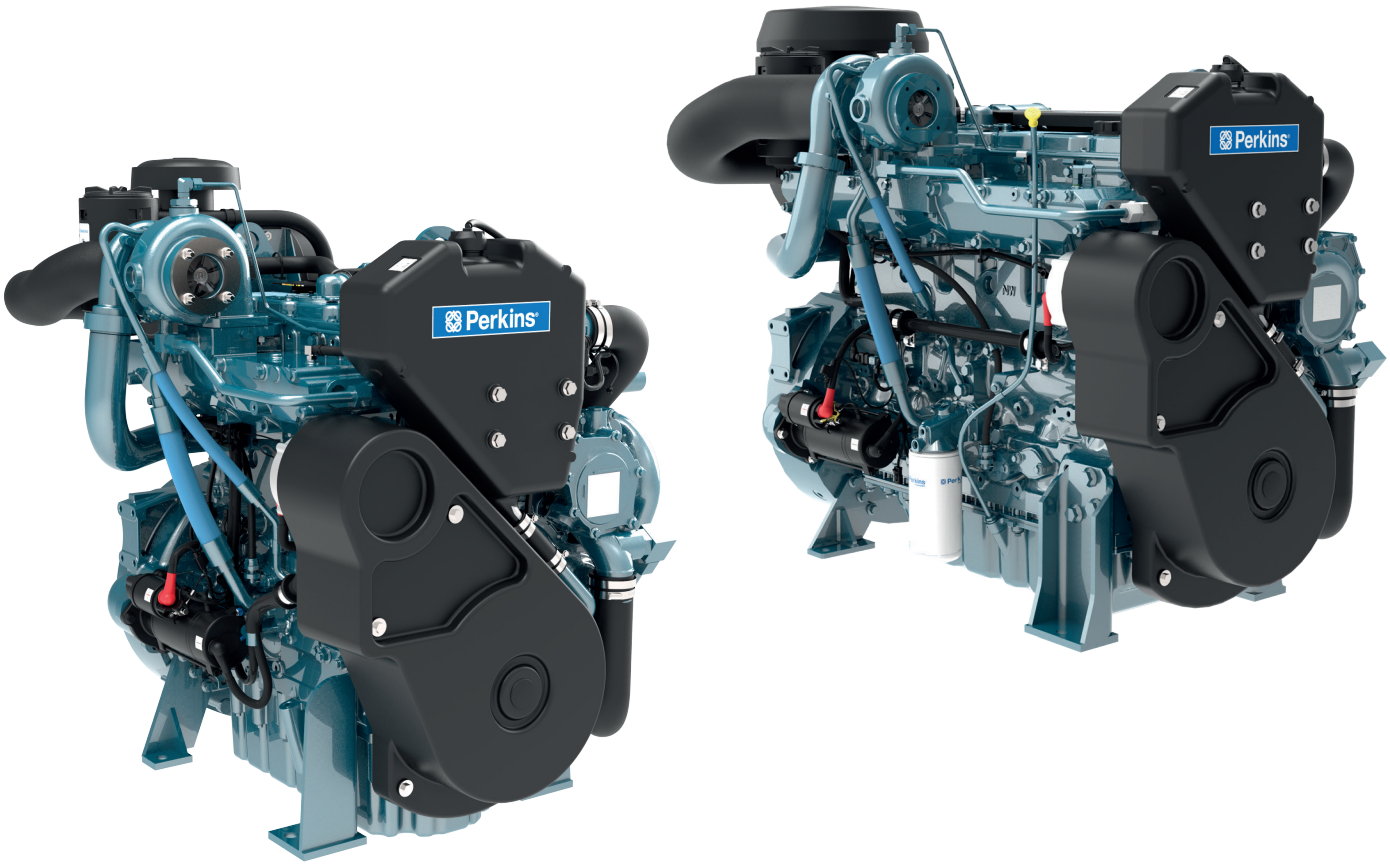
Part No 643-4241

GB

Troubleshooting Guide



E44 & E70B Marine Auxiliary Engine

Perkins®

Marine Power

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, including human factors that can affect safety. 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 verify that you are authorized to perform this work, and have read and understood the operation, lubrication, maintenance and repair information.

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

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

⚠ WARNING

The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

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

A non-exhaustive list of 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. You must not use this product in any manner different from that considered by this manual without first satisfying yourself that you have considered all safety rules and precautions applicable to the operation of the product in the location of use, including site-specific rules and precautions applicable to the worksite. 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 you are authorized to perform this work, and that the product will not be damaged or become unsafe by the operation, lubrication, maintenance or repair procedures that you intend to use.

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 have the most current information available.

NOTICE

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

Other parts may not meet certain original equipment specifications.

When replacement parts are installed, the machine owner/user should ensure that the machine re-mains in compliance with all applicable requirements.

In the United States, the maintenance, replacement, or repair of the emission control devices and systems may be performed by any repair establishment or individual of the owner’s choosing.

Note: All illustrations are typical examples.

Chapter Page

Electronic Troubleshooting

Welding Precaution

Correct welding procedures are necessary in order to avoid damage to the following components:

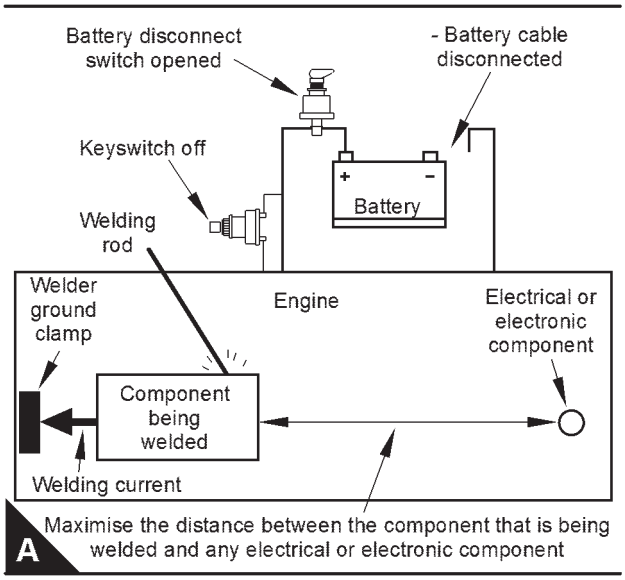
- Electronic Control Module (ECM) on the engine
- Sensors
- Associated components

Components for the driven equipment should also be considered. When possible, remove the component that requires welding. When welding on an engine that is equipped with an ECM and removal of the component is not possible, the following procedure must be followed. This procedure minimizes the risk to the electronic components.

1. Stop the engine. Remove the electrical power from the ECM.
2. Ensure that the fuel supply to the engine is turned off.
3. Disconnect the negative battery cable from the battery. If a battery disconnect switch is installed, open the switch.
4. Disconnect all electronic components from the wiring harnesses. Include the following components:
   - Electronic components for the driven equipment
   - ECM.
   - Sensors.
   - Electronically controlled valves.
   - Relays.

NOTICE

Do not use electrical components (ECM or ECM sensors) or electronic component grounding points for grounding the welder.



Service welding guide (typical diagram)

5. When possible, connect the ground clamp for the welding equipment directly to the engine component that will be welded. Place the clamp as close as possible to the weld. Close positioning reduces the risk of welding current damage to the engine bearings, to the electrical components, and to other components.
6. Protect the wiring harnesses from welding debris and/or from welding spatter.
7. Use standard welding procedures to weld the materials together.

System Overview

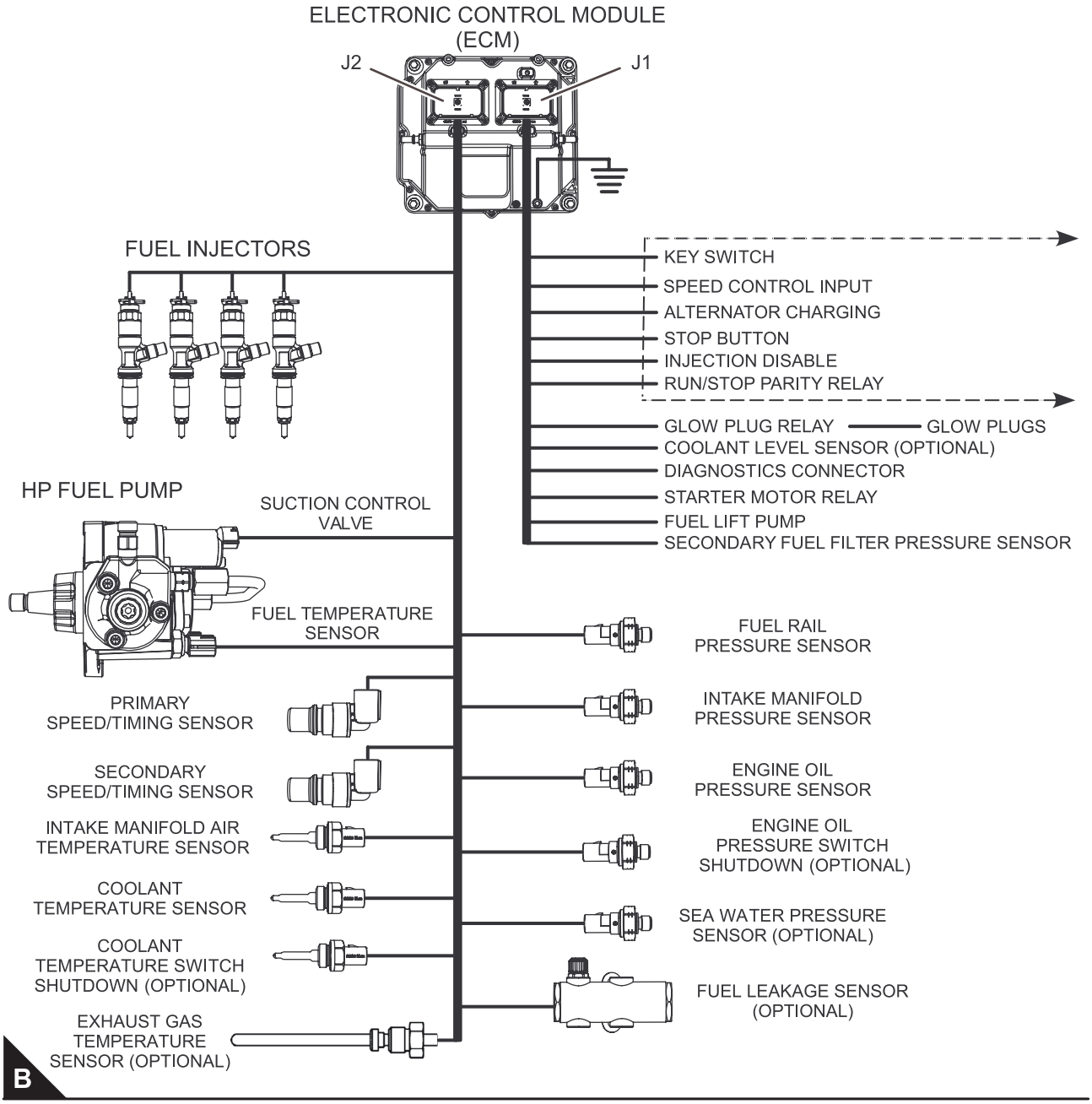
The engine has an electronic control system.

The control system consists of the following components:

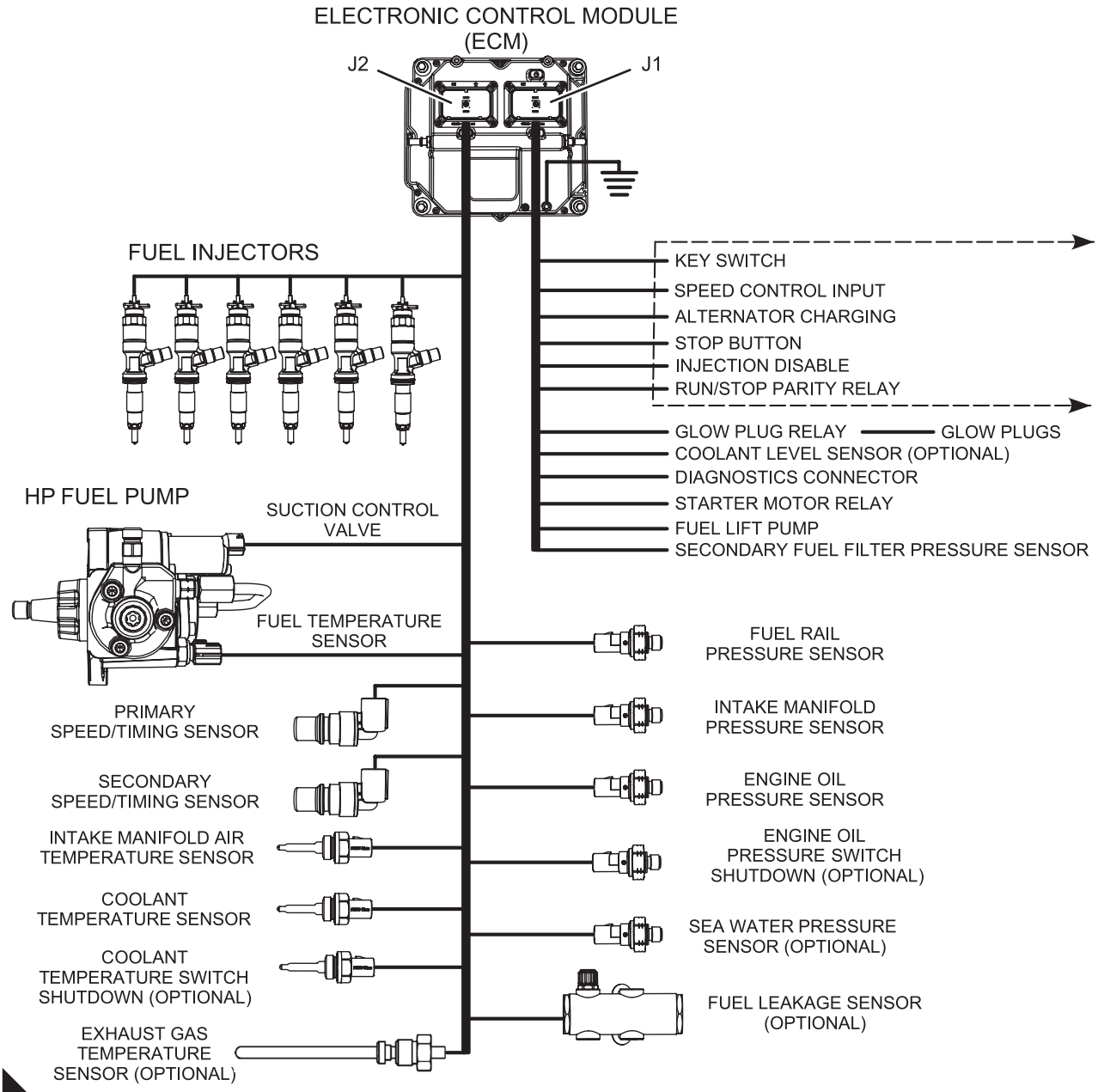
- Electronic Control Module (ECM)
- Software (flash file)
- Wiring
- Sensors
- Actuators

Electronic Circuit Diagram

E44



E70B

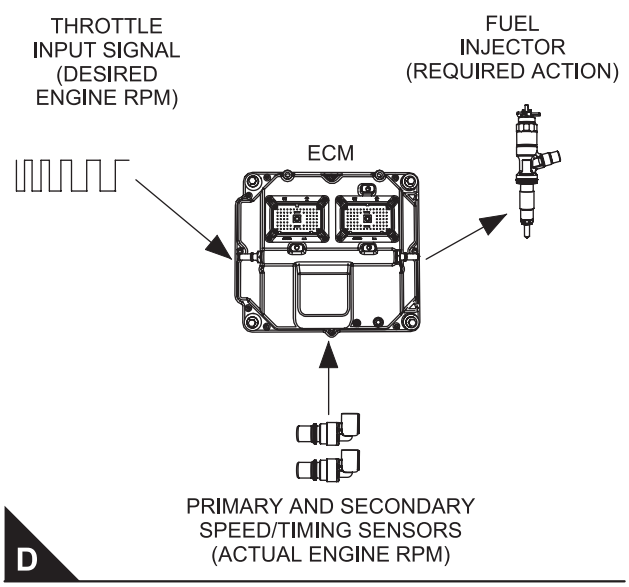

ELECTRONIC CONTROL MODULE
(ECM)
J2
J1
FUEL INJECTORS
KEY SWITCH
SPEED CONTROL INPUT
ALTERNATOR CHARGING
STOP BUTTON
INJECTION DISABLE
RUN/STOP PARITY RELAY
GLOW PLUG RELAY
GLOW PLUGS
COOLANT LEVEL SENSOR (OPTIONAL)
DIAGNOSTICS CONNECTOR
STARTER MOTOR RELAY
FUEL LIFT PUMP
SECONDARY FUEL FILTER PRESSURE SENSOR
HP FUEL PUMP
SUCTION CONTROL
VALVE
FUEL TEMPERATURE
SENSOR
FUEL RAIL
PRESSURE SENSOR
PRIMARY
SPEED/TIMING SENSOR
INTAKE MANIFOLD
PRESSURE SENSOR
SECONDARY
SPEED/TIMING SENSOR
ENGINE OIL
PRESSURE SENSOR
INTAKE MANIFOLD AIR
TEMPERATURE SENSOR
ENGINE OIL
PRESSURE SWITCH
SHUTDOWN (OPTIONAL)
COOLANT
TEMPERATURE SENSOR
SEA WATER PRESSURE
SENSOR (OPTIONAL)
COOLANT
TEMPERATURE SWITCH
SHUTDOWN (OPTIONAL)
FUEL LEAKAGE SENSOR
(OPTIONAL)
EXHAUST GAS
TEMPERATURE
SENSOR (OPTIONAL)
C

System Operation

Engine Governor

The ECM governs the engine. The ECM determines the timing, the injection pressure, and the amount of fuel that is delivered to each cylinder. These factors are based on the actual conditions and on the desired conditions at any given time during starting and operation.

The governor uses the throttle signal to determine the desired engine speed. The governor compares the desired engine speed to the actual engine speed. The actual engine speed is determined through interpretation of the signals that are received by the ECM from the engine speed/timing sensors. If the desired engine speed is greater than the actual engine speed, the governor injects more fuel to increase the engine speed.



Engine speed control

Timing Considerations

Once the governor has determined the amount of fuel that is required, the governor must determine the timing of the fuel injection. Fuel injection timing is determined by the ECM after considering input from the following components:

- Coolant temperature sensor
- Intake manifold air temperature sensor
- Intake manifold pressure sensor

The ECM adjusts timing for optimum engine performance and for economic fuel usage. Actual timing and desired timing cannot be viewed with the electronic service tool. The ECM determines the location of top centre of the number one cylinder from the signals that are provided by the engine speed/timing sensors. The ECM determines when injection should occur relative to the top centre position. The ECM then provides the signal to the injector at the desired time.

Fuel Injection

The ECM sends a high-voltage signal to the injector solenoids to energize the solenoids. By controlling the timing and the duration of the high-voltage signal, the ECM can control the following aspects of injection:

- Injection timing
- Fuel delivery

The flash file inside the ECM establishes certain limits on the amount of fuel that can be injected. The FRC Fuel Limit is a limit that is based on the intake manifold pressure. The FRC Fuel Limit is used to control the air/fuel ratio for control of emissions. When the ECM senses a higher intake manifold pressure, the ECM increases the FRC Fuel Limit. A higher intake manifold pressure indicates that there is more air in the cylinder. When the ECM increases the FRC Fuel 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 is like the rack stops and the torque spring on a mechanically governed engine. The Rated Fuel Limit provides the power curves and the torque curves for a specific engine family and a specific engine rating. All of these limits are determined at the factory. These limits cannot be changed.

ECM Lifetime Totals

The ECM maintains total data of the engine for the following parameters:

- “Total Operating Hours”
- “Engine Lifetime Hours”
- “Total Idle Time”
- “Total Idle Fuel”
- “Total Fuel”
- “Total Max Fuel”
- “Engine Starts”

The “Total Operating Hours” is the operating hours of the engine. The operating hours do not include

the time when the ECM is powered but the engine is not running.

The “Engine Lifetime Hours” is the number of hours when electrical power has been applied to the engine. These hours will include the time when the ECM is powered but the engine is not running.

“Total Idle Time” and “Total Idle Fuel” can include operating time when the engine is not operating under a load.

Fuel Information can be displayed in US gallons or in liters.

“Total Fuel” is the total amount of fuel that is consumed by the engine during operation.

“Total Max Fuel” is the maximum amount of fuel that could have been consumed by the engine during operation.

“Engine Starts” is the total number of times when the engine has been started.

Programmable Parameters

Certain parameters that affect engine operation may be changed with the electronic service tool. The be changed with the electronic service tool. The parameters are stored in the ECM, and the parameters are protected from unauthorized changes by passwords. These parameters are either system configuration parameters or customer parameters.

System configuration parameters are set at the factory. System configuration parameters affect emissions or power ratings within an engine family. Factory passwords must be obtained and factory passwords must be used to change the system configuration parameters.

Customer parameters are variable. Customer parameters can affect the following characteristics of the engine within the limits that are set by the factory and the monitoring system:

- RPM ratings
- Power ratings

Customer passwords may be required to change customer specified parameters.

Some of the parameters may affect engine operation in an unusual way. An operator might not expect this type of effect. Without adequate training, these parameters may lead to power complaints or performance complaints even though the performance of the engine is to the specification.

Refer to Troubleshooting, “Configuration Parameters” for additional information on this subject.

Passwords

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

Customer parameters can be protected by customer passwords. The customer passwords are programmed by the customer. Factory passwords can be used to change customer passwords if customer passwords are lost.

Refer to Troubleshooting, “Factory Passwords” for additional information on this subject.

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.

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

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

Breakout Harness – A breakout harness is a test harness that is designed to connect into the engineharness. 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 Trouble Code”.

Communication Adapter Tool – The communication adapter provides a communication

link between the ECM and the electronic service tool.

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 may be derated. The map for the engine derate is programmed into the ECM software. The type of derate can be one or more of three 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 governor uses signals from the ECM, the speed/timing sensors, and other sensors to determine the desired engine speed.

Diagnostic Trouble Code – A diagnostic trouble 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 design is a type of connector that is used on this 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. Engine monitoring also warns the operator of detected faults.

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

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

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

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 requires calibration.

14. There is a special instruction for the device.

15. The signal from the device is high (least severe).

16. The signal from the device is high (moderate severity).

17. The signal from the device is low (least severe).

18. The signal from the device is low (moderate severity).

19. There is an error in the data from the device.

31. Condition exists.

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

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

FRC – See “Fuel Ratio Control” .

Fuel Pump – See “High Pressure Fuel 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 high-pressure fuel pump and the fuel rail pressure sensor work with the ECM 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 a signal to the ECM that is dependent on the pressure of the fuel in the fuel rail.

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 a higher intake manifold air pressure (more air into the cylinder) is sensed, the FRC Limit is increased (more fuel into the cylinder).

Full Load Setting (FLS) – The FLS is the parameter that represents the fuel system adjustment. This adjustment is made at the factory in order to fine-tune the fuel system. This parameter must be programmed.

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

Glow Plug – The glow plug is an optional starting aid for cold conditions. One glow plug is installed in each combustion chamber in order to improve the ability of the engine to start. The ECM uses information from the engine sensors to determine when the glow plug relay must provide power to each glow plug. Each of the glow plugs then provides a hot surface in the combustion chamber in order to vaporize the mixture of air and fuel. The vaporization 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 Pump – This device supplies fuel under pressure to the fuel rail (high-pressure fuel rail).

High Pressure Fuel Rail – See “Fuel Rail” .

Injector Trim Codes – Injector trim codes are codes that contain 30 characters. The codes are supplied with new injectors. The code is input through the electronic service tool into the ECM. The injector trim codes compensate for variances in manufacturing of the electronic unit injector and for the life of the electronic unit injector.

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.

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 other electronic devices.

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

OEM – OEM is an abbreviation for the Original Equipment Manufacturer. The OEM 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. A parameter helps determine specific characteristics or behaviors of the engine.

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

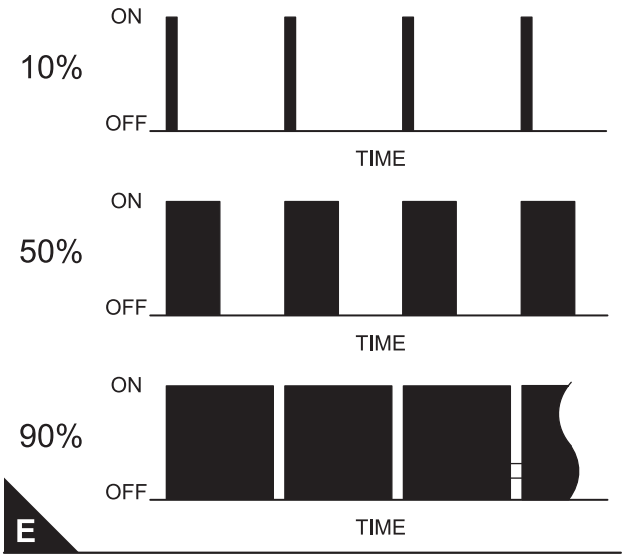
Personality Module – See “Flash File” .

Power Cycling – Power cycling refers to the action of cycling the isolator switch from any position to the OFF position, and to the START/RUN position.

Pressure Limiting Valve (PLV) – The PLV is a valve in the fuel rail that prevents excessive pressure. The PLV will reduce the pressure to a safe level that will limit engine operation but the reduced pressure will not stop the engine.

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 “TIME OFF” can be varied. This ratio is also referred to as a duty cycle.



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

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

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

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

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

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

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

Suction Control Valve (SCV) – The SCV is a control device in the high-pressure fuel pump. The valve controls the pressure in the fuel rail by varying the amount of fuel that enters the chambers in the pump.

Supply Voltage – The supply voltage is a continuous voltage that is supplied to a component. The power may be generated by the ECM or the power may be battery voltage that is supplied by the engine wiring.

Suspect Parameter Number (SPN) – The SPN is a J1939 number that identifies the specific component of the electronic control system that has experienced a diagnostic code.

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 control panel.

Top Centre Position – The top centre 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.

Electronic Service Tools

Perkins electronic service tools are designed to help the service technician perform the following tasks:

- Information access
- System diagnostics
- System calibrations
- System configurations
- Data link communications

Required Service Tools

Required Service Tool
Allen Wrench 4.0 mm (0.16 inch)
Transducer Magnetic Transducer As (Timing Calibration)
Transducer Adapter Adapter As (Timing Calibration)
Voltage Tester
Crimp Tool (12-GA TO 18-GA)
Wire Removal Tool
Removal Tool
Wedge Removal Tool
Multimeter Probe
Digital Multimeter Gp (Heavy Duty)

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

Optional service tools that can be used when the engine is serviced.

Description
Digital Pressure Indica-tor Gp (DEALER TOOL)
Battery Load Tester
Temperature Adapter Gp
Hose Connector
Hose Connector
Crimp Tool (4-GA TO 10-GA)
AC/DC Current Probe
Tube As (SIGHT GAUGE)
Wiring Harness (ECM BYPASS)
Control Harness As (ENGINE ECM BYPASS)

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
- Calibrations
- Programming of flash file
- Parameter programming
- Copy configuration function for ECM replacement
- Data logging
- Graphs (real time)

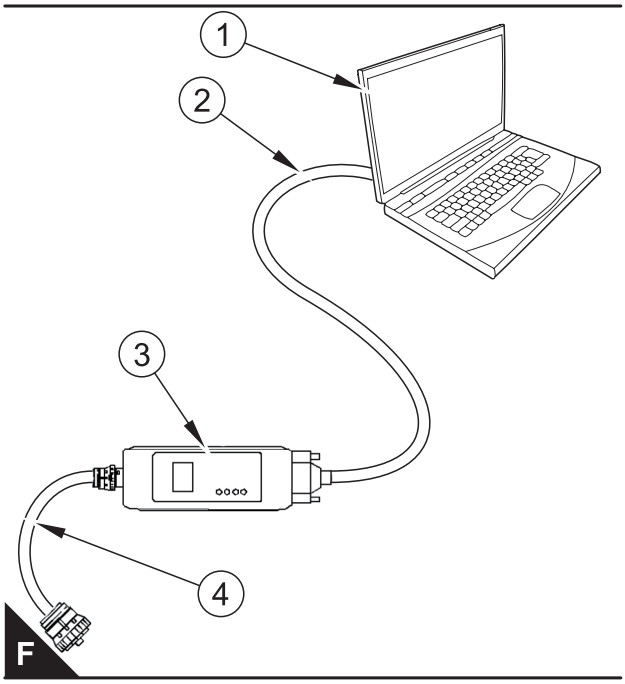
Service tools that are required in order to use the Electronic Service Tool.

Service Tools for the use of the Electronic Service Tool
PC- Minimum Required Specifications: 2.0 GHz Pentium processor or greater 1 GB of RAM 500 MB of available hard drive space CD ROM drive Super VGA monitor or dis-play (1024 x 768) Microsoft® Windows XP SP3, Vista Business SP2, or Windows 7 Professional RS232 port with a 16550 UART for use with Comm Adaptor II USB 1.1 or 2.0 port for use with Comm Adaptor 3 Ethernet R45 connector Built in pointing device or mouse Microsoft® Internet Explorer 7.0
Recommended Specifications: 2.0 GHz dual core processor 3 GB of RAM 3 GB of available hard drive space DVD ROM drive 15.4 inch XGA screen (1280 x 1024) Microsoft® Windows XP SP3 or later, Vista Business SP2 or Windows 7 Professional RS232 port with a 16550 UART for use with Comm Adaptor II USB 1.1 or 2.0 port for use with Comm Adaptor 3 Ethernet R45 connector Built in pointing device or mouse Latest version of Microsoft® Internet Explorer
Communication Adapter (Electronic Service Tool to the ECM interface)
Adapter cable as[1]
Communication Adapter (Electronic Service Tool to the ECM interface)
Single Use Programme License[2]
Data Subscription for all Engines[2]

[1] This tool is required to connect to the USB port on computers that are not equipped with an RS232 serial port.
[2] Refer to Perkins Engine Company Limited

Note: For more information on the Electronic Service Tool and the PC requirements, refer to the documentation that accompanies the software for the Electronic Service Tool.

Connecting the Electronic Service Tool and the Communication Adapter II



(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. Remove the electrical power from the ECM.
2. Turn the keyswitch to the OFF position.
3. 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 an RS232 serial port.

4. Connect cable (4) between the “DATA LINK” end of communication adapter (3) and the service tool connector.
5. Place the keyswitch in the ON position.

Note: 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 Does Not Communicate”.

Indicator Outputs

Indicator Lamps

The functions of the indicator lamps are designed to display the maximum amount of information on the minimum number of lamps. The layout and the function of the indicator lamps depends on the type of control panel. The following types of control panel are used:

Analog Gauge Panel

G

(1). Coolant Temperature Gauge

(2). Oil Pressure Gauge

(3). Shutdown/Stop Indicator

(4). Local Engine Start Push Button

(5). Local Engine Stop Push Button

(6). Tachometer with LCD for engine diagnostic information

(7). Warning Indicator

(8). LCD

(9). Tachometer button

(10). 3 Position Mode Select Switch

(11). Horn

On the panel, two indicators are installed. The indicators are shutdown/stop indicator (3) and warning indicator (7).

Shutdown/Stop Indicator (3) – This indicator will illuminate red when the ECM detects that an active diagnostic warning is present on the J1939 data link.

Warning Indicator (7) – This indicator will illuminate yellow when the ECM detects an active event code on the J1939 data link.

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 to be sure that replacing the ECM will correct a fault. Verify that the suspect ECM is the cause of the fault.

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 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 fault, reconnect the suspect ECM. Verify that the fault returns. If the fault returns, replace the ECM.

Note: If an ECM is used as a test ECM, select “Test ECM Mode” 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. 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 Installation Guide.

4. Remove power from the ECM.
5. Remove the ECM.

6. Install the replacement ECM

7. If the replacement ECM is 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.

Self-Diagnostics

Engine Diagnostic Trouble Codes

The engine Electronic Control Module (ECM) can detect faults in the electronic system and with engine operation. A self-diagnostic check is also performed whenever power is applied to the ECM. For a list of possible codes, refer to Troubleshooting, “Diagnostic Trouble Codes (Engine Diagnostic Trouble Codes)”.

When a fault is detected, a diagnostic trouble code (DTC) is generated. Each DTC has a lamp status that is assigned to the code, according to the severity. The possible lamps include Malfunction Indicator
(MIL), Amber warning (AWL), Red Stop (RSL), and Protection (Protect). The DTCs conform to the Society of Automotive Engineers (SAE) J1939 standard.

Diagnostic Trouble Code – When a fault in the electronic system is detected, the ECM generates a diagnostic trouble code. The diagnostic trouble code 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 – Many generated codes are stored in the permanent memory of the ECM. 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, an active diagnostic trouble code may be generated whenever a component is disconnected. When the component is reconnected, the code is no longer active.

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, an active diagnostic trouble code may be generated 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.

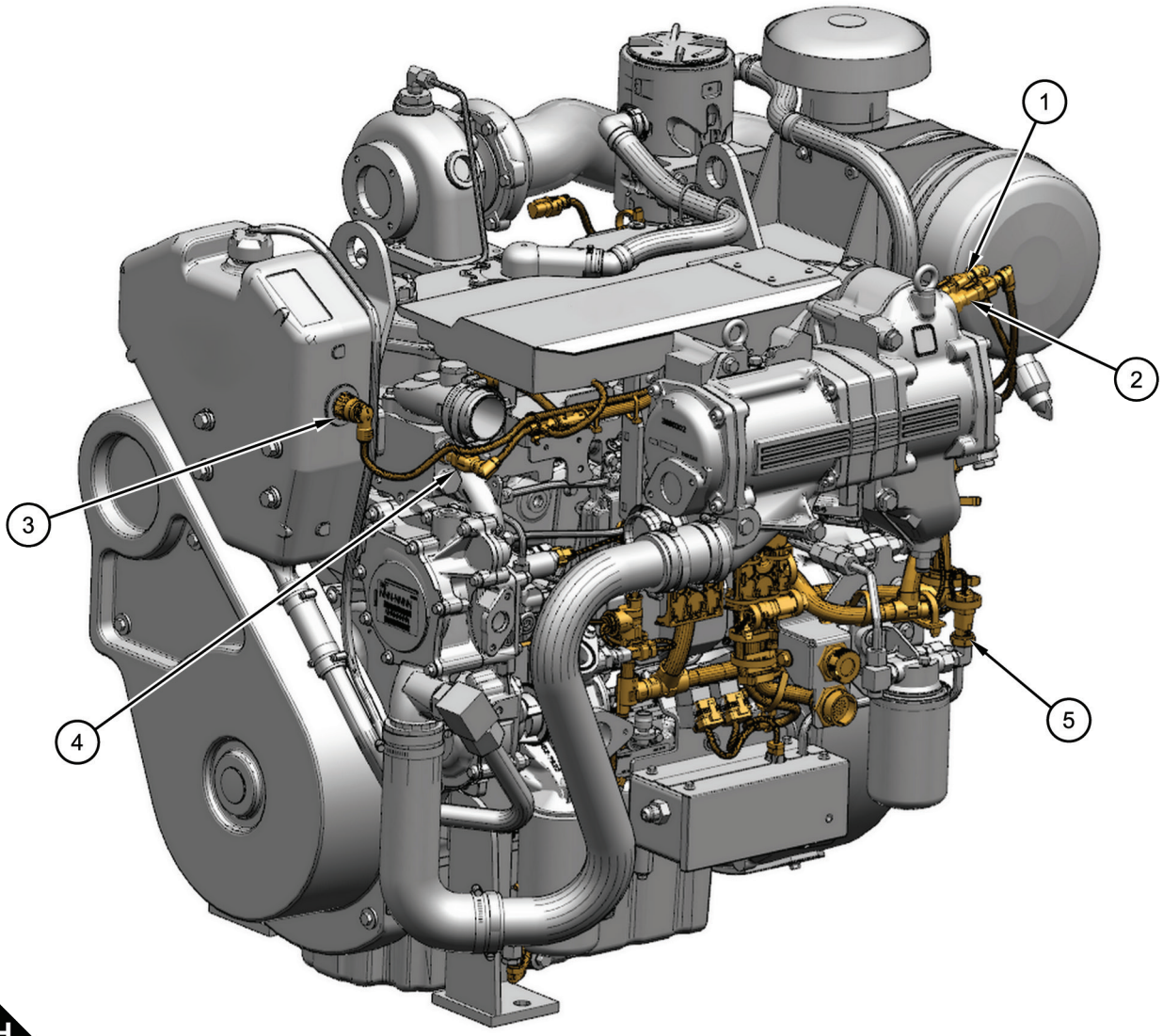
Sensors and Electrical Connectors

SMCS Code: 1900-NS; 7553-WW

Note: In the following illustrations, some components have been removed to improve visibility.

Sensor Locations for Auxiliary Engines - E44

The illustrations in this section show the typical locations of the sensors. Specific engines may appear different from the illustration due to differences in applications.



H

A typical example of the sensor locations on the left side of the engine

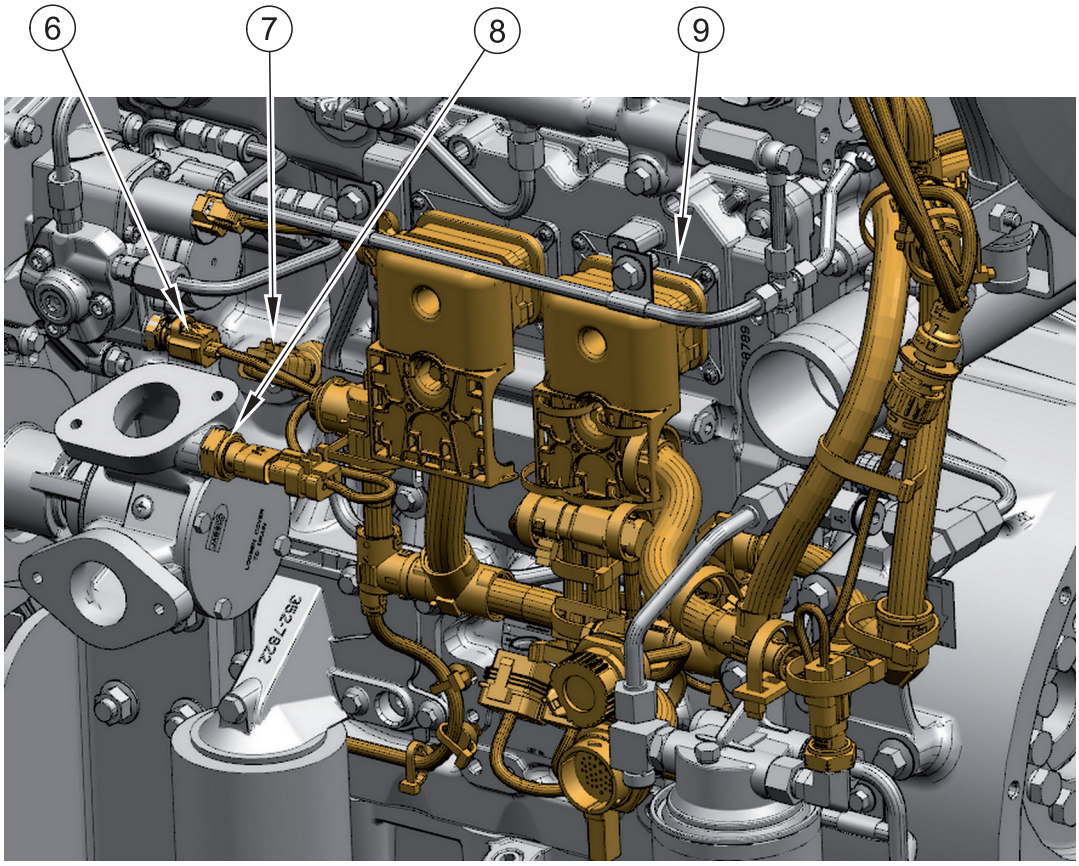
(1). Inlet Manifold Air Temperature Sensor

(2). Inlet Manifold Air Pressure Sensor

(3). Header tank level switch (optional)

(4). Coolant Temperature Sensor

(5). Fuel Pressure Sensor



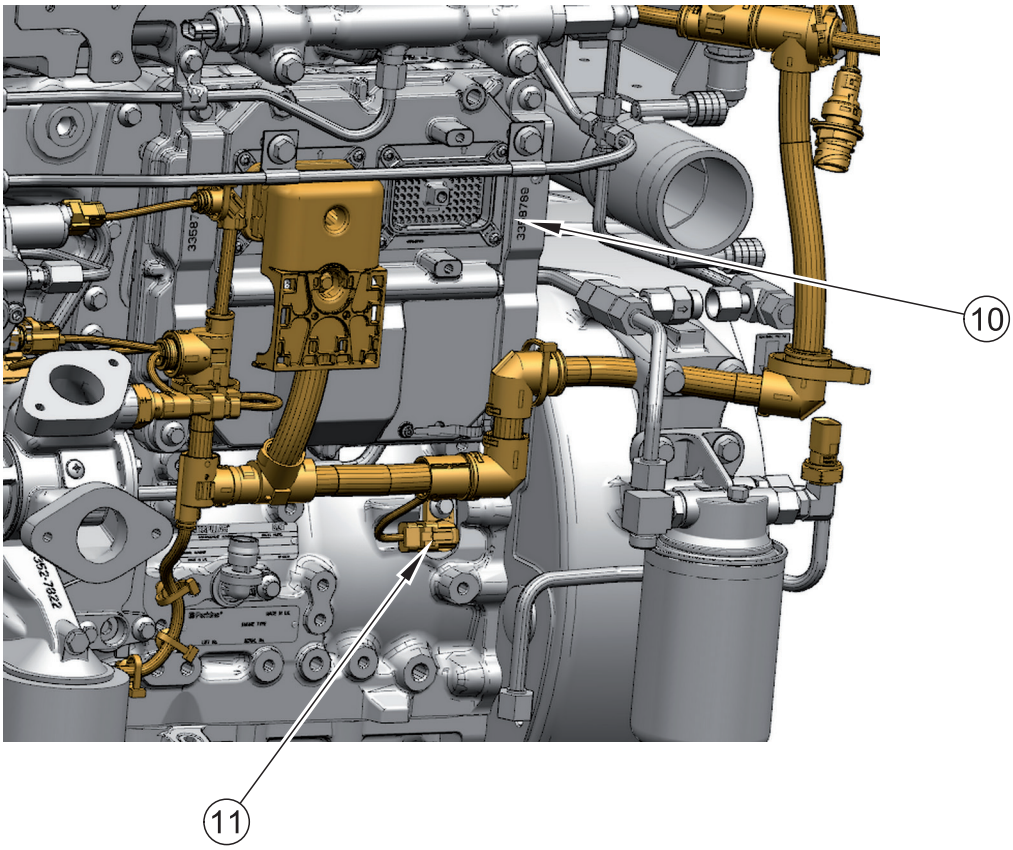
I

(6). Fuel Temperature Sensor

(7). Crankcase Pressure Sensor

(8). Oil Pressure Sensor (optional)

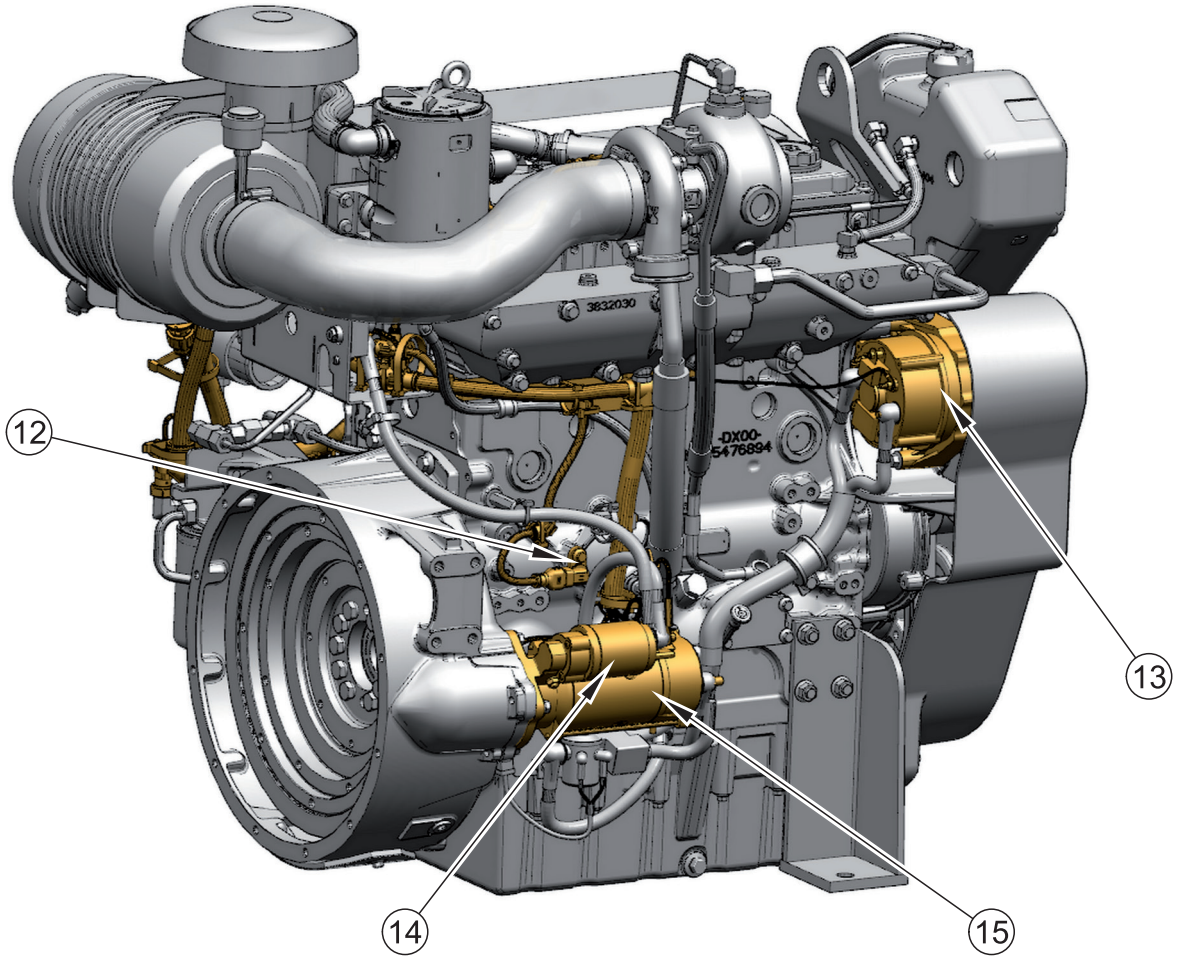
(9). Electronic Control Module (ECM)



J

(10). Electronic Control Module (ECM)

(11). Primary Speed/Timing Sensor



K

A typical example of the sensor locations on the right side of the engine

(12). Secondary Speed/Timing Sensor

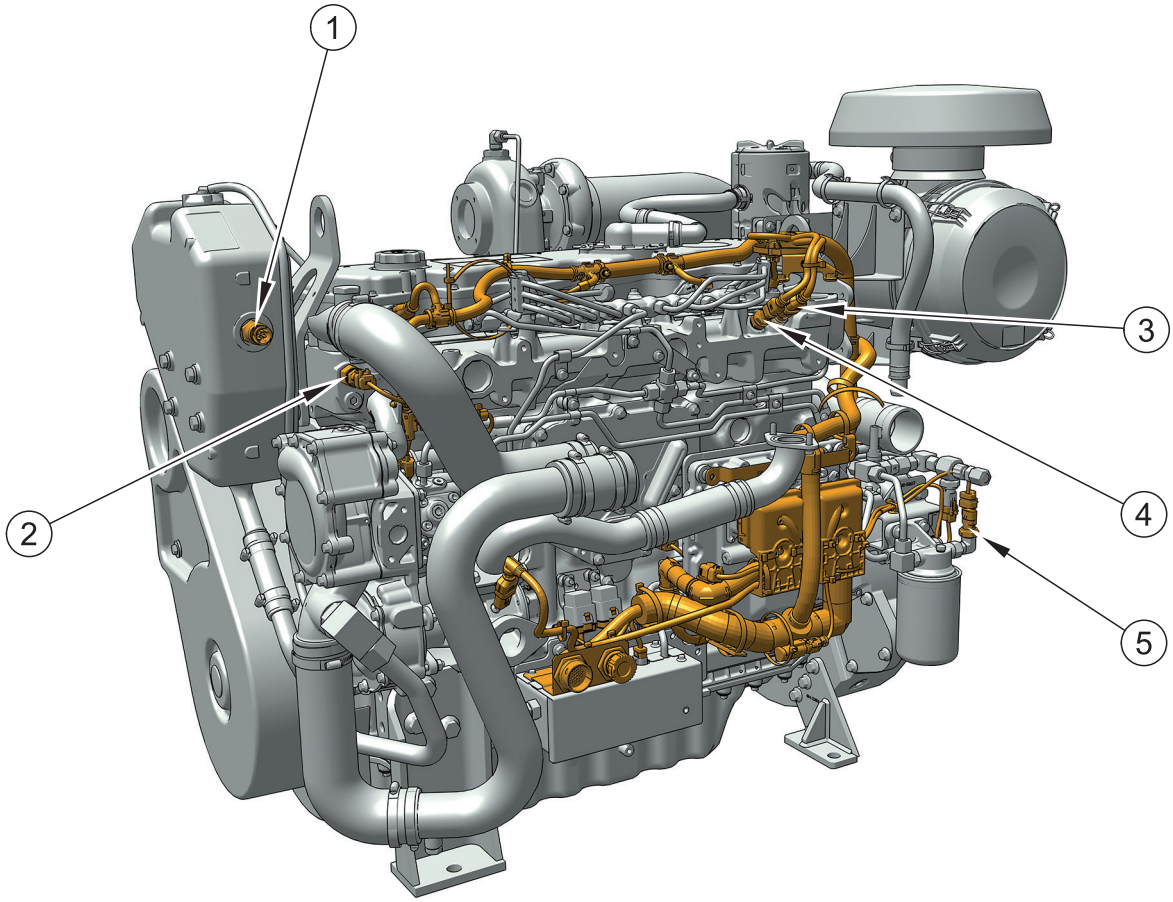
(13). Alternator

(14). Starter Solenoid

(15). Electric Starting Motor

Sensor Locations for Auxiliary Engines - E70B

The illustrations in this section show the typical locations of the sensors. Specific engines may appear different from the illustration due to differences in applications.



L

A typical example of the sensor locations on the left side of the engine

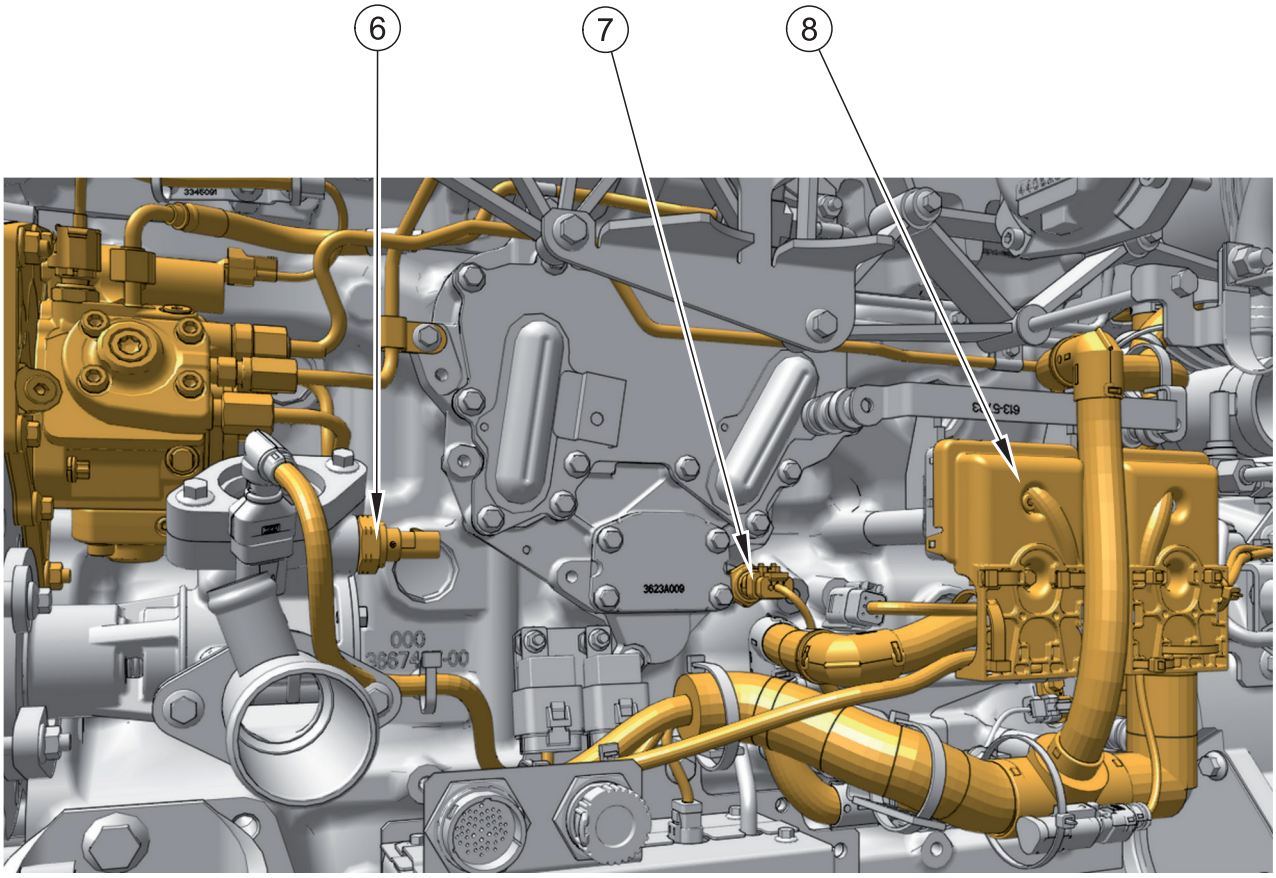
(1). Header tank level switch (optional)

(2). Coolant Temperature Sensor

(3). Inlet Manifold Air Temperature Sensor

(4). Inlet Manifold Air Pressure Sensor

(5). Fuel Pressure Sensor

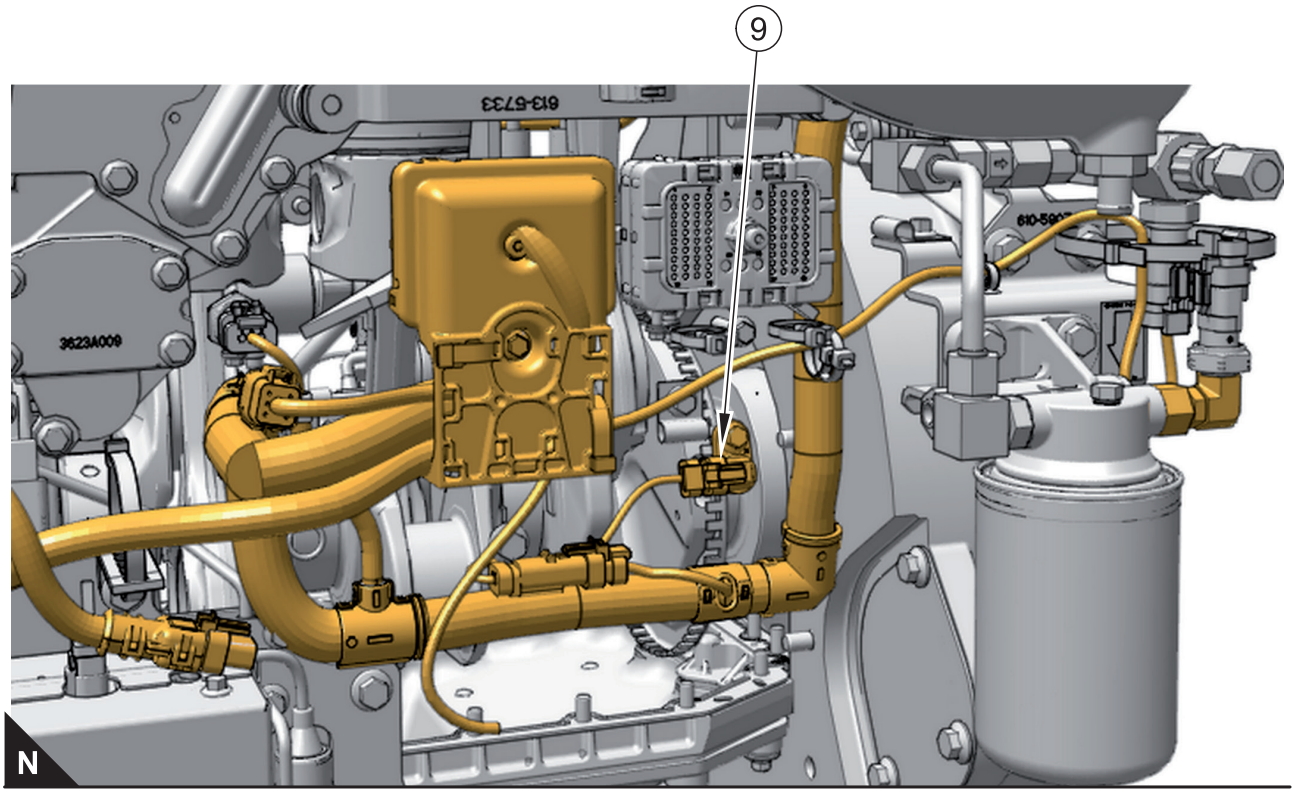


M

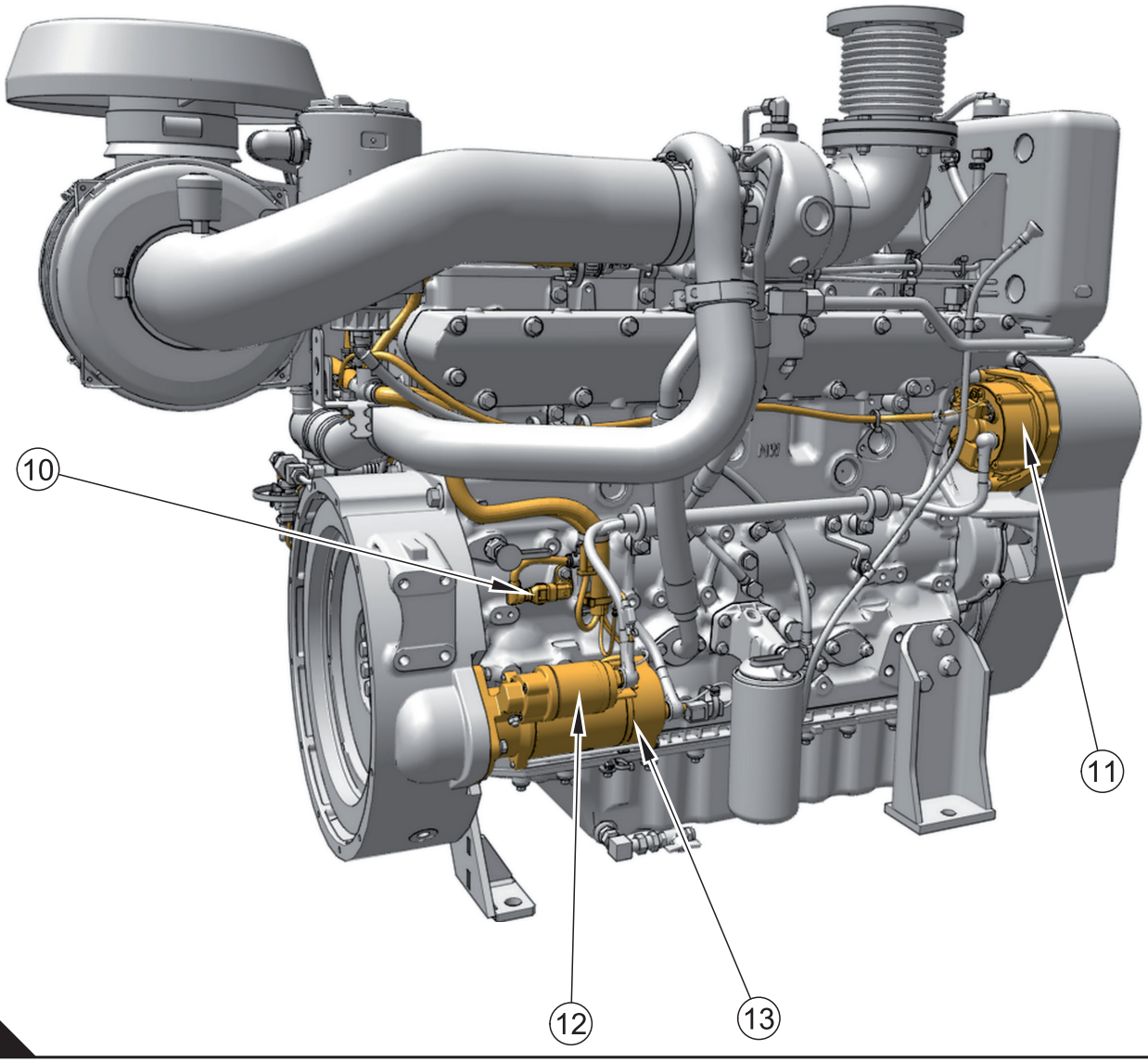
(6). Coolant Pressure Sensor

(7). Oil Pressure Sensor

(8). Electronic Control Module (ECM)



(9). Primary Speed/Timing Sensor



O

A typical example of the sensor locations on the right side of the engine

(10). Secondary Speed/Timing Sensor

(11). Alternator

(12). Starter Solenoid

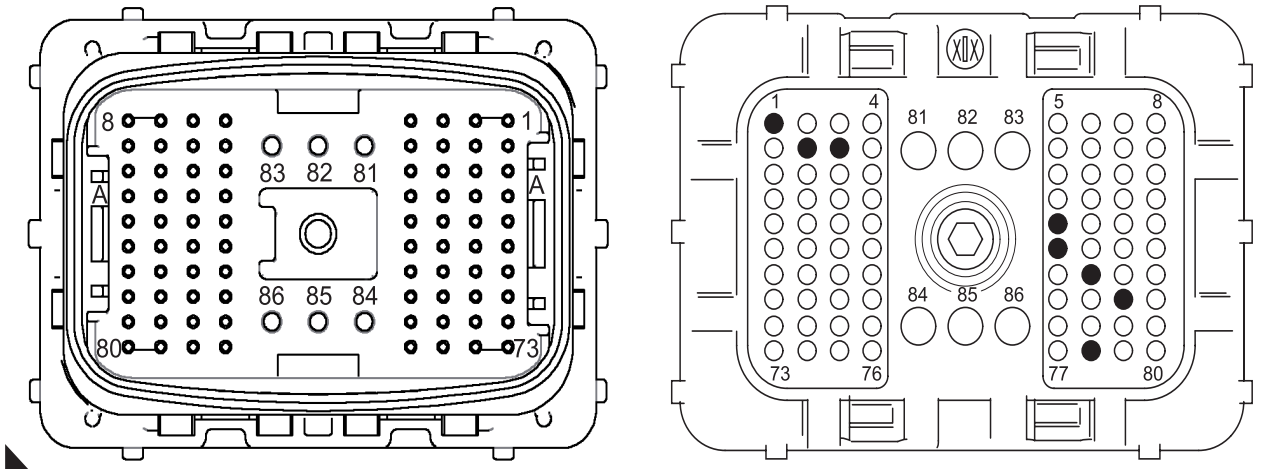
(13). Electric Starting Motor

Engine Wiring Information

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

ECM Harness Connector Terminals

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

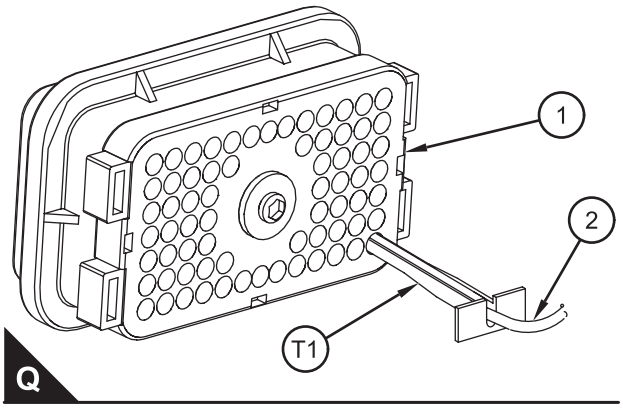


Typical layout of the Connector Pins (view from the rear)

Removal and Installation of the Harness Connector Terminals

Terminal Removal

Required Tool		
Item	**Qty**	**Part Name**
T1	1	Wire Removal Tool (Red)



(1). ECM connector

(2). Wire (T1) 151-6320 Wire Removal Tool (Red)

1. Remove ECM connector (1) from the ECM.
2. Position wire removal tool (T1) around wire (2).

Note: Ensure that wire removal tool (T1) stays perpendicular to the face of ECM connector (1).

3. Push wire removal tool (T1) into the hole for the terminal. Gently pull wire (2) to remove the terminal from the rear of ECM connector (1).
4. Remove wire removal tool (T1) from wire (2).

Note: If a terminal must be replaced, use 9X-3402 Connector Socket (16-GA TO 18-GA) for 16 and 18 AWG wire. Use 126-1768 Connector Socket (14-GA TO 16-GA) for 14 AWG wire.

Terminal Insertion

1. Push the terminal into the rear of ECM connector (1) until the terminal engages with the locking device.
2. Gently pull on wire (2) to ensure that the terminal is retained by the locking device.
3. Connect ECM connector (1) to the ECM and then tighten the retaining screw to a torque of 6 N·m (53.1 lb in).

ECM Harness Connector Terminals

The Electronic Control Module (ECM) uses connectors that have 70 terminals to interface to the wiring harness. A more in depth explanation of the connector can be found in the Users Handbook & Installation Information manual.

Programming Parameters

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 is incremented whenever a parameter is changed.

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 eliminate 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. If the "ECM Replacement" feature cannot be used, perform the following procedures:

- Program the test ECM with the values from the "Customer Specified Parameters Worksheet" .
- Program the values from the System Configuration Parameters.

Note: If the "ECM Replacement" feature cannot 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 eliminates 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 eliminates 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.

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 authorized distributors.

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.

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

Unlock parameters.

Factory passwords are required in order to unlock certain system configuration parameters. Refer to Troubleshooting, “System Configuration Parameters”.

Clear engine events and certain diagnostic trouble codes.

Most engine events require factory passwords in order to clear the code from ECM memory. Clear these codes only when you are certain that the fault has been corrected. For example, the 190-15 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. The electronic service tool will display the information that is required to obtain the passwords.

Flash Programming

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

The electronic service tool is used to flash program a flash file into the ECM. The flash programming transfers the flash file from the PC to the ECM.

Flash Programming a Flash File

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

Note: If you do not have the part number for the flash file, please refer to your Perkins distributor.

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

2. Connect the electronic service tool to the diagnostic 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 Does Not Communicate”.

5. Flash program the flash file into the ECM.
    a. Select the engine ECM under the “Detected ECMs” .
    b. Press the “Browse” button in order to select the part number of the flash file that will be programmed into the ECM.
    c. When the correct flash file is selected, press the “Open” button.
    d. Verify that the “File Values” match the application. If the “File Values” do not match the application, search for the correct flash file.
    e. When the correct flash file is selected, press the “Begin Flash” button.
    f. The electronic service tool will indicate when flash programming has been successfully completed.
6. If the engine rating is being changed, factory passwords must be obtained before the flash file will be accepted.
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.
8. Start the engine and check for proper operation. Check that there are no active diagnostic codes.

“WinFlash” Error Messages

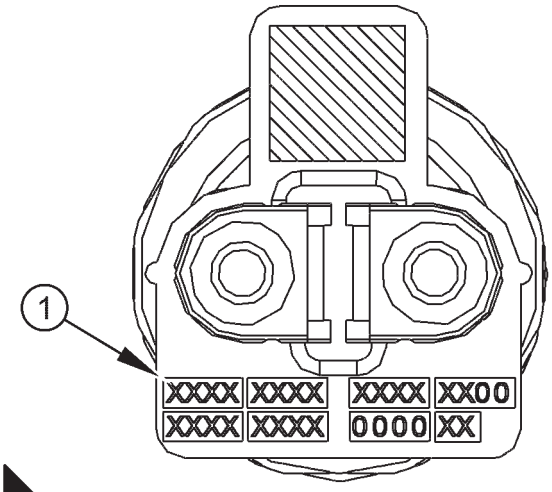
If any error messages are displayed during flash programming, click on the “Cancel” button in order to stop the process. Access the information about the “ECM Summary” under the “Information” menu.

Ensure that you are programming the correct flash file for your engine.

If a 630-2 diagnostic trouble code is displayed after flash programming, a required parameter is missing. Program the missing parameter.

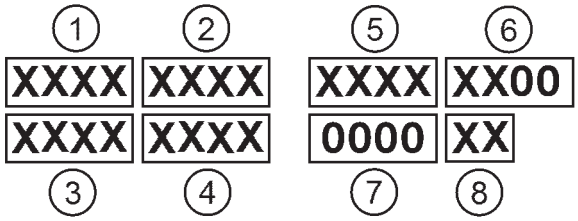
Injector Code - Calibrate

Injector codes are codes that are 30 hexadecimal characters in length that are supplied with each injector. The code is on a plate on the top of the injector and a card is also included in the packaging for the injector. The code is used by the Electronic Control Module (ECM) to balance the performance of the injectors.



A

Illustration (A) shows the label with the injector code.



B

Sequence for recording the injector code

The electronic service tool is used to load the injector codes into the ECM.

The injector codes 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 630-2 is active.
- Electronic injectors are exchanged between cylinders.

Note: Diagnostic code 630-2 will also become active if the engine serial number, FLS or FTS are not entered into the ECM.

If the ECM is replaced, the injector codes are normally transferred to the new ECM as part of the “Copy Configuration” procedure. If the “Copy Configuration” procedure fails, the injector codes must be loaded manually.

Installing Injector Codes

Note: The injector code is located on the electronic unit injector.

1. Record the injector code for each electronic unit injector.
2. Connect the electronic service tool to the diagnostic connector. Refer to Troubleshooting, “Electronic Service Tools”.
3. Turn the keyswitch to the ON position.
4. Select the following menu options on the electronic service tool:

- Service
- Calibrations
- Injector Trim Calibration

5. Select the appropriate cylinder.
6. Click on the “Change” button.
7. Input the applicable injector code that was recorded in Test Step 1.
8. Click on the “OK” button.

The injector code is loaded into the ECM.

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

Exchanging Electronic Unit Injectors

Exchanging electronic unit injectors can help determine if a combustion problem is in the electronic unit injector or in the cylinder. If two electronic unit injectors that are currently installed in the engine are exchanged between cylinders, the injector codes must 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.

Customer Specified Parameters

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

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 by the customer. The "Equipment ID" is not required by the Electronic Control Module (ECM).

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

Engine Rating Parameter

Rating Number

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

Minimum	Maximum	Default
1	4	1

Miscellaneous

Engine Acceleration Rate

The "Engine Acceleration Rate" parameter is the acceleration rate for the engine under normal operating conditions. A setting of "0" disables this function.

Cooldown Delay Time

Value	Default
1 to 60 minutes	5 minutes

Minimum	Maximum	Default
0 rpm	65503 rpm/sec	0 rpm/sec

Configurable Inputs

Coolant Level Switch

A coolant level sensor is an optional switch input. Programming the "Coolant Level Switch" parameter to "Enabled" notifies the ECM that a coolant level switch input is present. If this parameter is programmed to "Enabled" and the coolant level falls below the measured level, a "111-1" diagnostic code will be displayed.

Value	Default
Installed Not Installed	Not Installed

System Settings

System Operating Voltage Configuration

The System Operating Voltage Configuration parameter is the operating voltage for the engine electrical system.

Value	Default
12 VDC 24 VDC	Customer Option

Passwords

Customer Password 1

The Customer Password 1 is the first security password that can be defined by the customer.

Value	Default
Eight alphanumeric characters	Eight spaces

Customer Password 2

The Customer Password 2 is the second security password that can be defined by the customer.

Value	Default
Eight alphanumeric characters	Eight spaces

Security Access Parameters

CAN Communication Protocol Write Security

The CAN Communication Protocol Write Security parameter control the security required for writing information through the CAN bus.

Value	Default
Seed and Key No Security	Seed and Key

CAN Communication Protocol Read Security

The CAN Communication Protocol Read Security parameter control the security required for reading information from the CAN bus.

Value	Default
Seed and Key No Security	Seed and Key

Customer Specified Parameters Table

Customer Specified Parameters		
ECM Parameter	**Possible Values**	**Default Value**
ECM Identification Parameter		
Equipment ID	17 Digits(1)	Not Programmed
Engine Rating Parameter		
Rating Number	1 to 7	1
Rating Frequency	-	50 Hz
Rated Engine Speed	-	1500 rpm
Rated Real Genset Power	-	80 kW
Rated Apparent Genset Power	-	Unavailable Parameter
Rating Configuration	-	Low Emissions
Rated Standby Power	-	95 kW
Rated Prime Power	-	86 kW
Rated Genset Speed	-	1500 rpm
Engine Rating Application Type	-	Prime
Miscellaneous		
Engine Acceleration Rate	0 to 65503 rpm/sec	250 rpm/sec
Low Idle Speed	-	1100 rpm
Engine	Engine #1	-
Cool down Speed	-	1100 rpm
Cool down Duration	-	0 min
Crank Duration	-	15 sec
Maximum Number of Crank Cycles	-	3
Droop Mode Selection-	-	Isochronous

Engine Speed Droop	-	3.0%
Remote Throttle Control Min Speed	-	125 rpm
Remote Throttle Control Max Speed	-	125 rpm
Remote Throttle Control Ramp Rate	-	10 rpm/sec
Configurable Inputs		
Coolant Level Switch	Not Installed Installed	Not Installed
Remote Throttle Control Install	-	Installed
Fuel Level Sensor Installation Status	-	Not Installed
Coolant Level Sensor	-	Installed
Exhaust Temperature Sensor Installation Status	-	Not Installed
Engine Oil Temperature Sensor Installation Status	-	Not Installed
Engine Coolant Pressure Sensor Type Configuration	-	400 kPa Sensor
Unfiltered Fuel Pressure Sensor Installation Status	-	Not Installed
Fuel Filter (Suction Side) Intake Pressure Sensor Installation Status	-	Not Installed
Fuel Supply Pump Intake Pressure Sensor Installation Status	-	Not Installed
Unfiltered Engine Oil Pressure Sensor Installation Status	-	Not Installed
Engine Coolant Pressure Sensor Installation Status	-	Not Installed
Coolant Level Switch Configuration	-	Open When Low
Seawater Outlet Pressure Configuration	-	Unavailable
Fuel Rail Leak Detection Sensor Installation Status	-	Not Installed
Fuel/Water Separator Switch Installation Status	-	Not Installed
Maintenance Indicator Mode	-	Off
PM1 Interval	-	Unavailable
Maintenance Level 1 Cycle Interval Hours	-	500 Hours
Engine State Control Input Configuration	-	CAN Input
Desired Speed Input Configuration	-	CAN Input
Droop/Isochronous Switch Enable	-	Disabled

Emergency Shutdown Override Switch Installation Status	-	Installed
Emergency Shutdown Override Input Configuration	-	Switch to Ground
External Speed Selection Switch Enable	-	Enabled
Remote Emergency Stop (E-Stop) Switch Input Type Configuration	-	Normally Closed (to Ground)
System Operating Voltage Configuration	-	24 Volt
Governor (Proportional) Gain Percentage	-	100.0 %
Governor (Integral) Stability Percentage	-	100.0 %
Governor Transient Response Loop Gain Percentage	-	100.0 %
FLS	-	38
FTS	-	0
System Settings		
System Operating Voltage Configuration	12 VDC 24 VDC	Customer Option
Passwords		
Customer Password 1	Eight alphanumeric characters	Eight spaces
Customer Password 2	Eight alphanumeric characters	Eight spaces
Security Access Parameters		
CAN Communication Protocol Write Security	Seed and Key No Security	Seed and Key
CAN Communication Protocol Read Security	Seed and Key No Security	Seed and Key

(1) Available characters depend on the service tool that is used.

Customer Specified Parameters Worksheet

Customer Specified Parameters Worksheet	
ECM Identification Parameter	
Equipment ID	
Engine Rating Parameter	
Rating Number	
Miscellaneous	
Engine Acceleration Rate	
Configurable Inputs	
Coolant Level Switch	
System Settings	
System Operating Voltage Configuration	
Passwords	
Customer Password 1	

Customer Password 2	
Security Access Parameters	
CAN Communication Protocol Write Security	
CAN Communication Protocol Read Security	

System Configuration Parameters

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 change through the life of the engine.

System configuration parameters must be reprogrammed if an Electronic Control Module (ECM) is replaced. System configuration parameters are not 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 factory adjustment to the fuel system 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 630-2 diagnostic code from becoming active.

“Full Torque Setting”

“Full Torque Setting” is like “Full Load Setting” . If the ECM is replaced, the full torque setting must be reprogrammed in order to prevent a 630-2 diagnostic code from becoming active.

“Rating”

The “Rating” 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 have a different code to all other horsepower ratings and emission certifications. This rating is a code that prevents the use of an incorrect power rating and/or emission rating for a specific engine.

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, the engine will not run.The engine will not run.

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

This code does not require programming when the replacement ECM is for the same engine rating.

If the ECM is for a different engine rating, then the following components may require replacement: 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 local OEM dealer for further information.

“Engine Serial Number”

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

“ECM Software Release Date”

This parameter is defined by the rating interlock and this parameter is not programmable. The “ECM Software Release Date” is used to provide the version of the software. The Customer parameters and the software change levels can be monitored by this date. The date is provided in the month and the year (JAN14). Jan is the month (January). 14 is the year (2014).

Symptom Troubleshooting

Acceleration Is Poor or Throttle Response Is Poor

If possible, download the “Warranty Report” from the engine ECM before performing this procedure.

Probable Causes

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

Recommended Actions

NOTICE

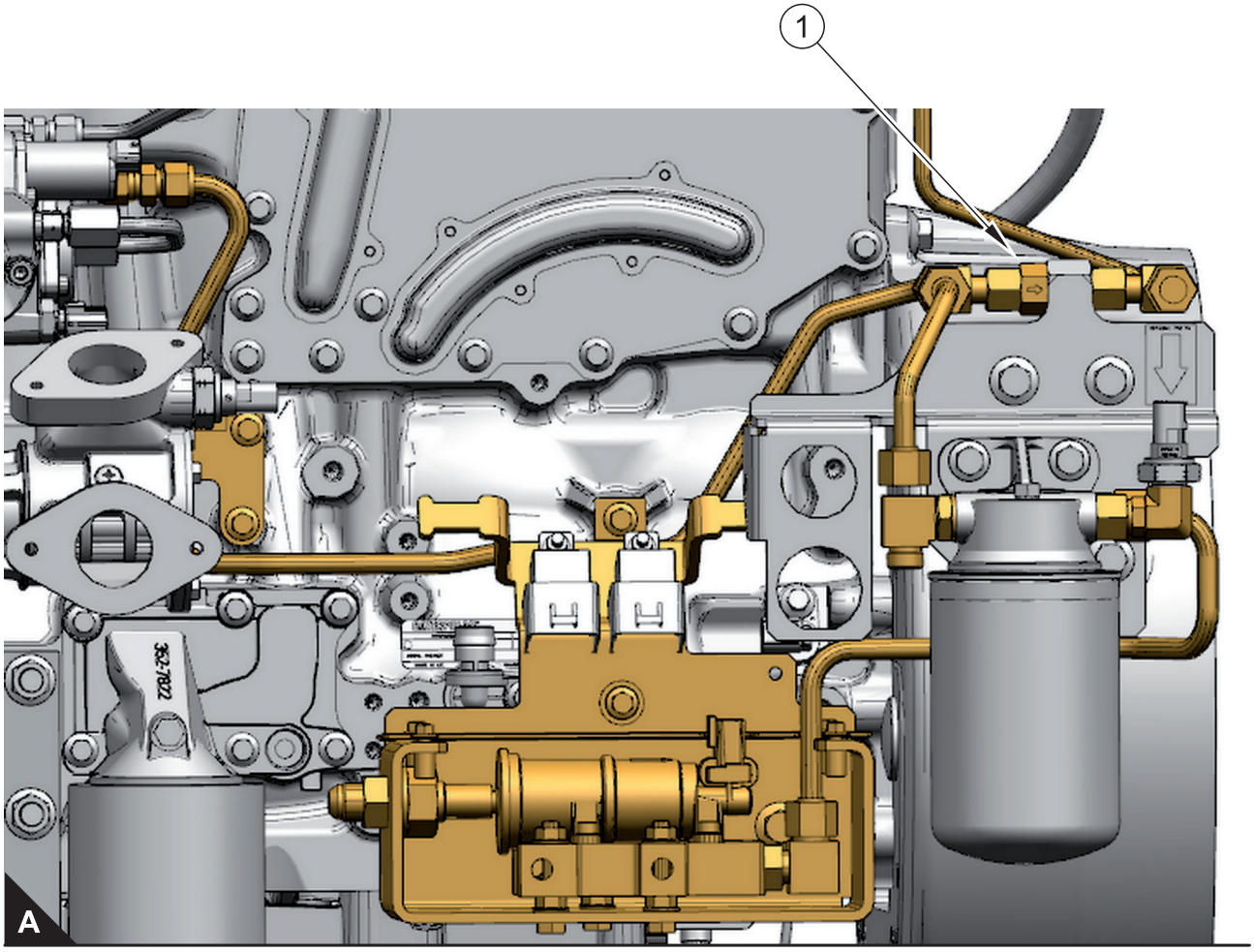
Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

Note: The procedures have been listed in order of probability. Complete the procedures in order.

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

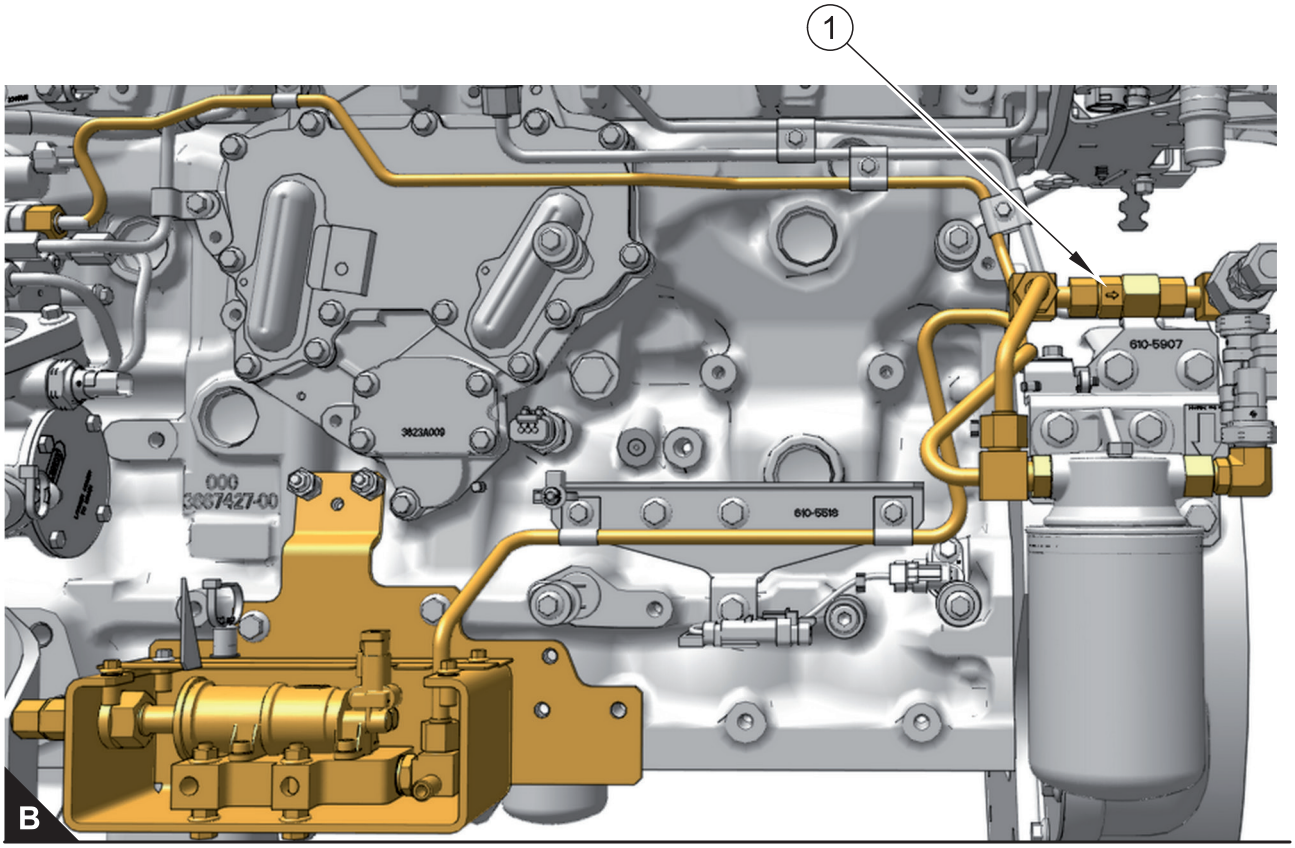
Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes **Note:** Certain diagnostic codes and/or event codes may cause poor performance. Refer to in the electronic service tool. A. Use the electronic service tool to check for active or logged codes. B. Use the electronic service tool to check the histogram information if the engine has been derated. **Note:** If the histograms contain engine derates and no diagnostic codes are present, then the engine is operating normally.	Derate or diagnostic codes	**Result:** A diagnostic code is present. Troubleshoot the code and then reset the histogram. **Result:** A diagnostic code is not present. Proceed to Test Step 2.
2. Parameters in the Electronic Control Module (ECM) A. Use the electronic service tool to verify that the correct parameters are being used. Refer to Troubleshooting, “System Configuration Parameters” for additional information.	Parameters	**Result:** The parameters are not correct. Input the correct parameters. Refer to Troubleshooting, “Configuration Parameters” for additional information. **Result:** The parameters are correct. Proceed to Test Step 3.
3. Electrical connectors A. Turn the isolator switch to the ON position. B. Use the electronic service tool to check the intake manifold pressure. C. Run the engine until the speed is equal to the maximum no-load speed. D. Use the electronic service tool to make sure that the throttle is set to reach the maximum no-load speed.	Electrical connections	**Result:** The intake manifold pressure is not zero ± 0.5 kPa (zero ± 0.070 psi). Check the 5 VDC sensor supply for the intake manifold pressure. Refer to Troubleshooting, “Sensor Supply -Test”. **Result:** The throttle response is not as expected. If the maximum no-load speed cannot be obtained refer to Troubleshooting, “Switch Circuits - Test” and Troubleshooting, “Mode Selection - Test”. **Result:** All responses are normal. Proceed to Test Step 4
4. Air Intake and Exhaust System A. Observe the check engine lamp. Check for an air filter restriction indicator, if equipped. Replace a plugged air filters. Refer to the Users Handbook. B. Check the air inlet and exhaust system for restrictions and/or leaks.	Restrictions	**Result:** There are restrictions in the air inlet or exhaust system. Make the necessary repairs, **Result:** There are no restrictions in the air inlet or exhaust system. Proceed to Test Step 5.
5. Valve Lash **Note:** The valve lash can affect the performance of the engine. A. Check the valve lash.	Valve lash	**Result:** The valve lash is not set correctly. Check the valve lash. **Result:** The valve lash is correct. Proceed to Test Step 6.

6. Turbocharger **Note:** The turbocharger that is installed on the engine is a non-serviceable item. If any mechanical fault exists, then the faulty turbocharger must be replaced. A. Ensure that the mounting bolts for the turbocharger are tight. B. Check that the oil drain for the turbocharger is not blocked or restricted. C. Check that the compressor housing for the turbocharger is free of dirt and debris. Make sure that the housing is not damaged. D. Check that the turbine housing for the turbocharger is free of dirt and debris. Make sure that the housing is not damaged. E. Check that the turbine blades rotate freely in the turbocharger.	Turbocharger	**Result:** There is a fault on the turbocharger. Repair the turbocharger or replace the turbocharger. **Result:** The turbocharger is OK. Proceed to Test Step 7.
7. Fuel Supply A. Visually check the fuel level in the fuel tank. Do not rely on the fuel gauge only. B. Ensure that the vent in the fuel cap is not filled with debris. C. Ensure that the fuel supply valve (if equipped) is in the full OPEN position. D. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax). E. Check the primary filter/water separator for water in the fuel. F. Check for fuel supply lines that are restricted. G. Check that the low-pressure fuel lines are tight and secured properly. H. Replace the primary and secondary fuel filters. G. Check the diesel fuel for contamination. H. Check for air in the fuel system. I. Ensure that the fuel system has been primed.	Fuel system	**Result:** The fuel supply is not OK. Repair the fuel system or replace the fuel system components, as necessary. **Result:** The fuel supply is OK. Proceed to Test Step 8.



E44

(1). Electric Fuel Lift Pump Pressure Regulator



E70B

(1). Electric Fuel Lift Pump Pressure Regulator

8. Electric Fuel Lift Pump (EFLP) Pressure Regulator Flow Test A. Disconnect the EFLP return line from the drain port on the EFLP. Install a suitable blanking cap on the open port in the return line. B. Connect a temporary drain line to the drain port of the EFLP. C. Place the end of the temporary drain line into a suitable cali-brated container. D. With the isolator switch in the ON position but the engine not running, use a suitable multimeter to measure the input voltage to the EFLP. Record the reading. E. With the isolator switch in the ON position but the engine not running, measure the fuel flow from the temporary drain line. F. Remove the temporary drain line. Reconnect the EFLP return line to the drain port on the EFLP.	EFLP flow rate	**Result:** The fuel flow is greater than the minimum limit. Proceed to Test Step 12. **Result:** The fuel flow is less than the minimum limit. Proceed to Test Step 9.
9. Electric Fuel Lift Pump (EFLP) Return Test A. Make sure that the EFLP return line is not blocked or kinked. B. If the EFLP return line is clear, confirm that the Electric Fuel Lift Pump (EFLP) is operating. Make sure that fuel lines between the EFLP and the EFLP pressure regulator are not blocked or kinked.	PRV test	**Result:** All fuel lines are clear. The EFLP is suspect. Proceed to Test Step 10. **Result:** The EFLP is OK and all fuel lines are clear. Proceed to Test Step 12.
10. EFLP Flow Test at the Secondary Fuel Filter Inlet A. Make sure that the isolator switch is in the OFF position. B. Disconnect the fuel inlet connection from the primary fuel filter head. C. Install a suitable blank on the fuel inlet port on the primary fuel filter head. D. Place the open end of the fuel inlet line in a suitable calibrated container. E. With the isolator switch in the ON position, measure the flow from the fuel line.	PRV test	**Result:** The fuel flow from the EFLP below the minimum specification. Replace the EFLP. Confirm that the fault has been eliminated. **Result:** The fuel flow from the EFLP is above the minimum specification. Proceed to Test Step 11.
11. Check the Return Fuel Lines A. Make sure that the EFLP return line is not blocked or kinked.	Return lines	**Result:** The EFLP return line is blocked or kinked. Clear or replace the blocked line. **Result:** The EFLP return line is clear. Contact the Perkins dealer.

12. Low Compression (Cylinder Pressure) A. Perform a compression test.	Cylinder compression	**Result:** The results of the compression test are outside the specifications. Investigate the cause and rectify any faults. **Note:** 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 **Result:** The results of the compression test are OK. Proceed to Test Step 13.
13. Low Compression (Cylinder Pressure) A. Perform a compression test.	Cylinder compression	**Result:** The results of the compression test are outside the specifications. Investigate the cause and rectify any faults. **Note:** 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 **Result:** The results of the compression test are OK. Proceed to Test Step 14.
14. Individual Malfunctioning Cylinders A. With the engine speed at a fast idle, use the electronic service tool to perform the manual “Cylinder Cut Out Test” . As each cylinder is cut out, listen for a change in the sound from the engine. When a cylinder is cut out, there should be a notice-able change in the sound of the engine. If a change in the sound of the engine is not noted, the isolated cylinder is not operating under normal conditions. If the isolation of a cylinder results in a change in the sound that is less notice-able, the cylinder may be operating below normal performance.	Cylinders	**Result:** The test indicates a faulty cylinder. 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. **Result:** The test indicates that all cylinders are OK. Contact the Perkins dealer.
15. Electronic Unit Injectors A. Use the electronic service tool to perform the automatic “Cylinder Cut Out Test” . **Note:** If the compression test that was performed in Test Step 11 was satisfactory, the “Cylinder Cut Out Test” will identify any faulty injectors.	Electronic Unit Injectors	**Result:** A faulty injector is indicated. Remove any faulty electronic unit injectors. Install new electronic unit injectors. Repeat the automatic “Cylinder Cut Out Test” . If the fault is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. **Result:** All injectors are OK. Proceed to Test Step 16.

16. Individual Malfunctioning Cylinders A. With the engine speed at a fast idle, use the electronic service tool to perform the manual “Cylinder Cut Out Test” . As each cylinder is cut out, listen for a change in the sound from the engine. When a cylinder is cut out, there should be a notice-able change in the sound of the engine. If a change in the sound of the engine is not noted, the isolated cylinder is not operating under normal conditions. If the isolation of a cylinder results in a change in the sound that is less notice-able, the cylinder may be operating below normal performance.	Cylinders	**Result:** The test indicates a faulty cylinder. 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. **Result:** The test indicates that all cylinders are OK. Contact the Perkins dealer.

Alternator Is Noisy

Note: This symptom is not an electronic system fault.

Probable Causes

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

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Alternator Drive Belt and Tensioner A. Inspect the condition of the alternator drive belt. B. Check the belt tension. If necessary, check the automatic belt tensioner.	Drive belt	**Result:** The alternator drive belt is in good condition and the belt tension is correct. Proceed to Test Step 2. **Result:** The alternator drive belts are not in good condition or the belt tension is incorrect. If the alternator drive belts are worn or damaged, replace the belts. If necessary, replace the automatic belt tensioner. Refer to Disassembly and Assembly for the correct procedure. **Result:** The alternator drive belts are in good condition and the belt tension is correct. Proceed to Test Step 2.
2. Alternator Mounting Bracket A. Inspect the alternator mounting bracket for cracks and distortion.	Alternator Mounting Bracket	**Result:** The alternator mounting bracket is cracked and distorted. Repair the mounting bracket or replace the mounting bracket. **Note:** The repair/replacement will ensure that the alternator drive belt and the alternator drive pulley are in alignment. **Result:** The alternator mounting bracket is OK. Proceed to Test Step 3.
3. Alternator Drive Pulley A. Check the condition of the alternator drive pulley. Look for deep grooves that have been worn into the pulley by the belt. Check that the nut for the pulley has not become loose.	Alternator Drive Pulley	**Result:** There is excessive wear on the alternator drive pulley. Replace the pulley. **Result:** The alternator drive pulley nut was loose. Tighten the nut. **Result:** There is not excessive wear on the alternator drive pulley. Proceed to Test Step 4.
4. Alternator Bearings A. Check the alternator bearings for signs of wear.	Alternator bearings	**Result:** The alternator bearings are not OK. Repair the alternator or replace the alternator, as needed. **Result:** The alternator bearings are OK. Contact the Perkins dealer.

Alternator Problem

Note: This symptom is not an electronic system fault.

Probable Causes

- Alternator drive belt and tensioner
- Alternator
- Charging circuit

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Alternator Drive Belt and Tensioner A. Inspect the condition of the alternator drive belt. B. Check the belt tension. If necessary, check the automatic belt tensioner. **Note:** Excessive belt tension can result in damage to the alternator.	Drive belt	**Result:** The alternator drive belt is in good condition and the belt tension is correct. If the alternator drive belts are worn or damaged, replace the belts. If necessary, replace the automatic belt tensioner. **Result:** The alternator drive belts are in good condition and the belt tension is correct. Proceed to Test Step 2.
2. Alternator A. Verify that the alternator is operating correctly.	Alternator	**Result:** The alternator is not operating correctly. Repair the alternator or replace the alternator, as necessary. **Result:** The alternator is operating properly. Proceed to Test Step 3.
3. Charging Circuit A. Inspect the battery cables, wiring, and connections in the charging circuit.	Charging circuit	**Result:** The charging circuit is not operating correctly. Clean all connections and tighten all connections. Replace any faulty parts. **Result:** The charging circuit is operating correctly. Contact the Perkins dealer.

Battery Problem

Probable Causes

- Charging circuit
- Battery
- Auxiliary device

Recommended Actions
Complete the procedure in the order in which the steps are listed.

Troubleshooting Test Steps	Values	Results
1. Charging Circuit A. Check that the battery charging circuit is operating correctly. Refer to Troubleshooting, “Alternator Problem”.	Charging circuit	**Result:** The charging circuit is not OK. Repair the charging circuit, as necessary. **Result:** The charging circuit is OK. Proceed to Test Step 2.
2. Battery A. Verify that the battery is no longer able to hold a charge.	Battery	**Result:** The battery is not OK. Replace the battery. Refer to the Users Handbook, “Battery - Replace”. **Result:** The battery is OK. Proceed to Test Step 3.
3. Auxiliary Device A. Check if an auxiliary device has drained the battery by being left in the ON position.	Auxiliary Device	**Result:** The battery has been drained by an auxiliary device being left in the ON position. Charge the battery. Verify that the battery is able to maintain a charge. **Result:** The battery has not been drained by an auxiliary device being left in the ON position. Contact the Perkins dealer.

Coolant Contains Oil

Probable Causes

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

Recommended Actions

Complete the procedure in the order in which the steps are listed.

Troubleshooting Test Steps	Values	Results
1. Engine Oil Cooler A. Drain the coolant from the cooling system. Drain the lubricating oil from the engine oil cooler. Refer to the Users Handbook for more information. B. Check for leaks in the engine oil cooler.	Oil Cooler	**Result:** A leak is found in the engine oil cooler. Install a new oil cooler. Flush the cooling system. Refer to the Users Handbook for the correct procedure. Refill the cooling system with the correct coolant. Refill the engine with the proper oil after the leak has been repaired. **Result:** A leak was not found in the engine oil cooler. Proceed to Test Step 2.
2. Cylinder Head Gasket A. Remove the cylinder head. B. Inspect the cylinder head gasket for faults and any signs of leakage.	Cylinder head gasket	**Result:** The cylinder head gasket does not show signs of damage or leakage. C. Install a new cylinder head gasket and install the cylinder head. **Result:** The cylinder head gasket shows signs of damage or leakage. Proceed to Test Step 3.
3. Cylinder Head A. Check for cracks in the cylinder head. Perform a leak test on the cylinder head.	Cylinder head	**Result:** A fault is found in the cylinder head. Repair the cylinder head or replace the cylinder head. In-stall the cylinder head. **Result:** A fault is not found in the cylinder head. Proceed to Test Step 4.
4. Cylinder Block A. Inspect the top face of the cylinder block for faults and signs of leakage.	Cylinder block	**Result:** A fault is found in the cylinder block. Repair the cylinder block or replace the cylinder block. Inspect the top deck. **Result:** No fault is found in the cylinder block. Install the cylinder head. Contact the Perkins dealer.

Coolant Level Is Low

Use this procedure when the engine coolant level is repeatedly found to be low or any of the following diagnostic codes are active:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
111-17	Engine Coolant Level : Low - least severe	The coolant level is low for 10 seconds with the engine running. The ECM has been powered for at least 2 seconds. There are no electrical faults or battery faults on the circuit.
111-18	Engine Coolant Level : Low - moderate severity	The coolant level is low for 10 seconds with the engine running. The ECM has been powered for at least 2 seconds. There are no electrical faults or battery faults on the circuit. The engine will be derated.
111-1	Engine Coolant Level : Low - most severe (3)	The coolant level is low for 60 seconds with the engine not running. The ECM has been powered for at least 2 seconds. There are no electrical faults or battery faults on the circuit. The engine will be derated.

Note: Diagnostic codes will only be present if a coolant level switch is installed.

Inspect the cooling system.

Coolant Temperature Is High

This procedure covers the following diagnostic trouble codes:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
110-15	Engine Coolant Temperature : High - least severe	The coolant temperature has been at 109° C (228° F) for 10 seconds. The ECM has been powered for at least 2 seconds. The engine has been running for at least 185 seconds. There are no electrical faults or battery faults on the circuit.
110-16	Engine Coolant Temperature : High - moderate severity	The coolant temperature has been at 111° C (232° F) for 10 seconds. The ECM has been powered for at least 2 seconds. The engine has been running for at least 185 seconds. There are no electrical faults or battery faults on the circuit.
110-0	Engine Coolant Temperature : High - most severe	The coolant temperature has been at 114° C (237° F) for 10 seconds. The ECM has been powered for at least 2 seconds. The engine has been running for at least 185 seconds. There are no electrical faults or battery faults on the circuit.
Access the monitoring system on the electronic service tool to view the current trip points for these codes.		

Probable Causes

- Diagnostic codes
- Coolant level
- Coolant temperature sensor
- Radiator and hoses

- Radiator cap and pressure relief valve
- Water temperature regulator
- Engine cooling fan (if equipped)
- Coolant quality
- Coolant pump
- Cylinder head gasket

Recommended Actions
Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes A. Use the electronic service tool to check for diagnostic codes that relate to the temperature in the cooling system.	Diagnostic Codes	**Result:** Diagnostic codes are not present. Return the unit to service. **Result:** Diagnostic codes are present. Proceed to Test Step 2.
2. Coolant Level A. Check the coolant level.	Engine coolant level	**Result:** The engine coolant level is low. Check the cooling system for leaks. Refer to Troubleshooting, “Coolant Level is Low” for additional information. Repair any leaks immediately. **Result:** The engine coolant level is OK. Proceed to Test Step 3.
3. Coolant Temperature Sensor A. Compare the reading for the coolant temperature on the electronic service tool to the reading for the coolant temperature on a calibrated test gauge.	Coolant temperature sensor	**Result:** The temperature sensor is not accurate. Troubleshoot the circuit and the coolant temperature sensor. Refer to Troubleshooting, “Sensor Signal (Analog, Passive) - Test”. **Result:** The temperature sensor is reading accurately. For engines with keel cooling, proceed to Test Step 4. For engines with raw water cooling, proceed to Test Step 5.
4. Keel Cooling System and Hoses **Note:** This Test Step is only applicable to engines with keel cooling. A. Check the cooling system for dirt, debris, and/or damage. B. Check for collapsed hoses and/or other restrictions. C. Check that the auxiliary water pump is operating correctly. D. Check the skin tank for internal blockage. E. Ensure that the skin tank size is sufficient. An undersized skin tank does not have enough area for the effective release of heat. An undersized skin tank may cause the engine to run at a temperature that is higher than normal. The normal temperature depends on the ambient water temperature.	Cooling system and hoses	**Result:** The cooling system is blocked or damaged. Remove any dirt and/or debris and repair/replace any damaged components. **Result:** The skin tank has internal blockage. Remove the blockage. **Result:** The cooling system is not damaged and the skin tank does not have an internal blockage. Proceed to Test Step 5.

5. Raw Water Cooling System and Hoses **Note:** This Test Step is only applicable to engines with raw water cooling. A. Check the cooling system for dirt, debris, and/or damage. B. Check for collapsed hoses and/or other restrictions. C. Check that the auxiliary water pump is operating correctly. D. Check the raw water inlet for blockage or restriction. E. Check the heat exchanger for internal blockage.	Cooling system and hoses	**Result:** The cooling system or the raw water inlet is blocked or damaged. Remove any dirt and/or debris and repair/replace any damaged components. **Result:** The heat exchanger has internal blockage. Remove the blockage or replace the heat exchanger. **Result:** The cooling system is not damaged and the heat exchanger does not have an internal blockage. Proceed to Test Step 6.
6. Filler Cap and Pressure Relief Valve A. Pressure-test the cooling system. B. Check that the seating surfaces of the pressure relief valve and the filler cap are clean and undamaged. C. Check operation of the pressure relief valve and/or the water temperature regulator.	Filler cap	**Result:** The pressure relief valve and/or the water temperature regulator are not operating properly. Clean the components or replace the components. **Result:** The pressure relief valve and/or the water temperature regulator are operating properly. Proceed to Test Step 7.
7. Water Temperature Regulator Check the water temperature regulator for correct operation.	Water Temperature Regulator	**Result:** The water temperature regulator is not operating correctly. Replace the water temperature regulator. **Result:** The water temperature regulator is operating correctly. Proceed to Test Step 8.
8. Coolant Quality A. Check the quality of the coolant.	Coolant	**Result:** The coolant is not of an acceptable quality. Drain and refill the coolant system with coolant of the correct quality. **Result:** The coolant is of an acceptable quality. Proceed to Test Step 9.
9. Coolant Pump A. Inspect the impeller of the coolant pump for damage and/or erosion. B. Make sure that the drive gear is not loose on the drive shaft of the coolant pump.	Coolant pump	**Result** The coolant pump is damaged or not operating correctly. If necessary, replace the coolant pump. **Result** The coolant pump is not damaged and the pump is operating correctly. Proceed to Test Step 10.
10. 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 or discolouration of the coolant. **Note:** If bubbles are present in the coolant or the coolant is discoloured, combustion gases may be entering the cooling system.	Cylinder Head gasket	**Result:** Bubbles are present in the coolant or the coolant is discoloured. Check the cylinder head gasket. Refer to the recommended action for the cylinder head gasket within Troubleshooting, “Oil Contains Coolant”. Check the cylinder head for flatness. Refer to the recommended action for checking flatness of the cylinder head. **Result:** There is no evidence of gas leakage into the cooling system. Contact the Perkins dealer.

Crankcase Breather Ejects Oil

The crankcase breather canister includes a pressure relief valve that prevents a build-up of excessive pressure in the breather canister.

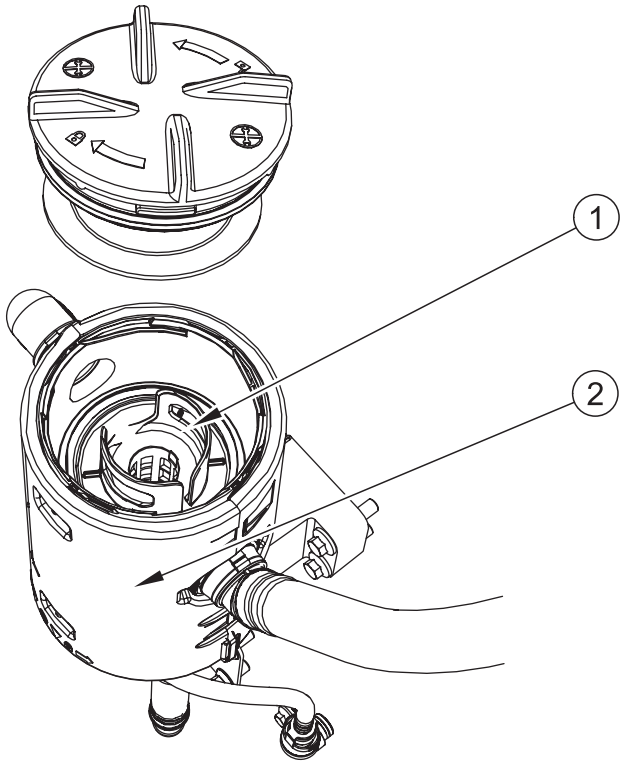
In normal operation of the engine, the pressure relief valve remains closed. If there is evidence of oil staining on the cylinder head behind the breather canister, perform the following procedure to diagnose the fault.

Probable Causes

- Breather filter
- Breather hoses
- Excessive blow-by

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.



C

(1). Filter element

(2). Breather canister

Troubleshooting Test Steps	Values	Results
1. Breather Filter A. Check that filter element (1) is correctly installed and that the element is not damaged. B. Check for restrictions or blockages in breather canister (2). **Note:** In cold ambient conditions, ice can form in the outlets of the breather canister.	Filter	**Result:** The filter element (1) is not correctly installed or the element is damaged. Install the filter element correctly or replace the filter element. **Result:** There are restrictions or blockages in the breather canister. Clean the interior of the breather canister. **Result:** The breather is clean and operating correctly. Proceed to Test Step 2.
2. Breather Hoses A. Make sure that the oil return hose from the breather canis-ter is not pinched or blocked. B. Make sure that the breather outlet hose from the breather canister is not pinched or blocked.	Hoses	**Result:** One or more of the hoses is pinched or blocked. Clear the hose or replace the hose. **Result:** All of the hoses are clear. Proceed to Test Step 3.
3. Excessive Blow-by **Note:** Excessive blow-by increases the flow of fumes through the breather system and can cause the breather filter to block. The pressure relief valve may then open. A. Check the engine for excessive blow-by.	Blow-by	**Result:** There is excessive blow-by. Replace the breather filter. Investigate the cause of the excessive blow-by. Refer to Troubleshooting, “Oil Consumption Is Excessive”. **Result:** The blow-by is not excessive. Contact the Perkins dealer.

Crankcase Fumes Disposal Tube Has Oil Draining

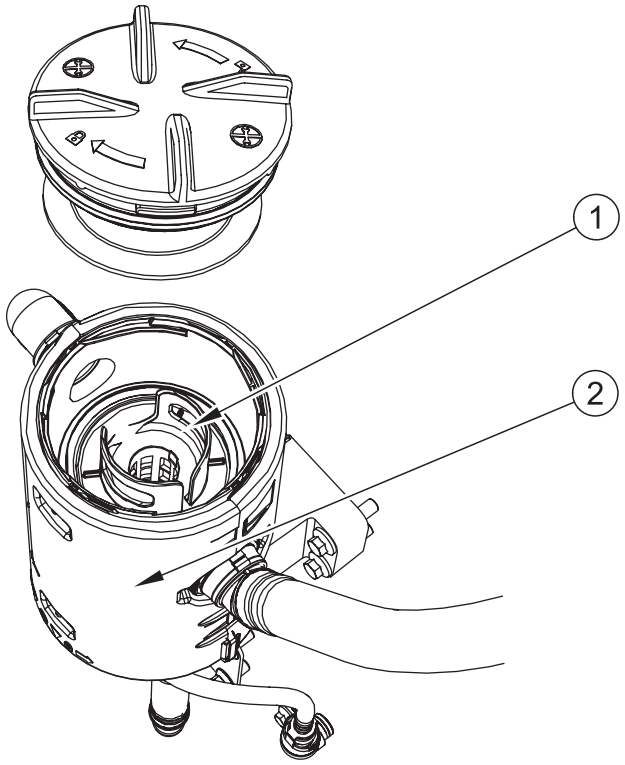
A discharge of condensation from the breather is normal. The discharge is normally clear but can contain soot. Although the discharge can contain oil vapor, any liquid oil must be limited to 0.5 g (0.02 oz) per hour. An oil discharge more than 0.5 g (0.02 oz) must be investigated.

Probable Causes

- Breather filter
- Engine oil level
- One-way valve
- Excessive blow-by

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

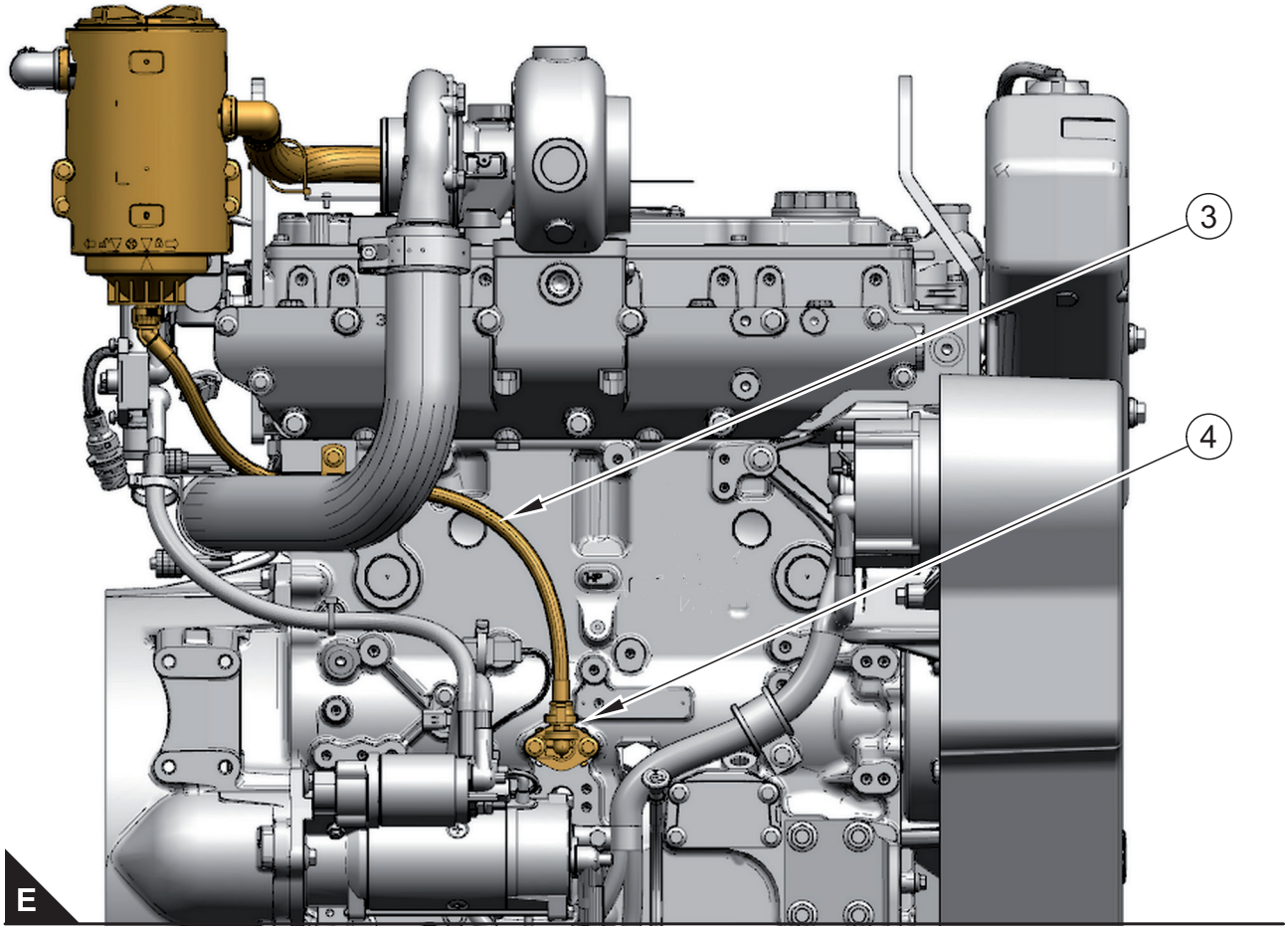


D

(1). Filter element

(2). Breather canister

Troubleshooting Test Steps	Values	Results
1. Breather Filter A. Check that filter element (1) is correctly installed and that the element is not damaged. B. Check for restrictions or blockages in breather canister (2). **Note:** If a new filter element blocks before the service period are completed, the blockage can indicate a fault in the engine. **Note:** In cold ambient conditions, ice can form in the outlets of the breather canister	Filter	**Result:** The filter element (1) is not correctly installed or the element is damaged. Install the filter element correctly or replace the filter element. **Result:** There are restrictions or blockages in the breather canister. Clean the interior of the breather canister. **Result:** The breather is clean and operating correctly. Proceed to Test Step 2.
2. Engine Oil Level A. Check the oil level in the engine.	Oil level	**Result:** The engine oil level is high. Check for contamination of the oil with fuel or coolant. Refer to Troubleshooting, “Oil Contains Fuel” or Troubleshooting, “Oil Contains Coolant”. If the engine oil is not contaminated, remove the excess oil. **Result:** The engine oil level is correct. Proceed to Test Step 3.



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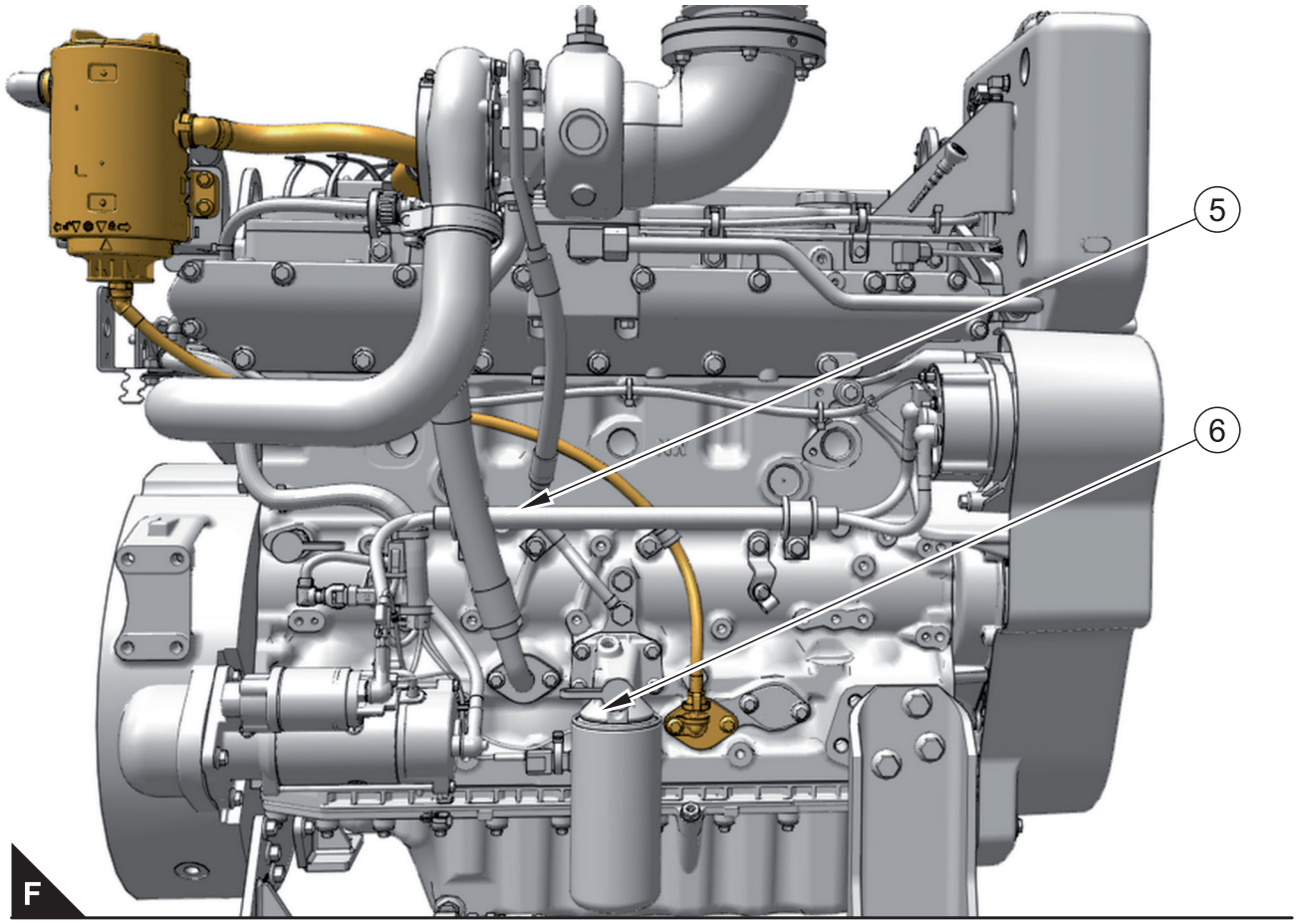
(3). Breather drain hose

(4). One-way valve



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Troubleshooting Test Steps	Values	Results
3. One-way Valve A. Disconnect breather drain hose (3) from one-way valve (4) and then remove the one-way valve from the engine. . B. Use a suitable cleaning solution to flush the one-way valve. C. Connect a low-pressure air supply breather drain hose side of the one-way valve. The air must flow freely through the valve. D. Connect a low-pressure air supply crankcase side of the one-way valve. The valve must block the airflow.	One-way valve	Result: The one-way valve does not operate correctly. Install a replacement valve. Result: The one-way valve operates correctly. Proceed to Test Step 4.
4. Excessive Blow-by **Note:** Excessive blow-by increases the flow of fumes through the breather system and can cause the breather filter to block. The pressure relief valve may then open. A. Check the engine for excessive blow-by.	Blow-by	**Result:** There is excessive blow-by. Replace the breather filter. Investigate the cause of the excessive blow-by. Refer to Troubleshooting, “Oil Consumption Is Excessive”. **Result:** The blow-by is not excessive. Contact the Perkins dealer.

Cylinder Is Noisy

Probable Causes

- Diagnostic codes
- Fuel quality
- Valve train components
- Low Compression (Cylinder Pressure)
- Injectors
- Pistons

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes A. Establish communication between the electronic service tool and the Electronic Control Module (ECM). B. Download the “Warranty Report” from the engine ECM before performing any troubleshooting or clearing diagnostic trouble codes.	Codes	**Result:** A diagnostic trouble code is active or logged. Troubleshoot the active or logged codes. **Result:** A diagnostic trouble code is not active or logged. Proceed to Test Step 2.
2. Fuel Quality A. Check the fuel quality. B. Refer to Users Handbook for information on the proper characteristics of the fuel for the engine.	Fuel	**Result:** The fuel quality is not OK. Drain the fuel system and replace the fuel filters. Fill the fuel system with fuel that meets the standard in the Users Handbook, “Fluid Recommendations”. Prime the fuel system. Refer to the Users Handbook, “Fuel System - Prime”. Verify that the procedure has eliminated the noise. **Result:** The fuel quality is OK. Proceed to Test Step 3.
3. Valve Train Components A. Check the valve lash. Refer to Troubleshooting, “Valve Lash Is Excessive”. B. Check for damage to valve train components. Remove the valve cover from the suspect cylinders. Check the following items for damage: · Valve springs · Rocker shaft · Bridges · Pushrods · Camshaft followers	Valve train	**Result:** Valve train components are damaged. Make the necessary repairs, Verify that the repair has eliminated the noise. **Result:** The valve train components are not damaged. Proceed to Test Step 4.

4. Low Compression (Cylinder Pressure) A. Perform a compression test.	Cylinder compression	**Result:** The results of the compression test are outside the specifications. Investigate the cause and rectify any faults. **Note:** 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 **Result:** The results of the compression test are OK. Proceed to Test Step 5.
5. Electronic Unit Injectors A. Use the electronic service tool to perform the automatic “Cylinder Cut Out Test” . **Note:** If the compression test that was performed in Test Step 9 was satisfactory, the “Cylinder Cut Out Test” will identify any faulty injectors.	Electronic Unit Injectors	**Result:** A faulty injector is indicated. Remove any faulty electronic unit injectors. Install new electronic unit injectors. Repeat the automatic “Cylinder Cut Out Test” . If the fault is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. **Result:** All injectors are OK. Proceed to Test Step 6.
6. Pistons A. Inspect the pistons for damage and wear.	Pistons	**Result:** One or more pistons are worn or damaged. Replace any worn or damaged parts. Verify that the repair has eliminated the noise. **Result:** All pistons are OK. Contact the Perkins dealer.

ECM Does Not Communicate with Other Modules

Probable Causes

- Electrical connectors
- Data Link
- Electronic Control Module (ECM)
- CAN data link

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 Does Not Communicate”.
2. Ensure that the following items are correctly installed and undamaged. Refer to Troubleshooting, “Electrical Connectors - Inspect”.
   - P1 and P2 connectors on the ECM
   - Wiring to display modules
   - Wiring to other control modules
3. Troubleshoot the data link for possible faults. Refer to Troubleshooting, “Data Link - Test”.
4. Verify that the CAN data link does not have an open or short circuit. Refer to Troubleshooting, “CAN Data Link - Test”.

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 “Enter Factory Passwords” dialog box.
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

For additional information, refer to Troubleshooting, “Factory Passwords”.

Electronic Service Tool Does Not Communicate

Probable Causes

- Configuration of 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

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Configuration of the Communications Adapter A. Access “Preferences” under the “Utilities” menu on the electronic service tool. B. Check for hardware that uses the same ports as the communications adaptor.	Communications adapter configuration	**Result:** The correct “Communications Interface Device” is not selected. Select the correct “Communications Interface Device” . **Result:** The correct port is not selected for use by the communication adapter. Select the correct port for use by the communication adapter. **Note:** The most commonly used port is “COM 1” . **Result:** Other hardware is sharing the same port with the communications adaptor. Exit or close the software programs for that device. **Result:** The communications adaptor is correctly configured. Proceed to Test Step 2.
2. Electrical Connectors A. Check for correct installation of the P1 and P2 ECM con-nectors and of the connector for the electronic service tool.	Electrical connectors	**Result:** The connectors are not correctly installed. Repair or replace the connectors, as necessary. **Result:** The connectors are OK. Proceed to Test Step 3.
3. Communication Adapter and/or Cables A. Check that the firmware and driver files are the most current files for the type of communication adapter that is being used. Verify that the correct cable is being used between the communication adapter and the diagnostic connector. B. Disconnect and then reconnect the cable that attaches the communication adapter to the diagnostic connector. C. Check the operating system on the laptop computer.	Comms adaptor and cables	**Result:** The firmware or driver files are not the most current files. Update the firmware or driver files to the most current files. **Result:** The cable between the communication adapter and the diagnostic connector is not correct. Replace the cable between the communication adapter and the diagnostic connector with the correct type. **Result:** The laptop computer has a Windows operating system. Restart the laptop computer in order to eliminate the possibility of a conflict in the software. **Result:** The adaptor and cables are OK. Proceed to Test Step 4.
4. Electrical Power Supply to the Diagnostic Connector A. Use a multimeter to check that battery voltage is present between terminals A and B of the diagnostic connector. **Note:** If the communication adapter is not receiving power, the LED display on the communication adapter will be off.	Electrical power	**Result:** Battery voltage is not present between terminals A and B of the diagnostic connector. Investigate the cause and repair, as necessary. **Result:** Battery voltage is present between terminals A and B of the diagnostic connector. Proceed to Test Step 5.
5. Electronic Service Tool and Related Hardware A. Connect the electronic service tool to a different engine. **Note:** This process eliminates the electronic service tool and the related hardware as the fault.	Hardware	**Result:** The same fault occurs on a different engine. Check the electronic service tool and the related hardware for faults. **Result:** The fault does not occur on a different engine. Proceed to Test Step 6

6. Electrical Power Supply to the Electronic Control Module (ECM) A. Check the power supply to the ECM. **Note:** If the ECM is not receiving battery voltage, the ECM will not communicate.	Power to ECM	**Result:** The power supply to the ECM is incorrect. Investigate the cause and repair, as necessary. **Result:** The power supply to the ECM is OK. Proceed to Test Step 7.
7. Data Link A. Troubleshoot the Data Link for possible faults. Refer to Troubleshooting, “Data Link - Test”.	Data link	**Result:** A fault was identified in the data link and the link is now OK. Return the unit to service. **Result:** The data link is OK. Contact the Perkins dealer.

Engine Cranks but Does Not Start

If possible, download the “Warranty Report” from the engine ECM before performing this procedure.

Probable Causes

- Diagnostic codes
- Visible faults
- Air intake and exhaust system
- Speed/timing sensor
- Low-pressure fuel system
- High-pressure fuel system
- Glow plugs
- Low compression (cylinder pressure)

Recommended Actions

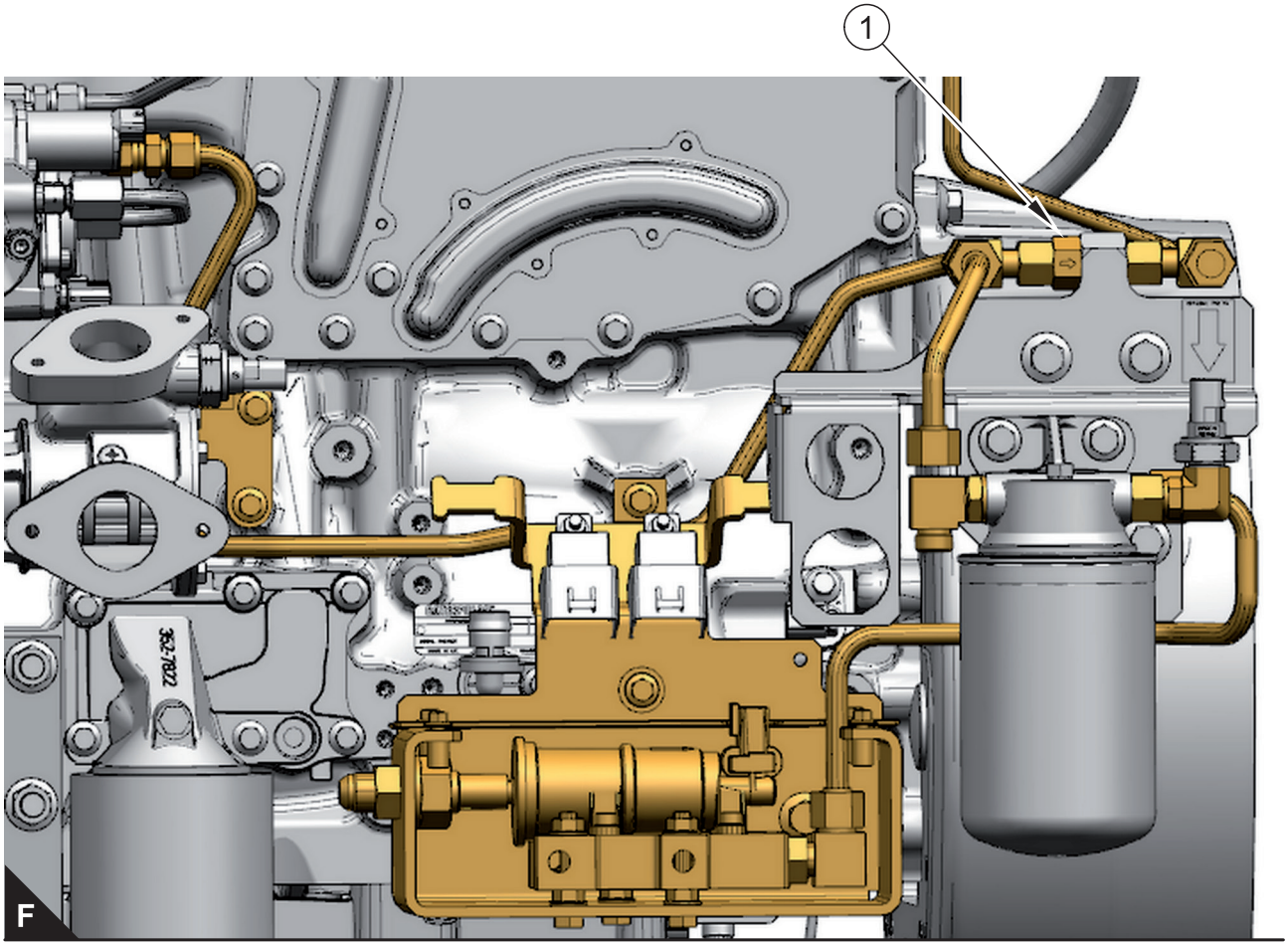
NOTICE

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.

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes A. Use the electronic service tool to check for active or logged codes.	Diagnostic codes	**Result:** A diagnostic code is present. Troubleshoot the code and then reset the histogram. **Result:** A diagnostic code is not present. Proceed to Test Step 2.
2. Visible Faults A. Check that the fuel supply valve (if equipped) is in the OPEN position. B. Check for the correct level of fuel, oil, and coolant. C. Check for water in the primary fuel filter/water separator. D. If the ambient temperature is below 0 °C (32 °F), check the specification of engine oil and oil for the machine. E. Visually inspect the engine for the following faults: • Missing components • Damaged components • Damaged electrical cables or loose electrical cables • Oil leaks • Fuel leaks • All fuel filters are correctly installed. F. Check that the battery voltage is correct. If the ambient temperature is below 0 °C (32 °F), check that the correct specification of engine oil and oil for the machine is used. G. Use the electronic service tool to check the average cranking speed of the engine.	Visible faults	**Result:** The fuel supply valve (if equipped) is not in the OPEN position. Move the fuel supply valve to the OPEN position. **Result:** The level of fuel, oil, or coolant is not correct. Replenish any fluids with an incorrect level. **Result:** Water is present in the primary fuel filter/water separator. Drain any water from the primary fuel filter/water separator. **Result:** Battery voltage is low. Check the battery. Refer to Troubleshooting, “Battery Problem”. **Result:** The correct specification of engine oil and oil for the machine is not in use. Replenish the system with oil of the correct specification for the ambient conditions. **Result:** The cranking speed is less than 150 rpm. Investigate the cause of the low cranking speed and rectify, as necessary. **Result:** All checks are OK. Proceed to Test Step 3.
3. Air Intake and Exhaust System A. Check the air filter restriction indicator, if equipped. B. Check the air intake and exhaust systems for the following defects: · Blockages · Restrictions · Damage to lines or hoses	Air and Exhaust System restrictions	**Result:** The air filter is restricted. Replace the air filter. **Result:** There are system restrictions. **Result:** The air intake and exhaust system are OK. Proceed to Test Step 4.
4. Speed/Timing Sensors A. Crank the engine and observe the engine speed on the electronic service tool status screen. Refer to Troubleshooting, “Speed/Timing - Test” for additional information. Upon initial cranking, the status for engine speed may indicate that the engine speed signal is abnormal. This message will be replaced with an engine speed once the ECM is able to calculate a speed from the signal.	Speed/timing sensor	**Result:** The speed/timing sensors are not operating correctly. Test the speed/timing sensors. Refer to Troubleshooting, “Speed/Timing - Test”. **Result:** The speed/timing sensors are operating correctly. Proceed to Test Step 5.

5. Low-Pressure Fuel System A. Visually check the fuel tank for fuel. Note: The fuel gauge may be faulty. B. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax). C. Check for fuel supply lines that are restricted or not correctly installed. E. Check for air in the fuel system and that the fuel system is primed. D. Check the diesel fuel for contamination.	Low-pressure fuel system	**Result:** The fuel tank level is low. Fill the fuel tank. **Result:** The fuel contains solidified wax. Replace the fuel with fuel of the correct specification for the ambient conditions. **Result:** There are fuel supply lines that are restricted or not correctly installed. Install the fuel lines correctly. Replace any damaged or restricted fuel lines. Replace the primary fuel filter and the secondary fuel filters. **Result:** There is air in the fuel system. Prime the fuel system. **Result:** The diesel fuel is contaminated. Drain the fuel tank and the fuel system. Replace the primary fuel filter and the secondary fuel filters. Refer to the Users Handbook for further information. Fill and prime the fuel system with fuel of the correct specification. **Result:** The low-pressure fuel system is OK. Proceed to Test Step 6.



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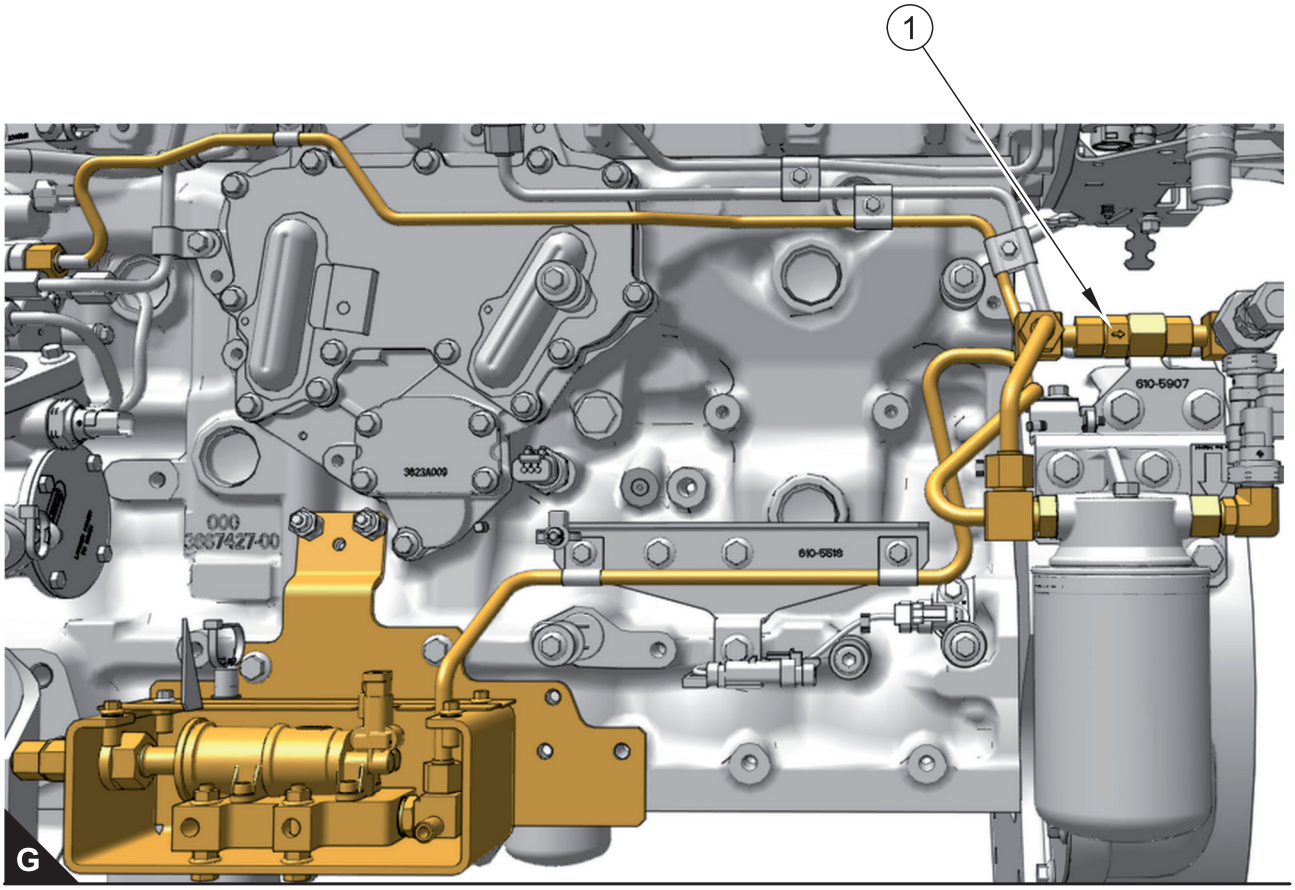
(1). Electric Fuel Lift Pump Pressure Regulator



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(1). Electric Fuel Lift Pump Pressure Regulator

Troubleshooting Test Steps	Values	Results
6. Electric Fuel Lift Pump (EFLP) Pressure Regulator Flow Test A. Disconnect the EFLP return line from the drain port on the EFLP. Install a suitable blanking cap on the open port in the EFLP return line. B. Connect a temporary drain line to the drain port on the EFLP. C. Place the end of the temporary drain line into a suitable calibrated container. D. With the isolator switch in the ON position but the engine not running, use a suitable multimeter to measure the input voltage to the EFLP. Record the reading. E. With the isolator switch in the ON position but the engine not running, measure the fuel flow from the temporary drain line. F. For a 12 VDC system, refer to Installation Guide for the minimum acceptable flow rate. G. For a 24 VDC system, refer to Installation Guide for the minimum acceptable flow rate. H. Remove the temporary drain line from the drain port on the EFLP. Connect the EFLP return line to the EFLP.	EFLP flow rate	**Result:** The fuel flow is greater than the minimum limit. Proceed to Test Step 9. **Result:** The fuel flow is less than the minimum limit. Proceed to Test Step 7.
7. Check the Return Fuel Lines A. Make sure that the EFLP return line is not blocked or kinked. B. If the EFLP return line is clear, confirm that the Electric Fuel Lift Pump (EFLP) is operating. Make sure that fuel lines be-tween the EFLP and the EFLP pressure regulator are not blocked or kinked.	Return lines	**Result:** The EFLP return line or the fuel lines between the EFLP and the EFLP regulator are blocked or kinked. Clear or replace the blocked line. **Result:** The EFLP return line and the fuel lines between the EFLP and the EFLP pressure regulator are clear. Replace the EFLP. If the fault is still present, proceed to Test Step 8.

8. High-Pressure Fuel System A. Use the electronic service tool to check the absolute fuel rail pressure while the engine is cranking at a minimum speed of 150 rpm.	High-pressure fuel system	**Result:** The absolute fuel rail pressure is less than 25 MPa (3625 psi). Check for fuel leaks in the high-pressure fuel system. Rectify any fuel leaks and then recheck the pressure in the fuel rail. Use the electronic service tool to perform a solenoid test on the fuel injection pump. Refer to Troubleshooting, “Solenoid Valve - Test”. Check the Pressure Limiting Valve (PLV) in the fuel rail for leakage. If the valve is leaking, replace the valve and re-check the pressure in the fuel rail. 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 the Users Handbook, “Engine Oil Sample - Obtain”. If the analysis confirms that there is fuel in the engine oil system, investigate the cause. **Result:** The absolute fuel rail pressure is greater than 25 MPa (3625 psi). 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 have not been intentionally disabled, proceed to Test Step 9. Use the electronic service tool to perform an injector solenoid test. Refer to Troubleshooting, “Injector Solenoid Circuit - Test”. If the engine will not start, proceed to Test Step 11.
9. Electronic Control Module (ECM) Make sure that the latest flash file for the application is installed in the ECM.	ECM	**Result:** Installation of the latest flash file does not eliminate the fault. Contact the Perkins dealer. **Note:** This consultation can greatly reduce the repair time. If the dealer recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”. Attempt to start the engine. If the engine will not start, install the original ECM and then proceed to Test Step 10. If the engine starts normally, reconnect the suspect ECM and then verify that the fault returns when the suspect ECM is installed. If the engine will not start with the suspect ECM, replace the ECM and then check that the engine starts normally.

10. High-Pressure Fuel Pump A. Check the timing of the high-pressure fuel pump.	HP fuel pump	**Result:** The timing of the high-pressure fuel pump is incorrect. Correct the timing of the high-pressure fuel pump. With the high-pressure fuel pump correctly timed, check that the engine starts normally. If the engine will not start, proceed to Test Step 11. Result: The timing of the high-pressure fuel pump is correct. Replace the high-pressure fuel pump. Check that the engine starts normally. If the engine will not start, proceed to Test Step 11.
11. Glow Plugs **Note:** Faulty glow plugs will only affect engine starting when the ambient temperature is between 5° C (41° F) and −25° C (−13° F). A. Check the operation of the glow plugs. Refer to Trouble-shooting, “Glow Plug Starting Aid - Test”.	Glow plugs	**Result:** One or more of the glow plugs are faulty. Replace any faulty glow plugs. Check that the engine starts normally. If the engine will not start, proceed to Test Step 12.
12. Low Compression (Cylinder Pressure) A. Perform a compression test.	Cylinder compression	**Result:** The results of the compression test are outside the specifications. Investigate the cause and rectify any faults. **Note:** 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 **Result:** The results of the compression test are OK. Contact the Perkins dealer.

Engine Does Not Crank

Probable Causes

- Battery cables and batteries
- Switches and/or circuit breakers
- Starting motor relay, solenoid, and starting circuit
- Starting motor and/or flywheel ring gear
- Engine accessories and generator
- Hydraulic lock

Recommended Repairs
Complete the procedure in the order in which the steps are listed.

Troubleshooting Test Steps	Values	Results
1. Battery Cables and Batteries A. Inspect the main power switch, battery posts, and battery cables for loose connections and for corrosion. If the battery cables are corroded, remove the battery cables and clean the battery cables. Tighten any loose connections. B. Inspect the batteries. C. Charge the batteries. Test the batteries.	Batteries and cables	**Result:** The batteries and cables are not OK. Make the necessary repairs. **Result:** The batteries and cables are OK. Proceed to Test Step 2.
2. Switches and/or Circuit Breakers A. Check any switches and/or circuit breakers that may interfere with the engine cranking. Refer to the electrical schematic for additional information.	Switches and/or circuit breakers	**Result:** The switches and/or circuit breakers are not OK. Make the necessary repairs. **Result:** The switches and/or circuit breakers are OK. Proceed to Test Step 3.
3. Starting Motor Relay, Solenoid, and Starting Circuit A. Test the operation of the starting motor circuit.	Starting motor relay, solenoid, and circuit	**Result:** The starting motor relay, solenoid, or starting circuit are not OK. Make the necessary repairs. **Result:** The starting motor solenoid and circuit are OK. Proceed to Test Step 4.
4. Starting Motor and/or Flywheel Ring Gear A. Test the operation of the starting motor. B. Check the wiring for the starting motor. C. Check the pinion clearance. Inspect the pinion and the fly-wheel ring gear for damage.	Starter pinion and flywheel ring gear are OK	**Result:** The starter pinion and flywheel ring gear are not OK. Make the necessary repairs. **Result:** The starting motor and flywheel ring gear are OK. Proceed to Test Step 5.
5. Engine Accessories and Generator A. Ensure free movement of the driveline. B. Remove and inspect any engine accessories that may lock up the engine. The following list contains examples of engine accessories that may lock up the engine: · Hydraulic pump that is driven from the rear gear group · Air compressor · Engine oil pump · Other components that are driven by the engine	Engine accessories and transmission	**Result:** The engine accessories or generator are not OK. Make the necessary repairs. **Result:** The engine accessories and generator are OK. Proceed to Test Step 6.

6. Hydraulic Lock **Note:** If an injector has been replaced, evacuate any fluids from the cylinder and attempt to start the engine. Fuel will flow from the cylinder head into the cylinders when a unit injector is removed. A. Check for fluid in the cylinders by removing the individual unit injectors. Check for damaged seals. B. If there was excessive fuel in the cylinder, replace the seals and reinstall the injector. Drain any excess fuel from the cylinder head. C. If a mechanical problem is suspected, disassemble the engine. · Seizure · Broken components · Bent components	Hydraulic lock	**Result:** The engine has a hydraulic lock. Make the necessary repairs. **Result:** The engine rotates freely. Contact the Perkins dealer.

Engine Has Early Wear

Probable Causes

- Incorrect maintenance intervals and/or incorrect oil
- Contaminated engine oil
- Low oil pressure
- Leaks in air intake system
- Dirt in fuel

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Incorrect Maintenance Intervals and/or Incorrect Oil A. Use engine oil that is recommended and change the engine oil at the interval that is recommended by the engines Users Handbook	Maintenance intervals	**Result:** The engine oil was not changed at the interval that is recommended by the Users Handbook. Use the recommended grade of oil. Change the engine oil at the interval that is recommended. Repair or replace any damaged parts. **Result:** The engine oil was changed at the interval that is recommended by the Users Handbook. Proceed to Test Step 2.

2. Contaminated Engine Oil A. Obtain an S-O-S (Schedule Oil Sampling) oil analysis. The analysis will identify oil contamination. B. Check the oil filter bypass valve. **Note:** If the oil filter bypass valve is open, the oil will not be filtered.	Contamination	**Result:** The oil is contaminated. Determine the reason for any contamination of the engine oil and make the necessary repairs. Drain the crankcase and refill the crankcase with clean engine oil. Install new engine oil filters. **Result:** The oil filter bypass valve is open. Replace the oil filter element. Check the oil filter bypass valve for a weak spring or for a broken spring. If the spring is broken, replace the spring. Verify that the oil bypass valve is operating correctly. **Result:** The oil is not contaminated. Proceed to Test Step 3.
3. Low Oil Pressure **Note:** Engine oil that is contaminated with another liquid can cause low engine oil pressure. High engine oil level can be an indication of contamination. A. Obtain an analysis of the engine oil. B. Check the inlet screen on the suction tube and remove any material that may be restricting engine oil flow. **Note:** The inlet screen of the suction tube for the engine oil pump can have a restriction. This restriction will cause cavitation and a loss of engine oil pressure. When some components of the engine show wear in a short time, the cause can be a restriction in a passage for engine oil. An indicator for the engine oil pressure may indicate sufficient pressure, but a component is worn due to a lack of lubrication. In such a case, look at the passage for the engine oil supply to the component.	Oil pressure	**Result:** Analysis indicates that the oil is contaminated. Replace the oil and the oil filter. **Result:** The inlet tube has a restriction. Clear the obstruction. Verify the repair. **Result:** The oil pressure is low. Refer to Troubleshooting, “Oil Pressure Is Low” for the testing procedure. Repair any identified faults.. **Result:** The oil pressure is normal. Proceed to Test Step 4.
4. Leaks in Air Intake System **Note:** A leak in the air intake system may allow unfiltered air into the engine. A. Inspect the air intake system for streaks which may indicate a leakage of unfiltered air. Inspect all of the gaskets and the connections.	Air leak	**Result:** There are air leaks. Repair any leaks. **Result:** There are no air leaks. Proceed to Test Step 5.
5. Dirt in Fuel A. Remove the fuel filters. Inspect the fuel filters for contamination. **Note:** Contaminants in the fuel such as hydrogen sulfide and sulphur can lead to the formation of acids in the crankcase. B. Obtain a fuel analysis.	Fuel and fuel filters	**Result:** The fuel has contamination. Determine the cause of any contamination and make the necessary repairs. Install new fuel filters. **Result:** The fuel is not contaminated. Contact the Perkins dealer.

Engine Has Mechanical Noise (Knock)

Probable Causes

- Diagnostic codes
- Electrical connections
- Fuel injection
- Fuel quality
- Correct lubrication
- Isolate the source of the noise.
- Valve train components
- Gear train and lower end components
- Crankshaft

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes A. Establish communication between the electronic service tool and the Electronic Control Module (ECM). Refer to Troubleshooting, “Electronic Service Tools”, if necessary. B. Download the “Warranty Report” from the engine ECM before performing any troubleshooting or clearing diagnostic trouble codes.	Diagnostic codes	**Result:** There are active codes. Troubleshoot any active codes before continuing with this procedure. **Result:** There are no active codes. Proceed to Test Step 2.
2. Electrical Connections A. Check for the correct installation of the ECM P1 and P2 connectors. Check for correct installation of the fuel injector connectors.	Connectors	**Result:** There are suspect connectors. Repair connectors that are suspect or replace connectors that are suspect. Perform the “Wiggle Test” on the electronic service tool **Result:** There are no suspect connectors. Proceed to Test Step 3.
3. Fuel Injection A. Perform the “Fuel System Verification Test” in the “Diagnostic Tests” under the “Diagnostics” menu.	Fuel System Verification Test	**Result:** The test was not successful. Diagnose the fault and then repair the fault. Reset all active codes and clear all logged codes. Verify that the repair has eliminated the noise. **Result:** The test was successful. Proceed to Test Step 4.

4. Fuel Quality A. Obtain a fuel analysis in order to confirm that the correct fuel is being used for the engine.	Fuel	**Result:** The fuel quality is not OK. Replace the fuel. Verify that the repair eliminated the noise. **Result:** The fuel quality is OK. Proceed to Test Step 5.
5. Correct Lubrication A. Check for correct lubrication of the valve components. Check for sufficient lubrication between the injector tappets and the rocker arms. B. Check for blocked oil passages. Oil passages must be clean. Clean any oil passages that are questionable. C. Inspect the engine oil filters for ferrous material. D. Obtain an S-O-S (Schedule Oil Sampling) oil analysis. The analysis will contribute to a better understanding of oil contamination and the origin of the contamination.	Lubrication	**Result:** The oil passages are blocked or the engine does not have correct lubrication. Make the necessary repairs, Verify that the repair eliminated the noise. **Result:** The oil passages are not blocked and the engine has proper lubrication. Proceed to Test Step 6.
6. Isolate the Source of the Noise A. Attempt to isolate the source of the noise.	Engine accessory	**Result** An engine accessory is the source of the noise. Repair the engine accessory and/or replace the engine accessory, as necessary. **Result** An engine accessory is not the source of the noise. Proceed to Test Step 7.
7. Valve Train Components A. Check the valve lash. B. Check for damage to valve train components. Remove the valve cover. Check the following items for damage: • Camshaft • Valve springs • Camshaft followers • Rocker shaft • Bridges • Pushrods • C. Check for valves that do not move freely. If necessary, remove the cylinder head and inspect the valves.	Valve train	**Result:** The valve train components are damaged. Make the necessary repairs, Verify that the repair eliminated the noise. **Result:** The valve train components are not damaged. Proceed to Test Step 8.
8. Gear Train and Components of the Lower End A. Inspect the gear train and lower end components.	Gear train	**Result:** The gear train or lower end components are damaged. Replace any damaged parts. **Result:** The gear train or lower end components are not damaged. Proceed to Test Step 9.

9. Crankshaft A. Inspect the crankshaft and the related components. Look for worn thrust plates and wear on the crankshaft. B. Inspect the connecting rod bearings and the bearing surfaces on the crankshaft. Make sure that the bearings are in the correct position.	Crankshaft	**Result:** The crankshaft or the related components are damaged or worn. Repair or replace any damaged parts. Verify that the repair eliminated the noise. **Result:** The crankshaft or the related components are not damaged or worn. Contact the Perkins dealer.

Engine Misfires, Runs Rough or Is Unstable

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

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

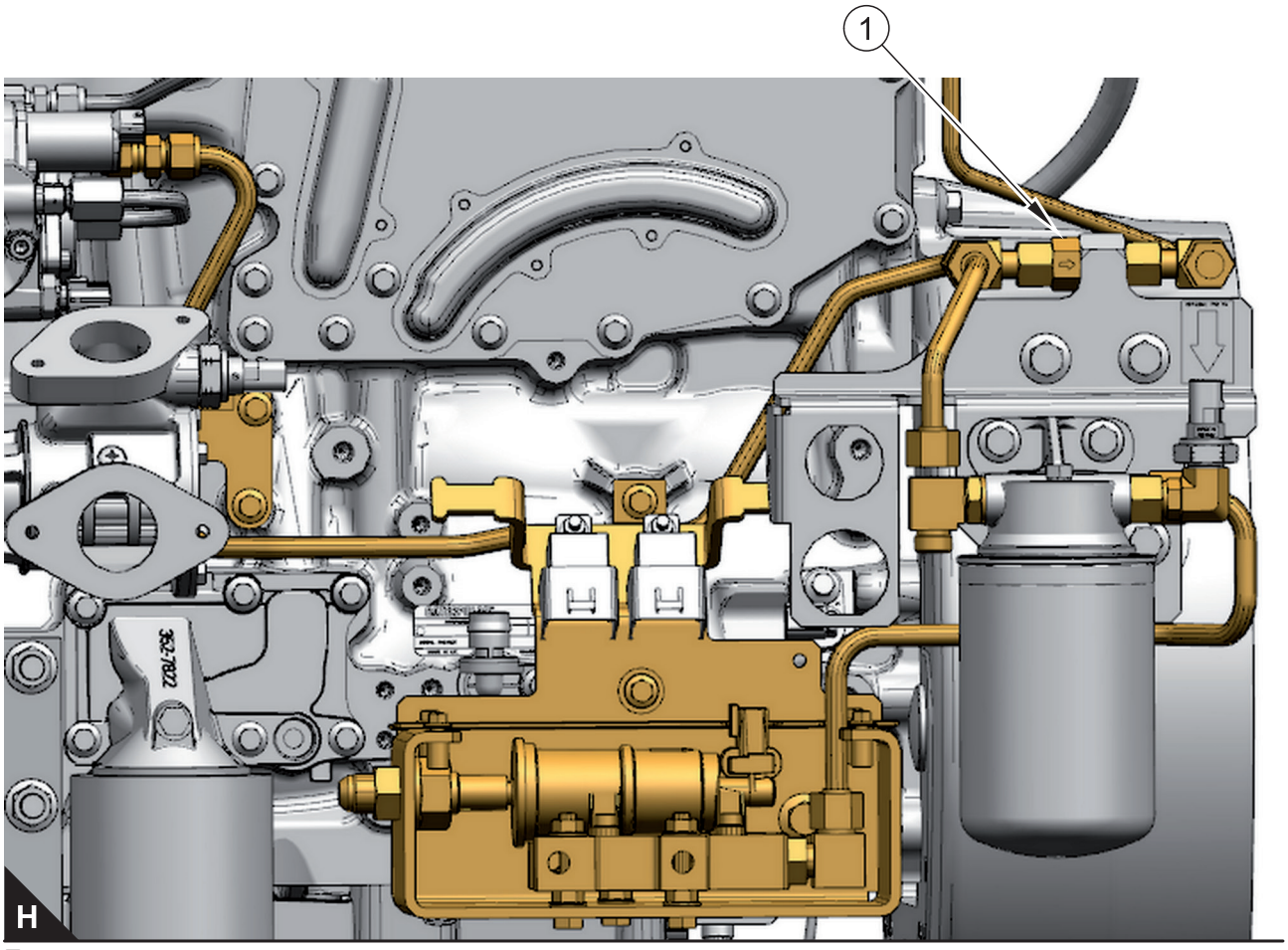
- Diagnostic codes
- Fuel supply
- High-pressure fuel pump SCV
- High-pressure fuel pump
- Low compression (cylinder pressure)
- Electronic unit injectors
- Individual malfunctioning cylinder

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

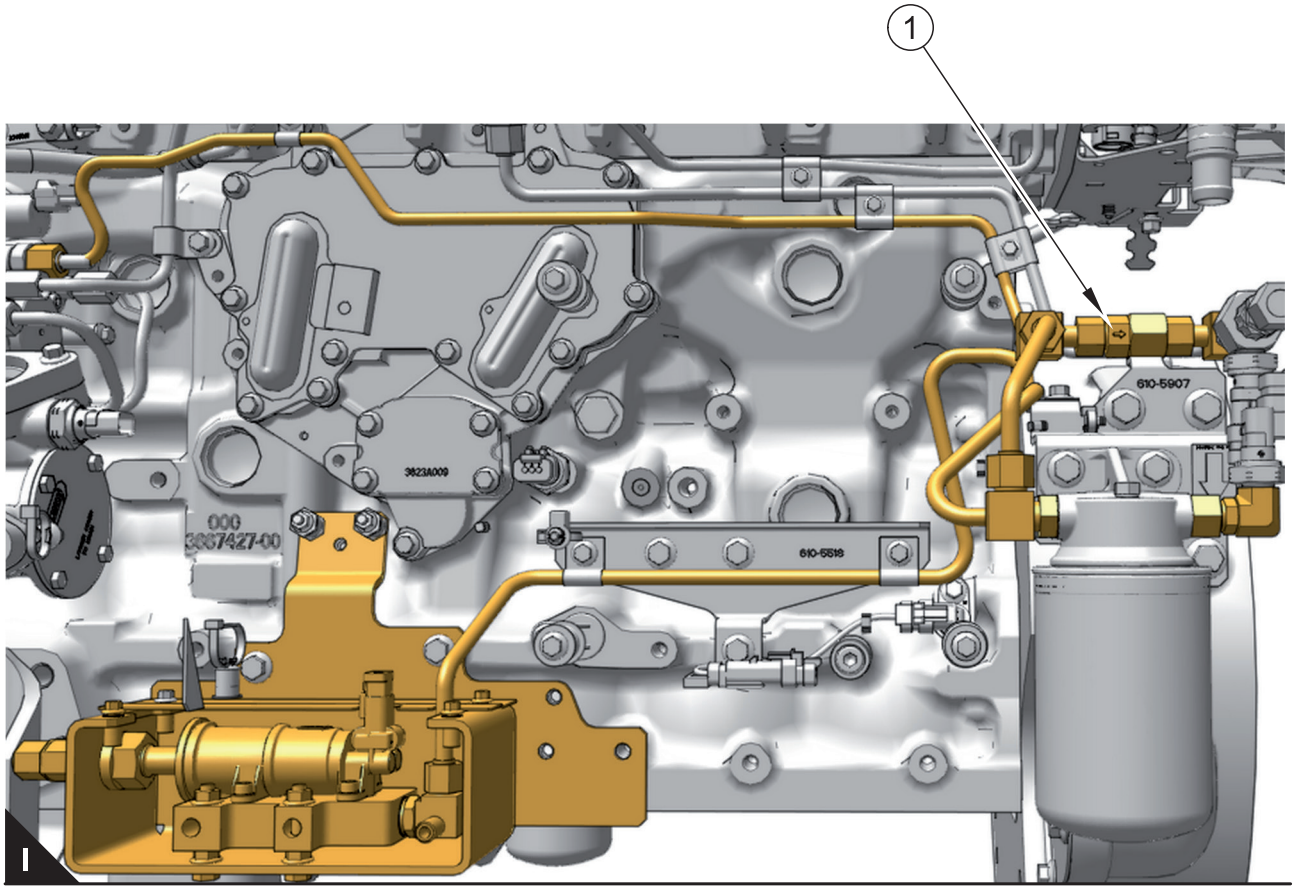
Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes A. Establish communication between the electronic service tool and the Electronic Control Module (ECM). Refer to Troubleshooting, “Electronic Service Tools”, if necessary. B. Download the “Warranty Report” from the engine ECM before performing any troubleshooting or clearing diagnostic trouble codes.	Codes	**Result**: There are active codes. Troubleshoot any active codes before continuing with this procedure. **Result:** There are no active codes. Proceed to Test Step 2.

2. Fuel Supply A. Visually check the fuel tank for fuel. The fuel gauge may be faulty. B. Ensure that the fuel supply valve (if equipped) is in the full OPEN position. C. Check the primary filter/water separator for water in the fuel. D. Check for fuel supply lines that are restricted. E. Check for air in the fuel system. F. Obtain a fuel analysis to confirm that the correct fuel is being used.	Fuel supply	**Result:** There is air in the fuel system. Prime the fuel system. **Result:** The fuel quality is not OK. Replace the fuel. Replace the primary and secondary fuel filters. Verify that the repair eliminated the fault. **Result:** The fuel quality is OK. Proceed to Test Step 3.



E44

(1). Electric Fuel Lift Pump Pressure Regulator



E70B

(1). Electric Fuel Lift Pump Pressure Regulator

Troubleshooting Test Steps	Values	Results
3. Electric Fuel Lift Pump Pressure (EFLP) Regulator Flow Test A. Disconnect the EFLP return line from the drain port on the EFLP. Install a suitable blanking cap on the open port in the TPIR return line. B. Connect a temporary drain line to the drain port on the EFLP. C. Place the end of the temporary drain line into a suitable calibrated container. D. With the isolator switch in the ON position but the engine not running, use a suitable multimeter to measure the input voltage to the EFLP. Record the reading. E. With the isolator switch in the ON position but the engine not running, measure the fuel flow from the temporary drain line. H. Remove the temporary drain line from the drain port on the EFLP. Connect the EFLP return line to the EFLP.	EFLP flow rate	**Result:** The fuel flow is greater than the minimum limit. Proceed to Test Step 6. **Result:** The fuel flow is less than the minimum limit. Proceed to Test Step 4.
4. Return Pressure Relief Valve Test A. Disconnect the return line from the secondary fuel filter base and install a blank on the line. Install a temporary line and a calibrated container to the filter base. B. With the isolator switch in the ON position, measure fuel flow from the temporary line. C. If the fuel flow is more than 300 mL/min (10.2 oz/min), replace the secondary fuel filter base. D. Remove the temporary line and reconnect the return line. E. If the secondary fuel filter base has been replaced, attempt to start the engine. If the engine does not start, use the following procedure to check the fuel flow from the EFLP: F. Disconnect the fuel inlet from the primary fuel filter. Place the open end of the disconnected line into a calibrated container. G. With the isolator switch in the ON position, measure the flow from the fuel line.	PRV test	**Result:** The fuel flow is more than 5% below the accept-able limit. Replace the EFLP. **Result:** The fuel flow is more than 5% above the accept-able limit. Contact the Perkins dealer. **Result:** The fuel flow is within the acceptable limit. Proceed to Test Step 5.
5. Check the Return Fuel Lines A. Make sure that the EFLP return line is not blocked or kinked. B. If the EFLP return line is clear, confirm that the Electric Fuel Lift Pump (EFLP) is operating. Make sure that fuel lines on the EFLP are not blocked or kinked.	Return lines	**Result:** The EFLP return line or the fuel lines on the EFLP are blocked or kinked. Clear or replace the blocked line. **Result:** The EFLP return line or the fuel lines on the EFLP are clear. Replace the EFLP. If the fault is still present, proceed to Test Step 6.

6. High-Pressure Fuel Pump SCV A. Use the electronic service tool to perform a solenoid test on the fuel injection pump. Refer to Troubleshooting, “Solenoid Valve -Test”.	HP fuel pump SCV	**Result:** The solenoid valve test fails. Replace the HP fuel pump SCV and solenoid assembly. **Result:** The solenoid valve test passes successfully. Proceed to Test Step 7.
7. High-Pressure Fuel Pump **Note:** The fuel injection pump that is installed by the factory is a non-serviceable item. If any fault occurs within the fuel injection pump, the fuel injection pump must be replaced. A. Use the electronic service tool to select the correct screen to display any diagnostic trouble codes that relate to the fuel injection pump.	HP fuel pump	**Result:** There are diagnostic codes associated with the high-pressure fuel pump. Diagnose the codes. Refer to Troubleshooting, “Trouble-shooting with a Diagnostic Code”. If necessary, replace the high-pressure fuel pump. **Result:** The high-pressure fuel pump is OK. Proceed to Test Step 8.
8. Low Compression (Cylinder Pressure) A. Perform a compression test.	Cylinder compression	**Result:** The results of the compression test are outside the specifications. Investigate the cause and rectify any faults. **Note:** Possible causes of low compression are shown in the following list: · loosen glow plugs · Faulty piston · Faulty piston rings · Worn cylinder bores · Worn valves · Faulty cylinder head gasket · Damaged cylinder head **Result:** The results of the compression test are OK. Proceed to Test Step 9.
9. Electronic Unit Injectors A. Use the electronic service tool to perform the automatic “Cylinder Cut Out Test” . **Note:** If the compression test that was performed in Test Step 8 was satisfactory, the “Cylinder Cut Out Test” will identify any faulty injectors.	Electronic Unit Injectors	**Result:** A faulty injector is indicated. Remove any faulty electronic unit injectors. Install new electronic unit injectors. Repeat the automatic “Cylinder Cut Out Test” . If the fault is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. Result: All injectors are OK. Proceed to Test Step 10.
10. Individual Malfunctioning Cylinders A. With the engine speed at a fast idle, use the electronic service tool to perform the manual “Cylinder Cut Out Test” . As each cylinder is cut out, listen for a change in the sound from the engine. When a cylinder is cut out, there should be a notice-able change in the sound of the engine. If a change in the sound of the engine is not noted, the isolated cylinder is not operating under normal conditions. If the isolation of a cylinder results in a change in the sound that is less noticeable, the cylinder may be operating below normal performance.	Cylinders	**Result:** The test indicates a faulty cylinder. 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. **Result:** The test indicates that all cylinders are OK. Contact the Perkins dealer.

Engine Overspeeds

This procedure covers the following diagnostic trouble code:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
190-15	Engine Overspeed Warning - Level 1	The engine has exceeded the value that is programmed into the Electronic Control Module (ECM) for 0.6 seconds. There are no diagnostic trouble codes for the speed/timing sensors. The engine has been running for at least 3 seconds.
190-0	Engine Overspeed Warning - Level 3	The engine has exceeded the value that is programmed into the Electronic Control Module (ECM) for 0.6 seconds. There are no diagnostic trouble codes for the speed/timing sensors. The engine has been running for at least 3 seconds. The engine may shut down.

The ECM limits the flow of fuel in order to prevent the engine speed from exceeding the value that is programmed into the ECM. When the engine speed has dropped to less than the value that is programmed into the ECM, the 190-XX code will be reset.

If the engine speed exceeds the value that is programmed into the ECM, the ECM illuminates the warning lamp and a 190-XX code is logged. Factory passwords are required in order to clear the code.

The history of engine overspeeds can be viewed on the electronic service tool.

Probable Causes

- Turbocharger
- Combustible gases or liquid in the intake air

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Turbocharger **Note:** The turbocharger that is installed on the engine is a nonserviceable item. If any mechanical fault exists, then the faulty turbocharger must be replaced. A. Check for any oil that may be leaking into the intake air.	Turbocharger	**Result:** The turbocharger is leaking oil into the intake air. Replace the turbocharger. **Result:** The turbocharger is not leaking oil into the intake air. Proceed to Test Step 2.

2. Combustible Gases or Liquid in the Intake Air A. Check for combustible gases in the surrounding atmosphere. B. Check for combustible liquid in the air intake. C. Check for correct operation of the ether starting aid (if equipped).	Air quality	**Result:** The atmosphere has combustible gases. Do not operate the engine in an environment with combustible gases. **Result:** There is combustible liquid in the air intake. Remove the liquid. Investigate and rectify the cause of liquid ingestion **Result:** The intake air does not contains combustible gases. Contact the Perkins dealer.

Engine Shutdown Occurs Intermittently

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
- Switches

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes **Note:** Certain diagnostic codes and/or event codes may cause an engine shutdown. A. Connect the electronic service tool and check for active codes and for logged codes.	Codes	**Result:** There are active codes. Troubleshoot any active codes before continuing with this procedure. **Result:** There are no active codes. Proceed to Test Step 2.
2. Electrical Connectors A. Check for the correct installation of the ECM J1/P1 and the J2/P2 connectors. Check for correct installation of the fuel injector connectors.	Connectors	**Result:** There are suspect connectors. Use the electronic service tool to perform the “Wiggle Test” . Repair connectors that are suspect or replace connectors that are suspect. **Result:** There are no suspect connectors. Proceed to Test Step 3.

3. Fuel Supply A. Ensure that the vent in the fuel cap is not filled with debris. B. Ensure that the fuel supply valve (if equipped) is in the full OPEN position. C. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax). D. Check the primary filter/water separator for water in the fuel. E. Check for fuel supply lines that are restricted. F. Check the diesel fuel for contamination. G. Check for air in the fuel system.	Fuel system	**Result:** The fuel supply is not OK. Service the fuel system or repair the fuel system components, as necessary. **Result:** The fuel supply is OK. Proceed to Test Step 4.
4. Switches A. Check the isolator switch input to the ECM. B. Check any engine shutdown switches and associated wiring.	Switches	**Result:** The shutdown switches and wiring are not OK. Make the necessary repairs, Verify that the repair eliminated the fault. **Result:** The shutdown switches and wiring are OK. Contact the Perkins dealer.

Engine Top Speed Is Not Obtained

Note: If this fault occurs only under load, refer to Troubleshooting, “Acceleration Is Poor or Throttle Response Is Poor”.

Probable Causes

- Diagnostic codes
- ECM parameters
- Air intake and exhaust system
- Fuel supply
- Low compression (cylinder pressure)
- Electronic unit injectors
- Individual malfunctioning cylinders

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes A. Establish communication between the electronic service tool and the Electronic Control Module (ECM). Refer to Troubleshooting, “Electronic Service Tools”, if necessary. B. Download the “Warranty Report” from the engine ECM before performing any troubleshooting or clearing diagnostic trouble codes. Troubleshoot any active codes before continuing with this procedure.	Diagnostic codes	**Result:** There are active or logged codes. Troubleshoot any codes before continuing with this procedure. **Result:** There are no active or logged codes. Proceed to Test Step 2.
2. ECM Parameters A. Use the electronic service tool to verify that the correct engine parameters are being used. Refer to Troubleshooting, “System Configuration Parameters” and Troubleshooting, “Customer Configuration Parameters” for additional information.	Parameters	**Result:** The parameters are not configured correctly. Correctly configure the parameters. Verify that the configuration change eliminated the fault. **Result:** The parameters are configured correctly. Proceed to Test Step 3.
3. Air Intake and Exhaust System A. Check the air filter restriction indicator, if equipped. Clean plugged air filters or replace plugged air filters. Refer to the Users Handbook. B. Check the air inlet and exhaust system for restrictions and/or leaks.	Restrictions	**Result:** The air filter is plugged. Clean or replace the air filter. Refer to the Users Handbookl for further information. **Result:** There are restrictions in the air inlet or exhaust system. Make the necessary repairs, Verify that the repair eliminated the fault. **Result:** There are no restrictions in the air inlet or exhaust system. Proceed to Test Step 4.
4. Fuel Supply A. Ensure that the vent in the fuel cap is not filled with debris. B. Ensure that the fuel supply valve (if equipped) is in the full OPEN position. C. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax). D. Check the primary filter/water separator for water in the fuel. E. Check for fuel supply lines that are restricted. F. Replace the primary and secondary fuel filters. G. Check the diesel fuel for contamination. H. Check for air in the fuel system.	Fuel system	**Result:** The fuel contains solidified wax. Replace the fuel with fuel of the correct specification for the ambient conditions. **Result:** There are fuel supply lines that are restricted. Replace any damaged or restricted fuel lines. Replace the primary fuel filter and the secondary fuel filters. Refer to the Users Handbook for further information. **Result:** There is air in the fuel system. Prime the fuel system. **Result:** The diesel fuel is contaminated. Drain the fuel tank and the fuel system. Replace the primary fuel filter and the secondary fuel filters. Refer to the Users Handbook for further information. Fill and prime the fuel system with fuel of the correct specification. **Result:** The fuel supply is OK. Proceed to Test Step 5.

5. Electric Fuel Lift Pump (EFLP) Flow Test A. Disconnect the EFLP return line from the drain port on the EFLP. Install a suitable blanking cap on the open port in the EFLP return line. B. Connect a temporary drain line to the drain port on the EFLP. C. Place the end of the temporary drain line into a suitable calibrated container. D. With the isolator switch in the ON position but the engine not running, use a suitable multimeter to measure the input voltage to the EFLP. Record the reading. E. With the isolator switch in the ON position but the engine not running, measure the fuel flow from the temporary drain line. F. For a 12 VDC system. For fuel flow rates refer to the Installation Guide G. For a 24 VDC system. For fuel flow rates refer to the Installation Guide H. Remove the temporary drain line from the drain port on the EFLP. Connect the EFLP return line to the EFLP.	EFLP flow rate	**Result:** The fuel flow is greater than the minimum limit. Proceed to Test Step 8. **Result:** The fuel flow is less than the minimum limit. Proceed to Test Step 6.
6. Return Pressure Relief Valve Test A. Disconnect the return line from the secondary fuel filter base and install a blank on the line. Install a temporary line and a calibrated container to the filter base. B. With the isolator switch in the ON position, measure fuel flow from the temporary line. C. If the fuel flow is more than 300 mL/min (10.2 oz/min), re-place the secondary fuel filter base. D. Remove the temporary line and reconnect the return line. E. If the secondary fuel filter base has been replaced, attempt to start the engine. If the engine does not start, use the following procedure to check the fuel flow from the EFLP: F. Disconnect the fuel inlet from the fuel filter. Place the open end of the disconnected line into a calibrated container. G. With the isolator switch in the ON position, measure the flow from the fuel line.	PRV test	**Result:** The fuel flow is more than 5% below the acceptable limit. Replace the EFLP. **Result:** The fuel flow is more than 5% above the acceptable limit. Contact the Perkins dealer. **Result:** The fuel flow is within the acceptable limit. Proceed to Test Step 7.
7. Check the Return Fuel Lines A. Make sure that the EFLP return line is not blocked or kinked. B. If the EFLP return line is clear, confirm that the Electric Fuel Lift Pump (EFLP) is operating. Make sure that fuel lines between the EFLP are not blocked or kinked.	Return lines	**Result:** The EFLP return line or the fuel lines between the EFLP are blocked or kinked. Clear or replace the blocked line. **Result:** The EFLP return line and the fuel lines between the EFLP are clear. Replace the EFLP. If the fault is still present, proceed to Test Step 8.

8. Low Compression (Cylinder Pressure) A. Perform a compression test.	Cylinder compression	**Result:** The results of the compression test are outside the specifications. Investigate the cause and rectify any faults. **Note:** 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 **Result:** The results of the compression test are OK. Proceed to Test Step 9.
9. Electronic Unit Injectors A. Use the electronic service tool to perform the automatic “Cylinder Cut Out Test” . **Note:** If the compression test that was performed in Test Step 8 was satisfactory, the “Cylinder Cut Out Test” will identify any faulty injectors.	Electronic Unit Injectors	**Result:** A faulty injector is indicated. Remove any faulty electronic unit injectors. Install new electronic unit injectors. Repeat the automatic “Cylinder Cut Out Test” . If the fault is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. **Result:** All injectors are OK. Proceed to Test Step 10.
10. Individual Malfunctioning Cylinders A. With the engine speed at a fast idle, use the electronic service tool to perform the manual “Cylinder Cut Out Test” . As each cylinder is cut out, listen for a change in the sound from the engine. When a cylinder is cut out, there should be a noticeable change in the sound of the engine. If a change in the sound of the engine is not noted, the isolated cylinder is not operating under normal conditions. If the isolation of a cylinder results in a change in the sound that is less noticeable, the cylinder may be operating below normal performance.	Cylinders	**Result:** The test indicates a faulty cylinder. 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. **Result:** The test indicates that all cylinders are OK. Contact the Perkins dealer.

Engine Vibration Is Excessive

Probable Causes

- Engine supports
- Driven equipment
- Low compression (cylinder pressure)
- Electronic unit injectors
- Individual malfunctioning cylinder

Recommended Actions
Note: Complete the procedure in the order in which the steps are listed.

Troubleshooting Test Steps	Values	Results
1. Engine Supports A. Inspect the mounts and the brackets while you run the engine through the speed range. Look for mounts and brackets that are loose and/or broken. B. Check the alignment of the following before operating the engine under load for any length of time: · Mounts · Coupling	Engine supports	**Result:** The mounts and brackets are loose and/or broken. Replace the mounts and brackets that are loose and/or broken. **Result:** The mounts and brackets are not loose and/or broken. Proceed to Test Step 2.
2. Driven Equipment A. Inspect the mounting bolts for the driven equipment. Inspect the alignment and the balance of the driven equipment. B. Inspect the coupling.	Driven equipment	**Result** The driven equipment and the alignment are not OK. Repair or replace the driven equipment. **Result:** The driven equipment and the alignment are OK. Proceed to Test Step 3.
3. Low Compression (Cylinder Pressure) A. Perform a compression test.	Cylinder compression	**Result:** The results of the compression test are outside the specifications. Investigate the cause and rectify any faults. **Note:** 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 **Result:** The results of the compression test are OK. Proceed to Test Step 4.
4. Electronic Unit Injectors A. Use the electronic service tool to perform the automatic “Cylinder Cut Out Test” . **Note:** If the compression test that was performed in Test Step 4 was satisfactory, the “Cylinder Cut Out Test” will identify any faulty injectors.	Electronic Unit Injectors	**Result**: A faulty injector is indicated. Remove any faulty electronic unit injectors. Install new electronic unit injectors. Repeat the automatic “Cylinder Cut Out Test” . If the fault is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. Result: All injectors are OK. Proceed to Test Step 5.

5. Individual Malfunctioning Cylinders A. With the engine speed at a fast idle, use the electronic service tool to perform the manual “Cylinder Cut Out Test” . As each cylinder is cut out, listen for a change in the sound from the engine. When a cylinder is cut out, there should be a notice-able change in the sound of the engine. If a change in the sound of the engine is not noted, the isolated cylinder is not operating under normal conditions. If the isolation of a cylinder results in a change in the sound that is less noticeable, the cylinder may be operating below normal performance.	Cylinders	**Result:** The test indicates a faulty cylinder. 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. **Result:** The test indicates that all cylinders are OK. Contact the Perkins dealer.

Exhaust Has Excessive Black Smoke

Probable Causes

- Diagnostic codes
- Parameters in the Electronic Control Module (ECM)
- Air intake system or exhaust system
- Valve lash
- Turbocharger
- Low compression (cylinder pressure)
- Electronic unit injectors
- Individual malfunctioning cylinder

Recommended Actions

Note: Complete the procedure in the order in which the steps are listed.

Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes **Note:** Certain diagnostic codes and/or event codes may cause poor performance. Refer to in the electronic service tool. A. Use the electronic service tool to check for active or logged codes.	Engine Derate or Diagnostic Codes	**Result:** A diagnostic code is present. Troubleshoot the code. **Result:** A diagnostic code is not present. Proceed to Test Step 2.
2. Parameters in the Electronic Control Module (ECM) A. Use the electronic service tool to verify that the correct parameters are being used. Refer to Troubleshooting, “System Configuration Parameters” for additional information.	Parameters	Result: The parameters are not correct. Input the correct parameters. Refer to Troubleshooting, “Con-figuration Parameters” for additional information. **Result:** The parameters are correct. Proceed to Test Step 3.

3. Air Intake and Exhaust System A. Observe the check engine lamp. Check for an air filter restriction indicator, if equipped. Replace a plugged air filters. B. Check the air inlet and exhaust system for restrictions and/or leaks.	Restrictions	**Result:** There are restrictions in the air inlet or exhaust system. Make the necessary repairs, **Result:** There are no restrictions in the air inlet or exhaust system. Proceed to Test Step 4.
4. Valve Lash A. Check the valve lash.	Valve lash	**Result:** The valve lash is not correct. Investigate the cause of the excessive valve lash. **Result:** The valve lash is correct. Proceed to Test Step 5.
5. Turbocharger **Note:** The turbocharger that is installed on the engine is a non-serviceable item. If any mechanical fault exists, then the faulty turbocharger must be replaced. A. Ensure that the mounting bolts for the turbocharger are tight. B. Check that the oil drain for the turbocharger is not blocked or restricted. C. Check that the compressor housing for the turbocharger is free of dirt and debris. Make sure that the housing is not damaged. D. Check that the turbine housing for the turbocharger is free of dirt and debris. Make sure that the housing is not damaged. E. Check that the turbine blades rotate freely in the turbocharger.		**Result:** There is a fault on the turbocharger. Repair the turbocharger or replace the turbocharger. **Result:** The turbocharger is OK. Proceed to Test Step 6.
6. Low Compression (Cylinder Pressure) A. Perform a compression test.	Cylinder compression	**Result:** The results of the compression test are outside the specifications. Investigate the cause and rectify any faults. **Note:** 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 **Result:** The results of the compression test are OK. Proceed to Test Step 7.

7. Electronic Unit Injectors A. Use the electronic service tool to perform the automatic “Cylinder Cut Out Test” . **Note:** If the compression test that was performed in Test Step 6 was satisfactory, the “Cylinder Cut Out Test” will identify any faulty injectors.	Electronic Unit Injectors	**Result:** A faulty injector is indicated. Remove any faulty electronic unit injectors. Install new electronic unit injectors. Repeat the automatic “Cylinder Cut Out Test” . If the fault is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. **Result:** All injectors are OK. Proceed to Test Step 8.
8. Individual Malfunctioning Cylinders A. With the engine speed at a fast idle, use the electronic service tool to perform the manual “Cylinder Cut Out Test” . As each cylinder is cut out, listen for a change in the sound from the engine. When a cylinder is cut out, there should be a noticeable change in the sound of the engine. If a change in the sound of the engine is not noted, the isolated cylinder is not operating under normal conditions. If the isolation of a cylinder results in a change in the sound that is less noticeable, the cylinder may be operating below normal performance.	Cylinders	**Result:** The test indicates a faulty cylinder. 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. **Result:** The test indicates that all cylinders are OK. Contact the Perkins dealer.

Exhaust Has Excessive White Smoke

Note: Some white smoke may be present during cold start-up conditions and during acceleration after a prolonged period at low idle. If the white smoke persists, there may be a fault.

Probable Causes

- Diagnostic codes
- ECM Flash file
- Starting aids
- Coolant temperature
- Cooling system
- Fuel quality
- Valve lash
- Low compression (cylinder pressure)
- Electronic unit injectors
- Individual malfunctioning cylinder

Recommended Actions
Diagnostic Codes

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes A. Establish communication between the electronic service tool and the Electronic Control Module (ECM) . Refer to Troubleshooting, “Electronic Service Tools”, if necessary. B. Determine if a code is active or logged.	Diagnostic codes	**Result:** A code is active or logged. Troubleshoot any active codes before continuing with this procedure. **Result:** A code is not active or logged. Proceed to Test Step 2.
2. ECM Flash File A. Verify that the latest flash file is installed in the ECM.	Flash file	**Result:** The latest flash file is not installed. Install the latest flash file. Refer to Troubleshooting, “ECM Software - Install” for the correct procedure. Verify that the repair eliminates the fault. **Result:** The latest flash file is installed. Proceed to Test Step 3.
3. Starting Aids A. Check operation of starting aids. Verify that the starting aids are operating correctly. Refer to Troubleshooting, “Glow Plug Starting Aid - Test”. B. Check the configuration screen on the electronic service tool in order to verify that ether injection is not enabled.	Starting aid	**Result:** The starting aids are not operating correctly. Make the necessary repairs. Verify that the repair corrected the fault. **Result:** The starting aids are operating correctly. Proceed to Test Step 4.
4. Coolant Temperature A. Check that the water temperature regulator is operating correctly.	Coolant temperature	**Result:** The water temperature regulator is not operating correctly. Replace the water temperature regulator. Verify that the repair corrected the fault. **Result:** The water temperature regulator is operating correctly. Proceed to Test Step 5.
5. Cooling System A. Check for an internal coolant leak into the cylinder and/or the exhaust.	Internal coolant leak	**Result:** There is an internal coolant leak. Make the necessary repairs. Verify that the repair eliminated the fault. **Result:** There is not an internal coolant leak. Proceed to Test Step 6.
6. Fuel Quality A. Check the fuel quality. B. Refer to Users Handbook for information on the proper characteristics of the fuel for the engine.	Fuel	**Result:** The fuel quality is not OK. Drain the fuel system and replace the fuel filters. Fill the fuel system with fuel that meets the standard in the Users Handbook, “Fluid Recommendations”. Prime the fuel system. Verify that the procedure has eliminated the noise. **Result:** The fuel quality is OK. Proceed to Test Step 7.

7. Valve Lash **Note:** The valve lash can affect the performance of the engine. A. Check the valve lash.	Valve lash	**Result:** The valve lash is not correct. Investigate the cause of the excessive valve lash. **Result:** The valve lash is correct. Proceed to Test Step 8.
8. Low Compression (Cylinder Pressure) A. Perform a compression test.	Cylinder compression	**Result:** The results of the compression test are outside the specifications. Investigate the cause and rectify any faults. **Note:** 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 **Result:** The results of the compression test are OK. Proceed to Test Step 9.
9. Electronic Unit Injectors A. Use the electronic service tool to perform the automatic “Cylinder Cut Out Test” . **Note:** If the compression test that was performed in Test Step 8 was satisfactory, the “Cylinder Cut Out Test” will identify any faulty injectors.	Electronic Unit Injectors	**Result:** A faulty injector is indicated. Remove any faulty electronic unit injectors. Install new electronic unit injectors. Repeat the automatic “Cylinder Cut Out Test” . If the fault is still apparent, remove the replacement electronic unit injector and install the original electronic unit injector. **Result:** All injectors are OK. Proceed to Test Step 10.
10. Individual Malfunctioning Cylinders A. With the engine speed at a fast idle, use the electronic service tool to perform the manual “Cylinder Cut Out Test” . As each cylinder is cut out, listen for a change in the sound from the engine. When a cylinder is cut out, there should be a notice-able change in the sound of the engine. If a change in the sound of the engine is not noted, the isolated cylinder is not operating under normal conditions. If the isolation of a cylinder results in a change in the sound that is less noticeable, the cylinder may be operating below normal performance.	Cylinders	**Result:** The test indicates a faulty cylinder. 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. **Result:** The test indicates that all cylinders are OK. Contact the Perkins dealer.

Exhaust Temperature Is High

The Electronic Control Module (ECM) monitors the temperature sensor in the outlet from the turbocharger.

Certain operating conditions may cause the exhaust temperature to increase to a level that may damage engine components. If a high exhaust temperature occurs, the ECM derates the engine to reduce the exhaust temperature. The engine is derated only to a level that allows the exhaust temperature to return to an acceptable level.

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
173-15	Engine Exhaust Gas Temperature : High - least severe (1)	The ECM has been powered for at least 2 seconds. The engine has been running for at least 10 seconds. There are no diagnostic trouble codes for the exhaust gas temperature sensor. There are no diagnostic trouble codes for the 5 VDC supply.
173-16	Engine Exhaust Gas Temperature : High - moderate severity (2)	The ECM has been powered for at least 2 seconds. The engine has been running for at least 10 seconds. There are no diagnostic trouble codes for the exhaust gas sensor. There are no diagnostic trouble codes for the 5 VDC supply. The engine will be derated.
173-0	Engine Exhaust Gas Temperature : High - most severe (3)	The ECM has been powered for at least 2 seconds. The engine has been running for at least 10 seconds. There are no diagnostic trouble codes for the exhaust gas sensor. There are no diagnostic trouble codes for the 5 VDC supply. The engine will be derated.

Probable Causes

- Inlet system leak
- Engine operating conditions
- High altitude
- Obstructed Aftercooler

Complete the procedure in the order in which the steps are listed.

Troubleshooting Test Steps	Values	Results
1. Check for Inlet System Leakage A. Apply a light load to the engine and check for leakage from the inlet system downstream of the turbocharger.	Inlet system leaks	**Result:** Leakage was found. Repair the leaks. Return the unit to service. **Result:** Leakage was not found. Proceed to Test Step 2.
2. Check the Engine Operating Conditions A. Use the electronic service tool to check the histograms. Use the histograms to determine if the high exhaust temperature occurred during normal operation. If possible, interview the operator. Determine if the engine is being operated under heavy load. Ensure that the engine is being operated at an acceptable engine speed. If derates are suspected, reset the histogram and return the unit to service. If the histogram repopulates without fault codes, the derating of the engine was under normal engine operation.	Type of operation	**Result:** The code was logged during a heavy load. Reduce the load on the engine. Return the unit to service. **Result:** The code was not logged during a heavy load. Proceed to Test Step 3.
3. Check for an Obstructed Exhaust Manifold Cooler A. The exhaust gas temperature can increase if the coolant flow through the exhaust manifold cooler is obstructed. Check the coolant passages in the exhaust manifold cooler for obstructions or debris. Ensure that the flow of coolant through the exhaust manifold cooler is adequate.	Obstructed exhaust manifold cooler	**Result:** The flow of coolant through the exhaust manifold cooler is obstructed. Clear any obstructions. Return the unit to service. **Result:** The exhaust manifold cooler is not obstructed. Contact the Perkins dealer.
4. Check for an Obstructed Aftercooler A. The intake manifold air temperature can increase if the flow through the Air to Air Aftercooler (ATAAC) is obstructed. Check the ATAAC for obstructions or debris. Ensure that the flow of air through the ATAAC is adequate.	Obstructed ATAAC	Result: The Aftercooler was obstructed. Clear any obstructions. Return the unit to service. Result: The Aftercooler was not obstructed. Contact the Perkins dealer.

Fuel Consumption Is Excessive

Probable Causes

- Diagnostic codes
- Misreading of fuel level
- Fuel leakage
- Fuel quality
- Quality of oil
- Coolant temperature
- Prolonged operation at idle speed
- Air intake and exhaust system
- Reduced pressure of intake air

Recommended Actions
Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes **Note:** Certain diagnostic codes and/or event codes may cause high fuel consumption. A. Use the electronic service tool to check for active or logged codes	Diagnostic codes	**Result:** A diagnostic code is present. Troubleshoot the code and then verify that the fuel consumption is normal. **Result:** A diagnostic code is not present. Proceed to Test Step 2.
2. Misreading of Fuel Level **Note:** Misreading of the fuel gauge can give a false indication of fuel consumption. A. Monitor the fuel consumption over a period of 50 engine hours.	Fuel level	**Result:** Fuel consumption is normal for the operating conditions. Return the unit to service. **Result:** Fuel consumption is high for the operating conditions. Proceed to Test Step 3.
3. Fuel Leakage A. Check the engine for signs of fuel leakage.	Fuel leaks	**Result:** Evidence of a fuel leak is found. Repair or replace the component that is leaking fuel. **Result:** No evidence of a fuel leak is found. Proceed to Test Step 4.
4. Fuel Quality **Note:** The grade of the fuel affects the rate of fuel consumption. Refer to the engines Users Handbook for additional information. Cold weather adversely affects the characteristics of the fuel. Refer to the Users Handbook Manual for information on improving the characteristics of the fuel during cold-weather operation. A. Check the fuel quality. B. Refer to Users Handbook for information on the proper characteristics of the fuel for the engine.	Fuel quality	**Result:** The fuel quality does not meet specifications. Drain the fuel system and replace the fuel filters. Fill the fuel system with fuel that meets the standard in the Users HANDBOOK, “Fluid Recommendations”. Prime the fuel system. Refer to the Users Handbook, “Fuel System - Prime”. **Result:** The fuel quality meets specifications. Proceed to Test Step 5.
5. Quality of Oil **Note:** 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 for high ambient temperatures will affect fuel consumption in cold ambient temperatures. A. Check that the engine oil meets the required specification.	Engine oil quality	**Result:** The engine oil does not meet the required specification. Refill the oil system with oil of an acceptable quality. Refer to the applicable sections in the Users Handbook. **Result:** The engine oil meets the required specification. Proceed to Test Step 6.
6. Coolant Temperature **Note:** 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. A. Check that the water temperature regulator is operating correctly.	Coolant temperature	Result: The water temperature regulator is not operating correctly. Replace the water temperature regulator. Verify that the re-pair corrected the fault. Result: The water temperature regulator is operating correctly. Proceed to Test Step 7.

7. Prolonged Operation at Idle Speed **Note:** Prolonged operation of the engine at idle speed increases fuel consumption. A. Check for extended periods of engine operation at idle speed	Extended idle operation	**Result:** The engine is operating at idle speed for extended periods. When possible, stop the engine to conserve fuel. **Result:** The engine is not operating at idle speed for extended periods. Proceed to Test Step 8.
8. Air Intake and Exhaust System A. Check the air filter restriction indicator, if equipped. B. Check the air intake and exhaust systems for the following defects: · Blockages · Restrictions · Damage to lines or hoses	Air and Exhaust System restrictions	**Result:** The air filter is restricted. Replace the air filter. **Result:** There are system restrictions. **Result:** The air intake and exhaust system is OK. Proceed to Test Step 9.
9. Reduced Pressure of Intake Air **Note:** If the air pressure is lower than normal, the same power can only be achieved by the following: · Higher engine speed · Injection of more fuel Either of these conditions will increase the fuel consumption. A. Check all pipes from the outlets of the turbocharger compressor to the inlet manifold for leaks. B. Check for the correct operation of the wastegate in the turbocharger.	Intake air	**Result:** There is a leak in the intake air system. Repair the leak or replace the component that is causing the leak. **Result:** The turbocharger wastegate is not operating correctly. Replace the turbocharger. **Result:** The air intake system and the wastegate are OK. Contact the Perkins dealer.

Fuel Filter Is Restricted (Secondary Fuel Filter)

Note: The following codes are only applicable for engines with a pre-filter pressure sensor.

The Electronic Control Module (ECM) detects an abnormal differential pressure across the active secondary fuel filter.

Use this procedure if one of the following codes is active.

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
95-15	Engine Fuel Filter Differential Pressure : High -least severe (1)	The differential pressure across the active secondary fuel filter is high. No 3510 codes are active. The code is logged.

Probable Cause

- Diagnostic codes
- Secondary Fuel filter blocked
- Sensor

Recommended Actions

Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes A. Connect the electronic service tool to the diagnostic connector. Refer to Troubleshooting, “Electronic Service Tools”, if necessary. B. Determine if a diagnostic is active or recently logged.	Diagnostic codes	**Result:** A 95-15 code is present. Proceed to Test Step 2. **Result:** A 95-15 code is not present. Return the unit to service.
2. Change the Active Fuel Filters A. Replace the active secondary fuel filter. Refer to the Users Handbook, “Fuel System Secondary Filter -Replace”. B. Replace the active primary fuel filter. Refer to the Users Handbook, “Fuel System Primary Filter (Water Separator) Element - Replace”.	Fuel filter change	**Result:** The code is no longer active. Use the electronic service tool to clear all logged diagnostic codes and verify that the fault has been eliminated. Return the unit to service. **Result:** The 95-15 code becomes active after changing the fuel filters. Proceed to Test Step 3.
3. Fuel Pressure Sensors A. Use the electronic service tool to compare the status of the following parameters with the engine not running: · Secondary Fuel Filter Pre-filter Pressure · Secondary Fuel Filter Post-filter Pressure	Fuel pressure sensors	**Result:** A sensor does not read atmospheric pressure while the engine is not running. Troubleshoot the sensor circuit. Refer to Troubleshooting, “Sensor Signal (Analog Active) - Test”. **Result:** The sensors read atmospheric pressure while the engine is off. Contact the Perkins dealer.

Fuel Rail Pressure Problem

Use this procedure to troubleshoot abnormal fuel rail pressure or use this procedure if any of the following diagnostic trouble codes are active. Refer to Troubleshooting, “Diagnostic Trouble Codes” for information about the codes.

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
157-16	Engine Injector Metering Rail #1 Pressure: High - moderate severity (2)	No other 157-XX codes are active. 3509-XX codes are not active. No codes for the high-pressure fuel pump or the injectors are active. The fuel rail pressure is above an acceptable level. The code is logged. Engine power is derated.
157-18	Engine Injector Metering Rail #1 Pressure: Low - moderate severity (2)	No other 157-XX codes are active. 3509-XX codes are not active. No codes for the high-pressure fuel pump or the injectors are active. The fuel rail pressure is below an acceptable level. The code is logged. Engine power is derated.
1239-31	Engine Fuel Leakage 1	3509-XX codes are not active. 3510-XX codes are not active. There is a probable fuel leak from the high-pressure fuel system. The amount of leakage is a calculated parameter. The code is logged. The engine may shut down.
5571-0	High Pressure Common Rail Fuel Pressure Relief Valve : Active	3509-XX codes are not active. 3510-XX codes are not active. The pressure limiting valve in the fuel rail is open. This code is a calculated parameter. The code is logged.

Probable Causes

- Diagnostic codes
- Electrical connectors
- Fuel filters
- Fuel rail pressure sensor
- High fuel rail pressure
- Low fuel rail pressure

Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes A. Connect the electronic service tool to the diagnostic connector. Refer to Troubleshooting, “Electronic Service Tools”, if necessary. B. Determine if a diagnostic is active or recently logged.	Diagnostic codes	**Result:** A 157-16 or 157-18 code is present. Proceed to Test Step 2. **Result:** A code other than 157-16 or 157-18 is present. Troubleshoot the code. Refer to the proper trouble-shooting procedure.
2. Electrical Connectors A. Check for the correct installation of the ECM J1/P1 and the J2/P2 connectors. Check for correct installation of the connector on the fuel rail pressure sensor.	Connectors	**Result:** There are suspect connectors. Use the electronic service tool to perform the “Wiggle Test” . Repair or replace connectors that are suspect. **Result:** There are no suspect connectors. Proceed to Test Step 3.
3. Fuel Filters A. Replace the primary fuel filter and the secondary fuel filters. Refer to the Users Handbook for further information.	Fuel filters	**Result:** The filters have been replaced and the fault is eliminated. Return the unit to service. **Result:** The filters have been replaced and the fault is still present. Proceed to Test Step 3.
4. Fuel Rail Pressure Sensor A. Make sure that the engine has been shut down for at least 10 minutes. Use the electronic service tool to check the status of the “Fuel Rail Pressure”	Pressure sensor	**Result:** The “Fuel Rail Pressure (absolute)” is more than 5,000 kPa (725 psi). Test the fuel rail pressure sensor. Refer to Troubleshooting, “Sensor Signal (Analog, Active) - Test”. Use the electronic service tool to perform the “Fuel Rail Pressure Test” . If the test fails, replace the fuel rail pressure sensor. Confirm that the fault has been eliminated. **Result:** The “Fuel Rail Pressure (absolute)” is less than 5,000 kPa (725 psi). Use the electronic service tool to perform the “Fuel Rail Pressure Test” . If the test fails, replace the fuel rail pressure sensor. If the fault is still present and the fuel rail pressure is high, proceed to Test Step 5. If the fault is still present and the fuel rail pressure is low, proceed to Test Step 9.

5. High Fuel Rail Pressure A. Use the electronic service tool to perform the “Fuel Rail Pressure Test” .	High fuel rail pressure	**Result:** The Fuel Rail Pressure Test fails. Replace the SCV and solenoid. If the replacement SCV does not eliminate the fault, turn the isolator switch to the OFF position and disconnect the electrical connector from the EFLP. With the isolator switch in the ON position, measure the voltage at the harness connector for the EFLP. The volt-age must be between 10 VDC and 14 VDC for a 12 VDC system. The voltage must be between 20 VDC and 28 VDC for a 24 VDC system. If the voltage is be-low 10 VDC for a 12 VDC system, investigate the cause. If the voltage is below 20 VDC for a 24 VDC system, investigate the cause. Refer to Troubleshooting, “Fuel Pump Relay Circuit - Test” Turn the isolator switch to the OFF position and then re-connect the electrical connector to the EFLP. If a repair has been performed to rectify a low supply voltage to the EFLP, attempt to start the engine. If the engine does not start, proceed to Test Step 6. Result: The fuel system is OK. Proceed to Test Step 9.
6. Electric Fuel Lift Pump (EFLP) Flow Test A. Disconnect the EFLP return line from the drain port on the EFLP. Install a suitable blanking cap on the open port in the TPIR return line. B. Connect a temporary drain line to the drain port on the EFLP. C. Place the end of the temporary drain line into a suitable cali-brated container. D. With the isolator switch in the ON position but the engine not running, use a suitable multimeter to measure the input voltage to the EFLP. Record the reading. E. With the isolator switch in the ON position but the engine not running, measure the fuel flow from the temporary drain line. F. For a 12 VDC system. For fuel flow rates refer to the Installation Guide G. For a 24 VDC system. For fuel flow rates refer to the Installation Guide H. Remove the temporary drain line from the drain port on the EFLP. Connect the EFLP return line to the EFLP.	TPIR flow rate	**Result:** The fuel flow is greater than the minimum limit. Proceed to Test Step 9. **Result:** The fuel flow is less than the minimum limit. Proceed to Test Step 7.

7. Return Pressure Relief Valve Test A. Disconnect the return line from the secondary fuel filter base and install a blank on the line. Install a temporary line and a calibrated container to the filter base. B. With the isolator switch in the ON position, measure fuel flow from the temporary line. C. If the fuel flow is more than 300 mL/min (10.2 oz/min), replace the secondary fuel filter base. D. Remove the temporary line and reconnect the return line. E. If the secondary fuel filter base has been replaced, attempt to start the engine. If the engine does not start, use the following procedure to check the fuel flow from the EFLP: F. Disconnect the fuel inlet from the primary fuel filter. Place the open end of the disconnected line into a calibrated container. G. With the isolator switch in the ON position, measure the flow from the fuel line.	PRV test	**Result:** The fuel flow is more than 5% below the acceptable limit. Replace the EFLP. **Result:** The fuel flow is more than 5% above the acceptable limit. Contact the Perkins dealer. **Result:** The fuel flow is within the acceptable limit. Proceed to Test Step 8.
8. Check the Return Fuel Lines A. Make sure that the EFLP return line is not blocked or kinked. B. If the EFLP return line is clear, confirm that the Electric Fuel Lift Pump (EFLP) is operating. Make sure that fuel lines between the EFLP are not blocked or kinked.	Low fuel rail pressure	**Result:** The high-pressure fuel system has a leak. Rectify any fuel leaks. **Result:** The Electric Fuel Lift Pump (EFLP) is not operating correctly. Refer to Troubleshooting, “Fuel Pump Relay Circuit -Test”. **Result:** There is air in the low-pressure fuel system. Identify the cause of the air in the system. Remove the air from the low-pressure fuel system. **Result:** The Fuel Rail Pressure Relief Valve Test fails. If excessive leakage is identified, replace the fuel rail. If the fault is still present, turn the isolator switch to the OFF position and disconnect the electrical connector from the EFLP. With the isolator switch in the ON position, measure the voltage at the harness connector for the EFLP. The voltage must be between 10 VDC and 14 VDC for a 12 VDC system. The voltage must be between 20 VDC and 28 VDC for a 24 VDC system. If the voltage is below 10 VDC for a 12 VDC system, investigate the cause. If the voltage is below 20 VDC for a 24 VDC system, investigate the cause. Refer to Troubleshooting, “Fuel Pump Relay Circuit - Test” Turn the isolator switch to the OFF position and then re-connect the electrical connector to the EFLP. If a repair has been performed to rectify a low supply voltage to the EFLP, check for the original fault. If the fault is still present, proceed to Test Step 10. **Result:** The fuel system is OK.

10. Electric Fuel Lift Pump (EFLP) Pressure Regulator Flow Test A. Disconnect the EFLP return line from the drain port on the EFLP. Install a suitable blanking cap on the open port in the TPIR return line. B. Connect a temporary drain line to the drain port on the EFLP. C. Place the end of the temporary drain line into a suitable calibrated container. D. With the isolator switch in the ON position but the engine not running, use a suitable multimeter to measure the input voltage to the EFLP. Record the reading. E. With the isolator switch in the ON position but the engine not running, measure the fuel flow from the temporary drain line. F. For a 12 VDC system. For fuel flow rates refer to the Installation Guide G. For a 24 VDC system. For fuel flow rates refer to the Installation Guide H. Remove the temporary drain line from the drain port on the EFLP. Connect the EFLP return line to the EFLP.	TPIR flow rate	**Result:** The fuel flow is greater than the minimum limit. Proceed to Test Step 9. **Result:** The fuel flow is less than the minimum limit. Proceed to Test Step 11.
11. Return Pressure Relief Valve Test A. Disconnect the return line from the secondary fuel filter base and install a blank on the line. Install a temporary line and a calibrated container to the filter base. B. With the isolator switch in the ON position, measure fuel flow from the temporary line. C. If the fuel flow is more than 300 mL/min (10.2 oz/min), replace the secondary fuel filter base. D. Remove the temporary line and reconnect the return line. E. If the secondary fuel filter base has been replaced, attempt to start the engine. If the engine does not start, use the following procedure to check the fuel flow from the EFLP: F. Disconnect the fuel inlet from the primary fuel filter. Place the open end of the disconnected line into a calibrated container. G. With the isolator switch in the ON position, measure the flow from the fuel line.	PRV test	Result: The fuel flow is more than 5% below the acceptable limit. Replace the EFLP. Result: The fuel flow is more than 5% above the acceptable limit. Contact the Perkins dealer. Result: The fuel flow is within the acceptable limit. Proceed to Test Step 12.
12. Check the Return Fuel Lines A. Make sure that the EFLP return line is not blocked or kinked.. B. If the EFLP return line is clear, confirm that the Electric Fuel Lift Pump (EFLP) is operating. Make sure that fuel lines between the EFLP are not blocked or kinked.	Return lines	**Result:** The EFLP return line or the fuel lines between the EFLP are blocked or kinked. Clear or replace the blocked line. **Result:** The EFLP return line and the fuel lines between the EFLP are clear. Replace the EFLP. If the fault is still present, contact the Perkins dealer.

Fuel Temperature Is High

This procedure covers the following diagnostic codes:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
174-15	Engine Fuel Temperature 1 : High - least severe (1)	The temperature of the low-pressure fuel in the high-pressure fuel pump is high. The ECM has been powered for at least 2 seconds. The engine has been operating for at least 185 seconds. There are no other faults in the electrical system. The warning lamp will come on. The warning lamp will go off when the temperature drops below the trip point.
174-16	Engine Fuel Temperature 1 : High - moderate severity (2)	The temperature of the low-pressure fuel in the high-pressure fuel pump is high. The ECM has been powered for at least 2 seconds. The engine has been operating for at least 185 seconds. There are no other faults in the electrical system. The warning lamp will come on. The engine may be derated by 20%. The warning lamp will go off when the temperature drops below the trip point for 15 seconds.

Probable causes

- Incorrect position of fuel shut-off valves
- Fuel level in tank
- Return fuel cooler (if equipped)
- Return fuel lines
- Location of the fuel tank

Recommended Actions

Note: Complete the procedure in the order in which the steps are listed.

Troubleshooting Test Steps	Values	Results
1. Incorrect Position of Fuel Shut-off Valves A. Make sure that any fuel shut-off valves in the feed lines be-tween the fuel tank and the engine are open. B. Make sure that any fuel shut-off valves in the return lines be-tween the engine and the fuel tank are open.	Valve positions	**Result:** A fuel valve is closed or not fully open. Move the valve to the fully OPEN position. **Result:** All fuel valves are fully open. Proceed to Test Step 2.

2. Fuel Level in Tank **Note:** If the level in the fuel tank is low, the hot return fuel can raise the temperature in the fuel tank. A. Check the fuel level in the fuel tank.	Valve positions	**Result:** A fuel valve is closed or not fully open. Move the valve to the fully OPEN position. **Result:** All fuel valves are fully open. Proceed to Test Step 2.
2. Fuel Level in Tank **Note:** If the level in the fuel tank is low, the hot return fuel can raise the temperature in the fuel tank. A. Check the fuel level in the fuel tank.	Fuel level	**Result:** The fuel level in the tank is low. Replenish the fuel tank at the earliest opportunity. **Result:** The fuel level in the tank is sufficient to prevent excessive fuel heating. Proceed to Test Step 3.
3. Return Fuel Cooler (If Equipped) A. Check the fins on the return fuel cooler for blockage with dirt or debris. Check for fins that are bent or missing.	Fuel cooler	**Result:** The fins on the return fuel cooler are blocked with dirt or debris. Clean the return fuel cooler. **Result** The fins on the return fuel cooler are bent or missing. Repair or replace the return fuel cooler. **Result** The return fuel cooler is OK. Proceed to Test Step 4.
4. Return Fuel Lines A. Check the return fuel lines for blockage or restrictions.	Return fuel lines	**Result:** The return fuel lines are blocked or restricted. Clear the blockage or restriction. If necessary, replace the return fuel line. **Result** The return fuel lines are clear. Proceed to Test Step 5.
5. Location of the Fuel Tank A. Make sure that the fuel tank is not close to a heat source.	Tank location	**Result:** The return fuel lines are blocked or restricted. Clear the blockage or restriction. If necessary, replace the return fuel line. **Result** The return fuel lines are clear. Proceed to Test Step 5.

Inlet Air Is Restricted

If a restriction in the air inlet is suspected, follow this procedure:

Inlet Air Temperature Is High

Use this procedure to determine the cause of high air inlet temperature.

Probable Causes

- Diagnostic codes
- High ambient air temperature
- Intake air restriction and/or high altitude
- Intake air from a heated area

Recommended Actions
Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes A. Establish communication between the electronic service tool and the Electronic Control Module (ECM). Refer to Troubleshooting, “Electronic Service Tools”, if necessary. B. Download the “Warranty Report” from the engine ECM be-fore performing any troubleshooting or clearing diagnostic trouble codes.	Diagnostic codes	**Result:** There are active or logged codes. Troubleshoot any codes before continuing with this procedure. **Result:** There are no active or logged codes. Proceed to Test Step 2.
2. High Ambient Air Temperature A. Determine if the ambient air temperature is within the de-sign specifications for the cooling system and the air charge cooler.	Ambient Air temperature	**Result:** The ambient air temperature is not within the design specifications. When possible, modify the cooling system and the air charge cooler in order to make the system suitable for local conditions. **Result:** The ambient air temperature is within the design specifications. Operate the engine at a reduced load or operate the engine at a reduced speed. Proceed to Test Step 3.
3. Intake Air Restriction and/or High Altitude A. Measure the intake manifold pressure while the engine is operating under load. **Note:** 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 turbo-charger works harder in order to achieve the desired intake manifold pressure. This increases intake air temperature.	Intake air problem	**Result:** There is a suspected intake air restriction. Check for blocked air filters. Check for obstructions in the air intake. Replace the air filters or remove the obstruction from the air intake. **Result:** High altitude operation is suspected of causing the symptom. Make sure that the settings for the engine are correct for the altitude. **Result:** There are no air restrictions or altitude issues. Proceed to Test Step 4.
4. Intake Air from a Heated Area A. Ensure that the air inlet system is not receiving air from a heated area.	Intake air temperature	**Result:** The intake air is from a heated area. If necessary, relocate the air supply to the intake manifold to the outside of the engine enclosure. Check for air leaks in the pipe between the air inlet and the inlet to the turbocharger compressor. **Result:** The intake air is not from a heated area. Contact the Perkins dealer.

Intake Manifold Air Pressure Is Low

The Electronic Control Module (ECM) monitors the intake manifold air pressure. The following code is associated with low intake manifold air pressure:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
102-18	Engine Intake Manifold #1 Pressure : Low - moderate severity	This pressure is a variable value that is calculated by the ECM. The resulting value depends on the operating conditions of the engine.

Probable Causes

- Intake air filter
- Air intake system
- Turbocharger

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Intake Air Filter A. Ensure that the air filter is clean and serviceable.	Air filter	**Result:** The air filter is blocked. Replace the air filter element. Refer to the Users Handbook, “Engine Air Cleaner Element -Replace”. **Result:** The air filter is OK. Proceed to Test Step 2.
2. Air Intake System A. Check the air intake system for the following defects: · Blockages · Restrictions · Damage to the air intake ducts and hoses · Loose connections and air leaks	Air intake	**Result:** The air intake system is blocked, restricted, damaged, or loose. Make all necessary repairs to the air intake system. **Result:** The air intake system is OK. Proceed to Test Step 3.
3. Turbocharger **Note:** The turbocharger that is installed on the engine is a non-serviceable item. If any mechanical fault exists, then the turbocharger must be replaced. A. Check that the compressor housing for the turbocharger is free of dirt and debris. B. Check that the turbine housing for the turbocharger is free of dirt and debris. C. Check that the turbine blades rotate freely in the turbocharger.	Turbocharger	**Result:** There is a fault with the turbocharger. Replace the turbocharger. **Result:** The turbocharger is OK. Contact the Perkins dealer.

Intake Manifold Air Temperature Is High

The Electronic Control Module (ECM) monitors the intake manifold air for excessive temperature. The following codes are associated with high intake manifold air temperature:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
105-15	Engine Intake Manifold #1 Temperature : High - least severe (1)	The engine has been running for 3 minutes. No other 105 codes are active. 168 codes are not active. The intake manifold air temperature exceeds the value that is programmed into the ECM for 8 seconds. The code is logged. This code will be reset when the temperature is less than 123° C (253° F) for 4 seconds.
105-16	Engine Intake Manifold #1 Temperature : High - Moderate Se-verity (2	The engine has been running for 3 minutes. No other 105 codes are active. 168 codes are not active. The intake manifold air temperature exceeds the value that is programmed into the ECM for 8 seconds. The engine will be de-rated. The code is logged. For Turbo Aftercooled Engines: This code will be result when the temperature is less than 125° C (257° F) for 20 seconds. For Turbo Engines: This code will be result when the temperature is less than 150° C (302° F) for 20 seconds.

Probable Causes

- Coolant level
- Cooling fan (if applicable)
- Air inlet and exhaust system
- Ambient temperature
- Running condition

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Coolant Level A. Check that the coolant is filled to the correct level. **Note:** If the coolant level is too low, air will get into the cooling system. Air in the cooling system will cause a reduction in coolant flow.	Coolant	**Result:** The coolant level is low. Fill the coolant system to the correct level. Refer to the Users Handbook, “Coolant Level - Check”. **Result:** The coolant level is OK. Proceed to Test Step 2.
2. Air Intake and Exhaust System A. Check the air intake and exhaust system for the following defects: · Blockages · Restrictions · Damage to the air intake ducts and hoses · Loose connections and air leaks	Air intake and exhaust	**Result:** The air intake or exhaust system is blocked, restricted, damaged, or loose. Make all necessary repairs to the air intake system. **Result:** The air intake and exhaust system are OK. For applications with a raw water cooling system or a keel cooled cooling system, proceed to Test Step 3. For applications with a radiator cooling system, proceed to Test Step 5.
3. Check for an Obstructed Heat Exchanger A. The intake manifold air temperature can increase if the flow through the heat exchanger is obstructed. Check the heat exchanger for obstructions or debris. Ensure that the flow of coolant through the heat exchanger is adequate.	Obstructed heat exchanger	**Result:** The heat exchanger was obstructed. Clear any obstructions. Return the unit to service. **Result:** The heat exchanger was not obstructed. Proceed to Test Step 4.

4. Check the Flow Through the Sea Water Pump A. The intake manifold air temperature can increase if the flow from the sea water pump is reduced. Ensure that the flow of water through the sea water pump is adequate.	Obstructed sea water pump	**Result:** The sea water pump is obstructed. Clear any obstructions. Return the unit to service. **Result:** The flow from the sea water pump is reduced. Repair the sea water pump or replace the sea water pump. Result: The output from the sea water pump is sufficient. Contact the Perkins dealer.
5. Check for an Obstructed Aftercooler A. The intake manifold air temperature can increase if the flow through the aftercooler is obstructed. Check the after-cooler for obstructions or debris. Ensure that the flow of air through the aftercooler is adequate.	Obstructed heat exchanger	**Result:** The aftercooler was obstructed. Clear any obstructions. Return the unit to service. **Result:** The aftercooler was not obstructed. Proceed to Test Step 6
6. Ambient Temperature A. Check for a high ambient temperature. **Note:** When outside temperatures are too high, there is insufficient temperature difference between the outside air and the intake air.	Ambient Temperature	**Result**: The ambient air temperature is high. Operate the engine at reduced speed or reduced power. **Result**: The ambient air temperature is OK. Proceed to Test Step 7.
7. Running Condition A. Check that the engine is not operating in the lug condition. **Note**: When the load that is applied to the engine is too large, the engine will run in the lug condition. When the engine is running in the lug condition, engine rpm does not increase with an increase of fuel. This lower engine rpm causes a re-duction in coolant flow through the system.	Running condition	**Result:** The engine is operating in the lug condition. Reduce the load on the engine or, if possible, increase the power rating of the engine. **Result**: The engine is not operating in the lug condition. Contact the Perkins dealer.

Oil Consumption Is Excessive

Probable Causes

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

Recommended Actions
Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Misreading Oil Level A. Accurately measure the consumption of oil and fuel over a period of 50 engine hours.	Oil level	**Result**: The oil consumption is less than 0.08% of the fuel consumption. Oil consumption is within specification. Return the unit to service **Result**: The oil consumption is greater than 0.08% of the fuel consumption. Proceed to Test Step 2.
2. Oil Leaks A. Check for evidence of oil leaks on the engine. B. Check for evidence of oil in the coolant.	Oil leaks	**Result**: An oil leak is identified. Rectify the cause of the oil leak. **Result**: Oil is present in the coolant. Refer to Troubleshooting, “Coolant Contains Oil”. No oil leaks are identified Proceed to Test Step 3.
3. Engine Crankcase Breather A. Check the engine crankcase breather for blockage or restrictions. B. Check for excessive oil from the outlet of the breather.	Breather	**Result**: The engine crankcase breather is blocked or restricted. Clear the blockage or restriction. **Result**: Excessive oil is ejected from the outlet of the breather. Investigate the cause of the excessive oil content in the breather flow. If equipped, replace the filter in the breather. **Result**: No oil is ejected through the breather. Proceed to Test Step 4.
4. Oil Level A. Check for a high oil level in the engine.	Oil level	**Result**: The oil level in the engine is high. Make sure that the oil is not contaminated with fuel. Refer to Troubleshooting, “Oil Contains Fuel”. Make sure that the oil is not contaminated with coolant. Refer to Troubleshooting, “Oil Contains Coolant”. Remove the excess oil. **Result**: The oil level is OK. Proceed to Test Step 5.
5. Air Intake and Exhaust System A. Check the air filter restriction indicator, if equipped. Check the air intake and the exhaust system for the following defects: · Blockages · Restrictions · Damage to the air intake and exhaust lines and hose	Air intake and exhaust system	**Result**: The air filter restriction indicator has operated or the air filter is blocked. Make sure that the air filter is clean and serviceable. If necessary, replace the air filter. **Result**: The air intake or the exhaust system is blocked, restricted, or damaged. Repair the air intake or the exhaust system, as required. **Result**: The air intake or the exhaust system is OK. Proceed to Test Step 6.

6. 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. A. Check that the oil drain for the turbocharger is not blocked or restricted. B. Check the turbocharger for evidence of an internal oil leak.	Turbocharger	**Result**: The oil drain for the turbocharger is blocked or restricted. Remove the blockage or restriction. If necessary, replace the oil drain line. **Result**: The turbocharger has an internal oil leak. Replace the turbocharger. **Result**: The turbocharger is OK. Proceed to Test Step 7.
7. Low Compression (Cylinder Pressure) A. Perform a compression test.	Cylinder compression	**Result**: The results of the compression test are outside the specifications. Investigate the cause and rectify any faults. **Note**: 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 **Result**: The results of the compression test are OK. Contact the Perkins dealer.

Oil Contains Coolant

Probable Causes

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

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Engine Oil Cooler A. Drain the engine lubricating oil and coolant from the engine. Check for leaks in the oil cooler assembly.	Oil cooler	**Result**: Evidence of coolant in the oil system is identified. Install a new oil cooler. **Result**: No evidence of coolant in the oil system is found. Proceed to Test Step 2.
2. Cylinder Head Gasket A. Remove the cylinder head. Inspect the cylinder head gasket for faults and any signs of leakage.	Cylinder head gasket	**Result**: The cylinder head gasket is faulty or shows signs of leakage. Install a new cylinder head gasket. **Result**: The cylinder head gasket is OK. Proceed to Test Step 3.

3. Cylinder Head A. Check the cylinder head for flatness. B. 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 leak-age. C. Check the internal core plugs in the cylinder head for signs of leakage.	Cylinder head	**Result**: The cylinder head is not within specification for flatness. Install a new cylinder head. **Result**: The cylinder head shows signs of a fault or leakage. Install a new cylinder head. **Result**: An internal core plug in the cylinder head shows signs of leakage. Replace the faulty core plug. **Result**: The cylinder head is OK. Proceed to Test Step 4.
4. Cylinder Block A. Inspect the top face of the cylinder block for faults and signs of leakage.	Cylinder block	**Result**: The top face of the cylinder block has a fault. Replace the cylinder block. **Result**: The top face of the cylinder block shows signs of leakage. Determine the cause of the leakage. Result: The cylinder block is OK. Install the cylinder head. 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 Users Handbook, “Engine Oil and Filter - Change” for more information. Fill the cooling system. Refer to the Users Handbook for more information. Contact the Perkins dealer.

Oil Contains Fuel Measuring Fuel Dilution

Diesel fuel is chemically similar to the lubricants that are used in diesel engines. A slow fuel leak will blend the fuel into the oil. Normal operating temperatures may cause volatile parts of the fuel to vaporize. The fuel that remains in the oil is less volatile.

A closed cup flash test can be performed to detect fuel dilution. The flash test is designed to measure the volatile parts of the fuel that are remaining in the oil. Detecting less volatile fuel is difficult. The lack of volatility reduces the accuracy of the flash test.

Since the flash test does not accurately detect fuel dilution, do not use the flash test as the only measure of fuel dilution. Instead, verify the dilution by the following methods:

- Gas chromatograph fuel dilution test
- Oil viscosity

The test that uses a gas chromatograph is designed to measure fuel dilution in crankcase oils. The gas chromatograph can identify the small chemical differences between diesel fuel and lubricating oil. A gas chromatograph is used to measure fuel dilution at all Perkins regional SOS laboratories. Some Perkins dealers also use a gas chromatograph. Even though the gas chromatograph provides a more accurate measure of fuel dilution, always verify the results with the viscosity test.

A significant level of fuel dilution reduces oil viscosity. If an unacceptable level of fuel dilution is suspected, the kinematic viscosity of the oil must be measured.

Fuel dilution that is greater than 4 percent will usually cause viscosity that is less than the specified viscosity grade. If the oil is still within the specified viscosity grade, fuel dilution is unlikely to have reached an unacceptable level. Use the following chart to determine if viscosity has reached the minimum acceptable level. The guidelines of viscosity in the chart are slightly less than the limits of the SAE viscosity grades. However, these guidelines still provide adequate engine protection.

Viscosity Grade	Minimum Oil Viscosity at 100 °C with Fuel Dilution Greater Than 4% as Measured by a Gas Chromatograph	Action
0W-40 5W-40 10W-40 15W-40	12.0 cSt	Investigate the cause of fuel dilution or reduce the engine oil change interval.
0W-30 5W-30 10W-30	9.0 cSt	

Verifying Fuel Dilution

Always verify fuel dilution by the combination of a viscosity test and a gas chromatograph test that gives a result more than 4 percent. If a fuel dilution test cannot be performed locally, submit an oil sample to a Perkins dealer for analysis.

Probable Causes

- Fuel injector seals
- Fuel injector tip
- Fuel injection pump seal failure

Recommended Actions
Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Fuel Injector Seals A. Check for signs of damage to the seals for the fuel injectors.	Fuel injector seals	**Result**: Injector seals are damaged. Replace any damaged injector seals. Result: All injector seals are OK. Proceed to Test Step 2.
2. Fuel Injector Tip A. Check for signs of damage to the fuel injectors. Check the fuel injector tip for cracks or breakage.	Fuel injector tip	Result: A fuel injector is damaged. Replace the fuel injector. Result: All fuel injectors are OK. Contact the Perkins dealer.
3. Fuel Injection Pump Seal A. Check for signs of fuel injection pump seal failure.	Fuel Injection Pump Seal	**Result**: A fuel injection pump seal is damaged. Replace the fuel injection pump seal. The fuel injection pump seals are OK. Contact the Perkins dealer.

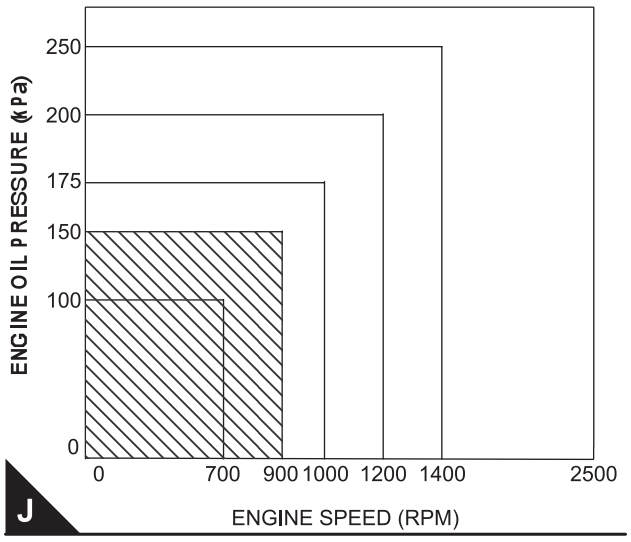
Oil Pressure Is Low

NOTICE

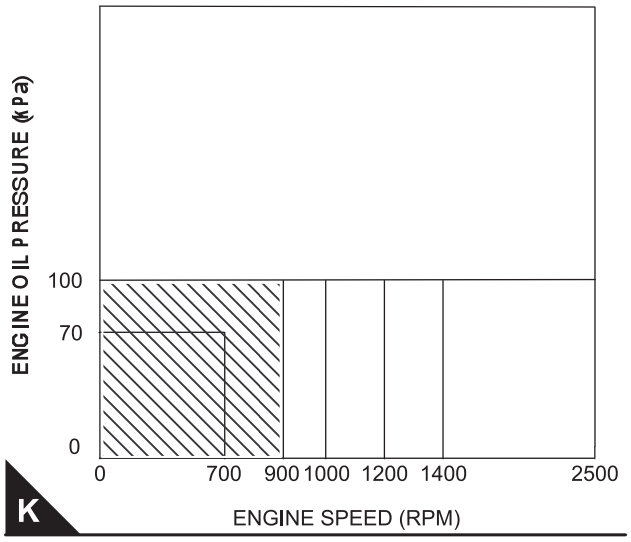
Do not operate the engine with low oil pressure. Engine damage will result. If measured oil pressure is low, discontinue engine operation until the fault is corrected.

The Electronic Control Module (ECM) monitors the engine oil pressure. The following codes are associated with low engine oil pressure:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
100-17	Engine Oil Pressure : Low - least severe (1)	The ECM has been powered for at least 2 seconds. The engine has been running for at least 10 seconds. There are no diagnostic trouble codes for the oil pressure sensor. There are no diagnostic trouble codes for the 5 VDC supply.
100-18	Engine Oil Pressure : Low - moderate severity (2)	The ECM has been powered for at least 2 seconds. The engine has been running for at least 10 seconds. There are no diagnostic trouble codes for the oil pressure sensor. There are no diagnostic trouble codes for the 5 VDC supply. The engine will be derated.
100-1	Engine Oil Pressure : Low - most severe (3)	The ECM has been powered for at least 2 seconds. The engine has been running for at least 10 seconds. There are no diagnostic trouble codes for the oil pressure sensor. There are no diagnostic trouble codes for the 5 VDC supply. The engine will be derated.



Diagnostic code 100-17 Engine Oil Pressure versus Engine Speed



Diagnostic code 100-1 Engine Oil Pressure versus Engine Speed

Probable Causes

- Engine oil level
- Oil specification
- Engine oil pressure
- Engine oil filter
- Engine oil cooler

Recommended Actions
Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Engine Oil Level A. Check the engine oil level.	Oil level	**Result**: The engine oil level is low. Fill the oil system to the full mark on the dipstick. **Result**: The engine oil level is OK. Proceed to Test Step 2.
2. Oil Specification A. Check that engine oil of the correct specification is being used. Refer to the Users Handbook, “Refill Capacities and Recommendations”.	Oil specification	**Result**: An incorrect specification of engine oil is being used. Drain the oil system and refill the oil system with engine oil of the correct specification. Refer to Users Handbook, “Engine Oil and Filter - Change”. **Result**: The engine contains oil of the correct specification. Proceed to Test Step 3.
3. Engine Oil Pressure A. 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.	Oil pressure	**Result**: The oil pressure reading from the electronic service tool and the pressure on the test gauge are different. Install a new oil pressure transmitter. **Result**: The oil pressure reading from the electronic service tool and the pressure on the test gauge are similar. Proceed to Test Step 4.
4. Engine Oil Filter A. Remove the engine oil filter. Refer to the Users Handbook, “Engine Oil and Filter - Change”. B. Inspect the engine oil filter for evidence of blockage.	Oil filter	**Result**: The oil filter is blocked. Install a new oil filter. Refer to the Users Handbook, “Engine Oil and Filter - Change” for further information. **Result**: The oil filter is OK. Install a new oil filter. Refer to the Users Handbook, “Engine Oil and Filter - Change” for further information. Proceed to Test Step 5.
5. Engine Oil Cooler A. Check the oil cooler for signs of damage or restrictions.	Oil cooler	**Result**: The oil cooler has signs of damage or restriction. Install a new oil cooler. **Result**: The oil cooler is OK. Proceed to Test Step 6.
6. Fuel in the Engine Oil A. Check fuel contamination of the engine oil. Refer to Troubleshooting, “Oil Contains Fuel”.	Oil contamination	**Result**: The oil contains fuel. Refer to Troubleshooting, “Oil Contains Fuel”. Result: The oil is not contaminated. Proceed to Test Step 7.
7. Piston Cooling Jets A. Inspect the piston cooling jets for cracks, damage, or missing jets.	Piston cooling jets	Result: A piston cooling jet is cracked, damaged, or missing. Install a new piston cooling jet. Result: The piston cooling jets are OK. Proceed to Test Step 8.

8. Engine Oil Suction Tube A. Check the inlet screen on the oil suction tube and remove any material that may be restricting oil flow. B. Check the joints of the oil suction tube for cracks or a dam-aged joint. **Note**: Cracks or damage may allow air leakage into the supply to the oil pump.	Oil suction tube	**Result**: The inlet screen on the oil suction tube is blocked with debris. Remove the debris from the inlet screen. **Result**: The oil suction tube is cracked. Install a new oil suction tube. The oil suction tube is OK. Proceed to Test Step 9.
9. Engine Oil Pump Pressure Relief Valve A. Inspect the components of the pressure relief valve for excessive wear or damage.	Pressure relief valve	**Result**: A component in the pressure relief valve is not within specification. Repair the pressure relief valve or replace the pressure relief valve, if necessary. The pressure relief valve is OK. Proceed to Test Step 10.
10. Engine Oil Pump A. Inspect the components of the engine oil pump for excessive wear.	Oil pump	**Result**: A component in the oil pump is not within specification. Repair the oil pump or replace the oil pump, if necessary. The oil pump is OK. Proceed to Test Step 11.
11. Bearing Clearance A. Inspect the engine components for excessive bearing clearance or damaged bearings. Inspect the following components for excessive bearing clearance: · Crankshaft main bearings · Connecting rod bearings · Camshaft front bearing · Idler gear bearing	Bearing clearance	**Result**: An engine bearing is not within specification. Install a new bearing. **Result**: All engine bearings are within specification. Contact the Perkins dealer.

Power Is Intermittently Low or Power Cutout Is Intermittent

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

Probable Causes

- Diagnostic codes
- ECM parameters
- ECM connection
- Fuel supply
- Intake manifold pressure

Recommended Actions

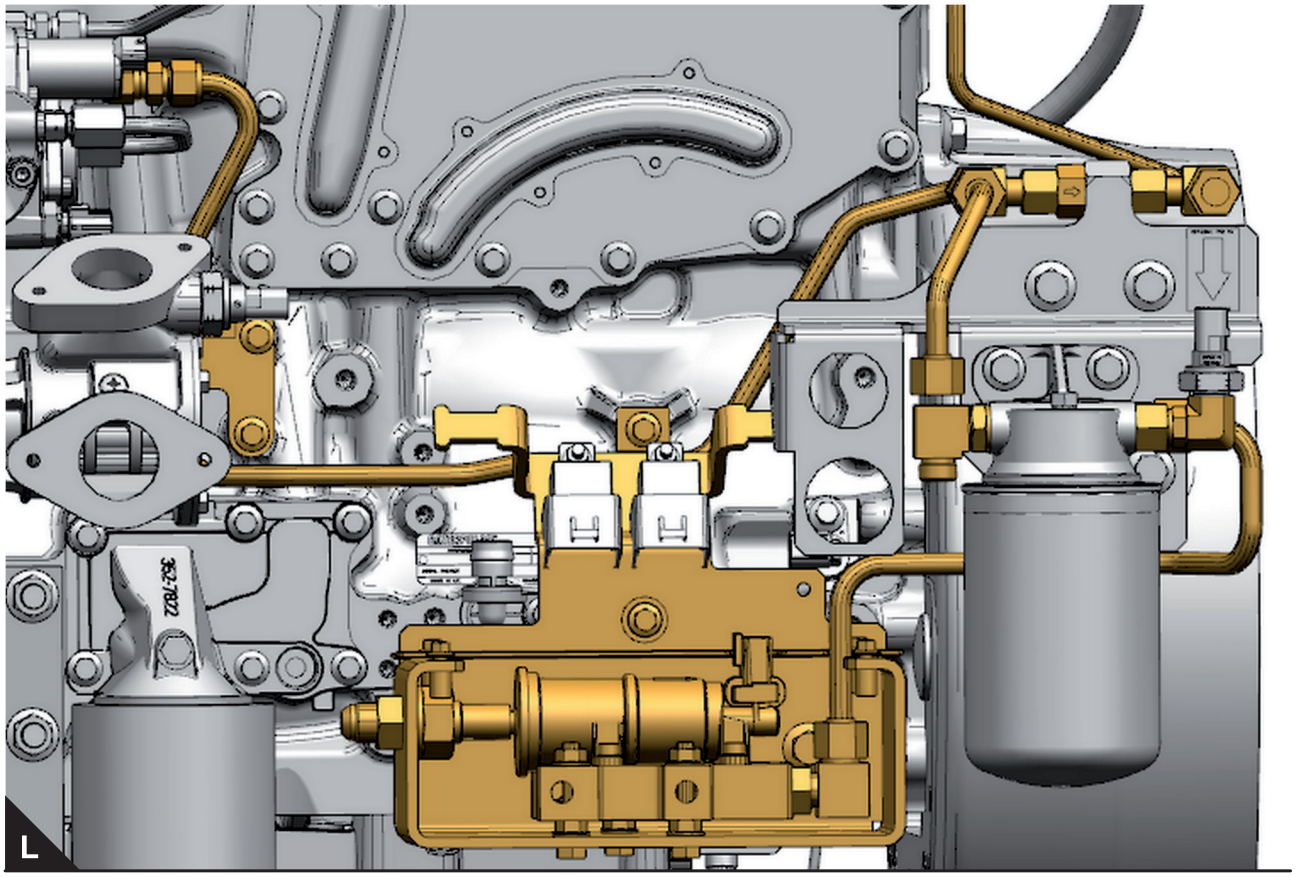
NOTICE

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.

Note: The procedures have been listed in order of probability. Complete the procedures in order.

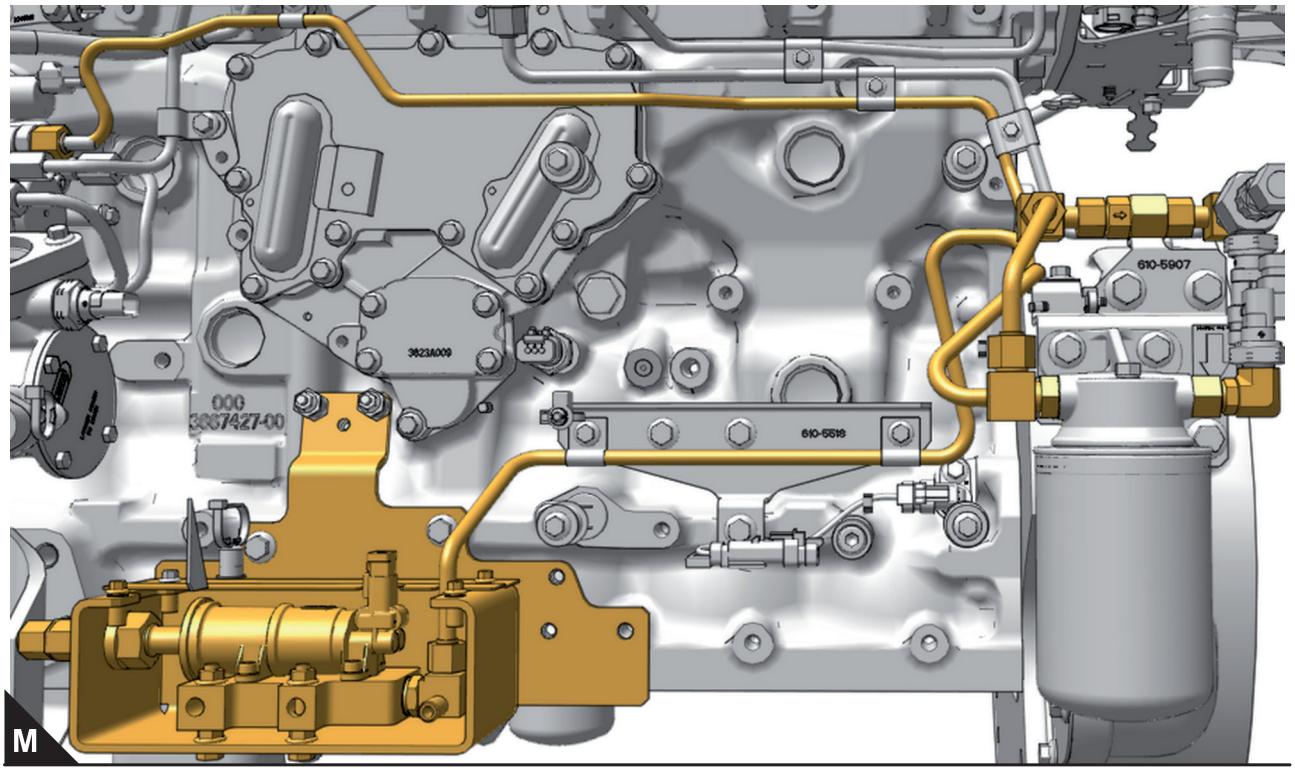
Troubleshooting Test Steps	Values	Results
1. Diagnostic Codes A. Establish communication between the electronic service tool and the Electronic Control Module (ECM). Refer to Troubleshooting, “Electronic Service Tools”, if necessary. B. Download the “Warranty Report” from the engine ECM before performing any troubleshooting or clearing diagnostic trouble codes. Troubleshoot any active codes before continuing with this procedure.	Diagnostic codes	**Result**: There are active or logged codes. Troubleshoot any codes before continuing with this procedure. **Result**: There are no active or logged codes. Proceed to Test Step 2.
2. ECM Parameters A. Use the electronic service tool to verify that the correct engine parameters are being used. Refer to Troubleshooting, “System Configuration Parameters” and Troubleshooting, “Customer Configuration Parameters” for additional information.	Parameters	**Result**: The parameters are not configured correctly. Correctly configure the parameters. Verify that the configuration change eliminated the fault. **Result**: The parameters are configured correctly. Proceed to Test Step 3.
3. ECM Connection A. Check that the P1 and P2 connectors are correctly installed. **Note**: If a fault is suspected with the ECM power or ground connections, refer to Troubleshooting, “Electrical Power Supply - Test”.	ECM connection	**Result**: An ECM connector is not correctly installed. Repair the electrical connector or replace the electrical connector. **Result**: Both ECM connectors are correctly installed. Proceed to Test Step 4.

4. Fuel Supply A. Ensure that the vent in the fuel cap is not filled with debris. B. Ensure that the fuel supply valve (if equipped) is in the full OPEN position. C. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax). D. Check the primary filter/water separator for water in the fuel. E. Check for fuel supply lines that are restricted. F. Replace the primary and secondary fuel filters. G. Check the diesel fuel for contamination. H. Check for air in the fuel system..	Fuel system	**Result**: The fuel contains solidified wax. Replace the fuel with fuel of the correct specification for the ambient conditions. **Result**: There are fuel supply lines that are restricted. Replace any damaged or restricted fuel lines. Replace the primary fuel filter and the secondary fuel filters. Refer to the Users Handbook for further information. **Result**: There is air in the fuel system. Prime the fuel system. **Result**: The diesel fuel is contaminated. Drain the fuel tank and the fuel system. Replace the primary fuel filter and the secondary fuel filters. Refer to the Users Handbook for further information. Fill and prime the fuel system with fuel of the correct specification. “Fuel System - Prime”. Result: The fuel supply is OK. Proceed to Test Step 5.



E44

(1). Electric Fuel Lift Pump (EFLP) Pressure



E70B

(1). Electric Fuel Lift Pump (EFLP) Pressure

Troubleshooting Test Steps	Values	Results
5. Electric Fuel Lift Pump (EFLP) Pressure Regulator Flow Test A. Disconnect the EFLP return line from the drain port on the EFLP. Install a suitable blanking cap on the open port in the EFLP return line. B. Connect a temporary drain line to the drain port on the EFLP. C. Place the end of the temporary drain line into a suitable calibrated container. D. With the isolator switch in the ON position but the engine not running, use a suitable multimeter to measure the input voltage to the EFLP. Record the reading. E. With the isolator switch in the ON position but the engine not running, measure the fuel flow from the temporary drain line. F. For a 12 VDC system, refer to Installation Guide for the minimum acceptable flow rate. G. For a 24 VDC system, refer to Installation Guide for the minimum acceptable flow rate. H. Remove the temporary drain line from the drain port on the EFLP. Connect the EFLP return line to the EFLP.	TPIR flow rate	**Result**: The fuel flow is greater than the minimum limit. Proceed to Test Step 8. **Result**: The fuel flow is less than the minimum limit. Proceed to Test Step 6.
6. Return Pressure Relief Valve Test A. Disconnect the return line from the secondary fuel filter base and install a blank on the line. Install a temporary line and a calibrated container to the filter base. B. With the isolator switch in the ON position, measure fuel flow from the temporary line. C. If the fuel flow is more than 300 mL/min (10.2 oz/min), re-place the secondary fuel filter base. D. Remove the temporary line and reconnect the return line. E. If the secondary fuel filter base has been replaced, attempt to start the engine. If the engine does not start, use the following procedure to check the fuel flow from the EFLP: F. Disconnect the fuel inlet from the primary fuel filter. Place the open end of the disconnected line into a calibrated container. G. With the isolator switch in the ON position, measure the flow from the fuel line.	PRV test	**Result**: The fuel flow is more than 5% below the acceptable limit. Replace the EFLP. **Result**: The fuel flow is more than 5% above the acceptable limit. Contact the Perkins dealer. **Result**: The fuel flow is within the acceptable limit. Proceed to Test Step 7.
7. Check the Return Fuel Lines A. Make sure that the EFLP return line is not blocked or kinked. B. If the EFLP return line is clear, confirm that the Electric Fuel Lift Pump (EFLP) is operating. Make sure that fuel lines between the EFLP and the EFLP regulator are not blocked or kinked.	Return lines	**Result**: The EFLP return line or the fuel lines between the EFLP and the EFLP regulator are blocked or kinked. Clear or replace the blocked line. **Result**: The EFLP return line and the fuel lines between the EFLP and the EFLP regulator are clear. Replace the EFLP. If the fault is still present, proceed to Test Step 8.

8. Intake Manifold Pressure A. Use the electronic service tool to verify the intake manifold pressure. Turn the isolator switch to the ON position. The intake manifold pressure must read 0 ± 0.5 kPa (0 ± 0.07 psi).	0 ± 0.5 kPa (0 ± 0.07 psi)	**Result**: The intake manifold pressure does not read 0 ± 0.5 kPa (0 ± 0.07 psi). Refer to Troubleshooting, “Intake Manifold Air Pressure Is Low”. **Result**: The intake manifold pressure reads 0 ± 0.5 kPa (0 ± 0.07 psi). Contact the Perkins dealer.

Sea Water Pump Pressure Is Low

This procedure is only applicable to applications with a raw water cooling system.

The following code is associated with low sea water pump outlet pressure:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
2435-17	Seawater Pump Outlet Pressure : Low - least severe (1)	The ECM detects that the outlet pressure of the sea water pump is below the trip point for 30 seconds. The warning lamp is lit and the code is logged.

Probable Causes

- Diagnostic code
- Pump inlet blocked
- Pump impeller damaged

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Check for Diagnostic Codes A. Establish communication between the electronic service tool and the Electronic Control Module (ECM). B. Download the “Warranty Report” from the engine ECM before performing any troubleshooting or clearing diagnostic trouble codes.	Diagnostic codes	**Result**: There are active or logged codes. Troubleshoot any codes before continuing with this procedure. **Result**: A 2435-17 code is active or recently logged. Proceed to Test Step 2.
2. Check the Inlet Pipe for the Sea Water Pump A. Disconnect the inlet pipe from the sea water pump. B. Check the inlet pipe for the following defects: · Blockages · Restrictions · Damage to the pipe · Loose connections	Inlet pipe	**Result**: The inlet pipe is blocked, restricted, damaged, or loose. Make all necessary repairs to the inlet pipe. Confirm that the fault has been eliminated. **Result**: The inlet pipe is OK. Do not reconnect the pipe. Proceed to Test Step 3.

3. Check the Sea Water Pump Impeller A. Crank the engine by hand and check the sea water pump impeller for damage.	Pump impeller	**Result**: The sea water pump impeller is damaged. Replace the impeller. Confirm that the fault has been eliminated. **Result**: The sea water pump impeller is OK. Contact the Perkins dealer.

Valve Lash Is Excessive

Probable Causes

- Lubrication
- Valve train components

Recommended Actions

Note: The procedures have been listed in order of probability. Complete the procedures in order.

Troubleshooting Test Steps	Values	Results
1. Lubrication A. Remove the valve mechanism cover. B. 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 with the valve mechanism cover removed.	Lubrication	**Result**: The oil flow to the valve mechanism is insufficient. Make sure that the passages for the engine oil are clear. **Result**: The oil flow to the valve mechanism is OK. Proceed to Test Step 2.
2. Valve Train Components A. Check the hydraulic lifters for correct operation. B. Inspect the following components of the valve train for abnormal or excessive wear, straightness, and cleanliness: · Rocker arms · Valve bridges · Pushrods · Hydraulic lifters · Camshaft · Valve stems · Rocker shaft	Valve train components	**Result**: A valve train component is worn, bent, or not clean. Repair or replace the component. **Note**: If the camshaft is replaced, new hydraulic lifters must also be installed. **Result**: All the valve train components are OK. If the valve lash is still excessive, contact the Perkins dealer.

Troubleshooting with a Diagnostic Code

Diagnostic Trouble Codes (Engine Diagnostic Trouble Codes)

The following table lists all the J1939 diagnostic trouble codes for the engine. The table includes a description for each code and the recommended troubleshooting procedure to be performed.

J1939 Code	Description	Refer to Procedure
94-3	Engine Fuel Delivery Pressure : Voltage Above Normal	Sensor Signal (Analog, Active) - Test
94-4	Engine Fuel Delivery Pressure : Voltage Below Normal	Sensor Signal (Analog, Active) - Test
95-15	Engine Fuel Filter Differential Pressure : High - least severe (1)	Fuel Filter is Restricted (Secondary Fuel Filter)
96-17	Fuel Level : Low - least severe (1)	This code does not indicate a fault. Replenish the fuel tank at the earliest opportunity.
100-1	Engine Oil Pressure : Low - most severe (3)	Oil Pressure is Low
100-3	Engine Oil Pressure : Voltage Above Normal	Sensor Signal (Analog, Active) - Test
100-4	Engine Oil Pressure : Voltage Below Normal	Sensor Signal (Analog, Active) - Test
100-17	Engine Oil Pressure : Low - least severe (1)	Oil Pressure is Low
100-18	Engine Intake Manifold #1 Pressure : Low - moderate severity (2)	Intake Manifold Air Pressure is Low
105-3	Engine Intake Manifold #1 Temperature : Voltage Above Normal	Sensor Signal (Analog, Passive) - Test
105-4	Engine Intake Manifold #1 Temperature : Voltage Below Normal	Sensor Signal (Analog, Passive) - Test
105-15	Engine Intake Manifold #1 Temperature : High - least severe (1)	Intake Manifold Air Pressure is High
105-16	Engine Intake Manifold #1 Temperature : High - moderate severity (2)	Intake Manifold Air Pressure is High
109-3	Engine Coolant Pressure : Voltage Above Normal	Sensor Signal (Analog, Active) - Test
109-4	Engine Coolant Pressure : Voltage Below Normal	Sensor Signal (Analog, Active) - Test
110-3	Engine Coolant Temperature : Voltage Above Normal	Sensor Signal (Analog, Passive) - Test
110-4	Engine Coolant Temperature : Voltage Below Normal	Sensor Signal (Analog, Passive) - Test
110-15	Engine Coolant Temperature : High - least severe (1)	Coolant Temperature is High
110-16	Engine Coolant Temperature : High - moderate severity (2)	Coolant Temperature is High
111-1	Engine Coolant Level : Low - most severe (3)	Coolant Level is Low
111-17	Engine Coolant Level : Low - least severe (3)	Coolant Level is Low
111-18	Engine Coolant Level : Low - moderate severity (2)	Coolant Level is Low
157-3	Engine Injector Metering Rail #1 Pressure : Voltage Above Normal	Sensor Signal (Analog, Active) - Test
157-4	Engine Injector Metering Rail #1 Pressure : Voltage Below Normal	Sensor Signal (Analog, Active) - Test
157-16	Engine Injector Metering Rail #1 Pressure : High - moderate severity (2)	Fuel Rail Pressure Problem
157-18	Engine Injector Metering Rail #1 Pressure : Low - moderate severity (2)	Fuel Rail Pressure Problem
168-2	Battery Potential / Power Input 1 : Erratic, Intermittent, or Incorrect	Electrical Power Supply - Test
168-3	Battery Potential / Power Input 1 : Voltage Above Normal	Electrical Power Supply - Test
168-4	Battery Potential / Power Input 1 : Voltage Below Normal	Electrical Power Supply - Test

173-0	Engine Exhaust Gas Temperature : High - most severe (3)	Exhaust Temperature is High
173-15	Engine Exhaust Gas Temperature : High - least severe (1)	Exhaust Temperature is High
173-16	Engine Exhaust Gas Temperature : High - moderate severity (2)	Exhaust Temperature is High
174-3	Engine Fuel Temperature 1 : Voltage Above Normal	Sensor Signal (Analog, Passive) - Test
174-4	Engine Fuel Temperature 1 : Voltage Below Normal	Sensor Signal (Analog, Passive) - Test
174-15	Engine Fuel Temperature 1 : High - least severe (1)	Fuel Temperature is High
174-16	Engine Fuel Temperature 1 : High - moderate severity (2)	Fuel Temperature is High
190-8	Engine Speed : Abnormal Frequency, Pulse Width, or Period	Speed / Timing - Test
190-15	Engine Speed : High - least severe (1)	Engine Overspeeds
190-0	Engine Speed : High - most severe (3)	Engine Overspeeds
630-2	Calibration Memory : Erratic, Intermittent, or Incorrect	Flash Programming
631-2	Calibration Module : Erratic, Intermittent, or Incorrect	ECM Memory - Test
637-11	Engine Timing Sensor : Other Failure Mode	Speed / Timing - Test
639-9	J1939 Network #1 : Abnormal Update Rate	CAN Data Link - Test
651-2	Engine Injector Cylinder # 01 : Erratic, Intermittent, or Incorrect	Injector Data Incorrect - Test
651-5	Engine Injector Cylinder # 01 : Current Below Normal	Injector Solenoid - Test
651-6	Engine Injector Cylinder # 01 : Current Above Normal	Injector Solenoid - Test
652-2	Engine Injector Cylinder # 02 : Erratic, Intermittent, or Incorrect	Injector Data Incorrect - Test
652-5	Engine Injector Cylinder # 02 : Current Below Normal	Injector Solenoid - Test
652-6	Engine Injector Cylinder # 02 : Current Above Normal	Injector Solenoid - Test
653-2	Engine Injector Cylinder # 03 : Erratic, Intermittent, or Incorrect	Injector Data Incorrect - Test
653-5	Engine Injector Cylinder # 03 : Current Below Normal	Injector Solenoid - Test
653-6	Engine Injector Cylinder # 03 : Current Above Normal	Injector Solenoid - Test
654-2	Engine Injector Cylinder # 04 : Erratic, Intermittent, or Incorrect	Injector Data Incorrect - Test
654-5	Engine Injector Cylinder # 04 : Current Below Normal	Injector Solenoid - Test
654-6	Engine Injector Cylinder # 04 : Current Above Normal	Injector Solenoid - Test
676-6	Engine Glow Plug Relay : Current Above Normal	Glow Plug Starting Aid - Test
677-5	Engine Starter Motor Relay : Current Below Normal	Relay - Test (Starting Motor Relay)
677-6	Engine Starter Motor Relay : Current Above Normal	Relay - Test (Starting Motor Relay)
678-3	ECU 8 Volts DC Supply : Voltage Above Normal	Sensor Supply - Test
678-4	ECU 8 Volts DC Supply : Voltage Below Normal	Sensor Supply - Test
723-8	Engine Speed Sensor #2 : Abnormal Frequency, Pulse Width, or Period	Speed / Timing - Test
1075-5	Engine Electric Lift Pump for Engine Fuel Supply : Current Below Normal	Relay - Test (EFLP Relay)
1075-6	Engine Electric Lift Pump for Engine Fuel Supply : Current Above Normal	Relay - Test (EFLP Relay)
1076-5	Engine Fuel Injection Pump Fuel Control Valve : Current Below Normal	Solenoid Valve - Test
1076-6	Engine Fuel Injection Pump Fuel Control Valve : Current Above Normal	Solenoid Valve - Test
1208-3	Engine Pre-filter Oil Pressure : Voltage Above Normal	Sensor Signal (Analog, Active) - Test
1208-4	Engine Pre-filter Oil Pressure : Voltage Below Normal	Sensor Signal (Analog, Active) - Test
1239-31	Engine Fuel Leakage 1	Fuel Rail Pressure Problem
1381-3	Engine Fuel Supply Pump Inlet Pressure : Voltage Above Normal	Sensor Signal (Analog, Active) - Test
1381-4	Engine Fuel Supply Pump Inlet Pressure : Voltage Below Normal	Sensor Signal (Analog, Active) - Test
2434-3	Engine Exhaust Manifold Bank #1 Temperature #1 : Voltage Above Normal	Sensor Signal (Analog, Active) - Test
2434-4	Engine Exhaust Manifold Bank #1 Temperature #1 : Voltage Below Normal	Sensor Signal (Analog, Active) - Test
2435-3	Seawater Pump Outlet Pressure : Voltage Above Normal	Sensor Signal (Analog, Active) - Test

2435-4	Seawater Pump Outlet Pressure : Voltage Below Normal	Sensor Signal (Analog, Active) - Test
2435-17	Seawater Pump Outlet Pressure : Low - least severe (1)	Seawater Pump Pressure is Low
3509-3	Sensor Supply Voltage 1 : Voltage Above Normal	Sensor Supply - Test
3509-4	Sensor Supply Voltage 1 : Voltage Below Normal	Sensor Supply - Test
3510-3	Sensor Supply Voltage 2 : Voltage Above Normal	Sensor Supply - Test
3510-4	Sensor Supply Voltage 2 : Voltage Below Normal	Sensor Supply - Test
3563-3	Engine Intake Manifold #1 Absolute Pressure : Voltage Above Normal	Sensor Signal (Analog, Active) - Test
3563-4	Engine Intake Manifold #1 Absolute Pressure : Voltage Below Normal	Sensor Signal (Analog, Active) - Test
3563-13	Engine Intake Manifold #1 Absolute Pressure : Calibration Required	Sensor Calibration Required - Test
5417-3	Fuel Filter (Suction Side) Intake Pressure : Voltage Above Normal	Sensor Signal (Analog, Active) - Test
5417-4	Fuel Filter (Suction Side) Intake Pressure : Voltage Below Normal	Sensor Signal (Analog, Active) - Test
5517-0	High Pressure Common Rail Fuel Pressure Relief Valve : Active	Fuel Rail Pressure Problem
5579-3	Engine Filtered Fuel Delivery Pressure : Voltage Above Normal	Sensor Signal (Analog, Active) - Test
5579-4	Engine Filtered Fuel Delivery Pressure : Voltage Below Normal	Sensor Signal (Analog, Active) - Test

Troubleshooting with an Event Code

Event Codes

An event code alerts the operator to an abnormal engine operating condition such as low oil pressure or high coolant temperature. As this engine normally reports faults as J1939 codes, event codes are only identifiable by the Failure Mode Identifier (FMI). The FMI is the second element of the fault code. All events are identified by the following FMIs:

FMI	Description
15	Parameter High - Least Severe (1)
16	Parameter High - Moderate Severity (2)
0	Parameter High - Most Severe (3)
17	Parameter Low - Least Severe (1)
18	Parameter Low - Moderate Severity (2)
1	Parameter Low - Most Severe (3)

The Electronic Control Module (ECM) can log events. Logged events usually indicate a mechanical fault instead of an electronic system fault or the engine is operating outside the design specification.

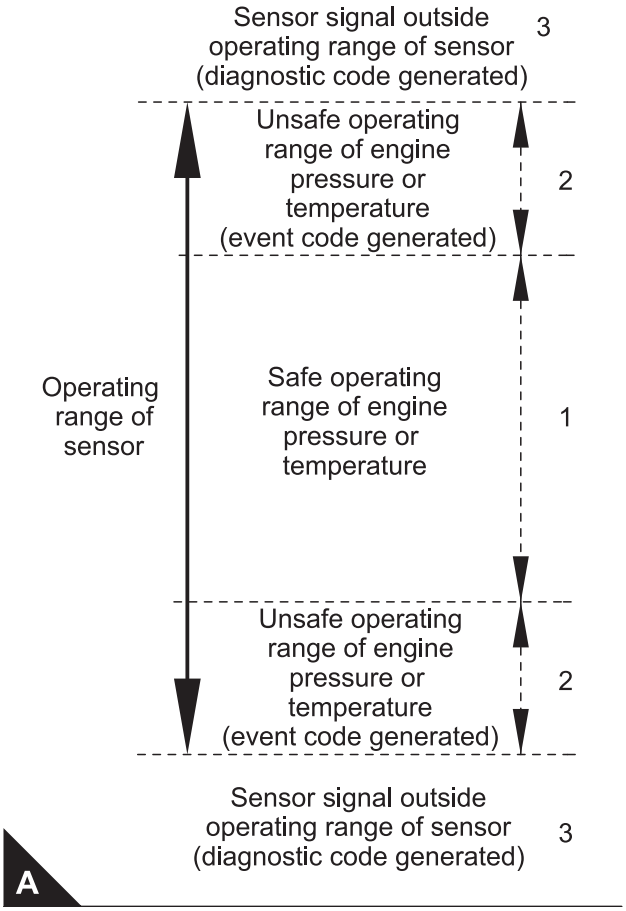
Note: If a diagnostic code has already been logged, any associated event code to that fault will not be logged.

Note: If an event code is already active, a diagnostic code that is associated with the same sensor will not be active.

Active Event Codes

An active event code represents a fault with engine operation. Correct the fault as soon as possible. Active event codes are listed in ascending numerical order. The code with the lowest number is listed first. Event codes will cause the warning lamp to illuminate and the event will be logged.

The following Illustration is an example of the operating range of an oil temperature sensor. Do not use the Illustration to troubleshoot the oil temperature sensor.



Example of the typical operating range of a sensor

(1). This area represents the normal operating range of the engine parameter.

(2). In these areas, the engine is operating in an unsafe operating range of the monitored parameter. An event code will be generated for the monitored parameter. The sensor circuit does not have an electronic fault.

(3). In these areas, the signal from the sensor is outside of the operating range of the sensor. The sensor circuit has an electronic fault. A diagnostic code will be generated for the sensor circuit. Refer to Troubleshooting, “Self Diagnostics” for additional information on diagnostic codes.

The following format is used for event codes:

“XXXX-YY Description of the event”

The “XXXX” represents a System Parameter Number for the event code. The “-YY” represents FMI for the severity of the event. The FMI is followed by a description of the event. Refer to the following example:

"100-17 Engine Oil Pressure : Low - Least Severe (1)"

In this example, the number "-17" indicates the severity of the event. The ECM has three levels of response to events:

Level (1) – This level can be referred to as the "Warning Level" . This condition represents a serious problem with engine operation. However, this condition does not require the engine to derate or shut down. The warning lamp will come on.

Level (2) – This level can be referred to as the "Derate Level" . For this condition, the ECM will derate the engine in order to help prevent possible engine damage. The warning lamp will flash.

Level (3) – This level can be referred to as the "Shutdown Level" . A "Level 3" event code will be logged in the ECM and the engine will shut down if the shutdown feature is enabled. The warning lamp will flash and the shutdown lamp will come on.

Responses to certain events may be programmed into the ECM. Refer to Troubleshooting, "System Configuration Parameters".

Logged Event Codes

When the ECM generates an event code, the ECM logs the code in permanent memory. The ECM has an internal diagnostic clock. The ECM will record the following information when an event code is generated:

- The hour of the first occurrence of the code
- The hour of the last occurrence of the code
- The number of occurrences of the code

Logged events are listed in chronological order. The most recent event code is listed first.

This information can be helpful for troubleshooting intermittent faults. Logged codes can also be used to review the performance of the engine.

Clearing Event Codes

A code is cleared from memory when one of the following conditions occur:

- The code does not recur for 100 hours.
- A new code is logged and there are already ten codes in memory. In this case, the oldest code is cleared.
- The service technician manually clears the code.

Always clear logged event codes after investigating and correcting the fault which generated the code.

Troubleshooting

For basic troubleshooting of the engine, perform the following steps in order to diagnose a malfunction:

1. Obtain the following information about the complaint from the operator:

- The event and the time of the event
- Determine the conditions for the event. The conditions will include the engine rpm and the load.
- Determine if there are any systems that were installed by the dealer or by the customer that could cause the event.
- Determine whether any additional events occurred.

2. Verify that the complaint is not due to normal engine operation. Verify that the complaint is not due to error of the operator.
3. Refer to Troubleshooting, "Diagnostic Trouble Codes". Perform the troubleshooting procedure that is shown against the reported code.

If these steps do not resolve the fault, identify the procedures in this manual that best describe the event. Check each probable cause according to the tests that are recommended.

Diagnostic Functional Tests

CAN Data Link - Test

Use this procedure if a fault is suspected in the CAN data link. Also, use this procedure if the following diagnostic code is active:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
639-9	J1939 Network #1 : Abnormal Up-date Rate	Another controller has incorrectly stopped transmitting data or another controller has in-correctly started transmitting data. The ECM will log the diagnostic code. The engine will not start.
Follow the troubleshooting procedure to identify the root cause of the fault.		

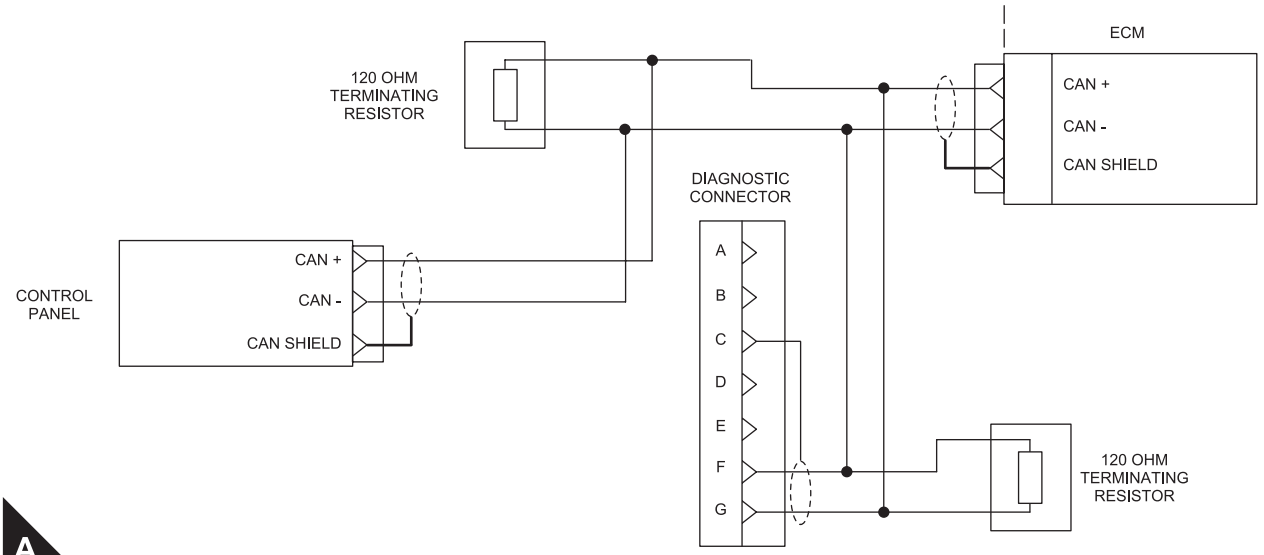
Note: Refer to Troubleshooting, “Sensors and Electrical Connectors” for the locations of the components listed in this procedure.

The following background information is related to this procedure:

The CAN data link is also known as the J1939 data links. A data link is an industry standard for sending data between different devices in the same application.

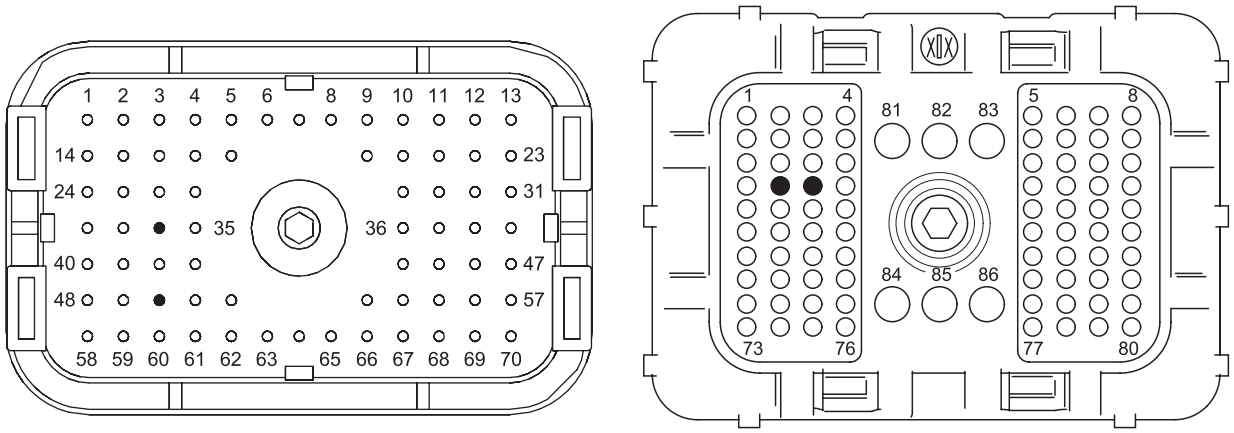
High-speed data is transferred via the data link. The data link cannot be accurately tested without complicated equipment. The data link requires a resistance of 60 Ohms between the two wires to transmit the data correctly. This resistance is made up of two 120 Ohm resistors. The two resistors are known as “Terminating Resistors” . The terminating resistors should be at opposite ends of a data link circuit. If this resistance is not present, then the data will be intermittent or unreadable.

Note: The wiring for a J1939 data link is a shielded twisted-pair cable. If the wiring is damaged, the replacement type must be shielded twisted-pair cable.



A

Schematic for the CAN data link



B A5E2v1 (70 pins) A5E2v2 (86 pins)

Pin locations on the P1 connector

A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
34	26	Primary J1939 Data Link -
50	25	Primary J1939 Data Link +

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring A. Turn the isolator switch to the OFF position. B. Inspect the connectors in the circuit for the CAN data link. 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. D. Check the screw for the ECM connectors for correct torque of 6 N·m (53 lb in). E. Check all wiring associated with the CAN data link for abrasions and pinch points.	Damaged wire or connector	**Result**: A damaged wire or damaged connector was found. Repair the damaged wire or the damaged connector. Use the electronic service tool to clear all logged diagnostic codes. Verify that the repair eliminates the fault. **Result**: A damaged wire or damaged connector was not found. Proceed to Test Step 2.
2. Check the Data Link Terminating Resistance A. Disconnect the P1 connector from the ECM. B. Measure the resistance between P1:50 or 25 and P1:34 or 26	Between 50 Ohms and 70 Ohms	**Result**: The resistance is less than 50 Ohms - there is a short circuit in the harness. 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 correctly connected. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: The resistance is between 110 and 130 Ohms - one of the terminating resistors may have failed. 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 on 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 110 and 130 Ohms, proceed to Test Step 4. **Result**: The resistance is greater than 150 Ohms. Proceed to Test Step 3. **Result**: The resistance is between 50 and 70 Ohms The resistance is correct . The fault may be in the connection to other devices on the data link. Proceed to Test Step 3.
3. Check the Data Link Wiring A. Disconnect each of the connectors that connect other devices on the data link. B. Use a multimeter to measure the resistance between P1:50 or 25 and the associated CAN+ pin on the control panel. C. Use a multimeter to measure the resistance between P1:50 or 25 and pin (G) on the diagnostic connector. D. Use a multimeter to measure the resistance between P1:34 or 26 and the associated CAN- pin on the control panel. E. Use a multimeter to measure the resistance between P1:34 or 26 and pin (F) on the diagnostic connector.	Less than two Ohms	**Result**: At least one of the resistance measurements is greater than two Ohms - there is an open circuit or high resistance in the wiring. 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 correctly connected. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair has eliminated the fault. **Result**: All measured resistances are less than two Ohms. Proceed to Test Step 4

4. Check the Other Devices on the CAN Data Link A. Use the appropriate service tools to diagnose other devices on the data link.	Other devices are OK	**Result**: At least one of the other devices is not operating correctly. Use the appropriate service tools to repair other devices on the data link. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: The other devices are operating correctly. Contact the Perkins dealer.

Data Link Circuit - Test

System Operation Description:

Use this procedure if the electronic service tool will not communicate with the 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 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 depends on the application.

The positive data link signal is from P1:8 to pin “D” of the diagnostic connector. The negative data link signal is from P1:9 to pin “E” of the diagnostic connector.

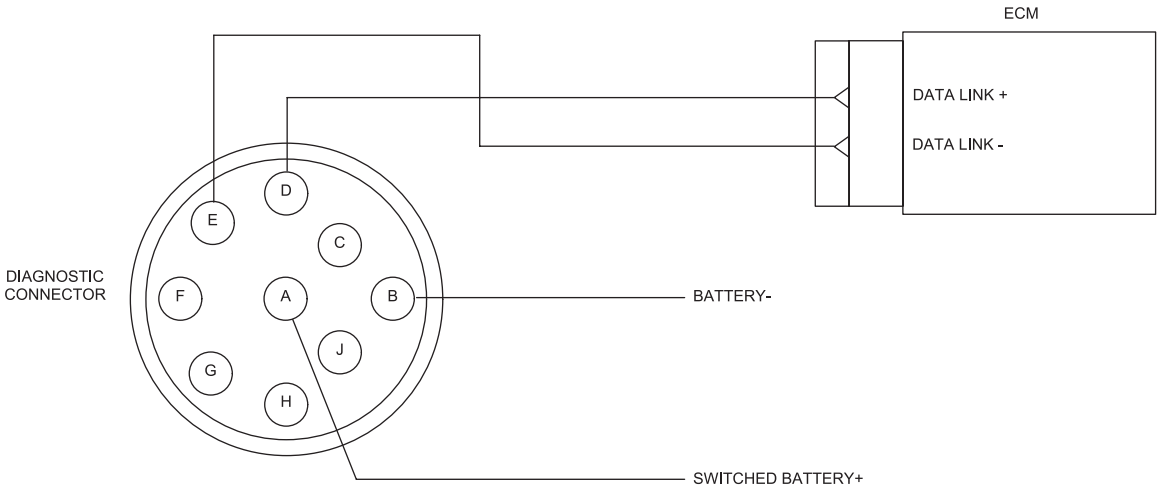
The following information refers to the pin number. Ensure that the correct connector is used.

Communication

The electronic service tool may indicate the following error message:

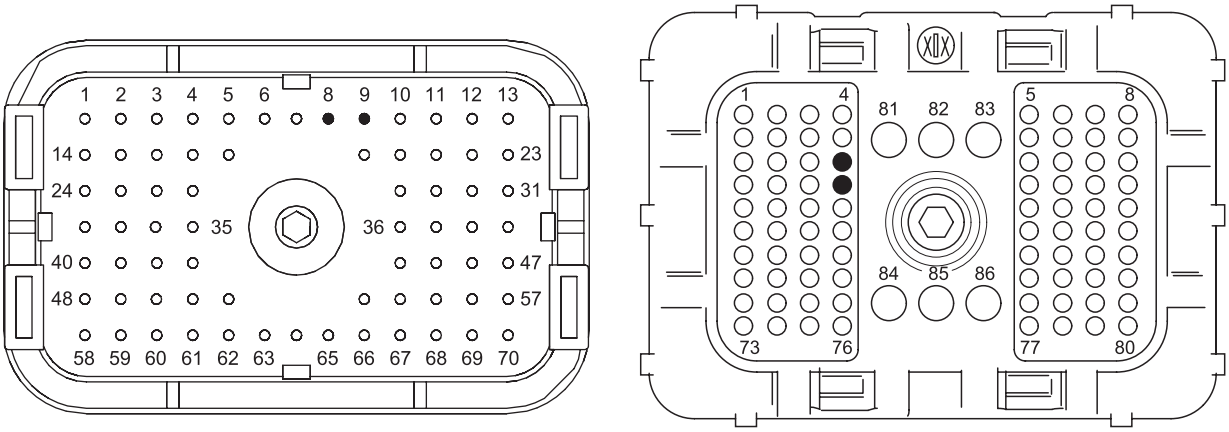
The version of the ECM is not recognized and the integrity of the changed parameters and displayed data is not guaranteed.

This message will indicate that the version of the software that is in the electronic service tool is obsolete. Install the latest version of the software for the electronic service tool in order to rectify the fault.



C

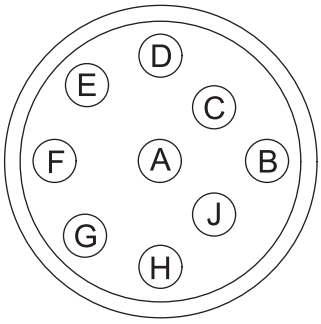
Schematic of the diagnostic connector and the data link connector (Refer to electrical schematics for complete information).



D A5E2v1 (70 pins) A5E2v2 (8 pins)

P1 pin locations for the diagnostic connector

A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
8	20	CDL+
9	28	CDL-



E

Typical view of the diagnostic connector from the wire side

(A) Switched battery +

(B) Battery ground (GND)

(D) Data link +

(E) Data link -

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring A. Turn the isolator switch to the OFF position. B. Thoroughly inspect the following electrical connectors: · P1/J1 ECM connector · Diagnostic connector 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 connectors that are associated with the data link. D. Check the screw for the ECM connectors for correct torque of 6N·m (53 lb in). E. Check the harness for abrasion and pinch points from the wires that connect the diagnostic connector to the ECM.	Damaged wire or connector	**Result**: A damaged wire or damaged connector was found. Repair the damaged wire or the damaged connector. Use the electronic service tool to clear all logged diagnostic codes. Verify that the repair eliminates the fault. **Result**: A damaged wire or damaged connector was not found. Proceed to Test Step 2.
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 isolator switch to the ON position.	Power lamp on	**Result**: The power lamp is not illuminated on the communications adapter - the communications adapter is not receiving the correct voltage. Proceed to Test Step 3. **Result**: The power lamp is illuminated on the communications adapter - the communications adapter is receiving the correct voltage. Proceed to Test Step 5.

3. Check the Battery Voltage at the Diagnostic Connector A. Disconnect the electronic service tool from the diagnostic connector. B. Turn the isolator switch to the ON position. C. Use a multimeter to measure the voltage from pin A (battery+) and pin B (ground) of the diagnostic connector.	11 VDC to 13.5 VDC for a 12 V system. 22 VDC to a 24 V system	**Result**: Not OK - the diagnostic connector is not receiving the correct voltage. Proceed to Test Step 4. **Result**: OK - the diagnostic connector is receiving the correct voltage. Proceed to Test Step 5
4. Bypass the Wiring for the Diagnostic Connector A. Disconnect the wires from pin A and pin B of the diagnostic connector. B. Fabricate a jumper wire to connect pin “A” of the diagnostic connector to battery+ and pin “B” to battery-. C. Connect the electronic service tool to the diagnostic connector. D. Turn the isolator switch to the ON position.	Power lamp on	**Result**: The power lamp on the communications adapter is illuminated - the fault is in the wiring. Repair the faulty harness or replace the faulty harness. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: The power lamp on the communications adapter is not illuminated. Proceed to Test Step 6.
5. Check the Data Link Connections A. Turn the isolator switch to the OFF position. B. Disconnect the communications adapter from the diagnostic connector. C. Disconnect the P1 connector from the ECM. D. Check the resistance between P1:8 or 20 and pin “D” on the diagnostic connector. E. Check the resistance between P1:9 or 28 and pin “E” on the diagnostic connector.	Less than two Ohms	**Result**: At least one of the measured resistances is greater than two Ohms - there is an open circuit or high resistance in the data link wiring. Repair the connectors and/or the harness, or replace the connectors and/or the harness. Ensure that all seals are correctly in place and ensure that the connectors are correctly connected. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: All resistance measurements are less than two Ohms. Proceed to Test Step 6.

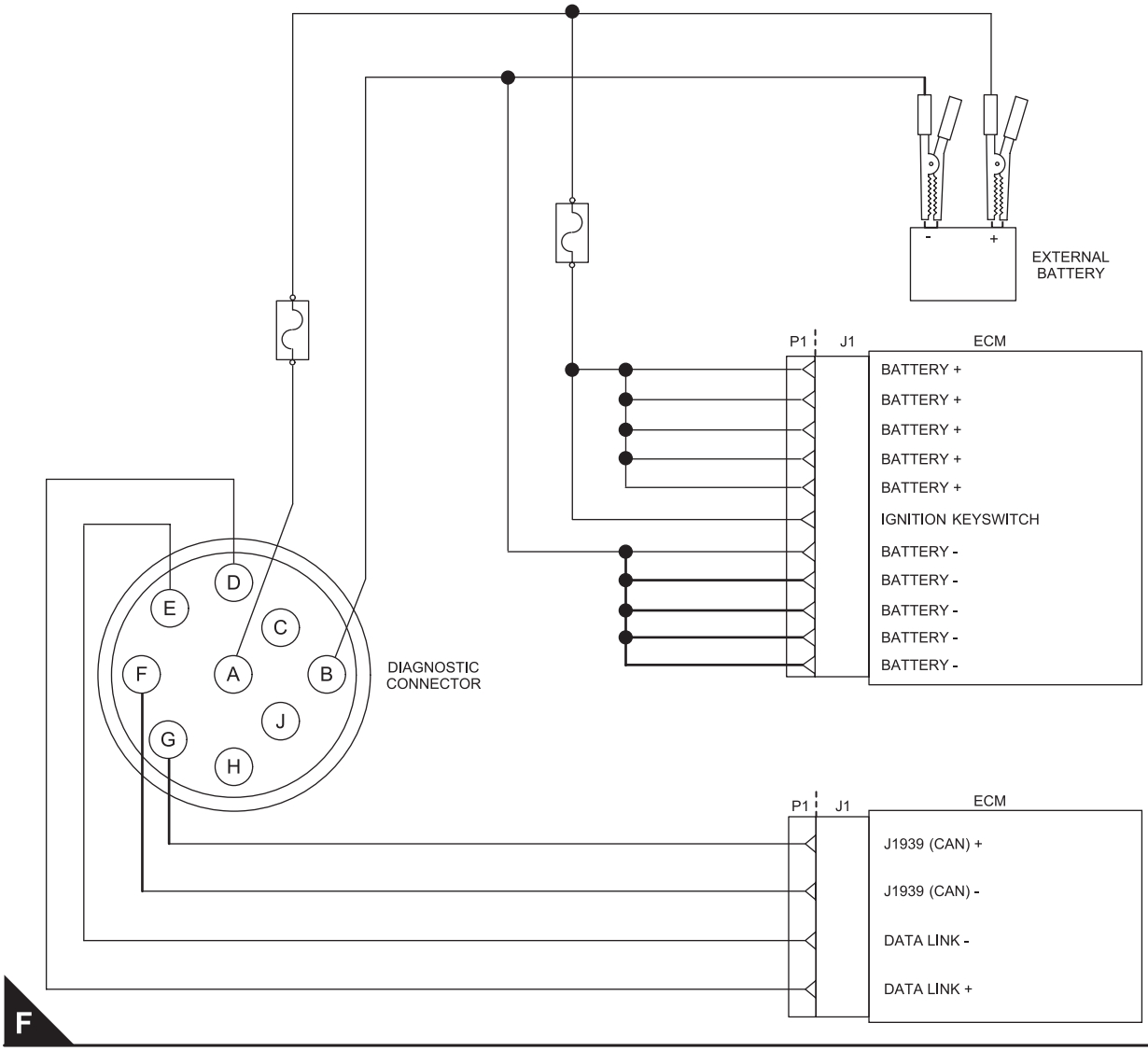
6. Change the Electronic Service Tool Components A. If another electronic engine is available, connect the electronic service tool to the other engine. Ensure that the same cables are used. B. Turn the isolator switch to the ON position. Determine if the electronic service tool operates correctly on the other engine. C. If another engine is not available, obtain a replacement communications adapter and a replacement set of cables. Ensure that the 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 isolator switch 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 original set 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 isolator switch to the ON position.	The electronic service tool operates correctly	**Result**: A different electronic service tool works on the original engine while the engine is being tested. Send the faulty electronic service tool for repairs. **Result**: The original electronic service tool works on another engine Proceed to Test Step 7.

⚠ WARNING

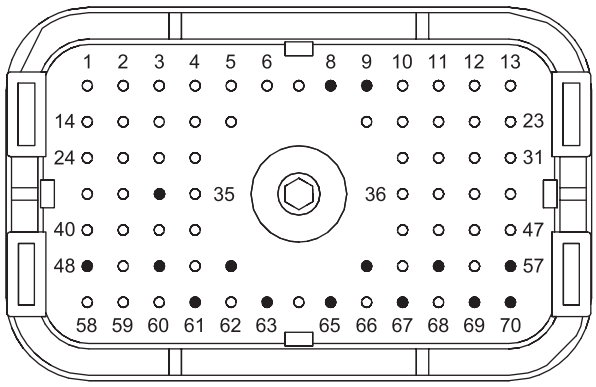
Batteries give off flammable fumes which can explode To avoid injury or death, do not strike a match, cause a spark, or smoke in the vicinity of a battery.

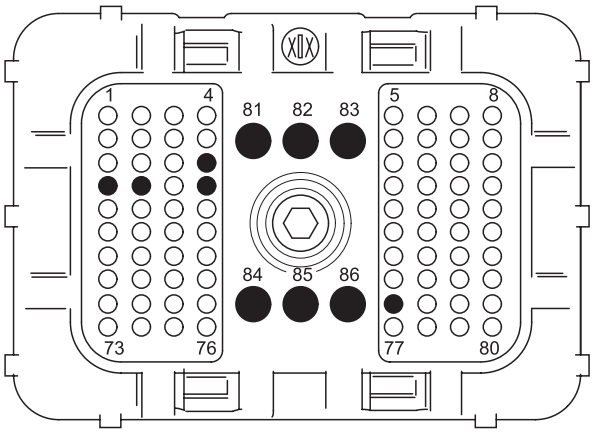
NOTICE

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.



Schematic of the bypass harness connector (Refer to electrical schematics for complete information)





G A5E2v1 (70pins) A5E2v2 (86pins)

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

A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
8	20	CDL+
9	28	CDL-
34	26	Primary J1939 Data Link -
48	84	ECM Power Supply
50	25	Primary J1939 Data Link +
52	85	ECM Power Supply
53	86	
55	-	
57	-	
61	81	ECM Power Return
63	82	
65	83	
67	-	
69	-	
70	69	Ignition Key Switch

Troubleshooting Test Steps	Values	Results
7. Connect an Electronic Service Tool and the ECM to another Battery A. Turn the isolator switch to the OFF position. B. Connect the battery wires from the bypass harness of the electronic service tool to a different battery that is not on the engine.	The electronic service tool operates correctly	**Result**: The electronic service tool operates correctly with the bypass harness - the fault is in the wiring. Refer to Troubleshooting, “Sensor Supply - Test”. **Result**: The electronic service tool is not operating correctly. Proceed to Test Step 8.

8. Check if a Replacement 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 the Perkins Dealer. Note: This consultation can greatly reduce the repair time. C. If the dealer recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”. D. Turn the isolator switch to the ON position. Use the electronic service tool to verify that the repair eliminates the fault.	Fault eliminated	**Result**: The fault is eliminated with the test ECM. Reconnect the suspect ECM. If the fault returns with the suspect ECM, permanently install the replacement ECM. **Result**: The fault is still present with the replacement ECM. Do not use the replacement ECM. Contact the Perkins Dealer.
7. Connect an Electronic Service Tool and the ECM to another Battery A. Turn the isolator switch to the OFF position. B. Connect the battery wires from the bypass harness of the electronic service tool to a different battery that is not on the engine.	The electronic service tool operates correctly	**Result**: The electronic service tool operates correctly with the bypass harness - the fault is in the wiring. Refer to Troubleshooting, “Sensor Supply - Test”. **Result**: The electronic service tool is not operating correctly. Proceed to Test Step 8.
8. Check if a Replacement 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 the Perkins Dealer. Note: This consultation can greatly reduce the repair time. C. If the dealer recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”. D. Turn the isolator switch to the ON position. Use the electronic service tool to verify that the repair eliminates the fault.	Fault eliminated	**Result**: The fault is eliminated with the test ECM. Reconnect the suspect ECM. If the fault returns with the suspect ECM, permanently install the replacement ECM. **Result**: The fault is still present with the replacement ECM. Do not use the replacement ECM. Contact the Perkins Dealer.

ECM Memory - Test

This procedure covers the following diagnostic code:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
631-2	Calibration Module : Erratic, Intermittent or Incorrect	The Electronic Control Module (ECM) detects incorrect engine software. If equipped, the warning light will come on. This diagnostic code is not logged. Factory passwords are required to clear this diagnostic code. The engine will not start. The flash file in the ECM is from the wrong engine family.

1. Confirm that a 631-2 diagnostic code is active.
2. If a 631-2 diagnostic code is active, obtain the engine serial number.
3. Use SIS Web to determine the latest available flash file for the engine. Verify that the latest available flash file is loaded into the ECM.
4. 4. If necessary, use the electronic service tool to install the correct flash file into the ECM. Refer to Troubleshooting, “Flash Programming”.
5. If the fault is still present, contact the Perkins dealer.

Electrical Connectors - Inspect

System Operation Description:

Most electrical faults are caused by poor connections. The following procedure will assist in detecting faults with connectors and with wiring. If a fault is found, correct the condition and verify that the fault is resolved.

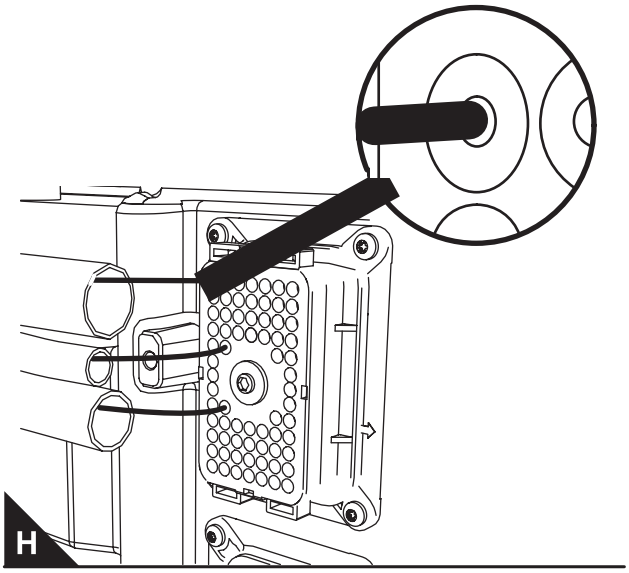
Intermittent electrical faults are sometimes resolved by disconnecting and reconnecting connectors. Check for diagnostic codes immediately before disconnecting a connector. Also check for diagnostic codes after reconnecting the connector. If the status of a diagnostic code is changed due to disconnecting 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 removal tool to remove the pins from the P1/P2 connectors.
- Always use a crimp tool to service Deutsch HD and DT connectors. Never solder the terminals onto the wires.
- Always use a removal tool to remove wedges from DT connectors. Never use a screwdriver to pry a wedge from a connector.
- Always use a crimp tool to service AMP seal connectors.
- Refer to Troubleshooting, “ECM Harness Connector Terminals” 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 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.



Leaky seal at the connector (typical example) Some components are not shown for clarity.

(1). Wire pulled to one side. Note the gap between the seal and the wire

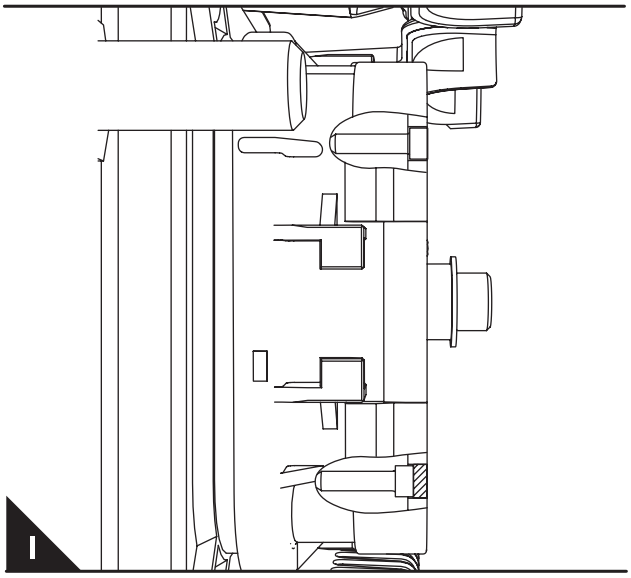
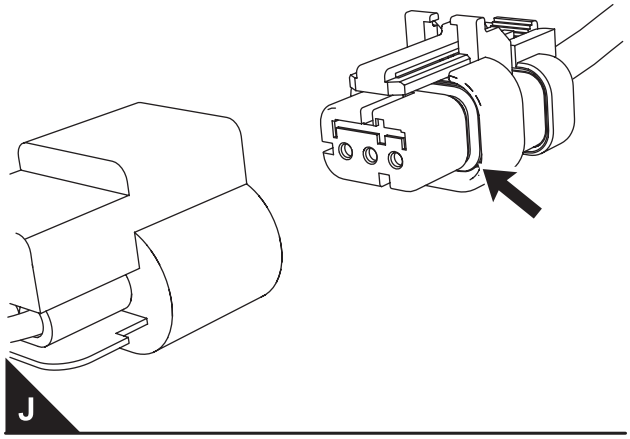


Diagram for the installation of a connector plug (typical example)

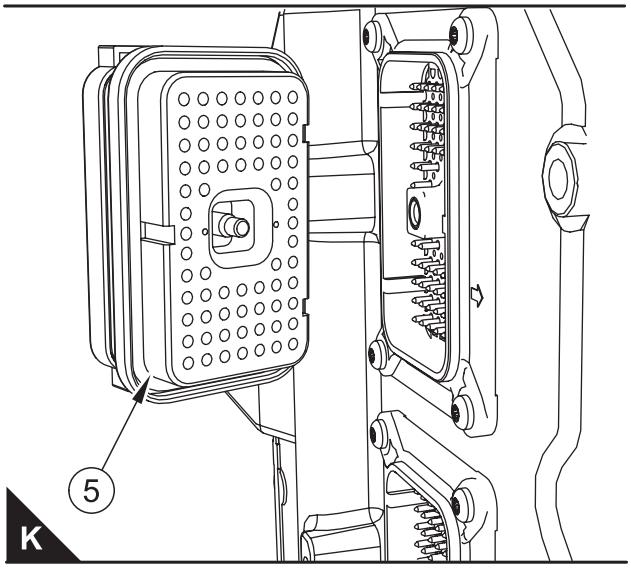
(2). ECM connector

(3). Correctly inserted plug

(4). Incorrectly inserted plug



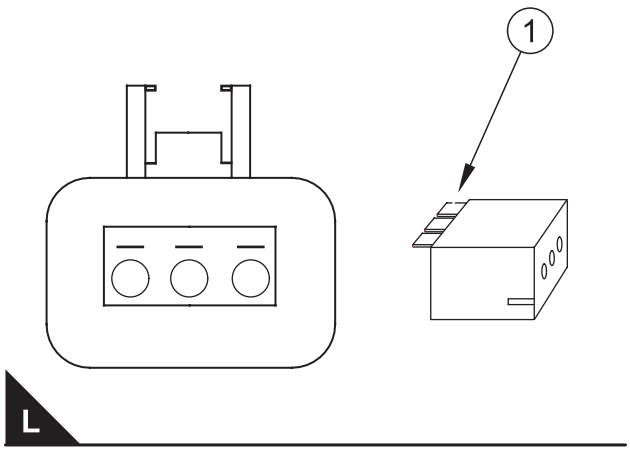
Seal for a three-pin connector (typical example)



(5). Seal for ECM connector

Troubleshooting Test Steps	Values	Results
1. Check Connectors for Moisture and Corrosion A. Inspect all the harnesses. Ensure that the routing of the wiring harness allows the wires to enter the face of each connector at a perpendicular angle. Otherwise, the wire will deform the seal bore. This situation will create a path for the entrance of moisture. Verify that the seals for the wires are sealing correctly. 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. 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**: Some minor seal abrasion on connector seals is normal. 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 repaired. If the source of the moisture entry is not repaired, the fault will recur. Simply drying the connector will not rectify 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 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.	Harness connectors and seals are OK	Result: A fault has been found with the harness or the connectors. 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 getting into the connector. Even if the moisture entry path is repaired, replacement of the wires may be necessary. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: The harness, connectors, and seals are in good condition. Proceed to Test Step 2.
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 edge B. Check the fasteners for the harness and the strain relief components on the ECM to verify that the harness is correctly secured. Also check all of the fasteners to verify that the harness is not compressed. Pull back the harness sleeves 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.	The wiring is OK	**Result**: There is damage to the harness. Repair the wires or replace the wires, as required. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: The wires are free of abrasion, nicks, and cuts and the harness is correctly clamped. Proceed to Test Step 3.

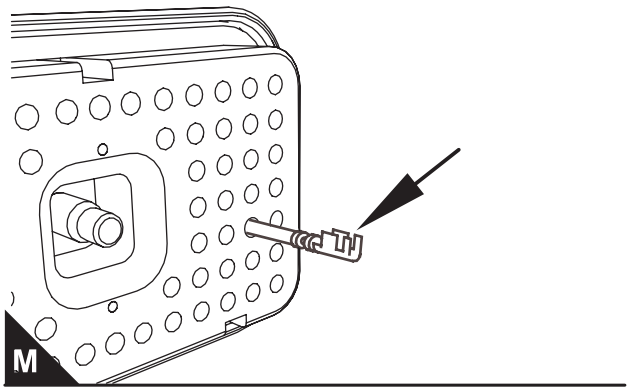
3. Inspect the Connector Terminals A. Visually inspect each terminal in the connector. Verify that the terminals are not damaged. Verify that the terminals are correctly aligned in the connector and verify that the terminals are correctly located in the connector.	Terminals are aligned and undamaged	**Result**: The terminals of the connector are damaged. Repair the terminals and/or replace the terminals, as required. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: The terminals are OK. Proceed to Test Step 4.



A typical example of the lock wedge.

(1). Lock wedge

Troubleshooting Test Steps	Values	Results
4. Perform a Pull Test on Each Wire Terminal Connection 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.	Pull test OK	**Result**: A wire has been pulled from a terminal or a terminal has been pulled from the connector in the 45 N (10 lb) pull test. Use a crimp tool to replace the terminal. Replace damaged connectors, as required. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: All terminals pass the pull test. Proceed to Test Step 5.



Troubleshooting Test Steps	Values	Results
5. Check Individual Pin Retention into the Socket A. Verify that the sockets provide good retention for the pins. Insert a new pin into each socket one at a time to check for a good grip on the pin by the socket.	The sockets provide good retention for the new pin.	**Result**: Terminals are damaged. Use a crimp tool to replace the damaged terminals. Verify that the repair eliminates the problem. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: The terminals are OK. Proceed to Test Step 6.
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.	The connectors are locked and are not damaged	**Result**: The locking mechanism for the connector is dam-aged or missing. Repair the connector or replace the connector, as required. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: The connectors are in good condition. Proceed to Test Step 7.
7. Check the Screws on the ECM Connectors (70/80 way) A. Visually inspect the screws for the ECM connectors. Ensure that the threads on each screw are not damaged. B. Connect the ECM connectors. C. Use a 7 mm Torx screw to retain each of the ECM connectors. D. Tighten the two Torx screws for the ECM connector to the correct torque of 6 N·m (53 lb in).	The ECM connectors are secure.	**Result**: The screws for the ECM connectors are damaged or a threaded hole in the ECM is damaged. Repair the connectors or replace the connectors or screws, as required. If a threaded hole in the ECM is damaged, replace the ECM. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: The ECM connectors are secured. Proceed to Test Step 8.
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 to reproduce intermittent faults. If an intermittent fault exists, the status will be highlighted and an audible beep will be heard.	Intermittent faults were indicated	**Result**: No intermittent faults were found. If you were sent from another procedure, return to the procedure and continue testing. If this test confirms that the fault has been eliminated, return the engine to service. **Result**: At least one intermittent fault was indicated. Repair the harness or the connector. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

Electrical Power Supply - Test

This procedure tests that the correct voltage is being supplied to the Electronic Control Module (ECM).

This procedure covers the following codes:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
168-2	Battery Potential / Power Input 1 : Erratic, Intermittent, or Incorrect	This code indicates that the battery circuit for the ECM is intermittent while the engine is running. The ECM detects the following conditions: Three voltage readings that are below 6 VDC in a period of 7 seconds will be detected by the ECM. The voltage must then increase to more than 9 VDC. The isolator switch is in the ON position. The engine is running. The engine is not cranking. The diagnostic code will be logged. If the battery voltage disappears without returning, the ECM will not log this diagnostic code and the engine will shut down. The check engine lamp and the warning lamp may come on. The engine may experience changes in the engine rpm, and intermittent engine shut-downs or complete engine shutdowns while the diagnostic code is present. The ECM may stop injecting fuel, depending on the length of time for the occurrence of the fault.
168-3	Battery Potential / Power Input #1 : Voltage Above Normal	This code indicates that the battery circuit to the ECM has excessive voltage while the engine is running. The ECM detects the following conditions: For 24 V systems, the battery voltage to the ECM exceeds 32 VDC for more than 0.5 seconds. For 12 V systems, the battery voltage to the ECM exceeds 16 VDC for more than 0.5 seconds. The isolator switch is in the ON position. The engine is not cranking. The engine has been running for more than 5 seconds. The ECM will log the diagnostic code. If equipped, the warning lamp may come on.

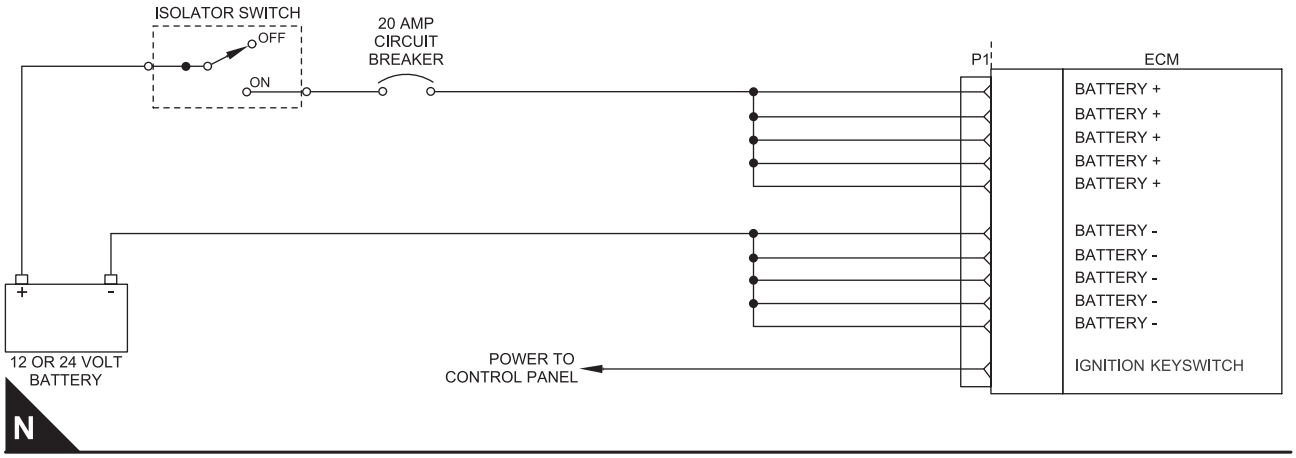
168-4	Battery Potential / Power Input 1 : Voltage Below Normal	This code indicates that the battery circuit for the ECM has low voltage while the engine is running. The ECM detects the following conditions: For 24 V systems, the battery voltage to the ECM is below 18 VDC for more than 0.5 seconds. For 12 V systems, the battery voltage to the ECM is below 9 VDC for more than 0.5 seconds. The isolator switch is in the ON position. The engine is not cranking. The engine has been running for more than 3 seconds. If equipped, the warning lamp may 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. The engine will derate 100 percent. The engine may experience changes in rpm, intermittent engine shutdowns, or complete engine shutdowns while this diagnostic code is present.
Follow the troubleshooting procedure to identify the root cause of the fault.		

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: 48 or 84, 52 or 85, 53 or 86, 55, and 57. The battery- is supplied through P1: 61 or 81, 63 or 82, 65 or 83, 67, and 69. The ECM receives the input from the isolator switch at P1:70 or 69 when the isolator switch is in the ON 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.

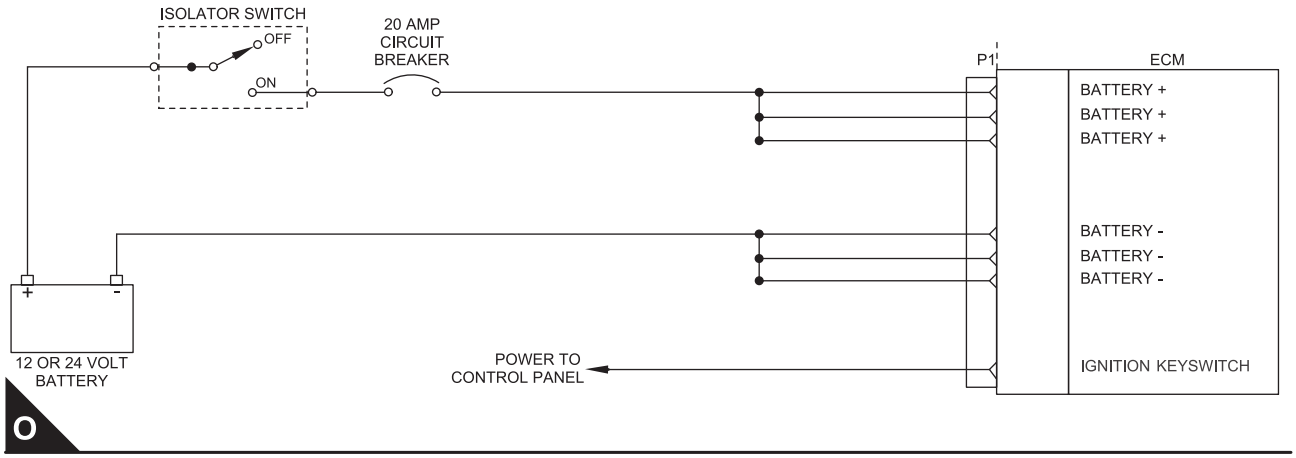
An intermittent power supply to the ECM can occur on either the positive side or on the negative side of the battery circuit. The connections for the unswitched battery+ are routed through a dedicated protection device (circuit breaker).

The engine ECM requires the isolator switch to be in the ON position to maintain communications.

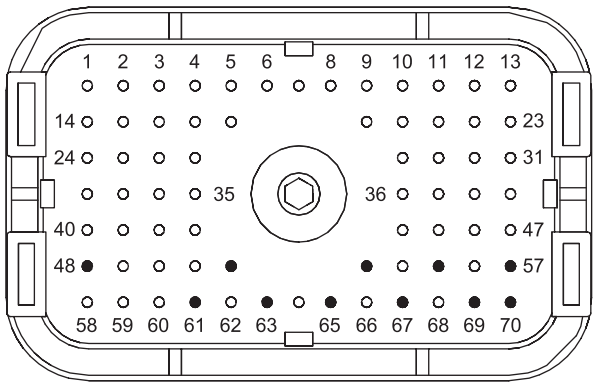
For intermittent faults, temporarily bypassing the application wiring may be an effective means of determining the root cause. If the symptoms disappear with the bypass wiring, the application wiring is the cause of the fault. A means of bypassing the application wiring is explained in this test procedure.

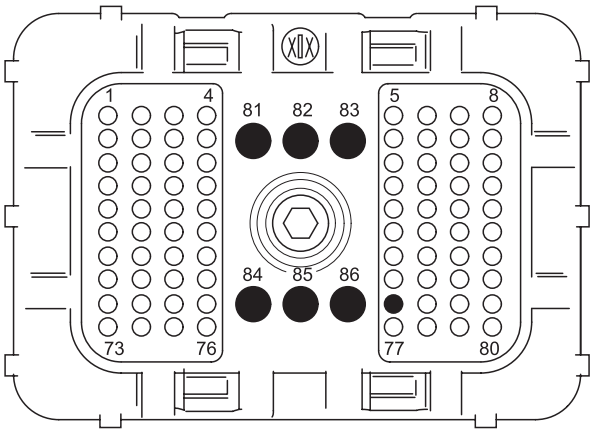


Schematic for the electrical power supply circuit (Constant Speed)



Schematic for the electrical power supply circuit (Variable Speed)





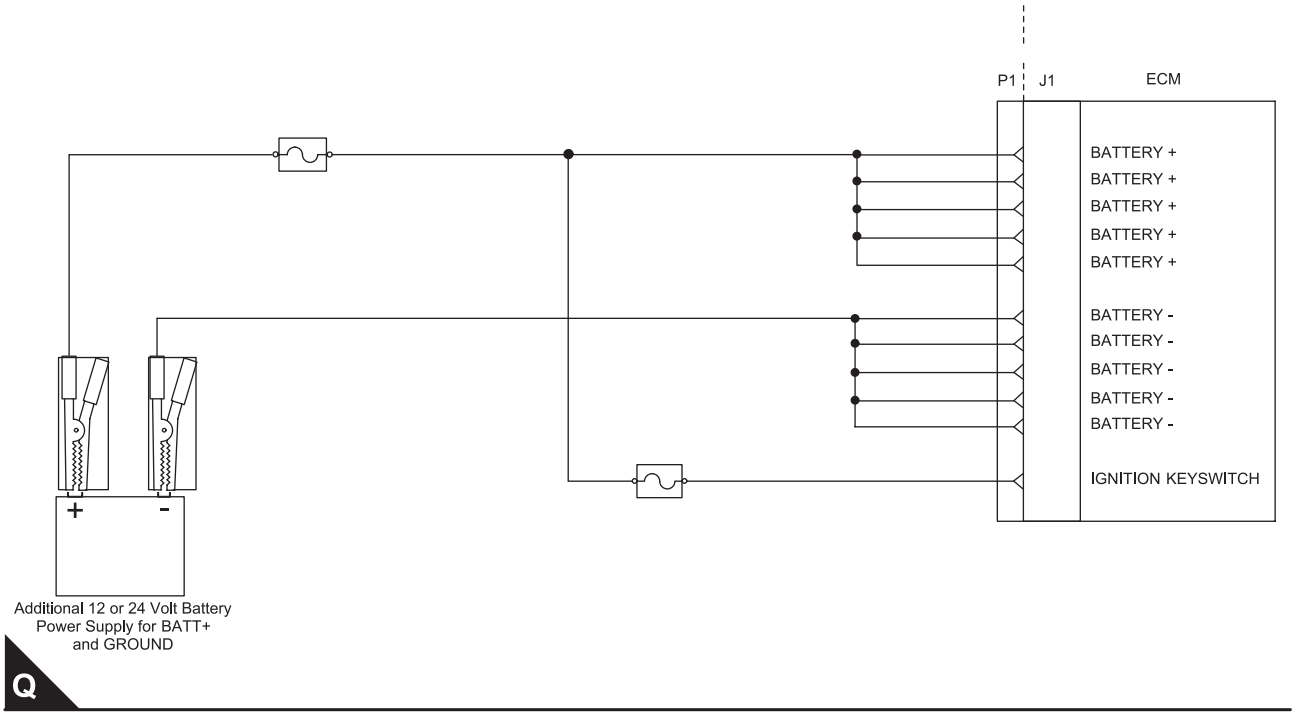
P A5E2v1 (70pins) A5E2v2 (86pins)

View of the pin locations on the P1 connector for the isolator switch and battery supply circuit

A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
48	84	ECM Power Supply
52	85	ECM Power Supply
53	86	ECM Power Supply
55	-	ECM Power Supply
57	-	ECM Power Supply
61	81	ECM Power Return
63	82	ECM Power Return
65	83	ECM Power Return
67	-	ECM Power Return
69	-	ECM Power Return
70	69	Ignition Key Switch

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring A. Thoroughly inspect the battery connections and the connections to the isolator switch. 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 electrical power sup-ply circuit. C. Check the ECM connector for the correct torque of 5 N·m (44 lb in) D. Check the harness for abrasion and for pinch points from the battery through the isolator switch to the ECM.	Damaged wire or connector	**Result**: A damaged wire or damaged connector was found. Repair the damaged wire or the damaged connector. Use the electronic service tool to clear all logged diagnostic codes. Verify that the repair eliminates the fault. **Result**: All connectors, pins, and sockets are correctly connected and/or inserted and the harness is free of corrosion, of abrasion, or of pinch points. Proceed to Test Step 2.

2. Check for Active Diagnostic Codes or Logged Diagnostic Codes A. Connect the electronic service tool to the diagnostic connector. B. Turn the isolator switch to the ON position and start the engine. 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 for the diagnostic codes to be-come active.	Diagnostic codes	**Result**: There are no active 168 diagnostic codes currently. If the fault is intermittent, refer to Troubleshooting, “Electrical Connectors - Inspect”. If the ECM is receiving no battery voltage, proceed to Test Step 3. **Result**: There is an active 168 diagnostic code. Proceed to Test Step 3.
3. Check the Batteries A. Load-test the batteries. Use a suitable battery load tester. Refer to Systems Operation, Testing and Adjusting, “Battery -Test” for the correct procedure.	Battery load test passed	**Result**: The batteries do not pass the load test. For 12 V systems, the measured voltage is less than 11.0 VDC. For 24 V systems, the measured voltage is less than 22.0 VDC. Recharge or replace the faulty batteries. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: The batteries pass the load test. For 12 V systems, the measured voltage is at least 11.0 VDC. For 24 V systems, the measured voltage is at least 22.0 VDC. Proceed to Test Step 4.
4. Check the Battery Voltage at the ECM Connector A. Disconnect the P1 connector from the ECM. B. Turn the isolator switch to the ON position. C. Measure the voltage between the following points: · P1:48 or 84 and P1:61or 81 · P1:52 or 85 and P1:63 or 82 · P1:53 or 86 and P1:65 or 83 · P1:55 and P1:67 · P1:57 and P1:69 · P1:70 or 69 and P1:69	At least 11 VDC for a 12 V sys-tem. At least 22 VDC for a 24 V system.	**Result**: The measured voltage is within the expected range -the ECM is receiving the correct voltage. If an intermittent fault is suspected, refer to Troubleshooting, “Electrical Connectors - Inspect”. **Result**: The measured voltage is not within the expected range. Proceed to Test Step 5.



Schematic for the bypass application harness

⚠ WARNING

Batteries give off flammable fumes which can explode. To avoid injury or death, do not strike a match, cause a spark, or smoke in the vicinity of a battery.

NOTICE

Do not connect the bypass harness to the battery until all of the in-line fuses have been removed from the Battery + line. If the fuses are not removed before connection to the battery, a spark may result

Note: This bypass harness is only for test applications. This bypass harness must be removed before the application is released to the customer. The bypass harness is used to determine if there are interruptions in power to the ECM or to the isolator switch circuit.

Troubleshooting Test Steps	Values	Results
5. Bypass the Application Harness A. Turn the isolator switch 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 battery 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 J2:46 and ground. The voltage should be +5 VDC. **Note**: Remove the bypass harness and restore all wiring to the original condition after testing.	4.9 to 5.1 VDC	**Result**: The measured voltage is correct. The symptoms disappear when the bypass harness is installed - the fault is in the application wiring. Check for aftermarket engine protection switches that interrupt power. Repair the faulty wiring or replace the faulty wiring. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The measured voltage is incorrect. Proceed to Test Step 6.
6. Check if a Replacement 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 the Perkins Dealer. Note: This consultation can greatly reduce the repair time. C. If the dealer recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”. D. Turn the isolator switch to the ON position. Use the electronic service tool to verify that the repair eliminates the fault.	Fault eliminated	**Result**: The fault is eliminated with the test ECM. Reconnect the suspect ECM. If the fault returns with the suspect ECM, permanently install the replacement ECM. **Result**: The fault is still present with the replacement ECM. Do not use the replacement ECM. Contact the Perkins Dealer.

Glow Plug Starting Aid - Test

(If Equipped)

This procedure covers the following diagnostic code:

Use this procedure if there is a suspected fault in the glow plug start aid circuit or the glow plugs.

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
676-6	Engine Glow Plug Relay : Current Above Normal	The Electronic Control Module (ECM) detects the following conditions: The engine is not cranking. The ECM has been powered for at least one second. There is a high current condition (short circuit) in the glow plug start aid relay circuit for more than 2 seconds. If equipped, the warning light will come on. 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. 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.
Follow the troubleshooting procedure to identify the root cause of the fault.		

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 isolator switch in the ON position, the ECM monitors the following parameters to decide if the glow plugs need to be switched ON:

- Coolant temperature
- Intake manifold air temperature

If the glow plugs are required, then the ECM will activate the glow plug and glow plug earth relays for a controlled period. While the glow plug relays are activated, the glow plug start aid relay will supply power to the glow plugs. If a “Wait To Start” lamp is installed, then this lamp will be illuminated to indicate the “Wait To Start” period.

“Wait to Start Lamp”

This feature may be included as an option.

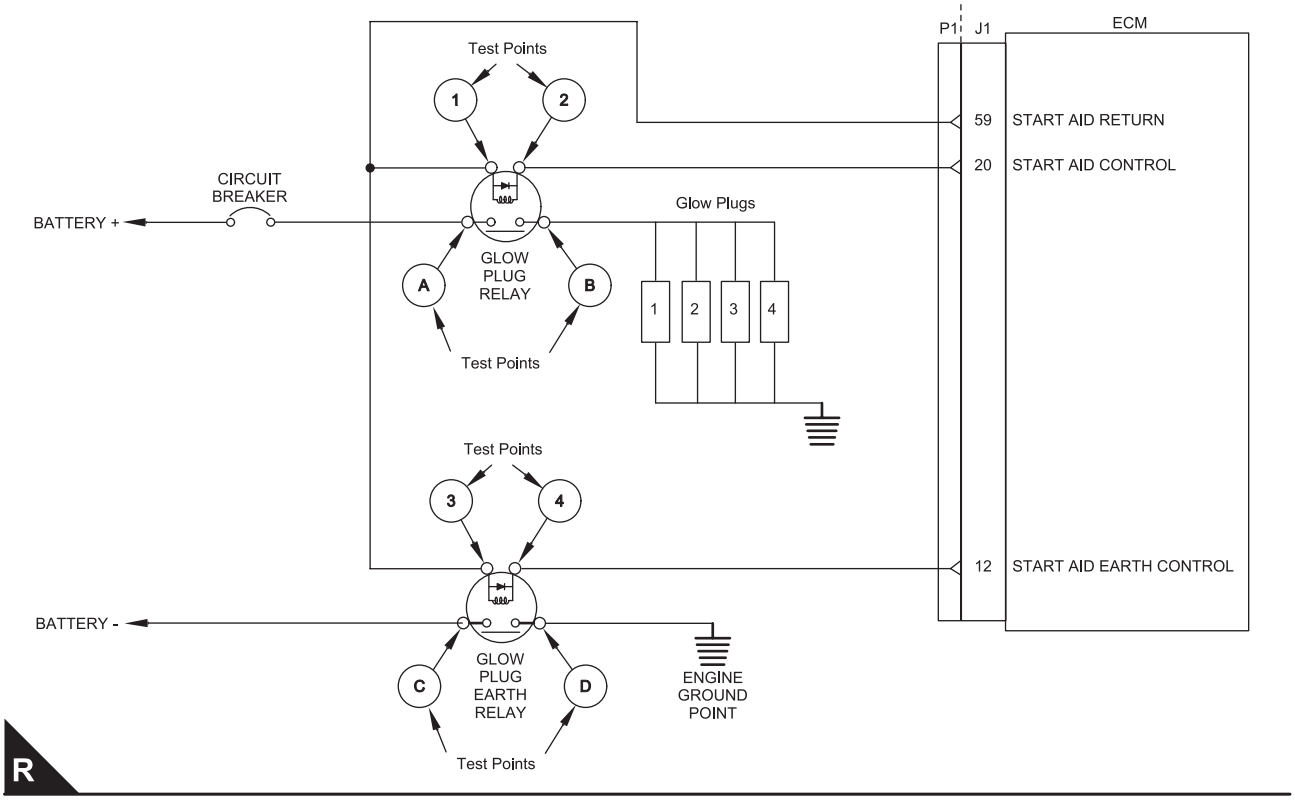
When glow plugs need to be activated prior to starting, a lamp will indicate that the operator needs to “Wait to Start” . Starting aids may be used during the cranking of the engine. Starting aids may be used if the engine has previously been started. The “Wait to Start” lamp will not be active in these conditions.

Electronic Service Tool Test Aid

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

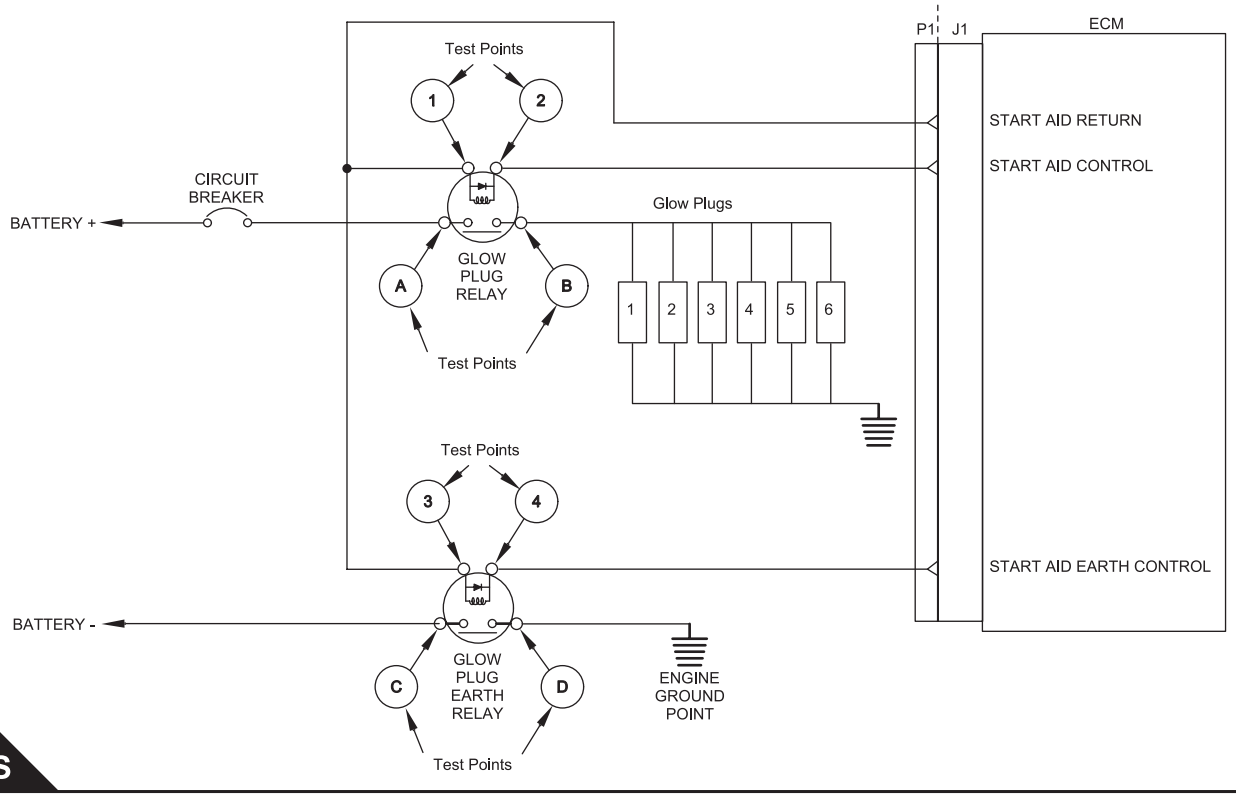
Overview of the Glow Plug Start Aid Override Test

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



E44

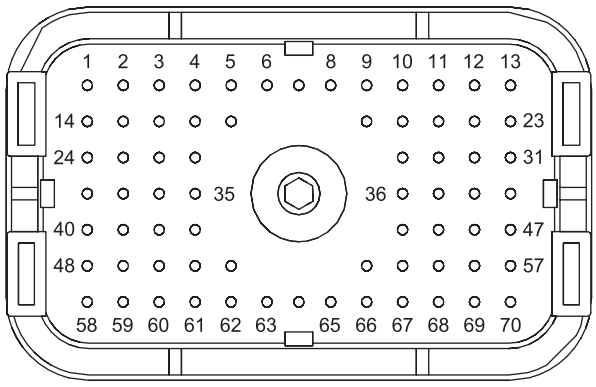
Schematic for the glow plug starting aid circuit

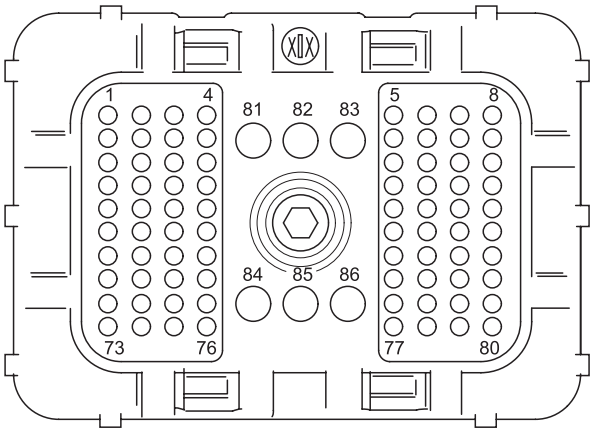


S

E70B

Schematic for the glow plug starting aid circuit





T

A5E2v1 (70pins)

A5E2v2 (86pins)

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring A. Check that the fuses are not blown. B. Inspect the terminals on the glow plug start aid relay and then inspect the connector on the flying lead from the relay. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details. C. Inspect the bus bar for the glow plugs. Ensure that the nuts that secure the bus bar to each glow plug are tightened to a torque of 2 N·m (17 lb in). Ensure that the bus bar is not shorted to the engine. D. 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. E. Check the screw for the ECM connector for the correct torque of 6 N·m (53 lb in). F. Check the harness for abrasion and pinch points from the glow plugs back to the ECM.	Loose connection or damaged wire	**Result**: There is a fault in a connector or the wiring. Repair any faulty connectors or replace the wiring harness. Ensure that all seals are properly in place and ensure that the connectors are correctly coupled. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **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. The bus bar is secured to the glow plugs and not shorted to ground. Proceed to Test Step 2.
2. Check for Active Diagnostic Codes A. Connect the electronic service tool to the diagnostic connector. B. Turn the isolator switch to the ON position. Note: Do not start the engine. C. Use the electronic service tool to select the “Glow Plug Start Aid Override Test” to turn on the power for the glow plugs. D. Check for active diagnostic codes or recently logged diagnostic codes.	Diagnostic codes	**Result**: No diagnostic codes are present. There may be an intermittent fault in an electrical component between the ECM and the glow plugs. The problem may be inside an electrical connector. Refer to Troubleshooting, “Electrical Connector - Inspect” to identify intermittent faults. If no connector faults are identified, proceed to Test Step 3. **Result**: Diagnostic code 676-6 is active or recently logged. Proceed to Test Step 6.
3. Check the Battery Supply Voltage at the Glow Plug Re-lay Connector A. Turn the isolator switch to the OFF position. B. Remove the glow plug start aid relay. C. Turn the isolator switch to the ON position. Do not start the engine. D. Use a suitable multimeter to measure the voltage between Test Point (1) on the harness connector for the relay and a suitable ground.	At least 10 VDC for a 12 V system. At least 22 VDC for a 24 V system.	**Result**: The voltage is not within the expected range - the fault is in the battery supply wiring to the glow plug start aid relay. Repair the faulty wiring or replace the faulty wiring. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The voltage is within the expected range. Proceed to Test Step 4.

4. Create a Short Circuit at the Glow Plug Relay Connector A. Turn the isolator switch to the OFF position. B. Remove the glow plug start aid relay. C. Fabricate a jumper wire. Install the jumper wire between Test Point 1 and Test Point 2 on the harness connector for the glow plug relay. D. Turn the isolator switch to the ON position. E. Use the electronic service tool to select the “Glow Plug Start Aid Override Test” to turn on the power for the glow plugs. F. Use the electronic service tool to check for active diagnostic codes. Wait at least 30 seconds for activation of the diagnostic codes. G. Turn the isolator switch to the OFF position and remove the jumper wire.	Glow plug relay	**Result**: A 676-6 diagnostic code is active with the jumper installed. Install a replacement glow plug relay. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: No diagnostic code is active and the fault is still present. Proceed to Test Step 5.
5. Check the Wiring Between the ECM and the Relay for an Open Circuit A. Verify that the isolator switch is in the OFF position. B. Disconnect the P1 connector from the ECM. C. Inspect the P1 connector. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details. D. Measure the resistance between Test Point 2 on the harness connector for the relay and P1:20 or 53.	Less than two Ohms	**Result**: The resistance measurement is greater than two Ohms - the fault is in the wiring between the relay and the ECM. Repair the faulty wiring or replace the faulty wiring. **Result**: The resistance measurement is less than two Ohms. Proceed to Test Step 8.
6. Create an Open Circuit at the Relay A. Turn the isolator switch to the OFF position. B. Disconnect the glow plug start aid relay. C. Use the electronic service tool to select the “Glow Plug Start Aid Override Test” to turn on the power for the glow plugs. D. Use the electronic service tool to check for active diagnostic codes. Wait at least 30 seconds for activation of the diagnostic codes.	Diagnostic codes	**Result**: A 676-6 diagnostic code was previously active. No diagnostic code is active with the relay disconnected. Install a replacement glow plug start aid relay. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The 676-6 diagnostic code is still active with the relay disconnected. Proceed to Test Step 7.
7. Check the Wiring Between the Relay and the ECM for a Short Circuit A. Disconnect the P1 connector. B. Inspect the P1 connector. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details. C. Use a suitable multimeter to measure the resistance between P1:20 or 53 and all other terminals on the P1 connector.	Greater than 100 Ohms	**Result**: At least one of the resistance measurements is less than 100 Ohms - there is a short in the wiring between the relay and the ECM. Repair the faulty wiring or replace the faulty wiring. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: All resistance measurements are greater than 100 Ohms. The fault may be in the earth return circuit. Proceed to Test Step 8.

8. Check the Battery Return at the Glow Plug Earth Relay Connector A. Turn the isolator switch to the OFF position. B. Remove the glow plug start aid earth relay. D. Use a suitable multimeter to measure the resistance between Test Point (3) on the harness connector for the relay and a suitable ground.	Less than two Ohms	**Result**: The measured resistance is greater than two Ohms. Repair the faulty wiring or replace the faulty wiring. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The measured resistance is less than two Ohms. Proceed to Test Step 9.
9. Create a Short Circuit at the Glow Plug Earth Relay Connector A. Turn the isolator switch to the OFF position. B. Remove the glow plug start aid earth relay. C. Fabricate a jumper wire. Install the jumper wire between Test Point 3 and Test Point 4 on the harness connector for the glow plug earth relay. D. Turn the isolator switch to the ON position. E. Use the electronic service tool to select the “Glow Plug Start Aid Override Test” to turn on the power for the glow plugs. F. Use the electronic service tool to check for active diagnostic codes. Wait at least 30 seconds for activation of the diagnostic codes. G. Turn the isolator switch to the OFF position and remove the jumper wire.	Glow earth plug relay	**Result**: A 676-6 diagnostic code is active with the jumper installed. Install a replacement glow plug earth relay. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: No diagnostic code is active and the fault is still present. Proceed to Test Step 10.
10. Check the Wiring Between the ECM and the Earth Re-lay for an Open Circuit A. Verify that the isolator switch is in the OFF position. B. Disconnect the P1 connector from the ECM. C. Inspect the P1 connector. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details. D. Measure the resistance between Test Point 4 on the harness connector for the relay and P1:12 or 8.	Less than two Ohms	**Result**: The resistance measurement is greater than two Ohms - the fault is in the wiring between the relay and the ECM. Repair the faulty wiring or replace the faulty wiring. **Result**: The resistance measurement is less than two Ohms. Proceed to Test Step 11.
11. Check if a Replacement 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 the Perkins dealer. Note: This consultation can greatly reduce the repair time. C. If the dealer recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”. D. Turn the isolator switch to the ON position. Use the electronic service tool to verify that the repair eliminates the fault.	Fault eliminated	**Result**: The fault is eliminated with the test ECM. Reconnect the suspect ECM. If the fault returns with the suspect ECM, permanently install the replacement ECM. **Result**: The fault is still present with the replacement ECM. Do not use the replacement ECM. Proceed to Test Step 12.

12. Check the Operation of the Glow Plugs A. Place a suitable clamp-on ammeter on the power supply wire. B. Use the electronic service tool to select the “Glow Plug Start Aid Override Test” to turn on the power for the glow plugs. C. Wait for 20 seconds and then note the reading on the clamp-on ammeter.	Approximately 28 Amps at 12 VDC or 16 Amps at 24 VDC.	**Result**: The reading on the clamp on ammeter near the expected reading. The glow plugs are operating correctly. Return the engine to service. **Result**: The reading on the clamp on ammeter is between zero and the expected reading. Proceed to Test Step 13. **Result**: The reading on the clamp on ammeter is zero. Proceed to Test Step 14.
13. Test the Continuity of the Glow Plugs A. Disconnect the power supply and remove the bus bar from the glow plugs. B. Use a suitable digital multimeter to check continuity (resistance). Turn the audible signal on the digital multimeter ON. C. Place one probe on the connection for one of the glow plugs and the other probe to a suitable ground. The digital multimeter should make an audible sound. D. Repeat the continuity check on the remaining glow plugs.	One or more glow plugs do not have continuity.	**Result**: One or more of the glow plugs do not display continuity. Replace any glow plugs that do not show continuity. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: All glow plugs display continuity. Contact the Perkins dealer.
14. Check the Circuit Breaker A. Turn the battery disconnect switch to the OFF position. B. Check the circuit breaker for the glow plug start aid relays.	Tripped circuit breaker	**Result**: The circuit breaker is tripped - there is a short in the power circuit for the glow plugs. Do not reset the circuit breaker at the stage. Proceed to Test Step 15. **Result**: The circuit breaker is not tripped - there may be an open circuit in the power circuit for the glow plugs. Proceed to Test Step 17.
15. Disconnect the Relay and Check the Circuit Breaker A. Disconnect the glow plug start aid relay. B. Reset the circuit breaker for the relay. C. Turn the battery disconnect switch to the ON position. Wait for 5 seconds. D. Turn the battery disconnect switch to the OFF position. E. Check the circuit breaker.	Tripped circuit breaker	**Result**: The circuit breaker is tripped - there is a short circuit in the wiring between the circuit breaker and the glow plug start aid relay. Repair the faulty wiring or replace the faulty wiring. Reset the circuit breaker and reconnect the relay. Turn the battery disconnect switch to the ON position. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The circuit breaker is not tripped. Proceed to Test Step 16.

16. Check the Wiring Between the Start Aid Relay and the Bus Bar for a Short Circuit A. Disconnect the power supply wire from the bus bar. B. Measure the resistance between Test Point B on the harness connector for the relay to a suitable engine ground.	Greater than 10000 Ohms	**Result**: The resistance is greater than 10000 Ohms. Install a replacement start aid relay. Reconnect the power supply wire to the bus bar. Turn the battery disconnect switch to the ON position. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The resistance is less than 10000 Ohms - there is a short in the wiring between the start aid relay and the bus bar. Repair the faulty wiring or replace the faulty wiring. Turn the battery disconnect switch to the ON position. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault.
17. Check the Input Voltage to the Relay A. Disconnect the connector for the glow plug start aid relay. B. Turn the battery disconnect switch to the ON position. C. Measure the voltage at Test Point A on the harness connector for the relay to a suitable ground.	At least 10 VDC for a 12 VDC system At least 22 VDC for a 24 VDC system	**Result**: The voltage is not as expected - The fault is in the wiring between the battery and the relay. Repair the faulty wiring or replace the faulty wiring. Reconnect the relay. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The voltage is as expected. Leave the relay disconnected and proceed to Test Step 18.
18. Bypass the Start Aid Relay A. Turn the battery disconnect switch to the OFF position. B. Fabricate an 8 AWG jumper wire that is 150 mm (6 inch) long. C. Install the jumper wire between Test Point A and Test Point B on the harness connector for the relay. D. Turn the battery disconnect switch to the ON position. E. Use a clamp-on ammeter to measure the current on the power supply wire to the glow plugs. F. Turn the battery disconnect switch to the OFF position. G. Remove the jumper.	Approximately 28 Amps at 12 VDC or 16 Amps at 24 VDC.	**Result**: The reading on the clamp-on ammeter is correct. Install a replacement relay. Turn the battery disconnect switch to the ON position. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The reading on the clamp-on ammeter is zero - the fault is in the wiring between the relay and the bus bar. Repair the faulty wiring or replace the faulty wiring. Turn the battery disconnect switch to the ON position. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. If the procedure did not correct the issue, proceed to Test Step 19.

19. Bypass the Start Aid Earth Relay A. Turn the battery disconnect switch to the OFF position. B. Fabricate an 8 AWG jumper wire that is 150 mm (6 inch) long. C. Install the jumper wire between Test Point C and Test Point D on the harness connector for the relay. D. Turn the battery disconnect switch to the ON position. E. Use a clamp-on ammeter to measure the current on the power supply wire to the glow plugs. F. Turn the battery disconnect switch to the OFF position. G. Remove the jumper.	Approximately 28 Amps at 12 VDC or 16 Amps at 24 VDC.	**Result**: The reading on the clamp-on ammeter is correct. Install a replacement earth relay. Turn the battery disconnect switch to the ON position. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The reading on the clamp-on ammeter is zero - the fault is in the wiring between the earth relay and battery -. Repair the faulty wiring or replace the faulty wiring. Turn the battery disconnect switch to the ON position. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. If the procedure did not correct the issue, contact the Perkins dealer.

Injector Data Incorrect - Test

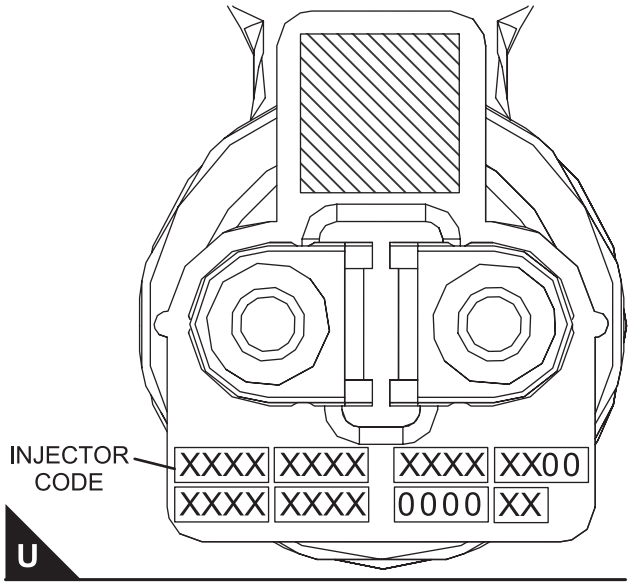
This procedure covers the following codes:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
651-2	Engine Injector Cylinder #01 : Erratic, Intermittent, or Incorrect	The Electronic Control Module (ECM) detects an injector code that is incorrect for the engine. If equipped, the warning lamp will come on.
652-2	Engine Injector Cylinder #02 : Erratic, Intermittent, or Incorrect	
653-2	Engine Injector Cylinder #03 : Erratic, Intermittent, or Incorrect	
654-2	Engine Injector Cylinder #04 : Erratic, Intermittent, or Incorrect	
655-2	Engine Injector Cylinder #05 : Erratic, Intermittent, or Incorrect	
656-2	Engine Injector Cylinder #06 : Erratic, Intermittent, or Incorrect	

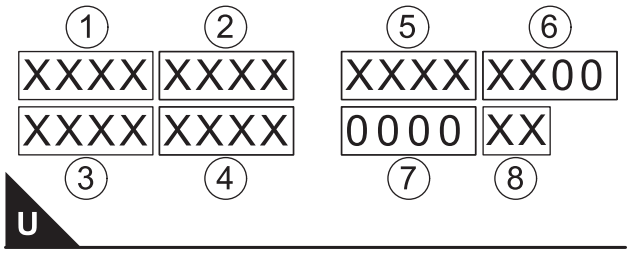
The following background information is related to this procedure:

Injector codes are codes that are 30 hexadecimal characters in length that are supplied with each injector. The code is on a plate on the top of the injector and a card is also included in the packaging for the injector. The code is used by the ECM to balance the performance of the injectors.

Refer to Troubleshooting, “Injector Code - Calibrate” for further information.



Label with an injector code



Sequence for recording the injector code

Troubleshooting Test Steps	Values	Results
1. Check for Diagnostic Codes A. Connect the electronic service tool to the diagnostic connector. B. Turn the isolator switch to the ON position. C. Check for active diagnostic codes that are related to this procedure. D. Check the screw for the ECM connectors for correct torque of 6 N·m (53 lb in). E. Check all wiring associated with the CAN data link for abrasions and pinch points.	Damaged wire or connector	**Result**: One or more of the diagnostic codes that are listed are active at this time. Make a note of any cylinder numbers with the active diagnostic code. Proceed to Test Step 2. **Result**: None of the diagnostic codes that are listed in the table are active at this time. Return the unit to service.

2. Check the Injector Code on any Suspect Cylinders A. Connect the electronic service tool to the diagnostic connector. Refer to Troubleshooting, “Electronic Service Tools”. B. Turn the isolator switch to the ON position. C. Select the following menu options on the electronic service tool to obtain the injector codes from the ECM: · Service · Calibrations · Injector Trim Calibration D. Make a note of the injector codes for any suspect cylinders.	-	**Result**: The card that was supplied with the injector is available for the suspect cylinders. Compare the injector code from the card with the injector code that was recorded from the electronic service tool for each suspect cylinder. If the codes match, the injector is incorrect for the engine. Replace the injector. If the codes do not match, then use the electronic service tool to input the code from the card. **Result**: The card that was supplied with the injector code is not available. Remove the valve mechanism cover. Make a note of the injector code that is on the injector in any suspect cylinders. Compare the injector code from the injector with the injector code from the electronic service tool for each suspect cylinder. If the codes match, the injector is incorrect for the engine. Replace the injector. If the codes do not match, then use the electronic service tool to input the code from the card.

Injector Solenoid - Test

This procedure covers the following diagnostic codes:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
651-5	Engine Injector Cylinder #01 : Current Below Normal	These diagnostic codes indicate an open circuit (low current) in either the solenoid or the wiring for the electronic unit injector. The Electronic Control Module (ECM) detects the following conditions: A low current condition (open circuit) for each of five consecutive attempts to operate Battery voltage above 9 VDC for 2 seconds The warning light will come on. The ECM will log the diagnostic code. The engine will have low power and/or rough running. When an “Cylinder Cutout Test” is performed, a faulty electronic unit injector will indicate a low reading in comparison with the other electronic unit injectors. The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged. An open circuit will prevent the operation of the electronic unit injector.
652-5	Engine Injector Cylinder #02 : Current Below Normal	
653-5	Engine Injector Cylinder #03 : Cur-rent Below Normal	
654-5	Engine Injector Cylinder #04 : Current Below Normal	
651-6	Engine Injector Cylinder #01 : Current Above Normal	These diagnostic codes indicate a short circuit (high current) in either the solenoid or the wiring for the electronic unit injector. The ECM detects the following conditions: A high current condition (short circuit) for each of five consecutive attempts to operate Battery voltage above 9 VDC for 2 seconds The warning light will come on. The ECM will log the diagnostic code. The engine will have low power and/or rough running. The ECM will continue to attempt to operate the electronic unit injector after the diagnostic code has been logged. A short circuit will prevent the operation of the electronic unit injector.
652-6	Engine Injector Cylinder #02 : Current Above Normal	
653-6	Engine Injector Cylinder #03 : Current Above Normal	
654-6	Engine Injector Cylinder #04 : Cur-rent Above Normal	
Follow the troubleshooting procedure to identify the root cause of the fault.		

An electrical fault can prevent the electronic unit injector from operating. An open or short circuit in the ECM that is unique to one electronic unit injector will prevent that electronic unit injector from operating. An open or short circuit in common wiring within the ECM can prevent the two electronic unit injectors that share that common wiring from operating.

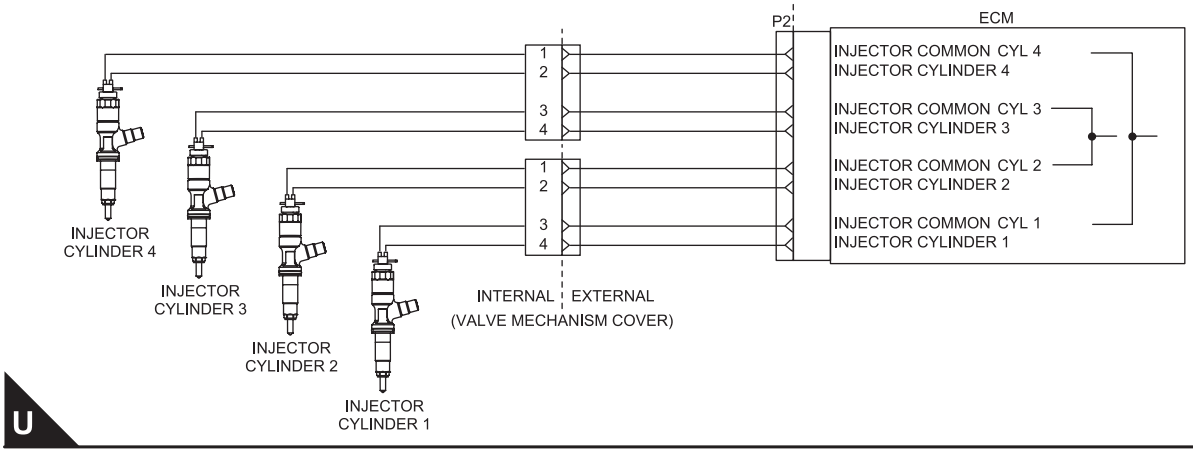
Perform this procedure under conditions that are identical to the conditions that exist when the fault occurs. Typically, faults with the injector solenoid occur when the engine is warmed up and/or when the engine is under vibration (heavy loads).

These engines have Electronic Unit Injectors (EUI). The ECM sends a pulse to each injector solenoid. The pulse is sent at the correct time and at the correct duration for a given engine load and speed. The solenoid is mounted on top of the fuel injector body.

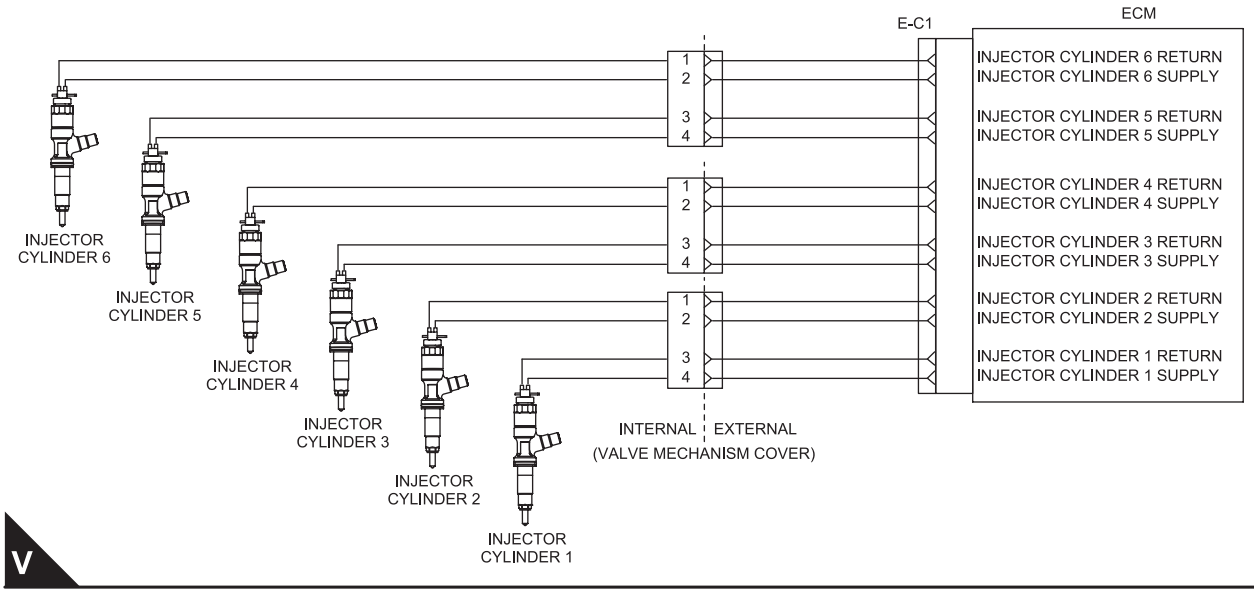
If an open circuit is detected in the solenoid circuit, a diagnostic code is generated. The ECM continues to try to fire the injector. If a short circuit is detected, a diagnostic code is generated. The ECM will periodically try to fire the injector. If the short circuit remains, this sequence of events will be repeated until the fault is corrected.

“Injector Solenoid Test”

Use the “Injector Solenoid Test” to diagnose an open or 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” .



Schematic of the circuit for the injector solenoids on E44 engines



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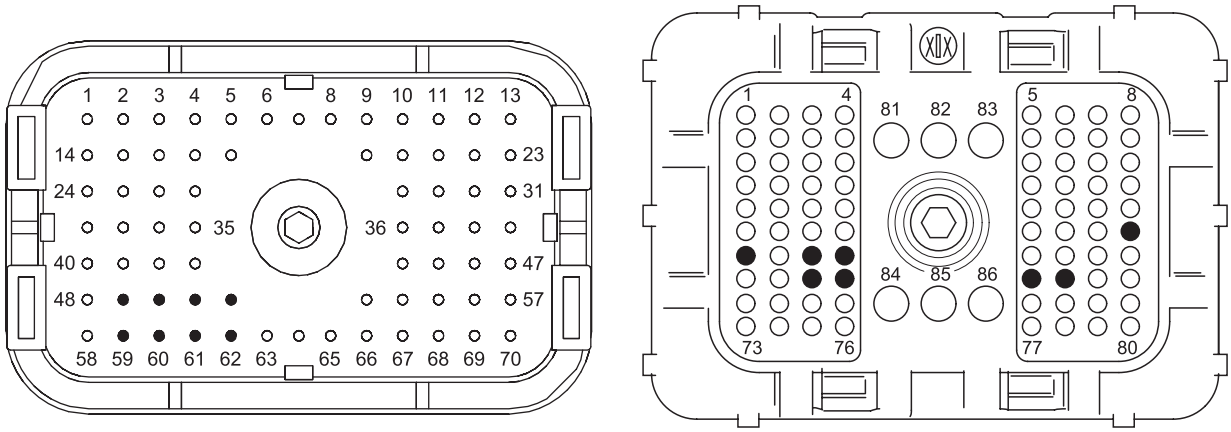
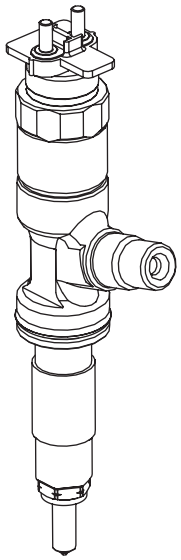
Schematic of the circuit for the injector solenoids on E70B engines



W A5E2v1 (70pins) A5E2v2 (86pins)

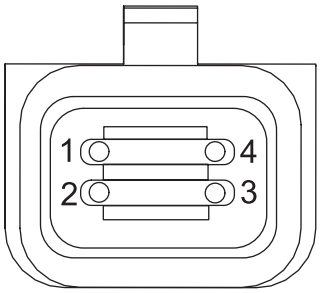
View of the pin locations on the P2 connector.

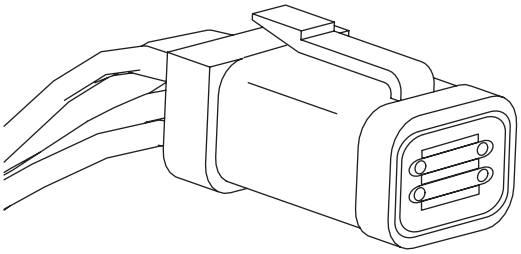
A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
60	52	Digitial Speed Control Raise
59	54	Glowplug Relay Return
52	85	ECM Power Supply
51	12	APP Starter Relay (-)
62	59	Injection Disable
61	81	ECM Power Return
50	25	Primary J1939 Data Link +
49	60	Coolant Level



X

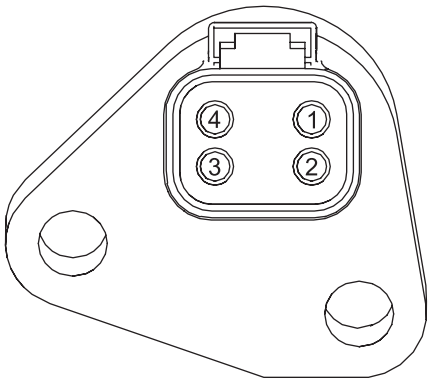
Typical example of the fuel injector

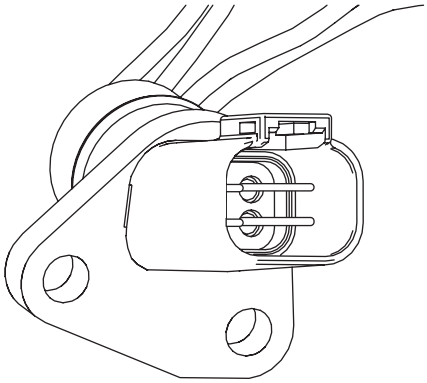




Y

Typical example of the harness connector for the fuel injector solenoids





Y

Typical example of the connector in the cylinder head

⚠ WARNING

Electrical Shock Hazard. The electronic unit injectors use DC voltage. The ECM sends this voltage to the electronic unit injectors. Do not come in contact with the harness connector for the electronic unit injectors while the engine is operating. Failure to follow this instruction could result in personal injury or death.

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring A. Turn the isolator switch to the OFF position. A strong electrical shock hazard is present if the isolator switch is not turned OFF. B. Thoroughly inspect the connectors at the cylinder head. 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 tor-que of 6 N·m (53 lb in). E. Check the harness and wiring for abrasion and for pinch points from the injectors to the ECM.	Loose connection or damaged wire	**Result**: There is a fault in a connector or the wiring. Repair any faulty connectors or replace the wiring harness. Ensure that all seals are properly in place and ensure that the connectors are correctly coupled. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: All connectors, pins, and sockets are correctly coupled and/or inserted. The harness is free of corrosion, abrasion, and pinch points. Proceed to Test Step 2.
2. 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 isolator switch to the ON position. E. Access the “Injector Solenoid Test” by accessing the following display screens in order: · “Diagnostics” · “Diagnostic Tests” · “Injector Solenoid Test” F. Activate the test. **Note**: Do not confuse the “Injector Solenoid Test” with the “Cylinder Cutout Test” . The “Cylinder Cutout Test” is used to shut off fuel to a specific cylinder while the engine is running. The “Injector Solenoid Test” is used to actuate the injector solenoids while the engine is not running.	“OK” , “OPEN” , or “SHORT”	**Result**: All cylinders indicate “OK” - There is not an electronic fault with the injectors at this time. Use the electronic service tool to clear all logged diagnostic codes. Return the engine to service. Result: “OPEN” Note the cylinders that indicate “OPEN” . Proceed to Test Step 3. **Result**: “SHORT” Note the cylinders that indicate “SHORT” . Proceed to Test Step 4.

3. Check the Harness between the ECM and the Cylinder Head for an Open Circuit A. Turn the isolator switch to the OFF position. A strong electrical shock hazard is present if the isolator switch is not turned OFF. B. Disconnect the connector for the suspect injector from the cylinder head. C. Fabricate a jumper wire 100 mm (4 inch) long with terminals on both ends of the wire. D. Insert one end of the jumper wire into the terminal for the supply to the suspect injector. Insert the other end of the jumper wire into the terminal for the return circuit for the suspect injector. E. Turn the isolator switch to the ON position. 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.	Suspect injector indicates SHORT	**Result**: The electronic service tool displays “SHORT” for the cylinder with the jumper wire. Proceed to Test Step 5. **Result**: The electronic service tool does not display “SHORT” for the cylinder with the jumper wire. Proceed to Test Step 6.
4. Check the Harness between the ECM and the Cylinder Head for a Short Circuit A. Turn the isolator switch to the OFF position. A strong electrical shock hazard is present if the isolator switch is not turned OFF. B. Disconnect the connector for the suspect injector from the cylinder head. Note: Cylinder 1 and cylinder 2 share the same connector. Cylinder 3 and cylinder 4 share the same connector. C. Turn the isolator switch to the ON position. D. Perform the “Injector Solenoid Test” at least two times. E. Repeat this test for each suspect injector. Stop the “Injector Solenoid Test” before handling the jumper wires.	Suspect injector indicates “OPEN”	**Result**: The electronic service tool displays “OPEN” for the suspect cylinder and the cylinder that shares the same connector. Proceed to Test Step 5. **Result**: The electronic service tool does not display “OPEN” for the suspect cylinder Proceed to Test Step 6.
5. Exchange the Injector Harness Under the Valve Mechanism Cover A. Turn the isolator switch to the OFF position. A strong electrical shock hazard is present if the isolator switch is not turned OFF. B. Remove the valve mechanism cover. C. Disconnect the connector for the suspect injector from the cylinder head. Disconnect the connector from the adjacent pair of injectors. D. Exchange the two internal harnesses. E. Turn the isolator switch to the ON position. F. Perform the “Injector Solenoid Test” at least two times.	Fault moves to another injector	**Result**: Exchanging the harnesses causes the fault to move to another injector - There is a fault with the suspect injector harness under the valve mechanism cover. Repair the suspect injector harness or replace the suspect injector harness under the valve mechanism cover. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: The fault remains on the same injector when the harness is exchanged - the injector may be faulty. Replace the faulty injector. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault.

6. Bypass the Wiring Between the ECM and the Cylinder Head A. Turn the isolator switch to the OFF position. A strong electrical shock hazard is present if the isolator switch is not turned OFF. B. Disconnect connector P2 from the ECM. C. Thoroughly inspect the P2 connector. Refer to Trouble-shooting, “Electrical Connectors - Inspect”. D. Disconnect the connector for the suspect injector from the cylinder head. E. Remove the supply wire and the return wire for the suspect injector from the P2 connector. Remove the supply wire and the return wire for the suspect injector from the connector on the engine harness. F. Fabricate two jumper wires that are long enough to reach from the ECM to the connector for the suspect injector. G. Insert one end of a jumper wire into the terminal for the supply to the suspect injector on the P2 connector. Insert the other end of the jumper wire into the terminal on the connector for the supply to the suspect injector. H. Insert one end of the other jumper wire into the return terminal for the suspect injector on the P2 connector. Insert the other end of the jumper wire into the return terminal on the connector for the suspect injector. I. Reinstall the P2 connector to the ECM. J. Reconnect the connector for the suspect injector to the cylinder head. K. Turn the isolator switch to the ON position. L. Perform the “Injector Solenoid Test” at least two times.	Wiring bypass	**Result**: The fault disappears with the jumper wire installed. The fault is in the engine harness. Repair the faulty wiring or replace the faulty wiring. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The fault is still present with the jumper wire installed. There may be a fault with the ECM. Proceed to Test Step 7.
7. Check if a Replacement 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 the Perkins dealer. **Note**: This consultation can greatly reduce the repair time. C. If the dealer recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”. D. Turn the isolator switch to the ON position. Use the electronic service tool to verify that the repair eliminates the fault.	Fault eliminated	**Result**: The fault is eliminated with the test ECM. Reconnect the suspect ECM. If the fault returns with the suspect ECM, permanently install the replacement ECM. **Result**: The fault is still present with the replacement ECM. Do not use the replacement ECM. Contact the Perkins dealer.

Relay - Test

(Electric Fuel Lift Pump Relay)

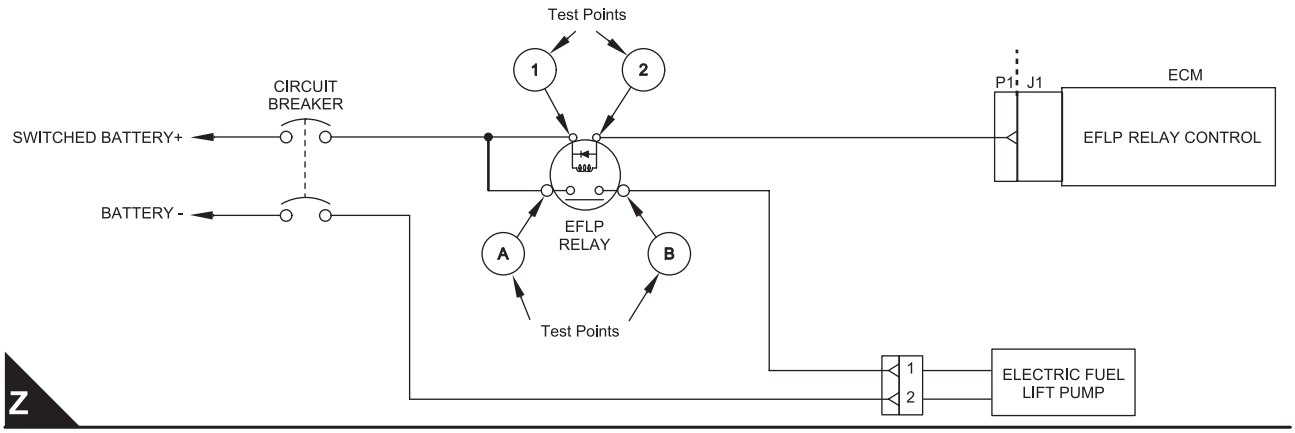
This procedure covers the following codes:

Also, use this procedure if the Electric Fuel Lift Pump (EFLP) relay is not operating correctly.

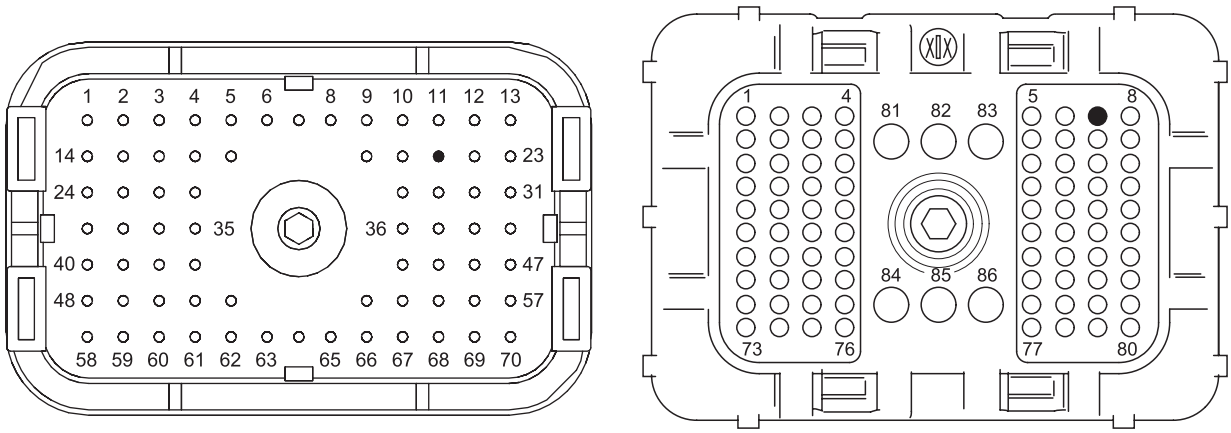
Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
1075-5	Engine Electric Lift Pump for Engine Fuel supply: Current Below Normal	The Electronic Control Module (ECM) detects the following conditions: There are no active 168 diagnostic codes. The ECM is not attempting to power the relay. The ECM has been powered for at least 2 seconds. There is a low current condition in the EFLP relay circuit for more than 2 seconds. The warning light will come on. The diagnostic code will be logged. The ECM is unable to activate the relay for the EFLP. The EFLP will not operate or the EFLP will operate all the time. The engine will not operate.
1075-6	Engine Electric Lift Pump for Engine Fuel supply: Current Above Normal	The ECM detects the following conditions: There are no active 168 diagnostic codes. The ECM is attempting to power the relay. The ECM has been powered for at least 2 seconds. There is a high current condition in the EFLP relay circuit for more than 2 seconds. The warning light will come on. The diagnostic code will be logged. The ECM is unable to activate the relay for the EFLP. The EFLP will not operate or the EFLP will operate all the time. The engine will not operate. The ECM will continue to attempt to activate the relay. If the current is OK for 6 seconds, then the diagnostic code will be cleared.

The following background information is related to this procedure:

The EFLP is used to provide positive fuel pressure to the high-pressure fuel pump. When the isolator switch is turned to the ON position, battery power is supplied to activate the relay for the EFLP. If the engine is not running, the ECM will deactivate the relay for the EFLP after 2 minutes.



Schematic of the circuit for the EFLP and relay (Refer to electrical schematics for complete information)



View of the pin location on the P1 connector for the EFLP

A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
21	7	Fuel Lift Pump Relay(+)

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring A. Check that the circuit breakers are not tripped. B. Inspect the terminals on the EFLP relay and the P1 ECM connector. 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 EFLP relay. D. Check the screw for the ECM connector for the correct tor-que of 6 N·m (53 lb in). E. Check the harness for abrasion and pinch points from the EFLP relay back to the ECM and the isolator switch.	Loose connection or damaged wire	**Result**: There is a fault in a connector or the wiring. Repair any faulty connectors or replace the wiring harness. Ensure that all of the seals are properly in place and ensure that the connectors are correctly coupled. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: All connectors, pins, and sockets are correctly coupled and/or inserted. The harness is free of corrosion, abrasion, and pinch points. The circuit breaker is not tripped. Proceed to Test Step 2.
2. Check for Active Diagnostic Codes A. Connect the electronic service tool to the diagnostic connector. B. Turn the isolator switch to the ON position. Note: Do not start the engine. C. Check for active diagnostic codes or recently logged diagnostic codes.	Diagnostic codes	**Result**: No diagnostic codes are present. There may be an intermittent fault in an electrical component between the ECM and the EFLP. The problem may be inside an electrical connector. Refer to Troubleshooting, “Electrical Connector - Inspect” to identify intermittent faults. If no connector faults are identified, proceed to Test Step 3. **Result**: A 1075-5 diagnostic code is active or recently logged. Proceed to Test Step 3. **Result**: A 1075-6 diagnostic code is active or recently logged. Proceed to Test Step 4.
3. Create a Short Circuit at the EFLP Relay Connector A. Turn the isolator switch to the OFF position. B. Remove the EFLP relay. C. Fabricate a jumper wire that is 150 mm (6 inch) long. Use the jumper wire to connect socket 1 to socket 2 on the harness connector for the EFLP relay. D. Turn the isolator switch to the ON position. E. Use the electronic service tool to check for active diagnostic codes. Wait at least 30 seconds for activation of the diagnostic codes. F. Turn the isolator switch to the OFF position and remove the jumper wire.	EFLP relay	**Result**: A 1075-6 diagnostic code is active with the jumper installed. Install a replacement EFLP relay. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The 1075-5 diagnostic code is still active. Proceed to Test Step 5.

4. Create an Open Circuit at the Relay A. Turn the isolator switch to the OFF position. B. Disconnect the EFLP relay. C. Turn the isolator switch to the ON position. D. Use the electronic service tool to check for active diagnostic codes. Wait at least 30 seconds for activation of the diagnostic codes.	EFLP relay	**Result**: A 1075-6 diagnostic code was previously active. A 1075-5 diagnostic code is active with the relay disconnected. Install a replacement EFLP. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The 1075-6 diagnostic code is still active with the relay disconnected. Proceed to Test Step 5.
5. Bypass the EFLP Relay Control Wire A. Verify that the isolator switch is in the OFF position. B. Disconnect the P1 connector from the ECM. C. Disconnect the EFLP relay connector. C. Remove the wire from P1:21 or 7. D. Remove the wire from socket 2 in the EFLP relay connector. E. Fabricate a jumper wire that is long enough to reach from the ECM to the EFLP relay connector. Insert one end of the jumper into P1:21 or 7. Insert the other end of the jumper into socket 2 in the EFLP relay connector. F. Reconnect the P1 connector. Reconnect the EFLP relay connector. G. Turn the isolator switch to the ON position. Use the electronic service tool to check for an active 1075-X diagnostic code. H. Turn the isolator switch to the OFF position. Restore the original harness wiring.	ECM	**Result**: The fault is eliminated with the test ECM. Reconnect the suspect ECM. If the fault returns with the suspect ECM, permanently install the replacement ECM. **Result**: The fault is still present with the replacement ECM. Do not use the replacement ECM. Contact the Perkins dealer.

Relay - Test

(Starting Motor Relay)

This procedure covers the following codes:

Also, use this procedure if the starting motor is not operating correctly.

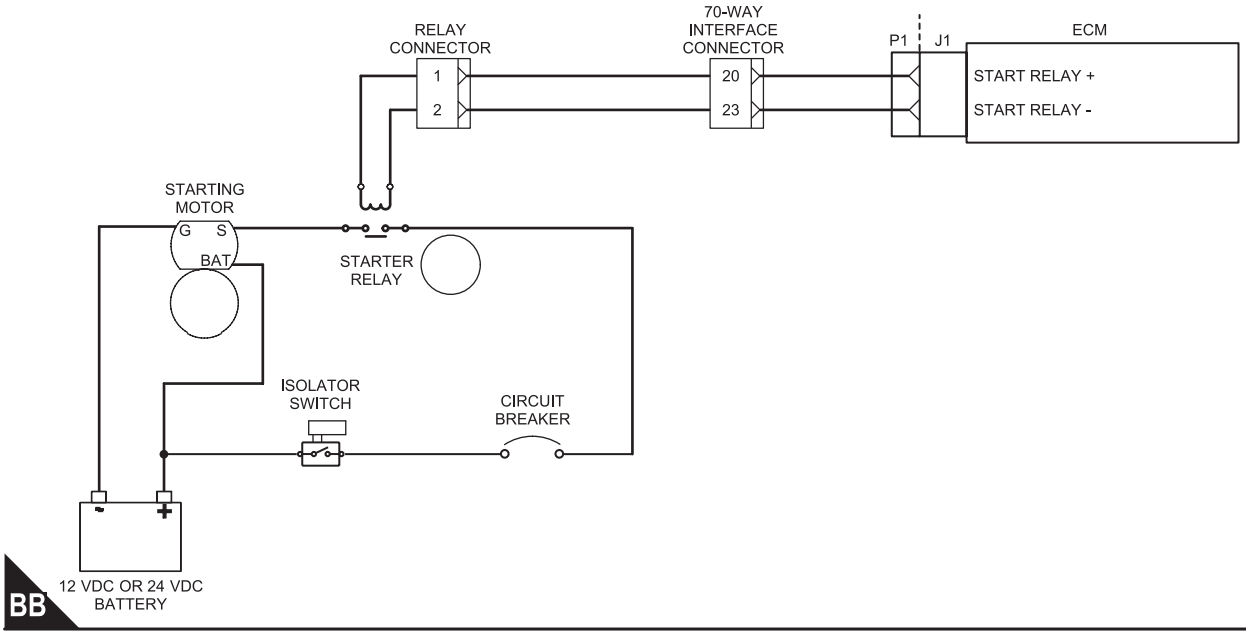
Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
677-5	Engine Starter Motor Relay : Current Below Normal	The Electronic Control Module (ECM) detects the following conditions: A low current condition (open circuit) in the circuit for the starting motor relay for one second. The ECM has been powered for at least one second.
677-6	Engine Starter Motor Relay : Current Above Normal	The ECM detects the following conditions: A high current condition (short circuit) in the circuit for the starting motor relay for at least one second. The ECM has been powered for at least one second.

The following background information is related to this procedure:

When the control panel sends a start signal to the

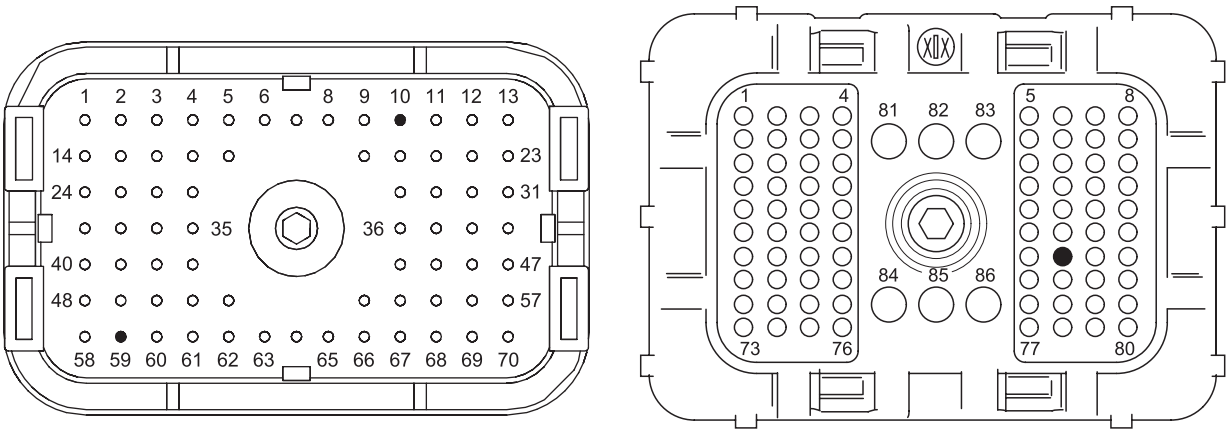
engine ECM, pin P1:10 energizes the starter relay. The return from the relay is to pin P1:59 or 54.

The starting motor relay supplies battery power to the relay solenoids in the starting motor. This internal relay provides high current battery voltage to the starting motor.



BB

Schematic of the circuit for the starting motor



CC

A5E2v1 (70pins)

A5E2v2 (86pins)

View of the pin locations on the P1 connector for the starting motor relay

A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
10	-	
59	54	Glowplug Relay Return

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring A. Check that the circuit breaker is not tripped. B. Inspect the terminals on the starting motor relay and the 70/86-way interface connector. 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 starting motor relay. D. Check the screw for the ECM connector for the correct tor-que of 6 N·m (53 lb in). E. Check the harness for abrasion and pinch points from the starting motor relay back to the ECM.	Loose connection or damaged wire	**Result**: There is a fault in a connector or the wiring. Repair any faulty connectors or replace the wiring harness. Ensure that all of the seals are properly in place and ensure that the connectors are correctly coupled. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: All connectors, pins, and sockets are correctly coupled and/or inserted. The harness is free of corrosion, abrasion, and pinch points. The circuit breaker is not tripped. Proceed to Test Step 2.
2. Check for Active Diagnostic Codes A. Connect the electronic service tool to the diagnostic connector. B. Turn the isolator switch to the ON position. **Note**: Do not start the engine. C. Check for active diagnostic codes or recently logged diagnostic codes.	Diagnostic codes	**Result**: No diagnostic codes are present. There may be an intermittent fault in an electrical component between the ECM and the starting motor. The problem may be inside an electrical connector. Refer to Trouble-shooting, “Electrical Connector - Inspect” to identify intermittent faults. If no connector faults are identified, proceed to Test Step 3. **Result**: A 677-5 diagnostic code is active or recently logged. Proceed to Test Step 3. **Result**: A 677-6 diagnostic code is active or recently logged. Proceed to Test Step 4.
3. Create a Short Circuit at the Starting Motor Relay Connector A. Turn the isolator switch to the OFF position. B. Remove the starting motor relay. C. Fabricate a jumper wire that is 150 mm (6 inch) long. Use the jumper wire to connect socket 1 to socket 2 on the harness connector for the starting motor relay.. D. Turn the isolator switch to the ON position. E. Press the start key on the control panel. F. Use the electronic service tool to check for active diagnostic codes. Wait at least 30 seconds for activation of the diagnostic codes. G. Turn the isolator switch to the OFF position and remove the jumper wire.	Starting motor	**Result**: A 677-6 diagnostic code was previously active. A 677-5 diagnostic code is active with the relay disconnected. Install a replacement starting motor. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. Result: The 677-6 diagnostic code is still active with the relay disconnected. Proceed to Test Step 5.

5. Bypass the Start Relay +ve Wire A. Verify that the isolator switch is in the OFF position. B. Disconnect the P1 connector from the ECM. C. Disconnect the starting motor relay connector. D. Remove the wire from P1:10. E. Remove the wire from socket 1 starting motor relay connector. F. Fabricate a jumper wire that is long enough to reach from the ECM to the starting motor relay connector. Insert one end of the jumper into P1:10. Insert the other end of the jumper into socket 1 on the starting motor relay connector. G. Reconnect the P1 connector. Reconnect the starting motor relay connector. H. Attempt to start the engine. Use the electronic service tool to check for an active 677-XX diagnostic code. I. Turn the isolator switch to the OFF position. Restore the original harness wiring.	Wiring	**Result**: There are no active 677-XX diagnostic codes at this time. Repair the faulty wiring or replace the faulty wiring between P1:10 and socket 1 on the starting motor relay connector. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: A 677-XX diagnostic code is still active at this time. Proceed to Test Step 6.
6. Bypass the Start Relay -ve Wire A. Verify that the isolator switch is in the OFF position. B. Disconnect the P1 connector from the ECM. C. Disconnect the starting motor relay connector. D. Remove the wire from P1:59 or 54. E. Remove the wire from socket 2 starting motor relay connector. F. Fabricate a jumper wire that is long enough to reach from the ECM to the starting motor relay connector. Insert one end of the jumper into P1:59 or 54. Insert the other end of the jumper into socket 2 on the starting motor relay connector. G. Reconnect the P1 connector. Reconnect the starting motor relay connector. H. Attempt to start the engine. Use the electronic service tool to check for an active 677-XX diagnostic code. I. Turn the isolator switch to the OFF position. Restore the original harness wiring.	Wiring	**Result**: There are no active 677-XX diagnostic codes at this time. Repair the faulty wiring or replace the faulty wiring between P1:59 or 54 and socket 2 on the starting motor relay connector. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: A 677-XX diagnostic code is still active at this time. Proceed to Test Step 7.

7. Check if a Replacement ECM Eliminates the Fault A. Make sure that the latest flash file for the application is in-stalled in the ECM. Refer to Troubleshooting, “Flash Programming”. B. Contact the Perkins dealer. Note: This consultation can greatly reduce the repair time. C. If Perkins recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”. D. Turn the isolator switch to the ON position. Use the electronic service tool to verify that the repair eliminates the fault.	ECM	**Result**: The fault is eliminated with the test ECM. Reconnect the suspect ECM. If the fault returns with the suspect ECM, permanently install the replacement ECM. **Result**: The fault is still present with the replacement ECM. Do not use the replacement ECM. Proceed to Test Step 8.
8. Programming a Flash File A. Make sure that the latest flash file (Revision) for the application is installed in the ECM. Refer to Troubleshooting, “Flash Programming”.	ECM	**Result**: The flash programming was successful. Return the unit to service. The flash programming was not successful. Repair any active diagnostic or event codes. Contact the Perkins dealer.

Sensor Calibration Required -Test

This procedure covers the following diagnostic codes:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
3563-13	Engine Intake Manifold #1 Absolute Pressure : Out of Calibration	At key on, the intake manifold pressure sensor is checked for a zero reading. During calibration, the pressure offset value is outside the acceptable range. The code is logged.
Follow the troubleshooting procedure in order to identify the root cause of the fault.		

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring A. Thoroughly inspect the terminal connections on the P2J/2 ECM connector and the intake manifold pressure sensor connector. Refer to Troubleshooting, “Electrical Connectors - Inspect”. B. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector and the sensor connector that are associated with the active diagnostic code. C. Check the screw for the ECM connector for the correct torque of 6 N·m (53 lb in). D. Check the harness for corrosion, abrasion, and pinch points from the solenoids to the ECM.	Loose connection or damaged wire	**Result**: There is a fault in a connector or the wiring. Repair any faulty connectors or replace the wiring harness. Ensure that all of the seals are properly in place and ensure that the connectors are correctly coupled. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: All connectors, pins, and sockets are correctly coupled and/or inserted. The harness is free of corrosion, abrasion, and pinch points. Proceed to Test Step 2

2. Check for Active Diagnostic Codes A. Turn the isolator switch to the OFF position. B. Connect the electronic service tool to the diagnostic connector. C. Turn the isolator switch to the ON position. Wait at least 20 seconds for activation of the diagnostic codes. D. Verify if the diagnostic code that is listed in the table are active. E. Turn the isolator switch to the OFF position.	Diagnostic codes	**Result**: A 3563-13 diagnostic code is active. Proceed to Test Step 3. **Result**: No diagnostic codes are active. Return the unit to service.
3. Check the Intake Manifold Pressure Sensor A. Turn the isolator switch to the OFF position. B. Disconnect the intake manifold pressure sensor connector. C. Inspect the connector pins for corrosion and moisture. D. Reconnect the intake manifold pressure sensor connector. E. Connect the electronic service tool. A. Turn the isolator switch to the ON position. F. Monitor the status parameter for the intake manifold pres-sure while flexing the wiring.	Sensor	**Result**: A 3563-13 diagnostic code is active. Temporarily connect a replacement intake manifold pressure sensor to the harness. Turn the isolator switch to the ON position. Use the electronic service tool in order to check for active diagnostic codes. Wait at least 30 seconds in order for the codes to be displayed. If the fault is eliminated, reconnect the suspect sensor. If the fault returns, permanently install the replacement sensor. If the fault is not eliminated with a replacement sensor, contact the Perkins dealer. **Result**: No diagnostic code is active. The fault is eliminated. Return the unit to service.

Sensor Supply - Test

This procedure covers the following diagnostic codes:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
678-3	ECU 8 Volts DC Supply : Voltage Above Normal	The ECM detects the following conditions: The 8 VDC supply is more than 8.8 VDC for more than one second. The ECM has been powered for more than 3 seconds. Diagnostic code 168-4 is not active. The ECM will log the diagnostic code and the warning lamp will illuminate while this diagnostic code is active. The engine may be limited to low idle.
678-4	ECU 8 Volts DC Supply : Voltage Below Normal	The ECM detects the following conditions: The 8 VDC supply is less than 7.2 VDC for more than one second. The ECM has been powered for more than 3 seconds. Diagnostic code 168-4 is not active. The ECM will log the diagnostic code and the warning lamp will illuminate while this diagnostic code is active. The engine may be limited to low idle. An active diagnostic code may not cause any noticeable effect on engine response unless the voltage drops below 6.5 VDC.

3509-3	Sensor Supply Voltage 1 : Voltage Above Normal	The ECM detects the following conditions: The 5 VDC supply for the sensors is greater than 5.16 VDC for more than one second. The ECM has been powered for at least 3 seconds. Diagnostic code 168-4 is not active. The warning lamp will come on. The ECM sets all the sensors on the 5 VDC circuit to the default values. The engine will be derated.
3509-4	Sensor Supply Voltage 1 : Voltage Below Normal	The ECM detects the following conditions: The 5 VDC supply for the sensors is less than 4.84 VDC for more than one second. The ECM has been powered for at least 3 seconds. Diagnostic code 168-4 is not active. The warning lamp will come on. The ECM sets all the sensors on the 5 VDC circuit to the default values. The engine will be derated.
3510-3	Sensor Supply Voltage 2 : Voltage Above Normal	The ECM detects the following conditions: The 5 VDC supply for the sensors is greater than 5.16 VDC for more than one second. The ECM has been powered for at least 3 seconds. Diagnostic code 168-4 is not active. The warning lamp will come on. The ECM sets all the sensors on the 5 VDC circuit to the default values. The engine will be derated.
3510-4	Sensor Supply Voltage 2 : Voltage Below Normal	The ECM detects the following conditions: The 5 VDC supply for the sensors is less than 4.84 VDC for more than one second. The ECM has been powered for at least 3 seconds. Diagnostic code 168-4 is not active. The warning lamp will come on. The ECM sets all the sensors on the 5 VDC circuit to the default values. The engine will be derated.
Follow the troubleshooting procedure in order to identify the root cause of the fault.		

Note: A 3509-XX diagnostic code indicates a fault in the 5 VDC circuit on the J2/P2 connector. A 3510-XX diagnostic code indicates a fault in the 5 VDC circuit on the J1/P1 connector. A 678-XX diagnostic code indicates a fault in the 8 VDC circuit on the J2/P2 connector.

The following background information is related to this procedure:

The ECM supplies regulated +5 VDC to the following sensors:

- Intake manifold air pressure sensor
- Fuel rail pressure sensor
- Engine post filter oil pressure sensor
- Sea water pressure for raw water cooling system only (if equipped)

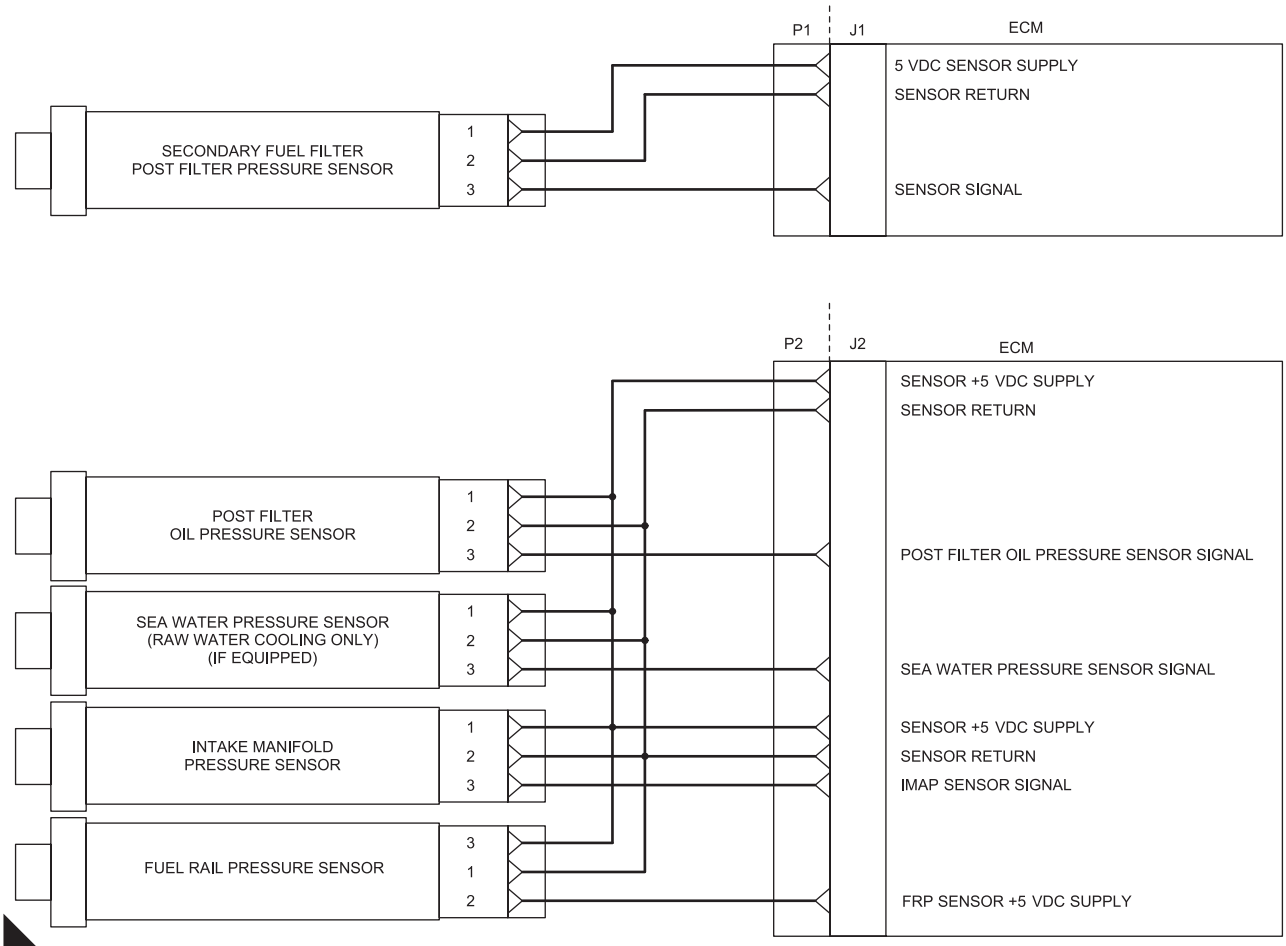
- Secondary fuel filter post pressure

The ECM supplies regulated +8 VDC to the following sensors:

- Primary speed/timing sensor
- Secondary speed/timing sensor
- Exhaust gas temperature sensor

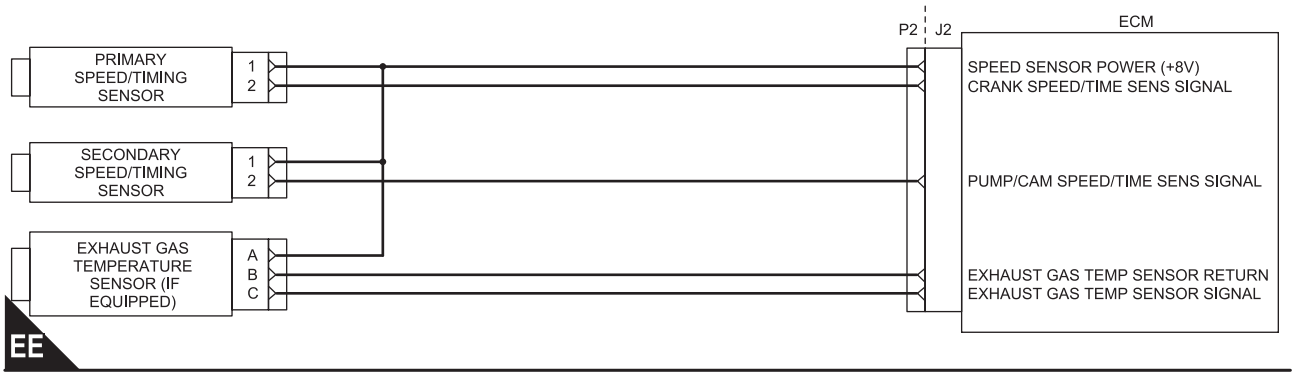
A diagnostic code can be caused by the following conditions:

- A short circuit in the harness
- A short circuit to a voltage that is higher than 5.16 VDC for a 5 VDC supply
- A short circuit to a voltage that is higher than 8.8 VDC for an 8 VDC supply
- A faulty sensor
- A faulty ECM
- An open circuit in the harness

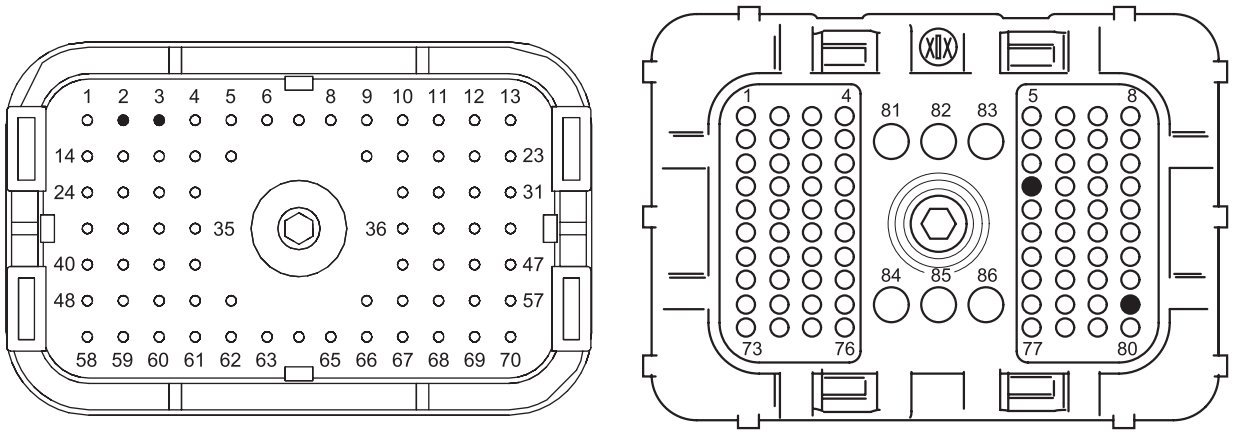


DD

5 VDC supply circuit



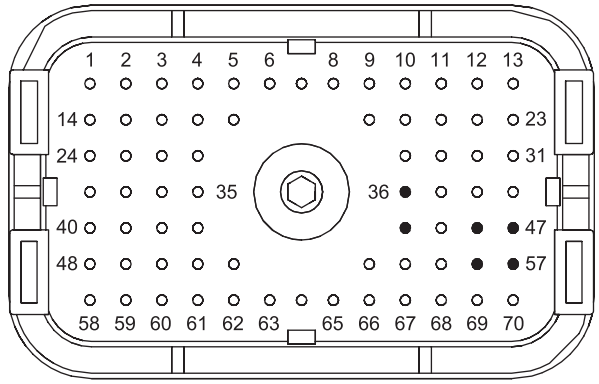
8 VDC supply circuit



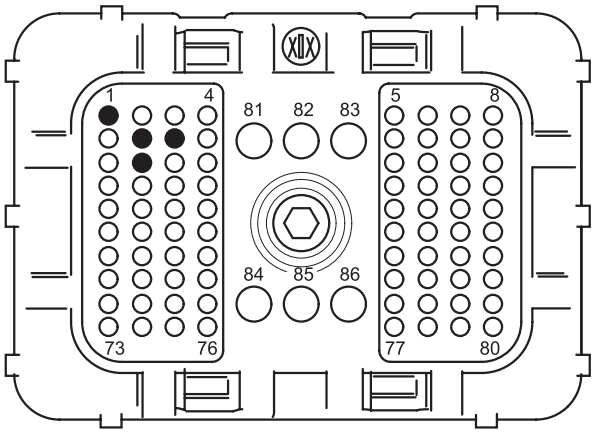
A5E2v1 (70pins) A5E2v2 (86pins)

P1 pin locations for the sensor supply circuits

A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
2	72	5v Sensor Power
3	29	5v Sensor Return



A5E2v1 (70pins)

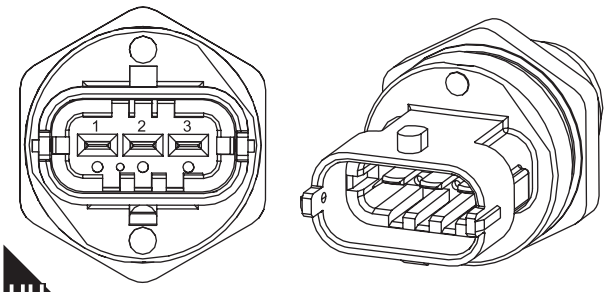


A5E2v2 (86pins)

GG

P2 pin locations for the sensor supply circuits

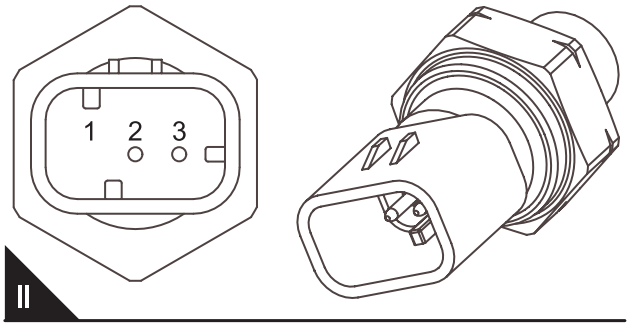
A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
36	-	-
44	18	Engine Speed/Timing Sensor Power
46	1	5v Analogue Power
47	-	5v Analogue Power
56	10	5v Sensor Return
57	11	Engine Analog Sensor Return



HH

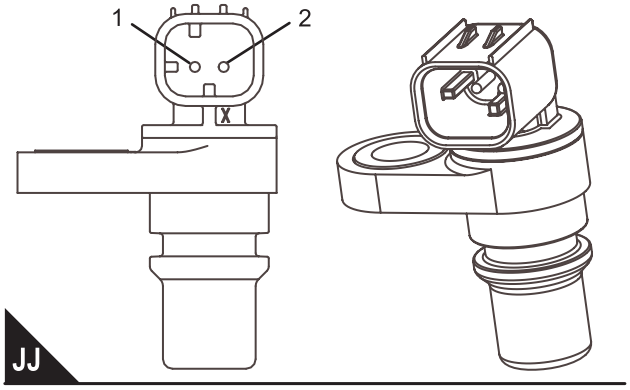
Fuel rail pressure sensor

(1) Ground
(2) Signal
(3) 5 VDC Supply



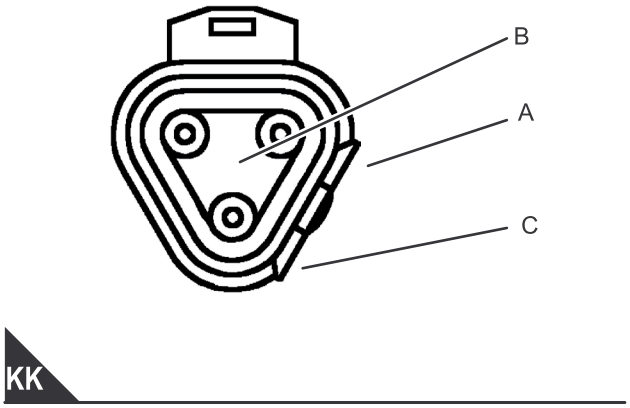
Typical example of an engine pressure sensor

(1) 5 VDC Supply
(2) Ground
(3) Signal



Typical example of a speed/timing sensor

(1) 8 VDC supply
(2) Signal



Typical example of an exhaust gas temp sensor

(A) 8 VDC supply
(B) Ground
(C) Signal

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring A. Thoroughly inspect the terminal connections on the P2/J2 and P1/J1 ECM connectors and the engine sensors. Refer to Troubleshooting, “Electrical Connectors - Inspect”. B. Perform a 45 N (10.1 lb) pull test on each of the wires in the ECM connector. Perform the same test on the sensor connectors that are associated with the active diagnostic code. C. Check the screw for the ECM connector for the correct tor-que of 6 N·m (53.1 lb in). D. Check the harness for corrosion, abrasion, and pinch points from the engine sensors to the ECM.	Loose connection or damaged wire	**Result**: There is a fault in a connector or the wiring. Repair any faulty connectors or replace the wiring harness. Ensure that all the seals are properly in place and ensure that the connectors are correctly coupled. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: All connectors, pins, and sockets are correctly coupled and/or inserted. The harness is free of corrosion, abrasion, and pinch points. Proceed to Test Step 2.
2. Check for Active Diagnostic Codes A. Turn the isolator switch to the OFF position. B. Connect the electronic service tool to the diagnostic connector. C. Turn the isolator switch to the ON position. Wait at least 20 seconds for activation of the diagnostic codes. D. Verify if any of the diagnostic codes that are listed in Table 94 are active. E. Turn the isolator switch to the OFF position.	Diagnostic codes	**Result**: Diagnostic code 678-4, 3509-4 or 3510-4 is active. Proceed to Test Step 3. **Result**: Diagnostic code 678-3, 3509-3 or 3510-3 is active. Proceed to Test Step 7. **Result**: There are no active sensor supply diagnostic codes. The fault may be intermittent. Refer to Troubleshooting “Electrical Connector - Inspect” to identify intermittent faults.
3. Disconnect the Sensors One at a Time A. Turn the isolator switch to the OFF position. B. For a 3509-X diagnostic code, disconnect the sensors on the 5 VDC supply circuit on ECM connector P2 one at a time. For a 3510-X diagnostic code, disconnect the sensors on the 5 VDC supply circuit on ECM connector P1 one at a time. For a 678-4 diagnostic code, disconnect the sensors on the 8 VDC supply circuit one at a time. Wait for 30 seconds after each sensor is disconnected. Use the electronic service tool to monitor the diagnostic codes. The sensor supply diagnostic code will become inactive when the sensor that caused the diagnostic code is disconnected. C. Ensure that all the sensors on the applicable sensor supply circuit are disconnected.	Diagnostic code	**Result**: The sensor supply diagnostic is no longer active with all the sensors disconnected. Replace the suspect sensor. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The sensor supply diagnostic code is still active with all the sensors disconnected. Proceed to Test Step 4.

4. Disconnect the P2 ECM Connector A. Turn the isolator switch to the OFF position. B. Connect the electronic service tool to the diagnostic connector. C. For a 3509-4 code, perform steps D. to G. D. Disconnect the P2 connector from the ECM. E. Check the ECM connectors for corrosion and moisture. Refer to Troubleshooting, “Electrical Connectors - Inspect”. F. Temporarily remove pins P2:46 or 1 and P2:47. G. Reconnect connector P2 to the ECM. H. For a 3510-4 code, perform steps I. to L. I. Disconnect the P1 connector from the ECM. J. Check the ECM connectors for corrosion and moisture. Refer to Troubleshooting, “Electrical Connectors - Inspect”. K. Temporarily remove pin P1:2. L. Reconnect connector P1 to the ECM. M. For a 678-4 code, perform steps N. to Q. N. Disconnect the P2 connector from the ECM. O. Check the ECM connectors for corrosion and moisture. Refer to Troubleshooting, “Electrical Connectors - Inspect”. P. Temporarily remove pin P2:44 or 18. Q. Reconnect connector P2 to the ECM. R. Turn the isolator switch to the ON position. S. Check for active diagnostic codes on the electronic service tool.	Diagnostic codes	**Result**: Diagnostic code XXXX-4 was previously active and is no longer active. Do not replace the previously removed pins. Proceed to Test Step 6. **Result**: Diagnostic code XXXX-4 was previously active and is no longer active. Replace all wires on the ECM connector to the original configuration. Proceed to Test Step 9. **Result**: The XXXX-4 diagnostic code is still active. Proceed to Test Step 5.
5. Check if a Replacement 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 the Perkins dealer. Note: This consultation can greatly reduce the repair time. C. If the dealer recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”. D. Turn the isolator switch to the ON position. Use the electronic service tool to verify that the repair eliminates the fault.	ECM	**Result**: The fault is eliminated with the test ECM. Reconnect the suspect ECM. If the fault returns with the suspect ECM, permanently install the replacement ECM. **Result**: The fault is still present with the replacement ECM. Do not use the replacement ECM. Contact the Perkins dealer.

6. Reconnect the Pins for the Supply One at a Time and Check for Active Diagnostic Codes A. Turn the isolator switch to the OFF position. B. Disconnect the P2 connector from the ECM. C. For a 3509-4 diagnostic code, replace one of the following pins: · P2:46 or 1 · P2:47 D. For a 678-4 diagnostic code, replace pin P2:44. or 18 Reconnect the P2 connector to the ECM. Check for active diagnostic codes on the electronic service tool.	Diagnostic code	**Result**: A 3509-4 diagnostic code is active. Make a note of the pin that was replaced and proceed to Test Step 9. **Result**: There is no active 3509-4 diagnostic code. Remove the pin that was previously replaced and then repeat this Test Step for the other pin. **Result**: A 3510-4 diagnostic code is active. Proceed to Test Step 9. **Result**: A 678-4 diagnostic code is active. Proceed to Test Step 9.

7. Check the Supply from the ECM A. For a 3510-3 diagnostic code, perform steps B. to G. B. Disconnect the P1 connector from the ECM. C. Check the ECM connector for corrosion and moisture. Refer to Troubleshooting, “Electrical Connectors - Inspect”. D. Remove the wire from P1:2.or 72 E. Install a jumper wire to P1:2 or 72. F. Measure the voltage from the end of the jumper wire to P1:3 or 29. G. Measure the voltage from the end of the jumper wire to P1:47 or 70. H. For a 3509-3 diagnostic code, perform steps I. to O. I. Disconnect the P2 connector from the ECM. J. Check the ECM connector for corrosion and moisture. Refer to Troubleshooting, “Electrical Connectors - Inspect”. K. Remove the wires from P2:46 or 1 and P2:47. L. Install a jumper wire to P2:46 or 1. M. Measure the voltage from the end of the jumper wire to P2:56 or 10. N. Install a jumper wire to P2:47. O. Measure the voltage from the end of the jumper wire to P2:57 or 11. P. For a 678-3 diagnostic code, perform steps Q. to U. Q. Disconnect the P2 connector from the ECM. R. Check the ECM connector for corrosion and moisture. Refer to Troubleshooting, “Electrical Connectors - Inspect”. S. Remove the wire from P2:44 or 18. T. Install a jumper wire to P2:44 or 18. U. Measure the voltage from the end of the jumper wire to P2:38 or 27.	4.84 VDC to 5.16 VDC or 7.8 VDC to 8.2 VDC	**Result**: The voltage is not within the expected range. Proceed to Test Step 8. **Result**: The voltage is within the expected range. Proceed to Test Step 9.

8. Check if a Replacement 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 the Perkins dealer. **Note**: This consultation can greatly reduce the repair time. C. If the TC recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”. D. Turn the isolator switch to the ON position. Use the electronic service tool to verify that the repair eliminates the fault.	ECM	**Result**: The fault is eliminated with the test ECM. Reconnect the suspect ECM. If the fault returns with the suspect ECM, permanently install the replacement ECM.
9. Measure the Supply to the Sensor A. Turn the isolator switch to the ON position. B. For a 3510-X diagnostic code, perform steps C. to D. C. Disconnect all the components that are supplied with 5 VDC from P1:2 or 72. D. Measure the voltage between terminal 1 and terminal 2 on the connector for the secondary fuel filter post filter sensor. E. For a 3509-X diagnostic code, perform steps F. to G. F. Disconnect all the sensors that are supplied with 5 VDC from the pin that was previously identified. G. Measure the voltage between the terminal for the 5 VDC supply and the ground terminal on the connector for each of the sensors. H. For a 678-X diagnostic code, perform steps I. to K. I. Disconnect both of the speed/timing sensors and the Exhaust Gas Temperature Sensor. J. Speed/Timing Sensors: Measure the voltage between pin 1 and pin 2 on the connector for each of the sensors. K. Exhaust Gas Temperature Sensor: Measure the voltage be-tween pin A and pin B on the connector for the sensor.	4.84 VDC to 5.16 VDC or 7.8 VDC to 8.2 VDC	**Result**: The supply is within the expected range. Proceed to Test Step 10. **Result**: The voltage is greater than the expected range. Check the supply wire for a short to a higher voltage source. Repair the supply wire and/or replace the supply wire. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: The voltage is less than the expected range. Check the supply wire for a short to ground. Repair the supply wire and/or replace the supply wire. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault.
10. 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 to repro-duce intermittent faults. **Note**: If an intermittent fault exists, the status will be high-lighted and an audible beep will be heard.	Wiggle test	**Result**: At least one intermittent fault was indicated. Repair the harness or the connector. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair eliminates the fault. **Result**: No intermittent faults were indicated during the “Wiggle Test” . If the fault has been eliminated, return the unit to service. If the fault is still present, contact the Perkins dealer.

Sensor Signal (Analog, Active)- Test

This procedure covers the following diagnostic codes:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
94-3	Engine Fuel Delivery Pressure : Voltage Above Normal (If equipped)	The ECM detects the following conditions: The signal voltage from the secondary fuel filter inlet pressure sensor is above 4.8 VDC. If equipped, the warning light will come on. The ECM will log the diagnostic code.
94-4	Engine Fuel Delivery Pressure : Voltage Below Normal (If equipped)	The ECM detects the following conditions: The signal voltage from the secondary fuel filter inlet pressure sensor is less than 0.2 VDC. If equipped, the warning light will come on. The ECM will log the diagnostic code.
100-3	Engine Oil Pressure : Voltage Above Normal	The ECM detects the following conditions: The signal voltage from the engine oil pressure sensor is greater than 4.8 VDC for more than 8 seconds. If equipped, the warning lamp will come on. The ECM will log the diagnostic code. The ECM will set data for engine oil pressure to the default value. The default engine oil pressure is 600 kPa (87.0 psi). The electronic service tool will display “Voltage Above Nor-mal” on the status screens.
100-4	Engine Oil Pressure : Voltage Below Normal	The ECM detects the following conditions: The signal voltage from the engine oil pressure sensor is less than 0.2 VDC for more than 8 seconds. The ECM has been powered for at least 2 seconds. If equipped, the warning lamp will come on. The ECM will log the diagnostic code. The ECM will set data for the engine oil pressure to the default value. The default engine oil pressure is 600 kPa (87.0 psi). The electronic service tool will display “Voltage Below Normal” on the status screens.
157-3	Engine Injector Metering Rail #1 Pressure : Voltage Above Normal	The ECM detects the following conditions: The signal voltage for the fuel rail pressure sensor is more than 4.925 VDC for 0.6 seconds. If equipped, the warning lamp will flash. The ECM will log the diagnostic code. The electronic service tool will display “70000 kPa” next to “Desired Fuel Rail Pressure” and “Ac-ual Fuel Rail Pressure” on the status screens. The engine will be derated.
157-4	Engine Injector Metering Rail #1 Pressure : Current Below Normal	The ECM detects the following conditions: The signal voltage for the fuel rail pressure sensor is less than 0.065 VDC for 0.6 seconds. If equipped, the warning lamp will flash. The ECM will log the diagnostic code. The electronic service tool will display “70000 kPa” next to “Desired Fuel Rail Pressure” and “Actual Fuel Rail Pressure” on the status screens. The engine will be derated.

1208-3	Engine Pre-filter Oil Pressure : Voltage Above Normal	The Electronic Control Module (ECM) detects the following conditions: The signal voltage from the engine pre-filter oil pressure sensor is greater than 4.8 VDC for more than 8 seconds. If equipped, the warning lamp will come on. The ECM will log the diagnostic code.
1208-4	Engine Pre-filter Oil Pressure : Voltage Below Normal	The ECM detects the following conditions: The signal voltage from the engine pre-filter oil pressure sensor is less than 0.2 VDC for more than 8 seconds. The ECM has been powered for at least 2 seconds. If equipped, the warning lamp will come on. The ECM will log the diagnostic code.
1381-3	Engine Fuel Supply Pump Inlet Pressure : Voltage Above Normal (If equipped)	The ECM detects the following conditions: The signal voltage from the primary fuel filter outlet pressure sensor is above 4.8 VDC. If equipped, the warning light will come on. The ECM will log the diagnostic code.
1381-4	Engine Fuel Supply Pump Inlet Pressure : Voltage Below Normal (If equipped)	The ECM detects the following conditions: The signal voltage from the primary fuel filter outlet pressure sensor is less than 0.2 VDC. If equipped, the warning light will come on. The ECM will log the diagnostic code.
2434-3	Engine Exhaust Manifold Bank #1 Temperature #1 : Voltage Above Normal	The ECM detects the following conditions: The signal voltage from the exhaust gas temperature sensor is greater than 4.8 VDC. If equipped, the warning lamp will come on. The ECM will log the diagnostic code. The electronic service tool will display “Voltage Above Normal” on the status screens.
2434-4	Engine Exhaust Manifold Bank #1 Temperature #1 : Voltage Below Normal	The ECM detects the following conditions: The signal voltage from the exhaust gas temperature sensor is less than 0.2 VDC. If equipped, the warning lamp will come on. The ECM will log the diagnostic code. The electronic service tool will display “Voltage Below Normal” on the status screens.
2435-3	Seawater Pump Outlet Pressure : Voltage Above Normal (If equipped)	**Note**: This code is only applicable to engines that use a raw water cooling system. The ECM detects the following conditions: The signal voltage from the seawater pump outlet pressure sensor is greater than 4.8 VDC. If equipped, the warning lamp will come on. The ECM will log the diagnostic code. The electronic service tool will display “Voltage Above Normal” on the status screens.
2435-4	Seawater Pump Outlet Pressure : Voltage Below Normal (If equipped)	**Note**: This code is only applicable to engines that use a raw water cooling system. The ECM detects the following conditions: The signal voltage from the seawater pump outlet pressure sensor is less than 0.2 VDC. If equipped, the warning lamp will come on. The ECM will log the diagnostic code. The electronic service tool will display “Voltage Below Normal” on the status screens.

3563-3	Engine Intake Manifold #1 Absolute Pressure : Voltage Above Normal	The ECM detects the following conditions: The signal voltage from the intake manifold pressure sensor is above 4.8 VDC for at least 8 seconds. The ECM has been powered for 2 seconds. If equipped, the warning light will 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 2 seconds. The ECM will then flag the intake manifold pressure as being invalid. A default value is then used for the intake manifold pressure.
3563-4	Engine Intake Manifold #1 Absolute Pressure : Voltage Below Normal	The ECM detects the following conditions: The signal voltage from the intake manifold pressure sensor is less than 0.2 VDC for at least 8 seconds. The ECM has been powered for 2 seconds. If equipped, the warning light will 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 2 seconds. The ECM will then flag the intake manifold pressure as being invalid. A default value is then used for intake manifold pressure.
5417-3	Fuel Filter (Suction Side) Intake Pressure : Voltage Above Normal (If equipped)	The ECM detects the following conditions: The signal voltage from the primary fuel filter inlet pressure sensor is above 4.8 VDC. If equipped, the warning light will come on. The ECM will log the diagnostic code.
5417-4	Fuel Filter (Suction Side) Intake Pressure : Voltage Below Normal (If equipped)	The ECM detects the following conditions: The signal voltage from the primary fuel filter inlet pressure sensor is less than 0.2 VDC. If equipped, the warning light will come on. The ECM will log the diagnostic code.
5579-3	Engine Filtered Fuel Delivery Pressure : Voltage Above Normal	The ECM detects the following conditions: The signal voltage from the secondary fuel filter outlet pressure sensor is above 4.8 VDC. If equipped, the warning light will come on. The ECM will log the diagnostic code.
5579-4	Engine Filtered Fuel Delivery Pressure : Voltage Below Normal	The ECM detects the following conditions: The signal voltage from the secondary fuel filter outlet pressure sensor is less than 0.2 VDC. If equipped, the warning light will come on. The ECM will log the diagnostic code.
Follow the troubleshooting procedure in order to identify the root cause of the fault.		

The following conditions must exist before any of the above codes will become active:

- There are no active 3509 codes.
- There are no active 3510 codes.
- There are no active 168 codes.

The following background information is related to this procedure:

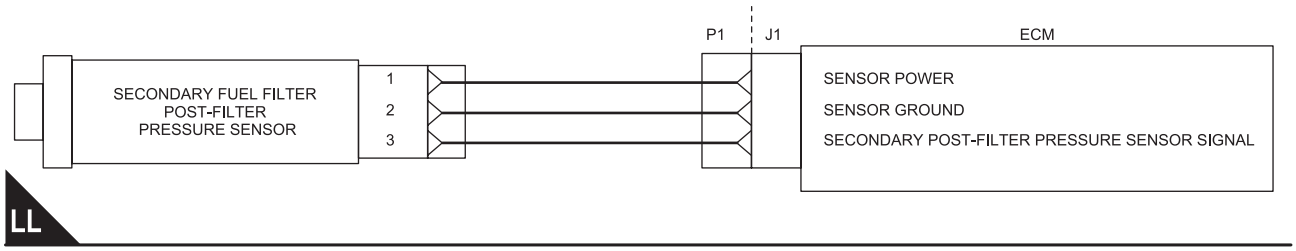
Note: The terminals on the fuel rail pressure sensor are wired differently from all other pressure sensors.

The 5 VDC sensor supply provides power to all 5 VDC sensors. The ECM supplies 5 VDC to terminal “3” of the fuel rail pressure sensor connector. The ECM supplies 8 VDC to terminal “A” of the exhaust gas temperature sensor connector. The ECM supplies 5 VDC to terminal “1” of all other active sensor connectors. The sensor common from the ECM connector goes to terminal “1” of the connector for the fuel rail pressure sensor. The sensor common from the ECM connector goes to terminal “B” of the connector for the exhaust gas temperature sensor. The sensor common from the ECM connector goes to terminal “2” of all other active sensor connectors. The sensor supply is output short circuit protected. A short circuit to the battery will not damage the circuit inside the ECM.

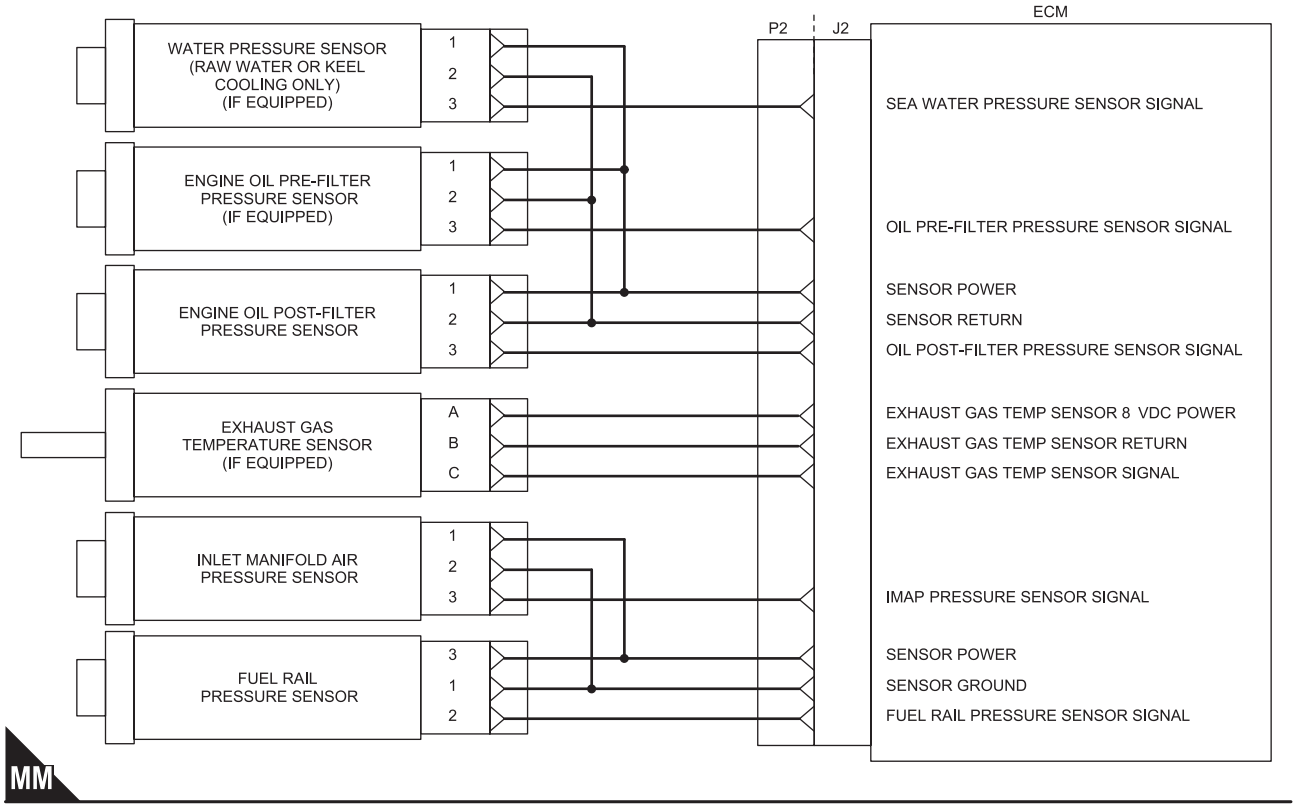
Pull-up Voltage:

The ECM continuously outputs a pull-up voltage on the circuit for the sensor signal wire. The ECM uses this pull-up voltage to detect an open in the signal circuit. When the ECM detects a voltage above a threshold on the signal circuit, an open circuit diagnostic code (XXXX-3) is generated for the sensor.

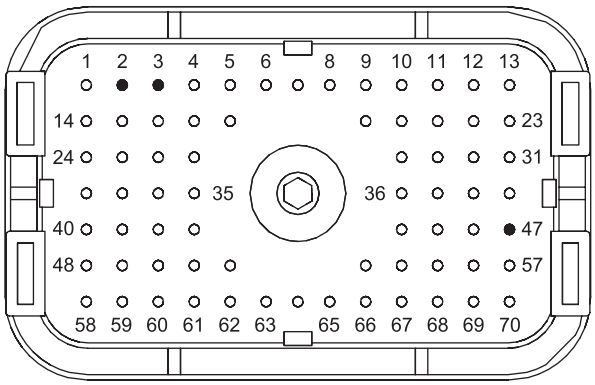
If the sensor is disconnected, pull-up voltage indicates that the wires from the sensor connector to the ECM are not open or shorted to ground. If the sensor is disconnected, the absence of pull-up voltage indicates an open in the signal wire or a short to ground. If the sensor is disconnected and the voltage is different from pull-up voltage, the signal wire is shorted to another wire in the harness.

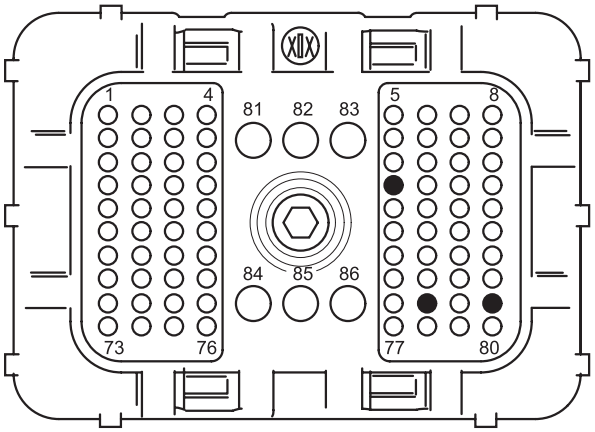


Schematic for the active sensors on the P1 connector



Schematic for the active sensors on the P2 connector



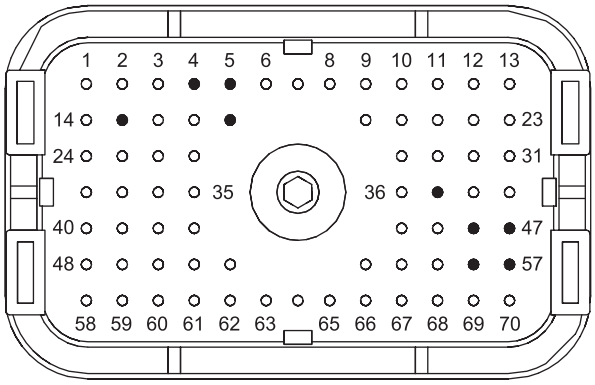


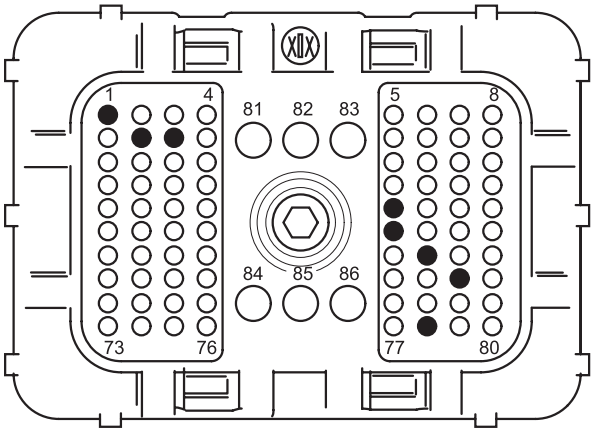
A5E2v1 (70pins) A5E2v2 (86pins)

NN

Pin locations on the P1 connector for the active sensors

A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
2	72	5v Sensor Power
3	29	5v Sensor Return
47	70	Fuel Secondary Postfilter Pressure





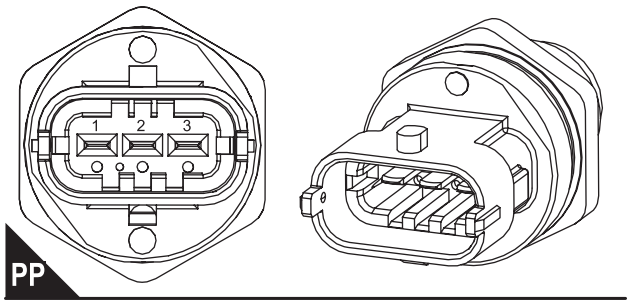
A5E2v1 (70pins) A5E2v2 (86pins)

OO

Pin locations on the P2 connector for the active sensors

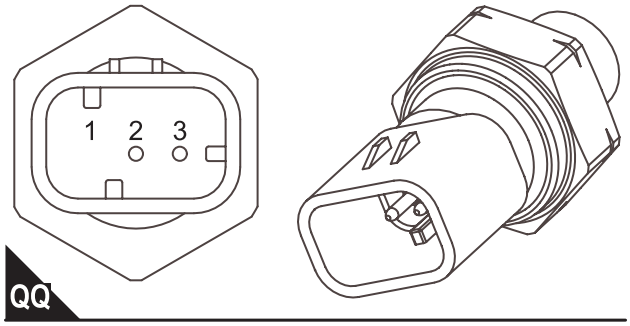
A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
4	54	Inlet Manifold Air Pressure
5	45	Sea Water Pressure

15	78	Engine Oil Pressure - Prefiltered
18	63	Exhaust Gas Temp
37	37	Fuel Rail Pressure Signal
46	1	5v Analogue Power
47	-	5v Analogue Power
56	10	5v Sensor Return
57	11	Engine Analog Sensor Return



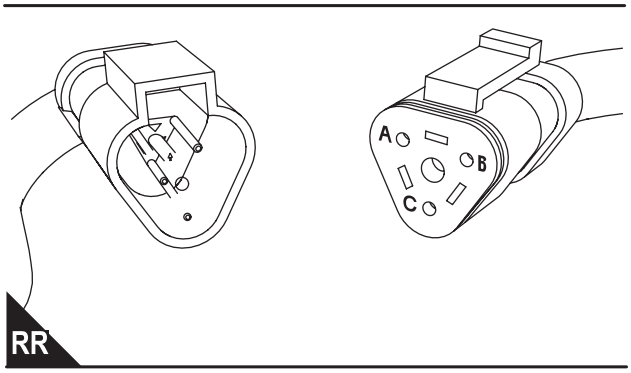
Fuel rail pressure sensor

(1) Ground
(2) Signal
(3) 5 VDC Supply



Typical example of an engine pressure sensor

(1) 5 VDC Supply
(2) Ground
(3) Signal



(A) 5 VDC Supply
(B) Ground
(C) Signal

Exhaust Gas Temperature Sensor (if equipped)

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring A. Thoroughly inspect the terminal connections on the P2/J2 ECM connectors and the engine active sensors. Refer to Troubleshooting, “Electrical Connectors - Inspect”. B. Perform a 45 N (10.1 lb) pull test on each of the wires in the ECM connector. Perform the same test on the sensor connectors that are associated with the active diagnostic code. C. Check the screw for the ECM connector for the correct torque of 6 N·m (53.1 lb in). D. Check the harness for corrosion, abrasion, and pinch points from the engine active sensors to the ECM.	Loose connection or damaged wire	**Result**: There is a fault in a connector or the wiring. Repair any faulty connectors or replace the wiring harness. Ensure that all the seals are properly in place and ensure that the connectors are correctly coupled. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: All connectors, pins, and sockets are correctly coupled and/or inserted. The harness is free of corrosion, abrasion, and pinch points. Proceed to Test Step 2.
2. Check For Active Diagnostic Codes A. Turn the isolator switch to the OFF position. B. Connect the electronic service tool to the diagnostic connector. C. Turn the isolator switch to the ON position. Wait at least 10 seconds for activation of the diagnostic codes. D. Verify if any of the diagnostic codes that are listed in Table 96 are active. E. Turn the isolator switch to the OFF position.	Diagnostic codes	**Result**: There are no active diagnostic codes for the active sensors. If there are logged diagnostic codes for the active sensors, the fault may be intermittent. Refer to Troubleshooting, “Electrical Connectors - Inspect” to identify intermittent faults. **Result**: An XXXX-3 or an XXXX-4 diagnostic code is active for one or more of the active sensors. Proceed to Test Step 3.
3. Check the Supply Voltage at the Sensor Connector A. Turn the isolator switch to the OFF position. B. Disconnect the connector for the suspect sensor. C. Turn the isolator switch to the ON position. Do not start the engine. D. Measure the voltage between the supply terminal and the ground terminal on the harness connector for the suspect sensor. The voltage measurement should be 8.0 ± 0.2 VDC for the exhaust gas temperature sensor. The voltage measurement should be 5.0 ± 0.2 VDC for all other sensors. E. Turn the isolator switch to the OFF position. F. Reconnect the sensor.	7.8 VDC to 8.2 VDC for the exhaust gas temperature sensor. 4.8 VDC to 5.2 VDC for all other sensors.	**Result**: The voltage measurement is not within the expected range. The fault is in the supply wire or the ground wire in the engine wiring harness. Repair the faulty wiring or replace the faulty wiring. Use the electronic service tool to clear all logged diagnostic codes. Return the engine to service. **Result**: The voltage measurement is within the expected range - The correct supply voltage is reaching the sensor. Proceed to Test Step 4.
4. Check the Type of Diagnostic Code that is Active A. Turn the isolator switch 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.	Diagnostic codes	**Result**: An XXXX-4 diagnostic code is active for one or more of the active sensors currently. Proceed to Test Step 5. **Result**: An XXXX-3 diagnostic code is active for one or more of the active sensors currently. Proceed to Test Step 7.

5. Create An Open Circuit at the Sensor Connector A. Turn the isolator switch to the OFF position. B. Disconnect the connector for the sensor with the XXXX-4 diagnostic code. C. Turn the isolator switch to the ON position. Wait for at least 10 seconds for activation of the diagnostic codes. D. Use the electronic service tool to check the “Active Diagnostic Code” screen. Check for an XXXX-3 diagnostic code.	Diagnostic codes	**Result**: An XXXX-4 diagnostic code was active before disconnecting the sensor. An XXXX-3 diagnostic code became active after disconnecting the sensor - the sensor is faulty. Temporarily connect a new sensor to the harness, but do not install the new sensor in the engine. Use the electronic service tool to verify that the repair eliminates the fault and then permanently install the new sensor. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The XXXX-4 diagnostic code is still active. Proceed to Test Step 6.
6. Check the Signal Wire for a Short Circuit A. Turn the isolator switch to the OFF position. B. Disconnect the P2 connector and disconnect the connector from the suspect sensor. C. Use a multimeter to check for resistance between the applicable signal terminal on the P2 connector and all other terminals on the P2 connector.	Greater than 100 Ohms	**Result**: At least one of the resistance measurements is less than 100 Ohms - The fault is in the engine harness. Repair the faulty connector or replace the faulty harness. Use the electronic service tool to verify that the repair eliminates the fault. **Result**: All resistance measurements are greater than 100 Ohms. Proceed to Test Step 9.
7. Create a Short Circuit at the Sensor Connector A. Turn the isolator switch to the OFF position. B. Disconnect the connector for the suspect sensor. C. Fabricate a jumper wire that is 150 mm (5.9 inch) long. Crimp a terminal to both ends of the wire. D. Use the jumper to connect the sensor signal terminal to the sensor ground terminal on the harness connector for the suspect sensor. E. Turn the isolator switch to the ON position. Do not start the engine. F. Access the “Active Diagnostic Codes” screen on the electronic service tool and check for an active XXXX-4 diagnostic code for the suspect sensor. G. Remove the jumper. Reconnect the sensor.	Diagnostic codes	**Result**: An XXXX-3 diagnostic code was active before in-stalling the jumper. An XXXX-4 diagnostic code became active with the jumper installed - the sensor may be faulty. Temporarily connect a new sensor to the harness, but do not install the new sensor in the engine. Use the electronic service tool to verify that the repair eliminates the fault and then permanently install the new sensor. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The XXXX-3 diagnostic code remains active when the jumper is installed. Proceed to Test Step 8.
8. Check the Signal Wire for an Open Circuit A. Turn the isolator switch to the OFF position. B. Disconnect the P2 connector and disconnect the connector from the suspect sensor. C. Use a multimeter to check for resistance between the applicable signal terminal on the sensor connector and the applicable terminal on the P2 connector.	Less than 2 Ohms.	**Result**: The resistance measurement is greater than 2 Ohms - The fault is in the engine harness. Repair the faulty wiring or replace the faulty wiring. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The resistance measurement is less than 2 Ohms. The fault is in the ECM. Proceed to Test Step 9.

9. Check if a Replacement 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 the Perkins dealer. Note: This consultation can greatly reduce the repair time. C. If the dealer recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”. D. Turn the isolator switch to the ON position. Use the electronic service tool to verify that the repair eliminates the fault.	Fault eliminated	**Result**: The fault is eliminated with the test ECM. Reconnect the suspect ECM. If the fault returns with the suspect ECM, permanently install the replacement ECM. **Result**: The fault is still present with the replacement ECM. Do not use the replacement ECM. Contact the Perkins dealer.

Sensor Signal (Analog, Passive) - Test

This procedure covers the following diagnostic codes:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
105-3	Engine Intake Manifold #1 Temperature : Voltage Above Normal	The Electronic Control Module (ECM) detects the following conditions: The signal voltage from the intake manifold air temperature sensor is greater than 4.95 VDC for more than 8 seconds. Engine coolant temperature is above −10 °C (15.0 °F). The ECM will use the default value of 70° C (158.0° 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. The engine may show the following symptoms: Poor stability Poor cold running Poor acceleration under load White smoke
105-4	Engine Intake Manifold #1 Temperature : Voltage Below Normal	The ECM detects the following conditions: The signal voltage from the intake manifold air temperature sensor is less than 0.2 VDC for more than 8 seconds. The ECM will use the default value of 70 °C (158.0°F) for the intake manifold air temperature. “Voltage Low” will be displayed next to the status for “Intake Manifold Air Temperaure” on the electronic service tool. The engine may show the following symptoms: Poor stability Poor cold running Poor acceleration under load White smoke

110-3	Engine Coolant Temperature : Voltage Above Normal	The ECM detects the following conditions: The signal voltage from the engine coolant temperature sensor is greater than 4.95 VDC for more than 8 seconds. An active diagnostic code will be generated after 8 seconds. The ECM will default to 90° C (194.0° F) for engine coolant temperature. “Voltage Above Normal” will be displayed next to the status for “Engine Coolant Temperature” on the electronic service tool. The engine may show the following symptoms: Poor stability Poor cold running White smoke
110-4	Engine Coolant Temperature : Voltage Below Normal	The ECM detects the following conditions: The signal voltage from the engine coolant temperature sensor is less than 0.2 VDC for more than 8 seconds. 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 (194.0 °F) for engine coolant temperature. “Voltage Below Normal” will be displayed next to the status for “Engine Coolant Temperature” on the electronic service tool. The engine may show the following symptoms: Poor stability Poor cold running White smoke
174-3	Engine Fuel Temperature 1 : Voltage Below Normal	The ECM detects the following conditions: The signal voltage from the engine fuel temperature sensor is greater than 4.95 VDC for more than 8 seconds. An active diagnostic code will be generated after 8 seconds. The ECM will default to 40° C (104.0° F) for fuel temperature. “Voltage Above Normal” will be displayed next to the status for “Engine Fuel Temperature” on the electronic service tool.
174-4	Engine Fuel Temperature 1 : Voltage Above Normal	The ECM detects the following conditions: The signal voltage from the engine fuel temperature sensor is less than 0.2 VDC for more than 8 seconds. An active diagnostic code will be generated after 8 seconds. The ECM will default to 40° C (104.0° F) for fuel temperature. “Voltage Below Normal” will be displayed next to the status for “Engine Fuel Temperature” on the electronic service tool.
175-3	Engine Oil Temperature 1 : Voltage Above Normal	The ECM detects the following conditions: The signal voltage from the engine oil temperature sensor is greater than 4.95 VDC for more than 8 seconds. An active diagnostic code will be generated after 8 seconds. “Voltage Above Normal” will be displayed next to the status for “Engine Oil Temperature” on the electronic service tool.
175-4	Engine Oil Temperature 1 : Voltage Below Normal	The ECM detects the following conditions: The signal voltage from the engine oil temperature sensor is less than 0.2 VDC for more than 8 seconds. An active diagnostic code will be generated after 8 seconds. “Voltage Below Normal” will be displayed next to the status for “Engine Oil Temperature” on the electronic service tool.
Follow the troubleshooting procedure in order to identify the root cause of the fault.		

Note: The following conditions must exist before any of the above codes will become active

• The ECM has been powered for at least 2 seconds.

• There are no active 168-X diagnostic codes.

The ECM will log the diagnostic code. If equipped, the warning light will turn ON.

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
- Engine fuel temperature sensor
- Engine oil temperature sensor (if equipped)

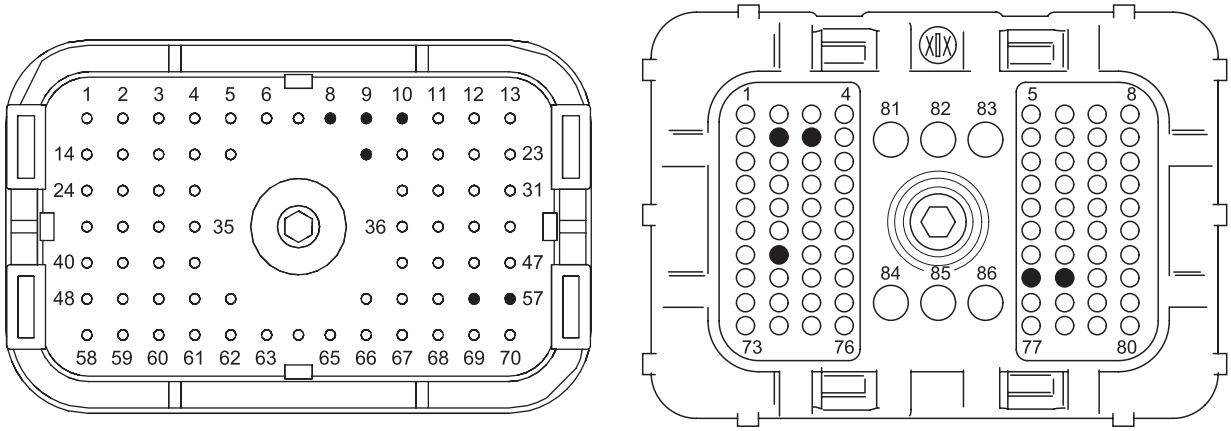
The following background information is related to this procedure:

The troubleshooting procedures for the diagnostic codes of each temperature sensor are identical. The temperature sensors have two terminals. The signal line is connected to each sensor connector terminal 1. Terminal 2 is the return line. The signal voltage from terminal 1 of each sensor is supplied to the appropriate terminal in the P2/J2 connector or the P1/J1 connector.

The ECM continuously outputs a pull-up voltage on the circuit for the sensor signal wire. The ECM uses this pull-up voltage to detect an open in the signal circuit. When the ECM detects a voltage above a threshold on the signal circuit, an open circuit diagnostic code (XXX-3) is generated for the sensor.

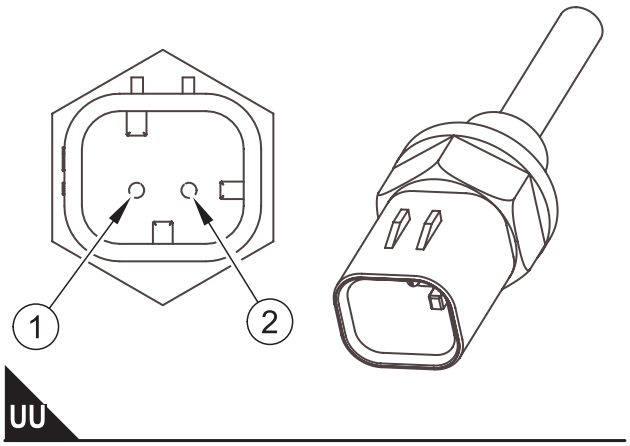
If the sensor is disconnected, pull-up voltage at the connector indicates that the wires are not open or shorted to ground. If the sensor is disconnected, the absence of pull-up voltage indicates an open in the signal wire or a short to ground. If the sensor is disconnected and the voltage is different from pull-up voltage, the signal wire is shorted to another wire in the harness.

Schematic for passive engine temperature sensors on the P2 connector



P2 pin locations for the temperature sensors

A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
8	-	-
9	50	Coolant Temperature
10	61	Fuel Temperature
19	62	Intake Manifold Air Temperature Signal
56	10	5v Sensor Return
57	11	Engine Analog Sensor Return



Typical view of an engine temperature sensor

(1) Signal
(2) Ground

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring A. Thoroughly inspect the terminal connections on the ECM connectors and the engine temperature sensors. Refer to Troubleshooting, “Electrical Connectors - Inspect”. B. Perform a 45 N (10.1 lb) pull test on each of the wires in the ECM connector. Perform the same test on the sensor connectors that are associated with the active diagnostic code. C. Check the screw for the ECM connector for the correct torque of 6 N·m (53.1 lb in). D. Check the harness for corrosion, abrasion, and pinch points from the engine temperature sensors to the ECM.	Loose connection or damaged wire	**Result**: There is a fault in a connector or the wiring. Repair any faulty connectors or replace the wiring harness. Ensure that all the seals are properly in place and ensure that the connectors are correctly coupled. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: All connectors, pins, and sockets are correctly coupled and/or inserted. The harness is free of corrosion, abrasion, and pinch points. Proceed to Test Step 2.
2. Check the Type of Diagnostic Code that is Active A. Turn the isolator switch 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.	Diagnostic codes	Result: An XXXX-4 diagnostic code is active for one or more of the temperature sensors currently. Proceed to Test Step 3. Result: An XXXX-3 diagnostic code is active for one or more of the temperature sensors currently. Proceed to Test Step 5.
3. Create An Open Circuit at the Sensor Connector A. Turn the isolator switch to the OFF position. B. Disconnect the connector for the sensor with the XXXX-4 diagnostic code. C. Turn the isolator switch to the ON position. Wait for at least 10 seconds for activation of the diagnostic codes. D. Use the electronic service tool to check the “Active Diagnostic Code” screen. Check for an XXXX-3 diagnostic code.	Diagnostic codes	**Result**: An XXXX-4 diagnostic code is active with the sensor connected. An XXXX-3 diagnostic code is active with the sensor disconnected. The sensor is faulty. Temporarily connect a new sensor to the harness, but do not install the new sensor in the engine. Use the electronic service tool to verify that the repair eliminates the fault and then permanently install the new sensor. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The XXXX-4 diagnostic code is still active. Proceed to Test Step 6.

4. Check the Signal Wire for a Short Circuit A. Turn the isolator switch to the OFF position. B. Disconnect the P2 connector and disconnect the connector from the suspect sensor. C. Use a multimeter to check for resistance between the applicable signal terminal on the P2 connector and all other terminals on the P2 connector.	Greater than 100 Ohms	**Result**: At least one of the resistance measurements is less than 100 Ohms - The fault is in the engine harness. Repair the faulty connector or replace the faulty harness. Use the electronic service tool to verify that the repair eliminates the fault. **Result**: All resistance measurements are greater than 100 Ohms. Proceed to Test Step 7.
5. Create a Short Circuit at the Sensor Connector A. Turn the isolator switch to the OFF position. B. Disconnect the P2 connector and disconnect the connector from the suspect sensor. C. Use a multimeter to check for resistance between the applicable signal terminal on the sensor connector and the applicable terminal on the P2 connector.	Less than 2 Ohms.	**Result**: The resistance measurement is greater than 2 Ohms - The fault is in the engine harness. Repair the faulty wiring or replace the faulty wiring. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The resistance measurement is less than 2 Ohms. The fault is in the ECM. Proceed to Test Step 9.
7. Check if a Replacement 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 the Perkins dealer. Note: This consultation can greatly reduce the repair time. C. If the dealer recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”. D. Turn the isolator switch to the ON position. Use the electronic service tool to verify that the repair eliminates the fault.	Fault eliminated	**Result**: The fault is eliminated with the test ECM. Reconnect the suspect ECM. If the fault returns with the suspect ECM, permanently install the replacement ECM. **Result**: The fault is still present with the replacement ECM. Do not use the replacement ECM. Contact the Perkins dealer.

Solenoid Valve - Test

This procedure covers the following diagnostic codes:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
1076-5	Engine Fuel Injection Pump Fuel Control Valve : Current Below Normal	The Electronic Control Module (ECM) detects the following conditions: Low current in the output from the ECM to the fuel pump solenoid for 0.6 seconds There are no active 168 diagnostic codes. The ECM has been powered for at least 0.25 seconds. If equipped, the warning lamp will come on. The ECM will log the diagnostic code. This diagnostic code detects a fault in the circuit for the fuel pump solenoid.

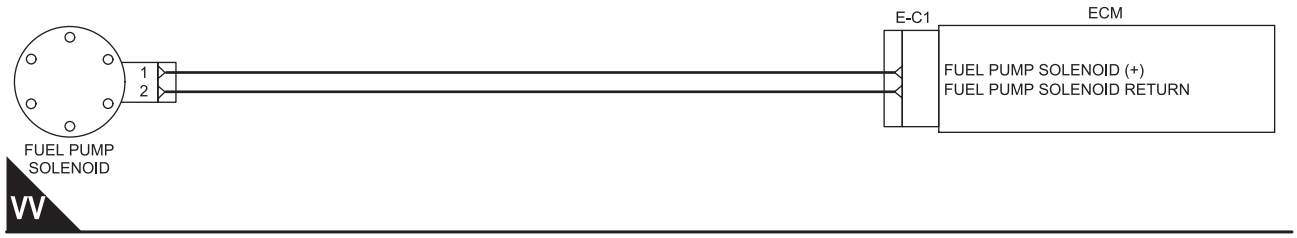
1076-6	Engine Fuel Injection Pump Fuel Control Valve : Current Above Normal	The ECM detects the following conditions: High current in the output from the ECM to the fuel pump solenoid for 0.6 seconds. There are no active 168 diagnostic codes. The ECM has been powered for at least 0.25 seconds. If equipped, the warning lamp will come on. The ECM will log the diagnostic code. This diagnostic code detects a fault in the circuit for the fuel pump solenoid. This fault is most likely to be caused by a high side short to ground or a low side short to power.
Follow the troubleshooting procedure in order to identify the root cause of the fault.		

The following background information is related to this procedure:

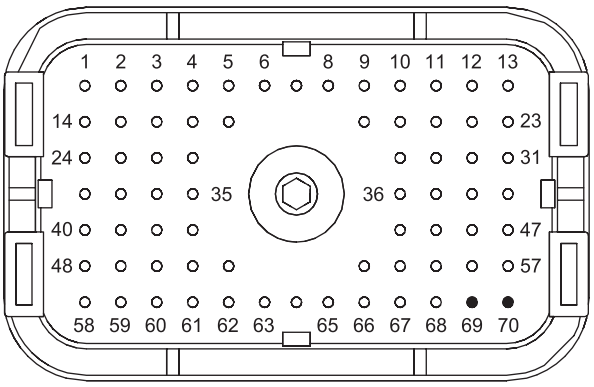
Suction Control Valve for the High-Pressure Fuel Pump.

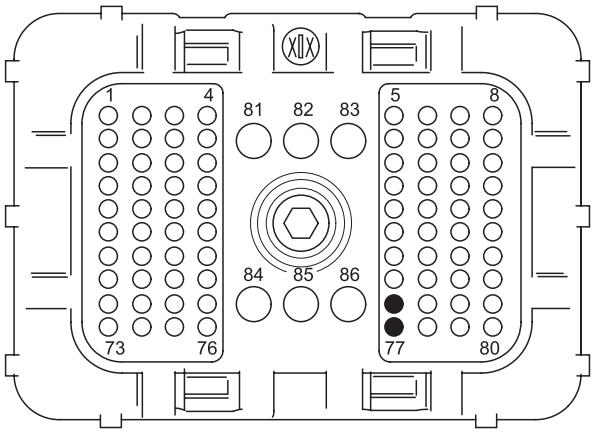
The fuel rail pump solenoid is used to control the output from the fuel rail pump. The solenoid receives an electrical supply from the ECM. The fuel rail pump solenoid is then energized when the fuel is to be pumped into the fuel rail.

The amount of fuel that is required is calculated by the software that is contained in the ECM. The fuel pump solenoid is controlled by a PWM signal from the ECM.



Schematic for the solenoid valve

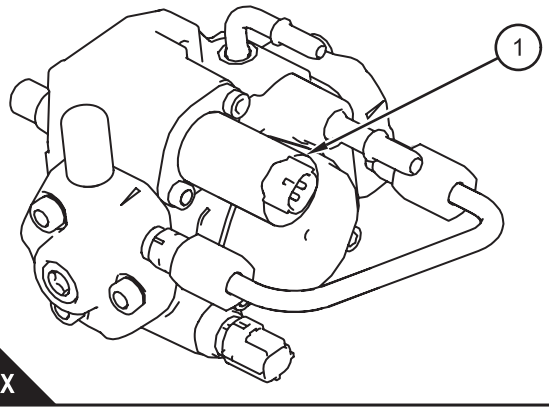




WW A5E2v1 (70pins) A5E2v2 (86pins)

Pin locations on the P2 connector for the solenoid valve

A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
69	77	Fuel Pump Solenoid (+)
70	69	Fuel Pump Solenoid Return



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Solenoid Valve - Typical Example

(1) Solenoid Valve

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring A. Thoroughly inspect the terminal connections on the P2/J2 ECM connector and the solenoids. Refer to Troubleshooting, “Electrical Connectors - Inspect”. B. Perform a 45 N (10.1 lb) pull test on each of the wires in the ECM connector. Perform the same test on the solenoid connectors that are associated with the active diagnostic code. C. Check the screw for the ECM connector for the correct torque of 6 N·m (53.1 lb in). D. Check the harness for corrosion, abrasion, and pinch points from the solenoids to the ECM.	Loose connection or damaged wire	**Result**: There is a fault in a connector or the wiring. Repair any faulty connectors or replace the wiring harness. Ensure that all the seals are properly in place and ensure that the connectors are correctly coupled. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: All connectors, pins, and sockets are correctly coupled and/or inserted. The harness is free of corrosion, abrasion, and pinch points. Proceed to Test Step 2.
2. Check for Active Diagnostic Codes A. Turn the isolator switch to the OFF position. B. Connect the electronic service tool to the diagnostic connector. C. Turn the isolator switch to the ON position. Wait at least 20 seconds for activation of the diagnostic codes. D. Verify if any of the diagnostic codes that are listed in Table 100 are active. E. Turn the isolator switch to the OFF position.	Diagnostic codes	**Result**: A 1076-5 diagnostic code is active. Proceed to Test Step 3. **Result**: A 1076-6 diagnostic is active. Proceed to Test Step 5.
3. Create a Short Circuit at the Harness Connector for the Solenoid A. Turn the isolator switch to the OFF position. B. Disconnect the connector for the suspect solenoid. C. Fabricate a jumper wire that is 150 mm (5.9 inch) long. D. Install the wire between the two pins on the harness connector for the fuel pump solenoid to create a short circuit. E. Turn the isolator switch to the ON position. Wait for 10 seconds. Check for active diagnostic codes on the electronic service tool. F. Remove the jumper wire from the connector for the solenoid valve.	Solenoid	**Result**: A 1076-5 diagnostic code was active before installing the jumper. A 1076-6 diagnostic code is active when the jumper is installed - There is a fault in the solenoid. Temporarily connect a replacement fuel pump solenoid to the harness. Turn the isolator switch to the ON position. Use the electronic service tool to check for active diagnostic codes. Wait at least 30 seconds for the codes to be displayed. If the fault is eliminated, reconnect the suspect solenoid. If the fault returns, permanently install the replacement solenoid. **Result**: A 1076-5 diagnostic code is still active with the jumper installed. Proceed to Test Step 4.

4. Check the Wiring for an Open Circuit A. Turn the isolator switch to the OFF position. B. Disconnect the P2 connector and the connector for the fuel pump solenoid. C. Use a multimeter to check the resistance between P2:69 and the pin 1 on the fuel pump solenoid harness connector. D. Use a multimeter to check the resistance between P2:70 and pin 2 on the fuel pump solenoid harness connector. E. Reconnect the connectors.	Less than 2 Ohms	**Result**: One of the measured resistances is greater than 2 Ohms - There is a fault in the engine wiring harness Repair the engine wiring harness or replace the engine wiring harness. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: All measured resistances are less than 2 Ohms. Proceed to Test Step 7.
5. Create an Open Circuit at the Solenoid A. Turn the isolator switch to the OFF position. B. Disconnect the connector for the suspect solenoid. C. Turn the isolator switch to the ON position. Wait for 10 seconds. Check for active diagnostic codes on the electronic service tool.	Solenoid	**Result**: A 1076-6 diagnostic code was active before disconnecting the valve. A 1076-5 diagnostic code is active with the solenoid disconnected. Temporarily connect a replacement solenoid to the harness. Turn the isolator switch to the ON position. Use the electronic service tool to check for active diagnostic codes. Wait at least 30 seconds for the codes to be displayed. If the fault is eliminated, reconnect the suspect solenoid. If the fault returns, permanently install the replacement solenoid. **Result**: A 1076-6 diagnostic code is still active with the valve disconnected. Proceed to Test Step 6.
6. Check the Wiring for a Short Circuit A. Turn the isolator switch to the OFF position. B. Disconnect the P2 connector and the connector for the suspect solenoid. C. Use a multimeter to check the resistance between P2:69 and all other terminals on P2. D. Use a multimeter to check the resistance between P2:70 and all other terminals on P2. E. Reconnect the connectors.	Greater than 100 Ohms	**Result**: At least one of the resistance measurements is less than 100 Ohms - The fault is in the engine harness. Repair the faulty harness or replace the faulty harness. Use the electronic service tool to verify that the repair eliminates the fault. **Result**: All resistance measurements are greater than 100 Ohms. Proceed to Test Step 7.
7. Check if a Replacement ECM Eliminates the Fault A. Make sure that the latest flash file for the application is in-stalled in the ECM. Refer to Troubleshooting, “Flash Programming”. B. Contact the Perkins dealer. Note: This consultation can greatly reduce the repair time. C. If the dealer recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”. D. Turn the isolator switch to the ON position. Use the electronic service tool to verify that the repair eliminates the fault.	Fault eliminated	**Result**: The fault is eliminated with the test ECM. Reconnect the suspect ECM. If the fault returns with the suspect ECM, permanently install the replacement ECM. **Result**: The fault is still present with the replacement ECM. Do not use the replacement ECM. Contact the Perkins dealer.

Speed/Timing - Test

This procedure covers the following diagnostic codes:

Diagnostic Trouble Codes for Low Coolant Level		
J1939 Code	**Code Description**	**Comments**
190-8	Engine Speed : Abnormal Frequency, Pulse Width, or Period	The Electronic Control Module (ECM) detects the following conditions: 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 3 seconds. 678 diagnostic trouble codes are not active. The warning light will come on and the diagnostic code will be logged. The ECM will use the signal from the secondary speed/timing sensor. The engine will be derated. If the signal from the secondary speed/timing sensor is also lost, the engine will shut down.
723-8	Engine Speed Sensor #2 : Abnormal Frequency, Pulse Width or Period	The ECM detects the following conditions: A loss of signal from the secondary speed/timing sensor for 2 seconds while the signal from the primary speed/timing sensor remained valid The engine has been running for more than 3 seconds. 678 diagnostic trouble codes are not active. The warning lamp will come on and the diagnostic code will be logged. The loss of signal from the secondary speed/timing sensor will prevent the engine from starting.
637-11	Engine Timing Sensor - Other Failure Mode	The ECM detects the following conditions: The outputs from the primary speed/timing sensor and the secondary speed/timing sensor differ by more than 8 degrees of crankshaft rotation. The engine has been running for more than 5 seconds. Diagnostic code 190-8 is not active. 678 diagnostic codes are not active. The warning light will come on. This code will not be logged.
Follow the troubleshooting procedure in order to identify the root cause of the fault.		

Use this procedure when the engine will not start and the electronic service tool indicates a faulty sensor. These events are indicated by displaying “Not Detected” against the faulty sensor on the “No Start Parameter” screen.

The engine uses two engine speed/timing sensors. The primary speed/timing sensor is on the left-hand side of the cylinder block close to the flywheel housing. The primary speed/timing sensor generates a signal by detecting the movement of the teeth that are on the crankshaft timing ring. The signal that is generated by the speed/timing sensor is transmitted to the ECM. The ECM uses the signal from the speed/timing sensor to calculate the position of the crankshaft. The signal is also used to determine the engine speed.

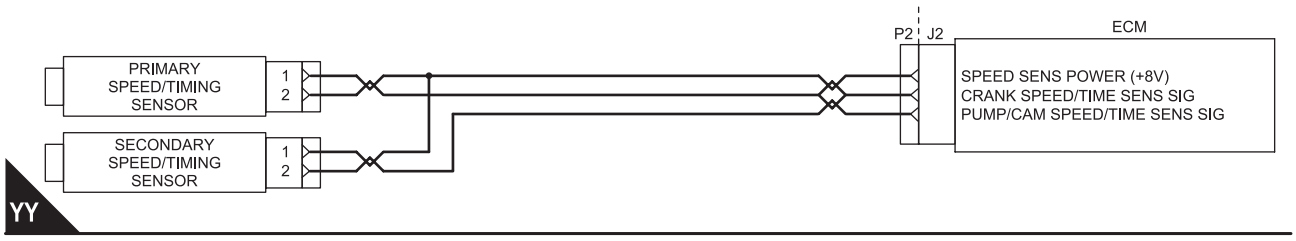
The secondary speed/timing sensor is on the right-

hand side of the cylinder block toward the rear of the engine. The secondary speed/timing sensor generates a signal that is related to the camshaft position. The secondary speed/timing sensor detects the movement of the teeth on the timing ring for the camshaft. The signal that is generated by the speed/timing sensor is transmitted to the ECM. The ECM calculates the speed and the rotational position of the engine by using the signal. The secondary speed/timing sensor is required for starting purposes.

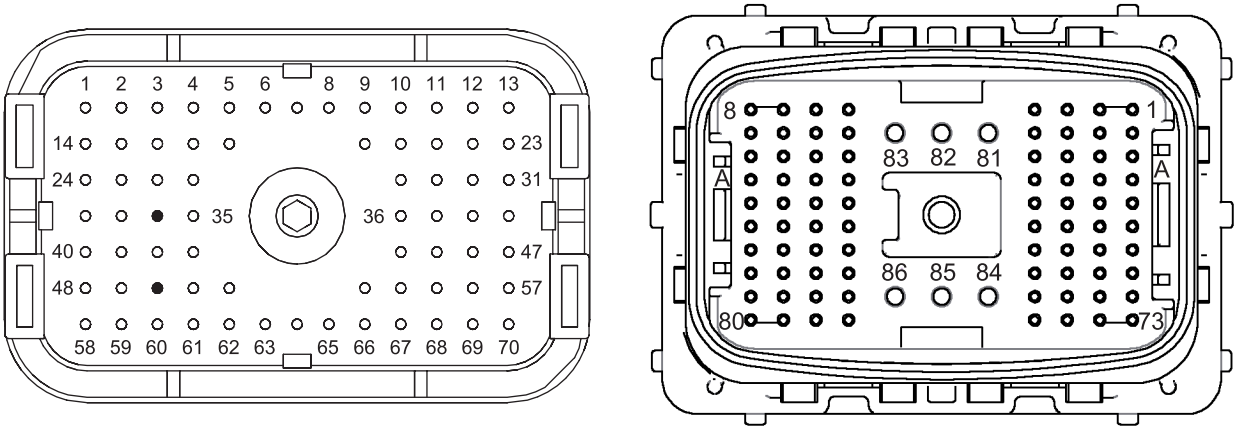
During normal operation, the secondary speed/timing sensor is used to determine the cycle that the engine is on. When the timing has been established, the primary speed/timing sensor is then used to determine the engine speed and the angular position.

The loss of signal to the primary sensor and/or the secondary sensor will result in one of the following faults:

- The engine will continue to run when only one sensor signal is present from either the primary sensor or the secondary sensor.
- Loss of signal both sensors during operation of the engine will cause fuel injection to be terminated and the engine will stop.



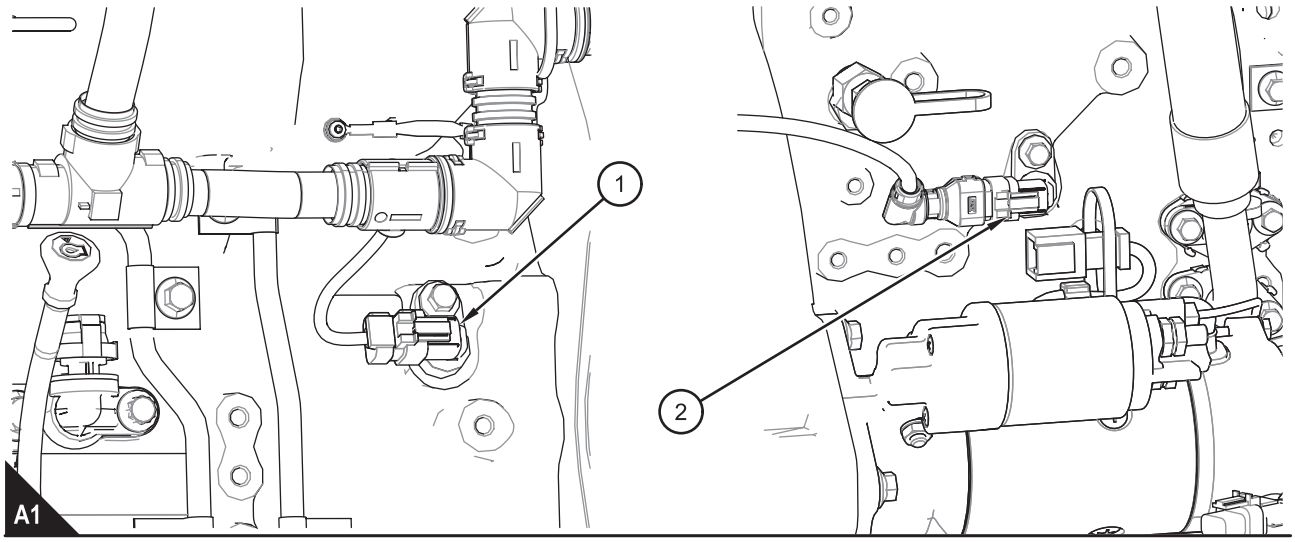
Schematic for the speed/timing sensors



ZZ A5E2v1 (70pins) A5E2v2 (86pins)

View of the pin locations for the speed/timing sensor on the P2 connector

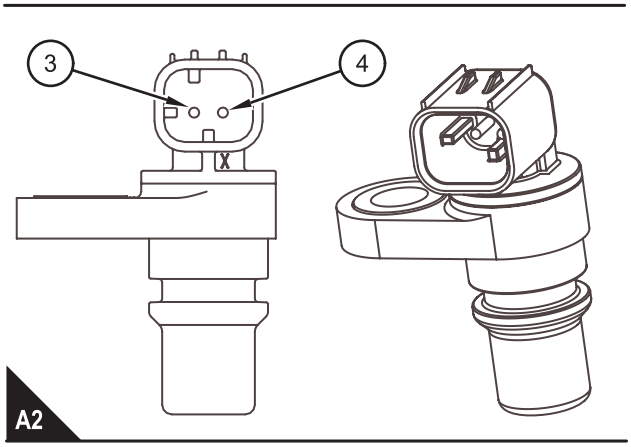
A5E2v1 (70 pins)	A5E2v2 (86 pins)	Description
44	18	Engine Speed/Timing Sensor Power
38	27	Crank Speed / Timing Sensor (-)
39	28	Cam Speed / Timing Sensor (-)



A1

View of the sensor locations on the engine

(1) Primary speed/timing sensor
(2) Secondary speed/timing sensor



Speed/Timing sensor - Typical Example

(3) 8 VDC Supply
(4) Signal

Troubleshooting Test Steps	Values	Results
1. Inspect Electrical Connectors and Wiring A. Turn the isolator switch to the OFF position. B. Inspect the connectors for the speed/timing sensors. Refer to Troubleshooting, “Electrical Connectors - Inspect”. C. Perform a 45 N (10.1 lb) pull test on each of the wires in the suspect sensor connector and the sensor connections at the ECM. D. Check the screw for the ECM connector for the correct torque of 6 N·m (53.1 lb in). E. Check the ground connection on the ECM for abrasions and pinch points. F. Check the harness for abrasion and pinch points from the suspect sensor to the ECM. G. Check that the suspect sensor is installed correctly. Check that the suspect sensor is fully seated into the engine.	Loose connection or damaged wire	**Result**: There is a fault in a connector or the wiring. Repair any faulty connectors or replace the wiring harness. Ensure that all the seals are properly in place and ensure that the connectors are correctly coupled. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: All connectors, pins, and sockets are correctly coupled and/or inserted. The harness is free of corrosion, abrasion, and pinch points. Proceed to Test Step 2.
2. Check For Active Diagnostic Codes A. Turn the isolator switch to the OFF position. B. Connect the electronic service tool to the diagnostic connector. C. Turn the isolator switch to the ON position. If the engine will start, then run the engine. D. Use the electronic service tool to monitor active diagnostic codes or recently logged diagnostic codes. E. Turn the isolator switch to the OFF position.	Diagnostic codes	**Result**: There are no active diagnostic codes for the pressure sensors. If there are logged diagnostic codes for the pressure sensors, the fault may be intermittent. Refer to Troubleshooting, “Electrical Connectors - Inspect” to identify intermittent faults. **Result**: There is an active 637-11 diagnostic code. Proceed to Test Step 3. **Result**: There is an active 190-8 or 723-8 diagnostic code. Proceed to Test Step 5.

3. Inspect the Sensors A. Ensure that the speed/timing sensors are correctly seated in the cylinder block. Ensure that the retaining bolts are tightened to a torque of 22 N·m (194.7 lb in). Ensure that the speed/timing sensors are not damaged. Replace any damaged sensors. B. Turn the isolator switch to the ON position. If the engine will run, then run the engine. C. Use the electronic service tool to check if the 637-11 diagnostic code is still active.	Diagnostic codes	**Result**: A 637-11 diagnostic code is no longer active. Use the electronic service tool to clear all logged diagnostic codes. Return the engine to service. **Result**: A 637-11 diagnostic code is still active. Proceed to Test Step 4.
4. Check the Crankshaft Timing Ring and the Timing Ring on the Camshaft A. Remove the primary speed/timing sensor and the secondary speed/timing sensor. B. Use a flashlight to check the timing ring on the camshaft through the camshaft timing hole for damage. C. Use a flashlight to check the crankshaft timing ring for damaged teeth or missing teeth. Ensure that the crankshaft timing ring has not been displaced from the crankshaft.	Loose timing ring or damaged timing segments	**Result**: Found fault with the crankshaft timing ring or timing ring on the camshaft. If necessary, replace the camshaft. Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair has eliminated the fault. **Result**: No faults found. Repeat this procedure from Test Step 3.
5. Measure the Supply Voltage at the Sensor Connector A. Turn the isolator switch to the OFF position. B. Disconnect the speed/timing sensor with the active diagnostic code. C. Turn the isolator switch to the ON position. D. Measure the voltage from terminal 1 on the sensor connector to engine ground.	7.5 VDC to 8.5 VDC	**Result**: The sensor supply voltage is not within the expected range - The fault is in the sensor supply wiring between the sensor and the ECM. Repair the faulty wiring or replace the faulty wiring. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The sensor supply voltage is correct. Proceed to Test Step 6.
6. Exchange the Sensors A. Turn the isolator switch to the OFF position. B. Exchange the primary speed/timing sensor with the secondary speed/timing sensor. C. Turn the isolator switch to the ON position. D. Start the engine. E. Use the electronic service tool to check for active diagnostic codes. Wait for 30 seconds for diagnostic codes to become active.	A 190-8 diagnostic code was previously active. A 723-8 diagnostic code is now active. OR A 723-8 diagnostic code was previously active. A 190-8 diagnostic code is now active.	**Result**: The active diagnostic code is now for the other speed/timing sensor. Install a replacement sensor. **Result**: The diagnostic code that was previously active is still active. Proceed to Test Step 7.
7. Check the Signal Wire for an Open Circuit A. Turn the isolator switch to the OFF position. B. Disconnect the P2 connector. Disconnect the connector for the suspect speed/timing sensor. C. Use a multimeter to check the resistance between terminal 2 on the harness connector for the sensor and the appropriate terminal on the P2 connector.	Less than 2 Ohms	**Result**: The resistance is greater than 2 Ohms - There is an open circuit or high resistance in the signal wire. Repair the faulty wiring or replace the faulty wiring. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: The resistance is greater than 2 Ohms. Proceed to Test Step 8.

8. Check the Signal Wire for a Short Circuit A. Turn the isolator switch to the OFF position. B. Disconnect the P2 connector. Disconnect the connector for the suspect speed/timing sensor. C. Use a multimeter to check the resistance between the suspect sensor signal terminal on the P2 connector and all other terminals on the P2 connector.	Greater than 100 Ohms	**Result**: At least one of the resistance measurements is less than 100 Ohms - The fault is in the sensor signal wiring. Repair the faulty wiring or replace the faulty wiring. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault. **Result**: All resistance measurements are greater than 100 Ohms. Proceed to Test Step 9.
9. Check if a Replacement ECM Eliminates the Fault A. Make sure that the latest flash file for the application is in-stalled in the ECM. Refer to Troubleshooting, “Flash Programming”. B. Contact the Perkins dealer. This consultation can greatly reduce the repair time. C. If the TC recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, “Replacing the ECM”. D. Turn the isolator switch to the ON position. Use the electronic service tool to verify that the repair eliminates the fault.	Fault eliminated	**Result**: The fault is eliminated with the test ECM. Reconnect the suspect ECM. If the fault returns with the suspect ECM, permanently install the replacement ECM. **Result**: The fault is still present with the replacement ECM. Do not use the replacement ECM. Contact the Perkins dealer.

California Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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