CATERPILLAR®

SENR1003-06
August 2000

Troubleshooting

3500B Generator Set Engines

3DM1-Up (Engine)
4GM1-Up (Engine)
5XM1-Up (Engine)
6PM1-Up (Engine)
7KM1-Up (Engine)
8EM1-Up (Engine)
8RM1-Up (Engine)
6HN1-Up (Engine)
6PN1-Up (Engine)
6WN1-Up (Engine)
7RN1-Up (Engine)
9AN1-Up (Engine)
3LS1-Up (Engine)
3MS1-Up (Engine)
3NS1-Up (Engine)
3TS1-Up (Engine)
3WS1-Up (Engine)
3XS1-Up (Engine)
1NW1-Up (Engine)
1PW1-Up (Engine)
2FW1-Up (Engine)
2HW1-Up (Engine)
2JW1-Up (Engine)
3DW1-Up (Engine)
4AW1-Up (Engine)
5AW1-Up (Engine)

Prime Power, Standby and Marine Auxiliary Generator Set Engines

Important Safety Information

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

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

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

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

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

⚠ WARNING

The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

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

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

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. For a list of the most current publication form numbers available, see the Service Manual Contents Microfiche, REG1139F.

⚠ WARNING

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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Electronic Troubleshooting

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System Overview

SMCS Code: 1901-038

The engine is designed for electronic control of most engine operating functions. The electronic system consists of an Electronic Control Module (ECM), wiring harness, switches, sensors, and Electronic Unit Injectors. The ECM monitors parameters during engine operation.

Electronic Controls

Electronic Control Module

The ECM supplies signals to the Electronic Unit Injectors. The ECM signals control 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 governs engine speed. Desired engine rpm is determined by the throttle position sensor signal and certain sensor readings. Diagnostic codes may derate the engine. Actual engine rpm is determined by the Engine Speed/Timing signal.

Fuel Injection

The ECM controls the timing of the injectors. The ECM varies the signals to the injectors. 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 rpm.

Injection timing depends on engine rpm, load, and other operational factors. The ECM detects the top center of each cylinder. The ECM sends an injection signal at the desired time. The ECM limits engine power during cold mode operation. The ECM modifies the injection timing and the ECM cuts out the 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 FRC Fuel Position controls the fuel limit for exhaust smoke. The FRC is based on the maximum allowable fuel to air ratio. 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 provides power. The Rated Fuel Position provides the power curves and the torque curves for a specific engine family.

Engine Wiring Diagram for the 3500B Engine with CMS and Without 2301A Loadshare

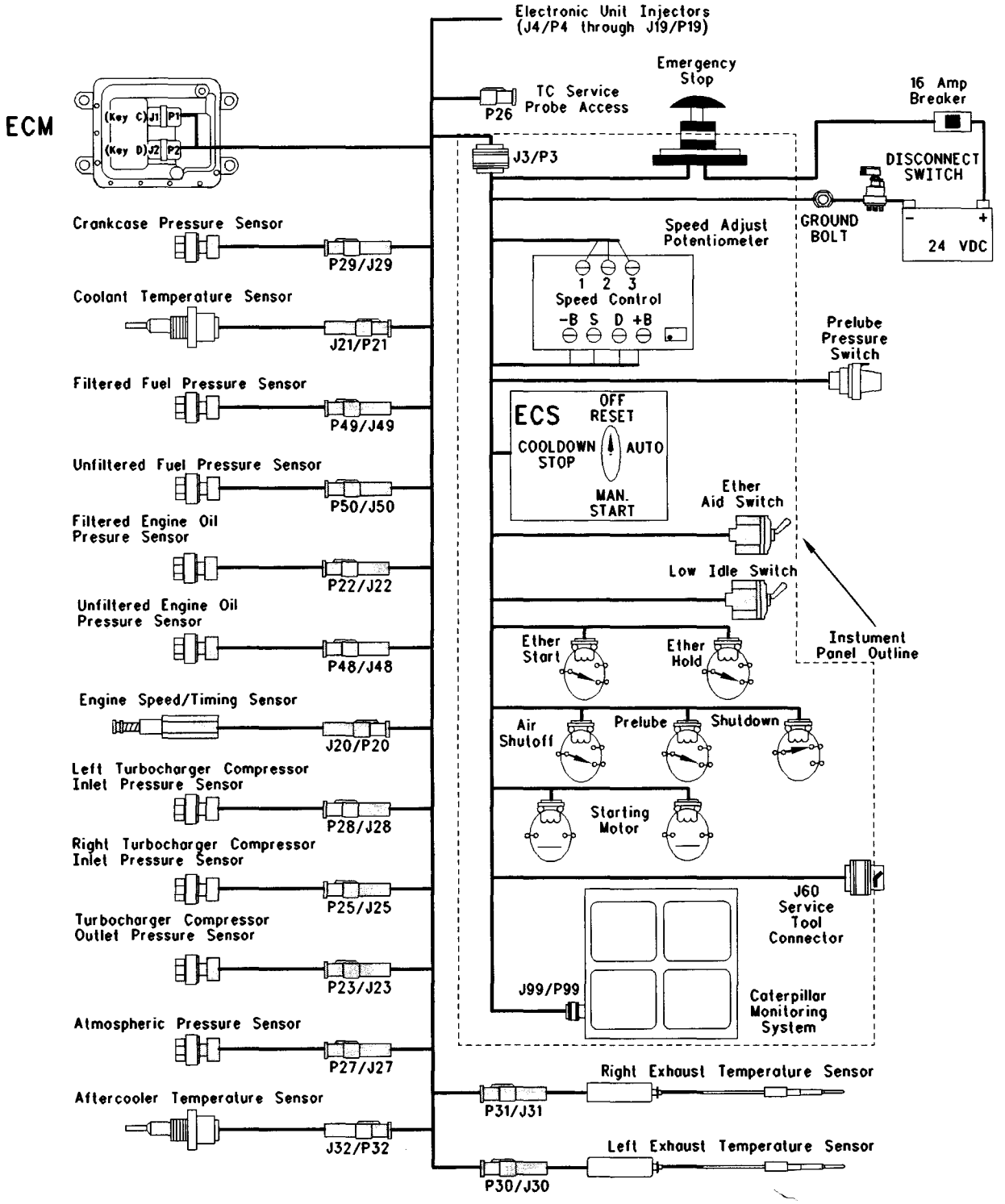

Illustration 1

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Engine Wiring Diagram for the 3500B Engine with EMCP II and 2301A Loadshare

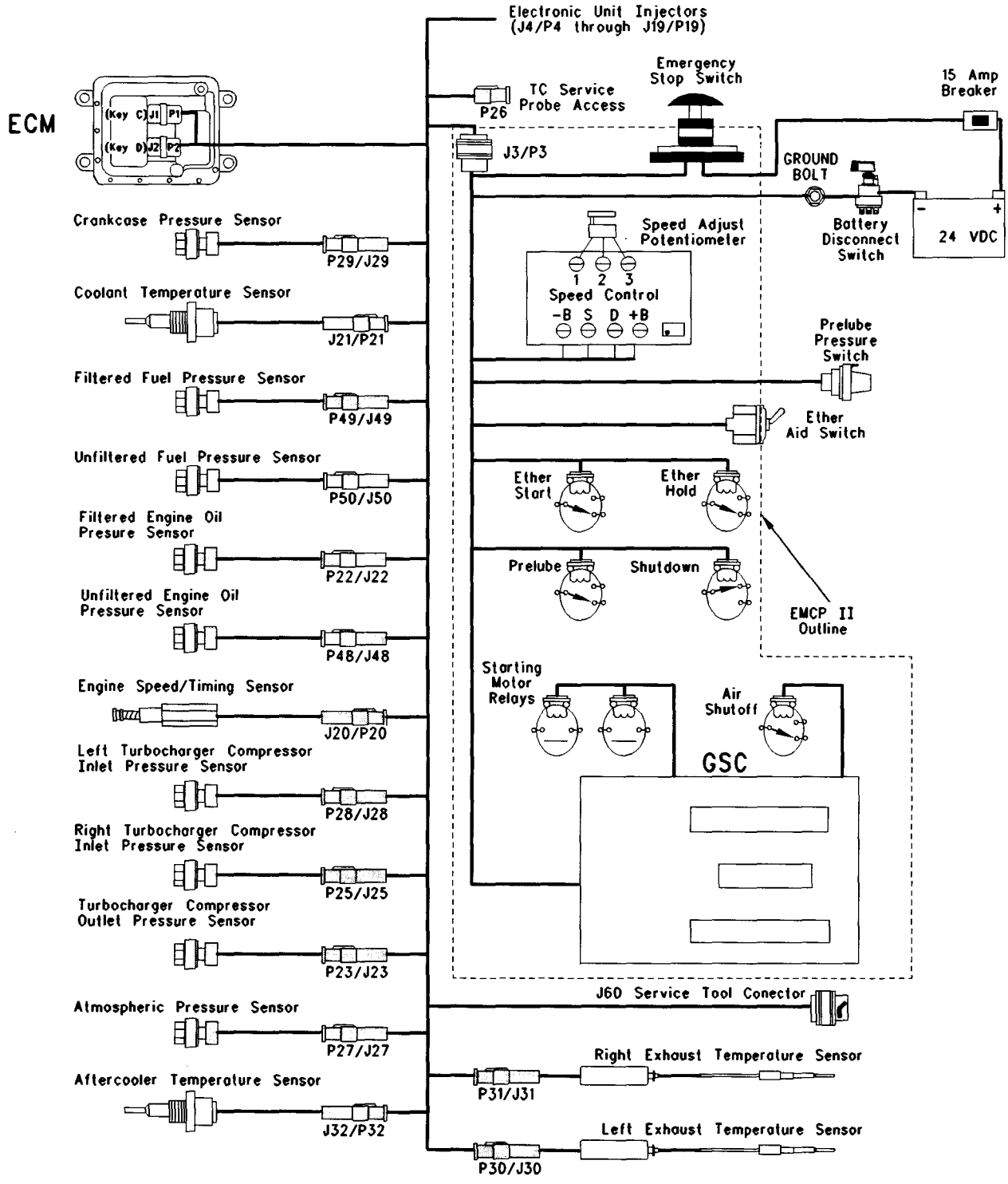

Illustration 2 g00638235

Location Of The Engine Components

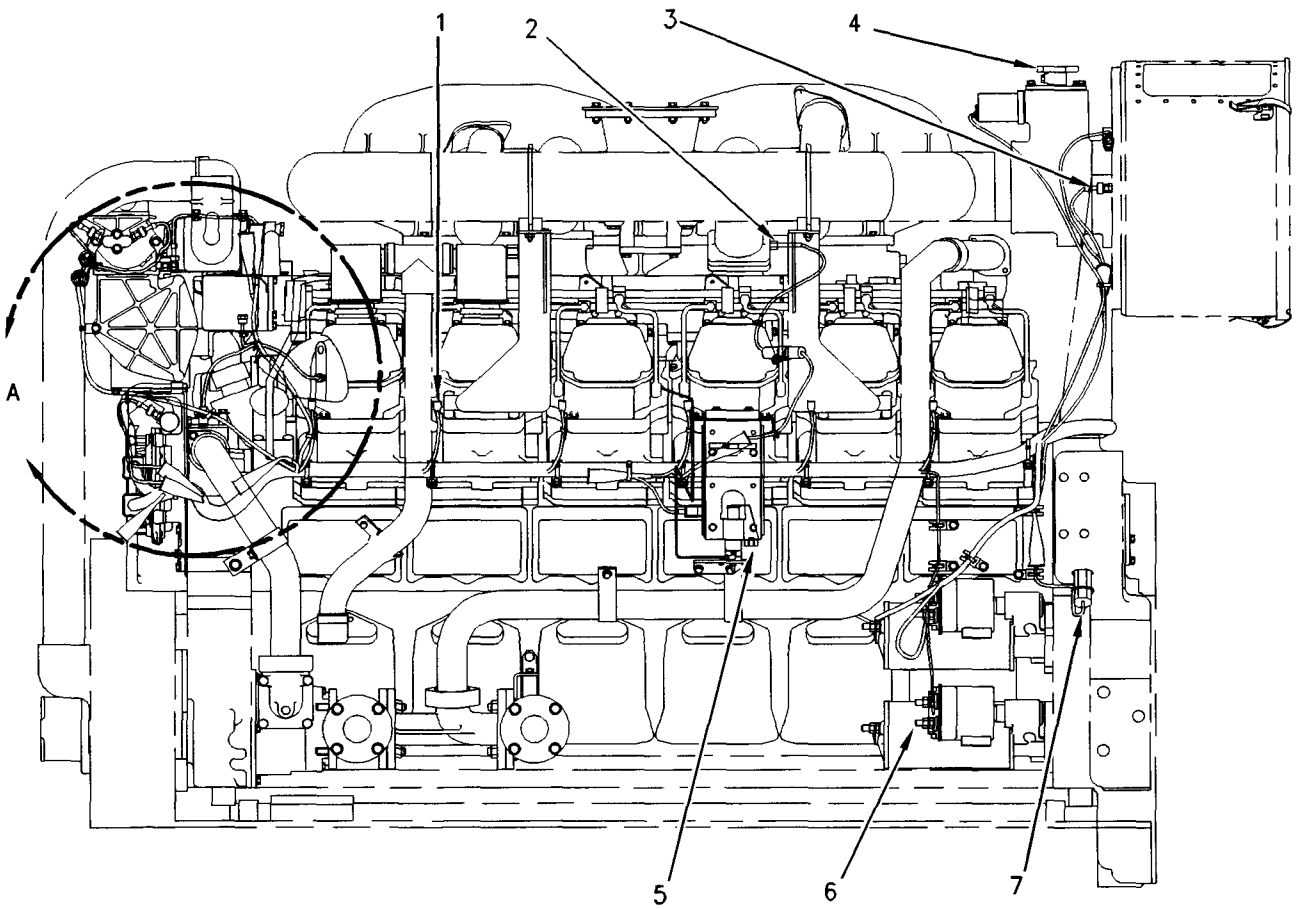

Illustration 3 g00594440

Left Side View

(1) Connector for the electronic unit injector. (2) Left exhaust temperature sensor. (3) Left turbocharger compressor inlet pressure sensor. (4) Air shutoff. (5) Ether starting aid. (6) Electric starting motor. (7) Engine speed/timing sensor.

Location Of The Engine Components

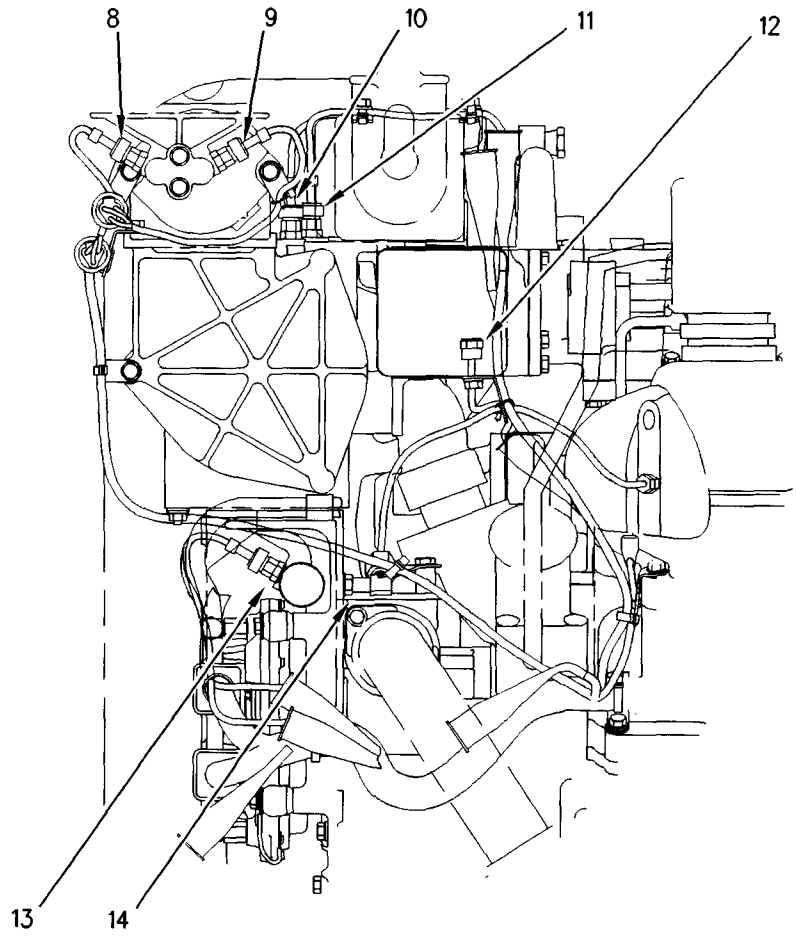

Illustration 4 g00594443

A View

(8) Unfiltered fuel pressure sensor. (9) Filtered fuel pressure sensor. (10) Unfiltered engine oil pressure sensor. (11) Filtered engine oil pressure sensor. (12) Coolant temperature sensor. (13) Atmospheric pressure sensor. (14) Aftercooler temperature sensor.

Location Of The Engine Components

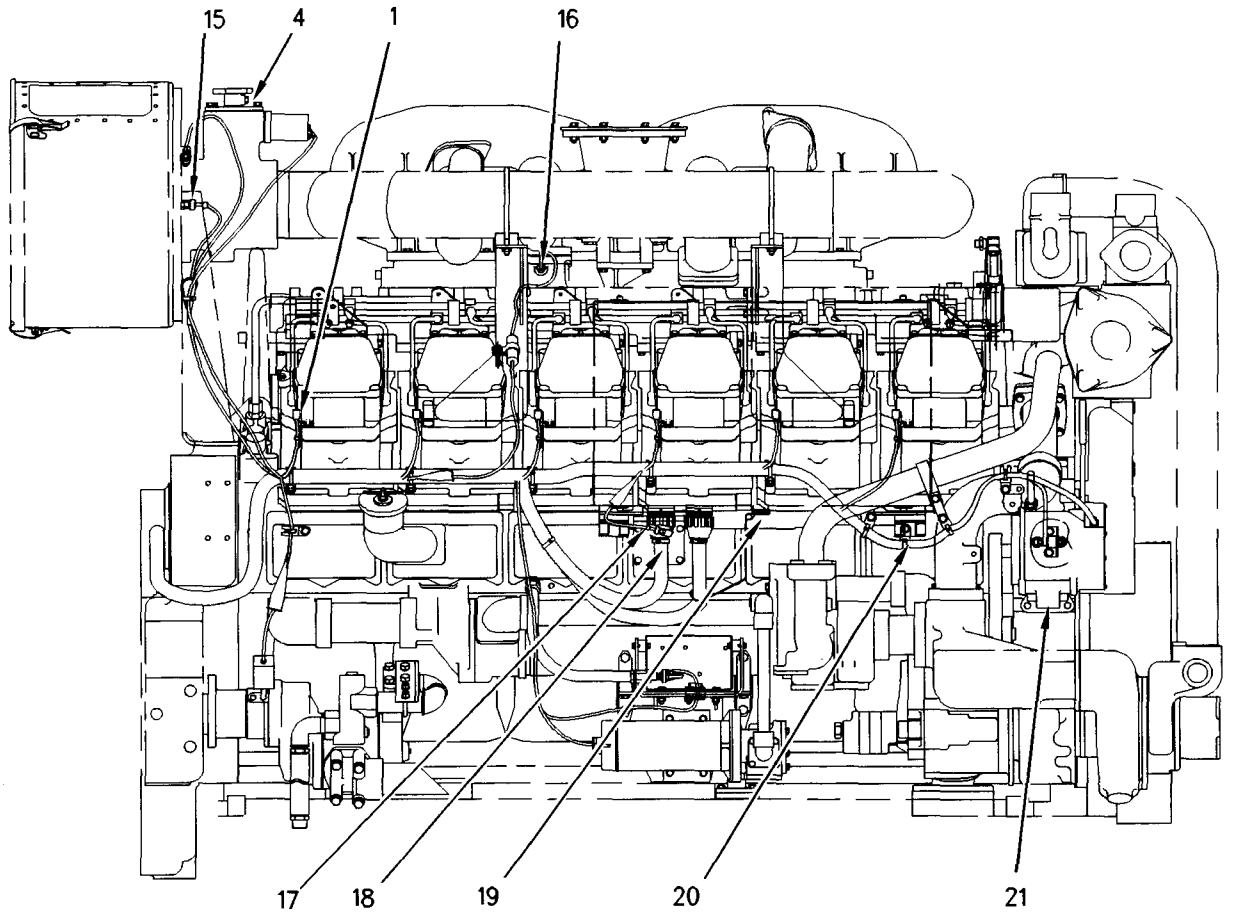

Illustration 5 g00638771

Right Side View

(15) Right turbocharger compressor inlet pressure sensor. (4) Air shutoff. (1) Connector for the electronic unit injector. (16) Right exhaust temperature sensor. (17) Crankcase pressure sensor. (18) Instrument panel connector J3A/P3A. (19) Electronic service tool connector J60/P60. (20) Customer connector J3/P3. (21) Alternator.

Location Of The Engine Components

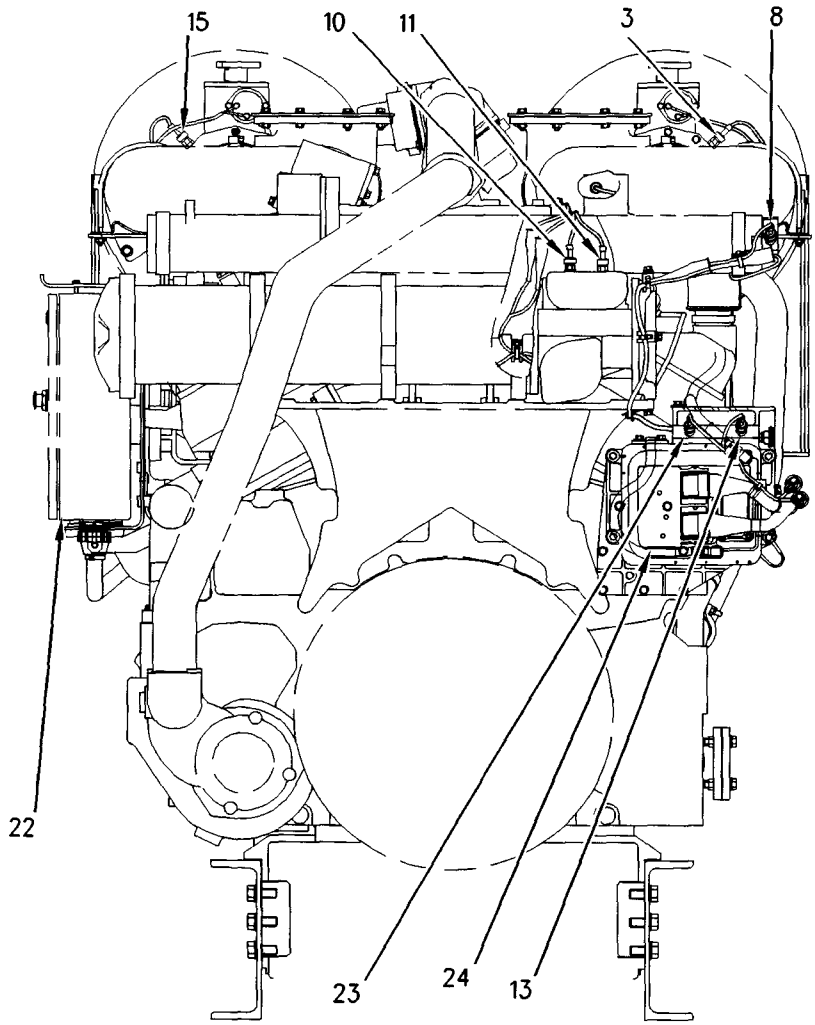

Illustration 6 g00638776

Front View

(15) Right turbocharger compressor inlet pressure sensor. (10) Unfiltered engine oil pressure sensor. (11) Filtered engine oil pressure sensor. (3) Left turbocharger compressor inlet pressure sensor. (8) Unfiltered fuel pressure sensor. (22) Instrument panel. (23) Turbocharger compressor outlet pressure sensor. (24) ECM. (13) Atmospheric pressure sensor.

Location Of The Engine Components

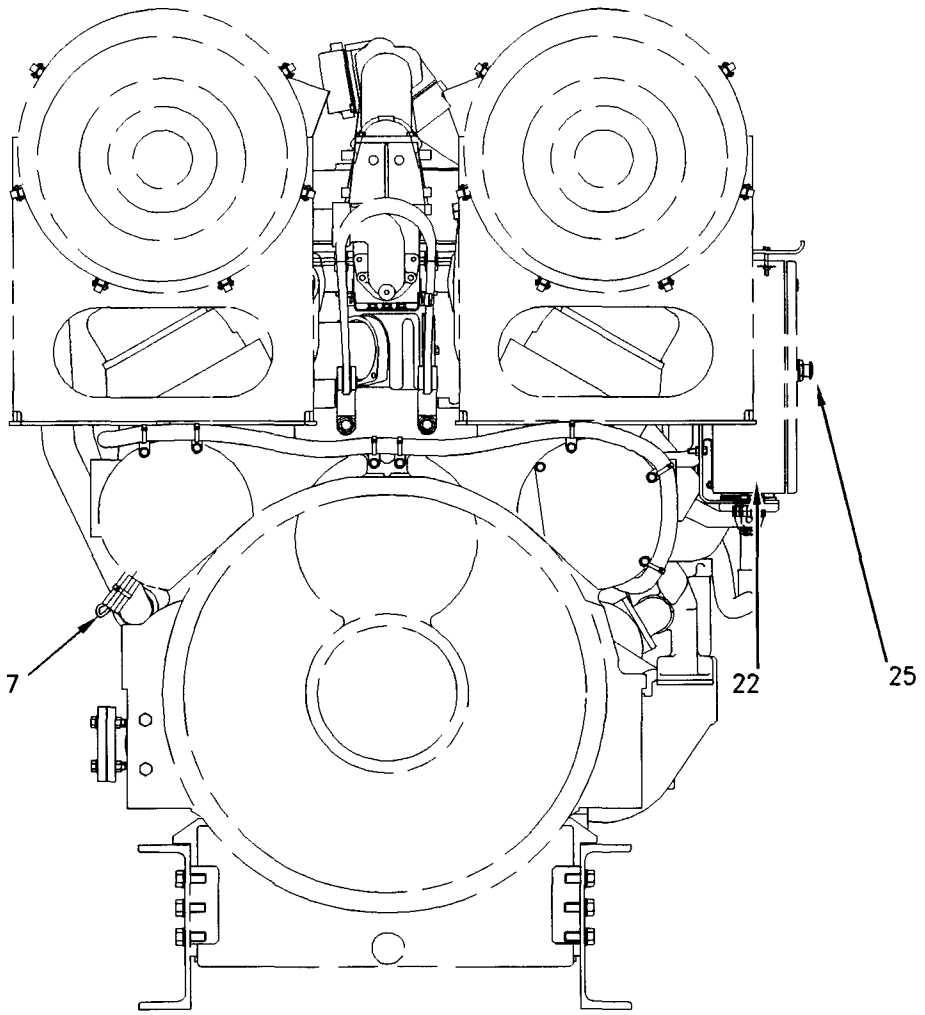

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Illustration 7

Rear View

(7) Engine speed/timing sensor. (22) Instrument panel. (25) Emergency stop push button.

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Self-Diagnostics

SMCS Code: 1901-038

The 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 ECM circuitry.

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 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 Electronic Technician (ET).
- Perform sensor calibrations.
- Read the programmable parameters.
- Change the programmable parameters.

The ET requires a communication adapter to communicate with the 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 Probes
175-3700	Connector Repair Kit
1U-5804	Crimp 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	Clip
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".

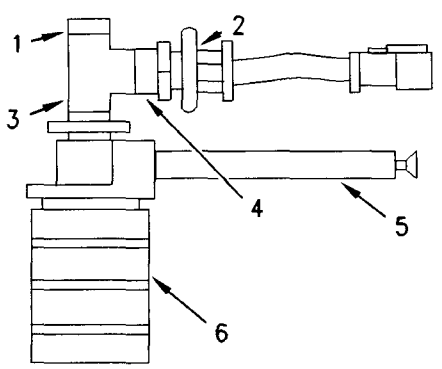

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Illustration 8

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.

Electronic Technician

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

- Sensor Values
- Diagnostic codes
- Engine configuration

The ET can perform the following functions:

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

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

Table 3

Required Electronic Service Tools for the Use of 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 ET
JERD2129 or JERD2142	Data Subscription for all engines and machines Data Subscription for machines only
NEHS0758(1)	Service Program Module for the 171-4401 Communication Adapter II
160-0141(2)	Data Link Cable
160-0133(2)	Data Link Cable
171-4401(2)	Communication Adapter II for use between ET and the ECM

(1) The subscription will be updated at regular intervals.
(2) This part number is part of the 171-4400 Communication Adapter II Group. The 7X-1701 Communication Adapter and wiring will also work.

Connecting ET and the Communication Adapter II

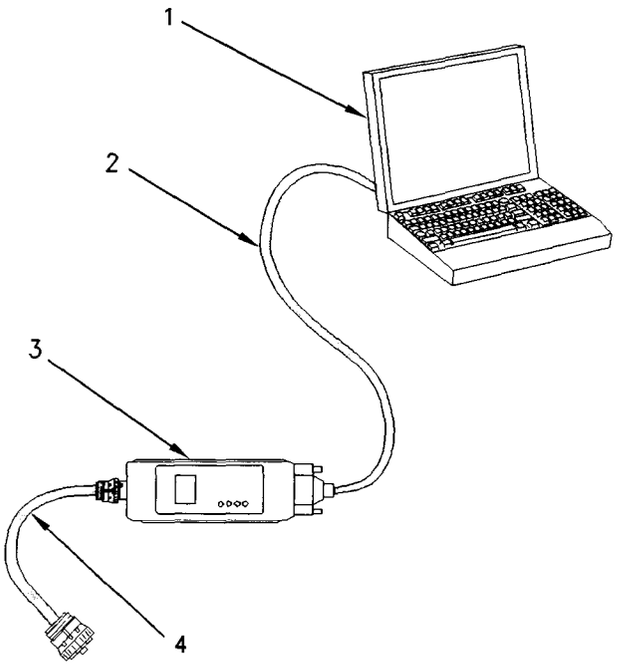

Illustration 9 g00647144

(1) Personal computer
(2) 160-0141 Data Link Cable
(3) 171-4401 Communication Adapter II
(4) 160-0133 Data Link Cable

Note: The 7X-1701 Communication Adapter will also work.

The power supply provides the Communication Adapter II with 24 VDC. Use the following procedure to connect the ET and the Communication Adapter II to the engine.

1. Remove the power from the battery terminal block.
2. Connect the **160-0133** Data Link Cable. The cable connects to the J42 service tool connector and the control connector on the Communication Adapter II.
3. Connect the **160-0141** Data Link Cable. The cable connects to the laptop computer's RS232 serial port and the service tool connector on the Communication Adapter II.

4. Connect the battery power to the battery terminal block. Check the Emergency Stop and the Start/Run/Stop circuit. Verify that the circuit is disconnected. If the ET and the Communication Adapter II do not communicate with the Electronic Control Module (ECM), refer to Troubleshooting, "Electronic Service Tool Will Not Communicate With ECM".

Table 4

Communication Adapter II Specifications	
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)

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Electronic Display Module

SMCS Code: 1901-038

The electronic display module can display a CID-FMI from the engine control system. Three switches are used to select various operating modes and display modes. Refer to the Service Manual for more information.

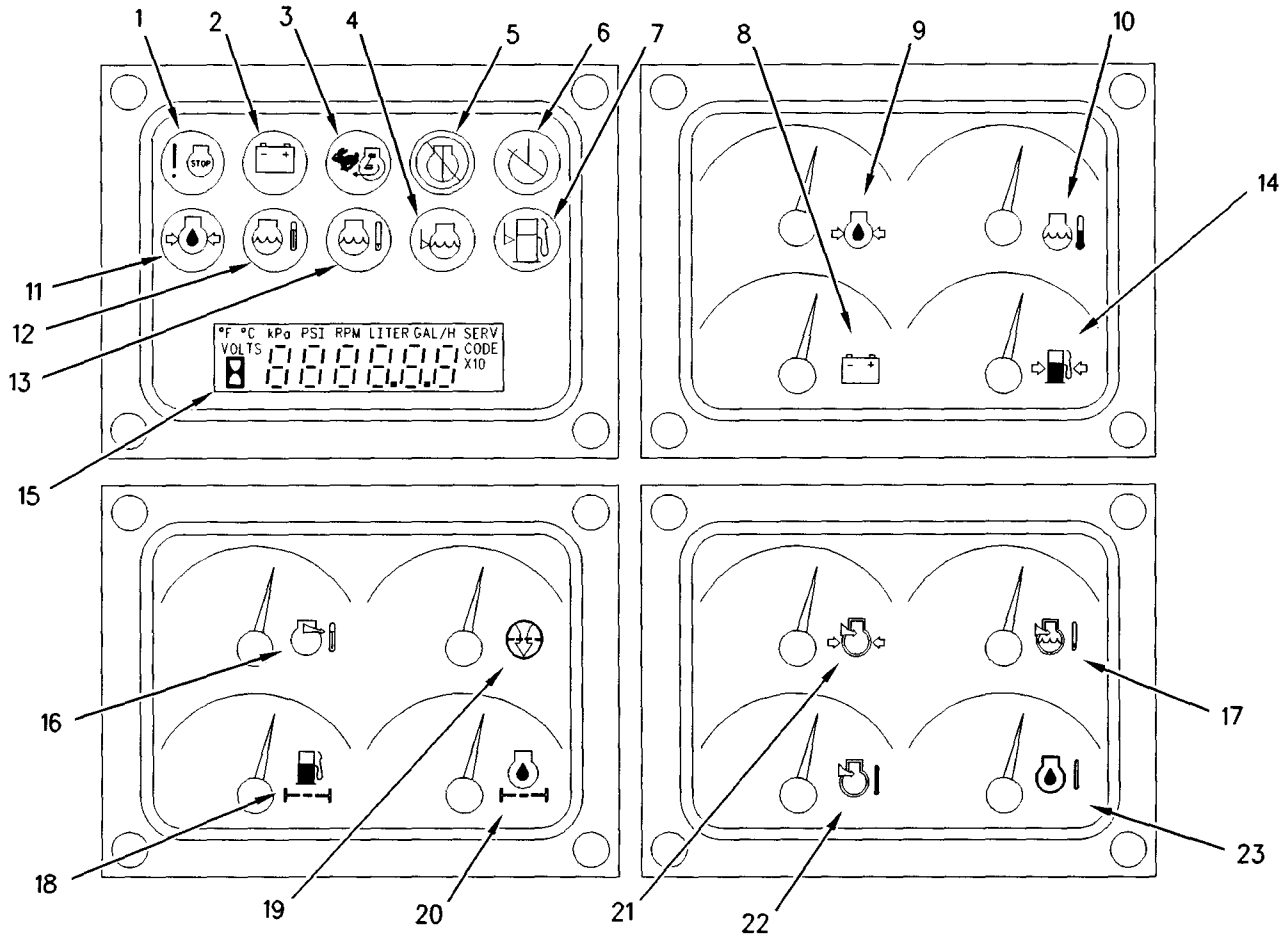

Illustration 10 g00593058

Caterpillar Monitoring System

(1) Shutdown
(2) System Voltage
(3) Overspeed
(4) Low Coolant Level
(5) Overcrank
(6) Not in AUTO
(7) Low Fuel Level
(8) System Voltage
(9) Oil Pressure
(10) Coolant Temperature
(11) Low Oil Pressure
(12) High Coolant Temperature
(13) Low Coolant Temperature
(14) Fuel Pressure
(15) LED Display
(16) Exhaust Temperature
(17) Aftercooler Temperature
(18) Fuel Filter Restriction
(19) Air Inlet Restriction
(20) Oil Filter Restriction
(21) Inlet Air Pressure
(22) Inlet Air Temperature
(23) Oil Temperature

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Engine Monitoring System

SMCS Code: 1901-038

The ECM monitors 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 certain parameters.

The ET can select the ECM response. The ET can be used to program the level of engine monitoring and the delay times.

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

Table 5

Engine Monitoring System						
Parameter	**ECM Response**	**Default Trip Point**	**Default Delay Time**	**Limits**		
				Range for Trip Point		**Delay Time**
				Low	High	
Low System Voltage	Off					
	Warning	20 VDC	10 Seconds	20 VDC	22 VDC	1 to 30 seconds
Low Oil Pressure	Off					
	Warning	(1)	4 Seconds	N/A		1 to 15 seconds
	Shutdown	(1)	9 Seconds	N/A		1 to 15 seconds
High Coolant Temperature	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	Off					
	Warning	80 °C (176 °F)	5 Seconds	63 °C (145 °F)	85 °C (185 °F)	1 to 60 Seconds
Engine Overspeed	Off					
	Warning	1.18 × Rated Speed	0 Seconds	1200 rpm	2400 rpm	0 to 5 Seconds
	Shutdown (50 Hz)	1.18 × Rated Speed	0 Seconds	1200 rpm	2400 rpm	0 to 5 Seconds
	Shutdown (60 Hz)	1.18 × Rated Speed	0 Seconds	1200 rpm	2400 rpm	0 to 5 Seconds
Air Filter Restriction Pressure	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	Off					
	Derate	(2)	N/A	250 m (820 ft)	3658 m (12001 ft)	N/A
High Exhaust Temperature	Off					
	Warning	(2)	5 Seconds	500 °C (932 °F)	800 °C (1472 °F)	1 to 60 Seconds
	Derate	(2)	5 Seconds			1 to 60 Seconds
Oil Filter Differential Pressure	Off					
	Warning	105 kPa (15 psi)	5 Seconds	70 kPa (10 psi)	105 kPa (15 psi)	1 to 60 Seconds

(continued)

(Table 5, contd)

Fuel Filter Differential Pressure	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 30 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	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

(1) Refer to the oil pressure map.
(2) Refer to the Performance and Ratings Specifications in the TMI (Technical Marketing Information).

Oil Pressure Map

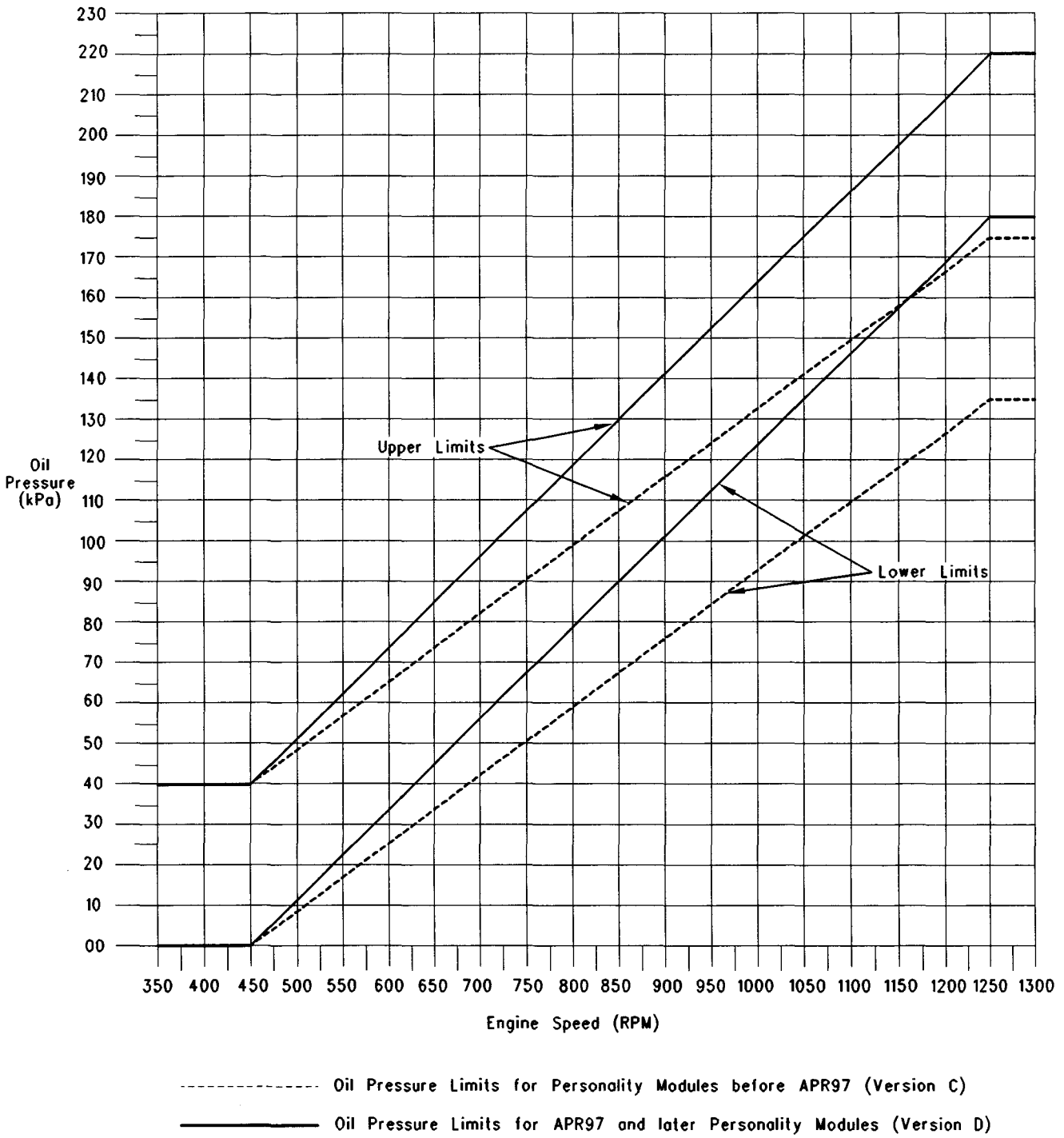

Illustration 11
Oil Pressure Map

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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 second 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.

The engine monitoring system is enabled after the engine is started. When the engine is within 50 rpm of low idle, the ECM will check the parameters. The ECM will not check the parameter for low oil pressure. Low oil pressure has an additional 10 second delay after the engine is started. The delay is designed to eliminate false low oil pressure warnings.

Use care when you program the trip point and the delay time. Check that the ECM response is correct for your application. If the legal range is not exceeded, the engine monitoring system will accept any setting.

The engine will shut down if the trip point for a shutdown is lower than the trip point for a warning. 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 High Coolant Temperature 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 6

Parameter	**Hysteresis**
ECM Voltage	3 VDC
Oil Pressure	50 kPa (7 psi)
High Coolant Temperature	3 °C (7 °F)
Low Coolant Temperature	3 °C (7 °F)
Overspeed	100 rpm
Air Inlet Restriction	N/A
Altitude	N/A
High Exhaust Temperature	102 °C (216 °F)
Oil Filter Differential Pressure	10 kPa (1.5 psi)
Fuel Filter Differential Pressure	10 kPa (1.5 psi)
Crankcase Pressure	N/A
Aftercooler Water Temperature	3 °C (7 °F)

Most active engine derates that occur are activated when the associated parameter is out of range.

When the parameter returns to normal operation, the active engine derate is disengaged.

There are a few exceptions:

- High exhaust temperature
- High air filter restriction
- Crankcase pressure

The active engine derate is latched until the ECM is powered down.

Programming Parameters

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Programming Parameters

SMCS Code: 1901-038

The ET can view certain parameters that can affect the operation of the engine. The ET can change certain parameters that can affect the operation of the engine. The parameters are stored in the ECM. The parameters are NOT stored in the Personality Module. 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.

i01171722

Factory Passwords

SMCS Code: 1901-038

Factory Level Passwords are required to clear certain logged events. Factory Level Passwords are required to change certain parameters such as Full Load Setting. The passwords restrict changes to authorized personnel. When the correct passwords have been entered, the changes will be programmed in the ECM.

Factory Level Passwords are required to clear all events.

The Electronic Service Tool Factory Level Password screen will display the following parameters:

- ECM serial number
- Engine serial number
- Electronic Service Tool
- Electronic Service Tool serial number
- Reason Code
- Total Tattletale number

In order to obtain the proper passwords, the information must be given to an authorized Caterpillar dealer. The old interlock code is required to change the interlock code on a used ECM. The new interlock code is also required to change the interlock code on a used ECM. The passwords are controlled by Caterpillar. The passwords may only be obtained by an authorized Caterpillar dealer. The passwords may only be used for one programming session. A new set of passwords will be required to perform the following functions:

- Clear all events.
- Program the parameters.

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Flash Programming

SMCS Code: 1901-038

Flash Programming – This is a method of programming or updating the personality module in an ECM.

The ET can be utilized to flash a new personality module into the ECM. This eliminates the need to physically remove the personality module from the ECM. This is the preferred method for updating the software. There is no risk of moisture entry into the ECM due to improper seal installation. The flash is accomplished by transferring the data from the PC to the ECM.

Note: If the appropriate computer (PC) and software (ET) are not available, the personality module can be physically removed and replaced.

Flash Programming a Personality Module

1. Connect the ET to the service tool connector.
2. Select "WinFlash" from the "Utilities" menu on the ET.

   "WinFlash" will try to detect an ECM.
3. When an ECM has been detected, the "ECM Selector" window will appear. Select the appropriate ECM and then select "OK".

   The "Flash File Selection" window will appear.
4. The flash files are located on a disk drive and in a directory. Select the correct disk drive and the directory from "Drives" and "Directories" on the ET.

   A list of flash files will appear.
5. Select the correct file from the list of flash files. Read the "Description" and the "File Info" in order to verify that the correct file is selected. Select "OK".
6. Select the "Begin Flash" button in order to program the personality module.

   When the flash is completed, this message will appear: "Flash Completed Successfully".
7. Start the engine and check for proper operation.

a. If a diagnostic code of 268-02 "Check Programmable Parameters" is generated, program any parameters that were not in the old personality module.

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

"WinFlash" Error Messages

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

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System Configuration Parameters

SMCS Code: 1901-038

System Configuration Parameters are parameters that affect emissions, power of the engine, and other features. The parameters are programmed at the factory. In most cases, the parameters do not need to be changed. You must reprogram the System Configuration Parameters if the ECM is replaced and/or you reprogram the engine rating. You do not need to reprogram the System Configuration Parameters if you replace the Personality Module. Proper values for these parameters are available on an Electronic Service Tool. Certain Configuration Parameters are also stamped on the Engine Information Plate.

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

The following functions will be performed with an engine that has EMCP II:

- Automatic Start/Stop
- Air Shutoff
- Cooldown

Note: Changing the parameters that are protected by factory passwords may cause your Caterpillar warranty to be voided.

Engine Serial Number

The engine serial number should be programmed to match the engine information plate. The serial number is not programmed on a new ECM.

Rated Fuel Position

This parameter is used to set engine power. A Factory Password is required to change this setting.

Table 7

Minimum	Default	Maximum
Minimum Rack	Engine Dependent	Engine Dependent

Acceleration Delay

When the engine is started the ECM will limit the engine to low idle. The ECM will no longer limit the engine rpm when the following conditions exist:

- The engine oil pressure is above 70 kPa (10 psi).
- The acceleration delay is reached.

Programming this parameter to 0 will disable this function.

Note: If the engine is configured to operate in Direct Fuel Control Mode, this parameter is disabled.

Table 8

Minimum	Default	Maximum
0 seconds	0 seconds	60 seconds

Acceleration Ramp Rate

The acceleration ramp rate is the maximum ramp rate of the desired engine rpm. The desired engine rpm will be set to low idle until the engine rpm reaches 400. When the engine rpm becomes greater than 400 rpm, desired engine rpm will start increasing until the required desired engine rpm is reached.

Note: If the engine is configured to operate in Direct Fuel Control Mode, this parameter is disabled.

Table 9

Minimum RPM per second	Default RPM per second	Maximum RPM per second
1 rpm/sec	250 rpm/sec	750 rpm/sec

Low Idle

The parameter defines the lowest rpm level.

Note: If the engine is configured to operate in Direct Fuel Control Mode, this parameter is disabled.

Table 10

Minimum	Default	Maximum
810 rpm	1000 rpm	1000 rpm

Cooldown Speed

This parameter defines the engine rpm level when the ECS is placed in the STOP position.

Table 11

Minimum	Default	Maximum
810 rpm	1000 rpm	1800 rpm

Cooldown Time

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

Note: This parameter should be programmed to 0 if EMCP II is connected to this system. Problems may result if both controls try to perform this function.

Table 12

Minimum	Default	Maximum
0 minutes	0 minutes	30 minutes

Prelube Time

The parameter sets the amount of time for prelubrication. Programming this parameter to 0 will disable this function.

Table 13

Minimum	Default	Maximum
0 seconds	0 seconds	210 seconds

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.

Note: This parameter should be programmed to 0 if EMCP II is connected to this system. Problems may result if both controls try to perform this function.

Table 14

Minimum	Default	Maximum
0 seconds	0 seconds	60 seconds

Cranking Cycles

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

Table 15

Minimum	Default	Maximum
0	0	10

Crank Terminate Speed

This parameter determines when the starting motor will disengage.

Table 16

Minimum	Default	Maximum
100 rpm	400 rpm	500 rpm

Air Shutoff

Programming the parameter to "OFF" will disable the air shutoff. This parameter should be programmed to "OFF" if the function is not being used or installed on this engine. This will prevent diagnostics from being logged.

Table 17

Minimum	Default	Maximum
OFF	OFF	ON

Ether Control

Programming this parameter to "OFF" will disable the function. This parameter should be programmed to "OFF" if the function is not being used or installed on this engine. This will prevent diagnostics from being logged.

Table 18

Minimum	Default	Maximum
OFF	OFF	ON

Engine Cooling System

This parameter determines the cooling system. The parameter requires a factory password to change.

Table 19

Minimum	Default	Maximum
SCAC	SCAC	JWAC

Fuel Correction Factor

The parameter is programmed to a numerical value. The calculations will be adjusted in accordance with the numerical value. The parameter requires a factory password to change.

CAT Data Link

This parameter determines the engine identification for the secondary CAT Data Link.

Table 20

Minimum	Default	Maximum
Engine Control 1	Engine Control 1	Engine Control 8

Cold Mode Cylinder Cutout

This parameter provides the strategy for the cold mode cylinder cutout.

Table 21

Minimum	Default	Maximum
Disabled	Disabled	Enabled

Direct Fuel Control Mode

If you program the parameter to "ON", you will enable the Direct Fuel Control Mode. The parameter requires a factory password to change. This feature requires special hardware in order to operate properly.

Table 22

Minimum	Default	Maximum
OFF	OFF	ON

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Factory Passwords Worksheet

SMCS Code: 1901-038

Factory passwords are required to perform the following functions:

- Clear logged events
- Program the engine monitoring system.
- Program the Rated Fuel Position.
- Program the cooling system.
- Program the Total Fuel.
- Program the Total Hours.
- Program the Direct Fuel Control Mode.

The following information is required to obtain Caterpillar Factory Passwords:

Table 23

Caterpillar Dealer Code	
Name	
Address	
Phone Number	

Note: Record logged events before you remove the ECM.

The following information is required to obtain factory passwords.

Table 24

Engine hours	

Note: Engine hours do not include service meter hours.

View the factory password screen on the Electronic Service Tool. Record the following information:

Table 25

Electronic Service Tool Serial Number	
Engine Serial Number	
ECM Serial Number	
Total Tattletale	
Reason Code	
Other parameters	

Injector Codes

Table 26

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

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Customer Parameters Worksheet

SMCS Code: 1901-038

Record the following information before you change any programmable parameter:

Table 27

Engine Serial Number	
ECM Serial Number	
Rated Fuel Position	
Low Idle Speed	
Acceleration Delay Time	
Acceleration Ramp Rate	
Cooldown Time	
Cooldown Speed	
Prelube Time	
Crank Duration	
Total Number of Crank Cycles	
Air Shutoff	
Fuel Control	
Direct Fuel Control Mode	

Record the following information from the engine information plate.

- Engine serial number

Record the following information from the engine monitoring system.

ECM Voltage

Table 28

Warning Trip Point	
Warning Delay Time	

Engine Oil Pressure

Table 29

Warning Trip Point	
Warning Delay Time	
Shutdown Trip Point	
Shutdown Delay Time	

High Coolant Temperature

Table 30

Warning Trip Point	
Warning Delay Time	
Derate Trip Point	
Derate Delay Time	
Shutdown Trip Point	
Shutdown Delay Time	

Low Coolant Temperature

Table 31

Warning Trip Point	
Warning Delay Time	

Engine Overspeed

Table 32

Warning Trip Point	
Warning Delay Time	
Shutdown Trip Point	
Shutdown Delay Time	

Air Inlet Restriction

Table 33

Warning Trip Point	
Warning Delay Time	
Derate Trip Point	
Derate Delay Time	

Altitude

Table 34

Derate Trip Point	

High Exhaust Temperature

Table 35

Warning Trip Point	
Warning Delay Time	
Derate Trip Point	
Dlay Time	

Engine Oil Filter Differential Pressure

Table 36

Warning Trip Point	
Warning Delay Time	

Fuel Filter Differential Pressure

Table 37

Warning Trip Point	
Warning Delay Time	

Crankcase Pressure

Table 38

Warning Trip Point	
Warning Delay Time	
Shutdown Trip Point	
Shutdown Delay Time	

Aftercooler Temperature

Table 39

Warning Trip Point	
Warning Delay Time	
Derate Trip Point	
Derate Delay Time	
Shutdown Trip Point	
Shutdown Delay Time	

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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 take a long time. Follow the troubleshooting procedures in this manual in order to be sure that replacing the ECM will correct the problem. Verify that the suspect ECM is the cause of the problem.

Note: Ensure that the ECM is receiving power and that the ECM is properly grounded before a replacement of the ECM is attempted. Refer to Troubleshooting, "Electrical Power Supply".

A test ECM can be used to determine if the ECM is faulty. Install a test ECM in place of the suspect ECM. Transfer the personality module from the suspect ECM to the test 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 test ECM resolves the problem, reconnect the suspect ECM. Verify that the problem returns. If the problem returns, replace the ECM.

Note: When a new ECM is not available, you may need to remove an ECM from an engine that is not in service. The ECM must have the same serial number suffix. Ensure that the replacement ECM and the Personality Module Interlock Code 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 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 ET to the service tool connector.
2. Print the parameters from the "Configuration" screen on ET. If a printer is unavailable, record all of the parameters. Record any logged diagnostic codes and logged event codes for your records.
3. Use the "Copy Configuration/ECM Replacement" feature that is found under the "Service" menu on 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 keyswitch to the OFF/RESET 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.
   d. Remove the mounting bolts from the ECM.
   e. Disconnect the ECM ground strap from the engine.
   f. If you are flash programming, go to Step 7. If you are physically replacing the personality module, proceed to Step 5.

Note: Flash programming is the preferred method for replacing the personality module. The personality module can be physically removed, if flash programming is unsuccessful.

NOTICE
Moisture entry into the ECM from improper servicing can result in ECM failure.

5. Remove the personality module from the old ECM.
   a. Remove the tag wire from the back cover of the ECM.
   b. Remove the bolts from the back cover of the ECM.
   c. Remove the O-ring seal from the cover.
   d. Remove the personality module by squeezing the tabs on the ends of the blue plastic case. Pull the module straight out of the ECM.

NOTICE
Improper O-ring placement could result in moisture damage from improper sealing. Do not over tighten bolts! This could result in damaged threads and moisture damage from improper sealing.

6. Install the personality module into the replacement ECM.
   a. Carefully seat the personality module in the EPROM carrier socket.

Note: **Do not use excessive force to insert the module into the socket.** The socket will accept the personality module in only one position. A click is audible when the personality module is inserted correctly.

b. Install the O-ring seal for the cover of the personality module.

c. Install the access cover for the personality module on the ECM. Tighten the cover bolts for the personality module to a torque of 1.36 N·m (12 lb in).

7. 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.

c. Ensure that the ECM mounting hardware is installed correctly. The fuel lines should not be pulling 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 a torque of 2.25 N·m (20 lb in).

f. If the personality module has been physically replaced, go to Step 9. If you are flash programming, continue to Step 8.

8. Flash program the personality module into the ECM. Refer to Troubleshooting, "Flash Programming" for the correct procedure.

9. Use ET to match the engine application and the Personality Module Interlock Code if the replacement ECM was used for a different application.

10. Configure the ECM.

a. If the "Copy Configuration" process from Step 3 was successful, return to the "Copy Configuration/ECM Replacement" screen on ET and select "Program ECM". Go to Step 12.

b. If the "Copy Configuration" process was unsuccessful, program the ECM parameters. The parameters should 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.

11. Calibrate the injection timing. Refer to Troubleshooting, "Engine Speed/Timing Sensor - Calibrate".

12. Check for diagnostic codes and event codes.

Troubleshooting without a Diagnostic Code

i01177333

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. Repair all ACTIVE Diagnostic Codes.

Perform the following steps in order to determine the problem.

1. Gather Operator Information.
2. Verify that the complaint is not due to normal engine operation.
3. Perform a visual inspection. Inspect the following items:
   - Fuel Level
   - Oil Level
   - Fuel Supply
   - Oil Supply
   - Wiring
   - Connectors
4. Check and repair all diagnostic codes.

If these inspections do not reveal any problems, use the procedures in this manual that best describes the symptoms.

Check if any logged diagnostic codes are present.

i01364577

Alternator

SMCS Code: 1405-035

The probable root causes are listed in order below:

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

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 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".

i01183766

Can Not Reach Top Engine RPM

SMCS Code: 1000-038; 1901-038

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

The probable root causes are listed in order below:

- Derated Engine
- Personality Module
- Throttle Position Sensor signal
- Fuel supply
- Air inlet or exhaust restriction
- Leaks in air system
- Faulty accessory equipment

Perform the following test in order:

1. Connect an Electronic Service Tool and check for logged derate events. A derate status flag will appear on the Electronic Service Tool if an active engine derate is occurring. The engine speed might be limited due to one of the following possible causes: altitude, exhaust temperatures that are high, and air filters that are dirty.

2. Verify that the correct Personality Module is installed. Refer to Troubleshooting, "Programming Parameters".

3. Use the Electronic Service Tool in order to monitor the status of the throttle. Observe the throttle position. The throttle position should be stable. The throttle position should reach 100 percent. Refer to Troubleshooting, "Speed Control".

4. Check fuel lines for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines. Refer to the Systems Operation, "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 unit 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 Instruction, SEBD0717, "Diesel Fuels And Your Engine". Check the fuel pressure with engine cranking. Check the fuel pressure at the filter. Refer to the Specifications Manual for correct pressure values. 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.

5. Check air inlet and exhaust systems for restrictions and/or leaks. Refer to the Systems Operation.

6. Observe the Check Engine Lamp. Check for a air filter restriction indicator. Replace plugged air filters and/or clean filters. Refer to the Testing and Adjusting , "Air Inlet and Exhaust System". Refer to Troubleshooting, "Engine Sensor Open/Short Test".

7. Check all accessory equipment.

i01010876

Coolant in Engine Oil

SMCS Code: 1300-038; 1901-038

Note: This is NOT an electronic system problem. Refer to the Systems Operation for additional information.

The probable root causes are listed in order below:

- Failure of any of the oil cooler cores
- Failure of cylinder head gasket
- Crack in cylinder head

Perform the following tests in order:

1. Install a new oil cooler core. Drain the crankcase. Refill the crankcase with clean lubricant. Install new oil filters.

2. Check the cylinder liner. Install a new cylinder head gasket. Install new liner water seals in the spacer plate. Tighten the bolts that hold the cylinder head according to the Specifications Manual.

3. Check for cracks in the cylinder head. Repair the cylinder head and/or replace the cylinder head. Check for cracked liners. Replace cracked cylinder liners. Repair the cylinder block and/or replace the cylinder block.

i01200347

Coolant Temperature Is Too High

SMCS Code: 1350-038; 1901-038

The probable root causes are listed in order below:

- Radiator cooling fins
- Low coolant level
- Coolant leak

- Faulty engine cooling fan
- Engine Speed/Timing sensor
- Faulty pressure relief valve
- Cooling system
- Faulty temperature gauge
- Faulty jacket water coolant pump
- Too much load on the system

Perform the following tests in order:

1. Check the radiator cooling fins for dirt and/or debris. Remove the dirt and/or debris.
2. Inspect the coolant level. If necessary, add coolant.
3. Check the cooling system for leaks.
   a. Inspect the coolant for presence of bubbles.
   b. Check the cooling system for combustion gases. Refer to Testing and Adjusting, "Cooling Systems".
4. Check for proper operation of the cooling fan. Check applicable drive belts, pumps, speed sensors and/or control solenoids for proper operation.
5. Connect an ET and monitor the cooling fan. Check for a error with the Engine Speed/Timing Sensor. Refer to Troubleshooting, "Engine Speed/Timing Sensor - Calibrate".
6. Check operation of the pressure relief valve and the radiator cap. If necessary, clean the pressure relief valve and/or the radiator cap.
   a. Check that the seating surface of the valve is clean and undamaged. If necessary, install new parts.
7. Pressure test the cooling system. Refer to Testing and Adjusting, "Cooling Systems".
   a. Clean the radiator and flush the radiator. Refer to Testing and Adjusting, "Cooling Systems".
8. Check the water temperature regulators for correct operation.
   a. Check the temperature gauge for correct operation. If necessary, install new parts.
9. Inspect the impeller vanes at the jacket water pump for damage and/or erosion. Repair impeller vanes and/or replace the impeller vanes.
10. Reduce the load.

i01365337

ECM Will Not Accept Factory Passwords

SMCS Code: 1901-038

The probable root causes are listed in order below:

- Incorrect password
- Incorrect Serial Number
- Total Tattletale
- Reason Code

Perform the following tests in order:

1. Verify that the correct passwords were entered. Check for proper letters in each password. Check for proper accuracy in each password. Turn the ECS to the OFF/RESET position for 30 seconds and then retry.
2. Verify that the ET indicates the Password entry screen.
3. Verify that the engine serial number that is used to calculate the password is correct. Refer to Troubleshooting, "Programming Parameters"for more details.
4. Verify that the following items are correct: Total Tattletale, Reason Code, Serial Number for the ET, and ECM Serial Number. Refer to Troubleshooting, "Programming Parameters"for more details.

i01234632

ECM Will Not Communicate with Other Systems or Display Modules

SMCS Code: 1901-038

The probable root causes are listed in order below:

- ECM
- Connector or wiring problem
- CAT Data Link

Perform the following tests in order:

1. Connect the ET. If the ECM does not communicate with the ET, refer to Troubleshooting, "Electronic Service Tool Will Not Communicate With ECM".

2. Check for correct installation of the ECM connectors J1/P1, J2/P2 and Machine Interface Connector. Refer to Troubleshooting, "Inspecting Electrical Connectors".

3. Refer to Troubleshooting, "CAT Data Link".

i01200352

Electronic Service Tool Will Not Communicate with ECM

SMCS Code: 1901-038

The probable root causes are listed in order below:

- Connector or wiring problem
- Communication adapter and/or cable
- Battery voltage
- Service tool
- Personality module
- CAT data link
- Electrical power supply to the ECM

Perform the following tests in order:

1. Check for correct installation of the ECM connectors J1/P1, J2/P2 and Service Tool Connector J24/P24. Refer to Troubleshooting, "Inspecting Electrical Connectors".

2. Disconnect the Communication Adapter from the ECM. Reconnect the Communication Adapter to the ECM.

   a. Verify that the correct cable from the Communication Adapter to the ECM is being used. Refer to Troubleshooting, "Electronic Service Tools".

3. Verify that battery voltage is present at pin A and pin B of the Service Tool Connector. If the Communication Adapter is not receiving power the display will be blank.

4. In order to eliminate the ET as the problem, verify if the problem can be repeated with another engine. If the problem can be repeated with another engine, refer to Troubleshooting, "CAT Data Link".

5. Check for correct installation of the ECM Personality Module.

Note: If the Personality Module has not been installed, the engine will not start. If the Personality Module has not been installed, the engine will not communicate. Refer to Troubleshooting, "Programming Parameters".

6. Check the ET for a 248-09 diagnostic code. Refer to Troubleshooting, "CAT Data Link".

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

Note: If the ECM is not receiving 24 VDC The ECM will not communicate.

i01199893

Engine Cranks but Will Not Start

SMCS Code: 1000-038; 1901-038

The probable root causes are listed in order below:

- Electrical power supply
- Low fuel level
- Starting aids
- Shutdown switch
- Active engine shutdown
- Electrical connectors
- Circuit breakers
- Personality Module
- Engine Speed/Timing sensor
- Injector solenoid
- Fuel supply

Perform the following tests in order:

1. Measure the voltage at the ECM connector J1-23. If the ECM is not receiving battery voltage the ECM will not power up. Refer to Troubleshooting, "Electrical Power Supply".

2. Visually check fuel level. If necessary, add fuel.

3. If cold ambient conditions exist, check operation of starting aids. Replace the ether canister if the ether is low. Ensure the proper operation of the Jacket Water Heater. Repair the Jacket Water Heater and/or replace the Jacket Water Heater. Check for presence of solidified fuel (wax).

4. The shutdown switch should be in the OFF position. Connect the ET. Use the ET in order to verify the status of the shutdown switch. If the ET will not communicate with the ECM, refer to 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. Refer to Troubleshooting, "Emergency Stop Switch".

5. Use the 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.

6. Check for correct installation of the ECM connectors J1/P1, J2/P2, Engine Speed/Timing Sensor J20/P20, and Unit Injector connectors J4/P4 through J19/P19. Refer to Troubleshooting, "Inspecting Electrical Connectors".

7. The circuit breakers may exceed the trip point due to overheating. Check the circuit breakers. Reset the circuit breakers if the circuit breakers are tripped.

8. The diagnostic code 253-02 should not be present. If the diagnostic code is present, refer to Troubleshooting, "Programming Parameters".

9. Crank the engine. Observe the engine rpm on the ET. If the ET indicates 0 rpm, refer to 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.

10. Perform the Injector Solenoid Test. Verify that the ECM is energizing all the injector solenoids. Refer to Troubleshooting, "Injector Solenoids".

11. Check the fuel system, if there is no smoke at the exhaust. Check fuel lines for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines. Refer to the Systems Operation, "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 unit 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 Instruction, SEBD0717, "Diesel Fuels And Your Engine". Check the fuel pressure while the engine is cranking. Check the fuel pressure at the filter. Refer to the Specifications manual for correct pressure values. 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 problem with the combustion system.

i01010885

Engine Has Early Wear

SMCS Code: 1000-038; 1901-038

Note: This is NOT an electronic system problem. Refer to the Systems Operation for additional information.

The probable root causes are listed in order below:

- Dirt in lubrication oil
- Leaks in Air Inlet system
- Fuel dilution
- Low oil pressure

Perform the following tests in order:

1. Remove dirty lubrication oil.

2. Install new oil filters.

3. Put clean oil in the engine.

4. Check the bypass valve spring at the oil filter.

   a. Inspect all gaskets and connections. Repair any leaks.

Note: This will cause high fuel consumption and low engine oil pressure. This condition may also increase the oil level in the crankcase. Refer to Troubleshooting, "Engine Has Low Oil Pressure".

i01200354

Engine Misfires, Runs Rough or Is Unstable

SMCS Code: 1000-038; 1901-038

Note: If the symptom cannot be repeated, refer to Troubleshooting, "Low Power/Poor or No Response to Throttle". If the symptom can be repeated continue with this procedure.

The probable root causes are listed in order below:

- Cold mode operation
- Throttle signal
- Electrical connector
- Injector solenoid
- Fuel supply
- Air inlet restrictions
- Exhaust restrictions

Note the conditions that caused the problem. Troubleshooting the symptoms under other conditions can give misleading results.

Perform the following tests in order:

1. Use the ET in order to verify that the engine has exited cold mode. During Cold Mode, injection timing is modified. The cylinders may cut out. Cold mode cylinder cutouts may cause variations in vibration and available power. This is normal operation.

   a. Use the ET in order to monitor the temperature of the coolant. If the reading is incorrect, refer to Troubleshooting, "Engine Sensor Open/Short Test".

2. Use the ET in order to monitor the status of the throttle. Observe the throttle position. The throttle position should be stable. The throttle position should reach 100 percent. Refer to Troubleshooting, "Speed Control".

3. Check for correct installation of the ECM connector J2/P2 and Electronic Unit Injector connector J4/P4 through J19/P19. Refer to Troubleshooting, "Inspecting Electrical Connectors".

4. Use the ET to determine if any active diagnostic codes are present for the Injector Solenoids. Use the 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 the ET. Perform the Cylinder Cutout Test. Locate the misfiring cylinder. Refer to Troubleshooting, "Injector Solenoids".

5. Check fuel lines for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines. Refer to the Systems Operation, "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 unit 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 at 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 Instruction, SEBD0717, "Diesel Fuels And Your Engine". Check the fuel pressure while the engine is cranking. Check the fuel pressure at the filter. Refer to the Specifications manual for correct pressure values. 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 problem with the combustion system.

6. Check for restrictions in the air inlet system. Refer to the Systems Operation.

7. Check for restrictions in the exhaust system. Refer to the Systems Operation.

i01087553

Engine Oil in Cooling System

SMCS Code: 1350-038; 1901-038

This is NOT an electronic system problem. Refer to the Systems Operation for additional information.

The probable root causes are listed in order below:

- Faulty engine oil cooler core
- Failure of cylinder head gasket or water seals

Perform the following tests in order:

1. Inspect each engine oil cooler core. Replace the engine oil cooler or repair the engine oil cooler.

2. Check the cylinder liner projection. Install a new cylinder head gasket and new water seals in the spacer plate. Tighten the cylinder head bolts according to the Specifications Manual.

i01232790

Engine Stalls at Low RPM

SMCS Code: 1000-038; 1901-038

The probable root causes are listed in order below:

- Faulty fuel injector(s)
- Low fuel pressure
- Faulty engine accessories

Perform the following tests in order:

1. Check for correct installation of the ECM connector J2/P2 and Fuel Injector connectors J4/P4 through J19/P19. Repair the connector and/or replace the connector. Refer to Troubleshooting, "Inspecting Electrical Connectors".

2. Check for active diagnostic codes. Check for logged diagnostic codes. Perform the Injector Solenoid Test. Verify that the ECM is energizing all the injector solenoids. Refer to Troubleshooting, "Injector Solenoids".

3. Check fuel lines for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines. Refer to the Systems Operation, "Fuel System".

4. 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

5. 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 at 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.

6. Check fuel quality. In temperatures below 0 °C (32 °F), check for solidified fuel (wax). Refer to Special Instruction, SEBD0717, "Diesel Fuels And Your Engine". Check the fuel pressure while the engine is cranking. Check the fuel pressure at the filter. Refer to the Specifications manual for correct pressure values. 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.

7. Check all accessory equipment.

i01199969

Engine Will Not Crank

SMCS Code: 1000-038; 1901-038

The probable root causes are listed in order below.

- Shutdown switch
- ECS
- Battery cables and/or batteries
- Starting motor
- Flywheel ring gear
- Hydraulic cylinder lock
- Internal engine problem

Perform the following tests in order:

1. Ensure that the shutdown switch is in the OFF position. Use the ET to confirm the switch status. Check for CID-FMI 337-03. If the CID-FMI is active, refer to Troubleshooting, "Emergency Stop Switch". If your application has EMCP II, refer to Service Manual, SENR5398.
2. Check the ECS and verify proper operation. Refer to Troubleshooting, "Engine Control Switch (ECS)".
3. The following items should be checked for loose connections and corrosion: Master Disconnect Switch, battery posts, battery, and battery cables. Clean the cables and/or connections if corrosion is found. Load test the battery. Refer to Special Instruction, SEHS9249, "Use Of 4C4911 Battery Load Tester" for more information. If necessary, charge the batteries. Refer to Special Instruction, SEHS7633, "Battery Test Procedure".
4. Test the operation of the starting motor. Check the system wiring to the starting motor. If equipped, inspect the Caterpillar Prelubrication System for proper operation. Refer to Troubleshooting, "Starting Motor System".
5. Ensure that the timing pin is not left in the flywheel housing after you set the valve lash. Use the **9S-9082** Engine Turning Tool and attempt to manually turn the engine.
6. Inspect the engine accessories if the engine will not turn. Remove the engine accessories and inspect the engine accessories that can lock up the engine. Repair the engine accessories and/or replace the engine accessories. Refer to Systems Operation for additional information.
7. Remove injectors and check for fluid in the cylinders.
8. Disassemble the engine. Inspect the engine for internal component damage. Refer to Disassembly and Assembly Manual.

i01014717

Excessive Engine Oil Consumption

SMCS Code: 1300-038; 1901-038

Note: This is NOT an electronic system problem. Refer to the Systems Operation for additional information.

The probable root causes are listed in order below:

- Oil leaks
- Crankcase breather
- Oil level
- Oil cooler
- Coolant temperature
- Dowel
- Breather element
- Turbocharger
- Cylinder head

Perform the following tests in order:

1. Inspect the engine for oil leaks. Repair all oil leaks.
2. Check the crankcase breather(s) for restrictions and/or debris. If necessary, clean the crankcase breather.
3. Inspect the oil level. Remove any extra oil from the engine. Verify that there is a correct amount of oil in engine.
4. Check for restrictions in the oil cooler. Check the oil cooler bypass valve. If necessary, replace the oil cooler bypass valve.
5. Check for a high coolant temperature. Refer to Troubleshooting, "Engine Coolant Is Too Hot".
6. The dowel should be installed in the left bolt hole of the rocker shaft. The dowel is located between the rocker shaft and valve cover base. Check the shaft and the valve cover base.
7. Check the breather element for debris. If necessary, replace the breather element.
8. Check the inlet manifold for oil. If necessary, repair the turbocharger.

9. Reconditioning of the cylinder head is required. If necessary, install new parts.

i01232792

Excessive Black Smoke

SMCS Code: 1000-038; 1901-038

The probable root causes are listed in order below:

- Leaking fuel injector
- Air inlet restriction
- Leaking air system
- Incorrect calibration of the Engine Speed/Timing Sensor
- Rated Fuel Position and/or FRC Fuel Position
- Atmospheric pressure sensor
- Personality module
- Fuel supply
- Fuel Injector Timing Height

Perform the following tests in order:

1. Perform the Cylinder Cutout Test. Use similar conditions for the test that were experienced during operation. Refer to Troubleshooting, "Injector Solenoids".

   a. Cut out the individual cylinder for 30 seconds to 1 minute. Verify that the smoke decreases.

2. Connect an ET. Check the atmospheric pressure reading. Check the turbocharger inlet pressure.

   a. Check air inlet and exhaust systems for restrictions and/or leaks. Remove any restrictions. Repair any leaks that are found.

3. Verify that the turbocharger has not failed. Refer to the Systems Operation.

   a. Replace plugged air filters, and/or clean the filters. Refer to Operation and Maintenance Manual.

   b. Verify proper operation of the Turbocharger Outlet (boost) and Atmospheric Pressure Sensors. Refer to Troubleshooting, "Engine Sensor Open/Short Test".

4. Check the calibration of the Engine Speed/Timing Sensor. Refer to Troubleshooting, "Engine Speed/Timing Sensor - Calibrate".

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

5. Monitor the Turbocharger Compressor Outlet and the Atmospheric Pressure with an ET. Operate the machine under full load. Use the ET in order to monitor the following values: Turbocharger Compressor Outlet Pressure, Fuel Position, Rated Fuel Position, and FRC Fuel Position. The Fuel Position should equal the Rated Fuel Position. The FRC Fuel Position should be less than the Rated Fuel Position. Refer to Systems Operation, Testing and Adjusting.

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.

6. Check the Atmospheric Pressure Sensor for dirt and/or debris. Remove the dirt and/or the debris. The atmospheric pressure should be between 75 ± 25 kPa (11 ± 4 psi). Refer to Troubleshooting, "Engine Sensor Open/Short Test".

7. Verify that the correct Personality Module is installed. Refer to Troubleshooting, "Programming Parameters".

8. Check fuel lines for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines. Refer to the Systems Operation, "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 at 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 Instruction, SEBD0717, "Diesel Fuels And Your Engine". Check the fuel pressure while the engine is cranking. Check the fuel pressure at the filter. Refer to the Specifications manual for correct pressure values. 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.

9. Check the height of the injector follower. Refer to the Systems Operation, "Check valve adjustment".

i01200366

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.

The probable root causes are listed in order below:

- Starting aids
- Coolant temperature sensor
- Thermostats
- Speed/Timing sensor
- Leaking injector
- Personality module
- Fuel supply
- Component wear
- Cooling system

Perform the following tests in order:

1. Check for proper operation of installed starting aids. Check for proper operation of the jacket water heater. Repair the jacket water heater or replace the jacket water heater.

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 Troubleshooting, "Ether Injection System".

2. Use the ET in order to verify that the engine has exited cold mode. Use the ET in order to monitor the coolant temperature. If the reading is incorrect, refer to Troubleshooting, "Engine Sensor Open/Short Test".

3. Verify that the engine reaches full operating temperature. If the engine does not reach full operating temperature, a thermostat may be stuck open. Remove the thermostat and inspect the thermostat. If necessary, repair the thermostat and/or replace the thermostat .

4. Check the calibration of the Engine Speed/Timing Sensor. Refer to Troubleshooting, "Engine Speed/Timing Sensor - Calibrate".

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

5. Perform the Cylinder Cutout Test. Use similar conditions for the test that were experienced during operation. Refer to Troubleshooting, "Injector Solenoids".

a. Cut out the individual cylinder for 30 seconds to 1 minute. Verify that the smoke decreases.

6. Verify that the correct Personality Module is installed. Refer to Troubleshooting, "Programming Parameters".

7. Inspect the fuel system components. Check for correct fuel pressure. Check fuel quality. Low cetane fuel can create white smoke. Replace the fuel with a higher cetane fuel. In temperatures below 0 °C (32 °F), check for solidified fuel (wax). Refer to Special Instruction, SEBD0717, "Diesel Fuels And Your Engine".

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

9. Check for a coolant leak. Check the cooling system for the following problems: coolant in cylinder and coolant in exhaust system. Refer to the Systems Operation, "Cooling System".

i01211435

Exhaust Temperature Is Too High

SMCS Code: 1050-038; 1901-038

The probable root causes are listed in order below:

- Speed/Timing sensor
- Electrical connectors
- Injector solenoids
- Air leak
- Exhaust restriction

Perform the following tests in order:

1. Check the ET for the following logged Diagnostic Codes: 190-02 and 190-08. Refer to Troubleshooting, "Engine Speed/Timing Sensor".
2. Check for correct installation of the ECM connectors J2/P2 and Electronic Fuel Injector connector J4/P4 through J19/P19. Refer to Troubleshooting, "Inspecting Electrical Connectors".
3. Use the 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 the ET. Perform the Cylinder Cutout Test. Locate the misfiring cylinder. Refer to Troubleshooting, "Injector Solenoids".
4. Check pressure in the air inlet manifold. Check for air inlet leaks. Look for restrictions at the air cleaner. Check for leaks between the exhaust manifold and the turbocharger.
5. Check for exhaust restrictions.

i01207841

Fuel Dilution of Engine Oil

SMCS Code: 1300-038; 1901-038

The probable root causes are listed in order below:

- Leaking fuel seals
- Leaking fuel injector
- Cracked fuel supply manifold
- Leaking fuel transfer pump seal

Perform the following tests in order:

1. Inspect the fuel seals on the fuel injector for damage. If necessary, replace the fuel seals.
   a. Inspect the fuel seals on the cylinder head for damage. If necessary, replace the fuel seals.
2. Inspect the fuel injector for damage. If necessary, replace the fuel injector.
3. Inspect the fuel supply manifold for damage. If necessary, replace the manifold.
4. Repair the fuel transfer pump and/or replace the fuel transfer pump.

i01207846

Fuel in Cooling System

SMCS Code: 1350-038; 1901-038

The probable root causes are listed in order below:

- Internal cylinder head

Perform the following tests in order:

1. Remove the valve cover. Remove the fuel supply. Remove 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 the fuel injector. If leakage is present, remove the fuel injector. Install a new O-ring seal.

i01200375

Intermittent Engine Shutdown

SMCS Code: 1000-038; 1901-038

The probable root causes are listed in order below:

- Engine shutdown
- Faulty electrical connections
- Electrical power supply to the ECM
- Circuit breakers
- Engine Speed/Timing Sensor
- Fuel supply

Perform the following test in order:

1. Connect an ET and check for engine shutdowns. Determine the reason for the shutdown. After correcting the problem, cycle the ECS to the OFF position for at least 15 seconds before you try to restart the engine.

2. Inspect the electrical connectors for proper installation. Refer to Troubleshooting, "Inspecting Electrical Connectors".

3. Check the ET for the following logged Diagnostic Codes: 168-01 and 168-02. Follow battery wires from the ECM back to the battery compartment. Refer to Electrical System Schematic. Inspect the wires and the power relay. Check the power to the ECM and the ground connections. Refer to Troubleshooting, "Electrical Power Supply to the ECM".

4. The circuit breakers may have exceeded the trip point due to overheating. Check the circuit breakers on the machine. Reset the circuit breakers if the circuit breakers are tripped.

5. Check the ET for the following logged Diagnostic Codes: 190-02 and 190-08. Refer to Troubleshooting, "Engine Speed/Timing Sensor".

6. Check fuel lines for the following problems: restrictions, collapse, and pinched line Repair the lines and/or replace the lines. Refer to the Systems Operation, "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 performing the following procedures:

      - Replacing the fuel filters
      - Working on the low pressure fuel supply circuit
      - Replacing unit 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 at 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 Instruction, SEBD0717, "Diesel Fuels And Your Engine". Check the fuel pressure while the engine is cranking. Check the fuel pressure at the filter. Refer to the Specifications manual for correct pressure values. 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.

i01200376

Intermittent Low Power or Power Cutout

SMCS Code: 1000-038; 1901-038

The probable root causes are listed in order below:

- Fuel level
- Derate mode
- Throttle signal
- Electrical power supply to the ECM
- Fuel supply

Perform the following tests in order:

1. Monitor fuel level during engine operation. If a low fuel level causes the problem maintain a higher fuel level.

2. Connect an ET and check for logged derate events. A derate status flag will appear on the ET if an active engine derate is occurring. The engine speed might be limited due to one of the following possible causes: altitude, exhaust temperatures that are high, and air filters that are dirty.

3. Use the ET in order to monitor the status of the throttle. Observe the throttle position. The throttle position should be stable. The throttle position should reach 100 percent. Refer to Troubleshooting, "Speed Control".

4. Check the ET for the following logged Diagnostic Codes: 168-01 and 168-02. Follow battery wires from the ECM back to the battery compartment. Refer to Electrical System Schematic. Inspect the wires and the power relay. Check the power to the ECM and the ground connections. Refer to Troubleshooting, "Electrical Power Supply to the ECM".

5. Check fuel lines for the following problems: restrictions, collapse, and pinched line Repair the lines and/or replace the lines. Refer to the Systems Operation, "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 unit 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 at 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 Instruction, SEBD0717, "Diesel Fuels And Your Engine". Check the fuel pressure while the engine is cranking. Check the fuel pressure at the filter. Refer to the Specifications manual for correct pressure values. 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.

i01010931

Low Engine Oil Pressure

SMCS Code: 1300-038; 1901-038

Note: This is NOT an electronic system problem. Refer to the Systems Operation for additional information.

NOTICE

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

The probable root causes are listed in order below:

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

Perform the following tests in order:

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

2. Check the operation of bypass valve for the filter. Inspect the oil filter. If the oil filter is dirty, install a new oil filter.

3. Clean the oil cooler core(s) and/or install new oil cooler core(s).

   a. Remove dirty oil from the engine. Put clean oil in the engine.

4. Check for presence of fuel in lubricating oil. Refer to Troubleshooting, "Fuel Dilution Of Engine Oil" .

5. Check the oil pressure gauge on another engine.

6. Clean the bypass valve and the housing. If necessary, install new parts.

7. Check for blockage in the oil pump inlet screen. Check for air leakage into the supply to the oil pump. Examine the oil pump for excessive wear.

8. If necessary, install a new camshaft and/or camshaft bearings. Inspect the main bearings. If necessary, replace the main bearings.

i01200379

Low Power/Poor or No Response to Throttle

SMCS Code: 1000-038; 1901-038

The probable root causes are listed in order below:

- Cold mode operation
- Coolant temperature sensor
- Fuel level
- Derate mode
- Throttle signal
- Electrical connectors
- Injector solenoid
- Fuel consumption
- Air inlet restriction
- ECM
- Fuel supply

Perform the following tests in order:

1. Use the ET in order to verify that the engine has exited cold mode. During Cold Mode, injection timing is modified. The cylinders may cut out. Cold Mode Cylinder Cutouts may cause variations in vibration and available power. This is normal operation.

2. Use the ET in order to monitor the temperature of the coolant. If the reading is incorrect, refer to Troubleshooting, "Engine Sensor Open/Short Test".

3. Monitor fuel level during engine operation. If a low fuel level causes the problem, maintain a higher fuel level.

4. Connect an ET and check for logged derate events. A derate status flag will appear on the ET if an active engine derate is occurring. The engine speed might be limited due to one of the following possible causes: altitude, exhaust temperatures that are high, and air filters that are dirty.

5. Use the ET in order to monitor the status of the throttle. Observe the throttle position. The throttle position should be stable. The throttle position should reach 100 percent. Refer to Troubleshooting, "Speed Control".

6. Check for correct installation of the ECM connectors J2/P2 and Electronic Unit Injector connector J4/P4 through J19/P19. Refer to Troubleshooting, "Inspecting Electrical Connectors".

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

8. Use the ET in order to monitor the engine status. Operate the engine under full load. Check actual fuel, max fuel, and FRC Limit. The actual fuel consumption should be equal to Max Fuel. The actual fuel consumption should be less than the FRC limit. If the actual fuel consumption is equal to Max Fuel and the actual fuel consumption is less than the FRC limit, the electronics are operating correctly. If the readings are incorrect, refer to Troubleshooting, "Engine Sensor Open/Short Test".

9. Check the air inlet and exhaust systems for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines. Refer to Testing and Adjusting, "Air Inlet and Exhaust System".

   a. Observe the Check Engine Lamp. Check for a air filter restriction indicator. Replace plugged air filters and/or clean filters. Refer to the Testing and Adjusting , "Air Inlet and Exhaust System". Repair any leaks. Refer to Troubleshooting, "Engine Sensor Open/Short Test".

10. If you have replaced the ECM, refer to Troubleshooting, "Programming Parameters".

11. Check fuel lines for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines. Refer to the Systems Operation, "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 filters

- Working on the low pressure fuel supply circuit
- Replacing unit 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 at 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 Instruction, SEBD0717, "Diesel Fuels And Your Engine". Check the fuel pressure while the engine is cranking. Check the fuel pressure at the filter. Refer to the Specifications manual for correct pressure values. 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 problem with the combustion system.

i01087535

Mechanical Noise (Knock) in Engine

SMCS Code: 1000-038; 1901-038

Note: This is NOT an electronic system problem. Refer to the Systems Operation for additional information.

The probable root causes are listed in order below:

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

Perform the following tests in order:

1. 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. Refer to the engine System Operation.
2. Remove the valve cover from the suspect cylinder(s). Check the following items for damage: camshaft, valve rotocoil, valve springs, lifters, push rods, and bridges. 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.
3. Inspect the connecting rod bearings and the bearing surfaces (journals) on the crankshaft. Replace any damaged parts.

i01211481

Noise Coming from Cylinder

SMCS Code: 1000-038; 1290-038

The probable root causes are listed in order below:

- Low quality fuel
- Engine Speed/Timing sensor
- Electrical connectors
- Injector solenoids
- Not enough lubrication
- Damage to valve train components

Perform the following tests in order:

1. Check fuel quality. Refer to Special Instruction, SEBD0717, "Diesel Fuels And Your Engine". Remove unsatisfactory fuel from the fuel tank. Install new fuel filters. Use proper grade of clean fuel in the fuel tank.
2. Calibrate the engine Speed/Timing Sensor. Refer to Troubleshooting, "Engine Speed/Timing Sensor - Calibrate".
3. Check for correct installation of the ECM connector J2/P2 and Fuel Injector connectors J4/P4 through J19/P19. Repair the connector and/or replace the connector. Refer to Troubleshooting, "Inspecting Electrical Connectors". Check for active diagnostic codes. Check for logged diagnostic codes.
4. Use the ET to determine if any active diagnostic codes are present. Use the ET to determine if any logged diagnostic codes are present. Perform the Injector Solenoid Test. Observe that the injector solenoids are being energized on the ET. Perform the Cylinder Cutout Test. Locate the misfiring cylinder. Refer to Troubleshooting, "Injector Solenoids".

5. Check the lubrication in the valve compartment. Check for sufficient lubrication between the injector tappet and the rocker arm buttons. Refer to Troubleshooting , "Too Much Valve Lash".

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

i01232799

Poor Fuel Consumption

SMCS Code: 1000-038; 1901-038

The probable root causes are listed in order below:

- Improper machine operation
- Engine Speed/Timing sensor
- Electrical connectors
- Injector solenoids
- Fuel supply
- Air inlet or exhaust restrictions
- Leaks in air system
- Accessory equipment

Perform the following tests in order:

1. Use an ET to check the Trip Totals. Use an ET to check the Job Totals. Check the totals for the following data: idle time, poor operating habits, and high load factor.

Note: Engine operation can be affected by environmental conditions.

2. Check the calibration of the Engine Speed/Timing Sensor. Refer to Troubleshooting, "Engine Speed/Timing Sensor - Calibrate".

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

3. Check for correct installation of the ECM connector J2/P2 and Fuel Injector connectors J4/P4 through J19/P19. Repair the connector and/or replace the connector. Refer to Troubleshooting, "Inspecting Electrical Connectors".

4. Check for active diagnostic codes. Check for logged diagnostic codes. Perform the Injector Solenoid Test. Verify that the ECM is energizing all the injector solenoids. Refer to Troubleshooting, "Injector Solenoids".

5. Check fuel lines for the following problems: restrictions, collapse, and pinched line. Repair the lines and/or replace the lines. Refer to the Systems Operation, "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 Instruction, SEBD0717, "Diesel Fuels And Your Engine". Check the fuel pressure while the engine is cranking. Check the fuel pressure at the filter. Refer to the Specifications manual for correct pressure values. 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.

6. Check air inlet and exhaust systems for restrictions and/or leaks. Refer to the Systems Operation.

7. Observe the Check Engine Lamp. Check for a air filter restriction indicator. Replace plugged air filters and/or clean filters. Refer to the Testing and Adjusting , "Air Inlet and Exhaust System". Refer to Troubleshooting, "Engine Sensor Open/Short Test".

8. Check all accessory equipment.

i01009634

Too Much Valve Lash

SMCS Code: 1000-038; 1901-038

Note: This is NOT an electronic system problem. Refer to the Systems Operation for additional information.

The probable root causes are listed in order below:

- Rocker arm
- Not enough lubrication
- Worn rocker arm
- Worn bridges for valves
- Worn push rods
- Worn valve lifters
- Worn camshaft
- Worn valve stem
- Incorrect valve lash
- Worn rocker shaft retaining bolt

Perform the following tests in order:

1. Check for proper installation of the rocker arm adjustment screw locknut. If the rocker arm adjustment screw locknut is loose, adjust the valve lash. Refer to Testing and Adjusting, "Air Inlet And Exhaust System".

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

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

   a. Adjust the valve lash. Refer to Testing and Adjusting, "Air Inlet And Exhaust System".

4. Check the bridges for signs of wear. Adjust the bridges and/or replace the bridges.

   a. If there is too much wear, install new parts. Adjust the valve lash. Refer to Testing and Adjusting, "Air Inlet And Exhaust System".

5. Inspect the push rods for signs of wear.

   a. If there is too much wear, install new push rods. Adjust the valve lash. Refer to Testing and Adjusting, "Air Inlet And Exhaust System".

6. Clean the valve train. Install new valve lifters.

7. Check the camshaft for wear.

8. Check the valve stem for signs of wear. Check for free movement of valves or bent valve stem.

   a. Adjust the valve lash. Refer to Testing and Adjusting, "Air Inlet And Exhaust System".

9. Check valve lash.

   a. Adjust the valve lash. Refer to Testing and Adjusting, "Air Inlet And Exhaust System".

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

i01087255

Too Much Vibration

SMCS Code: 1000-038; 1901-038

Note: This is NOT an electronic system problem. Refer to the Systems Operation for additional information.

The probable root causes are listed in order below:

- Vibration damper
- Loose engine supports
- Alignment and balance

Perform the following tests in order.

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

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

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

i01206815

Valve Rotocoil or Spring Lock Is Free

SMCS Code: 1109-038

The probable root causes are listed in order below:

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

Perform the following tests in order:

1. Determine the cause of the cracked rotocoil.
   a. Replace the cracked rotocoil.
2. Check the locks. A broken lock can cause the valve to fall into the cylinder.
3. Install the new valve spring(s). Replace the valve and/or other damaged parts.

Troubleshooting with a Diagnostic Code

i01392208

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 MID, CID and FMI. The module identifier (MID) indicates the electronic module that generated the diagnostic code. The MID for the ECM is 36. The component identifier (CID) indicates the component in the system. The failure mode identifier (FMI) indicates the failure mode that is present. Diagnostic codes may be viewed on an ET or one of the various electronic display modules. Do not confuse diagnostic codes with diagnostic events.

Active Diagnostic Codes and Event Codes

An Active diagnostic code represents a problem with the electronic control system. This problem should be corrected as soon as possible. When an active diagnostic code is generated, a display module such as the Caterpillar Monitoring System may produce a warning.

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. Any Logged diagnostic codes will automatically be deleted if no additional occurrences are recorded in 100 hours. Some diagnostic codes may be easily triggered. 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.

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

Logged Events

The ECM can log events. Events refer to engine operating conditions such as low oil pressure or high coolant temperature. Logged events do not indicate an electronic system problem.

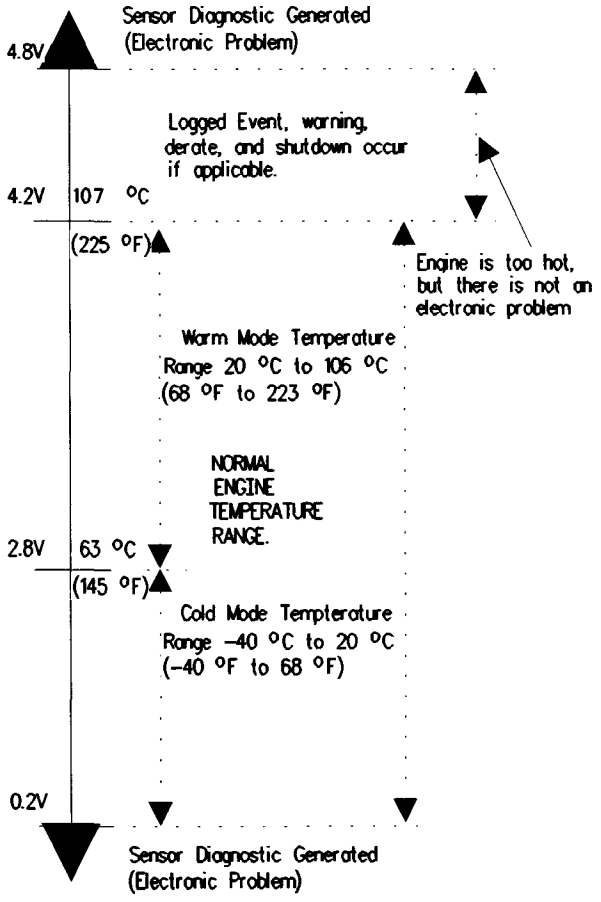

Illustration 12 g00740986

The diagram indicates output voltage from the Coolant Temperature Sensor. The 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 Shutdown
- Engine Alarm
- Engine Derate

The ET can be used to activate these features. When the features are activated, the display will appear on an electronic monitoring module. An Event will be logged in the ECM. When the features are not activated, the display will not appear on a monitoring module but an Event will be logged.

Diagnostic Terminology

Module Identifier (MID)

The module identifier (MID) indicates the electronic module that generated the diagnostic code.

- The module identifier (30) indicates the Caterpillar Monitoring System.
- The module identifier (36) indicates the engine ECM.

Failure Mode Identifier (FMI)

- The FMI (00) indicates that the data is above the normal range.
- The FMI (01) indicates that the data is below the normal range.
- The FMI (02) indicates an incorrect signal.
- The FMI (03) indicates that the voltage is above the normal range.
- The FMI (04) indicates that the voltage is below the normal range.
- The FMI (05) indicates that the current is below the normal range.
- The FMI (06) indicates that the current is above the normal range.
- The FMI (08) indicates an abnormal signal.
- The FMI (09) indicates an abnormal update.
- The FMI (12) indicates that a device or a component failed.
- The FMI (13) indicates that a component is out of calibration.

i01316657

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316661

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316664

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316666

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316670

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316672

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316676

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316680

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316683

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316684

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316685

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316688

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316713

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316715

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316719

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316724

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352027

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352033

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352035

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352041

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352045

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352061

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352086

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352090

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01330812

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01330816

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01330822

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01330828

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01330831

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01330837

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01330841

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01330845

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

SMCS Code: 1290-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. The ECM will continue to operate all injectors.

Perform the following diagnostic procedure: "Injector Solenoids"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01351436

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

SMCS Code: 1913-038

Conditions Which Generate This Code:

The 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. The CID-FMI may be viewed on a display module or the ET.

Test Step 1.

A. Determine if the Direct Fuel Control Mode is ON or OFF. View the configuration screen in order to find the status of Direct Fuel Control Mode.

Expected Result:

Results:

- OFF – The Direct Fuel Control Mode is OFF or N/A. Proceed to test step 2.
- ON – The Direct Fuel Control Mode is ON. Proceed to test step 3.

Test Step 2.

Perform the following diagnostic procedure: "Speed Control"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

Test Step 3.

Perform the following diagnostic procedure: "Direct Fuel Control Mode"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352098

MID 036 - CID 0094 - FMI 02 Fuel Pressure misinstalled

SMCS Code: 1901-038

Conditions Which Generate This Code:

The ECM reads a negative differential pressure between the unfiltered fuel pressure sensor and the filtered fuel pressure sensor. The sensors may be installed incorrectly.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET. The ECM flags filtered fuel pressure as invalid data. The engine monitoring system for this feature will be disabled.

Correctly install the sensor.

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352108

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 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 CID-FMI may be viewed on a display module or the ET. The ECM flags filtered 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.

i01352113

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

SMCS Code: 1901-038

Conditions Which Generate This Code:

The Electronic Control Module 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 CID-FMI may be viewed on a display module or the ET. The ECM flags filtered 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.

i01283582

MID 036 - CID 0094 - FMI 13 Fuel Pressure calibration required

SMCS Code: 1901-038

Conditions Which Generate This Code:

The Electronic Control Module records one of the following conditions. The filtered fuel pressure sensor never calibrated. The ECM reads filtered fuel pressure less than 35 kPa (5 psi). The ECM reads filtered fuel pressure more than 130 kPa (19 psi). The filtered fuel pressure changes more than 25 kPa (3.6 psi) during a calibration attempt.

System Response:

The CID-FMI may be viewed on a display module or an Electronic Service Tool. The diagnostic codes are active. The diagnostic codes are not logged in memory. The engine monitoring system is disabled for filtered fuel pressure.

Perform the following diagnostic procedure: "Analog Sensor - Calibrate"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01354325

MID 036 - CID 0100 - FMI 02 Engine Oil Pressure out of range

SMCS Code: 1924-038

Conditions Which Generate This Code:

The ECM reads a negative differential pressure between the unfiltered engine oil pressure sensor and the filtered engine oil pressure sensor. The sensors are installed incorrectly.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET. The ECM flags the filtered engine oil pressure as invalid data. The engine monitoring system will be disabled for filtered engine oil pressure.

Correctly install the sensor.

Results:

- REPAIRED, OK – STOP.

i01316765

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 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 CID-FMI may be viewed on a display module or the ET. 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.

i01316791

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 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 CID-FMI may be viewed on a display module or the ET. 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.

i01316795

MID 036 - CID 0100 - FMI 13 Engine Oil Pressure calibration required

SMCS Code: 1924-038

Conditions Which Generate This Code:

The Electronic Control Module records one of the following conditions:

- The Engine Oil Pressure Sensor never calibrated.
- The ECM reads oil pressure less than 35 kPa (5 psi).
- The pressure is greater than 130 kPa (19 psi).
- The oil pressure signal is more than 27 kPa (4 psi) from the atmospheric pressure.
- The oil pressure changes more than 25 kPa (3.6 psi) during a calibration attempt.

System Response:

The CID-FMI may be viewed on a display module or the ET. The diagnostic codes are active. The diagnostic codes are not logged in memory.

Perform the following diagnostic procedure: "Analog Sensor - Calibrate"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316800

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

SMCS Code: 1916-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on a display module or the ET. 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.

i01316817

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

SMCS Code: 1916-038

Conditions Which Generate This Code:

The Electronic Control Module 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 CID-FMI may be viewed on a display module or the ET. 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.

i01316896

MID 036 - CID 0101 - FMI 13 Crankcase Pressure calibration required

SMCS Code: 1916-038

Conditions Which Generate This Code:

The Electronic Control Module records one of the following conditions. The Crankcase Pressure Sensor never calibrated. The crankcase pressure is less than 45 kPa (6.5 psi). The crankcase pressure is greater than 111 kPa (16 psi). The crankcase pressure changes more than 5 kPa (0.7 psi) during a calibration attempt. The diagnostics 101-03 or 101-04 are active.

System Response:

The CID-FMI may be viewed on a display module or the ET. The diagnostic codes are active. The diagnostic codes are not logged in memory.

Perform the following diagnostic procedure: "Analog Sensor - Calibrate"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316899

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 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 CID-FMI may be viewed on a display module or the ET. 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.

i01316921

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 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 CID-FMI may be viewed on a display module or the ET. 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.

i01316923

MID 036 - CID 0168 - FMI 00 System Voltage High

SMCS Code: 1401-038

Conditions Which Generate This Code:

The 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. The CID-FMI may be viewed on a display module or the ET.

Perform the following diagnostic procedure: "Electrical Power Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316926

MID 036 - CID 0168 - FMI 01 System Voltage Low

SMCS Code: 1401-038

Conditions Which Generate This Code:

The 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. The CID-FMI may be viewed on a display module or the ET.

Perform the following diagnostic procedure: "Electrical Power Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01356650

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. The CID-FMI may be viewed on a display module or the ET.

Perform the following diagnostic procedure: "Electrical Power Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316932

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 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 ECM detects an incorrect signal for one second. The battery voltage is greater than 9 VDC for the last two seconds. The CID-FMI is logged in memory.

System Response:

The CID-FMI may be viewed on a display module or the ET.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01316935

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

SMCS Code: 1912-038

Conditions Which Generate This Code:

The signal wire at the Primary Engine Speed/Timing Sensor is disconnected and/or broken. There is a short circuit to +Battery. The CID-FMI is logged in memory.

System Response:

The CID-FMI may be viewed on a display module or the ET.

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

Results:

- OK – STOP.

- REPAIRED, OK – STOP.

i01283737

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 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 for five seconds. The engine speed/timing signal returns for five seconds.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01330959

MID 036 - CID 0248 - FMI 09 CAT Data Link Communications

SMCS Code: 1901-038

Conditions Which Generate This Code:

The battery voltage to the ECM has been above 9 VDC for the last two seconds. The engine is not cranking. Communication was lost for two or more seconds. The CID-FMI is logged in memory.

System Response:

The CID-FMI may be viewed on a display module or the ET.

Perform the following diagnostic procedure: "CAT Data Link"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01283742

MID 036 - CID 0253 - FMI 02 Personality Module mismatch

SMCS Code: 1901-038

Conditions Which Generate This Code:

The Personality Module is for a different engine.

System Response:

The CID-FMI is not logged in memory. The CID-FMI may be viewed on a display module or the ET. The fuel injection is disabled. If a personality module from another engine family is installed, the mismatch can be programmed to allow the engine to start. Refer to Troubleshooting, "System Configuration Parameters" for additional information on the Personality Module Mismatch.

Perform the following diagnostic procedure: "ECM/Personality Module"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01283744

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

SMCS Code: 1901-038

Conditions Which Generate This Code:

The ECM has detected an internal fault. The CID-FMI is logged in memory.

System Response:

The CID-FMI may be viewed on a display module or the ET. Engine power and performance may be affected. Any normal ECM function may be affected.

Perform the following diagnostic procedure: "ECM/Personality Module"

Results:

- OK – STOP.

- REPAIRED, OK – STOP.

i01283746

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

SMCS Code: 1905-038

Conditions Which Generate This Code:

The 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 CID-FMI may be viewed on display modules or the ET.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01283748

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

SMCS Code: 1408-038-NS

Conditions Which Generate This Code:

The Electronic Control Module reads an analog sensor supply voltage above 5.5 VDC for two or more seconds. The ECM has been powered for three seconds.

Note: Normal voltage is 5.0 ± 0.5 VDC.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET. Analog sensors are set to the default values.

Perform the following diagnostic procedure: "Analog Sensor Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01283766

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

SMCS Code: 1408-038-NS

Conditions Which Generate This Code:

The Electronic Control Module reads an analog sensor supply voltage below 4.5 VDC for two seconds. The ECM has been powered for three seconds.

Note: Normal voltage is 5.0 ± 0.5 VDC.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET. The analog sensors are set to the default values.

Perform the following diagnostic procedure: "Analog Sensor Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01283782

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 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 ± 0.5 VDC.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET.

Perform the following diagnostic procedure: "Digital Sensor Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01283793

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 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 ± 0.5 VDC.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET.

Perform the following diagnostic procedure: "Digital Sensor Supply"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01283805

MID 036 - CID 0268 - FMI 02 Check Programmable Parameters

SMCS Code: 1901-038

Conditions Which Generate This Code:

If one or more of the programmable parameters has not been programmed, a diagnostic code 268-02 will be generated and the unprogrammed parameters will be set to default. Certain aspects of the engine's performance and Engine Monitoring may be affected.

System Response:

The CID-FMI may be viewed on a display module or the ET. The engine performance and/or system operation may be affected.

Perform the following diagnostic procedure: "ECM/Personality Module"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01320316

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

SMCS Code: 1052-038

Conditions Which Generate This Code:

The ECM reads turbocharger compressor outlet pressure above 200 kPa (29 psi). The engine speed is within 50 rpm of low idle for 5 seconds. The diagnostic codes 262-03, 262-04, 273-03, and 273-04 are not active.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET. 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.

i01283819

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 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. The CID-FMI is logged in memory.

System Response:

The CID-FMI may be viewed on a display module or the ET. 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.

i01283828

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 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. The CID-FMI is logged in memory.

System Response:

The CID-FMI may be viewed on a display module or the ET. 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.

i01283839

MID 036 - CID 0273 - FMI 13 Turbo Outlet Pressure calibration required

SMCS Code: 1052-038

Conditions Which Generate This Code:

The Electronic Control Module detects one of the following conditions. The turbocharger compressor outlet pressure is ± 15 kPa (2.1 psi) from the atmospheric pressure. The turbocharger compressor outlet pressure is less than 35 kPa (5 psi). The turbocharger compressor outlet pressure is greater than 122 kPa (17 psi). The turbocharger compressor outlet pressure changed more than 10 kPa (1.4 psi) during a calibration attempt. A pressure calibration has not been performed on a new ECM. A manual calibration failed. The diagnostics 273-03 or 273-04 are active.

System Response:

The CID-FMI may be viewed on the display modules or the ET. The diagnostic codes are active. The diagnostic codes are not logged in memory.

Perform the following diagnostic procedure: "Analog Sensor - Calibrate"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01283852

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 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 CID-FMI may be viewed on a display module or the ET. 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.

i01283864

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

SMCS Code: 1923-038

Conditions Which Generate This Code:

The Electronic Control Module 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 CID-FMI may be viewed on a display module or the ET. 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.

i01283918

MID 036 - CID 0274 - FMI 13 Atmospheric Pressure calibration required

SMCS Code: 1923-038

Conditions Which Generate This Code:

Any one of the following conditions is present:

- A pressure calibration has not been performed on a new sensor.
- A manual calibration failed.
- The ECM reads an atmospheric pressure signal that is less than 45 kPa (6.5 psi) absolute or greater than 111 kPa (16 psi) absolute pressure.
- The diagnostics 274-03 or 274-04 are active.
- The atmospheric pressure changes more than 5 kPa (0.7 psi).

System Response:

When this CID-FMI is active the atmospheric pressure will default to 0 kPa (0 psi). The CID-FMI may be viewed on a display module or the ET. The diagnostic codes are active. The diagnostic codes are not logged in memory.

Perform the following diagnostic procedure: "Analog Sensor - Calibrate"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01283924

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 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 CID-FMI may be viewed on a display module or the ET. The right turbocharger compressor inlet pressure is set to a default value of 45 kPa (7 psi). The engine monitoring system is disabled for right turbocharger inlet pressure.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01283934

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 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. The CID-FMI is logged in memory.

System Response:

The CID-FMI may be viewed on a display module or the ET. 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.

i01283948

MID 036 - CID 0275 - FMI 13 Right Turbo Inlet Pressure calibration required

SMCS Code: 1052-038

Conditions Which Generate This Code:

The Electronic Control Module detects one of the following conditions. The turbocharger compressor inlet pressure is ± 8 kPa (1.2 psi) from the atmospheric pressure. The turbocharger compressor inlet pressure is less than 45 kPa (6.6 psi). The turbocharger compressor inlet pressure is greater than 111 kPa (16 psi). The turbocharger compressor inlet pressure changed more than 5 kPa (0.7 psi) during a calibration attempt. A pressure calibration has not been performed on a new ECM. A manual calibration failed. The diagnostic codes 275-03 and 275-04 are active.

System Response:

The CID-FMI may be viewed on the display modules or the ET. The diagnostic codes are active. The diagnostic codes are not logged in memory. The ECM flags filter restriction as invalid data. The engine monitoring system is disabled for right turbocharger inlet pressure.

Perform the following diagnostic procedure: "Analog Sensor - Calibrate"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01283957

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 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 CID-FMI may be viewed on a display module or the ET. The left turbocharger compressor inlet pressure is set to a default value of 45 kPa (7 psi). The engine monitoring is disabled left turbocharger inlet pressure.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01283972

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 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. The CID-FMI is logged in memory.

System Response:

The CID-FMI may be viewed on a display module or the ET. 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.

i01283984

MID 036 - CID 0276 - FMI 13 Left Turbo Inlet Pressure calibration required

SMCS Code: 1052-038

Conditions Which Generate This Code:

The Electronic Control Module detects one of the following conditions. The turbocharger compressor inlet pressure is ± 8 kPa (1.2 psi) from the atmospheric pressure. The turbocharger compressor inlet pressure is less than 45 kPa (6.5 psi). The turbocharger compressor inlet pressure is greater than 111 kPa (16 psi). The turbocharger compressor inlet pressure changed more than 5 kPa (0.7 psi) during a calibration attempt. A pressure calibration has not been performed on a new ECM. A manual calibration failed. The diagnostic codes 276-03 and 276-04 are active.

System Response:

The CID-FMI may be viewed on the display modules or an Electronic Service Tool. The diagnostic codes are active. The diagnostic codes are not logged in memory. The ECM flags filter restriction as invalid data. The engine monitoring system is disabled for left turbocharger inlet pressure.

Perform the following diagnostic procedure: "Analog Sensor - Calibrate"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01283995

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 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 CID-FMI may be viewed on a display module or an Electronic Service Tool. 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.

i01284008

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

SMCS Code: 1063-038

Conditions Which Generate This Code:

The Electronic Control Module 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 CID-FMI may be viewed on a display module or an Electronic Service Tool. 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.

i01284813

MID 036 - CID 0289 - FMI 02 Unfiltered Fuel Pressure misinstalled

SMCS Code: 1261-038-NS

Conditions Which Generate This Code:

The ECM reads a negative differential pressure between the unfiltered fuel pressure sensor and the filtered fuel pressure sensor. The sensors may be installed incorrectly.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or an Electronic Service Tool. The ECM flags unfiltered fuel pressure as invalid data. The engine monitoring system is disabled for unfiltered fuel pressure.

Correctly install the sensor.

Results:

- REPAIRED, OK – STOP.

i01352231

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 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 CID-FMI may be viewed on a display module or the ET. 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.

i01352237

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 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 CID-FMI may be viewed on a display module or the ET. The ECM flags unfiltered 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.

i01352239

MID 036 - CID 0289 - FMI 13 Unfiltered Fuel Pressure calibration required

SMCS Code: 1261-038-NS

Conditions Which Generate This Code:

The Electronic Control Module records one of the following conditions. The Unfiltered Fuel Pressure Sensor never calibrated. The ECM reads unfiltered fuel pressure less than 35 kPa (5 psi). The ECM reads filtered fuel pressure more than 130 kPa (19 psi). The unfiltered fuel pressure is more than ± 27 kPa (4 psi) from the atmospheric pressure. The unfiltered fuel pressure changes more than 25 kPa (3.6 psi) during a calibration attempt.

System Response:

The CID-FMI may be viewed on a display module or the ET. The diagnostic codes are active. The diagnostic codes are not logged in memory. The engine monitoring system for this feature will be disabled.

Perform the following diagnostic procedure: "Analog Sensor - Calibrate"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352242

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

SMCS Code: 1901-038

Conditions Which Generate This Code:

One line for the ECS is open and one line is low.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET. The ECM will flag the ignition switch as invalid data.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352244

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. The CID-FMI may be viewed on a display module or the ET.

Perform the following diagnostic procedure: "Emergency Stop Switch"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352250

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

SMCS Code: 1319-038

Conditions Which Generate This Code:

The 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. The CID-FMI may be viewed on a display module or the ET.

Perform the following diagnostic procedure: "Prelubrication System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352251

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

SMCS Code: 1319-038

Conditions Which Generate This Code:

The ECM detects a short circuit to ground condition.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET.

Perform the following diagnostic procedure: "Prelubrication System"

Results:

- OK – STOP.
- NOT OK – STOP.

i01352275

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

SMCS Code: 1426-038

Conditions Which Generate This Code:

The ECM detects an open circuit at the start relay. The ECM detects a short to battery voltage at the start relay.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET.

Perform the following diagnostic procedure: "Starting Motor System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352279

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

SMCS Code: 1426-038

Conditions Which Generate This Code:

The ECM detects a short circuit to ground condition.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET.

Perform the following diagnostic procedure: "Starting Motor System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352281

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

SMCS Code: 1078-038

Conditions Which Generate This Code:

The ECM detects an open circuit at the air shutoff relay. The ECM detects a short to battery voltage at the air shutoff relay. The ECM can only detect this condition when the air shutoff relay is not energized.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET.

Perform the following diagnostic procedure: "Air Shutoff System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352282

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

SMCS Code: 1078-038

Conditions Which Generate This Code:

The Electronic Control Module detects a short circuit to ground condition. The ECM can only detect this condition when the air shutoff relay is energized.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET.

Perform the following diagnostic procedure: "Air Shutoff System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01352284

MID 036 - CID 0542 - FMI 02 Unfiltered Engine Oil Pressure misinstalled

SMCS Code: 1924-038

Conditions Which Generate This Code:

The ECM reads a negative differential pressure between the unfiltered engine oil pressure sensor and the filtered engine oil pressure sensor. The sensors may be installed incorrectly.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET. The ECM flags unfiltered engine oil pressure as invalid data. The engine monitoring system for this feature will be disabled.

Correctly install the sensor.

Results:

- REPAIRED, OK – STOP.

i01352287

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 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 CID-FMI may be viewed on a display module or the ET. 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.

i01352289

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 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 CID-FMI may be viewed on a display module or an ET. 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.

i01352293

MID 036 - CID 0542 - FMI 13 Unfiltered Engine Oil Pressure cal required

SMCS Code: 1924-038

Conditions Which Generate This Code:

The Electronic Control Module records one of the following conditions. The engine oil pressure sensor never calibrated. The engine oil pressure is greater than ± 27 kPa (4 psi) from the atmospheric pressure. The ECM reads engine oil pressure less than 35 kPa (5 psi). The engine oil pressure is greater than 130 kPa (19 psi). The engine oil pressure changes more than 25 kPa (3.6 psi) during a calibration attempt. The diagnostics 274-03 or 274-04 are active.

System Response:

The CID-FMI may be viewed on a display module or the ET. The diagnostic codes are active. The diagnostic codes are not logged in memory.

Perform the following diagnostic procedure: "Analog Sensor - Calibrate"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01320435

MID 036 - CID 0545 - FMI 05 Ether Start Relay open/short to +batt

SMCS Code: 1456-038

Conditions Which Generate This Code:

The ECM has been powered up for two seconds. The ECM detects an open circuit and/or a short circuit to the +Battery at the Ether Start Output.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET. Ether injection is disabled.

Perform the following diagnostic procedure: "Ether Injection System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01284385

MID 036 - CID 0545 - FMI 06 Ether Start Relay short to ground

SMCS Code: 1456-038

Conditions Which Generate This Code:

The ECM has been powered up for two seconds. The ECM detects a short circuit to ground at the Ether Start Output. The CID-FMI is logged in memory.

System Response:

The CID-FMI may be viewed on a display module or the ET. Ether injection is disabled.

Perform the following diagnostic procedure: "Ether Injection System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01320438

MID 036 - CID 0546 - FMI 05 Ether Hold Relay open/short to ground

SMCS Code: 1456-038

Conditions Which Generate This Code:

The ECM has been powered up for two seconds. The ECM detects an open circuit and/or a short circuit to ground at the Ether Hold Output.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET. Ether injection is disabled.

Perform the following diagnostic procedure: "Ether Injection System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01320463

MID 036 - CID 0546 - FMI 06 Ether Hold Relay short to +batt

SMCS Code: 1456-038

Conditions Which Generate This Code:

The ECM has been powered up for two seconds. The ECM detects a short circuit to the +Battery at the Ether Hold Output.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET. Ether injection is disabled.

Perform the following diagnostic procedure: "Ether Injection System"

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01320612

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

SMCS Code: 1919-038

Conditions Which Generate This Code:

The 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 90 percent or less than 10 percent.

System Response:

The CID-FMI is logged in memory. The CID-FMI may be viewed on a display module or the ET. The status screen on the ET will show the parameter as invalid data.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

i01320613

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

SMCS Code: 1919-038

Conditions Which Generate This Code:

The 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 90 percent or less than 10 percent. The CID-FMI is logged in memory.

System Response:

The CID-FMI may be viewed on a display module or the ET. The status screen on the ET will show the parameter as invalid data.

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

Results:

- OK – STOP.
- REPAIRED, OK – STOP.

Diagnostic Functional Tests

i01349210

Air Shutoff System

SMCS Code: 1078-038

System Operation Description:

The Electronic Control Module (ECM) has the ability to stop the engine by cutting off the air supply in an emergency situation. The ECM activates two relays which energize the two air shutoff solenoids. The solenoids trip the air shutoff valves.

There are two conditions which cause the engine control to activate the air shutoff relay. The first condition occurs when the operator initiates a remote shutdown. If the remote emergency stop button is activated the fuel is shut off and the air shutoff relay is activated. The ECM will hold the relays active for 1.5 seconds. The second condition occurs for an engine overspeed. The engine overspeed could be an actual overspeed condition or a simulated overspeed condition. The simulated overspeed condition can be obtained by using the Overspeed Verify Switch.

The air shutoff relay can also be activated without the aid of the ECM. When the emergency stop on the instrument panel is depressed, the air shutoff relay is activated. The air shutoff timer will allow the air shutoff relay to deactivate after 2.5 seconds in order to prevent damage to the air shutoff solenoids.

Regardless of the reason for activation, the Engine Control Switch (ECS) must be turned to the OFF/RESET position for three seconds in order to reset the ECM and the air shutoff timer.

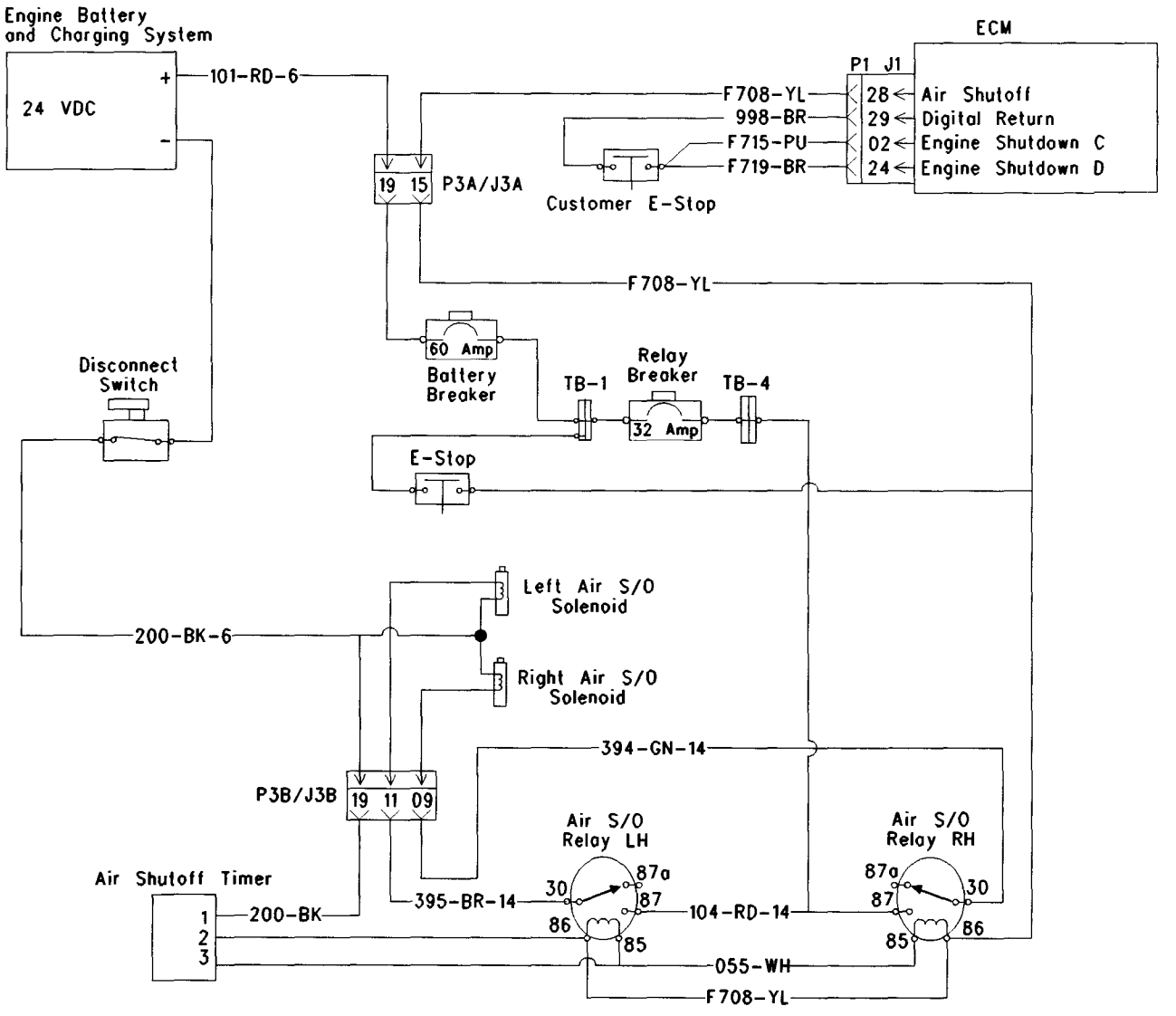

Illustration 13 g00724112

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

Expected Result:

The connectors and wiring should be free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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 OFF/RESET position.

C. Connect the ET.

D. Turn the ECS to the ON position. The engine should be off.

E. Access the override on the ET. Activate the override for the air shutoff.

F. Disable the override for the air shutoff.

Expected Result:

The air shutoff relay should activate. The air shutoff relay should deactivate after 1.5 seconds. While the relay is active, the air shutoff solenoid should also be active.

Results:

- OK – The air shutoff solenoid activated correctly. STOP.
- Not OK – The solenoid failed to activate. Proceed to test step 3.

Test Step 3. Test for Voltage from the Air Shutoff Relay.

A. Turn the ECS to the OFF/RESET position.

B. The output to the solenoids is terminal 30 on the air shutoff relays. The wires to the solenoids are 395-BR and 394-GR. Connect a test lamp between terminal 30 on the air shutoff relay and the –Battery terminal.

C. Turn the ECS to the ON position. The engine should be off.

D. Access the override on the ET. Activate the override for the air shutoff. Monitor the test lamp.

E. Disable the override for the air shutoff.

F. If a second air shutoff relay is installed, repeat the above steps for the other air shutoff relay.

Expected Result:

The test lamp should light for 1.5 seconds.

Results:

- OK – The test lamp did light for 1.5 seconds. The relay is operating correctly. Proceed to test step 4.
- Not OK – The test lamp did not light for 1.5 seconds. Proceed to test step 5.

Test Step 4. Test for voltage at the Air Shutoff Solenoids.

A. Turn the ECS to the OFF/RESET position.

B. At the solenoid, disconnect the wires that go to the air shutoff solenoid.

C. Use a test lamp to monitor the voltage at the air shutoff solenoid. Connect the test lamp across the wires that were removed from the solenoid in the previous step.

D. Turn the ECS to the ON position. The engine should be off.

E. Access the override on the ET. Activate the override for the air shutoff. Monitor the test lamp.

F. Disable the override for the air shutoff.

G. If a second air shutoff solenoid is installed, repeat the above steps for the other air shutoff solenoid.

Expected Result:

The test lamp should light for 1.5 seconds.

Results:

- OK – The test lamp did light for 1.5 seconds. The circuit is operating correctly to this point.

  Repair: Temporarily install a new air shutoff solenoid. Ensure that the problem is no longer present. Reinstall the old solenoid. If the problem returns, replace the air shutoff solenoid.

  STOP.

- Not OK – The test lamp did not light for 1.5 seconds. System voltage was not available at the solenoid. There is a problem in the wiring between the air shutoff solenoid and the air shutoff relay.

  Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

Test Step 5. Test for voltage at the coil of the Air Shutoff Relay.

A. Turn the ECS to the OFF/RESET position.

B. Remove wire F708-YL from the air shutoff relay. If two air shutoff relays are present disconnect wire F708-YL from both of the relays. Connect the test lamp between wire F708-YL of the air shutoff relay and the –Battery terminal.

C. Turn the ECS to the ON position. The engine should be off.

D. Access the override on the ET. Activate the override for the air shutoff.

This test will cause a 446-05 CID-FMI to be logged. Be sure to delete this CID-FMI when this test is completed.

E. Disable the override for the air shutoff.

F. If a second air shutoff relay is installed, repeat the above steps for the other air shutoff relay.

G. Reconnect all wires.

Expected Result:

The test lamp should light for 1.5 seconds indicating that ECM voltage was present.

Results:

- OK – The test lamp did light for 1.5 seconds. Voltage from the ECM was present. Proceed to test step 6.
- Not OK – The test lamp did not light. The voltage from the ECM was not present. Proceed to test step 7.

Test Step 6. Check the Resistance at the Connector of the Air Shutoff Timer.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect the connector to the air shutoff timer.

C. Check the resistance at the connector of the air shutoff timer. Check the resistance between wire 200-BK on Pin 1 and the –Battery terminal.

D. Check the resistance at the connector of the air shutoff timer. Check the resistance between wire F708-YL on Pin 2 and wire 055-WH on Pin 3.

Expected Result:

The resistance of the wire on Pin 1 should be less than 10 ohms. The resistance between the wires on Pin 2 and Pin 3 should be approximately 260 ohms if one relay is present. The resistance between the wires on Pin 2 and Pin 3 should be approximately 130 ohms when two relays are present.

Results:

- OK – The resistance on the wires meets the above requirements. The relay coils are okay. The relay's NORMALLY OPEN contacts may be faulty.

  Repair: Temporarily install a new air shutoff solenoid. Ensure that the problem is no longer present. If the problem still exists the air shutoff relay is okay. Replace the air shutoff timer. Verify that this solves the problem.

  STOP.

- Not OK – The resistance does not meet the above requirements. Check the coil of the air shutoff relay for an open. The coil resistance should be approximately 260 ohms.

  Repair: Replace the air shutoff relay if the coil of the relay is bad. Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

Test Step 7. Test the Output Voltage from the ECM.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect P1 from the ECM. Remove the wire from P1-28.

C. Install a jumper wire at P1-28. Reconnect ECM connector P1.

D. Connect the test lamp between the wire at P1-28 and the –Battery terminal.

E. Turn the ECS to the ON position. The engine should be off.

F. Access the override on the ET. Activate the override for the air shutoff.

This test will cause a 446-05 CID-FMI to be logged. Be sure to delete this CID-FMI when this test is completed.

G. Disable the override for the air shutoff.

H. Turn the ECS to the OFF/RESET position. Remove the jumper wire.

Expected Result:

The test lamp should light for 1.5 seconds.

Results:

- OK – The test lamp did light for 1.5 seconds. Voltage from the ECM was present. There is a problem in the wiring between the ECM and the air shutoff relay.

  Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

- **Not OK** – The test lamp did not light. The voltage from the ECM was not present.

  Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

  STOP.

i01349534

Analog Sensor Supply

SMCS Code: 1901-038

System Operation Description:

The Analog Sensor Supply provides power to all analog sensors. The Electronic Control Module (ECM) supplies 5.0 ± 0.5 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 supply line to the +Battery 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.

Note: The Engine Monitoring System can be programmed by dealers and/or customers. Dealers and/or customers can monitor customized warnings, derates, shutdown override setpoints, and delay times using the Electronic Technician (ET). Customized parameters may affect the behavior of the ECM. The behavior of the ECM may vary from the description that is given in this system operation section. You may refer to Troubleshooting, "Engine Monitoring System" in order to determine if there are any parameters that are affecting engine operation.

The following list contains a description of the analog sensors that are found on the engine.

Aftercooler Temperature Sensor – The ECM uses the signal from the sensor to monitor changes in system temperature. The ECM makes adjustments to the system's operating parameters as the temperature changes. This allows the engine to operate at optimal performance through a wide range of operating temperatures. The operating range of the sensor is –40 °C to 120 °C (–40 °F to 248 °F).

Coolant Temperature Sensor – Cold Mode operation improves the engine starting ability. Cold Mode operation helps to control white smoke during cold starts. Cold Mode operation helps to improve warm up time of the engine. In Normal Mode, injection timing is varied as a function of engine speed and load. The process of combustion is improved by controlling the injection timing in Cold Mode. Transient engine response is slower in Cold Mode operation. Cold Mode operation is activated when the engine water temperature is below 60 °C (140 °F). Cold Mode operation will remain active until water temperature rises above 63 °C (145 °F). The engine will alternate between Cold Mode and Normal Mode during operation, as engine temperature fluctuates. The operating range of the sensor is –40 °C to 120 °C (–40 °F to 248 °F).

Filtered Fuel Pressure Sensor – The sensor is used in conjunction with the Unfiltered Fuel Pressure sensor to determine the restriction across the fuel filters. The sensor output is a DC voltage that varies with filtered fuel pressure between 0.2 VDC and 4.8 VDC. The sensor is located on the end cap of the fuel filter housing. The operating range of the sensor is 0.0 kPa to 1090 kPa (0.0 psi to 158 psi). 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. A manual calibration of the sensor should be done if the sensor or the ECM has been replaced. Refer to Troubleshooting, "Anolog Sensor - Calibrate".

Unfiltered Fuel Pressure Sensor – The sensor is used in conjunction with the Filtered Fuel Pressure sensor to determine the restriction across the fuel filters. The sensor output is a DC voltage that varies with unfiltered fuel pressure between 0.2 VDC and 4.8 VDC. The sensor is located on the end cap of the fuel filter housing. The operating range of the sensor is 0.0 kPa to 1090 kPa (0.0 psi to 158 psi). 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. A manual calibration of the sensor should be done if the sensor or the ECM has been replaced. Refer to Troubleshooting, "Anolog Sensor - Calibrate".

Filtered Engine Oil Pressure Sensor – The sensor is used in conjunction with the Unfiltered Engine Oil Pressure sensor in order to determine the restriction across the engine oil filters. The ECM uses this sensor to detect low engine oil pressure which may indicate a failed engine oil pump or low engine oil pressure. The signal is compared with a map of engine oil pressure versus engine rpm which is stored in the ECM. The sensor output is a DC voltage that varies with engine oil pressure between 0.2 VDC and 4.8 VDC. The sensor is located downstream of the engine oil filter. The operating range of the sensor is 0.0 kPa to 1090 kPa (0.0 psi to 158 psi). 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. A manual calibration of the sensor should be done if the sensor or the ECM has been replaced. Refer to Troubleshooting, "Anolog Sensor - Calibrate".

Unfiltered Engine Oil Pressure Sensor – The sensor is used in conjunction with the Filtered Engine Oil Pressure sensor to determine the restriction across the engine oil filters. The sensor output is a DC voltage that varies with unfiltered engine oil pressure between 0.2 VDC and 4.8 VDC. The sensor is located before the engine oil filters in the oil passage of the engine oil filter housing. The operating range of the sensor is 0.0 kPa to 1090 kPa (0.0 psi to 158 psi). 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. A manual calibration of the sensor should be done if the sensor or the ECM has been replaced. Refer to Troubleshooting, "Anolog Sensor - Calibrate".

Left Turbocharger Compressor Inlet Pressure Sensor – The sensor is used in conjunction with the Atmospheric Pressure Sensor to determine if the engine air filter is plugged. The sensor indicates if the left turbocharger compressor inlet has a restriction. The sensor output is a DC voltage between 0.2 VDC and 4.8 VDC that varies with left turbocharger compressor inlet pressure. The operating range of the sensor is 0.0 kPa to 111 kPa (0.0 psi to 16 psi). 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. A manual calibration of the sensor should be done if the sensor or the ECM has been replaced. Refer to Troubleshooting, "Anolog Sensor - Calibrate".

Right Turbocharger Compressor Inlet Pressure Sensor – The sensor is used in conjunction with the Atmospheric Pressure Sensor to determine if the engine air filter is plugged. The sensor indicates if the right turbocharger compressor inlet has a restriction. The sensor output is a DC voltage between 0.2 VDC and 4.8 VDC that varies with right turbocharger compressor inlet pressure. The operating range of the sensor is 0.0 kPa to 111 kPa (0.0 psi to 16 psi). 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. A manual calibration of the sensor should be done if the sensor or the ECM has been replaced. Refer to Troubleshooting, "Anolog Sensor - Calibrate".

Turbocharger Compressor Outlet Pressure Sensor – The sensor is used to obtain boost pressure. Boost pressure is used to control the ratio of fuel to air during acceleration. The ECM limits the amount of fuel that is injected, based upon inlet manifold pressure. Information in the ECM defines the relationship between the manifold pressure and the fuel ratio control limit (FRC). The operation is similar to the fuel ratio control on an engine with a mechanical governor. The sensor output is a DC voltage between 0.2 VDC and 4.8 VDC that varies with turbocharger outlet pressure. The operating range of the sensor is 0.0 kPa to 452 kPa (0.0 psi to 65 psi). 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. A manual calibration of the sensor should be done if the sensor or the ECM has been replaced. Refer to Troubleshooting, "Anolog Sensor - Calibrate".

Atmospheric Pressure Sensor – The sensor is used to provide an atmospheric pressure signal to the ECM. If the Atmospheric Pressure Sensor should fail, the Right Turbocharger Compressor Inlet Pressure Sensor is used as a substitute. If the Right Turbocharger Compressor Inlet Pressure Sensor should fail, the Left Turbocharger Compressor Inlet Pressure Sensor is used as a substitute. The sensor output is a DC voltage between 0.2 VDC and 4.8 VDC that varies with atmospheric pressure. The operating range of the sensor is 0.0 kPa to 111 kPa (0.0 psi to 16 psi). The sensor is used to calibrate the other pressure sensors 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 a diagnostic message will be generated and the engine may be derated. A manual calibration of the sensor should be done if the sensor or the ECM has been replaced. Refer to Troubleshooting, "Anolog Sensor - Calibrate".

Crankcase Pressure Sensor – The sensor is used in conjunction with the Atmospheric Pressure Sensor to determine if the engine crankcase pressure is too high. The Atmospheric pressure is subtracted from the Absolute crankcase pressure. The difference between the Atmospheric pressure and the Absolute crankcase pressure is the Differential Crankcase Pressure. The sensor output is a DC voltage between 0.2 VDC and 4.8 VDC that varies with crankcase pressure. The operating range of the sensor is 0.0 kPa to 111 kPa (0.0 psi to 16 psi). 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. A manual calibration of the sensor should be done if the sensor or the ECM has been replaced. Refer to Troubleshooting, "Anolog Sensor - Calibrate".

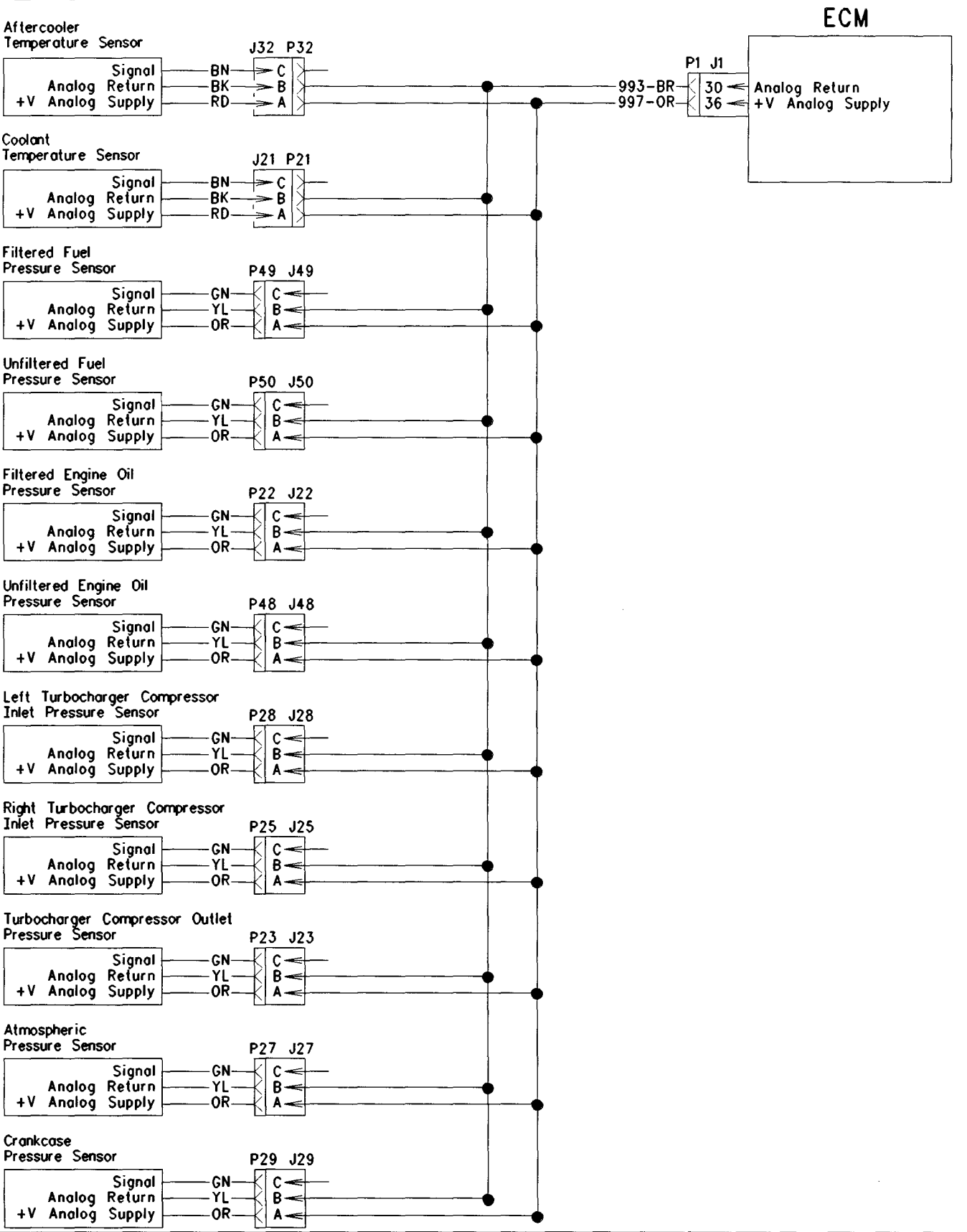

Illustration 14
Schematic

g00599048

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. Check all of the connectors and wiring for the following problems: damage, corrosion, abrasion, and incorrect attachment.

Expected Result:

The connectors and wiring should be free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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 and/or wiring or replace the connectors and/or wiring.

  STOP.

Test Step 2. Check for a Short Circuit in the Harness.

A. Disconnect ECM connector J1/P1. Disconnect all of the analog sensors.

B. Measure the resistance between the analog supply P1-36 and the analog return P1-30.

C. Measure the resistance between the analog supply P1-36 and the engine ground.

D. Measure the resistance between the analog return P1-30 and the engine ground.

Expected Result:

The resistance should be more 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: Repair the connectors and/or wiring or replace the connectors and/or wiring.

  STOP.

Test Step 3. Check the Analog Sensor Supply Voltage at the ECM.

A. Remove P1-36 from the ECM connector. Install a jumper wire into the socket for P1-36.

B. Remove P1-30 from the ECM connector. Install a jumper wire into the socket for P1-30.

C. Reconnect ECM connector J1/P1.

D. Turn the circuit breaker for the battery to the ON position.

E. Turn the ECS to the ON position. The engine should be off.

F. Measure the voltage between the analog supply P1-36 and the analog return P1-30 on P1.

G. Turn the ECS to the OFF/RESET position.

H. Remove the jumper wires and reconnect P1-36 and P1-30.

Expected Result:

The supply voltage should be 5.0 ± 0.5 VDC.

Results:

- OK – The supply voltage is 5.0 ± 0.5 VDC. Proceed to test step 4.
- Not OK – The supply voltage is not 5.0 ± 0.5 VDC. The supply voltage is not correct at the ECM.

  Repair: Perform a diagnostic functional test. Refer to Troubleshooting, "Electrical Power Supply".

  STOP.

Test Step 4. Check the Analog Sensor Supply Voltage at the Sensor Connector.

A. Turn the ECS to the ON position. The engine should be off.

B. Measure the voltage between socket A and socket B on the harness side of all analog sensor connectors. Ensure that you are measuring on the harness side of the connector since the sensors are disconnected.

Expected Result:

The supply voltage should be 5.0 ± 0.5 VDC.

Results:

- **OK** – The supply voltage is 5.0 ± 0.5 VDC. Proceed to test step 5.
- **Not OK** – The supply voltage is not 5.0 ± 0.5 VDC. There is an open circuit in the harness or connectors.

  Repair: Repair the connectors and/or wiring or replace the connectors and/or wiring.

  STOP.

Test Step 5. Check the Analog Sensors for Short Circuits.

A. Connect one analog sensor at a time.

B. Check the analog sensor supply voltage between the analog supply terminal-A (997-OR) and the analog return terminal-B (993-BR). Repeat this step with all of the analog sensors.

C. Turn the ECS to the OFF/RESET position.

Expected Result:

The supply voltage should be 5.0 ± 0.5 VDC after each analog sensor is connected.

Results:

- **OK** – The analog supply voltage is 5.0 ± 0.5 VDC when all of the sensors are connected. The analog sensor supply and the harness are okay. STOP.
- **Not OK** – The supply voltage is not 5.0 ± 0.5 VDC after a sensor is connected. 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: Perform the diagnostic functional test in Troubleshooting, "Inspecting Electrical Connectors".

  STOP.

i01349597

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 ECM to the Caterpillar Monitoring System. The CAT Data Link is used for programming and troubleshooting the ECM.

The ECM communicates with the Caterpillar Monitoring System through the sharing of electronic system diagnostics and engine information.

The ECM communicates with the ET in order to share status and diagnostic information. The 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 ET.

The engine can be programmed by using Flash programming over the CAT Data Link.

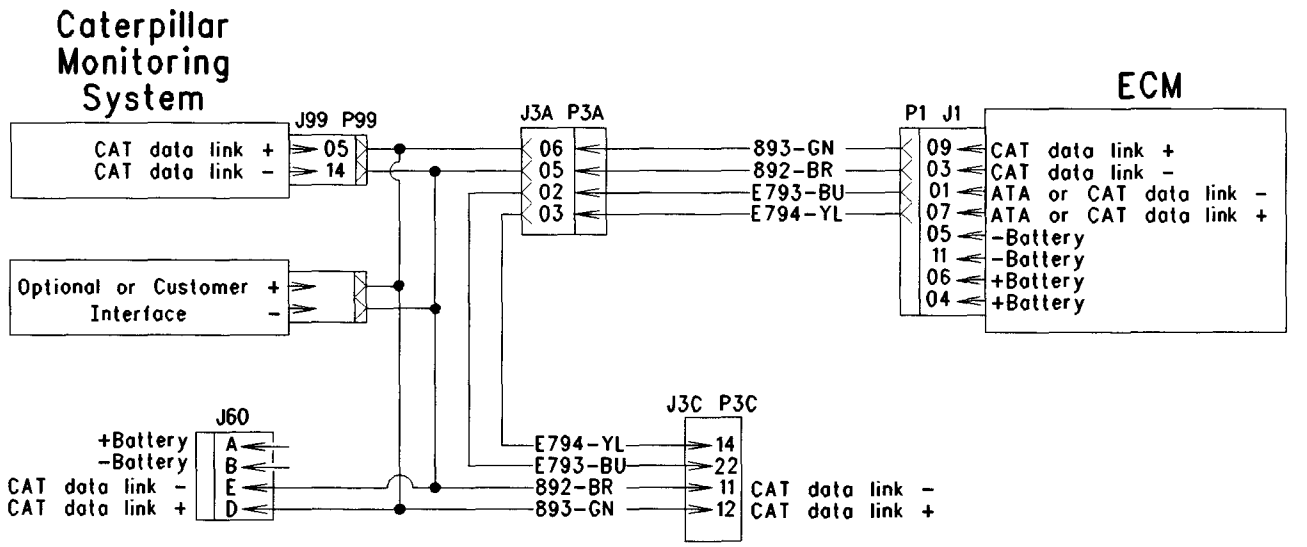

Illustration 15 g00731012

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

Expected Result:

The connectors and wiring should be free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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 connector and/or wiring or replace the connector and/or wiring.

  STOP.

Test Step 2. Check the CAT Data Link.

A. Turn the ECS to the OFF/RESET position.

B. Connect the ET.

C. Turn the circuit breaker for the battery to the ON position.

D. Turn the ECS to the STOP position.

E. Check for any LOGGED diagnostic codes.

F. Start the engine and read the status information on the ET.

G. Observe the engine oil pressure and the coolant temperature on the Caterpillar Monitoring System.

Note: If some of the parameters, but not all of the parameters were displayed, the CAT Data Link is OK. Check the component that is associated with any missing parameter.

Expected Result:

The ET should display the Status Information. The Caterpillar Monitoring System should display engine parameters.

Results:

- **OK** – The CAT Data Link is operating correctly at this time. **STOP.**
- **No Parameter Displayed.** – There is a problem with the CAT Data Link. Proceed to test step 3.
- **Service Tool Did Not Power Up.** – The ET or the Communication Adapter did not power up. Proceed to test step 4.

Test Step 3. Check Communication with the ET and the Communication Adapter.

A. Turn the ECS to the OFF/RESET position.

B. Reconnect ECM connectors J1/P1 and J2/P2.

C. Disconnect J3C/P3C.

D. Connect the ET.

E. Turn the ECS to the STOP position.

F. Read LOGGED Diagnostics and Status Information on the ET.

Expected Result:

Status Information appears on the ET.

Results:

- **OK** – The Status Information appears on the ET. Proceed to test step 5.
- **Not OK** – Status Information does not appear on the ET. Proceed to test step 6.

Test Step 4. Check for the Battery Voltage.

A. Turn the ECS to the OFF/RESET position.

B. Ensure that all connectors are connected.

C. Turn the ECS to the STOP position.

D. Measure the voltage between pin A and pin B at J60.

Expected Result:

The voltage should be between 20 VDC and 28 VDC.

Results:

- **OK** – The voltage is between 20 VDC and 28 VDC.

  Repair: Repair the connector and/or wiring or replace the connector and/or wiring.

  STOP.

- **Not OK** – The voltage is not between 20 VDC and 28 VDC. There is a problem in the harness or electrical power supply.

  Repair: Repair the connector and/or wiring or replace the connector and/or wiring.

  STOP.

Test Step 5. Check For Shorts in the Harness

A. Turn the ECS to the OFF/RESET position.

B. Disconnect the ECM connectors J1/P1 and J2/P2. Disconnect the service tool connector J60/P60. Disconnect connector J99/P99 of the Caterpillar Monitoring System . Disconnect any other devices that are attached to the Caterpillar Monitoring System.

C. Ensure that the connector J3A/P3A is connected.

D. Measure resistance from P1-3 to P1-9.

E. Check the resistance at the following points:

- P1-3 to P1-5
- P1-9 to P1-5
- P1-3 to P1-6
- P1-3 to P1-4
- P1-9 to P1-4
- P1-3 to P1-11
- P1-9 to P1-11

F. Measure the resistance from P99-5 to P99-14.

Expected Result:

Resistance should read more than 20,000 Ohms for each measurement.

Results:

- **OK** – The resistance is greater than 20,000 Ohms. The harness is free of shorts. Proceed to test step 7.
- **Not OK** – The resistance is less than 20,000 Ohms.

  Repair: Repair the connector and/or wiring or replace the connector and/or wiring.

  STOP.

Test Step 6. Check the Operation of the ET.

Verify proper operation of the ET on another engine.

Expected Result:

The ET and the Communications Adapter should work on another engine.

Results:

- **OK** – The ET and the Communications Adapter did work on another engine. Proceed to test step 5.

- **Not OK** – The ET and the Communications Adapter did not work on another engine. There is a problem with the ET, cables, or the Communication Adapter.

  Repair: Repair the connector and/or wiring or replace the connector and/or wiring.

  STOP.

Test Step 7. Check the Resistance Through the Harness.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect the ECM connectors J1/P1 and J2/P2. Disconnect the service tool connector J60/P60 and the monitoring system J99/P99. Disconnect any other devices that are attached to the Caterpillar Monitoring System.

C. Ensure that the customer connector J3A/P3A is connected.

D. Use a suitable piece of wire to short P1-9 to P1-3.

E. Measure the resistance between P99-14 to P99-5.

F. Measure the resistance between pin D and pin E of the Service Tool Connector J60.

Expected Result:

Resistance should read less than 10 Ohms through the wires.

Results:

- **OK** – Resistance is less than 10 Ohms through the harness and connectors. Proceed to test step 8.

- **Not OK** – Resistance is greater than 10 Ohms. There is an open circuit in the harness or connectors.

  Repair: Repair the connector and/or wiring or replace the connector and/or wiring.

  STOP.

Test Step 8. Check Isolated Communication.

A. Turn the ECS to the OFF/RESET position.

B. Reconnect the ECM connectors and the Customer Connector.

C. Disconnect J99/P99. Disconnect the customer connector J3/P3.

D. Install the ET.

E. Turn the ECS to the STOP position.

F. Read LOGGED Diagnostics.

G. Turn the ECS to the START position.

H. Read the Status information.

Expected Result:

The ET should display any Diagnostics and Status Information.

Results:

- **OK** – Diagnostics and status information is displayed on the ET. Proceed to test step 9.

- **Not OK** – Diagnostics and status information is displayed on the ET. Verify proper operation of the ET and Communication Adapter on another engine.

  Repair: Perform a diagnostic functional test. Refer to Troubleshooting, "Electrical Power Supply".

  STOP.

Test Step 9. Verify the CAT Data Link.

A. Turn the ECS to the OFF/RESET position.

B. Reconnect all of the connectors.

C. Turn the ECS to the STOP position.

D. Observe the parameters on the Monitoring System.

Note: The CAT Data Link is operating correctly at this time. If some of the parameters, but not all of the parameters were displayed, the CAT Data Link is okay. Check the component that is associated with any missing parameter.

Note: The Monitoring System can display a message that indicates a fault with the ECM. The message may not indicate that the ECM is faulty. The message is displayed when the system no longer receives any engine related parameters.

Expected Result:

The parameters should appear on the Caterpillar Monitoring System.

Results:

- **OK** – The parameters are available for viewing on the ET. **STOP.**
- **Not OK** – The parameters are not available for viewing on the ET.

  Repair: There is a problem with the Caterpillar Monitoring System and/or the data link cable. Check that the cable is not too long. Refer to Service Manual, SENR6587.

  STOP.

i01349712

Digital Sensor Supply

SMCS Code: 1901-038

System Operation Description:

The Digital Sensor Supply provides power to all digital sensors. The Electronic Control Module (ECM) supplies 8.0 ± 0.32 VDC from the ECM connector J1/P1 to each digital sensor connector pin "A". The digital sensor return is used as the return line for the digital sensors, speed/timing sensors, and the switch inputs to the ECM. The digital return line is from the ECM connector J1/P1 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 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 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 output is a constant frequency signal 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 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 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 output is a constant frequency signal 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 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).

Note: The Engine Monitoring System can be programmed by dealers and/or customers. Dealers and/or customers can monitor customized warnings, derates, shutdown override setpoints, and delay times using the Electronic Technician (ET). Customized parameters may affect the behavior of the ECM. The behavior of the ECM may vary from the description that is given in this System Operation section. You may refer to Troubleshooting, "Engine Monitoring System" in order to determine if there are any parameters that are affecting engine operation.

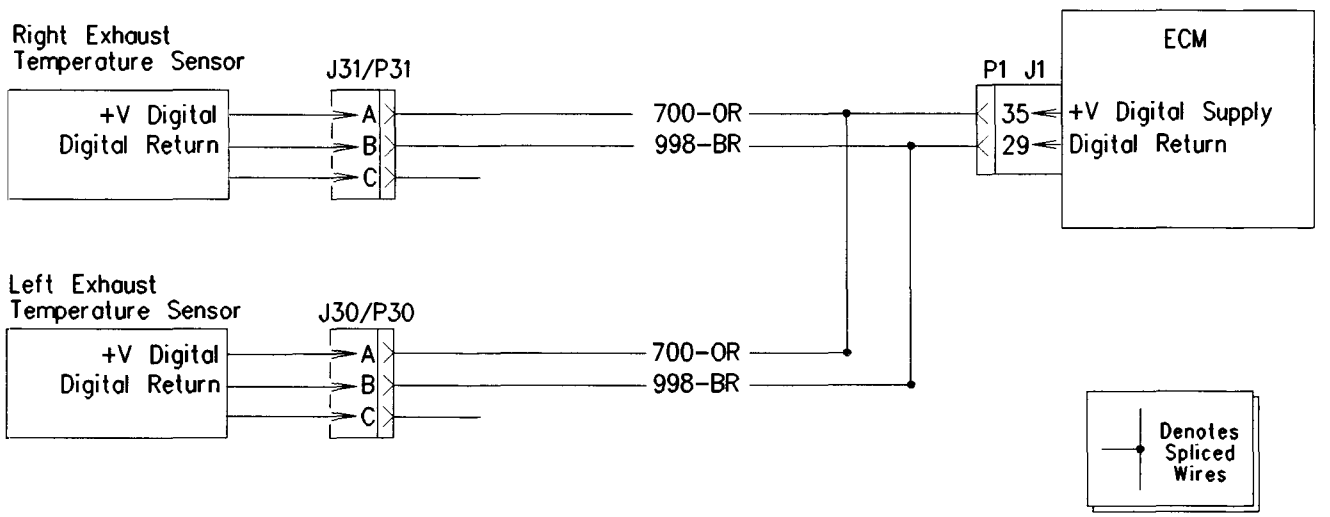

Illustration 16 g00594674

Schematic

Test Step 1. Check for Connector Damage.

A. Turn the breaker at the battery to the OFF position.

B. Turn the ECS to the OFF/RESET position.

C. Check the connectors and wiring for the following problems: damage, corrosion, abrasion, and incorrect attachment .

Expected Result:

The connectors and wiring should be free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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.

A. Disconnect ECM connector J1/P1, ECM connector J2/P2, and all of the digital sensors.

B. Measure the resistance between the digital supply P1-35 (700-OR) and the digital return P1-29 (998-BR) on connector P1.

C. Measure the resistance between the digital supply P1-35 (700-OR) and engine ground.

D. Measure the resistance between the digital return P1-29 (998-BR) and engine ground.

Expected Result:

The resistance should be 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: Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

Test Step 3. Check the Digital Supply Voltage at the ECM.

A. Remove the digital supply line on pin P1-35 of the ECM. Install a jumper into the socket for P1-35.

B. Remove the digital supply line on pin P1-29 of the ECM. Install a jumper into the socket for P1-29.

C. Reconnect the ECM connectors.

D. Turn the breaker at the battery to the ON position.

E. Turn the ECS to the ON position. The engine should be off.

F. Measure the voltage between the digital supply P1-35 and the digital return P1-29.

G. Remove the jumpers and replace all wires.

Expected Result:

The supply voltage should be 8.0 ± 0.5 VDC.

Results:

- **OK** – The supply voltage is 8.0 ± 0.5 VDC. The digital sensor supply is producing the correct voltage. Proceed to test step 4.
- **Not OK** – The supply voltage is not 8.0 ± 0.5 VDC. The digital sensor is not producing the correct voltage.

  Repair: Perform the following diagnostic procedure Troubleshooting, "Electrical Power Supply".

  STOP.

Test Step 4. Check the Digital Sensor Supply Voltage at the Sensor Connector.

A. Measure the digital sensor supply voltage between the digital supply terminal-A (700-OR) and the digital return terminal-B (998-BR) of all the digital sensors.

Expected Result:

The supply voltage should be 8.0 ± 0.5 VDC.

Results:

- **OK** – The supply voltage is 8.0 ± 0.5 VDC at all of the digital sensor connectors. Proceed to test step 5.
- **Not OK** – The supply voltage is not 8.0 ± 0.5 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.

A. Connect one digital sensor at a time.

B. Check the digital sensor supply voltage between the digital supply terminal-A (700-OR) and the digital return terminal-B (998-BR). Repeat this step with all of the digital sensors.

C. Turn the ECS to the OFF/RESET position.

Expected Result:

The supply voltage should be 8.0 ± 0.5 VDC.

Results:

- **OK** – The supply voltage is 8.0 ± 0.5 VDC. The digital sensor supply is correct. The harness is okay. **STOP.**
- **Not OK** – The supply voltage is not 8.0 ± 0.5 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: Perform the diagnostic functional test in Troubleshooting, "Inspecting Electrical Connectors".

  STOP.

i01349808

Direct Fuel Control Mode

SMCS Code: 1901-038

System Operation Description:

The Direct Fuel Control Mode enables the engine to be controlled by an external governor. You must install the components of the signal converter for the Direct Fuel Control in order to operate in Direct Fuel Control Mode. The configuration parameter must be programmed to "ON " in order for the ECM to respond properly to the external governor.

The input to the signal converter is a 0 to 200 mA signal. The signal is received from the external governor. The signal output of the signal converter is a pulse width modulated PWM signal.

The output signal varies with the current to the signal converter. The ECM calculates the Desired Fuel from the PWM signal.

You have a valid Desired Fuel signal when the duty cycle is between 2 and 95 percent. If an invalid Desired Fuel signal is received the engine will automatically be set to a minimum fuel setting and the engine will shut down.

The droop is not used for the Direct Fuel Control Mode. Disconnecting the droop at the ECM will not affect engine operation.

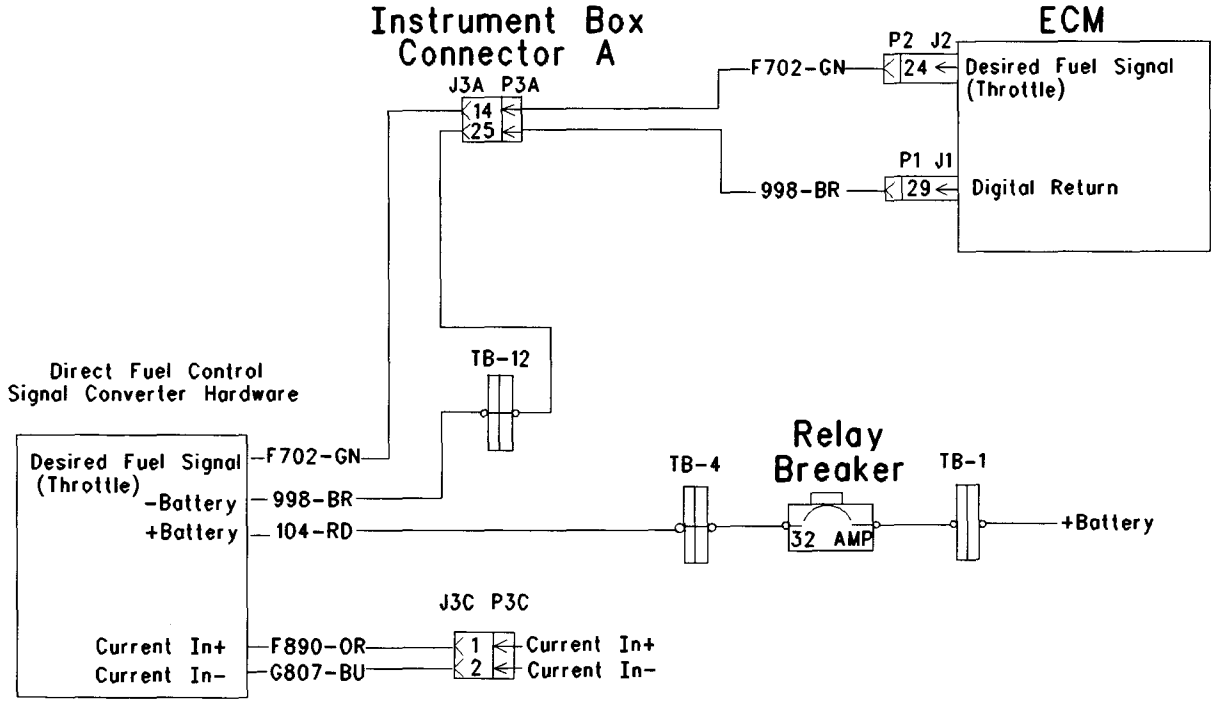

Illustration 17 g00637385

Test Step 1. Check for Connector Damage.

A. Verify that the circuit breaker has not been tripped.

B. Turn the circuit breaker for the battery to the OFF position.

C. Turn the ECS to the OFF/RESET position.

D. Check the components and wiring for the following problems: damage, corrosion, abrasion, and incorrect attachment.

Expected Result:

The components should be free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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 and/or wiring or replace the connectors and/or wiring.

  STOP.

Test Step 2. Check the Current Input.

A. Measure the current to the signal converter.

Note: Some external governors may only be able to output approximately 150 mA. This should not be seen as a problem with the external governor.

Expected Result:

The current range should be between 0 and 200 mA.

Results:

- **OK** – The current is within the correct range. Proceed to test step 3.
- **Not OK** – The current is not within the correct range.

  Repair: Replace the external governor that is supplying the controlling current.

  STOP.

Test Step 3. Check the Voltage at the Battery.

A. Turn the circuit breaker at the battery to the ON position.

B. Connect one probe of the voltage test lamp to +Battery terminal.

C. Connect one probe of the voltage test lamp to –Battery terminal.

Expected Result:

The lamp should illuminate.

Results:

- **OK** – The lamp illuminates. Proceed to test step 4.
- **Not OK** – The lamp does not illuminate.

  Repair: The lamp is faulty or there is a problem with the battery.

  STOP.

Test Step 4. Check the Voltage at the Signal Converter.

A. Connect one probe of the voltage test lamp to the +Battery terminal at the signal converter.

B. Connect one probe of the voltage test lamp to the –Battery terminal at the signal converter.

Expected Result:

The lamp should illuminate.

Results:

- **OK** – The lamp illuminates. Proceed to test step 5.
- **Not OK** – The lamp does not illuminate.

  Repair: There is a problem with the supply voltage.

  STOP.

Test Step 5. Check the Desired Fuel Position.

A. Turn the ECS to the STOP position.

B. Observe the throttle position reading on the ET.

C. Vary the current to the signal converter.

Expected Result:

The throttle position on the ET should read 0 percent at zero current input and a higher percentage when the current is increased.

Results:

- **OK** – The throttle position on the ET corresponds with the current input. **STOP.**
- **Not OK** – The throttle position does not correspond to the current input. Proceed to test step 6.

Test Step 6. Check the Hardware.

A. Remove the Desired Fuel signal output wire from the Signal Converter.

B. Set the multimeter to "VDC".

C. Press the "Hz" button twice so that the "%" symbol is displayed.

D. Place one probe on the Desired Fuel signal output of the signal converter.

E. Place the other probe on the -Battery terminal of the signal converter.

F. Monitor the output of the percent duty cycle from the signal converter.

G. Adjust the current input from a low current setting to a high current setting.

Note: The throttle position on the ET will not match the percent duty cycle on the multimeter.

Expected Result:

The duty cycle should be between 3 and 5 percent at the low setting and above 60 percent at the high setting.

Results:

- OK – The correct signal is being supplied. Proceed to test step 7.
- Not OK – The duty cycle is not correct on the multimeter.

  Repair: Temporarily install another signal converter. Verify that the problem is no longer present. Reinstall the old signal converter. If the problem returns replace the signal converter.

  STOP.

Test Step 7. Check the ECM.

A. Turn the ECS to the STOP position.

B. Replace the wire of the Desired Fuel output on the signal converter.

C. Set the multimeter to "VDC".

D. Press the "Hz" button twice so that the "%" symbol is displayed.

E. Measure the voltage between the ECM connector P2-24 and ECM connector P1-29.

F. Monitor the output of the percent duty cycle on the multimeter.

G. Monitor the percent throttle position on the ET.

H. Vary the input current to the signal converter.

Expected Result:

The duty cycle should be between 3 and 5 percent at the low setting and above 60 percent at the high setting. The percent throttle position should be between 0 and 100 percent.

Results:

- OK – The duty cycle and the throttle position is correct. STOP.
- Not OK-Duty Cycle – The duty cycle is not correct.

  Repair: There is a problem in the wiring between P2-24 and the signal converter.

  STOP.

- Not OK-Throttle Position – The duty cycle is okay. The Throttle Position is incorrect.

  Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

  STOP.

i01349914

ECM/Personality Module

SMCS Code: 1901-038

System Operation Description:

The Electronic Control Module (ECM) is the computer which controls the engine. The Personality Module contains the software that determines the function of the ECM. The two must be used together.

The ECM consists of the following items:

- A microprocessor that will execute the following ECM functions: governing, injection timing control, system diagnostics, and data link communication
- A permanent memory that stores programmable parameters and diagnostic codes
- Input circuits that filter electrical noise from sensor signals
- Input circuits that protect internal circuits in the ECM from potentially damaging voltage levels
- Output circuits that provide high voltage for the injector solenoids and relays
- Power circuits that provide a clean, stable, electrical power for the injector solenoids, internal circuits, and external sensors

The Personality Module consists of the following items:

- The personality module contains all of the software for the ECM. Updating the personality module to a different version may cause some engine features to behave differently.
- Control maps define such operating conditions as timing and fuel rates. These maps help to achieve optimum engine performance and fuel consumption. The maps are programmed into the Personality Module at the factory.

The Personality Module on earlier engines could be updated only by the removal of the module from the ECM. A module that contained a different program would then be installed. A new type of memory chip which can be programmed through the use of ET is now used. This is called "FLASH" memory. "FLASH" memory has the advantage of retaining programmed information indefinitely and "FLASH" memory can be reprogrammed without opening the case of the ECM. This process of Flash Programming is accomplished through the use of ET. Refer to Troubleshooting, "Flash Programming".

Note: The Personality Module can still be removed and replaced. Flash Programming is the preferred method for reprogramming a Personality Module.

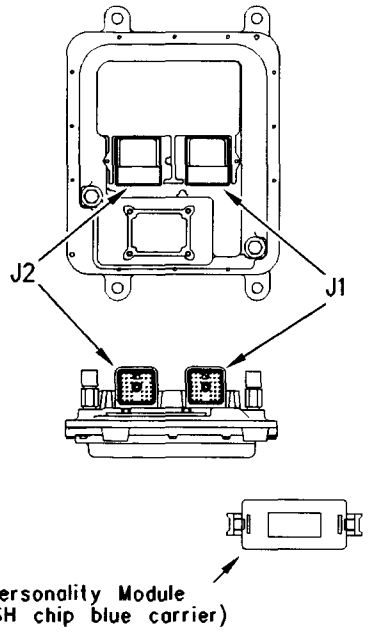

Illustration 18 g00589030
Personality Module

Test Step 1. Check for Active Codes.

A. Turn the ECS to the OFF/RESET position.

B. Connect the ET.

C. Turn the ECS to the ON position. The engine should be off.

D. Check for active diagnostic codes.

Results:

- **253-02 Present** – Proceed to test step 2.
- **254-12 Present** – If an internal problem develops, the diagnostic code 254-12 becomes active. This indicates that the ECM has detected an internal problem that cannot be fixed.

  Repair: Replace the ECM. Ensure that the new ECM serial number ends in CD. Refer to Troubleshooting, "Replacing the ECM" before replacing the ECM.

  STOP.

- **268-02 Present**

  Repair: Reprogram the system configuration parameters. Refer to Troubleshooting, "Programming Parameters" for additional information.

  STOP.

Test Step 2. Check for a Personality Module Mismatch.

A. Verify that the correct ECM has been installed.

B. Check the ECM part number. Check the last two characters of the ECM serial number.

Expected Result:

The ECM serial number should end with a CD.

Results:

- **OK** – The serial number of the ECM ends with a CD. Verify that the correct Personality Module is installed.

  Repair: Connect the ET and reprogram the interlock code.

  STOP.

- **Not OK** – The serial number of the ECM does not end in a CD.

  Repair: Replace the ECM. Ensure that the new ECM serial number ends in CD. Refer to Troubleshooting, "Replacing the ECM" before replacing the ECM.

  STOP.

i01349937

Electrical Power Supply

SMCS Code: 1401-038

System Operation Description:

The electrical power for the engine comes through a 16 amp circuit breaker, the Engine Control Switch (ECS), and the Electronic Control Module (ECM). The system receives battery voltage when the ECS is in the AUTO, START or STOP positions. A signal is provided to the ECM that senses the position of the Engine Control Switch. When the ECM senses battery voltage on this input, the ECM will power up. If the voltage is removed from the input, the ECM will power down.

An emergency stop for engine operation is provided in the starting system. Power to the ECM flows through the ECM breaker and the ECM relay. The ECM relay is energized when the ECS is in the AUTO, START or STOP positions and the emergency stop button is not activated. When the emergency stop button is activated, power is removed from the coil of the ECM relay. The contacts of the ECM relay open removing the power to the ECM.

The presence of two +Battery and two –Battery connections to the ECM reduce harness resistance. All of these connections must be complete in order to ensure proper engine operation.

With intermittent faults, you may want to bypass the engine wiring. Bypassing the wiring helps to locate the problem. If the problem is no longer present with the bypass in place, the engine wiring is faulty.

Note: If your system has EMCP II, refer to Service Manual, SENR5398.

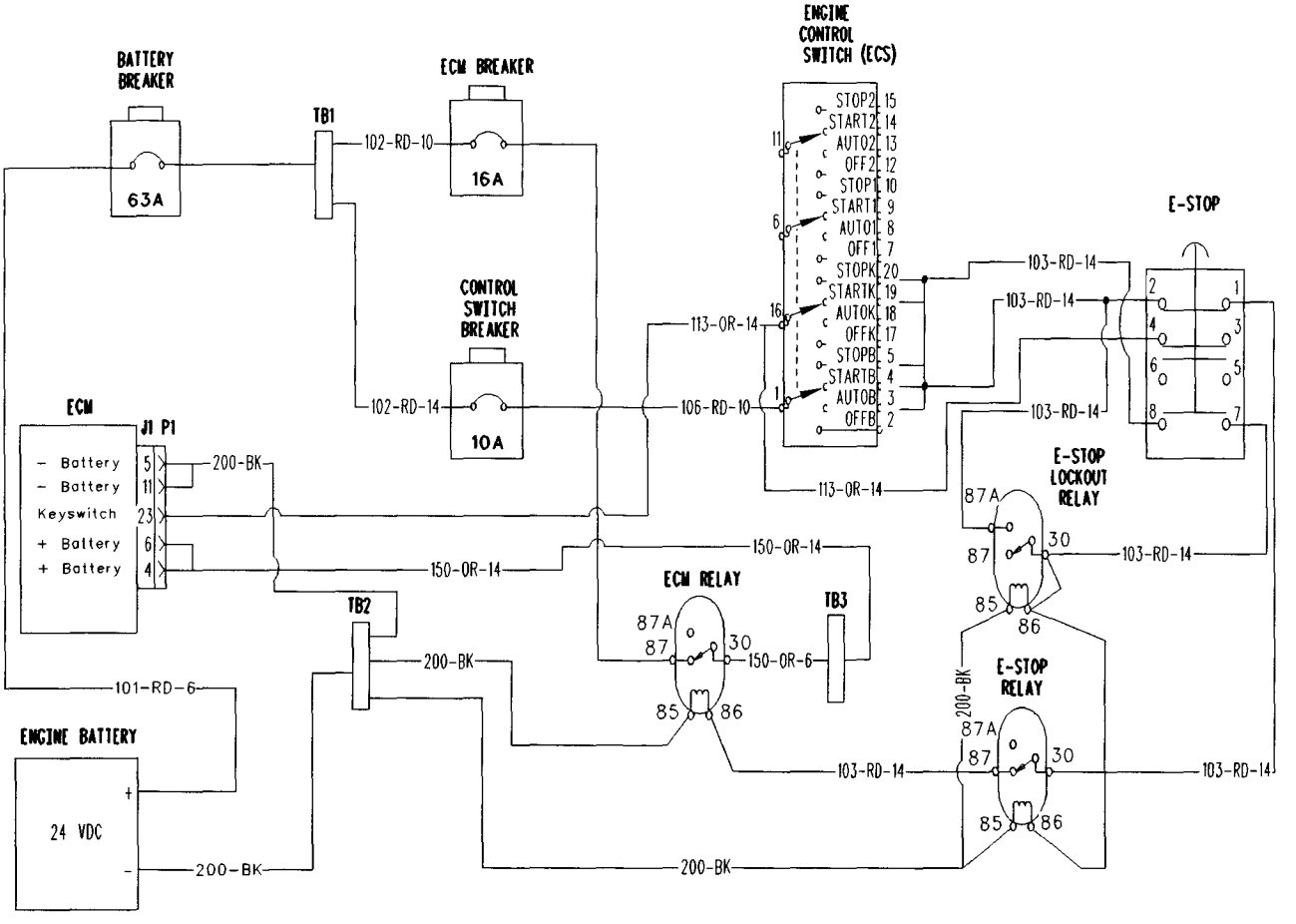

Illustration 19 g00721122

Test Step 1. Check for Connector Damage.

A. Verify that the circuit breakers are not tripped.

B. Verify that the emergency stop switches are not activated.

C. Turn the circuit breaker for the battery to the OFF position.

D. Turn the ECS to the OFF/RESET position.

E. Check the connectors and wiring for the following problems: damage, abrasion, corrosion, and incorrect attachment.

Expected Result:

The connectors and wiring are free of the following problems: damage, abrasion, corrosion, and incorrect attachment.

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 and/or wiring or replace the connectors and/or wiring.

  STOP.

Test Step 2. Check the Voltage to the ECM.

A. Disconnect ECM connector J1/P1.

B. Turn the circuit breaker for the battery to the ON position.

C. Turn the ECS to the STOP position.

D. Measure the voltage between P1-6 and P1-5.

E. Measure the voltage between P1-4 and P1-11.

F. Measure the voltage between P1-23 and P1-11.

Expected Result:

The voltage should be ± 1 VDC from the voltage at the battery terminals. The voltage should be between 23 VDC and 27 VDC.

Results:

- OK – The ECM is receiving the correct voltage. Proceed to test step 8.
- Out Of Range – The voltage is incorrect. The battery or the alternator may be causing the problem. 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 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 should be at least 23.5 VDC, and the batteries should 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 the Emergency Stop Relay.

A. Reconnect ECM connector J1/P1.

B. Turn the circuit breaker for the battery to the ON position.

C. Turn the ECS to the STOP position.

D. Measure the voltage from wire 103-RD on terminal 30 of the emergency stop relay to the –Battery terminal.

Expected Result:

The voltage should be 23 VDC to 27 VDC.

Results:

- OK – The voltage is 23 to 27 VDC. Proceed to test step 5.
- Not OK – The voltage is not 23 to 27 VDC. Proceed to test step 7.

Test Step 5. Check the Voltage at the ECM Relay.

A. Measure the voltage from wire 103-RD on terminal 86 of the ECM relay to the –Battery terminal.

Expected Result:

The voltage should be 23 to 27 VDC.

Results:

- OK – The voltage is 23 to 27 VDC. Proceed to test step 6.
- Not OK – The voltage is not 23 to 27 VDC.

  Repair: Check the voltage on terminal 87 on the Emergency Stop relay. If the voltage is correct the wire from the Emergency Stop relay to the ECM relay may be the problem. If the voltage is incorrect replace the Emergency Stop relay.

  STOP.

Test Step 6. Check the Voltage at the Output of the ECM Relay.

A. Measure the voltage from wire 102-RD on terminal 87 of the ECM relay to the –Battery terminal.

B. Measure the voltage from wire 150-OR on terminal 30 of the ECM relay to the –Battery terminal.

Expected Result:

The voltage should be 23 to 27 VDC on both terminals.

Results:

- OK – The voltage is 23 to 27 VDC on both terminals.

  Repair: The wire from the ECM relay to the ECM is bad. Repair the connectors and/or wiring or replace the connectors and/or wiring.

  STOP.

- Not OK - Terminal 87 – The voltage is incorrect on terminal 87.

  Repair: Verify that the circuit breakers for the battery and for the ECM are not tripped. Repair the connectors and/or wiring or replace the connectors and/or wiring.

  STOP.

- Not OK - Terminal 30 – The voltage is incorrect on terminal 30.

  Repair: Verify that wire 200-BK on terminal 85 of the ECM relay is not damaged. Replace the ECM relay. Verify that the original condition is resolved.

  STOP.

Test Step 7. Check the Voltage at the Engine Control Switch.

A. Measure the voltage at the ECS when the switch is in the positions that are listed in Table 40.

Table 40

Engine Control Switch		
Switch Position	**Terminal**	**Voltage**
STOP	1, 3, 4, 5, 16, 19, 20	23 to 27 VDC
START	1, 3, 4, 5, 16, 19, 20	23 to 27 VDC
AUTO	1, 3, 4, 5, 16, 18, 19, 20	23 to 27 VDC(1).
OFF/RESET	3, 4, 5, 16, 18, 19, 20	0 VDC

(1) Check the remote START/STOP switch if applicable

Expected Result:

The measured voltage at the ECS should agree with the voltage that is listed in Table 40.

Results:

- OK – The correct voltage appears at the ECS.

  Repair: Verify that the emergency stop is working correctly. The problem could be in two places. Check the wiring between the ECS and the emergency stop switch. Check the wiring between the emergency stop switch and the emergency stop relay. Repair the connectors and/or wiring or replace the connectors and/or wiring.

  STOP.

- Not OK-Terminal 1 – The correct voltage does not appear on Terminal 1 of the ECS.

  Repair: Check the harness between the ECS and the battery. Verify that the circuit breakers for the battery and the control switch are not tripped. The problem is in the wiring and/or connectors. Repair the connectors and/or wiring or replace the connectors and/or wiring.

  STOP.

- Not OK- Other Terminals – The correct voltage appears on terminal 1 on the ECS. The voltage is incorrect at other terminals on the ECS.

  Repair: Replace the ECS. If the problem is no longer present, reinstall the old ECS. If the problem returns, replace the ECS.

  STOP.

Test Step 8. Check the Voltage at the Sensor Power Supplies.

A. Turn the ECS to the STOP position.

B. Measure the voltage from the analog sensor supply P1-36 to the analog sensor return P1-30.

C. Measure the voltage from digital sensor supply P1-35 to the digital sensor return P1-29.

Expected Result:

The voltage should be 5.0 ± 0.25 VDC between P1-36 and P1-30. The voltage should be 8.0 ± 0.25 VDC between P1-35 and P1-29.

Results:

- OK – The sensor power supplies are functioning properly. The ECM is powered up. The problem is not in the electrical system. There may be a mechanical problem. **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 sensors, replace the ECM.

Repair: Refer to Troubleshooting, "Replacing the ECM".

STOP.

i01349989

Emergency Stop Switch

SMCS Code: 1901-038

System Operation Description:

The customer's emergency stop switch sends two signals to the Electronic Control Module (ECM). The signals are used to determine if the emergency stop switch is active. The emergency stop switch is active when the switch is in the open state and the two signals are held high. The emergency stop switch is inactive when the switch is in the closed state and the two signals are held low.

If the ECM is powering up and one of the signals from the emergency stop switch is in a different state from the other signal, the ECM knows that one of the signals is faulty. If one of the signals from the emergency stop switch is in a different state from the other signal, the ECM will generate a diagnostic code that remains active until power to the ECM is cycled. The ECM will not allow the crank cycle to begin if the signals are opposite of each other. The ECM will allow the engine to be started manually in this state.

The ECM monitors the emergency stop signals at all times. If the engine is running and one of the signals from the emergency stop switch changes states, the engine will continue to run. The ECM initiates an emergency stop shutdown only when both signals are in the open state during engine operation.

When a signal from the emergency stop switch is received, the ECM will activate the air shutoff solenoid.

For safety, the ECM will not allow the starting sequence to begin when the emergency stop switch is activated. The engine will not be able to restart until the following conditions are met:

- The engine rpm must equal zero.
- The emergency stop inputs must go low.
- The ECM has been reset.

Note: If one of the signals from the emergency stop switch is in a different state from the other signal, the Electronic Technician screen will display the warning "INVALID DATA".

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. Check connectors and associated wiring for the following problems: damage, corrosion, abrasion, and incorrect attachment.

Expected Result:

The connectors and wiring should be free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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 the ON Status of the Emergency Stop Switch.

A. Turn the circuit breaker for the battery to the ON position.

B. Connect the ET.

C. Turn the ECS to the STOP position.

D. Activate the emergency stop switch.

E. Observe the status of the emergency stop switch on the ET.

Expected Result:

The parameter for the emergency stop switch should read "ON".

Results:

- **OK** – The emergency stop switch is working correctly. Proceed to test step 3.
- **Not OK** – The parameter for the emergency stop switch does not display "ON". Proceed to test step 4.

Test Step 3. Check the OFF Status of the Emergency Stop Switch.

A. Deactivate the emergency stop switch.

Expected Result:

The parameter for the emergency stop switch should read "OFF".

Results:

- OK – The emergency stop switch is functioning correctly. STOP.
- Not OK – The parameter for the emergency stop switch does not display "OFF". Proceed to test step 4.

Test Step 4. Test the ECM.

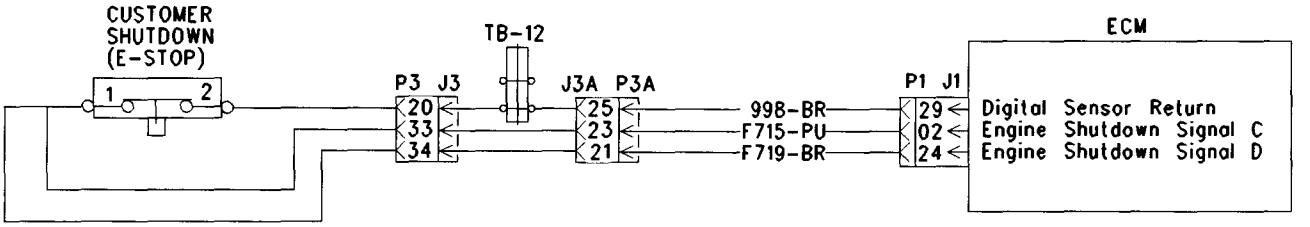

Illustration 20 g00728931

Schematic

A. Turn the ECS to the OFF/RESET position.

B. Disconnect connector P1 from the ECM. Remove wires P1-29, P1-02 and P1-24 from ECM connector P1.

C. Locate a suitable jumper wire.

D. Insert the jumper wire at P1. Connect P1-02 and P1-24 to P1-29.

E. Reconnect connector P1 to ECM connector J1.

F. Turn the ECS to the STOP position.

G. Observe the parameters for the emergency stop on the ET.

H. Turn the ECS to the OFF/RESET position. Remove the jumper wire and reinstall all wires.

Expected Result:

The parameter for the emergency stop switch should display "OFF" when the jumper is installed. The parameter for the emergency stop switch should display "ON" when the jumper is removed.

Results:

- OK – The problem is not with the ECM. Proceed to test step 5.
- Not OK – The parameter on the ECM is incorrect.

  Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

  STOP.

Test Step 5. Check the Switches and the Wiring.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect connector P1 from ECM connector J1.

C. Activate the emergency stop switch.

D. Measure the resistance between P1-29 and P1-02.

E. Measure the resistance between P1-29 and P1-24.

Expected Result:

The resistance should be greater than 20,000 Ohms.

Results:

- **OK** – The resistance is greater than 20,000 Ohms. Proceed to test step 6.
- **Not OK** – The resistance is less than 20,000 Ohms. There is a short circuit in the emergency stop switch.

  Repair: Repair the switch or wiring and/or replace the switch or wiring.

  STOP.

Test Step 6. Deactivate the Switch.

A. Deactivate the emergency shutdown switch.

B. Measure the resistance between P1-29 and P1-02.

C. Measure the resistance between P1-29 and P1-24.

Expected Result:

The resistance should read less than 10 Ohms.

Results:

- **OK** – The resistance is less than 10 Ohms. The emergency shutdown switch is okay. **STOP.**
- **Not OK** – The resistance is greater than 10 Ohms. There is an open circuit in the emergency shutdown switch.

  Repair: Repair the switch or wiring and/or replace the switch or wiring.

  STOP.

i01350054

Engine Control Switch (ECS)

SMCS Code: 1901-038

System Operation Description:

The Electronic Control Module (ECM) receives four input signals from the Engine Control Switch (ECS). The input signals allow the control to determine the mode of operation. The ECS can operate in four modes: OFF/RESET, MAN/START, COOLDOWN/STOP, and AUTO.

When the ECS is set to the OFF/RESET position, the START/RUN/STOP input and the AUTO input are open. The ECM is not powered. Engine operation will stop when the ECS is switched to this position.

When the ECS is set to the AUTO position, the START/RUN/STOP input is open and the AUTO input is low. The ECM is powered. If the remote START/STOP Switch is closed, the engine start sequence will begin.

When the ECS is set to the MAN/START position, the START/RUN/STOP input is low and the ECS in AUTO input is open. The ECM will begin the engine start sequence.

When the ECS is set to the COOLDOWN/STOP position, the START/RUN/STOP input and the ECS in AUTO input are open. After the engine cooldown, the ECM will shut down the engine.

If the signals from the START/RUN/STOP input are in opposite states, the ECM determines that one of the signals is faulty. The ECM ignores the signals until power is cycled to the ECM.

If this occurs, the engine must be cranked manually. Use the Manual Crank Switch which is located inside the Electronic Instrument Panel. When the engine is shut down, the ECS must be placed in the OFF/RESET position. This will disconnect power to the ECM. A CID-FMI will be active until the ECM is powered down. The parameter for the Ignition Switch will display "ABNORMAL DATA" until power to the ECM is cycled.

If the engine is running and the signals from the START/RUN/STOP input change to opposite states, the engine will continue to run. The ECM generates a diagnostic code that will remain active until power to the ECM is cycled. When the engine is shut down, the ECS must be placed in the OFF/RESET position. This will disconnect power to the ECM.

If you close the Remote START/STOP Switch, and the ECS is in the AUTO position, the engine will start. The parameter for the switch will display "ON" or "OFF". This parameter is available on the ET only when the ECS is in the AUTO position.

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

Expected Result:

The connectors and wiring should be free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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. If necessary, replace the ECS.

  STOP.

Test Step 2. Check the Status of the Switch.

A. Turn the circuit breaker for the battery to the ON position.

B. Turn the circuit breaker for the Mag Relay of the Starting Motor System to the OFF position.

C. Activate the emergency stop switch. This will prevent the engine from starting during the following tests.

D. Turn the ECS to the STOP position.

E. Connect an ET to the service tool connector.

F. Observe the parameter for the ignition switch on the ET.

Expected Result:

The parameter for the ignition switch should read "STOP".

Results:

- OK – The parameter does display "STOP". The ECS is functioning correctly. Proceed to test step 3.
- Not OK – The parameter does not display "STOP". Proceed to test step 4.

Test Step 3. Check the Status of the Switch.

A. Turn the ECS to the START position.

B. Observe the parameter for the ignition switch on the ET.

Expected Result:

The parameter for the ignition switch should read "RUN".

Results:

- OK – The parameter for the ignition switch does display "RUN". The ECS is working correctly. Proceed to test step 5.
- Not OK – The parameter for the ignition switch does not display "RUN". Proceed to test step 4.

Test Step 4. Install a Jumper Wire.

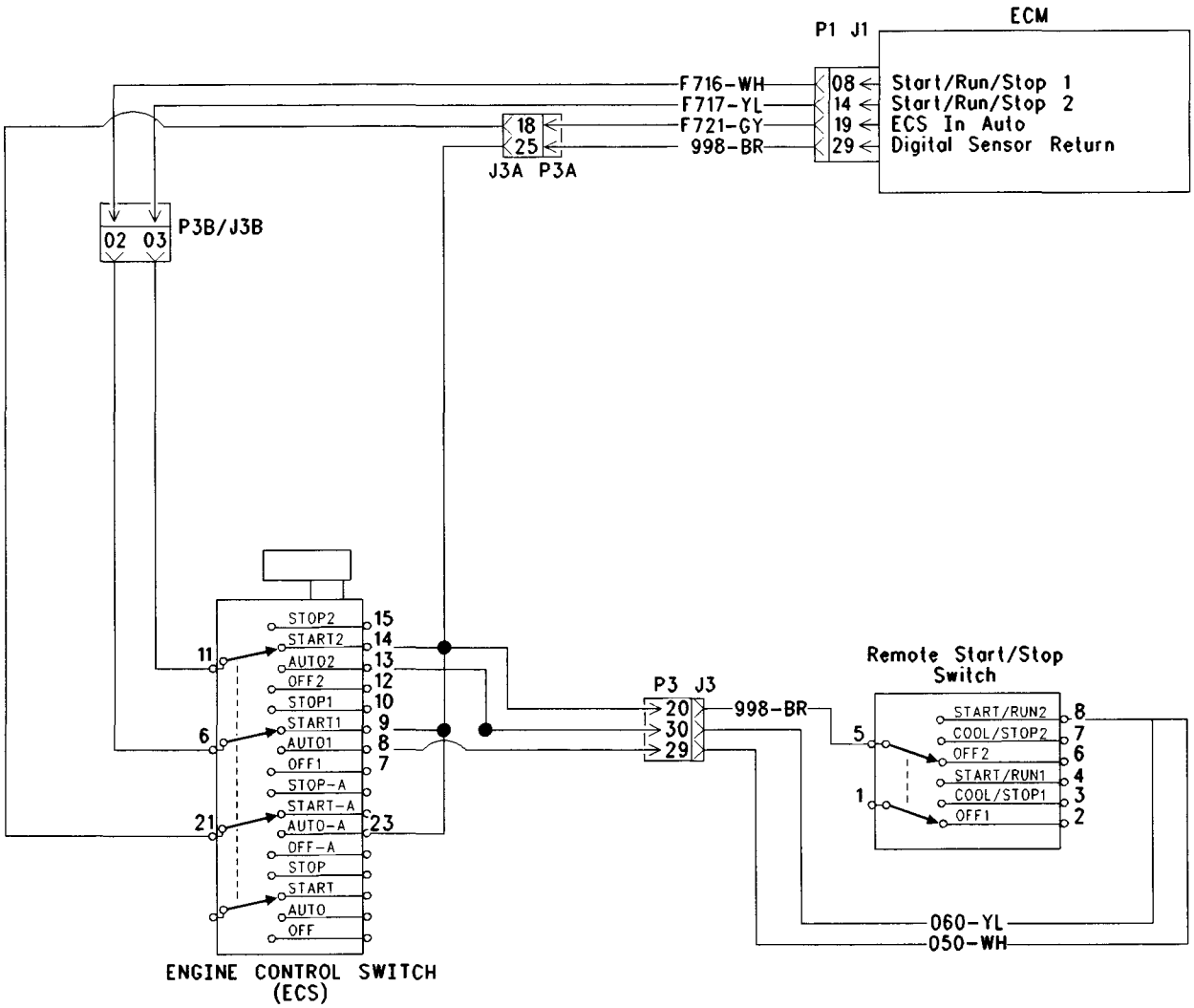

Illustration 21 g00724278

A. Turn the ECS to the OFF/RESET position.

B. Disconnect ECM connector P1. Remove P1-14, P1-8 and P1-29.

C. Fabricate a jumper wire.

D. Install the jumper wire at P1. Connect P1-14 and P1-8 to P1-29. Reconnect P1.

E. Turn the ECS to the STOP position.

F. Observe the parameter for the ignition switch on the ET.

G. Turn the ECS to the OFF/RESET position and remove the jumper wire.

Expected Result:

The parameter for the ignition switch should display "RUN" while the jumper wire is installed. The parameter for the ignition switch should display"STOP" when the jumper wire is removed.

Results:

- **OK** – The parameter for the ignition switch displays the proper states. The problem is not with the ECM. Proceed to test step 6.
- **Not OK** – The parameter for the ignition switch does not show the correct states.

Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

STOP.

Test Step 5. Check the Status of the Switch.

A. Turn the ECS to AUTO. Place the Remote START/STOP Switch in the START position.

B. Observe the parameters for the ignition switch on the ET. Observe the parameters for the remote start on the ET.

Expected Result:

The parameter for the ignition switch should read "AUTO". The parameter for the remote start should read "ON".

Results:

- **OK** – The parameter for the ignition switch does display "AUTO". The parameter for the remote start does read "ON". The ECS and the remote START/STOP switch are working correctly. **STOP.**
- **Remote Start Not OK** – The parameter for the remote start does not display "ON". There is a problem with the wiring between the remote START/STOP switch and the ECS. Proceed to test step 7.
- **Ignition Switch Not OK** – The parameter for the ignition switch does not display "AUTO". Proceed to test step 8.

Test Step 6. Check the Switch and the Wiring.

A. Turn the ECS to the OFF position.

B. Disconnect ECM connector J1/P1.

C. Measure the resistance between the digital return P1-29 and P1-8.

D. Measure the resistance between the digital return P1-29 and the P1-14.

E. Turn the ECS to the STOP position and repeat the above two measurements.

Expected Result:

The resistance should be greater than 20,000 Ohms.

Results:

- **OK** – The resistance is greater than 20,000 Ohms. The ECS is functioning properly. Proceed to test step 9.
- **Not OK** – The resistance is less than 20,000 Ohms. There is a short circuit in the ECS.

  Repair: Repair the connectors or wiring and/or replace the connectors or wiring. If necessary, replace the ECS.

  STOP.

Test Step 7. Check the Switch and the Wiring.

A. Turn the ECS to the AUTO position with the Remote START/STOP Switch in the STOP position.

B. Measure the resistance between P1-29 and P1-8.

C. Measure the resistance between P1-29 and P1-14.

Expected Result:

The resistance should be greater than 20,000 Ohms.

Results:

- **OK** – The resistance is greater than 20,000 Ohms. The ECS is functioning properly. Proceed to test step 10.
- **Not OK** – The resistance is less than 20,000 Ohms. There is a short circuit in the ECS.

  Repair: Repair the connectors or wiring and/or replace the connectors or wiring. If necessary, replace the ECS.

  STOP.

Test Step 8. Install a Jumper Wire.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect ECM connector P1.

C. Remove the wires from P1-19 and P1-29.

D. Fabricate a jumper wire.

E. Install the jumper wire at P1. Connect P1-19 to P1-29. Reconnect P1.

F. Turn the circuit breaker for the battery to the ON position.

G. Turn the ECS to the STOP position.

H. Observe the parameter for the ignition switch on the ET.

I. Turn the ECS to the OFF/RESET position.

J. Remove the jumper wire.

Expected Result:

The parameter for the ignition switch should read "AUTO" while the jumper wire is installed. The parameter for the ignition switch should read "STOP" when the jumper wire is removed.

Results:

- **OK** – The parameter for the ignition switch displays the proper state. The ECS is functioning properly. **STOP.**
- **Not OK** – The parameter for the ignition switch does not display the correct states.

  Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

  STOP.

Test Step 9. Check the Switch and the Wiring.

A. Turn the circuit breaker for the battery to the OFF position.

B. Turn the ECS to the START position.

C. Measure the resistance between P1-29 and P1-8.

D. Measure the resistance between P1-29 and P1-14.

Expected Result:

The resistance should read less than 10 Ohms.

Results:

- **OK** – The resistance is less than 10 Ohms. The ECS is functioning properly. Proceed to test step 7.
- **Not OK** – The resistance is greater than 10 Ohms. There is an open circuit in the ECS.

  Repair: Repair the connectors or wiring and/or replace the connectors or wiring. If necessary, replace the ECS.

  STOP.

Test Step 10. Check the Switch and the Wiring.

A. Turn the ECS to the AUTO position . Ensure that the Remote START/RUN/STOP Switch is in the START/RUN position.

B. Measure the resistance between P1-29 and P1-8.

C. Measure the resistance between P1-29 and P1-14.

Expected Result:

The resistance should read less than 10 Ohms.

Results:

- **OK** – The resistance is less than 10 Ohms. The ECS is functioning properly. Proceed to test step 8.
- **Not OK** – The resistance is greater than 10 Ohms. There is an open circuit in the ECS.

  Repair: Repair the connectors or wiring and/or replace the connectors or wiring. If necessary, replace the ECS.

  STOP.

i01350101

Engine Sensor Open/Short Test

SMCS Code: 1901-038

System Operation Description:

Engine sensors provide various signals to the engine ECM. These sensors receive a regulated voltage from the ECM. Analog sensors receive 5.0 ± 0.5 VDC and digital sensors receive 8.0 ± 0.5 VDC.

The ECM performs an automatic calibration of these sensors whenever the ECM is powered and the engine is off for at least five seconds. During an automatic calibration, the ECM calibrates pressure sensors against the Atmospheric Pressure Sensor and an acceptable offset pressure range.

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 position.

C. Check the connectors and wiring for the following problems: damage, corrosion, abrasion, and incorrect attachment.

Expected Result:

The connectors and wiring should be free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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 ET.

B. Turn the ECS to the ON position. The engine should be off.

C. 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 Supply short to +batt and/or 262-04 5 Volt Sensor Supply short to ground are present. Determine if the diagnostic codes 263-03 Digital Sensor Supply short to +batt and/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, 02 or 08** – A diagnostic code with a FMI of 00, 02 or 08 is present. Proceed to test step 10.
- **262-03 or 262-04 Active Code** – A diagnostic code of 263-03 or 263-04 is present.

  Repair: Perform a diagnostic functional test. Refer to 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 a diagnostic functional test. Refer to 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.

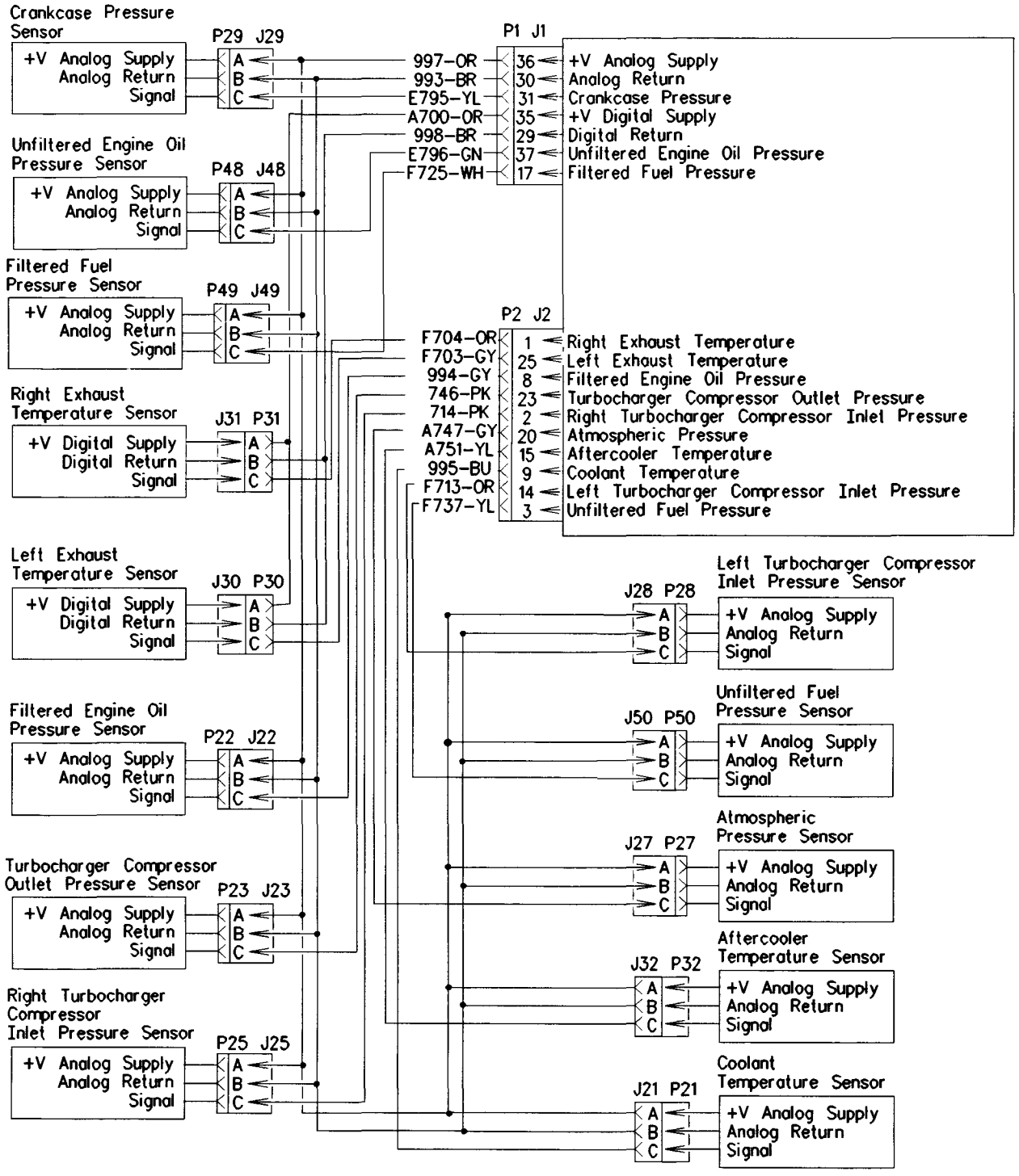

Illustration 22 g00722937

A. Turn the ECS to the OFF/RESET position.

B. Disconnect the suspect sensor.

C. Turn the ECS to the ON position. The engine should be off.

D. Measure the voltage between pin A and pin B for the suspect sensor.

Expected Result:

The supply voltage should be 5.0 ± 0.5 VDC for all analog sensors and 8.0 ± 0.5 VDC for all digital sensors.

Results:

- **OK** – The voltage is 5.0 ± 0.5 VDC for all analog sensors and 8.0 ± 0.5 VDC for all digital sensors. Proceed to test step 5.
- **Not OK** – The voltage is not 5.0 ± 0.5 VDC for all analog sensors and 8.0 ± 0.5 VDC for all digital sensors. Proceed to test step 6.

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.

C. Turn the ECS to the ON position. The engine should be off.

D. Measure the voltage between pin A and pin B for the suspect sensor.

Expected Result:

The supply voltage should be 5.0 ± 0.5 VDC for all analog sensors and 8.0 ± 0.5 for all digital sensors.

Results:

- **OK** – The voltage is 5.0 ± 0.5 VDC for all analog sensors and 8.0 ± 0.5 VDC for all digital sensors. Proceed to test step 7.
- **Not OK** – The voltage is not 5.0 ± 0.5 VDC for all analog sensors and 8.0 ± 0.5 VDC for all digital sensors. Proceed to test step 6.

Test Step 5. Install a Jumper Wire.

A. Turn the ECS to the OFF/RESET position.

B. Use a wire with socket terminals at each end. Connect pin B and pin C together on the ECM side of the sensor connector.

C. Turn the ECS to the ON 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 short.

Expected Result:

The CID-FMI should change 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 8.

Test Step 6. Check the Sensor Supply Voltage at the ECM.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect ECM connector P1.

C. Check the analog supply voltage by removing wires P1-36 (997-OR) and P1-30 (993-BR) from ECM connector P1.

Check the digital supply voltage by removing wires P1-35 (700-OR) and P1-29 (998-BR) from ECM connector P1.

Install jumper wires with socket terminals at each end into connector P1 after removing the wires.

D. Reconnect connector P1 to the ECM.

E. Turn the ECS to the ON position. The engine should be off.

F. Measure the analog voltage between P1-36 (997-OR) and P1-30 (993-BR).

G. Measure the digital voltage between P1-35 (700-OR) and P1-29 (998-BR).

H. Turn the ECS to the OFF/RESET position.

I. Remove the jumper wires and replace all wires.

Expected Result:

The supply voltage should be 5.0 ± 0.5 VDC for all analog sensors and 8.0 ± 0.5 for all digital sensors.

Results:

- **OK- Analog or Digital** – The supply voltage is 5.0 ± 0.5 VDC for all analog sensors and 8.0 ± 0.5 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 ± 0.5 VDC for all analog sensors and 8.0 ± 0.5 for all digital sensors. The voltage at the ECM is not correct.

  Repair: Perform a diagnostic functional test. Refer to Troubleshooting, "Electrical Power Supply".

  STOP.

Test Step 7. Create an Open Circuit at the Sensor Connector.

A. Turn the ECS to the OFF/RESET position.

B. Turn the ECS to the ON position. The engine should be off.

C. 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. Reset the system. Delete the logged diagnostic codes when you are finished.

D. Reconnect the suspect sensor.

Expected Result:

The CID-FMI should change 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 9.

Test Step 8. Install a Jumper Wire at the ECM Connector.

A. Connect the suspect sensor.

B. Disconnect ECM connector P1.

C. Remove the suspect sensor's signal wire from the ECM connector P1. Remove the suspect sensor's return wire from the ECM connector P1. Install a jumper wire with socket terminals at each end into connector P1 for both wires.

D. Reconnect connector P1 to the ECM.

E. Turn the ECS to the ON position. The engine should be off.

F. The CID-FMI should change from 03 to 04 when the jumper is in place.

G. Remove the jumper and reconnect all wires.

Expected Result:

The CID-FMI should change 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 Troubleshooting, "Replacing the ECM".

  STOP.

Test Step 9. Create an Open at the ECM.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect the suspect sensor signal wire from the ECM connector P1.

C. Turn the ECS to the ON position. The engine should be off.

D. 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. Reset the system. Delete the logged diagnostic codes when you are finished.

Expected Result:

The CID-FMI should change 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 Troubleshooting, "Replacing the ECM".

  STOP.

Test Step 10. Check the Fluid Level.

A. Check the fuel level.

B. Check the engine oil level.

C. Check for any leaks.

Expected Result:

The fuel and oil level should be okay. There should not be any leaks.

Results:

- **OK** – The fuel and oil levels are correct. Proceed to test step 11.

- **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 11. 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 ON position. The engine should be off.

D. Observe the temperature reading for the suspect sensor. The ET should display the same temperature as the **6V-9130** Temperature Adapter.

Note: When the temperature is below 0 °C (32 °F), the temperature can vary 15 °C (59 °F).

E. If you are troubleshooting a pressure sensor, disconnect the sensor.

F. Remove the suspect sensor from the engine.

G. Connect the suspect sensor to the sensor connector.

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 ON position. The engine should be off.

K. Observe the pressure reading for the suspect sensor. The 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 ET and the pressure test kit.

Expected Result:

The ET should show the correct temperature. The ET should show constant pressure. The ET should show a 5 ± 2 kPa (0.7 ± 0.3 psi) drop in pressure when the vacuum is applied.

Results:

- **OK** – The ET shows the correct temperature. The ET shows a constant pressure. The ET shows a 5 ± 2 kPa (0.7 ± 0.3 psi) drop in pressure while the vacuum is being applied. The sensor is working correctly. Reset the system and note any active diagnostic codes. **STOP.**

- **Not OK Analog** – The ET does not show a constant pressure. The ET does not show a 5 ± 2 kPa (0.7 ± 0.3 psi) drop in pressure while the vacuum is being applied. An analog sensor is not producing the correct reading. Proceed to test step 12.

- **Not OK Digital** – The ET does not show the correct temperature. A digital sensor is not producing the correct reading. Proceed to test step 13.

- **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 12. Check the Analog Sensor's Signal Voltage at the Connector.

A. Turn the ECS to the ON position. The engine should be off.

B. Measure the sensor signal voltage between pin C and pin B at the sensor connector.

Expected Result:

The signal voltage should be 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 16.

- **Not OK** – The signal voltage is not between 0.2 VDC and 4.8 VDC for analog sensors. Proceed to test step 14.

Test Step 13. Check the Digital Sensor's Signal Frequency and the Duty Cycle at the Connector.

A. Turn the ECS to the ON position. The engine should be off.

B. Measure the frequency and the duty cycle between pin C and pin B of the suspect digital sensor at the sensor connector P1.

C. Turn the ECS to the OFF/RESET position.

D. Replace pin C in the sensor connector.

Expected Result:

The frequency reading should be between 150 Hz and 1000 Hz.

When the temperature is below 49 °C (120 °F), the duty cycle should be between 10% to 21%.

When the temperature is between 49 °C (120 °F), and 851 °C (1564 °F) the duty cycle should be between 22% to 88%.

When the temperature is above 851 °C (1564 °F), the duty cycle should be between 80% to 90%.

Results:

- **OK** – The frequency and the duty cycle are correct. Proceed to test step 17.

- **Not OK** – The frequency and the duty cycle are not correct. Proceed to test step 14.

Test Step 14. Check for Shorts inthe Wiring Harness.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect the ECM connectors J1/P1 and J2/P2. Disconnect the suspect sensor.

C. Measure the resistance between the suspect sensor signal wire at the ECM connector and the supply voltage at the ECM connector.

D. Measure the resistance between the suspect sensor signal wire at the ECM connector and the sensor return line at the ECM connector.

E. Measure the resistance between the suspect sensor signal wire at the ECM connector and engine ground.

Expected Result:

The resistance should be greater than 20,000 Ohms.

Results:

- **OK** – The resistance is greater than 20,000 Ohms. Proceed to test step 15.

- **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 15. Check the Resistance through the Harness.

A. Disconnect the suspect sensor connector.

B. Use a suitable piece of wire to connect pin A to pin C.

C. Measure the resistance between suspect sensor signal wire and the suspect sensor voltage supply at the ECM connector P1.

D. Use a suitable piece of wire to connect pin B to pin C.

E. Measure the resistance between the sensor signal wire and the sensor return line at the ECM connector P1.

F. Turn the ECS to the OFF/RESET position.

G. Remove all wire shorts.

H. Reconnect all connectors.

Expected Result:

The resistance should be less than 10 Ohms.

Results:

- **OK Analog** – The resistance is less than 10 Ohms. Proceed to test step 16.

- **OK Digital** – The resistance is less than 10 Ohms. Proceed to test step 17.

- **Not OK** – The resistance is greater than 10 Ohms.

  Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

Test Step 16. Check the Analog Sensor's Signal Voltage at the ECM.

A. Turn the ECS to the ON position. The engine should be off.

B. Measure the sensor signal voltage between pin C and pin B at the ECM connector P1.

C. Observe the sensor reading on the status screen on the ET.

D. Turn the ECS to the OFF/RESET position.

Note: The status screen on the ET displays "ABNORMAL SIGNAL" when the ECM reads a signal that is out of range.

Expected Result:

The signal voltage for the analog sensors should be 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. Reset the system and note any diagnostic codes. **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: Perform a diagnostic functional test. Refer to Troubleshooting, "Analog Sensor Supply".

  STOP.

- **Intermittent Problem** – The readings are not consistent.

  Repair: Perform a diagnostic test. Refer to Troubleshooting, "Inspecting Electrical Connectors".

  STOP.

- **ABNORMAL SIGNAL** – The status screen on the ET displays "ABNORMAL SIGNAL". The signal is out of range.

  Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

  STOP.

Test Step 17. Check the Digital Sensor's Signal Frequency and the Duty Cycle at the ECM.

A. Turn the ECS to the ON position. The engine should be off.

B. Measure the frequency and the duty cycle between pin C and pin B of the suspect digital sensor at the ECM connector P1.

C. Start the engine.

D. Observe the sensor reading on the status screen on the ET.

Note: The status screen on the ET displays "ABNORMAL SIGNAL" when the ECM reads a signal that is out of range.

E. Turn the ECS to the OFF/RESET position.

Expected Result:

The frequency reading should be between 150 Hz and 1000 Hz.

When the temperature is below 49 °C (120 °F), the duty cycle should be between 10% to 21%.

When the temperature is between 49 °C (120 °F), and 851 °C (1564 °F) the duty cycle should be between 22% to 88%.

When the temperature is above 851 °C (1564 °F), the duty cycle should be between 80% to 90%.

While the engine is cold, the ET should read 30 °C (86 °F). As the engine warms up the exhaust temperature should increase.

Results:

- **OK** – The digital sensor voltage at the ECM is correct. Reset the system and note any diagnostic codes. **STOP.**
- **Not OK** – The digital sensor voltage at the ECM is not correct.

  Repair: Perform a diagnostic functional test. Refer to Troubleshooting, "Digital Sensor Supply".

  STOP.

- **Intermittent Problem** – The readings are not consistent.

  Repair: Perform a diagnostic test. Refer to Troubleshooting, "Inspecting Electrical Connectors".

  STOP.

- **ABNORMAL SIGNAL** – The status screen on the ET displays "ABNORMAL SIGNAL". The signal is out of range.

  Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

  STOP.

i01350331

Engine Speed/Timing Sensor

SMCS Code: 1912-038

System Operation Description:

The Electronic Control Module (ECM) provides the Engine Speed/Timing Sensor with 12.5 ± 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: The Engine Monitoring System can be programmed by dealers and/or customers. Dealers and/or customers can monitor customized warnings, derates, shutdown override setpoints, and delay times using the Electronic Technician (ET). Customized parameters may affect the behavior of the ECM. The behavior of the ECM may vary from the description that is given in this system operation section.

The Engine Speed/Timing Sensor generates a pulse signal to the Electronic Control Module (ECM) as each tooth passes the sensor. The ECM counts the pulses in order to determine the engine rpm. The ECM memorizes the pattern of the pulses. The ECM compares that pattern to a standard pattern in order to determine the crankshaft position. The ECM uses this information to determine the No. 1 cylinder. The ECM then triggers each unit injector to fire in the correct firing order and at the correct time. The actual timing and duration of each injection is determined by the ECM. The ECM uses engine rpm and engine load to determine the timing and duration of injection. The loss of the signal from the Engine Speed/Timing Sensor generates an alert on the ET status screen. The loss of the signal from the Engine Speed/Timing Sensor triggers the termination of the signals to the fuel injectors by the ECM.

Note: If the engine timing gear is installed backward, the diagnostic code 190-08 will be generated. If this code is active, the ECM will not fire the injectors. You may refer to Troubleshooting, "Engine Monitoring System" in order to determine if there are any parameters that are affecting engine operation.

Test Step 1. Check for Connector Damage.

A. Turn the ECS to the OFF/RESET position.

B. Check the connectors and wiring for the following problems: damage, corrosion, abrasion, and incorrect attachment.

Expected Result:

The connectors and wiring are free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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 and/or wiring or replace the connectors and/or wiring.

  STOP.

Test Step 2. Check for a CID-FMI.

A. Connect the ET.

B. Turn the ECS to the ON position. The engine should be off.

C. Access the logged diagnostic codes on the ET.

Expected Result:

The ET indicates an active CID-FMI 190-03.

Results:

- **OK** – The CID-FMI 190-03 is active. Proceed to test step 3.
- **Not OK** – The CID-FMI 190-03 is not active. Proceed to test step 4.

Test Step 3. Check for Shorts in the Harness.

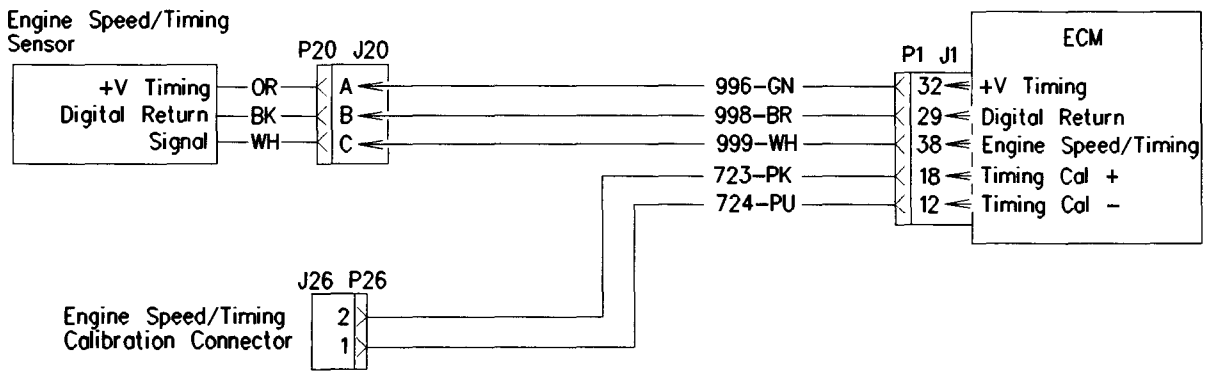

Illustration 23 g00594171

Schematic

A. Turn the ECS to the OFF/RESET position.

B. Disconnect connectors J1/P1 and J20/P20.

C. Measure the resistance between J20-A (996-GN) and J20-B (998-BR).

D. Measure the resistance between J20-A (996-GN) and J20-C (999-WH).

E. Measure the resistance between J20-B (998-BR) and J20-C (999-WH).

F. Measure the resistance from the following points to engine ground: J20-A, J20-B, and J20-C.

Expected Result:

Resistance should be more 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 or the connectors.

  Repair: Repair the connectors and/or wiring or replace the connectors and/or wiring.

  STOP.

Test Step 4. Check the Sensor.

NOTICE

Be sure to extend the sliphead before you install the Engine Speed/Timing Sensor. Also check that the engine timing gear is in a position that will not allow the sliphead of the Engine Speed/Timing Sensor to protrude into one of the slots of the engine timing gear. This is done visually with a flashlight prior to the installation of the Engine Speed/Timing Sensor. Turn the crankshaft to rotate the engine 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 J20/P20 and remove the Engine Speed/Timing 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.

F. Install the Engine Speed/Timing Sensor.

Expected Result:

The sliphead should take at least 22 N (5 lb) of force 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 and/or the sliphead has insufficient tension.

  Repair: Replace the Engine Speed/Timing Sensor. Calibrate the sensor. Refer to Troubleshooting, "Engine Speed/Timing Sensor - Calibrate".

  STOP.

Test Step 5. Check the Resistance through the Harness.

A. Use a suitable piece of wire to short J20-A (996-GN) to J20-B (998-BR).

B. Measure the resistance from P1-32 (996-GN) and P1-29 (998-BR).

C. Use a suitable piece of wire to short J20-A (996-GN) to J20-C (999-WH).

D. Measure the resistance between P1-32 (996-GN) and P1-38 (999-WH).

E. Remove all shorts and reconnect J1/P1 and J20/P20.

Expected Result:

The resistance should be less than 10 Ohms through the wires.

Results:

- OK – The resistance is less than 10 Ohms. Proceed to test step 7.
- Not OK – The resistance is greater than 10 Ohms. There is an open circuit or excessive resistance in the harness or connectors.

Repair: Repair the connectors and/or wiring or replace the connectors and/or wiring.

STOP.

Test Step 6. Check the Engine RPM on the ET.

A. Connect the ET to the service tool connector.

B. Turn the ECS to the ON position. Start the engine, when possible.

C. Crank the engine. Observe the display on the ET.

Expected Result:

The ET should display a steady engine speed between 100 and 250 RPM while the engine is cranking.

Results:

- **OK** – The ET displays a steady engine speed between 100 and 250 RPM while the engine is cranking. The Engine Speed/Timing Sensor is operating normally at this time. **STOP.**
- **Not OK** – The ET does not display a steady engine speed between 100 and 250 RPM while the engine is cranking. The Engine Speed/Timing Sensor is not operating normally at this time. Proceed to test step 8.
- **The Engine Will Not Start.** – The engine will not start, but engine speed appears on the ET.

  Repair: Repair the connectors and/or wiring or replace the connectors and/or wiring.

  STOP.

Test Step 7. Check the Engine RPM on the ET.

A. Turn the ECS to the ON position. The engine should be off.

B. Crank the engine. Observe the display on the ET.

Expected Result:

The ET should display a steady engine speed between 100 and 250 RPM while the engine is cranking.

Results:

- **OK** – The ET displays a steady engine speed between 100 and 250 RPM while the engine is cranking. The Engine Speed/Timing Sensor is operating normally at this time. **STOP.**
- **Not OK** – The ET does not display a steady engine speed between 100 and 250 RPM while the engine is cranking. The engine speed on the ET is incorrect. Proceed to test step 9.

Test Step 8. Check the Voltage at the Sensor.

A. Turn the ECS to the ON position. The engine should be off.

B. Measure the voltage between P20-A and P20-B.

Expected Result:

The supply voltage should be 12.5 ± 1.0 VDC.

Results:

- **OK** – The supply voltage is 12.5 ± 1.0 VDC. The sensor is receiving correct supply voltage. Proceed to test step 10.
- **Not OK** – The supply voltage is not 12.5 ± 1.0 VDC. The supply voltage is incorrect. Proceed to test step 11.

Test Step 9. Check the Signal Voltage at the ECM.

A. Turn the ECS to the ON position. The engine should be off.

B. Measure the voltage between P1-38 (999-WH) and P1-29 (998-BR).

C. Crank the engine and measure the voltage between P1-38 (999-WH) and P1-29 (998-BR).

D. Turn the ECS to the OFF/RESET position.

Expected Result:

The voltage should measure less than 3 VDC or more than 9 VDC when the ECS is in the ON position and the engine is not cranking. While the engine is cranking, the voltage should be between 2.0 VDC and 7.0 VDC.

Note: The voltage signal is generated by the presence or the absence of a tooth on the timing gear.

Results:

- **OK** – A correct voltage appears at ECM connector P1 but the ECM is not reading the signal.

  Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

  STOP.

- Not OK – There is an intermittent problem in the Speed/Timing circuit.

  Repair: Repair the connectors and/or wiring or replace the connectors and/or wiring.

  STOP.

Test Step 10. Check the Voltage at the Sensor.

A. Reconnect all connectors.

B. Remove the wire P20-C from the sensor connector.

C. Reconnect J20/P20.

D. Measure the voltage between P20-C and P20-B. Crank the engine and measure the voltage between P20-C and P20-B.

E. Turn the ECS to the OFF/RESET position.

F. Reinsert the sensor signal wire back into P20-C.

Expected Result:

The voltage should measure less than 3 VDC or more than 9 VDC when the ECS is in the ON position and the engine is not cranking. While the engine is cranking, the voltage should be between 2.0 VDC and 7.0 VDC.

Note: The voltage output is determined by the presence or the absence of a tooth on the timing gear.

Results:

- OK – The Engine Speed/Timing Sensor is producing the correct output signal. Proceed to test step 3.

- Not OK – The Engine Speed/Timing Sensor is not producing the correct output signal.

  Repair: Replace the Engine Speed/Timing Sensor. Calibrate the sensor. Refer to Troubleshooting, "Engine Speed/Timing Sensor - Calibrate".

  STOP.

Test Step 11. Check the Supply Voltage at the Harness Side of the Sensor Connector.

A. Measure the supply voltage between J20-A (996-GN) and J20-B (998-BR).

Expected Result:

The supply voltage should be 12.5 ± 1.0 VDC.

Results:

- OK – The supply voltage is 12.5 ± 1.0 VDC. The supply voltage is okay. There is an open circuit or excessive resistance in J20/P20.

  Repair: Repair the connectors and/or wiring or replace the connectors and/or wiring.

  STOP.

- Not OK – The supply voltage is not 12.5 ± 1.0 VDC. The supply voltage is incorrect. Proceed to test step 12.

Test Step 12. Check the Supply Voltage at the ECM.

A. Measure the supply voltage between P1-32 (996-GN) and P1-29 (998-BR).

B. Turn the ECS to the OFF/RESET position.

Expected Result:

The supply voltage should be 12.5 ± 1.0 VDC.

Results:

- OK – The supply voltage is 12.5 ± 1.0 VDC. There is an open circuit or excessive resistance.

  Repair: Repair the connectors and/or wiring or replace the connectors and/or wiring.

  STOP.

- Not OK – The supply voltage is not 12.5 ± 1.0 VDC. The supply voltage is incorrect.

  Repair: Perform a diagnostic test. Refer to Troubleshooting, "Electrical Power Supply".

  STOP.

i01350446

Ether Injection System

SMCS Code: 1456-038

System Operation Description:

When the engine is in AUTO mode, the engine uses an Ether System to improve starting in cold temperatures. The duration of the ether cycle is based on the engine coolant temperature. The Electronic Control Module (ECM), which controls the ether system, uses the engine coolant temperature sensor to detect engine temperature. The ECM determines if ether should be injected by monitoring actual engine rpm and the engine temperature. The ECM will activate the ether solenoid if the engine coolant temperature is below a set temperature and the engine rpm is below a certain level. The ether will activate for a minimum of 15 seconds at 30 °C (86 °F) up to a maximum of 130 seconds at –50 °C (–58 °F). The automatic ether injection system is disabled whenever engine rpm exceeds 400 rpm or the engine coolant temperature exceeds 30 °C (86 °F).

The ether injection system can also be operated in manual mode. The ether system is switched into manual mode whenever the starting aid switch is depressed. Manual mode also allows ether to be injected whenever the coolant temperature is less than 30 °C (86 °F) and engine rpm is greater than 50 rpm. Ether is injected in manual mode if the starting aid switch is depressed and the coolant temperature is below the maximum limit. The manual mode will allow ether to be injected for a maximum of 130 seconds when the switch is toggled.

Two driver outputs are used from the ECM. One output provides +Battery to one terminal of the ether start relay. The other terminal is connected to the digital return. The other output connects one terminal of the ether hold relay to –Battery and the other terminal to +Battery. The drivers and the relays are used to provide a higher voltage signal that will actuate the ether solenoids. A lower voltage signal is then used to hold the ether solenoid valves open. The solenoids will be damaged if battery voltage is applied continuously.

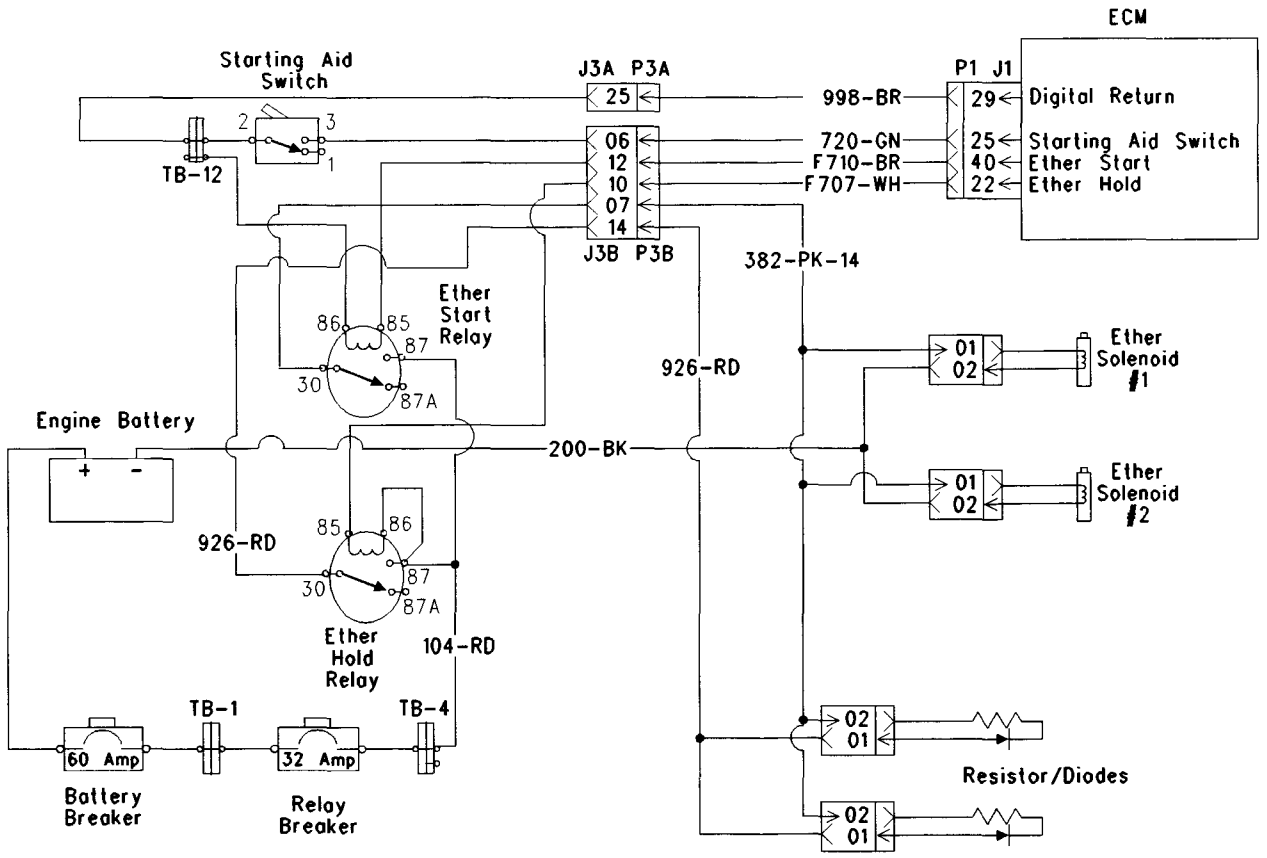

Illustration 24 g00729099

Schematic

Test Step 1. Check for Connector Damage.

A. Check the circuit breakers.

B. Turn the circuit breaker for the battery to the OFF position.

C. Turn the ECS to the OFF/RESET position.

D. Check connectors and wiring for the following problems: damage, corrosion, abrasion, and incorrect attachment.

Expected Result:

The connectors and wiring should be free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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 Diagnostics on the ET.

A. Remove the ether canister(s) from the ether solenoid(s).

B. Turn the circuit breaker for the battery to the ON position.

C. Turn the ECS to the STOP position.

D. Connect the ET.

E. Determine if CID-FMI 545-05, 545-06, 546-05 or 546-06 is active or logged.

F. Toggle the starting aid switch. Observe the parameter for the ether switch on the ET.

Expected Result:

The parameter for the ether switch should display "ON" while the starting aid switch is toggled. The parameter for the ether switch should display "OFF" when the switch is released.

Results:

- **OK** – No active codes or logged codes are present. The ether injection system does not inject ether. Proceed to test step 3.
- **Active Code** – Active Diagnostics are displayed. Proceed to test step 4.
- **Logged Code** – Logged Diagnostics are displayed. Check for an intermittent short or for an open in the wiring or in the connectors

  Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

- **Not OK** – The starting aid switch is not functioning correctly. Proceed to test step 15.

Test Step 3. Check the Ether Canisters.

A. Turn the circuit breaker for the battery to the OFF position.

B. Turn the ECS to the OFF/RESET position.

C. Remove the ether canister(s) from the ether solenoid(s). Determine if the canister contains any ether. Ether can not be injected if the canister is empty.

Expected Result:

The ether canister should not be empty.

Results:

- **OK** – The ether canister is not empty. Proceed to test step 4.
- **Not OK** – The ether canister is empty.

  Repair: Replace the empty ether canister with a full ether canister.

  STOP.

Test Step 4. Check the Voltage from the Ether Start Relay.

A. Turn the circuit breaker for the battery to the OFF position.

B. Turn the ECS to the OFF/RESET position.

C. Remove the ether canister(s) from the ether solenoid(s).

D. Connect the ET.

E. Turn the circuit breaker to the battery to the ON position.

F. Connect a voltmeter between wire 382-PK on terminal 30 of the ether start relay and ground.

G. Turn the ECS to the STOP position.

H. Select the "Diagnostic Tests" on the ET.

I. Select the "Override Parameters" screen on the ET.

J. Activate the ether override and observe the voltmeter while ether injection is "ON". Disable the ether override. Do not allow the ether to be "ON" for more than two minutes. Damage to the solenoid may occur.

Expected Result:

The voltage at the ether start relay should be 24 ± 3 VDC during the first two seconds of injection. The voltage then decreases to 3 ± 1 VDC for the remainder of the injection duration.

Results:

- **OK** – The voltage at the ether start relay is 24 ± 3 VDC during the first two seconds of injection. The voltage then decreases to approximately 3 ± 1 VDC for the remainder of injection duration. Proceed to test step 5.
- **Not OK - 24 VDC** – The voltage at the ether start relay is not 24 ± 3 VDC during the first two seconds of injection. Proceed to test step 6.
- **Not OK - 3 VDC** – The voltage did not decrease to approximately 3 ± 1 VDC for the remainder of the injection duration. Proceed to test step 9.

Test Step 5. Check the Voltage at the Ether Solenoids.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect the ether solenoid connector at the solenoid.

C. Connect a voltmeter to pin 1 and pin 2 of the ether solenoid connector.

D. Turn the ECS to the STOP position.

E. Activate the ether override and observe the voltmeter while ether injection is on. Disable the ether override. This procedure must be performed on both solenoids if two solenoids are present. Do not allow the ether to be on for more than two minutes. Damage to the solenoid may occur.

F. Reconnect all connectors.

Expected Result:

The voltage at the ether solenoid should be 24 ± 3 VDC during the first two seconds of injection. The voltage then decreases to 3 ± 1 VDC for the remainder of the injection duration.

Results:

- **Ok** – The voltage at the ether solenoid is 24 ± 3 VDC during the first two seconds of injection. The voltage then decreases to approximately 3 ± 1 VDC for the remainder of injection duration.

  Repair: If ether is not being injected, temporarily replace the ether solenoid. If the problem is no longer present, reinstall the old solenoid. If the problem returns, replace the solenoid.

  STOP.

- **Not Ok - 24 VDC** – The voltage at the ether solenoid is not 24 ± 3 VDC during the first two seconds of injection.

  Repair: Inspect the wiring and connectors between the ether start relay and the connectors at the ether solenoids. Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

- **Not Ok - 3 VDC** – The voltage did not decrease to 3 ± 1 VDC for the remainder of the injection duration. Proceed to test step 9.

Test Step 6. Check ECM Voltage at the Ether Start Relay.

A. Turn the ECS to the OFF/RESET position.

B. Connect a voltmeter between wire F710-BR on terminal 85 of the ether start relay to ground.

C. Turn the ECS to the STOP position.

D. Activate the ether override and observe the voltmeter while ether injection is on. Disable the ether override. Do not allow the ether to be on for more than two minutes. Damage to the solenoid may occur.

Expected Result:

The voltage should measure 24 ± 3 VDC for two seconds.

Results:

- **OK** – The voltage was 24 ± 3 VDC. Proceed to test step 7.
- **Not OK** – The voltage was not 24 ± 3 VDC. Proceed to test step 8.

Test Step 7. Check the Battery Voltage to the Ether Start Relay.

A. Measure the voltage between wire 104-RD on terminal 87 of the ether start relay and ground.

Expected Result:

The voltage should be 24 ± 3 VDC.

Results:

- **OK** – The voltage is 24 ± 3 VDC.

  Repair: Disconnect wire 998-BR on terminal 86 of the ether start relay. Check this wire for continuity to ground. If the wire is okay replace the ether start relay. If the wire is not okay repair the wire. Verify that the system is operating correctly.

  STOP.

- **Not OK** – The voltage is not 24 ± 3 VDC.

  Repair: Verify that the breakers for the battery and/or the relay are not tripped. Disconnect wire 104-RD on terminal 87 of the ether start relay. Check wire 104-RD for continuity to +Battery. If the wire is not okay repair the wire. Verify that the system is operating correctly.

  STOP.

Test Step 8. Check the Voltage from the ECM to the Ether Start Relay.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect connector P1 from the ECM.

C. Remove wire F710-BR from connector P1-40. Install a jumper wire that has a socket on one end into P1-40. Reconnect connector P1 to the ECM.

D. Connect a voltmeter between the jumper wire in P1-40 and ground.

E. Turn the ECS to the STOP position.

F. Activate the ether override and observe the voltmeter while ether injection is on. Disable the ether override. Do not allow the ether to be on for more than two minutes. Damage to the solenoid may occur.

G. Remove all wire jumpers and reconnect all connectors.

Expected Result:

The voltage at the ECM should be 24 ± 3 VDC for two seconds.

Results:

- **OK** – The voltage at the ECM is 24 ± 3 VDC for two seconds.

  Repair: The wire F710-BR and/or the connectors between the ECM and the ether start relay need repair. Inspect the wiring and connectors between the ether start relay and the connector at the ECM. Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

- **Not OK** – The voltage at the ECM is not 24 ± 3 VDC for two seconds.

  Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

  STOP.

Test Step 9. Check the Voltage from the Ether Hold Relay.

A. Turn the ECS to the OFF/RESET position.

B. Connect a voltmeter between wire 926-RD on terminal 30 of the ether hold relay and ground.

C. Turn the ECS to the STOP position.

D. Activate the ether override and observe the voltmeter while ether injection is on. Disable the ether override. Do not allow the ether to be on for more than two minutes. Damage to the solenoid may occur.

Expected Result:

The voltage at terminal 30 should be 24 ± 3 VDC during injection.

Results:

- **OK** – The voltage at terminal 30 is 24 ± 3 VDC during injection. Proceed to test step 10.

- **Not OK** – The voltage at terminal 30 is not 24 ± 3 VDC during injection. Proceed to test step 12.

Test Step 10. Check the Voltage at the Resistor and the Diode Assembly.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect the 2 Pin connector at the resistor and the diode assembly.

C. Connect a voltmeter to pin 1 of the resistor and the diode assembly and ground.

D. Turn the ECS to the STOP position.

E. Activate the ether override and observe the voltmeter while ether injection is on. Disable the ether override. This procedure must be performed on all of the resistor and diode assemblies, if more than one resistor and diode assembly is present. Do not allow the ether to be on for more than two minutes. Damage to the solenoid may occur.

Expected Result:

The voltage should be 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.

  Repair: There is a problem in the harness between the ether hold relay and the resistor and diode assembly. Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

Test Step 11. Check the Resistor and Diode Assembly.

A. Disconnect the 2 Pin connector at the resistor and the diode assembly.

B. Set the multimeter to the "Check Diode" setting.

C. Connect the positive lead of the multimeter to pin 2 and the negative lead to pin 1 of the resistor and the diode assembly and observe the multimeter.

D. Connect the positive lead of the multimeter to pin 1 and the negative lead to pin 2 of the resistor and the diode assembly and observe the multimeter.

E. Repeat the measurements for all of the resistor and the diode assemblies if more than one resistor and diode assembly is present.

Expected Result:

When the positive lead of the multimeter is connected to pin 2 and the negative lead to pin 1, the multimeter should display an overload "(OL)".

When the positive lead of the multimeter is connected to pin 1 and the negative lead to pin 2, the multimeter should display a number less than one.

Results:

- **OK** – The resistor and the diode assembly is operating correctly.

  Repair: There is a problem in the harness between the resistor and diode assembly and the ether solenoids. Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

- **Not OK** – The resistor and the diode assembly is not operating correctly.

  Repair: The resistor and the diode assembly is causing the problem. Temporarily replace the resistor and the diode assembly. If the problem is no longer present, reinstall the resistor and the diode assembly. If the problem returns replace the resistor and the diode assembly.

  STOP.

Test Step 12. Check the Battery Voltage to the Ether Hold Relay.

A. Measure the voltage between wire 104-RD on terminal 87 and terminal 86 of the ether hold relay and ground.

Expected Result:

The voltage should be 24 ± 3 VDC.

Results:

- **OK** – The voltage is 24 ± 3 VDC. Proceed to test step 13.

- **Not OK** – The voltage is not 24 ± 3 VDC.

  Repair: Verify that the breakers for the battery and/or the relay are not tripped. Disconnect wire 104-RD on terminal 87 of the ether hold relay. Check wire 104-RD for continuity to +Battery. If the wire is not okay repair the wire. Verify that the system is operating correctly.

  STOP.

Test Step 13. Check the Coil of the Ether Hold Relay.

A. Turn the ECS to the OFF/RESET position.

B. Remove wire F707-WH from terminal 85 of the ether hold relay. Connect a voltage test lamp between terminal 85 of the ether hold relay and –Battery terminal.

C. Turn the ECS to the STOP position.

D. Monitor the voltage test lamp for illumination.

E. Remove the test lamp and reconnect all wires.

Expected Result:

The voltage test lamp should illuminate.

Results:

- **OK** – The voltage test lamp illuminates. Proceed to test step 14.

- **Not OK** – The voltage test lamp does not illuminate. The problem is the ether hold relay.

  Repair: Temporarily replace the ether hold relay. If the problem is no longer present, reinstall the ether hold relay. If the problem returns replace the ether hold relay.

  STOP.

Test Step 14. Check the Signal of the Ether Hold Relay to the ECM.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect ECM connector P1.

C. Remove wire F707-WH from P1-22. Install a jumper wire that has a socket on one end into P1-22.

D. Reconnect ECM connector P1.

E. Connect one end of a voltage test lamp to the jumper wire and the other end to +Battery.

F. Turn the ECS to the STOP position.

G. Activate the ether override and observe the test lamp while ether injection is on. Disable the ether override. Do not allow the ether to be on for more than two minutes. Damage to the solenoid may occur.

H. Remove all jumpers and connect all connectors.

Expected Result:

The voltage test lamp should illuminate.

Results:

- **OK** – The voltage test lamp illuminates.

  Repair: There is a problem in the wiring between the ECM and the ether hold relay. Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

- **Not OK** – The voltage test lamp does not illuminate.

  Repair: Verify that the test lamp is operating correctly. Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

  STOP.

Test Step 15. Check the Wires of the Starting Aid Switch at the Harness.

A. Turn the circuit breaker to the battery to the OFF position.

B. Turn the ECS to the OFF/RESET position.

C. Disconnect J1/P1 and the starting aid switch.

D. Obtain a suitable piece of wire. Connect the wires at the starting aid switch together.

E. Measure the resistance between the ether switch P1-25 and the digital return P1-29.

Expected Result:

The resistance should be less than 10 Ohms.

Results:

- **OK** – The resistance is less than 10 Ohms. The switch wiring is not the problem. Proceed to test step 16.

- **Not OK** – The resistance is greater than 10 Ohms. There is a problem with the switch wiring in the harness.

  Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

Test Step 16. Check the Starting Aid Switch.

A. Turn the circuit breaker for the battery to the OFF position.

B. Turn the ECS to the OFF/RESET position.

C. Disconnect the starting aid switch.

D. Toggle the starting aid switch.

E. Measure the resistance between pin 1 and pin 2 of the starting aid switch.

F. Release the starting aid switch and repeat the previous measurement.

Expected Result:

The resistance should be less than 10 Ohms with the switch toggled. The resistance should be greater than 20,000 Ohms when the switch is released.

Results:

- **OK** – The resistance is less than 10 Ohms with the switch toggled. The resistance is greater than 20,000 Ohms when the switch is released.

  Repair: The switch is operating correctly but the ECM is not reading the switch correctly. Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

  STOP.

- **Not OK** – The resistance is greater than 10 Ohms when the switch is toggled. The resistance is less than 20,000 Ohms when the switch is released.

  Repair: There is a problem with the starting aid switch. Temporarily replace the starting aid switch with a new switch. If the problem is no longer present, reinstall the old switch. If the problem returns, replace the switch.

  STOP.

i01350583

Injector Solenoids

SMCS Code: 1290-038-JV

System Operation Description:

The engine uses Electronic Unit 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. If a diagnostic is detected in the solenoid circuit, the ECM will disable that solenoid circuit. The ECM keeps the solenoid circuit disabled for 10 revolutions of the crankshaft. The ECM then tries to fire the injector. If the diagnostic is still present, the ECM will disable the circuit for another 10 revolutions of the crankshaft. This sequence of events will be repeated indefinitely until the problem is corrected.

The 105 volt pulse can be individually cut out to aid in troubleshooting misfire problems by using the Electronic Technician (ET). The solenoid is mounted on top of the fuel injector body.

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

Expected Result:

The connectors and wiring should be free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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 LOGGED Diagnostic Codes.

A. Connect the 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 the ET.

Expected Result:

A CID-FMI 1-05 to 16-05 or 1-06 to 16-06 should not be logged.

Results:

- **OK** – A CID-FMI 1-05 to 16-05 or 1-06 to 16-06 is not logged. Proceed to test step 3.
- **Not OK** – A CID-FMI 1-05 to 16-05 or 1-06 to 16-06 is logged. Proceed to test step 5.

Test Step 3. 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 J4/P4 through J19/P19 are properly connected.

D. Turn the circuit breaker for the battery to the ON position.

E. Install the ET.

F. Start the engine.

G. Apply a load to the engine.

H. Perform the following steps on all suspect cylinders (solenoids).

I. Use the diagnostic tests on the ET to initiate the Cylinder Cutout Test.

J. 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.

K. Disable the override.

Expected Result:

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.

Results:

- **OK** – There was a noticeable change in engine performance during the Cylinder Cutout Test. **STOP.**
- **Not OK** – There was no noticeable change in engine performance during the Cylinder Cutout Test. Proceed to test step 4.

Test Step 4. Check the Injector Lash and the Engine Valve Lash Setting.

A. Turn the circuit breaker for the battery to the OFF position.

B. Turn the ECS to the OFF/RESET position.

C. Check the injector and the engine valve lash setting. Refer to the Systems Operation, "Testing and Adjusting".

Expected Result:

The engine valve lash setting is correct. The injectors are okay.

Results:

- **OK** – The injector is okay. **STOP.**
- **Not OK** – The injector is not okay. A problem is found with the injector.

  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.

Test Step 5. Check the Resistance of the Harness from the Solenoid to the ECM Connector.

⚠ WARNING

This engine uses high voltage to control the fuel injectors.

Disconnect electronic fuel injector 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 ECM connector J2/P2 and injector connectors J4/P4 through J19/P19.

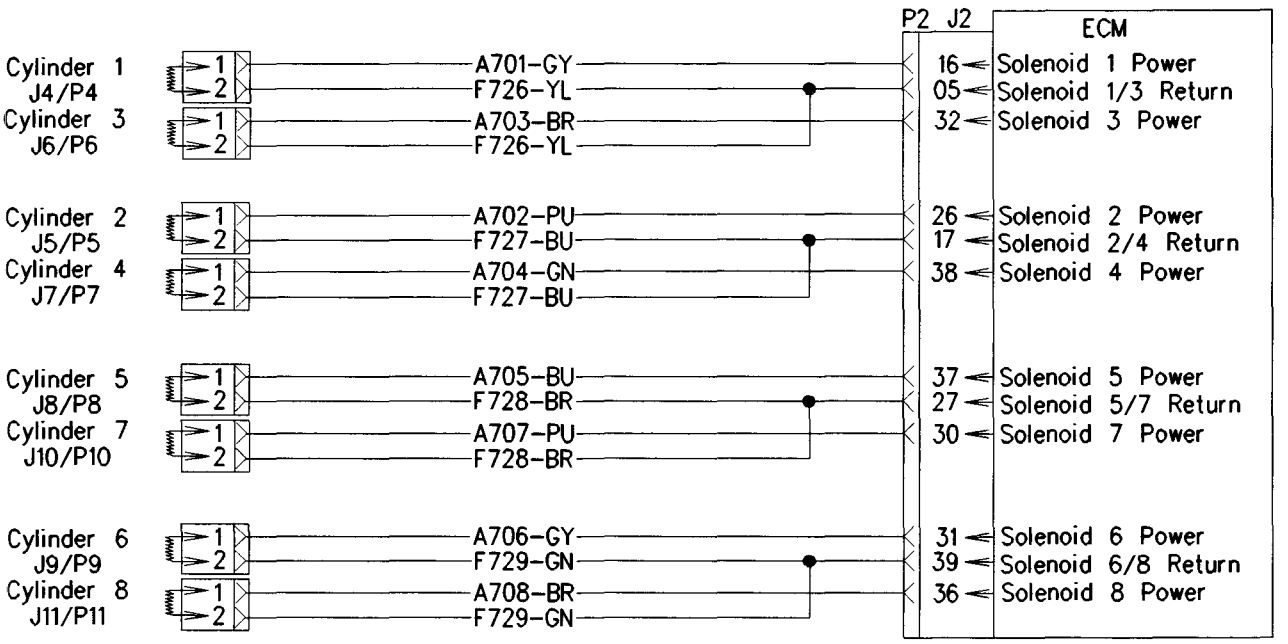

Illustration 25 g00599630

8 Cylinder Engine

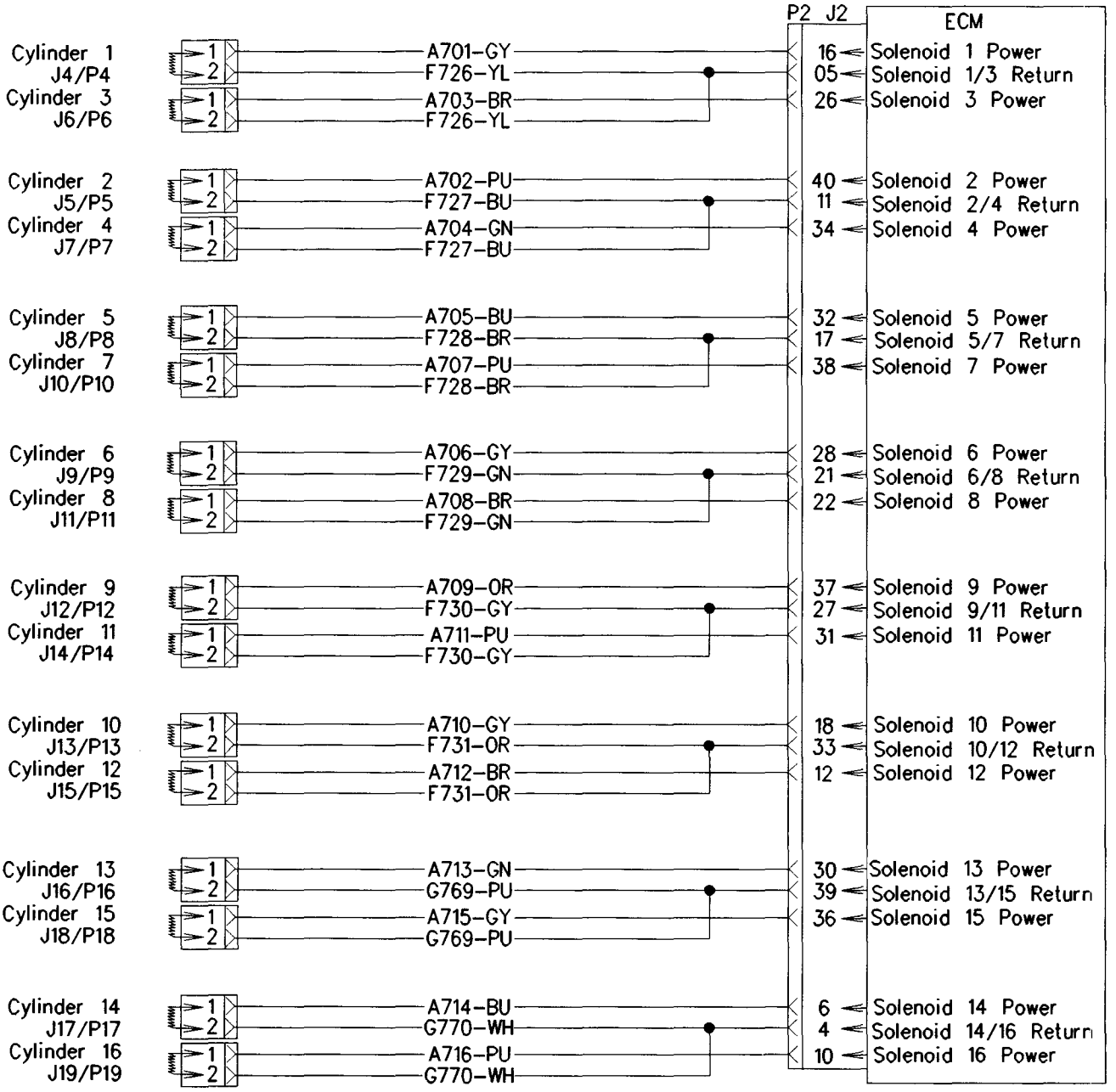

Illustration 26 g00599635

12 or 16 Cylinder Engine

D. Measure the resistance at the J2 connector between the power output for the individual solenoid and the solenoid return. For the eight cylinder engine, refer to Illustration 25. For the twelve or the sixteen cylinder engine, refer to Illustration 26.

Expected Result:

The resistance should be greater than 20,000 Ohms.

Results:

- **OK** – The resistance is greater than 20,000 Ohms. Proceed to test step 6.
- **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 6. Check for Shorts in the Harness to Engine Ground.

⚠ WARNING

This engine uses high voltage to control the fuel injectors.

Disconnect electronic fuel injector enable circuit connector to prevent personal injury.

Do not come in contact with the fuel injector terminals while the engine is running.

A. For the 3508B, measure the resistance between the following points and engine ground: J2-5, J2-16, J2-17, J2-26, J2-27, J2-30, J2-31, J2-32, J2-36, J2-37, J2-38, and J2-39.

B. For either the 3512B engine or the 3516B engine, measure the resistance between the following points and engine ground: J2-4, J2-5, J2-6, J2-10, J2-11, J2-12, J2-16, J2-17, J2-18, J2-21, J2-22, J2-26, J2-27, J2-28, J2-30, J2-31, J2-32, J2-33, J2-34, J2-36, J2-37, J2-38, J2-39, and J2-40.

Expected Result:

The resistance should be greater than 20,000 Ohms.

Results:

- OK – The resistance is greater than 20,000 Ohms. Proceed to test step 7.
- 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 7. Check for Open Circuits in the Harness.

A. Use a suitable piece of wire to short socket 1 to socket 2 at each injector connector.

B. Measure the resistance at the J2 connector between the power output for the individual solenoid and the solenoid return. For the eight cylinder engine, refer to Illustration 25. For the twelve or the sixteen cylinder engine, refer to Illustration 26.

Expected Result:

The resistance should be less than 10 Ohms.

Results:

- OK – The resistance is less than 10 Ohms. Proceed to test step 8.
- Not OK – The resistance is greater than 10 Ohms.

  Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

Test Step 8. Measure the Resistance at the Valve Cover Base.

⚠ WARNING

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 J4/P4 through J19/P19 are disconnected.

D. Measure the solenoid resistance between pin 1 and pin 2 at J4 through J19.

E. Record the measured resistance for each solenoid.

Expected Result:

Resistance should be between 0.5 and 1.5 Ohms.

Results:

- OK – The resistance is between 0.5 and 1.5 Ohms. Proceed to test step 9.
- Not OK – The resistance is not between 0.5 and 1.5 Ohms. Proceed to test step 10.

Test Step 9. 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. 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 connected. Ensure that the injector connectors J4/P4 through J19/P19 are connected.

D. Connect the ET.

E. Turn the circuit breaker for the battery to the ON position.

F. Turn the ECS to the STOP position.

G. Use the Diagnostic Tests on the ET to initiate the Injector Solenoid Test.

H. 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.

Expected Result:

As each solenoid is energized by the ECM, an audible click of the solenoid should be heard. The solenoids will be energized one at a time in the following numerical order: 1 to 16. There will be a momentary delay between each one.

Results:

- OK – The audible click is heard for each solenoid. Proceed to test step 3.
- Not OK – The audible click is not heard for each solenoid.

  Repair: Perform a diagnostic functional test. Refer to Troubleshooting, "Electrical Power Supply".

  STOP.

Test Step 10. Check the Resistance of the Injector Solenoid.

⚠ 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 ECS to the OFF/RESET position.

B. Remove the valve cover of the suspected cylinder.

C. Remove the harness yoke from the solenoid terminals.

D. Measure the resistance between the two solenoid terminals on top of the injector. Record the resistance.

E. Measure the resistance from either solenoid terminal to the fuel injector body (metal).

F. Record the resistance.

G. Reconnect the harness yoke and install the valve cover.

Expected Result:

Resistance between the two solenoid terminals should be between 0.5 and 1.5 Ohms. Resistance from either solenoid terminal to the fuel injector body (metal) should be greater than 20,000 Ohms.

Results:

- OK – All resistance readings are within limits. There is a problem in the valve cover base harness.

  Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

- Not OK – 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.

i01365302

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 due to connectors. If a problem is found in an electrical connector, repair the connector. Do NOT cut connector wires unless terminals are being replaced. Repair the connectors with a **1U-5804** Crimp Tool.

Intermittent electrical problems often disappear by disconnecting and reconnecting connectors. Check for diagnostic codes before disconnecting and connecting a connector. If a diagnostic code is generated due to disconnecting and reconnecting a connector there are several possible reasons. The likely problems are loose or improperly crimped terminals, moisture, corrosion, or connectors not mated securely.

The following procedure will ensure the correct installation of pins and sockets in connectors:

- Do not solder the sockets and pins to the wires.
- Do not crimp any more than one wire into a socket or into a pin. Refer to Illustration 29.
- Sockets and pins should be crimped on the wires. Use the **1U-5804** Crimp Tool for 12 - 18 gauge wire.
- Unused slots for sockets and pins must be filled with sealing plugs in order to ensure that the connector is sealed.
- Sealing plugs should be installed on the back side of the connector. Wires are inserted into the connector from the back side.
- The sealing plugs that are installed in unused slots must seal correctly. The plug rests against the seal face. Do not permit the large end of the plug to go past the seal face. Refer to Illustration 30 for correct installation of plugs.

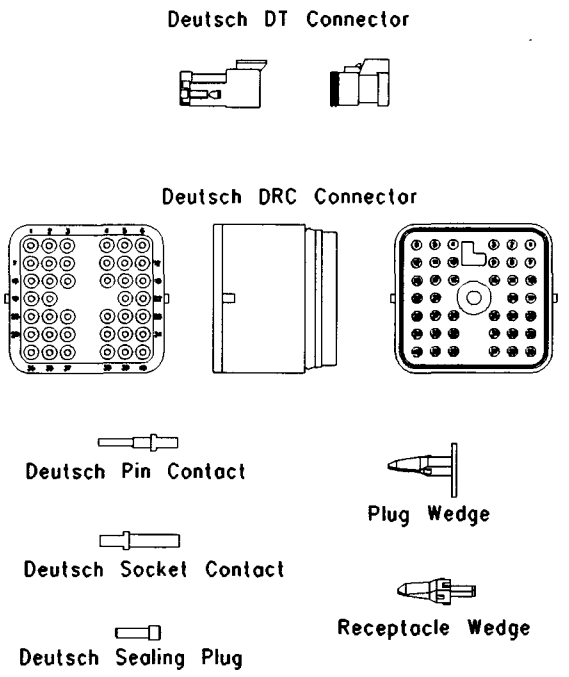

Illustration 27 g00706127

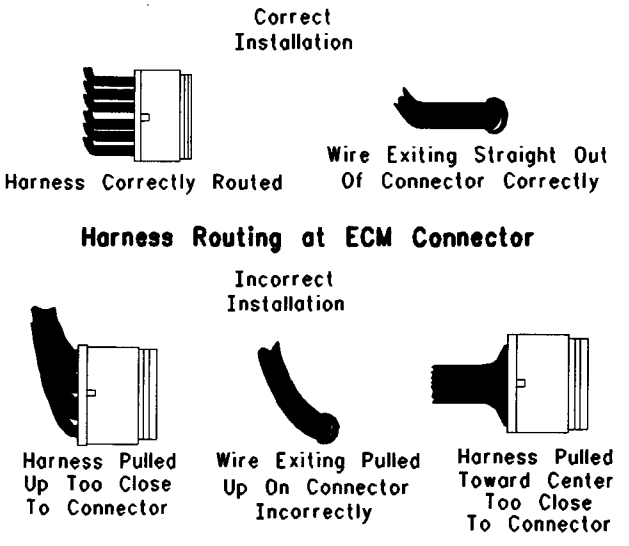

Illustration 28 g00720332

Harness

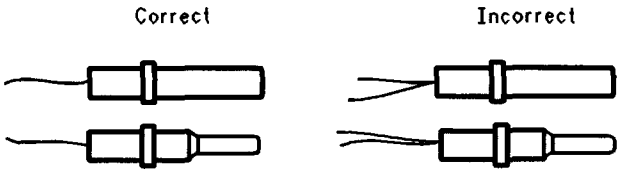

Illustration 29 g00721340

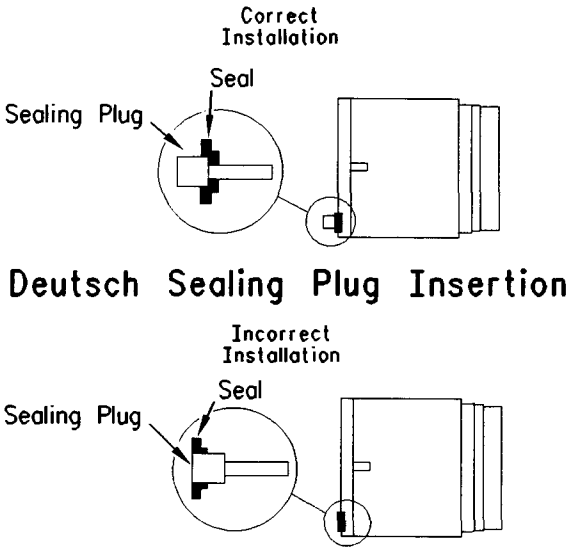

Illustration 30 g00690571

Deutsch Sealing Plug

Test Step 1. Check The Locking Of The DT Connector (Deutsch) And Check The Lock Ring Of The HD Style Connector (Deutsch).

A. Ensure that the connector is properly locked. Also ensure that the two halves of the connector can not be pulled apart.

B. Verify that the latch tab of the connector is properly latched. Also verify that the latch tab of the connector returns to the fully latched position.

Expected Result:

The connector will securely lock. The connector and the locking mechanism are without cracks or breaks.

Results:

- OK – Proceed to Test Step 2.
- Not OK

  Repair: Repair the connector or replace the connector, as required.

  Verify that the repair eliminates the problem.

  STOP.

Test Step 2. Check The Allen Head Screw On The ECM Connector.

A. Ensure that the allen head screw is properly tightened. Be careful not to overtighten the screw and break the screw.

B. Do not exceed 2.25 N·m (20 lb in) of torque on the allen head screw.

Expected Result:

The ECM connector is secure and the allen head screw is properly torqued.

Results:

- OK – Proceed to Test Step 3.
- Not OK

  Repair: Repair the connector or replace the connector, as required.

  Verify that the repair eliminates the problem.

  STOP.

Test Step 3. Perform A Pull Test On Each Wire Terminal Connection.

A. Each terminal and each connector should easily withstand 45 N (10 lb) of pull 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.

B. The DT connectors use an orange wedge to lock the terminals in place. Ensure that the orange wedge is not missing and that the orange wedge is installed properly on the DT connectors.

Note: Terminals should ALWAYS be crimped onto the wires by using a Crimp Tool. Do not solder terminals. Use the **1U-5804** Crimp Tool.

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 – Proceed to Test Step 4.
- Not OK

  Repair: Repair the circuit.

  Verify that the repair eliminates the problem.

  STOP.

Test Step 4. Monitor The Electronic Service Tool While The Wiring And The Connectors Are Being Pulled.

A. If there is an Active Diagnostic Code that pertains to the circuit, perform the following test:

Monitor the Active Diagnostic Code Screen on ET while all harnesses and connectors that connect to the component with the Active Diagnostic Code are pulled. If the harness is being pulled and the Active Diagnostic Code disappears, there is a problem in the wiring or the connector.

B. If there are no Active Diagnostic Codes that pertain to the circuit, perform the following test:

Monitor the Display Status Screen ET for the component while the harnesses are being pulled. If the harness is being pulled and the reading changes erratically, there is a problem in the wiring or the connector.

C. If there are no Active Diagnostic Codes and the operator is complaining about speed burps or power cutouts, perform the following test:

Run the engine and listen for speed burps or power cutouts while the wiring or the connectors are pulled. If the harness is being pulled and the engine has a speed burp or a power cutout, there could be a problem in the wiring or the connector.

Expected Result:

The problem appears to be external to the harnesses and connectors. Pulling on the harness and the connectors has no effect on the Active Diagnostic Code, component status, or engine performance.

Results:

- OK – Proceed to Test Step 5.
- Not OK

  Repair: Repair the circuit.

  Verify that the repair eliminates the problem.

  STOP.

Test Step 5. Check Wires For Nicks In The Insulation Or Abrasion.

A. Carefully inspect each wire for signs of abrasion, nicks, or cuts.

The following areas are locations that should be checked:

- Exposed insulation
- Points of rubbing wire against the engine
- Points of rubbing wire against a sharp point

B. Check all of the hold down clamps for the harness in order to verify that the harness is properly clamped. Also check all of the hold down clamps for the harness in order to verify that the harness is not compressed by the clamp. Pull back the harness sleeves in order to check for a flattened portion of wire. The flattened portion of wire is caused by the clamp that holds the harness.

Expected Result:

The wires are free of abrasion, nicks, or cuts and the harness is properly clamped.

Results:

- OK – Proceed to Test Step 6.
- Not OK

  Repair: Repair the wires or replace the wires, as required.

  Verify that the repair eliminates the problem.

  STOP.

Test Step 6. Check Connectors For Moisture Or Corrosion.

A. Ensure that the connector seals and the white sealing plugs are in place. If any of the seals or plugs are missing, replace the seal or plug. If necessary, replace the connector.

B. Check all of the wiring harnesses in order to verify that the harness does not make a sharp bend out of a connector. This will deform the connector seal and this will create a path for the entrance of moisture.

Thoroughly inspect ECM Connectors J1/P1 and J2/P2 for evidence of moisture entry.

Note: It is normal to see some minor seal abrasion on the ECM Connector seals. Minor seal abrasion will not allow the entry of moisture.

C. 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 reoccur. Simply drying the connector will not fix the problem. Likely paths for the entrance of moisture are illustrated in the following list:

- Missing seals
- Improperly installed seals
- Nicks in exposed insulation
- Improperly mated connectors

Moisture can also travel from one connector through the inside of a wire to the ECM Connector. If moisture is found in the ECM connector, thoroughly check all connectors and wires on the harness that connect to the ECM. The ECM is not the source of the moisture. Do not replace an ECM if moisture is found in either ECM connector.

Note: 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. Do not use any cleaners that contain 1,1,1 trichloro-ethylene because 1,1,1 trichloro-ethylene may damage the connector.

Expected Result:

All of the connectors should be completely coupled and all of the seals should be completely inserted. The harness and the wiring should be free of corrosion, abrasion or pinch points.

Results:

- **OK** – Proceed to Test Step 7.
- **Not OK**

Repair: Repair the circuit. Ensure that all of the seals are properly in place and ensure that the connectors are completely coupled.

Verify that the repair eliminates the problem by running the engine for several minutes and by checking 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 that have moisture. These wires may have moisture that is trapped inside the insulation. Verify that the repair eliminates the problem.

STOP.

Test Step 7. Inspect The Connector Terminals.

A. 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** – Proceed to Test Step 8.
- **Not OK**

Repair: Repair the terminals and/or replace the terminals, as required.

Verify that the repair eliminates the problem.

STOP.

Test Step 8. Check the Individual Pin Retention Into the Socket.

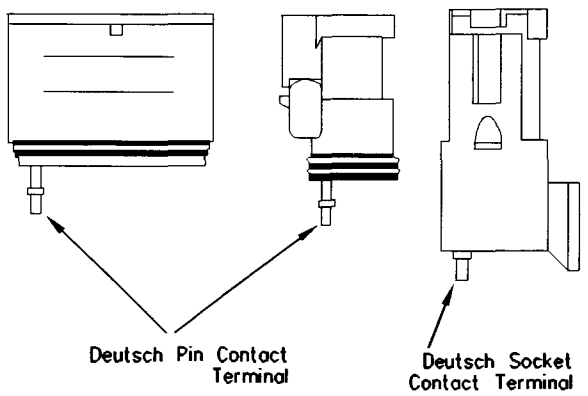

Illustration 31 g00690572

Deutsch Contact Terminals

Note: This is especially important for intermittent problems.

A. Use a new pin. Insert the pin into each socket one at a time in order to check for a good grip on the pin by the socket.

B. Use a new socket. Insert the socket over each pin one at a time in order to check for a good grip on the pin by the socket. The pins are located on the mating side of the connector.

C. The contact terminal should stay connected when the connector is held in the position shown in Illustration 31. The contact terminal is the pin or the socket.

Expected Result:

The pins and the sockets appear to be OK.

Results:

- OK – STOP.
- Not OK

  Repair: Repair the terminals and/or replace the terminals.

  Verify that the repair eliminates the problem.

  STOP.

i01350729

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 or 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 engine 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 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 engine prelube pressure switch is activated.
- The user defined engine prelube duration has been reached.

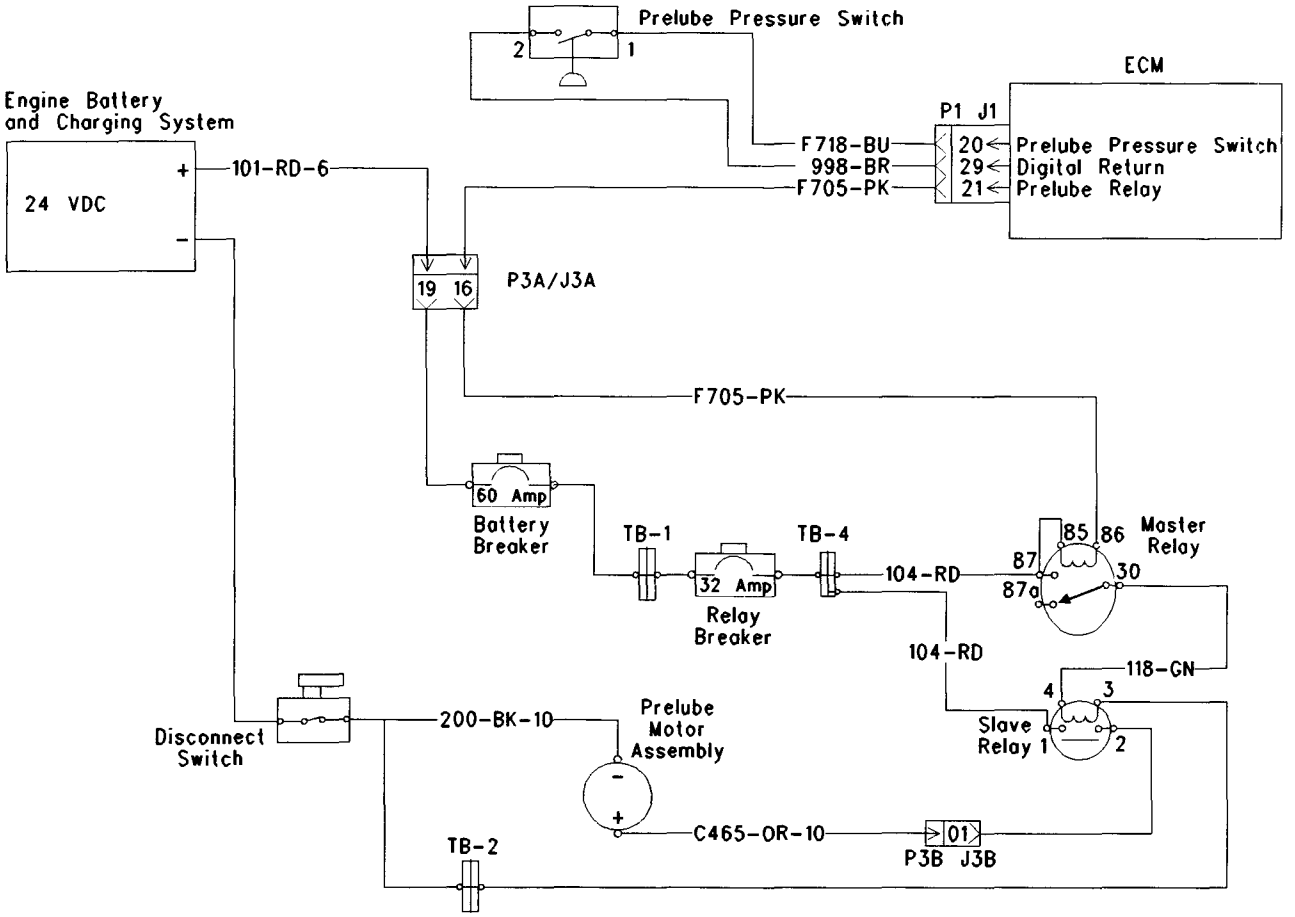

Illustration 32 g00732147

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

Expected Result:

The connectors and wiring should be free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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 the Engine Prelube Pressure Switch.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect ECM connector J1/P1.

C. Measure the resistance between the engine prelube pressure switch P1-20 and the Digital Return P1-29.

D. Reconnect the ECM connector P1.

Expected Result:

The resistance should be greater than 20,000 Ohms.

Results:

- **OK** – The resistance is greater than 20,000 Ohms. The engine prelube pressure switch is not active. Proceed to test step 3.

- Not OK – The resistance is less than 20,000 Ohms. The engine 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 4.

Test Step 3. Check the Status of the Engine Prelube Pressure Switch on ET.

A. Turn the ECS to the OFF/RESET position.

B. Connect the ET.

C. Turn the circuit breaker for the battery to the ON position.

D. Turn the ECS to the STOP position.

E. Observe the parameters for the engine prelube and for the ignition switch.

Expected Result:

The parameter for the engine prelube should display "OFF". The parameter for the ignition switch should display "STOP".

Results:

- OK – The parameter for the engine prelube displays "OFF" and the parameter for the ECS displays "STOP". Proceed to test step 5.

- 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.

- Ignition Switch Not OFF

  Repair: Perform a diagnostic functional test. Refer to Troubleshooting, "Engine Control Switch (ECS)".

  STOP.

Test Step 4. Measure the Resistance of the Engine Prelube Pressure Switch.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect the wires from terminal 1 and terminal 2 of the engine prelube pressure switch.

C. Measure the resistance between terminal 1 and terminal 2 of the engine prelube pressure switch.

Expected Result:

The resistance should be greater than 20,000 Ohms.

Results:

- OK – The resistance is greater than 20,000 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 20,000 Ohms. There is a problem with the engine prelube pressure switch.

  Repair: Temporarily replace the engine 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 5. Check the Status of the ECS on ET.

A. Use the ET and view the following parameters: Engine Prelube and Ignition Switch.

B. Turn the ECS to the START position.

C. View the parameters for the engine prelube pressure switch and the ignition switch. View the parameters before the engine prelube duration expires and before the switch activates.

Note: If necessary, program the engine prelube duration to 60 seconds.

Expected Result:

When the ECS is in the STOP position, the engine prelube should display "OFF" and the ignition switch should display "STOP". When the ECS is in the START position, the engine prelube should display "ON" and the ignition switch should display "RUN".

Results:

- OK – The parameters are correct. Proceed to test step 6.

- Not OK – The status of the ignition switch does not display "RUN".

Repair: Perform a diagnostic functional test. Refer to Troubleshooting, "Engine Control Switch (ECS)".

STOP.

Test Step 6. Check for Output Voltage to the Prelube Motor.

A. Turn the ECS to the OFF/RESET position.

B. Connect one end of the voltage test lamp to –Battery terminal.

C. Connect the other end of the voltage test lamp to wire C465-OR on terminal 2 of the Prelube Slave Relay ("PPRS").

D. Turn the ECS to the START position.

E. Monitor the voltage test lamp for illumination.

F. Turn the ECS to the STOP position.

Expected Result:

The voltage test lamp should illuminate.

Results:

- **OK** – The voltage test lamp illuminates. Proceed to test step 12.
- **Not OK** – The voltage test lamp does not illuminate. Proceed to test step 7.

Test Step 7. Check for Output Voltage to the Prelube Slave Relay.

A. Leave one end of the voltage test lamp on the –Battery terminal.

B. Connect the other end of the voltage test lamp to wire 118-GN on terminal 30 of the Prelube Master Relay ("PPRM").

C. Turn the ECS to the START position.

D. Monitor the voltage test lamp for illumination.

E. Turn the ECS to the STOP position.

Expected Result:

The voltage test lamp should illuminate.

Results:

- **OK** – The voltage test lamp illuminates. The problem is the Prelube Slave Relay.

Repair: Temporarily replace the Prelube Slave Relay with a new relay. If the problem is no longer present, reinstall the old Prelube Slave Relay. If the problem returns, replace the Prelube Slave Relay. The wire 118-GN between the slave relay and the master relay could possibly be faulty.

STOP.

- **Not OK** – The voltage test lamp does not illuminate. Proceed to test step 8.

Test Step 8. Check the Coil of the Prelube Master Relay.

A. Leave the ECS in the STOP position.

B. Leave one end of the voltage test lamp on the –Battery terminal.

C. Connect the other end of the voltage test lamp to wire F708-PK on terminal 86 of the Prelube Master Relay ("PPRM").

D. Monitor the voltage test lamp for illumination.

Expected Result:

The voltage test lamp should illuminate.

Results:

- **OK** – The voltage test lamp illuminates. The master relay and the slave relay activate. The prelube motor runs. Proceed to test step 11.
- **Not OK** – The voltage test lamp does not illuminate. Proceed to test step 9.

Test Step 9. Check the Battery Voltage to the Prelube Master Relay.

A. Leave the ECS in the STOP position.

B. Leave one end of the voltage test lamp on the –Battery terminal.

C. Connect the other end of the voltage test lamp to wire 104-RD on terminal 85 of the Prelube Master Relay ("PPRM").

D. Monitor the voltage test lamp for illumination.

Expected Result:

The voltage test lamp should illuminate.

Results:

- **OK** – The voltage test lamp illuminates. The problem is the Master Slave Relay.

Repair: Temporarily replace the Master Slave Relay with a new Master Slave Relay. If the problem is no longer present, reinstall the old Master Slave Relay. If the problem returns, replace the Master Slave Relay.

STOP.

- **Not OK** – The voltage test lamp does not illuminate. Proceed to test step 10.

Test Step 10. Check for Supply Voltage to the ECM.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect ECM connector J1/P1.

C. Install a jumper wire that has a pin on one end into P1-5.

D. Connect one end of the voltage test lamp to the jumper wire and the other end to P1-4.

E. Monitor the voltage test lamp.

F. Remove all jumpers and replace all wires.

Expected Result:

The voltage test lamp should illuminate.

Results:

- **OK** – The voltage test lamp illuminates. Proceed to test step 11.
- **Not OK** – The voltage test lamp does not illuminate. There is a problem with the lamp or the wiring to the battery.

  Repair: Repair the lamp or wiring and/or replace the lamp or wiring.

  STOP.

Test Step 11. Check the ECM.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect ECM connector J1/P1.

C. Install a jumper wire that has a pin on one end into P1-4.

D. Install a jumper wire that has a pin on one end into P1-21.

E. Reconnect the ECM connector P1.

F. Connect one end of the voltage test lamp to the jumper wire that is in P1-21 and the other end of the voltage test lamp to the jumper wire that is in P1-4.

G. Turn the ECS to the STOP position.

H. Access the override on the ET.

I. Enable the override for the engine prelube pressure switch.

J. Monitor the voltage test lamp.

K. Disable the override.

L. Remove all jumpers and replace all wires.

Expected Result:

The voltage test lamp should illuminate.

Results:

- **OK** – The voltage test lamp illuminates. There is a problem in the wiring between the ECM and the relay.

  Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

  STOP.

- **Not OK** – The voltage test lamp does not illuminate.

  Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

  STOP.

Test Step 12. Check the Operation of the Prelube Motor.

A. Turn the circuit breaker for the battery to the OFF position.

B. Turn the ECS to the OFF/RESET position.

C. Connect one side of a suitable piece of 10 AWG wire to +Battery terminal.

D. For one second, connect the other end of the wire to the +Battery terminal of the prelube motor.

Expected Result:

The prelube motor should start while the wire is connected to the +terminal.

Results:

- **OK** – The prelube motor starts. There is a problem in the wiring harness.

  Repair: Inspect the connectors and the wiring between the + terminal of the prelube motor and pin 2 of the Prelube Slave Relay.

  STOP.

- **Not OK** – The prelube motor did not start. The problem appears to be in the prelube motor.

  Repair: Temporarily replace the prelube motor with a new prelube motor. If the problem is no longer present, reinstall the old prelube motor. If the problem returns, replace the prelube motor.

  STOP.

i01350986

Speed Control

SMCS Code: 1901-038

System Operation Description:

The sensor for engine speed control provides a throttle signal and a droop signal to the Electronic Control Module (ECM). The sensor output for rated speed is a pulse width modulated signal (PWM) at a constant frequency. The speed signal varies with the position of the speed adjust potentiometer. The sensor output for droop is a PWM signal at a constant frequency. The droop signal varies with the position of the droop adjust potentiometer. The output signal is referred to as a Duty Cycle or as a PWM signal. The output signal is expressed as a percentage between 0 and 100 percent for the speed adjust and a percentage between 0 and 10 percent for the droop adjust.

The ECM calculates the desired engine rpm from the rated speed signal and the droop signal. The rated speed signal is valid when the duty cycle is in the range of 5 to 95 percent. If the ECM determines that the rated speed signal is invalid, the engine rpm will be set to the programmed low idle.

Note: Desired speed can be adjusted from 1369 to 1945 rpm for a 60 Hz system and from 1141 to 1621 rpm for a 50 Hz system.

The droop signal is valid when the duty cycle is in the range of 15 to 85 percent. If the ECM determines that the droop signal is invalid, the engine will run with NO droop which is referred to as Isochronous Mode.

Some applications may choose not to use the speed sensor. Some applications may use a load sharing module. The load sharing module is configured to provide the engine control with a Rated Speed Signal. The signal has the same characteristics as the above defined signal. Some of these load sharing modules can not provide a signal until the engine is running. In these cases, troubleshooting should be performed while the engine is running.

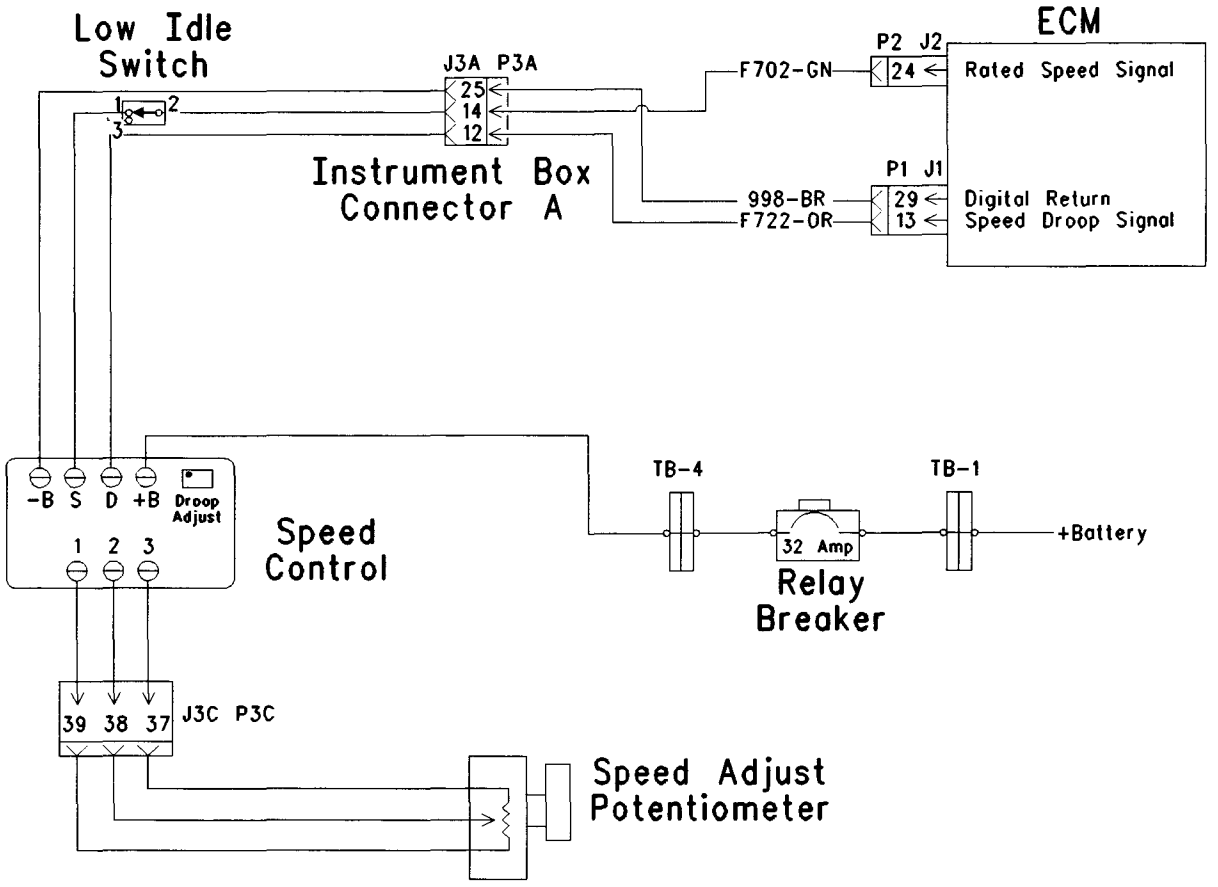

Illustration 33 g00631341

Test Step 1. Check for Connector Damage.

A. Verify that the circuit breakers are not tripped.

B. Turn the circuit breaker at the battery to the OFF position.

C. Turn the ECS to the OFF/RESET position.

D. Check the connectors and wiring for the following problems: damage, corrosion, abrasion, and incorrect attachment

Expected Result:

The connectors and wiring should be free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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 the Voltage.

A. Turn the circuit breaker at the battery to the ON position.

B. Connect one probe of the voltage test lamp to +Battery terminal. Connect one probe of the voltage test lamp to the –Battery terminal. If the voltage test lamp illuminates, the lamp is functioning properly. If the voltage test lamp does not illuminate, either the lamp is faulty or there is a problem with the battery.

C. Connect one probe of the voltage test lamp to the +Battery terminal of the speed control. Connect one probe of the voltage test lamp to the –Battery terminal of the Speed Control.

Expected Result:

The voltage test lamp should illuminate.

Results:

- **OK** – The voltage test lamp illuminates. The voltage supply to the speed control is correct. Proceed to test step 3.
- **Not OK** – The voltage test lamp does not illuminate.

  Repair: There is a problem with the supply voltage to the speed control.

  STOP.

Test Step 3. Determine the Component that has Failed.

A. Determine if the problem is with the input for the throttle or the droop.

B. Turn the ECS to the STOP position.

C. Observe the position of the throttle on the ET as you turn the speed adjust potentiometer.

D. Observe the droop on the ET as you turn the droop adjust potentiometer.

E. Select "UNSURE" if the source of the problem is unknown.

Expected Result:

The throttle position on the ET should vary with the turning of the speed adjust potentiometer. The droop on the ET should vary with the turning of the droop adjust potentiometer.

Results:

- **RATED SPEED** – The throttle position on the ET does not vary with the turning of the Speed Adjust Potentiometer. Proceed to test step 4.
- **DROOP SPEED** – The droop on the ET does not vary with the turning of the droop adjust potentiometer. Proceed to test step 5.
- **Unsure** – The problem is not apparent. Proceed to test step 4.

Test Step 4. Check the Throttle Position.

A. Turn the ECS to the STOP position.

B. Observe the position of the throttle on the ET.

C. Turn the speed adjust potentiometer to the lowest setting.

- 60 Hz equals 1369 RPM
- 50 Hz equals 1141 RPM

D. Start at the low idle position. Slowly turn the speed adjust potentiometer in the other direction. Monitor the position of the throttle on the ET.

Expected Result:

The throttle position on the ET should read 0 percent at the lowest setting and 0 to 100 percent as the speed adjust potentiometer is adjusted.

Results:

- **OK** – The speed control is operating correctly. STOP.
- **Not OK** – The throttle position on the ET does not vary as the speed adjust potentiometer is adjusted. Proceed to test step 6.

Test Step 5. Check the Droop.

A. Turn the ECS to the STOP position.

B. Observe the droop on the ET.

C. Turn the droop adjust potentiometer in a counterclockwise direction.

D. Slowly turn the droop adjust potentiometer in a clockwise direction. Monitor the droop on the ET.

Note: Do not overturn the droop adjust potentiometer in the clockwise direction. The signal will become erratic.

Expected Result:

The droop on the ET should read 0 percent at the lowest setting and 0 to 10 percent as the droop adjust potentiometer is adjusted.

Results:

- **OK** – The droop is operating correctly. STOP.
- **Not OK** – The droop on the ET does not vary as the droop adjust potentiometer is adjusted. Proceed to test step 7.

Test Step 6. Check the Speed Control.

A. Remove the wire from the S terminal at the speed control.

B. Set the multimeter to "VDC". Press the "Hz" button twice so that the % symbol is displayed.

C. Place one probe of the multimeter on the S terminal of the speed control. Place the other probe on the –Battery terminal of the speed control.

D. Monitor the output of the percent duty cycle from the speed control on the multimeter. Turn the speed adjust potentiometer from the low setting to the high setting.

Note: The throttle position on the ET will NOT match the percent duty cycle on the multimeter.

Expected Result:

The duty cycle should be between 4 and 10 percent at the low setting and between 90 and 95 percent at the high setting.

Results:

- OK – The speed control is supplying the correct signal. Proceed to test step 8.
- Not OK – The duty cycle is not correct on the multimeter.

  Repair: Temporarily install another speed control. Verify that the problem is no longer present. Reinstall the old speed control. If the problem returns, replace the speed control.

  STOP.

Test Step 7. Check the Droop Signal.

A. Remove the wire from the D terminal of the speed control.

B. Set the multimeter to "VDC". Press the "Hz" button twice so that the % symbol is displayed.

C. Place one probe of the multimeter on the D terminal of the speed control. Place the other probe on the –Battery terminal of the speed control.

D. Monitor the output of the percent duty cycle from the speed control on the multimeter. Turn the droop adjust potentiometer from the low setting to the high setting.

Note: The droop on the ET will NOT match the percent duty cycle on the multimeter.

Expected Result:

The duty cycle is between 15 and 85 percent. This range should be attainable.

Results:

- OK – The speed control is providing the correct Droop Signal. Proceed to test step 9.
- Not OK – The problem appears to be in the speed control.

  Repair: Temporarily install another speed control. Verify that the problem is no longer present. Reinstall the old speed control. If the problem returns, replace the speed control.

  STOP.

Test Step 8. Check ECM Input.

A. Turn the ECS to the STOP position.

B. Set the multimeter to "VDC". Press the "Hz" button twice so that the % symbol is displayed.

C. Measure the voltage between pins P2-24 and P1-29 on the ECM connectors.

D. Monitor the output of the percent duty cycle from the speed control on the multimeter. Monitor the percent throttle position on the ET. Turn the speed adjust potentiometer from the low setting to the high setting.

Expected Result:

The duty cycle should be between 4 and 10 percent at the low setting and between 90 and 95 percent at the high setting. The percent throttle position should be between 0 and 100 percent for the above settings of the speed adjust potentiometer.

Results:

- OK – The duty cycle is correct. Proceed to test step 5.
- Duty Cycle Not OK – The duty cycle is not correct.

  Repair: There is a problem in the wiring between P2-24 and the S terminal of the speed control. Verify that the low idle switch is functioning properly.

  STOP.

- Throttle Position Not OK – The duty cycle is correct but the throttle position is not correct. The ECM is not processing the correct signal.

Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

STOP.

Test Step 9. Check ECM Input.

A. Turn the ECS to the STOP position.

B. Measure the voltage between pins P1-13 and P1-29 on the ECM connector.

C. Set the multimeter to "VDC". Press the "Hz" button twice so that the % symbol is displayed.

D. Monitor the output of the percent duty cycle from the speed control on the multimeter. Monitor the droop on the ET. Turn the droop adjust potentiometer from the low setting to the high setting.

Note: Do not overturn the droop adjust potentiometer in the clockwise direction. The signal will become erratic.

Expected Result:

The duty cycle should be between 1 and 15 percent at the clockwise setting and between 85 and 99 percent at the counterclockwise setting. The droop should be between 0 and 100 percent for the above settings of the droop adjust potentiometer.

Results:

- **OK** – The duty cycle is correct. **STOP.**
- **Duty Cycle Not OK** – The duty cycle is not correct.

  Repair: There is a problem in the wiring between P2-24 and the D terminal of the speed control.

  STOP.

- **Droop Not OK** – The duty cycle is correct but the droop is not correct. The ECM is not processing the correct signal.

  Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

  STOP.

i01351095

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. When the ECS is placed in the START position, the ECM will activate the prelube system. Refer to Troubleshooting, "Prelubrication System". The engine control will start the first crank cycle when the prelube is completed. The crank cycle continues for the programmed time or the engine speed reaches the crank terminate speed. If crank terminate speed is not reached before reaching the cycle crank time, the starting motor will deactivate for a time that is equal to the cycle crank time.

This process will repeat for a programmed amount of times (Total Number of Crank Cycles). If the engine does not start the starter mode on the Electronic Technician (ET) will display "OVERCRANK". The engine control will be in an idle state. The crank cycle can be restarted by turning the ECS to the OFF or STOP position and then turning the ECS to the START position.

Note: When the starting motor fails to engage the flywheel due to a Butt engagement, that crank cycle will still be counted in the total number of crank cycles.

Note: If you are troubleshooting a system that has EMCP II, this function will be performed by the control panel. Refer to the Service Manual, SENR5398.

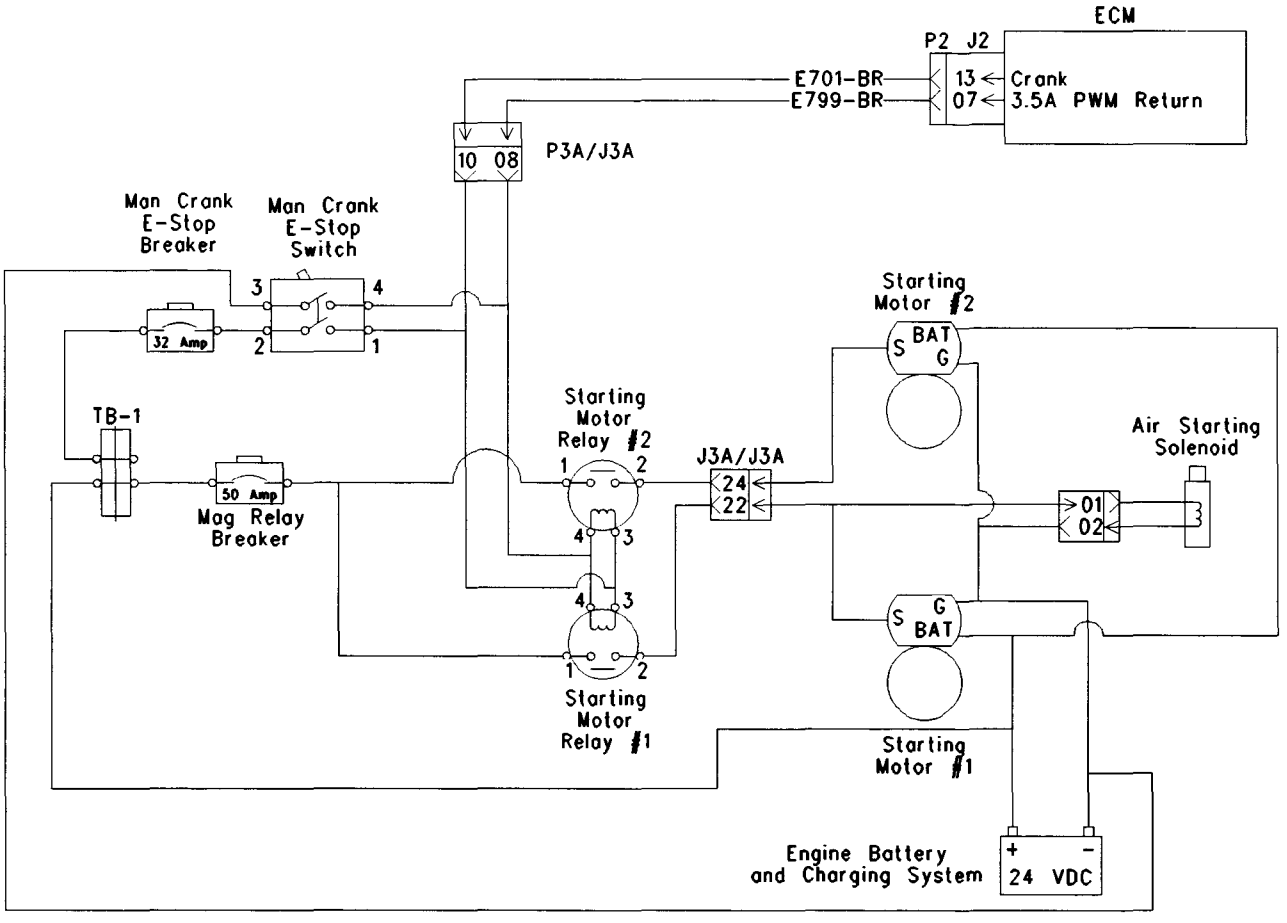

Illustration 34 g00598835

Schematic

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

Expected Result:

The connectorsand wiring should be free of the following problems: damage, corrosion, abrasion, and incorrect attachment.

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

A. Turn the circuit breaker for the battery to the ON position.

B. Turn the ECS to the STOP position.

C. Connect an ET to the service tool connector.

D. Observe the "startup mode" parameters on the ET status screen.

E. Turn the ECS to the START position. Continue monitoring engine parameters as the engine cranks.

F. 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 should display "CRANK". The engine cranks.

Results:

- **OK** – The "startup mode" parameter on the status screen on the ET displays "CRANK". The engine cranks. **STOP.**
- **Not OK-Engine Doesn't Crank** – The "startup mode" parameter on the status screen on the 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 the ET does not display "CRANK".

  Repair: Perform a diagnostic functional test. Refer to Troubleshooting, "Engine Control Switch (ECS)".

  STOP.

Test Step 3. Manually Crank the Engine.

A. Turn the ECS to the STOP position.

B. Open the electronic instrument panel.

C. Connect one end of the voltage test lamp to –Battery terminal. Connect the other end of the voltage test lamp to wire 314-PU on terminal 2 of the mag relay.

D. Turn the ECS to the START position.

E. Activate the manual crank switch.

F. Monitor the voltage test lamp.

Expected Result:

The voltage test lamp should illuminate.

Results:

- **OK** – The voltage test lamp illuminates. Proceed to test step 7.
- **Not OK** – The voltage test lamp does not illuminate. Proceed to test step 4.

Test Step 4. Check the Coil on the Mag Relay.

A. Turn the ECS to the OFF/RESET position.

B. Remove wire E779-BR from terminal 4 of the mag relay. Connect one end of the voltage test lamp to –Battery terminal. Connect the other end of the voltage test lamp to terminal 4 of the mag relay.

C. Turn the ECS to the STOP position.

D. Activate the override for the starting motor relay.

Note: This test will cause a 444-05 CID-FMI to be Logged. Delete this CID-FMI when you are finished with this test.

E. Monitor the voltage test lamp.

F. Turn off the override for the starting motor relay.

G. Remove the voltage test lamp and replace all wires.

Expected Result:

The voltage test lamp should illuminate.

Results:

- **OK** – The voltage test lamp illuminates.

  Repair: The problem appears to be with the mag relay. Temporarily install a new mag relay. Verify that the problem is no longer present. Reinstall the old mag relay. If the problem returns, replace the mag relay.

  STOP.

- **Not OK** – The voltage test lamp does not illuminate. Proceed to test step 5.

Test Step 5. Check the ECM Signal at the Mag Relay.

A. Turn the ECS to the OFF/RESET position.

B. Connect one end of the voltage test lamp to –Battery terminal. Connect the other end of the voltage test lamp to wire F701-BR on terminal 3 of the mag relay.

C. Turn the ECS to the STOP position.

D. Activate the override for the starting motor relay.

Note: This test will cause a 444-05 CID-FMI to be Logged. Delete this CID-FMI when you are finished with this test.

E. Monitor the voltage test lamp.

F. Turn off the override for the starting motor relay.

Expected Result:

The voltage test lamp should illuminate.

Results:

- **OK** – The voltage test lamp illuminates.

  Repair: The coil of the mag relay is open. Temporarily install a new mag relay. Verify that the problem is no longer present. Reinstall the old mag relay. If the problem returns, replace the mag relay.

  STOP.

- **Not OK** – The voltage test lamp does not illuminate. Proceed to test step 6.

Test Step 6. Check the ECM Signal at the ECM.

A. Turn the ECS to the OFF/RESET position.

B. Disconnect ECM connector P2 from the ECM. Remove the wire from P2-7 and P2-13.

C. Obtain two suitable pieces of 18 AWG wire with socket pins on one end.

D. Install one wire at P2-7. Install the second wire at P2-13. Reconnect ECM connector P2.

E. Connect one probe of the voltage test lamp to the wire at P2-7. Connect the other probe to the wire at P2-13.

F. Turn the ECS to the STOP position.

G. Activate the override for the starting motor relay.

Note: This test will cause a 444-05 CID-FMI to be Logged. Delete this CID-FMI when you are finished with this test.

H. Turn off the override for the starting motor relay.

I. Turn the ECS to the OFF/RESET position. Remove all jumpers and replace all wires.

Expected Result:

The voltage test lamp should illuminate.

Results:

- **OK** – The voltage test lamp illuminates.

  Repair: The problem is not with the ECM. The problem is most likely in the wiring between ECM connector P2 and the mag relay.

  STOP.

- **Not OK** – The voltage test lamp does not illuminate.

  Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

  STOP.

Test Step 7. Check the Solenoid.

A. Turn the ECS to the OFF/RESET position.

B. Connect one end of a suitable piece of 10 AWG wire to +Battery terminal. Connect the other end to the S terminal of the starting solenoid for one second.

Expected Result:

The starting solenoid should activate while the wire is connected to the S terminal.

Results:

- **OK** – The starting solenoid activated. The problem appears to be in the system wiring.

  Repair: Verify that the circuit breaker for the mag relay has not tripped. Check and repair the wiring between the S terminal of the starting solenoid and terminal 2 of the mag relay. Verify repairs by checking starting solenoid operation.

  STOP.

- **Not OK** – The starting solenoid did not activate. The problem appears to be in the starting solenoid.

  Repair: Temporarily install a new starting solenoid. Verify that the problem is no longer present. Reinstall the old starting solenoid. If the problem returns, replace the starting solenoid.

  STOP.

Calibration Procedures

i01351299

Analog Sensor - Calibrate

SMCS Code: 1901-038

System Operation Description:

The ECM attempts to perform an automatic calibration of all pressure sensors whenever the ECM is powered and the engine is off for at least five seconds. Cranking the engine during the first five seconds causes the ECM to abort the calibration attempt. A manual calibration should be performed if a pressure sensor is replaced.

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 diagnostic codes with an FMI of 03 and/or 04.

Test Step 1. Check for ACTIVE Diagnostic Codes.

A. Turn the keyswitch to the OFF/RESET position.

B. Connect an ET to the service tool connector.

C. Turn the keyswitch to the ON position. The engine should be off.

D. Check for active diagnostics.

Expected Result:

There should be no active diagnostics.

Results:

- **OK** – There were no active diagnostic codes. Proceed to test step 2.
- **Not OK** – A diagnostic code is present. A pressure sensor with an active diagnostic code cannot be calibrated.

  Repair: Perform the appropriate troubleshooting procedure.

  STOP.

Test Step 2. Perform a Manual Calibration of the Sensors.

A. Select the sensor calibration on the ET. The ECM will perform a manual pressure sensor calibration when this screen is entered.

Expected Result:

The ET indicates that the calibration was completed.

Results:

- **OK** – The ET indicates that the calibration was completed. STOP.
- **Not OK** – All pressure sensors could not be calibrated. Proceed to test step 3.

Test Step 3. Determine the Cause of Failed Manual 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 the ET for the pressure sensor reading.

D. Turn the keyswitch to the OFF/RESET position.

Expected Result:

The ECM should read crankcase pressure as 8 kPa (1.1 psi) from the atmospheric pressure reading. The ECM should read turbocharger compressor inlet pressure as 8 kPa (1.1 psi) from the atmospheric pressure reading. The ECM should read engine oil pressure as 27 kPa (4 psi) from the atmospheric pressure reading. The ECM should read turbocharger compressor outlet pressure as 15 kPa (2 psi) from the atmospheric pressure reading. The atmospheric pressure reading should be steady. The atmospheric pressure in your area will be displayed from 5 kPa (0.7 psi).

Results:

- **OK** – Repeat manual calibration of the sensors. STOP.
- **Not OK** – There is a problem with the wiring harness and/or the sensor. Inspect the components for damage, corrosion or abrasion. Repair the components and/or replace the components.

Repair: Perform the appropriate troubleshooting procedure.

STOP.

i01351312

Engine Speed/Timing Sensor - Calibrate

SMCS Code: 1912-038

System Operation Description:

The Engine Speed/Timing Sensor provides engine information to the Electronic Control Module (ECM). The sensor generates a pulse signal. A loss of the engine speed/timing signal 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.

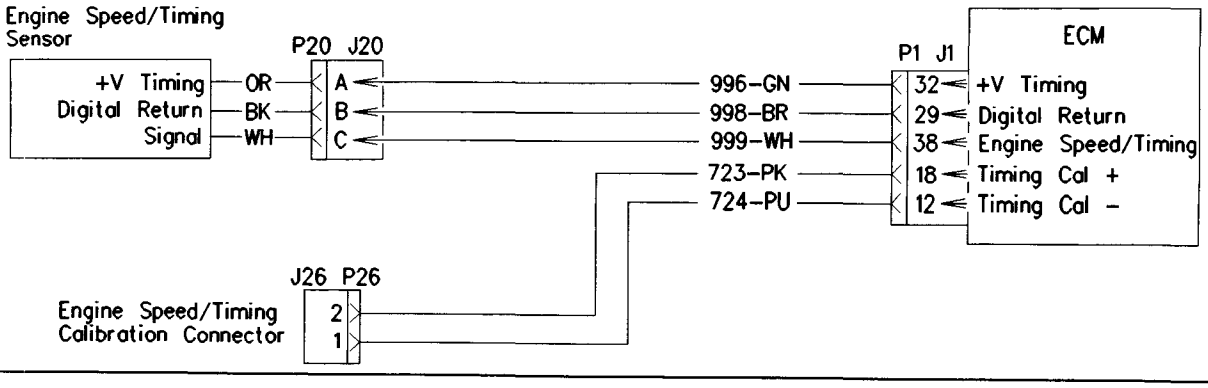

Illustration 35 g00594171

Schematic

Test Step 1. Check for an Active Diagnostic Code.

A. Connect the ET at the Service Tool Connector.

B. Remove the timing calibration plug from the flywheel housing.

C. 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.

D. Install the **6V-3093** Transducer Adapter into the hole for the timing calibration at the flywheel.

E. 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.

F. 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 2.

- **Not OK** – CID-FMI 261-13 is not the only active code at this time.

  Repair: Repair any active diagnostic codes.

  STOP.

Test Step 2. Calibration

A. Select "Service" from the main menu on the ET. Select "Calibrations" from the drop-down menu. Select Timing Calibration.

B. Press the "Continue" button on the ET. Wait until the ET indicates that the ECM has calculated the timing reference.

Note: Engine speed will be set to 800 rpm by the ECM during the calibration.

Note: If the ET reads "CALIBRATION UNSUCCESSFUL", the electronic injection timing has not been set.

Expected Result:

The timing should calibrate.

Results:

- **OK** – The timing calibration was successful. STOP.

- **Not OK** – The timing did not calibrate.

  Repair: Excessive backlash in the engine gear train will cause inconsistent timing. Refer to Systems Operation for identifying and repairing a gear train problem.

  STOP.

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