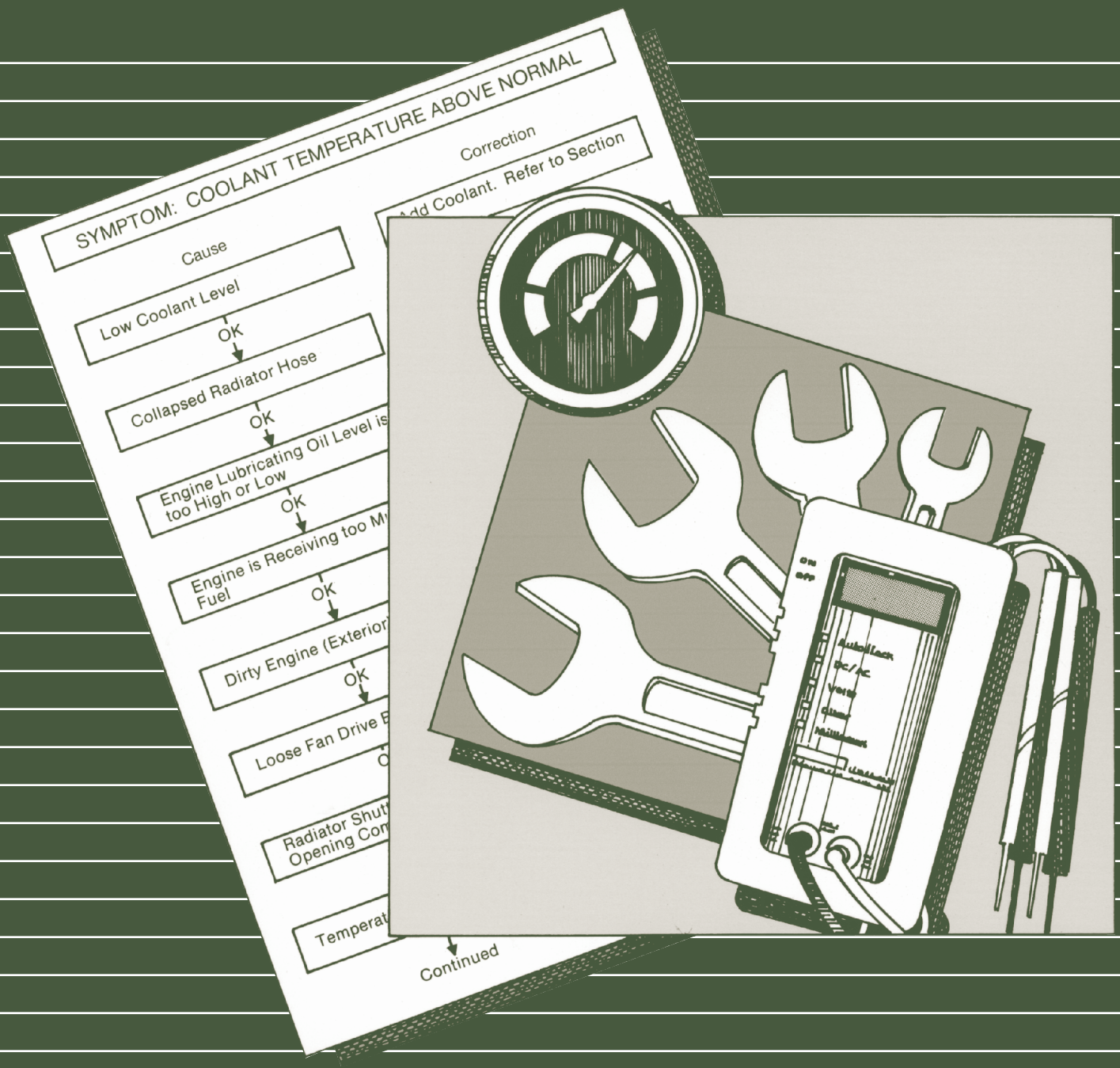
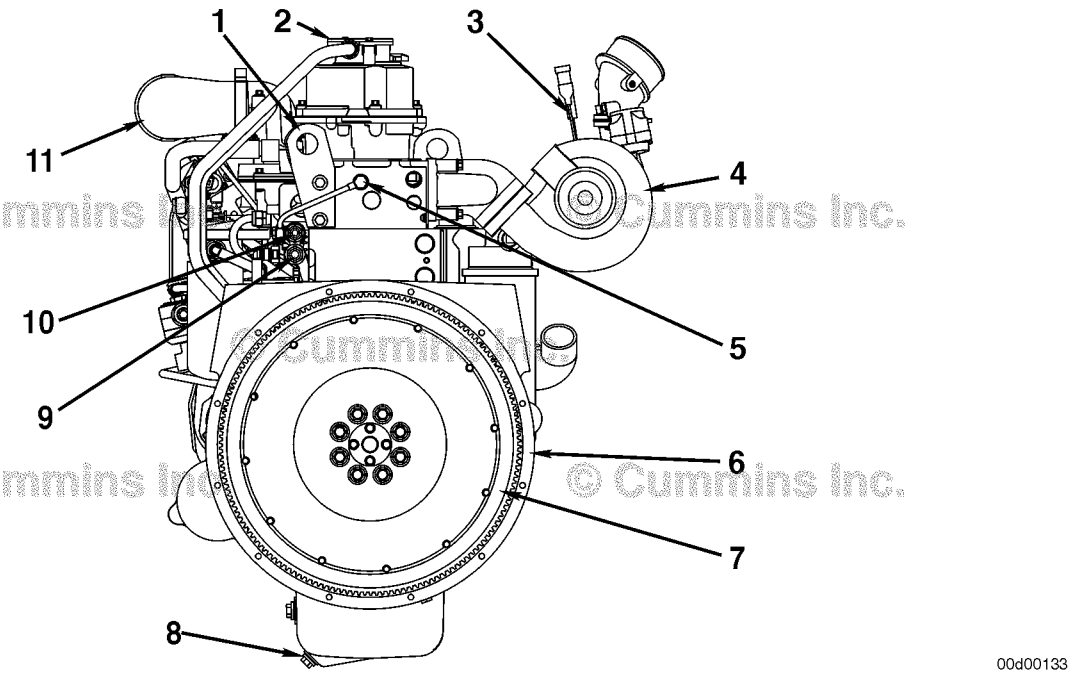
Troubleshooting and Repair Manual ISB, ISBe2, ISBe3, ISBe4, QSB4.5, QSB5.9, QSB6.7, ISC, QSC8.3, ISL, ISLe3, ISLe4, and QSL9, CM850 Electronic Control System Volume 1



Engine Diagrams

Engine Views

With CM850



Rear View (ISC, QSC8.3, ISL, and QSL9)

1 Engine lifting bracket
2 Crankcase breather
3 Turbocharger speed sensor (**only** on variable geometry turbochargers)
4 Turbocharger (variable geometry turbocharger shown)
5 Injector drain line connection
6 Flywheel housing
7 Flywheel
8 Engine oil drain plug
9 OEM fuel supply line connection
10 OEM fuel drain line connection
11 Air intake connection.

Notes

FAULT CODE 0001 - Exhaust Gas Pressure Sensor Number 1 Circuit - Voltage Above Normal, or Shorted to High Source

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the exhaust gas pressure sensor and circuit.**		
STEP 1A:	Inspect the exhaust gas pressure sensor and connector pins.	Dirty or damaged pins?	
STEP 1B:	Check the circuit response.	Fault Code 0001 inactive and Fault Code 0002 active?	
STEP 1C:	Check the sensor supply voltage and return circuit.	4.75 to 5.25 VDC?	
STEP 1D:	Check the fault code and verify sensor condition.	Fault Code 0001 present?	
STEP 2:	**Check the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness.**		
STEP 2A:	Inspect the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins.	Dirty or damaged pins?	
STEP 2B:	Check for an open circuit in the exhaust gas treatment monitor harness.	Less than 10 ohms?	
STEP 2C:	Check for a pin-to-pin short circuit in the exhaust gas treatment monitor harness.	Greater than 100k ohms?	
STEP 2D:	Check for a pin-to-pin short circuit in the exhaust gas treatment monitor harness.	Greater than 100 ohms?	
STEP 2E:	Check for fault code presence.	Fault Code 0001 present?	
STEP 3:	**Clear the fault code.**		
STEP 3A:	Disable the fault code.	Fault Code 0001 present?	

STEP 2: Check the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness.

STEP 2A: Inspect the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins.

Condition:
- Turn keyswitch OFF
- Disconnect the exhaust gas treatment monitor unit from the exhaust gas treatment monitor harness.

Action	Specification/Repair	Next Step
Inspect the exhaust gas treatment monitor unit and exhaust gas treatment monitor harness connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the exhaust gas treatment monitor unit connector or exhaust gas treatment monitor harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins if possible. Use the following procedure(s) in the Troubleshooting and Repair Manual ISC, ISC^{e}, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. • Refer to Procedure 011-038 in Section 11. • Refer to Procedure 011-035 in Section 11.	3A
	Dirty or damaged pins? **NO**	2B

FAULT CODE 123 - Intake Manifold Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.

⚠CAUTION⚠

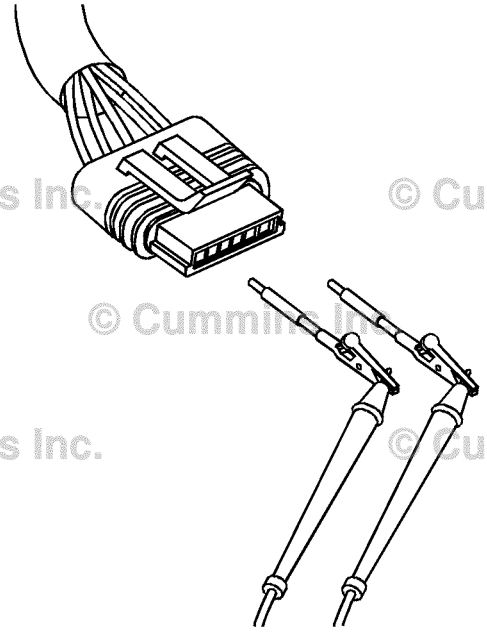
To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement:Part Number 3164596 - male Framatome test leadPart Number 3822917 - female Deutsch/AMP/ Metri-Pack test lead.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for sensor supply fault codes.**	**Fault Code 187 active?**	
STEP 1B:	**Check for an inactive fault code.**	**Fault Code 123 inactive?**	
STEP 2:	**Check the intake manifold pressure sensor and circuit.**		
STEP 2A:	**Inspect the intake manifold pressure sensor and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the sensor supply voltage and return circuit.**	**4.75 to 5.25 VDC?**	
STEP 2C:	**Check the circuit response.**	**Fault Code 122 active and Fault Code 123 inactive?**	
STEP 2D:	**Check the fault codes and verify sensor condition.**	**Fault Code 123 active?**	
STEP 3:	**Check the engine control module and engine harness.**		
STEP 3A:	**Inspect engine control module and engine harness connector pins.**	**Dirty or damaged pins?**	
STEP 3A-1:	**Check the sensor supply voltage and return circuit.**	**4.75 to 5.25 VDC?**	
STEP 3A-2:	**Check for an active fault code.**	**Fault Code 123 inactive?**	
STEP 3B:	**Inspect engine control module and engine harness connector pins.**	**Dirty or damaged pins?**	
STEP 3B-1:	**Check the engine control module response.**	**Fault Code 122 active and Fault Code 123 inactive?**	
STEP 3B-2:	**Check for an active fault code.**	**Fault Code 123 inactive?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 123 inactive?**	
STEP 4B:	**Clear the inactive fault codes.**	**All fault codes cleared?**	

STEP 2B: Check the accelerator pedal or lever position sensor supply voltage and return circuit.

Condition:
- Turn keyswitch OFF.
- Disconnect the accelerator pedal or lever position sensor from the OEM harness.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Measure the voltage from the accelerator pedal or lever position +5 VDC SUPPLY pin to the accelerator pedal or lever position RETURN pin at the sensor connector of the OEM harness. Refer to the wiring diagram for connector pin identification.	4.75 to 5.25 VDC? **YES**	2C
	4.75 to 5.25 VDC? **NO**	3A



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STEP 3B: Check for an inactive fault code.

Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use INSITE™ to read the fault codes.	Fault Code 134 inactive? **YES** **Repair:** The removal and installation of the connector corrected the fault.	4A
	Fault Code 134 inactive? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A

STEP 4: Clear the fault codes.

STEP 4A: Disable the fault code.

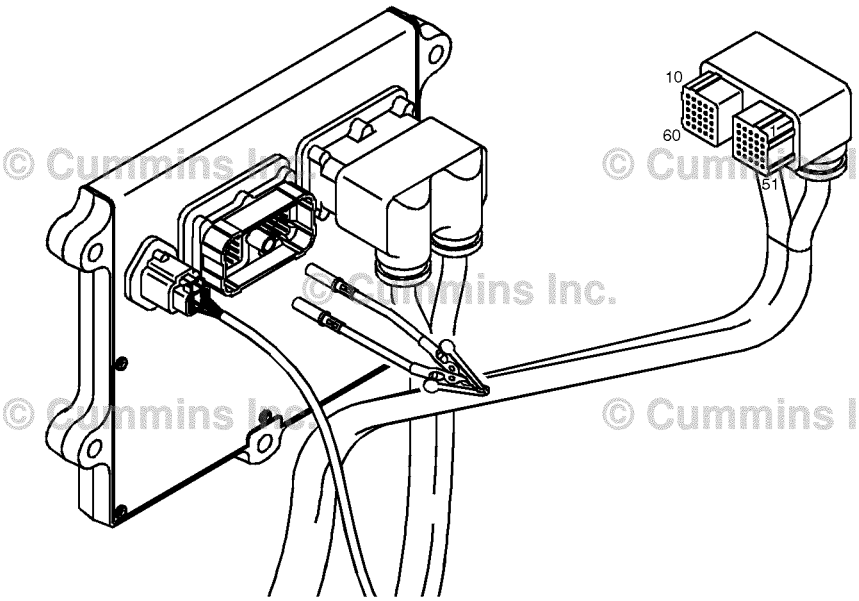
Condition:
- Connect all components.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool, verify that the fault code is inactive.	Fault Code 134 inactive? **YES**	4B
	Fault Code 134 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and rechecked.	1A

STEP 3B-1: Check the engine control module response.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check the ECM response. Place a jumper wire between the oil pressure +5 volt SUPPLY pin and the oil pressure SIGNAL pin at the engine control module engine connector. Refer to the wiring diagram for connector pin identification. Start and idle the engine for 1 minute with the oil temperature higher than 49°C [120°F]. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 135 active and Fault Code 141 inactive? **YES**	3B-2
	Fault Code 135 active and Fault Code 141 inactive? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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FAULT CODE 144 (QSB Marine Application) - Engine Coolant Temperature 1 Sensor Circuit - Voltage Above Normal or Shorted to High Source

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.

⚠CAUTION⚠

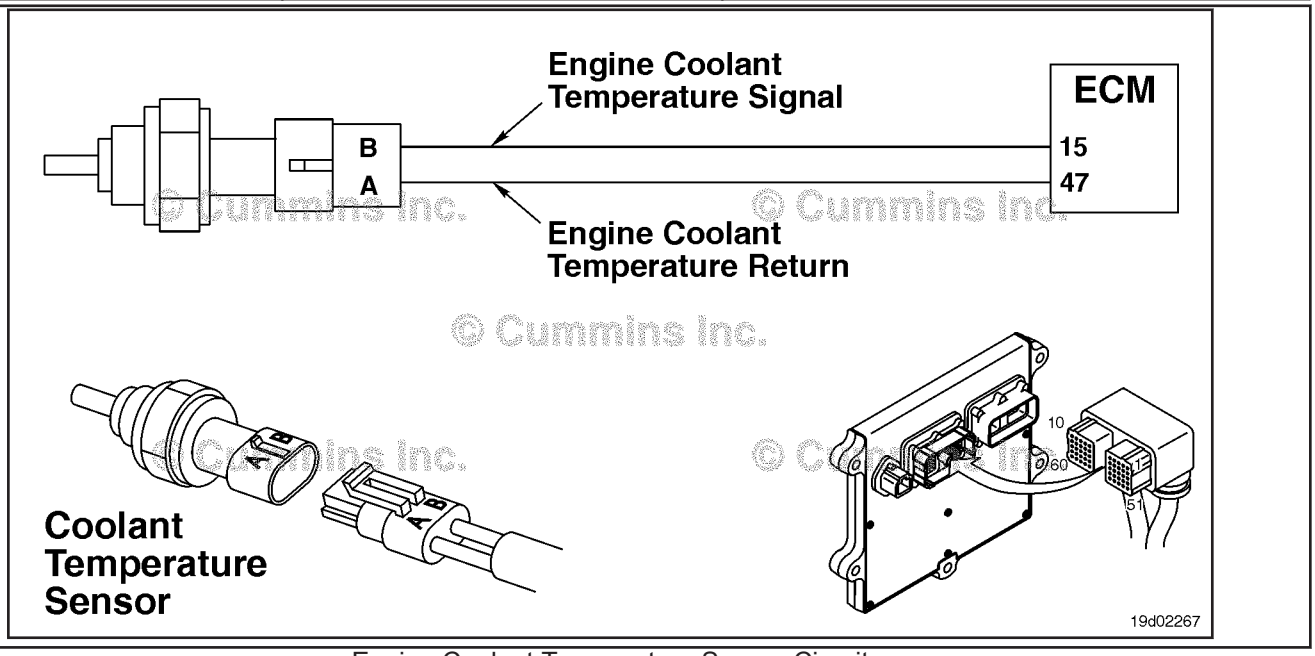
To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - Deutsch/AMP/Metri-Pack test lead and Part Number 3822917 - Deutsch/AMP/Metri-Pack test lead.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	Check for an inactive fault code.	Fault Code 144 inactive?	
STEP 2:	**Check the engine coolant temperature sensor and circuit.**		
STEP 2A:	Inspect the engine coolant temperature sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the sensor resistance.	180 ohms to 160k ohms?	
STEP 2C:	Check the fault codes and verify sensor condition.	Fault Code 144 is active?	
STEP 3:	**Check the ECM and engine harness.**		
STEP 3A:	Inspect the ECM and engine harness connector pins.	Dirty or damaged pins?	
STEP 3B:	Check the ECM response.	Fault Code 145 active and Fault Code 144 inactive?	
STEP 3C:	Check for an open circuit in the engine harness.	Less than 10 ohms?	
STEP 3C-1:	Check for an open circuit in the engine harness.	Less than 10 ohms?	
STEP 3D:	Check for a pin-to-pin short circuit in the engine harness.	Greater than 100k ohms?	
STEP 3E:	Check for an inactive fault code.	Fault Code 144 inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 144 inactive?	
STEP 4B:	Clear the inactive fault codes.	All fault codes cleared?	

Fault Code 146 (QSB Marine Application)

Engine Coolant Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level

CODES	REASON	EFFECT
Fault Code: 146 PID(P), SID(S): P110 SPN: 110 FMI: 0/16 Lamp: Amber SRT:	Engine Coolant Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level. Engine coolant temperature signal indicates engine coolant temperature is above engine protection warning limit.	Marine: calibration dependent.



Engine Coolant Temperature Sensor Circuit

Circuit Description:

The engine coolant temperature sensor is used by the Electronic Control Module (ECM) to monitor the engine coolant temperature. The ECM monitors the voltage on the signal pin and converts this to a temperature value. The engine coolant temperature value is used by the ECM for the engine protection system and engine emissions control.

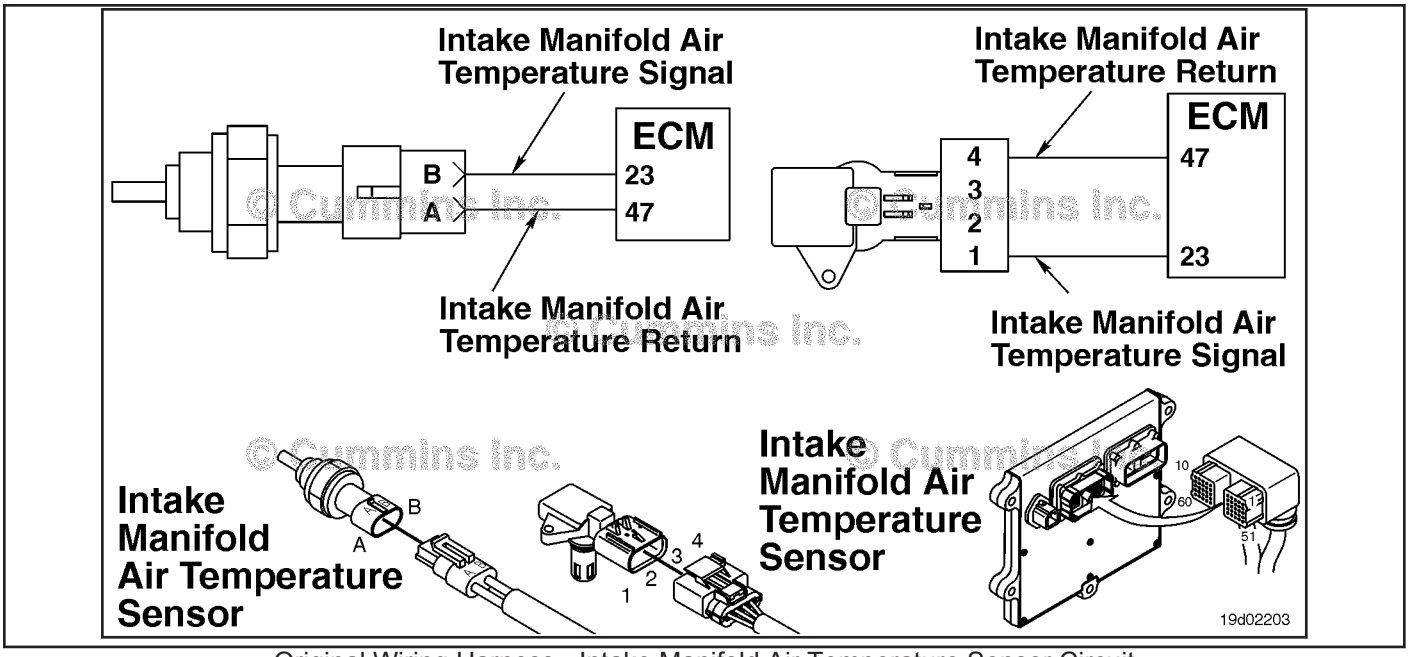
Component Location:

The engine coolant temperature sensor is located on the exhaust side of the engine near the thermostat housing. Refer to Procedure 100-002 for a detailed component location view.

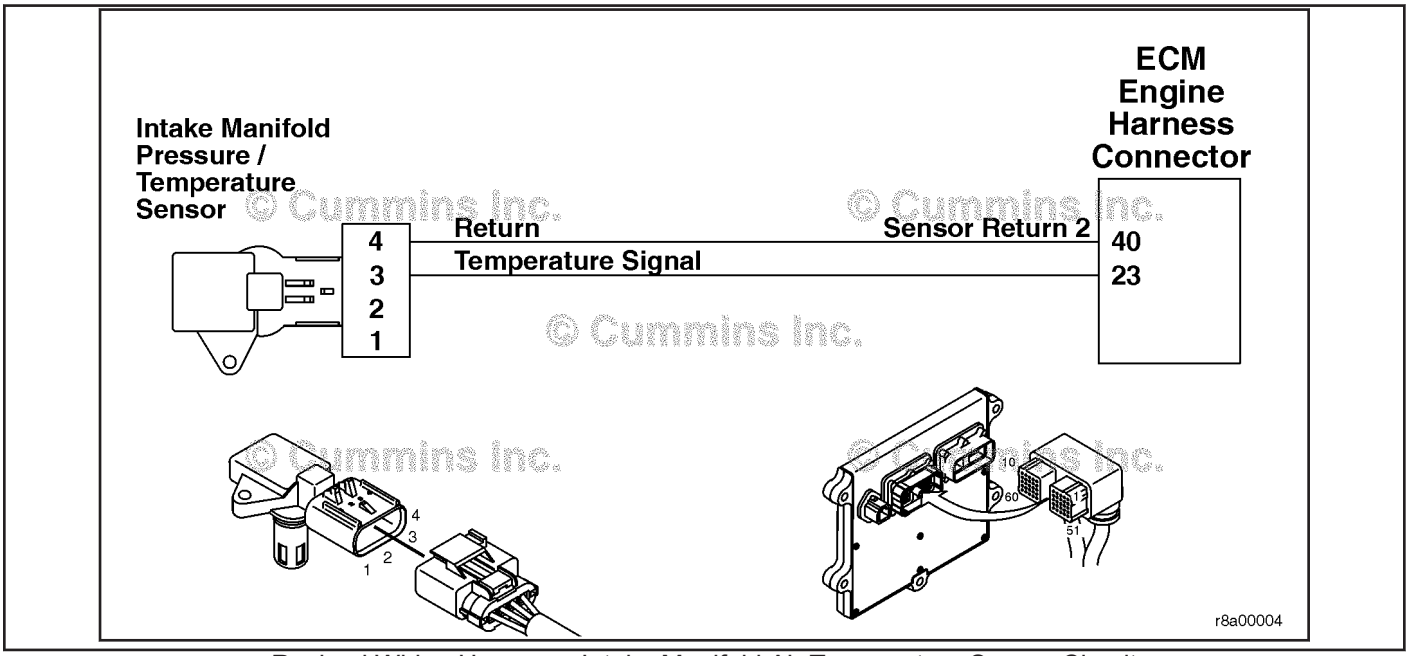
Shop Talk:

This fault code indicates that coolant temperature has exceeded the engine protection limits for high coolant temperature. Refer to Engine Coolant Temperature Above Normal symptom troubleshooting tree.

Refer to Troubleshooting Fault Code t05-146



Original Wiring Harness - Intake Manifold Air Temperature Sensor Circuit



Revised Wiring Harness - Intake Manifold Air Temperature Sensor Circuit

Refer to Troubleshooting Fault Code t05-154.

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for an active fault code.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for an active fault code. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 195 active? **YES**	2A
	Fault Code 195 active? **NO**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.

STEP 2: Check the engine coolant level sensor and circuit.

STEP 2A: Inspect the engine coolant level sensor and connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the OEM harness and engine coolant level sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or OEM harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **NO**	2B

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for sensor supply fault codes.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for sensor supply fault codes. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 352 active? **YES**	Refer to Fault Code 352
	Fault Code 352 active? **NO**	1B

STEP 1B: Check for an inactive fault code.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for an inactive fault code. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 196 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 196 inactive? **NO**	2A

STEP 2D: Check the fault codes and verify sensor condition.

Condition:
- Turn keyswitch OFF.
- Connect the barometric pressure sensor to the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 222 active? **YES** **Repair:** A damaged sensor has been detected. Replace the barometric pressure sensor. Refer to Procedure 019-004 in Section 19.	4A
	Fault Code 222 active? **NO** **Repair:** None. The removal and installation of the connector corrected the fault.	4A

STEP 3: Check the engine control module and engine harness.

STEP 3A: Inspect engine control module and engine harness connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and engine control module engine connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Wire insulation damage • Connector shell broken. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the engine control module engine connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **NO**	3A-1

Multi-Unit Number 3	Multi-Unit Number 2	Multi-Unit Number 1	Description
Inactive	Active	Active	Secondary 2
Active	Inactive	Inactive	Secondary 3
Active	Inactive	Active	Secondary 4
Active	Active	Inactive	Secondary 5
Active	Active	Active	Error Condition

Refer to Troubleshooting Fault Code t05-237

STEP 4: Clear the fault codes.

STEP 4A: Disable the fault code.

Condition:
- Connect all components.
- Turn keyswitch ON.
- Engine **not** running.
- Vehicle **not** moving.

Action	Specification/Repair	Next Step
Disable the fault code. • With the keyswitch ON and the vehicle stationary, wait 1 minute. • Use INSITE™ electronic service tool, verify that Fault Code 242 is inactive.	Fault Code 242 inactive? **YES**	4B
	Fault Code 242 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact your local Cummins® Authorized Repair Location or OEM dealer if all the steps have been completed and checked again.	1A

STEP 4B: Clear the inactive fault codes.

Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Clear the inactive fault codes. • Use INSITE™ electronic service tool to erase the inactive fault codes.	All fault codes cleared? **YES**	Repair complete
	All fault codes cleared? **NO** **Repair:** Troubleshoot any remaining fault codes.	Appropriate troubleshooting steps

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for an active fault code.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for an active fault code. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 271 active? **YES**	2A
	Fault Code 271 active? **NO**	Inactive or Intermittent Fault Code, Refer to Procedure 019-362.

STEP 2: Check the electronic fuel control actuator and circuit.

STEP 2A: Inspect the electronic fuel control actuator and connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the electronic fuel control actuator from the engine harness.

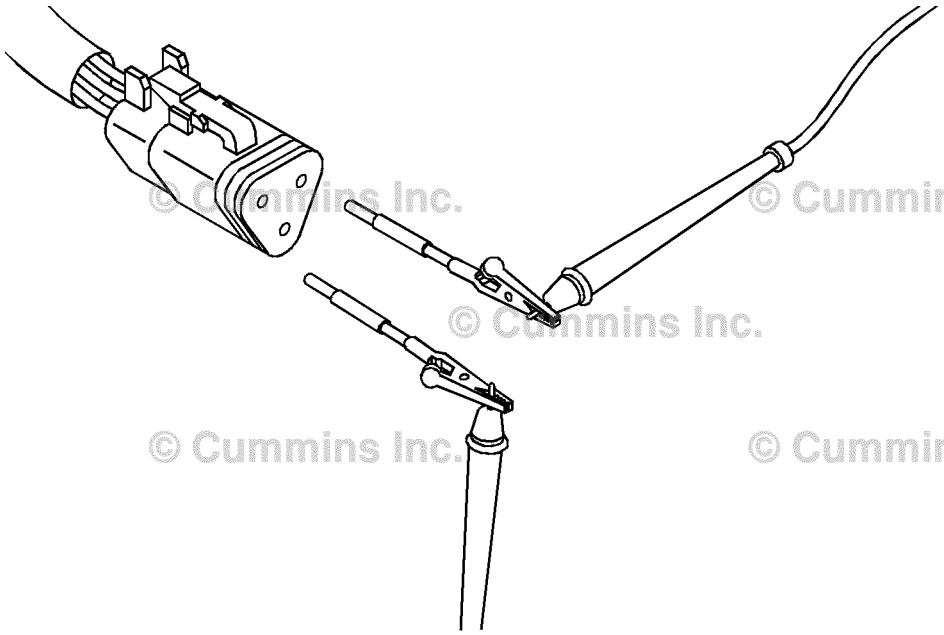
Action	Specification/Repair	Next Step
Inspect the engine harness and actuator connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pin • Connector shell broke • Wire insulation damage • Damaged locking tab connector. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	4A
	Dirty or damaged pins? **NO**	2B

Refer to Troubleshooting Fault Code t05-272

STEP 4B: Check for an open or short circuit in the J1939 data link harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the data link adapter from the service data link connector.

Action	Specification/Repair	Next Step
Check for an open or short circuit. • Measure the resistance between the SAE J1939 data link (+) wire and the SAE J1939 data link (-) wire on the service data link connector. Refer to the circuit diagram or wiring diagram for connector pin identification. Follow the general resistance measurement techniques described in the following procedure and the wiring diagram. Refer to Procedure 019-360 in Section 19.	50 ohms to 70 ohms? **YES**	5A
	50 ohms to 70 ohms? **NO** **Repair:** An open or short has been detected on the service data link connector or harness connection to the J1939 data link backbone. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	6A



anti-theft device or bad Cummins ECM. It may be necessary to contact the OEM for proper multiplexing configuration.

On-Board Diagnostics (OBD) Information:

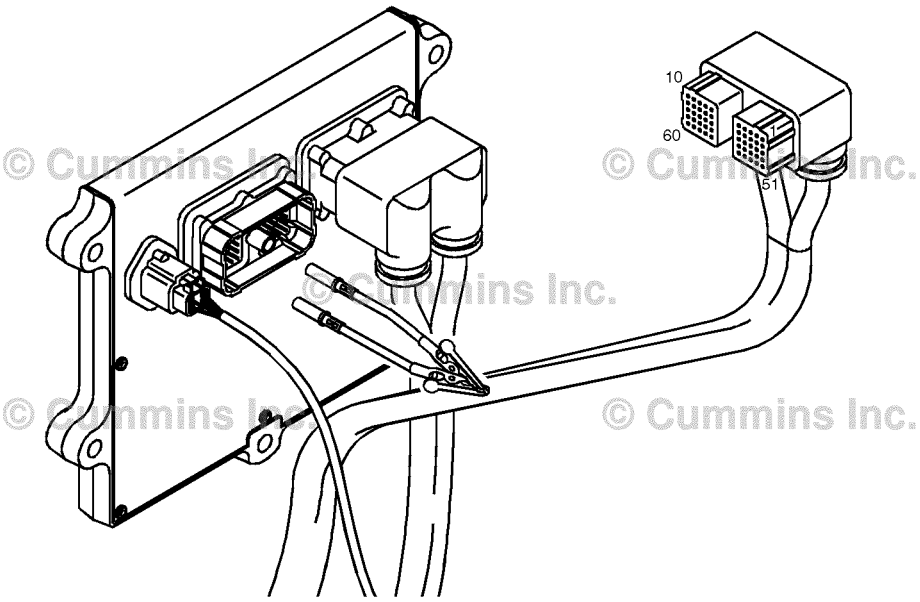
- The ECM illuminates the appropriate amber or red fault lamp when the diagnostic runs and fails.
- The ECM turns off the appropriate fault lamp when the diagnostic runs and passes.

Refer to Troubleshooting Fault Code t05-291

STEP 3C: Check the circuit response.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Place a jumper wire between the barometric pressure +5 volt SUPPLY pin and the barometric pressure SIGNAL pin at the engine control module engine connector. Check for the appropriate circuit response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 221 active? **YES**	3D
	Fault Code 221 active? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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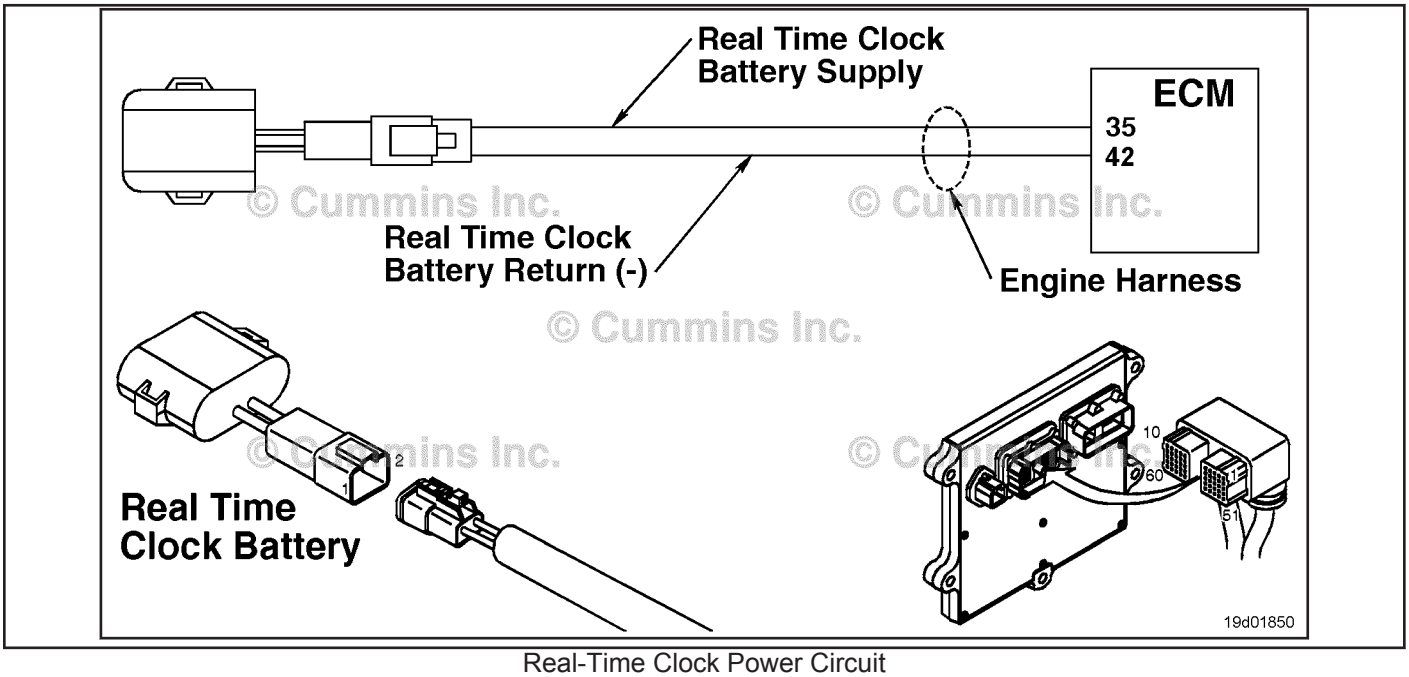
Fault Code 319

Real-Time Clock Power Interrupt - Data Erratic, Intermittent or Incorrect

CODES	REASON	EFFECT
Fault Code: 319 PID(P), SID(S): P251 SPN: 251 FMI: 2/2 Lamp: Amber (Maintenance Flashout) SRT:	Real-Time Clock Power Interrupt - Data Erratic, Intermittent or Incorrect. Real-time clock lost power.	None on performance. Data in the ECM will **not** have accurate time and date information.



Real-Time Clock Power Circuit

Circuit Description:

Under ordinary operating conditions, the real-time clock in the electronic control module (ECM) is powered by the vehicle's batteries. If battery power to the ECM is lost, then the real-time clock will be powered by a battery in the engine harness (if equipped).

Component Location:

The real-time clock battery is secured to the engine harness near the ECM. Refer to Procedure 100-002 (Engine Diagrams) in Section E for a detailed component location view.

Shop Talk:

This fault indicates that the real-time clock in the ECM lost power. Possible causes for this fault are weak or failed real-time clock battery, failed wiring or connectors between the battery and ECM, or the engine is **not** equipped with a real-time clock battery and the vehicle battery power to the ECM is lost.

NOTE: If the Real Time Clock is supplied by the OEM via a CAN BUS and a battery backup is **not** used, then refer to the OEM wiring diagram. If this is the case, then check INSITE™ electronic service tool, “Advanced ECM Data - Real Time Clock Settings.” If the OEM supplies a Real Time Clock signal, then the address **must** be set according to the OEM wiring or the fault code will become active.

Refer to Troubleshooting Fault Code t05-319

STEP 2D: Check for high resistance or an open circuit in the injector solenoid.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injector solenoid.

Action	Specification/Repair	Next Step
Check for an open circuit. • Remove the injector and swap it with an injector in another bank. Refer to Procedure 006-026 in Section 6. • Turn keyswitch ON. • Operate engine and let it idle. • Use INSITE™ electronic service tool to read the fault codes. Note: Cylinders 1, 2, and 3 (Cylinders 1 and 2 for 4-cylinder engines) are on the same injector bank. Cylinders 4, 5, and 6 (Cylinders 3 and 4 for 4-cylinder engines) are on the same injector bank.	Did the fault code follow the injector? **YES** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A
	Did the fault code follow the injector? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	5A

STEP 3: Check the engine harness.

STEP 3A: Inspect the engine harness and injector pass-through connector pins.

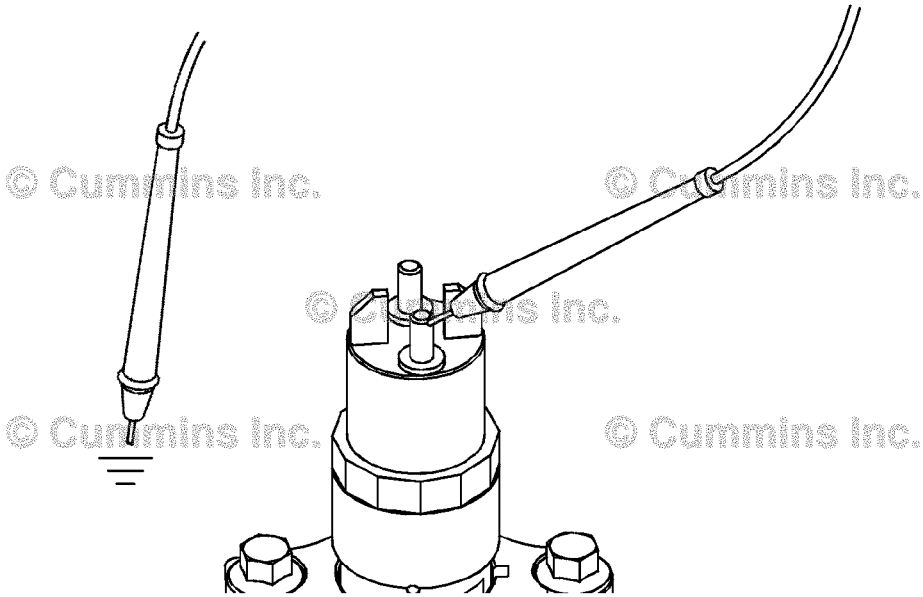
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Inspect the engine harness and connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris on or in the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connectors, or pins, if possible. Repair the engine harness. Refer to Procedure 019-043 in Section 19.	5A
	Dirty or damaged pins? **NO**	3B

STEP 3C: Check the injector solenoids for short circuits to ground.

Condition:
- Turn keyswitch OFF.
- Remove the rocker cover.
- Disconnect the injector harness from the injectors being tested.

Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder 4 SIGNAL pin and engine block ground. • Measure the resistance between the cylinder 5 SIGNAL pin and engine block ground • Measure the resistance between the cylinder 6 SIGNAL pin and engine block ground. Reference the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES** **Repair:** Troubleshoot the engine wiring harness, injector harness, and pass-through connector for a short circuit. • Repair or replace the damaged component.	5A
	Greater than 100k ohms? **NO** **Repair:** Replace the injector. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A



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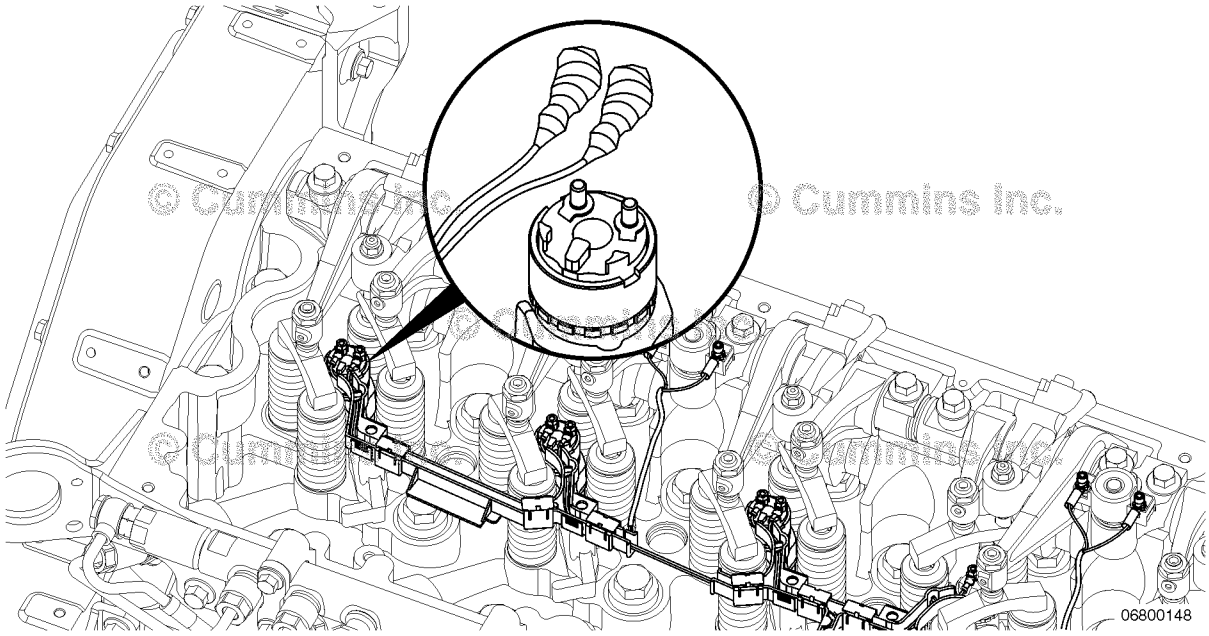
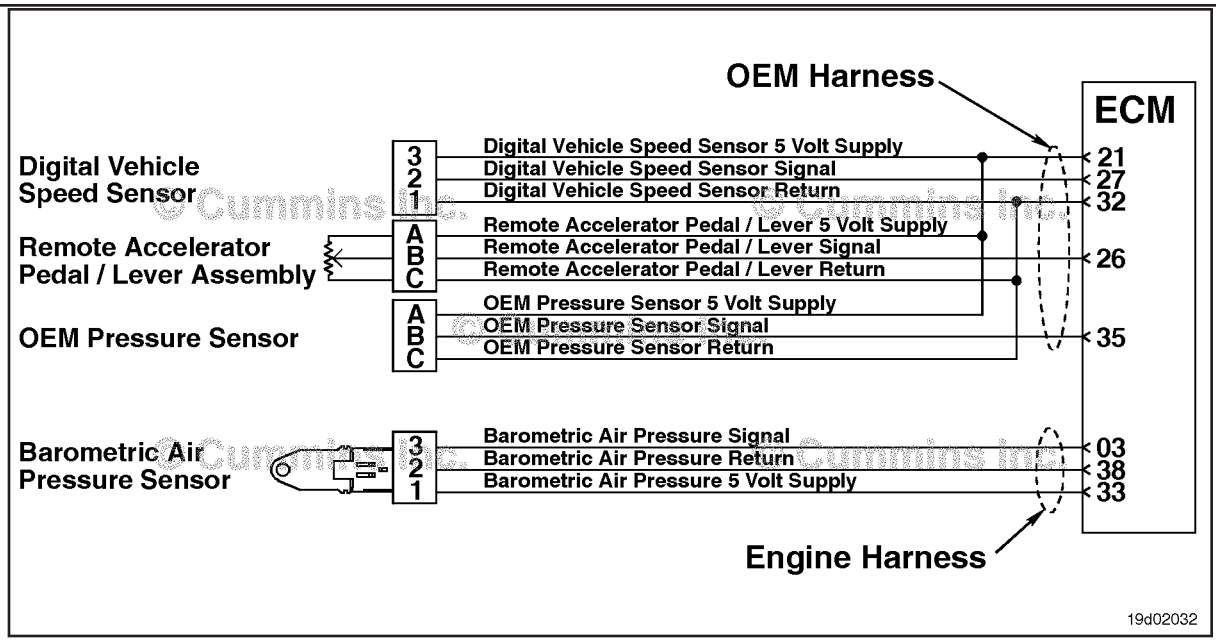
STEP 4A-1: Injector isolation.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Complete injector isolation. • Remove the valve cover. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 003-011 in Section 3. • Disconnect the injector wiring harness from injector number 4. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6. • Place tape on the ends of the injector wiring harness to make sure the harness ends do **not** come in contact with each other or the engine block. • Place the valve cover on the engine. Note: It is **not** necessary to bolt the valve cover in place. Operate the engine and observe the fault codes. • Use INSITE™ electronic service tool to clear the fault codes. • Operate the engine and idle for 1 minute. • Use INSITE™ electronic service tool to read the fault codes.	Multiple (same bank) injector fault codes active? **YES**	4A-2
	Multiple (same bank) injector fault codes active? **NO** **Repair:** Replace injector number 4. Use the following procedure in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Service Manual, Bulletin Number 4021271. Refer to Procedure 006-026 in Section 6.	5A





ISBe CM850 / ISLe CM850 / QSB4.5, QSB5.9, QSB6.7 CM850 / QSC8.3 CM850/ QSL9 CM850 - Sensor Supply Voltage Number 1 Circuit

Refer to Troubleshooting Fault Code t05-386

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for an active fault code.

Condition:
- Turn keyswitch ON
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for an active fault code. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 418 active? **YES**	1B
	Fault Code 418 active? **NO**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.

STEP 1B: Check for water in fuel/water separator bowl.

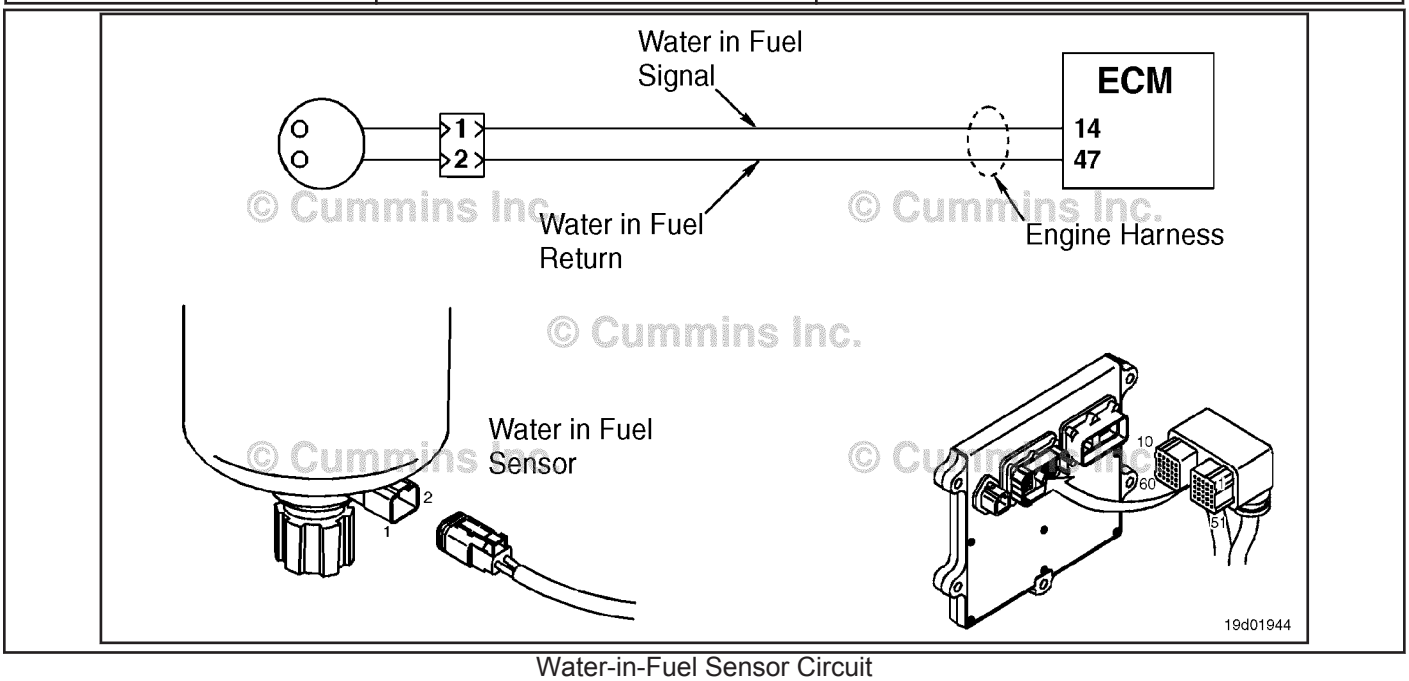
Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Check for water in fuel/water separator bowl. • Drain the water from the fuel filter housing.	Fault Code 418 active? **YES**	2A
	Fault Code 418 active? **NO**	4A

Fault Code 429 (Automotive Application)

Water-in-Fuel Indicator Sensor Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 429 PID(P), SID(S): P097 SPN: 97 FMI: 4/4 Lamp: Amber SRT:	Water-in-Fuel Indicator Sensor Circuit - Voltage Below Normal or Shorted to Low Source. Low voltage detected at the water-in-fuel circuit.	None on performance. No water-in-fuel warning available.



Water-in-Fuel Sensor Circuit

Circuit Description:

The water-in-fuel sensor is attached to the fuel filter. The water-in-fuel sensor sends a signal to the ECM when a set volume of water has accumulated in the fuel filter. The water-in-fuel circuit contains two wires: A return ground and a signal wire.

Component Location:

The water-in-fuel sensor is integrated into the bottom of the OEM supplied suction fuel filter. The OEM supplied fuel filter is located on the intake side of the engine. For marine applications the water-in-fuel sensor is mounted in a filter housing which contains a serviceable element. The filter housing location will vary with each OEM.

Shop Talk:

The water-in-fuel sensor is integrated into the fuel filter; it is automatically replaced whenever the fuel filter is replaced. For marine applications the sensor is **not** integrated into the fuel filter and is a serviceable item. Possible causes of this fault code include:

- Signal circuit shorted to ground in the harness, sensor, or connector.

Refer to Troubleshooting Fault Code t05-429

TROUBLESHOOTING STEP

STEP 1: Check the NISS.

STEP 1A: Verify the NISS is connected to the OEM harness.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Verify the NISS is connected to the OEM harness. -	NISS is connected to the OEM harness? **YES**	1B
	NISS is connected to the OEM harness? **NO** **Repair:** Connect the NISS to the OEM harness. Refer to the OEM service manual.	3A

STEP 1B: Inspect the NISS and connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the NISS from the OEM harness.

Action	Specification/Repair	Next Step
Inspect the connector pins for the following:Inspect the OEM harness and NISS connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM or OEM harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19.	3A
	Dirty or damaged pins? **NO**	1C

Conditions for Setting the Fault Codes:

The ECM detects that primary ECM power supply dropped below 6.2 VDC while the keyswitch was in the ON position. The fault code will be active when the keyswitch is turned on following the incomplete power-down event.

Action Taken When the Fault Code is Active:

- The ECM records the fault code immediately when the diagnostic runs and fails.
- Power-down data like trip information, maintenance monitor, and fault code information will **not** get saved to permanent memory when the keyswitch is turned off.

Conditions for Clearing the Fault Code:

The ECM **must** see primary ECM battery voltage above 6.2 VDC when the keyswitch is turned off before the fault code will go inactive.

Shop Talk:

This fault is set active if the ECM battery supply voltage drops below 6.2 VDC while the keyswitch is in the ON position.

Make sure the ECM unswitched battery supply is coming directly from the battery and **not** the starter. If unswitched power is coming from the starter, it is possible for the battery voltage to drop low enough during cranking to set this fault active.

This fault can also be caused by resistance in the ECM battery supply (+) or (-) circuits. Resistance in these circuits can cause the voltage level at the ECM input to drop low enough to set Fault Code 434 active.

This fault can also be caused by a short to ground in the injector wiring harness. Check the injector wires are oriented so that they will **not** interfere with a rocker lever or other component in the overhead system. Remove the valve cover and check for proper alignment of the injector wiring harness.

On-Board Diagnostics (OBD) Information (Euro 4 Certified Engines):

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared using the INSITE™ service tool.
- The fault code will be cleared from memory after 40 consecutive drive cycles where the diagnostic runs and passes.

On-Board Diagnostics (OBD) Information (Euro 4 Stage 1+ Certified Engines):

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- An engine torque derate will be activated after 50 hours of engine operation with the fault code active.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 1 ignition cycle that the diagnostic runs and does **not** fail. The MIL lamp **cannot** be cleared using the INSITE™ service tool.
- The fault code will be cleared from memory after 400 days or 9600 hours of engine operation.

Refer to Troubleshooting Fault Code t05-434

TROUBLESHOOTING STEP

STEP 1: Check the battery.

STEP 1A: Check the battery connections.

Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Check the battery voltage. • Check the battery terminal connections on both positive (+) and negative (-) terminals.	Connections tight and corrosion-free? **YES**	1B
	Connections tight and corrosion-free? **NO** **Repair:** Tighten the loose connections, and clean the terminals. Refer to the OEM service manual.	4A

STEP 8B: **Clear the inactive fault codes.** **All fault codes cleared?**

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Read the fault codes.

Condition:
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Read the fault codes. • Start the engine and let it idle for one minute. • Use INSITE™ electronic service tool to read the fault codes. • Check for fault codes related to the fuel pump actuator shorted low or high.	Are Fault Code(s) 271, 272, 2311, or 1117 active or high inactive counts? **YES**	Appropriate Troubleshooting Tree
	Are Fault Code(s) 271, 272, 2311, or 1117 active or high inactive counts? **NO**	2A

STEP 2: Check for air in the fuel.

STEP 2A: Check for air in the fuel.

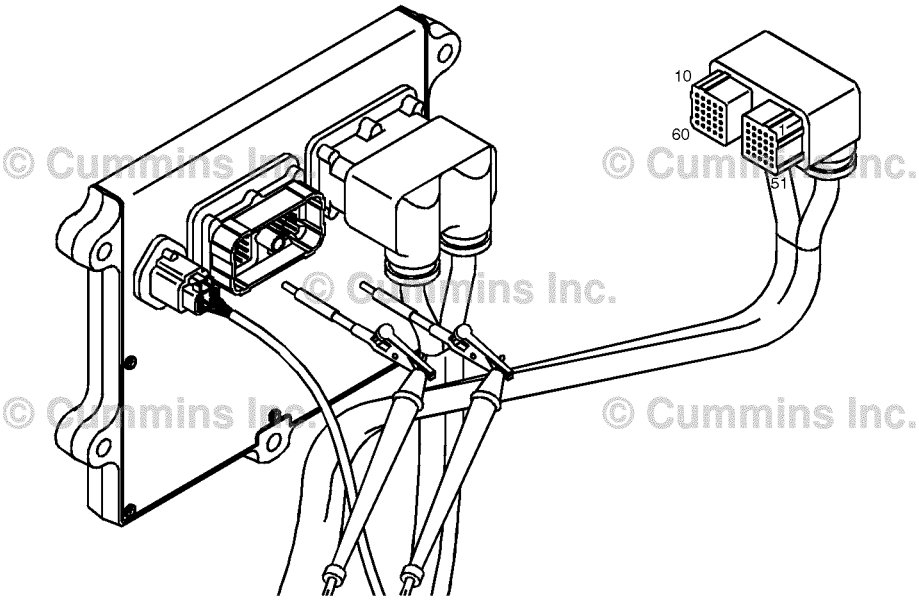
Condition:
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check for air in the fuel.	Air in the fuel? **YES** **Repair:** Air detected Correct the source of the air leak. Use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe4, and QSL9 Engines Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-003 in Section 6.	Appropriate Troubleshooting Tree
	Air in the fuel? **NO**	3A

STEP 3A-1: Check the sensor supply voltage and return circuit.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the rail fuel pressure +5 volt SUPPLY pin to the rail fuel pressure RETURN pin at the ECM engine connector. Refer to the wiring diagram for connector pin identification.	4.75-VDC to 5.25-VDC? **YES**	3A-2
	4.75-VDC to 5.25-VDC? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



STEP 3: Check the ECM and engine harness.

STEP 3A: Inspect ECM and engine harness connector pins.

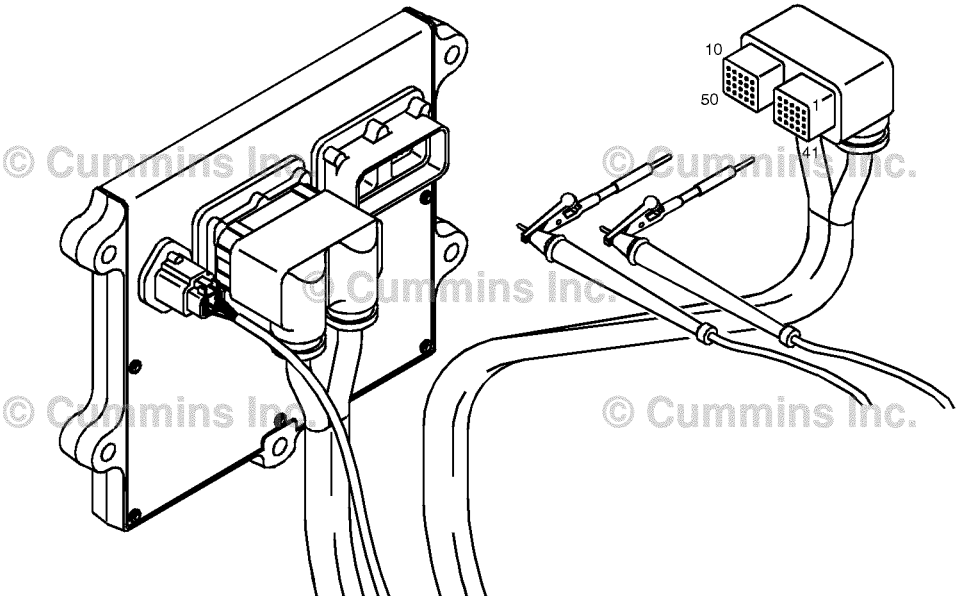
Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM connector.

Action	Specification/Repair	Next Step
Inspect the engine harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or engine harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-043 in Section 19.	4A
	Dirty or damaged pins? **NO**	3A-1

STEP 3B: Check for a pin-to-pin short circuit in the OEM harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM.
- Disconnect the alternate torque switch from the OEM harness.

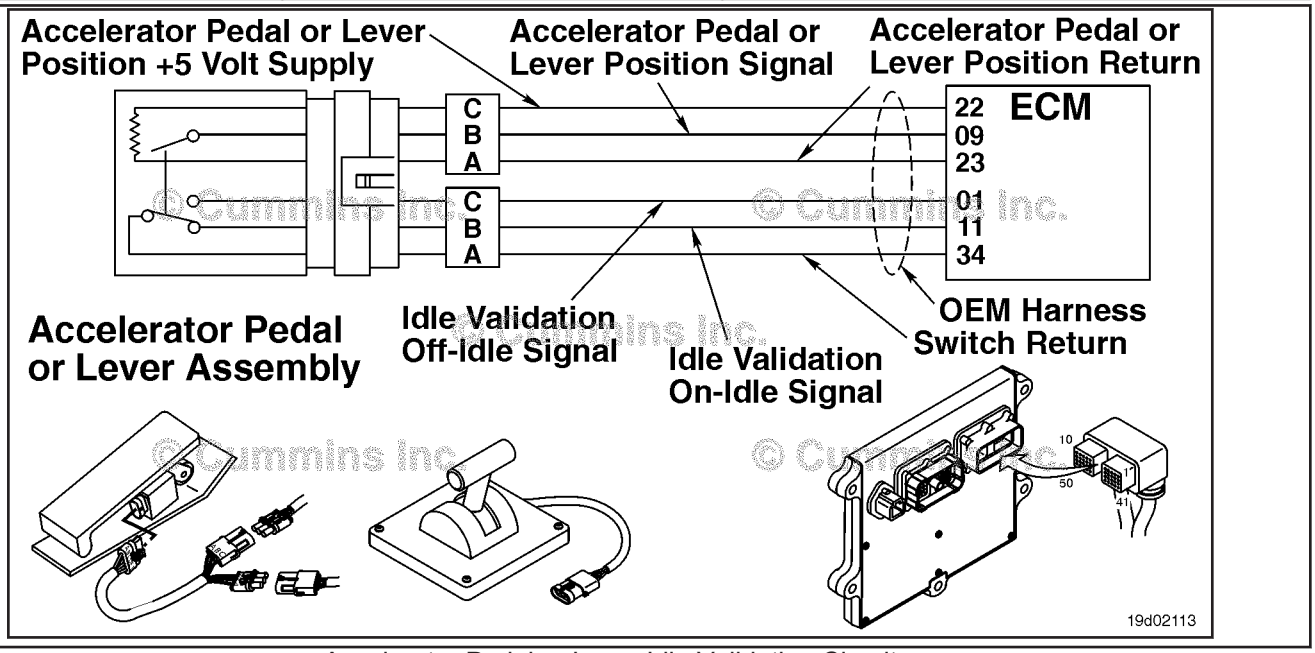
Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Measure the resistance between the alternate torque switch pin in the OEM harness ECM connector and all other pins in the OEM connector. Refer to the circuit diagram or the wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100K ohms? **YES**	3C
	Greater than 100K ohms? **NO** **Repair:** A pin-to-pin short circuit on the alternate torque switch circuit has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	4A



Fault Code 551 (NISS)

Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal or Shorted to Low Source

CODES	REASON	EFFECT
Fault Code: 551 PID(P), SID(S): S230 SPN: 558 FMI: 4/4 Lamp: Amber SRT:	Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal or Shorted to Low Source. No voltage detected simultaneously on both the idle validation off-idle and on-idle circuits.	Automotive: Engine will **only** idle. Marine: Severe derate in engine speed. Limp home capability **only**.



Accelerator Pedal or Lever Idle Validation Circuit

Circuit Description:

The idle validation switch is used by the electronic control module (ECM) to indicate when the accelerator pedal or lever is released (on-idle) or depressed (off-idle). The switch is adjusted by the accelerator pedal or lever manufacturers to switch from on-idle to off-idle at the correct accelerator pedal or lever position. The switch return is a shared return with other OEM cab switches.

Component Location:

The nonintegrated sensor switch (NISS) is located on the accelerator pedal or lever assembly.

Shop Talk:

- This fault code is usually caused by a short circuit to ground in the harness, an uncalibrated accelerator pedal or lever assembly, or a miswired idle validation switch.
- When installing a new accelerator pedal or lever assembly, it **must** be calibrated before operating the engine. To calibrate, turn the keyswitch to the ON position and fully depress and release the pedal or lever three times.

Refer to Troubleshooting Fault Code t05-551

FAULT CODE 554 - Injector Metering Rail 1 Pressure - Data Erratic, Intermittent, or Incorrect

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check for sensor circuit fault codes.**		
STEP 1A:	**Check for Fault Codes 451 and 452**	**Fault Code 451 or 452 is active?**	
STEP 2:	**Check the rail fuel pressure sensor and circuit.**		
STEP 2A:	**Inspect the rail fuel pressure sensor and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the circuit response.**	**Fault Code 451 active?**	
STEP 2C:	**Check the circuit response.**	**Fault Code 452 active?**	
STEP 3:	**Check the ECM and engine harness.**		
STEP 3A:	**Inspect CM and engine harness connector pins.**	**Dirty or damaged pin?**	
STEP 3B:	**Check the circuit response.**	**Fault Code 451 active?**	
STEP 3C:	**Check the circuit response.**	**Fault Code 452 active?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 554 inactive?**	
STEP 4B:	**Clear the inactive fault codes.**	**All faults cleared?**	

TROUBLESHOOTING STEP

STEP 1: Check for sensor circuit fault codes.

STEP 1A: Check for Fault Codes 451 and 452.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for active fault codes. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 451 or 452 is active? **YES**	Appropriate troubleshooting tree.
	Fault Code 451 or 452 is active? **NO**	2A

FAULT CODE 585 - Starter Relay Circuit - Voltage Below Normal or Shorted to Low Source

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.

⚠CAUTION⚠

To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.

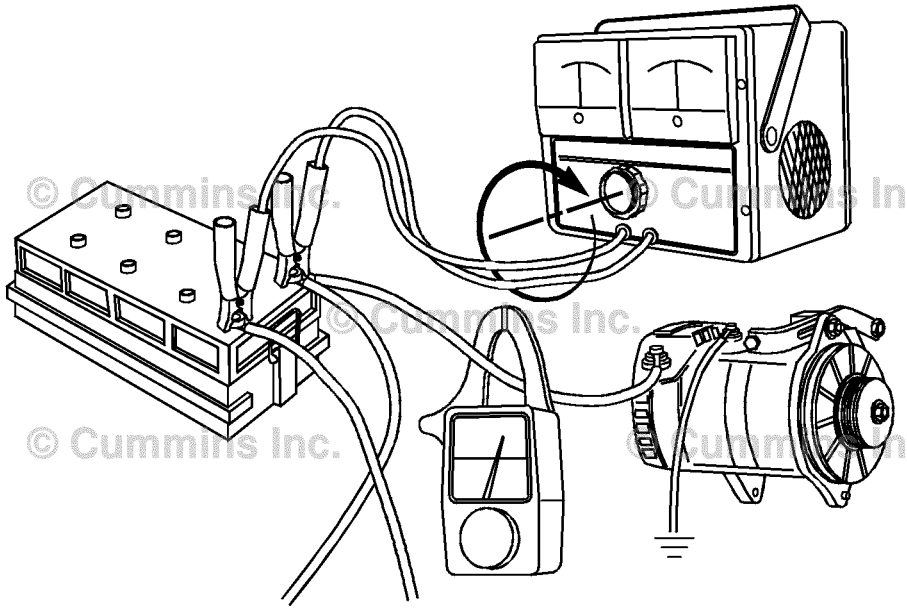
STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	Check for an active fault code.	Fault Code 585 active?	
STEP 2:	**Check starter lockout relay and circuit.**		
STEP 2A:	Inspect starter relay and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the starter lockout relay resistance.	Greater than 6 ohms?	
STEP 2B-1:	Check for a pin to ground short circuit in the starter lockout relay.	Greater than 100k ohms?	
STEP 2C:	Check the starter lockout relay diagnostic supply voltage, supply line and return circuit.	Greater than 3.75-VDC?	
STEP 3:	**Check the OEM harness.**		
STEP 3A:	Inspect ECM and OEM harness connector pins.	Dirty or damaged pins?	
STEP 3B:	Check for a short circuit to ground in the OEM harness.	Greater than 100k ohms?	
STEP 3C:	Check for a pin-to-pin short circuit in the OEM harness.	Greater than 100k ohms?	
STEP 3D:	Check for an inactive fault code.	Fault Code 585 is inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 585 inactive?	
STEP 4B:	Clear the inactive fault codes.	All faults cleared?	

STEP 2: Check the charging system.

STEP 2A: Inspect the alternator.

Condition:
- Turn keyswitch OFF.
- Use OEM ammeter or install an ammeter between the alternator and the battery.

Action	Specification/Repair	Next Step
Check the charging rate of the alternator. • Start the engine and check the alternator's charging rate (amps). NOTE: It will probably be necessary to place a load on the batteries to measure the alternator output properly.	Is the alternator charging within OEM specifications? **YES**	3A
	Is the alternator charging within OEM specifications? **NO** **Repair:** Repair or replace the alternator, regulator, and/or OEM wiring to the alternator. Refer to the OEM service manual.	3A



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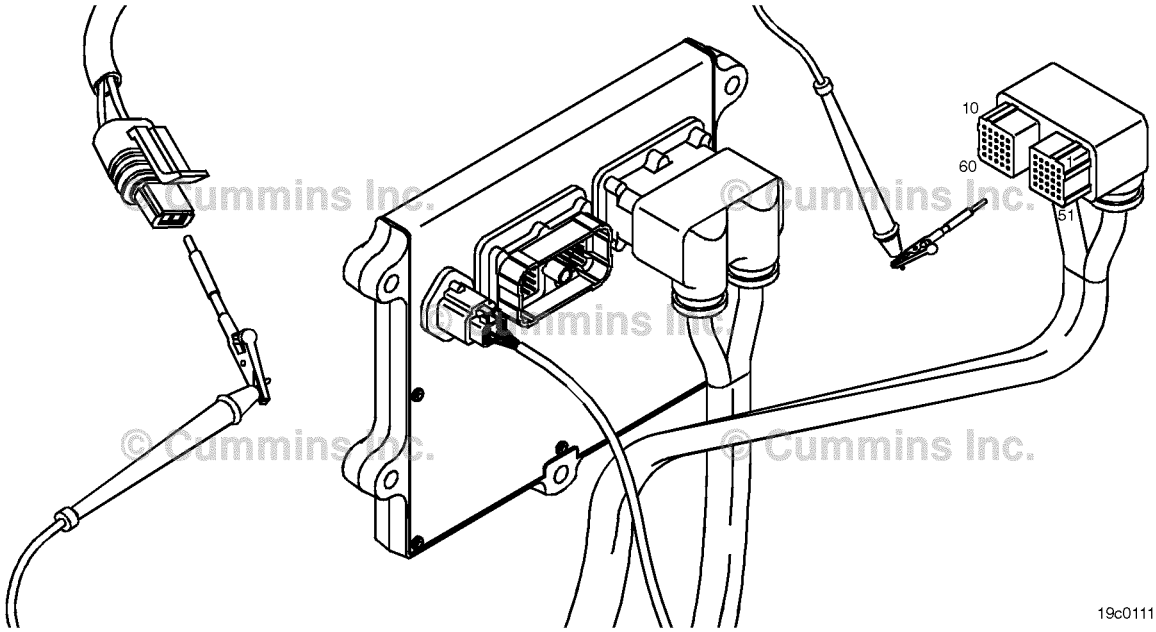
STEP 2D: Check for an open circuit.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the turbocharger speed sensor from the engine harness.

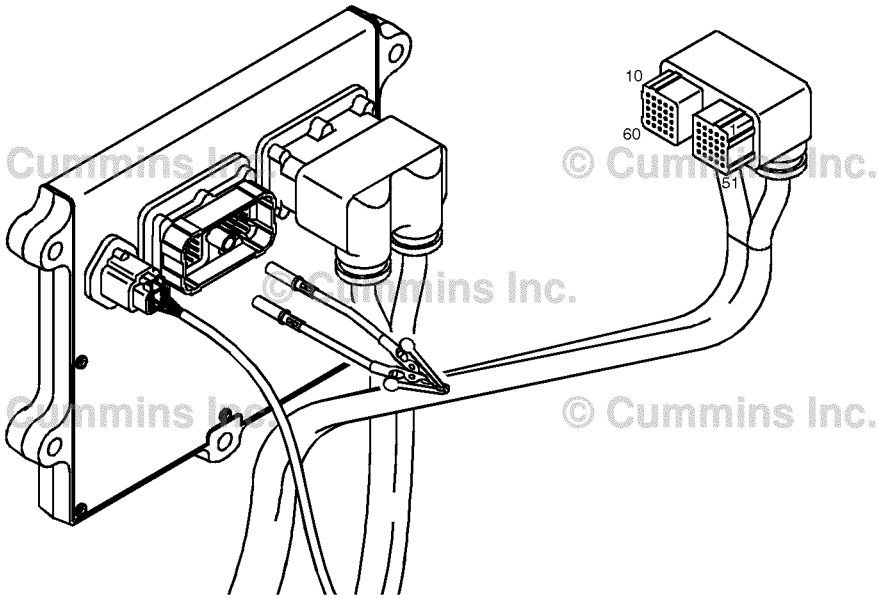
Action	Specification/Repair	Next Step
Check for an open circuit. • Measure the resistance between the turbocharger speed SIGNAL pin at the ECM connector of the engine harness and the turbocharger speed SIGNAL pin at the turbocharger speed sensor connector of the engine harness. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Less than 10 ohms? **YES**	2E
	Less than 10 ohms? **NO** **Repair:** Repair or replace the engine harness.	3A



STEP 2E-1: Check the ECM response.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Place a jumper wire between the crankshaft engine speed SUPPLY pin and the crankshaft engine speed SIGNAL pin at the ECM port. Check for the appropriate ECM response. • Read the crankshaft engine speed sensor state using the INSITE™ electronic service tool monitor mode. Refer to the circuit diagram or wiring diagram for connector pin identification.	Monitor crankshaft engine speed sensor state equals high? **YES** **Repair:** Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19.	4A
	Monitor crankshaft engine speed sensor state equals high? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



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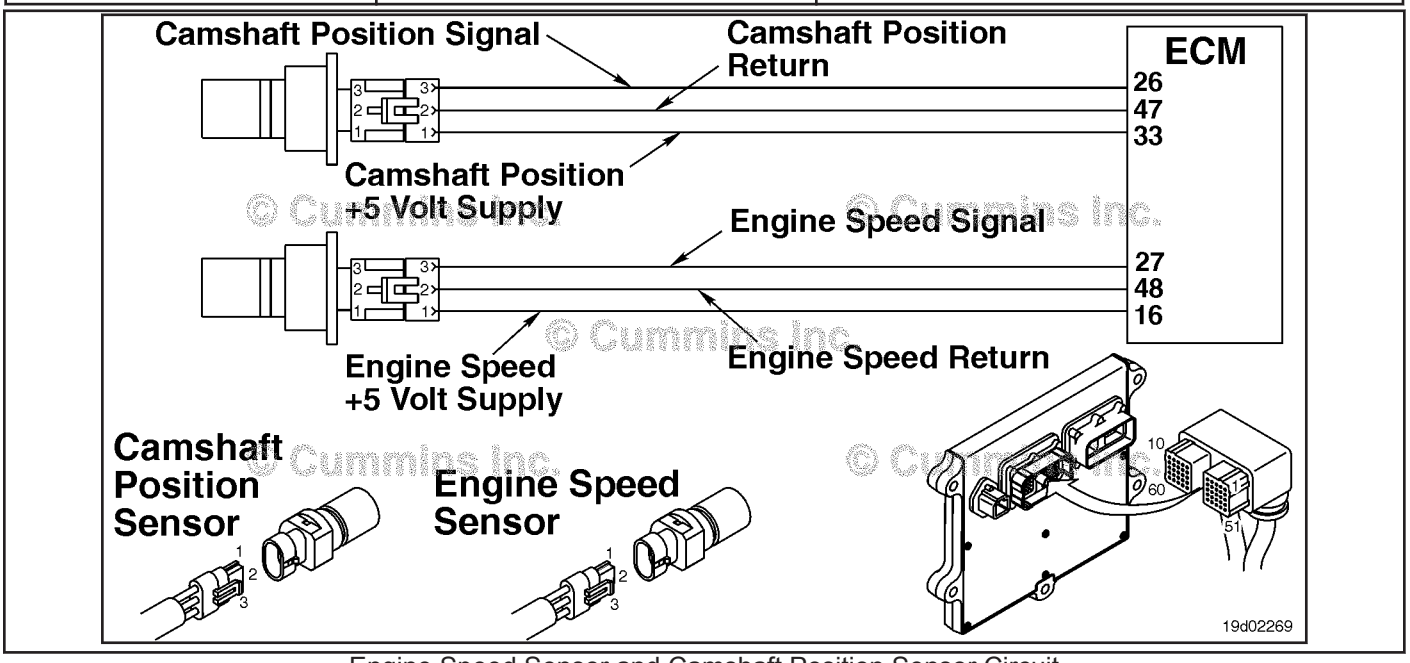
Fault Code 731 (QSB Marine Application)

Engine Speed Sensor/Position Camshaft and Crankshaft Misalignment - Mechanical System Not Responding Properly or Out of Adjustment

CODES	REASON	EFFECT
Fault Code: 731 PID(P), SID(S): S064 SPN: 723 FMI: 7/7 Lamp: Amber SRT:	Engine Speed Sensor/Position Camshaft and Crankshaft Misalignment - Mechanical System Not Responding Properly or Out of Adjustment. Mechanical misalignment between the crankshaft and camshaft engine speed sensors.	Engine will run derated. Excessive smoke, hard start, and rough idle possible.



Engine Speed Sensor and Camshaft Position Sensor Circuit

Circuit Description:

The engine speed sensor and camshaft position sensor provide an engine speed and position signal to the electronic control module (ECM) through the engine harness.

Component Location:

Refer to Procedure 100-002 (Engine Views) in Section E for a detailed component location view.

Shop Talk:

This fault will become active anytime the ECM receives a signal from both the primary EPS (crankshaft sensor) and the backup EPS (camshaft sensor), and the ECM determines that the camshaft and crankshaft signals are **not** in the correct phase. If this fault code is active immediately following a repair that includes camshaft removal, it is likely that the camshaft gear was installed incorrectly and is **not** timed correctly.

Refer to Troubleshooting Fault Code t05-731

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement:Part Number 3163151 - Electronic Control Module (ECM) Bench Calibration HarnessPart Number 3164185 - ECM Bench Calibration Adapter Cable.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check for adaptive cruise control hardware.**		
STEP 1A:	**Check for correct hardware.**	**Is adaptive cruise hardware installed on the vehicle?**	
STEP 2:	**Check SAE J1939 communications.**		
STEP 2A:	**Check for ECM communication with INSITE™ electronic service tool.**	**Does INSITE™ electronic service tool communicate with the ECM?**	
STEP 2B:	**Inspect the OEM harness and ECM connector pins.**	**Dirty or damaged pins?**	
STEP 2C:	**Check ECM communication with the ECM bench calibration harness.**	**Does INSITE™ electronic service tool communicate with the ECM?**	
STEP 3:	**Clear the fault codes.**		
STEP 3A:	**Disable the fault code.**	**Fault Code 784 inactive?**	
STEP 3B:	**Clear the inactive fault codes.**	**All fault codes cleared?**	

TROUBLESHOOTING STEP

STEP 1: Check for adaptive cruise control hardware.

STEP 1A: Check for correct hardware.

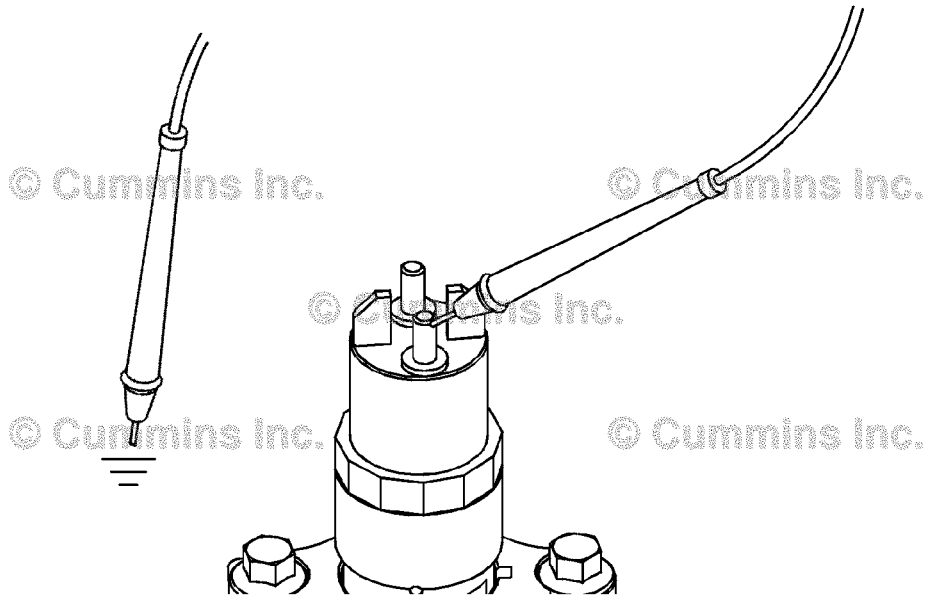
Condition:
- Turn keyswitch OFF.

Action	Specification/Repair	Next Step
Check the hardware. • Verify that the adaptive cruise hardware is installed on the vehicle.	Is adaptive cruise hardware installed on the vehicle? **YES**	2A
	Is adaptive cruise hardware installed on the vehicle? **NO** **Repair:** Use INSITE™ electronic service tool, disable the adaptive cruise feature.	3A

STEP 4F: Check the injector solenoids for short circuits to ground.

Condition:
- Turn keyswitch OFF.
- Disconnect all injector pass-through connectors from the engine harness.
- Disconnect the injector harness from the injectors being tested.

Action	Specification/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance between the cylinder number 1 DRIVER pin and engine block ground. • Measure the resistance between the cylinder number 2 DRIVER pin and engine block ground. • Measure the resistance between the cylinder number 3 DRIVER pin and engine block ground. • Measure the resistance between the cylinder number 4 DRIVER pin and engine block ground. • Measure the resistance between the cylinder number 5 DRIVER pin and engine block ground. • Measure the resistance between the cylinder number 6 DRIVER pin and engine block ground. Use a wiring diagram for pin identification and the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES** **Repair:** Repair or replace the injector harness. Refer to Procedure 019-063 in Section 19.	5A
	Greater than 100k ohms? **NO** **Repair:** Replace the injector(s). • For ISC, QSC, and ISL engines, use the following procedure in the ISC, ISCe, QSC8.3, ISL, ISLe3, ISLe4 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Refer to Procedure 006-026 in Section 6. • For ISB engines, use the following procedure in the ISB, ISBe, QSB (Common Rail Fuel System) Engines, Service Manual, Bulletin 4021271. Refer to Procedure 006-026 in Section 6.	5A



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FAULT CODE 1144 - Injector Solenoid Driver Cylinder 5 - Mechanical System Not Responding Properly or Out of Adjustment

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for Fault Code 1144.**	**Active or high inactive counts of Fault Code 1144, excessive exhaust smoke, and loud engine knock occurs?**	
STEP 2:	**Check the fuel system.**		
STEP 2A:	**Check for a stuck open injector.**	**Does the engine knock, and excessive exhaust smoke go away and Fault Code 1144 is inactive?**	
STEP 2A-1:	**Check for progressive cylinder damage. Measure engine crankcase blowby.**	**Is the crankcase blowby measurement within the specified limit?**	
STEP 3:	**Reset the fault code.**		
STEP 3A:	**Disable the fault code.**	**Fault Code 1144 inactive?**	
STEP 3B:	**Reset the inactive fault codes.**	**All fault codes reset?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for Fault Code 1144.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for an inactive fault code. • Use INSITE™ electronic service tool to read the fault codes.	Active or high inactive counts of Fault Code 1144, excessive exhaust smoke, and loud engine knock occurs? **YES**	2A
	Active or high inactive counts of Fault Code 1144, excessive exhaust smoke, and loud engine knock occurs? **NO**	3A

STEP 2D: Check the fault codes and verify accelerator pedal condition.

Condition:
- Turn keyswitch OFF.
- Connect the accelerator pedal to the OEM harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate ECM response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 1241 active? **YES** **Repair:** A damaged accelerator pedal has been detected. Contact the appropriate OEM or dealership for repair instructions. Replace the accelerator pedal. Refer to the OEM service manual.	4A
	Fault Code 1241 active? **NO** **Repair:** None. The removal and installation of the connector corrected the problem.	4A

STEP 3: Check the ECM and OEM harness.

STEP 3A: Inspect the ECM and OEM harness connector pins.

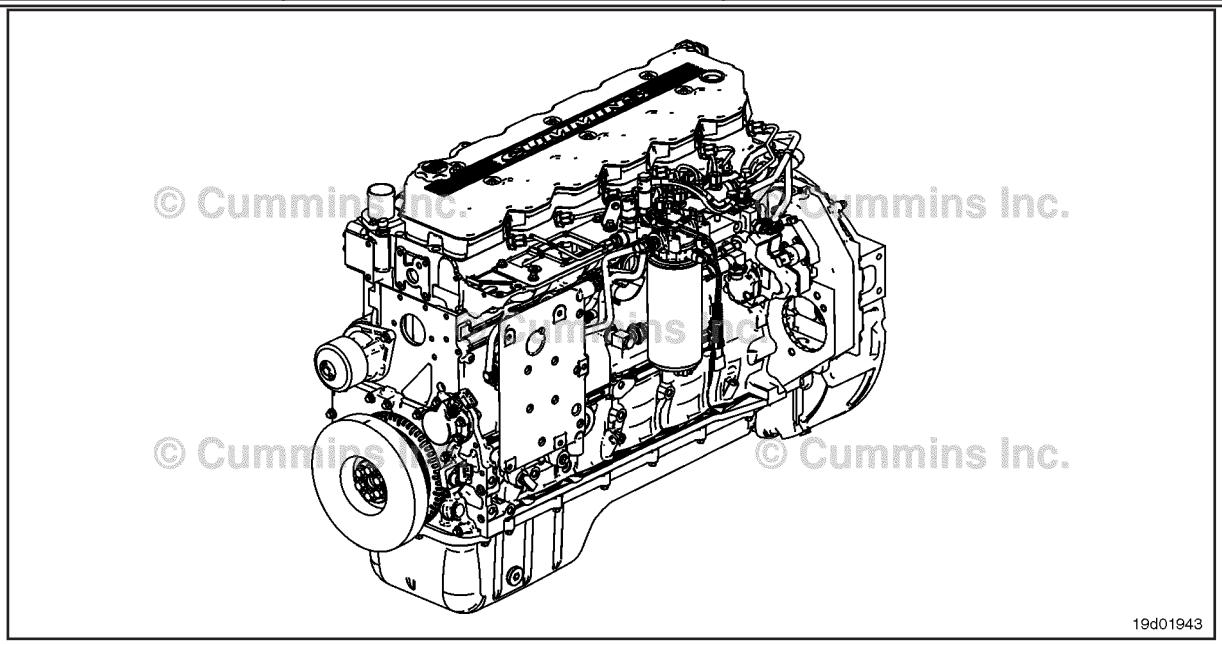
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the ECM connector.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the ECM connector or OEM harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **NO**	3B

Fault Code 1656

Engine Misfire Cylinder 3 - Condition Exists.

CODES	REASON	EFFECT
Fault Code: 1656 PID(P), SID(S): SPN: 1325 FMI: 11/31 Lamp: Amber SRT:	Engine Misfire Cylinder 3 - Condition Exists. Engine misfire has been detected in cylinder number 3.	Possible low power, rough idle, or misfire.



Circuit

Circuit Description:

An algorithm in the ECM calibration monitors engine speed as each injector fires while the engine is at idle. If a cylinder has high or low contribution to engine speed, this fault will become active. The intention of this fault is to assist in troubleshooting performance complaints such as engine misfire and low power.

Component Location:

The ECM is located on the intake side of the engine. Refer to Procedure 100-002 (Engine Diagrams) in Section E for a detailed component location view.

Shop Talk:

If Fault Code 1656 is inactive in the ECM memory and there is no complaint such as “low power” or “engine misfire”, it is possible that an intermittent event such as air entering the fuel system following a filter change caused the fault. Inactive counts of Fault Code 1656 should be disregarded unless other performance symptoms are present. The engine coolant temperature must be greater than 71°C [160°F] before this diagnostic will run.

Causes of cylinder misfire can include:

- Valve lash out of specification (compare actual valve lash to reset limits)
- Cylinder failure (check for high blowby when the engine is loaded)
- Valve failure or valve held open (listen for intake valve “chirping” noise in the intake)
- Cylinder head or gasket failure (look for signs of oil, coolant, or casting flash in the intake or exhaust passages)
- Extreme camshaft wear (inspect the camshaft lobes for wear)

FAULT CODE 1665 - Exhaust Gas Temperature 1 Circuit - Voltage Below Normal, or Shorted to Low Source

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.

⚠CAUTION⚠

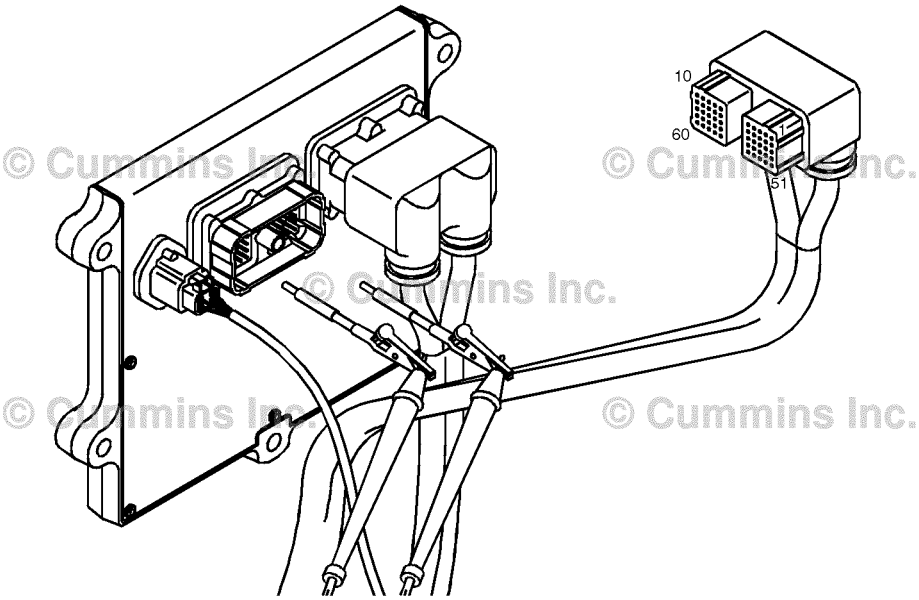
To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	Check for an inactive fault code.	Fault Code 1665 inactive?	
STEP 2:	**Check the exhaust gas temperature #1 sensor and circuit.**		
STEP 2A:	Inspect the exhaust gas temperature #1 sensor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check the circuit response.	Fault Code 1666 active and fault code 1665 inactive?	
STEP 2C:	Check the fault codes and verify sensor condition.	Fault Code 1665 is active?	
STEP 3:	**Check the ECM and engine harness.**		
STEP 3A:	Inspect the ECM and engine harness connector pins.	Dirty or damaged pins?	
STEP 3B:	Check the circuit response.	Fault Code 1666 active and Fault Code 1665 inactive?	
STEP 3C:	Check for a pin to pin short circuit in the engine harness.	Greater than 100K ohms?	
STEP 3D:	Check for a pin short circuit to ground.	Greater than 100K ohms?	
STEP 3E:	Check for an inactive fault code.	Fault Code 1665 inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 1665 inactive?	
STEP 4B:	Clear the inactive fault codes.	All fault codes cleared?	

STEP 3A-1: Check the sensor supply voltage and return circuit.

Condition:
- Turn keyswitch OFF
- Disconnect the engine harness from the ECM
- Turn keyswitch ON

Action	Specification/Repair	Next Step
Check the supply voltage and return circuit. • Measure the voltage from the CATALYST TANK LEVEL +5 VDC SUPPLY pin to the CATALYST TANK LEVEL RETURN pin at the engine control module engine connector. Refer to the wiring diagram for connector pin identification.	4.75 to 5.25 VDC? **YES**	3A-2
	4.75 to 5.25 VDC? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A



pressure water or steam clean the parts before putting them in the cleaning tank. Removing the heaviest dirt before placing in the tank will allow the cleaner to work more effectively and the cleaning agent will last longer.

Rinse all the parts in hot water after cleaning. Dry completely with compressed air. Blow the rinse water from all the capscrew holes and the oil drillings.

If the parts are **not** to be used immediately after cleaning, dip them in a suitable rust proofing compound. The rust proofing compound **must** be removed from the parts before assembly or installation on the engine.

Steam Cleaning

Steam cleaning can be used to remove all types of dirt that can contaminate the cleaning tank. It is a good method for cleaning the oil drillings and coolant passages

⚠WARNING⚠

When using a steam cleaner, wear safety glasses or a face shield, as well as protective clothing. Hot steam can cause serious personal injury.

Do **not** steam clean the following components:

- Electrical Components
- Wiring Harnesses
- Belts and Hoses
- Bearings (ball or taper roller)
- Electronic Control Module (ECM)
- ECM Connectors
- Capacitive Coil Driver Module (CCD)
- Ignition Coils and Leads
- NOx Sensor
- Fuel Control Valve
- Throttle Driver and Actuator.

Plastic Bead Cleaning

Cummins Inc. does **not** recommend the use of glass bead blast or walnut shell media on **any** engine part. Cummins Inc. recommends using **only** plastic bead media, Part Number 3822735 or equivalent on any engine part. **Never** use sand as a blast media to clean engine parts. Glass and walnut shell media when **not** used to the media manufacturer's recommendations can cause excess dust and can embed in engine parts that can result in premature failure of components through abrasive wear.

Plastic bead cleaning can be used on many engine components to remove carbon deposits. The cleaning process is controlled by the use of plastic beads, the operating pressure and cleaning time.

△CAUTION△

Do not use bead blasting cleaning methods on aluminum pistons skirts or the pin bores in any piston, piston skirt or piston crown. Small particles of the media will embed in the aluminum or other soft metal and result in premature wear of the cylinder liner, piston rings, pins and pin bores. Valves, turbocharger shafts, etc., can also be damaged. Follow the cleaning directions listed in the procedures.

△CAUTION△

Do not contaminate wash tanks and tank type solvent cleaners with the foreign material and plastic beads. Remove the foreign material and plastic beads with compressed air, hot high pressure water or steam before placing them in tanks or cleaners. The foreign material and plastic beads can contaminate the tank and any other engine parts cleaned in the tank. Contaminated parts may cause failures from abrasive wear.

Plastic bead blasting media, Part Number 3822735, can be used to clean all piston ring grooves. Do **not** sure any bead blasting media on piston pin bores or aluminum skirts.

Follow the equipment manufacturer's cleaning instructions. Make sure to adjust the air pressure in the blasting machine to the bead manufacturer's recommendations. Turning up the pressure can move material on the part and cause the plastic bead media to wear out more quickly. The following guidelines can be used to adapt to manufacturer's instructions:

1 Bead size: U.S. size Number 16 — 20 for piston cleaning with plastic bead media, Part Number 3822735

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for an inactive fault code.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for an inactive fault code. • Use INSITE™ to read the fault codes.	Fault Code 1674 inactive? **YES**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.
	Fault Code 1674 inactive? **NO**	2A

STEP 2: Check the exhaust gas temperature #2 sensor and circuit.

STEP 2A: Inspect the exhaust gas temperature #2 sensor and connector pins.

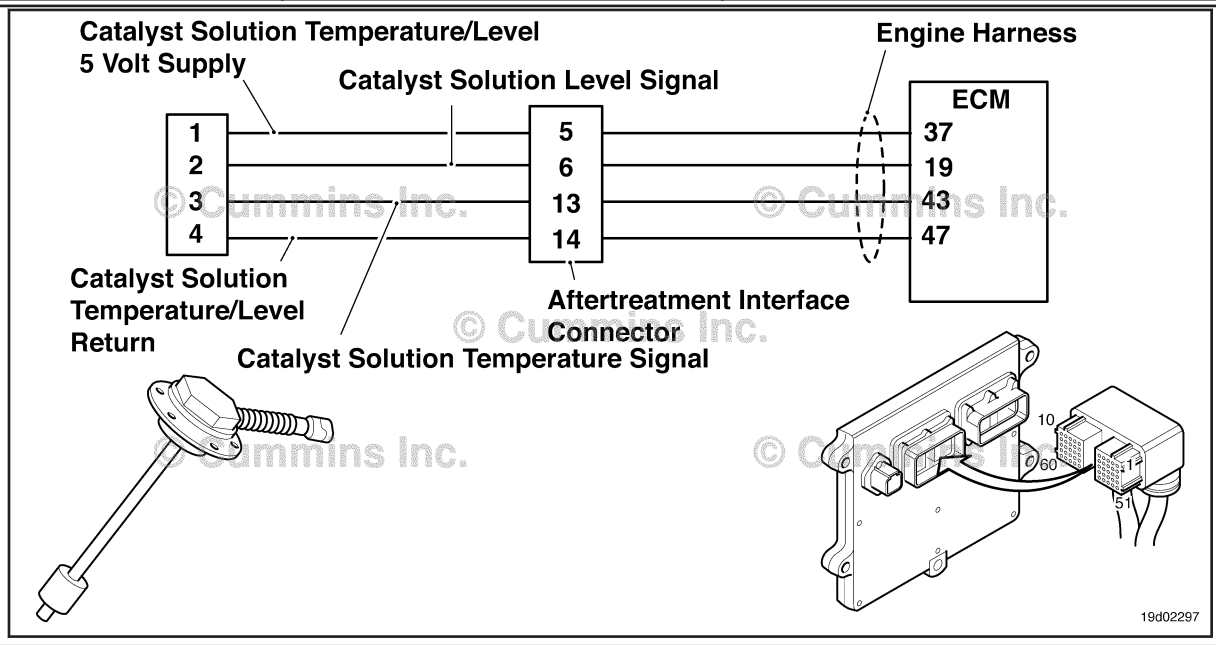
Condition:
- Turn keyswitch OFF.
- Disconnect the exhaust gas temperature #2 sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and exhaust gas temperature #2 sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **NO**	2B

Fault Code 1678

Catalyst Tank Temperature — Voltage Above Normal, or Shorted to High Source

CODES	REASON	EFFECT
Fault Code: 1678 PID(P), SID(S): SPN: 3031 FMI: 3 Lamp: Amber SRT:	Catalyst Tank Temperature — Voltage Above Normal, or Shorted to High Source. High signal voltage or open circuit detected at the catalyst tank temperature sensor circuit	Default temperature value used for catalyst tank temperature.



Circuit: Catalyst Tank Temperature Sensor

Circuit Description:

The catalyst solution temperature sensor is used by the electronic control module (ECM) to monitor the temperature of the catalyst solution inside the catalyst tank. The ECM monitors the voltage on the signal pin and converts this to a temperature value.

Component Location:

The catalyst solution temperature sensor is located in the catalyst tank. The tank is mounted by the OEM. For more information, contact the OEM service manual.

Shop Talk:

The catalyst solution temperature sensor shares return wires in the engine harness with other sensors. An open return can cause multiple fault codes to be active.

Possible causes of this fault code include:

- Open return circuit in the harness, connectors, or sensor.
- Open signal circuit or shorted to a voltage source.

On-Board Diagnostics (OBD) Information (Euro 4 Certified Engines):

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does **not** fail. The MIL lamp and fault code can also be cleared using the INSITE™ service tool.

STEP 5: Check the DEF lines and fittings for restriction and contamination.

STEP 5A: Check the DEF dosing unit fittings and lines.

Condition:
- Clean the front face of the doser before removing any lines.
- Disconnect the DEF line from the aftertreatment nozzle and secure appropriately.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.
- Start the engine and operate at low idle.

Action	Specification/Repair	Next Step
Inspect the DEF dosing unit fittings and lines for the following: NOTE: Clean the front face of the aftertreatment dosing unit and lines with warm water or mild detergent before removing any line. This is to prevent any contamination due to service intervention. • Loose DEF inlet connectors or fitting • Cracked DEF lines, resulting in leaks or drawing in air • Restricted or damaged DEF supply or return lines • Be sure DEF is returning to the tank during the priming cycle.	DEF fittings and lines pass the inspections? **YES**	5B
	DEF fittings and lines pass the inspections? **NO** **Repair:** Repair or replace DEF fittings, lines, and/or connector. Refer to the OEM service manual.	3B

STEP 5B: Inspect the DEF dosing unit inline screen filter connection.

Condition:
- Clean the front face of the doser before removing any lines.
- Disconnect the DEF supply line from the dosing unit and secure appropriately.

Action	Specification/Repair	Next Step
Inspect the DEF dosing unit inline screen filter connection. • Remove the diesel exhaust fluid dosing unit supply line • Inspect the inlet screen filter. Use the following procedure for ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 1 or ISC, ISCe, QSC8.3, ISL, ISLe3, and QSL9 engines. Refer to Procedure 011-060 in Section 11. NOTE: Clean the front face of the aftertreatment dosing unit and lines with warm water or mild detergent before removing any lines. This is to prevent any contamination due to service intervention. Use the following procedure to identify the different connections on the DEF dosing unit. Refer to Procedure 019-440 in Section 19.	Contamination present at the screen filter? **YES** **Repair:** Replace the screen filter.	5C
	Contamination present at the screen filter? **NO**	5C

FAULT CODE 1689 - Real-Time Clock Power Interrupt - Data Erratic, Intermittent or Incorrect

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.

⚠CAUTION⚠

To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part No. 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part No. 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the real-time clock battery and connections.**		
STEP 1A:	Inspect the ECM and engine harness connector pins.	Dirty or damaged pins?	
STEP 1B:	Check the real-time clock battery voltage at the ECM harness connector.	Between 3.3-VDC and 3.6-VDC?	
STEP 1B-1:	Inspect the real-time clock battery and engine wire harness connector pins.	Dirty or damaged pins?	
STEP 1B-2:	Check the real-time clock battery voltage at the battery module connector.	Between 3.3-VDC and 3.6-VDC?	
STEP 2:	**Check the battery module harness.**		
STEP 2A:	Check for an open circuit in the engine harness.	Less than 10 ohms?	
STEP 2B:	Check for a short circuit in the engine harness.	More than 100k ohms?	
STEP 2C:	Check for a short circuit to ground.	More than 100k ohms?	
STEP 3:	**Clear the fault codes.**		
STEP 3A:	Disable the fault code.	Fault Code 1689 inactive?	
STEP 3B:	Clear the inactive fault codes.	All fault codes cleared?	

STEP 3: Check the dosing control unit and dosing control unit harness.

STEP 3A: Inspect the dosing control unit and dosing control unit connector pins.

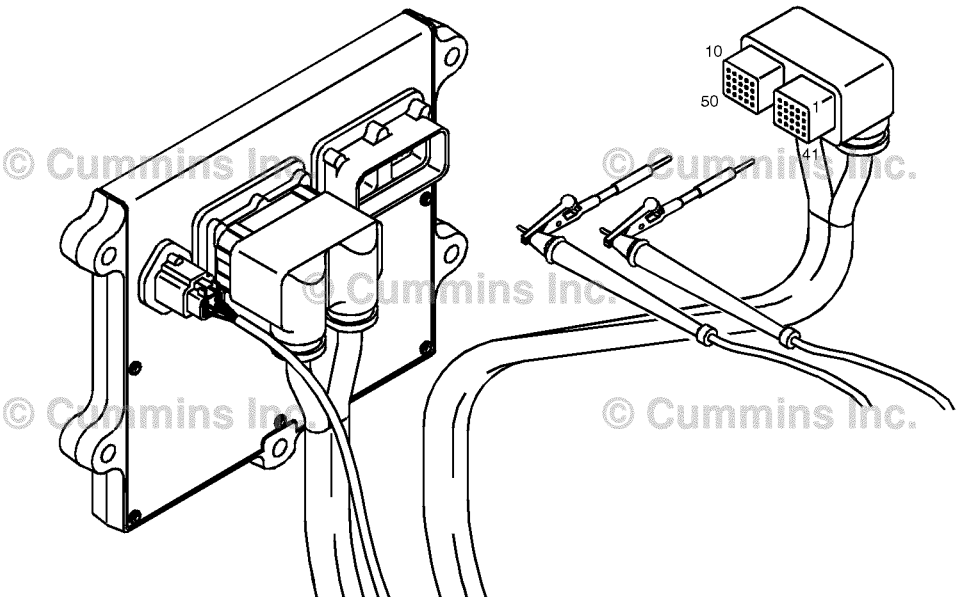
Condition:
- Turn keyswitch OFF.
- Disconnect the OEM harness from the dosing control unit.

Action	Specification/Repair	Next Step
Inspect the OEM harness ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the dosing control unit. • Clean the connector and pins. • Repair the damaged harness, connector, or pins, if possible. Refer to Procedure 019-071 in Section 19.	4A
Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **NO**	3B

STEP 4B: Check for an open or short circuit in the ECM J1939 data link harness.

Condition:
- Turn keyswitch OFF
- Disconnect the OEM harness from the ECM.

Action	Specification/Repair	Next Step
Check for an open or short circuit. • Measure the resistance between the SAE J1939 Data Link (+) wire and the SAE J1939 Data Link (-) wire on the appropriate Cummins® ECM OEM connection to the J1939 data link harness connector. Refer to the wiring diagram or circuit diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Resistance between 50 and 70 ohms? **YES**	4C
	Resistance between 50 and 70 ohms? **NO** **Repair:** An open or short has been detected in the OEM harness. Repair or replace the OEM harness. Refer to Procedure 019-071 in Section 19.	5A



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Fault Code 1845 - Water-in-Fuel Indicator Sensor Circuit - Voltage Above Normal or Shorted to High Source (For Generator Engines Only)

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.

⚠CAUTION⚠

To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for an active fault code.**	**Fault Code 1845 active?**	
STEP 2:	**Check the water-in-fuel sensor and circuit.**		
STEP 2A:	**Inspect the engine harness and the water-in-fuel sensor and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the water-in-fuel sensor resistance.**	**Greater than 200k ohms?**	
STEP 2C:	**Check the fault codes and verify water-in-fuel sensor condition.**	**Fault Code 1845 active?**	
STEP 3:	**Check the ECM and engine harness.**		
STEP 3A:	**Inspect the ECM and engine harness connector pins.**	**Dirty or damaged pins?**	
STEP 3B:	**Check the ECM response.**	**Fault Code 1846 active and Fault Code 1845 inactive?**	
STEP 3C:	**Check for an open circuit in the engine harness.**	**Less than 10 ohms?**	
STEP 3C-1:	**Check for an open circuit in the engine harness.**	**Less than 10 ohms?**	
STEP 3D:	**Check for a pin-to-pin short circuit in the engine harness.**	**Greater than 100k ohms?**	
STEP 3E:	**Check for an inactive fault code.**	**Fault Code 1845 inactive?**	
STEP 4:	**ECM calibration and clear fault codes.**		
STEP 4A:	**Check if an ECM calibration update is available.**	**If a calibration update for this fault code is available, does the ECM contain that revision or higher?**	
STEP 4B:	**Disable the fault code.**	**Fault code inactive?**	

STEP 2: Check the exhaust gas temperature #1 sensor and circuit.

STEP 2A: Inspect the exhaust gas temperature #1 sensor and connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the exhaust gas temperature #1 sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and exhaust gas temperature #1 sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected in the sensor or harness connector. Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check the circuit response.

Condition:
- Turn keyswitch OFF.
- Disconnect the exhaust gas temperature #1 sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate ECM response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 1666 active? **YES**	2C
	Fault Code 1666 active? **NO**	3A

STEP 5B: Check the fuel pump actuator resistance.

Condition:
- Turn keyswitch OFF.
- Disconnect the fuel pump actuator from the engine harness.

Action	Specification/Repair	Next Step
Check the fuel pump actuator resistance. • Measure the resistance between the fuel pump actuator SIGNAL pin and the fuel pump actuator RETURN pin at the actuator connector. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 0 ohms and less than 5 ohms? **YES**	5C
	Greater than 0 ohms and less than 5 ohms? **NO** **Repair:** Replace the fuel pump actuator. Refer to Procedure 019-117 in Section 19.	7A

STEP 5C: Check the fuel pump actuator for a short to ground.

Condition:
- Turn keyswitch OFF.
- Disconnect the fuel pump actuator from the engine harness.

Action	Specification/Repair	Next Step
Check the fuel pump actuator for a short to ground. • Measure the resistance between the fuel pump actuator SIGNAL pin and the engine block ground.	Greater than 100 ohms? **YES**	5D
	Greater than 100 ohms? **NO** **Repair:** Replace the fuel pump actuator. Refer to Procedure 019-117 in Section 19.	7A

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for an active fault code.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for an active fault code. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 2186 active? **YES**	2A
	Fault Code 2186 active? **NO**	Use the following procedure for an inactive or intermittent fault code. Refer to Procedure 019-362 in Section 19.

STEP 2: Check the sensors and circuits connected to the sensor supply and return.

STEP 2A: Inspect the accelerator pedal or lever position sensor and circuit connected to the sensor supply and return.

Condition:
- Turn keyswitch OFF.
- Disconnect the accelerator pedal or lever position sensor from the OEM harness.

Action	Specification/Repair	Next Step
Inspect the OEM harness and ECM connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** A damaged connection has been detected. • Clean the connector and pins. • Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-071 in Section 19.	4A
	Dirty or damaged pins? **NO**	2B

FAULT CODE 2215 (ISC/QSC/ISL/QSL Automotive, Industrial, or Marine Application) - Fuel Pump Delivery Pressure Low - Data Valid But Below Normal Operating Range - Moderately Severe Level

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	Read the fault codes.	Fault Code 275, 449, 1117, or 2311 active or high inactive counts?	
STEP 1B:	Inspect for external fuel leaks.	Fuel leaks present?	
STEP 1C:	Verify the rail fuel pressure sensor accuracy.	Fuel rail pressure +/- 43 bar [+/- 624 psi]?	
STEP 2:	**Check engine operation.**		
STEP 2A:	Attempt to start the engine.	Engine start?	
STEP 2B:	Check the fuel supply.	Adequate amount of fuel in the tank?	
STEP 3:	**Check the low-pressure fuel system. (Engine not operating)**		
STEP 3A:	Check the fuel lift pump pressure.	Fuel lift pump pressure within specifications?	
STEP 3B:	Measure the fuel gear pump pressure.	Fuel gear pump pressure greater than specifications?	
STEP 4:	**Check the low-pressure fuel system. (Engine operating)**		
STEP 4A:	Check for external fuel leak.	Any external fuel leaks?	
STEP 4B:	Check for air in the high-pressure pump fuel supply.	Air present in the fuel supply?	
STEP 4C:	Measure inlet restriction at the original equipment manufacturer (OEM) connection point.	OEM inlet restriction above specification?	
STEP 4D:	Measure inlet restriction at the gear pump inlet.	Gear pump inlet restriction above specification?	
STEP 4E:	Measure the gear pump pressure.	Gear pump pressure above specification?	
STEP 4F:	Measure the fuel filter restriction.	Fuel filter pressure drop above specification?	
STEP 5:	**Check the high-pressure fuel system.**		
STEP 5A:	Measure the fuel pump head flow.	Fuel pump head flow greater than 100 cc [3.4 oz] in 30 seconds of cranking?	
STEP 5B:	Check for excessive fuel return from the fuel injector drain line.	Fuel injector leakage excessive?	
STEP 5C:	Check for excessive fuel return from the high-pressure pump.	Fuel pump leakage excessive?	
STEP 5D:	Check for excessive leakage from the rail fuel pressure relief valve.	Rail fuel pressure relief valve leaking more than 30 drops per minute?	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for an active fault code.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool to read the fault codes.

Action	Specification/Repair	Next Step
Check for an active fault code. • Use INSITE™ electronic service tool to read the fault codes.	Are other fault codes active? **YES** **Repair:** Troubleshoot the active fault codes.	Go to appropriate fault code troubleshooting tree.
	Are other fault codes active? **NO**	2A

STEP 3B: Check the circuit response.

Condition:
- Turn keyswitch OFF.
- Disconnect the electric fuel lift pump from the engine harness.
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use the INSITE™ electronic service tool to read the fault codes.	Fault Code 2265 is active and Fault Code 2266 is inactive? **YES**	3C
	Fault Code 2265 is active and Fault Code 2266 is inactive? **NO**	4A

STEP 3C: Check the fault codes and verify sensor condition.

Condition:
- Turn keyswitch OFF.
- Connect the electric fuel lift pump to the engine harness.
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate circuit response after 30 seconds. • Use the INSITE™ electronic service tool to read the fault codes.	Fault Code 2266 is active? A damaged fuel lift pump has been detected. Replace the electric fuel lift pump. Use the following procedure in the ISC, QSC8.3, ISL, and QSL9 Series Engines Troubleshooting and Repair Manual, Bulletin 4021418 or the ISB Troubleshooting and Repair Manual, Bulletin 3666477. Refer to Procedure 005-045 in Section 5. **YES**	5A
	Fault Code 2266 is active? **NO** **Repair:** None. The removal and installation of the connector corrected the problem.	5A

STEP 4: Clear the fault codes.

STEP 4A: Disable the fault code.

Condition:
- Connect all components.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for one minute. • Verify that Fault Code 2273 is inactive.	Fault Code 2273 inactive? **YES**	4B
	Fault Code 2273 inactive? **NO**	1A

STEP 4B: Clear the inactive fault codes.

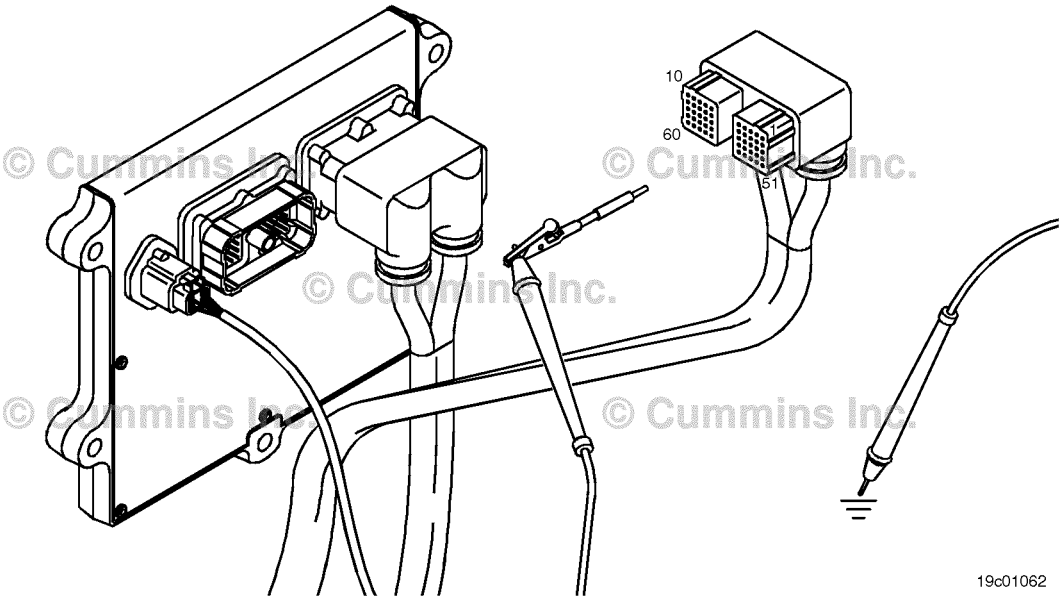
Condition:
- Connect all components.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Clear the inactive fault codes. • Use INSITE™ electronic service tool, erase the inactive fault codes .	All fault codes cleared? **YES**	Repair complete
	All fault codes cleared? **NO**	Appropriate troubleshooting steps

STEP 3C: Check the engine harness for a short to ground.

Condition:
- Turn keyswitch OFF.
- Disconnect the fuel pump actuator from the engine harness.
- Disconnect the engine harness from the ECM.

Action	Specification/Repair	Next Step
Check the engine harness and fuel pump actuator resistance. • Measure the resistance between the fuel pump actuator SIGNAL pin and the ECM connector of the engine harness and engine block ground.	Greater than 100k ohms? **YES**	3D
	Greater than 100k ohms? **NO** **Repair:** Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19.	4A



FAULT CODE 2346 (ISC/QSC/ISL/QSL Automotive, Industrial, or Marine Application) - Turbocharger Turbine Inlet Temperature (Calculated) - Data Valid but Above Normal Operational Range - Least Severe Level

TROUBLESHOOTING SUMMARY

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for active fault codes.**	**Active fault codes present?**	
STEP 1B:	**Check for inactive fault codes.**	**Fault Codes 2973 inactive?**	
STEP 2:	**Check the air handling system.**		
STEP 2A:	**Check the charge-air cooler, clamps, hoses, and piping.**	**Air leak present or clamps loose?**	
STEP 2B:	**Inspect the turbocharger compressor and turbine blades.**	**Damage found on turbocharger blades?**	
STEP 2C:	**Check the variable geometry actuator rod for correct travel.**	**Does the turbocharger actuator rod extend between 8 and 9 mm [0.321 and 0.36 in]?**	
STEP 2C-1:	**Check for air leaks and inspect the air lines.**	**Air leaks found in the system?**	
STEP 2C-2:	**Check for air pressure at the turbocharger control valve.**	**Is vehicle air tank pressure air pressure present at the turbocharger control valve outlet?**	
STEP 2C-3:	**Check for air leaks at the turbocharger control valve outlet outlet.**	**Can air be heard escaping from the turbocharger control valve outlet?**	
STEP 2C-4:	**Check for correct turbocharger actuator travel.**	**Does the turbocharger actuator rod travel at least 12 mm [0.472 in]?**	
STEP 3:	**Clear the fault codes.**		
STEP 3A:	**Disable the fault code.**	**Fault Code 2346 inactive?**	
STEP 3B:	**Clear the inactive fault codes.**	**All fault codes cleared?**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Check for active fault codes.

Condition:
- Connect INSITE™ electronic service tool.
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Check for active fault codes. • Use INSITE™ electronic service tool to read the fault codes.	Active fault codes present? **YES**	Troubleshoot active fault codes
	Active fault codes present? **NO**	1B

FAULT CODE 2349 - EGR Valve Control Circuit - Current Below Normal or Open Circuit

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	Read the fault codes.	Fault Code 2349 active?	
STEP 2:	**Check the EGR valve motor and circuit.**		
STEP 2A:	Inspect the EGR valve motor and connector pins.	Dirty or damaged pins?	
STEP 2B:	Check for an open circuit in the EGR valve motor.	Less than 15 ohms?	
STEP 3:	**Check the engine harness.**		
STEP 3A:	Inspect the engine harness and ECM connector pins.	Dirty or damaged pins?	
STEP 3B:	Check for an open circuit in the engine harness.	Less than 10 ohms?	
STEP 3C:	Check for a short circuit from pin to pin in the engine harness.	Greater than 100k ohms?	
STEP 3D:	Check for a short circuit to a voltage source in the engine harness.	Less than 1.5 VDC?	
STEP 3E:	Check for an inactive fault code.	Fault Code 2349 inactive?	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	Disable the fault code.	Fault Code 2349 inactive?	
STEP 4B:	Clear the inactive fault codes.	All fault codes cleared?	

FAULT CODE 2357 - EGR Valve Control - Mechanical System Not Responding Properly or Out of Adjustment

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.

⚠CAUTION⚠

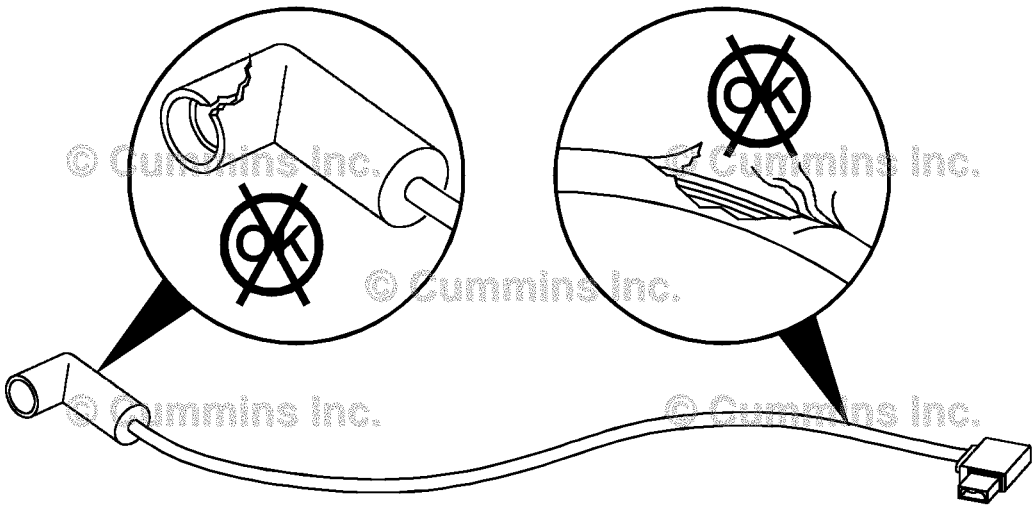
To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the engine harness.**		
STEP 1A:	**Inspect the engine harness and ECM connector pins.**	**Dirty or damaged pins?**	
STEP 1B:	**Check the EGR valve position sensor signal for a short circuit.**	**Greater than 100k ohms?**	
STEP 2:	**Check the ECM.**		
STEP 2A:	**Check the EGR valve position sensor signal voltage.**	**Less than 0.1 VDC?**	
STEP 3:	**Check the EGR valve assembly.**		
STEP 3A:	**Perform the INSITE™ electronic service tool EGR Valve Test.**	**EGR valve position 100 percent when open?**	
STEP 3B:	**Perform the INSITE™ electronic service tool EGR Valve Test.**	**EGR valve position less than 10 percent when closed?**	
STEP 4:	**Clear the fault codes.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 2357 inactive?**	
STEP 4B:	**Clear the inactive fault codes.**	**All fault codes cleared?**	

STEP 2B: Check the engine brake wiring harness for damage.

Condition:
- Turn keyswitch OFF.
- Remove the rocker lever cover. Use the following procedure in the Troubleshooting and Repair Manual, ISC, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418. Refer to Procedure 003-011 in Section 3.
- Remove the engine brake jumper harness between that pass-through connector and the engine brake solenoid.

Action	Specification/Repair	Next Step
Inspect the internal engine brake jumper harness connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Damaged connectors or wire insulation? **YES** **Repair:** Repair or replace the engine brake harness. Refer to Procedure 019-043 in Section 19.	4A
	Damaged connectors or wire insulation? **NO**	2C



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STEP 2: Check the exhaust gas pressure sensor and circuit.

STEP 2A: Inspect the exhaust gas pressure sensor and connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the exhaust gas pressure sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connector, or pins if possible.	4A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check the circuit response.

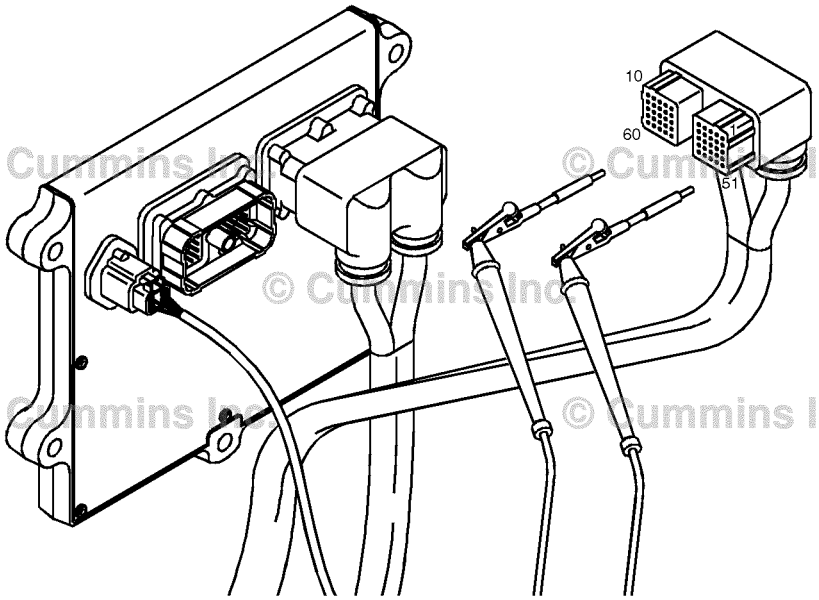
Condition:
- Turn keyswitch OFF.
- Disconnect the exhaust gas pressure sensor from the engine harness.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate ECM response after 30 seconds. • Use INSITE™ electronic service tool to read the fault codes.	Fault Code 2374 active and Fault Code 2373 inactive? **YES**	2C
	Fault Code 2374 active and Fault Code 2373 inactive? **NO**	3A

STEP 3C: Check for a pin-to-pin short circuit in the engine harness.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the ECM.
- Disconnect the EGR temperature sensor from the engine harness.

Action	Specification/Repair	Next Step
Check for a pin-to-pin short. • Measure the resistance between the EGR temperature sensor SIGNAL pin in the engine harness ECM connector and all other pins in the engine harness ECM connector. Refer to the circuit diagram or wiring diagram for connector pin identification. Use the following procedure for general resistance measurement techniques. Refer to Procedure 019-360 in Section 19.	Greater than 100k ohms? **YES**	3D
	Greater than 100k ohms? **NO** **Repair:** A pin-to-pin short circuit on the signal line has been detected in the engine harness. Repair or replace the engine harness. Refer to Procedure 019-043 in Section 19.	4A



Refer to Troubleshooting Fault Code t05-2383

STEP 1D: Check for an inactive fault code.

Condition:
- Connect all components.
- Turn keyswitch ON
- Connect the INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for the appropriate response after 30 seconds. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 2385 inactive? **YES** **Repair:** None. The removal and installation of the connector corrected the fault.	2A
	Fault Code 2385 inactive? **NO** **Repair:** The troubleshooting procedures need to be repeated from the beginning. A failure mode should have been detected. Replace the ECM. Refer to Procedure 019-031 in Section 19.	2A

STEP 2: Clear the fault codes.

STEP 2A: Disable the fault code.

Condition:
- Connect all components.
- Turn keyswitch ON.
- Connect the INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Disable the fault code. • Start the engine and let it idle for 1 minute. • Use INSITE™ electronic service tool to verify the fault code is inactive.	Fault Code 2385 inactive? **YES**	2B
	Fault Code 2385 inactive? **NO** **Repair:** Return to the troubleshooting steps or contact a local Cummins® Authorized Repair Location if all steps have been completed and rechecked.	1A

STEP 2: Check the turbocharger position sensor.

STEP 2A: Inspect the turbocharger position sensor and engine harness connector pins.

Condition:
- Turn keyswitch OFF.
- Disconnect the turbocharger position sensor from the engine harness.

Action	Specification/Repair	Next Step
Inspect the engine harness and turbocharger position sensor connector pins for the following: • Loose connector • Corroded pins • Bent or broken pins • Pushed back or expanded pins • Moisture in or on the connector • Missing or damaged connector seals • Dirt or debris in or on the connector pins • Connector shell broken • Wire insulation damage • Damaged connector locking tab. Use the following procedure for general inspection techniques. Refer to Procedure 019-361 in Section 19.	Dirty or damaged pins? **YES** **Repair:** Clean the connector and pins. Repair the damaged harness, connector, or pins if possible. Refer to Procedure 019-043 in Section 19.	3A
	Dirty or damaged pins? **NO**	2B

STEP 2B: Check the turbocharger position sensor signal voltage.

Condition:
- Turn keyswitch OFF.
- Disconnect the engine harness from the electronic control module.
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool to the SAEJ1939 or SAEJ1587/1708 OEM data link connector.

Action	Specification/Repair	Next Step
Use the INSITE™ electronic service tool Data Logger/Monitor to check the turbocharger position sensor signal voltage. -	Less than 0.1-VDC? **YES**	3A
	Less than 0.1-VDC? **NO** **Repair:** Replace the ECM. Refer to Procedure 019-031 in Section 19.	4A

FAULT CODE 2557 - Auxiliary PWM Driver #1 - Voltage Above Normal or Shorted to High Source

TROUBLESHOOTING SUMMARY

⚠CAUTION⚠

To reduce the possibility of damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.

⚠CAUTION⚠

To reduce the possibility of pin and harness damage, use the following test leads when taking a measurement: Part Number 3822758 - male Deutsch™/AMP™/Metri-Pack™ test lead and Part Number 3822917 - female Deutsch™/AMP™/Metri-Pack™ test lead.

STEPS		SPECIFICATIONS	SRT CODE
STEP 1:	**Check the fault codes.**		
STEP 1A:	**Check for an inactive fault code.**	**Fault Code 2557 inactive?**	
STEP 2:	**Check the transmission shift modulator and circuit.**		
STEP 2A:	**Inspect the transmission shift modulator and connector pins.**	**Dirty or damaged pins?**	
STEP 2B:	**Check the resistance of the transmission shift modulator.**	**Less than 2.2k ohms?**	
STEP 2C:	**Check the transmission shift modulator diagnostic supply voltage, supply line and return circuit.**	**Greater than 5-VDC?**	
STEP 2D:	**Check for an open circuit in the output device driver return circuit.**	**Less than 10 ohms?**	
STEP 3:	**Check the ECM and OEM harness.**		
STEP 3A:	**Inspect the ECM and OEM harness connector pins.**	**Dirty or damaged pins?**	
STEP 3B:	**Check for an open circuit in the OEM harness.**	**Less than 10 ohms?**	
STEP 3C:	**Check for a pin to pin short circuit in the OEM harness.**	**Greater than 100k ohms?**	
STEP 3D:	**Check for an inactive fault code.**	**Fault Code 2557 inactive?**	
STEP 4:	**Clear the fault code.**		
STEP 4A:	**Disable the fault code.**	**Fault Code 2557 inactive?**	
STEP 4B:	**Clear the inactive fault codes.**	**All fault codes cleared?**	

The NOx sensor is permanently attached to the NOx control module. They are serviced as a single component and can **not** be replaced individually.

Possible causes of this fault code include:

- The aftertreatment outlet NOx sensor is **not** receiving power from the battery supply circuit in the OEM harness. This could be caused by an open circuit in the power supply wire, blown NOx sensor fuse, or low voltage supplied by the battery.
- Open return circuit on the aftertreatment outlet NOx sensor circuit between the battery circuit aftertreatment outlet NOx sensor.
- Open or short circuit on the J1939 datalink circuit between the engine ECM and aftertreatment outlet NOx sensor.
- Intermittent communications between the aftertreatment outlet NOx sensor and the primary engine ECM on the J1939 datalink.
- A damaged engine ECM
- Incorrect engine calibration.

Refer to Troubleshooting Fault Code t05-2771

STEP 1B: Check for inactive counts of Fault Code 1682, 3548, 3569, 3575, or 3738.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Use INSITE™ electronic service tool to check for inactive counts of Fault Code 1682, 3548, 3569, 3575, or 3738 in the ECM. • Look specifically for one or more inactive counts of Fault Code 1682, 3548, 3569, 3575, or 3738 within 50 engine hours of this fault code being set.	Recent inactive counts of Fault Code 1682, 3548, 3569, 3575, or 3738 present that have **not** been addressed? **YES** **Repair:** Troubleshoot Fault Code 1682, 3548, 3569, 3575, or 3738 before returning to this fault code troubleshooting tree.	Fault Code 1682, 3548, 3569, 3575, or 3738 troubleshooting tree.
	Recent inactive counts of Fault Code 1682, 3548, 3569, 3575, or 3738 present that have **not** been addressed? **NO**	1C

STEP 1C: Check the remaining active/inactive fault codes.

Condition:
- Turn keyswitch ON.
- Connect INSITE™ electronic service tool.

Action	Specification/Repair	Next Step
Check for active fault codes. • Use INSITE™ electronic service tool to read the fault codes. • Troubleshoot any other active fault codes first. • All other active fault codes except Fault Code 2772 **must** be resolved before following this troubleshooting tree. • Check for performance complaints • Troubleshoot any performance complaints related to smoke or misfire first. NOTE: Fault Code 2773 is caused by the same symptoms as Fault Code 2772, but at a more severe level. Therefore, if both fault codes are active, Fault Code 2773 should **always** be addressed first.	Active fault codes or performance complaints present? (With the exception of Fault Code 2772) **YES**	Appropriate troubleshooting tree.
	Active fault codes or performance complaints present? (With the exception of Fault Code 2772) **NO**	2A

Shop Talk:

The intake manifold pressure sensor monitors pressure in the intake manifold. This fault is set active when the intake manifold pressure is too high or too low for the present engine operating conditions. The ECM compares the intake manifold pressure reading to turbocharger speed (estimated by the ECM in some engines) to determine if the pressure reading is valid.

Possible causes of this fault are:

- A damaged intake manifold pressure sensor.
- A damaged barometric pressure sensor.
- Leaks in the air intake system between the turbocharger and intake manifold.
- Restriction in the charge-air cooler.
- A damaged turbocharger speed sensor.
- A damaged turbocharger compressor intake temperature sensor.
- A damaged engine wiring harness can cause intermittent fault codes due to intermittent resistances. Check the wiring diagram for shared supply and return circuit on sensors. It is possible that more than one sensor could be reading in range but incorrectly if a common supply/ground problem exists in the circuit. Use INSITE™ electronic service tool to log any fluctuation in sensor voltage/values when the harness is moved.

NOTE: Converting gauge pressure to absolute pressure may be required, depending on the engine.

- Barometric pressure is approximately 29.92 in-Hg at sea level. (Absolute Pressure)
- The intake manifold gauge pressure is approximately 0 in-Hg when the engine is **not** operating.
- 29.92 in-Hg = 1 atmosphere = 1.013 bar

Example: If the barometric (absolute) pressure sensor reads (31) in-Hg and the intake manifold (gauge) pressure reads -5 in-Hg, then the difference can be calculated as follows:

1. Convert intake manifold (gauge) pressure to absolute pressure = (-5 + 29) = 24 in-Hg.

2. Subtract the new 24 in-Hg from the original barometric value 31 in-Hg. (31 - 24) = 7

3. The difference is 7 in-Hg. Since the value is greater than the specification of 3 in-Hg, it will cause the fault to become active at key ON.

4. Use the Barometric Pressure at Altitude table in the following procedure to help understand ambient pressure at different altitudes. Refer to Procedure 018-028 in Section V.

The sensor return configuration for Euro 4 ISB engines has been changed for automotive wiring harnesses manufactured from February 2012 onward. The new style wiring harnesses can be be identified using the method below:

- Disconnect the ECM connector
- Disconnect the camshaft position sensor
- Disconnect the intake manifold pressure/temperature sensor
- Check for continuity between the intake manifold pressure/temperature sensor RETURN pin and the camshaft position sensor RETURN pin
- Check for continuity between ECM pin 47 and the camshaft position sensor RETURN pin
- Use the table below to determine which harness is fitted to the engine.

Engine Harnesses			
From	To	New Harness	Old Harness
Intake manifold pressure/ temperature sensor RETURN pin	Camshaft position sensor RETURN pin	Open circuit	Short circut
ECM pin 47	Camshaft position sensor RETURN pin	Open circuit	Short circuit

NOTE: QSB engines, all C series engines, and all L series engines are **not** affected by this change.

Engine Will Not Shut Off

This is symptom tree t081

Cause	Correction
STEP 1 Keyswitch circuit is malfunctioning	Check the vehicle keyswitch circuit. Refer to Procedure 019-064.
OK Go To Next Step	
STEP 2 Engine is running on fumes drawn into the air intake	Check the air intake ducts. Locate and isolate the source of the fumes. Repair as necessary. Refer to the OEM service manual.
OK Go To Next Step	
STEP 3 Turbocharger oil seal is leaking	Check the turbocharger compressor and turbine seals. Refer to Procedure 010-033 in the Troubleshooting and Repair Manual, ISC, QSC8.3, ISL and QSL9 Engines, Bulletin 4021418.

Engine Performance Troubleshooting Tree - ISC/QSC/ISL/QSL with CM850 Electronic Control System

This troubleshooting procedure should be followed for the following symptoms:

- Engine Acceleration or Response Poor
- Cranking Fuel Pressure is Low
- Engine Operating Fuel Pressure is Low
- Engine Decelerates Slowly
- Engine Difficult to Start or Will Not Start (Exhaust Smoke)
- Engine Difficult to Start or Will Not Start (No Exhaust Smoke)
- Engine Power Output Low
- Engine Runs Rough at Idle
- Engine Runs Rough or Misfires
- Engine Speed Surges at Low or High Idle
- Engine Speed Surges Under Load or in Operating Range
- Smoke, Black - Excessive
- Smoke, White - Excessive
- Engine Shuts Off or Dies Unexpectedly or Dies During Deceleration
- Engine Starts but Will Not Keep Running
- Engine Will Not Reach Rated Speed (RPM)
- Intake Manifold Pressure (Boost) is Below Normal

How to Use This Troubleshooting Procedure:

This symptom tree can be used to troubleshoot all performance based symptoms listed above. Start by performing Step 1 troubleshooting. Step 2 will ask a series of questions and will provide a list of troubleshooting steps to perform depending on the symptom. Perform the list of troubleshooting steps in the sequence shown in the Specifications/ Repair section of the tree.

Shop Talk:

Driveability is a term that in general describes vehicle performance on the road. Driveability problems for an engine can be caused by several different factors. Some of the factors are engine-related and some are **not**. Before troubleshooting it is important to determine the exact complaint and whether the engine has a real driveability problem or if it simply does **not** meet driver expectations.

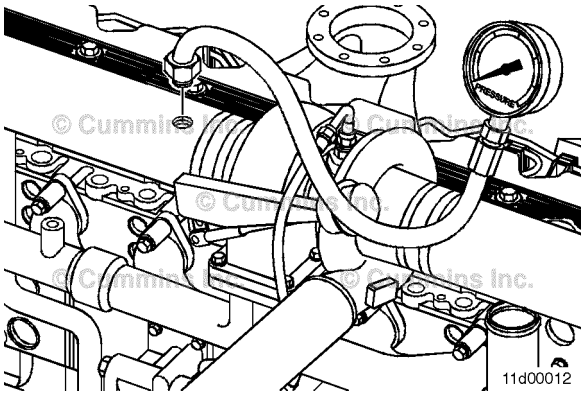
Low power is a term that is used in the field to describe many different performance problems. Low power is defined as the inability of the engine to produce the power necessary to move the vehicle at a speed that can be reasonably expected under the given conditions of load, grade, wind, and so on.

Poor acceleration or response is described as the inability of the vehicle to accelerate satisfactorily from a stop or from the bottom of a grade. It can also be the lag in acceleration during an attempt to pass or overtake another vehicle at conditions less than rated speed and load. Poor acceleration or response is difficult to troubleshoot since it can be caused by several factors.

STEP 7E: Check exhaust restriction.

Condition:
- Refer to Procedure 011-009 in Section 11.

Action	Specification/Repair	Next Step
Check the exhaust system back pressure by installing a pressure gauge into the exhaust system just past the turbocharger outlet. Refer to Procedure 011-009 in Section 11.	Is exhaust back pressure less than 40 in-H_2O [3 in-Hg]? **YES**	7F
	Is exhaust back pressure less than 40 in-H_2O [3 in-Hg]? **NO** **Repair:** Inspect exhaust system for source of high restriction.	Repair complete



STEP 7F: Check engine blowby.

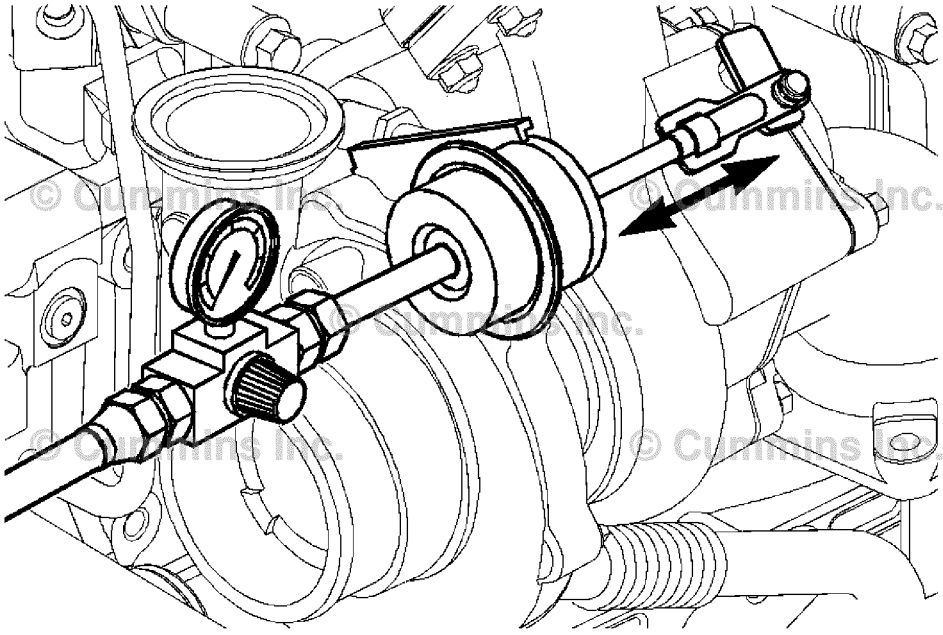
Condition:
- Refer to Procedure 014-005 in Section 14.

Action	Specification/Repair	Next Step
Measure the engine blowby as outlined in Procedure 014-005.	Are the engine blowby measurements within specification? **YES**	Return to Step 2 or contact a Cummins® Authorized Repair Location for further diagnostic and troubleshooting instructions.
	Are the engine blowby measurements within specification? **NO**	Go to step 7F-1.

STEP 5G-1: Inspect the turbocharger wastegate for proper operation.

Condition:
- Engine OFF.
- Remove the wastegate actuator hose from the wastegate actuator.

Action	Specification/Repair	Next Step
Check for wastegate actuator rod for movement. Use the following procedure in the ISBe, ISB, and QSB (Common Rail Fuel System) Service Manual, Bulletin 4021271. Refer to Procedure 010-050 in Section 10. Use Cummins® tool, Part Number 382379, to apply a regulated air supply of 59 in-Hg (29 psi) to the wastegate actuator capsule. Check for wastegate actuator rod for movement.	Did the wastegate actuator rod move? **YES**	5H
	Did the wastegate actuator rod move? **NO**	5G-2



STEP 4B: Check for air in the high pressure pump fuel supply.

Condition:
None

Action	Specification/Repair	Next Step
Check for air in the fuel. Refer to Procedure 006-003 in Section 6 in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Series Engines Service Manual, Bulletin 4021271.	Is air present in the fuel supply? **YES** **Repair:** Locate and correct the cause of air ingestion in the fuel supply system. Sources of air ingestion include loose fuel filters, loose fuel line fittings, loose or cracked fuel tank stand-pipes, or severe restrictions in the fuel supply lines and filters.	Repair complete
	Is air present in the fuel supply? **NO**	4C

STEP 4C: Measure the fuel inlet restriction.

Condition:
None

Action	Specification/Repair	Next Step
Measure the fuel inlet restriction at the customer connection. Refer to Procedure 006-020 in Section 6 in the ISB, ISBe, ISBe4, QSB4.5, QSB5.9, and QSB6.7 (Common Rail Fuel System) Series Engines Service Manual, Bulletin 4021271. Maximum fuel inlet restriction at the customer connection • New Filter: 63.5 mm-Hg [2.5 in-Hg] • Dirty Filter: 101.6 mm-Hg [4.0 in-Hg]	Is the fuel inlet restriction above specification? **YES** **Repair:** Find and correct the cause of high fuel inlet restriction. Look for plugged OEM fuel filters or screens, a restricted ECM cooler, pinched OEM fuel lines, or a restricted stand pipe in the OEM fuel tank.	Repair complete
	Is the fuel inlet restriction above specification? **NO**	4D

STEP 3G-1: Check the fuel gear pump pressure.

Condition:
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Install a pressure gauge at the pressure side fuel filter head. • Measure the fuel gear pump output pressure while cranking the engine. Refer to Procedure 005-025 (Fuel Pump Gear Pump) in Section 5 in the ISC, ISCe, QSC8.3, ISL, ISLe3 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. Cranking speed **must** be greater than 150 rpm.	Is the fuel gear pump pressure greater than 69 kPa [10 psi] while cranking? **YES** **Repair:** Follow Fault Code 2215 troubleshooting tree. Refer to Bulletin 4021416 Troubleshooting and Repair Manual, ISB, ISBe4, QSB4.5, QSB5.9, QSB6.7, ISC, QSC8.3, ISL, and QSL9 Engines, CM850 Electronic Control System.	Repair complete
	Is the fuel gear pump pressure greater than 69 kPa [10 psi] while cranking? **NO**	3G-2

STEP 3G-2: Check the fuel lift pump pressure.

Condition:
- Turn keyswitch ON.

Action	Specification/Repair	Next Step
Install a pressure gauge at the inlet port of the fuel pump. • Measure the fuel lift pump output pressure. Refer to Procedure 005-045 (Fuel Lift Pump) in Section 5 in the ISC, ISCe, QSC8.3, ISL, ISLe3 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418. At initial key-on, the lift pump will run for 60 seconds then stop. The lift pump will run for 30 seconds at key-on and 30 seconds after starting the engine.	Is the fuel lift pump pressure greater than the specifications? **YES** **Repair:** Replace the fuel pump. Refer to Procedure 005-025 (Fuel Pump Gear Pump) in Section 5 in the ISC, ISCe, QSC8.3, ISL, ISLe3 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418.	Repair complete
	Is the fuel lift pump pressure greater than the specifications? **NO** **Repair:** Replace the fuel lift pump. Refer to Procedure 005-045 (Fuel Lift Pump) in Section 5 in the ISC, ISCe, QSC8.3, ISL, ISLe3 and QSL9 Troubleshooting and Repair Manual, Bulletin 4021418.	Repair complete

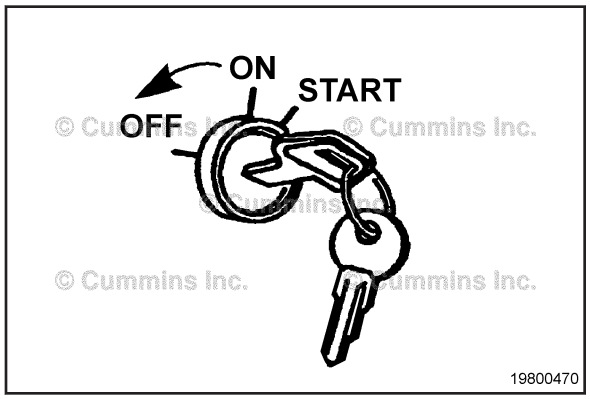
STEP 2E: Engine Acceleration or Response Poor, Engine Power Output Low, Engine Decelerates Slowly, Intake Manifold Pressure (Boost) is Below Normal or Engine Will Not Reach Rated Speed (RPM)

Condition: N/A		
Action	**Specification/Repair**	**Next Step**
Interview the driver and verify the complaint. N/A	Is the engine symptom Engine Acceleration or Response Poor, Engine Power Output Low, Engine Decelerates Slowly, Intake Manifold Pressure (Boost) is Below Normal or Engine Will **Not** Reach Rated Speed (RPM)? **YES** **Repair:** Perform the troubleshooting steps in the recommended order listed below: Step 5 - Air Handling Checks Step 4 - Fuel Systems Checks Step 7 - Electronics Checks Step 8 - Base Engine Checks	Perform the troubleshooting steps suggested in the repair procedure.
	Is the engine symptom Engine Acceleration or Response Poor, Engine Power Output Low, Engine Decelerates Slowly, Intake Manifold Pressure (Boost) is Below Normal or Engine Will **Not** Reach Rated Speed (RPM)? **NO**	Step 2F

STEP 6F: Isolate EGR System.

Condition:
- Turn keyswitch OFF.
- Disconnect the EGR valve differential pressure sensor.

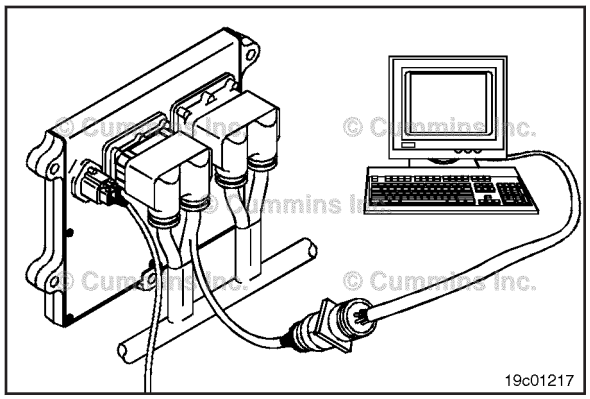
Action	Specification/Repair	Next Step
Disconnect the EGR valve differential pressure sensor. Use the following procedure in the ISB (4 cylinder) and ISBe (4 and 6 cylinder) Electronic Control System Troubleshooting and Repair manual, Bulletin 3666477. Refer to Procedure 019-370 in Section 19. Operate the engine at which the Performance or Excessive Smoke (Black) complaint occurs. By disconnecting the EGR valve differential pressure sensor, the ECM will command the EGR valve to close. No engine derate will be commanded by the ECM. Fault Code 2274 will become active with the EGR valve differential pressure sensor disconnected.	Was the Performance or Excessive Smoke (Black) complaint corrected by disconnecting the EGR valve differential pressure sensor? **YES**	6F-1
	Was the Performance or Excessive Smoke (Black) complaint corrected by disconnecting the EGR valve differential pressure sensor? **NO**	Perform next troubleshooting procedure as outlined in Step 2.



Initial Check

NOTE: If the tool will **not** communicate with the keyswitch in the ON position, cycle the keyswitch and try again.

The ECM calibration process occurs with the keyswitch turned ON. **Always** follow the instructions on the service tool screens.



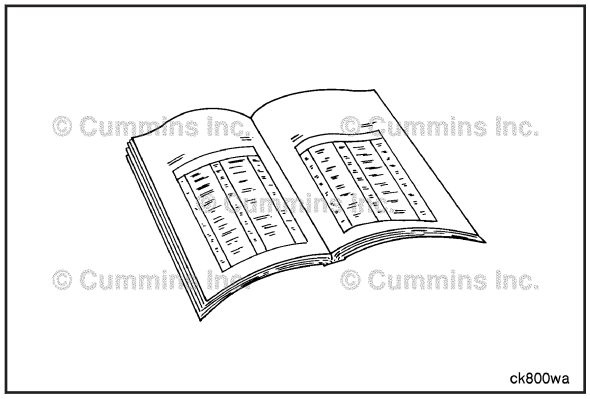
Preparatory Steps

Connect INSITE™ electronic service tool to the service tool data link, which is located on the engine or in the cab.

See the help section within INSITE™ electronic service tool for detailed ECM calibration procedures.

After an ECM is replaced or calibrated, the actual engine hours / distance **must** be entered correctly into the ECM.

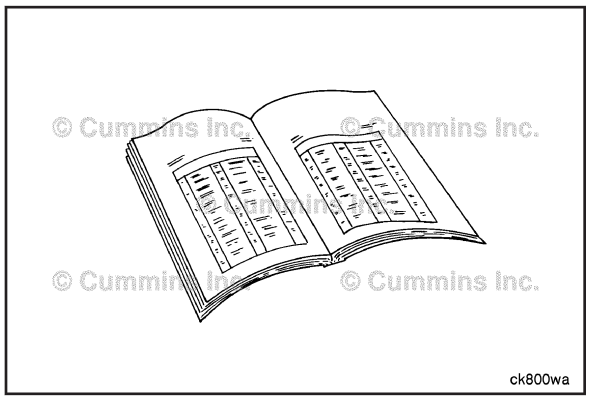
Input the values of ECM Distance Offset, ECM Time Offset, Engine Distance Offset, and Engine Time Offset prior to replacement or calibration of the ECM. These parameters can be found in the Trip Information section of Features and Parameters.



Following calibration download, if new fault codes or fault conditions exist, perform the following steps in order to understand if the calibration is working correctly and is the appropriate calibration for the application.

If it is suspected that the calibration is **not** working correctly, make sure that the appropriate calibration was loaded for the engine, equipment, and application.

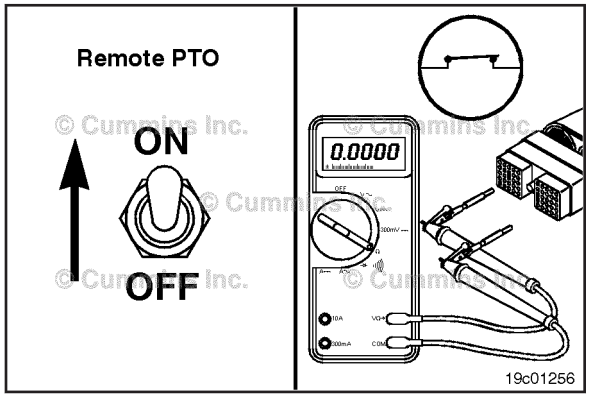
If no issues are found, no further action is required.



Inspect

Establish if the suspected feature creating the problem is operating correctly. Reference the relevant “Electronic Controlled Fuel System” (Procedure 101-007) in Section 1 of the appropriate Operation and Maintenance Manual or in INSITE™ electronic service tool “Fault Information System” for further information.

Programmable Feature/Parameters Not Correct		
Symptom	**Probable Cause**	**Correction**
Remote accelerator control has no effect on engine speed	Remote accelerator feature has been turned off.	Turn on the remote accelerator feature using INSITE™ electronic service tool.
	Vehicle has a multiplexed remote accelerator control and the multiplexing feature has been turned off.	Verify that the remote accelerator control is multiplexed. Turn on the multiplexing feature for the remote throttle control using INSITE™ electronic service tool.
Lamps do **not** operate	5 A or 15 A Power fuse in engine harness blown.	Check fuses and verify the ECM is getting power on the keyswitch wire.
	Vehicle has multiplexed lamps and the multiplexing feature has been turned off.	Verify that the lamps are multiplexed. Turn on the multiplexing feature for the lamps using INSITE™ electronic service tool.
Engine brakes do **not** operate	Vehicle has multiplexed engine brake switches and the multiplexing feature has been turned off.	Verify that the engine brake switches are multiplexed. Turn on the multiplexing feature for the engine brake switches using INSITE™ electronic service tool.
Engine will **not** respond to one or all of the operator's switch(es)	Vehicle has multiplexed switches and the multiplexing feature has been turned off.	Verify that the switches are multiplexed. Turn on the multiplexing feature for the switches using INSITE™ electronic service tool.



Remote PTO Switch Circuit (019-079)

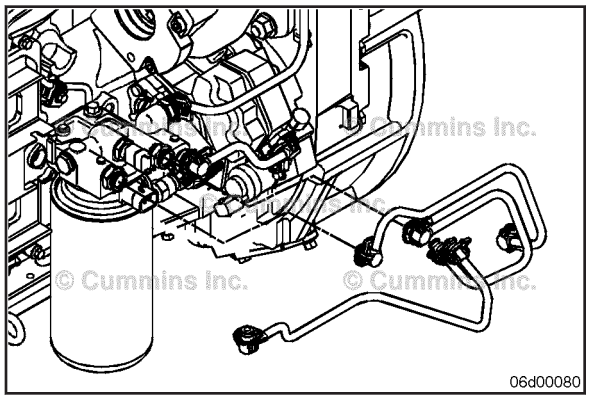
Resistance Check

⚠CAUTION⚠
Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.

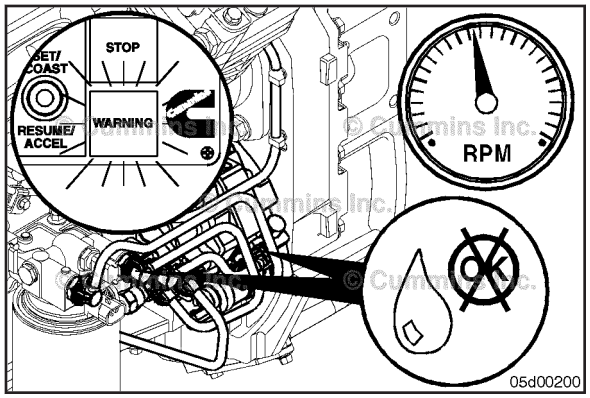
Disconnect the original equipment manufacturer (OEM) harness connector from the electronic control module (ECM).

Insert a test lead into the remote power take-off (PTO) switch return pin of the OEM harness connector and connect it to the multimeter probe. Insert the other test lead into the remote PTO switch signal pin of the connector and connect it to the other probe.

Make sure the switch is connected to the circuit. Move the remote PTO switch to the ON position. Measure the resistance with the multimeter. The multimeter **must** show a closed circuit (10 ohms or less). If the circuit is **not** closed, inspect the switch return wire and the remote PTO switch signal wire for an open circuit. Repair or replace the OEM harness, provided the switch has been previously checked. Refer to the OEM troubleshooting and repair manual for the procedures.



Install the low-pressure fuel supply lines. Refer to Procedure 006-024.

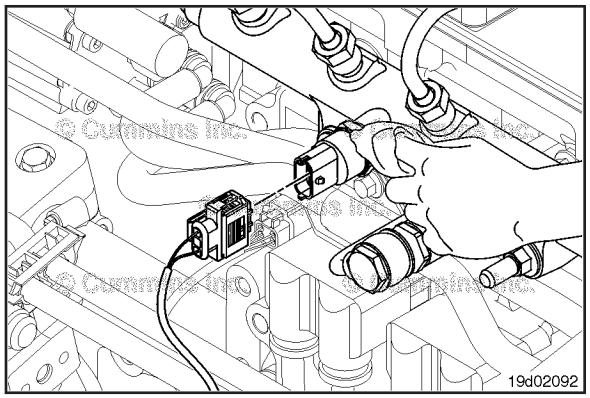


Operate the engine and check for leaks or fault codes.

Rail Fuel Pressure Sensor (019-115)

General Information

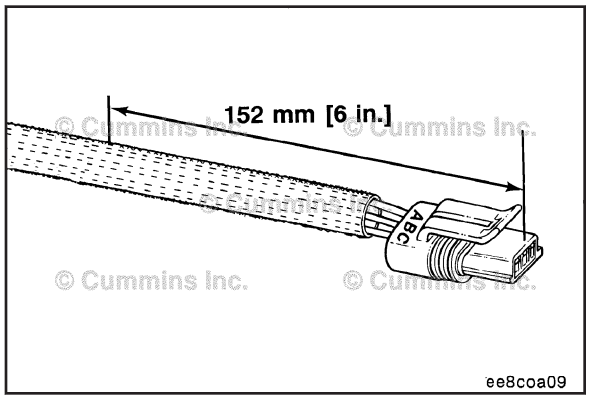
The fuel pressure sensor is located on the fuel rail mounted on the inlet manifold.



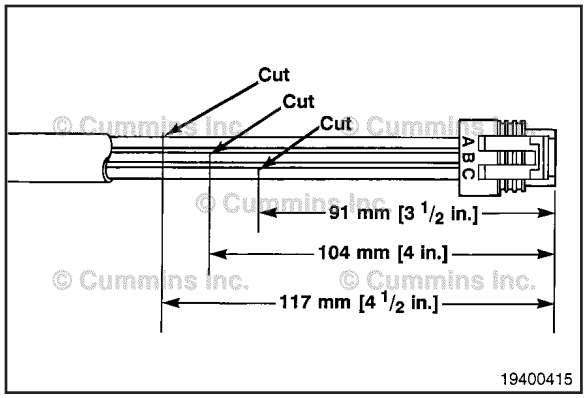
Remove

Clean the area around the fuel pressure sensor.

Disconnect the pressure sensor connector from the engine harness.



Measure 152 mm [6 in] back from the face of the connector, and remove the wiring harness protective cover.

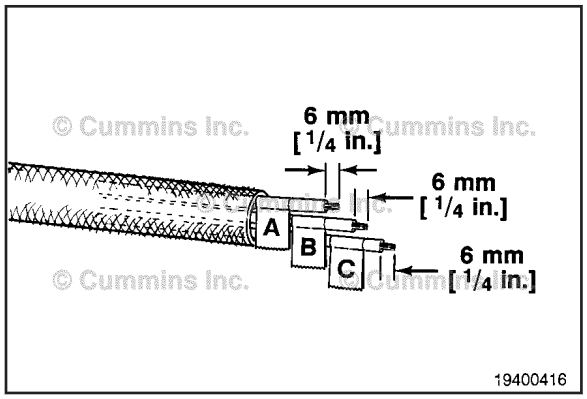


Before cutting the wires, measure and tag the wires.

Use wire cutters to cut wire A 117 mm [4-½ in] from the face of the connector.

Use wire cutters to cut wire B 104 mm [4 in] from the face of the connector.

Use wire cutters to cut wire C 91 mm [3-½ in] from the face of the connector.



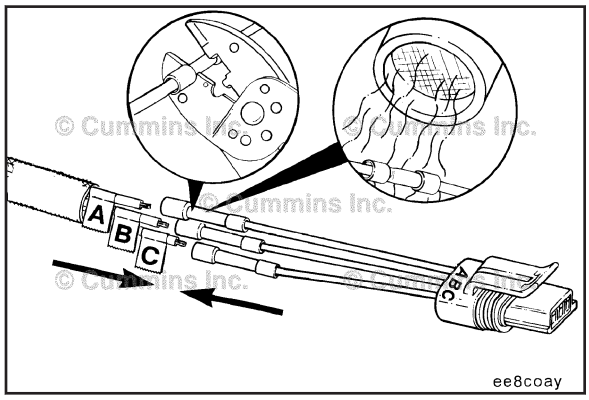
Use crimping tool, Part Number 3822930, to remove 6 mm [¼ in] of insulation from all electrical wires.

Before installing the new connector, perform a test fit to make sure the connector is keyed correctly.

Refer to the appropriate wiring repair kit in the service tools table in the front of Section 19 for the correct repair connector.

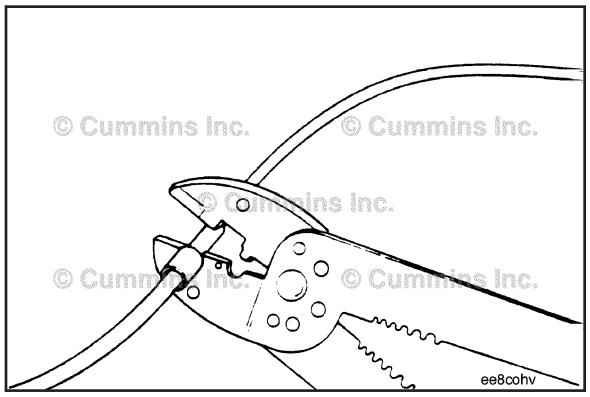
Refer to Section E for pin locations.

Replace one contact at a time. If more than one wire needs replaced, attach a lettered tag to each wire removed.

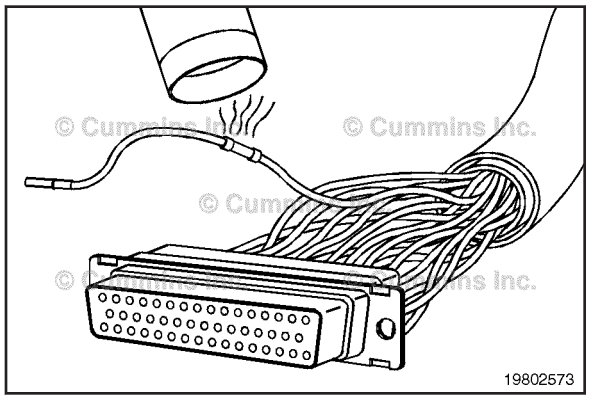


Install the terminal repair wires on the bare wires and use wire crimping tool, Part Number 3822930, to crimp the terminals.

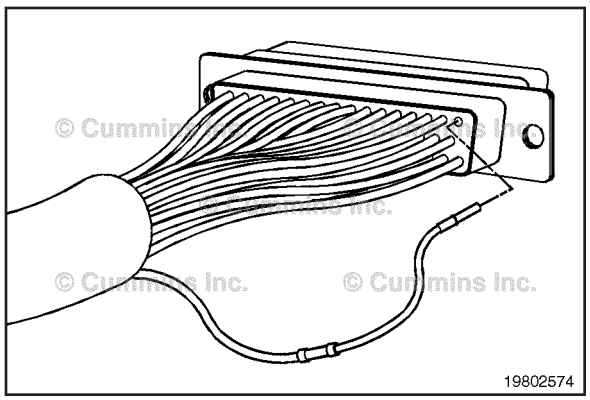
Use heat gun, Part Number 3822860, to heat the shrink tubing. The tubing will shrink and make the connection waterproof.



Use the wire crimping tool to crimp the repair wire onto the bare wire.



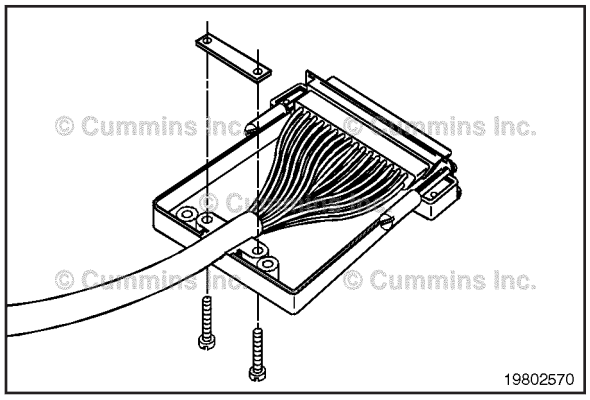
Use heat gun, Part Number 3822860, to heat shrink the tubing around the wire. The tubing will shrink and make the connection waterproof.



Insert the pin into the correct hole of the connector.

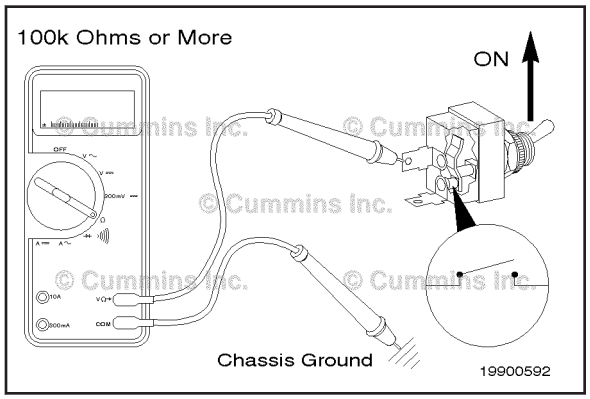
The pin **must** click into place and hold the wire in the connector.

Pull the wire gently to make sure it is seated in the connector.



Tighten the strain relief.

Complete the assembly of the backshell by placing the two halves together and tightening the screws.



Check for Short Circuit to Ground

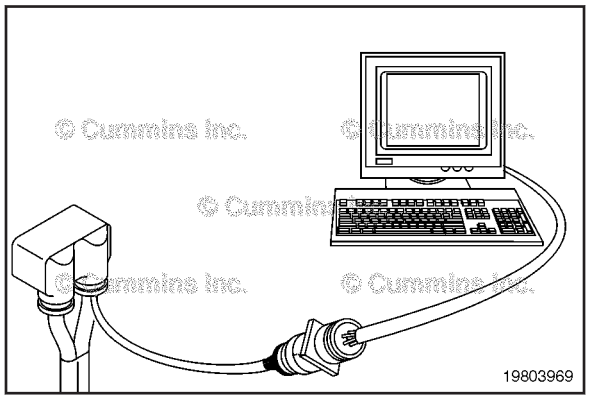
Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground.

Move the switch to the ON position, and measure the resistance.

The multimeter **must** show an open circuit (100k ohms or more).

If the circuit is **not** open, the switch is damaged and **must** be replaced.

Refer to the OEM repair manual for replacement procedures.



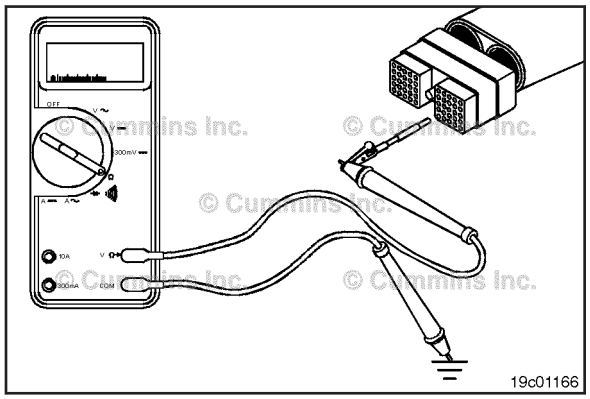
Two-Speed Axle Switch Circuit (019-256)

Resistance Check

⚠CAUTION⚠
Proper leads and/or a Cummins® approved circuit testing tool must be used when working with electrical connectors to prevent pin expansion and damage to the connector.

If INSITE™ electronic service tool is available, monitor the 2-speed axle switch circuit for proper operation.

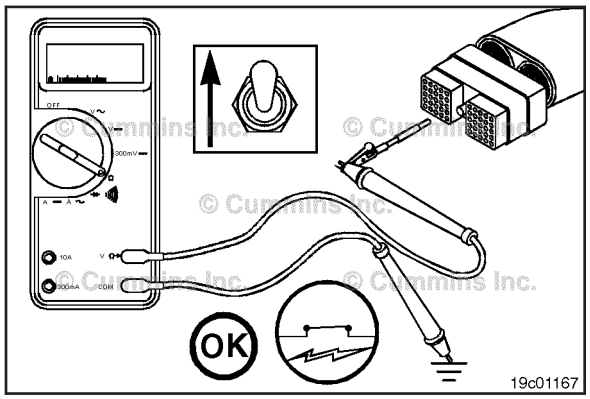
If **not**, follow the troubleshooting procedures in this section.



Disconnect the OEM harness from the ECM connector.

Insert a test lead into the 2-speed axle switch signal pin of the OEM harness connector, and attach it to a multimeter probe.

Touch the other multimeter probe to the engine block ground.

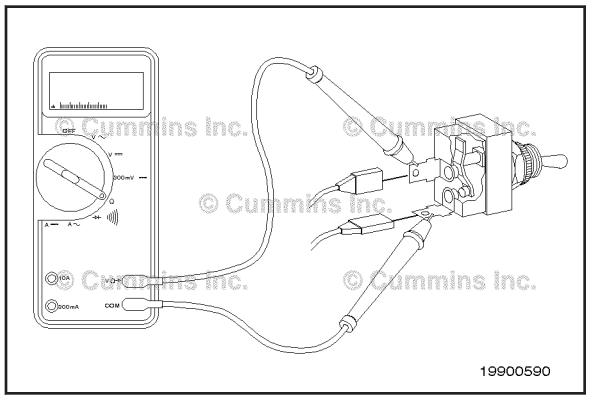


Move the 2-speed axle switch to the ON position.

The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, inspect the 2-speed-axle-switch signal wire for an open circuit. Refer to the OEM troubleshooting and repair manual.

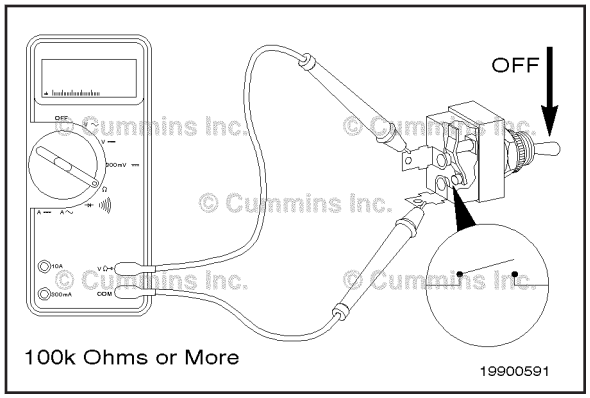
If the resistance is within specification, the 2-speed axle switch signal pin **must** be checked for a short circuit to ground, a short circuit from pin-to-pin, and a short circuit to an external voltage source.



Resistance Check

If INSITE™ is available, monitor the switch for proper operation. If INSITE™ is **not** available, follow the troubleshooting procedures in this section.

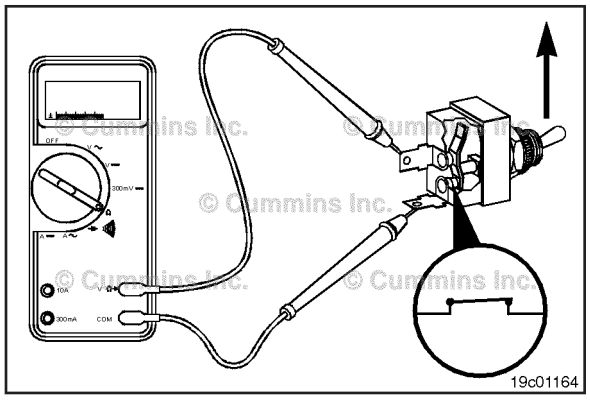
Locate the remote accelerator switch. Remove and tag the two connectors from the terminals on the switch.



Touch the multimeter probes to the terminals on the switch.

Move the switch to the OFF position and measure the resistance. The multimeter **must** show an open circuit (100K ohms or more).

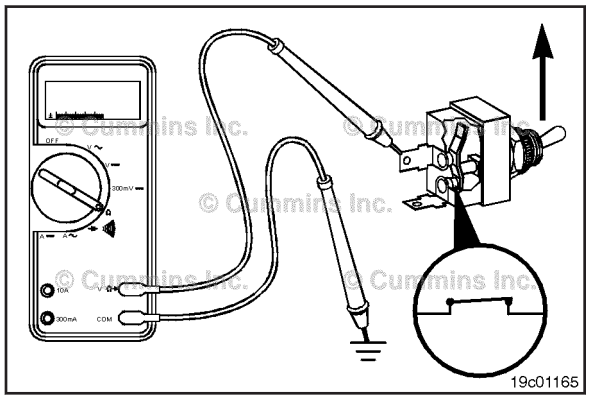
If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for the replacement procedures.



Move the switch to the ON position and measure the resistance. The multimeter **must** show a closed circuit (10 ohms or less).

If the circuit is **not** closed, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures.

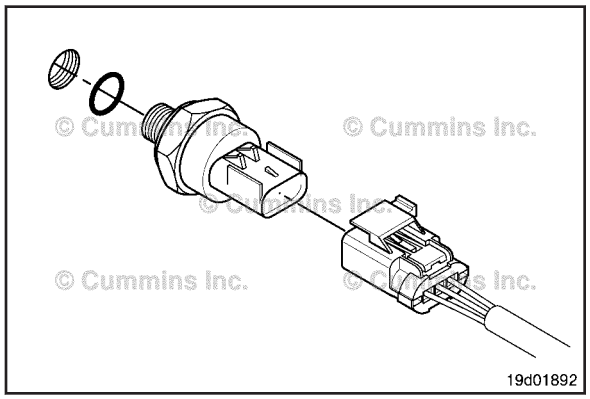
If the resistance value is correct, the switch **must** still be checked for a short circuit to ground.



Check for Short Circuit to Ground

Touch one of the multimeter probes to one of the switch terminals. Touch the other probe to chassis ground. Move the switch to the ON position and measure the resistance. The multimeter **must** show an open circuit (100K ohms or more). If the circuit is **not** open, the switch has failed. Refer to the OEM troubleshooting and repair manual for replacement procedures.

If the switch passes all of the previous checks, the circuit **must** be checked for an open circuit, a short circuit to ground, a short circuit from pin to pin and a short circuit to an external voltage source.



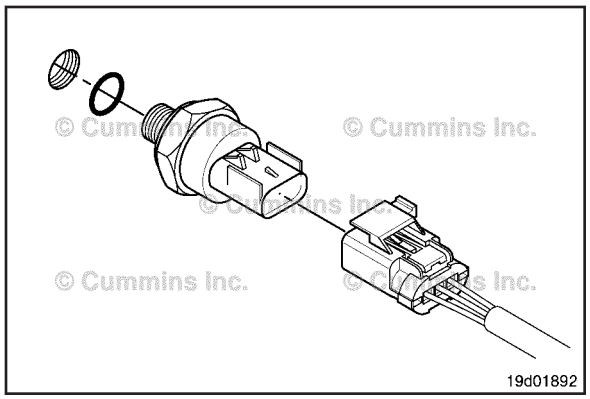
Install

Make sure the new sensor has an o-ring.

Lubricate the o-ring with clean engine oil.

Install a new sensor into the engine. Tighten the sensor.

Torque Value: 18 N•m [159 in-lb]



Push the connectors together until they lock.

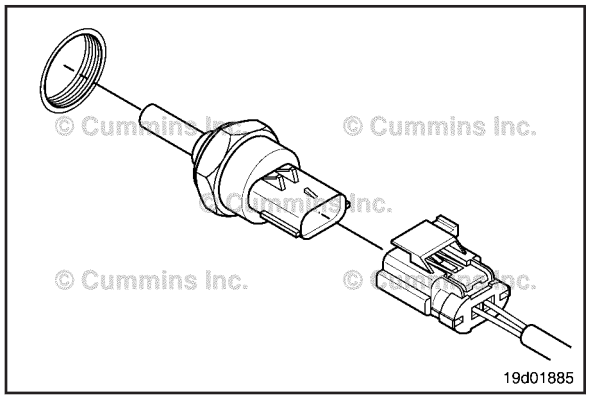
Slide the locking tab to the lock position.

EGR Temperature Sensor (019-378)

General Information

The exhaust gas recirculation (EGR) cooler outlet temperature sensor is used to measure the temperature of the exhaust gas that exits the EGR cooler. The ECM uses this temperature to control the emission levels of the engine.

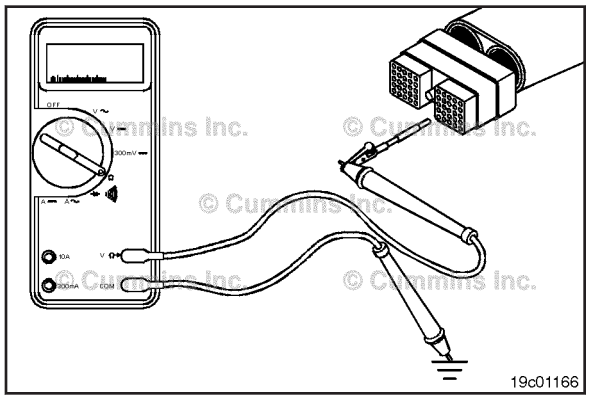
The EGR cooler outlet temperature sensor is located at the intake air horn at the front of the engine.



Remove

Lift the tab and detach the connector from the sensor.

Remove the sensor from the air intake connection.



Check for Short Circuit to Ground

Disconnect the OEM harness connector from the ECM connector. Disconnect the intake air heater control relay from the OEM harness. Set the multimeter to measure resistance.

Insert the test lead into the intake air heater control relay signal pin of the OEM harness connector. Touch the other multimeter probe to engine block ground. Measure the resistance.

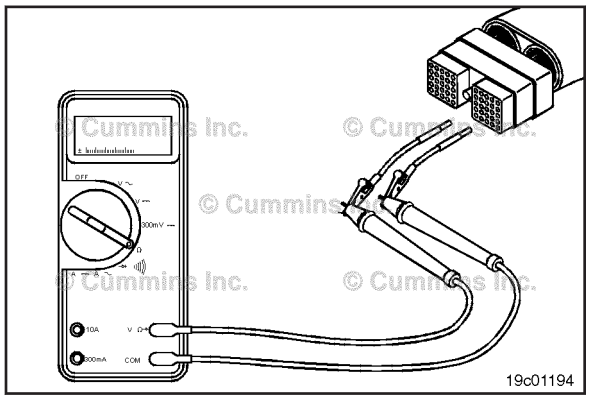
The multimeter **must** show a measurement of 100k ohms or more (open circuit).

If the measured value is less than 100k ohms, there is a short circuit to ground in the signal wire. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.

Repeat the short to ground check for the return wire. Measure the resistance from the intake air heater control relay return pin of the OEM harness connector to engine block ground.

The multimeter **must** show a measurement of 100k ohms or more (open circuit).

If the measured value is less than 100k ohms, there is a short circuit to ground in the return wire. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.



Check for Short Circuit from Pin to Pin

Disconnect the OEM harness connector from the ECM connector. Disconnect the intake air heater control relay from the OEM harness. Set the multimeter to measure resistance.

Measure the resistance from the intake air heater control relay signal pin in the OEM harness connector to all other pins in the connector.

The multimeter **must** show a measurement of 100k ohms or more (open circuit).

If the measured value is less than 100k ohms, there is a short circuit between the signal wire and any other pin that measured a closed circuit. Repair or replace the OEM harness. Refer to the OEM troubleshooting and repair manual.