Throttle Position Sensor Circuit - Test

SMCS - 1439-038; 1913-038

System Operation Description:

Note: If the vessel is equipped with a Multi-Station Control System (MSCS), refer to Service Manual, RENR7651, "Marine Multi-Station Control System" for the proper troubleshooting procedure.

The use of a Throttle Position Sensor (TPS) eliminates the need for a mechanical throttle and governor linkages. The TPS converts a lever movement by the operator into an electrical signal. The electrical signal is sent to the engine's Electronic Control Module (ECM). The ECM processes the signal in order to control the engine speed.

A Pulse Width Modulated signal (PWM) is created by the TPS. The duty cycle varies with the throttle position. The signal has a low duty cycle when the throttle is at low idle. The signal has a high duty cycle when the throttle is at high idle.
The signal that is produced by the TPS has a variable frequency. The frequency of the signal must be between 150 Hz and 1050 Hz or the ECM will activate an -08 diagnostic code. Use this procedure to troubleshoot these diagnostic codes:

- 91-08 Throttle Position signal abnormal
- 1249-08 Secondary Throttle Position signal abnormal

A problem with the circuit for the synchronization switch may prevent the ECM from responding to a valid signal from the TPS. The following active diagnostic codes will also prevent the ECM from responding to the throttle input:

- 91-13 Throttle Position Calibration required
- 268-02 Check Programmable Parameters
- 1249-13 Secondary Throttle Position Calibration required

If one of the above diagnostic codes is active, troubleshoot that code before you continue with this procedure. If you suspect a problem with the synchronization switch, refer to diagnostic functional tests Troubleshooting, "Engine Synchronization Switch Circuit - Test".

This troubleshooting procedure verifies that the signal from a TPS is valid at the ECM.
When you make repairs to the circuit for the TPS, follow the guidelines in Special Instruction, REHS1187, "Electronic Installation Guide". This document provides information that will ensure that the TPS is protected from transient voltages and from problems that are caused by improper grounding.

Two throttle position sensors are shown in Illustration 2. A vessel may contain more than one TPS. Each TPS may be connected to more than one ECM. Refer to the vessel's schematic diagram for the actual configuration. Use this procedure to troubleshoot all possible configurations.

Illustration 2

Typical schematic for the throttle position sensor

Test Step 1. Verify that the "Secondary Throttle Enable" Parameter is Programmed Correctly

A. Connect the Caterpillar Electronic Technician (ET) to the service tool connector.

B. Establish communication with the ECM that activated the 08 diagnostic code.

C. Verify that the "Secondary Throttle Enable" status is programmed correctly.
   a. If the engine is equipped with a single TPS, verify that the "Secondary Throttle Enable" parameter is programmed to "Disabled".

   b. If the engine is equipped with multiple throttle position sensors, verify that the "Secondary Throttle Enable" parameter is programmed to "Enabled".

Expected Result:
The "Secondary Throttle Enable" parameter is programmed correctly.

Results:
• **OK** - The "Secondary Throttle Enable" parameter is programmed correctly. Proceed to Test Step 2.

• **Not OK** - The "Secondary Throttle Enable" parameter is not programmed correctly.

**Repair:** Program the "Secondary Throttle Enable" parameter to the correct value. Verify that the repair eliminates the problem.

**STOP**

**Test Step 2. Inspect the Electrical Connectors and the Wiring**

A. Remove the electrical power from the ECM.

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Illustration 3  
Engine view (typical example)

(1) J1/P1 ECM connector
Illustration 4

Engine view (typical example)

(2) P61 Customer connector

B. Thoroughly inspect connectors (1) and (2). Inspect the connections on each throttle position sensor. Refer to diagnostic functional tests Troubleshooting, "Electrical Connectors - Inspect".
P1 terminals that are associated with the throttle position sensor

(P1-66) Primary throttle position

(P1-68) Secondary throttle position
J61/P61 terminals that are associated with the throttle position sensor

(10) Primary throttle position
(4) Secondary throttle position

C. Perform a 45 N (10 lb) pull test on each of the wires that are associated with the throttle position sensor.

D. Check the allen head screw on the customer connector and on each ECM connector for the proper torque. Refer to diagnostic functional tests Troubleshooting, "Electrical Connectors - Inspect" for the correct torque values.

E. Check the harness and wiring for abrasions and for pinch points from each throttle position sensor to the ECM and from the throttle position sensor to the electrical power source.

Expected Result:
All connectors, pins, and sockets are completely coupled and/or inserted, and the harness and wiring are free of corrosion, of abrasion or of pinch points.

**Results:**

- **OK** - The wiring and the connectors appear to be OK. Proceed to Test Step 3.
- **Not OK** - There is a problem with the wiring and/or the connectors.

  **Repair:** Repair the wiring and/or the connectors. Replace parts, if necessary. Ensure that all of the seals are properly connected. Verify that the repair eliminates the problem.

  **STOP**

**Test Step 3. Check for Supply Voltage at the Throttle Position Sensor**

A. Disconnect the harness connector from the suspect throttle position sensor.

B. Restore the electrical power to the ECM.

C. Measure the voltage between terminals A and B on the harness connector for the throttle position sensor.

**Expected Result:**

The supply voltage is at least 11 VDC for a 12 volt system. The supply voltage is at least 22 VDC for a 24 volt system.

**Results:**

- **OK** - The supply voltage is at least 11 VDC for a 12 volt system. The supply voltage is at least 22 VDC for a 24 volt system. The supply voltage is reaching the sensor. Proceed to Test Step 4.
- **Not OK** - The supply voltage is incorrect.

  **Repair:** The configuration of the wiring between the battery and the throttle position sensor depends on the vessel's configuration. The problem could be in the wiring or in a connector. There may be a problem with the battery. Perform the necessary repairs. When you make repairs to the wiring for the TPS, follow the guidelines in Special Instruction, REHS1187, "Electronic Installation Guide". Verify that the problem is resolved.

  **STOP**

**Test Step 4. Check the Signal Wire for a Short Circuit**

A. Remove the electrical power from the ECM.

B. Disconnect the P1 connector from every ECM on the vessel. Verify that the electrical connector for the suspect throttle position sensor is disconnected.

  **Note:** Be sure to wiggle the harnesses during the following measurements. Be sure to wiggle each harness near each connector.

C. Measure the resistance between terminal P1-66 and all of the other terminals in the P1 connector for the ECM that activated the -08 diagnostic code.
Expected Result:

Each resistance measurement indicates an open circuit.

Results:

- **OK** - Each resistance measurement indicates an open circuit. Connect the P1 connectors. Proceed to Test Step 6.

- **Not OK** - At least one resistance measurement does not indicate an open circuit.

  **Repair:** There is a problem with the signal wire for the throttle position sensor. The problem could be in the wiring or in a connector. Repair the wiring and/or the connector, when possible. Replace parts, if necessary. Verify that the problem is resolved.

STOP

Test Step 5. Check the Signal Wire for an Open Circuit

**Note:** Be sure to wiggle the harnesses during the following measurement. Be sure to wiggle each harness near each connector.

Measure the resistance between terminal P1-66 for the ECM that activated the 08 diagnostic code and terminal C of the harness connector for the suspect TPS.

Expected Result:

The resistance measurement is less than ten Ohms.

Results:

- **OK** - The resistance measurement is less than ten Ohms. Connect all of the electrical connectors. Proceed to Test Step 6.

- **Not OK** - The resistance measurement is greater than ten Ohms. There is a problem with the signal wire.

  **Repair:** The problem could be in the wiring or in a connector. Repair the wiring and/or the connector, when possible. Replace parts, if necessary. Verify that the problem is resolved.

STOP

Test Step 6. Check the Frequency of the Throttle Position Signal at the Sensor

A. Connect the Cat (ET) to the service tool connector. Refer to electronic troubleshooting Troubleshooting, "Electronic Service Tools".

B. Connect a breakout T between the harness connectors (3 pin) for the throttle position sensor.

C. Connect a multimeter between terminals B and C on the breakout T.

D. Restore the electrical power to the ECM.

E. Measure the frequency of the throttle position signal. Slowly move the throttle from low idle to high idle and back to low idle while you measure the frequency of the signal.
F. Use Cat ET to check for active diagnostic codes. Slowly move the throttle from the low idle position to the high idle position. Look for an 08 diagnostic code while you move the throttle.

**Expected Result:**

The frequency of the signal remains between 150 Hz and 1050 Hz as you move the throttle. An 08 diagnostic code is not activated.

**Results:**

- **OK** - The frequency of the signal remains between 150 Hz and 1050 Hz as you move the throttle. An 08 diagnostic code is not activated.

  **Repair:** Perform the following procedure:

  1. Remove the electrical power from the ECM.
  2. Remove the breakout T.
  3. Connect the harness connectors for the throttle position sensor.
  4. Restore the electrical power to the ECM.
  5. Operate the throttle throughout the entire range.

      If the problem does not recur, the problem is resolved. The original problem was probably caused by a poor electrical connection. Return the engine to service.

**STOP**

- **Not OK** - The frequency of the signal is incorrect. A 91-08 diagnostic code is activated.

  **Repair:** Perform the following procedure:

  1. Remove the electrical power from the ECM.
  2. Replace the throttle position sensor. Check for an 08 diagnostic code again.

      If the diagnostic code does not recur, the problem is resolved. Return the engine to service.

      If the diagnostic code recurs, replace the ECM. Refer to electronic troubleshooting Troubleshooting, "Replacing the ECM". Verify that the problem is resolved.

**STOP**