



Troubleshooting

1104D and 1106D Industrial Engines

NH (Engine)

NJ (Engine)

PJ (Engine)

Important Safety Information

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

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

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

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

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



The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

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

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

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

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



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

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

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Troubleshooting Section

Electronic Troubleshooting

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System Overview

System Operation

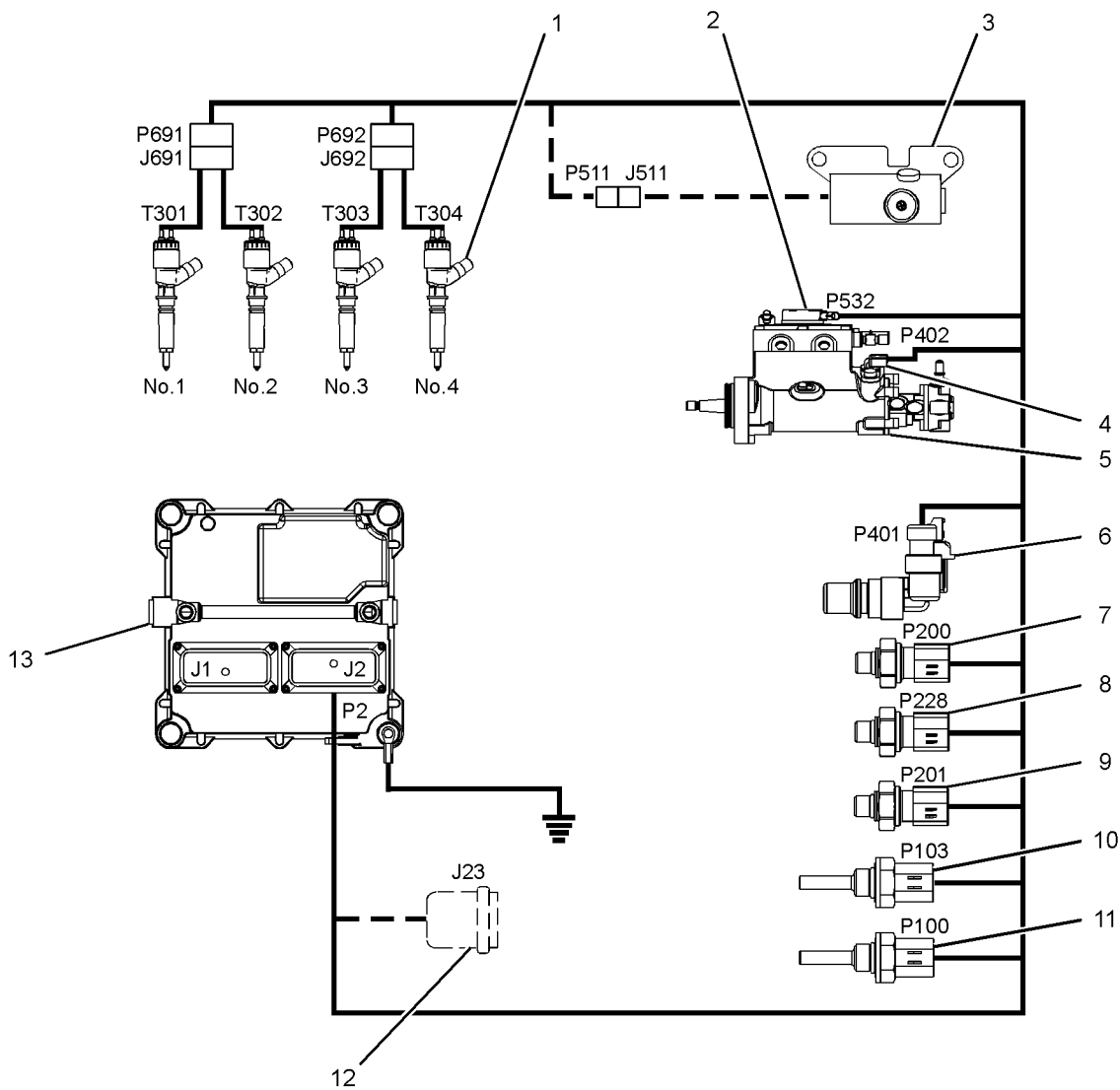


Illustration 1

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1104D engine

- (1) Electronic Unit Injector
- (2) Solenoid for the Fuel Rail Pump
- (3) Wastegate Regulator (if equipped)
- (4) Secondary Speed/Timing Sensor
- (5) Fuel Rail Pump

- (6) Primary Speed/Timing Sensor
- (7) Intake Manifold Pressure Sensor
- (8) Fuel Rail Pressure Sensor
- (9) Engine Oil Pressure Sensor
- (10) Intake Manifold Air Temperature Sensor

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

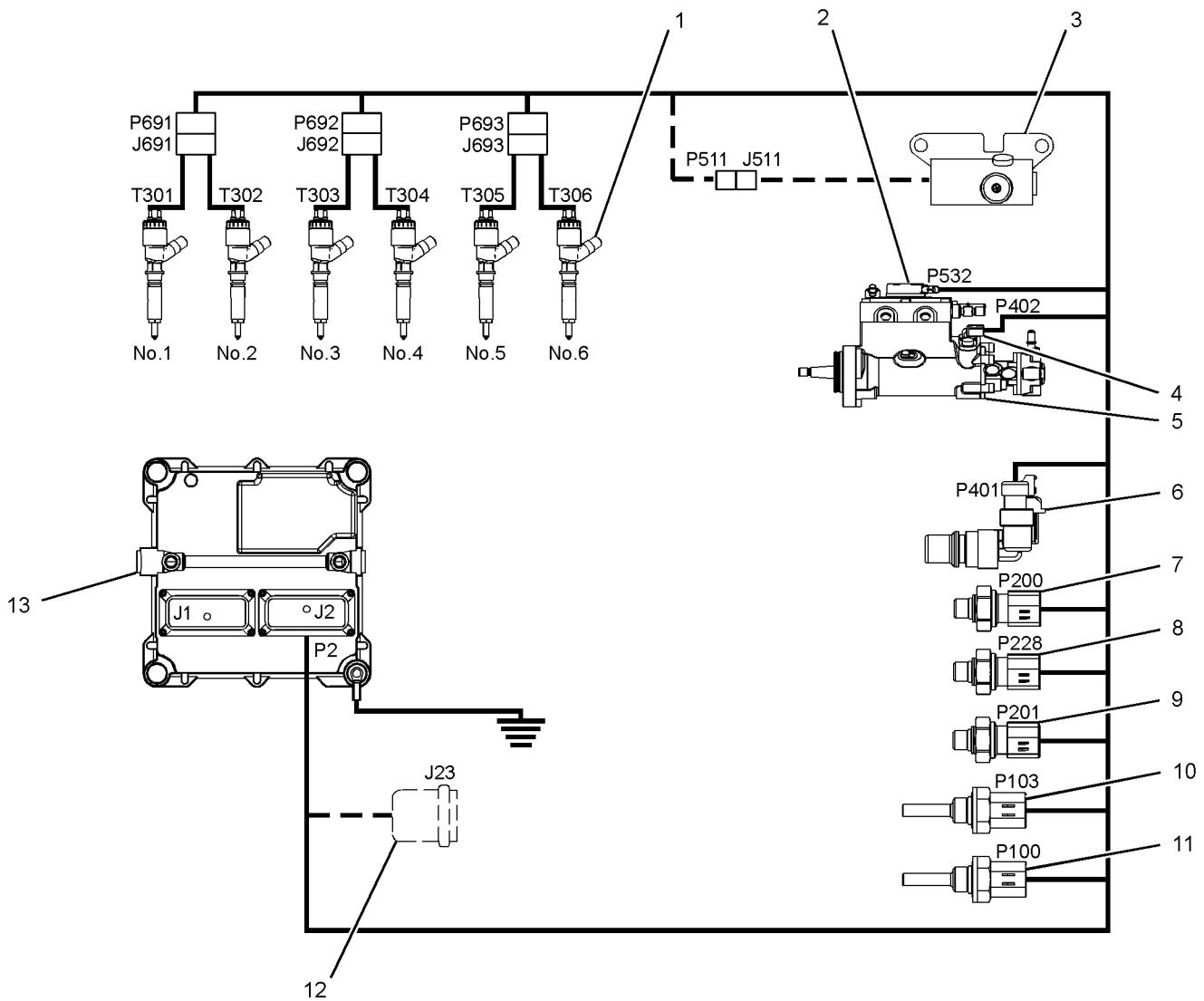


Illustration 2
1106D engine

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

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

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

- Engine power
- Torque curves
- Engine speed (rpm)
- Engine Noise

- Smoke and Emissions

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

Engine Speed Governor

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

Timing Considerations

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

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

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

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

Fuel Injection

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

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

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

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

Diagnostic Codes

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

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

Event Codes

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

Programmable Parameters

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

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

Passwords

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

Refer to Troubleshooting, "Programming Parameters" and Troubleshooting, "Factory Passwords".

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Glossary

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

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

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

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

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

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

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

Code – Refer to "Diagnostic Code" or "Event Code".

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

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

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

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

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

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

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

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

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

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

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

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

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

Duty Cycle – Refer to “Pulse Width Modulation”.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

7 – The mechanical system is not responding properly.

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

9 – There has been an abnormal update.

10 – There is an abnormal rate of change.

11 – The failure mode is not identifiable.

12 – The device or the component is damaged.

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

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

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

FRC – See “Fuel Ratio Control”.

Fuel Pump – See “Fuel Rail Pump”.

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

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

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

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

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

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

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

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

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

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

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

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

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

High Pressure Fuel Rail – See “Fuel Rail”.

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

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

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

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

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

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

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

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

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

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

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

Personality Module – See “Flash File”.

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

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

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

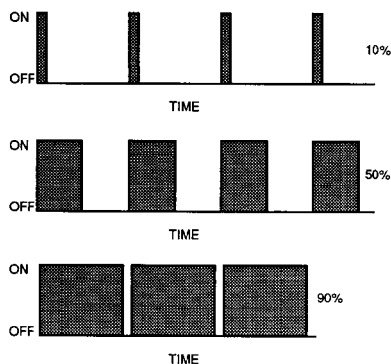


Illustration 3

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Top Center Position – The top center position refers to the crankshaft position when the No.1 piston position is at the highest point of travel. The engine must be turned in the normal direction of rotation in order to reach this point.

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

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

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

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

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Electronic Service Tools

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

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

Required Service Tools

Table 1

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

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

Optional Service Tools

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

Table 2

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

Perkins Electronic Service Tool

The Perkins Electronic Service Tool can display the following information:

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

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

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

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

Table 3

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

(1) Refer to Perkins Engine Company Limited.

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

Connecting the Electronic Service Tool and the Communication Adapter II

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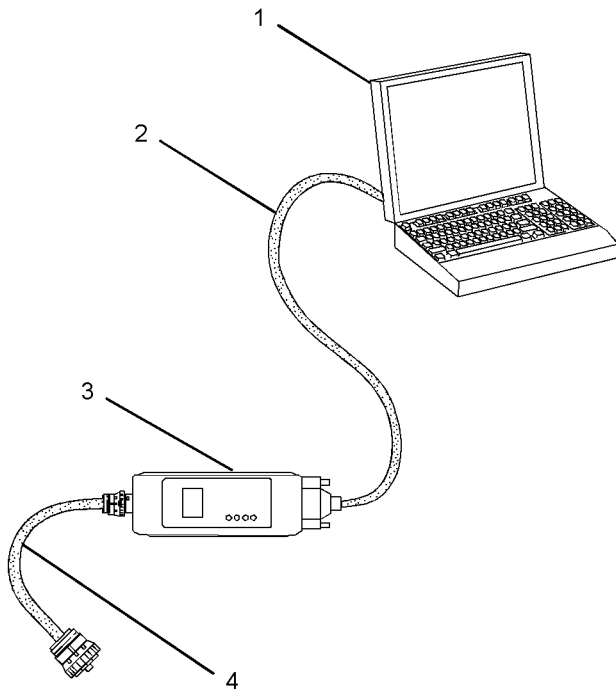


Illustration 4

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

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

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

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

Note: The Adapter Cable Assembly (4) is required to connect to the USB port on computers that are not equipped with a RS232 serial port.
3. Connect cable (4) between the “DATA LINK” end of communication adapter (3) and the service tool connector.
4. Place the keyswitch in the ON position. If the Electronic Service Tool and the communication adapter do not communicate with the Electronic Control Module (ECM), refer to the diagnostic procedure Troubleshooting, “Electronic Service Tool Will Not Communicate With ECM”.

Indicator Lamps

Indicator Lamps

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

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

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

Functions of the Lamps

Shutdown Lamp

Lamp check – When the keyswitch is turned to ON, the lamp will illuminate for 2 seconds. The lamp will then be extinguished unless there is an active warning.

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

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

Warning Lamp

Lamp check – When the keyswitch is turned to ON, the lamp will illuminate for 2 seconds. The lamp will then be extinguished unless there is an active warning.

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

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

Wait to Start Lamp

Lamp check – When the keyswitch is turned to ON, the lamp will illuminate for 2 seconds. The lamp will then be extinguished unless “Wait to Start” is active.

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

Low Oil Pressure

Lamp check – When the keyswitch is turned to ON, the lamp will illuminate for 2 seconds. The lamp will then be extinguished unless there is an active warning.

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

PTO Lamp

Lamp check – When the keyswitch is turned to ON, the lamp will illuminate for 2 seconds. The lamp will then be extinguished unless the PTO mode is active.

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

On – The lamp will illuminate when PTO mode is engaged.

Color of Lamps

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

Operation of the Indicator Lamps

Table 4

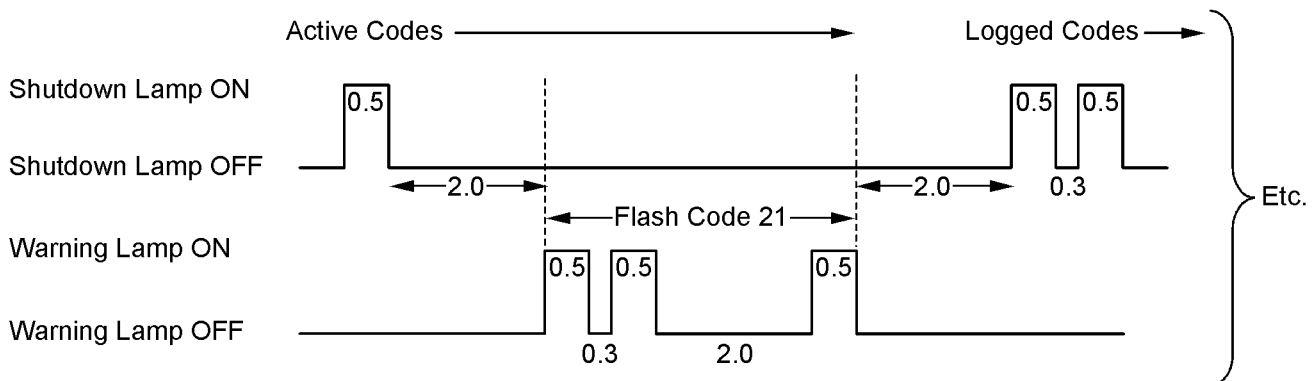
Warning Lamp (Alert Lamp)	Shutdown Lamp (Action Lamp)	Lamp State	Description of the Indication	Engine State
On	On	Lamp Check	When the keyswitch is switched on, the lamps illuminate for a period of 2 seconds and the lamps will then be extinguished.	The keyswitch is on but the engine has not yet been cranked.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

Flash Codes

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

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

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



Note: All times shown in seconds

Illustration 5

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

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

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

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

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Replacing the ECM

NOTICE

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

Dispose of all fluids according to local regulations and mandates.

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

The engine is equipped with an Electronic Control Module (ECM). The ECM contains no moving parts. Follow the troubleshooting procedures in this manual in order to be sure that replacing the ECM will correct the 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 in order to determine if the ECM on the engine is faulty. Install a test ECM in place of the suspect ECM. Install the flash file into the test ECM. Program the parameters for the test ECM. The parameters must match the parameters in the suspect ECM. Refer to the following test steps for details. If the test ECM resolves the fault, reconnect the suspect ECM. Verify that the fault returns. If the fault returns, replace the ECM.

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

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

NOTICE

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

Perform the following procedure in order to replace the ECM.

1. Connect the Electronic Service Tool to the diagnostic connector.
2. Use the "Copy Configuration ECM Replacement" function from the Electronic Service Tool. If the "Copy Configuration" is successful, proceed to Step 4. If the "Copy Configuration" failed, proceed to Step 3.

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

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

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

4. Remove power from the ECM.
5. Remove the ECM. Refer to Disassembly and Assembly, "Electronic Control Module - Remove and Install".
6. Install the replacement ECM. Refer to Disassembly and Assembly, "Electronic Control Module - Remove and Install".
7. Download the flash file.
 - a. Connect the Electronic Service Tool to the diagnostic connector.
 - b. Select "WinFlash" from the "Utilities" menu of the electronic service tool.
 - c. Select the downloaded flash file.

8. If necessary, use the electronic service tool to clear the rating interlock. To clear the rating interlock, enter the factory password when the electronic service tool is first connected. Activating the "Test ECM" mode will also clear the rating interlock.
9. Use the electronic service tool to program the parameters. Perform the following procedure.
 - a. If the "Copy Configuration" procedure was successful, use the "Copy Configuration, ECM Replacement" function to load the configuration file into the ECM.

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

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

Perform the "Fuel System Verification Test".

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

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Self-Diagnostics

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

- Diagnostic
- Event

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

Diagnostic codes can have two different states:

- Active
- Logged

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

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

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

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

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Sensors and Electrical Connectors

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

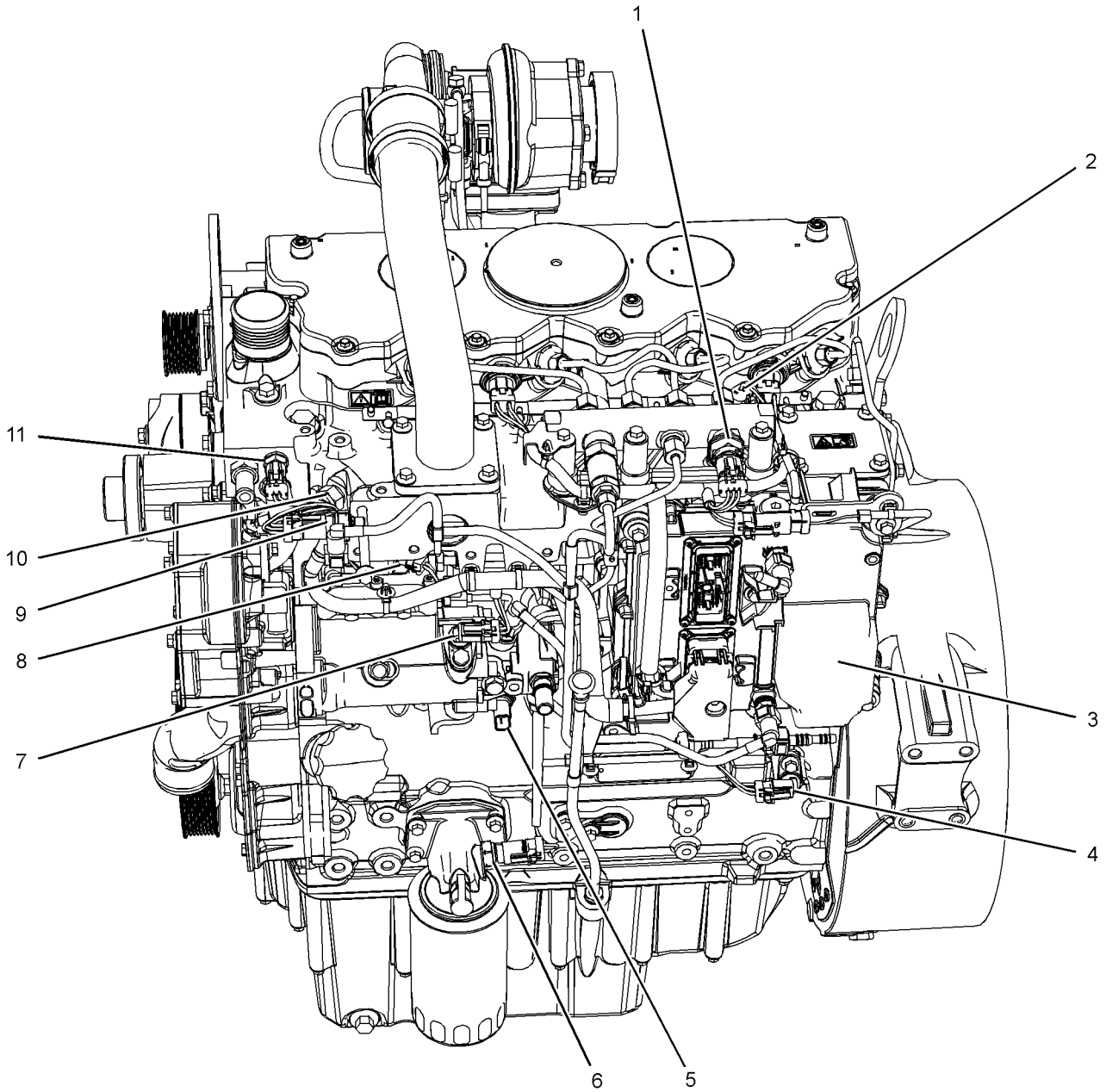


Illustration 6

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Sensor locations on the 1104D engine

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

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

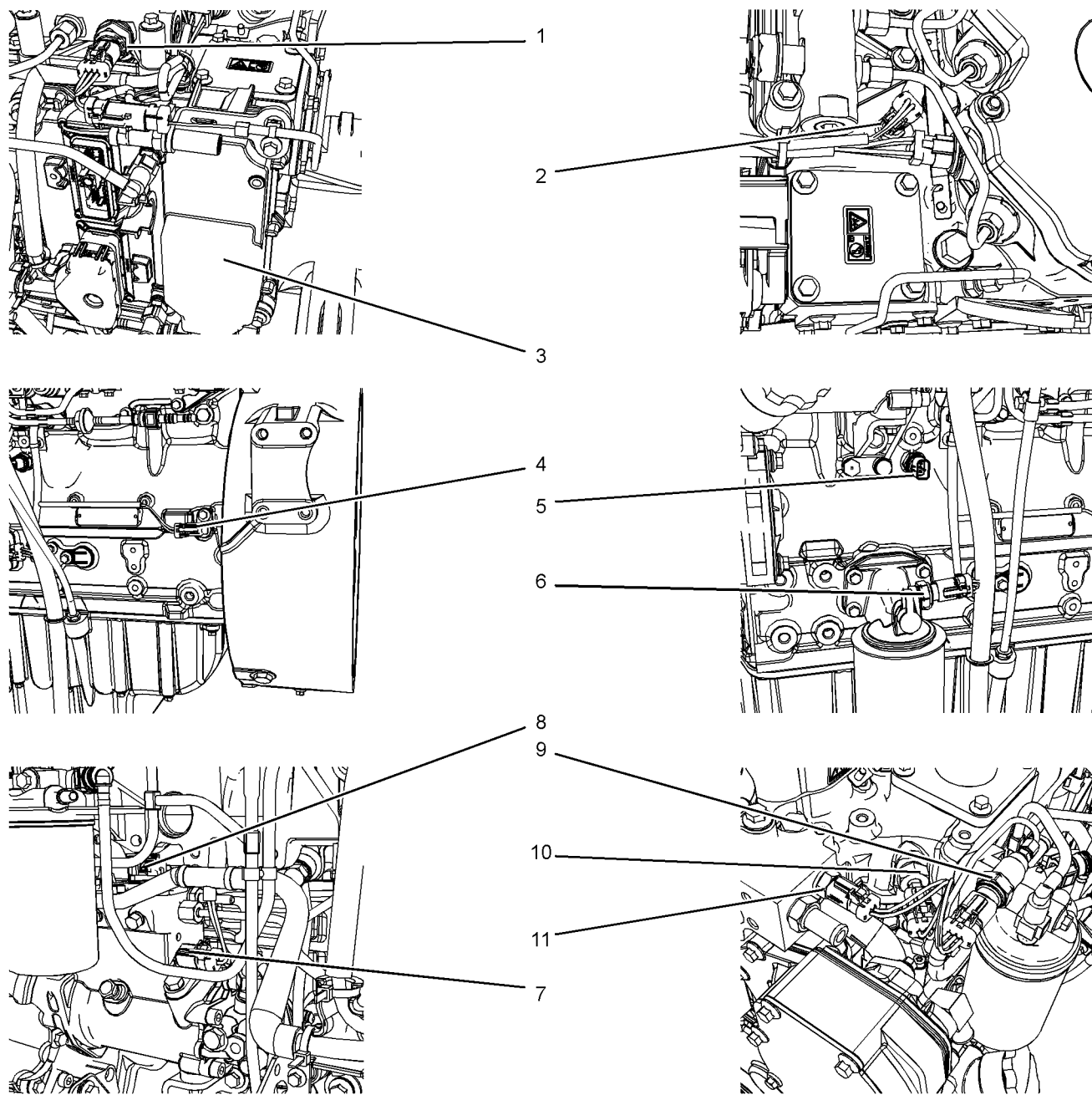


Illustration 7

Detailed views of the sensor locations on the 1104D engine

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