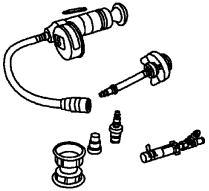
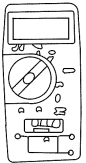
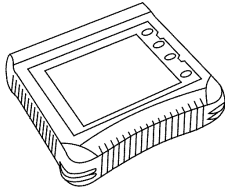
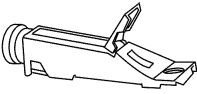


## DIAGNOSIS AND TESTING

### Engine Cooling

Refer to [Wiring Diagrams Cell 33](#) for schematic and connector information.

#### Special Tool(s)

 <p>ST1474-A</p>	<p>Pressure Tester 014-R1072 or equivalent</p>
 <p>ST1137-A</p>	<p>73III Automotive Meter 105-R0057 or equivalent</p>
 <p>ST2332-A</p>	<p>Worldwide Diagnostic System (WDS) Vehicle Communication Module (VCM) with appropriate adapters, or equivalent diagnostic tool</p>
 <p>ST1720-A</p>	<p>Battery/Anti-Freeze Tester 014-R1060 or equivalent</p>

#### Principles of Operation

The cooling fan motor and shroud is serviced as an assembly. If DTC P0480 or P0481 is present, refer to the [Powertrain Control/Emissions Diagnosis \(PC/ED\) manual](#).

#### Inspection and Verification

**⚠ WARNING:** Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine is cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth).

**⚠ CAUTION:** Check the coolant level, engine oil and transmission fluid, top off the coolant if needed. If there is engine coolant in the engine oil or transmission fluid, the cause must be corrected and oil/fluid changed or major component damage may occur.


1. Verify the customer's concern by operating the engine to duplicate the condition.
2. Inspect to determine if any of the following mechanical or electrical concerns apply.

#### Visual Inspection Chart

Mechanical
<ul style="list-style-type: none"> <li>• Leaks</li> <li>• Hoses</li> <li>• Hose clamps</li> <li>• Head gaskets</li> <li>• Intake manifold gasket</li> <li>• Coolant pump</li> <li>• Radiator</li> <li>• Degas bottle</li> <li>• Heater core</li> <li>• Cooling fan motor and shroud</li> <li>• Engine coolant temperature (ECT) sensor</li> <li>• Cylinder head temperature (CHT) sensor</li> <li>• Circuitry</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and go to the Symptom Chart.

**DIAGNOSIS AND TESTING (Continued)**

5.  **CAUTION:** Some vehicle cooling systems are filled with Motorcraft Premium Gold Engine Coolant VC-7-A (in California, Oregon and New Mexico VC-7-B, in Canada CVC-7-A) or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.

Inspect the coolant condition.

- 1 Inspect the coolant color.
  - If Motorcraft Premium Gold Engine Coolant (yellow color) VC-7-A (in California, Oregon and New Mexico VC-7-B, in Canada CVC-7-A) or equivalent meeting Ford specification WSS-M97B51-A1 has a clear or pale yellow color, this indicates higher water content than required.
  - Dark brown can indicate unauthorized stop leak may have been used. Use Cooling System Stop Leak Pellets VC-6 or equivalent meeting Ford specification WSS-M99B37-B6.
  - A light or reddish brown color indicates that rust may be present in the cooling system. Flush the system and refill with the correct mixture of water and engine coolant.
  - An iridescent sheen on top of the coolant can indicate a trace of oil is entering the system. For additional information on engine diagnosis, refer to Section 303-00.
  - A milky brown color may indicate that engine oil is entering the cooling system. If engine oil is suspected, the cause of the leak may be internal to the engine. For additional information, refer to Section 303-00.
- 2 If the engine coolant appearance is acceptable, test the engine coolant freezing point range with the battery and anti-freeze tester. The freezing point should be in the range -40°C to -20°C (-50°F to -10°F). If the vehicle is driven in cold climates less than -32°C (-34°F), it may be necessary to increase the coolant concentration to get adequate freeze protection.
  - Maximum coolant concentration is 60 percent coolant/40 percent water.
  - Minimum coolant concentration is 40 percent coolant/60 percent water.
- 3 Adjust coolant range and level, if necessary:
  - If coolant is low, add specified coolant mixture only.
  - If the engine coolant tests too weak, add straight engine coolant until the readings are within acceptable levels.
  - If the engine coolant tests strong, remove some of the engine coolant and add water until the readings are within acceptable levels.
6. If the concern remains after the inspection, determine the symptom(s) and GO to [Symptom Chart](#).

**Diagnostic Trouble Code (DTC) Index****Powertrain Control Module Diagnostic Trouble Code (DTC) Index**

DTC	Description	Action
P0480	Low Fan Control (LFC)/Fan Control 1 (FC1) Primary Circuit Malfunction	Refer to the <a href="#">Powertrain Control/Emissions Diagnosis (PC/ED) manual</a> .
P0481	High Fan Control (HFC)/Fan Control 3 (FC3) Primary Circuit Malfunction	Refer to the <a href="#">Powertrain Control/Emissions Diagnosis (PC/ED) manual</a> .

**DIAGNOSIS AND TESTING (Continued)**

**Symptom Chart**

**Symptom Chart**

Condition	Possible Sources	Action
<ul style="list-style-type: none"> <li>Loss of coolant</li> </ul>	<ul style="list-style-type: none"> <li>Radiator</li> <li>Coolant pump seal</li> <li>Radiator hoses</li> <li>Heater hoses</li> <li>Heater core</li> <li>Engine gaskets</li> <li>Degas bottle</li> </ul>	<ul style="list-style-type: none"> <li>GO to Pinpoint Test A.</li> </ul>
<ul style="list-style-type: none"> <li>The engine overheats</li> </ul>	<ul style="list-style-type: none"> <li>Thermostat</li> <li>Coolant pump</li> <li>Internal engine coolant leak</li> <li>Radiator</li> <li>Cooling fan</li> <li>Pressure relief cap or radiator cap</li> </ul>	<ul style="list-style-type: none"> <li>GO to Pinpoint Test B.</li> </ul>
<ul style="list-style-type: none"> <li>The engine does not reach normal operating temperature</li> </ul>	<ul style="list-style-type: none"> <li>Thermostat</li> </ul>	<ul style="list-style-type: none"> <li>GO to Pinpoint Test C.</li> </ul>

**Pinpoint Tests**


**Pinpoint Test A: Loss Of Coolant**

**Possible Causes**

- Radiator
- Coolant pump seal

- Radiator hoses
- Heater hoses
- Heater core
- Engine gaskets
- Degas bottle

**PINPOINT TEST A: LOSS OF COOLANT**

Test Step		Result / Action to Take
<b>A1</b>	<b>CHECK THE ENGINE COOLANT LEVEL</b>	
<p> <b>WARNING:</b> Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine is cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth).</p> <p><b>NOTE:</b> Allow the engine to cool before checking the engine coolant level.</p> <ul style="list-style-type: none"> <li>Key in OFF position.</li> <li>Visually check the engine coolant level at the degas bottle.</li> <li><b>Is the engine coolant level within specification?</b></li> </ul>		<p><b>Yes</b> GO to <b>A2</b>.</p> <p><b>No</b> REFILL the engine coolant as necessary. GO to <b>A2</b>.</p>
<b>A2</b>	<b>CHECK THE PRESSURE RELIEF CAP</b>	
<ul style="list-style-type: none"> <li>Carry out the cap test. Go to Component Tests in this section.</li> <li><b>Is pressure relief cap/radiator cap OK?</b></li> </ul>		<p><b>Yes</b> GO to <b>A3</b>.</p> <p><b>No</b> INSTALL a new pressure relief cap/radiator cap. TEST the system for normal operation.</p>

(Continued)

**DIAGNOSIS AND TESTING (Continued)**

**PINPOINT TEST A: LOSS OF COOLANT (Continued)**

Test Step		Result / Action to Take
<b>A3</b>	<b>CHECK THE ENGINE COOLANT FOR INTERNAL LEAK</b>	<b>Yes</b> If engine oil is evident, REFER to Section 303-00.  <b>No</b> GO to <a href="#">A4</a> .
	<ul style="list-style-type: none"> <li>Key in OFF position.</li> <li>Inspect the engine coolant in the degas bottle for signs of engine oil.</li> <li><b>Is oil evident in the coolant?</b></li> </ul>	
<b>A4</b>	<b>CHECK THE ENGINE FOR COOLANT</b>	<b>Yes</b> If coolant is in the engine, REFER to Section 303-00.  <b>No</b> GO to <a href="#">A5</a> .
	<ul style="list-style-type: none"> <li>Remove the oil level indicator from the engine.</li> <li><b>Is coolant evident in the oil?</b></li> </ul>	
<b>A5</b>	<b>PRESSURE TEST THE ENGINE COOLING SYSTEM</b>	<b>Yes</b> REPAIR or install new components. TEST the system for normal operation.  <b>No</b> The cooling system is operational. GO to <a href="#">Symptom Chart</a> .
	<ul style="list-style-type: none"> <li>Pressure test the engine cooling system. Go to Component Tests in this section.</li> <li><b>Does the engine cooling system leak?</b></li> </ul>	

**Pinpoint Test B: The Engine Overheats**


**Normal Operation**

Under normal operation, warm coolant flows from the engine through the radiator and back to the engine.

**Possible Causes**

- Thermostat
- Coolant pump
- Internal engine coolant leak
- Radiator
- Cooling fan
- Pressure relief cap or radiator cap

**PINPOINT TEST B: THE ENGINE OVERHEATS**

Test Step		Result / Action to Take
<b>B1</b>	<b>CHECK THE ENGINE COOLANT LEVEL</b>	<b>Yes</b> GO to <a href="#">B2</a> .  <b>No</b> REFILL the engine coolant at the degas bottle. <a href="#">GO to Pinpoint Test A</a> .
	<p> <b>WARNING:</b> Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine is cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth).</p> <p><b>NOTE:</b> If the engine is hot, allow the engine to cool before proceeding.</p> <ul style="list-style-type: none"> <li>Key in OFF position.</li> <li>Check the engine coolant level at the degas bottle.</li> <li><b>Is the engine coolant OK?</b></li> </ul>	
<b>B2</b>	<b>CHECK THE COOLANT CONDITION</b>	<b>Yes</b> GO to <a href="#">B3</a> .  <b>No</b> FLUSH the engine cooling system. REFER to Engine and Radiator Flushing in this section. TEST the system for normal operation.
	<ul style="list-style-type: none"> <li>Check the coolant for dirt, rust or contamination.</li> <li><b>Is the coolant condition OK?</b></li> </ul>	

(Continued)

**DIAGNOSIS AND TESTING (Continued)****PINPOINT TEST B: THE ENGINE OVERHEATS (Continued)**

Test Step		Result / Action to Take
<b>B3</b>	<b>CHECK FOR AN AIRFLOW OBSTRUCTION</b>	<p><b>Yes</b> REMOVE the obstruction. CLEAN the A/C condenser core and radiator. TEST the system for normal operation.</p> <p><b>No</b> For 4.0L engines, GO to <b>B4</b>. For 4.6L (3V) engines, GO to <b>B5</b>.</p>
	<ul style="list-style-type: none"> <li>Inspect the A/C condenser core and radiator for obstructions such as leaves or dirt.</li> <li><b>Is there an obstruction?</b></li> </ul>	
<b>B4</b>	<b>CHECK THE THERMOSTAT OPERATION (4.0L ENGINES)</b>	<p><b>Yes</b> INSTALL a new thermostat. REFER to Thermostat and Thermostat Housing — Exploded View and Thermostat — 4.0L SOHC in this section. TEST the system for normal operation.</p> <p><b>No</b> For diagnosis and testing of the engine, REFER to Section 303-00.</p>
	<ul style="list-style-type: none"> <li>While observing the ECT sensor reading, start the engine and allow the engine to run for 10 minutes.</li> <li>Feel the upper radiator hose.</li> <li><b>Does the upper radiator hose remain at ambient temperature when the ECT sensor is reading between 88°C - 93°C (190°F and 200°F)?</b></li> </ul>	
<b>B5</b>	<b>CHECK THE THERMOSTAT OPERATION (4.6L ENGINES)</b>	<p><b>Yes</b> INSTALL a new thermostat. REFER to Thermostat — 4.6L (3V) in this section. TEST the system for normal operation.</p> <p><b>No</b> For diagnosis and testing of the engine, REFER to Section 303-00.</p>
	<ul style="list-style-type: none"> <li>Start the engine and allow the engine to run for 10 minutes.</li> <li>Feel the upper radiator hose.</li> <li><b>Does the upper radiator hose remain at ambient temperature?</b></li> </ul>	

**Pinpoint Test C: The Engine Does Not Reach Normal Operating Temperature****Possible Causes**

- Thermostat

**PINPOINT TEST C: PINPOINT TEST C: THE ENGINE DOES NOT REACH NORMAL OPERATING TEMPERATURE**

Test Step		Result / Action to Take
<b>C1</b>	<b>CHECK THE ENGINE TEMPERATURE</b>	<p><b>Yes</b> INSTALL a new thermostat. REFER to Thermostat and Thermostat Housing — Exploded View and Thermostat — 4.0L SOHC or Thermostat — 4.6L (3V) in this section. TEST the system for normal operation.</p> <p><b>No</b> For diagnosis and testing of the engine coolant temperature gauge, REFER to Section 413-00.</p>
	<ul style="list-style-type: none"> <li>Start the engine and allow the engine to idle for 10 minutes.</li> <li>Feel the upper radiator hose.</li> <li><b>Does the upper radiator hose start to get hot before idling for 10 minutes?</b></li> </ul>	

**Component Tests****Pressure Test**

- Turn the engine OFF.

**DIAGNOSIS AND TESTING (Continued)**

2. **⚠ WARNING:** Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine is cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth).

Check the engine coolant level. Refer to Cooling System Draining, Filling and Bleeding in this section.

3. Connect the Radiator Heater Core Pressure Tester to the degas bottle nipple and vent hose. Install a pressure test pump to the quick connect fitting of the test adapter.
4. **⚠ CAUTION:** Do not pressurize the cooling system beyond 152 kPa (22 psi).  
**NOTE:** If the plunger of the pump is depressed too quickly, an erroneous pressure reading will result.  
Slowly depress the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained.
5. If the pressure relief cap does not hold pressure, remove and wash the pressure relief cap in clean water to dislodge all foreign material from the gaskets. Check the sealing surface in the filler neck.
6. If 110 kPa (16 psi) cannot be reached, install a new pressure relief cap. If more than 124 kPa (18 psi) shows on gauge, install a new pressure relief cap.

7. **⚠ CAUTION:** If the pressure drops, check for leaks at the engine-to-heater core hoses, engine-to-radiator hoses, water valve hose (if applicable), oil cooler return tube gasket, radiator and heater core or other system components and connections. Any leaks which are found must be corrected and the system rechecked.

Pressurize the engine cooling system as described in Step 4 (using a pressure relief cap that operates within the specified upper and lower pressure limits). Observe the gauge reading for approximately 2 minutes. Refer to General Specifications. Pressure should not drop during this time.

8. Release the system pressure by loosening the pressure relief cap. Check the engine coolant level and replenish, if necessary, with the correct engine coolant mixture. Refer to Cooling System Draining, Filling and Bleeding in this section.

**Cap**

- ⚠ WARNING:** Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine is cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, turn and remove the pressure relief cap (still with a cloth).

1. Remove the pressure relief cap from the degas bottle.
2. Follow the instructions from the pressure tester manufacturer.
3. **NOTE:** If the plunger of the pump is depressed too quickly, an erroneous pressure reading will result.

Slowly depress the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained.


**DIAGNOSIS AND TESTING (Continued)**

4. If the pressure test gauge readings are not within specifications, install a new pressure relief cap. If the pressure test gauge readings are within specifications, carry out the cooling system Pressure Test.

**Thermostat**

A new thermostat should be installed only after the following electrical and mechanical tests have been carried out.

**Thermostat — Electrical Test**

 **CAUTION:** Always vent the exhaust to the outside when carrying out this test.

**NOTE:** The electrical thermostat test is most accurate if carried out at less than 37.8°C (100°F) ambient air. This test may be carried out with or without the hood open and with the engine warm or cold.

1. Check the engine coolant level. Fill as needed.
2. With the ignition OFF, remove the engine coolant temperature (ECT) or cylinder head temperature (CHT) sensor harness connector and attach ECT or CHT sensor "T" cable as a jumper between the powertrain control module (PCM) and the ECT or CHT sensor. Attach the 73III Automotive Meter to the ECT or CHT sensor "T" cable. Voltage values (0-5 V) may now be monitored while the sensor retains its connection to the wiring harness.

An appropriate diagnostic tool may be used to monitor the ECT on vehicles equipped with data link connector (DLC).

3. **NOTE:** Running this test with the vehicle in gear or with the A/C compressor clutch engaged (running) will cause incorrect diagnosis.

Place the transmission in PARK (P) or NEUTRAL (N).

4. Start the engine and allow the engine to idle throughout this test. Allow the engine to run for 2 minutes, then record the ECT or CHT voltage. Record the ECT or CHT voltage every 60 seconds. When the ECT or CHT voltage trend changes direction or only changes slightly (0.03 volts or less) from the previous reading, record this as the thermostat opening voltage. Use the voltage and corresponding coolant temperature chart listed below for 4.6L (3V) engines only.


Coolant Temperature	CHT (Volts)
22°C (71°F)	3.00
43°C (109°F)	2.01
71°C (159°F)	1.01
82°C (180°F)	0.75
91°C (195°F)	0.059
97°C (206°F)	0.050
105°C (221°F)	0.040

5. If the thermostat opening voltage is greater than 0.75 volts and less than 82°C (180°F), install a new thermostat.
6. If the thermostat opening voltage is less than 0.75 volts and greater than 82°C (180°F), the thermostat is good and a new thermostat should not be installed. GO to [Symptom Chart](#) for further instructions.

**Thermostat — Mechanical Test**

1. Remove the thermostat.
2. Check the thermostat for seating. Hold the thermostat up to a lighted background. Leakage of light around the thermostat valve at room temperature indicates that a new thermostat should be installed. Some thermostats have a small leakage notch at one location on the perimeter of the thermostat valve, which is considered normal.
3. Immerse the thermostat in a boiling coolant and water mixture.
4. See the General Specifications chart for thermostat opening temperatures.

**Radiator Leak Test, Removed From the Vehicle**

 **CAUTION:** Never leak test an aluminum radiator in the same water that copper/brass radiators are tested in. Flux and caustic cleaners may be present in the cleaning tank and they will damage aluminum radiators.

**NOTE:** Always install plugs in the oil cooler fittings before leak-testing or cleaning any radiator.

**NOTE:** Clean the radiator before leak-testing to avoid contamination of tank.

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**DIAGNOSIS AND TESTING (Continued)**

1. Leak-test the radiator in clean water with 138 kPa (20 psi) air pressure.
-