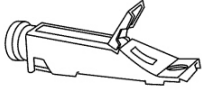
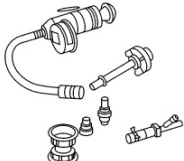
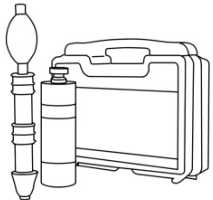
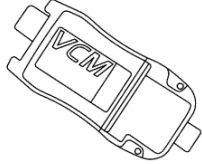

SECTION 303-03A Engine Cooling

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DIAGNOSIS AND TESTING**Engine Cooling****Special Tool(s)**

 <p>ST1720-A</p>	Coolant/Battery Refractometer 023-00164 or equivalent
 <p>ST1474-A</p>	Pressure Test Kit 014-R1072 or equivalent
 <p>ST3254-A</p>	UView® Combustion Leak Tester UVU560000-R or equivalent
 <p>ST2834-A</p>	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware or equivalent scan tool

Material

Item	Specification
Motorcraft® Premium Gold Engine Coolant VC-7-B (US); CVC-7-B (Canada)	WSS-M97B51-A1

Principles of Operation

Engine coolant flows primarily from the engine to the radiator circuit and back to the coolant pump. From the coolant pump, coolant is sent through the engine block and cylinder heads. A separate circuit from the engine also feeds the heater core with coolant. The coolant pump is operated by engine rotation through a pulley which is driven by the accessory drive belt to circulate the coolant. The coolant thermostat is a control valve actuated by coolant temperature. When the thermostat is closed, coolant flow bypasses the radiator circuit and returns to the coolant pump. When the thermostat is opened, coolant is allowed to flow through the radiator circuit in order to transfer engine-generated heat to the outside air.

The degas bottle holds surplus coolant and removes air from the cooling system, which reduces hot spots. It also allows for coolant expansion and system pressurization, replenishes coolant to the cooling system and serves as the location for service fill.

The cooling fan draws air through the radiator to help cool the system coolant as it passes through the radiator.

The thermostat monitor is a function of the PCM and is designed to verify correct thermostat operation. The monitor will be executed once per drive cycle and has a monitor run duration of 300-800 seconds. If a malfunction occurs, DTC P0125 or P0128 is set, and the Malfunction Indicator Lamp (MIL) will be illuminated.

For vehicle/engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

DIAGNOSIS AND TESTING (Continued)

Inspection and Verification

⚠ WARNING:

Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

NOTICE:

The engine cooling system is filled with Motorcraft® Premium Gold Engine Coolant. Mixing coolant types degrades the corrosion protection of Motorcraft® Premium Gold Engine Coolant. Do not mix coolant types. Failure to follow these instructions may result in engine or cooling system damage.

NOTE:

Vehicles have the pressure relief cap on the degas bottle and no radiator cap.

1. Verify the customer concern.
2. Visually check the engine coolant level at the degas bottle when the system is cold.
3. Make sure the pressure relief cap is installed correctly.
4. Record any cooling system DTCs retrieved. Refer to the PCM DTC Chart in this section for DTC descriptions.

5. **NOTE:**
Take note of any coolant odor or steam coming from cooling system components.

If the system coolant is filled correctly and no DTCs associated with fail-safe cooling are retrieved, verify the customer's concern by operating the engine to duplicate the condition.

6. **NOTE:**
Refer to the coolant flow diagram in the Description and Operation Engine Cooling portion of this section.

Inspect to determine if any of the following mechanical or electrical concerns apply.

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> • Leaks or weeps at: <ul style="list-style-type: none"> — Hoses — Tubes — Clamp joints — Quick connect couplings (if equipped) — Gaskets — O-rings — Thermostat housing — Radiator — Pressure relief cap — Coolant pump — Heater core (wet floor or coolant odor in vehicle) — Coolant crossover manifold assembly (if equipped) — Oil cooler (if equipped) — Degas bottle — Cylinder block core plugs — Cylinder head core plugs — Block heater (if equipped) 	<ul style="list-style-type: none"> • Inoperative or damaged: <ul style="list-style-type: none"> — Electric cooling fan — Wiring, connectors, relays or modules — Engine Coolant Temperature (ECT) sensor (if equipped) — Cylinder Head Temperature (CHT) sensor (if equipped) — Vehicle Speed Sensor (VSS)

Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"> • Cracked or damaged: <ul style="list-style-type: none"> — Hoses — Tubes — Hose clamps — Thermostat housing — Radiator — Pressure relief cap — Cooling fan — Coolant pump — Degas bottle — Oil cooler (if equipped) — Coolant crossover manifold assembly (if equipped) — Cylinder block core plugs — Cylinder head core plugs — Block heater (if equipped) • Restricted airflow through the A/C condenser/radiator 	

DIAGNOSIS AND TESTING (Continued)**Visual Inspection Chart (Continued)**

Mechanical	Electrical
<ul style="list-style-type: none"> • Drive belt loose, worn or installed incorrectly • Broken or weak drive belt tensioner • Excessive white or light gray exhaust smoke (may have burnt coolant odor) • Coolant in engine oil • Engine oil in coolant 	

7. If the inspection reveals an obvious concern that can be readily identified, repair it as necessary. Test the system for normal operation.
8. Inspect the coolant condition in the following sequence:
- 1 Inspect the coolant color.
 - If Motorcraft® Premium Gold Engine Coolant has a clear or pale yellow color, this indicates higher water content than required. Test the engine coolant freezing point range with the Coolant/Battery Refractometer. The freezing point should be in the range -45°C to -23°C (-49°F to -9°F). If the vehicle is driven in cold climates less than -36°C (-33°F), it may be necessary to increase the coolant concentration to get adequate freeze protection. Recommended coolant concentration is 50/50 ethylene glycol to distilled water.
 - A pale green color indicates incorrect coolant (green in color) may have been added to the system. Use of incorrect (green in color) coolant degrades the corrosion protection of Motorcraft® Premium Gold Engine Coolant. Flush the system and refill with the correct mixture of distilled water and Motorcraft® Premium Gold Engine Coolant.
 - **NOTE:**
If cooling system stop leak pellets are used, Motorcraft® Premium Gold Engine Coolant may darken from yellow to golden tan.

Dark brown could indicate a commercially available stop leak may have been used. Flush the system and refill with the correct mixture of distilled water and Motorcraft® Premium Gold Engine Coolant.
 - 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 distilled water and Motorcraft® Premium Gold Engine Coolant.
 - An iridescent sheen on top of the coolant could indicate a trace of oil is entering the system. For information on engine diagnosis, refer to Section 303-00.
 - A milky brown color may indicate that engine oil is entering the cooling system. Pressure test the cooling system. Refer to Component Tests in this section. If engine oil is suspected, the cause of the leak may be internal to the engine. Refer to Section 303-00.
 - 2 If the engine coolant appearance is acceptable, test the engine coolant freezing point range with the Coolant/Battery Refractometer. The freezing point should be in the range -45°C to -23°C (-49°F to -9°F). If the vehicle is driven in cold climates less than -36°C (-33°F), it may be necessary to increase the coolant concentration to get adequate freeze protection. Recommended coolant concentration is 50/50 ethylene glycol to distilled water.
 - Maximum coolant concentration is 60/40 for cold weather areas.
 - Minimum coolant concentration is 40/60 for warm weather areas.
 - 3 Adjust coolant range and level if necessary:
 - If coolant is low, add specified coolant mixture only.
 - If the engine coolant tests too weak, remove some of the engine coolant and add undiluted engine coolant until the readings are within acceptable levels.
 - If the engine coolant tests strong, remove some of the engine coolant and add distilled water until the readings are within acceptable levels.
9. If an obvious cause for an observed or reported concern is found, correct the cause and test the system for normal operation before proceeding to the next step.
10. **NOTE:**
Make sure to use the latest scan tool software release.

If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).
11. **NOTE:**
The Vehicle Communication Module (VCM) LED prove out confirms power and ground from the DLC are provided to the VCM.

If the scan tool does not communicate with the VCM:
- check the VCM connection to the vehicle.
 - check the scan tool connection to the VCM.
 - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.
12. If the scan tool does not communicate with the vehicle:
- verify the ignition key is in the ON position.

DIAGNOSIS AND TESTING (Continued)

- verify the scan tool operation with a known good vehicle.
 - refer to Section 418-00 to diagnose no response from the PCM.
13. Carry out the network test.
- If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
 - If the network test passes, retrieve and record continuous memory DTCs.
14. Clear the continuous DTCs and carry out the self-test diagnostics PCM.
15. If the DTCs recovered are related to the concern, go to the PCM DTC Chart. For all other DTCs, refer to Section 419-10.
16. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

DTC Chart**PCM DTC Chart**

DTC	Description	Action
P0217	Engine Coolant Overtemperature Condition	GO to Pinpoint Test B.
P1285	Cylinder Head Overtemperature Condition	GO to Pinpoint Test B.
P1299	Cylinder Head Overtemperature Protection Active	GO to Pinpoint Test B.
P0125	Insufficient Coolant Temp For Closed Loop Fuel Control	GO to Pinpoint Test C.
P0128	Coolant Thermostat (Coolant Temp Below Thermostat Regulating Temperature)	GO to Pinpoint Test C.
P0480 P0481 P0482	Fan 1, 2 or 3 Control Circuit, Respectively	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
All Other DTCs	—	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart**Symptom Chart**

Condition	Possible Sources	Action
• Loss of coolant	<ul style="list-style-type: none"> • Coolant hoses or tubes • Hose clamps • Coolant pump O-ring seal or gasket • Thermostat O-ring seal or gasket • Thermostat housing • Radiator • Degas bottle • Pressure relief cap • Coolant pump leaking from weep hole • Heater core • Coolant crossover manifold assembly (if equipped) • Engine gaskets (may leak internally or externally) • Oil cooler (if equipped) (may leak internally or externally) • Cylinder block core plugs • Cylinder head core plugs • Block heater (if equipped) 	• GO to Pinpoint Test A.
• The engine overheats	<ul style="list-style-type: none"> • Low coolant level • External engine coolant leak • Airlock in system • Pressure relief cap installation • Restricted airflow through the A/C condenser/radiator • Internal engine coolant leak • Coolant condition/concentration • Accessory drive components • Non-OEM engine enhancement components 	• GO to Pinpoint Test B.

DIAGNOSIS AND TESTING (Continued)**Symptom Chart (Continued)**

Condition	Possible Sources	Action
	<ul style="list-style-type: none"> • Electric cooling fan • Radiator • Thermostat • Engine Coolant Temperature (ECT) indicator system (gauge) • ECT sensor (if equipped) • Cylinder Head Temperature (CHT) sensor (if equipped) • Heater core • Coolant pump • Coolant flow restriction 	
<ul style="list-style-type: none"> • The engine does not reach normal operating temperature 	<ul style="list-style-type: none"> • Low coolant level • Thermostat • Electric cooling fan always on • ECT indicator system (gauge) • ECT sensor (if equipped) • CHT sensor (if equipped) 	<ul style="list-style-type: none"> • GO to Pinpoint Test C.
<ul style="list-style-type: none"> • The block heater does not operate correctly 	<ul style="list-style-type: none"> • Block heater power cable • Block heater 	<ul style="list-style-type: none"> • CHECK continuity in all 3 power cable circuits. If any circuit measures greater than 5 ohms, INSTALL a new power cable. • CHECK the resistance of the block heater. If the resistance does not measure between 12.5 and 17 ohms, INSTALL a new block heater.
<ul style="list-style-type: none"> • The electric cooling fan is inoperative in one or more speeds or does not operate correctly 	<ul style="list-style-type: none"> • Wiring • Relays • Fuses • Fan control module • Cooling fan motor • Cooling fan resistor 	<ul style="list-style-type: none"> • REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
<ul style="list-style-type: none"> • The electric cooling fan stays on all the time 	<ul style="list-style-type: none"> • Wiring • Relays 	<ul style="list-style-type: none"> • REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
<ul style="list-style-type: none"> • Noisy electric cooling fan operation 	<ul style="list-style-type: none"> • Foreign material contamination • Fan motor • Fan blade detached from fan motor 	<ul style="list-style-type: none"> • REMOVE the foreign material from the cooling fan and shroud. TEST the system for normal operation. If still noisy, INSTALL a new cooling fan assembly. • INSTALL a new cooling fan assembly.

Pinpoint Tests**Pinpoint Test A: Loss of Coolant****Normal Operation**

The engine cooling system is a closed system that provides for coolant expansion and contraction and also changes in pressure as coolant warms and cools with engine operation. Various gaskets, seals, hoses and clamps are used to contain coolant within the cooling system and keep other fluids and contaminants from entering the cooling system.

Coolant loss can be attributed to either external or internal leaks anywhere within the cooling system.

For vehicle/engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

This pinpoint test is intended to diagnose the following:

- Coolant hoses or tubes
- Hose clamps
- Thermostat O-ring seal or gasket
- Coolant pump O-ring seal or gasket
- Thermostat housing
- Radiator
- Pressure relief cap

DIAGNOSIS AND TESTING (Continued)

- Coolant pump leaking from weep hole
- Heater core
- Coolant crossover manifold assembly (if equipped)
- Engine gaskets
- Oil cooler (if equipped)
- Degas bottle
- Cylinder block core plugs
- Cylinder head core plugs
- Block heater (if equipped)
- Engine Coolant Temperature (ECT) sensor (if equipped)

PINPOINT TEST A: LOSS OF COOLANT**WARNING:**

Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

Test Step		Result / Action to Take
A1	CARRY OUT INSPECTION AND VERIFICATION	
	<ul style="list-style-type: none"> • Carry out the Inspection and Verification procedure in this section. • Were any concerns found? 	<p>Yes REPAIR as needed. TEST the system for normal operation.</p> <p>No GO to A2.</p>
A2	CHECK THE ENGINE COOLANT LEVEL	
	<p>NOTE: Allow the engine to cool before checking the engine coolant level.</p> <ul style="list-style-type: none"> • Ignition OFF. • Visually inspect the engine coolant level at the degas bottle. • Is the engine coolant level within specifications? 	<p>Yes GO to A3.</p> <p>No ADJUST the engine coolant level as necessary. GO to A3.</p>
A3	PRESSURE TEST THE ENGINE COOLING SYSTEM	
	<ul style="list-style-type: none"> • Pressure test the engine cooling system. Refer to Component Tests, Cooling System Pressure Test in this section. • Does the engine cooling system leak externally? 	<p>Yes REPAIR or INSTALL new components. TEST the system for normal operation.</p> <p>No GO to A4.</p>
A4	CHECK THE ENGINE COOLANT FOR AN INTERNAL LEAK	
	<ul style="list-style-type: none"> • Inspect the engine coolant in the degas bottle for signs of engine oil. • Is engine oil evident in the coolant? 	<p>Yes GO to Section 303-00 for engine diagnosis.</p> <p>No GO to A5.</p>
A5	CHECK THE ENGINE OIL FOR COOLANT	
	<ul style="list-style-type: none"> • Remove the oil level indicator from the engine. • Is coolant evident in the oil? 	<p>Yes GO to Section 303-00 for engine diagnosis.</p> <p>No GO to A6.</p>
A6	CHECK THE COOLING SYSTEM FOR COMBUSTION GASES	
	<ul style="list-style-type: none"> • NOTE: Use UView® Combustion Leak Tester, part No. UVU560000-R or equivalent. • Using a cooling system combustion gas leak tester, following the instructions supplied with the tester, check the coolant for combustion gases. • Are combustion gases present? 	<p>Yes GO to Section 303-00 for engine diagnosis.</p> <p>No The cooling system is operational.</p>

DIAGNOSIS AND TESTING (Continued)**Pinpoint Test B: The Engine Overheats****Normal Operation**

The engine cooling system functions to maintain engine temperatures during operation. Correct coolant flow through the engine, radiator and remainder of cooling system passages and components is essential to maintaining a correct engine temperature.

Engine coolant flows primarily from the engine to the radiator circuit and back to the coolant pump. From the coolant pump, coolant is sent through the engine block and cylinder heads. A separate circuit from the engine also feeds the heater core with coolant. The coolant pump is operated by engine rotation through a pulley which is driven by the accessory drive belt to circulate the coolant. The coolant thermostat is a control valve actuated by coolant temperature. When the thermostat is closed, coolant flow bypasses the radiator circuit and returns to the coolant pump. When the thermostat is opened, coolant is allowed to flow through the radiator circuit in order to transfer engine-generated heat to the outside air.

Engine overheating generally occurs when there is a disruption in the ability to control either coolant flow at the correct rate, the inability to transfer heat from the engine through the coolant (including low coolant) or an inability to transfer engine-generated heat to the outside air through the radiator.

For vehicle/engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

- DTC P0217 Engine Coolant Overtemperature Condition
- DTC P1285 Cylinder Head Overtemperature Condition
- DTC P1299 Cylinder Head Overtemperature Protection Active

This pinpoint test is intended to diagnose the following:

- Low coolant level
- External engine coolant leak
- Airlock in system
- Pressure relief cap installation
- Restricted airflow through the A/C condenser/radiator
- Internal engine coolant leak
- Coolant condition/concentration
- Accessory drive components
- Non-OEM engine enhancement components
- Electric cooling fan
- Engine Coolant Temperature (ECT) indicator system (gauge)
- ECT sensor (if equipped)
- Cylinder Head Temperature (CHT) sensor (if equipped)
- Heater core
- Coolant pump
- Coolant flow restriction

PINPOINT TEST B: THE ENGINE OVERHEATS**⚠ WARNING:**

Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

Test Step		Result / Action to Take
B1	CARRY OUT INSPECTION AND VERIFICATION	
	<ul style="list-style-type: none"> • Carry out the Inspection and Verification procedure in this section. • Were any concerns found? 	<p>Yes REPAIR as needed. TEST the system for normal operation.</p> <p>No GO to B2.</p>
B2	CHECK FOR DTCs	
	<ul style="list-style-type: none"> • Check for DTC P0217, P1285 or P1299. • Is DTC P0217, P1285 or P1299 present? 	<p>Yes GO to B3.</p> <p>No Actual engine overheating has not been verified. CHECK the ECT gauge operation. REFER to Section 413-01. If any other DTCs are retrieved, REFER to the</p>

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST B: THE ENGINE OVERHEATS (Continued)

B2	CHECK FOR DTCs (Continued)	
		Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B3	CHECK FOR AN AIRFLOW OBSTRUCTION	
	<ul style="list-style-type: none"> Check the radiator or A/C condenser for an external obstruction such as leaves or cardboard. Is an obstruction present? 	<p>Yes REMOVE the obstruction. TEST the system for normal operation.</p> <p>No GO to B4.</p>
B4	CHECK THE ENGINE COOLANT LEVEL	
	<p>NOTE: Allow the engine to cool before checking the coolant level.</p> <ul style="list-style-type: none"> Ignition OFF. Visually check the engine coolant level in the degas bottle. Is the engine coolant level within specification? 	<p>Yes GO to B5.</p> <p>No ADJUST the engine coolant level as necessary. GO to B5.</p>
B5	PRESSURE TEST THE ENGINE COOLING SYSTEM	
	<ul style="list-style-type: none"> Pressure test the engine cooling system. Refer to Component Tests, Cooling System Pressure Test in this section. Does the engine cooling system leak externally? 	<p>Yes REPAIR or INSTALL new components. TEST the system for normal operation.</p> <p>No GO to B6.</p>
B6	CHECK THE ENGINE COOLANT FOR AN INTERNAL LEAK	
	<ul style="list-style-type: none"> Inspect the engine coolant in the degas bottle for signs of engine oil. Is engine oil evident in the coolant? 	<p>Yes GO to Section 303-00 for engine diagnosis.</p> <p>No GO to B7.</p>
B7	CHECK THE ENGINE OIL FOR COOLANT	
	<ul style="list-style-type: none"> Remove the oil level indicator from the engine. Is coolant evident in the engine oil? 	<p>Yes GO to Section 303-00 for engine diagnosis.</p> <p>No GO to B8.</p>
B8	CHECK THE COOLING SYSTEM FOR COMBUSTION GASES	
	<ul style="list-style-type: none"> NOTE: Use UView® Combustion Leak Tester, part No. UVU560000-R or equivalent. <p>Using a cooling system combustion gas leak tester, following the instructions supplied with the tester, check the coolant for combustion gases.</p> <ul style="list-style-type: none"> Are combustion gases present? 	<p>Yes GO to Section 303-00 for engine diagnosis.</p> <p>No GO to B9.</p>
B9	CHECK COOLANT CONDITION	
	<ul style="list-style-type: none"> Check the coolant for dirt, rust or contamination and check the coolant concentration. Is the coolant condition OK? 	<p>Yes GO to B10.</p> <p>No FLUSH the engine cooling system. REFER to Cooling System Flushing in this section. TEST the system for normal operation.</p>
B10	CHECK THE ELECTRIC COOLING FAN OPERATION	
	<ul style="list-style-type: none"> Start the engine. Place the climate control function selector in the MAX A/C position and the blower motor switch in the HI position. Did the electric cooling fan operate? 	<p>Yes GO to B11.</p> <p>No DIAGNOSE the electric cooling fan operation. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p>

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

B11	CHECK THE COOLANT PUMP OPERATION	
	<ul style="list-style-type: none"> Start the engine. Allow the engine to run for 10 minutes. Place the climate control function selector in the MAX HEAT position. Feel the heater outlet hose. Is the heater outlet hose hot? 	<p>Yes GO to B12.</p> <p>No INSTALL a new coolant pump. TEST the system for normal operation.</p>
B12	CHECK THE THERMOSTAT OPERATION	
	<ul style="list-style-type: none"> Start the engine. Allow the engine to run for 10 minutes. Feel the upper radiator hose. Is the upper radiator hose hot? 	<p>Yes CHECK the ECT gauge operation. REFER to Section 413-01.</p> <p>No GO to B13.</p>
B13	VISUALLY INSPECT THE THERMOSTAT	
	<ul style="list-style-type: none"> Carry out the Thermostat Visual Inspection in the Component Tests portion of this section. Is the thermostat damaged? 	<p>Yes INSTALL a new thermostat. TEST the system for normal operation.</p> <p>No INSTALL a new thermostat. TEST the system for normal operation. If the engine still overheats, INSTALL a new radiator. TEST the system for normal operation.</p>

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

The engine cooling system functions to maintain engine temperatures during operation. Correct coolant flow through the engine, radiator and remainder of cooling system passages and components is essential to maintaining a correct engine temperature.

Engine coolant flows primarily from the engine to the radiator circuit and back to the coolant pump. From the coolant pump, coolant is sent through the engine block and cylinder heads. A separate circuit from the engine also feeds the heater core with coolant. The coolant pump is operated by engine rotation through a pulley which is driven by the accessory drive belt to circulate the coolant. The coolant thermostat is a control valve actuated by coolant temperature. When the thermostat is closed, coolant flow bypasses the radiator circuit and returns to the coolant pump. When the thermostat is opened, coolant is allowed to flow through the radiator circuit in order to transfer engine generated heat to the outside air.

Concerns of engine inability to reach normal operating temperature typically occur when the rate of coolant flow through some coolant circuits (radiator, heater core) is more than expected given the conditions, or when the cooling fans operate all the time. Heat is not allowed to build in the engine because a heat exchanger is removing too much heat, including the radiator, heater core and oil cooler. In addition, perceived concerns that the engine does not reach normal operating temperature can be related to a low coolant level or trapped air which does not allow for hot coolant to be available at the heater core, an inoperative climate control system, or for concerns perceived or related to an incorrect engine temperature gauge indication.

For vehicle/engine specific information, refer to Engine Cooling in the Description and Operation portion of this section.

- DTC P0125 Insufficient Coolant Temp for Closed Loop Fuel Control
- DTC P0128 Coolant Thermostat (Coolant Temp Below Thermostat Regulating Temperature)

This pinpoint test is intended to diagnose the following:

- Low coolant level
- Thermostat
- Engine Coolant Temperature (ECT) indicator system (gauge)
- Engine cooling fan

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

Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

DIAGNOSIS AND TESTING (Continued)

PINPOINT TEST C: THE ENGINE DOES NOT REACH NORMAL OPERATING TEMPERATURE (Continued)

Test Step		Result / Action to Take
C1	CARRY OUT INSPECTION AND VERIFICATION	
	<ul style="list-style-type: none"> • Carry out the Inspection and Verification procedure in this section. • Were any concerns found? 	<p>Yes REPAIR as needed. TEST the system for normal operation.</p> <p>No GO to C2.</p>
C2	CHECK FOR DTCs P0125 or P0128	
	<ul style="list-style-type: none"> • Check for DTC P0125 or P0128. • Is DTC P0125 or P0128 present? 	<p>Yes GO to C3.</p> <p>No The cooling system is operational. If an inoperative ECT gauge is suspected, CHECK the ECT gauge operation. REFER to Section 413-01. If an inoperative climate control system is suspected, CHECK the climate control system operation. REFER to Section 412-00. If any other DTCs are retrieved, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p>
C3	CHECK THE ELECTRIC COOLING FAN OPERATION	
	<ul style="list-style-type: none"> • Allow the engine to cool. • Make sure the A/C switch is OFF. • Start the engine. • Check the electric cooling fan. • Is the electric cooling fan on all the time? 	<p>Yes DIAGNOSE the electric cooling fan operation. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p> <p>No GO to C4.</p>
C4	CHECK THE COOLANT LEVEL	
	<ul style="list-style-type: none"> • NOTE: Allow the engine to cool before checking the coolant level. • Visually check the engine coolant level in the degas bottle. • Is the engine coolant level within specification? 	<p>Yes INSTALL a new thermostat. TEST the system for normal operation.</p> <p>No GO to Pinpoint Test A to diagnose a coolant leak.</p>

Component Tests

Cooling System Pressure Test



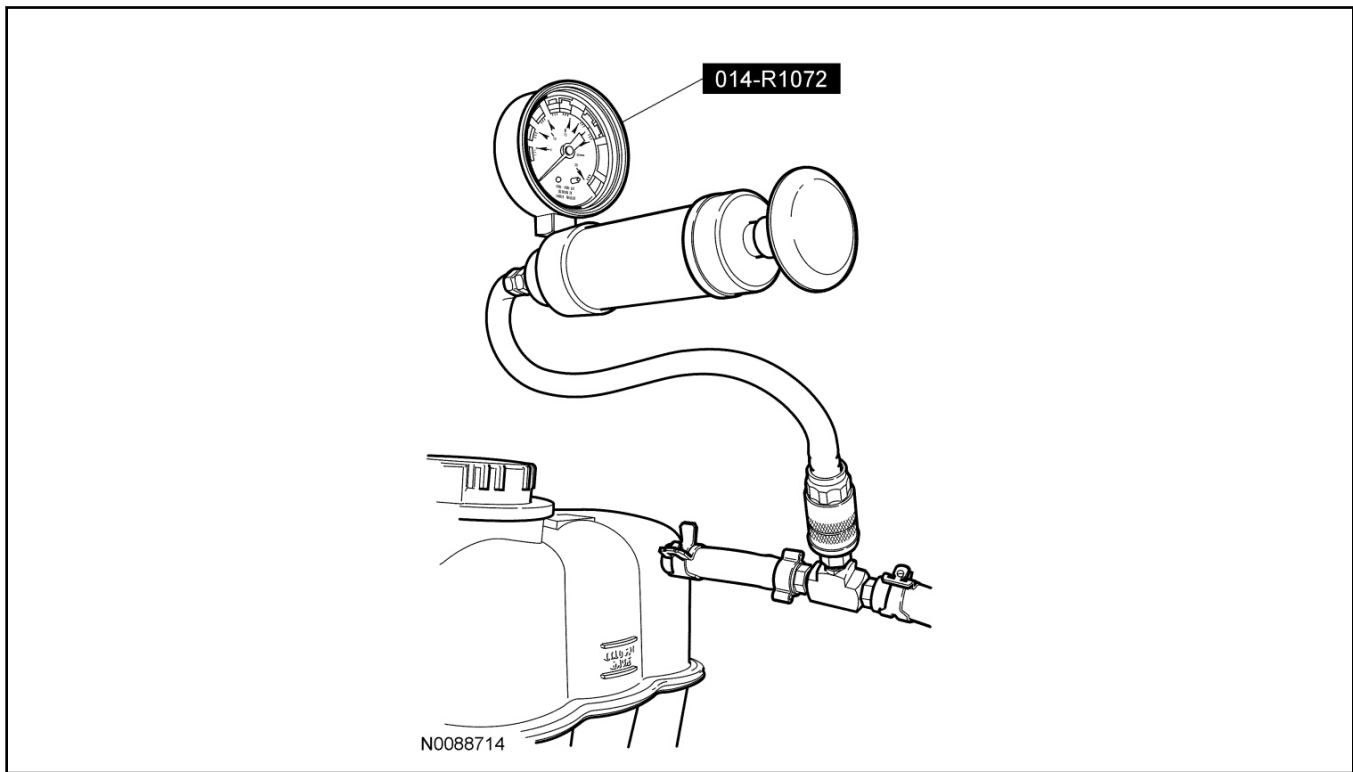
WARNING:

Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

NOTE:

Vehicles have the pressure relief cap on the degas bottle and no radiator cap.

1. Turn the engine OFF.
2. Check the engine coolant level. Adjust the coolant level as necessary.
3. Attach the Pressure Test Kit to the degas bottle nipple and overflow hose. Install a pressure test pump to the quick connect fitting of the test adapter.

DIAGNOSIS AND TESTING (Continued)

4. **NOTICE:**
Do not pressurize the cooling system beyond the maximum pressure listed in the specifications table in this section or cooling system components may be damaged.

NOTE:

If the plunger of the pressure tester is depressed too fast, 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. If the pressure reading exceeds the maximum cap pressure listed in the specifications table, install a new pressure relief cap.

5. If the system does not hold pressure, remove the pressure relief cap and wash in clean water to dislodge all the foreign material from the gasket. Check the sealing surface in the filler neck of the degas bottle for nicks or cuts. Install the pressure relief cap.
6. Pressurize the engine cooling system as described in Step 4 above. Observe the gauge reading for approximately 2 minutes. Pressure should not drop during this time. If the pressure drops within this time, inspect for leaks and repair as necessary.
7. If no leaks are found and the pressure drops, the pressure relief cap may be leaking. Install a new pressure relief cap and retest the system.
8. If no leaks are found after a new pressure relief cap is installed, and the pressure drops, the leak may be internal to the engine. Inspect the coolant for engine oil and the engine oil for coolant. Refer to Section 303-00 to diagnose the engine.
9. Release the system pressure by loosening the pressure relief cap. Check the coolant level and adjust as necessary.

Thermostat

A new thermostat should be installed only after the following tests and checks have been carried out:

- Pinpoint Test A, B or C
- Thermostat Visual Inspection

Thermostat Visual Inspection

1. Remove the thermostat.
2. Examine the thermostat for signs of damage including:
 - Valve not fully seated (light visible through the valve)
 - Foreign material lodged in the main valve
 - Bent or broken frame or flange
 - Bent or broken spring

DIAGNOSIS AND TESTING (Continued)

- Bent or broken valve or valve stem
- Wax leaking from wax reservoir or a bulge in the reservoir
- Any other damage or distortion

3. NOTE:

If no damage is found during the inspection, do not attempt to open the thermostat using hot water or other heat sources. This method is not an accurate means to test the function of the thermostat and may damage the thermostat.

If damage is found during the inspection, remove any foreign material or broken pieces and install a new thermostat.

- 4.** If no damage is found during the inspection, continue troubleshooting the system concern. Go to the Symptom Chart for further instructions.

Radiator Leak Test, Removed From Vehicle**NOTICE:**

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:

Clean the radiator before leak testing to avoid contamination of tank.

- 1.** Leak test the radiator in clean water with pressurized air to the maximum pressure listed in the Specifications.