

SMCS - 1439, 1912

i01927891

**System Operation Description:**

The engine uses two engine speed/timing sensors. Both of the engine speed/timing sensors detect the reference for engine speed and timing from a unique pattern on the camshaft gear. The ECM counts the time between pulses that is created by the sensor as the gear rotates in order to determine rpm. The ECM remembers the pattern of the pulses. The ECM uses the pattern of the pulses in order to determine the position of the crankshaft.

When the timing has been established, the ECM triggers each injector in the correct firing order at the correct time.

The actual timing and duration of each injection is based on engine rpm and load. If the engine is running and the signal from one of the engine speed/timing sensors is lost, no noticeable change in engine performance will be noticed.

The engine will start and the engine will run when only one sensor signal is present from either of the sensors. The loss of the signal from both of the sensors during engine operation will result in the termination of injection and the shutting down the engine by the ECM. The loss of the signal from both of the sensors during start-up will prevent the engine from starting.

Both sensors are magnetic sensors. The two sensors are not interchangeable. Do not switch the positions of the sensors. The two sensors must be replaced as a pair. If the sensors are replaced, a timing calibration is not necessary for the engine. **Timing calibration is only necessary after replacing an ECM that will not communicate.**

If a replacement of the ECM is required, the ECM parameters and the timing calibration can be transferred from the suspect ECM to the replacement ECM. Timing calibration will not be necessary. This feature requires the Caterpillar Electronic Technician (Cat ET) and this feature is only possible if the existing ECM can communicate with Cat ET. Use the procedure "Copy Configuration - ECM Replacement" on Cat ET. Refer to Troubleshooting, "Programming Parameters" for more information.

**When the sensors are being installed, complete all of the following tasks:**

- Lubricate the O-ring with oil.
- Ensure that the sensor has a face seal inside the connector body. If a seal is damaged or missing, replace the seal.
- Ensure that the sensor is fully seated into the engine before tightening the bracket bolt.
- Ensure that the connector is latched on both sides.
- Ensure that the harness is properly secured, and ensure that the harness is attached to the harness clip.

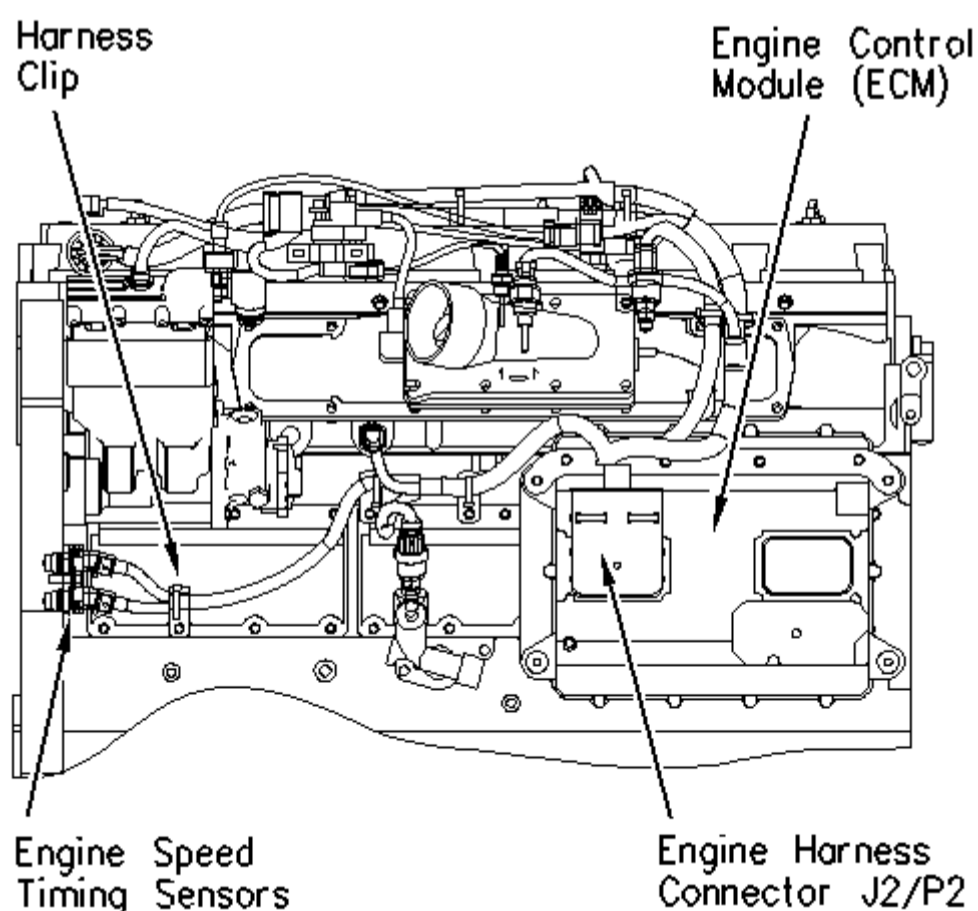


Illustration 1  
Left side engine view (typical view)

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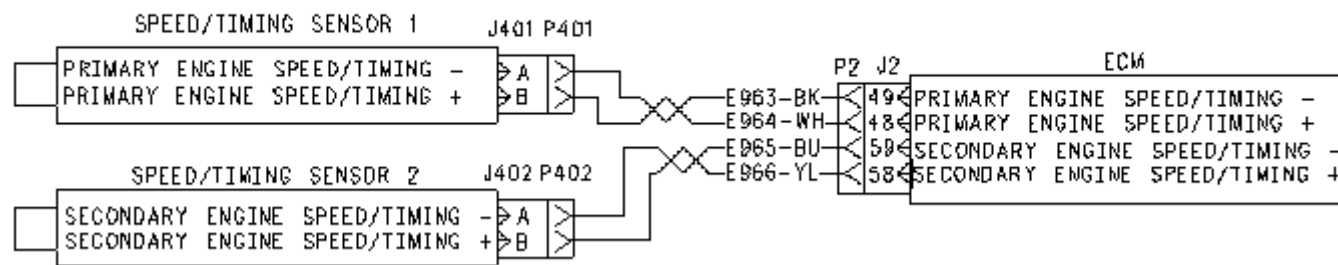


Illustration 2  
Schematic

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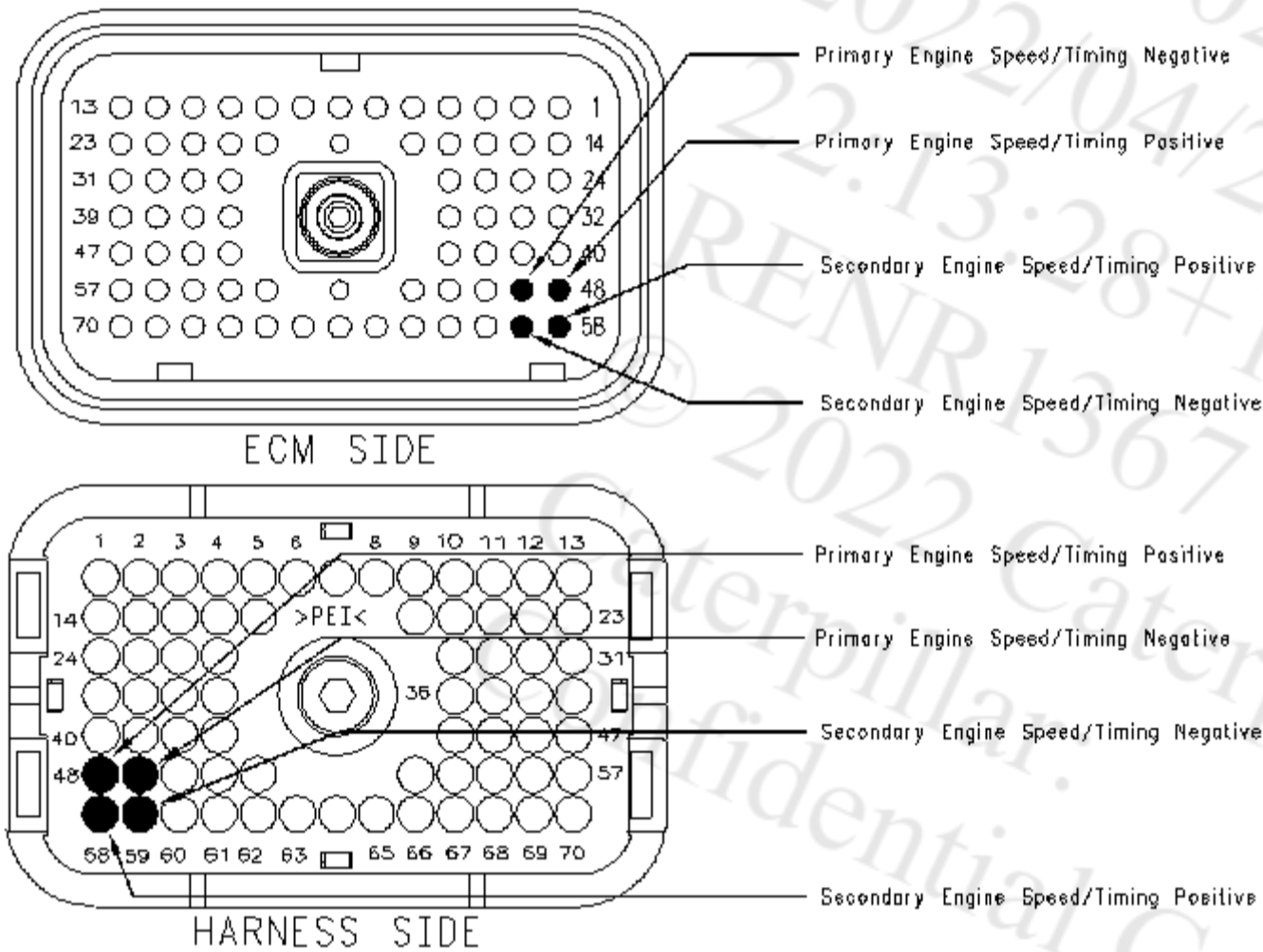


Illustration 3  
P2 ECM connector

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### Test Step 1. Check for Active Diagnostic Codes and Logged Diagnostic Codes

- A. Connect Cat ET to the data link connector.
- B. Turn the key switch to the ON position.
- C. Check for one of the following logged diagnostic codes or active diagnostic codes:
  - o 64-02 Secondary Engine Speed loss of signal (34)
  - o 64-11 Secondary Engine Speed no pattern (34)
  - o 190-02 Secondary Engine Speed Loss of Signal (34)
  - o 190-11 Secondary Engine Speed no pattern (34)

**Note:** If the diagnostic code is logged but not active, run the engine until the engine is at normal operating temperature. The problem may only occur when the engine is at the normal operating temperature. If the engine will not start, monitor the engine rpm from Cat ET while the engine is being cranked. Cat ET may need to be powered from another battery while the engine is being cranked. This is done in order to ensure that Cat ET does not reset.

### Expected Result:

One or more of the diagnostic codes that are listed above are logged or active.

**Note:** If you have been directed here from Troubleshooting, "Troubleshooting without a Diagnostic Code" for the following reason, select "No Engine rpm":

- The engine rpm was not indicated on Cat ET.

#### Results:

- **OK** - There is an active diagnostic code or a logged diagnostic code. Proceed to Test Step 3.
- **Not OK** - If none of the codes that are listed are active diagnostic codes or logged diagnostic codes and the engine is not running properly, refer to the appropriate symptoms in the service manual. **STOP**
- **No Engine rpm** - Engine rpm is not indicated on Cat ET. Proceed to Test Step 2.

#### Test Step 2. Check the Installation of the Sensors and the Bracket

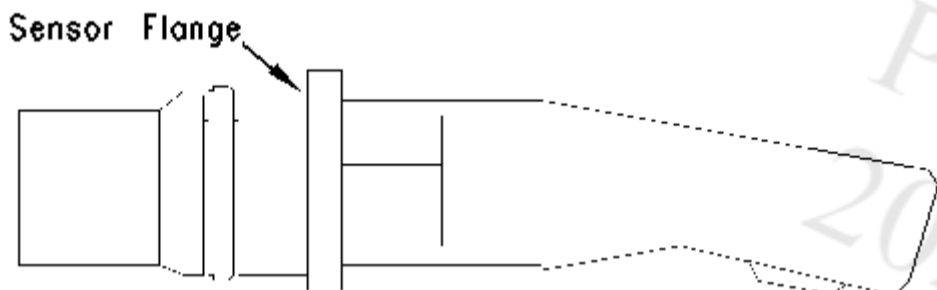


Illustration 4  
Flange of the sensor and mounting bracket

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- The flange of the sensor should be flush against the engine in order to ensure proper operation.
- Inspect the bracket in order to ensure that the installation allows the flange of the sensor to be flush against the engine. Verify that the bracket is not bent.

**Note:** The bracket cannot be replaced separately.

- Ensure that one O-ring has been installed on the sensor, and ensure that the O-ring is free of damage.

**Note:** If the flange of the sensor is bent or if an obstruction is preventing the sensor from reading a good pattern, the engine will not start.

#### Results:

- **OK** - The sensors and the bracket are properly installed. Proceed to Test Step 3.
- **Not OK** -  
**Repair:** Perform the following procedure in order to properly install the sensors and the bracket:

- Loosen the bolt that holds the sensor mounting bracket to the engine.
- Seat the sensor and tighten the bolt.  
If the sensor will not seat, repair the sensor or replace the sensor, as required.
- Ensure that the sensor is properly oriented and that the harness is secured in the proper location.
- Verify that the repair eliminates the problem.

**STOP**

#### Test Step 3. Measure the Sensor Resistance Through the Engine Harness

- Turn the key switch to the OFF position.
- Thoroughly inspect ECM vehicle harness connector J2/P2. Refer to Troubleshooting, "Electrical Connectors - Inspect" for details.
- Perform a 45 N (10 lb) pull test on the following wires in the ECM engine harness connector P2 that are associated with the engine speed/timing sensors:
  - P2:48
  - P2:49
  - P2:58

- o P2:59

- D. Ensure that the latch tab on the connector is properly latched and ensure that the latch tab is fully latched.
- E. Check the ECM connector (allen head screw) for the proper torque of 6.0 N·m (55 lb in).
- F. Repair the harness or repair the connector if a problem is found.
- G. Ensure that the wiring harness is correctly routed and secured at the proper locations.
- H. Ensure that the harness wiring is not pulled too tightly. When the harness wiring is pulled too tightly, vibrations or movement can cause intermittent connections.
- I. Inspect the harness wiring for nicks and abrasions.
- J. If the harness and the connector are OK, disconnect ECM connector J2/P2.
- K. Primary engine speed/timing sensor
  - a. Use a multimeter to measure the resistance from P2:48 (Primary Engine Speed/Timing +) to P2:49 (Primary Engine Speed/Timing -).
  - b. Check for an intermittent open circuit or short circuit by moving the harness while the measurement for resistance is being taken. Pull the wires that are directly behind the sensors or shake the wires that are directly behind the sensors.  
Resistance ... 75 to 230 Ohms
- L. Secondary engine speed/timing sensor
  - a. Use a multimeter to measure the sensor resistance (Ohms) from P2: 58 (Secondary Engine Speed/Timing +) to P2:59 (Secondary Engine Speed/Timing -).
  - b. Check for an intermittent open circuit or short circuit by moving the harness while the measurement for resistance is being taken. Pull the wires that are directly behind the sensors or shake the wires that are directly behind the sensors.  
Resistance ... 600 to 1800 Ohms

**Expected Result:**

The readings agree with the values that are listed above.

**Results:**

- **OK** - Neither a short circuit nor an open circuit is indicated. Proceed to Test Step 5.
- **Not OK** - The sensor resistance is not within the acceptable range when the sensor resistance is measured through the engine harness. Proceed to Test Step 4.

**Test Step 4. Measure the Resistance of the Sensor at the Sensor**

- A. Turn the key switch to the OFF position.
- B. Check the harness and the wiring for abrasion and pinch points from the sensor back to the ECM.
- C. Disconnect the suspect sensor from the engine harness.
- D. Thoroughly inspect ECM engine harness connectors for the sensors J401/P401 or J402/P402. Refer to Troubleshooting, "Electrical Connectors - Inspect" for details.
- E. Primary engine speed/timing sensor
  - a. Use a multimeter to measure the sensor resistance (Ohms) from J401:B (Primary Engine Speed/Timing +) to J401:A (Primary Engine Speed/Timing -).  
Resistance ... 75 to 230 Ohms
- F. Secondary engine speed/timing sensor
  - a. Use a multimeter to measure the sensor resistance (Ohms) from J402:B (Secondary Engine Speed/Timing +) to J402:A (Secondary Engine Speed/Timing -).  
Resistance ... 600 to 1800 Ohms

**Note:** Timing calibration is not necessary following replacement of the speed/timing sensors. Refer to the information in the System Operation Section regarding the installation of sensors.

**Expected Result:**



The readings agree with the values that are listed above.

#### Results:

- **OK** - The sensor resistance is correct. Proceed to Test Step 5.
- **Not OK** - The sensor resistance is out of the range.

**Repair:** Perform the following procedure in order to check and install the new sensor:

1. Before installing the new sensor, measure the resistance of the new sensor.

**Note:** If the new sensor resistance is not in the correct range, inspect the wiring harness for damage.

If the new sensor resistance is in the correct range, install the new sensor in the engine, as follows:

- a. Loosen the bolt that holds the sensor mounting bracket to the engine.
- b. Ensure that one O-ring is installed and free of damage.
- c. Seat the sensor and tighten the bolt.  
If the sensor will not seat, repair the sensor or replace the sensor, as required.

**Note:** The sensor must not be removed from the bracket.

- d. Ensure that the sensor is properly oriented and that the harness is secured in the proper location.

2. Verify that the repair eliminates the problem.

#### STOP

#### Test Step 5. Install the Bypass Harness for the Engine Speed/Timing Sensors

- A. Turn the key switch to the OFF position.
- B. Disconnect ECM connector J2/P2.
- C. Install the wiring harness to the P2 ECM connector. Connect the wiring:
  - P2:48 to the white wire
  - P2:49 to the black wire
  - P2:58 to the yellow wire
  - P2:59 to the blue wire

**Note:** Twisted pair wiring is required. Ensure that the wires have at least one twist per inch.

- D. Reconnect the J2/P2 ECM connector.
- E. Start the engine in order to determine if the bypass harness repairs the problem.

#### Expected Result:

The problem is corrected with the installation of the bypass harness.

#### Results:

- **OK** - The bypass harness corrected the problem.  
**Repair:** Permanently install a new section of harness.

#### STOP

- **Not OK** - The bypass harness did not correct the problem.  
**Repair:** Verify that the correct terminals have been installed in the correct location of the P2 ECM connector. If the temporary harness was installed correctly, install the original wiring.

Proceed to Test Step 6.

#### Test Step 6. Check the ECM

- A. Turn the key switch to the OFF position.
- B. Temporarily connect a test ECM.

C. Start the engine. Run the engine in order to repeat the conditions when the problem occurs.

D. If the problem is resolved with the test ECM, reconnect the suspect ECM.

E. If the problem returns with the suspect ECM, replace the ECM.

Verify that the repair eliminates the problem.

**Expected Result:**

The problem remains with the suspect ECM.

**Results:**

- **OK** - The problem is resolved with the test ECM and the problem returns with the suspect ECM. Replace the ECM. Verify that the repair eliminates the problem.**STOP**
- **Not OK** - The problem was not resolved with a test ECM.  
**Repair:** Replace the sensor. Verify that the repair eliminates the problem.

**STOP**

1AJ1-UP, 7AS1-UP, 8SZ1-UP, 8YL1-UP, 9SZ1-UP, BKD1-UP, CKM1-UP, CRP1-UP, DPF1-UP, G3E1-UP, HEP1-UP, LEF1-UP

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