

Troubleshooting

1106D Electric Power Generation (EPG)

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.



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.



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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Troubleshooting Section

Electronic Troubleshooting

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System Overview

System Operation

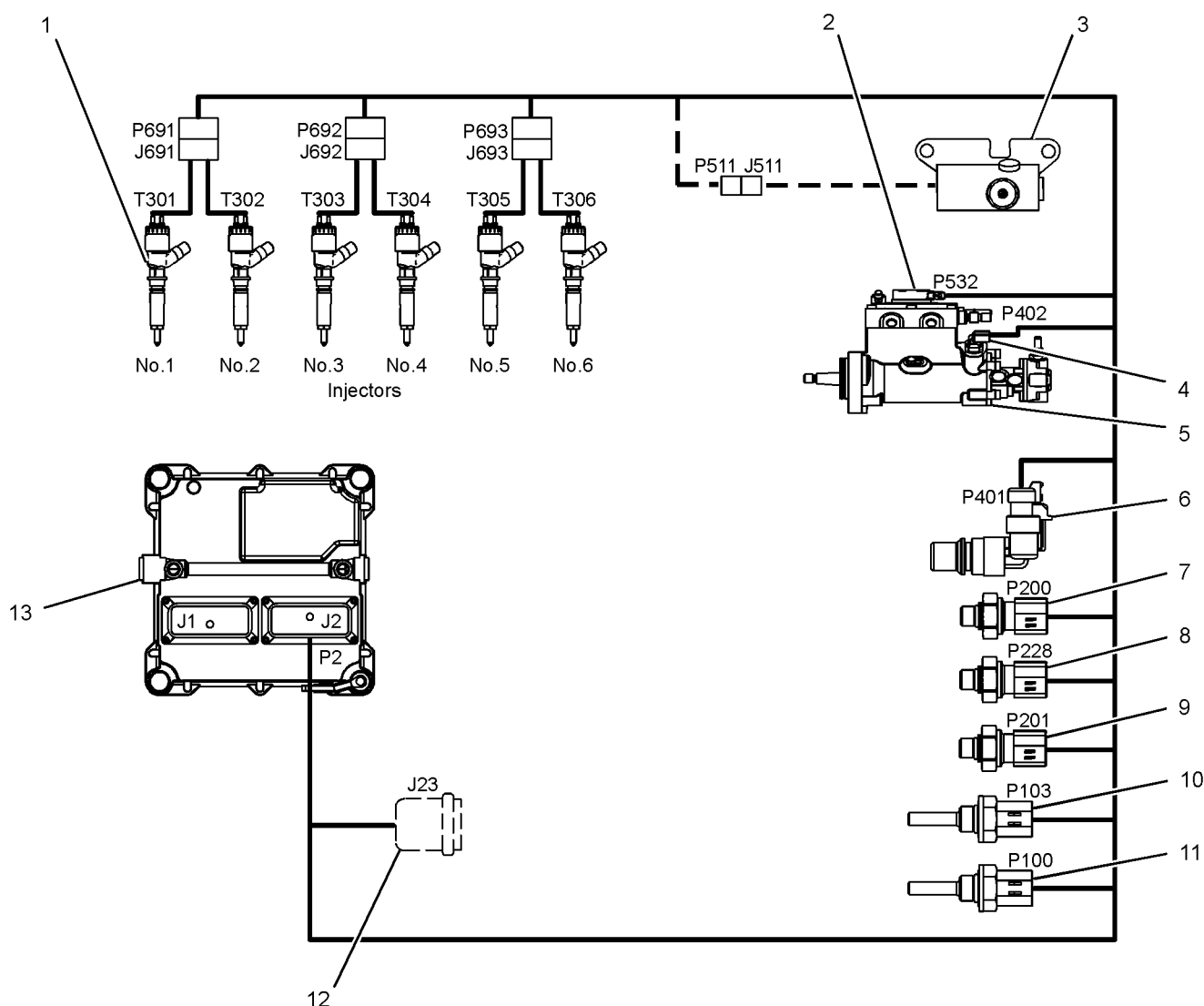


Illustration 1

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- (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 Temperature Sensor

- (11) Coolant Temperature Sensor
- (12) Diagnostic Connector (if equipped)
- (13) Electronic Control Module (ECM)

The 1106D engine was 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 personality module is the software for the computer. The personality module defines the following characteristics of the engine:

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

Engine Speed Governor

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.

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.

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
- Speed control device

At start-up, the ECM determines the top center position of the number 1 cylinder from the secondary speed/timing sensor in the fuel rail pump. The ECM decides 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 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. The actual timing can be viewed with an electronic service tool. Also, the desired timing can be viewed with an electronic service tool.

Fuel Injection

The personality module 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 air 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 air pressure, the ECM increases the FRC Limit. A higher intake manifold air 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 personality module and these limits cannot be changed by the operator.

Diagnostic Codes

When the ECM detects an electronic system problem, the ECM generates a diagnostic code. Also, the ECM logs the diagnostic code in order to indicate the time of the problem's occurrence. The ECM also logs the number of occurrences of the problem. Diagnostic codes are provided in order to indicate that the ECM has detected an electrical problem or an electronic problem 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 problem. Use the electronic service tool to access the diagnostic codes. The problem 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 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 emissions or power ratings within the engine. Factory passwords must be obtained and factory passwords must be used to change the System Configuration Parameters.

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.

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 the engine. 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 an electronic 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 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.

Ether Relay – The ether relay is used to actuate the ether injection system. The ECM controls the relay.

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.

13 – The device or the component is not calibrated.

14 and 15 – These locations are reserved for a future assignment.

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 number 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.

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

Power Cycling – Power cycling 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.

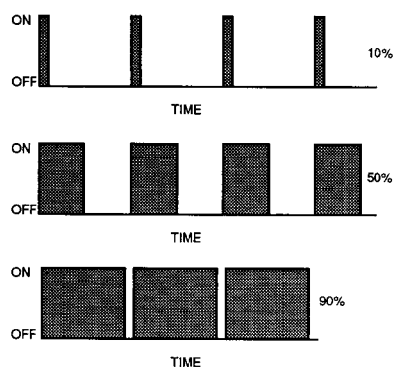


Illustration 2

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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 personality module 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.

Speed Demand Input – The speed demand input is a signal that is sent to the ECM in order to calculate desired engine speed.

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 speed controller.

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.

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

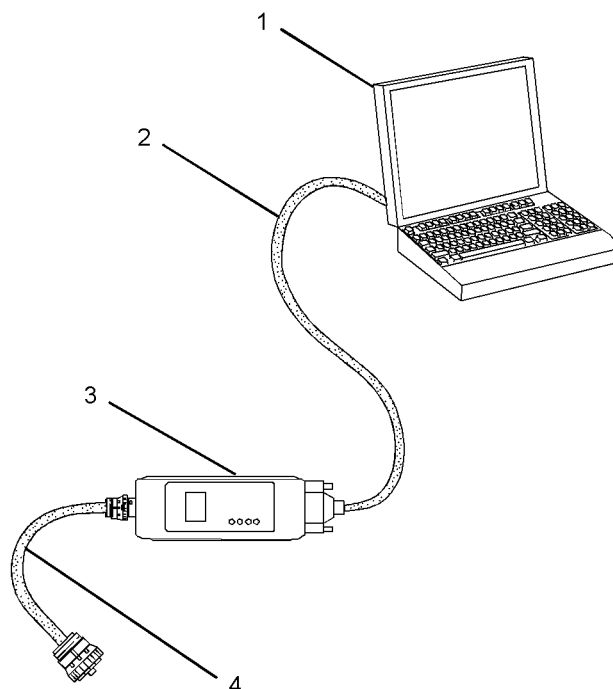


Illustration 3

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- (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 (4) 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".

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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.

Eight 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 “Low oil pressure”, “Overspeed”, “High Coolant Temperature”, “Diagnostic”, “Derate” and “Maintenance”.

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 the ON position, the lamp will come on for two seconds. The lamp will then go off unless there is an active warning.

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

Warning Lamp

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

On – The lamp will be on when the warning level has been reached.

Low Oil Pressure

Lamp check – When the keyswitch is turned to the ON position, the lamp will come on for two seconds.

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.

High Coolant Temperature Lamp

Lamp check – When the keyswitch is turned to the ON position, the lamp will come on for two seconds.

On – The lamp will come on when a “high coolant temperature” event is detected. The “Warning” lamp and the “Shutdown” lamp may also come on.

Overspeed Lamp

Lamp check – When the keyswitch is turned to the ON position, the lamp will come on for two seconds. The lamp will then go off unless the engine overspeeds.

On – The lamp will come on when an “engine overspeed” event is detected. The “Warning” lamp and the “Shutdown” lamp may also come on.

Derate Lamp

Lamp check – When the keyswitch is turned to the ON position, the lamp will come on for two seconds.

On – The lamp will come on when the engine is derated.

Diagnostic Lamp

Lamp check – When the keyswitch is turned to the ON position, the lamp will come on for two seconds.

Flashing – The lamp will flash when a diagnostic code or an event code is active. Refer to “Flash Codes”.

Maintenance Lamp

Lamp check – When the keyswitch is turned to the ON position, the lamp will come on for two seconds. The lamp will then go off unless maintenance is due.

On – The lamp will come on when maintenance is due.

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)	Diagnostic Lamp	Derate Lamp	Lamp State	Description of the Indication	Engine State
On	On	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	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	Flashing	Off	Warning (Warning only)	If the warning lamp comes on during engine operation, and the diagnostic lamp is flashing, the lamps indicate that one or more of the warning values for the engine protection strategy have been exceeded and that there is an active event code. 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.
On	Off	Flashing	On	Derate (Warning and Derate)	If both the warning lamp and the derate lamp come on during engine operation, and the diagnostic lamp is flashing, 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	Flashing	Off	Engine shutdown (Warning and shutdown)	If both the warning lamp and the shutdown lamp come on during engine operation, and the diagnostic lamp is flashing, the lamps indicate that one or more of the shutdown values for the engine protection strategy has been exceeded and there is an active event code.	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.
Off	Off	Flashing	Off	Diagnostic (Diagnostic only)	When the diagnostic lamp flashes during operation of the engine, the lamp indicates that an active diagnostic code (an electrical fault) is present. However, the diagnostic code is not serious enough to cause a derate or a shutdown.	The engine is operating but there is one or more faults with the electronic system for the engine.

(continued)

(Table 4, contd)

Off	Off	Flashing	On	Derate (Diagnostic and Derate)	If the derate lamp comes on during engine operation, and the diagnostic lamp is flashing, the lamps indicate that an active diagnostic code (an electrical fault) is present. The diagnostic code is serious enough to cause an engine derate.	The engine is operating. However, an active diagnostic code is causing an engine derate.
Off	On	Flashing	Off	Engine Shutdown	If the shutdown lamp comes on during engine operation, and the diagnostic lamp is flashing, this indicates that an active diagnostic code (an electrical fault) is present. The diagnostic code is serious enough to cause the engine to shutdown.	The engine is either shutdown or an engine shutdown is imminent. A serious diagnostic code is active.

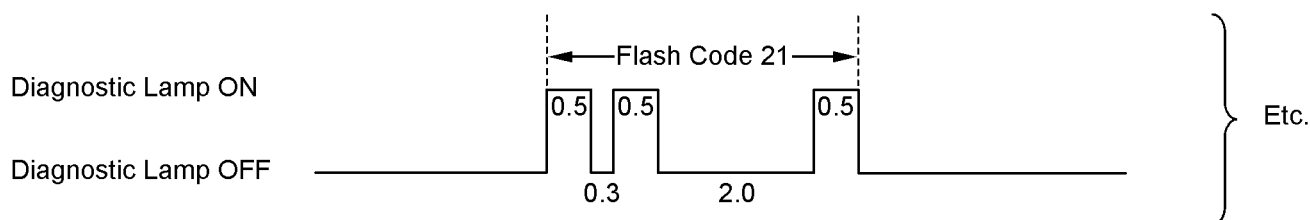
Flash Codes

The “Flash Code” feature is used to flash the two digit code of all active diagnostic and event codes. Refer to the Troubleshooting Guide, “Diagnostic Codes” for the flash code that is related to the diagnostic code or an event.

When a diagnostic code or an event code is active or logged, the diagnostic lamp will flash repeatedly in order to indicate the codes.

Each flash will be on for half a second and off for 300 milliseconds. The “Diagnostic” lamp will remain off for two seconds between each digit of a code. If there is more than one diagnostic code, the “Diagnostic” lamp will go off for five seconds. The lamp will then flash in order to indicate the next code.

As an example, an active diagnostic code of “21” is indicated by the “Diagnostic” 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.



Note: All times shown in seconds

Illustration 4

g02048816

Once all codes have been flashed, the “Diagnostic” lamp will go off for a period of 15 seconds before starting the sequence again.

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

i03805671

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 with the correct part number 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.

Note: If an ECM is intended to be used as a test ECM, "Test ECM Mode" must be selected on the electronic service tool before the engine serial number is entered.

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, an ECM can be used from an engine that is not in service. The ECM must have the same serial number suffix. Ensure that the replacement ECM and the part number for 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 4. 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 the Perkins intranet.

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. If the replacement ECM is intended to be used as a test ECM, select "Test ECM Mode" on the electronic service tool.

8. 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.
9. 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.
10. 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".

11. Check for logged diagnostic codes. Factory passwords are required to clear logged events.

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Self-Diagnostics

The Electronic Control Module (ECM) has the ability to detect faults in the electronic system and with engine operation. A self-diagnostic check is also performed whenever power is applied to the ECM.

When a fault is detected, a code is generated. An alarm may also be generated. There are two types of codes:

- Diagnostic codes
- Event codes

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

Diagnostic codes can have two different states:

- Active

- Logged

Active Code – An active diagnostic code indicates that an active fault 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 fault.

Logged codes may not indicate that a repair is needed. The fault may have been temporary. The fault 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 faults. Logged codes can also be used to review the performance of the engine and the electronic system.

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Sensors and Electrical Connectors

The Electronic Control Module (ECM) and the sensors are located on the left side of the engine. Refer to Figure 5.

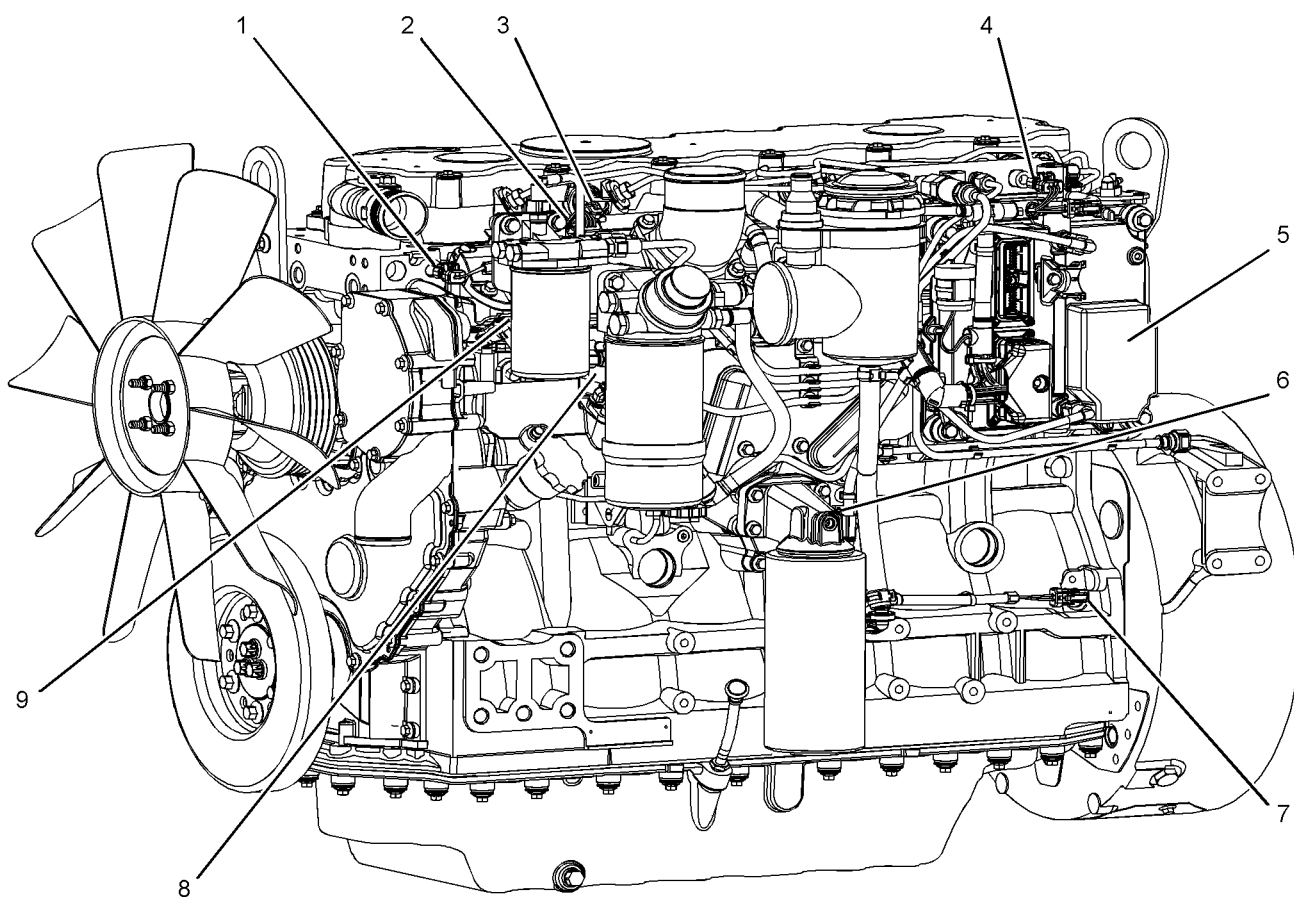


Illustration 5

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Sensor locations

- (1) Coolant Temperature Sensor
- (2) Intake Manifold 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.

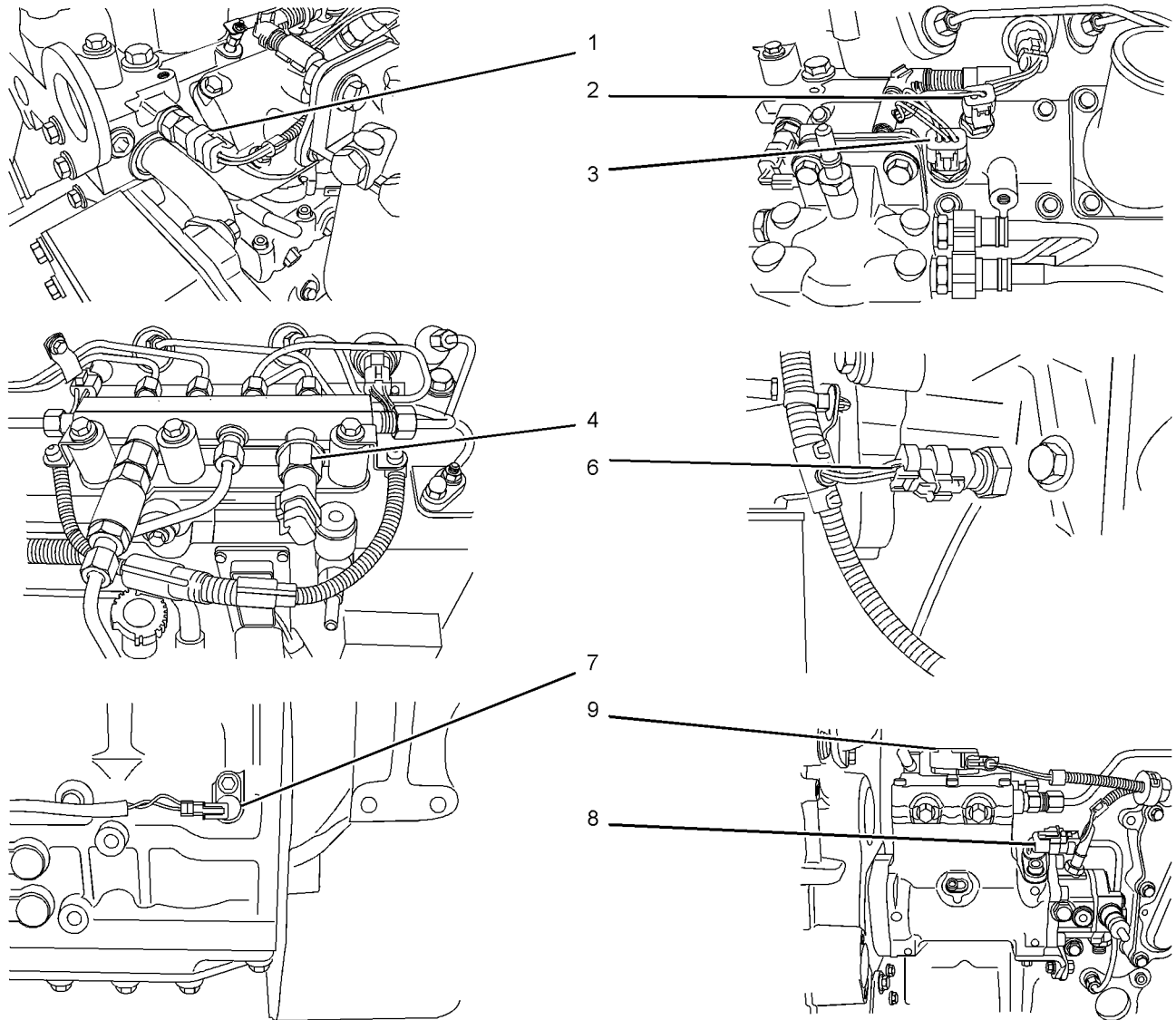


Illustration 6
Detailed views of the sensor locations

g01811835

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 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	Electronic Unit Injectors for No. 5 and No. 6 Cylinders (4 Pin Connector)
P511	Wastegate regulator (if equipped) (2 Pin Connector)

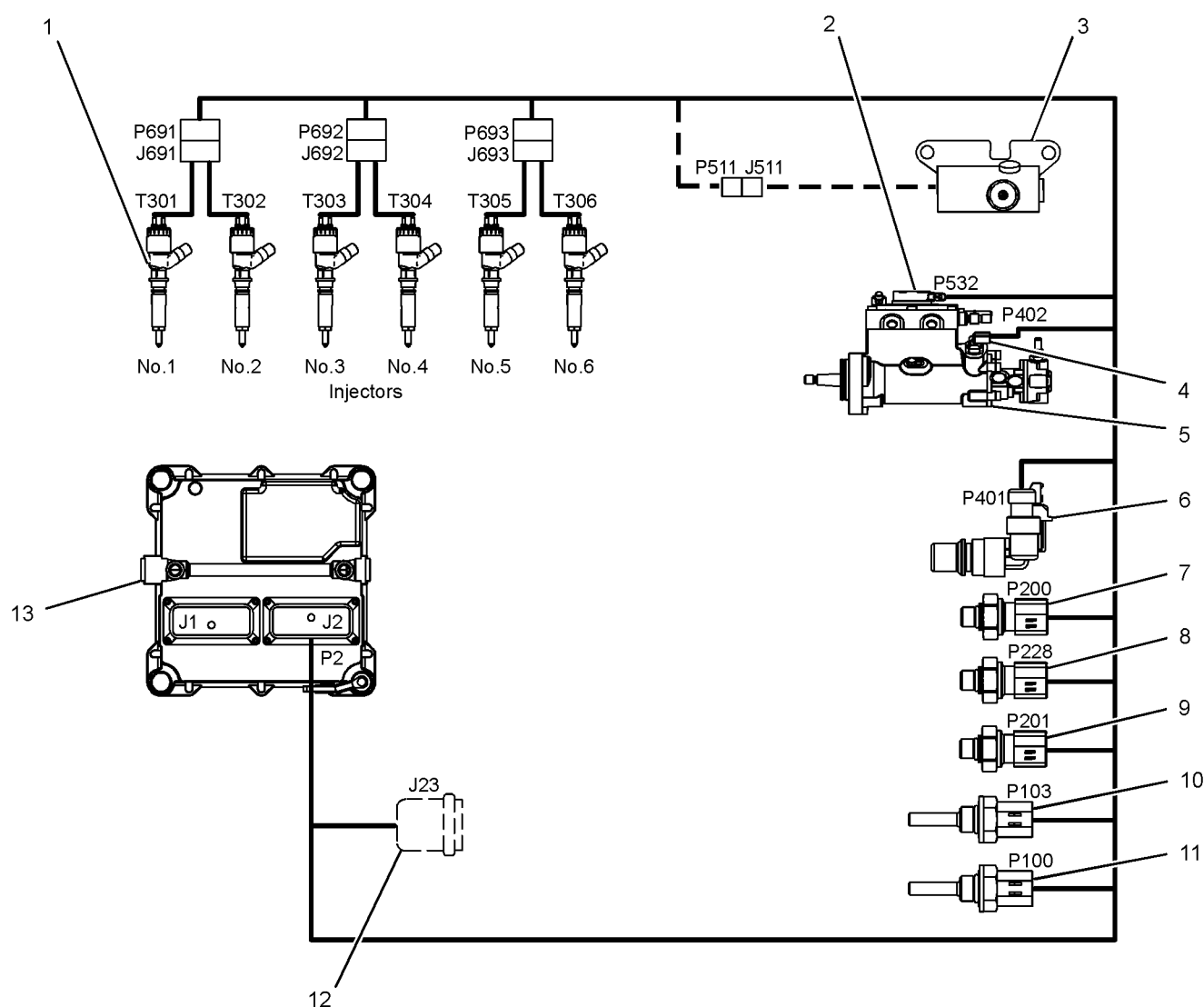


Illustration 7

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- (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 Temperature Sensor

- (11) Coolant Temperature Sensor
 (12) Diagnostic Connector (if equipped)
 (13) Electronic Control Module (ECM)

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Table 6

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.

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.

Schematic Diagrams

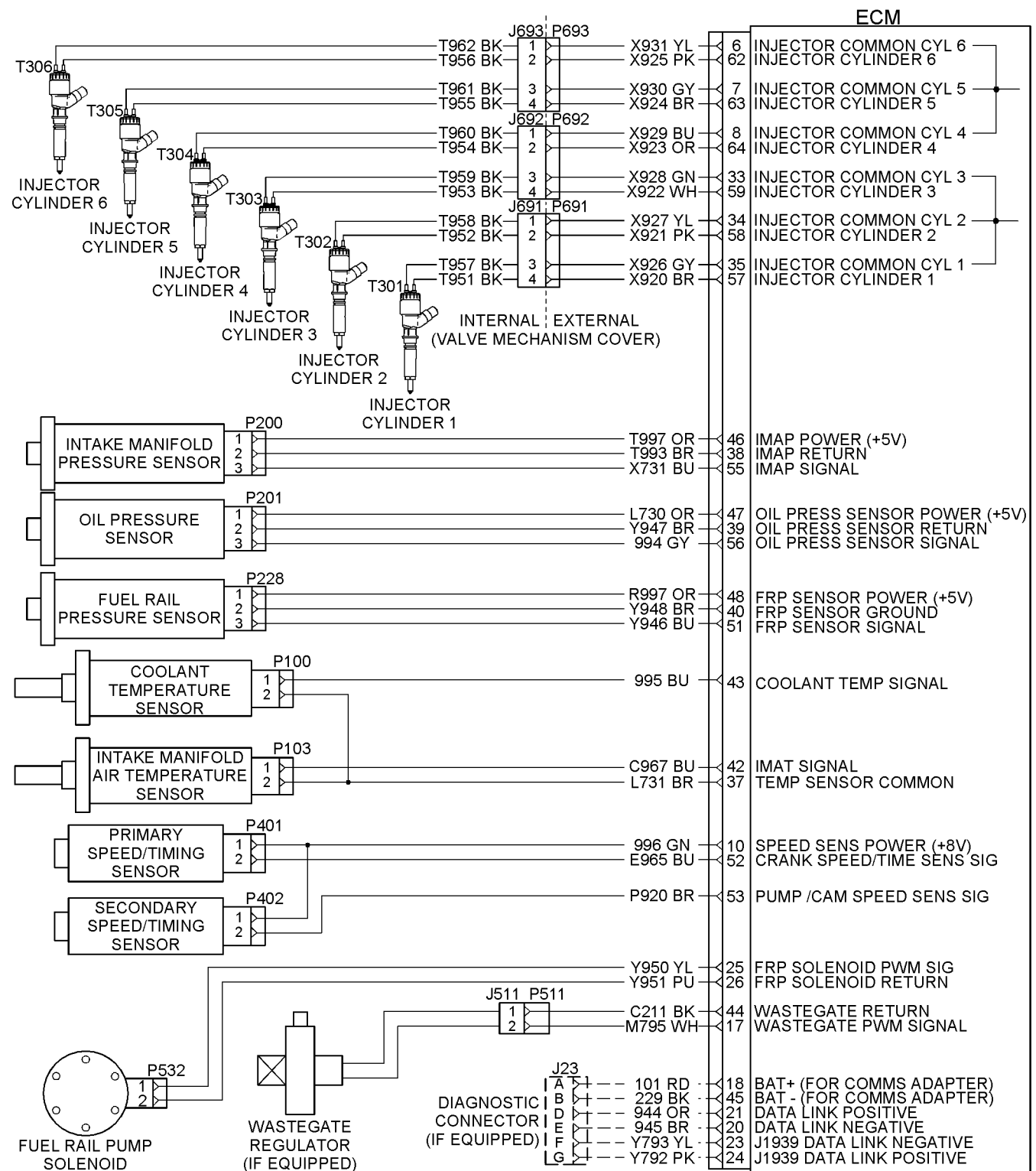


Illustration 8

Schematic Diagram for the Engine Harness

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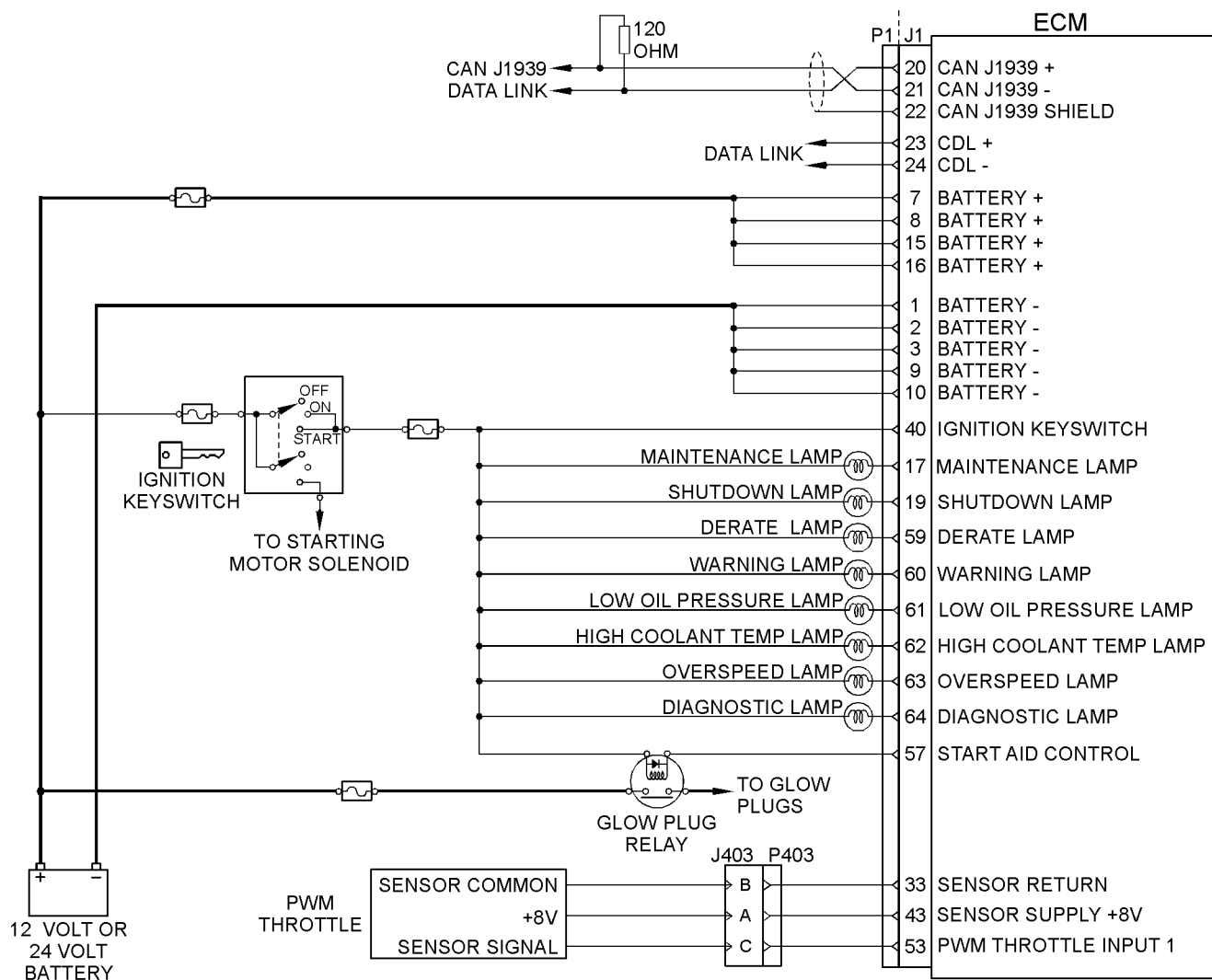


Illustration 9
Schematic Diagram for a Typical Application

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ECM Harness Connector Terminals

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

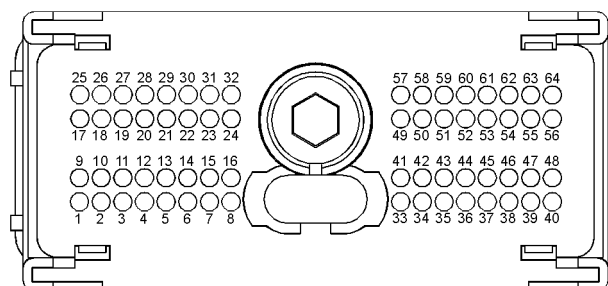


Illustration 10
Layout of the Connector Pins (view from the rear)

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Removal and Installation of the Harness Connector Terminals

Terminal Removal

Table 7

Required Tools		
Part Number	Part Description	Qty
27610285	Removal Tool	1

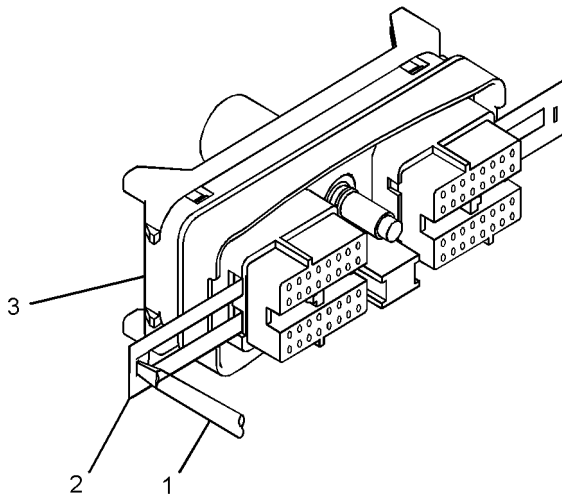


Illustration 11

g01784793

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.

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".

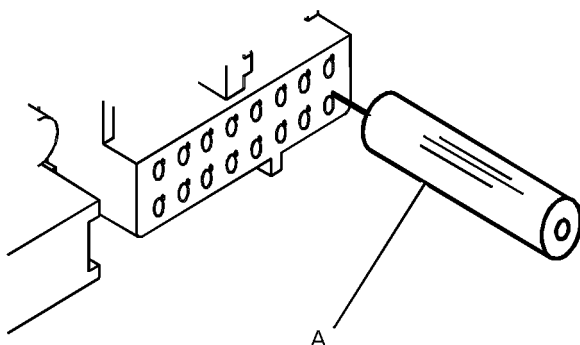


Illustration 12

g01784822

Removal Tool

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.

i03434204

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 fault in 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 rectify the fault, 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 rectifies the fault.

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 rectifies the fault, 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.

i03434261

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 a fault has been rectified. 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.

i03807230

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 program a flash file into the ECM. The 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 Intranet.

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

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. 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 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 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.

i03818309

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 268-2 is active.
- Electronic unit injectors are exchanged between cylinders.

Exchanging Electronic Unit Injectors

Exchanging electronic unit injectors can help determine if a fault 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 diagnostic 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.

i02453742

Speed Demand Input Setup

The 1106D engine can have a digital input that uses a Pulse Width Modulated (PWM) signal, an analog input or an input that is provided through a communications port (J1939 Torque Speed Control (TSC1)). The Electronic Control Module (ECM) must be programmed for the type of input that is being used. With certain types of primary input, a second input may be available.

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

- Analog throttle
- PWM throttle
- Communications port throttle (J1939 TSC1)

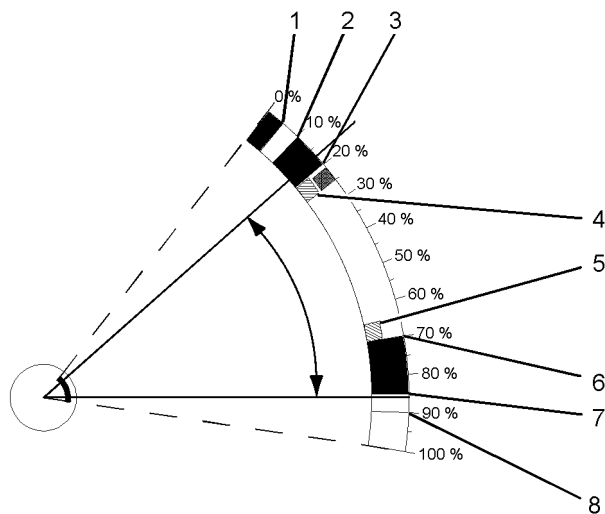


Illustration 13

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Typical Range of Throttle

- (1) Lower Diagnostic Limit (Default=5)
- (2) Lower Position Limit (Default=10)
- (3) Initial Lower Position (Default=20)
- (4) Lower Dead Zone % (Default=5)
- (5) Upper Dead Zone % (Default=5)
- (6) Initial Upper Position (Default=70)
- (7) Upper Position Limit (Default=85)
- (8) Upper Diagnostic Limit (Default=90)

PWM inputs and communications port inputs do not require any additional programming. If an analog input is selected, the following parameters must be programmed into the ECM.

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 8

Range	Default
0 to 100 percent	0 percent

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 9

Range	Default
0 to 100 percent	0 percent

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 speed demand input devices.

Table 10

Range	Default
0 to 100 percent	0 percent

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 speed demand input devices.

Table 11

Range	Default
0 to 100 percent	0 percent

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 speed demand input devices.

Table 12

Range	Default
0 to 100 percent	0 percent

Initial Upper 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 the upper position limit to make an allowance for manufacturing tolerances between different speed demand input devices.

Table 13

Range	Default
0 to 100 percent	0 percent

Lower Dead Zone

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

Table 14

Range	Default
0 to 100 percent	0 percent

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 15

Range	Default
0 to 100 percent	0 percent

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 operational requirements change.

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 personality module defines the power rating family. The personality module can contain one to four ratings. The rating number defines the power rating that is used within the power rating family.

Table 16

Minimum	Maximum	Default
1	4	1

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 17

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

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 18

Value	Default
Not Installed Installed	Not Installed

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 19

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 20

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 21

Value	Default
Disabled Enabled	Disabled

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 22

Value	Default
Disabled Enabled	Disabled

Configurable Inputs

Overspeed Protection

The “Overspeed Protection” speed is the engine rpm when a shutdown will occur. Overspeed protection is used in order to protect the engine from damage. Overspeed protection must be enabled in “Monitoring Mode Shutdowns”.

Table 23

Minimum	Maximum	Default
1500 rpm	2100 rpm	2100 rpm

Configurable Governor Droop

“Configurable Governor Droop” allows the engine to run in “droop mode” when the genset is operated in parallel with other gensets.

Table 24

Minimum	Maximum	Default
0 percent	8 percent	0 percent

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 25

Value	Default
Disabled Enabled	Disabled

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 26

Value	Default
Disabled Enabled	Disabled

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 27

Value	Default
Disabled Enabled	Disabled

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 28

Value	Default
Disabled Enabled	Disabled

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Customer Specified Parameters Table

Table 29

Customer Specified Parameters		
ECM Parameter	Possible Values	Default Value
Engine Rating Parameter		
"Rating Number"	1 to 4	1
ECM Identification Parameter		
"Equipment ID"	17 Digits Available characters are dependent on the service tool that is used	Not Programmed
Throttle Lock Parameters		
"Throttle Lock Feature Installation Status"	Installed Not Installed	Not Installed
"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
J1939 Continuous Fault Handling		
"Remote Torque Speed Control Enable Status"	Disabled Enabled	Disabled
Configurable Inputs		
"Overspeed Protection"	1500 to 2100 rpm	2100 rpm
"Configurable Governor Droop"	0% to 8%	0%
"Coolant Level Sensor"	Not Installed Installed J1:38	Not Installed
"Air Filter Restriction Switch Installation Status"	Not Installed Installed J1:47	Not Installed
"Fuel/Water Separator Switch Installation Status"	Not Installed Installed J1:44	Not Installed
"User Defined Switch Installation Status"	Not Installed Installed J1:48	Not Installed

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Customer Specified Parameters Worksheet

Table 30

Customer Specified Parameters Worksheet	
Engine Rating Parameter	
"Rating Numbers"	
ECM Identifications Parameters	
"Equipment ID"	
Throttle Lock Parameters	
"Throttle Lock Feature Installation Status"	
"Throttle Lock Increment Speed Ramp Rate"	
"Throttle Lock Engine Set Speed Increment"	
Miscellaneous	
"Monitoring Mode Shutdowns"	
J1939 Continuous Fault Handling	
"Remote Torque Speed Control Enable Status"	
Configurable Inputs	
"Overspeed Protection"	
"Configurable Governor Droop"	
"Coolant Level Sensor"	
"Air Filter Restriction Switch Installation Status"	
"Fuel/Water Separator Switch Installation Status"	
"User Defined Switch Installation Status"	

System Configuration Parameters

i03818369

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 268-2 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 268-2 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 253-2 (Personality Module erratic, intermittent or incorrect) 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. Contact the application OEM 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 (DEC08). DEC is the month (December). 08 is the year (2008).

Troubleshooting without a Diagnostic Code

i03858309

Alternator Noise

Note: This is not an electronic system fault.

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

Probable Causes

- Alternator drive belt
- Alternator mounting bracket
- 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 and the pulley are correctly aligned. If the alignment is incorrect, investigate the cause of the misalignment. 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.

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".

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Alternator Will Not Charge

Note: This is not an electronic system fault.

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 incorrect, investigate the cause of the misalignment. 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

i03807352

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

i03807312

Battery

Note: This is not an electronic system fault.

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 Systems Operation, 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.

Can Not Reach Top Engine RPM

Note: If this fault occurs only under load, refer to Troubleshooting, "Low Power".

Probable Causes

- Diagnostic codes
- ECM parameters
- Signal for the Speed demand input
- Air intake and exhaust system
- Valve lash
- Turbocharger
- Fuel supply
- Low compression (cylinder pressure)
- 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 fault is not an incorrectly 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 reset the parameters to the OEM specifications.
6. Ensure that the repairs have eliminated the poor performance.

7. If the repairs have not eliminated the faults proceed to "Throttle Signal for the Speed Demand Input".

Signal for the Speed Demand Input

1. Use the electronic service tool and observe the signal for the speed demand input.
2. If the signal is erratic, refer to Troubleshooting, "Speed Control (Analog) - Test" or refer to Troubleshooting, "Speed Control (Digital) - Test".
3. 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 "Valve Lash".

Valve Lash

1. Check the valve lash and reset the valve lash, if necessary. Refer to Systems Operation, 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, 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 Systems Operation, Testing and Adjusting, "Turbocharger - 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 "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 Systems Operation, Testing and Adjusting, "Fuel System - Prime".

10. Check the fuel pressure. Refer to Systems Operation, 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 "Low Compression (Cylinder Pressure)".

Low Compression (Cylinder Pressure)

1. Perform a compression test. Refer to Systems Operation, 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. 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".

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Coolant in Engine Oil

Note: This is not an electronic system fault.

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 Systems Operation, 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 Systems Operation, 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 Systems Operation, 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 Systems Operation, 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.

i03438642

Coolant Temperature Is Too High

Note: This is not an electronic system fault.

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 Systems Operation, 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 Systems Operation, Testing and Adjusting, "Cooling System".

Water Temperature Regulator

Check the water temperature regulator for correct operation. Refer to Systems Operation, 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 Operation, Testing and Adjusting, "Cylinder Head - Inspect". Fit the pressure cap if there are no bubbles in the coolant.

i03807570

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 displaying 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

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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 diagnostic 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 faults. Refer to Troubleshooting, "Data Link Circuit - Test".

i03807610

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 diagnostic connector
- Electronic service tool and related hardware
- Electrical power supply to the Electronic Control Module (ECM)
- 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 diagnostic connector. Refer to Troubleshooting, "Electrical Connectors - Inspect".

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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 diagnostic connector. Reconnect the communication adapter to the diagnostic connector.
3. Verify that the correct cable is being used between the communication adapter and the diagnostic 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 Diagnostic Connector

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

Electronic Service Tool and Related Hardware

In order to eliminate the electronic service tool and the related hardware as the cause of the fault, connect the electronic service tool to a different engine. If the same fault 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 Systems Operation, Testing and Adjusting, "Charging System - Test".

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

Data Link

Troubleshoot the data link for possible faults. Refer to Troubleshooting, "Data Link Circuit - Test".

Engine Cranks but Will Not Start

Probable Causes

- Diagnostic codes
- Visible faults
- Air intake and exhaust system
- Primary speed/timing sensor
- Low pressure fuel system
- Secondary speed/timing sensor
- High pressure fuel system
- Glow plugs
- Valve lash
- Low compression (cylinder 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

Use one of the following methods to check for active diagnostic codes:

- Flash Codes
- The display on the control panel
- The electronic service tool

Flash Codes

Note: The following procedure is only applicable if the machine is equipped with the appropriate warning lamps.

1. Check the warning lamps on the control panel for flash codes. Flash codes are explained in Troubleshooting, "Indicator Lamps".
2. If any flash codes are displayed, troubleshoot the codes before continuing with this procedure. Refer to Troubleshooting, "Troubleshooting with a Diagnostic Code".

3. Attempt to start the engine. If the engine will not start, proceed to "Visible Faults".

Display on the Control Panel

Note: The following procedure is only applicable if the machine is equipped with a display on the control panel.

1. Check the display on the control panel for active diagnostic codes.
2. Troubleshoot any active codes before continuing with this procedure. Refer to Troubleshooting, "Troubleshooting with a Diagnostic Code".
3. Attempt to start the engine. If the engine will not start, proceed to "Visible Faults".

Electronic Service Tool

1. Connect the electronic service tool to the diagnostic connector.
2. Check for active diagnostic codes on the electronic service tool.
3. Troubleshoot any active codes before proceeding with this procedure. Refer to Troubleshooting, "Troubleshooting with a Diagnostic Code".
4. Attempt to start the engine. If the engine will not start, proceed to "Visible Faults".

Visible Faults

1. Visually inspect the engine for the following faults:
 - Missing components
 - Damaged components
 - Damaged electrical cables or loose electrical cables
 - Oil leaks
 - Fuel leaks
2. Check the following items:
 - Check for smoke from the exhaust when the engine is cranking. If smoke is seen during cranking, there may be a mechanical fault in the engine. Refer to "Low Compression (Cylinder Pressure)".
 - Check for the proper level of fuel, oil and coolant.
 - Ensure that the fuel supply valve (if equipped) is in the full OPEN position.

- 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.

- Make sure that all fuel filters are correctly installed.

- Drain any water from the primary fuel filter/water separator.

3. Rectify any faults that are found during the visual checks.

4. Attempt to start the engine. If the engine will not start, 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. Attempt to start the engine. If the engine will not start, proceed to "Primary Speed/timing Sensor".

Primary Speed/timing Sensor

1. Disconnect the P401 connector from the primary speed/timing sensor.

2. Attempt to start the engine.

3. If the engine starts, check for a fault in the circuit for the primary speed/timing sensor. Refer to Troubleshooting, "Engine Speed/Timing Sensor Circuit - Test".

4. If the engine does not start, inspect the timing ring on the crankshaft for misalignment.

5. If necessary, repair the timing ring. Refer to Disassembly and Assembly, "Crankshaft Timing Ring - Remove and Install".

6. Attempt to start the engine. If the engine will not start, proceed to "Low Pressure Fuel System".

Low Pressure Fuel System

1. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).
2. Check for fuel supply lines that are restricted.
3. Check that the low pressure fuel lines are correctly installed.
4. Check the diesel fuel for contamination. Refer to Systems Operation, Testing and Adjusting, "Fuel Quality - Test".
5. Check for air in the fuel system. Refer to Systems Operation, Testing and Adjusting, "Air in Fuel - Test".
6. Ensure that the fuel system has been primed. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime".
7. Attempt to start the engine. If the engine will not start, continue with this procedure.
8. Replace the primary fuel filter and the secondary fuel filter. Refer to the Operation and Maintenance Manual, "Fuel System Primary Filter (Water Separator) Element - Replace".
9. Attempt to start the engine. If the engine will not start, continue with this procedure.
10. Check the flow of fuel through the transfer pump. If the flow of fuel through the transfer pump is less than 250 mL per minute at 150 rpm, replace the transfer pump. Refer to Disassembly and Assembly, "Fuel Transfer Pump - Remove" and Disassembly and Assembly, "Fuel Transfer Pump - Install".
11. Attempt to start the engine. If the engine will not start, proceed to "Secondary Speed/timing Sensor".

Secondary Speed/timing Sensor

1. Connect the electronic service tool to the diagnostic connector.
2. Check that the desired fuel rail pressure is at least 25 MPa (3625 psi) when the engine is cranking.
3. If the desired fuel rail pressure is less than 25 MPa (3625 psi), perform the following procedure:
 - a. Use the electronic service tool to check the signal from the secondary speed/timing sensor while the engine is cranking.

- b. If the signal from the secondary speed/timing sensor is 0 rpm, investigate the secondary speed/timing sensor. Refer to Troubleshooting, "Engine Speed/Timing Sensor Circuit - Test".
- c. If a fault is identified in the circuit for the secondary speed/timing sensor, repair the fault and then attempt to start the engine. If the engine will not start, proceed to "High Pressure Fuel System".
- d. If the signal from the secondary speed/timing sensor is greater than 0 rpm and the engine will not start, proceed to "High Pressure Fuel System".

High Pressure Fuel System

1. Use the electronic service tool to check the absolute fuel rail pressure while the engine is cranking at a minimum speed of 150 rpm.
2. If the absolute fuel rail pressure is less than 25 MPa (3625 psi), perform the following procedure:
 - a. Check that the inlet pressure at the fuel rail pump is greater than 50 kPa (7.25 psi). If the inlet pressure is less than 50 kPa (7.25 psi), repeat the diagnostic process from "Low Pressure Fuel System".
 - b. Check for fuel leaks in the high pressure fuel system. Rectify any fuel leaks and then recheck the pressure in the fuel rail. If the fuel rail pressure is greater than 25 MPa (3625 psi), proceed to test step 3.
 - c. Use the electronic service tool to perform a solenoid test on the fuel rail pump. Refer to Troubleshooting, "Fuel Rail Pump Solenoid - Test".
 - d. If any service has been performed as a result of Step 2.c, attempt to start the engine. If the engine will not start, repeat the diagnostic process from "Diagnostic Codes".
 - e. Check the pressure relief valve in the fuel rail for leakage. If the pressure relief valve is leaking, replace the valve and recheck the pressure in the fuel rail.
 - f. If the pressure relief valve in the fuel rail is not leaking, check for fuel in the engine oil system. If fuel is suspected in the oil system, take an engine oil sample for analysis. Refer to Operation and Maintenance Manual, "Engine Oil Sample - Obtain". If the analysis confirms that there is fuel in the engine oil system, investigate the cause.

- g. If fuel is not found in the oil system, check the electronic unit injectors for excessive fuel leak off.
- h. If the leak off is greater than 38 mL (1.3 oz) in 30 seconds for a 6 cylinder engine or the leak off is greater than 25 mL (0.85 oz) in 30 seconds for a 4 cylinder engine, replace the electronic unit injectors.

Note: The fault is not in the fuel rail pump. Do not replace the pump.

- i. If the leak off is less than 38 mL (1.3 oz) in 30 seconds for a 6 cylinder engine or the leak off is less than 25 mL (0.85 oz) in 30 seconds for a 4 cylinder engine, proceed to Test Step 3.d.
3. If the absolute fuel rail pressure is greater than 25 MPa (3625 psi), perform the following procedure:
- a. Use the electronic service tool to make sure that the status of the electronic unit injectors is not "Disabled". If the injectors are disabled but the injectors were not intentionally disabled with the electronic service tool, proceed to test step 3.d.
 - b. If the electronic unit injectors are not disabled, use the electronic service tool to perform an injector solenoid test. Refer to Troubleshooting, "Injector Solenoid Circuit - Test".
 - c. If any service has been performed as a result of Step 3.b, attempt to start the engine. If the engine will not start, proceed to "Glow Plugs".
 - d. Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "Flash Programming".
 - e. Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

- f. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".
- g. Attempt to start the engine. If the engine will not start, install the original ECM and then proceed to Test Step 3.i.
- h. If the engine starts normally, stop the engine and then attempt to start the engine again. If the engine will not start at the second attempt, proceed to Test Step 3.k.

- i. If the engine starts normally, reconnect the suspect ECM and then verify that the fault returns when the suspect ECM is installed.
- j. If the engine will not start with the suspect ECM, replace the ECM. Check that the engine starts normally. If the engine starts normally, no further testing is required.
- k. Replace the ECM again and then replace the fuel rail pump. Verify that the fault has been eliminated. If the engine will not start, proceed to "Glow Plugs".
- l. Check the timing of the fuel rail pump. Refer to Systems Operation, Testing and Adjusting, "Fuel Injection Timing - Check".
- m. If the timing of the fuel rail pump required adjustment and the engine will not start, proceed to "Glow Plugs".
- n. If the timing of the fuel rail pump was correct, replace the fuel rail pump. 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, Testing and Adjusting, "Glow Plugs - Test".
2. If necessary, replace faulty glow plugs. Refer to Disassembly and Assembly, "Glow Plug - Remove and Install".
3. Attempt to start the engine. If the engine will not start, proceed to "Valve Lash".

Valve Lash

1. Check the valve lash. Refer to Systems Operation, Testing and Adjusting, "Engine Valve Lash - Inspect/Adjust".
2. Attempt to start the engine. If the engine will not start, proceed to "Low Compression (Cylinder Pressure)".

Low Compression (Cylinder Pressure)

1. Perform a compression test. Refer to Systems Operation, 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 fault.

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Engine Has Early Wear

Note: This is not an electronic system fault.

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 Systems Operation, 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 Systems Operation, Testing and Adjusting, "Fuel Quality - Test".

Low Oil Pressure

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

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Engine Misfires, Runs Rough or Is Unstable

The probable root causes are listed in order below:

Note: If the fault is intermittent and the fault 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
- Speed demand input
- Air intake and exhaust system
- Glow plugs
- Valve lash
- 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.

Speed Demand Input

1. Use the electronic service tool and observe the signal for the Speed Demand Input.
2. If the signal is erratic, refer to Troubleshooting, “Speed Control (Analog) - Test” or Troubleshooting, “Speed Control (Digital) - Test”.
3. 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 “Glow Plugs”.

Glow Plugs

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

Valve Lash

1. Check the valve lash and reset the valve lash if it is necessary. Refer to Systems Operation, Testing and Adjusting, “Engine Valve Lash - Inspect and Adjust”.
2. If the repair does 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 Systems Operation, Testing and Adjusting, “Fuel Quality - Test”.

9. Check for air in the fuel system. Refer to Systems Operation, Testing and Adjusting, "Air in Fuel - Test".
10. Ensure that the fuel system has been primed. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime".
11. Check the fuel pressure. Refer to Systems Operation, 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 Systems Operation, 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 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".
5. If the fault is not eliminated, check for active diagnostic fault codes.

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Engine Oil in Cooling System

Note: This is not an electronic system fault.

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 Systems Operation, 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 Systems Operation, 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 Systems Operation, 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 Systems Operation, 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".

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Engine Vibration

Note: This is not an electronic system fault.

Refer to Systems Operation, 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 fault. 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 Systems Operation, Testing and Adjusting, “Compression - Test”.
2. If low compression is noted on any cylinders, investigate the cause and rectify the fault.

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 fault.
 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”.

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Engine Will Not Crank

Probable Causes

- Power generator
- Battery cables and/or batteries
- Starting motor solenoid or starting circuit

- Starting motor and/or flywheel ring gear
- Electrical power supply
- Internal engine fault
- Control system

Recommended Repairs

Power Generator

Make sure that the power generator is free to rotate. If the power generator does not rotate, refer to the documentation that is supplied by the OEM.

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 Systems Operation, Testing and Adjusting, "Battery - Test".

Starting Motor Solenoid or Starting Circuit

1. Test the operation of the starting motor solenoid. Refer to Systems Operation, 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 Systems Operation, 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

If there is no electrical power supply, investigate the cause and rectify any defects. Refer to Systems Operation, Testing and Adjusting, "Charging System - 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

Control System

Check that power is being provided from the control system to the solenoid on the starting motor.

Note: If power is not reaching the solenoid on the starting motor, the engine will not crank.

i03808909

Excessive Black Smoke

Probable Causes

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

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 Systems Operation, 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, then the turbocharger must 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 Systems Operation, Testing and Adjusting, "Wastegate - Inspect". If the wastegate actuator is faulty, replace the turbocharger. Refer to Disassembly and Assembly, "Turbocharger - Remove" and Disassembly and Assembly, "Turbocharger - Install".
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 fault.
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 Systems Operation, 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 fault.
 5. If the repair does not eliminate the fault 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, proceed 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 faults were detected, refer to the Troubleshooting Guide for the application.

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. Refer to Troubleshooting, "Engine Oil in Cooling System".
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, 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 Systems Operation, 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 Guide for the application.

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Excessive Fuel Consumption

Probable Causes

- Fuel quality
- Quality of oil
- Low engine temperature
- Air intake and exhaust system
- Reduced pressure of intake air
- Excessive valve lash
- Failure of the primary speed/timing sensor

Recommended Actions

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 "Low Engine Temperature".

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".

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 Systems Operation, Testing and Adjusting, "Air Inlet and Exhaust System".
2. Check the exhaust system for leakage or restrictions. Refer to Systems Operation, 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.
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 Systems Operation, 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 Systems Operation, Testing and Adjusting, “Engine Valve Lash - Inspect/Adjust” for the correct procedure.

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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 Systems Operation, 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 Systems Operation, 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 Systems Operation, 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 Systems Operation, 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 Systems Operation, 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.

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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.

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Intermittent Engine Shutdown

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

Probable Causes

- Diagnostic codes
- 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 before continuing with this procedure.

Electrical Connectors

1. Check for correct installation of ECM connectors at the following locations:
 - P1 ECM connector
 - P2 ECM connector
 - P100 Engine coolant temperature sensor connector
 - P201 Engine oil pressure sensor connector
 - P401 Primary speed/timing sensor connector
 - P402 Secondary speed/timing sensor connector
 - P532 Fuel injection pump solenoid connector
2. Refer to Troubleshooting, "Electrical Connectors - Inspect".

3. Use the electronic service tool to check for the following logged diagnostic code: 253-2 "Personality Module mismatch". If this diagnostic code is logged, proceed to Troubleshooting, "Electrical Connectors - Inspect".
4. 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, "Ignition Keyswitch Circuit and Battery Supply Circuit - Test" for more information.
5. 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 Systems Operation, Testing and Adjusting, "Fuel Quality - Test".
9. Check for air in the fuel system. Refer to Systems Operation, Testing and Adjusting, "Air in Fuel - Test".
10. Ensure that the fuel system has been primed. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime".
11. Check the fuel pressure. Refer to Systems Operation, Testing and Adjusting, "Fuel System Pressure - Test".

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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 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. Verify the correct pin positions for the power connections and the ground connections for the ECM.
4. If a fault is suspected with the ECM power and ground connections refer to Troubleshooting, "Ignition Keyswitch Circuit and Battery Supply Circuit - Test".
5. Verify that the ECM connections for the power and ground connections at the fuel pump are correctly connected.
6. Repair any faults and ensure that the faults have been eliminated.
7. 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 Systems Operation, Testing and Adjusting, "Fuel Quality - Test".
9. Check for air in the fuel system. Refer to Systems Operation, Testing and Adjusting, "Air in Fuel - Test".
10. Ensure that the fuel system has been primed. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime".
11. Check the fuel pressure. Refer to Systems Operation, Testing and Adjusting, "Fuel System Pressure - Test".
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. Check the intake manifold pressure. The pressure should read 0 kPa (0 Psi).
4. Use the electronic service tool to check for the following logged diagnostic codes:
 - 1785-3 Intake Manifold Pressure Sensor voltage high
 - 1785-4 Intake Manifold Pressure Sensor voltage low

If either of these diagnostic codes are logged, proceed to Troubleshooting, "Engine Pressure Sensor Open or Short Circuit - Test".

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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. Check the engine oil level. If necessary, add oil.

2. If the fault is still apparent, proceed 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, proceed 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, proceed 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, proceed 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, proceed 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, proceed 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, proceed 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, proceed 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

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Low Power

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. Ensure that the fault is not a programmed parameter.
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. Use the electronic service tool to reset the parameters to the OEM specifications.
6. Ensure that the repairs have eliminated the poor performance.
7. 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 kPa (0 psi). Check the 5 Volt sensor supply for the intake manifold pressure. Refer to Troubleshooting, "5 Volt 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. If the maximum no-load speed of the engine is erratic refer to Troubleshooting, "Speed Demand Circuit (Analog) - Test" or Troubleshooting, "Speed Demand Circuit (Digital) - Test".
6. 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 Systems Operation, 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 Systems Operation, Testing and Adjusting, "Turbocharger - 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 Systems Operation, Testing and Adjusting, "Fuel Quality - Test".
9. Check for air in the fuel system. Refer to Systems Operation, Testing and Adjusting, "Air in Fuel - Test".
10. Ensure that the fuel system has been primed. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime".
11. Check the fuel pressure. Refer to Systems Operation, Testing and Adjusting, "Fuel System Pressure - Test".
12. 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 Systems Operation, 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 "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, 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.

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.

i03809192

Noise Coming from Cylinder

Probable Causes

- Fuel quality
- Valve lash
- Electronic unit injectors
- Pistons

Recommended Actions

Fuel Quality

1. Check the fuel quality. Refer to Systems Operation, 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, proceed 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".
5. If the fault has not been eliminated, proceed to "Pistons".

Pistons

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

Troubleshooting with a Diagnostic Code

i03809150

Diagnostic Code Cross Reference

Table 31

CDL Code	Description	3rd Party Device J1939 Code	Flash Code
0001-02	Cylinder #1 Injector Data Incorrect	651-2	71
0001-05	Cylinder #1 Injector open circuit	651-5	71
0001-06	Cylinder #1 Injector short	651-6	71
0001-07	Cylinder #1 Injector Not Responding	651-7	71
0002-02	Cylinder #2 Injector Data Incorrect	652-2	72
0002-05	Cylinder #2 Injector open circuit	652-5	72
0002-06	Cylinder #2 Injector short	652-6	72
0002-07	Cylinder #2 Injector Not Responding	652-27	72
0003-02	Cylinder #3 Injector Data Incorrect	653-2	73
0003-05	Cylinder #3 Injector open circuit	653-5	73
0003-06	Cylinder #3 Injector short	653-6	73
0003-07	Cylinder #3 Injector Not Responding	653-7	73
0004-02	Cylinder #4 Injector Data Incorrect	654-2	74
0004-05	Cylinder #4 Injector open circuit	654-5	74
0004-06	Cylinder #4 Injector short	654-6	74
0004-07	Cylinder #4 Injector Not Responding	654-7	74
0005-02	Cylinder #5 Injector Data Incorrect	655-2	75
0005-05	Cylinder #5 Injector open circuit	655-5	75
0005-06	Cylinder #5 Injector short	655-6	75
0005-07	Cylinder #5 Injector Not Responding	655-7	75
0006-02	Cylinder #6 Injector Data Incorrect	656-2	76
0006-05	Cylinder #6 Injector open circuit	656-5	76
0006-06	Cylinder #6 Injector short	656-6	76
0006-07	Cylinder #6 Injector Not Responding	656-7	76
0041-03	8 Volt DC Supply short to +batt	678-03	21
0041-04	8 Volt DC Supply short to ground	678-04	21
0091-08	Throttle Position signal abnormal	91-08	32
0100-03	Engine Oil Pressure open/short to +batt	100-03	24
0100-04	Engine Oil Pressure short to ground	100-04	24

(continued)

(Table 31, contd)

CDL Code	Description	3rd Party Device J1939 Code	Flash Code
0100-10	Engine Oil Pressure Sensor abnormal rate of change	100-10	26
0110-03	Engine Coolant Temperature open/short to +batt	110-03	27
0110-04	Engine Coolant Temperature short to ground	110-04	27
0168-00	System Voltage High	168-00	51
0168-01	System Voltage Low	168-01	51
0168-02	System Voltage intermittent/erratic	168-02	51
0172-03	Intake Manifold Air Temp open/short to +batt	105-03	38
0172-04	Intake Manifold Air Temp short to ground	105-04	38
0190-08	Engine Speed signal abnormal	190-08	34
0247-09	J1939 Data Link communications	639-09	65
0253-02	Personality Module mismatch	631-02	56
0261-11	Engine Timing Calibration invalid	637-11	42
0262-03	5 Volt Sensor DC Power Supply short to +batt	1079-03	21
0262-04	5 Volt Sensor DC Power Supply short to ground	1079-04	21
0268-02	Check Programmable Parameters	630-02	56
0342-08	Secondary Engine Speed signal abnormal	723-08	34
0526-05	Turbo Wastegate Drive current low	1188-05	33
0526-06	Turbo Wastegate Drive current high	1188-06	33
1690-08	Analog Speed Demand Abnormal signal	29-08	66
1779-05	Fuel Rail Pressure Valve 1 Solenoid open circuit	1347-05	47
1779-06	Fuel Rail Pressure Valve 1 Solenoid short to ground	1347-06	47
1779-08	Fuel Rail Pressure Valve 1 Solenoid abnormal frequency, pulse width or period	1347-08	47
1785-03	Intake Manifold Pressure Sensor voltage high	102-03	25
1785-04	Intake Manifold Pressure Sensor voltage low	102-04	25
1785-10	Intake Manifold Pressure Sensor abnormal rate of change	102-04	25
1797-03	Fuel Rail Pressure Sensor open/short to +batt	157-03	37
1797-04	Fuel Rail Pressure Sensor short to ground	157-04	37
1834-02	Ignition Keyswitch loss of signal	158-02	-
2246-06	Glow plug Start Aid Relay Current High	676-06	57
Event Codes			
E085-1	Shutdown Overriden	1237-1	12
E255-1	Diagnostic Reset	704-00	59
E264-3	E-Stop Shutdown	970-31	58
E360-1	Low Oil Pressure - Warning	100-17	24
E360-3	Low Oil Pressure - Shutdown	100-01	24
E361-1	High Engine Coolant Temperature - Warning	110-15	27
E361-2	High Engine Coolant Temperature - Derate	110-16	27

(continued)

(Table 31, contd)

CDL Code	Description	3rd Party Device J1939 Code	Flash Code
E361-3	High Engine Coolant Temperature - Shutdown	110-00	27
E362-1	Engine Overspeed - Warning	190-15	35
E362-3	Engine Overspeed - Shutdown	190-00	35
E396-2	High Fuel Rail Pressure	157-15	47
E398-2	Low Fuel Rail Pressure	157-17	47
E539-1	High Intake Manifold Air Temperature - Warning	1636-15	38

i03795209

i03795221

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 diagnostic lamp will flash and the derate lamp will come on. An active diagnostic code will be generated. The ECM will log the diagnostic code.

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.

CID 0001 FMI 05

Conditions Which Generate This Code:

This diagnostic code indicates 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:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When the "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. 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.

i03795249

CID 0001 FMI 06

Conditions Which Generate This Code:

This diagnostic code indicates 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:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When the "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. 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.

i03795297

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 diagnostic lamp will flash and the derate lamp 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 by 20%.

Troubleshooting:

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.

i03795363

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 0002-05 and 0002-06 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 diagnostic lamp will flash and the derate lamp will come on. An active diagnostic code will be generated. The ECM will log the diagnostic code.

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.

i03795370

CID 0002 FMI 05

Conditions Which Generate This Code:

This diagnostic code indicates 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:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When the "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. 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.

i03795504

CID 0002 FMI 06

Conditions Which Generate This Code:

This diagnostic code indicates 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:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When the "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. 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.

i03795537

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 diagnostic lamp will flash and the derate lamp 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 by 20%.

Troubleshooting:

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.

i03795549

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 0003-05 and 0003-06 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 diagnostic lamp will flash and the derate lamp will come on. An active diagnostic code will be generated. The ECM will log the diagnostic code.

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.

i03795592

CID 0003 FMI 05

Conditions Which Generate This Code:

This diagnostic code indicates 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:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When the "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. 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.

i03795600

CID 0003 FMI 06

Conditions Which Generate This Code:

This diagnostic code indicates 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:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When the "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. 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.

i03797009

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 diagnostic lamp will flash and the derate lamp 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 by 20%.

Troubleshooting:

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:

i03797011

- OK – STOP.

CID 0004 FMI 05

i03797010

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 0004-05 and 0004-06 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 diagnostic lamp will flash and the derate lamp will come on. An active diagnostic code will be generated. The ECM will log the diagnostic code.

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.

Conditions Which Generate This Code:

This diagnostic code indicates 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:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When the "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. 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.

i03797012

CID 0004 FMI 06

Conditions Which Generate This Code:

This diagnostic code indicates 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:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When the "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. 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.

i03797013

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 derate lamp 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 by 20%.

Troubleshooting:

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.

i03797029

CID 0005 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. 5 cylinder is out of limits.
- Diagnostic code 168-01 is not active.
- Diagnostic codes 0005-05 and 0005-06 are not active.
- No 0041 diagnostic codes are active.
- No 0262 diagnostic codes are active.

- Diagnostic code 190-08 is not active.
- No 0110 diagnostic codes are active.

System Response:

If equipped, the diagnostic lamp will flash and the derate lamp 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.

i03797030

CID 0005 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. 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:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When the "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. 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.

i03797033

CID 0005 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. 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:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When the "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. 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.

i03797050

CID 0005 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 diagnostic lamp will flash and the derate lamp 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 by 20%.

Troubleshooting:

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.

i03797051

CID 0006 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. 6 cylinder is out of limits.
- Diagnostic code 168-01 is not active.
- Diagnostic codes 0006-05 and 0006-06 are not active.
- No 0041 diagnostic codes are active.
- No 0262 diagnostic codes are active.
- Diagnostic code 190-08 is not active.
- No 0110 diagnostic codes are active.

System Response:

If equipped, the diagnostic lamp will flash and the derate lamp 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.

i03797069

CID 0006 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. 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:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When the "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. 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.

i03797070

CID 0006 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. 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:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash.

Possible Performance Effect:

The engine will have low power and/or rough running.

Troubleshooting:

When the "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. 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.

i03797072

CID 0006 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 diagnostic lamp will flash and the derate lamp 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 by 20%.

Troubleshooting:

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.

CID 0041 FMI 03

i03797073

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.
- Diagnostic code 168-01 is not active.

System Response:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash. An active diagnostic code may not cause any noticeable effect on engine response unless the voltage is above 12 or 13 VDC.

Possible Performance Effect:

The engine may be limited to low idle.

Troubleshooting:

This signal is not normally used in this application. If this diagnostic code is observed, check the associated wiring on the engine.

Refer to the Engine Electrical Schematic.

Results:

- OK – STOP.

CID 0041 FMI 04

i03797075

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 168-01 is not active at the same time.

System Response:

The ECM will log the diagnostic code. If equipped, the diagnostic lamp will flash. 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.

Troubleshooting:

This signal is not normally used in this application. If this diagnostic code is observed, check the associated wiring on the engine.

Refer to the Engine Electrical Schematic.

Results:

- OK – STOP.

CID 0091 FMI 08

i03797080

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal frequency from the digital speed control circuit 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 91-03 is not active.
- Diagnostic code 91-04 is not active.

System Response:

The ECM sets the "Throttle Position" to "0%".

If equipped, the diagnostic lamp will flash. 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 may remain at low idle while the diagnostic code is active.

Troubleshooting:

This diagnostic code indicates that the frequency of a digital throttle signal is out of the normal range.

Perform the following diagnostic procedure: "Speed Control (PWM) - Test"

Results:

- OK – STOP.

i03797081

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 Volts DC 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 diagnostic lamp will flash. 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.

CID 0100 FMI 04

i03797131

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 Volts DC 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 diagnostic lamp will flash. 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 diagnostic 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.

i03797149

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 diagnostic lamp will flash. The ECM will log the diagnostic code.

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.

i03797150

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 Volts DC for more than eight seconds.
- The ECM has been powered for at least two seconds.

System Response:

If equipped, the diagnostic lamp will flash. 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:

The diagnostic code will detect an excessively high voltage from the engine coolant temperature sensor.

Perform the following diagnostic procedure: "Engine Temperature Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i03797151

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 Volts DC 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 diagnostic lamp will flash. 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.

Possible Performance Effect:

- Poor stability
- Poor cold running

- White smoke

i03797318

Troubleshooting:

The diagnostic code will detect an excessively low voltage from the engine coolant temperature sensor.

Perform the following diagnostic procedure: "Engine Temperature Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i03797152

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 Volt DC systems, the battery voltage to the ECM exceeds 32 Volts for more than 0.5 seconds.
- For 12 Volt DC systems, the battery voltage to the ECM exceeds 16 Volts 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 diagnostic lamp will flash.

Possible Performance Effect:

None

Troubleshooting:

This diagnostic code will detect excessively high voltage in the battery circuit to the Electronic Control Module (ECM) while the engine is running.

Perform the following diagnostic procedure: "Ignition Keyswitch Circuit and Battery Supply Circuit - Test"

Results:

- OK – STOP.

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 position.
- The engine is not cranking.
- The engine is running for more than three seconds.
- For 24 Volt DC systems, the battery voltage to the ECM is below 18 Volts for more than 0.5 seconds.
- For 12 Volt DC systems, the battery voltage to the ECM is below 9 Volts for more than 0.5 seconds.

System Response:

If equipped, the diagnostic lamp will flash and the derate lamp will come on. The ECM will normally log the diagnostic code. If battery voltage disappears without returning, the ECM will not log this diagnostic code and the engine will shut down.

Possible Performance Effect:

The engine will derate 100 percent.

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:

This diagnostic code will detect low voltage in the battery circuit for the Electronic Control Module (ECM) while the engine is running.

Perform the following diagnostic procedure: "Ignition Keyswitch Circuit and Battery Supply Circuit - Test"

Results:

- OK – STOP.

i03797330

i03797369

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.

The ECM detects the following conditions:

- Three voltage readings that are below 6 Volts DC in a period of 7 seconds will be detected by the ECM. The voltage must subsequently increase to more than 9 Volts DC.
- The keyswitch is in the ON position.
- The engine is running.
- The engine is not cranking.

System Response:

The diagnostic code will normally be logged. If equipped, the diagnostic lamp will flash. If the battery voltage disappears without returning, the ECM will not log this diagnostic code and the engine will shut down. This will be dependent on the length of time for the occurrence of the fault.

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. The ECM may stop injecting fuel. This may be dependent on the length of time for the occurrence of the fault.

Troubleshooting:

This diagnostic code detects intermittent voltage in the battery circuit for the Electronic Control Module (ECM) while the engine is running.

Perform the following diagnostic procedure: "Ignition Keyswitch Circuit and Battery Supply Circuit - Test"

Results:

- OK – STOP.

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 Volts DC 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:

If equipped, the diagnostic lamp will flash. The ECM will log the diagnostic code.

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.

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.

i03797372

i03797393

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 Volts DC for more than eight seconds.
- The ECM has been powered for at least two seconds.
- Diagnostic code 0168-01 is not active.

System Response:

If equipped, the diagnostic lamp will flash. The ECM will log the diagnostic code.

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.

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.

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 diagnostic lamp will flash and the derate lamp will come on. The shutdown lamp may come on. 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:

This diagnostic code will detect a loss of signal from the primary speed/timing sensor.

Perform the following diagnostic procedure: "Engine Speed/Timing Sensor Circuit - Test"

Results:

- OK – STOP.

i03797430

CID 0247 FMI 09

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following condition:

- Another controller has incorrectly stopped transmitting a J1939 speed request (TSC1) or another controller has started transmitting a J1939 speed request incorrectly.

System Response:

If equipped, the diagnostic lamp will flash. The diagnostic code will be logged.

Some system functions may not operate correctly.

Troubleshooting:

This diagnostic code detects an abnormal signal from the J1939 data link.

Perform the following diagnostic procedure: "CAN Data Link Circuit - Test"

Results:

- OK – STOP.

i03797571

CID 0253 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects incorrect engine software.

System Response:

If equipped, the diagnostic lamp will flash.

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.

i03797609

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 degrees.
- The engine has been running for more than five seconds.
- Diagnostic code 190-08 is not active.
- No 41 diagnostic codes are active.

System Response:

Default timing is used. This code will not be logged. If equipped, the diagnostic lamp will flash when this code is active.

Possible Performance Effect:

The engine may not run smoothly when this code is active.

Troubleshooting:

Perform the following diagnostic procedure: "Engine Speed/Timing Sensor Circuit - Test"

Results:

- OK – STOP.

i03797631

CID 0262 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The 5 volt supply for the pressure and temperature sensors is greater than 5.16 Volts DC 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 log the diagnostic code. If equipped, the diagnostic lamp will flash and the derate lamp will come on.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

This diagnostic code will detect an excessively high voltage in the 5 Volt supply circuit.

Perform the following diagnostic procedure: "5 Volt Sensor Supply Circuit - Test"

Results:

- OK – STOP.

i03797669

CID 0262 FMI 04**Conditions Which Generate This Code:**

The Engine Control Module (ECM) detects the following conditions:

- The 5 volt supply for the pressure and temperature sensors is less than 4.84 Volts DC 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 log the diagnostic code. If equipped, the diagnostic lamp will flash and the derate lamp will come on.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

This diagnostic code will detect an excessively low voltage in the 5 Volt supply circuit.

Perform the following diagnostic procedure: "5 Volt Sensor Supply Circuit - Test"

Results:

- OK – STOP.

i03797692

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
- Trim codes for the injectors
- Engine serial number
- All of the injector trim files are not loaded into the ECM. Engine performance and emissions are affected.

System Response:

If equipped, the diagnostic lamp will flash and the derate lamp may come on. 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.

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.

i03797713

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:

If equipped, the diagnostic lamp will flash and the diagnostic code will be logged.

Possible Performance Effect:

If the signal from the secondary speed/timing sensor is lost and the engine is stopped, the engine will not restart. 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.

Troubleshooting:

This diagnostic code indicates that the signal from the secondary speed/timing sensor is incorrect.

Perform the following diagnostic procedure: "Engine Speed/Timing Sensor Circuit - Test"

Results:

- OK – STOP.

i03797733

CID 0526 FMI 05

Conditions Which Generate This Code:

This diagnostic code will only appear if an electronically controlled wastegate is installed.

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 active 0168 diagnostic codes

System Response:

If equipped, the diagnostic lamp will flash and the derate lamp will come on. The diagnostic code will be logged. 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 will detect 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.

i03797770

CID 0526 FMI 06

Conditions Which Generate This Code:

This diagnostic code will only appear if an electronically controlled wastegate is installed.

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 active 0168 diagnostic codes

System Response:

If equipped, the diagnostic lamp will flash and the derate lamp will come on. The diagnostic code will be logged. 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 will detect 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.

CID 1690 FMI 08

i03799256

Conditions Which Generate This Code:

Although the signal from the analog throttle is within the normal range of 0.5 Volts to 4.5 Volts, the signal has an abnormal frequency, an abnormal pulse width or an abnormal time period.

System Response:

The Electronic Control Module (ECM) will log the diagnostic code.

The warning lamp will illuminate and the diagnostic lamp will flash.

Possible Performance Effect:

The engine speed changes to the default selected speed of 1500 rpm or 1800 rpm.

Troubleshooting:

Perform the following diagnostic procedure: "Speed Control (Analog) - Test"

Results:

- OK – STOP.

CID 1779 FMI 05

i03797790

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 pump.

System Response:

If equipped, the diagnostic lamp will flash 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.

CID 1779 FMI 06

i03799115

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 pump.

System Response:

If equipped, the diagnostic lamp will flash 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.

i03799338

CID 1779 FMI 08

Conditions Which Generate This Code:

This diagnostic code indicates that the signal to the solenoid for the fuel rail pump is abnormal.

System Response:

If equipped, the diagnostic lamp will flash and the ECM will log the diagnostic code.

Possible Performance Effect:

An erratic signal 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.

i03799117

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.
- Diagnostic code 168-01 is not active.
- No 262 codes for the 5 volt supply are active.

System Response:

If equipped, the diagnostic lamp will flash and the derate lamp may come on. The ECM will log the diagnostic code. 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 derate the engine. The derate will prevent any overpressure in the intake manifold which could be caused by an overspeed of the turbocharger.

Possible Performance Effect:

- The engine will be derated by 20%.

Troubleshooting:

This 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.

i03799129

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 than 0.2 VDC for at least two seconds.
- The ECM has been powered for two seconds.
- Diagnostic code 168-01 is not active.
- No 262 codes for the 5 volt supply are active.
- The keyswitch is in the ON position so that the ECM is energized.

System Response:

If equipped, the diagnostic lamp will flash and the derate lamp may come on. The ECM will log the diagnostic code. 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 derate the engine. The derate will prevent any overpressure in the intake manifold which could be caused by an overspeed of the turbocharger.

Possible Performance Effect:

- The engine will be derated by 100%.

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.

i03799135

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 diagnostic lamp will flash and the derate lamp will come on. The diagnostic code will be logged.

The ECM will flag the intake manifold pressure as being invalid. A default value is used for the intake manifold pressure.

Note: Any open circuits or short circuits in the signal wire for the oil pressure may reset this diagnostic.

Possible Performance Effect:

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.

The engine will be derated.

Troubleshooting:

This diagnostic code will 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.

i03799136

CID 1797 FMI 03**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 0168-00 is not active.
- The signal voltage for the pressure in the fuel rail is more than 4.8 Volts DC for 0.6 seconds.

System Response:

If equipped, the diagnostic lamp will flash and the derate lamp will come on. The diagnostic code will be logged.

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 detects an excessively high voltage from the fuel rail pressure sensor.

Perform the following diagnostic procedure: "Engine Pressure Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i03799149

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 Volts DC for 0.6 seconds.

System Response:

If equipped, the warning lamp will come on. The diagnostic code will be logged.

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 detects an excessively low voltage from the fuel rail pressure sensor.

Perform the following diagnostic procedure: "Engine Pressure Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i03825509

CID 1834 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following condition:

The power from the keyswitch was erratic because the power cycled at least three times within the last second.

System Response:

A warning will appear on the display on the control panel while this diagnostic code is active. The warning lamp or the shutdown lamp may illuminate and the warning horn may sound. The ECM will log the diagnostic code. The ECM will stop energizing the injector solenoids and the engine will shut down.

Possible Performance Effect:

The engine will shut down.

Perform the following diagnostic procedure: "Ignition Keyswitch Circuit and Battery Supply Circuit - Test"

Results:

- OK – STOP.

i03799170

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:

If equipped, the diagnostic lamp will flash. The diagnostic code will be logged. An ECM that was previously blank will require a total of 2 hours of operation before the diagnostic code will be logged.

Possible Performance Effect:

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.

The engine may be difficult to start in cold temperatures and the exhaust may emit white smoke.

Troubleshooting:

This diagnostic code detects an excessively high current in the circuit for the starting aid relay.

Perform the following diagnostic procedure: "Starting Aid (Glow Plug) Relay Circuit - Test"

Results:

- OK – STOP.

Troubleshooting with an Event Code

Event Codes

i02411070

The Electronic Control Module (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 fault 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.

i03813829

E085 Engine Shutdown Overridden

Conditions Which Generate This Code:

The emergency shutdown override switch has been set to Override.

Note: This event code indicates a switch position. The code does not indicate a fault in the electronic system.

System Response:

The event code will be logged.

The warning lamp will be illuminated and the diagnostic lamp will flash the event code.

The event may be viewed by using a display module or by using the electronic service tool.

Possible Performance Effect:

E085-1

None

Troubleshooting:

This event indicates that the emergency shutdown override switch has been activated. This event does not represent a fault in the Electronic Control Module (ECM).

The engine will not shut down automatically in an emergency situation.

No troubleshooting is required.

Results:

- OK – STOP.

i03852049

E255 Diagnostic Reset

Conditions Which Generate This Code:

This code becomes active for three seconds after another event code has been cleared.

System Response:

The warning lamp will be illuminated and the diagnostic lamp will flash the event code.

Possible Performance Effect:

E255-1

None

Troubleshooting:

This event indicates that another event code has been cleared. This event does not represent a fault in the Electronic Control Module (ECM).

No troubleshooting is required.

Results:

- OK – STOP.

i03813872

E264 Emergency Stop Activated

Conditions Which Generate This Code:

The emergency stop button has been depressed.

Note: This event code indicates a switch position. The code does not indicate a fault in the electronic system.

System Response:

The warning lamp will be illuminated and the diagnostic lamp will flash the event code.

The event may be viewed by using a display module or by using the electronic service tool.

Possible Performance Effect:**E264-1**

None

Troubleshooting:

This event indicates that the emergency stop button has been depressed. This event does not represent a fault in the Electronic Control Module (ECM).

The engine will be shut down.

No troubleshooting is required.

Results:

- OK – STOP.

i03820011

E360 Low Engine Oil Pressure**Conditions Which Generate This Code:**

The Electronic Control Module (ECM) detects a fault with the engine's oil pressure. The ECM detects the following faults:

- The engine has been running for more than ten seconds.
- The oil pressure is below the trip point for the event code. Refer to Table 32 for a list of trip points for low oil pressure.
- Diagnostic code 100-3 Engine Oil Pressure open/short to +batt is not active.
- Diagnostic code 100-4 Engine Oil Pressure short to ground is not active.

Note: This event code represents an event. This does not represent an electronic system fault.

Table 32

Trip Points for Low Oil Pressure				
	E360-1		E360-3	
	RPM	kPa Gauge	RPM	kPa Gauge
Trip level	0	0	0	0
	1500	250 kPa (36 psi)	1500	100 kPa (14 psi)
	1800	250 kPa (36 psi)	1800	100 kPa (14 psi)
Delay to activation	8 seconds		4 seconds	

System Response:

The event code will be logged.

The warning lamp will be illuminated and the diagnostic lamp will flash the event code.

Possible Performance Effect:

E360-1

None

E360-3

The derate lamp will be illuminated. The ECM will derate the power at 17 percent per second for two seconds.

The shutdown lamp will be illuminated. If the "Enable Shutdown" parameter is enabled, the engine will shut down.

Troubleshooting:

Refer to Troubleshooting, "Low Engine Oil Pressure".

Results:

- OK – STOP.

i03820012

E361 High Engine Coolant Temperature

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a fault with the engine's coolant temperature. The ECM detects the following faults:

- The engine has been running for more than three minutes.
- The engine coolant temperature trip level for the event code is reached.
- Diagnostic code 110-3 Engine Coolant Temperature open/short to +batt is not active.
- Diagnostic code 110-4 Engine Coolant Temperature short to ground is not active.

Table 33

Engine Coolant Trip Level Table			
Engine Model	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

System Response:

The event code will be logged.

The warning lamp will be illuminated and the diagnostic lamp will flash the event code.

Possible Performance Effect:

E361-1 There is no performance effect.

None

E361-2 The engine will be derated at a rate of one percent per second.

The derate lamp will be illuminated.

E361-3 The shutdown lamp will be illuminated.

The ECM will shut down the engine after two seconds when the trip level has been reached.

A 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.

i03813909

E362 Engine Overspeed

Conditions Which Generate This Code:

The engine speed is above the trip point for engine overspeed. Refer to Table 34.

Note: This event code represents an event. This does not represent an electronic system fault.

Table 34

Trip Points for Engine Overspeed		
	E362-1	E362-3
Trip Point (RPM)	2200	2300
Delay to Activation	0.6 seconds	0 seconds

Note: The electronic service tool can be used to change the trip points for engine overspeed.

System Response:

The event code will be logged.

The event may be viewed by using a display module or by using the electronic service tool.

Possible Performance Effect:

E362-1

The warning lamp will be illuminated and the diagnostic lamp will flash the event code.

The fuel injection will be switched OFF until the engine speed drops below the trip point by 200 RPM.

E362-3

The warning lamp and the shutdown lamp will be illuminated and the diagnostic lamp will flash the event code.

If the "Enable Shutdown" parameter is enabled, the engine will be shut down.

This event indicates excessive engine speed. This event does not represent a fault in the Electronic Control Module (ECM).

This event does not represent a fault in a speed/timing sensor.

No troubleshooting is required.

Results:

- OK – STOP.

i03813912

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 faults:

- The ECM detects fuel rail pressure that is more than the pressure that is required for the operating conditions.
- Diagnostic code 262-3 5 Volt Sensor DC Power Supply voltage above normal is not active.
- Diagnostic code 262-4 5 Volt Sensor DC Power Supply voltage below normal is not active.
- Diagnostic code 1797-3 Fuel Rail Pressure Sensor voltage above normal is not active.
- Diagnostic code 1797-4 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 warning lamp will be illuminated and the diagnostic lamp will flash the event code.

The event code will be logged.

Possible Performance Effect:

E396-2

The derate lamp will be illuminated.

The engine will be derated until the keyswitch is turned to OFF and then turned to ON.

Troubleshooting:

The event code does not indicate a fault with the electronic system. This event indicates high fuel pressure. Refer to Systems Operation, Testing and Adjusting, "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.

i03813929

E398 Low Fuel Rail Pressure

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a fault with low fuel rail pressure. The ECM detects the following faults:

- The ECM determines that the expected fuel rail pressure is lower than the pressure that is requested by the electronic control system.
- Diagnostic code 262-3 5 Volt Sensor DC Power Supply voltage above normal is not active.
- Diagnostic code 262-4 5 Volt Sensor DC Power Supply voltage below normal is not active.
- Diagnostic code 1797-3 Fuel Rail Pressure Sensor voltage above normal is not active.
- Diagnostic code 1797-4 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 warning lamp will be illuminated and the diagnostic lamp will flash the event code.

The event code will be logged.

Possible Performance Effect:

E398-2

The derate lamp will be illuminated.

The engine will be derated until the keyswitch is turned to OFF and then turned to ON.

Troubleshooting:

Low fuel pressure may be caused by the following faults:

- A fault in the fuel return system
- A fault in the fuel pressure control
- A leak in the high pressure fuel system
- A failed relief valve, the fuel pump or an electronic unit injector

The event code does not represent a fault in the electronic system. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Inspect".

Results:

- OK – STOP.

i03813930

E539 High Intake Manifold Air Temperature

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a fault with the intake manifold air temperature. The ECM detects the following faults:

- The engine has been running for more than 3 minutes.
- The trip point for the event code for intake manifold air temperature is reached.
- Diagnostic code 172-3 Intake Manifold Air Temperature open/short to +batt is not active.
- Diagnostic code 172-4 Intake Manifold Air Temperature short to ground is not active.

Table 35

Trip Points for the Intake Manifold Air Temperature		
	E539-1	E539-2
Engine Model		
Turbocharged Aftercooled Engines (TA)	82 °C (179 °F)	86 °C (186 °F)

System Response:

The warning lamp will be illuminated. If equipped, the diagnostic lamp will flash the event code.

The event code will be logged.

Possible Performance Effect:

E539-1

None

E539-2

The engine will be derated.

Refer to Troubleshooting, "Intake Air Temperature Is Too High".

Results:

- OK – STOP.

Diagnostic Functional Tests

i03814010

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:

- 262-3 5 Volt Sensor DC Power Supply voltage above normal
- 262-4 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 Electronic Control Module (ECM) supplies regulated +5 Volts DC 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

The supply for the +5 Volt 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 Volts DC.

The +5 Volt 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 or an open circuit in the harness
- A suspect sensor
- A suspect ECM

Table 36

P2 Pin Connections				
Sensor Pin	Function	Fuel Rail Pressure Sensor	Intake Manifold Pressure Sensor	Oil Pressure sensor
1	+5 Volts DC	48	46	47
2	Common	40	38	39
3	Signal	51	55	56

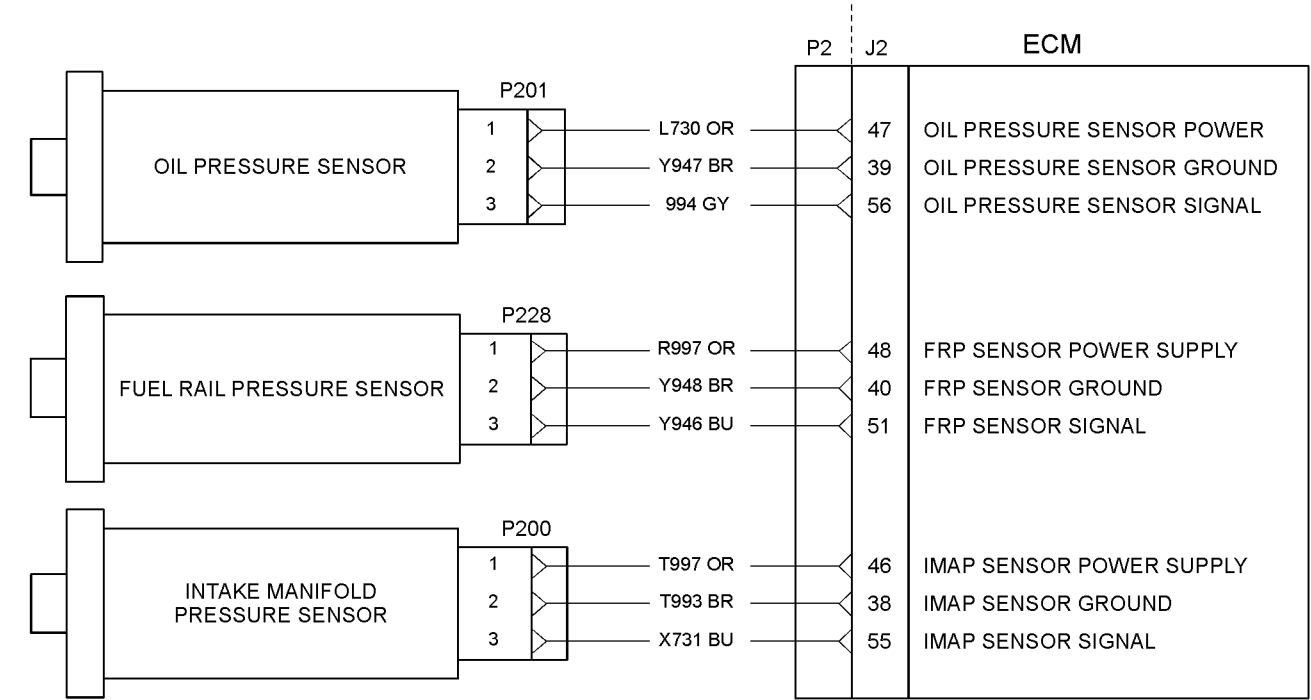


Illustration 14
Typical example of the schematic for the sensors

g01800518

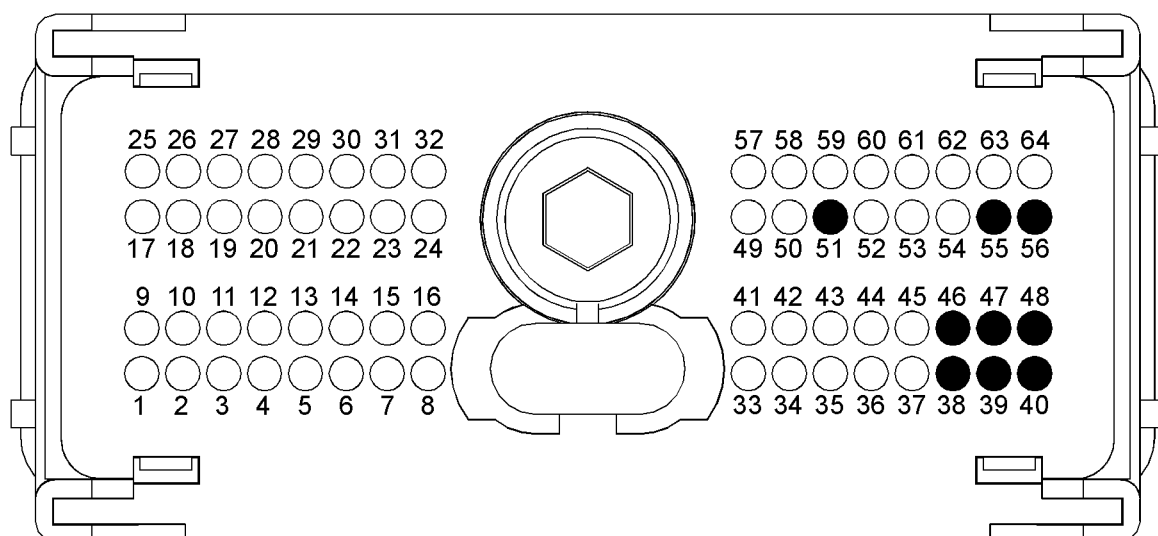


Illustration 15

g01800553

Typical example of the locations of the P2 pins for the pressure sensors

(38) Ground (GND) Intake Manifold Pressure Sensor

(39) Ground (GND) Oil Pressure Sensor

(40) Ground (GND) Fuel Rail Pressure Sensor

(46) Voltage supply (+5 Volts DC) Intake Manifold Pressure Sensor

(47) Voltage supply (+5 Volts DC) Oil Pressure Sensor

(48) Voltage supply (+5 Volts DC) Fuel Rail Pressure Sensor

(51) Signal (SIG) Fuel Rail Pressure Sensor

(55) Signal (SIG) Intake Manifold Pressure Sensor

(56) Signal (SIG) Oil Pressure Sensor

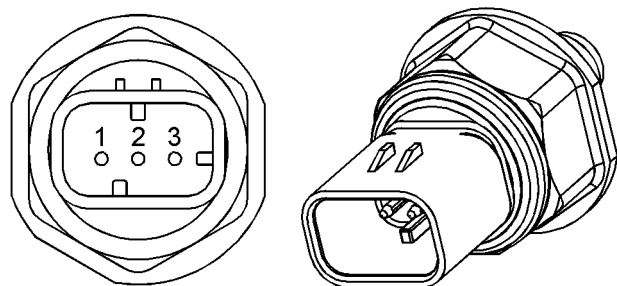


Illustration 16

g01173224

Typical example of the fuel rail pressure sensor

(1) Voltage supply (Vs)

(2) Ground (GND)

(3) Signal (SIG)

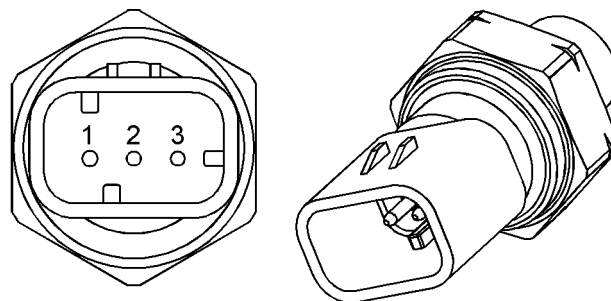


Illustration 17

g01173225

Typical example of the intake manifold pressure sensor

(1) Voltage Supply (Vs)

(2) Ground (GND)

(3) Signal (SIG)

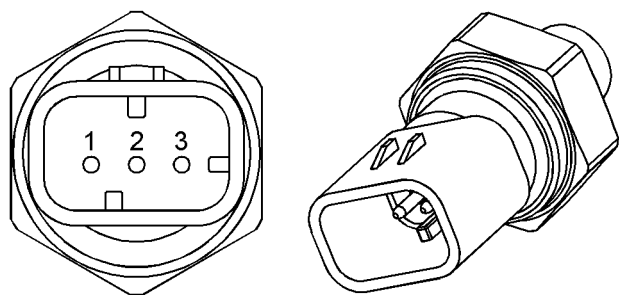


Illustration 18

g01173226

Typical example of the oil pressure sensor

- (1) Voltage Supply (Vs)
- (2) Ground (GND)
- (3) Signal (SIG)

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 problems:
 - Damage
 - Abrasion
 - Corrosion
 - Incorrect attachment
- C. Refer to Troubleshooting, “Electrical Connectors - Inspect”.
- D. Check the wire connectors at the following positions:
 - ECM
 - Pressure sensors

The wire connectors are shown in table 36.

- 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.

Verify that the repair eliminates the fault.

STOP.

Test Step 2. Check for Active Diagnostic Codes

- A. Connect the electronic service tool to the diagnostic connector.
- B. Turn the keyswitch to the ON position.
- C. Use the electronic service tool 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:

- 262-3 5 Volt Sensor DC Power Supply voltage above normal
- 262-4 5 Volt Sensor DC Power Supply voltage below normal

Results:

- OK – A 262-4 diagnostic code is active. Proceed to Test Step 3.
- OK – A 262-3 diagnostic code is active. Proceed to Test Step 7.
- Not OK – 262-4 and 262-3 diagnostic codes 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 electronic service tool in order to monitor the diagnostic codes.
- C. Disconnect the pressure sensors one at a time. Wait for 30 seconds after each of the sensors is disconnected.

Note: The diagnostic code will become inactive when the sensor that caused the diagnostic code is disconnected.

- D. Ensure that all the pressure sensors are disconnected.

Expected Result:

The diagnostic code is not active when all of the sensors are disconnected.

Results:

- OK – The 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 – The diagnostic code 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 suspect sensor and connect a replacement sensor. Do not install the replacement sensor to the engine.
- B. Use the electronic service tool in order to monitor the diagnostic codes.

Expected Result:

The diagnostic code is not active.

Results:

- OK – The diagnostic code is not active.

Repair: Install the replacement sensor on the engine. Use the electronic service tool in order to clear all logged diagnostic codes. Replace all wires to the original configuration.

Verify that the repair eliminates the fault.

STOP.

- Not OK – The diagnostic code is still active.

Repair: Do not use the new sensor. Repair the connectors or the wiring and/or replace the connectors or the wiring. Refer to Troubleshooting, "Electrical Connectors - Inspect".

Verify that the repair eliminates the fault.

STOP.

Test Step 5. Disconnect the ECM Connector and Check for Active Diagnostic Codes

- A. Turn the keyswitch to the OFF position.

- B. Connect the electronic service tool to the diagnostic connector.

- C. Check the ECM connectors for corrosion and moisture.

- D. Disconnect the P2 ECM connector from the ECM.

- E. Reconnect the P1 connector to the ECM.

- F. Turn the keyswitch to the ON position.

- G. Check for active diagnostic codes on the electronic service tool.

Note: A "voltage high" diagnostic code (open circuit) should be active for all of the following sensors:

- Engine pressure sensors
- Engine temperature sensors

Expected Result:

The diagnostic codes are not active. A "voltage high" diagnostic code (open circuit) is active for all of the engine pressure sensors and temperature sensors.

Results:

- OK – The diagnostic code is not active. Proceed to Test Step 6.
- Not OK – The diagnostic codes are still active.

Repair: Perform the following repair:

1. Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "Flash Programming".
2. Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

3. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".
4. Use the electronic service tool to recheck the system for active diagnostic codes.
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 6. Check the +5 Volt Supply Wire for a Short to Engine Ground or a Short to Other Wires in the Harness

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the J2/P2 ECM connector.
- C. Ensure that the analog sensors are disconnected at the sensor connectors.

Note: Wiggle the harness during the following test procedures in order to identify any intermittent short connectors.

- D. Measure the resistance from P2:2 to all terminals on the P2 ECM connector. Measure the resistance from the P2:2 to the ECM ground strap.

Expected Result:

Each resistance measurement is more than 20,000 Ohms.

Results:

- OK – The resistance check does not indicate a short in the engine harness to engine ground.

Repair: If a speed control device is installed, repeat this process for J1:54. If the throttle sensors pass the tests, the fault is intermittent.

Refer to Troubleshooting, “Electrical Connectors - Inspect”.

Use the electronic service tool in order to clear all logged diagnostic codes.

Replace all wires to the original configuration.

Restart the Test Step.

STOP.

- Not OK – A resistance measurement is less than 20,000 Ohms. The +5 V supply wire is shorted in the engine harness or the +5 V supply wire is shorted to the engine ground.

Repair: Repair the faulty wire or replace the faulty wire.

Use the electronic service tool in order to clear all logged diagnostic codes.

Verify that the repair eliminates the fault.

STOP.

Test Step 7. Measure the +5 Volt Supply to the Sensor

- A. Turn the keyswitch to the ON position.

Note: All the pressure sensors should be disconnected.

- B. Measure the voltage between terminal 1 (Pressure sensor +5 Volts) and the engine ground for each of the pressure sensors.

Expected Result:

The voltage is 5.0 ± 0.16 Volts DC.

Results:

- OK – The +5 Volt supply is within the expected range. Proceed to Test Step 8.
- Not OK – The voltage is greater than 5.16 Volts DC.

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.

Test Step 8. Check the Ground Wire

- A. Turn the keyswitch to the ON position.

- B. Measure the voltage between terminal 1 (pressure sensor +5 Volts) and terminal 2 (pressure sensor ground) on all of the pressure sensors.

- C. While the voltage is monitored, perform a 45 N (10 lb) pull test on the ground wires for the +5 Volt supply.

Expected Result:

The voltage is 5.0 ± 0.16 Volts DC.

Results:

- OK – The voltage is within the range.

Repair: If the fault is intermittent, refer to Troubleshooting, “Electrical Connectors - Inspect”.

STOP.

- Not OK – The voltage is not within the range.

Repair: Inspect the common wire for an open circuit.

Repair the common wire and/or replace the common wire.

Verify that the repair eliminates the fault.

STOP.

i03814034

CAN Data Link Circuit - Test

System Operation Description:

Use this procedure under the following circumstances:

Use this procedure if the following diagnostic code is active:

- 0247-9 SAE J1939 Data Link abnormal update rate

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 transferred 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.

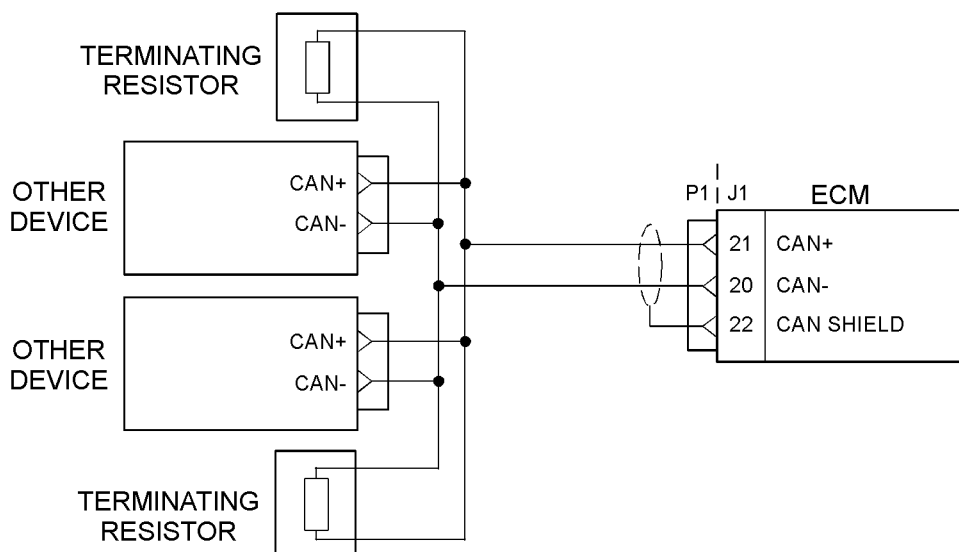


Illustration 19

g01801898

Typical example of the schematic for the CAN data link

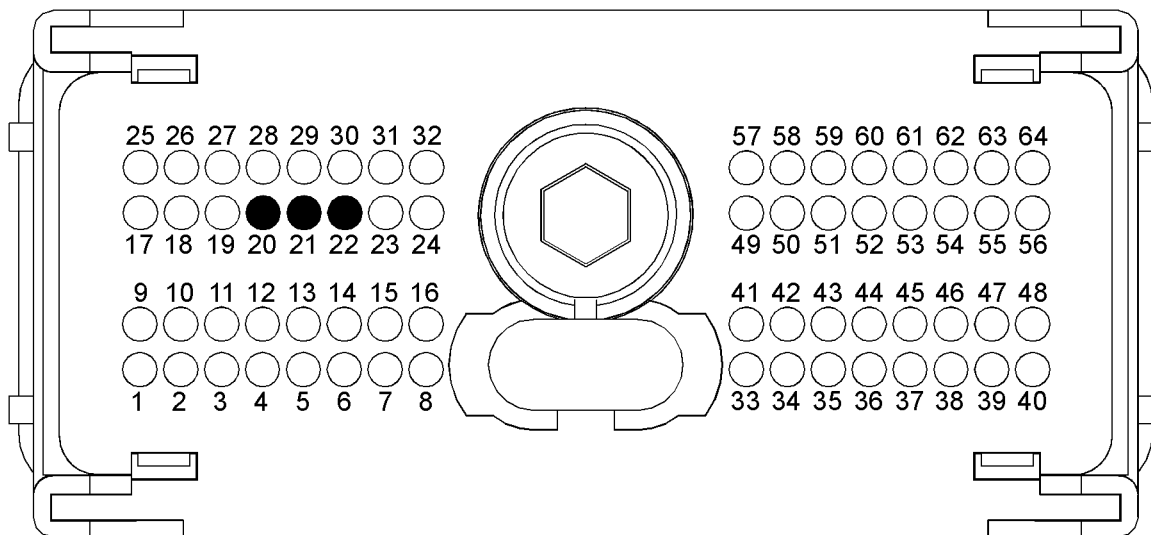


Illustration 20

g01801913

Typical view of the pin locations on the P1connector

(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 20.
- D. Check the harness for abrasion and pinch points from the keyswitch to the Electronic Control Module (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

- Disconnect the P1 connector from the ECM.
- 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 ECMs 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

- Disconnect each of the connectors that connect other devices on the data link.
- 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.
- 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.
- 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 less than 2.0 Ohms.

Results:

- OK – The resistance is less than 2.0 Ohms. Proceed to Test Step 4.
- Not OK – Some resistances are more than 2.0 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

- 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.

Repair: Repeat this test procedure from Test Step 1.

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.

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 electronic service tool is not the same version of the software that is in the ECM. Install the latest version of the software for the electronic service tool in order to rectify the fault.

i03814073

Data Link Circuit - Test

System Operation Description:

Use this procedure if the electronic service tool will not communicate with the Electronic Control Module (ECM) through the data link.

The following background information is related to this procedure:

The data link is the standard data link that is used by the ECM in order to communicate with the electronic service tool.

The ECM provides multiple connections for the 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 electronic service tool may indicate the following error message:

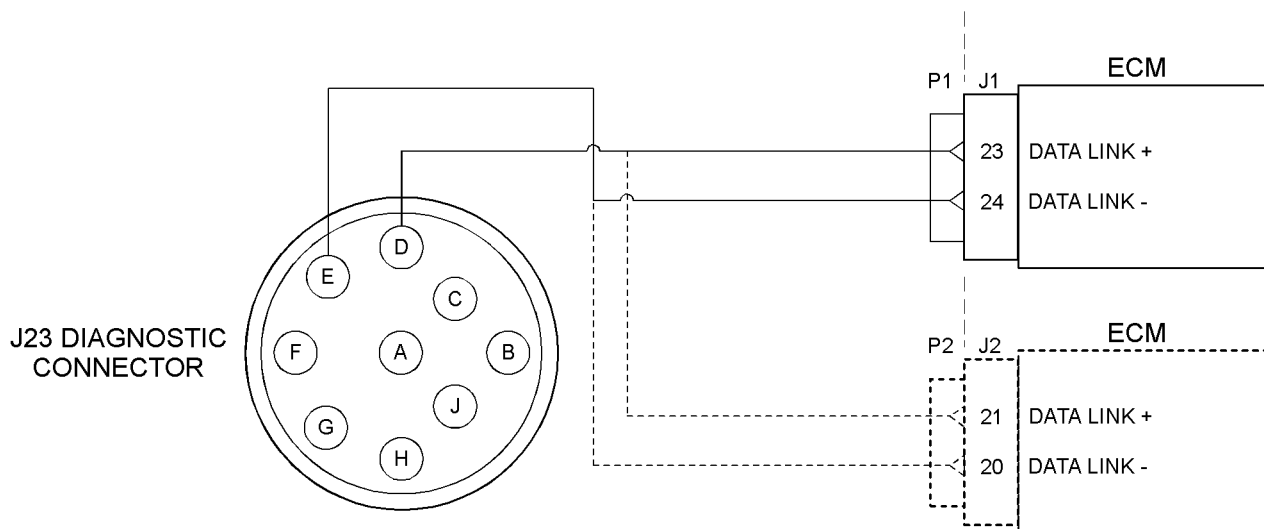


Illustration 21

g01801933

Schematic of the diagnostic connector and the data link connector

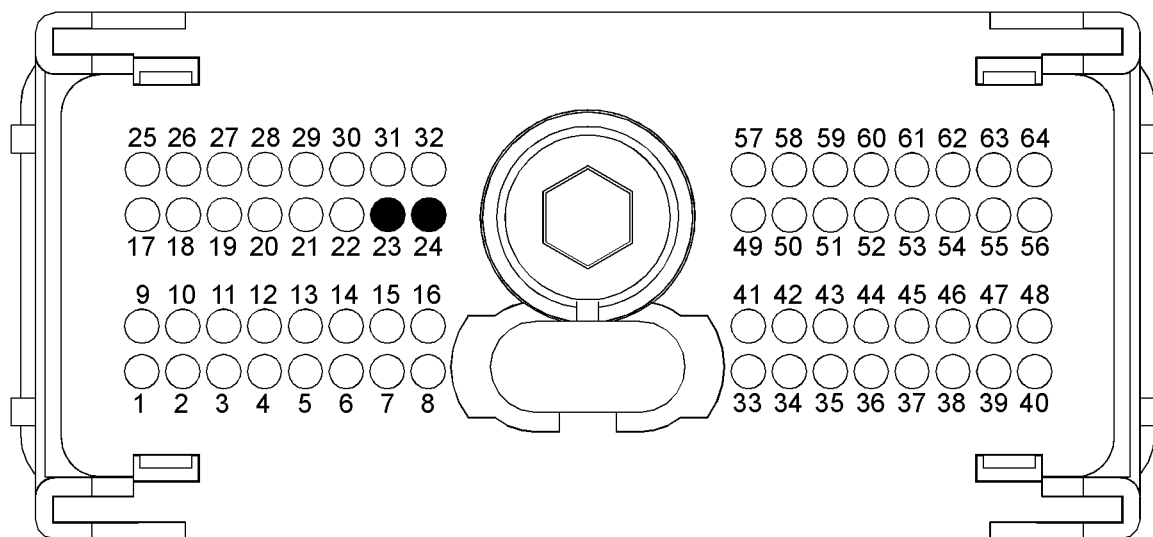


Illustration 22

g01801995

Typical view of the P1 pin locations for the diagnostic connector
 (23) Data link + (24) Data link -

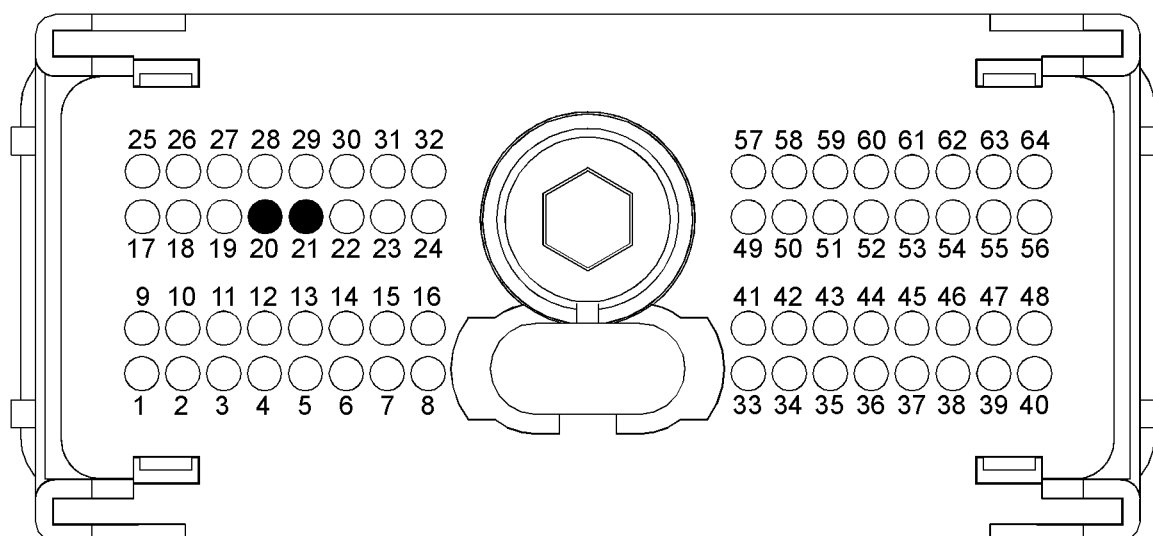


Illustration 23

Typical view of the P2 pin locations for the diagnostic connector
(20) Data link - (21) Data link +

g01801993

Test Step 1. Inspect Electrical Connectors and Wiring

A. Thoroughly inspect the following electrical connectors:

- P1/J1 ECM connector
- P2/J2 ECM connector
- J23 diagnostic 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 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 in the Data Link

A. Connect the electronic service tool 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 this step is being performed as a result of an instruction in “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

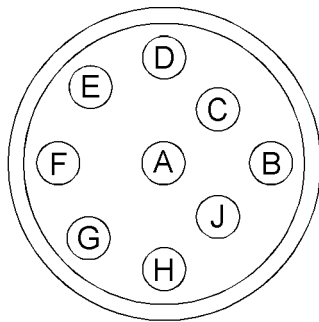


Illustration 24

g01241517

Typical view of the 9 pin diagnostic connector from the wire side

- (A) Switched battery +
- (B) Battery ground (GND)
- (D) Data link +
- (E) Data link -

- 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 Volts DC and 27.0 Volts DC for a 24 Volt system and between 11.0 Volts DC and 13.5 Volts DC 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 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 connector P1 from the ECM. Check the resistance between P1:23 and pin “D” on the diagnostic connector. If the diagnostic connector is installed on the engine, disconnect P2 from the ECM. Check the resistance between P2:21 and pin “D” on the diagnostic connector.
- D.** If the diagnostic connector is installed on the application, check the resistance between P1:24 and pin “E” on the diagnostic connector. If the diagnostic connector is installed on the engine, check the resistance between P2:20 and pin “E” on the diagnostic connector.

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 Electronic Service Tool Components

- A. If another electronic engine is available, connect the electronic service tool to the other engine. Ensure that the same cables are used.
- B. Turn the keyswitch to the ON position. Determine if the electronic service tool operates correctly on the other engine.
- C. If another engine is not available, obtain a replacement communications adapter and a replacement set of cables. Ensure that the set of cables for the electronic service tool are a complete set.
- D. Install the replacement communications adapter and the set of cables for the electronic service tool and connect to the diagnostic connector.
- E. Turn the keyswitch to the ON position.
- F. If changing the communications adapter or the cables allows the electronic service tool to operate correctly, perform the following procedure:
 - a. Replace the components from the new set of cables with components from the oldset of cables. Replace one component at a time.
 - b. Apply power to the electronic service tool after each of the components is replaced. Use this method to find the faulty component.
- G. If changing the cables does not allow the electronic service tool to operate correctly, connect another electronic service tool.
- H. Turn the keyswitch to the ON position.

Expected Result:

Result 1 The original electronic service tool works on another engine.

Result 2 A different electronic service tool 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 electronic service tool for repairs.

STOP.

Test Step 7. Connect an Electronic Service Tool 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 Figure 25 for details of the bypass harness.

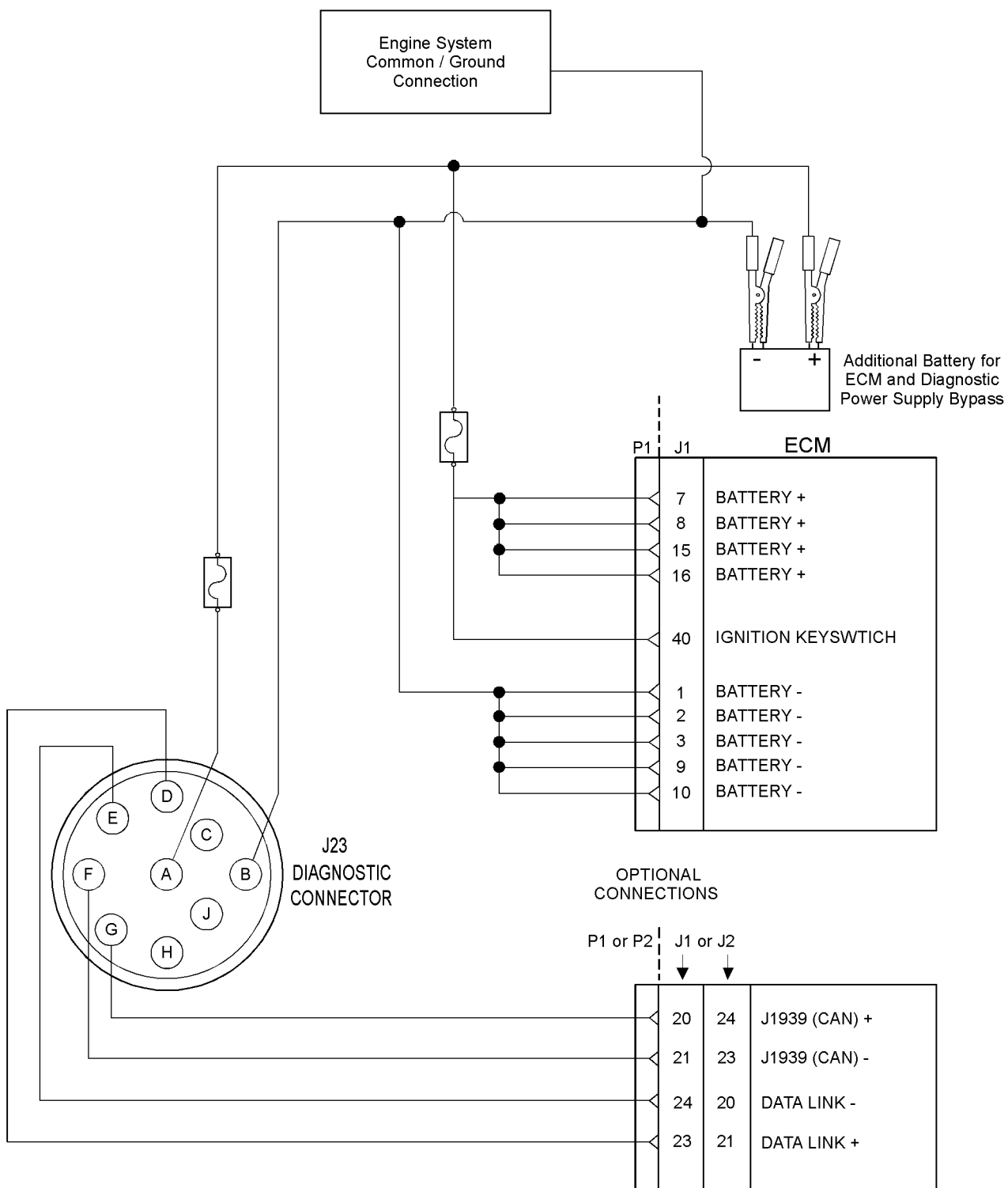


Illustration 25
Schematic of the bypass harness connector

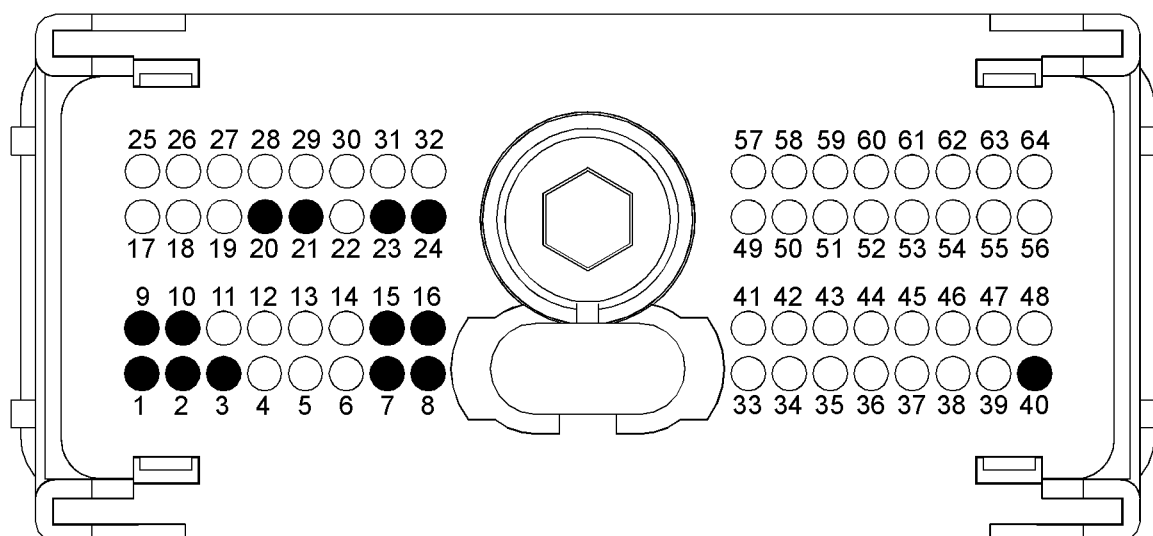


Illustration 26

g01802213

Typical view of the pin locations on connector P1 for the diagnostic and data link connectors

- | | | |
|--------------------------|---------------------------|--------------------|
| (1) Battery ground (GND) | (9) Battery ground (GND) | (21) J1939 (CAN) + |
| (2) Battery ground (GND) | (10) Battery ground (GND) | (23) Data link + |
| (3) Battery ground (GND) | (15) Battery + | (24) Data link - |
| (7) Battery + | (16) Battery + | (40) Keyswitch |
| (8) Battery + | (20) J1939 (CAN) - | |

A. Connect the battery wires from the bypass harness of the electronic service tool to a different battery that is not on the engine.

Expected Result:

The electronic service tool is operating correctly.

Results:

- Yes

Repair: Refer to Troubleshooting, "Engine Wiring Information".

STOP.

- No

Repair: Perform the following repair:

1. Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "Flash Programming".
2. Remove all temporary jumpers and reconnect all connectors.
3. Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

4. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".

5. Use the electronic service tool to recheck the system for active diagnostic codes.

6. If the fault is eliminated with the test ECM, reconnect the suspect ECM.

7. If the fault returns with the suspect ECM, replace the ECM.

8. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

STOP.

i03816029

ECM Memory - Test

System Operation Description:

This procedure covers the following diagnostic codes:

- 253-2 Personality Module mismatch

Background Information

253-2

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 253-2 diagnostic code is active.

Results:

- A 253-2 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.

i03458880

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.

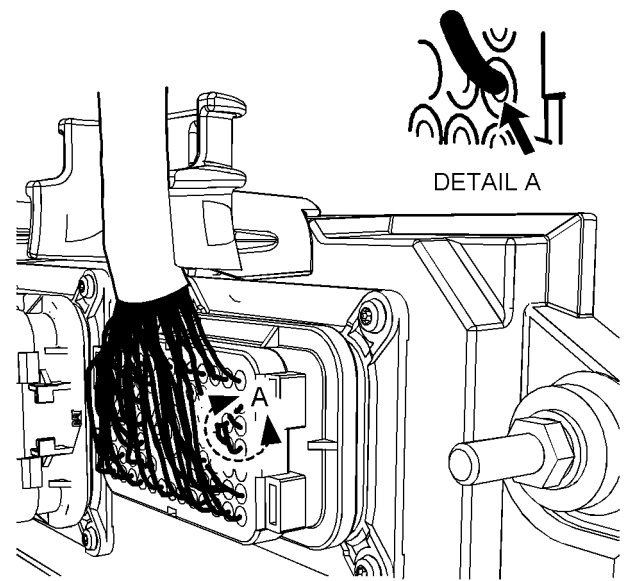
Test Step 1. Check Connectors for Moisture and Corrosion

Illustration 27

g01131211

Leaky seal at the connector (typical example)

- 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 27. This will create a path for the entrance of moisture. Verify that the seals for the wires are sealing correctly.

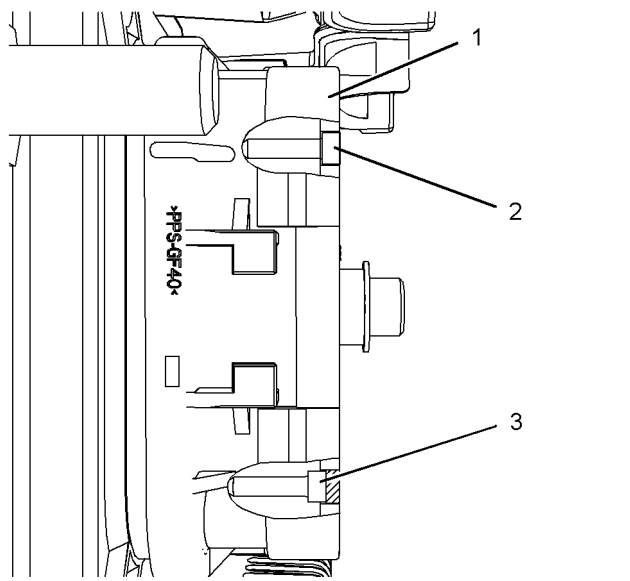


Illustration 28 g01131276

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 28.

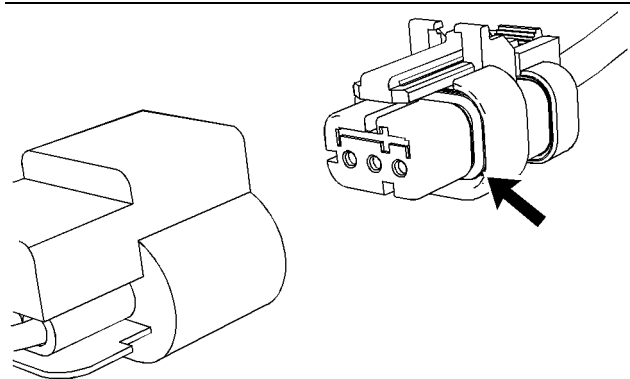


Illustration 29 g01131019

Seal for a three-pin connector (typical example)

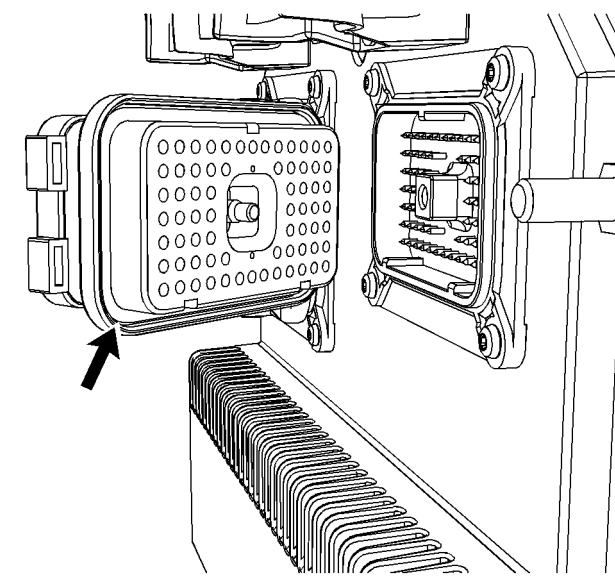


Illustration 30 g01131165

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

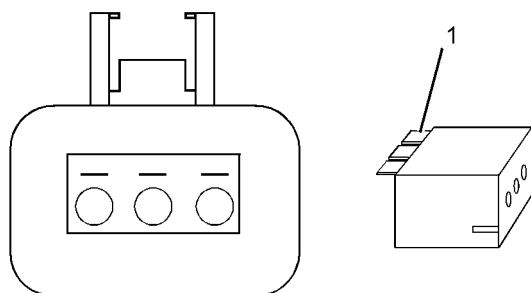


Illustration 31

g01802454

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

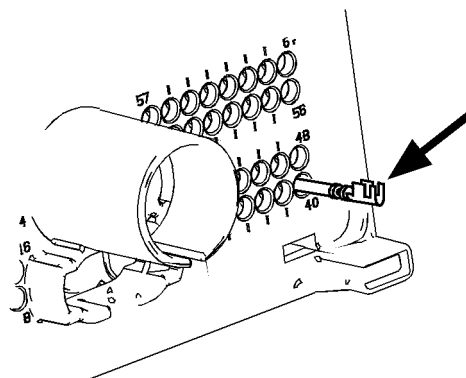


Illustration 32

g01802455

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 locking mechanism for the connector 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 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 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.

i03816072

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:

- 100-3 Engine Oil Pressure Sensor voltage above normal
- 100-4 Engine Oil Pressure Sensor voltage below normal

- 100-10 Engine Oil Pressure Sensor abnormal rate of change
- 1785-3 Intake Manifold Pressure Sensor voltage above normal
- 1785-4 Intake Manifold Pressure Sensor voltage below normal
- 1785-10 Intake Manifold Pressure Sensor abnormal rate of change
- 1797-3 Fuel Rail Pressure Sensor voltage above normal
- 1797-4 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 Volts DC 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 (XXX-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.

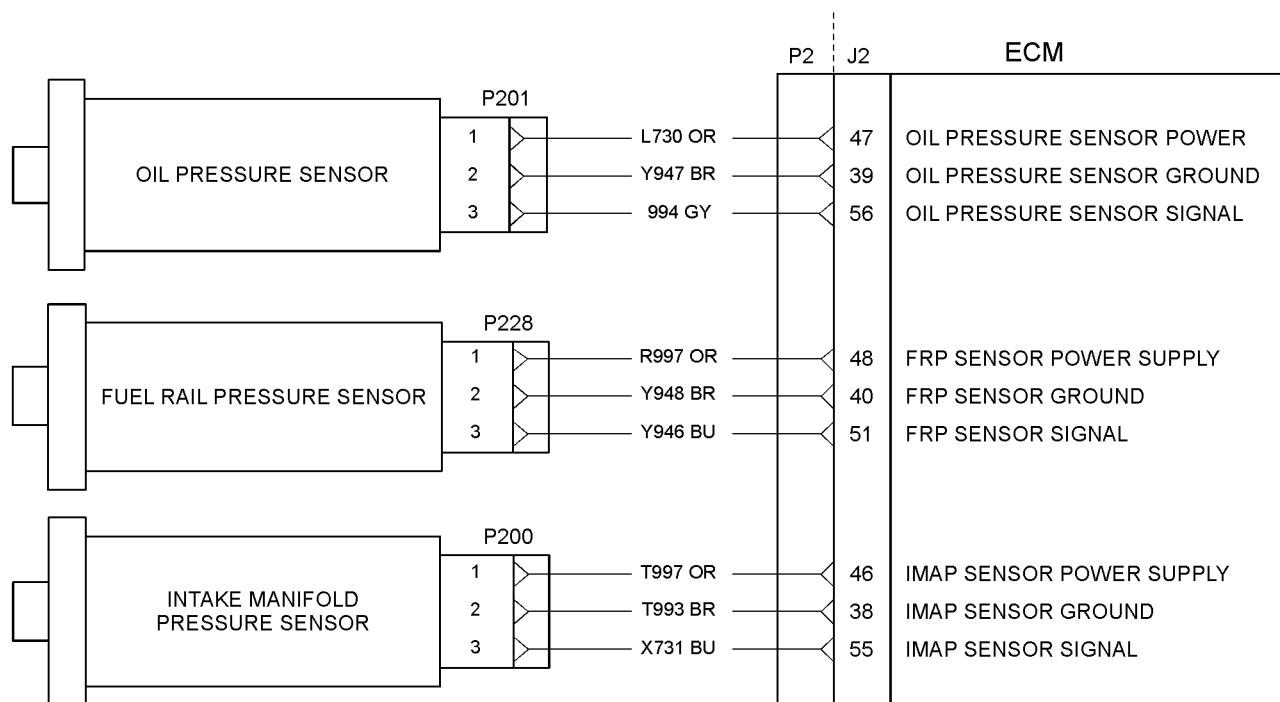


Illustration 33

g01800518

Typical example of the schematic for the sensors

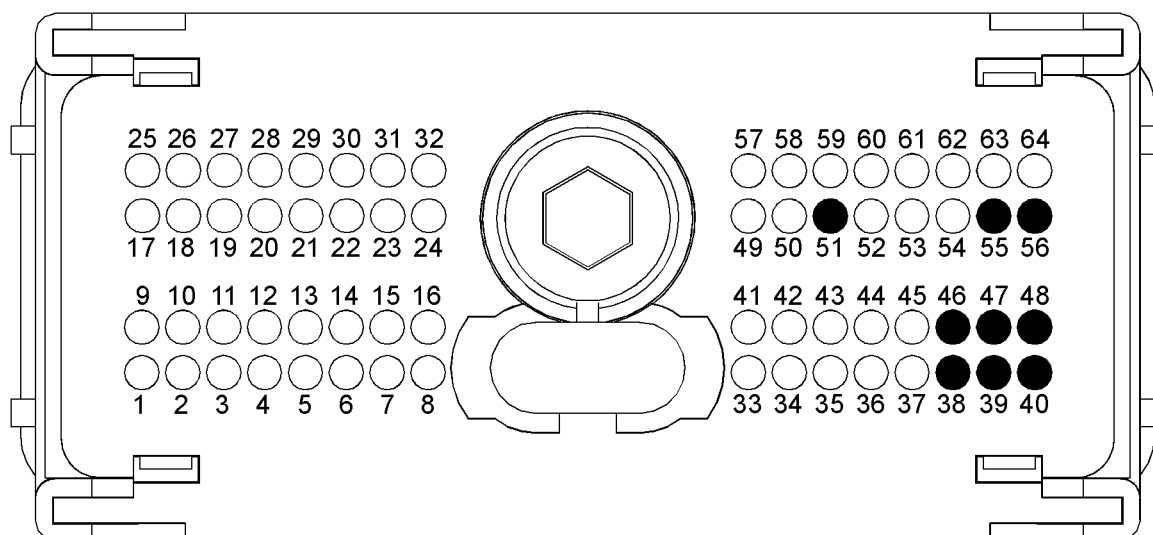


Illustration 34

g01802515

Typical view of the P2 pressure sensor pin locations

- | | | |
|---|---|---------------------------------------|
| (38) Ground (GND) Intake Manifold Pressure Sensor | (47) Voltage supply (+5 Volts DC) Oil Pressure Sensor | (56) Signal (SIG) Oil Pressure Sensor |
| (39) Ground (GND) Oil Pressure Sensor | (48) Voltage supply (+5 Volts DC) Fuel Rail Pressure Sensor | |
| (40) Ground (GND) Fuel Rail Pressure Sensor | (51) Signal (SIG) Fuel Rail Pressure Sensor | |
| (46) Voltage supply (+5 Volts DC) Intake Manifold Pressure Sensor | (55) Signal (SIG) Intake Manifold Pressure Sensor | |

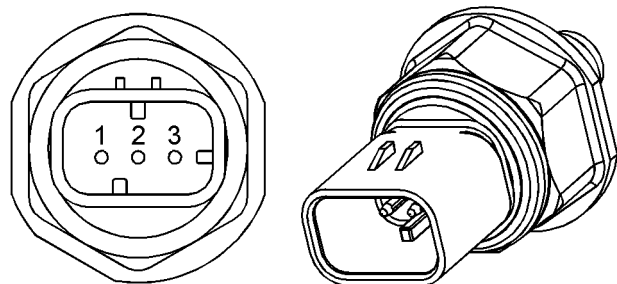


Illustration 35

g01170309

Fuel rail pressure sensor

- (1) Voltage supply (+5 Volts DC)
- (2) Ground (GND)
- (3) Signal (SIG)

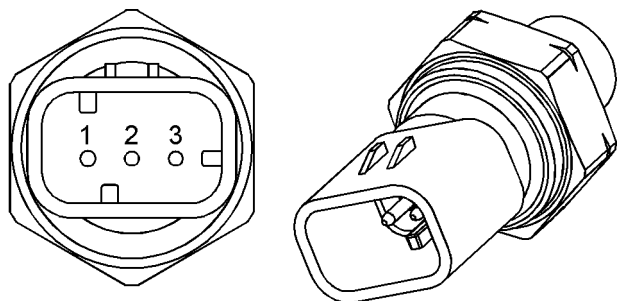


Illustration 36

g01170310

Intake manifold pressure sensor

- (1) Voltage Supply (+5 Volts DC)
- (2) Ground (GND)
- (3) Signal (SIG)

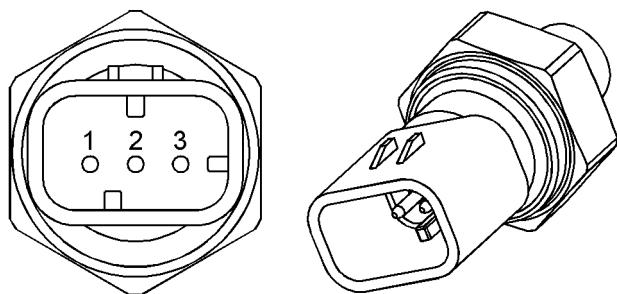


Illustration 37

g01170311

Typical example of the oil pressure sensor

- (1) Voltage Supply (+5 Volts DC)
- (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 DC 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:

- 100-3 Engine Oil Pressure Sensor voltage above normal
- 100-4 Engine Oil Pressure Sensor voltage below normal
- 100-10 Engine Oil Pressure Sensor abnormal rate of change
- 1785-3 Intake Manifold Pressure Sensor voltage above normal
- 1785-4 Intake Manifold Pressure Sensor voltage below normal
- 1785-10 Intake Manifold Pressure Sensor abnormal rate of change
- 1797-3 Fuel Rail Pressure Sensor voltage above normal
- 1797-4 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 electronic service tool in order to identify intermittent connections.

STOP.

Test Step 2. Inspect Electrical Connectors And Wiring

- 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 electronic service tool 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 electronic service tool 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: Use the electronic service tool to 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 in order for the diagnostic codes to become active.
- D. Use the electronic service tool 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 Below Normal" diagnostic code became active after disconnecting the sensor. Proceed to Test Step 6.
- Not OK – There is a short circuit between the sensor connector on the harness 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 Volts DC.

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 electronic service tool 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 electronic service tool 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 on the electronic service tool 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 electronic service tool 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 the electronic service tool 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. Monitor 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 the electronic service tool 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. Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "Flash Programming".
2. Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

3. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".
4. Use the electronic service tool to recheck the system for active diagnostic codes.
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.

i03816249

- 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 electronic service tool 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: Use the electronic service tool to perform a "Wiggle Test". If no fault is found, restart this procedure and carefully perform each step.

STOP.

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.
- There is an active diagnostic code or a recently logged diagnostic code that is related to the following:
- 190-8 Engine Speed signal abnormal
- 342-8 Secondary Engine Speed signal abnormal

The engine uses two engine speed/timing sensors. The primary speed/timing sensor is located on the left hand side of the cylinder block close to the flywheel housing. The secondary speed/timing 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 crankshaft timing ring. The crankshaft timing ring 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 signal from the speed/timing sensor to calculate the position of the crankshaft. To determine the engine speed, the ECM measures the time between the pulses that are created by the sensor as the crankshaft timing ring rotates.

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 timing ring 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. During normal operation, the secondary speed/timing sensor is used to determine the timing for starting purposes.

During normal operation, the secondary speed/timing sensor is used to determine when the number 1 piston is at the top of the compression stroke for starting purposes. When the timing has been established, the primary speed/timing sensor is then used to determine the engine speed.

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 in the derate mode.
- 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 37

P2/J2 Pin Connections			
Function	Sensor Pin	Primary Speed/Timing Sensor (Crankshaft)	Secondary Speed/Timing Sensor (Camshaft)
+8 Volt Supply	1	10	10
Signal	2	52	53

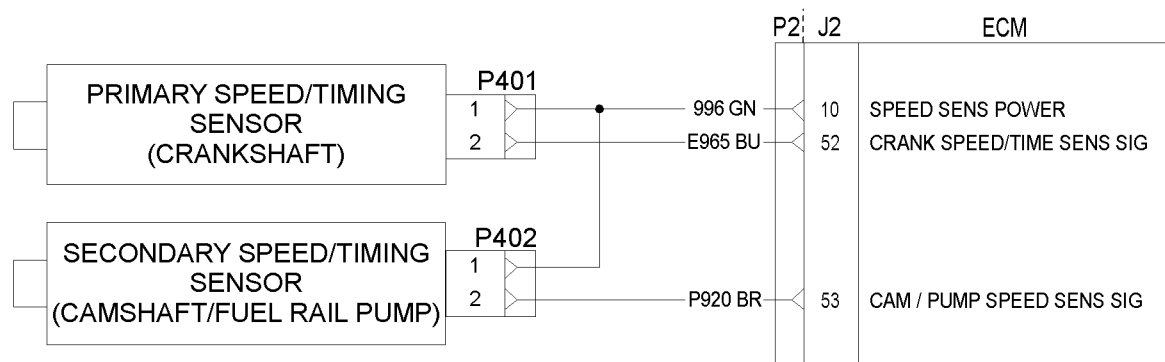


Illustration 38

The schematic for the speed/timing sensors

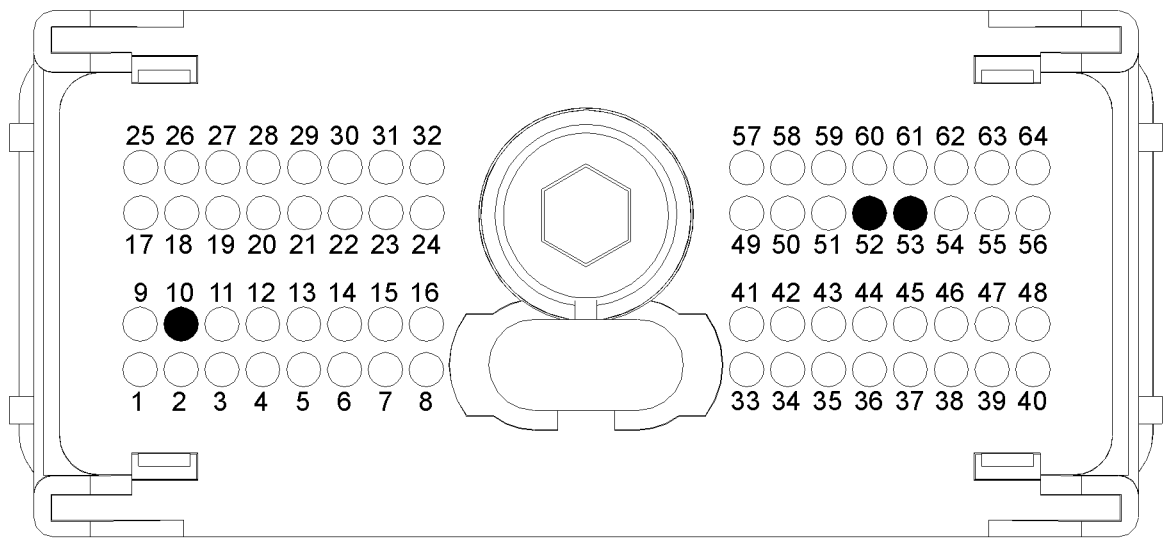


Illustration 39 g01188474
Typical view of the pin locations for the speed/timing sensors
(10) Speed/ Timing sensor supply (8v) (52) Primary speed/timing sensor signal (53) Secondary speed/timing sensor signal

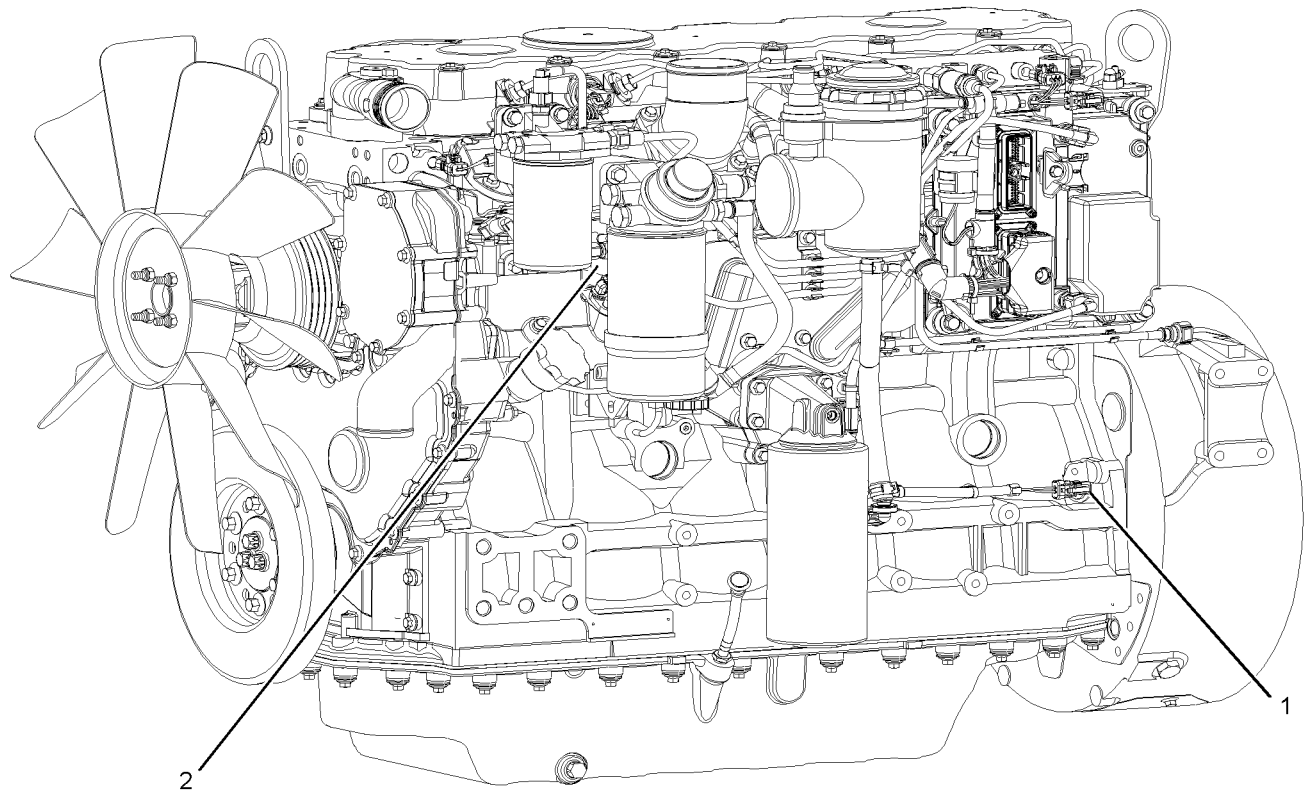


Illustration 40 g01188476
Typical view of the sensor locations
(1) Primary speed/timing sensor (2) Secondary speed/timing sensor

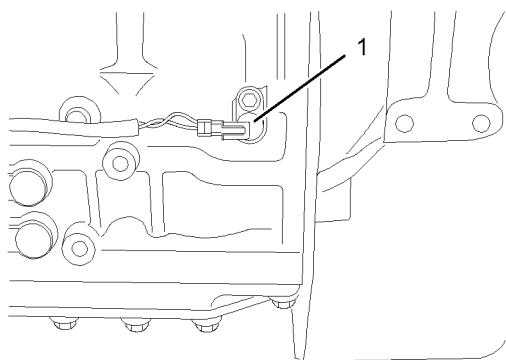


Illustration 41

g01188477

(1) Primary speed/timing sensor (crankshaft)

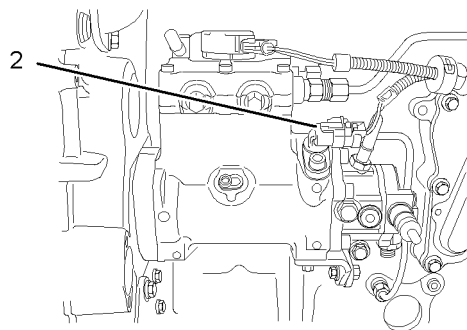


Illustration 42

g01212569

(2) Secondary speed/timing sensor (camshaft)

Test Step 1. Inspect the Electrical Connectors and the Harness

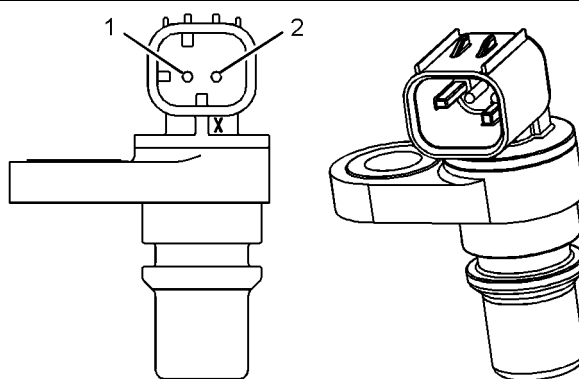


Illustration 43

g01212995

Typical example of a speed/timing sensor

(1) Voltage Supply (8V)

(2) Signal

- 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 39.

- 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 suspect sensor to the ECM.
- F. 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.

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 electronic service tool to the diagnostic connector.
- C. Turn the keyswitch to the ON position. If the engine will start, then run the engine.
- D. Use the electronic service tool 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 signal abnormal
- 342-8 Secondary Engine Speed signal abnormal

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 and terminal 2 on the secondary speed/timing sensor. The resistance should be less than 2.0 Ohms.
- D. Check the resistance between P2:10 and terminal 1 on the secondary speed/timing sensor. 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.

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 and terminal 2 on the secondary speed/timing sensor. The resistance should be less than 2.0 Ohms.
- D. Check the resistance between P2:10 and terminal 1 on the secondary speed/timing sensor. 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.

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 connector. 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.

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.

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 electronic service tool in order to monitor the diagnostic codes.
- G. 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: 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. Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "Flash Programming".
 - B. Contact Perkins Global Technical Support.
- Note:** This consultation can greatly reduce the repair time.
- C. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".
 - D. Use the electronic service tool to recheck the system for active diagnostic codes.
 - E. If the fault is resolved with the test ECM, reconnect the suspect ECM.
 - F. If the fault returns with the suspect ECM, replace the ECM.
 - G. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

Expected Result:

The fault is eliminated.

Results:

- OK
– 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.

Verify that the repair eliminates the fault.

STOP.

i03816070

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 active, recently logged or when a diagnostic code can easily be activated.

- 110-3 Engine Coolant Temperature voltage above normal
- 110-4 Engine Coolant Temperature voltage below normal
- 172-3 Intake Manifold Air Temperature voltage above normal
- 172-4 Intake Manifold Air Temperature 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.

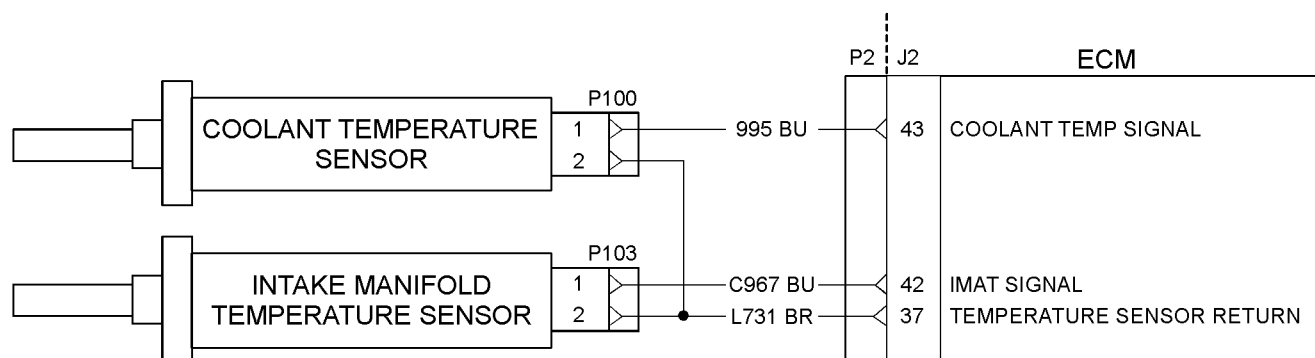


Illustration 44
Schematic for engine temperature sensors

g01803534

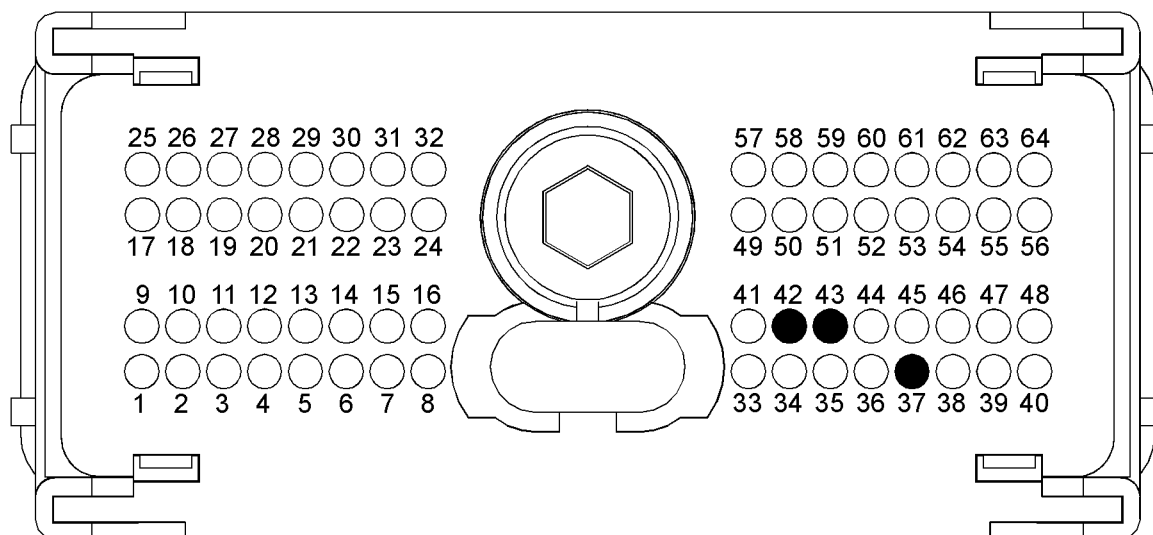


Illustration 45
Typical view of the P2 pin locations for the pressure sensor

g01803535

- | | |
|--|--|
| (37) Ground (GND) Intake Manifold Air Temperature Sensor | (42) Signal (SIG) Intake Manifold Air Temperature Sensor |
| (37) Ground (GND) Coolant Temperature Sensor | (43) Signal (SIG) Coolant Temperature Sensor |

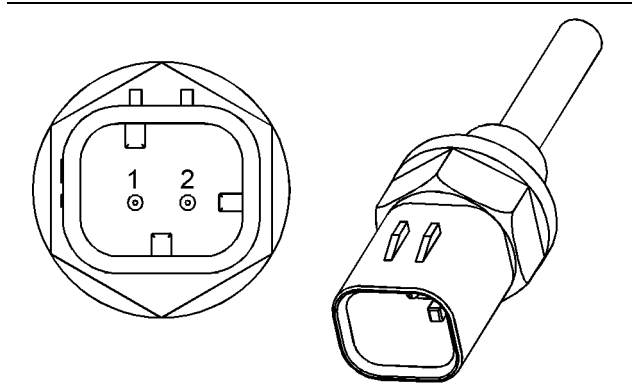


Illustration 46

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 electronic service tool to the diagnostic connector.

B. Turn the keyswitch to the ON position.

Note: Wait at least 30 seconds in order to allow activation of the diagnostic codes.

C. Use the electronic service tool in order to verify if any of the following diagnostic codes are active or recently logged:

- 110-3 Engine Coolant Temperature voltage above normal
- 110-4 Engine Coolant Temperature voltage below normal
- 172-3 Intake Manifold Air Temperature voltage above normal
- 172-4 Intake Manifold Air Temperature 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 – STOP.

Test Step 2. Inspect Electrical Connectors And Wiring

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 45.

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.

F. Use the electronic service tool to perform a “Wiggle Test”. The “Wiggle Test” will identify intermittent connections.

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 30 seconds in order to allow activation of the diagnostic codes.

B. Access the “Active Diagnostic Code” screen on the electronic service tool and check for active diagnostic codes.

C. Determine if the fault is related to an open circuit diagnostic code or a short circuit diagnostic code.

Expected Result:

A short circuit diagnostic code or an open circuit diagnostic code is active.

Results:

- OK - SHORT Circuit – A short circuit diagnostic code is active at this time. Proceed to Test Step 4.
- OK - OPEN Circuit – An open circuit 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: Use the electronic service tool to 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 for the sensor with the short circuit diagnostic code.
- C. Turn the keyswitch to the ON position.

Note: Wait at least 30 seconds in order to allow activation of the diagnostic codes.

- D. Access the "Active Diagnostic Code" screen on the electronic service tool. Check for an active open circuit diagnostic code.

Expected Result:

An open circuit diagnostic code for the disconnected sensor is now active.

Results:

- OK – A short circuit diagnostic code was active before disconnecting the sensor. An open circuit diagnostic code became active after disconnecting the sensor.

Repair: Perform the following procedure:

1. Refer to Troubleshooting, "Electrical Connectors - Inspect".
2. Inspect the seals of the connectors for damage.
3. Connect the sensor and verify that the fault returns. If the fault returns, the sensor is faulty. Replace the sensor.

4. Use the electronic service tool to remove all inactive 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 30 seconds in order to allow 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 electronic service tool 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 in order to allow 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. If the diagnostic code remains active, replace the sensor.
3. Verify that the repair eliminates the fault.
4. Clear all inactive diagnostic codes.

STOP.

- Not OK – The open circuit 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/J2 ECM 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 electronic service tool in order to monitor the “Active Diagnostic Code” screen. Wait at least 30 seconds in order to allow activation of the code.

An open circuit diagnostic code should be active for the suspect sensor.

Note: When P2 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. Address 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 electronic service tool before installing the jumper wire and after installing the jumper wire.
- H. Remove the signal pin from the P2 connector for the suspect sensor. Remove the P2:37 connector. Install one end of the jumper on the suspect sensor signal pin on the connector P2. Install the other end of the jumper to P2:37 common connection for the sensors. Reassemble the P2 connector to the ECM. Use the electronic service tool in order to check the diagnostic codes. Wait at least 30 seconds in order to allow activation of the short circuit diagnostic code.

Note: The open circuit 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 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 – Proceed to test step 7.
- Not OK

Repair: The ECM does not operate correctly.

1. Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, “Flash Programming”.
2. Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

3. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”.
4. Use the electronic service tool to recheck the system for active diagnostic codes.
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 7. Bypass the Harness Wiring Between the ECM and the Sensor Connector

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the P2/J2 connector for 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 electronic service tool in order 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 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. Verify that the repair eliminates the fault.

STOP.

- Not OK – The most likely cause is an intermittent fault.

Repair: Use the electronic service tool to perform a "Wiggle Test". If no fault is found, restart this procedure and carefully perform each step.

STOP.

Note: The fuel rail pump is installed on the engine at the factory. The fuel rail pump is not a 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 an active diagnostic code or if a diagnostic code can easily be activated.

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, the ECM and the software. The fuel rail pressure sensor measures the fuel pressure in the high pressure fuel rail. The signal from the fuel rail pressure sensor 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. The engine will shut down or the engine will fail to start. The fuel rail pressure can be observed on the status screen of the electronic service tool.

i03816030

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:

- 1779-5 Fuel Rail #1 Pressure Valve Solenoid current below normal
- 1779-6 Fuel Rail #1 Pressure Valve Solenoid current above normal
- 1779-8 Fuel Rail #1 Pressure Valve Solenoid abnormal frequency, pulse width or period

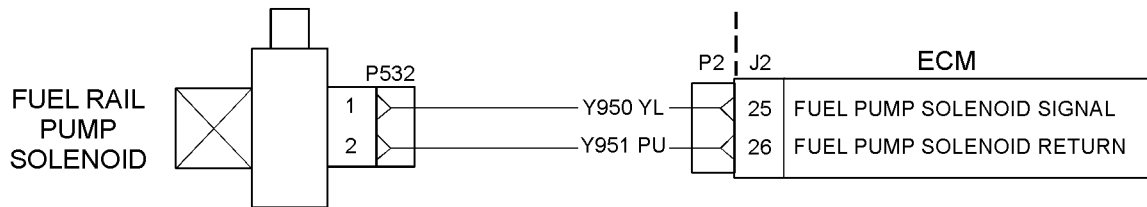


Illustration 47

g01803553

Typical schematic of the circuit for the fuel rail pump solenoid

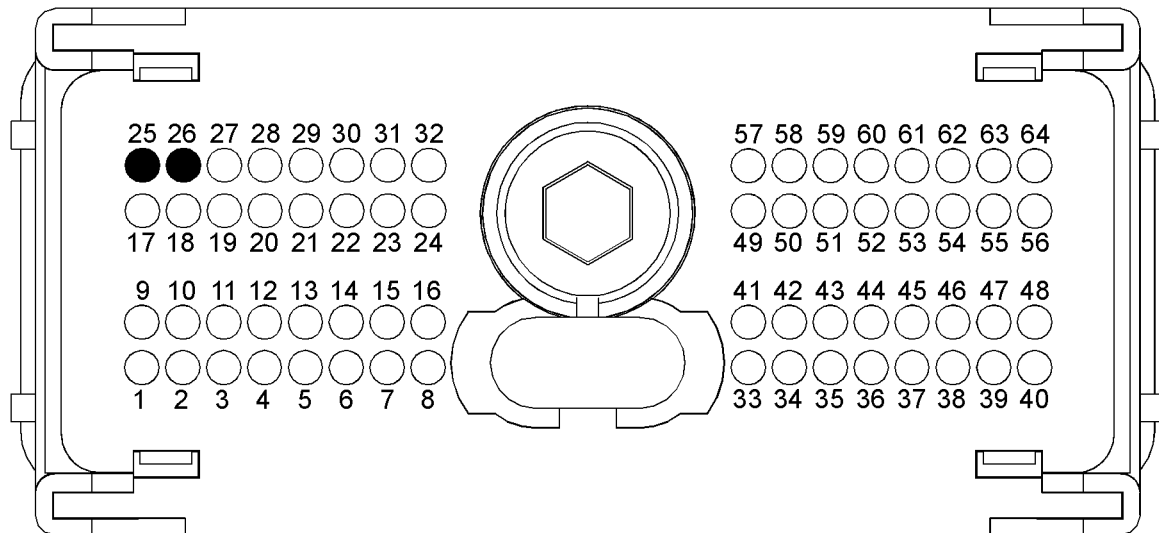


Illustration 48

g01803554

Typical view of the pin locations on the P2 connector for the fuel rail pump solenoid

(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 48.
- 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. Use the electronic service tool in order to perform a "Wiggle Test". The "Wiggle Test" is used 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 electronic service tool to the diagnostic connector.
- B. Turn the keyswitch to the ON position.
- C. Use the electronic service tool to verify if any of the following diagnostic codes are active or recently logged:
 - 1779-5 Fuel Rail #1 Pressure Valve Solenoid current below normal
 - 1779-6 Fuel Rail #1 Pressure Valve Solenoid current above normal
 - 1779-8 Fuel Rail #1 Pressure Valve Solenoid abnormal frequency, pulse width or period

Expected Result:

One or more of the following diagnostic codes are active or recently logged:

- 1779-5 Fuel Rail #1 Pressure Valve Solenoid current below normal
- 1779-6 Fuel Rail #1 Pressure Valve Solenoid current above normal
- 1779-8 Fuel Rail #1 Pressure Valve Solenoid abnormal frequency, pulse width or period

Results:

- 1779-5 or 1779-8 – Proceed to Test Step 3.
- 1779-6 – 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 2.0 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 the 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 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 1.0 Ohms.

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 electronic service tool in order to clear all logged diagnostic codes.

Use the electronic service tool in order to perform the fuel rail pump solenoid test.

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. Tighten the screw for the ECM connector to a torque of 5.0 N·m (44 lb in).

Use the electronic service tool in order to perform the fuel rail pump solenoid test.

Verify that the repair eliminated the fault.

If the diagnostic code has been cleared, install the new fuel rail pump to the engine. Refer to Disassembly and Assembly, "Fuel Injection Pump - Install".

STOP.

Test Step 5. Check the Fuel Rail Pump Solenoid for a Short Circuit

- Turn the keyswitch to the OFF position.
- Disconnect the connector from the fuel rail pump solenoid.
- Turn the keyswitch to the ON position.
- Use the electronic service tool 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. Tighten the screw for the ECM connector to a torque of 5.0 N·m (44 lb in).

Use the electronic service tool in order to clear all logged diagnostic codes.

Use the electronic service tool 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 pump to the engine. Refer to Disassembly and Assembly, "Fuel Injection Pump - Remove" and Disassembly and Assembly, "Fuel Injection Pump - Install".

STOP.

- Not OK – The harness has a short circuit or the ECM has a short circuit. Proceed to Test Step 6.

Test Step 6. Check the harness for the Fuel Rail Pump Solenoid for a Short Circuit

- Turn the keyswitch to the OFF position.
- Disconnect the P532 connector from the fuel rail pump solenoid.
- Disconnect the P2 connector from the ECM.
- Measure the resistance between P2:26 and P2:25.
- Measure the resistance between P2:25 and voltage +.
- Measure the resistance between P2:25 and the voltage (-).
- Measure the resistance between P2:26 and voltage +.
- 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 electronic service tool 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 electronic service tool in order to perform the fuel rail pump solenoid test.
- F. Use the electronic service tool in order to monitor the status screen.

Expected Result:

Diagnostic code 1779-6 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. Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, “Flash Programming”.
- B. Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

- C. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”.
- D. Use the electronic service tool to recheck the system for active diagnostic codes.

Expected Result:

The fault is eliminated.

Results:

- OK – The fault is eliminated with the test ECM.

Repair: Perform the following procedure:

1. Reconnect the suspect ECM.
2. If the fault returns with the suspect ECM, replace the ECM.
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

Repair: Repeat the test procedure from Test Step 1.

STOP.

i03814357

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:

- 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

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 and 16. The battery- is supplied through P1: 1, 2, 3, 9 and 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.

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, although it is possible to power up the electronic service tool, there may be no communication 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 the electronic service tool if the keyswitch is in the OFF position. This is normal.

For intermittent faults such as intermittent shutdowns that could be caused by the wiring on the application, temporarily bypassing the wiring on the application may be an effective means of determining the root cause. If the symptoms disappear with the bypass wiring, the wiring on the application is the cause of the fault. A means of bypassing the wiring on the application 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.

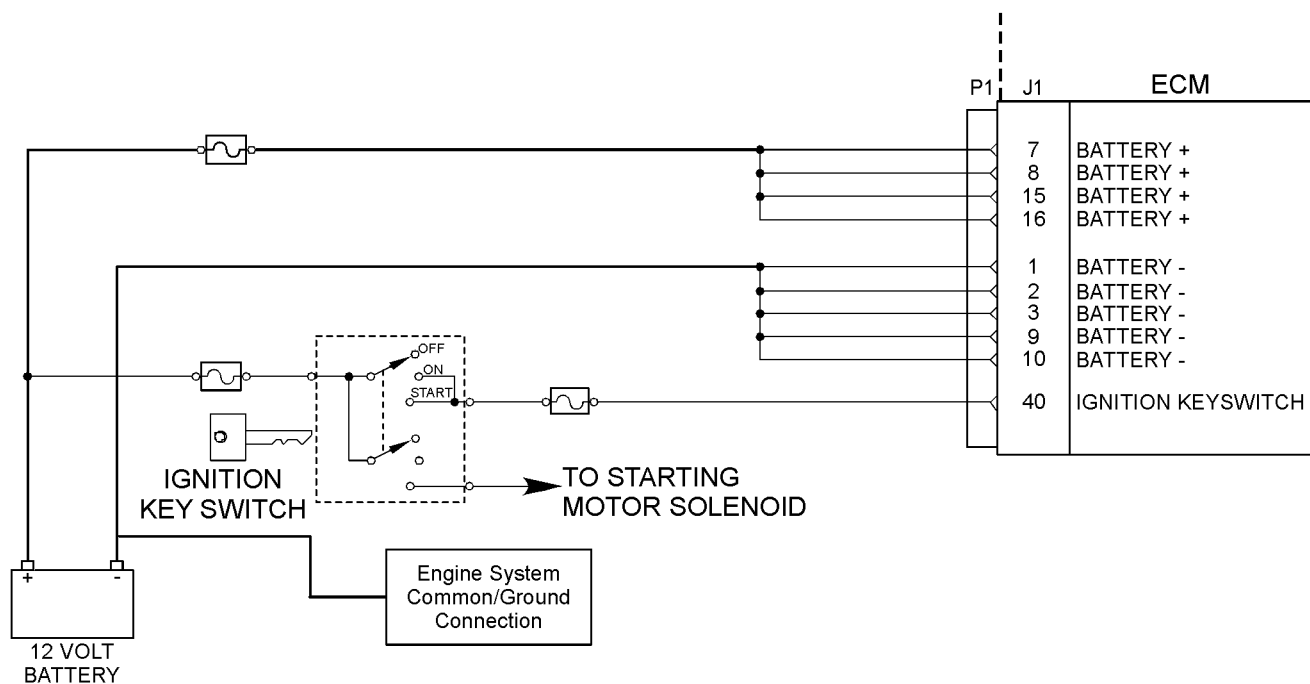


Illustration 49
Schematic for the ignition keyswitch and battery supply circuit

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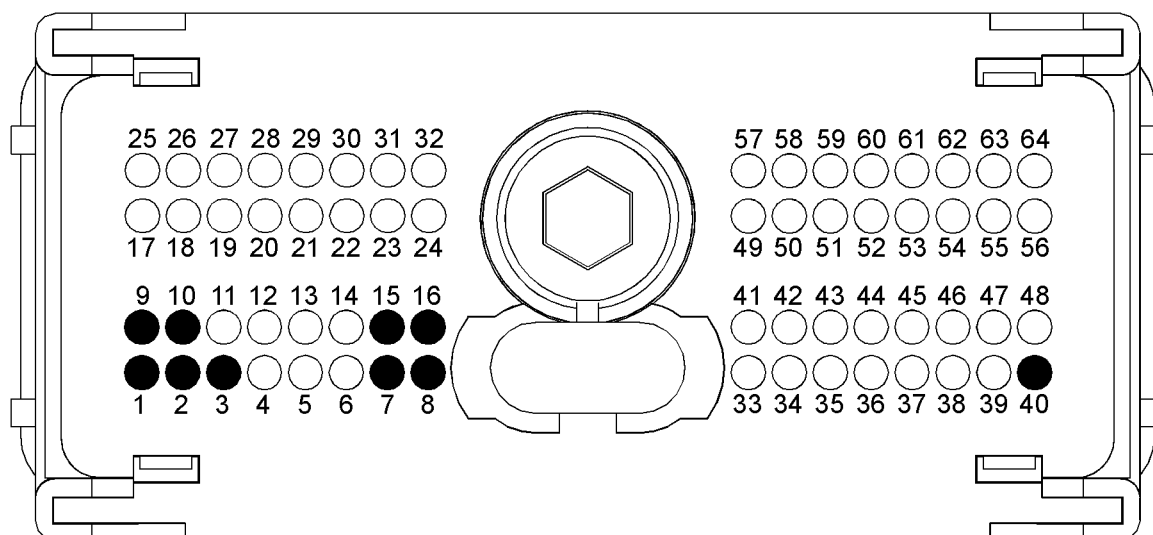


Illustration 50
View of the pin locations on the P1 connector for the ignition keyswitch and battery supply circuit

g01803934

- | | | |
|--------------------------|---------------------------|--------------------------|
| (1) Battery ground (GND) | (8) Battery+ | (16) Battery+ |
| (2) Battery ground (GND) | (9) Battery ground (GND) | (40) Ignition key switch |
| (3) Battery ground (GND) | (10) Battery ground (GND) | |
| (7) Battery+ | (15) Battery+ | |

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 electronic service tool 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 electronic service tool to the diagnostic connector.
- B.** Turn the keyswitch to the ON position.
- C.** Monitor the active diagnostic code screen on the electronic service tool. 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 – A 168-x diagnostic code or diagnostic code 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 P1 connector from the ECM.
- 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 Volts DC with no suspected intermittent faults at this time.

For 24 Volt Systems, the measured voltage is a constant 22.0 to 27.0 Volts DC with no suspected intermittent faults at this time.

Results:

- OK – The ECM is receiving the correct voltage.

Repair: If an intermittent fault 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.

For intermittent faults such as intermittent shutdowns that could be caused by the wiring on the application, temporarily bypassing the wiring on the application 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.

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. 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 Volts DC. For 24 Volt systems, the measured voltage is at least 22.0 Volts DC.

Results:

- OK – The batteries pass the load test. For 12 Volt systems, the measured voltage is at least 11.0 Volts DC. For 24 Volt systems, the measured voltage is at least 22.0 Volts DC.

Repair: Refer to the service manual for the application for instructions on troubleshooting the harness on the application. Troubleshoot the harness on the application and repair the harness on the application, as required.

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 Volts DC. For 24 Volt systems, the measured voltage is less than 22.0 Volts DC.

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 Harness on the Application

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 problem is interruptions in battery power to the ECM or to the keyswitch circuit.

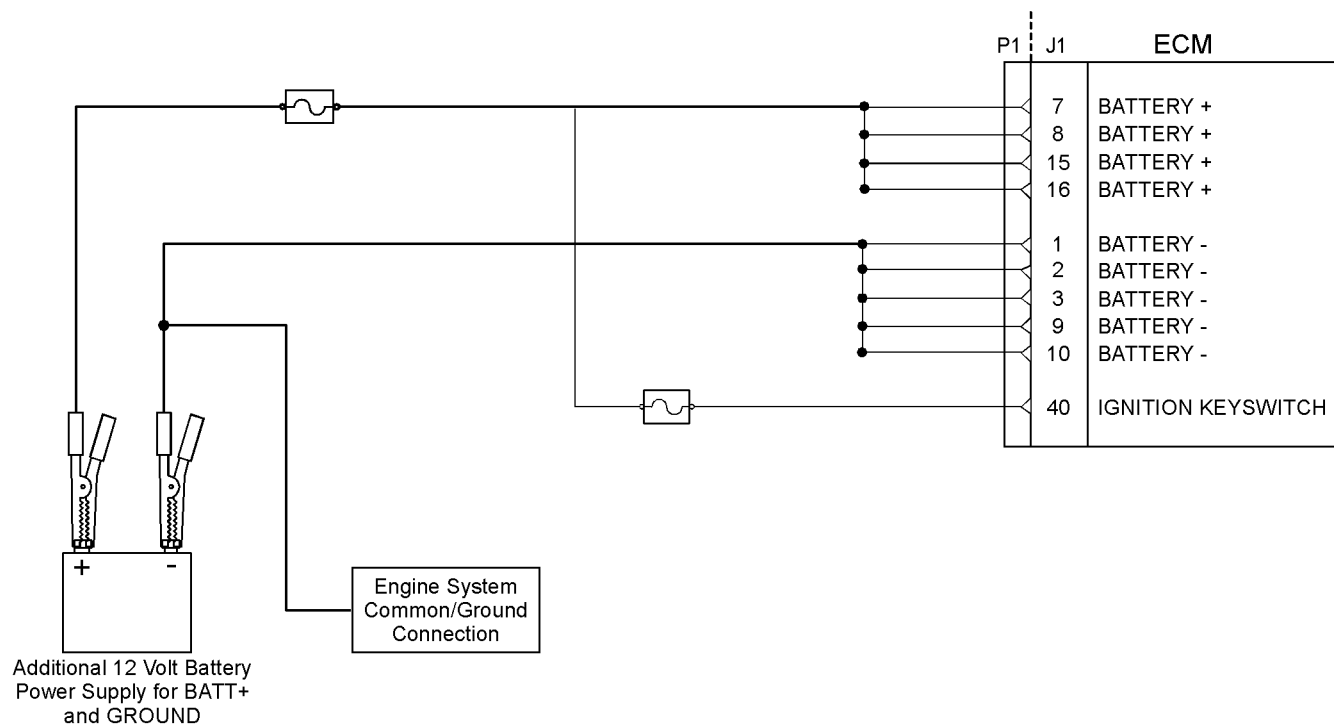


Illustration 51

g01803954

Schematic for the bypass harness for the application

- A.** Turn the keyswitch to the OFF position.
- B.** Disconnect the P1 connector from the ECM.
- 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. Use a multimeter to measure the voltage between P2:46 and ground. The voltage should be +5 Volts DC.**

Note: Remove the bypass harness and restore all wiring to the original condition after testing.

Expected Result:

If the measured voltage between P2:46 and ground is +5 Volts DC, installing the bypass has eliminated the fault.

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 machine to the OEM dealer to repair. STOP.
- Not OK

Repair: Perform the following procedure:

1. 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.
2. If the fault still exists, make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "Flash Programming".
3. Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

4. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".
5. Use the electronic service tool to recheck the system for active diagnostic codes.
6. If the fault is resolved with the test ECM, reconnect the suspect ECM.
7. If the fault returns with the suspect ECM, replace the ECM.
8. Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

STOP.

i03814233

Indicator Lamp Circuit - Test

System Operation Description:

Use this procedure when the lamps are not operating correctly.

Also, use this procedure if another procedure has directed you here.

The following diagnostic lamps are available:

- Diagnostic lamp
- Warning lamp
- Derate lamp
- Shutdown lamp
- Overspeed lamp
- Low oil pressure lamp
- High coolant temperature lamp
- Maintenance lamp

The electronic service tool can be used as a diagnostic aid in order to switch the individual lamps ON and OFF.

Note: The diagnostic functions that switch the lamps are contained in the "Override" section in the "diagnostics" menu of the electronic service tool.

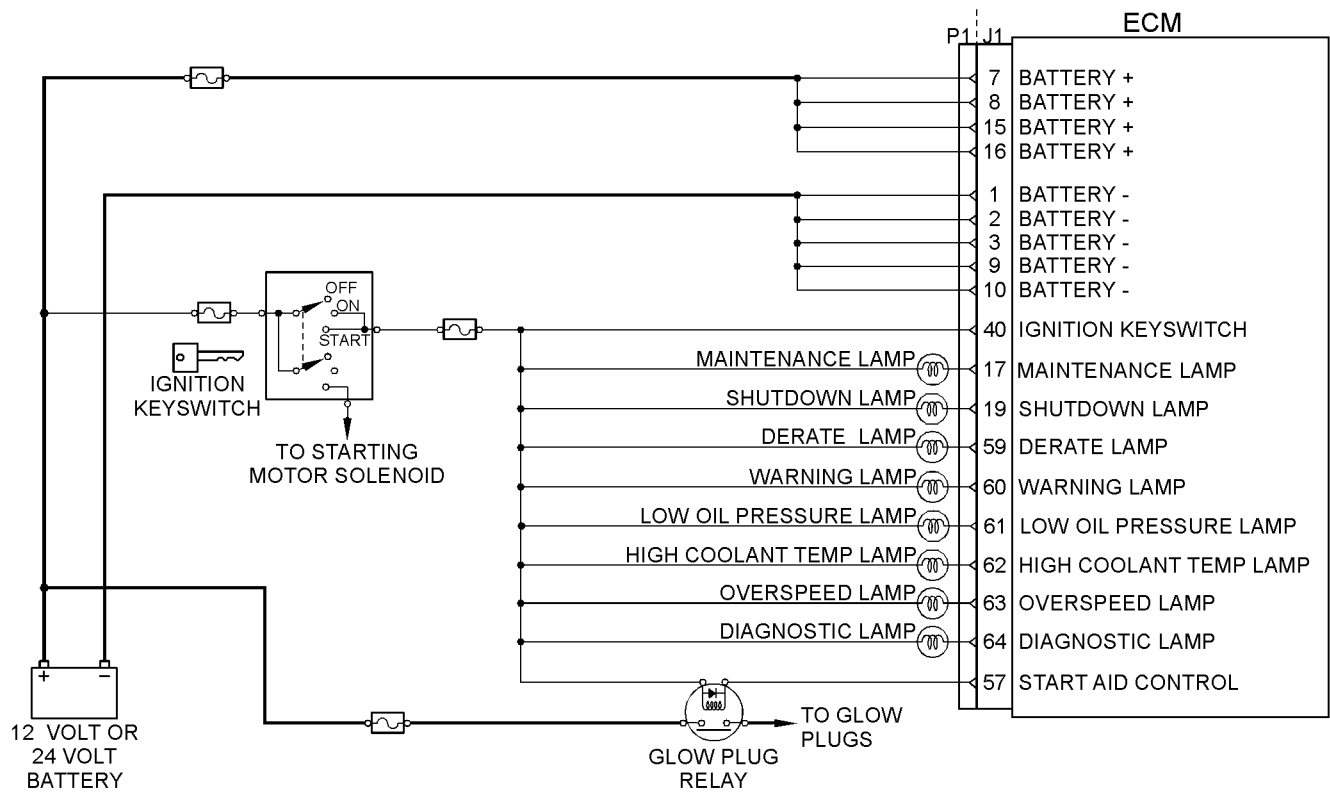


Illustration 52

g02053753

Typical schematic of the circuit for the indicator lamps

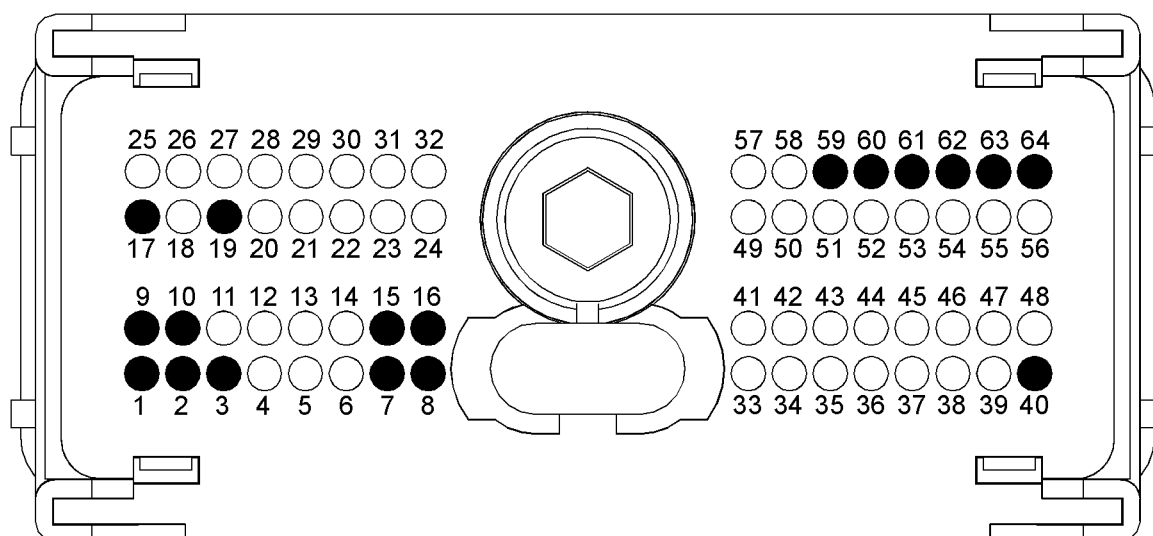


Illustration 53

g02053754

Pin locations for the indicator lamps on the P1 connector

- | | | |
|-------------------|-----------------------|------------------------------------|
| (1) Ground (GND) | (8) Battery (+) | (59) Derate lamp |
| (2) Ground (GND) | (15) Battery (+) | (60) Warning lamp |
| (3) Ground (GND) | (16) Battery (+) | (61) Low oil pressure lamp |
| (9) Ground (GND) | (17) Maintenance lamp | (62) High coolant temperature lamp |
| (10) Ground (GND) | (19) Shutdown lamp | (63) Overspeed lamp |
| (7) Battery (+) | (40) Keyswitch | (64) Diagnostic lamp |

Test Step 1. Inspect Electrical Connectors and Wiring

- Turn the keyswitch to the OFF position.
- Thoroughly inspect P1 connector and the lamp connections. Refer to Troubleshooting, "Electrical Connectors - Inspect" for details.
- Perform a 45 N (10 lb) pull test on each of the wires in the customer connector and the ECM connector that are associated with the diagnostic lamp.
- Check the screw for the P1 connector for the correct torque of 5.0 N·m (44 lb in).
- 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.

Verify that the repair eliminates the fault.

STOP.

Test Step 2. Inspect the Lamp, the Fuse, and the Power Supply

- Disconnect the lamp from the harness. Inspect the lamp in order to determine if the lamp has failed.
- Measure the resistance across the two terminals of the lamp. If the resistance is more than 2000 Ohms, the bulb has failed.
- 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. 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 electronic service tool 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 electronic service tool.

- C.** Measure the voltage at the lamp socket.

Expected Result:

The voltage should be between 12.0 Volts DC and 24.0 Volts DC.

Results:

- OK – The voltage is between 12.0 Volts DC and 24.0 Volts DC.

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 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:

When the jumper is connected, the diagnostic lamp comes on. Also, the diagnostic lamp goes 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.

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 a 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 test lamp between the battery+ and the jumper wire.
- E.** Reconnect the P1 connector to the ECM.
- F.** Turn the keyswitch to the ON position. Use the electronic service tool 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 electronic service tool.

Expected Result:

The lamp comes on.

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 – The ECM has a fault.

Repair: Perform the following procedure:

1. Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "Flash Programming".
2. Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

3. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".
4. Use the electronic service tool to recheck the indicator lamps.
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 verify that the repair eliminates the fault.

STOP.

i03814033

Injector Data Incorrect - Test

System Operation Description:

Use this procedure under the following conditions:

Use this procedure for any of the following diagnostic codes:

- 1-2 Cylinder #1 Injector Data Incorrect
- 2-2 Cylinder #2 Injector Data Incorrect
- 3-2 Cylinder #3 Injector Data Incorrect
- 4-2 Cylinder #4 Injector Data Incorrect
- 5-2 Cylinder #5 Injector Data Incorrect
- 6-2 Cylinder #6 Injector Data Incorrect

The following background information is related to this procedure:

The engine has electronic unit injectors that are electronically controlled. The Electronic Control Module (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 trim file for the injector must be programmed into the ECM. The trim files for the injectors allow each individual injector to be fine tuned for optimum performance. The ECM will generate the following diagnostic code if the trim files for the injectors are not programmed:

- 253-2 Personality Module mismatch

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 electronic service tool 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.

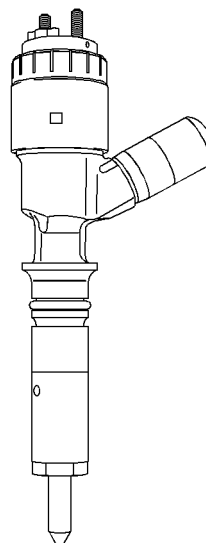


Illustration 54

g01336666

Typical example of the electronic unit injector

Test Step 1. Check for Diagnostic Codes That Are Related to this Procedure.

- A. Connect the electronic service tool 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 Data Incorrect
- 2-2 Cylinder #2 Injector Data Incorrect

- 3-2 Cylinder #3 Injector Data Incorrect
- 4-2 Cylinder #4 Injector Data Incorrect
- 5-2 Cylinder #5 Injector Data Incorrect
- 6-2 Cylinder #6 Injector Data Incorrect

Expected Result 2

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 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

- Use the electronic service tool in order to make a note of the logged diagnostic codes.
- 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 electronic service tool in order to program the replacement trim files for the injectors. Refer to Troubleshooting, "Injector Trim File" for further information.

Use the electronic service tool in order to clear the logged codes.

Turn the keyswitch to the ON position.

Start the engine.

Use the electronic service tool in order to perform the "Fuel System Verification - Test". If the cylinders indicate "PASS", then the fault has been cleared.

Verify that the repair eliminates the fault.

STOP.

Test Step 3. Check the ECM

- Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "Flash Programming".

- Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

- If the Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".

- Use the electronic service tool 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.

- If the test ECM eliminates the fault, reconnect the suspect ECM.

- Use the electronic service tool in order to perform the "Fuel System Verification - Test".

Expected Result:

The test ECM clears the fault. Using the electronic service tool 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. Verify that the repair eliminates the fault.

Repair: Replace the ECM.

STOP.

- Not OK – The test ECM did not eliminate the fault.

Repair: Repeat the test procedure from Test Step 1.

STOP.

i03813911

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:

- 1-5 Cylinder #1 Injector open circuit
- 1-6 Cylinder #1 Injector short
- 2-5 Cylinder #2 Injector open circuit
- 2-6 Cylinder #2 Injector short
- 3-5 Cylinder #3 Injector open circuit
- 3-6 Cylinder #3 Injector short
- 4-5 Cylinder #4 Injector open circuit
- 4-6 Cylinder #4 Injector short
- 5-5 Cylinder #5 Injector open circuit
- 5-6 Cylinder #5 Injector short
- 6-5 Cylinder #6 Injector open circuit
- 6-6 Cylinder #6 Injector short

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 70 volt 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 is detected in the solenoid circuit, a diagnostic code is generated. The ECM continues to try to fire the injector. If a short 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 electronic service tool 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 electronic service tool will indicate the status of the solenoid as “OK”, “Open”, or “Short”. Due to the use of a shared supply, a short circuit in the wire that is used as a supply for the injector solenoid will cause three cylinders to have diagnostic codes.

“Cylinder Cutout Test”

Use the “Cylinder Cutout Test” on the electronic service tool to diagnose a malfunctioning injector while the engine is running. All active diagnostic codes must be repaired before running the “Cylinder Cutout Test”. When a good injector is cut out, the “Fuel Position” should change. The change in the fuel position is caused by the other injectors that are compensating for the cut out injector. If a malfunctioning injector is cut out, the “Fuel Position” will not change. The “Cylinder Cutout Test” is used to isolate the malfunctioning injector in order to avoid replacement of good injectors.

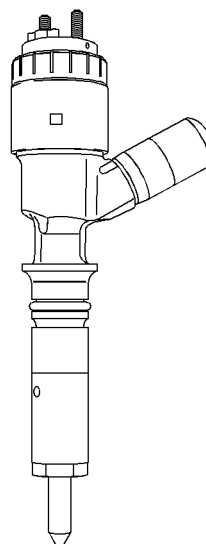


Illustration 55

Typical example of the fuel injector

g01336666

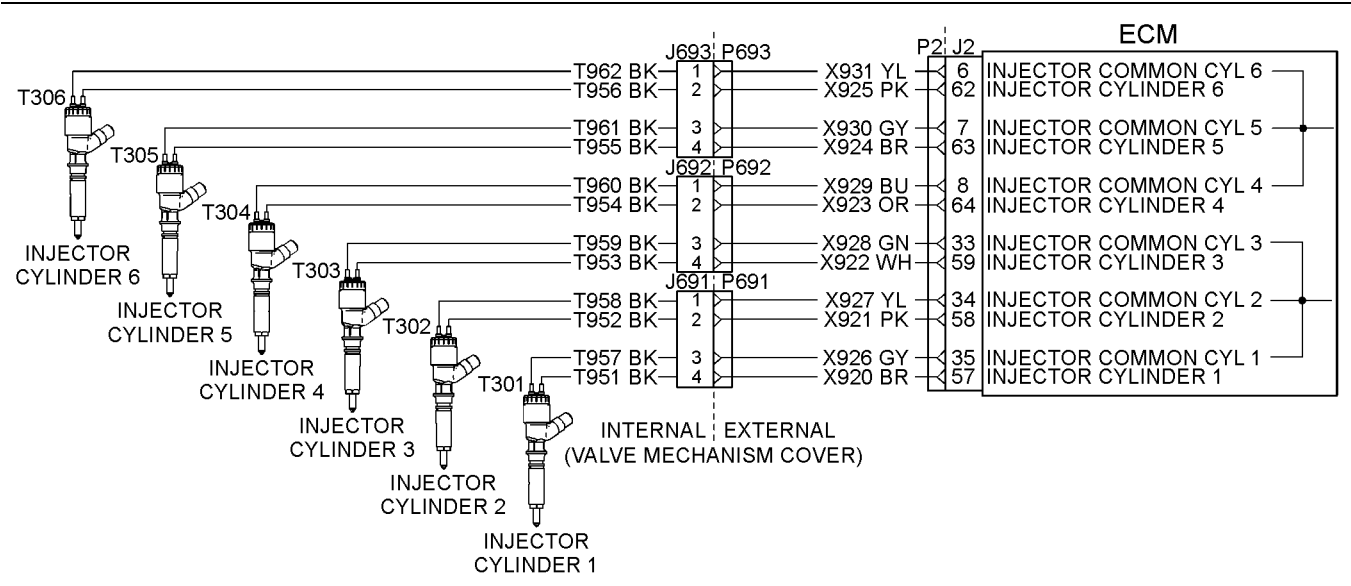


Illustration 56
Schematic of the circuit for the injector solenoids

g01810354

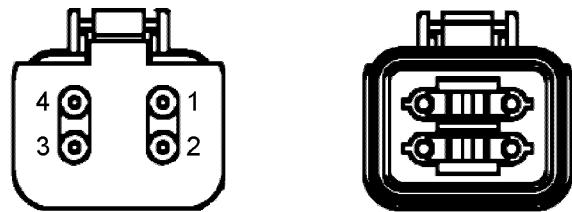


Illustration 57
Typical example of a harness connector for a fuel injector

g01237524

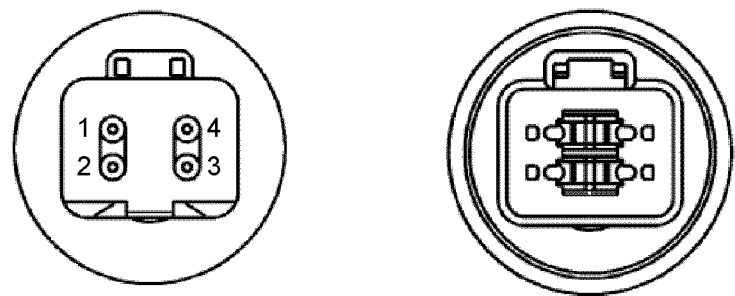


Illustration 58
Typical example of the cylinder head connector

g01237558

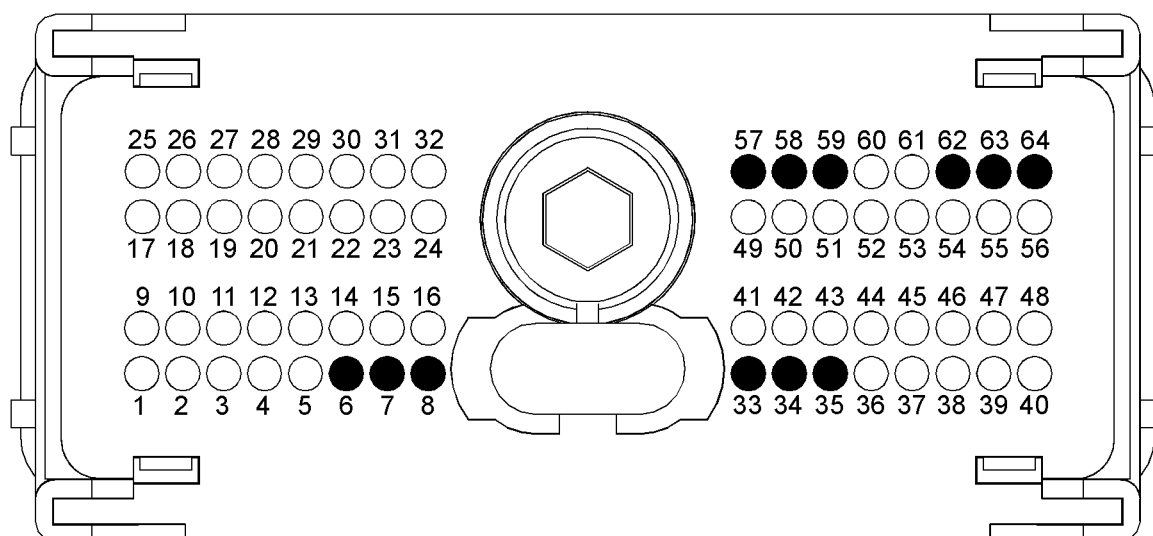


Illustration 59

g01805334

View of the pin locations on the P2connector for the injectors

(6) Injector (Number 6 Return)
(7) Injector (Number 5 Return)
(8) Injector (Number 4 Return)
(33) Injector (Number 3 Return)

(34) Injector (Number 2 Return)
(35) Injector (Number 1 Return)
(57) Injector (Number 1)
(58) Injector (Number 2)

(59) Injector (Number 3)
(62) Injector (Number 6)
(63) Injector (Number 5)
(64) Injector (Number 4)

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.

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 electronic service tool 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 electronic service tool.

Expected Result:

One or more diagnostic codes that are related to the injector solenoids have been logged:

- 1-5 Cylinder #1 Injector open circuit
- 1-6 Cylinder #1 Injector short
- 2-5 Cylinder #2 Injector open circuit
- 2-6 Cylinder #2 Injector short
- 3-5 Cylinder #3 Injector open circuit
- 3-6 Cylinder #3 Injector short
- 4-5 Cylinder #4 Injector open circuit
- 4-6 Cylinder #4 Injector short
- 5-5 Cylinder #5 Injector open circuit
- 5-06 Cylinder #5 Injector short
- 6-05 Cylinder #6 Injector open circuit
- 6-06 Cylinder #6 Injector short

Results:

- OK – One or more diagnostic codes have been logged. Proceed to Test Step 4.
- Not OK – No diagnostic codes have been logged. Proceed to Test Step 3.

Test Step 3. 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” on the electronic service tool 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 electronic service tool.
- E. Select the “6 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 “6 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 electronic service tool.

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 4.

- Not OK – One or more cylinders displayed “Not OK” during the test. Proceed to Test Step 4.

Test Step 4. 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” on the electronic service tool 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.

H. Perform the “Injector Solenoid Test” at least two times.

Expected Result:

All cylinders indicate “OK”.

Results:

- OK – There is not an electronic fault with the injectors at this time.

Repair: If the “Cylinder Cutout 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 8.

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.

- Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF.
- Disconnect the connectors from the valve cover base.
- Turn the keyswitch to the ON position.
- Fabricate a jumper wire 100 mm (4 inch) long with terminals on both ends of the wire.
- Insert one end of the jumper wire into the supply terminal for the suspect injector. Insert the other end of the jumper wire into the return terminal for the suspect injector.

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:

The electronic service tool displays “Short” 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.

- Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF.
- Remove the valve cover.
- Disconnect the harness from the suspect injector. Disconnect the harness from the injectors that shares the same supply circuit as the suspect injector.

Note: 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 three injectors that share a common supply indicate “Open”, the open circuit is probably caused by a faulty ECM.

- Thoroughly clean the terminals on three injectors and on the harness connectors.
- Exchange the harness between two of the three injectors that share the common driver.
- Turn the keyswitch to the ON position.
- 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.

Verify that the repair eliminates the fault.

STOP.

- Not OK – The injector may be faulty.

Repair: Replace the faulty injector.

Restore the wiring to the correct injectors.

Perform the “Injector Solenoid Test”.

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.

- Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF.
- Disconnect connector P2 from the ECM.
- 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.
- Reinstall connector P2 to the ECM.
- Turn the keyswitch to the ON position.
- Perform the “Injector Solenoid Test” at least two times.

Expected Result:

The electronic service tool displays “Short” for the cylinder with the jumper wire.

Note: 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: If three injectors that share a supply indicate “Open”, the open circuit is probably caused by a faulty ECM.

Repair the engine harness or replace the engine harness, as required.

Verify that the repair eliminates the fault.

STOP.

- Not OK – There may be a fault with the ECM.

Repair: Perform the following procedure:

- Remove the jumper wire from connector P2 and reinstall the injector wires.
- Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, “Flash Programming”.
- Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

- If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”.
- Perform the “Injector Solenoid Test”.
- 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.

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.

- 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 "Open".

Results:

- OK – All cylinders indicate "Open". Proceed to Test Step 10.
- Not OK – One or more cylinders indicate "Short". Note the cylinders that indicate "Short". 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 "Open" 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 these 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.

Verify that the repair eliminates the fault.

STOP.

- Not OK – There may be a fault with the ECM.

Repair: Perform the following procedure:

1. Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "Flash Programming".
2. Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

3. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".
4. Perform the "Injector Solenoid 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 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 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 "Open".

Results:

- OK – All of the injectors that were disconnected indicate "Open".

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 "Short".

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.

Verify that the repair eliminates 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.

- Turn the keyswitch to the OFF position. A strong electrical shock hazard is present if the keyswitch is not turned OFF.
- Disconnect the connector P2 from the ECM.
- 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".

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.

Perform the "Injector Solenoid Test" in order to verify that the repair eliminates the fault.

STOP.

i03813889

Speed Control (Analog) - Test

System Operation Description:

Use this procedure if another procedure has directed you here. Use this procedure if the following diagnostic code is active:

- 1690-8 Analog Speed Demand Abnormal signal

The diagnostic code above relates to an analog voltage output from the system that is controlling the engine.

Note: In other applications, the analog voltage output is generated by an accelerator or a hand throttle. These terms will still be displayed on the electronic service tool for this application.

Use the electronic service tool in order to check the input status.



Illustration 60
Schematic of the analog speed control device

g01810415

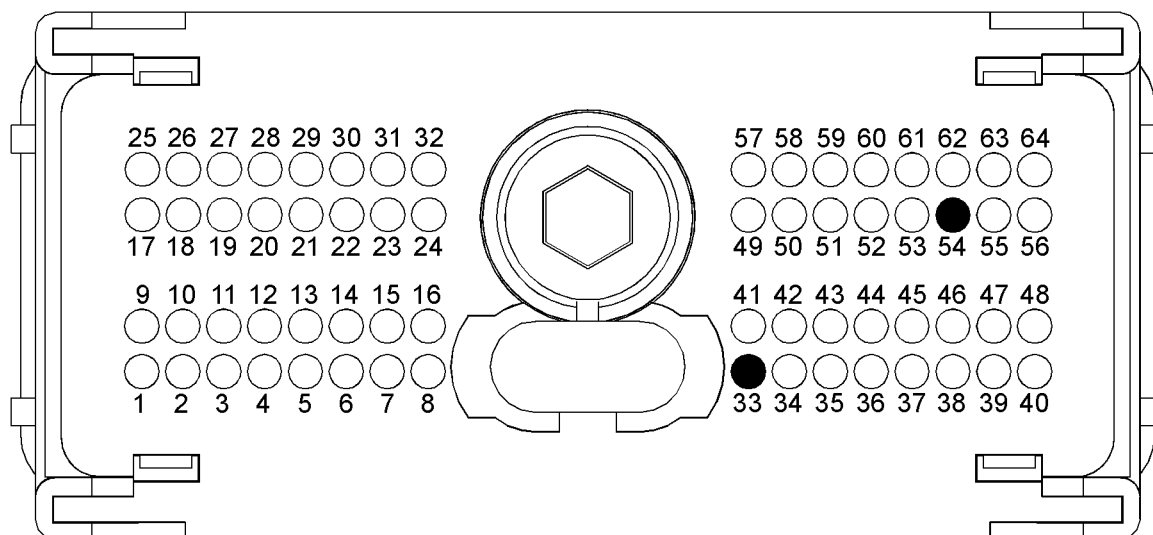


Illustration 61
Typical view of the pin locations on the P1 connector for the speed control circuit
(33) Device ground (GND) (54) Analog throttle input 1

g01810453

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 speed control device. Check the wire connectors at the ECM and at the control system. The wire connectors are shown in Figure 61.
- 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.

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 electronic service tool to check for diagnostic codes.

Expected Result:

RESULT 1 The electronic service tool displays a 1690-8 diagnostic code.

RESULT 2 The electronic service tool displays no active diagnostic codes.

Results:

- Result 1 – Proceed to Test Step 3.
- Result 2 – There may be an intermittent connection in the wiring. Proceed to Test Step 3.

Test Step 3. Check the Control Signal

- A. Refer to the OEM supplied manual for the control system.
- B. Check that the output signal from the control system is correct.

Expected Result:

The output signal from the control system should be within the specification in the OEM supplied manual.

Results:

- OK – The output signal from the control system is correct. Proceed to Test Step 4.
- Not OK – The output signal from the control system is not correct or the control system is incorrectly configured.

Repair: Repair the control system or configure the control system. Refer to the OEM supplied manual.

Verify that the repair eliminates the fault.

STOP.

Test Step 4. Check the Signal at the ECM

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the P1 connector.
- C. Temporarily remove the pin from P1:54.
- D. Reconnect P1 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. Check that the signal at the ECM is the same value as the output signal from the control system.
- H. Turn the keyswitch to the OFF position.
- I. Remove P1 connector and reinstall P1:54.
- J. Reconnect P1 connector.

Expected Result:

The signal at the ECM is the same value as the output signal from the control system.

Results:

- OK – The ECM terminals have the correct voltage for the control system.

Repair: Perform the following repair:

1. Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "Flash Programming".
2. Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

3. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".
4. Use the electronic service tool to recheck the system for active diagnostic codes.
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.

- 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 control system. Repair the damaged cables or replace the damaged cables. Check that the repairs have eliminated the fault. STOP.

i03813871

Speed Control (PWM) - Test

System Operation Description:

Use this procedure under the following conditions:

Use this procedure if the following diagnostic code is indicated:

- 91-8 Throttle Position Signal Abnormal

Also, use this procedure if the digital speed control device is suspected of incorrect operation.

Speed Control Signal

The digital speed control device is used to provide a digital signal to the Electronic Control Module (ECM). The output from the device is a constant frequency signal with a fixed pulse width that corresponds to the required engine speed. This output signal is referred to as a pulse width modulated (PWM) signal and this output signal is expressed as a percentage or as a duty cycle.

The digital signal is generated by the system that controls the speed of the engine.

In other applications, the control system is referred to as an accelerator or a throttle. These terms are still displayed on the electronic service tool for this application.

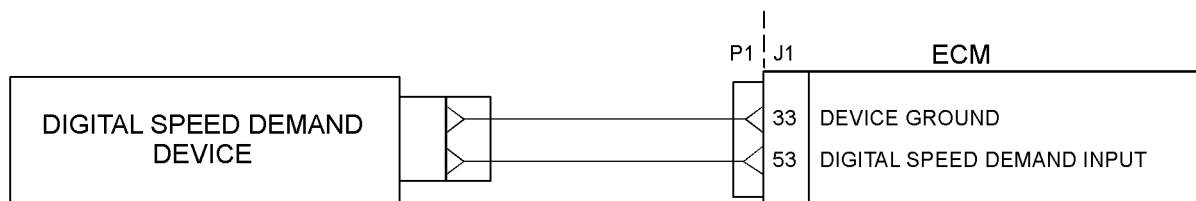


Illustration 62

g01810534

Typical schematic of the digital speed demand device

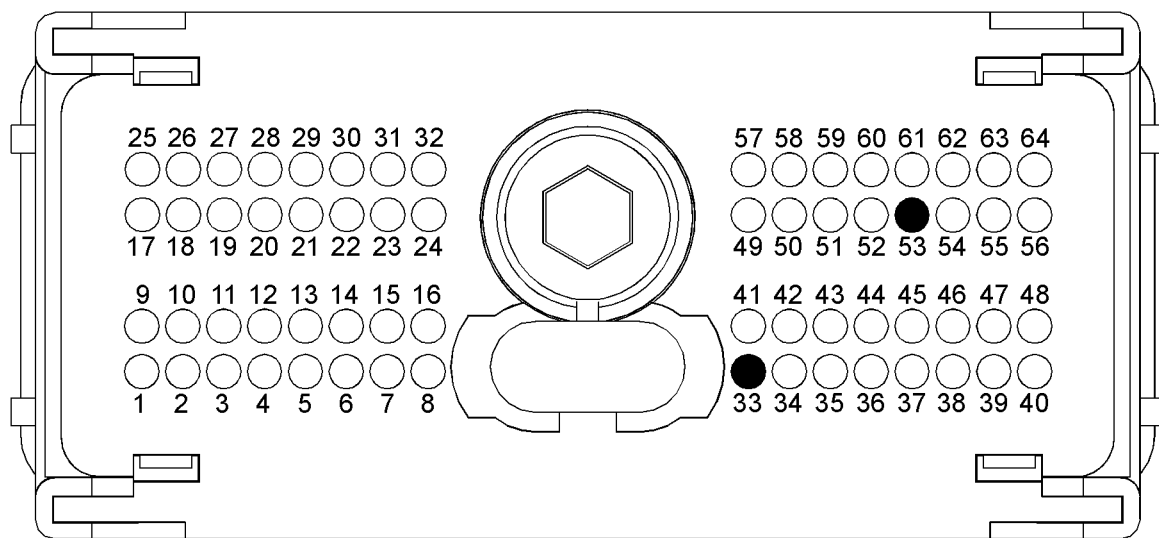


Illustration 63

g01810793

Typical example of the pin locations on the P1 connector

(33) Digital speed demand device return

(53) Digital speed demand device input

Test Step 1. Inspect Electrical Connectors and Wiring

- A. Inspect the P1/J1 connector, OEM harness and the associated connectors. Thoroughly inspect the connector on the digital speed control device. 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 speed control device:
 - P1:33
 - 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, abrasion or 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.

Verify that the repair eliminates the fault.

STOP.

Test Step 2. Check for Active Diagnostic Codes

- A. Connect the electronic service tool to the diagnostic connector.
- B. Turn the keyswitch to the ON position.
- C. Monitor the active diagnostic code screen on the electronic service tool. Check and record active diagnostic codes.

Expected Result:

Result 1 Diagnostic code 91-8 is active.

Result 2 There are no active diagnostic codes that are associated with the speed control circuit at this time. However, a fault is suspected.

Results:

- Result 1 – Proceed to Test Step 3.
- Result 2 – There may be an intermittent connection in the wiring. Proceed to Test Step 3.

Test Step 3. Check the Control Signal

- A. Refer to the OEM supplied manual for the control system.
- B. Check that the output signal from the control system is correct.

Expected Result:

The output signal from the control system should be within the specification in the OEM supplied manual.

Results:

- OK – The output signal from the control system is correct. Proceed to Test Step 4.
- Not OK – The output signal from the control system is not correct or the control system is incorrectly configured.

Repair: Repair the control system or configure the control system. Refer to the OEM supplied manual.

Verify that the repair eliminates the fault.

STOP.

Test Step 4. Check the Signal at the ECM

- A. Turn the keyswitch to the OFF position.
- B. Remove the P1 connector.
- C. Temporarily remove the pin from P1:53.
- D. Reconnect the P1 connector.
- E. Connect the red probe of a multimeter to the removed pin and the black probe of the multimeter to P1:33.
- F. Turn the keyswitch to the ON position.
- G. Check that the signal at the ECM is the same value as the output signal from the control system.
- H. Turn the keyswitch to the OFF position.
- I. Remove the P1 connector and reinstall P1:53.
- J. Reconnect P1 connector.

Expected Result:

The signal at the ECM is the same value as the output signal from the control system.

Results:

- OK – The terminals on the ECM have the correct voltage for the control system.

Repair: Perform the following repair:

1. Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "Flash Programming".
2. Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

3. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".
4. Use the electronic service tool to recheck the system for active diagnostic codes.
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.

- 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 control system. Repair the damaged cables or replace the damaged cables. Confirm that the repairs have eliminated the fault. STOP.

i03813830

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:

- 2246-6 Glow Plug Start Aid Relay Current High

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 supply power to the glow plugs.

Electronic Service Tool Test Aid

The electronic service tool includes the test “Glow Plug Override Test”. The “Glow Plug Override Test” will assist the analysis of the cold starting aid.

Overview of the Glow Plug Override Test

This glow plug override test switches on the cold starting aid when the engine is not running. The glow plug override test aids the analysis of the circuit for the glow plug start aid relay.

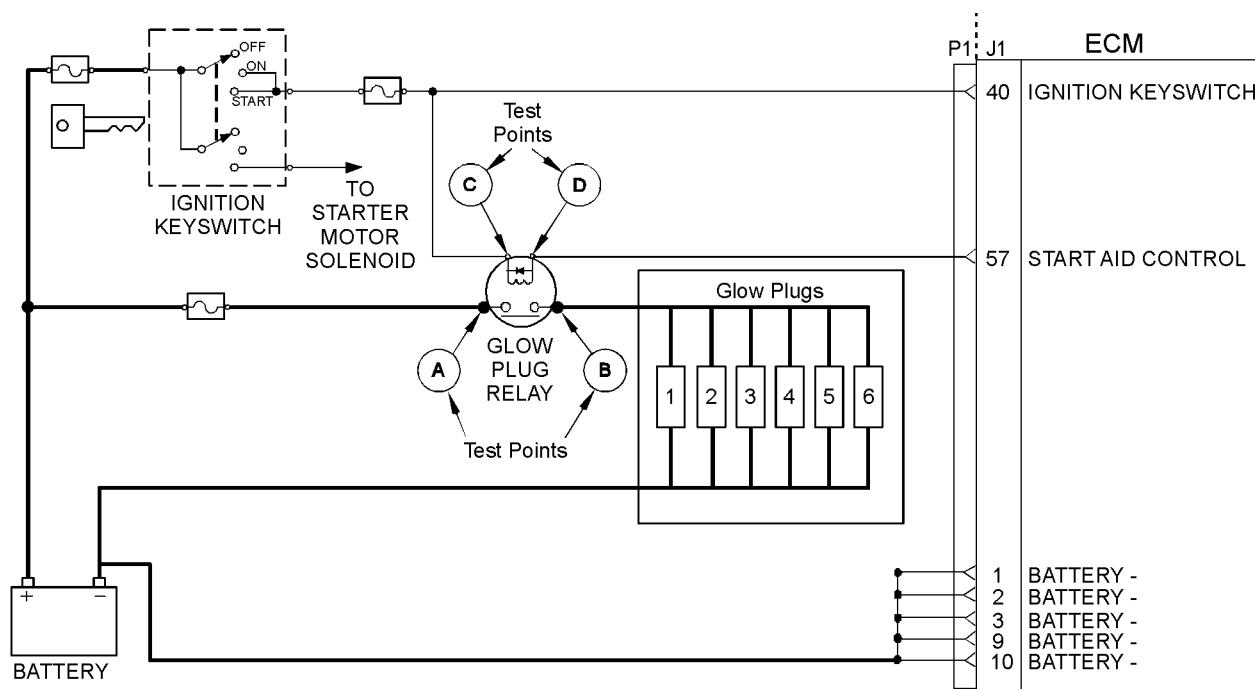


Illustration 64

Typical schematic for the starting aid system

g02053797

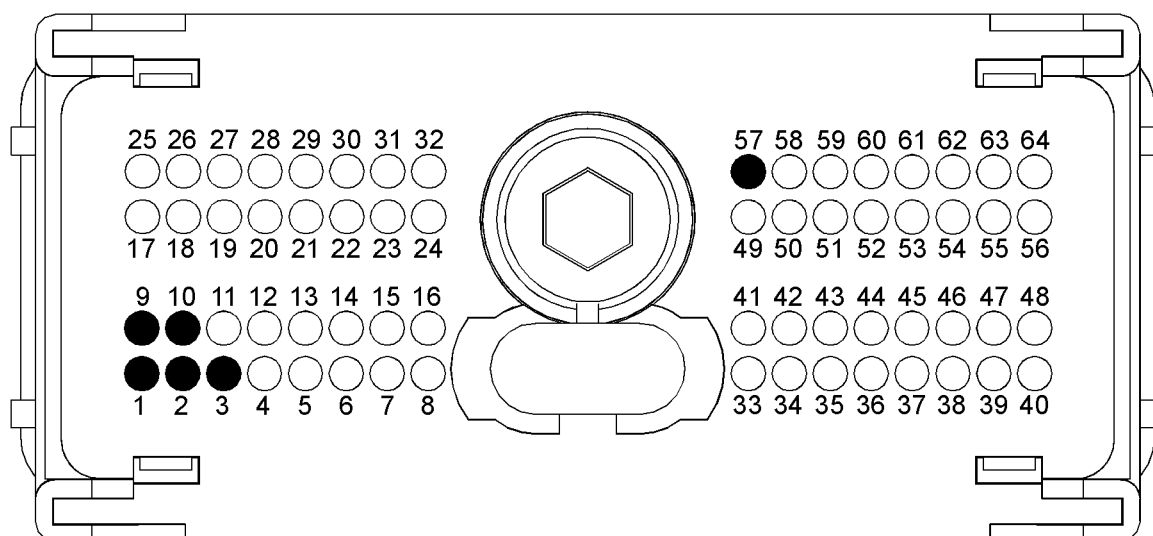


Illustration 65

g02053833

Typical view of the pin locations on the P1 connector for the starting aid

(1) Ground (GND)
(2) Ground (GND)

(3) Ground (GND)
(9) Ground (GND)

(10) Ground (GND)
(57) Start aid control

Test Step 1. Inspect Electrical Connectors and Wiring

A. Inspect the following connectors:

- P1 connector
- P2 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.

Verify that the repair has eliminated the fault.

STOP.

Test Step 2. Check for Active Diagnostic Codes

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

B. Turn the keyswitch to the ON position.

Note: Do not start the engine.

C. Use the electronic service tool 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:

- 2246-6 Glow Plug Start Aid Relay Current High

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 electronic service tool 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 Systems Operation, Testing and Adjusting, “Glow Plugs - Test”.

STOP.

Test Step 3. Check the Wiring for a Short Circuit

- Turn the keyswitch to the OFF position.
- Disconnect the P1 connector from the ECM.
- Check the connector, pins and the sockets for corrosion or damage.
- 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 J1 connector is less than 10,000 Ohms then there is a short circuit or high resistance in the connection to another wire. Locate the short circuit 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.

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

- Turn the keyswitch to the OFF position.
- Disconnect the connection from test point “D” on the glow plug start aid relay.
- Connect a jumper wire between the battery ground and terminal “D” on the glow plug start aid relay.
- Measure the voltage from the battery ground and terminal “B” on the glow plug start aid relay.
- Turn the keyswitch to the ON position.

Note: The engine has not been started at this Test Step.

- 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 Volts DC.

The keyswitch is in the ON position. The measured voltage for the 12 Volt systems is a constant 10.5 to 13.5 Volts DC. The measured voltage for the 24 Volt systems is a constant 21.0 to 27.0 Volts DC.

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. Verify that the repair eliminates the fault.

If the fault still exists, proceed to Test step 5.

Test Step 5. Check the ECM

- Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, “Flash Programming”.

- Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

C. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".

D. Use the electronic service tool in order to perform a "Glow Plug Override Test".

Expected Result:

The test ECM functions correctly. Performing the "Glow Plug Override Test" energizes the glow plugs.

Results:

- OK – The test ECM operates correctly.

Repair: The fault is resolved with the test ECM.

1. Reconnect the suspect ECM.
2. Use the electronic service tool in order to perform a "Glow Plug Override Test".
3. If the fault returns with the suspect ECM, replace the ECM.
4. 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 – Repeat the test procedure from Test Step 1.

The control system for the electronically controlled wastegate precisely regulates the intake manifold pressure by using a wastegate regulator 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 regulator to control the wastegate in order to provide the precise value of intake manifold pressure. The wastegate regulator is controlled by a PWM signal from the ECM.

If there is a fault with the wastegate regulator, one of the following conditions must be met in order for these diagnostic codes to be active:

- The "Turbo Wastegate Solenoid Output" is active.
- The ECM is controlling boost with the wastegate regulator during normal operation.

Note: Attempting to defeat the wastegate could cause a permanent derate. Factory passwords will be required to return full power to the engine.

i03809319

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:

- 526-5 Turbo Wastegate Drive current low
- 526-6 Turbo Wastegate Drive current high

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.

Table 38

Pin Connections		
Sensor Pin	Function	P2 Pin Connection
1	Ground	44
2	Signal	17

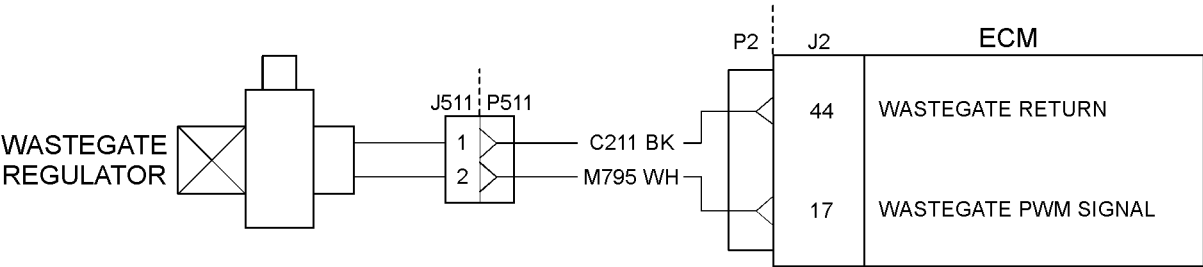


Illustration 66
Schematic for the wastegate regulator

g01806857

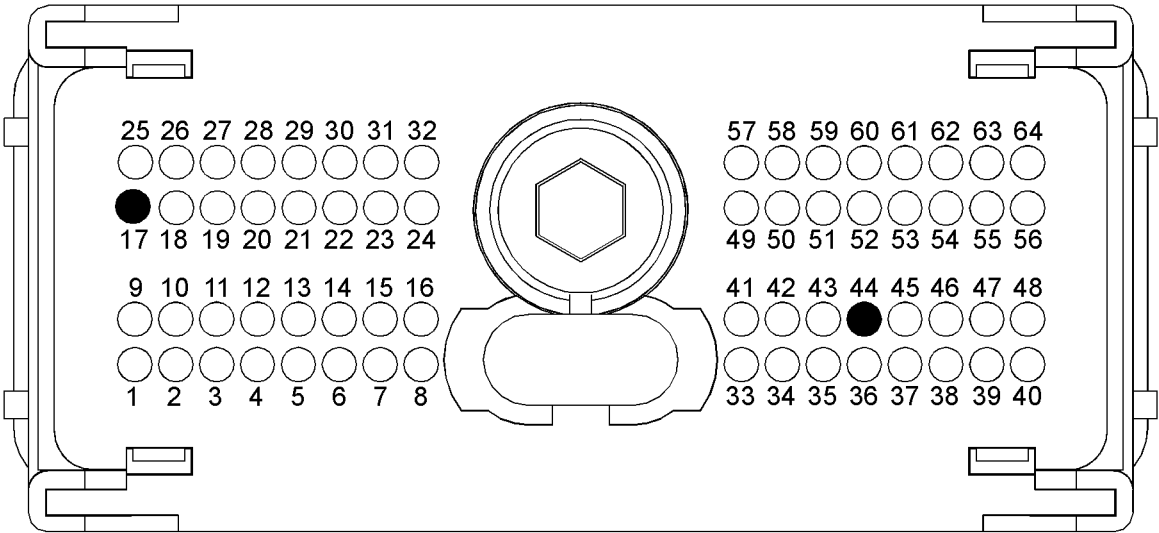


Illustration 67
Typical view of the pin locations on the P1 connector for the wastegate regulator
(17) Wastegate pulse width modulation (PWM) signal
(44) Wastegate return

g01806859

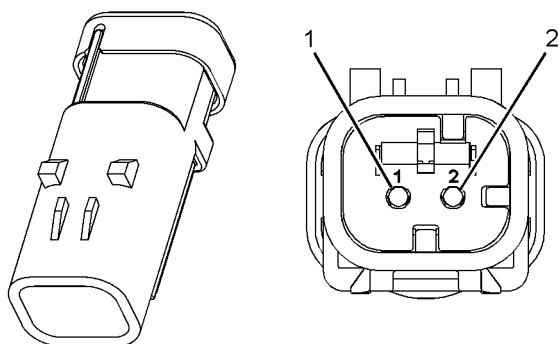


Illustration 68 g01806858

View of the connector for the Wastegate regulator

- (1) Ground (GND)
(2) Signal (SIG)

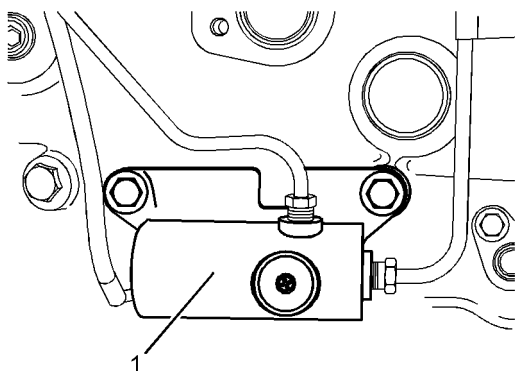


Illustration 69 g01806873

Wastegate regulator

- (1) Wastegate regulator

Test Step 1. Check for Diagnostic Codes

- Turn the keyswitch to the OFF position.
- Connect the electronic service tool to the diagnostic connector.
- Turn the keyswitch to the ON position. Start the electronic service tool.
- Monitor the electronic service tool for active diagnostic codes and/or logged diagnostic codes.

Expected Result:

One or more diagnostic codes are active or logged.

Results:

- 526-5, 526-6 are active and/or logged – Proceed to Test Step 2.
- No Codes – The fault seems to be eliminated.

Repair: For intermittent faults, refer to Troubleshooting, “Electrical Connectors - Inspect”.

STOP.

Test Step 2. Inspect Electrical Connectors and Wiring

- Thoroughly inspect the P2/J2 connectors and the P511 connector for the wastegate regulator. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.
- Perform a 45 N (10 lb) pull test on each of the wires that are associated with the wastegate solenoid.
- 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.

Verify that the repair eliminates the fault.

STOP.

Test Step 3. Determine the Diagnostic Code that is Active

- Turn the keyswitch to the ON position. Access the “Diagnostics Tests” on the electronic service tool. Activate the “Turbo Wastegate Solenoid Test”. Wait at least 30 seconds in order for the result to be displayed.

- Determine if the fault is related to either of the following:

- “Low current” (open circuit)
- “High current” (short circuit)

Expected Result:

The electronic service tool 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.

Test Step 4. Create a Short Circuit in the Harness at the Solenoid

- Turn the keyswitch to the OFF position.
- Disconnect the P511 connector for the wastegate regulator.
- Fabricate a jumper wire between P511:1 and P511:2 in order to create a short circuit.
- Turn the keyswitch to the ON position. Access the “Diagnostics Tests” on the electronic service tool. Activate the “Turbo Wastegate Solenoid Test”. Wait at least 30 seconds in order for the result to be displayed.
- Check for active diagnostic codes on the electronic service tool.

Expected Result:

The 526-6 diagnostic code is now active.

Results:

- OK – The 526-6 diagnostic code is now active. There is a fault with the solenoid in the wastegate regulator.

Repair: Perform the following procedure:

- Temporarily connect a replacement wastegate regulator.
- Turn the keyswitch to the ON position. Access the “Diagnostics Tests” on the electronic service tool. Activate the “Turbo Wastegate Solenoid Test”. Wait at least 30 seconds in order for the result to be displayed.
- If the diagnostic test is successful, 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

- Turn the keyswitch to the OFF position.
- Temporarily remove the wires from P2:17 and P2:44.
- Fabricate a jumper wire between P2:17 and P2:44 in order to create a short circuit.

Note: P2/J2 must be connected during the next step.

- Turn the keyswitch to the ON position. Access the “Special Tests” under the “Diagnostics” menu on the electronic service tool. Activate the “Turbo Wastegate Solenoid Output Test” on the electronic service tool. Wait at least 30 seconds for activation of the diagnostic codes.
- Check for active diagnostic codes on the electronic service tool.

Expected Result:

The 526-6 diagnostic code is now active.

Results:

- OK – The 526-6 diagnostic code is now active. There is a fault in the harness between the ECM and the solenoid.

Repair: Repair the harness or replace the harness.

STOP.

- Not OK – There is still an open circuit diagnostic code.

Repair: Perform the following repair:

- Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, “Flash Programming”.
- Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

- If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”.
- Use the electronic service tool to recheck the system for active diagnostic codes.

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 6. Disconnect the Solenoid in order to Create an Open Circuit

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the P511 connector for the wastegate regulator in order to create an open circuit.
- C. Turn the keyswitch to the ON position. Access the "Special Tests" under the "Diagnostics" menu on the electronic service tool. Activate the "Turbo Wastegate Solenoid Output Test" on the electronic service tool. Wait at least 30 seconds for activation of the diagnostic codes.
- D. Check for active diagnostic codes on the electronic service tool.

Expected Result:

The 526-5 diagnostic code is now active.

Results:

- OK – The 526-5 diagnostic code is now active.

Repair: There is a short in the solenoid for the wastegate regulator.

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 – There is still a 526-6 diagnostic code. 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 "Special Tests" under the "Diagnostics" menu on the electronic service tool. Activate the "Turbo Wastegate Solenoid Output Test" on the electronic service tool. Wait at least 30 seconds for activation of the diagnostic codes.

- D. Check for active diagnostic codes on the electronic service tool.

Expected Result:

526-5 diagnostic code is now active.

Results:

- OK – The 526-5 diagnostic code 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.

STOP.

- Not OK – The 526-6 diagnostic code is still present.

Repair: Perform the following repair:

1. Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "Flash Programming".
2. Contact Perkins Global Technical Support.

Note: This consultation can greatly reduce the repair time.

3. If Perkins Global Technical Support recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".
4. Use the electronic service tool to recheck the system for active diagnostic codes.
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.

- Not OK – Repeat the diagnostic procedure from Test Step 1.

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