Engine Cranks but Will Not Start

Probable Causes

- Diagnostic codes
- Visible faults
- Air intake and exhaust system
- Primary speed/timing sensor
- Low pressure fuel system
- Secondary speed/timing sensor
- High pressure fuel system
- Glow plugs
- Valve lash
- Low compression (cylinder pressure)

Recommended Actions

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

Diagnostic Codes

Use one of the following methods to check for active diagnostic codes:

- Flash Codes
- The display on the control panel
- The electronic service tool

Flash Codes

Note: The following procedure is only applicable if the machine is equipped with the appropriate warning lamps.

1. Check the warning lamps on the control panel for flash codes. Flash codes are explained in Troubleshooting, "Flash Codes".

2. If any flash codes are displayed, troubleshoot the codes before continuing with this procedure. Refer to Troubleshooting, "Troubleshooting with a Diagnostic Code".

3. Attempt to start the engine. If the engine will not start, proceed to "Visible Faults".

Display on the Control Panel

Note: The following procedure is only applicable if the application is equipped with a display on the control panel.

1. Check the display on the control panel for active diagnostic codes.

2. Troubleshoot any active codes before continuing with this procedure. Refer to Troubleshooting, "Troubleshooting with a Diagnostic Code".

3. Attempt to start the engine. If the engine will not start, proceed to "Visible Faults".

Electronic Service Tool

1. Connect the electronic service tool to the diagnostic connector.

2. Check for active diagnostic codes on the electronic service tool.

3. Investigate any active codes before continuing with this procedure. Refer to Troubleshooting, "Troubleshooting with a Diagnostic Code".

4. Attempt to start the engine. If the engine will not start, proceed to "Visible Faults".
Visible Faults

1. Visually inspect the engine for the following faults:
   - Missing components
   - Damaged components
   - Damaged electrical cables or loose electrical cables
   - Oil leaks
   - Fuel leaks

2. Check the following items:
   - Check for smoke from the exhaust when the engine is cranking. If smoke is seen during cranking, there may be a mechanical fault in the engine. Refer to "Low Compression (Cylinder Pressure)".
   - Check for the proper level of fuel, oil and coolant.
   - Ensure that the fuel supply valve (if equipped) is in the full OPEN position.
   - If the ambient temperature is below 0 °C (32 °F), make sure that the correct specification of engine oil and oil for the machine is used.
   - Check that the battery voltage is correct.
   - Use the electronic service tool to check the average cranking speed of the engine. If the cranking speed is less than 150 rpm, investigate the cause of the low cranking speed.
   - Make sure that all fuel filters are correctly installed.
   - Drain any water from the primary fuel filter/water separator.

3. Rectify any faults that are found during the visual checks.

4. Attempt to start the engine. If the engine will not start, proceed to "Air Intake and Exhaust System".

Air Intake and Exhaust System

1. Check the air filter restriction indicator, if equipped.

2. Ensure that the air filter is clean and serviceable.

3. Check the air intake and exhaust systems for the following defects:
   - Blockages
   - Restrictions
Damage to lines or hoses

4. Repair any defects before attempting to restart the engine.

5. Attempt to start the engine. If the engine will not start, proceed to "Primary Speed/timing Sensor".

**Primary Speed/timing Sensor**

1. Disconnect connector P401 from the primary speed/timing sensor.

2. Attempt to start the engine.

3. If the engine starts, check for a fault in the circuit for the primary speed/timing sensor. Refer to Troubleshooting, "Engine Speed/Timing Sensor Circuit - Test".

4. If the engine does not start, inspect the timing ring on the crankshaft for misalignment.

5. If necessary, repair the timing ring. Refer to Disassembly and Assembly, "Crankshaft Timing Ring - Remove and Install".

6. Attempt to start the engine. If the engine will not start, proceed to "Low Pressure Fuel System".

**Low Pressure Fuel System**

1. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).

2. Check for fuel supply lines that are restricted.

3. Check that the low pressure fuel lines are correctly installed.


5. Check for air in the fuel system. Refer to Systems Operation, Testing and Adjusting, "Air in Fuel - Test".

6. Ensure that the fuel system has been primed. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime".

7. Attempt to start the engine. If the engine will not start, continue with this procedure.


9. Attempt to start the engine. If the engine will not start, continue with this procedure.

10. Check the flow of fuel through the transfer pump. If the flow of fuel through the transfer pump is less than 250 mL per minute at 150 rpm, replace the transfer pump. Refer to Disassembly and Assembly, "Fuel Transfer Pump - Remove" and Disassembly and Assembly, "Fuel Transfer Pump - Install".
11. Attempt to start the engine. If the engine will not start, proceed to "Secondary Speed/timing Sensor".

**Secondary Speed/timing Sensor**

1. Connect the electronic service tool to the diagnostic connector.

2. Check that the desired fuel rail pressure is at least 25 MPa (3625 psi) when the engine is cranking.

3. If the desired fuel rail pressure is less than 25 MPa (3625 psi), perform the following procedure:
   a. Use the electronic service tool to check the signal from the secondary speed/timing sensor while the engine is cranking.
   b. If the signal from the secondary speed/timing sensor is 0 rpm, investigate the secondary speed/timing sensor. Refer to Troubleshooting, "Engine Speed/Timing Sensor Circuit - Test".
   c. If a fault is identified in the circuit for the secondary speed/timing sensor, repair the fault and then attempt to start the engine. If the engine will not start, proceed to "High Pressure Fuel System".
   d. If the signal from the secondary speed/timing sensor is greater than 0 rpm and the engine will not start, proceed to "High Pressure Fuel System".

**High Pressure Fuel System**

1. Use the electronic service tool to check the absolute fuel rail pressure while the engine is cranking at a minimum speed of 150 rpm.

2. If the absolute fuel rail pressure is less than 25 MPa (3625 psi), perform the following procedure:
   a. Check that the inlet pressure at the fuel rail pump is greater than 50 kPa (7.25 psi). If the inlet pressure is less than 50 kPa (7.25 psi), repeat the diagnostic process from "Low Pressure Fuel System".
   b. Check for fuel leaks in the high pressure fuel system. Rectify any fuel leaks and then recheck the pressure in the fuel rail. If the fuel rail pressure is greater than 25 MPa (3625 psi), proceed to test step 3.
   c. Use the electronic service tool to perform a solenoid test on the fuel rail pump. Refer to Troubleshooting, "Fuel Rail Pump Solenoid - Test".
   d. If any service has been performed as a result of Step 2.c, attempt to start the engine. If the engine will not start, repeat the diagnostic process from "Diagnostic Codes".
   e. Check the pressure relief valve in the fuel rail for leakage. If the pressure relief valve is leaking, replace the valve and recheck the pressure in the fuel rail.
f. If the pressure relief valve in the fuel rail is not leaking, check for fuel in the engine oil system. If fuel is suspected in the oil system, take an engine oil sample for analysis. Refer to the Operation and Maintenance Manual, "Engine Oil Sample - Obtain". If the analysis confirms that there is fuel in the engine oil system, investigate the cause.

g. If fuel is not found in the oil system, check the electronic unit injectors for excessive fuel leak off. Refer to Special Instruction KENR6938, "High Leakoff of the Electronic Unit Injector".

h. If the leak off is greater than 38 mL (1.3 oz) in 30 seconds for a 6 cylinder engine or the leak off is greater than 25 mL (0.85 oz) in 30 seconds for a 4 cylinder engine, replace the electronic unit injectors.

   **Note:** The fault is not in the fuel rail pump. Do not replace the pump.

i. If the leak off is less than 38 mL (1.3 oz) in 30 seconds for a 6 cylinder engine or the leak off is less than 25 mL (0.85 oz) in 30 seconds for a 4 cylinder engine, proceed to Test Step 3.d.

3. If the absolute fuel rail pressure is greater than 25 MPa (3625 psi), perform the following procedure:

   a. Use the electronic service tool to make sure that the status of the electronic unit injectors is not "Disabled". If the injectors are disabled but the injectors were not intentionally disabled with the electronic service tool, proceed to test step 3.d.

   b. If the electronic unit injectors are not disabled, use the electronic service tool to perform an injector solenoid test. Refer to Troubleshooting, "Injector Solenoid Circuit - Test".

   c. If any service has been performed as a result of Step 3.b, attempt to start the engine. If the engine will not start, proceed to "Glow Plugs".

   d. Make sure that the latest flash file for the application is installed in the ECM. Refer to Troubleshooting, "Flash Programming".

   e. Contact the technical communicator at the Caterpillar dealer.

      **Note:** This consultation can greatly reduce the repair time.

   f. If the technical communicator recommends the use of a test ECM, install a test ECM. Refer to Troubleshooting, "Replacing the ECM".

   g. Attempt to start the engine. If the engine will not start, install the original ECM and then proceed to Test Step 3.l.

   h. If the engine starts normally, stop the engine and then attempt to start the engine again. If the engine will not start at the second attempt, proceed to Test Step 3.k.

   i. If the engine starts normally, reconnect the suspect ECM and then verify that the fault returns when the suspect ECM is installed.

   j. If the engine will not start with the suspect ECM, replace the ECM. Check that the engine starts normally. If the engine starts normally, no further testing is required.
k. Replace the ECM again and then replace the fuel rail pump. Verify that the fault has been eliminated. If the engine will not start, proceed to "Glow Plugs".

l. Check the timing of the fuel rail pump. Refer to Systems Operation, Testing and Adjusting, "Fuel Injection Timing - Check".

m. If the timing of the fuel rail pump required adjustment and the engine will not start, proceed to "Glow Plugs".

n. If the timing of the fuel rail pump was correct, replace the fuel rail pump. If the engine will not start, proceed to "Glow Plugs".

**Glow Plugs**

**Note:** Faulty glow plugs will only affect engine starting when the ambient temperature is below 10 °C (50 °F).

1. Check the operation of the glow plugs. Refer to Systems Operation, Testing and Adjusting, "Glow Plugs - Test".

2. If necessary, replace faulty glow plugs. Refer to Disassembly and Assembly, "Glow Plug - Remove and Install".

3. Attempt to start the engine. If the engine will not start, proceed to "Valve Lash".

**Valve Lash**

1. Check the valve lash. Refer to Systems Operation, Testing and Adjusting, "Engine Valve Lash - Inspect/Adjust".

2. Attempt to start the engine. If the engine will not start, proceed to "Low Compression (Cylinder Pressure)".

**Low Compression (Cylinder Pressure)**

1. Perform a compression test. Refer to Systems Operation, Testing and Adjusting, "Compression - Test".

2. If low compression is noted on any cylinders, investigate the cause and rectify the cause.

   Possible causes of low compression are shown in the following list:

   - Loose glow plugs
   - Faulty piston
   - Faulty piston rings
   - Worn cylinder bores
   - Worn valves
- Faulty cylinder head gasket
- Damaged cylinder head

3. Perform all necessary repairs.

4. Ensure that the repairs have eliminated the fault.