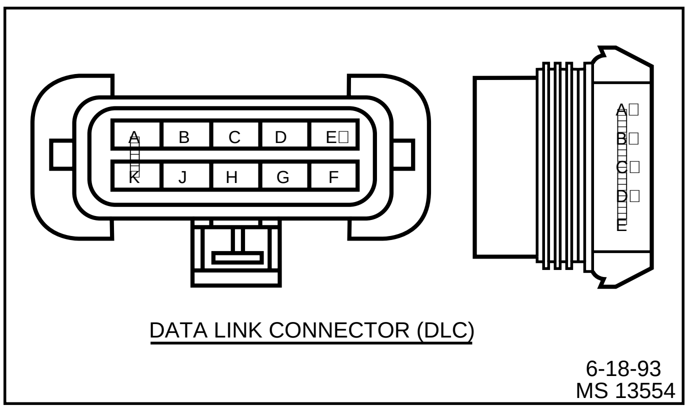

Figure 1-1 - Marine Data Link Connector (DLC)

a hand-held diagnostic scanner, plugged into the DLC.

Once the DTC tool has been connected, and “service mode” or “ON” selected, the ignition switch must be moved to the key “ON,” engine “OFF” position. At this point, the MIL should flash DTC 12 two times consecutively. This would be the following flash sequence: “flash, pause, flash-flash, long pause, flash, pause, flash-flash.” DTC 12 indicates that the ECM’s diagnostic system is operating. If DTC 12 is not indicated, a problem is present within the diagnostic system itself, and should be addressed by consulting the “On-Board Diagnostic (OBD) System Check” in the Diagnosis section.

Following the output of DTC 12, the MIL will indicate a DTC two times if a DTC is present, or it will continue to flash DTC 12. If more than one DTC has been stored in the ECM’s memory, the DTC’s will be flashed out from the lowest to the highest, with each DTC being flashed two times. At the end of the DTC’s, the ECM will simply go back and start over with flashing DTC 12.

Service Mode

When the DTC tool is installed at the DLC and “service mode” or “ON” is selected, the system will enter what is called the “Service Mode.” In this mode, the ECM will:

- Display a DTC 12 by flashing the MIL, indicating that the diagnostic system is working.
- Display any stored DTC’s by flashing the MIL. Each DTC will be flashed two times, then DTC 12 will be flashed again.

Normal Mode

When the DTC tool is in the “normal mode” or “OFF,” it has no affect on the engine operation.

MEFI On-Board Diagnostic (OBD) System Check

After the visual/physical inspection, the “On-Board Diagnostic (OBD) System Check” is the starting point for all diagnostic procedures. Refer to Diagnosis section.

The correct procedure to diagnose a problem is to follow two basic steps:

1. Are the on-board diagnostics working? This is determined by performing the “On-Board Diagnostic (OBD) System Check.” Since this is the starting point for the diagnostic procedures, always begin here. If the on-board diagnostics are not working, the OBD system check will lead to a Diagnostic Procedure in the Diagnosis section to correct the problem. If the on-board diagnostics are working properly, the next step is:
2. Is there a DTC stored? If a DTC is stored, go directly to the number DTC procedure in the Diagnosis section. This will determine if the fault is still present.

DLC Scan Tools

The ECM can communicate a variety of information through the DLC. This data is transmitted at a high frequency which requires a scan tool for interpretation.

With an understanding of the data which the scan tool displays, and knowledge of the circuits involved, the scan tool can be very useful in obtaining information which would be more difficult or impossible to obtain with other equipment.

A scan tool does not make the use of Diagnostic Procedures unnecessary, nor do they indicate exactly where the problem is in a particular circuit. Some Diagnostic Procedures incorporate steps with the use of a scan tool (scan diagnostics), or with the DTC tool (non-scan diagnostics).

Scan Tool Use With Intermittents

The scan tool provides the ability to perform a “wiggle test” on wiring harnesses or components with the engine not running, while observing the scan tool display.

The scan tool can be plugged in and observed while driving the boat under the condition when the MIL turns “ON” momentarily, or when the engine driveability is momentarily poor. If the problem seems to be related to certain parameters that can be checked on the scan tool, they should be checked while driving the boat. If there does not seem to be any correlation between the problem and any specific circuit, the scan tool can be checked on each position, watching for a period of time to see if there is any change in the readings that indicates intermittent operation.

The scan tool is also an easy way to compare the operating parameters of a poorly operating engine with those of a known good one. For example, a sensor may shift in value but not set a DTC.

The scan tool has the ability to save time in diagnosis and prevent the replacement of good parts. The key to using the scan tool successfully for diagnosis lies in the technicians ability to understand the system they are trying to diagnose, as well as an understanding of the scan tool operation and limitations. The technician should read the tool manufacturer’s operating manual to become familiar with the tool’s operation.

How Diagnostic Trouble Codes (DTC) Are Set

The ECM is programmed to receive calibrated voltage signals from the sensors. The voltage signal from the sensor may range from as low as 0.1 volt to as high as 4.9 volts. The sensor voltage signal is calibrated for engine application. This would be the sensor’s operating parameter or “window.” The ECM and sensors will be discussed further in the ECM and Sensor section.

If a sensor is within its operating or acceptable parameters (Figure 1-2), the ECM does not detect a problem. When a sensor voltage signal falls out of this “window,” the ECM no longer receives a signal voltage within the operating “window.” When the ECM does not receive the “window” voltage for a calibratible length of time, a DTC will be stored. The MIL will be illuminated and a known default value will replace the sensor value to restore engine performance.

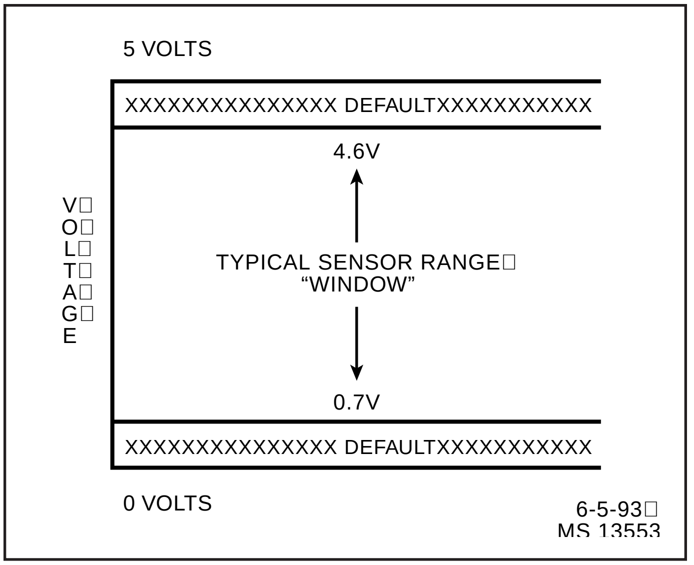

Figure 1-2 - Example of Sensor Normal Operation

Clearing Diagnostic Trouble Codes (Non-Scan)

1. Install Diagnostic Trouble Code (DTC) tool.
2. Ignition “ON,” engine “OFF.”
3. Switch DTC tool to “service mode” or “ON.”
4. Move the throttle from 0% (idle) to 100% (WOT) and back to 0%.
5. Switch DTC tool to “normal mode” or “OFF.” (If this step is not performed, the engine may not start and run).
6. Turn ignition “OFF” for at least 20 seconds.
7. Ignition “ON,” engine “OFF.”
8. Switch DTC tool to “service mode” or “ON” and verify DTC 12 only. Remove DTC tool.
9. If original DTC(s) are still present, check “Notice” below and repeat the DTC clearing procedure.
10. If new DTC(s) are displayed, perform the OBD system check.

NOTICE: When clearing DTC’s with or without the use of a scan tool, the ignition must be cycled to the “OFF” position or the DTC’s will not clear.

Clearing Diagnostic Trouble Codes (Scan)

1. Install scan tool.
2. Start engine.
3. Select “clear DTC’s” function.
4. Clear DTC’s.
5. Turn ignition “OFF” for at least 20 seconds.
6. Turn ignition “ON” and read DTC’s. If DTC’s are still present, check “Notice” below and repeat procedure following from step 2.

NOTICE: When clearing DTC’s with or without the use of a scan tool, the ignition must be cycled to the “OFF” position or the DTC’s will not clear.

Non-Scan Diagnosis Of Driveability Concerns (No DTC’s Set)

If a driveability concern still exists after following the OBD system check and reviewing the Symptoms section, an out of range sensor may be suspected. Because of the unique design of the MEFI system, the ECM will replace sensed values with calibrated default values in the case of a sensor or circuit malfunction. By allowing this to occur, limited engine performance is restored until the boat is repaired. A basic understanding of sensor operation is necessary to be able to diagnose an out of range sensor.

If the sensor is out of range, but still within the operating “window” of the ECM, the problem will go undetected by the ECM and may result in a driveability concern.

A good example of this would be if the coolant sensor was reading incorrectly and indicating to the ECM that coolant temperature was at 50°F, but actual coolant temperature was at 150°F (Figure 1-3). This would cause the ECM to deliver more fuel than what was actually needed by the engine. This resulted in an overly rich condition, causing rough running. This condition would not have caused a DTC to set, as the ECM interprets this as within the operating “window.”

To identify a sensor that is out of range, you may unplug the sensor electrical connector while the engine is running. After about 2 minutes, the DTC for that sensor will set, illuminate the MIL, and replace the sensed value with a calibrated default value. If at that point, a noticeable performance increase is observed, the non-scan DTC table for that particular sensor may be followed to correct the problem.

NOTICE: Be sure to clear each DTC after disconnecting and reconnecting each sensor. Failure to do so may result in a misdiagnosis of the driveability concern.

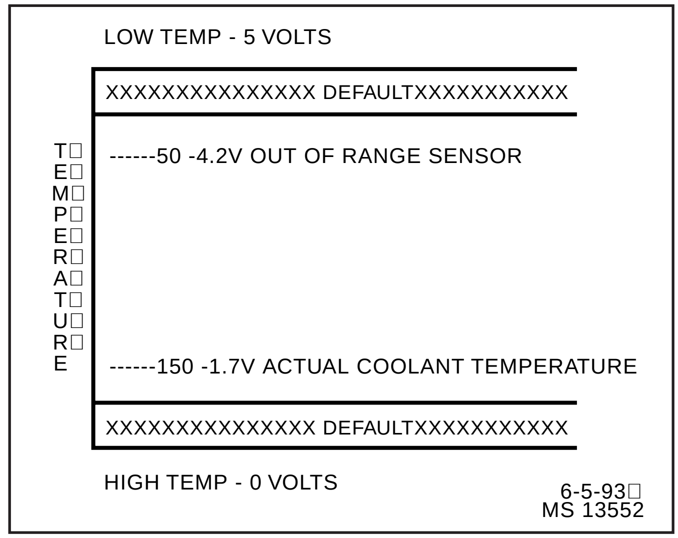

Figure 1-3 - Example of Shifted Sensor Operation

Aftermarket (Add-On) Electrical And Vacuum Equipment

Aftermarket, add-on electrical and vacuum equipment is defined as any equipment installed on a vehicle after leaving the factory that connects to the vehicles electrical or vacuum systems.

Notice: Do not attach add-on vacuum operated equipment to this engine. The use of add-on vacuum equipment may result in damage to engine components or systems.

Notice: Connect any add-on electrically operated equipment to the vehicle’s electrical system at the battery (power and ground) in order to prevent damage to the vehicle.

Add-on electrical equipment, even when installed to these strict guidelines, may still cause the powertrain system to malfunction. This may also include equipment not connected to the vehicle’s 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, diagnose the problem in the normal manner.

Use of Circuit Testing Tools

Do not use a test lamp in order to diagnose the engine electrical systems unless specifically instructed by the diagnostic procedures. Use the J 35616-A connector test adapter kit whenever diagnostic procedures call for probing any connectors.

Tools Needed To Service The System

Refer to Special Tools in this section for engine control tools for servicing the system.

Service Precautions

The following requirements must be observed when working on MEFI equipped engines.

1. Before removing any ECM system component, disconnect the negative battery cable.
2. Never start the engine without the battery being solidly connected.
3. Never separate the battery from the on-board electrical system while the engine is running.
4. Never separate the battery feed wire from the charging system while the engine is running.
5. When charging the battery, disconnect it from the vehicle's electrical system.
6. Ensure that all cable harnesses are connected solidly and the battery connections are thoroughly clean.
7. Never connect or disconnect the wiring harness at the ECM when the ignition is switched "ON."
8. Before attempting any electric arc welding on the vehicle, disconnect the battery leads and the ECM connector(s).
9. When steam cleaning engines, do not direct the nozzle at any ECM system components. If this happens, corrosion of the terminals or damage of components can take place.
10. Use only the test equipment specified in the diagnostic procedures, since other test equipment may either give incorrect test results or damage good components.
11. All measurements using a multimeter must use a digital meter with a rating of 10 megaohm input impedance.
12. When a test light is specified, a "low-power" test light must be used. Do not use a high-wattage test light. While a particular brand of test light is not suggested, a simple test on any test light will ensure it to be safe for system circuit testing (Figure 1-4). Connect an accurate ammeter (such as the high-impedance digital multimeter) in series with the test light being tested, and power the test light ammeter circuit with the vehicle battery.

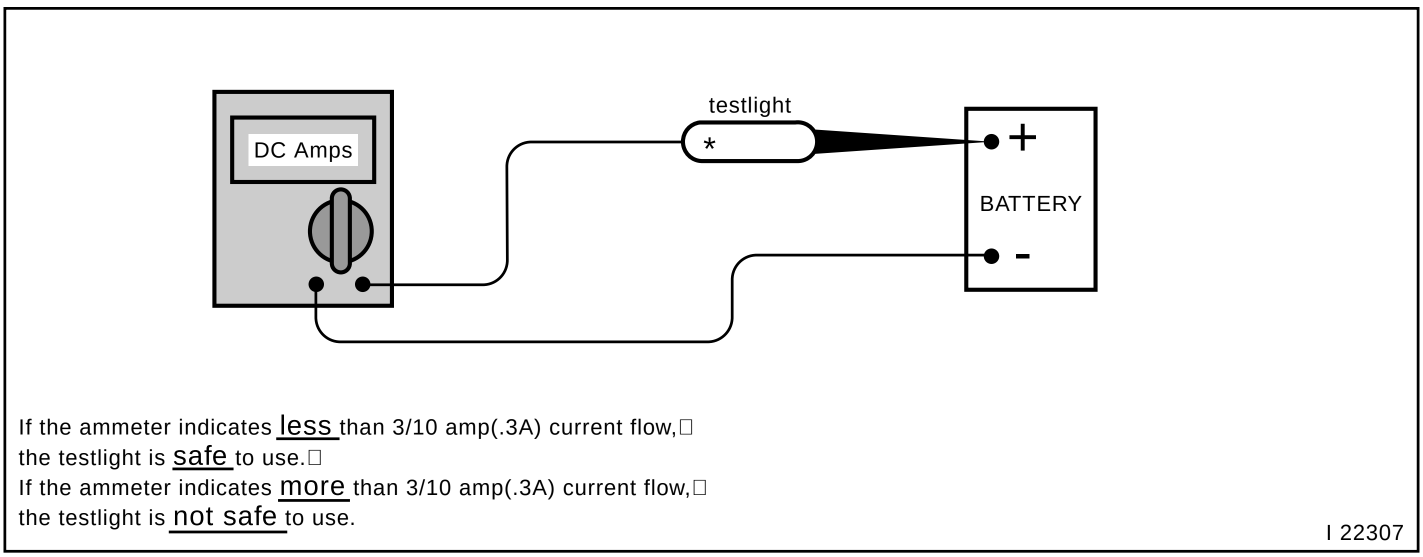

Figure 1-4 - Test Light Amperage Draw Test

Special Tools (1 of 3)

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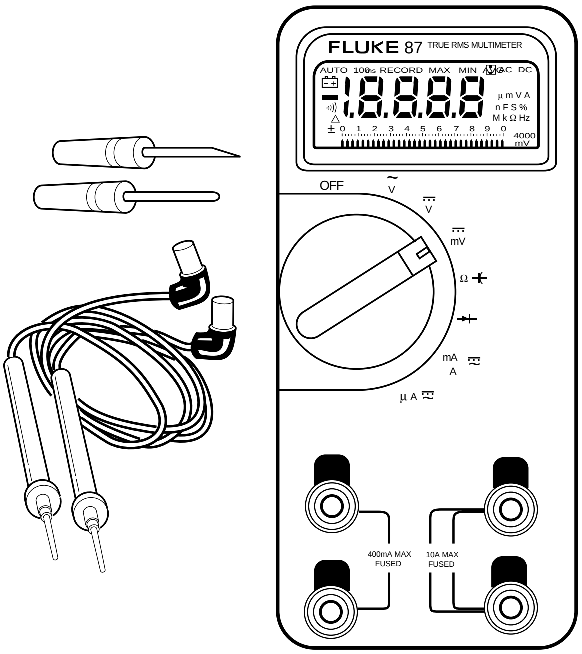
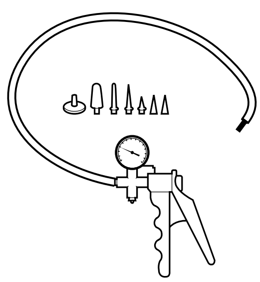
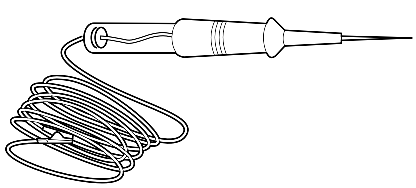
<td>

J 39978</td>
<td><u>VOLTMETER</u> - Voltage position measures magnitude of voltage when connected in parallel to an existing circuit. A digital voltmeter with a 10 megohm input impedance is used because this type of meter will not load down the circuit and result in faulty readings. Some circuits require accurate low voltage readings because they have a very high resistance.

<u>AMMETER</u> - When used as an ammeter, this meter accurately measures extremely low current flow. Refer to meter instructions for more information.
• Selector must be set properly for both function and range. DC is used for most measurements.

<u>OHMMETER</u> - Measures resistance of circuit directly in ohms. Refer to meter instructions for more information.
• OL display in all ranges indicates open circuit.
• Zero display in all ranges indicates a short circuit.
• An intermittent connection in a circuit may be indicated by a digital reading that will not stabilize on the circuit.
• Range Switch - Automatic and Manual.
200ý - Reads ohms directly
2K, 20K, 200Ký - Reads ohms in thousands
2M, 20M, 200Mý - Reads ohms in millions</td>
</tr>
<tr>
<td>
J 23738-A</td>
<td>VACUUM PUMP WITH GAUGE (20 IN. HG. MINIMUM)
Use the gauge to monitor manifold engine vacuum and use the hand pump to check vacuum sensors, solenoids and valves.</td>
</tr>
<tr>
<td>
J 34142-B</td>
<td>UNPOWERED TEST LIGHT
Used for checking wiring for a complete circuit, voltages and grounds.</td>
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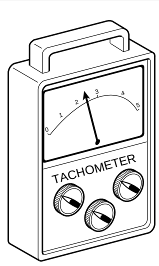
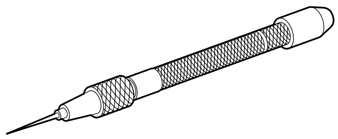
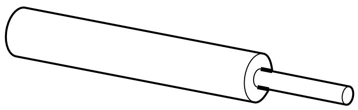
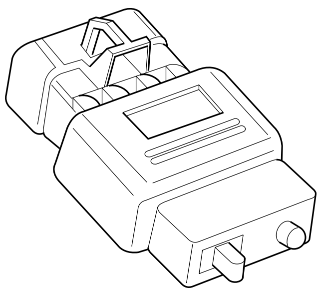
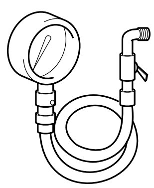
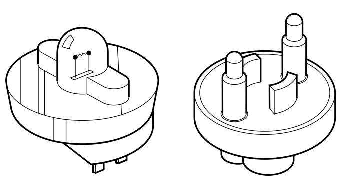
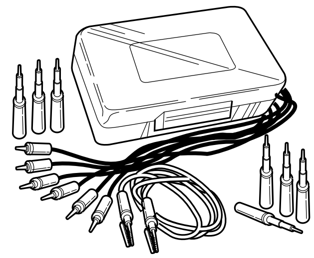
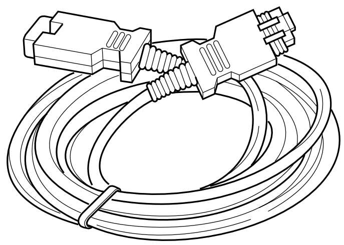
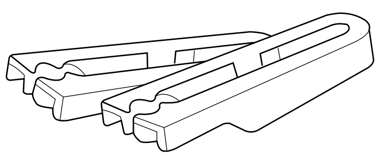
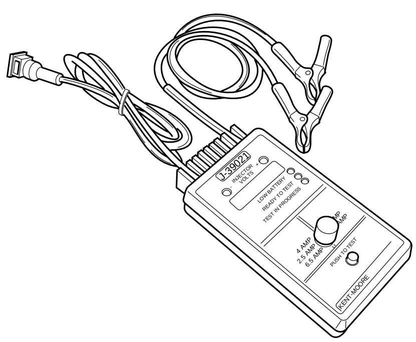
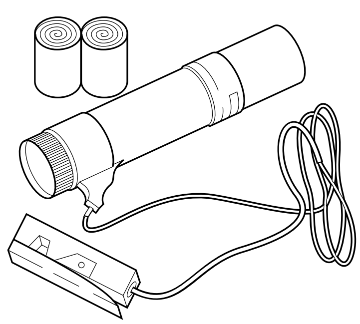
<tr>
<td>

NS 14574</td>
<td>TACHOMETER
Must have inductive trigger signal pick-up.</td>
</tr>
</table>

Special Tools (2 of 3)

 J 35689	**METRI-PACK TERMINAL REMOVER** Used for removing 150 series Metri-Pack “pull-to-seat” terminals from connectors. Refer to wiring harness service in MEFI General Information Section for removal procedure.
 J 28741-A/BT-8234-A	**WEATHER PACK TERMINAL REMOVER** Used for removing terminals from Weather Pack connectors. Refer to wiring harness service in MEFI General Information Section for removal procedure.
 TA 06075	**DIAGNOSTIC TROUBLE CODE (DTC) TOOL** A hand held diagnostic tool that plugs into the DLC connector for various diagnostics.
 RTK0078	**FUEL PRESSURE GAUGE** Used for checking fuel system pressure on MFI and PFI engines.
 J 34730-2C & J 34730-350/BT 8329	**INJECTOR HARNESS TEST LIGHT** A specially designed light used to visually indicate injector electrical pulses from the ECM.
 RT0086	**DIACOM SCAN TOOL** A hand held diagnostic tool that plugs into the DLC connector for various diagnostics. It will display various parameters.

Special Tools (3 of 3)

 J 35616	**HARNESS TEST ADAPTER KIT** Used to make electrical test connections in current Weather Pack, Metri-Pack and Micro-Pack style terminals.
 TA 06076	**20’ DIAGNOSTIC CONNECTOR EXTENSION CABLE** Extension cable to go between the scan tool and the DLC on the engine harness.
 J 37088-A/BT-9171	**FUEL LINE QUICK-CONNECT SEPARATOR** Used to release fuel line quick-connect fittings.
 J 39021	**INJECTOR TESTER** Separately energizes each injector to compare for equal fuel pressure drops over a constant time interval.
 J 34186	**TIMING LIGHT** Must have inductive signal pickup.

ABBREVIATIONS

BARO	-	BAROMETRIC PRESSURE
BAT	-	BATTERY, BATTERY POSITIVE TERMINAL, BATTERY OR SYSTEM VOLTAGE
B+	-	BATTERY POSITIVE
CKP	-	CRANKSHAFT POSITION SENSOR
CKT	-	CIRCUIT
CMP	-	CAMSHAFT POSITION SENSOR
CONN	-	CONNECTOR
CYL	-	CYLINDER
DEG	-	DEGREES
DIAG	-	DIAGNOSTIC
DLC	-	DATA LINK CONNECTOR
DMM	-	DIGITAL MULTIMETER
DTC	-	DIAGNOSTIC TROUBLE CODE
ECM	-	ENGINE CONTROL MODULE
ECT	-	ENGINE COOLANT TEMPERATURE SENSOR
EEPROM	-	ELECTRONIC ERASABLE PROGRAMMABLE READ ONLY MEMORY
EI	-	ELECTRONIC IGNITION
EMI	-	ELECTROMAGNETIC INTERFERENCE
ENG	-	ENGINE
GND	-	GROUND
GPH	-	GALLONS PER HOUR
HVS	-	HIGH-VOLTAGE SWITCH
IAC	-	IDLE AIR CONTROL
IAT	-	INTAKE AIR TEMPERATURE
IC	-	IGNITION CONTROL
IGN	-	IGNITION
INJ	-	INJECTOR
I/O	-	INPUT/OUTPUT
kPa	-	KILOPASCAL
KS	-	KNOCK SENSOR SYSTEM
KV	-	KILOVOLTS
MAP	-	MANIFOLD ABSOLUTE PRESSURE
MEFI	-	MARINE ELECTRONIC FUEL INJECTION
MFI	-	MULTIPORT FUEL INJECTION
MIL	-	MALFUNCTION INDICATOR LAMP
MSEC	-	MILLSECOND
N/C	-	NORMALLY CLOSED
N/O	-	NORMALLY OPEN
OBD	-	ON-BOARD DIAGNOSTIC SYSTEM CHECK
OPT	-	OPTIONAL
PFI	-	PORT FUEL INJECTION
PROM	-	PROGRAMMABLE READ ONLY MEMORY
RAM	-	RANDOM ACESS MEMORY
REF HI	-	REFERENCE HIGH
REF LO	-	REFERENCE LOW
ROM	-	READ ONLY MEMORY
SLV	-	SLAVE
SW	-	SWITCH
TACH	-	TACHOMETER
TBI	-	THROTTLE BODY INJECTION
TERM	-	TERMINAL
TP	-	THROTTLE POSITION SENSOR
V	-	VOLTS
VAC	-	VACUUM
WOT	-	WIDE OPEN THROTTLE
“ HG	-	INCHES OF MERCURY

Diagnosis

The diagnostic tables and functional checks in this manual are designed to locate a faulty circuit or component through logic based on the process of elimination. The tables are prepared with the requirement that the system functioned correctly at the time of assembly and that there are no multiple failures.

Engine control circuits contain many special design features not found in standard vehicle wiring. Environmental protection is used extensively to protect electrical contacts. Proper splicing methods must be used when necessary.

The proper operation of low amperage input/output circuits depend upon good continuity between circuit connectors. It is important before component replacement and/or during normal troubleshooting procedures that a visual inspection of any questionable mating connector is performed. Mating surfaces should be properly formed, clean and likely to make proper contact. Some typical causes of connector problems are listed below:

- Improperly formed contacts and/or connector housing.
- Damaged contacts or housing due to improper engagement.
- Corrosion, sealer or other contaminants on the contact mating surfaces.
- Incomplete mating of the connector halves during initial assembly or during subsequent troubleshooting procedures.
- Tendency for connectors to come apart due to vibration and/or temperature cycling.
- Terminals not fully seated in the connector body.
- Inadequate terminal crimps to the wire.

On-Board Service

Wiring Harness Service

Figure 1-5

Wiring harnesses should be replaced with proper part number harnesses. When wires are spliced into a harness, use the same gauge wire with high temperature insulation only.

With the low current and voltage levels found in the system, it is important that the best possible bond be made at all wire splices by soldering the splices as shown in Figure 1-5.

Use care when probing a connector or replacing a connector terminal. It is possible to short between opposite terminals. If this happens, certain components can be damaged. Always use jumper wires with the corresponding mating terminals between connectors for circuit checking. **NEVER** probe through connector seals, wire insulation, secondary ignition wires, boots, nipples or covers. Microscopic damage or holes may result in water intrusion, corrosion and/or component failure.

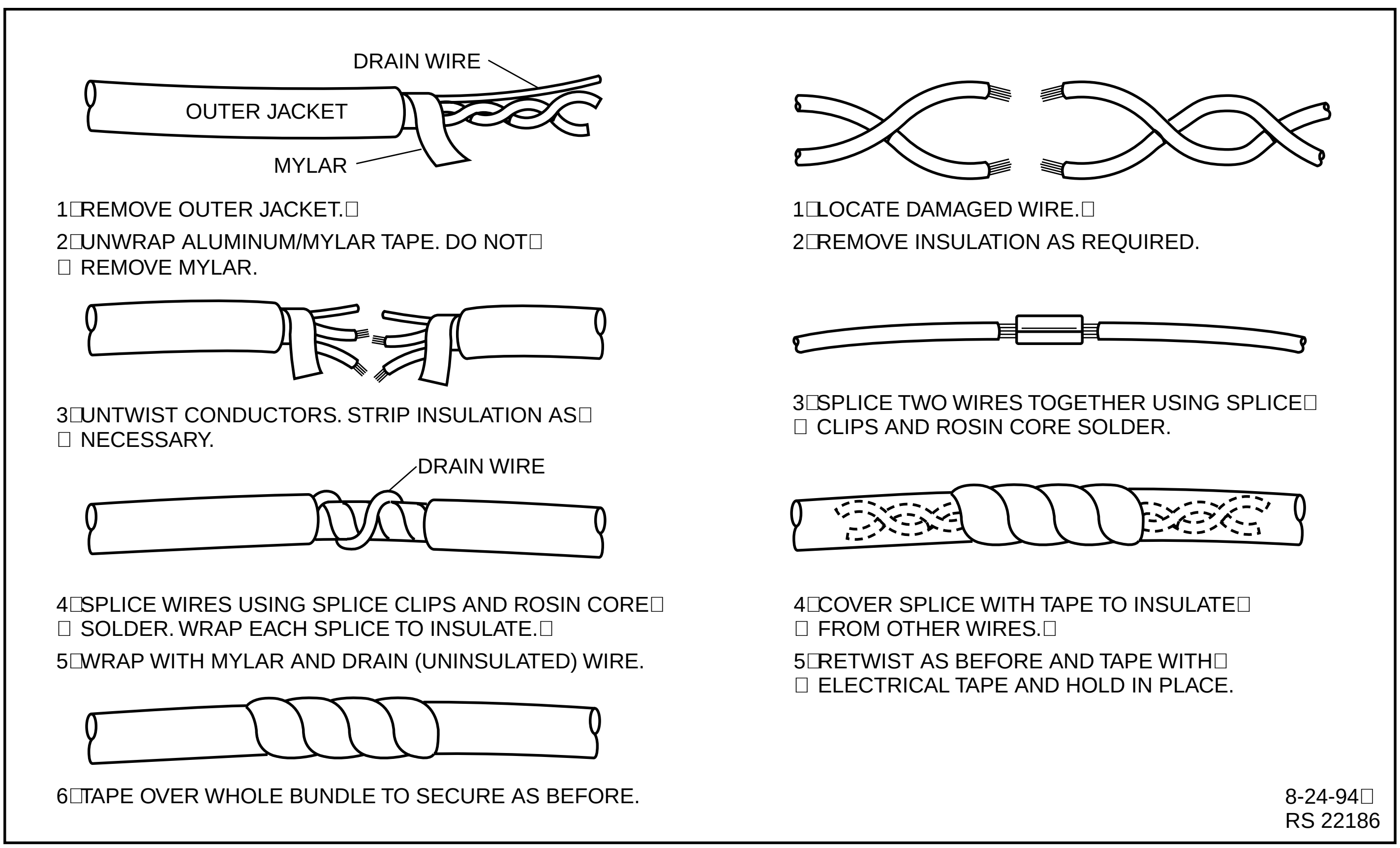


Figure 1-5 - Wiring Harness Repair

Wiring Connector Service

Most connectors in the engine compartment are protected against moisture and dirt which could create oxidation and deposits on the terminals. This protection is important because of the very low voltage and current levels found in the electronic system. The connectors have a lock which secures the male and female terminals together. A secondary lock holds the seal and terminal into the connector.

When diagnosing, 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 locate the open circuit condition. This should always be considered when an open circuit or failed sensors is indicated. Intermittent problems may also be caused by oxidized or loose connections.

Before making a connector repair, be certain of the type of connector. Some connectors look similar but are serviced differently.

Metri-Pack Series 150 Terminals

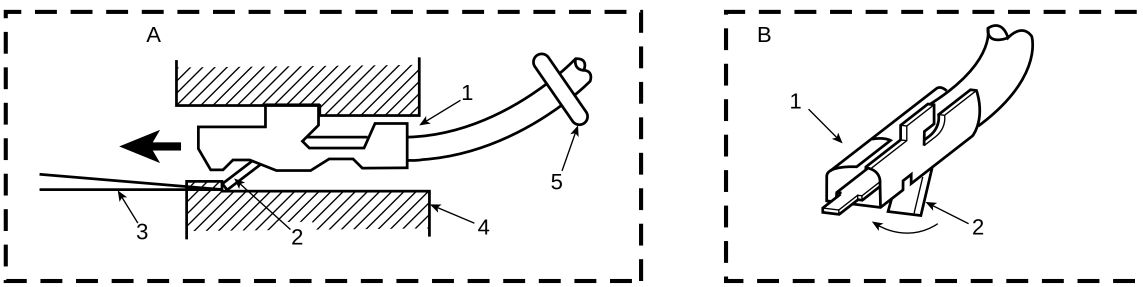
Figure 1-6

Some ECM harness connectors contain terminals called Metri-Pack (Figure 1-6). These are used at some of the sensors and the distributor connector.

Metri-Pack terminals are also called "Pull-To-Seat" terminals because, to install a terminal on a wire, the wire is first inserted through the seal and connector. The terminal is then crimped on the wire, and the terminal is pulled back into the connector to seat it in place.

To remove a terminal:

1. Slide the seal back on the wire.
2. Insert tool J 35689 or equivalent, as shown in Figure 1-6, to release the terminal locking tang.
3. Push the wire and terminal out through the connector. If the terminal is being reused, reshape the locking tang.



1. METRI-PACK SERIES 150 FEMALE TERMINAL.
2. LOCKING TANG.
3. TOOL J35689 OR BT-8446.
4. CONNECTOR BODY.
5. SEAL.

RS 22187

Figure 1-6 - Metri-Pack Series 150 Terminal Removal

Weather-Pack Connectors

Figure 1-7

Figure 1-7 shows a Weather-Pack connector and the tool (J28742 or equivalent) required to service it. This tool is used to remove the pin and sleeve terminals. If terminal removal is attempted without using the special tool required, there is a good chance that the terminal will be bent or deformed, and unlike standard blade type terminals, these terminals cannot be straightened once they are bent.

Make certain that the connectors are properly seated and all of the sealing rings in place when connecting leads. The hinge-type flap provides a secondary locking feature for the connector. It improves the connector reliability by retaining the terminals if the small terminal lock tangs are not positioned properly. Weather-Pack connections cannot be replaced with standard connections.

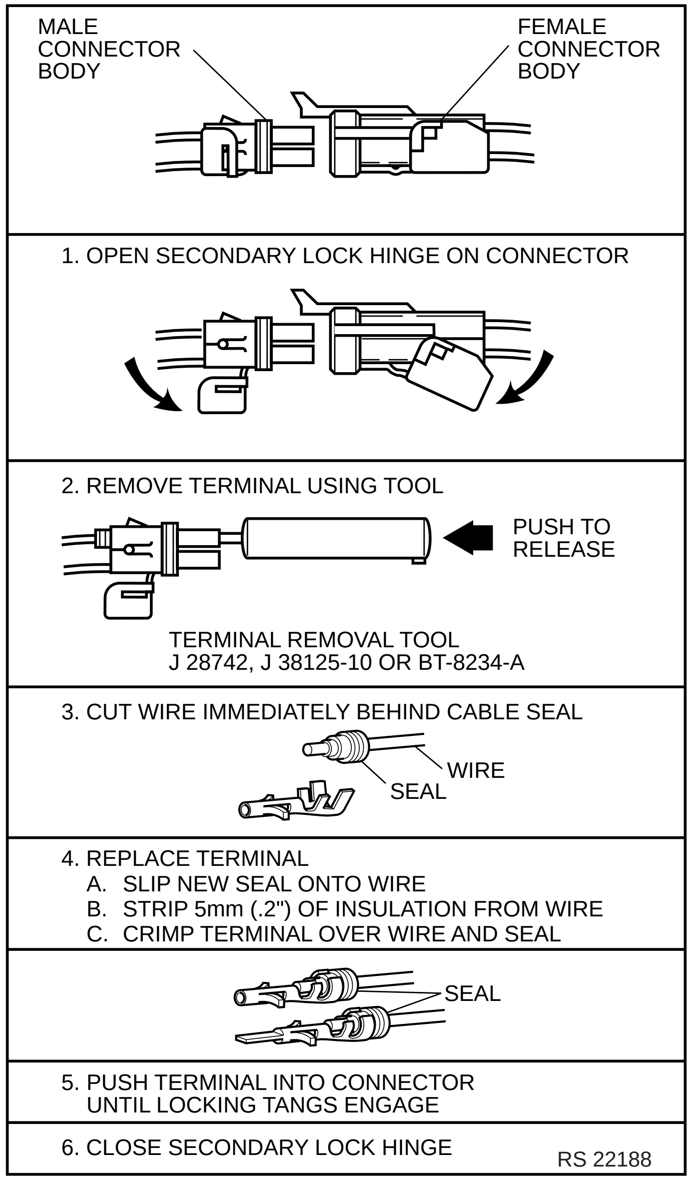


Figure 1-7 - Weather-Pack Terminal Repair

Micro-Pack 100/W Series Connectors

Figure 1-8

The harness connectors used with the ECM "J1" and "J2" connectors are Micro-Pack 100/W Series. It is used for its ruggedized construction, capable of carrying more current and provides good sealing ability. The connector is made up of five different parts (refer to Figure 1-8 View A): Strain Relief (1), Seal (2), Connector (3), Index Cover (4) and Terminals (not shown).

Remove or Disconnect

1. Negative battery cable.
2. Connector from ECM by lifting up locking tab with thumb and pulling on connector body.

Inspect

- Check strain relief for being cracked or locking tab damaged.
- Check index cover for being cracked.
- Check seal for being torn, twisted or out of shape from improper installation.
- Check terminals for being corroded, out of position, bent or stretched out.
  – Use a wire gauge .038 for checking terminal internal fit. Wire gauge should slide with smooth feel and not be loose.

Notice: If you are only going to clean terminals, complete disassembly is not necessary. Remove index cover from the connector by pushing on Tab C on both sides and sliding off cover. Care must be taken not to move terminals out of their position. The index cover locks the terminals in position. If repair or replacement of parts is needed, DO NOT remove index cover at this time.

3. With a small screwdriver, move Tabs A on strain relief (1) to unlock position.
4. Open strain relief as shown in View B.
5. Release Tabs B (View C) on connector (3) by pushing inward with both thumbs or small screwdriver.
6. Push Tabs B through strain relief (1) with thumbs or small screwdriver while in released position.

Important

- Where there are not wires in strain relief, small plugs are installed. DO NOT lose the plugs, they are important to help keep connector assembly sealed.

7. Remove plugs where there are not any wires.
8. Slide strain relief off of seal and back on wires.
9. Slide seal off of connector and back on wires.

Important

- To ensure proper engine operation after repair of connector assembly, wires must be in proper connector location. Before removing index cover, note if there are any wires of the same color. Mark these wires from the location that they were removed. For the remaining wires, their location can be found by referring to "Wiring Diagrams" in the Diagnosis section. The strain relief is numbered for identifying wire location.

10. Index cover (4) by pushing in on Tabs C with a small screwdriver.
11. Terminals by pulling out of connector.
12. Seal (2) from wires.
13. Strain relief (1) from wires.

Clean and Inspect

- Terminals for corrosion.
  – Use spray electrical contact cleaner.
- Loose crimps on terminals.
- Broken wires at terminals.

Notice: For terminal replacement, refer to instructions found with terminal repair kit and crimper tool.

Install or Connect

1. Align index cover (4) on connector (3) and lock into position. Make sure Tabs C are locked.
2. Align seal (2) on connector (3) and slide all the way on.
   - DO NOT install strain relief (1) onto connector (3) yet.
3. One wire with terminal installed, through strain relief (1) in location that it was removed.
   - Start with the lowest numbered wire position for that connector.
4. Terminal through seal (2), connector (3) and into index cover (4) until it locks in place.
5. Remaining wires one at a time per same method.
   - Keep wires straight.
   - DO NOT kink wires.
6. Strain relief (1) onto seal (2) and connector (3).
7. Lock Tabs B into strain relief (1).
8. Plugs into strain relief (1) where there are not any wires.
9. Fold strain relief (1) together and lock Tabs A.
10. Connector assembly to ECM.
11. Negative battery cable.

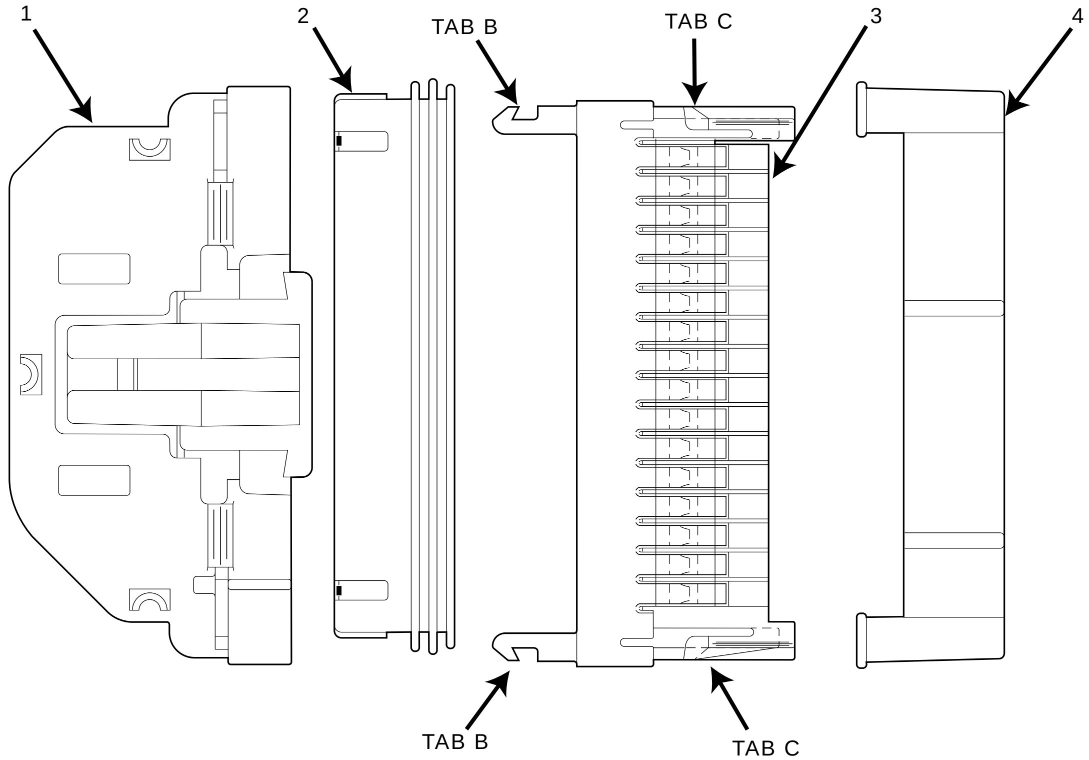


FIGURE A - EXPLODED VIEW OF CONNECTOR ASSEMBLY

1 STRAIN RELIEF	3 CONNECTOR
2 SEAL	4 INDEX COVER

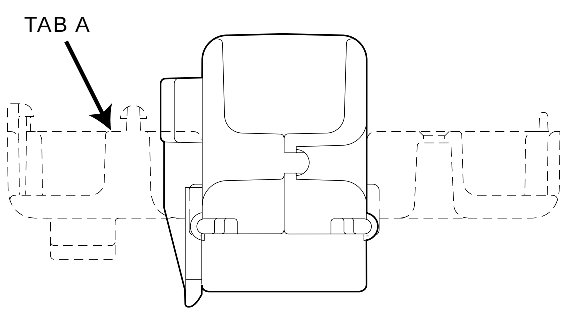


FIGURE B - STRAIN RELIEF CLOSED

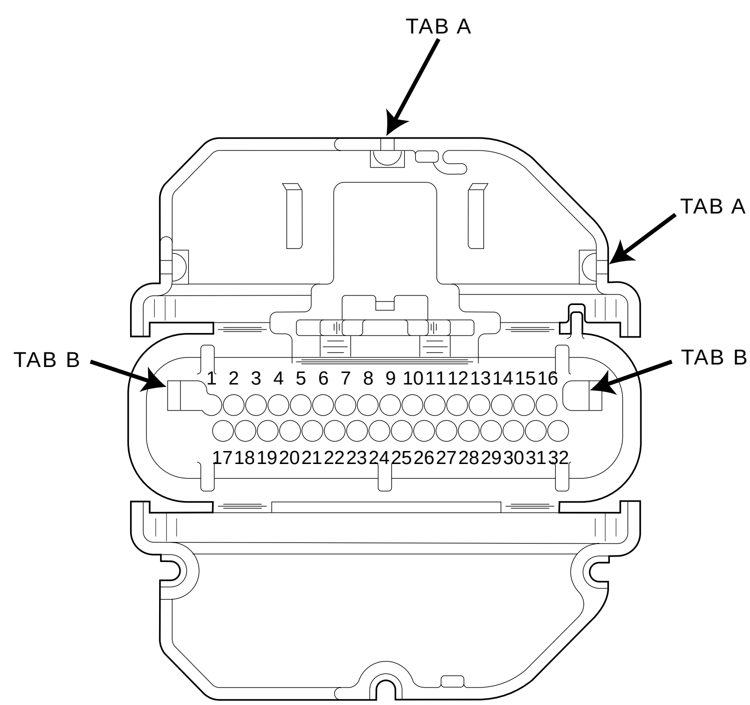


FIGURE C - STRAIN RELIEF OPENED

PS 19745

Figure 1-8 - Micro-Pack 100/W Series

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Marine Electronic Fuel Injection (MEFI)

Section 2

Engine Control Module (ECM) and Sensors

This section will describe the function of the Engine Control Module (ECM) and the sensors. The section explains how voltages reflect the inputs and outputs of the ECM. The sensors are described how they operate and how to replace them.

Contents

General Description

The Marine Electronic Fuel Injection (MEFI) system is equipped with a computer that provides the operator with state-of-the-art control of fuel and spark delivery. Before we discuss the computers on the Marine applications, let's discuss how computers use voltage to send and receive information.

Computers and Voltage Signals

Voltage is electrical pressure. Voltage does not flow through circuits. Instead, voltage causes current. Current does the real work in electrical circuits. It is current, the flow of electrically charged particles, that energizes solenoids, closes relays and illuminates lamps.

Besides causing current flow in circuits, voltage can be used as a signal. Voltage signals can send information by changing levels, changing waveform (shape) or changing the speed (frequency(at which the signal switches from one level to another. Computers use voltage signals to communicate with one another. The different circuits inside computers also use voltage signals to talk to each other.

There are two kinds of voltage signals, analog and digital. Both of these are used in computer systems. It is important to understand the difference between them and the different ways they are used.

Analog Signals

An analog signal is continuously variable. This means that the signal can be any voltage within a certain range.

An analog signal usually gives information about a condition that changes continuously over a certain range. For example, in a marine engine, temperature is usually provided by an analog signal. There are two general types of sensors that produce analog signals, the 3-wire and the 2-wire sensors.

Three-Wire Sensors

Figure 2-1 shows a schematic representation of a 3-wire sensor. All 3-wire sensors have a reference voltage, a ground and a variable "wiper." The lead coming off of the "wiper" will be the signal to the Engine Control Module (ECM). As this "wiper" position changes, the signal voltage to the ECM also changes.

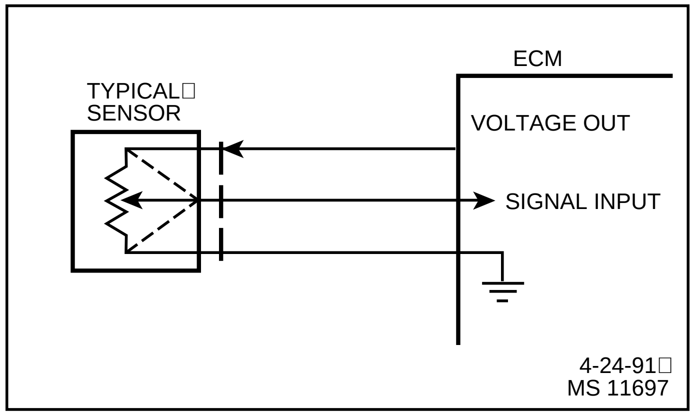


Figure 2-1 - Three-Wire Sensors

Two-Wire Sensors

Figure 2-2 shows a schematic representation of a 2-wire sensor. This sensor is basically a variable resistor in series with a known-fixed resistor within the ECM. By knowing the values of the input voltage and the voltage drop across the known resistor, the value of the variable resistor can be determined. The variable resistors that are commonly used are called thermistors. A thermistor's resistance varies with temperature.

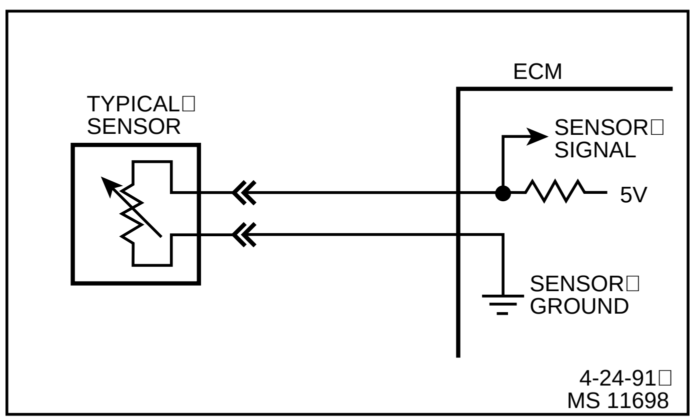


Figure 2-2 - Two-Wire Sensors

Digital Signals

Digital signals are also variable, but not continuously. They can only be represented by distinct voltages within a range. For example, 1V, 2V or 3V would be allowed, but 1.27V or 2.56V would not. Digital signals are especially useful when the information can only refer to two conditions: “YES” and “NO,” “ON” and “OFF” or “HIGH” and “LOW.” This would be called a digital binary signal. A digital binary signal is limited to two voltage levels. One level is a positive voltage, the other is no voltage (zero volts). As you can see in Figure 2-3, a digital binary signal is a square wave.

The ECM uses digital signals in a code that contains only ones and zeros. The high voltage of the digital signal represents a one (1), and no voltage represents a zero (0). Each “zero” and each “one” is called a bit of information, or just a “bit.” Eight bits together are called a “word.” A word, therefore, contains some combination of eight binary code bits.

Binary code is used inside the ECM and between a computer and any electronic device that understands the code. By stringing together thousands of bits, computers can communicate and store an infinite varieties of information. To a computer that understands binary, 11001011 might mean that it should turn an output device “ON” at slow speed. Although the ECM uses 8-bit digital codes internally and when talking to another computer, each bit can have a meaning.

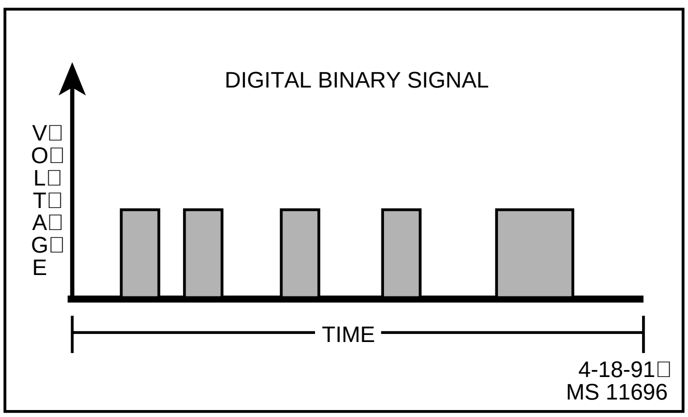


Figure 2-3 - Digital Voltage Signal

Switch Types

Switched inputs (also known as discretes) to the ECM can cause one bit to change, resulting in information being communicated to the ECM. Switched inputs can come in two types: “pull-up” and “pull-down” types. Both types will be discussed.

With “pull-up” type switch, the ECM will sense a voltage when the switch is CLOSED. With “pull-down” type switch, the ECM will sense a voltage when the switch is OPEN.

Pulse Counters

For the ECM to determine frequency information from a switched input, the ECM must measure the time between the voltage pulses. As a number of pulses are recorded in a set amount of time, the ECM can calculate the frequency. The meaning of the frequency number can have any number of meanings to the ECM.

An example of a pulse counter type of input is the Crankshaft Position (CKP) sensor input. The ECM can count a train of pulses, a given number of pulses per engine revolution. In this way, the ECM can determine the RPM of the engine.

Engine Control Module (ECM)

The Engine Control Module (ECM), located on the engine, is the control center of the fuel injection system. It controls the following:

- Fuel control circuit
- Ignition control circuit
- Idle Air Control (IAC)
- Knock Sensor (KS) system
- On-board diagnostics for engine functions

It constantly looks at the information from various sensors, and controls the systems that affect engine performance. The ECM also performs the diagnostic function of the system. It can recognize operational problems, alert the operator through the MIL (Malfunction Indicator Lamp) and store diagnostic trouble codes, or logged warnings, which identify the problem areas to aid the technician in making repairs. Refer to *General Information* section for more information on using the diagnostic function of the ECM.

ECM Function

The ECM supplies either 5 or 12 volts to power various sensors or switches. This is done through resistances in the ECM 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 39978 meets this requirement.

The ECM controls output circuits such as the injectors, IAC, relays, etc. by controlling the ground or power feed circuit.

Memory

There are three types of memory storage within the ECM. They are ROM, RAM and EEPROM.

ROM

Read Only Memory (ROM) is a permanent memory that is physically soldered to the circuit boards within the ECM. The ROM contains the overall control programs. Once the ROM is programmed, it cannot be changed. The ROM memory is non-erasable, and does not need power to be retained.

RAM

Random Access Memory (RAM) is the microprocessor “scratch pad.” The processor can write into, or read from this memory as needed. This memory is erasable and needs a constant supply of voltage to be retained. If the voltage is lost, the memory is lost.

EEPROM

The Electronically Erasable Programmable Read Only Memory (EEPROM) is a permanent memory that is physically soldered within the ECM. The EEPROM contains program and calibration information that the ECM needs to control engine operation.

The EEPROM is not replaceable. If the ECM is replaced, the new ECM will need to be programmed by the engine manufacturer with the calibration information that is specific to each marine application.

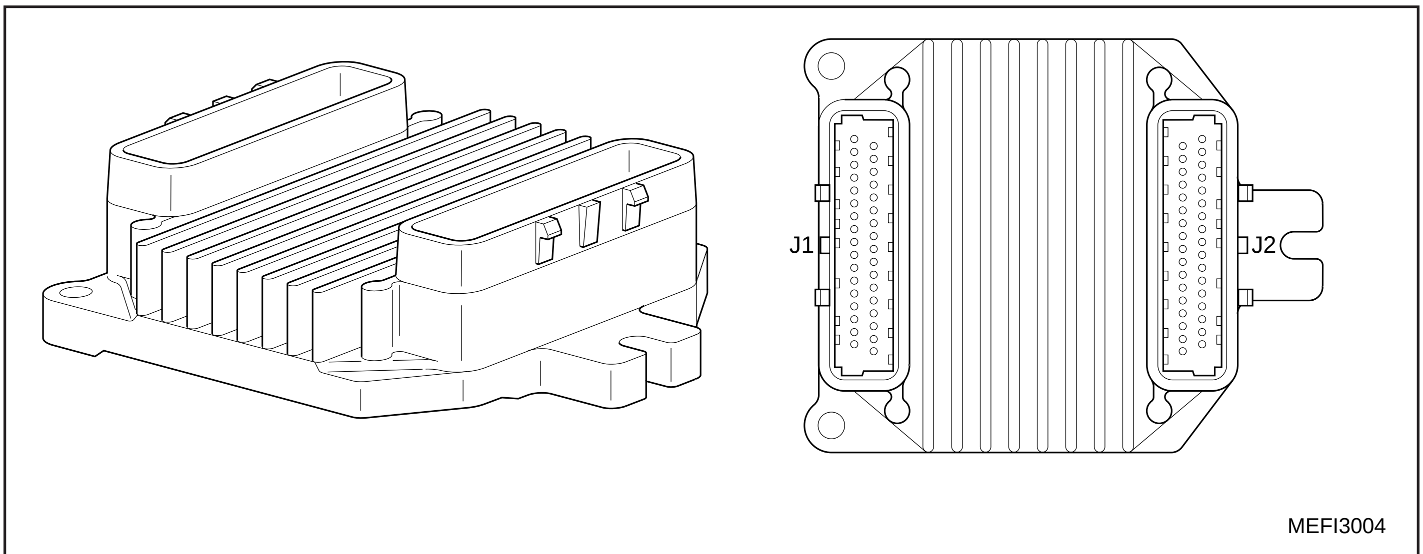


Figure 2-4 - Engine Control Module (ECM)

Speed Density System

The Marine Electronic Fuel Injection (MEFI) system is a speed and air density system. The system is based on "speed density" fuel management.

Sensors provide the ECM with the basic information for the fuel management portion of its operation. Signals to the ECM establish the engine speed and air density factors.

Speed

The engine speed signal comes from the CKP sensor to the ECM. The ECM uses this information to determine the "speed" or RPM factor for fuel and spark management.

Density

One particular sensor contributes to the density factor, the Manifold Absolute Pressure (MAP) sensor. The MAP sensor is a 3-wire sensor that monitors the changes in intake manifold pressure which results from changes in engine loads. These pressure changes are supplied to the ECM in the form of electrical signals.

As intake manifold pressure increases, the vacuum decreases. The air density in the intake manifold also increases, and additional fuel is needed.

The MAP sensor sends this pressure information to the ECM, and the ECM increases the amount of fuel injected, by increasing the injector pulse width. As manifold pressure decreases, the vacuum increases, and the amount of fuel is decreased.

These two inputs, MAP and RPM, are the major determinants of the air/fuel mixture delivered by the fuel injection system. The remaining sensors and switches provide electrical inputs to the ECM, which are used for modification of the air/fuel mixture, as well as for other ECM control functions, such as idle control.

ECM Inputs and Sensor Descriptions

Figure 2-5 lists the data sensors, switches, and other inputs used by the ECM to control its various systems. Although we will not cover them all in great detail, there will be a brief description of each.

Input Components

The ECM monitors the input components for circuit continuity and out-of-range values. This includes performance checking. Performance checking refers to indicating a fault when the signal from a sensor does not seem reasonable, such as a throttle position (TP) sensor that indicates high throttle position at low engine loads or MAP voltage. The input components may include, but are not limited to, the following sensors:

- Intake air temperature (IAT) sensor (5.0/5.7L only)
- Crankshaft position (CKP) sensor
- Camshaft position (CMP) sensor
- Knock sensor(s) (KS)
- Throttle position (TP) sensor
- Engine coolant temperature (ECT) sensor
- Manifold absolute pressure (MAP) sensor

Output Components

Diagnose the output components for the proper response to ECM 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:

- The malfunction indicator lamp (MIL) control
- The check gauges lamp control
- The general warning 2 (low oil pressure) lamp control

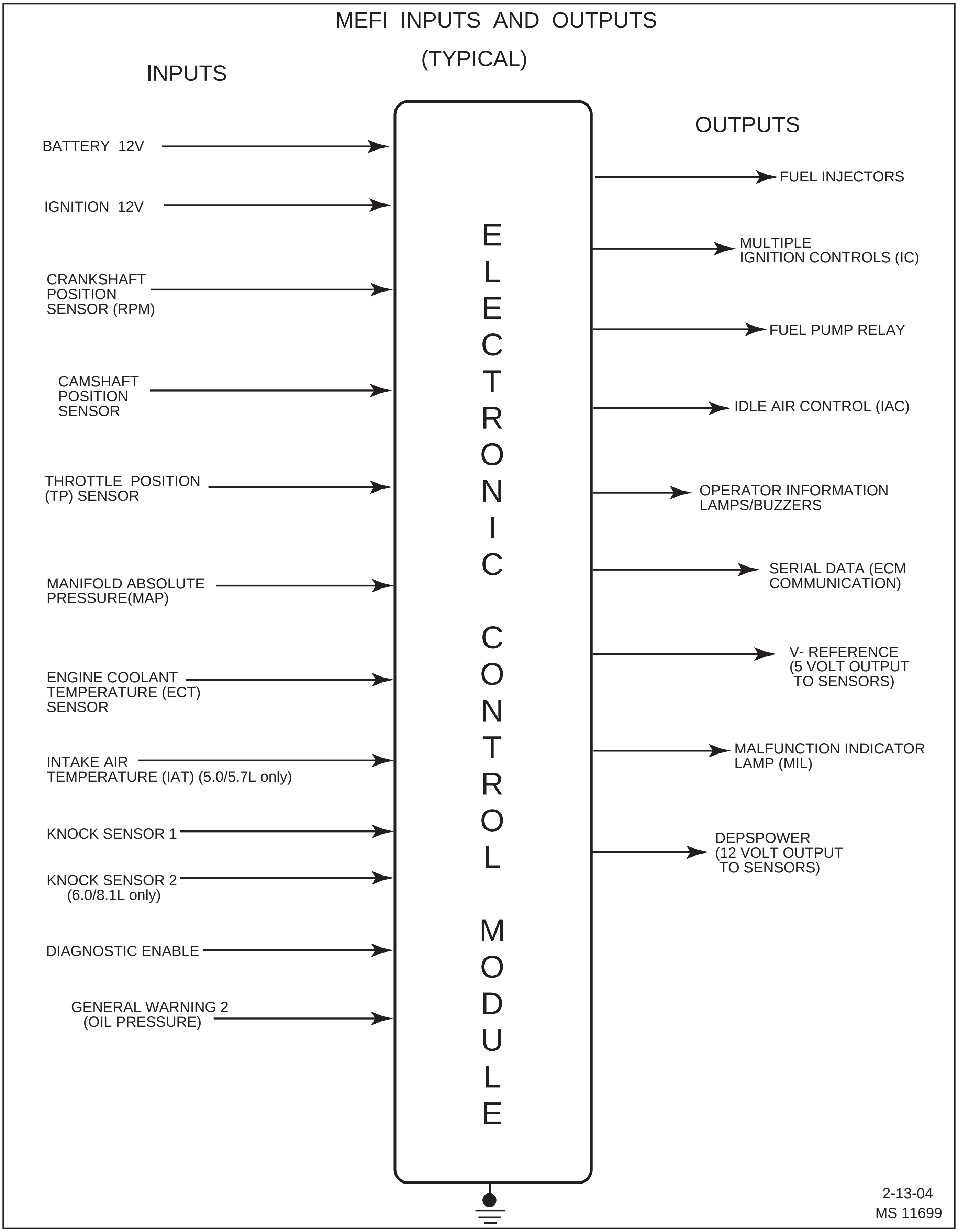


Figure 2-5 - ECM Inputs and Outputs (Typical)

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 (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

The ECM supplies a 5 volt signal to the ECT sensor through a resistor in the ECM and measures the voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the voltage, the ECM calculates the engine coolant temperature. Engine coolant temperature affects most systems the ECM controls.

A hard fault in the engine coolant sensor circuit should set DTC 14 or DTC 15; an intermittent fault may or may not set a DTC. The DTC "Diagnostic Aids" also contains a chart to check for sensor resistance values relative to temperature.

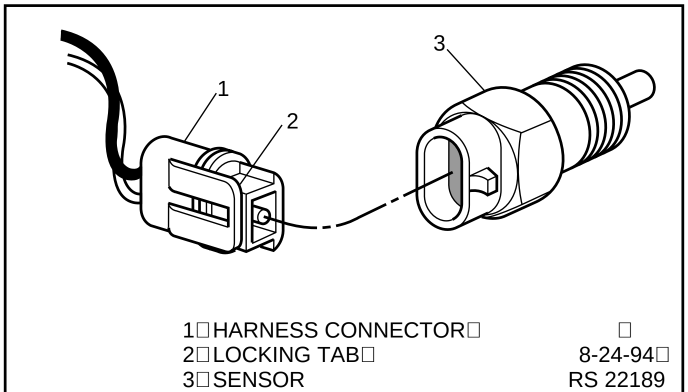


Figure 2-6 - Engine Coolant Temperature (ECT) Sensor

Manifold Absolute Pressure (MAP) Sensor

The Manifold Absolute Pressure (MAP) sensor is a pressure transducer that measures the changes in the intake manifold pressure. The pressure changes as a result of engine load and speed change, and the MAP sensor converts this into a voltage output.

A closed throttle on engine coastdown would produce a relatively low MAP output voltage, while a wide open throttle would produce a high MAP output voltage. This high output voltage is produced because the pressure inside the manifold is almost the same as outside the manifold, so you measure almost 100% of outside air pressure. MAP is the opposite of what you would measure on a vacuum gauge. When manifold pressure is high, vacuum is low, causing a high MAP output voltage. The MAP sensor is also used to measure barometric pressure under certain conditions, which allows the ECM to automatically adjust for different altitudes.

The ECM supplies a 5 volt reference voltage to the MAP sensor. As the manifold pressure changes, the electrical resistance of the MAP sensor also changes. By monitoring the sensor output voltage, the ECM knows the manifold pressure. A higher pressure, low vacuum (high voltage) requires more fuel. A lower pressure, high vacuum (low voltage) requires less fuel. The ECM uses the MAP sensor to control fuel delivery and ignition timing. A failure in the MAP sensor circuit should set a DTC 33 or DTC 34.

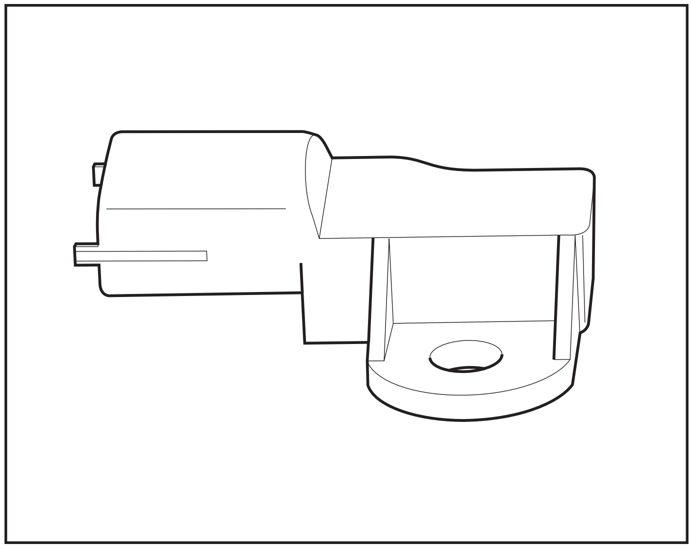


Figure 2-7 - Manifold Absolute Pressure (MAP) Sensor/ Intake Air Temperature (IAT) Sensor (Used On 5.0/5.7L Engines)

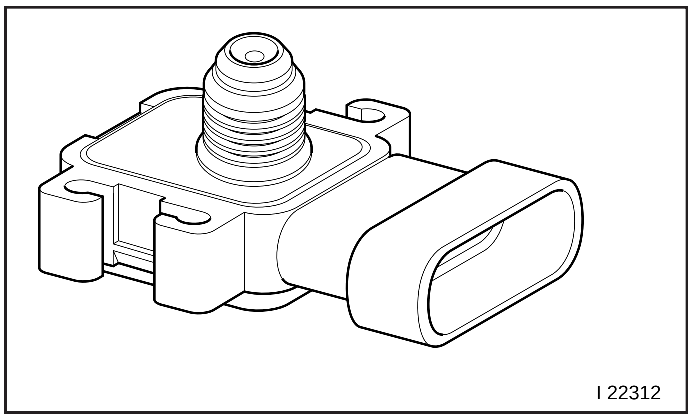


Figure 2-8 - Manifold Absolute Pressure (MAP) Sensor (Used On 6.0/8.1L Engines)

Throttle Position (TP) Sensor

The Throttle Position (TP) sensor is a potentiometer connected to the throttle shaft on the throttle body. By monitoring the voltage on the signal line, the ECM 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 ECM 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 ECM thinks the throttle is moving. A hard failure in the TP sensor circuit should set either a DTC 21 or DTC 22. Once a DTC is set, the ECM will use a calibratible default value for throttle position and some engine performance will return.

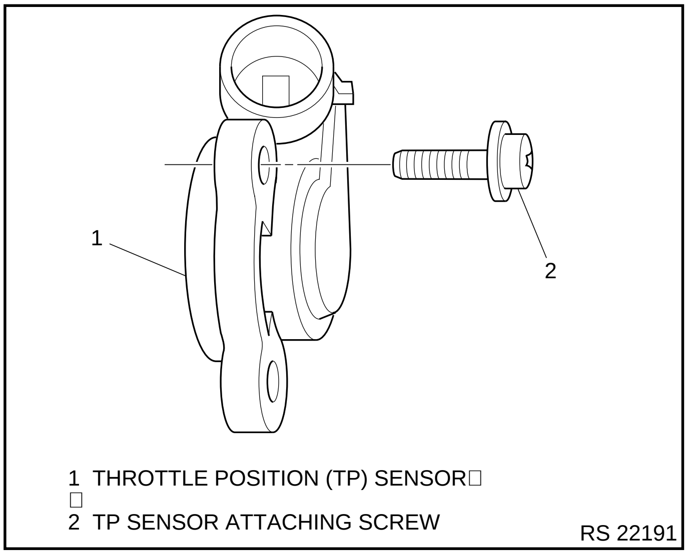


Figure 2-10 - Throttle Position (TP) Sensor (Typical)

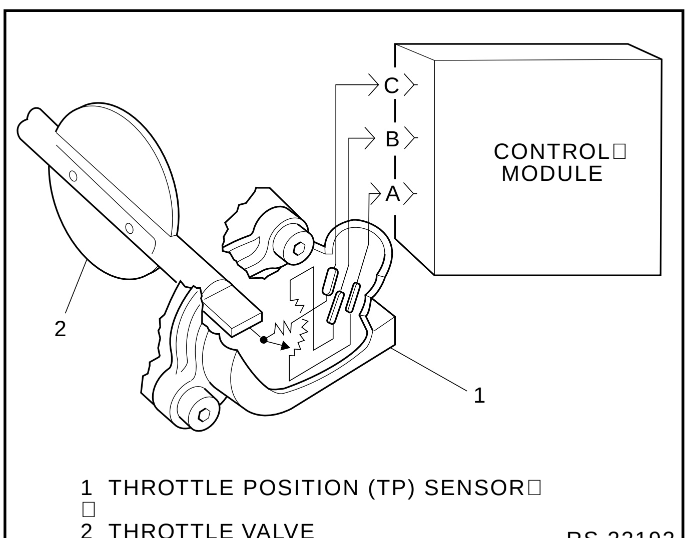


Figure 2-11 - Throttle Position (TP) Sensor (Typical)

Intake Air Temperature (IAT) Sensor (5.0/5.7L)

The Intake Air Temperature (IAT) sensor is a thermistor which changes value based on the temperature of air entering the engine (Figure 2-12). Low temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

The ECM supplies a 5 volt signal to the sensor through a resistor in the ECM and measures the voltage. The voltage will be high when the incoming air is cold, and low when the incoming air is hot. By measuring the voltage, the ECM calculates the incoming air temperature. The IAT sensor signal is used to determine spark timing based on incoming air density.

The scan tool displays temperature of the air entering the engine, which should read close to ambient air temperature when engine is cold, and rise as engine compartment temperature increases. If the engine has not been run for several hours (overnight), the IAT sensor and ECT sensor temperatures should read close to each other. A failure in the IAT sensor circuit should set DTC 23 or DTC 25.

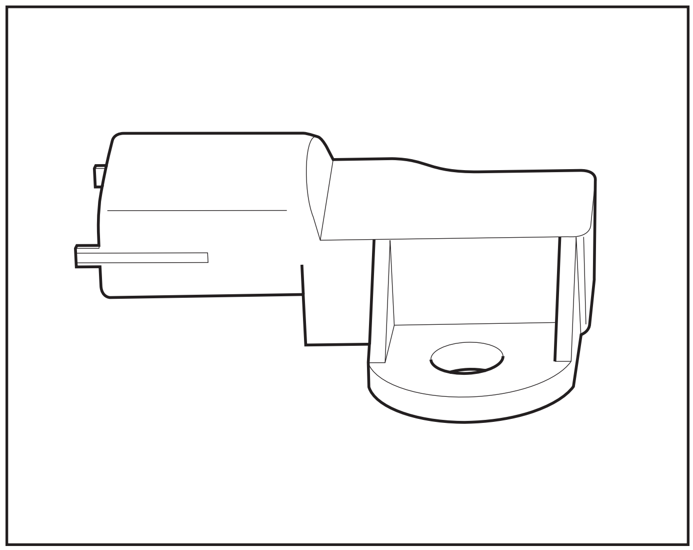


Figure 2-12 - Manifold Absolute Pressure (MAP) Sensor/
Intake Air Temperature (IAT) Sensor
(Used On 5.0/5.7L Engines)

Ignition Control (IC) Reference

The Ignition Control (IC) reference (RPM signal) is supplied to the ECM by way of the crankshaft position sensor. This pulse counter type input creates the timing signal for the pulsing of the fuel injectors, as well as the IC functions. This signal is used for a number of control and testing functions within the ECM.

Knock Sensor (KS) System Description

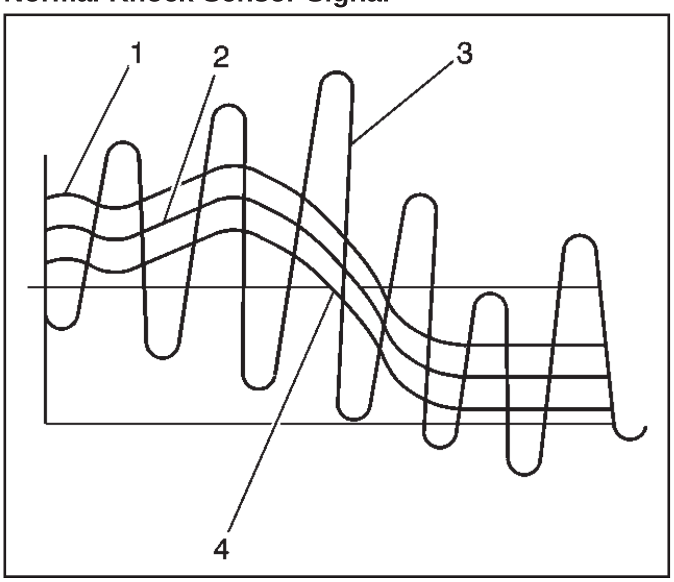
Purpose:

To control spark knock (detonation), a knock sensor (KS) system is used. This system is designed to retard spark timing when excessive spark knock is detected in the engine. The KS system allows the engine to use maximum spark advance for optimal driveability and fuel economy under all operating conditions.

Operation:

The ECM uses a knock sensor(s) to detect abnormal vibration in the engine (detonation/spark knock). Mounted on the engine block, the knock sensor(s) produces an AC voltage signal at all engine speeds and loads. The ECM then adjusts the spark timing based on the amplitude and frequency of the KS signal. The ECM uses the KS signal to calculate an average voltage. Then, the ECM assigns a voltage range above and below the average voltage value. The ECM checks the KS and related wiring by comparing the actual knock signal to the assigned voltage range. A normal KS signal should vary outside the assigned voltage range as shown in the NORMAL KS figure. If the ECM detects a KS signal within the assigned voltage range as shown in the ABNORMAL KS figure, the applicable DTC will set.

Normal Knock Sensor Signal



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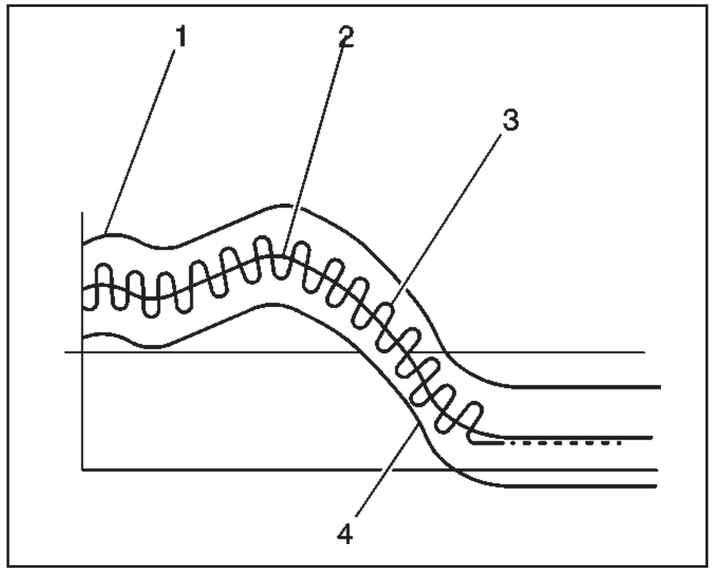
Abnormal Knock Sensor Signal



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Legend

1. Upper fail region
2. Knock sensor calculated average
3. Knock sensor signal
4. Lower fail region

Discrete Switch Inputs

Several discrete switch inputs are utilized by the MEFI system to identify abnormal conditions that may affect engine operation. Pull-up and pull-down type switches are currently used in conjunction with the ECM to detect critical conditions to engine operation.

If a switch changes states from its normal at rest position, that is, normally closed to open, or normally open to closed, the ECM senses a change in voltage and responds by entering Power reduction mode.

This engine protection feature allows the operator normal engine operations up to 2500 RPM, but disables half the fuel injectors until the engine drops below 1200 RPM. Then normal engine operation is restored until the RPM limit is exceeded. This feature allows the operator a safe maneuvering speed while removing the possibility of high RPM engine operation until the problem is corrected.

Switches that may be used with the MEFI system to detect critical engine operation parameters are:

- Oil Pressure

Diagnosis

Engine Control Module (ECM)

To read and clear diagnostic trouble codes, use a scan tool or Diagnostic Trouble Code (DTC) tool.

Important: Use of a scan tool is recommended to clear diagnostic trouble codes from the ECM memory. Diagnostic trouble codes can also be cleared by using the DTC tool.

Since the ECM can have a failure which may affect more than one circuit, following the diagnostic procedures will determine which circuit has a problem and where it is.

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

- Check for good ECM power and grounds.
- There is a problem with the ECM terminal connections. The diagnostic table will say ECM connections or ECM. The terminals may have to be removed from the connector in order to check them properly.
- EEPROM program is not correct for the application. Incorrect components may cause a malfunction and may or may not set a DTC.
- 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 portions of the system involved.
- Shorted relay coil or harness. Relays are turned "ON" and "OFF" by the ECM using internal electronic switches called drivers. A shorted relay coil or harness may not damage the ECM but will cause the relay to be inoperative.

On-Board Service

Engine Control Module (ECM) Replacement

Notice: When replacing the ECM, the ignition must be "OFF" and disconnect the battery before disconnecting or reconnecting the ECM "J1" and "J2" connectors to prevent internal damage to the ECM.

Notice: To prevent possible electrostatic discharge damage to the ECM, do not touch the connector pins. The ECM is an electrical component. Do Not soak in any liquid cleaner or solvent, as damage may result.

Remove or Disconnect

1. Negative battery cable.
2. "J1" and "J2" connectors from ECM.
3. The ECM mounting screws.
4. ECM from mounting bracket.

Important

- Make sure the new ECM has the same part number and service number as the old ECM, to insure proper engine performance.

Install or Connect

1. New ECM to mounting bracket.
2. The ECM mounting screws. Torque to 10-14 N•m (88-124 lb in).
3. "J1" and "J2" connectors to ECM.
4. Negative battery cable.

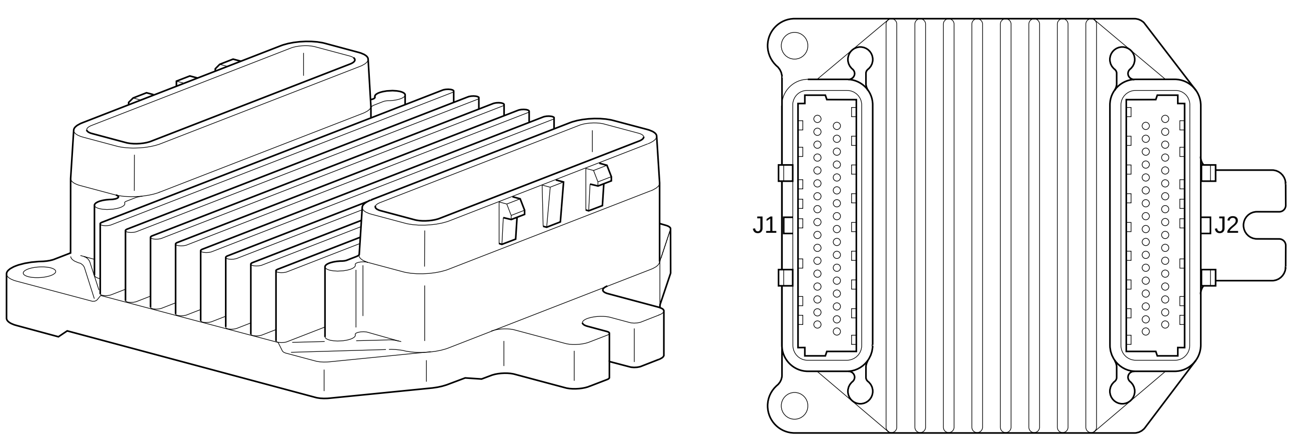
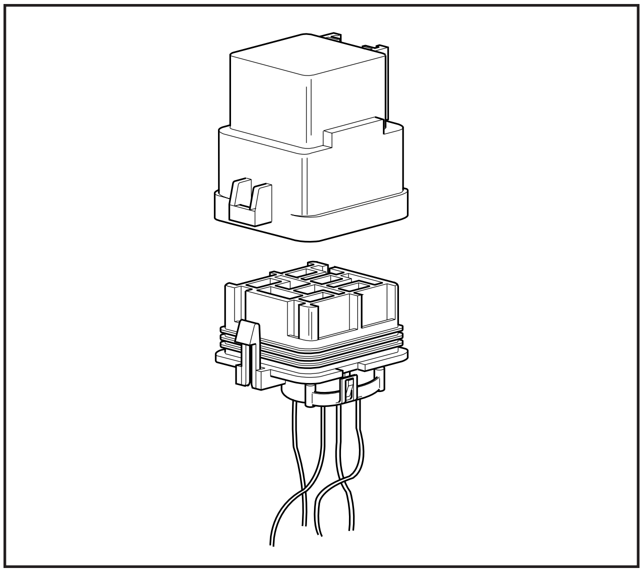


Figure 2-13 - Engine Control Module (ECM)



mefi4337

System Relay Replacement

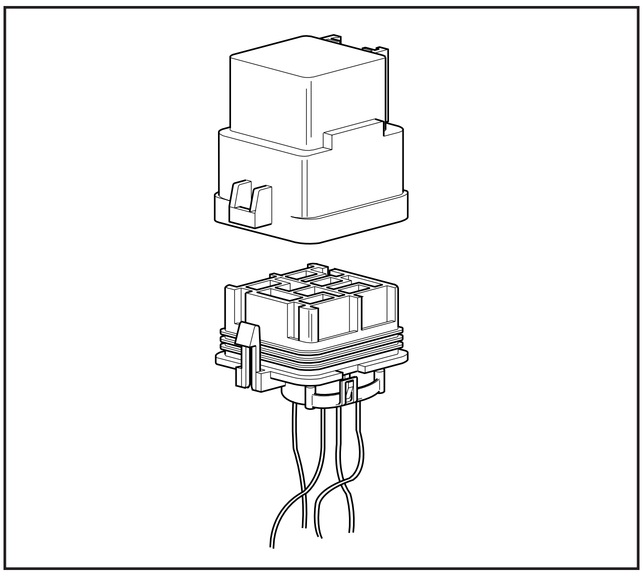
Removal Procedure

1. Turn the ignition OFF.
2. Remove the retainer.
3. Disconnect the system relay electrical connector.
4. Remove the system relay.

Important: The system relay is an electrical component. Do Not soak in any liquid or solvent as damage may result.

Installation Procedure

1. Install the system relay.
2. Reconnect the system electrical connector.
3. Install the retainer clip.



mefi4337

Fuel Pump Relay Replacement

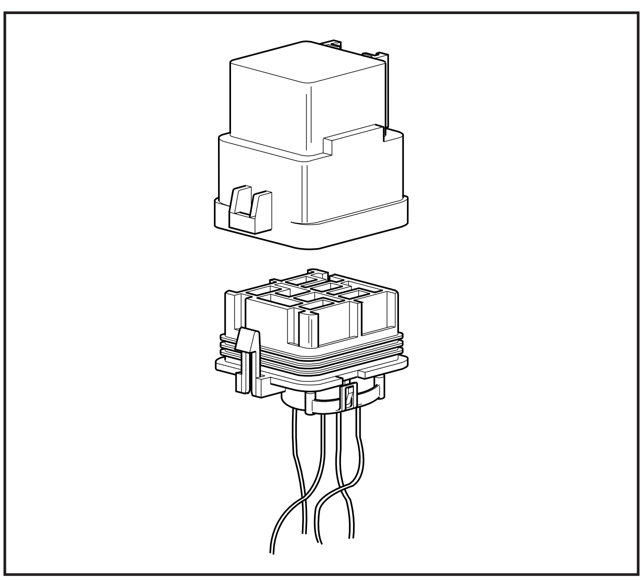
Removal Procedure

1. Turn the ignition OFF.
2. Remove the retainer.
3. Disconnect the fuel pump relay electrical connector.
4. Remove the fuel pump relay.

Important: The fuel pump relay is an electrical component. Do Not soak in any liquid or solvent as damage may result.

Installation Procedure

1. Install the fuel pump relay.
2. Reconnect the fuel pump relay electrical connector.
3. Install the retainer clip.



mefi4337

Starter Relay Replacement

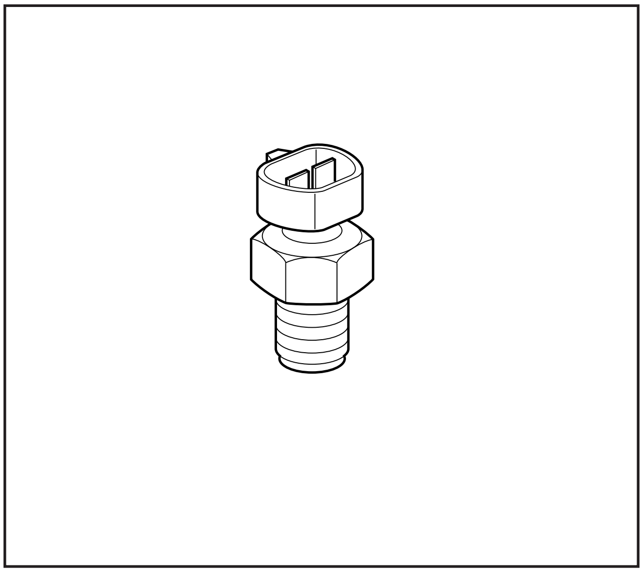
Removal Procedure

1. Turn the ignition OFF.
2. Remove the retainer.
3. Disconnect the starter relay electrical connector.
4. Remove the starter relay.

Important: The starter relay is an electrical component. Do Not soak in any liquid or solvent as damage may result.

Installation Procedure

1. Install the starter relay.
2. Reconnect the starter relay electrical connector.
3. Install the retainer clip.



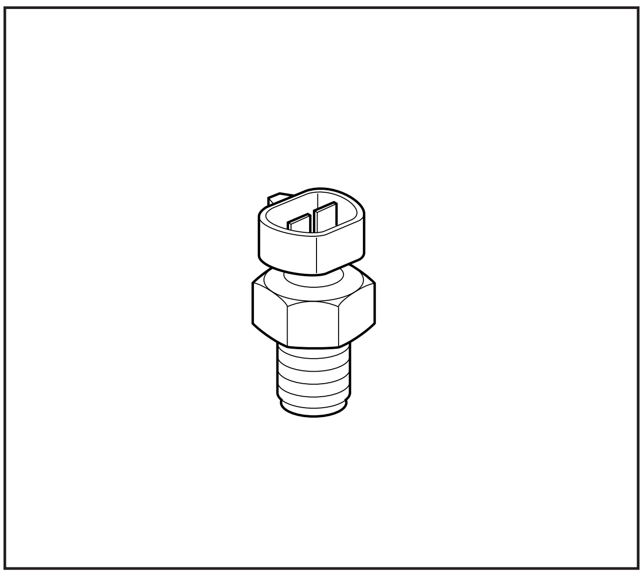
mefi4333

Engine Coolant Temperature (ECT) Sensor Replacement

Notice: Care must be taken when handling the ECT sensor. Damage to the sensor will affect proper operation of the MEFI system.

Remove or Disconnect

1. Turn OFF the ignition.
2. Drain the cooling system below the level of the ECT sensor (if necessary).
3. Disconnect the ECT electrical connector.
4. Remove the ECT sensor.



mefi4333

Installation Procedure

Important: Coat ECT sensor threads with Teflon tape sealant prior to installation.

1. Install the ECT sensor.

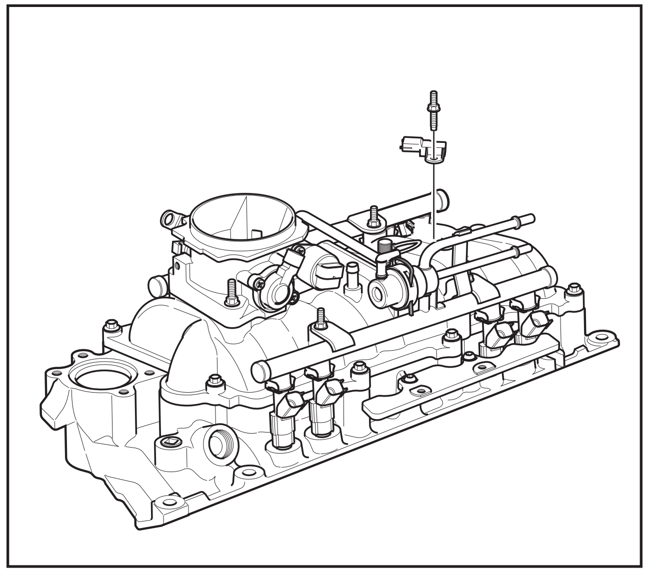
   Tighten

   Tighten the ECT sensor to 20 N•m (15 lb ft).
2. Reconnect the ECT electrical connector.
3. Refill the cooling system (if necessary).

Manifold Absolute Pressure (MAP) / Intake Air Temperature (IAT) Sensor Replacement (5.0/5.7L)

Removal Procedure

1. Remove the MAP sensor retaining stud.
2. Remove the MAP sensor from the intake manifold.
3. Inspect the MAP sensor seal for wear or damage and replace as necessary.



map rr

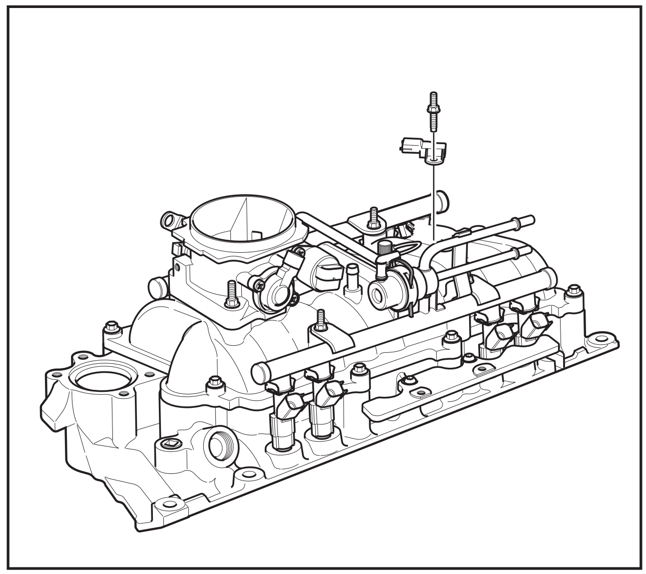
Installation Procedure

Important: Lightly coat the MAP sensor seal with rubber lubricant before installing the sensor. The lubricant should be applied with a sponge or brush. To prevent blockage, avoid dipping the sensor port directly into the lubricant.

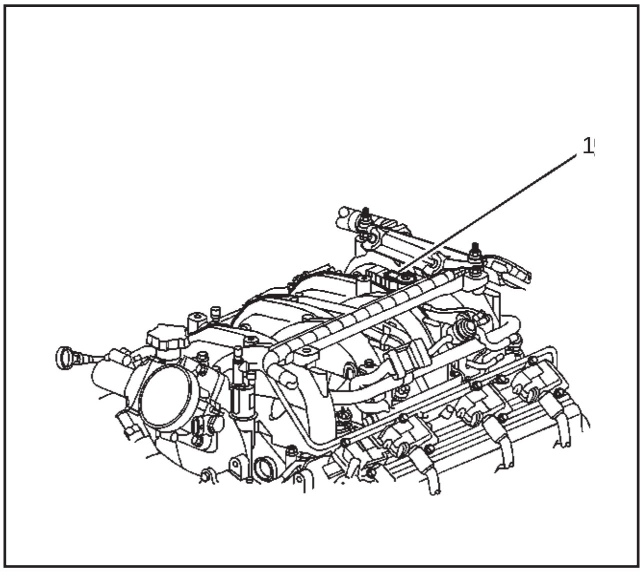
1. Install the MAP sensor.
2. Install the MAP sensor retaining stud.

   Tighten

   Tighten the MAP sensor retaining stud to 12 N•m (106 lb in).
3. Connect the manifold absolute pressure (MAP) sensor electrical connector.



map rr

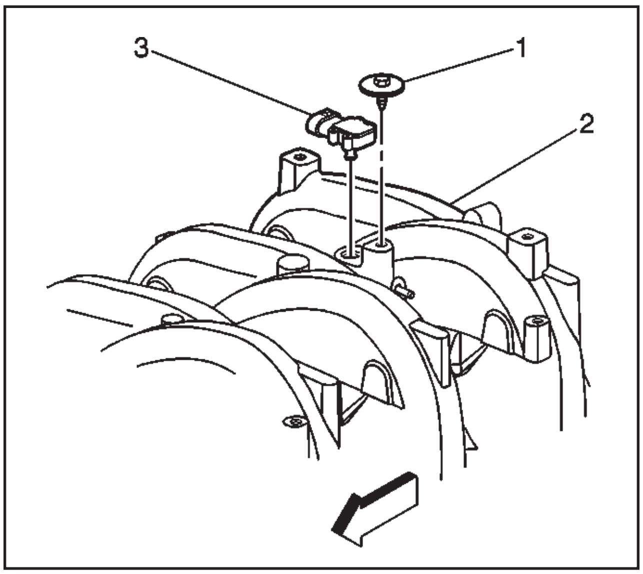


684798

Manifold Absolute Pressure (MAP) Sensor Replacement (6.0/8.1L)

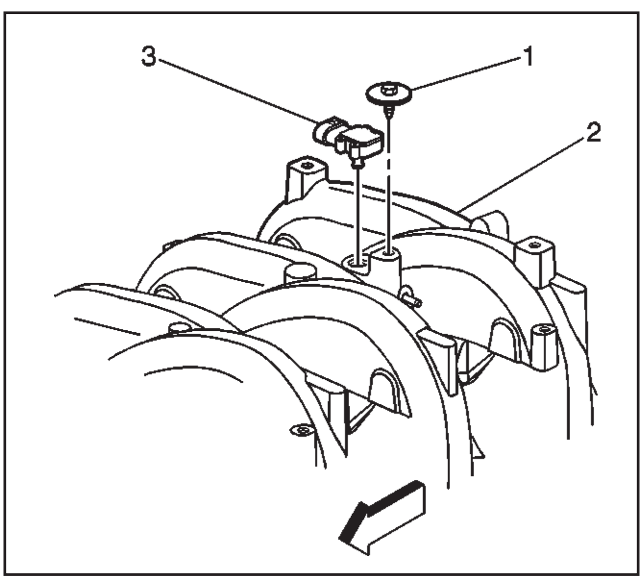
Removal Procedure

1. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).



684801

2. Remove the MAP sensor retaining bolt and washer (1).
3. Remove the MAP sensor (3) from the intake manifold (2).
4. Inspect the MAP sensor seal for wear or damage and replace as necessary.



684801

Installation Procedure

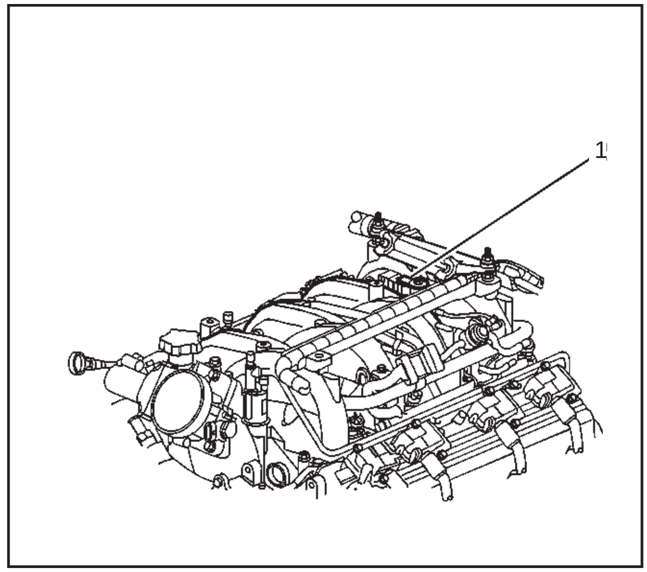
Important: Lightly coat the MAP sensor seal with rubber lubricant before installing the sensor. The lubricant should be applied with a sponge or brush. To prevent blockage, avoid dipping the sensor port directly into the lubricant.

1. Install the MAP sensor (3).
2. Install the MAP sensor retaining bolt and washer (1).

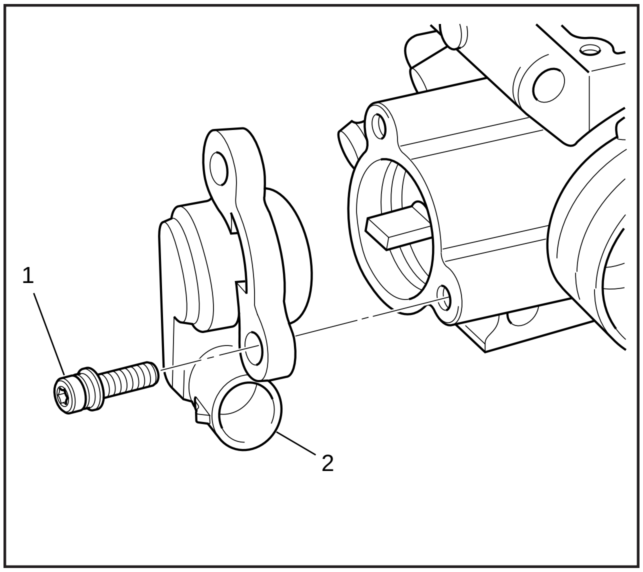
   Tighten

   Tighten the MAP sensor retaining bolt to 12 N•m (106 lb in).

3. Connect the MAP sensor electrical connector (1).



684798



PS19190

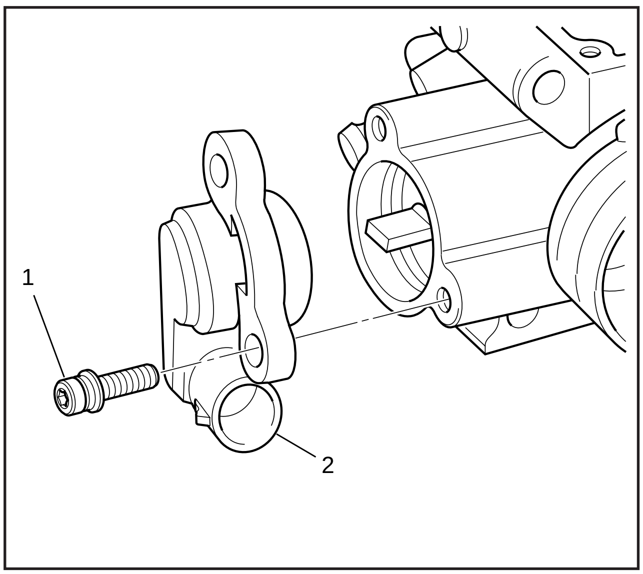
Throttle Position (TP) Sensor

Remove or Disconnect

1. Flame arrestor.
2. TP sensor electrical connector.
3. TP sensor attaching screws (1).
4. TP sensor (2).

Important

- The TP sensor is an electrical component. Do Not soak in any liquid cleaner or solvent, as damage may result.
- If replacing TP sensor, install new screws that are supplied with the TP sensor service package.



PS19190

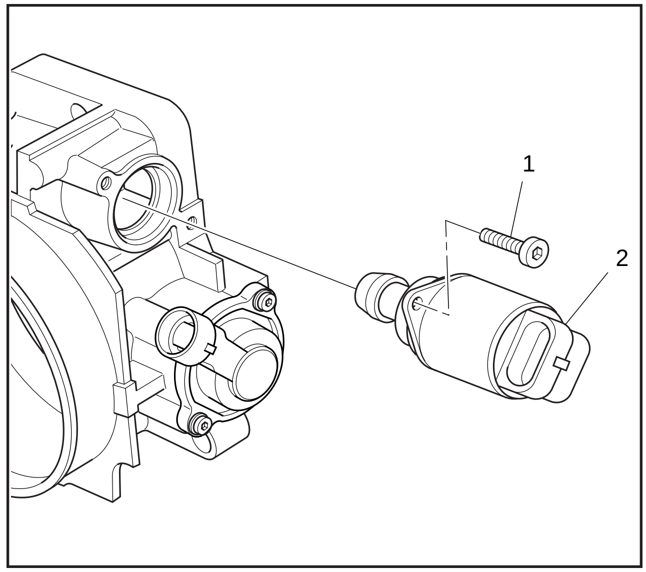
Install or Connect

1. TP sensor over throttle shaft.
2. With throttle valve in the normal closed position (idle), install TP sensor on throttle body assembly, making sure TP sensor pickup lever lines up with the tang on the throttle actuator lever.
3. TP sensor attaching screws. Torque to 2 N•m (18 lb in).
4. TP sensor electrical connector.
5. Flame arrestor.

Idle Air Control (IAC) Valve

Remove or Disconnect

1. Flame arrestor.
2. IAC electrical connector.
3. IAC valve attaching screws (1).
4. IAC valve (2).



M4085

Notice: On IAC valves that have been in service, Do Not push or pull on the IAC valve pintle. The force required to move the pintle may damage the threads on the worm drive. Also, Do Not soak IAC valve in any liquid cleaner or solvent, as damage may result.

Clean and Inspect

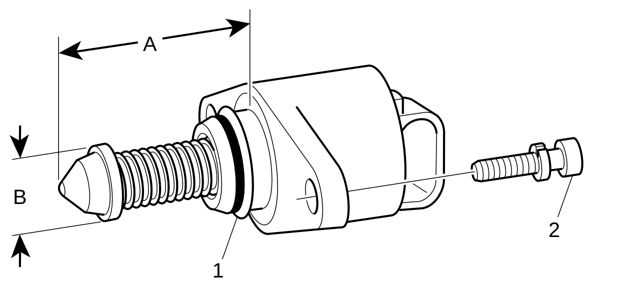
- Clean IAC valve O-ring sealing surface, pintle valve seat and air passage.
  - Use carburetor cleaner to remove carbon deposits. Do Not use a cleaner that contains methyl ethyl ketone, an extremely strong solvent, and not necessary for this type of deposit.
  - Shiny spots on the pintle or seat are normal, and do not indicate misalignment or a bent pintle shaft.

Important

- If installing a new IAC valve, be sure to replace with an identical part number. IAC valve pintle shape and diameter are designed for the specific application.

Measure (If installing a new IAC valve)

- Distance between tip of IAC valve pintle and mounting surface.
  - If greater than 28 mm, use finger pressure to slowly retract the pintle. The force required to retract the pintle of a new valve will not cause damage to the valve.



1 O-RING - IAC VALVE
2 IAC VALVE ATTACHING SCREW
A DISTANCE OF PINTLE EXTENSION
B DIAMETER OF PINTLE

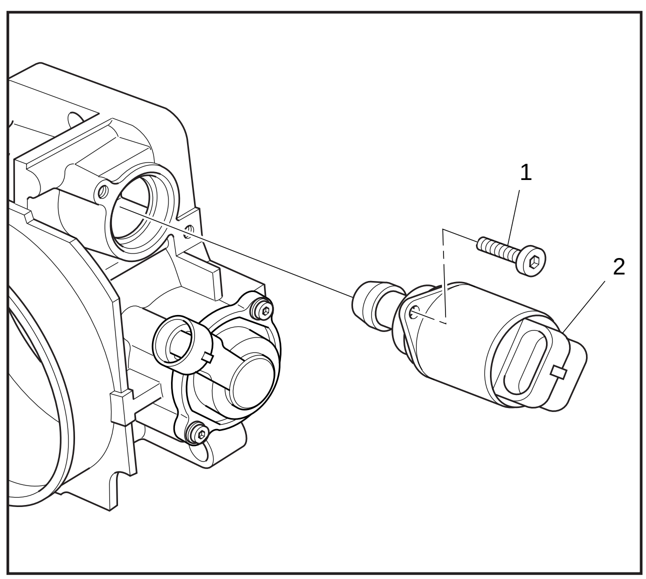
8-24-94
RS 22181

Install or Connect

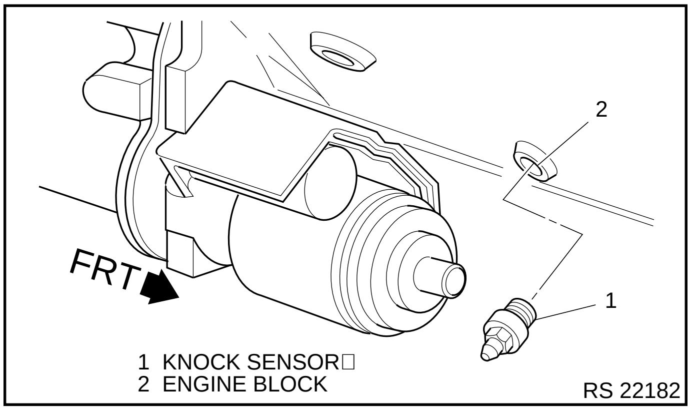
1. New O-ring on IAC valve and lubricate.

Notice: New IAC valves have been preset at the factory and should not require any adjustment.

2. IAC valve to throttle body using attaching screws. Torque to 3.2 N•m (28 lb in).
3. IAC valve electrical connector.
4. Reset IAC valve pintle position:
   - Turn ignition “OFF” for 10 seconds.
   - Start and run engine for 5 seconds.
   - Ignition “OFF” for 10 seconds.
   - Restart engine and check for proper idle.



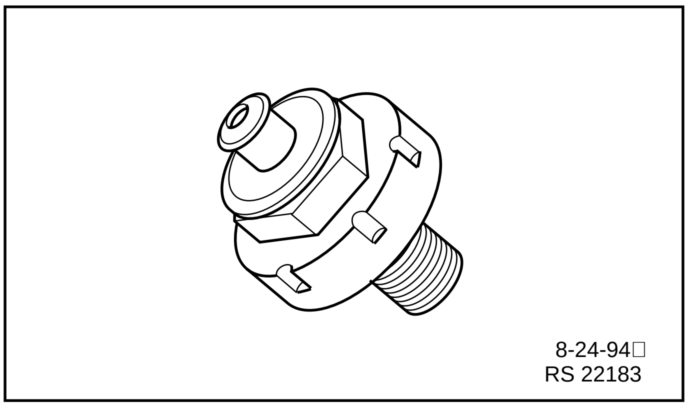
M4085



Knock Sensor (KS) (5.0/5.7L)

Remove or Disconnect

1. Negative battery cable.
2. Knock sensor electrical connector.
3. Knock sensor from engine block.

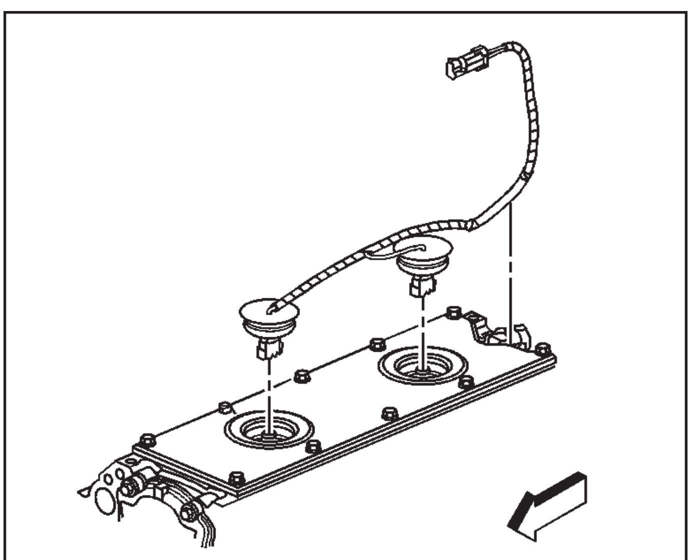


Install or Connect

Important

- If installing a new knock sensor, be sure to replace with an identical part number.
- When installing knock sensor, be sure to install in the same location removed from.
- If installing knock sensor in water jacket, use Teflon sealer.

1. Knock sensor into engine block. Be sure threads are clean. Torque to 15-22 N•m (11-16 lb ft).
2. Knock sensor electrical connector.
3. Negative battery cable.

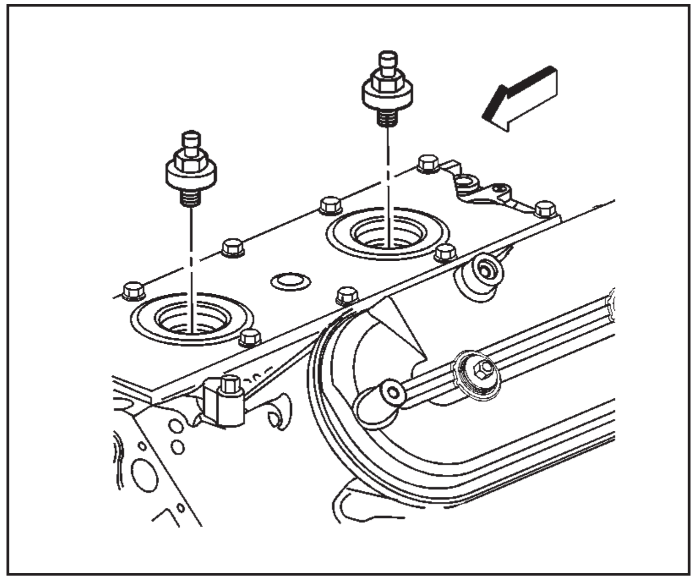


Knock Sensors (KS) (6.0L)

Remove or Disconnect

1. Remove the intake manifold. Refer to Intake Manifold Replacement in Engine Mechanical - 6.0L.
2. Gently pry up the rubber covers.
3. Disconnect the knock sensor electrical connectors.

4. Remove the knock sensors.

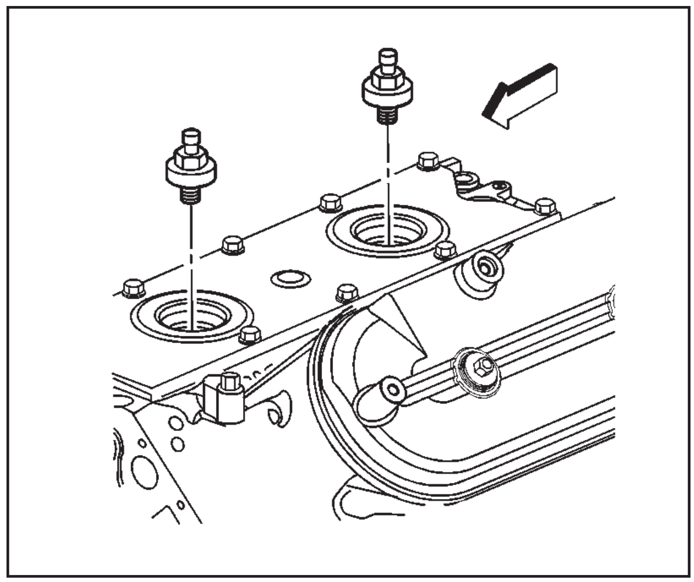


Install or Connect

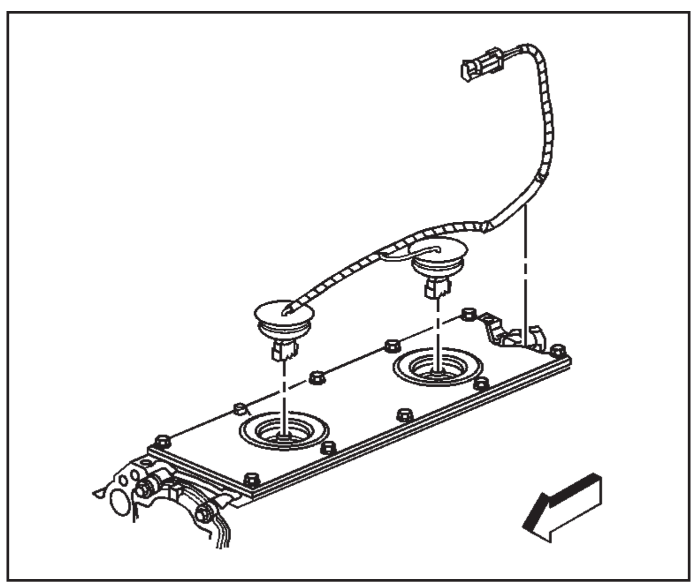
Important

- If installing a new knock sensor, be sure to replace with an identical part number.
- When installing knock sensor, be sure to install in the same location removed from.

1. Knock sensors into engine block. Be sure threads are clean. Torque to 20 N•m (15 lb ft).



2. Connect the knock sensor electrical connectors.
3. Push down on the rubber covers.
4. Install the intake manifold. Refer to Intake Manifold Replacement in Engine Mechanical - 6.0L.



Torque Specifications

Fastener Tightening Specifications (5.0/5.7L)

Application	N•m	Lb Ft	Lb In
ECM Mounting Screws	10-14		88-124
ECT Sensor	12		108
MAP/IAT Sensor Attaching Stud	5-7		44-62
TP Sensor Attaching Screws	2		18
IAC Valve Attaching Screws	3.2		28
Knock Sensor	15-22	11-16	

Fastener Tightening Specifications (6.0/8.1L)

Application	N•m	Lb Ft	Lb In
ECM Mounting Screws	10-14		88-124
ECT Sensor	12		108
MAP Sensor Attaching Screw	5-7		44-62
TP Sensor Attaching Screws	2		18
IAC Valve Attaching Screws	3.2		28
Knock Sensors	20	15	

Marine Electronic Fuel Injection (MEFI)

Section 3A

Fuel Metering System - 5.0/5.7L

This section describes how the fuel metering system operates, and provides a description of components used on the Marine Electronic Fuel Injection equipped engines. The fuel metering system information described in this section is limited to the 5.0/5.7L. All other systems will be detailed in a separate section.

Contents

General Description

Purpose

The function of the fuel metering system is to deliver the correct amount of fuel to the engine under all operating conditions. Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold near each cylinder.

Modes Of Operation

The ECM looks at inputs from several sensors to determine how much fuel to give the engine. The fuel is delivered under one of several conditions, called “modes.” All the “modes” are controlled by the ECM and are described below.

Starting Mode

When the ignition switch is turned to the crank position, the ECM turns the fuel pump relay “ON,” and the fuel pump builds up pressure. The ECM then checks the ECT, MAP and TP sensors, and determines the proper air/fuel ratio for starting. The ECM controls the amount of fuel delivered in the starting mode by changing how long the injectors are turned “ON” and “OFF.” This is done by “pulsing” the injectors for very short times.

Clear Flood Mode

If the engine floods, it can be cleared by opening the throttle to 100% (wide open throttle) during cranking. The ECM then shuts down the fuel injectors so no fuel is delivered. The ECM holds this injector rate as long as the throttle stays at 100%, and the engine speed is below 300 RPM. If the throttle position becomes less than 100%, the ECM returns to the starting mode.

Run Mode

When the engine is first started and RPM is above 300 RPM, the system operates in the run mode. The ECM will calculate the desired air/fuel ratio based on these ECM inputs: RPM, ECT and MAP. Higher engine loads (MAP input) and colder engine temperatures (ECT input) require more fuel, or a richer air/fuel ratio.

Acceleration Mode

The ECM looks at rapid changes in TP sensor and MAP, and provides extra fuel by increasing the injector pulse width.

Fuel Cutoff Mode

No fuel is delivered by the injector when the ignition is “OFF,” to prevent dieseling. Also, injector pulses are not delivered if the ECM does not receive distributor reference pulses, which means the engine is not running. The fuel cutoff mode is also enabled at high engine RPM, as an overspeed protection for the engine. When fuel cutoff is in effect due to high RPM, injector pulses will resume after engine RPM drops below the maximum OEM RPM specification (Rev Limit).

Power Reduction Mode

Power reduction mode is a function of the ECM that reduces

engine power under certain conditions. Power reduction will disable one fuel injector driver when the engine speed goes above 2500 rpm, and enable the fuel injector driver when the engine speed drops below 1200 rpm. Power reduction may be active for the following conditions:

- Engine coolant temperature too high
- Low oil pressure
- Transmission temperature too high (if applicable)

Fuel Metering System Components

The fuel metering system (Figure 3-1) is made up of the following parts:

- Fuel supply components (fuel tank, pump, lines, filter).
- Fuel pump electrical circuit.
- Fuel rail assembly, including fuel injectors and pressure regulator assembly.
- Throttle body assembly, including an IAC valve and TP sensor.

Quick-Connect Fittings

Quick-Connect fittings provide a simplified means of installing and connecting fuel system components. The fittings consists of a unique female connector and a compatible male pipe end. O-rings, located inside the female connector, provide the fuel seal. Integral locking tabs inside the female connector hold the fittings together.

Fuel Supply Components (FCC System)

The Fuel Control Cell (FCC) incorporates two (2) fuel pumps to provide uninterrupted flow of fuel to your marine engine.

Fuel is fed into the FCC by a low-pressure, high volume electric fuel pump. This pump flows fuel at a volume which exceeds the fuel flow rate required of the high-pressure pump by engine demands.

The high pressure pump, mounted inside the FCC bowl, provides the necessary fuel pressure and volume to maintain proper engine performance, and always has an ample supply of fuel to meet the idle, cruise and acceleration fuel requirements fo the engine.

The fuel pressure regulator, located on the fuel rail, controls fuel pressure and maintains a constant pressure across the fuel delivery system. Fuel not used by the engine, excess fuel, is returned to the FCC canister.

The fuel delivered to the engine by the FCC is filtered by a filter and water separator element, which surrounds the high pressure pump inside the FCC bowl.

The fuel enters the FCC bowl from two (2) components, the low-pressure pump (initial input) and the fuel pressure regulator (unused recirculating). Fuel exits the FCC bowl at two (2) locations, the high-pressure output to the fuel rail and all excess fuel in the FCC bowl is routed back to the fuel tank via a return line.

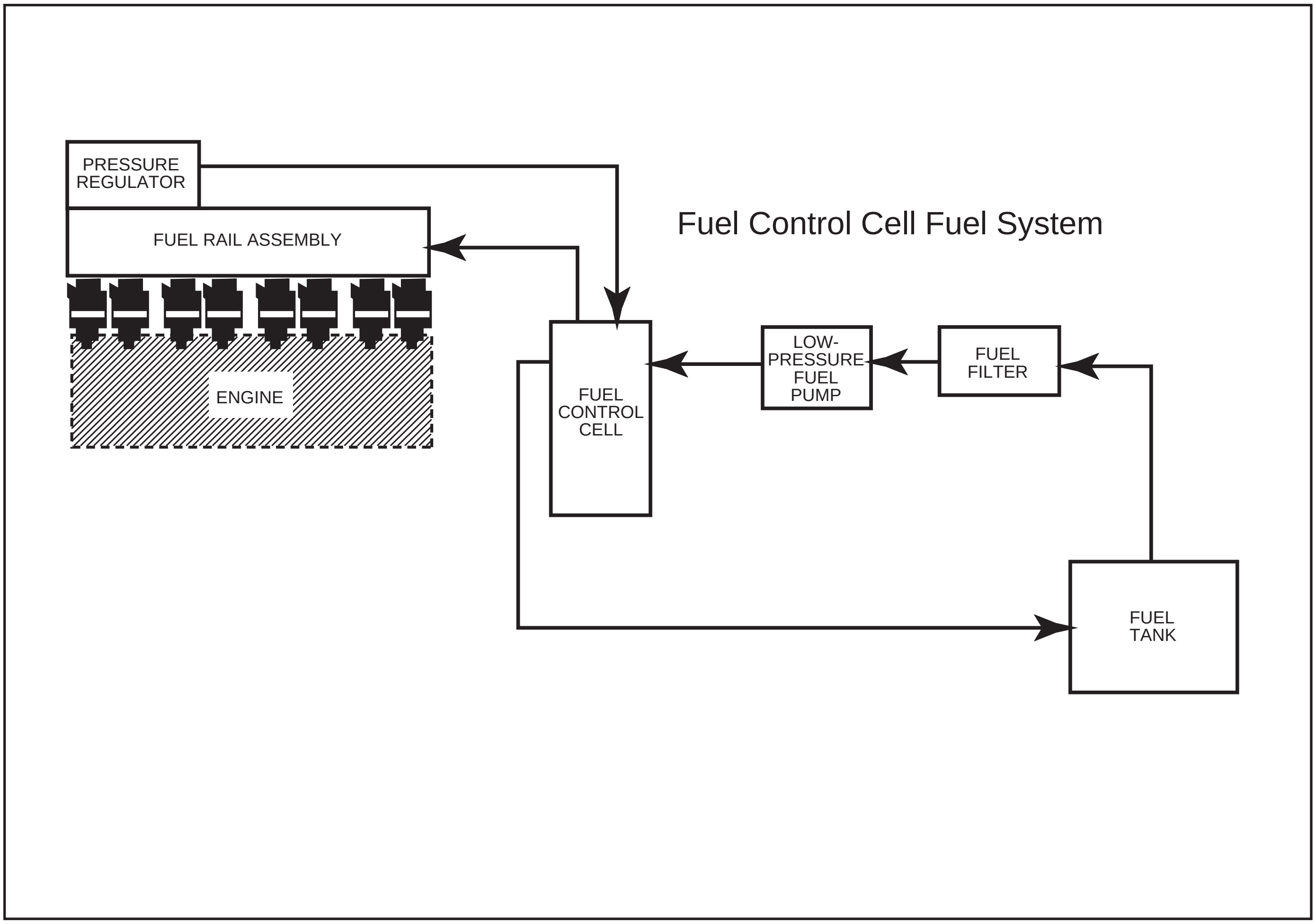


Figure 3-1 - Fuel Metering System (Typical)

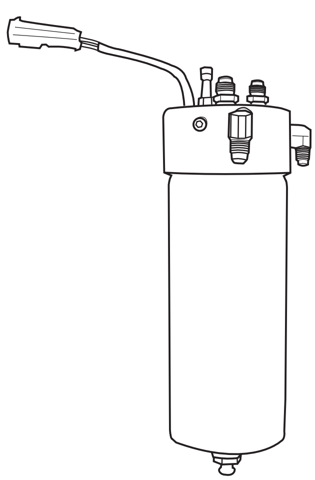


Figure 3-2 - Typical Fuel Control Cell (FCC)

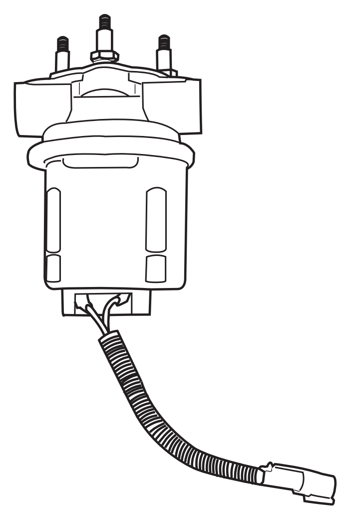


Figure 3-3 - Low Pressure Fuel Pump

Fuel Pump Electrical Circuit

When the ignition switch is turned “ON,” the ECM turns the fuel pump relay “ON” for two seconds causing the fuel pump(s) to pressurize the MEFI fuel system.

When the ignition switch is turned to the crank position, the ECM turns the fuel pump relay “ON” causing the fuel pump to run.

If the ECM does not receive ignition reference pulses (engine cranking or running), it shuts “OFF” the fuel pump relay, causing the fuel pump to stop.

An inoperative fuel pump relay will result in an “Engine Cranks But Will Not Run” condition.

Fuel Rail Assembly

The fuel rail (Figure 3-3) is mounted to the engine intake manifold, and performs several functions. It positions the injectors in the intake manifold, distributes fuel evenly to the injectors, and integrates the fuel pressure regulator into the fuel metering system.

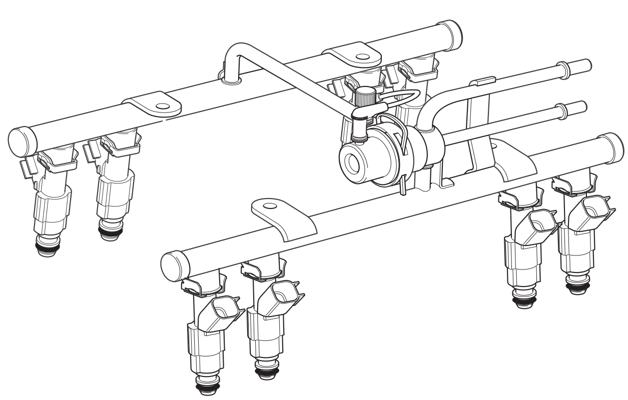
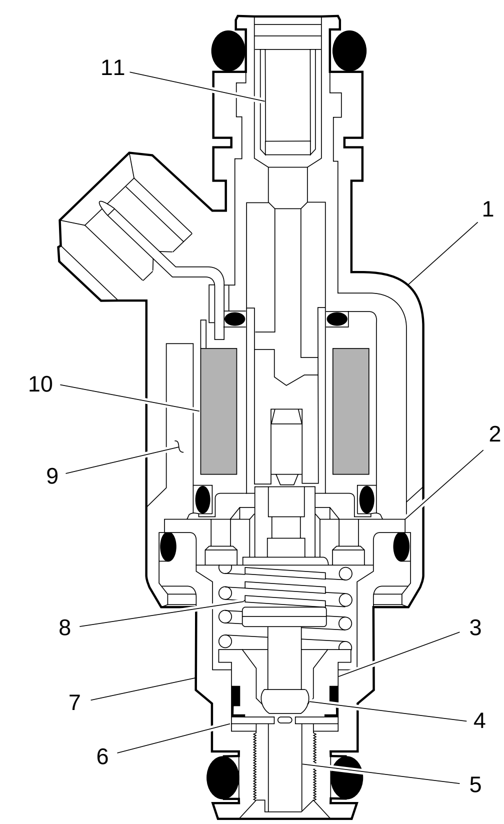


Figure 3-3 - Fuel Rail Assembly

Fuel Injectors

The fuel injector assembly is a solenoid-operated device, controlled by the ECM, that meters pressurized fuel to a single engine cylinder (Figure 3-4). The ECM energizes the injector solenoid, which opens a ball valve, allowing fuel to flow past the ball valve, and through a recessed flow director plate. The director plate has six machined holes that control the fuel flow, generating a conical spray pattern of finely atomized fuel at the injector tip. Fuel is directed at the intake valve, causing it to become further atomized and vaporized before entering the combustion chamber.

An injector that is stuck partly open would cause loss of pressure after engine shut down. Consequently, long cranking times would be noticed. Dieseling could also occur, because some fuel could be delivered to the engine after the ignition is turned “OFF.” A fuel injector that does not open, may cause a “no-start” or a misfire.



1 SOLENOID ASSEMBLY
2 SPACER AND GUIDE ASSEMBLY
3 CORE SEAT
4 BALL VALVE
5 SPRAY TIP
6 DIRECTOR PLATE
7 SPRAY HOUSING
8 CORE SPRING
9 SOLENOID HOUSING
10 SOLENOID
11 FUEL INLET FILTER

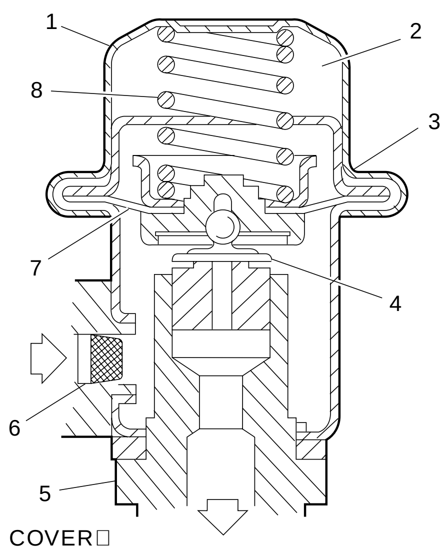
4-11-96
9P 0413-SY

Figure 3-4 - Fuel Injector Assembly (Typical)

Pressure Regulator Assembly

The pressure regulator is a diaphragm-operated relief valve with fuel pump pressure on one side, and regulator spring pressure and intake manifold vacuum on the other side (Figure 3-5). The regulator's function is to maintain a constant pressure differential across the injectors at all times. The pressure regulator compensates for engine load by increasing fuel pressure as engine vacuum drops.

With the ignition "ON," engine "OFF" (zero vacuum), fuel pressure at the pressure test connection should be 284-325 kPa (41-47 psi). If the pressure is too low, poor performance or a "no-start" may result. If pressure is too high, excessive odor may result.



1 COVER

2 VACUUM CHAMBER
(VACUUM SOURCE TUBE NOT SHOWN)

3 O - RING SEAL

4 FUEL PRESSURE REGULATOR VALVE

5 BASE ASSEMBLY

6 FILTER SCREEN (IF EQUIPPED)

7 DIAPHRAGM

8 SPRING

4-11-96
NA 0493-SY

Figure 3-5 - Pressure Regulator Assembly (Typical)

Throttle Body Assembly

The throttle body assembly is attached to the intake manifold air plenum, and is used to control air flow into the engine, thereby controlling engine output (Figure 3-6). The throttle plates within the throttle body are opened by the driver through the throttle controls. During engine idle, the throttle plates are closed, and air flow control is handled by the Idle Air Control (IAC) valve, described below.

The throttle body also provides the location for mounting the TP sensor and for sensing changes in engine vacuum due to throttle plates position.

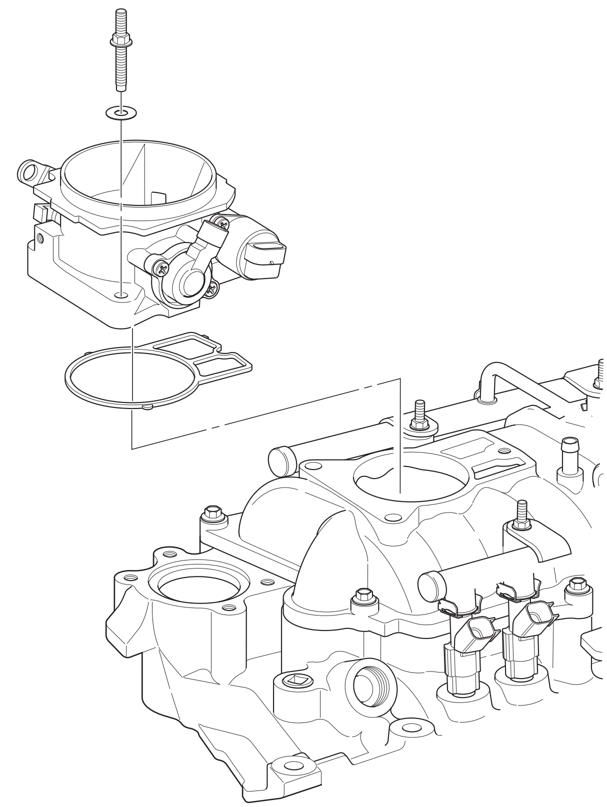


Figure 3-6 - Throttle Body Assembly

Idle Air Control (IAC) Valve

The purpose of the IAC valve assembly (Figures 3-7 and 3-8) is to control engine idle speed, while preventing stalls due to changes in engine load.

The IAC valve, mounted to the throttle body, controls bypass air around the throttle plates (Figure 3-7). By moving a conical valve known as a pintle, IN, towards the seat (to decrease air flow); or OUT, away from the seat (to increase air flow), a controlled amount of air moves around the throttle plates. If RPM is too low, more air is bypassed around the throttle plates to increase it. If RPM is too high, less air is bypassed around the throttle plates to decrease it.

The ECM moves the IAC valve in small steps. These can be monitored by scan tool test equipment, which plugs into the Data Link Connector (DLC).

During idle, the proper position of the IAC valve is calculated by the ECM, based on battery voltage, coolant temperature and engine RPM. If the RPM drops below specification and the throttle plates are closed, the ECM senses a near stall condition and calculates a new valve position to prevent stalling.

- Engine idle speed is a function of total air flow into the engine based on IAC valve pintle position plus throttle plates opening.

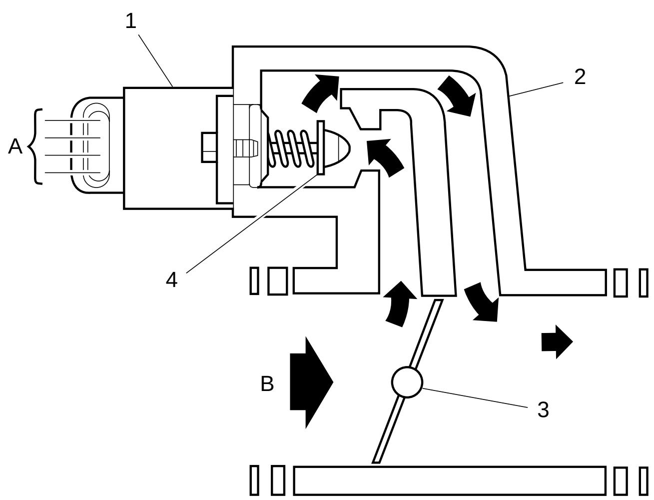


Figure 3-7 - IAC Valve Air Flow Diagram

- “Controlled” idle speed is programmed into the ECM, which determines the correct IAC valve pintle position to maintain the desired idle speed for all engine operating conditions and loads.
- The minimum air rate is set at the factory with a stop screw. This setting allows enough air flow by the throttle plates to cause the IAC valve pintle to be positioned at a calibrated number of steps (counts) from the seat, during “controlled” idle operation. This minimum air rate setting should not be altered by turning the stop screw or bending the linkage. Improper idle control will result.

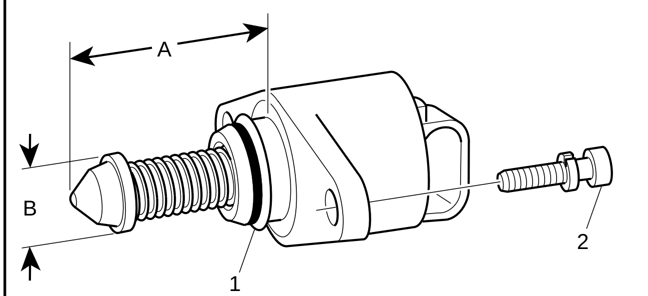


Figure 3-8 - Flange Mounted Type IAC Valve

Diagnosis

If the Engine Cranks But Will Not Run or immediately stalls, Table A-3 of the Diagnosis section must be used to determine if the failure is in the ignition system or the fuel system.

On-Board Service

Caution:

To reduce the risk of fire and personal injury, relieve fuel system pressure before servicing fuel system components.

After relieving fuel pressure, a small amount of fuel may be released when servicing fuel lines or connections. To reduce the chance of personal injury, 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 disconnection is completed.

Fuel Control On-Board Service

The following is general information required when working on the fuel system:

- Always keep a dry chemical fire extinguisher near the work area.
- Fuel pipe fittings require new O-rings when assembling.
- Do not replace fuel pipe with fuel hose.
- Always bleed off fuel pressure before servicing any fuel system components.
- Do not do any repairs on the fuel system until you have read the instructions and checked the figures relating the repair.
- Observe all notices and cautions.

Fuel Pressure Relief Procedure

Tool Required:

J 34730-1, Fuel Pressure Gauge

Important

- Refer to manufacturer's warnings and cautions before proceeding.

1. Disconnect negative battery cable to avoid possible fuel discharge if an accidental attempt is made to start the engine.
2. Loosen fuel filler cap to relieve any tank vapor pressure.
3. Connect fuel pressure gauge J 34730-1 to fuel pressure connector assembly. Wrap a shop towel around fitting while connecting the gauge to avoid any spillage.
4. Install bleed hose into an approved container and open valve to bleed system pressure. Fuel connections are now safe for servicing.
5. Drain any fuel remaining in the gauge into an approved container.

Flame Arrestor

Remove or Disconnect

1. Flame arrestor retaining clamp.
2. Flame arrestor.

Inspect

- Flame arrestor element for dust, dirt or water. Replace if required.

Install or Connect

1. Flame arrestor to throttle body.
2. Flame arrestor retaining clamp to flame arrestor.

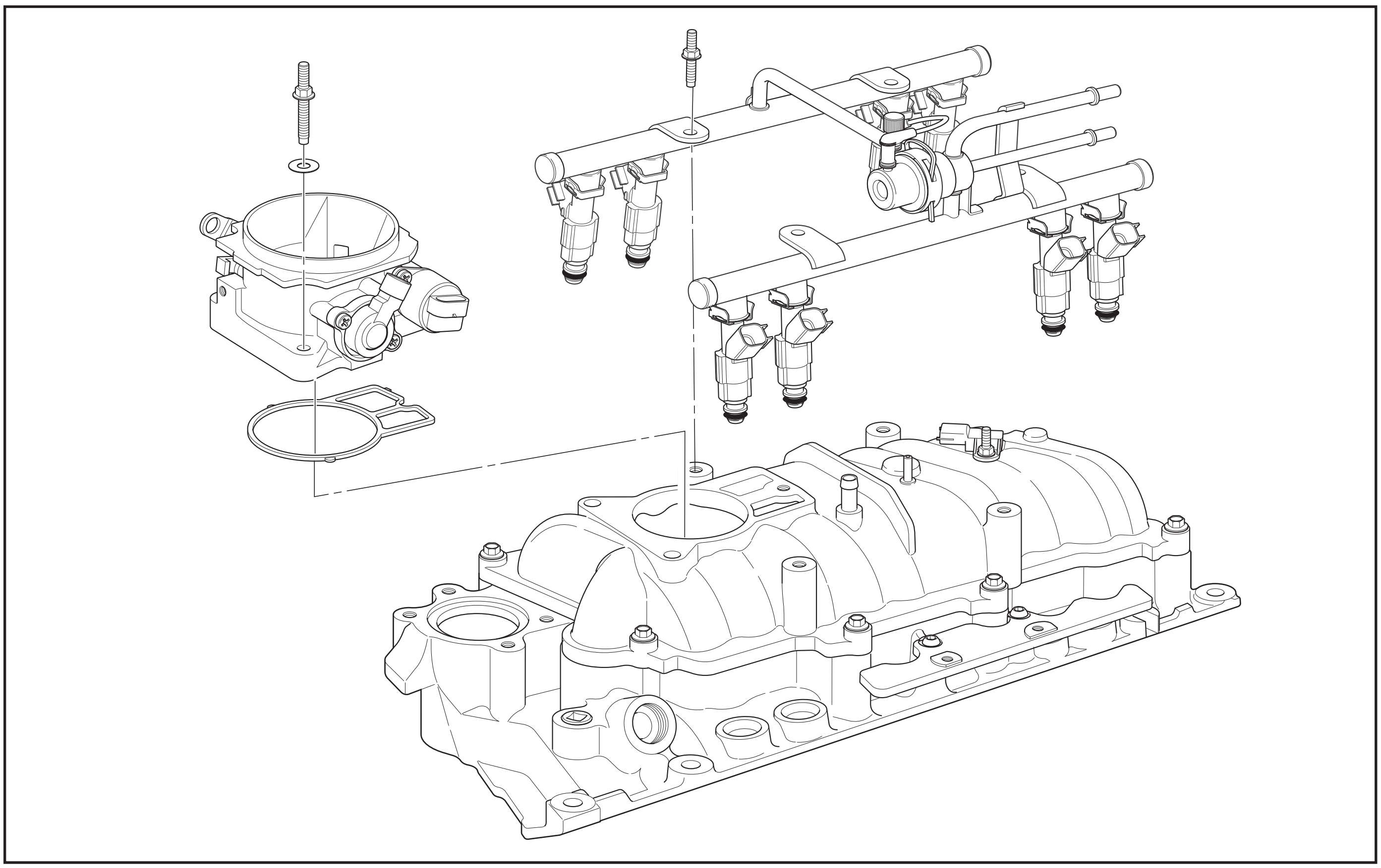


Figure 3-9 - Fuel Rail and Throttle Body Assemblies

Throttle Body Assembly

The throttle body assembly repair procedures cover component replacement with the unit on the vessel. However, throttle body replacement requires that the complete unit be removed from the engine.

Clean

Important

- Do not soak the throttle body in cold immersion type cleaner. The throttle valves have a factory applied sealing compound (DAG material is applied to outside edge of each valve and throttle bore) to prevent air bypass at closed throttle. Strong solvents or brushing will remove the material. To clean the throttle body following disassembly, use a spray type cleaner such as GM X66-A or GM 1052626. Use a shop towel to remove heavy deposits.

Notice: The TP sensor and the IAC valve are electrical components and should NOT come in contact with solvent or cleaner as they may be damaged.

Remove or Disconnect

1. Negative battery cable.
2. Flame arrestor.
3. Electrical connectors from TP sensor and IAC valve.
4. Throttle cable.
5. Throttle body attaching bolts.
6. Throttle body assembly and flange gasket.
   - Discard gasket.

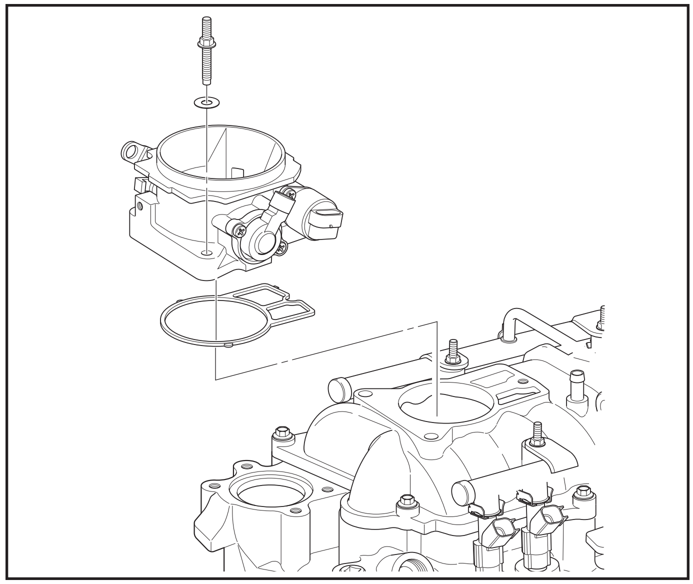
Clean

Notice: Use care in cleaning old gasket material from machined aluminum surfaces as sharp tools may damage sealing surfaces.

- Gasket sealing surfaces.

Install or Connect

1. Throttle body assembly with new flange gasket.
2. Throttle body attaching bolts. Torque to 15 N•m (11 lb.ft.).
3. Throttle cable to throttle body.
4. Electrical connectors to TP sensor and IAC valve.
5. Flame arrestor.
6. Negative battery cable.



Inspect

- With the engine “OFF,” check to see that the throttle lever is free.
  – Move the throttle lever to wide open throttle and release.

Reset IAC valve pintle position:

- Move throttle lever slightly.
- Start and run engine for 5 seconds.
- Turn ignition “OFF” for 10 seconds.
- Restart engine and check for proper idle operation.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Turn the ignition switch back to the “ON” position and check for fuel leaks.

Quick Connect Fitting(s) Service

Tools Required

J 37088-A Tool Set, Fuel Line Quick-Connect Separator

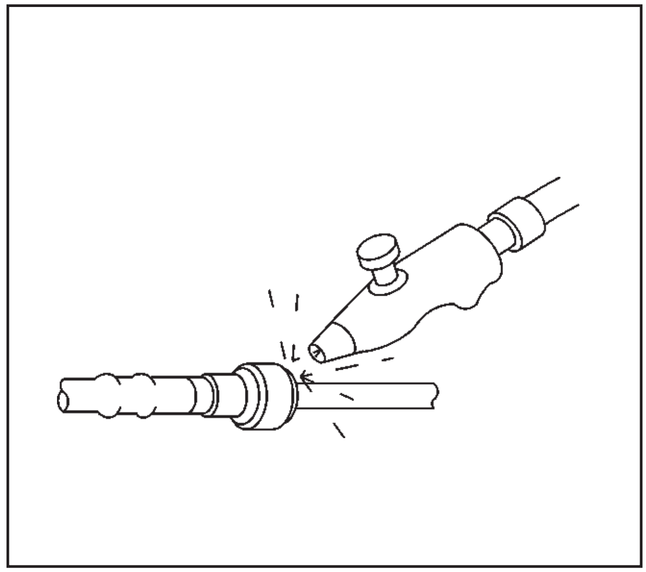
J 44581 Fuel Line Quick Connect Separator

Removal Procedure

1. Relieve the fuel system pressure before servicing any fuel system connection. Refer to *Fuel Pressure Relief Procedure.*
2. Remove the retainer from the quick-connect fitting.

Caution: Wear safety glasses in order to avoid eye damage.

3. Blow dirt out of the fittig using compressed air.



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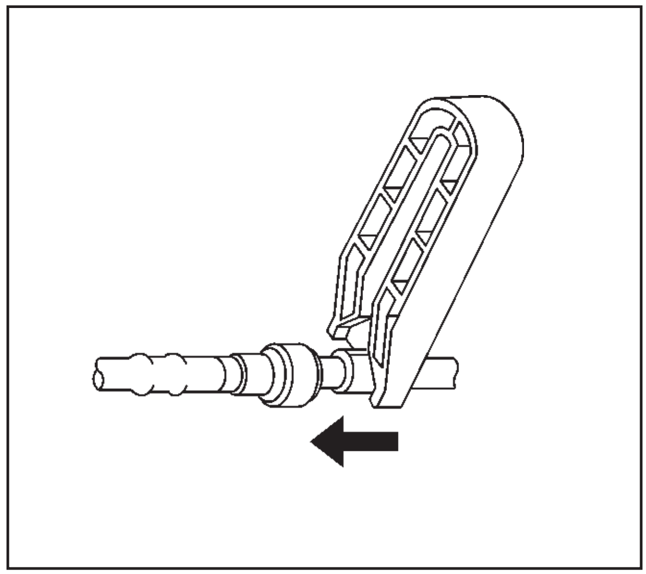
4. Choose the correct tool from the tool set for the size of the fitting. Insert the tool into the female connector, then push inward in order to release the locking tabs.



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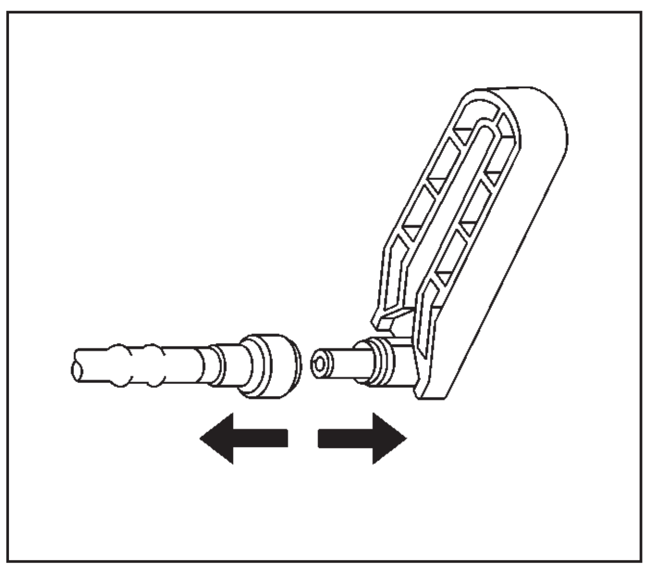
5. Pull the connection apart.
6. Use a clean shop towel in order to wipe off the male pipe end.
7. Inspect both ends of the fitting for dirt and burrs. Clean or replace the components as required.



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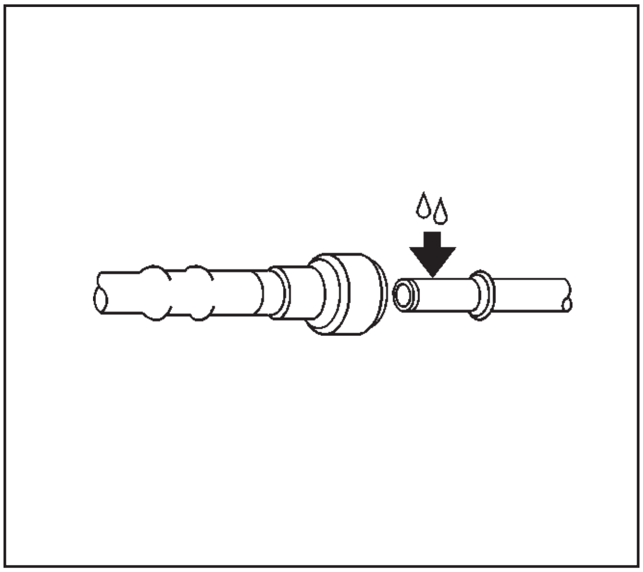

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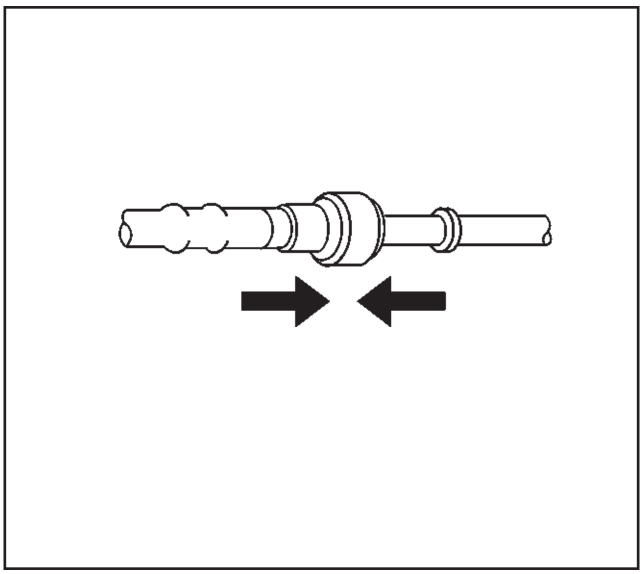
Installation Procedure

1. Apply a few drops of clean engine oil to the male pipe end.



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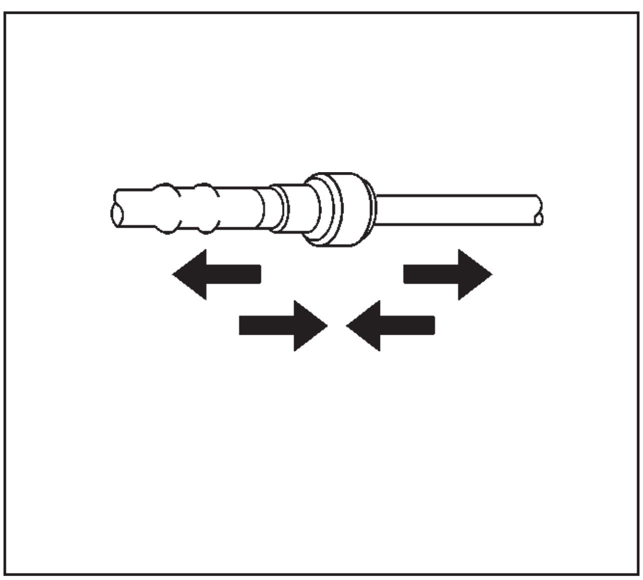
2. Push both sides of the fitting together in order to snap the retaining tabs into place.



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3. Once installed, pull on both sides of the fitting in order to make sure the connection is secure.
4. Install the retainer to the quick-connect fitting.

Fuel Rail Assembly

The fuel rails should be removed as an assembly with the injectors attached. Names of component parts will be found on the numbered list that accompanies the disassembled view.

Notice:

- Use care in removing the fuel rail assembly to prevent damage to the injector electrical connector terminals and the injector spray tips.
- When removed, support the rail to avoid damaging its components.
- Prevent dirt and other contaminants from entering open lines and passages. Fittings should be capped and holes plugged during servicing.

Clean

- Before removal, the fuel rail assembly may be cleaned with a spray type engine cleaner, GM X-30A or equivalent, following package instructions. Do Not soak fuel rails in liquid cleaning solvent.

Caution: Safety glasses must be worn when using compressed air as flying dirt particles may cause eye injury.

- Where injectors fit into intake manifold, use compressed air to blow out dirt from around injectors before removing.

Remove or Disconnect

Caution: To reduce the risk of fire and personal injury, relieve the fuel system pressure before servicing the fuel system components.

1. Negative battery cable.
2. Relieve fuel pressure.
   - Refer to the “Fuel Pressure Relief Procedure.”
   - Fuel pressure connector assembly is located on the fuel rail.
3. Fuel inlet line, follow procedure for Quick Connect Fittings outlined in this section.
4. Fuel outlet line, follow procedure for Quick Connect Fittings outlined in this section.
5. Vacuum line to fuel pressure regulator.
6. Electrical connectors from injectors.
7. Move wire harness out of way.
8. Four attaching screws for fuel rail.
9. Fuel rails as an assembly with injectors.
10. Injectors from rails, follow procedure for injector removal outlined in this section.

Clean and Inspect

Notice: If it is necessary to remove rust or burrs from the fuel rail pipes, use emery cloth in a radial motion with the tube end to prevent damage to the O-ring sealing surface.

- Use a clean shop towel to wipe off male pipe ends.
- Inspect all connectors for dirt and burrs. Clean or replace components/assemblies as required.

Disassemble

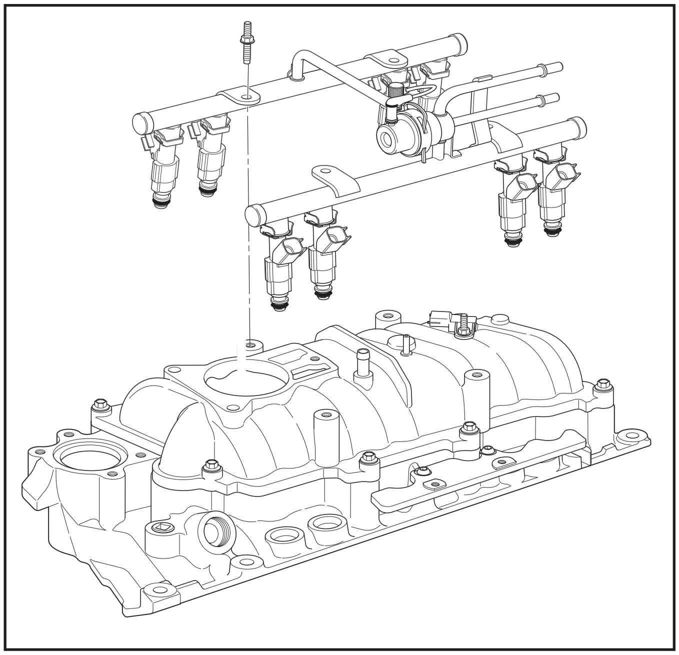
- Injector O-ring seal from spray tip end of each injector. Discard O-ring seals.

Assemble

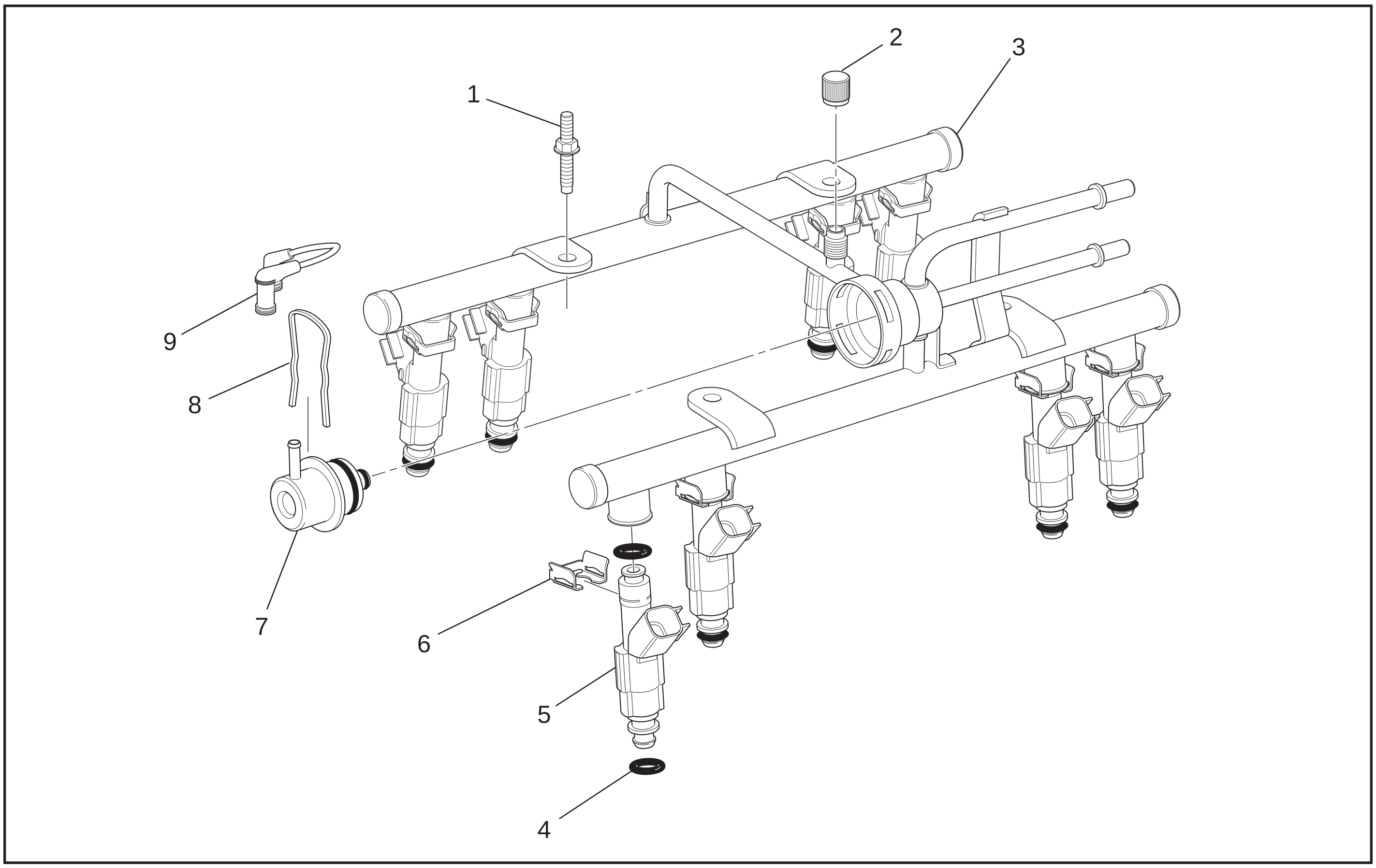
- Lubricate new injector O-ring seals with clean engine oil and install on spray tip end of each injector.

Install or Connect

1. Lubricate injector O-ring seals and install injectors following injector installation procedure outlined in this section.
2. Fuel rails as an assembly with injectors onto intake manifold.
   - If injectors are lined up properly they will slide into place.
   - Push gently and evenly on rail to set injectors all the way into their bores
3. Fuel rail attaching screws. Torque to 10 N•m (88 lb.in.).
4. Injector electrical connectors and secure harness in place.
5. Vacuum line to fuel pressure regulator.
6. Fuel inlet line, follow procedure for Quick Connect Fittings outlined in this section.
7. Fuel outlet line, follow procedure for Quick Connect Fittings outlined in this section.
8. Negative battery cable.
9. Prime fuel system by cycling key “ON” and “OFF” a few times with engine “OFF.”



Fuel Rail Removal and Installation



Fuel Rail Assembly

Legend

(1) Fuel Rail Attaching Stud
(2) Fuel Pressure Connection Cap
(3) Fuel Rail Assembly
(4) Fuel Injector O-Ring
(5) Fuel Injector Assembly
(6) Fuel Injector Retaining Clip
(7) Fuel Pressure Regulator
(8) Fuel Pressure Regulator Retaining Clip
(9) Fuel Pressure Regulator Vacuum LIne

Fuel Injectors

Notice: Use care in removing injectors to prevent damage to the injector electrical connector pins or the injector spray tips. The fuel injector is serviced as a complete assembly only. Since it is an electrical component, Do Not immerse it in any cleaner.

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel pressure.
   - Refer to the “Fuel Pressure Relief Procedure.”
3. Fuel rail assembly following the procedures outlined in this section.

Disassemble

1. Release injector clip by sliding off injector.
2. Fuel injector from rail.
3. Injector O-ring seals from both ends of the injector and discard.
4. Injector retainer clip from rail.

Clean and Inspect

- Injector bores in fuel rail and intake manifold for nicks, burrs or corrosion damage. If severe, replace. Clean lightly with emery cloth in a radial motion.
- Injector O-ring seal grooves for nicks, burrs or corrosion. Replace injector if damaged. Clean with spray cleaner and wipe groove clean with lint free cloth.
- Do Not use abrasive materials or wire brush on injectors. They are plated with an anti-corrosive material.

Important

- When ordering individual replacement fuel injectors, be sure to order the identical part number that is inscribed on the old injector.

Assemble

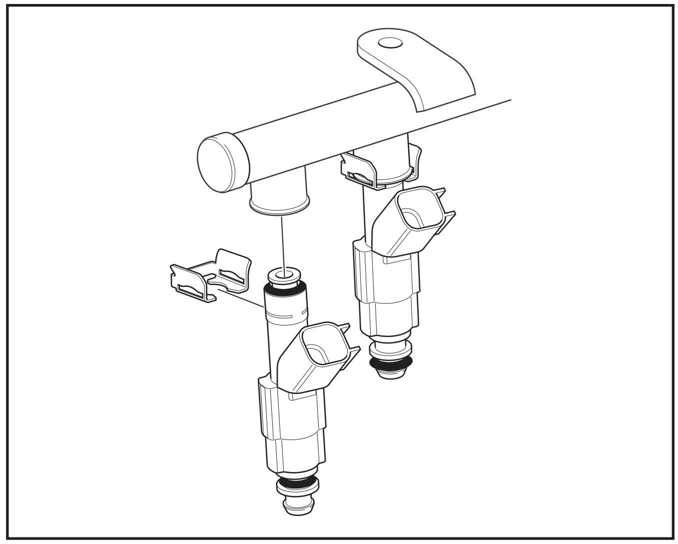
1. Lubricate new injector O-ring seals with clean engine oil and install on injector.
2. New retainer clip onto injector.
3. Fuel fuel injector assembly into fuel rail injector socket with electrical connector facing outward.
4. Rotate injector retainer clip to locking position.

Install or Connect

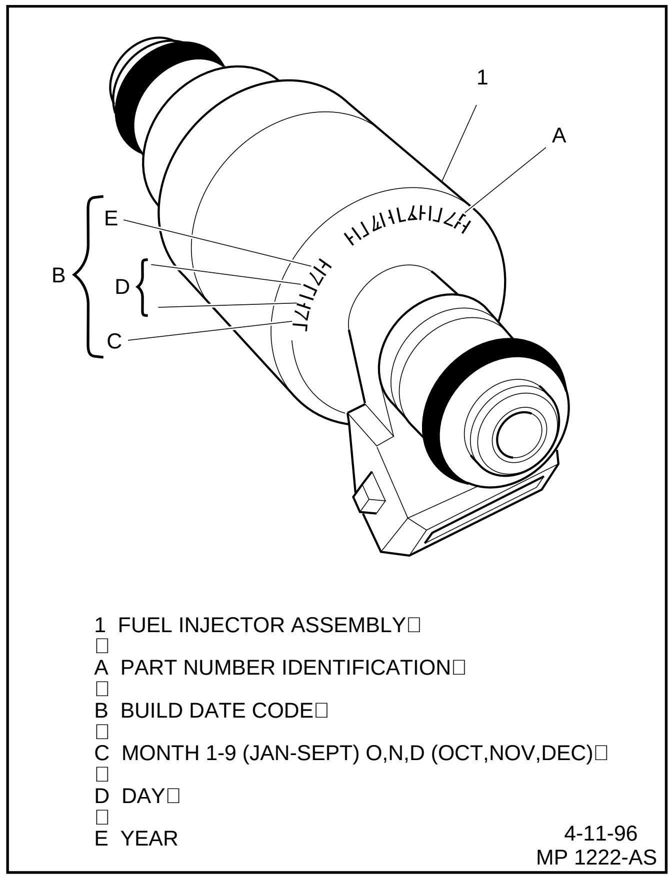
1. Fuel rail assembly following procedures outlined in this section.
2. Negative battery cable.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Turn the ignition switch back to the “ON” position and check for fuel leaks.



Fuel Injector and Retainer Clip



Injector Part Number Location

Fuel Pressure Regulator Assembly

Important

- The fuel pressure regulator is serviced as a complete assembly only.
- Fuel pressure must be relieved before servicing the fuel system.
- Refer to "Fuel Pressure Relief Procedure."

Remove or Disconnect

1. Negative battery cable.
2. Vacuum hose from regulator.
3. Fuel outlet line nut.
   - Use back up wrench to hold pressure regulator to keep from turning and damage.
   - Discard outlet line nut O-ring.
4. Pressure regulator attaching screw.
5. Pressure regulator from fuel rail.
6. Pressure regulator O-ring and discard.

Inspect

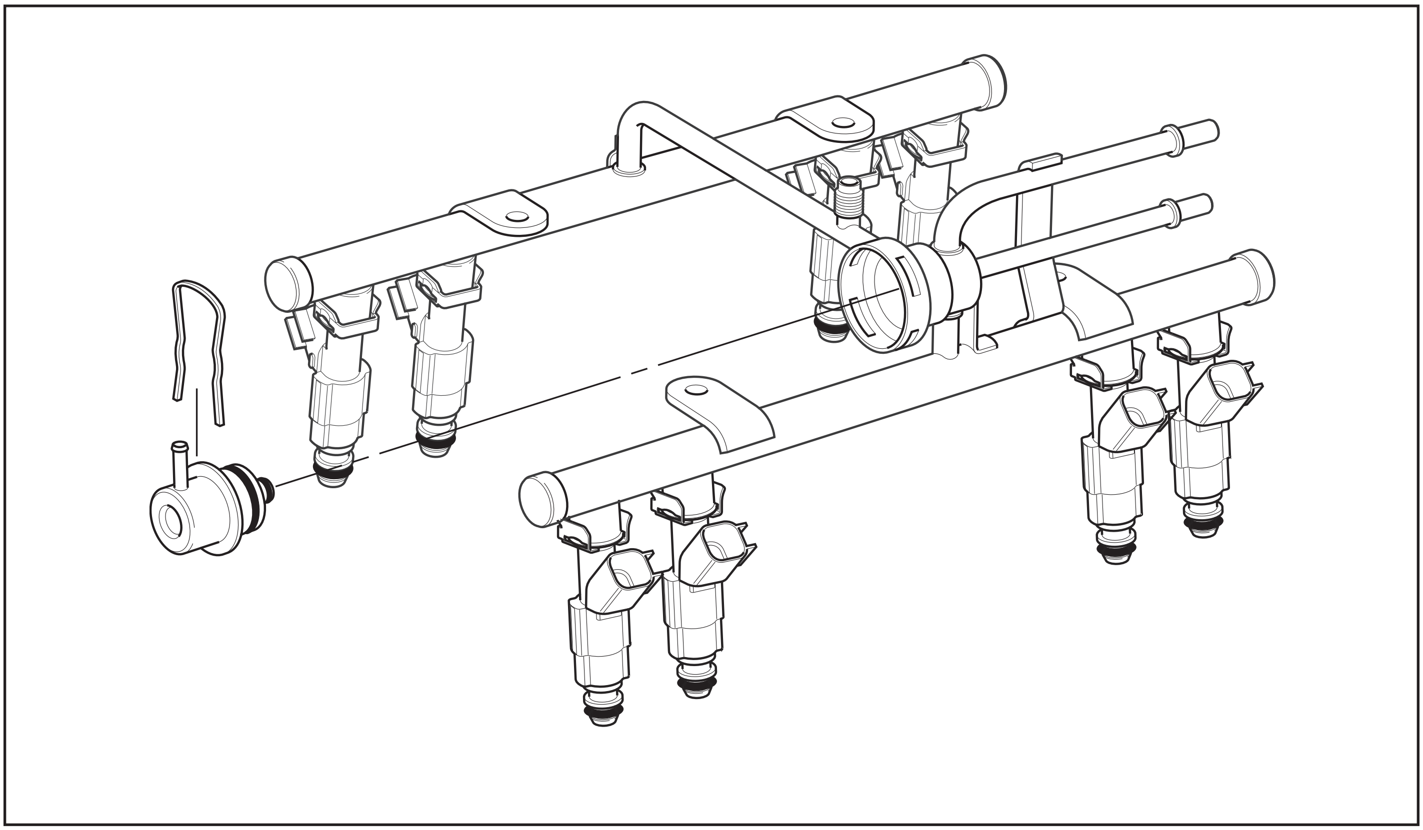
- The fuel input port of the pressure regulator may contain a filter screen. Inspect the screen for dirt and debris. If dirty, use a pick to remove filter screen and discard. Replace with new filter screen supplied in service package.

Install or Connect

1. Lubricate new fuel pressure regulator O-ring with clean engine oil and install on regulator.
2. Push pressure regulator into rail.
3. Pressure regulator attaching screw. Finger tighten only.
4. Lubricate new outlet line O-ring and install on end of line.
5. Outlet line assembly with nut to pressure regulator. Finger tighten only.
6. Torque pressure regulator attaching screw to 9.5 N•m (84 lb.in.).
7. Torque outlet line nut to 17.5 N•m (13 lb.ft.).
   - Use backup wrench to keep pressure regulator from turning and damage.
8. Vacuum line to pressure regulator.
9. Negative battery cable.

Inspect

- Turn ignition switch to the "ON" position for 2 seconds, then turn to the "OFF" position for 10 seconds. Turn the ignition switch back to the "ON" position and check for fuel leaks.



Fuel Pressure Regulator

Fuel Control Cell (FCC) Replacement - Screw On Bowl and Clamp On Bowl

Important

- Fuel pressure must be relieved before servicing the fuel pump.
- Refer to “Fuel Pressure Relief Procedure.”

Remove or Disconnect

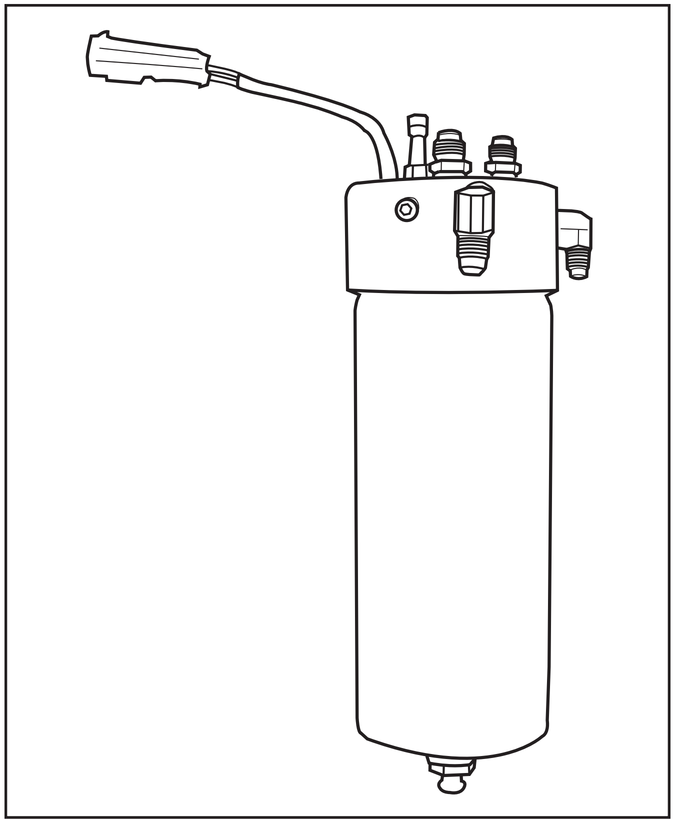
1. Negative battery cable.
2. Fuel pump electrical connector.
3. Inlet and outlet fuel line fittings.
4. Fuel Control Cell (FCC) attaching bolts.
5. Fuel Control Cell (FCC).

Install or Connect

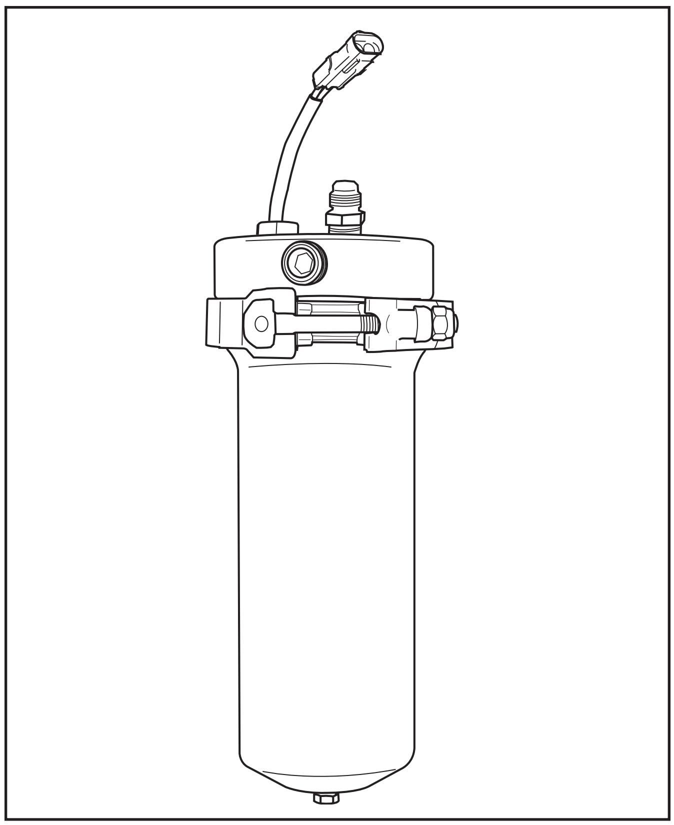
1. Fuel Control Cell (FCC).
2. Fuel Control Cell (FCC) attaching bolts.
3. Inlet and outlet fuel line fittings.
4. Fuel pump electrical connector.
5. Negative battery cable.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Turn the ignition switch back to the “ON” position and check for fuel leaks.



Fuel Control Cell (FCC) - Screw On Bowl



Fuel Control Cell (FCC) - Clamp On Bowl

Fuel Control Cell (FCC) - Screw On Bowl - Drain Water (With Engine OFF)

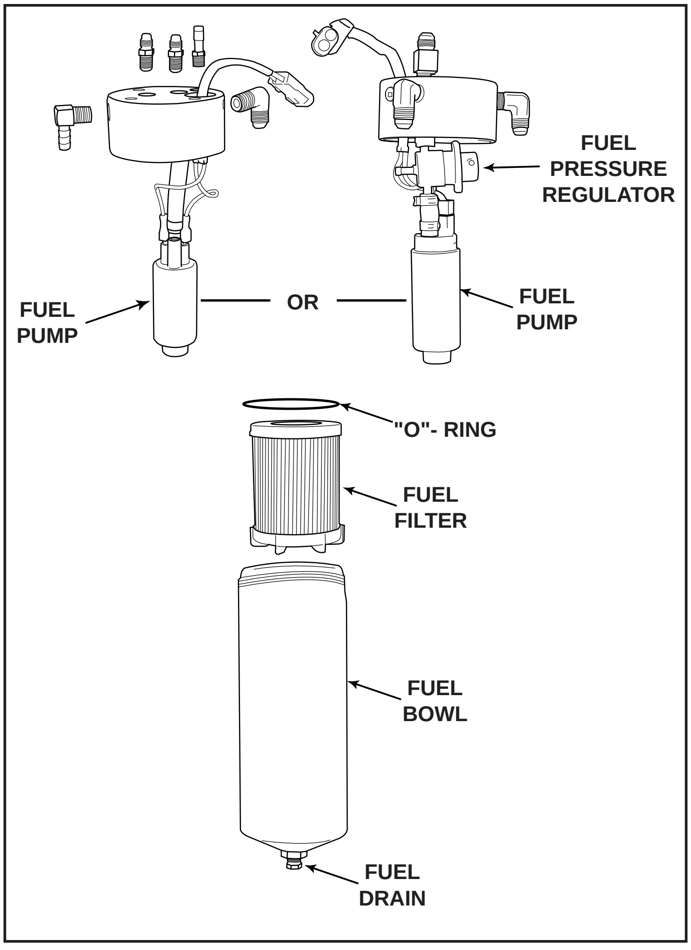
1. Disconnect the two-wire electrical harness.
2. Hold the 3/4" jam nut located at the bottom of the FCC bowl with a wrench, remove the 3/16" allen plug and drain bowl contents into a suitable container.

Caution: Both fuel, which is explosive, and water will drain from the FCC bowl.

3. Apply pipe sealant suitable for use with gasoline to the threads fo the 3/16" allen plug.
4. Tighten the 3/16" allen plug while holding the 3/4" jam nut with a wrench.
5. Re-connect the two-wire electrical harness.

Inspect

- Turn ignition switch to the "ON" position for 2 seconds, then turn to the "OFF" position for 10 seconds. Cycle the ignition several times to fill the FCC bowl. Turn the ignition switch back to the "ON" position and check for fuel leaks.



Fuel Control Cell (FCC) - Screw On Bowl - Element Replacement (With Engine OFF)

1. Disconnect the two-wire electrical harness.
2. Hold the 3/4" jam nut located at the bottom of the FCC bowl with a wrench, remove the 3/16" allen plug and drain bowl contents into a suitable container.

Caution: Both fuel, which is explosive, and water will drain from the FCC bowl.

3. Using a strap type oil filter wrench, remove the bowl by turning it counterclockwise as viewed from the bottom.
4. Slide bowl downward over the suspended filter element. It may be necessary to pull the unit to one side or remove the fuel line from the feed pump to remove the bowl.
5. Remove the fuel filter element from the suspended pump by gripping the fuel pump with one hand and pulling the filter downward with the other hand.
6. Push on new filter element over the electric pump.
7. Using a pick made of soft material, such as a toothpick, remove the old "O"-ring from inside the FCC bowl mounting head.

Caution: The mounting head "O"-ring groove may be damaged by using a sharp tool to remove this "O"-ring.

8. Lubricate the new "O"-ring with a light grease and install the new "O"-ring in the FCC head.
9. Grease taper and threads on the bowl and, by hand, thread the bowl into the FCC mounting head. Tighten the bowl firmly back into the head with an oil filter wrench.
10. Apply pipe sealant suitable with gasoline to the 3/16" allen plug.
11. Install and tighten the 3/16" allen plug while holding the 3/4" jam nut with a wrench.
12. Re-connect the two-wire electrical harness.

Inspect

- Turn ignition switch to the "ON" position for 2 seconds, then turn to the "OFF" position for 10 seconds. Cycle the ignition several times to fill the FCC bowl. Turn the ignition switch back to the "ON" position and check for fuel leaks.

Fuel Control Cell (FCC) - Clamp On Bowl - Drain Water (With Engine OFF)

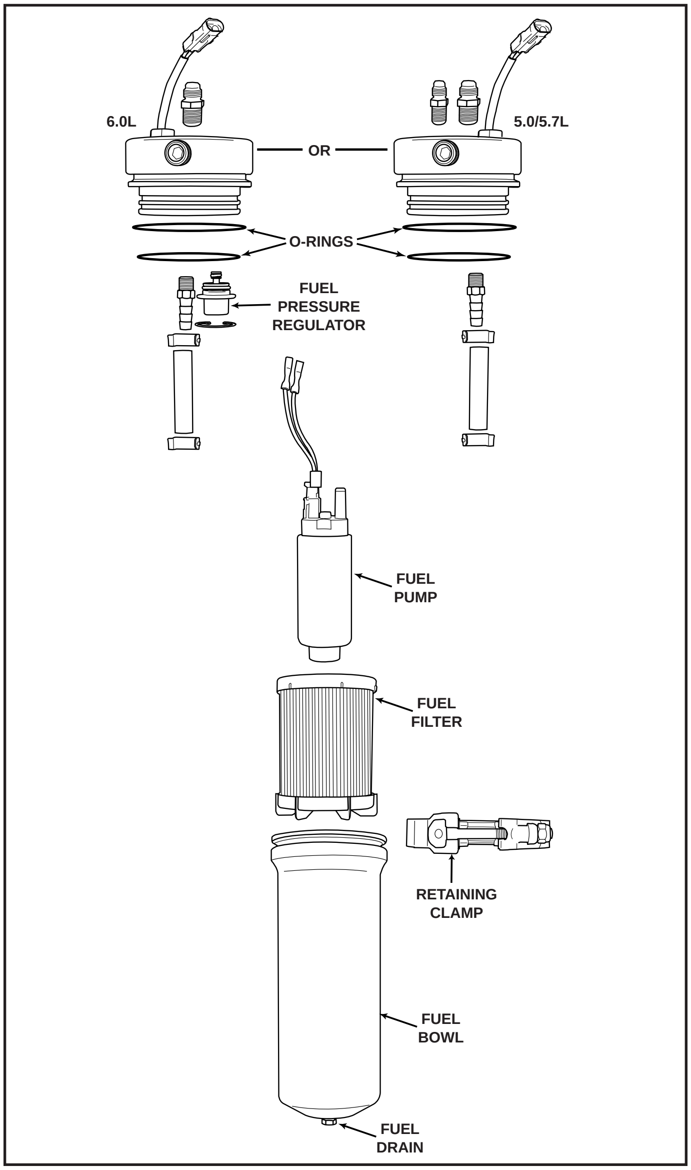
1. Disconnect the two-wire electrical harness.
2. Remove the 7/16” plug and drain the bowl contents into a suitable container.

Caution: Both fuel, which is explosive, and water will drain from the FCC bowl.

3. Apply pipe sealant, suitable for use with gasoline, to the threads fo the 7/16” plug.
4. Install and tighten the 7/16” plug securely.
5. Reconnect the two-wire electrical harness.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Cycle the ignition several times to fill the FCC bowl. Turn the ignition switch back to the “ON” position and check for fuel leaks.



Fuel Control Cell (FCC) - Clamp On Bowl - Element Replacement (With Engine OFF)

1. Disconnect the two-wire electrical harness.
2. Remove the 7/16” plug and drain the bowl contents into a suitable container.

Caution: Both fuel, which is explosive, and water will drain from the FCC bowl.

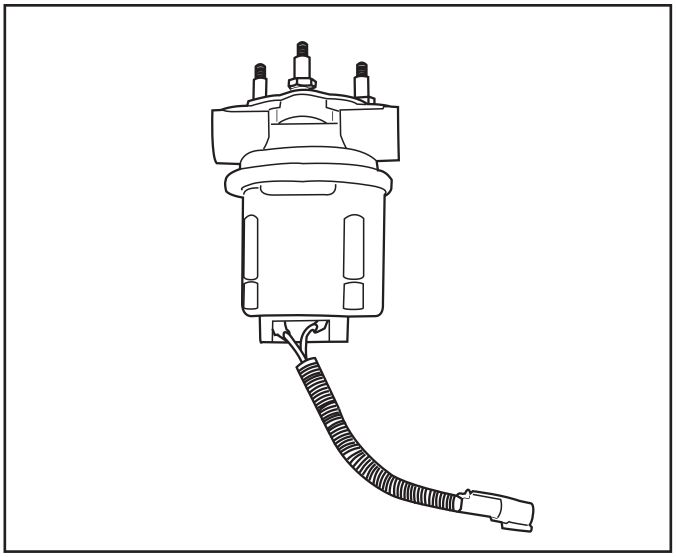
3. Remove the canister retaining clamp.
4. Slide bowl downward over the suspended filter element. It may be necessary to pull the unit to one side to remove the bowl.
5. Remove the fuel filter element from the suspended pump by gripping the fuel pump with one hand and pulling the filter downward with the other hand.
6. Push on new filter element over the electric pump.
7. Using a pick made of soft material, such as a toothpick, remove the old “O”-rings from the FCC bowl mounting head.

Caution: The mounting head “O”-ring grooves may be damaged by using a sharp tool to remove these “O”-rings.

8. Lubricate the new “O”-rings with fuel resistant “O”-ring lubricant, and install the new “O”-rings on the FCC head.
9. Apply pipe sealant, suitable for use with gasoline, to the threads fo the 7/16” plug.
10. Install and tighten the 7/16” plug securely.
11. Install the bowl firmly back onto the FCC head.
12. Install the canister retaining clamp and tighten securely.
13. Reconnect the two-wire electrical harness.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Cycle the ignition several times to fill the FCC bowl. Turn the ignition switch back to the “ON” position and check for fuel leaks.



Low-Pressure Fuel Pump Replacement

Important

- Fuel pressure must be relieved before servicing the fuel pump.
- Refer to “Fuel Pressure Relief Procedure.”

Remove or Disconnect

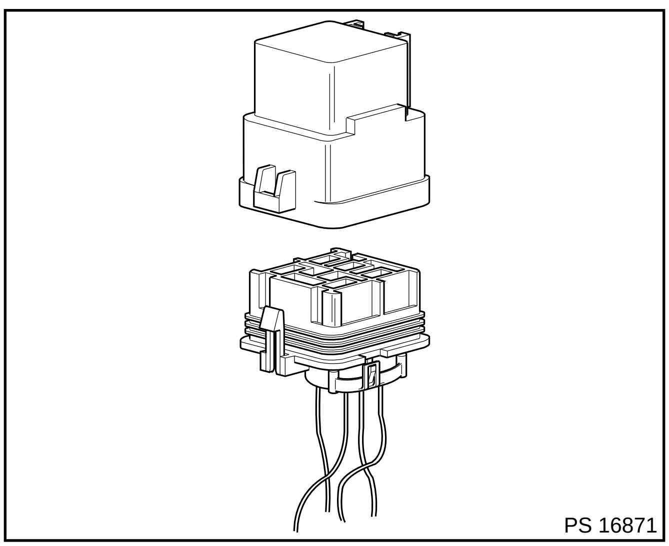
1. Negative battery cable.
2. Fuel pump electrical connector.
3. Inlet and outlet fuel line fittings.
4. Fuel pump attaching bolts.
5. Fuel pump.

Install or Connect

1. Fuel pump.
2. Fuel pump attaching bolts.
3. Inlet and outlet fuel line fittings.
4. Fuel pump electrical connector.
5. Negative battery cable.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Turn the ignition switch back to the “ON” position and check for fuel leaks.



Fuel Pump Relay

Remove or Disconnect

1. Retainer, if installed.
2. Fuel pump relay electrical connector.
3. Fuel pump relay.

Important

- The fuel pump relay is a electrical component. Do Not soak in any liquid cleaner or solvent as damage may result.

Install or Connect

1. Fuel pump relay.
2. Fuel pump relay electrical connector.
3. Retainer clip.

Torque Specifications

Fastener Tightening Specifications

Application	N•m	Lb Ft	Lb In
Throttle Body Attaching Screws	15	11	
IAC Valve Attaching Screws	3.2		28
Fuel Pressure Connector	13		115
Fuel Rail Attaching Screws	10		88

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Marine Electronic Fuel Injection (MEFI)

Section 3B

Fuel Metering System - 6.0L

This section describes how the fuel metering system operates, and provides a description of components used on the Marine Electronic Fuel Injection equipped engines. The fuel metering system information described in this section is limited to the 6.0L. All other systems will be detailed in a separate section.

Contents

General Description

Purpose

The function of the fuel metering system is to deliver the correct amount of fuel to the engine under all operating conditions. Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold near each cylinder.

Modes Of Operation

The ECM looks at inputs from several sensors to determine how much fuel to give the engine. The fuel is delivered under one of several conditions, called “modes.” All the “modes” are controlled by the ECM and are described below.

Starting Mode

When the ignition switch is turned to the crank position, the ECM turns the fuel pump relay “ON,” and the fuel pump builds up pressure. The ECM then checks the ECT, MAP and TP sensors, and determines the proper air/fuel ratio for starting. The ECM controls the amount of fuel delivered in the starting mode by changing how long the injectors are turned “ON” and “OFF.” This is done by “pulsing” the injectors for very short times.

Clear Flood Mode

If the engine floods, it can be cleared by opening the throttle to 100% (wide open throttle) during cranking. The ECM then shuts down the fuel injectors so no fuel is delivered. The ECM holds this injector rate as long as the throttle stays at 100%, and the engine speed is below 300 RPM. If the throttle position becomes less than 100%, the ECM returns to the starting mode.

Run Mode

When the engine is first started and RPM is above 300 RPM, the system operates in the run mode. The ECM will calculate the desired air/fuel ratio based on these ECM inputs: RPM, ECT and MAP. Higher engine loads (MAP input) and colder engine temperatures (ECT input) require more fuel, or a richer air/fuel ratio.

Acceleration Mode

The ECM looks at rapid changes in TP sensor and MAP, and provides extra fuel by increasing the injector pulse width.

Fuel Cutoff Mode

No fuel is delivered by the injector when the ignition is “OFF,” to prevent dieseling. Also, injector pulses are not delivered if the ECM does not receive distributor reference pulses, which means the engine is not running. The fuel cutoff mode is also enabled at high engine RPM, as an overspeed protection for the engine. When fuel cutoff is in effect due to high RPM, injector pulses will resume after engine RPM drops below the maximum OEM RPM specification (Rev Limit).

Power Reduction Mode

Power reduction mode is a function of the ECM that reduces engine power under certain conditions. Power reduction will disable one fuel injector driver when the engine speed goes above 2500 rpm, and enable the fuel injector driver when the engine speed drops below 1200 rpm. Power reduction may be active for the following conditions:

- Engine coolant temperature too high
- Low oil pressure

Fuel Metering System Components

The fuel metering system (Figure 3-1) is made up of the following parts:

- Fuel supply components (fuel tank, pump, lines, filter).
- Fuel pump electrical circuit.
- Fuel rail assembly, including fuel injectors
- Throttle body assembly, including an IAC valve and TP sensor.

Fuel Supply Components (FCC System)

Quick-Connect Fittings

Quick-Connect fittings provide a simplified means of installing and connecting fuel system components. The fittings consists of a unique female connector and a compatible male pipe end. O-rings, located inside the female connector, provide the fuel seal. Integral locking tabs inside the female connector hold the fittings together.

The Fuel Control Cell (FCC) incorporates two (2) fuel pumps to provide uninterrupted flow of fuel to your marine engine.

Fuel is fed into the FCC by a low-pressure, high volume electric fuel pump. This pump flows fuel at a volume which exceeds the fuel flow rate required of the high-pressure pump by engine demands.

The high pressure pump, mounted inside the FCC bowl, provides the necessary fuel pressure and volume to maintain proper engine performance, and always has an ample supply of fuel to meet the idle, cruise and acceleration fuel requirements of the engine.

The fuel pressure regulator, also located inside the FCC, controls fuel pressure and maintains a constant pressure across the fuel delivery system. Fuel not used by the engine, excess fuel, is returned to the FCC canister.

The fuel delivered to the engine by the FCC is filtered by a filter and water separator element, which surrounds the high pressure pump inside the FCC bowl.

The fuel enters the FCC bowl from two (2) components, the low-pressure pump (initial input) and the fuel pressure regulator (unused recirculating). Fuel exits the FCC bowl at two (2) locations, the high-pressure output to the fuel rail and all excess fuel in the FCC bowl is routed back to the fuel tank via a return line.

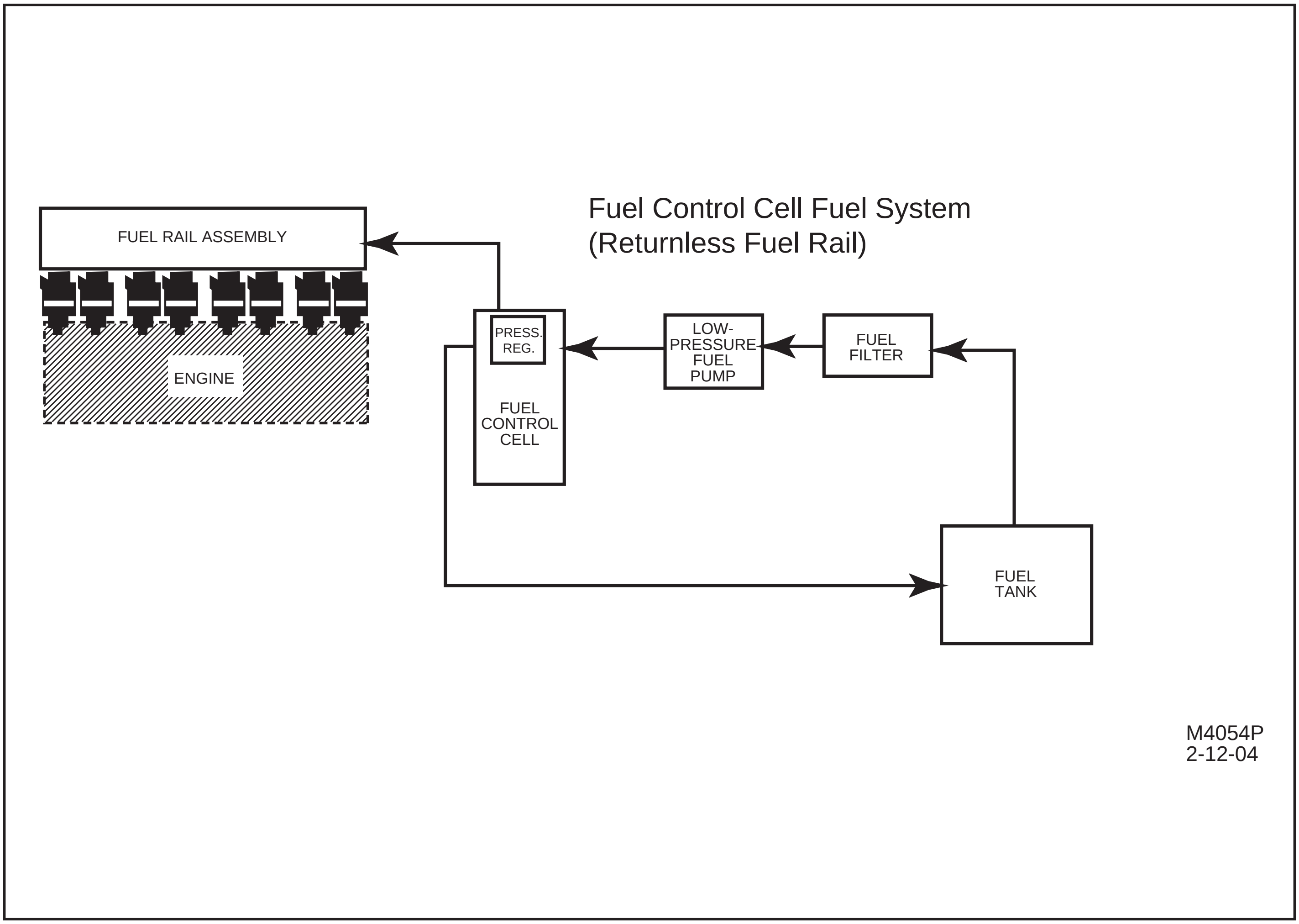


Figure 3-1 - Fuel Metering System (Typical)

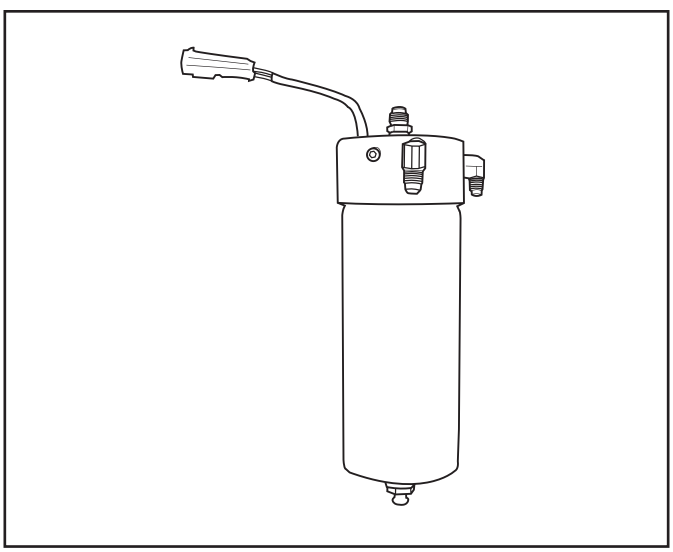


Figure 3-2 - Fuel Control Cell (FCC)

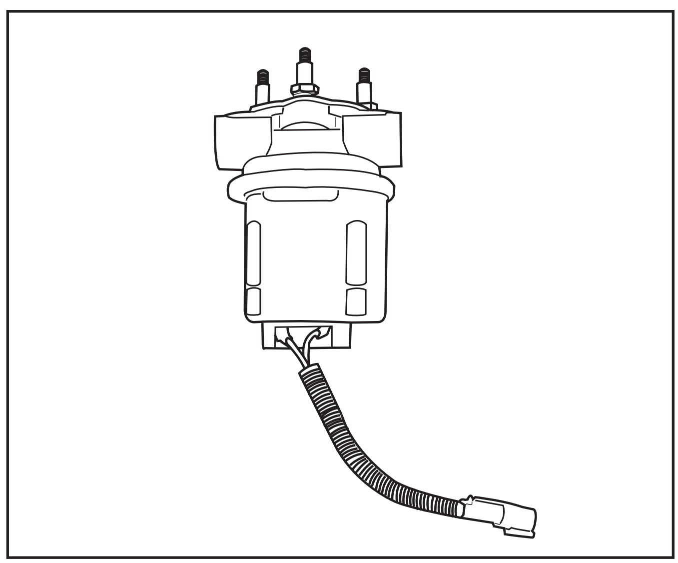


Figure 3-3 - Low Pressure Fuel Pump

Fuel Pump Electrical Circuit

When the ignition switch is turned "ON," the ECM turns the fuel pump relay "ON" for two seconds causing the fuel pump(s) to pressurize the MEFI fuel system.

When the ignition switch is turned to the crank position, the ECM turns the fuel pump relay "ON" causing the fuel pump to run.

If the ECM does not receive ignition reference pulses (engine cranking or running), it shuts "OFF" the fuel pump relay, causing the fuel pump to stop.

An inoperative fuel pump relay will result in an "Engine Cranks But Will Not Run" condition.

Fuel Rail Assembly

The fuel rail (Figure 3-3) is mounted to the engine intake manifold, and performs several functions. It positions the injectors (3) in the intake manifold, distributes fuel evenly to the injectors, and integrates the fuel pressure regulator (2) into the fuel metering system.

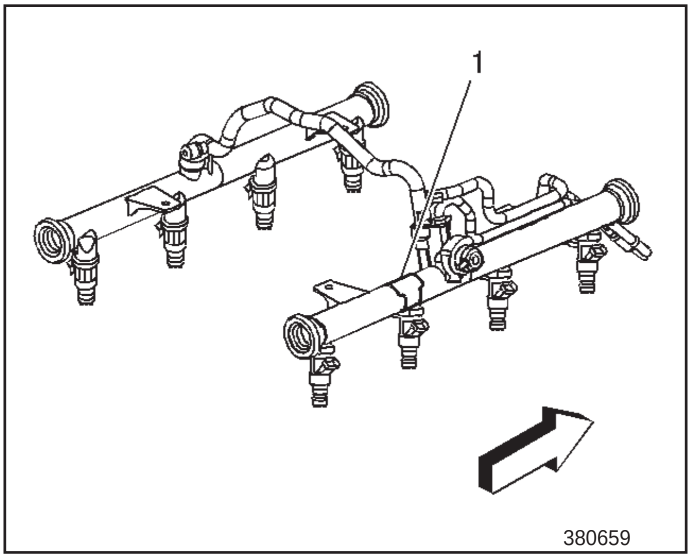


Figure 3-3 - Fuel Rail Assembly

Fuel Injectors

The Multec 2 fuel injector assembly is a solenoid operated device, controlled by the ECM, that meters pressurized fuel to a single engine cylinder. The ECM energizes the high-impedance (12.2 ohms) injector solenoid (1) to open a normally closed ball valve (2). This allows fuel to flow into the top of the injector, past the ball valve and through a director plate (3) at the injector outlet. The director plate has four machined holes that control the fuel flow, generating a spray of finely atomized fuel at the injector tip. Fuel from the injector tip is directed at the intake valve, causing it to become further atomized and vaporized before entering the combustion chamber. An injector stuck partly open can cause a loss of pressure after engine shutdown. Consequently, long engine cranking times would be noticed on some engines.

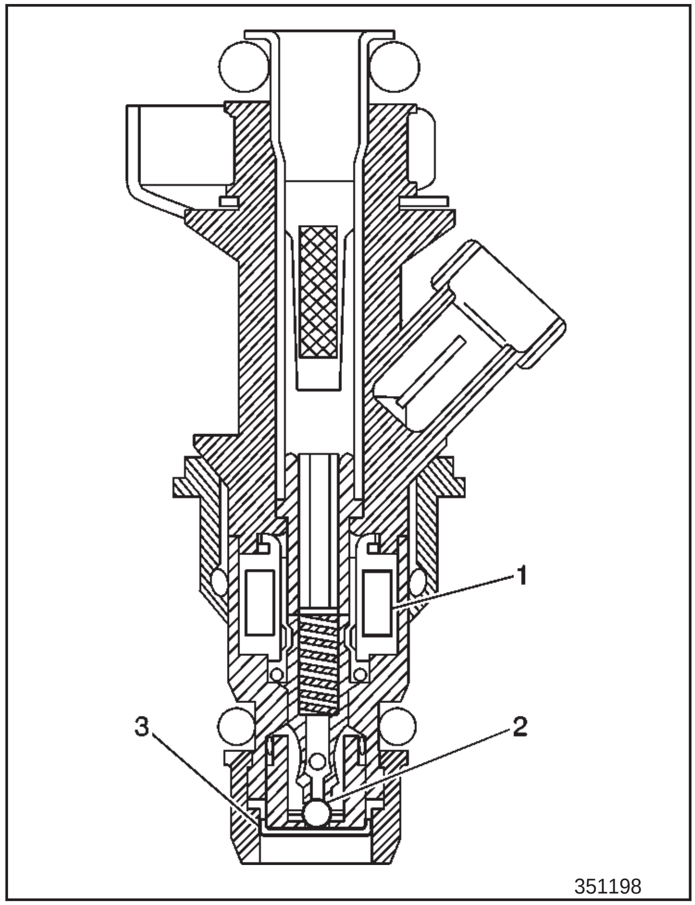


Figure 3-4 - Fuel Injector Assembly (Typical)

Pressure Regulator Assembly

The pressure regulator is a diaphragm-operated relief valve with fuel pump pressure on one side, and regulator spring pressure on the other side (Figure 3-5). The regulator's function is to maintain a constant pressure differential across the injectors at all times.

With the ignition "ON," engine "OFF", fuel pressure at the pressure test connection should be 59-61 psi. If the pressure is too low, poor performance or a "no-start" may result. If pressure is too high, excessive odor may result.

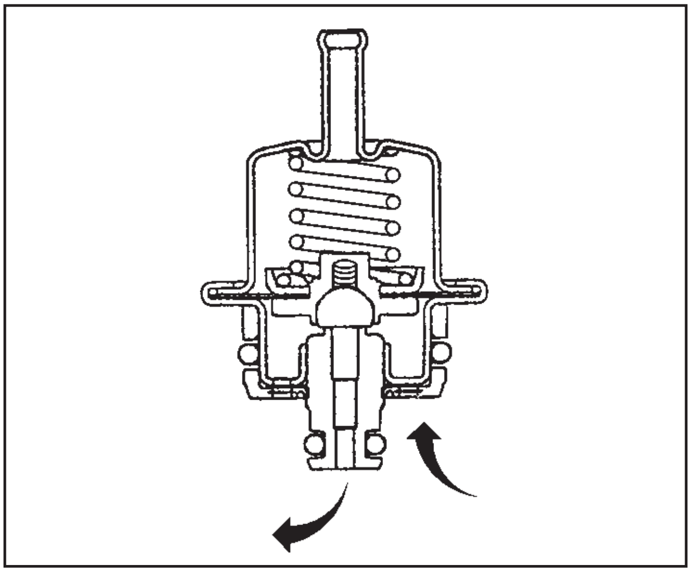


Figure 3-5 - Pressure Regulator Assembly (Typical)

Throttle Body Assembly

The throttle body assembly is attached to the intake manifold air plenum, and is used to control air flow into the engine, thereby controlling engine output (Figure 3-6). The throttle plates within the throttle body are opened by the driver through the throttle controls. During engine idle, the throttle plates are closed, and air flow control is handled by the Idle Air Control (IAC) valve, described below.

The throttle body also provides the location for mounting the TP sensor and for sensing changes in engine vacuum due to throttle plates position.

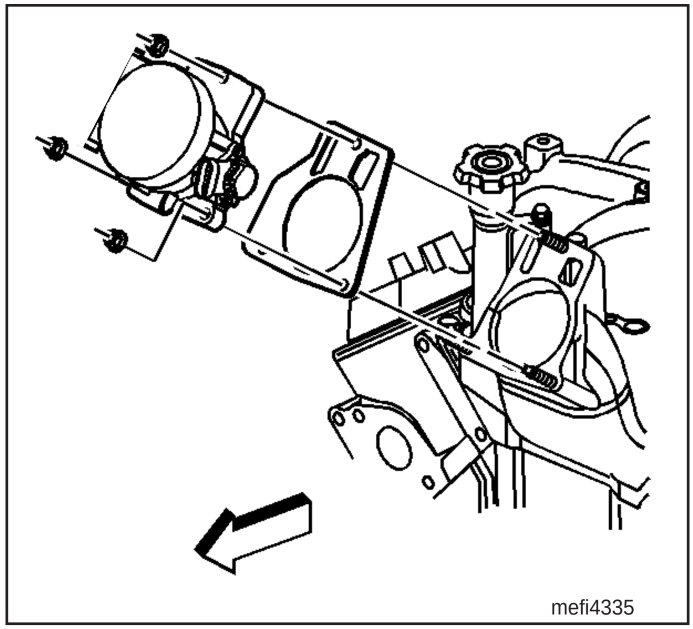


Figure 3-6 - Throttle Body Assembly (Typical)

Idle Air Control (IAC) Valve

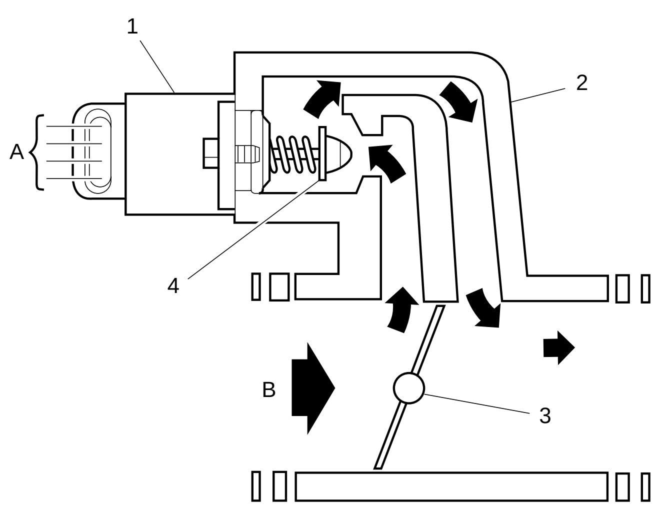
The purpose of the IAC valve assembly (Figures 3-7 and 3-8) is to control engine idle speed, while preventing stalls due to changes in engine load.

The IAC valve, mounted to the throttle body, controls bypass air around the throttle plates (Figure 3-7). By moving a conical valve known as a pintle, IN, towards the seat (to decrease air flow); or OUT, away from the seat (to increase air flow), a controlled amount of air moves around the throttle plates. If RPM is too low, more air is bypassed around the throttle plates to increase it. If RPM is too high, less air is bypassed around the throttle plates to decrease it.

The ECM moves the IAC valve in small steps. These can be monitored by scan tool test equipment, which plugs into the Data Link Connector (DLC).

During idle, the proper position of the IAC valve is calculated by the ECM, based on battery voltage, coolant temperature and engine RPM. If the RPM drops below specification and the throttle plates are closed, the ECM senses a near stall condition and calculates a new valve position to prevent stalling.

- Engine idle speed is a function of total air flow into the engine based on IAC valve pintle position plus throttle plates opening.

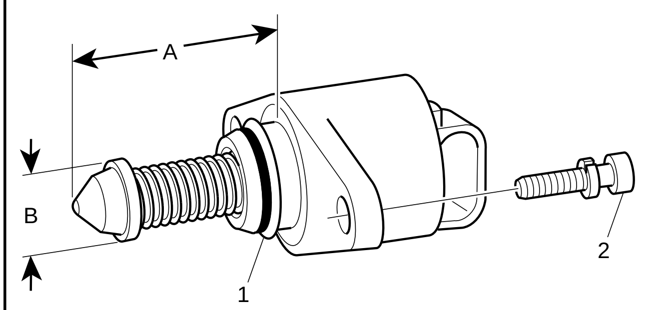


1 IDLE AIR CONTROL (IAC) VALVE
2 THROTTLE BODY ASSEMBLY
3 THROTTLE VALVE
4 IAC VALVE PINTLE
A ELECTRICAL INPUT SIGNAL
B AIR INLET

8-25-94
RS 22193

Figure 3-7 - IAC Valve Air Flow Diagram

- "Controlled" idle speed is programmed into the ECM, which determines the correct IAC valve pintle position to maintain the desired idle speed for all engine operating conditions and loads.
- The minimum air rate is set at the factory with a stop screw. This setting allows enough air flow by the throttle plates to cause the IAC valve pintle to be positioned at a calibrated number of steps (counts) from the seat, during "controlled" idle operation. This minimum air rate setting should not be altered by turning the stop screw or bending the linkage. Improper idle control will result.



1 O-RING - IAC VALVE
2 IAC VALVE ATTACHING SCREW
A DISTANCE OF PINTLE EXTENSION
B DIAMETER OF PINTLE

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RS 22181

Figure 3-8 - Flange Mounted Type IAC Valve

Diagnosis

If the Engine Cranks But Will Not Run or immediately stalls, Table A-3 of the Diagnosis section must be used to determine if the failure is in the ignition system or the fuel system.

On-Board Service

Caution:

To reduce the risk of fire and personal injury, relieve fuel system pressure before servicing fuel system components.

After relieving fuel pressure, a small amount of fuel may be released when servicing fuel lines or connections. To reduce the chance of personal injury, 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 disconnection is completed.

Fuel Control On-Board Service

The following is general information required when working on the fuel system:

- Always keep a dry chemical fire extinguisher near the work area.
- Fuel pipe fittings require new O-rings when assembling.
- Do not replace fuel pipe with fuel hose.
- Always bleed off fuel pressure before servicing any fuel system components.
- Do not do any repairs on the fuel system until you have read the instructions and checked the figures relating the repair.
- Observe all notices and cautions.

Fuel Pressure Relief Procedure

Tool Required:

J 34730-1, Fuel Pressure Gauge

Important

- Refer to manufacturer's warnings and cautions before proceeding.

1. Disconnect negative battery cable to avoid possible fuel discharge if an accidental attempt is made to start the engine.
2. Loosen fuel filler cap to relieve any tank vapor pressure.
3. Connect fuel pressure gauge J 34730-1 to fuel pressure connector assembly. Wrap a shop towel around fitting while connecting the gauge to avoid any spillage.
4. Install bleed hose into an approved container and open valve to bleed system pressure. Fuel connections are now safe for servicing.
5. Drain any fuel remaining in the gauge into an approved container.

Flame Arrestor

Remove or Disconnect

1. Flame arrestor retaining clamp.
2. Flame arrestor.

Inspect

- Flame arrestor element for dust, dirt or water. Replace if required.

Install or Connect

1. Flame arrestor to throttle body.
2. Flame arrestor retaining clamp to flame arrestor.

Throttle Body Assembly Replacement

Remove or Disconnect

1. Disconnect the negative battery cable.
2. Remove the flame arrestor clamp and flame arrestor.
3. Disconnect the electrical connectors from the IAC valve and the TP sensor.
4. Disconnect the throttle cable.
5. Remove the throttle body assembly attaching nuts.
6. Remove the throttle body assembly and gasket.
7. Discard the gasket.

Important: To o prevent damage to the throttle valve, it is essential that the unit be placed on a holding fixture before performing service.

Notice: Stuff a rag in the intake manifold opening to prevent foreign material from entering the engine.

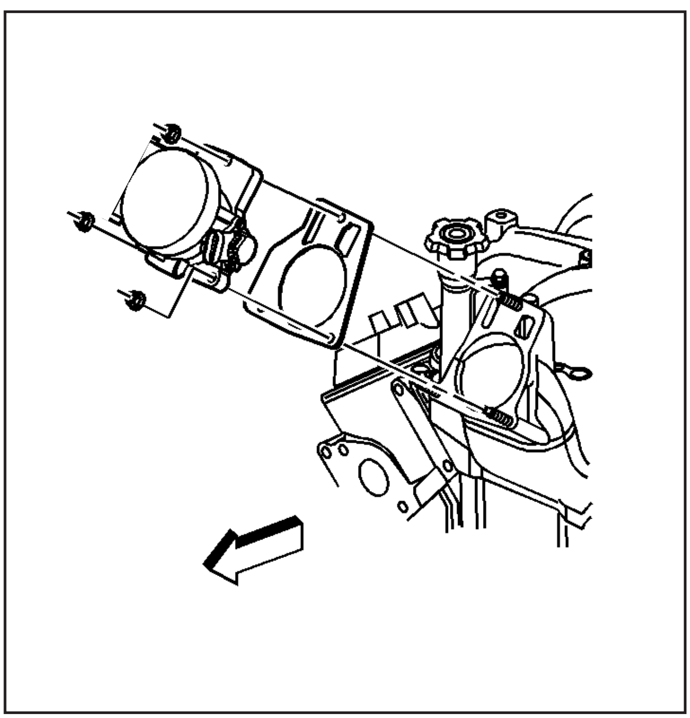
Inspect

- Manifold bore for loose parts and foreign material.
- Manifold mating surface for cleanliness or burrs that could affect gasket sealing.

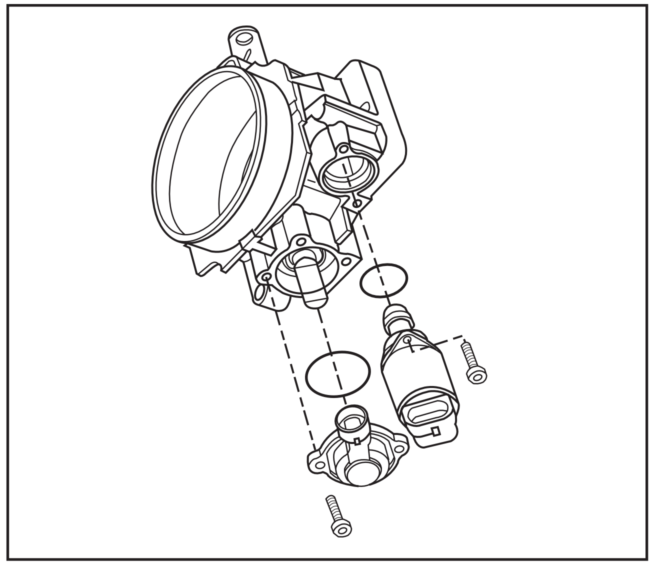
Important: Clean the throttle bore and valve deposits using carburetor cleaner and a parts cleaning brush. Do Not use a cleaner that contains methyl ethyl ketone, an extremely strong solvent, and not necessary for this type of deposit.

The throttle body metal parts may be cleaned in a cold, immersion type cleaner following the disassembly of the unit.

Notice: The TP sensor and IAC valve should not come in contact with solvent or cleaner, as they may be damaged. These components must be removed before immersion. Follow the procedures outlined in this section.



Throttle Body Removal



Throttle Body Assembly

Caution: Safety glasses must be worn when using compressed air, as flying dirt particles may cause eye injury.

- Clean all metal parts thoroughly and blow dry with compressed air. Be sure that all fuel and air passages are free of dirt and burrs.
- Inspect the mating surfaces for damage that could affect gasket sealing.
- Inspect throttle body for cracks in casting.
- The thread-locking compound supplied in the service repair kit is a small vial of thread-locking compound with directions for use. If this material is not available, use Loctite® 262 or equivalent.

Notice: When precoating the mounting bolts, do not use a higher strength locking compound than recommended. This may cause the removal of the bolts to be very difficult.

Install or Connect

1. Install a new throttle body gasket.
2. Install the throttle body assembly and the throttle body assembly attaching nuts.

   Tighten

   Tighten the throttle body assembly attaching nuts to 10 N·m (89 lb in).
3. Reconnect the throttle cable.
4. Reconnect the electrical connectors to the IAC valve and the TP sensor.
5. Install the flame arrestor and clamp. Securely tighten the clamp.
6. Reconnect the negative battery cable.

Quick Connect Fitting(s) Service

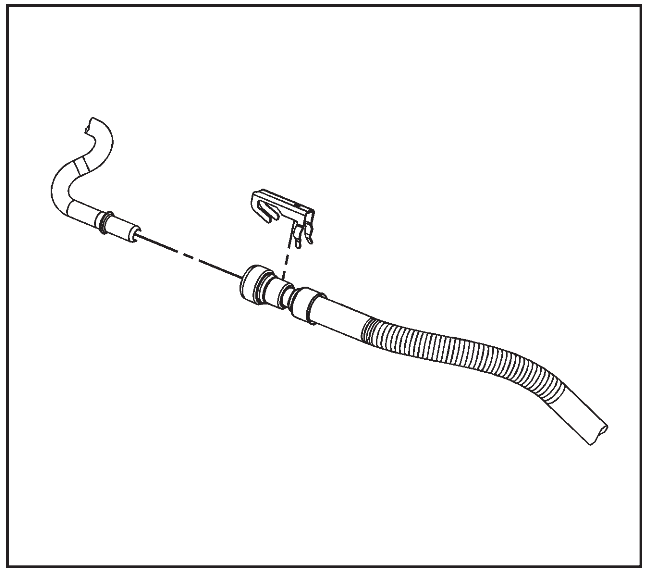
Tools Required

J 37088-A Tool Set, Fuel Line Quick-Connect Separator

J 44581 Fuel Line Quick Connect Separator

Remove or Disconnect

1. Relieve the fuel system pressure before servicing any fuel system connection. Refer to *Fuel Pressure Relief Procedure.*
2. Remove the retainer from the quick-connect fitting.



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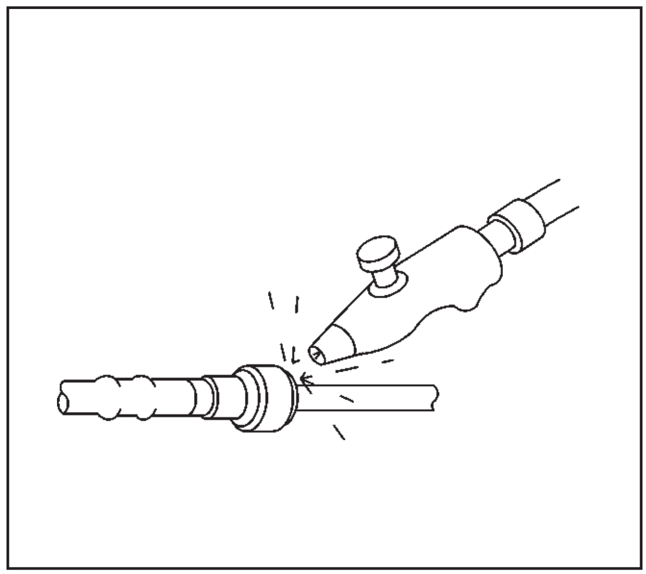
Caution: Wear safety glasses in order to avoid eye damage.

3. Blow dirt out of the fitting using compressed air.



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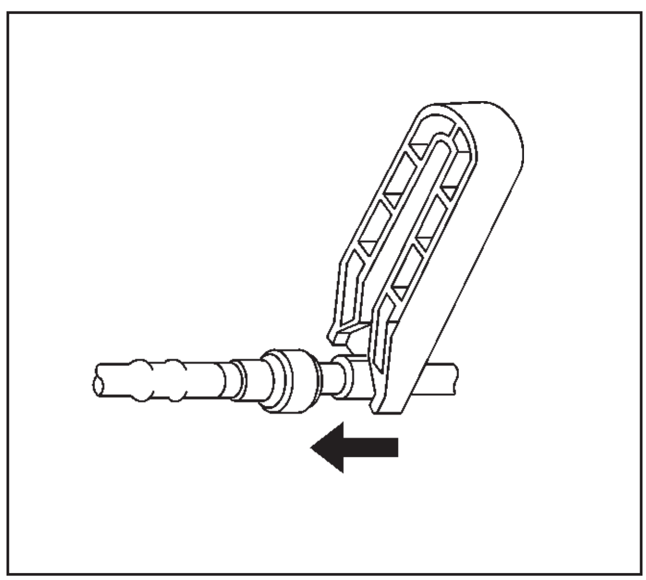
4. Choose the correct tool from the tool set for the size of the fitting. Insert the tool into the female connector, then push inward in order to release the locking tabs.



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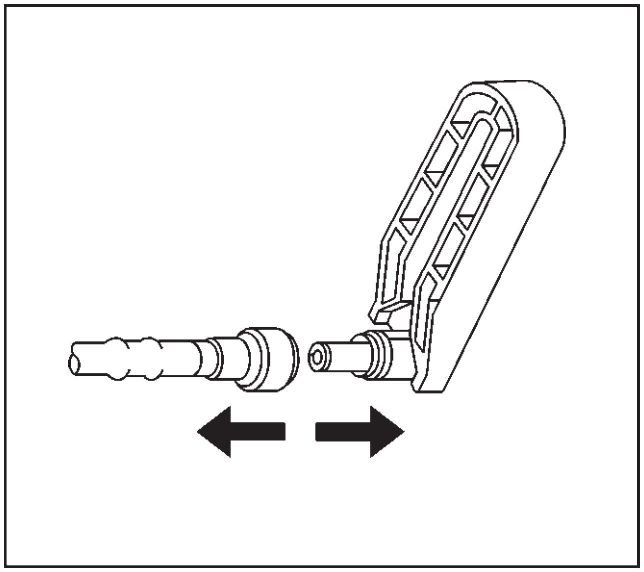

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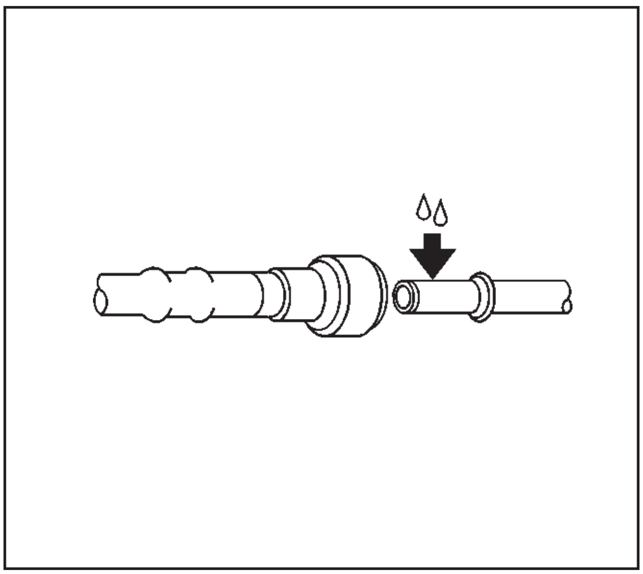
5. Pull the connection apart.
6. Use a clean shop towel in order to wipe off the male pipe end.
7. Inspect both ends of the fitting for dirt and burrs. Clean or replace the components as required.



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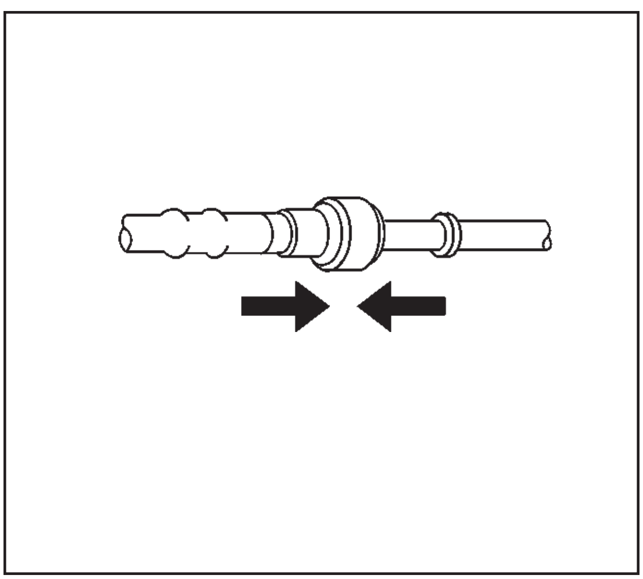
Install or Connect

1. Apply a few drops of clean engine oil to the male pipe end.



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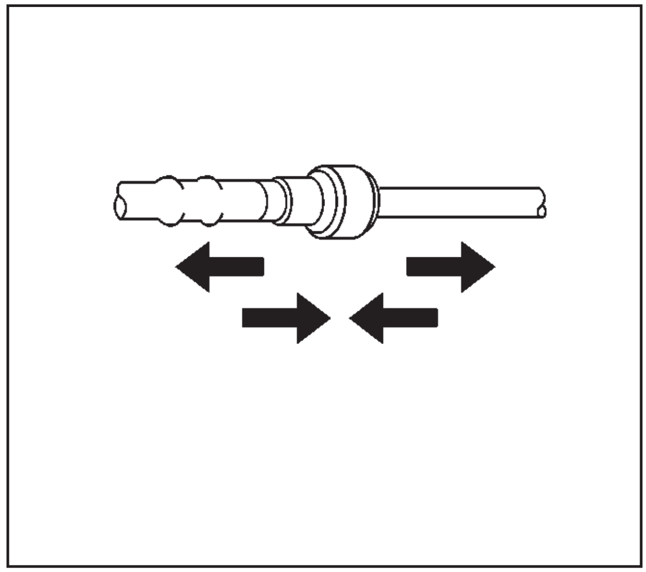
2. Push both sides of the fitting together in order to snap the retaining tabs into place.

3. Once installed, pull on both sides of the fitting in order to make sure the connection is secure.



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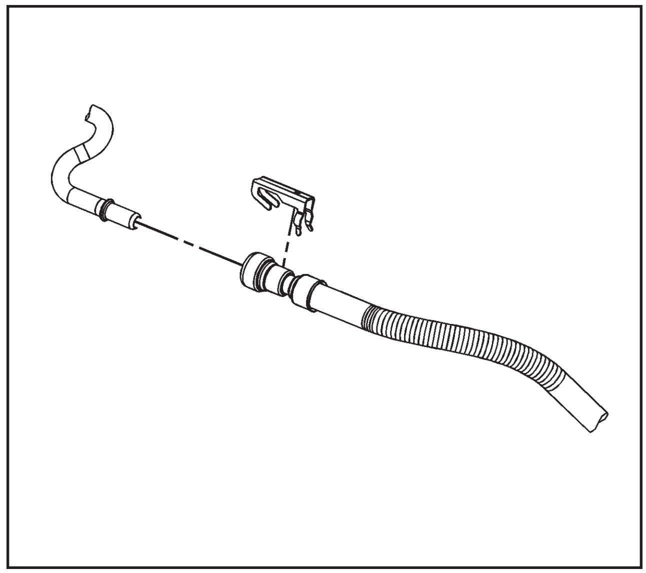
4. Install the retainer on to the quick-connect fitting.



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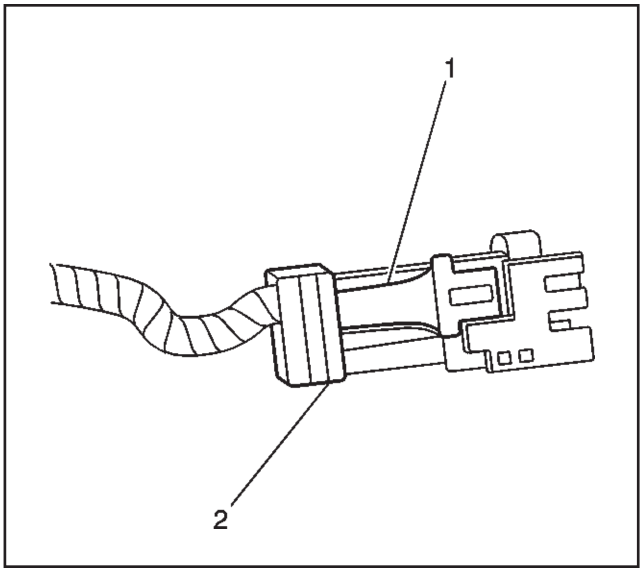

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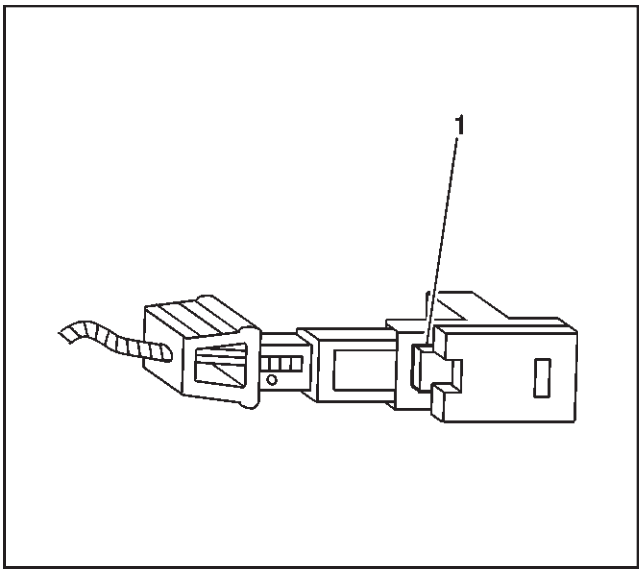
Fuel Rail Assembly Replacement

Remove or Disconnect

1. Relieve the fuel system pressure. Refer to *Fuel Pressure Relief Procedure.*
2. Remove the engine cover.
3. Before removal, clean the fuel rail assembly with a spray type engine cleaner, GM X-30A or equivalent, if necessary. Follow the package instructions. Do not soak fuel rails in liquid cleaning solvent.
4. Disconnect the TP sensor harness connector.
5. Disconnect the IAC valve harness connector.
6. Identify the connectors to their corresponding injectors to ensure correct injector firing order after reassembly.
7. Pull the top portion (2) of the injector connector up. Do not pull the top portion of the connector past the top of the white portion (1).



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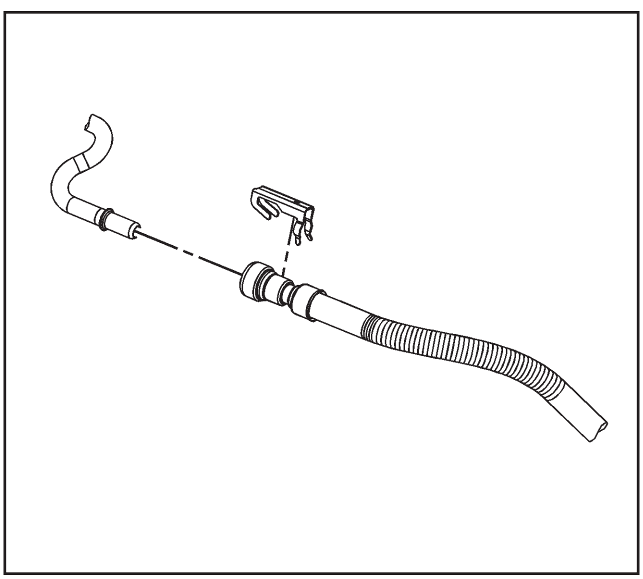
8. Push the tab (1) on the lower side of the injector connector in order to release the connector from the injector.
9. Repeat step 9 and step 10 for each injector connector.



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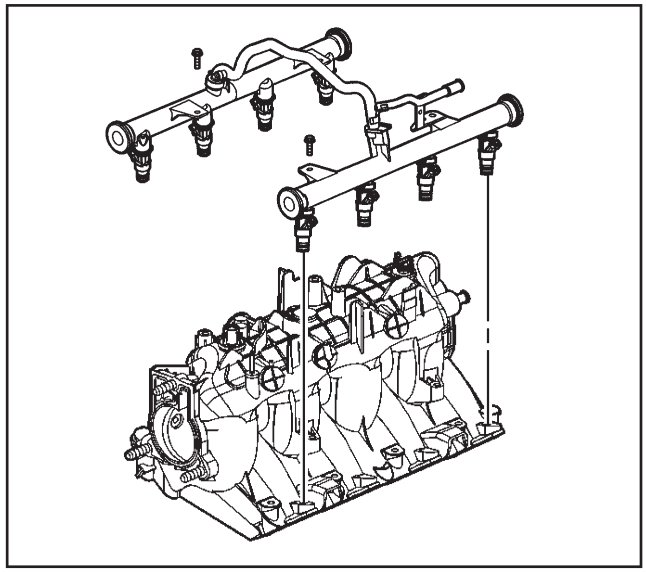
10. Disconnect the fuel feed line from the fuel rail. Refer to Quick Connect Fitting procedure in this section.

12. Remove the fuel rail attaching bolts.
13. Remove the fuel rail assembly.

Notice:

- Remove the fuel rail assembly carefully in order to prevent damage to the injector electrical connector terminals and the injector spray tips. Support the fuel rail after the fuel rail is removed in order to avoid damaging the fuel rail components.
- Cap the fittings and plug the holes when servicing the fuel system in order to prevent dirt and other contaminants from entering open pipes and passages.



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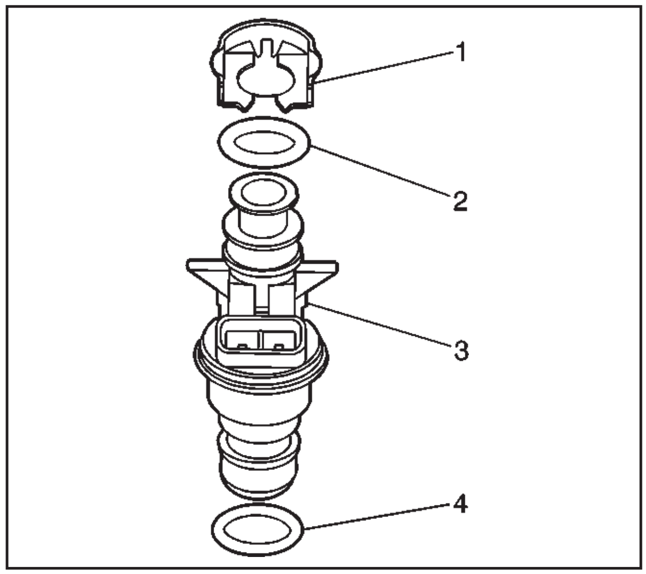
14. Remove the injector lower O-ring seal (4) from the spray tip end of each injector (3).
15. Discard the O-ring seals.



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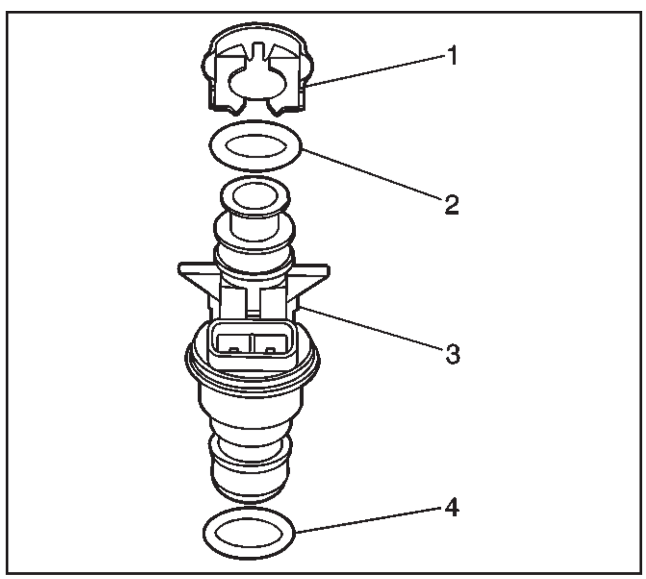
Install or Connect

1. Lubricate the new lower injector O-ring seals (4) with clean engine oil.
2. Install the new O-ring seals (4) on the spray tip end of each injector (3).



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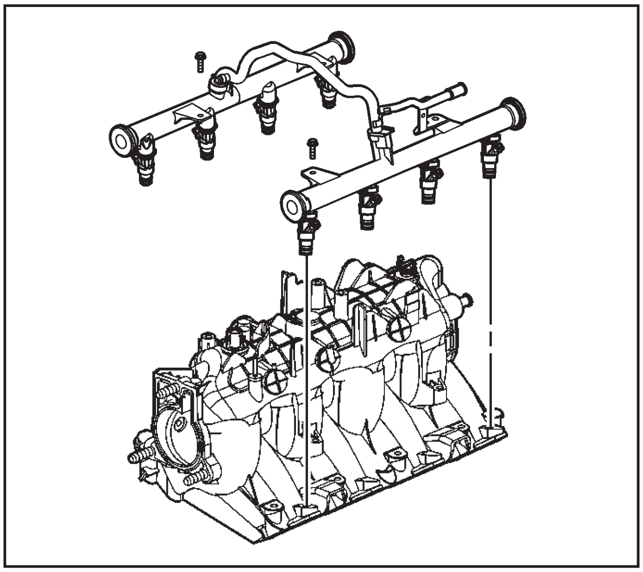

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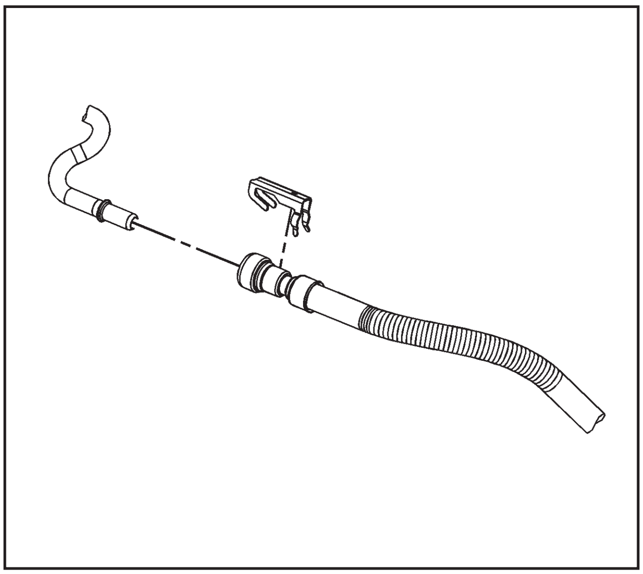
3. Install the fuel rail assembly to the intake manifold.
4. Apply a 5 mm (0.020 in) band of GM P/N 12345382 threadlock or equivalent to the threads of the fuel rail attaching bolts.
5. Install the fuel rail attaching bolts.

   Tighten

   Tighten the fuel rail attaching bolts to 10 N·m (89 lb in).



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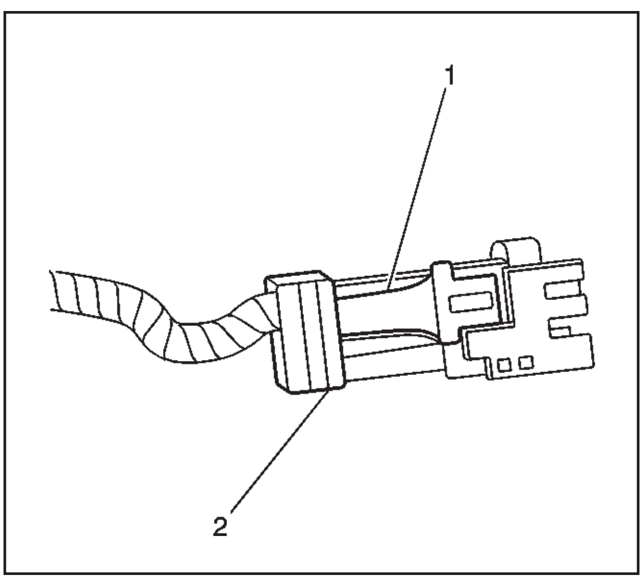
6. Connect the fuel feed line to the fuel rail. Refer to Quick Connect Fitting procedure in this section.



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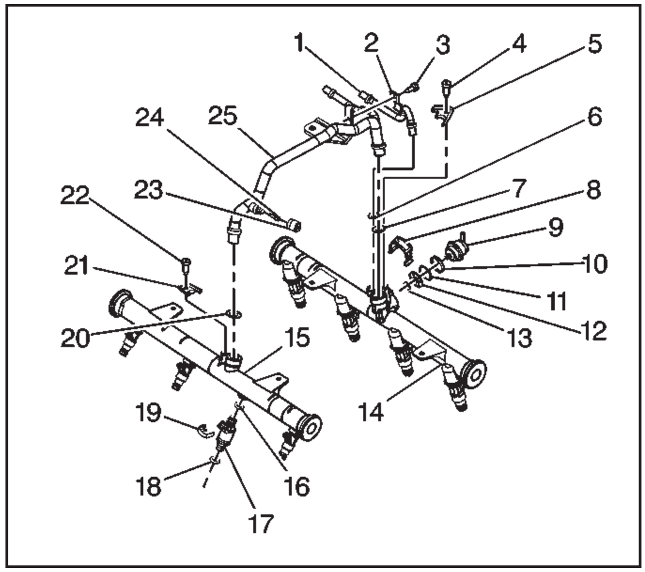
8. Connect the injector electrical connectors
   - Install each connector on the proper injector in order to ensure correct injector firing order.
   - Rotate the injectors as required in order to avoid stretching the wire harness.
9. Reconnect the TP sensor harness connector.
10. Reconnect the IAC valve harness connector.
11. Install the engine cover.
12. Connect the negative battery cable.
13. Inspect for leaks.
    13.1. Turn the ignition ON for 2 seconds.
    13.2. Turn the ignition OFF for 10 seconds.
    13.3. Turn the ignition ON.
    13.4. Inspect for fuel leaks.

Fuel Injector Replacement

Remove or Disconnect

Important: The engine oil may be contaminated with fuel if the fuel injectors are leaking.

1. Remove the fuel rail assembly. Refer to *Fuel Rail Assembly Replacement.*
2. Remove the injector retainer clip (4).
3. Insert the fork of J 43013, the fuel injector assembly removal tool, between the fuel rail pod and the 3 protruding retaining clip ledges. Use a prying motion while inserting the tool in order to force the injector out of the fuel rail pod.



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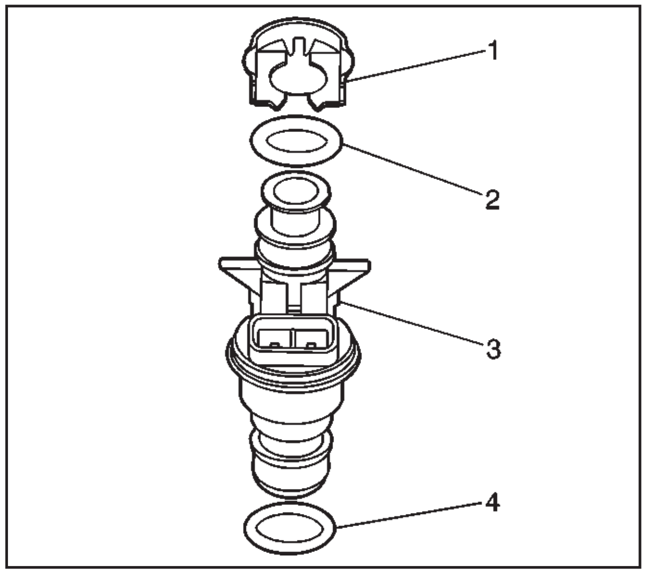
4. Discard the injector retainer clip (1).
5. Remove the injector O-ring seals (2), (4) from both ends of the injector. Discard the O-ring seals.



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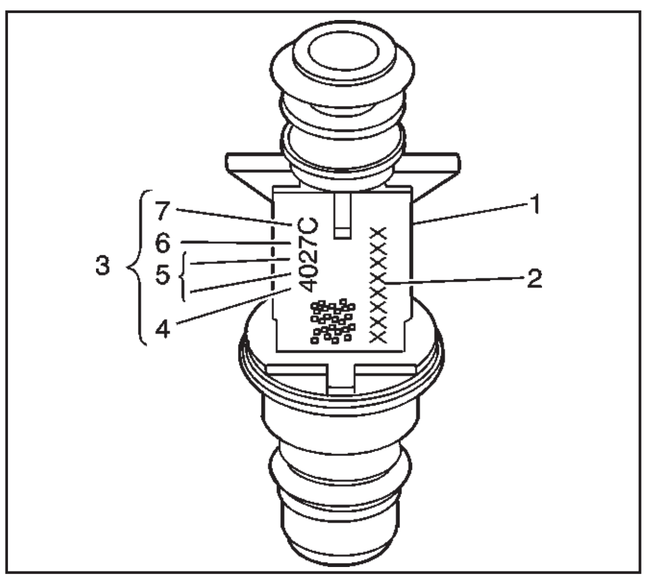
Install or Connect

Important: When ordering new fuel injectors, be sure to order the correct injector for the application being serviced.

The fuel injector assembly (1) is stamped with a part number identification (2). A four digit build date code (3) indicates the month (4), day (5), year (6) and the shift (7) that built the injector.



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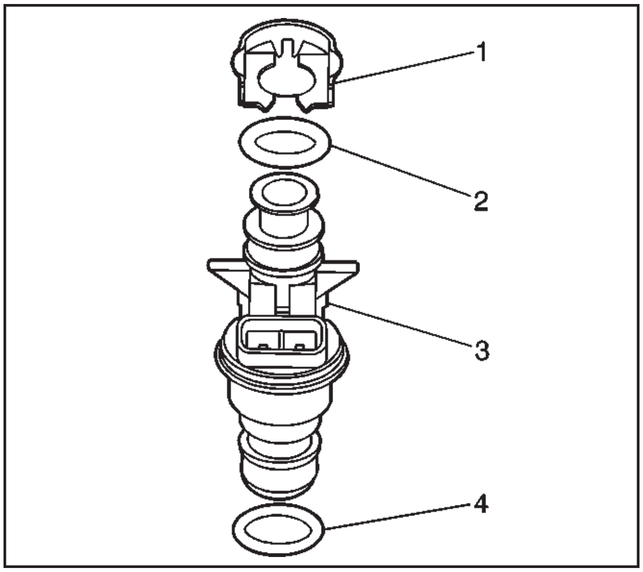

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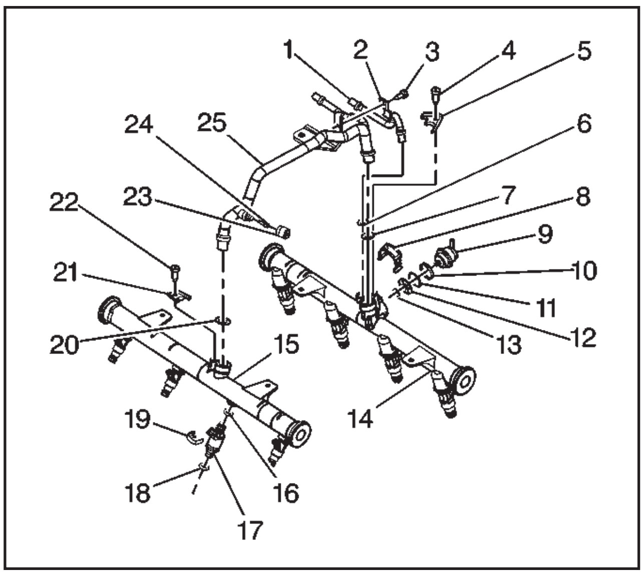
1. Lubricate the new O-ring seals (2), (4) with clean engine oil.
2. Install the new injector O-ring seals on the injector.
3. Install a new retainer clip (1) on the injector.



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4. Push the fuel injector (5) into the fuel rail injector socket with the electrical connector facing outwards. The retainer clip (4) locks on to a flange on the fuel rail injector socket.
5. Install the fuel rail assembly. Refer to Fuel Rail Assembly Replacement procedure in this section.

Fuel Control Cell (FCC) Replacement - Screw On Bowl and Clamp On Bowl

Important

- Fuel pressure must be relieved before servicing the fuel pump.
- Refer to “Fuel Pressure Relief Procedure.”

Remove or Disconnect

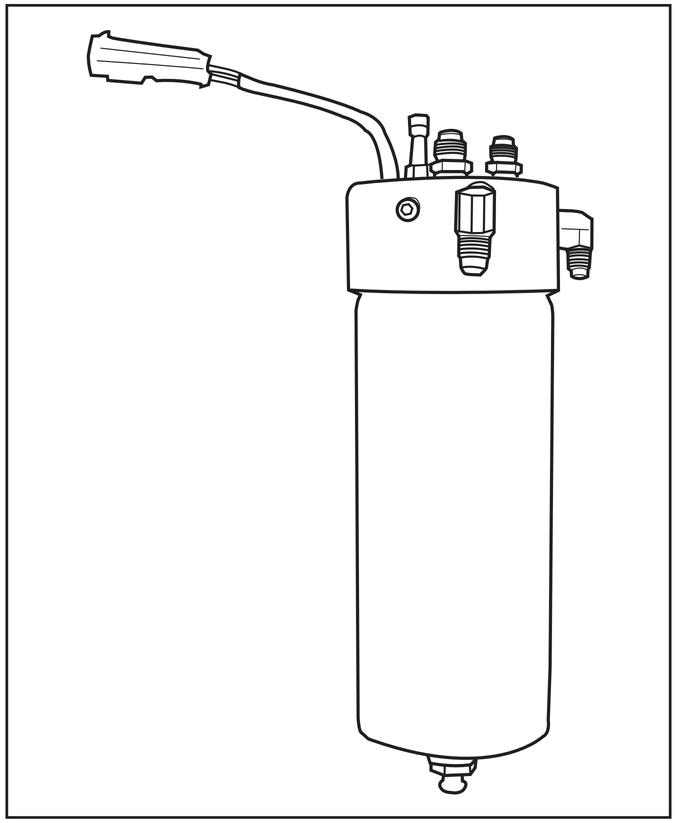
1. Negative battery cable.
2. Fuel pump electrical connector.
3. Inlet and outlet fuel line fittings.
4. Fuel Control Cell (FCC) attaching bolts.
5. Fuel Control Cell (FCC).

Install or Connect

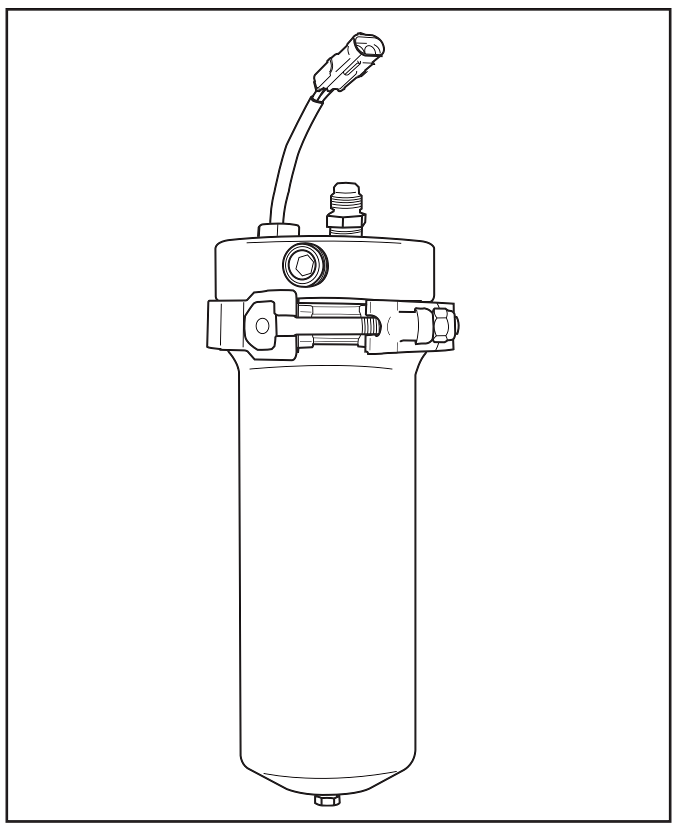
1. Fuel Control Cell (FCC).
2. Fuel Control Cell (FCC) attaching bolts.
3. Inlet and outlet fuel line fittings.
4. Fuel pump electrical connector.
5. Negative battery cable.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Turn the ignition switch back to the “ON” position and check for fuel leaks.



Fuel Control Cell (FCC) - Screw On Bowl



Fuel Control Cell (FCC) - Clamp On Bowl

Fuel Control Cell (FCC) - Screw On Bowl - Drain Water (With Engine OFF)

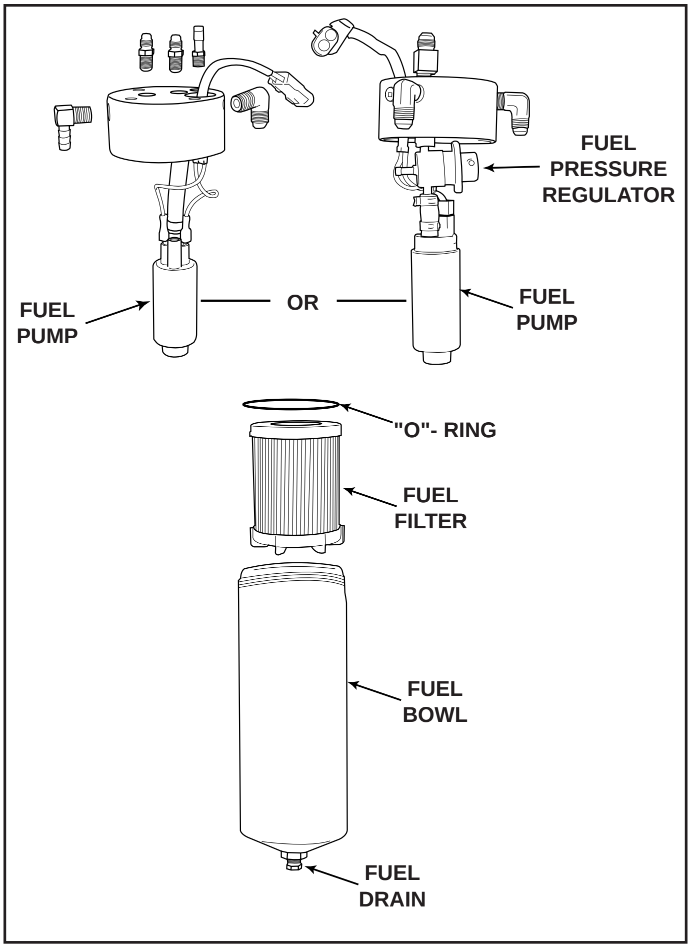
1. Disconnect the two-wire electrical harness.
2. Hold the 3/4” jam nut located at the bottom of the FCC bowl with a wrench, remove the 3/16” allen plug and drain bowl contents into a suitable container.

Caution: Both fuel, which is explosive, and water will drain from the FCC bowl.

3. Apply pipe sealant suitable for use with gasoline to the threads fo the 3/16” allen plug.
4. Tighten the 3/16” allen plug while holding the 3/4” jam nut with a wrench.
5. Re-connect the two-wire electrical harness.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Cycle the ignition several times to fill the FCC bowl. Turn the ignition switch back to the “ON” position and check for fuel leaks.



Fuel Control Cell (FCC) - Screw On Bowl - Element Replacement (With Engine OFF)

1. Disconnect the two-wire electrical harness.
2. Hold the 3/4” jam nut located at the bottom of the FCC bowl with a wrench, remove the 3/16” allen plug and drain bowl contents into a suitable container.

Caution: Both fuel, which is explosive, and water will drain from the FCC bowl.

3. Using a strap type oil filter wrench, remove the bowl by turning it counterclockwise as viewed from the bottom.
4. Slide bowl downward over the suspended filter element. It may be necessary to pull the unit to one side or remove the fuel line from the feed pump to remove the bowl.
5. Remove the fuel filter element from the suspended pump by gripping the fuel pump with one hand and pulling the filter downward with the other hand.
6. Push on new filter element over the electric pump.
7. Using a pick made of soft material, such as a toothpick, remove the old “O”-ring from inside the FCC bowl mounting head.

Caution: The mounting head “O”-ring groove may be damaged by using a sharp tool to remove this “O”-ring.

8. Lubricate the new “O”-ring with a light grease and install the new “O”-ring in the FCC head.
9. Grease taper and threads on the bowl and, by hand, thread the bowl into the FCC mounting head. Tighten the bowl firmly back into the head with an oil filter wrench.
10. Apply pipe sealant suitable with gasoline to the 3/16” allen plug.
11. Install and tighten the 3/16” allen plug while holding the 3/4” jam nut with a wrench.
12. Re-connect the two-wire electrical harness.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Cycle the ignition several times to fill the FCC bowl. Turn the ignition switch back to the “ON” position and check for fuel leaks.

Fuel Control Cell (FCC) - Clamp On Bowl - Drain Water (With Engine OFF)

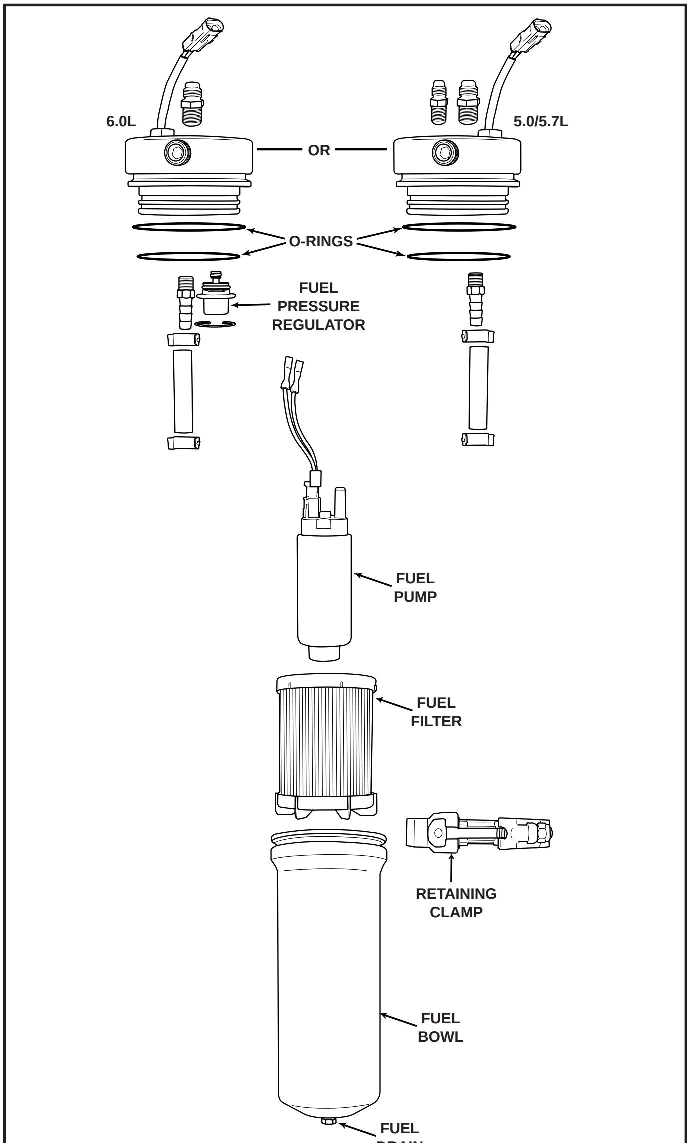
1. Disconnect the two-wire electrical harness.
2. Remove the 7/16” plug and drain the bowl contents into a suitable container.

Caution: Both fuel, which is explosive, and water will drain from the FCC bowl.

3. Apply pipe sealant, suitable for use with gasoline, to the threads fo the 7/16” plug.
4. Install and tighten the 7/16” plug securely.
5. Reconnect the two-wire electrical harness.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Cycle the ignition several times to fill the FCC bowl. Turn the ignition switch back to the “ON” position and check for fuel leaks.



Fuel Control Cell (FCC) - Clamp On Bowl - Element Replacement (With Engine OFF)

1. Disconnect the two-wire electrical harness.
2. Remove the 7/16” plug and drain the bowl contents into a suitable container.

Caution: Both fuel, which is explosive, and water will drain from the FCC bowl.

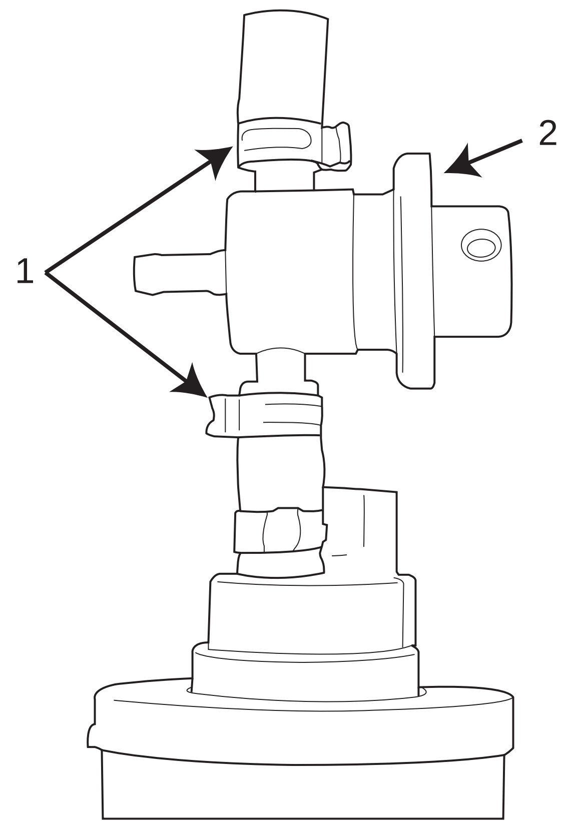
3. Remove the canister retaining clamp.
4. Slide bowl downward over the suspended filter element. It may be necessary to pull the unit to one side to remove the bowl.
5. Remove the fuel filter element from the suspended pump by gripping the fuel pump with one hand and pulling the filter downward with the other hand.
6. Push on new filter element over the electric pump.
7. Using a pick made of soft material, such as a toothpick, remove the old “O”-rings from the FCC bowl mounting head.

Caution: The mounting head “O”-ring grooves may be damaged by using a sharp tool to remove these “O”-rings.

8. Lubricate the new “O”-rings with fuel resistant “O”-ring lubricant, and install the new “O”-rings on the FCC head.
9. Apply pipe sealant, suitable for use with gasoline, to the threads fo the 7/16” plug.
10. Install and tighten the 7/16” plug securely.
11. Install the bowl firmly back onto the FCC head.
12. Install the canister retaining clamp and tighten securely.
13. Reconnect the two-wire electrical harness.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Cycle the ignition several times to fill the FCC bowl. Turn the ignition switch back to the “ON” position and check for fuel leaks.



Fuel Pressure Regulator Replacement

Remove or Disconnect

Important

- Fuel pressure must be relieved before servicing the fuel pump.
- Refer to “Fuel Pressure Relief Procedure.”

1. Remove the FCC bowl. Refer to Fuel Control Cell - Element Replacement steps 1-5.
2. Remove the two clamps (1).
3. Remove the fuel pressure regulator (2).

Install or Connect

4. Install the fuel pressure regulator (2).
5. Install two new clamps (1).
6. Push on a new filter element over the electric pump.
7. Install the FCC bowl. Refer to Fuel Control Cell - Element Replacement steps 7-12.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Cycle the ignition several times to fill the FCC bowl. Turn the ignition switch back to the “ON” position and check for fuel leaks.

Low-Pressure Fuel Pump Replacement

Important

- Fuel pressure must be relieved before servicing the fuel pump.
- Refer to "Fuel Pressure Relief Procedure."

Remove or Disconnect

1. Negative battery cable.
2. Fuel pump electrical connector.
3. Inlet and outlet fuel line fittings.
4. Fuel pump attaching bolts.
5. Fuel pump.

Install or Connect

1. Fuel pump.
2. Fuel pump attaching bolts.
3. Inlet and outlet fuel line fittings.
4. Fuel pump electrical connector.
5. Negative battery cable.

Inspect

- Turn ignition switch to the "ON" position for 2 seconds, then turn to the "OFF" position for 10 seconds. Turn the ignition switch back to the "ON" position and check for fuel leaks.

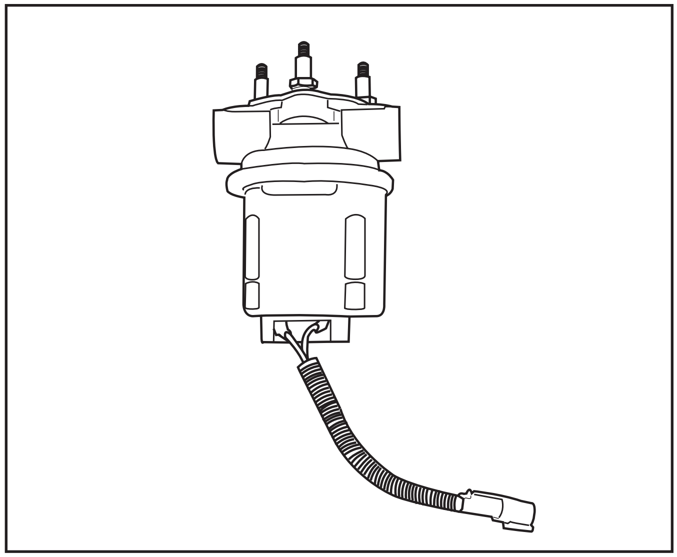


Figure 3-3 - Low Pressure Fuel Pump

Fuel Pump Relay

Remove or Disconnect

1. Retainer, if installed.
2. Fuel pump relay electrical connector.
3. Fuel pump relay.

Important

- The fuel pump relay is a electrical component. Do Not soak in any liquid cleaner or solvent as damage may result.

Install or Connect

1. Fuel pump relay.
2. Fuel pump relay electrical connector.
3. Retainer clip.

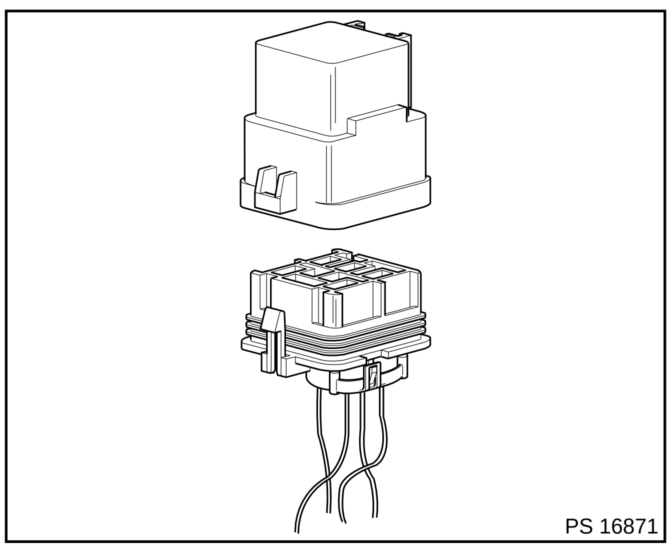


Figure 3-18- Fuel Pump Relay

Torque Specifications

Fastener Tightening Specifications

Application	N•m	Lb Ft	Lb In
Throttle Body Attaching Screws	15	11	
IAC Valve Attaching Screws	3.2		28
Fuel Pressure Connector	13		115
Fuel Rail Attaching Screws	10		89

Marine Electronic Fuel Injection (MEFI)

Section 3C

Fuel Metering System - 8.1L

This section describes how the fuel metering system operates, and provides a description of components used on the Marine Electronic Fuel Injection equipped engines. The fuel metering system information described in this section is limited to the 8.1L. All other systems will be detailed in a separate section.

Contents

General Description

Purpose

The function of the fuel metering system is to deliver the correct amount of fuel to the engine under all operating conditions. Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold near each cylinder.

Modes Of Operation

The ECM looks at inputs from several sensors to determine how much fuel to give the engine. The fuel is delivered under one of several conditions, called “modes.” All the “modes” are controlled by the ECM and are described below.

Starting Mode

When the ignition switch is turned to the crank position, the ECM turns the fuel pump relay “ON,” and the fuel pump builds up pressure. The ECM then checks the ECT, MAP and TP sensors, and determines the proper air/fuel ratio for starting. The ECM controls the amount of fuel delivered in the starting mode by changing how long the injectors are turned “ON” and “OFF.” This is done by “pulsing” the injectors for very short times.

Clear Flood Mode

If the engine floods, it can be cleared by opening the throttle to 100% (wide open throttle) during cranking. The ECM then shuts down the fuel injectors so no fuel is delivered. The ECM holds this injector rate as long as the throttle stays at 100%, and the engine speed is below 300 RPM. If the throttle position becomes less than 100%, the ECM returns to the starting mode.

Run Mode

When the engine is first started and RPM is above 300 RPM, the system operates in the run mode. The ECM will calculate the desired air/fuel ratio based on these ECM inputs: RPM, ECT and MAP. Higher engine loads (MAP input) and colder engine temperatures (ECT input) require more fuel, or a richer air/fuel ratio.

Acceleration Mode

The ECM looks at rapid changes in TP sensor and MAP, and provides extra fuel by increasing the injector pulse width.

Fuel Cutoff Mode

No fuel is delivered by the injector when the ignition is “OFF,” to prevent dieseling. Also, injector pulses are not delivered if the ECM does not receive distributor reference pulses, which means the engine is not running. The fuel cutoff mode is also enabled at high engine RPM, as an overspeed protection for the engine. When fuel cutoff is in effect due to high RPM, injector pulses will resume after engine RPM drops below the maximum OEM RPM specification (Rev Limit).

Power Reduction Mode

Power reduction mode is a function of the ECM that reduces engine power under certain conditions. Power reduction will disable one fuel injector driver when the engine speed goes above 2500 rpm, and enable the fuel injector driver when the engine speed drops below 1200 rpm. Power reduction may be active for the following conditions:

- Engine coolant temperature too high
- Low oil pressure
- Transmission temperature too high (if applicable)

Fuel Metering System Components

The fuel metering system (Figure 3-1) is made up of the following parts:

- Fuel supply components (fuel tank, pump, lines, filter).
- Fuel pump electrical circuit.
- Fuel rail assembly, including fuel injectors and pressure regulator assembly.
- Throttle body assembly, including an IAC valve and TP sensor.

Quick-Connect Fittings

Quick-Connect fittings provide a simplified means of installing and connecting fuel system components. The fittings consists of a unique female connector and a compatible male pipe end. O-rings, located inside the female connector, provide the fuel seal. Integral locking tabs inside the female connector hold the fittings together.

Fuel Supply Components (FCC System)

The Fuel Control Cell (FCC) incorporates two (2) fuel pumps to provide uninterrupted flow of fuel to your marine engine.

Fuel is fed into the FCC by a low-pressure, high volume electric fuel pump. This pump flows fuel at a volume which exceeds the fuel flow rate required of the high-pressure pump by engine demands.

The high pressure pump, mounted inside the FCC bowl, provides the necessary fuel pressure and volume to maintain proper engine performance, and always has an ample supply of fuel to meet the idle, cruise and acceleration fuel requirements of the engine.

The fuel pressure regulator, located on the fuel rail, controls fuel pressure and maintains a constant pressure across the fuel delivery system. Fuel not used by the engine, excess fuel, is returned to the FCC canister.

The fuel delivered to the engine by the FCC is filtered by a filter and water separator element, which surrounds the high pressure pump inside the FCC bowl.

The fuel enters the FCC bowl from two (2) components, the low-pressure pump (initial input) and the fuel pressure regulator (unused recirculating). Fuel exits the FCC bowl at two (2) locations, the high-pressure output to the fuel rail and all excess fuel in the FCC bowl is routed back to the fuel tank via a return line.

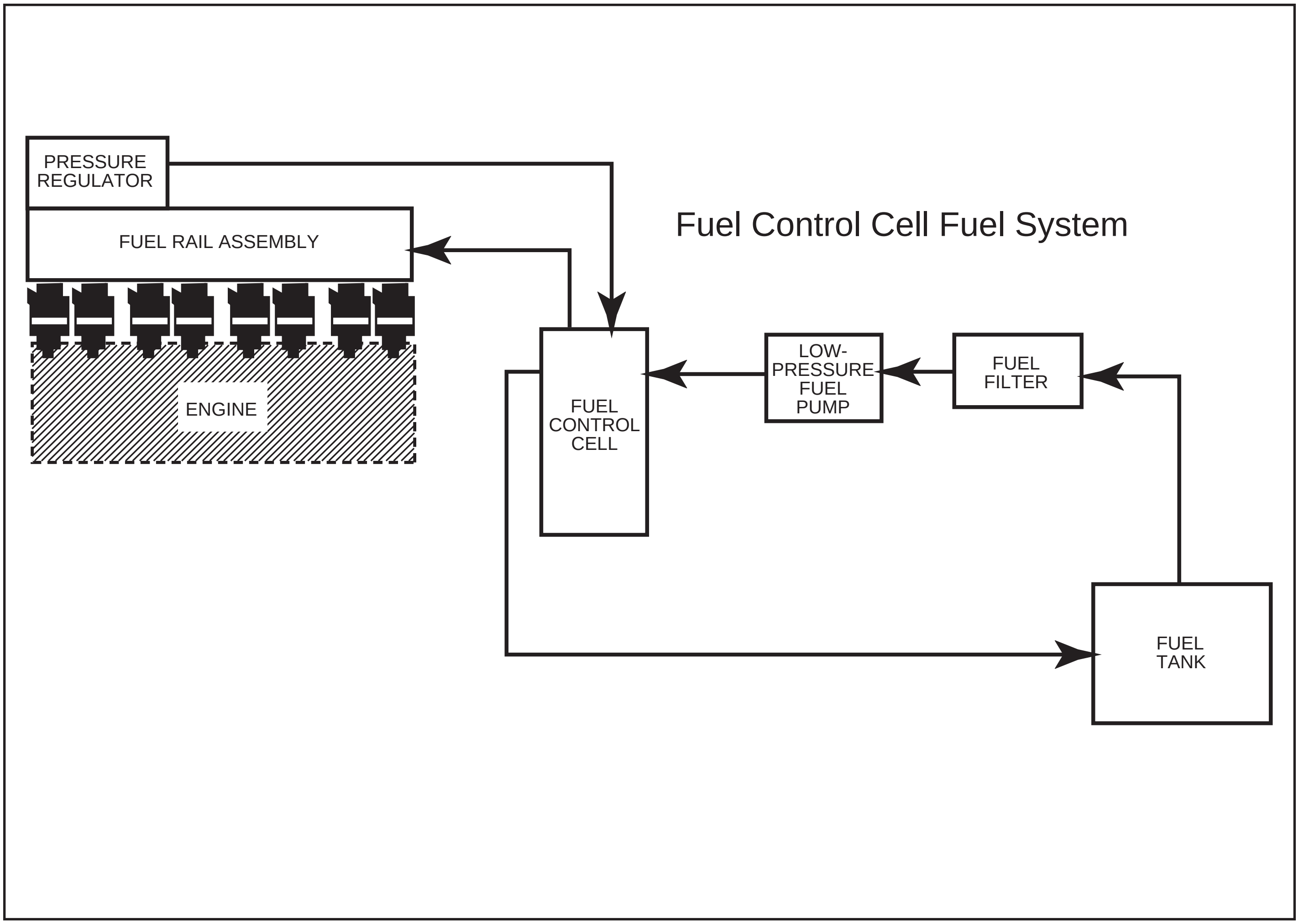


Figure 3-1 - Fuel Metering System (Typical)

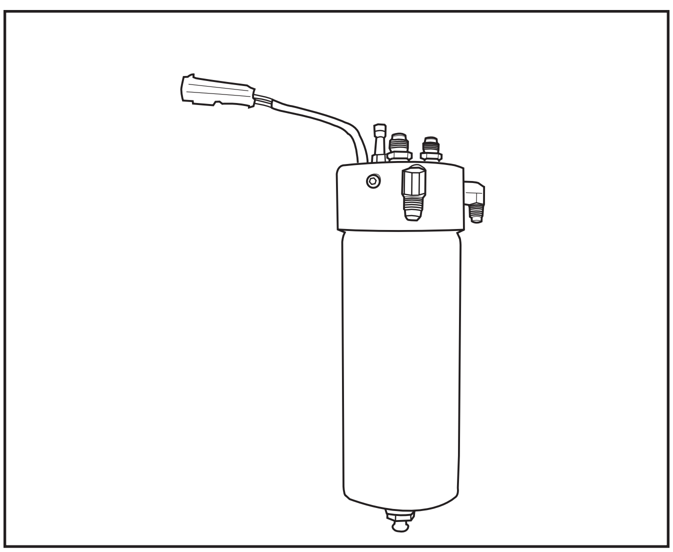


Figure 3-2 - Fuel Control Cell (FCC)

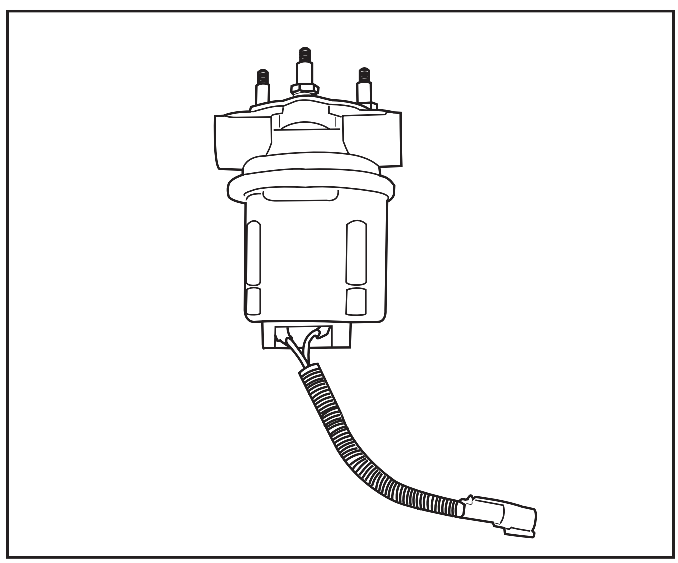


Figure 3-3 - Low Pressure Fuel Pump

Fuel Pump Electrical Circuit

When the ignition switch is turned “ON,” the ECM turns the fuel pump relay “ON” for two seconds causing the fuel pump(s) to pressurize the MEFI fuel system.

When the ignition switch is turned to the crank position, the ECM turns the fuel pump relay “ON” causing the fuel pump to run.

If the ECM does not receive ignition reference pulses (engine cranking or running), it shuts “OFF” the fuel pump relay, causing the fuel pump to stop.

An inoperative fuel pump relay will result in an “Engine Cranks But Will Not Run” condition.

Fuel Rail Assembly

The fuel rail (Figure 3-3) is mounted to the engine intake manifold, and performs several functions. It positions the injectors (3) in the intake manifold, distributes fuel evenly to the injectors, and integrates the fuel pressure regulator (2) into the fuel metering system.

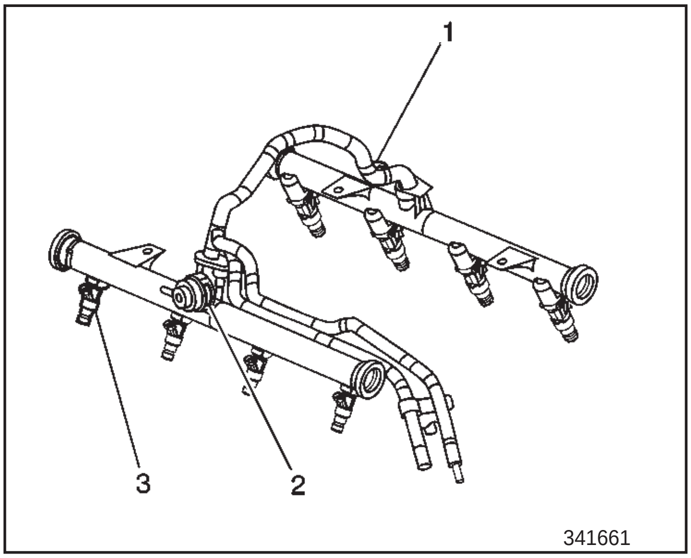


Figure 3-3 - Fuel Rail Assembly

Fuel Injectors

The Multec 2 fuel injector assembly is a solenoid operated device, controlled by the ECM, that meters pressurized fuel to a single engine cylinder. The ECM energizes the high-impedance (12.2 ohms) injector solenoid (1) to open a normally closed ball valve (2). This allows fuel to flow into the top of the injector, past the ball valve and through a director plate (3) at the injector outlet. The director plate has four machined holes that control the fuel flow, generating a spray of finely atomized fuel at the injector tip. Fuel from the injector tip is directed at the intake valve, causing it to become further atomized and vaporized before entering the combustion chamber. An injector stuck partly open can cause a loss of pressure after engine shutdown. Consequently, long engine cranking times would be noticed on some engines.

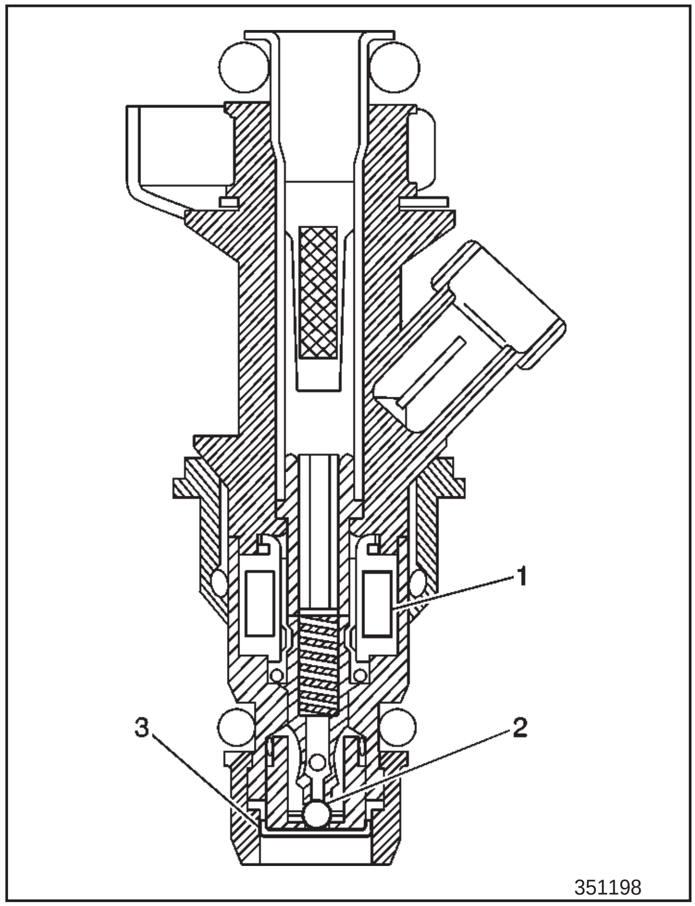


Figure 3-4 - Fuel Injector Assembly

Pressure Regulator Assembly

The pressure regulator is a diaphragm-operated relief valve with fuel pump pressure on one side, and regulator spring pressure and intake manifold vacuum on the other side (Figure 3-5). The regulator's function is to maintain a constant pressure differential across the injectors at all times. The pressure regulator compensates for engine load by increasing fuel pressure as engine vacuum drops.

With the ignition "ON," engine "OFF" (zero vacuum), fuel pressure at the pressure test connection should be 284-325 kPa (41-47 psi). If the pressure is too low, poor performance or a "no-start" may result. If pressure is too high, excessive odor may result.

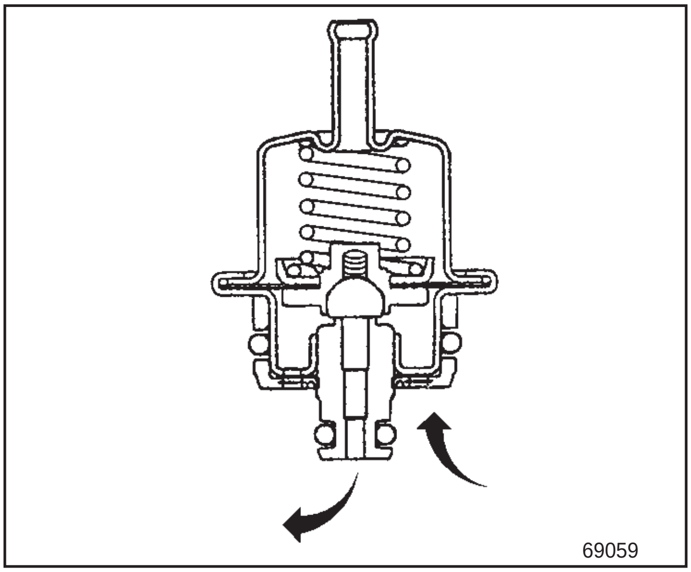


Figure 3-5 - Pressure Regulator Assembly

Throttle Body Assembly

The throttle body assembly is attached to the intake manifold air plenum, and is used to control air flow into the engine, thereby controlling engine output (Figure 3-6). The throttle plates within the throttle body are opened by the driver through the throttle controls. During engine idle, the throttle plates are closed, and air flow control is handled by the Idle Air Control (IAC) valve, described below.

The throttle body also provides the location for mounting the TP sensor and for sensing changes in engine vacuum due to throttle plates position.

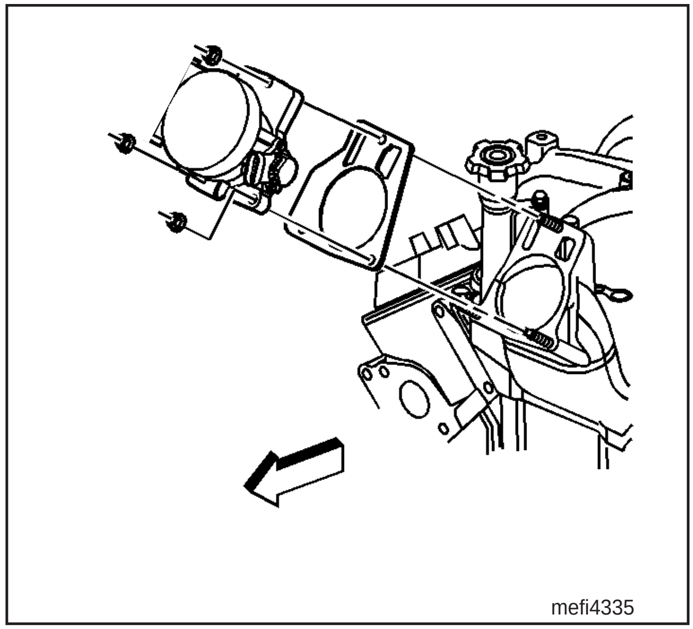


Figure 3-6 - Throttle Body Assembly

Idle Air Control (IAC) Valve

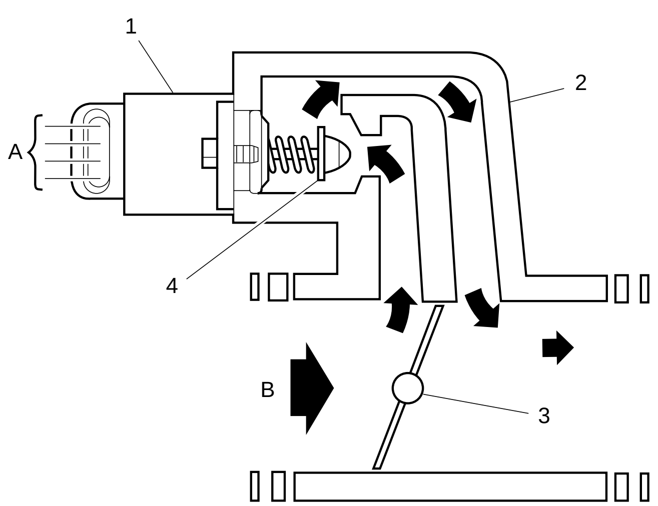
The purpose of the IAC valve assembly (Figures 3-7 and 3-8) is to control engine idle speed, while preventing stalls due to changes in engine load.

The IAC valve, mounted to the throttle body, controls bypass air around the throttle plates (Figure 3-7). By moving a conical valve known as a pintle, IN, towards the seat (to decrease air flow); or OUT, away from the seat (to increase air flow), a controlled amount of air moves around the throttle plates. If RPM is too low, more air is bypassed around the throttle plates to increase it. If RPM is too high, less air is bypassed around the throttle plates to decrease it.

The ECM moves the IAC valve in small steps. These can be monitored by scan tool test equipment, which plugs into the Data Link Connector (DLC).

During idle, the proper position of the IAC valve is calculated by the ECM, based on battery voltage, coolant temperature and engine RPM. If the RPM drops below specification and the throttle plates are closed, the ECM senses a near stall condition and calculates a new valve position to prevent stalling.

- Engine idle speed is a function of total air flow into the engine based on IAC valve pintle position plus throttle plates opening.

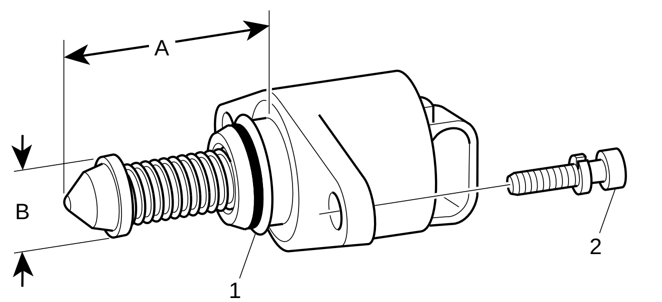


1 IDLE AIR CONTROL (IAC) VALVE
2 THROTTLE BODY ASSEMBLY
3 THROTTLE VALVE
4 IAC VALVE PINTLE
A ELECTRICAL INPUT SIGNAL
B AIR INLET

8-25-94
RS 22193

Figure 3-7 - IAC Valve Air Flow Diagram

- "Controlled" idle speed is programmed into the ECM, which determines the correct IAC valve pintle position to maintain the desired idle speed for all engine operating conditions and loads.
- The minimum air rate is set at the factory with a stop screw. This setting allows enough air flow by the throttle plates to cause the IAC valve pintle to be positioned at a calibrated number of steps (counts) from the seat, during "controlled" idle operation. This minimum air rate setting should not be altered by turning the stop screw or bending the linkage. Improper idle control will result.



1 O-RING - IAC VALVE
2 IAC VALVE ATTACHING SCREW
A DISTANCE OF PINTLE EXTENSION
B DIAMETER OF PINTLE

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RS 22181

Figure 3-8 - Flange Mounted Type IAC Valve

Diagnosis

If the Engine Cranks But Will Not Run or immediately stalls, Table A-3 of the Diagnosis section must be used to determine if the failure is in the ignition system or the fuel system.

On-Board Service

Caution:

To reduce the risk of fire and personal injury, relieve fuel system pressure before servicing fuel system components.

After relieving fuel pressure, a small amount of fuel may be released when servicing fuel lines or connections. To reduce the chance of personal injury, 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 disconnection is completed.

Fuel Control On-Board Service

The following is general information required when working on the fuel system:

- Always keep a dry chemical fire extinguisher near the work area.
- Fuel pipe fittings require new O-rings when assembling.
- Do not replace fuel pipe with fuel hose.
- Always bleed off fuel pressure before servicing any fuel system components.
- Do not do any repairs on the fuel system until you have read the instructions and checked the figures relating the repair.
- Observe all notices and cautions.

Fuel Pressure Relief Procedure

Tool Required:

J 34730-1, Fuel Pressure Gauge

Important

- Refer to manufacturer's warnings and cautions before proceeding.

1. Disconnect negative battery cable to avoid possible fuel discharge if an accidental attempt is made to start the engine.
2. Loosen fuel filler cap to relieve any tank vapor pressure.
3. Connect fuel pressure gauge J 34730-1 to fuel pressure connector assembly. Wrap a shop towel around fitting while connecting the gauge to avoid any spillage.
4. Install bleed hose into an approved container and open valve to bleed system pressure. Fuel connections are now safe for servicing.
5. Drain any fuel remaining in the gauge into an approved container.

Flame Arrestor

Remove or Disconnect

1. Flame arrestor retaining clamp.
2. Flame arrestor.

Inspect

- Flame arrestor element for dust, dirt or water. Replace if required.

Install or Connect

1. Flame arrestor to throttle body.
2. Flame arrestor retaining clamp to flame arrestor.

Throttle Body Assembly Replacement

Remove or Disconnect

1. Disconnect the negative battery cable.
2. Remove the flame arrestor clamp and flame arrestor.
3. Disconnect the electrical connectors from the IAC valve and the TP sensor.
4. Disconnect the throttle cable.
5. Remove the throttle body assembly attaching nuts.
6. Remove the throttle body assembly and gasket.
7. Discard the gasket.

Important: To o prevent damage to the throttle valve, it is essential that the unit be placed on a holding fixture before performing service.

Notice: Stuff a rag in the intake manifold opening to prevent foreign material from entering the engine.

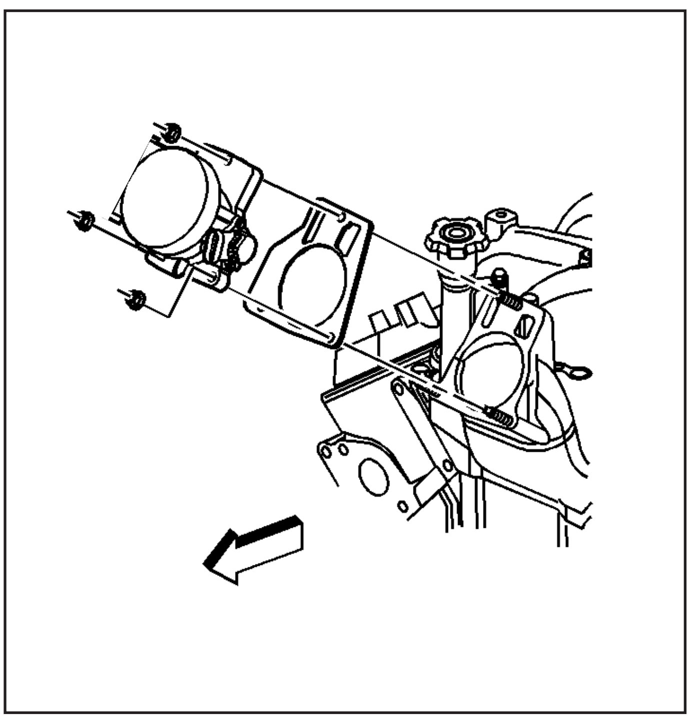
Inspect

- Manifold bore for loose parts and foreign material.
- Manifold mating surface for cleanliness or burrs that could affect gasket sealing.

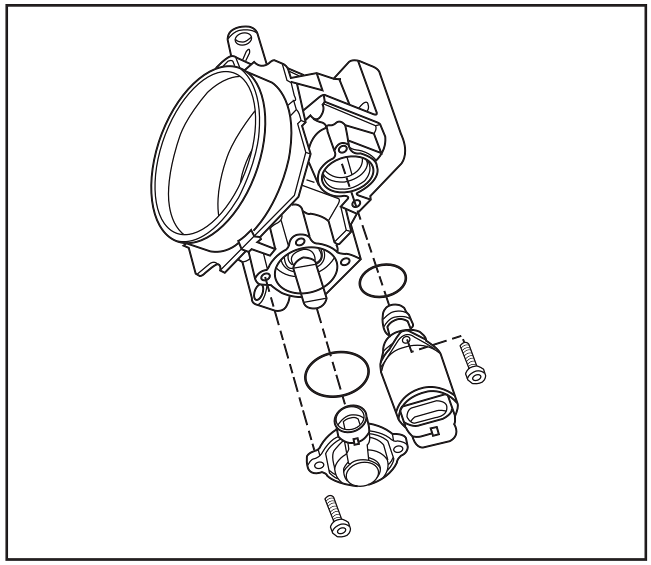
Important: Clean the throttle bore and valve deposits using carburetor cleaner and a parts cleaning brush. Do Not use a cleaner that contains methyl ethyl ketone, an extremely strong solvent, and not necessary for this type of deposit.

The throttle body metal parts may be cleaned in a cold, immersion type cleaner following the disassembly of the unit.

Notice: The TP sensor and IAC valve should not come in contact with solvent or cleaner, as they may be damaged. These components must be removed before immersion. Follow the procedures outlined in this section.



Throttle Body Removal



Throttle Body Assembly

Caution: Safety glasses must be worn when using compressed air, as flying dirt particles may cause eye injury.

- Clean all metal parts thoroughly and blow dry with compressed air. Be sure that all fuel and air passages are free of dirt and burrs.
- Inspect the mating surfaces for damage that could affect gasket sealing.
- Inspect throttle body for cracks in casting.
- The thread-locking compound supplied in the service repair kit is a small vial of thread-locking compound with directions for use. If this material is not available, use Loctite® 262 or equivalent.

Notice: When precoating the mounting bolts, do not use a higher strength locking compound than recommended. This may cause the removal of the bolts to be very difficult.

Install or Connect

1. Install a new throttle body gasket.
2. Install the throttle body assembly and the throttle body assembly attaching nuts.

   Tighten

   Tighten the throttle body assembly attaching nuts to 10 N·m (89 lb in).
3. Reconnect the throttle cable.
4. Reconnect the electrical connectors to the IAC valve and the TP sensor.
5. Install the flame arrestor and clamp. Securely tighten the clamp.
6. Reconnect the negative battery cable.

Quick Connect Fitting(s) Service

Tools Required

J 37088-A Tool Set, Fuel Line Quick-Connect Separator

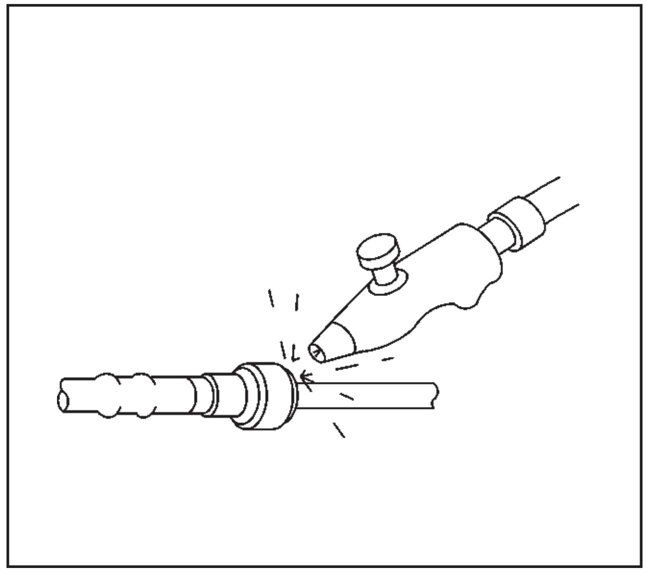
J 44581 Fuel Line Quick Connect Separator

Remove or Disconnect

1. Relieve the fuel system pressure before servicing any fuel system connection. Refer to *Fuel Pressure Relief Procedure.*
2. Remove the retainer from the quick-connect fitting.

Caution: Wear safety glasses in order to avoid eye damage.

3. Blow dirt out of the fitting using compressed air.



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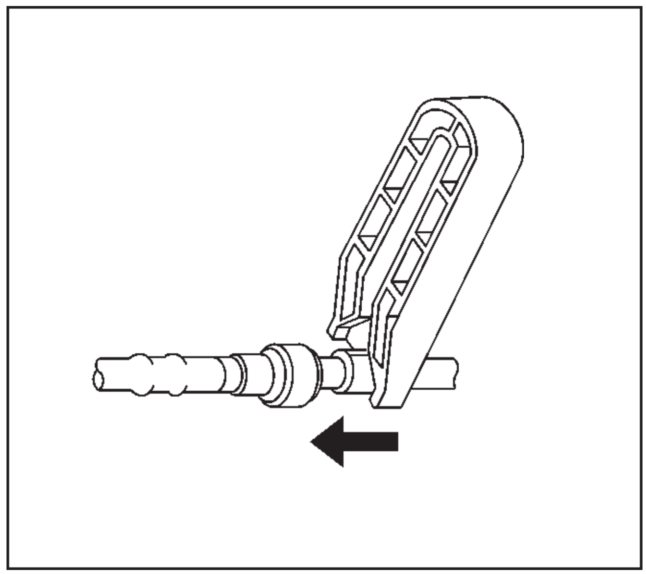
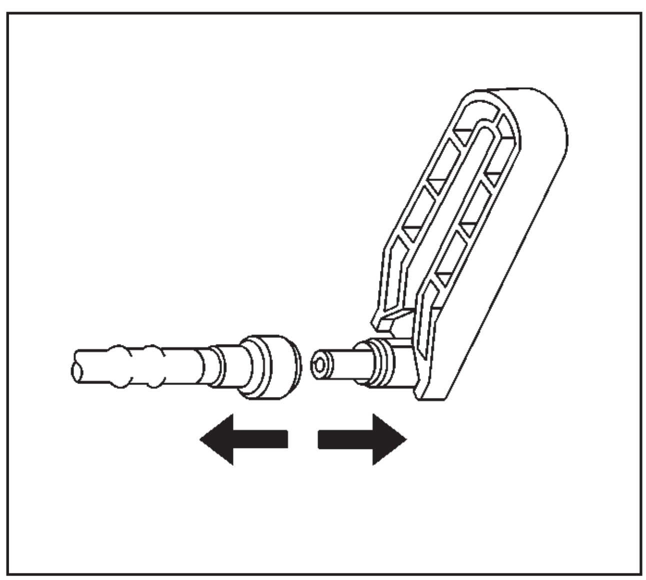
4. Choose the correct tool from the tool set for the size of the fitting. Insert the tool into the female connector, then push inward in order to release the locking tabs.



12780

5. Pull the connection apart.
6. Use a clean shop towel in order to wipe off the male pipe end.
7. Inspect both ends of the fitting for dirt and burrs. Clean or replace the components as required.



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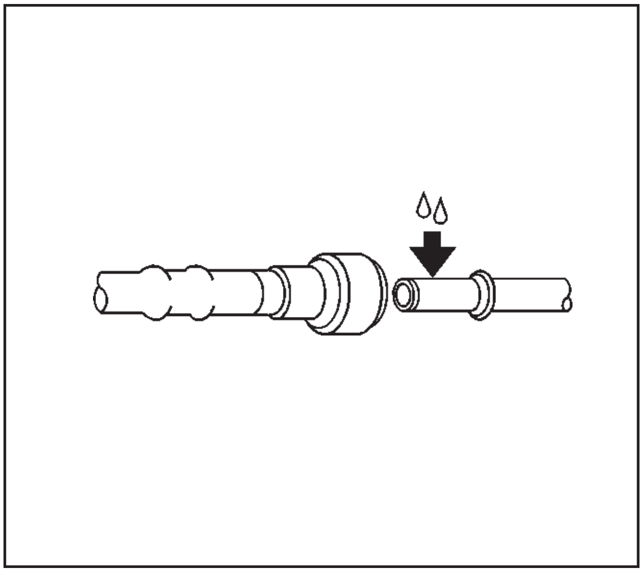
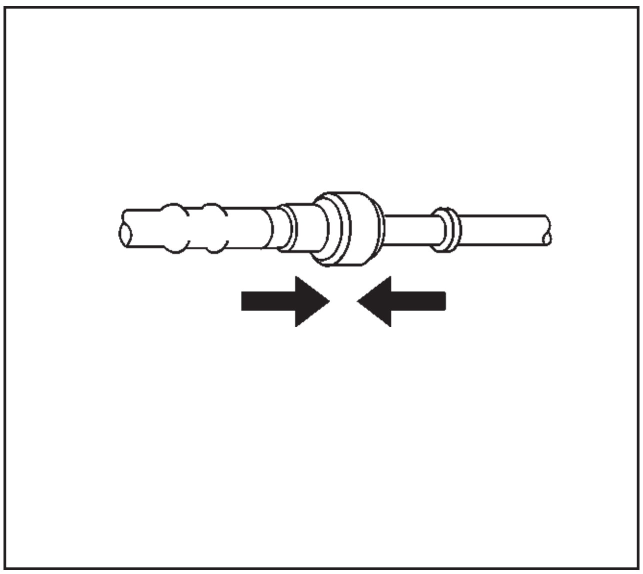


12784

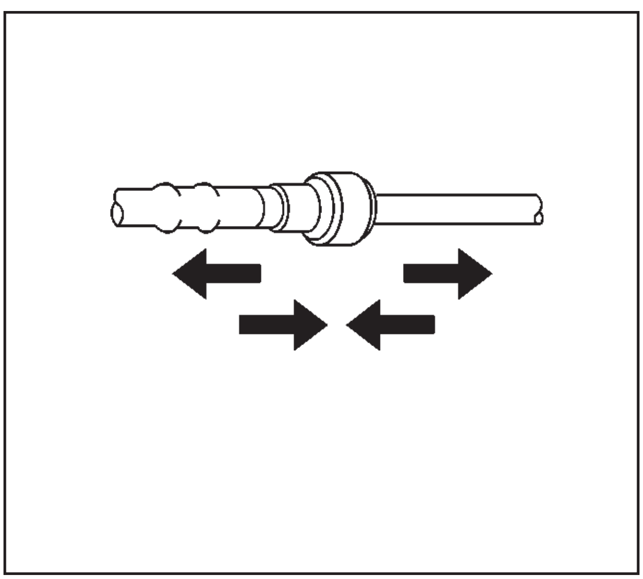
Install or Connect

1. Apply a few drops of clean engine oil to the male pipe end.



12786

2. Push both sides of the fitting together in order to snap the retaining tabs into place.



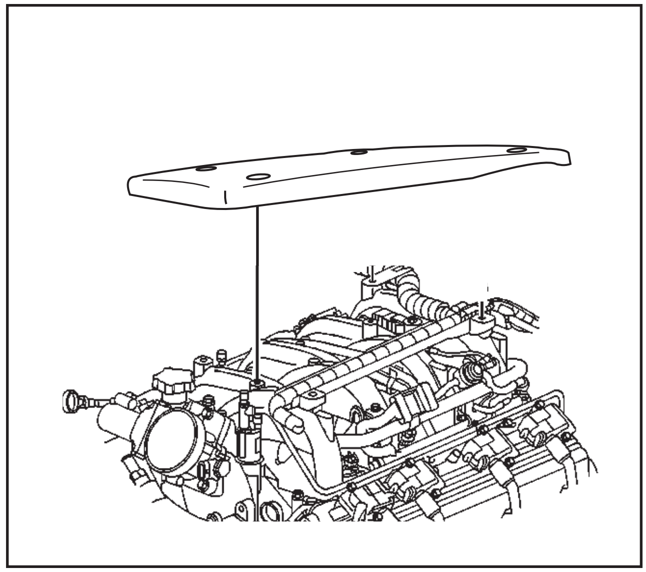
12787

3. Once installed, pull on both sides of the fitting in order to make sure the connection is secure.
4. Install the retainer to the quick-connect fitting.

Fuel Rail Assembly Replacement

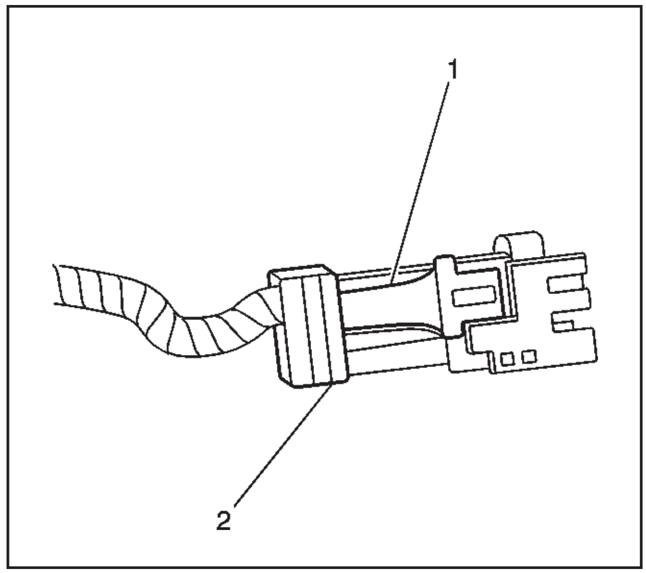
Remove or Disconnect

1. Relieve the fuel system pressure. Refer to *Fuel Pressure Relief Procedure.*
2. Before removal, clean the fuel rail assembly with a spray type engine cleaner, GM X-30A or equivalent, if necessary. Follow the package instructions. Do not soak fuel rails in liquid cleaning solvent.
3. Remove the engine cover.

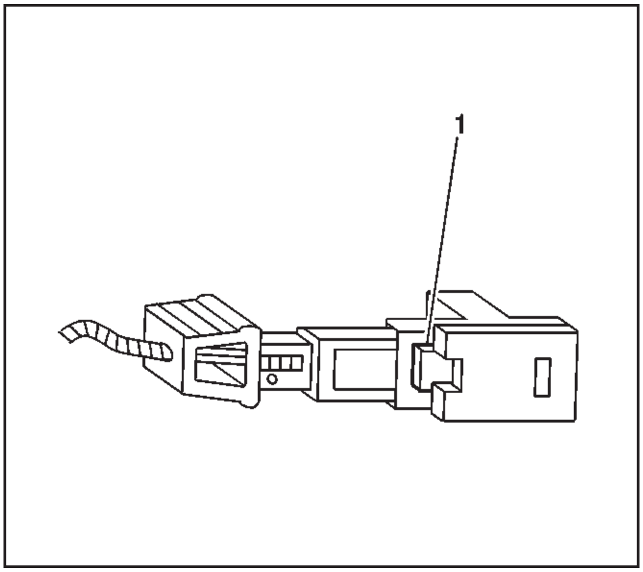


665445

4. Disconnect the TP sensor harness connector.
5. Disconnect the IAC valve harness connector.
6. Identify the connectors to their corresponding injectors to ensure correct injector firing order after reassembly.
7. Pull the top portion (2) of the injector connector up. Do not pull the top portion of the connector past the top of the white portion (1).

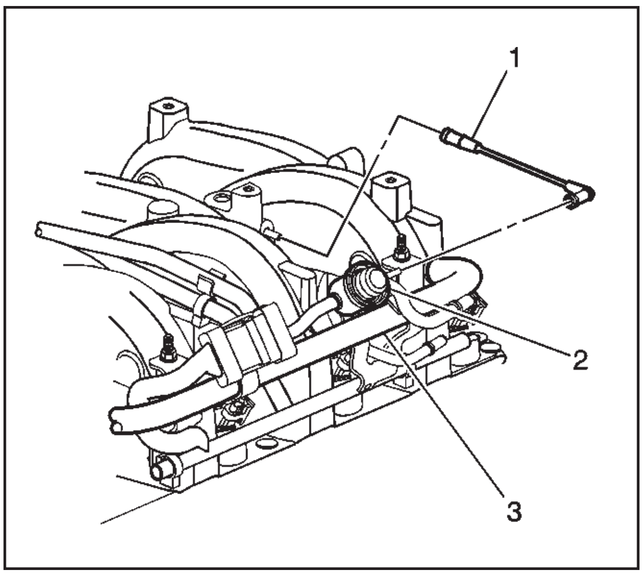


372749



372753

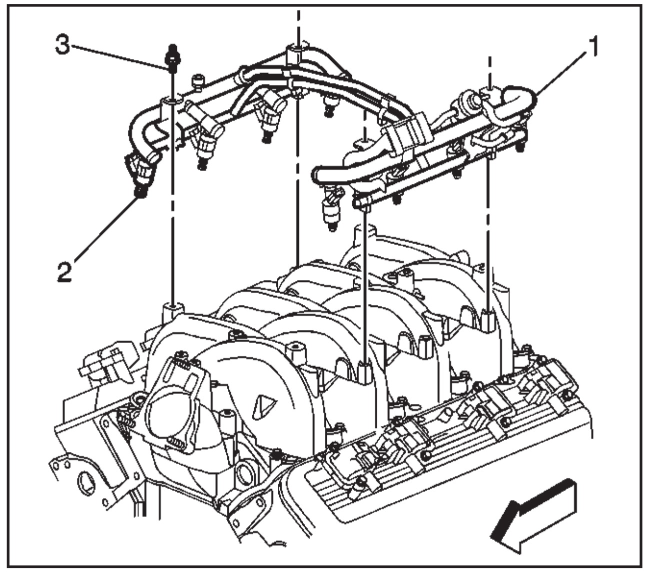
8. Push the tab (1) on the lower side of the injector connector in order to release the connector from the injector.
9. Repeat step 9 and step 10 for each injector connector.



665447

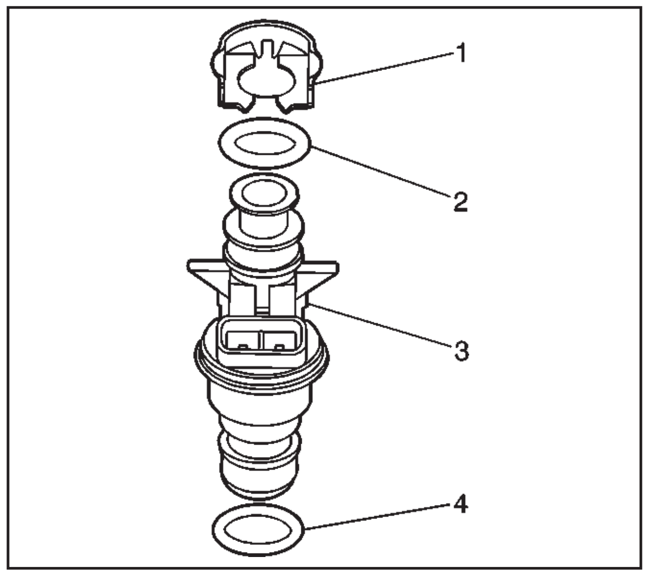
10. Disconnect the fuel feed and return from the fuel rail. Refer to Quick Connect Fitting procedure in this section.
11. Disconnect the fuel pressure regulator vacuum line.

12. Remove the fuel rail attaching bolts.
13. Remove the fuel rail assembly.



665443

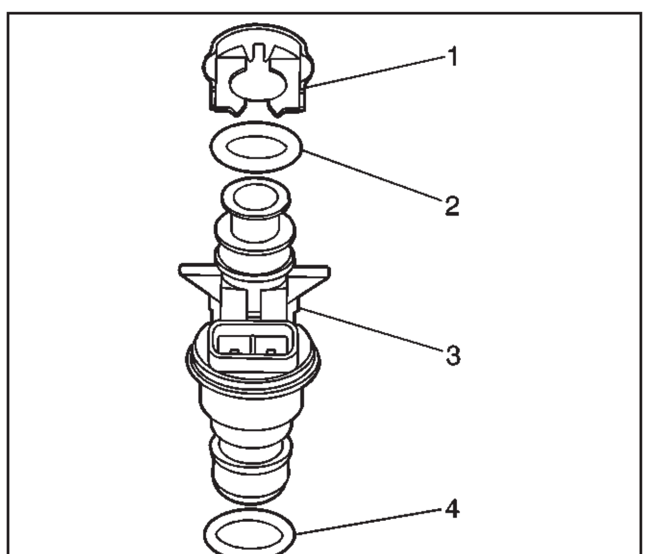
14. Remove the injector lower O-ring seal (4) from the spray tip end of each injector (3).
15. Discard the O-ring seals.



351185

Install or Connect

1. Lubricate the new lower injector O-ring seals (4) with clean engine oil.
2. Install the new O-ring seals (4) on the spray tip end of each injector (3).



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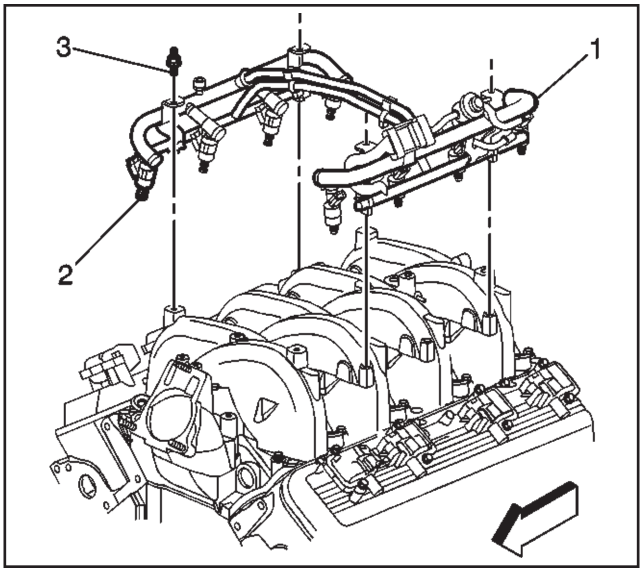
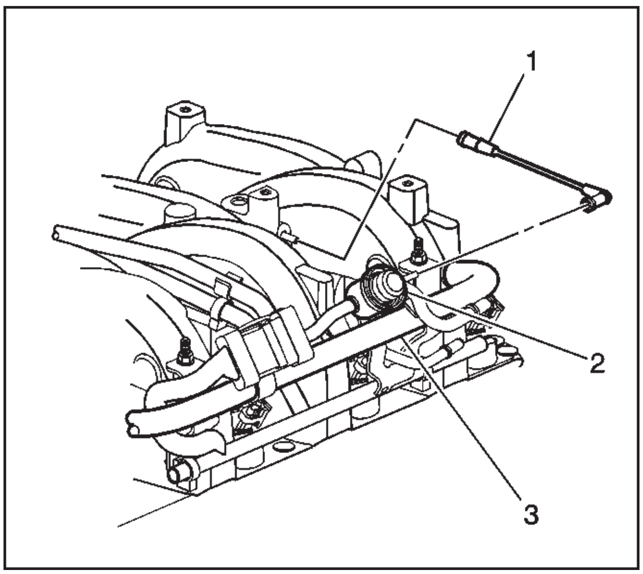


665443

3. Install the fuel rail assembly to the intake manifold.
4. Apply a 5 mm (0.020 in) band of GM P/N 12345382 threadlock or equivalent to the threads of the fuel rail attaching bolts.
5. Install the fuel rail attaching bolts.

   Tighten

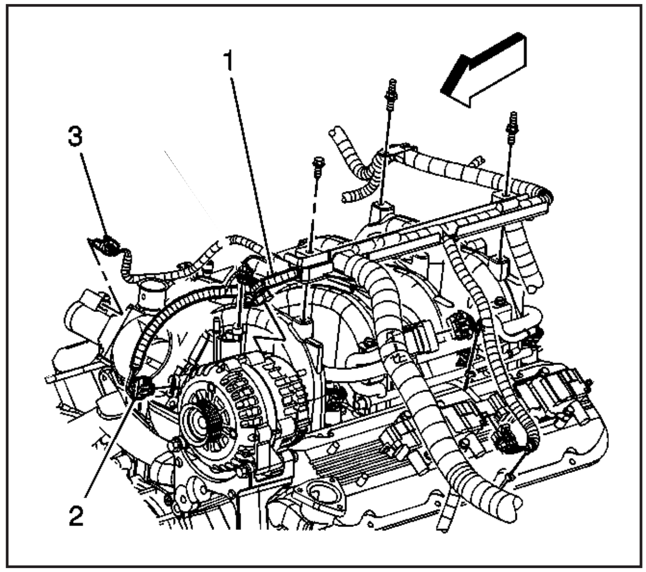
   Tighten the fuel rail attaching bolts to 12 N·m (106 lb in).



665447

6. Connect the fuel pressure regulator vacuum line.
7. Connect the fuel feed and return lines to the fuel rail. Refer to Quick Connect Fitting procedure in this section.

8. Connect the injector electrical connectors
   - Install each connector on the proper injector in order to ensure correct injector firing order.
   - Rotate the injectors as required in order to avoid stretching the wire harness.



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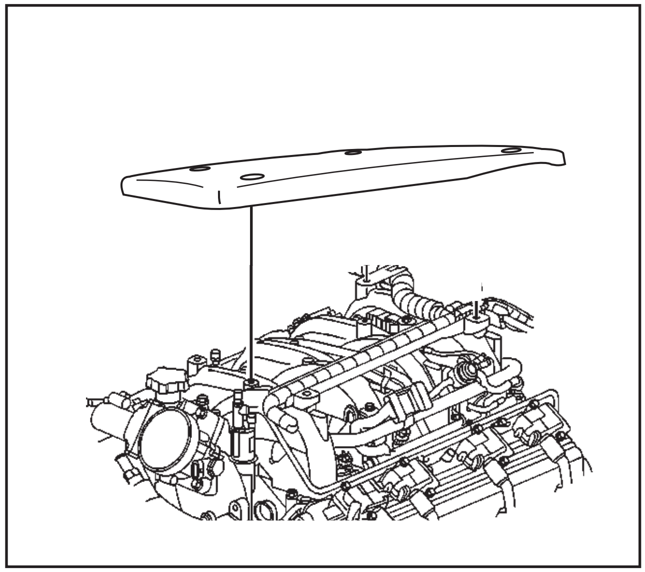
9. Reconnect the TP sensor harness connector.
10. Reconnect the IAC valve harness connector.
11. Install the engine cover.
12. Connect the negative battery cable.
13. Inspect for leaks.
    13.1. Turn the ignition ON for 2 seconds.
    13.2. Turn the ignition OFF for 10 seconds.
    13.3. Turn the ignition ON.
    13.4. Inspect for fuel leaks.



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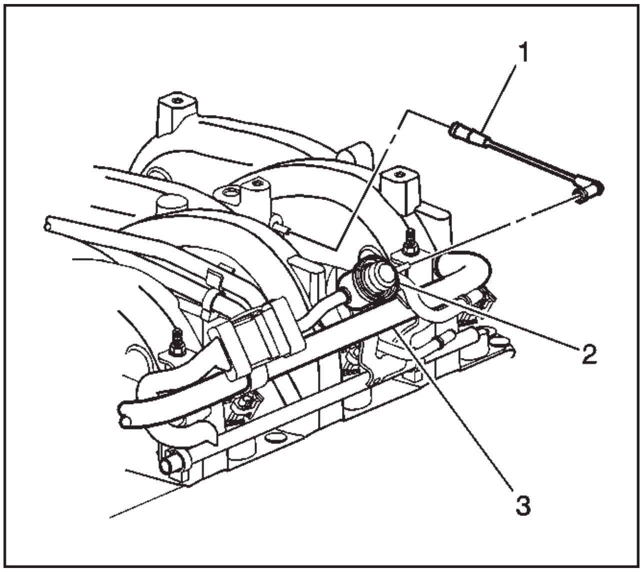
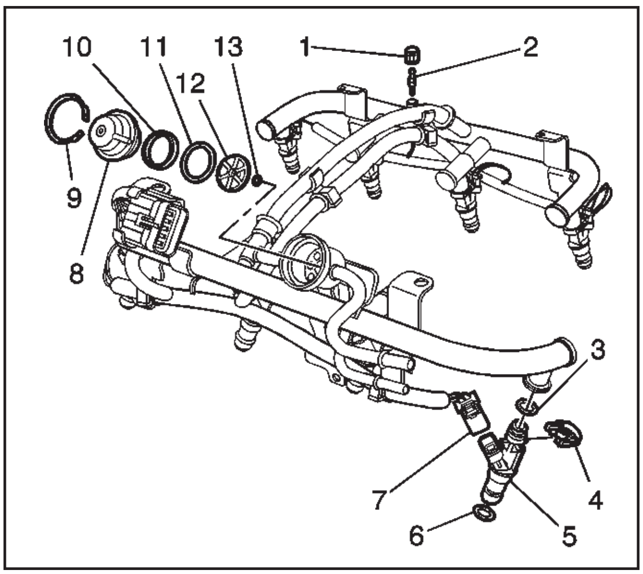
Fuel Pressure Regulator Replacement



665447

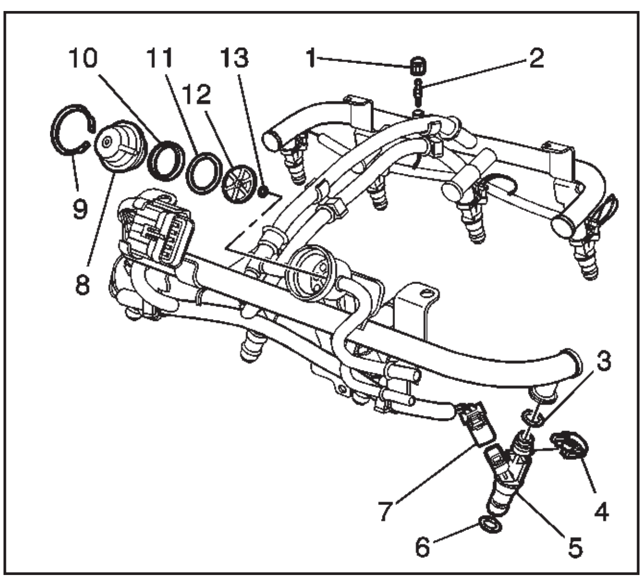
Remove or Disconnect

1. Relieve the fuel system pressure. Refer to *Fuel Pressure Relief Procedure.*
2. Disconnect the fuel pressure regulator vacuum line (1).



705539

3. Clean any dirt from the fuel pressure regulator retainer and the surrounding area.
4. Remove the fuel pressure regulator retainer (9).
5. Remove the fuel pressure regulator (8) from the fuel pressure regulator housing.

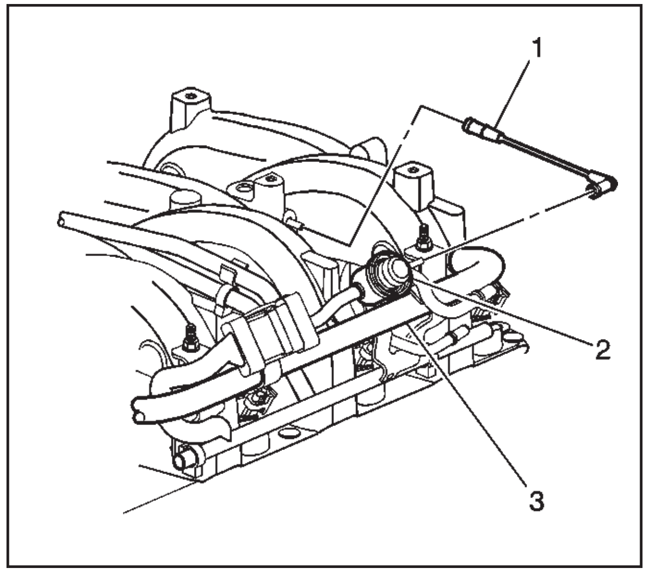


705539

Install or Connect

1. Install the backup ring (10) on the fuel pressure regulator (8).
2. Install the new large O-ring (11) on the fuel pressure regulator.
3. Install the regulator filter (12) on the fuel pressure regulator.
4. Install the new small O-ring (13) on the fuel pressure regulator.
5. Lubricate the fuel pressure regulator large O-ring and the small O-ring with clean engine oil.
6. Push the fuel pressure regulator into the regulator housing on the fuel rail.
7. Install a new fuel pressure regulator retainer (9).

8. Connect the fuel pressure regulator vacuum line.
9. Connect the negative battery cable.
10. Inspect for leaks.
    10.1. Turn the ignition ON for 2 seconds.
    10.2. Turn the ignition OFF for 10 seconds.
    10.3. Turn the ignition ON.
    10.4. Inspect for fuel leaks.



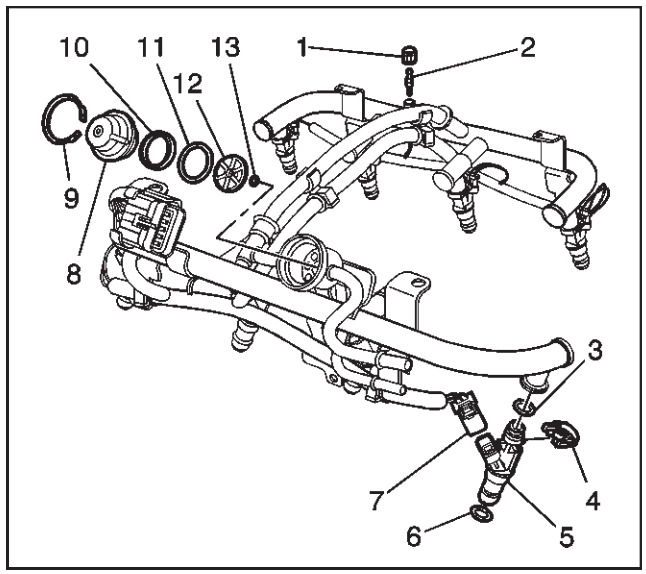
665447

Fuel Injector Replacement

Remove or Disconnect

Important: The engine oil may be contaminated with fuel if the fuel injectors are leaking.

1. Remove the fuel rail assembly. Refer to *Fuel Rail Assembly Replacement.*
2. Remove the injector retainer clip (4).
3. Insert the fork of J 43013, the fuel injector assembly removal tool, between the fuel rail pod and the 3 protruding retaining clip ledges. Use a prying motion while inserting the tool in order to force the injector out of the fuel rail pod.



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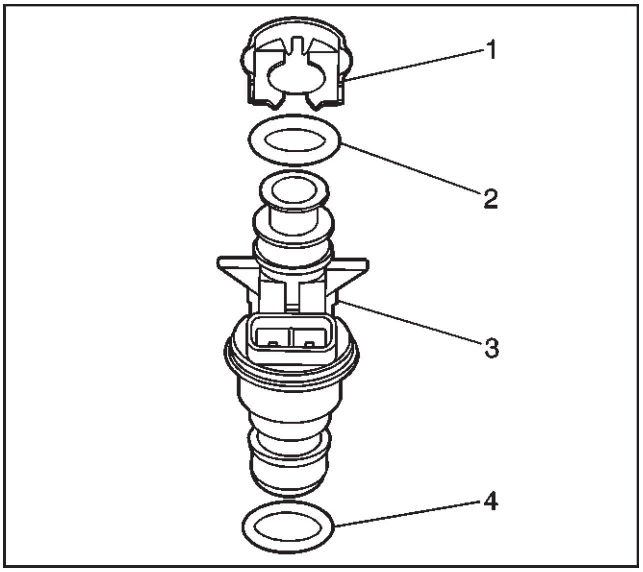
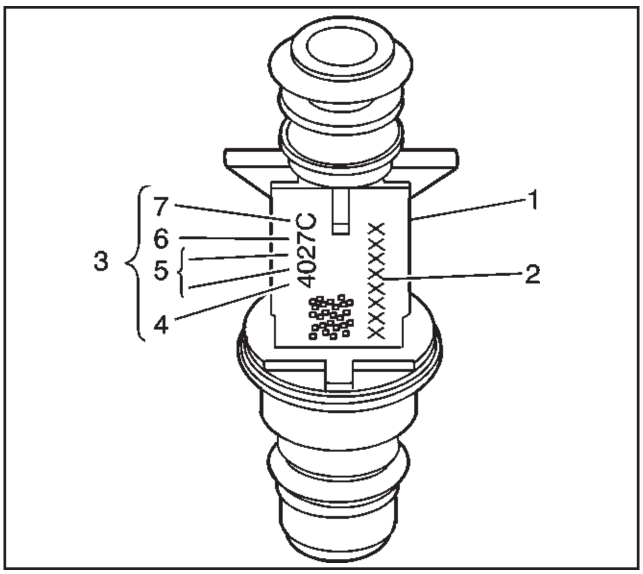


351185

4. Discard the injector retainer clip (1).
5. Remove the injector O-ring seals (2), (4) from both ends of the injector. Discard the O-ring seals.

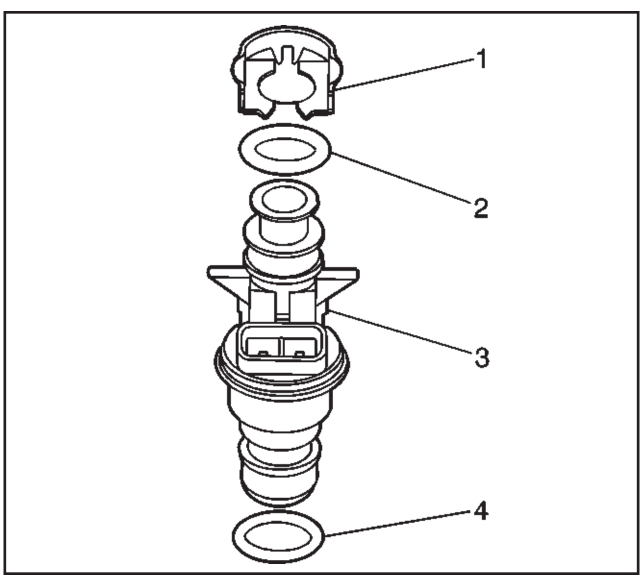


351196

Install or Connect

Important: When ordering new fuel injectors, be sure to order the correct injector for the application being serviced.

The fuel injector assembly (1) is stamped with a part number identification (2). A four digit build date code (3) indicates the month (4), day (5), year (6) and the shift (7) that built the injector.



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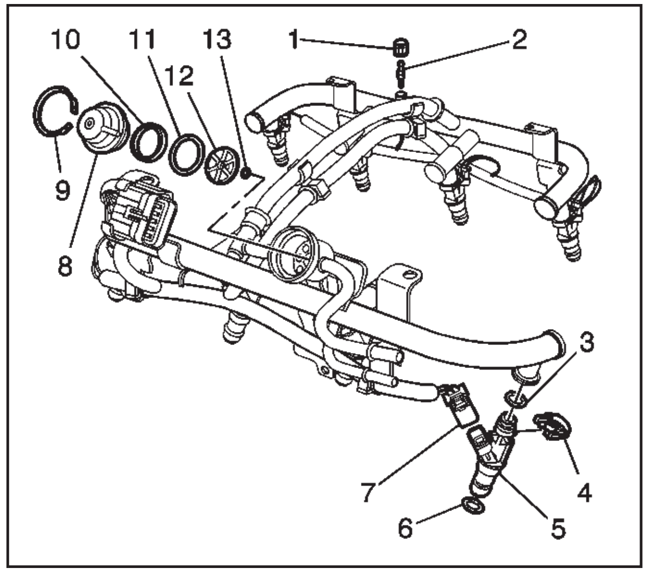
1. Lubricate the new O-ring seals (2), (4) with clean engine oil.
2. Install the new injector O-ring seals on the injector.
3. Install a new retainer clip (1) on the injector.

4. Push the fuel injector (5) into the fuel rail injector socket with the electrical connector facing outwards. The retainer clip (4) locks on to a flange on the fuel rail injector socket.
5. Install the fuel rail assembly. Refer to Fuel Rail Assembly Replacement procedure in this section.



705539

Fuel Control Cell (FCC) Replacement - Screw On Bowl and Clamp On Bowl

Important

- Fuel pressure must be relieved before servicing the fuel pump.
- Refer to “Fuel Pressure Relief Procedure.”

Remove or Disconnect

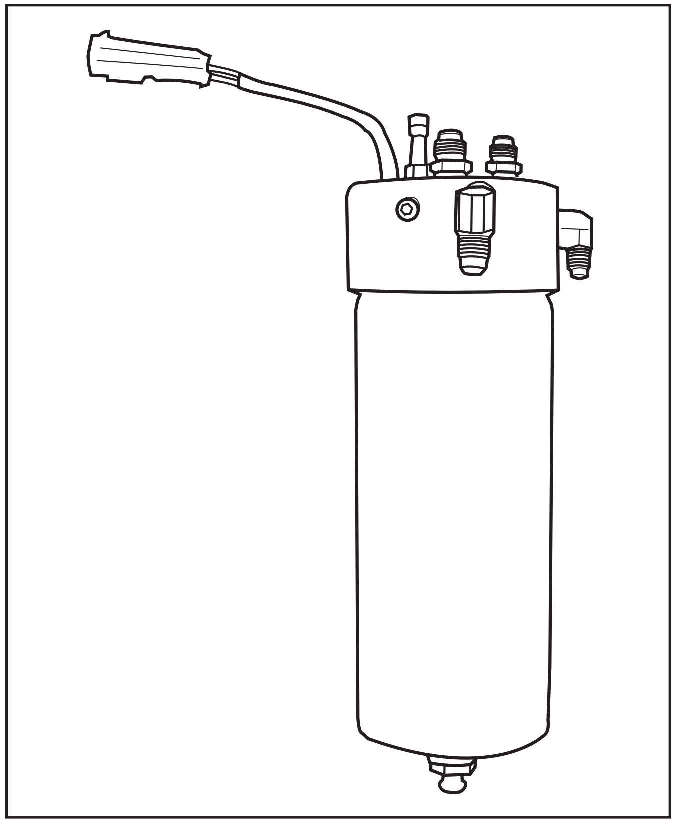
1. Negative battery cable.
2. Fuel pump electrical connector.
3. Inlet and outlet fuel line fittings.
4. Fuel Control Cell (FCC) attaching bolts.
5. Fuel Control Cell (FCC).

Install or Connect

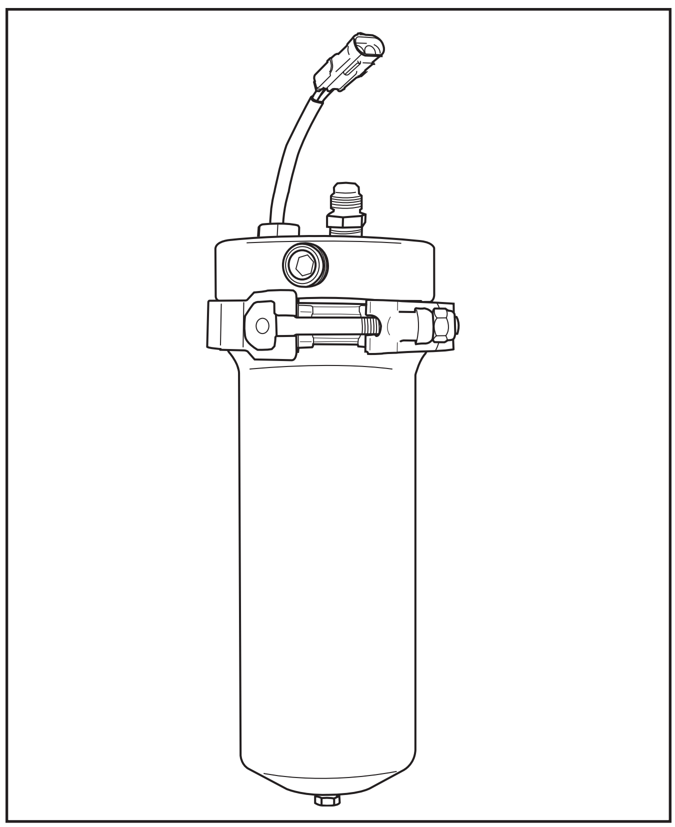
1. Fuel Control Cell (FCC).
2. Fuel Control Cell (FCC) attaching bolts.
3. Inlet and outlet fuel line fittings.
4. Fuel pump electrical connector.
5. Negative battery cable.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Turn the ignition switch back to the “ON” position and check for fuel leaks.



Fuel Control Cell (FCC) - Screw On Bowl



Fuel Control Cell (FCC) - Clamp On Bowl

Fuel Control Cell (FCC) - Screw On Bowl - Drain Water (With Engine OFF)

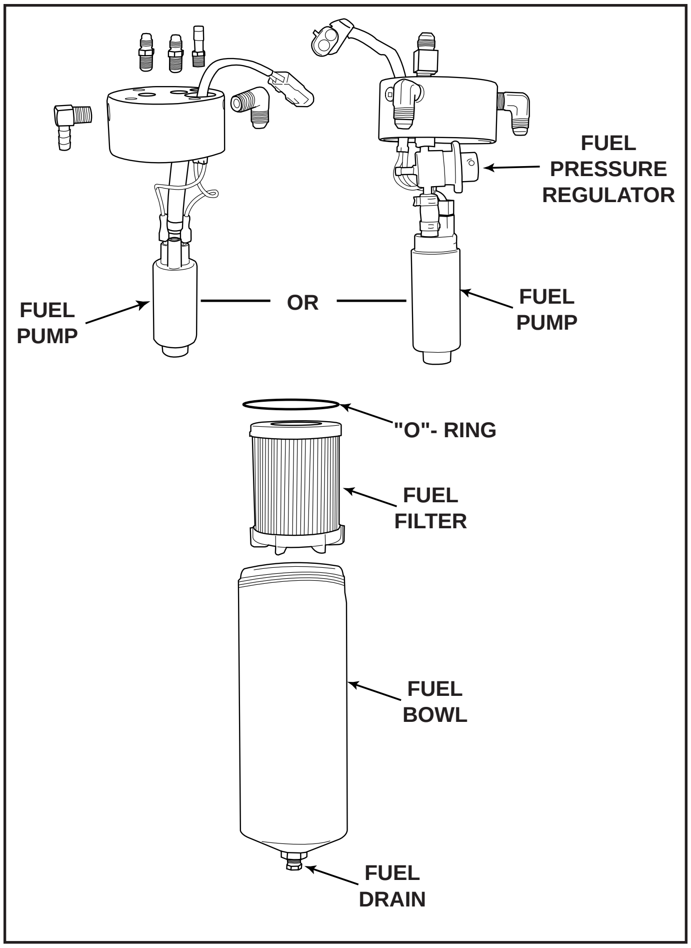
1. Disconnect the two-wire electrical harness.
2. Hold the 3/4” jam nut located at the bottom of the FCC bowl with a wrench, remove the 3/16” allen plug and drain bowl contents into a suitable container.

Caution: Both fuel, which is explosive, and water will drain from the FCC bowl.

3. Apply pipe sealant suitable for use with gasoline to the threads fo the 3/16” allen plug.
4. Tighten the 3/16” allen plug while holding the 3/4” jam nut with a wrench.
5. Re-connect the two-wire electrical harness.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Cycle the ignition several times to fill the FCC bowl. Turn the ignition switch back to the “ON” position and check for fuel leaks.



Fuel Control Cell (FCC) - Screw On Bowl - Element Replacement (With Engine OFF)

1. Disconnect the two-wire electrical harness.
2. Hold the 3/4” jam nut located at the bottom of the FCC bowl with a wrench, remove the 3/16” allen plug and drain bowl contents into a suitable container.

Caution: Both fuel, which is explosive, and water will drain from the FCC bowl.

3. Using a strap type oil filter wrench, remove the bowl by turning it counterclockwise as viewed from the bottom.
4. Slide bowl downward over the suspended filter element. It may be necessary to pull the unit to one side or remove the fuel line from the feed pump to remove the bowl.
5. Remove the fuel filter element from the suspended pump by gripping the fuel pump with one hand and pulling the filter downward with the other hand.
6. Push on new filter element over the electric pump.
7. Using a pick made of soft material, such as a toothpick, remove the old “O”-ring from inside the FCC bowl mounting head.

Caution: The mounting head “O”-ring groove may be damaged by using a sharp tool to remove this “O”-ring.

8. Lubricate the new “O”-ring with a light grease and install the new “O”-ring in the FCC head.
9. Grease taper and threads on the bowl and, by hand, thread the bowl into the FCC mounting head. Tighten the bowl firmly back into the head with an oil filter wrench.
10. Apply pipe sealant suitable with gasoline to the 3/16” allen plug.
11. Install and tighten the 3/16” allen plug while holding the 3/4” jam nut with a wrench.
12. Re-connect the two-wire electrical harness.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Cycle the ignition several times to fill the FCC bowl. Turn the ignition switch back to the “ON” position and check for fuel leaks.

Fuel Control Cell (FCC) - Clamp On Bowl - Drain Water (With Engine OFF)

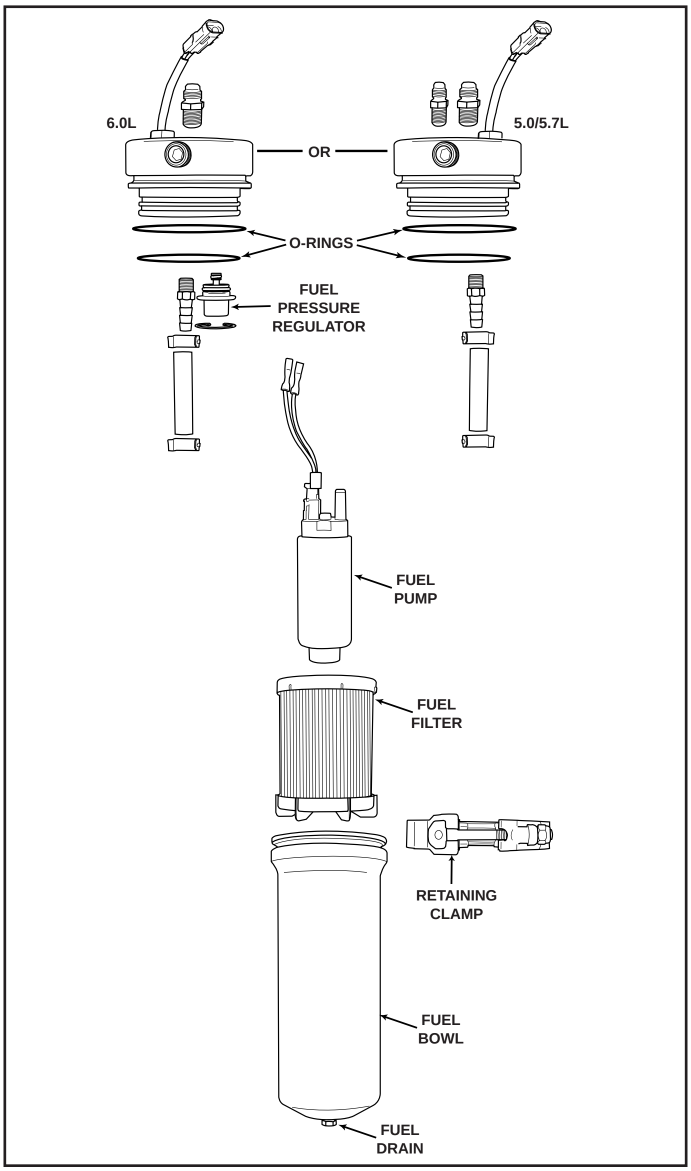
1. Disconnect the two-wire electrical harness.
2. Remove the 7/16” plug and drain the bowl contents into a suitable container.

Caution: Both fuel, which is explosive, and water will drain from the FCC bowl.

3. Apply pipe sealant, suitable for use with gasoline, to the threads fo the 7/16” plug.
4. Install and tighten the 7/16” plug securely.
5. Reconnect the two-wire electrical harness.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Cycle the ignition several times to fill the FCC bowl. Turn the ignition switch back to the “ON” position and check for fuel leaks.



Fuel Control Cell (FCC) - Clamp On Bowl - Element Replacement (With Engine OFF)

1. Disconnect the two-wire electrical harness.
2. Remove the 7/16” plug and drain the bowl contents into a suitable container.

Caution: Both fuel, which is explosive, and water will drain from the FCC bowl.

3. Remove the canister retaining clamp.
4. Slide bowl downward over the suspended filter element. It may be necessary to pull the unit to one side to remove the bowl.
5. Remove the fuel filter element from the suspended pump by gripping the fuel pump with one hand and pulling the filter downward with the other hand.
6. Push on new filter element over the electric pump.
7. Using a pick made of soft material, such as a toothpick, remove the old “O”-rings from the FCC bowl mounting head.

Caution: The mounting head “O”-ring grooves may be damaged by using a sharp tool to remove these “O”-rings.

8. Lubricate the new “O”-rings with fuel resistant “O”-ring lubricant, and install the new “O”-rings on the FCC head.
9. Apply pipe sealant, suitable for use with gasoline, to the threads fo the 7/16” plug.
10. Install and tighten the 7/16” plug securely.
11. Install the bowl firmly back onto the FCC head.
12. Install the canister retaining clamp and tighten securely.
13. Reconnect the two-wire electrical harness.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Cycle the ignition several times to fill the FCC bowl. Turn the ignition switch back to the “ON” position and check for fuel leaks.

Low-Pressure Fuel Pump Replacement

Important

- Fuel pressure must be relieved before servicing the fuel pump.
- Refer to “Fuel Pressure Relief Procedure.”

Remove or Disconnect

1. Negative battery cable.
2. Fuel pump electrical connector.
3. Inlet and outlet fuel line fittings.
4. Fuel pump attaching bolts.
5. Fuel pump.

Install or Connect

1. Fuel pump.
2. Fuel pump attaching bolts.
3. Inlet and outlet fuel line fittings.
4. Fuel pump electrical connector.
5. Negative battery cable.

Inspect

- Turn ignition switch to the “ON” position for 2 seconds, then turn to the “OFF” position for 10 seconds. Turn the ignition switch back to the “ON” position and check for fuel leaks.

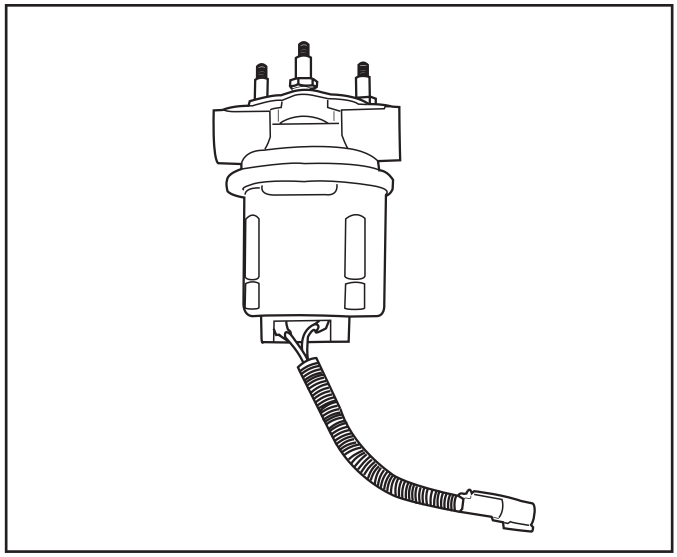


Figure 3-3 - Low Pressure Fuel Pump

Fuel Pump Relay

Remove or Disconnect

1. Retainer, if installed.
2. Fuel pump relay electrical connector.
3. Fuel pump relay.

Important

- The fuel pump relay is a electrical component. Do Not soak in any liquid cleaner or solvent as damage may result.

Install or Connect

1. Fuel pump relay.
2. Fuel pump relay electrical connector.
3. Retainer clip.

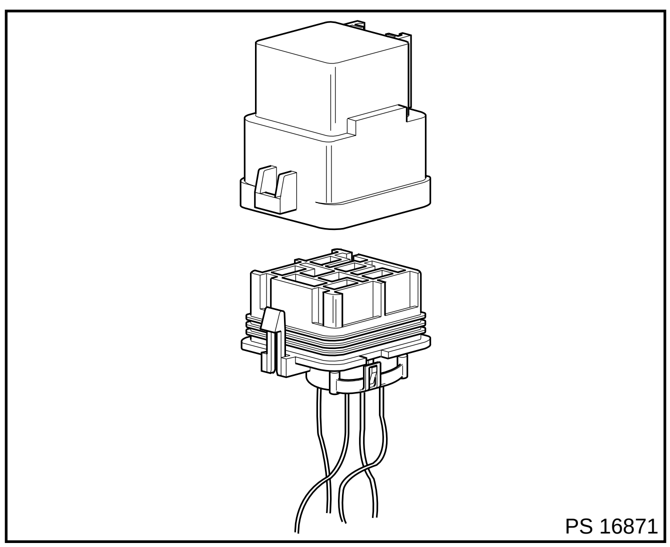


Figure 3-18- Fuel Pump Relay

Torque Specifications

Fastener Tightening Specifications

Application	N•m	Lb Ft	Lb In
Throttle Body Attaching Screws	15	11	
IAC Valve Attaching Screws	3.2		28
Fuel Pressure Connector	13		115
Fuel Pressure Regulator Attaching Screw	9.5		84
Fuel Pressure Regulator Outlet Line Nut	17.5	13	
Fuel Rail Jumper Line Attaching Screws	7		62
Fuel Rail Attaching Screws	10		88

Marine Electronic Fuel Injection (MEFI 4)

Section 4A

Distributor Ignition (DI)

This section will describe the Distributor Ignition (DI) System used on the 5.0L and the 5.7L engines. The DI system uses a single ignition coil and a mechanical distributor. The section explains the individual components of the Distributor Ignition System. Electronic Ignition System is explained in Section 4B.

Contents

Ignition System Specifications

Application	Specifications	
	Metric	English
Firing Order	1-8-4-3-6-5-7-2	
Spark Plug Wire Resistance	10,000 ohms per foot	
Spark Plug Torque	15 N·m	11 lb ft
Spark Plug Gap	1.52 mm	.060 in
Spark Plug Type	R030010	

Fastener Tightening Specifications

Application	Specifications	
	Metric	English
Camshaft Position (CMP) Sensor Bolt	9 N·m	72 lb in
Crankshaft Position (CKP) Sensor Bolt	9 N·m	72 lb in
Distributor Hold Down Bolt	25 N·m	18 lb ft
Distributor Cap Bolts	2.4 N·m	21 lb in
Engine Control Module (ECM) Mounting Screws	10-14 N·m	88-124 lb in
Ignition Coil Attaching Bolts	12 N·m	106 lb in
Knock Sensor (KS)	20 N·m	15 lb ft

Distributor Ignition (DI) System Description

Ignition System Overview

The ignition system consists of the following components or circuits:

- The 8 ignition secondary wires
- The ignition coil
- The ignition control (IC) circuit
- The camshaft position (CMP) sensor
- The camshaft reluctor wheel
- The crankshaft position (CKP) sensor
- The crankshaft reluctor wheel
- The related connecting wires
- The engine control module (ECM)

To properly control ignition timing, the ECM relies on the following information:

- Engine load, manifold pressure or vacuum
- Atmospheric, barometric, pressure
- Engine temperature
- Intake air temperature, if applicable
- Engine speed (RPM)

The ignition control utilizes the following to control spark timing functions:

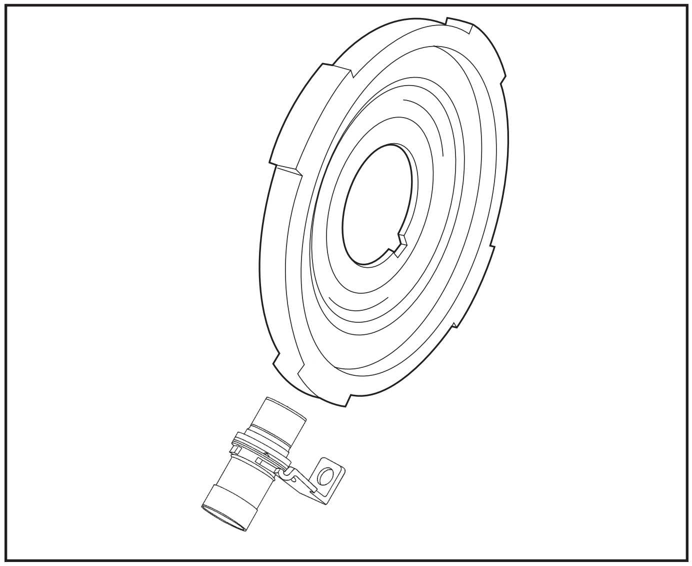
- The 4X signal - The 4X crankshaft position sensor sends a signal to the ECM. The ECM uses this signal to determine crankshaft position, or engine speed.
- The 1X signal - The 1X camshaft position sensor sends a signal to the ECM. The ECM uses this signal to quickly determine what cylinder to fire the ignition coil on.
- The ignition control (IC) circuit - The ECM uses this circuit to trigger the ignition coil.

The distributor used on the MEFI equipped engines is designed for the marine/industrial environment. The base plate of the distributor is equipped with two special vents to prevent any fuel vapors from igniting. With the high voltage produced by the distributor, a special material is used for the distributor cap and rotor. It is a thermoplastic, injection-molded, glass-reinforced polyester. This material provides the dielectric and insulation property needed, and also prevents carbon tracking.

Distributors with separate coils are used on the MEFI engines. The ignition coil connects to the distributor cap through a high tension wire.

There is no scheduled maintenance or periodic lubrication required. Engine oil lubricates the lower bushing and the upper bushing is pre-lubricated and sealed.

Crankshaft Position (CKP) Sensor and Reluctor Wheel



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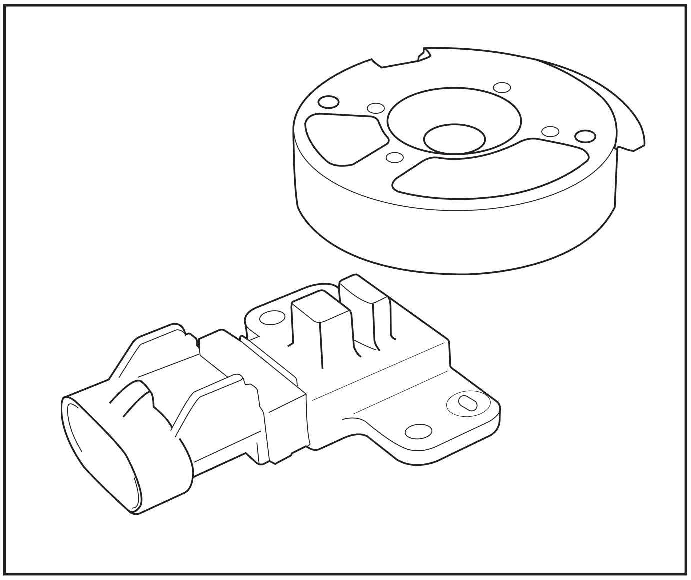
The crankshaft position (CKP) sensor is a magneto resistive type sensor. The CKP sensor works in conjunction with a 4X reluctor wheel. The reluctor wheel is mounted on the front of the crankshaft. The CKP sensor outputs a 4X signal for spark control, tachometer output and fuel control. All CKP signals are output as a digital waveform.

The 5.7L, right-hand rotation, uses a different crankshaft reluctor wheel than a normal, left-hand rotation engine.

Camshaft Position (CMP) Sensor and Reluctor Wheel

The camshaft position (CMP) sensor works in conjunction with a 1X reluctor wheel mounted inside the distributor housing. The CMP is used to determine the top dead center position of cylinder #1, and will synchronize with the 4X CKP sensor signal for quicker starting. The CMP signals are output as a digital waveform.



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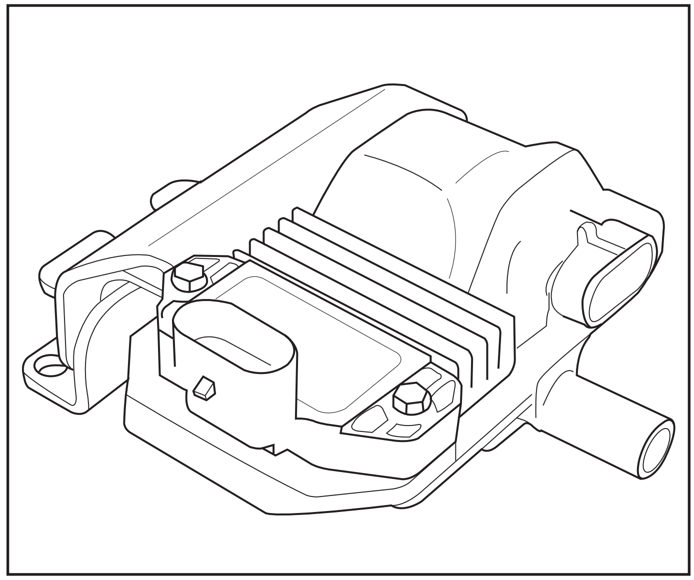
The DI ignition system may require the distributor to be readjusted if it is moved for any reason. In the past, the distributor would be rotated to adjust ignition timing. The ignition timing on this engine is not adjustable. Moving the distributor will NOT change ignition timing at all. The ignition timing is determined and controlled by the ECM. However, if the distributor is not positioned properly, driveability problems will exist.

In order to properly set the distributor position, a scan tool MUST be used. There is a parameter on the data stream called ìCam Retard.î Cam retard must be set to 43-47 degrees, or driveability problems will exist.

Ignition Coil



M4093

The design construction of the ignition coil affects its output. The DI system ignition coil was designed to produce greater spark voltage, longer spark and operate at higher RPM. The DI system coil has the secondary winding wrapped around the primary winding, and the primary winding is wrapped around the iron core. The coil is not oil filled, the windings are covered in an epoxy compound for protection against moisture and arc over.

There is an iron laminated square frame around the coil windings. This is to increase magnetic flux path and store energy to produce higher secondary spark voltage. The coilís mounting bracket is attached to ground.

The coil generates a high secondary voltage (up to 35,000 volts) when the primary circuit is broken. A secondary high tension wire connects from the top post of the coil to the center post of the distributor cap. There is one 2-wire connector on the coil that is used for battery voltage input and the trigger signal from the IC module.

Noteworthy Ignition Information

There are important considerations to point out when servicing the ignition system. The following noteworthy information will list some of these to help the technician in servicing the ignition system.

- The ignition coils secondary voltage output capabilities are very high - more than 40,000 volts. Avoid body contact with ignition high voltage secondary components when the engine is running or personal injury may result.
- The 4X crankshaft position (CKP) sensor is the most critical part of the ignition system. If the sensor is damaged so that the pulses are not generated, the engine does not start.
- The CKP sensor clearance is very important. If the interrupter ring is bent or damaged in any way, the CKP sensor may be destroyed. Extreme care must be exercised during removal and installation procedures.
- The ignition timing is not adjustable. Moving the distributor changes the "Cam Retard." Cam Retard MUST be set at 43-47 degrees, or a driveability problem will exist.
- Be careful not to damage the secondary ignition wires or boots when servicing the ignition system. Rotate each boot in order to dislodge the boot from the plug or coil/cap tower before pulling the boot from the spark plug or the coil/cap tower.

Engine Control Module (ECM)

The ECM is responsible for maintaining proper spark and fuel injection timing for all driving conditions. To provide optimum driveability and emissions, the ECM monitors input signals from the additional following components in calculating ignition control (IC) spark timing:

- The engine coolant temperature (ECT) sensor
- The intake air temperature (IAT) sensor
- The throttle position (TP) sensor
- The manifold absolute pressure (MAP) sensor

Knock Sensor (KS) System Description

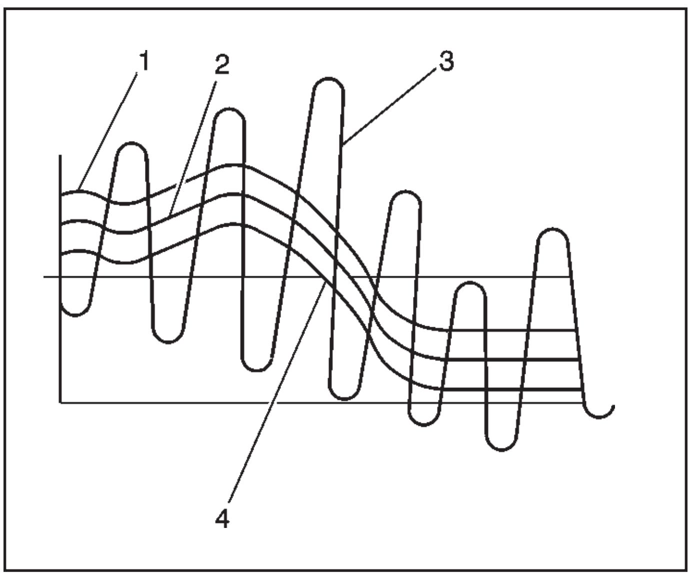
Purpose

To control spark knock (detonation), a knock sensor (KS) system is used. This system is designed to retard spark timing when excessive spark knock is detected in the engine. The KS system allows the engine to use maximum spark advance for optimal driveability and fuel economy under all operating conditions.

Operation

The ECM uses a knock sensor to detect abnormal vibration in the engine (detonation/spark knock). Mounted on the engine block, the knock sensor produces an AC voltage signal at all engine speeds and loads. The ECM then adjusts the spark timing based on the amplitude and frequency of the KS signal. The ECM uses the KS signal to calculate an average voltage. Then, the ECM assigns a voltage range above and below the average voltage value. The ECM checks the KS and related wiring by comparing the actual knock signal to the assigned voltage range. A normal KS signal should vary outside the assigned voltage range as shown in the NORMAL KS figure. If the ECM detects a KS signal within the assigned voltage range as shown in the ABNORMAL KS figure, the applicable DTC will set.

Normal Knock Sensor Signal



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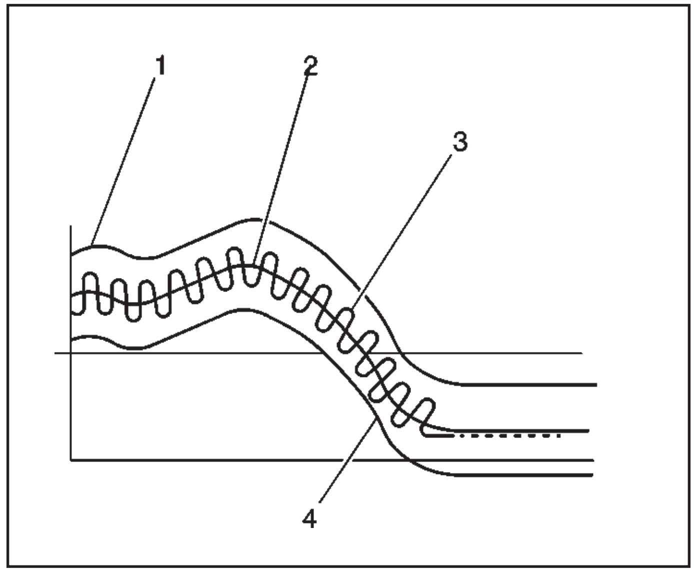
Abnormal Knock Sensor Signal



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Legend

1. Upper fail region
2. Knock sensor calculated average
3. Knock sensor signal
4. Lower fail region

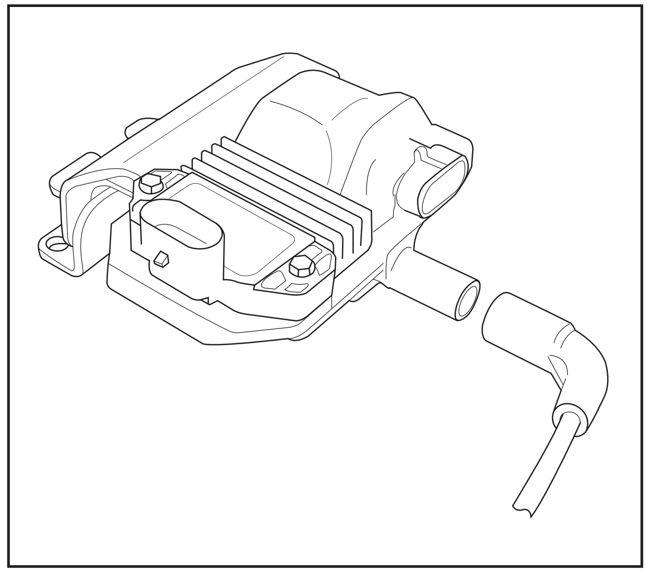
A diagnostic trouble code (DTC) may set for the following conditions or faults:

- ï The ECM malfunctions in a manner which will not allow the ECM to run a diagnostic of the KS circuit.
- The KS signal is within the assigned voltage range.
- The KS signal is not present.
- The Knock Sensor is improperly torqued.

Ignition Coil Replacement

Removal Procedure

1. Disconnect the secondary coil wire at the ignition coil. Refer to Spark Plug Wire Replacement.
2. Disconnect the ignition coil harness connector.
3. Remove the ignition coil mounting bolts.
4. Remove the ignition coil.



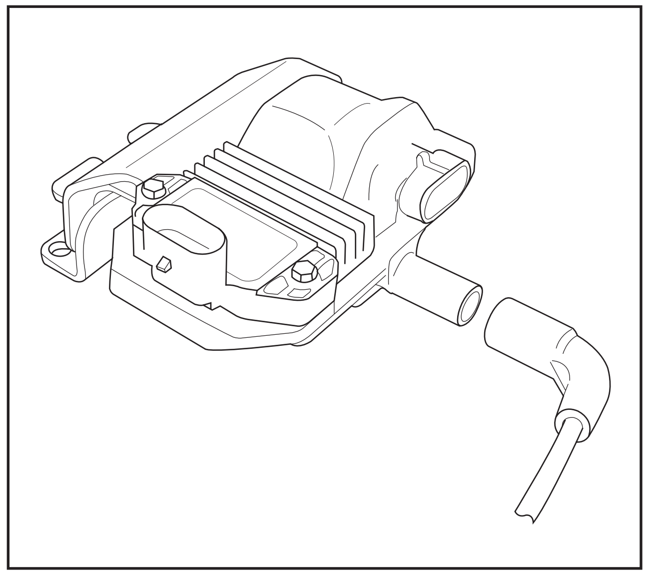
M4093

Installation Procedure

1. Install the ignition coil.
2. Install the ignition coil mounting bolts.

   Tighten

   Tighten the ignition coil mounting bolts to 12 N·m (106 lb in).
3. Connect the ignition coil harness connector.
4. Connect the coil wire at the ignition coil. Refer to Spark Plug Wire Replacement.

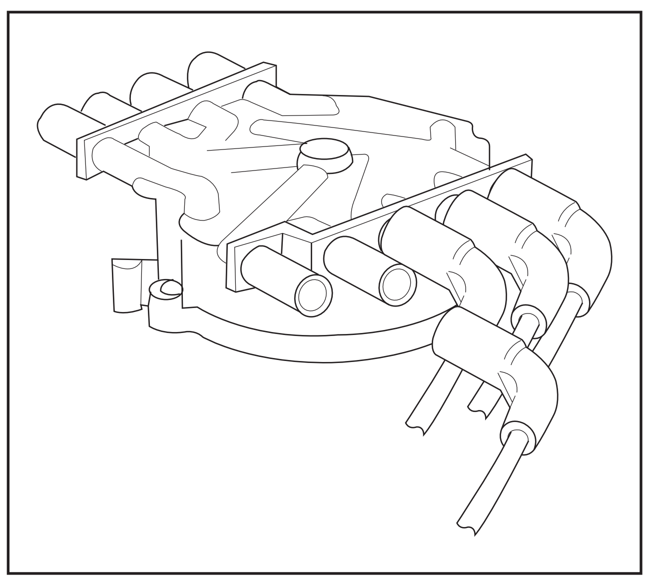


M4093

Spark Plug Wire Replacement

Removal Procedure

1. Disconnect the spark plug wire at each spark plug.
   - 1.1. Twist each spark plug wire 1/2 turn.
   - 1.2. Pull only on the boot in order to remove the wire from each spark plug.
2. Disconnect the spark plug wire from the distributor cap.
   - 2.1. Twist each spark plug wire 1/2 turn.
   - 2.1. Pull only on the boot in order to remove the wire from each tower.



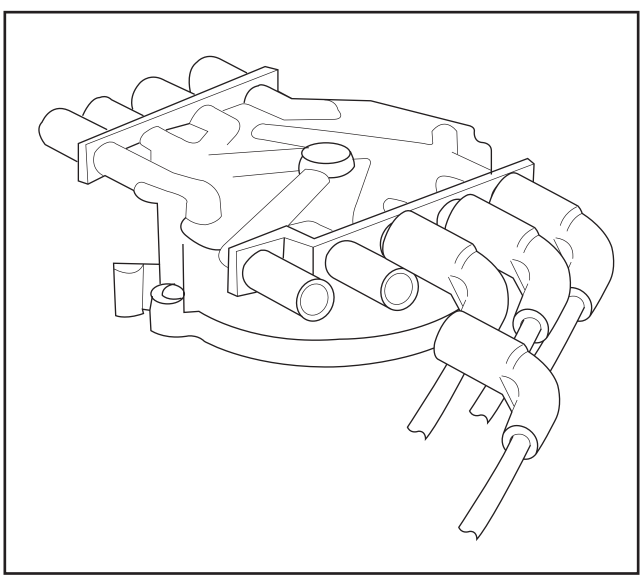
M4094

Spark Plug Wire Inspection

Spark plug wire integrity is vital for proper engine operation. A thorough inspection will be necessary to accurately identify conditions that may affect engine operation. Inspect for the following conditions:

1. Correct routing of the spark plug wires. Incorrect routing may cause cross-firing.
2. Any signs of cracks or splits in the wires.
3. Inspect each boot for the following conditions:
   - Tearing
   - Piercing
   - Arcing
   - Carbon tracking
   - Corroded terminal

If corrosion, carbon tracking or arcing are indicated on a spark plug wire boot or on a terminal, replace the wire and the component connected to the wire.



M4094

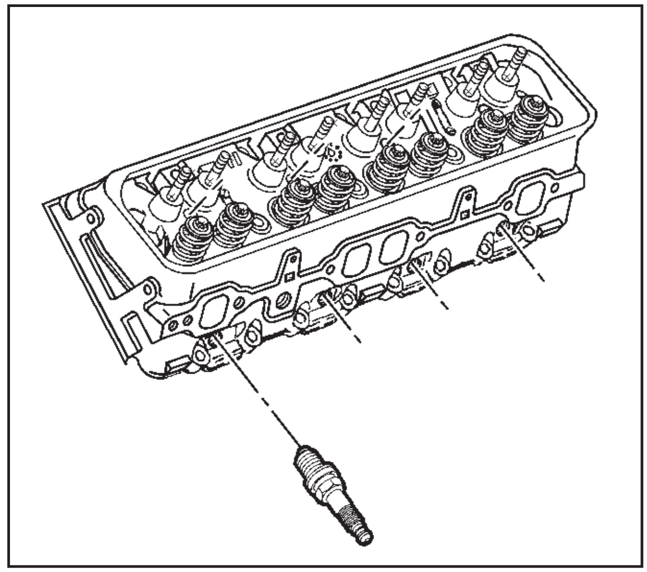
Installation Procedure

1. Install the spark plug wire at the correct distributor tower.
2. Install the spark plug wire at the correct spark plug.
3. Inspect the wires for proper installation:
   3.1. Push sideways on each boot in order to inspect the seating.
   3.2. Reinstall any loose boot.

Spark Plug Replacement

Removal Procedure

1. Remove the spark plug wires. Refer to Spark Plug Wire Replacement.
2. Loosen each spark plug one or two turns.
3. Brush or air blast away any dirt from around the spark plugs.
4. Remove the spark plugs one at a time and place each plug in a tray marked with the corresponding cylinder numbers.



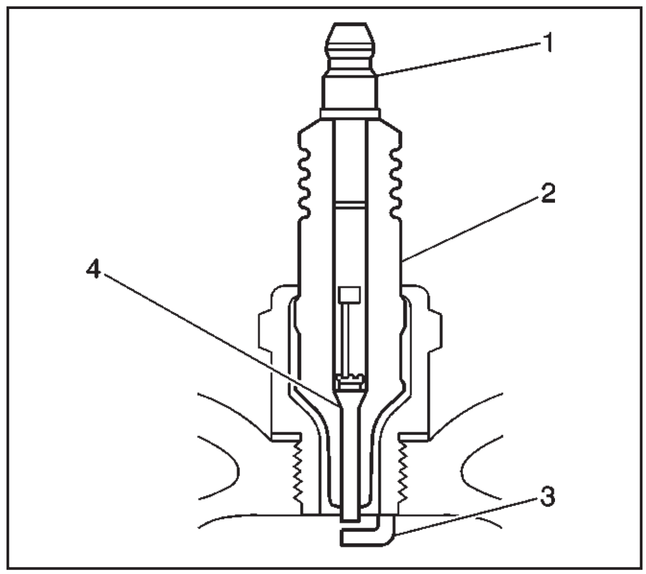
317307

Spark Plug Usage

- Ensure that the correct spark plug is installed. An incorrect spark plug causes driveability conditions.
- Ensure that the spark plug has the correct heat range. An incorrect heat range causes the following conditions:
  - Spark plug fouling - colder plug
  - Pre-ignition causing spark plug and/or engine damage - hotter plug

Spark Plug Inspection

- Inspect the terminal post (1) for damage.
  - Inspect for a bent or broken terminal post (1).



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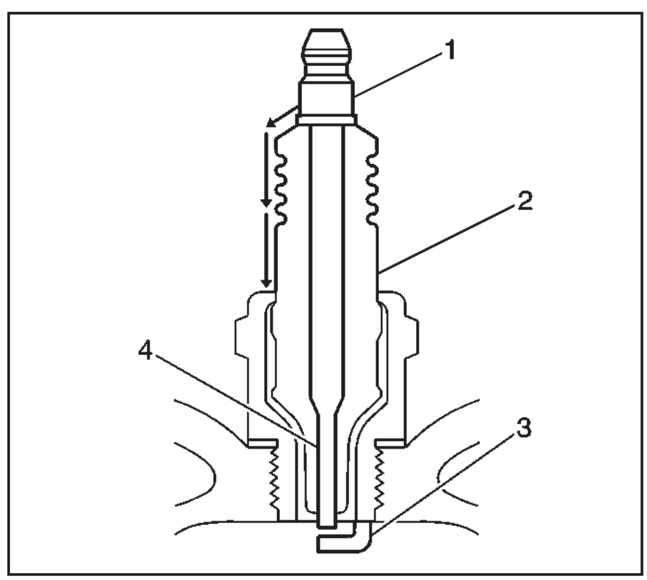
  - Test for a loose terminal post (1) by twisting an pulling the post. The terminal post (1) should NOT move.
- Inspect the insulator (2) for flashover or carbon tracking, soot. This is caused by the electrical charge traveling across the insulator (2) between the terminal post (1) and ground. Inspect for the following conditions:



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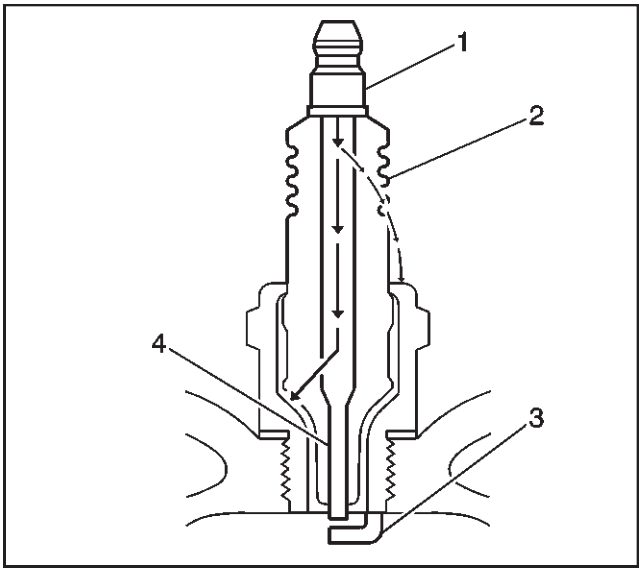

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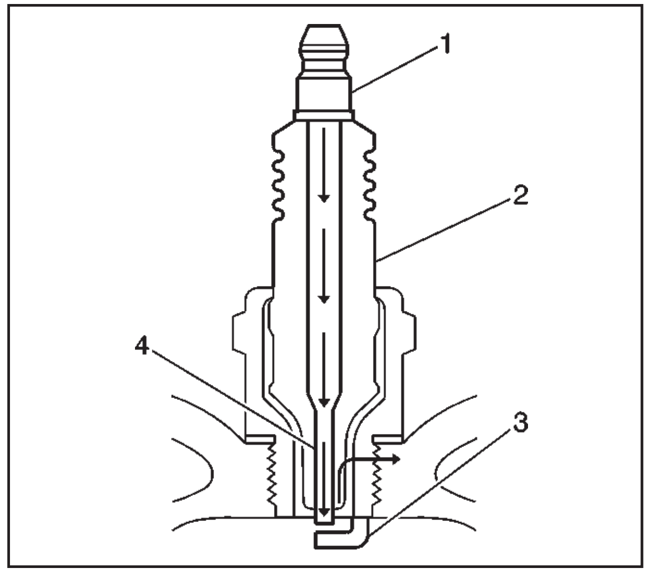
– Inspect the spark plug boot for damage.

– Inspect the spark plug recess area of the cylinder head for moisture, such as oil, coolant or water. A spark plug boot that is saturated causes arcing to ground.

- Inspect the insulator (2) for cracks. All or part of the electrical charge may arc through the crack instead of the electrodes (3,4).

- Inspect for evidence of improper arcing.
  - Measure the gap between the center electrode (4) and the side electrode (3) terminals. An excessively wide electrode gap can prevent correct spark plug operation.
  - Inspect for the correct spark plug torque. Insufficient torque can prevent correct spark plug operation. An over torqued spark plug may cause the insulator (2) to crack.
  - Inspect for signs of tracking that occurred near the insulator tip instead of the center electrode (4).
  - Inspect for a broken or worn side electrode (3).
  - Inspect for a broken, worn or loose center electrode (4) by shaking the spark plug.
    - A rattling sound indicates internal damage.
    - A loose center electrode (4) reduces the spark intensity.
  - Inspect for bridged electrodes (3, 4). Deposits on the electrodes (3, 4) reduce or eliminates the gap.
  - Inspect for worn or missing platinum pads on the electrodes (3, 4), if equipped.
  - Inspect for excessive fouling.
- Inspect the spark plug recess area of the cylinder head for debris. Dirty or damaged threads can cause the spark plug not to seat correctly during installation.



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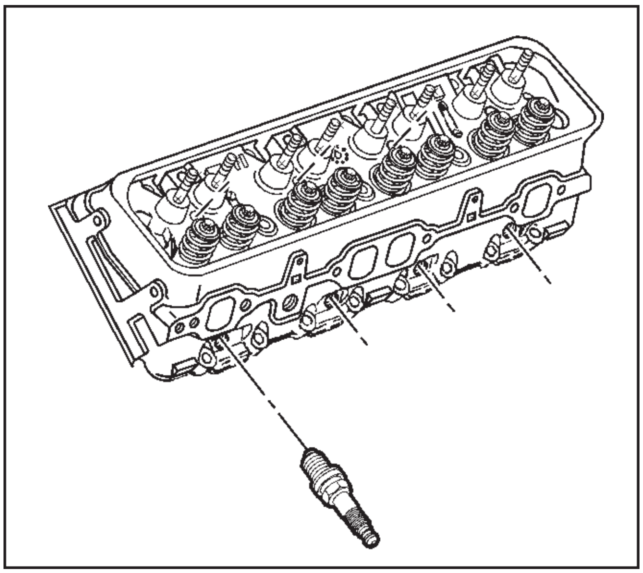
Spark Plug Visual Inspection

- Normal Operation - Brown to grayish-tan with small amounts of white powdery deposits are normal combustion by-products from fuels with additives.
- Carbon Fouled - Dry, fluffy black carbon, or soot caused by the following condition:
  - Rich fuel mixtures
    - Leaking fuel injectors
    - Excessive fuel pressure
    - Restricted flame arrestor/air filter element
    - Incorrect combustion
  - Reduced ignition system voltage output
    - Weak coil(s)
    - Worn ignition wires
    - Incorrect spark plug gap
  - Excessive idling or slow speeds under light loads can keep spark plug temperatures so low that normal combustion deposits may not burn off.

- Deposit Fouling - Oil, coolant or additives that include substances such as silicone, very white coating, reduces the spark intensity. Most powdery deposits will not effect spark intensity unless they form into a glazing over the electrode.



317307

Installation Procedure

1. Properly position each spark plug washer.
2. Inspect each spark plug gap. Adjust each plug as needed.

   Specification

   Spark plug gap: 1.524 mm (0.060 in)
3. Install the spark plugs.

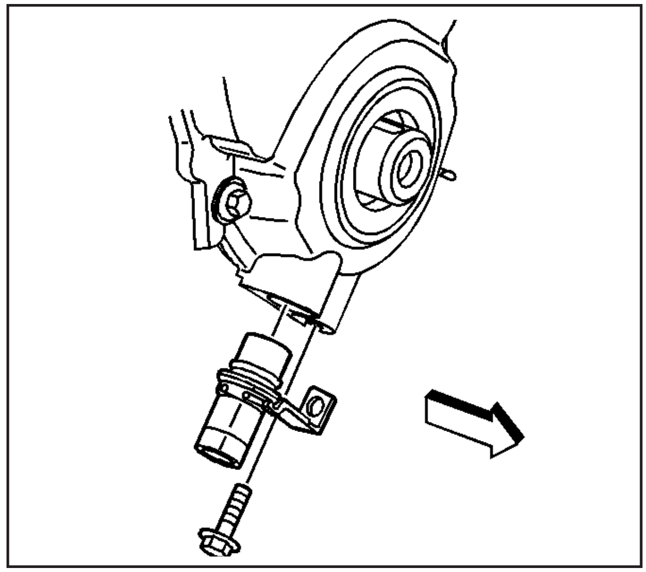
   Tighten

   Tighten the spark plugs to 20 N·m (15 lb ft).
4. Install the spark plug wires. Refer to *Spark Plug Wire Replacement.*

Crankshaft Position (CKP) Sensor Replacement

Removal Procedure

1. Disconnect the crankshaft position (CKP) sensor harness connector at the CKP sensor.
2. Remove the CKP sensor retaining bolt.
3. Remove the CKP sensor.



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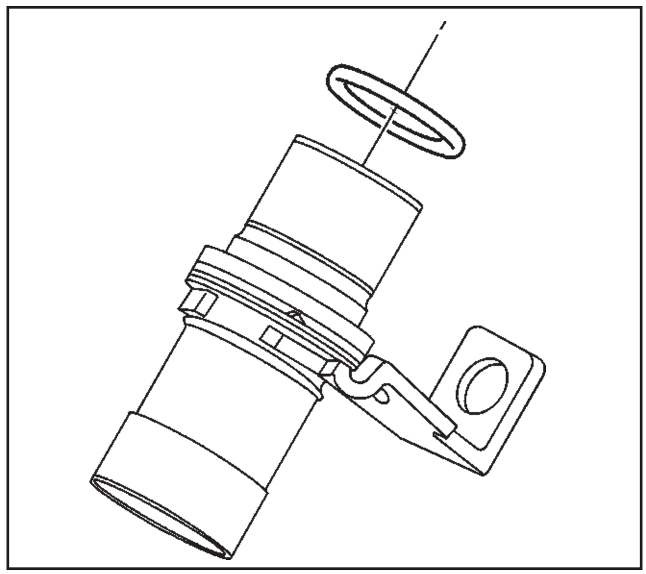
Important: Always install a NEW crankshaft position sensor O-ring during assembly.

4. Remove the CKP sensor O-ring and discard.
5. Install the NEW CKP sensor O-ring.



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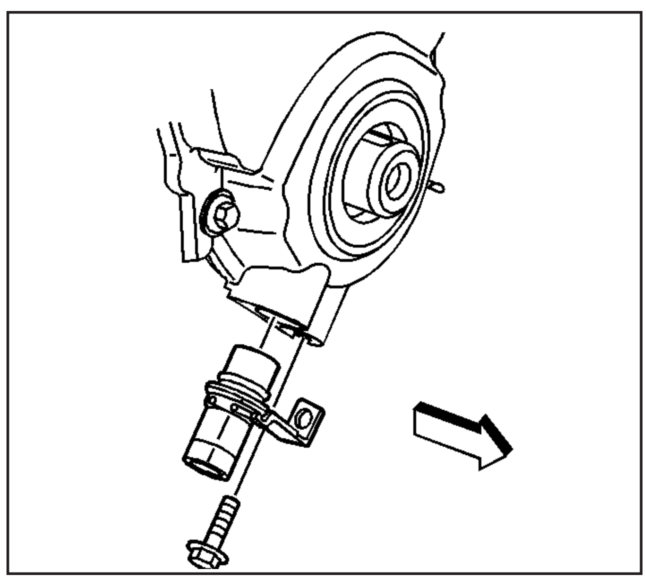
Installation Procedure

Important: Ensure that the crankshaft position sensor is fully seated and held stationary in the engine front cover bore. A crankshaft position sensor that is not completely seated will cock in the front cover bore and may result in erratic engine operation.

1. Lubricate the crankshaft position sensor O-rings with clean engine oil.
2. Install the crankshaft position sensor until fully seated into the front cover.
3. Install the crankshaft position sensor bolt.

   Tighten

   Tighten the crankshaft position sensor bolt to 9 N·m (80 lb in).



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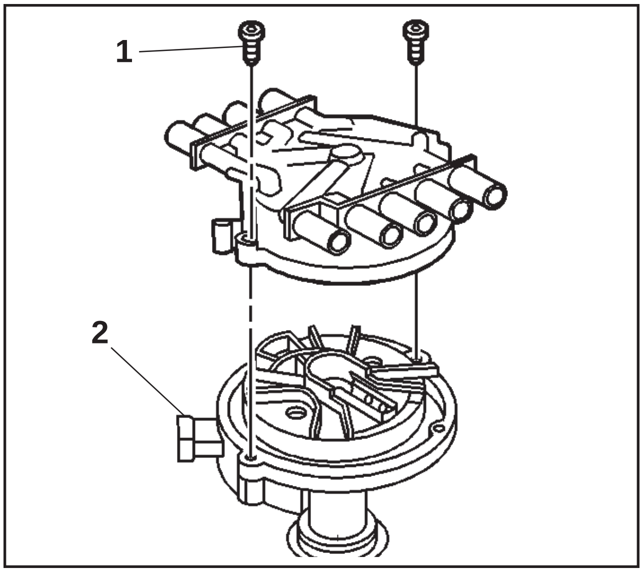

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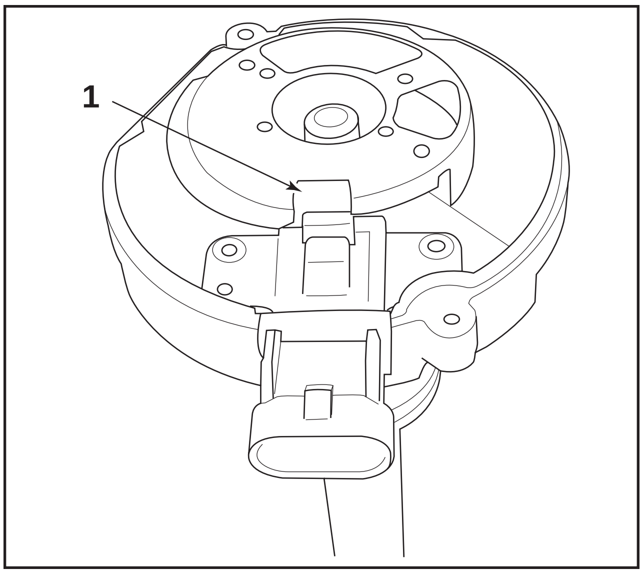
Camshaft Position (CMP) Sensor Replacement

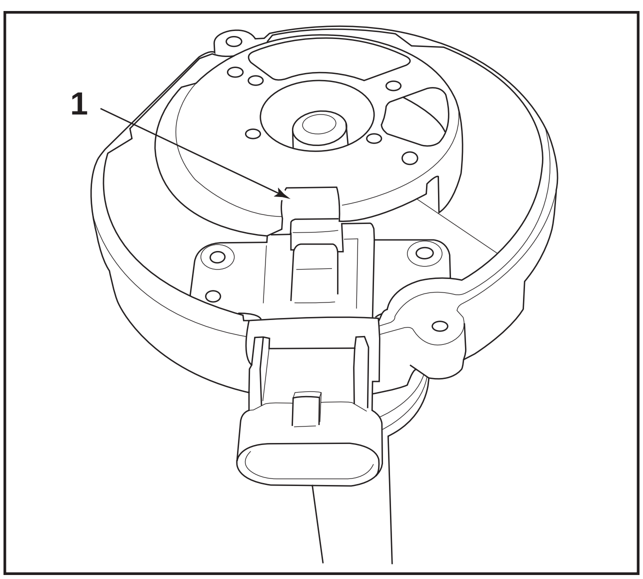
Removal Procedure

1. Disconnect the camshaft position (CMP) sensor harness connector from the CMP sensor (2).
2. Remove the distributor cap bolts (1).
3. Remove the distributor cap.



M4090

4. Remove the distributor rotor retaining screws.
5. Remove the distributor rotor.
6. Remove the CMP sensor retaining screws.
7. Align the notch (1) in the reluctor wheel with the CMP sensor.
8. Remove the CMP sensor.



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Installation Procedure

1. Align the notch (1) in the reluctor wheel with the CMP sensor.
2. Install the CMP sensor.
3. Install the CMP sensor retaining screws.

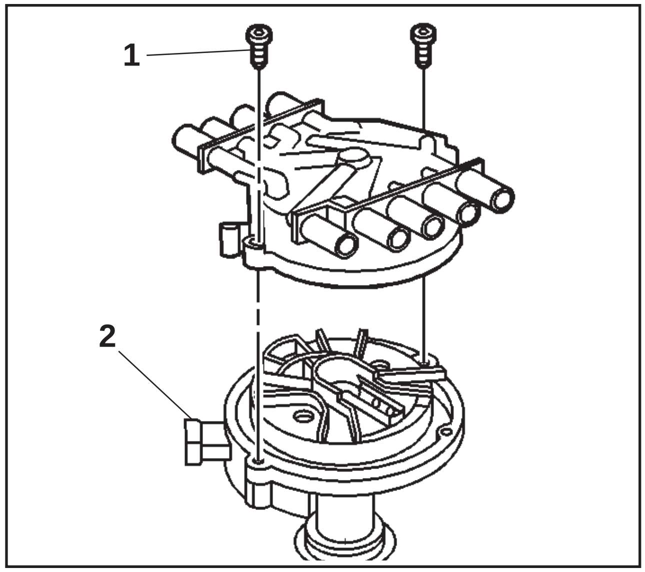
   Tighten

   Tighten the CMP sensor retaining screws to 9 N·m (72 lb in).
4. Install the distributor rotor.
5. Install the distributor rotor retaining screws.

6. Install the distributor cap.
7. Install the distributor cap bolts (1).

   Tighten

   Tighten the distributor cap bolts to 2.4 N·m (21 lb in).
8. Connect the camshaft position (CMP) sensor harness connector to the CMP sensor (2).



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Setting Cam Retard

Important: Moving the distributor DOES NOT adjust ignition timing. Ignition timing is completely computer controlled. However, a parameter called “Cam Retard” must be within specifications or driveability problems will exist.

1. Connect laptop, using Diacom (PCM p/n RT0086) in order to read serial data.
2. Start the engine.
3. Look at the “Cam Retard” parameter.

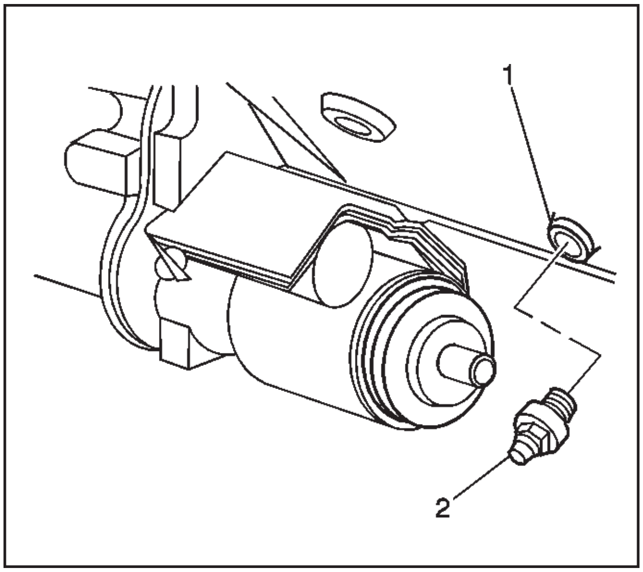
RT0086

Notice: Cam Retard MUST be set to 43-47 degrees.

4. If the Cam Retard is not within specification, loosen the distributor hold down bolt.
5. Rotate distributor until specification can be achieved.

   Tighten

   Tighten the distributor hold down bolt to 25 N·m (18 lb ft).

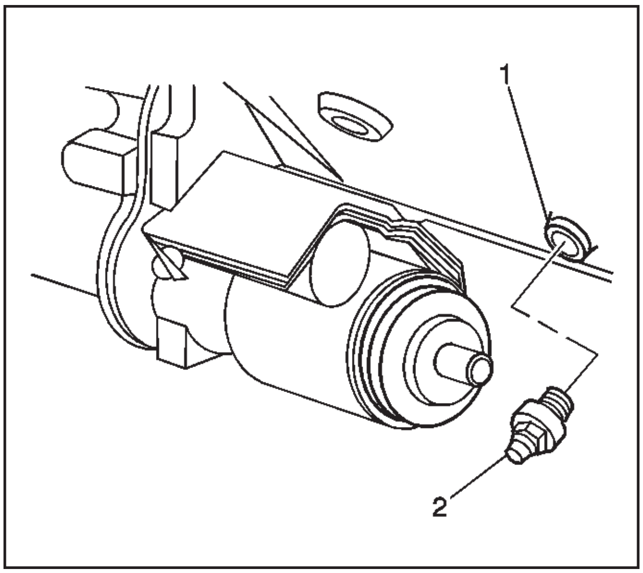


20272

Knock Sensor (KS) Replacement

Removal Procedure

1. Remove the wiring harness connector from the knock sensor (2).
2. Remove the knock sensor (2) from the engine block (1).



20272

Installation Procedure

1. Install the knock sensor (2) into the engine block (1).

   Tighten

   Tighten the knock sensor to 19 N·m (14 lb ft).
2. Connect the knock sensor harness connector to the knock sensor (2).

Marine Electronic Fuel Injection (MEFI 4)

Section 4B

Electronic Ignition

This section will describe the Electronic Ignition (EI) System used on the 6.0L and 8.1L engines. The EI system uses an individual ignition coil for each cylinder. The section explains the individual components of the Electronic Ignition System. Distributor Ignition System is explained in Section 4A.

Contents

Ignition System Specifications

Application	Metric	English
Firing Order	1-8-7-2-6-5-4-3	
Spark Plug Wire Resistance	10,000 ohms per foot	
Spark Plug Torque	15 N·m	11 lb ft
Spark Plug Gap	1.52 mm	.060 in
Spark Plug Type - 6.0L	R030011	
Spark Plug Type - 8.1L	R030009	

Fastener Tightening Specifications

Application	Metric	English
Camshaft Position (CMP) Sensor Bolt - 6.0L	29 N·m	21 lb ft
Camshaft Position (CMP) Sensor Bolt - 8.1L	25 N·m	18 lb ft
Crankshaft Position (CKP) Sensor Bolt - 6.0L	25 N·m	18 lb ft
Crankshaft Position (CKP) Sensor Bolt - 8.1L	25 N·m	18 lb ft
Engine Control Module (ECM) Mounting Screws	10-14 N·m	88-124 lb in
Ignition Coil Attaching Bolts	12 N·m	106 lb in
Knock Sensor (KS)	20 N·m	15 lb ft

Electronic Ignition (EI) System Description

Ignition System Overview

The ignition system consists of the following components or circuits:

- The 8 ignition secondary wires
- The 8 ignition coils
- The 8 ignition control (IC) circuits
- The camshaft position (CMP) sensor
- The camshaft reluctor wheel
- The crankshaft position (CKP) sensor
- The crankshaft reluctor wheel
- The related connecting wires
- The engine control module (ECM)

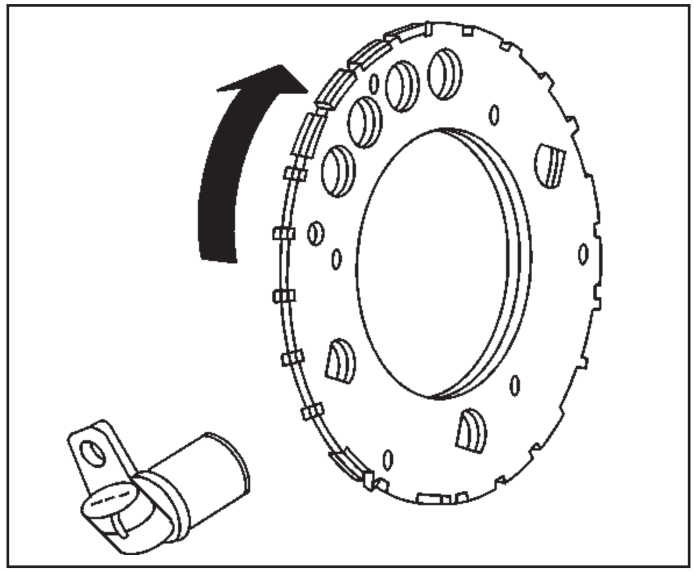
To properly control ignition timing, the ECM relies on the following information:

- Engine load, manifold pressure or vacuum
- Atmospheric, barometric, pressure
- Engine temperature
- Intake air temperature, if applicable
- Engine speed (RPM)

The ignition control utilizes the following to control spark timing functions:

- The 24X signal - The 24X crankshaft position sensor sends a signal to the ECM. The ECM uses this signal to determine crankshaft position, or engine speed.
- The 1X signal - The 1X camshaft position sensor sends a signal to the ECM. The ECM uses this signal to quickly determine what cylinder to fire the ignition coil on.
- The ignition control (IC) circuits - The ECM uses these circuits to trigger the ignition coils.

Crankshaft Position (CKP) Sensor and Reluctor Wheel



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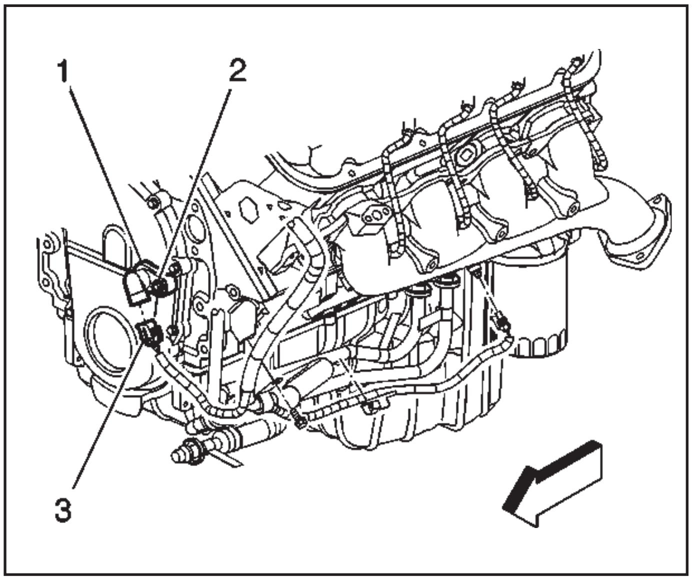
The crankshaft position (CKP) sensor is a magneto resistive type sensor. The CKP sensor works in conjunction with a 24X reluctor wheel. The reluctor wheel is mounted on the rear of the crankshaft. The 24X reluctor wheel uses 2 different width notches that are 15 degrees apart. This pulse width encoded pattern allows cylinder position identification within 90 degrees of crankshaft rotation. In some cases, this can be achieved within 45 degrees of crankshaft rotation. The reluctor wheel also has dual track notches that are 180 degrees out of phase. This design allows for quicker starts and accuracy. The CKP sensor also outputs a 4X signal for spark control, tachometer output and fuel control. All CKP signals are output as a digital waveform.

Camshaft Position (CMP) Sensor and Reluctor Wheel

The camshaft position (CMP) sensor works in conjunction with a 1X reluctor wheel mounted at the rear of the camshaft. The CMP is used to determine the top dead center position of cylinder #1, and will synchronize with the 24X CKP sensor signal for quicker starting. The CMP signals are output as a digital waveform.



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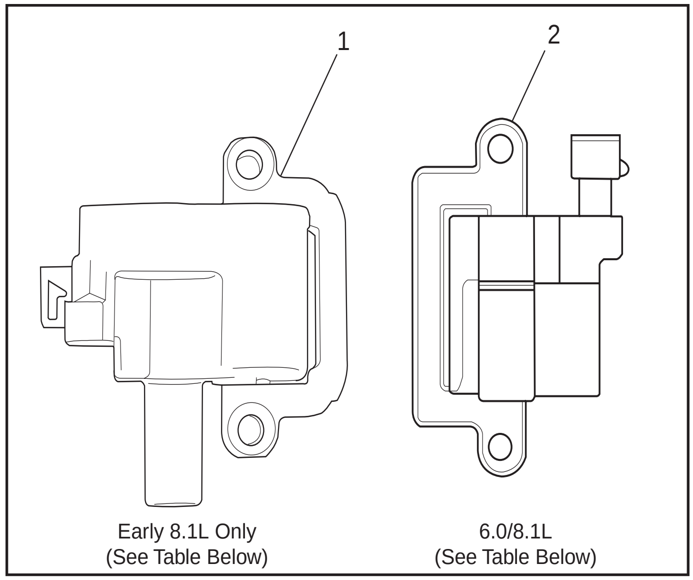
Ignition Coils



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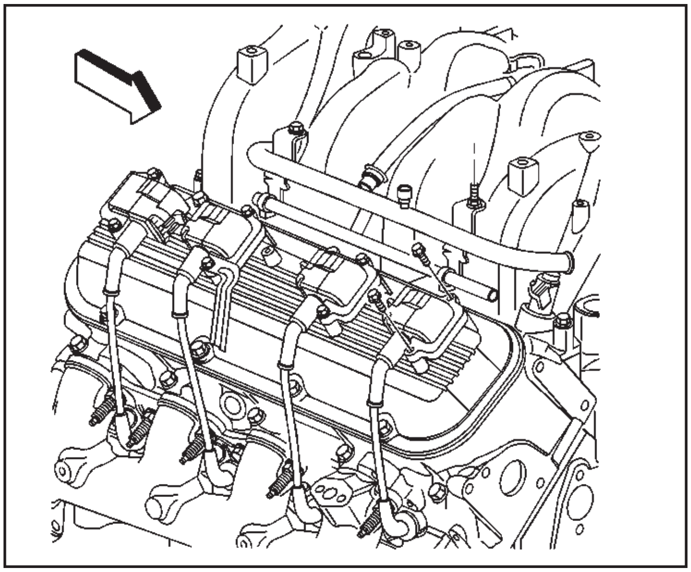
The ignition system on this engine features a multiple coil configuration and is known as coil near plug. There are two styles of ignition coil assemblies (1) and (2) for the 8.1L engine. The engine could have either style. The two styles are not interchangeable. The following table illustrates the type of coil used:

Engine	OLD Coil (1)	NEW Coil (2)
8.1L H.O.	Prior to S/N 425408	425408 to present
6.0L	N/A	ALL



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The 8 ignition coils are individually mounted above each cylinder on the rocker covers, the coils are fired sequentially. There is an ignition control (IC) circuit for each ignition coil. The 8 ignition control circuits are connected to the ECM. The ECM triggers each ignition coil individually and makes all timing decisions. The ignition coils are supplied with the following circuits:

- The ignition voltage circuit
- The ignition control circuit
- The ground circuit
- The reference low circuit

The ignition voltage circuits also supply the power for the fuel injectors. Each coil is serviced separately.

This system puts out very high ignition energy for plug firing. Less energy is lost to ignition wire resistance because the ignition wires are much shorter than in a conventional ignition system.

Noteworthy Ignition Information

There are important considerations to point out when servicing the ignition system. The following noteworthy information will list some of these to help the technician in servicing the ignition system.

- The ignition coils secondary voltage output capabilities are very high - more than 40,000 volts. Avoid body contact with ignition high voltage secondary components when the engine is running or personal injury may result.
- The 24X crankshaft position (CKP) sensor is the most critical part of the ignition system. If the sensor is damaged so that the pulses are not generated, the engine does not start.
- The CKP sensor clearance is very important. If the interrupter ring is bent or damaged in any way, the CKP sensor may be destroyed. Extreme care must be exercised during removal and installation procedures.
- The ignition timing is not adjustable. There are no timing marks on the crankshaft balancer or the timing chain cover.
- Be careful not to damage the secondary ignition wires or boots when servicing the ignition system. Rotate each boot in order to dislodge the boot from the plug or coil tower before pulling the boot from the spark plug or the ignition coil tower.

Engine Control Module (ECM)

The ECM is responsible for maintaining proper spark and fuel injection timing for all driving conditions. To provide optimum driveability and emissions, the ECM monitors input signals from the additional following components in calculating ignition control (IC) spark timing:

- The engine coolant temperature (ECT) sensor
- The intake air temperature (IAT) sensor
- The throttle position (TP) sensor
- The manifold absolute pressure (MAP) sensor

Knock Sensor (KS) System Description

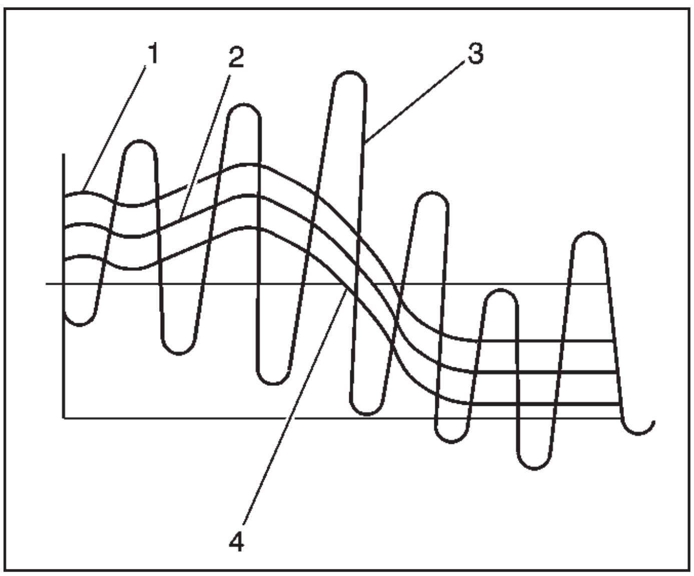
Purpose

To control spark knock (detonation), a knock sensor (KS) system is used. This system is designed to retard spark timing when excessive spark knock is detected in the engine. The KS system allows the engine to use maximum spark advance for optimal driveability and fuel economy under all operating conditions.

Operation

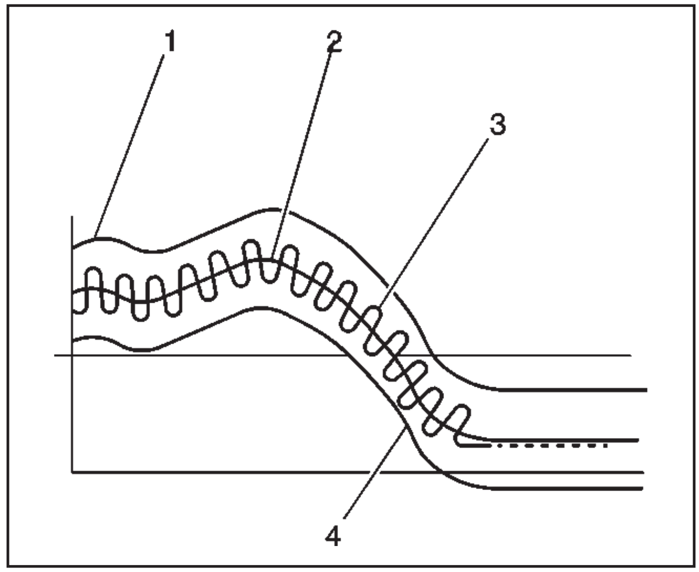
The ECM uses a knock sensor(s) to detect abnormal vibration in the engine (detonation/spark knock). Mounted on the engine block, the knock sensor(s) produces an AC voltage signal at all engine speeds and loads. The ECM then adjusts the spark timing based on the amplitude and frequency of the KS signal. The ECM uses the KS signal to calculate an average voltage. Then, the ECM assigns a voltage range above and below the average voltage value. The ECM checks the KS and related wiring by comparing the actual knock signal to the assigned voltage range. A normal KS signal should vary outside the assigned voltage range as shown in the NORMAL KS figure. If the ECM detects a KS signal within the assigned voltage range as shown in the ABNORMAL KS figure, the applicable DTC will set.

Normal Knock Sensor Signal



245253

Abnormal Knock Sensor Signal



245257

Legend

1. Upper fail region
2. Knock sensor calculated average
3. Knock sensor signal
4. Lower fail region

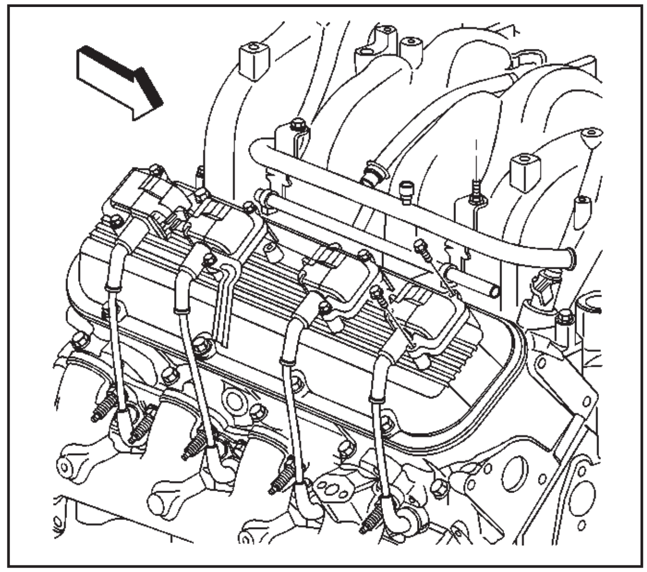
A diagnostic trouble code (DTC) may set for the following conditions or faults:

- The ECM malfunctions in a manner which will not allow the ECM to run a diagnostic of the KS circuit.
- The KS signal is within the assigned voltage range.
- The KS signal is not present.
- The Knock Sensor is improperly torqued.

Ignition Coil(s) Replacement

Removal Procedure

1. Disconnect the spark plug wires at the ignition coils. Refer to Spark Plug Wire Replacement.
2. Disconnect the ignition coil harness connector.
3. Remove the ignition coil mounting bolts.
4. Remove the ignition coil.



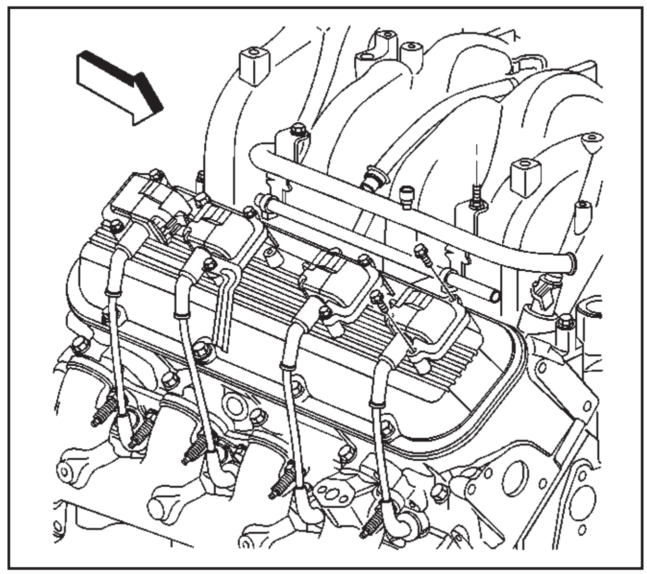
703554

Installation Procedure

1. Install the ignition coil.
2. Install the ignition coil mounting bolts.

   Tighten

   Tighten the ignition coil mounting bolts to 12 N·m (106 lb in).
3. Connect the ignition coil harness connector.
4. Connect the spark plug wires at the ignition coils. Refer to Spark Plug Wire Replacement.

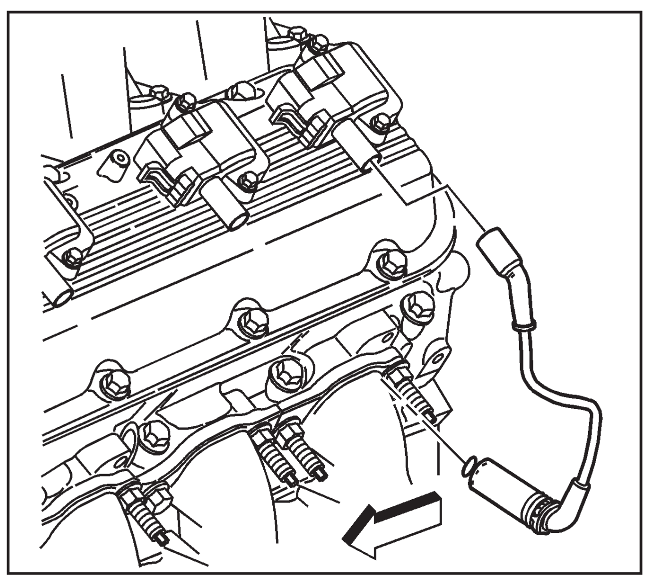


703554

Spark Plug Wire Replacement

Removal Procedure

1. Disconnect the spark plug wire at each spark plug.
   - 1.1. Twist each spark plug wire 1/2 turn.
   - 1.2. Pull only on the boot in order to remove the wire from each spark plug.
2. Disconnect the spark plug wire from each ignition coil.
   - 2.1. Twist each spark plug wire 1/2 turn.
   - 2.1. Pull only on the boot in order to remove the wire from each ignition coil.



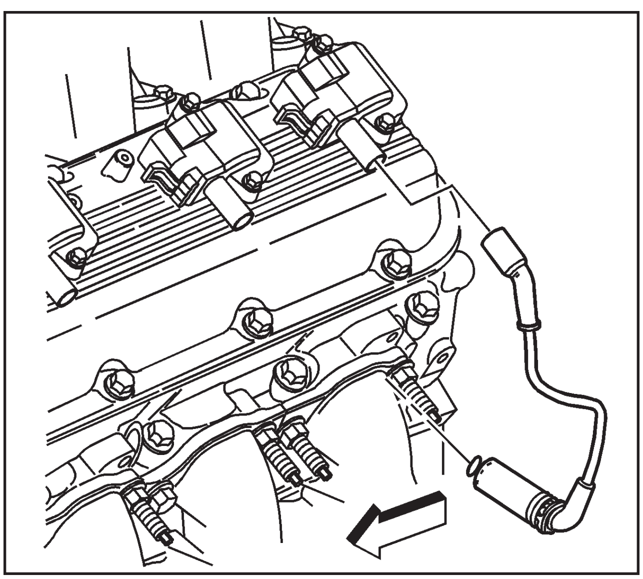
470666

Spark Plug Wire Inspection

Spark plug wire integrity is vital for proper engine operation. A thorough inspection will be necessary to accurately identify conditions that may affect engine operation. Inspect for the following conditions:

1. Correct routing of the spark plug wires. Incorrect routing may cause cross-firing.
2. Any signs of cracks or splits in the wires.
3. Inspect each boot for the following conditions:
   - Tearing
   - Piercing
   - Arcing
   - Carbon tracking
   - Corroded terminal

If corrosion, carbon tracking or arcing are indicated on a spark plug wire boot or on a terminal, replace the wire and the component connected to the wire.



470666

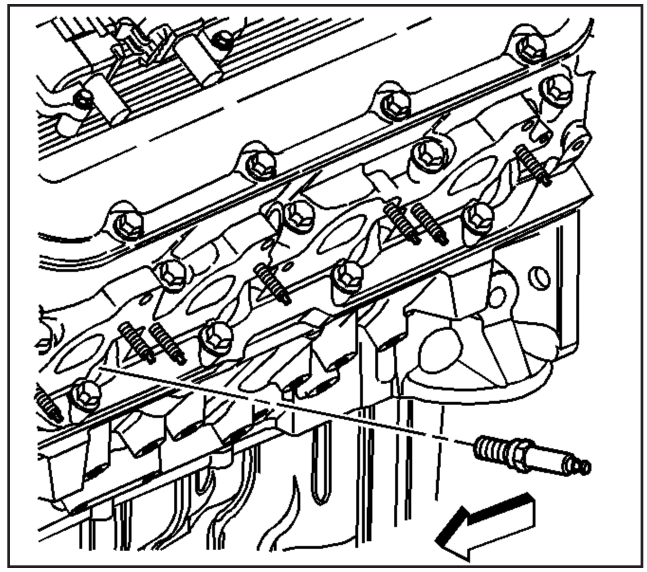
Installation Procedure

1. Install the spark plug wire at each ignition coil.
2. Install the spark plug wire at each spark plug.
3. Inspect the wires for proper installation:
   - 3.1. Push sideways on each boot in order to inspect the seating.
   - 3.2. Reinstall any loose boot.

Spark Plug Replacement

Removal Procedure

1. Remove the spark plug wires. Refer to Spark Plug Wire Replacement.
2. Loosen each spark plug one or two turns.
3. Brush or air blast away any dirt from around the spark plugs.
4. Remove the spark plugs one at a time and place each plug in a tray marked with the corresponding cylinder numbers.



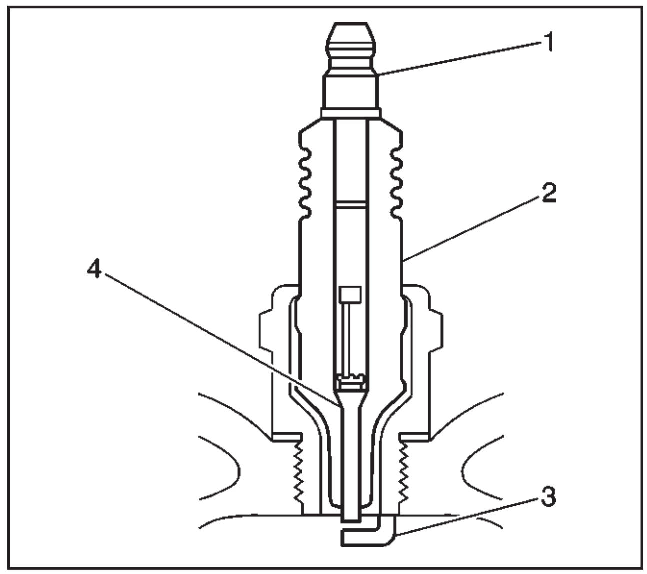
mefi4339

Spark Plug Usage

- Ensure that the correct spark plug is installed. An incorrect spark plug causes driveability conditions.
- Ensure that the spark plug has the correct heat range. An incorrect heat range causes the following conditions:
  – Spark plug fouling - colder plug
  – Pre-ignition causing spark plug and/or engine damage - hotter plug

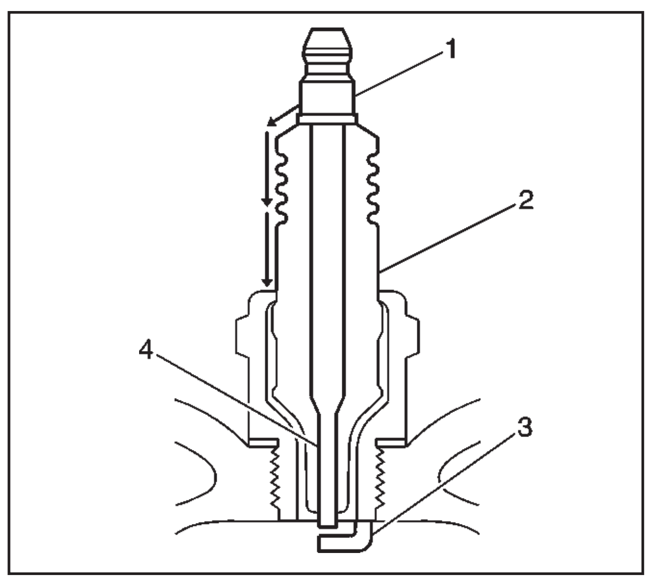
Spark Plug Inspection

- Inspect the terminal post (1) for damage.
  – Inspect for a bent or broken terminal post (1).



622530

  – Test for a loose terminal post (1) by twisting an pulling the post. The terminal post (1) should NOT move.
- Inspect the insulator (2) for flashover or carbon tracking, soot. This is caused by the electrical charge traveling across the insulator (2) between the terminal post (1) and ground. Inspect for the following conditions:



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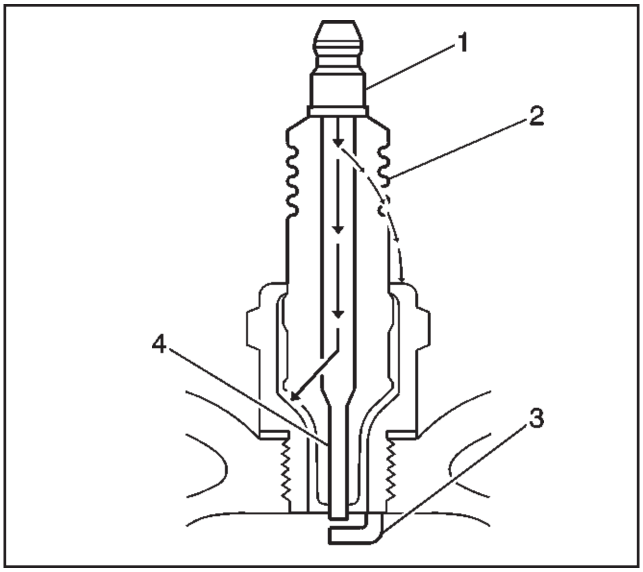


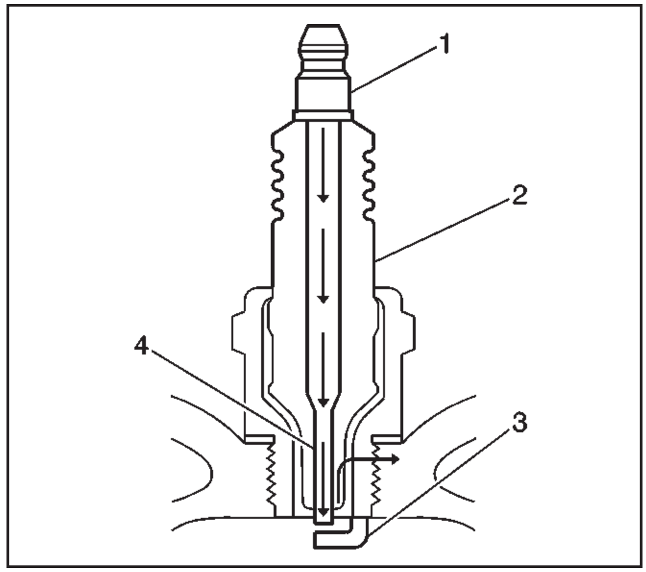
622528

– Inspect the spark plug boot for damage.

– Inspect the spark plug recess area of the cylinder head for moisture, such as oil, coolant or water. A spark plug boot that is saturated causes arcing to ground.

- Inspect the insulator (2) for cracks. All or part of the electrical charge may arc through the crack instead of the electrodes (3,4).

- Inspect for evidence of improper arcing.
  - Measure the gap between the center electrode (4) and the side electrode (3) terminals. An excessively wide electrode gap can prevent correct spark plug operation.
  - Inspect for the correct spark plug torque. Insufficient torque can prevent correct spark plug operation. An over torqued spark plug may cause the insulator (2) to crack.
  - Inspect for signs of tracking that occurred near the insulator tip instead of the center electrode (4).
  - Inspect for a broken or worn side electrode (3).
  - Inspect for a broken, worn or loose center electrode (4) by shaking the spark plug.
    - A rattling sound indicates internal damage.
    - A loose center electrode (4) reduces the spark intensity.
  - Inspect for bridged electrodes (3, 4). Deposits on the electrodes (3, 4) reduce or eliminates the gap.
  - Inspect for worn or missing platinum pads on the electrodes (3, 4), if equipped.
  - Inspect for excessive fouling.
- Inspect the spark plug recess area of the cylinder head for debris. Dirty or damaged threads can cause the spark plug not to seat correctly during installation.

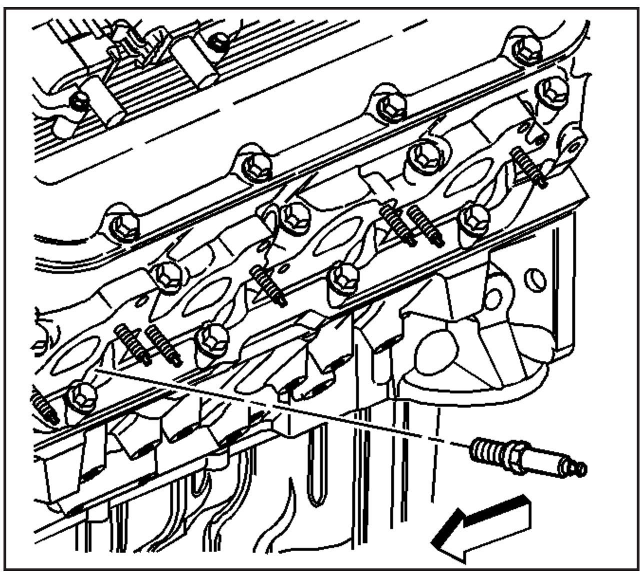


622527

Spark Plug Visual Inspection

- Normal Operation - Brown to grayish-tan with small amounts of white powdery deposits are normal combustion by-products from fuels with additives.
- Carbon Fouled - Dry, fluffy black carbon, or soot caused by the following condition:
  - Rich fuel mixtures
    - Leaking fuel injectors
    - Excessive fuel pressure
    - Restricted flame arrestor/air filter element
    - Incorrect combustion
  - Reduced ignition system voltage output
    - Weak coil(s)
    - Worn ignition wires
    - Incorrect spark plug gap
  - Excessive idling or slow speeds under light loads can keep spark plug temperatures so low that normal combustion deposits may not burn off.

- Deposit Fouling - Oil, coolant or additives that include substances such as silicone, very white coating, reduces the spark intensity. Most powdery deposits will not effect spark intensity unless they form into a glazing over the electrode.



mefi4339

Installation Procedure

1. Properly position each spark plug washer.
2. Inspect each spark plug gap. Adjust each plug as needed.

   Specification

   Spark plug gap: 1.524 mm (0.060 in)
3. Install the spark plugs.

   Tighten

   Tighten the spark plugs to 20 N·m (15 lb ft).
4. Install the spark plug wires. Refer to Spark Plug Wire Replacement.

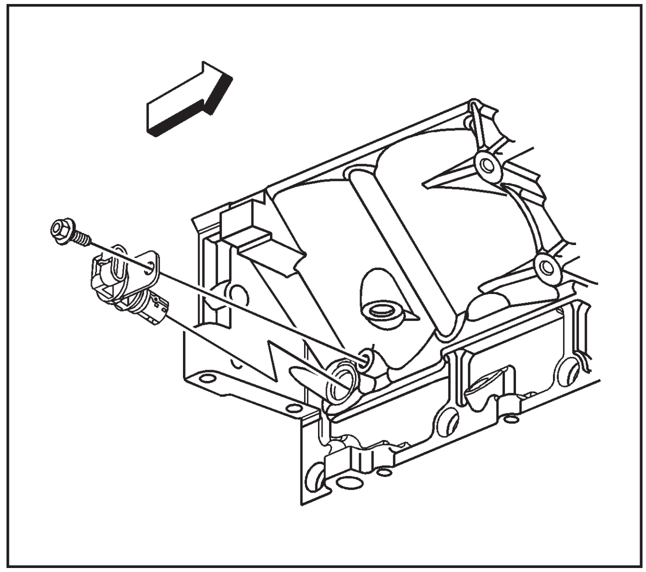
Crankshaft Position (CKP) Sensor Replacement - 6.0L

Removal Procedure

1. Remove the starter.
2. Disconnect the crankshaft position (CKP) sensor harness connector at the CKP sensor.

Important: Clean the area around the CKP sensor before removal in order to avoid debris from entering the engine.

2. Remove the CKP sensor retaining bolt.
3. Remove the CKP sensor.



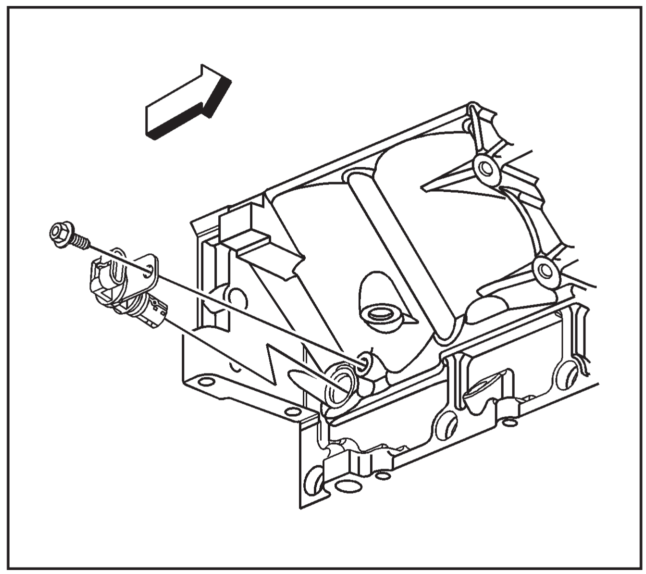
1239292

Installation Procedure

1. Install the crankshaft position sensor into the engine block.
2. Install the crankshaft position sensor bolt.

   Tighten

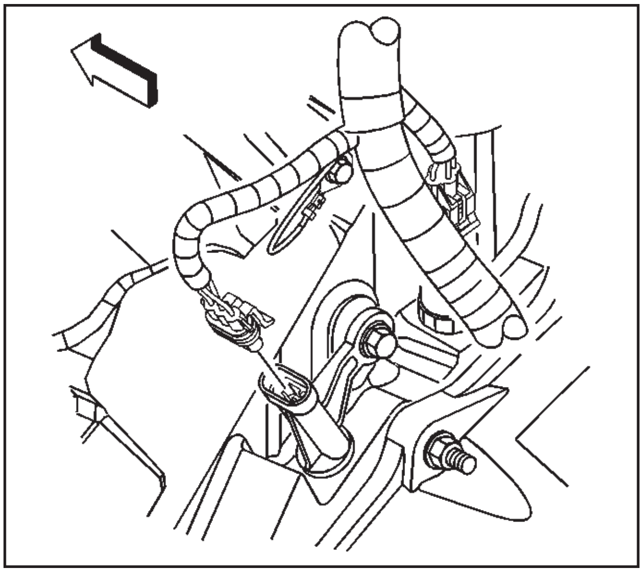
   Tighten the crankshaft position sensor bolt to 25 N·m (18 lb ft).
3. Install the starter.



1239292

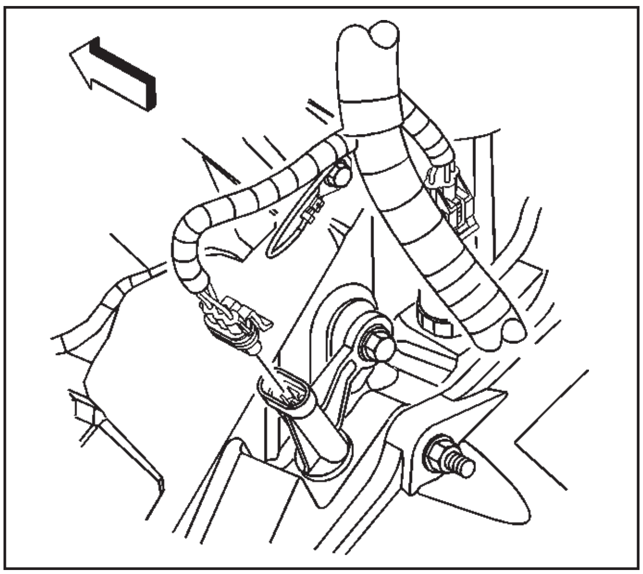
Crankshaft Position (CKP) Sensor Replacement - 8.1L

Removal Procedure



674728

1. Disconnect the crankshaft position (CKP) sensor harness connector at the CKP sensor.

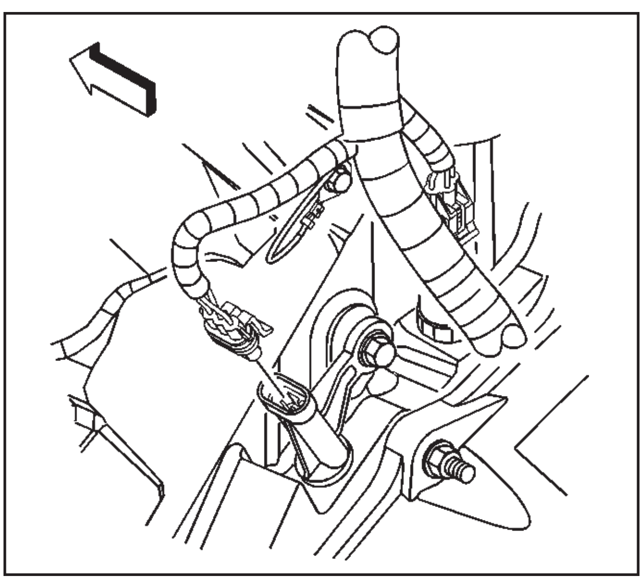


624728

Important: Use penetrating oil, and allow the oil to soak around the CKP sensor prior to removing the sensor.

2. Remove the CKP sensor retaining bolt.
3. Twist the sensor prior to removal.
4. Remove the CKP sensor.

Installation Procedure



624728

Important: Ensure that the crankshaft position sensor is fully seated against the crankshaft reluctor ring. The upper flange on the sensor MAY NOT seat against the engine block. The sensor is designed to wear to zero tolerance against the reluctor ring. The sensor is designed to be removed and installed three times. Exceeding three installations with the same sensor may result in engine driveability problems or a possible no-start.

Important: The crankshaft position sensor bolt has a thread sealant applied to the threads. The thread sealant may have come off during the removal of the bolt. Ensure that the bolt hole is clean of any debris before installing the crankshaft sensor bolt.

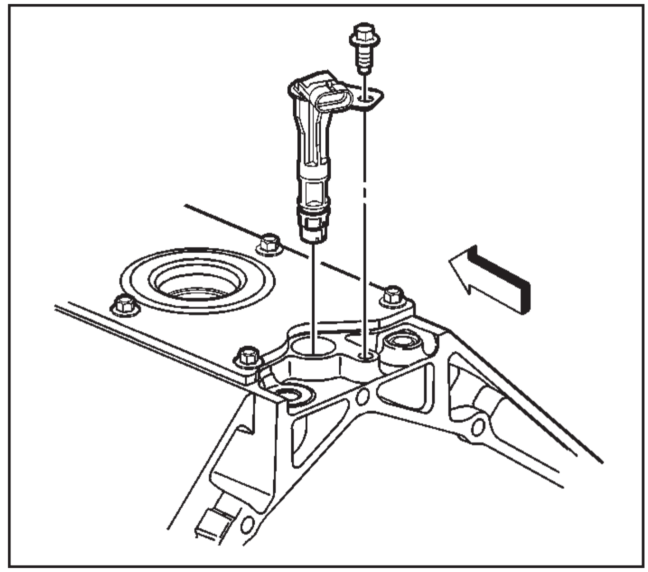
1. Inspect both crankshaft position sensor O-rings for cuts, cracks, tears or damage. Replace the O-rings as needed. Lubricate the crankshaft position sensor O-rings with clean engine oil.
2. Install the crankshaft position sensor into the engine block.

   There may be a slight resistance as the O-rings seat into the engine block.
3. Apply thread sealer to the crankshaft position sensor bolt.
4. Install the crankshaft position sensor bolt.

   Tighten

   Tighten the crankshaft position sensor bolt to 25 N·m (18 lb ft).

Camshaft Position (CMP) Sensor Replacement - 6.0L



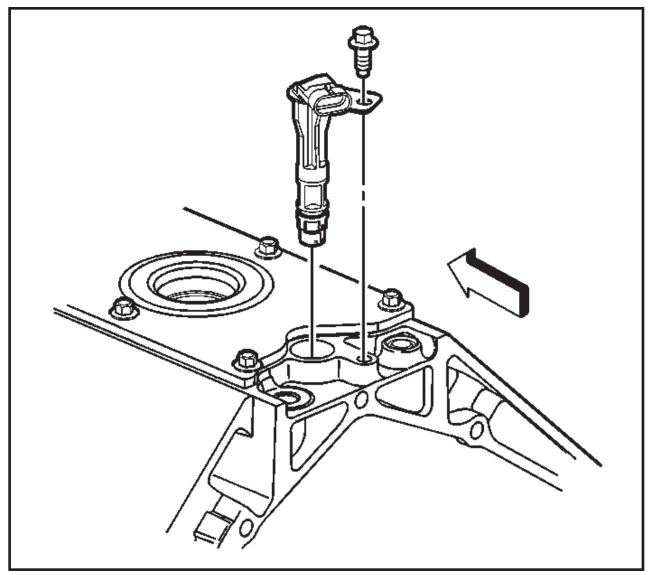
260128

Removal Procedure

1. Remove the intake manifold.
2. Disconnect the camshaft position (CMP) sensor harness connector.

Important: Clean the area around the CKP sensor before removal in order to avoid debris from entering the engine.

2. Remove the CMP sensor retaining bolt.
3. Remove the CMP sensor.



260128

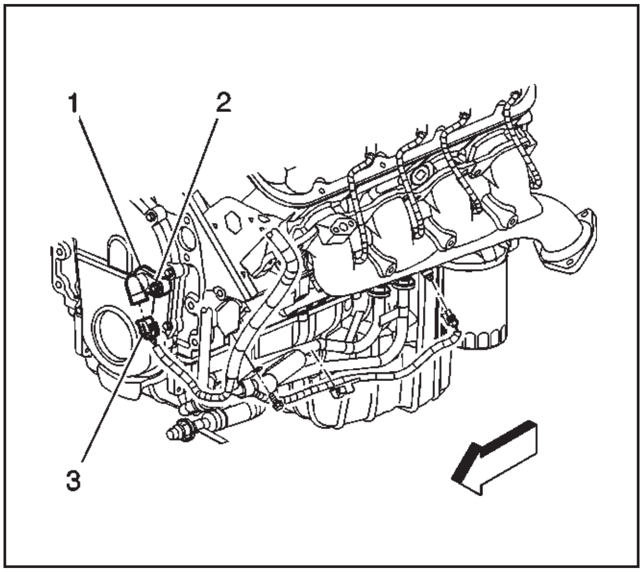
Installation Procedure

Important: Inspect the CMP sensor O-ring for wear or damage. If a problem is found, replace the O-ring. Lubricate the new O-ring with clean engine oil before installing.

1. Install the CMP sensor.
2. Install the CMP sensor retaining bolt.

   Tighten

   Tighten the bolt 29 N·m (21 lb ft).
3. Connect the CMP sensor harness connector (3).

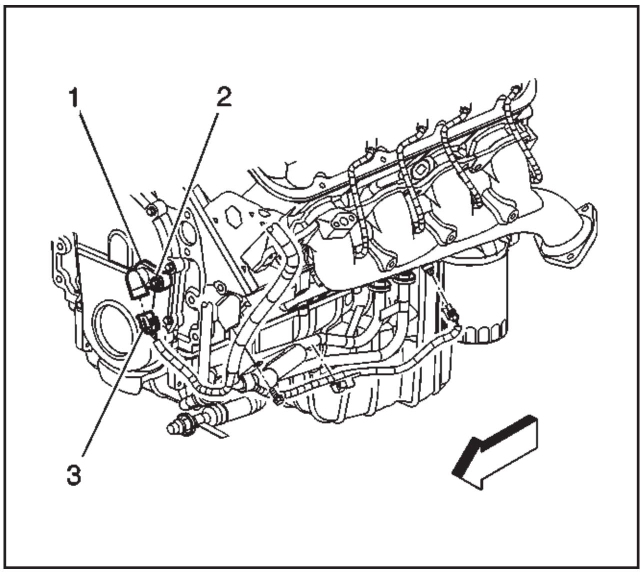


690593

Camshaft Position (CMP) Sensor Replacement - 8.1L

Removal Procedure

1. Disconnect the camshaft position (CMP) sensor harness connector (3) from the CMP sensor (1).
2. Remove the CMP sensor retaining bolt (2).
3. Remove the CMP sensor (1).
4. Inspect the CMP sensor for wear, cracks or leakage if the sensor is not being replaced.



690593

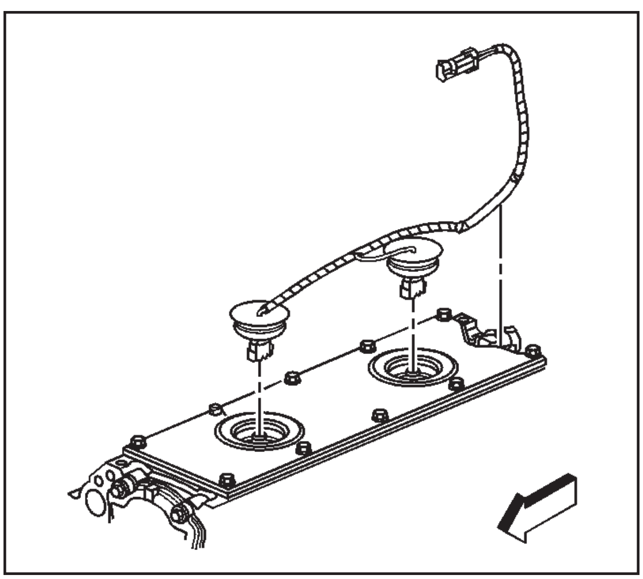
Installation Procedure

Important: Inspect the CMP sensor O-ring for wear or damage. If a problem is found, replace the O-ring. Lubricate the new O-ring with clean engine oil before installing.

1. Install the CMP sensor (1).
2. Install the CMP sensor retaining bolt (2).

   Tighten

   Tighten the bolt 10 N·m (88 lb in).
3. Connect the CMP sensor harness connector (3).



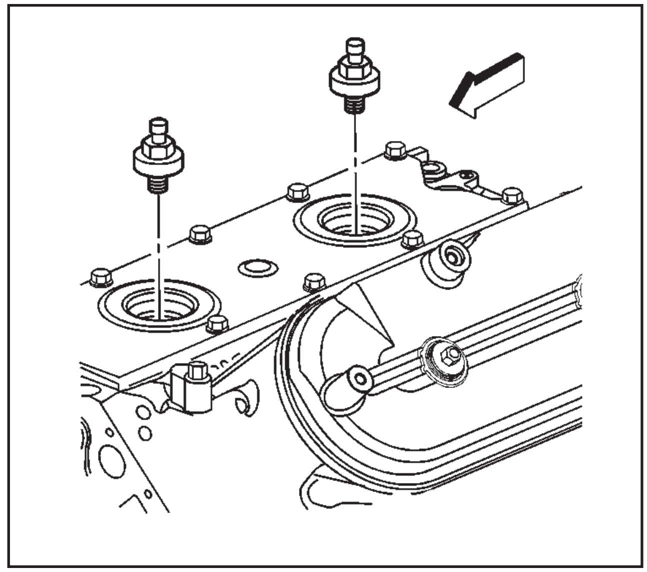
832149

Knock Sensors (KS) (6.0L)

Remove or Disconnect

1. Remove the intake manifold. Refer to Intake Manifold Replacement in Engine Mechanical - 6.0L.
2. Gently pry up the rubber covers.
3. Disconnect the knock sensor electrical connectors.

4. Remove the knock sensors.



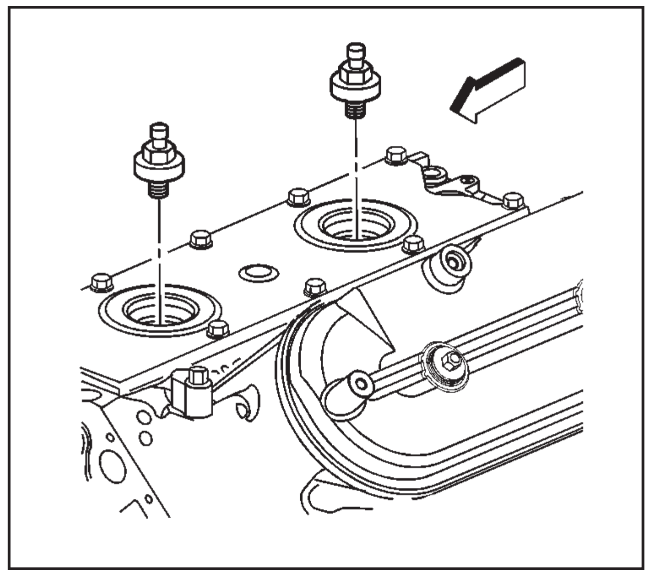
309864

Install or Connect

Important

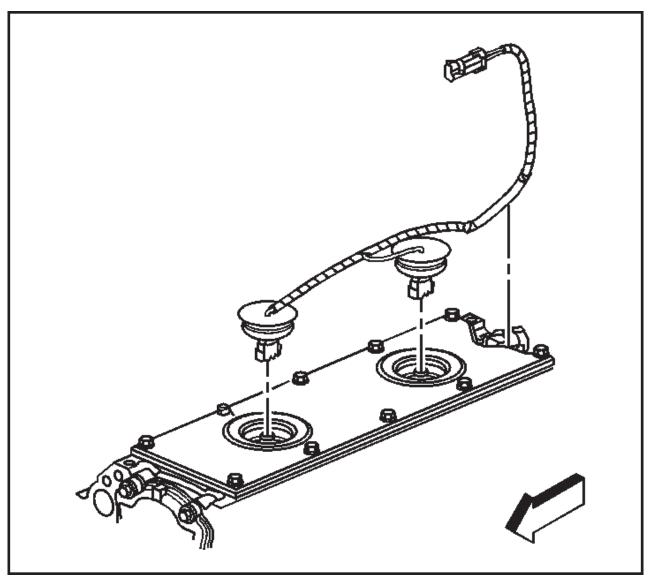
- If installing a new knock sensor, be sure to replace with an identical part number.
- When installing knock sensor, be sure to install in the same location removed from.

1. Knock sensors into engine block. Be sure threads are clean. Torque to 20 N•m (15 lb ft).



309864

2. Connect the knock sensor electrical connectors.
3. Push down on the rubber covers.
4. Install the intake manifold. Refer to Intake Manifold Replacement in Engine Mechanical - 6.0L.



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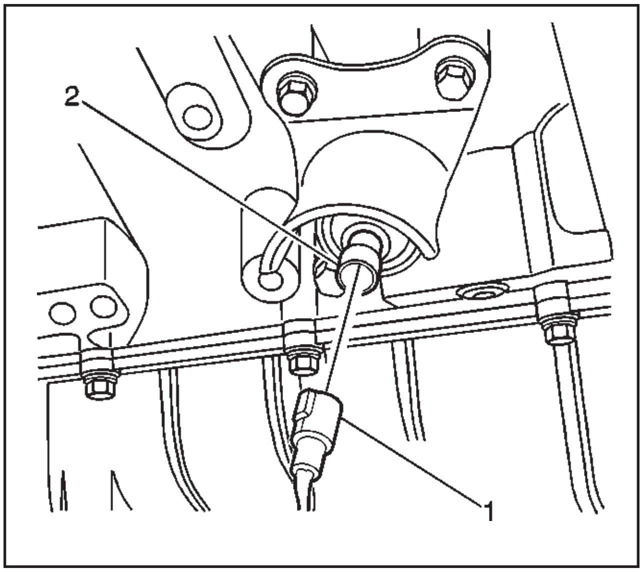
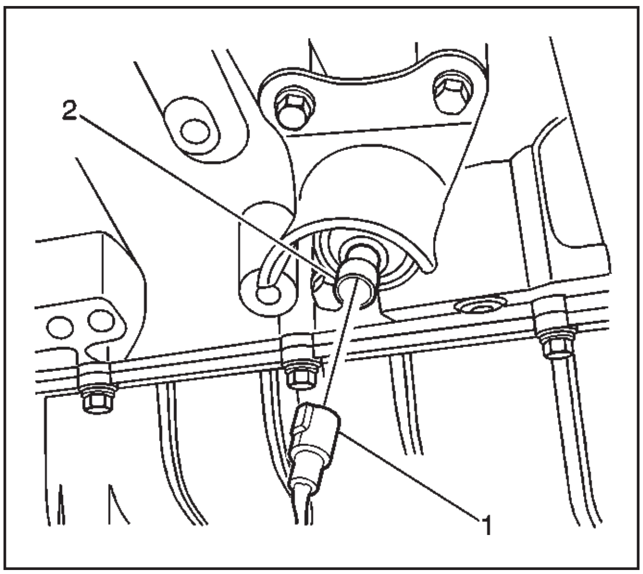


678815

Knock Sensor (KS) 1 Replacement - 8.1L

Removal Procedure

1. Remove the wiring harness connector (1) from the knock sensor (2).
2. Remove the knock sensor (2) from the engine block.



678815

Installation Procedure

1. Install the knock sensor (2) into the engine block.

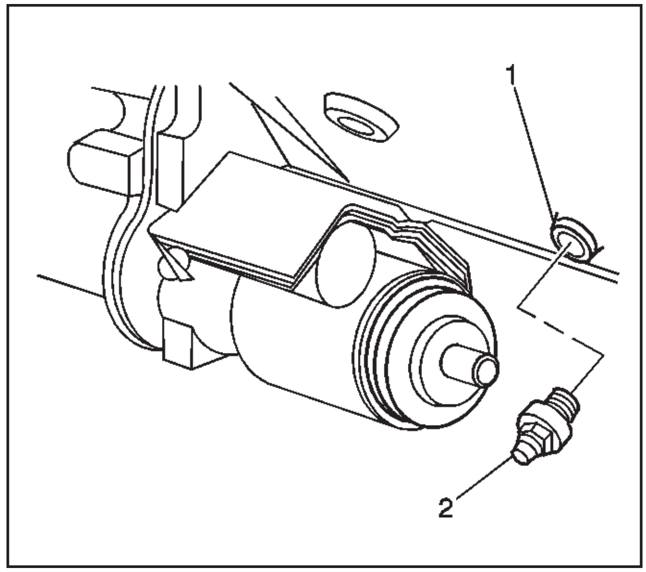
   Tighten

   Tighten the knock sensor to 20 N·m (15 lb ft).
2. Connect the knock sensor harness connector (1) to the knock sensor (2).

Knock Sensor (KS) 2 Replacement - 8.1L

Removal Procedure

1. Remove the wiring harness connector from the knock sensor (2).
2. Remove the knock sensor (2) from the engine block (1).



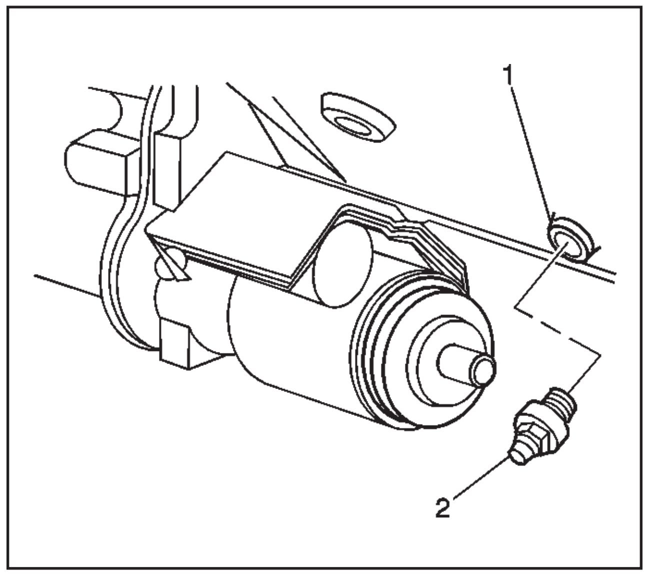
20272

Installation Procedure

1. Install the knock sensor (2) into the engine block (1).

   Tighten

   Tighten the knock sensor to 20 N·m (15 lb ft).
2. Connect the knock sensor harness connector to the knock sensor (2).



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Marine Electronic Fuel Injection (MEFI 4/4B)

Section 5

Diagnosis

This section will be used to perform diagnostic procedures on the Marine Electronic Fuel Injection (MEFI 4/4B) equipped engines. It describes the system circuits and diagnostic procedures used to diagnose the circuits. It will be used to correct Diagnostic Trouble Codes (DTCs) by following step-by-step procedures. This section contains the On-Board Diagnostic (OBD) System Check, which MUST be the first step performed, before any other diagnostics or repairs are made to the MEFI 4/4B system.

The assumption is made that on all diagnostic procedures, the engine is equipped with MEFI 4/4B ECM, sensors, wiring harness, fuel components and ignition components. The wiring schematics and circuit identifications are for the MEFI 4/4B originally equipped wiring harness.

The Diagnostic Procedures (DP) and voltages shown are prepared with the requirement that the system functioned correctly at the time of assembly and that there are no multiple failures.

Contents

Diagnosis

The diagnostic procedures and functional checks in this manual are designed to locate a faulty circuit or component through logic based on the process of elimination. The procedures are prepared with the requirement that the system functioned correctly at the time of assembly and that there are no multiple failures.

Engine control circuits contain many special design features not found in standard vehicle wiring. Environmental protection is used extensively to protect electrical contacts. Proper splicing methods must be used when necessary.

The proper operation of low amperage input/output circuits depend upon good continuity between circuit connectors. It is important before component replacement and/or during normal troubleshooting procedures that a visual inspection of any questionable mating connector is performed. Mating surfaces should be properly formed, clean and likely to make proper contact. Some typical causes of connector problems are listed below:

- Improperly formed contacts and/or connector housing.
- Damaged contacts or housing due to improper engagement.
- Corrosion, sealer or other contaminants on the contact mating surfaces.
- Incomplete mating of the connector halves during initial assembly or during subsequent troubleshooting procedures.
- Tendency for connectors to come apart due to vibration and/or temperature cycling.
- Terminals not fully seated in the connector body.
- Inadequate terminal crimps to the wire.

Engine Controls

Specifications

ECT Temperature vs. Resistance Values (Approximate)

°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238

ECT Temperature vs. Resistance (cont'd)

°C	°F	OHMS
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
-5	23	12300
-10	14	16180
-15	5	21450
-20	-4	28680
-30	-22	52700
-40	-40	100700

Ignition System Specifications (5.0 / 5.7L)

Application	Specifications	
	Metric	English
Firing Order (LH)	1-8-4-3-6-5-7-2	
Firing Order (RH)	1-2-7-5-6-3-4-8	
Spark Plug Wire Resistance	10,000 ohms per foot	
Spark Plug Torque	15 N·m	11 lb ft
Spark Plug Gap	1.52 mm	.060 in
Spark Plug Type	R030010	

Ignition System Specifications (6.0 / 8.1L)

Application	Specifications	
	Metric	English
Firing Order	1-8-7-2-6-5-4-3	
Spark Plug Wire Resistance	10,000 ohms per foot	
Spark Plug Torque	15 N·m	11 lb ft
Spark Plug Gap	1.52 mm	.060 in
Spark Plug Type (8.1L)	R030009	
Spark Plug Type (6.0L)	R030011	

Fastener Tightening Specifications (5.0/5.7L)

Application	Specifications	
	Metric	English
Camshaft Position (CMP) Sensor Bolt	9 N·m	72 lb in
Crankshaft Position (CKP) Sensor Bolt	9 N·m	72 lb in
Engine Control Module (ECM) Mounting Screws	10-14 N·m	88-124 lb in
Engine Coolant Temperature (ECT) Sensor	17 N·m	13 lb ft
Fuel Rail Attaching Bolts	10 N·m	89 lb in
Idle Air Control (IAC) Valve Attaching Screws	3.2 N·m	28 lb in
Ignition Coil Attaching Bolts	12 N·m	106 lb in
Knock Sensor (KS)	20 N·m	15 lb ft
Throttle Body Attaching Bolts	10 N·m	88.5 lb in
Throttle Position (TP) Sensor Attaching Screws	2 N·m	18 lb in

Fastener Tightening Specifications (6.0L)

Application	Specifications	
	Metric	English
Camshaft Position (CMP) Sensor Bolt	29 N·m	21 lb ft
Crankshaft Position (CKP) Sensor Bolt	25 N·m	18 lb ft
Engine Control Module (ECM) Mounting Screws	10-14 N·m	88-124 lb in
Engine Coolant Temperature (ECT) Sensor	20 N·m	15 lb ft
Fuel Rail Attaching Bolts	10 N·m	89 lb in
Idle Air Control (IAC) Valve Attaching Screws	3.2 N·m	28 lb in
Ignition Coil Attaching Bolts	12 N·m	106 lb in
Knock Sensors (KS)	20 N·m	15 lb ft
Throttle Body Attaching Bolts	10 N·m	88.5 lb in
Throttle Position (TP) Sensor Attaching Screws	2 N·m	18 lb in

Fastener Tightening Specifications (8.1L)

Application	Specifications	
	Metric	English
Camshaft Position (CMP) Sensor Bolt	12 N·m	106 lb in
Crankshaft Position (CKP) Sensor Bolt	12 N·m	106 lb in
Engine Control Module (ECM) Mounting Screws	10-14 N·m	88-124 lb in
Engine Coolant Temperature (ECT) Sensor	17 N·m	13 lb ft
Fuel Rail Attaching Bolts	10 N·m	89 lb in
Idle Air Control (IAC) Valve Attaching Screws	3.2 N·m	28 lb in
Ignition Coil Attaching Bolts	12 N·m	106 lb in
Knock Sensors (KS)	20 N·m	15 lb ft
Throttle Body Attaching Bolts	10 N·m	88.5 lb in
Throttle Position (TP) Sensor Attaching Screws	2 N·m	18 lb in

Engine Scan Tool Data List

The Engine Scan Tool Data List contains all engine related parameters that are available on the scan tool. Use the Engine Scan Tool Data List only after the following is determined:

- On-Board Diagnostic System Check is completed.
- No Diagnostic Trouble Codes (DTCs).
- On-board diagnostics are functioning properly.

Scan tool values from a properly running engine may be used for comparison with the engine you are diagnosing. The Engine Scan Tool Data List represents values that would be seen on a normal running engine.

Important: A scan tool that displays faulty data should not be used. The scan tool problem should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to *Symptoms* for diagnosis.

Typical Diacom (Preferred Screen) Data List (Idle / Operating Temperature / Neutral / Sea Level)

5.7L MPI

DIACOM+

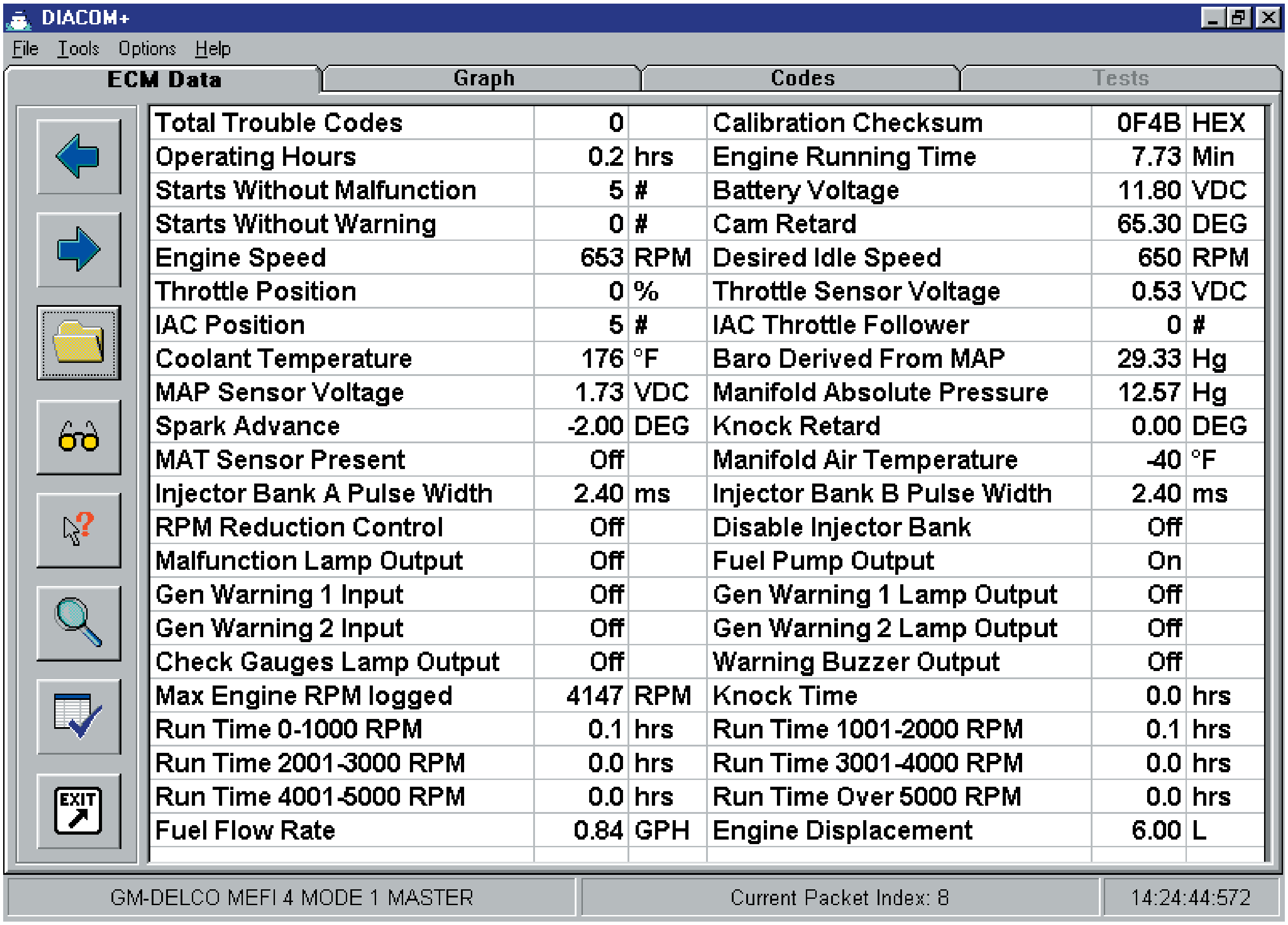
File Tools Options Help

ECM Data | Graph | Codes | Tests

Total Trouble Codes	0		Calibration Checksum	CB17	HEX
Operating Hours	11.1	hrs	Engine Running Time	0.73	Min
Starts Without Malfunction	89	#	Battery Voltage	14.30	VDC
Starts Without Warning	10	#	Cam Retard	45.50	DEG
Engine Speed	653	RPM	Desired Idle Speed	650	RPM
Throttle Position	0	%	Throttle Sensor Voltage	0.61	VDC
IAC Position	54	#	IAC Throttle Follower	0	#
Coolant Temperature	154	°F	Baro Derived From MAP	29.76	Hg
MAP Sensor Voltage	1.69	VDC	Manifold Absolute Pressure	12.36	Hg
Spark Advance	6.00	DEG	Knock Retard	0.00	DEG
MAT Sensor Present	On		Manifold Air Temperature	118	°F
Injector Bank A Pulse Width	1.80	ms	Injector Bank B Pulse Width	1.80	ms
RPM Reduction Control	Off		Disable Injector Bank	Off	
Malfunction Lamp Output	Off		Fuel Pump Output	On	
Gen Warning 1 Input	Off		Gen Warning 1 Lamp Output	Off	
Gen Warning 2 Input	Off		Gen Warning 2 Lamp Output	Off	
Check Gauges Lamp Output	Off		Warning Buzzer Output	Off	
Max Engine RPM logged	5732	RPM	Knock Time	0.0	hrs
Run Time 0-1000 RPM	5.4	hrs	Run Time 1001-2000 RPM	1.8	hrs
Run Time 2001-3000 RPM	0.5	hrs	Run Time 3001-4000 RPM	3.1	hrs
Run Time 4001-5000 RPM	0.2	hrs	Run Time Over 5000 RPM	0.0	hrs
Fuel Flow Rate	0.70	GPH	Engine Displacement	5.70	L

GM-DELCO MEFI 4 MODE 1 MASTER | Current Packet Index: 4 | 13:37:23:481

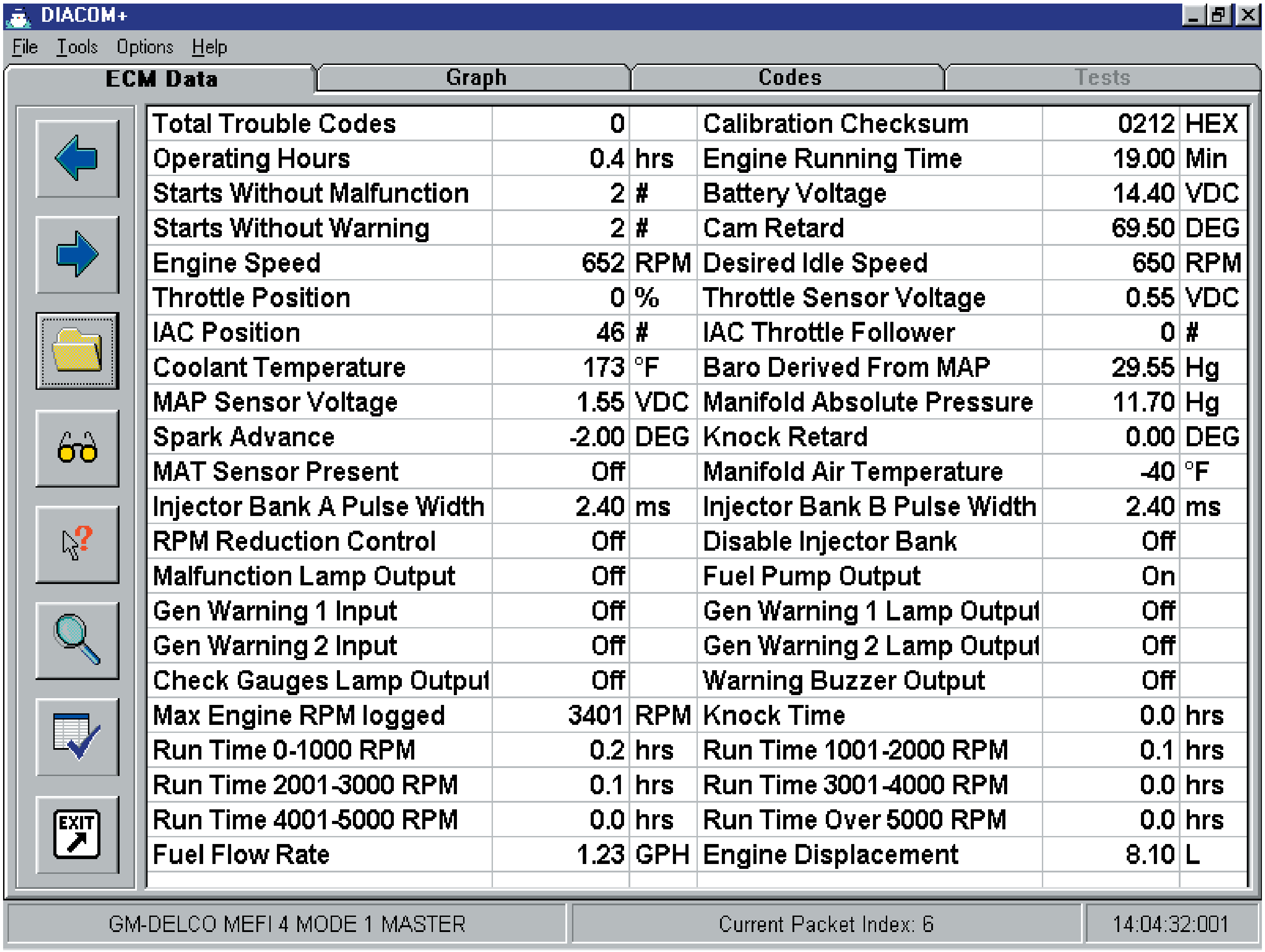
6.0L MPI



Total Trouble Codes	0		Calibration Checksum	0F4B	HEX
Operating Hours	0.2	hrs	Engine Running Time	7.73	Min
Starts Without Malfunction	5	#	Battery Voltage	11.80	VDC
Starts Without Warning	0	#	Cam Retard	65.30	DEG
Engine Speed	653	RPM	Desired Idle Speed	650	RPM
Throttle Position	0	%	Throttle Sensor Voltage	0.53	VDC
IAC Position	5	#	IAC Throttle Follower	0	#
Coolant Temperature	176	°F	Baro Derived From MAP	29.33	Hg
MAP Sensor Voltage	1.73	VDC	Manifold Absolute Pressure	12.57	Hg
Spark Advance	-2.00	DEG	Knock Retard	0.00	DEG
MAT Sensor Present	Off		Manifold Air Temperature	-40	°F
Injector Bank A Pulse Width	2.40	ms	Injector Bank B Pulse Width	2.40	ms
RPM Reduction Control	Off		Disable Injector Bank	Off	
Malfunction Lamp Output	Off		Fuel Pump Output	On	
Gen Warning 1 Input	Off		Gen Warning 1 Lamp Output	Off	
Gen Warning 2 Input	Off		Gen Warning 2 Lamp Output	Off	
Check Gauges Lamp Output	Off		Warning Buzzer Output	Off	
Max Engine RPM logged	4147	RPM	Knock Time	0.0	hrs
Run Time 0-1000 RPM	0.1	hrs	Run Time 1001-2000 RPM	0.1	hrs
Run Time 2001-3000 RPM	0.0	hrs	Run Time 3001-4000 RPM	0.0	hrs
Run Time 4001-5000 RPM	0.0	hrs	Run Time Over 5000 RPM	0.0	hrs
Fuel Flow Rate	0.84	GPH	Engine Displacement	6.00	L

GM-DELCO MEFI 4 MODE 1 MASTER | Current Packet Index: 8 | 14:24:44:572

8.1L MPI



Total Trouble Codes	0		Calibration Checksum	0212	HEX
Operating Hours	0.4	hrs	Engine Running Time	19.00	Min
Starts Without Malfunction	2	#	Battery Voltage	14.40	VDC
Starts Without Warning	2	#	Cam Retard	69.50	DEG
Engine Speed	652	RPM	Desired Idle Speed	650	RPM
Throttle Position	0	%	Throttle Sensor Voltage	0.55	VDC
IAC Position	46	#	IAC Throttle Follower	0	#
Coolant Temperature	173	°F	Baro Derived From MAP	29.55	Hg
MAP Sensor Voltage	1.55	VDC	Manifold Absolute Pressure	11.70	Hg
Spark Advance	-2.00	DEG	Knock Retard	0.00	DEG
MAT Sensor Present	Off		Manifold Air Temperature	-40	°F
Injector Bank A Pulse Width	2.40	ms	Injector Bank B Pulse Width	2.40	ms
RPM Reduction Control	Off		Disable Injector Bank	Off	
Malfunction Lamp Output	Off		Fuel Pump Output	On	
Gen Warning 1 Input	Off		Gen Warning 1 Lamp Output	Off	
Gen Warning 2 Input	Off		Gen Warning 2 Lamp Output	Off	
Check Gauges Lamp Output	Off		Warning Buzzer Output	Off	
Max Engine RPM logged	3401	RPM	Knock Time	0.0	hrs
Run Time 0-1000 RPM	0.2	hrs	Run Time 1001-2000 RPM	0.1	hrs
Run Time 2001-3000 RPM	0.1	hrs	Run Time 3001-4000 RPM	0.0	hrs
Run Time 4001-5000 RPM	0.0	hrs	Run Time Over 5000 RPM	0.0	hrs
Fuel Flow Rate	1.23	GPH	Engine Displacement	8.10	L

Engine Diacom Data Definitions

The Engine Diacom Data Definitions contain a brief description of all engine related parameters available on the PCM Preferred Screen.

ECM Data Descriptions

TOTAL TROUBLE CODES - Scan Tool Range 0-999- This indicates the number of stored Diagnostic Trouble Codes (DTC)..

CALIBRATION CHECKSUM - Scan Tool Range 0-65535 - This number is automatically calculated by the ECM. This number may also be used as a calibration identifier.

ENGINE HOURS - Scan Tool Range 0.0-9999.9 Hrs - Indicates the total engine running time.

ENGINE RUNNING TIME - Scan Tool Range 0.00-9999.99 Min - Indicates the amount of time the ignition key was in the "ON" or "RUN" position. Once the key has been cycled to the "OFF" position, this counter will reset to 0.00.

STARTS WITHOUT MALFUNCTION - Scan Tool Range 0-9999 - The ECM keeps track of how many engine starts occur without a DTC stored in memory. This counter resets whenever a DTC is detected.

BATTERY VOLTAGE - Scan Tool Range 0.00 - 25.50 volts - This represents the system voltage. This is monitored through "J2-1" of the ECM.

STARTS WITHOUT WARNING - Scan Tool Range 0-9999 - The ECM keeps track of how many engine starts occur without a warning stored in memory. This counter resets whenever a warning is detected.

CAM RETARD - Scan Tool Range 00.00-99.99 degrees - This information is used by the ECM in order to determine spark delivery. The 6.0L and 8.1L engines have a fixed sensor.

Note: The 5.0L and 5.7L engines have an adjustable sensor. Moving the distributor on these applications changes the Cam Retard, not ignition timing. This value MUST be 43-47 degrees, or drivability problems will occur.

ENGINE SPEED - Scan Tool Range 0-9999 RPM - Engine speed is computed by the ECM from the crankshaft position sensor input. It should remain close to the desired idle under various engine loads with engine idling.

DESIRED IDLE - Scan Tool Range 0-3187 RPM - The idle speed that is commanded by the ECM. The ECM will compensate for various engine loads based on engine coolant temperature to keep the engine at the desired speed.

THROTTLE POSITION - Scan Tool Range 0% - 99.6% - Throttle position is computed by the ECM from the TP Sensor voltage. Throttle Position should display 0% at idle and 99.6% at wide open throttle.

THROTTLE SENSOR VOLTAGE - Scan Tool Range 0.00-5.00 Volts - This is the voltage being monitored by the ECM on the TP sensor signal circuit. The voltage will increase from about 0.60 volt at idle, to about 4.50 volts at WOT.

IAC POSITION - Scan Tool Range 0-255 - 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 help maintain desired idle RPM.

IAC THROTTLE FOLLOWER - Scan Tool Range 0-255 - When the throttle is moved from the closed throttle position, some idle air control counts are added to prevent stalling when returned to the closed throttle position.

COOLANT TEMPERATURE - Scan Tool Range -40°F to 304°F - The Engine Coolant Temperature (ECT) sensor is mounted in the coolant stream and sends engine temperature information to the ECM. The ECM supplies 5 volts to the ECT sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold (internal resistance high), the ECM monitors a high signal voltage and interprets it as a cold engine. As the sensor warms (internal resistance decreases), the voltage signal will decrease and the ECM will interpret the lower voltage as a warm engine.

BARO DERIVED FROM MAP - Scan Tool Range 00.00-99.99 Hg - The Barometric Pressure reading displayed is measured from the MAP sensor signal, monitored at ignition "ON," engine "OFF," and WOT conditions. The Barometric Pressure is used to compensate for altitude differences.

MAP SENSOR VOLTAGE - Scan Tool Range 0.00-5.00 Volts - The Manifold Absolute Pressure (MAP) sensor measures the change in the intake manifold pressure from engine load and speed changes. As intake manifold pressure increases, intake vacuum decreases resulting in a higher MAP sensor voltage reading.

MANIFOLD ABSOLUTE PRESSURE - Scan Tool Range 00.00-99.99 Hg - The Manifold Absolute Pressure (MAP) sensor measures the change in the intake manifold pressure from engine load and speed changes. As intake manifold pressure increases, intake vacuum decreases resulting in a higher MAP sensor Hg reading.

SPARK ADVANCE - Scan Tool Range -90.00° to 90.00°- This is a display of the spark advance, which the ECM calculates, and then provides all spark advance to the ignition system. The ECM computes the desired spark advance using data such as engine temperature, RPM, engine load and operating mode. There is no adjustment for spark advance. The ECM also uses spark advance to help maintain idle speed. Under normal operating condition, with the engine warmed up and 0% throttle angle, it is normal to see spark advance vary continuously.

KNOCK RETARD - Scan Tool Range 0.00°-45.50° - Indicates the amount of spark the ECM is removing from spark advance, in response to the signal from the knock sensor(s).

MAT SENSOR PRESENT - Scan Tool Range "YES" or "NO" - Indicates whether a manifold air temperature sensor is present in the system. This sensor is often referred to as an Intake Air Temperature (IAT) sensor.

MANIFOLD AIR TEMPERATURE - Scan Tool Range -40°F to 304°F - The ECM converts the resistance of the intake air temperature sensor to degrees. Intake Air Temperature (IAT) is used by the ECM to adjust fuel delivery and spark timing according to incoming air density. (5.0/5.7L Only).

INJECTOR BANK A PULSE WIDTH - Scan Tool Range 0-1000.00 msec. - Indicates the amount of time the ECM is commanding the injectors "ON" during each engine cycle. A larger injector pulse width will cause more fuel to be delivered. Inj. Pulse Width should increase with increased engine load.

INJECTOR BANK B PULSE WIDTH - Scan Tool Range 0-1000.00 msec. - Indicates the amount of time the ECM is commanding the injectors "ON" during each engine cycle. A larger injector pulse width will cause more fuel to be delivered. Inj. Pulse Width should increase with increased engine load.

RPM REDUCTION CONTROL - Scan Tool Displays "ON" or "OFF" - Indicates whether or not the ECM is functioning in RPM Reduction mode. During this mode, the ECM only triggers one injector driver, resulting in fuel to only half of the cylinders.

DISABLE INJECTOR BANK - Scan Tool Displays "ON" or "OFF" - Indicates whether or not the ECM is disabling one injector while in RPM Reduction mode.

MALFUNCTION INDICATOR LAMP OR MALFUNCTION LAMP OUTPUT - Scan Tool Displays "ON" or "OFF" - Indicates the ECM commanded state of the Malfunction Indicator Lamp. Should display "ON" with the ignition "ON," engine "OFF."

FUEL PUMP OUTPUT - Scan Tool Displays "ON" or "OFF" - Indicates the ECM commanded state of the fuel pump relay driver circuit.

GEN WARNING 1 INPUT - Scan Tool Displays "ON" or "OFF" - This is a discrete input to the ECM on J1-19 for the transmission temperature switch. ON indicates the switch is grounded (Transmission Temperature Switch >235°F - optional).

GEN WARNING 1 LAMP OUTPUT - Scan Tool Displays "ON" or "OFF" - Indicates the ECM commanded state of J1-22 (Transmission Temperature Lamp - optional).

GEN WARNING 2 INPUT - Scan Tool Displays "ON" or "OFF" - This is a discrete input to the ECM on J1-4 for the oil pressure switch. ON indicates the oil pressure switch is grounded (Low Oil Pressure Switch <10 psi).

GEN WARNING 2 LAMP OUTPUT - Scan Tool Displays "ON" or "OFF" - Indicates the ECM commanded state of J1-23 (Low Oil Pressure Lamp).

CHECK GAUGES LAMP OUTPUT - Scan Tool Displays "ON" or "OFF" - Indicates the ECM commanded state of the Check Gauges lamp. This lamp indicates an engine over temp condition.

WARNING BUZZER OUTPUT - Scan Tool Displays "ON" or "OFF" - Indicates the ECM commanded state of the Buzzer. The buzzer may be commanded "ON" for various conditions.

MAX ENGINE RPM LOGGED - Scan Tool Displays 0-9999 RPM - The ECM keeps a log of the maximum RPM the engine has turned.

KNOCK TIME - Scan Tool Displays 0.0-9999.99 hours - The ECM keeps track of the total time that the ECM has detected engine knock.

RUN TIME 0-1000 RPM - Scan Tool Displays 0.0-9999.9 hours - The ECM keeps track of the total time that the engine has ran between 0-1000 RPM.

RUN TIME 1001-2000 RPM - Scan Tool Displays 0.0-9999.9 hours - The ECM keeps track of the total time that the engine has ran between 1001-2000 RPM.

RUN TIME 2001-3000 RPM - Scan Tool Displays 0.0-9999.9 hours - The ECM keeps track of the total time that the engine has ran between 2001-3000 RPM.

RUN TIME 3001-4000 RPM - Scan Tool Displays 0.0-9999.9 hours - The ECM keeps track of the total time that the engine has ran between 3001-4000 RPM.

RUN TIME 4001-5000 RPM - Scan Tool Displays 0.0-9999.9 hours - The ECM keeps track of the total time that the engine has ran between 4001-5000 RPM.

RUN TIME OVER 5000 RPM - Scan Tool Displays 0.0-9999.9 hours - The ECM keeps track of the total time that the engine has ran over 5000 RPM.

FUEL FLOW RATE - Scan Tool Range 0-100 gph - This is the gallons per hour of fuel that the engine is consuming.

ENGINE DISPLACEMENT - Scan Tool Range 5.0/5.7/6.0/8.1 liter - This is the displacement in liters of the engine being looked at.

ECM Diagnostic Trouble Codes

The Malfunction Indicator Lamp (MIL) will be “ON” if the malfunction exists under the conditions listed below. If the malfunction clears, the lamp will go out and the Diagnostic Trouble Code (DTC) will be stored in the ECM. Any DTC’s stored will be erased if no problem reoccurs within 50 engine starts. The amount of time after the malfunction occurs before the MIL illuminates is calibratible. (Instantly or up to one minute).

Many of the DTC tables include a functional check of the system that may pinpoint a problem. However, it is important to remember that the DTC tables are specifically designed for use only when a DTC is set. Therefore, a thorough understanding of the normal operation of the system being diagnosed is necessary, and use of the tables for this purpose is at the discretion of the technician.

NOTICE: Some DTC’s are referred as “Latching Codes.” A latching code will cause the MIL lamp to stay “ON” during an ignition cycle whether the malfunction is corrected or not. This also means you can not clear the DTC during the same ignition cycle.

Diagnostic Trouble Code (DTC) Table

DTC	Description
DTC 14	Engine Coolant Temperature (ECT) Sensor Circuit. Coolant Sensor Voltage High. (Low Temperature Indicated)
DTC 15	Engine Coolant Temperature (ECT) Sensor Circuit. Coolant Sensor Voltage Low. (High Temperature Indicated)
DTC 21	Throttle Position (TP) Sensor Circuit. Throttle Position Sensor Skewed High.
DTC 21	Throttle Position (TP) Sensor Circuit. Throttle Position Sensor Voltage High.
DTC 22	Throttle Position (TP) Sensor Circuit. Throttle Position Sensor Voltage Low.
DTC 23	Intake Air Temperature (IAT) Sensor Circuit. Manifold Temperature Sensor Voltage High. (Low Temperature Indicated)
DTC 25	Intake Air Temperature (IAT) Sensor Circuit. Manifold Temperature Sensor Voltage Low. (High Temperature Indicated)
DTC 33	Manifold Absolute Pressure (MAP) Sensor Circuit. Manifold Pressure Sensor Voltage High.
DTC 34	Manifold Absolute Pressure (MAP) Sensor Circuit. Manifold Pressure Sensor Voltage Low.
DTC 41	EST Fault - EST A Fault. (Cylinder/Coil #1) or (5.0/5.7L Ignition Control Circuit)
DTC 41	EST Fault - EST B Fault. (Cylinder/Coil #8)
DTC 41	EST Fault - EST C Fault. (Cylinder/Coil #7)
DTC 41	EST Fault - EST D Fault. (Cylinder/Coil #2)
DTC 41	EST Fault - EST E Fault. (Cylinder/Coil #6)
DTC 41	EST Fault - EST F Fault. (Cylinder/Coil #5)
DTC 41	EST Fault - EST G Fault. (Cylinder/Coil #4)
DTC 41	EST Fault - EST H Fault. (Cylinder/Coil #3)
DTC 44	ESC System Cannot Detect Knock. Knock Sensor (KS) 1 Circuit Inactive.
DTC 44	ESC System Cannot Detect Knock. Knock Sensor (KS) 2 Circuit Inactive. (6.0/8.1L only)
DTC 51	ECM Calibration Checksum Failure.
DTC 81	Exhaust Temperature Switch Circuit. (If Applicable) *** See Note.** Oil/CAT Low. (High Exhaust Temperature Indicated - 248° ± 5° F.)
DTC 81	Optional CAN BUS 3-wire Oil Pressure Sensor Circuit (If Applicable). Oil/CAT Low. (Low Oil Pressure Indicated - < 10 psi)

Diagnostic Trouble Code (DTC) Table (cont'd)

DTC	Description
DTC 81	Crankshaft Position (CKP) Sensor Circuit Fault. Crank Signal Fault. (Hard or No Start, Backfire, No Power)
DTC 81	Camshaft Position (CMP) Sensor Circuit Fault. CAM Signal Fault. (No Symptom)
DTC 81	DEPSPWR Circuit. DEPSPWR Out of Range. (Hard or No Start, No Symptom)
DTC 81	5 Volt Reference Circuit. 5 Volt Reference Malfunction. (Hard Start, Rough, Rich Exhaust)
DTC 81	Fuel Pump Relay Circuit. Fuel Pump Low/Open. (No Fuel Pump Operation)
DTC 81	Fuel Pump Relay Circuit. Fuel Pump High. (No Fuel Pump Operation)
DTC 81	Injector Driver A Circuit. Inj A High. [Cylinders 1,4,6,7 (6.0/8.1L) / Cylinders 2,3,5,8 (5.0/5.7L)]
DTC 81	Injector Driver A Circuit. Inj A Low/Open. [Cylinders 1,4,6,7 (6.0/8.1L) / Cylinders 2,3,5,8 (5.0/5.7L)]
DTC 81	Injector Driver B Circuit. Inj B High. [Cylinders 2,3,5,8 (6.0/8.1L) / Cylinders 1,4,6,7 (5.0/5.7L)]
DTC 81	Injector Driver B Circuit. Inj B Low/Open. [Cylinders 2,3,5,8 (6.0/8.1L) / Cylinders 1,4,6,7 (5.0/5.7L)]

*** NOTE:** Exhaust Temperature Switches ARE NOT used on engines using the 3-wire CAN BUS Oil Pressure Sensor. If a DTC 81 OIL/CAT trouble code is displayed on your scan tool; verify your engine configuration to determine which DTC 81 OIL/CAT diagnostic procedure to perform.

Logged Warnings

Using Diacom, these warnings will be displayed under the "'Codes" tab. They can be cleared the same as the trouble codes. Unlike trouble codes, these warnings do not turn on the MIL nor can they be flashed out through the MIL, using the DTC tool.

Diacom Description	Affected Circuit(s)	Power Reduction Mode
Engine Over Temperature Telltale Set	Engine Overheating based on ECT value	Enabled when ECT value >220°F
Low System Voltage Telltale Set	Indicates battery/charging system voltage low	No action, set when voltage <10v
General Warning 1 Telltale Set	(J1-19) Transmission Over-temp >235°F	Enabled when trans sw closes
*General Warning 2 Telltale Set	(J1-4) Low Oil Pressure (if using a single-wire oil pressure switch) <10 psi	Enabled when oil sw closes
*Low Oil Pressure Telltale Set	(J2-20) Low Oil Pressure (if using a 3-wire CAN BUS oil pressure sensor)	Enabled, when oil press. <10 psi, also DTC 81 - Oil/CAT Low set.

'Power Reduction Mode' limits engine RPM to 2000. Above 2000 RPM the ECM will disable half of the fuel injectors. Reducing engine RPM below 1200 will restore normal engine operation, until RPM exceeds 2000. Using Diacom, you can verify that the engine is going into RPM Reduction by observing the "RPM Reduction Control" data display. The displayed value will change from "OFF" to "ON" when the engine exceeds 2000 RPM.

*** NOTE:** Depending on the configuration of the engine, you will only see one of the Low Oil Pressure Logged Warnings. General Warning 2 IS NOT used on engines using the 3-wire CAN BUS Oil Pressure Sensor. You could see the General Warning 2 and DTC 81 OIL/CAT Low Set on an engine equipped with the low oil pressure switch and exhaust temperature switches. In this case, General Warning 2 indicates a low oil pressure condition was detected; and the DTC 81 OIL/CAT Low indicates the exhaust temperature exceeded 248° F, usually caused by a lack of raw water flow through the exhaust system.

Logged Warnings

Using Diacom, these warnings will be displayed under the "'Codes" tab. They can be cleared the same as the trouble codes. Unlike trouble codes, these warnings do not turn on the MIL nor can they be flashed out through the MIL, using the DTC tool.

Description
Engine Over Temperature Telltale Set
Low System Voltage Telltale Set
General Warning 1 Telltale Set
General Warning 2 Telltale Set
Low Oil Pressure Telltale Set

Clearing Diagnostic Trouble Codes - Non Scan

1. Install Diagnostic Trouble Code (DTC) tool.
2. Ignition "ON," engine "OFF."
3. Switch DTC tool to "service mode" or "ON."
4. Move the throttle from 0% (idle) to 100% (WOT) and back to 0%.
5. Switch DTC tool to "normal mode" or "OFF." (If this step is not performed, the engine may not start and run).
6. Turn ignition "OFF" for at least 20 seconds.
7. Ignition "ON," engine "OFF."
8. Switch DTC tool to "service mode" or "ON" and verify DTC 12 only. Remove DTC tool.
9. If original DTC's are still present, check "Notice" below and repeat the DTC clearing procedure.
10. If new DTC's are displayed, perform the "On-Board Diagnostic" (OBD) system check.

Clearing Diagnostic Trouble Codes - Scan

1. Install scan tool.
2. Start engine.
3. Link Diacom to the ECM.
3. Select "Codes" tab on the Diacom display.
4. Select "Erase Trouble Codes".
5. Turn ignition "OFF" for at least 20 seconds.
6. Turn ignition "ON" and read DTC's. If DTC's are still present, check "Notice" below and repeat procedure following from step 2.

NOTICE: When clearing DTC's with or without the use of a scan tool, the ignition must be cycled to the "OFF" position or the DTC's will not clear.

Fuel System Specifications

Use regular unleaded gasoline rated at 87 octane or higher. It is recommended that the gasoline meet specifications which were developed by the American Automobile Manufacturers Association for better vehicle performance and engine protection. Gasoline meeting the AAMA specification could provide improved drivability and emission control system protection compared to other gasoline.

Be sure the posted octane is at least 87. If the octane is less than 87, you may get a heavy knocking noise when you drive. If it's bad enough, it can damage your engine.

If you are using fuel rated at the recommended octane or higher and you still hear a heavy knocking, you engine needs service. But don't worry if you hear a little pinging noise when you're accelerating. That's normal, and you don't have to buy a higher octane fuel to get rid of pinging. It's the heavy, constant knock that means you have a problem.

Some gasoline that are not reformulated for low emissions contain an octane-enhancing additive called methylcyclopentadlenyl manganese tricarbonyl (MMT); ask your service station operator whether or not this fuel contains MMT. General Motors does not recommend the use of such gasoline. If fuels containing MMT are used, spark plug life may be reduced and your system performance may be affected.

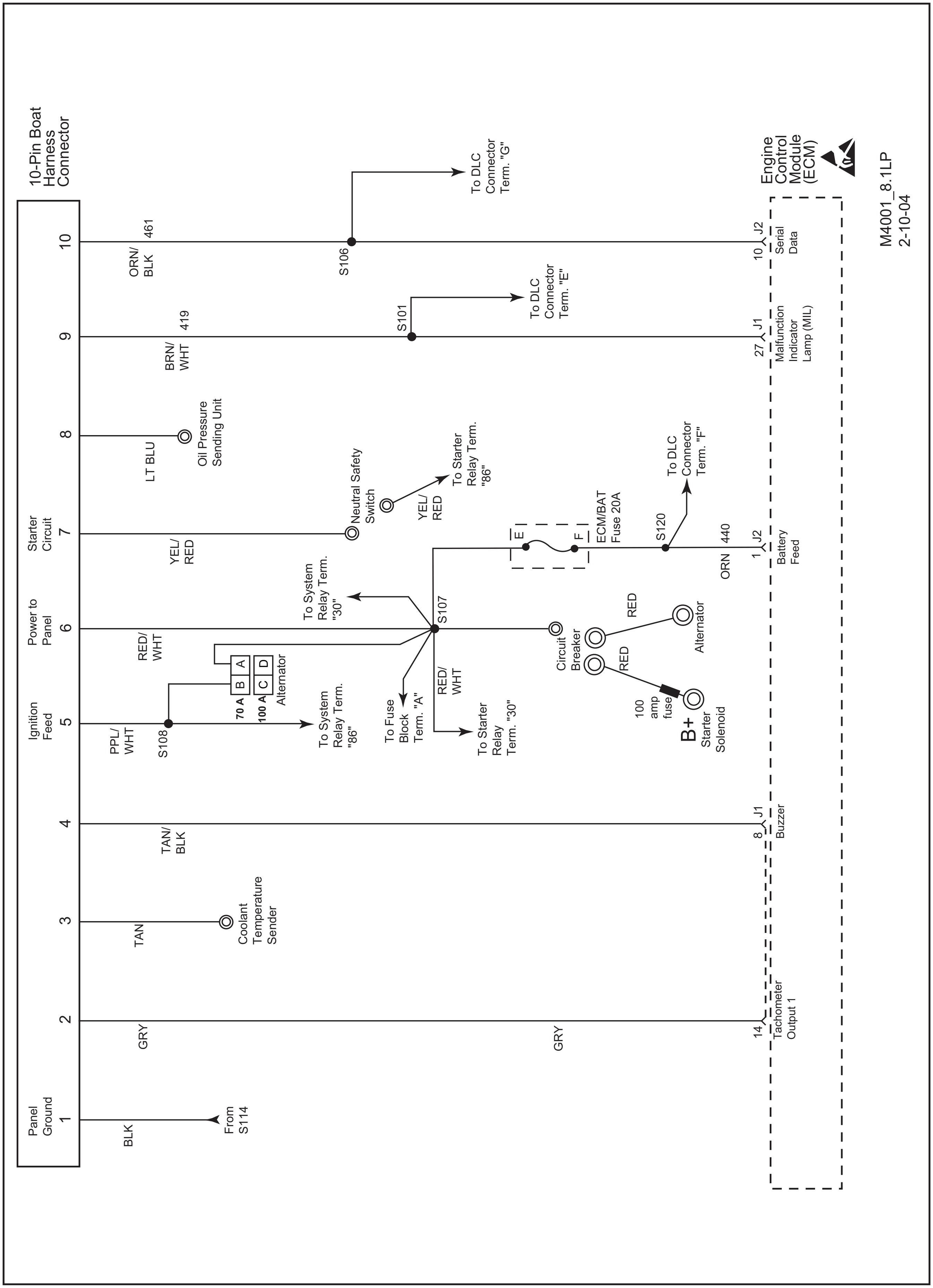
To provide cleaner air, all gasoline in the United States is now required to contain additives that will help prevent deposits from forming in your engine and fuel system, allowing your emission control system to function properly. Therefore, you should not have to add anything to the fuel. In addition, gasoline containing oxygenates, such as ethers and ethanol, and reformulated gasoline may be available in your area to help clean the air. General Motors recommends that you use these gasoline if they comply with the specifications described earlier.

Notice: Your vehicle was not designed for fuel that contains methanol. Don't use it. It can corrode metal parts in your fuel system and also damage plastic and rubber parts.

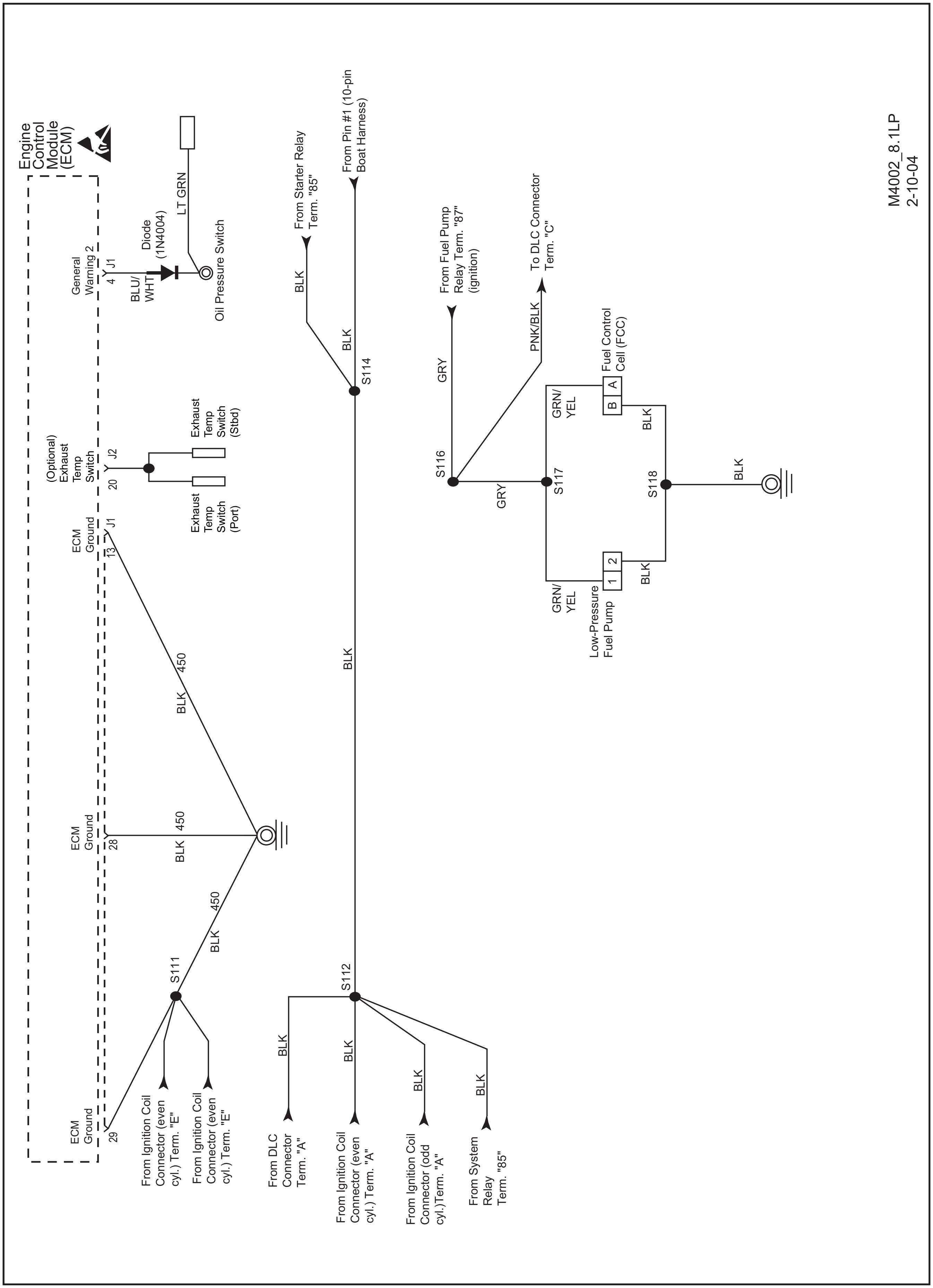
Fuels in Foreign Countries (Gasoline Engines)

If you plan on operating this engine in another country outside the United States and Canada, the proper fuel may be hard to find. Never use leaded gasoline or any other fuel not recommended in the previous text on fuel.

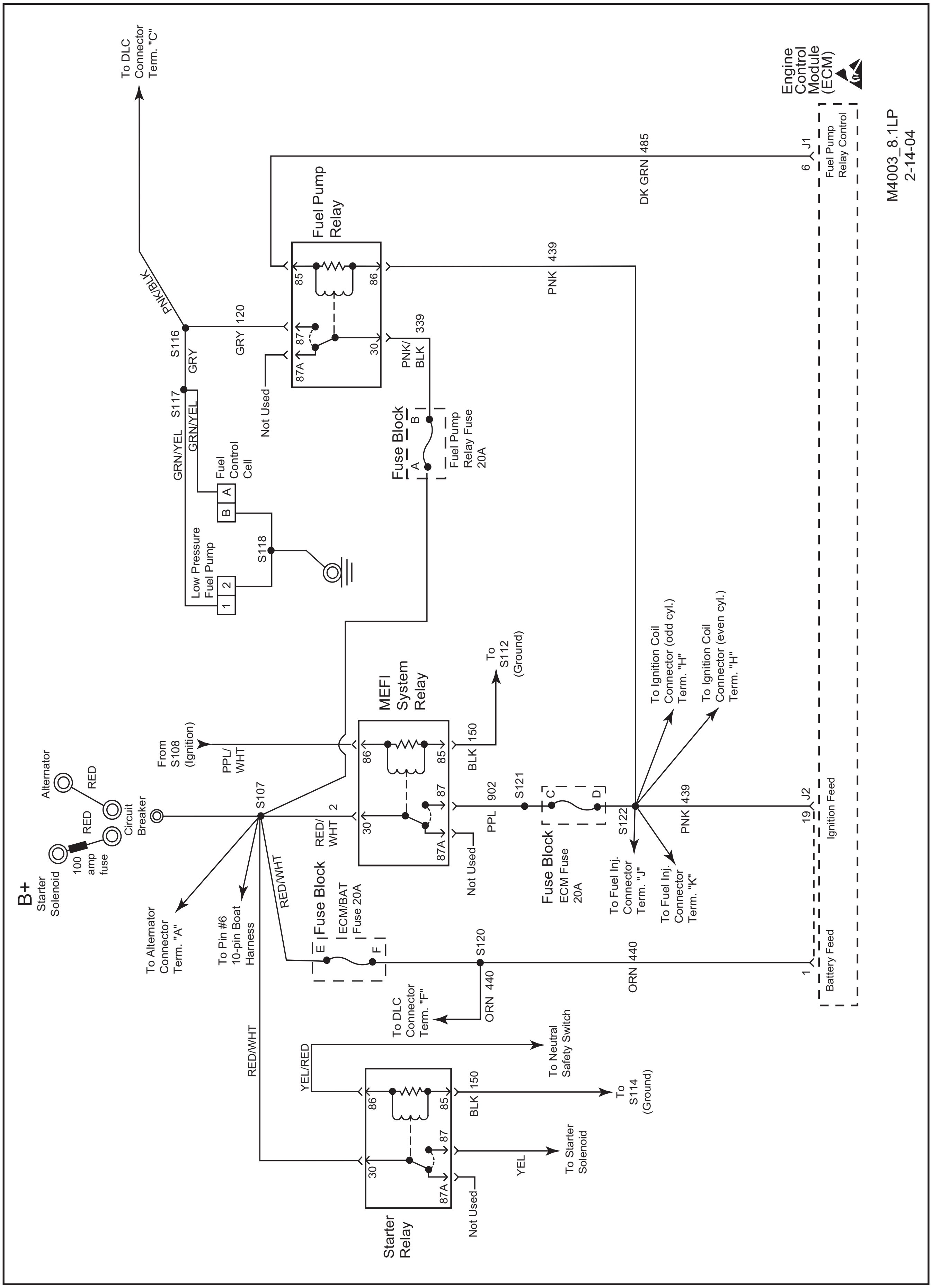
Engine Controls Wiring Schematics- 6.0/8.1L (1 of 13)



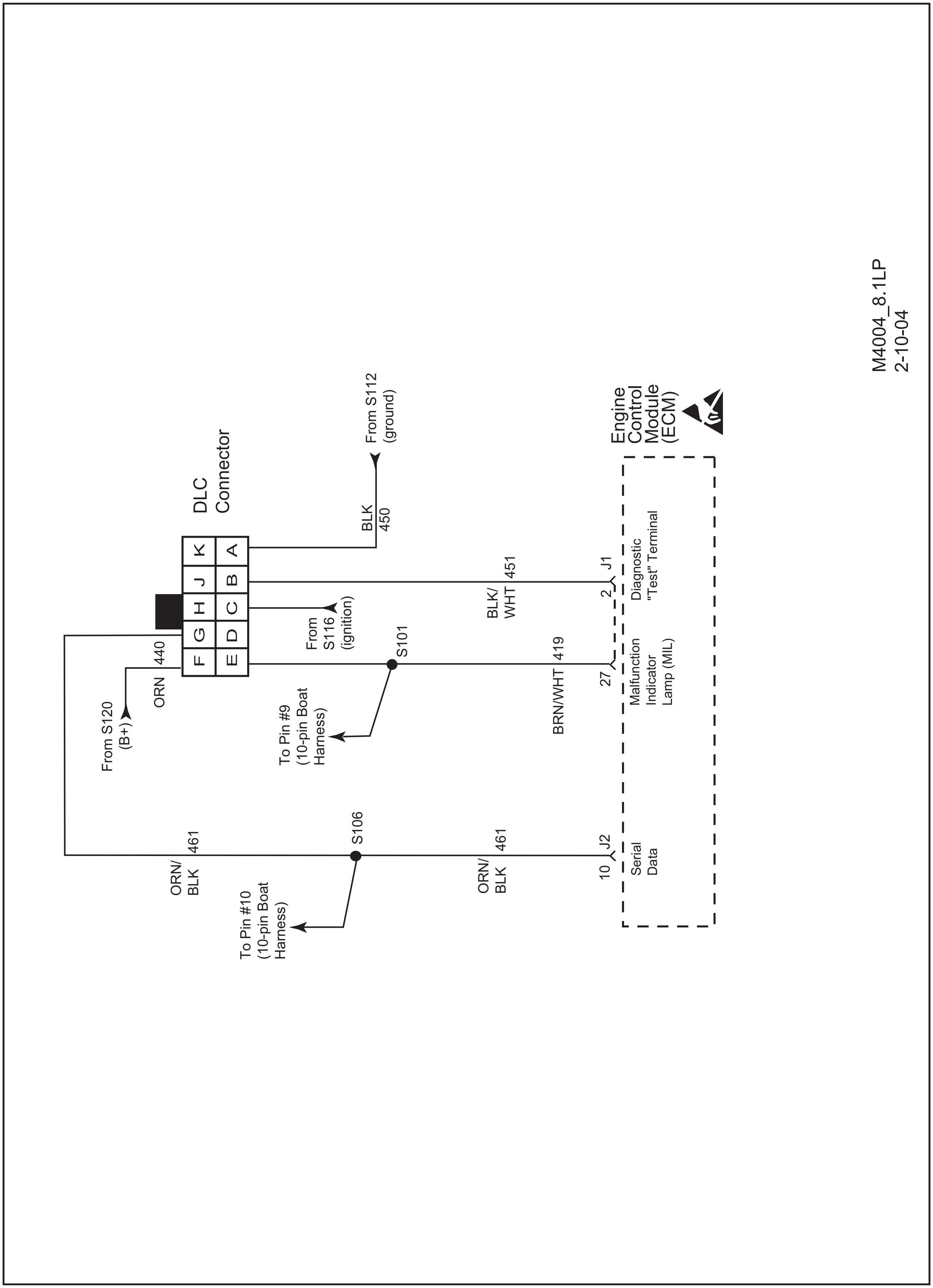
Engine Controls Wiring Schematics - 6.0/8.1L (2 of 13)

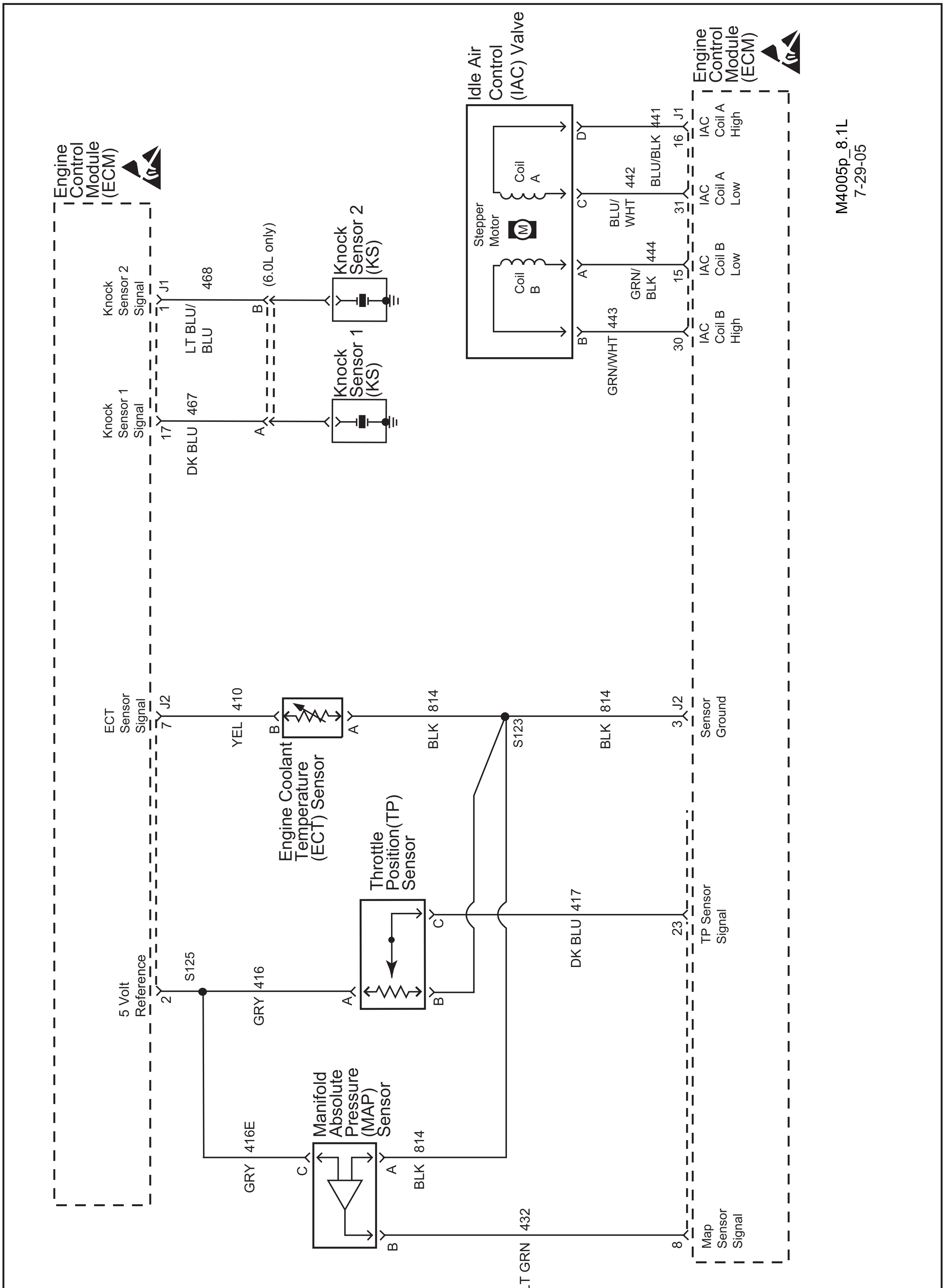


Engine Controls Wiring Schematics- 6.0/8.1L (3 of 13)

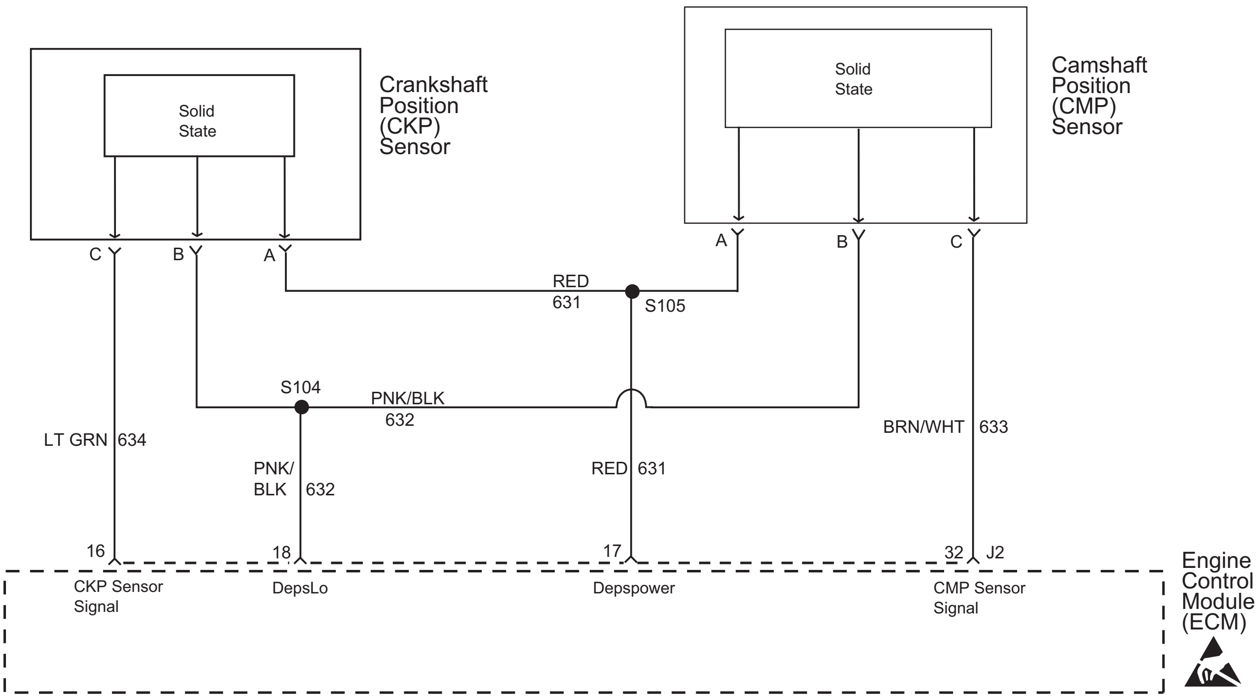


Engine Controls Wiring Schematics- 6.0/8.1L (4 of 13)

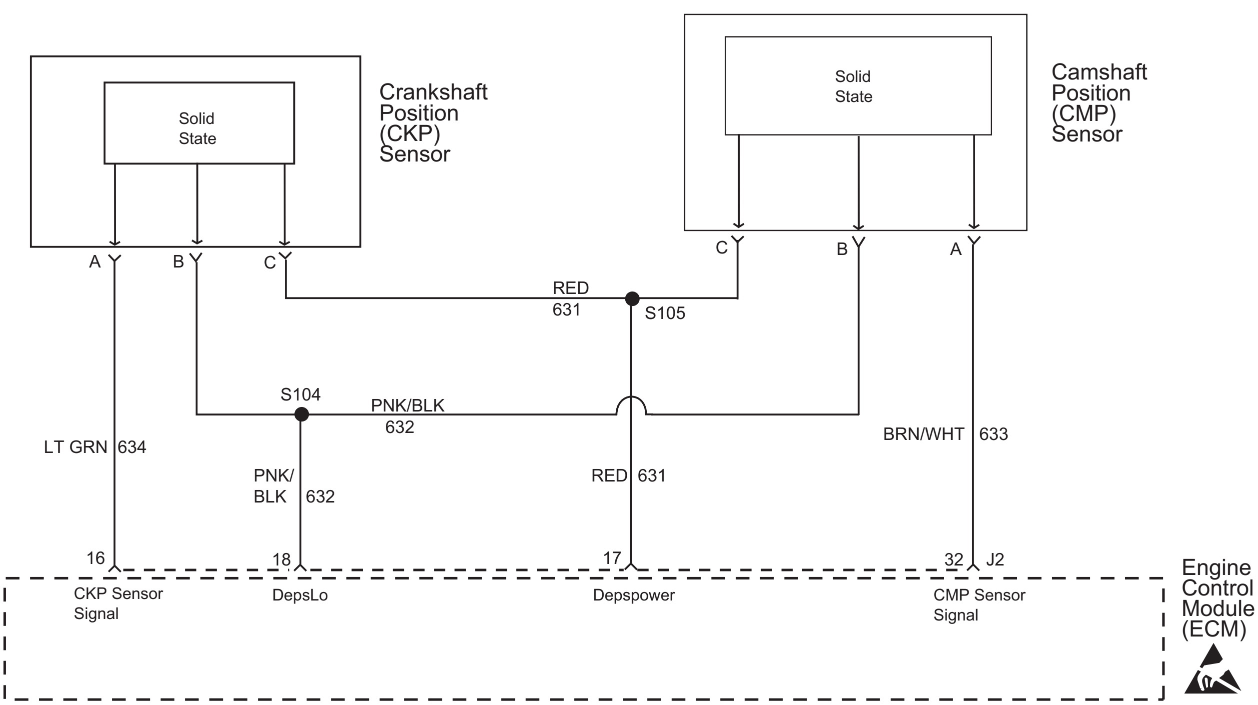



Engine Controls Wiring Schematics- 6.0/8.1L (5 of 13)
Engine Control Module (ECM)
Knock Sensor 2 Signal
1 J1
LT BLU/ BLU
468
Knock Sensor 1 Signal
17
DK BLU 467
(6.0L only)
Knock Sensor 2 (KS)
Knock Sensor 1 (KS)
ECT Sensor Signal
7 J2
YEL 410
Engine Coolant Temperature (ECT) Sensor
BLK 814
S123
5 Volt Reference
2
S125
GRY 416
Throttle Position(TP) Sensor
DK BLU 417
Manifold Absolute Pressure (MAP) Sensor
GRY 416E
BLK 814
LT GRN 432
Idle Air Control (IAC) Valve
Stepper Motor
Coil A
Coil B
443
GRN/WHT
GRN/ BLK 444
BLU/ WHT 442
BLU/BLK 441
16 J1
IAC Coil A High
31
IAC Coil A Low
15
IAC Coil B Low
30
IAC Coil B High
3 J2
Sensor Ground
23
TP Sensor Signal
8
Map Sensor Signal
M4005p_8.1L
7-29-05

Engine Controls Wiring Schematics- 6.0/8.1L (6 of 13)



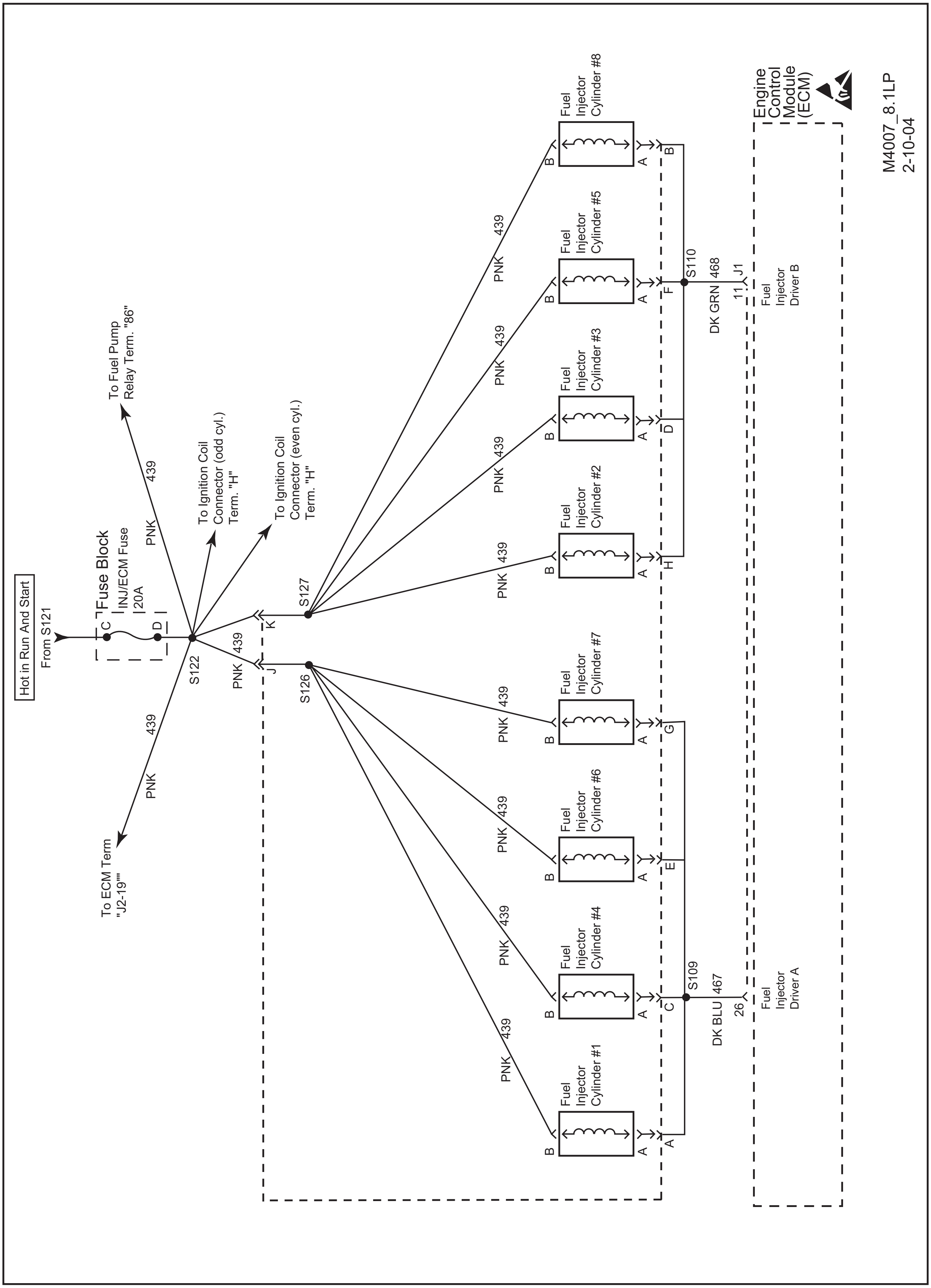
8.1L Engine



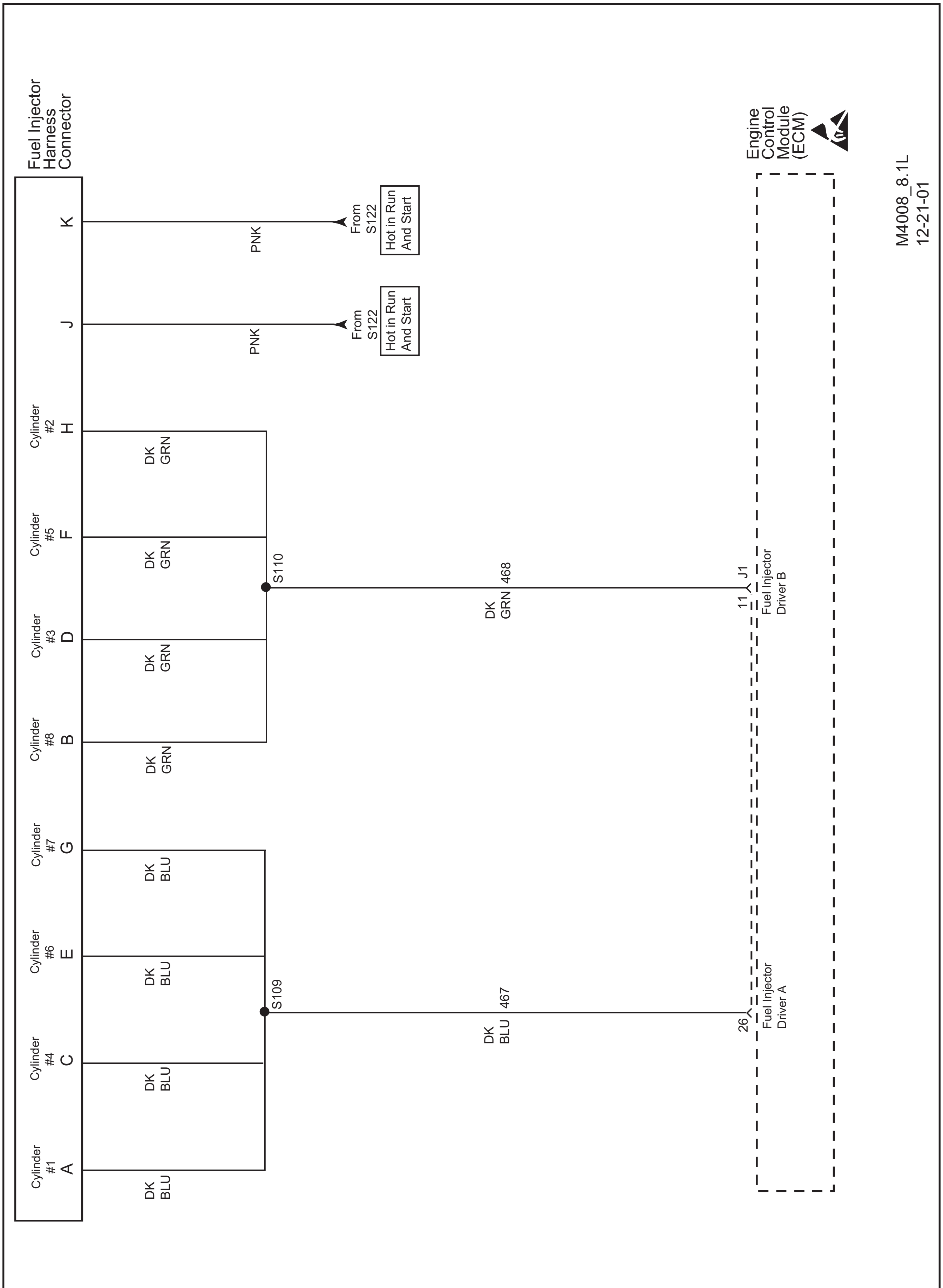
6.0L Engine

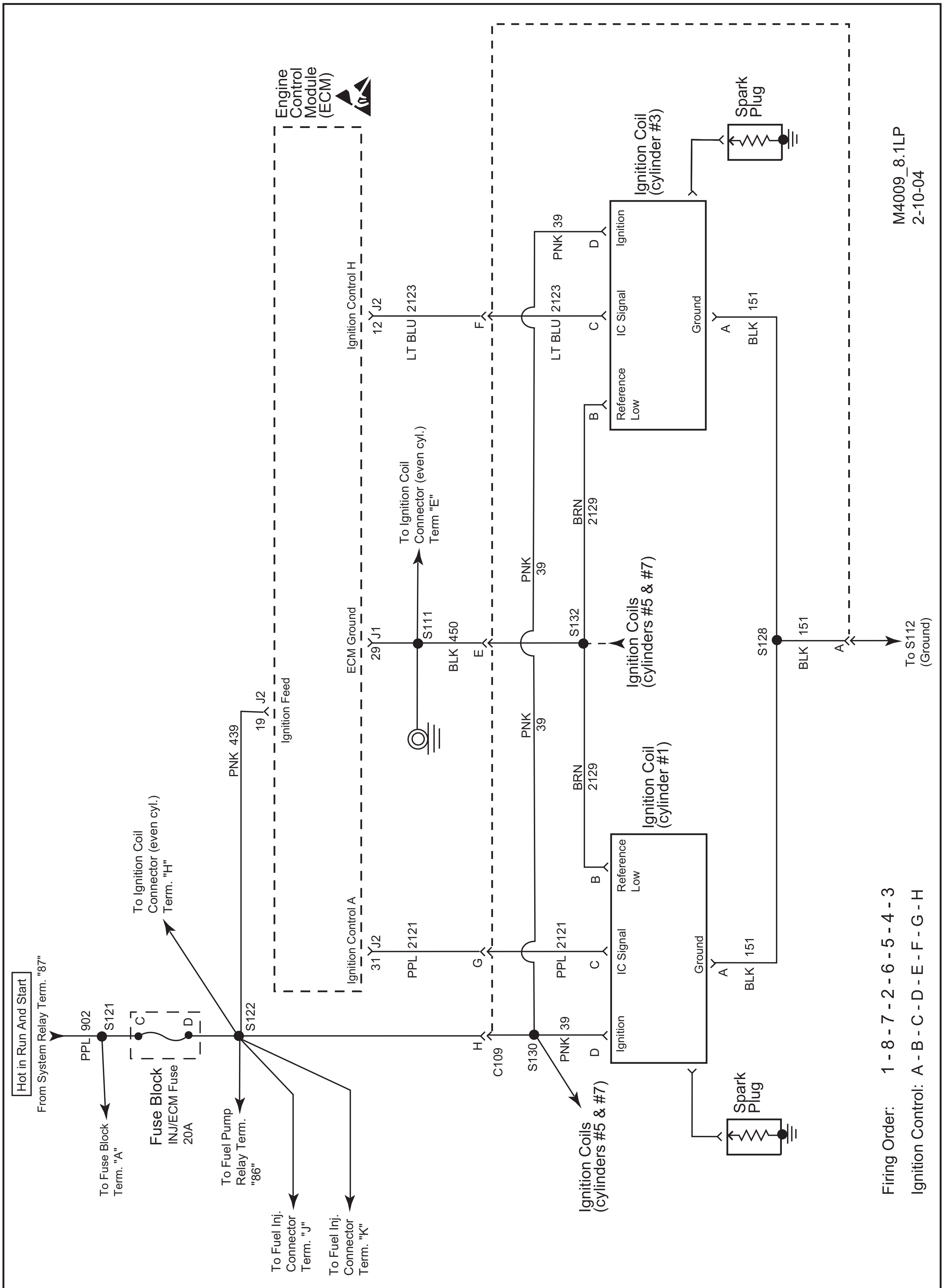
M4006_8.1L
2-10-04

Engine Controls Wiring Schematics- 6.0/8.1L (7 of 13)

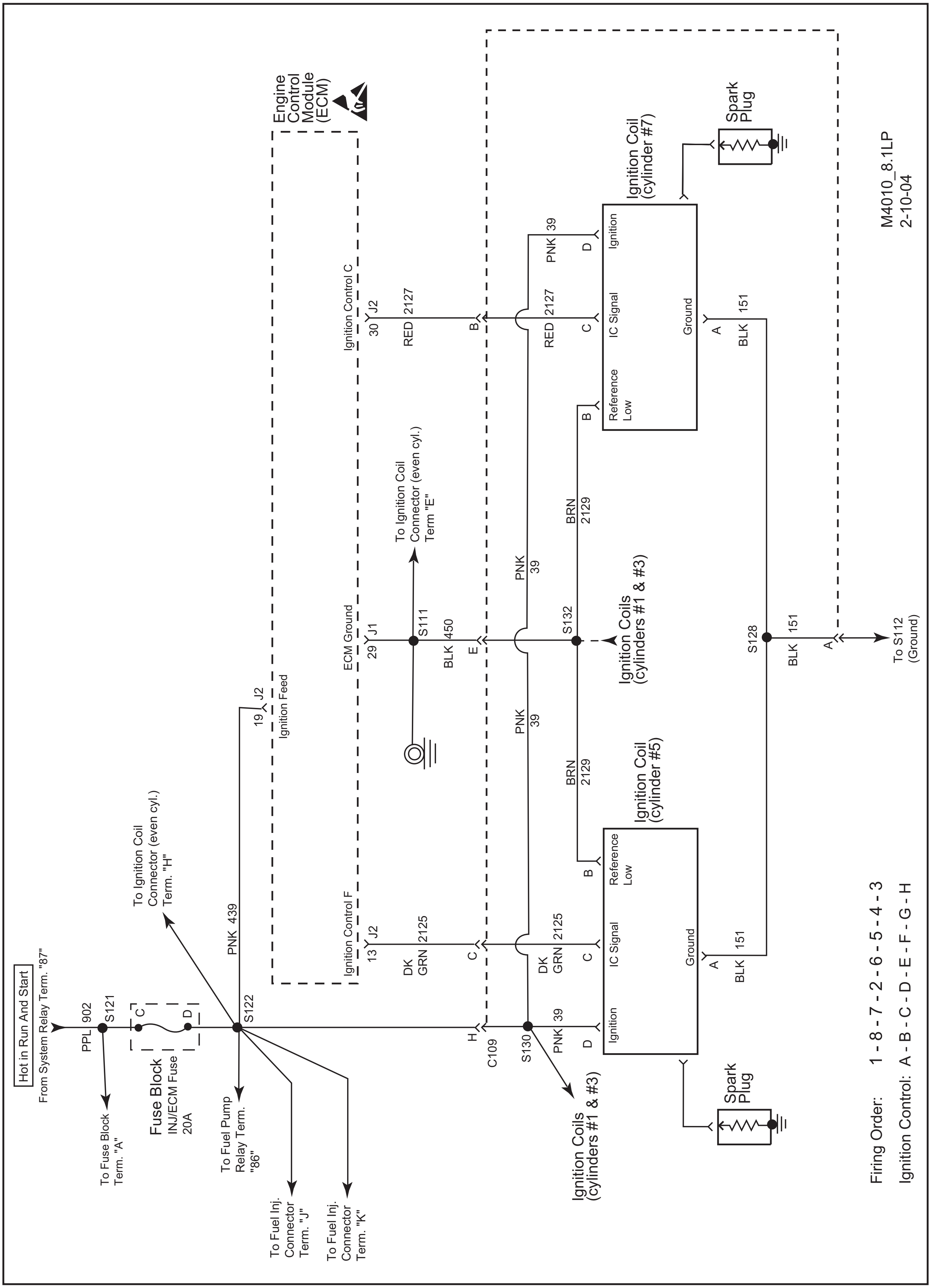


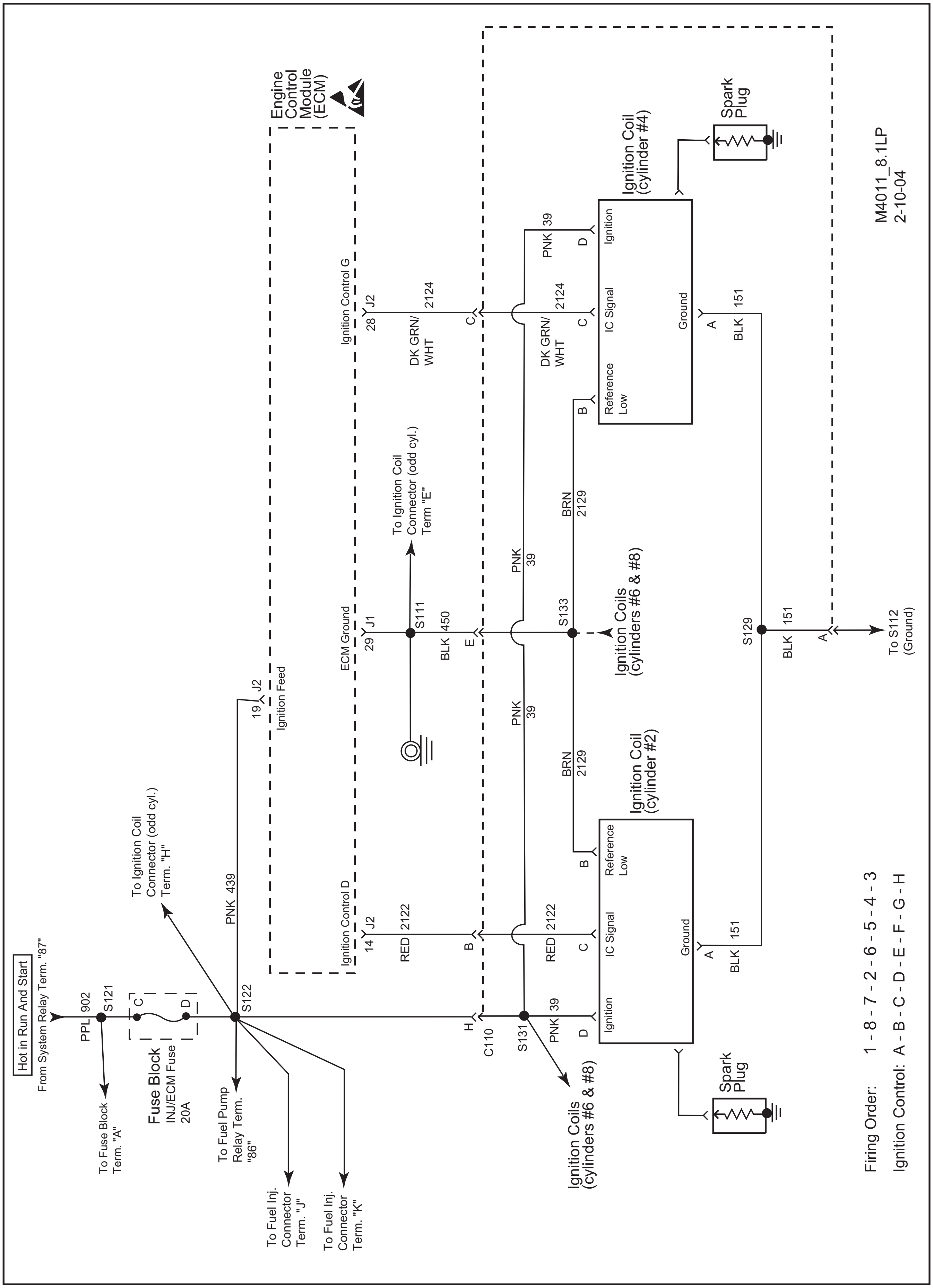
Engine Controls Wiring Schematics- 6.0/8.1L (8 of 13)



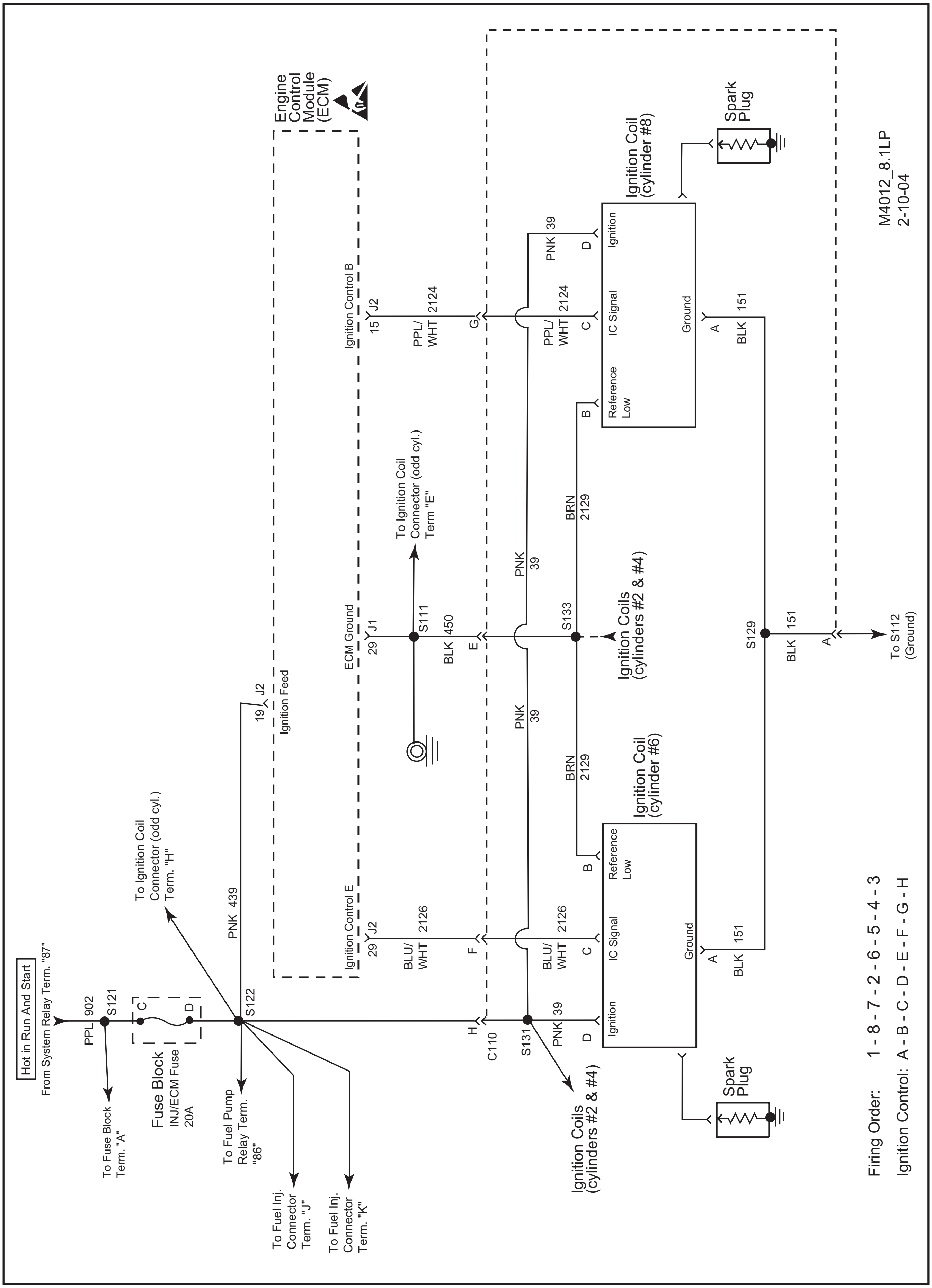

Engine Controls Wiring Schematics- 6.0/8.1L (9 of 13)
Hot in Run And Start
From System Relay Term. "87"
PPL 902
S121
To Fuse Block Term. "A"
Fuse Block
INJ/ECM Fuse
20A
C
D
S122
To Ignition Coil Connector (even cyl.) Term. "H"
To Fuel Pump Relay Term. "86"
To Fuel Inj. Connector Term. "J"
To Fuel Inj. Connector Term. "K"
PNK 439
19 J2
Ignition Feed
Ignition Control A
31 J2
PPL 2121
ECM Ground
29 J1
S111
BLK 450
To Ignition Coil Connector (even cyl.) Term "E"
Ignition Control H
12 J2
LT BLU 2123
Engine Control Module (ECM)
H
G
E
F
C109
S130
PNK 39
D
C
B
A
Ignition Coils (cylinders #5 & #7)
Ignition
IC Signal
Reference Low
Ground
BLK 151
Ignition Coil (cylinder #1)
Spark Plug
BRN 2129
S132
Ignition Coils (cylinders #5 & #7)
S128
To S112 (Ground)
Ignition Coil (cylinder #3)
M4009_8.1LP
2-10-04
Firing Order: 1 - 8 - 7 - 2 - 6 - 5 - 4 - 3
Ignition Control: A - B - C - D - E - F - G - H

Engine Controls Wiring Schematics- 6.0/8.1L (10 of 13)

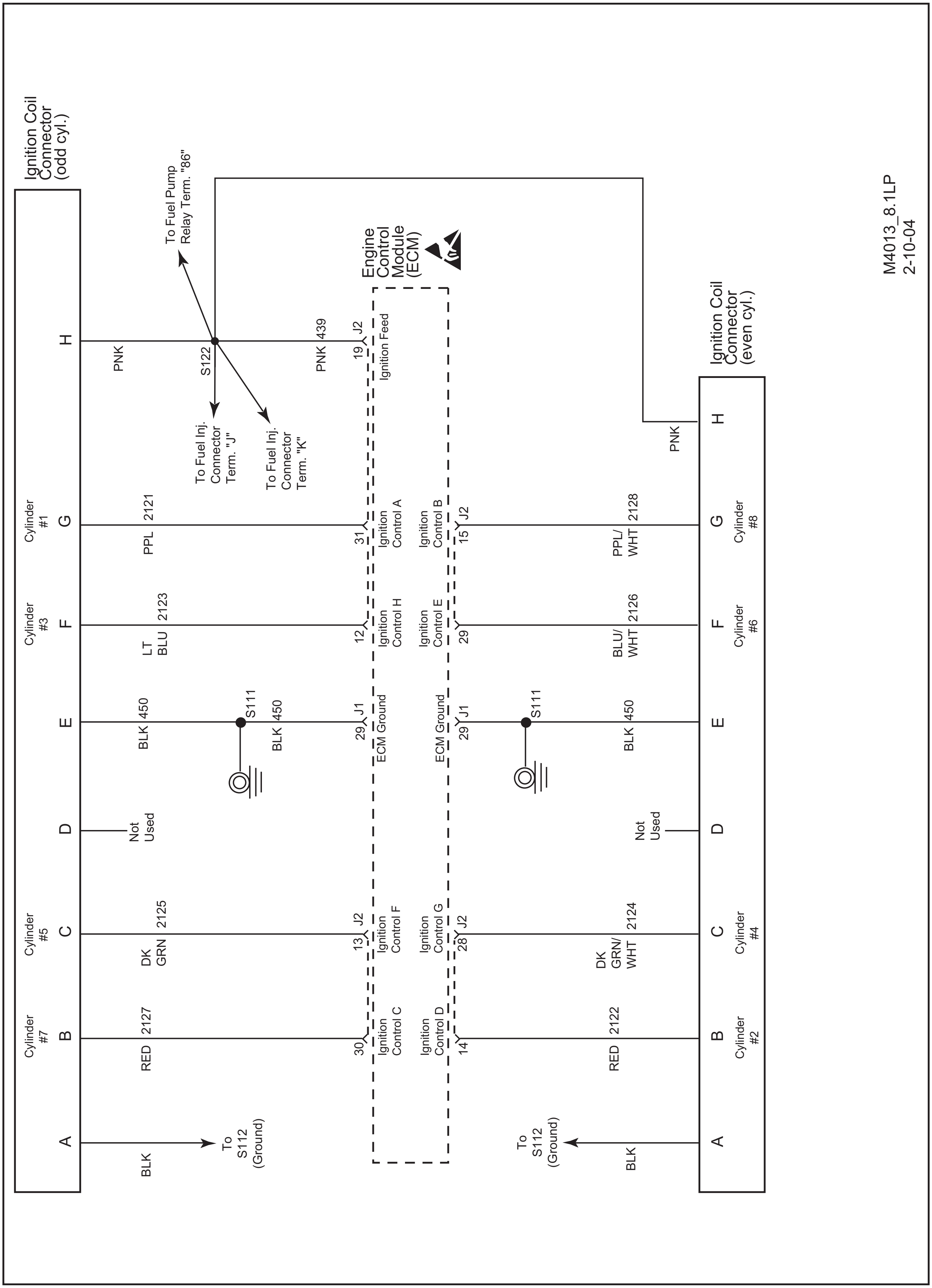



Engine Controls Wiring Schematics- 6.0/8.1L (11 of 13)
Hot in Run And Start
From System Relay Term. "87"
PPL 902
S121
To Fuse Block Term. "A"
Fuse Block
INJ/ECM Fuse
20A
C
D
S122
To Fuel Pump Relay Term. "86"
To Fuel Inj. Connector Term. "J"
To Fuel Inj. Connector Term. "K"
To Ignition Coil Connector (odd cyl.) Term. "H"
PNK 439
19 J2
Ignition Feed
Engine Control Module (ECM)
Ignition Control D
14 J2
RED 2122
B
ECM Ground
29 J1
S111
BLK 450
E
To Ignition Coil Connector (odd cyl.) Term "E"
Ignition Control G
28 J2
DK GRN/ WHT
2124
C
H
C110
S131
PNK 39
D
Ignition Coils (cylinders #6 & #8)
PNK 39
BRN 2129
S133
Ignition Coils (cylinders #6 & #8)
Ignition Coil (cylinder #2)
Ignition
IC Signal
Reference Low
Ground
A
BLK 151
RED 2122
Spark Plug
Ignition Coil (cylinder #4)
DK GRN/ WHT
2124
S129
BLK 151
A
To S112 (Ground)
M4011_8.1LP
2-10-04
Firing Order: 1 - 8 - 7 - 2 - 6 - 5 - 4 - 3
Ignition Control: A - B - C - D - E - F - G - H

Engine Controls Wiring Schematics- 6.0/8.1L (12 of 13)



Engine Controls Wiring Schematics- 6.0/8.1L (13 of 13)



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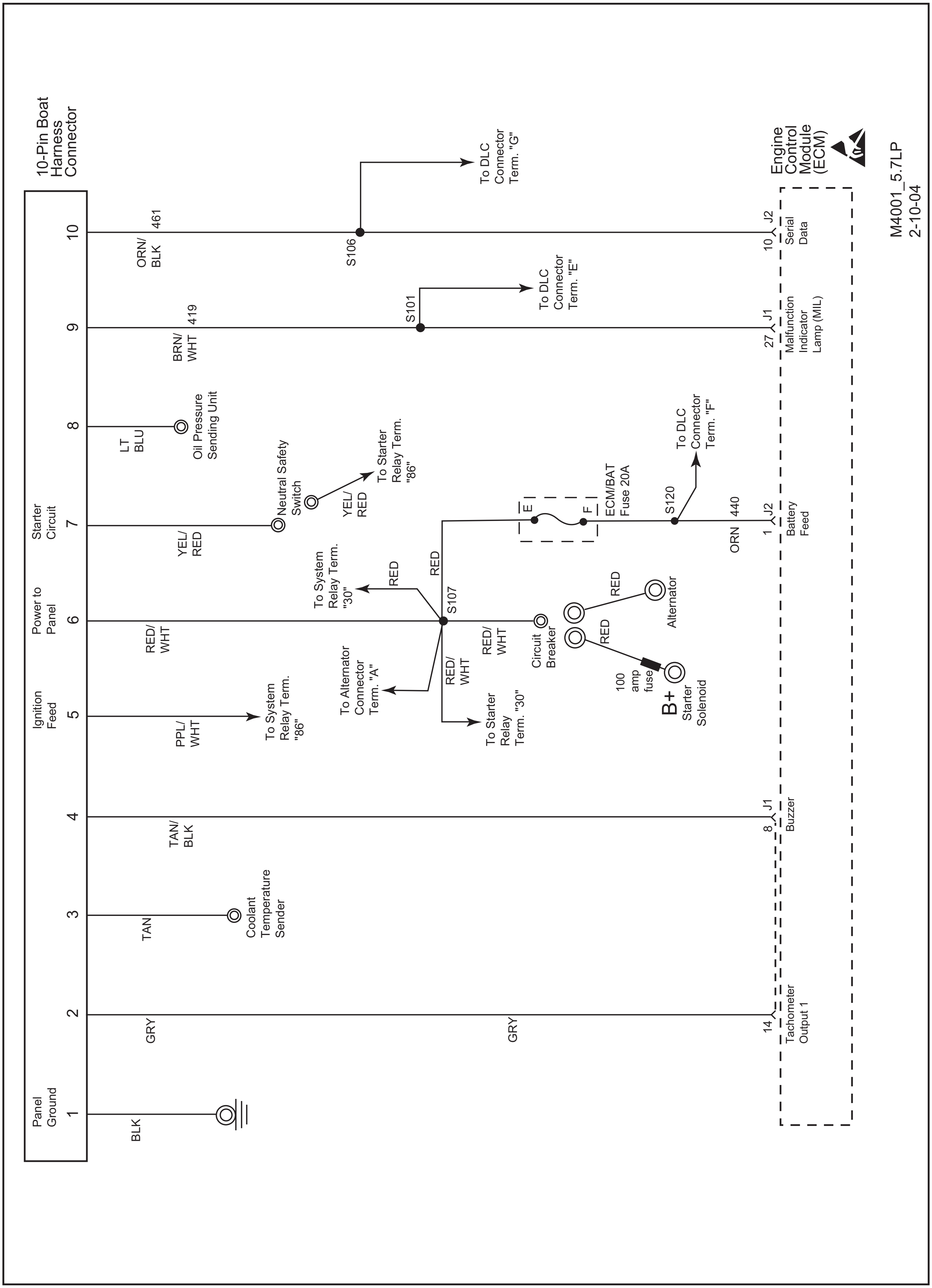
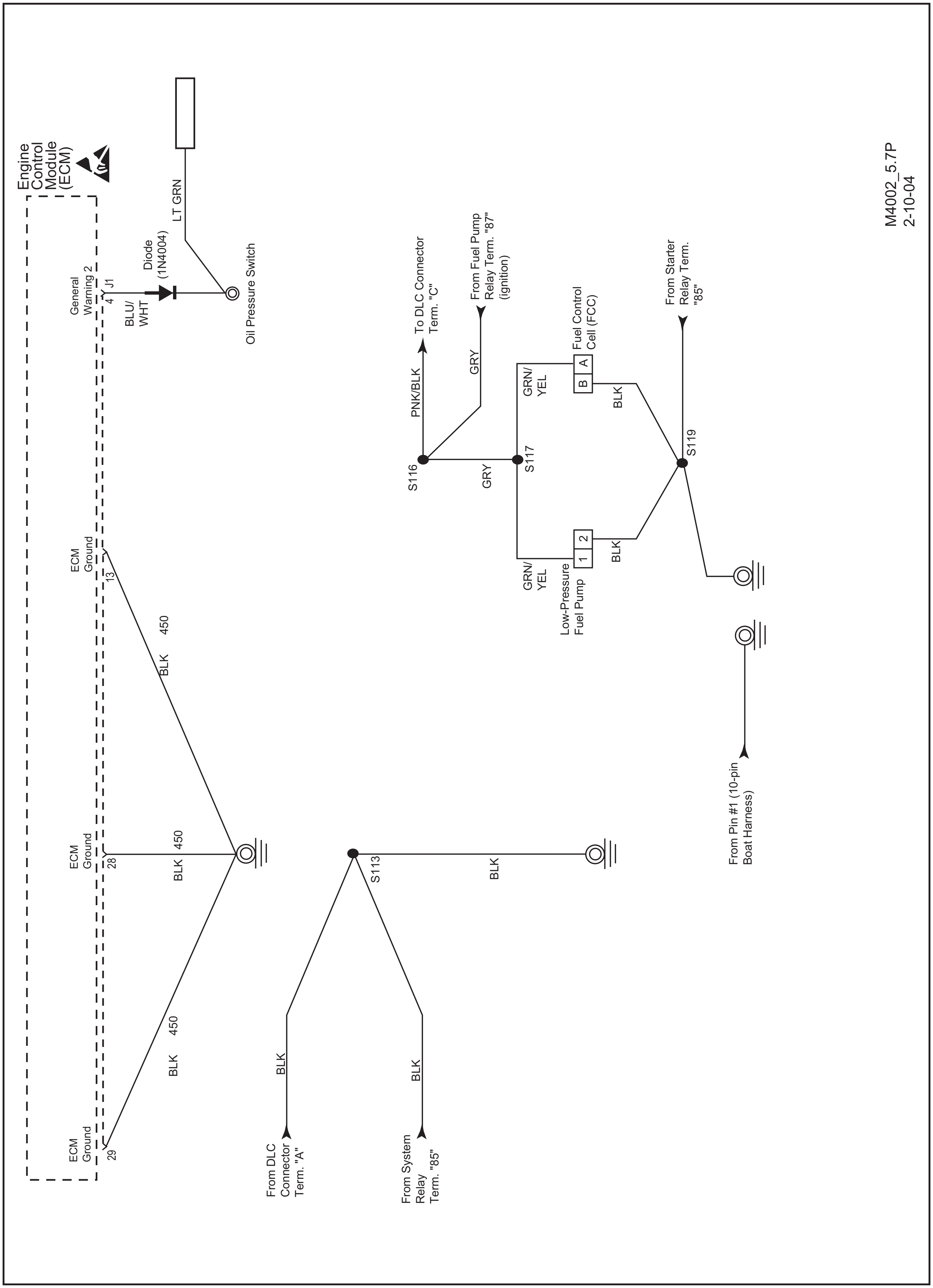
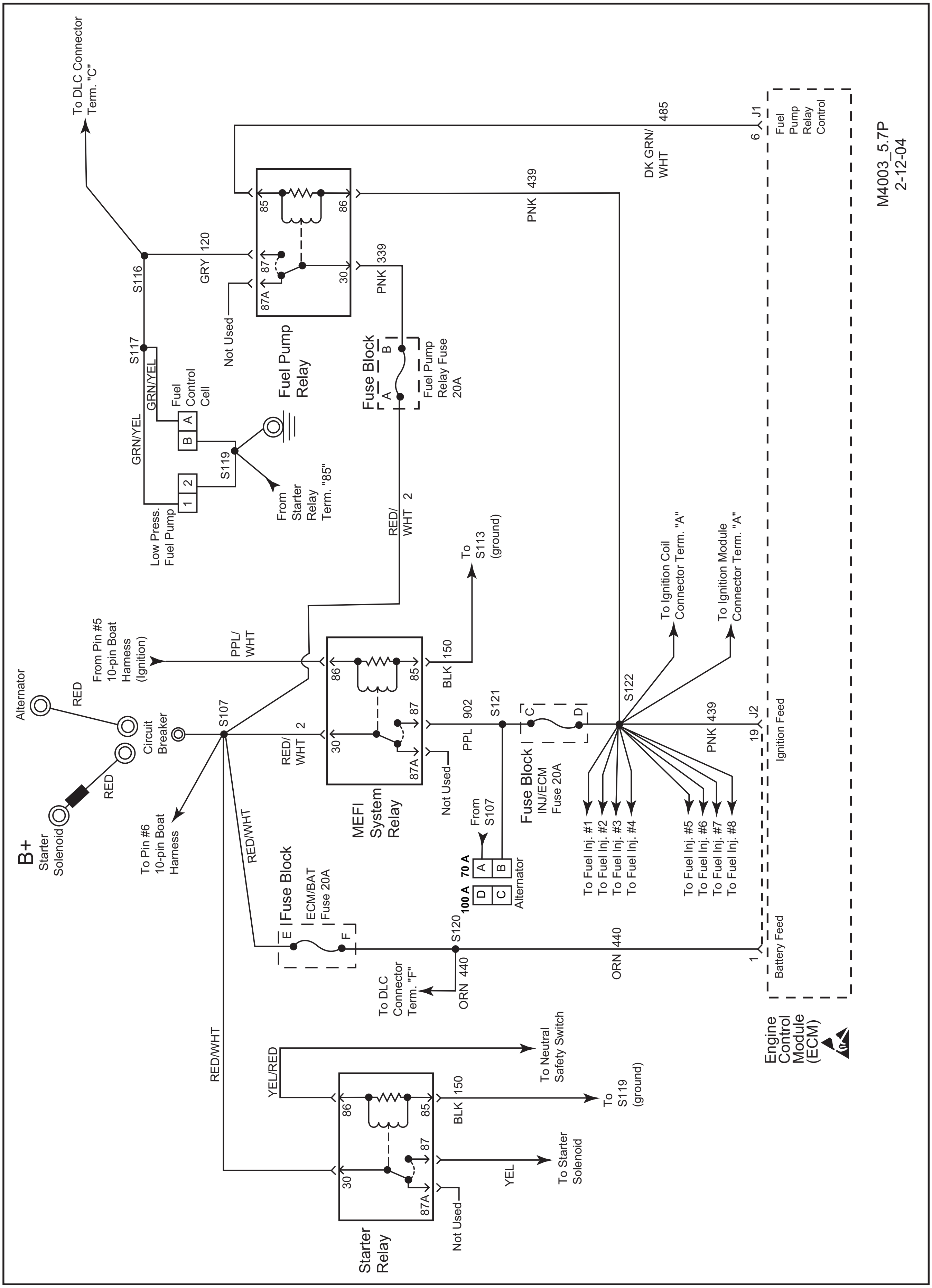
Engine Controls Wiring Schematics- 5.0/5.7L (1 of 9)



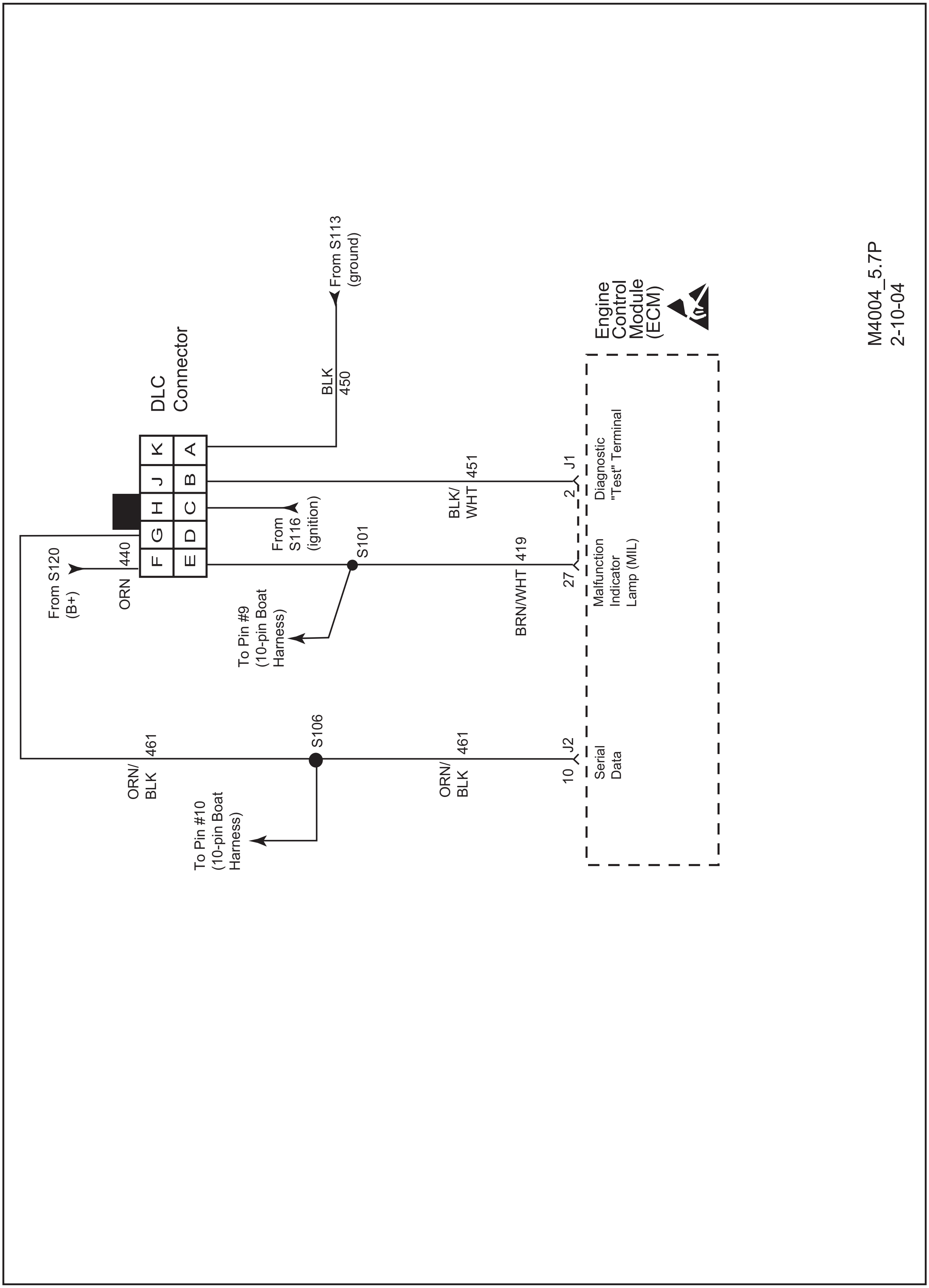
Engine Controls Wiring Schematics- 5.0/5.7L (2 of 9)



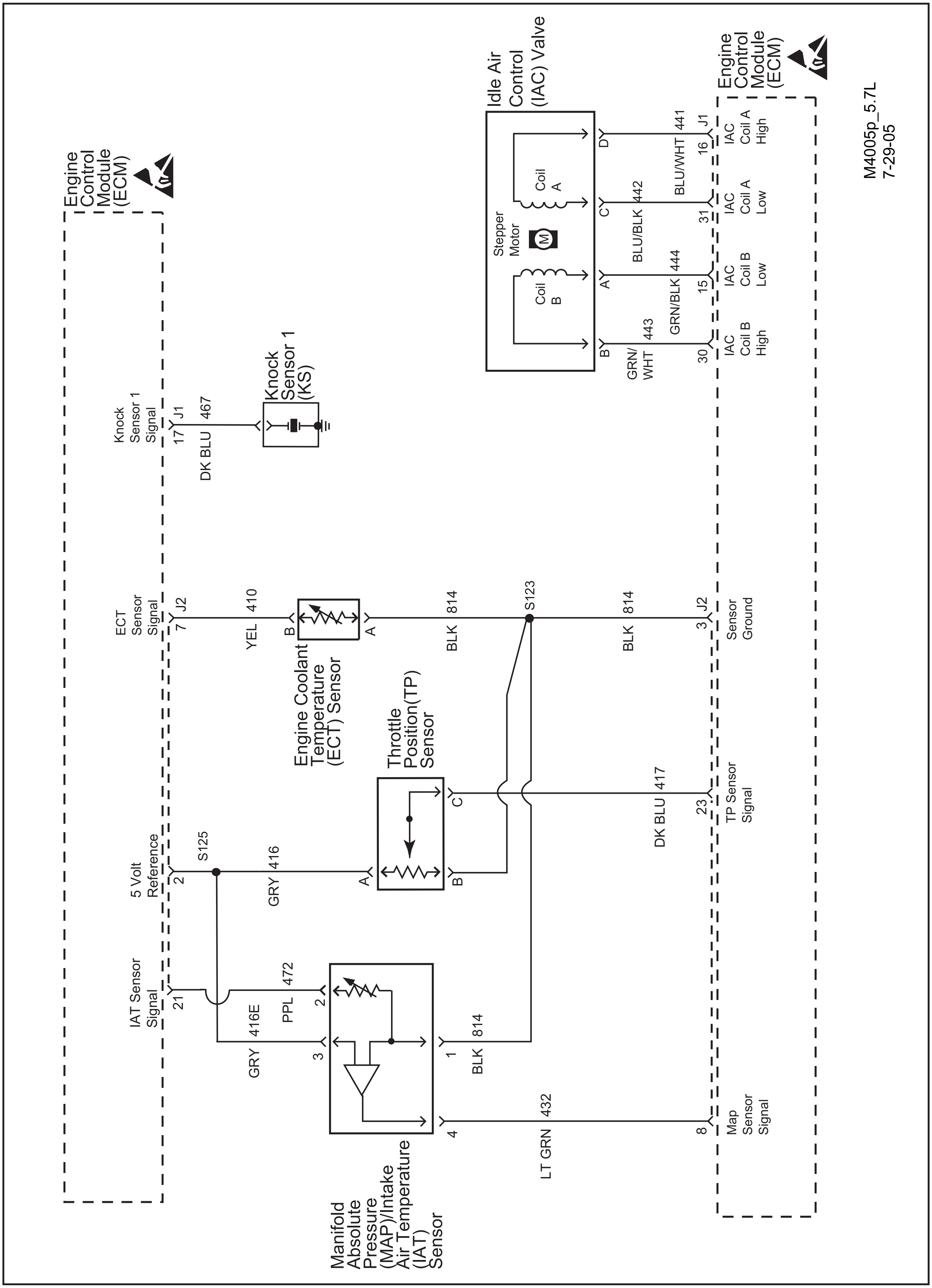
Engine Controls Wiring Schematics- 5.0/5.7L (3 of 9)



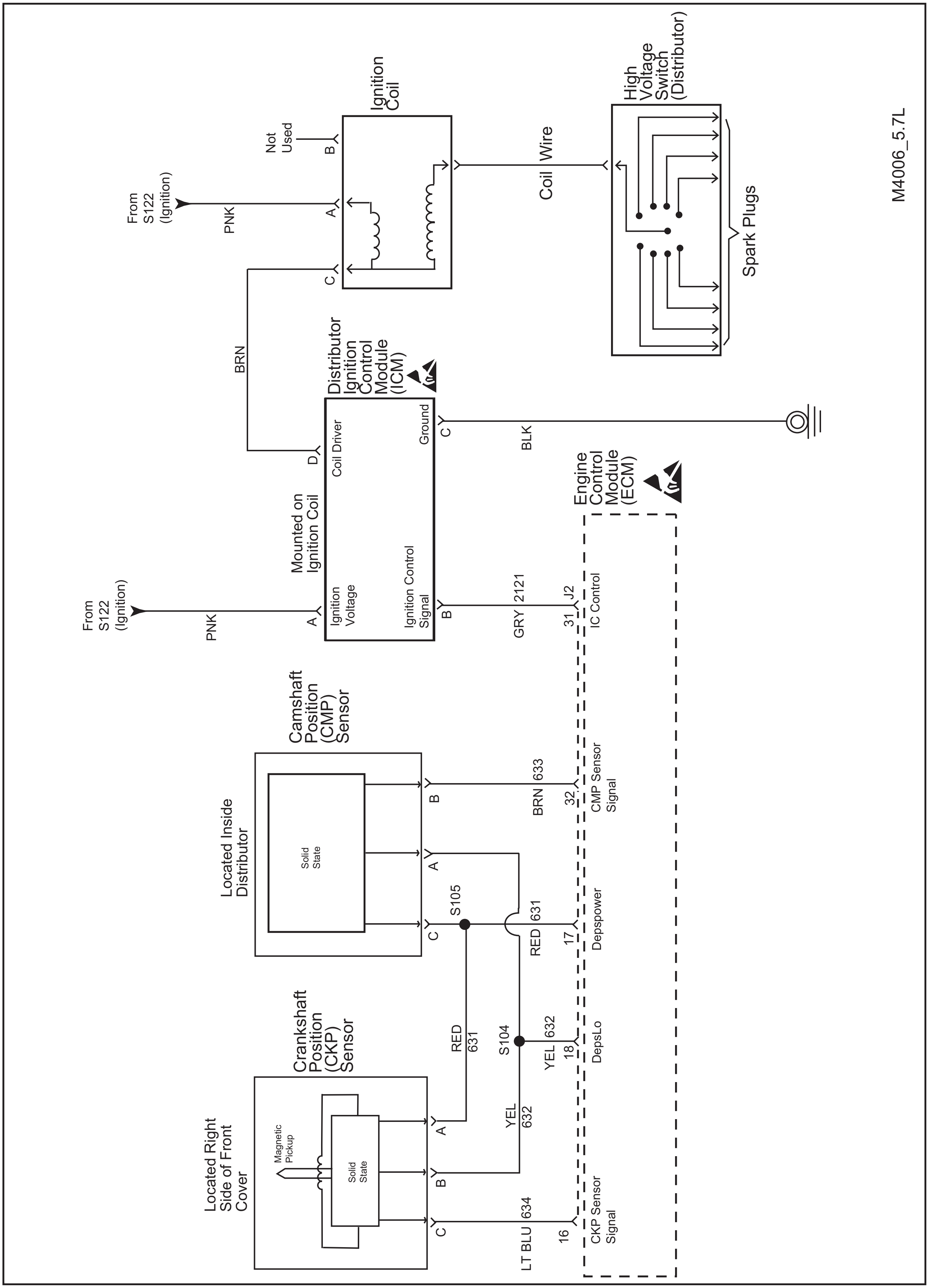
Engine Controls Wiring Schematics- 5.0/5.7L (4 of 9)



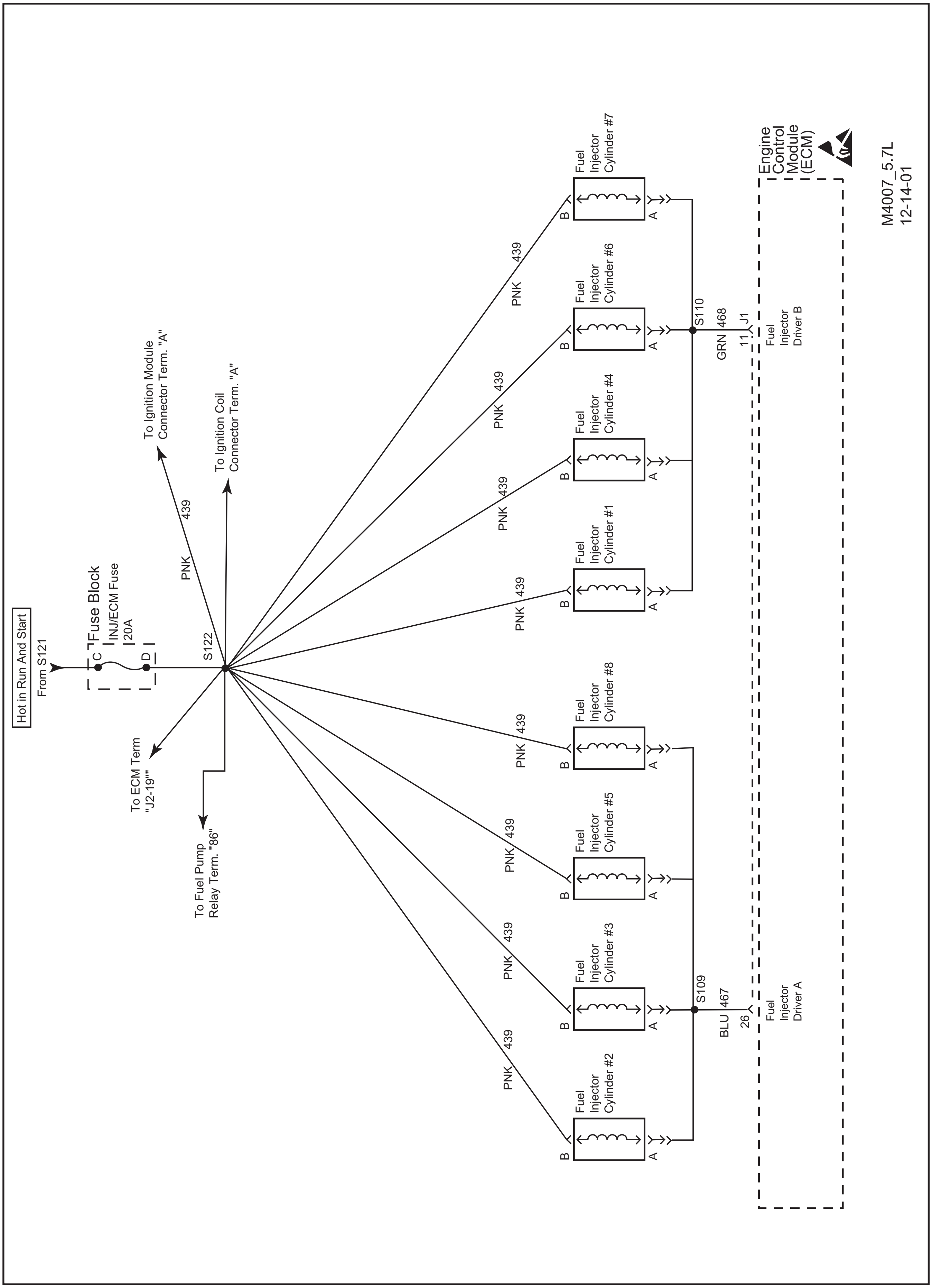
Engine Controls Wiring Schematics- 5.0/5.7L (5 of 9)



Engine Controls Wiring Schematics- 5.0/5.7L (6 of 9)



Engine Controls Wiring Schematics- 5.0/5.7L (7 of 9)



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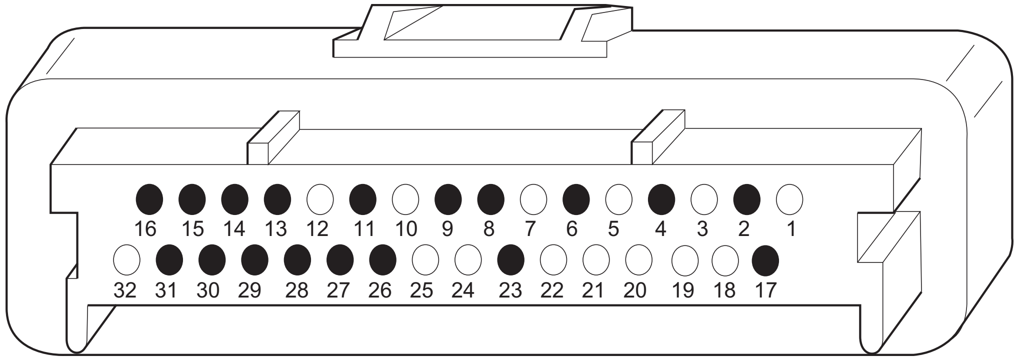
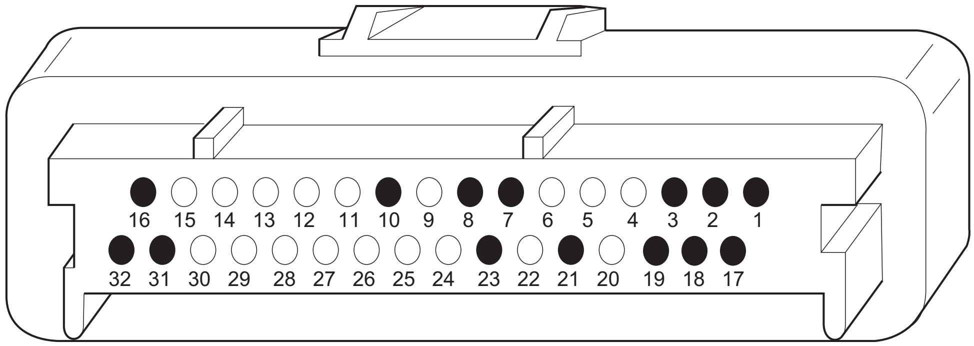
ECM Connector Pinout Identification (1 of 2) (5.0/5.7L)



J-1
ECM 32 WAY CONNECTOR

ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J1-1			
J1-2	451	BLK/WHT	DIAGNOSTIC “TEST” TERMINAL
J1-3			
J1-4		BLU/WHT	GENERAL WARNING 2 (OIL PRESSURE) (Input)
J1-5			
J1-6	485	DK GRN/WHT	FUEL PUMP RELAY CONTROL
J1-7			
J1-8		TAN/BLK	BUZZER
J1-9		TAN/WHT	CHECK GAUGES LAMP (ENGINE OVER TEMP)
J1-10			
J1-11	468	DK GRN	FUEL INJECTOR B DRIVER
J1-12			
J1-13	450	BLK	ECM GROUND
J1-14		GRY	TACHOMETER OUTPUT 1
J1-15	444	GRN/BLK	IDLE AIR CONTROL (IAC) COIL “B” LOW
J1-16	441	BLU/WHT	IDLE AIR CONTROL (IAC) COIL “A” HIGH
J1-17	467	DK BLU	KNOCK SENSOR SIGNAL
J1-18			
J1-19			
J1-20			
J1-21			
J1-22			
J1-23		LT BLU	GENERAL WARNING 2 LAMP (OIL PRESS)
J1-24			
J1-25			
J1-26	467	DK BLU	FUEL INJECTOR A DRIVER
J1-27	419	BRN/WHT	MALFUNCTION INDICATOR LAMP
J1-28	450	BLK	ECM GROUND
J1-29	450	BLK	ECM GROUND
J1-30	443	GRN/WHT	IDLE AIR CONTROL (IAC) COIL “A” LOW
J1-31	442	BLU/BLK	IDLE AIR CONTROL (IAC) COIL “B” HIGH
J1-32			

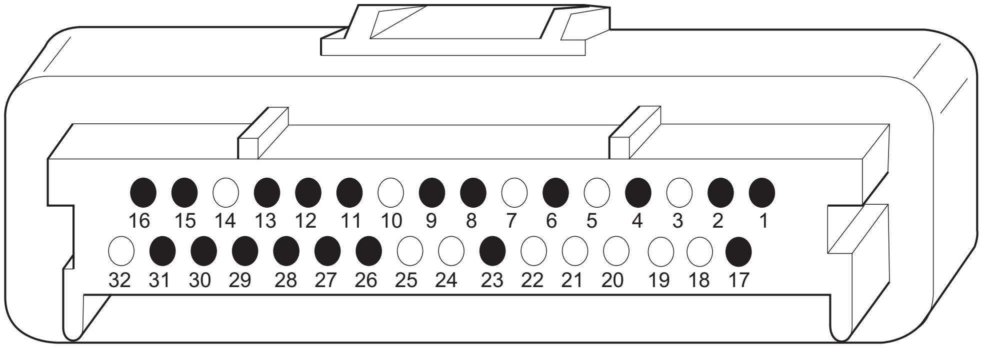
ECM Connector Pinout Identification (2 of 2) (5.0/5.7L)



J-2
ECM 32 WAY CONNECTOR

ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J2-1	440	ORN	BATTERY FEED
J2-2	416	GRY	5 VOLT REFERENCE
J2-3	814	BLK	SENSOR GROUND
J2-4			
J2-5			
J2-6			
J2-7	410	YEL	ECT SENSOR SIGNAL
J2-8	432	LT GRN	MAP SENSOR SIGNAL
J2-9			
J2-10	461	ORN/BLK	SERIAL DATA
J2-11			
J2-12			
J2-13			
J2-14			
J2-15			
J2-16	634	LT BLU	CRANK SENSOR SIGNAL
J2-17	631	RED	DEPSPOWER
J2-18	632	YEL	DEPSLO
J2-19	439	PNK	IGNITION FEED
J2-20			
J2-21	472	PPL/WHT	IAT SENSOR SIGNAL
J2-22			
J2-23	417	DK BLU	TP SENSOR SIGNAL
J2-24			
J2-25			
J2-26			
J2-27			
J2-28			
J2-29			
J2-30			
J2-31	2121	GRY	IGNITION CONTROL
J2-32	633	BRN	CAM SENSOR SIGNAL

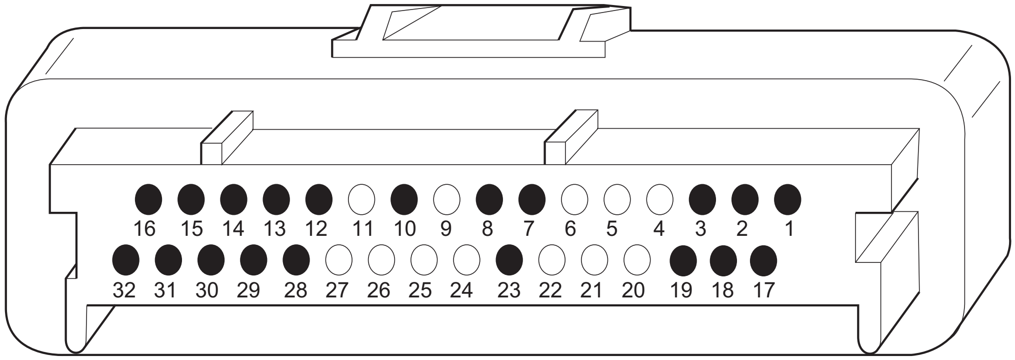
ECM Connector Pinout Identification (1 of 2) (6.0/8.1L)



J-1
ECM 32 WAY CONNECTOR

ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J1-1	468	LT BLU/BLU	KNOCK SENSOR 2 SIGNAL
J1-2	451	BLK/WHT	DIAGNOSTIC “TEST” TERMINAL
J1-3			
J1-4		BLU/WHT	GENERAL WARNING 2 (OIL PRESSURE) (Input)
J1-5			
J1-6	485	DK GRN/WHT	FUEL PUMP RELAY CONTROL
J1-7			
J1-8			BUZZER
J1-9			CHECK GAUGES LAMP (ENGINE OVER TEMP)
J1-10			
J1-11	468	DK GRN	FUEL INJECTOR B DRIVER
J1-12			
J1-13	450	BLK	ECM GROUND
J1-14		GRY	TACHOMETER OUTPUT 1
J1-15	444	GRN/BLK	IDLE AIR CONTROL (IAC) COIL “B” LOW
J1-16	441	BLU/BLK	IDLE AIR CONTROL (IAC) COIL “A” HIGH
J1-17	467	DK BLU	KNOCK SENSOR 1 SIGNAL
J1-18			
J1-19			
J1-20			
J1-21			
J1-22			
J1-23		LT BLU	GENERAL WARNING 2 LAMP (OIL PRESS)
J1-24			
J1-25			
J1-26	467	DK BLU	FUEL INJECTOR A DRIVER
J1-27	419	BRN/WHT	MALFUNCTION INDICATOR LAMP
J1-28	450	BLK	ECM GROUND
J1-29	450	BLK	ECM GROUND
J1-30	443	GRN/WHT	IDLE AIR CONTROL (IAC) COIL “B” HIGH
J1-31	442	BLU/WHT	IDLE AIR CONTROL (IAC) COIL “A” LOW
J1-32			

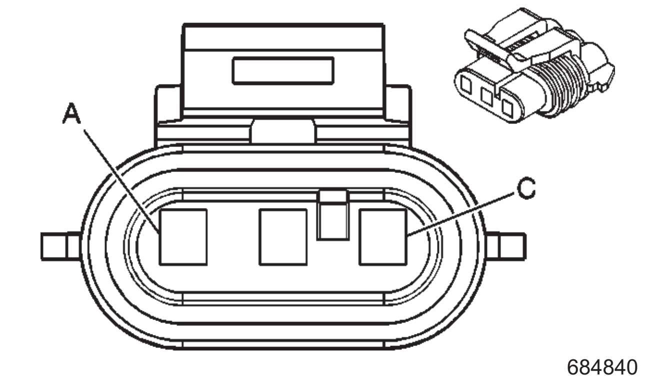
ECM Connector Pinout Identification (2 of 2) (6.0/8.1L)



J-2
ECM 32 WAY CONNECTOR

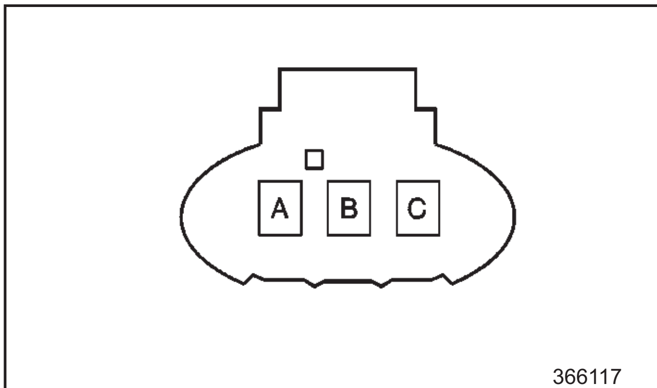
ECM PIN NUMBER	CKT(WIRE) NUMBER	CKT (WIRE) COLOR	CIRCUIT DESCRIPTION
J2-1	440	ORN	BATTERY FEED
J2-2	416	GRY	5 VOLT REFERENCE
J2-3	814	BLK	SENSOR GROUND
J2-4			
J2-5			
J2-6			
J2-7	410	YEL	ECT SENSOR SIGNAL
J2-8	432	LT GRN	MAP SENSOR SIGNAL
J2-9			
J2-10	461	ORN/BLK	SERIAL DATA
J2-11			
J2-12	2123	LT BLU	IGNITION CONTROL H
J2-13	2125	DK GRN	IGNITION CONTROL F
J2-14	2122	PPL/WHT	IGNITION CONTROL D
J2-15	2128	RED/WHT	IGNITION CONTROL B
J2-16	634	LT GRN	CRANK SENSOR SIGNAL
J2-17	631	RED	DEPSPOWER
J2-18	632	PNK/BLK	DEPSLO
J2-19	439	PNK	IGNITION FEED
J2-20		BRN	EXHAUST TEMPERATURE SWITCH INPUT
J2-21			
J2-22			
J2-23	417	DK BLU	TP SENSOR SIGNAL
J2-24			
J2-25			
J2-26			
J2-27			
J2-28	2124	LT BLU/WHT	IGNITION CONTROL G
J2-29	2126	GRN/WHT	IGNITION CONTROL E
J2-30	2127	RED	IGNITION CONTROL C
J2-31	2121	PPL	IGNITION CONTROL A
J2-32	633	BRN/WHT	CAM SENSOR SIGNAL

Camshaft Position (CMP) Sensor (8.1L)



Connector Part Information	• 12129946 • 3-Way F Metri-Pack 150 Series Sealed		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RED	631	DEPSPOWER (12V Ref)
B	YEL/BLK	1868	DEPSLO (Low Ref)
C	BRN/WHT	633	CMP Sensor Signal

Crankshaft Position (CKP) Sensor (8.1L)



Connector Part Information	• 15324165 • 3-Way F Metri-Pack 150 Series Sealed		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RED	631	DEPSPOWER (12V Ref)
B	YEL/BLK	1868	DEPSLO (Low Ref)
C	DK BLU/WHT	1869	CKP Sensor Signal

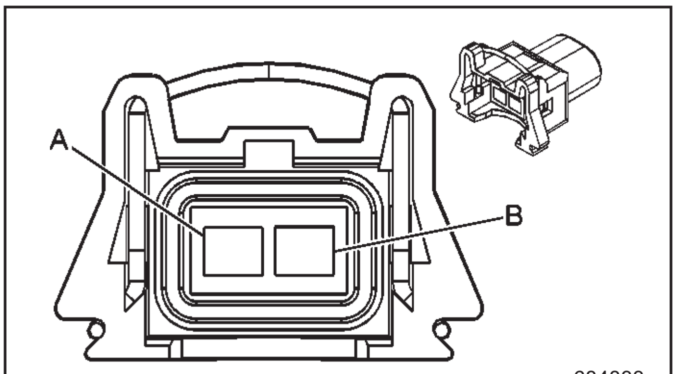
Camshaft Position (CMP) Sensor (6.0L)

Pin	Wire Color	Circuit No.	Function
A	BRN/WHT	633	CMP Sensor Signal
B	YEL/BLK	1868	DEPSLO (Low Ref)
C	RED	631	DEPSPOWER (12V Ref)

Crankshaft Position (CKP) Sensor (6.0L)

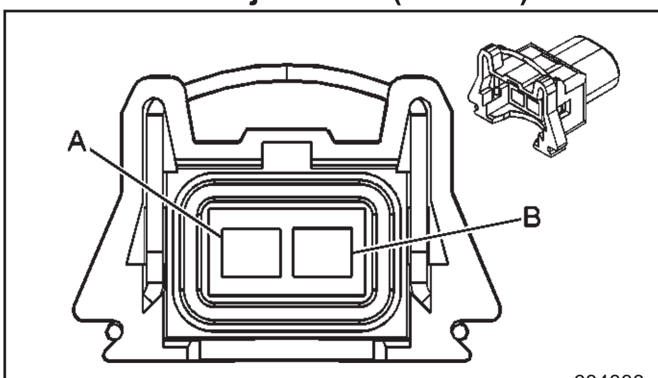
Pin	Wire Color	Circuit No.	Function
A	DK BLU/WHT	1869	CKP Sensor Signal
B	YEL/BLK	1868	DEPSLO (Low Ref)
C	RED	631	DEPSPOWER (12V Ref)

Fuel Injector #1 (6.0/8.1L)



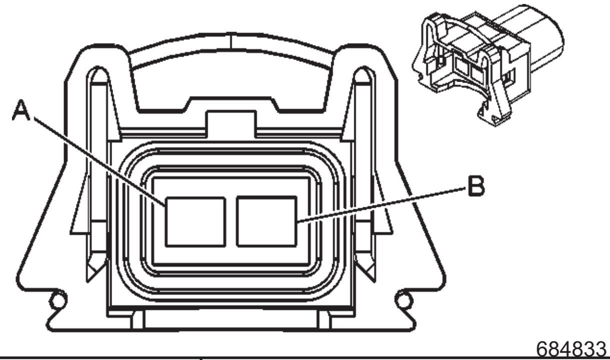
Connector Part Information	• 12129140 • 2-Way F Metri-Pack 280.1 P2S (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	DK BLU	467	Fuel Injector 1 Control
B	PNK	439	Ignition Voltage

Fuel Injector #2 (6.0/8.1L)



Connector Part Information	• 12129140 • 2-Way F Metri-Pack 280.1 P2S (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	DK GRN	468	Fuel Injector 2 Control
B	PNK	439	Ignition Voltage

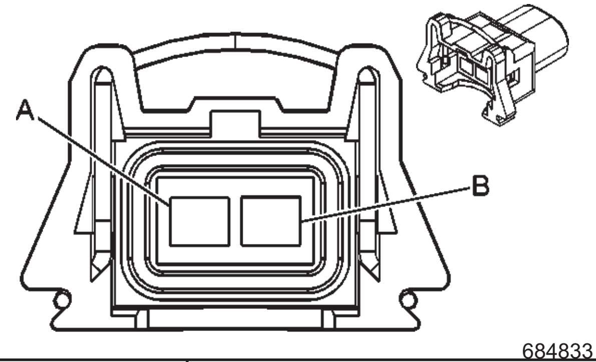
Fuel Injector #3 (6.0/8.1L)



Connector Part Information	• 12129140 • 2-Way F Metri-Pack 280.1 P2S (BLK)

Pin	Wire Color	Circuit No.	Function
A	DK GRN	468	Fuel Injector 3 Control
B	PNK	439	Ignition Voltage

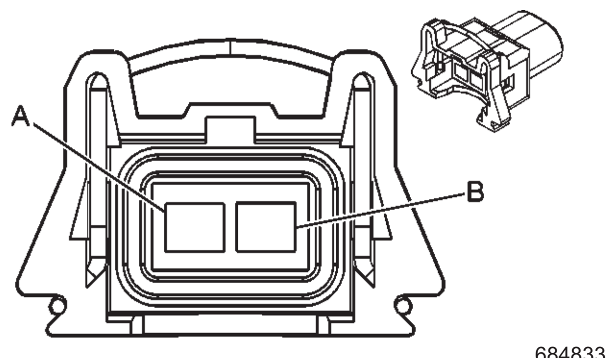
Fuel Injector #4 (6.0/8.1L)



Connector Part Information	• 12129140 • 2-Way F Metri-Pack 280.1 P2S (BLK)

Pin	Wire Color	Circuit No.	Function
A	DK BLU	467	Fuel Injector 4 Control
B	PNK	439	Ignition Voltage

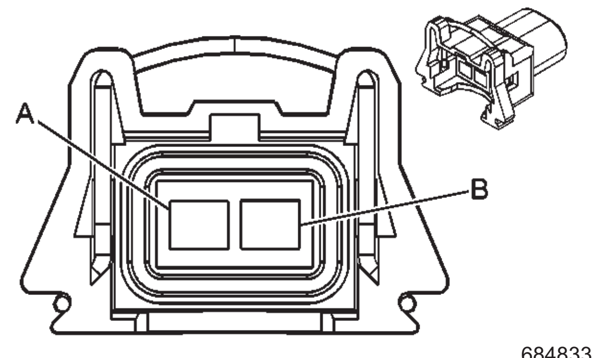
Fuel Injector #5 (6.0/8.1L)



Connector Part Information	• 12129140 • 2-Way F Metri-Pack 280.1 P2S (BLK)

Pin	Wire Color	Circuit No.	Function
A	DK GRN	468	Fuel Injector 5 Control
B	PNK	439	Ignition Voltage

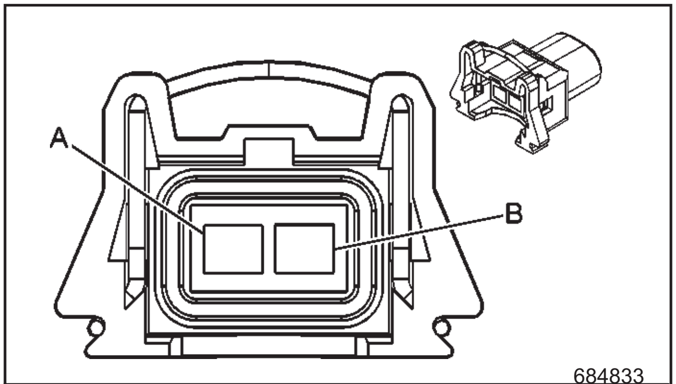
Fuel Injector #6 (6.0/8.1L)



Connector Part Information	• 12129140 • 2-Way F Metri-Pack 280.1 P2S (BLK)

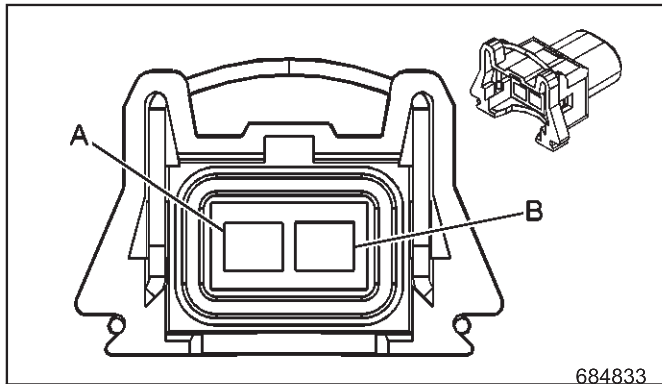
Pin	Wire Color	Circuit No.	Function
A	DK BLU	467	Fuel Injector 6 Control
B	PNK	439	Ignition Voltage

Fuel Injector #7 (6.0/8.1L)



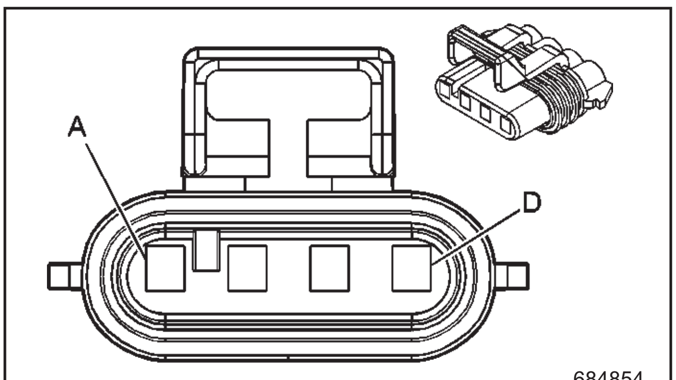
Connector Part Information	• 12129140 • 2-Way F Metri-Pack 280.1 P2S (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	DK BLU	467	Fuel Injector 7 Control
B	PNK	439	Ignition Voltage

Fuel Injector #8 (6.0/8.1L)



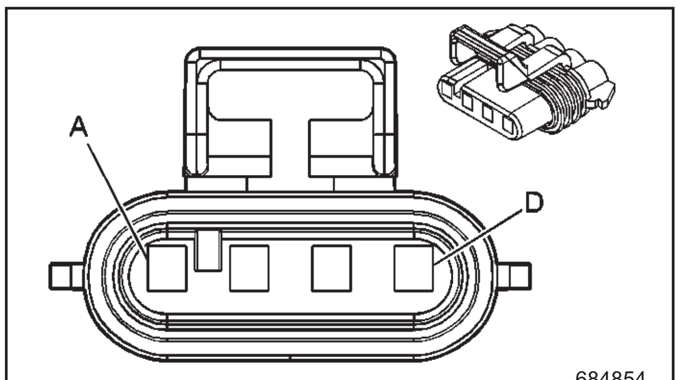
Connector Part Information	• 12129140 • 2-Way F Metri-Pack 280.1 P2S (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	DK GRN	468	Fuel Injector 8 Control
B	PNK	439	Ignition Voltage

Ignition Coil/Driver - Cylinder #1 (6.0/8.1L)



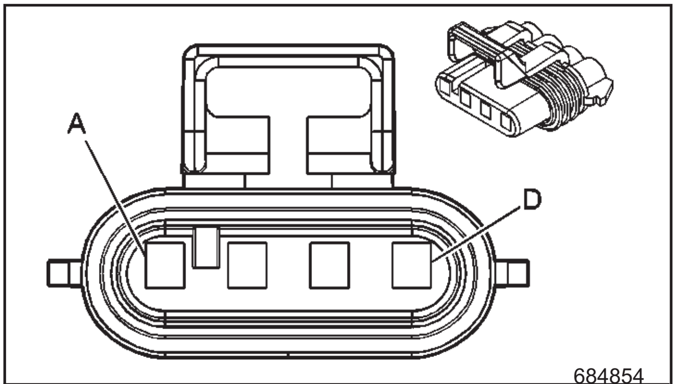
Connector Part Information	• 12162144 • 4-Way F Metri-Pack 150 Series Sealed (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	151	Ground
B	BRN	2129	Low Reference
C	PPL	2121	IC 1 Control
D	PNK	39	Ignition Voltage

Ignition Coil/Driver - Cylinder #3 (6.0/8.1L)



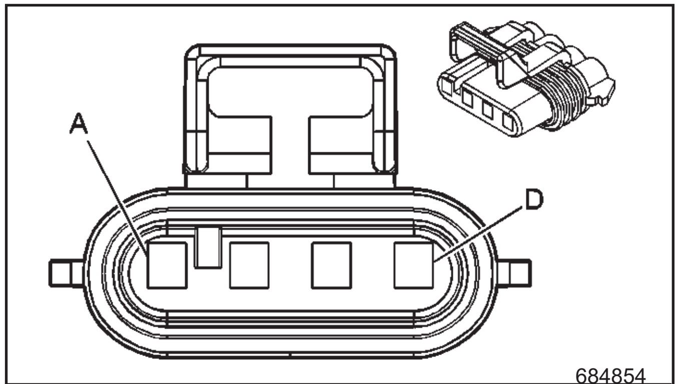
Connector Part Information	• 12162144 • 4-Way F Metri-Pack 150 Series Sealed (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	151	Ground
B	BRN	2129	Low Reference
C	PPL	2123	IC 3 Control
D	PNK	39	Ignition Voltage

Ignition Coil/Driver - Cylinder #5 (6.0/8.1L)



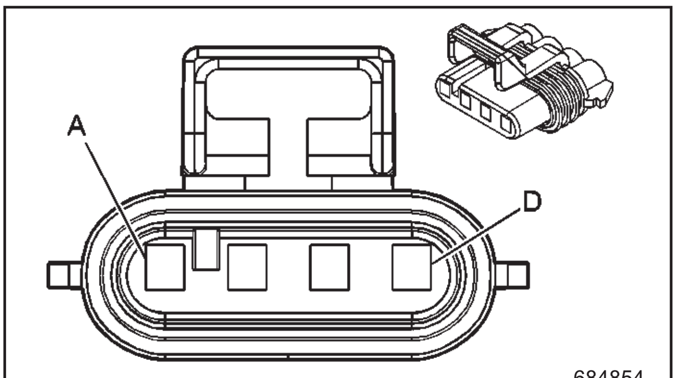
Connector Part Information		• 12162144 • 4-Way F Metri-Pack 150 Series Sealed (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	151	Ground
B	BRN	2129	Low Reference
C	PPL	2125	IC 5 Control
D	PNK	39	Ignition Voltage

Ignition Coil/Driver - Cylinder #7 (6.0/8.1L)



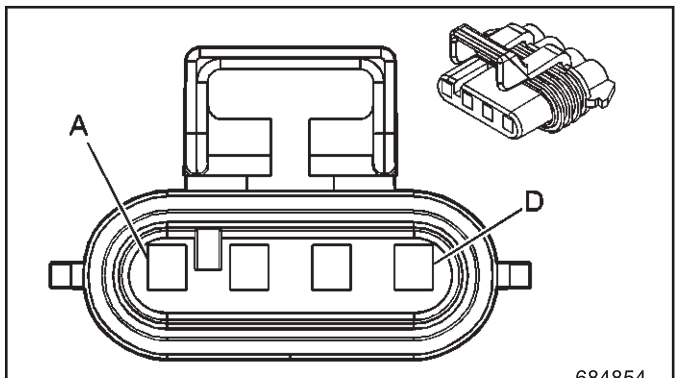
Connector Part Information		• 12162144 • 4-Way F Metri-Pack 150 Series Sealed (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	151	Ground
B	BRN	2129	Low Reference
C	PPL	2127	IC 7 Control
D	PNK	39	Ignition Voltage

Ignition Coil/Driver - Cylinder #2 (6.0/8.1L)



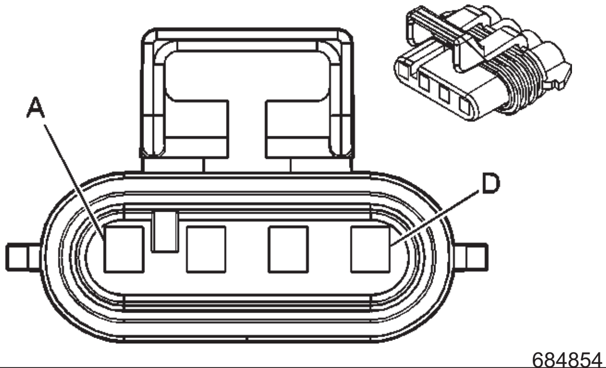
Connector Part Information		• 12162144 • 4-Way F Metri-Pack 150 Series Sealed (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	151	Ground
B	BRN	2129	Low Reference
C	PPL	2122	IC 1 Control
D	PNK	39	Ignition Voltage

Ignition Coil/Driver - Cylinder #4 (6.0/8.1L)



Connector Part Information		• 12162144 • 4-Way F Metri-Pack 150 Series Sealed (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	151	Ground
B	BRN	2129	Low Reference
C	PPL	2124	IC 3 Control
D	PNK	39	Ignition Voltage

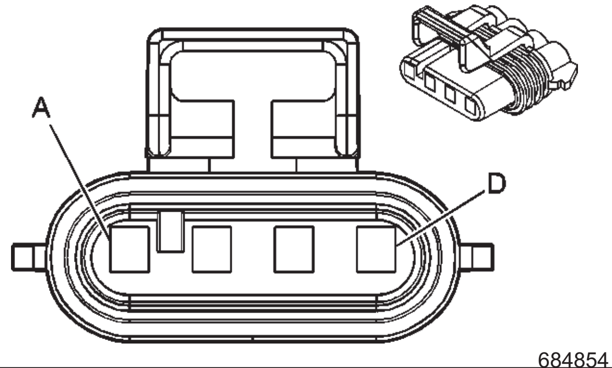
Ignition Coil/Driver - Cylinder #6 (6.0/8.1L)



Connector Part Information	• 12162144 • 4-Way F Metri-Pack 150 Series Sealed (BLK)

Pin	Wire Color	Circuit No.	Function
A	BLK	151	Ground
B	BRN	2129	Low Reference
C	PPL	2126	IC 6 Control
D	PNK	39	Ignition Voltage

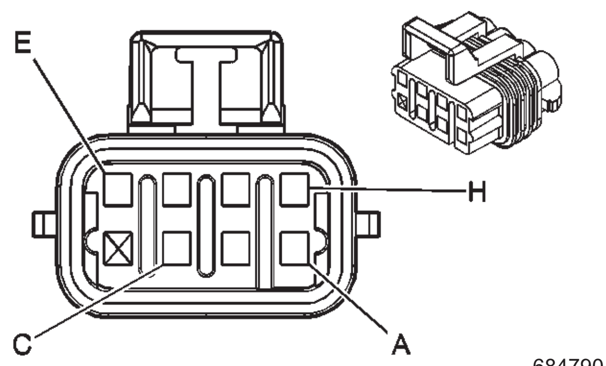
Ignition Coil/Driver - Cylinder #8 (6.0/8.1L)



Connector Part Information	• 12162144 • 4-Way F Metri-Pack 150 Series Sealed (BLK)

Pin	Wire Color	Circuit No.	Function
A	BLK	151	Ground
B	BRN	2129	Low Reference
C	PPL	2128	IC 8 Control
D	PNK	39	Ignition Voltage

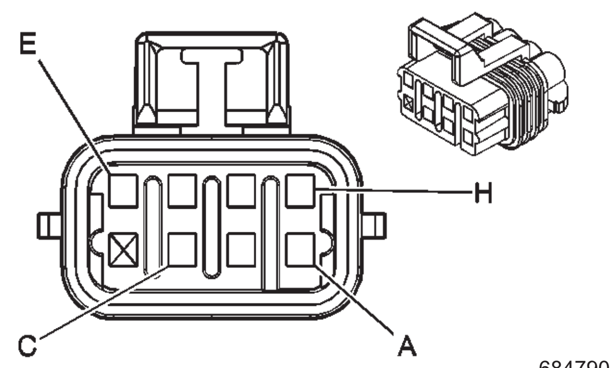
Ignition Coils - 1,3,5,7 (Inline Connector-8.1L)



Connector Part Information	• 12047938 • 7-Way F Metri-Pack 150 Series Sealed (LT GRY)

Pin	Wire Color	Circuit No.	Function
A	BLK	151	Ground
B	RED	2127	IC 7 Control
C	DK GRN	2125	IC 5 Control
E	BRN	2129	Low Reference
F	LT BLU	2123	IC 3 Control
G	PPL	2121	IC 1 Control
H	PNK	39	Ignition Voltage

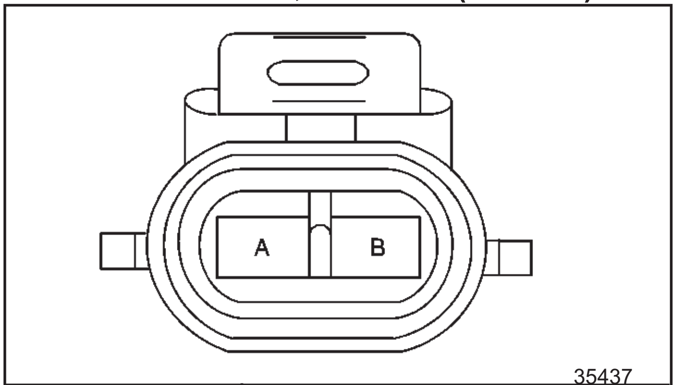
Ignition Coils - 2,4,6,8 (Inline Connector-8.1L)



Connector Part Information	• 12047938 • 7-Way F Metri-Pack 150 Series Sealed (LT GRY)

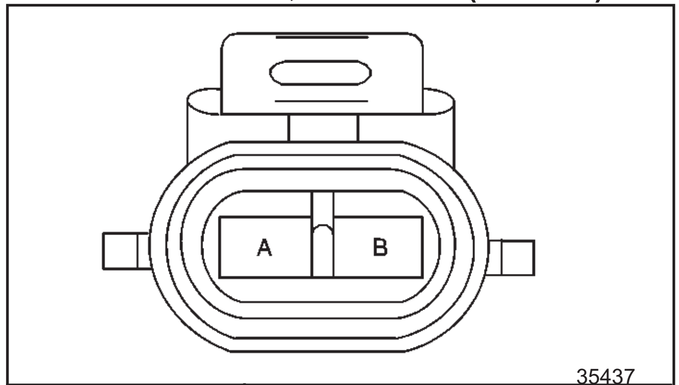
Pin	Wire Color	Circuit No.	Function
A	BLK	151	Ground
B	RED/WHT	2122	IC 2 Control
C	DK GRN/WHT	2124	IC 4 Control
E	BRN/WHT	2130	Low Reference
F	LT BLU/WHT	2126	IC 6 Control
G	PPL/WHT	2128	IC 8 Control
H	PNK	39	Ignition Voltage

Knock Sensor, LH - Odd (6.0/8.1L)



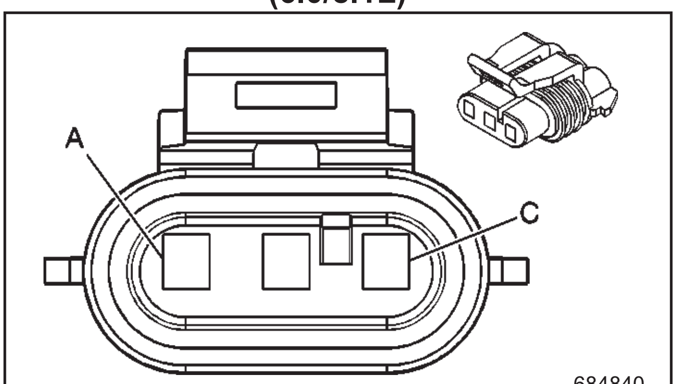
Connector Part Information		• 15355362 • 1-Way F Metri-Pack 150 Series Sealed (NAT)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	DK BLU	467	KS 1 Signal

Knock Sensor, RH - Even (6.0/8.1L)

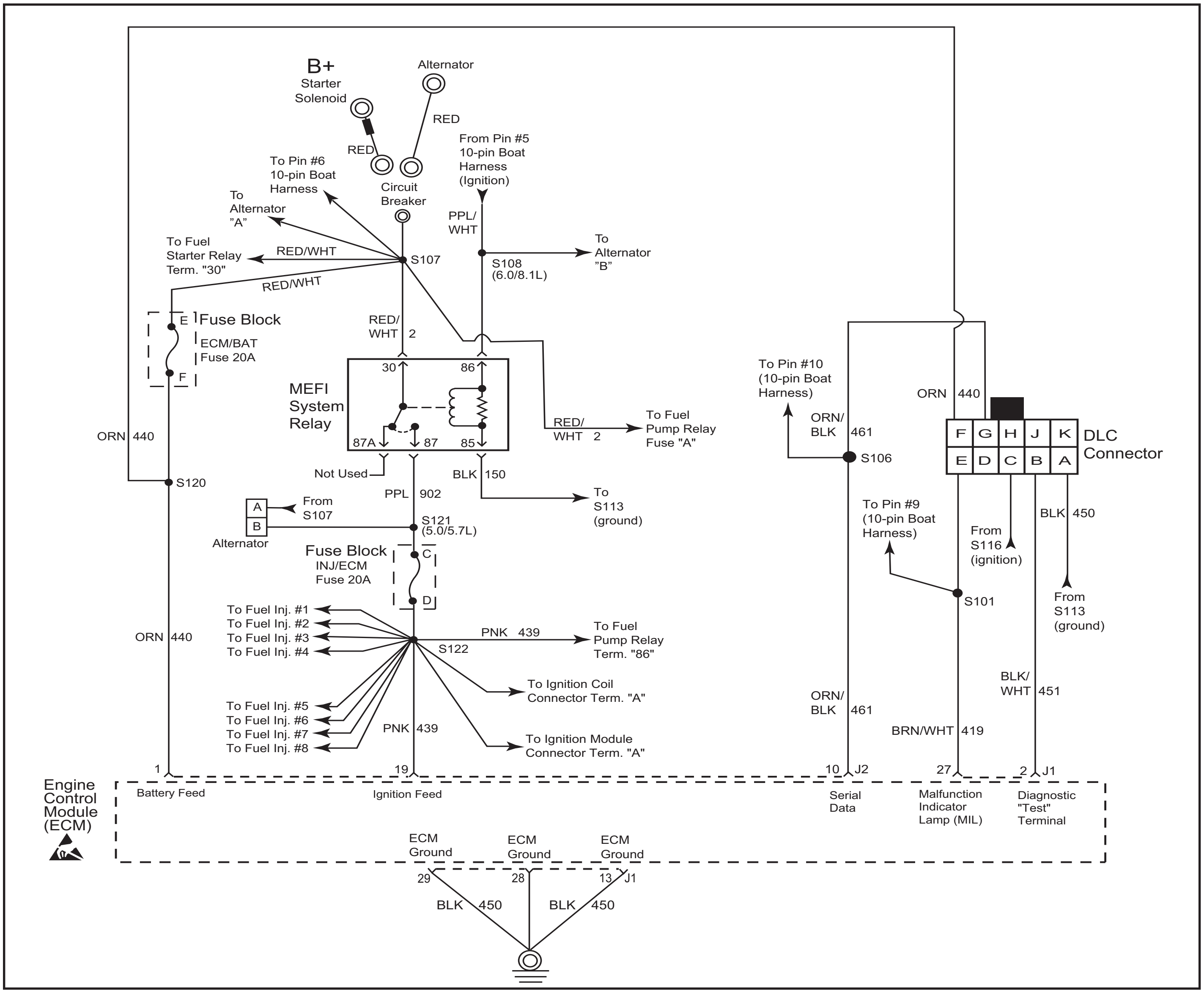


Connector Part Information		• 15355362 • 1-Way F Metri-Pack 150 Series Sealed (NAT)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	LT BLU	468	KS 2 Signal

Manifold Absolute Pressure (MAP) Sensor (6.0/8.1L)



Connector Part Information		• 12129946 • 3-Way F Metri-Pack 150 Series Sealed (GRY)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	814	Low Reference
B	LT GRN	432	MAP Sensor Signal
C	GRY	416E	5 Volt Reference



M4050P
3-2-04

On-Board Diagnostic (OBD) System Check - Scan

Circuit Description

The on-board diagnostic system check must be the starting point for any drivability complaint diagnosis. Before using this procedure, you should perform a careful visual/physical check of the ECM and engine grounds for being clean and tight.

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 the following items:

- Inspect the ECM 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 Table:

1. Conditions of the starting system that require repair before proceeding are no crank or slow crank conditions. Always verify battery condition and connections prior to troubleshooting starter issues. Crank with no start and hard start conditions are addressed by this procedure.
2. The Malfunction Indicator Lamp data display should be “ON” steady with the ignition “ON,” engine “OFF.” If it is a steady “OFF”, DP A-1 should be used to isolate the malfunction; otherwise continue to step 3.
5. Checks the Malfunction Indicator Lamp circuit (419) and ensures that the ECM is able to flash DTC’s. The Malfunction Indicator Lamp data display will ‘flash’ a DTC 12 twice (“ON”-”OFF”-pause-”ON”-”OFF”-”ON”-”OFF”-pause...), followed by any DTC’s stored in memory, then repeat the sequence.

Test Description (continued)

6. When you return to the Diacom 'Tests' menu to disable the base timing mode, first select "Activate Base Timing Mode" then select "Disable Base Timing Mode". When you return to the 'ECM Data' display you will have to re-link to the ECM to display data.
7. If the engine will not start, DP A-3 should be used to diagnose this condition.
8. Troubleshoot DTC(s) first. If Logged Warnings are displayed, refer to the chart on page 5-11 for the circuit affected. Troubleshoot and repair the condition that caused the Logged Warning, then Repeat the OBD System Check.
9. A scan tool parameter which is not within the typical range may help to isolate the area which is causing the problem.
12. a. **Verify your Diacom Installation and cables on a known good engine.**

    b. Verify that no auxiliary devices are plugged into the serial data line. Normally, aftermarket devices are wired in at the DLC connector and are disconnected when Diacom is connected. Verify that no device is wired in at pin-10 of the engine's 10-pin main harness connector, and pin-10 is an open connection.

On-Board Diagnostic (OBD) System Check - Scan

Step	Action	Value	Yes	No
1	**Important:** • Do not perform this diagnostic if there is not a drivability concern, unless another procedure directs you to that diagnostic. • Before you proceed with diagnosis, search for applicable service bulletins. • Before you proceed with diagnosis, perform a visual inspection of the engine for damaged wiring, connections, or assemblies. • Unless a diagnostic procedure instructs you, DO NOT clear the DTC's. • If there is a condition with the starting system, repair that first. • Ensure the battery has a full charge. • Ensure the battery cables are clean and tight. • Ensure the ECM grounds are clean, tight and in the correct location. 1. Ignition "ON," engine "OFF." 2. Install Diacom Diagnostic Scan tool 3. Attempt to display 'ECM Data' Does the scan tool display 'ECM Data'?	—	Go to Step 2	Go to Step 10
2	1. Using Diacom, display 'ECM Data'. 2. Ignition "ON," engine "OFF." 3. Observe the Malfunction Indicator Lamp on the ECM data display. Is the Malfunction Indicator Lamp "ON"?	—	Go to Step 3	Go to DP-A1
3	1. Using Diacom, display 'ECM Data'. 2. Ignition "ON," engine "OFF." 3. Observe the Malfunction Indicator Lamp on the ECM data display. Does the Malfunction Indicator Lamp flash DTC 12?	—	Go to Step 4	Go to Step 5
4	1. Verify a known good Diacom scan tool. 2. Check CKT 451 for a short to ground. 3. If a problem is found, repair as necessary. Was a problem found?	—	Repeat OBD System Check	Go to Step 13

On-Board Diagnostic (OBD) System Check - Scan (cont'd)

Step	Action	Value	Yes	No
5	1. On the Diacom screen select the 'Tests' tab, and select "Activate Base Timing Mode." 2. Select Diacom, 'ECM Data' display. 3. Ignition "ON," engine "OFF." 4. Link to the ECM and observe the Malfunction Indicator Lamp on the ECM data display. Does the Malfunction Indicator Lamp flash DTC 12?	—	Go to Step 6	Go to DP A-2
6	1. On the Diacom screen select the 'Tests' tab, and select "Disable Base Timing Mode." 2. Using Diacom, display 'ECM Data'. Attempt to start the engine. Did the engine start and continue to run?	—	Go to Step 8	Go to Step 7
7	Crack the throttle open no more than 25% (if a flooded engine is suspected, go to wide open throttle) and re-attempt to start the engine. Did the engine start and continue to run?	—	Go to Step 8	Go to DP A-3
8	Select "Codes" tab on the Diacom display. Are any DTCs or Logged Warnings stored?	—	Go to applicable DTC Table	Go to Step 9
9	Compare 'ECM' data values displayed on the scan tool to the typical scan tool data values page. Are the displayed values normal or close to the typical values?	—	Refer to Symptoms Section 7	Refer to DTC Procedure for the Circuit that is Out of Range
10	1. Ignition "ON", Engine OFF. 2. Using a DMM verify B+ at Terminal D of the INJ/ECM fuse. Was B+ present?	B+	Go to Step12	Go to step 11
11	1. Ignition "OFF". 2. Verify INJ/ECM fuse. 3. If a problem is found, replace the fuse and repeat step 10, if the fuse blows again check CKT 439 for an open or short to ground. 4. If a problem is found, repair as necessary. Was a problem found?	—	Repeat OBD System Check	Go to DP A-6
12	1. Ignition "OFF." 2. Check for faulty connections or faulty scan tool. **NOTE: See Test Descriptions. You must verify that your Diacom is properly installed and functioning on a known good engine, before proceeding with the tests.** 3. Disconnect the ECM. 4. Check the serial data CKT 461 for an open, short to ground or short to voltage. Also, check the DLC battery feed CKT 440 for an open or short to ground and the DLC ground CKT 450 for an open. 5. If a problem is found, repair as necessary. Was a problem found?	—	Repeat OBD System Check	Go to Step 13
13	Repair faulty connections or replace the ECM. Is action complete?	—	Repeat OBD System Check	—

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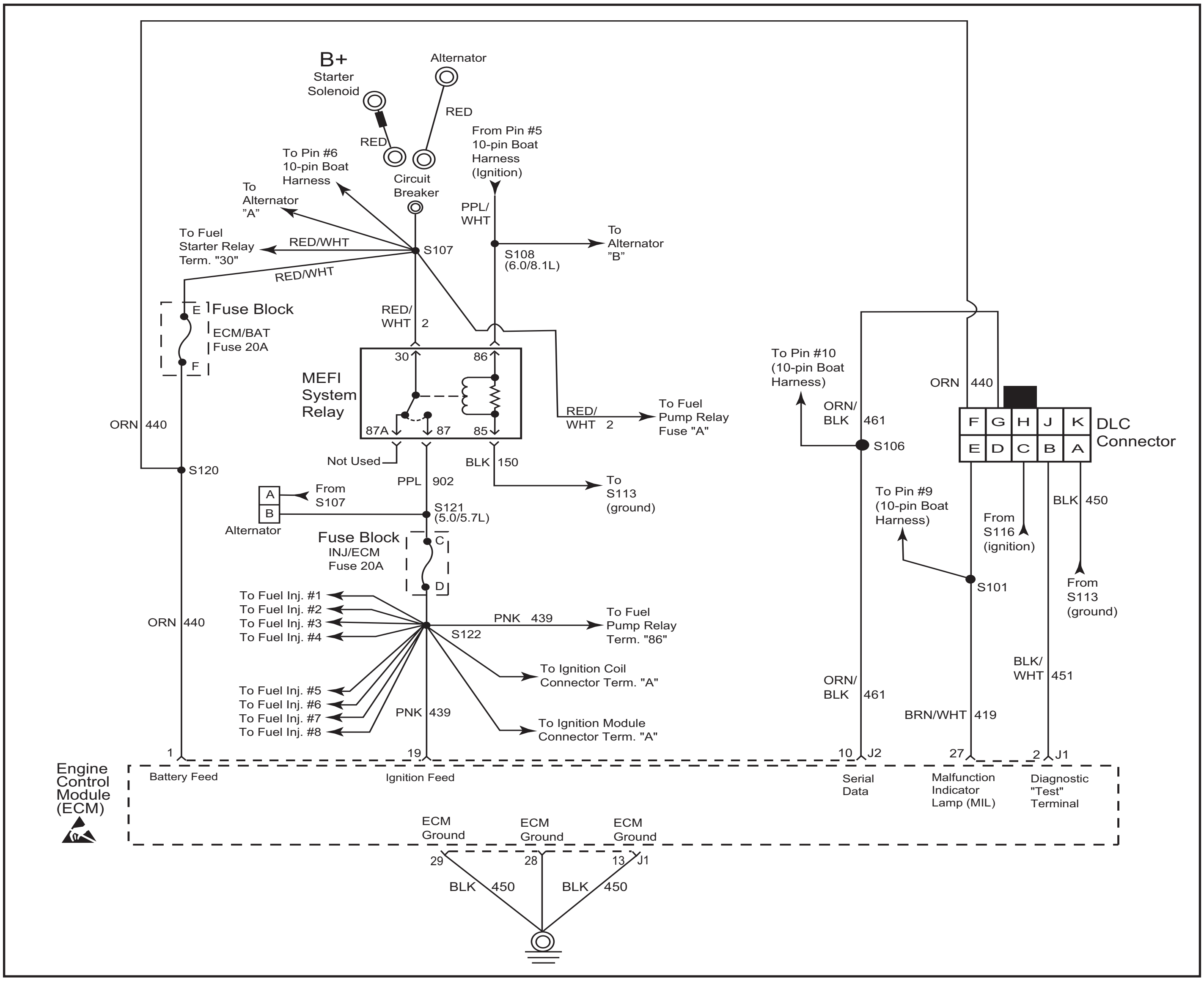

M4050P
3-2-04

Diagnostic Procedure (DP) A-1 - No Malfunction Indicator Lamp (MIL) - Diagnostic Trouble Code (DTC) Tool Installed

Circuit Description

When the Diagnostic Trouble Code (DTC) tool is installed, it plugs into the DLC terminals “F” and “E”. It receives voltage through CKT 440 terminal “F”. Terminal “E” is grounded through CKT 419 from the ECM, terminal “J1-27”. There should always be a steady MIL with the ignition “ON” and the engine “OFF.” The Electronic Control Module (ECM) turns the MIL “ON” by providing the ground to CKT 419.

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:

- Inspect the ECM harness and connectors 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 or an open in the MIL driver circuit (CKT 419).
- If the engine cranks but will not run, check for an open ECM ignition or battery feed, or a poor ECM to engine ground.

Test Description

Number(s) below refer to the Step number(s) on the Diagnostic Table:

3. This step ensures that battery voltage is available to terminal “F” of the DLC connector.
4. This step checks for ground present at terminal “E” of the DLC connector. This indicates the ECM is capable of completing the ground to the MIL.
5. This step isolates the cause of an incomplete ground circuit to either faulty wiring or faulty ECM circuitry.
7. This step ensures that battery voltage is available to the ECM.

Diagnostic Procedure (DP) A-1 - No Malfunction Indicator Lamp (MIL) - Diagnostic Trouble Code (DTC) Tool Installed

Step	Action	Value	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	1. Remove Diagnostic Trouble Code (DTC) tool. 2. Ignition "ON," engine "OFF." 3. Using a test light connected to ground, probe terminal "F" of the DLC. Does the test light illuminate brightly?	—	Go to Step 4	Go to Step 10
4	1. Ignition "ON," engine "OFF." 2. Using a test light connected to B+, probe terminal "E" of the DLC. Does the test light illuminate brightly?	—	Go to Step 11	Go to Step 5
5	1. Ignition "OFF." 2. Disconnect ECM "J1" connector. 3. Using a DMM, measure the resistance between ECM harness connector terminal "J1-27" and DLC terminal "E." Is the resistance within the specified values?	0 ohms	Go to Step 17	Go to Step 13
6	Check the ECM/BAT fuse. Is the fuse good?	—	Go to Step 7	Go to Step 14
7	1. Ignition "OFF." 2. Disconnect both ECM connectors. 3. Using a test light connected to ground, probe ECM harness connector pin "J2-1." Does the test light illuminate brightly?	—	Go to Step 8	Go to Step 15
8	1. Ignition "ON," engine "OFF." 2. Using a test light connected to ground, probe ECM harness connector pin "J2-19." Does the test light illuminate brightly?	—	Go to Step 12	Go to Step 9
9	Check the INJ/ECM fuse. Is the fuse good?	—	Go to Step 16	Go to Step 16
10	Locate and repair open or short to ground in CKT 440. Is action complete?	—	Go to OBD System Check	—
11	Repair or replace faulty Diagnostic Trouble Code tool. Is action complete?	—	Go to OBD System Check	—
12	1. Locate and repair faulty ECM grounds. 2. If a problem is found, repair as necessary. Is action complete?	—	Go to OBD System Check	Go to Step 17

Diagnostic Procedure (DP) A-1 - No Malfunction Indicator Lamp (MIL) - Diagnostic Trouble Code (DTC) Tool Installed

Step	Action	Value	Yes	No
13	Locate and repair open in CKT 419. Is action complete?	—	Go to OBD System Check	—-
14	Locate and repair short to ground in CKT 440, then replace the fuse. Is action complete?	—	Go to OBD System Check	—
15	Locate and repair open in CKT 440. Is action complete?	—	Go to OBD System Check	—
16	Locate and repair open or short to ground in CKT 439. Was a problem found?	—	Verify Repair	Go to DP A-6
17	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Go to OBD System Check	—

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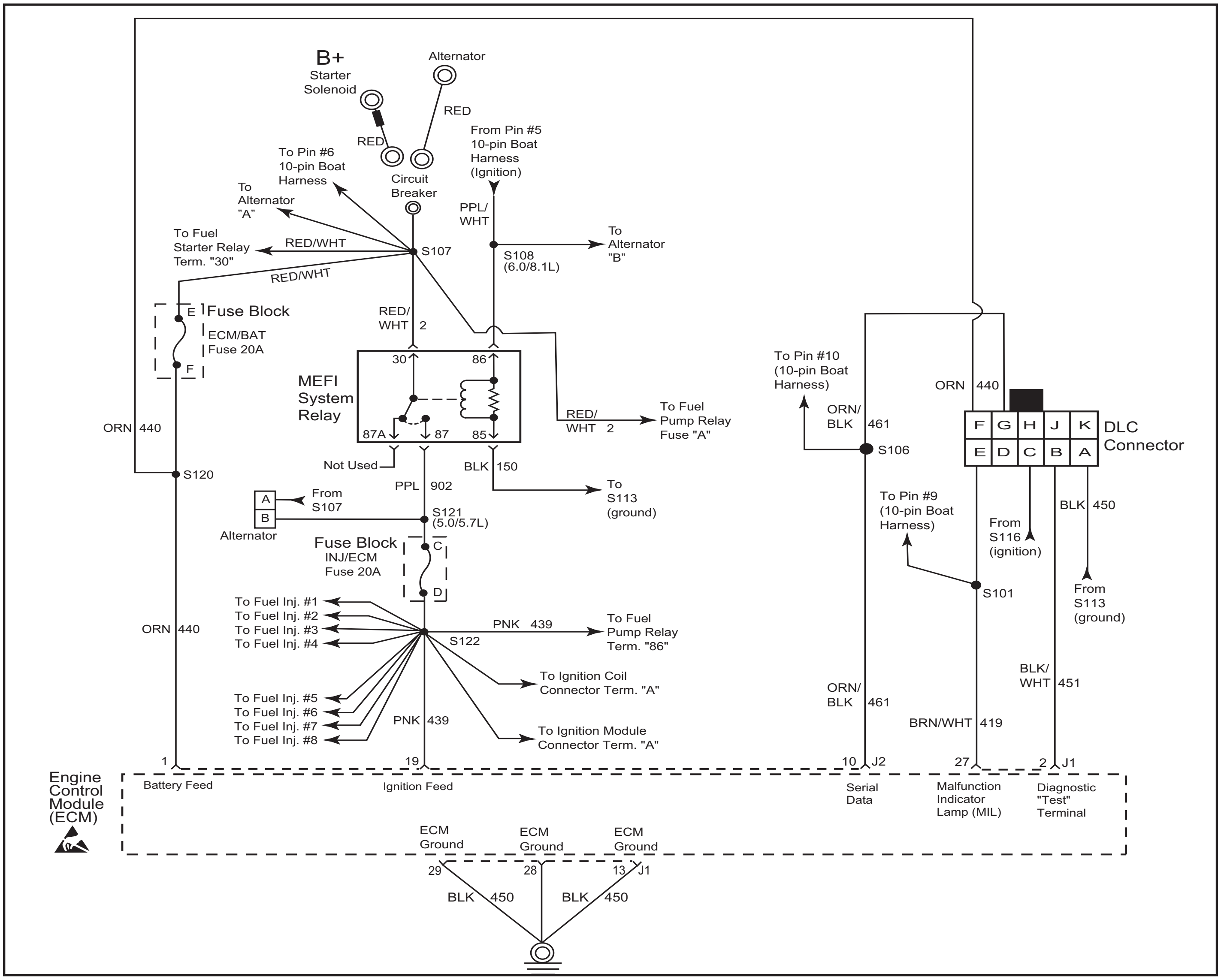


M4050P
3-2-04

Diagnostic Procedure (DP) A-2 - Malfunction Indicator Lamp (MIL) "On" Steady - Will Not Flash DTC 12 - Diagnostic Trouble Code (DTC) Tool Installed

Circuit Description

When the Diagnostic Trouble Code (DTC) tool is installed, it plugs into the DLC terminals "F" and "E". It receives voltage through CKT 440 terminal "F". Terminal "E" is grounded through CKT 419 from the ECM, terminal "J1-27". There should always be a steady MIL with the ignition "ON" and the engine "OFF." The Electronic Control Module (ECM) turns the MIL "ON" by providing the ground to CKT 419.

When the diagnostic "test" terminal on the DLC is grounded by jumping terminal "B" to terminal "A", the ground circuit is completed. The MIL will flash a DTC 12 twice, followed by any DTC's stored in memory. A steady light suggests CKT 419 is shorted to ground or an open in CKT 451 from the ECM to the DLC.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check for the following items:

- Poor connection or damaged harness. Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.

Test Description

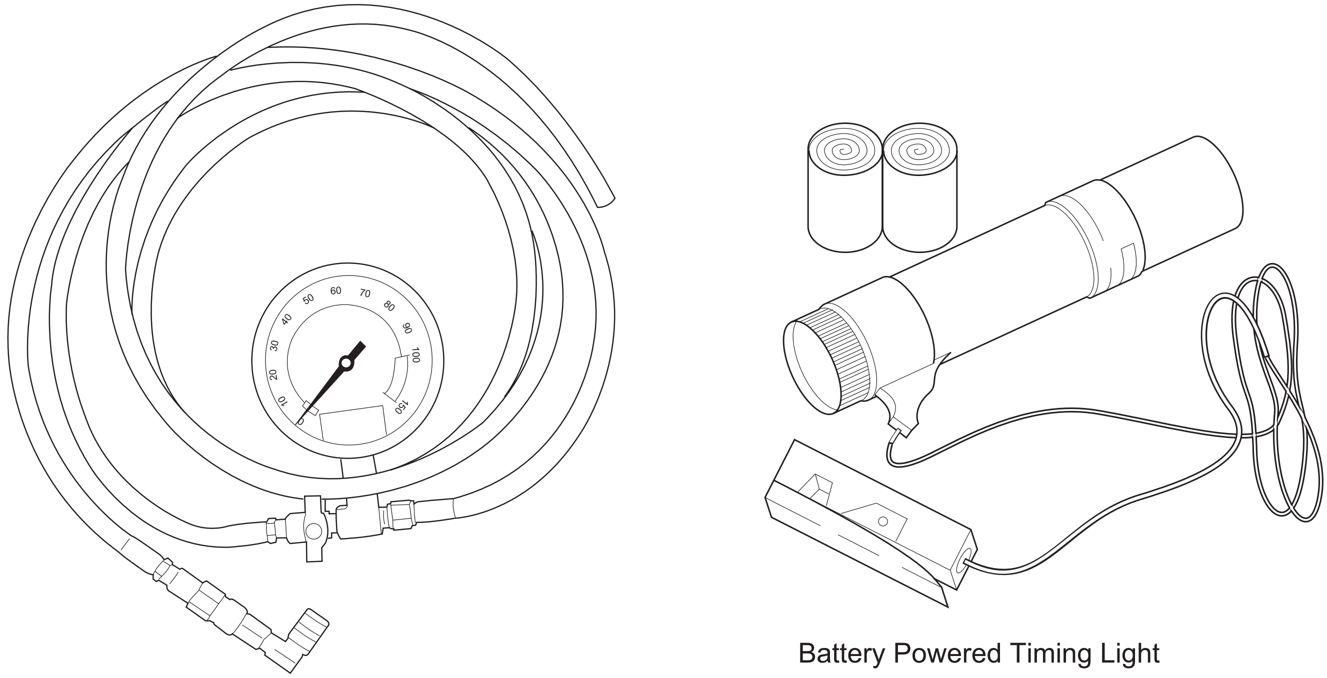
Number(s) below refer to the Step number(s) on the Diagnostic Table

2. If the light goes "OFF" when the ECM connectors are disconnected, CKT 419 is not shorted to ground.
3. This step will check for an open diagnostic CKT 451.
7. At this point, the MIL wiring is OK. If DTC 12 does not flash, replace the ECM.

NOTICE: Before replacing ECM, check the MDTC tool on another engine to make sure it is working properly.

Diagnostic Procedure (DP) A-2 - Malfunction Indicator Lamp (MIL) "On" Steady - Will Not Flash DTC 12 - Diagnostic Trouble Code (DTC) Tool Installed

Step	Action	Value	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 ECM "J1" and "J2"connectors. 2. Ignition "ON," engine "OFF," observe the MIL. Is the MIL "ON?"	—	Go to Step 5	Go to Step 3
3	1. Ignition "OFF." 2. Connect ECM connector "J2." 3. With ECM "J1" connector disconnected, jump terminals "A" to "B" at the DLC. 4. Connect test light between ECM connector terminal "J1-2" and B+. Does test light illuminate brightly?	—	Go to Step 4	Go to Step 6
4	1. Verify correct operation of DTC tool on a known good system. 2. If a problem is found, repair as necessary. Is action complete?	—	Go to OBD System Check	Go to Step 7
5	Locate and repair short to ground in CKT 419. Is action complete?	—	Go to OBD System Check	—
6	Locate and repair open in CKT 450 and/or CKT 451. Is action complete?	—	Go to OBD System Check	—
7	1. Repair faulty ECM connections or replace faulty ECM. 2. Recheck for DTC 12. Is action complete?	—	Go to OBD System Check	—



M4051
9-18-02

Diagnostic Procedure (DP) A-3 - Engine Cranks But Will Not Run

Circuit Description

In the Ignition system and the fuel injector circuit, the supply voltage comes from the MEFI system relay. From the MEFI system relay, CKT 902 delivers supply voltage to the INJ/ECM fuse, Fuel Pump Relay fuse and to the ignition coil(s).

After supply voltage passes through the INJ/ECM fuse, it branches out into separate CKT’s 439. One is the supply voltage for injector harness and another one goes to ECM terminal “J2-19.” The ECM will control the opening and closing of the injectors through injector driver CKT 468 and CKT 467 by connecting them to ground.

The Ignition system receives supply voltage through CKT 902. The ECM will control the spark timing. For further explanation of ignition systems, see “Ignition System Check,” Diagnostic Procedure A-7A or A-7B.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check for the following items:

- Poor connection or damaged harness. Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- This table assumes that battery voltage and engine cranking speed are OK, and there is adequate fuel in the tank.
- Water or foreign material in fuel system can cause a no start.
- A defective MAP sensor may cause a no start or a start and stall condition.

If above are all OK, refer to “Hard Start” in Symptoms section.

Test Description

Number(s) below refer to the Step number(s) on the Diagnostic Table:

3. Use fuel pressure gauge RTK0078 or equivalent. Wrap shop towel around the fuel pressure tap to absorb any small amount of fuel leakage that may occur when installing the gauge.
5. No spark may be caused by one of several components related to the distributor ignition system. The distributor ignition system check will address all problems related to the causes of a no spark condition.
6. No spark may be caused by one of several components related to the ignition system. The ignition system check will address all problems related to the causes of a no spark condition.
12. Checks for 12 volt supply to injectors. Due to the injectors wired in parallel, there should be a light on both terminals.
13. Checks continuity of CKT 467 and CKT 468.

Diagnostic Procedure (DP) A-3 - Engine Cranks But Will Not Run

Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic”(OBD) System Check performed?	—	Go to Step 2	Go to OBD System Check
2	**Important:** Refer to the applicable DTC diagnostic procedure if any of the following DTC’s are set: 41 or 81. Turn the ignition “ON,” engine “OFF.” Do the fuel pump(s) operate for 2 seconds?	—	Go to Step 3	Go to DP A-5
3	1. Turn ignition “OFF.” 2. Disconnect crankshaft position sensor harness connector. 3. Turn ignition “ON,” engine “OFF.” 4. Using a DMM, measure the voltage between the Depspower and Depslo circuits of the harness connector. Is the voltage within the specified range?	11-13 volts	Go to Step 4	Refer to DTC 81 - Crankshaft Position (CKP) Sensor Circuit Fault
4	1. Turn ignition “OFF.” 2. Install a fuel pressure gauge. 3. Turn ignition “ON,” engine “OFF.” Is the fuel pressure within the specified range?	See Master Specification Sheet (end of this section)	Go to Step 5	Go to DP A-4
5	Check for a contaminated fuel condition. Was a problem found?	—	Verify Repair	(5.0/5.7L) Go to Step 6 (6.0/8.1L) Go to Step 7
6	1. Using a known good timing light, check for spark at the ignition coil secondary wire. 2. Clip the timing light pickup onto the ignition coil secondary wire. 3. While cranking the engine, observe the timing light. Is the timing light flashing, indicating spark?	—	Go to Step 7	Go to DP A-7A (5.0/5.7L) Go to DP A-7B (6.0/8.1L)
7	1. Using a known good timing light, check for spark at a spark plug secondary wire. 2. Clip the timing light pickup onto a spark plug secondary wire. 3. While cranking the engine, observe the timing light. Is the timing light flashing, indicating spark?	—	Go to Step 8	Go to DP A-7A (5.0/5.7L) Go to DP A-7B (6.0/8.1L)

Diagnostic Procedure (DP) A-3 - Engine Cranks But Will Not Run

Step	Action	Value	Yes	No
8	Perform the following additional inspections: • Inspect that the throttle angle is at 0% at a closed throttle. If the throttle angle is not at 0%, refer to DTC 21 Throttle Position (TP) Sensor Circuit High Voltage or DTC 22 Throttle Position (TP) Sensor Circuit Low Voltage. • Inspect that the Engine Coolant Temperature (ECT) sensor is not shifted, refer to DTC 14 Engine Coolant Temperature (ECT) Sensor Circuit - Low Temp Indicated or DTC 15 Engine Coolant Temperature (ECT) Sensor Circuit - High Temp Indicated • Inspect the spark plugs for being gas fouled. If the spark plugs are gas fouled, determine what caused the rich condition. • Inspect for an engine mechanical failure that causes an engine not to start (i.e. timing chain, low compression). Refer to Engine Compression Test in Engine Mechanical. • Compare MAP/BARO parameters to another engine. The parameter values should be close to each other. Was a problem found?	—	Go to Step 9	Go to Hard Start Symptom for diagnosis
9	1. Select the Diagnostic Trouble Codes (DTC) option and the Clear DTC option using the scan tool. 2. Attempt to start the engine. Does the engine start and continue to run?	—	Go to Step 10	Go to Step 2
10	1. Idle the engine at the normal operating temperature. 2. Select the Diagnostic Trouble Codes (DTC) option using the scan tool. Are any DTCs displayed?	—	Go to the applicable DTC procedure	System OK

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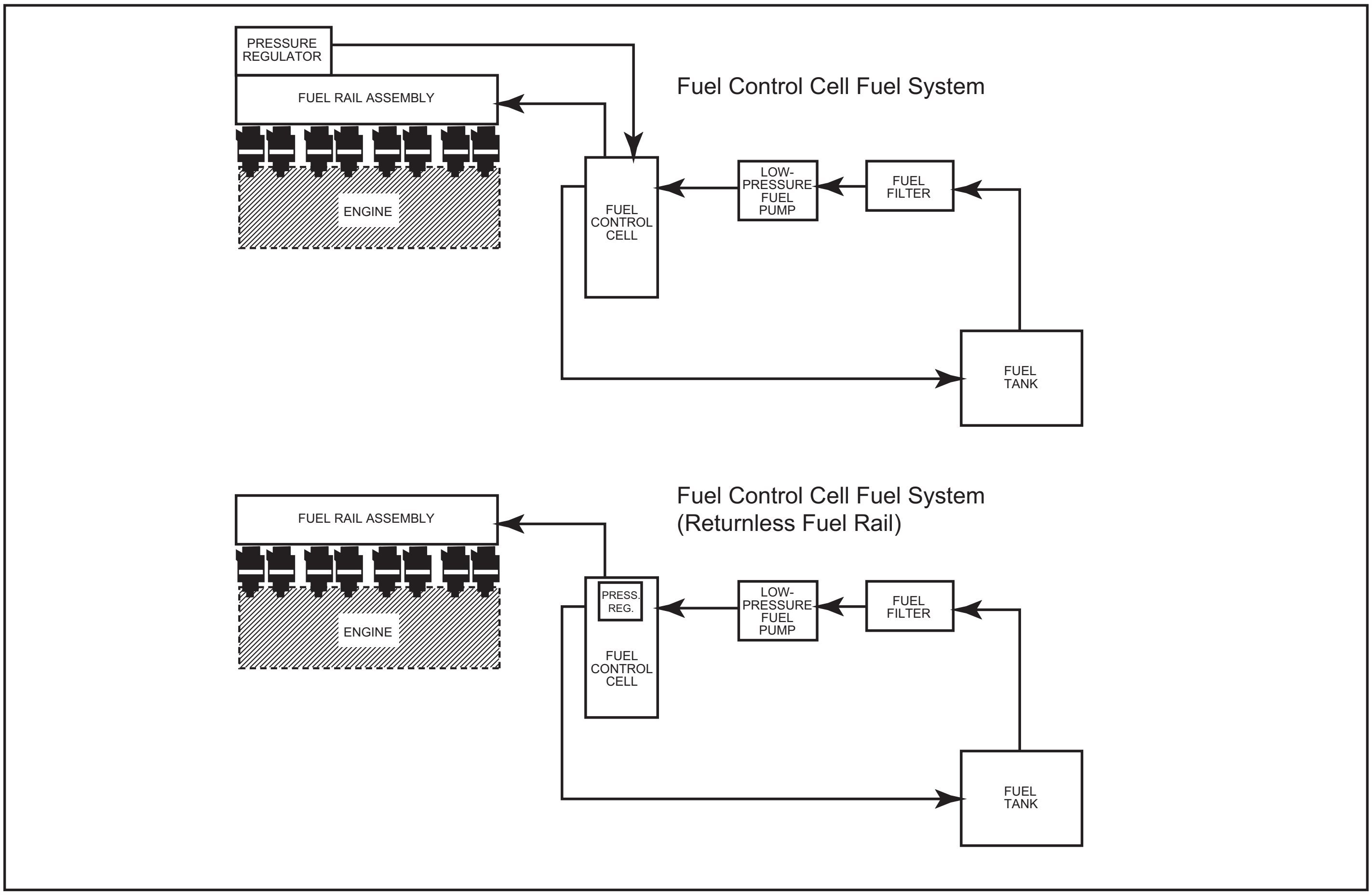

M4054P
2-12-04

Diagnostic Procedure (DP) A-4 Fuel System Diagnosis

Circuit Description

When the ignition switch is ON, the ECM activates the electric fuel pump. The fuel pump remains ON as long as the ECM receives reference pulses from the ignition system. If there are no reference pulses, the ECM turns the fuel pump OFF after about 2 seconds.

The electric pump delivers fuel through an in-pipe fuel filter to the fuel rail assembly. The fuel pump provides 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.

Test Description

Number(s) below refer to the step number(s) on the diagnostic table:

2. When the ignition switch is ON and the fuel pumps are running, the fuel pressure indicated by the fuel pressure gauge should read WOT values on the Master Specifications Sheet found at the end of this section. The spring pressure inside the fuel pressure regulator controls the fuel pressure.
3. A fuel system that drops more than 2 psi in 10 minutes has a leak in one or more of the following areas:
   - The fuel pump check valve.
   - The fuel pump flex pipe.
   - The valve or valve seat within the fuel pressure regulator.
   - The fuel injector(s).
4. A fuel system that drops more than 2 psi in 10 minutes after being relieved to 10 psi indicates a leaking fuel pump check valve.
5. Fuel pressure that drops off during acceleration, cruise or hard cornering may cause a lean condition. A lean condition can cause a loss of power, surging or misfire.
8. **If equipped with vacuum bias fuel pressure regulator -** 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.

12. A rich condition may result from the fuel pressure being above the required value. See the Master Specification Sheet found at the end of this section. Drivability conditions associated with rich conditions can include hard starting followed by black smoke and a strong sulfur smell in the exhaust.
13. This test determines if the high fuel pressure is due to a restricted fuel return pipe or if the high fuel pressure is due to a faulty fuel pressure regulator.
15. A lean condition may result from the fuel pressure being below the required value. See the Master Specification Sheet found at the end of this section. Drivability conditions associated with lean conditions can include hard starting (when the engine is cold), hesitation, poor drivability, lack of power, surging and misfiring.

    Notice: Do not allow the fuel pressure to exceed 75 psi. Excessive pressure may damage the fuel pressure regulator.
16. Restricting the fuel return pipe with the J 37287 fuel pipe shut-off adapter causes the fuel pressure to rise above the regulated pressure. Using a scan tool to pressurize the fuel system, the fuel pressure should rise above 62 psi as the valve on the fuel pipe shut-off adapter connected to the fuel return pipe becomes partially closed.
22. 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.
    1. Remove the fuel rail. Refer to Fuel Rail Assembly Replacement.
    2. Reinstall the crossover pipe to the right fuel rail. Refer to Fuel Rail Assembly Replacement.
    3. Connect the fuel feed pipe and the fuel return pipe to the fuel rail. Refer to Fuel Rail Assembly Replacement.
    4. 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. Also verify that the fuel injector retaining clips are intact.

5. Pressurize the fuel system by using the scan tool fuel pump enable.
6. Visually and physically inspect the fuel injector nozzles for leaks.

Diagnostic Procedure (DP) A-4 Fuel System Diagnosis

Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic” (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Turn OFF the ignition. ***Caution: Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. 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.*** 2. Install the J 34730-1A fuel pressure gauge. 3. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 4. Turn the ignition ON leaving the engine OFF. 5. Bleed the air out of the fuel pressure gauge. 6. Turn the ignition OFF for 10 seconds. 7. Turn the ignition ON leaving the engine OFF. **Important:** The fuel pump will run for approximately 2 seconds. Cycle the ignition as necessary in order to achieve the highest possible fuel pressure. 8. Observe the fuel pressure with the fuel pump running. Is the fuel pressure within the specified limits?	See Master Specification Sheet (end of this section	Go to Step 3	Go to Step 12

Diagnostic Procedure (DP) A-4 Fuel System Diagnosis (cont'd)

Step	Action	Value	Yes	No
3	**Important:** The fuel pressure may vary slightly when the fuel pump stops running. After the fuel pump stops running, the fuel pressure should stabilize and remain constant. Does the fuel pressure drop more than the specified value in 10 minutes?	10 psi	Go to Step 10	Go to Step 4
4	Relieve the fuel pressure to the first specified value. Does the fuel pressure drop more than the second specified value in 10 minutes?	10 psi 2 psi	Go to Step 19	Go to Step 5
5	Do you suspect the fuel pressure of dropping-off during acceleration, cruise or hard cornering?	—	Go to Step 6	Go to Step 8
6	Visually and physically inspect the following items for a restriction: • The fuel filter • The fuel feed pipe Did you find a restriction?	—	Go to Step 24	Go to Step 7
7	1. Remove the fuel sender assembly. 2. Visually and physically inspect the following items: • The fuel strainer/check valve for a restriction. • The fuel pump pipe for leaks. • Verify the fuel pump is the correct fuel pump for this vehicle. Did you find a problem in any of these areas?	—	Go to Step 24	Go to Step 19
8	1. Start the engine. 2. Allow the engine to idle at normal operating temperature. 3. Record the fuel pressure reading. 4. Disconnect vacuum line to fuel pressure regulator. Does the fuel pressure increase by the amount specified?	3-10 psi	Go to Symptoms	Go to Step 9
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 drop by the amount specified?	3-10 psi	Go to Step 20	Go to Step 21

Diagnostic Procedure (DP) A-4 Fuel System Diagnosis (cont'd)

Step	Action	Value	Yes	No
10	1. Relieve the fuel pressure. Refer to Fuel Pressure Relief Procedure. 2. Disconnect the fuel feed pipe and the fuel return pipe from the fuel rail. 3. Install the J 37287 fuel pipe shut-off adapters between the fuel feed pipe and the fuel return pipe and the fuel rail. 4. Open the valves on the fuel pipe shut-off adapters. 5. Turn the ignition ON. 6. Pressurize the fuel system using a scan tool. 7. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 8. Bleed the air out of the fuel pressure gauge. 9. Wait for the fuel pressure to build. 10. Close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe. Does the fuel pressure remain constant?	—	Go to Step 19	Go to Step 11
11	1. Open the valve in the fuel pipe shut-off adapter that is connected to the fuel feed pipe. 2. Pressurize the fuel system using a scan tool. 3. Wait for the fuel pressure to build. 4. Close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe. Does the fuel pressure remain constant?	—	Go to Step 21	Go to Step 22
12	Is the fuel pressure above the maximum specified limit?	See Master Specification Sheet (end of this section)	Go to Step 13	Go to Step 15
13	1. Relieve the fuel pressure. Refer to the Fuel Pressure Relief Procedure. 2. Disconnect the fuel return pipe from the fuel rail. 3. Attach a length of flexible fuel hose to the fuel rail outlet passage. 4. Place the open end of the flexible fuel hose into an approved gasoline container. 5. Turn the ignition OFF for 10 seconds. 6. Turn the ignition ON. 7. Observe the fuel pressure with the fuel pump running. Is the fuel pressure within the specified limits?	See Master Specification Sheet (end of this section)	Go to Step 23	Go to Step 14
14	Visually and physically inspect the fuel rail outlet passages for a restriction. Was a restriction found?	—	Go to Step 24	Go to Step 21
15	Is the fuel pressure above the specified value?	0 kPa (0 psi)	Go to Step 16	Go to Step 17

Diagnostic Procedure (DP) A-4 Fuel System Diagnosis

Step	Action	Value	Yes	No
16	1. Relieve the fuel pressure. Refer to Fuel Pressure Relief Procedure. 2. Disconnect the fuel return pipe from the fuel rail. 3. Install the J 37287 fuel pipe shut-off adapter between the fuel return pipe and the fuel rail. 4. Open the valve on the fuel pipe shut-off adapter. 5. Turn the ignition ON. 6. Pressurize the fuel system using a scan tool. 7. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 8. Bleed the air out of the fuel pressure gauge. Notice: Do not allow the fuel pressure to exceed 517 kPa (75 psi). Excessive pressure may damage the fuel pressure regulator. 9. Slowly close the valve in the fuel pipe shut-off adapter that is connected to the fuel return pipe. Does the fuel pressure rise above the maximum value?	See Master Specification Sheet (end of this section)	Go to Step 21	Go to Step 7
17	Turn ON the fuel pump using a scan tool. Does the fuel pump run?	—	Go to Step 18	Go to DP A-5
18	Visually and physically inspect the following items: • The fuel filters for obstructions. • The fuel feed pipes for a restriction. • The fuel strainers for obstructions. • The fuel pump pipes for leaks. Did you find a problem in any of these areas?	—	Go to Step 24	Go to Step 19
19	Replace the fuel pump. Is the action complete?	—	System OK	—
20	Locate and repair the loss of vacuum to the fuel pressure regulator. Is the action complete?	—	System OK	—
21	Replace the fuel pressure regulator. Is the action complete?	—	System OK	—
22	Locate and replace any leaking fuel injector(s). Is the action complete?	—	System OK	—
23	Locate and repair the restriction in the fuel return pipe. Is the action complete?	—	System OK	—
24	Repair the problem as necessary. Is the action complete?	—	System OK	—

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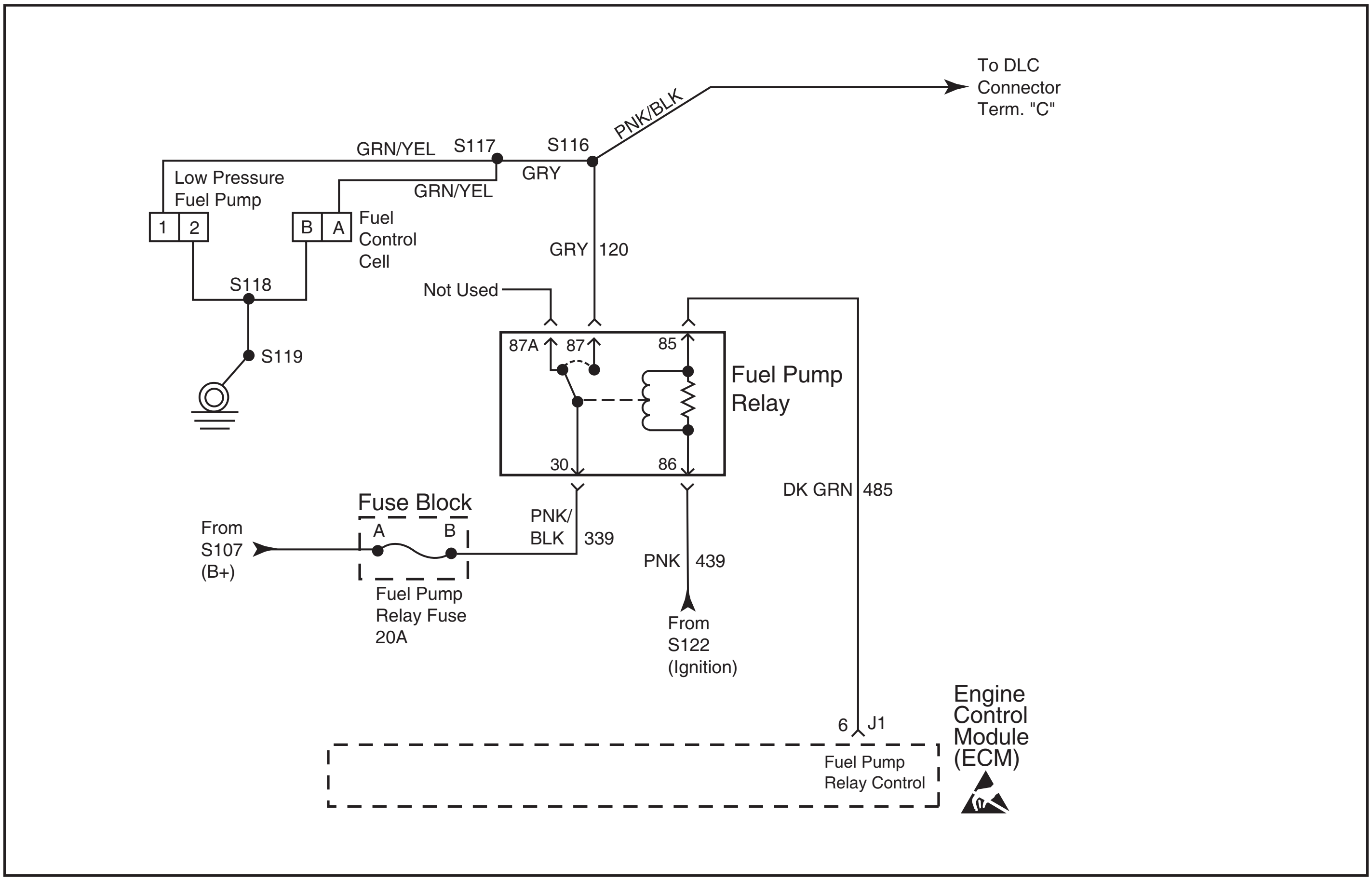

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2-10-04

Diagnostic Procedure (DP) A-5 Fuel Pump Relay Circuit Diagnosis

Circuit Description

When the ignition switch is ON, the ECM activates the electric fuel pumps. The fuel pumps remain ON as long as the ECM receives reference pulses from the ignition system. If there are no reference pulses, the ECM turns the fuel pumps OFF after about 2 seconds. The pumps deliver fuel to the fuel rail and injectors, then to the pressure regulator, where the system pressure remains at the required specification while the fuel pumps are running. See Master Specification Sheet found at the end of this section. Excess fuel returns to the fuel tank, on the FCC system. When the engine is stopped, a scan tool, in the output controls function, can turn ON the fuel pump.

Improper fuel system pressure results in one or many of the following symptoms:

- Cranks but will not run
- Cuts out, may feel like an ignition problem
- Poor fuel economy
- Loss of power
- Hesitation
- DTCs

Diagnostic Aids

The following conditions may have caused the fuel pump fuse to open:

- The fuse is faulty
- There is an intermittent short in the fuel pump power feed circuit.
- The fuel pump has an intermittent internal problem.

For an intermittent condition, refer to Symptoms.

Test Description

Number(s) below refer to the step number(s) on the diagnostic table:

3. Refer to Thumbnail Schematic for proper terminal identification.
5. The test lamp only illuminates for two seconds even through the scan tool commanded position is ON. You will have to command the fuel pump OFF then ON to re-enable the ECM fuel pump control.
12. Inspect the fuel pump fuse for an open. If the fuse is open, inspect the circuit for a short to ground.
20. Inspect the fuel pump fuse for an open. If the fuse is open, inspect the circuit for a short to ground.

Diagnostic Procedure (DP) A-5 Fuel Pump Relay Circuit Diagnosis

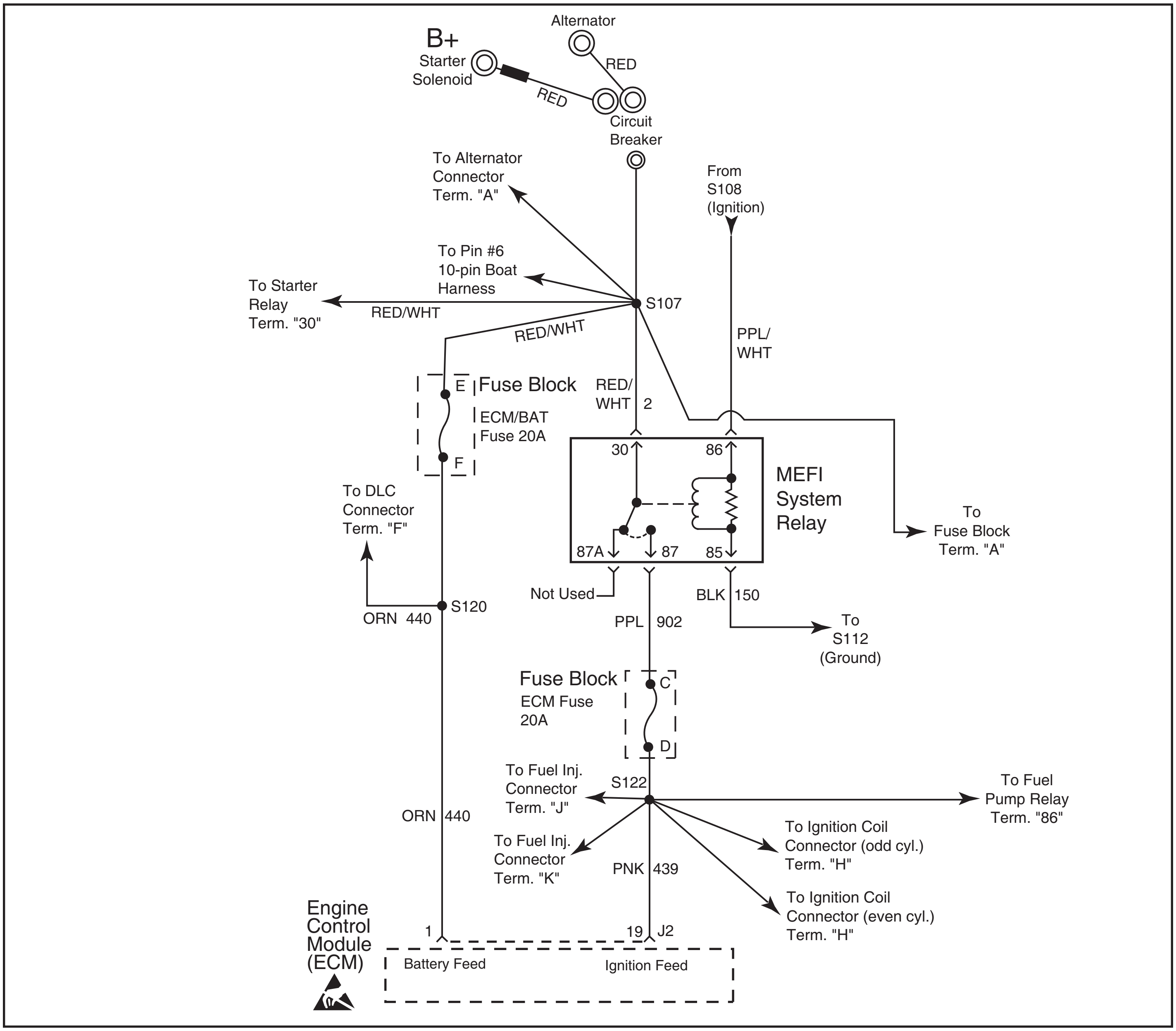
Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic” (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Check the fuel pump relay fuse. Is the fuse open?	—	Go to Step 9	Go to Step 3
3	1. Install a scan tool. 2. Disconnect the fuel pump relay harness connector. 3. Turn ON the ignition leaving the engine OFF. 4. Probe the fuel pump relay battery feed circuit, terminal “30,” at the harness connector with a test lamp J 34142-B connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 12
4	Probe the fuel pump relay ignition feed circuit, terminal “86,” at the harness connector with a test lamp J 34142-B connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 13
5	1. Probe the fuel pump control circuit, terminal “85,” at the harness connector with a test lamp J 34142-B connected to B+. 2. Enable the fuel pump using the scan tool. Does the test lamp illuminate for 2 seconds?	—	Go to Step 6	Go to Step 11
6	**Important:** Ignition must be ON before performing this step. Jumper the fuel pump relay battery feed circuit, terminal “30” to the fuel pump load circuit, terminal “87,” at the harness connector using a fused jumper wire. Does the fuel pump operate?	—	Go to Step 18	Go to Step 7
7	1. Leave the fused jumper wire connected. 2. Disconnect the fuel pump harness connector at the fuel pump. 3. Probe the power feed circuit in the fuel pump harness connector with a test lamp J 34142-B connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 14
8	1. Leave the fused jumper wire connected. 2. Connect the test lamp J 34142-B between the battery feed circuit and the ground circuit in the fuel pump harness connector. Does the test lamp illuminate?	—	Go to Step 25	Go to Step 15
9	1. Turn OFF the ignition. 2. Remove the fuel pump fuse. 3. Disconnect the fuel pump harness connector at the fuel pump. 4. Probe the load circuit for the fuel pump relay at the harness connector, terminal “87” with a test lamp J 34142-B connected to B+. Does the test lamp illuminate?	—	Go to Step 16	Go to Step 10

Diagnostic Procedure (DP) A-5 Fuel Pump Relay Circuit Diagnosis

Step	Action	Value	Yes	No
10	Probe the battery feed circuit for the fuel pump relay at the harness connector with a test lamp J 34142-B connected to B+. Does the test lamp illuminate?	—	Go to Step 20	Go to Step 21
11	1. Turn OFF the ignition. 2. Disconnect the ECM connector J1. 3. Measure the continuity of the fuel pump relay control circuit from the fuel pump relay harness connector to the ECM connector using the DMM J 39200. Does the DMM display the specified value or lower?	5 ohms	Go to Step 22	Go to Step 17
12	Repair the open or grounded battery feed circuit to the relay. Replace the fuel pump relay fuse if the fuse is open. Is the action complete?	—	Go to Step 26	—
13	Repair the open or grounded fuel pump relay ignition circuit. Is the action complete?	—	Go to Step 26	—
14	Repair the open circuit between the fuel pump relay and the fuel pump. Is the action complete?	—	Go to Step 26	—
15	Repair the open fuel pump ground circuit. Is the action complete?	—	Go to Step 26	—
16	Repair the short to ground in the fuel pump relay load circuit between the relay and the fuel pump. Is the action complete?	—	Go to Step 26	—
17	Repair the fuel pump relay control circuit. Is the action complete?	—	Go to Step 26	—
18	Inspect for poor connections at the relay harness connector. Did you find and correct the condition?	—	Go to Step 26	Go to Step 19
19	Replace the relay. Refer to Fuel Pump Relay Replacement. Is the action complete?	—	Go to Step 26	—
20	Repair the short to ground in the battery feed circuit to the fuel pump relay. Replace the fuel pump relay fuse if the fuse is open. Is the action complete?	—	Go to Step 26	—
21	1. Turn OFF the ignition. 2. Re-install the fuel pump relay. 3. Install a new fuse. 4. Connect the fuel pump harness to the fuel pump. 5. Turn ON the ignition leaving the engine OFF. 6. Command the fuel pump relay ON using a scan tool. Is the fuel pump fuse open?	—	Go to Step 24	Go to Diagnostic Aids

Diagnostic Procedure (DP) A-5 Fuel Pump Relay Circuit Diagnosis

Step	Action	Value	Yes	No
22	Inspect for a poor connection at the ECM. Did you find and correct the condition?	—	Go to Step 26	Go to Step 23
23	Replace the ECM. Is the action complete?	—	Go to Step 26	—
24	1. Inspect the fuel pump harness for a short to ground. 2. If you find a short, repair the circuit as necessary and replace the fuse. Did you find and correct the condition?	—	Go to Step 26	Go to Step 25
25	**Important:** Inspect for poor electrical connections at the fuel pump harness before replacing the fuel pump. Replace the faulty fuel pump, and replace the fuse. Is the action complete?	—	Go to Step 26	—
26	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC Information option using the scan tool. 2. Attempt to start the engine. Does the engine start and continue to operate?	—	Go to Step 27	Go to Step 2
27	1. Idle the engine until the normal operating temperature is reached. 2. Select the Diagnostic Trouble Code (DTC) option. Are any DTCs displayed?	—	Go to the applicable DTC table	System OK



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2-10-04

Diagnostic Procedure (DP) A-6 System Relay Diagnosis

Circuit Description

The system relay powers the following components:

- Injectors
- Ignition Coils

Diagnostic Aids

The following may cause an intermittent:

- Poor connections. Check for adequate terminal tension.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

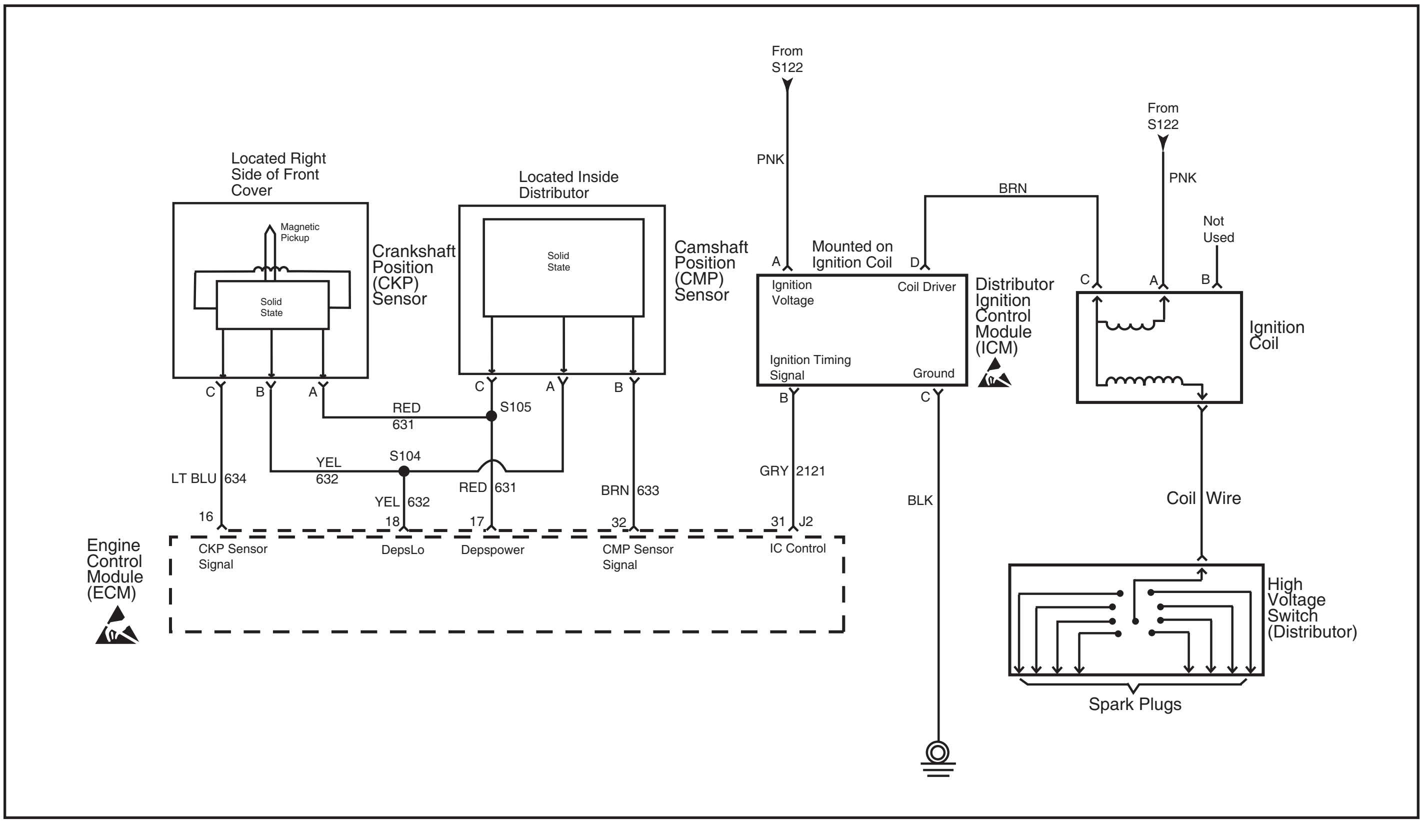
Test Description

Number(s) below refer to the step number(s) on the diagnostic table:

2. Refer to Thumbnail Schematic for proper relay terminal identification.
4. This step is testing the relay ground circuit.
5. This step isolates the circuit from the system relay. All of the circuits are good if the test lamp illuminates.
9. The open circuit will be between the splice and the system relay.

Diagnostic Procedure (DP) A-6 System Relay Diagnosis

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Turn OFF the ignition. 2. Disconnect the system relay electrical connector. 3. Probe system relay terminal "30," using a test lamp J 34142-B connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 3	Go to Step 8
3	1. Turn ON the ignition leaving the engine OFF. 2. Probe system relay terminal "86," using a test lamp J 34142-B connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 9
4	1. Turn OFF the ignition. 2. Measure the resistance of the system relay ground circuit using a DMM J 39200 connected to the battery ground. Is the resistance less than the specified value?	0-5 ohms	Go to Step 5	Go to Step 10
5	1. Turn OFF the ignition. 2. Jumper system relay terminal "30" and system relay terminal "87," together using a fused jumper wire. 3. Probe the ECM fuse with a test lamp J34142-B connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 11
6	Inspect closely for poor terminal contact at the system relay connector. Did you find and correct the condition?	—	System OK	Go to Step 7
7	Replace the system relay. Is the action complete?	—	System OK	—
8	Repair the open B+ supply to system relay terminal "30." Is the action complete?	—	System OK	—
9	Repair the ignition feed circuit to system relay terminal "86." Is the action complete?	—	System OK	—
10	Repair the system relay ground circuit. Is the action complete?	—	System OK	—
11	Repair the system relay load circuit (CKT 902). Is the action complete?	—	System OK	—



M4053
9-18-02

Diagnostic Procedure (DP) A-7A Distributor Ignition Diagnosis (5.0/5.7L Only)

Circuit Description

This system includes the distributor, the camshaft position (CMP) sensor, the ignition control (IC) module, the secondary wires, the spark plugs, the knock sensor (KS) and the crankshaft position (CKP) sensor. The ignition system is controlled by the ECM. The ECM monitors the information from various sensors, computes the desired spark timing, and controls the dwell and firing of the ignition coil via the IC line to the IC module.

Diagnostic Aids

Check for the following conditions:

- <u>Poor connection at ECM.</u> Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

Number(s) below refer to the step number(s) on the diagnostic table:

2. This test checks for the 12 volt supply to the CKP sensor.
3. This test checks for the ground supplied to the CKP sensor
4. If the timing light flashes, spark is present on that wire.
7. This test checks for the trigger to the coil.

Diagnostic Procedure (DP) A-7A Distributor Ignition Diagnosis (5.0/5.7L Only)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	***Caution: Before proceeding, remove all injector connectors and the ignition module connector (5.0/5.7L), or disconnect the harness connectors at the ignition coils and the injectors(6.0/8.1L) in order to prevent personal injury from engine rotation, sparks and excessive engine fueling.*** 1. Turn ON the ignition leaving the engine OFF. 2. Disconnect the Crankshaft Position (CKP) sensor harness connector. 3. Using a DMM connected to a known good ground, measure the voltage at terminal "A" (Depspower) at the CKP sensor harness. Does the DMM display the specified value?	B+	Go to Step 3	Go to Step 21
3	Using a DMM, measure the voltage between the CKP sensor harness connector terminals "A" (Depspower) and "B" (Depslo). Does the DMM display the specified value?	B+	Go to Step 4	Go to Step 22
4	1. Turn ignition "OFF." 2. Disconnect the ECM "J2" connector. 3. Using a DMM, measure resistance between terminal "C" of the CKP sensor and ECM harness connector "J2-16." Does the DMM display the specified value?	0 ohms	Go to Step 5	Go to Step 23
5	1. Check the spark plug wires for open circuits, cracks or improper seating of terminals at the spark plugs, distributor and ignition coil before proceeding with the test. 2. Using a timing light, check for spark on a plug wire while cranking the engine. If there is no spark on one wire, check a second wire. A few flashes then nothing is considered no spark. Does the timing light flash while cranking the engine, on all cylinders?	—	Go to Diagnostic Aids	Go to Step 6
6	Using a timing light, check for spark on the coil wire while cranking the engine. A few flashes then nothing is considered no spark. Does the timing light flash while cranking the engine?	—	Go to Step 15	Go to Step 7
7	Measure the coil wire resistance. Does the resistance measure approximately the specified value?	1,000 ohm/in.	Go to Step 8	Go to Step 36
8	1. Disconnect the ignition coil harness connector. 2. Using a test lamp connected to B+, probe the ignition coil driver circuit, terminal "C." Does the test lamp flash while cranking the engine?	—	Go to Step 10	Go to Step 9

Diagnostic Procedure (DP) A-7A Distributor Ignition Diagnosis (5.0/5.7L Only)

Step	Action	Value	Yes	No
9	1. Turn the ignition “OFF.” 2. Using a test lamp connected to B+, probe the ignition coil driver circuit, terminal “C.” Does the test lamp illuminate brightly?	—	Go to Step 33	Go to Step 11
10	1. Turn the ignition “ON,” engine “OFF.” 2. Using a DMM connected to a known good ground, measure the coil ignition voltage, terminal “A.” Does the voltage measure above the specified value?	10.0 volts	Go to Step 26	Go to Step 20
11	1. Turn the ignition “OFF.” 2. Check for an open circuit between the ignition coil and the IC module. If a problem is found, repair as necessary. Was a problem found?	—	Go to Step 32	Go to Step 12
12	1. Turn the ignition “ON,” engine “OFF.” 2. Disconnect the IC module harness connector. 3. Using a DMM connected to a known good ground, measure the IC module ignition voltage terminal “A.” Does the voltage measure above the specified value?	10.0 volts	Go to Step 13	Go to Step 24
13	Using a test lamp connected to B+, probe the IC module harness connector ground circuit, terminal “C.” Does the test lamp illuminate brightly?	—	Go to Step 14	Go to Step 28
14	1. Using a DMM connected to a known good ground, set to AC scale, probe the IC module harness connector timing control circuit, terminal “B.” 2. Crank the engine. 3. Observe the voltage while the engine is cranking. Does the voltage measure above the specified value?	1.0 - 4.0 volts	Go to Step 25	Go to Step 17
15	1. Remove the distributor cap. 2. Check the cap for the following conditions: • Cracks • Moisture • Carbon Tracks • Physical Damage Did you find any of these conditions?	—	Go to Step 38	Go to Step 16
16	1. Crank the engine. 2. Observe the distributor rotor while the engine is cranking Did the distributor rotor turn?	—	Go to Step 37	Go to Engine Mechanical
17	1. Turn the ignition “OFF.” 2. Disconnect the ECM “J1” and “J2” connectors. 3. Check the ignition timing control circuit for an open between the ECM and the IC module. If a problem is found, repair as necessary. Was a problem found?	—	Go to Step 29	Go to Step 18

Diagnostic Procedure (DP) A-7A Distributor Ignition Diagnosis (5.0/5.7L Only)

Step	Action	Value	Yes	No
18	Using a test lamp connected to B+, probe the ignition timing control circuit at the ECM harness connector, "J2-31." Does the test lamp illuminate brightly?	—	Go to Step 30	Go to Step 19
19	1. Turn the ignition "ON," engine "OFF." 2. Using a test lamp connected to a known good ground, probe the ignition timing control circuit at the ECM harness connector, "J2-31." Does the test lamp illuminate brightly?	—	Go to Step 31	Go to Step 27
20	Locate and repair an open or short to ground on the ignition voltage circuit at the ignition coil. Is action complete?	—	Verify Repair	—
21	Check for an open or short to ground on the CKP or CMP Depspower circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 27
22	Check for an open on the CKP or CMP depslo circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 27
23	Check for an open on the CKP sensor signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 27
24	Locate and repair an open or short to ground on the ignition voltage circuit at the IC module. Is action complete?	—	Verify Repair	—
25	Check for poor connections at IC module. If a problem is found, repair as necessary. Was a problem found?	—	Go to Step 34	Go to Step 39
26	Check for poor connections at ignition coil. If a problem is found, repair as necessary. Was a problem found?	—	Go to Step 34	Go to Step 35
27	Check for poor connections at the ECM. If a problem is found, repair as necessary. Was a problem found?	—	Go to Step 34	Go to Step 40
28	Locate and repair the open IC module ground circuit. Is action complete?	—	Verify Repair	—
29	Locate and repair the open ignition timing control circuit. Is action complete?	—	Verify Repair	—
30	Locate and repair the grounded ignition timing control circuit. Is action complete?	—	Verify Repair	—
31	Locate and repair the short to voltage in the ignition timing control circuit. Is action complete?	—	Verify Repair	—
32	Locate and repair the open in the coil driver circuit between the ignition coil and the IC module. Is action complete?	—	Verify Repair	—

Diagnostic Procedure (DP) A-7A Distributor Ignition Diagnosis (5.0/5.7L Only)

Step	Action	Value	Yes	No
33	Locate and repair the short to ground in the coil driver circuit between the ignition coil and the IC module. Is action complete?	—	Verify Repair	—
34	Repair the circuit as necessary. Is action complete?	—	Verify Repair	—
35	Replace the faulty ignition coil. Is action complete?	—	Verify Repair	—
36	Replace the coil wire. Is action complete?	—	Verify Repair	—
37	Replace the distributor rotor. Is action complete?	—	Verify Repair	—
38	Replace the distributor cap. Is action complete?	—	Verify Repair	—
39	Replace the faulty IC module. Is action complete?	—	Verify Repair	—
40	Replace the ECM. Is action complete?	—	Verify Repair	—

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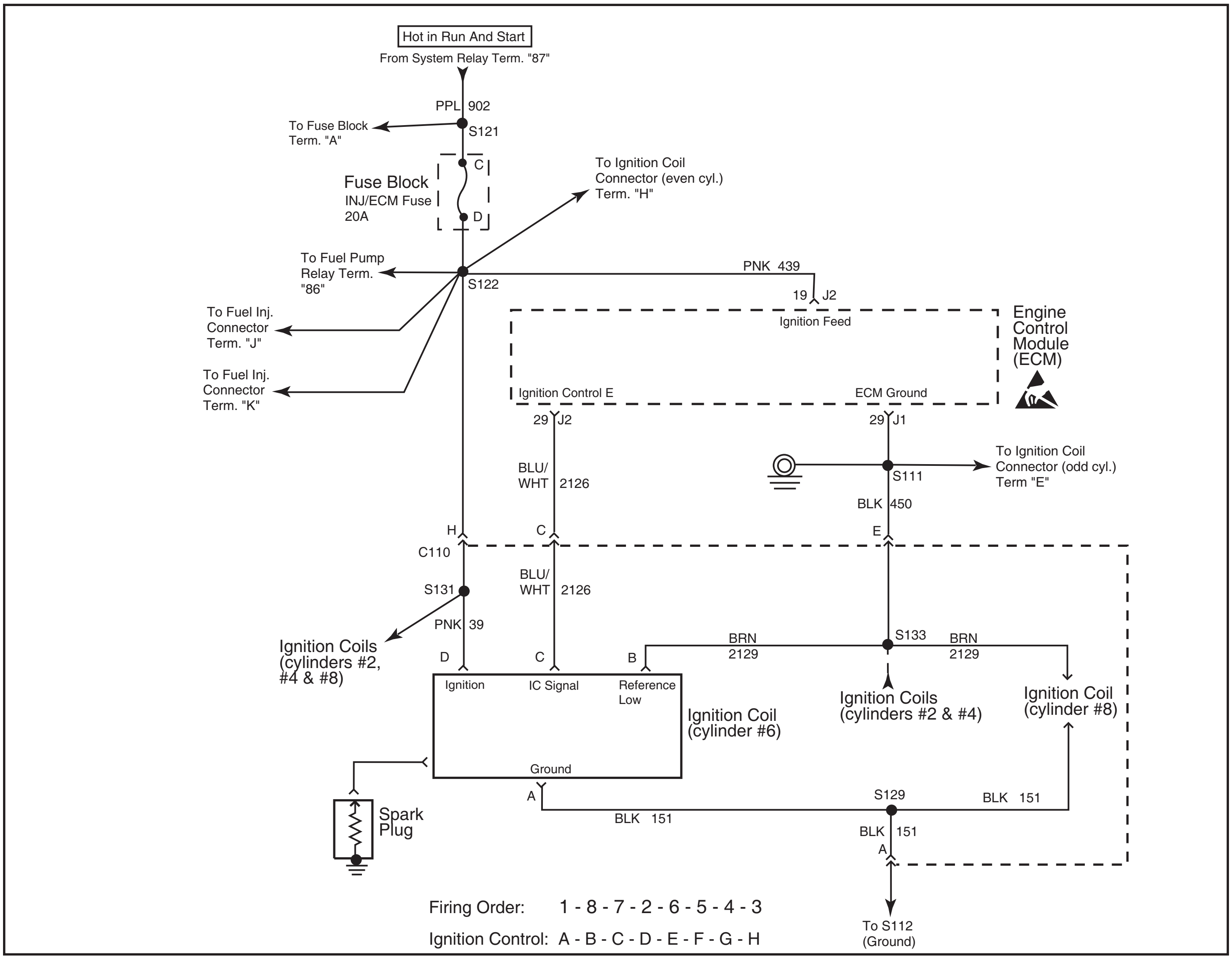


M4071P
2-10-04

Diagnostic Procedure (DP) A-7B Electronic Ignition System Diagnosis (6.0/8.1L Only)

Circuit Description

The ignition system on this engine uses an individual ignition coil/module for each cylinder. The ECM controls the ignition system operation. The ECM controls each coil using one of eight Ignition Control (IC) circuits. The ECM commands the IC circuit low when a spark event is requested. This causes the IC module to energize the ignition coil to create a spark at the spark plug. Each ignition coil/module has the following circuits:

- A power feed
- A ground circuit
- An Ignition Control (IC) circuit
- A reference low circuit

Sequencing and timing are ECM controlled. This DTC sets when the IC circuit is out of range.

Diagnostic Aids

Check for the following conditions:

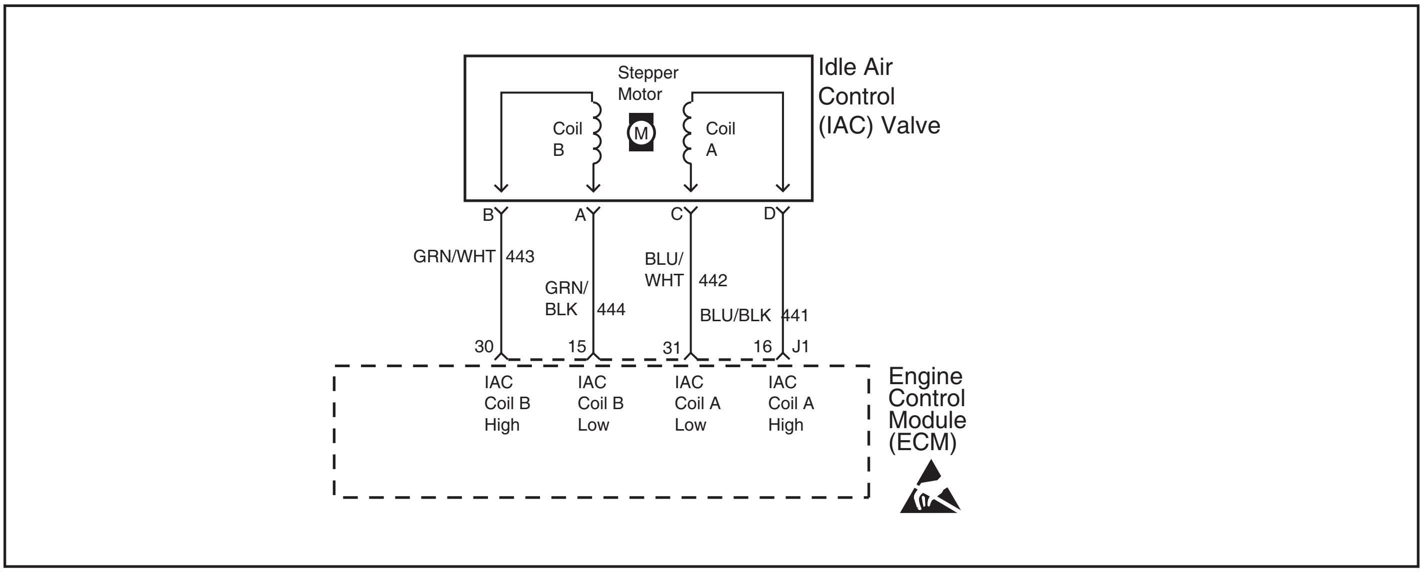
- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

2. This step verifies the fault is present.
4. This step tests the integrity of the IC circuit and the ECM output.
5. This step tests for a short to ground on the IC signal circuit.

Diagnostic Procedure (DP) A-7B Electronic Ignition System Diagnosis (6.0/8.1L Only)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	**Important:** If all the Ignition Control (IC) DTCs are set at the same time, inspect the IC ground circuits for an open. 1. Install a scan tool. 2. Using a scan tool, clear DTCs. 3. Start and idle the engine for 2 minutes. 4. Check for DTCs. Does the scan tool indicate a DTC 41 for ignition coil?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the engine. 2. Disconnect the ignition coil electrical harness. 3. Measure the frequency at the ignition control signal circuit using the DMM J 39200 on the DC Hertz scale. Is the frequency within the specified range?	3.0-20 Hz	Go to Step 7	Go to Step 4
4	Measure the voltage at the ignition control signal circuit using the DMM J 39200. Is the voltage greater that the specified value?	1.0 volts	Go to Step 8	Go to Step 5
5	1. Turn OFF the engine. 2. Disconnect the ECM connector J2. 3. Test the continuity from the IC circuit (at the ignition coil harness connector) to the ECM connector using the DMM J 39200. Does the DMM indicate continuity?	—	Go to Step 6	Go to Step 9
6	Test the resistance from the IC circuit (at the ignition coil harness connector) to ground using the DMM J 39200. Does the DMM indicate OL (out-of-limits)?	—	Go to Step 10	Go to Step 9
7	Replace the ignition coil. Is the action complete?	—	Go to Step 12	—
8	Repair the Ignition Control circuit for a short to voltage. Is the action complete?	—	Go to Step 12	—
9	Repair the Ignition Control circuit for an open or grounded circuit. Is the action complete?	—	Go to Step 12	—
10	1. Inspect for poor connections at the ECM connector. 2. Replace the terminal if necessary. Did you find and correct the problem?	—	Go to Step 12	Go to Step 11
11	Replace the ECM. Is the action complete?	—	Go to Step 12	—
12	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC information option using the scan tool. 2. Idle the engine at the normal operating temperature. Is DTC 41 indicated?	—	Go to Step 2	Go to Step 13
13	Select the Diagnostic Trouble Code (DTC) option. Does the scan tool display any DTCs that you have not diagnosed?	—	Go to the applicable DTC table	System OK



M4059
9-18-02

Diagnostic Procedure (DP) A-8 Idle Air Control Functional Test

Circuit Description

The ECM controls idle speed to a calibrated "desired" RPM based on sensor inputs and actual engine RPM. The ECM uses four (4) circuits to move the Idle Air Control (IAC) valve. The movement of the IAC valve varies the amount of air flow bypassing the throttle plates. The ECM controls idle speed by determining the position of the IAC valve.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check for the following items:

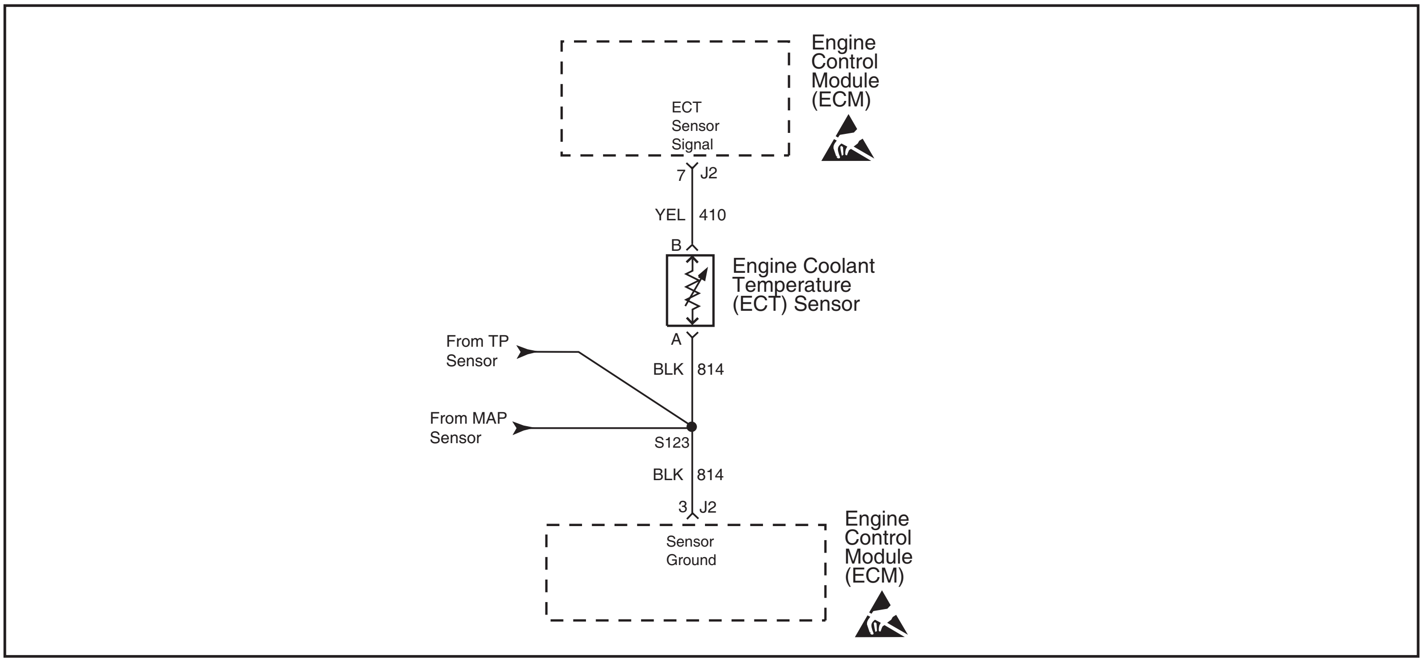
- Poor connection or damaged harness. Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal to wire connection and damaged harness.
- Check for vacuum leaks, disconnected or brittle vacuum hoses, cuts, etc. Examine manifold and throttle body gaskets for proper seal. Check for cracked intake manifold.
- Check for poor connections, opens or short to grounds in CKT's 441, 442, 443 and 444. This may result in improper idle control.
- An IAC valve which is "frozen" and will not respond to the ECM, a throttle stop screw which has been tampered with, or a damaged throttle body or linkage may cause improper idle.

Test Description

2. This step determines if the IAC valve is functioning properly.
4. This step determines if the circuitry or the IAC valve is faulty.

Diagnostic Procedure (DP) A-8 Idle Air Control Functional Test

Step	Action	Value	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" for 10 seconds. 2. Disconnect IAC harness connector. 3. Turn ignition "ON." 4. Using a test lamp J 34142-B connected to ground, probe one of the four IAC harness terminals. 5. Repeat steps 3 and 4 for each terminal. 6. Turn ignition "OFF." Does the test lamp blink on all four terminals?	—	Go to Step 3	Go to Step 7
3	1. Engine should be at normal operating temperature. 2. Start engine and allow idle to stabilize. 3. Record RPM. 4. Ignition "OFF" for 10 seconds. 5. Disconnect IAC harness connector. 6. Restart engine and record RPM. Is RPM higher than the first recorded RPM by more than the specified value?	200 RPM	Go to Step 4	Go to Step 5
4	1. Reinstall IAC harness connector. 2. Idle speed should gradually return within 75 RPM of the original recorded RPM within 30 seconds. Does RPM return to original recorded RPM?	—	Go to Step 6	Go to Step 5
5	1. Ignition "OFF" for 10 seconds. 2. Disconnect IAC harness connector. 3. Turn ignition "ON." 4. Using a test lamp J 34142-B connected to ground, probe one of the four IAC harness terminals. 5. Repeat steps 3 and 4 for each terminal. 6. Turn ignition "OFF." Does the test lamp blink on all four terminals?	—	Go to Step 8	Go to Step 7
6	IAC circuit is functioning properly.	—	—	—
7	Locate and repair poor connection, open, or short to ground in the IAC circuit that did not blink. If a problem was found, repair as necessary. Was a problem found?	—	Go to OBD System Check	Go to Step 9
8	Check for poor IAC connections or replace the faulty IAC valve. Is action complete?	—	Go to OBD System Check	—
9	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Go to OBD System Check	—



M4060
9-18-02

DTC 14 - Engine Coolant Temperature (ECT) Sensor Circuit - Low Temp Indicated (Scan Diagnostics) (High Voltage)

Circuit Description

The Engine Coolant Temperature (ECT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 410 to the sensor. When the engine coolant is cold, the sensor (thermistor) resistance is high. As the engine coolant warms up, the sensor resistance becomes less. See engine coolant temperature sensor table under "Diagnostic Aids." At normal operating temperature (85°C - 95°C or 185°F - 203°F), the voltage will measure about 1.5-2.0 volts.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the scan tool while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.
- The scan tool displays engine coolant temperature in degrees Celsius and Fahrenheit. If the engine is cold (not running within 8 hours), the scan tool should display a ECT sensor value within a few degrees of outside air temperature. This may help aid in diagnosing a "shifted" coolant sensor. After engine is started, the temperature should rise steadily and then stabilize at operating temperature when the thermostat opens.
- If DTC 33 is also set, check for open ground CKT 814.

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

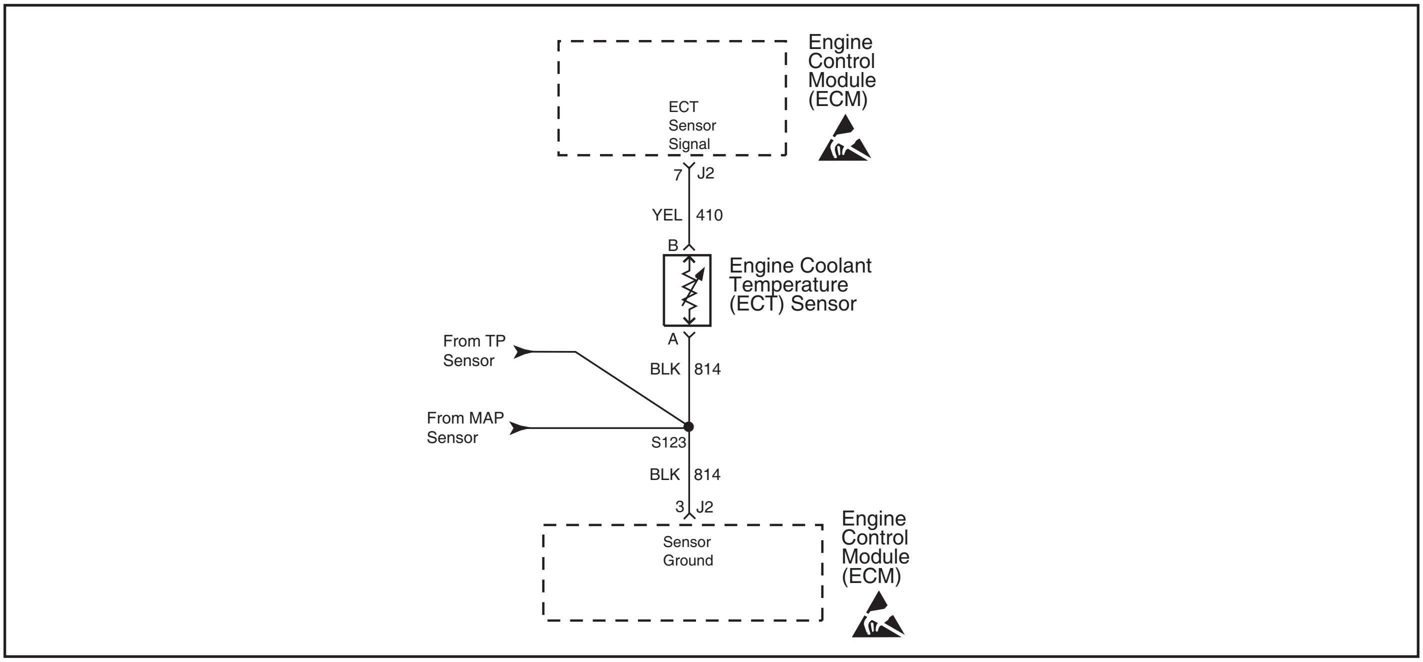
2. DTC 14 will set if signal voltage indicates a coolant temperature below -30°C (-22°F).
3. This test simulates a DTC 15. If the ECM recognizes the low voltage signal and displays a high temperature, the ECM and wiring are OK.

Engine Coolant Temperature Sensor Table

°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 14 - Engine Coolant Temperature (ECT) Sensor Circuit - Low Temp Indicated (Scan Diagnostics) (High Voltage)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature less than the specified value?	-30°C (-22°F)	Go to Step 3	Go to Step 4
3	1. Turn ignition OFF. 2. Disconnect the ECT sensor harness connector. 3. Connect a jumper wire from harness terminal "A" (CKT 814) to harness terminal "B" (CKT 410). 4. Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature above the specified value?	130°C (266°F)	Go to Step 6	Go to Step 5
4	DTC 14 is intermittent. Locate and repair intermittent faulty connections. • Refer to "Diagnostic Aids."	—	Verify Repair	—
5	Locate and repair open in CKT 410 or CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
6	Repair faulty ECT sensor. Is action complete?	—	Verify Repair	—
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



M4060
9-18-02

DTC 15 - Engine Coolant Temperature (ECT) Sensor Circuit - High Temp Indicated (Scan Diagnostics) (Low Voltage)

Circuit Description

The Engine Coolant Temperature (ECT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 410 to the sensor. When the engine coolant is cold, the sensor (thermistor) resistance is high. As the engine coolant warms up, the sensor resistance becomes less. See engine coolant temperature sensor table under "Diagnostic Aids." At normal operating temperature (85°C - 95°C or 185°F - 203°F), the voltage will measure about 1.5-2.0 volts.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the ECT display on the scan tool while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.
- The scan tool displays engine coolant temperature in degrees Celsius and Fahrenheit. If the engine is cold (not running within 8 hours), the scan tool should display a ECT sensor value within a few degrees of outside air temperature. This may help aid in diagnosing a "shifted" coolant sensor. After engine is started, the temperature should rise steadily and then stabilize at operating temperature when the thermostat opens.
- Check harness routing for a potential short to ground in CKT 410.

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

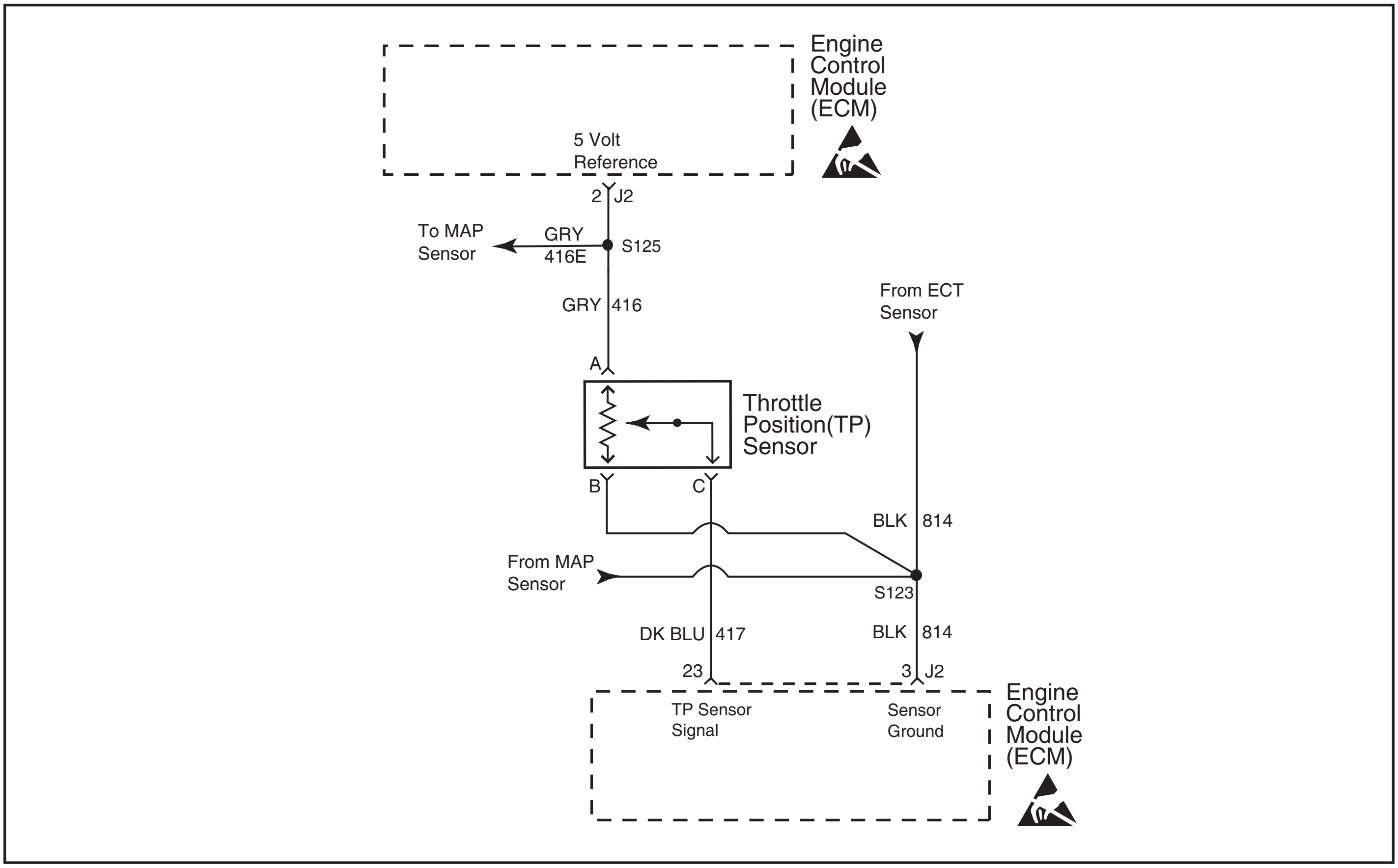
2. DTC 15 will set if signal voltage indicates a coolant temperature above 130°C or 266°F.
3. This test simulates a DTC 14. If the ECM recognizes the high voltage signal and displays a low temperature, the ECM and wiring are OK.

Engine Coolant Temperature Sensor Table

°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 15 - Engine Coolant Temperature (ECT) Sensor Circuit - High Temp Indicated (Scan Diagnostics) (Low Voltage)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature greater than the specified value?	130°C (266°F)	Go to Step 3	Go to Step 4
3	1. Turn ignition OFF. 2. Disconnect ECT sensor harness connector. 3. Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature below the specified value?	-30°C (-22°F)	Go to Step 6	Go to Step 5
4	DTC 15 is intermittent. Locate and repair intermittent faulty connections. • Refer to "Diagnostic Aids."	—	Verify Repair	—
5	Locate and repair short to ground in CKT 410. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
6	Repair faulty ECT sensor. Is action complete?	—	Verify Repair	—
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



M4061
11-20-02

DTC 21 - Throttle Position (TP) Sensor Circuit - Signal Voltage High (Scan Diagnostics)

Circuit Description

The Throttle Position (TP) sensor is a potentiometer that provides a voltage signal that changes relative to the throttle blade. Signal voltage should vary from about .7 volt at idle to about 4.8 volts at Wide Open Throttle (WOT).

The TP sensor signal is one of the most important inputs used by the ECM for fuel control and for IAC control.

The ECM supplies a 5 volt signal to the sensor through CKT 416. CKT 814 is the TP sensor ground circuit. The TP sensor will send a voltage signal back to the ECM, through CKT 417, according to where the throttle blades are positioned.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the TP sensor display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the TP sensor display will indicate the location of the fault.
- The scan tool reads throttle position in voltage and percentage relative to the throttle blade opening. With ignition “ON,” engine “OFF,” throttle blades closed (idle), the voltage should be 0.3-0.9 volts. The voltage should steadily increase as the throttle is moved toward Wide Open Throttle (WOT).
- If a TP sensor circuit failure is present, the MAP sensor default value will be used along with the TP sensor default value.

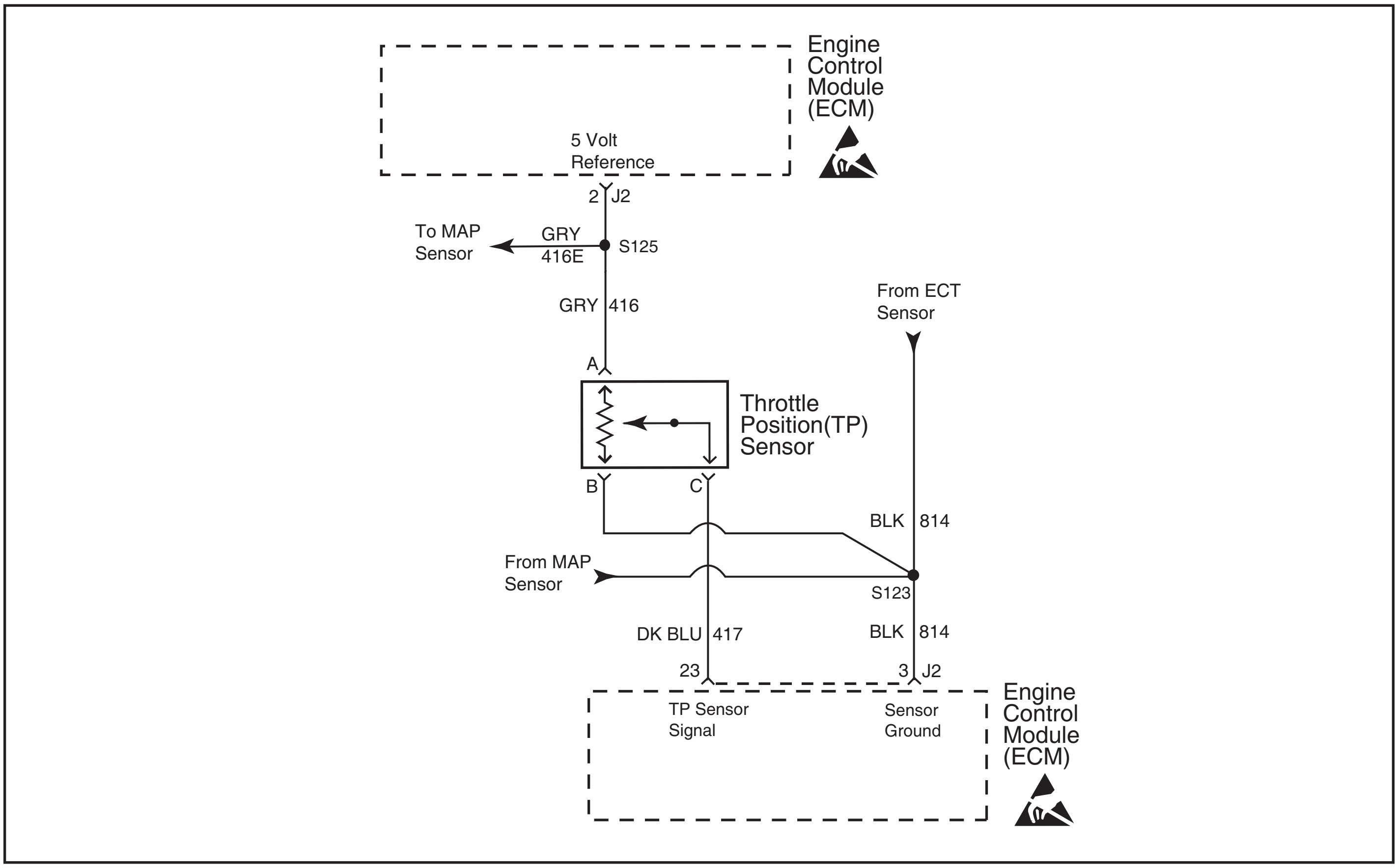
After repairs, clear DTC’s following “Clear DTC’s Procedure.” Failure to do so may result in DTC’s not properly being cleared.

Test Description

2. With the throttle closed, the TP sensor voltage should read 0.3-0.9 volt. If it does not, check the throttle cable adjustment or for bent or binding linkage.
3. This test simulates a DTC 22. If the ECM recognizes the low voltage signal, the ECM and wiring are OK.
4. Using DMM from harness terminal “A” (CKT 416) harness terminal “B” (CKT 814) checks the sensor ground circuit. A faulty sensor ground CKT 814 will cause a DTC 21.

DTC 21 - Throttle Position (TP) Sensor Circuit - Signal Voltage High (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Throttle closed. 2. Turn ignition ON, leaving engine OFF. Does scan tool indicate TP sensor voltage greater than the specified value?	4 volts	Go to Step 3	Go to Step 5
3	1. Turn ignition OFF. 2. Disconnect TP sensor harness connector. 3. Turn ignition ON, leaving engine OFF. Does DMM indicate a voltage less than the specified value?	.36 volt	Go to Step 4	Go to Step 6
4	Connect DMM from harness terminal "A" (CKT 416) to harness terminal "B" (CKT 814). Does DMM indicate a voltage greater than the specified value?	4 volts	Go to Step 8	Go to Step 7
5	DTC 21 is intermittent. Locate and repair intermittent faulty connections. • Refer to "Diagnostic Aids."	—	—	—
6	Locate and repair short to voltage in CKT 417. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 9
7	Locate and repair open in ground CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 9
8	Replace faulty TP sensor. Is action complete?	—	Verify Repair	—
9	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



M4061
11-20-02

DTC 22 - Throttle Position (TP) Sensor Circuit - Signal Voltage Low (Scan Diagnostics)

Circuit Description

The Throttle Position (TP) sensor is a potentiometer that provides a voltage signal that changes relative to the throttle blade. Signal voltage should vary from about .7 volt at idle to about 4.8 volts at Wide Open Throttle (WOT).

The TP sensor signal is one of the most important inputs used by the ECM for fuel control and for IAC control.

The ECM supplies a 5 volt signal to the sensor through CKT 416. CKT 814 is the TP sensor ground circuit. The TP sensor will send a voltage signal back to the ECM, through CKT 417, according to where the throttle blades are positioned.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the TP sensor display on the scan tool while moving connectors and wiring harnesses related to the TP sensor. A change in the TP sensor display will indicate the location of the fault.
- The scan tool reads throttle position in voltage and percentage relative to the throttle blade opening. With ignition "ON," engine "OFF," throttle blades closed (idle), the voltage should be 0.3-0.9 volts. The voltage should steadily increase as the throttle is moved toward Wide Open Throttle (WOT).
- If DTC 34 is also set, check for a short to ground in CKT 416 or CKT 416E.
- If a TP sensor circuit failure is present, the MAP sensor default value will be used along with the TP sensor default value.

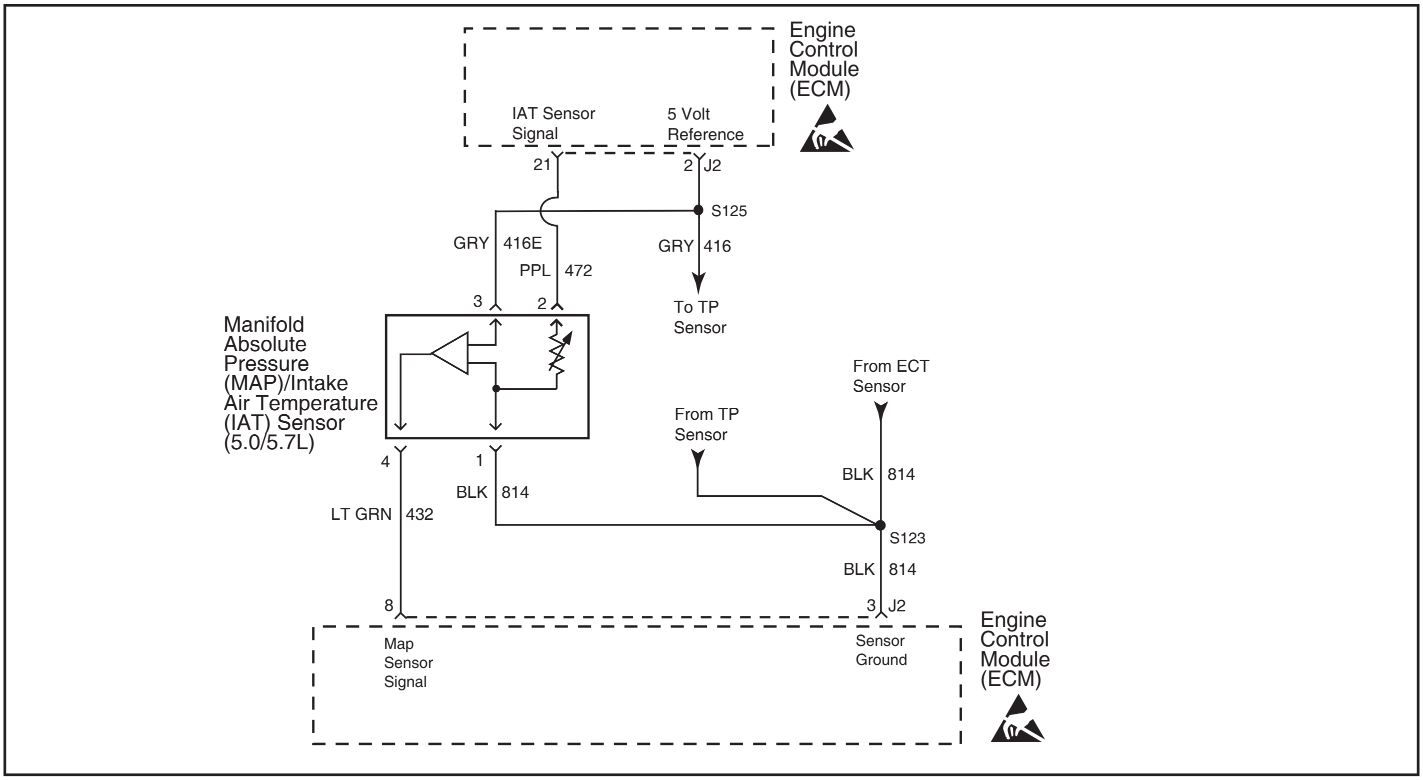
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

2. With the throttle closed, the TP sensor voltage should read 0.3-0.9 volt. If it does not, check the throttle cable adjustment or for bent or binding linkage.
3. This test simulates a DTC 21. If the ECM recognizes the high signal voltage, the ECM and wiring are OK.
4. This test checks for the 5 volt reference on CKT 416.

DTC 22 - Throttle Position (TP) Sensor Circuit - Signal Voltage Low (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Throttle closed. 2. Turn ignition ON, leaving engine OFF. Does scan tool indicate TP sensor voltage less than the specified value?	.36 volt	Go to Step 3	Go to Step 5
3	1. Turn ignition OFF. 2. Disconnect TP sensor harness connector. 3. Connect a jumper wire from harness terminal "A" (CKT 416) to harness terminal "C" (CKT 417). 4. Turn ignition ON, leaving engine OFF. Does scan tool indicate TP sensor voltage greater than the specified value?	4 volts	Go to Step 8	Go to Step 4
4	1. Turn ignition OFF. 2. Connect DMM from harness terminal "A" (CKT 416) to a known good ground. 3. Turn ignition ON, leaving engine OFF. Does DMM indicate a voltage greater than the specified value?	4 vts	Go to Step 7	Go to Step 6
5	DTC 22 is intermittent. Locate and repair intermittent faulty connections. • Refer to "Diagnostic Aids."	—	—	—
6	Locate and repair open or short to ground in CKT 416. Also check CKT 416E to the MAP sensor for a short to ground. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 9
7	Locate and repair open or short to ground in CKT 417. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 9
8	Replace faulty TP sensor. Is action complete?	—	Verify repair	—
9	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify repair	—



M4055
9-18-02

DTC 23 - Intake Air Temperature (IAT) Sensor Circuit - Low Temp Indicated (5.0/5.7L Only) (Scan Diagnostics)

Circuit Description

The Intake Air Temperature (IAT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 472 to the sensor. When the intake air temperature is cold, the sensor (thermistor) resistance is high. As the intake air temperature warms up, the sensor resistance becomes less. See intake air temperature sensor table under "Diagnostic Aids."

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the scan tool while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.
- The scan tool displays intake air temperature in degrees Celsius and Fahrenheit. If the engine is cold (not running within 8 hours), the scan tool should display a IAT sensor value within a few degrees of outside air temperature. This may help aid in diagnosing a "shifted" IAT sensor.
- If DTC 33 is also set, check for open ground CKT 814.

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

Test Description

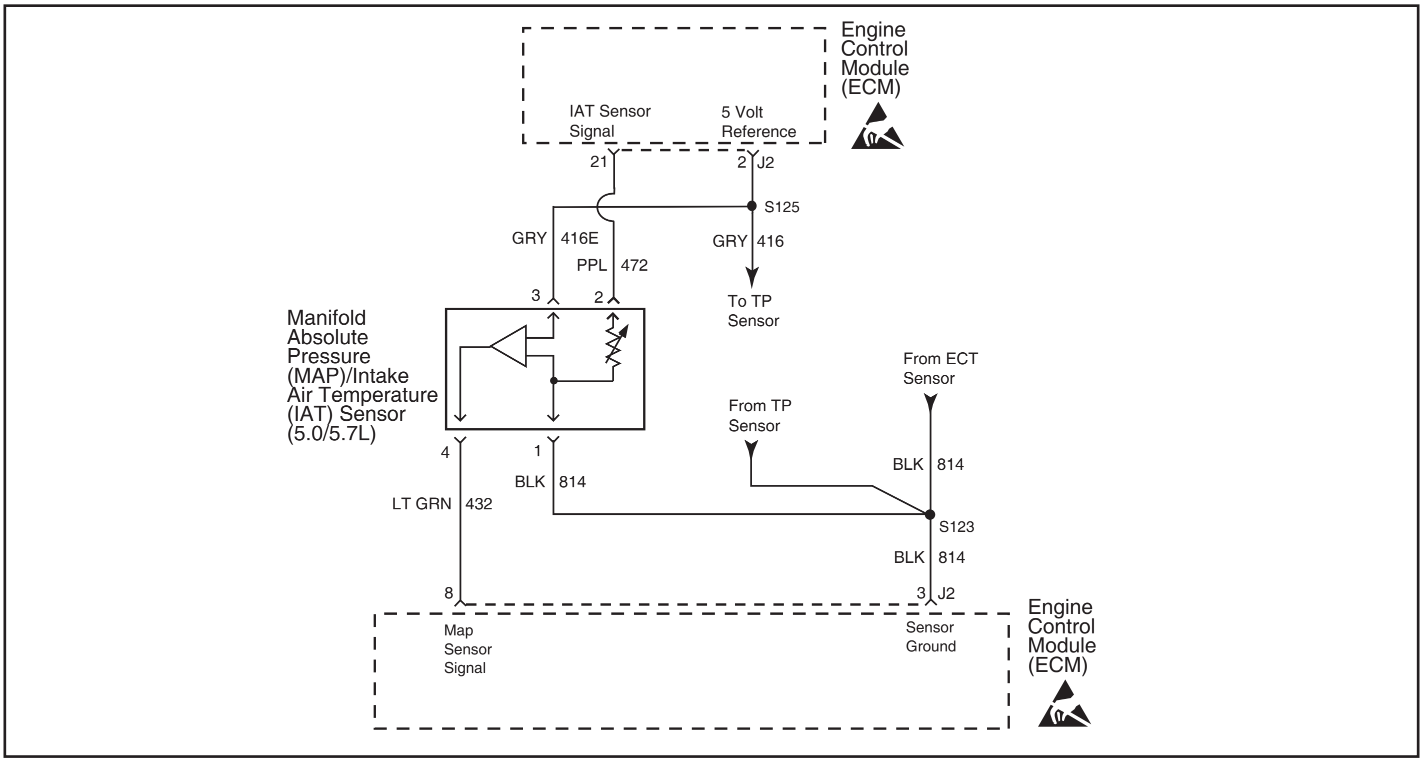
2. DTC 23 will set if signal voltage indicates a intake air temperature below -30°C (-22°F).
3. This test simulates a DTC 25. If the ECM recognizes the low voltage signal and displays a high temperature, the ECM and wiring are OK.

Intake Air Temperature Sensor Table

°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 23 - Intake Air Temperature (IAT) Sensor Circuit - Low Temp Indicated (5.0/5.7L Only) (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Turn ignition ON, leaving engine OFF. Does scan tool display an intake air temperature less than the specified value?	-30°C (-22°F)	Go to Step 3	Go to Step 4
3	1. Turn ignition OFF. 2. Disconnect IAT sensor harness connector. 3. Connect a jumper wire from harness terminal "2" (CKT 472) to harness terminal "1" (CKT 814). 4. Turn ignition ON, leaving engine OFF. Does scan tool display a coolant temperature above the specified value?	130°C (266°F)	Go to Step 6	Go to Step 5
4	DTC 23 is intermittent. Locate and repair intermittent faulty connections. • Refer to "Diagnostic Aids."	—	Verify Repair	—
5	Locate and repair open in CKT 472 or CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
6	Repair faulty IAT sensor. Is action complete?	—	Verify Repair	—
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



M4055
9-18-02

DTC 25 - Intake Air Temperature (IAT) Sensor Circuit - High Temp Indicated (5.0/5.7L Only) (Scan Diagnostics)

Circuit Description

The Intake Air Temperature (IAT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies 5 volts on CKT 472 to the sensor. When the intake air temperature is cold, the sensor (thermistor) resistance is high. As the intake air temperature warms up, the sensor resistance becomes less. See intake air temperature sensor table under "Diagnostic Aids."

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the IAT display on the scan tool while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.
- The scan tool displays intake air temperature in degrees Celsius and Fahrenheit. If the engine is cold (not running within 8 hours), the scan tool should display an IAT sensor value within a few degrees of outside air temperature. This may help aid in diagnosing a "shifted" IAT sensor.
- Check harness routing for a potential short to ground in CKT 472.

After repairs, clear DTC's following "Clear DTC's Procedure.

Failure to do so may result in DTC's not properly being cleared.

Test Description

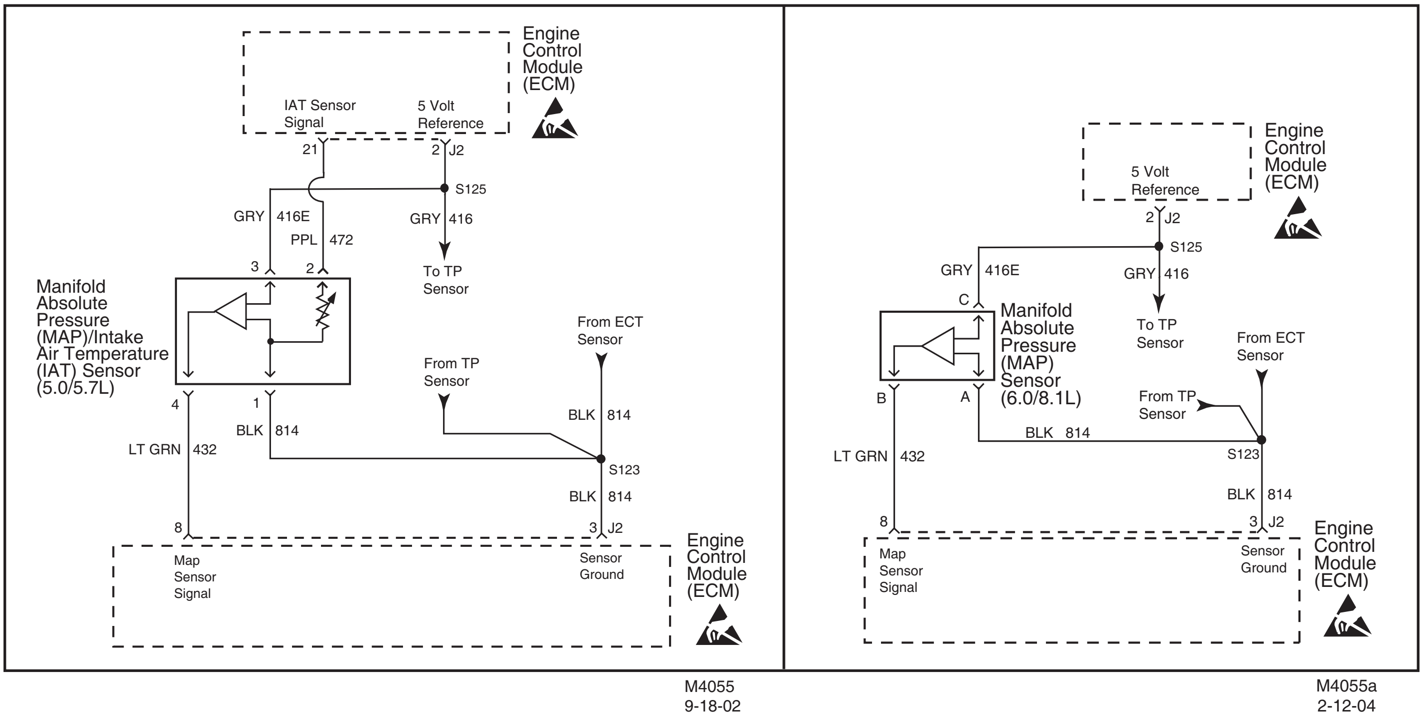
2. DTC 25 will set if signal voltage indicates an intake air temperature above 130°C or 266°F.
3. This test simulates a DTC 23. If the ECM recognizes the high voltage signal and displays a low temperature, the ECM and wiring are OK.

Intake Air Temperature Sensor Table

°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 25 - Intake Air Temperature (IAT) Sensor Circuit - High Temp Indicated (5.0/5.7L Only) (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic” (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Turn ignition ON, leaving engine OFF. Does scan tool display an intake air temperature greater than the specified value?	130°C (266°F)	Go to Step 3	Go to Step 4
3	1. Turn ignition OFF. 2. Disconnect IAT sensor harness connector. 3. Turn ignition ON, leaving engine OFF. Does scan tool display an intake air temperature below the specified value?	-30°C (-22°F)	Go to Step 6	Go to Step 5
4	DTC 25 is intermittent. Locate and repair intermittent faulty connections. • Refer to “Diagnostic Aids.”	—	Verify Repair	—
5	Locate and repair short to ground in CKT 472. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
6	Repair faulty IAT sensor. Is action complete?	—	Verify Repair	—
7	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



DTC 33 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage High (Scan Diagnostics)

Circuit Description

The Manifold Absolute Pressure (MAP) sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to about 4.0-4.5 volts at Wide Open Throttle (WOT).

If the MAP sensor fails, the ECM will substitute a default MAP value that will vary with RPM.

The MAP sensor voltage of 5 volts is delivered to the MAP sensor through CKT 416E. CKT 814 is the ground circuit for the MAP sensor. The MAP signal CKT 432 will send a voltage signal back to the ECM according to what the manifold pressure is.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAP sensor display on the scan tool while moving connectors and wiring harnesses related to the MAP sensor. A change in the MAP sensor display will indicate the location of the fault.
- If the idle is rough or unstable, refer to Symptoms for items which may cause an unstable idle.
- With the ignition "ON," engine "OFF," the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of altitude and is referred to as BARO. Comparison of this BARO reading, with a known good MAP sensor, is a good way to check the accuracy of a "suspect" sensor. Reading should be the same, plus or minus 0.4 volt.
- If DTC 14 is also set, check for open in ground CKT 814.
- If a MAP sensor circuit failure is present, the TP sensor default value will be used along with the MAP sensor default value.

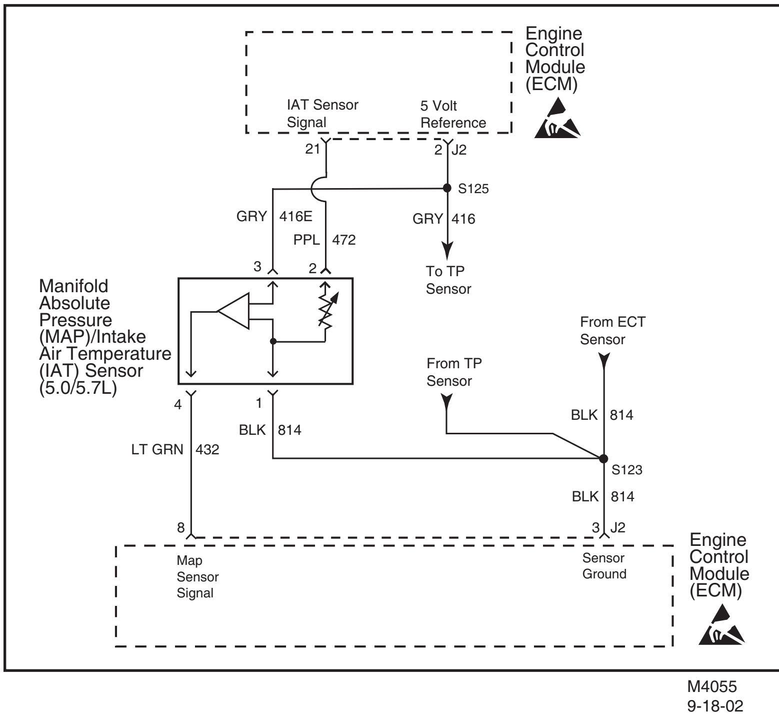
After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

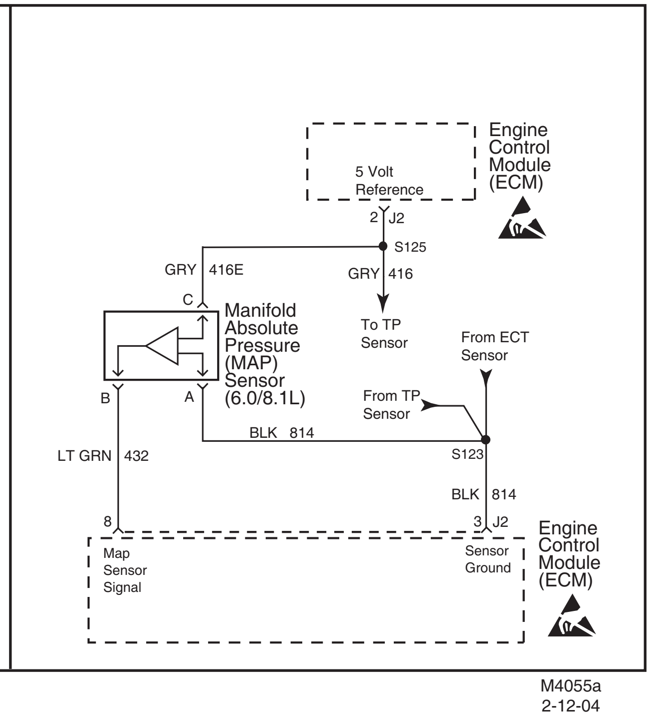
Test Description

2. This step will determine if there is an adequate vacuum supply to the MAP sensor. If the vacuum gauge reading is erratic, refer to the "Rough or Unstable Idle" symptom.
4. This step simulates a DTC 34. If the ECM recognizes the low signal voltage and sets a DTC 34, the ECM and wiring are OK.
5. This step checks for an open in ground CKT 814.

DTC 33 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage High (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic” (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Install a vacuum gauge to a manifold vacuum source. 2. Start engine and raise to about 1000 RPM in neutral. 3. The vacuum reading should be steady. Is the vacuum gauge reading steady and above the specified value?	14” Hg (45.5 kPa)	Go to Step 3	Go to Step 6
3	1. Install a scan tool. 2. Start the engine and allow engine to idle. Does scan tool indicate MAP sensor voltage greater than the specified value?	4 volts	Go to Step 4	Go to Step 7
4	1. Turn the ignition OFF. 2. Disconnect MAP sensor harness connector. 3. Turn the ignition ON, leaving the engine OFF. Does scan tool indicate MAP sensor voltage less than the specified value?	1 volt	Go to Step 5	Go to Step 8
5	1. Turn the ignition OFF. 2. Connect DMM from CKT 814 to CKT 416E. (5.0/5.7L) harness terminal “1” to harness terminal “3.” (6.0/8.1L) harness terminal “A” to harness terminal “C.” 3. Turn the ignition ON, leaving the engine OFF. Does DMM indicate a voltage greater than the specified value?	4 volts	Go to Step 10	Go to Step 9
6	Repair low or unsteady vacuum problem. Is action complete?	—	Verify Repair	—
7	DTC 33 is intermittent. Locate and repair intermittent faulty connections. • Refer to “Diagnostic Aids.”	—	—	—
8	Locate and repair short to voltage in CKT 432. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 11
9	Locate and repair open in CKT 814. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 11
10	Check for plugged or leaking sensor vacuum fitting. If OK, replace faulty MAP sensor. Is action complete?	—	Verify Repair	—
11	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—





DTC 34 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage Low (Scan Diagnostics)

Circuit Description

The Manifold Absolute Pressure (MAP) sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1.0-1.5 volts at idle to about 4.0-4.5 volts at Wide Open Throttle (WOT).

If the MAP sensor fails, the ECM will substitute a default MAP value that will vary with RPM.

The MAP sensor voltage of 5 volts is delivered to the MAP sensor through CKT 416E. CKT 814 is the ground circuit for the MAP sensor. The MAP signal CKT 432 will send a voltage signal back to the ECM according to what the manifold pressure is.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the MAP sensor display on the scan tool while moving connectors and wiring harnesses related to the MAP sensor. A change in the MAP sensor display will indicate the location of the fault.
- If the idle is rough or unstable, refer to Symptoms for items which may cause an unstable idle.
- With the ignition “ON,” engine “OFF,” the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of altitude and is referred to as BARO. Comparison of this BARO reading, with a known good MAP sensor, is a good way to check the accuracy of a “suspect” sensor. Reading should be the same, plus or minus 0.4 volt.
- If a MAP sensor circuit failure is present, the TP sensor default value will be used along with the MAP sensor default value.

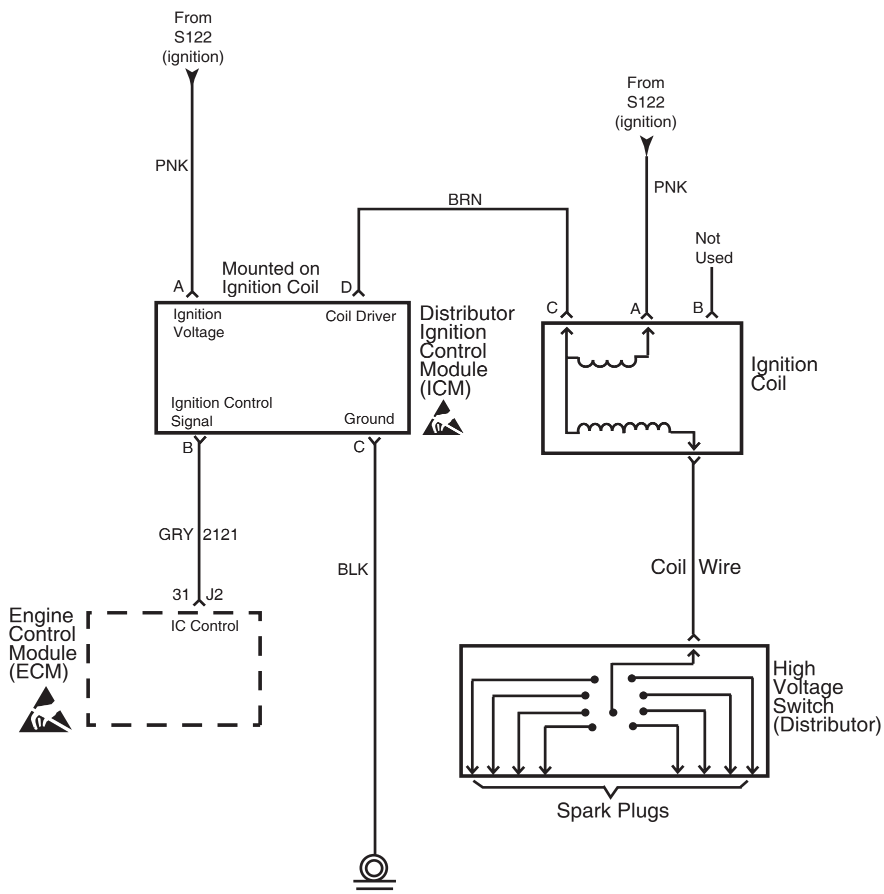
After repairs, clear DTC’s following “Clear DTC’s Procedure.” Failure to do so may result in DTC’s not properly being cleared.

Test Description

2. This step will determine if there is an adequate vacuum supply to the MAP sensor. If the vacuum gauge reading is erratic, refer to the “Rough or Unstable Idle” symptom.
3. This step determines if DTC 34 is the result of a hard failure or an intermittent condition. A DTC will set when MAP signal voltage is too low with engine running.
4. This step simulates a DTC 33. If the ECM recognizes the high signal voltage, the ECM and wiring are OK.
5. This step checks for the 5 volt reference on CKT 416E.

DTC 34 - Manifold Absolute Pressure (MAP) Sensor Circuit - Signal Voltage Low (Scan Diagnostics)

Step	Action	Value	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. Install a vacuum gauge to a manifold vacuum source. 3. Start engine and raise to about 1000 RPM in neutral. 4. The vacuum reading should be steady. Is the vacuum gauge reading steady and above the specified value?	14” Hg (45.5 kPa)	Go to Step 3	Go to Step 6
3	1. Install a scan tool. 2. Start the engine and allow the engine to idle. Does scan tool indicate MAP sensor voltage less than the specified value?	1 volt	Go to Step 4	Go to Step 7
4	1. Turn the ignition OFF. 2. Disconnect MAP sensor harness connector. 3. Connect DMM from CKT 432 to CKT 416E. (5.0/5.7L) harness terminal “4” to harness terminal “3.” (6.0/8.1L) harness terminal “B” to harness terminal “C.” 4. Turn the ignition ON, leaving the engine OFF. Does scan tool indicate MAP sensor voltage greater than the specified value?	4 volts	Go to Step 10	Go to Step 5
5	1. Turn OFF the ignition. 2. Connect DMM from harness terminal “3” (CKT 416E) (5.0/5.7L), terminal “C” (8.1L) to a known good ground. 3. Turn ON the ignition, leaving the engine OFF. Does DMM indicate a voltage greater than the specified value?	4 volts	Go to Step 9	Go to Step 8
6	Repair low or unsteady vacuum problem. Is action complete?	—	Verify Repair	—
7	DTC 34 is intermittent. Locate and repair intermittent faulty connections. • Refer to “Diagnostic Aids.”	—	—	—
8	Locate and repair open or short to ground in CKT 416E. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 11
9	Locate and repair open or short to ground in CKT 432. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 11
10	Check for plugged or leaking sensor vacuum fitting. If OK, replace faulty MAP sensor. Is action complete?	—	Verify Repair	—
11	Repair faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



M4064
9-25-02

DTC 41 (EST A Fault) - Ignition Control Circuit (5.0/5.7L ONLY)

Circuit Description

The ECM controls the ignition system operation. The ECM controls the ignition coil using the Ignition Control (IC) circuit. The ECM commands the IC circuit low when a spark event is requested. This causes the IC module to energize the ignition coil to create a spark at the spark plug. The ignition module has the following circuits:

- A power feed
- A ground circuit
- An Ignition Control (IC) circuit
- A reference low circuit

Ignition Timing is ECM controlled, and not-adjustable. This DTC sets when the IC circuit is out of range.

Diagnostic Aids

Check for the following conditions:

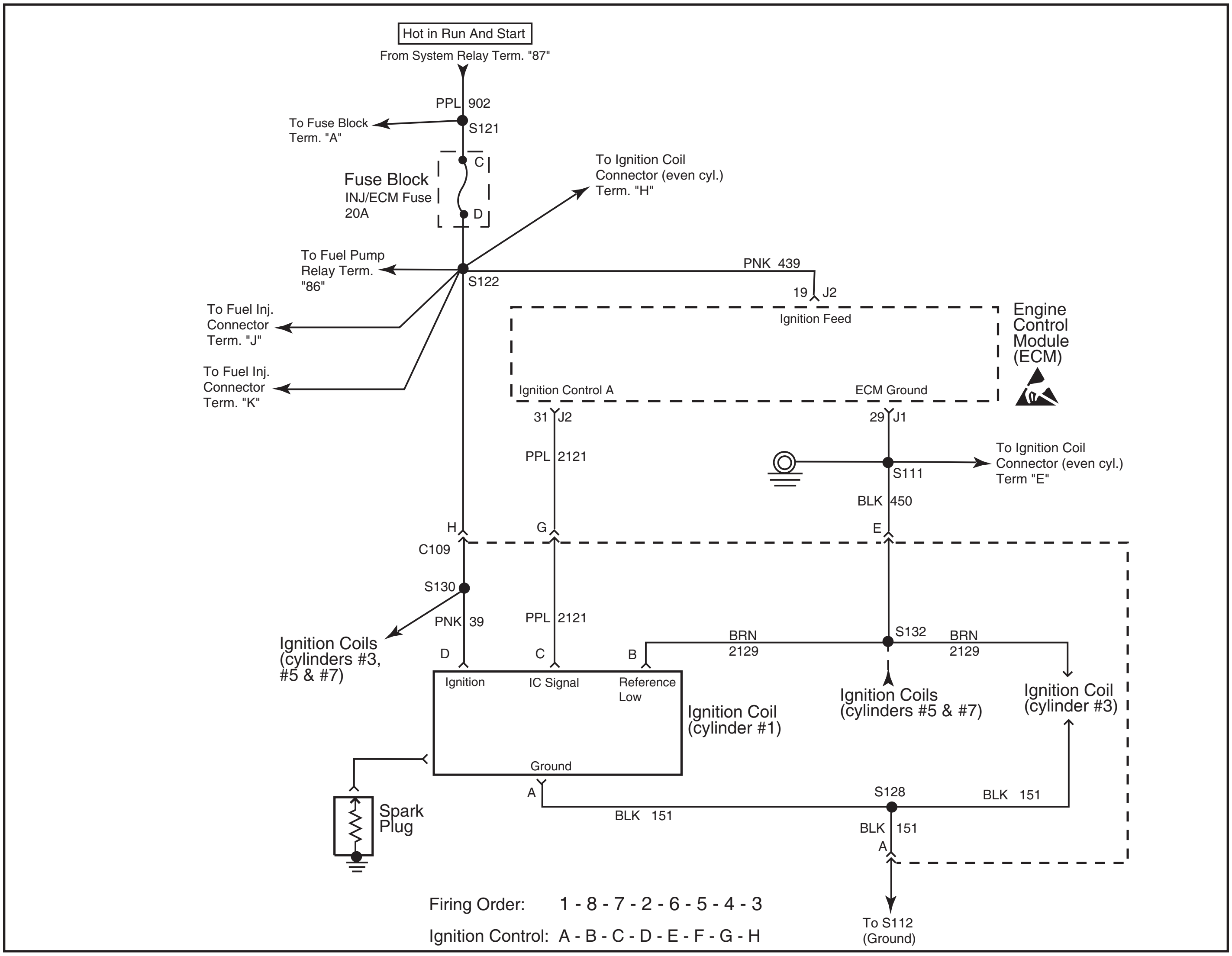
- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

2. This step verifies the fault is present.
4. This step tests the integrity of the IC circuit and the ECM output.
5. This step tests for a short to ground on the IC signal circuit.

DTC 41 (EST A Fault) - Ignition Control Circuit (5.0/5.7L ONLY)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Turn ignition "ON," engine "OFF." 2. Disconnect the ignition coil electrical harness. 3. Measure the frequency at the ignition coil driver circuit, Pin C, using the DMM J 39200 on the DC Hertz scale. 4. Crank the engine. Is the frequency within the specified range?	3.0-20 Hz	Go to Step 7	Go to Step 3
3	1. Turn ignition "ON," engine "OFF." 2. Measure the voltage at the ignition coil connector, Pin A, using the DMM J 39200. Is the voltage greater that the specified value?	1.0 volts	Go to Step 9	Go to Step 4
4	1. Disconnect the ignition control module electrical harness. 2. Measure the voltage at the ignition timing signal circuit, Pin B, using the DMM J 39200. Is the voltage greater that the specified value?	1.0 volts	Go to Step 8	Go to Step 5
5	1. Turn OFF the engine. 2. Disconnect the ECM connector J2. 3. Test the continuity from the IC circuit (at the ignition control module connector, Pin B) to the ECM connector terminal "J2-31," using the DMM J 39200. Does the DMM indicate continuity?	—	Go to Step 6	Go to Step 9
6	Test the resistance from the IC circuit (at the ignition coil harness connector, Pin C) to ground using the DMM J 39200. Does the DMM indicate OL (out-of-limits)?	—	Go to Step 10	Go to Step 9
7	Replace the ignition coil. Is the action complete?	—	Go to Step 12	—
8	Repair the Ignition Control circuit for a short to voltage. Is the action complete?	—	Go to Step 12	—
9	Repair the Ignition Control circuit for an open or grounded circuit. Is the action complete?	—	Go to Step 12	—
10	1. Inspect for poor connections at the ECM connector. 2. Replace the terminal if necessary. Did you find and correct the problem?	—	Go to Step 12	Go to Step 11
11	Replace the ECM. Is the action complete?	—	Go to Step 12	—
12	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC information option using the scan tool. 2. Idle the engine at the normal operating temperature. Is DTC 41 indicated?	—	Go to Step 2	Go to Step 13
13	Select the Diagnostic Trouble Code (DTC) option. Does the scan tool display any DTCs that you have not diagnosed?	—	Go to the applicable DTC table	System OK



M4065P
2-10-04

DTC 41 (EST A Fault) - Ignition Coil 1 Control Circuit (6.0/8.1L)

Circuit Description

The ignition system on this engine uses an individual ignition coil/module for each cylinder. The ECM controls the ignition system operation. The ECM controls each coil using one of eight Ignition Control (IC) circuits. The ECM commands the IC circuit low when a spark event is requested. This causes the IC module to energize the ignition coil to create a spark at the spark plug. Each ignition coil/module has the following circuits:

- A power feed
- A ground circuit
- An Ignition Control (IC) circuit
- A reference low circuit

Sequencing and timing are ECM controlled. This DTC sets when the IC circuit is out of range.

Diagnostic Aids

Check for the following conditions:

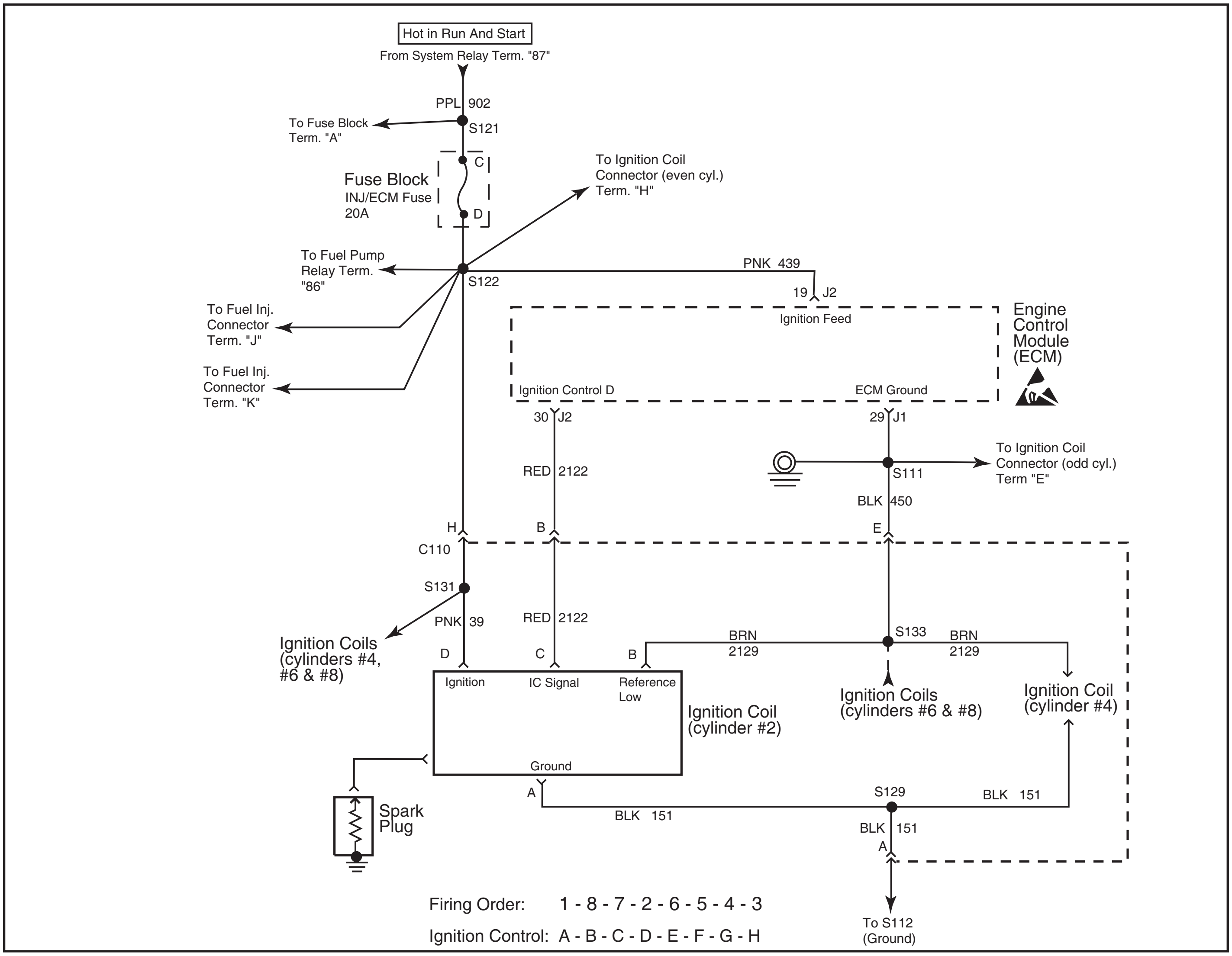
- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

2. This step verifies the fault is present.
4. This step tests the integrity of the IC circuit and the ECM output.
5. This step tests for a short to ground on the IC signal circuit.

DTC 41 (EST A Fault) - Ignition Coil 1 Control Circuit (6.0/8.1L)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Important: If all the Ignition Control (IC) DTCs are set at the same time, inspect the IC ground circuits for an open. 1. Install a scan tool. 2. Using a scan tool, clear DTCs. 3. Start and idle the engine for 2 minutes. 4. Check for DTCs. Does the scan tool indicate a DTC 41 for ignition coil 1?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the engine. 2. Disconnect the ignition coil electrical harness. 3. Measure the frequency at the ignition control signal circuit using the DMM J 39200 on the DC Hertz scale. Is the frequency within the specified range?	3.0-20 Hz	Go to Step 7	Go to Step 4
4	Measure the voltage at the ignition control signal circuit using the DMM J 39200. Is the voltage greater that the specified value?	1.0 volts	Go to Step 8	Go to Step 5
5	1. Turn OFF the engine. 2. Disconnect the ECM connector J2. 3. Test the continuity from the IC circuit (at the ignition coil harness connector) to the ECM connector using the DMM J 39200. Does the DMM indicate continuity?	—	Go to Step 6	Go to Step 9
6	Test the resistance from the IC circuit (at the ignition coil harness connector) to ground using the DMM J 39200. Does the DMM indicate OL (out-of-limits)?	—	Go to Step 10	Go to Step 9
7	Replace the ignition coil. Is the action complete?	—	Go to Step 12	—
8	Repair the Ignition Control circuit for a short to voltage. Is the action complete?	—	Go to Step 12	—
9	Repair the Ignition Control circuit for an open or grounded circuit. Is the action complete?	—	Go to Step 12	—
10	1. Inspect for poor connections at the ECM connector. 2. Replace the terminal if necessary. Did you find and correct the problem?	—	Go to Step 12	Go to Step 11
11	Replace the ECM. Is the action complete?	—	Go to Step 12	—
12	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC information option using the scan tool. 2. Idle the engine at the normal operating temperature. Is DTC 41 indicated?	—	Go to Step 2	Go to Step 13
13	Select the Diagnostic Trouble Code (DTC) option. Does the scan tool display any DTCs that you have not diagnosed?	—	Go to the applicable DTC table	System OK



M4069P
2-10-04

DTC 41 (EST D Fault) - Ignition Coil 2 Control Circuit (6.0/8.1L)

Circuit Description

The ignition system on this engine uses an individual ignition coil/module for each cylinder. The ECM controls the ignition system operation. The ECM controls each coil using one of eight Ignition Control (IC) circuits. The ECM commands the IC circuit low when a spark event is requested. This causes the IC module to energize the ignition coil to create a spark at the spark plug. Each ignition coil/module has the following circuits:

- A power feed
- A ground circuit
- An Ignition Control (IC) circuit
- A reference low circuit

Sequencing and timing are ECM controlled. This DTC sets when the IC circuit is out of range.

Diagnostic Aids

Check for the following conditions:

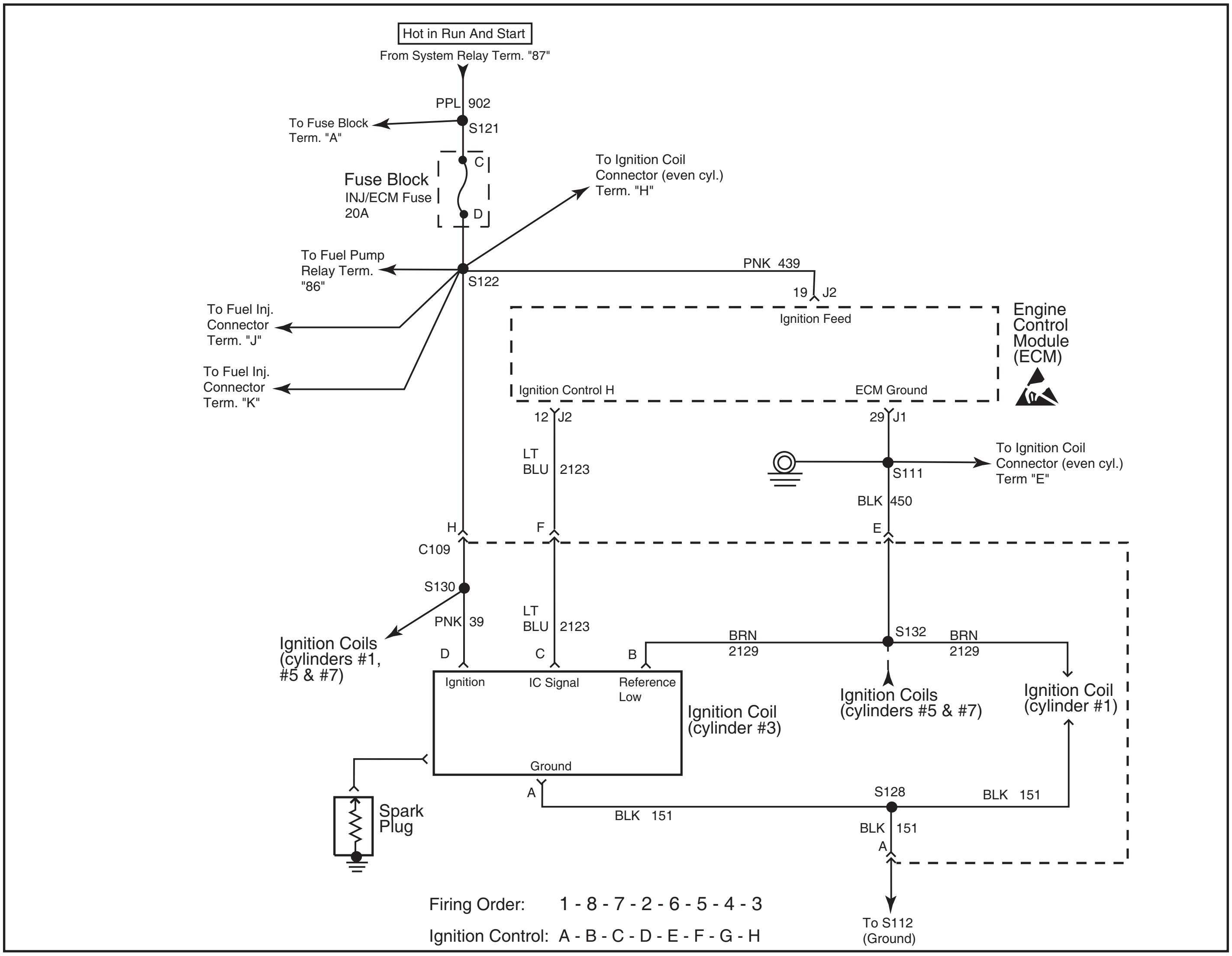
- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

2. This step verifies the fault is present.
4. This step tests the integrity of the IC circuit and the ECM output.
5. This step tests for a short to ground on the IC signal circuit.

DTC 41 (EST D Fault) - Ignition Coil 2 Control Circuit (6.0/8.1L)

Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic” (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Important: If all the Ignition Control (IC) DTCs are set at the same time, inspect the IC ground circuits for an open. 1. Install a scan tool. 2. Using a scan tool, clear DTCs. 3. Start and idle the engine for 2 minutes. 4. Check for DTCs. Does the scan tool indicate a DTC 41 for ignition coil 2?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the engine. 2. Disconnect the ignition coil electrical harness. 3. Measure the frequency at the ignition control signal circuit using the DMM J 39200 on the DC Hertz scale. Is the frequency within the specified range?	3.0-20 Hz	Go to Step 7	Go to Step 4
4	Measure the voltage at the ignition control signal circuit using the DMM J 39200. Is the voltage greater that the specified value?	1.0 volts	Go to Step 8	Go to Step 5
5	1. Turn OFF the engine. 2. Disconnect the ECM connector J2. 3. Test the continuity from the IC circuit (at the ignition coil harness connector) to the ECM connector using the DMM J 39200. Does the DMM indicate continuity?	—	Go to Step 6	Go to Step 9
6	Test the resistance from the IC circuit (at the ignition coil harness connector) to ground using the DMM J 39200. Does the DMM indicate OL (out-of-limits)?	—	Go to Step 10	Go to Step 9
7	Replace the ignition coil. Is the action complete?	—	Go to Step 12	—
8	Repair the Ignition Control circuit for a short to voltage. Is the action complete?	—	Go to Step 12	—
9	Repair the Ignition Control circuit for an open or grounded circuit. Is the action complete?	—	Go to Step 12	—
10	1. Inspect for poor connections at the ECM connector. 2. Replace the terminal if necessary. Did you find and correct the problem?	—	Go to Step 12	Go to Step 11
11	Replace the ECM. Is the action complete?	—	Go to Step 12	—
12	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC information option using the scan tool. 2. Idle the engine at the normal operating temperature. Is DTC 41 indicated?	—	Go to Step 2	Go to Step 13
13	Select the Diagnostic Trouble Code (DTC) option. Does the scan tool display any DTCs that you have not diagnosed?	—	Go to the applicable DTC table	System OK



M4066P
2-10-04

DTC 41 (EST H Fault) - Ignition Coil 3 Control Circuit (6.0/8.1L)

Circuit Description

The ignition system on this engine uses an individual ignition coil/module for each cylinder. The ECM controls the ignition system operation. The ECM controls each coil using one of eight Ignition Control (IC) circuits. The ECM commands the IC circuit low when a spark event is requested. This causes the IC module to energize the ignition coil to create a spark at the spark plug. Each ignition coil/module has the following circuits:

- A power feed
- A ground circuit
- An Ignition Control (IC) circuit
- A reference low circuit

Sequencing and timing are ECM controlled. This DTC sets when the IC circuit is out of range.

Diagnostic Aids

Check for the following conditions:

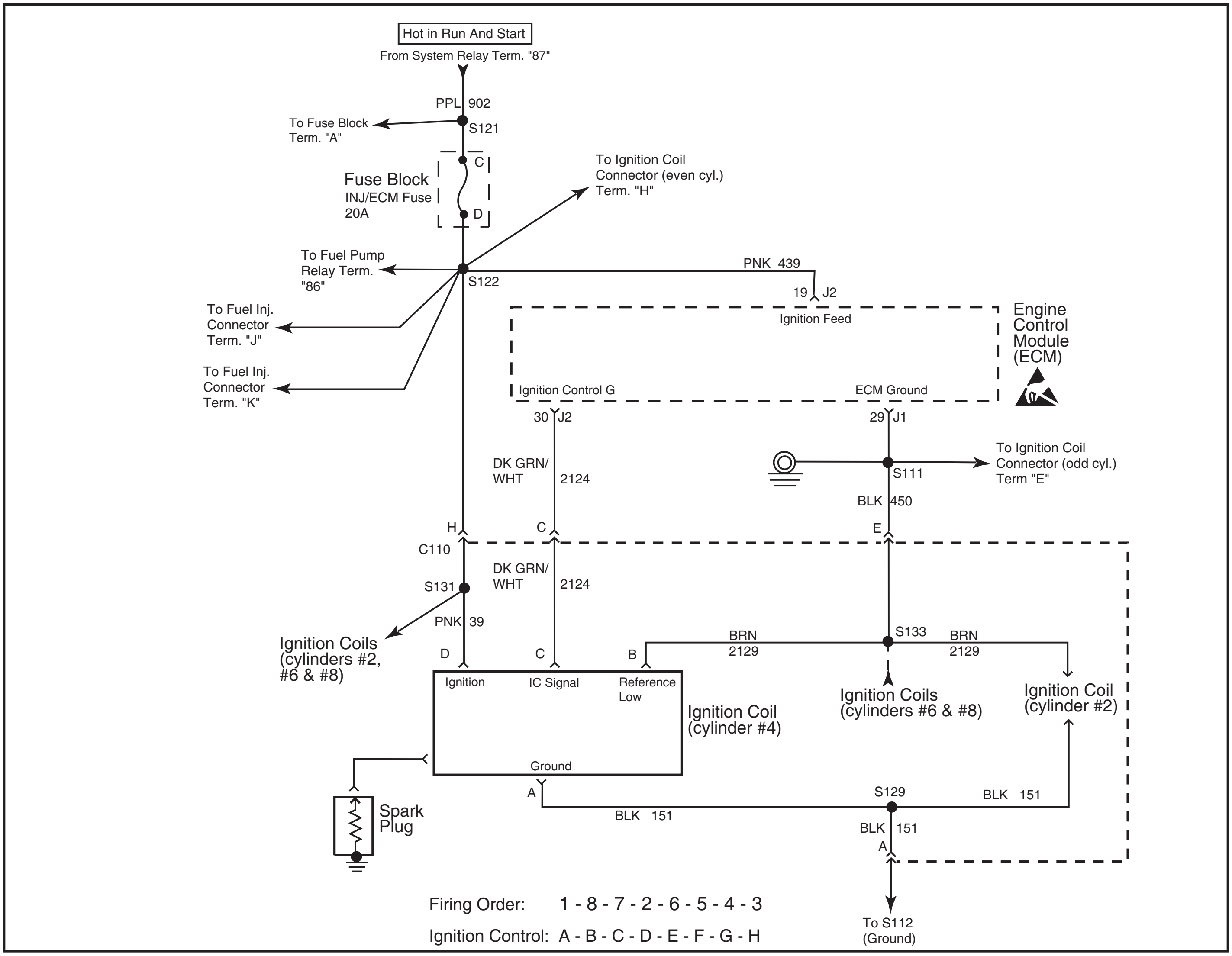
- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

2. This step verifies the fault is present.
4. This step tests the integrity of the IC circuit and the ECM output.
5. This step tests for a short to ground on the IC signal circuit.

DTC 41 (EST H Fault) - Ignition Coil 3 Control Circuit (6.0/8.1L)

Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic” (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Important: If all the Ignition Control (IC) DTCs are set at the same time, inspect the IC ground circuits for an open. 1. Install a scan tool. 2. Using a scan tool, clear DTCs. 3. Start and idle the engine for 2 minutes. 4. Check for DTCs. Does the scan tool indicate a DTC 41 for ignition coil 3?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the engine. 2. Disconnect the ignition coil electrical harness. 3. Measure the frequency at the ignition control signal circuit using the DMM J 39200 on the DC Hertz scale. Is the frequency within the specified range?	3.0-20 Hz	Go to Step 7	Go to Step 4
4	Measure the voltage at the ignition control signal circuit using the DMM J 39200. Is the voltage greater that the specified value?	1.0 volts	Go to Step 8	Go to Step 5
5	1. Turn OFF the engine. 2. Disconnect the ECM connector J2. 3. Test the continuity from the IC circuit (at the ignition coil harness connector) to the ECM connector using the DMM J 39200. Does the DMM indicate continuity?	—	Go to Step 6	Go to Step 9
6	Test the resistance from the IC circuit (at the ignition coil harness connector) to ground using the DMM J 39200. Does the DMM indicate OL (out-of-limits)?	—	Go to Step 10	Go to Step 9
7	Replace the ignition coil. Is the action complete?	—	Go to Step 12	—
8	Repair the Ignition Control circuit for a short to voltage. Is the action complete?	—	Go to Step 12	—
9	Repair the Ignition Control circuit for an open or grounded circuit. Is the action complete?	—	Go to Step 12	—
10	1. Inspect for poor connections at the ECM connector. 2. Replace the terminal if necessary. Did you find and correct the problem?	—	Go to Step 12	Go to Step 11
11	Replace the ECM. Is the action complete?	—	Go to Step 12	—
12	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC information option using the scan tool. 2. Idle the engine at the normal operating temperature. Is DTC 41 indicated?	—	Go to Step 2	Go to Step 13
13	Select the Diagnostic Trouble Code (DTC) option. Does the scan tool display any DTCs that you have not diagnosed?	—	Go to the applicable DTC table	System OK



M4070P
2-10-04

DTC 41 (EST G Fault) - Ignition Coil 4 Control Circuit (6.0/8.1L)

Circuit Description

The ignition system on this engine uses an individual ignition coil/module for each cylinder. The ECM controls the ignition system operation. The ECM controls each coil using one of eight Ignition Control (IC) circuits. The ECM commands the IC circuit low when a spark event is requested. This causes the IC module to energize the ignition coil to create a spark at the spark plug. Each ignition coil/module has the following circuits:

- A power feed
- A ground circuit
- An Ignition Control (IC) circuit
- A reference low circuit

Sequencing and timing are ECM controlled. This DTC sets when the IC circuit is out of range.

Diagnostic Aids

Check for the following conditions:

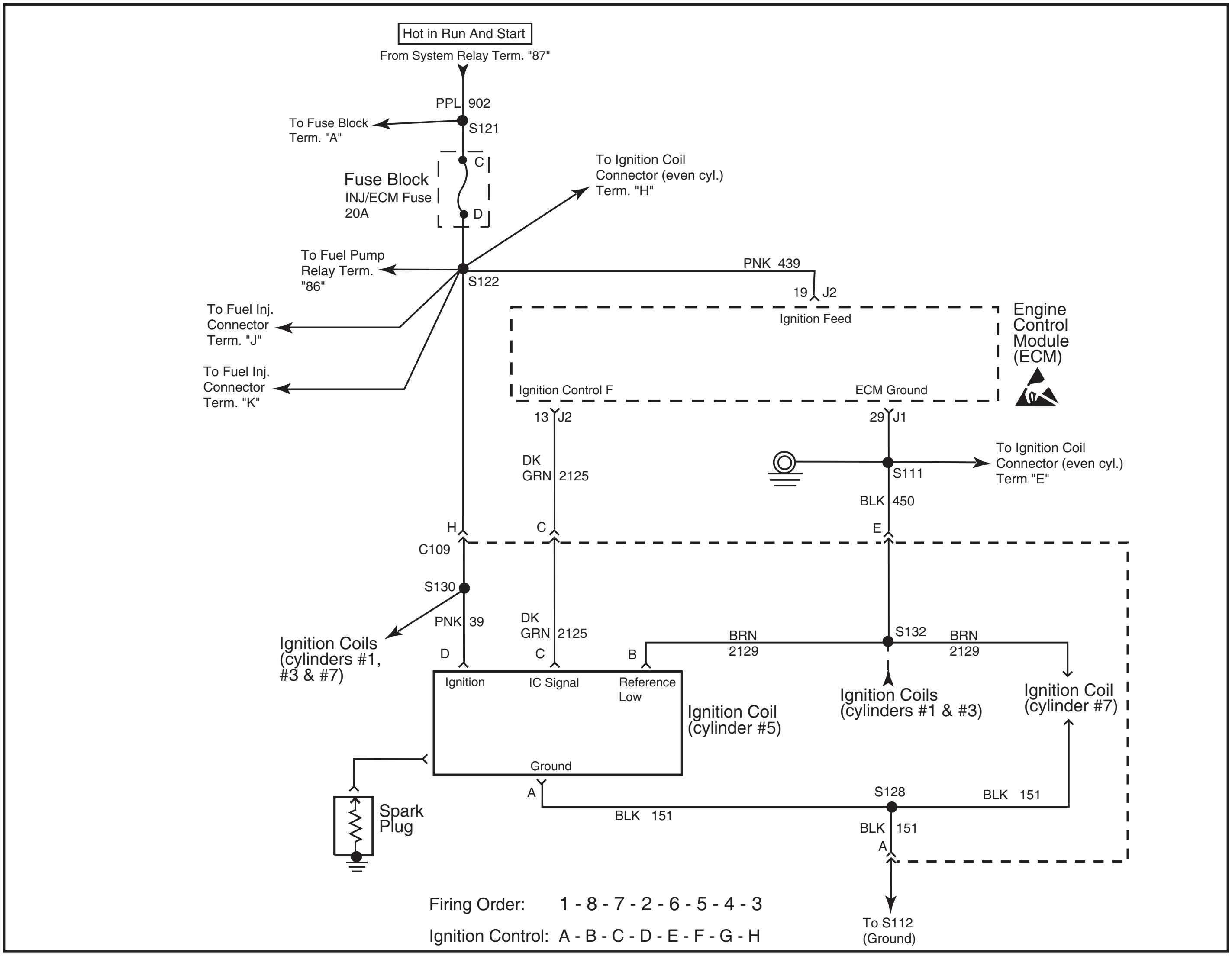
- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

2. This step verifies the fault is present.
4. This step tests the integrity of the IC circuit and the ECM output.
5. This step tests for a short to ground on the IC signal circuit.

DTC 41 (EST G Fault) - Ignition Coil 4 Control Circuit (6.0/8.1L)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Important: If all the Ignition Control (IC) DTCs are set at the same time, inspect the IC ground circuits for an open. 1. Install a scan tool. 2. Using a scan tool, clear DTCs. 3. Start and idle the engine for 2 minutes. 4. Check for DTCs. Does the scan tool indicate a DTC 41 for ignition coil 4?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the engine. 2. Disconnect the ignition coil electrical harness. 3. Measure the frequency at the ignition control signal circuit using the DMM J 39200 on the DC Hertz scale. Is the frequency within the specified range?	3.0-20 Hz	Go to Step 7	Go to Step 4
4	Measure the voltage at the ignition control signal circuit using the DMM J 39200. Is the voltage greater that the specified value?	1.0 volts	Go to Step 8	Go to Step 5
5	1. Turn OFF the engine. 2. Disconnect the ECM connector J2. 3. Test the continuity from the IC circuit (at the ignition coil harness connector) to the ECM connector using the DMM J 39200. Does the DMM indicate continuity?	—	Go to Step 6	Go to Step 9
6	Test the resistance from the IC circuit (at the ignition coil harness connector) to ground using the DMM J 39200. Does the DMM indicate OL (out-of-limits)?	—	Go to Step 10	Go to Step 9
7	Replace the ignition coil. Is the action complete?	—	Go to Step 12	—
8	Repair the Ignition Control circuit for a short to voltage. Is the action complete?	—	Go to Step 12	—
9	Repair the Ignition Control circuit for an open or grounded circuit. Is the action complete?	—	Go to Step 12	—
10	1. Inspect for poor connections at the ECM connector. 2. Replace the terminal if necessary. Did you find and correct the problem?	—	Go to Step 12	Go to Step 11
11	Replace the ECM. Is the action complete?	—	Go to Step 12	—
12	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC information option using the scan tool. 2. Idle the engine at the normal operating temperature. Is DTC 41 indicated?	—	Go to Step 2	Go to Step 13
13	Select the Diagnostic Trouble Code (DTC) option. Does the scan tool display any DTCs that you have not diagnosed?	—	Go to the applicable DTC table	System OK



M4067P
2-10-04

DTC 41 (EST F Fault) - Ignition Coil 5 Control Circuit (6.0/8.1L)

Circuit Description

The ignition system on this engine uses an individual ignition coil/module for each cylinder. The ECM controls the ignition system operation. The ECM controls each coil using one of eight Ignition Control (IC) circuits. The ECM commands the IC circuit low when a spark event is requested. This causes the IC module to energize the ignition coil to create a spark at the spark plug. Each ignition coil/module has the following circuits:

- A power feed
- A ground circuit
- An Ignition Control (IC) circuit
- A reference low circuit

Sequencing and timing are ECM controlled. This DTC sets when the IC circuit is out of range.

Diagnostic Aids

Check for the following conditions:

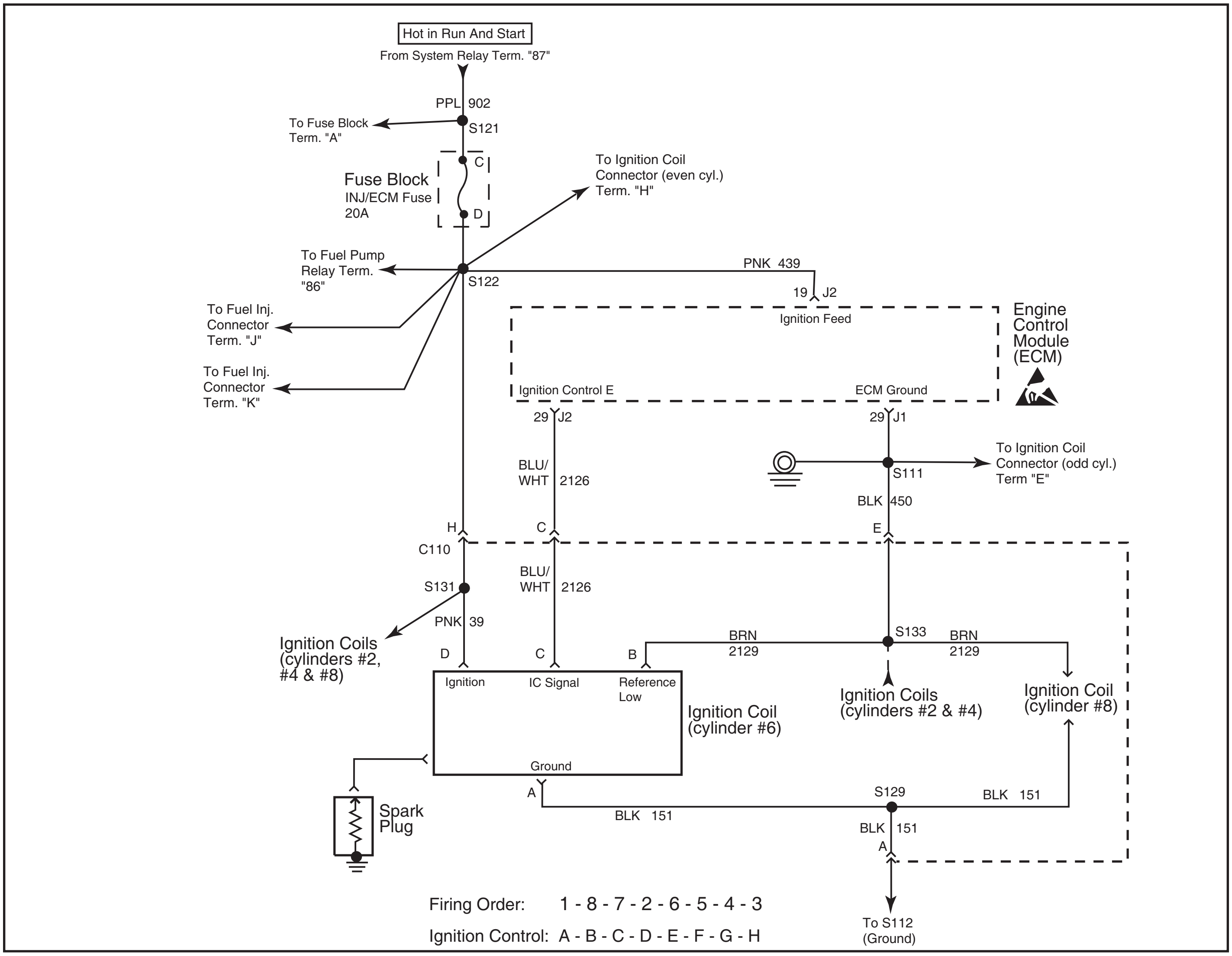
- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

2. This step verifies the fault is present.
4. This step tests the integrity of the IC circuit and the ECM output.
5. This step tests for a short to ground on the IC signal circuit.

DTC 41 (EST F Fault) - Ignition Coil 5 Control Circuit (6.0/8.1L)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Important: If all the Ignition Control (IC) DTCs are set at the same time, inspect the IC ground circuits for an open. 1. Install a scan tool. 2. Using a scan tool, clear DTCs. 3. Start and idle the engine for 2 minutes. 4. Check for DTCs. Does the scan tool indicate a DTC 41 for ignition coil 5?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the engine. 2. Disconnect the ignition coil electrical harness. 3. Measure the frequency at the ignition control signal circuit using the DMM J 39200 on the DC Hertz scale. Is the frequency within the specified range?	3.0-20 Hz	Go to Step 7	Go to Step 4
4	Measure the voltage at the ignition control signal circuit using the DMM J 39200. Is the voltage greater that the specified value?	1.0 volts	Go to Step 8	Go to Step 5
5	1. Turn OFF the engine. 2. Disconnect the ECM connector J2. 3. Test the continuity from the IC circuit (at the ignition coil harness connector) to the ECM connector using the DMM J 39200. Does the DMM indicate continuity?	—	Go to Step 6	Go to Step 9
6	Test the resistance from the IC circuit (at the ignition coil harness connector) to ground using the DMM J 39200. Does the DMM indicate OL (out-of-limits)?	—	Go to Step 10	Go to Step 9
7	Replace the ignition coil. Is the action complete?	—	Go to Step 12	—
8	Repair the Ignition Control circuit for a short to voltage. Is the action complete?	—	Go to Step 12	—
9	Repair the Ignition Control circuit for an open or grounded circuit. Is the action complete?	—	Go to Step 12	—
10	1. Inspect for poor connections at the ECM connector. 2. Replace the terminal if necessary. Did you find and correct the problem?	—	Go to Step 12	Go to Step 11
11	Replace the ECM. Is the action complete?	—	Go to Step 12	—
12	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC information option using the scan tool. 2. Idle the engine at the normal operating temperature. Is DTC 41 indicated?	—	Go to Step 2	Go to Step 13
13	Select the Diagnostic Trouble Code (DTC) option. Does the scan tool display any DTCs that you have not diagnosed?	—	Go to the applicable DTC table	System OK



M4071P
2-10-04

DTC 41 (EST E Fault) - Ignition Coil 6 Control Circuit (6.0/8.1L)

Circuit Description

The ignition system on this engine uses an individual ignition coil/module for each cylinder. The ECM controls the ignition system operation. The ECM controls each coil using one of eight Ignition Control (IC) circuits. The ECM commands the IC circuit low when a spark event is requested. This causes the IC module to energize the ignition coil to create a spark at the spark plug. Each ignition coil/module has the following circuits:

- A power feed
- A ground circuit
- An Ignition Control (IC) circuit
- A reference low circuit

Sequencing and timing are ECM controlled. This DTC sets when the IC circuit is out of range.

Diagnostic Aids

Check for the following conditions:

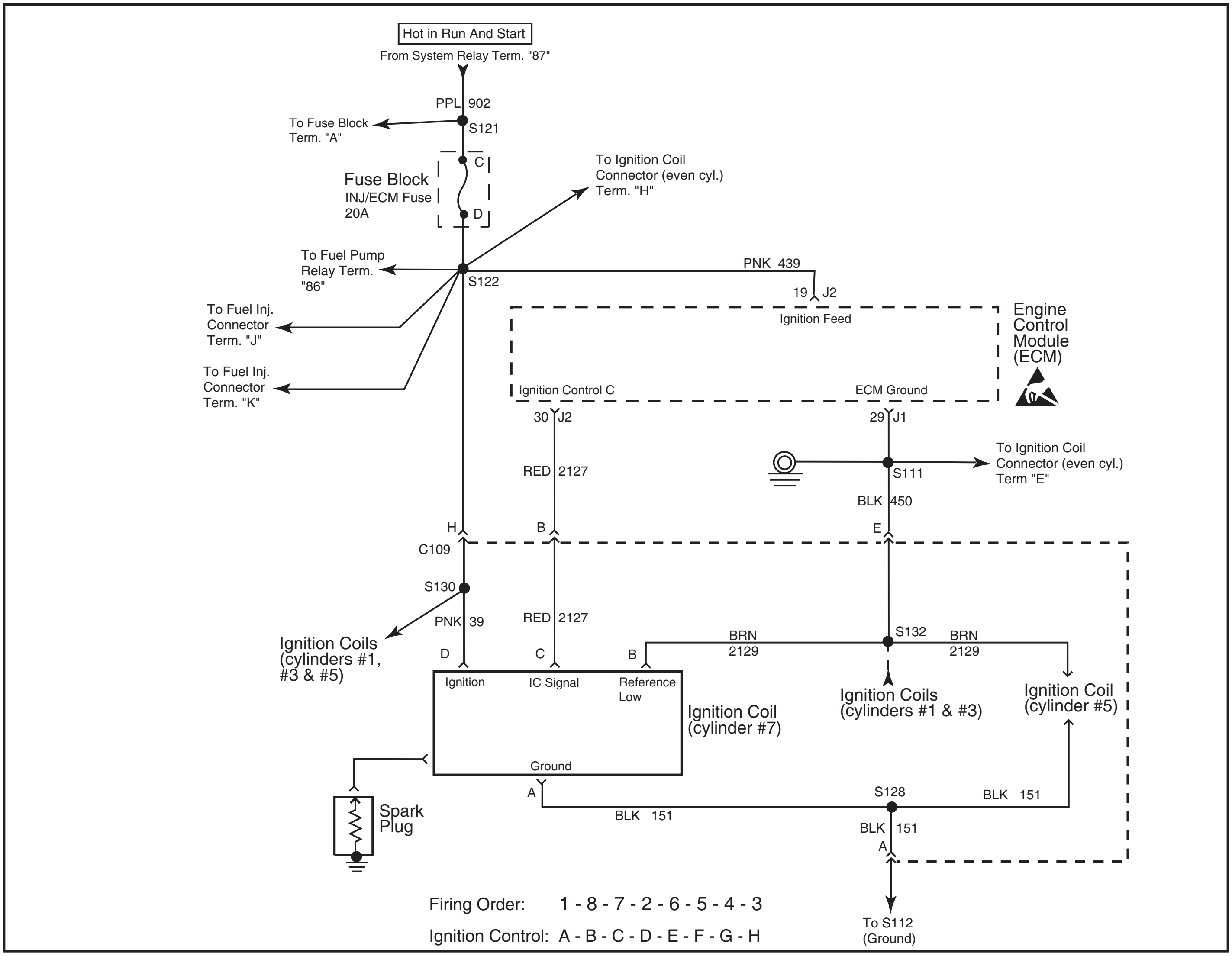
- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

2. This step verifies the fault is present.
4. This step tests the integrity of the IC circuit and the ECM output.
5. This step tests for a short to ground on the IC signal circuit.

DTC 41 (EST E Fault) - Ignition Coil 6 Control Circuit (6.0/8.1L)

Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic” (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Important: If all the Ignition Control (IC) DTCs are set at the same time, inspect the IC ground circuits for an open. 1. Install a scan tool. 2. Using a scan tool, clear DTCs. 3. Start and idle the engine for 2 minutes. 4. Check for DTCs. Does the scan tool indicate a DTC 41 for ignition coil 1?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the engine. 2. Disconnect the ignition coil electrical harness. 3. Measure the frequency at the ignition control signal circuit using the DMM J 39200 on the DC Hertz scale. Is the frequency within the specified range?	3.0-20 Hz	Go to Step 7	Go to Step 4
4	Measure the voltage at the ignition control signal circuit using the DMM J 39200. Is the voltage greater that the specified value?	1.0 volts	Go to Step 8	Go to Step 5
5	1. Turn OFF the engine. 2. Disconnect the ECM connector J2. 3. Test the continuity from the IC circuit (at the ignition coil harness connector) to the ECM connector using the DMM J 39200. Does the DMM indicate continuity?	—	Go to Step 6	Go to Step 9
6	Test the resistance from the IC circuit (at the ignition coil harness connector) to ground using the DMM J 39200. Does the DMM indicate OL (out-of-limits)?	—	Go to Step 10	Go to Step 9
7	Replace the ignition coil. Is the action complete?	—	Go to Step 12	—
8	Repair the Ignition Control circuit for a short to voltage. Is the action complete?	—	Go to Step 12	—
9	Repair the Ignition Control circuit for an open or grounded circuit. Is the action complete?	—	Go to Step 12	—
10	1. Inspect for poor connections at the ECM connector. 2. Replace the terminal if necessary. Did you find and correct the problem?	—	Go to Step 12	Go to Step 11
11	Replace the ECM. Is the action complete?	—	Go to Step 12	—
12	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC information option using the scan tool. 2. Idle the engine at the normal operating temperature. Is DTC 41 indicated?	—	Go to Step 2	Go to Step 13
13	Select the Diagnostic Trouble Code (DTC) option. Does the scan tool display any DTCs that you have not diagnosed?	—	Go to the applicable DTC table	System OK



M4068P
2-10-04

DTC 41 (EST C Fault) - Ignition Coil 7 Control Circuit (6.0/8.1L)

Circuit Description

The ignition system on this engine uses an individual ignition coil/module for each cylinder. The ECM controls the ignition system operation. The ECM controls each coil using one of eight Ignition Control (IC) circuits. The ECM commands the IC circuit low when a spark event is requested. This causes the IC module to energize the ignition coil to create a spark at the spark plug. Each ignition coil/module has the following circuits:

- A power feed
- A ground circuit
- An Ignition Control (IC) circuit
- A reference low circuit

Sequencing and timing are ECM controlled. This DTC sets when the IC circuit is out of range.

Diagnostic Aids

Check for the following conditions:

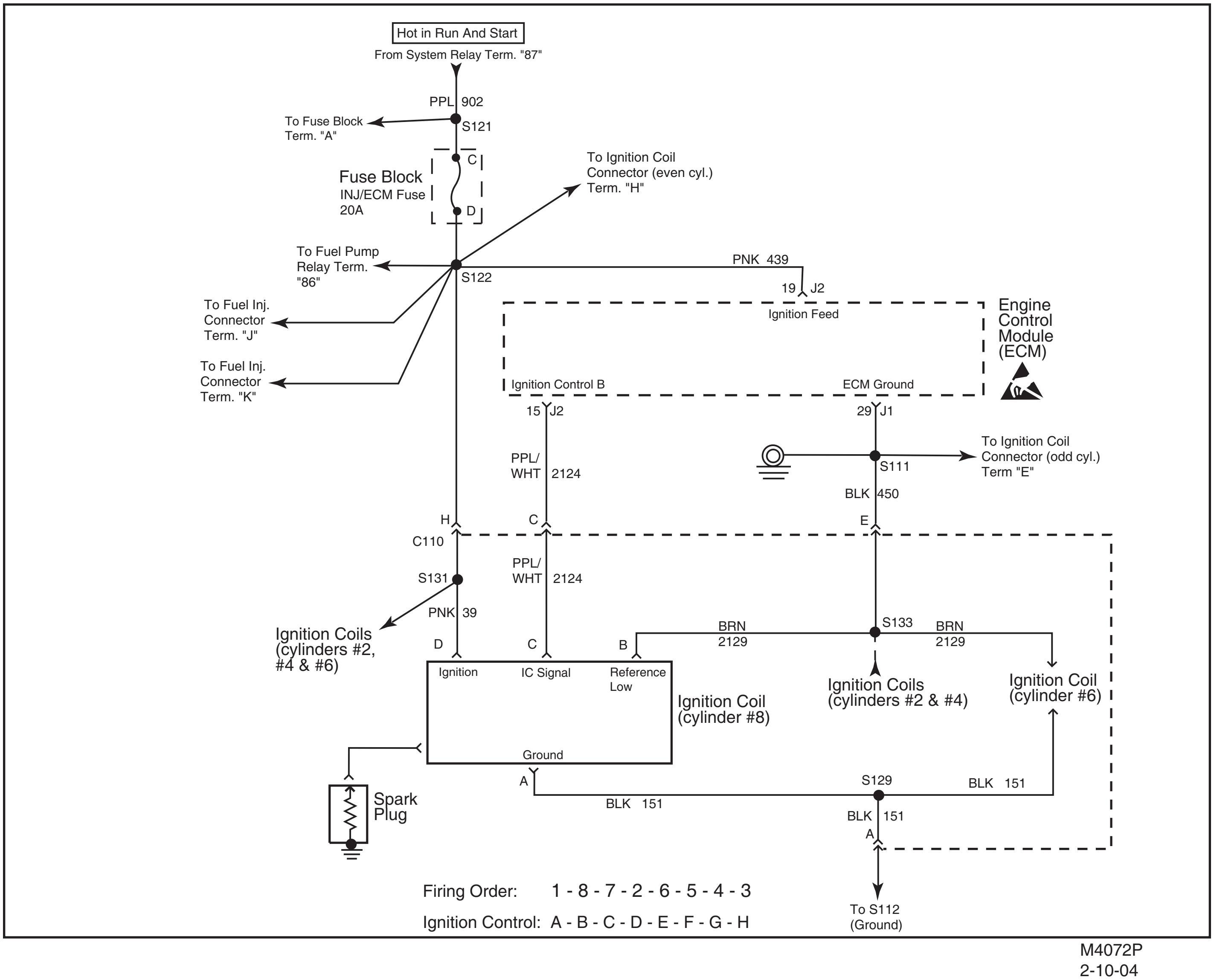
- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

2. This step verifies the fault is present.
4. This step tests the integrity of the IC circuit and the ECM output.
5. This step tests for a short to ground on the IC signal circuit.

DTC 41 (EST C Fault) - Ignition Coil 7 Control Circuit (6.0/8.1L)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Important: If all the Ignition Control (IC) DTCs are set at the same time, inspect the IC ground circuits for an open. 1. Install a scan tool. 2. Using a scan tool, clear DTCs. 3. Start and idle the engine for 2 minutes. 4. Check for DTCs. Does the scan tool indicate a DTC 41 for ignition coil 7?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the engine. 2. Disconnect the ignition coil electrical harness. 3. Measure the frequency at the ignition control signal circuit using the DMM J 39200 on the DC Hertz scale. Is the frequency within the specified range?	3.0-20 Hz	Go to Step 7	Go to Step 4
4	Measure the voltage at the ignition control signal circuit using the DMM J 39200. Is the voltage greater that the specified value?	1.0 volts	Go to Step 8	Go to Step 5
5	1. Turn OFF the engine. 2. Disconnect the ECM connector J2. 3. Test the continuity from the IC circuit (at the ignition coil harness connector) to the ECM connector using the DMM J 39200. Does the DMM indicate continuity?	—	Go to Step 6	Go to Step 9
6	Test the resistance from the IC circuit (at the ignition coil harness connector) to ground using the DMM J 39200. Does the DMM indicate OL (out-of-limits)?	—	Go to Step 10	Go to Step 9
7	Replace the ignition coil. Is the action complete?	—	Go to Step 12	—
8	Repair the Ignition Control circuit for a short to voltage. Is the action complete?	—	Go to Step 12	—
9	Repair the Ignition Control circuit for an open or grounded circuit. Is the action complete?	—	Go to Step 12	—
10	1. Inspect for poor connections at the ECM connector. 2. Replace the terminal if necessary. Did you find and correct the problem?	—	Go to Step 12	Go to Step 11
11	Replace the ECM. Is the action complete?	—	Go to Step 12	—
12	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC information option using the scan tool. 2. Idle the engine at the normal operating temperature. Is DTC 41 indicated?	—	Go to Step 2	Go to Step 13
13	Select the Diagnostic Trouble Code (DTC) option. Does the scan tool display any DTCs that you have not diagnosed?	—	Go to the applicable DTC table	System OK



DTC 41 (EST B Fault) - Ignition Coil 8 Control Circuit (6.0/8.1L)

Circuit Description

The ignition system on this engine uses an individual ignition coil/module for each cylinder. The ECM controls the ignition system operation. The ECM controls each coil using one of eight Ignition Control (IC) circuits. The ECM commands the IC circuit low when a spark event is requested. This causes the IC module to energize the ignition coil to create a spark at the spark plug. Each ignition coil/module has the following circuits:

- A power feed
- A ground circuit
- An Ignition Control (IC) circuit
- A reference low circuit

Sequencing and timing are ECM controlled. This DTC sets when the IC circuit is out of range.

Diagnostic Aids

Check for the following conditions:

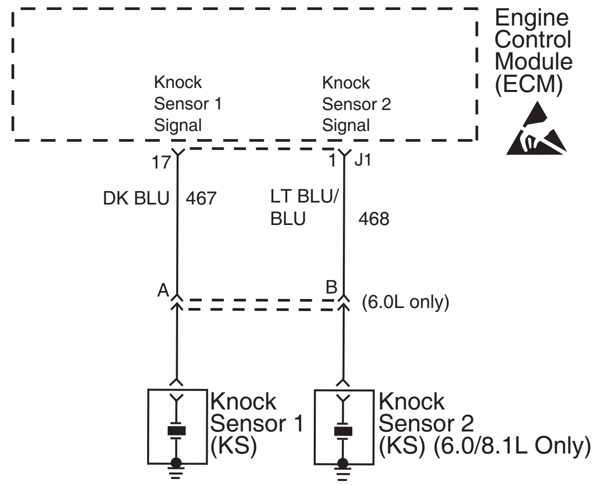
- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

2. This step verifies the fault is present.
4. This step tests the integrity of the IC circuit and the ECM output.
5. This step tests for a short to ground on the IC signal circuit.

DTC 41 (EST B Fault) - Ignition Coil 8 Control Circuit (6.0/8.1L)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Important: If all the Ignition Control (IC) DTCs are set at the same time, inspect the IC ground circuits for an open. 1. Install a scan tool. 2. Using a scan tool, clear DTCs. 3. Start and idle the engine for 2 minutes. 4. Check for DTCs. Does the scan tool indicate a DTC 41 for ignition coil 8?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the engine. 2. Disconnect the ignition coil electrical harness. 3. Measure the frequency at the ignition control signal circuit using the DMM J 39200 on the DC Hertz scale. Is the frequency within the specified range?	3.0-20 Hz	Go to Step 7	Go to Step 4
4	Measure the voltage at the ignition control signal circuit using the DMM J 39200. Is the voltage greater that the specified value?	1.0 volts	Go to Step 8	Go to Step 5
5	1. Turn OFF the engine. 2. Disconnect the ECM connector J2. 3. Test the continuity from the IC circuit (at the ignition coil harness connector) to the ECM connector using the DMM J 39200. Does the DMM indicate continuity?	—	Go to Step 6	Go to Step 9
6	Test the resistance from the IC circuit (at the ignition coil harness connector) to ground using the DMM J 39200. Does the DMM indicate OL (out-of-limits)?	—	Go to Step 10	Go to Step 9
7	Replace the ignition coil. Is the action complete?	—	Go to Step 12	—
8	Repair the Ignition Control circuit for a short to voltage. Is the action complete?	—	Go to Step 12	—
9	Repair the Ignition Control circuit for an open or grounded circuit. Is the action complete?	—	Go to Step 12	—
10	1. Inspect for poor connections at the ECM connector. 2. Replace the terminal if necessary. Did you find and correct the problem?	—	Go to Step 12	Go to Step 11
11	Replace the ECM. Is the action complete?	—	Go to Step 12	—
12	1. Select the Diagnostic Trouble Code (DTC) option and the Clear DTC information option using the scan tool. 2. Idle the engine at the normal operating temperature. Is DTC 41 indicated?	—	Go to Step 2	Go to Step 13
13	Select the Diagnostic Trouble Code (DTC) option. Does the scan tool display any DTCs that you have not diagnosed?	—	Go to the applicable DTC table	System OK



M4063
3-2-04

DTC 44 - Knock Sensor (KS) 1 Circuit (Scan Diagnostics)

Circuit Description

The ECM uses the Knock Sensor(s) in order to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM. DTC 44 will set only if the ECM does not see any activity on the KS signal circuit(s).

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- Loose Knock Sensor(s) in engine block.
- Poor connection at the Knock Sensor(s).

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

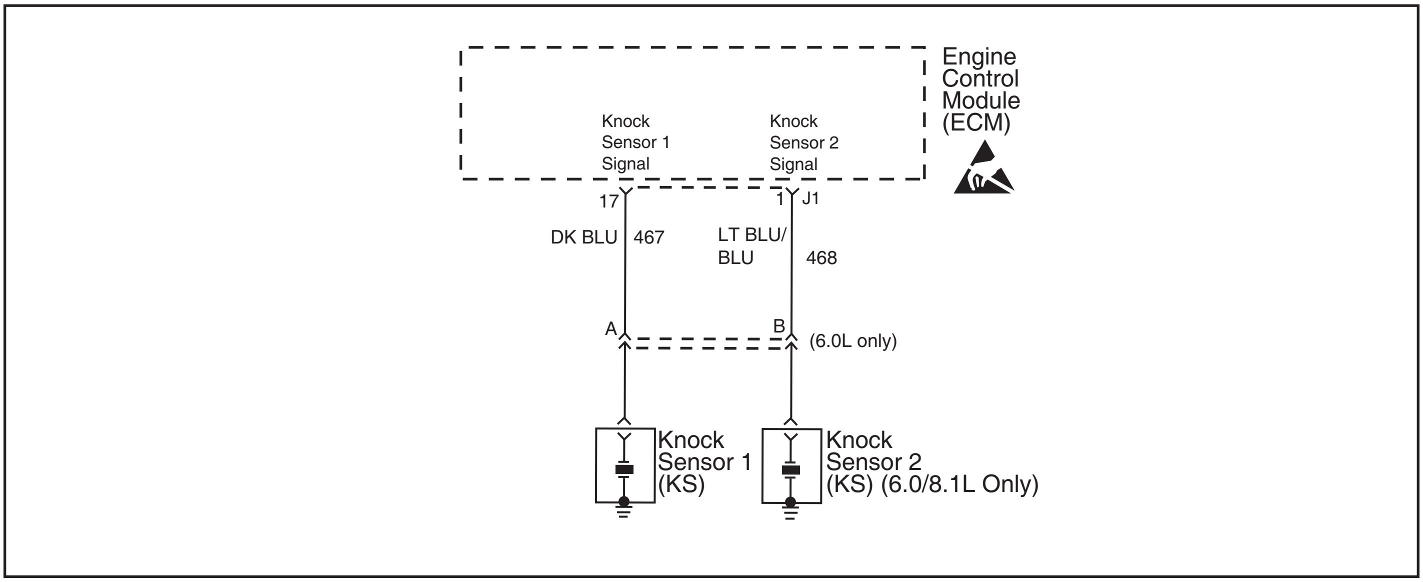
If CKT 467 or CKT 468 are routed too close to secondary ignition wires, the ECM may see the interference as a knock signal, resulting in false timing retard.

Test Description

4. This step ensures the knock sensor is secured properly in the engine block.
5. Checks to see that the knock sensor circuit is within specifications.

DTC 44 - Knock Sensor (KS) 1 Circuit (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Important: If you can hear the engine knock, repair the engine mechanical problem before proceeding with this diagnostic table. Check the KS signal circuit for incorrect routing near the secondary wires. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 3
3	Check the KS signal circuit for any terminals not being fully seated or for incorrect installation. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 4
4	Check knock sensor for being loose in the engine block. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 5
5	1. Install scan tool. 2. Select the option to view the data list. 3. Select to view the knock signal 1 parameter. 4. Disconnect "J1" harness connector. 5. Connect a DMM from "J1-17" (CKT 467 - Knock Signal 1) to a known good ground near the knock sensor. Is resistance between the specified value?	93-107K ohms	Go to Step 8	Go to Step 6
6	Locate and repair open or short to ground in the circuit that were out of range. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
7	Inspect knock sensor terminal contacts. If OK, replace faulty knock sensor. Is action complete?	—	Verify Repair	—
8	Replace faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



M4063
3-2-04

DTC 44 - Knock Sensor (KS) 2 Circuit (Scan Diagnostics) (6.0/8.1L Only)

Circuit Description

The ECM uses the Knock Sensor(s) in order to detect engine detonation. This detection allows the ECM to retard spark timing based on the KS signal coming into the ECM. DTC 44 will set only if the ECM does not see any activity on the KS signal circuit(s).

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage.
- Loose Knock Sensor(s) in engine block.
- Poor connection at the Knock Sensor(s).

After repairs, clear DTC's following "Clear DTC's Procedure." Failure to do so may result in DTC's not properly being cleared.

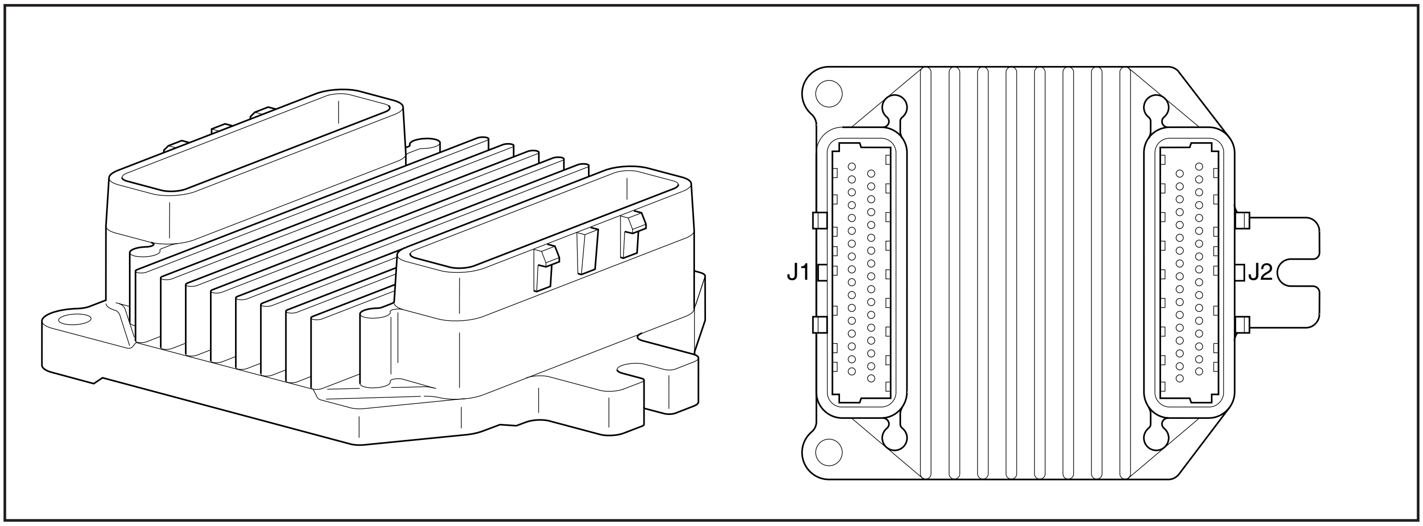
If CKT 467 or CKT 468 are routed too close to secondary ignition wires, the ECM may see the interference as a knock signal, resulting in false timing retard.

Test Description

4. This step ensures the knock sensor is secured properly in the engine block.
5. Checks to see that the knock sensor circuit is within specifications.

DTC 44 - Knock Sensor (KS) 2 Circuit (Scan Diagnostics) (6.0/8.1L Only)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Important: If you can hear the engine knock, repair the engine mechanical problem before proceeding with this diagnostic procedure. Check the KS signal circuit for incorrect routing near the secondary wires. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 3
3	Check the KS signal circuit for any terminals not being fully seated or for incorrect installation. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 4
4	Check knock sensor for being loose in the engine block. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 5
5	1. Install scan tool. 2. Select the option to view the data list. 3. Select to view the knock signal 2 parameter. 4. Disconnect "J1" harness connector. 5. Connect a DMM from "J1-1" (CKT 468 - Knock Signal 2) to a known good ground near knock sensor. Is resistance between the specified value?	93-107K ohms	Go to Step 8	Go to Step 6
6	Locate and repair open or short to ground in the circuit that were out of range. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
7	Inspect knock sensor terminal contacts. If OK, replace faulty knock sensor. Is action complete?	—	Verify Repair	—
8	Replace faulty ECM connections or replace faulty ECM. Is action complete?	—	Verify Repair	—



MEFI3004

DTC 51 - Calibration Checksum Failure (Scan Diagnostics)

Circuit Description

This test allows the ECM to check for a calibration failure by comparing the calibration value to a known value stored in the EEPROM.

This test is also used as a security measure to prevent improper use of calibration or changes to these calibrations that may alter the designed function of MEFI.

Diagnostic Aids

If DTC 51 failed more than once, but is intermittent, replace the ECM.

Test Description

2. This step checks to see if the fault is present during diagnosis. If present, the ECM is not functioning properly and must be replaced or reprogrammed.

DTC 51 - Calibration Checksum Failure (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Install Diagnostic Trouble Code (DTC) tool. 2. Using "Clear DTC Procedure," clear DTC 51. 3. Turn the ignition ON, leaving the engine OFF. 4. Switch DTC tool to "service mode," or "ON." Does DTC 51 reset?	—	Go to Step 3	Refer to Diagnostic Aids
3	Replace or reprogram faulty ECM and verify DTC does not reset. Is action complete?	—	Verify Repair	—

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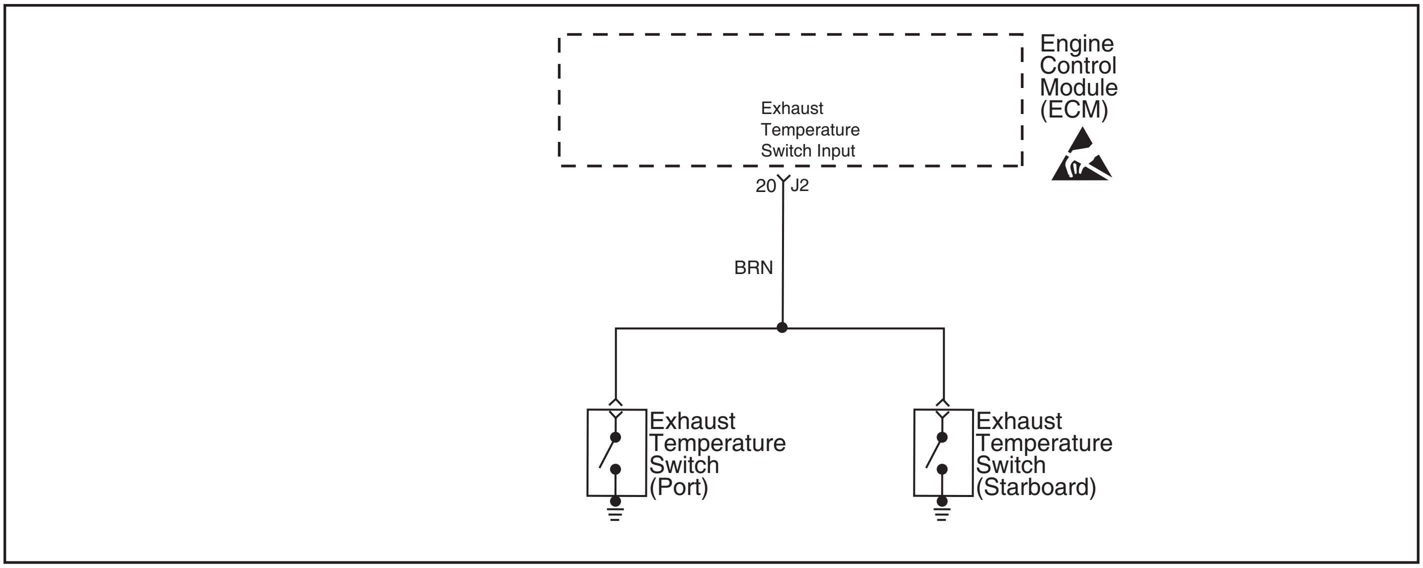


M4095
2-27-04

DTC 81 - Exhaust Temperature Switch (ETS) Circuit - High Temp. Indicated (Scan Diagnostics)

Circuit Description

The Exhaust Temperature Switch (ETS) circuit monitors for a high exhaust temperature due to a lack of raw water cooling. The switch is a normally open device, and is grounded when the temperature reaches 248° ± 5° F.

Diagnostic Aids

Check for the following conditions:

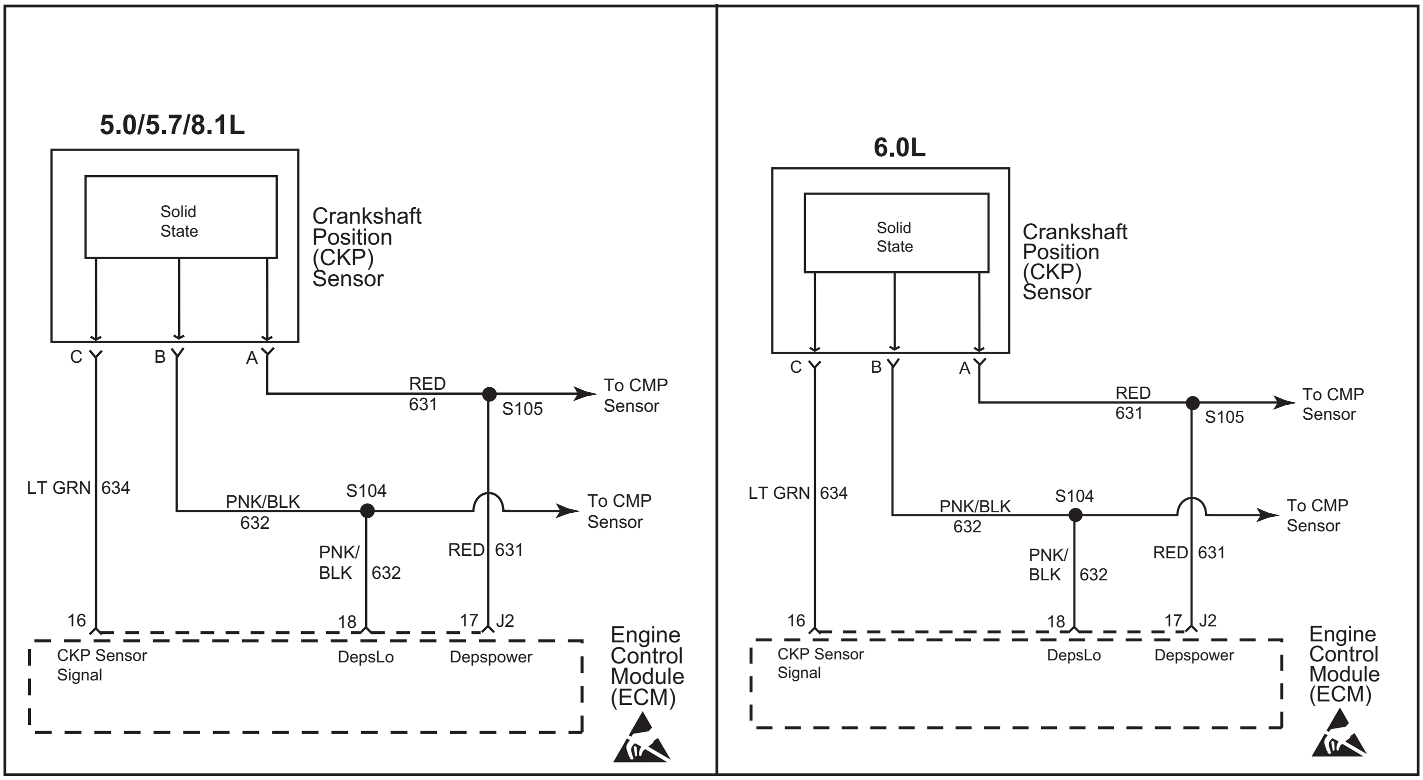
- Poor connection at ECM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Corrosion
- Mis-routed harness
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

2. This step checks to see if the fault is due to improper cooling to the exhaust system.
3. This step checks for a shorted port side exhaust temperature switch.
4. This step checks for a short to ground in the circuit.

DTC 81 - Exhaust Temperature Switch (ETS) Circuit - High Temp. Indicated (Scan Diagnostics)

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	Verify proper cooling system operation, including raw water pump volume test. Was a problem found?	—	Repair as necessary	Go to Step 3
3	1. Disconnect the port exhaust temp. switch harness connector. 2. Using a DMM, measure resistance between the switch terminal and the exhaust elbow/riser. Does the DMM display the specified value?	0 ohms	Go to Step 7	Go to Step 4
4	Using a DMM, measure the resistance between the port exhaust temp. switch harness connector and a known good ground. Does the DMM display the specified value?	0 ohms	Go to Step 5	Go to Step 10
5	1. Disconnect the starboard exhaust temp. switch harness connector. 2. Using a DMM, measure resistance between the switch terminal and the exhaust elbow/riser. Does the DMM display the specified value?	0 ohms	Go to Step 7	Go to Step 6
6	Locate and repair a short to ground in the exhaust temperature switch circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 9
7	Verify exhaust elbow temperature is not exceeding 248°F. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 8
8	Replace faulty exhaust temperature switch. Is action complete?	—	Verify Repair	—
9	Replace the faulty ECM. Is the action complete?	—	Verify Repair	—
10	Problem may be intermittent. Refer to Diagnostic Aids.	—	—	—



M4078
2-13-04

M4078a
2-13-04

DTC 81 - Crankshaft Position (CKP) Sensor Circuit Fault

Circuit Description

The CKP sensor works in conjunction with a 24X encoded (6.0/8.1L), or a 4X (5.0/5.7L) reluctor wheel. The CKP sensor is a three-wire sensor; 12 volt supply (depspower), reference ground (depslo) and a signal circuit.

As the crankshaft rotates, the reluctor wheel teeth interrupt a magnetic field produced by a magnet within the sensor. The sensor's internal circuitry detects this and produces a signal which the ECM reads. The ECM uses this signal to accurately measure crankshaft speed, or engine RPM.

Diagnostic Aids

Check for the following conditions:

- Poor connection in harness. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.
- Crankshaft reluctor wheel damage or improper installation.
- 6.0/8.1L - Excessive air gap between the CKP sensor and the reluctor wheel (The CKP sensor can be removed and reinstalled a maximum of three times). Each time the sensor is installed, it makes direct contact with the reluctor wheel, and the sensor wears to the proper air gap. After the third installation, the air gap becomes too big, and the circuit may cause erratic performance, or a no start situation.

Excess crankshaft end play causes the CKP sensor reluctor wheel to move out of alignment with the CKP sensor. This could result in any one of the following:

- A no start
- A start and stall
- Erratic performance

Test Description

2. This test checks for an intermittent DTC 81 (CKP sensor fault). If the engine does not start, and DTC 81 is not present, refer to DP A-3.
3. This test checks for the 12 volt supply voltage to the CKP sensor.
4. This test verifies the ground circuit to the CKP sensor.

DTC 81 - Crankshaft Position (CKP) Sensor Circuit Fault

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Install a scan tool. 2. Clear Diagnostic Trouble Codes. 3. Crank or start the engine. If the engine will not start, do not crank the engine for more than 20 seconds. 4. Check for diagnostic trouble codes. Is DTC 81 (CKP Sensor Circuit Fault) present?	—	Go to Step 3	Intermittent Problem Go to Diagnostic Aids
3	***Caution: Before proceeding, remove all injector connectors and the ignition module connector (5.0/5.7L), or disconnect the harness connectors at the ignition coils and the injectors in order to prevent personal injury from engine rotation, sparks and excessive engine fueling.*** 1. Turn "ON" the ignition, leaving the engine "OFF." 2. Disconnect the Crankshaft Position (CKP) sensor harness connector. 3. Using a DMM connected to a known good ground, measure the voltage at the Depspower circuit at the CKP sensor harness. Does the DMM display the specified value?	11-13 volts	Go to Step 4	Go to Step 9
4	Using a DMM, measure the voltage between the Depspower circuit and the Depslo circuit at the sensor harness connector. Does the DMM display the specified value?	11-13 volts	Go to Step 5	Go to Step 10
5	1. Turn ignition "OFF." 2. Disconnect the ECM "J2" connector. 3. Using a DMM, measure resistance between the CKP sensor signal circuit at the sensor harness connector and ECM harness connector "J2-16." Does the DMM display the specified value?	0 ohms	Go to Step 8	Go to Step 6
6	Check for CKP sensor signal circuit open (CKT 634). If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
7	Check for CKP sensor signal circuit shorted to voltage, or shorted to ground. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 8
8	1. Jump the Depspower circuit at the CKP sensor harness connector to the CKP sensor using a fused jumper wire. (5.0/5.7/8.1L) - Harness terminal "A" to connector terminal "A." (6.0L) - Harness terminal "C" to connector terminal "C." 2. Jump terminal "B" of the CKP sensor harness connector to terminal "B" of the CKP sensor.			

DTC 81 - Crankshaft Position (CKP) Sensor Circuit Fault (cont'd)

Step	Action	Value	Yes	No
8	3. Using a DMM connected to a known good ground, probe the sensor signal circuit at the CKP sensor. (5.0/5.7/8.1L) - Sensor terminal "C." (6.0L) - Sensor terminal "A." 4. Hand crank the engine. Does the voltage transition between O and more than 7 volts?	—	Go to Step 15	Go to Step 12
9	Locate and repair an open in the CKP sensor "Depspower" circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 15
10	Locate and repair an open or poor connection in the CKP sensor "Depslo" circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 15
11	Locate and repair an open, short to ground or short to voltage in the CKP sensor signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 15
12	1. Remove the CKP sensor. 2. Visually inspect the CKP sensor for physical damage, loose or improper installation or wiring routed too close to secondary ignition components. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 13
13	Inspect for poor connections at the CKP sensor. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 14
14	Replace the faulty CKP sensor. Is the action complete?	—	Verify Repair	—
15	Inspect for poor connections at the ECM. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 16
16	Replace the ECM. Is the action complete?	—	Verify Repair	—

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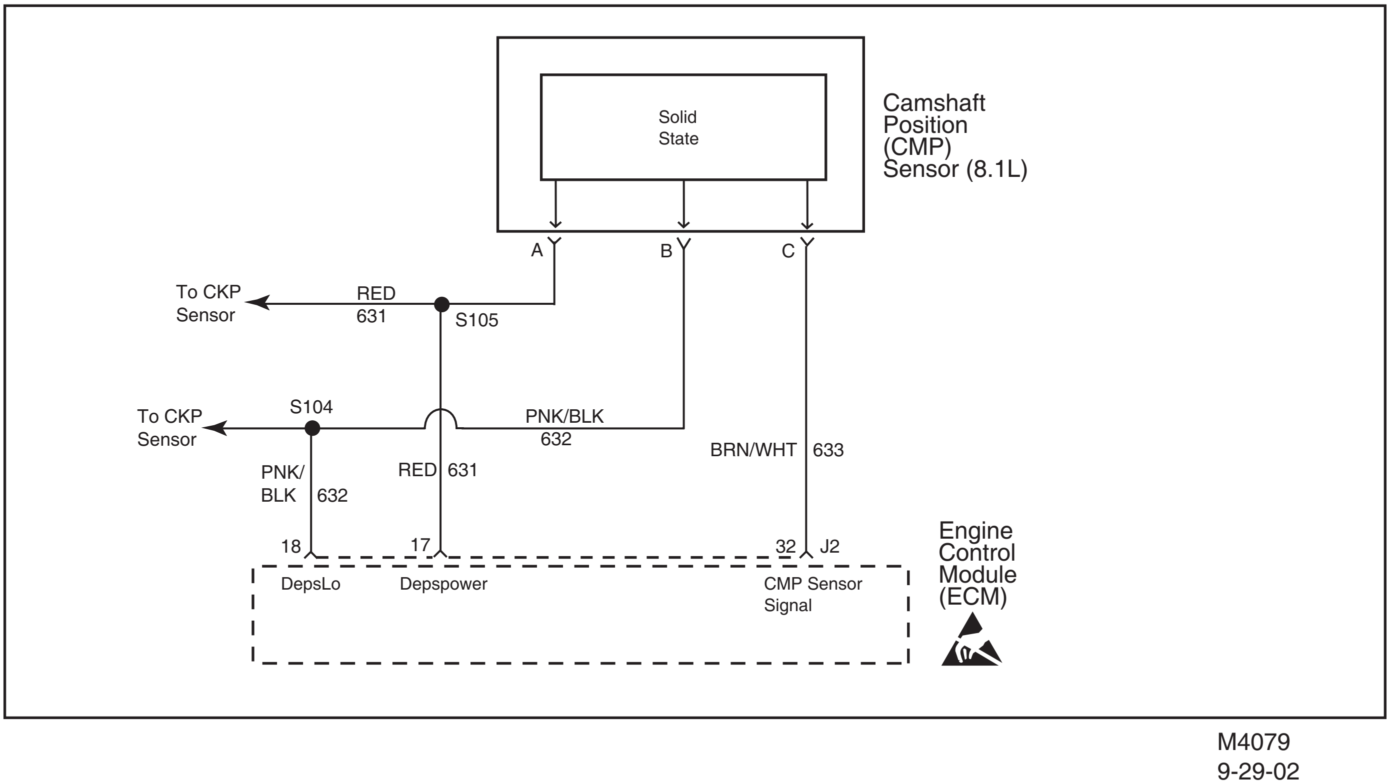
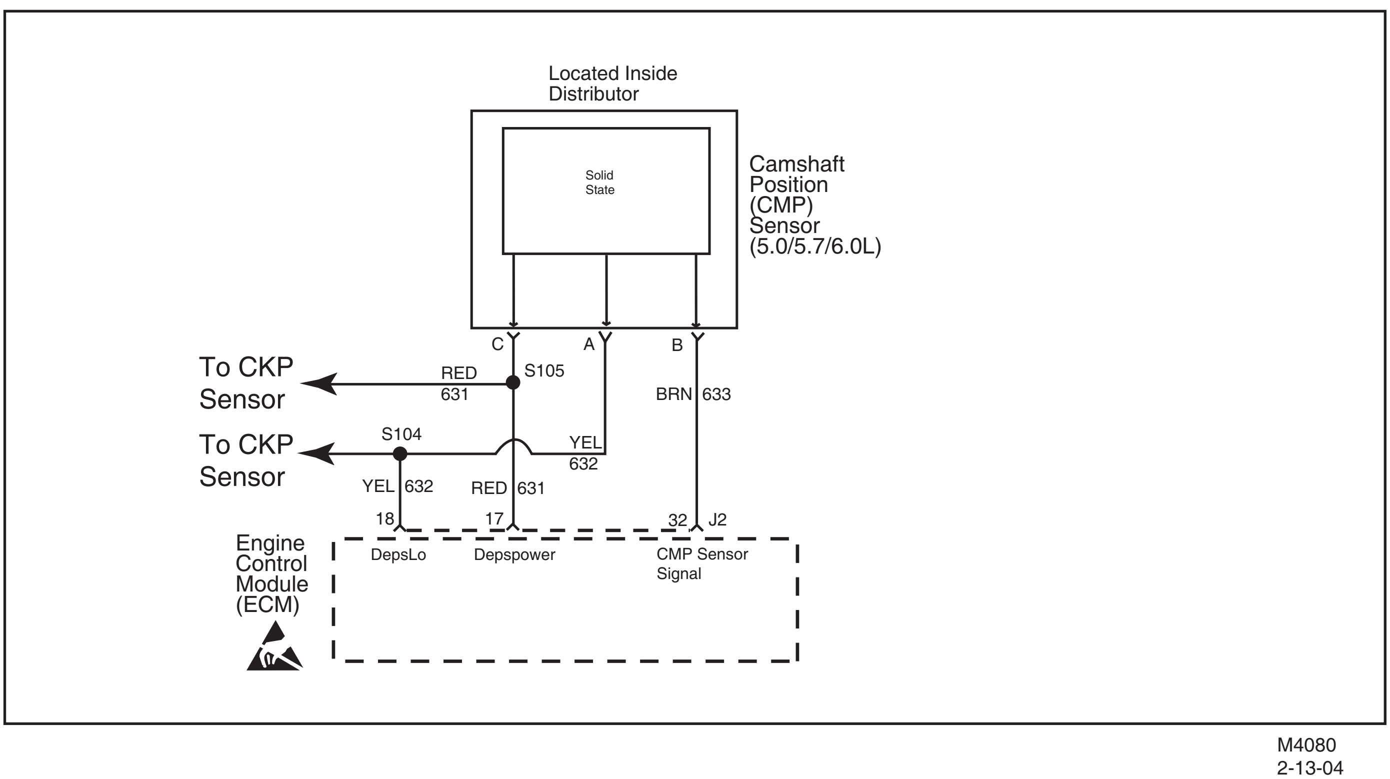




DTC 81 - Camshaft Position (CMP) Sensor Circuit Fault

Circuit Description

The CMP sensor works in conjunction with a 1X reluctor wheel on the camshaft (6.0/8.1L), or the distributor shaft (5.7L). The CMP sensor is a three-wire sensor; 12 volt supply (depspower), reference ground (depslo) and a signal circuit.

The CMP sensor determines whether a cylinder is on a firing stroke or on an exhaust stroke. As the camshaft rotates, the reluctor wheel interrupts a magnetic field produced by a magnet within the sensor. The sensor's internal circuitry detects this and produces a signal which the ECM reads. The ECM uses this 1X signal in combination with the crankshaft position (CKP) sensor 24X (6.0/8.1L), or 4X (5.0/5.7L) signal in order to determine crankshaft position and stroke.

Observe that as long as the ECM receives the CKP sensor 24X (6.0/8.1L), or 4X (5.0/5.7L) signal, the engine will start. The ECM can determine top dead center for all cylinders by using the CKP sensor 24X (6.0/8.1L), or 4X (5.0/5.7L) signal alone. The CMP sensor 1X signal is used by the ECM to determine if the cylinder at top dead center is on the firing stroke or the exhaust stroke. If the ECM does not detect a signal from the 6.0/8.1L CMP sensor, the ECM goes into a "waste spark" system. A slightly longer cranking time may be a symptom of this condition. If the ECM does not detect a signal from the 5.0/5.7L CMP sensor, the only effect is power balance function of a scan tool will not operate. The CMP sensor signal is used in diagnostics in order to perform a Cylinder Balance Test, using a scan tool.

Diagnostic Aids

Check for the following conditions:

- Camshaft reluctor wheel damage
- The sensor coming in contact with the reluctor wheel
- A cracked or damaged sensor
- Foreign material passing between the sensor and reluctor wheel

If you find damage to the reluctor wheel, refer to Camshaft Replacement in Engine Mechanical (6.0/8.1L).

If you find damage to the reluctor wheel, refer to Distributor Replacement in Engine Mechanical (5.7L).

If the condition is suspected to be intermittent, check for poor connections in the harness. Inspect the harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals and poor terminal to wire connection.

Test Description

2. This test checks for the 12 volt supply voltage to the CMP sensor.
3. This test verifies the ground circuit to the CMP sensor.

DTC 81 - Camshaft Position (CMP) Sensor Circuit Fault

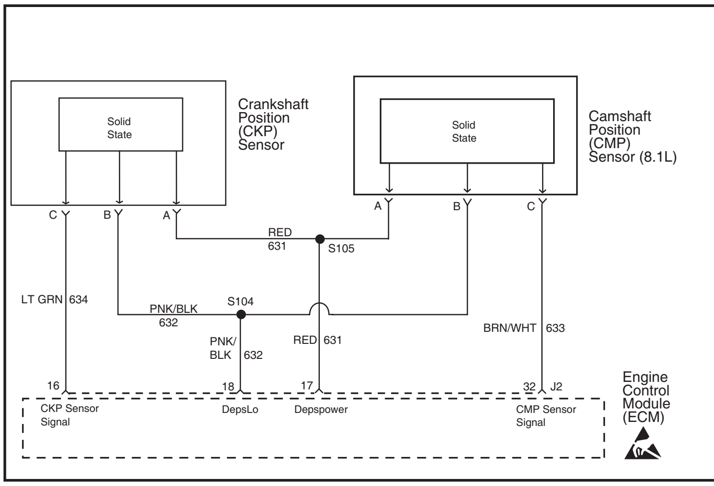
Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Install a scan tool. 2. Clear Diagnostic Trouble Codes. 3. Crank or start the engine. If the engine will not start, do not crank the engine for more than 20 seconds. 4. Check for diagnostic trouble codes. Is DTC 81 (CMP Sensor Circuit Fault) present?	—	Go to Step 3	Intermittent Problem Go to Diagnostic Aids
3	***Caution: Before proceeding, remove all injector connectors and the ignition module connector (5.0/5.7),or disconnect the harness connectors at the ignition coils and the injectors in order to prevent personal injury from engine rotation, sparks and excessive engine fueling.*** 1. Turn "ON" the ignition, leaving the engine "OFF." 2. Disconnect the Camshaft Position (CMP) sensor harness connector. 3. Using a DMM connected to a known good ground, measure the voltage at terminal "A" (8.1L), or "C" (5.0/5.7/6.0L) (Depspower) of the CMP sensor harness. Does the DMM display the specified value?	11-13 volts	Go to Step 4	Go to Step 9

DTC 81 - Camshaft Position (CMP) Sensor Circuit Fault

Step	Action	Value	Yes	No
4	Using a DMM, measure the voltage between the CMP sensor harness connector terminals “A” (8.1L), or “C” (5.0/5.7L) (Depspower) and “B” (8.1L), or “A” (5.0/5.7/6.0L) (Depslo). Does the DMM display the specified value?	11-13 volts	Go to Step 5	Go to Step 10
5	1. Turn ignition “OFF.” 2. Disconnect the ECM “J2” connector. 3. Using a DMM, measure resistance between terminal “C” (8.1L), or “B” (5.0/5.7/6.0L) of the CMP sensor and ECM harness connector “J2-32.” Does the DMM display the specified value?	0 ohms	Go to Step 8	Go to Step 6
6	Check for CMP sensor signal circuit 633 open. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 7
7	Check for CMP sensor signal circuit 633 shorted to voltage, or shorted to ground. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 8
8	1. Jump terminal “A” (8.1L), or “C” (5.0/5.7/6.0L) of the CMP sensor harness connector to terminal “A” (8.1L), or “C” (5.0/5.7L) of the CMP sensor using a fused jumper wire. 2. Jump terminal “B” (8.1L), or “A” (5.0/5.7/6.0L) of the CMP sensor harness connector to terminal “B” (8.1L), or “A” (5.0/5.7/6.0L) of the CMP sensor. 3. Using a DMM connected to a known good ground, probe terminal “C” (8.1L), or “B” (5.0/5.7/6.0L) (sensor signal) of the CMP sensor. 4. Hand crank the engine. Does the voltage transition between O and more than 7 volts?	—	Go to Step 15	Go to Step 12
9	Locate and repair an open in the CMP sensor “Depspower” circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 15
10	Locate and repair an open or poor connection in the CMP sensor “Depslo” circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 15
11	Locate and repair an open, short to ground or short to voltage in the CMP sensor signal circuit. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 15

DTC 81 - Camshaft Position (CMP) Sensor Circuit Fault (cont'd)

Step	Action	Value	Yes	No
12	1. Remove the CMP sensor. 2. Visually inspect the CMP sensor for physical damage, loose or improper installation or wiring routed too close to secondary ignition components. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 13
13	Inspect for poor connections at the CMP sensor. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 14
14	Replace the faulty CMP sensor. Is the action complete?	—	Verify Repair	—
15	Inspect for poor connections at the ECM. If a problem is found, repair as necessary. Was a problem found?	—	Verify Repair	Go to Step 16
16	Replace the ECM. Is the action complete?	—	Verify Repair	—



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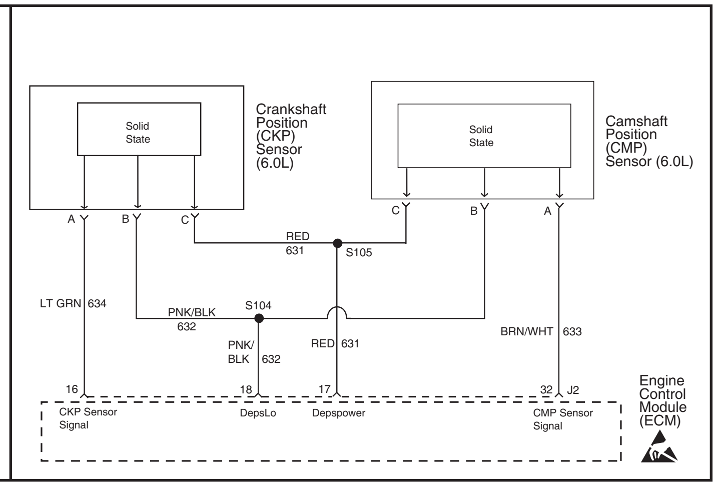

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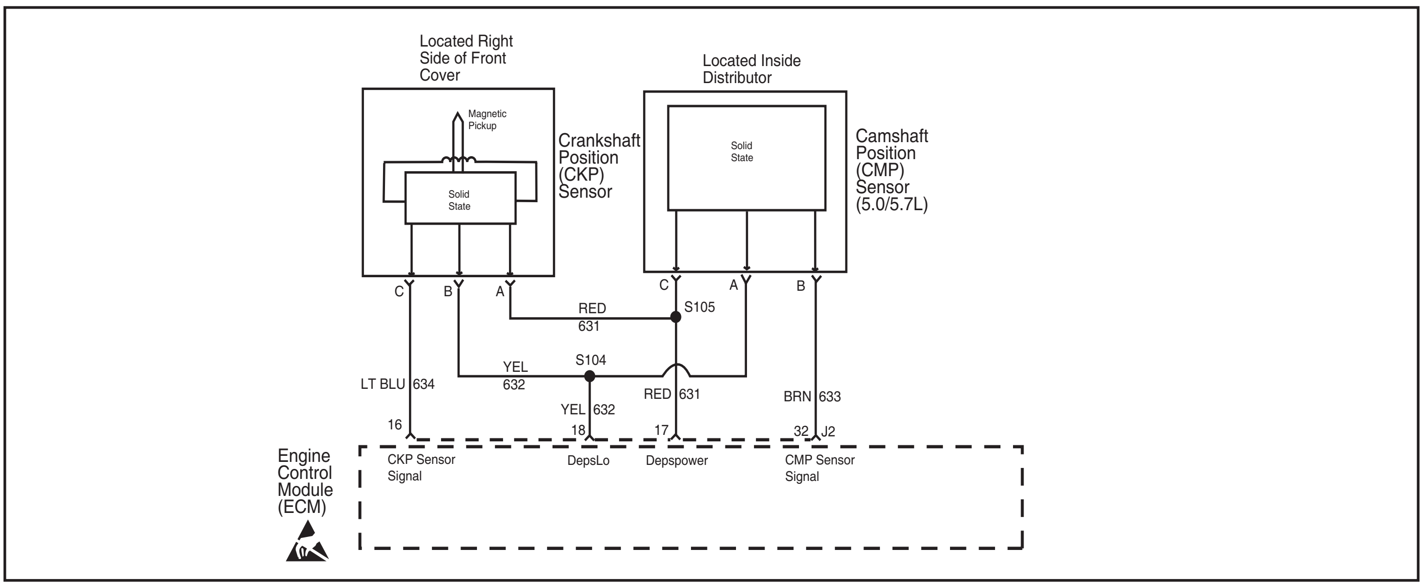


M4077
9-29-02

DTC 81 - Depspower Circuit Out of Range

Circuit Description

The Engine Control Module (ECM) uses a dedicated 12 volt reference circuit for the Crankshaft Position (CKP) sensor and the Camshaft Position (CMP) sensor. This circuit supplies 12 volts to only the CKP and the CMP sensor circuits. This circuit is referred to as Depspower. The ECM monitors the voltage on the Depspower circuit. This DTC sets if the voltage is out of range.

Diagnostic Aids

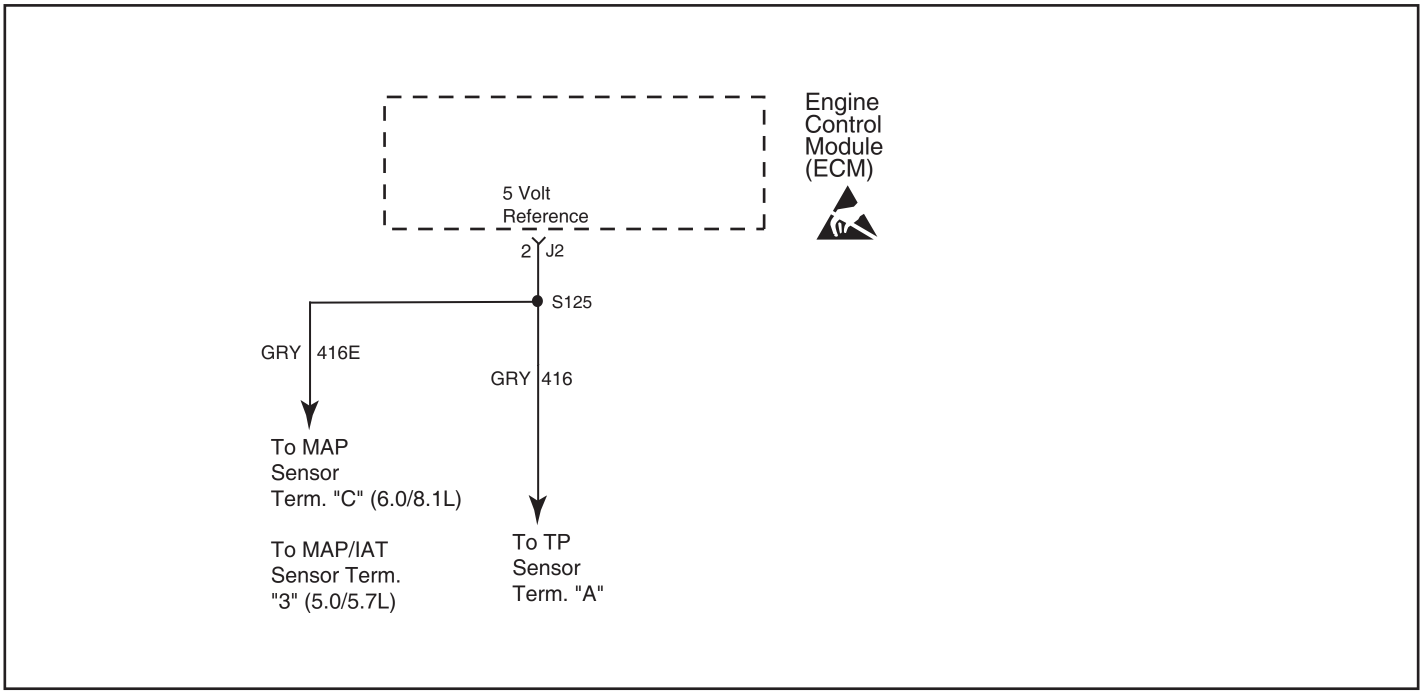
If the condition is suspected to be intermittent, refer to Intermittent Conditions.

Test Description

3. The Depspower circuit may be shorted to another ECM circuit. The shorted circuit may not be apparent when the ECM harness connector is disconnected.

DTC 81 - Depspower Circuit Out of Range

Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic” (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Disconnect the ECM harness connector J2. 2. Turn ON the ignition, with the engine OFF. 3. Using a DMM connected to a known good ground, probe the other lead of the DMM to the Depspower circuit (J2-17) at the ECM harness connector. Does the circuit measure more than the specified value?	12 V	Go to Step 6	Go to Step 3
3	Before proceeding, remove the following fuses: • ECM/BAT • ECM • Fuel Pump Relay 1. Disconnect the CKP sensor and the CMP sensor harness connectors. 2. Using a DMM, test the continuity from the Depspower circuit to all other ECM circuits at the ECM J2 harness connector. Do any of the circuits indicate a resistance within the specified range?	0-2 ohms	Go to Step 7	Go to Step 9
4	1. Turn OFF the ignition. 2. Disconnect the ECM connector J2. 3. Using a test lamp connected to B+, probe Depspower circuit (J2-17) at the ECM harness connector. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 5
5	Using a DMM, test the continuity from the Depspower circuit to all other ECM circuits at the ECM J2 harness connector. Do any of the circuits indicate a resistance within the specified range?	0-2 ohms	Go to Step 7	Go to Step 9
6	Locate and repair a short to voltage on the Depspower circuit. Is action complete?	—	Verify Repair	—
7	Locate and repair short between the Depspower circuit and the ECM circuit that had continuity. Is action complete?	—	Verify Repair	—
8	Locate and repair short to ground on the Depspower circuit. Is action complete?	—	Verify Repair	—
9	Replace the ECM. Is action complete?	—	Verify Repair	—



M4083
2-10-04

DTC 81 - 5 Volt Reference Circuit Out of Range

Circuit Description

The Engine Control Module (ECM) uses a common 5 volt reference circuit as a sensor feed. This circuit supplies 5 volts to the Manifold Absolute Pressure (MAP) sensor, Intake Air Temperature (IAT) sensor and the Throttle Position (TP) sensor. The ECM monitors the voltage on the 5 volt reference circuit. This DTC sets if the voltage is out of range.

Diagnostic Aids

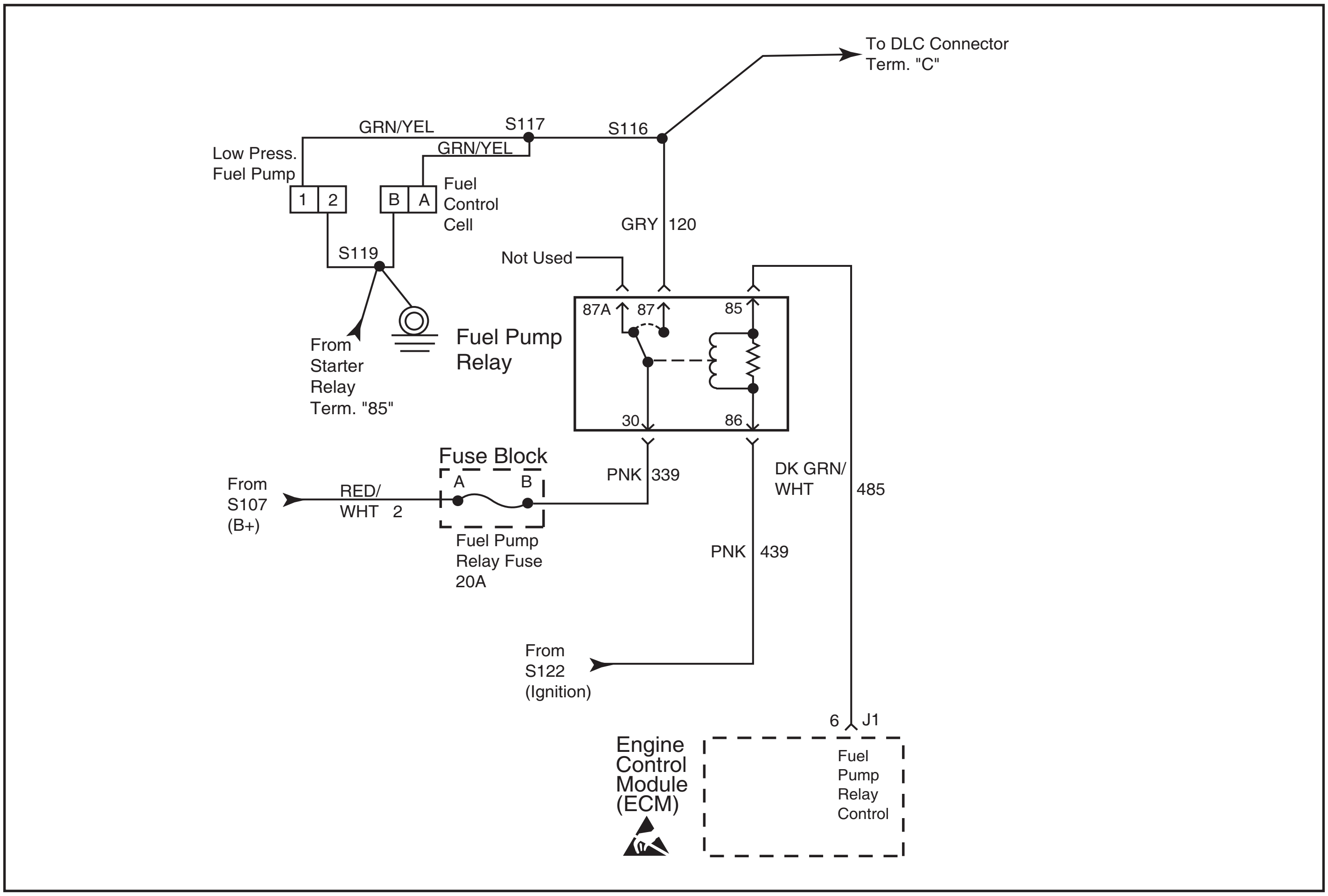
If the condition is suspected to be intermittent, refer to Intermittent Conditions.

Test Description

3. The 5 volt reference circuit may be shorted to another ECM circuit. The shorted circuit may not be apparent when the ECM harness connector is disconnected.

DTC 81 - 5 Volt Reference Circuit Out of Range

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Turn ON the ignition, with the engine OFF. 2. Using a DMM connected to a known good ground, probe the other lead of the DMM to the 5 volt reference circuit at the TPS or MAP sensor harness connector. Does the circuit measure more than the specified value?	5.1 V	Go to Step 6	Go to Step 3
3	Before proceeding, remove the following fuses: • ECM/BAT • ECM • Fuel Pump Relay 1. Disconnect the MAP sensor and the TP sensor harness connectors. 2. Using a DMM, test the continuity from the 5 volt reference circuit to all other ECM circuits at the ECM J2 harness connector. Do any of the circuits indicate a resistance within the specified range?	0-2 ohms	Go to Step 7	Go to Step 9
4	1. Turn OFF the ignition. 2. Disconnect the ECM connector J2. 3. Using a test lamp connected to B+, probe 5 volt reference circuit (J2-2) at the ECM harness connector. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 5
5	Using a DMM, test the continuity from the 5 volt reference circuit to all other ECM circuits at the ECM J2 harness connector. Do any of the circuits indicate a resistance within the specified range?	0-2 ohms	Go to Step 7	Go to Step 9
6	Locate and repair a short to voltage on the 5 volt reference circuit. Is action complete?	—	Verify Repair	—
7	Locate and repair short between the 5 volt reference circuit and the ECM circuit that had continuity. Is action complete?	—	Verify Repair	—
8	Locate and repair short to ground on the 5 volt reference circuit. Is action complete?	—	Verify Repair	—
9	Replace the ECM. Is action complete?	—	Verify Repair	—



M4084P
2-10-04

DTC 81 - Fuel Pump Relay Driver Circuit High, Low or Open

Circuit Description

The Engine Control Module (ECM) controls the relay by grounding the control circuit via an internal switch called a driver. The primary function of the driver is to supply the ground for the controlled component. This driver has a fault line which the ECM monitors. When the ECM commands the relay ON, the voltage of the control circuit should be low, near 0 volts. When the ECM commands the relay OFF, the voltage should be high, near battery voltage. If the fault detection circuit senses a voltage other than what the ECM expects, the fault line status changes causing the DTC to set.

The relay controls the high current flow to the fuel pump. This allows the ECM driver to only have to control the relatively low current used by the relay.

Diagnostic Aids

If the condition is suspected to be intermittent, refer to Intermittent Conditions.

Test Description

2. Listen for an audible click when the relay operates. Command both the ON and OFF states. Repeat the commands if necessary.
3. This test can detect a partially shorted coil which would cause an excessive current flow. Leaving the circuit energized for 2 minutes allows the coil to warm up. When warm, the coil may open, and the current drops to 0, or the coil may short, and the current goes above 0.75 amp.
5. Identify and test the relay coil terminals in order to avoid improper diagnosis.
12. If no trouble is found in the control circuit or the connection at the ECM, the ECM may be faulty. However, this is an extremely unlikely failure.

DTC 81 - Fuel Pump Relay Driver Circuit High, Low or Open

Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic” (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Turn ON the ignition, with the engine OFF. 2. Command the relay ON and OFF using a scan tool, or cycle the ignition switch “OFF” and then “ON.” Does the relay turn ON and OFF when commanded?	—	Go to Step 3	Go to Step 5
3	1. Turn OFF the ignition. 2. Disconnect the ECM connector J1. 3. Install a 5 amp fused jumper wire from a known good ground to the control circuit at the ECM harness connector (J1-6). 4. Turn ON the ignition, with the engine OFF. Important: Replace the relay if the DMM goes to 0 during the current draw test. 5. Using a DMM on 40 amp scale, measure the current from the relay control circuit in the ECM harness connector to ground for 2 minutes. Does the current draw measure less than the specified value?	0.75 A	Go to Diagnostic Aids	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay connector. 3. Using a DMM, measure the resistance from the relay control circuit in the ECM harness connector to ground. Does the DMM display infinite resistance or OL (out-of-limits)?	—	Go to Step 12	Go to Step 10
5	1. Turn OFF the engine. 2. Disconnect the fuel pump relay connector. 3. Connect a test lamp between the fuel pump relay harness connector terminal “85” and the fuel pump relay harness connector terminal “86.” 4. Turn ON the ignition, with the engine OFF. 5. Using a scan tool, command the relay ON and OFF, or cycle the ignition switch “OFF” and then “ON.” Does the test lamp turn ON and OFF when commanded?	—	Go to Step 8	Go to Step 6
6	1. Turn ON the ignition, with the engine OFF. 2. Using a test lamp connected to ground, probe the fuel pump relay harness connector terminal “86.” Is the test lamp illuminated?	—	Go to Step 7	Go to Step 11
7	1. Turn OFF the ignition. 2. Reconnect the relay. 3. Disconnect the ECM connector J1. 4. Turn ON the ignition, with the engine OFF. 5. Using a fused jumper wire connected to ground, momentarily probe ECM harness connector terminal “J1-6.” Does the relay turn ON when the circuit is grounded and OFF when the circuit is opened?	—	Go to Step 9	Go to Step 10

DTC 81 - Fuel Pump Relay Driver Circuit High, Low or Open (cont'd)

Step	Action	Value	Yes	No
8	Locate and repair faulty connections at the relay. Was a problem found?	—	Verify Repair	Go to Step 12
9	Locate and repair faulty connections at the ECM. Was a problem found?	—	Verify Repair	Go to Step 13
10	Repair the faulty relay control circuit 485. Is action complete?	—	Verify Repair	—
11	Repair the faulty relay ignition feed circuit 439. Is action complete?	—	Verify Repair	—
12	Replace the faulty relay. Is action complete?	—	Verify Repair	—
13	Replace the ECM Is action complete?	—	Verify Repair	—

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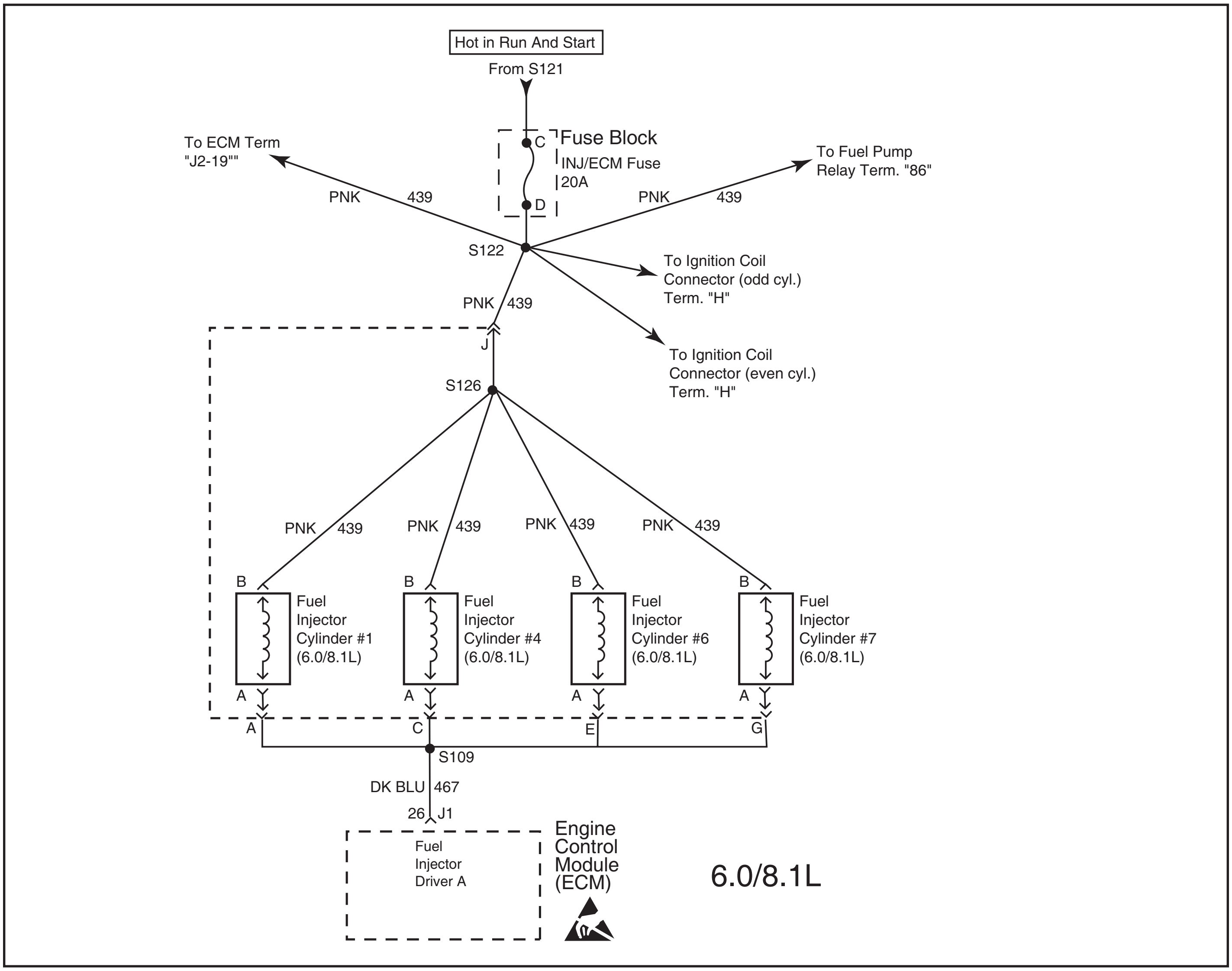

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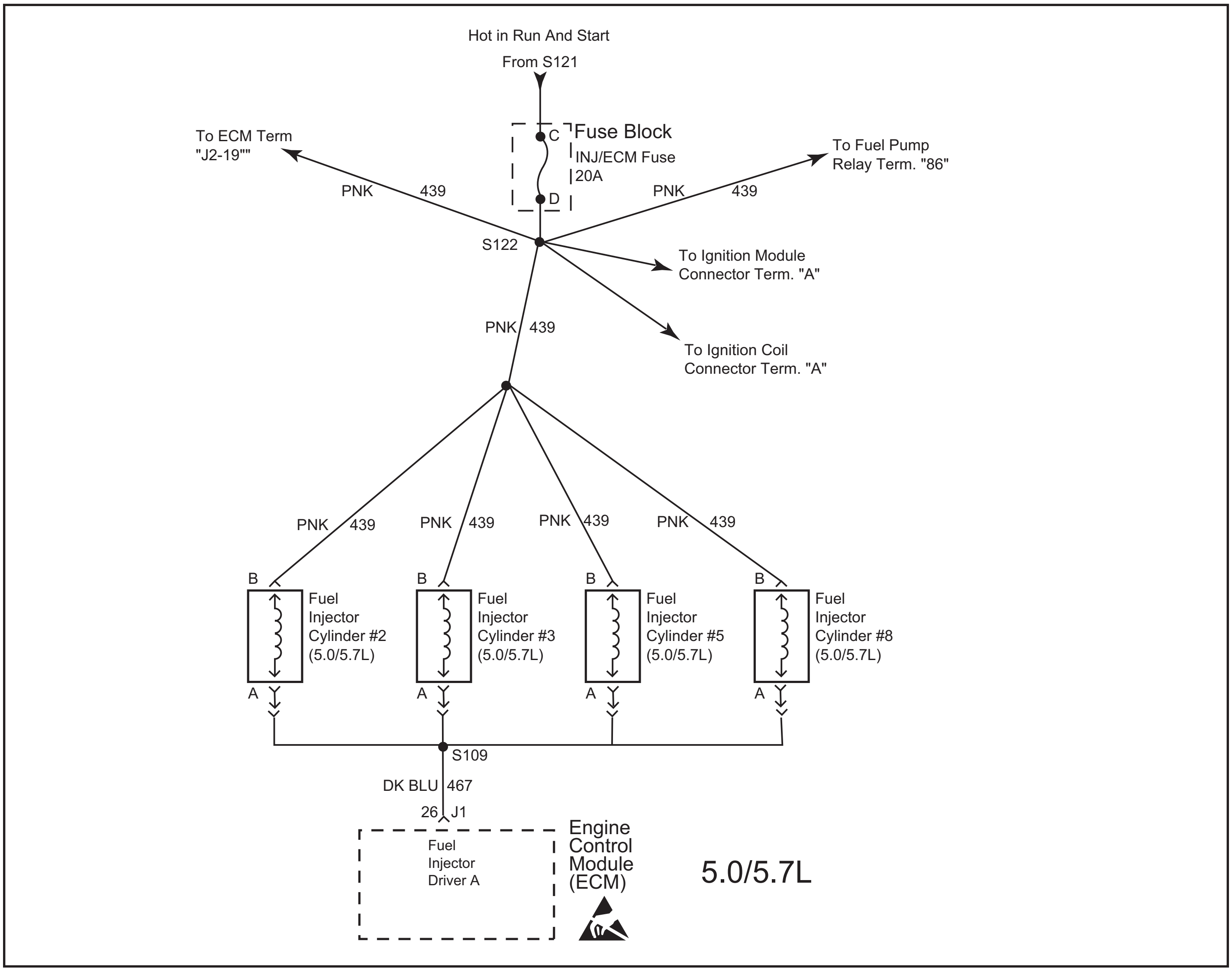

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2-10-04

DTC 81 - Fuel Injector Driver A Circuit High, Low or Open

Circuit Description

The Engine Control Module (ECM) enables the fuel injector drivers. An ignition voltage is supplied to the fuel injectors. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a driver. The ECM monitors the status of each driver. If the ECM detects an incorrect voltage for the commanded state of the driver, a fuel injector control DTC sets.

Diagnostic Aids

Performing the Fuel Injector Coil test may help isolate an intermittent condition. Refer to Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F) or Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Outside 10-35 Degrees C (50-95 Degrees F).

If the condition is suspected to be intermittent, refer to Intermittent Conditions.

Test Description

4. This step tests for voltage at the fuel injector harness connector. The ECM/INJ fuse supplies power to the coil side of the fuel injector harness connector. If the fuse is open, a short to ground on the fuel injector B+ supply circuit is indicated. The ECM/INJ fuse also supplies voltage to the ignition coils. If the fuse is open, inspect the circuits to the ignition coils for a short to ground.
5. This test verifies that the ECM is able to control the fuel injector. If the test lamp blinks, then the ECM and wiring are OK.
6. This step tests if a ground is constantly being applied to the fuel injector.

DTC 81 - Fuel Injector Driver A Circuit High, Low or Open

Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic” (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Disconnect the appropriate harness connectors of the four fuel injectors. 2. Turn ON the ignition, with the engine OFF. 3. Using a test lamp connected to a known good ground, probe the ignition voltage circuits of each fuel injector on the harness connector. Does the test lamp illuminate on all four circuits?	—	Go to Step 3	Go to Step 9
3	1. Connect the fuel injector test lamp J 34730-2C (noid light) between the control circuit and the ignition voltage circuit of the fuel injector harness connector. Repeat for all four fuel injectors. 2. Start the engine. Does the test lamp blink on all four fuel injector harness connectors?	—	Go to Step 7	Go to Step 4
4	Does the test lamp remain illuminated at all times on any of the four fuel injector harness connectors?	—	Go to Step 6	Go to Step 5
5	Locate and repair an open or short to voltage in the fuel injector control circuit. Was a problem found?	—	Verify Repair	Go to Step 8
6	Locate and repair a short to ground in the fuel injector control circuit. Was a problem found?	—	Verify Repair	Go to Step 11
7	Locate and repair poor connections at the harness connector of the fuel injector. Was a problem found?	—	Verify Repair	Go to Step 10
8	Locate and repair poor connections at the harness connector of the ECM. Was a problem found?	—	Verify Repair	Go to Step 11
9	Important: The ECM fuse also supplies voltage to the ignition coils. If the fuse is open, inspect all related circuits for a short to ground. Repair an open or short to ground in the fuel injector ignition voltage circuit. Was a problem found?	—	Verify Repair	—
10	Replace the fuel injector. Is action complete?	—	Verify Repair	—
11	Replace the ECM. Is action complete?	—	Verify Repair	—

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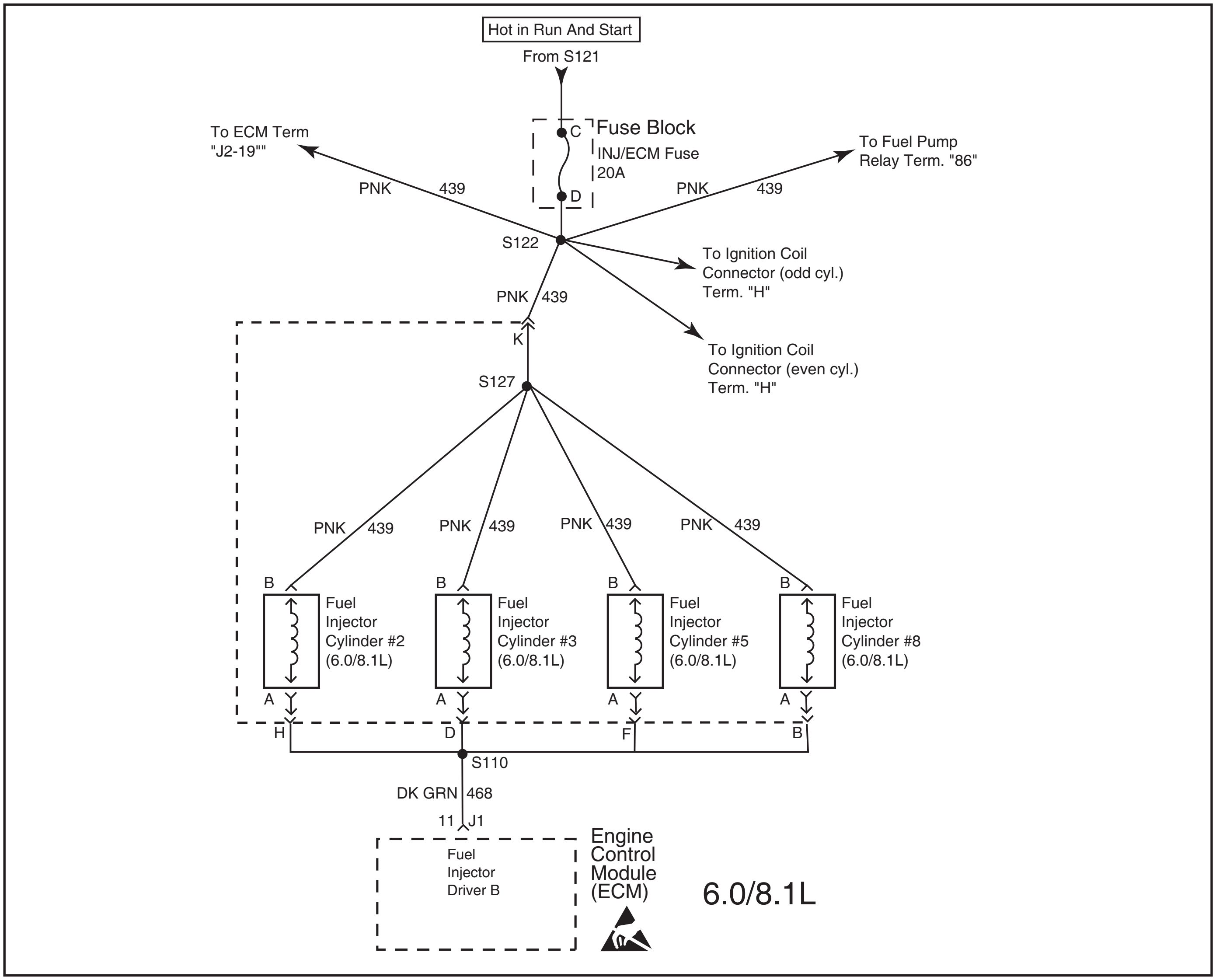

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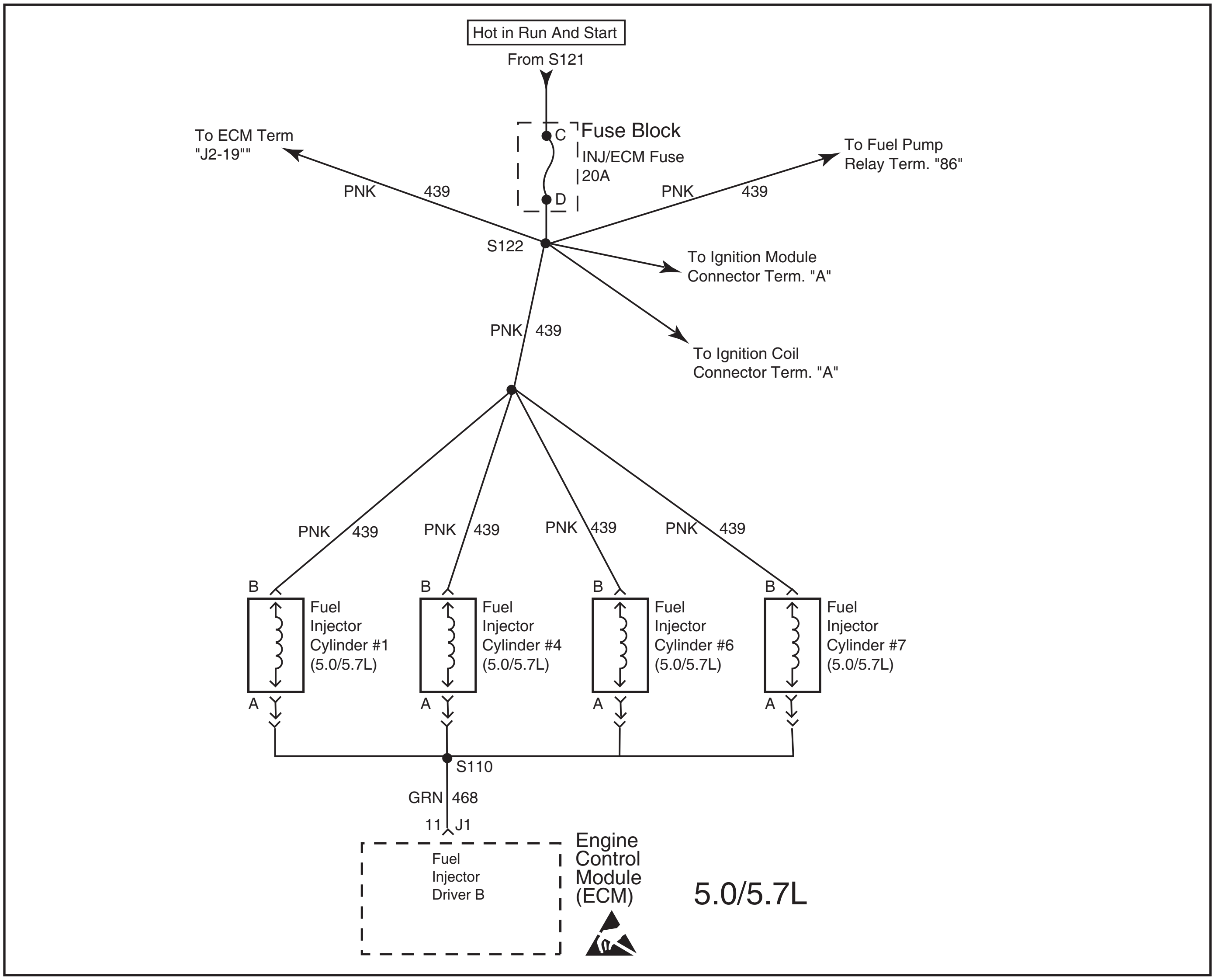

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DTC 81 - Fuel Injector Driver B Circuit High, Low or Open

Circuit Description

The Engine Control Module (ECM) enables the fuel injector drivers. An ignition voltage is supplied to the fuel injectors. The ECM controls each fuel injector driver by grounding the control circuit via a solid state device called a driver. The ECM monitors the status of each driver. If the ECM detects an incorrect voltage for the commanded state of the driver, a fuel injector control DTC sets.

Diagnostic Aids

Performing the Fuel Injector Coil test may help isolate an intermittent condition. Refer to Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Between 10-35 Degrees C (50-95 Degrees F) or Fuel Injector Coil Test - Engine Coolant Temperature (ECT) Outside 10-35 Degrees C (50-95 Degrees F).

If the condition is suspected to be intermittent, refer to Intermittent Conditions.

Test Description

4. This step tests for voltage at the fuel injector harness connector. The ECM/INJ fuse supplies power to the coil side of the fuel injector harness connector. If the fuse is open, a short to ground on the fuel injector B+ supply circuit is indicated. The ECM/INJ fuse also supplies voltage to the ignition coils. If the fuse is open, inspect the circuits to the ignition coils for a short to ground.
5. This test verifies that the ECM is able to control the fuel injector. If the test lamp blinks, then the ECM and wiring are OK.
6. This step tests if a ground is constantly being applied to the fuel injector.

DTC 81 - Fuel Injector Driver B Circuit High, Low or Open

Step	Action	Value	Yes	No
1	Was the “On-Board Diagnostic” (OBD) system check performed?	—	Go to Step 2	Go to OBD System Check
2	1. Disconnect the appropriate harness connectors of the four fuel injectors. 2. Turn ON the ignition, with the engine OFF. 3. Using a test lamp connected to a known good ground, probe the ignition voltage circuits of each fuel injector on the harness connector. Does the test lamp illuminate on all four circuits?	—	Go to Step 3	Go to Step 9
3	1. Connect the fuel injector test lamp J 34730-2C between the control circuit and the ignition voltage circuit of the fuel injector harness connector. Repeat for all four fuel injectors. 2. Start the engine. Does the test lamp blink on all four fuel injector harness connectors?	—	Go to Step 7	Go to Step 4
4	Does the test lamp remain illuminated at all times on any of the four fuel injector harness connectors?	—	Go to Step 6	Go to Step 5
5	Locate and repair an open or short to voltage in the fuel injector control circuit. Was a problem found?	—	Verify Repair	Go to Step 8
6	Locate and repair a short to ground in the fuel injector control circuit. Was a problem found?	—	Verify Repair	Go to Step 11
7	Locate and repair poor connections at the harness connector of the fuel injector. Was a problem found?	—	Verify Repair	Go to Step 10
8	Locate and repair poor connections at the harness connector of the ECM. Was a problem found?	—	Verify Repair	Go to Step 11
9	**Important:** The ECM fuse also supplies voltage to the ignition coils. If the fuse is open, inspect all related circuits for a short to ground. Repair an open or short to ground in the fuel injector ignition voltage circuit. Was a problem found?	—	Verify Repair	—
10	Replace the fuel injector. Is action complete?	—	Verify Repair	—
11	Replace the ECM. Is action complete?	—	Verify Repair	—

PCM 2002-2004 MASTER ENGINE SPECIFICATIONS

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 8.1L (STD) (385 HP)	MP 8.1L (HO) (425 HP)	MP 6.0L (375 HP)
Displacement	5.0L (305 CID)	5.7L (350 CID)	8.1L (496 CID)	8.1L (496 CID)	6.0L (364 CID)
Bore	3.75 in. (95.0 mm)	4.0 in. (101.6 mm)	4.25 in. (107.95 mm)	4.25 in. (107.95 mm)	4.0007 in. (101.618 mm)
Stroke	3.48 in. (88.3 mm)	3.48 in. (88.3 mm)	4.370 in. (111.0 mm)	4.370 in. (111.0 mm)	3.622 in. (92.0 mm)
Compression Ratio	9.4:1	9.4:1	9.1:1	9.1:1	9.4:1
Compression Pressure	130 - 215 psi	130 - 215 psi	130 - 175 psi	130 - 175 psi	130 - 215 psi
WOT Operating RPM **Preferred WOT RPM**	4200-4600 4400	4800 - 5200 5000	4200 - 4600 4400	4600 - 5200 5000	4800 - 5300 5200
Cruising RPM (Max)	3800	3800	3600	3800	4000
Idle RPM (In Gear)	650 (Not Adjustable)	650 (Not Adjustable)	650 (Not Adjustable)	650 (Not Adjustable)	650 (Not Adjustable)
Oil Pressure @ 2000 RPM	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 80 psi (172 - 552 kPa)
Minimum Oil Pressure	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle
Spark Plug P/N **Spark Plug Gap**	R030010 0.060 in.	R030010 0.060 in.	R030009 0.060 in.	R030009 0.060 in.	R030011 0.060 in.
Firing Order	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-7-2-6-5-4-3 (LH) NA	1-8-7-2-6-5-4-3 (LH) NA	1-8-7-2-6-5-4-3 (LH) NA
Thermostat	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	NA FWC 160˚F (61.7˚C)
Over-Temperature	193° F (89.8° C)	193° F (89.8° C)	220° F (104.8° C)	208° F (98° C)	220° F (104.8° C)
Electrical System	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground
Alternator Rating	70 Amps	70 / 100 Amps	70 / 100 Amps	70 / 100 Amps	70 Amps
Ignition Timing	Not Adjustable	Not Adjustable	Not Adjustable	Not Adjustable	Not Adjustable
CAM Retard	43-47 degrees	43-47 degrees	Not Adjustable	Not Adjustable	Not Adjustable
Battery Rating	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah

PCM 2002-2004 MASTER FUEL PRESSURE SPECIFICATIONS

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 8.1L (STD) (385 HP)	MP 8.1L (HO) (425 HP)	MP 6.0L (375 HP)
Fuel Pressure STD. FCC	49-54 psi @ idle 57-62 psi @ WOT	49-54 psi @ idle 57-62 psi @ WOT	37-43 psi @ idle 44-48 psi @ WOT	37-43 psi @ idle 44-48 psi @ WOT	**MY ‘03 Only** 49-52 psi @ idle 57-60 psi @ WOT
Fuel Pressure - FCC Returnless Rail					**MY ‘04** 59-61 psi (Idle and WOT)
Fuel Pressure - LPFP ALL ENGINES	4 - 7 psi	4 - 7 psi	4 - 7 psi	4 - 7 psi	4 - 7 psi

PCM MASTER ENGINE SPECIFICATIONS - 2005

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 6.0L (375 HP)
Displacement	5.0L (305 CID)	5.7L (350 CID)	6.0L (364 CID)
Bore	3.75 in. (95.0 mm)	4.0 in. (101.6 mm)	4.0007 in. (101.618 mm)
Stroke	3.48 in. (88.3 mm)	3.48 in. (88.3 mm)	3.622 in. (92.0 mm)
Compression Ratio	9.4:1	9.4:1	9.4:1
Compression Pressure	130 - 215 psi	130 - 215 psi	130 - 215 psi
WOT Operating RPM Preferred WOT RPM	4600-5000 4800	4800 - 5200 5000	4800 - 5300 5200
Cruising RPM (Max)	3800	4000	4000
Idle RPM (In Gear)	650 (Not Adjustable)	650 (Not Adjustable)	650 (Not Adjustable)
Oil Pressure @ 2000 RPM	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 80 psi (172 - 552 kPa)
Minimum Oil Pressure	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle
Spark Plug P/N Spark Plug Gap	R030010 0.060 in.	R030010 0.060 in.	R030011 0.060 in.
Firing Order	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-7-2-6-5-4-3 (LH) NA
Thermostat	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	NA FWC 160˚F (61.7˚C)
Over- Temperature	220° F (104.8° C)	220° F (104.8° C)	220° F (104.8° C)
Electrical System	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground
Alternator Rating	70 / 100 Amps	100 Amps	70 / 100 Amps
Ignition Timing	Not Adjustable	Not Adjustable	Not Adjustable
CAM Retard	43-47 degrees	43-47 degrees	Not Adjustable
Battery Rating	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah

PCM MASTER FUEL PRESSURE SPECIFICATIONS - 2005

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 6.0L (375 HP)
Fuel Pressure STD. FCC	57-62 psi @ WOT	57-62 psi @ WOT	MY '03 Only 57-60 psi @ WOT
Fuel Pressure - FCC Returnless to Rail			MY '04 and newer 57-62 psi (WOT)
Fuel Pressure - LPFP ALL ENGINES	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)

IMPORTANT: FUEL PRESSURE MEASUREMENT MUST BE MADE WITH THE ENGINE UNDER LOAD.

PCM MASTER WARNING/ALARM SPECIFICATIONS - 2005

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 6.0L (375 HP)
Coolant Over-Temperature Sensor	220° F (104.8° C) Water Temp Lamp Power Reduction	220° F (104.8° C) Water Temp Lamp Power Reduction	220° F (104.8° C) Water Temp Lamp Power Reduction
Transmission Over-Temperature Switch (Optional)	235° F ± 10° F Gen. Warning #1 Trans Temp Lamp Power Reduction	235° F ± 10° F Gen. Warning #1 Trans Temp Lamp Power Reduction	235° F ± 10° F Gen. Warning #1 Trans Temp Lamp Power Reduction
Low Oil Pressure Switch	< 10 psi Gen. Warning #2 Oil Pressure Lamp Power Reduction	< 10 psi Gen. Warning #2 Oil Pressure Lamp Power Reduction	< 10 psi Gen. Warning #2 Oil Pressure Lamp Power Reduction
Exhaust Over-Temperature Switch (Optional)	248° F ± 5° F M.I.L. - DTC 81 Check Engine Lamp	248° F ± 5° F M.I.L. - DTC 81 Check Engine Lamp	248° F ± 5° F M.I.L. - DTC 81 Check Engine Lamp

NOTE: 'Power Reduction" mode limits engine RPM to 2000. Above 2000 RPM the ECM will disable half of the fuel injectors. Reducing engine RPM below 1200 will restore normal engine operation until RPM exceeds 2000. Depending upon Instrument Panel configuration, individual warning lights, Check Engine/Check Gauges indicator, and/or an audible alarm buzzer may light/sound when a malfunction occurs.

PCM MASTER ENGINE SPECIFICATIONS - 2006

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 6.0L (375 HP)
Displacement	5.0L (305 CID)	5.7L (350 CID)	6.0L (364 CID)
Bore	3.75 in. (95.0 mm)	4.0 in. (101.6 mm)	4.0007 in. (101.618 mm)
Stroke	3.48 in. (88.3 mm)	3.48 in. (88.3 mm)	3.622 in. (92.0 mm)
Compression Ratio	9.4:1	9.4:1	9.4:1
Compression Pressure	130 - 215 psi	130 - 215 psi	130 - 215 psi
WOT Operating RPM Preferred WOT RPM	4600-5000 4800	4800 - 5200 5000	4800 - 5300 5200
Cruising RPM (Max)	3800	4000	4000
Idle RPM (In Gear)	650 (Not Adjustable)	650 (Not Adjustable)	650 (Not Adjustable)
Oil Pressure @ 2000 RPM	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 80 psi (172 - 552 kPa)
Minimum Oil Pressure	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle
Spark Plug P/N Spark Plug Gap	R030010 0.060 in.	R030010 0.060 in.	R030011 0.060 in.
Firing Order	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-7-2-6-5-4-3 (LH) NA
Thermostat	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	NA FWC 160˚F (61.7˚C)
Over- Temperature	220° F (104.8° C)	220° F (104.8° C)	220° F (104.8° C)
Electrical System	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground
Alternator Rating	70 / 100 Amps	100 Amps	70 / 100 Amps
Ignition Timing	Not Adjustable	Not Adjustable	Not Adjustable
CAM Retard	43-47 degrees	43-47 degrees	Not Adjustable
Battery Rating	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah

PCM MASTER FUEL PRESSURE SPECIFICATIONS - 2006

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 6.0L (375 HP)
Fuel Pressure STD. FCC	57-62 psi @ WOT	57-62 psi @ WOT	**MY '03 Only** 57-60 psi @ WOT
Fuel Pressure - FCC Returnless to Rail			**MY '04 and newer** 57-62 psi (WOT)
Fuel Pressure - LPFP ALL ENGINES	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)

IMPORTANT: FUEL PRESSURE MEASUREMENT MUST BE MADE WITH THE ENGINE UNDER LOAD.

PCM MASTER WARNING/ALARM SPECIFICATIONS - 2006

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 6.0L (375 HP)
Coolant Over-Temperature Sensor	220° F (104.8° C) Water Temp Lamp Power Reduction	220° F (104.8° C) Water Temp Lamp Power Reduction	220° F (104.8° C) Water Temp Lamp Power Reduction
Low Oil Pressure Switch	< 10 psi Gen. Warning #1 Oil Pressure Lamp	< 10 psi Gen. Warning #1 Oil Pressure Lamp	< 10 psi Gen. Warning #1 Oil Pressure Lamp

NOTE: 'Power Reduction" mode limits engine RPM to 2000. Above 2000 RPM the ECM will disable half of the fuel injectors. Reducing engine RPM below 1200 will restore normal engine operation until RPM exceeds 2000. Depending upon Instrument Panel configuration, individual warning lights, Check Engine/Check Gauges indicator, and/or an audible alarm buzzer may light/sound when a malfunction occurs.

Marine Electronic Fuel Injection (MEFI)

Section 6

Positive Crankcase Ventilation (PCV) System

Contents

General Description

A “closed” crankcase ventilation system is used to provide a more complete scavenging of crankcase vapors. Fresh air from the air cleaner is supplied to the crankcase, mixed with blow-by gases, and then passed through a Positive Crankcase Ventilation (PCV) valve into the intake manifold (Figure 6-1).

Operation

The primary control is through the PCV valve (Figure 6-2) which meters the flow at a rate depending on manifold vacuum.

To maintain idle quality, the PCV valve restricts the flow when intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent tube into the engine air inlet to be consumed by normal combustion.

Results of Incorrect Operation

A plugged valve or hose may cause:

- Rough idle.
- Stalling or slow idle speed.
- Oil leaks.
- Sludge in the engine.

A leaking valve or hose may cause:

- Rough idle.
- Stalling.
- High idle speed.

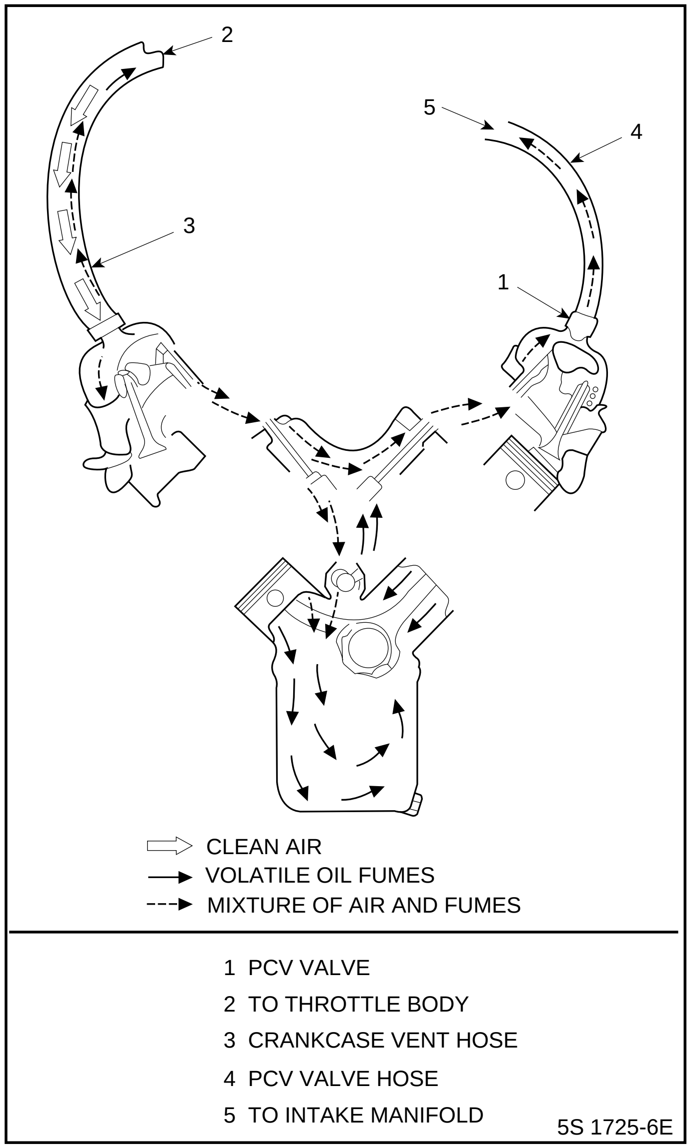


Figure 6-1 - Positive Crankcase Ventilation (PCV) Valve Flow (Typical)

Diagnosis

Functional Check of Positive Crankcase Ventilation (PCV) Valve

If an engine is idling rough, check for a plugged PCV valve or hose. Perform the following functional check of the PCV valve:

1. Remove PCV valve from the intake manifold.
2. Run the engine at idle.
3. Place your thumb over the end of the PCV valve to check for vacuum. If there is no vacuum present at the valve, check for plugged PCV valve, hoses, or manifold vacuum port. Replace plugged or deteriorated hoses.
4. Turn engine “OFF” and remove the PCV valve. Shake the valve and listen for the rattle of the check needle inside the valve. If the valve does not rattle, replace the PCV valve.

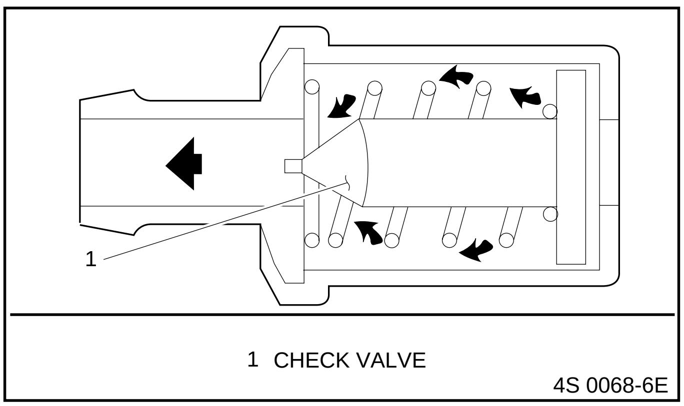


Figure 6-2 - PCV Valve Cross-Section

With this system, any blow-by in excess of the system capacity (from a badly-worn engine, sustained heavy load, etc.) is exhausted into the intake manifold and is drawn into the engine. Proper operation of the PCV system is dependent upon a sealed engine. If oil sludging or dilution is noted, and the PCV system is functioning properly, check engine for possible cause and correct to ensure that the system will function as intended.

Functional Check of Positive Crankcase Ventilation (PCV) System

1. Check PCV valve for correct application.
2. Engine at normal operating temperature.
3. Block off PCV system fresh air inlet passage.
4. Remove the engine oil dipstick and install a vacuum gauge on the dipstick tube.
5. Run the engine at 1500 RPM for 30 seconds and then read vacuum gauge while at 1500 RPM.

If vacuum is present, the PCV system is functioning properly. No vacuum indicated, the engine may not be sealed and/or is drawing in outside air. Check valve cover gasket, oil pan gasket, etc. for leaks. If the vacuum gauge registers a pressure, or the vacuum gauge is pushed out of the dipstick tube, check for the correct PCV valve, a plugged hose or excessive engine blow-by.

On-Board Service

An engine which is operated without any crankcase ventilation can be damaged. Therefore, it is important to replace the PCV valve at the intervals recommended by the manufacturer.

Periodically, inspect the hoses and clamps and replace any showing signs of deterioration.

Marine Electronic Fuel Injection (MEFI)

Section 7

Symptoms

Contents

Symptoms

Important Preliminary Checks

Before Starting

Before using this section you should have performed the "On-Board Diagnostic (OBD) System Check" and determined that:

- The ECM and MIL (Malfunction Indicator Lamp) are operating correctly.
- There are no DTC(s) stored.
- Ensure that the engine is not in RPM reduction mode. The ECM turns certain injectors OFF when the ECM detects certain conditions, such as engine over-temp.
- Verify the customer complaint and locate the correct symptom in the table of contents. Check the items indicated under that symptom.

Visual/Physical Check

Several of the symptom procedures call for a careful Visual/Physical Check. The importance of this step cannot be stressed too strongly - it can lead to correcting a problem without further checks and can save valuable time. This check should include:

- ECM grounds and sensor connections for being clean, tight and in their proper location.
- Vacuum hoses for splits, kinks and proper connections. Check thoroughly for any type of leak or restriction.
- Air leaks at throttle body mounting area and intake manifold sealing surfaces.
- Ignition wires for cracking, hardness, proper routing and carbon tracking.
- Wiring for proper connections, pinches and cuts. If wiring harness or connector repair is necessary, refer to *General Information* section for correct procedure.
- Moisture in primary or secondary ignition circuit connections.
- Salt corrosion on electrical connections and exposed throttle body linkages.

Intermittents

Important: Problem may or may not turn "ON" the Malfunction Indicator Lamp (MIL) or store a DTC. DO NOT use the Diagnostic Trouble Code (DTC) tables for intermittent problems. The fault must be present to locate the problem.

Most intermittent problems are caused by faulty electrical connections or wiring. Perform careful visual/physical check.

Check for the following conditions:

- Poor mating of the connector halves, or a terminal not fully seated in the connector body (backed out or loose).
- Improperly formed or damaged terminals and/or connectors.
- All connector terminals in the problem circuit should be carefully checked for proper contact tension.
- Poor terminal to wire connection (crimping). This requires removing the terminal from the connector body to check. Refer to "Wiring Harness Service" in the *General Information* section.

The vessel may be driven with a J 39200 Digital Multimeter connected to a suspected circuit. An abnormal voltage when malfunction occurs is a good indication that there is a fault in the circuit being monitored.

A scan tool may also be used to help detect intermittent conditions. The record feature can be triggered to capture and store engine parameters within the scan tool when the malfunction occurs. This stored information then can be reviewed by the service technician to see what caused the malfunction.

To check loss of DTC memory, disconnect TP sensor and idle engine until the MIL comes "ON." DTC 22 should be stored and kept in memory when ignition is turned "OFF." If not the ECM is faulty. When this test is completed, make sure that you clear the DTC 22 from memory using "Clearing DTC Procedure" found in *General Information* section.

An intermittent MIL with no stored DTC may be caused by the following:

- Ignition coil shorted to ground and arcing at ignition wires or plugs.
- MIL wire to ECM shorted to ground.
- Poor ECM grounds.
- Check for an electrical system interference caused by a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
- Check for improper installation of electrical options such as lights, ship to shore radios, sonar, etc.
- Check that knock sensor wires are routed away from spark plug wires, ignition system components and charging system components.
- Check for secondary ignition components shorted to ground, or an open ignition coil ground (coil mounting brackets).
- Check for components internally shorted to ground such as starters, alternators or relays.

All Ignition Control (IC) module wiring should kept away from the alternator. Check all wires from the ECM to the ignition control module for poor connections.

If problem has not been found go to "ECM Connector Symptom Tables" at the end of *Symptoms* section.

Hard Start Symptom

Step	Action	Value	Yes	No
Definition: Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately dies.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Check to see if the operator is using the correct starting procedure as described in the owners manual. Educate the operator if they do not know. Does the driver know the correct starting procedure?	—	*Go to* Step 3	System normal
3	Was visual/physical check performed?	—	*Go to* Step 4	*Go to* Visual/ Physical Check
4	1. Check the camshaft position (CMP) sensor for proper mounting and/or a bad connection. A long crank time occurs if the ECM does not receive a CMP signal. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 5
5	1. Check for proper operation of fuel pump relay circuit. • *Refer to* Table A-5. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 6
6	1. Check for contaminated fuel. 2. Check fuel filters and water separator. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 7
7	1. Check for proper fuel pressure. • *Refer to* Table A-4. 2. Check for faulty fuel pump check valve. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 8
8	1. Check for proper ignition voltage output. • *Refer to* Table A-7. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 9
9	Is a scan tool being used?	—	*Go to* Step 11	*Go to* Step 10
10	1. Check for a ECT sensor shifted in value. 2. With engine completely cool, measure the resistance of the ECT sensor. 3. Refer to the Engine Coolant Temperature Sensor Temperature vs. Resistance value table on the facing page of DTC 14 in the *Diagnostics* section. Compare the approximate temperature of the ECT sensor to an accurate reading of ambient air temperature. Are the readings within the specified value?	-12° C (10° F)	*Go to* Step 15	*Go to* Step 14

Hard Start Symptom

Step	Action	Value	Yes	No
11	1. Check ECT sensor for being shifted in value. 2. With the engine completely cool, compare the ECT sensor temperature with an accurate reading of ambient air temperature. Are the temperatures within the specified value of each other?	-12° C (10° F)	*Go to* Step 12	*Go to* Step 14
12	1. Using a scan tool, display ECT sensor temperature and note value. 2. Check resistance of ECT sensor. 3. Go to Engine Coolant Temperature Sensor Temperature vs. Resistance value table on the facing page of DTC 14 in the *Diagnostics* section. Is resistance value of ECT sensor near the resistance of the value noted?	—	*Go to* Step 15	*Go to* Step 13
13	Locate and repair high resistance or poor connection in the ECT signal circuit or the ECT sensor ground. Is action complete?	—	*Go to* OBD System Check	—
14	Replace the ECT sensor. Is action complete?	—	*Go to* OBD System Check	—
15	1. Check for intermittent opens or shorts to ground in the MAP sensor circuits. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 16
16	1. Check for proper operation of the TP sensor. 2. Check for throttle linkage sticking, binding or worn causing TP sensor voltage to be higher than normal. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 17
17	1. Check for proper operation of the IAC valve. • *Refer to* Table A-8. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 18
18	1. Check for the following engine mechanical problems: • Low compression. • Leaking cylinder head gaskets. • Worn or incorrect camshaft. • Proper valve timing/valve train problem. • Restricted exhaust system. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 19

Hard Start Symptom

Step	Action	Value	Yes	No
19	1. Review all diagnostic steps within this procedure. 2. If all steps have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Scan tool data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	Contact OEM

Surges and/or Chuggles Symptom

Step	Action	Value	Yes	No
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.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Was visual/physical check performed?	—	*Go to* Step 3	*Go to* Visual/ Physical check
3	1. Check for correct cam retard setting. • *Refer to Distributor Ignition* section. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 4
4	1. Check for engine going into RPM reduction mode. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 5
5	1. Check for contaminated fuel. 2. Check fuel filters and water separator. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 6
6	1. Check for proper fuel pressure while the condition exists. • *Refer to* Table A-4. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 7
7	1. Check for intermittent opens or short to grounds in the ECT sensor, MAP sensor and TP sensor circuits. Also check for throttle linkage sticking, binding or worn. 2. An intermittent failure may not store a DTC. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 8
8	1. Check for proper ignition voltage output. • *Refer to* Table A-7. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 9
9	1. Check ignition coil(s) for cracks or carbon tracking. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 10
10	1. Check integrity of the primary and secondary wiring. 2. Check routing of the wiring. 3. Check condition of IC module, CKP sensor, distributor cap, rotor and spark plug wires. 4. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 11

Surges and/or Chuggles Symptom

Step	Action	Value	Yes	No
11	1. Remove spark plugs and check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. • *Refer to* Distributor Ignition System. ***Notice:*** 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?	—	*Go to* OBD System Check	*Go to* Step 12
12	1. Check items that can cause the engine to run rich. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 13
13	1. Check items that can cause the engine to run lean. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 14
14	1. Check the injector connections for proper mating. 2. If any of the injectors connectors are connected to an incorrect cylinder, correct as necessary. Was a prob3nd?	—	*Go to* OBD System Check	*Go to* Step 15
15	1. Check ECM grounds for being clean, tight and in the proper locations. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 16
16	1. Visually/physically check vacuum hoses for splits, kinks and proper connections and routing. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 17
17	1. Check for proper alternator voltage output. 2. The voltage should be between specified values. 3. If a problem is found, repair as necessary. Was a problem found?	11-16V	*Go to* OBD System Check	*Go to* Step 18
18	1. Review all diagnostic steps within this procedure. 2. If all steps have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Scan tool data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	Contact OEM

Lack of Power, Sluggish or Spongy Symptom

Step	Action	Value	Yes	No
Definition: Engine delivers less than expected power. Little or no increase in speed when accelerator pedal is pushed down part way.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Compare engine performance with a similar engine. Both engine's performance should be close. Is engine performance close to a similar engine.	—	No problem found	*Go to* Step 3
3	Was visual/physical check performed?	—	*Go to* Step 4	*Go to* Visual/ Physical check
4	1. Check for correct cam retard. • *Refer to Distributor Ignition* section. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 5
5	1. Remove and check flame arrestor for dirt, or for being restricted. 2. Replace flame arrestor if necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 6
6	1. Check for contaminated fuel. 2. Check fuel filters. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 7
7	1. Check for proper fuel pressure while the condition exists. • *Refer to* Table A-4. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 8
8	1. Check for injector driver CKT's 467 or 468 for an open. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 9
9	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 10
10	1. Check for proper ignition voltage output. • *Refer to* Table A-7. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 11
11	1. Remove spark plugs, check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. ***Notice:*** 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?	—	*Go to* OBD System Check	*Go to* Step 12

Lack of Power, Sluggish or Spongy Symptom

Step	Action	Value	Yes	No
12	1. Check ignition coil for cracks or carbon tracking. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 13
13	1. Check for intermittent opens or short to grounds in the ECT sensor, MAP sensor and TP sensor circuits. Also check for throttle linkage sticking, binding or worn. 2. An intermittent failure may not store a DTC. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 14
14	1. Check ECM grounds for being clean, tight and in their proper locations. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 15
15	1. Check for engine going into RPM reduction mode. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 16
16	1. Check diagnostic test CKT 451 for being shorted to ground. This will cause the RPM to be lowered. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 17
17	1. Check for proper alternator voltage output. 2. The voltage should be between specified values. 3. If a problem is found, repair as necessary. Was a problem found?	11-16V	*Go to* OBD System Check	*Go to* Step 18
18	1. Check for the following engine mechanical problems: • Low compression. • Leaking cylinder head gaskets. • Worn or incorrect camshaft. • Proper valve timing/valve train problem. • Restricted exhaust system. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 19
19	1. Check for excessive resistance on the bottom of the boat such as dirt, barnacles, etc. 2. Check for proper propeller size and pitch for that application. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 20
20	1. Review all diagnostic steps within this procedure. 2. When all steps have been completed and no malfunctions are found, review/inspect the following: • Visual/physical inspection. • Scan tool data. • All connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	Contact OEM

Detonation/Spark Knock Symptom

Step	Action	Value	Yes	No
Definition: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening.				
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Was visual/physical check performed?	—	*Go to* Step 3	*Go to* Visual/ Physical check
3	1. Check for correct base ignition timing. • *Refer to* “Ignition Timing Set Procedure” in the *Distributor Ignition* section. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 4
4	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 5
5	1. Check for good ignition system ground. 2. Check spark plugs for proper gap and heat range. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 6
6	1. Check for contaminated fuel. 2. Check for poor fuel quality and proper octane rating. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 7
7	1. Check for proper fuel pressure. • *Refer to* Table A-4. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 8
8	Is a scan tool being used?	—	*Go to* Step 9	*Go to* Step 10
9	If scan tool readings are normal (*Refer to* “Typical Scan Values”) and there are no engine mechanical faults, fill fuel tank with a known quality gasoline that has a minimum octane reading of 92 and re-evaluate vehicle performance. Is detonation present?	—	*Go to* Step 10	*Go to* OBD System Check
10	1. Check for obvious overheating problems: • Loose water pump belt. • Faulty or incorrect water pump. • Restriction in cooling system. • Faulty or incorrect thermostat. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 11
11	1. Check items that can cause an engine to run lean. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 12

Detonation/Spark Knock Symptom

Step	Action	Value	Yes	No
12	1. Check for ECT sensor being shifted in value. 2. Check for proper output voltage of the TP sensor at closed throttle and wide open throttle. Also check throttle linkage for sticking, binding or worn. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 13
13	1. Check for the following engine mechanical problems: • Low compression. • Low oil level. • Excessive oil in the combustion chambers due to valve seals leaking. • Worn or incorrect camshaft. • Proper valve timing/valve train problem. • Combustion chambers for excessive carbon build up. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 14
14	1. Remove excessive carbon buildup with a top engine cleaner. • *Refer to* instructions on top engine cleaner can. 2. Re-evaluate vehicle performance. Is detonation still present?	—	*Go to* Step 15	*Go to* OBD System Check
15	1. Review all diagnostic steps within this procedure. 2. If all steps have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Scan tool data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	Contact OEM

Hesitation, Sag, Stumble Symptom

Step	Action	Value	Yes	No
Definition: Momentary lack of response as the accelerator is pushed down. Can occur at all vehicle speeds. Usually most severe when first trying to make the vehicle move, as from a stop. May cause engine to stall if severe enough.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Was visual/physical check performed?	—	*Go to* Step 3	*Go to* Visual/ Physical check
3	1. Check for correct base ignition timing. • *Refer to* "Ignition Timing Set Procedure" in the *Distributor Ignition* section. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 4
4	1. Check for contaminated fuel. 2. Check fuel filters and water separator. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 5
5	1. Check for proper fuel pressure while the condition exists. • *Refer to* Table A-4. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 6
6	1. Check fuel injectors. • *Refer to* Injector Coil Test and Injector Balance Test at the end of this section. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 7
7	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 8
8	1. Check integrity of the primary and secondary wiring. 2. Check routing of the wiring. 3. Check condition of IC module, pick-up coil, distributor cap, rotor and spark plug wires. 4. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 9
9	1. Remove spark plugs and check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. • *Refer to* Table A-6. ***Notice:*** 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?	—	*Go to* OBD System Check	*Go to* Step 10

Hesitation, Sag, Stumble Symptom

Step	Action	Value	Yes	No
10	1. Check for the ECT sensor shifted in value. 2. Check for intermittent opens or short to grounds in the ECT sensor, MAP sensor and TP sensor circuits. Also check for throttle linkage sticking, binding or worn. 3. An intermittent failure may not store a DTC. 4. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 11
11	1. Check for engine going into RPM reduction mode. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 12
12	1. Check for proper alternator voltage output. 2. The voltage should be between specified values. 3. If a problem is found, repair as necessary. Was a problem found?	11-16V	*Go to* OBD System Check	*Go to* Step 13
13	1. Check for faulty or incorrect thermostat. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 14
14	1. Check intake valves for valve deposits. 2. If deposits are found, remove as necessary. Were deposits found on the intake valves?	—	*Go to* OBD System Check	*Go to* Step 15
15	1. Review all diagnostic steps within this procedure. 2. If all steps have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Scan tool data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	Contact OEM

Cuts Out, Misses Symptom

Step	Action	Value	Yes	No
Definition: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. The exhaust has a steady spitting sound at idle, low speed or on hard acceleration for fuel starvation that can cause engine to cut out.				
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Was visual/physical check performed?	—	*Go to* Step 3	*Go to* Visual/ Physical check
3	1. Check for contaminated fuel. 2. Check fuel filters and water separator. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 4
4	1. Check for proper fuel pressure while the condition exists. • *Refer to* Table A-4. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 5
5	1. Disconnect all injector harness connectors and install an injector test light J 34730-2 between the harness terminal connector of each injector. 2. Crank engine and note light on each connector. If test light fails to blink at any one of the connectors, it is a faulty injector drive circuit, harness, connector or terminal. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 6
6	1. Check fuel injectors. • *Refer to* Injector Coil Test and Injector Balance Test at the end of this section. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 7
7	1. Check for proper spark at each cylinder per manufactures recommendation. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 8
8	1. Remove spark plugs and check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. ***Notice:*** 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?	—	*Go to* OBD System Check	*Go to* Step 9

Cuts Out, Misses Symptom

Step	Action	Value	Yes	No
9	1. Check engine mechanical for the following conditions. • Low compression. • Sticking or leaking valves. • Bent push rods. • Worn rocker arms. • Broken valve springs. • Worn camshaft lobe(s). • Incorrect valve timing. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 10
10	1. Check Intake and exhaust manifold(s) for casting flash. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 11
11	1. Check for Electromagnetic Interference (EMI). A missing condition can be caused by EMI on the reference circuit. EMI can usually be detected by monitoring engine RPM with a scan tool or tachometer. A sudden increase in RPM with little change in actual engine RPM change, may indicate EMI is present. 2. If EMI is present, locate and repair the source. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 12
12	1. Review all diagnostic steps within this procedure. 2. If all steps have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Scan tool data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	Contact OEM

Rough, Unstable or Incorrect Idle, Stalling Symptom

Step	Action	Value	Yes	No
Definition: Engine runs unevenly at idle. If severe, the engine or vehicle may shake. Engine idle speed varies in RPM. Either condition may be severe enough to stall the engine.				
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Was visual/physical check performed?	—	*Go to* Step 3	*Go to* Visual/ Physical check
	1. Check for correct cam retard. • *Refer to Distributor Ignition* section. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 4
4	1. Check for proper operation of the IAC valve. • *Refer to* Table A-8. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 5
5	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 6
6	1. Check integrity of the primary and secondary wiring. 2. Check routing of the wiring. 3. Check condition of IC module, CKP sensor, distributor cap, rotor and spark plug wires. 4. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 7
7	1. Check ignition coil for cracks or carbon tracking. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 8
8	1. Remove spark plugs, check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. • *Refer to* Table A-6. ***Notice:*** 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?	—	*Go to* OBD System Check	*Go to* Step 9
9	Check the injector connections. If any of the injectors are connected to an incorrect cylinder, correct as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 10
10	1. Disconnect all injector harness connectors and install an injector test light J 34730-2 between the harness terminal connector of each injector. 2. Crank engine and note light on each connector. If test light fails to blink at any one of the connectors, it is a faulty injector drive circuit, harness, connector or terminal. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 11

Rough, Unstable or Incorrect Idle, Stalling Symptom

Step	Action	Value	Yes	No
11	1. Check fuel injectors. • *Refer to* Injector Coil Test and Injector Balance Test at the end of this section. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 12
12	1. Check for fuel in 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?	—	*Go to* OBD System Check	*Go to* Step 13
13	1. Check for intermittent opens or short to grounds in the ECT sensor, MAP sensor and TP sensor circuits. Also check for throttle linkage sticking, binding or worn. 2. An intermittent failure may not store a DTC. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 14
14	1. Check ECM grounds for being clean, tight and in their proper locations. 2. Also check that battery cables and ground straps are clean and secure. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 15
15	1. Check items that can cause the engine to run rich. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 16
16	1. Check items that can cause the engine to run lean. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 17
17	1. Check for proper alternator voltage output. 2. The voltage should be between specified values. 3. If a problem is found, repair as necessary. Was a problem found?	11-16V	*Go to* OBD System Check	*Go to* Step 18
18	1. Check the following engine mechanical items: • Check compression. • Sticking or leaking valves. • Worn camshaft lobe(s). • Valve timing. • Broken valve springs. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 19
19	1. Check intake valves for valve deposits. 2. If deposits are found, remove as necessary. Were deposits found on the intake valves?	—	*Go to* OBD System Check	*Go to* Step 20

Rough, Unstable, or Incorrect Idle, Stalling Symptom

Step	Action	Value	Yes	No
20	1. Check for faulty motor mounts. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 21
21	1. Review all diagnostic steps within this procedure. 2. If all steps have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Scan tool data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	Contact OEM

Poor Fuel Economy Symptom

Step	Action	Value	Yes	No
Definition: Fuel economy, as measured at selected intervals, is noticeably lower than expected. Also, economy is noticeably lower than it was on this vehicle at one time, as previously shown by documentation.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Was visual/physical check performed?	—	*Go to* Step 3	*Go to* Visual/ Physical check
3	1. Check owner's driving habits. Are excessively heavy loads being carried? Is accelerating too much, too often? 2. If a problem is found, repair as necessary. Was a problem found?	—	System normal	*Go to* Step 4
4	1. Check for correct base ignition timing. • *Refer to* "Ignition Timing Set Procedure" in the *Distributor Ignition* section. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 5
5	1. Check flame arrestor for dirt or being plugged. 2. Check for fuel leaks. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 6
6	1. Check for proper fuel pressure. • *Refer to* Table A-4. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 7
7	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 8
8	1. Remove spark plugs, check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. • *Refer to* Table A-6 ***Notice:*** 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?	—	*Go to* OBD System Check	*Go to* Step 9
9	1. Visually (physically) check vacuum hoses for splits, kinks and improper connections and routing. 2. If a problem is found, repair as necessary. Was a repair required?	—	*Go to* OBD System Check	*Go to* Step 10
10	1. Check engine compression for being low. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 11

Poor Fuel Economy Symptom

Step	Action	Value	Yes	No
11	1. Check exhaust system for possible restriction. 2. Inspect exhaust system for damaged or collapsed pipes. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 12
12	1. Check for excessive resistance on the bottom of the boat such as dirt, barnacles, etc. 2. Check for proper propeller size and pitch for that application. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 13
13	1. Review all diagnostic steps within this procedure. 2. When all steps have been completed and no malfunctions are found, review/inspect the following: • Visual/physical inspection. • Scan tool data. • All connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	Contact OEM

Dieseling, Run-On Symptom

Step	Action	Value	Yes	No
Definition: Engine continues to run after key is turned “OFF,” but runs very rough. If engine runs smooth, check ignition switch and adjustment.				
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Was visual/physical check performed?	—	*Go to* Step 3	*Go to* Visual/ Physical check
3	1. Check for leaking fuel injectors. • *Refer to* Table A-4. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 4
4	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 5
5	1. Check for obvious overheating problems: • Loose water pump belt. • Faulty or incorrect water pump. • Restriction in cooling system. • Faulty or incorrect thermostat. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 6
6	1. Check for proper operation of the MEFI relay. • *Refer to* Table A-6. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 7
7	1. Review all diagnostic steps within this procedure. 2. If all steps have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Scan tool data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	Contact OEM

Backfire Symptom

Step	Action	Value	Yes	No
Definition: Fuel ignites in the intake manifold, or in the exhaust system, making loud popping noise.				
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Was visual/physical check performed?	—	*Go to* Step 3	*Go to* Visual/ Physical check
3	1. Check flame arrestor for proper installation per manufactures recommendation. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 4
4	1. Check for proper fuel pressure. • *Refer to* Table A-4. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 5
5	1. Check for correct Cam Retard (5.0/5.7L only). • *Refer to* "Setting Cam Retard Procedure" in the *Distributor Ignition* section. 2. If a problem is found, repair as necessary. Was a problem found?	43-47 degrees	*Go to* OBD System Check	*Go to* Step 6
6	1. Check to see if engine is going into RPM reduction. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 7
7	Check the injector connections. If any of the injectors are connected to an incorrect cylinder, correct as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 8
8	1. Check fuel injectors. • *Refer to* Injector Coil Test and Injector Balance Test at the end of this section. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 9
9	1. Check for proper operation of Ignition Control (IC) circuit and the Knock Sensor (KS) circuit(s). 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 10
10	1. Check integrity of the primary and secondary wiring. 2. Check routing of the wiring. 3. Check condition of IC module, pick-up coil, distributor cap, rotor and spark plug wires. 4. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 11
11	1. Check ignition coil for cracks or carbon tracking. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 12

Backfire Symptom

Step	Action	Value	Yes	No
12	Check for intermittent open or short to ground in the ignition circuit to the system relay. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 13
13	1. Remove spark plugs, check for wet plugs, cracks, wear, improper gap, burned electrodes or heavy deposits. ***Notice:*** 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?	—	*Go to* OBD System Check	*Go to* Step 14
14	1. Check for intermittent opens or short to grounds in the MAP sensor and TP sensor circuits. Also check for throttle linkage sticking, binding or worn. 2. An intermittent failure may not store a DTC. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 15
15	1. Check engine mechanical for the following conditions: • Low compression. • Sticking or leaking valves. • Worn camshaft lobe(s). • Incorrect valve timing. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 16
16	1. Check Intake and exhaust manifold(s) for casting flash. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	*Go to* Step 17
17	1. Review all diagnostic steps within this procedure. 2. If all steps have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection. • Scan tool data. • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	*Go to* OBD System Check	Contact OEM

ECM Connector “J1”

	Pin Function	CKT No.	Wire Color	Component Connector	DTC(s) Affected	Possible Symptoms From Faulty Circuit
J1-01	Knock Sensor 2 Signal (6.0/8.1L Only)	468	lt blu/blu	Knock Sensor 2	44	Poor Fuel Economy, Poor Performance
J1-02	Diagnostic “Test” Terminal	451	blk/wht	Data Link Connector	None	Incorrect Idle, Poor Performance
J1-03	Master/Slave	916	yel	Twin Engine	None Connector	Lack of Data From Other Engine
J1-04	General Warning 2		blu/wht	oil press. switch	None	RPM Reduction
J1-05						
J1-06	Fuel Pump Relay Driver	465	dk grn/wht	Fuel Pump Relay	None	No Start
J1-07						
J1-08	Buzzer (Optional)	914	ppl	In-Line Boat Harness	None Harness	Loss of Instrument Indicator
J1-09	Check Gauges (Optional)	112	dk grn	In-Line Boat Harness	None	Loss of Instrument Indicator
J1-10						
J1-11	Injector Driver B	468	dk blu	Injectors	None	Rough Idle, Lack of Power, Stalling
J1-12						
J1-13	ECM Ground	450	blk	Engine Block	None	An open ground or high resistance ground may cause any or all symptoms.
J1-14	Tachometer Output Signal		gry	In-Line Boat Harness	None	Loss of tachometer reading
J1-15	IAC “B” Low	444	grn/blk	IAC Valve	None	Rough, Unstable or Incorrect Idle
J1-16	IAC “A” High	441	blu/wht	IAC Valve	None	Rough, Unstable or Incorrect Idle
J1-17	Knock Sensor 1 Signal	467	dk blu	Knock Sensor 1	44	Poor Fuel Economy, Poor Performance
J1-18	Not Used					
J1-19	General Warning 1 (Optional)	920	lt blu	Transmission Overtemp Switch	None	RPM Reduction
J1-20						
J1-21						
J1-22	General Warning 1 Lamp (Optional)	912	dk blu	Warning Cluster Connector	None	Loss of Instrument Light
J1-23	General Warning 2 (Optional)	911	dk grn	Warning Cluster Connector	None	Loss of Instrument Light
J1-24						
J1-25						
J1-26	Injector Driver A	467	dk blu	Injectors	None	Rough Idle, Lack of Power, Stalling
J1-27	Malfunction Indicator Lamp	419	brn/wht	DLC	None	MIL Inoperative
J1-28	ECM Ground	450	blk	Engine Block	None	An open ground or high resistance ground may cause any or all symptoms.

ECM Connector “J1”

Pin Function		CKT No.	Wire Color	Component Connector	DTC(s) Affected	Possible Symptoms From Faulty Circuit
J1-29	ECM Ground	450	blk	Engine Block	None	An open ground or high resistance ground may cause any or all symptoms.
J1-30	Knock Sensor 1 Signal	496	dk blu	Knock Sensor 1	44	Poor Fuel Economy, Poor Performance
J1-31	Not Used					
J1-32	Serial Data	461	orn/blk	Data Link Connector	None	No Serial Data

(1) Open Circuit
(2) Grounded Circuit
(3) Open/Grounded Circuit

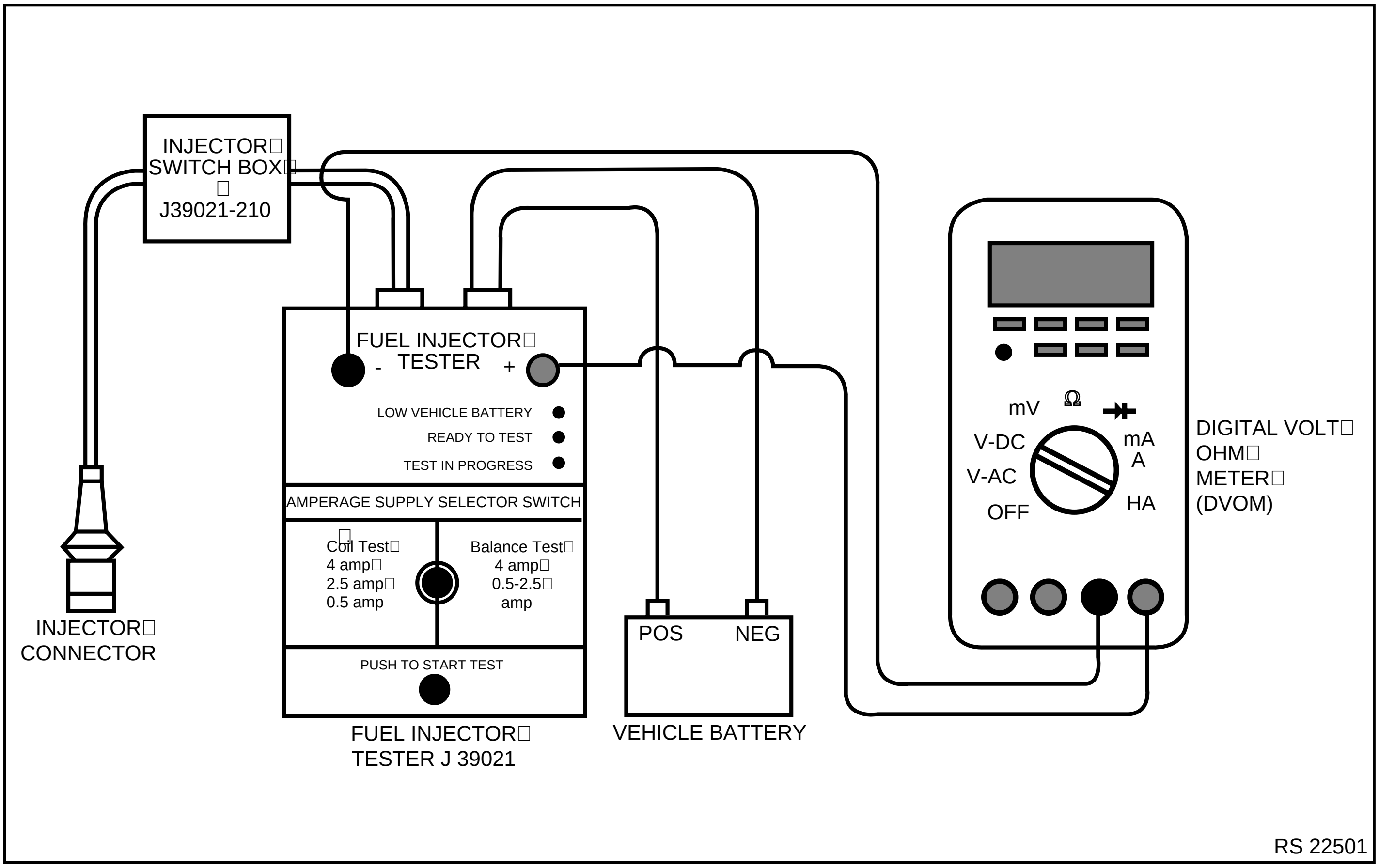
ECM Connector "J2"

Pin Function		CKT No.	Wire Color	Component Connector Cavity	DTC(s) Affected	Possible Symptoms From Faulty Circuit
J2-01	Battery Feed	440	orn	Splice	None	No Start
J2-02	5 Volt Reference	416	gry	MAP/IAT, TP Sensors	22, 25, 34	Lack of Power, Surge, Rough Idle, Exhaust Odor
J2-03	Sensor Ground	814	blk	MAP/IAT, TP Sensors	22, 25, 34	Lack of Power, Surge, Rough Idle, Exhaust Odor
J2-04						
J2-05						
J2-06						
J2-07	ECT Signal	410	yel	ECT Sensor	14 & 15	Poor Performance, Exhaust Odor Rough Idle, RPM Reduction
J2-08	MAP Signal	432	lt grn	MAP Sensor	33 & 34	Poor Performance, Surge, Poor Fuel Economy, Exhaust Odor
J2-09	CAN BUS LO		red	Twin Engine Connector	None	Lack of twin engine communication
J2-10	Serial Data	461	orn/blk	Data Link Connector	None	No Serial Data
J2-11						
J2-12	Ignition Control H	2123	lt blu	Ignition Coil Inline Connector	41 (cyl. #3)	Poor Performance, Poor Fuel Fuel Economy, engine misfire
J2-13	Ignition Control F	2125	dk grn	Ignition Coil Inline Connector	41 (cyl. #5)	Poor Performance, Poor Fuel Fuel Economy, engine misfire
J2-14	Ignition Control D	2122	ppl/wht	Ignition Coil Inline Connector	41 (cyl. #2)	Poor Performance, Poor Fuel Fuel Economy, engine misfire
J2-15	Ignition Control B	2128	red/wht	Ignition Coil Inline Connector	41 (cyl. #8)	Poor Performance, Poor Fuel Fuel Economy, engine misfire
J2-16	Crank Sensor Signal	634	lt grn	Crank Sensor	81	No Start
J2-17	Depspower	631	red	Crank and Cam Sensors	81	No Start, No symptom
J2-18	Depslo	632	pnk/blk	Crank and Cam Sensors	81	No Start, No symptom
J2-19	Ignition Feed	439	pnk	Splice	None	No Start, MIL Inoperative
J2-20						
J2-21						
J2-22						
J2-23	TP Signal	417	dk blu	TP Sensor	21 & 22	Poor Acceleration and Performance, Incorrect Idle
J2-24	CAN BUS HIGH		blk	Twin Engine Connector	None	Lack of twin engine communication
J2-25						
J2-26						
J2-27						
J2-28	Ignition Control G	2124	lt blu/wht	Ignition Coil Inline Connector	41 (cyl. #4)	Poor Performance, Poor Fuel Fuel Economy, engine misfire
J2-29	Ignition Control E	2126	grn/wht	Ignition Coil Inline Connector	41 (cyl. #6)	Poor Performance, Poor Fuel Fuel Economy, engine misfire

ECM Connector “J2”

Pin Function		CKT No.	Wire Color	Component Connector	DTC(s) Affected	Possible Symptoms From Faulty Circuit
J2-30	Ignition Control C	2127	red	Ignition Coil Inline Connector	41 (cyl. #7)	Poor Performance, Poor Fuel Fuel Economy, engine misfire
J2-31	Ignition Control A	2121	ppl	Ignition Coil Inline Connector	41 (cyl. #1)	Poor Performance, Poor Fuel Fuel Economy, engine misfire
J2-32	CAM Sensor Signal	633	brn/wht	CAM Sensor	81	No Symptom, Sluggishness

(1) Open circuit
(2) Grounded circuit
(3) Open/Grounded circuit



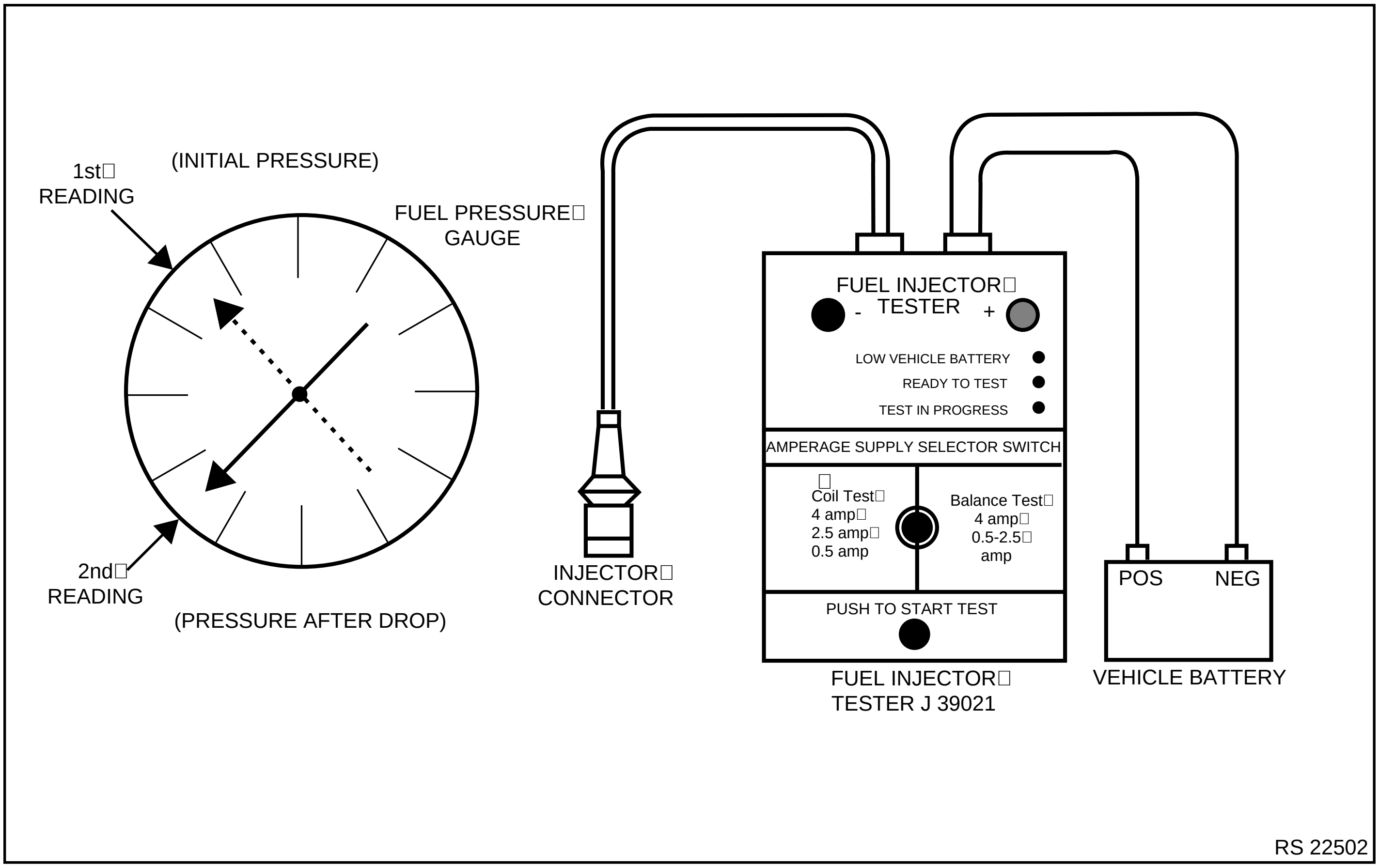
Fuel Injector Coil Test

Test Description

2. This is the set-up step for performing the Fuel Injector Coil Test Procedure. In addition to following the steps in this diagnostic table, also read the instructions included with the tools used to perform this test procedure.
3. The engine coolant temperature affects the ability of the Fuel Injector Tester to detect a faulty Fuel Injector. If the engine coolant temperature is NOT between 50°F and 95°F, allow the engine to warm or cool as necessary.
4. Due to a current surge, the first second of the voltage displayed by the DVOM may be inaccurate; therefore, begin recordingafter the first second of the voltage reading. The voltage displayed by the DVOM should be within the specified range. The voltage displayed by the DVOM may increase throughout the test as the fuel injector windings warm up and the resistance changes. An erratic voltage reading (large fluctuations in voltage that do not stabilize) indicates an intermittent connection within the fuel injector.

Fuel Injector Coil Test

Step	Action	Value	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." 2. Relieve the fuel pressure. • *Refer to* the "Fuel Pressure Relief Procedure" in the *Fuel Metering* section. 3. Access the Fuel Injector electrical connectors as required. • Refer to the "Fuel Injector" portion of the *Fuel Metering* section. 4. Connect the J 39021 Fuel Injector Tester to B+ and Ground. 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 DVOM to the Fuel Injector Tester. Refer to the illustrations associated with the test description. 7. Set the DVOM to the Tenths Scale (0.0). 8. Connect a scan tool. 9. Observe the Engine Coolant Temperature. Is the Engine Coolant Temperature within the specified limits?	10°C-35°C (50°F-95°F)	*Go to* Step 4	*Go to* Step 3
3	Allow the engine to warm or cool as necessary. Is the Engine Coolant Temperature within the specified limits?	10°C-35°C (50°F-95°F)	*Go to* Step 4	—
4	1. Connect the Fuel Injector Tester to a fuel injector. 2. Press the "Push to Start Test" Button on the Fuel Injector Tester. 3. Observe the voltage reading on the DVOM. ***Notice:*** The voltage reading may rise during the test. Watch for erractic voltage readings. 4. Repeat Steps 1 through 3 for each injector. Does any of the injector voltage readings fall outside of the specified value?	5.44-7.53 volts	*Go to* Step 5	*Go to* the Fuel Injector Balance Test
5	Replace the faulty fuel injector(s) that were not within the specified value. • Refer to the "Fuel Injector" portion of the *Fuel Metrering* section. Is the action complete?	5.44-7.53 volts	*Go to* Step 6	—
6	1. Using a scan tool, check for any DTC(s) present and clear them. 2. Attempt to start the engine. Does the engine start and continue to run?	—	*Go to* Step 7	*Go to* Step 2
7	1. Allow the engine to idle until reaching normal operating temperature. 2. Check for any DTC(s) present. Are any DTC(s) present?	—	*Go to* Applicable DTC Procedure	System OK



Fuel Injector Balance Test

Cylinder	1	2	3	4	5	6
1st Reading	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	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	165 kPa (24 psi)	179 kPa (26 psi)	172 kPa (25 psi)	151 kPa (22 psi)	165 kPa (24 psi)	166 kPa (24 psi)
Acceptable Range Average ±10 kPa: 86±10 kPa 76-96 kPa (12 psi ± 1.5 psi 11-14psi)	Injector OK	Faulty injector- too much fuel drop	Injector OK	Faulty injector- too little fuel drop	Injector OK	Injector OK

Circuit Description

The Fuel Injector Tester J 39021, the Injector Switch Box J 39021-210 and the Injector Harness Connector J39021-303 energize the injector for a precise amount of time allowing a measured amount of fuel into the manifold. This causes a drop in system fuel pressure that can be recorded and used to compare each injector. All injectors should be within the same pressure drop range, the average pressure drop value for all injectors is ±10 kPa (1.5 psi).

Test Description

Caution: Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. 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.

4. The engine coolant temperature must be below the operating temperature in order to avoid irregular fuel pressure readings due to Hot Soak fuel boiling.
5. The fuel pressure should be within the specified range. If the fuel pressure is not within the specified range, go to Table A-4 Fuel System Diagnosis in the *Diagnosis* section.
6. Allow the fuel pressure to stabilize about 3 minutes. On a hot engine, fuel pressure may increase due to fuel expansion after the pump stops running. This is a normal condition, but the fuel pressure should stabilize and hold. The fuel pressure should reach a steady value. If the fuel pressure does not reach a steady value, go to Table A-4 Fuel System Diagnosis in the Diagnosis section.
7. If the pressure drop value for each injector is within 10 kPa (1.5 psi) of the average pressure drop value, the injectors are flowing properly. Calculate the pressure drop value for each injector by subtracting the second pressure reading from the first pressure reading. Refer to the illustration above.

Fuel Injector Balance Test

Step	Action	Value	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	*Go to* Step 2	*Go to* OBD System Check
2	Was the Fuel Injector Coil Test performed?	—	*Go to* Step 3	*Go to* Fuel Injector Coil Test
3	Is the Engine Coolant Temperature above the specified value?	94°C (201°F)	*Go to* Step 4	*Go to* Step 5
4	Allow the engine to cool below the specified value. Is the action complete?	94°C (201°F)	*Go to* Step 5	—
5	1. Turn ignition "OFF." 2. Relieve the fuel pressure. • Refer to the "Fuel Pressure Relief Procedure" in the *Fuel Metering* section. 3. Install a fuel pressure gauge. 4. Ignition "ON," engine "OFF." 5. Energize the fuel pump using the scan tool. 6. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 7. Bleed the air out of the fuel pressure gauge. 8. Use the scan tool in order to energize the fuel pump and pressurize the fuel system. 9. Wait for the fuel pressure to build. **Important:** The fuel pump will run for approximately 2 seconds. Repeat step 5 as necessary in order to achieve the highest possible fuel pressure. 10. Observe the reading on the fuel pressure gauge. Is the fuel pressure within the specified limits?	See Master Specification Sheet (end of Section 5)	*Go to* Step 6	*Go to* Table A-4
6	Turn the fuel pump "OFF." Does the fuel pressure remain constant?	—	*Go to* Step 7	*Go to* Table A-4

Fuel Injector Balance Test

Step	Action	Value	Yes	No
7	1. Turn the ignition "OFF." 2. Connect the J 39021 Fuel Injector Tester, the J39021-303 Injector Harness Connector (if needed) and the J 39021-210 Injector Switch Box to a fuel injector. 3. Set the Amperage Supply Selector Switch on the Fuel Injector Tester to the "Balance Test" 0.5-2.5 amp position. 4. Select the injector to be tested on the Injector Switch Box. 5. Ignition "ON," engine "OFF." 6. Use a scan tool in order to pressurize the fuel system. 7. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure stabilizes. This is the 1st pressure reading. 8. Energize the fuel injector by depressing the "Push to Start Test" Button on the Fuel Injector Tester. 9. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure gauge needle has stopped moving. This is the 2nd pressure reading. 10. Repeat Steps 4 through 9 for each fuel injector. 11. Subtract the 2nd pressure reading from the 1st pressure reading for one fuel injector. The result is the pressure drop value. 12. Obtain a pressure drop value for each fuel injector. 13. Add all of the individual pressure drop values. This is the total pressure drop. 14. Divide the total pressure drip 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 amount?	10 kPa (1.5 psi)	*Go to* Step 8	Review *Symptoms* Section
8	***Notice:*** Do Not repeat any portion of this test before running the engine in order to prevent the engine from flooding. Re-test any fuel injector that does not meet the specification. Refer to the procedure in Step 7. 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 amount?	10 kPa (1.5 psi)	*Go to* Step 9	Review *Symptoms* Section
9	Replace the faulty fuel injector(s). Refer to the "Fuel Injector" portion of the *Fuel Metering* section. Is the action complete?	—	*Go to* Step 10	—

Fuel Injector Balance Test

Step	Action	Value	Yes	No
10	1. Turn ignition "OFF." 2. Remove test equipment. 3. Re-connect all harnesses and fuel lines. 4. Install a scan tool. 5. Ignition "ON," engine "OFF." 6. Check for fuel leaks. 7. Using the scan tool, clear any DTC(s) that are present. 8. Start the engine. 9. Idle the engine until it reaches normal operating temperature. 10. Check for any DTC(s) present. Are any DTC(s) present?	—	*Go to* applicable DTC Procedure	System OK

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PCM MASTER ENGINE SPECIFICATIONS - 2002-2004

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 8.1L (STD) (385 HP)	MP 8.1L (HO) (425 HP)	MP 6.0L (375 HP)
Displacement	5.0L (305 CID)	5.7L (350 CID)	8.1L (496 CID)	8.1L (496 CID)	6.0L (364) CID)
Bore	3.75 in. (95.0 mm)	4.0 in. (101.6 mm)	4.25 in. (107.95 mm)	4.25 in. (107.95 mm)	4.0007 in. (101.618 mm)
Stroke	3.48 in. (88.3 mm)	3.48 in. (88.3 mm)	4.370 in. (111.0 mm)	4.370 in. (111.0 mm)	3.622 in. (92.0 mm)
Compression Ratio	9.4:1	9.4:1	9.1:1	9.1:1	9.4:1
Compression Pressure	130 - 215 psi	130 - 215 psi	130 - 175 psi	130 - 175 psi	130 - 215 psi
WOT Operating RPM **Preffered WOT RPM**	4600-5000 4800	4800 - 5200 5000	4400 - 4800 4600	4800 - 5200 5000	4800 - 5300 5200
Cruising RPM (Max)	3800	4000	3800	4000	4000
Idle RPM (In Gear)	650 (Not Adjustable)	650 (Not Adjustable)	650 (Not Adjustable)	650 (Not Adjustable)	650 (Not Adjustable)
Oil Pressure @ 2000 RPM	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 80 psi (172 - 552 kPa)
Minimum Oil Pressure	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle
Spark Plug P/N **Spark Plug Gap**	R030010 0.060 in.	R030010 0.060 in.	R030009 0.060 in.	R030009 0.060 in.	R030011 0.060 in.
Firing Order	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-7-2-6-5-4-3 (LH) NA	1-8-7-2-6-5-4-3 (LH) NA	1-8-7-2-6-5-4-3 (LH) NA
Thermostat	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	NA FWC 160˚F (61.7˚C)
Over- Temperature	193° F (89.8° C)	193° F (89.8° C)	220° F (104.8° C)	208° F (98° C)	220° F (104.8° C)
Electrical System	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground
Alternator Rating	70 Amps	70 / 100 Amps	70 / 100 Amps	70 / 100 Amps	70 Amps
Ignition Timing	Not Adjustable	Not Adjustable	Not Adjustable	Not Adjustable	Not Adjustable
CAM Retard	43-47 degrees	43-47 degrees	Not Adjustable	Not Adjustable	Not Adjustable
Battery Rating	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah

PCM MASTER FUEL PRESSURE SPECIFICATIONS - 2002-2004

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 8.1L (STD) (385 HP)	MP 8.1L (HO) (425 HP)	MP 6.0L (375 HP)
Fuel Pressure STD. FCC	57-62 psi @ WOT	57-62 psi @ WOT	44-48 psi @ WOT	44-48 psi @ WOT	**MY '03 Only** 57-60 psi @ WOT
Fuel Pressure - FCC Returnless to Rail					**MY '04** 59-61 psi (WOT)
Fuel Pressure - LPFP ALL ENGINES	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)

IMPORTANT: FUEL PRESSURE MEASUREMENT MUST BE MADE WITH THE ENGINE UNDER LOAD.

Engine Specs
05/04

PCM MASTER ENGINE SPECIFICATIONS - 2005

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 6.0L (375 HP)
Displacement	5.0L (305 CID)	5.7L (350 CID)	6.0L (364 CID)
Bore	3.75 in. (95.0 mm)	4.0 in. (101.6 mm)	4.0007 in. (101.618 mm)
Stroke	3.48 in. (88.3 mm)	3.48 in. (88.3 mm)	3.622 in. (92.0 mm)
Compression Ratio	9.4:1	9.4:1	9.4:1
Compression Pressure	130 - 215 psi	130 - 215 psi	130 - 215 psi
WOT Operating RPM Preferred WOT RPM	4600-5000 4800	4800 - 5200 5000	4800 - 5300 5200
Cruising RPM (Max)	3800	4000	4000
Idle RPM (In Gear)	650 (Not Adjustable)	650 (Not Adjustable)	650 (Not Adjustable)
Oil Pressure @ 2000 RPM	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 80 psi (172 - 552 kPa)
Minimum Oil Pressure	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle
Spark Plug P/N Spark Plug Gap	R030010 0.060 in.	R030010 0.060 in.	R030011 0.060 in.
Firing Order	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-7-2-6-5-4-3 (LH) NA
Thermostat	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	NA FWC 160˚F (61.7˚C)
Over- Temperature	220° F (104.8° C)	220° F (104.8° C)	220° F (104.8° C)
Electrical System	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground
Alternator Rating	70 / 100 Amps	100 Amps	70 / 100 Amps
Ignition Timing	Not Adjustable	Not Adjustable	Not Adjustable
CAM Retard	43-47 degrees	43-47 degrees	Not Adjustable
Battery Rating	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah

PCM MASTER FUEL PRESSURE SPECIFICATIONS - 2005

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 6.0L (375 HP)
Fuel Pressure STD. FCC	57-62 psi @ WOT	57-62 psi @ WOT	**MY '03 Only** 57-60 psi @ WOT
Fuel Pressure - FCC Returnless to Rail			**MY '04 and newer** 57-62 psi (WOT)
Fuel Pressure - LPFP ALL ENGINES	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)

IMPORTANT: FUEL PRESSURE MEASUREMENT MUST BE MADE WITH THE ENGINE UNDER LOAD.

PCM MASTER WARNING/ALARM SPECIFICATIONS - 2005

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 6.0L (375 HP)
Coolant Over-Temperature Sensor	220° F (104.8° C) Water Temp Lamp Power Reduction	220° F (104.8° C) Water Temp Lamp Power Reduction	220° F (104.8° C) Water Temp Lamp Power Reduction
Transmission Over-Temperature Switch (Optional)	235° F ± 10° F Gen. Warning #1 Trans Temp Lamp Power Reduction	235° F ± 10° F Gen. Warning #1 Trans Temp Lamp Power Reduction	235° F ± 10° F Gen. Warning #1 Trans Temp Lamp Power Reduction
Low Oil Pressure Switch	< 10 psi Gen. Warning #2 Oil Pressure Lamp Power Reduction	< 10 psi Gen. Warning #2 Oil Pressure Lamp Power Reduction	< 10 psi Gen. Warning #2 Oil Pressure Lamp Power Reduction
Exhaust Over-Temperature Switch (Optional)	248° F ± 5° F M.I.L. - DTC 81 Check Engine Lamp	248° F ± 5° F M.I.L. - DTC 81 Check Engine Lamp	248° F ± 5° F M.I.L. - DTC 81 Check Engine Lamp

NOTE: 'Power Reduction" mode limits engine RPM to 2000. Above 2000 RPM the ECM will disable half of the fuel injectors. Reducing engine RPM below 1200 will restore normal engine operation until RPM exceeds 2000. Depending upon Instrument Panel configuration, individual warning lights, Check Engine/Check Gauges indicator, and/or an audible alarm buzzer may light/sound when a malfunction occurs.

PCM MASTER ENGINE SPECIFICATIONS - 2006

MODEL (Horsepower)	MP 5.0L (275 HP)	MP 5.7L (330 HP)	MP 6.0L (375 HP)
Displacement	5.0L (305 CID)	5.7L (350 CID)	6.0L (364 CID)
Bore	3.75 in. (95.0 mm)	4.0 in. (101.6 mm)	4.0007 in. (101.618 mm)
Stroke	3.48 in. (88.3 mm)	3.48 in. (88.3 mm)	3.622 in. (92.0 mm)
Compression Ratio	9.4:1	9.4:1	9.4:1
Compression Pressure	130 - 215 psi	130 - 215 psi	130 - 215 psi
WOT Operating RPM Preferred WOT RPM	4600-5000 4800	4800 - 5200 5000	4800 - 5300 5200
Cruising RPM (Max)	3800	4000	4000
Idle RPM (In Gear)	650 (Not Adjustable)	650 (Not Adjustable)	650 (Not Adjustable)
Oil Pressure @ 2000 RPM	25 - 60 psi (172 - 414 kPa)	25 - 60 psi (172 - 414 kPa)	25 - 80 psi (172 - 552 kPa)
Minimum Oil Pressure	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle	10 psi (69 kPa) at Idle
Spark Plug P/N Spark Plug Gap	R030010 0.060 in.	R030010 0.060 in.	R030011 0.060 in.
Firing Order	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-4-3-6-5-7-2 (LH) 1-2-7-5-6-3-4-8 (RH)	1-8-7-2-6-5-4-3 (LH) NA
Thermostat	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)	NA FWC 160˚F (61.7˚C)
Over- Temperature	220° F (104.8° C)	220° F (104.8° C)	220° F (104.8° C)
Electrical System	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground	12 Volt Negative (-) Ground
Alternator Rating	70 / 100 Amps	100 Amps	70 / 100 Amps
Ignition Timing	Not Adjustable	Not Adjustable	Not Adjustable
CAM Retard	43-47 degrees	43-47 degrees	Not Adjustable
Battery Rating	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah	650 CCA (Minimum) 120 Ah

PCM MASTER FUEL PRESSURE SPECIFICATIONS - 2006

MODEL (Horsepower)	**MP 5.0L (275 HP)**	**MP 5.7L (330 HP)**	**MP 6.0L (375 HP)**
Fuel Pressure STD. FCC	57-62 psi @ WOT	57-62 psi @ WOT	**MY '03 Only** 57-60 psi @ WOT
Fuel Pressure - FCC Returnless to Rail			**MY '04 and newer** 57-62 psi (WOT)
Fuel Pressure - LPFP ALL ENGINES	4 - 7 psi (WOT)	4 - 7 psi (WOT)	4 - 7 psi (WOT)

IMPORTANT: FUEL PRESSURE MEASUREMENT MUST BE MADE WITH THE ENGINE UNDER LOAD.

PCM MASTER WARNING/ALARM SPECIFICATIONS - 2006

MODEL (Horsepower)	**MP 5.0L (275 HP)**	**MP 5.7L (330 HP)**	**MP 6.0L (375 HP)**
Coolant Over-Temperature Sensor	220° F (104.8° C) Water Temp Lamp Power Reduction	220° F (104.8° C) Water Temp Lamp Power Reduction	220° F (104.8° C) Water Temp Lamp Power Reduction
Low Oil Pressure Switch	< 10 psi Gen. Warning #1 Oil Pressure Lamp	< 10 psi Gen. Warning #1 Oil Pressure Lamp	< 10 psi Gen. Warning #1 Oil Pressure Lamp

NOTE: 'Power Reduction" mode limits engine RPM to 2000. Above 2000 RPM the ECM will disable half of the fuel injectors. Reducing engine RPM below 1200 will restore normal engine operation until RPM exceeds 2000. Depending upon Instrument Panel configuration, individual warning lights, Check Engine/Check Gauges indicator, and/or an audible alarm buzzer may light/sound when a malfunction occurs.

ENGINE SPEC
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