



Troubleshooting

3500B and 3500C Marine Propulsion Engines

S2D1-Up (Engine)
S2E1-Up (Engine)
S2F1-Up (Engine)
B5G1-Up (Engine)
MRG1-Up (Engine)
PAG1-Up (Engine)
MKH1-Up (Engine)
S2J1-Up (Engine)
S2K1-Up (Engine)
S2L1-Up (Engine)
S2M1-Up (Engine)
S2N1-Up (Engine)
S2S1-Up (Engine)
S2T1-Up (Engine)
S2W1-Up (Engine)
S2X1-Up (Engine)
S2Y1-Up (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.

Caterpillar 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 Caterpillar 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. Caterpillar dealers have the most current information available.



When replacement parts are required for this product Caterpillar recommends using Caterpillar replacement parts or parts with equivalent specifications including, but not limited to, physical dimensions, type, strength and material.

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

SMCS Code: 1901-038; 1924

The engine is designed for electronic control of most engine operating functions. The electronic system consists of the following components: Electronic Control Module (ECM), wiring harness, switches, sensors, and electronic fuel injectors.

Electronic Controls

Electronic Control Module

The ECM controls the engine operation. The ECM consists of two main components, the control computer (hardware) and the personality module (software). The control computer consists of a microprocessor and electronic circuitry. The personality module is the software for the control computer which contains operating maps that define power and torque curves. The ECM monitors the engine parameters during operation. The ECM supplies signals to the electronic fuel injectors.

The ECM governs engine speed. Desired engine speed is determined by the throttle position sensor signal and certain sensor readings. Diagnostic codes may derate the engine. Actual engine speed is supplied to the ECM by the engine speed/timing sensor.

Fuel Injection

The ECM controls the timing of the engine by varying the signals to the electronic solenoids that control fuel injection. Fuel is injected only while an injector solenoid is energized by a 105 volt signal from the ECM. By controlling the timing and duration of the 105 volt signal, the ECM controls the fuel injection timing, the quantity of fuel and the desired engine speed. Injection timing depends on desired engine speed, load, and other operational factors.

The ECM limits engine power during cold mode operation. The ECM may modify the injection timing and the ECM may cut out certain engine cylinders. This will increase startability and this will reduce warm up time. Cold mode is activated whenever the engine coolant temperature falls below a predetermined value. Cold mode remains active until the engine has warmed or a time limit is exceeded.

The ECM is programmed at the factory which limits the quantity of fuel that can be injected. The position of the Fuel Ratio Control (FRC) controls the fuel limit for exhaust smoke. The FRC is based on the maximum allowable ratio of fuel to air. The FRC fuel position is increased when the ECM senses a higher turbocharger compressor outlet pressure. This will allow more fuel into the cylinder.

The rated fuel position is a limit that is based on the engine power rating. This is similar to the rack stops and the torque spring on a mechanically governed engine. The rated fuel position limits the power curve and the torque curve for a specific engine family.

Engine Wiring Diagram

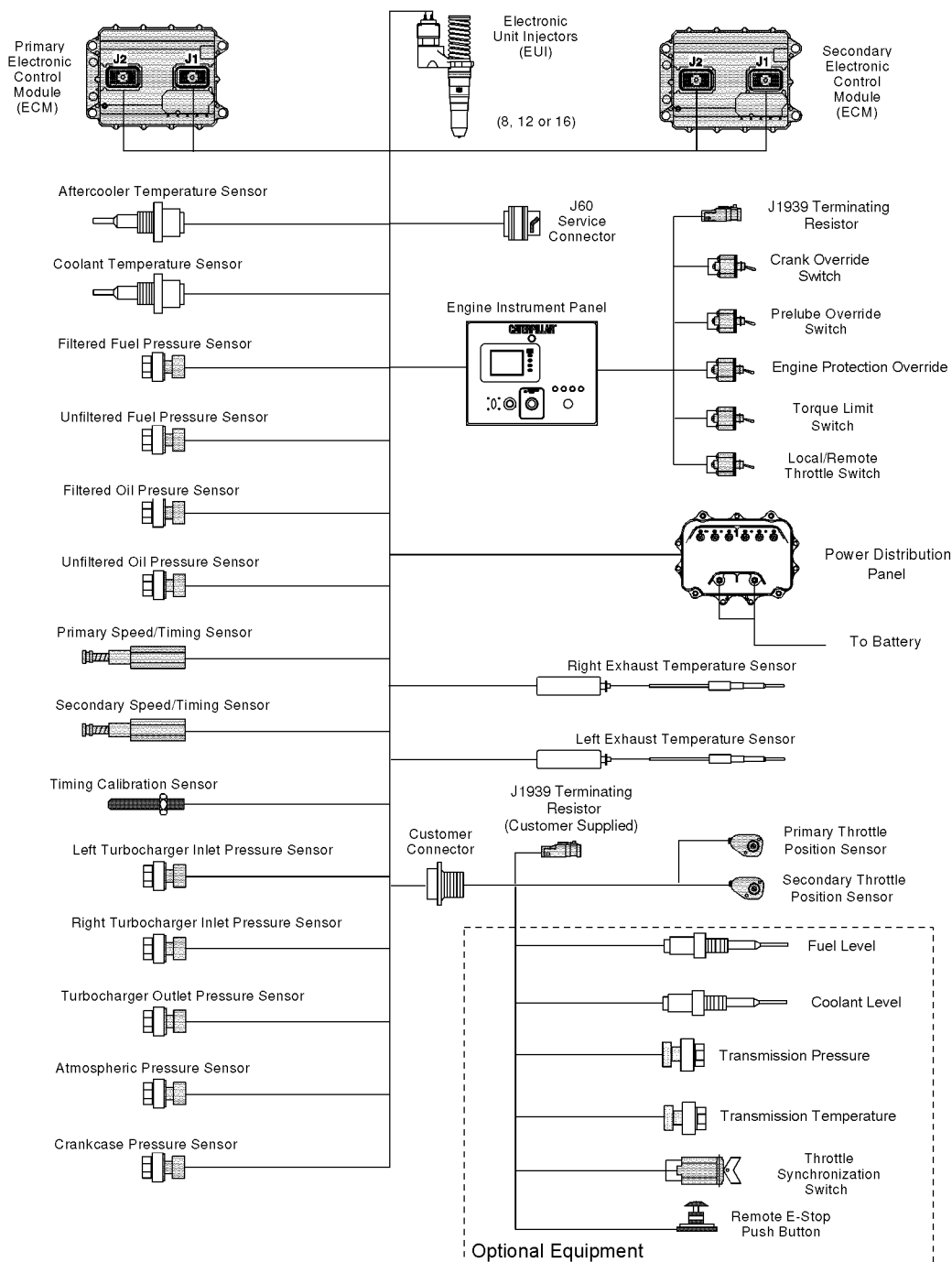


Illustration 1
Typical example

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Location of the Engine Components

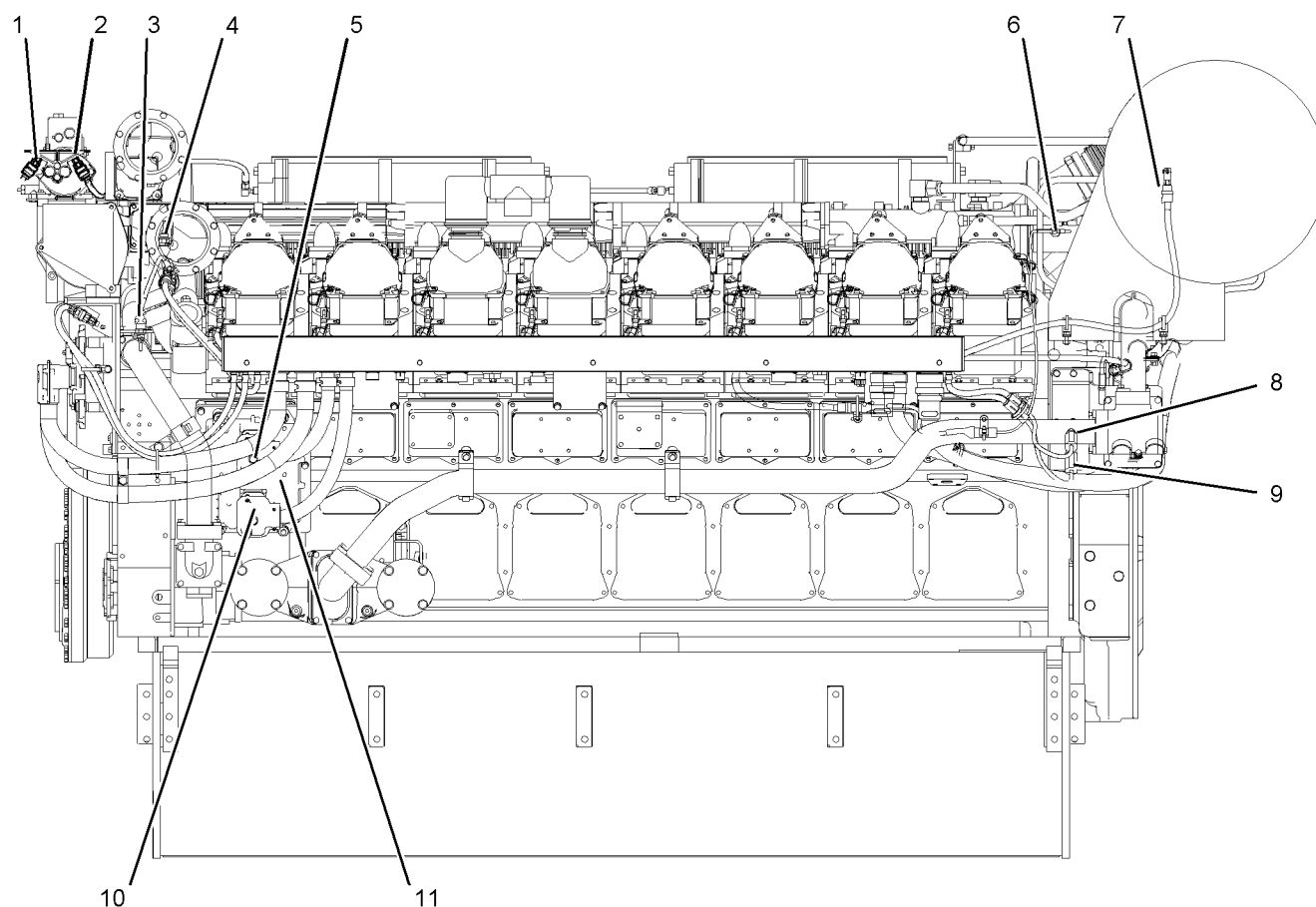


Illustration 2

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Left side view

- | | | |
|-------------------------------------|--|--|
| (1) Unfiltered fuel pressure sensor | (5) Secondary ECM connector J2 | (8) Secondary engine speed/timing sensor |
| (2) Filtered fuel pressure sensor | (6) Left exhaust temperature sensor | (9) Primary engine speed/timing sensor |
| (3) Aftercooler temperature sensor | (7) Left turbocharger compressor inlet pressure sensor | (10) Secondary ECM connector J1 |
| (4) Coolant temperature sensor | | (11) Secondary ECM |

Location of the Engine Components

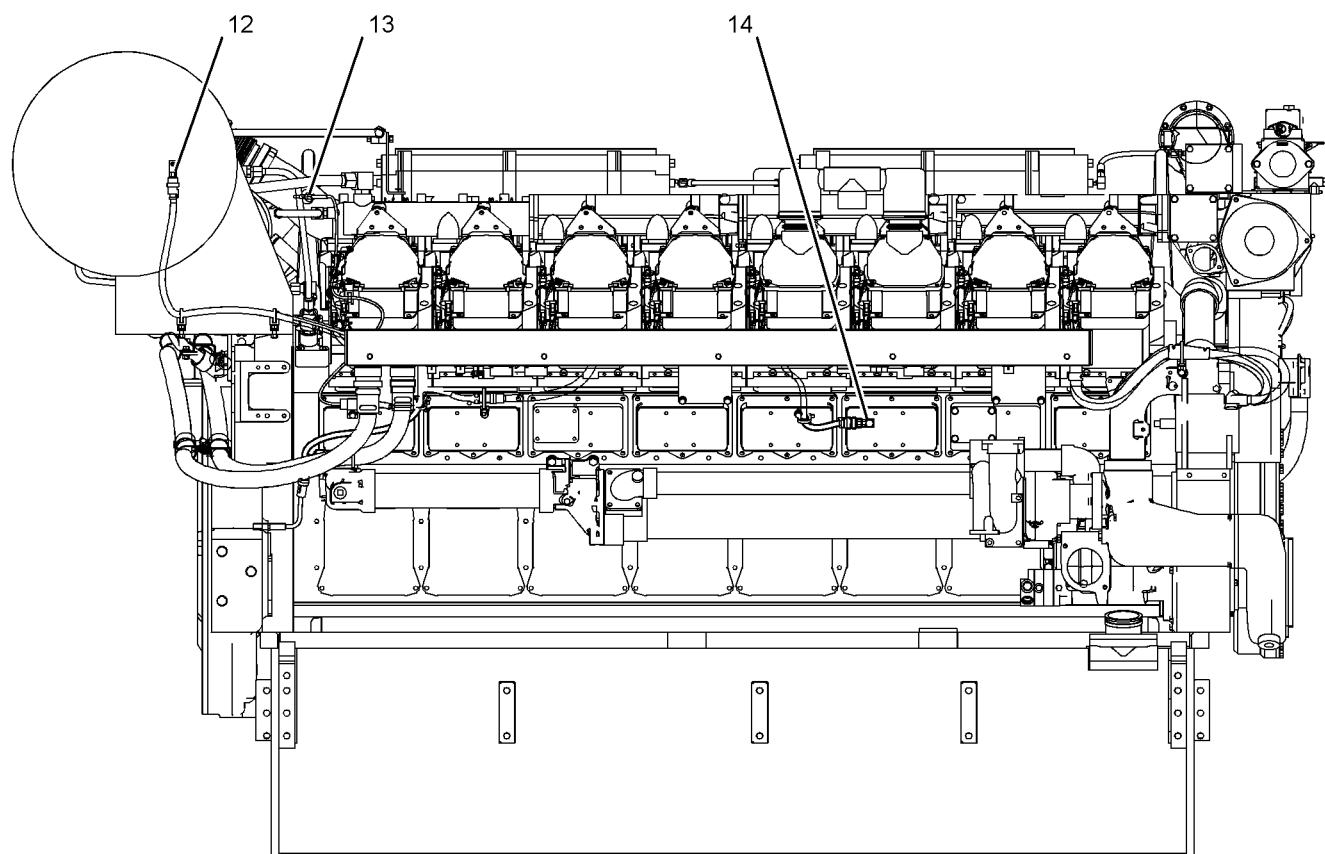


Illustration 3

Right side view

(12) Right turbocharger compressor inlet
pressure sensor

(13) Right exhaust temperature sensor
(14) Crankcase pressure sensor

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Location of the Engine Components

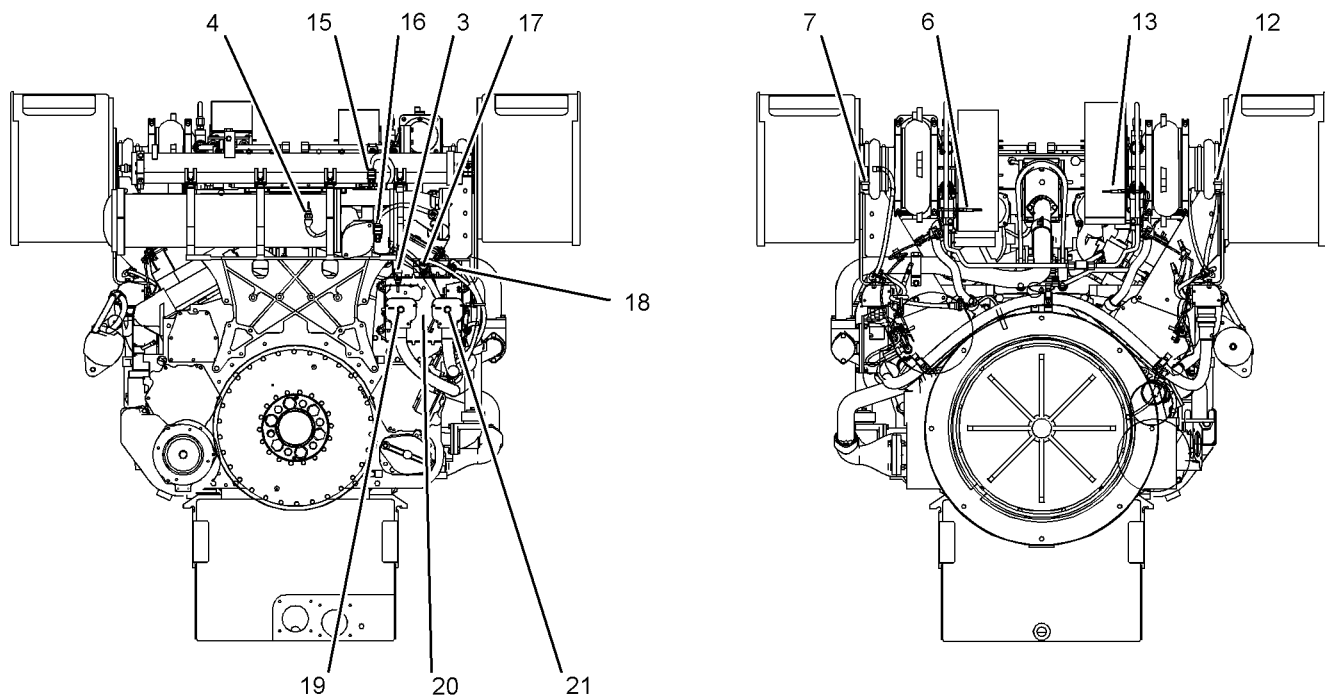


Illustration 4

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Front and rear view

(4) Coolant temperature sensor
 (15) Filtered engine oil pressure sensor
 (16) Unfiltered engine oil pressure sensor
 (3) Aftercooler temperature sensor
 (17) Turbocharger compressor outlet pressure sensor

(7) Left turbocharger compressor inlet pressure sensor
 (6) Left exhaust temperature sensor
 (13) Right exhaust temperature sensor
 (12) Right turbocharger compressor inlet pressure sensor

(18) Atmospheric pressure sensor
 (19) Primary ECM connector J1
 (20) Primary ECM
 (21) Primary ECM connector J2

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Self-Diagnostics

SMCS Code: 1901-038

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

- Diagnostic
- Event

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

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

The codes can have two different states:

- Active
- Logged

Active Code – An active diagnostic code or an active event code indicates that an active problem has been detected. 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.

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

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Electronic Service Tools

SMCS Code: 1901-038

The Caterpillar Electronic Service Tools are designed to perform the following functions:

- Obtain data from the engine.
- Display the diagnostic codes or display the event codes on the Caterpillar Electronic Technician (ET).
- Perform sensor calibrations.
- Read the programmable parameters.
- Change the programmable parameters.

The use of a communication adapter must be used in order for the Cat ET to communicate with the Electronic Control Module (ECM).

There are several service tools that are required in order to allow a service technician to perform the procedures. These tools are listed in the following tables.

Table 1

Required Service Tools	
Part Number	Description
N/A	4 mm Allen Wrench
N/A	Vacuum Pump Test Unit
1U-5805	Wire Removal Tool (14 AWG)
151-6320	Wire Removal Tool (16/18 AWG)
9U-7330	Digital Multimeter
7X-1710	Multimeter Probe
175-3700	Connector Repair Kit
1U-5804	Crimp Tool
7X-1695	Cable
6V-3093	Transducer Adapter
6V-2197	Transducer
147 - 6456	(Wedge Removal Tool)

Optional Service Tools

Two short jumper wires are needed to check continuity of some wiring harness circuits. The jumper wires are used to short two adjacent pins or sockets together in a connector.

A long extension wire may be needed to check continuity of some wiring harness circuits.

The following list contains service tools that are not required. These tools may be helpful to service the engine. The following optional tools are used to measure voltage, pressures and/or temperatures.

Table 2

Optional Service Tools	
Part Number	Description
1U-5470	Engine Pressure Group
4C-4071	Contact Removal Tool
4C-4072	Contact Removal Tool
4C-4073	Contact Removal Tool
4C-4074	Contact Removal Tool
4C-4075	Crimp Tool
146-4080	Digital Multimeter
4C-4911 ⁽¹⁾	Battery Load Tester
6V-9130 ⁽²⁾	Temperature Adapter
7X-6370	Adapter Cable
151-6320	Wire Removal Tool
8T-5319	Connector Tool Group
8T-8726	Adapter Cable
9S-9082	Engine Turning Tool
9S-9150	Terminal Crimp Tool As
5P-7277	Voltage Tester

⁽¹⁾ Refer to Special Instruction, SEHS9249, "Use of the 4C-4911 Battery Load Tester for 6, 8, and 12 Volt Lead". Also, refer to Special Instruction, SEHS7633, "Battery Test Procedure".

⁽²⁾ Refer to Special Instructions, SEHS8382, "Use of 6V-9130 Temperature Adapter Group".

Electronic Technician

The Caterpillar Electronic Technician (ET) is designed to run on a personal computer. Cat ET can display the status of a group of parameters. Cat ET can display the following information:

- Sensor values
- Diagnostic codes
- Engine configuration

Cat ET can perform the following functions:

- Diagnostic tests
- Sensor calibration
- Flash downloading
- Set programmable parameters

The following components are required to use Cat ET to service the engine.

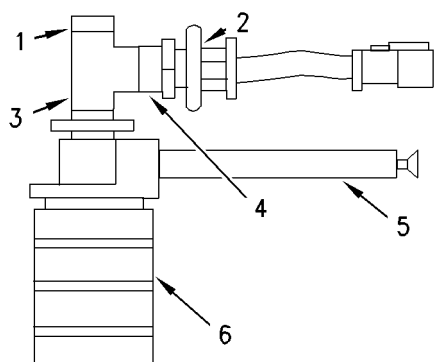


Illustration 5

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Vacuum pump test unit

(1) 4C-3973 Connector

(2) Pressure sensor

(3) Tee

(4) 9X-0263 Adapter

(5) 1U-5718 Vacuum Pump

(6) 169-7372 Fluid Sampling Bottle

Note: Similar parts may be used to build the vacuum pump test unit. The vacuum pump test unit can be used with the 1U-5470 Engine Pressure Group.

Table 3

Required Electronic Service Tools for the Use of Cat ET	
Part Number	Description
N/A	Requirements IBM PC compatible 100 MHz processor 32 megabyte of RAM 10 megabyte of available hard drive space CD-ROM drive 3.5" 1.44-MB floppy disk drive Windows NT or Windows 95 RS232 port with "16550AF UART" VGA monitor or display
N/A	Recommended Intel Pentium II 333 mHz processor 64 megabyte of RAM 4.3 gigabyte hard drive CD-ROM drive 14X speed
JERD2124	License for Cat ET
JERD2129	Data Subscription for all engines and machines
NEHS0758 ⁽¹⁾	Service Program Module for the 171 - 4401 Communication Adapter II
160 - 0141 ⁽²⁾	Adapter Cable As (Cat Data Link)
207 - 6845 ⁽²⁾	Adapter Cable As
171 - 4401 ⁽²⁾	Communication Adapter II for use between Cat ET and the ECM
237 - 7547 ⁽³⁾	Adapter Cable As

⁽¹⁾ The subscription will be updated at regular intervals.

⁽²⁾ This part number is part of the 171 - 4400 Communication Adapter II Group.

⁽³⁾ The 237 - 7547 Adapter Cable As is required to connect to the USB port on computers that are not equipped with a RS232 serial port.

Connecting Cat ET and the Communication Adapter II

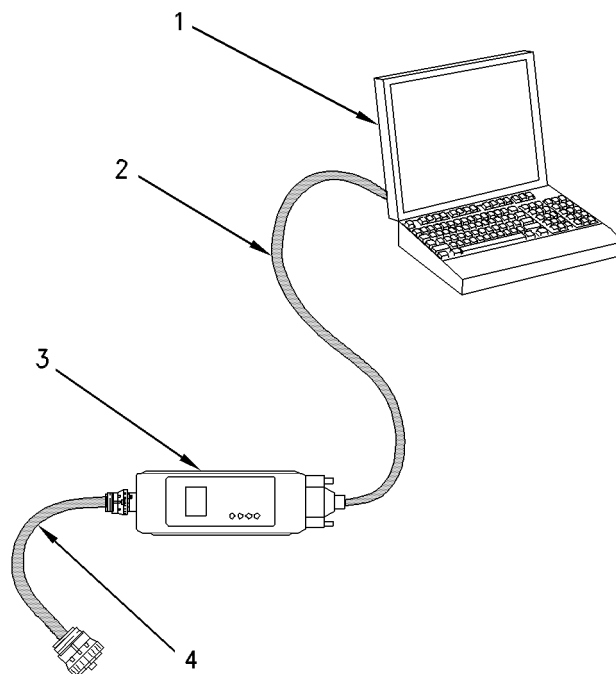


Illustration 6

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- (1) Personal computer
- (2) 160 - 0141 Data Link Cable
- (3) 171 - 4401 Communication Adapter II
- (4) 207 - 6845 Data Link Cable

The service tool connector provides the Communication Adapter II with 24 VDC. Use the following procedure to connect the Cat ET and the Communication Adapter II to the engine.

1. Turn the engine control to the OFF position.
2. Turn the Battery disconnect switch to the OFF position.
3. Connect the 207 - 6845 Data Link Cable between the J42 service tool connector and the control connector on the 171 - 4401 Communication Adapter II.
4. Connect the 160 - 0141 Data Link Cable between the laptop computer's RS232 serial port and the serial connector on the 171 - 4401 Communication Adapter II.
5. Turn the battery disconnect switch to the ON position.

6. Start the program for the Cat ET on the personal computer. Establish communication with the Engine's Electronic Control Module (ECM). If the Cat ET 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".

Table 4

Specifications for the Communication Adapter II	
Operating Voltage	7 VDC to 40 VDC at 1.0 amp
Operating Temperature	-18 °C to +65 °C (0 °F to 149 °F)
Storage Temperature	- 40 °C to +80 °C (-40 °F to 176 °F)
Dimensions	180 mm X 85 mm X 44.5 mm (7.085 inch X 3.343 inch X 1.75 inch)
Weight	454 g (1 lb)

i02627226

Electronic Display Module

SMCS Code: 1901-038

The control panel is the control station for the engine. The control panel has the following controls on the front of the panel: Marine Power Display (MPD), Engine Control Switch (ECS), emergency stop switch, and indicator lamps. The control panel contains the following controls on the inside of the panel: override switches, local/remote switch (throttle), control relays, and diodes.

Control Panel

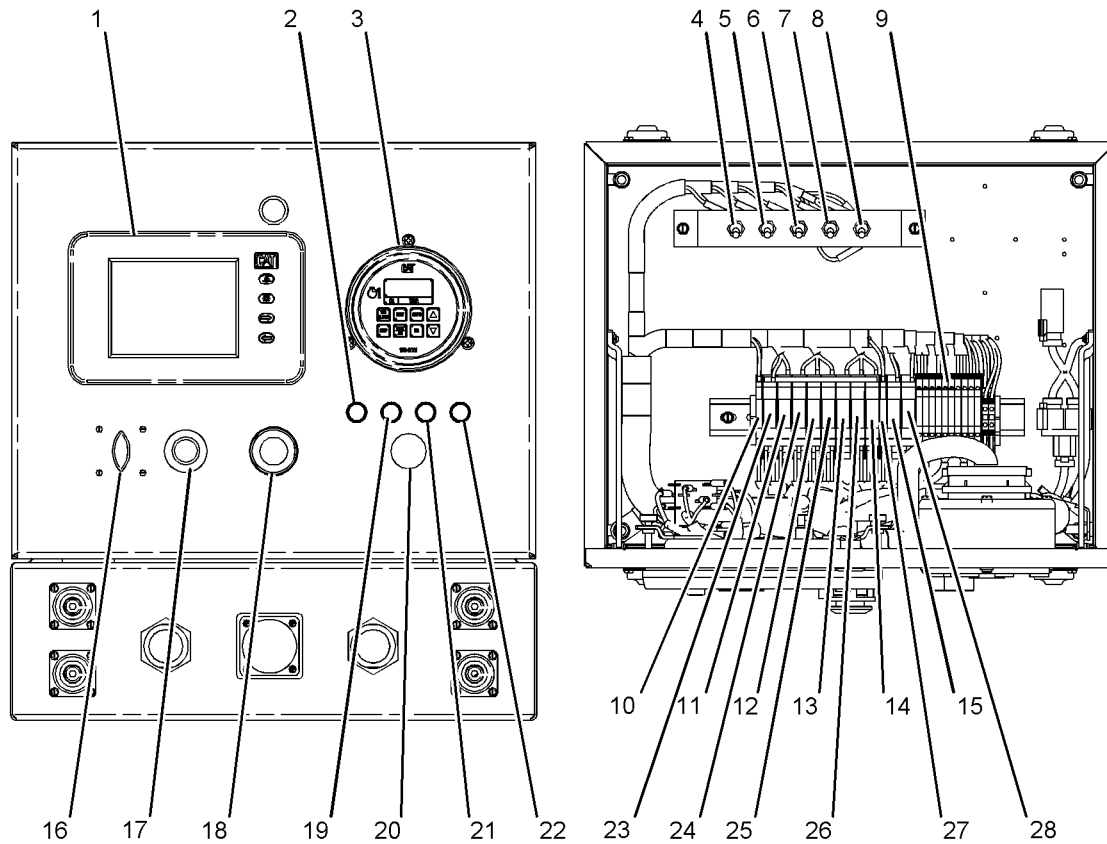


Illustration 7

g01316970

Control panel

- | | | |
|------------------------------------|----------------------------------|----------------------------------|
| (1) Marine Power Display | (19) Emergency stop lamp | (9) Engine control switch (ECS) |
| (2) Overspeed indicator | (20) Alarm (horn) | (10) Local emergency stop switch |
| (3) Pyrometer | (21) "Secondary ECM Ready" lamp | (11) Alarm (horn) |
| (4) Override switch (crank) | (22) "Secondary ECM Active" lamp | (12) Start select switch |
| (5) Prelube override switch | (23) "STE" relay | (13) "Power" relay |
| (6) Protection override switch | (24) "Run 1" relay | (14) "STE" relay |
| (7) Torque limit switch | (25) "STPE" relay | (15) "Reset 1" relay |
| (8) Local/remote switch (throttle) | (26) "Run 2" relay | (16) "Run 1" relay |
| (9) Diodes D1 to D10 | (27) "ECSIR" relay | (17) "Stop 1" relay |
| (10) "RSR" relay | (28) "SN" relay | (18) "STPE" relay |
| (11) "Reset 1" relay | (1) Marine Power Display (MPD) | (19) "Reset 2" relay |
| (12) "Stop 1" relay | (2) Overspeed indicator | (20) "Run 2" relay |
| (13) "Reset 2" relay | (3) Emergency stop lamp | (21) "Stop 2" relay |
| (14) "Stop 2" relay | (4) "Crank override" switch | (22) "ECSIR" relay |
| (15) Horn relay | (5) "Prelube override" switch | (23) "HRN" relay |
| (16) Engine control switch (ECS) | (6) "Protection override" switch | (24) "SN" relay |
| (17) Speed Control | (7) "Low idle" switch | (25) Redundant speed switch |
| (18) Emergency stop switch | (8) Diodes D1 to D10 | |

Power Distribution Panel

The power distribution panel distributes power to the various systems on the engine. The power distribution panel has two external connections for the battery. The power distribution panel has multiple breakers that are mounted externally. The power distribution panel contains the following controls on the inside of the panel: control relays, circuit breakers, diodes, control switches, and timer.

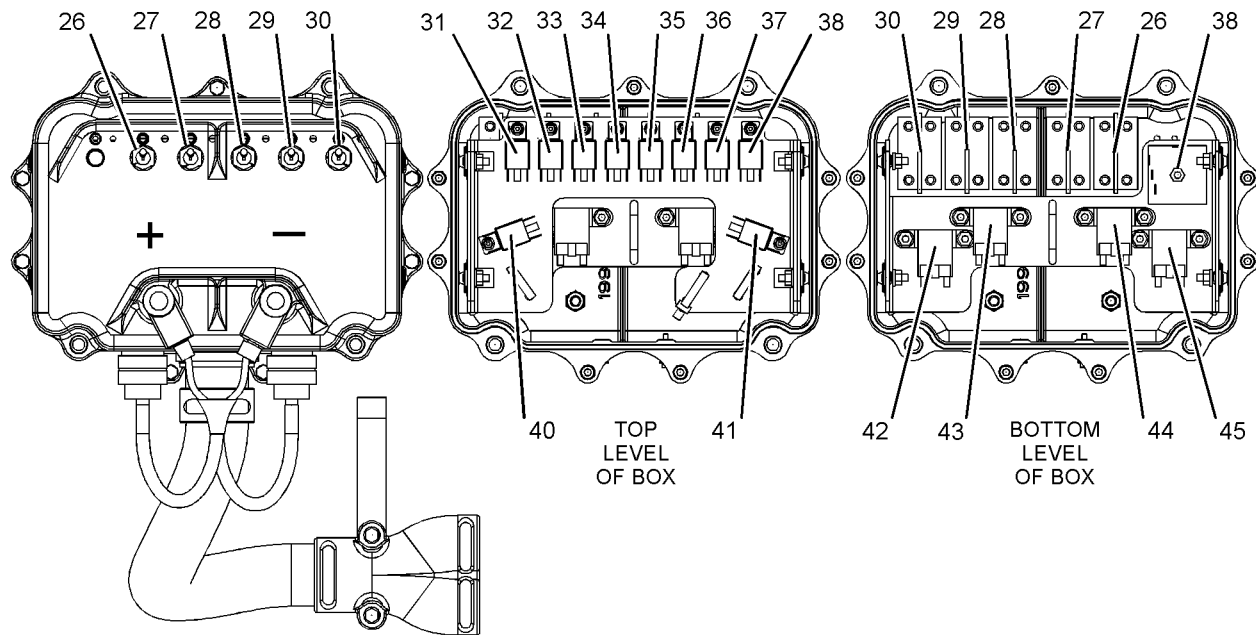


Illustration 8

g01316971

Power distribution panel

- | | | |
|--|--|---------------------------------------|
| (1) 20 Amp circuit breaker | (19) "R4A" relay | (32) "R4A" relay |
| (2) 20 Amp circuit breaker | (20) "R3A" relay | (33) "R4" relay |
| (3) 40 Amp circuit breaker | (21) "R2A" relay | (34) "R3A" relay |
| (4) 20 Amp circuit breaker | (22) "R1" relay | (35) "R3" relay |
| (5) 70 Amp circuit breaker | (23) "PPR1" switch | (36) "R2A" relay |
| (6) "SD Notify" relay | (24) "R4" relay | (37) "R2" relay |
| (7) Starter and alternator circuit breaker | (25) "R3" relay | (38) "R1" relay |
| (8) "Marine Power Display (MPD)" circuit breaker | (26) "R2" relay | (39) Air shutoff timer |
| (9) Circuit breaker for the prelube and air shutoff circuits | (27) "PPR2" relay | (40) General alarm relay |
| (10) Circuit breaker for the secondary ECM | (28) Circuit breaker for the primary ECM (20 Amp) | (41) "SD Notify" relay |
| (11) Air shutoff timer | (29) Circuit breaker for the secondary ECM (20 Amp) | (42) Starting motor magnetic switch 2 |
| (12) Circuit breaker for the primary ECM | (30) Circuit breaker for the prelube and air shutoff circuits (40 Amp) | (43) Starting motor magnetic switch 1 |
| (13) Air shutoff switch (ASOS) | (31) "Marine Power Display (MPD)" circuit breaker (20 Amp) | (44) "PPR1" switch |
| (14) Positive battery terminal | (32) Starter and alternator circuit breaker (70 Amp) | (45) Air shutoff switch (ASOS) |
| (15) Negative battery terminal | (33) "PPR2" relay | |
| (16) General alarm relay | | |
| (17) Starting motor magnetic switch 2 | | |
| (18) Starting motor magnetic switch 1 | | |

i01907886

Engine Monitoring System

SMCS Code: 1901-038

The Electronic Control Module (ECM) monitors engine parameters. If a parameter extends outside an acceptable range, the ECM will initiate action. The ECM can cause a warning to occur. The ECM can derate engine power. The ECM can cause an engine shutdown to occur. Not all of the actions are available for all parameters.

The Caterpillar Electronic Technician (ET) can be used to select the ECM response. Cat ET can be used to program the level of engine monitoring and the delay times.

Separate timers are used in the ECM for each response that is associated with a parameter. Once the trip point is exceeded for an action, the timer for that action is started. For example, if the high coolant temperature warning is set to 102 °C (216 °F) with a five seconds delay, the delay timer starts counting once the coolant temperature exceeds 102 °C (216 °F). If the coolant remained above 102 °C (216 °F) for five seconds, a warning would be issued.

Use care when you program the trip point and the delay times. The resulting ECM response must be correct for the application. If the acceptable range is not exceeded, the engine monitoring system will accept any setting.

If the trip point for a shutdown is lower than the trip point for a warning, the engine will shut down. The warning will not be activated.

Once a parameter has exceeded the trip point the parameter must drop a certain amount below the trip point before the ECM response will end.

If a warning is programmed to 102 °C (216 °F), the temperature must exceed the range in order for the warning to activate. The temperature must decrease below 99 °C (210 °F) for the warning to stop. The variance is the hysteresis. The following table gives the hysteresis for each parameter.

Table 5

Parameter	Hysteresis
ECM Voltage	2 VDC
Oil Pressure	20 kPa (2.9 psi)
High Coolant Temperature	5 °C (41 °F)
Low Coolant Temperature	5 °C (41 °F)
Overspeed	100 rpm
Air Inlet Restriction	1.5 kPa (6.0 inch of H ₂ O)
Altitude	0
High Exhaust Temperature	10 °C (50 °F)
Oil Filter Differential Pressure	10 kPa (1.5 psi)
Fuel Filter Differential Pressure	10 kPa (1.5 psi)
Crankcase Pressure	0.25 kPa (1.0047 inch of H ₂ O)
Aftercooler Water Temperature	3 °C (37 °F)
High Transmission Oil Temperature	5 °C (41 °F)
High Boost Pressure	0

Note: The following tables are examples. The values may have changed. Use Cat ET to determine the actual defaults and the specific configuration.

Table 6

Programmable Monitoring System						
Parameter	ECM Response	Default Trip Point	Default Delay Time	Limits		
				Range for Trip Point		Delay Time
				Low	High	
Low System Voltage	On/Off					
	Warning	20 VDC	10 Seconds	20 VDC	22 VDC	1 to 30 seconds
Low Oil Pressure	On/Off					
	Warning	(1)	4 Seconds	N/A		1 to 15 seconds
	Shutdown	(1)	9 Seconds	N/A		1 to 15 seconds
High Coolant Temperature	On/Off					
	Warning	102 °C (216 °F)	5 Seconds	90 °C (194 °F)	102 °C (216 °F)	1 to 60 Seconds
	Derate	107 °C (225 °F)	30 Seconds	90 °C (194 °F)	107 °C (225 °F)	1 to 60 Seconds
	Shutdown	107 °C (225 °F)	5 Seconds	90 °C (194 °F)	107 °C (225 °F)	1 to 60 Seconds
Low Coolant Temperature	On/Off					
	Warning	80 °C (176 °F)	5 Seconds	63 °C (145 °F)	85 °C (185 °F)	1 to 60 Seconds
Engine Overspeed	On/Off					
	Warning	Application Dependent	0 Seconds	1200 rpm	2400 rpm	0 to 5 Seconds
	Shutdown	Application Dependent	0 Seconds	1200 rpm	2400 rpm	0 to 5 Seconds
Air Filter Restriction Pressure	On/Off					
	Warning	7 kPa (1 psi)	5 Seconds	3 kPa (0.4 psi)	7 kPa (1 psi)	1 to 60 Seconds
	Derate	7 kPa (1 psi)	5 Seconds	1 kPa (0.14 psi)	7 kPa (1 psi)	1 to 60 Seconds
Altitude	On/Off					
	Derate	762 m (2500 ft)	0	250 m (820 ft)	4562 m (14967 ft)	0 seconds
High Exhaust Temperature	On/Off					
	Warning	600 °C (1112 °F)	5 Seconds	500 °C (932 °F)	800 °C (1472 °F)	1 to 60 Seconds
	Derate	750 °C (1382 °F)	5 Seconds			1 to 60 Seconds
Oil Filter Differential Pressure	On/Off					
	Warning	105 kPa (15 psi)	5 Seconds	70 kPa (10 psi)	105 kPa (15 psi)	1 to 60 Seconds

(continued)

(Table 6, contd)

Fuel Filter Differential Pressure	On/Off					
	Warning	105 kPa (15 psi)	5 Seconds	70 kPa (10 psi)	105 kPa (15 psi)	1 to 60 Seconds
Crankcase Pressure	Off					
	Warning	2 kPa (0.3 psi)	3 Seconds	0.5 kPa (0.1 psi)	6 kPa (0.9 psi)	1 to 60 Seconds
	Derate	6 kPa (0.9 psi)	10 Seconds	0.5 kPa (0.1 psi)	6 kPa (0.9 psi)	1 to 60 Seconds
	Shutdown	3.5 kPa (0.5 psi)	3 Seconds	0.5 kPa (0.1 psi)	6 kPa (0.9 psi)	1 to 60 Seconds
Aftercooler Water Temperature	On/Off					
	Warning	102 °C (216 °F)	5 Seconds	40 °C (104 °F)	102 °C (216 °F)	1 to 60 Seconds
	Derate	107 °C (225 °F)	5 Seconds	40 °C (104 °F)	107 °C (225 °F)	1 to 60 Seconds
	Shutdown	107 °C (225 °F)	5 Seconds	40 °C (104 °F)	107 °C (225 °F)	1 to 60 Seconds
High Boost Pressure	On/Off					
	Derate	400 kPa (58 psi)	30 Seconds	400 kPa (58 psi)	400 kPa (58 psi)	0 Seconds
High Transmission Oil Temperature ⁽²⁾	On/Off					
	Warning	99 °C (210 °F)	5 Seconds	20 °C (68 °F)	120 °C (248 °F)	1 to 120 Seconds
Low Transmission Oil Pressure ⁽²⁾	On/Off					
	Warning	1500 kPa (218 psi)	5 Seconds	900 kPa (131 psi)	2900 kPa (421 psi)	1 to 60 Seconds
Low Engine Coolant Level ⁽²⁾	On/Off					
	Warning	ON	10 Seconds	ON	ON	1 to 120 Seconds

⁽¹⁾ Refer to the oil pressure map.

⁽²⁾ Optional equipment

Note: The engine monitoring system is enabled after the engine is started. The ECM delays monitoring some parameters at start-up. The delay is designed to eliminate false warnings. The following parameters have a delay at start-up.

- The delay for low engine oil pressure is 10 seconds.
- The delay for high transmission oil temperature is 30 seconds.
- The delay for low transmission oil pressure is 30 seconds.
- The delay for low engine coolant temperature is 600 seconds.
- The delay for low engine coolant level is 60 seconds.

Oil Pressure Map

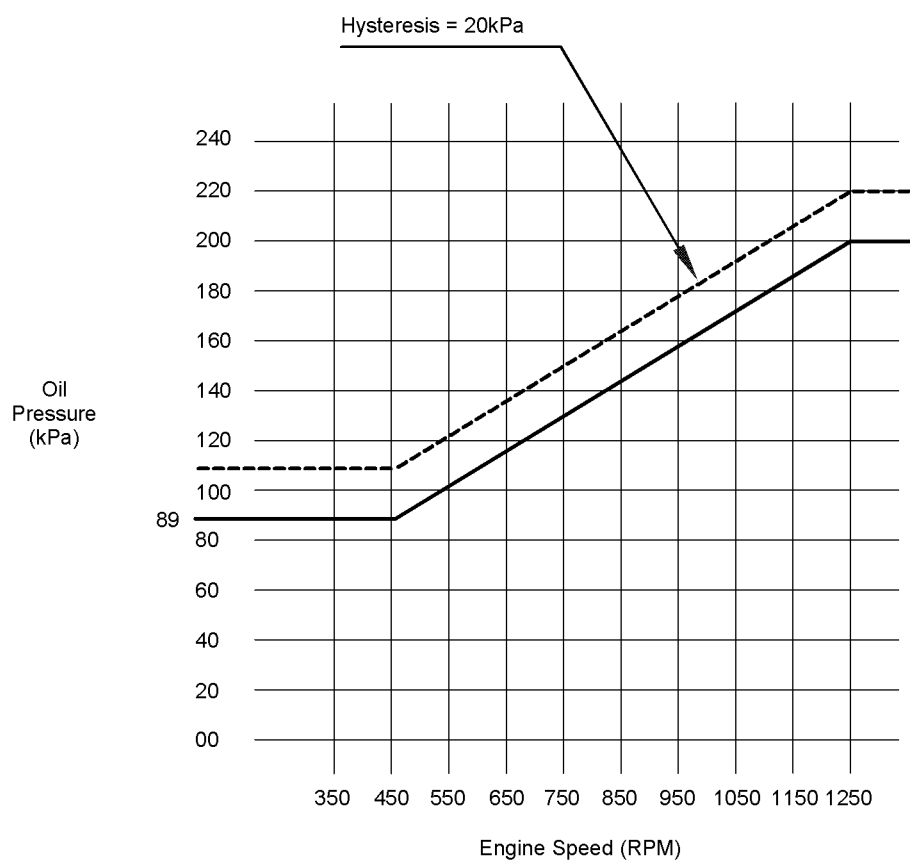


Illustration 9
Oil pressure map

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Programming Parameters

i02549044

Programming Parameters

SMCS Code: 1901-038

Caterpillar Electronic Technician (ET) can be used to view certain parameters that can affect the operation of the engine. Cat ET can also be used to change certain parameters. Some of the parameters are protected from unauthorized changes by passwords. Parameters that can be changed have a tattletale number. The tattletale number shows if a parameter has been changed.

i02399101

Factory Passwords

SMCS Code: 1901-038

Passwords

Passwords are part of a security system that helps to prevent unauthorized changing of certain parameters. Passwords prevent unauthorized erasing of logged events. Passwords allow the factory to control access to engine calibration parameters. Passwords allow the customer to control access to certain engine parameters.

Factory Passwords

Factory passwords are required to clear any event code. Factory passwords are required to change certain parameters such as "Full Load Setting". Factory passwords restrict changes to authorized personnel. When the correct factory passwords have been entered, the changes can then be made.

Note: Factory passwords are calculated on a computer system that is only available to Caterpillar dealers.

In order to obtain the proper factory passwords, certain information must be given to an authorized Caterpillar dealer. Since the factory passwords contain alphabetic characters, the Caterpillar Electronic Technician (ET) can be used to perform this function. In order to obtain the factory passwords, proceed as if you already have the factory passwords. At some point, if the factory passwords are actually needed, Cat ET will request the factory passwords and Cat ET will display the information that is required to obtain the factory passwords.

Note: The old interlock code is required to change the interlock code on a used Electronic Control Module (ECM). A new interlock code is also required to change the interlock code on a used ECM.

The Cat ET screen for factory passwords will display the following parameters:

- Serial number of the ECM
- Engine serial number
- Serial number for Cat ET
- Reason code
- Interlock code
- Total tattletale

Note: Factory passwords are only valid for the current Cat ET screen. A different set of factory passwords will be required if you exit the current Cat ET screen. A different set of passwords will be required to change information on another Cat ET screen.

Customer Passwords

Customer passwords allow the customer to restrict access to parameters that can be changed by the customer. The customer passwords cannot be longer than eight characters. The customer passwords may consist of alphanumeric characters. The customer has the option of entering one or two customer passwords.

If customer passwords have been entered, then the customer passwords are required to change any parameter that is customer programmable. Parameters that are customer programmable are those parameters that affect the engine speed limits and the power rating within an engine family. Refer to the diagnostic procedure Troubleshooting, "System Configuration Parameters" for more detail on parameters that are customer programmable.

Note: If the owner loses the owner's customer passwords, the owner will not be able to change parameters that are protected by customer passwords. You must use factory passwords in order to read the customer passwords. You may then use those customer passwords to change parameters that have been protected by customer passwords.

i01562584

Factory Passwords Worksheet

SMCS Code: 1901-038

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

Table 7

Dealer Code	
Customer's Name	
Address	
Telephone Number	
Information From Engine Information Plate	
Engine Serial Number	
Full Load Setting	
Full Torque Setting	
Information From Engine Hour Meter	
Engine Hours	
Information From Factory Password Entry Screen on ET	
Electronic Service Tool Serial Number	
Engine Serial Number	
ECM Serial Number	
Total Tattletale	
Reason Code	
From Interlock ⁽¹⁾	
To Interlock ⁽¹⁾	
Factory Passwords	
Factory Password (No. 1)	
Factory Password (No. 2)	

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

i02419726

Flash Programming

SMCS Code: 1901-038

Flash Programming – This is a method of programming or updating the flash file in an engine's Electronic Control Module (ECM).

Caterpillar Electronic Technician (ET) is used to flash program a file into the memory of the engine's ECM.

If you do not have the flash file, use the "Flash File Search" tool on the Service Technician Workbench (STW) to obtain the flash file for your engine. Alternatively, use the "Service Software Files" feature on SIS Web to obtain the flash file for your engine. You must have the engine serial number in order to search for the flash file. After locating the correct flash file, download the flash file to your PC. Write down the name of the flash file for future reference.

Programming a Flash File

1. Establish communication between Cat ET and the engine's ECM.
2. Select "WinFlash" from the "Utilities" menu on Cat ET.

Note: If "WinFlash" will not communicate with the ECM, refer to troubleshooting without a diagnostic code Troubleshooting, "Electronic Service Tool Will Not Communicate with ECM".

3. 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 name 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, obtain the correct flash file.
 - e. When the correct flash file is selected, press the "Begin Flash" button.
 - f. Cat ET will indicate when flash programming has been successfully completed.
4. Start the engine and check for proper operation. Repair any active diagnostic or event codes.

"WinFlash" Error Messages

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

i01908150

System Configuration Parameters

SMCS Code: 1901-038

System configuration parameters are parameters that affect emissions and power of the engine applications. Default values for the parameters are programmed at the factory. Some parameters may be changed by the customer in order to suit the needs of the specific application. Proper values for these parameters are available on the electronic service tool. Certain configuration parameters are also stamped on the engine information plate.

No password is required for programming a new Electronic Control Module (ECM) during the first 100 hours of service life. This 100 hour "free configuration" feature enables the customer to tailor the programmable setpoints to the requirements of the installation. Exceptions are "Fuel Limit" and "Personality Module Mismatch".

Note: If the parameters that are protected with the factory passwords are changed, the Caterpillar warranty may be voided.

Parameter Descriptions

"Injector Codes"

Note: The injector codes are not part of the "Configuration" screen on the electronic service tool. "Injector Codes Calibration" can be found under "Calibrations" in the "Service" menu on the electronic service tool.

The injector code is a number that is found on each of the unit injectors. The ECM uses this number to compensate for manufacturing variations between individual injectors. If you replace any of the unit injectors, you must reprogram the code for the new injectors. Also, if you replace the ECM, you must reprogram all of the injector codes.

"Fuel Ratio Control"

The "Fuel Ratio Control" limit controls the amount of fuel to air ratio by limiting the rack as a function of boost pressure, engine speed and altitude. The "Fuel Ratio Control" function permits an offset to be applied to the calculation for the altitude. The offset changes the fuel to the air ratio to a richer mixture or a leaner mixture.

"Rated Fuel Position"

This parameter is used to limit the engine power. A factory password is required to change this setting.

"Engine Cooling System Configuration"

This parameter is used as a switch to toggle between the SCAC cooling system or the JWAC cooling system.

"Cold Cylinder Cutout"

The cold cylinder cutout automatically stops fuel injection to cylinders that are not firing. The fuel injection is stopped to the cylinders until the engine reaches operating temperature.

"Cooldown Engine Speed"

This parameter defines the engine rpm level when the Engine Control Switch (ECS) is placed in the STOP position.

"Engine Cooldown Duration"

This parameter defines engine operation at the cooldown speed. Programming this parameter to 0 will disable this function.

"Engine Prelube Duration"

This parameter sets the engine prelubrication timeout period. Programming this parameter to 0 will disable this function.

"Crank Duration"

The crank duration determines when the starting motors will be energized. The crank duration determines when the starting motors will be disengaged. Programming this parameter to 0 will prevent the ECM from engaging the starting motors.

"Maximum Number of Crank Cycles"

This parameter is the total number of crank cycles that can be performed.

"Crank Terminate Speed"

This parameter determines when the starting motor will disengage.

"Total Tattletale"

The parameter counts the number of changes to system parameters.

Parameter Table

Table 8

System Configuration Parameters				
Parameter	ECM	Default	Range	Password
"Fuel Ratio Control Offset"	Primary	0	-25 to +25	No
"Rated Fuel Positon (mm)"	Primary	Software Dependent	Software Dependent	Yes
"Engine Cooling System Configuration"	Primary	SCAC	SCAC or JWAC	Yes
Cold Cylinder Cutout	Primary	Enabled	Enabled Disabled	No
"Cooldown Engine Speed (rpm)"	Primary	600	300 to 1600	No
"Engine Cooldown Duration (min)"	Primary	5	0 to 30	No
"Engine Prelube Duration (sec)"	Primary	0	0 to 210	No
"Crank Duration (sec)"	Primary	0	0 to 60	No
"Maximum Number of Crank Cycles"	Primary	0	0 to 10	No
"Crank Terminate Speed (rpm)"	Primary	400	100 to 500	No
"Total Tattletale"	Primary Secondary	0	0 to 255	N/A

Customer Parameters

"Equipment ID"

"Equipment ID" allows the customer to enter a description into the ECM in order to identify the vessel. A maximum of 17 characters may be entered in the field. This parameter is only for reference by the customer. This parameter is not required.

"Engine Serial Number"

"Engine Serial Number" must be programmed to match the engine serial number that is stamped on the engine information plate. If the ECM is replaced, the engine serial number must be programmed into the new ECM.

Note: When you are requesting factory passwords, always use the engine serial number that is resident in the ECM.

"ECM Serial Number"

The "ECM Serial Number" is stored in the memory of the ECM. The "ECM Serial Number" can be accessed by the use of the service tool.

"Personality Module Part Number"

"Personality Module Part Number" is programmed into the software.

"Personality Module Release Date"

"Personality Module Release Date" is programmed into the software.

"Engine Rotation"

The "Engine Rotation" can be viewed only.

"Engine Location"

If multiple engines are installed, the parameter for the engine location identifies the locations of the engines.

"Full Load Setting (FLS)"

"FLS" is a number that represents the adjustment to the fuel system that was made at the factory in order to fine tune the fuel system. The correct value for this parameter is stamped on the engine information plate. Factory passwords are required.

“Full Torque Setting (FTS)”

“FTS” is similar to “FLS”. Factory passwords are required.

“High Idle Speed”

The “High Idle Speed” is programmed into the software.

“Low Idle Speed”

“Low Idle Speed” is the minimum allowable operating speed for the engine.

“Fuel Correction Factor”

The “Fuel Correction Factor” is a parameter that adjusts the calculation of fuel consumption. The fuel correction factor is used to correct the estimated fuel rate.

“Coolant Level Sensor”

The “Coolant Level Sensor” parameter can be set to the following status: “Not Installed”, “Data Link”, and “Sensor”. If the sensor is available via the EMS panel in the engine control panel, set the status to the “Data Link”. If the sensor is mounted on the engine, set the status to the “Sensor”.

“Torque Limit Enable Status”

The “Torque Limit Enable Status” enables the torque limit.

“Maximum Engine Torque Limit”

The “Maximum Engine Torque Limit” and the range for the “Maximum Engine Torque Limit” is programmed into the software.

“Minimum Engine Torque Limit”

The “Minimum Engine Torque Limit” and the range for the “Minimum Engine Torque Limit” is programmed into the software.

“Coolant Warning Engine Load Enable Threshold”

The “Coolant Warning Engine Load Enable Threshold” is programmed in order to set the setpoint for low coolant.

“Air Shutoff Status”

This “Air Shutoff Status” enables the strategy for the air shutoff.

Parameter Table

Table 9

Customer Parameters				
Parameter	ECM	Default	Range	Password
"Equipment ID"	Primary Secondary	N/A	17 alphanumeric characters	No
"Engine Serial Number"	Primary Secondary		8 alphanumeric characters #AA#####	No
"ECM Serial Number"	Primary Secondary	ECM Serial Number	ECM Serial Number	N/A
"Personality Module Part Number"	Primary Secondary			N/A
"Personality Module Release Date"	Primary Secondary	Month Year		N/A
"Engine Rotation"	Primary Secondary	Forward	Forward/Reverse	N/A
"Engine Location"	Primary	Center	Port Center Starboard	No
"Full Load Setting (FLS)"	Primary Secondary	Not Programmed	-128 to +127	Yes
"Full Torque Setting (FTS)"	Primary Secondary	0	-128 to +127	Yes
"Rated Engine Speed"	Primary	Programmed at the Factory	Factory	N/A
"High Idle Speed (rpm)"	Primary	Programmed at the Factory	Factory	N/A
"Low Idle Speed (rpm)"	Primary Secondary	600	300 to 900	No
"Fuel Correction Factor"	Primary	0	-64 to +63.5	No
"Coolant Level Sensor"	Primary	Installed	"Not Installed" Data Link Sensor	No
"Torque Limit Enable Status"	Primary Secondary	"Not installed"	Installed "Not Installed"	No
"Maximum Engine Torque Limit"	Primary Secondary	Programmed at the Factory	Factory	No
"Minimum Engine Torque Limit"	Primary Secondary	Programmed at the Factory	Factory	No
"Coolant Warning Engine Load Enable" Threshold	Primary	40%	5 to 95%	No
"Air Shutoff Status"	Secondary	Enabled	Enabled Disabled	No

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Customer Parameters Worksheet

SMCS Code: 1901-038

Table 10

Parameter Worksheet	
System Configuration	
"Fuel Ratio Control Offset"	
"Rated Fuel Positon (mm)"	
"Engine Cooling System Configuration"	
Cold Cylinder Cutout	
"Cooldown Engine Speed (rpm)"	
"Engine Cooldown Duration (min)"	
"Engine Prelube Duration (sec)"	
"Crank Duration (sec)"	
"Maximum Number of Crank Cycles"	
"Crank Terminate Speed (rpm)"	
"Total Tattletale"	

Table 11

Injector Codes	
Injector Code (1)	
Injector Code (2)	
Injector Code (3)	
Injector Code (4)	
Injector Code (5)	
Injector Code (6)	
Injector Code (7)	
Injector Code (8)	
Injector Code (9)	
Injector Code (10)	
Injector Code (11)	
Injector Code (12)	
Injector Code (13)	
Injector Code (14)	
Injector Code (15)	
Injector Code (16)	

Table 12

Customer Parameters	
Parameter	
"Equipment ID"	
"Engine Serial Number"	
"ECM Serial Number"	
"Personality Module Part Number"	
"Personality Module Release Date"	
"Engine Rotation"	
"Engine Location"	
"Full Load Setting (FLS)"	
"Full Torque Setting (FTS)"	
"Rated Engine Speed"	
"High Idle Speed (rpm)"	
"Low Idle Speed (rpm)"	
"Fuel Correction Factor"	
"Coolant Level Sensor"	
"Torque Limit Enable Status"	
"Maximum Engine Torque Limit"	
"Minimum Engine Torque Limit"	
"Coolant Warning Engine Load Enable" Threshold	
"Air Shutoff Status"	

Table 13

Parameter Worksheet						
Programmable Monitoring System						
	Warning Trip Point	Warning Delay Time	Derate Trip Point	Derate Delay Time	Shutdown Trip Point	Shutdown Delay Time
Low System Voltage						
Low Oil Pressure						
High Coolant Temperature						
Low Coolant Temperature						
Engine Overspeed						
Air Filter Restriction Pressure						
Altitude						
High Exhaust Temperature						
Oil Filter Differential Pressure						
Fuel Filter Differential Pressure						
Crankcase Pressure						
Aftercooler Water Temperature						
High Transmission Oil Temperature						
Low Transmission Oil Pressure						

i01908773

Replacing the ECM

SMCS Code: 1901-038

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.

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

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 Electronic Control Module (ECM) contains no moving parts. Replacement of the ECM can be costly. Replacement can also be a time consuming task. Follow the troubleshooting procedures in this manual in order to be sure that replacing the ECM will correct the problem. Verify that the suspect ECM is the cause of the problem.

Note: Ensure that the ECM is receiving power and that the ECM is properly wired to the negative battery circuit before a replacement of the ECM is attempted. Refer to the diagnostic functional test Troubleshooting, "Electrical Power Supply".

A spare ECM can be used to determine if the ECM is faulty. Install a spare ECM in place of the suspect ECM. Transfer the personality module from the suspect ECM to the spare ECM. Program the parameters for normal operation. The parameters must match the parameters in the suspect ECM. Refer to the following test steps for details. If the spare ECM resolves the problem, reconnect the suspect ECM. Verify that the problem returns. If the problem returns, replace the ECM.

Note: The replacement or the spare ECM must have the same serial number suffix as the suspect ECM. Ensure that the replacement ECM and the interlock code for the personality module match the suspect ECM. Be sure to record the parameters from the replacement ECM. Use the "Copy Configuration/ECM Replacement" feature that is found under the "Service" menu on the Caterpillar Electronic Technician (ET).

NOTICE

If the personality module and engine application are not matched, engine damage may result.

Perform the following procedure in order to replace the ECM.

1. Connect the Cat ET to the service tool connector for the engine.
2. Print the parameters from the "Configuration" screen on Cat ET. If a printer is unavailable, record all of the parameters. Record any logged diagnostic codes and logged event codes for your records. Record the injector codes from the "Calibrations" screen in the "Service" menu on Cat ET.

Note: The injector trim code is a number that is found on each of the unit injectors. The ECM uses this number to compensate for manufacturing variations between individual injectors. If you replace any of the unit injectors, you must reprogram the trim code for the new injectors. Also, if you replace the ECM, you must reprogram all of the trim codes.

3. Use the "Copy Configuration/ECM Replacement" feature that is found under the "Service" menu on Cat ET. Select "Load from ECM" in order to copy the configuration from the suspect ECM.

Note: If the "Copy Configuration" process fails and the parameters were not obtained in Step 2, the parameters must be obtained elsewhere. Some parameters are stamped on the engine information plate, but most parameters must be obtained from the factory.

4. Remove the ECM.
 - a. Turn the engine control to the OFF position.
 - b. Disconnect the ECM connectors J1/P1 and J2/P2.

NOTICE

Use a suitable container to catch any fuel that might spill. Clean up any spilled fuel immediately.

NOTICE

Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over disconnected fuel system component.

- c. Remove the fuel lines from the ECM (if equipped).
 - d. Remove the mounting bolts from the ECM.
 - e. Disconnect the ECM ground strap from the engine.
 5. Install the replacement ECM.
 - a. Use the old mounting hardware to install the replacement ECM. The mounting hardware should be free of damage.
 - b. Reconnect the fuel lines (if equipped).
 - c. Ensure that the ECM mounting hardware is installed correctly. The fuel lines should not be putting tension on the ECM. The rubber grommets are used to protect the ECM from excessive vibration. The ECM should be able to drift in the rubber grommets. If the ECM cannot be moved slightly in the grommets, check that the fuel lines are not pulling the ECM against one side of the grommets.
 - d. Install the ECM ground strap on the engine.
 - e. Reconnect ECM connectors J1/P1 and J2/P2. Tighten the allen head screws on the connectors to the proper torque:
 - 40-pin connector 2.25 N·m (20 lb in)
 - 70-pin connector 6.0 N·m (53 lb in)
 6. Flash program the personality module into the ECM. Refer to the diagnostic procedure Troubleshooting, "Flash Programming" for the correct procedure.
 7. Use Cat ET to match the engine application and the interlock code if the replacement ECM was used for a different application.
 8. Configure the ECM.
 - a. If the "Copy Configuration" process from Step 3 was successful, return to the "Copy Configuration/ECM Replacement" screen on Cat ET and select "Program ECM". Proceed to Step 10.
 - b. If the "Copy Configuration" process was unsuccessful, program the ECM parameters. The parameters must match the parameters from Step 2.
- Note:** If the "Copy Configuration" process fails and the parameters were not obtained in Step 2, the parameters must be obtained elsewhere. Some parameters are stamped on the engine information plate, but most parameters must be obtained from the factory.
- c. If necessary, program the engine monitoring system.
 9. Calibrate the fuel injectors. Refer to the diagnostic functional test Troubleshooting, "Injector Codes - Calibrate".
 10. Calibrate the injection timing. Refer to the diagnostic functional test Troubleshooting, "Engine Speed/Timing Sensor - Calibrate".
 11. Check for diagnostic codes and for event codes.

Troubleshooting without a Diagnostic Code

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Symptoms

SMCS Code: 1000-038; 1901-038

Some engine symptoms can be unrelated to the electronic control system. Gather information about the complaint that describes the symptoms. Verify that the complaint is not due to normal engine operation.

Perform the following steps in order to determine the problem.

1. Repair all active diagnostic codes.
2. Gather operator information.
3. Verify that the complaint is not due to normal engine operation.
4. Perform a visual inspection of the engine. Inspect the following items:
 - Wiring
 - Connectors
 - Fuel level
 - Fuel supply
 - Engine oil level
 - Engine oil supply
 - Coolant level
 - Intake air system
 - Air exhaust system
5. Check the wiring and the connectors for the following problems:
 - Damage
 - Abrasion
 - Corrosion
 - Incorrect attachment
6. Check for any logged diagnostic codes.

- Determine if the logged diagnostic codes correlate to probable causes.
- Determine if the logged diagnostic codes occur at the same time as the symptoms.
- Determine if the logged diagnostic codes are logged repeatedly.

If these inspections do not reveal any problems, use the procedure that best describes the symptoms.

i02400486

Air Starting Motor

SMCS Code: 1451-035

The probable root causes are listed below:

- Low air pressure
 - Wiring
 - Control valve
 - Relay valve
 - Motor
1. Charge the air system.
 2. Repair the wiring and/or replace the wiring.
 3. Repair the control valve and/or replace the control valve.
 4. Repair the relay valve and/or replace the relay valve.
 5. Repair the motor and/or replace the motor.

The Air Starting Motor has a loss of power.

The probable root causes are listed below:

- Low air pressure
 - Improper lubrication
 - Worn parts
 - Air leaks
1. If necessary, charge the air system. Check the air system for leaks. Check the air compressor for correct operation.
 2. Check the lubrication system.

3. Inspect parts for wear. Replace any worn parts.
 - a. Inspect the vanes for damage. If the width of the vane is less than 32 mm (1.25 inch) at either end replace the vane.
 - b. Inspect the rotor bearings. If the bearings are loose or damaged replace the bearings.
 - c. Inspect the rotor for scoring. Attempt to remove the scoring with an emery cloth. If the scoring cannot be removed, replace the rotor.
 - d. Inspect the cylinders for cracks and/or scoring. If necessary, replace the cylinder.
4. Check for worn seals. Plug the exhaust and apply 205 kPa (30 psi) to the inlet. Place the unit in a nonflammable liquid for 30 seconds. If bubbles appear, replace the motor seals.

The pinion does not engage the flywheel.

The probable root cause is a broken clutch and/or other parts. Replace the clutch.

The pinion engages the flywheel but the flywheel does not turn.

The probable root cause is a broken shaft and/or gear teeth. Inspect the shaft and teeth for damage. Replace any damaged parts.

The pinion incorrectly engages the flywheel.

The probable root cause is a dry pinion shaft. Remove the pinion and apply grease on the splines and the pinion.

i01953472

Alternator

SMCS Code: 1405-035

The probable root causes are listed below:

- The alternator is not charging the battery.
- The battery charge is low.
- The battery charge is high.
- Noisy operation

Perform the following checks:

1. Loosen the drive belts on the alternator. Adjust the drive belt tension. Inspect all of the cables and the connections. Clean the connections and tighten the connections. Replace faulty parts. Inspect the rotor. Install a new rotor.

2. Inspect the rectifier diodes. Replace the diode.
3. Inspect the alternator for loose connections. Tighten all connections to the alternator. Inspect the regulator. If a replacement is required, the alternator must be disassembled.
4. Inspect the drive belts. Install new drive belts. Loosen the drive pulley. Tighten the pulley. Refer to the Specifications manual. If the belt and the pulley are misaligned, adjust the belt and the pulley. If the alternator bearings are worn, install new bearings.
5. If the problem is still present, refer to Special Instruction, REHS0354, "Charging System Troubleshooting".

i02421020

Can Not Reach Top Engine RPM

SMCS Code: 1000-038; 1901-038

Note: If this problem occurs under load, refer to the diagnostic procedure Troubleshooting, "Low Power/Poor Or No Response To Throttle".

Probable Causes

- Derated engine
- Cold mode
- Flash file
- Throttle signal
- Fuel supply
- Air inlet restriction
- Exhaust restriction
- Leaks in air system
- Valve adjustment
- Injectors
- Faulty accessory equipment

Recommended Actions

Derate

Connect Caterpillar Electronic Technician (ET) and check for an active derate event. A derate status flag will appear on Cat ET if an active engine derate is occurring. In order to view active events, go to the "Events" menu under "Diagnostics". Refer to Troubleshooting, "Troubleshooting with an Event Code" for the specific events for this application.

Cold Mode

Use Cat ET to verify that the engine has exited cold mode. A status flag will appear if the engine is operating in cold mode. This may limit engine speed.

Flash File

Verify that the correct flash file has been installed.

Throttle Signal

Use Cat ET in order to monitor the status of the throttle. Observe the throttle position. Verify that the throttle position is smooth from low idle to high idle. The throttle position should reach 100 percent at high idle.

Fuel Supply

Check fuel lines for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines.

1. Check the fuel tank for foreign objects which may block the fuel supply. Check for air leaks in the suction line of the fuel pump. Prime the fuel system after you perform the following procedures:
 - Replacing the fuel filters
 - Working on the low pressure fuel supply circuit
 - Replacing fuel injectors
2. Cold weather adversely affects the characteristics of the fuel. Refer to the Operation and Maintenance Manual for information on improving the characteristics of the fuel during cold weather operation.

3. Check the fuel pressure during engine cranking. Check the fuel pressure after the fuel filter. Refer to the Systems Operation/Testing and Adjusting manual for the correct pressure values. If the fuel pressure is low, replace the fuel filters. If the fuel pressure is still low, check the following items: fuel transfer pump, fuel transfer pump coupling, and fuel pressure regulating valve.

Air Inlet Restriction

Replace plugged air filters and/or clean the filters. Leaks in the air inlet manifold system can lower Inlet manifold pressure.

Exhaust Restriction

Check the exhaust system for restrictions and/or for leaks.

Valve Adjustment

Check the valve lash setting.

Injectors

Use Cat ET to determine if any active diagnostic codes are present for the injector solenoids. Perform the "Injector Solenoid Test". Observe that the injector solenoids are being energized on Cat ET. Perform the "Cylinder Cutout Test". Locate the misfiring cylinder. Refer to the diagnostic functional test Troubleshooting, "Injector Solenoids".

Faulty Accessory Equipment

Check attached accessory equipment. Ensure that the accessory equipment is not lugging down the engine.

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Coolant in Engine Oil

SMCS Code: 1300-038; 1901-038

Probable Causes

- Failure of the oil cooler core
- Failure of cylinder head gasket
- Crack in cylinder head
- Cracked cylinder liner
- Cylinder liner seals
- Water pump

Recommended Actions

Failure of Oil Cooler Cores

Inspect the oil cooler for leaks. Make repairs, as needed. Drain the crankcase. Refill the crankcase with clean lubricant. Change the oil filters.

Failure of Cylinder Head Gasket

Check the cylinder head gasket.

Crack in Cylinder Head

Check for cracks in the cylinder head. Repair the cylinder head and/or replace the cylinder head. Tighten the bolts that hold the cylinder head according to the Specifications manual.

Cracked Cylinder Liner

Check the cylinder liner for cracks. Use a borescope to check the cylinder liner.

Cylinder Liner Seals

Check the liner water seals in the spacer plate. Check the bottom seals on the liner for damage.

Water Pump

Check the weep hole in the water pump for blockage. Check the water pump seals for leakage.

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Coolant Temperature Is Too High

SMCS Code: 1350-038; 1901-038

Probable Causes

- Faulty temperature regulator
- Radiator
- Low coolant level
- Faulty jacket water coolant pump
- Faulty engine cooling fan (if equipped)
- Faulty pressure relief valve

Recommended Actions

Faulty Temperature Regulator

Check the water temperature regulator. A water temperature regulator that does not open, or a water temperature regulator that only opens part of the way can cause overheating.

Radiator

1. Check the cooling fins on the radiator for dirt and/or for debris. Remove the dirt and/or debris.

Inspect the cooling fins on the radiator for damage. Refer to the Systems Operation/Testing and Adjusting manual.

2. Check the radiator for internal blockage. Check the temperature difference between the top and the bottom of the radiator.

Low Coolant Level

1. Verify that the cooling system is filled to the proper level. 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 and bubbles in the coolant. Air bubbles will keep coolant away from the engine parts, which will prevent the transfer of heat to the coolant. Low coolant level is caused by leaks or incorrectly filling the radiator.
2. Check the mixture of antifreeze and water. The mixture should be approximately 50 percent water and 50 percent antifreeze with 3 to 6 percent coolant conditioner. Refer to Operation and Maintenance Manual. If the coolant mixture is incorrect, drain the system. Put the correct mixture of water, antifreeze and coolant conditioner in the cooling system.
3. Check for air in the cooling system. Air can enter the cooling system in different ways. The most common causes of air in the cooling system are the incorrect filling of the cooling system and combustion gas leakage into the cooling system. Combustion gas can get into the system through inside cracks, a damaged cylinder head, or a damaged cylinder head gasket.
4. Check the cooling system hoses and clamps. Damaged hoses with leaks can normally be seen. Hoses that have no visual leaks can soften during operation. The soft areas of the hose can become kinked or crushed during operation. These areas of the hose can restrict the coolant flow. Hoses become soft and/or get cracks after a period of time. The inside of a hose can deteriorate, and the loose particles of the hose can restrict the coolant flow.

Faulty Jacket Water Coolant Pump

Inspect the impeller vanes at the jacket water pump for damage and/or for erosion. Repair impeller vanes and/or replace the impeller vanes.

Faulty Engine Cooling Fan (if equipped)

1. If the fan is belt driven, check for loose drive belts. A loose fan drive belt will cause a reduction in the air flow across the radiator. Check the fan drive belt for proper belt tension. Adjust the tension of the fan drive belt, if necessary. Refer to Operation and Maintenance Manual.
2. Check the fan clutch, if equipped. A fan clutch or a hydraulic driven fan that is not turning at the correct speed can cause improper air speed across the radiator core. The lack of proper air flow across the radiator core can cause the coolant not to cool to the proper temperature differential.

Faulty Pressure Relief Valve

Check operation of the pressure relief valve and the radiator cap. If necessary, clean the pressure relief valve and/or the radiator cap. Check that the seating surface of the valve is clean and undamaged. If necessary, install new parts.

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ECM Will Not Accept Factory Passwords

SMCS Code: 1901-038

Probable Causes

One of the following items may not be recorded correctly on the Caterpillar Electronic Technician (ET):

- Passwords
- Serial numbers
- Total tattle tale
- 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 Cat ET is displaying the "Enter Factory Passwords" dialog box.
3. Use Cat ET to verify that the following information has been entered correctly:

- Engine serial number
- Serial number for the electronic control module
- Serial number for Cat ET
- Total tattle tale
- Reason code

For additional information, refer to Troubleshooting, "Factory Passwords".

i02561478

ECM Will Not Communicate with Other Systems or Display Modules

SMCS Code: 1901-038

Probable Causes

- Electronic Control Module (ECM)
- Connector or wiring problem
- Cat Data Link
- CAN data link (if applicable)

Recommended Actions

ECM

Connect Caterpillar Electronic Technician (ET). If the ECM does not communicate with the Cat ET, perform the diagnostic functional test Troubleshooting, "Electronic Service Tool Will Not Communicate With ECM".

Connectors or Wiring

Check for correct installation of the ECM connectors. Check any machine connector or the customer connector in the circuit for correct installation. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

Cat Data Link

Verify that the Cat Data Link does not have an open or short circuit. Refer to the diagnostic functional test Troubleshooting, "Cat Data Link".

CAN data link (if applicable)

Verify that the CAN data link does not have an open or short circuit. Refer to the diagnostic functional test Troubleshooting, "CAN Data Link".

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Electronic Service Tool Will Not Communicate with ECM

SMCS Code: 1901-038

Probable Causes

- Configuration for the communications adapter
- Electrical connectors
- Communication adapter and/or cables
- Electrical power supply to the service tool connector
- Caterpillar Electronic Technician (ET) and related hardware
- Electrical power supply to the Electronic Control Module (ECM)
- Flash file
- Cat Data Link

Recommended Actions

Start the engine. If the engine starts, but the ECM will not communicate with Cat ET, continue with this procedure. If the engine will not start, refer to Troubleshooting, "Engine Cranks but Will Not Start". If the engine will not crank, refer to Troubleshooting, "Engine Will Not Crank".

Configuration for the Communications Adapter

1. Access "Preferences" under the "Utilities" menu on Cat ET.
2. Verify that the correct "Communications Interface Device" is selected.
3. Verify that the correct port is selected for use by the communication adapter.

Note: The most commonly used port is "COM 1".

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

Electrical Connectors

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

Communication Adapter and/or Cables

1. If you are using a "Communication Adapter II", ensure that the firmware and software for the communication adapter are the most current files that are available. If the firmware and software do not match, the communication adapter will not communicate with Cat ET.
2. Disconnect the communication adapter and the cables from the service tool connector. Reconnect the communication adapter to the service tool connector.
3. Verify that the correct cable is being used between the communication adapter and the service tool connector. Refer to Troubleshooting, "Electronic Service Tools".

Electrical Power Supply to the Service Tool Connector

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

Cat ET and Related Hardware

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

Electrical Power Supply to the Electronic Control Module (ECM)

Check power to the ECM. Refer to Troubleshooting, "Electrical Power Supply".

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

Flash File

Ensure that the correct flash file is properly installed in the ECM.

Note: The new ECM does not have a flash file. The engine will not start and the engine will not communicate with Cat ET until the flash file has been installed. Refer to Troubleshooting, "Flash Programming".

Cat Data Link

Troubleshoot the Cat Data Link for possible problems. Refer to Troubleshooting, "Cat Data Link".

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Engine Cranks but Will Not Start

SMCS Code: 1000-038; 1901-038

The probable root causes are listed below:

- Electrical power supply
- Low fuel level
- Fuel supply
- Starting aids (if applicable)
- Cranking speed
- Shutdown switch
- Active engine shutdown
- Electrical connectors
- Circuit breakers
- Personality module
- Engine speed/timing sensor
- Injector solenoid
- Air shutoff (if applicable)

Perform the following checks:

1. Measure the voltage at the connector of the Electronic Control Module (ECM). If the ECM is not receiving battery voltage, the ECM will not power up. Refer to the diagnostic functional test Troubleshooting, "Electrical Power Supply".

2. Visually check the fuel level. If necessary, add fuel. Ensure the proper operation of the jacket water heater. Repair the jacket water heater and/or replace the jacket water heater. Check for the presence of solidified fuel (wax).
3. Check the fuel system. Check fuel lines for the following problems: restrictions, collapse, pinched line, and loose fittings. Repair the lines and/or replace the lines.
 - a. Check the fuel tank for foreign objects which may block the fuel supply. Check for air in the low pressure fuel supply system after you perform the following procedures:
 - Replacing the fuel filters
 - Working on the low pressure fuel supply circuit
 - Replacing fuel injectors
 - b. Purge air from the low pressure fuel supply circuit with the hand priming pump and by cranking the engine in 30 second cycles. After you crank the engine, stop for two minutes. This will allow the starting motor to cool. Loosen the vent plug for the fuel return line. The plug is located on the rear upper left side of the engine block. Hand prime the engine again if air in fuel continues. A sight glass in the low pressure supply line is helpful in diagnosing air in the fuel.
 - c. Check fuel quality. In temperatures below 0 °C (32 °F), check for solidified fuel (wax). Refer to Special Publication, SEBD0717, "Diesel Fuels And Your Engine". Check the fuel pressure while the engine is cranking. Check the fuel pressure at the filter. If the pressure is low, check for plugged fuel filters. If the fuel pressure is still low, check the following items: fuel transfer pump, fuel transfer pump coupling, and fuel pressure regulating valve.
4. If equipped, check the operation of the ether starting aids. Replace the ether canister if the ether is low. Refer to the diagnostic functional test Troubleshooting, "Ether Injection System".
5. Check the cranking speed of the starter.

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6. The shutdown switch should be in the OFF position. Connect the Caterpillar Electronic Technician (ET). Use Cat ET in order to verify the status of the shutdown switch. If the Cat ET will not communicate with the ECM, refer to the diagnostic procedure Troubleshooting, "Electronic Service Tool Will Not Communicate with ECM". When a shutdown occurs, the keyswitch must be turned to the OFF position. The keyswitch must then be turned to the ON position before the engine will start.
7. Use Cat ET to determine if any active shutdowns are present. If a Shutdown is "ACTIVE", determine the reason. After you correct the problem, turn the keyswitch to the OFF position for at least 15 seconds before you try to restart the engine.
8. Check for correct installation of the following components: ECM connectors J1/P1 and J2/P2, customer connector, connector for the engine speed/timing sensor, and fuel injector connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".
9. The circuit breakers may exceed the trip point due to overheating. Check the circuit breakers on the machine. Reset the circuit breakers if the circuit breakers are tripped.
10. If the diagnostic code 253-02 is present, program with the correct flash file.
11. Crank the engine and observe the engine rpm on Cat ET. If engine rpm is 0, refer to the diagnostic functional test Troubleshooting, "Engine Speed/Timing Sensor".
 - a. Ensure that the timing reference gear is installed correctly. The engine will not start if the gear was installed backward. Check for proper orientation between the crankshaft and camshaft drive gears. Correct the orientation and/or replace the drive gear. Refer to Disassembly and Assembly Manual.
12. Perform the "Injector Solenoid Test". Verify that the ECM is energizing all the injector solenoids. Refer to the diagnostic functional test Troubleshooting, "Injector Solenoids".
13. Verify that both of the air shutoff valves are open and that both of the air shutoffs are in the starting position.
14. Check for a problem with the combustion system.

Engine Has Early Wear

SMCS Code: 1000-038; 1901-038

Probable Causes

- Incorrect engine oil
- Contaminated engine oil
- Contaminated air
- Contaminated fuel
- Low oil pressure

Recommended Actions

Incorrect Engine Oil

Use engine oil that is recommended and change the engine oil at the interval that is recommended by the engine's Operation and Maintenance Manual.

Contaminated Engine Oil

Drain the crankcase and refill the crankcase with clean engine oil. Install new engine oil filters. Refer to the engine's Operation and Maintenance Manual.

If the oil filter bypass valve is open, the oil will not be filtered. Check the oil filter bypass valve for a weak spring or for a broken spring. If the spring is broken, replace the spring. Refer to the engine's Disassembly and Assembly manual. Make sure that the oil bypass valve is operating correctly.

Contaminated Air

Inspect the air inlet system for leaks. Inspect all of the gaskets and the connections. Repair any leaks.

Inspect the air filter. Replace the air filter, if necessary.

Contaminated Fuel

Inspect the fuel filter. Replace the fuel filter, if necessary.

Contaminants in the fuel such as hydrogen sulfide and sulfur can lead to the formation of acids in the crankcase. Obtain a fuel analysis.

Low Oil Pressure

When some components of the engine show bearing 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. Refer to the Systems Operation/Testing and Adjusting manual.

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Engine Misfires, Runs Rough or Is Unstable

SMCS Code: 1000-038; 1901-038

Note: If the symptom is intermittent and the symptom cannot be repeated, refer to Troubleshooting, "Intermittent Low Power or Power Cutout". If the symptom is consistent and the symptom can be repeated, continue with this procedure.

Probable Causes

- Diagnostic codes
- Electrical connectors
- Fuel supply
- Cold mode operation and cold cylinder cutout
- Throttle signal
- Unit injectors
- Air inlet and exhaust system

Recommended Actions

Note: If the symptom only occurs under certain operating conditions (high idle, full load, engine operating temperature, etc), test the engine under those conditions. Troubleshooting the symptom under other conditions can give misleading results.

Diagnostic Codes

Check for active diagnostic codes on Caterpillar Electronic Technician (ET). Troubleshoot any active codes before continuing with this procedure.

Electrical Connectors

Check for correct installation of the J1/P1 and J2/P2 Electronic Control Module (ECM) connectors and the unit injector connectors. Refer to Troubleshooting, "Inspecting Electrical Connectors".

Fuel Supply

Check the fuel level in the fuel tank. Ensure that adequate fuel is available for the application.

Check fuel lines for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines.

1. Check the fuel tank for foreign objects which may block the fuel supply. Check for air leaks in the suction line of the fuel pump. Prime the fuel system after you perform the following procedures:
 - Replacing the fuel filters
 - Working on the low pressure fuel supply circuit
 - Replacing fuel injectors
2. Cold weather adversely affects the characteristics of the fuel. Refer to the Operation and Maintenance Manual for information on improving the characteristics of the fuel during cold weather operation.
3. Check the fuel pressure during engine operation. Check the fuel pressure after the fuel filter. Refer to the Systems Operation/Testing and Adjusting manual for the correct pressure values. If the fuel pressure is low, replace the fuel filters. If the fuel pressure is still low, check the following items: fuel transfer pump, fuel transfer pump coupling, and fuel pressure regulating valve.

Cold Mode Operation and Cold Cylinder Cutout

Use Cat ET in order to verify that the engine has exited cold mode. During cold mode, fuel injection timing is modified. When the engine is in cold mode, the cold cylinder cutout strategy may be active. Cold mode cylinder cutouts may cause variations in vibration and available power. This is normal operation.

Throttle Signal

Monitor the throttle signal on Cat ET. Verify that the throttle signal is smooth from the low idle position to the high idle position.

Unit Injectors

1. Use Cat ET to determine if there are any active diagnostic codes for the unit injectors.
2. Perform the "Injector Solenoid Test" on Cat ET in order to determine if all of the injector solenoids are being energized by the ECM.

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3. Perform the "Cylinder Cutout Test" on Cat ET in order to identify any misfiring cylinder(s). Refer to Troubleshooting, "Injector Solenoids" for more information.

Air Inlet and Exhaust System

1. Check for an air filter restriction. Clean plugged air filters or replace plugged air filters. Refer to the Operation and Maintenance Manual.
2. If air shutoff valves are installed, verify that the air shutoff valves are fully opened.
3. Check the air inlet and exhaust system for restrictions and/or leaks. Refer to the Systems Operation/Testing and Adjusting for information on the air inlet and exhaust system.

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Engine Oil in Cooling System

SMCS Code: 1350-038; 1901-038

Probable Causes

- Engine oil cooler core
- Cylinder head gasket
- Water pump

Recommended Actions

Engine Oil Cooler Core

1. Inspect the engine oil cooler core for leaks. If a leak is found, replace the oil cooler core. Refer to Disassembly and Assembly.
2. Drain the crankcase and refill the crankcase with clean engine oil. Install new engine oil filters. Refer to Operation and Maintenance Manual.

Cylinder Head Gasket

1. Remove the cylinder head. Refer to Disassembly and Assembly.
2. Check the cylinder liner projection. Refer to Systems Operation/Testing and Adjusting.
3. Install a new cylinder head gasket and new water seals in the spacer plate. Refer to Disassembly and Assembly.

Water Pump

Check the weep hole in the water pump for blockage. Check the water pump seals.

Engine Stalls at Low RPM

SMCS Code: 1000-038; 1901-038

Probable Causes

- Unit injectors
- Fuel supply
- Air shutoff valves (if applicable) or blocked air supply
- Low engine idle
- Accessory equipment

Recommended Actions

Unit Injectors

1. Check for correct installation of the J1/P1 and J2/P2 connectors for the Electronic Control Module (ECM). Check for correct installation of the connectors for the unit injectors. Refer to Troubleshooting, "Inspecting Electrical Connectors".
2. Perform the "Injector Solenoid Test" with the Caterpillar Electronic Technician (ET) in order to determine if all of the injector solenoids are being energized by the ECM.
3. Perform the "Cylinder Cutout Test" with Cat ET in order to identify any injectors that might be misfiring. Refer to Troubleshooting, "Injector Solenoids" for the proper procedure.

Fuel Supply

1. Check the fuel pressure. Refer to the Systems Operation/Testing and Adjusting manual for the correct procedure.
2. Check the fuel lines for the following problems: restrictions, collapsed lines, and pinched lines. If problems are found with the fuel lines, repair the lines and/or replace the lines.
3. Check the fuel tank for foreign objects which may block the fuel supply.

NOTICE

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

4. Prime the fuel system if any of the following procedures have been performed:

- Replacement of the fuel filters
- Service on the low pressure fuel supply circuit
- Replacement of unit injectors

Note: A sight glass in the fuel supply line is helpful in diagnosing air in the fuel.

5. Cold weather adversely affects the characteristics of the fuel. Refer to the applicable Operation and Maintenance Manual for information on improving the characteristics of the fuel during cold weather operation.
6. Check the fuel pressure after the fuel filter while the engine is being cranked. Refer to the Systems Operation/Testing and Adjusting manual for the correct pressure values. If the fuel pressure is low, replace the fuel filters. If the fuel pressure is still low, check the following items: fuel transfer pump, fuel transfer pump coupling, and fuel pressure regulating valve.

Air Shutoff Valves (if applicable)

1. Verify that the air shutoff valves are open.
2. Check for restrictions in the air inlet system. Refer to the Systems Operation/Testing and Adjusting manual for information on the air inlet system.

Low Idle

Check the low idle setting.

Accessory Equipment

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

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Engine Will Not Crank

SMCS Code: 1000-038; 1901-038

Probable Causes

- Batteries
- Battery cables
- Starting circuit
- Starting motor solenoid

- Starting motor
- Shutdown switch
- Prelubrication system (if applicable)
- Faulty crank enable switch (if applicable)
- Flywheel ring gear
- Transmission (if applicable)
- Engine accessories
- Hydraulic cylinder lock
- Internal engine problem
- The secondary ECM is not connected to the –Battery. The yellow “SECONDARY ECM READY” indicator on the panel for the Marine Power Display (MPD) does not illuminate and the red “OVERSPEED” indicator illuminates upon an attempt to start the engine.

Recommended Actions

Batteries and/or Battery Cables

1. 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.
2. Inspect the batteries.
 - a. Charge the batteries. Refer to Special Instruction, SEHS7633, “Battery Test Procedure”.
 - b. Load test the batteries. Refer to Special Instruction, SEHS9249, “Use of 4C-4911 Battery Load Tester for 6, 8 and 12 Volt Lead Acid Batteries”.

Starting Motor Solenoid or Starting Circuit

1. Check the operation of the engine start switch. Monitor the engine start switch on Caterpillar Electronic Technician (ET).

Refer to the appropriate troubleshooting test that is applicable to your engine if repairs are required.
2. Test the operation of the starting motor solenoid.
3. Check the wiring to the starting motor solenoid.

Starting Motor or Flywheel Ring Gear

1. Test the operation of the starting motor.
2. Inspect the solenoid on the starter and the flywheel ring gear for damage.

Prelubrication System (if applicable)

If equipped, inspect the prelubrication system for proper operation.

Shutdown Switch

Use Cat ET to monitor the status of the engine. Check the status of engine shutdowns that are "ACTIVE" due to shutdown switches. Determine the cause for the engine shutdown and take the necessary action in order to resolve the shutdown.

Crank Enable Switch (if applicable)

Ensure that the crank enable switch is not faulty.

Transmission or Engine Accessories (if applicable)

1. If the engine's application has a transmission neutral switch, test the operation of the transmission neutral switch. Ensure that the machine is in neutral gear before attempting to start the engine.
2. Ensure free movement of the driveline.
3. Ensure that the timing pin was not left in the flywheel housing.
4. Remove any engine accessories that may lock up the engine and inspect any engine accessories that may lock up the engine.

The following list illustrates 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

Hydraulic Cylinder Lock

Check for fluid in the cylinders (hydraulic cylinder lock) by removing the individual unit injectors.

Note: Drain the fuel from the cylinder head. Fuel will flow from the cylinder head into the cylinders when the unit injector is removed.

Internal Engine Problem

Disassemble the engine. Refer to the Disassembly and Assembly manual. Inspect the internal components for the following conditions:

- Seizure
- Broken components
- Bent components

The Secondary ECM is Not Connected to the –Battery

If the yellow "SECONDARY ECM READY" indicator on the panel for the MPD does not illuminate and the red "OVERSPEED" indicator illuminates upon an attempt to start the engine, perform the following procedure.

1. At the power distribution panel, open the 20 Amp circuit breaker for the panel for the MPD. The MPD will turn off.
2. Reset the air shutoffs (if equipped). Cycle the power to the ECM.
3. Start the engine.
4. At the power distribution panel, close the 20 Amp circuit breaker for the panel for the MPD. The MPD will turn on.

Determine the reason for the secondary ECM to be disconnected from battery power. The secondary ECM can be connected to battery power and the engine will continue running. The yellow "SECONDARY ECM READY" indicator will illuminate on the panel for the MPD.

i02549516

Excessive Engine Oil Consumption

SMCS Code: 1300-038; 1901-038

Probable Causes

- Oil leaks
- Oil level
- Engine oil cooler
- Turbocharger

- Valve guides
- Piston rings
- Incorrect installation of the compression ring and/or the intermediate ring

Recommended Actions

Oil Leaks

Locate all oil leaks. Repair the oil leaks. Check for dirty crankcase breathers.

Oil Level

Inspect the engine oil level. Remove any extra oil from the engine. Recheck all fluid levels.

Engine Oil Cooler

Check for leaks in the engine oil cooler. Check for oil in the engine coolant. If necessary, repair the engine oil cooler.

Turbocharger

Check the air inlet manifold for oil. Check for oil leakage past the seal rings in the impeller end of the turbocharger shaft. If necessary, repair the turbocharger.

Valve Guides

If the valve guides are worn, reconditioning of the cylinder head is required.

Piston Rings

Inspect the internal engine components. Replace any worn components.

- Atmospheric pressure sensor
- “Fuel Position” and/or “FRC Fuel Limit”
- Flash file
- Fuel quality
- Valve adjustment

Recommended Actions

Air Shutoff (if applicable)

Check that both the air shutoffs are open.

Air Inlet and Exhaust System

1. Check the air inlet system for restrictions and/or for leaks.
 - a. Check for an air filter restriction.
 - b. Check for derates and for alarms.
 - c. Perform a visual inspection of the system for restrictions and/or for leaks.
2. Check the exhaust system for restrictions.
3. Repair any leaks that were found. Remove any restrictions that were found. Replace any damaged components that were found.

Fuel Injector

Check that the injector trim codes have been entered. Perform the “Cylinder Cutout Test”. Use similar conditions for the test that were experienced during operation. Refer to the diagnostic functional test Troubleshooting, “Injector Solenoids”.

Turbocharger

Verify that the turbocharger has not failed. Periodic inspection and cleaning is recommended for the turbocharger compressor housing (inlet side).

Atmospheric Pressure Sensor

1. Check the atmospheric pressure sensor for dirt and/or for debris. Remove the dirt and/or the debris. The atmospheric pressure should be between 50 kPa (7.2 psi) and 100 kPa (14.5 psi). The atmospheric pressure will vary depending on your altitude. If there is an active diagnostic code, perform the diagnostic functional test Troubleshooting, “Engine Sensor Open/Short Test”.

Excessive Black Smoke

SMCS Code: 1000-038; 1901-038

Probable Causes

- Air shutoff (if applicable)
- Air inlet and exhaust system
- Fuel injector
- Turbocharger

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2. Verify that the crankshaft and the camshaft drive gears are set with the proper orientation. Refer to the Disassembly and Assembly manual.

Turbocharger Compressor Outlet Pressure Sensor, “Fuel Position”, and/or “FRC Fuel Limit”

1. Monitor the status of “Fuel Position” and “Rated Fuel Limit” while the engine is operating under full load. If “Fuel Position” equals “Rated Fuel Limit” and “Fuel Position” is less than “FRC Fuel Limit”, the electronics are operating correctly. Otherwise, proceed to the next Step.
2. Verify that there are no active diagnostic codes for the turbocharger compressor outlet pressure sensor.
3. Monitor the status of “Turbocharger compressor outlet pressure” and “Atmospheric Pressure” for normal operation on the Caterpillar Electronic Technician (ET). When the engine is not running, “Turbocharger compressor outlet pressure” should be 0 kPa (0 psi).

Note: A problem with the FRC will only cause black smoke during acceleration. A problem with the FRC will not cause black smoke during steady state operation.

Flash File

Verify that the correct flash file is installed. Refer to Troubleshooting, “Flash Programming” for more information.

Fuel Quality

Cold weather adversely affects the characteristics of the fuel. Refer to Operation and Maintenance Manual for information on improving the characteristics of the fuel during cold weather operation.

Valve Adjustment

Check the valve adjustment. Refer to the Systems Operation/Testing and Adjusting manual for more information.

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Excessive White Smoke

SMCS Code: 1000-038; 1901-038

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

Probable Causes

- Starting aids (if applicable)
- Coolant temperature sensor
- Water temperature regulators
- Engine speed/timing sensor
- Unit injectors
- Flash file
- Fuel supply
- Component wear
- Cooling system

Recommended Actions

Starting Aids (if applicable)

1. If equipped, check for proper operation of installed starting aids.
 - a. Ensure that the ether canister is not empty and/or low. Replace the ether canister if the ether canister is empty and/or low.
 - b. Actuate the system manually after start-up and observe results. The ether system will not operate if the coolant temperature is too high. Refer to the diagnostic functional test Troubleshooting, “Ether Injection System”.

Coolant Temperature Sensor

1. Use the Caterpillar Electronic Technician (ET) to verify that the engine has exited cold mode.
2. Compare the coolant temperature from Cat ET to the coolant temperature that is obtained from the 6V-9130 Temperature Adapter (MULTIMETER).

Water Temperature Regulators

Check the water temperature regulators for correct operation. Verify that the engine reaches full operating temperature. If the engine does not reach full operating temperature, a water temperature regulator may be stuck open. Remove the water temperature regulator and inspect the water temperature regulator. If necessary, repair the water temperature regulator and/or replace the coolant temperature regulator. Refer to the Systems Operation/Testing and Adjusting manual for the proper procedure.

Engine Speed/Timing

Check the calibration of the engine speed/timing sensor. Refer to Troubleshooting, "Engine Speed/Timing Sensor - Calibrate".

Unit Injectors

Perform the "Cylinder Cutout Test" on Cat ET in order to try to isolate any injectors that might be misfiring. Refer to Troubleshooting, "Injector Solenoids".

Flash File

Verify that the correct flash file is installed.

Fuel Supply

Check the fuel quality. Low cetane fuel can create white smoke. If necessary, replace the fuel with a higher cetane fuel. Cold weather adversely affects the characteristics of the fuel. Refer to the Operation and Maintenance Manual for information on improving the characteristics of the fuel during cold weather operation.

Check the fuel level in the fuel tank. Ensure that adequate fuel is available for the application.

Component Wear

Check the engine for the following problems: Excessive valve wear, piston wear, ring wear, liner wear, and reduced compression pressure.

Cooling System

Check for proper operation of the jacket water heater. Repair the jacket water heater or replace the jacket water heater. Check for an internal coolant leak into the cylinder and/or the exhaust. Refer to the Systems Operation/Testing and Adjusting manual for more information.

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Exhaust Temperature Is Too High

SMCS Code: 1050-038; 1901-038

Probable Causes

- Diagnostic codes
- Air inlet and exhaust system
- Air leak

Recommended Actions

Diagnostic Codes

Connect Caterpillar Electronic Technician (ET) in order to determine if any diagnostic codes for the injector solenoids are present. Check that the injector trim codes have been entered. Perform the "Injector Solenoid Test". Observe that the injector solenoids are being energized on Cat ET. Perform the "Cylinder Cutout Test". Locate the misfiring cylinder. Refer to the diagnostic functional test Troubleshooting, "Injector Solenoids".

Air Inlet and Exhaust System

1. Check the air inlet manifold pressure. Check for air inlet restrictions and/or leaks. Refer to the Systems Operation/Testing and Adjusting manual for more information.
2. Check for leaks between the exhaust manifold and the turbocharger. Check for exhaust restrictions. Refer to the Systems Operation/Testing and Adjusting manual for more information.

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Fuel Dilution of Engine Oil

SMCS Code: 1300-038; 1901-038

Probable Causes

- Leaking seals on the case of the unit injector or on the barrel of the unit injector
- Leaking seals on the fuel line adapter for the cylinder head
- Excessive leakage from the unit injector tip or breakage of the unit injector tip
- Cracked fuel supply manifold
- Leaking seal on the fuel transfer pump

Recommended Actions

Leaking Seals on the Case of the Unit Injector or on the Barrel of the Unit Injector

Look for signs of damage to the seals for the unit injectors. Replace any seals that are leaking.

Leaking Seals on the Fuel Line Adapter for the Cylinder Head

Look for signs of damage to the seals on the fuel line adapter for the cylinder head. Repair any leaking fuel lines or components and/or replace any leaking fuel lines or components.

Excessive Leakage from the Unit Injector Tip or Breakage of the Unit Injector Tip

Look for signs of damage to the unit injectors. If necessary, repair the unit injectors or replace the unit injectors.

Cracked Fuel Supply Manifold

Look for signs of damage to the fuel supply manifold.

Leaking Fuel Transfer Pump Seal

Ensure that the weep hole is not plugged. If necessary, repair the fuel transfer pump or replace the fuel transfer pump.

i02281012

Fuel in Cooling System

SMCS Code: 1350-038; 1901-038

The probable root cause is a damaged O-ring seal for a fuel injector.

Perform the following procedure:

Remove the valve cover. Remove the fuel supply. Disconnect the fuel return line from the cylinder head. Cap the fuel return connector and apply 700 kPa (102 psi) maximum air pressure to the fuel supply connector. Check for fuel leakage around each fuel injector. If leakage is present, remove the leaking fuel injector. Install a new O-ring seal onto the injector. Install the injector. Connect the fuel return line. Install the valve cover. Verify that the problem is resolved.

i02526655

Intermittent Engine Shutdown

SMCS Code: 1000-038; 1901-038

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

Probable Causes

- Engine start switch
- Engine speed/timing sensor(s)

- Electrical connections
- Fuel supply
- Engine shutdown switch (if applicable)
- Crank without injection input (if applicable)

Recommended Actions

Engine Start Switch

Check the engine start switch on Cat ET. Look for an intermittent problem in the wiring for the engine start switch.

Engine Speed/Timing Sensor

If the following diagnostic codes are applicable, check Cat ET for any logged diagnostic codes for the primary engine speed/timing sensor: 190-02, 190-03, and 190-08. If the engine is equipped with a secondary engine speed/timing sensor, check for any of the following logged diagnostic codes: 342-02, 342-03, and 342-08. Refer to the diagnostic functional test Troubleshooting, "Engine Speed/Timing Sensor".

Electrical Connectors

1. Check Cat ET for the following logged diagnostic codes: 168-01 and 168-02. Follow the battery wires from the ECM back to the battery compartment. Refer to the electrical system schematic. Inspect the wires and the power relay. Check the power to the ECM and to the ground connections. Refer to the diagnostic functional test Troubleshooting, "Electrical Power Supply".
2. Check for correct installation of the J1/P1 and J2/P2 Electronic Control Module (ECM) connectors. Refer to Troubleshooting, "Inspecting Electrical Connectors".
3. Inspect the battery wires from the ECM back to the battery compartment. Refer to the Electrical System Schematic. Inspect the wires and the power relay. Check the power and ground connections to the ECM. Refer to Troubleshooting, "Electrical Power Supply" for more information.

Fuel Supply

Check the fuel level in the fuel tank. Ensure that adequate fuel is available for the application.

Check fuel lines for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines.

1. Check the fuel tank for foreign objects which may block the fuel supply. Check for air leaks in the suction line of the fuel pump. Prime the fuel system after you perform the following procedures:
 - Replacing the fuel filters
 - Working on the low pressure fuel supply circuit
 - Replacing fuel injectors
2. Cold weather adversely affects the characteristics of the fuel. Refer to the Operation and Maintenance Manual for information on improving the characteristics of the fuel during cold weather operation.
3. Check the fuel pressure during engine operation. Check the fuel pressure after the fuel filter. Refer to the Systems Operation/Testing and Adjusting manual for the correct pressure values. If the fuel pressure is low, replace the fuel filters. If the fuel pressure is still low, check the following items: fuel transfer pump, fuel transfer pump coupling, and fuel pressure regulating valve.

Engine Shutdown Switch (if applicable)

Use Cat ET to monitor the status of the engine. Check for active shutdowns due to the engine shutdown switch. Determine the cause for the active shutdown and make any repairs necessary.

Crank Without Injection Input (if applicable)

If equipped, verify that the plug is installed for the crank without injection input. Ensure that the plug for the crank without injection input is installed securely. Refer to the diagnostic functional test Troubleshooting, "Crank without Injection Input".

i02526753

Intermittent Low Power or Power Cutout

SMCS Code: 1000-038; 1901-038

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

Probable Causes

- Fuel supply
- Derates
- Throttle signal

- Engine speed/timing sensor(s)
- Turbocharger
- Rated fuel position
- Air inlet and exhaust restrictions
- Power supply for the Electronic Control Module (ECM)
- Fuel position multiplier (if applicable)

Recommended Actions

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.

Fuel Supply

Check the fuel level in the fuel tank. Ensure that adequate fuel is available for the application.

Check fuel lines for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines.

1. Check the fuel tank for foreign objects which may block the fuel supply. Check for air leaks in the suction line of the fuel pump. Prime the fuel system after you perform the following procedures:
 - Replacing the fuel filters
 - Working on the low pressure fuel supply circuit
 - Replacing fuel injectors
2. Cold weather adversely affects the characteristics of the fuel. Refer to the Operation and Maintenance Manual for information on improving the characteristics of the fuel during cold weather operation.
3. Check the fuel pressure during engine operation. Check the fuel pressure after the fuel filter. Refer to the Systems Operation/Testing and Adjusting manual for the correct pressure values. If the fuel pressure is low, replace the fuel filters. If the fuel pressure is still low, check the following items: fuel transfer pump, fuel transfer pump coupling, and fuel pressure regulating valve.

Derate

Connect Caterpillar Electronic Technician (ET) and check for an active derate event. A derate status flag will appear on Cat ET if an active engine derate is occurring. In order to view active events, go to the "Events" menu under "Diagnostics".

Throttle Signal

Use Cat ET in order to monitor the status of the throttle. Observe the throttle position. Verify that the throttle position is smooth from low idle to high idle. The throttle position should reach 100 percent at high idle.

Engine Speed/Timing Sensor(s)

If the following diagnostic codes are applicable, check Cat ET for any logged diagnostic codes for the primary engine speed/timing sensor: 190-02, 190-03, and 190-08. If the engine is equipped with a secondary engine speed/timing sensor, check for any of the following logged diagnostic codes: 342-02, 342-03, and 342-08. Refer to the diagnostic functional test Troubleshooting, "Engine Speed/Timing Sensor".

Turbocharger

Ensure that the turbocharger is operating correctly. Periodic inspection and cleaning is recommended for the turbocharger compressor housing (inlet side).

Rated Fuel Position

Operate the engine under full load. Use Cat ET in order to monitor the following values: turbocharger compressor outlet pressure, fuel position, rated fuel position, and Fuel Ratio Control (FRC). The fuel position should equal the rated fuel position. The FRC fuel position should be greater than the rated fuel position.

If any of the above values are changing rapidly for no apparent reason, there may be an intermittent problem with the wiring. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

Air Inlet and Exhaust Restrictions

Check the air inlet system for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines.

Check for an air filter restriction indicator. Replace plugged air filters and/or clean filters. Repair any leaks.

ECM Power Supply

1. Inspect the circuit between the ECM and the batteries. Refer to the Electrical System Schematic. Inspect the wires, the connectors, and the components in the circuit. Refer to Troubleshooting, "Electrical Power Supply" for more information.
2. Inspect the circuit between the ECM and the keyswitch. Refer to the Electrical System Schematic. Inspect the wires, the connectors, and the components in the circuit. Refer to Troubleshooting, "Electrical Power Supply" for more information.

Fuel Position Multiplier (if applicable)

If equipped, use Cat ET to verify that the fuel position multiplier is not affecting the available fuel rack. Refer to the diagnostic procedure Troubleshooting, "Fuel Position Multiplier".

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Low Engine Oil Pressure

SMCS Code: 1300-038; 1901-038

NOTICE

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

Probable Causes

- Low engine oil level
- Dirty engine oil filters
- Restriction at engine oil pump
- Restriction in engine oil cooler(s)
- Fuel dilution of engine oil
- Camshaft and/or camshaft bearings
- Crankshaft bearings

Recommended Actions

Engine Oil Level

Inspect the engine oil level. If engine oil is low add engine oil.

Oil Filter

Inspect the engine oil filter. If the engine oil filter is dirty, install a new engine oil filter. Check the operation of bypass valve for the filter. Clean the bypass valve and the housing. If necessary, install new parts.

Engine Oil Pump

Check for blockage of the inlet screen in the engine oil pump. Examine the engine oil pump for excessive wear.

Oil Cooler

Inspect the engine's oil cooler. Clean the engine oil cooler core(s) and/or install new engine oil cooler core(s).

Fuel Dilution of Engine Oil

Check for presence of fuel in lubricating oil. Refer to the diagnostic procedure Troubleshooting, "Fuel Dilution of Engine Oil".

Camshaft and/or Crankshaft

Inspect the camshaft and/or camshaft bearings. Check the components for excessive wear. Excessive wear is an indication of a blocked oil passage. Inspect the crankshaft and/or crankshaft bearings. Check the components for excessive wear.

i02526779

Low Power/Poor or No Response to Throttle

SMCS Code: 1000-038; 1901-038

Probable Causes

- Fuel supply
- Derate mode
- Cold mode operation and cold cylinder cutout
- Throttle signal
- Electrical connectors
- Injector
- Fuel Ratio Control Limit (FRC)
- Air inlet restriction

- Exhaust restrictions
- Electronic Control Module (ECM)
- Fuel position multiplier (if applicable)
- Air shutoff valve (if applicable)

Recommended Actions

Fuel Supply

Check the fuel level in the fuel tank. Ensure that adequate fuel is available for the application.

Check fuel lines for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines.

1. Check the fuel tank for foreign objects which may block the fuel supply. Check for air leaks in the suction line of the fuel pump. Prime the fuel system after you perform the following procedures:
 - Replacing the fuel filters
 - Working on the low pressure fuel supply circuit
 - Replacing fuel injectors
2. Cold weather adversely affects the characteristics of the fuel. Refer to the Operation and Maintenance Manual for information on improving the characteristics of the fuel during cold weather operation.
3. Check the fuel pressure during engine operation. Check the fuel pressure after the fuel filter. Refer to the Systems Operation/Testing and Adjusting manual for the correct pressure values. If the fuel pressure is low, replace the fuel filters. If the fuel pressure is still low, check the following items: fuel transfer pump, fuel transfer pump coupling, and fuel pressure regulating valve.

Derate Mode

Connect Cat ET and check for logged derate events. A derate status flag will appear on Cat ET if an active engine derate is occurring. The engine speed might be limited due to one of the following possible causes: altitude, high exhaust temperatures, air filter restriction, high coolant temperature, aftercooler water temperature, and crankcase pressure.

Cold Mode Operation and Cold Cylinder Cutout

Use the Caterpillar Electronic Technician (ET) in order to verify that the engine has exited cold mode. During cold mode, fuel injection timing is modified. When the engine is in cold mode, the cold cylinder cutout strategy may be active. Cold mode cylinder cutouts may cause variations in vibration and available power. This is normal operation.

Throttle Signal

Use Cat ET in order to monitor the status of the throttle. Observe the throttle position. Verify that the throttle position is smooth from low idle to high idle. The throttle position should reach 100 percent at high idle.

Electrical Connector

Check for the correct installation of the ECM connector(s) J1/P1 and/or J2/P2. Check for correct installation of the applicable fuel Injector connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

Injector

Use Cat ET to determine if any active diagnostic codes are present. Check that the injector trim codes have been entered. Use Cat ET to determine if any logged diagnostic codes are present. Perform the "Injector Solenoid Test". Observe that the solenoids for the injectors are being energized on Cat ET. Perform the "Cylinder Cutout Test". Locate the misfiring cylinder. Refer to the diagnostic functional test Troubleshooting, "Injector Solenoids".

Fuel Ratio Control Limit (FRC)

Operate the engine under full load. Use Cat ET in order to monitor the following values: turbocharger compressor outlet pressure, fuel position, rated fuel position, and Fuel Ratio Control (FRC). The fuel position should equal the rated fuel position. The FRC fuel position should be greater than the rated fuel position.

If any of the above values are changing rapidly for no apparent reason, there may be an intermittent problem with the wiring. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

Air Inlet Restriction

Check for an air filter restriction indicator. Replace plugged air filters and/or clean the filters. Repair any leaks.

Check the air inlet system for the following problems: restrictions, collapse, pinched line, and loose fittings. Repair the lines and/or replace the lines.

Exhaust Restrictions

Check the exhaust system for the following problems: restrictions, collapse, pinched line, and loose fittings. Repair the lines and/or replace the lines.

Electronic Control Module (ECM)

If you have replaced the ECM, check the read/change system configuration parameters. Verify that the parameters match the information on the engine information plate. Verify that the correct flash file has been installed.

Fuel Position Multiplier (if applicable)

If equipped, use Cat ET to verify that the fuel position multiplier is not affecting the available fuel rack. Refer to Troubleshooting, "Fuel Position Multiplier" if a problem is suspected with the input for the fuel position multiplier.

Air Shutoff Valve (if applicable)

Check that both of the air shutoffs are open.

i02549632

Mechanical Noise (Knock) in Engine

SMCS Code: 1000-038; 1901-038

Probable Causes

- Faulty accessory
- Damage to valve train components
- Failure of connecting rod bearing
- Crankshaft bearings

Recommended Actions

Faulty Accessory

Isolate the source of the noise. Remove the suspect engine accessories. Inspect the suspect engine accessories. Repair the engine accessories and/or replace the engine accessories.

Damage to Valve Train Components

Remove the valve cover from the suspect cylinder(s). Check the following items for damage: camshaft, valve rotocoil, valve springs, lifters, pushrods, bridges, and injectors. Check for valves that do not move freely. Remove the cylinder head and inspect the valves. Replace any damaged parts. If damage has occurred, clean the following components: cylinder liner, piston, and exhaust system. Replace any damaged parts.

Failure of Connecting Rod Bearing

Inspect the connecting rod bearings and the bearing surfaces (journals) on the crankshaft. Check the piston pin for excessive wear. Replace any damaged parts.

Crankshaft Bearings

Check the crankshaft and/or crankshaft bearings. Check the components for excessive wear.

i02421025

Noise Coming from Cylinder

SMCS Code: 1000-038; 1290-038

Probable Causes

- Low quality fuel
- Engine speed/timing sensor
- Electrical connectors
- Injector
- Not enough lubrication
- Too much valve lash
- Damage to valve train components
- Failure of connecting rod bearing

Recommended Actions

Low Quality Fuel

Refer to Operation and Maintenance Manual for information on the proper characteristics of the fuel. Obtain a fuel analysis.

Engine Speed/Timing Sensor

Calibrate the engine speed/timing sensor if a CID-FMI 261-13 Engine Timing calibration required diagnostic code is active. Refer to the calibration procedure Troubleshooting, "Engine Speed/Timing Sensor - Calibrate".

Electrical Connectors

Check for the correct installation of the connector(s) for the Electronic Control Module (ECM) J1/P1 and/or J2/P2. Check for correct installation of the applicable fuel injector connectors. Repair the connector and/or replace the connector. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

Injector

Use Caterpillar Electronic Technician (ET) to determine if any diagnostic codes for the injector solenoids are present. Perform the "Injector Solenoid Test". Observe that the injector solenoids are being energized on Cat ET. Perform the "Cylinder Cutout Test". Locate the misfiring cylinder. Refer to the diagnostic functional test Troubleshooting, "Injector Solenoids".

Not Enough Lubrication

Check the lubrication in the valve compartment. Check for sufficient lubrication between the injector tappet and the rocker arm buttons. Check for blocked oil passages. Oil passages must be clean. Ensure that the oil passages that send oil to the cylinder heads are clean.

Valve Lash

Check the valve lash. Refer to the diagnostic procedure Troubleshooting, "Too Much Valve Lash".

Damage to Valve Train Components

Remove the valve cover from the suspect cylinder(s). Check the following items for damage: camshaft, valve rotocoil, valve springs, lifters, pushrods, and bridges. Check for valves that do not move freely. Remove the cylinder head. Inspect the valves. Replace any damaged parts.

Failure of Connecting Rod Bearing

Inspect the connecting rod bearings and the bearing surfaces (journals) on the crankshaft. Check the piston pin for excessive wear. Replace any damaged parts.

i02526831

Poor Fuel Consumption

SMCS Code: 1000-038; 1901-038

Probable Causes

- Engine speed/timing sensor(s)
- Electrical connectors
- Injector
- Fuel supply
- Air inlet restrictions
- Exhaust restrictions
- Accessory equipment

Recommended Actions

Engine Speed/Timing Sensor(s)

Check the calibration of the engine speed/timing sensor if a CID-FMI 261-13 Engine Timing calibration required diagnostic code is active. Refer to the calibration procedure Troubleshooting, "Engine Speed/Timing Sensor - Calibrate".

Electrical Connectors

Check for the correct installation of the connectors for the Electronic Control Module (ECM) J1/P1 and/or J2/P2. Check for the correct installation of the applicable fuel injector connectors. Repair the connector and/or replace the connector. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

Injector

Check for active diagnostic codes that are associated with the circuits for the fuel injector. Check that the injector trim codes have been entered. Perform the "Injector Solenoid Test". Verify that the ECM is energizing all the injector solenoids. Refer to the diagnostic functional test Troubleshooting, "Injector Solenoids".

Fuel Supply

Check the fuel level in the fuel tank. Ensure that adequate fuel is available for the application.

Check fuel lines for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines.

1. Check the fuel tank for foreign objects which may block the fuel supply. Check for air leaks in the suction line of the fuel pump. Prime the fuel system after you perform the following procedures:
 - Replacing the fuel filters
 - Working on the low pressure fuel supply circuit
 - Replacing fuel injectors
2. Cold weather adversely affects the characteristics of the fuel. Refer to the Operation and Maintenance Manual for information on improving the characteristics of the fuel during cold weather operation.
3. Check the fuel pressure during engine operation. Check the fuel pressure after the fuel filter. Refer to the Systems Operation/Testing and Adjusting manual for the correct pressure values. If the fuel pressure is low, replace the fuel filters. If the fuel pressure is still low, check the following items: fuel transfer pump, fuel transfer pump coupling, and fuel pressure regulating valve.

Air inlet Restrictions

Inspect the engine air cleaner. Replace plugged air filters and/or clean the filters. Check the air inlet systems for restrictions and for leaks.

Exhaust Restrictions

Check the exhaust systems for restrictions and for leaks.

Accessory Equipment

Check attached accessory equipment. Ensure that the accessory equipment is not lugging down the engine.

i02048525

Secondary ECM Assumes Control

SMCS Code: 1901-038

The probable root causes are listed below:

- Battery voltage to the primary Electronic Control Module (ECM)
- Open circuit and/or short circuit condition
- Primary ECM personality module
- Injector solenoid

- Circuit breaker
1. Turn the Engine Control Switch (ECS) to the OFF/RESET position. Wait for 15 seconds. Start the engine. Observe the status screen on the Caterpillar Electronic Technician (ET). Verify the position of the ECS. If the position is indicated incorrectly, perform the diagnostic functional test Troubleshooting, "Engine Control Switch (ECS)".
 2. Check the connectors and wiring for the following problems: damage, abrasion, corrosion, and incorrect attachment. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".
 3. Refer to the diagnostic functional test Troubleshooting, "Secondary ECM/Personality Module".
 4. Use Cat ET to determine if any active diagnostic codes are present for the injector solenoids. Use Cat ET to determine if any logged diagnostic codes are present for the injector solenoids. Perform the "Injector Solenoid Test". Observe that the injector solenoids are being energized on Cat ET. Perform the "Cylinder Cutout Test". Locate the misfiring cylinder. Refer to the diagnostic functional test Troubleshooting, "Injector Solenoids".
 5. Check the circuit breaker for the ECM. Reset the circuit breaker.

i02048574

Secondary ECM Indicator Fault

SMCS Code: 1901-038

The probable causes are listed below:

- Voltage to the secondary Electronic Control Module (ECM)
 - Secondary ECM personality module
 - Open and/or short circuit condition
 - Circuit breaker for the ECM
1. Turn the Engine Control Switch (ECS) to the OFF/RESET position. Wait for 15 seconds. Start the engine. Observe the status screen on the Caterpillar Electronic Technician (ET). Verify the position of the ECS. If the position is indicated incorrectly, perform the diagnostic functional test Troubleshooting, "Engine Control Switch (ECS)".

2. Refer to the diagnostic functional test Troubleshooting, "Secondary ECM/Personality Module".
3. Check the connectors and wiring for the following problems: damage, abrasion, corrosion, and incorrect attachment. Perform the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".
4. Check the circuit breaker for the ECM. Reset the circuit breaker.

i01912685

Synchronizing Switch Not Functioning Properly

SMCS Code: 1000-038

In order to synchronize the throttle control on multiple engines, the Electronic Control Module (ECM) receives four input signals to the ECM. One of the inputs is the primary throttle signal. Another one of the inputs is the secondary throttle signal. The other two inputs are from the engine synchronization switch. These four inputs can be used to synchronize the throttle signals from multiple engines. The response from the ECM to the four input values depends on the values in the following programmable parameters.

- Number of synchronized engines
- Engine location
- Secondary throttle

The logic and wiring for synchronization is dependent upon the number of engines that are being synchronized. The ECM response is dependent on the programmed engine location. Refer to Table 14 for the engine locations that are valid for a given number of engines.

Table 14

Number of Synchronized Engines	Valid Engine Locations	Secondary Throttle
none	Port Starboard Center Engine #n	Enabled Disabled
2	Port Starboard	unavailable
3	Port Starboard Center	unavailable
4 or more	Engine #n	unavailable

In a single engine installation, there could be up to two throttle inputs. One of the inputs is the primary throttle signal. Another one of the inputs is the secondary throttle signal. The secondary throttle is activated with a single switch. Illustration 10 shows the wiring for a single engine installation.

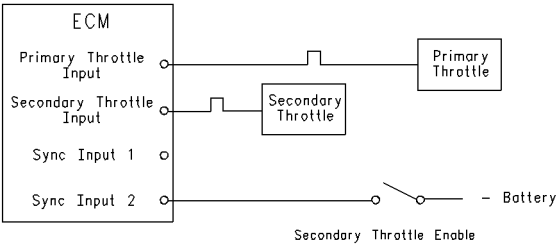


Illustration 10 g00996411
Wiring for the throttle in a single engine installation

Table 15 shows the logic for a single engine installation. If the primary throttle will be used, disable the secondary throttle by setting the parameter for the secondary throttle to the disabled position.

Table 15

Engine Synchronization Input		Active Throttle	Synchronization Status
1	2		
Open	Open	Primary	unavailable
Open	Low	Secondary	unavailable
Low	Open	Primary	unavailable
Low	Low	Primary	unavailable

In a twin engine installation, the ECM will assume that one engine is on the port side of the boat and that the other engine is on the starboard side of the boat. The ECM will label the engines as the port engine and as the starboard engine on the service tool and on the display. The operator can synchronize both engines in order to be controlled with either the port throttle or the starboard throttle. The operator could choose to not synchronize the engine throttles at all. Illustration 11 shows the wiring for twin engine installations.

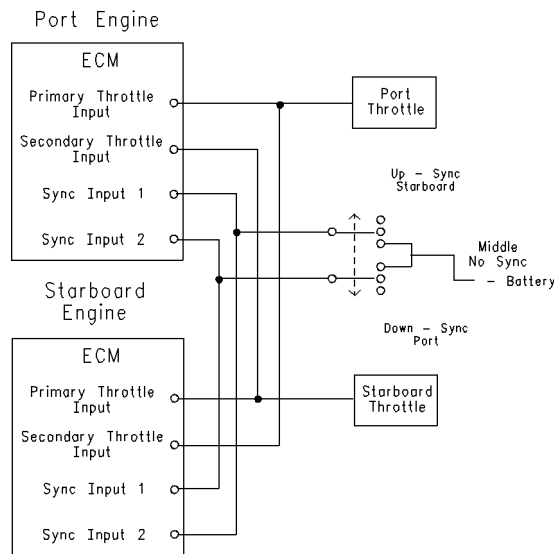


Illustration 11 g00996414

Wiring for the throttle in a twin engine installation

The logic for Illustration 11 is shown in Table 16.

Table 16

Synchronization Status		No Synchronization	Synchronization Port Side	Synchronization Starboard Side
Port	Engine Synchronization Input 1	Open	Low	Open
	Engine Synchronization Input 2	Open	Open	Low
	Active Throttle	Primary	Primary	Secondary
Starboard	Engine Synchronization Input 1	Open	Open	Low
	Engine Synchronization Input 2	Open	Low	Open
	Active Throttle	Primary	Secondary	Primary

Table 17 shows the logic for the Port side control in a twin engine installation.

Table 17

Engine Synchronization Input		Active Throttle	Port ECM Synchronization Status
1	2		
Open	Open	Primary	No Synchronization
Open	Low	Secondary	Synchronization on the Starboard side
Low	Open	Primary	Synchronization on the Port side
Low	Low	Primary	Invalid

Table 18 shows the logic for the Starboard side control in a twin engine installation.

Table 18

Engine Synchronization Input		Active Throttle	Starboard ECM Synchronization Status
1	2		
Open	Open	Primary	No Synchronization
Open	Low	Secondary	Synchronization on the Port side
Low	Open	Primary	Synchronization on the Starboard side
Low	Low	Primary	Invalid

When there are three engines in an installation, the engines will be arranged in a master-slave configuration. The user must designate the master throttle control. The user must synchronize throttle control to the master throttle control only. The user can add a fourth throttle control. The fourth throttle control can be used as the master throttle control.

Illustration 12 shows the wiring for an installation of three engines. Illustration 12 shows the center engine as the master throttle control.

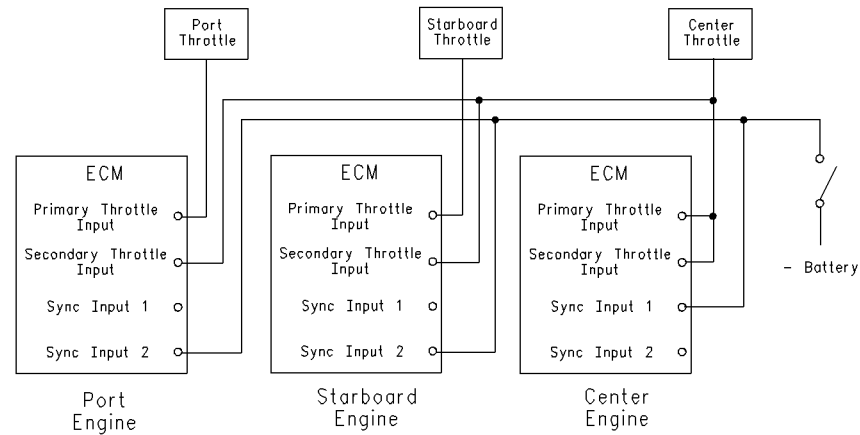


Illustration 12 g00996416
Wiring for the throttle in a triple engine installation (center as master throttle)

The logic for Illustration 12 is shown in Table 19.

Table 19

Engine Synchronization Input		No Synchronization	Synchronization
Port	Engine Synchronization Input 1	Open	Open
	Engine Synchronization Input 2	Open	Low
	Active Throttle	Primary	Secondary
Starboard	Engine Synchronization Input 1	Open	Open
	Engine Synchronization Input 2	Open	Low
	Active Throttle	Primary	Primary
Center	Engine Synchronization Input 1	Open	Low
	Engine Synchronization Input 2	Open	Open
	Active Throttle	Primary	Secondary

Illustration 13 shows the wiring for an installation of three engines. Illustration 13 shows the port engine as the master throttle control.

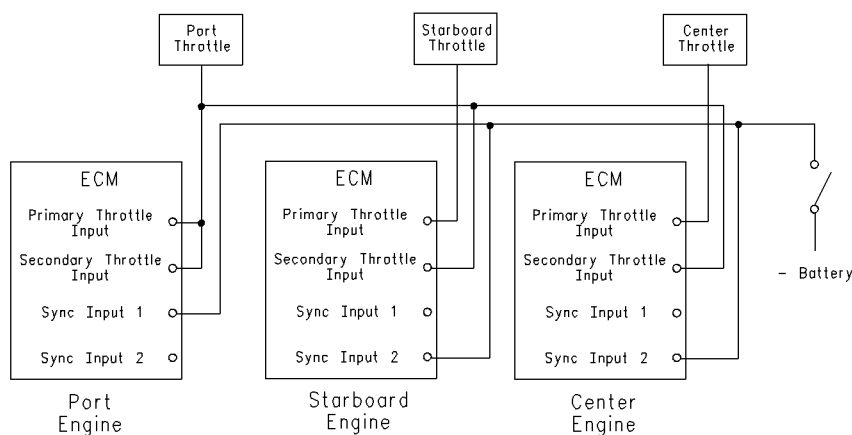


Illustration 13

g00996417

Wiring for the throttle in a triple engine installation (Port as master throttle)

The logic for Illustration 13 is shown in Table 20.

Table 20

Synchronization Status		No Synchronization	Synchronization
Port	Engine Synchronization Input 1	Open	Low
	Engine Synchronization Input 2	Open	Open
	Active Throttle	Primary	Secondary
Starboard	Engine Synchronization Input 1	Open	Open
	Engine Synchronization Input 2	Open	Low
	Active Throttle	Primary	Primary
Center	Engine Synchronization Input 1	Open	Open
	Engine Synchronization Input 2	Open	Low
	Active Throttle	Primary	Secondary

Illustration 14 shows the wiring for an installation of three engines. Illustration 14 shows the starboard engine as the master throttle control.

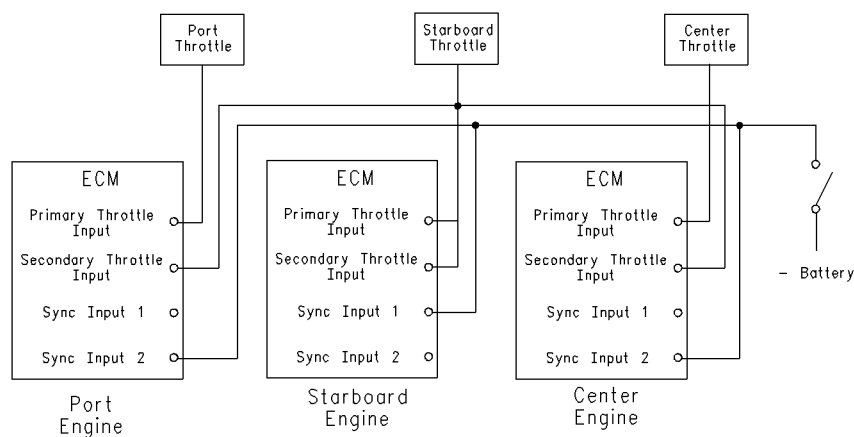


Illustration 14

g00996418

Wiring for the throttle in a triple engine installation (starboard as master throttle)

The logic for Illustration 14 is shown in Table 21.

Table 21

Synchronization Status		No Synchronization	Synchronization
Port	Engine Synchronization Input 1	Open	Open
	Engine Synchronization Input 2	Open	Low
	Active Throttle	Primary	Secondary
Starboard	Engine Synchronization Input 1	Open	Low
	Engine Synchronization Input 2	Open	Open
	Active Throttle	Primary	Primary
Center	Engine Synchronization Input 1	Open	Open
	Engine Synchronization Input 2	Open	Low
	Active Throttle	Primary	Secondary

Illustration 15 shows the wiring for an installation of three engines. Illustration 15 shows the fourth throttle as the master throttle control.

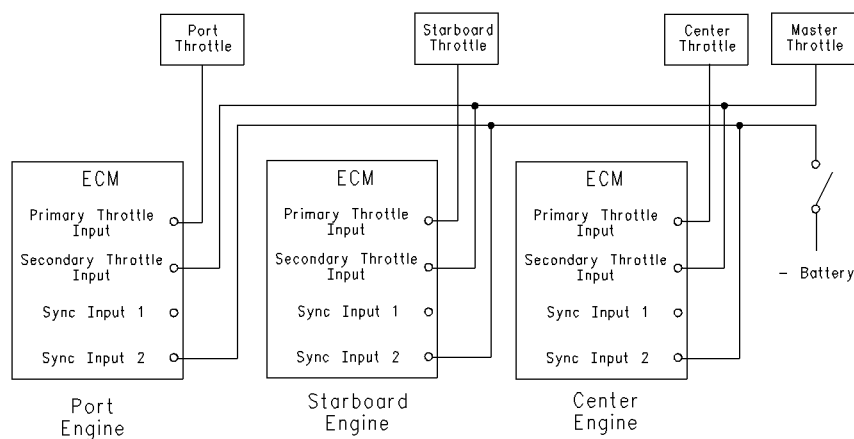


Illustration 15

g00996419

Wiring for the throttle in a triple engine installation (fourth throttle as master throttle)

The logic for Illustration 15 is shown in Table 22.

Table 22

Synchronization Status		No Synchronization	Synchronization
Port	Engine Synchronization Input 1	Open	Open
	Engine Synchronization Input 2	Open	Low
	Active Throttle	Primary	Secondary
Starboard	Engine Synchronization Input 1	Open	Open
	Engine Synchronization Input 2	Open	Low
	Active Throttle	Primary	Secondary
Center	Engine Synchronization Input 1	Open	Open
	Engine Synchronization Input 2	Open	Low
	Active Throttle	Primary	Secondary

Table 23 shows the logic for the ECM in a triple engine installation. Use the logic in Table 23 in order to synchronize multiple engines to a single throttle control.

Table 23

Engine Synchronization Input		Active Throttle	Port Starboard Center Synchronization Status (same for all)
1	2		
Open	Open	Primary	No Synchronization
Open	Low	Secondary	Synchronization
Low	Open	Primary	Synchronization
Low	Low	Primary	Invalid

If you are experiencing problems with the synchronization of the throttle controls, verify that the wiring matches the configurations for your application. Verify that the following parameters are programmed in order to match the configurations for your application.

- Number of synchronized engines
- Engine location
- Secondary throttle

The probable root causes are listed below:

- Vessel wiring
- Faulty synchronizing switch

Check the wiring for the following problems: damage, abrasion, corrosion, and incorrect attachments.

1. Check the wiring for continuity or shorts between the synchronizing switch and the ECM.
2. Check the wiring for continuity or shorts between the throttle position sensor and the ECM.
3. Check the wiring for continuity or shorts between the ECM connectors.

Check the synchronizing switch for proper operation.

1. Disconnect the wiring from the synchronizing switch.
2. Use a voltmeter to check the resistance across the contacts of the synchronizing switch as the synchronizing switch is turned to different positions.

i02549667

Too Much Valve Lash

SMCS Code: 1000-038; 1901-038

Probable Causes

- Rocker arm
- Not enough lubrication
- Worn rocker arm
- Worn bridges for valves
- Worn pushrods
- Worn valve lifters
- Worn camshaft
- Worn valve stem
- Incorrect valve lash
- Loose retaining bolt(s) for rocker shaft
- Worn valve springs
- Valve seats

Recommended Actions

Rocker Arm

Check for proper installation of the rocker arm adjustment screw locknut. If the rocker arm adjustment screw locknut is loose, adjust the valve lash.

Check the rocker arms for signs of wear. If there is too much wear, install new parts or rocker arms. Adjust the valve lash.

Not Enough Lubrication

Check the lubrication in the valve compartment. Check for sufficient lubrication between the injector tappet and the rocker arm buttons.

Worn Bridges for Valves

Check the bridges for signs of wear. Adjust the bridges and/or replace the bridges. If there is too much wear, install new parts. Adjust the valve lash.

Worn Pushrods

Inspect the pushrods for signs of wear. If there is too much wear, install new pushrods. Adjust the valve lash.

Worn Valve Lifters

Clean the valve train. Install new valve lifters.

Worn Camshaft

Check the camshaft for wear.

Worn Valve Stem

Check the valve stem for signs of wear. Check for free movement of valves. Check for a bent valve stem. Adjust the valve lash.

Loose Retaining Bolt(s) for Rocker Shaft

Repair the retaining bolt for the rocker shaft and/or replace the retaining bolt.

Worn Valve Springs

Check the valve springs for damage or for signs of wear. If there is too much wear, install new springs. Adjust the valve lash.

Valve Seats

Check the valve seats for signs of wear. If there is too much wear, install new valve seats. Adjust the valve lash.

i02304874

Too Much Vibration

SMCS Code: 1000-038; 1901-038

Probable Causes

- Vibration damper
- Loose engine supports

- Fan blade
- Misfiring cylinder
- Alignment and balance

Recommended Actions

Vibration damper

Check the vibration damper for damage. Tighten the bolts. Check the vibration damper bolt holes for damage and/or wear.

Loose engine supports

Run the engine. Check the engine for the following problems: loose mounts, broken mounts, loose brackets, and broken brackets. Tighten all mounting bolts.

Fan blade

Check the fan blade for damage. Ensure that the fan blade is balanced.

Misfiring cylinder

Check for a misfiring cylinder. Perform the Cylinder Cutout Test. Refer to the diagnostic functional test Troubleshooting, "Injector Solenoids".

Alignment and balance

Check alignment and the balance. If the symptom remains refer to the diagnostic procedure Troubleshooting, "Engine Misfires, Runs Rough or Is Unstable".

i02549674

Valve Rotocoil or Spring Lock Is Free

SMCS Code: 1109-038

Probable Causes

- Cracked inlet valve rotocoil
- Broken spring locks
- Broken valve spring(s)

Recommended Actions

Valve Rotocoil

Determine the cause of the cracked rotocoil. Install new parts.

Spring Locks

Check the locks. A broken lock can cause the valve to fall into the cylinder.

Valve Spring(s)

Install the new valve spring(s). Replace the valve and/or other damaged parts.

Troubleshooting with a Diagnostic Code

i01914069

Diagnostic Codes

SMCS Code: 1901-038

Diagnostic codes alert the operator that a problem exists. Diagnostic codes indicate the nature of the problem to the service technician. Diagnostic codes consist of the following identifiers: module identifier (MID), component identifier (CID), and failure mode identifier (FMI). The MID indicates the electronic module that generated the diagnostic code. The MID for the engine's Primary Electronic Control Module (ECM) is 36. The MID for the engine's Secondary Electronic Control Module (ECM) is 47. The CID indicates the component in the system. The FMI indicates the failure mode that is present. Diagnostic codes may be viewed on the Caterpillar Electronic Technician (ET). Do not confuse diagnostic codes with diagnostic events.

Active Diagnostic Codes

An active diagnostic code represents a problem with the electronic control system. Correct this problem as soon as possible. When an active diagnostic code is generated, a display module such as the Electronic Monitoring System (EMS) may produce a warning.

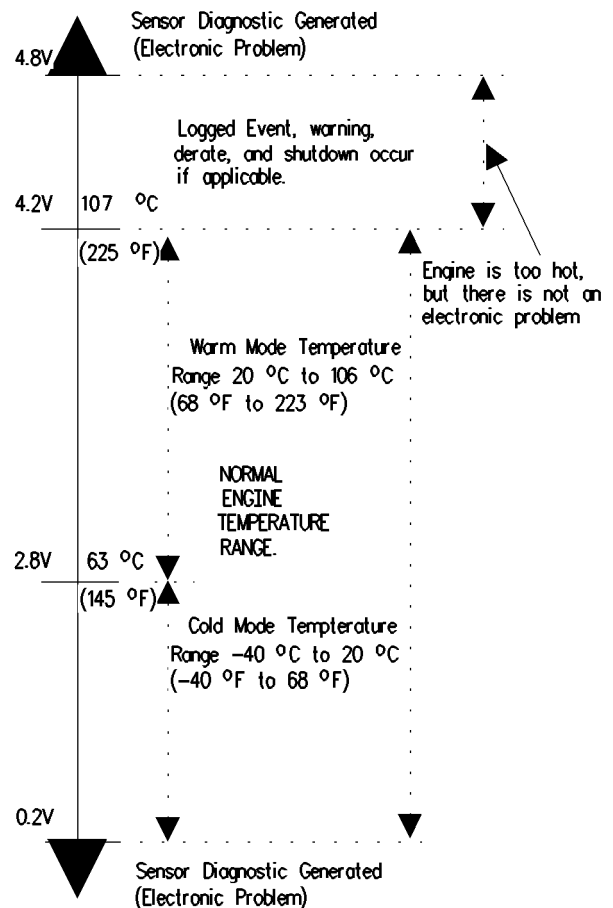


Illustration 16

g00740986

Typical example

Illustration 16 indicates a typical output voltage from the coolant temperature sensor. The Cat ET can be used to monitor the output voltage and temperature of any sensor. The Cat ET will display diagnostic codes that are associated with a sensor. As you look at Illustration 16, notice the output voltage of the sensor. A diagnostic code is generated when the ECM detects an abnormal output voltage from the sensor.

Note: Always clear logged diagnostic codes after investigating and correcting the problem which generated the code.

Logged Diagnostic Codes

When the ECM generates a diagnostic code the ECM logs the code in permanent memory. The ECM has an internal diagnostic clock. The ECM will record the hour of the first occurrence of the diagnostic code. The ECM will record the hour of the last occurrence of the diagnostic code. The ECM will record the number of occurrences of the code. This information is a valuable indicator for troubleshooting intermittent problems. Some diagnostic codes may log occurrences that did not result in complaints. The most likely cause of an intermittent problem is a faulty connection or damaged wiring. The next likely cause is a component failure. The least likely cause is the failure of the ECM. Diagnostic codes that are logged repeatedly may indicate a problem that needs special investigation.

If the symptoms continue, use the proper procedure for troubleshooting the symptoms that have been experienced by the operator.

i01954438

MID 036 - CID 0001 - FMI 05 Injector Cylinder 1 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 1 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954439

MID 036 - CID 0001 - FMI 06 Injector Cylinder 1 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 1 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954440

MID 036 - CID 0002 - FMI 05 Injector Cylinder 2 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 2 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954441

MID 036 - CID 0002 - FMI 06 Injector Cylinder 2 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 2 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954483

MID 036 - CID 0003 - FMI 05 Injector Cylinder 3 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 3 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954484

MID 036 - CID 0003 - FMI 06 Injector Cylinder 3 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 3 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954486

MID 036 - CID 0004 - FMI 05 Injector Cylinder 4 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 4 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954487

MID 036 - CID 0004 - FMI 06 Injector Cylinder 4 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 4 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954489

MID 036 - CID 0005 - FMI 05 Injector Cylinder 5 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 5 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954491

MID 036 - CID 0005 - FMI 06 Injector Cylinder 5 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 5 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954493

MID 036 - CID 0006 - FMI 05 Injector Cylinder 6 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 6 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954496

MID 036 - CID 0006 - FMI 06 Injector Cylinder 6 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 6 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954498

MID 036 - CID 0007 - FMI 05 Injector Cylinder 7 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 7 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954500

MID 036 - CID 0007 - FMI 06 Injector Cylinder 7 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 7 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954501

MID 036 - CID 0008 - FMI 05 Injector Cylinder 8 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 8 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954503

MID 036 - CID 0008 - FMI 06 Injector Cylinder 8 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 8 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954504

MID 036 - CID 0009 - FMI 05 Injector Cylinder 9 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 9 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954506

MID 036 - CID 0009 - FMI 06 Injector Cylinder 9 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 9 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954507

MID 036 - CID 0010 - FMI 05 Injector Cylinder 10 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 10 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954508

MID 036 - CID 0010 - FMI 06 Injector Cylinder 10 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or a short to ground in the No. 10 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954509

MID 036 - CID 0011 - FMI 05 Injector Cylinder 11 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 11 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954510

MID 036 - CID 0011 - FMI 06 Injector Cylinder 11 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 11 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954511

MID 036 - CID 0012 - FMI 05 Injector Cylinder 12 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 12 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954513

MID 036 - CID 0012 - FMI 06 Injector Cylinder 12 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 12 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954514

MID 036 - CID 0013 - FMI 05 Injector Cylinder 13 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 13 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954515

MID 036 - CID 0013 - FMI 06 Injector Cylinder 13 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 13 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954517

MID 036 - CID 0014 - FMI 05 Injector Cylinder 14 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 14 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954518

MID 036 - CID 0014 - FMI 06 Injector Cylinder 14 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 14 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954519

MID 036 - CID 0015 - FMI 05 Injector Cylinder 15 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 15 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954522

MID 036 - CID 0015 - FMI 06 Injector Cylinder 15 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 15 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954523

MID 036 - CID 0016 - FMI 05 Injector Cylinder 16 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 16 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954525

MID 036 - CID 0016 - FMI 06 Injector Cylinder 16 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 16 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954590

MID 036 - CID 0091 - FMI 08 Throttle Position signal abnormal

SMCS Code: 1913-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) has been powered up for three seconds. The diagnostic codes 263-03 and 263-04 are not active. The sensor frequency is greater than 1000 Hz or less than 150 Hz for two seconds. The duty cycle is greater than 95 percent or less than 5 percent for one second.

System Response:

The throttle position is set to a default value of 0 percent (low idle) by the ECM. The CID-FMI is logged in memory when the engine has been running for three seconds and the engine is not cranking.

Perform the following diagnostic procedure: "Throttle Position Sensor"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01915026

MID 036 - CID 0091 - FMI 13 Throttle Position calibration required

SMCS Code: 1913-038

Conditions Which Generate This Code:

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

- The duty cycle for the throttle position sensor signal is less than 5 percent or more than 95 percent.

This diagnostic code indicates that the throttle stops are improperly set.

System Response:

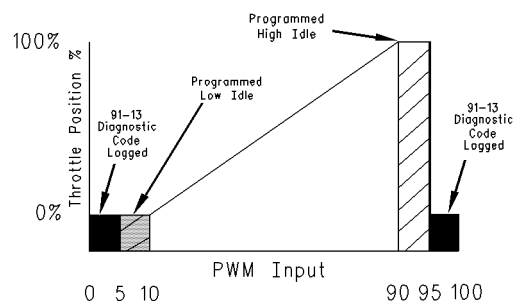


Illustration 17

g00764010

The ECM sets the desired engine speed to programmed low idle while this diagnostic code is active. The Caterpillar Electronic Technician (ET) will indicate a throttle position of 0 percent while this diagnostic code is active.

Possible Performance Effect:

The desired engine speed will return to low idle while this diagnostic code is active.

Troubleshooting:

Perform the following diagnostic procedure: "Throttle Position Sensor - Calibrate"

Results:

- OK – STOP.

i01936028

MID 036 - CID 0094 - FMI 03 Fuel Pressure open/short to +batt

SMCS Code: 1901-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is greater than 4.8 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The code is logged. The ECM flags filtered fuel pressure as invalid data and a default value of 500 kPa (73 psi) is used.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01936029

MID 036 - CID 0094 - FMI 04 Fuel Pressure short to ground

SMCS Code: 1901-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is below 0.2 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The code is logged. The ECM flags filtered fuel pressure as invalid data and a default value of 500 kPa (73 psi) is used.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954600

MID 036 - CID 0100 - FMI 03 Engine Oil Pressure open/short to +batt

SMCS Code: 1924-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is greater than 4.8 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The ECM flags engine oil pressure as invalid data and a default value of 500 kPa (73 psi) is used.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954601

MID 036 - CID 0100 - FMI 04 Engine Oil Pressure short to ground

SMCS Code: 1924-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is below 0.2 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The ECM flags engine oil pressure as invalid data and a default value of 500 kPa (73 psi) is used.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954609

MID 036 - CID 0101 - FMI 03 Crankcase Pressure open/short to +batt

SMCS Code: 1916-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is greater than 4.8 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The ECM flags crankcase pressure as invalid data. The engine monitoring system is disabled for crankcase pressure.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954610

MID 036 - CID 0101 - FMI 04 Crankcase Pressure short to ground

SMCS Code: 1916-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is less than 0.2 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The ECM flags crankcase pressure as invalid data. The engine monitoring system is disabled for crankcase pressure.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954615

MID 036 - CID 0110 - FMI 03 Engine Coolant Temperature open/short to +batt

SMCS Code: 1906-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is greater than 4.8 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The ECM flags coolant temperature as invalid data and a default value of -40 °C (-40 °F) is used.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954616

MID 036 - CID 0110 - FMI 04 Engine Coolant Temperature short to ground

SMCS Code: 1906-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is less than 0.2 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The ECM flags coolant temperature as invalid data and a default value of -40 °C (-40 °F) is used.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954667

MID 036 - CID 0168 - FMI 00 System Voltage High

SMCS Code: 1401-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) has been powered for three seconds. The engine is not cranking. The battery voltage is greater than 32 VDC for two seconds.

System Response:

The CID-FMI is logged in memory.

Perform the following diagnostic procedure:
"Electrical Power Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954670

MID 036 - CID 0168 - FMI 01 System Voltage Low

SMCS Code: 1401-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) has been powered for three seconds. The engine is not cranking. The battery voltage is less than 9 VDC for two seconds.

System Response:

The CID-FMI is logged in memory.

Perform the following diagnostic procedure:
"Electrical Power Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954671

MID 036 - CID 0168 - FMI 02 System Voltage intermittent/erratic

SMCS Code: 1401-038

Conditions Which Generate This Code:

The engine is running but not cranking. One of the following conditions exist. The battery voltage is less than 9 VDC for at least 0.06 seconds. Three times in the last seven seconds, the battery voltage was less than 9 VDC.

System Response:

The CID-FMI is logged in memory.

Perform the following diagnostic procedure:
"Electrical Power Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01935913

MID 036 - CID 0190 - FMI 02 Loss of Engine Speed signal

SMCS Code: 1912-038

Conditions Which Generate This Code:

The primary engine speed signal cannot be detected. The timing gear pattern returns within one second before being lost and the battery voltage is greater than 9 VDC for the last two seconds. The code is logged only if the engine has been running for three seconds. The code will be active and logged if the Electronic Control Module (ECM) detects an incorrect signal for one second. The battery voltage is greater than 9 VDC for the last two seconds.

System Response:

The code is logged. On engines with a secondary engine speed/timing sensor, the secondary engine speed/timing signal will be used if the primary engine speed/timing signal is lost.

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

Results:

- OK – STOP.

- REPAIRED, OK – STOP.

i01954681

MID 036 - CID 0190 - FMI 03 Engine Speed open/short to +batt

SMCS Code: 1912-038

Conditions Which Generate This Code:

A wire on the primary engine speed/timing sensor is disconnected and/or broken. There is a short circuit to the +Battery terminal.

System Response:

The CID-FMI is logged in memory. On engines with a secondary engine speed/timing sensor, the secondary engine speed/timing signal will be used if the primary engine speed/timing signal is lost.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954684

MID 036 - CID 0190 - FMI 07 Primary Speed Sensor misinstalled

SMCS Code: 1912-038

Conditions Which Generate This Code:

The primary engine speed/timing sensor is connected to the harness connector for the secondary engine speed/timing sensor.

System Response:

The CID-FMI is logged in memory.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954685

MID 036 - CID 0190 - FMI 08 Engine Speed signal abnormal

SMCS Code: 1912-038

Conditions Which Generate This Code:

The diagnostic code will become active if the following conditions exist. The engine speed is greater than 0 rpm. The primary engine speed/timing signal is incorrect.

System Response:

The code will become logged if the following conditions exist. The engine speed is greater than 0 rpm. The engine speed/timing signal is incorrect for five seconds. The engine speed/timing signal returns for five seconds.

On engines with a secondary engine speed/timing sensor, the secondary engine speed/timing signal will be used if the primary engine speed/timing signal is abnormal.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i02168582

MID 036 - CID 0248 - FMI 09 Cat Data Link not communicating

SMCS Code: 1901-038

Conditions Which Generate This Code:

The battery voltage to the Electronic Control Module (ECM) has been above 9 VDC for the last two seconds. The engine is not cranking. Communication was lost for two or more seconds.

System Response:

The CID-FMI is logged in memory.

Perform the following diagnostic procedure: "Cat Data Link"

Results:

- OK – STOP.

- REPAIRED, OK – STOP.

i01902426

MID 036 - CID 0253 - FMI 02 Personality Module mismatch

i02399280

SMCS Code: 1901-038

Conditions Which Generate This Code:

The personality module that is used for replacement is for a different engine family or a different engine application.

Note: The personality module is a flash file. The personality module is installed into the Electronic Control Module (ECM) by flash programming.

System Response:

The ECM will not log the diagnostic code. The engine will not start. The Caterpillar Electronic Technician (ET) will not be able to reset the diagnostic code.

Possible Performance Effect:

- The engine will not start.

Troubleshooting:

- Check the part number of ECM flash file. Ensure that the flash file part number agrees with the original engine arrangement.

Expected Result:

The correct flash file is installed in the ECM.

Results:

- OK – The correct flash file is installed in the ECM.

Repair: The diagnostic code 253-02 must be cleared if the correct flash file has been installed. Clearing this diagnostic code requires factory passwords. The personality module code must also be reset to zero.

STOP.

- Not OK – The correct flash file is not installed in the ECM.

Repair: Reprogram the ECM with the correct flash file. Refer to Troubleshooting, “Flash Programming”.

STOP.

MID 036 - CID 0254 - FMI 12 Electronic Control Module Error

SMCS Code: 1901-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) has detected an internal fault.

System Response:

The ECM will log the diagnostic code. Engine power and engine performance may be affected. Any normal ECM function may be affected.

Possible Performance Effect:

- Engine misfires
- Low power
- Reduced engine speed (rpm)
- Engine shutdown

Troubleshooting:

Replace the ECM. Ensure that the new ECM serial number ends with the same two characters as the original ECM serial number. Refer to Troubleshooting, “Replacing the ECM” before replacing the ECM.

Results:

- OK – STOP.

i01935923

MID 036 - CID 0261 - FMI 13 Engine Timing calibration required

SMCS Code: 1905-038

Conditions Which Generate This Code:

The engine speed/timing sensor has not been calibrated.

Note: This will not keep the engine from running. The fuel injection timing may be out of adjustment.

System Response:

The code is logged.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954690

MID 036 - CID 0262 - FMI 03 5 Volt Sensor DC Power Supply short to +batt

SMCS Code: 1408-038-NS

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads an analog sensor supply voltage above 5.2 VDC for two or more seconds. The ECM has been powered for three seconds.

Note: Normal voltage is 5.0 ± 0.2 VDC.

System Response:

The CID-FMI is logged in memory. Analog sensors are set to the default values.

Perform the following diagnostic procedure: "Analog Sensor Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954691

MID 036 - CID 0262 - FMI 04 5 Volt Sensor DC Power Supply short to ground

SMCS Code: 1408-038-NS

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads an analog sensor supply voltage below 4.8 VDC for two seconds. The ECM has been powered for three seconds.

Note: Normal voltage is 5.0 ± 0.2 VDC.

System Response:

The CID-FMI is logged in memory. The analog sensors are set to the default values.

Perform the following diagnostic procedure: "Analog Sensor Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954692

MID 036 - CID 0263 - FMI 03 Digital Sensor Supply short to +batt

SMCS Code: 1408-038-NS

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads a digital sensor supply voltage above 8.5 VDC for two seconds. The ECM has been powered for three seconds.

Note: Normal voltage is 8.0 ± 0.4 VDC.

System Response:

The CID-FMI is logged in memory.

Perform the following diagnostic procedure: "Digital Sensor Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954694

MID 036 - CID 0263 - FMI 04 Digital Sensor Supply short to ground

SMCS Code: 1408-038-NS

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads a digital sensor supply voltage below 7.5 VDC for two seconds. The ECM has been powered for three seconds.

Note: Normal voltage is 8.0 ± 0.4 VDC.

System Response:

The CID-FMI is logged in memory.

Perform the following diagnostic procedure: "Digital Sensor Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01923504

MID 036 - CID 0268 - FMI 02 Check Programmable Parameters

SMCS Code: 1901-038

Conditions Which Generate This Code:

One or more of the following programmable parameters have not been programmed:

- Engine serial number
- Full Load Setting (FLS)
- Full Torque Setting (FTS)
- Rated fuel position

System Response:

The code is logged. The engine performance and/or system operation may be affected.

- Check for parameters that have not been programmed.

Results:

- OK – A parameter has not been programmed.

Repair: Program the missing parameter. Refer to the diagnostic procedure Troubleshooting, "System Configuration Parameters".

STOP.

i02385805

MID 036 - CID 0273 - FMI 00 Turbo Outlet Pressure above normal

SMCS Code: 1052-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads turbocharger outlet pressure above 200 kPa (29 psi). The engine speed is within 50 rpm of low idle for five seconds. The diagnostic codes 262-03, 262-04, 273-03, and 273-04 are not active.

System Response:

The diagnostic code is logged in memory. The ECM flags turbocharger outlet pressure as invalid data and a default value of 0 kPa (0 psi) is used.

Possible Performance Effect:

Low power

Troubleshooting:

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01936079

MID 036 - CID 0273 - FMI 03 Turbo Outlet Pressure open/short to +batt

SMCS Code: 1052-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is greater than 4.8 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The code is logged. The ECM flags turbocharger compressor outlet pressure as invalid data and a default value of 0 kPa (0 psi) is used.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01936089

MID 036 - CID 0273 - FMI 04 Turbo Outlet Pressure short to ground

SMCS Code: 1052-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is less than 0.2 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The code is logged. The ECM flags turbocharger compressor outlet pressure as invalid data and a default value of 0 kPa (0 psi) is used.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954758

MID 036 - CID 0274 - FMI 03 Atmospheric Pressure open/short to +batt

SMCS Code: 1923-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is greater than 4.8 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The turbocharger compressor inlet pressure sensor (if equipped) is used as a backup for atmospheric pressure.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954760

MID 036 - CID 0274 - FMI 04 Atmospheric Pressure short to ground

SMCS Code: 1923-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads an atmospheric pressure signal voltage below 1.7 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The turbocharger compressor inlet pressure sensor (if equipped) is used as a backup for atmospheric pressure. The atmospheric pressure is set to a default value of 45 kPa (7 psi).

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01935990

**MID 036 - CID 0275 - FMI 03
Right Turbo Inlet Pressure
open/short to +batt****SMCS Code:** 1052-038**Conditions Which Generate This Code:**

The Electronic Control Module (ECM) reads signal voltage that is greater than 4.8 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The code is logged. The right turbocharger compressor inlet pressure is set to a default value of 45 kPa (7 psi).

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954762

**MID 036 - CID 0275 - FMI 04
Right Turbo Inlet Pressure
short to ground****SMCS Code:** 1052-038**Conditions Which Generate This Code:**

The Electronic Control Module (ECM) reads signal voltage that is less than 0.2 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The turbocharger compressor inlet pressure is set to a default value of 45 kPa (7 psi).

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i02174525

**MID 036 - CID 0276 - FMI 03
Left Turbo Inlet Pressure
open/short to +batt****SMCS Code:** 1052-038**Conditions Which Generate This Code:**

The Electronic Control Module (ECM) reads signal voltage that is greater than 4.8 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The code is logged. The left turbocharger compressor inlet pressure is set to a default value of 45 kPa (6.5 psi).

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01936097

**MID 036 - CID 0276 - FMI 04
Left Turbo Inlet Pressure short
to ground****SMCS Code:** 1052-038**Conditions Which Generate This Code:**

The Electronic Control Module (ECM) reads signal voltage that is less than 0.2 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The code is logged. The turbocharger compressor inlet pressure is set to a default value of 45 kPa (7 psi).

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01915091

MID 036 - CID 0277 - FMI 08 Timing Calibration signal abnormal

SMCS Code: 1408-038-NS

Conditions Which Generate This Code:

The engine speed is above low idle. The signal for Top Center is ± 30 degrees.

System Response:

The CID-FMI is logged in memory.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954871

MID 036 - CID 0279 - FMI 03 Aftercooler Temperature open/short to +batt

SMCS Code: 1063-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads an output voltage that is 4.8 VDC or more for one second. The ECM has been powered for three seconds. The CID-FMI 262-03 and/or the CID-FMI 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The ECM no longer optimizes engine operation according to aftercooler temperature. The ECM flags aftercooler temperature as invalid data. The engine monitoring system is disabled for aftercooler temperature.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954877

MID 036 - CID 0279 - FMI 04 Aftercooler Temperature short to ground

SMCS Code: 1063-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads an output voltage that is 0.2 VDC or less for one second. The ECM has been powered for three seconds. The CID-FMI 262-03 and/or the CID-FMI 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The ECM no longer optimizes engine operation according to aftercooler temperature. The ECM flags aftercooler temperature as invalid data. The engine monitoring system is disabled for aftercooler temperature.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954880

MID 036 - CID 0289 - FMI 03 Unfiltered Fuel Pressure open/short to +batt

SMCS Code: 1261-038-NS

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is greater than 4.8 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The ECM flags fuel pressure as invalid data. The engine monitoring system for this feature will be disabled.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954883

MID 036 - CID 0289 - FMI 04 Unfiltered Fuel Pressure short to ground

SMCS Code: 1261-038-NS

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is below 0.2 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The ECM flags unfiltered fuel pressure as invalid data. The engine monitoring system is disabled for unfiltered fuel pressure.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954884

MID 036 - CID 0336 - FMI 02 Incorrect ECS Switch inputs

SMCS Code: 1901-038

Conditions Which Generate This Code:

One line for the Engine Control Switch (ECS) is open and one line is low.

System Response:

The CID-FMI is logged in memory. The Electronic Control Module (ECM) will flag the ignition switch as invalid data.

Perform the following diagnostic procedure: "Engine Control Switch (ECS)"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954888

MID 036 - CID 0337 - FMI 02 Incorrect Remote E-Stop Switch inputs

SMCS Code: 1901-038

Conditions Which Generate This Code:

One line for the customer shutdown switch is open and one line is low.

System Response:

The CID-FMI is logged in memory.

Perform the following diagnostic procedure: "Emergency Stop Switch (Remote)"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954889

MID 036 - CID 0338 - FMI 05 Pre-Lube Relay open circuit

SMCS Code: 1319-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit at the prelube relay. The ECM detects a short to battery voltage at the prelube relay.

System Response:

The CID-FMI is logged in memory.

Perform the following diagnostic procedure: "Prelubrication System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954893

MID 036 - CID 0338 - FMI 06 Pre-Lube Relay short to ground

SMCS Code: 1319-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit at the prelube relay.

System Response:

The CID-FMI is logged in memory.

Perform the following diagnostic procedure: "Prelubrication System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954895

MID 036 - CID 0342 - FMI 02 Loss of Secondary Engine Speed signal

SMCS Code: 1912-038

Conditions Which Generate This Code:

The engine rpm signal can not be detected. The timing gear pattern returns within one second of being lost and battery voltage is greater than 9 VDC for the last two seconds. The fault is logged only if the engine has been running for three seconds. The fault will be active and logged if the Electronic Control Module (ECM) detects an incorrect signal for one second and the primary sensor signal is nominal. The primary sensor detects an engine speed that is greater than 100 rpm. The battery voltage is greater than 9 VDC for the last two seconds.

System Response:

The CID-FMI is logged in memory.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954901

MID 036 - CID 0342 - FMI 03 Secondary Engine Speed open/short to +batt

SMCS Code: 1912-038

Conditions Which Generate This Code:

A wire on the secondary engine speed/timing sensor is disconnected and/or broken. There is a short circuit to the +Battery terminal.

System Response:

The CID-FMI is logged in memory.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954905

MID 036 - CID 0342 - FMI 07 Secondary Speed Sensor misinstalled

SMCS Code: 1912-038

Conditions Which Generate This Code:

The secondary engine speed/timing sensor is connected to the harness connector for the primary engine speed/timing sensor.

System Response:

The CID-FMI is logged in memory.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954917

MID 036 - CID 0342 - FMI 08 Secondary Engine Speed signal abnormal

SMCS Code: 1912-038

Conditions Which Generate This Code:

The diagnostic code will become active if the following conditions exist. The engine speed is greater than 0 rpm. The engine speed/timing signal is incorrect. The code will become logged if the following conditions exist. The engine speed is greater than 0 rpm. The engine speed/timing signal is incorrect. The engine speed/timing signal returns after five seconds.

System Response:

The CID-FMI is logged in memory.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954916

MID 036 - CID 0444 - FMI 05 Start Relay open circuit

SMCS Code: 1426-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit and/or a short circuit to battery condition.

System Response:

The CID-FMI is logged in memory.

Perform the following diagnostic procedure: "Starting Motor System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954914

MID 036 - CID 0444 - FMI 06 Start Relay short to ground

SMCS Code: 1426-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit to ground condition.

System Response:

The CID-FMI is logged in memory.

Perform the following diagnostic procedure: "Starting Motor System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954915

MID 036 - CID 0446 - FMI 05 Air Shutoff Relay open

SMCS Code: 1078-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit and/or a short circuit to battery condition. The ECM can only detect this condition when the air shutoff relay is not energized.

System Response:

The CID-FMI is logged in memory.

Perform the following diagnostic procedure: "Air Shutoff System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954913

MID 036 - CID 0446 - FMI 06 Air Shutoff Relay short

SMCS Code: 1078-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit to ground. The ECM can only detect this condition when the air shutoff relay is not energized.

System Response:

The CID-FMI is logged in memory.

Perform the following diagnostic procedure: "Air Shutoff System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954911

MID 036 - CID 0542 - FMI 03 Unfiltered Engine Oil Pressure open/short to +batt

SMCS Code: 1924-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is greater than 4.8 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The ECM flags oil pressure as invalid data and a default value of 500 kPa (73 psi) is used.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954910

MID 036 - CID 0542 - FMI 04 Unfiltered Engine Oil Pressure short to ground

SMCS Code: 1924-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) reads signal voltage that is below 0.2 VDC for one second. The ECM has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active.

System Response:

The CID-FMI is logged in memory. The ECM flags oil pressure as invalid data and a default value of 500 kPa (73 psi) is used.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01954909

MID 036 - CID 0827 - FMI 08 Left Exhaust Temperature signal abnormal

SMCS Code: 1919-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) has been powered for three seconds. The diagnostic codes 263-03 and 263-04 are not active. The sensor frequency is greater than 1000 Hz or less than 150 Hz. The duty cycle is greater than 90 percent or less than 10 percent.

System Response:

The CID-FMI is logged in memory. The status screen on Caterpillar Electronic Technician (ET) will show the parameter as invalid data.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01936099

MID 036 - CID 0828 - FMI 08 Right Exhaust Temperature signal abnormal

SMCS Code: 1919-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) has been powered for three seconds. The diagnostic codes 262-03 and 262-04 are not active. The sensor frequency is greater than 1000 Hz or less than 150 Hz. The duty cycle is greater than 95 percent or less than 5 percent.

System Response:

The code is logged. The status screen on the Caterpillar Electronic Technician (ET) will show the parameter as invalid data.

Perform the following diagnostic procedure: "Engine Sensor Open/Short Test"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i02660170

MID 036 - CID 1249 - FMI 08 Secondary Throttle Position signal abnormal

SMCS Code: 1439-038; 1913-038-SE

Conditions Which Generate This Code:

The Electronic Control Module (ECM) has been powered up for three seconds. The sensor frequency is greater than 1000 Hz or less than 150 Hz for two seconds. The duty cycle is greater than 95 percent or less than 5 percent for one second.

System Response:

The throttle position is set to a default value of 0 percent (low idle) by the ECM. The CID-FMI is logged in memory when the engine has been running for three seconds and the engine is not cranking.

Perform the following diagnostic procedure: "Throttle Position Sensor"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i02660210

MID 036 - CID 1249 - FMI 13 Secondary Throttle Position calibration required

SMCS Code: 1439-038; 1913-038-SE

Conditions Which Generate This Code:

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

- The duty cycle for the throttle position sensor signal is less than 5 percent or more than 95 percent.

This diagnostic code indicates that the throttle stops are improperly set.

System Response:

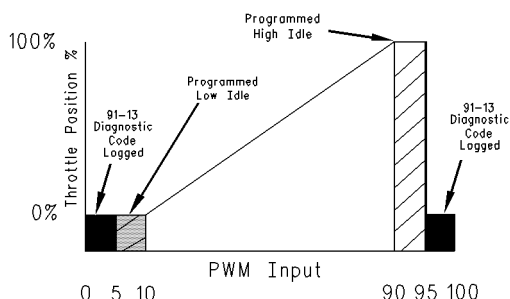


Illustration 18

g00764010

The ECM sets the desired engine speed to programmed low idle while this diagnostic code is active. The Caterpillar Electronic Technician (ET) will indicate a throttle position of 0 percent while this diagnostic code is active.

Possible Performance Effect:

The desired engine speed will return to low idle while this diagnostic code is active.

Troubleshooting:

Perform the following diagnostic procedure: "Throttle Position Sensor - Calibrate"

Results:

- OK – STOP.

i01954907

MID 036 - CID 1495 - FMI 02 Injector Trim Codes Not Programmed

SMCS Code: 1901-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects that one or more of the injector trim codes has not been programmed. The ECM has been powered for three seconds.

System Response:

The CID-FMI is logged in memory. The engine will start. The ECM will use a default setting of 0000 for an unprogrammed injector trim code.

Program the Missing Injector Trim Code(s).

- Connect the Caterpillar Electronic Technician (ET) to the service tool connector.
- Go to the calibration screen for the injector trim code(s).
- Enter the injector trim code that is stamped on the bottom of the injector for the appropriate cylinder.

Results:

- OK – The injector trim code has been entered.

Repair: After entering the injector trim code, turn the engine control to the OFF position. Leave the engine control in the OFF position for three seconds. Turn the engine control to the ON position. The diagnostic code should not be active.

STOP.

i01955123

MID 047 - CID 0001 - FMI 05 Injector Cylinder 1 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 1 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955125

MID 047 - CID 0001 - FMI 06 Injector Cylinder 1 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 1 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955127

MID 047 - CID 0002 - FMI 05 Injector Cylinder 2 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 2 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955129

MID 047 - CID 0002 - FMI 06 Injector Cylinder 2 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 2 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955130

MID 047 - CID 0003 - FMI 05 Injector Cylinder 3 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 3 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955131

MID 047 - CID 0003 - FMI 06 Injector Cylinder 3 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 3 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- REPAIRED, OK – STOP.
- OK – STOP.

i01955132

MID 047 - CID 0004 - FMI 05 Injector Cylinder 4 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 4 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955133

MID 047 - CID 0004 - FMI 06 Injector Cylinder 4 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 4 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955135

MID 047 - CID 0005 - FMI 05 Injector Cylinder 5 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 5 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955136

MID 047 - CID 0005 - FMI 06 Injector Cylinder 5 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 5 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955139

MID 047 - CID 0006 - FMI 05 Injector Cylinder 6 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 6 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955140

MID 047 - CID 0006 - FMI 06 Injector Cylinder 6 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 6 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955142

MID 047 - CID 0007 - FMI 05 Injector Cylinder 7 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 7 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955143

MID 047 - CID 0007 - FMI 06 Injector Cylinder 7 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 7 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955144

MID 047 - CID 0008 - FMI 05 Injector Cylinder 8 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 8 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955145

MID 047 - CID 0008 - FMI 06 Injector Cylinder 8 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 8 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955146

MID 047 - CID 0009 - FMI 05 Injector Cylinder 9 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 9 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955148

MID 047 - CID 0009 - FMI 06 Injector Cylinder 9 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 9 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955150

MID 047 - CID 0010 - FMI 05 Injector Cylinder 10 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 10 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955152

MID 047 - CID 0010 - FMI 06 Injector Cylinder 10 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 10 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955154

MID 047 - CID 0011 - FMI 05 Injector Cylinder 11 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 11 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955155

MID 047 - CID 0011 - FMI 06 Injector Cylinder 11 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 11 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955156

MID 047 - CID 0012 - FMI 05 Injector Cylinder 12 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 12 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955157

MID 047 - CID 0012 - FMI 06 Injector Cylinder 12 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 12 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955158

MID 047 - CID 0013 - FMI 05 Injector Cylinder 13 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 13 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955159

MID 047 - CID 0013 - FMI 06 Injector Cylinder 13 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 13 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955160

MID 047 - CID 0014 - FMI 05 Injector Cylinder 14 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 14 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955161

MID 047 - CID 0014 - FMI 06 Injector Cylinder 14 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 14 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955162

MID 047 - CID 0015 - FMI 05 Injector Cylinder 15 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 15 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955163

MID 047 - CID 0015 - FMI 06 Injector Cylinder 15 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 15 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955164

MID 047 - CID 0016 - FMI 05 Injector Cylinder 16 open circuit

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects an open circuit or short to battery voltage in the No. 16 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955166

MID 047 - CID 0016 - FMI 06 Injector Cylinder 16 short

SMCS Code: 1290-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a short circuit or short to ground in the No. 16 cylinder injector solenoid.

System Response:

The CID-FMI is logged in memory. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955201

MID 047 - CID 0190 - FMI 02 Loss of Engine Speed signal

SMCS Code: 1912-038

Conditions Which Generate This Code:

The primary engine speed signal cannot be detected. The timing gear pattern returns within one second before being lost and the battery voltage is greater than 9 VDC for the last two seconds. The fault is logged only if the engine has been running for three seconds. The fault will be active and logged if the Electronic Control Module (ECM) detects an incorrect signal for one second. The battery voltage is greater than 9 VDC for the last two seconds.

System Response:

The CID-FMI is logged in memory. If the primary engine speed/timing signal is lost, the secondary engine speed/timing signal will be used.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955209

MID 047 - CID 0190 - FMI 08 Engine Speed signal abnormal

SMCS Code: 1912-038

Conditions Which Generate This Code:

The diagnostic code will become active if the following conditions exist. The engine speed is greater than 0 rpm. The engine speed/timing signal is incorrect.

System Response:

The code will become logged if the following conditions exist. The engine speed is greater than 0 rpm. The engine speed/timing signal is incorrect for five seconds. The engine speed/timing signal returns for five seconds. When the primary engine speed/timing signal is abnormal, the secondary engine speed/timing signal will be used.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955213

MID 047 - CID 0342 - FMI 02 Loss of Secondary Engine Speed signal

SMCS Code: 1912-038

Conditions Which Generate This Code:

The secondary engine speed/timing signal cannot be detected. The timing gear pattern returns within one second of being lost and battery voltage is greater than 9 VDC for the last two seconds. The fault will be active if the Electronic Control Module (ECM) detects an incorrect signal for one second. The battery voltage is greater than 9 VDC for the last two seconds.

System Response:

The fault is logged only if the engine has been running for three seconds.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01955218

MID 047 - CID 0342 - FMI 08 Secondary Engine Speed signal abnormal

SMCS Code: 1912-038

Conditions Which Generate This Code:

The diagnostic code will become active if the following conditions exist. The engine speed is greater than 0 rpm. The engine speed/timing signal is incorrect.

System Response:

The code will become logged if the following conditions exist. The engine speed is greater than 0 rpm. The engine speed/timing signal is incorrect for five seconds. The engine speed/timing signal returns for five seconds.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

Troubleshooting with an Event Code

i01909353

Event Codes

SMCS Code: 1901-038

Use this section for the troubleshooting of problems that have generated event codes but do not have active diagnostic codes. When the event code is generated, the event is active. Any generated code becomes logged in the permanent memory of the Electronic Control Module (ECM).

Event codes alert the operator that an abnormal engine operating condition such as low oil pressure or high coolant temperature has been detected. Events do not indicate problems with the electronic system. Event codes also indicate the nature of the problem. Event codes may be viewed on a personal computer that has the software for the Caterpillar Electronic Technician (ET).

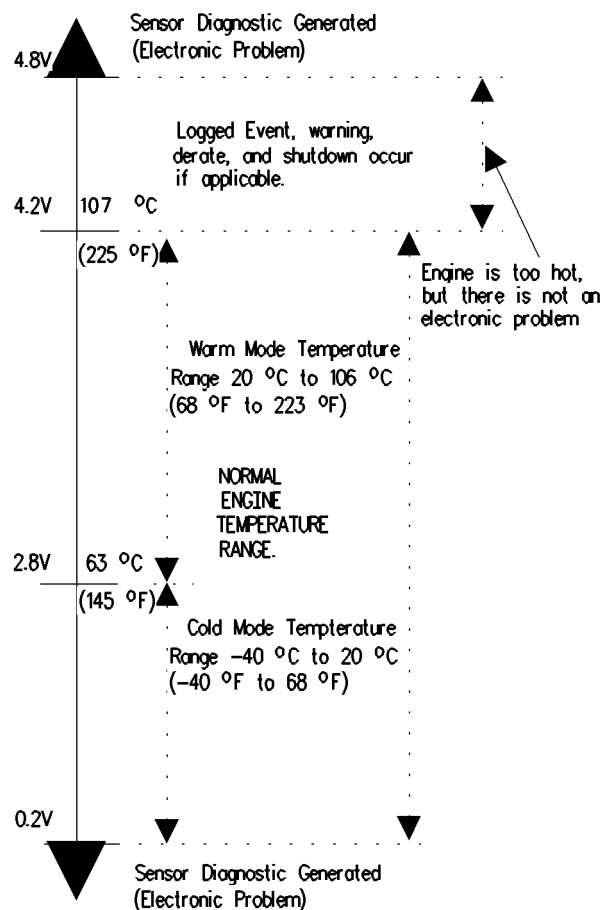


Illustration 19
Typical example

g00740986

Illustration 19 indicates output voltage from the Coolant Temperature Sensor. The Cat ET can be used to turn these features ON and OFF. When the features are turned ON, the display will appear on an electronic monitoring module and an event will also be logged in the ECM. When the features are turned OFF, the display will not appear on a monitoring module, but an Event will still be logged.

Programmable Engine Parameters

You can program the engine to perform the following actions for some applications:

- Engine Alarm

- Engine Derate
- Engine Shutdown

Table 24

3500B System Event Codes	
Event Code	Description
E007	High Aftercooler Temperature Derate
E008	High Aftercooler Temperature Shutdown
E012	High Crankcase Pressure Derate
E013	High Crankcase Pressure Shutdown
E015	High Engine Coolant Temperature Derate
E016	High Engine Coolant Temperature Shutdown
E017	High Engine Coolant Temperature Warning
E021	High Exhaust Temperature Derate
E031	Air Filter Restriction Derate
E038	Low Engine Coolant Temperature Warning
E040	Low Engine Oil Pressure Shutdown
E043	Low System Voltage Warning
E095	Fuel Filter Restriction Warning
E099	Engine Oil Filter Restriction Warning
E100	Low Engine Oil Pressure Warning
E101	High Crankcase Pressure Warning
E173	High Exhaust Temperature Warning
E190	Engine Overspeed Warning
E272	Inlet Air Restriction Warning
E279	High Aftercooler Temperature Warning

E007 High Aftercooler Temperature Derate

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- Engine coolant temperature that is greater than the default temperature of 107 °C (225 °F) for five seconds

System Response:

The event is logged. The ECM derates the engine from 0% to a maximum derate of 25% over a period of 480 seconds when the coolant temperature is above 107 °C (225 °F). The fuel limiting function will continue until the coolant temperature returns below 104 °C (219 °F) or until the maximum derate has been reached. After the temperature returns below 104 °C (219 °F) the derate due to high coolant temperature will be turned off.

Possible Performance Effect:

- Low power

Troubleshooting:

- There may be a problem with the cooling system.
- There may be a problem with the coolant temperature sensor.

Test Step 1. Check for “ACTIVE” Diagnostic Codes.

- Start the Caterpillar Electronic Technician (ET).
- Turn the main power to the ON position.
- Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.
- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Cooling System.

- A. Perform a check of the cooling system. Refer to the diagnostic procedure Troubleshooting, “Coolant Temperature is Too High” for possible causes.

Expected Result:

There are no problems with the cooling system.

Results:

- OK – There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There is a problem with the cooling system.

Repair: Repair the problem. Ensure that the repair eliminates the problem.

STOP.

i01909394

E008 High Aftercooler Temperature Shutdown

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- Engine coolant temperature that is greater than the default temperature of 107 °C (225 °F) for five seconds

System Response:

The engine will shut down after all of the conditions for shutdown are met. The event is logged.

Possible Performance Effect:

- Engine shutdown

Troubleshooting:

- There may be a problem with the cooling system.
- There may be a problem with the coolant temperature sensor.

Test Step 1. Check for “ACTIVE” Diagnostic Codes.

- A. Start the Caterpillar Electronic Technician (ET).

- B. Turn the main power to the ON position.

- C. Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.
- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Cooling System.

- A. Perform a check of the cooling system. Refer to the diagnostic procedure Troubleshooting, “Coolant Temperature is Too High” for possible causes.

Expected Result:

There are no problems with the cooling system.

Results:

- OK – There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There is a problem with the cooling system.

Repair: Repair the problem. Ensure that the repair eliminates the problem.

STOP.

i02399535

E009 High Altitude Derate

SMCS Code: 1901-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects atmospheric pressure that is less than 70 kPa

System Response:

The event is logged. The ECM limits the fuel above the default altitude of 762 m (2500 ft). The ECM will derate the engine in 3 percent increments for every 305 m (1000 ft) increase in elevation up to a maximum derate of 35 percent.

Possible Performance Effect:

- Low power

Troubleshooting:

- The engine is being operated at an altitude over 762 m (2500 ft) above sea level.
- There may be a problem with the atmospheric pressure sensor.

Check for “ACTIVE” Diagnostic Codes.

- Start the Caterpillar Electronic Technician (ET).
- Turn the main power to the ON position.
- Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. The engine is still derated.

Repair: The engine is being operated at an altitude in excess of 762 m (2500 ft) above sea level.

STOP.

- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

i01936298

E012 High Crankcase Pressure Derate

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- Crankcase pressure that is more than the default crankcase pressure of 6 kPa (24 inches of H₂O) for ten seconds

System Response:

The event is logged. The ECM limits the fuel above the default crankcase pressure of 6 kPa (24 inches of H₂O). The ECM derates the engine from 0% to a maximum derate of 15% over a period of 480 seconds when the crankcase pressure is above 6 kPa (24 inches of H₂O).

Possible Performance Effect:

- Low power

Troubleshooting:

- There may be a problem with the cooling system.
- There may be a problem with the crankcase pressure sensor.

Check for “ACTIVE” Diagnostic Codes.

- Start the Caterpillar Electronic Technician (ET).
- Turn the main power to the ON position.
- Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. The engine is still derated.

Repair: There may be a mechanical problem. Check the engine for problems.

STOP.

- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

i01909396

E013 High Crankcase Pressure Shutdown

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- Crankcase pressure that is more than the default crankcase pressure of 3.5 kPa (14 inches of H₂O) for three seconds

System Response:

The event is logged. The ECM will stop the fuel delivery to the injectors when the default crankcase pressure of 3.5 kPa (14 inches of H₂O) is exceeded.

Possible Performance Effect:

- Engine shutdown

Troubleshooting:

- There may be a problem with the cooling system.
- There may be a problem with the crankcase pressure sensor.

Check for “ACTIVE” Diagnostic Codes.

A. Start the Caterpillar Electronic Technician (ET).

B. Turn the main power to the ON position.

C. Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present.

Repair: There may be a mechanical problem. Check the engine for problems.

STOP.

- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

i01909398

E015 High Engine Coolant Temperature Derate

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- Engine coolant temperature that is greater than the default temperature of 107 °C (225 °F) for 30 seconds

System Response:

The event is logged. The ECM derates the engine from 0% to a maximum derate of 25% over a period of 480 seconds when the coolant temperature is above 107 °C (225 °F). The fuel limiting function will continue until the coolant temperature returns below 102 °C (215 °F) or until the maximum derate has been reached. After the temperature returns below 102 °C (215 °F) the derate due to high coolant temperature will be turned off.

Possible Performance Effect:

- Low power

Troubleshooting:

- There may be a problem with the cooling system.
- There may be a problem with the coolant temperature sensor.

i02399551

Test Step 1. Check for “ACTIVE” Diagnostic Codes.

- A.** Start the Caterpillar Electronic Technician (ET).
- B.** Turn the main power to the ON position.
- C.** Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.
- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Cooling System.

- A.** Perform a check of the cooling system. Refer to the diagnostic procedure Troubleshooting, “Coolant Temperature is Too High” for possible causes.

Expected Result:

There are no problems with the cooling system.

Results:

- OK – There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There is a problem with the cooling system.

Repair: Repair the problem. Ensure that the repair eliminates the problem.

STOP.

E016 High Engine Coolant Temperature Shutdown

SMCS Code: 1901-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) engine coolant temperature that is greater than the default temperature of 107 °C (225 °F) for five seconds.

System Response:

The ECM will shut down the engine after all of the conditions for shutdown are met. The event is logged.

Possible Performance Effect:

- Engine shutdown

Troubleshooting:

- There may be a problem with the cooling system.
- There may be a problem with the coolant temperature sensor.

Test Step 1. Check for “ACTIVE” Diagnostic Codes

- A.** Start the Caterpillar Electronic Technician (ET).
- B.** Restore electrical power to the ECM.
- C.** Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.
- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Cooling System

- A.** Perform a check of the cooling system. Refer to the diagnostic procedure Troubleshooting, “Coolant Temperature Is Too High” for possible causes.

Expected Result:

The cooling system is operating properly.

Results:

- OK – The cooling system is operating properly. There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There is a problem with the cooling system.

Repair: Repair the problem. Ensure that the repair eliminates the problem.

STOP.

i02399617

E017 High Engine Coolant Temperature Warning

SMCS Code: 1901-038

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects engine coolant temperature that is greater than the default temperature of 102 °C (216 °F) for five seconds.

System Response:

The event is logged. After the temperature returns below 97 °C (207 °F) the warning due to high coolant temperature will be turned off.

Possible Performance Effect:

- None

Troubleshooting:

- There may be a problem with the cooling system.
- There may be a problem with the coolant temperature sensor.

Test Step 1. Check for “ACTIVE” Diagnostic Codes.

- A.** Start the Caterpillar Electronic Technician (ET).
- B.** Turn the keyswitch to the ON position.
- C.** Check for any active diagnostic codes or for logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.
- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Cooling System.

- A.** Perform a check of the cooling system. Refer to the diagnostic procedure Troubleshooting, “Coolant Temperature is Too High” for possible causes.

Expected Result:

There are no problems with the cooling system.

Results:

- OK – There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There is a problem with the cooling system.

Repair: Repair the problem. Ensure that the repair eliminates the problem.

STOP.

i01909403

E021 High Exhaust Temperature Derate

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- Exhaust inlet temperature is greater than the default temperature of 750 °C (1382 °F) for five seconds.
- The engine has been running for three seconds.
- The diagnostic codes CID-FMI 827-08 and CID-FMI 828-08 are not active.

System Response:

The event is logged. The ECM derates the engine at 15 second intervals in 2% increments when the exhaust inlet temperature is above 750 °C (1382 °F) for 5 seconds. The fuel limiting function will continue until the exhaust temperature returns below 740 °C (1364 °F) or until the maximum derate has been reached. After the temperature returns below 740 °C (1364 °F) the derate due to a high exhaust temperature will be deactivated.

Possible Performance Effect:

- Low power

Troubleshooting:

- There may be an exhaust restriction.
- There may be an air leak.

Test Step 1. Check for “ACTIVE” Diagnostic Codes.

- Start the Caterpillar Electronic Technician (ET).
- Turn the main power to the ON position.
- Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.
- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Cooling System.

- Perform a check of the exhaust system. Refer to the diagnostic procedure Troubleshooting, “Exhaust Temperature is Too High” for possible causes.

Expected Result:

There are no problems with the exhaust system.

Results:

- OK – There are no problems with the exhaust system. There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There is a problem with the exhaust system.

Repair: Repair the problem. Ensure that the repair eliminates the problem.

STOP.

i01909427

E031 Air Inlet Restriction Derate

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- The air inlet pressure for the left turbocharger is above the default pressure of 7 kPa (28 inches of H₂O) for five seconds.
- The air inlet pressure for the right turbocharger is above the default pressure of 7 kPa (28 inches of H₂O) for five seconds.

System Response:

The event is logged. When the air inlet restriction exceeds 7 kPa (28 inches of H₂O) the ECM will derate the engine. The ECM will derate the engine in increments of 2% per 1 kPa (4 inches of H₂O) up to a maximum derate level of 25%. Air filter restriction is determined by measuring the atmospheric pressure and the turbocharger inlet pressures and calculating the difference.

Possible Performance Effect:

- Low power

Troubleshooting:

- There may be a problem with the air inlet system.
- There may be a problem with the atmospheric pressure sensor or the left or right turbocharger inlet pressure sensors.

Test Step 1. Check for “ACTIVE” Diagnostic Codes.

- A. Start the Caterpillar Electronic Technician (ET).
- B. Turn the main power to the ON position.
- C. Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.
- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Air Inlet System.

- A. Check for restrictions in the air inlet system. Refer to the Testing and Adjusting manual for information on inspecting the air inlet system.

Expected Result:

There are no problems with the air inlet system.

Results:

- OK – There are no problems with the air inlet system. There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There is a problem with the air inlet system.

Repair: Repair the problem. Ensure that the repair eliminates the problem.

STOP.

i02658702

E038 Low Engine Coolant Temperature Warning

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- The engine has been running for at least two minutes.
- Engine coolant temperature that has increased above 75 °C (167 °F)
- Engine coolant temperature that has decreased below 70 °C (158 °F) for two minutes

System Response:

The event is logged. After the temperature returns above 75 °C (167 °F) the warning due to low coolant temperature will be turned off.

Possible Performance Effect:

- None

Troubleshooting:

- There may be a problem with the coolant temperature sensor.
- Faulty water temperature regulator

- Long idle periods
- Very light loads

Test Step 1. Check for Active Diagnostic Codes

- Start the Caterpillar Electronic Technician (ET).
- Turn the keyswitch to the ON position.
- Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.
- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present.

STOP.

Test Step 2. Perform a Check of the Cooling System

- Perform a check of the cooling system. Test the water temperature regulator for proper operation. A regulator that is stuck open can cause overcooling. Coolant leaks that are around the water temperature regulator can cause overcooling. An example would be a leak in the vent line.

Note: Refer to the Systems Operation/Testing and Adjusting manual for information on testing the water temperature regulator.

Expected Result:

The water temperature regulator is operating correctly.

Results:

- OK – The water temperature regulator is operating correctly.

Repair: Cold ambient temperatures, light loads, or a slow engine speed can cause overcooling. This overcooling is caused by the low heat input of the engine.

STOP.

- Not OK – There is a problem with the water temperature regulator.

Repair: Replace the water temperature regulator.

STOP.

i01909471

E040 Low Engine Oil Pressure Shutdown

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- The engine has been running for at least ten seconds.
- Engine oil pressure is below the default trip line in Illustration 20 for an additional nine seconds.
- 100-03 "Engine Oil Pressure open/short to +batt" is not active.
- 100-04 "Engine Oil Pressure short to ground" is not active.

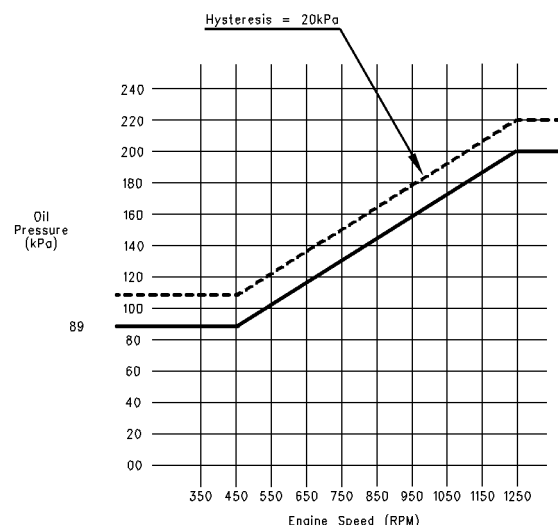


Illustration 20

Oil pressure map

g00994984

System Response:

The event is logged.

Possible Performance Effect:

- Engine shutdown

Troubleshooting:

- There may be a problem with the engine lubrication system.
- There may be a problem with the engine oil pressure sensor.

Test Step 1. Check for “ACTIVE” Diagnostic Codes.

- A. Start the Caterpillar Electronic Technician (ET).
- B. Turn the main power to the ON position.
- C. Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.
- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Engine Lubrication System.

- A. Perform a check of the engine lubrication system. Refer to the diagnostic procedure Troubleshooting, “Low Engine Oil Pressure”.

Expected Result:

There are no problems with engine oil pressure.

Results:

- OK – There are no problems with engine oil pressure. There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There are problems with engine oil pressure.

Repair: Repair the problem. Ensure that the repair eliminates the problem.

STOP.

i01909494

E043 Low System Voltage Warning

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- The ECM has been powered up for ten seconds.
- The supply voltage is below 20 VDC.

System Response:

The event is logged. If the system voltage rises above 22 VDC, the warning will become inactive.

Possible Performance Effect:

- None

Troubleshooting:

- There may be a problem with the batteries.
- There may be a problem with the electrical connections.

Test Step 1. Check for “ACTIVE” Diagnostic Codes.

- A. Start the Caterpillar Electronic Technician (ET).
- B. Turn the main power to the ON position.
- C. Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

i01909540

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.
- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Batteries.

- Measure no-load voltage at the battery posts. Refer to the Testing and Adjusting manual for the proper procedures to check the batteries.
- Load test the batteries. Use the 4C-4911 Battery Load Tester. Refer to the Operating Manual, SEHS9249. Refer to Special Instruction, SEHS7633.

Expected Result:

The no-load voltage at the batteries should be at least 23.5 VDC, and the batteries should pass the load test.

Results:

- OK – The no-load voltage at the batteries is at least 23.5 VDC, and the batteries pass the load test. There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – The no-load voltage at the batteries is less than 23.5 VDC, and/or the batteries fail the load test.

Repair: The batteries or the alternator are causing the problem. Recharge the batteries or replace the batteries. Verify that the original condition is resolved. Refer to the Testing and Adjusting manual for information on the charging system.

STOP.

E095 Fuel Filter Restriction Warning

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- The fuel filter differential pressure is above the default pressure of 105 kPa (15 psi) for the default time of five seconds.

System Response:

The event is logged. The warning for the fuel filter differential pressure becomes active when the fuel filter differential pressure exceeds the default trip point of 105 kPa (15 psi). The warning becomes inactive when the fuel filter differential pressure decreases below 95 kPa (14 psi).

Possible Performance Effect:

- None

Troubleshooting:

- There may be a problem with the fuel system.
- There may be a problem with the filtered fuel sensor or the unfiltered fuel sensor.

Test Step 1. Check for “ACTIVE” Diagnostic Codes.

- Start the Caterpillar Electronic Technician (ET).
- Turn the main power to the ON position. The engine should be OFF.
- Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.
- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Fuel System.

- A.** Check the fuel tank for foreign objects which may block the fuel supply. Check for air in the low pressure fuel supply system after you perform the following procedures:
- Replacing the fuel filters
 - Working on the low pressure fuel supply circuit
 - Replacing fuel injectors
- B.** Purge air from the low pressure fuel supply circuit with the hand priming pump and by cranking the engine in 30 second cycles. After you crank the engine, stop for two minutes. This will allow the starting motor to cool. Loosen the vent plug on the fuel return. The plug is located on the rear upper left side of the engine block. Hand prime the engine again if air in fuel continues. A sight glass in the low pressure supply line is helpful in diagnosing air in the fuel.
- C.** Check fuel quality. In temperatures below 0 °C (32 °F), check for solidified fuel (wax). Refer to Special Publication, SEBD0717, “Diesel Fuels And Your Engine”. Check the fuel pressure while the engine is cranking. Check the fuel pressure at the filter. If the pressure is low, check for plugged fuel filters. If the fuel pressure is still low, check the following items: fuel transfer pump, fuel transfer pump coupling, and fuel pressure regulating valve. Check for a combustion problem.

Expected Result:

There are no problems with the fuel system.

Results:

- OK – There are no problems with the fuel system. There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There are problems with the fuel system.

Repair: Repair the problem. Ensure that the repair eliminates the problem.

STOP.

i01909632

E099 Engine Oil Filter Restriction Warning

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- The oil filter differential pressure is above the default value of 105 kPa (15 psi) for the default time of five seconds.

System Response:

The event is logged. The warning for the oil filter differential pressure becomes active when the oil filter differential pressure exceeds the default trip point of 105 kPa (15 psi). The warning becomes inactive when the fuel filter differential pressure decreases below 95 kPa (14 psi).

Possible Performance Effect:

- None

Troubleshooting:

- There may be a problem with the oil filters.
- There may be a problem with the filtered oil sensor or the unfiltered oil sensor.

Test Step 1. Check for “ACTIVE” Diagnostic Codes.

- A.** Start the Caterpillar Electronic Technician (ET).
- B.** Turn the main power to the ON position. The engine should be OFF.
- C.** Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.

- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Lubrication System.

- A.** Check for dirty oil filters.

Expected Result:

There are problems with the oil filters.

Results:

- OK – The oil filters are dirty.

Repair: Replace the oil filters with new oil filters. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There are problems with the lubrication system.

Repair: Refer to the appropriate topic in the “Troubleshooting Without a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

i01909487

E100 Low Engine Oil Pressure Warning

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- The engine has been running for at least ten seconds.
- Engine oil pressure is below the default trip line in Illustration 21 for an additional four seconds.
- 100-03 “Engine Oil Pressure open/short to +batt” is not active.
- 100-04 “Engine Oil Pressure short to ground” is not active.

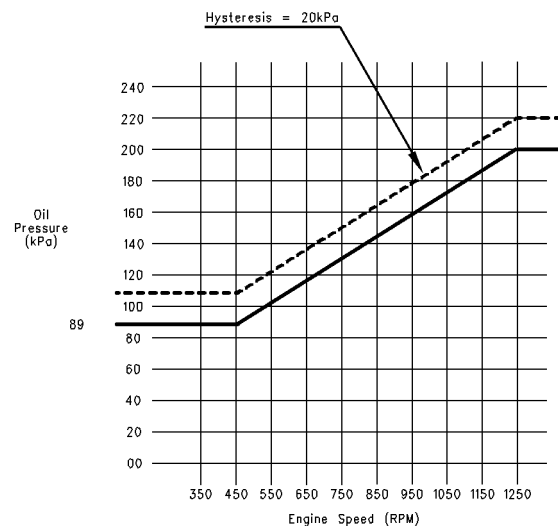


Illustration 21

Oil pressure map

g00994984

System Response:

The event is logged.

Possible Performance Effect:

- None

Troubleshooting:

- There may be a problem with the engine lubrication system.
- There may be a problem with the engine oil pressure sensor.

Test Step 1. Check for “ACTIVE” Diagnostic Codes.

- A.** Start the Caterpillar Electronic Technician (ET).
- B.** Turn the main power to the ON position.
- C.** Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.
- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Engine Lubrication System.

- A.** Perform a check of the engine lubrication system. Refer to the diagnostic procedure Troubleshooting, “Low Engine Oil Pressure”.

Expected Result:

There are no problems with engine oil pressure.

Results:

- OK – There are no problems with engine oil pressure. There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There are problems with engine oil pressure.

Repair: Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- The engine has been running for 12 seconds.
- The CID-FMI 110-03 is not active and the CID-FMI 110-04 is not active.

System Response:

The event is logged. After the crankcase pressure returns below 1.75 kPa (7 inches of H₂O) the warning due to high crankcase pressure will be turned off.

Possible Performance Effect:

- None

Troubleshooting:

- There may be a problem with the cooling system.
- There may be a problem with the crankcase pressure sensor.

Check for “ACTIVE” Diagnostic Codes

- A.** Start the Caterpillar Electronic Technician (ET).
- B.** Turn the keyswitch to the ON position.
- C.** Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present.

Repair: There may be a mechanical problem. Check the engine for problems.

STOP.

- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

i02174580

E101 High Crankcase Pressure Warning

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- Engine crankcase pressure is above the default pressure of 2 kPa (8 inches of H₂O) for the default time period of three seconds.

i01909644

E173 High Exhaust Temperature Warning

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- Exhaust inlet temperature is greater than the default temperature of 600 °C (1112 °F) for five seconds.
- The engine has been running for three seconds.
- The diagnostic codes CID-FMI 827-08 and CID-FMI 828-08 are not active.

System Response:

The event is logged. The warning is active when the exhaust inlet temperature is above 600 °C (1112 °F) for 5 seconds. After the temperature returns below 590 °C (1094 °F) the warning will become inactive. If the exhaust inlet temperature exceeds the trip point for one second, a new warning will take effect.

Possible Performance Effect:

- None

Troubleshooting:

- There may be an exhaust restriction above recommended levels.
- There may be a problem with the cooling system.
- There may be a problem with the coolant temperature sensor.

Test Step 1. Check for “ACTIVE” Diagnostic Codes.

- Start the Caterpillar Electronic Technician (ET).
- Turn the main power to the ON position.
- Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

No diagnostic codes are present.

Results:

- OK – No diagnostic codes are present. Proceed to Test Step 2.

- Not OK – Diagnostic codes are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Cooling System.

- Perform a check of the cooling system. Refer to the diagnostic procedure Troubleshooting, “Coolant Temperature is Too High” for possible causes.

Expected Result:

There are no problems with the cooling system.

Results:

- OK – There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There is a problem with the cooling system.

Repair: Repair the problem. Ensure that the repair eliminates the problem.

STOP.

i01962210

E190 Engine Overspeed Warning

SMCS Code: 1901-038

Conditions Which Generate This Code:

Engine speed is above the setpoint for engine overspeed. The default value for engine overspeed is dependent on the application. Use the Caterpillar Electronic Technician (ET) in order to monitor the system parameter for engine overspeed.

System Response:

The event is logged in memory. If the engine speed decreases 100 rpm below the default setpoint, the warning will become inactive.

Possible Performance Effect:

None

Troubleshooting:

This event indicates excessive engine speed. This does not represent a problem with the Electronic Control Module (ECM). This event does not represent a problem with the engine speed/timing sensor.

Engine Overspeed Warning

This event records the engine overspeed warning. No troubleshooting is required.

Expected Result:

Results:

- OK – STOP.

i02174584

E272 Inlet Air Restriction Warning

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- The air inlet pressure for the left turbocharger is above the default value of 7 kPa (28 inches of H₂O) for five seconds.
- The air inlet pressure for the right turbocharger is above the default value of 7 kPa (28 inches of H₂O) for five seconds.

System Response:

The ECM will log the event.

Possible Performance Effect:

- None

Troubleshooting:

- There may be a problem with the air inlet system.
- There may be a problem with one of the air inlet pressure sensors.

Test Step 1. Check for “ACTIVE” Diagnostic Codes

- A. Start the Caterpillar Electronic Technician (ET).
- B. Turn the keyswitch to the ON position. The engine should be OFF.
- C. Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

There are no diagnostic codes that are present.

Results:

- OK – There are no diagnostic codes that are present. Proceed to Test Step 2.
- Not OK – There are diagnostic codes that are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual.

Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Air Inlet System

- A. Perform a check of the air inlet system. Refer to the Testing and Adjusting manual for information on inspecting the air inlet and exhaust system.

Expected Result:

There are no problems with the air inlet system.

Results:

- OK – There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There is a problem with the air inlet system.

Repair: Repair the problem. Ensure that the repair eliminates the problem.

STOP.

i01909668

E279 High Aftercooler Temperature Warning

SMCS Code: 1901-038

Conditions Which Generate This Code:

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

- The aftercooler temperature is greater than the default temperature of 102 °C (216 °F) for five seconds.
- The diagnostic codes 279-03 and 279-04 are not active.

System Response:

The ECM will log the event. The warning is deactivated if the temperature decreases below 99 °C (210 °F).

Possible Performance Effect:

- None

Troubleshooting:

- There may be a problem with the aftercooler.
- There may be a problem with the aftercooler temperature sensor.

Test Step 1. Check for “ACTIVE” Diagnostic Codes.

- A. Start the Caterpillar Electronic Technician (ET).
- B. Turn the main power to the ON position. The engine should be OFF.
- C. Check for any Active Diagnostic Codes or Logged Diagnostic Codes.

Expected Result:

There should be no diagnostic codes that are present.

Results:

- OK – There are no diagnostic codes that are present. Proceed to Test Step 2.
- Not OK – There are diagnostic codes that are present.

Repair: Repair the diagnostic codes that are present. Refer to the appropriate topic in the “Troubleshooting With a Diagnostic Code” section of this manual. Ensure that the repair eliminates the problem.

STOP.

Test Step 2. Perform a Check of the Cooling System.

- A. Perform a check of the cooling system. Refer to the diagnostic procedure Troubleshooting, “Coolant Temperature is Too High” for possible causes.

Expected Result:

There are no problems with the cooling system.

Results:

- OK – There may be an intermittent problem.

Repair: Monitor the operation of the engine. Repair the problem. Ensure that the repair eliminates the problem.

STOP.

- Not OK – There is a problem with the cooling system.

Repair: Repair the problem. Ensure that the repair eliminates the problem.

STOP.

Diagnostic Functional Tests

i01988346

Air Shutoff System

SMCS Code: 1078-038

System Operation Description:

The secondary Electronic Control Module (ECM) has the ability to stop the engine by shutting off the inlet air supply in an emergency situation. The secondary ECM activates the output driver for the emergency shutdown system. The "ASOS" switch energizes the two air shutoff solenoids. The solenoids trip the air shutoff valves.

There are two conditions which cause the engine control to activate the output driver for the air shutoff relay. The first condition occurs when the operator activates the customer's emergency stop. When the customer's emergency stop button is activated, the emergency stop inputs U and T to the primary ECM and the secondary ECM from the customer connector go high. The secondary ECM will recognize this change. The secondary ECM will energize the output drive for the emergency shutdown system for one second through the diode assembly.

The second condition occurs for an engine overspeed. If an engine overspeed occurs, the ECM will activate the output driver for the emergency shutdown system through the diode assembly. An overspeed can be simulated by using the Caterpillar Electronic Technician (ET). In order to verify that the overspeed function is operable, the operator must access the screen for overriding parameters on Cat ET. When the override for the engine overspeed is set to the ON position, the setpoint for the engine overspeed is at 75% of the original setpoint. When the engine reaches the modified setpoint, the normal strategy for an engine overspeed is initiated.

Relay "R3A" and relay "R3" are energized through terminal 3 of the diode assembly. Terminal 3 of the diode assembly will energize relay "R3A" and relay "R3" for 1 second. The contacts of relay "R3" keeps relay "R3A" and relay "R3" energized until power is cycled. The contact of relay "R3A" keeps the coils of relay "R2" and relay "R2A" energized. When relays "R2" and "R2A" are energized, power is removed from the primary ECM and the secondary ECM. The primary ECM and the secondary ECM will power down. The injection signals to the injector solenoids will stop.

The contact of relay "R3A" also supplies power to terminal 1 of the connector for a timer and to the overspeed indicator on the instrument panel. When power is applied to terminal 1 of the connector for the timer, the timer will activate. The timer outputs 24 VDC from terminal 4 of the connector for the timer for 2.5 seconds. The 24 VDC from the timer is applied to the coil of the "ASOS" switch and to terminal 2 of the diode assembly. The "ASOS" switch energizes the two air shutoff solenoids. The solenoids trip the air shutoff valves. The 2.5 second time limit for activation of the "ASOS" switch prevents damage to the air shutoff solenoids. A normally open switch at the air shutoff valves will close when the air shutoff solenoid activates the air shutoff valve. The switch input to the primary ECM notifies the primary ECM that the air shutoff valves are closed. The ECM will not send injection signals to the injector solenoids until the switch inputs from the air shutoff valves indicate that the valves are open.

The "ASOS" switch can also be activated without the aid of the secondary ECM. When the local emergency stop switch on the instrument panel is depressed or the customer's remote emergency stop switch is activated, the coils of relay "R4" and relay "R4A" are energized. The contacts of relay "R4A" supplies power to terminal 1 of the connector for the timer and to the coils of relay "R2" and relay "R2A". When relays "R2" and "R2A" are energized, power is removed from the primary ECM and the secondary ECM. The circuit with the timer will operate in the same manner that was described above except that the emergency stop lamp on the instrument panel will illuminate and the relays "R3A" and "R3" will de-energize after 2.5 seconds. When relays "R3A" and "R3" de-energize, the overspeed indicator turns off.

Regardless of the reason for activation, the Engine Control Switch (ECS) must be turned to the OFF/RESET position for three seconds. This resets the ECM and the relays in the circuit. In addition to turning the ECS to the OFF/RESET position, the operator must determine the cause for the emergency shutdown before resetting the circuit. The operator must manually open the air shutoff valves before restarting the engine.

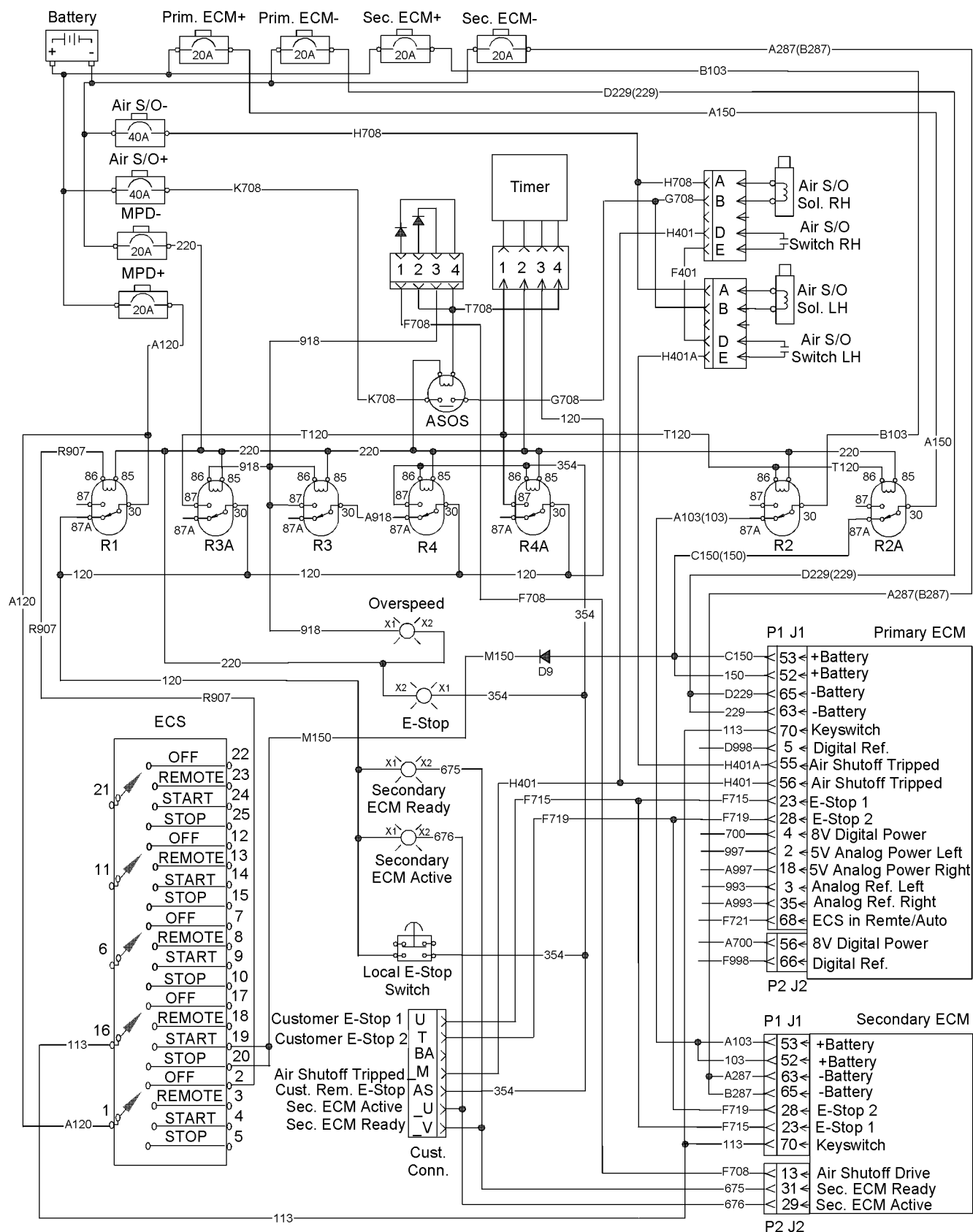


Illustration 22
Typical example

Test Step 1. Check for Connector Damage.

- A. Verify that the circuit breakers are not tripped.
- B. Turn the circuit breaker for the battery to the OFF position.
- C. Turn the ECS to the OFF/RESET position.
- D. Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details.
- E. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connectors that are associated with the circuit.
- F. Check the ECM connectors (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).
- G. Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted, and the harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring are not okay.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Test the Air Shutoff System.

- A. Turn the circuit breaker for the battery to the ON position.
- B. Turn the ECS to the STOP position. The engine should be off.
- C. Activate the customer's emergency stop switch.
- D. Monitor the air shutoff solenoids.
- E. Deactivate the customer's emergency stop switch.

Expected Result:

The air shutoff solenoids activated.

Results:

- OK – The air shutoff solenoids activated correctly.

Repair: The problem may be intermittent. If the problem is intermittent, refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

STOP.

- Not OK – The air shutoff solenoids failed to activate. Proceed to Test Step 3.

Test Step 3. Check for the Signal from the "ASOS" Switch at the Connector P-C1 for the Power Distribution Panel.

- A. Turn the ECS to the STOP position. The engine should be off.
- B. Activate the customer's emergency stop switch.
- C. Monitor the voltage on wire G708 on pin I at connector P-C1 of the rigid harness.
- D. Deactivate the customer's emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds. The circuit is operating correctly to this point. Proceed to Test Step 7.
- Not OK – The voltage did not measure 24 ± 3 VDC for approximately 2.5 seconds. Proceed to Test Step 4.

Test Step 4. Test for Voltage to the Coil of the "ASOS" Switch at the Connector P-C1 for the Power Distribution Panel.

- A. Turn the ECS to the STOP position. The engine should be off.
- B. Activate the customer's emergency stop switch.
- C. Monitor the voltage on wire F708 on pin G at connector P-C1 of the rigid harness.
- D. Deactivate the customer's emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 1 second.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 1 second. The circuit is operating correctly to this point. Proceed to Test Step 5.
- Not OK – No voltage was measured. Proceed to Test Step 14.

Test Step 5. Test for Voltage to the Coil of the “ASOS” Switch.

A. Turn the ECS to the OFF/RESET position.

B. The input to the coil of the “ASOS” switch is wire T708 from the diode assembly. Connect a voltmeter between wire T708 on the “ASOS” switch and the engine ground.

Note: The “ASOS” switch is turned on for one second by the ECM. The timer keeps the “ASOS” switch energized for approximately 2.5 seconds.

C. Turn the ECS to the STOP position. The engine should be off.

D. Activate the customer’s emergency stop switch.

E. Monitor the voltage on the voltmeter.

F. Deactivate the customer’s emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds. The circuit is operating correctly to this point. Proceed to Test Step 6.
- Not OK – No voltage was measured. Proceed to Test Step 10.
- Not OK – The voltage did not measure 24 ± 3 VDC for 2.5 seconds. Proceed to Test Step 8.

Test Step 6. Check for Voltage from the “ASOS” Switch to the Air Shutoff Solenoids.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect wire G708 from the “ASOS” switch.

C. Connect a voltmeter to the empty terminal on the “ASOS” switch. Connect the other lead of the voltmeter to engine ground.

D. Turn the ECS to the STOP position. The engine should be off.

E. Activate the customer’s emergency stop switch.

F. Monitor the voltage on the voltmeter.

G. Deactivate the customer’s emergency stop switch.

H. Reconnect wire G708 to the “ASOS” switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds. The circuit is operating correctly to this point.

Repair: Repair the wire G708 between the “ASOS” switch and terminal I at connector P-C1 of the rigid harness.

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC for approximately 2.5 seconds.

Repair: Verify that 24 ± 3 VDC is present on wire K708 at the normally open contacts of the “ASOS” switch. If voltage is not present on wire K708, check the wiring and the circuit breaker for the air shutoff for problems.

Check wire 220 on the coil of the “ASOS” switch for continuity to the –Battery. If necessary, repair the wire or replace the wire.

If wire 220 is okay and voltage is present on wire K708, replace the “ASOS” switch.

STOP.

Test Step 7. Check the Voltage at the Connector for the Air Shutoff Solenoids.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect the connector for the air shutoff solenoids. Disconnect the connector for the right and left sides of the engine.

C. Connect a voltmeter between wire G708 on the connector for the air shutoff solenoid and the engine ground.

D. Turn the ECS to the STOP position. The engine should be off.

E. Activate the customer’s emergency stop switch.

F. Monitor the voltage on the voltmeter.

G. Deactivate the customer's emergency stop switch.

H. Reconnect the connectors for the air shutoff solenoids.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds. The circuit is operating correctly to this point.

Repair: Check the wire H708 from terminal A of the connector for the air shutoff solenoid for continuity to the –Battery terminal. If the wire H708 to the –Battery terminal is okay, replace the air shutoff solenoid.

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC for approximately 2.5 seconds. System voltage was not available at the solenoid connector.

Repair: Repair the wire G708 between the connector for the air shutoff solenoids and terminal I at connector P-C1 of the rigid harness.

STOP.

Test Step 8. Check the Voltage at the Contact of Relay "R3A".

A. Turn the ECS to the OFF/RESET position.

B. Disconnect wire T120 from terminal 87 of relay "R3A".

C. Connect a voltmeter between terminal 87 of relay "R3A" and the engine ground.

D. Turn the ECS to the STOP position. The engine should be off.

E. Activate the customer's emergency stop switch.

F. Monitor the voltage on the voltmeter.

G. Deactivate the customer's emergency stop switch.

H. Reconnect wire T120.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC. Proceed to Test Step 9.
- Not OK – The voltage did not measure 24 ± 3 VDC. Proceed to Test Step 11.

Test Step 9. Check the Voltage at Terminal 4 of the Connector for the Timer.

A. Turn the ECS to the OFF/RESET position.

B. Connect a voltmeter between terminal 4 of the connector for the timer and engine ground.

C. Turn the ECS to the STOP position. The engine should be off.

D. Activate the customer's emergency stop switch.

E. Monitor the voltage on the voltmeter.

F. Deactivate the customer's emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds. Proceed to Test Step 12.
- Not OK – The voltage did not measure 24 ± 3 VDC for approximately 2.5 seconds.

Repair: Check for 24 ± 3 VDC on terminal 1 of the connector for the timer. If voltage is not present on terminal 1, repair the wire T120 between terminal 87 of relay "R3A" and terminal 1 of the connector for the timer.

If voltage is present on terminal 1 of the connector for the timer, verify that wire 220 on terminal 2 of the connector for the timer has continuity to the –Battery. If wire 220 does not have continuity to the –Battery, repair the wire.

Verify that 24 ± 3 VDC is present on terminal 3 of the connector for the timer. If 24 ± 3 VDC is not present on terminal 3 of the connector for the timer, verify that the engine control switch is not in the "OFF/RESET" position. Verify that the "MPD" breaker is not tripped. Check the normally closed contact of relay "R1" for proper operation. Check the wire 120 between terminal 3 of the connector for the timer and relay "R1" for damage. Check the wire A120 between relay "R1" and the "MPD" breaker for damage. If necessary, repair the wires.

If the voltage is present on terminal 1 and 3 of the timer and wire 220 is okay, replace the timer.

STOP.

Test Step 10. Check the Voltage at Terminal 4 of the Connector for the Diodes.

- A. Turn the ECS to the OFF/RESET position.
- B. Connect a voltmeter between terminal 4 of the connector for the diodes and the engine ground.
- C. Turn the ECS to the STOP position. The engine should be off.
- D. Activate the customer's emergency stop switch.
- E. Monitor the voltage on the voltmeter.
- F. Deactivate the customer's emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Repair: Repair the wire T708 between the connector for the diodes and the "ASOS" switch.

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC for approximately 2.5 seconds.

Repair:

1. Turn the ECS to the OFF/RESET position.
2. Connect a voltmeter between terminal 1 of the connector for the diodes and the engine ground.
3. Turn the ECS to the STOP position. The engine should be off.

4. Activate the customer's emergency stop switch.

5. Monitor the voltage on the voltmeter.

6. Deactivate the customer's emergency stop switch.

If the voltage measures 24 ± 3 VDC for approximately 1 second, replace the diodes.

If the voltage does not measure 24 ± 3 VDC for approximately 1 second, repair the wire F708 between the connector for the diodes and wire F708 on pin G at connector P-C1 of the right rail.

STOP.

Test Step 11. Check the Voltage at the Coil of Relay "R3A".

- A. Turn the ECS to the OFF/RESET position.
- B. Connect a voltmeter between wire 918 on terminal 86 of relay "R3A" and the engine ground.
- C. Turn the ECS to the STOP position. The engine should be off.
- D. Activate the customer's emergency stop switch.
- E. Monitor the voltage on the voltmeter.
- F. Deactivate the customer's emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC.

Repair: Check wire 220 on the coil of the "R3A" relay for continuity to the -Battery. If necessary, repair the wire or replace the wire.

Check for 24 ± 3 VDC on wire 120 on terminal 30 of relay "R3A". If 24 ± 3 VDC is not present on wire 120, verify that the engine control switch is not in the "OFF/RESET" position. Verify that the "MPD" breaker is not tripped. Check the normally closed contact of relay "R1" for proper operation. Check the wire 120 between terminal 30 of the relay "R3A" and relay "R1" for damage. Check the wire A120 between relay "R1" and the "MPD" breaker for damage. If necessary, repair the wires.

If wire 220 is okay and voltage is present on wire 120 on terminal 30, replace relay "R3A".

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC. Proceed to Test Step 13.

Test Step 12. Check the Voltage to Terminal 2 of the Connector for the Diodes from the Timer.

- Turn the ECS to the OFF/RESET position.
- Connect a voltmeter between the terminal 2 of the connector for the diodes and the engine ground.
- Turn the ECS to the STOP position. The engine should be off.
- Activate the customer's emergency stop switch.
- Monitor the voltage on the voltmeter.
- Deactivate the customer's emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC. Proceed to Test Step 13.
- Not OK – The voltage did not measure 24 ± 3 VDC.

Repair: Repair the wire T708 between the diodes and the timer.

STOP.

Test Step 13. Check the Voltage from Terminal 3 of the Connector for the Diode Assembly.

- Turn the ECS to the OFF/RESET position.
- Connect a voltmeter between terminal 3 of the connector for the diode assembly and the engine ground.
- Turn the ECS to the STOP position. The engine should be off.
- Activate the customer's emergency stop switch.
- Monitor the voltage on the voltmeter.
- Deactivate the customer's emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC.

Repair: Repair the wire 918 between the diodes and relay "R3A".

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC.

Repair: Replace the diodes.

STOP.

Test Step 14. Check the Output Driver for the Air Shutoff System at the ECM.

- Turn the ECS to the OFF/RESET position.
- Disconnect the secondary ECM connector J2.
- Remove wire F708 from ECM connector P2-13. Install a wire jumper into P2-13.
- Reconnect ECM connector P2.
- Connect a voltmeter between the wire jumper in P2-13 and engine ground.
- Turn the ECS to the STOP position. The engine should be off.
- Activate the customer's emergency stop switch.
- Monitor the voltage on the voltmeter.
- Deactivate the customer's emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC for one second.

Results:

- OK – The voltage measures 24 ± 3 VDC for one second.

Repair: Repair the wire F708 between the ECM connector and terminal G at connector P-C1 of the rigid harness.

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC.

Repair: Replace the ECM.

STOP.

i01900689

Analog Sensor Supply

SMCS Code: 1901-038

System Operation Description:

The analog sensor supply provides power to all analog sensors. The primary Electronic Control Module (ECM) supplies 5.0 ± 0.2 VDC from the ECM connector J1/P1 to each analog sensor connector. The sensor return line connects to the ECM connector J1/P1. The analog sensor supply is output short circuit protected. A short circuit to the battery will not damage the circuit inside the ECM.

Note: The analog sensors are not protected from overvoltage. A short from the analog supply line to the +Battery supply may damage the sensors. If CID-FMI 262-03 is logged, it is possible that all of the analog sensors have been damaged. Repair the analog sensor supply and check for any active sensor diagnostic codes in order to determine if a sensor has failed.

The ECM calibrates the sensor within the first five seconds after power is applied to the ECM. The ECM checks the sensor value against an acceptable pressure range. If the pressure value is not in this range, the previous calibration will be used. Refer to the calibration procedure Troubleshooting, "Analog Sensor - Calibrate".

The following analog sensors are found on the engine: aftercooler temperature sensor, coolant temperature sensor, filtered fuel pressure sensor, unfiltered fuel pressure sensor, filtered engine oil pressure sensor, unfiltered engine oil pressure sensor, left turbocharger compressor inlet pressure sensor, right turbocharger compressor inlet pressure sensor, turbocharger compressor outlet pressure sensor, atmospheric pressure sensor, and crankcase pressure sensor.

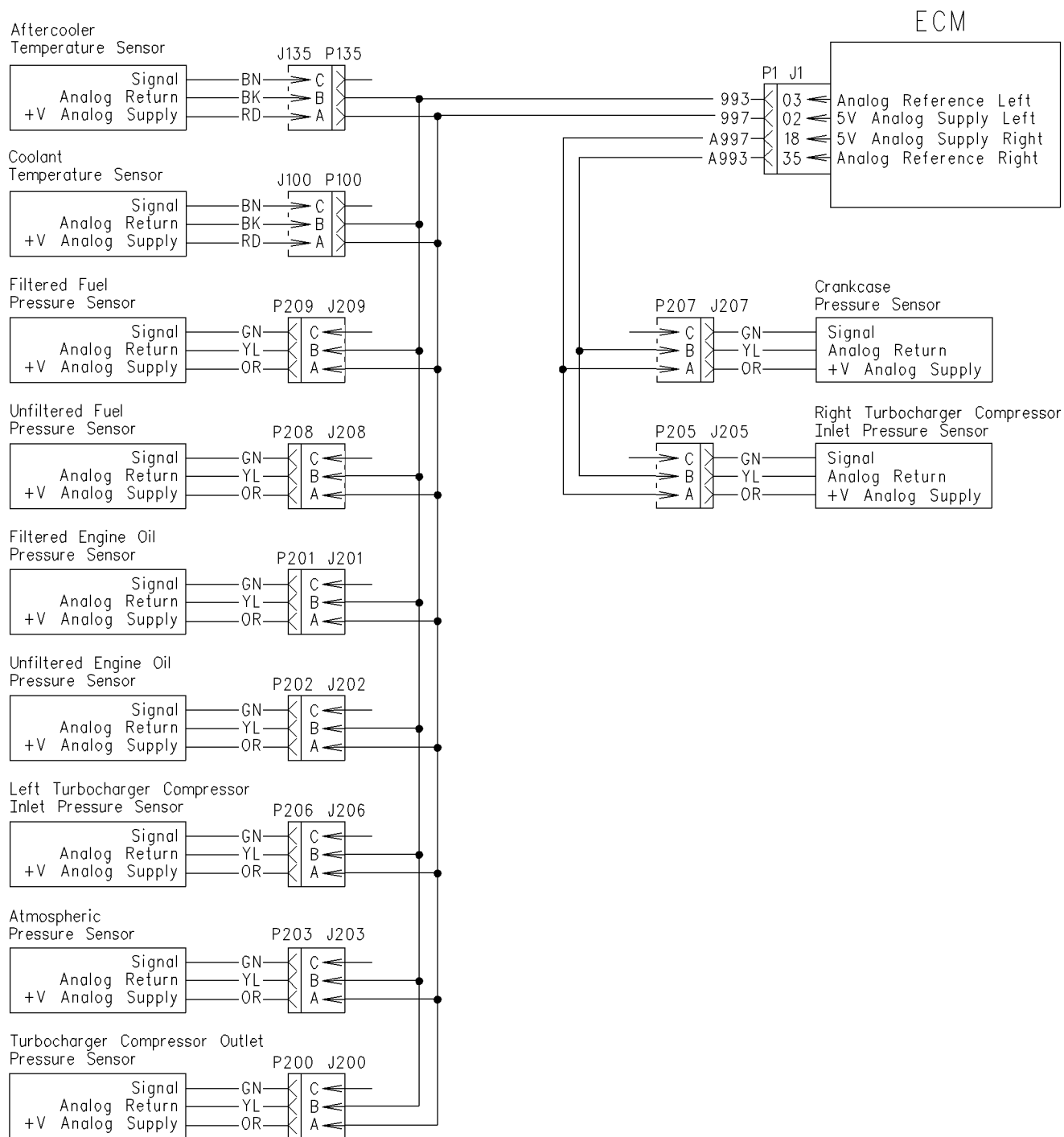


Illustration 23
Typical example

Test Step 1. Check for Connector Damage.

- A. Turn the circuit breaker for the battery to the OFF position.
- B. Turn the Engine Control Switch (ECS) to the OFF/RESET position.
- C. Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to Troubleshooting, "Inspecting Electrical Connectors" for details.
- D. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the circuit.
- E. Check the ECM connectors (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).
- F. Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted, and the harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring need repair.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Check the Harness for Shorts.

- A. Disconnect the primary ECM connector J1/P1. Disconnect all of the analog sensors.
- B. Measure the resistance between the analog supply P1-02 and the analog return P1-03.
- C. Measure the resistance between P1-18 and P1-35.
- D. Measure the resistance between P1-02 and engine ground.
- E. Measure the resistance between P1-03 and engine ground.
- F. Measure the resistance between P1-18 and engine ground.

- G. Measure the resistance between P1-35 and engine ground.

Expected Result:

The resistance is more than 20,000 Ohms for each measurement.

Results:

- OK – The resistance is more than 20,000 Ohms for each measurement. Proceed to Test Step 3.
- Not OK – The resistance is less than 20,000 Ohms for each measurement.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 3. Check the Analog Sensor Supply Voltage at the Primary ECM.

- A. Disconnect the primary ECM connector J1/P1.
 - B. Remove the wire 997 from the primary ECM connector P1-02. Remove the wire 993 from the primary ECM connector P1-03. Install wire jumpers into P1-02 and into P1-03.
 - C. Remove the wire A997 from the primary ECM connector P1-18. Remove the wire A993 from the primary ECM connector P1-35. Install wire jumpers into P1-18 and into P1-35.
- Note:** If you remove the sensor common from the ECM, an open circuit diagnostic code will be generated for all sensors that use the sensor common. Troubleshoot the original code. Delete the logged diagnostic codes when you are finished.
- D. Reconnect ECM connector J1/P1.
 - E. Turn the circuit breaker for the battery to the ON position.
 - F. Turn the ECS to the STOP position. The engine should be off.
 - G. Measure the voltage between the wire jumper in the analog supply P1-02 and the wire jumper in the analog return P1-03.
 - H. Measure the voltage between the wire jumper in the analog supply P1-18 and the wire jumper in the analog return P1-35.
 - I. Turn the ECS to the OFF/RESET position.
 - J. Remove the wire jumpers. Replace the wires that were removed above. Reconnect ECM connector J1/P1.

Expected Result:

The supply voltage is 5.0 ± 0.2 VDC.

Results:

- OK – The supply voltage is 5.0 ± 0.2 VDC. Proceed to Test Step 4.
- Not OK – The supply voltage is not 5.0 ± 0.2 VDC.

Repair: Perform the diagnostic functional test Troubleshooting, “Electrical Power Supply”.

STOP.

Test Step 4. Check the Analog Sensor Supply Voltage at the Sensor Connector.

- Turn the ECS to the STOP position. The engine should be off.
- Measure the voltage between socket-A and socket-B on the harness side of all analog sensor connectors.
- Turn the ECS to the OFF/RESET position.

Expected Result:

The supply voltage is 5.0 ± 0.2 VDC.

Results:

- OK – The supply voltage is 5.0 ± 0.2 VDC. Proceed to Test Step 5.
- Not OK – The supply voltage is not 5.0 ± 0.2 VDC.

Repair: There is an open circuit in the harness or connectors. Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 5. Check the Analog Sensors for Short Circuits.

- Turn the ECS to the STOP position. The engine should be off.
- Measure the voltage between socket-A and socket-B on the harness side of an analog sensor connector. Leave this sensor disconnected.
- Connect one sensor at a time.

Note: If the sensor is disconnected from the harness, an open circuit diagnostic code will be generated for that sensor. Troubleshoot the original diagnostic code. Delete the logged diagnostic codes when you are finished.

- Repeat this step with all of the analog sensors. For the last sensor, move the voltmeter to another sensor connector. Check the last sensor, as described above.

- Turn the ECS to the OFF/RESET position.

- Reconnect all sensors.

Expected Result:

The supply voltage is 5.0 ± 0.2 VDC after each analog sensor is connected.

Results:

- OK – The supply voltage is 5.0 ± 0.2 VDC after each analog sensor is connected.

Repair: The problem may be intermittent. If the problem is intermittent, perform the diagnostic functional test Troubleshooting, “Inspecting Electrical Connectors”.

STOP.

- Not OK – The voltage is okay before the sensor is connected. The voltage is not okay after the sensor is connected. The sensor may be internally shorted.

Repair: Temporarily replace the sensor. Verify that the new sensor solves the problem before permanently installing the new sensor.

STOP.

i01900697

CAN Data Link

SMCS Code: 1901-038

System Operation Description:

The CAN Data Link is used for communication between the following modules: engine's Electronic Control Module (ECM), customer devices, and various display modules. Two 120 Ohm terminating resistors must be installed in the wiring harness in order for the CAN Data Link to function properly.

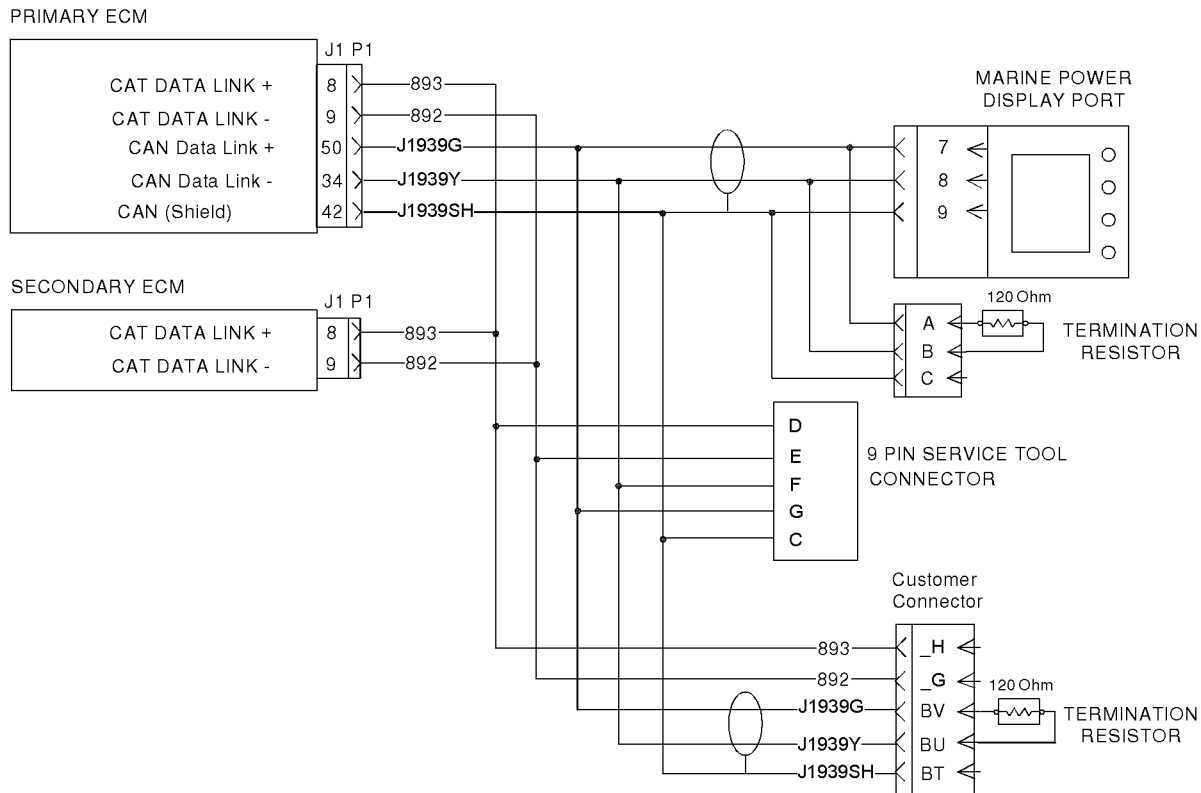


Illustration 24
Typical example

g01027471

Test Step 1. Check for Connector Damage.

- Turn the Engine Control Switch (ECS) to the OFF position.
- Turn the battery disconnect switch to the OFF position.
- Thoroughly inspect the primary ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details.
- Perform a 45 N (10 lb) pull test on each of the wires in the primary ECM connector that are associated with the circuit.
- Check the ECM connectors (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).
- Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted. The harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring are not okay.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Verify Proper Installation of the Terminating Resistors.

- Verify that the terminating resistors are installed on the ends of the data link.

- B.** Disconnect J1/P1 ECM connector and measure the resistance between P1-50 (CAN Data Link +) and P1-34 (CAN Data Link -).

Expected Result:

The resistance is between 60 ± 3 Ohms.

Results:

- OK – The resistance is within the range. Proceed to Test Step 3.
- Not OK – The range of the resistance is 120 ± 6 Ohms. A terminating resistor is missing or damaged.

Repair: If a termination resistor is missing, install the missing resistor. If both resistors are present, measure the resistance between pin A and pin B of the termination resistor. The resistance should measure 120 ± 3 Ohms. Replace the termination resistor if the resistance is not 120 ± 3 Ohms.

Refer to the Schematic in order to determine the missing resistor.

Verify that the repair eliminates the problem.

STOP.

Test Step 3. Check for a Short Circuit in the Harness.

- A.** Disconnect the J1/P1 ECM connector.
- B.** Remove the terminating resistors from the CAN Data Link harness.
- C.** If a Marine Power Display (MPD) is installed, disconnect the MPD.
- D.** Measure the resistance between the following pins.
- P1-50 (CAN Data Link +) and +Battery
 - P1-34 (CAN Data Link -) and +Battery
 - P1-50 (CAN Data Link +) to P1-34 (CAN Data Link -)
 - P1-50 (CAN Data Link +) to P1-42 (CAN Data Link Shield)
 - P1-34 (CAN Data Link -) to P1-42 (CAN Data Link Shield)
 - P1-50 (CAN Data Link +) and the -Battery terminal

Expected Result:

The resistance measures more than 20,000 Ohms.

Results:

- OK – The resistance is more than 20,000 Ohms. Proceed to Test Step 4.
- Not OK – The resistance is less than 20,000 Ohms.

Repair: There is a short in the harness wiring. Repair the connectors or wiring and/or replace the connectors or wiring.

Verify that the repair eliminates the problem.

STOP.

Test Step 4. Check for an Open Circuit in the Harness.

- A.** All connections should remain disconnected.
- B.** Fabricate a jumper wire. Short pin 7 and pin 8 on the connector for the marine power display.
- C.** Measure the resistance between P1-50 (CAN Data Link +) and P1-34 (CAN Data Link -) at the primary ECM connector P1.

Expected Result:

The resistance is less than 5 Ohms.

Results:

- OK – The resistance is less than 5 Ohms.

Repair: The harness for the CAN Data Link is okay. There may be a problem in the modules that are connected to the CAN Data Link. Reconnect all connectors and modules to the CAN Data Link. Connect a spare module in place of one of the modules on the CAN Data Link. If the diagnostic code disappears, replace the module. If the diagnostic code does not disappear, install the original module. Repeat this step until the problem is found.

STOP.

- Not OK – The resistance is greater than 5 Ohms.

Repair: There is an open in the harness wiring. Repair the connectors or wiring and/or replace the connectors or wiring.

Verify that the repair eliminates the problem.

STOP.

i02302453

Cat Data Link

SMCS Code: 1901-038

System Operation Description:

The Cat Data Link is used for communication between electronic modules. The Cat Data Link is used to communicate information from the Electronic Control Module (ECM) to the Electronic Monitoring System (EMS). The Cat Data Link is used for programming and troubleshooting the ECM.

The ECM communicates with the EMS in order to share engine information and diagnostics that may affect engine operation.

The ECM communicates with the Caterpillar Electronic Technician (ET) in order to share status and diagnostic information. The Cat ET can also be used to configure the ECM parameters on the engine. This information will not be available if communications fail between the ECM and the Cat ET.

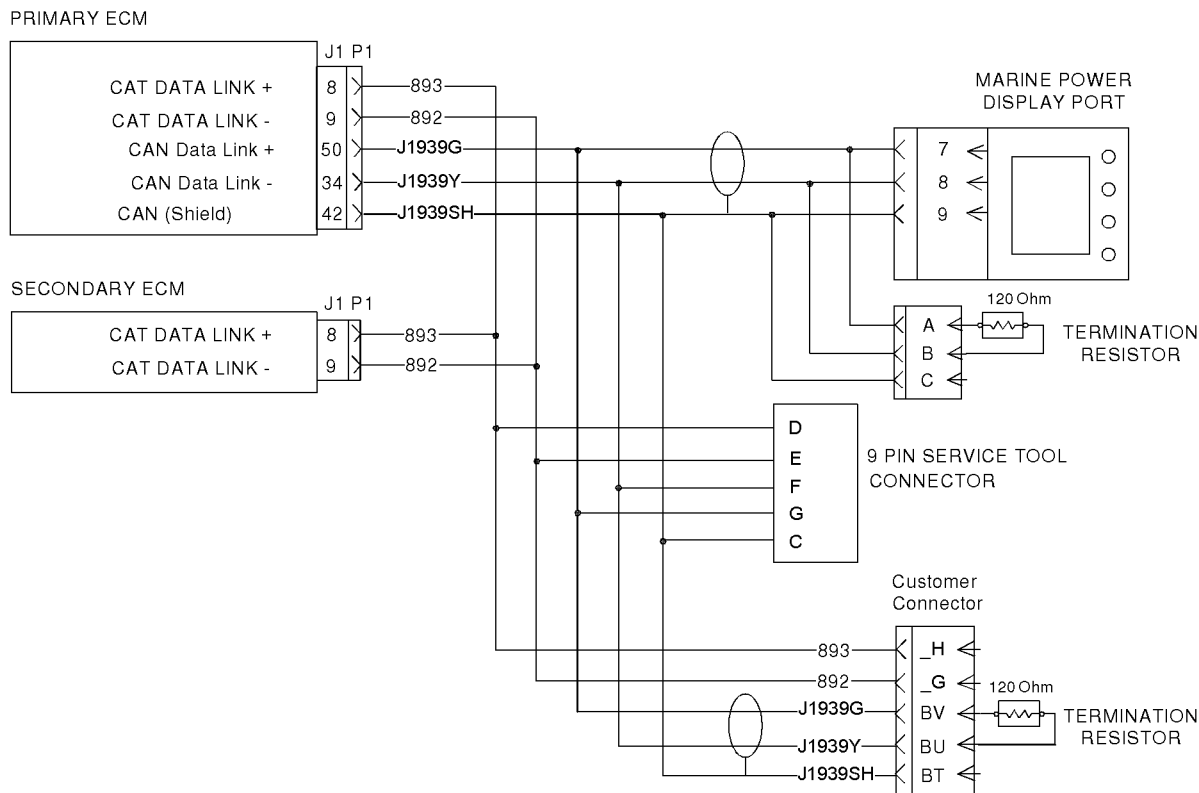


Illustration 25
Typical example

g01027471

Test Step 1. Check for Connector Damage

- Turn the Engine Control Switch (ECS) to the OFF/RESET position. The engine should be off.
- Turn the circuit breaker for the battery to the OFF position.
- Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details.
- Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the circuit.
- Check the ECM connectors (allen head screw) for the proper torque. Refer to Troubleshooting, "Inspecting Electrical Connectors".
- Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted, and the harness and wiring are free of corrosion, of abrasion and of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring need repair.

Repair: Repair the connectors and/or wiring or replace the connectors and/or wiring.

STOP.

Test Step 2. Check for Electrical Shorts in the Harness

- A.** Disconnect the ECM connectors for the primary ECM and for the secondary ECM.
- B.** Disconnect any module that is connected to the Cat Data Link.
- C.** Measure the resistance at the following points. Wiggle the harness during the measurement in order to reveal an intermittent short.
- Cat Data Link + to Cat Data Link –
 - Cat Data Link + to –Battery terminal
 - Cat Data Link – to –Battery terminal
 - Cat Data Link + to +Battery terminal
 - Cat Data Link – to +Battery terminal
 - Cat Data Link + to engine ground
 - Cat Data Link – to engine ground

Expected Result:

The resistance is greater than 20,000 Ohms for each measurement.

Results:

- OK – The resistance is greater than 20,000 Ohms. Proceed to Test Step 3.
- Not OK – The resistance is less than 20,000 Ohms. There is a short in the harness or in the connectors.

Repair: Repair the connector and/or wiring or replace the connector and/or wiring.

STOP.

Test Step 3. Check the Resistance through the Harness for an Open Circuit

- A.** Turn the ECS to the OFF/RESET position. The engine should be off.
- B.** Turn the circuit breaker for the battery to the OFF position.
- C.** Disconnect the ECM connectors for the primary ECM and for the secondary ECM.
- D.** Disconnect any module that is connected to the Cat Data Link.

- E.** Short the wires of the Cat Data Link together. Create the short at P1-9 and P1-8 of the primary ECM connector.
- F.** Set an ohmmeter on the 200 ohm scale. Measure the resistance between the terminals of the Cat Data Link + and the Cat Data Link –. Measure the resistance at the connectors for the primary ECM and the secondary ECM. Measure the resistance between the terminals of any module that was connected to the Cat Data Link. Wiggle the harness during the measurements in order to reveal an intermittent open condition.
- G.** Reconnect all connectors and modules.

Expected Result:

The resistance is less than five Ohms for each measurement.

Results:

- OK – The resistance is less than five Ohms for each measurement.

Repair: The harness is okay. There could be a problem with a module or with the ECM. Connect the suspect module on another engine. If the problem returns on the other engine, replace the suspect module. Turn the ECS to the OFF/RESET position. Turn the ECS to the ON position. If the diagnostic code is still present, replace the ECM. Refer to the diagnostic procedure Troubleshooting, “Replacing the ECM”.

STOP.

- Not OK – The resistance is greater than five Ohms for each measurement.

Repair: There is an open circuit or there is excessive resistance in the harness. Repair the connectors and/or wiring or replace the connectors and/or wiring.

STOP.

i01900698

Digital Sensor Supply

SMCS Code: 1901-038

System Operation Description:

The digital sensor supply provides power to all of the digital sensors on the engine. The primary Electronic Control Module (ECM) supplies 8.0 ± 0.4 VDC from the primary ECM connectors J1/P1 and J2/P2 to each digital sensor connector pin "A". The digital sensor reference is used as the return line for the digital sensors, speed/timing sensors, and the switch inputs to the primary ECM. The digital reference line is from the primary ECM connector J1/P1 and J2/P2 to each digital sensor connector pin "B". The digital sensor supply is output short circuit protected. A short circuit to the battery will not damage the circuit inside the primary ECM. The digital sensors are not protected from overvoltage.

The following list contains a description of the digital sensors that are found on the engine.

Left exhaust temperature sensor – The primary ECM uses the signal from the sensor to monitor left exhaust temperature. The sensor is mounted in the left exhaust manifold before the turbocharger. The sensor's output frequency is 500 Hz with a pulse width that varies with the exhaust temperature. The output signal is referred to as a duty cycle or as a pulse width modulated signal. The output signal is expressed as a percentage between 0 and 100 percent. The Caterpillar Electronic Technician (ET) will display the exhaust temperature as a value between 49 °C to 850 °C (120 °F to 1562 °F). If the actual temperature is between -40 °C to 49 °C (-40 °F to 120 °F), the display will read 30 °C (86 °F). If the temperature is above 851 °C (1564 °F), the display will read 851 °C (1564 °F).

Right exhaust temperature sensor – The primary ECM uses the signal from the sensor to monitor right exhaust temperature. The sensor is mounted in the right exhaust manifold before the turbocharger. The sensor's output frequency is 500 Hz with a pulse width that varies with the exhaust temperature. The output signal is referred to as a duty cycle or as a pulse width modulated signal. The output signal is expressed as a percentage between 0 and 100 percent. The Cat ET will display the exhaust temperature as a value between 49 °C to 850 °C (120 °F to 1562 °F). If the actual temperature is between -40 °C to 49 °C (-40 °F to 120 °F), the display will read 30 °C (86 °F). If the temperature is above 851 °C (1564 °F), the display will read 851 °C (1564 °F).

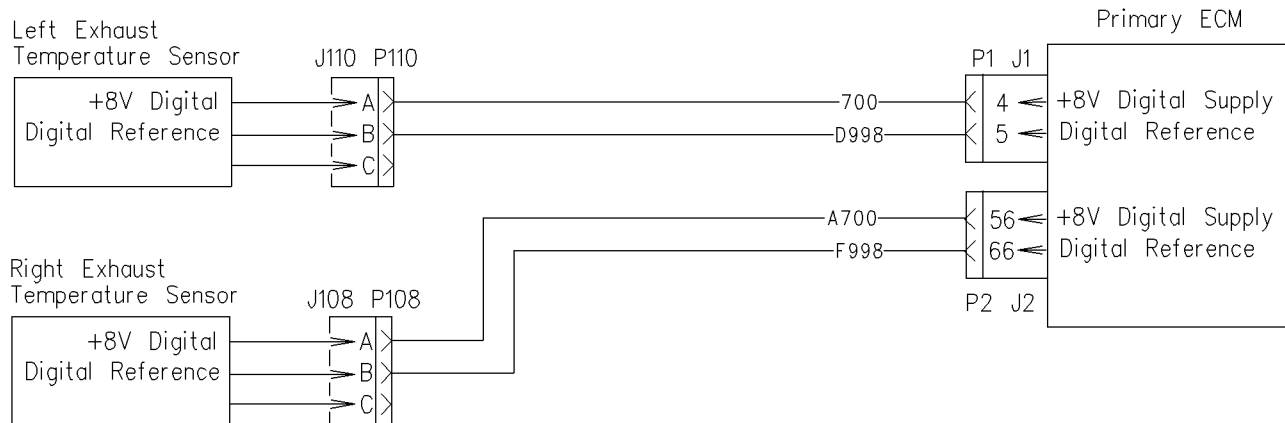


Illustration 26

g00989851

Typical example

Test Step 1. Check for Connector Damage.

- Turn the Engine Control Switch (ECS) to the OFF/RESET position.
- Turn the battery disconnect switch to the OFF position.
- Thoroughly inspect the primary ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details.
- Perform a 45 N (10 lb) pull test on each of the wires in the primary ECM connector that are associated with the circuit.
- Check the primary ECM connector (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).
- Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted. The harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring are not okay.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Check for a Short Circuit in the Wiring Harness.

- Disconnect the primary ECM connector J1/P1 and the secondary ECM connector J2/P2. Disconnect all of the digital sensors.
- Measure the resistance between the digital supply wire 700 in P1-4 and the digital return wire D998 in P1-5 of connector P1.
- Measure the resistance between the digital supply wire 700 in P1-4 and engine ground.
- Measure the resistance between the digital return wire D998 in P1-5 and engine ground.
- Measure the resistance between the digital supply wire 700 in P1-4 and the +Battery terminal.
- Measure the resistance between the digital return wire D998 in P1-5 and the +Battery terminal.
- Measure the resistance between the digital supply P2-56 (A700-BK) and the digital return P2-66 (F998-BK) on connector P2.
- Measure the resistance between the digital supply wire A700 in P2-56 and engine ground.
- Measure the resistance between the digital return wire F998 in P2-66 and engine ground.

- J. Measure the resistance between the digital supply wire A700 in P2-56 and the +Battery terminal.
- K. Measure the resistance between the digital return wire F998 in P2-66 and the +Battery terminal.

Expected Result:

The resistance is greater than 20,000 Ohms for each measurement.

Results:

- OK – The resistance is greater than 20,000 Ohms. Proceed to Test Step 3.
- Not OK – The resistance is less than 20,000 Ohms.

Repair: There is a short in the wiring harness. Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 3. Check the Digital Supply Voltage at the Primary ECM.

- A. Remove the wire 700 from the ECM connector P1-4. Install a jumper wire into the socket for P1-4.
- B. Remove the wire D998 from the ECM connector P1-5. Install a jumper wire into the socket for P1-5.
- C. Remove the wire A700 from the ECM connector P1-4. Install a jumper wire into the socket for P2-56.
- D. Remove the wire F998 from the ECM connector P2-66. Install a jumper wire into the socket for P2-66.

Note: If you remove the sensor common from the ECM, an open circuit diagnostic code will be generated for all sensors that use the sensor common. Troubleshoot the original code. Delete the logged diagnostic codes when you are finished.

- E. Turn the battery disconnect switch to the ON position.
- F. Turn the ECS to the STOP position. The engine should be off.
- G. Measure the voltage between the digital sensor supply P1-4 and the digital sensor return P1-5 at the wire jumpers.
- H. Measure the voltage between the digital sensor supply P2-56 and the digital sensor return P2-66 at the wire jumpers.

- I. Turn the ECS to the OFF/RESET position.
- J. Turn the battery disconnect switch to the OFF position.
- K. Remove the wire jumpers and reconnect the primary ECM connector J1/P1.
- L. Remove the wire jumpers and reconnect the primary ECM connector J2/P2.

Expected Result:

The supply voltage is 8.0 ± 0.4 VDC.

Results:

- OK – The supply voltage is 8.0 ± 0.4 VDC. The digital sensor supplies are producing the correct voltage. Proceed to Test Step 4.
- Not OK – The supply voltage is not 8.0 ± 0.4 VDC. The digital sensor supplies are not producing the correct voltage.

Repair: Perform the diagnostic functional test Troubleshooting, "Electrical Power Supply".

STOP.

Test Step 4. Check the Digital Sensor Supply Voltage at the Sensor Connector.

- A. Turn the battery disconnect switch to the ON position.
- B. Turn the ECS to the STOP position. The engine should be off.
- C. Measure the digital sensor supply voltage between the digital supply wire 700 in terminal-A and the digital return wire D998 in terminal-B at all of the digital sensors.
- D. Measure the digital sensor supply voltage between the digital supply wire A700 in terminal-A and the digital return wire F998 in terminal-B at all of the digital sensors.

Note: If the sensor is disconnected from the harness, an open circuit diagnostic code will be generated for that sensor. Troubleshoot the original code. Delete the logged diagnostic codes when you are finished.

- E. Turn the ECS to the OFF/RESET position.
- F. Turn the battery disconnect switch to the OFF position.

Expected Result:

The supply voltage is 8.0 ± 0.4 VDC.

Results:

- OK – The supply voltage is 8.0 ± 0.4 VDC at all of the digital sensor connectors. Proceed to Test Step 5.
- Not OK – The supply voltage is not 8.0 ± 0.4 VDC. There is an open circuit in the harness or connectors.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 5. Check the Digital Sensors for Short Circuits.

- Turn the battery disconnect switch to the ON position.
- Turn the ECS to the STOP position. The engine should be off.

Note: If the sensor is disconnected from the harness, an open circuit diagnostic code will be generated for that sensor. Troubleshoot the original code. Delete the logged diagnostic codes when you are finished.

- Connect one digital sensor at a time.
- Measure the voltage between the digital sensor supply P1-4 and the digital sensor return P1-5 at the ECM connector J1/P1. Repeat these steps with all of the digital sensors.
- Measure the voltage between the digital sensor supply P2-56 and the digital sensor return P2-66 at the ECM connector J2/P2. Repeat these steps with all of the digital sensors.
- Turn the ECS to the OFF/RESET position.
- Turn the battery disconnect switch to the OFF position.

Expected Result:

The supply voltage is 8.0 ± 0.4 VDC.

Results:

- OK – The supply voltage is 8.0 ± 0.4 VDC. The digital sensor supply is correct. The harness and sensors are okay.

Repair: Check the system for any diagnostic codes.

STOP.

- Not OK – The supply voltage is not 8.0 ± 0.4 VDC. The sensor may be internally shorted.

Repair: Temporarily install a new sensor. Ensure that the problem is no longer present. Reinstall the old sensor. If the problem returns, replace the sensor.

STOP.

- Intermittent – The problem is intermittent.

Repair: If the problem is intermittent, perform the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

STOP.

i01988349

Electrical Power Supply

SMCS Code: 1401-038

System Operation Description:

The engine has a Primary Electronic Control Module (ECM) and a Secondary Electronic Control Module (ECM). The electrical power to the primary ECM comes through the breaker for the primary ECM and the contact of relay "R2A". The electrical power to the secondary ECM comes through the breaker for the secondary ECM and the contact of relay "R2". Power goes to pin P1-53 and pin P1-52 of the ECM(s). The -Battery comes through the breakers for the primary ECM and the secondary ECM. The -Battery connects to pin P1-63 and pin P1-65 of the ECM(s).

The Engine Control Switch (ECS) sends a signal to pin P1-70 on the primary ECM and to pin P2-70 on the secondary ECM when the ECS is in the following positions: REMOTE, STOP, and START. When the primary ECM senses battery voltage on pin P1-70 of the primary ECM, the primary ECM will power up. When the secondary ECM senses battery voltage on pin P2-70 of the secondary ECM, the secondary ECM will power up. When the ECS is in the OFF/RESET position, voltage is not present on these inputs and the ECM(s) will power down.

If an emergency shutdown occurs, circuitry will energize relay "R2" and relay "R2A". When these two relays are energized the contacts of the relays will open. When the contacts of the relays open, battery power is removed from the ECM(s).

In order to restart the engine, the operator must correct the cause of the emergency shutdown. The Engine Control Switch (ECS) must be turned to the OFF/RESET position. This resets the electrical circuits in the circuit. In addition to turning the ECS to the OFF/RESET position, the operator must manually open the air shutoff valves before starting the engine.

The presence of two +Battery connections and two -Battery connections to the ECM reduce harness resistance. All of these connections must be complete in order to ensure proper engine operation.

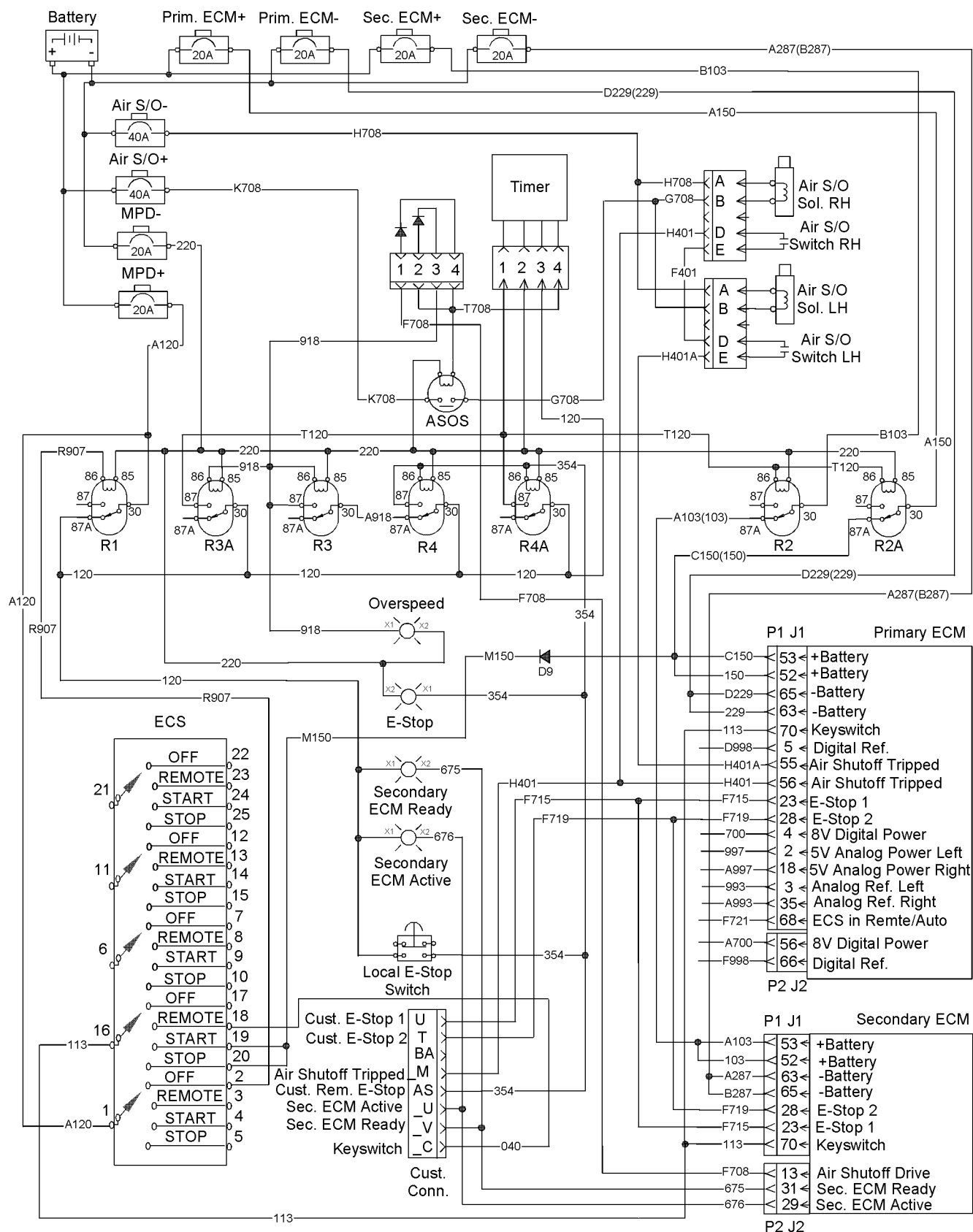


Illustration 27
Typical example

Note: If a remotestart switch is installed, the remote start switch must be in the LOCAL position for this test.

Test Step 1. Check for Connector Damage.

- A. Turn the ECS to the OFF/RESET position.
- B. Turn the circuit breaker for the battery to the OFF position.
- C. Verify that the circuit breakers are not tripped.
- D. Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details.
- E. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the circuit.
- F. Check the ECM connector (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).
- G. Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted, and the harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring need repair.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Check the Voltage to the ECM.

- A. Disconnect the primary ECM connector and the secondary ECM connector J1/P1.
- B. Turn the circuit breaker for the battery to the ON position.
- C. Turn the ECS to the STOP position.

Note: Verify that wires D229(229) and wires A287(287) have continuity from the ECM(s) to the –Battery terminal.

- D. Measure the voltage at the primary ECM and at the secondary ECM. Measure the voltage between P1-53 and P1-65. Measure the voltage between P1-52 and P1-63.
- E. Measure the voltage between P1-70 and P1-65 at the primary ECM.
- F. Measure the voltage between P1-70 and P1-65 at the secondary ECM.

Expected Result:

The voltage measures 24 ± 3 VDC. The difference between the three voltage measurements is less than 0.5 VDC.

Results:

- OK – The ECM is receiving the correct battery voltage. Proceed to Test Step 5.
- Not OK - P1-70 – The voltage is not 24 ± 3 VDC on the input for the keyswitch to the ECM. Proceed to Test Step 6.
- Not OK – The voltage is incorrect at the battery connections to the ECM(s). The wiring or components between the battery and the ECM are preventing the voltage from reaching the ECM. Proceed to Test Step 3.

Test Step 3. Check the Battery Voltage.

- A. Turn the circuit breaker for the battery to the OFF position.
- B. Turn the ECS to the OFF/RESET position.
- C. Measure no-load battery voltage at the battery terminals. Refer to Testing and Adjusting, "Test Tools for the Electrical System" for the proper procedures to check the batteries.
- D. Load test the batteries. Use the 4C-4911 Battery Load Tester. Refer to the Operating Manual, SEHS9249. Refer to Special Instruction, SEHS7633.

Expected Result:

The no-load voltage at the batteries is at least 23.5 VDC and the batteries pass the load test.

Results:

- OK – The battery voltage is okay and the battery passes the load test. Proceed to Test Step 4.
- Not OK – The battery voltage is incorrect and/or the battery fails the load test.

Repair: The batteries or the alternator are causing the problem. Recharge the batteries or replace the batteries. Verify that the original condition is resolved. Refer to Testing and Adjusting, “Electrical System”.

STOP.

Test Step 4. Check the Voltage at Relay “R2” and/or Relay “R2A”.

- Turn the circuit breaker for the battery to the ON position.
- Measure the voltage from wire A103(103) on terminal 87A of relay “R2” to the –Battery terminal. Measure the voltage from wire B103 on terminal 30 of relay “R2” to the –Battery terminal.
- Measure the voltage from wire C150(150) on terminal 87A of relay “R2A” to the –Battery terminal. Measure the voltage from wire A150 on terminal 30 of relay “R2A” to the –Battery terminal.

Expected Result:

The voltage measures 24 ± 3 VDC on all terminals.

Results:

- OK – The voltage is 24 ± 3 VDC.

Repair: Repair the wiring between relay “R2” and/or relay “R2A” and the ECM(s).

STOP.

- Not OK – The voltage is not 24 ± 3 VDC on terminal 30 of the ECM(s).

Repair: Verify that voltage is present on wire A150 at the breaker for the primary ECM. If voltage is present at the breaker, repair the wiring between the breaker for the primary ECM and relay “R2A”.

Verify that voltage is present on wire B103 at the breaker for the secondary ECM. If voltage is present at the breaker, repair the wiring between the breaker for the secondary ECM and relay “R2”.

STOP.

- Not OK – The voltage is not 24 ± 3 VDC on terminal 87A of the ECM(s).

Repair: Verify that voltage is not present on wire T120 at the coil of relay “R2A”. If voltage is present on wire T120, check all emergency stop switches for proper operation. Check for diagnostic codes for an engine overspeed. If voltage is not present on wire T120, replace relay “R2A”.

Verify that voltage is not present on wire T120 at the coil of relay “R2”. If voltage is present on wire T120, check all emergency stop switches for proper operation. Check for a diagnostic code for an engine overspeed. If voltage is not present on wire T120, replace relay “R2”.

STOP.

Test Step 5. Check the Voltage at the Sensor Power Supplies.

- Turn the ECS to the OFF/RESET position.
- Disconnect the primary ECM connector P1/J1.

Note: If you remove the sensor common from the ECM, an open circuit diagnostic code will be generated for all sensors that use the sensor common. Troubleshoot the original code. Delete the logged diagnostic codes when you are finished.

- Check the analog supply voltage. Remove the wire 997 from P1-2. Remove the wire 993 from P1-3. Install wire jumpers into the sockets for the above wires.
- Check the analog supply voltage. Remove the wire A997 from P1-18. Remove the wire A993 from P1-35. Install wire jumpers into the sockets for the above wires.
- Check the digital supply voltage. Remove the wire 700 from P1-4. Remove the wire D998 from P1-5. Install wire jumpers into the sockets for the above wires.
- Reconnect the primary ECM connector P1/J1.
- Disconnect the primary ECM connector P2/J2.
- Check the digital supply voltage. Remove the wire A700 from P2-56. Remove the wire F998 from P2-66. Install wire jumpers into the sockets for the above wires.
- Reconnect the primary ECM connector P2/J2.
- Turn the ECS to the STOP position.
- Measure the analog voltage between the wire jumpers in the following pins:
 - P1-2 and P1-3
 - P1-18 and P1-35

L. Measure the digital voltage between the wire jumpers in the following pins:

- P1-4 and P1-5
- P2-56 and P2-66

M. Turn the ECS to the OFF/RESET position.

N. Remove the wire jumpers. Replace all of the wires that were removed in the above steps. Reconnect the ECM connectors.

Expected Result:

The voltage measures 5.0 ± 0.2 VDC on the analog supplies. The voltage measures 8.0 ± 0.4 VDC on the digital supplies.

Results:

- OK – The sensor power supplies are functioning properly. The ECM is powered up.

Repair: The problem may be intermittent. If the problem is intermittent, perform the diagnostic functional test Troubleshooting, “Inspecting Electrical Connectors”.

STOP.

- Not OK – If the ECM is getting the correct voltage at the +Battery terminal, but the ECM does not supply the correct voltages to the sensor supplies, replace the ECM.

Repair: Refer to the diagnostic procedure Troubleshooting, “Replacing the ECM”.

STOP.

Test Step 6. Check the Voltage at the ECS.

A. Turn the ECS to the STOP position.

B. Measure the voltage at the ECS when the switch is in the STOP position. Measure the voltage between terminal 16 and engine ground. Measure the voltage between terminal 20 and engine ground.

Expected Result:

The voltage measures 24 ± 3 VDC on both terminals.

Results:

- OK – The voltage is 24 ± 3 VDC on both terminals.

Repair: The wiring between the ECS and the primary ECM and/or the secondary ECM needs repair. Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

- Not OK - Terminal 16 – The correct voltage is not present on terminal 16 of the ECS.

Repair: If 24 ± 3 VDC is present on terminal 20 of the ECS, replace the ECS.

STOP.

- Not OK - Terminal 20 – The correct voltage is not present on terminal 20 of the ECS. Proceed to Test Step 7.

Test Step 7. Check the Voltages at Relay “R1”.

A. Turn the ECS to the STOP position.

B. Measure the voltage between wire 120 on terminal 87A of relay “R1” and engine ground.

C. Measure the voltage between wire A120 on terminal 30 of relay “R1” and engine ground.

D. Turn the ECS to the OFF/RESET position.

Expected Result:

The voltage measures 24 ± 3 VDC on both terminals.

Results:

- OK – The voltage is 24 ± 3 VDC on both terminals.

Repair: The wiring between relay “R1” and the ECS needs repair. Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

- Not OK – The voltage is not 24 ± 3 VDC on terminal 30 of relay “R1”.

Repair: Verify that voltage is present on wire A120 at the “MPD” breaker. If voltage is present at the breaker, repair the wiring between the “MPD” breaker and relay “R1”.

STOP.

- Not OK – The voltage is not 24 ± 3 VDC on terminal 87A of relay “R1”.

Repair: Verify that voltage is not present on wire R907 at the coil of relay "R1". If voltage is present on wire R907, verify that the ECS is in the STOP position. If voltage is present on wire R907, check for a short to the +Battery on wire R907 or check the ECS for an internal short. If voltage is not present on wire R907, replace relay "R1".

STOP.

In order to start the engine after an emergency stop condition, the ECS must be turned to the OFF/RESET position. This resets the ECM and the air shutoff timer. In addition to turning the ECS to the OFF/RESET position, the operator must manually open the air shutoff valves before starting the engine.

i01988352

Emergency Stop Switch

SMCS Code: 1901-038

System Operation Description:

When the local emergency stop switch on the instrument panel is depressed, the coils of relay "R4" and relay "R4A" are energized. The contacts of relay "R4" keeps the coils of relay "R4" and relay "R4A" energized until the Engine Control Switch (ECS) is cycled to the OFF/RESET position. The contacts of relay "R4A" energizes the coils of relays "R2" and "R2A". When relays "R2" and "R2A" are energized, power is removed from the engine's primary Electronic Control Module (ECM) and the engine's secondary ECM. The primary ECM and the secondary ECM will power down. The injection signals to the injector solenoids will stop. The emergency stop lamp on the instrument panel will illuminate.

The contact of relay "R4A" also supplies power to terminal 1 of the connector for the timer. When power is applied to terminal 1 of the connector for the timer, the timer will activate. The timer outputs 24 VDC to terminal 4 of the connector for the timer for 2.5 seconds. The 24 VDC from terminal 4 of the connector for the timer is applied to the coil of the air shutoff switch (ASOS). The contact of the "ASOS" switch energizes the air shutoff solenoids. The timer will output voltage to the coil of the "ASOS" switch for approximately 2.5 seconds. The "ASOS" switch will then deactivate removing power to the air shutoff solenoids. This prevents damage to the air shutoff solenoids. A normally open switch at the air shutoff valves will close when the air shutoff solenoid activates the air shutoff valve. The switch input to the ECM notifies the ECM that the air shutoff valves are closed. The ECM will not send injection signals to the injector solenoids until the switch inputs from the air shutoff valves indicate that the valves are open.

Relay "R3A" and relay "R3" are energized at the same time as the "ASOS" switch through terminal 3 of the diode assembly. Terminal 3 of the diode assembly will energize relay "R3A" and relay "R3" for 2.5 seconds. The relays "R3A" and "R3" will de-energize after 2.5 seconds. The overspeed indicator on the instrument panel will illuminate for 2.5 seconds.

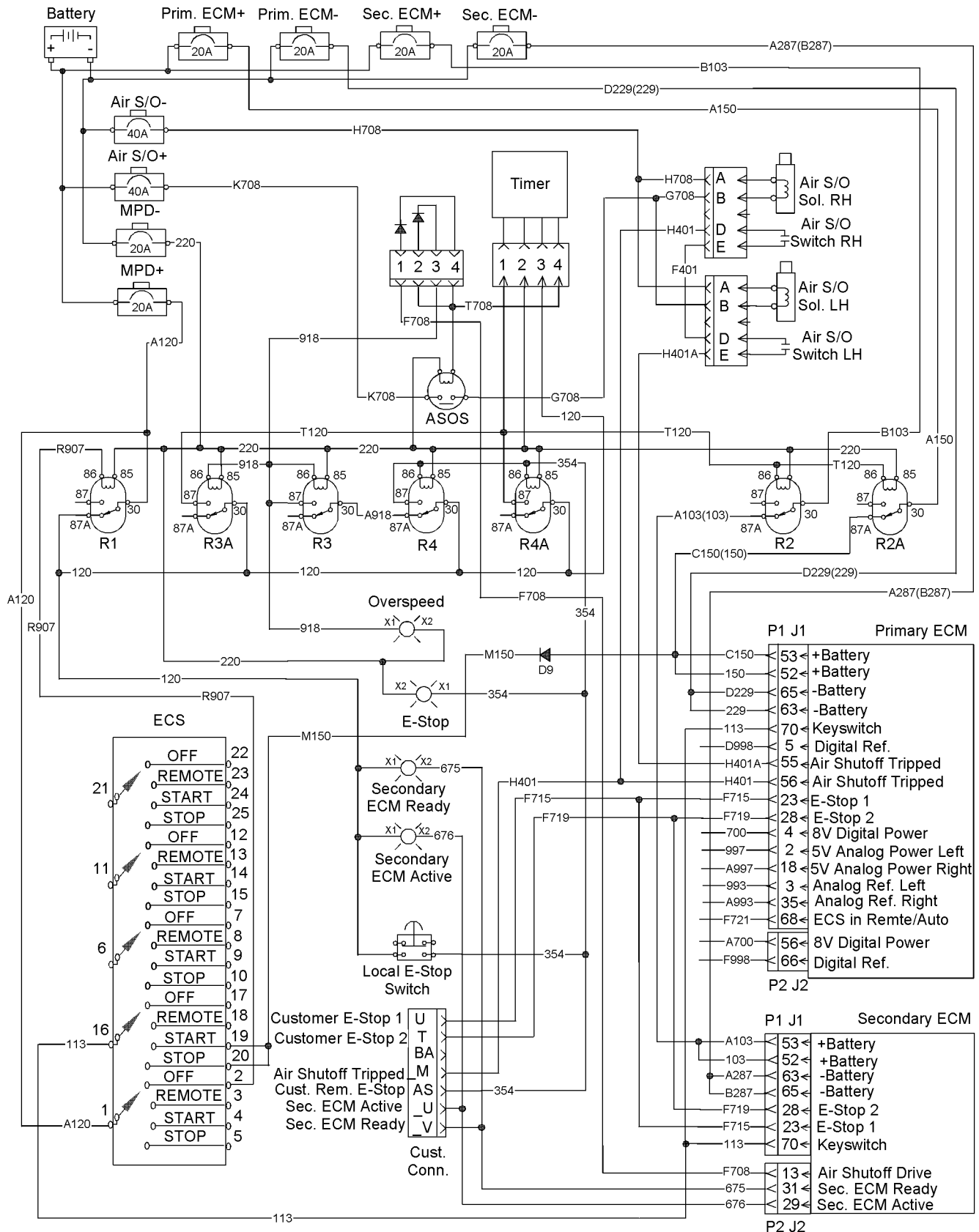


Illustration 28

Typical example

Test Step 1. Check for Connector Damage.

- A. Verify that the circuit breakers are not tripped.
- B. Turn the circuit breaker for the battery to the OFF position.
- C. Turn the ECS to the OFF/RESET position.
- D. Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details.
- E. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connectors that are associated with the circuit.
- F. Check the ECM connectors (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).
- G. Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted, and the harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring are not okay.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Test the Circuit for the Local Emergency Stop.

- A. Turn the circuit breaker for the battery to the ON position.
- B. Turn the ECS to the STOP position.
- C. Activate the local emergency stop switch on the instrument panel.
- D. Monitor the air shutoff solenoids.
- E. Deactivate the local emergency stop switch.

Expected Result:

The air shutoff solenoids activated.

Results:

- OK – The air shutoff solenoids activated correctly.

Repair: The problem may be intermittent. If the problem is intermittent, refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

STOP.

- Not OK – The air shutoff solenoids failed to activate. Proceed to Test Step 3.

Test Step 3. Check for the Signal from the "ASOS" Switch at the Connector P-C1 for the Power Distribution Panel.

- A. Turn the ECS to the STOP position.
- B. Activate the local emergency stop switch.
- C. Monitor the voltage on wire G708 on pin I at connector P-C1 of the rigid harness.
- D. Deactivate the local emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds. The circuit is operating correctly to this point. Proceed to Test Step 7.
- Not OK – The voltage did not measure 24 ± 3 VDC for approximately 2.5 seconds. Proceed to Test Step 4.

Test Step 4. Test for Voltage to the Coil of Relay "R4A" at the Connector P-C2 for the Power Distribution Panel.

- A. Turn the ECS to the STOP position.
- B. Activate the local emergency stop switch.
- C. Monitor the voltage on wire 354 on pin B at connector P-C2 of the rigid harness.
- D. Deactivate the local emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC. The circuit is operating correctly to this point. Proceed to Test Step 5.
- Not OK – No voltage was measured. Proceed to Test Step 11.

Test Step 5. Test for Voltage at the Coil of the “ASOS” Switch.

- Turn the ECS to the OFF/RESET position.
- The input to the coil of the “ASOS” switch is wire T708 from terminal 4 of the timer. Connect a voltmeter between wire T708 on the “ASOS” switch and the engine ground.
- Turn the ECS to the STOP position.
- Activate the local emergency stop switch.
- Monitor the voltage on the voltmeter.
- Deactivate the local emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds. The circuit is operating correctly to this point. Proceed to Test Step 6.
- Not OK – The voltage did not measure 24 ± 3 VDC. Proceed to Test Step 8.

Test Step 6. Check for Voltage from the “ASOS” Switch to the Air Shutoff Solenoids.

- Turn the ECS to the OFF/RESET position.
- Disconnect wire G708 from the “ASOS” switch.
- Connect a voltmeter to the empty terminal on the “ASOS” switch. Connect the other lead from the voltmeter to engine ground.
- Turn the ECS to the STOP position.
- Activate the local emergency stop switch.

- Monitor the voltage on the voltmeter.
- Deactivate the local emergency stop switch.
- Reconnect wire G708 to the “ASOS” switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds. The circuit is operating correctly to this point.

Repair: Repair the wire G708 between the “ASOS” switch and wire G708 on pin I at connector P-C1 of the rigid harness.

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC for approximately 2.5 seconds.

Repair: Verify that 24 ± 3 VDC is present on wire K708 at the normally open contacts of the “ASOS” switch. If voltage is not present on wire K708, check the wire K708 and the circuit breaker for the air shutoff for problems.

If voltage is present on the wire K708, check wire 220 on the coil of the “ASOS” switch for continuity to the –Battery. If necessary, repair the wire or replace the wire. If wire 220 is okay and voltage is present on wire K708, replace the “ASOS” switch.

STOP.

Test Step 7. Check the Voltage at the Connector for the Air Shutoff Solenoids.

- Turn the ECS to the OFF/RESET position.
- Disconnect the connector for the air shutoff solenoids. Disconnect the connector for the right and left sides of the engine.
- Connect a voltmeter between wire G708 on the connector for the air shutoff solenoid and the engine ground.
- Turn the ECS to the STOP position.
- Activate the local emergency stop switch.
- Monitor the voltage on the voltmeter.
- Deactivate the local emergency stop switch.

H. Reconnect the connectors for the air shutoff solenoids.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds. The circuit is operating correctly to this point.

Repair: Check the wire H708 from terminal A of the connector for continuity to the –Battery. If the wire H708 does not have continuity to the –Battery from terminal A of the connector, check for continuity on wire H708 on pin H at connector P-C1 of the rigid harness to –Battery. If the wire H708 does not have continuity to the –Battery from pin H at connector P-C1 of the rigid harness, verify that the breaker for the prelube and air shutoff is not tripped. If the wire H708 to the –Battery terminal is okay, replace the air shutoff solenoid. Verify that the circuit operates correctly.

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC for approximately 2.5 seconds. System voltage was not available at the solenoid connector.

Repair: There is a problem in the wiring between the connector for the air shutoff solenoids and wire G708 on pin I at connector P-C1 of the rigid harness. Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 8. Check the Voltage at the Contact of Relay “R4A”.

- Turn the ECS to the OFF/RESET position.
- Disconnect wire T120 from terminal 87 of relay “R4A”.
- Connect a voltmeter between terminal 87 of relay “R4A” and the engine ground.
- Turn the ECS to the STOP position.
- Activate the local emergency stop switch.
- Monitor the voltage on the voltmeter.
- Deactivate the local emergency stop switch.
- Turn the ECS to the OFF/RESET position.
- Reconnect wire T120.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC. Proceed to Test Step 9.
- Not OK – The voltage did not measure 24 ± 3 VDC. Proceed to Test Step 10.

Test Step 9. Check the Voltage at Terminal 4 of the Connector for the Timer.

- Connect a voltmeter between terminal 4 of the connector for the timer and engine ground.
- Turn the ECS to the STOP position.
- Activate the local emergency stop switch.
- Monitor the voltage on the voltmeter.
- Deactivate the local emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Repair: Repair wire T708 between the “ASOS” switch and terminal 4 of the timer.

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC for approximately 2.5 seconds.

Repair: Check for 24 ± 3 VDC on terminal 1 of the connector for the timer.

If voltage is not present on terminal 1, repair the wire T120 between terminal 87 of relay “R4A” and terminal 1 of the connector for the timer.

If voltage is present on terminal 1 of the connector for the timer, verify that wire 220 on terminal 2 of the connector for the timer has continuity to the –Battery. If wire 220 does not have continuity to the –Battery, repair the wire.

Verify that 24 ± 3 VDC is present on terminal 3 of the connector for the timer. If 24 ± 3 VDC is not present on terminal 3 of the connector for the timer, verify that the ECS is not in the "OFF/RESET" position. Verify that the "MPD" breaker is not tripped. Check the normally closed contact of relay "R1" for proper operation. Check the wire 120 between terminal 3 of the connector for the timer and relay "R1" for damage. Check the wire A120 between relay "R1" and the "MPD" breaker for damage. If necessary, repair the wires.

If the voltage is present on terminal 1 and 3 of the timer and wire 220 is okay, replace the timer.

STOP.

Test Step 10. Check the Voltage at the Coil of Relay "R4A".

- A. Connect a voltmeter between wire 354 on terminal 86 of relay "R4A" and the engine ground.
- B. Turn the ECS to the STOP position.
- C. Activate the local emergency stop switch.
- D. Monitor the voltage on the voltmeter.
- E. Deactivate the local emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC.

Repair: Check wire 220 on the coil of the "R4A" relay for continuity to the -Battery. If necessary, repair the wire or replace the wire.

Check for 24 ± 3 VDC on wire 120 on terminal 30 of relay "R4A". If 24 ± 3 VDC is not present on wire 120, verify that the ECS is not in the "OFF/RESET" position. Verify that the "MPD" breaker is not tripped. Check the normally closed contact of relay "R1" for proper operation. Check the wire 120 between terminal 30 of the relay "R4A" and relay "R1" for damage. Check the wire A120 between relay "R1" and the "MPD" breaker for damage. If necessary, repair the wires.

If wire 220 is okay and voltage is present on wire 120 on terminal 30, replace relay "R4A".

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC. Proceed to Test Step 11.

Test Step 11. Check the Voltage from the Local emergency Stop Switch to Relay "R4A".

- A. Turn the ECS to the OFF/RESET position.
- B. Disconnect wire 354 from the local emergency stop switch.
- C. Connect a voltmeter to the empty terminal on the local emergency stop switch. Connect the other lead from the voltmeter to engine ground.
- D. Turn the ECS to the STOP position.
- E. Activate the local emergency stop switch.
- F. Monitor the voltage on the voltmeter.
- G. Deactivate the local emergency stop switch.
- H. Reconnect wire 354.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC.

Repair: Repair the wire 354 between the local emergency stop switch and the wire 354 on pin B at connector P-C2 of the rigid harness.

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC. Proceed to Test Step 12.

Test Step 12. Check the Voltage to the Local emergency Stop Switch from Wire 120 on pin E at connector P-C2 of the rigid harness.

- A. Turn the ECS to the OFF/RESET position.
- B. Connect a voltmeter between wire 120 on the local emergency stop switch and engine ground.
- C. Turn the ECS to the STOP position.
- D. Monitor the voltage on the voltmeter.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC.

Repair: Replace the local emergency stop switch.

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC.

Repair: Check the wire 120 on pin E at connector P-C2 of the rigid harness between the connector and the local emergency stop switch for damage. Verify that the ECS is not in the "OFF/RESET" position. Verify that the "MPD" breaker is not tripped. Check the normally closed contact of relay "R1" for proper operation. Check the wire A120 between relay "R1" and the "MPD" breaker for damage. If necessary, repair the wires.

STOP.

i01988355

Emergency Stop Switch (Remote)

SMCS Code: 1901-038

System Operation Description:

The terminal AS on the customer connector is for the customer's remote emergency stop input to the engine's power distribution panel. When the customer's remote emergency stop switch is depressed, the coils of relay "R4" and relay "R4A" are energized. The contacts of relay "R4" keeps the coils of relay "R4" and relay "R4A" energized until the Engine Control Switch (ECS) is cycled to the OFF/RESET position. The contacts of relay "R4A" energizes the coils of relays "R2" and "R2A". When relays "R2" and "R2A" are energized, power is removed from the engine's primary Electronic Control Module (ECM) and the engine's secondary ECM. The primary ECM and the secondary ECM will power down. The injection signals to the injector solenoids will stop. The emergency stop lamp on the instrument panel will illuminate.

The contact of relay "R4A" also supplies power to terminal 1 of the connector for the timer. When power is applied to terminal 1 of the connector for the timer, the timer will activate. The timer outputs 24 VDC to terminal 4 of the connector for the timer for 2.5 seconds. The 24 VDC from terminal 4 of the connector for the timer is applied to the coil of the air shutoff switch (ASOS). The contact of the "ASOS" switch energizes the air shutoff solenoids. The timer will output voltage to the coil of the "ASOS" switch for approximately 2.5 seconds. The "ASOS" switch will then deactivate removing power to the air shutoff solenoids. This prevents damage to the air shutoff solenoids. A normally open switch at the air shutoff valves will close when the air shutoff solenoid activates the air shutoff valve. The switch input to the ECM notifies the ECM that the air shutoff valves are closed. The ECM will not send injection signals to the injector solenoids until the switch inputs from the air shutoff valves indicate that the valves are open.

Relay "R3A" and relay "R3" are energized at the same time as the "ASOS" switch through terminal 3 of the diode assembly. Terminal 3 of the diode assembly will energize relay "R3A" and relay "R3" for 2.5 seconds. The relays "R3A" and "R3" will de-energize after 2.5 seconds. The overspeed indicator on the instrument panel will illuminate for 2.5 seconds.

In order to start the engine after an emergency stop condition, the ECS must be turned to the OFF/RESET position. This resets the ECM and the air shutoff timer. In addition to turning the ECS to the OFF/RESET position, the operator must manually open the air shutoff valves before starting the engine.

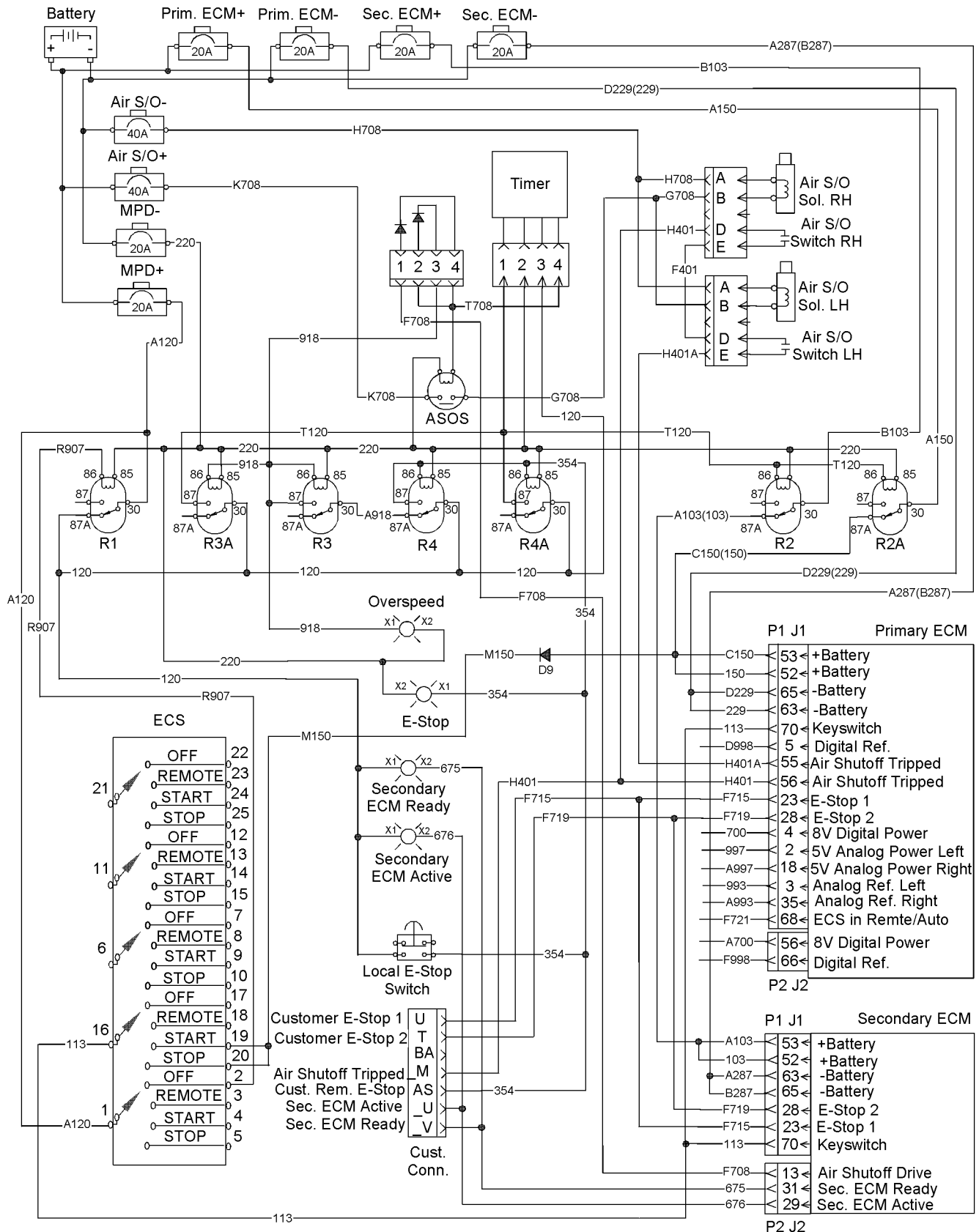


Illustration 29

Typical example

Test Step 1. Check for Connector Damage.

- A. Verify that the circuit breakers are not tripped.
- B. Turn the circuit breaker for the battery to the OFF position.
- C. Turn the ECS to the OFF/RESET position.
- D. Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details.
- E. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connectors that are associated with the circuit.
- F. Check the ECM connectors (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).
- G. Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted, and the harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring are not okay.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Test the Circuit for the Customer's Remote Emergency Stop.

- A. Turn the circuit breaker for the battery to the ON position.
- B. Turn the ECS to the STOP position.
- C. Activate the customer's remote emergency stop switch.
- D. Monitor the air shutoff solenoids.
- E. Deactivate the remote emergency stop switch.

Expected Result:

The air shutoff solenoids activated.

Results:

- OK – The air shutoff solenoids activated correctly.

Repair: The problem may be intermittent. If the problem is intermittent, refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

STOP.

- Not OK – The air shutoff solenoids failed to activate. Proceed to Test Step 3.

Test Step 3. Check for the Signal from the "ASOS" Switch at the Connector P-C1 for the Power Distribution Panel.

- A. Turn the ECS to the STOP position.
- B. Activate the remote emergency stop switch.
- C. Monitor the voltage on wire G708 on pin I at connector P-C1 of the rigid harness.
- D. Deactivate the remote emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds. The circuit is operating correctly to this point. Proceed to Test Step 7.
- Not OK – The voltage did not measure 24 ± 3 VDC for approximately 2.5 seconds. Proceed to Test Step 4.

Test Step 4. Test for Voltage to the Coil of Relay "R4A" at the Connector P-C2 for the Power Distribution Panel.

- A. Turn the ECS to the STOP position.
- B. Activate the remote emergency stop switch.
- C. Monitor the voltage on wire 354 on pin B at connector P-C2 of the rigid harness.
- D. Deactivate the remote emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC. The circuit is operating correctly to this point. Proceed to Test Step 5.
- Not OK – No voltage was measured. Proceed to Test Step 11.

Test Step 5. Test for Voltage at the Coil of the “ASOS” Switch.

- A. Turn the ECS to the OFF/RESET position.
- B. The input to the coil of the “ASOS” switch is wire T708 from terminal 4 of the timer. Connect a voltmeter between wire T708 on the “ASOS” switch and the engine ground.
- C. Turn the ECS to the STOP position.
- D. Activate the remote emergency stop switch.
- E. Monitor the voltage on the voltmeter.
- F. Deactivate the remote emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds. The circuit is operating correctly to this point. Proceed to Test Step 6.
- Not OK – The voltage did not measure 24 ± 3 VDC. Proceed to Test Step 8.

Test Step 6. Check for Voltage from the “ASOS” Switch to the Air Shutoff Solenoids.

- A. Turn the ECS to the OFF/RESET position.
- B. Disconnect wire G708 from the “ASOS” switch.
- C. Connect a voltmeter to the empty terminal on the “ASOS” switch. Connect the other lead from the voltmeter to engine ground.
- D. Turn the ECS to the STOP position.
- E. Activate the remote emergency stop switch.

- F. Monitor the voltage on the voltmeter.

- G. Deactivate the remote emergency stop switch.

- H. Reconnect wire G708 to the “ASOS” switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds. The circuit is operating correctly to this point.

Repair: Repair the wire G708 between the “ASOS” switch and wire G708 on pin I at connector P-C1 of the rigid harness.

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC for approximately 2.5 seconds.

Repair: Verify that 24 ± 3 VDC is present on wire K708 at the normally open contacts of the “ASOS” switch. If voltage is not present on wire K708, check the wire K708 and the circuit breaker for the air shutoff for problems.

If voltage is present on the wire K708, check wire 220 on the coil of the “ASOS” switch for continuity to the –Battery. If necessary, repair the wire or replace the wire. If wire 220 is okay and voltage is present on wire K708, replace the “ASOS” switch.

STOP.

Test Step 7. Check the Voltage at the Connector for the Air Shutoff Solenoids.

- A. Turn the ECS to the OFF/RESET position.
- B. Disconnect the connector for the air shutoff solenoids. Disconnect the connector for the right and left sides of the engine.
- C. Connect a voltmeter between wire G708 on the connector for the air shutoff solenoid and the engine ground.
- D. Turn the ECS to the STOP position.
- E. Activate the remote emergency stop switch.
- F. Monitor the voltage on the voltmeter.
- G. Deactivate the remote emergency stop switch.

H. Reconnect the connectors for the air shutoff solenoids.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds. The circuit is operating correctly to this point.

Repair: Check the wire H708 from terminal A of the connector for continuity to the –Battery. If the wire H708 does not have continuity to the –Battery from terminal A of the connector, check for continuity on wire H708 on pin H at connector P-C1 of the rigid harness to –Battery. If the wire H708 does not have continuity to the –Battery from pin H at connector P-C1 of the rigid harness, verify that the breaker for the prelube and air shutoff is not tripped. If the wire H708 to the –Battery terminal is okay, replace the air shutoff solenoid. Verify that the circuit operates correctly.

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC for approximately 2.5 seconds. System voltage was not available at the solenoid connector.

Repair: There is a problem in the wiring between the connector for the air shutoff solenoids and wire G708 on pin I at connector P-C1 of the rigid harness. Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 8. Check the Voltage at the Contact of Relay “R4A”.

- Turn the ECS to the OFF/RESET position.
- Disconnect wire T120 from terminal 87 of relay “R4A”.
- Connect a voltmeter between terminal 87 of relay “R4A” and the engine ground.
- Turn the ECS to the STOP position.
- Activate the remote emergency stop switch.
- Monitor the voltage on the voltmeter.
- Deactivate the remote emergency stop switch.
- Turn the ECS to the OFF/RESET position.
- Reconnect wire T120.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC. Proceed to Test Step 9.
- Not OK – The voltage did not measure 24 ± 3 VDC. Proceed to Test Step 10.

Test Step 9. Check the Voltage at Terminal 4 of the Connector for the Timer.

- Connect a voltmeter between terminal 4 of the connector for the timer and engine ground.
- Turn the ECS to the STOP position.
- Activate the remote emergency stop switch.
- Monitor the voltage on the voltmeter.
- Deactivate the remote emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Results:

- OK – The voltage measures 24 ± 3 VDC for approximately 2.5 seconds.

Repair: Repair wire T708 between the “ASOS” switch and terminal 4 of the timer.

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC for approximately 2.5 seconds.

Repair: Check for 24 ± 3 VDC on terminal 1 of the connector for the timer.

If voltage is not present on terminal 1, repair the wire T120 between terminal 87 of relay “R4A” and terminal 1 of the connector for the timer.

If voltage is present on terminal 1 of the connector for the timer, verify that wire 220 on terminal 2 of the connector for the timer has continuity to the –Battery. If wire 220 does not have continuity to the –Battery, repair the wire.

Verify that 24 ± 3 VDC is present on terminal 3 of the connector for the timer. If 24 ± 3 VDC is not present on terminal 3 of the connector for the timer, verify that the ECS is not in the "OFF/RESET" position. Verify that the "MPD" breaker is not tripped. Check the normally closed contact of relay "R1" for proper operation. Check the wire 120 between terminal 3 of the connector for the timer and relay "R1" for damage. Check the wire A120 between relay "R1" and the "MPD" breaker for damage. If necessary, repair the wires.

If the voltage is present on terminal 1 and 3 of the timer and wire 220 is okay, replace the timer.

STOP.

Test Step 10. Check the Voltage at the Coil of Relay "R4A".

- A. Connect a voltmeter between wire 354 on terminal 86 of relay "R4A" and the engine ground.
- B. Turn the ECS to the STOP position.
- C. Activate the remote emergency stop switch.
- D. Monitor the voltage on the voltmeter.
- E. Deactivate the remote emergency stop switch.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC.

Repair: Check wire 220 on the coil of the "R4A" relay for continuity to the -Battery. If necessary, repair the wire or replace the wire.

Check for 24 ± 3 VDC on wire 120 on terminal 30 of relay "R4A". If 24 ± 3 VDC is not present on wire 120, verify that the ECS is not in the "OFF/RESET" position. Verify that the "MPD" breaker is not tripped. Check the normally closed contact of relay "R1" for proper operation. Check the wire 120 between terminal 30 of the relay "R4A" and relay "R1" for damage. Check the wire A120 between relay "R1" and the "MPD" breaker for damage. If necessary, repair the wires.

If wire 220 is okay and voltage is present on wire 120 on terminal 30, replace relay "R4A".

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC. Proceed to Test Step 11.

Test Step 11. Check the Voltage from the Customer Connector for the Remote Emergency Stop to Relay "R4A".

- A. Turn the ECS to the OFF/RESET position.
- B. Disconnect wire 354 from the terminal AS of the customer connector.
- C. Connect a voltmeter to terminal AS on the customer connector. Connect the other lead from the voltmeter to engine ground.
- D. Turn the ECS to the STOP position.
- E. Activate the remote emergency stop switch.
- F. Monitor the voltage on the voltmeter.
- G. Deactivate the remote emergency stop switch.
- H. Reconnect wire 354.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC.

Repair: Repair the wire 354 between terminal AS on the customer connector and the wire 354 on pin B at connector P-C2 of the rigid harness.

STOP.

- Not OK – The voltage did not measure 24 ± 3 VDC.

Repair: Troubleshoot the customer's connection to the remote emergency stop input on terminal AS of the customer connector.

STOP.

i01900704

Engine Control Switch (ECS)

SMCS Code: 1901-038

System Operation Description:

The Engine Control Switch (ECS) can operate in four modes: OFF/RESET, START, STOP, and REMOTE.

The Primary Electronic Control Module (ECM) receives three signals that allow the ECM to determine the mode of operation. The input signals on P1-21 and P1-22 tell the ECM the position of the ECS. The input signals on P1-21 and P1-22 must be at the same potential or a diagnostic code will be generated. The third input signal on P1-68 tells the ECM if the ECS is in the REMOTE position. If the input signal on P1-68 is low, the ECM knows that the ECS is in the REMOTE position. The ECM knows that the engine is controlled remotely by the customer. If the input signal on P1-68 is not low, the ECM knows that the ECS is not in the REMOTE position. The ECM knows that the engine is controlled locally by the ECS on the instrument panel.

When the ECS is in the REMOTE position, inputs from the customer control the operation of the engine. The following list contains some of the inputs from the customer connector and the inputs function.

- C remote start 2
- D remote start 1
- E remote stop 1
- F remote stop 2
- S remote input
- -C keyswitch

When the ECS is in the REMOTE position, the "Remote Start" relay and the "Remote Stop" relay are energized. When the remote start inputs C and D go low, the following relays energize: "Run 1" relay, "Run 2" relay, "Reset 1" relay, and "Reset 2" relay. The start/run/stop inputs P1-21 and P1-22 will be pulled low. The engine will begin the start cycle. When the customer's remote stop inputs F and E are low, the following relays energize: "Stop 1" relay and "Stop 2" relay. The start/run/stop inputs P1-21 and P1-22 will be high. The engine will begin the stop function. When the ECS is in the REMOTE position, the "ECS in Remote" relay energizes. The "ECS in Remote" relay sends a signal to the customer connector that allows the customer to determine the position of the ECS.

When the ECS is in the START position, the following relays energize: "Run 1" relay, "Run 2" relay, "Reset 1" relay, and "Reset 2" relay. The start/run/stop inputs P1-21 and P1-22 will be pulled low. The engine will begin the start cycle.

When the ECS is in the STOP position, the following relays energize: "Stop 1" relay and "Stop 2" relay. The start/run/stop inputs P1-21 and P1-22 will be high.

When the ECS is in the OFF/RESET position, none of the relays are energized.

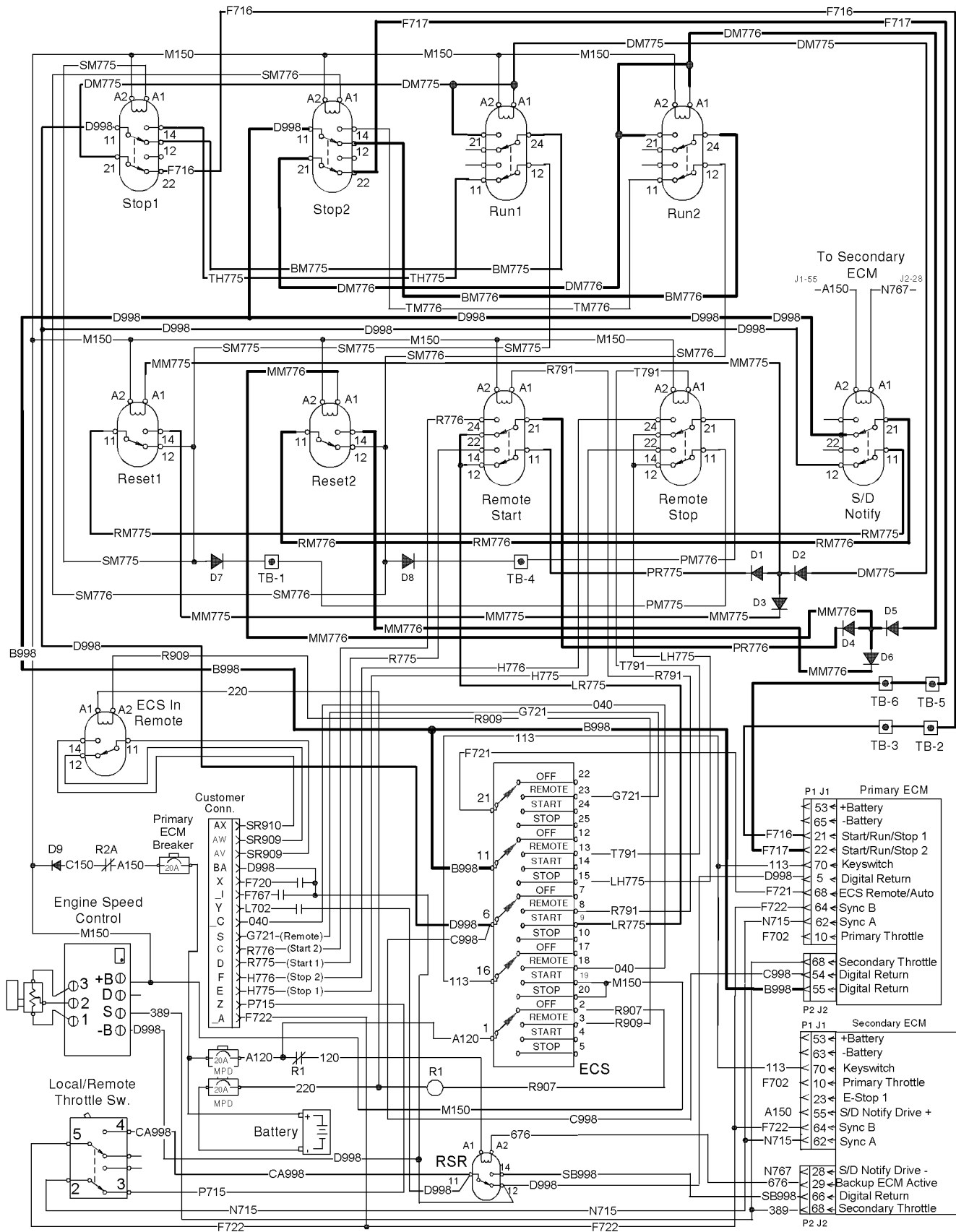


Illustration 30

Typical example

Test Step 1. Check for Connector Damage.

- A. Turn the circuit breaker for the battery to the OFF position.
- B. Turn the ECS to the OFF/RESET position.
- C. Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details.
- D. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the circuit.
- E. Check the ECM connector (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).
- F. Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted. The harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring need repair.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Check the Status of the ECS in the STOP Position.

- A. Turn the circuit breaker for the battery to the ON position.
- B. Connect the Caterpillar Electronic Technician (ET) to the service tool connector.
- C. Turn the ECS on the instrument panel to the STOP position.
- D. Observe the status for the ECS on Cat ET.

Expected Result:

The status for the ECS is "STOP".

Results:

- OK – The ECS is functioning correctly. Proceed to Test Step 3.
- Not OK – The status for the ECS is not "STOP". Proceed to Test Step 5.

Test Step 3. Check the Status of the ECS in the START Position.

- A. Turn the ECS on the instrument panel to the START position.
- B. Observe the status for the ECS on Cat ET.

Expected Result:

The status for the ECS is "RUN".

Results:

- OK – The ECS is functioning correctly. Proceed to Test Step 4.
- Not OK – The status of the ECS is not "RUN". Proceed to Test Step 5.

Test Step 4. Check the Status of the ECS in the REMOTE Position.

- A. Turn the ECS on the instrument panel to the REMOTE position.
- B. Observe the status for the ECS on Cat ET.

Expected Result:

The status for the ECS is "AUTO".

Results:

- OK – The ECS is working correctly.

Repair: The problem may be intermittent. If the problem is intermittent, perform the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

STOP.

- ECS Not OK – The status for the ECS is not "AUTO". Proceed to Test Step 6.

Test Step 5. Install a Wire Jumper at the ECM in order to Simulate a START/STOP Function.

- A. Turn the ECS to the OFF/RESET position.
- B. Disconnect the ECM connector P1.

- C. Remove wire F716 from P1-21. Install a wire jumper into the socket P1-21.
- D. Remove wire F717 from P1-22. Install a wire jumper into the socket P1-22.
- E. Reconnect the ECM connector P1.
- F. Fabricate a wire jumper.
- G. Install the wire jumper between terminal 11 of the ECS and the wire jumpers in P1-21 and P1-22.
- H. Turn the ECS to the STOP position.
- I. Observe the status for the ECS on Cat ET.
- J. Remove the wire jumper between terminal 11 of the ECS and the wire jumpers in P1-21 and P1-22.
- K. Observe the status for the ECS on Cat ET.
- L. Turn the ECS to the OFF/RESET position. Remove the wire jumpers and replace all wires. Reconnect the ECM connector P1.

Expected Result:

The status for the ECS displays "RUN" while the wire jumper is installed. The status for the ECS displays "STOP" when the wire jumper is removed.

Results:

- OK – The status for the ECS displays the proper states. The problem is not with the ECM. Troubleshoot the wire F716 and the wire F717. In order to troubleshoot the wire F716, proceed to Test Step 7. In order to troubleshoot the wire F717, proceed to Test Step 13.
- Not OK – The status for the ECS does not display the correct state.

Repair: Replace the ECM. Refer to the diagnostic procedure Troubleshooting, "Replacing the ECM".

STOP.

Test Step 6. Install a Wire Jumper at the ECM in order to Simulate an AUTO Condition.

- A. Turn the ECS on the instrument panel to the OFF/RESET position.
- B. Disconnect the ECM connector P1.
- C. Remove wire F721 from P1-68. Install a wire jumper into the socket P1-68.

- D. Reconnect the ECM connector P1.
- E. Fabricate a wire jumper.
- F. Install the wire jumper between terminal 11 of the ECS and the wire jumper in P1-68.
- G. Turn the ECS to the STOP position.
- H. Observe the status for the ECS on Cat ET.
- I. Remove the wire jumper between terminal 11 of the ECS and the wire jumper in P1-68.
- J. Observe the status for the ECS on Cat ET.
- K. Turn the ECS to the OFF/RESET position. Remove the wire jumpers and replace all wires. Reconnect the ECM connector P1.

Expected Result:

The status for the ECS displays "AUTO" while the wire jumper is installed. The status for the ECS displays "OFF" when the wire jumper is removed.

Results:

- OK – The status for the ECS displays the proper states. The problem is not with the ECM. Troubleshoot the wire F716 and the wire F717. In order to troubleshoot the wire F716, proceed to Test Step 7. In order to troubleshoot the wire F717, proceed to Test Step 13.
- Not OK – The status for the ECS does not display the correct state.

Repair: Replace the ECM. Refer to the diagnostic procedure Troubleshooting, "Replacing the ECM".

STOP.

Test Step 7. Check for Voltage on Wire F716 at the Normally Closed Contacts of the "Stop 1" Relay.

- A. Turn the remote start switch to the OFF position.
- B. Turn the ECS on the instrument panel to the START position.
- C. Measure the voltage between wire F716 at the normally closed contacts of the "Stop 1" relay and engine ground.
- D. Turn the ECS that is on the instrument panel to the STOP position.

Expected Result:

The voltage is 6.5 ± 0.5 VDC.

Results:

- OK – The voltage is 6.5 ± 0.5 VDC. Proceed to Test Step 8.
- Not OK – The voltage is not 6.5 ± 0.5 VDC.

Repair: Repair the wire F716 between the normally closed contacts on the “Stop 1” relay and the ECM.

STOP.

Test Step 8. Check for Voltage on Wire DM775 at the Normally Closed Contacts of the “Stop 1” Relay.

- A. Turn the ECS on the instrument panel to the START position.
- B. Measure the voltage between wire DM775 at the normally closed contacts of the “Stop 1” relay and engine ground.
- C. Turn the ECS that is on the instrument panel to the STOP position.

Expected Result:

The voltage is 6.5 ± 0.5 VDC.

Results:

- OK – The voltage is 6.5 ± 0.5 VDC. Proceed to Test Step 9.
- Not OK – The voltage is not 6.5 ± 0.5 VDC. The “Stop 1” relay’s normally closed contacts are faulty or the “Stop 1” relay is energized.

Repair: Check the voltage across the coil of the “Stop 1” relay. If voltage is present across the coil of the “Stop 1” relay, ensure that the ECS is not in the STOP position.

If no voltage is measured across the coil of the “Stop 1” relay, the normally closed contacts between wire F716 and wire DM775 are faulty. Replace the “Stop 1” relay and check for diagnostic codes.

STOP.

Test Step 9. Check for Voltage on Wire DM775 at the Normally Open Contacts of the “Run 1” Relay.

- A. Turn the ECS on the instrument panel to the START position.

- B. Measure the voltage between wire DM775 at the normally open contacts of the “Run 1” relay and engine ground.

- C. Turn the ECS that is on the instrument panel to the STOP position.

Expected Result:

The voltage is 6.5 ± 0.5 VDC.

Results:

- OK – The voltage is 6.5 ± 0.5 VDC. Proceed to Test Step 10.
- Not OK – The voltage is not 6.5 ± 0.5 VDC.

Repair: There is a problem with the wire DM775 between the “Stop 1” relay and the “Run 1” relay. Repair the wire DM775.

STOP.

Test Step 10. Check for Voltage on Wire BM775 at the Normally Open Contacts of the “Run 1” Relay.

- A. Turn the ECS on the instrument panel to the START position.

- B. Measure the voltage between wire BM775 at the normally open contacts of the “Run 1” relay and engine ground.

- C. Turn the ECS that is on the instrument panel to the STOP position.

Expected Result:

The voltage is 6.5 ± 0.5 VDC.

Results:

- OK – The voltage is 6.5 ± 0.5 VDC. Proceed to Test Step 11.
- Not OK – The voltage is not 6.5 ± 0.5 VDC. The “Run 1” relay is not energized or there is a problem with the normally open contacts between wire DM775 and wire BM775.

Repair: Check the voltage across the coil of the “Run 1” relay. The voltage should measure 24 ± 3 VDC. If the voltage is not 24 ± 3 VDC, verify that 24 ± 3 VDC is present between wire 120 at the coil of the “Run 1” relay and engine ground. If the voltage is present, verify that wire DM775 has continuity between the coil of the “Run 1” relay and the ECM. If wire DM775 is okay, replace the “Run 1” relay. If wire DM775 is not okay, repair the wire.

STOP.

Test Step 11. Check for Voltage on Wire BM775 at the Normally Closed Contacts of the "Stop 1" Relay.

- A. Turn the ECS on the instrument panel to the START position.
- B. Measure the voltage between wire BM775 at the normally closed contacts of the "Stop 1" relay and engine ground.
- C. Turn the ECS that is on the instrument panel to the STOP position.

Expected Result:

The voltage is 6.5 ± 0.5 VDC.

Results:

- OK – The voltage is 6.5 ± 0.5 VDC. Proceed to Test Step 12.
- Not OK – The voltage is not 6.5 ± 0.5 VDC.

Repair: There is a problem with the wire BM775 between the "Stop 1" relay and the "Run 1" relay. Repair the wire BM775.

STOP.

Test Step 12. Check for Voltage on Wire D998 at the Normally Closed Contacts of the "Stop 1" Relay.

- A. Turn the ECS on the instrument panel to the START position.
- B. Measure the voltage between wire D998 at the normally closed contacts of the "Stop 1" relay and engine ground.
- C. Turn the ECS to the STOP position.

Expected Result:

The voltage is 6.5 ± 0.5 VDC.

Results:

- OK – The voltage is 6.5 ± 0.5 VDC. The digital return wire is open between the "Stop 1" relay and the ECM.

Repair: Repair the wire D998.

STOP.

- Not OK – The voltage is not 6.5 ± 0.5 VDC. The normally closed contacts between wire BM775 and wire D998 are open.

Repair: Check the voltage across the coil of the "Stop 1" relay. The voltage should not measure 24 ± 3 VDC. If the voltage is 24 ± 3 VDC, the wire SM775 is shorted to ground or the ECS is in the STOP position. Repair the wire SM775 or repair the ECS. If voltage is not present across the coil of the "Stop 1" relay, replace the "stop 1" relay.

STOP.

Test Step 13. Check for Voltage on Wire F717 at the Normally Closed Contacts of the "Stop 2" Relay.

- A. Turn the remote start switch to the OFF position.
- B. Turn the ECS on the instrument panel to the START position.
- C. Measure the voltage between wire F717 at the normally closed contacts of the "Stop 2" relay and engine ground.
- D. Turn the ECS that is on the instrument panel to the STOP position.

Expected Result:

The voltage is 6.5 ± 0.5 VDC.

Results:

- OK – The voltage is 6.5 ± 0.5 VDC. Proceed to Test Step 14.
- Not OK – The voltage is not 6.5 ± 0.5 VDC.

Repair: Repair the wire F717 between the normally closed contacts on the "Stop 2" relay and the ECM.

STOP.

Test Step 14. Check for Voltage on Wire DM776 at the Normally Closed Contacts of the "Stop 2" Relay.

- A. Turn the ECS on the instrument panel to the START position.
- B. Measure the voltage between wire DM776 at the normally closed contacts of the "Stop 2" relay and engine ground.
- C. Turn the ECS that is on the instrument panel to the STOP position.

Expected Result:

The voltage is 6.5 ± 0.5 VDC.

Results:

- OK – The voltage is 6.5 ± 0.5 VDC. Proceed to Test Step 15.
- Not OK – The voltage is not 6.5 ± 0.5 VDC. There is a problem with the normally closed contacts of the “Stop 2” relay or the “Stop 2” relay is energized.

Repair: Check the voltage across the coil of the “Stop 2” relay. If voltage is present across the coil of the “Stop 2” relay, ensure that the ECS is not in the STOP position.

If no voltage is measured across the coil of the “Stop 2” relay, there is a problem with the normally closed contacts between wire F717 and wire DM776. Replace the “Stop 2” relay and check for diagnostic codes.

STOP.

Test Step 15. Check for Voltage on Wire DM776 at the Normally Open Contacts of the “Run 2” Relay.

- A. Turn the ECS on the instrument panel to the START position.
- B. Measure the voltage between wire DM776 at the normally open contacts of the “Run 2” relay and engine ground.
- C. Turn the ECS that is on the instrument panel to the STOP position.

Expected Result:

The voltage is 6.5 ± 0.5 VDC.

Results:

- OK – The voltage is 6.5 ± 0.5 VDC. Proceed to Test Step 16.
- Not OK – The voltage is not 6.5 ± 0.5 VDC.

Repair: There is a problem with the wire DM776 between the “Stop 2” relay and the “Run 2” relay. Repair the wire DM776.

STOP.

Test Step 16. Check for Voltage on Wire BM776 at the Normally Open Contacts of the “Run 2” Relay.

- A. Turn the ECS on the instrument panel to the START position.
- B. Measure the voltage between wire BM776 at the normally open contacts of the “Run 2” relay and engine ground.

- C. Turn the ECS that is on the instrument panel to the STOP position.

Expected Result:

The voltage is 6.5 ± 0.5 VDC.

Results:

- OK – The voltage is 6.5 ± 0.5 VDC. Proceed to Test Step 17.
- Not OK – The voltage is not 6.5 ± 0.5 VDC. The “Run 2” relay is not energized or there is a problem with the normally open contacts between wire DM776 and wire BM776.

Repair: Check the voltage across the coil of the “Run 2” relay. The correct voltage is 24 ± 3 VDC. If the voltage is not 24 ± 3 VDC, verify that 24 ± 3 VDC is present between wire 120 at the coil of the “Run 2” relay and engine ground. If the voltage is present, verify that wire DM776 has continuity between the coil of the “run 2 relay” and the ECM. If wire DM776 is okay, replace the “Run 2” relay. If wire DM776 is not okay, repair the wire or the component.

STOP.

Test Step 17. Check for Voltage on Wire BM776 at the Normally Closed Contacts of the “Stop 2” Relay.

- A. Turn the ECS on the instrument panel to the START position.
- B. Measure the voltage between wire BM776 at the normally closed contacts of the “Stop 2” relay and engine ground.
- C. Turn the ECS that is on the instrument panel to the STOP position.

Expected Result:

The voltage is 6.5 ± 0.5 VDC.

Results:

- OK – The voltage is 6.5 ± 0.5 VDC. Proceed to Test Step 18.
- Not OK – The voltage is not 6.5 ± 0.5 VDC.

Repair: There is a problem with the wire BM776 between the “Stop 2” relay and the “run 2 relay”. Repair the wire BM776.

STOP.

Test Step 18. Check for Voltage on Wire D998 at the Normally Closed Contacts of the “Stop 2” Relay.

- A. Turn the ECS on the instrument panel to the START position.
- B. Measure the voltage between wire D998 at the normally closed contacts of the “Stop 2” relay and engine ground.
- C. Turn the ECS that is on the instrument panel to the STOP position.

Expected Result:

The voltage is 6.5 ± 0.5 VDC.

Results:

- OK – The voltage is 6.5 ± 0.5 VDC. The digital return wire is open between the “Stop 2” relay and the ECM.

Repair: Repair the wire D998.

STOP.

- Not OK – The voltage is not 6.5 ± 0.5 VDC. The normally closed contacts between wire BM776-BK and wire D998 are open.

Repair: Check the voltage across the coil of the “Stop 2” relay. The correct voltage is 24 ± 3 VDC. If the voltage is 24 ± 3 VDC, the wire SM776 is shorted to ground or the ECS is in the STOP position. Repair the wire SM776 or repair the ECS. If voltage is not present across the coil of the “Stop 2” relay, replace the “Stop 2” relay.

STOP.

i01905746

Engine Sensor Open/Short Test

SMCS Code: 1901-038

System Operation Description:

Engine sensors provide various signals to the engine's primary Electronic Control Module (ECM). These sensors receive a regulated voltage from the primary ECM. Analog sensors receive 5.0 ± 0.2 VDC and digital sensors receive 8.0 ± 0.4 VDC.

The primary ECM performs an automatic calibration of these sensors whenever power is first applied to the engine ECM and the engine has been off for at least five seconds. During an automatic calibration, the primary ECM calibrates pressure sensors against the atmospheric pressure sensor and an acceptable offset pressure range.

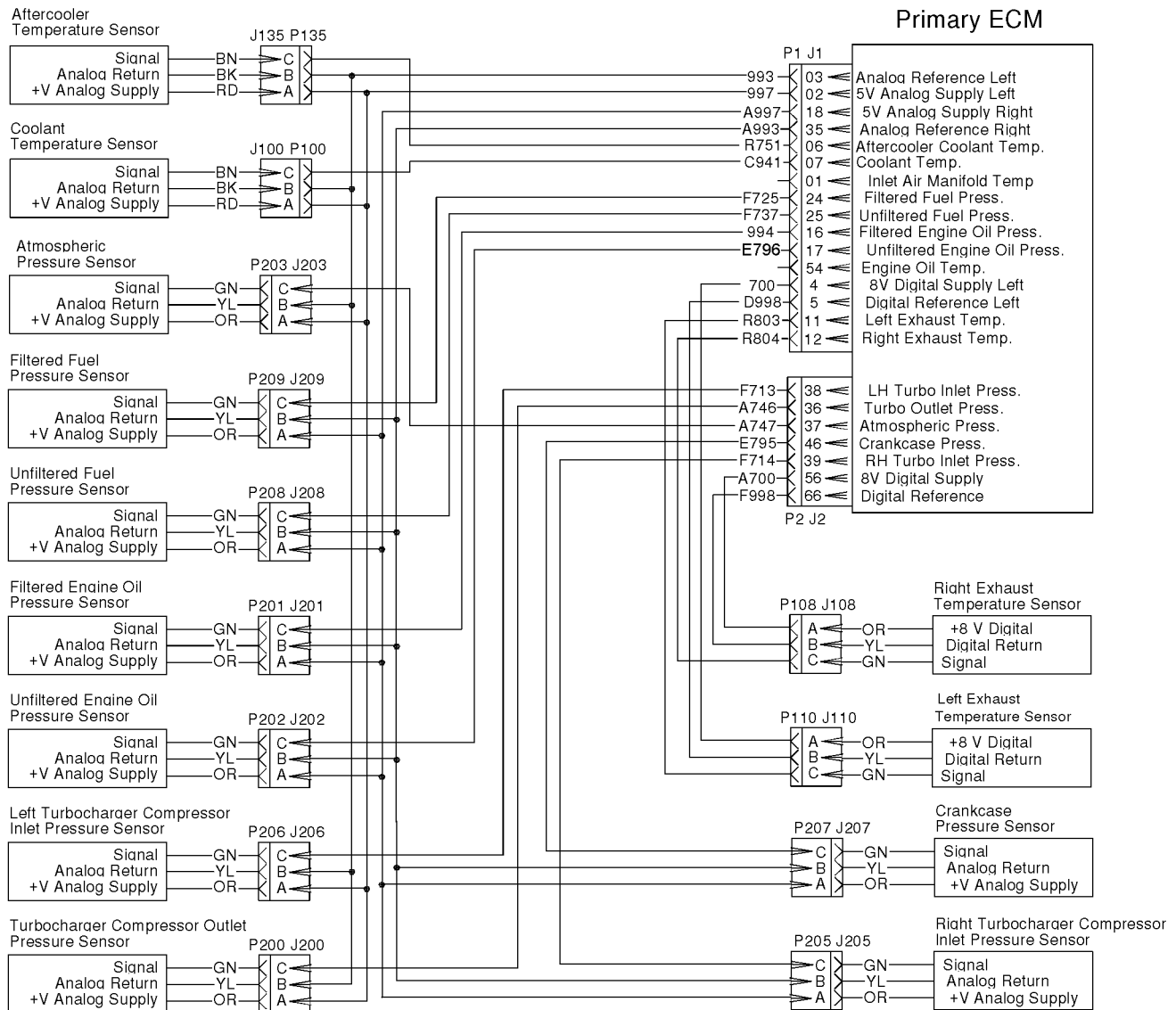


Illustration 31

g00992368

Typical example

Test Step 1. Check for Connector Damage.

- Turn the ECS to the OFF/RESET position.
- Turn the battery disconnect switch to the OFF position.
- Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details.

- Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the circuit.
- Check the ECM connector (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).
- Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted. The harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring are not okay.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Check for Active Diagnostic Codes.

- A. Connect the Caterpillar Electronic Technician (ET) to the ECM through the service tool connector.
- B. Turn the battery disconnect switch to the ON position.
- C. Turn the ECS to the STOP position. The engine should be off.
- D. Wait for 15 seconds for the CID-FMI.

Expected Result:

Determine the failure mode identifier (FMI). Determine if the diagnostic codes 262-03 5 Volt Sensor DC Power Supply short to +batt or 262-04 5 Volt Sensor DC Power Supply short to ground are present. Determine if the diagnostic codes 263-03 Digital Sensor Supply short to +batt or 263-04 Digital Sensor Supply short to ground are present.

Results:

- FMI 03 – A diagnostic code with a FMI of 03 is present. Proceed to Test Step 3.
- FMI 04 – A diagnostic code with a FMI of 04 is present. Proceed to Test Step 4.
- FMI 00 or 08 – A diagnostic code with a FMI of 00 or of 08 is present. Proceed to Test Step 11.
- 262-03 or 262-04 Active Code – A diagnostic code of 262-03 or of 262-04 is present.

Repair: Perform the diagnostic functional test Troubleshooting, “Analog Sensor Supply”.

STOP.

- 263-03 or 263-04 Active Code – A diagnostic code of 263-03 or 263-04 is present.

Repair: Perform the diagnostic functional test Troubleshooting, “Digital Sensor Supply”.

STOP.

Test Step 3. Check the Sensor Supply Voltage at the Sensor Connector if the Diagnostic Code FMI-03 is Present.

- A. Turn the ECS to the OFF/RESET position.
- B. Disconnect the suspect sensor.

Note: Disconnecting the sensor will generate an open circuit diagnostic code for any sensor that is disconnected. Troubleshoot the original diagnostic code. Reset the system. Delete the logged diagnostic codes when you are finished.

- C. Turn the ECS to the STOP position. The engine should be off.
- D. Measure the voltage on the ECM side of the sensor connector between pin A and pin B for the suspect sensor.

Expected Result:

The supply voltage is 5.0 ± 0.2 VDC for all analog sensors and 8.0 ± 0.4 VDC for all digital sensors.

Results:

- OK – The voltage is 5.0 ± 0.2 VDC for all analog sensors and 8.0 ± 0.4 VDC for all digital sensors. Proceed to Test Step 5.
- Not OK – The voltage is not 5.0 ± 0.2 VDC for all analog sensors and 8.0 ± 0.4 VDC for all digital sensors. Proceed to Test Step 7.

Test Step 4. Check the Sensor Supply Voltage at the Sensor Connector if the Diagnostic Code FMI-04 is Present.

- A. Turn the ECS to the OFF/RESET position.
- B. Disconnect the suspect sensor.

Note: Disconnecting the sensor will generate an open circuit diagnostic code for any sensor that is disconnected. Troubleshoot the original diagnostic code. Reset the system. Delete the logged diagnostic codes when you are finished.

- C. Turn the ECS to the STOP position. The engine should be off.

- D. Measure the voltage on the ECM side of the sensor connector between pin A and pin B for the suspect sensor.

Expected Result:

The supply voltage is 5.0 ± 0.2 VDC for all analog sensors and 8.0 ± 0.4 VDC for all digital sensors.

Results:

- OK – The voltage is 5.0 ± 0.2 VDC for all analog sensors and 8.0 ± 0.4 VDC for all digital sensors. Proceed to Test Step 8.
- Not OK – The voltage is not 5.0 ± 0.2 VDC for all analog sensors and 8.0 ± 0.4 VDC for all digital sensors. Proceed to Test Step 7.

Test Step 5. Check for a Short to the +Battery.

- A. Turn the ECS to the OFF/RESET position.

- B. Disconnect the suspect sensor.

Note: Disconnecting the sensor will generate an open circuit diagnostic code for any sensor that is disconnected. Troubleshoot the original diagnostic code. Reset the system. Delete the logged diagnostic codes when you are finished.

- C. Turn the ECS to the STOP position. The engine should be off.

- D. Measure the voltage on the ECM side of the sensor connector between pin B and the engine ground.

- E. Measure the voltage on the ECM side of the sensor connector between pin C and the engine ground.

- F. Turn the ECS to the OFF/RESET position.

Expected Result:

The voltage measures 24 ± 3 VDC when a short to the +Battery is present.

Results:

- OK – The voltage measures 24 ± 3 VDC. A short to the +Battery is present.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

- Not OK – The voltage on pin B should measure 0 VDC. The voltage on pin C may measure approximately 6.5 VDC. The voltage on pin C is a pull up voltage. The ECM provides the pull up voltage to the signal input when the ECM senses an open circuit in the incoming input signal. Frequency sensors do not receive a pull up voltage. The sensor common and signal wire are not shorted to the +Battery. Proceed to Test Step 6.

Test Step 6. Create a Short at the Sensor Connector.

- A. Turn the ECS to the OFF/RESET position.

- B. Use a wire jumper to connect pin B and pin C together on the sensor connector.

- C. Turn the ECS to the STOP position. The engine should be off.

- D. Check if the CID-FMI has changed from 03 to 04.

- E. Turn the ECS to the OFF/RESET position.

- F. Remove the wire jumper.

Expected Result:

The CID-FMI changes from 03 to 04.

Results:

- OK – The CID-FMI changed from 03 to 04. The circuit now indicates a short circuit diagnostic code.

Repair: Temporarily connect a new sensor. Verify that the new sensor solves the problem before you permanently install the new sensor. Calibrate the sensor.

STOP.

- Not OK – The CID-FMI did not change from 03 to 04. The circuit indicates an open circuit diagnostic code. Proceed to Test Step 9.

Test Step 7. Check the Sensor Supply Voltage at the ECM.

- A. Turn the ECS to the OFF/RESET position.

- B. Check the analog supply voltage.

- a. Check the left analog supply voltage by removing wire 997 in P1-02 and wire 993 in P1-03 from ECM connector P1. Install a wire jumper into the sockets for P1-02 and for P1-03.

- b. Check the right analog supply voltage by removing wire A997 in P1-18 and wire A993 in P1-35 from ECM connector P1. Install a wire jumper into the sockets for P1-35 and for P1-18.

Note: If you remove the sensor common from the ECM, an open circuit diagnostic code will be generated for all sensors that use the sensor common. Troubleshoot the original code. Delete the logged diagnostic codes when you are finished.

C. Check the digital supply voltage.

- a. Check the left digital supply voltage by removing wire 700 in P1-04 and wire D998 in P1-05 from ECM connector P1. Install a wire jumper into the sockets for P1-04 and for P1-05.
- b. Check the right digital supply voltage by removing wire A700 in P2-56 and wire F998 in P2-66 from ECM connector P2. Install a wire jumper into the sockets for P2-56 and for P2-66.

Note: If you remove the sensor common from the ECM, an open circuit diagnostic code will be generated for all sensors that use the sensor common. Troubleshoot the original code. Delete the logged diagnostic codes when you are finished.

D. Reconnect ECM connector J1/P1 and J2/P2.

E. Turn the ECS to the STOP position. The engine should be off.

F. Measure the analog voltage between the wire jumpers.

G. Measure the digital voltage between the wire jumpers.

H. Turn the ECS to the OFF/RESET position.

I. Turn the keyswitch for the ECM to the OFF position.

J. Remove the wire jumpers and replace all wires. Reconnect ECM connector J1/P1.

Expected Result:

The supply voltage is 5.0 ± 0.2 VDC for all analog sensors and 8.0 ± 0.4 for all digital sensors.

Results:

- OK - Analog or Digital – The supply voltage is 5.0 ± 0.2 VDC for all analog sensors and 8.0 ± 0.4 for all digital sensors. The supply voltage at the ECM is correct. There is a problem in the wiring between the ECM and the suspect sensor.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

- Not OK - Analog or Digital – The supply voltage is not 5.0 ± 0.2 VDC for all analog sensors and 8.0 ± 0.4 for all digital sensors. The voltage at the ECM is not correct.

Repair: Perform the diagnostic functional test Troubleshooting, "Electrical Power Supply".

STOP.

Test Step 8. Create an Open Circuit at the Sensor Connector.

A. Turn the ECS to the OFF/RESET position.

B. Leave the sensor disconnected.

C. Wait for a period of 15 seconds.

D. Turn the ECS to the STOP position. The engine should be off.

E. The CID-FMI should change from 04 to 03.

Note: Disconnecting the atmospheric pressure sensor will cause several sensor diagnostic codes to become active. Troubleshoot the original code. Delete the logged diagnostic codes when you are finished.

F. Turn the ECS to the OFF/RESET position.

G. Reconnect the suspect sensor.

Expected Result:

The CID-FMI changes from 04 to 03 when the sensor is disconnected.

Results:

- OK – The CID-FMI changed from 04 to 03 when the sensor was disconnected. The open circuit was seen by the ECM. The wiring between the ECM and the sensor is good.

Repair: Replace the suspect sensor. Verify that the repair eliminates the problem.

STOP.

- Not OK – The CID-FMI did not change from 04 to 03 when the sensor was disconnected. The open circuit was not seen at the ECM. Proceed to Test Step 10.

Test Step 9. Create a Short at the ECM Connector.

- Connect the suspect sensor.
- Remove the suspect sensor's signal wire from ECM connector P1 or P2. Install a wire jumper into the socket for the signal wire.
- Use a jumper to create a short between the wire jumper and the sensor's common wire.
- Turn the ECS to the STOP position. The engine should be off.
- The CID-FMI should change from 03 to 04 when the jumper is in place.
- Turn the ECS to the OFF/RESET position.
- Remove the wire jumper and replace the signal wire. Reconnect ECM connector J1/P1 and/or J2/P2.

Expected Result:

The CID-FMI changes from 03 to 04 when the jumper is in place.

Results:

- OK – The CID-FMI changed from 03 to 04 when the jumper was put in place. The ECM recognized the short at the ECM. There is a problem with the wiring between the ECM and the suspect sensor.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

- Not OK – The CID-FMI did not change from 03 to 04 when the jumper was put in place. The ECM did not see the short at the ECM. Replace the ECM.

Repair: Refer to the diagnostic procedure Troubleshooting, "Replacing the ECM".

STOP.

Test Step 10. Create an Open at the ECM.

- Turn the ECS to the OFF/RESET position.

- Remove the suspect sensor signal wire from J1/P1 or J2/P2.

- Turn the ECS to the STOP position. The engine should be off.

- Check if the CID-FMI has changed from 04 to 03.

Note: Disconnecting the atmospheric pressure sensor will cause several sensor diagnostic codes to become active. Troubleshoot the original code. Delete the logged diagnostic codes when you are finished.

- Turn the ECS to the OFF/RESET position.

- Replace the signal wire and reconnect ECM connector J1/P1 or J2/P2.

Expected Result:

The CID-FMI changes from 04 to 03 when the sensor signal wire is disconnected.

Results:

- OK – The CID-FMI changed from 04 to 03 when the sensor signal wire was disconnected. The ECM recognized the open at the ECM.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

- Not OK – The CID-FMI did not change from 04 to 03 when the sensor signal wire was disconnected. The ECM did not recognize the open at the ECM.

Repair: Refer to the diagnostic procedure Troubleshooting, "Replacing the ECM".

STOP.

Test Step 11. Check the Fluid Level.

- Check the fuel level.
- Check the engine oil level.
- Check for any leaks.

Expected Result:

The fuel and oil level are okay. There are not any leaks.

Results:

- OK – The fuel and oil levels are correct. Proceed to Test Step 12.
- Not OK – The fuel and/or oil levels are not correct.

Repair: If the oil level is low, add oil. If the fuel level is low, add fuel. Repair the leaks. Reset the system and note any active diagnostic codes.

STOP.

Test Step 12. Compare the Pressure or Temperature to the Actual Pressure or Temperature.

- A. Turn the ECS to the OFF/RESET position.
- B. If you are troubleshooting a temperature sensor, install a 6V-9130 Temperature Adapter near the sensor.
- C. Turn the ECS to the STOP position. The engine should be off.
- D. Observe the temperature reading for the suspect sensor. The Cat ET screen should display the same temperature as the 6V-9130 Temperature Adapter.
- E. If you are troubleshooting a pressure sensor, disconnect the sensor.
- F. Remove the suspect sensor from the engine.
- G. Reconnect the suspect sensor.
- H. Connect the vacuum pump test unit to the suspect sensor.
- I. Connect the vacuum pump to the differential pressure gauge.
- J. Turn the ECS to the STOP position.
- K. Observe the pressure reading for the suspect sensor. The Cat ET should display the barometric pressure in your area.
- L. Use the vacuum pump to pull 5 kPa (0.7 psi) of vacuum on the differential pressure gauge.

Note: The pressure gauge reading should remain constant until the vacuum is released.

- M. Compare the readings on the Cat ET and the pressure test kit.

Expected Result:

The Cat ET shows the correct temperature. The Cat ET shows constant pressure. The Cat ET shows a 5 ± 2 kPa (0.7 ± 0.3 psi) drop in pressure when the vacuum is applied.

Results:

- OK – The correct temperature is shown on the Cat ET. A constant pressure is shown on the Cat ET. A 5 ± 2 kPa (0.7 ± 0.3 psi) drop in pressure is shown on the Cat ET when the vacuum is applied. The sensor is working correctly.

Repair: Reset the system and note any active diagnostic codes.

STOP.

- Not OK - Analog – A constant pressure is not shown on the Cat ET. A 5 ± 2 kPa (0.7 ± 0.3 psi) drop in pressure is not shown on the Cat ET while the vacuum is being applied. An analog sensor is not producing the correct reading. Proceed to Test Step 13.
- Not OK - Digital – The correct temperature is not shown on the Cat ET. A digital sensor is not producing the correct reading. Proceed to Test Step 14.
- Vacuum Leak – A vacuum leak is suspected.

Repair: Check for leaks. If no leaks are found, there is an internal leak in the suspect pressure sensor. Replace the sensor and calibrate the sensor. Reset the system and note any active diagnostic codes.

STOP.

Test Step 13. Check the Analog Sensor's Signal Voltage at the Sensor Connector.

- A. Turn the ECS to the OFF/RESET position.
- B. Remove the sensor's signal wire from pin C of the sensor connector.
- C. Turn the ECS to the STOP position. The engine should be off.
- D. Measure the sensor signal voltage between the sensor's signal wire and pin B at the sensor connector.
- E. Turn the ECS to the OFF/RESET position.
- F. Replace the sensor signal wire and reconnect the sensor.

Expected Result:

The signal voltage is between 0.2 VDC and 4.8 VDC for analog sensors.

Results:

- OK – The signal voltage is between 0.2 VDC and 4.8 VDC for analog sensors. Proceed to Test Step 17.
- Not OK – The signal voltage is not between 0.2 VDC and 4.8 VDC for analog sensors. Proceed to Test Step 15.

Test Step 14. Check the Digital Sensor's Signal Frequency and the Duty Cycle at the Sensor Connector.

- Turn the ECS to the OFF/RESET position.
- Remove the sensor's signal wire from pin C of the sensor connector.
- Turn the ECS to the STOP position. The engine should be off.
- Measure the frequency and the duty cycle between the sensor's signal wire and pin B of the suspect digital sensor at the sensor connector.
- Turn the ECS to the OFF/RESET position.
- Turn the keyswitch for the ECM to the OFF position.
- Replace the sensor's signal wire and reconnect the sensor.

Expected Result:

The frequency reading is approximately 500 Hz.

When the temperature is below 49 °C (120 °F), the duty cycle is between 16 percent to 21 percent.

When the temperature is between 49 °C (120 °F) and 851 °C (1564 °F), the duty cycle is between 22 percent to 88 percent.

Results:

- OK – The frequency and the duty cycle are correct. Proceed to Test Step 18.
- Not OK – The frequency and the duty cycle are not correct. Proceed to Test Step 15.

Test Step 15. Check for Shorts in the Wiring Harness.

- Disconnect the ECM connectors J1/P1 and J2/P2. Disconnect the suspect sensor.
- Measure the resistance between the sensor signal wire and engine ground.

- Measure the resistance between the sensor common and engine ground.
- Measure the resistance between the sensor supply and engine ground at the ECM connector.

- Reconnect all connectors and all sensors.

Expected Result:

The resistance is greater than 20,000 Ohms.

Results:

- OK – The resistance is greater than 20,000 Ohms. Proceed to Test Step 16.
- Not OK – The resistance is less than 20,000 Ohms.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 16. Check the Resistance through the Harness.

- Disconnect the suspect sensor connector.
- Use a suitable piece of wire to connect pin A to pin C.
- Measure the resistance between the sensor signal wire and the sensor voltage supply at the ECM connector P1 or P2.
- Use a suitable piece of wire to connect pin B to pin C.
- Measure the resistance between the sensor signal and the sensor common at the ECM connector P1 or P2.
- Use a suitable piece of wire to connect pin A to pin B.
- Measure the resistance between the sensor supply and the sensor common at the ECM connector P1 or P2.
- Remove all wire shorts.
- Reconnect all connectors and all sensors.

Expected Result:

The resistance is less than 5 Ohms.

Results:

- OK - Analog – The resistance is less than 5 Ohms. Proceed to Test Step 17.

- OK - Digital – The resistance is less than 5 Ohms. Proceed to Test Step 18.
- Not OK – The resistance is greater than 5 Ohms.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 17. Check the Analog Sensor's Signal Voltage at the ECM.

- A. Turn the ECS to the STOP position. The engine should be off.
- B. Measure the sensor signal voltage between pin C and pin B at the ECM connector P1 or P2.
- C. Observe the sensor reading on the status screen on the Cat ET.

Note: The status screen on the Cat ET displays "ABNORMAL SIGNAL" when the ECM reads a signal that is out of the normal range.

- D. Turn the ECS to the OFF/RESET position.

Expected Result:

The signal voltage for the analog sensors is between 0.2 VDC and 4.8 VDC for the suspect analog sensor.

Results:

- OK – The signal voltage for the analog sensors is between 0.2 VDC and 4.8 VDC for the suspect analog sensor. The sensor voltage at the ECM is correct. The Cat ET screen displays the correct information.

Repair: There may be an intermittent problem. If the problem is intermittent, perform the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

STOP.

- Not OK – The signal voltage for the analog sensors is not between 0.2 VDC and 4.8 VDC for the suspect analog sensor. The sensor voltage at the ECM is not correct.

Repair: Repair the connectors and/or wiring between the ECM connector and the sensor.

STOP.

- ABNORMAL SIGNAL – The status screen on the Cat ET displays "ABNORMAL SIGNAL". The signal voltage for the analog sensors is between 0.2 VDC and 4.8 VDC for the suspect analog sensor. The sensor voltage at the ECM is correct.

Repair: Replace the ECM. Refer to the diagnostic procedure Troubleshooting, "Replacing the ECM".

STOP.

Test Step 18. Check the Digital Sensor's Signal Frequency and the Duty Cycle at the ECM.

- A. Turn the ECS to the STOP position.
- B. Measure the frequency and the duty cycle between pin C and pin B at the ECM connector P1 or P2.
- C. Start the engine.
- D. Observe the sensor reading on the status screen on the Cat ET.

Note: The status screen on the Cat ET displays "ABNORMAL SIGNAL" when the ECM reads a signal that is out of normal range.

- E. Turn the ECS to the OFF/RESET position.

Expected Result:

The frequency reading is approximately 500 Hz.

When the temperature is below 49 °C (120 °F), the duty cycle should be between 16 percent to 21 percent.

When the temperature is between 49 °C (120 °F) and 851 °C (1564 °F), the duty cycle is between 22 percent to 88 percent.

While the engine is cold, the Cat ET should read 30 °C (86 °F). As the engine warms up the exhaust temperature increases.

Results:

- OK – The digital sensor voltage at the ECM is correct.

Repair: There may be an intermittent problem. If the problem is intermittent, perform the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

STOP.

- Not OK – The digital sensor voltage at the ECM is not correct.

Repair: Repair the connectors and/or wiring between the ECM and the sensor.

STOP.

- ABNORMAL SIGNAL – The digital sensor voltage at the ECM is correct. The status screen on the Cat ET displays “ABNORMAL SIGNAL”. The signal is out of normal range.

Repair: Replace the ECM. Refer to the diagnostic procedure Troubleshooting, “Replacing the ECM”.

STOP.

i01900706

Engine Speed/Timing Sensor

SMCS Code: 1912-038

System Operation Description:

The engine speed/timing sensors provide engine speed information to the Electronic Control Module (ECM). The sensor generates a pulse signal. A loss of both signals causes the ECM to stop sending power to the fuel injectors.

If the primary engine speed/timing sensor fails, the ECM will use the secondary engine speed/timing sensor until electrical power is removed from the ECM. To prevent any unnecessary down time, the primary sensor should be repaired or replaced at the earliest possible convenience.

The Electronic Control Module (ECM) provides the engine speed/timing sensor with 12 ± 1.0 VDC. The engine speed/timing sensor provides a pulse signal to the ECM. The signal is created as the timing reference gear rotates past the pickup of the engine speed/timing sensor. The timing reference gear is mounted on the rear of the left camshaft. A unique tooth pattern on the timing reference gear allows the ECM to determine the crankshaft position, rotation, and rpm.

Note: If the ring gear is reversed, the diagnostic codes 190-08 and 342-08 will be generated and the ECM will not fire the injector solenoids.

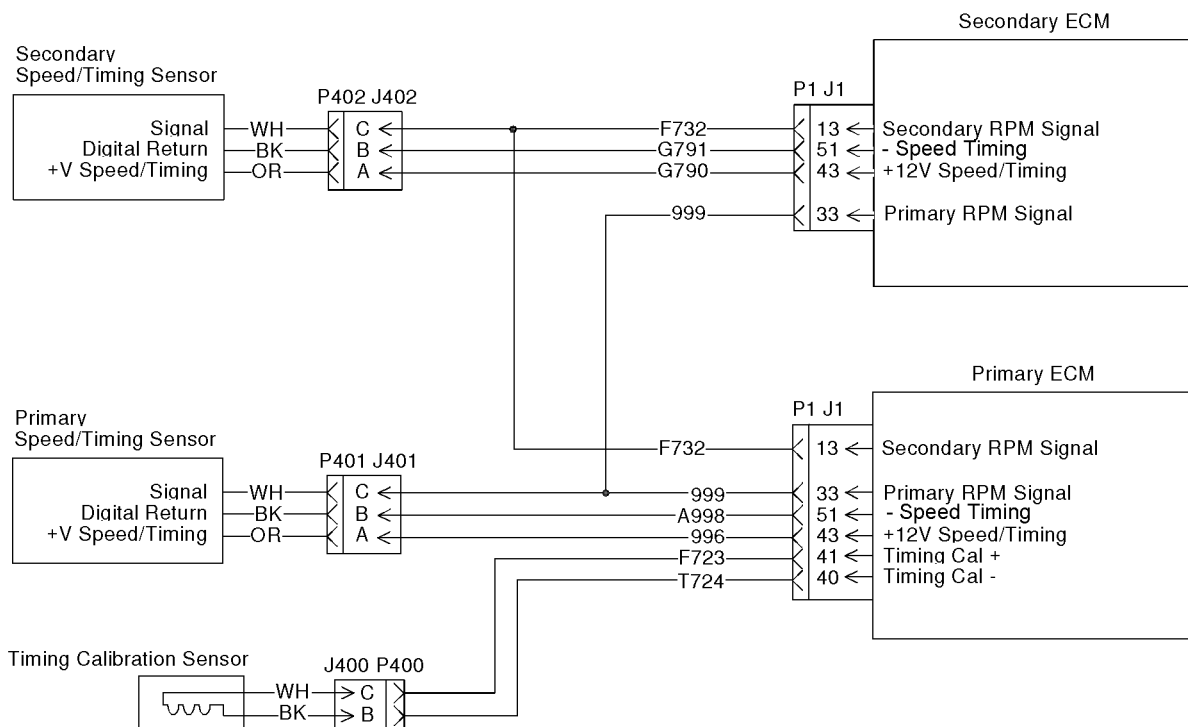


Illustration 32
Typical example

g01012369

Test Step 1. Check for Connector Damage.

- Turn the circuit breaker for the battery to the OFF/RESET position.
- Turn the ECS to the OFF position.
- Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details.
- Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the circuit.
- Check the ECM connector (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).
- Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted, and the harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring need repair.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Check for a CID-FMI.

- Connect the Caterpillar Electronic Technician (ET).
- Turn the circuit breaker for the battery to the ON position.
- Turn the ECS to the STOP position.
- Observe logged diagnostic codes on Cat ET.

Expected Result:

Cat ET indicates a CID-FMI 190-03 or 342-03.

Results:

- OK – Cat ET indicates a CID-FMI 190-03 or 342-03. Proceed to Test Step 3.
- Not OK – Cat ET indicates a CID-FMI 190-02, a CID-FMI 190-07 or a CID-FMI 190-08. Cat ET indicates a CID-FMI 342-02, a CID-FMI 342-07 or a CID-FMI 342-08. Proceed to Test Step 4.

Test Step 3. Check for Shorts in Wiring Harness.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect J1/P1 from the primary ECM. Disconnect J1/P1 from the secondary ECM. Disconnect the primary engine speed/timing sensor J401/P401. Disconnect the secondary engine speed/timing sensor J402/P402.

C. To test the primary engine speed/timing sensor, measure the resistance at the primary ECM connector P1:

Measure the resistance between P1-33 and P1-51.

Measure the resistance between P1-33 and P1-43.

Measure the resistance between P1-43 and P1-51.

Measure the resistance between P1-33 and engine ground.

Measure the resistance between P1-43 and engine ground.

Measure the resistance between P1-51 and engine ground.

D. To test the secondary engine speed/timing sensor, measure the resistance at the secondary ECM connector P1:

Measure the resistance between P1-13 and P1-51.

Measure the resistance between P1-13 and P1-43.

Measure the resistance between P1-43 and P1-51.

Measure the resistance between P1-13 and engine ground.

Measure the resistance between P1-43 and engine ground.

Measure the resistance between P1-51 and engine ground.

Expected Result:

The resistance is greater than 20,000 Ohms.

Results:

- OK – The resistance is greater than 20,000 Ohms. Proceed to Test Step 5.
- Not OK – The resistance is less than 20,000 Ohms. There is a short circuit in the harness wiring.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 4. Check the Engine Speed/Timing Sensor.

Note: An active CID-FMI 190-07 or an active CID-FMI 342-07 indicates that the connectors for the primary engine speed/timing sensor and the secondary engine speed/timing sensor have been installed incorrectly. The connector for the primary engine speed/timing sensor has been installed on the secondary engine speed/timing sensor and the connector for the secondary engine speed/timing sensor has been installed on the primary engine speed/timing sensor. Turn the ECS to the OFF/RESET position and switch the connectors. Turn the ECS to the STOP position and verify that the diagnostic codes are no longer active.

NOTICE

Be sure to extend the sliphead before installing the Speed/Timing Sensor and also check that the Timing Gear is in a position that will not allow the sliphead of the Speed/Timing Sensor to protrude into the slot of the Timing Gear before the sensor is installed (visually inspect with a flashlight). Turn the crankshaft to rotate the Timing Gear, if necessary, to position the gear in a place that will not allow the sliphead to protrude into a slot. If the sensor sliphead does protrude into one of the slots, the sliphead will be broken off as the gear begins to rotate.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect the sensor and remove the sensor.

C. Inspect the plastic sliphead for damage.

D. Check the tension. Gently extend the sliphead 3.5 mm (0.14 inch). Return the sliphead to the original position.

E. Extend the sliphead and reinstall the sensor.

Note: If you are troubleshooting the primary engine speed/timing sensor, disconnect the secondary sensor for the remainder of the test. If you are troubleshooting the secondary engine speed/timing sensor, disconnect the primary sensor for the remainder of the test.

Expected Result:

The sliphead takes at least 22 N (5 lb) of force in order to push in the sliphead from the extended position.

Results:

- OK – The engine speed/timing sensor and the sliphead are undamaged. The tension on the sliphead is normal. Reinstall the sensor. Proceed to Test Step 6.
- Not OK – The engine speed/timing sensor or the sliphead is damaged, or the sliphead has insufficient tension.

Repair: Replace the sensor. Calibrate the sensor. Perform the following diagnostic functional test Troubleshooting, “Engine Speed/Timing Sensor - Calibrate”.

STOP.

Test Step 5. Check for an Open in the Harness.

- A.** Turn the ECS to the OFF/RESET position.
- B.** For the primary engine speed/timing sensor, perform the following steps.
- a. Use a suitable piece of wire to short J401-A and J401-B together.
 - b. Measure the resistance between P1-43 and P1-51. Wiggle the harness during the measurement in order to reveal an intermittent condition.
 - c. Use a suitable piece of wire to short J401-A and J401-C.
 - d. Measure the resistance between P1-43 and P1-33. Wiggle the harness during the measurement in order to reveal an intermittent condition.
- C.** For the secondary engine speed/timing sensor, perform the following steps.
- a. Use a suitable piece of wire to short J402-A and J402-B.

- b. Measure the resistance between P1-43 and P1-51. Wiggle the harness during the measurement in order to reveal an intermittent condition.
 - c. Use a suitable piece of wire to short J402-A and J402-C together.
 - d. Measure the resistance between P1-43 and P1-13. Wiggle the harness during the measurement in order to reveal an intermittent condition.
- D.** Measure the resistance between the primary ECM connector P1-33 and the secondary ECM connector P1-33. Wiggle the harness during the measurement in order to reveal an intermittent condition.
- E.** Measure the resistance between the primary ECM connector P1-13 and the secondary ECM connector P1-13. Wiggle the harness during the measurement in order to reveal an intermittent condition.

Expected Result:

The resistance is less than 5 Ohms through the wires.

Results:

- OK – The resistance is less than 5 Ohms through the wires. Proceed to Test Step 11.
- Not OK – The resistance is greater than 5 Ohms through the wires. There is an open circuit in the harness or connectors.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 6. Check the Engine Speed.

- A.** Turn the ECS to the OFF/RESET position.
- B.** Connect Cat ET.
- C.** Crank the engine.
- D.** Observe the engine speed on the Cat ET screen.

Expected Result:

Cat ET displays a steady reading between 100 and 250 rpm. The engine starts.

Results:

- OK – The engine speed/timing sensor is operating correctly at this time.

Repair: The problem may be intermittent. If the problem is intermittent, perform the diagnostic functional test Troubleshooting, “Inspecting Electrical Connectors”.

STOP.

- ENGINE DOES NOT START – Engine speed appears on the Cat ET screen but the engine does not start.

Repair: Refer to the diagnostic procedure Troubleshooting, “Engine Cranks but Will Not Start”.

STOP.

- NO ENGINE SPEED SIGNAL – The engine will not start and no engine speed signal appears on the Cat ET screen. Proceed to Test Step 7.

Test Step 7. Check the Supply Voltage on the Sensor Side of the Sensor Connector.

- Turn the ECS to the STOP position.
- Measure the voltage between P401-A and P401-B.
- Measure the voltage between P402-A and P402-B.
- Turn the ECS to the OFF/RESET position.

Expected Result:

The voltage is 12 ± 1.0 VDC.

Results:

- OK – The voltage is 12 ± 1.0 VDC. Proceed to Test Step 8.
- Not OK – The voltage is not 12.5 ± 1.0 VDC. Proceed to Test Step 9.

Test Step 8. Check the Isolated Signal from the Sensor at the Sensor Connector.

- Remove pin-C from the sensor connector.
- Turn the ECS to the STOP position.
- Measure the voltage between pin-C and pin-B. Perform this step before you crank the engine. Perform this step while you are cranking the engine.

- Turn the ECS to the OFF/RESET position.

- Reinstall pin-C.

Expected Result:

With the ECS in the STOP position, the voltage is less than 3.0 or the voltage is greater than 10.0 VDC before you crank the engine. The voltage is 2.0 to 7.0 VDC when you crank the engine.

Results:

- OK – With the ECS in the STOP position, the voltage is less than 3.0 or the voltage is greater than 10.0 VDC before you crank the engine. The voltage is 2.0 to 7.0 VDC when you crank the engine. Proceed to Test Step 11.
- Not OK – With the ECS in the STOP position, the voltage is not less than 3.0 or the voltage is not greater than 10.0 VDC before you crank the engine. The voltage is not 2.0 to 7.0 VDC when you crank the engine.

Repair: Replace the sensor. Calibrate the sensor. Perform the diagnostic functional test Troubleshooting, “Engine Speed/Timing Sensor - Calibrate”.

STOP.

Test Step 9. Check the Supply Voltage on the ECM Side of the Sensor Connector.

- Measure voltage between J401-A and J401-B.
- Measure voltage between J402-A and J402-B.

Expected Result:

The voltage is 12 ± 1.0 VDC.

Results:

- OK – The voltage is 12 ± 1.0 VDC. The connector for the sensor is damaged.

Repair: Repair the connector or replace the connector.

STOP.

- Not OK – The voltage is not 12 ± 1.0 VDC. Proceed to Test Step 10.

Test Step 10. Check the Supply Voltage at the ECM.

- Measure the voltage at the primary ECM connector between P1-43 and P1-51. Measure the voltage at the secondary ECM connector between P1-43 and P1-51.

Expected Result:

The voltage is 12 ± 1.0 VDC.

Results:

- OK – There is an open circuit in the harness between the ECM and the sensor.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

- Not OK – Check that the ECM is receiving the correct supply voltage.

Repair: Perform the following diagnostic procedure Troubleshooting, “Electrical Power Supply”.

STOP.

Test Step 11. Check the Signal Voltage at the ECM.

- Turn the ECS to the STOP position.
- Measure the voltage between P1-33 and P1-51 for the primary engine speed/timing sensor. Measure the voltage before you crank the engine and while you crank the engine.
- Measure the voltage between P1-13 and P1-51 for the secondary engine speed/timing sensor. Measure the voltage before you crank the engine and while you crank the engine.

Turn the ECS to the OFF/RESET position.

Expected Result:

With the ECS in the STOP position, the voltage is less than 3.0 or the voltage is greater than 10.0 VDC before you crank the engine. The voltage is 2.0 to 7.0 VDC when you crank the engine.

Results:

- OK – With the ECS in the STOP position, the voltage is less than 3.0 or the voltage is greater than 10.0 VDC before you crank the engine. The voltage is 2.0 to 7.0 VDC when you crank the engine. Proceed to Test Step 12.
- Not OK – The sensor signal is not reaching the ECM. Recheck the harness and connectors for shorts or excessive resistance.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 12. Check the Engine Speed.

- Turn the ECS to the STOP position.
- Observe the engine speed on the Cat ET screen while you crank the engine.

Expected Result:

Cat ET displays a steady engine speed between 100 and 250 rpm while the engine is cranking.

Results:

- OK – Cat ET displays a steady engine speed between 100 and 250 rpm while the engine is cranking. The sensor is operating correctly at this time.

Repair: The problem may be intermittent. If the problem is intermittent, perform the diagnostic functional test Troubleshooting, “Inspecting Electrical Connectors”.

STOP.

- Not OK – A valid signal appears at the ECM connector but the ECM is not reading the signal properly.

Repair: Replace the ECM. Refer to the diagnostic procedure Troubleshooting, “Replacing the ECM”.

STOP.

i01900707

Injector Solenoids

SMCS Code: 1290-038-JV

System Operation Description:

The engine has electronic fuel injectors that are mechanically actuated and electronically energized. The Electronic Control Module (ECM) sends a 105 volt pulse to each injector solenoid. The pulse is sent at the proper time and at the correct duration for a given engine load and speed. The solenoid is mounted on top of the fuel injector body. The 105 volt pulse can be individually cut out to aid in troubleshooting misfire problems.

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

The injector codes must be programmed into the ECM. The injector code is a four digit number (last four digits of the serial number for the injector) that is found on each of the unit injectors. The ECM uses this number to compensate for manufacturing variations between individual injectors. If you replace any of the unit injectors, you must reprogram the code for the new injectors. Also, if you replace the ECM, you must reprogram all of the injector codes. The ECM will generate the following diagnostic code if the injector codes are not programmed:

- 1495-02 Injector Trim Codes Not Programmed

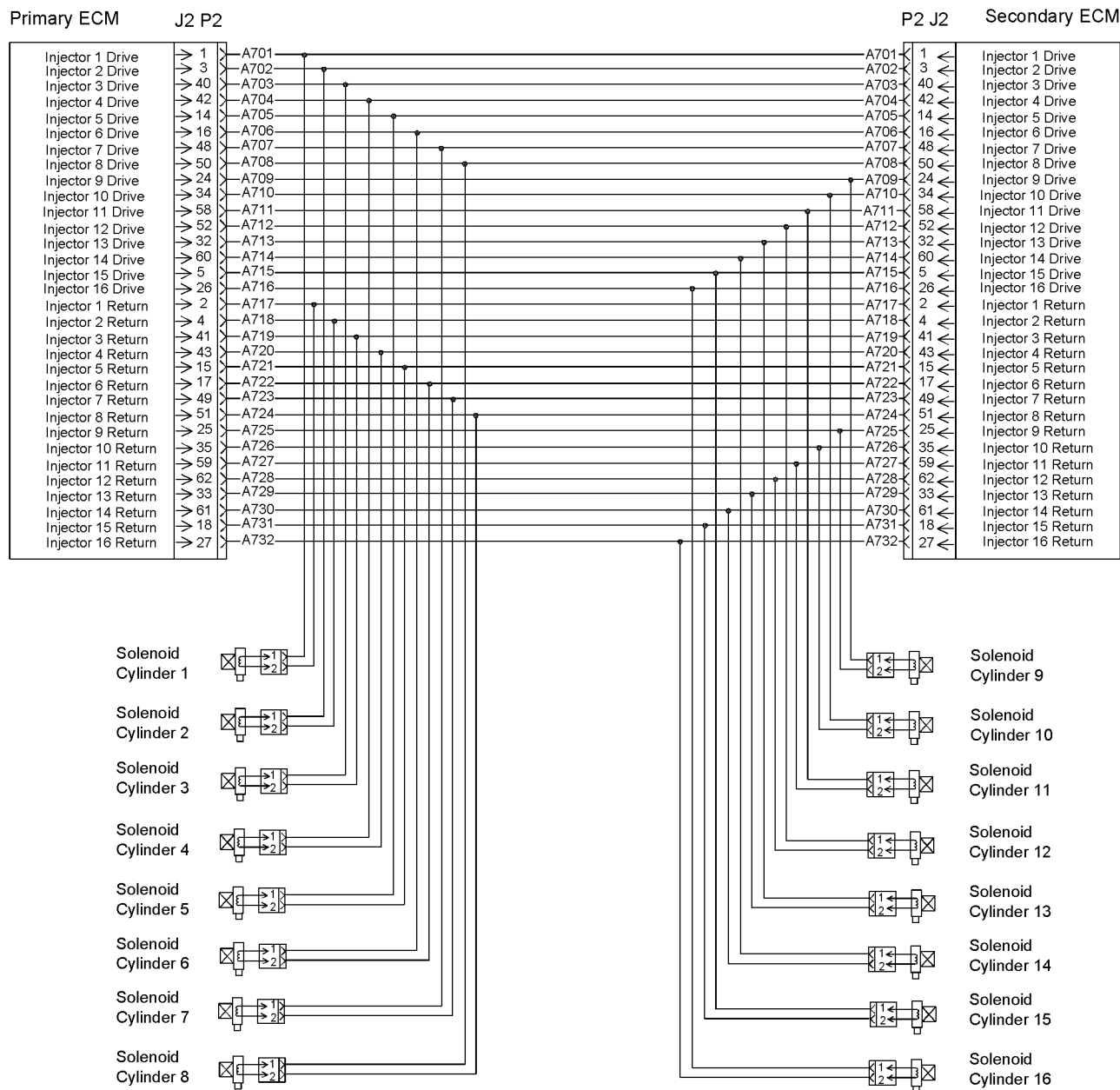


Illustration 33

Typical example

g00992542

Test Step 1. Check for Connector Damage.

- Turn the Engine Control Switch (ECS) to the OFF/RESET position.
- Turn the circuit breaker for the battery to the OFF position.

- Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details.
- Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the circuit.

- E. Check the ECM connector (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).
- F. Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted, and the harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring need repair.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Check for Logged Diagnostic Codes.

- A. Connect the Caterpillar Electronic Technician (ET).
- B. Turn the circuit breaker for the battery to the ON position.
- C. Turn the ECS to the STOP position.
- D. Observe the diagnostic codes on Cat ET.

Expected Result:

A CID-FMI from 1-05 to 16-05 or from 1-06 to 16-06 is not logged.

Results:

- OK – A CID-FMI from 1-05 to 16-05 or from 1-06 to 16-06 is not logged. Proceed to Test Step 3.
- Not OK – A CID-FMI from 1-05 to 16-05 or from 1-06 to 16-06 is logged. Proceed to Test Step 5.

Test Step 3. Perform the “Injector Solenoid Test”.

Note: This test will help the service technician verify that the ECM can fire the solenoids. Do not try to manually crank the engine during this test. The ECM will terminate the “Injector Solenoid Test”.

- A. Perform this test on both the primary ECM and on the secondary ECM.
- B. Turn the circuit breaker for the battery to the OFF position.

- C. Turn the ECS to the OFF/RESET position.

- D. Ensure that the ECM connector J2/P2 is connected. Ensure that the injector connectors J301/P301 through J316/P316 are connected.

- E. Connect Cat ET.

- F. Turn the circuit breaker for the battery to the ON position.

- G. Turn the ECS to the STOP position.

- H. Use diagnostic tests on Cat ET in order to initiate the injector solenoid test.

As each solenoid is energized by the ECM an audible click can be heard at the valve cover. Listen for a click at each valve cover. A black square will appear over the cylinder number when the cylinder is being fired.

Note: A false reading may result from the initial test. By the fourth consecutive test, the readings should become valid.

Expected Result:

As each solenoid is energized by the ECM, an audible click of the solenoid is heard. The solenoids are energized one at a time in the following numerical order: 1-16. There will be momentary delay between each one.

Results:

- OK – As each solenoid is energized an audible click is heard. Proceed to Test Step 4.
- Not OK – Verify that the ECM is receiving correct battery power.

Repair: Perform the diagnostic functional test Troubleshooting, “Electrical Power Supply”.

STOP.

Test Step 4. Perform the “Cylinder Cutout Test”.**NOTICE**

Engine power is reduced when a properly functioning cylinder is cut out. Make sure that you will not damage auxiliary or driven equipment if the engine power is suddenly reduced.

- A. Turn the circuit breaker for the battery to the OFF position.
- B. Turn the ECS to the OFF/RESET position.

- C. Verify that the ECM connector J2/P2 and the injector connectors J301/P301 through J316/P316 are properly connected.
- D. Turn the circuit breaker for the battery to the ON position.
- E. Connect Cat ET.
- F. Start the engine.
- G. Apply a load to the engine.
- H. Use the diagnostic tests on Cat ET to initiate the injector solenoid test.
- I. Check for a difference in the sound, feel, or power of the engine as each cylinder is cut out. The amount of change should be similar for all of the good cylinders. The amount of change should be minimal for a weak cylinder or a bad cylinder.
- J. Disable the override. Repeat above steps for each cylinder (solenoid).

Expected Result:

The amount of change is similar for all of the cylinders. The amount of change should be minimal for a weak cylinder or for a misfiring cylinder.

Results:

- OK – There was a similar change in the sound, feel, or power of the engine as each cylinder was cut out. The injectors are okay.

Repair: The test indicates that all of the cylinders are operating correctly.

STOP.

- Not OK – There was no change in the sound, feel, or power of the engine as one of the cylinder's was cut out. Proceed to Test Step 5.

Test Step 5. Check for a Short between Wires in the Harness.

 WARNING

This engine uses high voltage to control the fuel injectors.

Disconnect the fuel enable circuit connector to prevent personal injury.

Do not come in contact with the fuel injector terminals while the engine is running.

- A. Turn the circuit breaker for the battery to the OFF position.
- B. Turn the ECS to the OFF/RESET position.
- C. Disconnect J2/P2 and J301/P301 through J316/P316.
- D. Measure the resistance between the solenoid wire pairs at the ECM connector P2.
 - Measure the resistance for SOLENOID 1 at P2-1 and P2-2.
 - Measure the resistance for SOLENOID 2 at P2-3 and P2-4.
 - Measure the resistance for SOLENOID 3 at P2-40 and P2-41.
 - Measure the resistance for SOLENOID 4 at P2-42 and P2-43.
 - Measure the resistance for SOLENOID 5 at P2-14 and P2-15.
 - Measure the resistance for SOLENOID 6 at P2-16 and P2-17.
 - Measure the resistance for SOLENOID 7 at P2-48 and P2-49.
 - Measure the resistance for SOLENOID 8 at P2-50 and P2-51.
 - Measure the resistance for SOLENOID 9 at P2-24 and P2-25.
 - Measure the resistance for SOLENOID 10 at P2-34 and P2-35.
 - Measure the resistance for SOLENOID 11 at P2-58 and P2-59.
 - Measure the resistance for SOLENOID 12 at P2-52 and P2-62.
 - Measure the resistance for SOLENOID 13 at P2-32 and P2-33.
 - Measure the resistance for SOLENOID 14 at P2-60 and P2-61.
 - Measure the resistance for SOLENOID 15 at P2-5 and P2-18.
 - Measure the resistance for SOLENOID 16 at P2-26 and P2-27.

Expected Result:

The resistance is greater than 20000 Ohms.

Results:

- OK – The resistance is greater than 20000 Ohms. Proceed to Test Step 6.
- Not OK – The resistance is less than 20000 Ohms. There is a problem in the wiring harness.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 6. Check the Harness for a Short to Engine Ground.

This engine uses high voltage to control the fuel injectors.

Disconnect the fuel enable circuit connector to prevent personal injury.

Do not come in contact with the fuel injector terminals while the engine is running.

A. Measure the resistance between the individual solenoid wires and engine ground at connector P2:

- Measure the resistance between P2-1 and engine ground.
- Measure the resistance between P2-2 and engine ground.
- Measure the resistance between P2-3 and engine ground.
- Measure the resistance between P2-4 and engine ground.
- Measure the resistance between P2-5 and engine ground.
- Measure the resistance between P2-14 and engine ground.
- Measure the resistance between P2-15 and engine ground.
- Measure the resistance between P2-16 and engine ground.
- Measure the resistance between P2-17 and engine ground.
- Measure the resistance between P2-18 and engine ground.
- Measure the resistance between P2-24 and engine ground.
- Measure the resistance between P2-25 and engine ground.
- Measure the resistance between P2-26 and engine ground.
- Measure the resistance between P2-27 and engine ground.
- Measure the resistance between P2-32 and engine ground.
- Measure the resistance between P2-33 and engine ground.
- Measure the resistance between P2-34 and engine ground.
- Measure the resistance between P2-35 and engine ground.
- Measure the resistance between P2-40 and engine ground.
- Measure the resistance between P2-41 and engine ground.
- Measure the resistance between P2-42 and engine ground.
- Measure the resistance between P2-43 and engine ground.
- Measure the resistance between P2-48 and engine ground.
- Measure the resistance between P2-49 and engine ground.
- Measure the resistance between P2-50 and engine ground.
- Measure the resistance between P2-51 and engine ground.
- Measure the resistance between P2-52 and engine ground.
- Measure the resistance between P2-58 and engine ground.
- Measure the resistance between P2-59 and engine ground.
- Measure the resistance between P2-60 and engine ground.

- Measure the resistance between P2-61 and engine ground.
- Measure the resistance between P2-62 and engine ground.

Expected Result:

The resistance is greater than 20000 Ohms.

Results:

- OK – The resistance is greater than 20000 Ohms. Proceed to Test Step 7.
- Not OK – The resistance is less than 20000 Ohms. There is a short in the wiring harness.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 7. Check for an Open in the Harness.

A. Use a suitable piece of wire to short socket-1 to socket-2 at each solenoid connector.

B. Measure the resistance between the following solenoid wire pairs in connector P2:

- Measure the resistance for SOLENOID 1 at P2-1 and P2-2.
- Measure the resistance for SOLENOID 2 at P2-3 and P2-4.
- Measure the resistance for SOLENOID 3 at P2-40 and P2-41.
- Measure the resistance for SOLENOID 4 at P2-42 and P2-43.
- Measure the resistance for SOLENOID 5 at P2-14 and P2-15.
- Measure the resistance for SOLENOID 6 at P2-16 and P2-17.
- Measure the resistance for SOLENOID 7 at P2-48 and P2-49.
- Measure the resistance for SOLENOID 8 at P2-50 and P2-51.
- Measure the resistance for SOLENOID 9 at P2-24 and P2-25.
- Measure the resistance for SOLENOID 10 at P2-34 and P2-35.

- Measure the resistance for SOLENOID 11 at P2-58 and P2-59.
- Measure the resistance for SOLENOID 12 at P2-52 and P2-62.
- Measure the resistance for SOLENOID 13 at P2-32 and P2-33.
- Measure the resistance for SOLENOID 14 at P2-60 and P2-61.
- Measure the resistance for SOLENOID 15 at P2-5 and P2-18.
- Measure the resistance for SOLENOID 16 at P2-26 and P2-27.

Note: Repeat this test step for the secondary ECM.

Expected Result:

The resistance is less than 5 Ohms.

Results:

- OK – The resistance is less than 5 Ohms. Proceed to Test Step 8.
- Not OK – The resistance is greater than 5 Ohms. There is a problem in the wiring harness.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 8. Measure the Resistance of the Injector Solenoids through the Harness Yoke.



Personal injury can result from high voltage.

The Electronic Control Module produces high voltage.

Make sure the Electronic Control Module is not powered and the fuel injector solenoids are disconnected before proceeding.

- A.** Turn the circuit breaker for the battery to the OFF position.
- B.** Turn the ECS to the OFF/RESET position.
- C.** Ensure that the ECM connector J2/P2 is disconnected. Ensure that the injector connectors J301/P301 through J316/P316 are disconnected.

D. Measure the solenoid resistance between pin-1 and pin-2 at J301 through J316.

E. Record the measured resistance for each solenoid.

Expected Result:

The resistance is between 0.5 and 1.5 Ohms.

Results:

- OK – The resistance is between 0.5 and 1.5 Ohms.

Repair: The harness and the injector solenoid are okay. The problem may be intermittent. If the problem is intermittent, refer to the diagnostic functional test Troubleshooting, “Inspecting Electrical Connectors”.

STOP.

- Not OK – The resistance is not between 0.5 and 1.5 Ohms. Proceed to Test Step 9.

Test Step 9. Check the Resistance of the Injector Solenoids and Check for Shorts.

WARNING

This engine uses high voltage to control the fuel injectors.

Disconnect the fuel enable circuit connector to prevent personal injury.

Do not come in contact with the fuel injector terminals while the engine is running.

- Turn the ECS to the OFF/RESET position.
- Remove the valve cover of the suspected cylinder.
- Remove the harness yoke from the solenoid terminals.
- Measure the resistance between the two solenoid terminals on top of the injector. Record the resistance.
- Measure the resistance from either solenoid terminal to the fuel injector body (metal). Record the resistance.
- Reconnect the harness yoke and install the valve cover.

Expected Result:

Resistance between the two solenoid terminals is between 0.5 and 1.5 Ohms. Resistance from either solenoid terminal to the fuel injector body (metal) is greater than 20000 Ohms.

Results:

- OK – The resistance checks are okay. The injector is okay.

Repair: The harness yoke has a short or an open. Repair the harness yoke or replace the harness yoke.

STOP.

- Not OK – The resistance checks are not okay. The injector has failed.

Repair: Repair the injector. If the problem is still present, replace the injector. If the new injector has a 4-Digit code that is different from the old injector, change the code in the ECM.

STOP.

i02550953

Inspecting Electrical Connectors

SMCS Code: 1901-038

System Operation Description:

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

Intermittent electrical problems are sometimes resolved by disconnecting and reconnecting connectors. It is very important to check for diagnostic codes immediately before disconnecting a connector. Also check for diagnostic codes after reconnecting the connector. If the status of a diagnostic code is changed due to disconnecting and reconnecting a connector, there are several possible reasons. The likely reasons are loose terminals, improperly crimped terminals, moisture, corrosion, and inadequate mating of a connection.

Follow these guidelines:

- Always use a 1U-5804 Crimp Tool to service Deutsch HD and DT connectors. Never solder the terminals onto the wires. Refer to “SEHS9615, Servicing Deutsch HD and DT Style Connectors”.

- Always use a 147 - 6456 Wedge Removal Tool to remove wedges from DT connectors. Never use a screwdriver to pry a wedge from a connector.
- Always use a breakout harness for a voltmeter probe or a test light. Never break the insulation of a wire in order to access to a circuit for measurements.
- If a wire is cut, always install a new terminal for the repair.

⚠ WARNING

The connection of any electrical equipment and the disconnection of any electrical equipment may cause an explosion hazard which may result in injury or death. Do not connect any electrical equipment or disconnect any electrical equipment in an explosive atmosphere.

Test Step 1. Check Connectors for Moisture and Corrosion

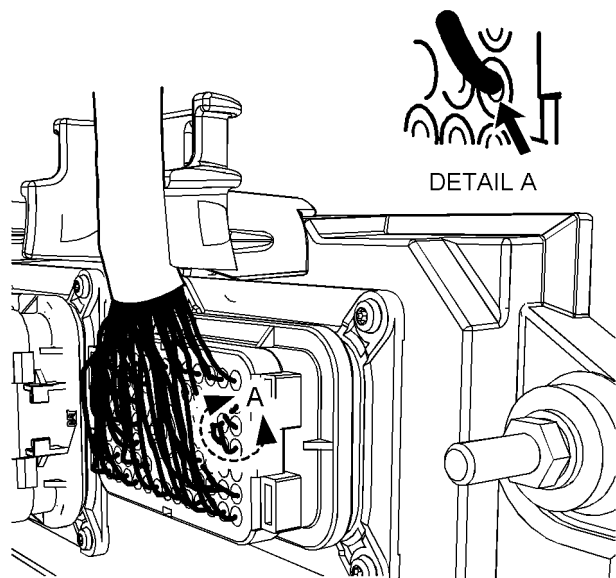


Illustration 34 g01131211
Leaky seal at the connector (typical example)

- A.** Inspect all wiring harnesses. Ensure that the routing of the wiring harness allows the wires to enter the face of each connector at a perpendicular angle. Otherwise, the wire will deform the seal bore. Refer to Illustration 34. This will create a path for the entrance of moisture. Verify that the seals for the wires are sealing correctly.

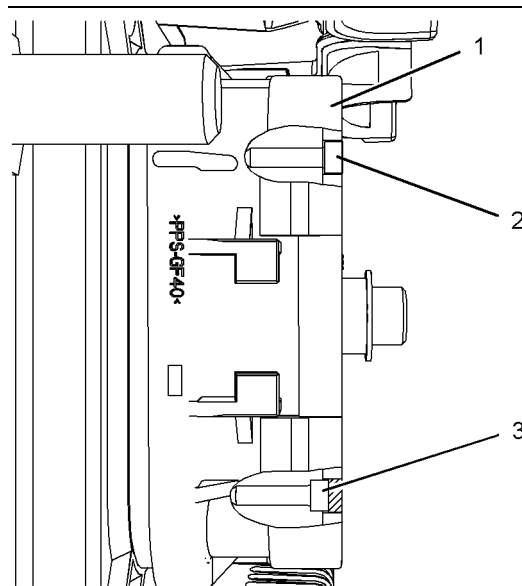


Illustration 35 g01131276
Diagram for the installation of a connector plug (typical example)
(1) Electronic Control Module (ECM) connector
(2) Correctly inserted plug
(3) Incorrectly inserted plug

- B.** Ensure that the sealing plugs are in place. If any of the plugs are missing, replace the plug. Ensure that the plugs are inserted correctly into the connector. Refer to Illustration 35.

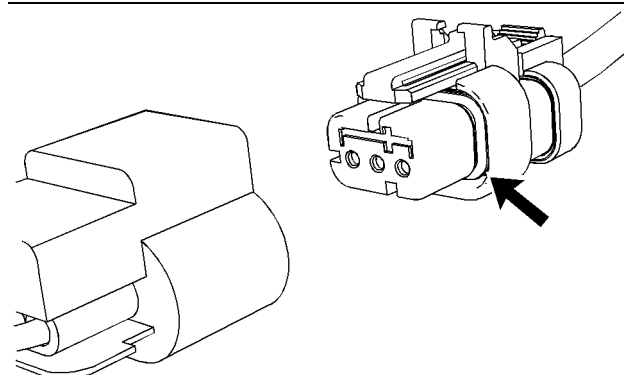


Illustration 36 g01131019
Seal for a three-pin connector (typical example)

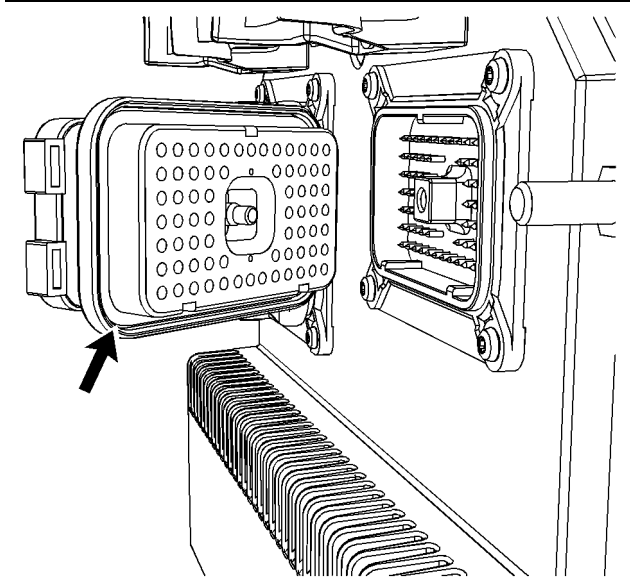


Illustration 37

g01131165

Seal for ECM connector (typical example)

C. Disconnect the suspect connector and inspect the connector seal. Ensure that the seals are in good condition. If necessary, replace the connector.

D. Thoroughly inspect the connectors for evidence of moisture entry.

Note: It is normal to see some minor seal abrasion on connector seals. Minor seal abrasion will not allow the entry of moisture.

If moisture or corrosion is evident in the connector, the source of the moisture entry must be found and the source of the moisture entry must be repaired. If the source of the moisture entry is not repaired, the problem will recur. Simply drying the connector will not fix the problem. Check the following items for the possible moisture entry path:

- Missing seals
- Improperly installed seals
- Nicks in exposed insulation
- Improperly mated connectors

Moisture can also travel to a connector through the inside of a wire. If moisture is found in a connector, thoroughly check the connector's harness for damage. Also check other connectors that share the harness for moisture.

Note: The ECM is a sealed unit. If moisture is found in an ECM connector, the ECM is not the source of the moisture. Do not replace the ECM.

Expected Result:

The harness wiring, connectors, and seals are in good condition. There is no evidence of moisture in the connectors.

Results:

- OK – The harness wiring, connectors, and seals are in good condition. Proceed to Test Step 2.
- Not OK – A problem has been found with the harness or the connectors.

Repair: Repair the connectors or the wiring, as required. Ensure that all of the seals are properly in place. Ensure that the connectors have been reattached.

If corrosion is evident on the pins, sockets or the connector, use only denatured alcohol to remove the corrosion. Use a cotton swab or a soft brush to remove the corrosion.

If moisture was found in the connectors, run the engine for several minutes and check again for moisture. If moisture reappears, the moisture is wicking into the connector. Even if the moisture entry path is repaired, it may be necessary to replace the wires.

Verify that the repair eliminates the problem.

STOP.

Test Step 2. Check the Wires for Damage to the Insulation

A. Carefully inspect each wire for signs of abrasion, of nicks, and of cuts.

Inspect the wires for the following conditions:

- Exposed insulation
- Rubbing of a wire against the engine
- Rubbing of a wire against a sharp point

B. Check all of the wiring harness fasteners in order to verify that the harness is properly secured. Also check all of the fasteners in order to verify that the harness is not compressed. Pull back the harness sleeves in order to check for a flattened portion of wire. A fastener that has been overtightened flattens the harness. This damages the wires that are inside the harness.

Expected Result:

The wires are free of abrasion, of nicks, and of cuts and the harness is properly clamped.

Results:

- OK – The harness is OK. Proceed to Test Step 3.
- Not OK – There is damage to the harness.

Repair: Repair the wires or replace the wires, as required. Verify that the repair eliminates the problem.

STOP.

Test Step 3. Inspect the Connector Terminals

- A.** Visually inspect each terminal in the connector. Verify that the terminals are not damaged. Verify that the terminals are properly aligned in the connector and verify that the terminals are properly located in the connector.

Expected Result:

The terminals are properly aligned and the terminals appear undamaged.

Results:

- OK – The terminals are OK. Proceed to Test Step 4.
- Not OK – The terminals of the connector are damaged.

Repair: Repair the terminals and/or replace the terminals, as required.

Verify that the repair eliminates the problem.

STOP.

Test Step 4. Perform a Pull Test on Each Wire Terminal Connection

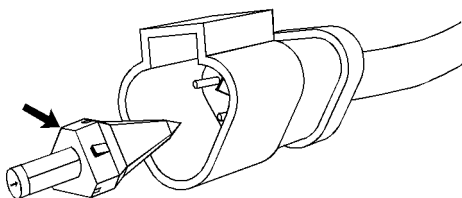


Illustration 38

g01131435

Receptacle lock wedge (typical example)

- A.** Ensure that the locking wedge for the connector is installed properly. Terminals cannot be retained inside the connector if the locking wedge is not installed properly.
- 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 properly crimped in the terminal and whether the terminal was properly inserted into the connector.

Expected Result:

Each terminal and each connector easily withstands 45 N (10 lb) of pull and each wire remains in the connector body.

Results:

- OK – All terminals pass the pull test. Proceed to Test Step 5.
- Not OK – A wire has been pulled from a terminal or a terminal has been pulled from the connector.

Repair: Use the 1U-5804 Crimp Tool to replace the terminal. Replace damaged connectors, as required. Verify that the repair eliminates the problem.

STOP.

Test Step 5. Check Individual Pin Retention into the Socket

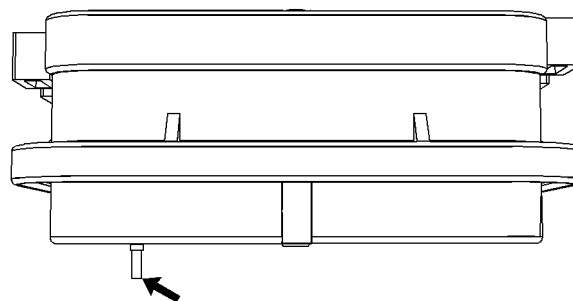


Illustration 39

g01131604

Diagram for testing pin retention (typical example)

- A.** Verify that the sockets provide good retention for the pins. Insert a new pin into each socket one at a time in order to check for a good grip on the pin by the socket.

Expected Result:

The sockets provide good retention for the new pin.

Results:

- OK – The terminals are OK. Proceed to Test Step 6.
- Not OK – Terminals are damaged.

Repair: Use the 1U-5804 Crimp Tool to replace the damaged terminals. Verify that the repair eliminates the problem.

STOP.

Test Step 6. Check the Locking Mechanism of the Connectors

- Ensure that the connectors lock properly. After locking the connectors, ensure that the two halves cannot be pulled apart.
- Verify that the latch tab of the connector is properly latched. Also verify that the latch tab of the connector returns to the locked position.

Expected Result:

The connector will securely lock. The connector and the locking mechanism are without cracks or breaks.

Results:

- OK – The connectors are in good repair. Proceed to Test Step 7.
- Not OK – The connector's locking mechanism is damaged or missing.

Repair: Repair the connector or replace the connector, as required. Verify that the repair eliminates the problem.

STOP.

Test Step 7. Check the Allen Head Screws on the Connectors

Visually inspect the allen head screws for the ECM connectors. Ensure that the threads on each allen head screw are not damaged.

- Connect the ECM connectors.

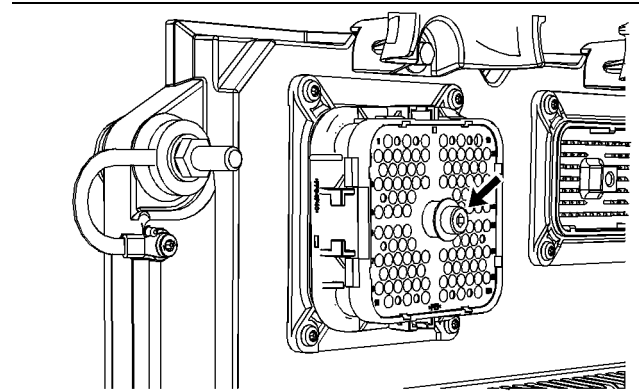


Illustration 40

g01132827

Allen head screw for the 120 pin ECM connector (typical example)

- Torque the allen head bolt for the 120 pin ECM connector to $7.0 \pm 0.5 \text{ N}\cdot\text{m}$ ($60 \pm 4 \text{ lb in}$).

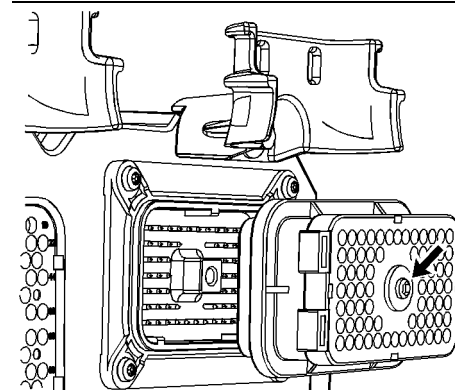


Illustration 41

g01132849

Allen head screw for the 70 pin ECM connector (typical example)

- Torque the allen head screw for the 70 pin ECM connector to $6.0 + 1.5 - 0.5 \text{ N}\cdot\text{m}$ ($55 + 13 - 4 \text{ lb in}$).

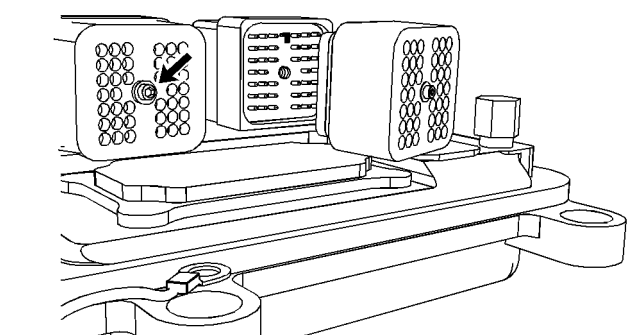


Illustration 42

g01132863

Allen head screw for the 40 pin ECM connector (typical example)

- Torque the allen head screw for the 40 pin ECM connector to $2.25 \pm 0.25 \text{ N}\cdot\text{m}$ ($20 \pm 2 \text{ lb in}$).

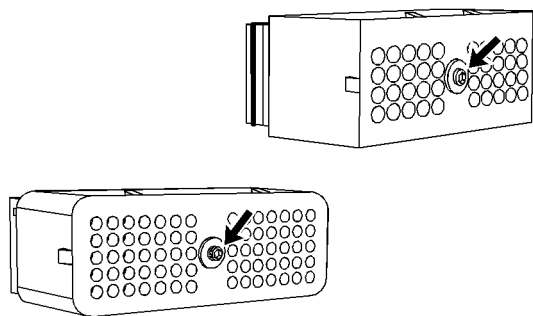


Illustration 43

g01133047

Allen head screw for the 40 pin customer connector and the 70 pin customer connector (typical example)

B. Connect the customer connector.

Torque the allen head screw for the 40 pin customer connector and the 70 pin customer connector to 2.25 ± 0.25 N·m (20 ± 2 lb in).

Expected Result:

The ECM connector is secure and the allen head screws are properly torqued.

Results:

- OK – The ECM connectors and the customer connector is properly connected. Proceed to Test Step 8.
- Not OK – The allen head screws for the ECM connector or the customer connector is damaged.

Repair: Repair the connector or replace the connector, as required. Verify that the repair eliminates the problem.

STOP.

Test Step 8. Perform the “Wiggle Test” on Caterpillar Electronic Technician (ET)

- Select the “Wiggle Test” from the diagnostic tests on Cat ET.
- Choose the appropriate group of parameters to monitor.
- Press the “Start” button. Wiggle the wiring harness in order to reproduce intermittent problems.

If an intermittent problem exists, the status will be highlighted and an audible beep will be heard.

Expected Result:

No intermittent problems were indicated during the “Wiggle Test”.

Results:

- OK – No intermittent problems were found. The harness and connectors appear to be OK. If you were sent from another procedure, return to the procedure and continue testing. If this test has resolved the problem, return the engine to service. STOP.
- Not OK – At least one intermittent problem was indicated.

Repair: Repair the harness or the connector. Verify that the repair eliminates the problem.

STOP.

i02384273

Prelubrication System

SMCS Code: 1319-038

System Operation Description:

The Electronic Control Module (ECM) has the ability to automatically prelube the engine before cranking. This prelubrication may increase the life of certain engine parts. The ECM will prelube the engine, when the Engine Control Switch (ECS) is placed in the START position. The ECM will prelube the engine, when the ECS is placed in the AUTO position and the remote start/run/stop switch is closed. The length of time for the prelube cycle can be programmed by the customer. The prelube cycle will end when the prelube pressure switch closes or if the customer programmed time ends. The engine speed must equal zero rpm before the prelube will begin.

The prelube cycle has the following status codes: “OFF”, “ON”, “COMPLETED”, and “DISABLED”.

The “OFF” status is entered when the engine control is first powered up with the ECS in the STOP position.

The “ON” status is entered when the ECM is on with the ECS in the START position.

The “COMPLETED” status is entered when the engine prelube duration is reached or when the engine prelube’s pressure switch is activated.

The “DISABLED” status is entered when the engine prelube duration is programmed to 0.

The prelube function will be aborted when one of the following conditions occur:

- The prelube pressure switch is activated.
- The user defined engine prelube duration has been reached.
- The operator activates the prelube override switch.

When the ECM senses the ECS in the START position, the ECM will activate the output driver for the “PPR1” relay. When the “PPR1” relay energizes, the normally open contacts of the “PPR1” relay close. This allows current to flow to the prelube motor. The prelube motor activates the prelube pump. The prelube pump builds pressure in the engine’s lubrication system. When the prelube pressure switch closes as a result of the increased pressure, the ECM input for the prelube pressure switch is taken low. The ECM then knows that the prelube pressure is adequate. The ECM will begin the starting sequence.

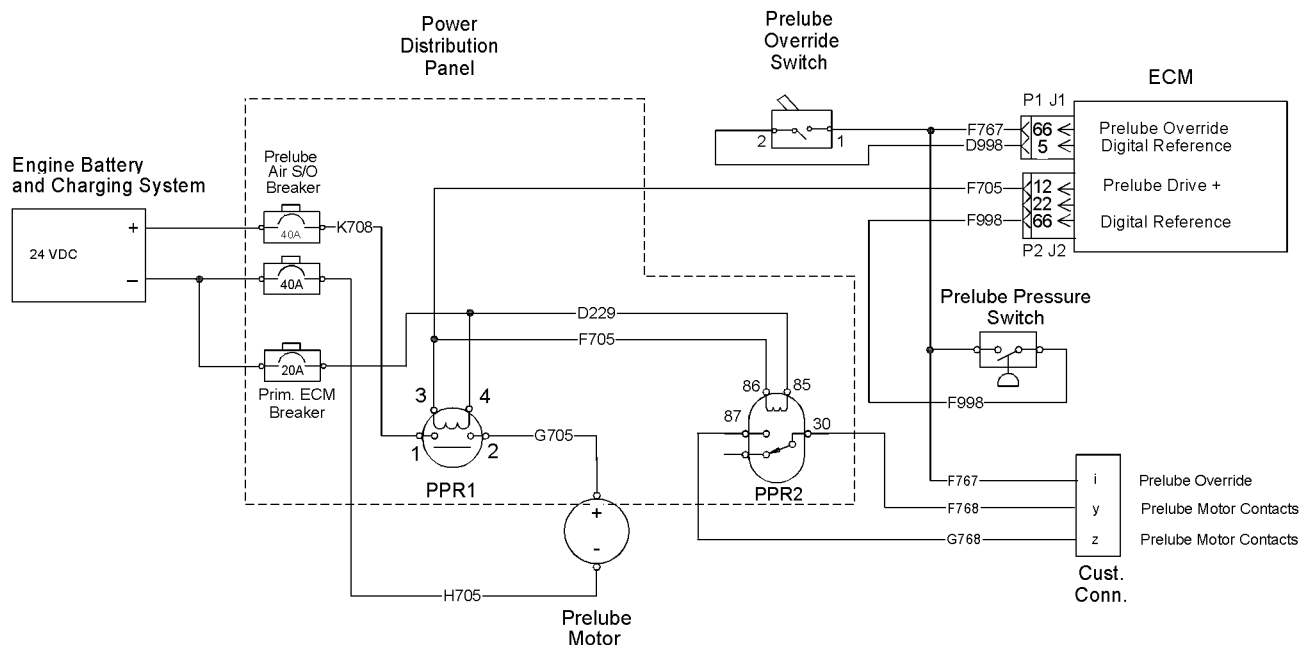


Illustration 44

g01193921

Test Step 1. Check for Connector Damage.

- Turn the circuit breaker for the battery to the OFF position.
- Turn the ECS to the OFF/RESET position.

- Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, “Inspecting Electrical Connectors” for details.
- Check the allen head screw on each ECM connector for the proper torque. Refer to Troubleshooting, “Inspecting Electrical Connectors” for the correct torque values.

- E. Check the ECM connector (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).
- F. Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted, and the harness and wiring are free of corrosion, of abrasion, and of pinch points.

Results:

- OK – The connectors and wiring are OK. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring are not OK.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Check the Resistance of the Prelube Pressure Switch at the ECM.

- A. Turn the ECS to the OFF/RESET position.
- B. Disconnect ECM connector J1/P1.
- C. Ensure that the prelube override switch is not activated.
- D. Measure the resistance between the prelube pressure switch P1-66 and the digital return P1-5.
- E. Reconnect the ECM connector P1.

Expected Result:

The resistance is greater than 20000 Ohms.

Note: If the engine has been running, the residual oil pressure may be high enough to activate the prelube pressure switch. If the residual oil pressure is high, the resistance would be less than 5 Ohms.

Results:

- OK – The resistance is greater than 20000 Ohms. The prelube pressure switch is not active. Proceed to Test Step 4.

- Not OK – The resistance is less than 20000 Ohms. The prelube pressure switch is active. Verify that the engine does not have a residual oil pressure that is high enough to activate the switch. If there is no residual oil pressure, the switch is not operating correctly or there is a problem with the wiring. Proceed to Test Step 3.

Test Step 3. Measure the Resistance of the Prelube Pressure Switch at the Prelube Pressure Switch.

- A. Turn the ECS to the OFF/RESET position.
- B. Disconnect the wires from the terminals of the prelube pressure switch.
- C. Measure the resistance between the terminals of the prelube pressure switch.

Expected Result:

The resistance is greater than 20000 Ohms.

Results:

- OK – The resistance is greater than 20000 Ohms. There is a problem with the wiring between ECM connector J1/P1 and the switch.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

- Not OK – The resistance is less than 20000 Ohms. There is a problem with the prelube pressure switch.

Repair: Temporarily replace the prelube pressure switch with a new switch. If the problem is no longer present, reinstall the old switch. If the problem returns, replace the switch.

STOP.

Test Step 4. Check the Status of the ECS and the Prelube Pressure Switch on the Caterpillar Electronic Technician (ET).

- A. Connect Cat ET to the service tool connector.
- B. Turn the ECS to the STOP position.
- C. Use Cat ET and view the following parameters: Engine Prelube and Ignition Switch.
- D. Go to the diagnostic test in the diagnostic section on CAT ET. Activate the override for the engine prelube.

- E. View the parameters for the prelube pressure switch and the ignition switch.
- F. Disable the override for the engine prelube.

Expected Result:

When the ECS is in the STOP position, the engine prelube displays "OFF" and the ignition switch displays "STOP". When the override for the engine prelube is activated, the engine prelube displays "ON" and the ignition switch displays "STOP".

Results:

- OK – The parameters are correct. Proceed to Test Step 5.
- Not OK – The status of the ignition switch does not display "STOP".

Repair: Perform the diagnostic functional test Troubleshooting, "Engine Control Switch (ECS)".

STOP.

- Prelube Disabled – The prelube function is disabled. The engine prelube duration is set to zero.

Repair: The cycle time of the engine prelube must be greater than zero for the prelube function to work.

STOP.

Test Step 5. Check for Output Voltage from the "PPR1" Relay at the Connector P-C1 to the Prelube Motor.

- A. Turn the ECS to the OFF/RESET position.
- B. Connect one end of the voltmeter to the –Battery terminal.
- C. Connect the other end of the voltmeter on wire G705 on pin X at connector P-C1 of the rigid harness.
- D. Turn the ECS to the STOP position.
- E. Go to the diagnostic test in the diagnostic section on CAT ET. Activate the override for the engine prelube.
- F. Monitor the voltage on the voltmeter.
- G. Disable the override for the engine prelube.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC. Proceed to Test Step 11.
- Not OK – The voltage is not 24 ± 3 VDC. Proceed to Test Step 6.

Test Step 6. Check for Output Voltage from the ECM at the Connector P-C1 to the "PPR1" Relay.

- A. Turn the ECS to the OFF/RESET position.
- B. Connect one end of the voltmeter to the –Battery terminal.
- C. Connect the other end of the voltmeter on wire F705 on pin c at connector P-C1 of the rigid harness.
- D. Turn the ECS to the STOP position.
- E. Go to the diagnostic test in the diagnostic section on CAT ET. Activate the override for the engine prelube.
- F. Monitor the voltage on the voltmeter.
- G. Disable the override for the engine prelube.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC. Proceed to Test Step 7.
- Not OK – The voltage is not 24 ± 3 VDC. Proceed to Test Step 10.

Test Step 7. Check for Output Voltage to the Prelube Motor from the "PPR1" Relay.

- A. Turn the ECS to the OFF/RESET position.
- B. Connect one end of the voltmeter to the –Battery terminal.
- C. Connect the other lead of the voltmeter to wire G705 on terminal 2 of the "PPR1" relay.
- D. Turn the ECS to the STOP position.
- E. Go to the diagnostic test in the diagnostic section on CAT ET. Activate the override for the engine prelube.
- F. Monitor the voltage on the voltmeter.
- G. Disable the override for the engine prelube.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC.

Repair: Repair the wire G705 between terminal 2 of the “PPR1” relay and terminal X at the connector P-C1 of the rigid harness.

STOP.

- Not OK – The voltage is not 24 ± 3 VDC. Proceed to Test Step 8.

Test Step 8. Check for Output Voltage to the “PPR1” Relay from the ECM.

- Leave one end of the voltmeter on the –Battery terminal.
- Connect the other lead of the voltmeter to wire F705 on terminal 3 of the “PPR1” relay.
- Turn the ECS to the STOP position.
- Go to the diagnostic test in the diagnostic section on CAT ET. Activate the override for the engine prelube.
- Monitor the voltage on the voltmeter.
- Disable the override for the engine prelube.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC. Proceed to Test Step 9.
- Not OK – The voltage is not 24 ± 3 VDC.

Repair: Repair the wire F705 between terminal 3 of the “PPR1” relay and terminal c at the connector P-C1 of the rigid harness.

STOP.

Test Step 9. Check the Voltage across the Coil of the “PPR1” Relay.

- Connect one lead of the voltmeter to wire D229 on terminal 4 of the “PPR1” relay.
- Connect the other lead of the voltmeter to wire F705 on terminal 3 of the “PPR1” relay.

- Turn the ECS to the STOP position.

- Go to the diagnostic test in the diagnostic section on CAT ET. Activate the override for the engine prelube.

- Monitor the voltage on the voltmeter.

- Disable the override for the engine prelube.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC.

Repair: Verify that 24 ± 3 VDC is present on terminal 1 of the “PPR1” relay. If voltage is not present on terminal 1 of the “PPR1” relay, check the wire K708 and the circuit breaker for the “Prelube Air S/O” between the “PPR1” relay and the battery.

If 24 ± 3 VDC is present on terminal 1 of the “PPR1” relay, replace the “PPR1” relay.

STOP.

- Not OK – The voltage is not 24 ± 3 VDC.

Repair: There is a problem with the wire D229 between the “PPR1” relay and the circuit breaker for the “primary ECM”. Disconnect wire D229 from terminal 4 of the “PPR1” relay. Check wire D229 for continuity to the circuit breaker for the “primary ECM”. Repair the wire or replace the wire.

STOP.

Test Step 10. Check the Voltage from the ECM to the “PPR1” Relay.

- Turn the ECS to the OFF/RESET position.

- Disconnect ECM connector J2/P2.

- Remove wire F705 from P2-12 at ECM connector P2. Install a wire jumper into P2-12.

- Connect a voltmeter between the wire jumper in P2-12 and the –Battery terminal.

- Turn the ECS to the STOP position.

- Go to the diagnostic test in the diagnostic section on CAT ET. Activate the override for the engine prelube.

- Monitor the voltage on the voltmeter.

- H. Disable the override for the engine prelube.
- I. Turn the ECS to the OFF/RESET position.
- J. Remove all jumpers and replace all wires.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC. There is a problem in the wire F705 between the ECM and terminal c at the connector P-C1 of the rigid harness.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

- Not OK – The voltage is not 24 ± 3 VDC.

Repair: The problem may be the ECM. Check the electrical power to the ECM. Refer to the diagnostic functional test Troubleshooting, “Electrical Power Supply”.

STOP.

Test Step 11. Check the Voltage at the Prelube Motor.

- A. Connect one end of the voltmeter to wire G705 at the prelube motor.
- B. Connect the other end of the voltmeter to the –Battery terminal.
- C. Turn the ECS to the STOP position.
- D. Go to the diagnostic test in the diagnostic section on CAT ET. Activate the override for the engine prelube.
- E. Monitor the voltage on the voltmeter.
- F. Disable the override for the engine prelube.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC. There is a problem in the prelube motor. Proceed to Test Step 12.
- Not OK – The voltage is not 24 ± 3 VDC.

Repair: There is a problem with the wire G705 between the connector for the prelube motor and terminal X at the connector P-C1 of the rigid harness. Repair wire G705.

STOP.

Test Step 12. Check the Operation of the Prelube Motor.

- A. Turn the ECS to the OFF/RESET position.
- B. Connect one side of a suitable piece of 10 AWG wire to the +Battery terminal.
- C. For one second, connect the other end of the wire to the +Battery terminal of the prelube motor.

Expected Result:

The prelube motor starts.

Results:

- OK – The prelube motor starts. There is a problem in the wiring harness at the prelube motor.

Repair: Inspect the connectors at the prelube motor.

STOP.

- Not OK – The prelube motor did not start.

Repair: Verify that wire H705 has continuity between the prelube motor and the circuit breaker for the “Prelube Air S/O”. If wire H705 is OK, replace the prelube motor with a new prelube motor. Verify that the problem is no longer present.

STOP.

i01988356

Secondary ECM/Personality Module

SMCS Code: 1901-038

System Operation Description:

The secondary Electronic Control Module (ECM) controls power to the secondary engine speed/timing sensor. The secondary ECM receives the input signals from the secondary engine speed/timing sensor and the primary engine speed/timing sensor. The secondary ECM also controls the air shutoff system by activating the output driver to the "ASOS" switch. The "ASOS" switch activates the air shutoff solenoids. The secondary ECM can also operate the fuel injector solenoids. This allows the secondary ECM to control fuel to the engine when the secondary ECM assumes control of the governing of the engine. All other engine functions are controlled by the primary ECM.

When power is applied to the system, the secondary ECM will illuminate the "Secondary ECM Ready" lamp and the "Secondary ECM Active" lamp for five seconds. The "Secondary ECM Ready" lamp should stay illuminated.

The secondary ECM provides governing of the engine if the primary ECM fails. If this occurs, the secondary ECM automatically assumes engine control. When the secondary ECM assumes engine control, the "Secondary ECM Active" lamp will illuminate.

The secondary ECM will take control due to the following reasons:

- Loss of the primary ECM heartbeat signal
- Two injector faults for the eight or the twelve cylinder engine
- Four injector faults for the sixteen cylinder engine

Note: The secondary ECM will remain in control of the engine until the power is cycled. The secondary ECM is not a fully functional ECM. The secondary ECM is used to keep the engine running until the vessel can obtain proper service.

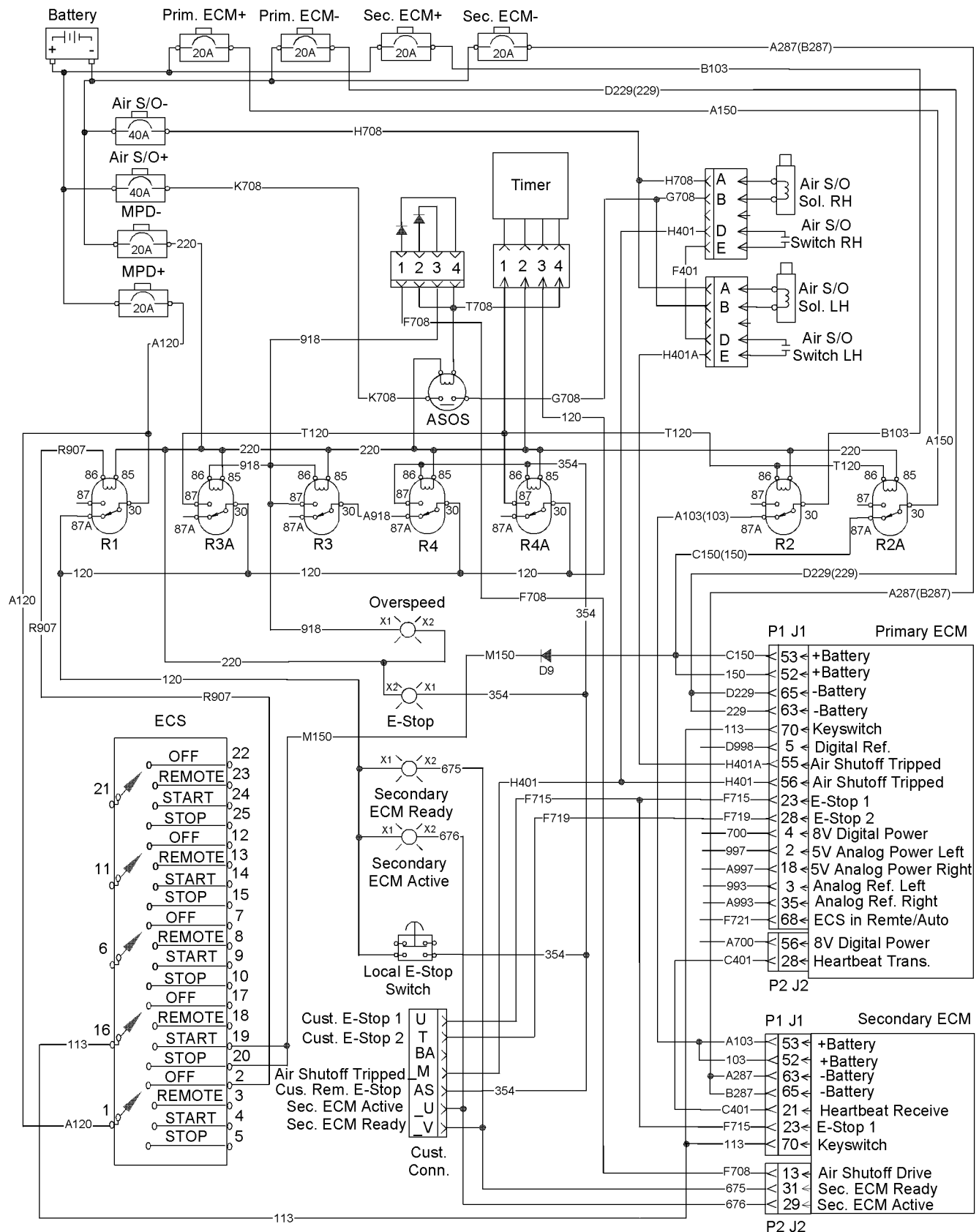


Illustration 45
Typical example

Test Step 1. Check for Connector Damage.

- A. Turn the ECS to the OFF/RESET position.
- B. Disconnect the main power.
- C. Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details.
- D. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the circuit.
- E. Check the ECM connector (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).
- F. Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted, and the harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.
- Not OK – The connectors and/or wiring need repair.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Check the "Secondary ECM Active" Lamp and the "Secondary ECM Ready" Lamp.

- A. Observe the "Secondary ECM Active" lamp and the "Secondary ECM Ready" lamp on the instrument panel when the ECS is turned to the STOP position.

Expected Result:

Both lamps illuminate for five seconds. The "Secondary ECM Ready" lamp stays illuminated. The "Secondary ECM Active" lamp turns off after five seconds.

Results:

- OK – Both lamps illuminated for five seconds. The "Secondary ECM Ready" lamp remained illuminated. The "Secondary ECM Active" lamp is off. The problem is no longer present.

Repair: The secondary ECM reads the primary ECM heartbeat signal. Active injector codes are not present. If the problem is intermittent, perform the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

STOP.

- Not OK – The "Secondary ECM Ready" lamp is not illuminated. Proceed to Test Step 6.
- "Secondary ECM Active" Lamp ON – Both lamps illuminated for five seconds. The "Secondary ECM Active" lamp remained illuminated. The secondary ECM has assumed control of the engine. Proceed to Test Step 3.

Test Step 3. Check for Logged Diagnostic Codes.

- A. Turn the ECS to the OFF/RESET position.
- B. Connect the Caterpillar Electronic Technician (ET).
- C. Turn the ECS to the STOP position.
- D. Observe the diagnostic codes on the Cat ET.

Note: The secondary ECM will assume control of an 8 cylinder engine or of a 12 cylinder engine if two or more diagnostic codes for the injectors are present. The secondary ECM will assume control of a 16 cylinder engine if four or more diagnostic codes for the injectors are present.

Expected Result:

Logged diagnostic codes are present.

Results:

- OK – A diagnostic code of CID 0579 - FMI 05 or a diagnostic code of CID 0579 - FMI 06 is present. Proceed to Test Step 8.
- OK – An error code for the fuel injectors is present.

Repair: Perform the diagnostic functional test Troubleshooting, "Injector Solenoids".

STOP.

- Not OK – No logged diagnostic codes are present. Proceed to Test Step 4.

Test Step 4. Check the Primary ECM Heartbeat Signal at the Primary ECM.

- A. Turn the ECS to the OFF/RESET position.
- B. Disconnect the primary ECM connector J2/P2.
- C. Remove wire C401 from the primary ECM connector P2-28. Install a wire jumper with sockets on both ends into ECM connector P2-28.
- D. Connect a multimeter that is capable of reading frequency between the wire jumper in P2-28 and the engine ground.
- E. Reconnect the primary ECM connector J2/P2.
- F. Turn the ECS to the STOP position.
- G. Observe the frequency of the primary ECM heartbeat signal on the multimeter display. If a number does not appear on the multimeter display, verify the connections. Measure the frequency from another digital sensor. Verify that the multimeter is operating correctly.
- H. Turn the ECS to the OFF/RESET position.
- I. Remove the wire jumper. Reconnect all wires and connectors.

Expected Result:

The frequency is between 15.67 and 16.33 Hz.

Results:

- OK – The frequency is between 15.67 and 16.33 Hz. Proceed to Test Step 5.
- Not OK – The frequency is not between 15.67 and 16.33 Hz. The primary ECM heartbeat signal is not within the frequency range.

Repair: Verify that the proper software has been installed. Verify that the primary ECM is receiving the correct voltage. Perform the diagnostic functional test Troubleshooting, “Electrical Power Supply”.

STOP.

Test Step 5. Check the Primary ECM Heartbeat Signal at the Secondary ECM.

- A. Turn the ECS to the OFF/RESET position.
- B. Disconnect the secondary ECM connector J1/P1.
- C. Remove the wire C401 from the secondary ECM connector P1-21.

- D. Connect a multimeter that is capable of reading frequency between wire C401 and engine ground.
- E. Reconnect the secondary ECM connector J1/P1.
- F. Turn the ECS to the STOP position.
- G. Observe the frequency of the primary ECM heartbeat signal on the multimeter display. If a number does not appear on the multimeter display, verify the connections. Measure the frequency from another digital sensor. Verify that the multimeter is operating correctly.
- H. Turn the ECS to the OFF/RESET position.
- I. Reconnect all wires and connectors.

Expected Result:

The frequency is between 15.67 and 16.33 Hz.

Results:

- OK – The frequency is between 15.67 and 16.33 Hz. Proceed to Test Step 6.
- Not OK – The frequency is not between 15.67 and 16.33 Hz. The signal is not within the frequency range.

Repair: Repair the wire C401 between the primary ECM connector P2-28 and the secondary ECM connector P1-21.

STOP.

Test Step 6. Test the “Secondary ECM Ready” Lamp.

- A. Turn the ECS to the OFF/RESET position.
- B. Disconnect the secondary ECM connector J2/P2.
- C. Remove the wire 675 from the secondary ECM connector J2-31.
- D. Connect a wire jumper between wire 675 and the engine ground.
- E. Reconnect the secondary ECM connector J1/P1.
- F. Turn the ECS to the STOP position.
- G. Observe the “Secondary ECM Ready” lamp.
- H. Turn the ECS to the OFF/RESET position.
- I. Remove the wire jumper. Reconnect all wires and connectors.

Expected Result:

The lamp illuminates while the jumper is connected.
The lamp does not illuminate when the jumper is removed.

Results:

- OK – The lamp illuminates while the jumper is connected. The lamp does not illuminate when the jumper is removed. Proceed to Test Step 7.
- Not OK – The lamp circuit is not functioning properly.

Repair: Verify that wire 675 is not open between the “Secondary ECM Ready” lamp and the ECM. Verify that voltage is present at wire 120 on terminal X1 of the “Secondary ECM Ready” lamp. If voltage is present on terminal X1, replace the “Secondary ECM Ready” lamp.

If voltage is not present on terminal X1, verify that the engine control switch is not in the OFF/RESET position. Verify that the “MPD” breaker is not tripped. Check the normally closed contact of relay “R1” for proper operation. Check the wire 120 between the “Secondary ECM Ready” lamp and relay “R1” for damage. Check the wire A120 between relay “R1” and the “MPD” breaker for damage. If necessary, repair the wires.

STOP.

Test Step 7. Test the “Secondary ECM Active” lamp.

- Turn the ECS to the OFF/RESET position.
- Disconnect the secondary ECM connector J2/P2.
- Remove the wire 676 from the secondary ECM connector J2-29.
- Connect a wire jumper between wire 676 and the engine ground.
- Reconnect the secondary ECM connector J1/P1.
- Turn the ECS to the STOP position.
- Observe the “Secondary ECM Active” lamp.
- Turn the ECS to the OFF/RESET position.
- Remove the wire jumper. Reconnect all wires and connectors.

Expected Result:

The lamp illuminates while the jumper is connected.
The lamp does not illuminate when the jumper is removed.

Results:

- OK – The “Secondary ECM Active” lamp circuit is okay.

Repair: If the problem is intermittent, perform the diagnostic functional test Troubleshooting, “Inspecting Electrical Connectors”.

STOP.

- Not OK – The lamp circuit is not functioning properly.

Repair: Verify that wire 676 is not open between the “Secondary ECM Active” lamp and the ECM. Verify that voltage is present on wire 120 at terminal X1 of the “Secondary ECM Active” lamp. If voltage is present on terminal X1, replace the “Secondary ECM Active” lamp.

If voltage is not present on terminal X1, verify that the engine control switch is not in the “OFF” position. Verify that the “MPD” breaker is not tripped. Check the normally closed contact of relay “R1” for proper operation. Check the wire 120 between the “Secondary ECM Ready” lamp and relay “R1” for damage. Check the wire A120 between relay “R1” and the “MPD” breaker for damage. If necessary, repair the wires.

STOP.

Test Step 8. Check for Shorts in the Wiring Harness.

- Turn the ECS to the OFF/RESET position.
- Disconnect the primary ECM J2/P2 and the secondary ECM connector J1/P1.
- Measure the resistance at the primary ECM between P2-28 and engine ground.
- Reconnect all wires and connectors.

Expected Result:

The resistance is greater than 20,000 Ohms.

Results:

- OK – The resistance is greater than 20,000 Ohms. Proceed to Test Step 9.

- Not OK – There is a problem in the wiring harness.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 9. Check for Opens in the Wiring Harness.

- A.** Measure the resistance of the wire C401 between the secondary ECM P1-21 and the primary ECM P2-28.

- B.** Reconnect all wires and connectors.

Expected Result:

The resistance is less than 5 Ohms.

Results:

- OK – The resistance is less than 5 Ohms. Proceed to Test Step 10.
- Not OK – There is a problem in the wiring harness.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 10. Check the Personality Module.

- A.** Determine if new software has recently been installed.

Note: If the secondary ECM does not see a primary ECM Heartbeat Signal, the secondary ECM will assume engine control. The power must be reset. After the power has been reset the primary ECM will take control of the engine.

- B.** Turn the ECS to the OFF/RESET Position.

- C.** Connect the Cat ET.

- D.** Wait for 70 seconds.

- E.** Verify that the correct personality module (software) is installed in the primary ECM.

- F.** Turn the ECS to the STOP position.

Expected Result:

No logged diagnostic codes should be present.

Results:

- OK – No logged diagnostic codes are present.

Repair: Verify that the “Secondary ECM Active” lamp and the “Secondary ECM Ready” lamp on the instrument panel illuminate when the ECS is turned to the STOP position.

STOP.

- Not - OK – Logged diagnostic codes are present.

Repair: Repair any diagnostic codes that are present.

STOP.

i01900709

Starting Motor System

SMCS Code: 1901-038

System Operation Description:

The Electronic Control Module (ECM) has the ability to crank the engine when the Engine Control Switch (ECS) is placed in the START position. The engine control will start the first crank cycle, when the ECS is placed in the START position. The crank cycle will continue for the time that is equal to the cycle crank time that has been programmed or the crank cycle will continue until the engine speed reaches the crank terminate speed. If crank terminate speed is not reached before the crank cycle time, the starting motor will deactivate at the end of the crank cycle time.

This process will repeat for a programmed amount of times “Total Number of Crank Cycles”. If the engine does not start, Caterpillar Electronic Technician (ET) will display “OVERCRANK”. The engine control will be in an idle state. The process can be restarted by turning the ECS to the OFF/RESET position. Next, turn the ECS to the STOP position. Then turn the ECS to the START position.

After the ECS is placed in the START position, the ECM will begin the prelube cycle. The ECM will send a signal to terminal BH of the customer connector after the prelube cycle is complete. The engine start signal will return on terminal BJ of the customer connector to the starting motor relays “SMMS1” and “SMMS2”. The starting motor relays will energize closing the normally open contacts of the relays. Current will flow to the starting motors. The starting motors will begin to crank the engine.

The engine can be manually started by using the “crank override switch” which is located on the inside of the instrument panel.

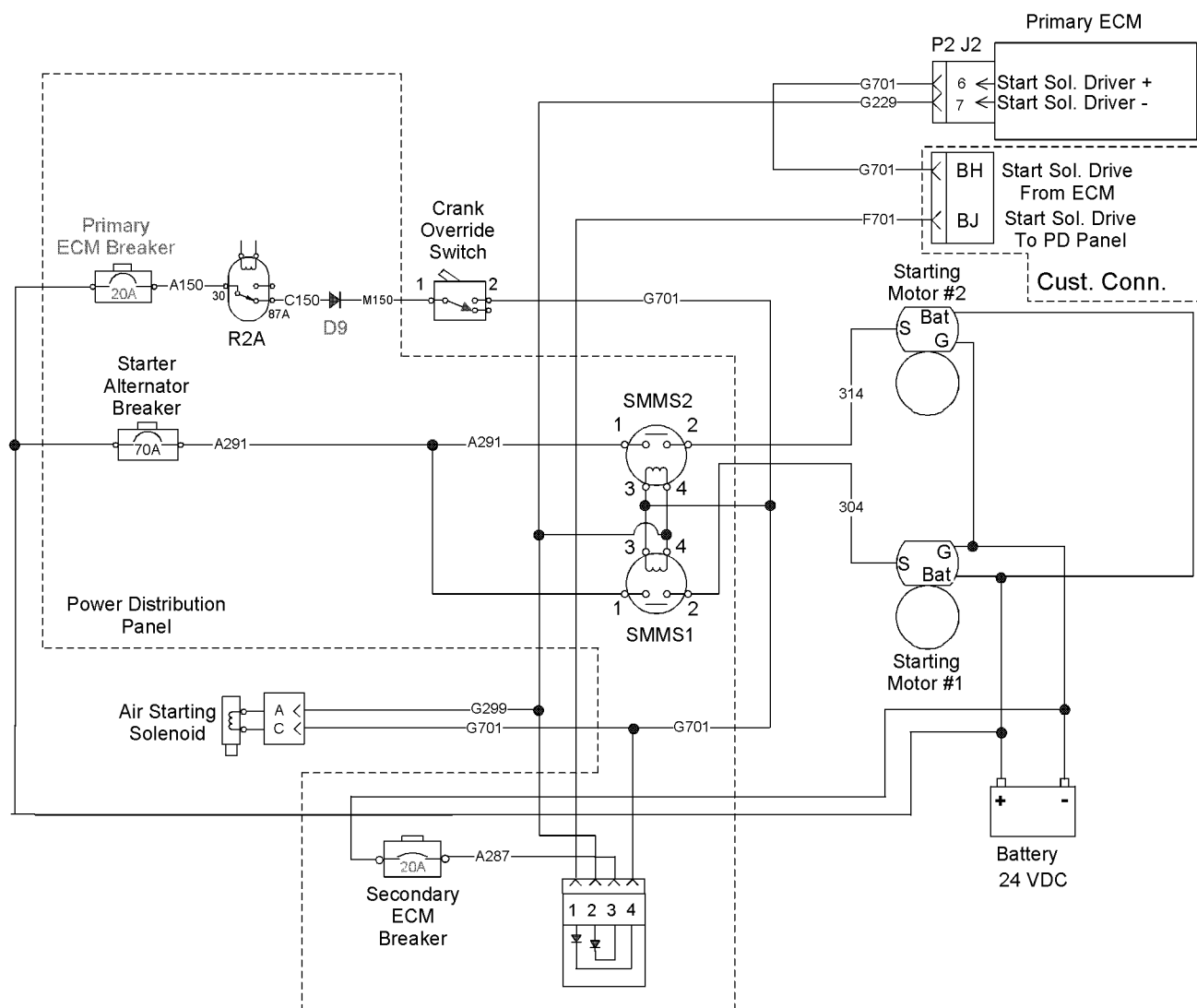


Illustration 46
Typical example

g01009170

Test Step 1. Check for Connector Damage.

- Turn the ECS to the OFF/RESET position.
- Turn the circuit breaker for the battery to the OFF position.
- Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect all of the other connectors. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details.
- Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the circuit.

- Check the ECM connector (allen head screw) for the proper torque of 6 ± 1 N·m (53 ± 9 lb in).

- Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted, and the harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are okay. Proceed to Test Step 2.

- Not OK – The connectors and/or wiring need repair.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Attempt to Start the Engine.

Note: After the ECS is placed in the START position, the ECM will begin the prelube cycle. The ECM will send a signal to terminal BH of the customer connector after the prelube cycle is complete. The engine start signal will return on terminal BJ of the customer connector to the starting motor relays “SMMS1” and “SMMS2”. The prelube cycle can be disabled by setting the duration of the prelube cycle to 0.

- Turn the circuit breaker for the battery to the ON position.
- Turn the ECS to the STOP position.
- Connect Cat ET to the service tool connector.
- Observe the “startup mode” parameter on the Cat ET status screen.
- Turn the ECS to the START position. Continue monitoring engine parameters as the engine cranks.

The crank cycle will continue for the time that is equal to the cycle crank time that has been programmed or the crank cycle will continue until the engine speed reaches the crank terminate speed.

Expected Result:

The status screen for the “startup mode” parameter displays “CRANK”. The engine cranks.

Results:

- OK – The “startup mode” parameter on the status screen on Cat ET displays “CRANK”. The engine cranks.

Repair: The problem may be intermittent. If the problem is intermittent, perform the diagnostic functional test Troubleshooting, “Inspecting Electrical Connectors”.

STOP.

- Not OK - Engine Doesn't Crank – The “startup mode” parameter on the status screen on Cat ET displays “CRANK”. The engine will not crank. Proceed to Test Step 3.

- Not OK - Status Screen – The “startup mode” parameter on the status screen on Cat ET does not display “CRANK”.

Repair: Perform the diagnostic functional test Troubleshooting, “Engine Control Switch (ECS)”.

STOP.

Test Step 3. Check the Start Signal at the Customer Connector.

- Connect one end of a voltmeter to the –Battery terminal. Connect the other end of the voltmeter to wire F701 on terminal BJ of the customer connector.
- Turn the ECS to the START position.
- Monitor the voltage on the voltmeter.
- Turn the ECS to the OFF/RESET position.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC. Proceed to Test Step 5.
- Not OK – The voltage is not 24 ± 3 VDC. Proceed to Test Step 4.

Test Step 4. Check the Start Signal at the Primary ECM.

- Disconnect the primary ECM connector J2/P2.
- Remove wire G701 from the primary ECM connector P2-6. Install a wire jumper into P2-6.
- Reconnect the primary ECM connector J2/P2.
- Connect one end of a voltmeter to the –Battery terminal. Connect the other end of the voltmeter to the wire jumper in P2-6.
- Turn the ECS to the START position.
- Monitor the voltage on the voltmeter.
- Turn the ECS to the OFF/RESET position.
- Remove the wire jumper and replace all wires.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC.

Repair: Check wire G701 for continuity between ECM connector P2-6 and terminal BH of the customer connector. If necessary, repair the wire. If wire G701 is okay, repair the wiring or devices on the customer's side of the customer connector.

STOP.

- Not OK – The voltage is not 24 ± 3 VDC.

Repair: The problem may be in the ECM. Check the electrical power to the ECM. Refer to the diagnostic functional test Troubleshooting, "Electrical Power Supply".

STOP.

Test Step 5. Check the Start Signal to "SMMS1" and "SMMS2" at the Rigid Harness.

- A. Connect one end of a voltmeter to the -Battery terminal. Connect the other end of the voltmeter to wire F701 on terminal _F of connector "P-C2" of the rigid harness.

B. Turn the ECS to the START position.

C. Monitor the voltage on the voltmeter.

D. Turn the ECS to the OFF/RESET position.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC. Proceed to Test Step 6.
- Not OK – The voltage is not 24 ± 3 VDC.

Repair: Repair the wire F701 between terminal BJ of the customer connector and terminal _F of connector "P-C2" of the rigid harness.

STOP.

Test Step 6. Check the Voltage from "SMMS1" and "SMMS2" at the Rigid Harness.

- A. Connect one end of a voltmeter to the -Battery terminal. Connect the other end of the voltmeter to wire 304 on terminal O of connector "P-C2" of the rigid harness.

B. Turn the ECS to the START position.

C. Monitor the voltage on the voltmeter.

D. Turn the ECS to the OFF/RESET position.

E. Connect one end of a voltmeter to the -Battery terminal. Connect the other end of the voltmeter to wire 314 on terminal R of connector "P-C2" of the rigid harness.

F. Turn the ECS to the START position.

G. Monitor the voltage on the voltmeter.

H. Turn the ECS to the OFF/RESET position.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC. Proceed to Test Step 10.
- Not OK – The voltage is not 24 ± 3 VDC. Proceed to Test Step 7.

Test Step 7. Check the Voltage at the Coil of "SMMS1" and the Coil of "SMMS2".

A. Turn the ECS to the OFF/RESET position.

B. Connect a voltmeter at the coil of "SMMS1". Connect the voltmeter between terminal 3 of "SMMS1" and engine ground.

C. Turn the ECS to the START position.

D. Monitor the voltage on the voltmeter.

E. Repeat the above steps for "SMMS2".

F. Turn the ECS to the STOP position.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC. Proceed to Test Step 8.
- Not OK – The voltage is not 24 ± 3 VDC.

Repair: Repair the wire F701 between the diode and terminal _F of connector "P-C2" of the rigid harness or repair the wire G701 between the diode and terminal 3 of "SMM2". Verify that the diode is working properly.

STOP.

Test Step 8. Check the Voltage across the Coil of "SMMS1" and across the Coil of "SMMS2".

- A. Turn the ECS to the OFF/RESET position.
- B. Connect a voltmeter across the coil of "SMMS1". Connect the voltmeter between terminal 4 and terminal 3 of "SMMS1".
- C. Turn the ECS to the START position.
- D. Monitor the voltage on the voltmeter.
- E. Repeat the above steps for "SMMS2".
- F. Turn the ECS to the STOP position.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC.

Repair: Verify that 24 ± 3 VDC is present on terminal 1 of "SMMS1" or on terminal 1 of "SMMS2". If voltage is not present on terminal 1 of "SMMS1" or on terminal 1 of "SMMS2", check the wire A291 between terminal 1 of the starter magnetic switches and the "Starter and Alternator" breaker. Verify that the "Starter and Alternator" breaker is functioning properly.

If voltage is present on terminal 1, proceed to Test Step 9.

- Not OK – The voltage is not 24 ± 3 VDC.

Repair: The problem is in the wire G229 between terminal 4 of "SMMS1" or "SMMS2" and the ECM. Check the wire G229 for continuity between terminal 4 of "SMMS1" or "SMMS2" and the ECM connector P2-7. Repair the wire or replace the wire.

STOP.

Test Step 9. Check the Voltage to the Rigid Harness from the Starter Motor Magnetic Switches.

- A. Connect one end of a voltmeter to the –Battery terminal. Connect the other end of the voltmeter to wire 314 on terminal 2 of "SMMS2".

- B. Turn the ECS to the START position.
- C. Monitor the voltage on the voltmeter.
- D. Turn the ECS to the STOP position.
- E. Connect one end of a voltmeter to the –Battery terminal. Connect the other end of the voltmeter to wire 304 on terminal 2 of "SMMS1".
- F. Turn the ECS to the START position.
- G. Monitor the voltage on the voltmeter.
- H. Turn the ECS to the STOP position.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC.

Repair: Repair the wire 314 between terminal 2 of "SMM2" and terminal R of connector "P-C2" of the rigid harness or the wire 304 between terminal 2 of "SMM1" and terminal O of connector "P-C2" of the rigid harness. Repair the wires or replace the wires.

STOP.

- Not OK – The voltage is not 24 ± 3 VDC.

Repair: Replace either relay "SMM2" or relay "SMM1".

STOP.

Test Step 10. Check the Voltage at the Starting Motor.

- A. Turn the ECS to the OFF/RESET position.
- B. Connect one end of a voltmeter to the –Battery terminal. Connect the other end of the voltmeter to wire 314 on terminal S of the starting motor.
- C. Turn the ECS to the START position.
- D. Monitor the voltage on the voltmeter.
- E. Turn the ECS to the STOP position.
- F. Connect one end of a voltmeter to the –Battery terminal. Connect the other end of the voltmeter to wire 304 on terminal S of the starting motor.
- G. Turn the ECS to the START position.
- H. Monitor the voltage on the voltmeter.
- I. Turn the ECS to the STOP position.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC. The starting motor did not activate. The problem appears to be in the starting motor.

Repair: Temporarily install a new starting motor. Verify that the problem is no longer present. Reinstall the old starting motor. If the problem returns, replace the starting motor.

STOP.

- OK – The voltage is 24 ± 3 VDC. The starting motor activated.

Repair: The problem may be intermittent. If the problem is intermittent, refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors".

STOP.

- Not OK – The voltage is not 24 ± 3 VDC.

Repair: The problem is in the wire 314 between the starting motor and terminal R of connector "P-C2" of the rigid harness or in the wire 304 between the starting motor and terminal O of connector "P-C2" of the rigid harness. Repair the wires or replace the wires.

STOP.

The throttle signal's duty cycle should be between 5 percent to 10 percent at low idle and 90 percent to 95 percent at high idle. The percent duty cycle is translated in the ECM into a throttle position of 0 percent to 100 percent. Use this procedure to troubleshoot an active diagnostic code of 91-08 Throttle Position signal abnormal or to troubleshoot an active diagnostic code of 1249-08 Secondary Throttle Position signal abnormal. The ECM will not respond to the throttle signal if there is an active 253-02 Personality Module mismatch.

i02659958

Throttle Position Sensor

SMCS Code: 1913-038

System Operation Description:

Terminal BN on the customer connector provides the primary throttle signal to the engine's Electronic Control Module (ECM). Terminal BM on the customer connector provides the secondary throttle signal to the engine's ECM. Both of the throttle signals should be a 500 Hz constant frequency signal with a pulse width that varies with the throttle signal. This output signal is referred to as a Pulse Width Modulated signal (PWM). This signal is expressed as a percentage between 0 percent and 100 percent.

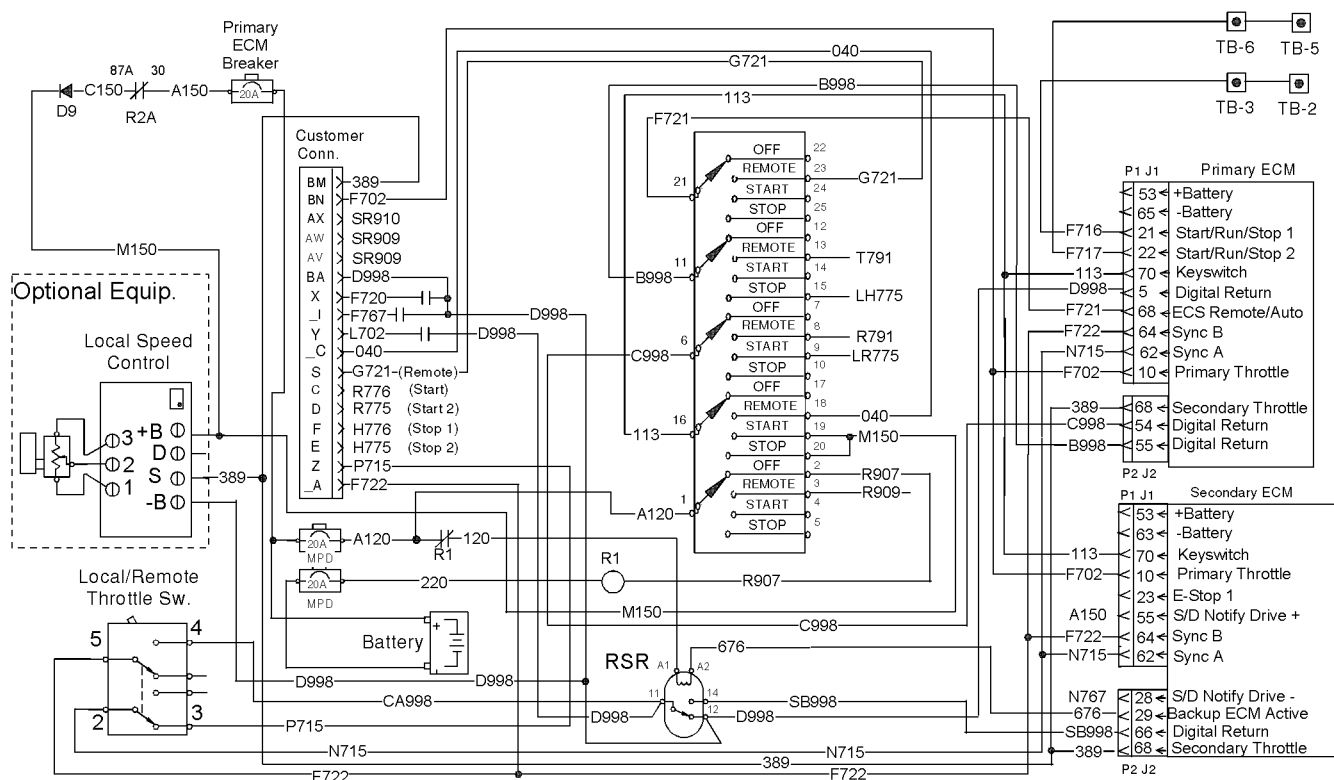


Illustration 47
Typical example

g01012536

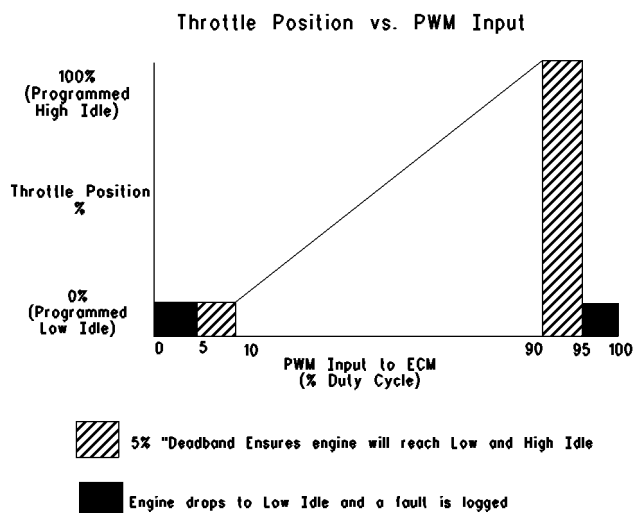


Illustration 48

g00725481

Throttle Position Versus PWM Input

Test Step 1. Check for Connector Damage.

- Turn the Engine Control Switch (ECS) to the OFF/RESET position.
- Thoroughly inspect the ECM connectors J1/P1 and J2/P2. Inspect the wiring and the connectors that are associated with the circuit. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors" for details on inspecting wiring and connectors.
- Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the circuit.
- Check the ECM connector (allen head screw) for the proper torque of $6 \pm 1 \text{ N}\cdot\text{m}$ ($53 \pm 9 \text{ lb}\cdot\text{in}$).
- Check the harness and the wiring for abrasion and for pinch points.

Expected Result:

All connectors, pins, and sockets are completely coupled and/or inserted, and the harness and wiring are free of corrosion, of abrasion or of pinch points.

Results:

- OK – The connectors and wiring are OK. If you are troubleshooting either the primary speed control or the secondary speed control from the customer, proceed to Test Step 2. If you are troubleshooting the local speed control on the instrument panel, proceed to Test Step 5.
- Not OK – The connectors and/or wiring need repair.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP.

Test Step 2. Check the Throttle Position on the Caterpillar Electronic Technician (ET).

- A. Connect Cat ET to the service tool connector.
- B. Turn the ECS to the STOP position.
- C. Observe the position of the throttle on Cat ET.
- D. Adjust the customer's throttle to the lowest setting.
- E. Start at the lowest position. Slowly adjust the customer's throttle to the highest setting. Monitor the position of the throttle on Cat ET.

Expected Result:

The throttle position on Cat ET is 0 percent at the lowest setting and 0 to 100 percent as the throttle is adjusted to the highest setting.

Results:

- OK – The throttle is operating correctly.

Repair: There may be an intermittent problem. If the problem is intermittent, refer to Troubleshooting, "Inspecting Electrical Connectors" for details on inspecting wiring and connectors.

STOP.

- Not OK – The throttle position on Cat ET does not change correctly. Proceed to Test Step 3.

Test Step 3. Check the Duty Cycle at the Customer Connector.

- A. Turn the ECS to the OFF/RESET position.
- B. Remove the wire for the throttle signal from the customer's connector. Refer to Illustration 47 for the schematic of the circuit.
- C. Set the multimeter to "VDC". Press the "Hz" button twice so that the % symbol is displayed.
- D. Place the red probe of the digital multimeter on the terminal for the throttle signal on the customer connector. Place the black probe of the multimeter on the -Battery terminal.
- E. Turn the ECS to the STOP position.
- F. Measure the percent duty cycle of the throttle signal. Adjust the throttle from the lowest position to the highest position.
- G. Turn the ECS to the OFF/RESET position.
- H. Replace all connectors and wires.

Expected Result:

The duty cycle is 5 to 10 percent at the lowest setting. The duty cycle is 90 to 95 percent at the highest setting.

Results:

- OK – The duty cycle and throttle position readings are correct. Proceed to Test Step 4.
- Not OK – The duty cycle reading is not correct. The throttle position signal is not reaching the ECM.

Repair: Check the signal from the customer's connector to the customer's speed control.

STOP.

Test Step 4. Check the Duty Cycle at the ECM Connector.

- A. Turn the ECS to the OFF/RESET position.
- B. Remove the ECM connector P1 from the ECM. Remove the throttle signal wire from the ECM connector P1. Refer to Illustration 47 for the schematic of the circuit.
- C. Reconnect the ECM connector J1/P1.
- D. Set the multimeter to "VDC". Press the "Hz" button twice so that the % symbol is displayed.

- E. Place the red probe of the digital multimeter on the throttle signal wire that was removed from ECM connector P1. Place the black probe of the multimeter on the –Battery terminal.
- F. Turn the ECS to the STOP position.
- G. Measure the percent duty cycle of the throttle signal. Move the throttle from the lowest setting to the highest setting.
- H. Turn the ECS to the OFF/RESET position.
- I. Replace all connectors and wires.

Expected Result:

The duty cycle is 5 to 10 percent at the lowest setting. The duty cycle is 90 to 95 percent at the highest setting.

Results:

- OK – The duty cycle and the throttle signal are correct.

Repair: Temporarily replace the ECM and perform the test again. If the problem is resolved, the ECM is faulty. Permanently replace the ECM. Refer to the diagnostic procedure Troubleshooting, “Replacing the ECM”.

STOP.

- Not OK – The duty cycle reading is not correct. The throttle signal is not reaching the ECM.

Repair: Repair the wire between ECM connector P1 and the customer connector.

STOP.

Test Step 5. Check the Throttle Position on the Caterpillar Electronic Technician (ET).

- A. Turn the ECS to the STOP position.
- B. Observe the position of the throttle on Cat ET.
- C. Turn the local speed control potentiometer that is on the instrument panel to the lowest setting.
- D. Start at the low idle position. Slowly turn the speed adjust potentiometer in the other direction. Monitor the position of the throttle on Cat ET.

Expected Result:

The throttle position on Cat ET reads 0 percent at the lowest setting and 0 to 100 percent as the speed adjust potentiometer is adjusted.

Results:

- OK – The local speed control is operating correctly.

Repair: There may be an intermittent problem. If the problem is intermittent, refer to Troubleshooting, “Inspecting Electrical Connectors” for details on inspecting wiring and connectors.

STOP.

- Not OK – The throttle position on Cat ET does not change correctly. Proceed to Test Step 6.

Test Step 6. Check the Supply Voltage to the Local Speed Control.

- A. Turn the ECS to the STOP position.

- B. Connect the red probe of the digital multimeter to the +B terminal of the local speed control. Connect the black probe of the digital multimeter to the –B terminal of the local speed control.

- C. Measure the voltage across the terminals of the local speed control.

Expected Result:

The voltage is 24 ± 3 VDC.

Results:

- OK – The voltage is 24 ± 3 VDC. The local speed control is receiving the correct voltage. Proceed to Test Step 8.
- Not OK – The voltage is not 24 ± 3 VDC. The local speed control is not receiving the correct voltage. Proceed to Test Step 7.

Test Step 7. Check the Voltage to the Local Speed Control at the Rigid Harness.

- A. Turn the ECS to the OFF/RESET position.

- B. Connect the red probe of the digital multimeter to wire C150 on terminal L of connector P-C2 of the rigid harness. Connect the black probe of the digital multimeter to the –Battery.

- C. Turn the ECS to the STOP position.

- D. Monitor the voltage on the digital multimeter.

- E. Turn the ECS to the OFF/RESET position.

Expected Result:

The voltage measures 24 ± 3 VDC.

Results:

- OK – The voltage measures 24 ± 3 VDC.

Repair: Check for 24 ± 3 VDC on wire C150 at diode D9 in the instrument panel. If voltage is not present on wire C150 at diode D9, repair the wire C150 between diode D9 and terminal L of connector P-C2 of the rigid harness.

STOP.

- Not OK – The voltage does not measure 24 ± 3 VDC.

Repair: Verify that the breaker for the primary ECM is not tripped. Check for 24 ± 3 VDC on terminal 87A at the normally closed contact of relay "R2A". Relay R2A is located in the power distribution panel. Verify that the normally closed contact of relay "R2A" is operating correctly.

If voltage is present on terminal 87A at the normally closed contact of relay "R2A", repair the wire C150 between the contacts of relay "R2A" and terminal L of connector P-C2 of the rigid harness.

If 24 ± 3 VDC is present on wire C150 at diode D9, verify that voltage is present on wire M150 at diode D9. If 24 ± 3 VDC is not present on wire M150 at diode D9, replace the diode D9.

If 24 ± 3 VDC is present at the diode D9 on wire M150, repair the wire M150 between the diode D9 and the local speed control.

STOP.

Test Step 8. Check the Local Speed Control.

- Remove the wire 389 from the S terminal at the local speed control.
- Set the multimeter to "VDC". Press the "Hz" button twice so that the % symbol is displayed.
- Place one probe of the multimeter on the S terminal of the local speed control. Place the other probe on the -Battery terminal of the local speed control.
- Turn the ECS to the STOP position.
- Measure the percent duty cycle from the speed control on the multimeter. Turn the potentiometer from the low setting to the high setting.

Note: The throttle position on the Cat ET will not match the percent duty cycle on the multimeter.

- Reconnect the wire 389 to the S terminal at the local speed control.

Expected Result:

The duty cycle is between 4 and 10 percent at the low setting and between 90 and 95 percent at the high setting.

Results:

- OK – The local speed control is supplying the correct signal. Proceed to Test Step 9.
- Not OK – The duty cycle is not correct on the multimeter.

Repair: Verify that the local speed control on the instrument panel is operating correctly. Temporarily install another speed control. Verify that the problem is no longer present. Reinstall the old speed control. If the problem returns, replace the local speed control.

STOP.

Test Step 9. Check the Duty Cycle at the ECM Connector.

- Turn the ECS to the OFF/RESET position.
- Remove the ECM connector P2 from the primary ECM. Remove the wire 389 from ECM connector P2-68.
- Reconnect the ECM connector P2.
- Place the red probe on wire 389. Place the black probe on the -Battery terminal.
- Turn the ECS to the STOP position.
- Measure the percent duty cycle of the speed control. Turn the potentiometer from the low setting to the high setting.
- Turn the ECS to the OFF/RESET position.
- Replace all connectors and wires.

Expected Result:

The duty cycle is 5 to 10 percent at the low idle stop. The duty cycle is 90 to 95 percent at the high idle stop.

Results:

- OK – The duty cycle and throttle position readings are correct.

Repair: Temporarily replace the ECM and perform the test again. If the problem is resolved, the ECM is faulty. Permanently replace the ECM. Refer to the diagnostic procedure Troubleshooting, "Replacing the ECM".

STOP.

- Not OK – The duty cycle reading is not correct. The throttle position signal is not reaching the ECM.

Repair: Verify if the throttle signal is reaching pin P2-68 at the secondary ECM. The signal is lost between the S terminal of the local speed control and the ECM. Repair the wire 389 between the local speed control and the ECM.

STOP.

Calibration Procedures

i02296725

Analog Sensor - Calibrate

SMCS Code: 1901-524

System Operation Description:

The Electronic Control Module (ECM) attempts to perform an automatic calibration of all pressure sensors whenever the ECM is powered and the engine has been off for at least ten seconds. Cranking the engine during the first ten seconds causes the ECM to abort the calibration attempt.

During an automatic pressure sensor calibration, the ECM checks all pressure sensors against an acceptable range. If any pressure sensor reading is outside the acceptable range, the previous calibration value is used. The ECM then calibrates all pressure sensors against the atmospheric pressure sensor.

A pressure sensor calibration will not be successful if there are active sensor diagnostic codes with an FMI of 03 and/or 04. A pressure sensor calibration will not be successful if one of the following conditions exist:

- The pressure reading is outside of an acceptable range.
- The pressure reading varies significantly during calibration.

Test Step 1. Check for “ACTIVE” Diagnostic Codes

- A. Disconnect the main power.
- B. Start Caterpillar Electronic Technician (ET).
- C. Connect the main power.
- D. Check for active diagnostics.

Expected Result:

There are no active diagnostics.

Results:

- OK – There are no active diagnostics. Proceed to Test Step 2.
- Not OK – A pressure sensor with an active diagnostic code cannot be calibrated.

Repair: Perform the appropriate troubleshooting procedure.

STOP.

Test Step 2. Perform a Calibration of the Sensors

- A. Select “Calibrations” from the “Service” menu on Cat ET. Select the “Pressure Sensor Calibration” from the “Calibrations” menu. The ECM will perform a pressure sensor calibration when this screen is entered.

Expected Result:

Cat ET indicates that the calibration was completed.

Results:

- OK – Cat ET indicates that the calibration was completed.

Repair: Reset the system and check for active diagnostic codes.

STOP.

- Not OK – All pressure sensors could not be calibrated. Proceed to Test Step 3.

Test Step 3. Determine the Cause of Failed Calibration

- A. Check if any pressure sensors have an active diagnostic code. A pressure sensor calibration will not be successful if there are active diagnostic codes with an FMI of 03 and/or 04.
- B. Verify that the correct sensor has been installed.
- C. Check the display status screen on Cat ET for the pressure sensor reading.

Note: The valid range for atmospheric pressure must be between 45 kPa (6.5 psi) and 111 kPa (16 psi) for a successful calibration.

Expected Result:

Cat ET displays the following pressures:

- Crankcase pressure is atmospheric pressure $\pm$ 8 kPa (1.2 psi).
- Turbocharger compressor inlet pressure is atmospheric pressure $\pm$ 8 kPa (1.2 psi).
- Turbocharger compressor outlet pressure is atmospheric pressure $\pm$ 15 kPa (2.2 psi).

- Fuel pressure is atmospheric pressure ± 27 kPa (3.9 psi).
- Engine oil pressure is atmospheric pressure ± 27 kPa (3.9 psi).

Results:

- OK – Repeat calibration of the sensors.

Repair: Repeat the calibration. Verify that no active diagnostic codes are present.

STOP.

- Not OK – There is a problem with the wiring harness and/or the sensor. Inspect the components for damage, for corrosion or for abrasion. Repair the components and/or replace the components.

Repair: Perform the appropriate troubleshooting procedure.

STOP.

i01900713

Engine Speed/Timing Sensor - Calibrate

SMCS Code: 1912-524

System Operation Description:

The engine speed/timing sensors provide engine information to the Electronic Control Module (ECM). The sensor generates a pulse signal. A loss of the signals from the secondary engine speed/timing sensor and the primary engine speed/timing sensor causes the ECM to stop sending power to the fuel injectors.

The ECM provides the engine speed/timing sensor with 12.5 ± 1.0 VDC. A unique tooth on the timing reference gear generates a unique duty cycle. The signal provides the ECM with information on the engine position.

If the primary engine speed/timing sensor fails, the ECM will use the secondary engine speed/timing sensor until electrical power is removed from the ECM. To prevent any unnecessary down time, replace the primary engine speed/timing sensor at the earliest possible convenience.

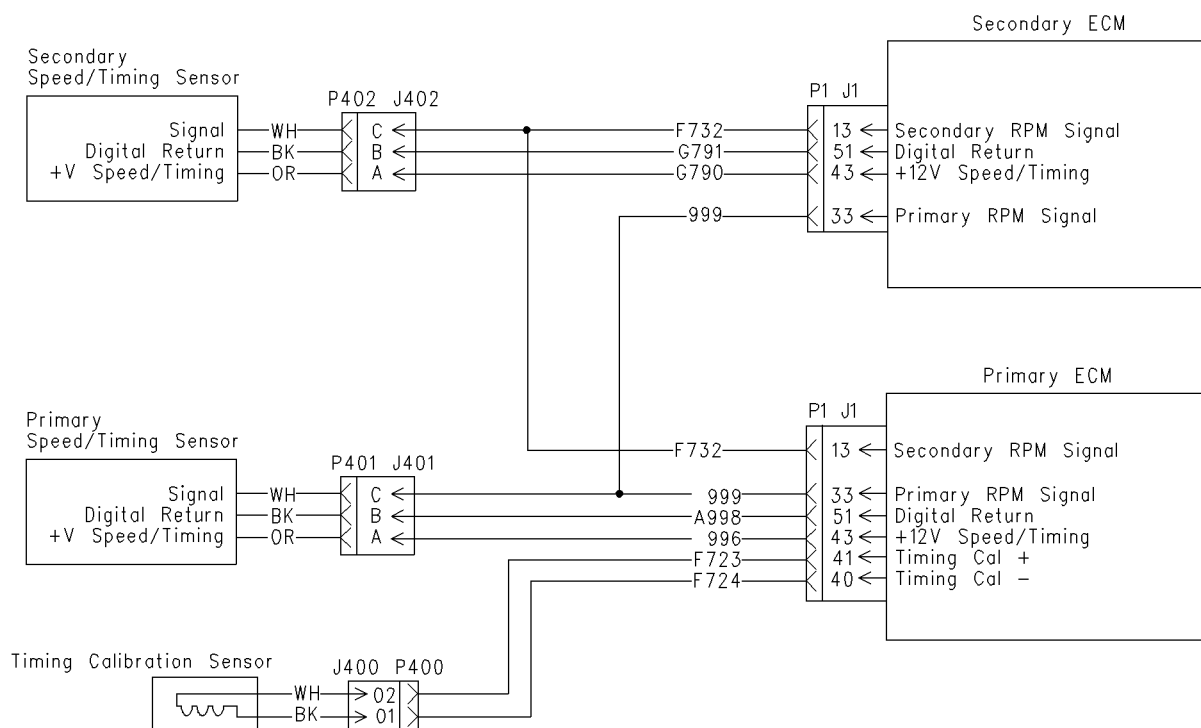


Illustration 49
Typical example

g00992448

Test Step 1. Check for Active Engine Diagnostics.

- Start the Caterpillar Electronic Technician (ET).
- Start the engine.
- Operate the engine until normal operating temperatures are obtained.

Expected Result:

There is one active diagnostic code 261-13.

Results:

- OK – The active diagnostic code is 261-13. Proceed to Test Step 2.
- Not OK – There is more than one active diagnostic code.

Repair: Repair any active diagnostic codes.

STOP.

Test Step 2. Install the Timing Calibration Probe.

- Turn the Engine Control Switch (ECS) to the OFF position.
- Remove the timing calibration plug from the flywheel housing.
- Examine the flywheel through the timing calibration hole. Ensure that the probe is not inserted into the timing pin hole. If necessary, turn the engine.
- Install the 6V - 3093 Transducer Adapter into the hole for the timing calibration at the flywheel.
- Insert the 6V - 2197 Magnetic Transducer through the 6V - 3093 Transducer Adapter. Insert the transducer until contact is made with the surface of the flywheel. Move the transducer 0.9 mm (0.04 inch) away from the flywheel.

NOTICE

Do not install the timing calibration probe over the timing pin hole at the flywheel or damage will result.

- Tighten the nut on the 6V - 3093 Transducer Adapter.

- G. Connect the 7X-1695 cable from the engine timing calibration probe to the connector P26.
- H. Start the engine. Allow the engine to exit cold mode operation.

Expected Result:

Only CID-FMI 261-13 should be active.

Results:

- OK – CID-FMI 261-13 is the only active code at this time. Proceed to Test Step 3.
- Not OK – CID-FMI 261-13 is not the only active code at this time.

Repair: Repair any active diagnostic codes.

STOP.

Test Step 3. Calibrate the Fuel Injection Timing.

- A. Select "Calibrations" from the "Service" menu on the Cat ET. Select the "Timing Calibration" from the "Calibrations" menu.

Note: Engine speed will be set to 800 rpm by the ECM during the calibration.

- B. Follow the instructions on the Cat ET screen.

Note: If the Cat ET screen reads "COULD NOT CALIBRATE", the timing has not been set.

Expected Result:

The timing calibration procedure is successful.

Results:

- OK – The timing calibration procedure was completed successfully.

Repair: Disconnect the timing calibration probe before you exit the "Timing Calibration" screen on the Cat ET. Reset the system and check for any diagnostic codes.

STOP.

- Not OK – The timing could not be calibrated.

Repair: Verify that the engine speed was stable during the testing (± 50 rpm). If the engine speed was unstable or the engine speed could not be controlled within ± 50 rpm because of mechanical factors or electrical factors, refer to the diagnostic procedure Troubleshooting, "Engine Misfires, Runs Rough or Is Unstable".

If all of the problems have been corrected but the timing can not be calibrated, check the cable of the 189-5746 Speed Sensor. Check the 189-5746 Speed Sensor in order to verify that the probe is not bent. Verify that the probe is installed correctly before restarting this procedure.

STOP.

i01951619

Throttle Position Sensor - Calibrate

SMCS Code: 1913-524

System Operation Description:

The throttle linkage should operate without binding or without excessive drag. When the throttle position sensor is not connected to the throttle, the throttle should return to low idle within one second. The calibration of the throttle position sensor requires the use of Caterpillar Electronic Technician (ET).

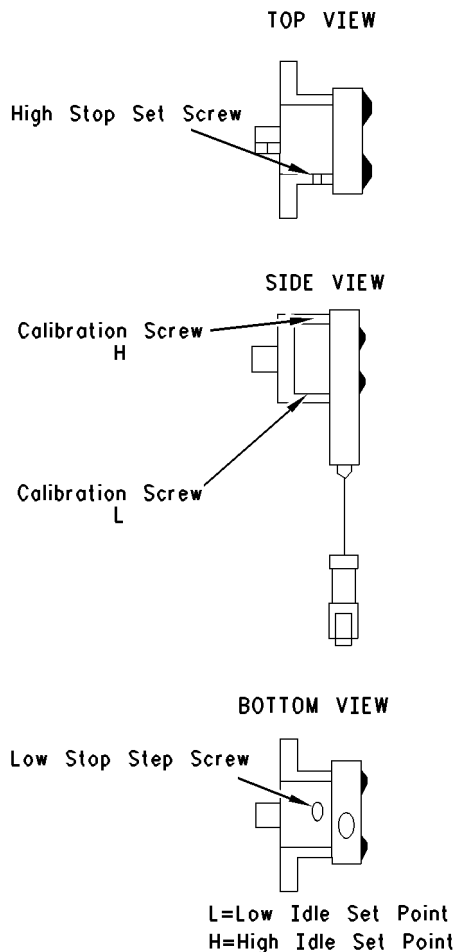


Illustration 50

g00726080

Test Step 1. Check and Adjust the Throttle Linkage.

A. Inspect the throttle linkage for components with the following conditions:

- Loose
- Bent
- Broken
- Missing
- Worn

B. Turn the keyswitch to the OFF position.

C. Connect Cat ET to the service tool connector.

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

E. Observe the indication for the duty cycle on the "Monitor Throttle Position Sensor Signal" screen of Cat ET.

F. Place the throttle lever in the position for low idle. Adjust the throttle linkage. Adjust the low idle set screw.

Expected Result:

When the throttle is in low idle, the duty cycle is 5 to 10 percent. After the adjustment is completed, the duty cycle increases when the throttle lever is moved from the low idle position.

Results:

- OK – When the throttle is in low idle, the duty cycle is 5 to 10 percent. After the adjustment is completed, the duty cycle increases when the throttle lever is moved from the low idle position. Proceed to Test Step 2.

- Not OK – There is a problem with the throttle position sensor.

Repair: Refer to the diagnostic functional test Troubleshooting, "Throttle Position Sensor".

STOP.

Test Step 2. Adjust the Throttle Linkage.

A. Place the throttle lever in the position of high idle. Adjust the throttle linkage. Adjust the high idle set screw.

Expected Result:

When the throttle is in high idle, the duty cycle is 90 to 95 percent.

Note: When the adjustment of the high idle is made on some types of linkage, the adjustment may change the low idle position. Repeat the adjustment for low idle in order to verify that the low idle is correctly adjusted.

Results:

- OK – The calibration was completed and verified.

Repair: Check for diagnostic codes. Repair any diagnostic codes.

STOP.

- Not OK – The calibration was not completed and verified. There is a problem with the throttle position sensor.

Repair: Refer to the diagnostic functional test Troubleshooting, “Throttle Position Sensor”.

STOP.

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