SENR9982-01
May 2006

Troubleshooting

1104D and 1106D Industrial Engines

NH (Engine)
NJ (Engine)
PJ (Engine)

Important Safety Information

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons.

The hazards are identified by the “Safety Alert Symbol” and followed by a “Signal Word” such as “DANGER”, “WARNING” or “CAUTION”. The Safety Alert “WARNING” label is shown below.

⚠ WARNING

The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

The message that appears under the warning explains the hazard and can be either written or pictorially presented.

Operations that may cause product damage are identified by “NOTICE” labels on the product and in this publication.

Perkins cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all inclusive. If a tool, procedure, work method or operating technique that is not specifically recommended by Perkins is used, you must satisfy yourself that it is safe for you and for others. You should also ensure that the product will not be damaged or be made unsafe by the operation, lubrication, maintenance or repair procedures that you choose.

The information, specifications, and illustrations in this publication are on the basis of information that was available at the time that the publication was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service that is given to the product. Obtain the complete and most current information before you start any job. Perkins dealers or Perkins distributors have the most current information available.

⚠ WARNING

When replacement parts are required for this product Perkins recommends using Perkins replacement parts.

Failure to heed this warning can lead to premature failures, product damage, personal injury or death.

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CID 0091 FMI 08 94
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CID 0110 FMI 03 96
CID 0110 FMI 04 96
CID 0168 FMI 00 96
CID 0168 FMI 01 97
CID 0168 FMI 02 97
CID 0172 FMI 03 98
CID 0172 FMI 04 98
CID 0190 FMI 08 99
CID 0247 FMI 09 99
CID 0247 FMI 12 99
CID 0253 FMI 02 100
CID 0261 FMI 11 100
CID 0262 FMI 03 100
CID 0262 FMI 04 101
CID 0268 FMI 02 101
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CID 0526 FMI 05 102
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Troubleshooting Section

Electronic Troubleshooting

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System Overview

System Operation

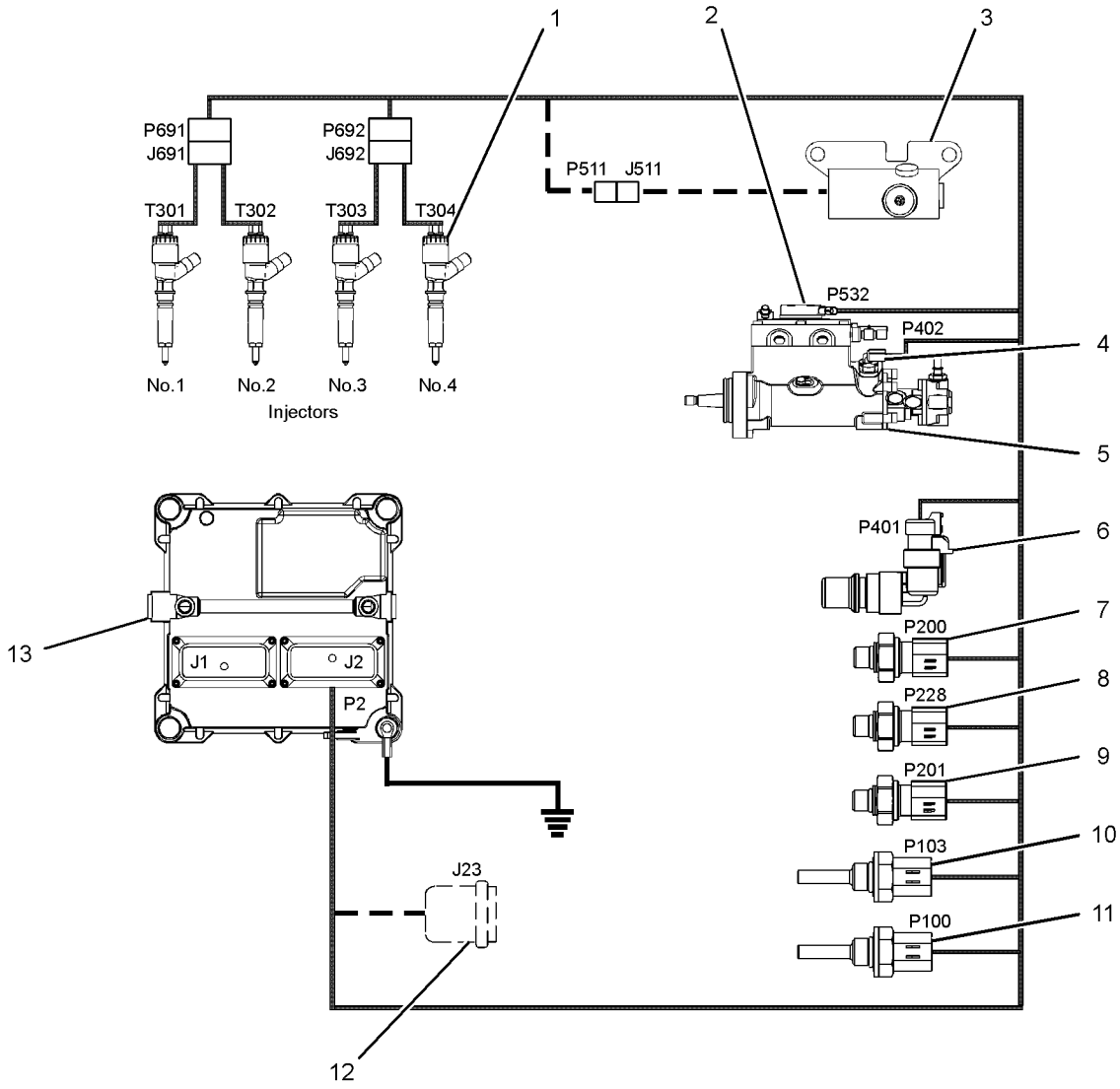

Illustration 1 g01236714

1104D engine

(1) Electronic Unit Injector
(2) Solenoid for the Fuel Rail Pump
(3) Wastegate Regulator (if equipped)
(4) Secondary Speed/Timing Sensor
(5) Fuel Rail Pump
(6) Primary Speed/Timing Sensor
(7) Intake Manifold Pressure Sensor
(8) Fuel Rail Pressure Sensor
(9) Engine Oil Pressure Sensor
(10) Intake Manifold Air Temperature Sensor
(11) Coolant Temperature Sensor
(12) Diagnostic Connector (if equipped)
(13) Electronic Control Module (ECM)

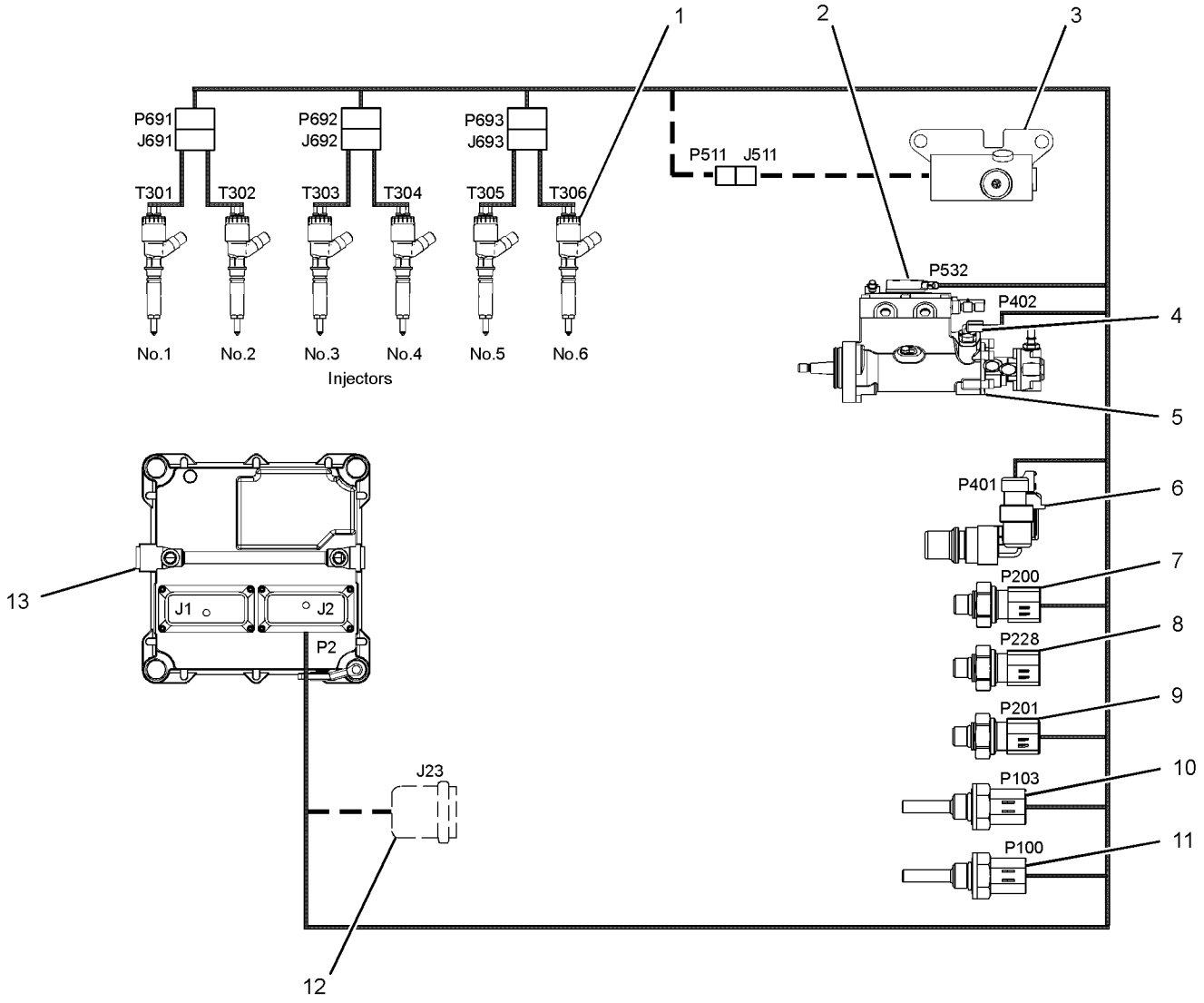

Illustration 2 g01178531

1106D engine

(1) Electronic Unit Injector
(2) Solenoid for the Fuel Rail Pump
(3) Wastegate Regulator (if equipped)
(4) Secondary Speed/Timing Sensor
(5) Fuel Rail Pump
(6) Primary Speed/Timing Sensor
(7) Intake Manifold Pressure Sensor
(8) Fuel Rail Pressure Sensor
(9) Engine Oil Pressure Sensor
(10) Intake Manifold Air Temperature Sensor
(11) Coolant Temperature Sensor
(12) Diagnostic Connector (if equipped)
(13) Electronic Control Module (ECM)

The engine is designed for electronic control. The engine has an Electronic Control Module (ECM), a fuel rail pump and electronic unit injectors. All of these items are electronically controlled. There are also a number of engine sensors. Turbocharged engines can be equipped with an electronically controlled wastegate for the turbocharger. The ECM controls the engine operating parameters through the software within the ECM and the inputs from the various sensors. The software contains parameters that control the engine operation. The parameters include all of the operating maps and customer selected parameters.

The electronic system consists of the ECM, the engine sensors and inputs from the parent machine. The ECM is the computer. The flash file is the software for the computer. The flash file defines the following characteristics of the engine:

- Engine power
- Torque curves
- Engine speed (rpm)
- Engine Noise
- Smoke and Emissions

The ECM determines the injection timing, the amount of fuel that is delivered to the cylinders and the intake manifold pressure if an electronically controlled wastegate is installed on the turbocharger. These decisions are based on the actual conditions and the desired conditions at any given time.

Engine Speed Governor

The governor has software that compares the desired engine speed to the actual engine speed. The actual engine speed is determined through the primary speed/timing sensor and the secondary speed/timing sensor. If the desired engine speed is greater than the actual engine speed, the governor injects more fuel in order to increase engine speed. If the actual engine speed is greater than the desired engine speed, the governor limits the amount of fuel that is supplied to the electronic unit injectors in order to reduce engine speed.

Timing Considerations

Fuel injection timing is determined by the ECM after considering input from the following components:

- Engine coolant temperature sensor
- The sensor for the intake manifold air temperature
- The sensor for the intake manifold pressure
- Speed/timing sensors
- Throttle position sensor

At engine start-up, the ECM determines the top center position of the number 1 cylinder from the speed/timing sensors. The ECM determines when fuel injection should occur relative to the top center position. The ECM optimizes engine performance by control of each of the electronic unit injectors so that the required amount of fuel is injected at the precise point of the engine's cycle. The electronic unit injectors are supplied with high pressure fuel from the fuel rail. The ECM also provides the signal to the solenoid in the fuel rail pump. The solenoid in the fuel rail pump controls a valve in the fuel rail pump. This valve controls the pressure in the fuel rail. Fuel that is not required for the engine is diverted away from the fuel rail pump back to the fuel tank.

The ECM adjusts injection timing and fuel pressure for the best engine performance, the best fuel economy and the best control of exhaust emissions.

Fuel Injection

The flash file inside the ECM sets certain limits on the amount of fuel that can be injected.

The Fuel Ratio Control Limit is a limit that is based on intake manifold pressure and engine rpm. The FRC Limit is used to control the air/fuel ratio in order to control the engine's exhaust emissions. When the ECM senses a higher intake manifold pressure, the ECM increases the FRC Limit. A higher intake manifold pressure indicates that there is more air in the cylinder. When the ECM increases the FRC Limit, the ECM allows more fuel into the cylinder.

The Rated Fuel Limit is a limit that is based on the power rating of the engine and on the engine rpm. The Rated Fuel Limit enables the engine power and torque outputs to conform to the power and torque curves of a specific engine model.

These limits are in the flash file and these limits cannot be changed by the operator.

Diagnostic Codes

When the ECM detects an electronic system fault, the ECM generates a diagnostic code. Also, the ECM logs the diagnostic code in order to indicate the time of the occurrence of the fault. The ECM also logs the number of occurrences of the fault. Diagnostic codes are provided in order to indicate that the ECM has detected an electrical fault or an electronic fault with the engine control system. In some cases, the engine performance can be affected when the condition that is causing the code exists.

If the operator indicates that a performance problem occurs, the diagnostic code may indicate the cause of the fault. Use the electronic service tool to access the diagnostic codes. The fault should then be corrected.

Event Codes

Event Codes are used to indicate that the ECM has detected an abnormal engine operating condition. The ECM will log the occurrence of the event code. This does not indicate an electrical malfunction or an electronic malfunction. For example, if the temperature of the coolant in the engine is higher than the permitted limit, then the ECM will detect the condition. The ECM will then log an event code for the condition.

Programmable Parameters

Certain parameters that affect the engine operation may be changed with electronic service tools. The parameters are stored in the ECM and some of the parameters are protected from unauthorized changes by passwords. These parameters are System Configuration Parameters.

System Configuration Parameters are set at the factory. System Configuration Parameters affect the emissions or the power ratings within the engine. Factory passwords must be obtained and used in order to changesome of the System Configuration Parameters. Examples of these parameters are FLS and FTS.

Passwords

System Configuration Parameters are protected by factory passwords. Factory passwords are calculated on a computer system that is available only to Perkins distributors. Since factory passwords contain alphabetic characters, only an electronic service tool may change System Configuration Parameters. System Configuration Parameters affect the power rating or the emissions.

Refer to Troubleshooting, “Programming Parameters” and Troubleshooting, “Factory Passwords”.

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Glossary

Active Diagnostic Code – An active diagnostic code alerts the operator or the service technician that an electronic system malfunction is currently present. Refer to the term “Diagnostic Code” in this glossary.

Adaptive Trim – This is a software process that is performed in the Electronic Control Module (ECM) that optimizes engine performance.

Alternating Current (AC) – Alternating current is an electric current that reverses direction at a regular interval that is reoccurring.

Before Top Center (BTC) – BTC is the 180 degrees of crankshaft rotation before the piston reaches the top dead center position in the normal direction of rotation.

Breakout Harness – A breakout harness is a test harness that is designed to connect into the engine harness. This connection allows a normal circuit operation and the connection simultaneously provides a Breakout T in order to measure the signals.

Bypass Circuit – A bypass circuit is a circuit that is used as a substitute circuit for an existing circuit. A bypass circuit is typically used as a test circuit.

CAN Data Link (see also J1939 CAN Data Link) – The CAN Data Link is a serial communications port that is used for communication with other microprocessor based devices.

Code – Refer to “Diagnostic Code” or “Event Code”.

Communication Adapter Tool – The communication adapter provides a communication link between the ECM and the electronic service tool.

Component Identifier (CID) – The CID is a number that identifies the specific component of the electronic control system that has experienced a diagnostic code.

Coolant Temperature Sensor – The coolant temperature sensor detects the engine coolant temperature for all normal operating conditions and for engine monitoring.

Data Link – The Data Link is a serial communication port that is used for communication with other devices such as the electronic service tool.

Derate – Certain engine conditions will generate event codes. Also, engine derates may be applied. The map for the engine derate is programmed into the ECM software. The derate can be one or more of 3 types: reduction of rated power, reduction of rated engine speed, and reduction of rated machine speed for OEM products.

Desired Engine Speed – The desired engine speed is input to the electronic governor within the ECM. The electronic governor uses the signal from the throttle position sensor, the engine speed/timing sensor, and other sensors in order to determine the desired engine speed.

Diagnostic Code – A diagnostic code is sometimes referred to as a fault code. These codes indicate an electronic system malfunction.

Diagnostic Lamp – A diagnostic lamp is sometimes called the check engine light. The diagnostic lamp is used to warn the operator of the presence of an active diagnostic code. The lamp may not be included in all applications.

Digital Sensor Return – The common line (ground) from the ECM is used as ground for the digital sensors.

Digital Sensors – Digital sensors produce a pulse width modulated signal. Digital sensors are supplied with power from the ECM.

Digital Sensor Supply – The power supply for the digital sensors is provided by the ECM.

Direct Current (DC) – Direct current is the type of current that flows consistently in only one direction.

DT, DT Connector, or Deutsch DT – This is a type of connector that is used on Perkins engines. The connectors are manufactured by Deutsch.

Duty Cycle – Refer to “Pulse Width Modulation”.

Electronic Engine Control – The electronic engine control is a complete electronic system. The electronic engine control monitors the engine operation under all conditions. The electronic engine control also controls the engine operation under all conditions.

Electronic Control Module (ECM) – The ECM is the control computer of the engine. The ECM provides power to the electronics. The ECM monitors data that is input from the sensors of the engine. The ECM acts as a governor in order to control the speed and the power of the engine.

Electronic Service Tool – The electronic service tool allows a computer (PC) to communicate with the ECM.

Engine Monitoring – Engine Monitoring is the part of the electronic engine control that monitors the sensors. This also warns the operator of detected problems.

Engine Oil Pressure Sensor – The engine oil pressure sensor measures engine oil pressure. The sensor sends a signal to the ECM that is dependent on the engine oil pressure.

Engine Speed/Timing Sensor – An engine speed/timing sensor is a hall effect switch that provides a digital signal to the ECM. The ECM interprets this signal as the crankshaft position and the engine speed. Two sensors are used to provide the speed and timing signals to the ECM. The primary sensor is associated with the crankshaft and the secondary sensor is associated with the camshaft.

Event Code – An event code may be activated in order to indicate an abnormal engine operating condition. These codes usually indicate a mechanical problem instead of an electrical system problem.

Failure Mode Identifier (FMI) – This identifier indicates the type of failure that is associated with the component. The FMI has been adopted from the SAE practice of J1587 diagnostics. The FMI follows the parameter identifier (PID) in the descriptions of the fault code. The descriptions of the FMIs are in the following list.

0 – The data is valid but the data is above the normal operational range.

1 – The data is valid but the data is below the normal operational range.

2 – The data is erratic, intermittent, or incorrect.

3 – The voltage is above normal or the voltage is shorted high.

4 – The voltage is below normal or the voltage is shorted low.

5 – The current is below normal or the circuit is open.

6 – The current is above normal or the circuit is grounded.

7 – The mechanical system is not responding properly.

8 – There is an abnormal frequency, an abnormal pulse width, or an abnormal time period.

9 – There has been an abnormal update.

10 – There is an abnormal rate of change.

11 – The failure mode is not identifiable.

12 – The device or the component is damaged.

Flash File – This file is software that is inside the ECM. The file contains all the instructions (software) for the ECM and the file contains the performance maps for a specific engine. The file may be reprogrammed through flash programming.

Flash Programming – Flash programming is the method of programming or updating an ECM with an electronic service tool over the data link instead of replacing components.

Fuel Injector E-Trim – Fuel injector E-trim is a software process that allows precise control of fuel injectors by parameters that are programmed into the ECM for each fuel injector. With the use of the electronic service tool, the service technician can read status information for the E-Trim. Data for E-Trim can also be programmed.

FRC – See “Fuel Ratio Control”.

Fuel Pump – See “Fuel Rail Pump”.

Fuel Rail – This item is sometimes referred to as the High Pressure Fuel Rail. The fuel rail supplies fuel to the electronic unit injectors. The fuel rail pump and the fuel rail pressure sensor work with the ECM in order to maintain the desired fuel pressure in the fuel rail. This pressure is determined by calibration of the engine in order to enable the engine to meet emissions and performance requirements.

Fuel Rail Pressure Sensor – The fuel rail pressure sensor sends an electronic signal to the ECM that is dependent on the pressure of the fuel in the fuel rail.

Fuel Rail Pump – This item is sometimes referred to as the High Pressure Fuel Rail Pump. This is a device that supplies fuel under pressure to the fuel rail (high pressure fuel rail).

Fuel Rail Pump Solenoid Valve – This is sometimes referred to as the High Pressure Fuel Rail Pump Solenoid Valve. This is a control device in the high pressure fuel rail pump. The ECM controls the pressure in the fuel rail by using this valve to divert excess fuel from the pump to the fuel tank.

Fuel Ratio Control (FRC) – The FRC is a limit that is based on the control of the ratio of the fuel to air. The FRC is used for purposes of emission control. When the ECM senses a higher intake manifold air pressure (more air into the cylinder), the FRC increases the FRC Limit (more fuel into the cylinder).

Full Load Setting (FLS) – The FLS is the parameter that represents the fuel system adjustment. This adjustment is made at the factory in order to fine tune the fuel system. The correct value for this parameter is stamped on the engine information ratings plate. This parameter must be programmed.

Full Torque Setting (FTS) – The FTS is the parameter that represents the adjustment for the engine torque. This adjustment is made at the factory in order to fine tune the fuel system. This adjustment is made in conjunction with the FLS. This parameter must be programmed.

Glow Plug – The glow plug is an optional starting aid for cold conditions. One glow plug is installed in each combustion chamber in order to improve the ability of the engine to start. The ECM uses information from the engine sensors such as the engine temperature to determine when the glow plug relay must provide power to each glow plug. Each of the glow plugs then provides a very hot surface in the combustion chamber in order to vaporize the mixture of air and fuel. This improves ignition during the compression stroke of the cylinder.

Glow Plug Relay – The glow plug relay is controlled by the ECM in order to provide high current to the glow plugs that are used in the starting aid system.

Harness – The harness is the bundle of wiring (loom) that connects all components of the electronic system.

Hertz (Hz) – Hertz is the measure of electrical frequency in cycles per second.

High Pressure Fuel Rail Pump – See “Fuel Rail Pump”.

High Pressure Fuel Rail Pump Solenoid Valve – See “Fuel Rail Pump Solenoid Valve”.

High Pressure Fuel Rail – See “Fuel Rail”.

Injector Codes – The injector codes or injector trim codes are numeric codes or alphanumeric codes that are etched or stamped on individual electronic unit injectors. These codes are used to fine tune the fuel delivery.

Injector Trim Files – Injector trim files are downloaded from a disk to the ECM. The injector trim files compensate for variances in manufacturing of the electronic unit injector and for the life of the electronic unit injector. The serial number for the electronic unit injector must be obtained in order to retrieve the correct injector trim file.

Intake Manifold Air Temperature Sensor – The intake manifold air temperature sensor detects the air temperature in the intake manifold. The ECM monitors the air temperature and other data in the intake manifold in order to adjust injection timing and other performance functions.

Intake Manifold Pressure Sensor – The Intake Manifold Pressure Sensor measures the pressure in the intake manifold. The pressure in the intake manifold may be different to the pressure outside the engine (atmospheric pressure). The difference in pressure may be caused by an increase in air pressure by a turbocharger (if equipped).

Integrated Electronic Controls – The engine is designed with the electronic controls as a necessary part of the system. The engine will not operate without the electronic controls.

J1939 CAN Data Link – This data link is a SAE standard diagnostic communications data link that is used to communicate between the ECM and the electronic devices.

Logged Diagnostic Codes – Logged diagnostic codes are codes which are stored in the memory. These codes are meant to be an indicator of possible causes for intermittent problems. Refer to the term “Diagnostic Code” in this glossary for more information.

OEM – OEM is an abbreviation for the Original Equipment Manufacturer. This is the manufacturer of the machine or the vehicle that uses the engine.

Open Circuit – An open circuit is a condition that is caused by an open switch, or by an electrical wire or a connection that is broken. When this condition exists, the signal or the supply voltage can no longer reach the intended destination.

Parameter – A parameter is a value or a limit that is programmable. This helps determine specific characteristics or behaviors of the engine.

Password – A password is a group of numeric characters or a group of alphanumeric characters that is designed to restrict access to parameters. The electronic system requires correct passwords in order to change some parameters (Factory Passwords). Refer to Troubleshooting, “Factory Passwords” for more information.

Personality Module – See “Flash File”.

Power Cycled – Power cycled happens when power to the ECM is cycled: ON, OFF, and ON. Power cycled refers to the action of cycling the keyswitch from any position to the OFF position, and to the START/RUN position.

Primary Speed/Timing Sensor – This sensor determines the position of the crankshaft during engine operation. If the primary speed/timing sensor fails during engine operation, the secondary speed/timing sensor is used to provide the signal.

Pulse Width Modulation (PWM) – The PWM is a signal that consists of pulses that are of variable width. These pulses occur at fixed intervals. The ratio of “TIME ON” versus total “TIME OFF” can be varied. This ratio is also referred to as a duty cycle.

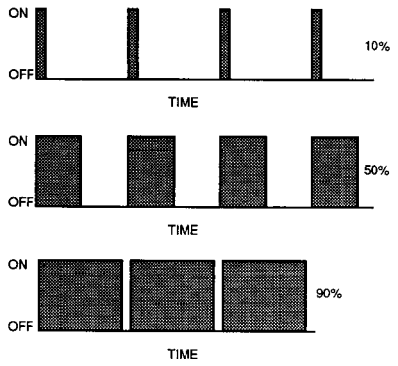

Illustration 3 g00284479

Rated Fuel Limit – This is a limit that is based on the power rating of the engine and on the engine rpm. The Rated Fuel Limit enables the engine power and torque outputs to conform to the power and torque curves of a specific engine model. These limits are in the flash file and these limits cannot be changed.

Reference Voltage – Reference voltage is a regulated voltage and a steady voltage that is supplied by the ECM to a sensor. The reference voltage is used by the sensor to generate a signal voltage.

Relay – A relay is an electromechanical switch. A flow of electricity in one circuit is used to control the flow of electricity in another circuit. A small current or voltage is applied to a relay in order to switch a much larger current or voltage.

Secondary Speed/Timing Sensor – This sensor determines the position of the camshaft during engine operation. If the primary speed/timing sensor fails during engine operation, the secondary speed/timing sensor is used to provide the signal.

Sensor – A sensor is a device that is used to detect the current value of pressure or temperature, or mechanical movement. The information that is detected is converted into an electrical signal.

Short Circuit – A short circuit is a condition that has an electrical circuit that is inadvertently connected to an undesirable point. An example of a short circuit is a wire which rubs against a vehicle frame and this rubbing eventually wears off the wire insulation. Electrical contact with the frame is made and a short circuit results.

Signal – The signal is a voltage or a waveform that is used in order to transmit information typically from a sensor to the ECM.

Supply Voltage – The supply voltage is a continuous voltage that is supplied to a component in order to provide the electrical power that is required for the component to operate. The power may be generated by the ECM or the power may be battery voltage that is supplied by the engine wiring.

System Configuration Parameters – System configuration parameters are parameters that affect emissions and/or operating characteristics of the engine.

Tattletale – Certain parameters that affect the operation of the engine are stored in the ECM. These parameters can be changed by use of the electronic service tool. The tattletale logs the number of changes that have been made to the parameter. The tattletale is stored in the ECM.

Throttle Position – The throttle position is the interpretation by the ECM of the signal from the throttle position sensor or the throttle switch.

Throttle Position Sensor – The throttle position sensor is a sensor that is usually connected to an accelerator pedal or a hand lever. This sensor sends a signal to the ECM that is used to calculate desired engine speed.

Throttle Switch – The throttle switch sends a signal to the ECM that is used to calculate desired engine speed.

Timing Calibration – The timing calibration is the adjustment of an electrical signal. This adjustment is made in order to correct the timing error between the camshaft and the engine speed/timing sensors or between the crankshaft and the engine speed/timing sensors.

Top Center Position – The top center position refers to the crankshaft position when the engine piston position is at the highest point of travel. The engine must be turned in the normal direction of rotation in order to reach this point.

Total Tattletale – The total tattletale is the total number of changes to all the parameters that are stored in the ECM.

Wait To Start Lamp – This is a lamp that is included in the cold starting aid circuit in order to indicate when the wait to start period has expired. The glow plugs have not deactivated at this point in time.

Wastegate – This is a device in a turbocharged engine that controls the maximum boost pressure that is provided to the inlet manifold.

Wastegate Regulator (if equipped) – The wastegate regulator controls the pressure in the intake manifold to a value that is determined by the ECM. The wastegate regulator provides the interface between the ECM and the mechanical system that regulates intake manifold pressure to the desired value that is determined by the software.

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Electronic Service Tools

Perkins electronic service tools are designed to help the service technician:

- Retrieve diagnostic codes.
- Diagnose electrical problems.
- Read parameters.
- Program parameters.
- Install trim files.

Required Service Tools

Table 1

Required Service Tools	
Part Number	**Description**
CH11155	Crimp Tool (12−AWG TO 18−AWG)
2900A019	Wire Removal Tool
27610285	Removal Tool
-	Suitable Digital Multimeter

Two short jumper wires are needed to check the continuity of some wiring harness circuits by shorting two adjacent terminals together in a connector. A long extension wire may also be needed to check the continuity of some wiring harness circuits.

Optional Service Tools

Table 2 lists the optional service tools that can be used when the engine is serviced.

Table 2

Part Number	Description
U5MK1092	Spoon Probe Kit(MULTIMETER)
- or -	Suitable Digital Pressure Indicator or Engine Pressure Group
-	Suitable Battery Load Tester
-	Suitable Temperature Adapter (MULTIMETER)
28170107	Bypass Harness As
2900A038	Harness As

Perkins Electronic Service Tool

The Perkins Electronic Service Tool can display the following information:

- Status of all pressure sensors and temperature sensors
- Programmable parameter settings
- Active diagnostic codes and logged diagnostic codes
- Logged events
- Histograms

The Electronic Service Tool can also be used to perform the following functions:

- Diagnostic tests
- Sensor calibrations
- Programming of flash files
- Parameter programming
- Copy configuration function for ECM replacement
- Data logging
- Graphs (real time)

Table 3 lists the service tools that are required in order to use the Electronic Service Tool.

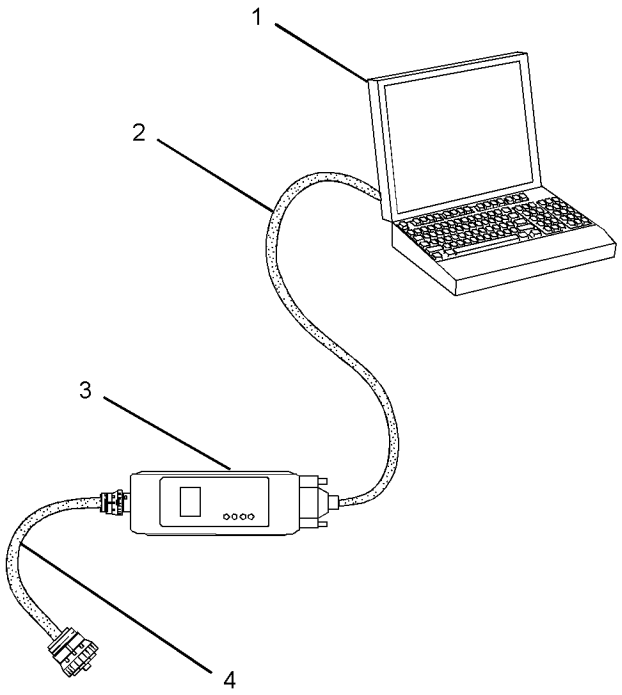
Table 3

Service Tools for the Use of the Electronic Service Tool	
Part Number	**Description**
-(1)	Single Use Program License
-(1)	Data Subscription for All Engines
27610251	Communication Adapter (Electronic Service Tool to ECM interface)
27610164	Adapter Cable As

(1) Refer to Perkins Engine Company Limited.

Note: For more information regarding the use of the Electronic Service Tool and the PC requirements for the Electronic Service Tool, refer to the documentation that accompanies your Perkins Electronic Service Tool software.

Connecting the Electronic Service Tool and the Communication Adapter II



g01121866

Illustration 4

(1) Personal Computer (PC)
(2) Adapter Cable (Computer Serial Port)
(3) Communication Adapter II
(4) Adapter Cable Assembly

Note: Items (2), (3) and (4) are part of the Communication Adapter II kit.

Use the following procedure in order to connect the Electronic Service Tool and the Communication Adapter II.

1. Turn the keyswitch to the OFF position.
2. Connect cable (2) between the “COMPUTER” end of communication adapter (3) and the RS232 serial port of PC (1).

Note: The Adapter Cable Assembly (4) is required to connect to the USB port on computers that are not equipped with a RS232 serial port.

3. Connect cable (3) between the “DATA LINK” end of communication adapter (3) and the service tool connector.
4. Place the keyswitch in the ON position. If the Electronic Service Tool and the communication adapter do not communicate with the Electronic Control Module (ECM), refer to the diagnostic procedure Troubleshooting, “Electronic Service Tool Will Not Communicate With ECM”.

i02492452

Indicator Lamps

Indicator Lamps

The functions of the indicator lamps are designed to display the maximum amount of information on the minimum number of lamps.

Five lamps are available as options. The “Shutdown” lamp and the “Warning” lamp will normally be installed in the application. Dedicated optional lamps for other items may also be installed. The remaining optional lamps are “Wait to start”, “Low oil pressure” and “PTO mode on”.

The “Shutdown” lamp and the “Warning” lamp can also be used to indicate a diagnostic code by use of the “Flash Code” feature. The “Flash Code” feature can be used to indicate all active diagnostic codes and logged diagnostic codes.

Functions of the Lamps

Shutdown Lamp

Lamp check – When the keyswitch is turned to ON, the lamp will come on for 2 seconds. The lamp will then go off unless there is an active warning.

Flashing – The lamp will be flashing when a derate is active or when a derate is present because of an active diagnostic code. An example of an active diagnostic code is “System Voltage High”.

On – The lamp will be on when the shutdown level in the engine protection strategy has been reached. The “Warning” lamp will also be on.

Warning Lamp

Lamp check – When the keyswitch is turned to ON, the lamp will come on for 2 seconds. The lamp will then go off unless there is an active warning.

Flashing – The lamp will be flashing when a “warning” or a “warning and derate” is active. This includes low oil pressure.

On – The lamp will be on when the shutdown level has been reached. The “Shutdown” lamp will also be on.

Wait to Start Lamp

Lamp check – When the keyswitch is turned to ON, the lamp will come on for 2 seconds. The lamp will then go off unless “Wait to Start” is active.

On – The lamp is on during a “Wait to Start” period.

Low Oil Pressure

Lamp check – When the keyswitch is turned to ON, the lamp will come on for 2 seconds. The lamp will then go off unless there is an active warning.

On – The lamp will come on when a low oil pressure event is detected. The “Warning” lamp and the “Shutdown” lamp may also come on.

PTO Lamp

Lamp check – When the keyswitch is turned to ON, the lamp will come on for 2 seconds. The lamp will then go off unless the PTO mode is active.

Flashing – The lamp will be flashing when the PTO mode is turned on but when the PTO is not engaged.

On – The lamp will come on when PTO mode is engaged.

Color of Lamps

Typically, the “Shutdown” lamp is colored red and the “Warning” lamp is colored amber. The other lamps are optional.

Operation of the Indicator Lamps

Table 4

Warning Lamp (Alert Lamp)	**Shutdown Lamp** (Action Lamp)	**Lamp State**	**Description of the Indication**	**Engine State**
On	On	Lamp Check	When the keyswitch is switched on, the lamps come on for a period of 2 seconds and the lamps will then go off.	The keyswitch is on but the engine has not yet been cranked.
Off	Off	No Faults	With the engine in operation, there are no active warnings, diagnostic codes or event codes.	The engine is operating with no detected faults.
On	Off	Active Diagnostic	If the warning lamp comes on during engine operation, this indicates that an active diagnostic code (an electrical fault) is present.	The engine is operating normally but there is one or more faults with the electronic management system for the engine.
On	Flashing	Derate (A derate is caused by certain active codes.)	If the warning lamp comes on and the shutdown lamp flashes during engine operation, this indicates that an active diagnostic code (an electrical fault) is present. The diagnostic is sufficiently serious in order to cause an engine derate.	The engine is operating but there is one or more active diagnostic codes that have initiated an engine derate.
Flashing	Off	Warning (Warning only)	When the warning lamp flashes during operation of the engine, the lamp indicates that one or more of the warning values for the engine protection strategy has been exceeded. However, the value has not been exceeded to a level that will cause a derate or a shutdown.	The engine is operating normally. However, there is one or more of the monitored engine parameters that are outside of the range that is acceptable.
Flashing	Flashing	Derate (Warning and Derate)	If both the warning lamp and shutdown lamp flash during operation of the engine, the lamps indicate that one or more of the values for the engine protection strategy have been exceeded beyond the level that will cause an engine derate.	The engine is operating. However, one or more of the monitored engine parameters is outside of the acceptable range. The acceptable range has been exceeded to a level which requires a warning and an engine derate.
On	On	Engine Shutdown	If both the warning lamp and the shutdown lamp come on during engine operation, this indicates one of the following conditions. 1. One or more of the shutdown values for the engine protection strategy has been exceeded. 2. A serious active diagnostic code has been detected. After a short period of time, the engine will shut down.	The engine is either shutdown or an engine shutdown is imminent. One or more monitored engine parameters have exceeded the limit for an engine shutdown. This pattern of lamps can be caused by the detection of a serious active diagnostic code.

Flash Codes

The “Flash Code” feature is used to flash the code of all active diagnostic codes and logged diagnostic codes.

The sequence for the flash code is started by moving the keyswitch to “Off” and then moving the keyswitch to “On” twice within a period of three seconds. After a delay of 2 seconds, the “Shutdown” lamp will flash once for a period of half a second. This sequence indicates the start of the active fault codes. After a further delay of 2 seconds, the “Warning” lamp will flash repeatedly in order to indicate the active diagnostic codes. Each flash will be on for half a second and off for 300 milliseconds. The “Warning” lamp will remain off for 2 seconds between each digit of a code. If there is more than one active diagnostic code, the “Shutdown” lamp will go off for 2 seconds. The lamp will then come on for a period of half a second. The “Warning” lamp will go off for a period of 2 seconds before starting the next code. If there are no active diagnostic codes, the “Warning” lamp will flash the code “551”. Refer to Troubleshooting Guide, “No Diagnostic Code Detected”.

As an example, an active diagnostic code of “21” is indicated by the “Warning” lamp coming on for 500 ms, then off for 300 ms, then on for 500 ms, then off for 2000 ms, then on for 500 ms and then off.

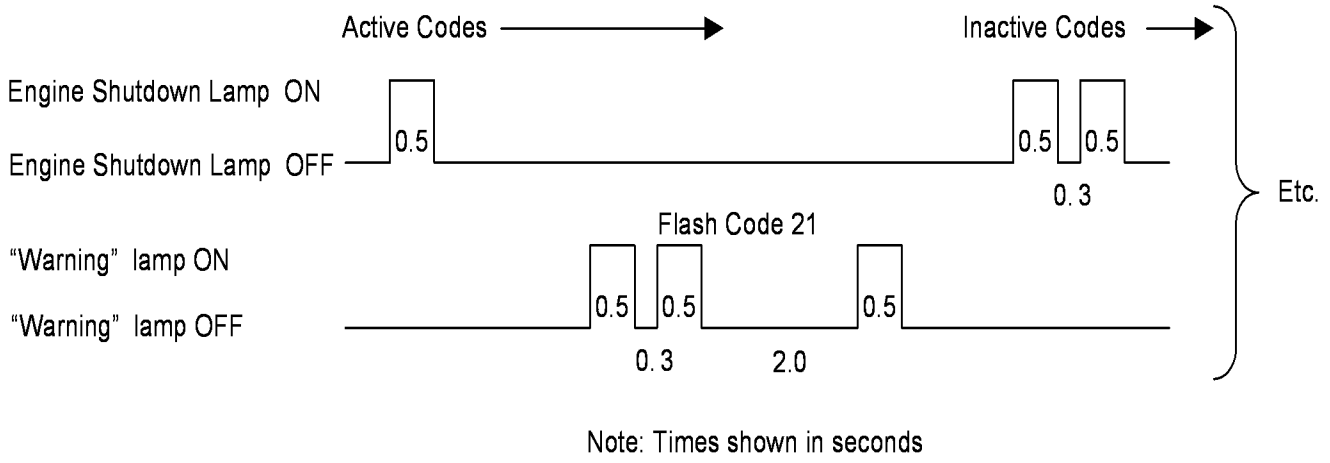


Illustration 5 g01194272

After all of the active diagnostic codes have been displayed, the “Shutdown” lamp will go off for 2 seconds. The “Shutdown” lamp will flash twice in order to indicate the start of the sequence that will display the logged diagnostic codes. The process for flashing logged diagnostic codes is identical to the process for flashing active diagnostic codes.

Note: If there are no logged codes then the “551” code should be flashed again.

After all of the codes have been displayed, the “Shutdown” lamp will flash 3 times in order to indicate that there are no further codes. Cycling the keyswitch twice within a period of 3 seconds will start the process again. All codes will be displayed in ascending numerical order.

Refer to the Troubleshooting Guide, “Diagnostic Codes” for the flash code that is related to the diagnostic code.

Note: Flash codes are always sent in ascending numerical order.

i02517235

Replacing the ECM

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

NOTICE
Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

The engine is equipped with an Electronic Control Module (ECM). The ECM contains no moving parts. Follow the troubleshooting procedures in this manual in order to be sure that replacing the ECM will correct the problem. Verify that the suspect ECM is the cause of the problem.

Note: Ensure that the ECM is receiving power and that the ECM is properly grounded before replacement of the ECM is attempted. Refer to the Schematic Diagram.

A test ECM can be used in order to determine if the ECM on the engine is faulty. Install a test ECM in place of the suspect ECM. Install the flash file into the test ECM. Program the parameters for the test ECM. The parameters must match the parameters in the suspect ECM. Refer to the following test steps for details. If the test ECM resolves the problem, reconnect the suspect ECM. Verify that the problem returns. If the problem returns, replace the ECM.

Use the Electronic Service Tool to read the parameters in the suspect ECM. Record the parameters in the suspect ECM. Install the flash file into the new ECM. After the ECM is installed on the engine, the parameters must be programmed into the new ECM.

Note: When a new ECM is not available, you may need to remove an ECM from an engine that is not in service. The ECM must have the same serial number suffix. Ensure that the replacement ECM and the flash file match the suspect ECM. Be sure to record the parameters from the replacement ECM. Use the “Copy Configuration ECM Replacement” function in the Electronic Service Tool.

NOTICE
If the flash file and engine application are not matched, engine damage may result.

Perform the following procedure in order to replace the ECM.

1. Connect the Electronic Service Tool to the diagnostic connector.

2. Use the “Copy Configuration ECM Replacement” function from the Electronic Service Tool. If the “Copy Configuration” is successful, proceed to Step 5. If the “Copy Configuration” failed, proceed to Step 3.

Note: Record any Logged Faults and Events for your records.

3. Record the following parameters:

   - Record all of the parameters on the “Configuration” screen.
   - Record all of the parameters on the “Throttle Configuration” screen.
   - Record all of the parameters on the “Mode Configuration” screen.
   - Record the serial numbers of the electronic unit injectors. The injector serial numbers are shown on the “Injector Trim Calibration” screen.

Note: If the parameters cannot be read, the parameters must be obtained elsewhere. Some parameters are stamped on the engine information plate, but most parameters must be obtained from the PTMI data on PerkinsSecured Internet.

4. Remove power from the ECM.

5. Remove the ECM. Refer to Disassembly and Assembly, “Electronic Control Module - Remove and Install”.

6. Install the replacement ECM. Refer to Disassembly and Assembly, “Electronic Control Module - Remove and Install”.

7. Download the flash file.

   a. Connect the Electronic Service Tool to the diagnostic connector.

   b. Select “WinFlash” from the “Utilities” menu of the electronic service tool.

   c. Select the downloaded flash file.

8. If necessary, use the electronic service tool to clear the rating interlock. To clear the rating interlock, enter the factory password when the electronic service tool is first connected. Activating the “Test ECM” mode will also clear the rating interlock.

9. Use the electronic service tool to program the parameters. Perform the following procedure.

   a. If the “Copy Configuration” procedure was successful, use the “Copy Configuration, ECM Replacement” function to load the configuration file into the ECM.

Note: During the following procedure, Factory Passwords may be required.

   b. If the “Copy Configuration” procedure failed, configure the parameters individually. The parameters should match the parameters from step 3.

      Perform the “Fuel System Verification Test”.

10. Check for logged diagnostic codes. Factory passwords are required to clear Logged Events.

i02492454

Self-Diagnostics

The Electronic Control Module (ECM) has the ability to detect problems with the electronic system and with engine operation. When a problem is detected, a code is generated. An alarm may also be generated. There are two types of codes:

- Diagnostic
- Event

Diagnostic Code – When a problem with the electronic system is detected, the ECM generates a diagnostic code. This indicates the specific problem with the circuitry.

Diagnostic codes can have two different states:

- Active
- Logged

Active Code – An active diagnostic code indicates that an active problem has been detected by the control system. Active codes require immediate attention. Always service active codes prior to servicing logged codes.

Logged Code – Every generated code is stored in the permanent memory of the ECM. The codes are logged for 100 operating hours unless a code is cleared by use of the electronic service tool.

Event Code – An event code is generated by the detection of an abnormal engine operating condition. For example, an event code will be generated if the oil pressure is too low. In this case, the event code indicates the symptom of a problem.

Logged codes may not indicate that a repair is needed. The problem may have been temporary. The problem may have been resolved since the logging of the code. If the system is powered, it is possible to generate an active diagnostic code whenever a component is disconnected. When the component is reconnected, the code is no longer active. Logged codes may be useful to help troubleshoot intermittent problems. Logged codes can also be used to review the performance of the engine and the electronic system.

i02488455

Sensors and Electrical Connectors

The Electronic Control Module (ECM) and the sensors are located on the left side of the engine. Refer to Figure 6 or 8.

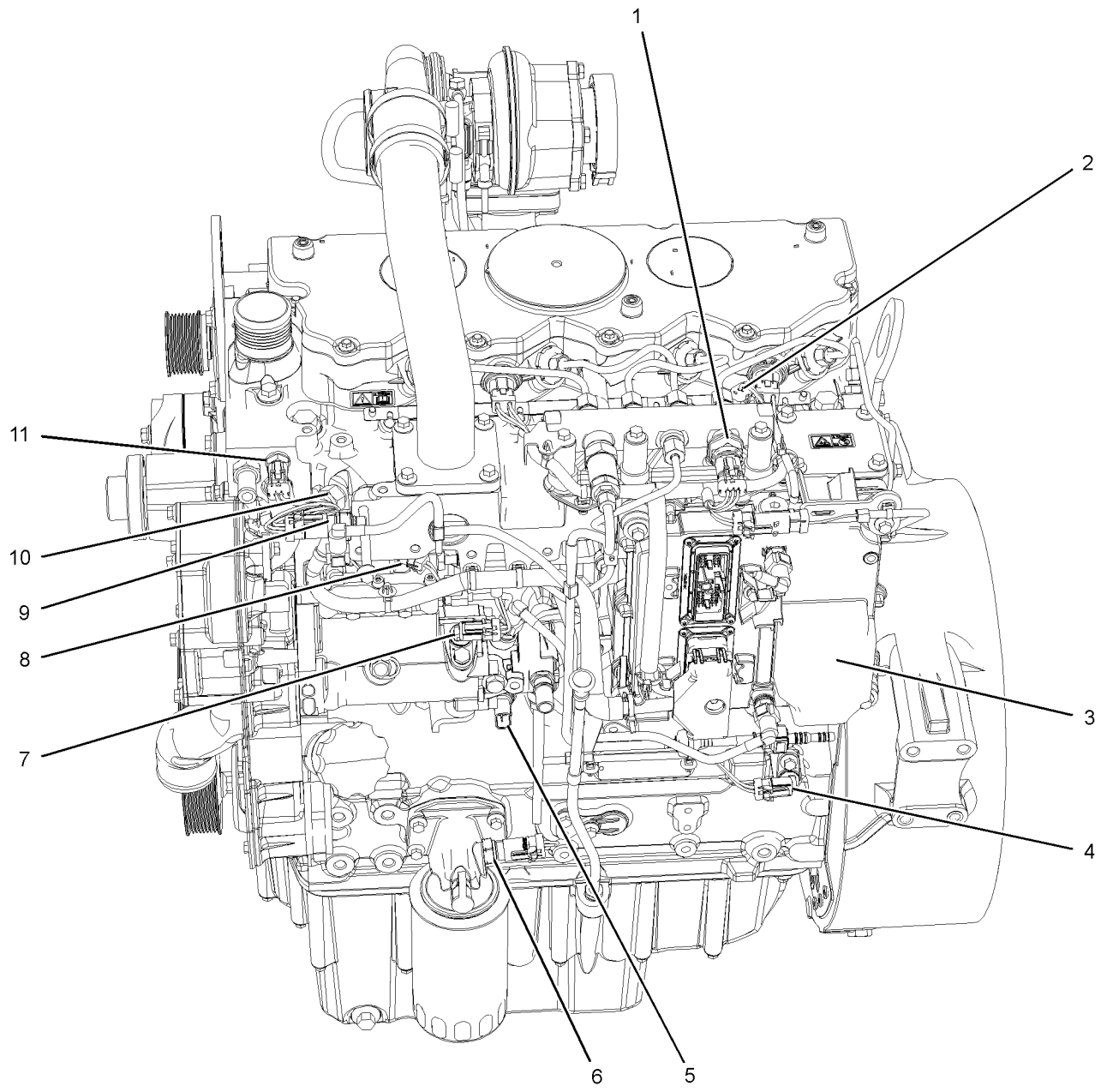


Illustration 6 g01248060

Sensor locations on the 1104D engine

(1) Fuel Rail Pressure Sensor
(2) Intake Manifold Air Temperature Sensor
(3) Electronic Control Module (ECM)
(4) Primary Speed/Timing Sensor
(5) Oil Pressure Sensor
(6) Oil Pressure Sensor (alternative location)
(7) Secondary Speed/Timing Sensor
(8) Solenoid for the Fuel Rail Pump
(9) Intake Manifold Pressure Sensor
(10) Intake Manifold Pressure Sensor (alternative location)
(11) Coolant Temperature Sensor

Note: If equipped, the wastegate regulator is installed on the right side of the engine.

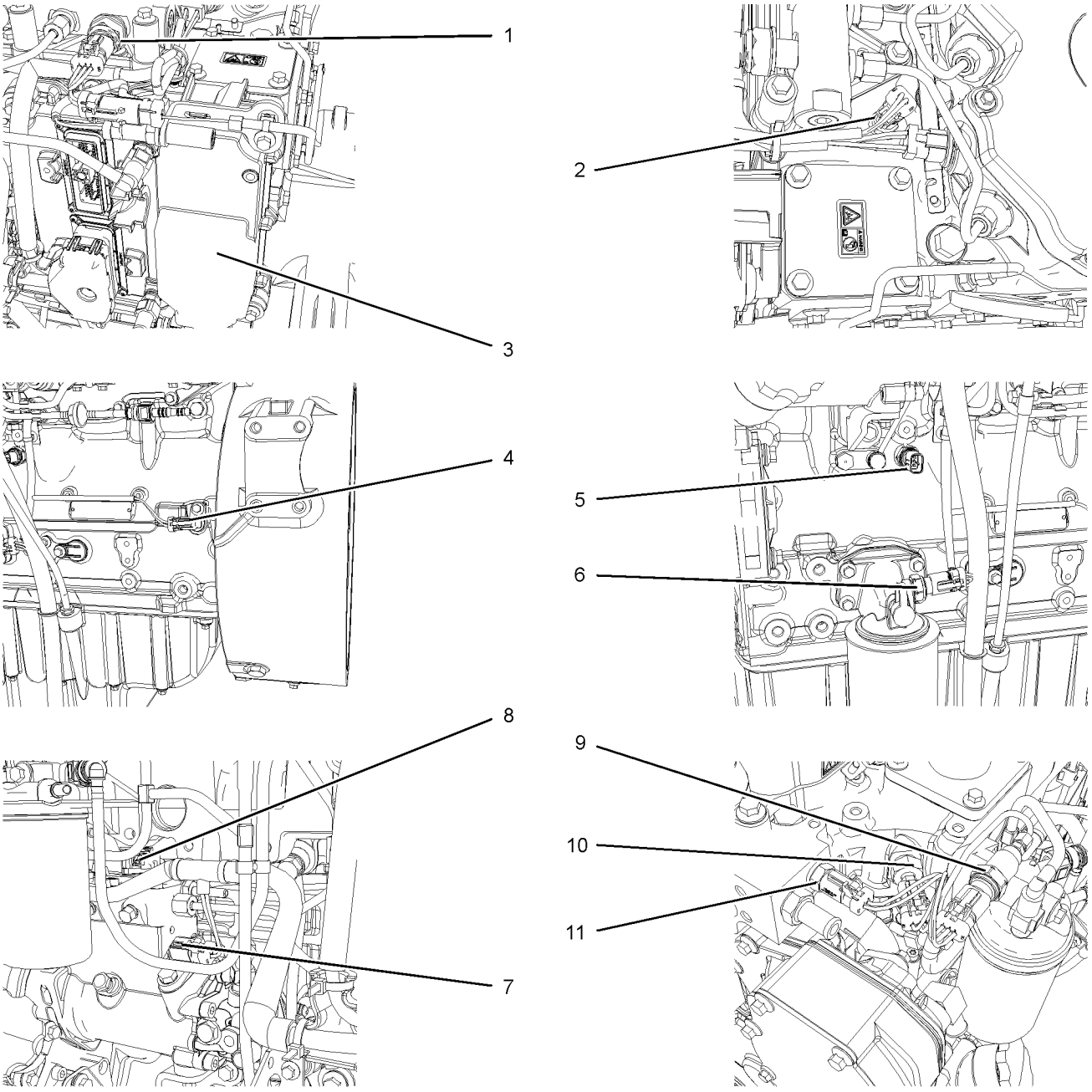
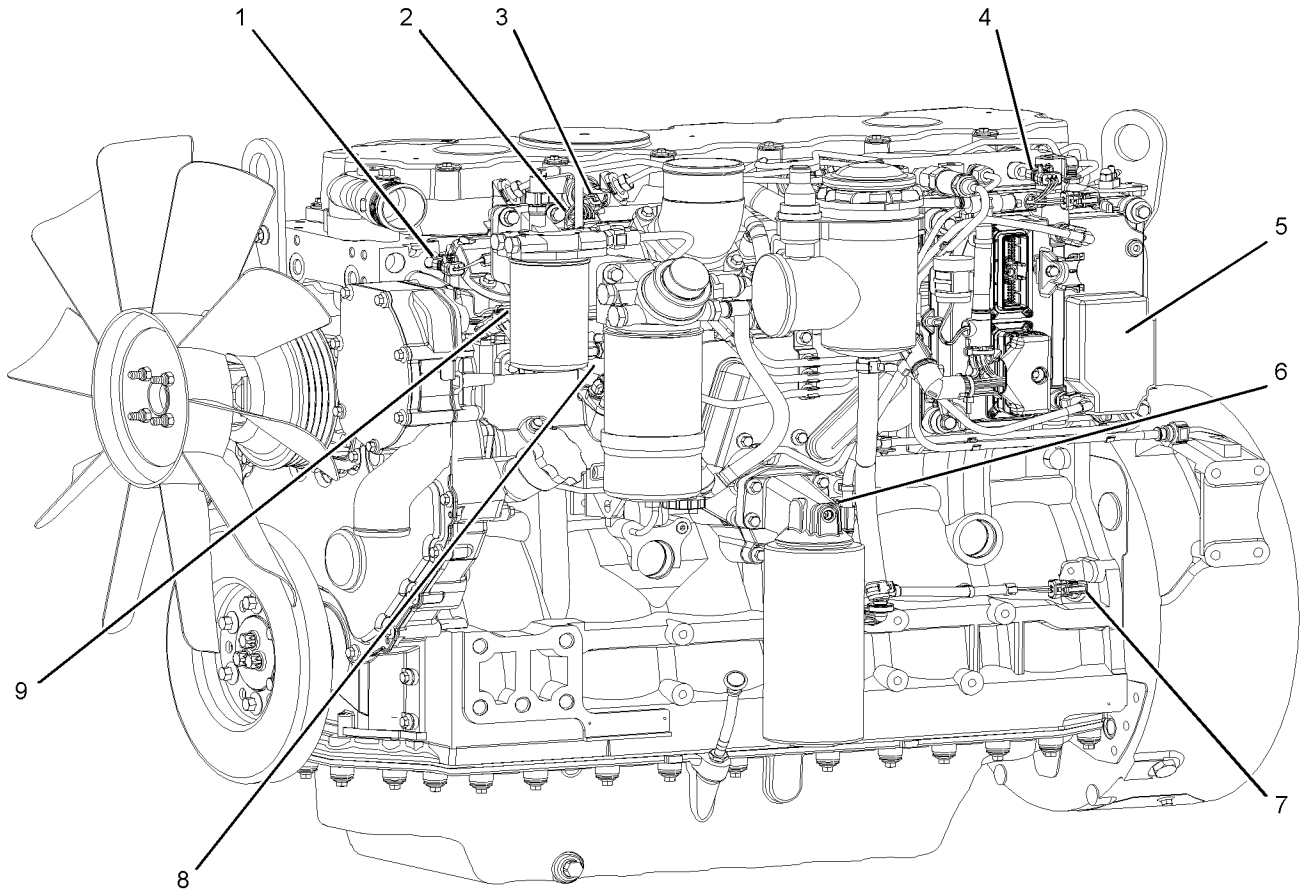


Illustration 7
g01248066

Close up views of the sensor locations on the 1104D engine



g01178874

Illustration 8

Sensor locations on the 1106D engine

(1) Coolant Temperature Sensor
(2) Intake Manifold Air Temperature Sensor
(3) Intake Manifold Pressure Sensor
(4) Fuel Rail Pressure Sensor
(5) Electronic Control Module (ECM)
(6) Oil Pressure Sensor
(7) Primary Speed/Timing Sensor
(8) Secondary Speed/Timing Sensor
(9) Solenoid for the Fuel Rail Pump

Note: If equipped, the wastegate regulator is installed on the right side of the engine.

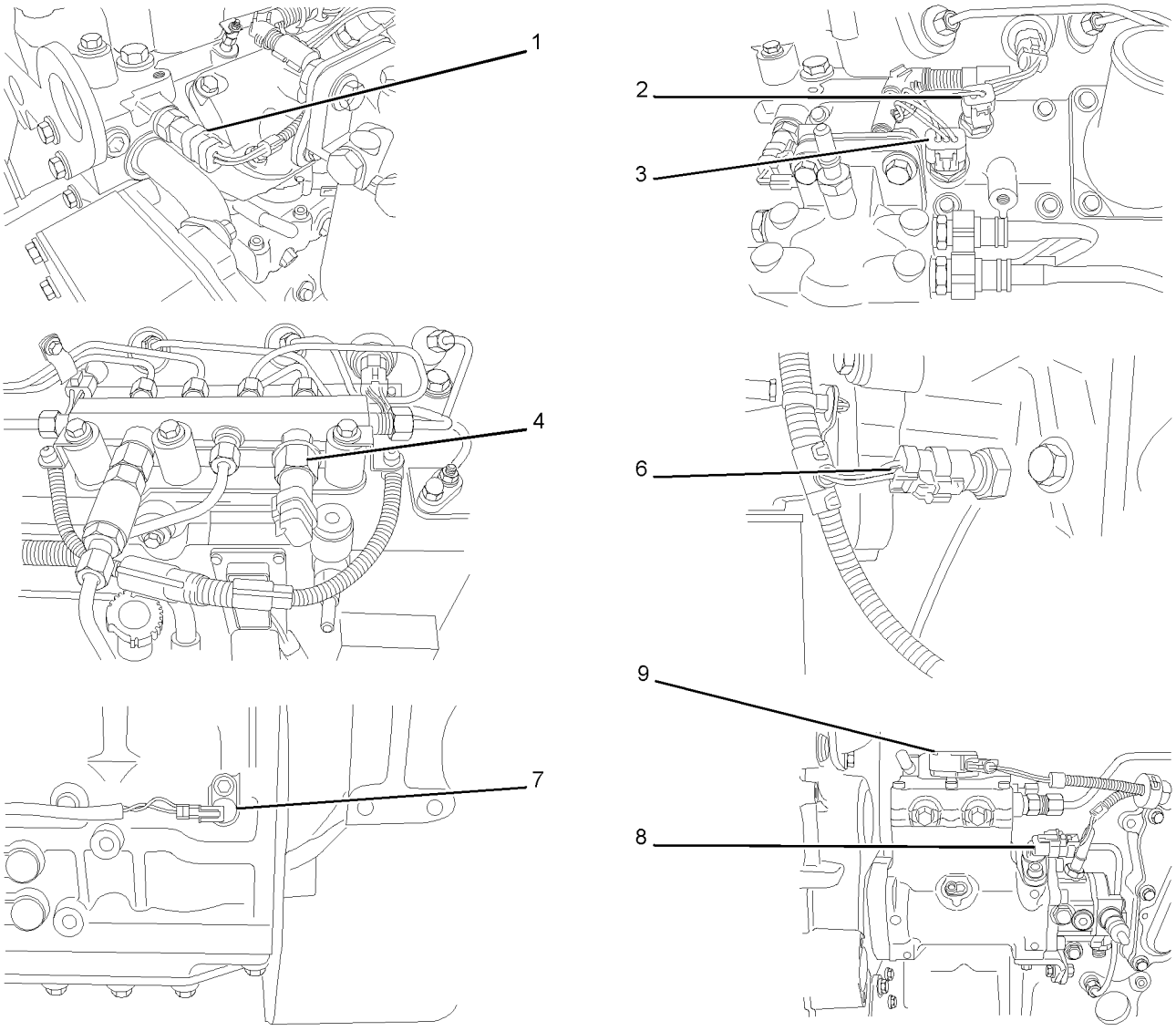


Illustration 9 g01178875

Close up views of the sensor locations on the 1106D engine

Table 5

Connector	Function
P1	Machine Harness to ECM Connector (64 Pin Connector)
P2	Engine Harness to ECM Connector (64 Pin Connector)
P532	Fuel Rail Pump Solenoid Connector (2 Pin Connector)
P402	Secondary Speed/Timing Sensor (2 Pin Connector)
P401	Primary Speed/Timing Sensor (2 Pin Connector)
P201	Engine Oil Pressure Sensor (3 Pin Connector)
P228	Fuel Rail Pressure Sensor (3 Pin Connector)
P200	Intake Manifold Pressure Sensor (3 Pin Connector)
P103	Intake Manifold Air Temperature Sensor (2 Pin Connector)
P100	Coolant Temperature Sensor (2 Pin Connector)
J23	Diagnostic Connector (if equipped)
P691/J691	Electronic Unit Injectors for No. 1 and No. 2 Cylinders (4 Pin Connector)
P692/J692	Electronic Unit Injectors for No. 3 and No. 4 Cylinders (4 Pin Connector)
P693/J693 (1106D engine only)	Electronic Unit Injectors for No. 5 and No. 6 Cylinders (4 Pin Connector)
P511	Wastegate regulator (if equipped) (2 Pin Connector)

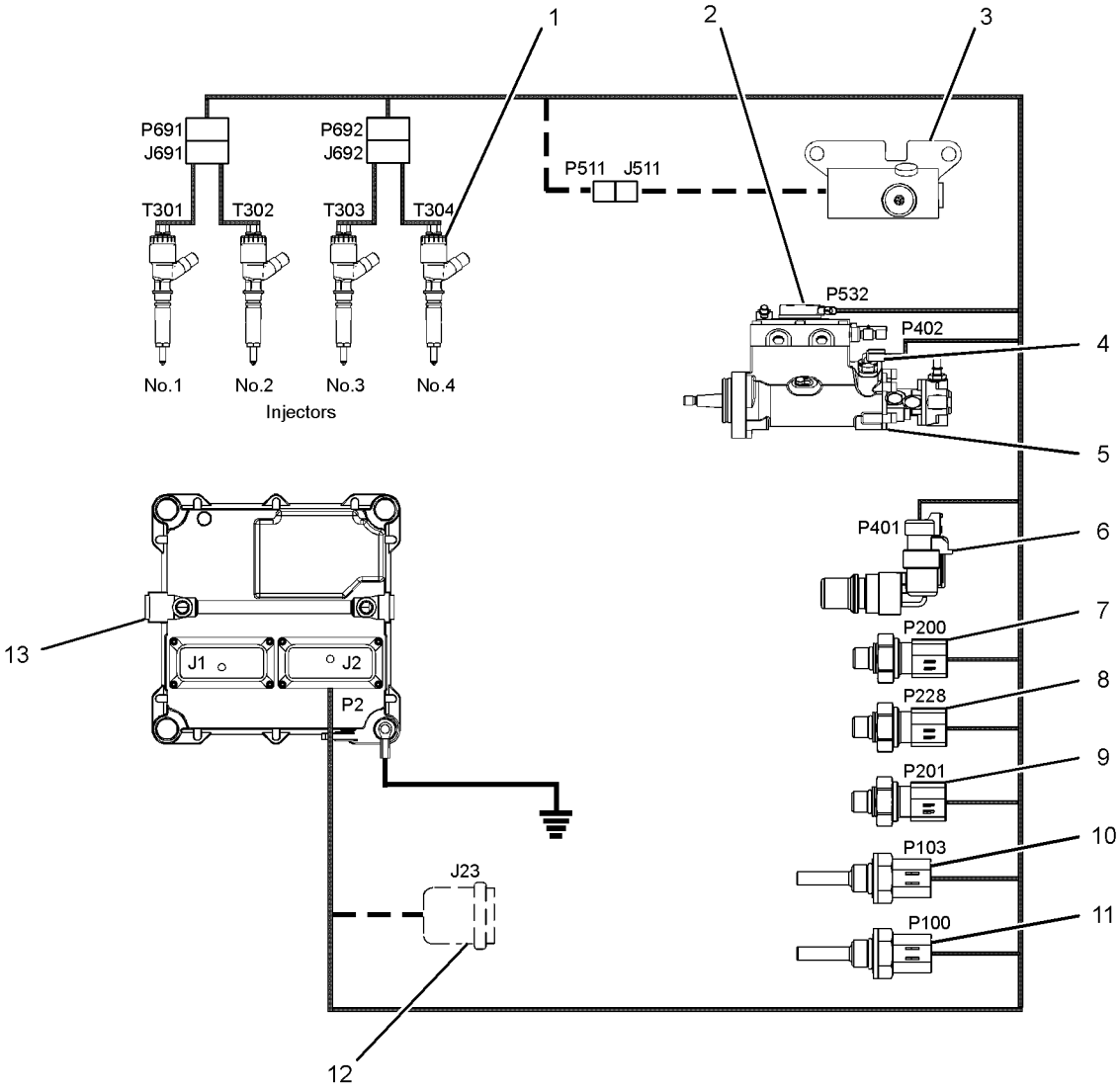


Illustration 10 g01236714

Schematic diagram for the 1104D engine

(1) Electronic Unit Injector
(2) Solenoid for the Fuel Rail Pump
(3) Wastegate Regulator (if equipped)
(4) Secondary Speed/Timing Sensor
(5) Fuel Rail Pump
(6) Primary Speed/Timing Sensor
(7) Intake Manifold Pressure Sensor
(8) Fuel Rail Pressure Sensor
(9) Engine Oil Pressure Sensor
(10) Intake Manifold Air Temperature Sensor
(11) Coolant Temperature Sensor
(12) Diagnostic Connector (if equipped)
(13) Electronic Control Module (ECM)

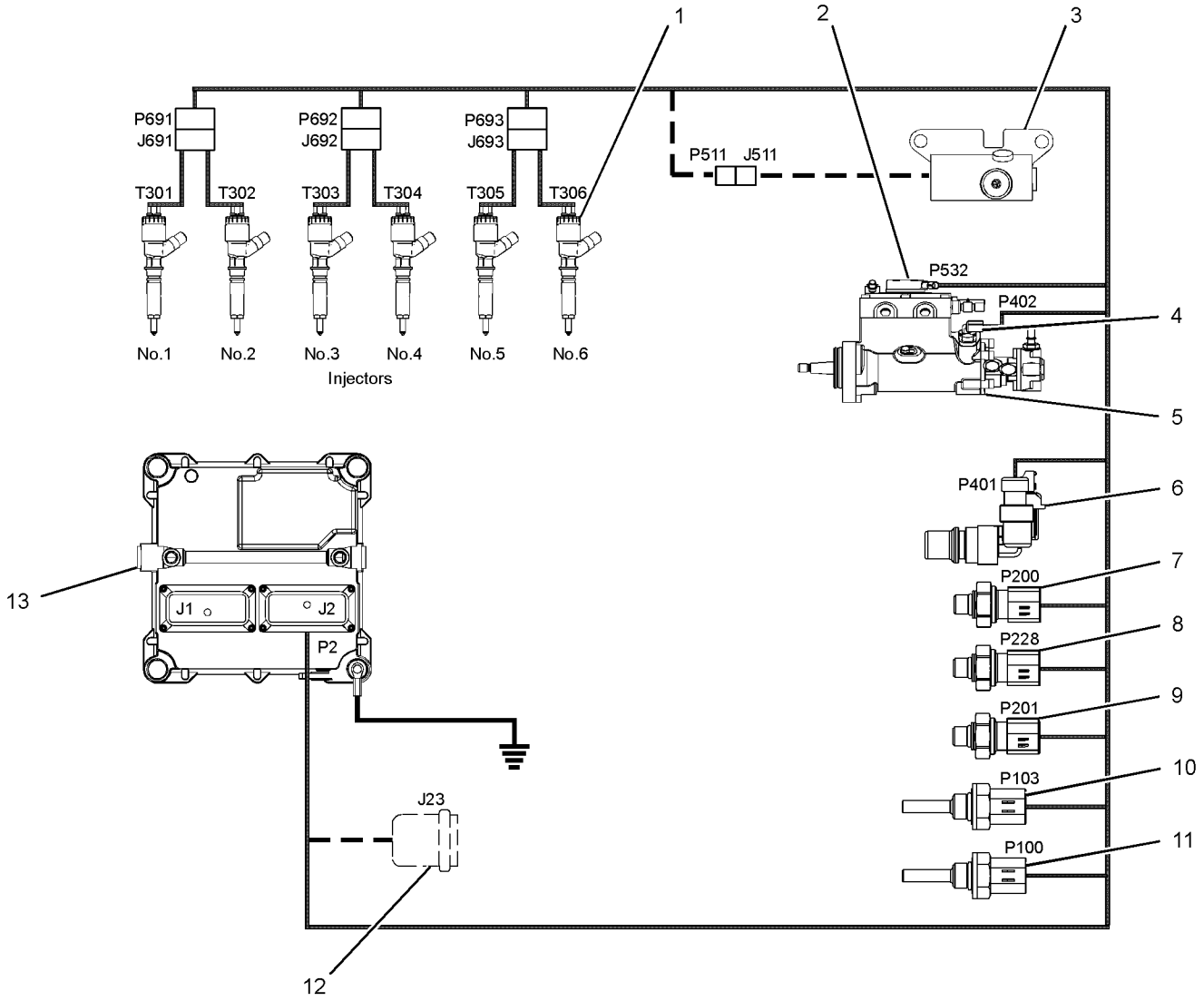


Illustration 11 g01258794

Schematic diagram for the 1106D engine

(1) Electronic Unit Injector
(2) Solenoid for the Fuel Rail Pump
(3) Wastegate Regulator (if equipped)
(4) Secondary Speed/Timing Sensor
(5) Fuel Rail Pump
(6) Primary Speed/Timing Sensor
(7) Intake Manifold Pressure Sensor
(8) Fuel Rail Pressure Sensor
(9) Engine Oil Pressure Sensor
(10) Intake Manifold Air Temperature Sensor
(11) Coolant Temperature Sensor
(12) Diagnostic Connector (if equipped)
(13) Electronic Control Module (ECM)

i02488469

Engine Wiring Information

Harness Wire Identification

Perkins identifies all wires with eleven solid colors. The circuit number is stamped on the wire at a 25 mm (1 inch) spacing. Table 6 lists the wire colors and the color codes.

Table 6

Color Codes for the Harness Wire			
Color Code	**Color**	**Color Code**	**Color**
BK	Black	BU	Blue
BR	Brown	PU	Purple
RD	Red	GY	Gray
OR	Orange	WH	White
YL	Yellow	PK	Pink
GN	Green		

For example, a wire identification of F730-OR on the schematic would signify an orange wire with the circuit number F730. F730-OR identifies the power supply for the oil pressure sensor.

Note: Always replace a harness wire with the same gauge of wire and with the same color code.

Note: In the following diagrams, “Pxxx” signifies a plug and “Jxxx” signifies a jack.

Schematic Diagrams

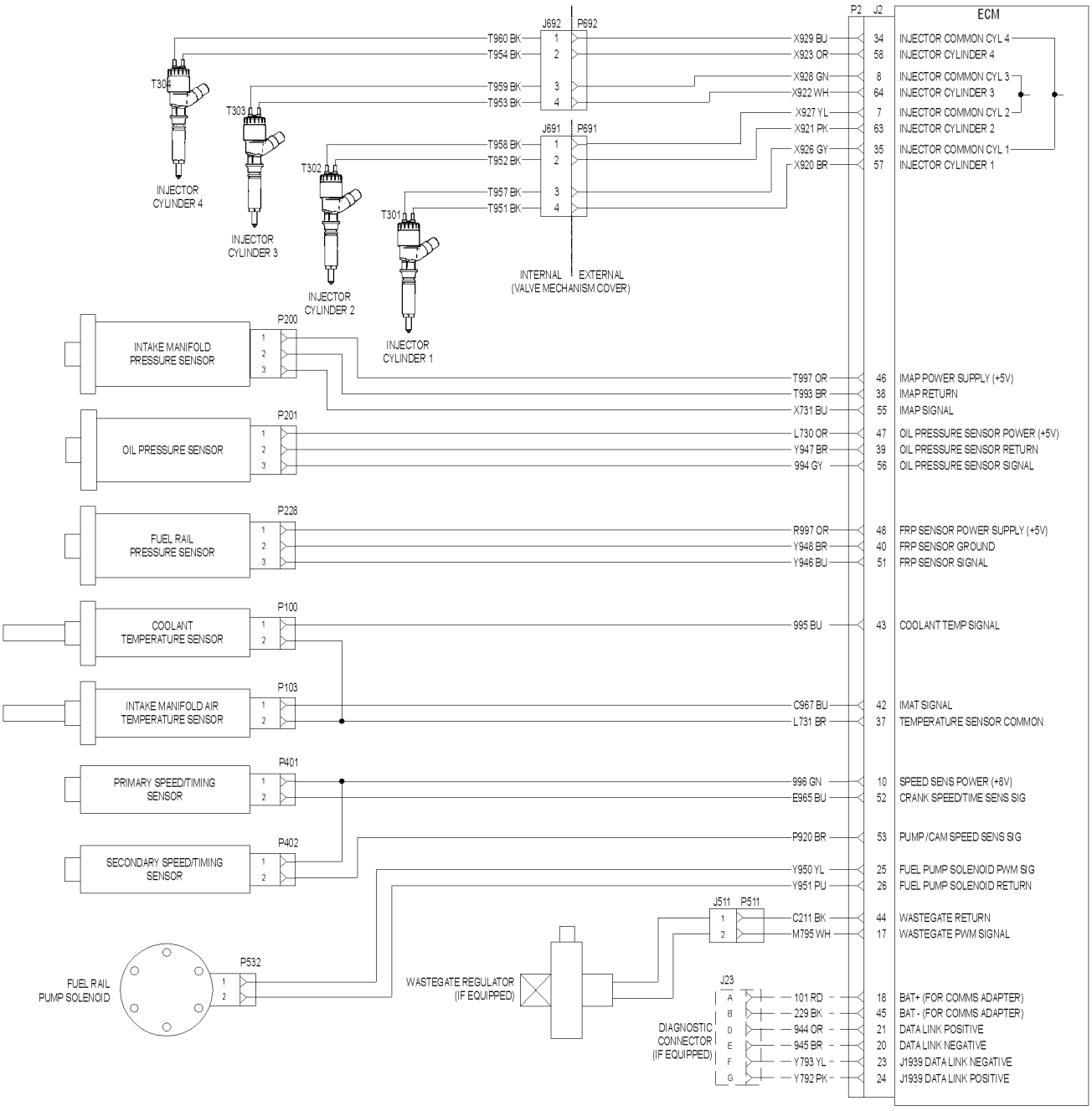


Illustration 12 g01238742

Schematic Diagram for the 1104D Engine Harness

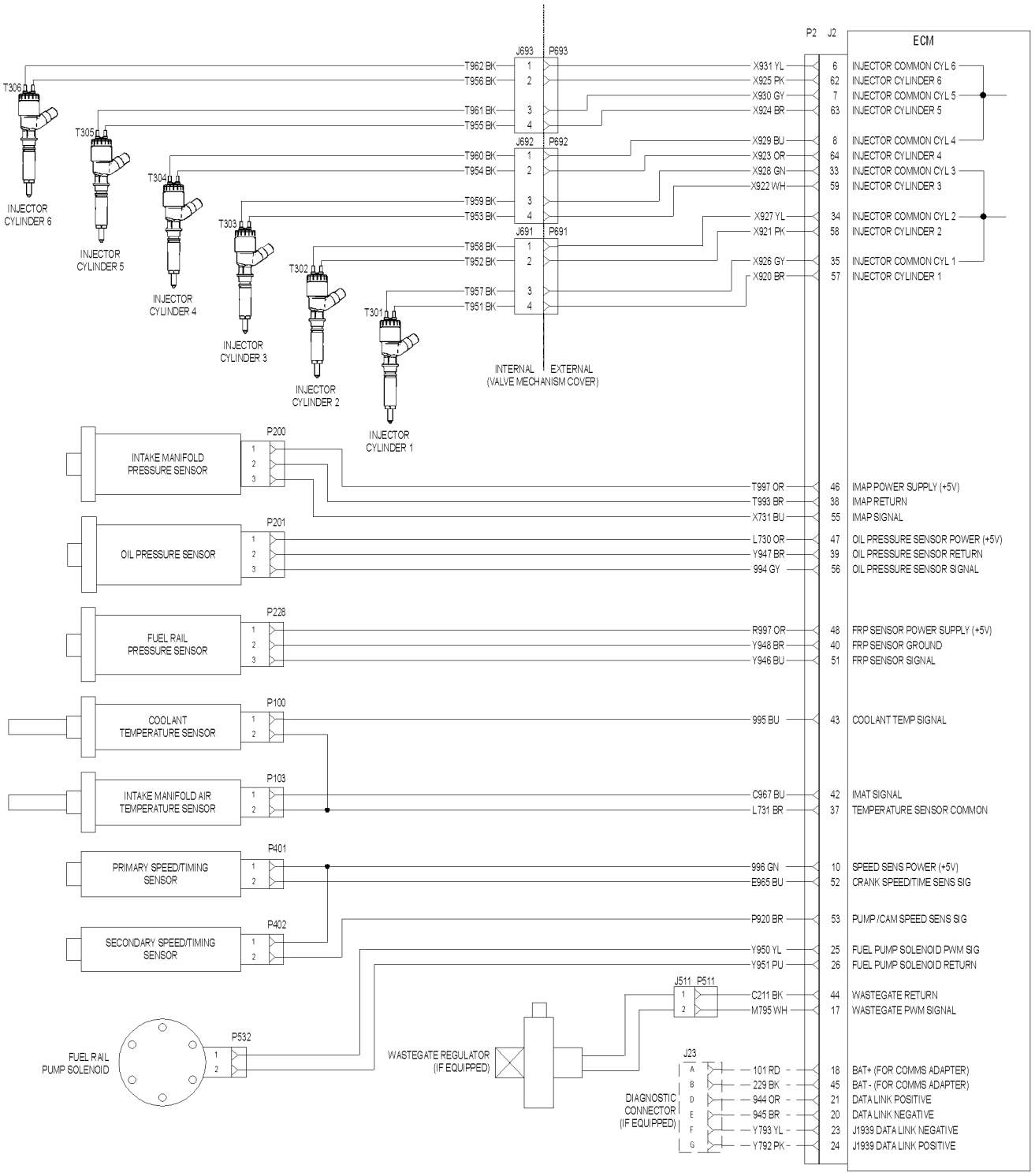


Illustration 13 g01258486

Schematic Diagram for the 1106D Engine Harness

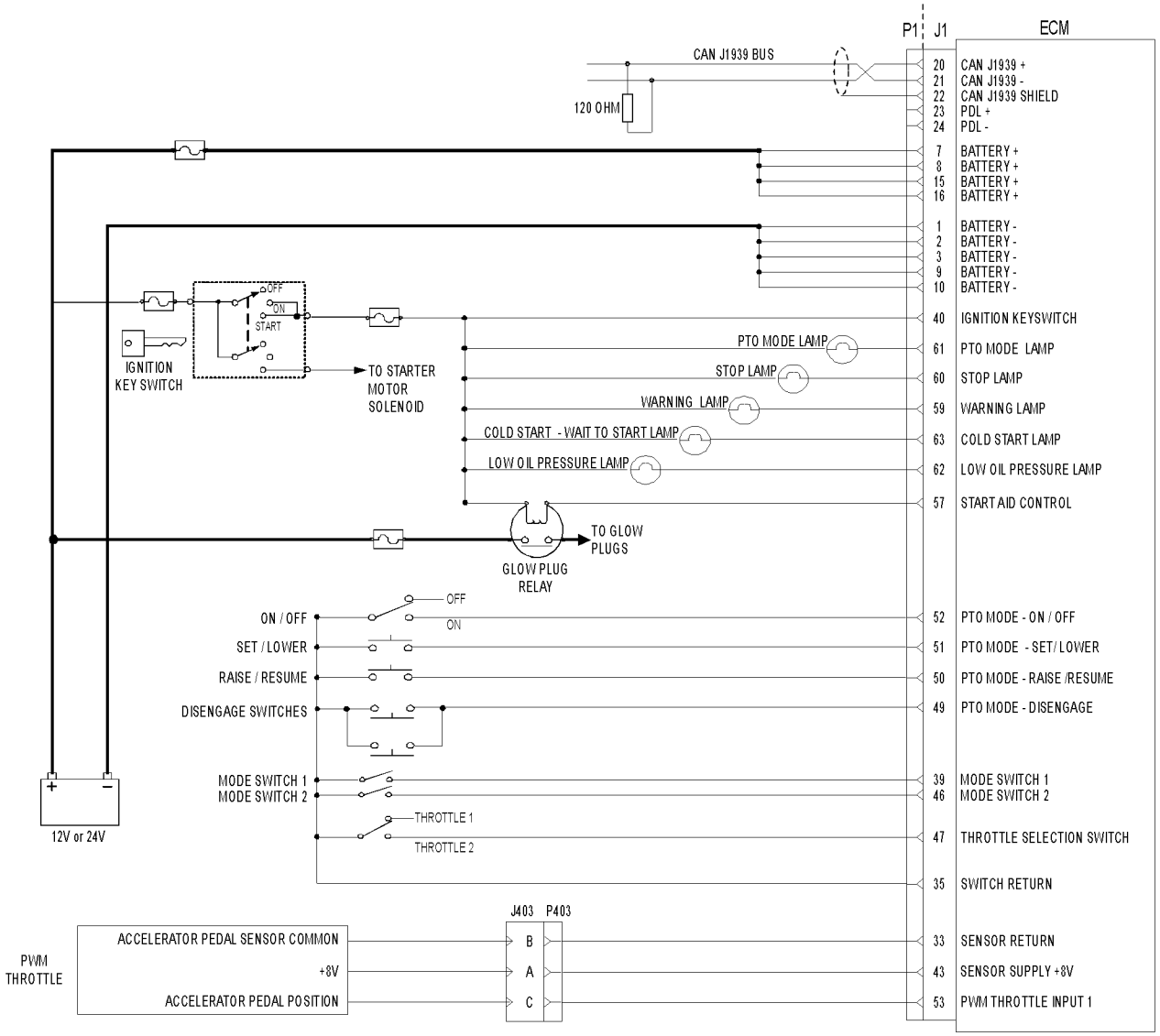


Illustration 14 g01246520

Schematic Diagram for a Typical Application

Note: The functionality of most of the connections to the J1 connector depend on the engine application.

i02414687

ECM Harness Connector Terminals

The Electronic Control Module (ECM) uses connectors that have 64 terminals to interface to the wiring harness.

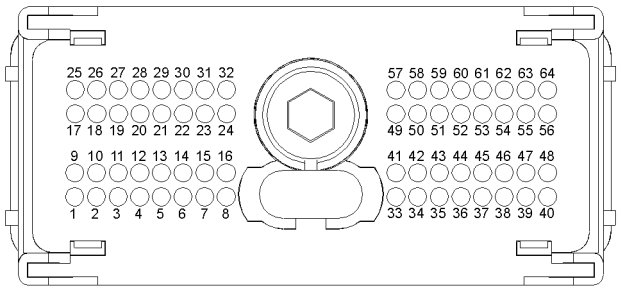


Illustration 15 g01170706

Layout of the Connector Pins (view from the rear)

Removal and Installation of the Harness Connector Terminals

Terminal Removal

Table 7

Required Tools		
Part Number	**Part Description**	**Qty**
27610285	Removal Tool	1

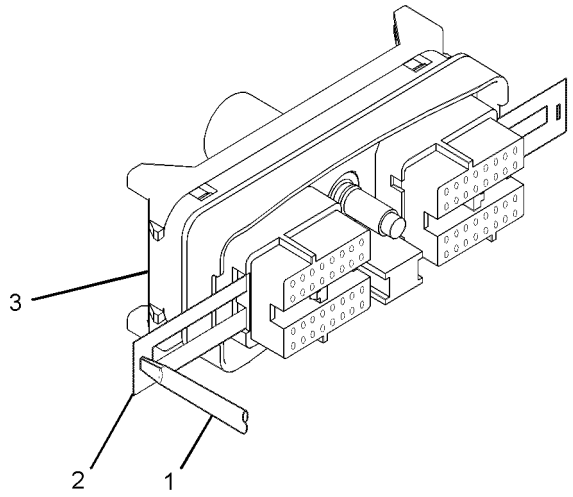


Illustration 16 g01201559

Removal of Terminal Position Assurance Components

1. Remove the connector from the ECM. Refer to Disassembly and Assembly, “Electronic Control Module - Remove and Install”.
2. Use a screwdriver that has a flat blade (1) to remove the two terminal position assurance components (2) from the connector (3).

Note: Do not use the removal tool to remove the terminal position assurance components.

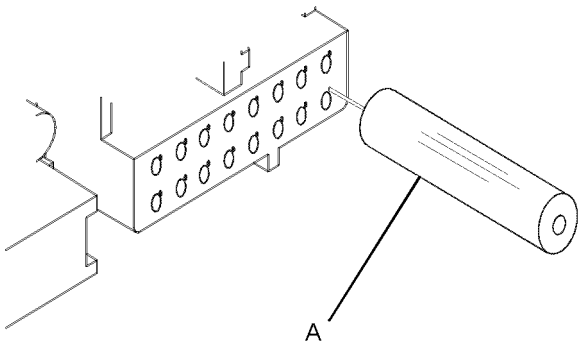


Illustration 17 g01201632

Removal Tool

3. Insert the removal tool into the hole that is adjacent to the terminal in order to release the locking device.

Note: Make sure that the tool stays perpendicular to the face of the connector.

4. Hold the tool in position and gently pull the wire in order to remove the terminal from the rear of the connector (3).
5. Remove the removal tool from the face of the connector (3).

Note: If a terminal must be replaced, part number 28170085 must be used.

Terminal Insertion

1. Push the terminal into the rear of the connector (3) until the terminal engages with the locking device.
2. Gently pull on the wire in order to make sure that the terminal is retained by the locking device.
3. Install the two terminal position assurance components (2) into the sides of the connector (3).
4. Connect the connector to the ECM. Refer to Disassembly and Assembly, “Electronic Control Module - Remove and Install”.

Programming Parameters

i02415216

Programming Parameters

The electronic service tool can be used to view certain parameters that can affect the operation of the engine. The electronic service tool can also be used to change certain parameters. The parameters are stored in the Electronic Control Module (ECM). Some of the parameters are protected from unauthorized changes by passwords. Parameters that can be changed have a tattletale number. The tattletale number shows if a parameter has been changed.

i02415218

Test ECM Mode

"Test ECM Mode" is a feature in the software that can be used to help troubleshoot an engine that may have a problem with the Electronic Control Module (ECM). This feature allows a standard ECM to be used as a test ECM. This feature eliminates the need to stock a test ECM.

1. Search for the latest flash file for the engine.

Note: If a newer software version is available for the engine, install the newest software on the suspect ECM. If the new software does not fix the problem continue with this procedure.

2. Use the "Copy Configuration" feature on the electronic service tool to copy the parameters from the suspect ECM.

Note: If the "ECM Replacement" feature cannot be used, record the programmed values into the "Customer Specified Parameters Worksheet". Also record the system configuration parameters.

3. Disconnect the suspect ECM. Temporarily connect the test ECM to the engine. Do not mount the test ECM on the engine.

4. Flash program the test ECM with the newest software that is available.

5. Start the "Test ECM Mode" on the electronic service tool. Access the feature through the "Service" menu. The electronic service tool will display the status of the test ECM and the hours that are remaining for the "Test ECM Mode".

Note: "Test ECM Mode" can only be activated if the engine serial number has not already been programmed during normal operation of the ECM. If the engine serial number is programmed and the ECM is not in "Test ECM Mode", the ECM can never be used as a test ECM.

6. Use the "Copy Configuration" feature on the electronic service tool to program the test ECM.

Note: If the "ECM Replacement" feature can not be used, program the test ECM with the values from the "Customer Specified Parameters Worksheet" and the values from the System Configuration Parameters.

7. Program the engine serial number into the test ECM.

Note: The "Test ECM Mode" must be activated before the engine serial number is programmed into the ECM.

8. Verify that the test ECM fixes the problem.

When the "Test ECM Mode" is activated, an internal timer sets a 24 hour clock. This clock will count down only while the ECM is powered and the keyswitch is in the ON position. After the ECM has counted down the 24 hour period, the ECM will exit the "Test ECM Mode". The parameters and the engine serial number will be set.

If the test ECM fixes the problem, the engine can be released while the "Test ECM Mode" is still active.

Once an ECM has been activated in the "Test ECM Mode", the ECM will stay in the "Test ECM Mode" until the timer times out. If the ECM is used as a test ECM for more than one engine, the "Test ECM Mode" must be reactivated. Anytime prior to the "Test ECM Mode" timing out, the ECM can be reset to 24 hours.

i02415222

ECM Snapshot

The Electronic Control Module (ECM) can record a snapshot of certain engine parameters. The snapshot records the parameters for a period of 13 seconds that surround an event. The following events trigger snapshots:

- Certain diagnostic codes
- Operator request

The ECM can store a maximum of two snapshots that are triggered by a diagnostic code. Two snapshots can be triggered manually. The snapshots are stored in a circular buffer. The newest snapshot will replace the oldest snapshot.

The ECM stores the snapshots in memory. Snapshots are maintained in the ECM until the snapshots are cleared. The following conditions will clear a snapshot:

- Operator request via the electronic service tool
- The snapshot has been stored for 100 hours of engine operation.

Snapshot That is Triggered by a Diagnostic Code

When certain diagnostic codes occur, the ECM records many of the status parameters that are available on the electronic service tool. The ECM records this information for approximately nine seconds before the code occurs and approximately four seconds after the code occurs.

Snapshot That is Triggered by the Operator

A snapshot can be triggered by the operator by using the electronic service tool.

On the electronic service tool, the snapshot can be triggered from the “Snapshot Recorder Tool”. Refer to the instructions on the screen or refer to the documentation for help on the system.

The “Raise/Resume” switch for the Power Take Off (PTO) may be able to generate a snapshot, if the option is installed.

If a snapshot can be generated by use of the “Raise/Resume” switch for the PTO, perform the following procedure to trigger a snapshot:

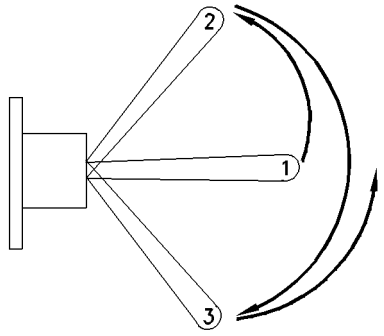


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Illustration 18

Typical “Raise/Resume” Switch for the PTO

(1) OFF position
(2) RAISE position
(3) RESUME position

1. Toggle the switch quickly from the OFF position (1) to the RAISE position (2).
2. Toggle the switch quickly from the RAISE position (2) to the RESUME position (3).
3. Toggle the switch quickly from the RESUME position (3) back to the OFF position (1).

Note: All three steps must occur within a one second time period in order to take a snapshot. Performing the steps in the reverse order also triggers a snapshot.

Use of Snapshot Data

Use snapshot data only to help determine engine operating conditions when an intermittent problem occurs. If an intermittent diagnostic code is causing problems, use the snapshot data. Snapshot data can be used to determine whether the problem occurs under specific circumstances. The following list contains examples of specific circumstances:

- Engine rpm
- Range of coolant temperatures

Use the snapshot data in order to determine the operating conditions that were present during the event. Attempt to duplicate the conditions in order to get the code to recur.

Replacement of electronic components should not be based on snapshot data alone. If too much emphasis is put on snapshot data, the result could be a misdiagnosed root cause. Also when snapshot data that is triggered by a diagnostic code is being viewed, the ECM sets a sensor value with an active diagnostic code to a default value when the code is active. This is the reason that the sensor value suddenly jumps to a specific value at the trigger point and the sensor value remains at the specific value for the rest of the snapshot frames.

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Factory Passwords

NOTICE
Operating the engine with a flash file not designed for that engine will damage the engine. Be sure the flash file is correct for your engine.

Note: Factory passwords are provided only to Perkins dealers.

Factory passwords are required to perform each of the following functions:

- Program a new Electronic Control Module (ECM).

  When an ECM is replaced, the system configuration parameters must be programmed into the new ECM. A new ECM will allow these parameters to be programmed once without factory passwords. After the initial programming, some parameters are protected by factory passwords.

- Rerate the engine.

  This may require changing the interlock code, which is protected by factory passwords.

- Clear engine events and certain diagnostic codes.

  Most engine events require factory passwords in order to clear the code from ECM memory. Clear these codes only when you are certain that the problem has been corrected. For example, the E362-1 Engine Overspeed requires the use of factory passwords in order to clear the code from ECM memory.

Since factory passwords contain alphabetic characters, the electronic service tool must be used to perform these functions. In order to obtain factory passwords, proceed as if you already have the password. If factory passwords are needed, the electronic service tool will request the factory passwords and the electronic service tool will display the information that is required to obtain the passwords. For the worksheet that is used for acquiring factory passwords, refer to Troubleshooting, “Factory Passwords Worksheet”.

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Factory Passwords Worksheet

Note: A mistake in recording these parameters will result in incorrect passwords.

Table 8

Factory Passwords Worksheet	
Dealer Code	
Customer’s Name	
Address	
Telephone Number	
Information From the Engine Information Plate	
Engine Serial Number	
Full Load Setting	
Full Torque Setting	
Information From the Diagnostic Clock	
Miles, Kilometers or Hours (As applicable)	
Information From the “Factory Password Entry Screen” on the Electronic Service Tool	
Electronic Service Tool Serial Number	
Engine Serial Number	
ECM Serial Number	
Total Tattletale	
Reason Code	
From Interlock(1)	
To Interlock(1)	
Factory Passwords	
Factory Password (No. 1)	
Factory Password (No. 2)	

(1) This parameter is required when the engine is being rerated.

i02415238

Flash Programming

Flash Programming – A method of loading a flash file into the Electronic Control Module (ECM)

The electronic service tool can be utilized to flash program a flash file into the ECM. The flash programming transfers the flash file from the PC to the ECM.

Flash Programming a Flash File

1. Obtain the part number for the new flash file.

Note: If you do not have the part number for the flash file, use “PTMI” on the Perkins Internet.

Note: You must have the engine serial number in order to search for the flash file's part number.

2. Connect the electronic service tool to the service tool connector.

3. Turn the keyswitch to the ON position. Do not start the engine.

4. Select "WinFlash" from the "Utilities" menu on the electronic service tool.

Note: If "WinFlash" will not communicate with the ECM, refer to Troubleshooting, "Electronic Service Tool Will Not Communicate with ECM".

5. Flash program the flash file into the ECM.

   a. Select the engine ECM under the "Detected ECMs".

   b. Press the "Browse" button in order to select the part number of the flash file that will be programmed into the ECM.

   c. When the correct flash file is selected, press the "Open" button.

   d. Verify that the "File Values" match the application. If the "File Values" do not match the application, search for the correct flash file.

   e. When the correct flash file is selected, press the "Begin Flash" button.

   f. The electronic service tool will indicate when flash programming has been successfully completed.

6. Start the engine and check for proper operation.

7. Access the "Configuration" screen under the "Service" menu in order to determine the parameters that require programming. Look under the "Tattletale" column. All of the parameters should have a tattletale of 1 or more. If a parameter has a tattletale of 0, program that parameter.

"WinFlash" Error Messages

If you receive any error messages during flash programming, click on the "Cancel" button in order to stop the process. Access the information about the "ECM Summary" under the "Information" menu. Ensure that you are programming the correct flash file for your engine.

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Injector Trim File

The electronic service tool is used to load the injector trim files into the Electronic Control Module (ECM).

The injector trim files must be loaded into the ECM if any of the following conditions occur:

- An electronic unit injector is replaced.
- The ECM is replaced.
- Diagnostic code 0268-02 is active.
- Electronic unit injectors are exchanged between cylinders.

Exchanging Electronic Unit Injectors

Exchanging electronic unit injectors can help determine if a combustion problem is in the electronic unit injector or in the cylinder. If two electronic unit injectors that are currently installed in the engine are exchanged between cylinders, the injector trim files can also be exchanged. Press the "Exchange" button at the bottom of the "Injector Trim Calibration" screen on the electronic service tool. Select the two electronic unit injectors that will be exchanged and press the "OK" button. The tattletale for the electronic unit injectors that were exchanged will increase by one.

Note: The serial number for the electronic unit injector and the confirmation code number for the electronic unit injector are located on the electronic unit injector.

1. Record the serial number and the confirmation code number for each electronic unit injector.

2. Obtain the injector trim file by one of the following methods:

   - Select "Service Software Files" on the Perkins Internet.
   - Use the compact disc that is included with a replacement electronic unit injector.

3. Enter the serial number for the electronic unit injector in the search field.

4. Download the injector trim file to the PC. Repeat this procedure for each electronic unit injector, as required.

5. Connect the electronic service tool to the service tool connector. Refer to Troubleshooting, “Electronic Service Tools”.

6. Turn the keyswitch to the ON position.

7. Select the following menu options on the electronic service tool:

   - Service
   - Calibrations
   - Injector Trim Calibration

8. Select the appropriate cylinder.

9. Click on the “Change” button.

10. Select the appropriate injector trim file from the PC.

11. Click on the “Open” button.

12. If you are prompted by the electronic service tool, enter the confirmation code number for the electronic unit injector into the field.

13. Click on the “OK” button.

    The injector trim file is loaded into the ECM.

14. Repeat the procedure for each cylinder, as required.

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Mode Switch Setup

The Mode Switches can be used to change the performance characteristics of the engine. The electronic service tool is used to program the characteristics. Select the “Service” drop-down menu and then select “Engine Operating Mode Configuration”. A maximum of two switches can be used. “Switch 1” is connected to J1:39 Mode Switch 1. “Switch 2” is connected to J1:46 Mode Switch 2. The other contact on both switches is connected to J1:35 Switch Return.

Number of Switch Inputs

This is the total number of switches that will be used. The switches can be individual switches or a multiple rotary switch.

Table 9

Range	Default
0 to 2	0

Mode Selection Number

This parameter is a non-programmable parameter that represents the number of possible combinations of switch positions. This parameter is based on the value that is programmed into the “Number of Switch Inputs” parameter.

Mode Selection Switch Input 2 and Mode Selection Switch Input 1

The number of these non-programmable parameters that are visible depends on the value that is programmed into the “Number of Switch Inputs” parameter. “Open” signifies that the switch is in the OFF position. “Ground” signifies that the switch is in the ON position.

Enabled

If “Yes” is selected on the drop-down menu, the ECM is programmed to use the values that are programmed into “Rating Number”, “Throttle 1 Droop Percentage”, “Throttle 2 Droop Percentage” and “TSC1 Droop Percentage” for the given combination of switch positions.

Table 10

Values	Default	Factory Password
Yes No	No	Yes

Rating Number

This parameter is the engine rating that is used by the Electronic Control Module (ECM) for a given combination of switch positions. There is a maximum of four ratings in a flash file.

Table 11

Range	Default	Factory Password
1 to the maximum number of ratings in the currently installed Flash File	1	No

Rated Speed (RPM)

This parameter represents the engine speed that is selected when the mode switch or the mode switches are in a particular position.

Table 12

Range	Default	Factory Password
“Programmed Low Idle” to “Programmed High Idle”	5.0%	No

Throttle 1 Droop Percentage

This parameter represents the amount of droop that is applied to the “Throttle 1” input.

Table 13

Range	Default	Factory Password
0 to 10 percent	5.0%	No

Throttle 2 Droop Percentage

This parameter represents the amount of droop that is applied to the “Throttle 2” input.

Table 14

Range	Default	Factory Password
0 to 10 percent	5.0%	No

TSC1 Droop Percentage

This parameter represents the amount of droop that is applied to the “Torque Speed Control 1(TSC1)” input.

Table 15

Range	Default	Factory Password
0 to 10 percent	5.1%	No

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Throttle Setup

The engine can have a digital throttle that uses a Pulse Width Modulated (PWM) signal, an analog throttle or a multi-position switched throttle. The Electronic Control Module (ECM) must be programmed for the type of throttle input that is being used.

Table 16

Throttle 1	Throttle 2
PWM (Digital Throttle)	Analog Throttle
PWM (Digital Throttle)	None
PWM (Digital Throttle)	Multi-position Throttle Switch
Analog Throttle	Analog Throttle
Analog Throttle	None
Analog Throttle	Multi-position Throttle Switch
None	Analog Throttle
None	None
None	Multi-position Throttle Switch
Multi-position Throttle Switch	Analog Throttle
Multi-position Throttle Switch	None

The throttle is set up using the electronic service tool. From the menu, select “Services”. On the “Services” screen, select “Throttle Configuration”. Select the type of throttle from the following list:

- No throttle
- Analog throttle
- PWM throttle
- Multi-position switch

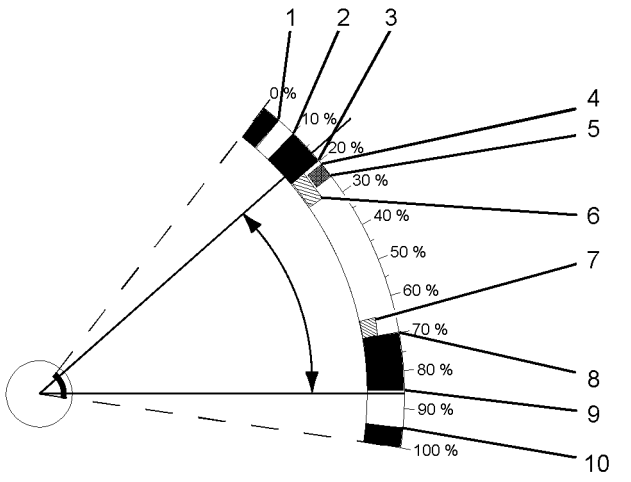

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Illustration 19

Typical Range of Throttle

(1) Lower Diagnostic Limit (Default=5)
(2) Lower Position Limit (Default=10)
(3) Initial Lower Position (Default=20)
(4) Idle Validation Minimum Off Threshold (Default=21)
(5) Idle Validation Maximum On Threshold (Default=25)
(6) Lower Dead Zone % (Default=5)
(7) Upper Dead Zone % (Default=5)
(8) Initial Upper Position (Default=70)
(9) Upper Position Limit (Default=85)
(10) Upper Diagnostic Limit (Default=90)

PWM throttles require additional programming. If a multi-position switch is selected, additional parameters must be programmed. Refer to the Troubleshooting Guide, “Multiposition Switch Setup”. If an analog throttle is selected, the following parameters must be programmed into the ECM.

Idle Validation

All analog throttles on mobile applications require an idle validation switch. If this parameter is programmed to “Yes”, the ECM will look for this switch input on pin J1:P45 for Idle Validation Switch 1 (IVS1) and J1:P44 for Idle Validation Switch 2 (IVS2).

Table 17

Values	Default
No Yes	Yes

Idle Validation Minimum Off (Open) Threshold

This is the minimum throttle percentage that will be detected by the ECM when the IVS is ON (Closed).

If the ECM detects a throttle percentage below this value with the idle validation switch OFF (Open), a fault code will be generated and the engine will remain at idle.

Refer to Table 18 and Table 19.

Table 18

Throttle Position Sensor (TPS)	Idle Validation Switch (IVS)	Throttle Demand Output	Fault Status	Comment
TPS< IVS Min OFF	OFF	Minimum Position	Raise missing idle	Force throttle demand to minimum
TPS< IVS Min OFF	ON	Throttle Position	Clear missing idle	Normal operation

Table 19

Range	Default
0 to 100%	21%

Idle Validation Maximum On (Closed) Threshold

This is the maximum throttle percentage that will be detected by the ECM when the idle validation switch (IVS) is OFF (Open) . When the idle validation switch is OFF (Open) and the ECM detects a signal that is higher than the programmed value for IVS Max ON, the ECM will generate a fault code and the engine will remain at idle.

Refer to Table 20 and Table 21.

Table 20

Throttle Position Sensor (TPS)	Idle Validation Switch (IVS)	Throttle Demand Output	Fault Status	Comment
TPS> IVS Max ON	OFF	Throttle Position	Clear unexpected idle	Normal operation
TPS< IVS Min Off	ON	Minimum Position	Raise unexpected idle.	Force throttle demand to minimum

Table 21

Range	Default
0 to 100%	25%

Lower Diagnostic Limit

This is the minimum throttle percentage that should be detected by the ECM in normal operation when the pedal is in the “off” position. A value below this limit will generate a short circuit diagnostic code. The range of this diagnostic detection area is from 0 percent to the programmed value for the lower position limit.

Table 22

Range	Default
0 to 100%	5%

Upper Diagnostic Limit

This is the minimum throttle percentage that is detected by the ECM in normal operation when the pedal is in the maximum position. A value above this limit will generate an open circuit diagnostic code. The range of this diagnostic detection area is from the programmed value of the upper position limit to 100 percent.

Table 23

Range	Default
0 to 100%	95%

Lower Position Limit

This is the minimum throttle percentage that will be interpreted by the ECM as zero throttle. This parameter is used with the value of initial lower position limit to make an allowance for manufacturing tolerances between different pedals.

Table 24

Range	Default
0 to 100%	10%

Upper Position Limit

This is the maximum throttle percentage that will be interpreted by the ECM as full throttle. This parameter is used with the value of the initial upper position limit to make an allowance for manufacturing tolerances between different pedals.

Table 25

Range	Default
0 to 100%	85%

Initial Lower Position Limit

This is the maximum throttle percentage that will be interpreted by the ECM as zero throttle. This parameter is used with the value of the lower position limit to make an allowance for manufacturing tolerances between different pedals.

Table 26

Range	Default
0 to 100%	20%

Initial Upper Position Limit

This is the minimum throttle percentage that will be interpreted by the ECM as full throttle. This parameter is used with the value of the upper position limit to make an allowance for manufacturing tolerances between different pedals.

Table 27

Range	Default
0 to 100%	70%

Lower Dead Zone

This is a throttle range above the initial lower position limit before the engine will increase in rpm.

Table 28

Range	Default
0 to 100%	8%

Upper Dead Zone

This is a throttle range that is below the initial upper position limit that does not allow the engine speed to increase.

Table 29

Range	Default
0 to 100%	5%

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Multiposition Switch Setup

The multi-position throttle switch is an optional throttle input. A maximum of four switches can be used. Four switches will allow a maximum of 16 speeds to be selected.

When the multi-position switch is selected as the “Throttle Type” on the “Throttle Configuration Screen” of the electronic service tool, additional information is required.

Number of Switch Inputs

This parameter is the total number of switches that will be used. The switches may be individual switches or a ganged rotary switch.

Table 30

Range	Default
1 to 4	1

Physical Position

This parameter is non-programmable. The parameter is used to signify the position of the rotary switch.

Input 4, Input 3, Input 2, Input 1

The number of these non-programmable parameters that are visible depends on the value that is programmed into the “Number of Switch Inputs” parameter. “Open” signifies that the switch is in the OFF position. “Ground” signifies that the switch is in the ON position.

Physical Position Enabled

If “Yes” is selected from the drop-down menu, the Electronic Control Module (ECM) sets the engine rpm to the value that is programmed into the “Engine Speed” for the configuration of the switches that is defined for that Physical Position.

Table 31

Value	Default
No Yes	No

Logical Position

The Logical Position is the order that is required by the user for a unique Physical Position.

Table 32

Range	Default
1 to 16	1

Engine Speed (in RPM)

The “Engine Speed” is the programmed engine rpm for a particular position of the multi-position throttle switch.

If the ECM detects a switch combination that has been configured as “No”, a fault code will be generated. In this situation, the ECM will ignore the multi-position switch until the keyswitch is cycled through OFF and ON.

Table 33

Range	Default
Programmed Low Idle to Programmed High Idle	0

Customer Specified Parameters

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Customer Specified Parameters

Customer specified parameters allow the engine to be configured to the exact needs of the application.

Customer parameters may be changed repeatedly as a customer's operation changes.

The following information is a brief description of the customer specified parameters. The following parameter values are included with the descriptions:

- Minimum
- Maximum
- Default

Engine Rating Parameter

Rating Number

The rating number is the selected rating within a power rating family. The flash file defines the power rating family. The flash file can contain one to four ratings. The rating number defines the power rating that is used within the power rating family.

Table 34

Minimum	Maximum	Default
1	4	1

Low/High Idle Parameters

Low Idle Speed

The "Low Idle Speed" is the minimum engine rpm.

Table 35

Minimum	Maximum	Default
700 rpm	1200 rpm	750 rpm

High Idle Speed

The "High Idle Speed" is the maximum engine rpm.

Table 36

Minimum	Maximum	Default
1900 rpm	2900 rpm	2650 rpm

ECM Identification Parameter

Equipment ID

"Equipment ID" is the identification of the equipment that is assigned by the customer. The "Equipment ID" is only for reference only by the customer. The "Equipment ID" is not required by the Electronic Control Module (ECM).

Table 37

Value	Default
17 digits The available characters are dependent on the service tool that is being used.	Not programmed

PTO and Throttle Lock Parameters

Throttle Lock Feature Installation Status

The "Throttle Lock Feature Installation Status" is used to turn on the throttle lock features. When this parameter is changed to "Installed", the "PTO engine Speed Setting", the "Throttle Lock Increment Speed Ramp Rate" and the "Throttle Lock Engine Set Speed Increment" parameters are active and the parameters can be programmed.

Table 38

Value	Default
Not Installed Installed	Not Installed

PTO Engine Speed Setting

The "PTO Engine Speed Setting" is the engine speed that is attained when the PTO switch is moved to the ON position. If the "PTO Engine Speed Setting" parameter is programmed, the feature is turned off. If the "PTO Engine Speed Setting" parameter is set to a value that is between "1" and the low idle speed, the parameter is set to the low idle speed value. If the "PTO Engine Speed Setting" parameter is set to a value that is higher than the high idle speed, the parameter is set to the high idle speed value.

Table 39

Minimum	Maximum	Default
0 rpm	3000 rpm	0 rpm

Throttle Lock Increment Speed Ramp Rate

The “Throttle Lock Increment Speed Ramp Rate” is the rate of engine acceleration when the PTO switch is held in the ACCELERATE position. If this parameter is set to “0”, the feature is turned off.

Table 40

Minimum	Maximum	Default
0 rpm/sec	600 rpm/sec	400 rpm/sec

Throttle Lock Engine Set Speed Increment

The “Throttle Lock Engine Set Speed Increment” controls the increase in engine speed when the PTO switch is briefly operated to ACCELERATE or DECELERATE. If this parameter is set to “0”, the feature is turned off.

Table 41

Minimum	Maximum	Default
0 rpm	200 rpm	10 rpm

Miscellaneous

Monitoring Mode Shutdowns

“Monitoring Mode Shutdowns” controls the shutdown feature that is associated with the engine monitoring feature. When this feature is enabled and an event code with a “-3” suffix is detected, the engine will be shut down.

Table 42

Value	Default
Disabled Enabled	Disabled

Monitoring Mode Derates

“Monitoring Mode Derates” controls the derate that is associated with the engine monitoring feature. When this feature is enabled and an event code with a “-2” is detected, the engine will be derated.

Table 43

Value	Default
Disabled Enabled	Enabled

Limp Home Desired Engine Speed

The “Limp Home Desired Engine Speed” is the maximum speed of the engine when the engine has been derated.

Table 44

Minimum	Maximum	Default
700 rpm	1800 rpm	1200 rpm

J1939 Continuous Fault Handling

Remote Torque Speed Control Enable Status

The “Remote Torque Speed Control Enable Status” parameter determines the way that faults will be handled by the ECM when the “J1939 Torque Speed Control (TSC1)” message is used as a speed request input to the ECM. Programming the “Remote Torque Speed Control Enable Status” to “Enabled” will cause the ECM to display a fault code if a valid TSC1 message is not received by the engine ECM within 30 seconds of the engine starting. If the“ Remote Torque Speed Control Enable Status” is programmed to “Disabled”, the engine will display a 247-12 Data Link malfunction immediately after a loss of a TSC1 message. Program “Remote Torque Speed Control Enable Status” to “Enabled” if the ECM will always be receiving a TSC1 message.

Table 45

Value	Default
Disabled Enabled	Disabled

Configurable Inputs

Coolant Level Sensor

A coolant level sensor is an optional switch input. Programming the “Coolant Level Sensor” parameter to “Enabled” notifies the ECM that a coolant level sensor input is present on pin J1:38. If this parameter is programmed to “Enabled” and the coolant level falls below the measured level, a “E2143-3” event code will be displayed.

Table 46

Value	Default
Installed Not Installed	Not Installed

Air Filter Restriction Switch Installation Status

An “Air Filter Restriction Switch” is an optional switch input. Programming the “Air Filter Restriction Switch Installation Status” parameter to “Enabled” notifies the ECM that an input from the air filter restriction switch is present on pin J1:47. When this parameter is programmed to “Enabled” and the air filter restriction switch closes, an E172-1 or J107-15 event code will be displayed.

Table 47

Value	Default
Installed Not Installed	Not Installed

Fuel/Water Separator Switch Installation Status

A fuel/water separator switch is an optional switch input. Programming the “Fuel/Water Separator Switch Installation Status” parameter to “Enabled” notifies the ECM that a fuel/water separator switch input is present on pin J1:44. When this parameter is programmed to “Enabled” and the fuel/water separator switch closes, an E232-1 or J97-15 event code will be displayed.

Table 48

Value	Default
Installed Not Installed	Not Installed

User Defined Switch Installation Status

A user defined shutdown switch is an optional switch input. Programming the “User Defined Switch Installation Status” parameter to “Enabled” notifies the ECM that a user defined switch input is present on pin J1:48. If this parameter is programmed to “Enabled” and the user defined shutdown switch closes, the engine will shut down.

Table 49

Value	Default
Installed Not Installed	Not Installed

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Customer Specified Parameters Table

Table 50

Customer Specified Parameters		
ECM Parameter	**Possible Values**	**Default Value**
Engine Rating Parameter		
“Rating Number”	1 to 4	1
Low/High Idle Parameters		
“Low Idle Speed”	700 to 1200 rpm	750 rpm
“High Idle Speed”	1900 to 2900 rpm	2650 rpm
ECM Identification Parameter		
“Equipment ID”	17 Digits Available characters are dependent on the service tool that is used	Not Programmed
PTO and Throttle Lock Parameters		
“Throttle Lock Feature Installation Status”	Installed Not Installed	Not Installed
“PTO Engine Speed Setting”	0 to 3000 rpm	0 rpm
“Throttle Lock Increment Speed Ramp Rate”	0 to 600 rpm/sec	400 rpm/sec
“Throttle Lock Engine Set Speed Increment”	0 to 200 rpm	10 rpm
Miscellaneous		
“Monitoring Mode Shutdowns”	Disabled Enabled	Disabled
“Monitoring Mode Derates”	Disabled Enabled	Enabled
“Limp Home Desired Engine Speed”	700 to 1800 rpm	1200 rpm
J1939 Continuous Fault Handling		
“Remote Torque Speed Control Enable Status”	Disabled Enabled	Disabled
Configurable Inputs		
“Coolant Level Sensor”	Not Installed Installed	Not Installed
“Air Filter Restriction Switch Installation Status”	Not Installed Installed	Not Installed
“Fuel/Water Separator Switch Installation Status”	Not Installed Installed	Not Installed
“User Defined Switch Installation Status”	Not Installed Installed	Not Installed

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Customer Specified Parameters Worksheet

Table 51

Customer Specified Parameters Worksheet	
Engine Rating Parameter	
“Rating Numbers”	
Low/High Idle Parameters	
“Low Idle Speed”	
“High Idle Speed”	
ECM Identifications Parameters	
“Equipment ID”	
PTO and Throttle Lock Parameters	
“Throttle Lock Feature Installation Status”	
“PTO Engine Speed Setting”	
“Throttle Lock Increment Speed Ramp Rate”	
“Throttle Lock Engine Set Speed Increment”	
Miscellaneous	
“Monitoring Mode Shutdowns”	
“Monitoring Mode Derates”	
“Limp Home Desired Engine Speed”	
J1939 Continuous Fault Handling	
“Remote Torque Speed Control Enable Status”	
Configurable Inputs	
“Coolant Level Sensor”	
“Air Filter Restriction Switch Installation Status”	
“Fuel/Water Separator Switch Installation Status”	
“User Defined Switch Installation Status”	

System Configuration Parameters

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System Configuration Parameters

System configuration parameters affect the emissions of the engine or the power of the engine. System configuration parameters are programmed at the factory. Normally, system configuration parameters would never need to be changed through the life of the engine. System configuration parameters must be reprogrammed if an Electronic Control Module (ECM) is replaced. System configuration parameters do not need to be reprogrammed if the ECM software is changed. Factory passwords are required to change these parameters. The following information is a description of the system configuration parameters.

Full Load Setting

The full load setting is a number that represents the adjustment to the fuel system that was made at the factory in order to fine tune the fuel system. If the ECM is replaced, the full load setting must be reprogrammed in order to prevent a 268-02 diagnostic code from becoming active.

Full Torque Setting

Full torque setting is similar to full load setting. If the ECM is replaced, the full torque setting must be reprogrammed in order to prevent a 268-02 diagnostic code from becoming active.

Rating Interlock

The rating interlock is a code that prevents the use of an incorrect power rating and/or emission rating for a specific engine. Each horsepower rating and each emission certification has a different code to all other horsepower ratings and emission certifications.

When an ECM is replaced, this rating interlock code must match the code that is stored in the ECM. If the rating interlock code does not match the code that is stored in the ECM, both of the following situations will exist:

- The engine will not run.
- Diagnostic code 0253-02 Personality Module mismatch will be active.

Note: The flash programming of a new rating interlock replaces the old rating interlock.

This code does not need to be programmed when the replacement ECM is for the same engine rating.

If the ECM is for a different engine rating, then the following components may need to be changed: pistons, fuel injectors, and other components. The engine information ratings plate must also be changed in order to reflect the new rating.

Some systems such as the cooling system or the transmission may also require changes when the engine is rerated. Please contact the local OEM dealer for further information.

Engine Serial Number

When a new ECM is delivered, the engine serial number in the ECM is not programmed. The engine serial number should be programmed to match the engine serial number that is stamped on the engine information plate.

ECM Software Release Date

This parameter is defined by the rating interlock and this parameter is not programmable. The ECM software release date is used to provide the version of the software. The Customer parameters and the software change levels can be monitored by this date. The date is provided in the month and the year (NOV05). NOV is the month (November). 05 is the year (2005).

Troubleshooting without a Diagnostic Code

i02528126

Alternator Noise

Note: This is not an electronic system problem.

Refer to Testing and Adjusting for information on possible electrical causes of this condition.

Probable Causes

- Alternator drive belt
- Alternator mounting bracket
- Automatic tensioner
- Alternator drive pulley
- Alternator bearings

Recommended Actions

Alternator Drive Belt

Inspect the condition of the alternator drive belt. If the alternator drive belt is worn or damaged, check that the drive belt for the alternator and the pulley are correctly aligned. If the alignment is correct, replace the drive belt. Refer to Disassembly and Assembly, “Alternator Belt - Remove and Install”.

Alternator Mounting Bracket

Inspect the alternator mounting bracket for cracks and wear. Repair the mounting bracket or replace the mounting bracket in order to ensure that the alternator drive belt and the alternator drive pulley are in alignment.

Automatic Tensioner

Check the tension on the alternator drive belts. If necessary, replace the automatic tensioner. Refer to Disassembly and Assembly, “Alternator - Remove” and Disassembly and Assembly, “Alternator - Install”.

Alternator Drive Pulley

Remove the nut for the alternator drive pulley and then inspect the nut and the drive shaft. If no damage is found, install the nut and tighten the nut to the correct torque. Refer to Specifications, “Alternator and Regulator” for the correct torque.

Alternator Bearings

Check for excessive play of the shaft in the alternator. Check for wear in the alternator bearings. The alternator is a nonserviceable item. The alternator must be replaced if the bearings are worn. Refer to Disassembly and Assembly, “Alternator - Remove” and Disassembly and Assembly , “Alternator - Install”.

i02344740

Alternator Will Not Charge

Note: This is not an electronic system problem.

Probable Causes

- Alternator drive belt
- Automatic tensioner
- Charging circuit
- Alternator

Recommended Actions

Alternator Drive Belt

Inspect the condition of the alternator drive belt. If the alternator drive belt is worn or damaged, check that the drive belt for the alternator and the pulley are correctly aligned. If the alignment is correct, replace the drive belt. Refer to Disassembly and Assembly, “Alternator Belt - Remove and Install”.

Automatic Tensioner

Check the tension on the alternator drive belt. If necessary, replace the automatic tensioner. Refer to Disassembly and Assembly, “Alternator - Remove” and Disassembly and Assembly, “Alternator - Install”.

Charging Circuit

Inspect the battery cables, wiring, and connections in the charging circuit. Clean all connections and tighten all connections. Replace any faulty parts.

Alternator

Verify that the alternator is operating correctly. Refer to Testing and Adjusting, “Alternator - Test”. The alternator is not a serviceable item. The alternator must be replaced if the alternator is not operating correctly. Refer to Disassembly and Assembly, “Alternator - Remove” and Disassembly and Assembly , “Alternator - Install”.

i02344743

Battery

Note: This is not an electronic system problem.

Probable Causes

- Charging circuit
- Battery
- Auxiliary device

Recommended Actions

Charging Circuit

If a fault in the battery charging circuit is suspected, refer to Troubleshooting, “Alternator Will Not Charge”.

Faulty Battery

1. Check that the battery is able to maintain a charge. Refer to Testing and Adjusting, “Battery - Test”.
2. If the battery does not maintain a charge, replace the battery. Refer to the Operation and Maintenance Manual, “Battery - Replace”.

Auxiliary Device

1. Check that an auxiliary device has drained the battery by being left in the ON position.
2. Charge the battery.
3. Verify that the battery is able to maintain a charge when all auxiliary devices are switched off.

i02528131

Can Not Reach Top Engine RPM

Note: If this fault occurs only under load, refer to Troubleshooting, “Low Power/Poor or No Response to Throttle”.

Probable Causes

- Diagnostic codes
- ECM parameters
- Throttle signal from the throttle position sensor
- Air intake and exhaust system
- Fuel supply
- Individual malfunctioning cylinders
- Electronic unit injectors

Recommended Actions

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

ECM Parameters

1. Ensure that the problem is not a programmed parameter.
2. Ensure that the correct mode was selected by using the electronic service tool.
3. Use the electronic service tool to verify the correct engine rating for the engine.
4. Use the electronic service tool to verify the maximum engine speed limit.
5. Use the electronic service tool to verify the following parameters at maximum speed: the boost pressure, the smoke limit, the torque limit, and the amount of fuel that is delivered.
6. Use the electronic service tool to reset the parameters to the OEM specifications.
7. Ensure that the repairs have eliminated the performance problems.
8. If the repairs have not eliminated the faults proceed to “Throttle Signal for the Throttle Position Sensor”.

Throttle Signal for the Throttle Position Sensor

1. Use the electronic service tool and observe the signal for the throttle position sensor. Make sure that the throttle reaches the 100% raw position and the calibrated position.
2. If the signal is erratic, refer to Troubleshooting, “Analog Throttle Position Sensor Circuit - Test” or refer to Troubleshooting, “Digital Throttle Position Sensor Circuit - Test”.

3. If the engine has a throttle switch refer to Troubleshooting, “Throttle Switch Circuit - Test”.

4. If the fault has not been eliminated, proceed to “Air Intake and Exhaust System”.

Air Intake and Exhaust System

1. Check the air filter restriction indicator, if equipped.

2. Ensure that the air filter is clean and serviceable.

3. Check the air intake and the exhaust system for the following defects:

   - Blockages
   - Restrictions
   - Damage to the air intake and exhaust lines and hoses

4. Make all necessary repairs to the engine.

5. Ensure that the repairs have eliminated the fault.

6. If the fault has not been eliminated, proceed to “Fuel Supply”.

Fuel Supply

1. Visually check the fuel tank for fuel. The fuel gauge may be faulty.

2. Ensure that the fuel supply valve is in the full OPEN position.

3. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).

4. Visually inspect the fuel supply lines for restrictions.

5. Check that the low pressure fuel lines are tight and secured properly.

6. Remove the fuel filters. Inspect the fuel filters for contamination. Install new fuel filters. Refer to the Operation and Maintenance Manual, “Fuel System Filter- Replace and Fuel System Primary Filter (Water Separator) Element - Replace”. Determine the cause of the contamination.

7. Check the diesel fuel for contamination. Refer to Systems Operation, Testing and Adjusting, “Fuel Quality - Test”.

8. Check for air in the low pressure fuel system. Refer to Systems Operation, Testing and Adjusting, “Air in Fuel - Test”.

9. Ensure that the fuel system has been primed. Refer to Testing and Adjusting, “Fuel System - Prime”.

10. Check the fuel pressure. Refer to Testing and Adjusting, “Fuel System Pressure - Test”.

⚠ WARNING

Contact with high pressure fuel may cause fluid penetration and burn hazards. High pressure fuel spray may cause a fire hazard. Failure to follow these inspection, maintenance and service instructions may cause personal injury or death.

NOTICE

Contact with high pressure fuel may cause personal injury or death. Wait 60 seconds after the engine has stopped to allow fuel pressure to purge before any service or repair is performed on the engine fuel lines.

11. If the high pressure fuel lines have a leak, the high pressure fuel lines must be replaced. Refer to Disassembly and Assembly, “Fuel injection lines - Remove and Fuel injection lines - Install”.

12. If the repairs do not eliminate the fault, proceed to “Individual Malfunctioning Cylinders”.

Individual Malfunctioning Cylinders

1. With the engine speed at a fast idle, use the electronic service tool to isolate one cylinder at a time. Note if there is any reduction in engine speed. If a reduction in engine speed is not noted, the isolated cylinder is not operating under normal conditions. If the isolation of a particular cylinder results in a reduction of engine speed that is less than normal, this may indicate that the cylinder is operating below normal performance. Investigate the cause of the fault on any cylinder that is not operating. Investigate the cause of the fault on any cylinder that is operating below normal performance.

2. If all cylinders have been checked and no faults were detected proceed to “Electronic Unit Injectors”.

Electronic Unit Injectors

1. With the engine speed at a fast idle, use the electronic service tool to isolate one cylinder at a time. Note if there is any reduction in engine speed. If a reduction in engine speed is not noted, the isolated electronic unit injector is not operating under normal conditions. If the isolation of a particular cylinder results in a reduction of engine speed that is less than normal, this may indicate that the electronic unit injector is operating below normal performance.

2. Remove the electronic unit injector from the suspect cylinder. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove”.

3. Install a new electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Install”.

4. Repeat the test in 1. If the fault is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove” and Disassembly and Assembly, “Electronic Unit Injector - Install”.

i02528174

Coolant in Engine Oil

Note: This is not an electronic system problem.

Probable Causes

- Engine oil cooler
- Cylinder head gasket
- Cylinder head
- Cylinder block

Recommended Actions

Engine Oil Cooler

1. Drain the engine lubricating oil from the engine.

2. Check for leaks in the oil cooler assembly. Refer to Testing and Adjusting, “Cooling System” for the correct procedure. If a leak is found, install a new oil cooler. Refer to Disassembly and Assembly, “Engine Oil Cooler - Remove” and Disassembly and Assembly, “Engine Oil Cooler - Install” for the correct procedure.

Cylinder Head Gasket

1. Remove the cylinder head. Refer to Disassembly and Assembly, “Cylinder Head - Remove” for the correct procedure.

2. Inspect the cylinder head gasket for faults and any signs of leakage.

3. To fit a new cylinder head gasket, refer to Disassembly and Assembly, “Cylinder Head - Install” for the correct procedure.

4. If there was no obvious signs of a faulty head gasket proceed to “Cylinder Head”.

Cylinder Head

1. Check the cylinder head for flatness. Refer to Testing and Adjusting, “Cylinder Head - Inspect” for the correct procedure.

2. Check the mating face of the cylinder head for faults and signs of leakage. If a fault is found, replace the cylinder head. If signs of leakage are found, determine the cause of the leakage. Refer to Testing and Adjusting, “Cylinder Head - Inspect” for the correct procedure.

3. Check the internal core plugs in the cylinder head for signs of leakage.

4. If the cylinder head is flat and if the cylinder head does not have any faults, refer to “Cylinder Block”.

Cylinder Block

Inspect the top face of the cylinder block for faults and signs of leakage. If a fault is found, replace the cylinder block. If signs of leakage are found, determine the cause of the leakage. Refer to Testing and Adjusting, “Cylinder Block - Inspect” for the correct procedure.

Assembly after Repair

1. Install the cylinder head. Refer to Disassembly and Assembly, “Cylinder Head - Install”.

2. Remove the oil filter element. Install a new engine oil filter element. Fill the engine with clean engine oil to the correct level. Refer to the Operation and Maintenance Manual, “Engine Oil and Filter - Change” for more information.

i02528229

Coolant Temperature Is Too High

Note: This is not an electronic system problem.

Probable Causes

- Radiator fins
- Coolant level
- Radiator cap and/or pressure relief valve
- Coolant temperature gauge
- Restriction in the coolant system
- Water temperature regulator
- Engine cooling fan
- Coolant pump
- Cylinder head gasket

Recommended Actions

Radiator Fins

Check the radiator fins for dirt, debris, and/or damage. Remove any dirt and/or debris and straighten any bent fins.

Coolant Level

1. Inspect the coolant level. If necessary, add coolant.
2. Check the cooling system for leaks. Repair any leaks immediately.

Radiator Cap and/or Pressure Relief Valve

1. Pressure test the cooling system. Refer to Testing and Adjusting, “Cooling System” for the correct procedure.
2. Check that the seating surfaces of the pressure relief valve and the radiator cap are clean and undamaged.
3. Check operation of the pressure relief valve and/or the radiator cap. If necessary, clean the components and/or replace the components.

Coolant Temperature Gauge

Compare the reading for the coolant temperature from the electronic service tool to the reading for the coolant temperature from a calibrated test gauge.

Restriction in the Coolant System

1. Visually inspect the cooling system for collapsed hoses and/or other restrictions.
2. Clean the radiator and flush the radiator. Refer to Testing and Adjusting, “Cooling System”.

Water Temperature Regulator

Check the water temperature regulator for correct operation. Refer to Testing and Adjusting, “Cooling System” for the proper procedure. If necessary, replace the water temperature regulator. Refer to Disassembly and Assembly, “Water Temperature Regulator - Remove and Install” for more information.

Engine Cooling Fan

1. Make sure that the engine cooling fan is correctly installed.
2. Make sure that the engine cooling fan is being driven correctly by the drive belt. If necessary, tighten the drive belt or replace the drive belt. Refer to Disassembly and Assembly, “Alternator Belt - Remove and Install”.
3. Check the engine cooling fan for damage. If necessary, replace the fan. Refer to Disassembly and Assembly, “Fan - Remove and Install”.

Coolant Pump

1. Inspect the impeller of the coolant pump for damage and/or erosion.
2. Make sure that the drive gear is not loose on the drive shaft of the coolant pump.
3. If necessary, replace the coolant pump. Refer to Disassembly and Assembly, “Water Pump - Remove” and Disassembly and Assembly, “Water Pump - Install”.

Cylinder Head Gasket

Switch off the engine and allow the engine to cool to below normal working temperature. Remove the pressure cap for the coolant system. Start the engine and inspect the coolant for the presence of bubbles. If bubbles are present in the coolant, combustion gases may be entering the cooling system. Check the cylinder head gasket. Refer to the recommended action for the cylinder head gasket within Troubleshooting, “Coolant in Engine Oil”. Check the cylinder head for flatness. Refer to the recommended action for checking flatness of the cylinder head within Systems Operations, “Cylinder Head - Inspect”. Fit the pressure cap if there are no bubbles in the coolant.

i02413819

ECM Will Not Accept Factory Passwords

Probable Causes

One of the following items may not be recorded correctly on the electronic service tool:

- Passwords
- Serial numbers
- Total tattletale
- Reason code

Recommended Actions

1. Verify that the correct passwords were entered. Check every character in each password. Remove the electrical power from the engine for 30 seconds and then retry.
2. Verify that the electronic service tool is on the “Factory Password” screen.
3. Use the electronic service tool to verify that the following information has been entered correctly:
   - Engine serial number
   - Serial number for the electronic control module
   - Serial number for the electronic service tool
   - Total tattletale
   - Reason code

i02413820

ECM Will Not Communicate with Other Systems or Display Modules

Probable Causes

- Electrical connectors
- Electronic Control Module (ECM)

Recommended Actions

1. Connect the electronic service tool to the service tool connector. If the ECM does not communicate with the electronic service tool, refer to Troubleshooting, “Electronic Service Tool Will Not Communicate with ECM”.
2. Ensure that the following items are correctly installed and undamaged. Refer to Troubleshooting, “Electrical Connectors - Inspect”.
   - P1/J1 and P2/J2 connectors on the ECM
   - Wiring to display modules
   - Wiring to other control modules
3. Troubleshoot the Perkins Data Link for possible problems. Refer to Troubleshooting, “Data Link Circuit - Test”.

i02535551

Electronic Service Tool Will Not Communicate with ECM

Probable Causes

- Configuration for the communications adapter
- Electrical connectors
- Communication adapter and/or cables
- Electrical power supply to the service tool connector
- Electronic service tool and related hardware

- Electrical power supply to the Electronic Control Module (ECM)
- Perkins Data Link

Recommended Actions

Start the engine. If the engine starts, but the ECM will not communicate with the electronic service tool, continue with this procedure. If the engine will not start, refer to Troubleshooting, “Engine Cranks but Will Not Start”. If the engine will not crank, refer to Troubleshooting, “Engine Will Not Crank”.

Configuration for the Communications Adapter

1. Access “Preferences” under the “Utilities” menu on the electronic service tool.
2. Verify that the correct “Communications Interface Device” is selected.
3. Verify that the correct port is selected for use by the communication adapter.

Note: The most commonly used port is “COM 1”.

4. Check for any hardware that is utilizing the same port as the communications adapter. If any devices are configured to use the same port, exit or close the software programs for that device.

Electrical Connectors

Check for correct installation of the P1/J1 and P2/J2 ECM connectors and of the service tool connector. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

Communication Adapter and/or Cables

1. Make sure that the firmware and driver files are the most current files that are available for the type of communication adapter that is being used. If the firmware and driver files do not match, the communication adapter will not communicate with the electronic service tool.
2. Disconnect the communication adapter and the cables from the service tool connector. Reconnect the communication adapter to the service tool connector.
3. Verify that the correct cable is being used between the communication adapter and the service tool connector. Refer to Troubleshooting, “Electronic Service Tools”.
4. If the laptop computer is using a Windows operating system, restart the laptop computer in order to eliminate the possibility of a conflict in the software.

Electrical Power Supply to the Service Tool Connector

Verify that battery voltage is present between terminals A and B of the service tool connector. If the communication adapter is not receiving power, the LED display on the communication adapter will be blank.

Electronic Service Tool and Related Hardware

In order to eliminate the electronic service tool and the related hardware as the problem, connect the electronic service tool to a different engine. If the same problem occurs on a different engine, check the electronic service tool and the related hardware in order to determine the cause of the fault.

Electrical Power Supply to the Electronic Control Module (ECM)

Check power to the ECM. Refer to Testing and Adjusting, “Charging System - Test”.

Note: If the ECM is not receiving battery voltage, the ECM will not communicate.

Perkins Data Link

Troubleshoot the Perkins Data Link for possible faults. Refer to Troubleshooting, “Data Link Circuit - Test”.

i02528112

Engine Cranks but Will Not Start

Probable Causes

- Diagnostic codes
- Air intake and exhaust system
- Glow plugs
- Valve lash
- Fuel supply
- Low compression (cylinder pressure)

- Electronic control system
- High pressure fuel system

Recommended Actions

NOTICE
Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

Visual Checks

1. Visually inspect the engine for the following faults:
   - Missing components
   - Damaged components
   - Damaged electrical cables or loose electrical cables
   - Oil leaks
   - Fuel leaks
   - Hydraulic leaks
   - Check for the proper level of fuel, oil and coolant
   - If the ambient temperature is below 0 °C (32 °F), make sure that the correct specification of engine oil and oil for the machine is used.
   - Check that the battery voltage is correct.
   - Use the electronic service tool to check the average cranking speed of the engine. If the cranking speed is less than 150 RPM, investigate the cause of the fault.

   Rectify any faults that are found during the visual checks.
2. Use a suitable hand tool in order to rotate the crankshaft. If the crankshaft does not rotate freely, check the engine for the following problems:
   - Seized piston
   - Defects in the drive gears
   - Fluid in the cylinder bores
   - Improper timing of valves
3. If the crankshaft rotates freely proceed to “Air Intake and Exhaust System”.

Air Intake and Exhaust System

1. Check the air filter restriction indicator, if equipped.
2. Ensure that the air filter is clean and serviceable.
3. Check the air intake and exhaust systems for the following defects:
   - Blockages
   - Restrictions
   - Damage to lines or hoses
4. Repair any defects before attempting to restart the engine.
5. If the engine will not start proceed to “Glow Plugs”.

Glow Plugs

Note: Faulty glow plugs will only affect engine starting when the ambient temperature is below 10 °C (50 °F).

1. Check the operation of the glow plugs. Refer to Systems Operation, “Glow Plugs - Test”.
2. If necessary, replace faulty glow plugs. Refer to Disassembly and Assembly, “Glow Plug - Remove and Install”.
3. If the repairs do not eliminate the fault, proceed to “Valve Lash”.

Valve Lash

1. Check the valve lash and reset the valve lash if it is necessary. Refer to Testing and Adjusting, “Engine Valve Lash - Inspect/Adjust”.

Ensure that the repairs have eliminated the active diagnostic codes before attempting to restart the engine.

Try to start the engine. If the engine does not start, verify that the crankshaft is rotating.

If the engine will not start proceed to “Fuel Supply”.

Fuel Supply

1. Visually check the fuel tank for fuel. The fuel gauge may be faulty.

2. Ensure that the fuel supply valve (if equipped) is in the full OPEN position.

3. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).

4. Check the primary filter/water separator for water in the fuel.

5. Check for fuel supply lines that are restricted.

6. Check that the low pressure fuel lines are tight and secured properly.

7. Check the fuel filters.

8. Check the diesel fuel for contamination. Refer to Testing and Adjusting, “Fuel Quality - Test”.

9. Check for air in the fuel system. Refer to Testing and Adjusting, “Air in Fuel - Test”.

10. Ensure that the fuel system has been primed. Refer to Testing and Adjusting, “Fuel System - Prime”.

11. If the repair does not eliminate the fault refer to “Low Compression (Cylinder Pressure)”.

Low Compression (Cylinder Pressure)

1. Perform a compression test. Refer to Testing and Adjusting, “Compression - Test ”.

2. If low compression is noted on any cylinders, investigate the cause and rectify the cause.

   Possible causes of low compression are shown in the following list:

   - Loose glow plugs
   - Faulty piston
   - Faulty piston rings
   - Worn cylinder bores
   - Worn valves
   - Faulty cylinder head gasket
   - Damaged cylinder head

3. Perform all necessary repairs.

4. Ensure that the repairs have eliminated the faults.

5. If the repair does not eliminate the fault refer to “Electronic Control System”.

Electronic Control System

1. Use the electronic service tool to check that fuel pressure is present in the fuel rail when the engine is cranking.

2. If the pressure demand for the fuel rail is greater than 5 MPa (725 psi), refer to “High Pressure Fuel System”.

3. If the pressure demand for the fuel rail is less than 5 MPa (725 psi), check the operation of the primary speed/timing sensor and the secondary speed/timing sensor. Refer to the Troubleshooting Guide, “Engine Speed/Timing Sensor Circuit - Test”. If necessary, replace any faulty sensor.

4. Make sure that any repairs have eliminated the fault.

High Pressure Fuel System

Use the electronic service tool to monitor a stable fuel rail pressure during engine cranking.

If the fuel rail pressure is less than 5 MPa (725 psi), perform the following procedure.

1. Check the current to the solenoid valve in the fuel injection pump. If no current is detected, investigate the cause of the fault.

2. Use the electronic service tool to perform the“Injector Solenoid Test”. If an injector fails the test, determine whether the fault is caused by the wiring, the ECM or the injector.

3. Install a test ECM in order to determine whether the ECM is the cause of the fault. Refer to the Troubleshooting Guide, “Replacing the ECM”.

4. Test the function of the fuel rail pressure sensor. Refer to the Troubleshooting Guide, “Engine Pressure Sensor Open or Short Circuit - Test”. If the pressure sensor is faulty, replace the pressure sensor.

5. If the fault is still apparent, replace the fuel injection pump. [Refer to Disassembly and Assembly, “Fuel Injection Pump - Remove” and Disassembly and Assembly, “Fuel Injection Pump - Install”.

If the fuel rail pressure is greater than 5 MPa (725 psi), perform the following procedure.

1. Check for leakage from the pressure relief valve in the fuel rail. If there is any leakage, replace the fuel rail.

2. Crank the engine and measure the leakage from the return line for the electronic unit injectors. If the leakage at an minimum engine cranking speed of 150 RPM is greater than 0.1 L/min (0.2 Pints/min), replace all of the electronic unit injectors.

3. Use the electronic service tool to perform the “Injector Solenoid Test”. If the test is satisfactory, replace the fuel injection pump.

i02413823

Engine Has Early Wear

Note: This is not an electronic system problem.

Probable Causes

- Multiple starts or cold operation
- Incorrect maintenance intervals
- Dirt in engine oil
- Incorrect oil
- Contaminated oil
- Leaks in air intake system
- Dirt in fuel
- Low oil pressure

Recommended Actions

Multiple Starts or Cold Operation

Frequent starting and stopping of the engine can cause early wear. Also, operation of the engine for short periods of time in cold conditions can cause early wear.

Incorrect Maintenance Intervals

If the engine is not correctly maintained, early wear will occur.

Make sure that the engine is maintained at the correct maintenance intervals. Refer to the Operation and Maintenance Manual, “Maintenance Interval Schedule”.

Dirt in Engine Oil

1. Drain the oil from the crankcase and refill the crankcase with clean engine oil. Install new engine oil filters. Refer to the Operation and Maintenance Manual for more information.

Incorrect Oil

1. Check that the engine is filled with oil of the correct specification. Refer to the Operation and Maintenance Manual, “Refill Capacities and Recommendations”.

2. If necessary, drain the engine oil system and refill the engine oil system. Refer to Operation and Maintenance Manual, “Engine Oil and Filter - Change”.

Contaminated Oil

Check an oil sample for contamination with fuel. If contamination is found, investigate the cause.

Leaks in Air Intake System

A leak in the air intake system may allow unfiltered air into the engine. Inspect the air intake system for streaks which may indicate a leakage of unfiltered air. Inspect all of the gaskets and the connections. Repair any leaks. Refer to Testing and Adjusting, “Air Intake System” for more information.

Dirt in Fuel

1. Remove the fuel filters. Inspect the fuel filters for contamination. Install new fuel filters. Refer to the Operation and Maintenance Manual, “Fuel System Filter- Replace” and Operation and Maintenance Manual, “Fuel System Primary Filter (Water Separator) Element - Replace”. Determine the cause of the contamination.

2. Check the diesel fuel for contamination. Refer to Testing and Adjusting, “Fuel Quality - Test”.

Low Oil Pressure

Refer to Troubleshooting, “Low Engine Oil Pressure” for the testing procedure. Repair any identified faults.

i02489087

Engine Misfires, Runs Rough or Is Unstable

The probable root causes are listed in order below:

Note: If the fault is intermittent and the problem cannot be duplicated, refer to Troubleshooting, “Intermittent Low Power or Power Cutout”.

Note: If the fault only occurs under certain conditions, test the engine under those conditions. Examples of certain conditions are high rpm, full load and engine operating temperature. Troubleshooting the symptoms under other conditions can give misleading results.

Probable Causes

- Diagnostic codes
- Throttle position sensor
- Air intake and exhaust system
- Fuel supply
- Fuel rail pump
- Low compression (cylinder pressure)
- Individual malfunctioning cylinder
- Electronic unit injectors

Recommended Actions

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

Throttle Position Sensor

1. Use the electronic service tool and observe the signal for the throttle position sensor. Make sure that the throttle reaches the 100% raw position and the calibrated position.
2. If the signal is erratic, refer to Troubleshooting, “Analog Throttle Position Sensor Circuit - Test” or Troubleshooting, “Digital Throttle Position Sensor Circuit - Test”.
3. If the engine has a 10 position throttle switch refer to Troubleshooting, “Throttle Switch Circuit - Test”.
4. If the repairs do not eliminate the fault proceed to “Air Intake and Exhaust System”.

Air Intake and Exhaust System

1. Check the air filter restriction indicator, if equipped.
2. Ensure that the air filter is clean and serviceable.
3. Check the air intake and exhaust systems for the following defects:
   - Blockages
   - Restrictions
   - Damage to lines or hoses
4. If the repairs do not eliminate the fault proceed to “Fuel Supply”.

Fuel Supply

1. Visually check the fuel tank for fuel. The fuel gauge may be faulty.
2. Ensure that the fuel supply valve (if equipped) is in the full OPEN position.
3. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).
4. Check the primary filter/water separator for water in the fuel.
5. Check for fuel supply lines that are restricted.
6. Check that the low pressure fuel lines are tight and secured properly.
7. Check the fuel filters.
8. Check the diesel fuel for contamination. Refer to Testing and Adjusting, “Fuel Quality - Test”.
9. Check for air in the fuel system. Refer to Testing and Adjusting, “Air in Fuel - Test”.
10. Ensure that the fuel system has been primed. Refer to Testing and Adjusting, “Fuel System - Prime”.
11. Check the fuel pressure. Refer to Testing and Adjusting, “Fuel System Pressure - Test”.
12. If the repair does not eliminate the fault refer to “Fuel Rail Pump”.

Fuel Rail Pump

Note: The fuel rail pump that is installed by the factory is a nonserviceable item. If any mechanical fault or any electrical fault occurs within the fuel rail pump then the fuel rail pump must be replaced.

1. Use the electronic service tool to select the correct screen display. Refer to Troubleshooting, “Troubleshooting with a Diagnostic Code”.
2. If the fault is not eliminated, refer to “Low Compression (Cylinder Pressure)”.

Low Compression (Cylinder Pressure)

1. Perform a compression test. Refer to Testing and Adjusting, “Compression - Test ”.
2. If low compression is noted on any cylinders, investigate the cause and rectify the cause.

   Possible causes of low compression are shown in the following list:

   - Loose glow plugs
   - Faulty piston
   - Faulty piston rings
   - Worn cylinder bores
   - Worn valves
   - Faulty cylinder head gasket
   - Damaged cylinder head
3. Perform all necessary repairs.
4. Ensure that the repairs have eliminated the faults.
5. If the repair does not eliminate the fault refer to “Individual Malfunctioning Cylinders”.

Individual Malfunctioning Cylinders

1. With the engine speed at a fast idle, use the electronic service tool to isolate one cylinder at a time. Note if there is any reduction in engine speed. If a reduction in engine speed is not noted, the isolated cylinder is not operating under normal conditions. If the isolation of a particular cylinder results in a reduction of engine speed that is less than normal, this may indicate that the cylinder is operating below normal performance. Investigate the cause of the fault on any cylinder that is not operating. Investigate the cause of the fault on any cylinder that is operating below normal performance.
2. Rectify any faults.
3. If all cylinders have been checked and no problems were detected proceed to “Electronic Unit Injectors”.

Electronic Unit Injectors

1. With the engine speed at a fast idle, use the electronic service tool to isolate one cylinder at a time. Note if there is any reduction in engine speed. If a reduction in engine speed is not noted, the isolated electronic unit injector is not operating under normal conditions. If the isolation of a particular cylinder results in a reduction of engine speed that is less than normal, this may indicate that the electronic unit injector is operating below normal performance.
2. Remove the electronic unit injector from the suspect cylinder. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove”.
3. Install a new electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Install”.
4. Repeat the test in 1. If the fault is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove” and Disassembly and Assembly, “Electronic Unit Injector - Install”.
5. If the fault is not eliminated, check for active diagnostic fault codes.

i02413836

Engine Oil in Cooling System

Note: This is not an electronic system problem.

Probable Causes

- Engine oil cooler
- Cylinder head gasket
- Cylinder head
- Cylinder block

Recommended Actions

Engine Oil Cooler

1. Drain the coolant from the engine and the radiator. Drain the lubricating oil from the engine oil cooler. Refer to the Operation and Maintenance Manual for more information.

2. Check for leaks in the oil cooler assembly. Refer to Testing and Adjusting, “Cooling System” for the correct procedure. If a leak is found, install a new oil cooler. Refer to Disassembly and Assembly, “Engine Oil Cooler - Remove” and Disassembly and Assembly, “Engine Oil Cooler - Install” for the correct procedure.

Cylinder Head Gasket

1. Remove the cylinder head. Refer to Disassembly and Assembly, “Cylinder Head - Remove” for the correct procedure.

2. Inspect the cylinder head gasket for faults and any signs of leakage.

3. To fit a new cylinder head gasket, refer to Disassembly and Assembly, “Cylinder Head - Install” for the correct procedure.

4. If there was no obvious signs of a faulty head gasket proceed to “Cylinder Head”.

Cylinder Head

1. Check the cylinder head for flatness. Refer to Testing and Adjusting, “Cylinder Head - Inspect” for the correct procedure.

2. Check the mating face of the cylinder head for faults and signs of leakage. If a fault is found, replace the cylinder head. If signs of leakage are found, determine the cause of the leakage. Refer to Testing and Adjusting, “Cylinder Head - Inspect” for the correct procedure.

3. If the cylinder head is flat and if the cylinder head does not have any faults, refer to “Cylinder Block”.

Cylinder Block

Inspect the top face of the cylinder block for faults and signs of leakage. If a fault is found, replace the cylinder block. If signs of leakage are found, determine the cause of the leakage. Refer to Testing and Adjusting, “Cylinder Block - Inspect” for the correct procedure.

Assembly after Repair

1. Install the cylinder head. Refer to Disassembly and Assembly, “Cylinder Head - Install”.

2. Replenish the engine with clean engine oil to the correct level. Refer to the Operation and Maintenance Manual, “Engine Oil and Filter - Change” for more information.

3. Fill the cooling system. Refer to the Operation and Maintenance Manual, “Cooling System Coolant (ELC) - Change”.

i02534845

Engine Speed Does Not Change

Note: Use this procedure only if the engine speed does not change. This fault will not occur in a generator set application.

Probable Causes

- Diagnostic codes
- Multi-position throttle switch
- Throttle position sensor

Recommended Repairs

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

Use the electronic service tool to check the setup of the throttle.

Multi-position Throttle Switch

Note: When the engine is operating and the fault occurs, the configuration of the throttle will not change. The configuration of the throttle only needs to be checked if the engine has never run.

If a fault with the multi-position throttle switch is suspected, refer to Troubleshooting, “Throttle Switch Circuit - Test”.

Throttle Position Sensor

Refer to Troubleshooting, “Analog Throttle Position Sensor Circuit - Test” or Troubleshooting, “Digital Throttle Position Sensor Circuit - Test” if any of the following diagnostic codes are active:

- 0041-03 8 Volt DC Supply voltage above normal
- 0041-04 8 Volt DC Supply voltage below normal
- 0091-08 Throttle Position Sensor abnormal frequency, pulse width or period
- 0774-08 Sec Throttle Position Sensor abnormal frequency, pulse width or period

i02534896

Engine Stalls at Low RPM

Probable Causes

- Diagnostic codes
- Accessory equipment
- Power mode control (if equipped)
- Fuel supply
- Electronic unit injectors

Recommended Actions

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

Accessory Equipment

Check all accessory equipment for problems that may create excessive load on the engine. Repair any damaged components or replace any damaged components.

If there are no faults with the accessory equipment, refer to “Power Mode Control (If Equipped)”.

Power Mode Control (If Equipped)

1. Check the data link. Refer to Troubleshooting, “ Data Link Circuit - Test”.
2. Check the engine wiring harness for defects. Refer to Troubleshooting, “Electricial Connectors - Inspect”.
3. If there are no apparent faults, refer to “Fuel Supply”.

Fuel Supply

1. Visually check the fuel tank for fuel. The fuel gauge may be faulty.
2. Ensure that the fuel supply valve (if equipped) is in the full OPEN position.
3. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).
4. Check the primary filter/water separator for water in the fuel.
5. Check for fuel supply lines that are restricted.
6. Check that the low pressure fuel lines are tight and secured properly.
7. Check the fuel filters.
8. Check the diesel fuel for contamination. Refer to Testing and Adjusting, “Fuel Quality - Test”.
9. Check for air in the fuel system. Refer to Testing and Adjusting, “Air in Fuel - Test”.
10. Ensure that the fuel system has been primed. Refer to Testing and Adjusting, “Fuel System - Prime”.
11. Check the fuel pressure. Refer to Testing and Adjusting, “Fuel System Pressure - Test”.
12. If necessary, repair any faults.
13. If there are no apparent faults, refer to “Electronic Unit Injectors”.

Electronic Unit Injectors

1. With the engine speed at a fast idle, use the electronic service tool to isolate one cylinder at a time. Note if there is any reduction in engine speed. If a reduction in engine speed is not noted, the isolated electronic unit injector is not operating under normal conditions. If the isolation of a particular cylinder results in a reduction of engine speed that is less than normal, this may indicate that the electronic unit injector is operating below normal performance.
2. Remove the electronic unit injector from the suspect cylinder. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove”.
3. Install a new electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Install”.
4. Repeat the test in 1. If the fault is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove” and Disassembly and Assembly, “Electronic Unit Injector - Install”.
5. If the fault is not eliminated, check for active diagnostic fault codes.

i02414532

Engine Vibration

Note: This is not an electronic system fault.

Refer to Testing and Adjusting for information on determining the cause of this condition.

Probable Causes

- Vibration damper
- Engine supports
- Low compression (cylinder pressure)
- Individual malfunctioning cylinder
- Electronic unit injectors

Recommended Actions

Vibration Damper

Check the vibration damper for damage. Install a new vibration damper, if necessary. Inspect the mounting bolts for damage and/or for wear. Replace any damaged bolts. Refer to Disassembly and Assembly, “Vibration Damper and Pulley - Remove” and Disassembly and Assembly, “Vibration Damper and Pulley - Install”.

Ensure that the repairs have eliminated the problem. If the vibration is still present proceed to “Engine Supports”.

Engine Supports

1. Check for any of the following conditions:
   - Loose engine supports
   - Loose mounting brackets or broken mounting brackets
   - Loose bolts
   - Omitted bolts
2. Make all necessary repairs. Ensure that the repairs have eliminated the fault. If the vibration is still present proceed to “Low Compression (Cylinder Pressure)”.

Low Compression (Cylinder Pressure)

1. Perform a compression test. Refer to Testing and Adjusting, “Compression - Test ”.
2. If low compression is noted on any cylinders, investigate the cause and rectify the cause.

   Possible causes of low compression are shown in the following list:
   - Loose glow plugs
   - Faulty piston
   - Faulty piston rings
   - Worn cylinder bores
   - Worn valves
   - Faulty cylinder head gasket
   - Damaged cylinder head
3. Perform all necessary repairs.
4. Ensure that the repairs have eliminated the faults.
5. If the repair does not eliminate the fault refer to “Malfunctioning Individual Cylinder”.

Malfunctioning Individual Cylinder

1. With the engine speed at a fast idle, use the electronic service tool to isolate one cylinder at a time. Note if there is any reduction in engine speed. If a reduction in engine speed is not noted, the isolated cylinder is not operating under normal conditions. If the isolation of a particular cylinder results in a reduction of engine speed that is less than normal, this may indicate that the cylinder is operating below normal performance. Investigate the cause of the fault on any cylinder that is not operating. Investigate the cause of the fault on any cylinder that is operating below normal performance.
2. If all cylinders have been checked and no faults were detected proceed to “Electronic Unit Injectors”.

Electronic Unit Injectors

1. With the engine speed at a fast idle, use the electronic service tool to isolate one cylinder at a time. Note if there is any reduction in engine speed. If a reduction in engine speed is not noted, the isolated electronic unit injector is not operating under normal conditions. If the isolation of a particular cylinder results in a reduction of engine speed that is less than normal, this may indicate that the electronic unit injector is operating below normal performance.

2. Remove the electronic unit injector from the suspect cylinder. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove”.

3. Install a new electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Install”.

4. Repeat the test in 1. If the fault is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove” and Disassembly and Assembly, “Electronic Unit Injector - Install”.

i02414534

Engine Will Not Crank

Probable Causes

- Machine security system
- Battery cables and/or batteries
- Starting motor solenoid or starting circuit
- Starting motor and/or flywheel ring gear
- Electrical power supply
- Internal engine fault

Recommended Repairs

Machine Security System

1. Verify that the correct keyswitch is being used. Turn the keyswitch to the ON position.

2. Use the electronic service tool in order to check if the 1639-09 Machine Security System is active. Verify that the lamp for the machine security system is on.

3. If the 1639-09 diagnostic code is active the machine security system is armed. Deactivate the machine security system and try to start the engine.

4. If the engine will not start use the electronic service tool to check for logged diagnostic codes.

5. Make repairs for all diagnostic codes. Ensure that the repair has eliminated the problem.

6. If there are no active diagnostic codes refer to the Troubleshooting Manual for your machine application.

Battery Cables and/or Batteries

1. Inspect the main power switch, battery posts, and battery cables for loose connections and corrosion. If the battery cables are corroded, remove the battery cables and clean the battery cables. Clean the battery posts. Replace the cables. Tighten any loose connections.

2. Inspect the batteries.

   a. Charge the batteries.

   b. Load test the batteries. Refer to Testing and Adjusting, “Battery - Test”.

Starting Motor Solenoid or Starting Circuit

1. Test the operation of the starting motor solenoid. Refer to Testing and Adjusting, “Electric Starting System - Test”.

2. Check the wiring to the starting motor solenoid.

Starting Motor and/or Flywheel Ring Gear

1. Test the operation of the starting motor. Check the wiring for the starting motor. Refer to Testing and Adjusting, “Electric Starting System - Test”.

2. Inspect the pinion on the starting motor and the flywheel ring gear for damage.

Electrical Power Supply

Check the electrical power supply. Refer to Troubleshooting, “Electrical Power Supply Circuit - Test”.

Internal Engine Fault

1. Remove the glow plugs. Refer to Disassembly and Assembly, “Glow Plugs - Remove and Install”.

2. Attempt to rotate the crankshaft through 360 degrees in both direction. If the crankshaft rotates correctly but fluid is expelled from the hole for the glow plug, investigate the cause of the fluid in the cylinder.

3. If the crankshaft rotates correctly and no fluid is expelled, install the glow plugs. Refer to Disassembly and Assembly, “Glow Plugs - Remove and Install”.

4. If the engine does not rotate in Step 2, disassemble the engine. Refer to Disassembly and Assembly.

5. Inspect the internal components for the following conditions:

   - Seizure
   - Broken components
   - Bent components

i02414535

Excessive Black Smoke

Probable Causes

- Diagnostic codes
- ECM software
- Air intake system or exhaust system
- Valve lash
- Turbocharger
- Low compression (cylinder pressure)
- Individual malfunctioning cylinder
- Electronic unit injectors

Recommended Actions

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

ECM Software

1. Connect the electronic service tool to the diagnostic connector and check for the following conditions:

   - Check for the correct engine serial number
   - Check for the correct arrangement number
   - Check for the correct software

2. Use the electronic service tool to verify any active diagnostic codes.

3. If diagnostic codes are present, the Electronic Control Module (ECM) must be programmed with the correct information.

4. If the repairs have not eliminated the fault proceed to “Air Intake System or Exhaust System”.

Air Intake System or Exhaust System

1. Check the air filter restriction indicator, if equipped.

2. Ensure that the air filter is clean and serviceable.

3. Check the air intake and the exhaust system for the following defects:

   - Blockages
   - Restrictions
   - Damage to the air intake and exhaust lines and hoses

4. Make all necessary repairs to the engine.

5. If the fault has not been eliminated, proceed to “Valve Lash”.

Valve Lash

Ensure that the valve lash is correct. Reset the valve lash if it is not correct. Refer to Testing and Adjusting, “Engine Valve Lash - Inspect/Adjust”.

If the repair does not eliminate the fault proceed to “Turbocharger”.

Turbocharger

Note: The turbocharger that is installed on this engine is a nonserviceable item. If any mechanical fault exists, except for the wastegate actuator, then the turbocharger must be replaced. The wastegate actuator can be replaced.

1. Ensure that the mounting bolts for the turbocharger are tight.

2. Check that the oil drain for the turbocharger is not blocked or restricted.

3. Check that the compressor housing for the turbocharger is free of dirt, debris and damage.

4. Check that the turbine housing for the turbocharger is free of dirt, debris and damage.

5. Check that the turbine blades rotate freely in the turbocharger.

6. Ensure that the wastegate on the turbocharger is adjusted correctly. Refer to Testing and Adjusting, “Wastegate - Inspect”. If the wastegate actuator is faulty, replace the wastegate actuator. Refer to Disassembly and Assembly, “Turbocharger - Disassemble” and Disassembly and Assembly, “Turbocharger - Assemble”.

7. If necessary, replace the turbocharger. Refer to Disassembly and Assembly, “Turbocharger - Remove” and Disassembly and Assembly, “Turbocharger - Install”.

8. Check that the repairs have eliminated the faults.

9. If the repairs have not eliminated the fault proceed to “Low Compression (Cylinder Pressure)”.

Low Compression (Cylinder Pressure)

1. Perform a compression test. Refer to Testing and Adjusting, “Compression - Test ”.

2. If low compression is noted on any cylinders, investigate the cause and rectify the cause.

   Possible causes of low compression are shown in the following list:

   - Loose glow plugs
   - Faulty piston
   - Faulty piston rings
   - Worn cylinder bores
   - Worn valves
   - Faulty cylinder head gasket
   - Damaged cylinder head

3. Perform all necessary repairs.

4. Ensure that the repairs have eliminated the faults.

5. If the repair does not eliminate the fault refer to “Individual Malfunctioning Cylinder”.

Individual Malfunctioning Cylinder

1. With the engine speed at a fast idle, use the electronic service tool to isolate one cylinder at a time. Note if there is any reduction in engine speed. If a reduction in engine speed is not noted, the isolated cylinder is not operating under normal conditions. If the isolation of a particular cylinder results in a reduction of engine speed that is less than normal, this may indicate that the cylinder is operating below normal performance. Investigate the cause of the fault on any cylinder that is not operating. Investigate the cause of the fault on any cylinder that is operating below normal performance.

2. If all cylinders have been checked and no problems were detected proceed to “Electronic Unit Injectors”.

Electronic Unit Injectors

1. With the engine speed at a fast idle, use the electronic service tool to isolate one cylinder at a time. Note if there is any reduction in engine speed. If a reduction in engine speed is not noted, the isolated electronic unit injector is not operating under normal conditions. If the isolation of a particular cylinder results in a reduction of engine speed that is less than normal, this may indicate that the electronic unit injector is operating below normal performance.

2. Remove the electronic unit injector from the suspect cylinder. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove”.

3. Install a new electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Install”.

4. Repeat the test in 1. If the fault is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove” and Disassembly and Assembly, “Electronic Unit Injector - Install”.

5. If the fault is not eliminated, refer to the Troubleshooting Manual for your engine application.

i02528860

Excessive Engine Oil Consumption

Probable Causes

- Misreading oil level
- Oil leaks
- Engine crankcase breather
- Oil level
- Air intake and exhaust system
- Turbocharger
- Low compression (cylinder pressure)

Recommended Actions

Misreading Oil Level

1. Accurately measure the consumption of oil and fuel over a period of 50 engine hours.
2. If the oil consumption is greater than 0.2% of the fuel consumption, use the following procedure in order to investigate the cause of the high oil consumption.

Oil Leaks

1. Check for evidence of oil leaks on the engine.
2. Rectify any oil leaks from the engine.
3. Check for evidence of oil in the coolant.
4. If no oil leaks are identified, refer to “Engine Crankcase Breather”.

Engine Crankcase Breather

1. Check the engine crankcase breather for blockage or restrictions.
2. Check for excessive oil from the outlet of the breather.
3. Repair all defects. Verify that the repair has eliminated the fault.
4. If no faults are found, refer to “Oil Level”.

Oil Level

1. Check the oil level in the engine.
2. If the oil level is high, check for contamination of the oil with coolant. Refer to Troubleshooting, “Coolant in Engine Oil”.
3. If no contamination is identified, remove any excess oil.
4. If the oil level is satisfactory, refer to “Air Intake and Exhaust System”.

Air Intake and Exhaust System

1. Check the air filter restriction indicator, if equipped.
2. Ensure that the air filter is clean and serviceable.
3. Check the air intake and the exhaust system for the following defects:
   - Blockages
   - Restrictions
   - Damage to the air intake and exhaust lines and hoses
4. Make all necessary repairs to the engine.
5. Ensure that the repairs have eliminated the diagnostic code.
6. If no faults are found, refer to “Turbocharger”.

Turbocharger

Note: The turbocharger that is installed on this engine is a nonserviceable item. If any mechanical fault exists, except for the wastegate actuator, then the turbocharger must be replaced.

1. Check that the oil drain for the turbocharger is not blocked or restricted.
2. Check the turbocharger for evidence of internal oil leaks.
3. If necessary, replace the turbocharger. Refer to Disassembly and Assembly, “Turbocharger - Remove” and Disassembly and Assembly, “Turbocharger - Install”.
4. Check that the repairs have eliminated the faults.
5. If the repairs have not eliminated the fault proceed to “Low Compression (cylinder pressure)”.

Low Compression (cylinder pressure)

1. Perform a compression test. Refer to Testing and Adjusting, “Compression - Test ”.
2. If low compression is noted on any cylinders, investigate the cause and rectify the cause.

   Possible causes of low compression are shown in the following list:

   - Loose glow plugs
   - Faulty piston
   - Worn piston rings
   - Worn cylinder bores
   - Worn valves
   - Faulty cylinder head gasket
   - Damaged cylinder head
3. Perform all necessary repairs.
4. Ensure that the repairs have eliminated the faults.
5. If the fault is not eliminated, refer to the Troubleshooting Manual for your engine application.

i02528865

Excessive Fuel Consumption

Probable Causes

- Diagnostic codes
- Misreading of fuel level
- Fuel quality
- Quality of oil
- Low engine temperature
- Prolonged operation at idle speed
- Engine operating speed
- Air intake and exhaust system
- Reduced pressure of intake air
- Excessive valve lash
- Failure of the primary speed/timing sensor

Recommended Actions

Diagnostic Codes

1. Use the electronic service tool to check for any diagnostic codes that may be related to high fuel consumption.

Misreading of Fuel Level

1. Monitor the fuel consumption over a period of 50 engine hours. If the fuel consumption is excessive, perform the following procedure.

Fuel Quality

1. The quality of the fuel that is used in the engine will affect the rate of fuel consumption. Refer to “General Fuel Information” in the Operation and Maintenance Manual, “Refill Capacities”.
2. If the fuel is not of an acceptable quality, drain the fuel system and replace the fuel filters. Refill the fuel system with fuel of an acceptable quality. Refer to the applicable sections in the Operation and Maintenance Manual.
3. If the fuel is of an acceptable quality, refer to “Quality of Oil”.

Quality of Oil

1. The nominal viscosity of the lubricating oil that is used in the engine will affect the rate of fuel consumption. The viscosity of lubricating oil is defined by the SAE grade of the lubricating oil. The grade of the lubricating oil must be correct for the ambient conditions. Lubricating oil that is intended for use in high ambient temperatures will have a negative effect upon the rate of fuel consumption in cold ambient temperatures. Refer to “Engine Oil” in the Operation and Maintenance Manual, “Refill Capacities”.
2. The actual viscosity of the lubricating oil that is used in the engine will change throughout the service life of the oil. Lubricating oil that is heavily contaminated will have a negative effect upon the rate of fuel consumption.
3. If the oil is not of an acceptable quality or if the oil has exceeded the service life, drain the oil system and replace the oil filters. Refill the oil system with oil of an acceptable quality. Refer to the applicable sections in the Operation and Maintenance Manual.

4. If the oil is of an acceptable quality, refer to “Operation in Cold Conditions”.

Low Engine Temperature

1. The operating temperature of the engine will affect the rate of fuel consumption. Operation of the engine below the correct temperature will increase fuel consumption. Failure of the water temperature regulator can prevent the engine from operating at the correct temperature.

2. If the engine operating temperature is low, check the operation of the water temperature regulator. If the water temperature regulator does not operate correctly, a new water temperature regulator must be installed. Refer to Disassembly and Assembly, “Water Temperature Regulator - Remove and Install”.

Prolonged Operation at Idle Speed

Prolonged operation of the engine at idle speed increases fuel consumption.

When the engine is operated at idle speed, the fuel that is consumed provides no useful work. Prolonged operation at idle speed will cause a measurable deterioration in the overall fuel consumption of the engine.

Operation of the engine for long periods at idle speed will cause a deterioration of the internal components of the engine. A deterioration of the internal components of the engine will increase fuel consumption.

Engine Operating Speed

The operating speed of the engine will affect the rate of fuel consumption.

High engine speed will increase fuel consumption. At high engine speeds, internal power losses in the engine increase and more power is required to drive the alternator and the fan. These power losses increase fuel consumption.

Lugging down the engine to a low engine speed will increase fuel consumption. At low engine speeds, the combustion efficiency of the engine is reduced. This will require more fuel to be used.

Air Inlet and Exhaust System

Leakage of gas or an increased restriction in either the air intake or the exhaust system can reduce the flow of combustion gas through the engine. A change in the flow of combustion air into the engine adversely affects combustion efficiency and the rate of fuel consumption.

1. Check the air intake system for leakage or restrictions. Refer to Testing and Adjusting, “Air Inlet and Exhaust System”.

2. Check the exhaust system for leakage or restrictions. Refer to Testing and Adjusting, “Air Inlet and Exhaust System”.

3. Repair all defects. Verify that the repair has eliminated the fault.

Reduced Pressure of Intake Air

1. If the pressure of the intake air at the intake manifold is lower than normal, either the speed of the engine will need to be higher or more fuel must be injected in order to produce the same power. Either of these conditions will increase the fuel consumption.

Note: If the engine is equipped with a wastegate regulator, low pressure in the air intake will create a 526-07 diagnostic code.

2. Check the pipe from the outlet of the turbocharger compressor to the intake manifold for leaks. If necessary, repair any leaks.

3. Check for the correct operation of the wastegate in the turbocharger. Refer to Testing and Adjusting, “Turbocharger Wastegate - Test”.

4. If the turbocharger is suspected as being faulty, replace the turbocharger. Refer to Disassembly and Assembly, “Turbocharger - Remove” and Disassembly and Assembly, “Turbocharger - Install”.

Excessive Valve Lash

Excessive valve lash will cause a change in the timing of the opening and closing of the inlet and exhaust valves. Excessive valve lash can cause a reduction of the flow of combustion air into the engine. Reduced flow of combustion air will increase the fuel consumption rate.

Refer to the Troubleshooting Guide, “Excessive Valve Lash”.

Failure of the Primary Speed/Timing Sensor

If the primary speed/timing sensor fails, the engine will continue to operate using the signal from the secondary speed/timing sensor on the fuel rail pump. The secondary speed/timing sensor is less precise than the primary speed/timing sensor. Timing differences between the secondary speed/timing sensor and the primary speed/timing sensor may cause an increase in fuel consumption.

1. Use the electronic service tool to check for active diagnostic codes that relate to the primary speed/timing sensor.

2. If necessary, replace the primary speed/timing sensor. Refer to Disassembly and Assembly, “Speed/Timing Sensor - Remove and Install”.

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Excessive Valve Lash

Note: This is not an electronic system fault.

Probable Causes

- Lubrication
- Valve train components
- Valve lash

Recommended Actions

Lubrication

1. Remove the valve mechanism covers. Refer to Disassembly and Assembly, “Valve Mechanism Cover - Remove and Install” for the correct procedure.

2. Crank the engine and check the lubrication in the valve compartment. Ensure that there is adequate engine oil flow in the valve compartment. The passages for the engine oil must be clean.

Note: Do not run the engine without the valve mechanism cover.

Valve Train Components

1. Inspect the following components of the valve train:
   - Rocker arms
   - Valve bridges
   - Pushrods
   - Valve lifters
   - Camshaft
   - Valve stems
   - Rocker shafts

2. Check the components for the following conditions: abnormal wear, excessive wear, straightness, and cleanliness. If necessary, use new parts for replacement.

Note: If the camshaft is replaced, new valve lifters must also be used.

Valve Lash

Adjust the valve lash of the engine. Refer to Testing and Adjusting, “Engine Valve Lash - Inspect/Adjust” for the correct procedure.

i02414539

Excessive White Smoke

Note: Some white smoke may be present during cold start-up conditions when the engine is operating normally. If the white smoke persists, there may be a fault.

Probable Causes

- Coolant temperature sensor circuit
- Low coolant temperature
- Glow plugs
- Fuel quality
- Valve lash
- Low compression (cylinder pressure)
- Individual malfunctioning cylinder

Recommended Actions

Coolant Temperature Sensor Circuit

1. Connect the electronic service tool to the diagnostic connector.

2. Monitor the display screen on the electronic service tool in order to verify the presence of active diagnostic codes for the coolant temperature. Refer to Troubleshooting, “Engine Temperature Sensor Open or Short Circuit - Test”.

3. If the fault has not been eliminated, proceed to “Low Coolant Temperature”.

Low Coolant Temperature

Check that the water temperature regulator is operating correctly. Refer to Testing and Adjusting, “Water Temperature Regulator - Test”.

If the water temperature regulator is operating correctly, refer to “Glow Plugs”.

Glow Plugs

1. Check for proper operation of the glow plugs. Refer to Testing and Adjusting, “Glow Plugs - Test”.
2. If the repairs do not eliminate the fault refer to “Fuel Quality”.

Fuel Quality

1. Check the diesel fuel for quality. Refer to Testing and Adjusting, “Fuel Quality - Test”.

Note: Diesel fuel with a low cetane value is likely to cause white smoke.

2. If the repair does not eliminate the fault refer to “Valve Lash”.

Valve Lash

1. Ensure that the valve lash is correct. Refer to Testing and Adjusting, “Engine Valve Lash - Inspect/Adjust”.
2. If the repair does not eliminate the fault proceed to “Low Compression (cylinder pressure)”.

Low Compression (cylinder pressure)

1. Perform a compression test. Refer to Testing and Adjusting, “Compression - Test ”.
2. If low compression is noted on any cylinders, investigate the cause and rectify the cause.

   Possible causes of low compression are shown in the following list:

   - Loose glow plugs
   - Faulty piston
   - Faulty piston rings
   - Worn cylinder bores
   - Worn valves
   - Faulty cylinder head gasket
   - Damaged cylinder head

3. Perform all necessary repairs.
4. Ensure that the repairs have eliminated the faults.
5. If the repair does not eliminate the fault refer to “Individual Malfunctioning Cylinder”.

Individual Malfunctioning Cylinder

1. With the engine speed at a fast idle, use the electronic service tool to isolate one cylinder at a time. Note if there is any reduction in engine speed. If a reduction in engine speed is not noted, the isolated cylinder is not operating under normal conditions. If the isolation of a particular cylinder results in a reduction of engine speed that is less than normal, this may indicate that the cylinder is operating below normal performance. Investigate the cause of the fault on any cylinder that is not operating. Investigate the cause of the fault on any cylinder that is operating below normal performance.
2. Rectify any faults.

i02414540

Intake Air Temperature Is Too High

Probable Causes

- High ambient air temperature
- Intake air restriction and/or high altitude
- Intake air from a heated area
- Intake manifold air temperature sensor and/or circuit
- Insufficient ambient air flow over the engine
- Reduced ambient air flow through the air charge cooler
- Reduced flow of intake air through the air charge cooler

Recommended Actions

High Ambient Air Temperature

1. Determine if the ambient air temperature is within the design specifications for the cooling system and the air charge cooler.

2. When the ambient temperature exceeds the capability of the cooling system or the air charge cooler, operate the engine at a reduced load or operate the engine at a reduced speed.

3. When possible, modify the cooling system and the air charge cooler in order to make the system suitable for local conditions.

Intake Air Restriction and/or High Altitude

Low air pressure at the air intake for the turbocharger can be caused by a restriction in the air intake or a high altitude. When the pressure of the intake air is low, the turbocharger (if equipped) works harder in order to achieve the desired intake manifold pressure. This increases intake air temperature.

Measure the intake manifold pressure while the engine is operating under load. For specific data, refer to the Perkins Technical Marketing Information for the engine.

Intake Air Restriction

1. Check for blocked air filters. Check for obstructions in the air intake.

2. Replace the air filters or remove the obstruction from the air intake.

High Altitude

Make sure that the settings for the engine are correct for the altitude.

Intake Air from a Heated Area

1. Ensure that the air inlet system is not receiving air from a heated area.

2. If necessary, relocate the air supply to the intake manifold to the outside of the engine enclosure.

3. Check for air leaks in the pipe between the air inlet and the inlet to the turbocharger compressor.

Intake Manifold Air Temperature Sensor and/or the Circuit

1. Allow the intake manifold air temperature sensor to cool and remove the sensor. Check the reading for the intake air temperature. If the sensor is operating correctly, the reading and the ambient temperature are approximately equal.

2. If the readings are approximately equal, reinstall the sensor.

3. If the reading is not correct, replace the sensor with a sensor that is known to be good. Verify that the fault is rectified.

Insufficient Ambient Air Flow over the Engine

1. If equipped, check the condition of the cooling fan and the drive belt.

2. If equipped, check that the cooling fan is operating correctly.

Reduced Ambient Air Flow through the Air Charge Cooler

1. Check that the ambient air flow through the air charge cooler is not obstructed.

2. Inspect the air charge cooler for contamination and/or bent fins or damaged fins.

3. If necessary, clean the air charge cooler.

4. If necessary, carefully straighten any bent fins on the air charge cooler.

Reduced Flow of Intake Air through the Air Charge Cooler

1. Check for contamination in the air pipe that connects the turbocharger to the air charge cooler.

   a. If dirt is found in the air pipe from the turbocharger to the air charge cooler, check all of the air inlet pipes upstream of the turbocharger for leaks.

   b. Clean all contaminated air inlet pipes or replace all contaminated air inlet pipes.

   c. Service the air cleaner and replace the air cleaner element.

2. If a thick oil film is found in the air pipe, inspect the turbocharger compressor housing. Examine both the inlet to the turbocharger compressor housing and the outlet from the turbocharger compressor for oil.

   a. If oil is found in the inlet to the turbocharger compressor housing, the oil originates from the engine crankcase breather.

   b. If oil is found in the outlet from the turbocharger compressor housing but oil is not found in the inlet to the compressor housing, the oil originates from the seals for the turbocharger bearings.

i02518234

Intermittent Engine Shutdown

Note: Use this procedure only if the engine shuts down completely and the engine must be restarted.

Probable Causes

- Diagnostic codes
- Air Intake
- Electrical connectors
- Fuel supply

Recommended Actions

Diagnostic Codes

Check for any event and active diagnostic codes on the electronic service tool. Troubleshoot any active codes or recently logged diagnostic codes before continuing with this procedure.

Air Intake

1. Check the air filter for blockage or restriction.
2. Check the air intake duct for blockages or restrictions.

Electrical Connectors

1. Check for correct installation of ECM connectors at the following locations:
   - P1 ECM connector
   - P2 ECM connector
   - P532 Fuel rail pump solenoid connector
2. Refer to Troubleshooting, “Electrical Connectors - Inspect”.
3. Inspect the battery wires from the ECM to the battery compartment. Refer to the Engine Wiring Diagram. Inspect the wires and the power relay. Check the power and ground connections to the ECM. Refer to Troubleshooting, “Fuel Injection Pump Circuit - Test” for more information.
4. Inspect the battery wires from the ECM to the battery compartment. Refer to the Schematic Diagram. Inspect the wires and the power relay. Check the power and ground connections to the ECM. Refer to the schematic diagram for more information.
5. Select the “Wiggle Test” from the diagnostic tests on the electronic service tool.
6. Choose the appropriate group of parameters to monitor.
7. Press the “Start” button. Wiggle the wiring harness in order to reproduce intermittent faults.

Note: If an intermittent fault exists, the status will be highlighted and an audible beep will be heard.

8. Repair any faults and ensure that the symptom has been cleared. If the symptom is still present, refer to “Fuel Supply”.

Fuel Supply

NOTICE
Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

1. Visually check the fuel tank for fuel. The fuel gauge may be faulty.
2. Ensure that the fuel supply valve (if equipped) is in the full OPEN position.
3. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).
4. Check the primary filter/water separator for water in the fuel.
5. Check for fuel supply lines that are restricted.
6. Check that the low pressure fuel lines are tight and secured properly.
7. Check the fuel filters.
8. Check the diesel fuel for contamination. Refer to Testing and Adjusting, “Fuel Quality - Test”.
9. Check for air in the fuel system. Refer to Testing and Adjusting, “Air in Fuel - Test”.
10. Ensure that the fuel system has been primed. Refer to Testing and Adjusting, “Fuel System - Prime”.
11. Check the fuel pressure. Refer to Testing and Adjusting, “Fuel System Pressure - Test”.

i02535522

Intermittent Low Power or Power Cutout

Note: Use this procedure only if the engine does not shut down completely.

Probable Causes

- Diagnostic codes
- Electrical connectors
- ECM connection
- Fuel supply
- Intake manifold pressure

Recommended Actions

NOTICE
Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

Diagnostic Codes

Check for active diagnostic codes and event codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

Electrical Connectors

1. Refer to Troubleshooting, “Electrical Connectors - Inspect”.
2. Repair the electrical connectors or replace the electrical connectors.
3. Ensure that all the connector seals are in place and that the connectors have been correctly installed.
4. Ensure that the repairs have eliminated the fault. If the fault has not been eliminated proceed to “ECM Connection”.

ECM Connection

1. Check that the P2/J2 connector is correctly connected.
2. Check that the P1/J1 connector is correctly connected.
3. If a fault is suspected with the ECM power and ground connections refer to Troubleshooting, “Electrical Power Supply Circuit - Test”.
4. Verify that the ECM connections for the power and ground connections at the fuel pump are correctly connected.
5. Repair any faults and ensure that the faults have been eliminated.
6. If the repairs do not eliminate the faults, proceed to “Fuel Supply”.

Fuel Supply

1. Visually check the fuel tank for fuel. The fuel gauge may be faulty.
2. Ensure that the fuel supply valve (if equipped) is in the full OPEN position.
3. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).
4. Check the primary filter/water separator for water in the fuel.
5. Check for fuel supply lines that are restricted.
6. Check that the low pressure fuel lines are tight and secured properly.
7. Check the fuel filters.
8. Check the diesel fuel for contamination. Refer to Testing and Adjusting, “Fuel Quality - Test”.
9. Check for air in the fuel system. Refer to Testing and Adjusting, “Air in Fuel - Test”.
10. Ensure that the fuel system has been primed. Refer to Testing and Adjusting, “Fuel System - Prime”.
11. Check the fuel pressure. Start the engine and then use the electronic service tool to check that the pressure in the fuel rail is more than 18000 kPa (2610 psi).
12. If the repair does not eliminate the fault refer to “Intake Manifold Pressure”.

Intake Manifold Pressure

1. Use the electronic service tool to verify the intake manifold pressure.
2. Turn the start switch to the ON position.

3. The intake manifold pressure should read 0 ± 0.5 kPa (0 ± 0.07 psi). If the intake manifold pressure is not within the limits, perform the following steps.

4. Check the air filter restriction indicator, if equipped.

5. Ensure that the air filter is clean and serviceable.

6. Check the air intake and the exhaust system for the following defects:

   - Blockages
   - Restrictions
   - Damage to the air intake and exhaust lines and hoses

i02528979

Low Engine Oil Pressure

NOTICE
Do not operate the engine with low oil pressure. Engine damage will result. If measured oil pressure is low, discontinue engine operation until the problem is corrected.

Probable Causes

- Engine oil level
- Oil specification
- Engine oil pressure gauge
- Engine oil filter
- Engine oil cooler
- Piston cooling jets
- Engine oil suction tube
- Engine oil pump
- Bearing clearance

Recommended Actions

Engine Oil Level

1. Inspect the engine oil level. If necessary, add oil.

2. If the fault is still apparent, refer to “Oil Specification”.

Oil Specification

1. Make sure that engine oil of the correct specification is used. Refer to the Operation and Maintenance Manual, “Refill Capacities and Recommendations”.

2. If necessary, drain the oil system and refill the oil system with engine oil of the correct specification. Refer to Operation and Maintenance Manual, “Engine Oil and Filter - Change”.

3. If the fault is still apparent, refer to “Engine Oil Pressure Gauge”.

Engine Oil Pressure Gauge

1. Check the actual engine oil pressure with a calibrated test gauge. Compare the oil pressure reading from the electronic service tool to the pressure on the test gauge.

2. If no difference is noted between the indicated oil pressures, refer to “Engine Oil Filter”.

Engine Oil Filter

1. Remove the engine oil filter. Refer to the Operation and Maintenance Manual, “Engine Oil and Filter - Change”.

2. Inspect the engine oil filter for evidence of blockage.

3. Install a new engine oil filter. Refer to the Operation and Maintenance Manual, “Engine Oil and Filter - Change”.

4. If the fault is still apparent, refer to “Engine Oil Cooler”.

Engine Oil Cooler

1. If oil flow or coolant flow through the oil cooler is suspected of being low, replace the oil cooler. Refer to Disassembly and Assembly, “Engine Oil Cooler - Remove” and Disassembly and Assembly, “Engine Oil Cooler - Install”.

2. If the fault is still apparent, refer to “Piston Cooling Jets”.

Piston Cooling Jets

1. Inspect the piston cooling jets for damage. Replace any piston cooling jet that appears to be cracked, broken or missing. Refer to Disassembly and Assembly, “Piston Cooling Jets - Remove and Install”.

2. If no damage is found, refer to “Engine Oil Suction Tube”.

Engine Oil Suction Tube

1. Check the inlet screen on the oil suction tube and remove any material that may be restricting oil flow.
2. Check the joints of the oil suction tube for cracks or a damaged joint that may allow air leakage into the supply to the oil pump.
3. If no faults are found, refer to “Engine Oil Pump”.

Engine Oil Pump

1. Inspect the components of the engine oil pump for excessive wear. Repair the oil pump or replace the oil pump, if necessary. Refer to Disassembly and Assembly, “Engine Oil Pump - Remove”, Disassembly and Assembly, “Engine Oil Pump - Install” and Disassembly and Assembly, “Engine Oil Relief Valve - Remove and Install”.
2. If no faults are found, refer to “Bearing Clearance”.

Bearing Clearance

Inspect the engine components for excessive bearing clearance or damaged bearings. If necessary, replace the bearings and/or the components. Inspect the following components for excessive bearing clearance:

- Crankshaft main bearings
- Connecting rod bearings
- Camshaft front bearing
- Idler gear bearing

i02535524

Low Power/Poor or No Response to Throttle

Probable Causes

- Diagnostic codes
- ECM parameters
- Electrical connectors
- Air intake and exhaust system
- Valve lash
- Turbocharger
- Fuel supply
- Low compression (cylinder pressure)
- Individual malfunctioning cylinder
- Electronic unit injectors

Recommended Actions

NOTICE
Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

ECM Parameters

1. Use the electronic service tool to make sure that the FLS and FTS parameters have been correctly entered.
2. Use the electronic service tool to ensure that the correct mode was selected.
3. Use the electronic service tool to verify that the correct engine rating has been provided.
4. Use the electronic service tool to verify the maximum engine speed limit.
5. Ensure that the repairs have eliminated the performance problems.
6. If the repairs have not eliminated the faults proceed to “Electrical Connectors”.

Electrical Connectors

1. Turn the keyswitch to the ON position.
2. Use the electronic service tool to verify that the intake manifold pressure is 0 ± 0.5 kPa (00 ± 0.070 psi). Check the 5 V sensor supply for the intake manifold pressure. Refer to Troubleshooting, “5 Volt Engine Pressure Sensor Supply Circuit - Test”.
3. Use the electronic service tool to verify the throttle position status.

4. Run the engine until the speed is equal to the maximum no-load speed.

5. Use the electronic service tool to make sure that the throttle is set to reach the maximum no-load speed.

6. If the maximum no-load speed can not be obtained refer to Troubleshooting, “Throttle Switch Circuit - Test” and Troubleshooting, “Mode Selection Circuit - Test”.

7. If the engine speed is erratic refer to Troubleshooting, “Analog Throttle Position Sensor Circuit - Test” or Troubleshooting, “Digital Throttle Position Sensor Circuit - Test”.

8. If the fault has not been eliminated, proceed to “Air Intake and Exhaust System”.

Air Intake and Exhaust System

1. Check the air filter restriction indicator, if equipped.

2. Ensure that the air filter is clean and serviceable.

3. Check the air intake and the exhaust system for the following defects:

   - Blockages
   - Restrictions
   - Damage to the air intake and exhaust lines and hoses

4. Make all necessary repairs to the engine.

5. If the fault has not been eliminated, proceed to “Valve Lash”.

Valve Lash

1. Check the valve lash and reset the valve lash, if necessary. Refer to Testing and Adjusting, “Engine Valve lash - Inspect and Adjust”.

2. If the repair does not eliminate the fault proceed to “Turbocharger”.

Turbocharger

Note: The turbocharger that is installed on this engine is a nonserviceable item. If any mechanical fault exists, except for the wastegate actuator, then the turbocharger must be replaced. The wastegate actuator can be replaced.

1. Ensure that the mounting bolts for the turbocharger are tight.

2. Check that the oil drain for the turbocharger is not blocked or restricted.

3. Check that the compressor housing for the turbocharger is free of dirt and debris.

4. Check that the turbine housing for the turbocharger is free of dirt and debris.

5. Check that the turbine blades rotate freely in the turbocharger.

6. Ensure that the wastegate on the turbocharger is adjusted correctly. Refer to Testing and Adjusting, “Wastegate - Inspect”. If the wastegate actuator is faulty, replace the wastegate actuator. Refer to Disassembly and Assembly, “Turbocharger - Disassemble” and Disassembly and Assembly, “Turbocharger - Assemble”.

7. If necessary, replace the turbocharger. Refer to Disassembly and Assembly, “Turbocharger - Remove” and Disassembly and Assembly, “Turbocharger - Install”.

8. Check that the repairs have eliminated the faults.

9. If the fault has not been eliminated, proceed to “Fuel Supply”.

Fuel Supply

1. Visually check the fuel tank for fuel. The fuel gauge may be faulty.

2. Ensure that the fuel supply valve (if equipped) is in the full OPEN position.

3. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).

4. Check the primary filter/water separator for water in the fuel.

5. Check for fuel supply lines that are restricted.

6. Check that the low pressure fuel lines are tight and secured properly.

7. Check the fuel filters.

8. Check the diesel fuel for contamination. Refer to Testing and Adjusting, “Fuel Quality - Test”.

9. Check for air in the fuel system. Refer to Testing and Adjusting, “Air in Fuel - Test”.

10. Ensure that the fuel system has been primed. Refer to Testing and Adjusting, “Fuel System - Prime”.

11. Check the fuel pressure. Refer to Testing and Adjusting, “Fuel System Pressure - Test”.

12. If the repair does not eliminate the fault refer to “Low Compression (Cylinder Pressure)”.

Low Compression (Cylinder Pressure)

1. Perform a compression test. Refer to Testing and Adjusting, “Compression - Test ”.

2. If low compression is noted on any cylinders, investigate the cause and rectify any faults.

   Possible causes of low compression are shown in the following list:

   - Loose glow plugs
   - Faulty piston
   - Faulty piston rings
   - Worn cylinder bores
   - Worn valves
   - Faulty cylinder head gasket
   - Damaged cylinder head

3. Perform all necessary repairs.

4. Ensure that the repairs have eliminated the faults.

5. If the repair does not eliminate the fault refer to “Individual Malfunctioning Cylinders”.

Individual Malfunctioning Cylinders

1. Use the electronic service tool to perform the “Cylinder Cut-out Test”. Note if there is any reduction in engine speed. If a reduction in engine speed is not noted, the isolated cylinder is not operating under normal conditions. If the isolation of a particular cylinder results in a reduction of engine speed that is less than normal, this may indicate that the cylinder is operating below normal performance. Investigate the cause of the fault on any cylinder that is not operating. Investigate the cause of the fault on any cylinder that is operating below normal performance.

2. If all cylinders have been checked and no faults were detected proceed to “Electronic Unit Injectors”.

Electronic Unit Injectors

1. Use the electronic service tool to perform the “Cylinder Cut-out Test”. Note if there is any reduction in engine speed. If a reduction in engine speed is not noted, the isolated electronic unit injector is not operating under normal conditions. If the isolation of a particular cylinder results in a reduction of engine speed that is less than normal, this may indicate that the electronic unit injector is operating below normal performance.

2. Remove the electronic unit injector from the suspect cylinder. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove”.

3. Install a new electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Install”.

4. Repeat the test in 1. If the fault is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove” and Disassembly and Assembly, “Electronic Unit Injector - Install”.

5. If the fault is not eliminated, check for active diagnostic fault codes.

i02529009

Mechanical Noise (Knock) in Engine

Probable Causes

- Accessory equipment
- Valve train components
- Pistons
- Connecting rod and main bearings

Recommended Actions

Accessory Equipment

1. Isolate the source of the noise. Remove the suspect engine accessory. Inspect the suspect engine accessory. Repair the engine accessory and/or replace the engine accessory if any defects are found.

2. If the mechanical noise is still apparent, refer to “Valve Train Components”.

Valve Train Components

1. Remove the valve mechanism cover. Check the following items for damage: camshaft, valve springs, lifters, pushrods, and bridges. Thoroughly clean the valve train components. If the camshaft is being replaced, also replace the valve lifters. Ensure that all of the valves move freely. Replace any damaged parts.

2. If the mechanical noise is still apparent, refer to “Pistons”.

Pistons

1. Inspect the pistons for damage and wear. Replace any damaged parts.

2. If the mechanical noise is still apparent, refer to “Connecting Rod and Main Bearings”.

Connecting Rod and Main Bearings

Inspect the connecting rod and main bearings. Also, inspect the bearing surfaces (journals) on the crankshaft. Replace any damaged parts.

i02529391

Noise Coming from Cylinder

Probable Causes

- Fuel quality
- Valve lash
- Pistons
- Electronic unit injectors

Recommended Actions

Fuel Quality

1. Check the fuel quality. Refer to Testing and Adjusting, “Fuel Quality - Test”.

2. If unsatisfactory fuel is found, perform the following procedure.

   a. Drain the fuel system.

   b. Replace the fuel filters. Refer to the Operation and Maintenance Manual, “Fuel System Primary Filter (Water Separator) Element - Replace” and Operation and Maintenance Manual, “Fuel System Filter - Replace”.

   c. Fill the fuel system with fuel that meets the standard in Operation and Maintenance Manual, “Fluid Recommendations”.

   d. Prime the fuel system. Refer to Operation and Maintenance Manual, “Fuel System - Prime”.

3. If the fault is not eliminated, refer to “Pistons”.

Pistons

1. Inspect the pistons for damage and wear. Replace any damaged parts.

2. If the noise is still apparent, refer to “Valve Lash”.

Valve Lash

1. Refer to Troubleshooting, “Excessive Valve Lash”.

2. If the fault has not been eliminated, proceed to “Electronic Unit Injectors”.

Electronic Unit Injectors

1. With the engine speed at a fast idle, use the electronic service tool to isolate one cylinder at a time. Note if there is any reduction in engine speed. If a reduction in engine speed is not noted, the isolated electronic unit injector is not operating under normal conditions. If the isolation of a particular cylinder results in a reduction of engine speed that is less than normal, this may indicate that the electronic unit injector is operating below normal performance.

2. Remove the electronic unit injector from the suspect cylinder. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove”.

3. Install a new electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Install”.

4. Repeat the test in 1. If the noise is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove” and Disassembly and Assembly, “Electronic Unit Injector - Install”.

Troubleshooting with a Diagnostic Code

i02489089

Diagnostic Code Cross Reference

Table 52

CDL Code	Description	3rd Party Device J1939 Code	Flash Code
N/A	No Diagnostic Code Detected	N/A	551
0001-02	Cylinder #1 Injector erratic, intermittent, or incorrect	651-2	111
0001-05	Cylinder #1 Injector current below normal	651-5	111
0001-06	Cylinder #1 Injector current above normal	651-6	111
0001-07	Cylinder #1 Injector not responding properly	651-7	111
0002-02	Cylinder #2 Injector erratic, intermittent, or incorrect	652-2	112
0002-05	Cylinder #2 Injector current below normal	652-5	112
0002-06	Cylinder #2 Injector current above normal	652-6	112
0002-07	Cylinder #2 Injector not responding properly	652-27	112
0003-02	Cylinder #3 Injector erratic, intermittent, or incorrect	653-2	113
0003-05	Cylinder #3 Injector current below normal	653-5	113
0003-06	Cylinder #3 Injector current above normal	653-6	113
0003-07	Cylinder #3 Injector Not Responding	653-7	113
0004-02	Cylinder #4 Injector erratic, intermittent, or incorrect	654-2	114
0004-05	Cylinder #4 Injector current below normal	654-5	114
0004-06	Cylinder #4 Injector current above normal	654-6	114
0004-07	Cylinder #4 Injector not responding properly	654-7	114
0005-02	Cylinder #5 Injector erratic, intermittent, or incorrect (C6.6 engine only)	655-2	115
0005-05	Cylinder #5 Injector current below normal (C6.6 engine only)	655-5	115
0005-06	Cylinder #5 Injector current above normal (C6.6 engine only)	655-6	115
0005-07	Cylinder #5 Injector not responding properly (C6.6 engine only)	655-7	115
0006-02	Cylinder #6 Injector erratic, intermittent, or incorrect (C6.6 engine only)	656-2	116
0006-05	Cylinder #6 Injector current below normal (C6.6 engine only)	656-5	116
0006-06	Cylinder #6 Injector current above normal (C6.6 engine only)	656-6	116
0006-07	Cylinder #6 Injector not responding properly (C6.6 engine only)	656-7	116
0041-03	8 Volt DC Supply voltage above normal	678-03	517
0041-04	8 Volt DC Supply voltage below normal	678-04	517
0091-02	Throttle Position Sensor erratic, intermittent, or incorrect	91-02	154

(continued)

(Table 52, contd)

CDL Code	Description	3rd Party Device J1939 Code	Flash Code
0091-03	Throttle Position Sensor voltage above normal	91-03	154
0091-04	Throttle Position Sensor voltage below normal	91-04	154
0091-08	Throttle Position Sensor abnormal frequency, pulse width, or period	91-08	154
0100-03	Engine Oil Pressure Sensor voltage above normal	100-03	157
0100-04	Engine Oil Pressure Sensor voltage below normal	100-04	157
0100-10	Engine Oil Pressure Sensor abnormal rate of change	100-10	157
0110-03	Engine Coolant Temperature Sensor voltage above normal	110-03	168
0110-04	Engine Coolant Temperature Sensor voltage below normal	110-04	168
0168-00	Electrical System Voltage high	168-00	422
0168-01	Electrical System Voltage low	168-01	422
0168-02	Electrical System Voltage erratic, intermittent, or incorrect	168-02	422
0172-03	Intake Manifold Air Temperature Sensor voltage above normal	105-03	133
0172-04	Intake Manifold Air Temperature Sensor voltage below normal	105-04	133
0190-08	Engine Speed Sensor abnormal frequency, pulse width, or period	190-08	141
0247-09	SAE J1939 Data Link abnormal update rate	-	514
0247-12	SAE J1939 Data Link failure	-	514
0253-02	Personality Module erratic, intermittent, or incorrect	631-02	415
0261-11	Engine Timing Offset fault	637-11	143
0262-03	5 Volt Sensor DC Power Supply voltage above normal	1079-03	516
0262-04	5 Volt Sensor DC Power Supply voltage below normal	1079-04	516
0268-02	Programmed Parameter Fault erratic, intermittent, or incorrect	630-02	527
0342-08	Secondary Engine Speed Sensor abnormal frequency, pulse width, or period	723-08	142
0526-05	Turbo Wastegate Drive current below normal	1188-05	177
0526-06	Turbo Wastegate Drive current above normal	1188-06	177
0526-07	Turbo Wastegate Drive not responding properly	1188-07	177
0774-02	Secondary Throttle Position Sensor erratic, intermittent, or incorrect	29-02	155
0774-03	Secondary Throttle Position Sensor voltage above normal	29-03	155
0774-04	Secondary Throttle Position Sensor voltage below normal	29-04	155
0774-08	Secondary Throttle Position Sensor abnormal frequency, pulse width, or period	29-08	155
1639-09	Machine Security System Module abnormal update rate	1196-09	426
1743-02	Engine Operation Mode Selector Switch erratic, intermittent, or incorrect	2882-02	144
1779-05	Fuel Rail #1 Pressure Valve Solenoid current below normal	1347-05	162
1779-06	Fuel Rail #1 Pressure Valve Solenoid current above normal	1347-06	162
1785-03	Intake Manifold Pressure Sensor voltage above normal	102-03	197
1785-04	Intake Manifold Pressure Sensor voltage below normal	102-04	197
1785-10	Intake Manifold Pressure Sensor abnormal rate of change	102-10	197
1797-03	Fuel Rail Pressure Sensor voltage above normal	157-03	159

(continued)

(Table 52, contd)

CDL Code	Description	3rd Party Device J1939 Code	Flash Code
1797-04	Fuel Rail Pressure Sensor voltage below normal	157-04	159
1834-02	Ignition Key Switch loss of signal	158-02	439
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i02412499

No Diagnostic Codes Detected

Conditions Which Generate This Code:

A flash code 0551 indicates that there are no detected faults in the system since the previous powering up.

System Response:

This code will not appear on the electronic service tool. The indicator lamps will flash the diagnostic code. For more information on flash codes, refer to Troubleshooting, “Indicator Lamps”.

Possible Performance Effect:

None

There are no faults that require troubleshooting.

Results:

- OK – STOP.

i02493340

CID 0001 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following condition:

- Data from the electronic unit injector for the No. 1 cylinder is out of limits.
- Diagnostic code 0168-01 is not active.
- Diagnostic codes 0001-05 and 0001-06 are not active.
- No 0041 diagnostic codes are active.
- No 0262 diagnostic codes are active.
- Diagnostic code 0190-08 is not active.
- No 0110 diagnostic codes are active.

System Response:

If equipped, the warning light will come on. An active diagnostic code will be generated. The ECM will log the diagnostic code. The ECM will trigger a snapshot.

Possible Performance Effect:

The engine will be derated while this diagnostic code is active.

Troubleshooting:

Perform the following diagnostic procedure: “Injector Data Incorrect - Test”

Results:

- OK – STOP.

i02493331

CID 0001 FMI 05

Conditions Which Generate This Code:

This diagnostic code is designed to indicate an open circuit (low current) in either the solenoid or the wiring for the electronic unit injector for No. 1 cylinder.

The Electronic Control Module (ECM) detects the following condition:

- A low current condition (open circuit) for each of five consecutive attempts to operate
- Battery voltage is higher than 9 volts for 2 seconds.

System Response:

If equipped, the warning light will come on. The ECM will log the diagnostic code.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When an injector cutout test is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors.

An electrical fault can prevent the electronic unit injector from operating. An open circuit in the wiring that is unique to the electronic unit injector will prevent that individual electronic unit injector from operating. On four cylinder engines, an open circuit in common wiring within the ECM can prevent the two electronic unit injectors that share that common wiring from operating. On six cylinder engines, an open circuit in common wiring within the ECM can prevent the three electronic unit injectors that share that common wiring from operating.

The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged but an open circuit will prevent the operation of the electronic unit injector.

Perform the following diagnostic procedure: “Injector Solenoid Circuit - Test”

Results:

- OK – STOP.

i02498241

CID 0001 FMI 06

Conditions Which Generate This Code:

This diagnostic code is designed to indicate a short circuit (high current) in either the solenoid or the wiring for the electronic unit injector for No. 1 cylinder.

The Electronic Control Module (ECM) detects the following conditions:

- A high current condition (short circuit) for each of five consecutive attempts to operate
- Battery voltage above 9 volts for 2 seconds

System Response:

If equipped, the warning light will come on. The ECM will log the diagnostic code.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When an injector cutout test is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors.

An electrical fault can prevent the electronic unit injector from operating. A short circuit in the wiring or the ECM that is unique to one electronic unit injector will prevent that individual electronic unit injector from operating. On four cylinder engines, a short circuit in common wiring within the ECM can prevent the two electronic unit injectors that share that common wiring from operating. On six cylinder engines, a short circuit in common wiring within the ECM can prevent the three electronic unit injectors that share that common wiring from operating.

The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged but a short circuit will prevent the operation of the electronic unit injector.

Perform the following diagnostic procedure: “Injector Solenoid Circuit - Test”

Results:

- OK – STOP.

i02518294

CID 0001 FMI 07

Conditions Which Generate This Code:

The electronic unit injector is no longer capable of delivering the correct amount of fuel.

System Response:

If equipped, the warning light will come on. The Electronic Control Module (ECM) will log the diagnostic code.

Note: The diagnostic code can be viewed on the electronic service tool.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

Use the electronic service tool to perform the Fuel System Verification Test. If the diagnostic code is still active, do the following procedure.

Replace the suspect electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove” and Disassembly and Assembly, “Electronic Unit Injector - Install”.

Use the electronic service tool to perform the fuel system verification test.

Perform the following diagnostic procedure: “None”

Results:

- OK – STOP.

i02493341

CID 0002 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following condition:

- Data from the electronic unit injector for the No. 2 cylinder is out of limits.
- Diagnostic code 0168-01 is not active.
- Diagnostic codes 0001-05 and 0001-06 are not active.
- No 0041 diagnostic codes are active.
- No 0262 diagnostic codes are active.
- Diagnostic code 0190-08 is not active.
- No 0110 diagnostic codes are active.

System Response:

If equipped, the warning light will come on. An active diagnostic code will be generated. The ECM will log the diagnostic code. The ECM will trigger a snapshot.

Possible Performance Effect:

The engine will be derated while this diagnostic code is active.

Troubleshooting:

Perform the following diagnostic procedure: “Injector Data Incorrect - Test”

Results:

- OK – STOP.

i02493335

CID 0002 FMI 05

Conditions Which Generate This Code:

This diagnostic code is designed to indicate an open circuit (low current) in either the solenoid or the wiring for the electronic unit injector for No. 2 cylinder.

The Electronic Control Module (ECM) detects the following condition:

- A low current condition (open circuit) for each of five consecutive attempts to operate
- Battery voltage is higher than 9 volts for 2 seconds.

System Response:

If equipped, the warning light will come on. The ECM will log the diagnostic code.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When an injector cutout test is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors.

An electrical fault can prevent the electronic unit injector from operating. An open circuit in the wiring that is unique to the electronic unit injector will prevent that individual electronic unit injector from operating. On four cylinder engines, an open circuit in common wiring within the ECM can prevent the two electronic unit injectors that share that common wiring from operating. On six cylinder engines, an open circuit in common wiring within the ECM can prevent the three electronic unit injectors that share that common wiring from operating.

The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged but an open circuit will prevent the operation of the electronic unit injector.

Perform the following diagnostic procedure: “Injector Solenoid Circuit - Test”

Results:

- OK – STOP.

i02498244

CID 0002 FMI 06

Conditions Which Generate This Code:

This diagnostic code is designed to indicate a short circuit (high current) in either the solenoid or the wiring for the electronic unit injector for No. 2 cylinder.

The Electronic Control Module (ECM) detects the following conditions:

- A high current condition (short circuit) for each of five consecutive attempts to operate
- Battery voltage above 9 volts for 2 seconds

System Response:

If equipped, the warning light will come on. The ECM will log the diagnostic code.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When an injector cutout test is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors.

An electrical fault can prevent the electronic unit injector from operating. A short circuit in the wiring or the ECM that is unique to one electronic unit injector will prevent that individual electronic unit injector from operating. On four cylinder engines, a short circuit in common wiring within the ECM can prevent the two electronic unit injectors that share that common wiring from operating. On six cylinder engines, a short circuit in common wiring within the ECM can prevent the three electronic unit injectors that share that common wiring from operating.

The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged but a short circuit will prevent the operation of the electronic unit injector.

Perform the following diagnostic procedure: “Injector Solenoid Circuit - Test”

Results:

- OK – STOP.

i02518295

CID 0002 FMI 07

Conditions Which Generate This Code:

The electronic unit injector is no longer capable of delivering the correct amount of fuel.

System Response:

If equipped, the warning light will come on. The Electronic Control Module (ECM) will log the diagnostic code.

Note: The diagnostic code can be viewed on the electronic service tool.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

Use the electronic service tool to perform the Fuel System Verification Test. If the diagnostic code is still active, do the following procedure.

Replace the suspect electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove” and Disassembly and Assembly, “Electronic Unit Injector - Install”.

Use the electronic service tool to perform the fuel system verification test.

Perform the following diagnostic procedure: “None”

Results:

- OK – STOP.

i02498318

CID 0003 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following condition:

- Data from the electronic unit injector for the No. 3 cylinder is out of limits.
- Diagnostic code 0168-01 is not active.
- Diagnostic codes 0001-05 and 0001-06 are not active.
- No 0041 diagnostic codes are active.
- No 0262 diagnostic codes are active.
- Diagnostic code 0190-08 is not active.
- No 0110 diagnostic codes are active.

System Response:

If equipped, the warning light will come on. An active diagnostic code will be generated. The ECM will log the diagnostic code. The ECM will trigger a snapshot.

Possible Performance Effect:

The engine will be derated while this diagnostic code is active.

Troubleshooting:

Perform the following diagnostic procedure: “Injector Data Incorrect - Test”

Results:

- OK – STOP.

i02493336

CID 0003 FMI 05

Conditions Which Generate This Code:

This diagnostic code is designed to indicate an open circuit (low current) in either the solenoid or the wiring for the electronic unit injector for No. 3 cylinder.

The Electronic Control Module (ECM) detects the following condition:

- A low current condition (open circuit) for each of five consecutive attempts to operate
- Battery voltage is higher than 9 volts for 2 seconds.

System Response:

If equipped, the warning light will come on. The ECM will log the diagnostic code.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When an injector cutout test is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors.

An electrical fault can prevent the electronic unit injector from operating. An open circuit in the wiring that is unique to the electronic unit injector will prevent that individual electronic unit injector from operating. On four cylinder engines, an open circuit in common wiring within the ECM can prevent the two electronic unit injectors that share that common wiring from operating. On six cylinder engines, an open circuit in common wiring within the ECM can prevent the three electronic unit injectors that share that common wiring from operating.

The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged but an open circuit will prevent the operation of the electronic unit injector.

Perform the following diagnostic procedure: “Injector Solenoid Circuit - Test”

Results:

- OK – STOP.

i02498247

CID 0003 FMI 06

Conditions Which Generate This Code:

This diagnostic code is designed to indicate a short circuit (high current) in either the solenoid or the wiring for the electronic unit injector for No. 3 cylinder.

The Electronic Control Module (ECM) detects the following conditions:

- A high current condition (short circuit) for each of five consecutive attempts to operate
- Battery voltage above 9 volts for 2 seconds

System Response:

If equipped, the warning light will come on. The ECM will log the diagnostic code.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When an injector cutout test is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors.

An electrical fault can prevent the electronic unit injector from operating. A short circuit in the wiring or the ECM that is unique to one electronic unit injector will prevent that individual electronic unit injector from operating. On four cylinder engines, a short circuit in common wiring within the ECM can prevent the two electronic unit injectors that share that common wiring from operating. On six cylinder engines, a short circuit in common wiring within the ECM can prevent the three electronic unit injectors that share that common wiring from operating.

The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged but a short circuit will prevent the operation of the electronic unit injector.

Perform the following diagnostic procedure: “Injector Solenoid Circuit - Test”

Results:

- OK – STOP.

i02518296

CID 0003 FMI 07

Conditions Which Generate This Code:

The electronic unit injector is no longer capable of delivering the correct amount of fuel.

System Response:

If equipped, the warning light will come on. The Electronic Control Module (ECM) will log the diagnostic code.

Note: The diagnostic code can be viewed on the electronic service tool.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

Use the electronic service tool to perform the Fuel System Verification Test. If the diagnostic code is still active, do the following procedure.

Replace the suspect electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove” and Disassembly and Assembly, “Electronic Unit Injector - Install”.

Use the electronic service tool to perform the fuel system verification test.

Perform the following diagnostic procedure: “None”

Results:

- OK – STOP.

i02498354

CID 0004 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following condition:

- Data from the electronic unit injector for the No. 4 cylinder is out of limits.
- Diagnostic code 0168-01 is not active.
- Diagnostic codes 0001-05 and 0001-06 are not active.
- No 0041 diagnostic codes are active.
- No 0262 diagnostic codes are active.
- Diagnostic code 0190-08 is not active.
- No 0110 diagnostic codes are active.

System Response:

If equipped, the warning light will come on. An active diagnostic code will be generated. The ECM will log the diagnostic code. The ECM will trigger a snapshot.

Possible Performance Effect:

The engine will be derated while this diagnostic code is active.

Troubleshooting:

Perform the following diagnostic procedure: “Injector Data Incorrect - Test”

Results:

- OK – STOP.

i02493337

CID 0004 FMI 05

Conditions Which Generate This Code:

This diagnostic code is designed to indicate an open circuit (low current) in either the solenoid or the wiring for the electronic unit injector for No. 4 cylinder.

The Electronic Control Module (ECM) detects the following condition:

- A low current condition (open circuit) for each of five consecutive attempts to operate
- Battery voltage is higher than 9 volts for 2 seconds.

System Response:

If equipped, the warning light will come on. The ECM will log the diagnostic code.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When an injector cutout test is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors.

An electrical fault can prevent the electronic unit injector from operating. An open circuit in the wiring that is unique to the electronic unit injector will prevent that individual electronic unit injector from operating. On four cylinder engines, an open circuit in common wiring within the ECM can prevent the two electronic unit injectors that share that common wiring from operating. On six cylinder engines, an open circuit in common wiring within the ECM can prevent the three electronic unit injectors that share that common wiring from operating.

The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged but an open circuit will prevent the operation of the electronic unit injector.

Perform the following diagnostic procedure: “Injector Solenoid Circuit - Test”

Results:

- OK – STOP.

i02498249

CID 0004 FMI 06

Conditions Which Generate This Code:

This diagnostic code is designed to indicate a short circuit (high current) in either the solenoid or the wiring for the electronic unit injector for No. 4 cylinder.

The Electronic Control Module (ECM) detects the following conditions:

- A high current condition (short circuit) for each of five consecutive attempts to operate
- Battery voltage above 9 volts for 2 seconds

System Response:

If equipped, the warning light will come on. The ECM will log the diagnostic code.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When an injector cutout test is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors.

An electrical fault can prevent the electronic unit injector from operating. A short circuit in the wiring or the ECM that is unique to one electronic unit injector will prevent that individual electronic unit injector from operating. On four cylinder engines, a short circuit in common wiring within the ECM can prevent the two electronic unit injectors that share that common wiring from operating. On six cylinder engines, a short circuit in common wiring within the ECM can prevent the three electronic unit injectors that share that common wiring from operating.

The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged but a short circuit will prevent the operation of the electronic unit injector.

Perform the following diagnostic procedure: “Injector Solenoid Circuit - Test”

Results:

- OK – STOP.

i02518297

CID 0004 FMI 07

Conditions Which Generate This Code:

The electronic unit injector is no longer capable of delivering the correct amount of fuel.

System Response:

If equipped, the warning light will come on. The Electronic Control Module (ECM) will log the diagnostic code.

Note: The diagnostic code can be viewed on the electronic service tool.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

Use the electronic service tool to perform the Fuel System Verification Test. If the diagnostic code is still active, do the following procedure.

Replace the suspect electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove” and Disassembly and Assembly, “Electronic Unit Injector - Install”.

Use the electronic service tool to perform the fuel system verification test.

Perform the following diagnostic procedure: “None”

Results:

- OK – STOP.

i02489300

CID 0005 FMI 02

Conditions Which Generate This Code:

This diagnostic code is applicable to six cylinder engines only.

The Electronic Control Module (ECM) detects the following condition:

- Data from the electronic unit injector for the No. 5 cylinder is out of limits.
- Diagnostic code 0168-01 is not active.

- Diagnostic codes 0001-05 and 0001-06 are not active.
- No 0041 diagnostic codes are active.
- No 0262 diagnostic codes are active.
- Diagnostic code 0190-08 is not active.
- No 0110 diagnostic codes are active.

System Response:

If equipped, the warning light will come on. An active diagnostic code will be generated. The ECM will log the diagnostic code. The ECM will trigger a snapshot.

Possible Performance Effect:

The engine will be derated while this diagnostic code is active.

Troubleshooting:

Perform the following diagnostic procedure: “Injector Data Incorrect - Test”

Results:

- OK – STOP.

i02489284

CID 0005 FMI 05

Conditions Which Generate This Code:

This diagnostic code is applicable to six cylinder engines only.

This diagnostic code is designed to indicate an open circuit (low current) in either the solenoid or the wiring for the electronic unit injector for No. 5 cylinder.

The Electronic Control Module (ECM) detects the following condition:

- A low current condition (open circuit) for each of five consecutive attempts to operate
- Battery voltage is higher than 9 volts for 2 seconds.

System Response:

If equipped, the warning light will come on. The ECM will log the diagnostic code.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When an injector cutout test is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors.

An electrical fault can prevent the electronic unit injector from operating. An open circuit in the wiring that is unique to the electronic unit injector will prevent that individual electronic unit injector from operating. On four cylinder engines, an open circuit in common wiring within the ECM can prevent the two electronic unit injectors that share that common wiring from operating. On six cylinder engines, an open circuit in common wiring within the ECM can prevent the three electronic unit injectors that share that common wiring from operating.

The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged but an open circuit will prevent the operation of the electronic unit injector.

Perform the following diagnostic procedure: “Injector Solenoid Circuit - Test”

Results:

- OK – STOP.

i02489293

CID 0005 FMI 06

Conditions Which Generate This Code:

This diagnostic code is applicable to six cylinder engines only.

This diagnostic code is designed to indicate a short circuit (high current) in either the solenoid or the wiring for the electronic unit injector for No. 5 cylinder.

The Electronic Control Module (ECM) detects the following conditions:

- A high current condition (short circuit) for each of five consecutive attempts to operate
- Battery voltage above 9 volts for 2 seconds

System Response:

If equipped, the warning light will come on. The ECM will log the diagnostic code.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When an injector cutout test is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors.

An electrical fault can prevent the electronic unit injector from operating. A short circuit in the wiring or the ECM that is unique to one electronic unit injector will prevent that individual electronic unit injector from operating. On four cylinder engines, a short circuit in common wiring within the ECM can prevent the two electronic unit injectors that share that common wiring from operating. On six cylinder engines, a short circuit in common wiring within the ECM can prevent the three electronic unit injectors that share that common wiring from operating.

The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged but a short circuit will prevent the operation of the electronic unit injector.

Perform the following diagnostic procedure: “Injector Solenoid Circuit - Test”

Results:

- OK – STOP.

i02489576

CID 0005 FMI 07

Conditions Which Generate This Code:

This diagnostic code is applicable to six cylinder engines only.

The electronic unit injector is no longer capable of delivering the correct amount of fuel.

System Response:

If equipped, the warning light will come on. The Electronic Control Module (ECM) will log the diagnostic code.

Note: The diagnostic code can be viewed on the electronic service tool.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

Use the electronic service tool to perform the Fuel System Verification Test. If the diagnostic code is still active, do the following procedure.

Replace the suspect electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove” and Disassembly and Assembly, “Electronic Unit Injector - Install”.

Use the electronic service tool to perform the fuel system verification test.

Perform the following diagnostic procedure: “None”

Results:

- OK – STOP.

i02489577

CID 0006 FMI 02

Conditions Which Generate This Code:

This diagnostic code is applicable to six cylinder engines only.

The Electronic Control Module (ECM) detects the following condition:

- Data from the electronic unit injector for the No. 6 cylinder is out of limits.
- Diagnostic code 0168-01 is not active.
- Diagnostic codes 0001-05 and 0001-06 are not active.
- No 0041 diagnostic codes are active.
- No 0262 diagnostic codes are active.
- Diagnostic code 0190-08 is not active.
- No 0110 diagnostic codes are active.

System Response:

If equipped, the warning light will come on. An active diagnostic code will be generated. The ECM will log the diagnostic code. The ECM will trigger a snapshot.

Possible Performance Effect:

The engine will be derated while this diagnostic code is active.

Troubleshooting:

Perform the following diagnostic procedure: “Injector Data Incorrect - Test”

Results:

- OK – STOP.

i02489582

CID 0006 FMI 05

Conditions Which Generate This Code:

This diagnostic code is applicable to six cylinder engines only.

This diagnostic code is designed to indicate an open circuit (low current) in either the solenoid or the wiring for the electronic unit injector for No. 6 cylinder.

The Electronic Control Module (ECM) detects the following condition:

- A low current condition (open circuit) for each of five consecutive attempts to operate
- Battery voltage is higher than 9 volts for 2 seconds.

System Response:

If equipped, the warning light will come on. The ECM will log the diagnostic code.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When an injector cutout test is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors.

An electrical fault can prevent the electronic unit injector from operating. An open circuit in the wiring that is unique to the electronic unit injector will prevent that individual electronic unit injector from operating. On four cylinder engines, an open circuit in common wiring within the ECM can prevent the two electronic unit injectors that share that common wiring from operating. On six cylinder engines, an open circuit in common wiring within the ECM can prevent the three electronic unit injectors that share that common wiring from operating.

The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged but an open circuit will prevent the operation of the electronic unit injector.

Perform the following diagnostic procedure: “Injector Solenoid Circuit - Test”

Results:

- OK – STOP.

i02489584

CID 0006 FMI 06

Conditions Which Generate This Code:

This diagnostic code is applicable to six cylinder engines only.

This diagnostic code is designed to indicate a short circuit (high current) in either the solenoid or the wiring for the electronic unit injector for No. 6 cylinder.

The Electronic Control Module (ECM) detects the following conditions:

- A high current condition (short circuit) for each of five consecutive attempts to operate
- Battery voltage above 9 volts for 2 seconds

System Response:

If equipped, the warning light will come on. The ECM will log the diagnostic code.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When an injector cutout test is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors.

An electrical fault can prevent the electronic unit injector from operating. A short circuit in the wiring or the ECM that is unique to one electronic unit injector will prevent that individual electronic unit injector from operating. On four cylinder engines, a short circuit in common wiring within the ECM can prevent the two electronic unit injectors that share that common wiring from operating. On six cylinder engines, a short circuit in common wiring within the ECM can prevent the three electronic unit injectors that share that common wiring from operating.

The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged but a short circuit will prevent the operation of the electronic unit injector.

Perform the following diagnostic procedure: “Injector Solenoid Circuit - Test”

Results:

- OK – STOP.

i02489586

CID 0006 FMI 07

Conditions Which Generate This Code:

This diagnostic code is applicable to six cylinder engines only.

The electronic unit injector is no longer capable of delivering the correct amount of fuel.

System Response:

If equipped, the warning light will come on. The Electronic Control Module (ECM) will log the diagnostic code.

Note: The diagnostic code can be viewed on the electronic service tool.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

Use the electronic service tool to perform the Fuel System Verification Test. If the diagnostic code is still active, do the following procedure.

Replace the suspect electronic unit injector. Refer to Disassembly and Assembly, “Electronic Unit Injector - Remove” and Disassembly and Assembly, “Electronic Unit Injector - Install”.

Use the electronic service tool to perform the fuel system verification test.

Perform the following diagnostic procedure: “None”

Results:

- OK – STOP.

i02526589

CID 0041 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The 8 volt supply is more than 8.8 VDC for more than one second.
- The ECM has been powered for more than three seconds.

System Response:

The ECM will log the diagnostic code and the check engine lamp will illuminate while this diagnostic code is active.

Possible Performance Effect:

The engine may be limited to low idle.

Note: The 8 volt supply may provide power to the digital throttle position sensor.

Note: The 8 volt supply provides power to the two speed/timing sensors.

Troubleshooting:

Perform the following diagnostic procedure: “Digital Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

i02526590

CID 0041 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The 8 volt supply is less than 7.2 VDC for more than one second.
- The ECM has been powered for more than three seconds.
- Diagnostic code 0168-01 is not active.

System Response:

The ECM will log the diagnostic code and the check engine lamp will illuminate while this diagnostic code is active. An active diagnostic code may not cause any noticeable effect on engine response unless the voltage drops below 6.5 VDC.

Possible Performance Effect:

The engine may be limited to low idle.

Note: The 8 volt supply may provide power to the digital throttle position sensor.

Note: The 8 volt supply provides power to the two speed/timing sensors.

Troubleshooting:

Perform the following diagnostic procedure: “Digital Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

i02526591

CID 0091 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) has detected an invalid combination of positions for the multi-position switches.

If the engine is equipped with an analog throttle position sensor then the signal from the throttle idle validation switch is invalid.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

Possible Performance Effect:

The engine speed defaults to low idle or a predetermined safe speed.

The engine will remain at this speed while the diagnostic code remains active.

The reduction of speed is determined by the current speed of the engine.

When a fault is detected and the engine is above the predetermined safe speed, the engine will reduce speed to the safe speed.

When a fault is detected and the engine is below the predetermined safe speed, the engine will match the correct speed.

All throttle switch inputs are ignored by the ECM until the fault is repaired.

All throttle switch inputs will also be ignored by the ECM until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

Proceed to “Test Step 1” if the engine is equipped with a throttle switch.

Proceed to “Test Step 2” if the engine is equipped with an analog throttle position sensor.

Test Step 1.

Perform the following diagnostic procedure: “Throttle Switch Circuit - Test”

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: “Analog Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

i02493481

CID 0091 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- ECM has been powered for at least 3 seconds.
- A signal voltage for the throttle position is above the diagnostic upper limit that is set for the application.
- The power supply for the throttle sensor is within the expected range.

System Response:

If equipped, the warning light will come on. The ECM logs the diagnostic code if the engine is running. The diagnostic codes can be viewed on the electronic service tool. The ECM will return the engine to low idle.

Possible Performance Effect:

Throttle inputs are ignored by the ECM until the fault is repaired.

Throttle inputs will also be ignored by the ECM until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

Monitor the configuration screen on the electronic service tool in order to determine the type of throttle position sensor that is used on the engine.

If the engine is equipped with an analog throttle position sensor, proceed to “Test Step 1”.

If the engine is equipped with a digital throttle position sensor, proceed to “Test Step 2”.

Test Step 1.

Perform the following diagnostic procedure: “Analog Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: “Digital Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

i02493487

CID 0091 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects all of the following conditions:

- The ECM has been powered for at least 3 seconds.
- A signal voltage for the throttle position is below the diagnostic lower limit that is set for the application.
- The power supply for the throttle sensor is within the expected range.

System Response:

If equipped, the warning light will come on. The ECM logs the diagnostic code if the engine is running. The diagnostic codes can be viewed on the electronic service tool. The ECM will return the engine to low idle.

Possible Performance Effect:

Throttle inputs are ignored by the ECM until the fault is repaired.

Throttle inputs will also be ignored by the ECM until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

Monitor the configuration screen on the electronic service tool in order to determine the type of throttle position sensor that is used on the engine.

If the engine is equipped with an analog throttle position sensor, proceed to “Test Step 1”.

If the engine is equipped with a digital throttle position sensor, proceed to “Test Step 2”.

Test Step 1.

Perform the following diagnostic procedure: “Analog Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: “Digital Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

i02526592

CID 0091 FMI 08

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal frequency from the accelerator pedal position sensor is less than 150 Hz or the signal frequency is greater than 1050 Hz for more than two seconds.
- The ECM has been powered for at least three seconds.
- Diagnostic code 0091-03 is not active.
- Diagnostic code 0091-04 is not active.
- Diagnostic codes for the 8 volt sensor supplies are not active.

System Response:

Limp home mode is activated.

The ECM sets the “Throttle Position” to “0%”. “DIAG” will be displayed next to the status for “Throttle Position” on the electronic service tool.

If equipped, the warning light will be on. The diagnostic code will be logged if the engine is running. The diagnostic code will not be logged if the engine is cranking.

Possible Performance Effect:

The engine will remain at low idle while the diagnostic code is active.

Throttle inputs are ignored by the ECM until the fault is repaired.

Throttle inputs will also be ignored by the ECM until the keyswitch has been turned to the OFF position and then back to the ON position.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

This diagnostic code indicates that the frequency of a digital throttle signal is out of the normal range.

Perform the following diagnostic procedure: “Digital Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

i02526593

CID 0100 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal voltage from the engine oil pressure sensor is greater than 4.95 VDC for more than eight seconds.
- The ECM has been powered for at least two seconds.
- The engine is not running or the engine coolant temperature is greater than 38 °C (100 °F).

System Response:

The ECM will log the diagnostic code. If equipped, the warning lamp will come on. The ECM will set data for engine oil pressure to the default value.

Note: The engine oil pressure that is displayed on the electronic service tool is the default value for engine oil pressure. The default engine oil pressure is 600 kPa (87 psi). The electronic service tool will display “Voltage Above Normal” on the status screens.

Possible Performance Effect:

None

Troubleshooting:

This diagnostic code can be caused by an open circuit or a short to another power source.

Perform the following diagnostic procedure: “Engine Pressure Sensor Open or Short Circuit - Test”

Results:

- OK – STOP.

i02526594

CID 0100 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal voltage from the engine oil pressure sensor is less than 0.1 VDC for more than eight seconds.
- The ECM has been powered for at least two seconds.
- The engine is running.

System Response:

The ECM will log the diagnostic code. If equipped, the warning lamp will come on. The ECM will set data for engine oil pressure to the default value. The electronic service tool will display “Voltage Below Normal” on the status screens.

Possible Performance Effect:

None

Troubleshooting:

This code can be caused by a short to ground or a shorted sensor.

Perform the following diagnostic procedure: “Engine Pressure Sensor Open or Short Circuit - Test”

Results:

- OK – STOP.

i02526595

CID 0100 FMI 10

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- No other codes for the oil pressure sensor are active.
- No 0262 diagnostic codes are active for the 5 volt supply.
- The engine speed is greater than 600 rpm.
- The engine oil pressure signal is within the limits of 410 kPa (59 psi) to 520 kPa (75 psi) with a pressure variation of less than 1.68 kPa (0.25 psi)for more than 30 seconds.
- The engine oil pressure signal remains constant for 30 seconds.

System Response:

If equipped, the warning lamp will be on.

The ECM will log the diagnostic code. The diagnostic code can be viewed on the electronic service tool.

The ECM will flag the engine oil pressure as invalid data.

The data for engine oil pressure is set to a default value of 500 kPa (72 psi).

The electronic service tool will display “Conditions Not Met” on the status screen.

Possible Performance Effect:

None

Troubleshooting:

This diagnostic code is designed to detect the loss of the 5 volt supply to the sensor.

Perform the following diagnostic procedure: “Engine Pressure Sensor Open or Short Circuit - Test”

Results:

- OK – STOP.

i02526596

CID 0110 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal voltage from the engine coolant temperature sensor is greater than 4.95 VDC for more than eight seconds.
- The ECM has been powered for at least two seconds.

System Response:

If equipped, the warning light will be on. An active diagnostic code will be generated after 8 seconds. The diagnostic code will be logged if the engine has been operating for more than 7 minutes.

The ECM will default to 90 °C (194 °F) for engine coolant temperature. “Voltage Above Normal” will be displayed next to the status for “Engine Coolant Temperature” on the electronic service tool.

Possible Performance Effect:

- Poor stability
- Poor cold running
- White smoke

Troubleshooting:

Perform the following diagnostic procedure: “Engine Temperature Sensor Open or Short Circuit - Test”

Results:

- OK – STOP.

i02526597

CID 0110 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal voltage from the engine coolant temperature sensor is less than 0.2 VDC for more than eight seconds.
- The ECM has been powered for at least two seconds.
- Diagnostic code 0168-01 is not active.

System Response:

The ECM will default to 90 °C (194 °F) for engine coolant temperature. “Voltage Below Normal” will be displayed next to the status for “Engine Coolant Temperature” on the electronic service tool.

If equipped, the warning light will come on. An active diagnostic code will be generated after 8 seconds. The diagnostic code will be logged if the engine has been operating for more than 7 minutes. When the diagnostic code is logged, the ECM will trigger a snapshot.

Possible Performance Effect:

- Poor stability
- Poor cold running
- White smoke

Troubleshooting:

Perform the following diagnostic procedure: “Engine Temperature Sensor Open or Short Circuit - Test”

Results:

- OK – STOP.

i02526598

CID 0168 FMI 00

Conditions Which Generate This Code:

This condition indicates that the battery circuit to the Electronic Control Module (ECM) has excessive voltage while the engine is running.

The ECM detects the following conditions:

- For 24 VDC systems, the battery voltage to the ECM exceeds 32 V for more than 0.5 seconds.
- For 12 VDC systems, the battery voltage to the ECM exceeds 16 V for more than 0.5 seconds.
- The keyswitch is in the ON mode.
- The engine is not cranking.

- The engine is running for more than 30 seconds.

System Response:

The ECM will log the diagnostic code. If equipped, the warning lamp may come on.

Possible Performance Effect:

None

Troubleshooting:

Perform the following diagnostic procedure: “Ignition Keyswitch Circuit and Battery Supply Circuit - Test”

Results:

- OK – STOP.

i02526599

CID 0168 FMI 01

Conditions Which Generate This Code:

This code indicates that the battery circuit for the Electronic Control Module (ECM) has low voltage while the engine is running. If battery voltage disappears without returning, the ECM will not log this diagnostic code and the engine will shut down.

The ECM detects the following conditions:

- The keyswitch is in the ON mode.
- The engine is not cranking.
- The engine is running for more than three seconds.
- For 24 VDC systems, the battery voltage to the ECM is below 18 V for more than 0.5 seconds.
- For 12 VDC systems, the battery voltage to the ECM is below 9 V for more than 0.5 seconds.

System Response:

The ECM will log the diagnostic code and the ECM will trigger a snapshot.

The engine will derate 100 percent.

If equipped, the warning lamp may come on.

Possible Performance Effect:

The engine may experience changes in the engine rpm, and intermittent engine shutdowns or complete engine shutdowns while the conditions that cause this diagnostic code are present.

Troubleshooting:

Perform the following diagnostic procedure: “Ignition Keyswitch Circuit and Battery Supply Circuit - Test”

Results:

- OK – STOP.

i02526600

CID 0168 FMI 02

Conditions Which Generate This Code:

This condition indicates that the battery circuit for the Electronic Control Module (ECM) is intermittent while the engine is running. If the battery voltage disappears without returning, the ECM will not log this diagnostic code and the engine will shut down.

The ECM detects the following conditions:

- Three voltage readings that are below 6 VDC in a period of 7 seconds will be detected by the ECM. The voltage must subsequently increase to more than 9 VDC.
- The keyswitch is in the ON position.
- The engine is running.
- The engine is not cranking.

System Response:

The ECM may stop injecting fuel. This may be dependent on the length of time of the occurrence of the fault.

The check engine lamp and the warning lamp may come on as if the keyswitch was just turned on and the engine started.

Possible Performance Effect:

The engine may experience changes in the engine rpm, and intermittent engine shutdowns or complete engine shutdowns while the conditions that cause this diagnostic code are present.

Troubleshooting:

Perform the following diagnostic procedure: “Ignition Keyswitch Circuit and Battery Supply Circuit - Test”

Results:

- OK – STOP.

i02526601

CID 0172 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal voltage from the intake manifold air temperature sensor is greater than 4.95 VDC for more than eight seconds.
- Engine coolant temperature is above −10 °C (15.0 °F).
- The ECM has been powered for at least two seconds.
- Diagnostic code 0168-01 is not active.

System Response:

The ECM will use the default value of 70 °C (158 °F) for the intake manifold air temperature. “Voltage High” will be displayed next to the status for “Intake Manifold Air Temperature” on the electronic service tool.

If equipped, the warning light will be on. The ECM will log the diagnostic code.

Possible Performance Effect:

- Poor stability
- Poor cold running
- White smoke
- Black smoke
- Poor acceleration under load

Troubleshooting:

This fault can be caused by an open circuit or a short to a power source.

Perform the following diagnostic procedure: “Engine Temperature Sensor Open or Short Circuit - Test”

Results:

- OK – STOP.

i02526602

CID 0172 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal voltage from the intake manifold air temperature sensor is less than 0.2 VDC for more than eight seconds.
- The ECM has been powered for at least two seconds.
- Diagnostic code 0168-01 is not active.

System Response:

The ECM will use the default value of 70 °C (158 °F) for the intake manifold air temperature. “Voltage Low” will be displayed next to the status for “Intake Manifold Air Temperature” on the electronic service tool.

If equipped, the warning light will be on. The ECM will log the diagnostic code.

Possible Performance Effect:

- Poor stability
- Poor cold running
- White smoke
- Black smoke
- Poor acceleration under load

Troubleshooting:

This fault can be caused by a sensor that is shorted to ground or a sensor that is internally shorted.

Perform the following diagnostic procedure: “Engine Temperature Sensor Open or Short Circuit - Test”

Results:

- OK – STOP.

i02493342

CID 0190 FMI 08

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The ECM detected an intermittent loss of signal or a complete loss of signal from the primary speed/timing sensor for 2 seconds.
- The engine has been running for more than three seconds.

System Response:

If equipped, the warning light will come on and the diagnostic code will be logged.

The ECM will use the signal from the secondary speed/timing sensor.

Possible Performance Effect:

The engine will be derated. If the signal from the secondary speed/timing sensor is also lost, the engine will shut down.

Troubleshooting:

Perform the following diagnostic procedure: “Engine Speed/Timing Sensor Circuit - Test”

Results:

- OK – STOP.

i02527035

CID 0247 FMI 09

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following condition:

- Another controller has stopped transmitting a J1939 speed request (TSC1) incorrectly or another controller has started transmitting a J1939 speed request incorrectly.

System Response:

Some system functions may not operate correctly.

Troubleshooting:

Perform the following diagnostic procedure: “CAN Data Link Circuit - Test”

Results:

- OK – STOP.

i02527036

CID 0247 FMI 12

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- There is an unexpected loss of a continuous J1939 Torque Speed Controller (TSC1) signal on the J1939 data link.
- The expected continuous TSC1 signal has never been received on the J1939 data link.

System Response:

Engine speed functions that are controlled through TSC1 will be disabled until the fault is rectified and the keyswitch is cycled through the OFF position and the ON position.

The engine speed will be reduced to a low idle. If the engine is equipped with a secondary throttle, the engine speed will change to the speed that is demanded by the secondary throttle.

The diagnostic code will be active and the diagnostic code will be logged.

Troubleshooting:

Check the configuration of the ECM. If the ECM for the engine has been incorrectly configured to expect a continuous TSC1 signal, remove “Continuous” for the TSC1 signal on the main “J1939” screen on the electronic service tool.

Perform the following diagnostic procedure: ““Use the OEM information to determine the machine ECM that provides the continuous speed signal. Refer to the troubleshooting procedures from the OEM to diagnose the faulty speed signal.””

Results:

- OK – STOP.

i02527037

CID 0253 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects incorrect engine software.

System Response:

If equipped, the warning light will come on.

This diagnostic code is not logged.

Factory passwords are required to clear this diagnostic code.

Possible Performance Effect:

The engine will not start.

Troubleshooting:

The flash file in the ECM is from the wrong engine family.

Use the electronic service tool to install the correct flash file into the ECM. Refer to the Troubleshooting Guide, “Flash Programming”.

Perform the following diagnostic procedure: “None”

Results:

- OK – STOP.

i02527038

CID 0261 FMI 11

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The primary speed/timing sensor and the secondary speed/timing sensor are off by more than 8 crankshaft degrees.
- The engine has been running for more than five seconds.
- Diagnostic code 0190-08 is not active.
- No 0041 diagnostic codes are active.

System Response:

This code will not be logged. If equipped, the warning light will be on when this code is active.

Possible Performance Effect:

The pressure in the fuel rail may be unstable and the engine may not run smoothly.

Troubleshooting:

Check the timing of the fuel rail pump. Refer to Disassembly and Assembly, “Fuel Injection Pump - Install”.

Results:

- OK – STOP.

i02527039

CID 0262 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The 5 volt supply is greater than 5.16 VDC for more than one second.
- The ECM has been powered for at least three seconds.
- Diagnostic code 0168-01 is not active.

System Response:

The ECM sets all of the pressure sensors and temperature sensors to the default values.

The ECM will derate the engine.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

Perform the following diagnostic procedure: “5 Volt Sensor Supply Circuit - Test”

Results:

- OK – STOP.

i02527040

CID 0262 FMI 04

Conditions Which Generate This Code:

The Engine Control Module (ECM) detects the following conditions:

- The 5 volt supply is less than 4.84 VDC for more than one second.
- The ECM has been powered for at least three seconds.
- Diagnostic code 0168-01 is not active.

System Response:

The ECM sets all of the pressure sensors and temperature sensors to the default values.

The ECM will derate the engine.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

Perform the following diagnostic procedure: “5 Volt Sensor Supply Circuit - Test”

Results:

- OK – STOP.

i02527041

CID 0268 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects one or more of the following conditions:

- One or more of the following configuration parameters are not programmed. The effect on the ECM depends on the parameter.
- FLS or FTS
- Injector trim codes
- Engine serial number
- All of the injector trim files are not loaded into the ECM. Engine performance and emissions are affected.

System Response:

Note: The fault is not logged.

The electronic service tool will display a list of the condition(s) on the “Active Diagnostics” screen that must be resolved. If equipped, the warning light will come on.

Possible Performance Effect:

The ECM may limit the engine to low idle and/or the ECM may derate the power. Engine performance and emissions are affected.

Troubleshooting:

Use the electronic service tool to correct parameters that have not been programmed or parameters that have been incorrectly programmed.

Perform the following diagnostic procedure: “Flash Programming”

Results:

- OK – STOP.

i02527042

CID 0342 FMI 08

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal from the secondary speed/timing sensor is lost and/or intermittent.
- The signal from the secondary speed/timing sensor was lost for at least 2 seconds while the signal from the primary speed/timing sensor remained valid and the engine was running.
- Diagnostic code 0168-01 is not active.
- The engine has been running for more than 3 seconds.
- No 0041 diagnostic codes are active.

System Response:

The ECM will illuminate the warning lamp and the code is logged.

Possible Performance Effect:

The performance will not be affected unless both speed signals are lost. The loss of the signals from both speed/timing sensors will cause the ECM to shut down the engine. The engine will not restart if the signal from the secondary speed/timing sensor is lost.

Troubleshooting:

Perform the following diagnostic procedure: “Engine Speed/Timing Sensor Circuit - Test”

Results:

- OK – STOP.

i02527043

CID 0526 FMI 05

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- A low current condition in the output from the ECM to the solenoid for the wastegate regulator
- No 0168 diagnostic codes are active.

System Response:

The ECM will log the diagnostic code. If equipped, the warning lamp will turn on once the diagnostic code has been active for 30 seconds. After the derate has been activated, the electronic service tool will indicate “Turbo Protection Derate Active”.

Possible Performance Effect:

The engine will be derated while this diagnostic code is active.

Troubleshooting:

This diagnostic code indicates a fault in the circuit for the solenoid in the wastegate regulator that is most likely to be an open circuit.

Perform the following diagnostic procedure: “Wastegate Solenoid - Test”

Results:

- OK – STOP.

i02527044

CID 0526 FMI 06

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- A high current condition in the output from the ECM to the solenoid in the wastegate regulator
- No 0168 diagnostic codes are active.

System Response:

The ECM will log the diagnostic code. If equipped, the warning lamp will turn on once the diagnostic code has been active for 30 seconds. After the derate has been activated, the electronic service tool will indicate “Turbo Protection Derate Active”.

Possible Performance Effect:

The engine will be derated while this diagnostic code is active.

Troubleshooting:

This diagnostic code indicates a fault in the circuit for the solenoid in the wastegate regulator. This problem is most likely to be caused by a high side short to ground or a low side short to power.

Perform the following diagnostic procedure: “Wastegate Solenoid - Test”

Results:

- OK – STOP.

i02489717

CID 0526 FMI 07

Conditions Which Generate This Code:

This diagnostic code indicates that the intake manifold pressure is not being controlled correctly.

The Electronic Control Module (ECM) will detect the following conditions:

- The ECM has been powered for more than 4 seconds.
- Diagnostic code 0168-01 is not active.

- No 1785 diagnostic codes are active.
- Diagnostic codes 0526-05 and 0526-06 are not active.
- No 0262 diagnostic codes are active.

Note: This diagnostic code will only appear if an electronically controlled wastegate is installed.

System Response:

If equipped, the warning lamp will come on and the ECM will log the diagnostic code.

Possible Performance Effect:

- The engine may not reach top RPM.
- The engine produces excessive black smoke.
- The engine has low power.

Troubleshooting:

When this diagnostic code is registered, the code indicates that a mechanical problem exists in the intake air system. The electronic part of the control system will be operating correctly.

Perform the following diagnostic procedure: “Systems Operation, Testing and Adjusting Manual, Turbocharger - Inspect”

Results:

- OK – STOP.

i02527048

CID 0774 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a position for the throttle switch that has not been defined.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will return the engine to low idle or to a safe speed while the diagnostic code is active.

Possible Performance Effect:

The engine speed defaults to low idle or a predetermined safe speed.

The engine will remain at this speed while the diagnostic code remains active.

The reduction of speed is determined by the current speed of the engine.

When a fault is detected and the engine is above the predetermined safe speed, the engine will reduce speed to the safe speed.

When a fault is detected and the engine is below the predetermined safe speed, the engine will match the correct speed.

Throttle inputs are ignored by the ECM until the fault is repaired.

Throttle inputs will also be ignored by the ECM until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

The engine will use the primary throttle only until the fault is repaired.

Perform the following diagnostic procedure: “Throttle Switch Circuit - Test”

Results:

- OK – STOP.

i02527049

CID 0774 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects one of the following conditions:

- The ECM has been powered for 3 seconds.
- Diagnostic code 0168-01 is not active.
- No 0262 diagnostic codes are active.
- The setting for the upper diagnostic limit has been exceeded for 1 second.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will return the engine to low idle or to a safe speed while the diagnostic code is active.

Possible Performance Effect:

Throttle inputs are ignored by the ECM until the fault is repaired.

Throttle inputs will also be ignored by the ECM until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

Monitor the configuration screen on the electronic service tool in order to determine the type of throttle position sensor that is used on the engine.

If the engine is equipped with an analog throttle position sensor, proceed to “Test Step 1”.

If the engine is equipped with a digital throttle position sensor, proceed to “Test Step 2”.

Test Step 1.

Perform the following diagnostic procedure: “Analog Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: “Digital Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

i02527050

CID 0774 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects one of the following conditions:

- The ECM has been powered for 3 seconds.
- Diagnostic code 0168-01 is not active.
- No 0262 diagnostic codes are active.
- The setting for the lower diagnostic limit has been exceeded for 1 second.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will return the engine to low idle or to a safe speed while the diagnostic code is active.

Possible Performance Effect:

Throttle inputs are ignored by the ECM until the fault is repaired.

Throttle inputs will also be ignored by the ECM until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

Monitor the configuration screen on the electronic service tool in order to determine the type of throttle position sensor that is used on the engine.

If the engine is equipped with an analog throttle position sensor, proceed to “Test Step 1”.

If the engine is equipped with a digital throttle position sensor, proceed to “Test Step 2”.

Test Step 1.

Perform the following diagnostic procedure: “Analog Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: “Digital Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

i02527051

CID 0774 FMI 08

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects one of the following conditions:

- The ECM has been powered for 3 seconds.
- Diagnostic code 0168-01 is not active.
- No 0262 codes are active for the analog sensors.
- No 0041 codes are active for the digital (PWM) sensors.
- Diagnostic codes 0774-03 and 0774-04 are not active.
- The frequency of the signal from the digital (PWM) sensor is less than 150 Hz for more than 1 second.
- The frequency of the signal from the digital (PWM) sensor is greater than 1050 Hz for more than 1 second.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will return the engine to low idle or to a safe speed while the diagnostic code is active.

Possible Performance Effect:

Throttle inputs are ignored by the ECM until the fault is repaired.

Throttle inputs will also be ignored by the ECM until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

Monitor the configuration screen on the electronic service tool in order to determine the type of throttle position sensor that is used on the engine.

If the engine is equipped with an analog throttle position sensor, proceed to “Test Step 1”.

If the engine is equipped with a digital throttle position sensor, proceed to “Test Step 2”.

Test Step 1.

Perform the following diagnostic procedure: “Analog Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: “Digital Throttle Position Sensor Circuit - Test”

Results:

- OK – STOP.

i02489777

CID 1639 FMI 09

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following condition:

- The ECM detects a loss of communications with the Machine Security System (MSS).

System Response:

The ECM will log the diagnostic code. The diagnostic code can be viewed on a display module or the electronic service tool.

Possible Performance Effect:

The engine will not start.

Troubleshooting:

Perform the following diagnostic procedure: “Data Link Circuit - Test”

Results:

- OK – STOP.

i02527056

CID 1743 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a combination of switch positions for the mode switches that has not been defined.

System Response:

The ECM will return the engine to the last good mode selection or setting.

Possible Performance Effect:

The engine will start and the engine will default to the previous mode selection. The engine may operate at reduced speed or reduced power. This will depend on the mode that is selected.

Perform the following diagnostic procedure: “Mode Selection Circuit - Test”

Results:

- OK – STOP.

i02527057

CID 1779 FMI 05

Conditions Which Generate This Code:

This diagnostic code indicates that the Electronic Control Module (ECM) has detected an open circuit or low current condition in the solenoid for the fuel rail.

System Response:

If equipped, the warning light will come on and the ECM will log the diagnostic code.

Possible Performance Effect:

An electrical fault may prevent the provision of pressure to the fuel rail. This may result in the loss of fuel injection. If the solenoid for the fuel rail pump fails, it is likely that fuel will not be pumped into the fuel rail. The engine will stop or the engine will not start.

Perform the following diagnostic procedure: “Fuel Rail Pump Solenoid - Test”

Results:

- OK – STOP.

i02527058

CID 1779 FMI 06

Conditions Which Generate This Code:

This diagnostic code indicates that the Electronic Control Module (ECM) has detected a short circuit or high current condition in the solenoid for the fuel rail.

System Response:

If equipped, the warning light will come on and the ECM will log the diagnostic code.

Possible Performance Effect:

An electrical fault may prevent the provision of pressure to the fuel rail. This may result in the loss of fuel injection. If the solenoid for the fuel rail pump fails, it is likely that fuel will not be pumped into the fuel rail. The engine will stop or the engine will not start.

Perform the following diagnostic procedure: “Fuel Rail Pump Solenoid - Test”

Results:

- OK – STOP.

i02527059

CID 1785 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The ECM has been powered for two seconds.
- The signal voltage from the intake manifold pressure sensor is above 4.95 VDC for at least two seconds.
- This diagnostic code can be caused by an open circuit or a short to another power source.

System Response:

If equipped, the warning light will be on. The ECM will log the diagnostic code. The ECM will trigger a snapshot. The data for the intake manifold pressure will be set to a maximum valid pressure for two seconds. The ECM will then flag the intake manifold pressure as being invalid. A default value is then used for the intake manifold pressure.

For engines with an electronically controlled wastegate, the current for the wastegate solenoid will be set to a default value while this code is active. This will cause the engine to have poor acceleration but the default setting will prevent any overpressure in the intake manifold which could be caused by an overspeed of the turbocharger.

Possible Performance Effect:

None

Troubleshooting:

Perform the following diagnostic procedure: “Engine Pressure Sensor Open or Short Circuit - Test”

Results:

- OK – STOP.

i02527060

CID 1785 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal voltage from the intake manifold pressure sensor is less then 0.2 VDC for at least two seconds.
- The ECM has been powered for two seconds.
- This code can be caused by a short to ground or a shorted sensor.
- The keyswitch is in the “ON” position so that the ECM is energized.

System Response:

If equipped, the warning light will be on. The ECM will log the diagnostic code. The ECM will trigger a snapshot. The data for the intake manifold pressure will be set to a maximum valid pressure for two seconds. The ECM will then flag the intake manifold pressure as being invalid. A default value is then used for the intake manifold pressure.

For engines with an electronically controlled wastegate, the current for the wastegate solenoid will be set to a default value while this code is active. This will cause the engine to have poor acceleration but the default setting will prevent any overpressure in the intake manifold which could be caused by an overspeed of the turbocharger.

Possible Performance Effect:

None

Troubleshooting:

Perform the following diagnostic procedure: “Engine Pressure Sensor Open or Short Circuit - Test”

Results:

- OK – STOP.

i02527061

CID 1785 FMI 10

Conditions Which Generate This Code:

This diagnostic code is designed to detect the loss of the 5 volt supply at the sensor connector.

The Electronic Control Module (ECM) detects the following conditions:

- The engine speed is more than 1000 rpm.
- The intake manifold pressure is within the acceptable range.
- No 0262 codes for the 5 volt supply are active.
- Diagnostic code 0168-01 is not active.

System Response:

If equipped, the warning light will be on. The ECM will log the diagnostic code. The ECM will trigger a snapshot. The ECM will flag the intake manifold pressure as being invalid. A default value is used for the intake manifold pressure.

For engines with an electronically controlled wastegate, the current for the wastegate solenoid will be set to a default value while this code is active. This will cause the engine to have poor acceleration but the default setting will prevent any overpressure in the intake manifold which could be caused by an overspeed of the turbocharger.

Note: Any open circuits or short circuits in the signal wire for the oil pressure may reset this diagnostic.

Possible Performance Effect:

- The engine will be derated.

Troubleshooting:

This diagnostic code is designed to detect the loss of the 5 V supply to the sensor.

Perform the following diagnostic procedure: “Engine Pressure Sensor Open or Short Circuit - Test”

Results:

- OK – STOP.

i02527062

CID 1797 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal voltage for the pressure in the fuel rail is more than 4.8 V for 0.6 seconds.

System Response:

If equipped, the warning lamp will be on. The ECM will log the diagnostic code. The electronic service tool will display “70000 kPa” next to “Desired Fuel Rail Pressure” and “Actual Fuel Rail Pressure” on the status screens.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

This code can be caused by a loss of reference ground, an open signal wire or a short to a voltage source.

Perform the following diagnostic procedure: “Engine Pressure Sensor Open or Short Circuit - Test”

Results:

- OK – STOP.

i02527063

CID 1797 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- No 0262 codes for the 5 volt supply are active.
- Diagnostic code 0168-01 is not active.
- The signal voltage for the pressure in the fuel rail is less than 0.2 V for 0.6 seconds.

System Response:

If equipped, the warning lamp will be on. The ECM will log the diagnostic code. The electronic service tool will display “70000 kPa” next to “Desired Fuel Rail Pressure” and “Actual Fuel Rail Pressure” on the status screens.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

This diagnostic code can be caused by a loss of the 5 V supply or a short to ground on the signal wire.

Perform the following diagnostic procedure: “Engine Pressure Sensor Open or Short Circuit - Test”

Results:

- OK – STOP.

i02527064

CID 1834 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following condition:

The signal from the keyswitch was erratic because the keyswitch was cycled at least three times within the last second.

Note: This code can be generated by rapidly cycling the keyswitch. Some control modules on the application may require this action in order to prompt flash codes. If this occurs, clear the logged diagnostic codes in order to prevent future confusion or an incorrect diagnosis.

System Response:

The ECM will log the diagnostic code and the warning lamp will come on while this diagnostic code is active. The ECM will stop energizing the injector solenoids and the engine will shut down.

Possible Performance Effect:

Engine shutdown

Troubleshooting:

Perform the following diagnostic procedure: “Ignition Keyswitch Circuit and Battery Supply Circuit - Test”

Results:

- OK – STOP.

i02527065

CID 2246 FMI 06

Conditions Which Generate This Code:

The Electronic Control Module (ECM) has detected a high current condition (short circuit) after attempting to activate the glow plug starting aid.

The ECM detects the following conditions:

- The engine is not cranking.
- The ECM has been powered for at least 1 second.
- There is a high current condition (short circuit) for more than 2 seconds.

System Response:

The ECM will log the code. An ECM that was previously blank will require a total of 2 hours of operation before the diagnostic code will be logged. If equipped, the warning light will come on. The ECM is unable to activate the relay for the glow plug starting aid. The glow plugs will not operate or the glow plugs will operate all the time.

Possible Performance Effect:

The engine may be difficult to start in cold temperatures and the exhaust may emit white smoke.

Troubleshooting:

Perform the following diagnostic procedure: “Starting Aid (Glow Plug) Relay Circuit - Test”

Results:

- OK – STOP.

Troubleshooting with an Event Code

i02411237

Event Codes

The ECM can log events. Events refer to engine operating conditions such as low oil pressure or high coolant temperature. Logged events usually indicate a mechanical problem instead of an electronic system problem.

Note: If a diagnostic code has already been logged then any associated event code to that fault will not be logged as well.

i02539780

E172 High Air Filter Restriction

Conditions Which Generate This Code:

This event code will only be generated if the switch for the air filter restriction is installed and the customer programmable feature is enabled.

The Electronic Control Module (ECM) detects a problem with the air flow. If the air flow has been restricted for more than thirty seconds, the ECM will generate this code.

Note: This code is generated only when the engine is running. This event code will become inactive when the restriction decreases for more than 5 seconds.

System Response:

The event code will be logged.

The optional warning lamp will be illuminated.

Possible Performance Effect:

E172-1

A blocked filter may cause the engine to experience symptoms such as low power.

Troubleshooting:

The event code may represent a problem with the electronic system. This event code normally indicates high air filter restriction. Refer to Testing and Adjusting Manual, “Air Inlet and Exhaust System - Inspect”.

Results:

- OK – STOP.

i02502980

E194 High Exhaust Temperature

Conditions Which Generate This Code:

The Electronic Control Module (ECM) monitors the following parameters in order to estimate the exhaust temperature:

- Intake manifold air temperature
- Barometric pressure
- Engine speed

High intake manifold air temperature, high altitude operation, and high engine loads can cause the exhaust temperature to increase to a level that may damage the components of the exhaust system. When this occurs, the ECM derates the engine in order to reduce the exhaust temperature. This protects the components of the exhaust system from damage.

System Response:

The code is logged. Passwords are not required in order to clear the logged code.

Possible Performance Effect:

Engine power is reduced.

Test Step 1. Determine the Operating Conditions

Determine if the engine was under heavy load or the engine is operating at a high altitude.

Expected Result:

The event occurred because of normal engine operation.

Results:

- OK – The event occurred because of normal engine operation. Clear the logged event and return the engine to service. STOP.
- Not OK – The event should not have occurred. If the engine is equipped with an air-to-air aftercooler, proceed to Test Step 2.

Test Step 2. Check the Air-to-Air Aftercooler (ATAAC) (if equipped)

The intake manifold air temperature can increase if the ATAAC is obstructed. Check the fins of the ATAAC for obstructions.

Expected Result:

The fins of the ATAAC are obstructed.

Results:

- OK – The fins of the ATAAC are obstructed.

  Repair: Clean the fins of the ATAAC. Clear the event. Refer to the OEM manual for the ATAAC. Return the engine to service.

  STOP.

- Not OK – The fins of the ATAAC are clear of obstructions.

  STOP.

i02536030

E232 High Fuel/Water Separator Water Level

Conditions Which Generate This Code:

This event code will only be generated if the switch on the water separator filter is installed and correctly wired to the ECM and the customer programmable feature is enabled.

The Electronic Control Module (ECM) detects a problem with the water level in the fuel filter. A water level sensor may be installed in the fuel filter. If the water rises above a set level for more than thirty seconds, the ECM will generate this code. The code will become inactive when the switch has been immersed in fuel for 5 seconds.

Note: The code is generated only when the engine is running.

System Response:

The event code will be logged.

The optional warning lamp will be illuminated.

Possible Performance Effect:

E232-1

None

Troubleshooting:

Refer to Testing and Adjusting manual, “Fuel System - Inspect”.

Results:

- OK – STOP.

i02536616

E360 Low Engine Oil Pressure

Conditions Which Generate This Code:

The following conditions occur:

360-1

- The engine has been running for at least ten seconds.
- There are no active diagnostic codes for the oil pressure sensor or for the atmospheric pressure sensor.
- Engine oil pressure is in the “LEVEL 1” area in Illustration 20 for eight seconds.

Note: The warning will be cancelled if the oil pressure rises 21 kPa (3 psi) above the set point for 20 seconds.

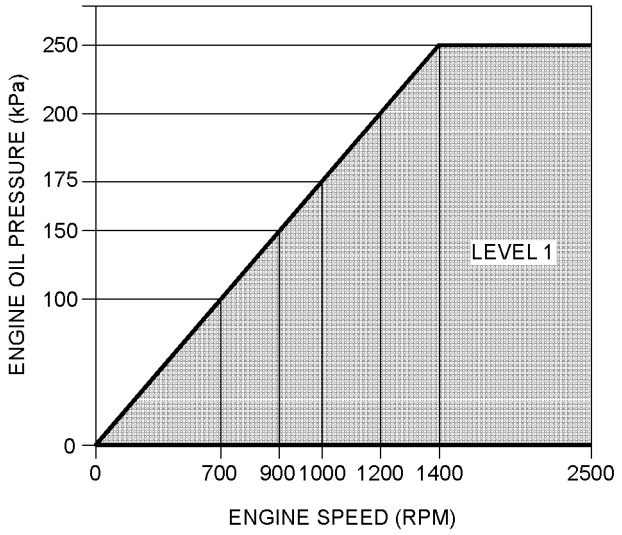
360-2

- The engine has been running for at least ten seconds.
- There are no active diagnostic codes for the oil pressure sensor or for the atmospheric pressure sensor.
- Engine oil pressure is in the “LEVEL 2” area in Illustration 21 for eight seconds.

Note: The derate will be cancelled if the oil pressure rises 21 kPa (3 psi) above the set point for 20 seconds.

360-3

- The engine has been running for at least ten seconds.
- There are no active diagnostic codes for the oil pressure sensor or for the atmospheric pressure sensor.
- Engine oil pressure is in the “LEVEL 3” area in Illustration 22 for four seconds.



g01269377

Illustration 20

Level 1 engine oil pressure versus engine speed

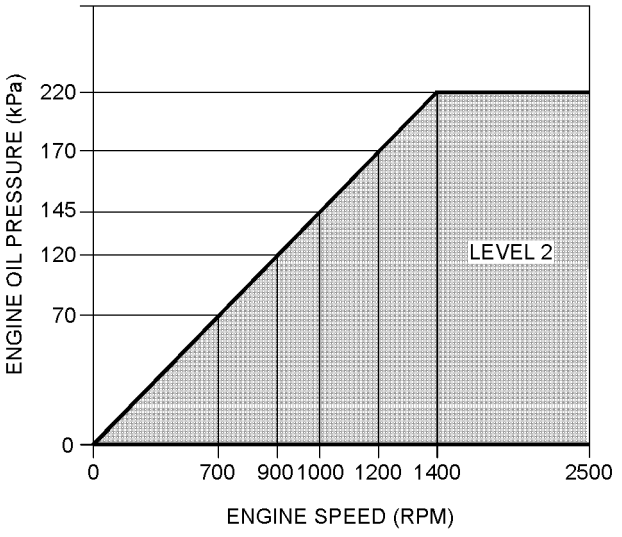


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Illustration 21

Level 2 engine oil pressure versus engine speed

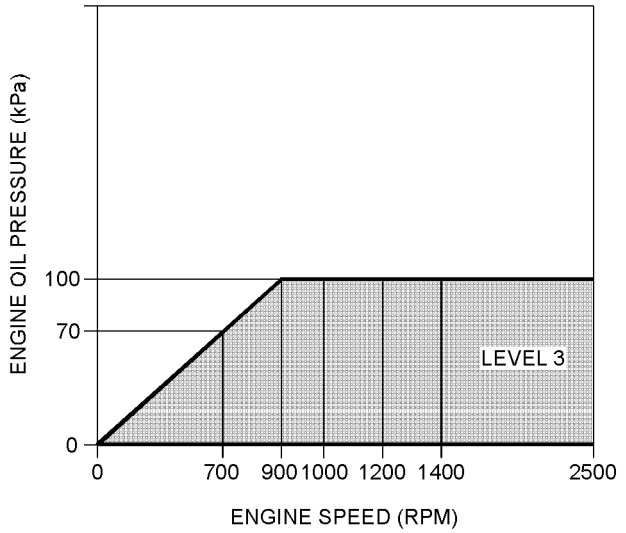

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Illustration 22

Level 3 engine oil pressure versus engine speed

System Response:

360-1

The warning lamp will flash while the warning is active.

The Electronic Control Module (ECM) will generate a 46 flash code that will be displayed via the diagnostic lamp.

The ECM will generate a E360-1 event code.

The ECM will generate a SPN 100-FMI 17 event code on the J1939 data link. The event code may be displayed on a receiving device on the J1939 data link.

360-2

The warning lamp will flash while the derate is active.

The ECM will generate a 46 flash code that will be displayed via the diagnostic lamp.

The ECM will generate a E360-2 event code.

The electronic service tool will display “Engine Derate” in the first “Engine Status” box on any status screen.

The ECM will generate a SPN 100-FMI 18 event code on the J1939 data link. The event code may be displayed on a receiving device on the J1939 data link.

360-3

The warning lamp will flash.

The ECM will generate a 46 flash code that will be displayed via the diagnostic lamp.

The ECM will generate a E360-3 event code.

The ECM will generate a SPN 100-FMI 01 event code on the J1939 data link. The event code may be displayed on a receiving device on the J1939 data link.

Possible Performance Effect:

360-1

Engine operation is not affected.

360-2

The ECM will derate power by 17.0 percent per second up to a maximum of 100 percent while the derate is active.

360-3

The engine will shut down.

Troubleshooting:

Refer to Troubleshooting, “Low Engine Oil Pressure”.

Results:

- OK – STOP.

i02493344

E361 High Engine Coolant Temperature

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a problem with the engine’s coolant temperature. The ECM detects the following problems:

- The engine has been running for more than 185 seconds.
- The trip level for the event code for the temperature of the engine coolant is reached.
- Diagnostic code 0110-03 Engine Coolant Temperature open/short to +batt is not active.
- Diagnostic code 0110-04 Engine Coolant Temperature short to ground is not active.
- Diagnostic code 0168-01 Electrical System voltage low is not active.

Table 53

Engine Coolant Trip Level Table			
	E361-1	**E361-2**	**E361-3**
Trip Level	113 °C (233 °F)	114 °C (237 °F)	118 °C (244 °F)
Delay to Activation	10 seconds	10 seconds	2 seconds
Reset Time	4 seconds	20 seconds	20 seconds

System Response:

The event code will be logged.

The optional warning lamp will be illuminated.

A snapshot will be triggered.

Possible Performance Effect:

E361-1

None

E361-2

The ECM will derate the power. The power will be derated at one percent per second.

The derate of the engine will only occur if the “Enable Derate” customer programmable parameter has been enabled.

E361-3

The ECM will shut down the engine after two seconds when the Engine Coolant Temperature Trip Level has been reached.

The shutdown of the engine will only occur if the “Enable Shutdown” customer programmable parameter has been enabled.

Troubleshooting:

Refer to Troubleshooting, “Coolant Temperature Is Too High”.

Results:

- OK – STOP.

i02536618

E362 Engine Overspeed

Conditions Which Generate This Code:

The engine speed is above 3000 RPM for more than 0.6 seconds.

Note: This event code represents an event. This does not represent an electronic system fault.

System Response:

The event code will be logged.

The optional warning lamp will be illuminated.

The event may be viewed by using a display module or by using the Perkins Electronic Service Tool (EST).

The ECM will reset the event when the engine speed is lower than 2800 RPM for 0.6 seconds.

The fuel injection will be disabled until the event has been reset.

Possible Performance Effect:

E362-1

None

Troubleshooting:

This event indicates excessive engine speed. This event does not represent a problem with the Engine Control Module (ECM).

This event does not represent a problem with the Electronic Speed/Timing Sensor.

The ECM logs the event.

No troubleshooting is required.

Results:

- OK – STOP.

i02493345

E396 High Fuel Rail Pressure

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects excessive fuel rail pressure. The ECM detects the following problems:

- The ECM detects fuel rail pressure that is more than the pressure that is required for the operating conditions.
- Diagnostic code 0262-03 5 Volt Sensor DC Power Supply voltage above normal is not active.
- Diagnostic code 0262-04 5 Volt Sensor DC Power Supply voltage below normal is not active.
- Diagnostic code 1797-03 Fuel Rail Pressure Sensor voltage above normal is not active.
- Diagnostic code 1797-04 Fuel Rail Pressure Sensor voltage below normal is not active.
- No diagnostic codes are active for the fuel rail pump.
- No diagnostic codes are active for the fuel injectors.

System Response:

The event code will be logged.

The optional warning lamp will be illuminated.

Possible Performance Effect:

The engine will be derated until the keyswitch is turned to OFF.

Troubleshooting:

The event code does not represent a problem with the electronic system. This event indicates high fuel pressure. Refer to Testing and Adjusting Manual, “Fuel System - inspect”.

A failed relief valve, the fuel pump or an electronic unit injector may cause an event code to be logged.

Results:

- OK – STOP.

i02493479

E398 Low Fuel Rail Pressure

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a problem with low fuel rail pressure. The ECM detects the following problem:

- The ECM determines that the expected fuel rail pressure is lower than the pressure that is requested by the electronic control system.
- Diagnostic code 0262-03 5 Volt Sensor DC Power Supply voltage above normal is not active.
- Diagnostic code 0262-04 5 Volt Sensor DC Power Supply voltage below normal is not active.
- Diagnostic code 1797-03 Fuel Rail Pressure Sensor voltage above normal is not active.
- Diagnostic code 1797-04 Fuel Rail Pressure Sensor voltage below normal is not active.
- No diagnostic codes are active for the fuel rail pump.
- No diagnostic codes are active for the fuel injectors.

System Response:

The event code will be logged.

The optional warning lamp will be illuminated.

Possible Performance Effect:

The engine will be derated until the keyswitch is turned to OFF.

Troubleshooting:

Low fuel pressure may be caused by the following problems. There can be a problem with the fuel return system. There can be a problem with the fuel pressure control. There can be a leak in the high pressure fuel system.

A failed relief valve, the fuel pump or an electronic unit injector may cause an event code to be logged.

The event code does not represent a problem with the electronic system. This event indicates low fuel rail pressure. Refer to Testing and Adjusting Manual, “Fuel System - Inspect”.

Results:

- OK – STOP.

i02493480

E539 High Intake Manifold Air Temperature

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a problem with the engine's intake manifold air temperature. The ECM detects the following problems:

- The engine has been running for more than 3 minutes.
- The temperature of the coolant is more than 99 °C (210 °F) and the intake manifold pressure is more than 30 kPa (4.35 psi).
- The intake manifold air temperature trip level for the event code is reached.
- Diagnostic code 0172-03 Intake Manifold Air Temperature voltage above normal is not active.
- Diagnostic code 0172-04 Intake Manifold Air Temperature voltage below normal is not active.

Table 54

Intake Manifold Air Temperature Trip Level Table		
	E539-1	**E539-2**
Turbocharged Engines (T)	139 °C (282 °F)	142 °C (287 °F)
Turbocharged Aftercooled Engines (TA)	82 °C (179 °F)	86 °C (186 °F)
Delay to Activation	8 seconds	8 seconds
Reset Time	4 seconds	4 seconds

System Response:

The event code will be logged.

If equipped, the warning lamp will be illuminated.

Possible Performance Effect:

E539-1

None

E539-2

The ECM will derate the power. The power will be derated at one percent per second.

The derate of the engine will only occur if the "Enable Derate" customer programmable parameter has been enabled.

Troubleshooting:

Refer to Troubleshooting, "Intake Air Temperature Is Too High".

Results:

- OK – STOP.

i02539800

E2143 Low Engine Coolant Level

Conditions Which Generate This Code:

This event code will only be generated if a coolant level sensor has been properly installed and the customer programmable feature has been enabled.

The Electronic Control Module (ECM) detects a problem with the engine coolant level. If the engine coolant level is low for more than thirty seconds, this code will be generated.

System Response:

The event code will be active and the event code will be logged.

The optional shutdown lamp will be illuminated.

The optional warning lamp will be illuminated.

If the optional shutdown feature is enabled, then the engine will be shutdown.

Possible Performance Effect:

E2143-3

If the application has enabled the optional shut down feature then the engine will shut down.

Troubleshooting:

The event code may represent a problem with the electronic system. This event normally indicates low engine coolant. Refer to Testing and Adjusting Manual, “Cooling System - Inspect”.

Results:

- OK – STOP.

Diagnostic Functional Tests

i02490153

5 Volt Sensor Supply Circuit - Test

System Operation Description:

Use this procedure to troubleshoot the system when one of the following diagnostic codes is active or easily repeated:

- 0262-03 5 Volt Sensor DC Power Supply voltage above normal
- 0262-04 5 Volt Sensor DC Power Supply voltage below normal

Also, use this procedure to troubleshoot the system when you have been directed here by another troubleshooting procedure.

The following background information is related to this procedure:

The Engine Control Module (ECM) supplies regulated +5 VDC to the following sensors:

- Fuel Rail Pressure Sensor through connector P228
- Intake Manifold Pressure Sensor through connector P200
- Engine Oil Pressure Sensor through connector P201
- Analog Throttle Demand Sensors (if equipped) through P1 OEM connector

The supply for the +5 V engine pressure sensor is routed from the ECM through the P2 connector to terminal 1 of each pressure sensor connector. The supply voltage is 5.0 ± 0.16 VDC. The +5 V supply to the Analog Throttle Demand Sensor is routed from the ECM through the P1 connector to the sensor pins “A”.

The +5 V diagnostic code is probably caused by a short circuit to ground or a short circuit to another voltage source in the harness.

A diagnostic code can be caused by the following conditions:

- A short circuit in the harness
- A suspect sensor
- A suspect ECM

Table 55

P2 Pin Connections				
Sensor Pin	**Function**	**Fuel Rail Pressure Sensor**	**Intake Manifold Pressure Sensor**	**Oil Pressure Sensor**
1	Volts (5 V)	48	46	47
2	Ground	40	38	39
3	Signal	51	55	56

Table 56

P1 OEM Connector			
Sensor Pin	**Function**	**Analog Throttle Sensor 1**	**Analog Throttle Sensor 2**
A	5 Volt Sensor Supply	41	42
B	Ground	33	34
C	Signal	54	55

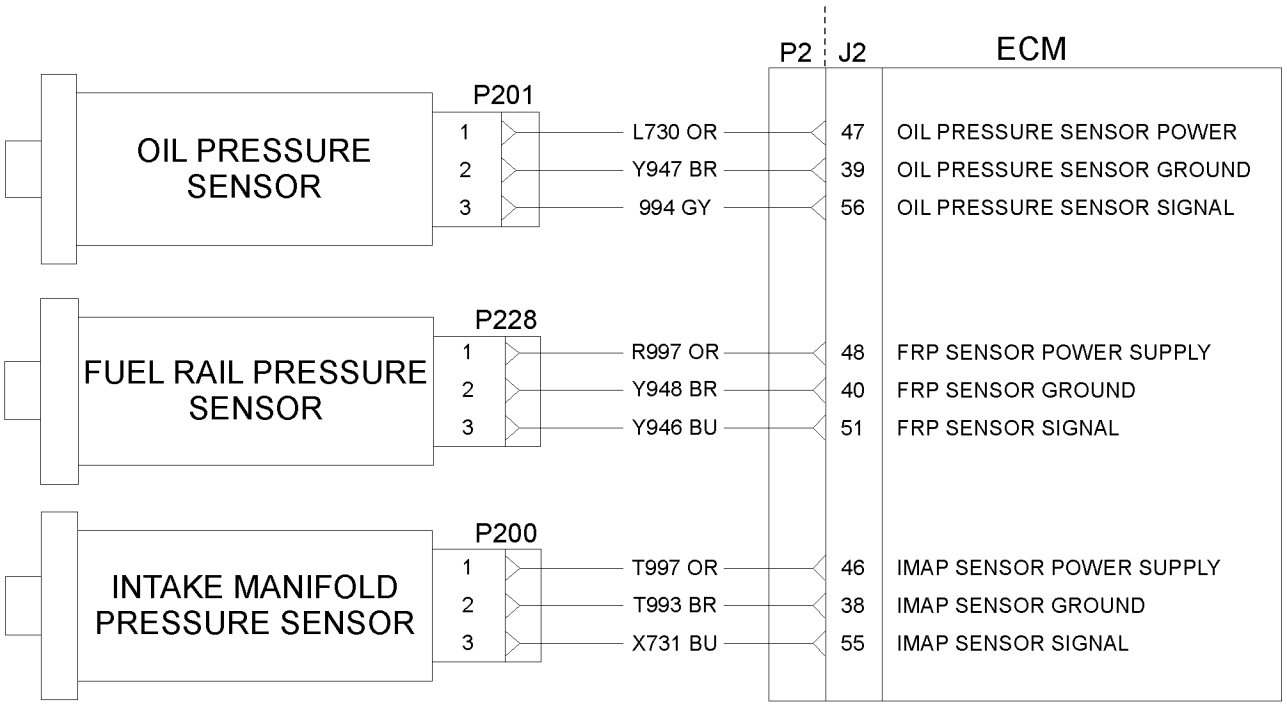
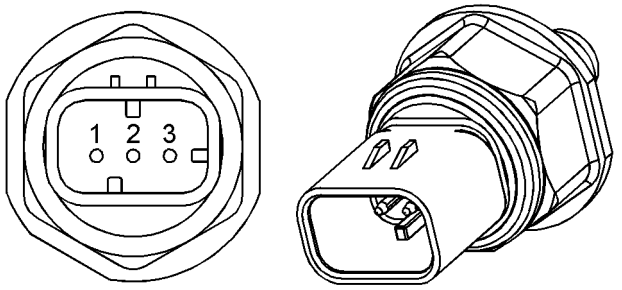


Illustration 23 g01249575

Typical example of the schematic for the sensors

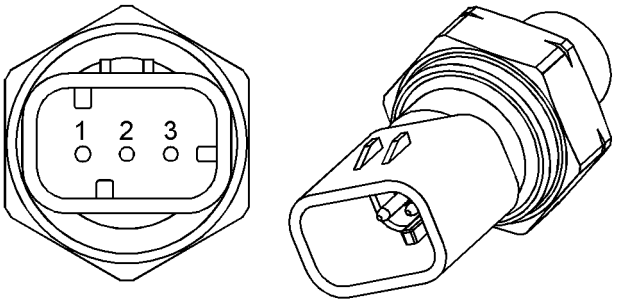


g01173224

Illustration 24

Typical example of the fuel rail pressure sensor

(1) Voltage supply (Vs)
(2) Ground (GND)
(3) Signal (SIG)

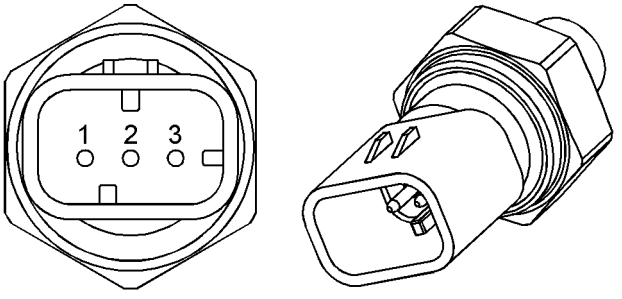


g01173225

Illustration 25

Typical example of the intake manifold pressure sensor

(1) Voltage Supply (Vs)
(2) Ground (GND)
(3) Signal (SIG)



g01173226

Illustration 26

Typical example of the oil pressure sensor

(1) Voltage Supply (Vs)
(2) Ground (GND)
(3) Signal (SIG)

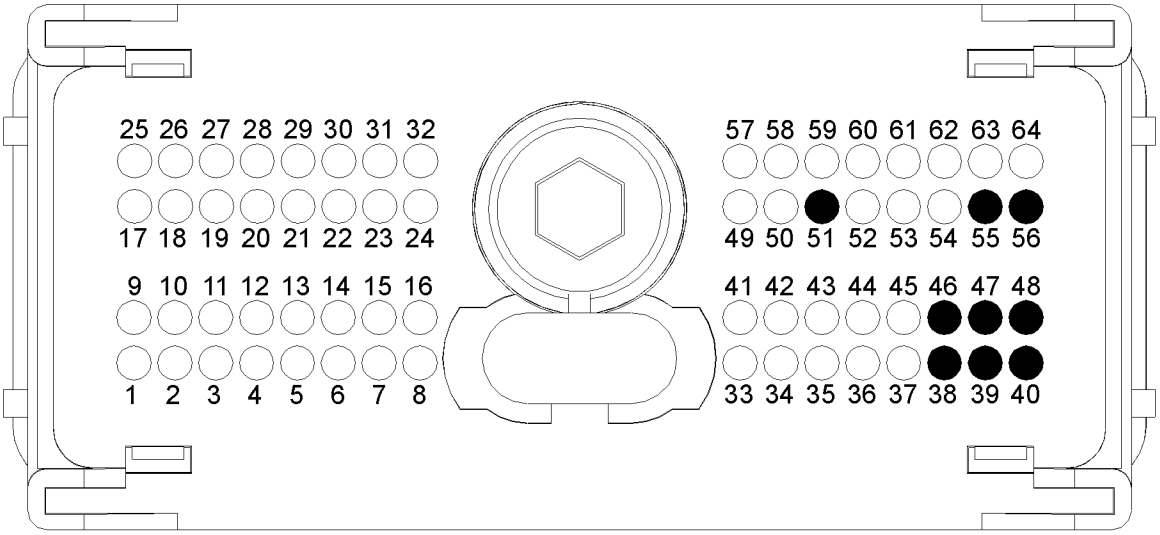


Illustration 27 g01173227

Typical example of the P2 pressure sensor pin locations

(38) Ground (GND) Intake Manifold Pressure Sensor
(39) Ground (GND) Oil Pressure Sensor
(40) Ground (GND) Fuel Rail Pressure Sensor
(46) Voltage supply (5V) Intake Manifold Pressure Sensor
(47) Voltage supply (5V)) Oil Pressure Sensor
(48) Voltage supply (5V) Fuel Rail Pressure Sensor
(51) Signal (SIG) Fuel Rail Pressure Sensor
(55) Signal (SIG) Intake Manifold Pressure Sensor
(56) Signal (SIG) Oil Pressure Sensor

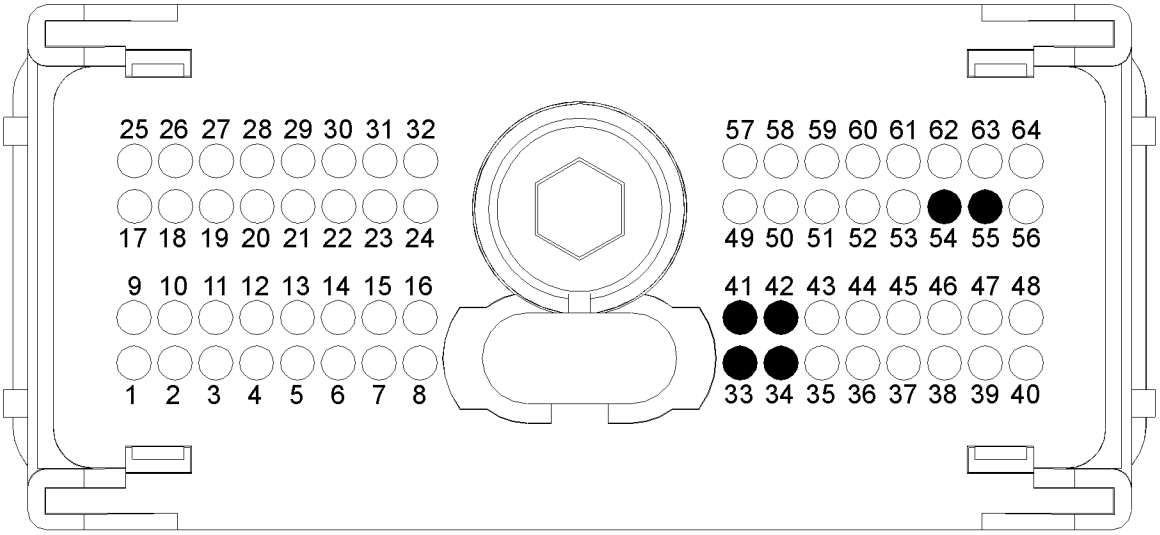


Illustration 28 g01207347

Typical example of the P1 pin locations for the analog throttle demand sensor

(33) Throttle 1 ground (GND)
(34) Throttle 2 ground (GND)
(41) Throttle 1 voltage supply (5V)
(42) Throttle 2 voltage supply (5V)
(54) Throttle 1 throttle position
(55) Throttle 2 throttle position

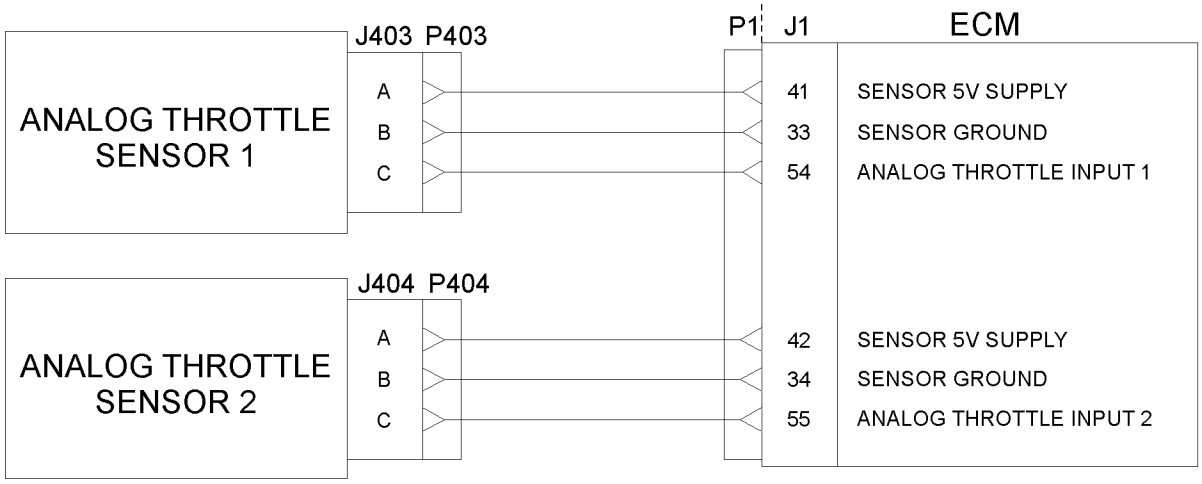


Illustration 29 g01246557

Typical example of the schematic for the P1 OEM connections for the analog throttle demand sensors

Test Step 1. Check for Connector Damage

A. Turn the keyswitch to the OFF position.

B. Check the connectors and the harness for the following faults:

- Damage
- Abrasion
- Corrosion
- Incorrect attachment

C. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

D. Perform a 45 N (10 lb) pull test on each of the wires in the harness that are associated with the throttle demand sensor. Check the wire connectors at the following positions:

- ECM
- Pressure sensors
- Throttle pedal

The wire connectors are shown in table 55 and table 56.

E. Check the screws for the ECM connectors for the correct torque of 5.0 N·m (44 lb in).

Expected Result:

The connectors and the harness should be free of the following faults: damage, abrasion, corrosion, and incorrect attachment.

Results:

- OK – Proceed to Test Step 2.
- Not OK

  Repair: Repair the connectors or the harness and/or replace the connectors or the harness.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 2. Check for Active Diagnostic Codes

A. Connect the Perkins Electronic Service Tool (EST) to the diagnostic connector.

B. Turn the keyswitch to the ON position.

C. Use the Perkins EST in order to monitor the diagnostic codes. Check and record any active diagnostic codes.

Note: Wait at least 15 seconds in order for the diagnostic codes to become active.

Expected Result:

One of the following diagnostic codes is active:

- 0262-03 5 Volt Sensor DC Power Supply voltage above normal
- 0262-04 5 Volt Sensor DC Power Supply voltage below normal

Results:

- OK – Diagnostic code 0262-04 is active. Proceed to Test Step 3.
- OK – Diagnostic code 0262-03 is active. Proceed to Test Step 6.
- Not OK – Diagnostic codes 0262-04 and 0262-03 are not active. Proceed to Test Step 4.

Test Step 3. Disconnect the Sensors

A. Turn the keyswitch to the ON position.

B. Use the Perkins EST in order to monitor the diagnostic codes.

C. Disconnect the pressure sensors one at a time. If the analog throttle demand sensors are installed, then disconnect the throttle sensors one at a time. Wait for 30 seconds after each of the sensors is disconnected.

Note: Diagnostic code 0262-04 will become inactive when the sensor that caused the 5 volt diagnostic code is disconnected.

D. Ensure that all the pressure sensors and the throttle demand sensors (if equipped) are disconnected.

Expected Result:

The 5 volt diagnostic code is not active when all of the sensors are disconnected.

Results:

- OK – The 5 volt diagnostic code is not active when all of the sensors are disconnected.

  Repair: Reconnect all of the sensors except the suspect sensor.

  Proceed to Test Step 4.

- Not OK – Diagnostic code 0262-04 is still active.

  Repair: Leave all of the sensors disconnected.

  Proceed to Test Step 5.

Test Step 4. Install a New Sensor

A. Remove the connector from the suspect sensor and connect the connector to a replacement sensor. Do not install the replacement sensor to the engine.

B. Use the Perkins EST in order to monitor the diagnostic codes.

Expected Result:

Diagnostic codes 0262-03 and 0262-04 are not active.

Results:

- OK – The 5 volt diagnostic code is not active.

  Repair: Use the Perkins EST in order to clear all logged diagnostic codes. Remove the suspect sensor and then install the replacement sensor. Connect the connector to the sensor.

  Verify that the repair eliminates the fault.

  STOP.

- Not OK – The 5 volt diagnostic code is still active.

  Repair: Do not use the new sensor.

  Proceed to Test Step 5.

Test Step 5. Disconnect the ECM Connector and Check for Active Diagnostic Codes

A. Turn the keyswitch to the OFF position.

B. Connect the Perkins EST to the diagnostic connector.

C. Check the ECM connectors for corrosion and moisture.

D. Disconnect the P2 ECM connector from the ECM.

E. If a P1:41 is installed, then temporarily disconnect the pin. If a P1:42 is installed, then temporarily disconnect the pin.

F. Reconnect the P1 connector to the ECM.

G. Turn the keyswitch to the ON position.

H. Check for active diagnostic codes on the Perkins EST.

Note: A “voltage high” diagnostic code (open circuit) should be active for all of the following sensors:

- Engine pressure sensors

- Engine temperature sensors
- Analog throttle demand sensors (if equipped)

Expected Result:

Diagnostic code 0262-04 is not active. A “voltage high” diagnostic code (open circuit) is active for all of the engine pressure sensors, temperature sensors and throttle demand sensors (if equipped).

Results:

- OK – Diagnostic code 0262-04 is not active.

  Repair: Replace all wires to the original configuration.

  Proceed to Test Step 6.

- Not OK – The 5 volt diagnostic codes are still active.

  Repair: Connect a test ECM. Refer to the Troubleshooting Guide, “Replacing the ECM” and Troubleshooting Guide, “Test ECM Mode”.

  If the test ECM fixes the fault, reconnect the suspect ECM.

  If the fault returns, permanently install the new ECM.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 6. Measure the +5 Volt Supply to the Sensor

A. Turn the keyswitch to the ON position.

Note: All the pressure sensors and the analog throttle demand sensors (if equipped) should be disconnected.

B. Measure the voltage between terminal 1 (Pressure sensor +5 V) and the engine ground for each of the pressure sensors.

C. Measure the voltage between terminal A (analog throttle demand sensors +5 V) and the engine ground for each of the analog throttle demand sensors.

Expected Result:

The voltage is 5.0 ± 0.16 VDC.

Results:

- OK – The +5 volt supply is within the expected range. Proceed to Test Step 7.
- Not OK – The voltage is greater than 5.16 volts.

  Repair: Check the +5 volt supply wire for a short to a higher voltage source.

  Repair the +5 volt supply wire and/or replace the +5 volt supply wire.

  Verify that the repair eliminates the fault.

  STOP.

- Not OK – The voltage is less than 4.84 volts.

  Repair: Check the +5 volt supply wire for a short to ground.

  Repair the +5 volt supply wire and/or replace the +5 volt supply wire.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 7. Perform the “Wiggle Test” on the Electronic Service Tool

A. Select the “Wiggle Test” from the diagnostic tests on the electronic service tool.

B. Choose the appropriate group of parameters to monitor.

C. Press the “Start” button. Wiggle the wiring harness in order to reproduce intermittent faults.

If an intermittent fault exists, the status will be highlighted and an audible beep will be heard.

Expected Result:

No intermittent faults were indicated during the “Wiggle Test”.

Results:

- OK – No intermittent faults were found. The harness and connectors appear to be OK. If you were sent from another procedure, return to the procedure and continue testing. If this test has resolved the fault, return the engine to service. STOP.

- Not OK – At least one intermittent fault was indicated.

  Repair: Repair the harness or the connector.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

i02490154

Analog Throttle Position Sensor Circuit - Test

System Operation Description:

Use this procedure if another procedure has directed you here. Use this procedure if any of the following diagnostic codes are active:

- 0091-03 Accelerator pedal - voltage above normal
- 0091-04 Accelerator pedal - voltage below normal
- 0774-03 Sec Throttle Position Sensor open/short to +batt
- 0774-04 Sec Throttle Position Sensor short to ground

The diagnostic codes above relate to an analog sensor. Use this procedure only if the analog sensor is a variable resistance potentiometer sensor.

The sensor is most likely to be mounted on the throttle pedal. The sensor is attached directly to the throttle assembly. The sensor provides an output voltage to the Electronic Control Module (ECM). The sensor output voltage will vary with the position of the throttle. Foot operated or hand operated throttle assemblies are available.

The sensor receives +5 volt power from the ECM. The sensor will produce a raw signal voltage that will alter between low idle and high idle. The voltage is changed into a throttle position within the range 0% to 100% by the ECM.

The sensor senses the speed requirement from the throttle position. A second sensor may override this speed requirement from the first sensor. This override will be subject to an input from either the SAE J1939 (CAN), or from the PTO controls.

Use the Perkins Electronic Service Tool (EST) in order to check the input status.

Table 57

P1 Pin Connections		
Function	**Throttle 1**	**Throttle 2**
+5 Volt Supply	41	42
Sensor Ground	33	34
Throttle Position Input	54	55
Idle Validation	45	44

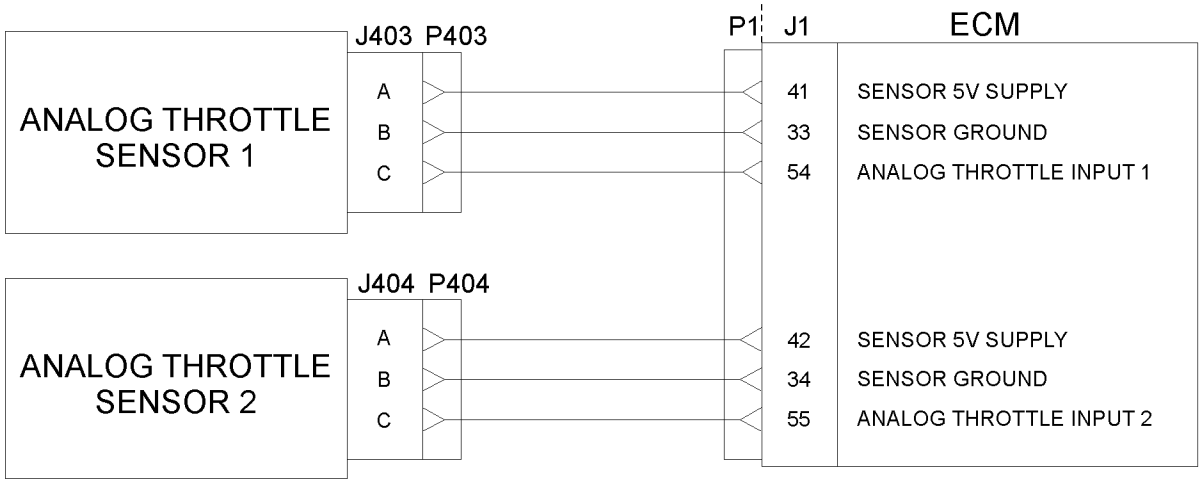


Illustration 30 g01246557

Schematic of the analog throttle demand sensors

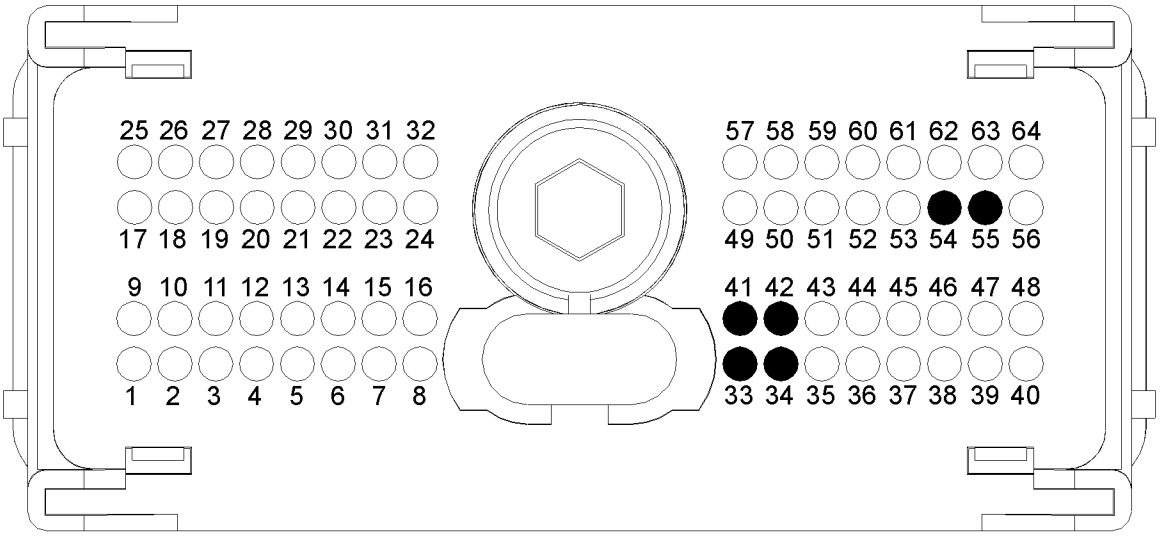


Illustration 31 g01206986

Typical view of the P1 connector pin locations

(33) Sensor Ground (GND)
(34) Sensor Ground (GND)
(41) Sensor supply (5v)
(42) Sensor supply (5v)
(54) Analog throttle input 1
(55) Analog throttle input 2

Test Step 1. Check for Connector Damage.

A. Turn the keyswitch to the OFF position.

B. Check the connectors and the harness for the following faults: damage, abrasion, corrosion, and incorrect attachment.

C. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

D. Perform a 45 N (10 lb) pull test on each of the wires in the harness that are associated with the throttle demand sensor. Check the wire connectors at the ECM and at the throttle pedal. The wire connectors are shown in table 57.

E. Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in).

Expected Result:

The connectors and the harness should be free of the following faults: damage, abrasion, corrosion, and incorrect attachment.

Results:

- OK – Proceed to Test Step 2.
- Not OK

  Repair: Repair the connectors or the harness and/or replace the connectors or the harness.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 2. Check for active Diagnostic Codes.

A. Turn the keyswitch to the ON position.

B. Use the Perkins EST to check for diagnostic codes.

Expected Result:

RESULT 1 The Perkins EST displays the following active diagnostic codes or recently logged diagnostic codes:

- 91-3 Throttle Position Sensor voltage above normal
- 91-4 Throttle Position Sensor voltage below normal
- 774-3 Secondary Throttle Position Sensor voltage above normal
- 774-4 Secondary Throttle Position Sensor voltage below normal

RESULT 2 The Perkins EST displays no active diagnostic codes:

Results:

- Result 1 – Proceed to Test Step 3.
- Result 2 – Proceed to Test Step 5.

Test Step 3. Check the Throttle Position with the Perkins Electronic Service Tool (EST).

A. Connect the Perkins EST to the diagnostic connector.

B. Turn the keyswitch to the ON position. The engine should be off.

C. Observe the throttle position reading on the Perkins EST.

D. Slowly depress the throttle and release the throttle.

Expected Result:

The output should increase when the throttle pedal is depressed.

The output should be between “20 percent” and “27 percent” at the low idle position. The output should be between “80 percent” and “87 percent” at the high idle position.

Results:

- OK – The sensor is operating correctly. Proceed to Test Step 4.
- Not OK – The ECM is not receiving a correct signal from the sensor. Proceed to Test Step 5.

Test Step 4. Check the Throttle Selection Status with the Perkins Electronic Service Tool (EST).

A. Check the status of the throttle selection switch (if equipped). Use the Perkins EST in order to check the status of the throttle selection switch.

Expected Result:

If the status of the throttle selection switch is shown in the OFF position, then the throttle 1 has control of the engine speed.

If the throttle selection switch status is shown in the ON position, then the throttle 2 has control of the engine speed.

The throttle may be overridden by using the SAE J1939 (CAN) data link or the set speed control.

Results:

- OK – The throttle demand switch is operating correctly.

  Repair: There may be an intermittent fault. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

  STOP.

- Not OK – The wrong throttle is selected. Change to the other throttle. There may be a fault with the selector switch input.

Repair: Check the connections between the throttle selection switch and P1:47 and P1:35. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

STOP.

Test Step 5. Check the Voltage at the Sensor

A. Turn the keyswitch to the OFF position.

B. Install a breakout “T” with 3 terminals to the sensor.

C. Turn the keyswitch to the ON position.

D. Measure the voltage between terminal “A” and terminal “B” on the breakout “T”.

Expected Result:

The supply voltage should be between 4.84 VDC and 5.16 VDC.

Results:

- OK – The supply voltage is reaching the sensor. Proceed to Test Step 6.
- Not OK – The supply voltage is not reaching the sensor.

  Repair: Refer to Troubleshooting, “5 Volt Sensor Supply Circuit - Test”.

  STOP.

Test Step 6. Check the Position of Sensor.

A. Turn the keyswitch to the OFF position.

B. Install a breakout “T” with 3 terminals to the sensor.

C. Turn the keyswitch to the ON position.

D. Measure the voltage between terminal “C” and terminal “B” on the breakout “T”.

E. Observe the voltage while the engine speed control is moved from the minimum to the maximum position.

Expected Result:

The voltage should vary between 1.5V and 4.4V when the speed control is moved from the minimum to the maximum position.

Results:

- OK – The throttle demand sensor is operating correctly. Proceed to Test Step 7.
- Not OK – The throttle demand sensor is faulty. Proceed to Test Step 8.

Test Step 7. Check the Sensor at the ECM.

A. Turn the keyswitch to the OFF position.

B. Remove the P1 OEM connector.

C. Temporarily remove the pin from P1:54.

D. Reconnect P1 OEM connector.

E. Connect the red probe of a multimeter to the removed pin and the black probe of a multimeter to P1:33.

F. Turn the keyswitch to the ON position.

G. Use the multimeter to display the output voltage of the sensor while the engine speed control is moved from the minimum position to the maximum position.

H. Turn the keyswitch to the OFF position.

I. Reconnect P1:54 to the P1 OEM connector.

J. Remove P1 OEM connector and reinstall P1:54 to the P1 OEM connector.

K. Reconnect P1 OEM connector.

Expected Result:

The output from the throttle demand sensor is 0.5 volts or less with the sensor slot in the released position.

The output from the throttle demand sensor is 4.5 volts or more with the sensor slot in the advanced position.

Results:

- OK – The ECM terminals have the correct voltage for the sensor.

  Repair: Check for the correct supply voltage at the ECM. If the voltage is correct, then the ECM is suspect.

  1. Temporarily connect a test ECM.

Note: The test ECM should be programmed with the correct software. All parameters should be set to the same value as the suspected ECM.

2. If the fault is eliminated with the test ECM, install the suspect ECM and verify that the fault returns.

3. If the fault returns replace the ECM.

STOP.

- Not OK – There is a fault in the harness or the connectors between the sensor and the ECM. Check all of the connections between the ECM and the sensor. Repair the damaged cables or replace the damaged cables. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repairs have eliminated the fault. STOP.

Test Step 8. Remove the Sensor from the Engine Speed Control Assembly.

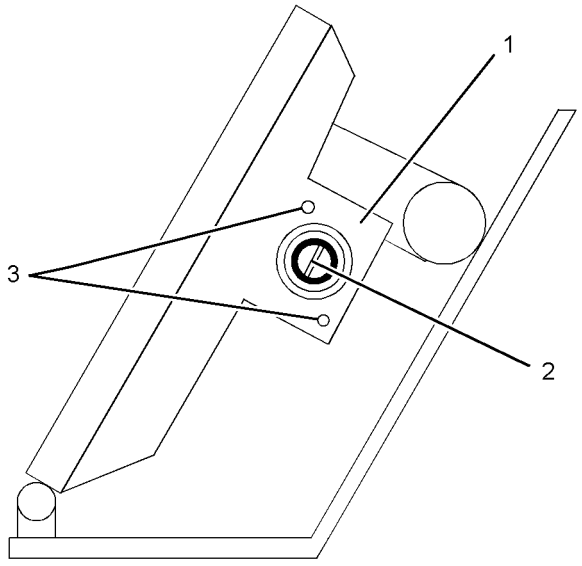


Illustration 32 g01170704

Throttle pedal assembly

(1) Sensor mounting face
(2) Sensor drive key
(3) Mounting screw holes

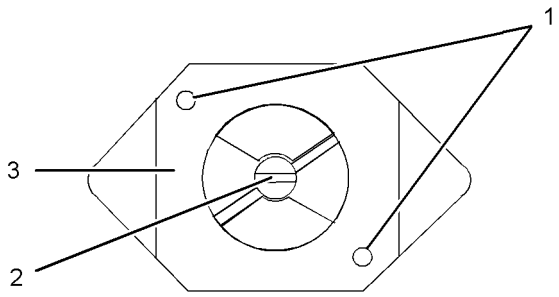


Illustration 33 g01170753

Throttle block assembly

(1) Mounting screw holes
(2) Sensor drive slot
(3) Sensor mounting face

A. Turn the keyswitch to the OFF position.

B. Record the position of the sensor before removing the sensor.

C. Remove the sensor from the housing and inspect the cables for signs of wear.

D. Connect a multimeter to terminal “C” and terminal “B” on the breakout “T”.

E. Turn the keyswitch to the ON position.

F. Record the signal voltage of the sensor with the sensor slot in the released position.

G. Record the signal voltage of the sensor with the sensor slot in the advanced position.

Expected Result:

The output from the sensor is 0.5 volts or less with the sensor slot in the released position.

The output from the sensor is 4.5 volts or more with the sensor slot in the advanced position.

Results:

- OK

  Repair: The operation of the sensor is correct. The fault is caused by the foot pedal or the lever assembly. Adjust the assembly or replace the assembly.

  Verify that the repairs have eliminated the fault.

  STOP.

- Not OK – The sensor is faulty.

Repair: Replace the sensor.

Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

STOP.

i02490176

CAN Data Link Circuit - Test

System Operation Description:

Use this procedure under the following circumstances:

Use this procedure if another procedure has directed you here. Use this procedure if any of the following diagnostic codes are active:

- 0247-09 SAE J1939 Data Link abnormal update rate
- 0247-12 SAE J1939 Data Link failure

The following background information is related to this procedure:

The CAN Data Link is also known as J1939 Data Link. The data link is an industry standard for sending data between different devices in the same application.

High speed data is transfered via the data link. The data link cannot be accurately tested without complicated equipment. The data link requires a resistance of 60 Ohms between the two wires to correctly transmit the data. This resistance is made up of two 120 Ohm resistors. The two resistors are known as “Terminating Resistors”. The terminating resistors should be at opposite ends of a data link network. If this resistance is not present, then the data will be intermittent or completely unreadable.

Note: The wiring for the J1939 data link is a shielded twisted pair cable. If the wiring is damaged the replacement type must be shielded twisted pair cable.

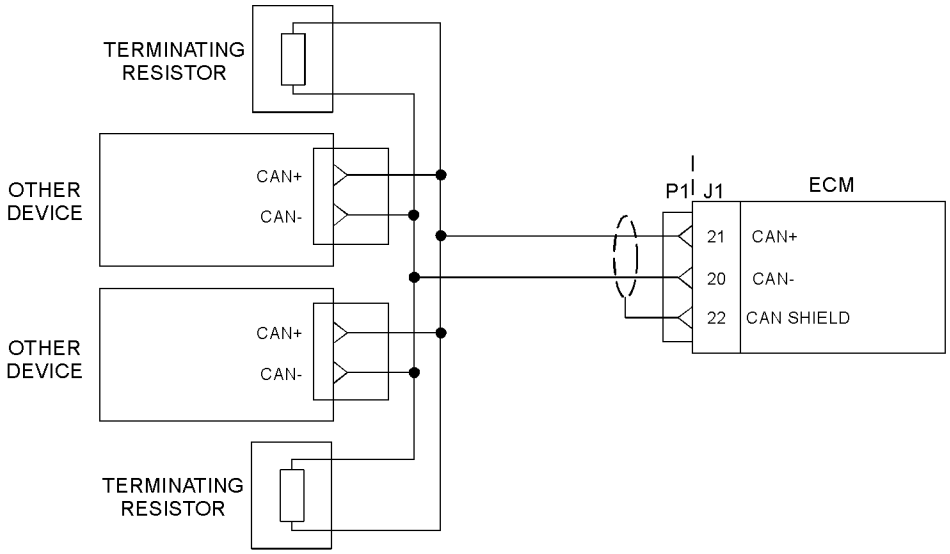


Illustration 34 g01244083

Typical example of the schematic for the CAN data link

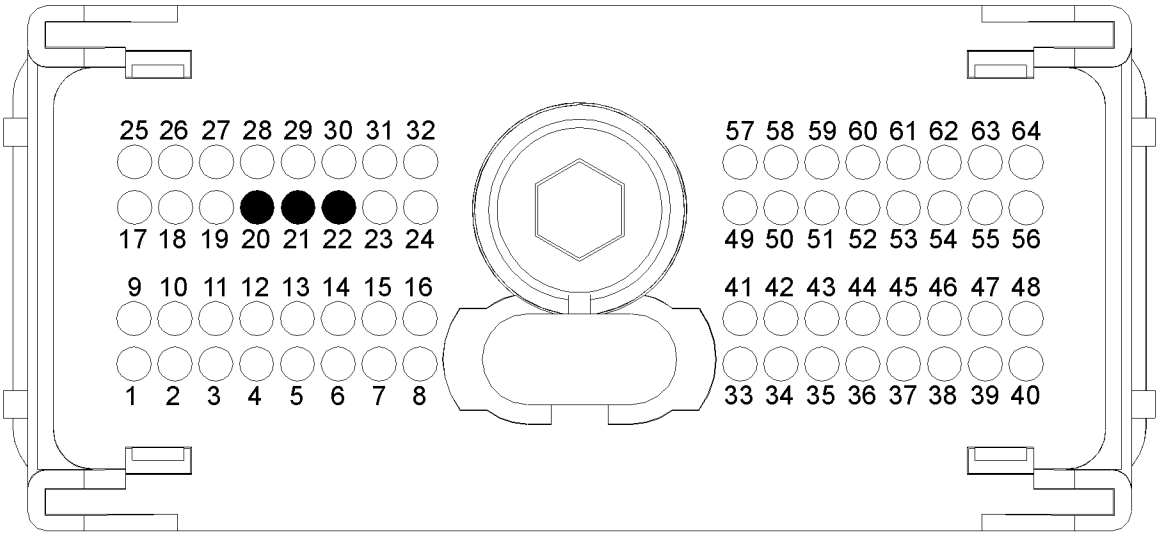


Illustration 35 g01209013

Typical view of the P1 connector pin locations

(20) CAN- (21) CAN+ (22) CAN Shield

Test Step 1. Inspect Electrical Connectors and Wiring.

A. Turn the keyswitch to the OFF position.

B. Thoroughly inspect the harness connector P1/J1 and any other connectors in the CAN data link circuit.

Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

C. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the CAN data link. Refer to Illustration 35.

D. Check the harness for abrasion and pinch points from the keyswitch to the ECM.

Expected Result:

All connectors, pins and sockets should be completely coupled and/or inserted. The harness should be free of corrosion, abrasion and/or pinch points.

Results:

- OK – Proceed to Test Step 2.
- Not OK

  Repair: Perform the following repair:

  Repair the connectors and/or the wiring, or replace the connectors and/or the wiring. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 2. Check the Data Link Terminating Resistance

A. Disconnect the P1 connector from the ECM.

B. Measure the resistance between P1:20 and P1:21.

Expected Result:

The resistance is between 50 and 70 Ohms.

Results:

- Result 1 – The resistance is between 50 and 70 Ohms. This is the correct resistance. The fault may be in the connection to other devices on the data link. Proceed to Test Step 3.
- Result 2 – The resistance is less than 50 Ohms. There is a short circuit in the harness.

  Repair: Repair the connectors or the harness and/or replace the connectors or the harness.

  Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.
- Result 3 – The resistance is between 110 and 130 Ohms. One of the terminating resistors may have failed.

  Repair: Locate the two terminating resistors and remove the two terminating resistors from the harness. Depending on the application, one or both of the terminating resistors may be located in other ECM's on the data link.

  Measure the resistance of the two terminating resistors.

  If one of the terminating resistors is incorrect, replace the faulty terminating resistor.

  If the two terminating resistors are between 50 and 70 Ohms, proceed to Test Step 4.
- Result 4 – The resistance is greater than 150 Ohms. There may be a break in the harness. Proceed to Test Step 3.

Test Step 3. Check the Data Link Wiring

A. Disconnect each of the connectors that connect other devices on the data link.

B. Use a multimeter in order to measure the resistance between P1:20 to each of the CAN+ pins that connect other devices on the data link.

C. Use a multimeter in order to measure the resistance between P1:21 to each of the CAN- pins that connect other devices on the data link.

D. Use a multimeter in order to measure the resistance between P1:22 to each of the CAN SHIELD pins that connect other devices.

Expected Result:

The resistance of each wire is below 2 Ohms.

Results:

- OK – The resistance is below 2 Ohms. Proceed to Test Step 4.
- Not OK – Some resistances are greater than 2 Ohms.

  Repair: Repair the connectors or the harness and/or replace the connectors or the harness.

  Ensure that all seals are correctly in place and ensure that the connectors are completely coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

  STOP.

Test Step 4. Check the other Devices on the J1939 Data Link

A. Use the appropriate service tools in order to diagnose other devices on the data link.

Expected Result:

The other devices are working correctly.

Results:

- OK – The other devices are operating correctly. Restart the diagnostic process. STOP.
- Not OK – The other devices are not working correctly.

  Repair: Use the appropriate service tools in order to diagnose other devices on the data link.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

i02490344

Data Link Circuit - Test

System Operation Description:

Use this procedure under the following circumstances:

Use this procedure if the Perkins Electronic Service Tool (EST) will not communicate with the Electronic Control Module (ECM) through the Perkins data link.

The following background information is related to this procedure:

The Perkins data link is the standard data link that is used by the ECM in order to communicate with the Perkins EST.

The ECM provides multiple connections for the Perkins data link. The technician must ensure that the correct connector is being tested. The connection that is used is dependent on the application.

If the diagnostic connector is on the engine, the positive data link signal will be from P2:21 to J23:D. The negative data link signal will be from P2:20 to J23:E.

If the diagnostic connector is off the engine, the positive data link signal will be from P1:23 to pin “D” of the diagnostic connector. The negative data link signal will be from P1:24 to pin “E” of the diagnostic connector.

The following information refers to the pin number. Ensure that the correct connector is used.

Communication

The Perkins EST may indicate the following error message:

The version of the ECM is not recognized and the integrity of the changed parameters and displayed data is not guaranteed.

This message will indicate that the version of the software that is in the Perkins EST is not the same version of the software that is in the ECM. Install the latest version of the Perkins EST software in order to rectify the fault.

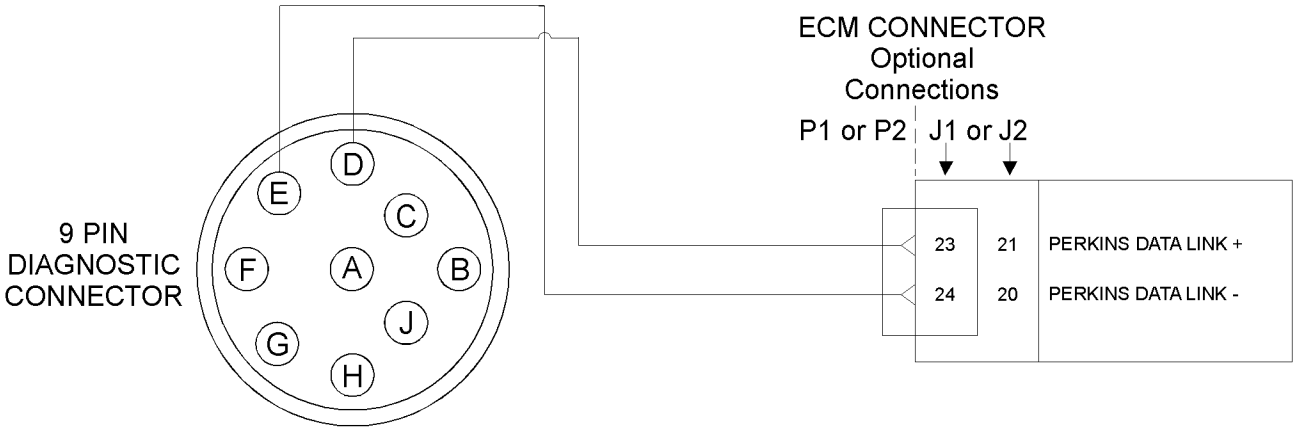


Illustration 36 g01244178

Schematic of the diagnostic connector and the Perkins Data Link connector

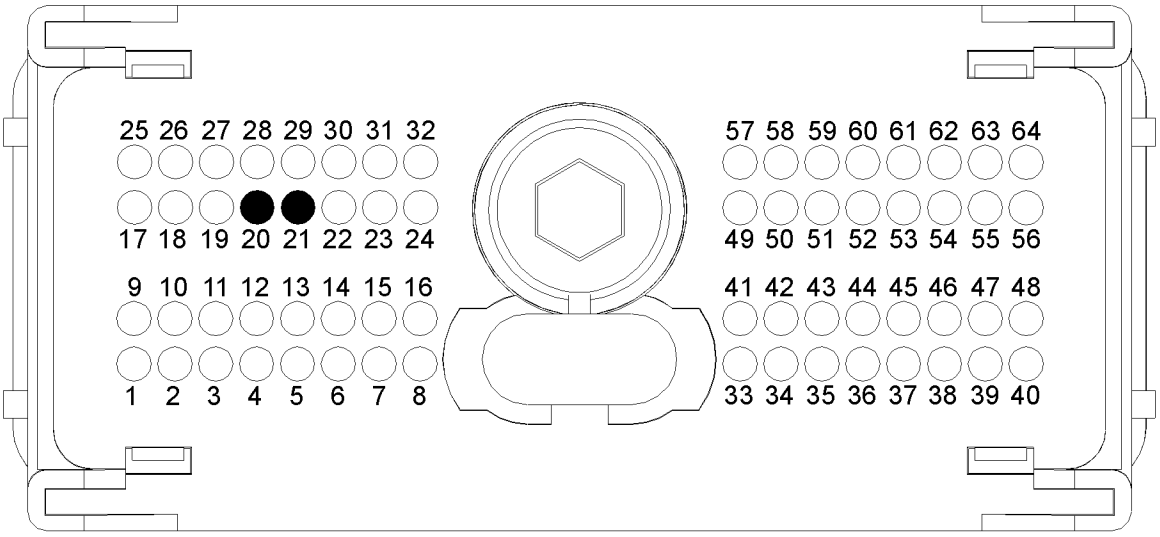


Illustration 37 g01208535

Typical view of the P2 pin locations for the diagnostic and Perkins Data Link connectors

(20) Perkins Data link (PDL) - (21) Perkins Data link (PDL) +

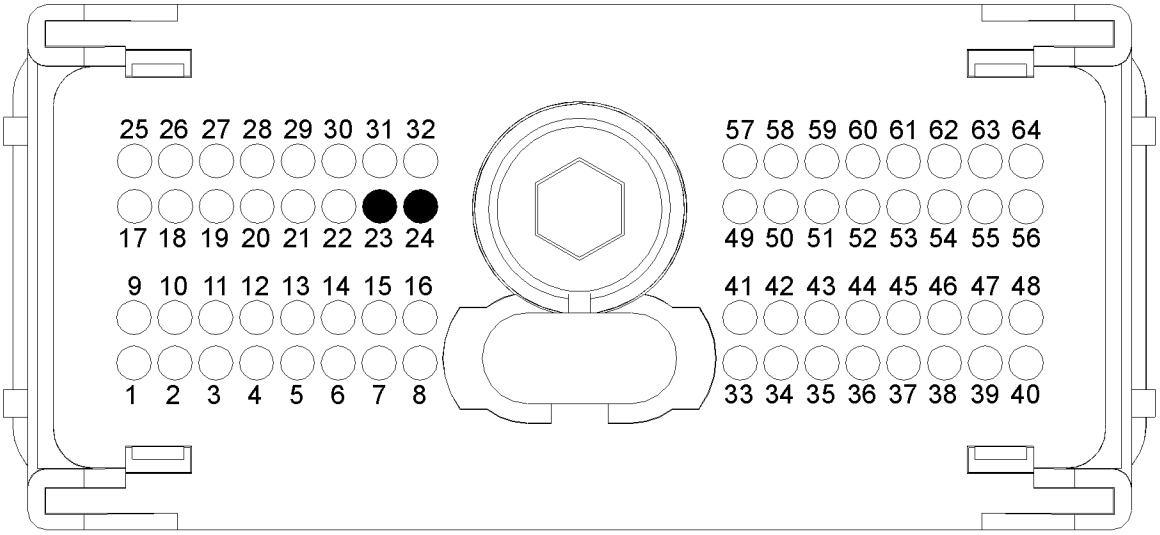


Illustration 38 g01208545

Typical view of the P1 pin locations for the diagnostic and Perkins Data Link connectors

(23) Perkins Data link (PDL) + (24) Perkins Data link (PDL) -

Test Step 1. Inspect Electrical Connectors and Wiring.

A. Thoroughly inspect the following electrical connectors:

- P2/J2 ECM connector
- P1/J1 ECM connector
- Pin D for the data link connector
- Pin E for the data link connector
- Perkins EST connectors

Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

B. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connectors that are associated with the data link.

C. Check the screw for the ECM connectors for correct torque of 5.0 N·m (44 lb in).

D. Check the harness for abrasion and pinch points from the wires that connect the diagnostic connector to the ECM.

Expected Result:

All connectors, pins and sockets should be completely coupled and/or inserted. The harness should be free of corrosion, abrasion and/or pinch points.

Results:

- OK – Proceed to Test Step 2.
- Not OK

  Repair: Perform the following repair:

  Repair the connectors and/or the harness, or replace the connectors and/or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 2. Determine the type of fault with the Perkins Data Link.

A. Connect the Perkins EST to the diagnostic connector that is on the engine harness or on the application.

B. Turn the keyswitch to the ON position.

Expected Result:

The power lamp should illuminate on the communications adapter. The power lamp on the communications adapter may illuminate when the keyswitch is in any position.

Results:

- OK – The communications adapter is currently receiving the correct voltage.

  Repair: If you are redirected to this step from “Check the wiring of the Diagnostic Connector”and if a jumper wire has been installed between pin “A” on the diagnostic connector and the positive terminal on the battery and if a jumper wire has been installed between pin “B” on the diagnostic connector and the negative terminal on the battery, remove the jumper wires and then repair the harness. If the harness cannot be repaired, replace the harness.

  Proceed to Test Step 5.

- Not OK – The communications adapter is not receiving the correct voltage. Proceed to Test Step 3.

Test Step 3. Check the Wiring of the Diagnostic Connector.

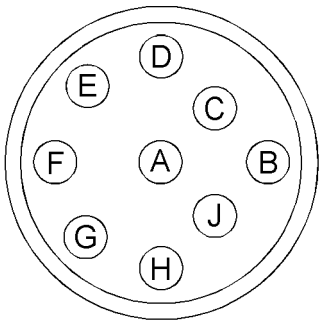


Illustration 39 g01244182

Typical view of the 9 pin diagnostic connectorfrom the wire side

(A) Switched battery +
(B) Battery ground (GND)
(D) Perkins Data link (PDL) +
(E) Perkins Data link (PDL) -

A. If the communications adapter is connected to the diagnostic connector on the engine, ensure that pin “A” and pin “B” are wired on the engine harness side of the connector.

Expected Result:

The pins are wired.

Results:

- OK – The harness is fully wired. Proceed to Test Step 4.
- Not OK – The data link connector power connections are not wired.

  Repair: Fabricate a jumper wire in order to connect pin “A” of the diagnostic connector to +battery and pin “B” to the -battery.

  Proceed to Test Step 2.

Test Step 4. Check the Battery Voltage at the Diagnostic Connector.

A. Turn the keyswitch to the ON position.

B. Use a multimeter in order to measure the voltage from pin A (+battery) and pin B (ground) of the diagnostic connector.

Expected Result:

The voltage is between 22.0 VDC and 27.0 VDC for a 24 volt system and between 11.0 VDC and 13.5 VDC for a 12 volt system.

Results:

- OK – The diagnostic connector is currently receiving the correct voltage. Proceed to Test Step 5.
- Not OK – The diagnostic connector is not receiving the correct voltage.

  Repair: Refer to Troubleshooting, “Engine Wiring Information”.

  .

  Proceed to Test Step 2.

Test Step 5. Check the Perkins Data Link Connections.

A. Turn the keyswitch to the OFF position.

B. Disconnect the communications adapter from the diagnostic connector.

C. If the diagnostic connector is installed on the application, disconnect P1 OEM connector from connector J1. Check the resistance between P1:23 and diagnostic pin “D”. If the diagnostic connector is installed on the engine, disconnect P2 from connector J2. Check the resistance between P2:21 and diagnostic pin “D”.

D. If the diagnostic connector is installed on the application, check the resistance between P1:24 and diagnostic pin “E”. If the diagnostic connector is installed on the engine, check the resistance between P2:20 and diagnostic pin “E”.

Expected Result:

The resistance that is measured is less than 10 Ohms.

Results:

- OK – The resistance is less than 10 Ohms. Proceed to Test Step 6.
- Not OK – The resistance is greater than 10 Ohms.

  Repair: Perform the following repair:

  Repair the connectors and/or the harness, or replace the connectors and/or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 6. Change the Perkins Electronic Service Tool (EST) Components.

A. If another electronic engine is available, connect the Perkins EST to the other engine. Ensure that the same cables are used.

B. Turn the keyswitch to the ON position. Determine if the Perkins EST operates correctly on the other engine.

C. If another engine is not available, obtain a replacement communications adapter and a replacement set of Perkins EST cables. Ensure that the set of Perkins EST cables are a complete set.

D. Install the replacement communications adapter and Perkins EST cables and connect to the diagnostic connector.

E. Turn the keyswitch to the ON position.

F. If changing the communications adapter or the Perkins EST cables allows the Perkins EST to operate correctly, use the following procedure:

a. Replace the components from the old set of Perkins EST cables into the new set of cables that operate. Replace one component at a time.

b. Apply power to the Perkins EST after each of the components is replaced. Use this method to find the faulty component.

G. If changing the Perkins EST cables does not allow the Perkins EST to operate correctly, connect another Perkins EST.

H. Turn the keyswitch to the ON position.

Expected Result:

Result 1 The original Perkins EST works on another engine.

Result 2 A different Perkins EST works on the original engine while the engine is being tested.

Results:

- Result 1 – Proceed to Test Step 7.
- Result 2

  Repair: Send the faulty Perkins EST for repairs.

  STOP.

Test Step 7. Connect a Perkins EST and the ECM to another Battery.

WARNING

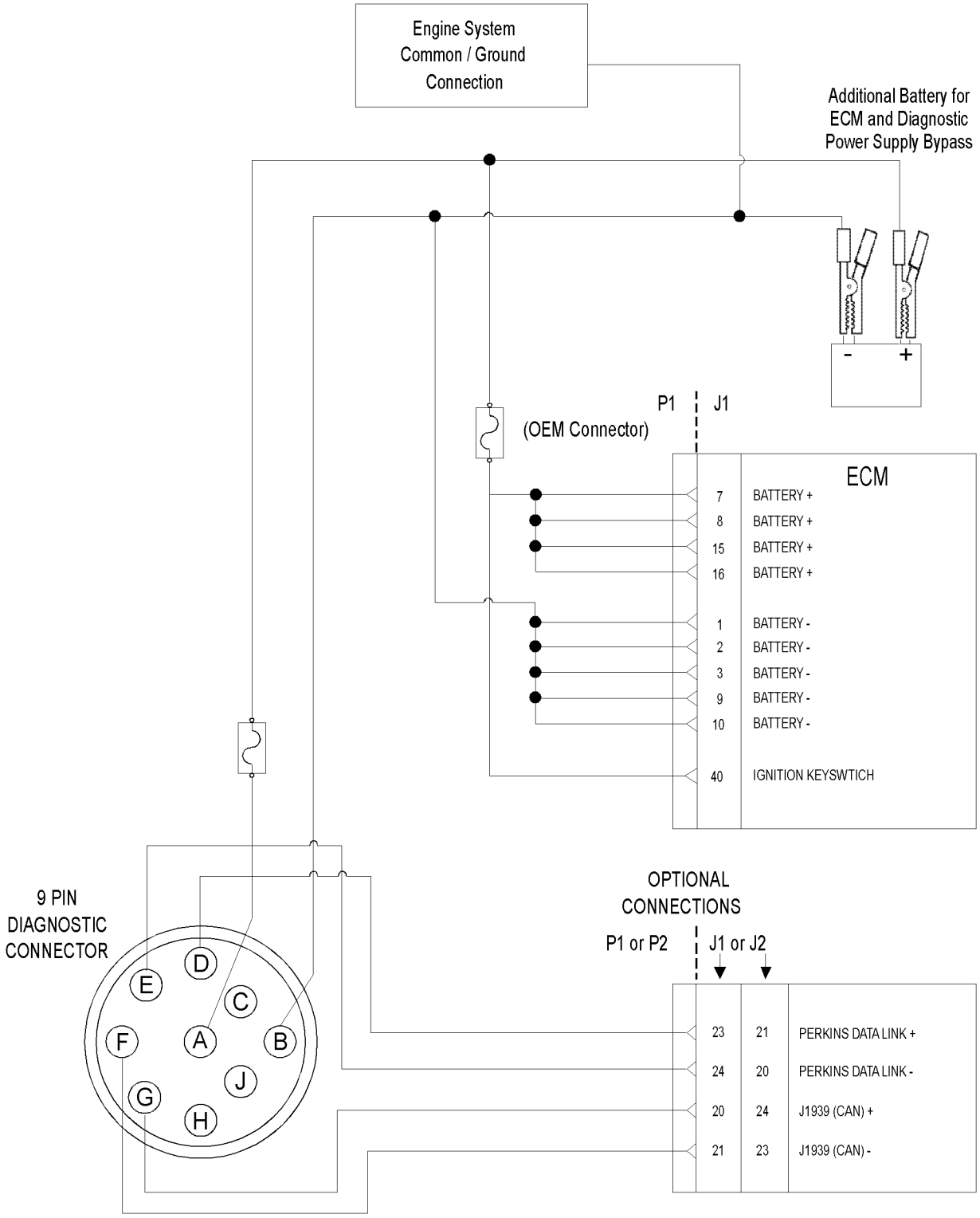
Batteries give off flammable fumes which can explode.

To avoid injury or death, do not strike a match, cause a spark, or smoke in the vicinity of a battery.

NOTICE

Do Not connect the Bypass Harness to the battery until the in-line fuse has been removed from the +Battery line. If the fuse is not removed before connection to the battery a spark may result.

Note: Refer to Troubleshooting, “Electronic Service Tools” for details of the bypass harness.



g01244183

Illustration 40

Schematic of the bypass harness connector

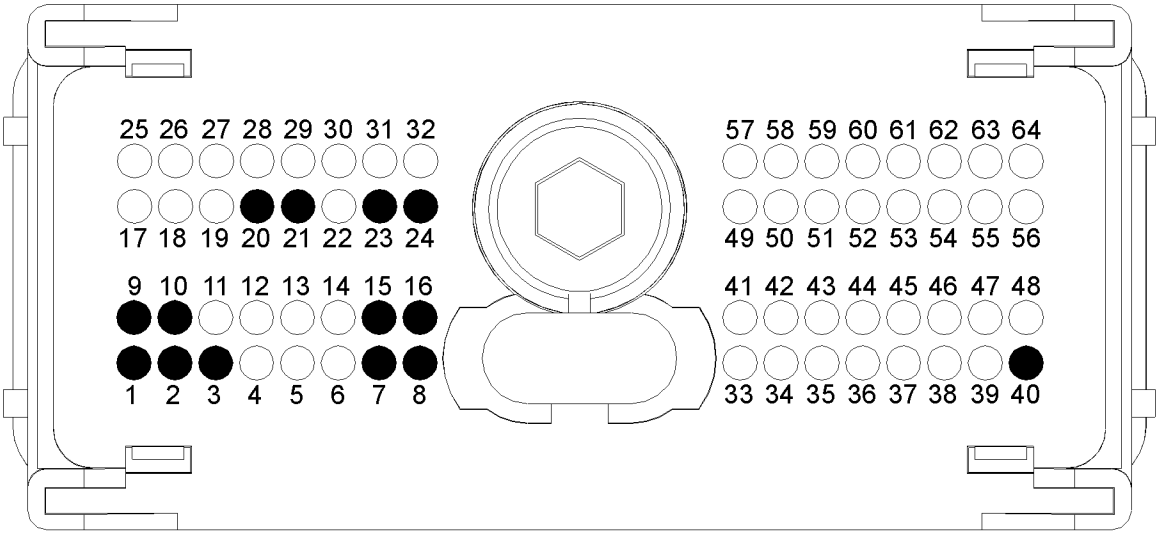


Illustration 41 g01184528

Typical view of the P1 OEM connector pin locations for the diagnostic and Perkins data link connectors

(1) Battery ground (GND)
(2) Battery ground (GND)
(3) Battery ground (GND)
(7) Battery +
(8) Battery +
(9) Battery ground (GND)
(10) Battery ground (GND)
(15) Battery +
(16) Battery +
(20) J1939 (CAN) -
(21) J1939 (CAN) +
(23) Perkins Data link (PDL) +
(24) Perkins Data link (PDL) +
(40) Keyswitch

A. Connect the battery wires from the bypass harness of the Perkins EST to a different battery that is not on the engine.

Expected Result:

The Perkins EST is operating correctly.

Results:

- Yes

  Repair: Refer to Troubleshooting, “Engine Wiring Information”.

  STOP.

- No

  Repair: Perform the following repair:

  1. Temporarily connect a test ECM.

Note: The test ECM should be programmed with the correct software. All parameters should be set to the same value as the suspect ECM.

2. Remove all jumper wires and reconnect all connectors.

3. Recheck the system for active diagnostic codes.

4. Repeat the Test.

5. If the fault is resolved with the test ECM, reconnect the suspect ECM.

6. If the fault returns with the suspect ECM, replace the suspect ECM.

7. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

STOP.

i02490763

Digital Throttle Position Sensor Circuit - Test

System Operation Description:

Use this procedure under the following situation:

Use this procedure if any of the following diagnostic codes are indicated:

- 0041-03 8 Volt DC Supply voltage above normal
- 0041-04 8 Volt DC Supply voltage below normal
- 0091-08 Throttle Position Sensor abnormal frequency, pulse width, or period

Also, use this procedure if the digital throttle position sensor is suspected of improper operation.

Digital Throttle Position Sensor

The digital throttle position sensor is used to provide a digital throttle position signal to the Engine Control Module (ECM). The sensor output is a constant frequency signal with a pulse width that varies with the pedal position. This output signal is referred to as either a duty cycle or a pulse width modulated signal (PWM) and this output signal is expressed as a percentage between 3 and 100 percent.

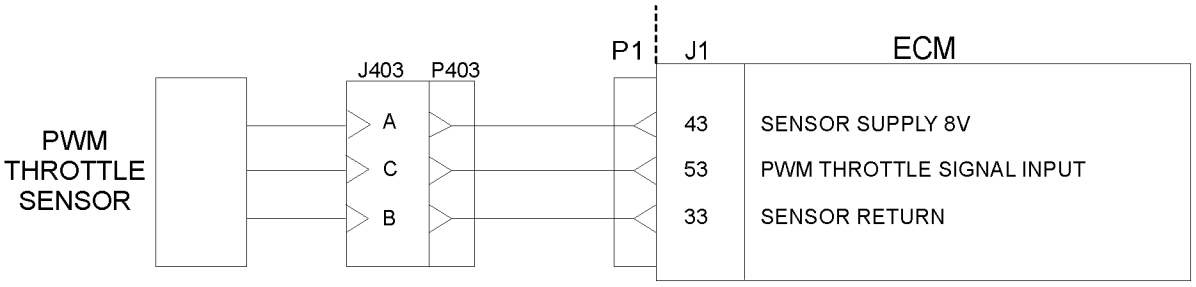
The digital throttle position sensor is most likely to be attached directly to the throttle pedal assembly. The digital throttle position sensor requires no adjustment.

The digital throttle position sensor will produce a duty cycle of 10 to 22 percent at low idle and 75 to 90 percent when the throttle pedal is fully depressed. The percent of duty cycle is translated in the ECM into a throttle position of 3 to 100 percent.

The digital throttle position sensor is powered by the ECM supply voltage (+8 VDC). The supply voltage is from the J1:43 to terminal “A” of the digital throttle position sensor connector.

If the application is using the ECM dedicated PTO functions, the digital throttle position sensor will be ignored while the engine is in PTO mode.

The ECM is in PTO mode if the “PTO ON/OFF Switch” is ON. This can be checked with Perkins Electronic Service Tool (EST). Refer to Troubleshooting, “PTO Switch Circuit - Test” for testing if the PTO is being used.



g01244561

Illustration 42

Typical schematic of the digital throttle position sensor

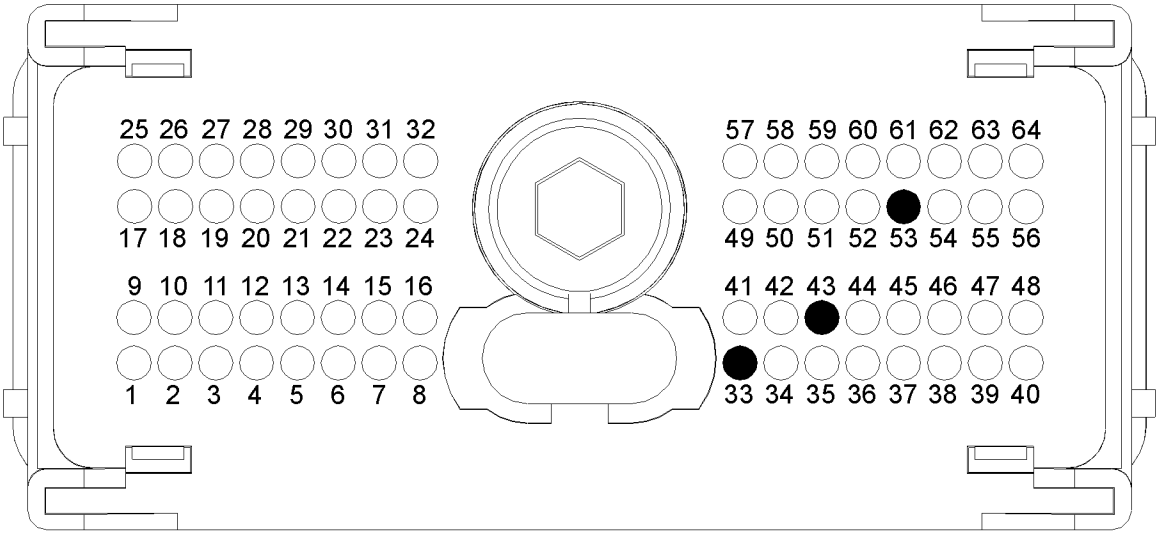


Illustration 43 g01207264

Typical example of the pin locations on the P1 connector

(33) Sensor return (43) Sensor supply (8v) (53) Sensor input

Test Step 1. Inspect Electrical Connectors and Wiring

A. Inspect the P1/J1 connector, OEM harness and the OEM connectors. Thoroughly inspect the digital throttle position sensor connector. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

B. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the digital throttle position sensor:

- P1:33
- P1:43
- P1:53

C. Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in).

D. Check the harness for abrasion and pinch points from the digital throttle position sensor to the ECM.

Expected Result:

All connectors, pins and sockets are completely coupled and/or inserted and the harness is free of corrosion, of abrasion or of pinch points.

Results:

- OK – Proceed to Test Step 2.
- Not OK

Repair: Perform the following repair:

Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled.

Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

STOP.

Test Step 2. Check for Active Diagnostic Codes

A. Connect Perkins EST to the data link connector.

B. Turn the keyswitch to the ON position.

C. Monitor the active diagnostic code screen on Perkins EST. Check and record active diagnostic codes.

Note: When the ECM automatically calibrates new duty cycle values for the low idle throttle position and the high idle throttle position, the ECM assumes 22 percent duty cycle at low idle and 75 percent duty cycle at high idle. As a result, you may notice that the throttle position status reaches 100 percent well before the throttle pedal is fully depressed. This is normal. After some cycling of the throttle pedal to the high idle position, the ECM will adjust the calibration automatically. The ECM will adjust the calibration automatically provided that the high idle stop position is within the 75 to 90 percent duty cycle range, and the low idle is in the 10 to 22 percent duty cycle range. During normal operation, you may also notice that more movement of the throttle pedal is required for the throttle position status to increase above three percent. You may also observe that the status reaches the 100 percent value prior to the limit of the high idle position. This is done in order to ensure that the throttle reaches these two critical points for engine operation.

Expected Result:

Result 1 Diagnostic code 0091-08 is active.

Result 2 Diagnostic code 0041-03 is active.

Result 3 There are no active diagnostic codes that are related to the digital throttle pedal position sensor circuit at this time, but a fault is suspected with operation of the digital throttle position sensor circuit.

Results:

- Result 1 – Proceed to Test Step 3.
- Result 2 – Proceed to Test Step 5.
- Result 3 – Proceed to Test Step 3.

Test Step 3. Check the Duty Cycle of the Digital Throttle Position Sensor

A. Verify that the keyswitch is in the ON position.

B. Monitor the duty cycle of the throttle sensor on the Perkins EST throttle display screen.

Expected Result:

The duty cycle is between 10 and 22 percent with the throttle pedal assembly in the low idle position, and the duty cycle is between 75 and 90 percent with the throttle pedal assembly in the high idle position.

Results:

- OK – The digital throttle position sensor is operating correctly. Proceed to Test Step 6.
- Not OK – The digital throttle position sensor circuit is not operating correctly. Proceed to Test Step 4.

Test Step 4. Check the Supply Voltage at the Digital Throttle Position Sensor

A. Turn the keyswitch to the OFF position.

B. Install a breakout “T” with 3 terminals at the digital throttle position sensor connector J403/P403.

C. Turn the keyswitch to the ON position.

D. Measure the voltage at terminal “A” (+8 V) with reference to terminal “B” (digital throttle position sensor ground).

Expected Result:

The measured voltage is between 7.5 VDC and 8.5 VDC for the digital throttle position sensor.

Results:

- OK – Proceed to Test Step 8.
- Not OK – The sensor is not receiving the correct voltage. Proceed to Test Step 5.

Test Step 5. Monitor Perkins Electronic Service Tool (EST) while the Digital Throttle Position Sensor is Being Disconnected

A. Access the active diagnostic code screen on Perkins EST. Ensure that one of the following diagnostic code is active before proceeding:

- 41-3
- 41-4

B. Monitor the active diagnostic code screen while the digital throttle position sensor is being disconnected and reconnected.

Expected Result:

One of the following diagnostic codes is still active after the digital throttle position sensor has been disconnected:

- 41-3
- 41-4

Results:

- OK – Ensure that the digital throttle position sensor has been reconnected before continuing. Proceed to Test Step 7.

- Not OK

  Repair: Perform the following diagnostic procedure:

  Temporarily install another digital throttle position sensor. Use the Perkins EST in order to check for an active +8 V diagnostic code. Replace the digital throttle position sensor if both of the following conditions occur:

  - The fault is corrected with the new digital throttle position sensor.
  - The fault returns after the old digital throttle position sensor has been reconnected.

  STOP.

Test Step 6. Check the Status of the PTO On/Off Switch and the Status of the Power Train Data Link with Perkins Electronic Service Tool (EST)

A. Check the status of the “PTO ON/OFF Switch” with Perkins EST in order to verify that the “PTO ON/OFF Switch” is switched OFF. The PTO mode may cause the ECM to ignore the digital throttle position sensor if demand is less than the PTO speed demand.

B. Start the engine. Use the Perkins EST in order to monitor the throttle position status. While the throttle position status is being monitored, depress the throttle pedal and release the throttle pedal. The throttle position status and the engine should respond to the change in the throttle pedal position.

C. Go to the “Configuration Settings” portion of Perkins EST and turn off the “Torque Speed Control”.

Note: The “Torque Speed Control” is an option that may be installed by the OEM.

D. While the throttle position status is being monitored, depress the throttle pedal and release the throttle pedal. Also depress the throttle pedal and release the throttle pedal while the engine response is being monitored.

Expected Result:

The throttle position status and the engine should respond to the change in the throttle pedal position.

Result 1 The digital throttle position sensor functions correctly.

Result 2 The throttle response is limited by a “Torque Speed Control” message.

Result 3 The PTO limits the throttle response.

Results:

- Result 1 – The digital throttle position sensor is operating correctly. Continue troubleshooting until the original condition is resolved. STOP.
- Result 2 – If the engine responds with the “Torque Speed Control Link” in a disabled condition and the engine does not respond with the “Power Train Data Link” in an enabled condition, a component of the “Power Train Data Link” is causing the response fault of the digital throttle position sensor. Refer to the OEM dealer in order to repair the faulty component of the “Power Train Data Link”. STOP.
- Result 3 – The ECM is operating in PTO mode.

  Repair: If the PTO should not be active, refer to the following diagnostic procedure: Troubleshooting, “PTO Switch Circuit - Test”

  STOP.

Test Step 7. Disconnect the Power Supply Connections for the Digital Throttle Position Sensor at the ECM

A. Turn the keyswitch to the OFF position.

B. Disconnect the P1 connector. Remove the P1:43 (8V). Remove the P1:33 (digital throttle position sensor ground) from the P1 connector.

C. Reconnect the P1 connector to J1.

D. Turn the keyswitch to the ON position.

E. Use Perkins EST to check for active diagnostic codes.

Expected Result:

One of the following diagnostic codes is still active after the terminals for sensor power have been disconnected:

- 41-3
- 41-4

Results:

- OK

  Repair: Perform the following repair:

  Check the battery voltage from P1 connectors at pins 1, 2, 3, 9 and 10 (Battery ground). Check the battery voltage from J1 connectors at pins 7, 8, 15, and 16 (Battery+). The measured voltage should be in one of the following ranges:

- For 12 volt systems, the voltage should be between 11.0 VDC and 13.5 VDC.
- For 24 volt systems, the voltage should be between 22.0 VDC and 27.0 VDC.

If the battery voltage is correct, temporarily connect a test ECM. Use Perkins EST to verify that the active diagnostic code is resolved. If the fault is corrected with the test ECM, reconnect the suspect ECM. Verify that the active diagnostic code returns. If the active diagnostic code returns with the suspect ECM, replace the ECM.

STOP.

- Not OK

Repair: Perform the following repair:

There is a fault in the harness between the ECM and the digital throttle position sensor. While active diagnostic codes are being monitored, connect the removed wires one at a time in order to verify that the active diagnostic codes reappear. ReplaceP1:33. Replace P1:43 (digital throttle position sensor ground 8 Volt). This procedure is used to find the wire that is causing the fault. Repair the harness or replace the harness, as required.

Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

STOP.

Test Step 8. Check the Duty Cycle of the Accelerator Pedal Position Sensor at the Sensor

Note: Performing certain steps within this procedure requires the use of a multimeter that is capable of measuring a PWM duty cycle.

A. Turn the keyswitch to the OFF position.

B. Remove the signal wire for the digital throttle position sensor (terminal “C”) from P403. Refer to illustration 42.

C. Install a breakout “T” with three terminals at the digital throttle position sensor connector J403/P403.

D. Connect the multimeter probes to terminal “B” (digital throttle position sensor signal) and terminal “B” (digital throttle position sensor ground) of the breakout T.

E. Turn the keyswitch to the ON position.

F. While the duty cycle is being monitored on the multimeter, depress the throttle pedal and release the throttle pedal.

Expected Result:

The duty cycle is between 10 and 22 percent with the throttle pedal assembly in the low idle position, and the duty cycle is between 75 and 90 percent with the throttle pedal assembly in the high idle position.

Results:

- OK – Reinsert the wire (terminal “C”) into the harness connector of the digital throttle position sensor. The digital throttle position sensor is working correctly. Proceed to Test Step 9.
- Not OK – Leave the PWM probe connected to the breakout “T”. Insert the wire (terminal “C”) into the machine harness connector. The throttle pedal assembly is faulty. Proceed to Test Step 10.

Test Step 9. Check the Duty Cycle of the Accelerator Pedal Position Sensor at the ECM

Note: Performing certain steps within this procedure requires the use of a multimeter that is capable of measuring a PWM duty cycle.

A. Turn the keyswitch to the OFF position.

B. Remove the P1:53. Disconnect the P1 connector in order to remove the terminal for the signal input of the digital throttle position sensor signal.

C. Connect the multimeter probes between the removed wire and the P1:33 (digital throttle position sensor ground).

D. Reconnect the P1 connector to the ECM.

E. Turn the keyswitch to the ON position.

F. Use the multimeter in order to display the duty cycle output of the digital throttle position sensor. While the duty cycle output of the digital throttle position sensor is being monitored on the multimeter, move the throttle assembly from the low idle position to the high idle position. Record the results.

G. Turn the keyswitch to the OFF position.

H. Remove the P1 connector from the ECM.

I. Install the pin P1:53.

J. Connect the P1 connector to the ECM.

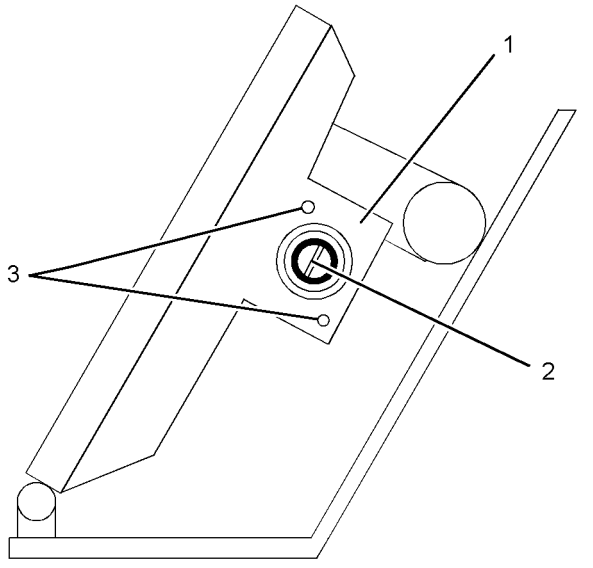
Expected Result:

The duty cycle is between approximately 10 and 22 percent with the throttle pedal assembly in the low idle position, and the duty cycle is between 75 and 90 percent with the throttle pedal assembly in the high idle position.

Results:

- OK – A good signal from the digital throttle position sensor is reaching the ECM. Verify that the ECM is receiving the correct battery voltage. If the ECM is receiving the correct battery voltage, temporarily connect a test ECM and verify that the fault is resolved. If the fault is rectified with the test ECM, reconnect the suspect ECM. If the fault returns with the suspect ECM, replace the ECM. STOP.
- Not OK – There is a fault with signal wire in the harness. Proceed to Test Step 11.

Test Step 10. Remove the Digital Throttle Position Sensor from the Throttle Pedal Assembly

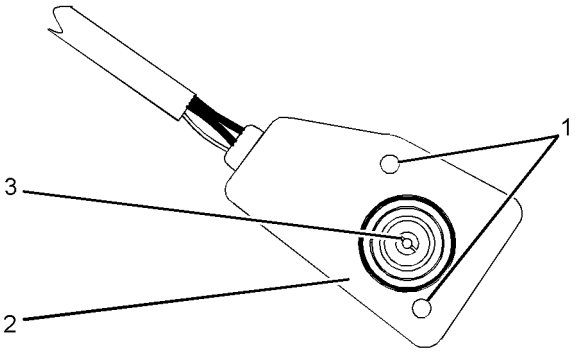


g01185326

Illustration 44

Throttle pedal assembly

(1) Sensor mounting face
(2) Sensor drive key
(3) Mounting screw holes

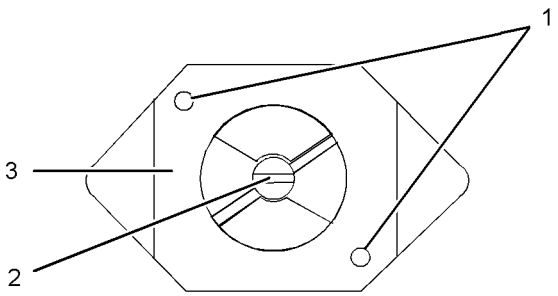


g01185327

Illustration 45

Throttle block assembly

(1) Mounting screw holes
(2) Sensor housing
(3) Sensor drive slot



g01185328

Illustration 46

Throttle block assembly

(1) Mounting screw holes
(2) Sensor drive slot
(3) Sensor mounting face

A. Verify that the keyswitch is in the OFF position.

B. Note the sensor orientation in the throttle pedal assembly and the sensor connector for the harness routing prior to sensor removal. Remove the digital throttle position sensor from the throttle pedal assembly. Thoroughly inspect the connector and the harness for signs of abrasion.

C. Connect a multimeter that is capable of measuring a PWM duty cycle to terminal “C” of the breakout “T”.

D. Turn the keyswitch to the ON position.

E. Display the duty cycle output of the digital throttle position sensor while the sensor slot is released. Use a screwdriver to advance the sensor slot to the maximum position. Refer to Illustration 46.

Expected Result:

When the sensor is removed from the accelerator pedal assembly and the sensor slot is released, the duty cycle is 10 percent or less. When the sensor slot is moved to the maximum position, the duty cycle increases to 90 percent or more.

Results:

- OK – The digital throttle position sensor is working correctly. Refer to the OEM dealer for correct replacement of the accelerator pedal assembly. STOP.
- Not OK – The digital throttle position sensor is faulty. Check the accelerator pedal assembly in order to ensure that the accelerator pedal assembly is not causing damage to the sensor. If the accelerator pedal assembly is causing damage to the sensor, refer to the OEM dealer for correct replacement of the accelerator pedal assembly. If the accelerator pedal assembly appears OK, replace the digital throttle position sensor. STOP.

Test Step 11. Route the Supply Bypass Wires to the Digital Throttle Position Sensor

A. Turn the keyswitch to the OFF position.

B. Temporarily remove the signal wire for the digital throttle position sensor from P1:53.

C. Remove terminal “C” (digital throttle position sensor signal) from the digital throttle position sensor connector.

D. Route the new wiring from the ECM to the digital throttle position sensor.

E. Turn the keyswitch to the ON position.

F. Check the duty cycle of the digital throttle position sensor on Perkins EST while the digital throttle pedal assembly is being moved over the full range.

Expected Result:

The duty cycle is between 10 and 22 percent with the throttle pedal assembly in the low idle position, and the duty cycle is between 75 and 90 percent with the throttle pedal assembly in the high idle position.

Results:

- OK

  Repair: Perform the following repair:

  The wiring from the ECM to the digital throttle position sensor appears faulty. Permanently install new wiring.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

- Not OK – Double check the wiring, P1/J1 connectors and the digital throttle position sensor connector. If a fault still exists, restart the test procedure. STOP.

i02493833

ECM Memory - Test

System Operation Description:

This procedure covers the following diagnostic codes:

- 0253-02 Personality Module erratic, intermittent, or incorrect

Background Information

0253-02

The flash file in the Electronic Control Module (ECM) is from the wrong engine family. The engine will not start.

Correct the Condition

Determine the diagnostic code that is active.

Expected Result:

A 0253-02 diagnostic code is active.

Results:

- A 0253-02 code is active

  Repair: Obtain the engine serial number. Use PTMI to determine the latest available flash file for the engine. Verify that the latest available flash file is loaded into the ECM.

  STOP.

i02499732

Electrical Connectors - Inspect

System Operation Description:

Most electrical faults are caused by poor connections. The following procedure will assist in detecting faults in connectors and wiring. If a fault is found, correct the condition and verify that the fault is resolved.

Intermittent electrical faults are sometimes resolved by disconnecting and reconnecting connectors. It is very important to check for diagnostic codes immediately before disconnecting a connector. Also check for diagnostic codes after reconnecting the connector. If the status of a diagnostic code is changed due to disconnecting and reconnecting a connector, there are several possible reasons. The likely reasons are loose terminals, improperly crimped terminals, moisture, corrosion, and inadequate mating of a connection.

Follow these guidelines:

- Always use a 27610285 Removal Tool to remove the pins from the P1/P2 connectors.
- Always use a 2900A033 Crimp Tool to service Deutsch HD and DT connectors. Never solder the terminals onto the wires.
- Always use a 28170079 Removal Tool to remove wedges from DT connectors. Never use a screwdriver to pry a wedge from a connector.
- Always use a 2900A033 Crimp Tool to service AMP seal connectors.
- Refer to Troubleshooting, “ECM Harness Connector Terminals” in order to service the connectors for the Electronic Control Module (ECM).
- Always use a breakout harness for a voltmeter probe or a test light. Never break the insulation of a wire in order to access a circuit for measurements.
- If a wire is cut, always install a new terminal for the repair.

⚠ WARNING

The connection of any electrical equipment and the disconnection of any electrical equipment may cause an explosion hazard which may result in injury or death. Do not connect any electrical equipment or disconnect any electrical equipment in an explosive atmosphere.

Test Step 1. Check Connectors for Moisture and Corrosion

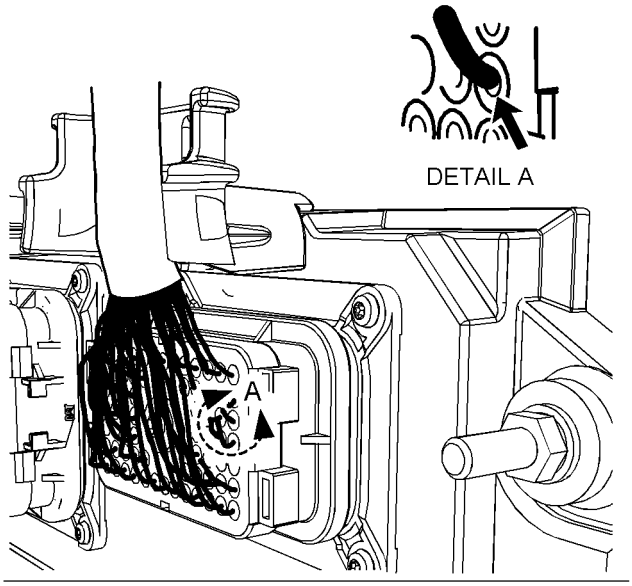


Illustration 47 g01131211

Leaky seal at the connector (typical example)

A. Inspect all the harnesses. Ensure that the routing of the wiring harness allows the wires to enter the face of each connector at a perpendicular angle. Otherwise, the wire will deform the seal bore. Refer to Illustration 47. This will create a path for the entrance of moisture. Verify that the seals for the wires are sealing correctly.

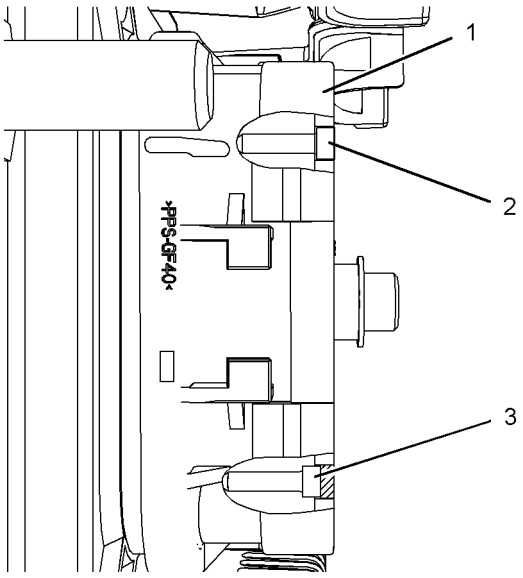


Illustration 48 g01131276

Diagram for the installation of a connector plug (typical example)

(1) ECM connector
(2) Correctly inserted plug
(3) Incorrectly inserted plug

B. Ensure that the sealing plugs are in place. If any of the plugs are missing, replace the plug. Ensure that the plugs are inserted correctly into the connector. Refer to Illustration 48.

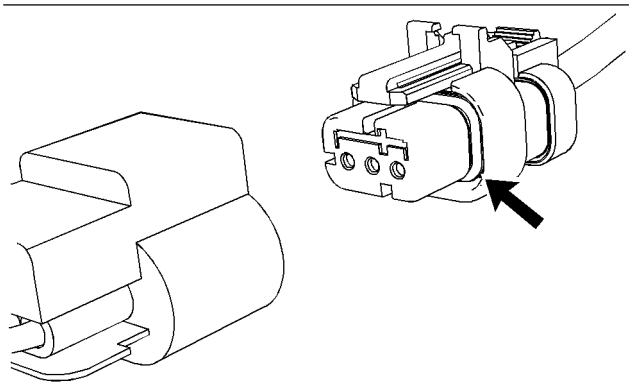


Illustration 49 g01131019

Seal for a three-pin connector (typical example)

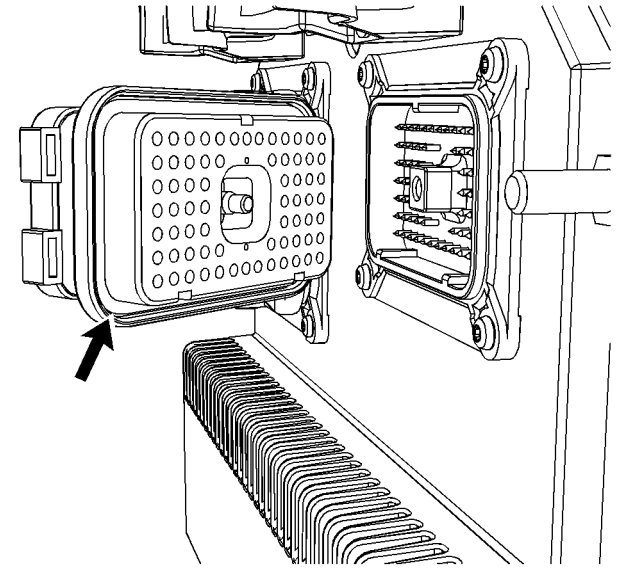


Illustration 50 g01131165

Seal for ECM connector (typical example)

C. Disconnect the suspect connector and inspect the connector seal. Ensure that the seal is in good condition. If necessary, replace the connector.

D. Thoroughly inspect the connectors for evidence of moisture entry.

Note: It is normal to see some minor seal abrasion on connector seals. Minor seal abrasion will not allow the entry of moisture.

If moisture or corrosion is evident in the connector, the source of the moisture entry must be found and the source of the moisture entry must be repaired. If the source of the moisture entry is not repaired, the fault will recur. Simply drying the connector will not fix the fault. Check the following items for the possible moisture entry path:

- Missing seals
- Incorrectly installed seals
- Nicks in exposed insulation
- Improperly mated connectors

Moisture can also travel to a connector through the inside of a wire. If moisture is found in a connector, thoroughly check the connector harness for damage. Also check other connectors that share the harness for moisture.

Note: The ECM is a sealed unit. If moisture is found in an ECM connector, the ECM is not the source of the moisture. Do not replace the ECM.

Expected Result:

The harness, connectors, and seals are in good condition. There is no evidence of moisture in the connectors.

Results:

- OK – The harness, connectors, and seals are in good condition. Proceed to Test Step 2.
- Not OK – A fault has been found with the harness or the connectors.

  Repair: Repair the connectors or the wiring, as required. Ensure that all of the seals are correctly installed. Ensure that the connectors have been reattached.

  If corrosion is evident on the pins, sockets or the connector, use only denatured alcohol to remove the corrosion. Use a cotton swab or a soft brush to remove the corrosion.

  If moisture was found in the connectors, run the engine for several minutes and check again for moisture. If moisture reappears, the moisture is wicking into the connector. Even if the moisture entry path is repaired, it may be necessary to replace the wires.

Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

STOP.

Test Step 2. Check the Wires for Damage to the Insulation

A. Carefully inspect each wire for signs of abrasion, nicks and cuts.

Inspect the wires for the following conditions:

- Exposed insulation
- Rubbing of a wire against the engine
- Rubbing of a wire against a sharp point

B. Check all of the fasteners on the harness and the strain relief components on the ECM in order to verify that the harness is correctly secured. Also check all of the fasteners in order to verify that the harness is not compressed. Pull back the harness sleeves in order to check for a flattened portion of wire. A fastener that has been overtightened flattens the harness. This damages the wires that are inside the harness.

Expected Result:

The wires are free of abrasion, nicks and cuts and the harness is correctly clamped.

Results:

- OK – The harness is OK. Proceed to Test Step 3.
- Not OK – There is damage to the harness.

  Repair: Repair the wires or replace the wires, as required.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 3. Inspect the Connector Terminals

A. Visually inspect each terminal in the connector. Verify that the terminals are not damaged. Verify that the terminals are correctly aligned in the connector and verify that the terminals are correctly located in the connector.

Expected Result:

The terminals are correctly aligned and the terminals appear undamaged.

Results:

- OK – The terminals are OK. Proceed to Test Step 4.
- Not OK – The terminals of the connector are damaged.

  Repair: Repair the terminals and/or replace the terminals, as required.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 4. Perform a Pull Test on Each Wire Terminal Connection

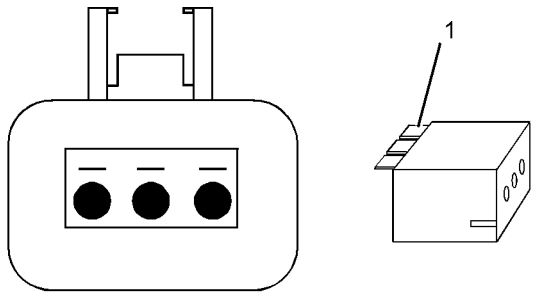


Illustration 51 g01237430

A typical example of the lock wedge.

(1) Lock wedge

A. Ensure that the locking wedge for the connector is installed correctly. Terminals cannot be retained inside the connector if the locking wedge is not installed correctly.

B. Perform the 45 N (10 lb) pull test on each wire. Each terminal and each connector should easily withstand 45 N (10 lb) of tension and each wire should remain in the connector body. This test checks whether the wire was correctly crimped in the terminal and whether the terminal was correctly inserted into the connector.

Expected Result:

Each terminal and each connector easily withstands 45 N (10 lb) of pull and each wire remains in the connector body.

Results:

- OK – All terminals pass the pull test. Proceed to Test Step 5.

- Not OK – A wire has been pulled from a terminal or a terminal has been pulled from the connector.

  Repair: Use the CH11155 Crimp Tool to replace the terminal. Replace damaged connectors, as required.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 5. Check Individual Pin Retention into the Socket

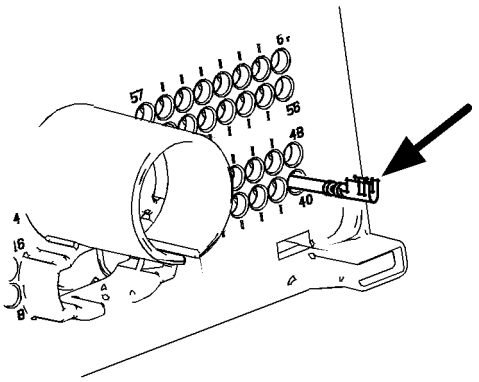


Illustration 52 g01237435

Diagram for testing pin retention

A. Verify that the sockets provide good retention for the pins. Insert a new pin into each socket one at a time in order to check for a good grip on the pin by the socket.

Expected Result:

The sockets provide good retention for the new pin.

Results:

- OK – The terminals are OK. Proceed to Test Step 6.

- Not OK – Terminals are damaged.

  Repair: Use the CH11155 Crimp Tool to replace the damaged terminals. Verify that the repair eliminates the problem.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 6. Check the Locking Mechanism of the Connectors

A. Ensure that the connectors lock correctly. After locking the connectors, ensure that the two halves cannot be pulled apart.

B. Verify that the latch tab of the connector is correctly latched. Also verify that the latch tab of the connector returns to the locked position.

Expected Result:

The connector is securely locked. The connector and the locking mechanism is not cracked or broken.

Results:

- OK – The connectors are in good repair. Proceed to Test Step 7.

- Not OK – The connector's locking mechanism is damaged or missing.

  Repair: Repair the connector or replace the connector, as required.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 7. Check the Screws on the ECM Connectors (64 way)

Visually inspect the screws for the ECM connectors. Ensure that the threads on each screw are not damaged.

A. Connect the ECM connectors.

  a. Use a 7 mm Torx screw in order to retain each of the ECM connectors.

  b. Tighten the two Torx screws for the ECM connector to the correct torque of 5.0 ± 1.0 N·m (44 ± 9 lb in).

Note: If the threaded insert in the ECM is damaged, the ECM must be replaced. Refer to Disassembly and Assembly, "Electronic Control Module - Remove and Install".

Expected Result:

The ECM connectors are secure and the Torx screws are correctly torqued.

Results:

- OK – The ECM connectors are secured. Proceed to Test Step 8.
- Not OK – The screws for the ECM connectors are damaged.

  Repair: Repair the connectors or replace the connectors or screws, as required.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 8. Perform the “Wiggle Test” on the Perkins Electronic Service Tool (EST)

A. Select the “Wiggle Test” from the diagnostic tests on the Perkins Electronic Service Tool (EST).

B. Choose the appropriate group of parameters to monitor.

C. Press the “Start” button. Wiggle the wiring harness in order to reproduce intermittent faults.

If an intermittent fault exists, the status will be highlighted and an audible beep will be heard.

Expected Result:

No intermittent faults were indicated during the “Wiggle Test”.

Results:

- OK – No intermittent faults were found. The harness and connectors appear to be OK. If this test was required as part of another procedure, return to that procedure and continue testing. If this test has resolved the fault, return the engine to service. STOP.
- Not OK – At least one intermittent fault was indicated.

  Repair: Repair the harness or the connector.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

i02493835

Engine Pressure Sensor Open or Short Circuit - Test

System Operation Description:

Use this procedure under the following conditions:

Use this procedure if another procedure has directed you here. Use this procedure if any of the following diagnostic codes are active:

- 0100-03 Engine Oil Pressure Sensor voltage above normal
- 0100-04 Engine Oil Pressure Sensor voltage below normal
- 0100-10 Engine Oil Pressure Sensor abnormal rate of change
- 1785-03 Intake Manifold Pressure Sensor voltage above normal
- 1785-04 Intake Manifold Pressure Sensor voltage below normal
- 1785-10 Intake Manifold Pressure Sensor abnormal rate of change
- 1797-03 Fuel Rail Pressure Sensor voltage above normal
- 1797-04 Fuel Rail Pressure Sensor voltage below normal

The following background information is related to this procedure:

The troubleshooting procedures for the diagnostic codes of each pressure sensor are identical. The 5 volt sensor supply provides power to all 5 volt sensors. The Electronic Control Module (ECM) supplies 5.0 ± 0.2 VDC to terminal “A” of each sensor connector. The sensor common from the ECM connector goes to terminal “B” of each sensor connector. The sensor supply is output short circuit protected. A short circuit to the battery will not damage the circuit inside the ECM.

Pull-up Voltage

The ECM continuously outputs a pull-up voltage on the circuit for the sensor signal wire. The ECM uses this pull-up voltage in order to detect an open in the signal circuit. When the ECM detects the presence of a voltage that is above a threshold on the signal circuit, the ECM will generate an open circuit diagnostic code (03) for the sensor.

If the sensor is disconnected at the sensor connector, the presence of pull-up voltage at the sensor connector indicates that the wires from the sensor connector to the ECM are not open or shorted to ground. If the sensor is disconnected at the sensor connector, the absence of pull-up voltage at the sensor connector indicates an open in the signal wire or a short to ground. If the sensor is disconnected at the sensor connector and the voltage at the sensor connector is different from pull-up voltage, the signal wire is shorted to another wire in the harness.

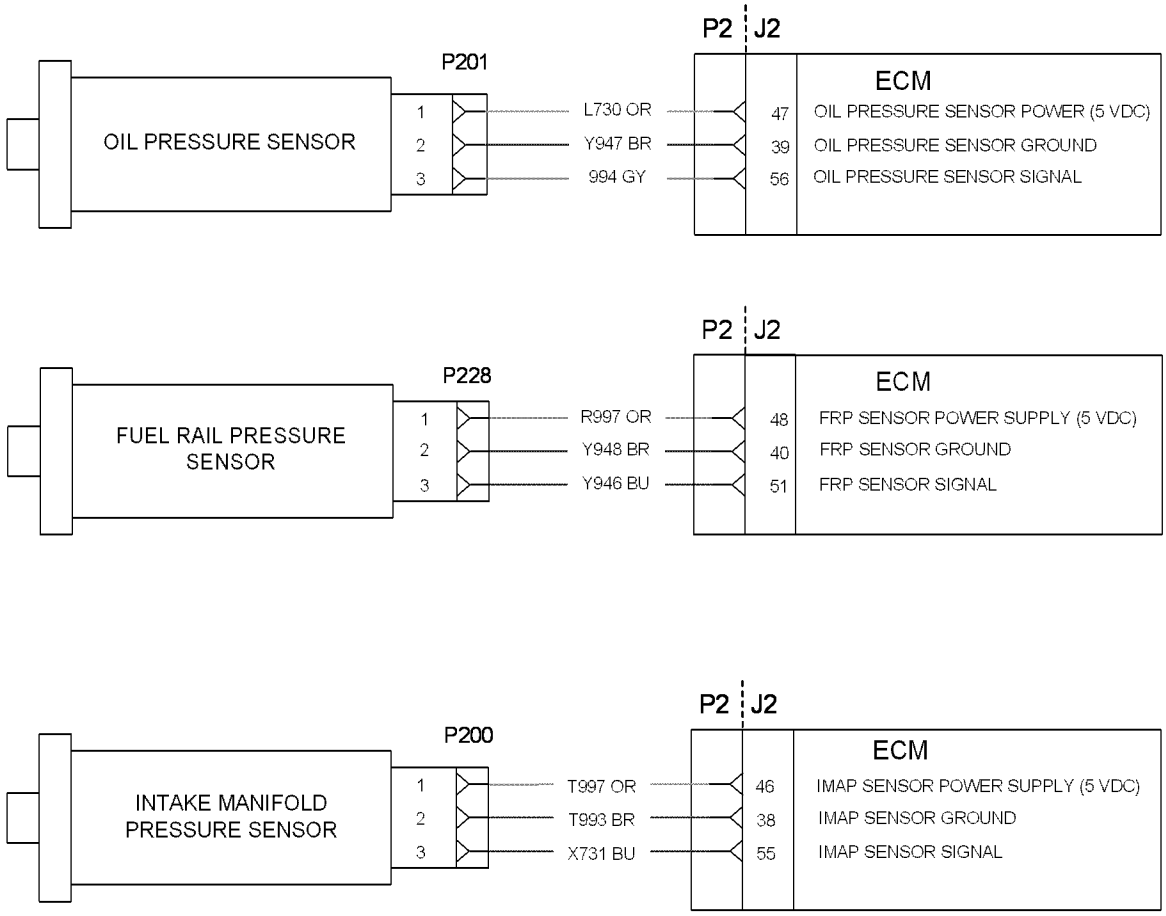
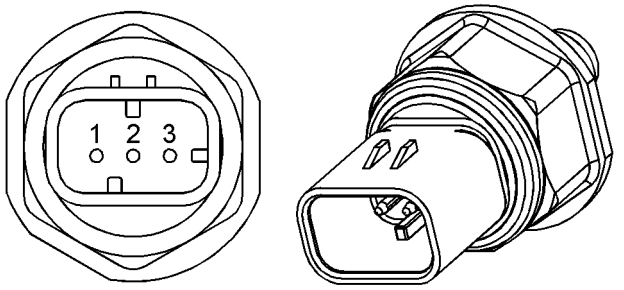


Illustration 53 g01188154

Typical example of the schematic for the sensors

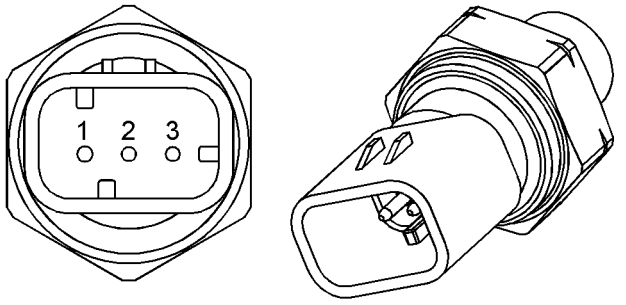


g01170309

Illustration 54

Fuel rail pressure sensor

(1) Voltage supply (Vs)
(2) Ground (GND)
(3) Signal (SIG)

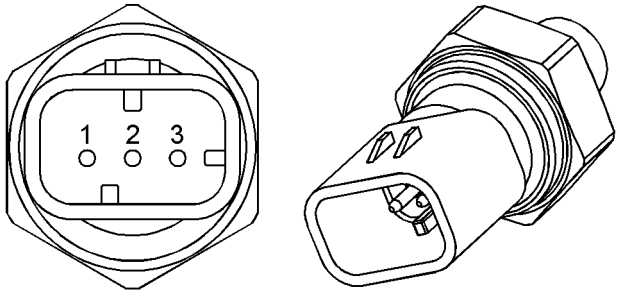


g01170310

Illustration 55

Intake manifold pressure sensor

(1) Voltage Supply (Vs)
(2) Ground (GND)
(3) Signal (SIG)



g01170311

Illustration 56

Typical example of the oil pressure sensor

(1) Voltage Supply (Vs)
(2) Ground (GND)
(3) Signal (SIG)

The troubleshooting procedures for the diagnostic codes of each pressure sensor are identical. The pressure sensors are active sensors. The pressure sensor has three terminals. Active sensors require supply voltage from the ECM. The ECM connector P2/J2 supplies +5 volts to terminal 1 of each sensor. The common line is connected to each sensor connector terminal 2. The signal voltage from terminal 3 of each sensor is supplied to the appropriate terminal at the ECM connector P2/J2.

Test Step 1. Verify All Active Diagnostic Codes.

A. Turn the keyswitch to the ON position. Wait at least 10 seconds for activation of the diagnostic codes.

B. Verify if any of the following diagnostic codes are active:

- 0100-03 Engine Oil Pressure Sensor voltage above normal
- 0100-04 Engine Oil Pressure Sensor voltage below normal
- 0100-10 Engine Oil Pressure Sensor abnormal rate of change
- 1785-03 Intake Manifold Pressure Sensor voltage above normal
- 1785-04 Intake Manifold Pressure Sensor voltage below normal
- 1785-10 Intake Manifold Pressure Sensor abnormal rate of change
- 1797-03 Fuel Rail Pressure Sensor voltage above normal
- 1797-04 Fuel Rail Pressure Sensor voltage below normal

Expected Result:

One or more of the preceding diagnostic codes are active.

Results:

- OK – Proceed to Test Step 2.
- Not OK

  Repair: Do not use this procedure if 1785-10 or 100-10 diagnostic codes are active. Refer to Troubleshooting, “5 volt Sensor Supply Circuit-Test”. When this test is complete, return to the start of this test.

If the preceding codes are logged, an intermittent condition may be causing the logged codes. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

Perform a “Wiggle Test” by using the Perkins Electronic Service Tool (EST) in order to identify intermittent connections.

STOP.

Test Step 2. Inspect Electrical Connectors And Wiring.

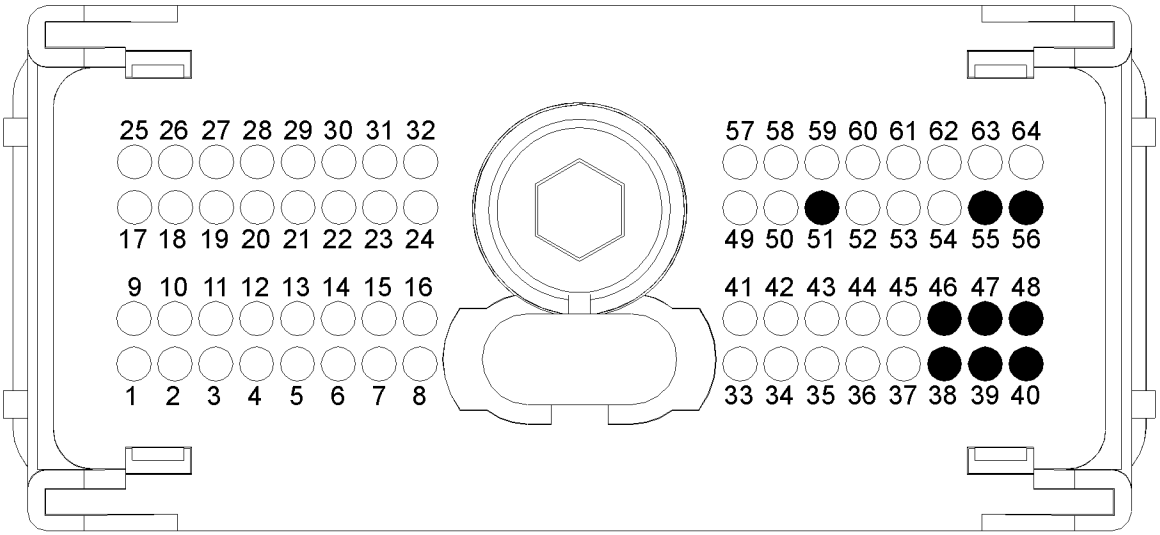


Illustration 57 g01170964

Typical view of the P2 pressure sensor pin locations

(38) Ground (GND) Intake Manifold Pressure Sensor
(39) Ground (GND) Oil Pressure Sensor
(40) Ground (GND) Fuel Rail Pressure Sensor
(46) Voltage supply (5v) Intake Manifold Pressure Sensor
(47) Voltage supply (5v) Oil Pressure Sensor
(48) Voltage supply (5v) Fuel Rail Pressure Sensor
(51) Signal (SIG) Fuel Rail Pressure Sensor
(55) Signal (SIG) Intake Manifold Pressure Sensor
(56) Signal (SIG) Oil Pressure Sensor

A. Thoroughly inspect the terminal connections on the P2/J2 ECM sensor connectors.

B. Thoroughly inspect the following engine pressure sensor connectors:

- P201 Engine Oil Pressure Sensor
- P228 Fuel Rail Pressure Sensor
- P200 Intake Manifold Pressure Sensor

C. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

D. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector and the sensor connectors that are associated with the active diagnostic code.

E. Check the screw for the ECM connector for the correct torque of 5 N·m (44 lb in).

F. Check the harness for abrasions and for pinch points from the sensors back to the ECM.

G. Use the Perkins EST to perform a “Wiggle Test”. The “Wiggle Test” will identify intermittent connections.

Expected Result:

All connectors, pins, and sockets should be completely coupled and inserted. The harness should be free of corrosion, abrasions and pinch points.

Results:

- OK – Proceed to Test Step 3.

- Not OK

  Repair: Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 3. Verify that the Diagnostic Code is Still Active.

A. Turn the keyswitch to the ON position. Wait at least 10 seconds for activation of the diagnostic codes.

B. Use the Perkins EST to check for active diagnostic codes. Record all active diagnostic codes.

C. Determine if the fault is related to an open circuit diagnostic code or a short circuit diagnostic code.

Expected Result:

Either a short circuit diagnostic code is active or an open circuit diagnostic code is active.

Results:

- OK - SHORT Circuit – A Voltage Above Normal diagnostic code is active at this time. Proceed to Test Step 4.

- OK - OPEN Circuit – A Voltage Below Normal diagnostic code is active at this time. Proceed to Test Step 5.

- Not OK – A short circuit diagnostic code is not active. An open circuit diagnostic code is not active. An intermittent fault may exist.

  Repair: By using the Perkins EST, perform a “Wiggle Test”. If faults are indicated then go to the appropriate procedure.

  STOP.

Test Step 4. Disconnect The Sensor In Order To Create An Open Circuit.

A. Turn the keyswitch to the OFF position.

B. Disconnect the sensor connector of the sensor with the short circuit diagnostic code.

C. Turn the keyswitch to the ON position. Wait at least 10 seconds for activation of the diagnostic codes.

D. Use the Perkins EST to check the “Active Diagnostic Code” screen. Check for a Voltage Below Normal diagnostic code.

Expected Result:

A Voltage Below Normal diagnostic code for the disconnected sensor is now active.

Results:

- OK – A Voltage Above Normal diagnostic code was active before disconnecting the sensor. An Voltage Above Normal diagnostic code became active after disconnecting the sensor. Proceed to Test Step 6.

- Not OK – There is a short circuit between the sensor harness connector and the ECM. Leave the sensor disconnected. Proceed to Test Step 8.

Test Step 5. Measure the Sensor Supply Voltage.

A. Turn the keyswitch to the OFF position.

B. Disconnect the sensor from the engine harness.

C. Turn the keyswitch to the ON position.

D. Measure the voltage at the plug for the sensor from the terminal 1 (pressure sensor supply) to terminal 2 (sensor common).

Expected Result:

The DC voltage from terminal 1 to terminal 2 measures 4.84 to 5.16 VDC.

Results:

- OK – The sensor supply voltage is correct. Proceed to Test Step 7.

- Not OK – The sensor supply voltage is out of the nominal range. Continue testing the sensor supply circuit.

  Repair: Proceed to the following repair: Troubleshooting, “5 Volt Sensor Supply Circuit - Test”

  STOP.

Test Step 6. Determine If The Short Circuit Is In The Connector Or In The Sensor.

A. Thoroughly inspect the connector for moisture.

B. Inspect the seals and reconnect the sensor.

C. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

D. If the short circuit diagnostic code reappears, the sensor or the sensor connector has a fault.

a. Temporarily connect a new sensor to the harness, but do not install the new sensor in the engine.

E. Use the Perkins EST to check for a short circuit diagnostic code. The new sensor should be connected to the harness at this time.

Expected Result:

The short circuit diagnostic code is not present when a new sensor is connected.

Results:

- OK – Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault. STOP.
- Not OK – Repair the engine harness connector. Use the Perkins EST to clear the logged diagnostic codes. STOP.

Test Step 7. Create a Short Circuit Between the Signal and the Common Terminals at the Engine Harness Connector.

A. Turn the keyswitch to the ON position.

B. Fabricate a jumper wire 150 mm (6 inch) long. Crimp a terminal to both ends of the wire.

C. Monitor the “Active Diagnostic Code” screen of the Perkins EST before installing the jumper wire and after installing the jumper wire.

D. Install the jumper on the engine harness connector. Install one end of the jumper at the sensor signal (terminal 3). Install the other end of the jumper at the common connection for the pressure sensor (terminal 2). Wait at least 30 seconds for activation of the short circuit diagnostic code.

Expected Result:

A short circuit diagnostic code is active when the jumper is installed. An open circuit diagnostic code is active when the jumper is removed.

Results:

- OK – The engine harness and the ECM are OK.

  Repair: Perform the following repair:

  1. Temporarily connect the suspect sensor.

  2. Use the Perkins EST to verify if the diagnostic code remains active.

  3. If the diagnostic code is active replace the sensor.

  4. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminated the fault.

  STOP.

- Not OK – The open circuit diagnostic code remains active when the jumper is installed. The most probable location for the open circuit is in the common wire for the sensor, or in the sensor signal wire of the engine harness between the ECM and the sensor. Remove the jumper. Proceed to Test Step 8.

Test Step 8. Check the Operation of the ECM by Creating Open and Short Circuits at the ECM Connector.

A. Turn the keyswitch to the OFF position.

B. Disconnect connector P2 from the ECM. Thoroughly inspect both halves of the connector for signs of corrosion or moisture. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

C. Reconnect P2 connector.

D. Turn the keyswitch to the ON position. Use Perkins EST in order to monitor the “Active Diagnostic Code” screen. Wait at least 10 seconds for activation of the code.

An open circuit diagnostic code should be active for the suspect sensor.

Note: When the P2connector is disconnected, all of the open circuit diagnostic codes for the pressure sensors and temperature sensors will be active. This is normal. Disregard the diagnostic codes for the pressure sensors and the temperature sensors that are not suspect. Direct your attention to the diagnostic codes for the suspect sensors only.

E. Turn the keyswitch to the OFF position.

F. Fabricate a jumper wire 150 mm (6 inch) long. Crimp a terminal to both ends of the wire.

G. Install the jumper wire on the P2 connector. Insert the jumper wire between the terminal for the suspect sensor signal and the common connection for the engine's pressure sensor.

Use Perkins EST to verify that there is a Voltage Above Normal diagnostic code.

Expected Result:

Voltage Below Normal diagnostic codes and Voltage Above Normal diagnostic codes were active.

Results:

- OK – The ECM is operating correctly. Proceed to Test Step 9.
- Not OK – One of the following conditions exists: The Voltage Below Normal diagnostic code is not active when the harness is disconnected. The Voltage Above Normal diagnostic code is not active when the jumper wire is installed.

  Repair: Perform the following repair:

  1. Temporarily connect a test ECM.

Note: The test ECM should have the same values and the same parameters as the suspect ECM.

2. Remove all jumpers and replace all connectors.

3. Use Perkins EST to recheck the system for active diagnostic codes.

4. Repeat the Test Step.

5. If the fault is resolved with the test ECM, reconnect the suspect ECM.

6. If the fault returns with the suspect ECM, replace the ECM.

7. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

STOP.

Test Step 9. Bypass the Harness Wiring Between the ECM and the Sensor Connector.

A. Turn the keyswitch to the OFF position.

B. Disconnect the P2 connector and disconnect the connector from the suspect sensor.

C. Remove the sensor signal wire from the P2 connector.

D. Remove the signal wire (terminal 3) from the sensor connector on the engine harness.

E. Fabricate a jumper wire that is long enough to reach from the ECM to the sensor connector or use an engine sensor harness bypass with 3 terminals.

Note: If an engine sensor harness bypass is being made, crimp a socket on one end in order to connect to the ECM. Crimp either a pin or a socket on the other end, as required.

F. Insert the one end of the engine sensor harness bypass into P2 connector on the engine harness. Insert the other end of the engine sensor harness bypass into the sensor connector of the engine harness.

G. Reconnect the P2 connector and the sensor connector.

H. Turn the keyswitch to the ON position.

I. Use the Perkins EST to monitor the "Active Diagnostic Code" screen for either the open circuit diagnostic code for the sensor or the short circuit diagnostic code for the sensor.

Expected Result:

The diagnostic code disappears when the jumper or the bypass is installed.

Results:

- OK – There is a fault in the wiring harness.

  Repair: Perform the following repair:

  1. Repair the faulty harness or replace the faulty harness.

  2. Clear all diagnostic codes.

  3. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

- Not OK – The most likely cause is an intermittent fault.

  Repair: By using the Perkins EST, perform a "Wiggle Test". If no fault is found, restart this procedure and carefully perform each step.

  STOP.

i02491413

Engine Speed/Timing Sensor Circuit - Test

System Operation Description:

Use this procedure to troubleshoot the system under the following conditions:

- Use this procedure if another procedure has directed you here.
- The engine will not start and the electronic service tool indicates a faulty sensor by displaying “Not Detected” against the faulty sensor on the “No Start Parameter” screen.
- There is an active diagnostic code or a recently logged diagnostic code that is related to the following:
- 0190-08 Engine Speed Sensor abnormal frequency, pulse width, or period
- 0342-08 Secondary Engine Speed Sensor abnormal frequency, pulse width, or period

The engine uses two engine speed/timing sensors. The primary crankshaft speed/timing sensor is located on the left hand side of the cylinder block close to the flywheel housing. The secondary camshaft/fuel rail pump sensor is mounted on the fuel rail pump. The primary speed/timing sensor that is mounted on the cylinder block generates a signal by detecting the movement of the teeth that are located on the speed/timing wheel. The speed/timing wheel is connected to the crankshaft. The signal that is generated by the speed/timing sensor is transmitted to the Electronic Control Module (ECM). The ECM uses the speed/timing sensor signal to calculate the position of the crankshaft. The signal is also used to determine the engine speed.

The secondary speed/timing sensor is located in the fuel rail pump. The secondary speed/timing sensor generates a signal that is related to the camshaft position. The fuel rail pump is mechanically connected to the camshaft. The secondary speed/timing sensor detects the movement of the teeth on the speed/timing wheel in the fuel rail pump. The signal that is generated by the speed/timing sensor is transmitted to the ECM. The ECM calculates the speed and the rotational position of the engine by using the signal. The secondary speed/timing sensor is required for starting purposes.

During normal operation, the secondary speed/timing sensor is used to determine the cycle that the engine is on. When the timing has been established, the primary speed/timing sensor is then used to determine the engine speed and the angular position.

The loss of signal to the primary sensor and/or the secondary sensor will result in one of the following faults:

- The loss of signal from the secondary speed/timing sensor during start-up will prevent the engine from starting.
- The engine will continue to run when only one sensor signal is present from either the primary sensor or the secondary sensor.
- The loss of signal from the primary speed/timing sensor during operation of the engine will result in engine operation with a derate.
- Loss of signal from the primary sensor and the secondary sensor during operation of the engine will cause fuel injection to be terminated and the engine will stop.

The primary sensor and the secondary sensor are interchangeable components. If a sensor is suspect the sensors can be exchanged in order to eliminate a fault. If a secondary sensor is suspect and a replacement secondary sensor is not available, then the primary sensor and the secondary sensor can be exchanged. This will allow testing to determine if the secondary sensor is faulty.

Table 58

P2/J2 Pin Connections			
Function	**Sensor Pin**	**Crankshaft Primary Sensor**	**Camshaft Secondary Sensor**
+8 Volt Supply	1	10	10
Signal	2	52	53

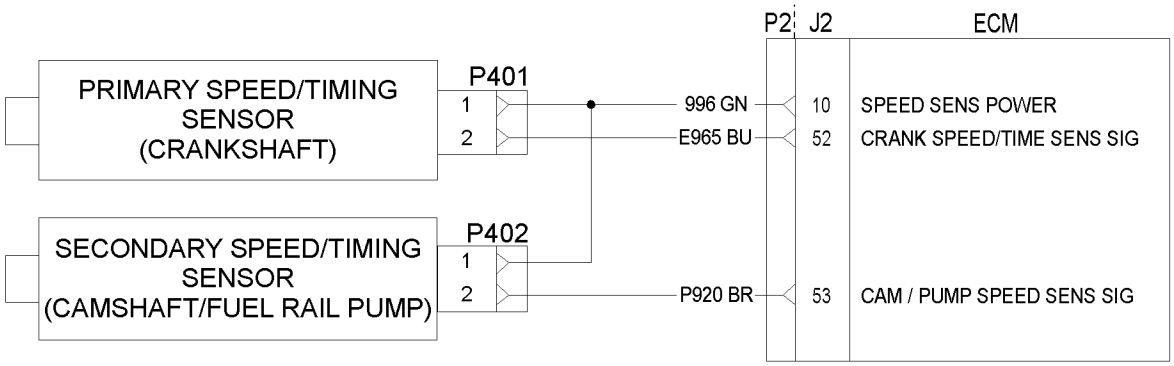


Illustration 58 g01245085

The schematic for the speed/timing sensors

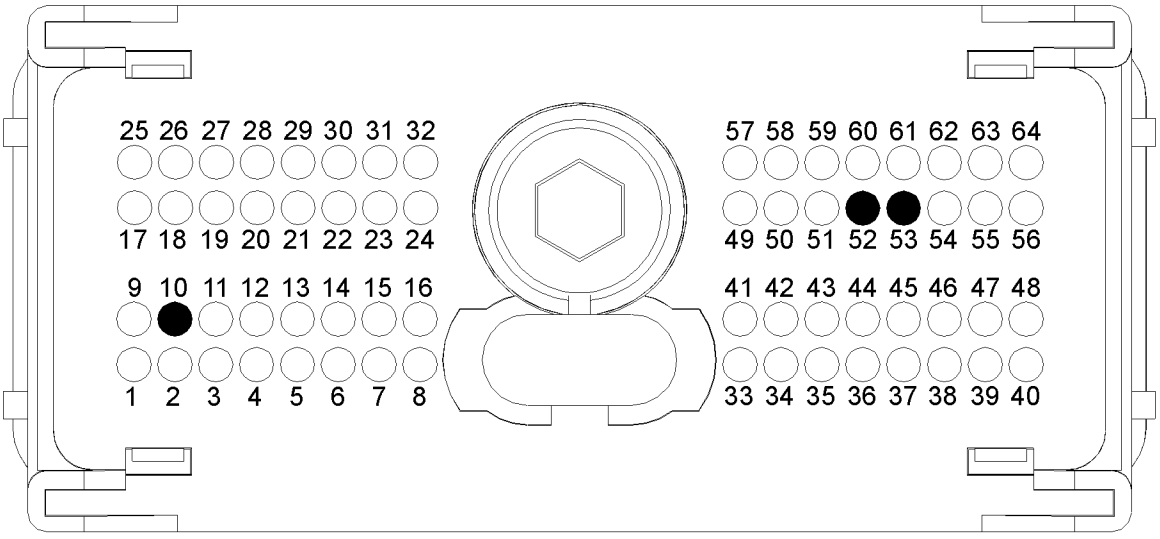


Illustration 59 g01188474

Typical view of the speed/timing sensor pin locations

(10) Speed/ Timing sensor supply (8v) (52) Crankshaft speed timing sensor signal (53) Pump/Cam speed sensor signal (Sig)

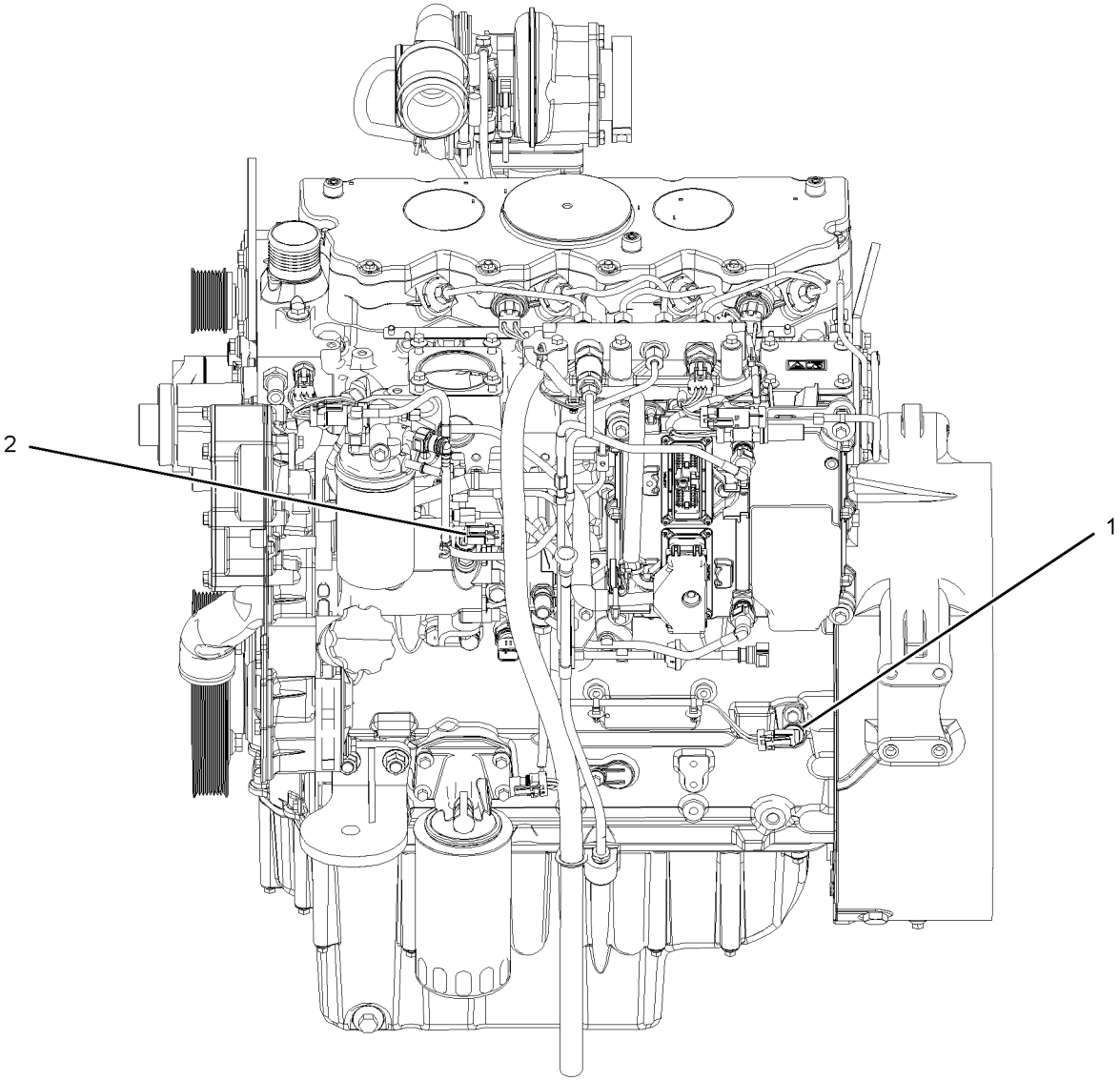


Illustration 60 g01245086

Typical view of the locations for the speed/timing sensor on the 1104D engine

(1) Primary speed/timing sensor (2) Secondary speed/timing sensor

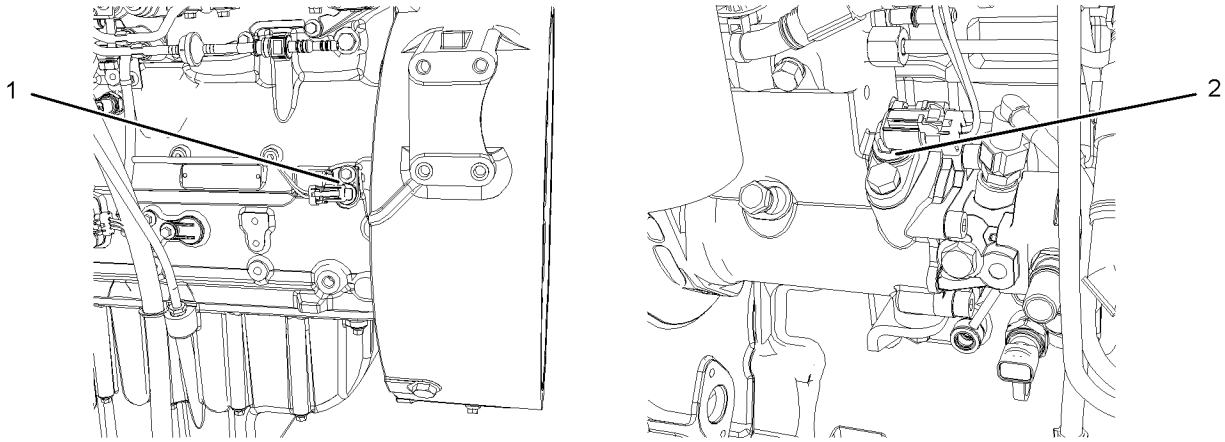


Illustration 61 g01249838

Detailed view of the sensor locations on the 1104D engine

(1) Primary crankshaft speed/timing sensor (2) Secondary speed/timing sensor

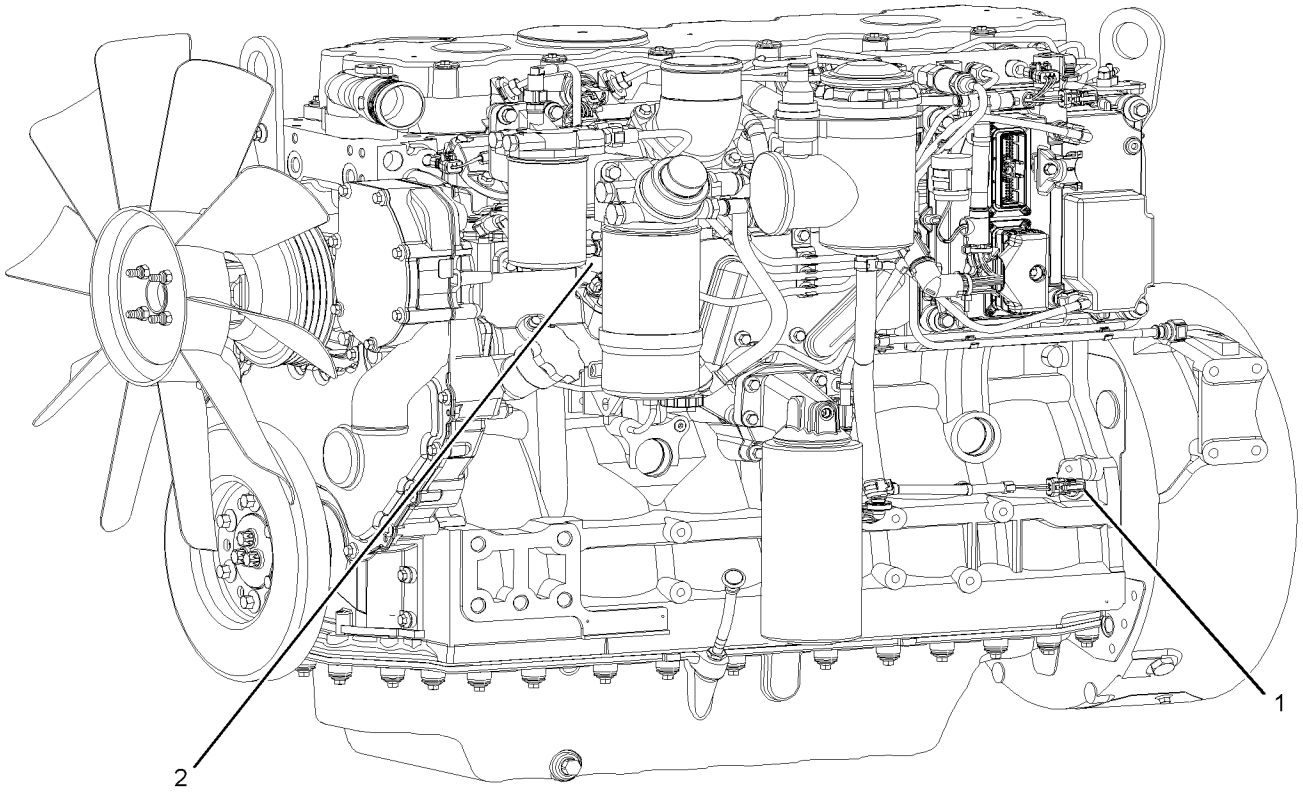


Illustration 62 g01188476

Typical view of the sensor locations on the 1106D engine

(1) Primary crankshaft speed/timing sensor (2) Secondary speed/timing sensor

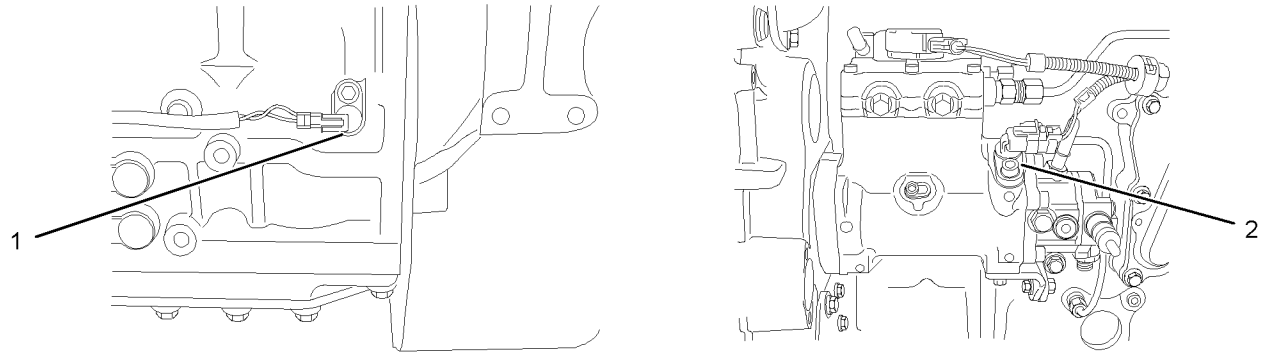


Illustration 63 g01249863

Detailed view of the sensor locations on the 1106D engine

(1) Primary speed/timing sensor (crankshaft)
(2) Secondary speed/timing sensor (camshaft)

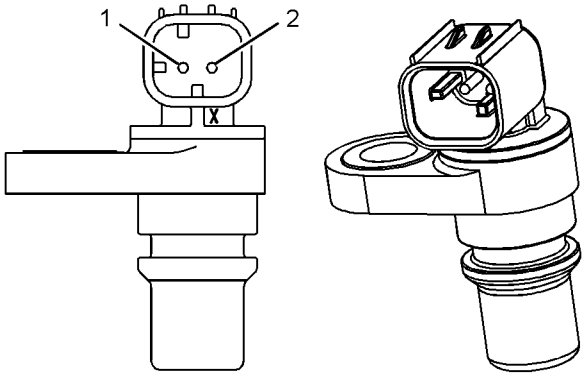


Illustration 64 g01212995

Typical example of the speed, crank and the fuel/camshaft speed sensors

(1) Voltage Supply (8V) (2) Signal (Sig)

Test Step 1. Inspect the Electrical Connectors and the Harness

A. Turn the keyswitch to the OFF position.

B. Thoroughly inspect the P2 connector and the suspect sensor connections. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

C. Perform a 45 N (10 lb) pull test on each of the wires in the suspect sensor connector and the sensor connections at the ECM. The wire connectors are shown in illustration 59.

D. Check that the ground connection on the ECM and the negative terminal on the battery are correctly installed.

E. Check the ground connection on the ECM for abrasions and pinch points.

F. Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in).

G. Check the harness for abrasion and pinch points from the suspect sensor to the ECM.

H. Check that the suspect sensor is installed correctly. Check that the suspect sensor is fully seated into the engine. Check that the sensor is securely latched.

Expected Result:

The electrical connectors and the cables are correctly installed.

Results:

- OK – The harness is OK. Proceed to Test Step 2.
- Not OK

Repair: Repair the faulty connectors or the harness and/or replace the faulty connectors or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are correctly coupled.

If a sensor must be replaced or the sensor must be reinstalled, complete all of the following tasks:

- Lubricate the O ring with clean engine lubricating oil.
- Ensure that the plug for the sensor has a seal inside the connector body. If a seal is damaged or missing, replace the seal.
- Ensure that the sensor is fully seated into the engine before tightening the bracket bolt.
- Ensure that the connector is latched.
- Ensure that the harness is correctly secured, and ensure that the harness is attached to the harness clip.

Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

STOP.

Test Step 2. Check for Active Diagnostic Codes and Recently Logged Diagnostic Codes

A. Turn the keyswitch to the OFF position.

B. Connect the Perkins Electronic Service Tool (EST) to the diagnostic connector.

C. Turn the keyswitch to the ON position. If the engine will start, then run the engine.

D. Use the Perkins EST in order to monitor active diagnostic codes or recently logged diagnostic codes.

Expected Result:

One or more of the following diagnostic codes are active or recently logged:

- 190-8 Engine Speed Sensor abnormal frequency, pulse width, or period
- 342-8 Secondary Engine Speed Sensor abnormal frequency, pulse width, or period

Results:

- 190-8 – Proceed to Test Step 4.
- 342-8 – Proceed to Test Step 3.
- Not OK – No active diagnostic codes or recently logged diagnostic codes are displayed. STOP.

Test Step 3. Check the Harness Between the Secondary Speed/Timing Sensor and the ECM

A. Turn the keyswitch to the OFF position.

B. Disconnect the P2 connector. Disconnect the connector for the primary speed/timing sensor. Disconnect the connector for the secondary speed/timing sensor.

C. Check the resistance between P2:53 to the secondary speed/timing sensor terminal 2. The resistance should be less than 2.0 Ohms.

D. Check the resistance between P2:10 to the secondary speed/timing sensor terminal 1. The resistance should be less than 2.0 Ohms.

Expected Result:

The readings agree with the values that are listed above.

Results:

- OK – The harness is not OPEN circuit. Proceed to Test Step 5.
- Not OK – The harness or the connector is an open circuit or high resistance.

  Repair: Repair the faulty connectors or the harness. Replace the faulty connectors or the harness. Reconnect all sensor and ECM connectors. Ensure that all of the seals are correctly in place. Ensure that all connectors are correctly coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

  STOP.

Test Step 4. Check the Harness Between the Primary Speed/Timing Sensor and the ECM.

A. Turn the keyswitch to the OFF position.

B. Disconnect the P2 connector. Disconnect the connector for the primary speed/timing sensor. Disconnect the connector for the secondary speed/timing sensor.

C. Check the resistance between P2:52 to the secondary speed/timing sensor terminal 2. The resistance should be less than 2.0 Ohms.

D. Check the resistance between P2:10 to the secondary speed/timing sensor terminal 1. The resistance should be less than 2.0 Ohms.

Expected Result:

The readings agree with the values that are listed above.

Results:

- OK – The harness is not OPEN circuit. Proceed to Test Step 6.
- Not OK – The harness is OPEN circuit.

  Repair: Repair the faulty connectors or the harness and/or replace the faulty connectors or the harness. Reconnect all sensor and ECM connectors. Ensure that all of the seals are correctly in place. Ensure that all connectors are correctly coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 5. Check that the Connections and the Wiring to the Secondary Speed/Timing Sensor and the ECM are Isolated from Other Power Sources

A. Turn the keyswitch to the OFF position.

B. Disconnect the P2 connector. Disconnect the connector for the primary speed/timing sensor. Disconnect the connector for the secondary speed/timing sensor.

C. Measure the resistance from P2:53 secondary speed/timing sensor signal input to all other pins on the P2. Measure the resistance from P2:53 secondary speed/timing sensor signal input to the ground and battery+ terminals. The resistance should be more than 20,000 Ohms.

D. Measure the resistance from P2:10 speed/timing sensor (+8 V supply) to all other pins on the P2. Measure the resistance from P2:10 speed/timing sensor (+8 V supply) to the ground and the battery+ terminals. The resistance should be more than 20,000 Ohms.

Expected Result:

The readings agree with the values that are listed above.

Results:

- OK – There is no short circuit. Proceed to Test Step 7.
- Not OK – The harness has a short circuit.

  Repair: Repair the faulty connectors or replace the faulty connectors. Repair the faulty harness or replace the faulty harness. Reconnect all sensor and ECM connectors. Ensure that all of the seals are correctly in place. Ensure that all connectors are correctly coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 6. Check that the Connections and the Wiring to the Primary Speed/Timing Sensor and the ECM are Isolated from the Other Power Sources

A. Turn the keyswitch to the OFF position.

B. Disconnect the P2 connector. Disconnect the connector for the primary speed/timing sensor. Disconnect the connector for the secondary speed/timing sensor.

C. Check the resistance between P2:52 to each of the other pins on P2. Check the resistance between P2:52 to the ground and battery+ terminals. The resistance should be more than 20,000 Ohms.

D. Check the resistance between P2:10 to each of the other pins on P2. Check the resistance between P2:10 to the ground and battery+ terminals. The resistance should be more than 20,000 Ohms.

Expected Result:

The readings agree with the values that are listed above.

Results:

- OK – The wires are not a short circuit. Proceed to Test Step 7.
- Not OK – The sensor wiring has a short circuit.

Repair: Repair the faulty connectors or replace the faulty connectors. Repair the faulty harness or replace the faulty harness. Reconnect all sensor and ECM connectors. Ensure that all of the seals are correctly in place. Ensure that all connectors are correctly coupled.

Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

STOP.

Test Step 7. Check if a Replacement Sensor Eliminates the Fault

A. Turn the keyswitch to the OFF position.

B. Disconnect the suspect sensor and remove the suspect sensor from the engine.

C. If a sensor must be replaced or a sensor must be reinstalled, complete all of the following tasks:

- Lubricate the O ring with clean engine lubricating oil.
- Ensure that the plug for the sensor has a seal inside the connector body. If a seal is damaged or missing, replace the seal.
- Ensure that the sensor is fully seated into the engine before tightening the bracket bolt.
- Ensure that the connector is latched.
- Ensure that the harness is correctly secured, and ensure that the harness is attached to the harness clip.

D. Turn the keyswitch to the ON position.

E. Start the engine.

F. Use the Perkins EST in order to monitor the diagnostic codes.

G. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the replacement sensor has eliminated the fault.

Expected Result:

The fault has been rectified.

Results:

- OK – If the fault is eliminated with the test sensor, reconnect the suspect sensor. If the fault returns with the suspect sensor, replace the suspect sensor.

  Repair: Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

- Not OK – The fault still exists. Proceed to Test Step 8.

Test Step 8. Check if the Replacement of the ECM Eliminates the Fault

A. Temporarily connect a test ECM. The test ECM must be programmed with the correct software. All parameters should be set to the same value of the suspect ECM.

B. Reconnect all connectors.

C. Connect the Perkins EST to the diagnostic connector.

D. Turn the keyswitch to the ON position.

E. Start the engine.

F. Use the Perkins EST in order to monitor the diagnostic codes.

G. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the replacement sensor has eliminated the fault.

Expected Result:

The fault is eliminated.

Results:

- OK – If the fault is eliminated with the test ECM, reconnect the suspect ECM. If the fault returns with the suspect ECM, replace the suspect ECM.

  Repair: Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

- Not OK – The fault was not resolved with a test ECM.

  Repair: Repeat this diagnostic process. If the fault persists, the fault may be a damaged timing ring. Check the timing ring and/or replace the timing ring.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

i02494232

Engine Temperature Sensor Open or Short Circuit - Test

System Operation Description:

Use this procedure under the following conditions:

This procedure covers open circuit diagnostic codes and short circuit diagnostic codes that are associated with the following sensors:

- Coolant temperature sensor
- Intake manifold air temperature sensor

Use this procedure to troubleshoot the system when one of the following diagnostic codes is an active diagnostic code or a recently logged diagnostic code or when a diagnostic code can easily be activated.

- 0110-03 Engine Coolant Temperature Sensor voltage above normal
- 0110-04 Engine Coolant Temperature Sensor voltage below normal
- 0172-03 Intake Manifold Air Temperature Sensor voltage above normal
- 0172-04 Intake Manifold Air Temperature Sensor voltage below normal

The following background information is related to this procedure:

The troubleshooting procedures for the diagnostic codes of each temperature sensor are identical. The temperature sensors are sensors that have two terminals. The connector P2:37 Electronic Control Module (ECM) is the common connection for the engine temperature sensors. The sensor common connection is shared between the temperature sensors. The common line is connected to each sensor connector terminal 2. Terminal 1 is the sensor output. The signal voltage from terminal 1 of each sensor is supplied to the appropriate terminal at ECM Connector P2/J2.

Pull-up Voltage

The ECM continuously outputs a pull-up voltage on the circuit for the sensor signal wire. The ECM uses this pull-up voltage in order to detect an open in the signal circuit. When the ECM detects the presence of a voltage that is above a threshold on the signal circuit, the ECM will generate an open circuit diagnostic code (3) for the sensor.

If the sensor is disconnected at the sensor connector, the presence of pull-up voltage at the sensor connector indicates that the wires from the sensor connector to the ECM are not open or shorted to ground. If the sensor is disconnected at the sensor connector, the absence of pull-up voltage at the sensor connector indicates an open in the signal wire or a short to ground. If the sensor is disconnected at the sensor connector and the voltage at the sensor connector is different from pull-up voltage, the signal wire is shorted to another wire in the harness.

The troubleshooting procedures for the diagnostic codes of each temperature sensor are identical. The temperature sensors are passive sensors. The temperature sensor has two terminals. The common line is connected to each sensor connector terminal 2. The signal voltage from terminal 1 of each sensor is supplied to the appropriate terminal at the P2/J2 ECM connector.

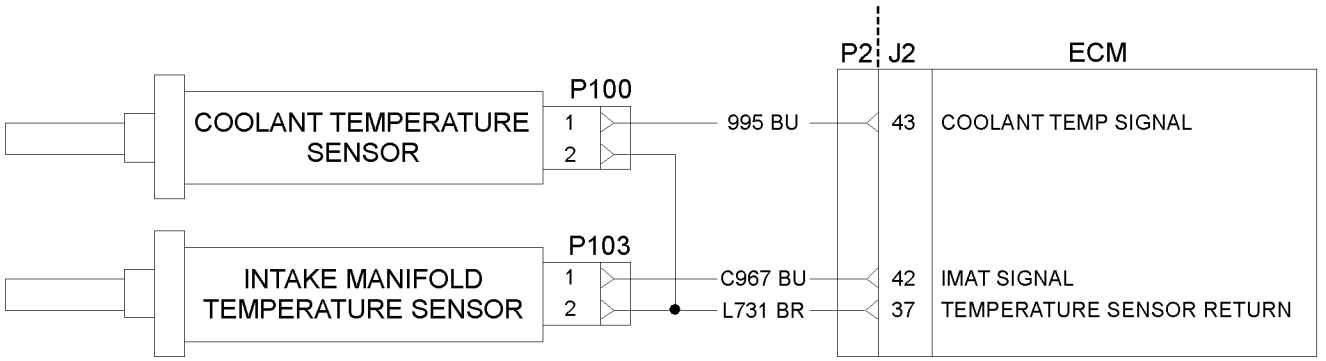


Illustration 65 g01249915

Schematic for engine temperature sensors

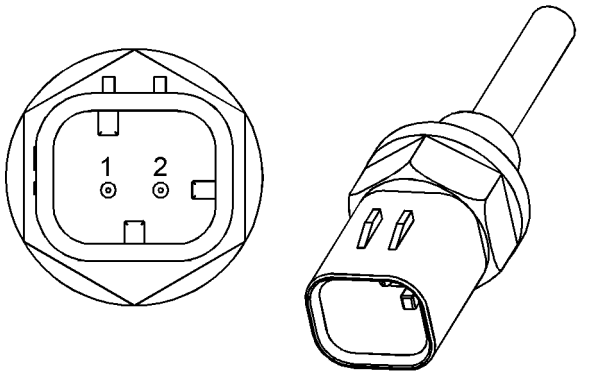


Illustration 66 g01170313

Engine coolant temperature sensor and intake manifold air temperature sensor

(1) Signal (SIG)
(2) Ground (GND)

Test Step 1. Verify All Active Diagnostic Codes.

A. Connect the Perkins Electronic Service Tool (EST) to the data link connector.

B. Turn the keyswitch to the ON position.

Note: Wait at least 30 seconds for activation of the diagnostic codes.

C. Use the Perkins EST in order to verify if any of the following diagnostic codes are active or recently logged:

- 0110-03 Engine Coolant Temperature Sensor voltage above normal
- 0110-04 Engine Coolant Temperature Sensor voltage below normal
- 0172-03 Intake Manifold Air Temperature Sensor voltage above normal
- 0172-04 Intake Manifold Air Temperature Sensor voltage below normal

Expected Result:

One or more of the preceding diagnostic codes are active or recently logged.

Results:

- Yes – Proceed to Test Step 2.
- No – The fault is intermittent. Proceed to Test Step 8.

Test Step 2. Inspect Electrical Connectors And Wiring.

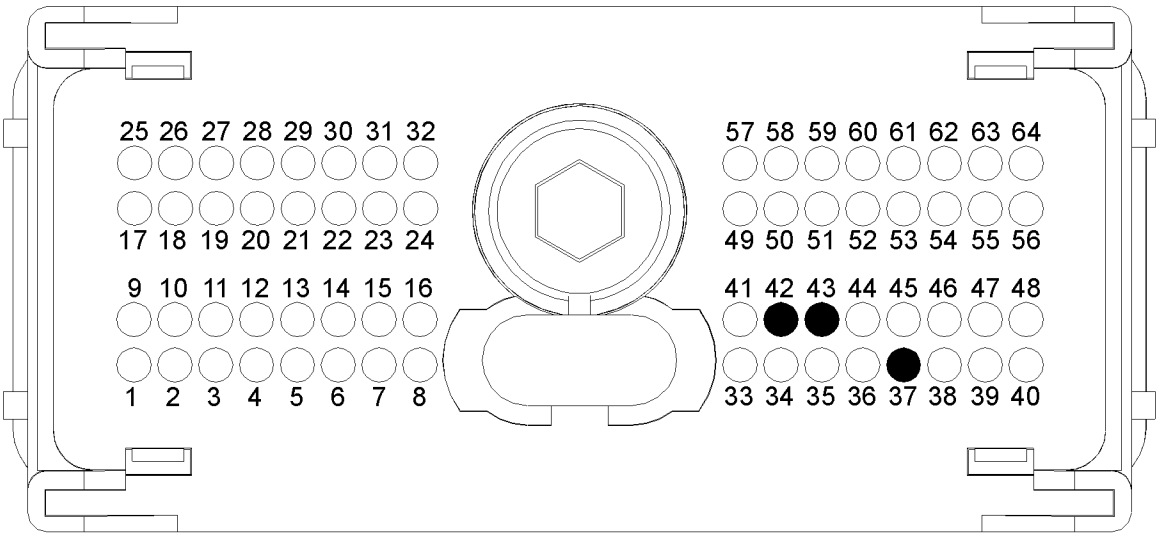


Illustration 67 g01170936

Typical view of the P2 pin locations on the temperature sensor

(37) Ground (GND) Intake Manifold Air Temperature Sensor
(37) Ground (GND) Coolant Temperature Sensor
(42) Signal (SIG) Intake Manifold Air Temperature Sensor
(43) Signal (SIG) Coolant Temperature Sensor

A. Thoroughly inspect ECM engine harness connector P2 and the suspect sensor connector. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

B. Perform a 45 N (10 lb) pull test on each of the wires in the sensor connector and the ECM connector that are associated with the active diagnostic code.

Refer to illustration 67.

C. Verify that the latch tab of the connector is correctly latched. Also verify that the latch tab of the connector has returned to the fully latching position.

D. Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in).

E. Check the harness for abrasions and for pinch points from the sensor to the ECM.

Expected Result:

All connectors, pins, and sockets should be completely coupled and/or inserted. The harness should be free of corrosion, abrasion, and pinch points.

Results:

- OK – Proceed to Test Step 3.
- Not OK – Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled. Clear all inactive diagnostic codes. Verify that the repair has eliminated the fault. Proceed to Test Step 3 if the fault has not been eliminated.

Test Step 3. Verify That The Diagnostic Code Is Still Active.

A. Turn the keyswitch to the ON position.

Note: Wait at least 10 seconds for activation of the diagnostic codes.

B. Access the “Active Diagnostic Code” screen on the Perkins EST and check for active diagnostic codes.

C. Determine if the fault is related to an Voltage Above Normal diagnostic code or a Voltage Below Normal diagnostic code.

Expected Result:

A Voltage Below Normal diagnostic code or an Voltage Above Normal diagnostic code is active.

Results:

- OK - SHORT Circuit – A Voltage Below Normal diagnostic code is active at this time. Proceed to Test Step 4.
- OK - OPEN Circuit – An Voltage Above Normal diagnostic code is active at this time. Proceed to Test Step 5.
- Not OK – A Voltage Below Normal diagnostic code is not active. An Voltage Above Normal diagnostic code is not active. An intermittent fault may exist.

  Repair: By using the Perkins EST, perform a "Wiggle Test". If faults are indicated then go to the appropriate procedure.

  STOP.

Test Step 4. Disconnect The Sensor In Order To Create An Open Circuit.

A. Turn the keyswitch to the OFF position.

B. Disconnect the sensor connector of the sensor with the short circuit diagnostic code.

C. Turn the keyswitch to the ON position.

Note: Wait at least 10 seconds for activation of the diagnostic codes.

D. Access the "Active Diagnostic Code" screen of the Perkins EST. Check for an active Voltage Above Normal diagnostic code.

Expected Result:

An Voltage Above Normal diagnostic code for the disconnected sensor is now active.

Results:

- OK – A Voltage Below Normal diagnostic code was active before disconnecting the sensor. An Voltage Above Normal diagnostic code became active after disconnecting the sensor.

  Repair: Refer to Troubleshooting, "Electrical Connectors - Inspect".

  Inspect the seals of the connectors for damage.

  Connect the sensor and verify that the fault returns. If the fault returns, the sensor is faulty.

  Replace the sensor.

  Clear all logged diagnostic fault codes.

  STOP.

- Not OK – There is a short circuit between the sensor harness connector and the ECM. Leave the sensor disconnected. Proceed to Test Step 6.

Test Step 5. Create A Short Circuit Between The Signal And The Common Terminals At The Sensor Harness Connector.

A. Disconnect the suspect sensor connector P100 for the coolant temperature sensor or disconnect P103 for the inlet manifold temperature sensor.

B. Turn the keyswitch to the ON position.

Note: Wait at least 10 seconds for the activation of any diagnostic fault codes.

C. Fabricate a jumper wire 150 mm (6 inch) long. Crimp a terminal to both ends of the wire.

D. Monitor the "Active Diagnostic Code" screen on the Perkins EST before installing the jumper wire and after installing the jumper wire.

E. Install the jumper on the engine harness connector for the suspect sensor, P100 for the coolant temperature sensor and P103 for the intake manifold temperature sensor. Install one end of the jumper at the sensor signal (terminal 1). Install the other end of the jumper at the common connection (terminal 2).

Note: Wait at least 30 seconds for activation of the short circuit diagnostic code.

Expected Result:

A Voltage Below Normal diagnostic code is active when the jumper is installed. An Voltage Above Normal diagnostic code is active when the jumper is removed.

Results:

- OK – The engine harness and the ECM are OK.

  Repair: Perform the following repair:

  1. Temporarily connect the suspect sensor.
  2. If the diagnostic code remains active, replace the sensor.
  3. Verify that the repair eliminates the fault.
  4. Clear all logged diagnostic codes.

  STOP.

- Not OK – The Voltage Above Normal diagnostic code remains active with the jumper in place. The most probable location for the open circuit is in the sensor common or the sensor signal wire in the engine harness between the ECM and the sensor. Remove the jumper. Proceed to Test Step 6.

Test Step 6. Check The Operation Of The ECM By Creating An Open And A Short Circuit At The ECM Connector.

A. Turn the keyswitch to the OFF position.

B. Disconnect the P2 connector.

C. Thoroughly inspect both halves of the connector for signs of corrosion or moisture. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

D. Turn the keyswitch to the ON position. Use the Perkins EST in order to monitor the “Active Diagnostic Code” screen. Wait at least 10 seconds for activation of the code.

An Voltage Above Normal diagnostic code should be active for the suspect sensor.

Note: When P2 is disconnected, all of the Voltage Above Normal diagnostic codes for the pressure sensors and temperature sensors will be active. This is normal. Disregard the diagnostic codes for the pressure sensors and the temperature sensors that are not suspect. Direct your attention to the diagnostic codes for the suspect sensors only.

E. Turn the keyswitch to the OFF position.

F. Fabricate a jumper wire 150 mm (6 inch) long. Crimp a terminal to both ends of the wire.

G. Monitor the “Active Diagnostic Code” screen on the Perkins EST before installing the jumper wire and after installing the jumper wire.

H. Remove the suspect sensor signal pin from the P2 connector, either pin P2:42 for the intake manifold temperature sensor or P2:43 for the coolant temperature sensor. Remove P2:37 sensor common connector. Install the jumper on the P2 connector. Install one end of the jumper at the suspect sensor signal pin. Install the other end of the jumper to P2:37 common connection for the sensors. Reassemble the P2 connector to the ECM. Use the Perkins EST in order to check the diagnostic codes. Wait at least 10 seconds for activation of the Voltage Below Normal diagnostic code.

Note: The Voltage Above Normal diagnostic code for the temperature sensor that is not suspect should become active when the sensor common connection is removed from the P2 connector. This code can be disregarded.

Expected Result:

A Voltage Below Normal diagnostic code is active when the jumper is installed. An Voltage Above Normal diagnostic code is active when the jumper is removed.

Results:

- OK – Proceed to test step 7.
- Not OK

  Repair: The ECM does not operate correctly.

  1. Temporarily connect a test ECM.

Note: The test ECM should be programmed with the correct software. All parameters should be set to the same value of the suspect ECM.

  2. Remove all jumpers and reconnect all connectors.

  3. If the fault is eliminated with the test ECM, reconnect the suspect ECM and verify that the fault returns.

  4. If the fault returns replace the suspect ECM. Refer to Troubleshooting, “Replacing the ECM”.

  5. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 7. Bypass The Harness Wiring Between The ECM And The Sensor Connector.

A. Turn the keyswitch to the OFF position.

B. Disconnect the P2 connector on the ECM harness, and the suspect sensor connector.

C. Remove the sensor signal wire from the P2 connector.

D. Remove the signal wire (terminal 1) from the sensor connector on the engine harness.

E. Fabricate a jumper wire that is long enough to reach from the ECM to the sensor connector with sockets on both ends.

F. Insert one end of the jumper into the ECM connector. Insert the other end of the jumper into the sensor connector of the engine harness.

G. Reconnect the connector for the ECM harness and the sensor connector.

H. Turn the keyswitch to the ON position.

I. Use the Perkins EST in order to monitor the "Active Diagnostic Code" screen for either the Voltage Above Normal diagnostic code for the sensor or the Voltage Below Normal diagnostic code for the sensor.

Expected Result:

The diagnostic code disappears when the jumper is installed.

Results:

- OK – There is a fault in the wiring harness.

  Repair: Perform the following repair:

  1. Repair the faulty harness or replace the faulty harness.
  2. Clear all diagnostic codes.
  3. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

- Not OK – The fault is intermittent. Proceed to Test Step 8.

Test Step 8. Perform the "Wiggle Test" on the Perkins Electronic Service Tool (EST)

A. Select the "Wiggle Test" from the diagnostic tests on the Perkins Electronic Service Tool (EST).

B. Choose the appropriate group of parameters to monitor.

C. Press the "Start" button. Wiggle the wiring harness in order to reproduce intermittent faults.

If an intermittent fault exists, the status will be highlighted and an audible beep will be heard.

Expected Result:

No intermittent faults were indicated during the "Wiggle Test".

Results:

- OK – No intermittent faults were found. The harness and connectors appear to be OK. If this test was required as part of another procedure, return to that procedure and continue testing. If this test has resolved the fault, return the engine to service. STOP.

- Not OK – At least one intermittent fault was indicated.

  Repair: Repair the harness or the connector.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

i02491415

Fuel Rail Pump Solenoid - Test

System Operation Description:

Use this procedure to troubleshoot the system when one of the following diagnostic codes is active or easily repeated:

- 1779-05 Fuel Rail #1 Pressure Valve Solenoid current below normal
- 1779-06 Fuel Rail #1 Pressure Valve Solenoid current above normal

Note: The fuel rail pump is installed on the engine at the factory. The fuel rail pump is not serviceable part. The fuel rail pump delivers fuel into the fuel rail at very high pressure.

Use this procedure to troubleshoot the system when there is a active diagnostic code or if a diagnostic code can easily be activated or when another procedure has directed you here.

The fuel rail pump solenoid is used to control the output from the fuel rail pump. The solenoid receives an electrical supply from the Electronic Control Module (ECM). The fuel rail pump solenoid is then energized when the fuel is required to be pumped into the fuel rail. Varying the timing of the voltage to the solenoid controls the fuel delivery from the fuel rail pump.

When the fuel rail pump solenoid is deactivated, the fuel that is not sent to the fuel rail is returned to the fuel tank.

The fuel rail pump solenoid forms part of the closed loop control system for the fuel rail pressure in conjunction with the fuel rail pressure sensor, ECM and the software. The fuel rail pressure sensor measures the fuel pressure in the high pressure fuel rail. The fuel rail pressure sensor signal is processed by the ECM and software. The measured pressure is compared to the desired fuel rail pressure for the given engine operating conditions.

If the fuel rail pump solenoid fails, it is likely that the fuel will not be pumped into the high pressure fuel rail and engine shutdown or failure to start the engine is expected. No fuel rail pressure can be observed on the status screen of the Perkins Electronic Service Tool (EST).

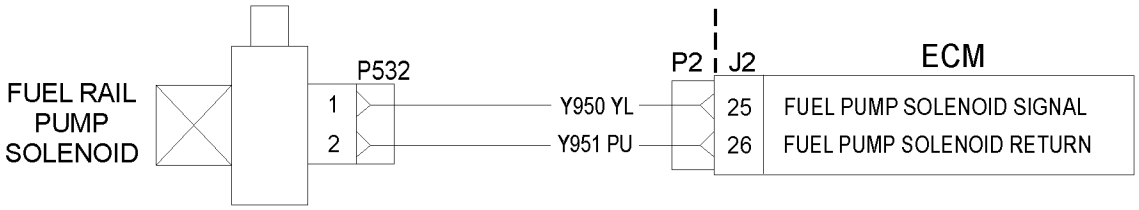


Illustration 68 g01245090

Typical schematic of the circuit for the fuel rail pump solenoid

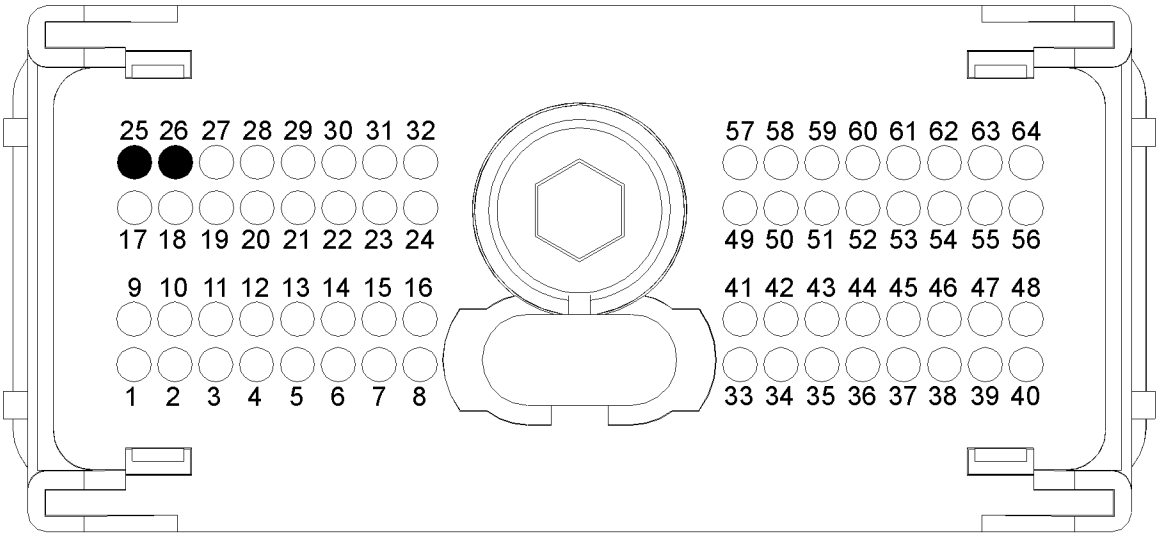


Illustration 69 g01194219

Typical view of the P2 ECM pin locations for the electrical power supply circuit

(25) Fuel rail pump solenoid PWM signal (26) Fuel rail pump solenoid return

Test Step 1. Inspect the Electrical Connectors and the Harness

⚠ WARNING

Electrical shock hazard. The fuel rail pump solenoid uses 63 to 73 volts.

A. Turn the keyswitch to the OFF position.

B. Thoroughly inspect the harness connector P2/J2 and the suspect connector P532. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

C. Perform a 45 N (10 lb) pull test on each of the wires in the solenoid connector P532 and the connector pins 25 and 26 that are associated with the fuel rail pump solenoid. Refer to illustration 69.

D. Check the harness for abrasions and for pinch points from the battery to the ECM. Check the harness for abrasions and for pinch points from the key switch to the ECM.

E. Perform a “Wiggle Test” by using the Perkins EST in order to identify intermittent connections.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted. The harness is free of corrosion, of abrasion, and of pinch points.

Results:

- OK – The connectors and the harness appear to be OK. Proceed to Test Step 2.
- Not OK – There is a fault with the connectors and/or the harness.

  Repair: Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

  STOP.

Test Step 2. Check for Active Diagnostic Codes

A. Connect the Perkins EST to the diagnostic connector.

B. Turn the keyswitch to the ON position.

C. Use the Perkins EST to verify if any of the following diagnostic codes are active or recently logged:

- 1779-05 Fuel Rail #1 Pressure Valve Solenoid current below normal
- 1779-06 Fuel Rail #1 Pressure Valve Solenoid current above normal

Expected Result:

One or more of the following diagnostic codes are active or recently logged:

- 1779-05 Fuel Rail #1 Pressure Valve Solenoid current below normal
- 1779-06 Fuel Rail #1 Pressure Valve Solenoid current above normal

Results:

- 1779-05 – Proceed to Test Step 3.
- 1779-06 – Proceed to Test Step 7.
- Not OK – No active diagnostic codes or recently logged diagnostic codes are displayed. STOP.

Test Step 3. Check the Harness for an Open Circuit

A. Turn the keyswitch to the OFF position.

B. Disconnect P2 from the ECM.

C. Measure the resistance between P2:25 and P2:26.

Expected Result:

The nominal resistance is less than 2 Ohms.

Results:

- OK – The harness and the solenoid do not have an open circuit.

  Repair: Check the high pressure fuel system for leaks. A mechanical relief valve is installed in the high pressure fuel rail. Check that there is no flow of fuel from the mechanical relief valve. Refer to Operation and Maintenance Manual, “High Pressure Fuel Lines”.

  If the fuel system is Not OK, repair the fuel system and restart the diagnostic process.

  If the fuel system is OK, proceed to Test Step 4.

- Not OK – There is an open circuit. Proceed to Test Step 4.

Test Step 4. Check the Fuel Rail Pump Solenoid for an Open Circuit

A. Turn the keyswitch to the OFF position.

B. Disconnect the fuel rail pump solenoid connector from the fuel rail pump solenoid.

C. Measure the resistance of the fuel rail pump solenoid.

Expected Result:

The nominal resistance is less than 1 Ohm.

Results:

- OK – There is an open circuit or there is an excessive resistance in the harness.

  Repair: Repair the connectors or the harness and/or replace the connectors or the harness.

  Ensure that all of the seals are correctly in place and ensure that all connectors are correctly coupled.

  Use the Perkins EST in order to perform the fuel rail pump solenoid test.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminated the fault.

  STOP.

- Not OK – The fuel rail pump solenoid is faulty.

  Repair: Temporarily connect a new fuel rail pump to the harness, but do not install the fuel rail pump to the engine.

  Reconnect the P2 to the ECM. Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in).

  Use the Perkins EST in order to perform the fuel rail pump solenoid test.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminated the fault.

  If the diagnostic code has been cleared, then install the new fuel rail pump to the engine. Refer to Disassembly and Assembly Manual, “Fuel Injection Pump- Install”.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 5. Check the Fuel Rail Pump Solenoid for a Short Circuit

A. Turn the keyswitch to the OFF position.

B. Disconnect the fuel rail pump solenoid connector.

C. Turn the keyswitch to the ON position.

D. Use the Perkins EST in order to perform the fuel rail pump solenoid test.

Expected Result:

A Current Below Normal diagnostic code is displayed. The Current Above Normal diagnostic code is not displayed.

Results:

- OK – A Current Below Normal diagnostic code is displayed. The harness has no shorts to supply or ground. The fuel rail pump solenoid is faulty.

  Repair: Temporarily connect a new fuel rail pump to the harness, but do not install the fuel rail pump to the engine.

  Reconnect P2 to the ECM. Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in).

  Use the Perkins EST in order to perform the fuel rail pump solenoid test.

  Verify that the repair eliminates the fault.

  If the diagnostic code has been cleared, then install the new fuel rail pressure pump to the engine. Refer to Disassembly and Assembly, “Electrical Connectors - Inspect”.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

- Not OK – The harness is a short circuit or the ECM is a short circuit. Proceed to Test Step 6.

Test Step 6. Check the Fuel Rail Pump Solenoid Harness for a Short Circuit

A. Turn the keyswitch to the OFF position.

B. Disconnect the P532 connector from the fuel rail pump solenoid.

C. Disconnect the P2 connector from the ECM.

D. Measure the resistance between P2:26 and P2:25.

E. Measure the resistance between P2:25 and voltage +.

F. Measure the resistance between P2:25 and the voltage (-).

G. Measure the resistance between P2:26 and voltage +.

H. Measure the resistance between P2:26 and voltage (-).

Expected Result:

The resistance is greater than 20,000 Ohms.

Results:

- OK – The harness has no short circuit to supply or ground. The ECM is suspect. Proceed to Test Step 7.
- Not OK – The harness has a short circuit.

  Repair: Repair the harness and connectors or replace the faulty harness and connectors.

  Connect the P532 connector to the fuel rail pump solenoid.

  Connect the P2 connector to the ECM.

  Turn the keyswitch to the ON position.

  Use the Perkins EST in order to perform the fuel rail pump solenoid test.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

  STOP.

Test Step 7. Check the ECM and the Harness

A. Turn the keyswitch to the OFF position.

B. Disconnect the P532 connector from the fuel rail pump solenoid.

C. Insert a jumper wire across P532.

D. Turn the keyswitch to the ON position.

E. Use the Perkins EST in order to perform the fuel rail pump solenoid test.

F. Use the Perkins EST in order to monitor the status screen.

Expected Result:

A 1779-06 diagnostic code is displayed.

Results:

- OK – The ECM and the ECM connections function. The solenoid is not an open circuit. Recheck the diagnostic codes. Proceed to Test Step 5.
- Not OK – The ECM is suspect. Proceed to Test Step 8.

Test Step 8. Check the ECM Function

A. Temporarily connect a test ECM. The test ECM should be programmed with the correct software. All parameters should be set to the same value of the suspect ECM.

B. Replace all connectors.

C. Connect the Perkins EST to the diagnostic connector.

D. Turn the keyswitch to the ON position.

E. Use the Perkins EST in order to monitor the status screen.

F. Use the Perkins EST in order to perform the fuel rail pump solenoid test.

G. Monitor the status screen on the Perkins EST.

Expected Result:

The fault is eliminated.

Results:

- OK – If the fault is eliminated with the test ECM, reconnect the suspect ECM. If the fault returns with the suspect ECM, replace the ECM. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault. STOP.

i02491416

Idle Validation Switch Circuit - Test

System Operation Description:

Use this procedure if any of the following diagnostic codes are active:

- 0091-02 Throttle Position Sensor erratic, intermittent, or incorrect
- 0774-02 Secondary Throttle Position Sensor erratic, intermittent, or incorrect

The idle validation switch (IVS) may be installed. The IVS is required for mobile applications that use an analog throttle. The IVS is part of the analog throttle demand sensor. The IVS is CLOSED when the low idle is set.

The analog throttle demand settings that are valid for the IVS threshold are programmed into the Electronic Control Module (ECM). Use the Perkins Electronic Service Tool (EST) in order to display the analog throttle demand settings.

If the IVS operates outside of the programmed range then the engine speed may not respond to changes in the throttle position for the suspect throttle.

The Perkins EST may be used for the following:

- If necessary, reset the IVS threshold for an existing IVS.
- If necessary, view the IVS change point and reset the IVS thresholds when a new throttle assembly is installed.

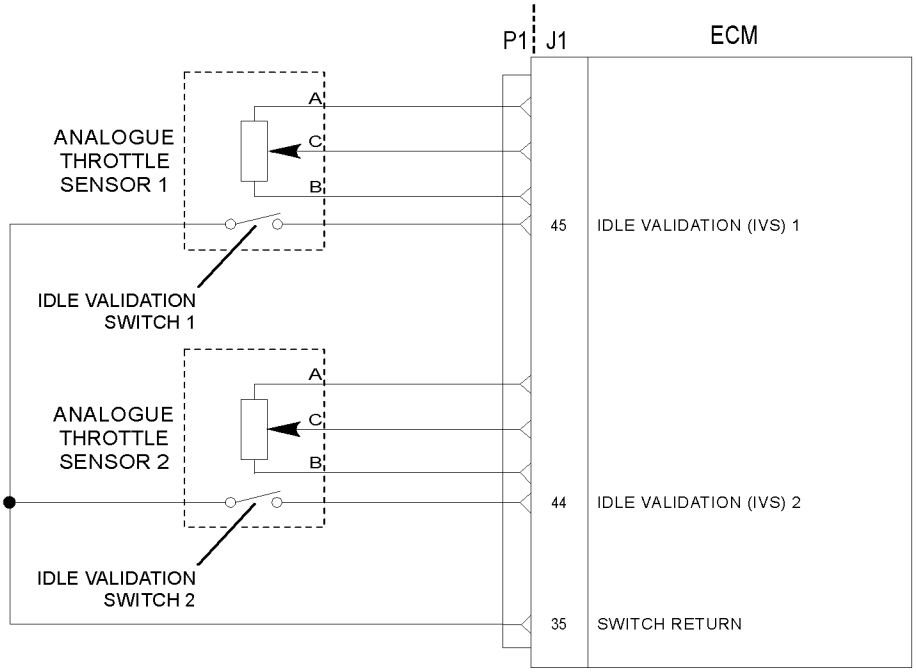


Illustration 70 g01245091

Schematic of the idle validation switch (IVS) circuit

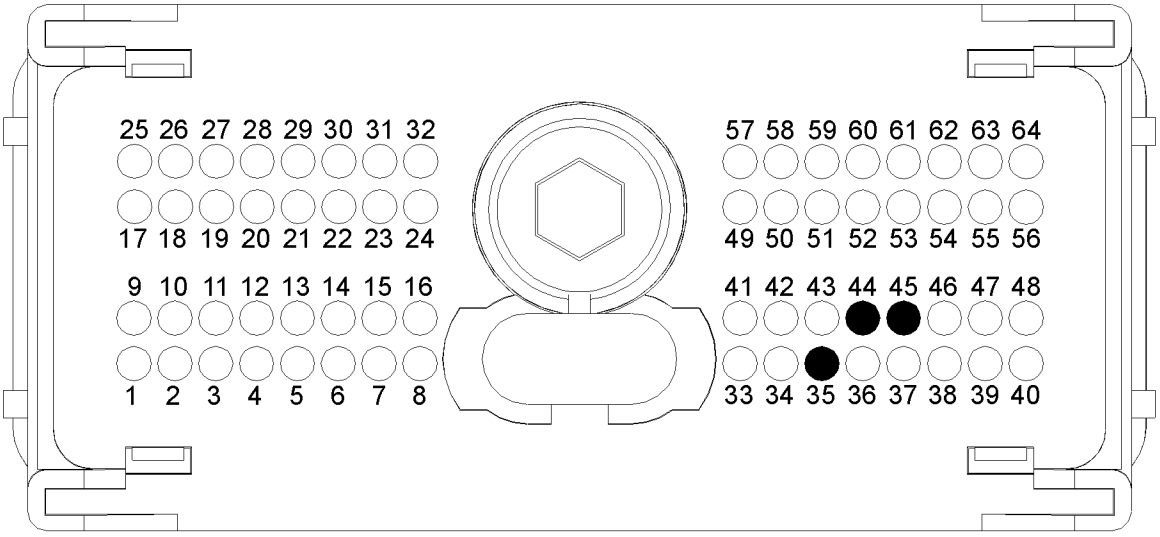


Illustration 71 g01207675

Typical view of the pin locations in the P1 connector

(35) Sensor Ground (GND) (44) Idle validation (IVS) 2 (45) Idle validation (IVS) 1

Test Step 1. Check the Operation of the Idle Validation Switch (IVS)

A. Connect the Perkins EST to the diagnostic connector.

B. Turn the keyswitch to the ON position.

C. Use the Perkins EST in order to check the current “Throttle Configuration”.

D. Select the “SERVICE” option from the drop-down menu of the Perkins EST.

E. Select the “Throttle Configuration” option on the Perkins EST. Select the appropriate analog “Throttle Configuration” summary from the menu on the left of the screen. The IVS window for the throttle will indicate “YES” if an IVS is installed. Make a note of the “Idle Validation Min OFF Threshold” parameters that are displayed in the “Throttle Configuration” menu of the Perkins EST. Make a note of the “Idle Validation Max ON Threshold” parameters that are displayed in the “Throttle Configuration” menu of the Perkins EST.

F. Select the “Throttle status” function on the Perkins EST. Select “Status” function and then select “Throttles” function.

G. The throttle is set in the low idle position.

H. Depress the throttle pedal slowly. The IVS status should change from CLOSED (ON) to OPEN (OFF).

Expected Result:

The IVS state changes from CLOSED (ON) to OPEN (OFF).

Results:

- OK – The IVS state changes from CLOSED (ON) to OPEN (OFF). Proceed to Test Step 2.
- Not OK – The IVS does not operate.

  Repair:

  Proceed to Test Step 3.

Test Step 2. Check the Idle Validation Switch (IVS) Threshold

A. Connect the Perkins EST to the diagnostic connector.

B. Turn the keyswitch to the ON position.

C. Use the Perkins EST in order to check the current “Throttle Configuration”.

D. Select the “SERVICE” option from the drop-down menu of the Perkins EST.

E. Select the “Throttle Configuration” option on the Perkins EST. Select the appropriate analog “Throttle Configuration” summary from the menu on the left of the screen. The IVS window for the throttle will indicate “YES” if an IVS is installed. Make a note of the “Idle Validation Min OFF Threshold” parameters that are displayed in the “Throttle Configuration” menu of the Perkins EST. Make a note of the “Idle Validation Max ON Threshold” parameters that are displayed in the “Throttle Configuration” menu of the Perkins EST.

F. To select the “Throttle status” function on the Perkins EST, select “Status” function and then select “Throttles” function.

G. The throttle is set in the low idle position.

H. Depress the throttle pedal slowly. The IVS status should change from CLOSED (ON) to OPEN (OFF).

Expected Result:

The IVS switch operates between the “Idle Validation Min OFF Threshold” and the “Idle Validation Max ON Threshold” parameters. Use the Perkins EST in order to view the parameters of the IVS switch.

Results:

- OK – The IVS switch operates within the “Idle Validation Min OFF Threshold” and the “Idle Validation Max ON Threshold” parameters. Use the Perkins EST in order to view the parameters of the IVS switch. STOP.
- Not OK – The IVS switch cannot operate within the “Idle Validation Min OFF Threshold” and the “Idle Validation Max ON Threshold” parameters. Use the Perkins EST in order to view the parameters of the IVS switch.

  Repair:

  Proceed to Test Step 7.

Test Step 3. Inspect Electrical Connectors and the Harness

A. Inspect the P1/J1 connector, the harness and all of the connectors for the IVS. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

B. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the suspect analog throttle switch:

- P1:35

- P1:44
- P1:45

C. Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in).

D. Check the harness for abrasion and pinch points from the analog throttle switch to the ECM.

Expected Result:

All connectors, pins and sockets are completely coupled and/or inserted and the harness is free of corrosion, abrasion and pinch points.

Results:

- OK – Proceed to Test Step 4.
- Not OK

  Repair: Perform the following repair:

  Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 4. Check the Location of the Fault

A. Disconnect the IVS harness connector.

B. Install a jumper wire between the IVS connections on the harness.

C. Turn the keyswitch to the ON position.

D. Install a jumper wire between the IVS connections on the harness. Use the Perkins EST in order to check for diagnostic codes.

E. Remove the jumper wire that is between the IVS connections on the harness. Use the Perkins EST in order to check for diagnostic codes.

Expected Result:

Connect the jumper wire. The IVS state on the Perkins EST throttle status screen will display the ON position.

Disconnect the jumper wire. The IVS state on the Perkins EST throttle status screen will display the OFF position.

Results:

- OK – The jumper wire is connected. The Perkins EST displays the IVS state in the ON position. The jumper wire is disconnected. The Perkins EST displays the IVS state in the OFF position. The IVS is suspect. Proceed to Test Step 6.
- Not OK – The harness and/or the ECM are suspect. Proceed to Test Step 5.

Test Step 5. Check the ECM function

A. Disconnect the P1 connector.

B. If the IVS 2 is suspect, temporarily remove connector P1:45. If the IVS 1 is suspect, temporarily remove P1:44.

C. Fabricate a jumper wire.

D. Turn the keyswitch to the ON position.

E. Install the jumper wire between the removed connector pin on the P1 connector and P1:35.

F. Use the Perkins EST in order to monitor the IVS status. Note the status of the IVS.

G. Disconnect the jumper wire.

H. Use the Perkins EST in order to monitor the IVS status. Note the status of the IVS.

Expected Result:

When the jumper wire is installed, the IVS state on the Perkins EST throttle status screen will display the ON position.

When the jumper wire is disconnected, the IVS state on the Perkins EST throttle status screen will display the OFF position.

Results:

- OK – When the jumper wire is connected, the Perkins EST shows the IVS state in the ON position. When the jumper wire is disconnected, the Perkins EST shows the IVS state in the OFF position .

  Repair:

  1. Inspect the harness between the ECM and IVS.

  2. Locate the fault.

  3. Repair the harness and/or replace the harness.

4. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

STOP.

- Not OK – The ECM is suspect.

Repair:

1. Temporarily connect a test ECM.

Note: The test ECM should be programmed with the correct software. All parameters should be set to the same value as the suspect ECM.

2. If the fault is eliminated with the test ECM, reconnect the suspect ECM.

3. If the fault returns with the suspect ECM, then the suspect ECM is faulty.

4. Replace the suspect ECM.

STOP.

Test Step 6. Check the Idle Validation Switch (IVS) at the Sensor

A. Turn the keyswitch to the OFF position.

B. Disconnect the IVS.

C. Set the throttle to low idle.

D. Check the resistance of the IVS.

E. Set the throttle to high idle.

F. Check the resistance of the IVS.

Expected Result:

The IVS reading should be more than 20,000 Ohms.

The IVS reading should be less than 10 Ohms at low idle.

Results:

- OK – The IVS indicates the resistance that is shown in the test. No fault is indicated at this time. Recheck the harness for intermittent connections. STOP.

- Not OK – The IVS is not functioning correctly.

Repair: Replace the IVS or replace the throttle demand sensor assembly. Refer to OEM manual for information on the throttle demand sensor. Check the IVS calibration.

Refer to Test Step 7.

- Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault. – STOP.

Test Step 7. Check the Idle Validation Switch (IVS) Calibration

A. Connect the Perkins EST to the diagnostic connector.

B. Turn the keyswitch to the ON position.

C. Select the “Throttle Configuration” option on the Perkins EST. Select the appropriate analog “Throttle Configuration” summary from the menu on the left of the screen. The IVS window for the throttle will indicate “YES” if an IVS is installed. Make a note of the “Idle Validation Min OFF Threshold” parameters that are displayed in the “Throttle Configuration” menu of the Perkins EST. Make a note of the “Idle Validation Max ON Threshold” parameters that are displayed in the “Throttle Configuration” menu of the Perkins EST.

D. Select the “Throttle status” function on the Perkins EST. Select “Status” function and then select “Throttles” function.

E. The throttle is set in the low idle position.

F. Depress the throttle pedal slowly. The raw percentage values for the throttle that are shown on the Perkins EST should increase and the IVS status should change from CLOSED (ON) to OPEN (OFF) position. Make a note of the raw reading for the throttle when the IVS reading changes from the CLOSED position to the OPEN position. Repeat this step in order to obtain accurate raw percentage values for the throttle. The noted value should be within the previously noted “Idle Validation Min OFF Threshold” and “Idle Validation Max ON Threshold” limits.

G. The throttle pedal is set to the full throttle position or the high idle position.

H. Release the throttle pedal slowly. The raw percentage values for the throttle that are shown on the Perkins EST should decrease and the IVS status should change from OPEN (OFF) to CLOSED (ON) position. Make a note of the raw reading for the throttle when the IVS reading changes from the OPEN position to the CLOSED position. Repeat this step in order to obtain accurate raw percentage values for the throttle. The noted value should be within the previously noted “Idle Validation Min OFF Threshold” and “Idle Validation Max ON Threshold” limits.

Expected Result:

The IVS operates within the “Idle Validation Min OFF Threshold” and the “Idle Validation Max ON Threshold” values that are shown on the “Configuration” menu of the Perkins EST.

Results:

- OK – The IVS operates within the “Idle Validation Min OFF Threshold” and the “Idle Validation Max ON Threshold” values that are shown on the “Configuration” menu of the Perkins EST. STOP.
- Not OK – Proceed to Test Step 8.

Test Step 8. Reset the Idle Validation Switch (IVS) Threshold Limits by Using the Perkins Electronic Service Tool (EST)

The Perkins EST can be used to reset the “Idle Validation Min OFF Threshold” and the “Idle Validation Max ON Threshold” limits that are shown in the current throttle configuration summary.

A. Calculate the new “Idle Validation Min OFF Threshold” limit. The “Idle Validation Min OFF Threshold” limit is 3% below the lowest raw values that are noted in Test Step 7.

Note: The default value for the “Idle Validation Min OFF Threshold” is 10%. The lowest value that should be set is 5%.

B. Calculate the new “Idle Validation Max ON Threshold” limit. The “Idle Validation Max ON Threshold” is 3% above the raw values that was noted for the “Idle Validation Max ON Threshold” limit. The “Idle Validation Max ON Threshold” is 3% above the highest raw % value that was noted in Test Step 7.

Note: The default value for the “Idle Validation Max ON Threshold” is 25%. The maximum value that is expected is 28%.

C. Enter the new threshold limits into the Perkins EST.

D. Turn the keyswitch to the OFF position. Turn the keyswitch to the ON position.

E. Repeat Test Step 7. Check that the IVS operates within the newly set threshold limits.

Expected Result:

The fault is cleared.

Results:

- OK – STOP.
- Not OK

  Repair: Perform the following repair:

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

i02491425

Ignition Keyswitch Circuit and Battery Supply Circuit - Test

System Operation Description:

This procedure tests that the correct voltage is being supplied to the Electronic Control Module (ECM).

Use this procedure to troubleshoot the system when one of the following diagnostic codes is active or easily repeated:

- 0168-00 Electrical System Voltage high
- 0168-01 Electrical System Voltage low
- 0168-02 Electrical System Voltage erratic, intermittent, or incorrect
- 1834-02 Ignition Keyswitch loss of signal

The ECM receives electrical power (battery voltage) through the wiring that is supplied by the manufacturer of the application. Unswitched battery voltage is supplied through P1: 7, 8, 15, 16. The negative battery is supplied through P1: 1, 2, 3, 9, 10. The ECM receives the input from the keyswitch at P1:40 when the keyswitch is in the ON position or in the START position. When the ECM detects battery voltage at this input, the ECM will power up. When battery voltage is removed from this input, the ECM will power down.

The cause of an intermittent power supply to the ECM can occur on either the positive side or on the negative side of the battery circuit. The connections for the unswitched +battery may be routed through a dedicated protection device (circuit breaker).

Some applications may be equipped with an engine protection shutdown system or an idle timer shutdown system that interrupts electrical power to the keyswitch. The engine protection shutdown system can be an aftermarket device and the idle timer shutdown system can be external to the ECM. Some of these systems will not supply power to the ECM until one of the following conditions is met:

- The engine is cranked.
- The engine oil pressure achieves acceptable limits.
- An override button is pressed.

Keep in mind that these devices may be the cause of intermittent power to the ECM. These devices may also shut down the engine.

Usually, battery power to the diagnostic connector is available and the battery power to the data link connector is independent of the keyswitch. Therefore, you will be able to power up the Perkins Electronic Service Tool (EST), but you may not be able to communicate with the engine ECM. The engine ECM requires the keyswitch to be in the ON position in order to maintain communications. The ECM may power down a short time after connecting Perkins EST if the keyswitch is in the OFF position. This is normal.

For intermittent faults such as intermittent shutdowns that could be caused by the application wiring, temporarily bypassing the application wiring may be an effective means of determining the root cause. If the symptoms disappear with the bypass wiring, the application wiring is the cause of the fault. A means of bypassing the application wiring is explained in this test procedure. This is especially important for applications that do not provide dedicated circuits for the unswitched battery and the connections for the keyswitch.

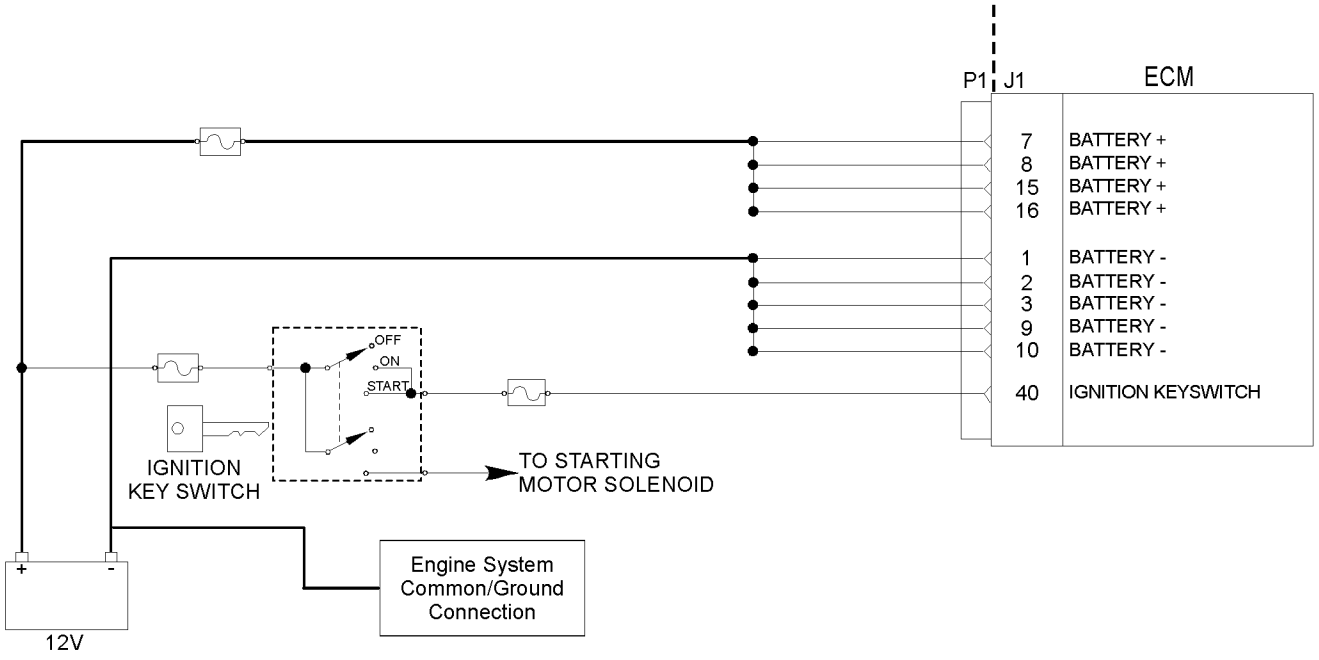


Illustration 72 g01245123

Schematic for the ignition keyswitch and battery supply circuit

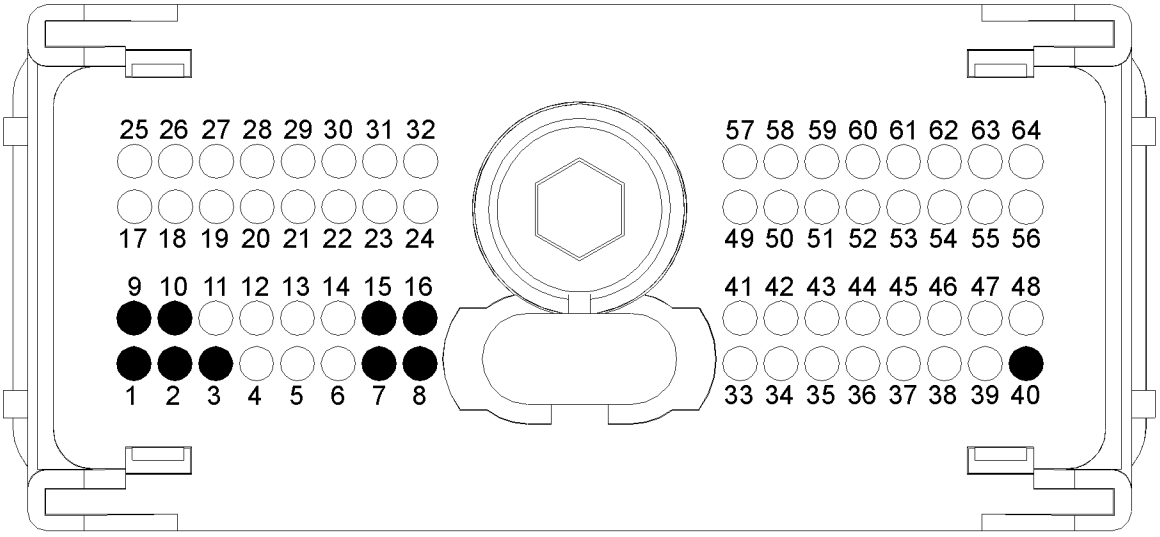


Illustration 73 g01193796

Typical rear view of the pin locations for the ignition keyswitch and battery supply circuit

(1) Battery ground (GND)
(2) Battery ground (GND)
(3) Battery ground (GND)
(7) Battery (+)
(8) Battery (+)
(9) Battery ground (GND)
(10) Battery ground (GND)
(15) Battery ground (GND)
(16) Battery ground (GND)
(40) Ignition key switch

Test Step 1. Inspect Electrical Connectors and Wiring

A. Thoroughly inspect the P1 connector, the battery connections and the connections to the keyswitch. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

B. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the following connections:

- P1: 7, 8, 15, 16 (Unswitched +Battery)
- P1: 1, 2, 3, 9, 10 (−Battery)
- P1:40 (keyswitch)

C. Use the Perkins EST to perform a “Wiggle Test”. Special attention must be paid to the following connections:

- P1: 7, 8, 15, 16
- P1: 1, 2, 3, 9, 10
- P1:40

D. Check the ECM connector for the correct torque of 5.0 N·m (44 lb in).

E. Check the harness for abrasion and for pinch points from the battery to the ECM, and from the keyswitch to the ECM.

Expected Result:

All connectors, pins and sockets are completely coupled and/or inserted and the harness is free of corrosion, of abrasion or of pinch points.

Results:

- OK – The harness and connectors appear to be OK. Proceed to Test Step 2.
- Not OK – There is a fault with the connectors and/or the harness.

  Repair: Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 2. Check for Active Diagnostic Codes or Logged Diagnostic Codes

A. Connect the Perkins EST to the diagnostic connector.

B. Turn the keyswitch to the ON position.

C. Monitor the active diagnostic code screen on Perkins EST. Check and record any active diagnostic codes or logged diagnostic codes.

Note: Wait at least 30 seconds in order for the diagnostic codes to become active.

Expected Result:

One of the following diagnostic codes is active or logged:

- 168-0 Electrical System Voltage high
- 168-1 Electrical System Voltage low
- 168-2 Electrical System Voltage erratic, intermittent, or incorrect
- 1834-2 Ignition Keyswitch loss of signal

Note: Diagnostic code 1834-2 can be generated by rapidly cycling the keyswitch. If diagnostic code 1834-2 is logged but not active, this may be the cause.

Results:

- OK – Diagnostic code 168-2 or 1834-2 is active or logged. Proceed to Test Step 3.
- Not OK – No diagnostic code is active.

  Repair: The fault is no longer present. If the fault is intermittent, refer to Troubleshooting, “Electrical Connectors - Inspect”.

  STOP.

Test Step 3. Check the Battery Voltage at the ECM Connector

A. Disconnect the connector P1 from the ECM connector.

B. Turn the keyswitch to the ON position.

C. Measure the voltage between P1:7 (Unswitched +Battery) and P1:1 (-Battery).

D. Measure the voltage between P1:8 (Unswitched +Battery) and P1:2 (-Battery).

E. Measure the voltage between P1:15 (Unswitched +Battery) and P1:9 (-Battery).

F. Measure the voltage between P1:16 (keyswitch) and P1:10 (-Battery).

G. Measure the voltage between P1:40 (keyswitch) and P1:3 (-Battery).

H. Turn the keyswitch to the OFF position.

Expected Result:

For 12 Volt systems, the measured voltage is a constant 11.0 to 13.5 VDC with no suspected intermittent faults at this time.

For 24 Volt systems, the measured voltage is a constant 22.0 to 27.0 VDC with no suspected intermittent faults at this time.

Results:

- OK – The ECM is receiving the correct voltage.

  Repair: If an intermittent condition is suspected, refer to Troubleshooting, “Electrical Connectors - Inspect”.

  STOP.

- Not OK - The ECM is not receiving the correct voltage.

  Repair: Check for continuity in the harness for the keyswitch from P1:40 through the keyswitch circuit to the batteries. Check the circuit protection for the circuit. Refer to the service manual for the instructions on troubleshooting the circuit for the keyswitch.

  For intermittent problems such as intermittent shutdowns that could be caused by the application wiring, temporarily bypassing the application wiring may be an effective means of determining the root cause.

  Proceed to Test Step 5.

- Not OK - No Voltage on P1: 7, 8, 15, 16 – No voltage was present on P1: 7, 8, 15, 16.

  Repair: Check for continuity in the harness for the unswitched +Battery from the ECM to the batteries. Check the circuit protection for the circuit. Check for continuity in the harness for the −Battery from the ECM to the batteries.

  For intermittent faults such as intermittent shutdowns that could be caused by the application wiring, temporarily bypassing the application wiring may be an effective means of determining the root cause.

  Proceed to Test Step 5.

- Not OK - Battery voltage is out of range – Proceed to Test Step 4.

Test Step 4. Check the Batteries

A. Measure no-load battery voltage at the battery terminals.

B. Load test the batteries. Use a suitable battery load tester.

Expected Result:

The batteries pass the load test. For 12 volt systems, the measured voltage is at least 11.0. For 24 volt systems, the measured voltage is at least 22.0.

Results:

- OK – The batteries pass the load test. For 12 volt systems, the measured voltage is at least 11.0. For 24 volt systems, the measured voltage is at least 22.0.

  Repair: Refer to the service manual for the application for instructions on troubleshooting the application harness. Troubleshoot the application harness and repair the application harness, as required.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repairs eliminate the fault.

  STOP.

- Not OK – The batteries do not pass the load test. For 12 volt systems, the measured voltage is less than 11.0. For 24 volt systems, the measured voltage is less than 22.0.

  Repair: Recharge or replace the faulty batteries.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 5. Bypass the Application Harness

⚠ WARNING

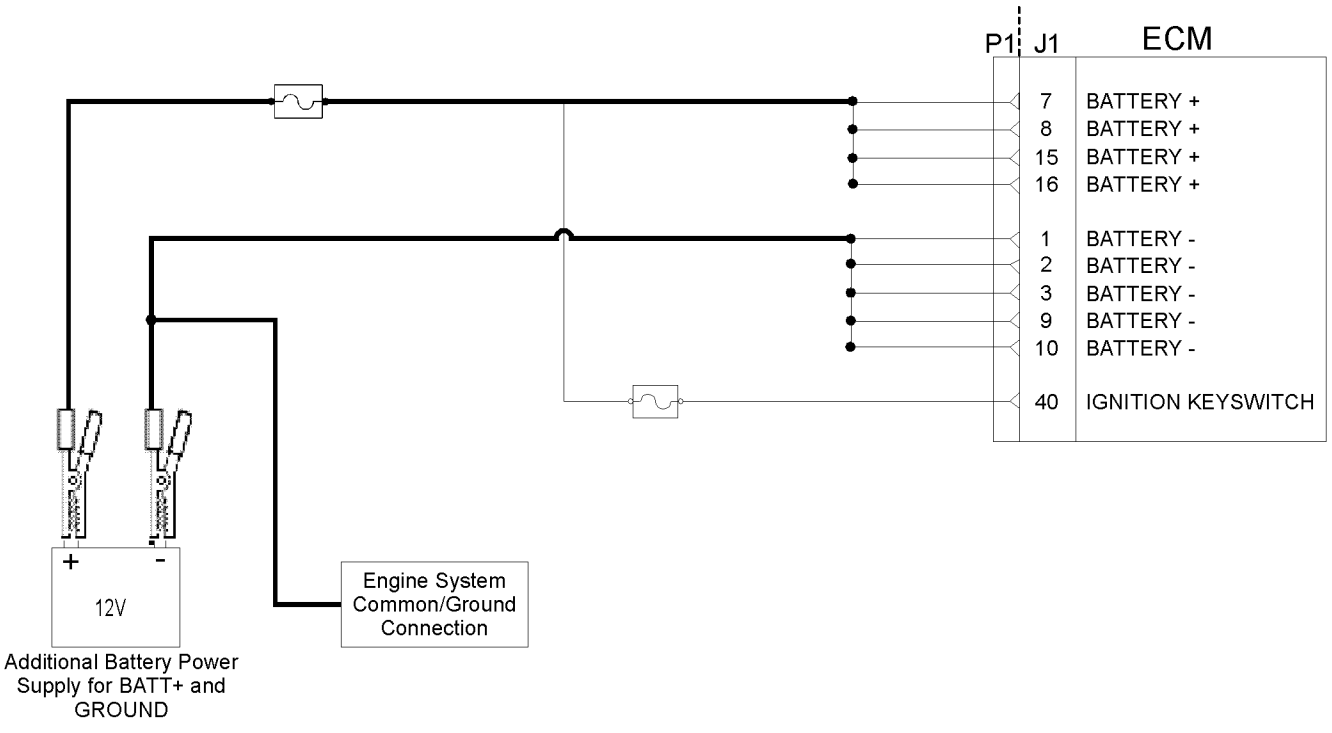
Batteries give off flammable fumes which can explode.

To avoid injury or death, do not strike a match, cause a spark, or smoke in the vicinity of a battery.

NOTICE

Do Not connect the bypass harness to the battery until all of the in-line fuses have been removed from the +Battery line. If the fuses are not removed before connection to the battery a spark may result.

Note: This bypass harness is only for test applications. This bypass harness must be removed before the application is released to the customer. The bypass harness can be used in order to determine if the cause of the intermittent faults are interruptions in battery power to the ECM or to the keyswitch circuit.



g01245124

Illustration 74

Schematic for the bypass application harness

A. Turn the keyswitch to the OFF position.

B. Disconnect the P1 connector from the ECM connector.

C. Connect a bypass harness to the ECM.

D. Remove the fuses from the +Battery wire of the bypass harness and connect the +Battery and the −Battery wires directly to the battery terminals.

Note: This bypass directly connects the circuit for the keyswitch to the ECM. The ECM will remain powered until the connection to the unswitched battery + line is disconnected. Remove the fuses from the in-line fuse holder to power down the ECM. Do not connect the bypass to the battery terminals or do not remove the bypass from the battery terminals without first removing the in-line fuses.

E. Connect the Perkins EST to the diagnostic connector of the bypass harness and verify that communication can be established.

Note: Remove the bypass harness and restore all wiring to the original condition after testing.

Expected Result:

Installing the bypass eliminates the fault.

Note: The status of the “Ignition Keyswitch” will always indicate ON while the bypass harness is installed.

Results:

- OK – The symptoms disappear when the bypass harness is installed. Also, the symptoms return when the bypass harness is removed. The fault is in the wiring for the application that supplies power to the ECM. Check for aftermarket engine protection switches that interrupt power. Send the application to the OEM dealer to repair. STOP.
- Not OK

  Repair: Connect the bypass to another battery and verify if the fault is resolved. If the fault is resolved, the fault is with the batteries on the application.

  If the fault still exists, temporarily connect a test ECM. Remove all jumpers and replace all connectors. Recheck the system for active diagnostic codes and repeat the Test Step. If the fault is resolved with the test ECM, reconnect the suspect ECM. If the fault returns with the suspect ECM, replace the ECM.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

i02491535

Indicator Lamp Circuit - Test

System Operation Description:

Use this procedure under the following circumstances:

- The lamps are not receiving battery voltage.
- The lamps are not operating correctly.

Also, use this procedure if another procedure has directed you here.

The following diagnostic lamps are available:

- Power Take Off (PTO) lamp
- Stop lamp
- Warning lamp
- Cold start (wait to start lamp)
- Low oil pressure lamp

The Perkins Electronic Service Tool (EST) can be used as a diagnostic aid in order to switch the individual lamps ON and OFF.

Note: The diagnostic aid function that switches the lamps is contained in the “Override” section in the “diagnostics” menu of the Perkins EST.

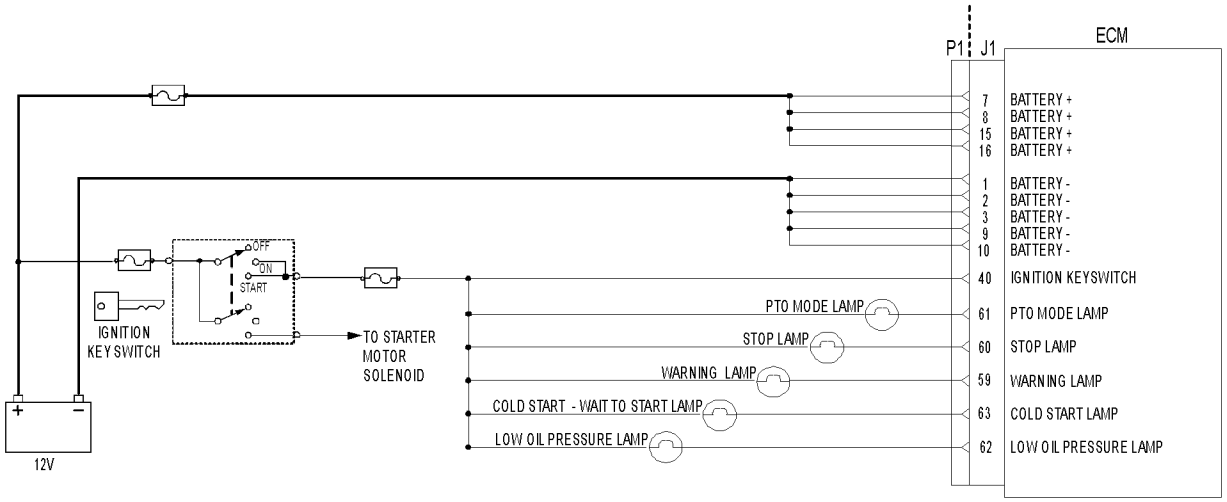


Illustration 75 g01245196

Typical schematic of the indicator lamp circuit

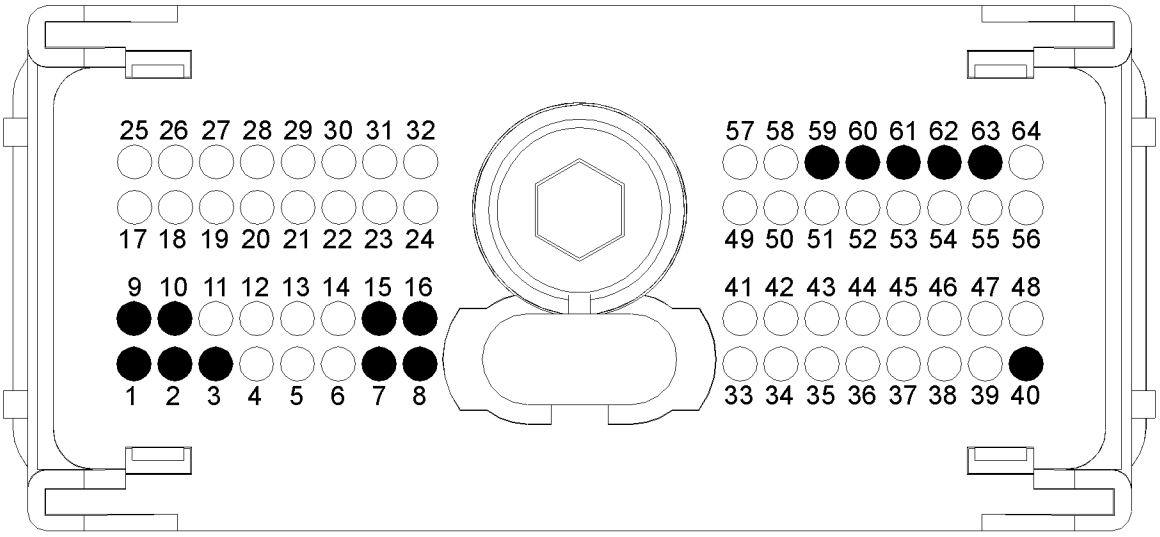


Illustration 76 g01176466

Typical example of the P1 OEM connector pin locations

(1) Ground (GND)
(2) Ground (GND)
(3) Ground (GND)
(9) Ground (GND)
(10) Ground (GND)
(7) Battery (+)
(8) Battery (+)
(15) Battery (+)
(16) Battery (+)
(40) Keyswitch
(59) Warning lamp
(60) Stop lamp
(61) PTO lamp
(62) Low oil pressure lamp
(63) Cold start lamp

Test Step 1. Inspect Electrical Connectors and Wiring

A. Turn the keyswitch to the OFF position.

B. Thoroughly inspect P1 OEM connector and the lamp connections. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

C. Perform a 45 N (10 lb) pull test on each of the wires in the customer connector and the Electronic Control Module (ECM) connector that is associated with the diagnostic lamp.

D. Check the screw for the P1 OEM connector for the correct torque of 5.0 N·m (44 lb in).

E. Check the harness for abrasions and for pinch points from the battery to the ECM.

Results:

- OK – Proceed to Test Step 2.
- Not OK

  Repair: Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 2. Inspect the Lamp, the Fuse, and the Power Supply

A. Disconnect the lamp from the harness. Inspect the lamp in order to determine if the lamp has failed.

B. Measure the resistance across the two terminals of the lamp. If the resistance is more than 2000 Ohms, the bulb has failed.

C. Check the battery by connecting a test lamp across the terminal of the battery.

Expected Result:

The lamp has less than 2000 Ohms and the power supply is OK.

Results:

- OK – The lamp appears to be operating correctly at this time. Proceed to Test Step 3.
- Not OK

  Repair: Replace the suspect component or repair the suspect component.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repairs have eliminated the fault.

  STOP.

Test Step 3. Measure the Input to the Lamp at the Lamp Socket

A. Turn the keyswitch to the ON position.

B. Use the Perkins EST to select the “override” function in order to switch individual lamps ON and OFF.

Note: The “Override” function is contained in the “Diagnostics” menu of the Perkins EST.

C. Measure the voltage at the lamp socket.

Expected Result:

The voltage should be between 12.0 VDC and 24.0 VDC.

Results:

- OK – The voltage is between 12.0 VDC and 24.0 VDC.

  Repair: Replace the bulb.

  Verify that the repair eliminates the fault.

  If the fault persists, measure the resistance across the 2 terminals of the lamp. If the resistance is more than 2000 Ohms, the replacement bulb has failed. Replace the bulb and repeat the test.

  If the fault persists, proceed to Test Step 4.

- Not OK – The voltage is not in the range that is expected. Proceed to Test Step 5.

Test Step 4. Test the Individual Lamp Circuits

A. Disconnect the P1 connector.

B. Temporarily disconnect the wire from the P1 connector socket that supplies the suspect lamp.

C. By using a jumper wire, connect the removed wire to the battery-.

D. Turn the keyswitch to the ON position and observe the lamp.

Expected Result:

The diagnostic lamp turns ON while the jumper is connected. Also, the diagnostic lamp turns OFF when the jumper is removed.

Results:

- OK – The circuit for the diagnostic lamp is functioning correctly. Proceed to Test Step 5.
- Not OK – The lamp did not turn ON. The lamp circuit is not functioning correctly. There is a fault in the harness between the lamp and the ECM.

  Repair: Repair the lamp circuit.

Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminated the fault.

STOP.

Test Step 5. Check the Voltage at the ECM.

A. Disconnect the P1 connector.

B. Temporarily disconnect the wire from the P1 connector that supplies the suspect lamp.

C. Fabricate the jumper wire with a suitable pin for the P1 connector.

D. Install one end of the jumper wire into the P1 connector that supplies the suspect lamp. Connect a voltage test bulb between the battery+ and the jumper wire.

E. Reinstall the P1 connector to the ECM.

F. Turn the keyswitch to the ON position. Use the Perkins EST to select the override function in order to switch individual lamps ON and OFF.

Note: The “Override” function is contained in the “Diagnostics” menu of the Perkins EST.

Expected Result:

The lamp should illuminate.

Results:

- OK – The ECM is operating correctly. There is a fault in the wiring or the lamp. Repair the wiring or the lamp, as required. Verify that the repair eliminates the fault.

  STOP.

- Not OK – Temporarily connect a test ECM. The test ECM must be programmed with the same parameters as the suspect ECM. Check the operation of the diagnostic lamp when the test ECM is installed. If the fault is resolved with the test ECM, then reconnect the suspect ECM. If the fault returns with the suspect ECM, then replace the suspect ECM.

  STOP.

i02491627

Injector Data Incorrect - Test

System Operation Description:

Use this procedure under the following situation:

Use this procedure for any of the following diagnostic codes:

- 0001-02 Cylinder #1 Injector erratic, intermittent, or incorrect
- 0002-02 Cylinder #2 Injector erratic, intermittent, or incorrect
- 0003-02 Cylinder #3 Injector erratic, intermittent, or incorrect
- 0004-02 Cylinder #4 Injector erratic, intermittent, or incorrect
- 0005-02 Cylinder #5 Injector erratic, intermittent, or incorrect (1106D engine only)
- 0006-02 Cylinder #6 Injector erratic, intermittent, or incorrect (1106D engine only)

The following background information is related to this procedure:

The engine has electronic unit injectors that are electronically controlled by the Electronic Control Module (ECM). The ECM sends a 70 volt pulse to each injector solenoid. The pulse is sent at the correct time and for the correct duration for a given engine load and engine speed. Use this procedure to identify the cause of the diagnostic code. Use this procedure to repair the system.

If an injector is replaced, then the correct injector trim files must be programmed into the ECM. The injector trim files allow each individual injector to be fine tuned for optimum performance. The ECM will generate the following diagnostic code if the injector codes are not programmed:

- 0268-02 Programmed Parameter Fault erratic, intermittent, or incorrect

Refer to Troubleshooting, “Injector Trim File” for further information.

If the ECM is replaced then the replacement ECM must be correctly programmed. Refer to Troubleshooting, “Replacing the ECM” for further information.

Use the Perkins Electronic Service Tool (EST) in order to perform the “Fuel System Verification - Test.”. The “Fuel System Verification - Test.” is used to check that the system operates correctly after a repair has been made.

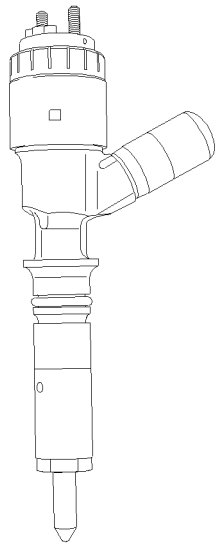


Illustration 77 g01208822

Typical example of the electronic unit injector

Test Step 1. Check for Diagnostic Codes That Are Related to this Procedure.

A. Connect the Perkins EST to the diagnostic connector.

B. Turn the keyswitch to the ON position.

C. Check for logged diagnostic codes that are related to this procedure.

D. Make a note of the logged diagnostic codes.

Expected Result:

Expected Result 1

One or more of the following diagnostic codes are logged:

- 1-2 Cylinder #1 Injector erratic, intermittent, or incorrect
- 2-2 Cylinder #2 Injector erratic, intermittent, or incorrect
- 3-2 Cylinder #3 Injector erratic, intermittent, or incorrect
- 4-2 Cylinder #4 Injector erratic, intermittent, or incorrect
- 5-2 Cylinder #5 Injector erratic, intermittent, or incorrect (1106D engine only)
- 6-2 Cylinder #6 Injector erratic, intermittent, or incorrect (1106D engine only)

Expected Result 2

On four cylinder engines, two injectors that share a common supply indicate a diagnostic code.

Note: Injectors 1 and 4 share a common injector driver circuit in the ECM. Injectors 2 and 3 share a common driver circuit in the ECM. If two injectors that share a common supply indicate a diagnostic code then this is probably caused by a faulty ECM.

On six cylinder engines, three injectors that share a common supply indicate a diagnostic code.

Note: Injectors 1, 2 and 3 share a common injector driver circuit in the ECM. Injectors 4, 5 and 6 share a common driver circuit in the ECM. If three injectors that share a common supply indicate a diagnostic code then this is probably caused by a faulty ECM.

Results:

- OK – Result 1 One or more diagnostic codes are logged. Proceed to Test Step 2.
- OK – Result 2 On four cylinder engines, two injectors that share a common supply indicate a diagnostic code. On six cylinder engines, three injectors that share a common supply indicate a diagnostic code. Proceed to Test Step 3.
- Not OK – No related diagnostic codes are logged. STOP.

Test Step 2. Check the Faulty Cylinder Numbers

A. Use the Perkins EST in order to make a note of the logged diagnostic codes.

B. Use the noted diagnostic codes in order to check the cylinders for faulty injectors.

Expected Result:

The diagnostic codes indicate the cylinder numbers that have faulty injectors.

Results:

- OK – No related diagnostic codes are logged. STOP.
- Not OK – The diagnostic codes indicate the cylinder numbers that have faulty injectors.

  Repair: Replace the faulty injectors.

Use the Perkins EST in order to program the replacement injector trim files . Refer to Troubleshooting, “Injector Trim File” for further information.

Use the Perkins EST in order to clear the logged codes.

Turn the keyswitch to the ON position.

Start the engine.

Use the Perkins EST in order to perform the “Fuel System Verification - Test”. If the cylinders indicate “PASS”, then the fault has been cleared.

Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

STOP.

Test Step 3. Check the ECM

A. Temporarily connect a test ECM.

Note: The test ECM must be correctly programmed. Refer to Troubleshooting, “Replacing the ECM”.

B. Use the Perkins EST in order to perform the “Fuel System Verification - Test.”. Verify that the test eliminates the fault.

Note: The “Fuel System Verification - Test.” will indicate if the cylinder has a “Pass” or “Fail”. If the cylinders indicate “Pass” then the fault has been cleared.

C. If the test ECM eliminates the fault, reconnect the suspect ECM.

D. Use the Perkins EST in order to perform the “Fuel System Verification - Test”.

Expected Result:

The test ECM clears the fault. Using the Perkins EST in order to perform the “Fuel System Verification - Test” with the suspect ECM indicates a “FAIL” condition.

Results:

- OK – The test ECM eliminates the fault and the suspect ECM indicates a “FAIL” condition. Replace the faulty ECM. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault. STOP.
- Not OK – The test ECM did not eliminate the fault. Proceed to Test Step 2.

i02491832

Injector Solenoid Circuit - Test

System Operation Description:

Use this procedure to troubleshoot any suspect faults with the injector solenoids.

Use this procedure for the following diagnostic codes:

- 0001-05 Cylinder #1 Injector current below normal
- 0001-06 Cylinder #1 Injector current above normal
- 0002-05 Cylinder #2 Injector current below normal
- 0002-06 Cylinder #2 Injector current above normal
- 0003-05 Cylinder #3 Injector current below normal
- 0003-06 Cylinder #3 Injector current above normal
- 0004-05 Cylinder #4 Injector current below normal
- 0004-06 Cylinder #4 Injector current above normal
- 0005-05 Cylinder #5 Injector current below normal (C6.6 engine only)
- 0005-06 Cylinder #5 Injector current above normal (C6.6 engine only)
- 0006-05 Cylinder #6 Injector current below normal (C6.6 engine only)
- 0006-06 Cylinder #6 Injector current above normal (C6.6 engine only)

Perform this procedure under conditions that are identical to the conditions that exist when the fault occurs. Typically, faults with the injector solenoid occur when the engine is warmed up and/or when the engine is under vibration (heavy loads).

These engines have Electronic Unit Injectors (EUI) that are mechanically actuated and electronically controlled. The Electronic Control Module (ECM) sends a pulse to each injector solenoid. The pulse is sent at the correct time and at the correct duration for a given engine load and speed. The solenoid is mounted on top of the fuel injector body.

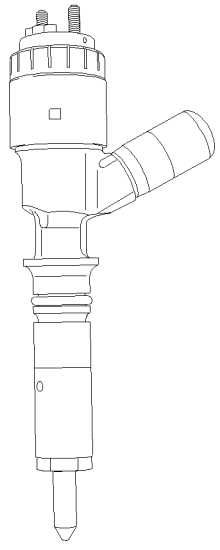
If an open circuit is detected in the solenoid, a diagnostic code is generated. The ECM continues to try to fire the injector. If a short circuit is detected, a diagnostic code is generated. The ECM will disable the solenoid circuit. The ECM will periodically try to fire the injector. If the short circuit remains, this sequence of events will be repeated until the fault is corrected.

“Injector Solenoid Test”

Use the “Injector Solenoid Test” on the Perkins Electronic Service tool (EST) to aid in diagnosing an open circuit or a short circuit diagnostic code while the engine is not running. The “Injector Solenoid Test” will send a signal to each solenoid. The Perkins EST will indicate the status of the solenoid as “OK”, “Open”, or “Short”.

Note: On four cylinder engines, the use of a shared supply will mean that a short circuit in the wire that is used as a supply for the injector solenoid will cause two cylinders to have diagnostic codes.

Note: On six cylinder engines, the use of a shared supply will mean that a short circuit in the wire that is used as a supply for the injector solenoid will cause three cylinders to have diagnostic codes.



g01208822

Illustration 78

Typical example of the fuel injector

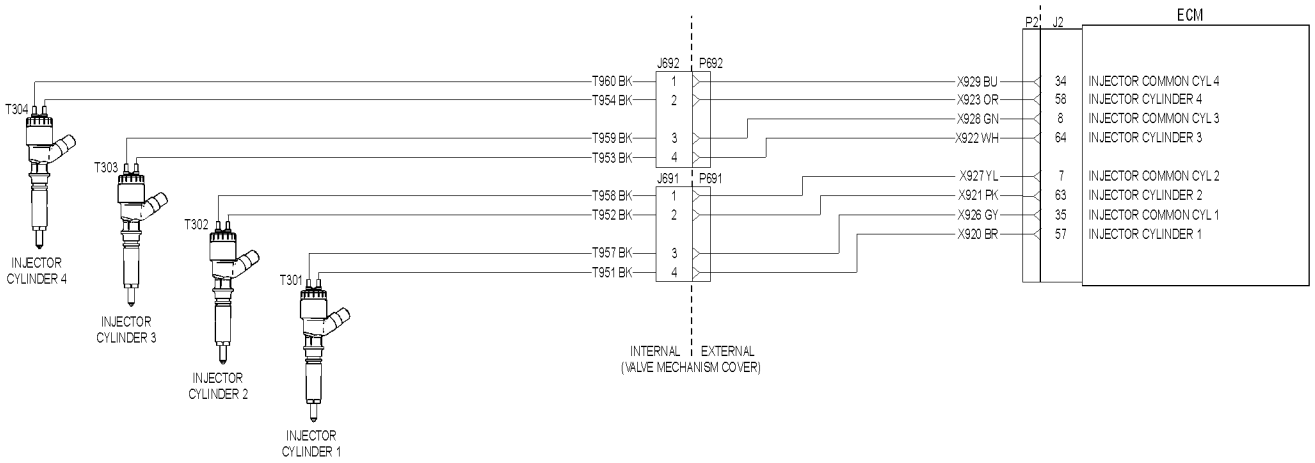


Illustration 79 g01245541

Schematic for the injector solenoid circuit for the 1104D engine

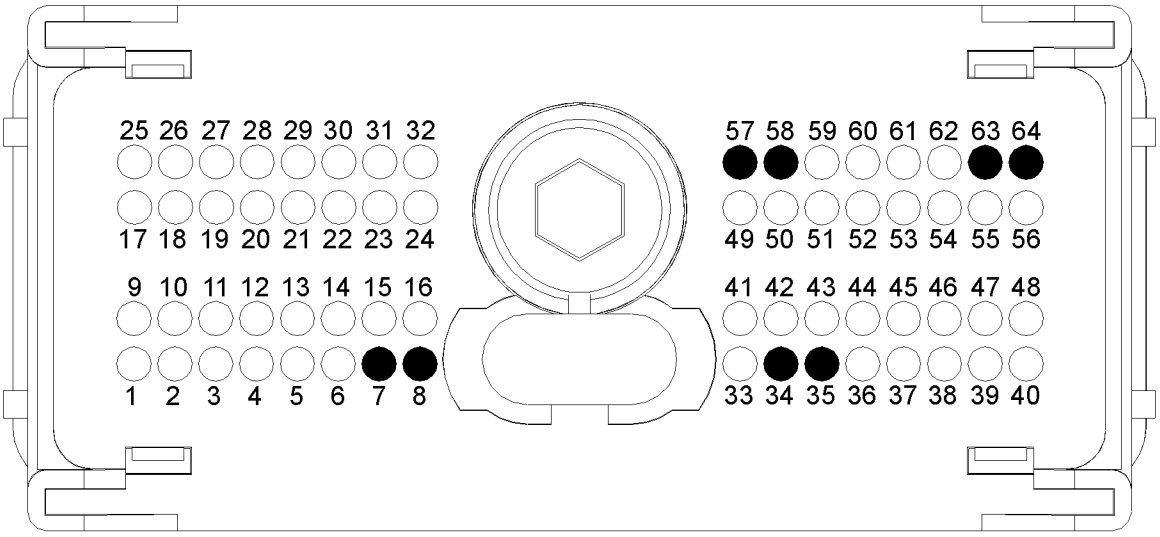


Illustration 80 g01253098

P2 pin connections for the 1104D engine

(57) Injector Cylinder (Number 1)
(35) Injector Cylinder (Number 1 Return)
(63) Injector Cylinder (Number 2)
(7) Injector Cylinder (Number 2 Return)
(64) Injector Cylinder (Number 3)
(8) Injector Cylinder (Number 3 Return)
(58) Injector Cylinder (Number 4)
(34) Injector Cylinder (Number 4 Return)

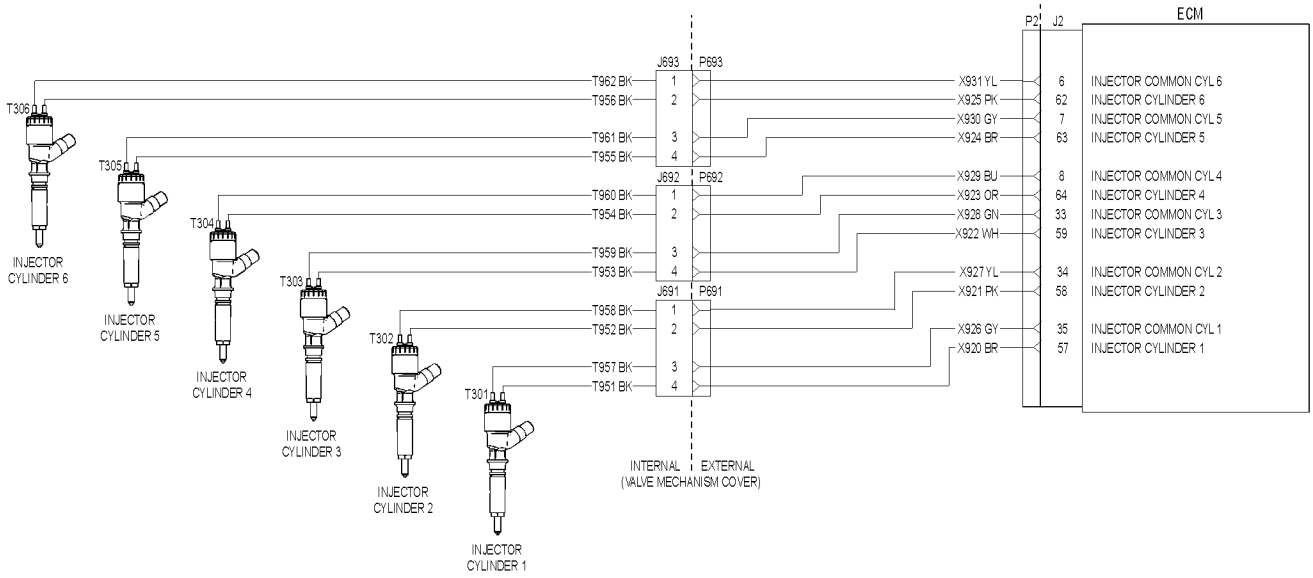


Illustration 81 g01245542

Schematic for the injector solenoid circuit for the 1106D engine

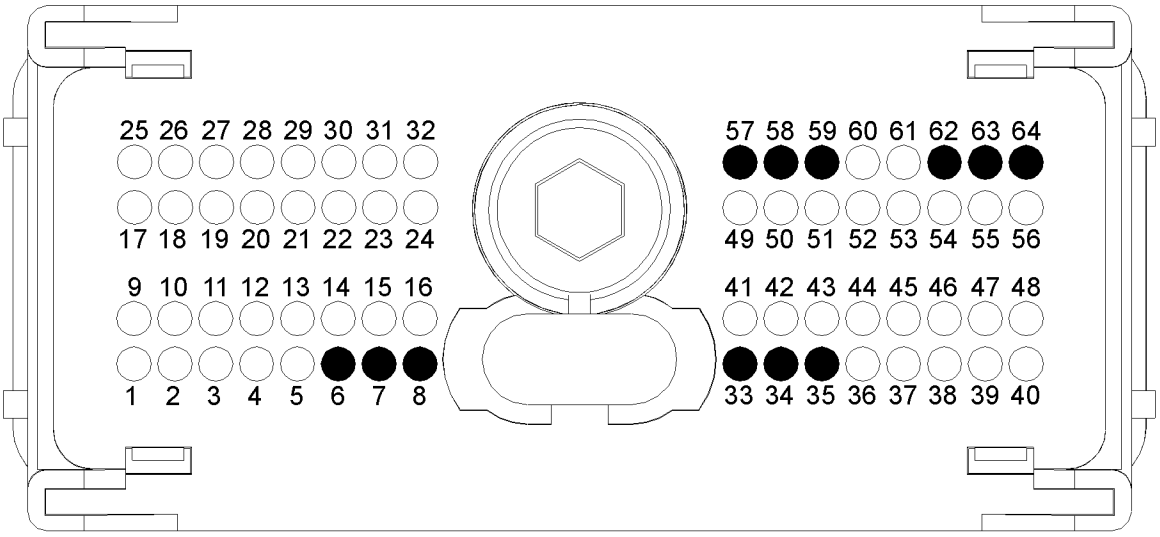


Illustration 82 g01171366

P2 pin connections for the 1106D engine

(57) Injector Cylinder (Number 1)
(35) Injector Cylinder (Number 1 Return)
(58) Injector Cylinder (Number 2)
(34) Injector Cylinder (Number 2 Return)
(59) Injector Cylinder (Number 3)
(33) Injector Cylinder (Number 3 Return)
(64) Injector Cylinder (Number 4)
(8) Injector Cylinder (Number 4 Return)
(63) Injector Cylinder (Number 5)
(7) Injector Cylinder (Number 5 Return)
(62) Injector Cylinder (Number 6)
(6) Injector Cylinder (Number 6 Return)

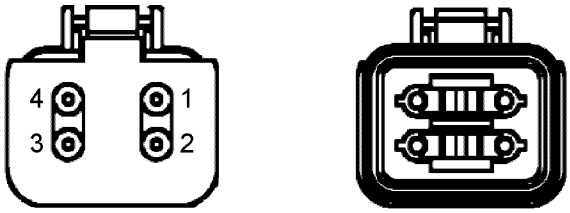


Illustration 83 g01245543

Typical example of the fuel injector harness connector

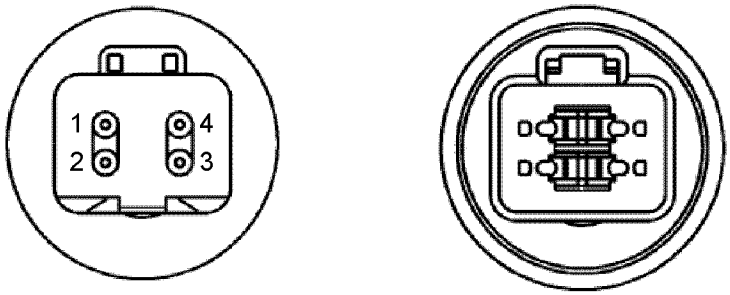


Illustration 84 g01245544

Typical example of the connector on the valve mechanism cover

Test Step 1. Inspect Electrical Connectors and Wiring

⚠ WARNING

Electrical shock hazard. The electronic unit injector system uses 67-73 volts.

A. Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF.

B. Thoroughly inspect connector P2. Thoroughly inspect the connectors at the valve cover base. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

C. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with injector solenoids.

D. Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in).

E. Check the harness and wiring for abrasion and for pinch points from the injectors to the ECM.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted and the harness is free of corrosion, of abrasion and of pinch points.

Results:

- OK – The harness is OK. Proceed to Test Step 2.
- Not OK – There is a fault in the connectors and/or the harness.

  Repair: Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled.

Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

STOP.

Test Step 2. Check for Logged Diagnostic Codes that are Related to the Injector Solenoids

A. Connect the Perkins EST to the diagnostic connector.

B. Turn the keyswitch to the ON position.

C. Check for logged diagnostic codes that are related to the injector solenoids on the Perkins EST.

Expected Result:

One or more diagnostic codes that are related to the injector solenoids have been logged:

- 1-5 Cylinder #1 Injector current below normal
- 1-6 Cylinder #1 Injector current above normal
- 2-5 Cylinder #2 Injector current below normal
- 2-6 Cylinder #2 Injector current above normal
- 3-5 Cylinder #3 Injector current below normal
- 3-6 Cylinder #3 Injector current above normal
- 4-5 Cylinder #4 Injector current below normal
- 4-6 Cylinder #4 Injector current above normal
- 5-5 Cylinder #5 Injector current below normal (C6.6 engine only)
- 5-6 Cylinder #5 Injector current above normal (C6.6 engine only)
- 6-5 Cylinder #6 Injector current below normal (C6.6 engine only)
- 6-6 Cylinder #6 Injector current above normal (C6.6 engine only)

Results:

- OK – One or more diagnostic codes have been logged. Proceed to Test Step 3.
- Not OK – No diagnostic codes have been logged. Proceed to Test Step 4.

Test Step 3. Use the “Injector Solenoid Test”

A. Start the engine.

B. Allow the engine to warm up to the normal operating temperature.

C. Stop the engine.

D. Turn the keyswitch to the ON position.

E. Access the “Injector Solenoid Test” by accessing the following display screens in order:

- “Diagnostics”
- “Diagnostic Tests”
- “Injector Solenoid Test”

F. Activate the test.

Note: Do not confuse the “Injector Solenoid Test” with the “Cylinder Cutout Test”. The “Cylinder Cutout Test” is used to shut off fuel to a specific cylinder while the engine is running. The “Injector Solenoid Test” is used to actuate the injector solenoids while the engine is not running. This allows the click of the injector solenoids to be heard while the engine is off in order to determine that the circuit is functioning correctly.

G. As each solenoid is energized by the ECM, an audible click can be heard at the valve cover.

Expected Result:

All cylinders indicate “OK”.

Results:

- OK – There is not an electronic fault with the injectors at this time.

  Repair: If the “Injector Solenoid Test” returned a “Not OK” for any injector, refer to Troubleshooting, “Engine Misfires, Runs Rough or Is Unstable”.

  STOP.

- Open – Note the cylinders that indicate “Open”. Proceed to Test Step 5.
- Short – Note the cylinders that indicate “Short”. Proceed to Test Step 4.

Test Step 4. Check the Variation of the Injectors between Cylinders

A. Start the engine.

B. Allow the engine to warm up to normal operating temperature.

C. After the engine is warmed to operating temperature, access the “Cylinder Cutout Test” by accessing the following display screens in order:

- “Diagnostics”
- “Diagnostic Tests”
- “Cylinder Cutout Test”

D. Select the start button at the bottom of the screen for the cylinder cutout test on the Perkins EST.

E. Select the “Cylinder Cutout Test”.

F. Follow the instructions that are provided in the cylinder cutout test. The cylinder cutout tests are interactive so the procedure is guided to the finish.

Note: The “Manual Cylinder Cutout Test” is also available. Access the manual test by selecting the “Change” button on the screen for the cylinder cutout test. The “Cylinder Cutout Test” is the recommended starting procedure. The automated tests run twice collecting data. The two sets of data are analyzed and an “OK” or “Not OK” result is displayed.

G. Check for active diagnostic codes and for logged diagnostic codes that are related to the injector solenoids.

Expected Result:

All cylinders indicate “OK” on the Perkins EST.

Results:

- OK – All cylinders indicate “OK”.

  Repair: If the engine is misfiring or if the engine has low power, refer to Troubleshooting, “Engine Misfires, Runs Rough or Is Unstable” and Troubleshooting, “Low Power/Poor or No Response to Throttle”.

  If a diagnostic code results from running the cylinder cutout test, proceed to Test Step 5.

- Not OK – One or more cylinders displayed “Not OK” during the test. Proceed to Test Step 5.

Test Step 5. Check the Harness between the ECM and the Valve Cover Base for an Open Circuit

⚠ WARNING

Electrical shock hazard. The electronic unit injector system uses 67-73 volts.

A. Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF.

B. Disconnect the connectors from the valve cover base.

C. Turn the keyswitch to the ON position.

D. Fabricate a jumper wire 100 mm (4 inch) long with terminals on both ends of the wire.

E. Insert one end of the jumper wire into the terminal for the suspect injector’s supply. Insert the other end of the jumper wire into the terminal for the suspect injector’s return circuit.

F. Perform the “Injector Solenoid Test” at least two times.

G. Repeat this test for each suspect injector. Stop the “Injector Solenoid Test” before handling the jumper wires.

Expected Result:

Perkins EST displays “Current Above Normal” for the cylinder with the jumper wire.

Results:

- OK – The harness between the ECM and the valve cover base is OK. Proceed to Test Step 6.
- Not OK – There is a fault between the ECM and the valve cover base. Proceed to Test Step 7.

Test Step 6. Check the Injector Harness Under the Valve Cover

⚠ WARNING

Electrical shock hazard. The electronic unit injector system uses 67-73 volts.

A. Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF.

B. Remove the valve cover.

C. On four cylinder engines, disconnect the harness from the suspect injector. Disconnect the harness from the injector that shares the same supply circuit as the suspect injector.

Note: On four cylinder engines, injectors 1 and 4 share a common injector driver circuit in the ECM. Injectors 2 and 3 share a common injector driver circuit in the ECM. If the two injectors that share a common supply indicate “Open Circuit” fault codes, the open circuit is probably caused by a faulty ECM.

D. On six cylinder engines, disconnect the harness from the suspect injector. Disconnect the harness from the injectors that share the same supply circuit as the suspect injector.

Note: On six cylinder engines, injectors 1, 2, and 3 share a common injector driver circuit in the ECM. Injectors 4, 5, and 6 share a common injector driver circuit in the ECM. If the three injectors that share a common supply indicate “Open Circuit” fault codes, the open circuit is probably caused by a faulty ECM.

E. Thoroughly clean the terminals on the injectors and on the harness connectors.

F. Exchange the harness between two of the injectors that share the common driver.

G. Turn the keyswitch to the ON position.

H. Perform the “Injector Solenoid Test” at least two times.

Expected Result:

Exchanging the harness between the two injectors caused the fault to move to the other injector.

Results:

- OK – There is a fault with the injector harness under the valve cover.

  Repair: Repair the injector harness or replace the injector harness under the valve cover.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

- Not OK – The injector may be faulty.

  Repair: Replace the faulty injector. Refer to Disassembly and Assembly, “Electronic Unit Injectors - Remove” and Disassembly and Assembly, “Electronic Unit Injectors - Install”.

  Restore the wiring to the correct injectors.

  Perform the “Injector Solenoid Test”.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 7. Check the ECM for an Open Circuit

⚠ WARNING

Electrical shock hazard. The electronic unit injector system uses 67-73 volts.

A. Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF.

B. Disconnect connector P2 from the ECM.

C. Remove the supply wire and the return wire for the suspect injector from connector P2. Install a jumper wire into connector P2 in order to provide a short between the supply and the return of the suspect injector.

D. Reinstall connector P2 to the ECM.

E. Turn the keyswitch to the ON position.

F. Perform the “Injector Solenoid Test” at least two times.

Expected Result:

Perkins EST displays “Current Above Normal” for the cylinder with the jumper wire.

Note: On four cylinder engines, shorting a shared supply will affect the status of two injectors. Ignore the status of the other injector that is on the shared supply.

Note: On six cylinder engines, shorting a shared supply will affect the status of three injectors. Ignore the status of the other injectors that are on the shared supply.

Results:

- OK – The ECM is OK.

  Repair: On four cylinder engines, if the two injectors that share a supply indicate “Open Circuit” fault codes, the open circuit is probably caused by a faulty ECM.

  On six cylinder engines, if the three injectors that share a supply indicate “Open Circuit” fault codes, the open circuit is probably caused by a faulty ECM.

  Repair the engine harness or replace the engine harness, as required.

Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

STOP.

- Not OK – There may be a fault with the ECM.

  Repair: Temporarily connect a test ECM.

  Remove the jumper wire from connector P2 and reinstall the injector wires.

  Perform the “Injector Solenoid Test”.

  If the test ECM fixes the fault, reconnect the suspect ECM.

  If the fault returns with the suspect ECM, replace the ECM. Refer to the Troubleshooting Guide, “Replacing the ECM”.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 8. Check the Harness between the ECM and the Valve Cover Base for a Short Circuit

⚠ WARNING

Electrical shock hazard. The electronic unit injector system uses 67-73 volts.

A. Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF.

B. Disconnect the connectors from the valve cover base.

C. Turn the keyswitch to the ON position.

D. Perform the “Injector Solenoid Test” at least two times.

Expected Result:

All cylinders indicate “Current Below Normal”.

Results:

- OK – All cylinders indicate “Current Below Normal”. Proceed to Test Step 10.
- Not OK – One or more cylinders indicate “Current Above Normal”. Note the cylinders that indicate “Current Above Normal”. Proceed to Test Step 9.

Test Step 9. Check the ECM for a Short Circuit

⚠ WARNING

Electrical shock hazard. The electronic unit injector system uses 67-73 volts.

A. Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF.

B. Disconnect connector P2 from the ECM and check for evidence of moisture entry.

C. Turn the keyswitch to the ON position.

D. Perform the “Injector Solenoid Test” at least two times.

Expected Result:

All cylinders indicate “Current Below Normal” when connector P2 is disconnected from the ECM.

Note: When the engine harness is disconnected, all of the diagnostic codes for supply voltage to the sensors will be active. This is normal. Clear all of the logged diagnostic codes after completing this test step.

Results:

- OK – The short circuit is in the engine harness.

  Repair: The fault is most likely in one of the wires to the injector. Inspect the connectors for moisture and for corrosion. Also, check the wire insulation for damage and for strands that are exposed.

  Repair the engine harness or replace the engine harness, as required. Clear all diagnostic codes after completing this test step.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

- Not OK – There may be a fault with the ECM.

  Repair: Temporarily connect a test ECM.

  Perform the “Injector Solenoid Test”.

If the test ECM fixes the fault, reconnect the suspect ECM.

If the fault returns with the suspect ECM, replace the ECM.

Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

STOP.

Test Step 10. Check the Engine Harness Under the Valve Cover for a Short Circuit

WARNING

Electrical shock hazard. The electronic unit injector system uses 67-73 volts.

A. Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF.

B. Remove the valve cover.

C. Disconnect each of the injectors that indicate a “Short” from the wiring harness. Ensure that each of the connectors from the disconnected injector harness does not touch any other components.

D. Turn the keyswitch to the ON position.

E. Perform the “Injector Solenoid Test” at least two times.

Expected Result:

All of the injectors that were disconnected indicate “Current Below Normal”.

Results:

- OK – All of the injectors that were disconnected indicate “Current Below Normal”.

  Repair: Leave the injector wires disconnected. The supply wire is not shorted to the engine.

  Proceed to Test Step 11.

- Not OK – One or more of the injectors that were disconnected indicate “Current Above Normal”.

  Repair: The fault is most likely in the supply to the injector. Inspect the connectors for moisture and for corrosion. Also, check the supply wire’s insulation for damage and for strands that are exposed.

  Repair the injector harness or replace the injector harness under the valve cover.

  Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

  STOP.

Test Step 11. Check for a Short Circuit in the Return Wire

WARNING

Electrical shock hazard. The electronic unit injector system uses 67-73 volts.

A. Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF.

B. Disconnect the connector P2 from the ECM.

C. Locate the terminal for the supply of the faulty injector in the connector P2. Measure the resistance from the terminal to the engine ground stud.

Expected Result:

The resistance is greater than 10 Ohms.

Results:

- OK – The resistance is greater than 10 Ohms.

  Repair: Reconnect connector P2.

  Replace the faulty injector.

  Perform the “Injector Solenoid Test”.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

- Not OK – There is a short in the return line.

  Repair: Disconnect the connectors from the valve cover base.

  Measure the resistance of the return wire between connector P2 and the engine ground stud.

  If the resistance is less than 10 Ohms, the fault is in the return wire between the ECM and the valve cover base.

  If the resistance is greater than 10 Ohms, the fault is in the return wire under the valve cover.

  Repair the injector harness or replace the injector harness.

Use the electronic service tool to clear all logged diagnostic codes and then perform the “Injector Solenoid Test” in order to verify that the repair eliminates the fault.

STOP.

i02500248

Mode Selection Circuit - Test

System Operation Description:

Use this procedure under the following circumstances:

- Diagnostic code 1743-02 has been generated.
- Check if the mode selector switch operates correctly.

The mode selector switch inputs provide the operator with the ability to select a maximum of four different modes of operation. Different modes of operation can be used in a particular situation by giving the operator a means to select the most efficient method of completing the required work.

Each mode has a single fuel limit map, a rated speed, and a matched fuel delivery. Each mode also has a specific droop value for throttle 1 and throttle 2.

For 1104D engines, refer to table 59 for a list of examples of different modes of operation.

For 1106D engines, refer to table 60 for a list of examples of different modes of operation. Refer to table 61 for a list of mode switch connections.

Table 59

Switch 2	Switch 1	Mode Number	1104D Engine Rating	Droop (%)(1)		
				Throttle 1	Throttle 2	Torque Speed Control
Open	Open	1	80 KW @ 2200 RPM	10	10	10
Open	Closed	2	80 KW @ 2200 RPM	5	2	0
Closed	Open	3	100 KW @2200 RPM	10	10	10
Closed	Closed	4	100 KW @ 2200 RPM	5	5	0

(1) Throttle droop can be configured in 1% increments.

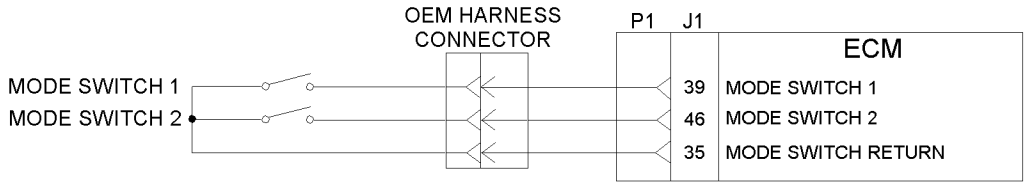
Table 60

Switch 2	Switch 1	Mode Number	1106D Engine Rating	Droop (%)(1)		
				Throttle 1	Throttle 2	Torque Speed Control
Open	Open	1	100 KW @ 2200 RPM	10	10	10
Open	Closed	2	100 KW @ 2200 RPM	5	2	0
Closed	Open	3	120 KW @2200 RPM	10	10	10
Closed	Closed	4	120 KW @ 2200 RPM	5	5	0

(1) Throttle droop can be configured in 1% increments.

Table 61

Function	P1 Connector Pin Assignment
Mode Switch 1	39
Mode Switch 2	46
Switch return (Ground)	35



g01210839

Illustration 85

Typical schematic for the mode selector switches

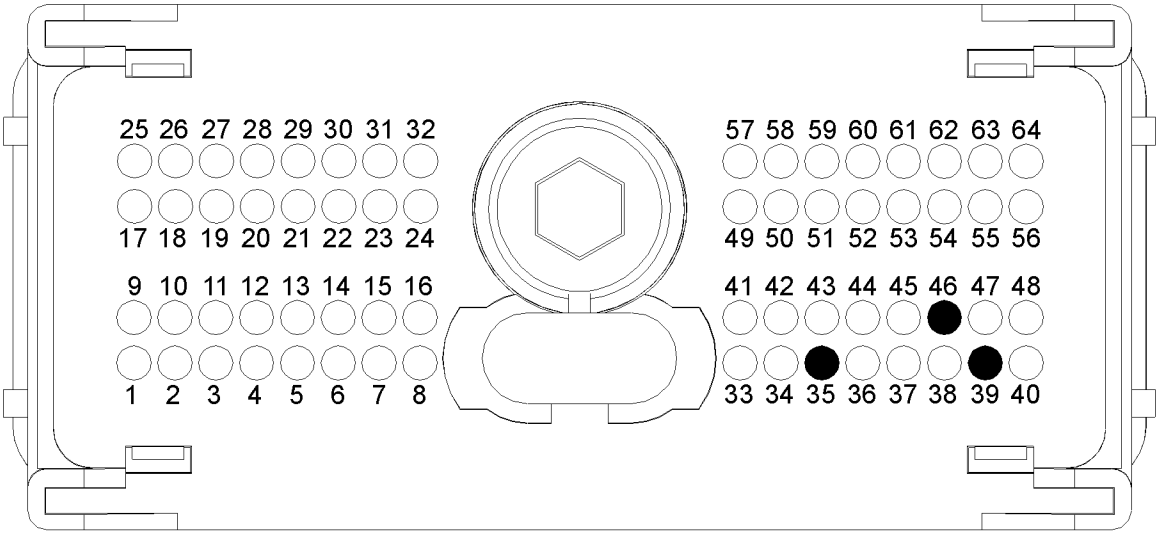


Illustration 86 g01174989

Typical view of the pin locations for the P1 OEM connector

(35) Mode switch return (GND) (39) Mode switch 1 (46) Mode switch 2

Test Step 1. Inspect Electrical Connectors and Wiring

A. Turn the keyswitch OFF.

B. Thoroughly inspect the P1 OEM connector. Thoroughly inspect the mode switch connectors, plugs and interconnections on the harness. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

C. Perform a 45 N (10 lb) pull test on each of the wires in the P1 OEM connector that are associated with the mode selector switches.

D. Check the screw for the Electronic Control Module (ECM) connector for the correct torque of 5.0 N·m (44 lb in).

E. Check the harness for abrasions and for pinch points from the battery to the ECM.

Results:

- OK – Proceed to Test Step 2.
- Not OK

  Repair: Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

- – If the fault has not been eliminated proceed to Test Step 2.

Test Step 2. Check the Status of the Mode Selector Switch

A. Turn the keyswitch to the OFF position.

B. Connect the Perkins Electronic Service Tool (EST) to the diagnostic connector.

C. Turn the keyswitch to the ON position.

D. Monitor the status screen on the Perkins EST. Cycle the mode switch to the ON position and to the OFF position.

Expected Result:

The switch status should change as you cycle the mode switches. When the switch is in the OFF position the switch has an open condition. When the switch is in the ON position the switch has a closed condition.

Results:

- OK

Repair: Verify that the status of the switch changes as the switch is cycled.

STOP.

- Not OK – There is a fault with the circuit for the mode selector switch. Proceed to Test Step 3.

Test Step 3. Insert a Jumper at the Suspect Mode Switch

A. Turn the keyswitch to the OFF position.

B. Perform the following procedure to test the circuit of mode selector switch No. 1. Place a jumper wire across the contacts of switch No. 1.

C. Perform the following procedure to test the circuit of mode selector switch No. 2. Place a jumper wire across the contacts of switch No. 2.

D. Turn the keyswitch to the ON position. Monitor the status screen on the Perkins EST. Connect the jumper wire. Monitor the Perkins EST status screen. Disconnect the jumper wire. Monitor the Perkins EST status screen.

Expected Result:

When the jumper wire is connected the switch should be in the CLOSED position.

Results:

- OK

  Repair: Verify that the jumper wire has been removed. The suspect mode selector switch is faulty. Replace the switch. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

  STOP.

- Not OK – Proceed to Test Step 4.

Test Step 4. Measure the Resistance of the Wire Harness at the ECM

A. Turn the keyswitch to the OFF position.

B. Disconnect the P1 OEM connector from J1.

C. Measure the resistance between P1:35 switch return and the following ECM pins:

- P1:46 Mode Switch No. 2
- P1:39 Mode Switch No. 1

D. Cycle each mode switch to the OFF position and to the ON position.

Expected Result:

The resistance is less than 10 Ohms in the mode switch ON position.

The resistance is more than 4000 Ohms in the mode switch OFF position.

Results:

- OK – There is no faults in the harness. Proceed to Test Step 5.
- Not OK – The fault is in the harness between the sensor connector and the P1 connector.

  Repair: Repair the connector or replace the connector. Use the electronic service tool to clear all diagnostic codes and then verify that the repair has eliminated the fault.

  Proceed to Test Step 5 if the fault has not been eliminated.

Test Step 5. Test the ECM

A. Turn the keyswitch to the OFF position.

B. Temporarily disconnect the P1 OEM connector from the ECM. Remove the pins 35, 39 and 46 from the P1 OEM connector.

C. Reconnect the P1 OEM connector.

D. Turn the keyswitch to the ON position. Monitor the status screen of the Perkins EST.

E. Disconnect the P1 OEM connector from J1.

F. Insert a jumper wire between the suspect switch socket and P1:35.

G. Turn the keyswitch to the ON position. Monitor the status screen of the Perkins EST.

Expected Result:

When the connections are removed from the P1 OEM connector, the mode switch indication on the Perkins EST will be in the OFF position. The switch will indicate an open condition.

When the jumper is connected to the P1 OEM connector, the mode switch indication on the Perkins EST will be in the ON position. The switch will indicate a closed condition.

Results:

- OK – The ECM is operating correctly. STOP.
- Not OK

Repair: If the fault has not been eliminated temporarily connect a test ECM. Remove all jumpers and replace all connectors. The test ECM should be programmed with the correct software. All parameters should be set to the same value of the suspect ECM.

If the fault is eliminated with the test ECM, reconnect the suspect ECM. If the fault returns with the suspect ECM, replace the suspect ECM.

Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

STOP.

i02491930

PTO Switch Circuit - Test

System Operation Description:

Use this procedure under the following circumstances:

- Verify that the PTO switches receive the correct supply voltage.
- Check that the PTO switches operate correctly.

Note: Some applications may only have one PTO switch.

Also, use this procedure if another procedure has directed you here.

The PTO switches provide the operator with the ability to select the desired engine speed. Engine speed will decrease with increasing load. The PTO switches can be used to control the engine speed.

The engine has the following options of set speed control:

- Single speed
- No speed (no PTO control)

The PTO switches are listed below:

- P1:52 PTO Control ON or P1
- P1:50 PTO Raise/Resume
- P1:51 PTO Set or Lower
- P1:49 (Clutch or Brake) PTO Disengage Switches

An indicator lamp is used to indicate the status of the PTO.

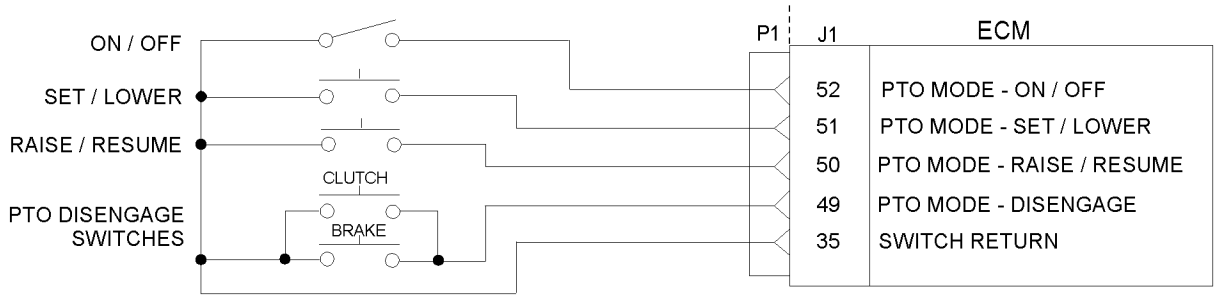


Illustration 87 g01245654

Schematic for the PTO switches

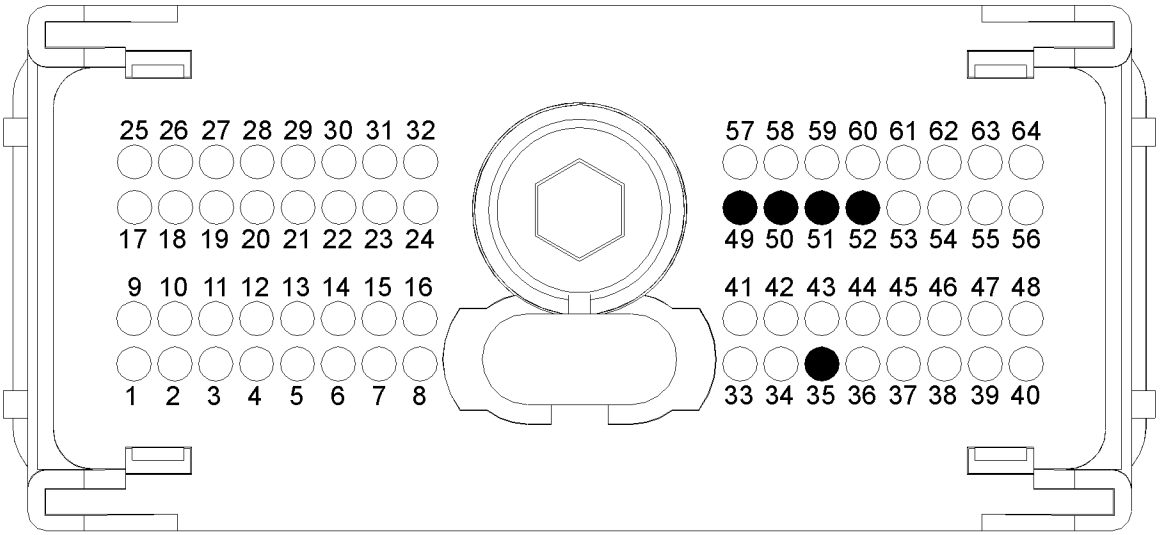


Illustration 88 g01187525

Typical view of the PTO switch pin locationson the P1 connector

(35) Switch Ground (GND)
(49) PTO mode - disengage
(50) PTO mode - raise/resume
(51) PTO mode - set/lower
(52) PTO mode - ON/OFF

Test Step 1. Inspect Electrical Connectors and Wiring

A. Turn the keyswitch to the OFF position.

B. Thoroughly inspect the J1/P1 connector on the Electronic Control Module (ECM), the switch connections and battery connections. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

C. Perform a 45 N (10 lb) pull test on each of the wires in the sensor connector and the ECM connector that are associated with the active diagnostic code. Refer to illustration 88.

D. Verify that the latch tab of the connector is correctly latched. Also verify that the latch tab of the connector has returned to the fully latching position.

E. Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in).

F. Check the harness for corrosion, abrasion, and pinch points from the throttle switch to the ECM.

Expected Result:

All connectors, pins and sockets should be completely inserted and coupled. The harness should be free of corrosion, abrasion and pinch points.

Results:

- OK – Proceed to Test Step 2.
- Not OK

  Repair: Repair the circuit.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 2. Check the "PTO Mode Switches" on the Perkins Electronic Service Tool (EST)

A. Turn the keyswitch to the OFF position.

B. Connect the Perkins Electronic Service Tool (EST) to the diagnostic connector.

C. Turn the keyswitch to the ON position.

D. Observe the status of the PTO mode switch on the Perkins EST while you operate the "PTO ON/OFF switch" from the ON position to the OFF position.

E. Use the Perkins EST in order to observe the status of the PTO mode switch while you operate the "PTO Set/Lower switch" from the OFF position to the ON position.

F. Use the Perkins EST in order to observe the status of the PTO mode switch while you operate the "PTO Raise/Resume switch" from the OFF position to the ON position.

Expected Result:

Result 1 The Perkins EST will show that the "PTO mode ON/OFF switch" is in the OPEN condition when the control switch is OFF.

The Perkins EST will show that the "PTO mode ON/OFF switch" is in the CLOSED condition when the control switch is ON.

Note: The PTO mode lamp should be OFF when the switch is in the OFF position. The lamp should be flashing when the switch is in the ON position.

Result 2 When the "PTO mode Set/Lower switch" is in the OFF position the switch should be in the OPEN position.

When the "PTO mode Set/Lower switch" is in the ON position the "PTO mode Set/Lower switch" should be in the CLOSED position.

Result 3 When the "PTO mode Raise/Resume switch" is in the OFF position the display screen should show an OPEN condition.

When the "PTO mode Raise/Resume switch" is in the ON position the display screen should show a CLOSED condition.

Note: The "PTO mode lamp" will flash when the "PTO mode" is switched ON. The PTO mode lamp should change from flashing to ON when the PTO mode Set/Lower switch is CLOSED. The PTO mode lamp should change from flashing to ON when the PTO mode Raise/Resume switch is CLOSED.

Results:

- OK – The PTO mode switches operate correctly. STOP.
- Not OK – Proceed to Test Step 3.

Test Step 3. Check the Status of the PTO Mode Disengage Switches

A. Use the Perkins EST in order to observe the switch status while the PTO mode disengage switches are operated OFF and ON.

Note: The PTO mode disengage switches usually function by the operation of the brake, clutch or the operator switch. These switches should be operated separately for this test.

Expected Result:

When the PTO mode is switched ON, the Perkins EST will show that the "PTO mode disengage switches" are in the "ENGAGED" position. If the "PTO mode disengage switches" is activated, the Perkins EST will show the status of the "PTO mode disengage switches". If the "PTO mode disengage switches" are activated, the Perkins EST will show that the "PTO mode disengage switches" are in the "DISENGAGED" position.

Results:

- OK – The "PTO mode disengage switches" operate correctly. STOP.
- Not OK – Proceed to Test Step 4.

Test Step 4. Check the Suspect PTO Switch

A. Turn the keyswitch to the OFF position.

B. Remove the two wires from the suspect switch. Use a suitable jumper in order to join the two wires together.

C. Turn the keyswitch to the ON position.

D. Monitor the status screen on the Perkins EST while the jumper wire is being disconnected and reconnected.

Expected Result:

When the jumper wire is connected the status of the PTO mode switches should be “CLOSED”.

When the jumper wire is disconnected the status of the PTO mode switches should be “OPEN”.

Results:

- OK – The switch is faulty.

  Repair: Replace the switch. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

  STOP.

- Not OK – There is a fault with the harness between the PTO mode switches and the engine ECM. Proceed to Test Step 5.

Test Step 5. Measure the Resistance of the Cables at the ECM

A. Turn the keyswitch to the OFF position.

B. Connect the cables to the suspect switch.

C. Disconnect the P1 connector from the ECM.

D. Measure the resistance between P1:35 and the appropriate pin on the P1 connector for the suspect switch. Refer to illustration 87.

E. Repeat the procedure for each of the PTO mode switches.

Expected Result:

The measured resistance should be less than 10 Ohms with the switch ON.

The measured resistance should be more than 20,000 Ohms with the switch OFF.

Results:

- OK – Proceed to Test Step 6.

- Not OK – There is a fault with the wires between the suspect switch and the P1 connector.

  Repair: Repair the wires or replace the wires.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

  STOP.

Test Step 6. Test the Engine ECM

A. Turn the keyswitch to the OFF position.

B. Disconnect the P1 OEM connector from the ECM.

C. By using a suitable pin removal tool, temporarily remove the wires from the suspect switch socket. Use a suitable pin removal tool to temporarily remove the wires from the P1:35.

D. Insert a jumper wire between the suspect switch socket and P1:35.

E. Turn the keyswitch to the ON position.

F. Monitor the status screen on the Perkins EST while the jumper wire is being disconnected and reconnected.

Expected Result:

The status screen should display an OPEN condition with the switch in the OFF position.

The status screen should display a CLOSED condition with the switch in the ON position.

Results:

- OK – The ECM is working correctly. STOP.

- Not OK – The ECM is not working correctly.

  Repair: Temporarily connect a test ECM.

  The test ECM should be programmed with the correct software. All parameters should be set to the same values as the suspect ECM.

  If the fault is eliminated with the test ECM, reconnect the suspect ECM.

  If the fault returns with the suspect ECM, then the suspect ECM is faulty.

  Replace the suspect ECM.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

  STOP.

i02491965

Starting Aid (Glow Plug) Relay Circuit - Test

System Operation Description:

Use this procedure if another test procedure has directed you here. Also use this procedure when there is an active fault for the glow plug start aid relay current.

Use this procedure for the following diagnostic codes:

- 2246-06 Glow Plug Start Aid Relay Current above normal

The following background information is related to this procedure:

The starting aid is used to improve the engine starting when the engine is cold. With the keyswitch in the ON position, the engine Electronic Control Module (ECM) will monitor the coolant temperature and the engine intake manifold air temperature in order to decide if the glow plugs are required to be switched ON. If the glow plugs are required, then the ECM will activate the starting aid relay for a controlled period of time. While the glow plug start aid relay is activated the glow plug start aid relay will switch power to the glow plugs. If a “Wait To Start” lamp is installed then this will be illuminated in order to indicate the “Wait To Start” period.

“Wait to Start/Start Aid Active Lamp”

This feature may be included as an option.

On a cold start, when the ECM decides that it is necessary for the glow plugs to be activated prior to starting, a lamp output will indicate that the operator needs to “Wait to Start”. It is possible that starting aids may be used during the cranking of the engine. Starting aids may be used if the engine has previously been started. The “Wait to Start” lamp will not be active in these conditions.

Perkins Electronic Service Tool (EST) Test Aid

The Perkins Electronic Service Tool (EST) includes the test “Glow Plug Start Aid Override Test”. The “Glow Plug Start Aid Override Test” will assist the analysis of the cold starting aid.

Overview of the Glow Plug Override Test

This glow plug start aid override test switches on the cold starting aid when the engine is not running. The glow plug start aid override test aids the analysis of the circuit for the glow plug start aid relay.

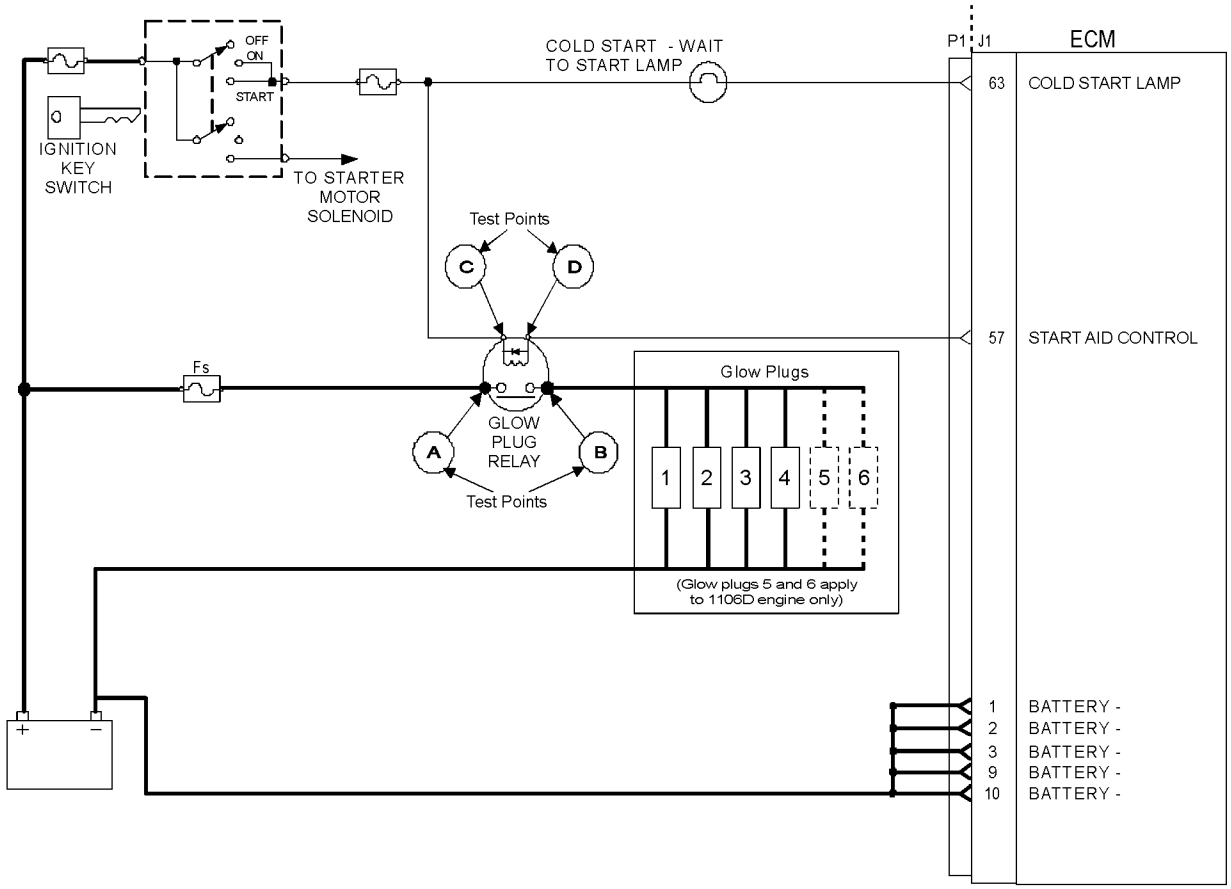


Illustration 89 g01245657

Typical schematic for the starting aid switch

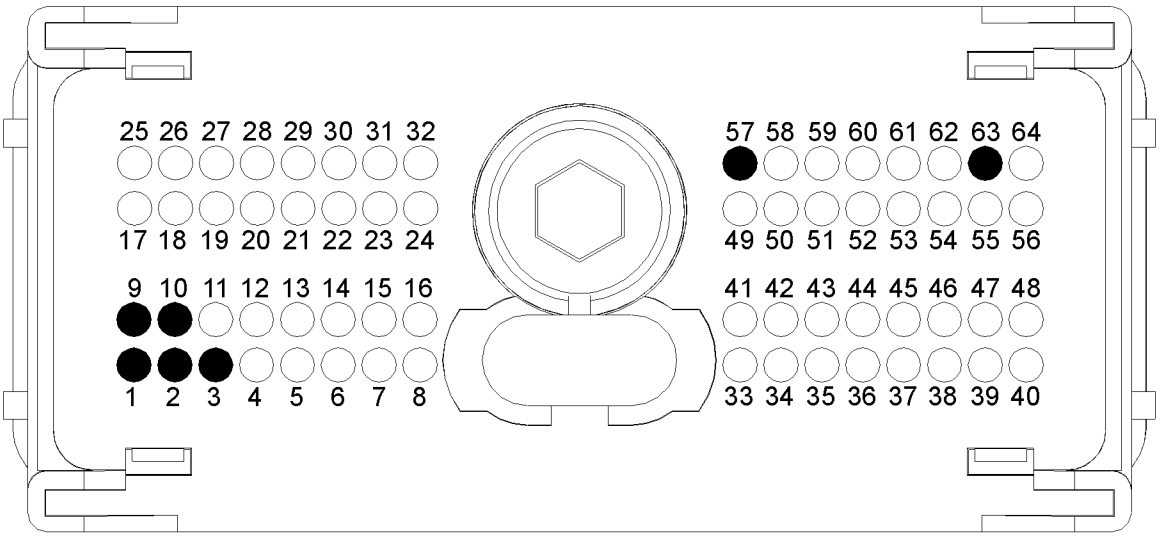


Illustration 90 g01205132

Typical view of the P1 OEM connector pin locations

(1) Ground (GND)
(2) Ground (GND)
(3) Ground (GND)
(9) Ground (GND)
(10) Ground (GND)
(57) Start aid control
(63) Cold start lamp

Test Step 1. Inspect Electrical Connectors and Wiring

A. Inspect the following connectors:

- P1 OEM connector
- P2 OEM connector

B. Inspect the terminal connections on the glow plug start aid relay. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

C. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the glow plug starting aid.

D. Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in).

E. Check the harness for abrasion and pinch points from the glow plugs back to the ECM.

F. Check that the fuses are not blown.

Expected Result:

All connectors, pins and sockets are correctly coupled and/or inserted. The harness is free of corrosion, abrasion and pinch points. The fuses are not blown.

Results:

- OK – The harness and the connectors appear to be OK. Proceed to Test Step 2.
- Not OK – There is a fault with the harness and connectors.

  Repair: Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled. Replace blown fuses.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

  STOP.

Test Step 2. Check for Active Diagnostic Codes

A. Connect the Perkins EST to the diagnostic connector.

B. Turn the keyswitch to the ON position.

Note: The engine has not been started at this Test Step.

C. Use the Perkins EST to select the “Glow Plug Override Test” in order to turn on the power for the glow plugs.

D. Check for active diagnostic codes or recently logged diagnostic codes.

Expected Result:

The following diagnostic code is active or recently logged:

- 2246-06 Glow Plug Start Aid Relay Current above normal

Results:

- OK – The expected diagnostic code is active or recently logged. Proceed to Test step 3.
- Not OK – An active diagnostic code or a recently logged diagnostic code was not displayed.

  Repair: Perform one of the following procedures:

  - If an intermittent fault is suspected, use the Perkins EST to perform a “Wiggle Test” in order to locate intermittent connections.
  - If there is a fault on the glow plug or a fault on the starting aid and a diagnostic code is not displayed then there may be a fault with the glow plug switched power circuit or there may be an open circuit in the relay coil circuit. The ECM does not monitor the status of these tests. Refer to Testing and Adjusting, “Glow Plugs - Test”.

  STOP.

Test Step 3. Check the Wiring for a Short Circuit

A. Turn the keyswitch to the OFF position.

B. Remove the P1 connector from the ECM.

C. Check the connector, pins and the sockets for corrosion or damage.

D. Check the resistance between P1:57 and each of the pins on the P1 connector.

Expected Result:

The resistance between P1:57 and each of the pins on the P1 connector is more than 10,000 Ohms.

Results:

- OK – The harness connects the ECM to the glow plug start aid relay and there are no shorts to other circuits. The ECM or the glow plug start aid relay is suspect. Proceed to Test Step 4.
- Not OK – The harness is faulty.

  Repair: If the resistance between P1:57 and each of the other pins on the P1 connector is less than 10,000 Ohms then there is a short circuit or high resistance in the connection to another wire. Locate the open circuit, the short circuit or high resistance in the connection in the harness. Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are correctly coupled. Replace any fuses that may be open circuit.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

  If the fault still exists, proceed to Test Step 4.

Test Step 4. Bypass the ECM In Order to Check the Operation of the Glow Plug Start Aid Relay

A. Turn the keyswitch to the OFF position.

B. Disconnect the connection from test point “D” on the glow plug start aid relay.

C. Connect a jumper wire between the battery ground and terminal “D” on the glow plug start aid relay.

D. Measure the voltage from the battery ground and terminal “B” on the glow plug start aid relay.

E. Connect a multimeter between terminal “B” on the glow plug start aid relay and the battery ground.

F. Turn the keyswitch to the ON position.

Note: The engine has not been started at this Test Step.

G. Use the electronic service tool in order to operate the glow plugs.

H. Measure the voltage from the battery ground and terminal “B” on the glow plug start aid relay.

Expected Result:

The keyswitch is in the OFF position. The voltage should be 0 VDC.

The keyswitch is in the ON position. The measured voltage for the 12 Volt systems is a constant 10.5 to 13.5 VDC. The measured voltage for the 24 Volt systems is a constant 21.0 to 27.0 VDC.

Results:

- OK – The glow plug start aid relay is operating correctly. Reconnect the connection to test point “D” on the glow plug start aid relay. Proceed to Test Step 5.
- Not OK – The glow plug start aid relay is faulty.

  Repair: Replace the glow plug start aid relay. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  If the fault still exists, proceed to Test step 5.

Test Step 5. Check the ECM

A. Disconnect the P2 connector and disconnect the P1 connector from the ECM.

B. Temporarily connect a test ECM. The test ECM should be programmed with the same values and parameters as the suspect ECM.

C. Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in).

D. Ensure that all connectors, pins and sockets are correctly coupled and/or inserted.

E. Use the Perkins EST in order to perform a “Glow Plug Override Test”.

Expected Result:

The replacement ECM functions correctly. Performing the “Glow Plug Override Test” energizes the glow plugs.

Results:

- OK – Install the replacement ECM. Refer to “ECM Replacement”. STOP.

i02491969

Throttle Switch Circuit - Test

System Operation Description:

Use this procedure to troubleshoot the system under the following conditions:

- Use this procedure if another procedure has directed you here.

- There is an active diagnostic code or a recently logged diagnostic code that is related to the following:

- 0091-02 Throttle Position Sensor erratic, intermittent, or incorrect

- 0774-02 Secondary Throttle Position Sensor erratic, intermittent, or incorrect

Check that the software configuration on the Electronic Control Module (ECM) is correct for a multi-position throttle.

If the engine has an analog throttle with Idle Validation Switch (IVS), then refer to Troubleshooting, “Idle Validation Switch Circuit - Test”.

The throttle switch provides the operator with the ability to select the desired engine speed. The throttle switch configuration may be selected between 0 to 4 switches. A multi-position rotary switch may be used.

The throttle switch is typically connected to the four throttle inputs of the ECM. Each position generates a specific ON/OFF pattern on the throttle inputs. A diagnostic code is generated if a pattern that does not correspond with any of the switch positions is detected.

Once a diagnostic code is generated, the ECM ignores the throttle input signals. The desired engine speed is set to low idle if no alternative throttle is detected.

Voltage at the throttle inputs to the ECM should be 13.8 ± 0.5 VDC when the throttle inputs are open. The voltage should be less than 0.5 VDC when the throttle inputs are closed.

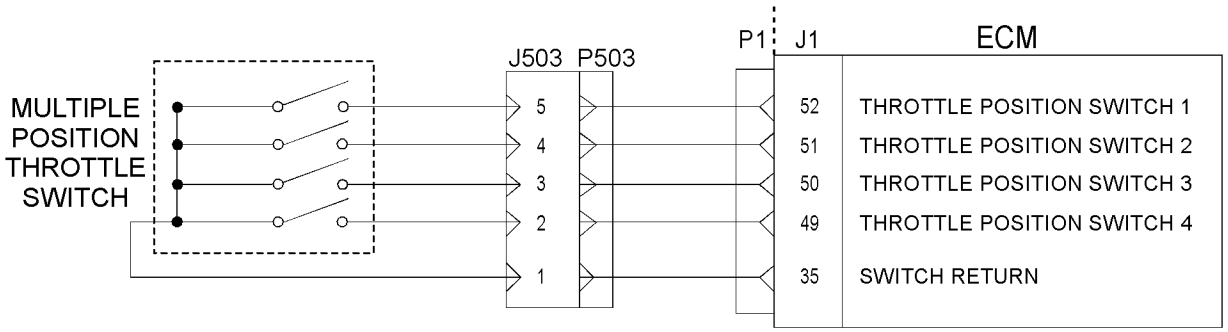


Illustration 91 g01245665

Schematic for the circuit for the throttle switch

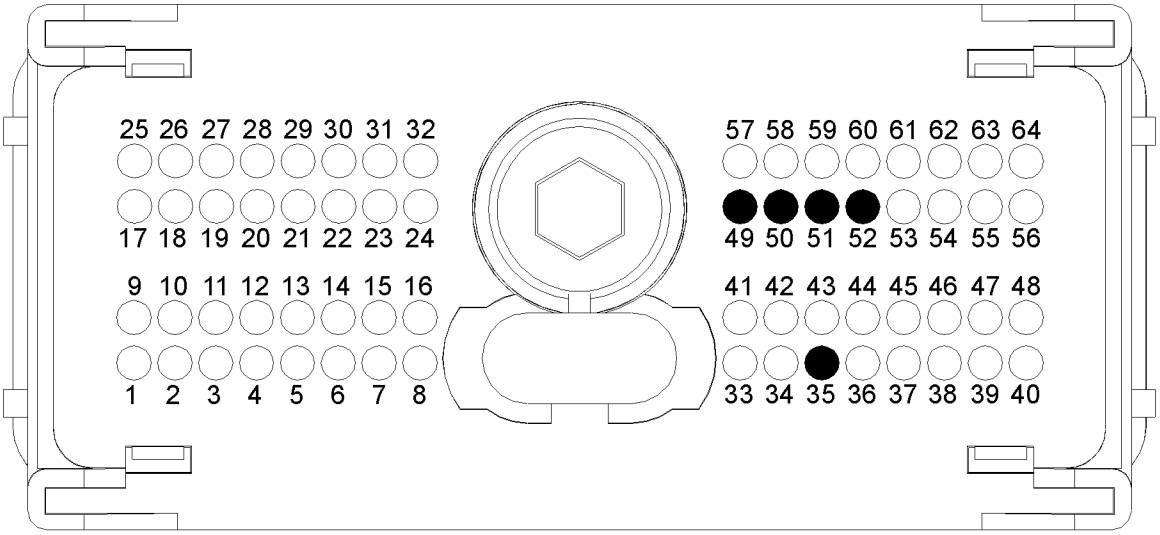


Illustration 92 g01193299

Typical view of the pin locations for the throttle switch on the P1 connector

(35) Switch return
(51) Throttle position switch 2
(49) Throttle position switch 4
(52) Throttle position switch 1
(50) Throttle position switch 3

Test Step 1. Inspect Electrical Connectors and Wiring

A. Turn the keyswitch to the OFF position.

B. Thoroughly inspect the P1/J1 connector and any other connectors that are included in the OEM application for this throttle switch. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

C. Perform a 45 N (10 lb) pull test on each of the wires in the sensor connector and the ECM connector that are associated with the active diagnostic code. Refer to illustration 92.

D. Verify that the latch tab of the connector is correctly latched. Also verify that the latch tab of the connector has returned to the fully latching position.

E. Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in).

F. Check the harness for corrosion, abrasion, and pinch points from the throttle switch to the ECM.

Expected Result:

All connectors, pins, and sockets should be completely inserted and coupled. The harness should be free of corrosion, abrasion and pinch points.

Results:

- OK – Proceed to Test Step 2.
- Not OK

  Repair: Repair the circuit.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 2. Check “Throttle Cab Switch Position” on the Perkins Electronic Service Tool (EST)

A. Connect Perkins Electronic Service Tool (EST) at the diagnostic connector.

B. Turn the keyswitch to the ON position.

C. Observe the status of the throttle switch and the throttle inputs on Perkins EST while you operate the throttle switch in each position.

Results:

- OK – The throttle switch is functioning correctly at this time.

  Repair: Refer to Troubleshooting, “Electrical Connectors - Inspect” if the fault is intermittent.

  STOP.

- Not OK – Record the suspect input. Proceed to Test Step 3.

Test Step 3. Jumper the Switch Input at the Throttle Switch Connector

A. Disconnect the throttle switch connector P503.

B. Observe the status of the suspect throttle input on Perkins EST.

C. Use a suitable jumper wire to short P503:1 to the terminal for the suspect throttle input at throttle switch connector P503.

D. Observe the status of the suspect throttle input on Perkins EST.

E. Remove the jumper wire.

Expected Result:

The status of the suspect throttle input should be OFF when throttle switch connector J503/P503 is disconnected. The status should be ON when the jumper wire is installed.

Results:

- OK – The harness and the ECM are OK.

  Repair: Replace the throttle switch.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

- Not OK – Proceed to Test Step 4.

Test Step 4. Check for Shorts in the Harness

A. Turn the keyswitch to the OFF position.

B. Disconnect the P1 connector and the throttle switch connector P503/J503.

C. Measure the resistance between engine ground and the terminal for the suspect throttle input at the throttle switch connector P503.

D. Measure the resistance between the terminal for the suspect throttle input at the throttle switch connector P503 and the remaining terminals at the connector.

Expected Result:

Resistance should be greater than 20,000 Ohms for each reading.

Results:

- OK – Proceed to Test Step 5.

- Not OK – There is a short in the harness between the ECM and the throttle switch.

  Repair: Repair the circuit.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 5. Check Resistance through the Harness

A. Use a jumper wire to short P503:1 to the terminal of the suspect throttle input at the throttle switch connector J503.

B. Measure the resistance between P1:35 and the terminal for the suspect throttle input on the P1 connector.

Expected Result:

Resistance should be less than 10 Ohms.

Results:

- OK – Proceed to Test Step 6.

- Not OK – There is an open circuit or excessive resistance in the harness.

  Repair: Repair the circuit.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 6. Check the Harness and the ECM

A. Turn the keyswitch to the OFF position.

B. Disconnect the P1 connector and remove the wire for the suspect throttle input from the P1 connector.

C. Reconnect all connectors.

D. Turn the keyswitch to the ON position.

E. Observe the status of the suspect throttle input on Perkins EST.

F. Turn the keyswitch to the OFF position.

G. Disconnect the P1 connector and remove the wire from P1:35.

H. Fabricate a jumper wire with pins at both ends. Insert the jumper wire at P1:35 and the suspect throttle input on the P1 connector.

I. Reconnect all connectors.

J. Turn the keyswitch to the ON position.

Note: Additional diagnostic codes will be generated because P1:35 will no longer be connected to other sensors and switches. Ignore the codes and clear the codes when you complete this test.

K. Observe the status of the suspect throttle input on Perkins EST.

L. Turn the keyswitch to the OFF position.

M. Remove the jumper wire from the P1 connector and reconnect all wires and connectors.

Expected Result:

The status of the suspect throttle input should be OFF when the throttle input is open. The status should be ON when the jumper wire is installed.

Results:

- OK – There is a fault in the harness between the ECM and the throttle switch.

  Repair: Repair the circuit.

  Verify that the repair eliminates the fault.

  STOP.

- Not OK – The switch signal appears at the ECM. The ECM is not reading the switch correctly.

  Repair: Verify your results. Replace the ECM. Refer to Troubleshooting, “Replacing the ECM” before replacing the ECM.

  STOP.

i02492077

Wastegate Solenoid - Test

System Operation Description:

Use this procedure under the following conditions:

Use this procedure if another procedure has directed you here. Use this procedure if any of the following diagnostic codes are active:

- 0526-05 Turbo Wastegate Drive current below normal
- 0526-06 Turbo Wastegate Drive current above normal
- 0526-07 Turbo Wastegate Drive not responding properly

Some engine models will have a turbocharger with an electronically controlled wastegate. Typically, the wastegate is a mechanical valve that is used in the turbocharger in order to regulate the intake manifold pressure to a set value.

The control system for the electronically controlled wastegate precisely regulates the intake manifold pressure by using a wastegate solenoid to control the wastegate.

The required intake manifold pressure is calculated by the software that is contained in the Electronic Control Module (ECM). The ECM uses the wastegate solenoid to control the wastegate in order to provide the precise value of intake manifold pressure. The wastegate solenoid is controlled by a PWM signal from the ECM.

Table 62

Pin Connections		
Sensor Pin	**Function**	**P2 Pin Connection**
1	Ground	44
2	Signal	17

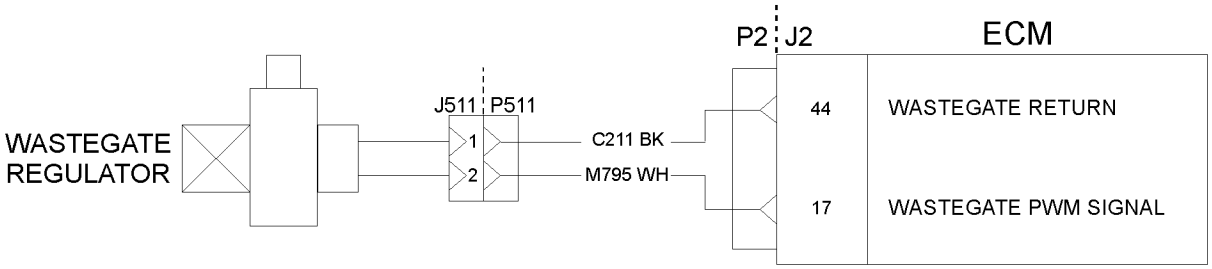


Illustration 93 g01245700

Schematic for the wastegate

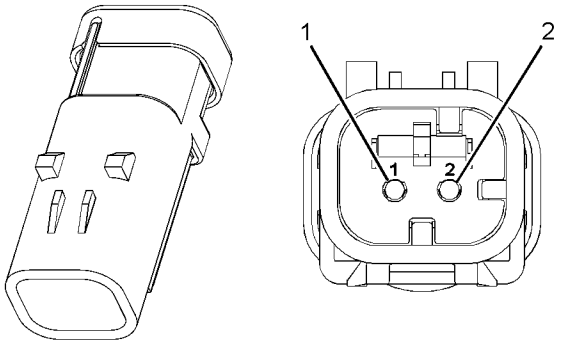


Illustration 94 g01245711

Wastegate connector

(1) Ground (GND) (2) Signal (SIG)

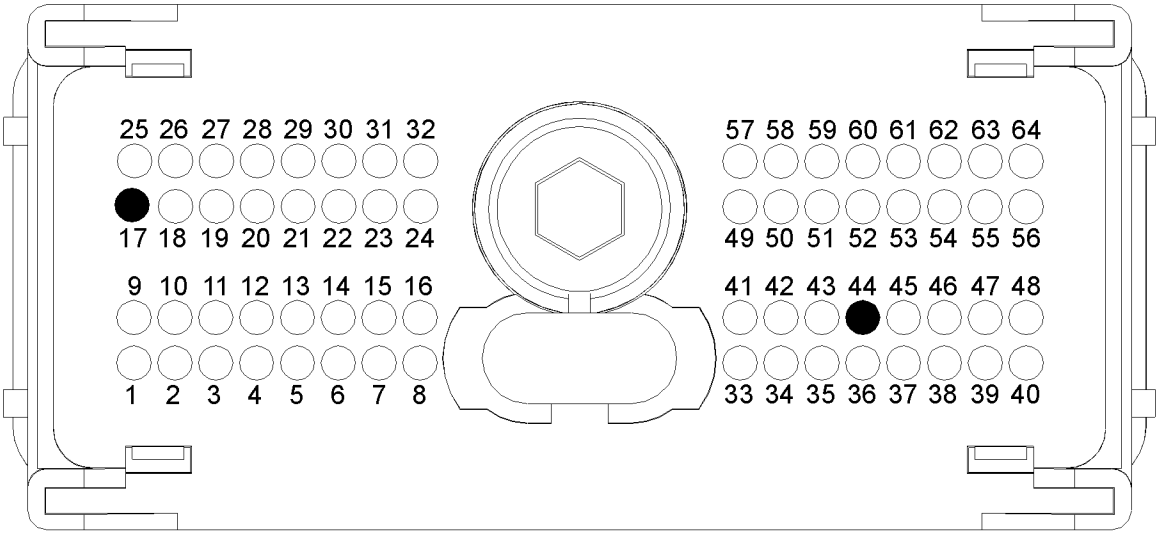


Illustration 95 g01172793

Typical view of the pin locations on the P1 connector

(17) Wastegate pulse width modulation (PWM) signal

(44) Wastegate return

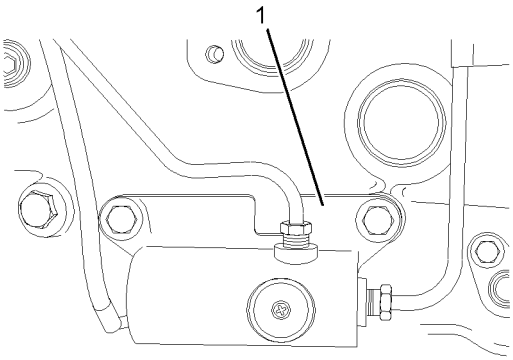


Illustration 96 g01172794

Wastegate solenoid

(1) Wastegate solenoid

Test Step 1. Check for Diagnostic Codes

A. Turn the keyswitch to the OFF position.

B. Connect the Perkins Electronic Service Tool (EST) to the data link connector.

C. Turn the keyswitch to the ON position. Start the Perkins EST.

D. Monitor the Perkins EST for active diagnostic codes and/or logged diagnostic codes.

Expected Result:

One or more diagnostic codes are active or logged.

Results:

- Diagnostic codes 526-5 and/or 526-6 are active and/or logged – Proceed to Test Step 2.
- No Codes – The fault seems to be resolved.

  Repair: For intermittent faults, refer to Troubleshooting, “Electrical Connectors - Inspect”.

  STOP.

Test Step 2. Inspect Electrical Connectors and Wiring

A. Thoroughly inspect the P2/J2 ECM connector and the P511 wastegate solenoid connector. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

B. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the wastegate solenoid.

C. Check the screw for the ECM connector for the correct torque of 5.0 N·m (44 lb in).

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted and the harness is free of corrosion, abrasion, and pinch points.

Results:

- OK – The harness is OK. Proceed to Test Step 3.

- Not OK – There is a fault in the connectors and/or the harness.

  Repair: Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly in place and ensure that the connectors are completely coupled.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

  STOP.

Test Step 3. Determine the Diagnostic Code that is Active

A. Turn the keyswitch to the ON position. Access the "Diagnostics Tests" on the Perkins EST. Activate the "Turbo Wastegate Solenoid Test". Wait at least 30 seconds in order for the result to be displayed.

B. Determine if the fault is related to either of the following:

- "Low current" (open circuit)
- "High current" (short circuit)

Expected Result:

The Perkins EST displays no diagnostic codes.

Results:

- OK – There are no active codes.

  Repair: The original codes may have been caused by a loose connector. If this is an intermittent fault, refer to Troubleshooting, "Electrical Connectors - Inspect".

  STOP.

- Not OK – Diagnostic code 526-5 is active at this time. Proceed to Test Step 4.
- Not OK – Diagnostic code 526-6 is active at this time. Proceed to Test Step 6.
- Not OK – Diagnostic code 526-7 is active at this time. Proceed to Test Step 4.

Test Step 4. Create a Short Circuit in the Harness at the Solenoid

A. Turn the keyswitch to the OFF position.

B. Disconnect the P511 turbo wastegate solenoid connector.

C. Fabricate a jumper wire between P511:1 and P511:2 in order to create a short circuit.

D. Turn the keyswitch to the ON position. Access the "Diagnostics Tests" on the Perkins EST. Activate the "Turbo Wastegate Solenoid Test". Wait at least 30 seconds in order for the result to be displayed.

E. Check for active diagnostic codes on the Perkins EST.

Expected Result:

Diagnostic code 526-6 is now active.

Results:

- OK – Diagnostic code 526-6 is now active. There is a problem with the solenoid.

  Repair: Perform the following procedure:

  1. Temporarily connect a replacement wastegate regulator.
  2. Turn the keyswitch to the ON position. Access the "Diagnostics Tests" on the Perkins EST. Activate the "Turbo Wastegate Solenoid Test". Wait at least 30 seconds in order for the result to be displayed.
  3. Diagnostic code 526-6 is no longer active.
  4. If the fault is eliminated, reconnect the suspect wastegate regulator. If the fault returns, permanently install the replacement wastegate regulator.

  STOP.

- Not OK – The low current diagnostic code (open circuit) is still active. Proceed to Test Step 5.

Test Step 5. Create a Short Circuit at the ECM

A. Turn the keyswitch to the OFF position.

B. Temporarily remove the wires from P2:17 and P2:44.

C. Fabricate a jumper wire between P2:17 and P2:44 in order to create a short circuit.

Note: The P2/J2 connector must be connected during the next step.

D. Turn the keyswitch to the ON position. Access the “Special Tests” under the “Diagnostics” menu on the Perkins EST. Activate the “Turbo Wastegate Solenoid Output” on the Perkins EST. Wait at least 30 seconds for activation of the diagnostic codes.

E. Check for active diagnostic codes on the Perkins EST.

Expected Result:

Diagnostic code 526-6 is now active.

Results:

- OK – Diagnostic code 526-6 is now active. There is a fault in the harness between the ECM and the solenoid.

  Repair: Repair the harness or replace the harness.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminated the fault.

  STOP.

- Not OK – There is still an open circuit diagnostic code.

  Repair: Perform the following procedure:

  1. Temporarily connect a test ECM. Refer to Troubleshooting, “Programming Parameters” before replacing the ECM.
  2. If the test ECM fixes the fault, reconnect the suspect ECM. If the fault returns, permanently install the replacement ECM.

  STOP.

Test Step 6. Disconnect the Solenoid in order to Create an Open Circuit

A. Turn the keyswitch to the OFF position.

B. Disconnect the P511 turbo wastegate solenoid connector in order to create an open circuit.

C. Turn the keyswitch to the ON position. Access the “Diagnostics Tests” on the Perkins EST. Activate the “Turbo Wastegate Solenoid Test”. Wait at least 30 seconds in order for the result to be displayed.

D. Check for active diagnostic codes on the Perkins EST.

Expected Result:

Diagnostic code 526-5 is now active.

Results:

- OK – Diagnostic code 526-5 is now active.

  Repair: There is a short in the solenoid.

  1. Temporarily connect a replacement wastegate regulator.
  2. If the fault is eliminated, reconnect the suspect wastegate regulator. If the fault returns, permanently install the replacement wastegate regulator.

  STOP.

- Not OK – Diagnostic code 526-6 is still active. Proceed to Test Step 7.

Test Step 7. Create an Open Circuit at the ECM

A. Turn the keyswitch to the OFF position.

B. Remove the wires from P2:17 and P2:44 in order to create an open circuit at the ECM.

C. Turn the keyswitch to the ON position. Access the “Diagnostics Tests” on the Perkins EST. Activate the “Turbo Wastegate Solenoid Test”. Wait at least 30 seconds in order for the result to be displayed.

D. Check for active diagnostic codes on the Perkins EST.

Expected Result:

Diagnostic code 526-5 is now active.

Results:

- OK – Diagnostic code 526-5 is now active. There is a short circuit in the harness between the ECM and the solenoid.

  Repair: Repair the harness or replace the harness.

  Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminated the fault.

  STOP.

- Not OK – Diagnostic code 526-5 is still present.

  Repair: Perform the following procedure:

  1. Temporarily connect a test ECM. Refer to Troubleshooting, “Programming Parameters” before replacing the ECM.

2. If the test ECM eliminates the fault, reconnect the suspect ECM. If the fault returns, permanently install the replacement ECM.

STOP.

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