

Engine Cooling

1. Verify the customer concern.
2. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
3. Visually inspect for obvious signs of mechanical or electrical damage.
4. If the concern is not an electrical fault and is not visually evident, verify the concern and refer to the symptom chart.
5. If the concern is an electrical fault and is not visually evident, use a fault code reader to retrieve the fault codes before proceeding to the symptom chart.

Visual Inspection Chart

Mechanical	Electrical
Leaks	Fuse
Coolant expansion tank	Wiring harness
Coolant pressure cap	Loose or corroded connector(s)
Cooling fan motor(s)	Cooling fan motor(s)
Radiator	Engine coolant temperature (ECT) sensor
Water pump	Cooling fan motor control module
-	Block heater

Condition(s):

DTC P0480; High/low signal from the cooling fan motor control module to the engine control module (ECM)

Possible Source(s):

- Fuse 8 (80A), engine compartment fuse box.
- Circuit.
- Cooling fan motor.
- Cooling fan motor control module.
- ECM.

Action(s) to take:

- GO to <<Pinpoint Test A>>.

Loss of coolant

Possible Source(s):

- Hoses.
- Hose connections.
- Radiator.
- Water pump.
- Heater core.

- Gaskets.
- Coolant expansion tank.
- Coolant pressure cap.
- Engine casting cracks.
- Engine core plugs.

Action(s) to take:

- Go to <<Pinpoint Test B>>.

Engine overheats

Possible Source(s):

- Engine coolant.
- Thermostat.
- Fuse 8 (80A), engine compartment fuse box.
- Circuit.
- Cooling fan motor(s).
- Radiator.
- Water pump.
- Water pump drive belt.
- Engine coolant temperature (ECT) sensor.
- ECM.
- Cooling fan motor control module.

Action(s) to take:

- Go to <<Pinpoint Test C>>.

Engine block heater does not operate properly

Possible Source(s):

- Block heater power cable.
- Block heater.

Action(s) to take:

- Go to <<Pinpoint Test D>>.

The engine does not reach normal operating temperature

Possible Source(s):

- Thermostat.

Action(s) to take:

- INSTALL a new thermostat.

A : DTC P0480; HIGH/LOW SIGNAL FROM THE COOLING FAN MOTOR CONTROL MODULE TO THE ECM

A1 : CHECK THE OPERATION OF THE COOLING FANS

1. Disconnect the engine coolant temperature sensor electrical connector.
2. Connect a 100 ohm resistor to the engine coolant temperature sensor electrical connector.
3. START and RUN the engine.

•Are the cooling fans operating?

-> Yes
Goto <<A2>>

-> No
Goto <<A7>>

A2 : CHECK THE OPERATION OF THE TWO COOLING FANS

1. Inspect the operation of the two cooling fans.

•Are both the cooling fans operating?

-> Yes
Connect the engine coolant temperature sensor electrical connector.
Goto <<A4>>

-> No
Goto <<A3>>

A3 : RUN THE TWO COOLING FANS AT MAXIMUM SPEED.

1. Turn the ignition switch to the OFF position and disconnect the cooling fan control module electrical connector JB187.
2. Remove the PWM signal wire from the cooling fan control module electrical connector JB187-1 (WU).
3. Connect the cooling fan control module electrical connector JB187 and turn the ignition switch to the RUN position. The cooling fans will run at maximum speed.
4. Allow the cooling fans to run for 5 minutes. Turn the ignition switch to the OFF position and disconnect the cooling fan control module electrical connector JB187.
5. Install the PWM signal wire to the cooling fan control module electrical connector JB187-1 (WU).
6. Connect the cooling fan control module electrical connector JB187 to the cooling fan control module.
7. Turn the ignition switch to the RUN position.

•Are both the cooling fans operating?

-> Yes
Connect the engine coolant temperature sensor electrical connector.
Goto <<A4>>

-> No
INSTALL a new cooling fan motor as necessary. For additional information, refer to <<Cooling Fan

Motor>>. CLEAR the DTC. TEST the system for normal operation.

A4 : CHECK CONTINUITY OF THE COOLING FAN MOTOR CONTROL MODULE SIGNAL WIRE FROM THE ECM

1. Turn the ignition switch to the OFF position.
2. Disconnect the ECM electrical connector EN16 and the cooling fan motor control module electrical connector JB187.
3. Measure the resistance between electrical connectors JB187-1 and EN16-51.

•Is the resistance less than 5 ohms?

-> Yes

Goto <<A5>>

-> No

REPAIR the circuit from the ECM to the cooling fan motor control module. CLEAR the DTC. TEST the system for normal operation.

A5 : CHECK THE COOLING FAN MOTOR CONTROL MODULE SIGNAL WIRE FROM THE ECM FOR A SHORT TO GROUND

1. Measure the resistance between JB187-1 and ground.

•Is the resistance less than 10,000 ohms?

-> Yes

Goto <<A6>>

-> No

REPAIR the circuit from the ECM to the cooling fan motor control module. CLEAR the DTC. TEST the system for normal operation.

A6 : CHECK THE COOLING FAN MOTOR CONTROL MODULE SIGNAL WIRE FROM THE ECM FOR A SHORT TO BATTERY POSITIVE

1. Measure the resistance between JB187-1 and JB187-2.

•Is the resistance less than 10,000 ohms?

-> Yes

INSTALL a new cooling fan motor control module. For additional information, refer to <<Cooling Fan—Control module>>. CLEAR the DTC. TEST the system for normal operation. If the DTC is repeated, INSTALL a new ECM. For additional information, refer to <<303-14>>.

-> No

REPAIR the circuit from the ECM to the cooling fan motor control module. CLEAR the DTC. TEST the system for normal operation.

A7 : CHECK FUSE 8 IN THE ENGINE COMPARTMENT FUSE BOX

1. Check the fuse.
 - Is the fuse OK?
 - > Yes
Goto <<A9>>
 - .
 - > No
Goto <<A8>>
 - .

A8 : CHECK FUSE 8 OF THE ENGINE COMPARTMENT FUSE BOX FOR A SHORT TO GROUND

1. Measure the resistance between electrical connector JB34-73 of the engine compartment fuse box and ground.
 - Is the resistance less than 10,000 ohms?
 - > Yes
REPAIR short to ground between the engine compartment fuse box and the cooling fan motor control module. INSTALL a new fuse. CLEAR the DTC. TEST the system for normal operation.
 - > No
INSTALL a new fuse. CLEAR the DTC. TEST the system for normal operation.

A9 : CHECK THE POWER SUPPLY TO THE COOLING FAN MOTOR CONTROL MODULE

1. Measure the voltage between the cooling fan motor control module electrical connector JB188-1 and ground.
 - Is the voltage less than 10 volts?
 - > Yes
Goto <<A10>>
 - .
 - > No
Goto <<A11>>
 - .

A10 : CHECK FOR BATTERY VOLTAGE AT FUSE 8 OF THE ENGINE COMPARTMENT FUSE BOX

1. Measure the voltage between the engine compartment fuse box electrical connector JB34-73 and ground
 - Is the voltage less than 10 volts?
 - > Yes
Repair the circuit between engine compartment fuse box and the battery. CLEAR the DTC. TEST the system for normal operation.
 - > No
REPAIR the circuit between the engine compartment fuse box and the cooling fan motor control module. CLEAR the DTC. TEST the system for normal operation.

A11 : CHECK THE IGNITION SUPPLY TO THE COOLING FAN MOTOR CONTROL MODULE

1. Turn the ignition switch to the RUN position.
2. Measure the voltage between the cooling fan motor control module electrical connector JB187-2 and ground.

•Is the voltage less than 10 volts?

-> Yes

REPAIR the circuit between the engine compartment fuse box and the cooling fan motor control module. CLEAR the DTC. TEST the system for normal operation.

-> No

Goto <<A12>>

A12 : CHECK THE COOLING FAN MOTOR CONTROL MODULE GROUND CIRCUIT

1. Measure the resistance between the cooling fan motor control module electrical connector JB188-2 and ground.

•Is the resistance less than 5 ohms?

-> Yes

INSTALL a new cooling fan motor control module. For additional information, refer to <<Cooling Fan—Control module>>. CLEAR the DTC. TEST the system for normal operation. If the DTC is repeated, INSTALL a new ECM. For additional information, refer to <<303-14>>.

-> No

REPAIR the ground circuit to the cooling fan motor control module. CLEAR the DTC. TEST the system for normal operation.

B : LOSS OF COOLANT

B1 : VISUAL INSPECTION

1. Visually inspect for loss of coolant.

•Is the engine cooling system leaking?

-> Yes

INSTALL a new component as required. For additional information, refer to the appropriate section. TEST the cooling system for normal operation.

-> No

Carry out the Cooling System Pressure TEST. For additional information, refer to the component test in this section.

C : THE ENGINE OVERHEATS

C1 : CHECK COOLANT



WARNING:

NEVER REMOVE THE COOLANT PRESSURE CAP UNDER ANY CIRCUMSTANCES WHILE THE ENGINE IS OPERATING. FAILURE TO FOLLOW THIS INSTRUCTION MAY RESULT IN PERSONAL INJURY.

TO AVOID HAVING SCALDING HOT COOLANT OR STEAM BLOW OUT OF THE COOLING SYSTEM, USE

EXTREME CARE WHEN REMOVING THE COOLANT PRESSURE CAP FROM A HOT COOLING SYSTEM. WAIT UNTIL THE ENGINE HAS COOLED, THEN WRAP A THICK CLOTH AROUND THE COOLANT PRESSURE CAP AND TURN IT SLOWLY UNTIL THE PRESSURE BEGINS TO RELEASE. STEP BACK WHILE THE PRESSURE IS RELEASED FROM THE SYSTEM. WHEN CERTAIN ALL THE PRESSURE HAS BEEN RELEASED (STILL WITH A CLOTH) TURN AND REMOVE THE COOLANT PRESSURE CAP FROM THE COOLANT EXPANSION TANK. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN PERSONAL INJURY.



CAUTION:

Never remove the coolant pressure cap under any circumstances while the engine is operating. Failure to follow this instruction may result in personal damage to the engine.

1. Inspect the coolant level.

•Is the coolant level OK?

-> Yes

Goto <<C2>>

.

-> No

DIAGNOSE and REPAIR the coolant leaks. REFILL the cooling system. For additional information, refer to <<Cooling System Draining, Filling and Bleeding>>. TEST the cooling system for normal operation.

C2 : CHECK THE CONDITION OF THE WATER PUMP DRIVE BELT

1. Inspect the water pump drive belt. For additional information, refer to <<303-05>>.

•Is the water pump drive belt OK?

-> Yes

Goto <<C3>>

.

-> No

INSTALL a new water pump drive belt. For additional information, refer to <<303-05>>. TEST the cooling system for normal operation.

C3 : CHECK THE WATER PUMP DRIVE

1. Remove the water pump drive belt. For additional information, refer to <<303-05>>.

2. Attempt to turn the water pump drive pulley by hand.

•Does the water pump drive pulley turn?

-> Yes

Goto <<C4>>

.

-> No

Goto <<C5>>

.

C4 : CHECK THE LEFT HAND EXHAUST CAMSHAFT

1. Remove the water pump. For additional information, refer to <<Water Pump>>.
2. Inspect the water pump drive shaft splines of the exhaust camshaft.

●Are the drive splines OK?

-> Yes

Install a new water pump. For additional information, refer to <<Water Pump>> . TEST the system for normal operation.

-> No

INSTALL a new camshaft. For additional information, refer to <<303-01>>. Install a new water pump. For additional information, refer to <<Water Pump>>. TEST the system for normal operation.

C5 : CHECK THE OPERATION OF THE COOLING FANS

1. Disconnect the engine coolant temperature (ECT) sensor electrical connector.
2. Connect a 100 ohm resistor to the engine coolant temperature sensor electrical connector.
3. Turn the ignition switch to the RUN position.

●Are the cooling fans operating?

-> Yes

Turn the ignition switch to the OFF position. Connect the ECT sensor.
Goto <<C7>>

-> No

Turn the ignition switch to the OFF position. Connect the ECT sensor.
Goto <<A1>>

C6 : CHECK THE AIR CONDITIONING CONDENSER AND RADIATOR CORE FOR OBSTRUCTION.

1. INSPECT the air conditioning condenser and radiator core for obstruction.

●Is the air conditioning condenser or radiator core obstructed?

-> Yes

Remove the obstruction and clean the air conditioning condenser and radiator core. TEST the system for normal operation.

-> No

Goto <<C8>>

C7 : CHECK THE OPERATION OF THE COOLING FANS WITH THE ENGINE RUNNING AT NORMAL OPERATING TEMPERATURE

1. START and RUN the engine until the ECT is between 95°C (203°F) and 105°C (221°F).

●Are the cooling fans operating?

-> Yes

Turn the ignition switch to the OFF position.
Goto <<C8>>

-> No

DIAGNOSE the electronic engine controls. For additional information, refer to <<303-14>>.

C8 : CHECK THE TEMPERATURE OF THE RADIATOR

1. Check the radiator core temperature.

•Is the radiator core hot?

-> Yes

Goto <<C9>>

-> No

Goto <<C10>>

C9 : CHECK THE RADIATOR CORE FOR COLD SPOTS

1. Check the radiator core for cold spots.

•Does the radiator core have any cold spots?

-> Yes

Backflush the radiator. For additional information, refer to <<Cooling System Backflushing>>. TEST the system for normal operation. If the fault is still present, INSTALL a new radiator. For additional information, refer to <<Radiator>>.

-> No

Goto <<C10>>

C10 : CHECK THE THERMOSTAT

1. TEST the thermostat. For additional information, refer to the component TEST in this section.

•Is the thermostat OK?

-> Yes

Goto <<C11>>

-> No

INSTALL a new thermostat. For additional information, refer to <<Thermostat>>. TEST the system for normal operation.

C11 : CHECK THE ENGINE OIL COOLER FOR A BLOCKAGE

1. Remove the engine oil cooler. For additional information, refer to <<303-01>>.

2. Check the engine oil cooler for a coolant blockage.

•Is the engine oil cooler blocked?

-> **Yes**

Install a new engine oil cooler. For additional information, refer to <<303-01>>. TEST the system for normal operation.

-> **No**

INSTALL a new water pump. For additional information, refer to <<Water Pump>>. TEST the system for normal operation.

D : THE ENGINE BLOCK HEATER DOES NOT OPERATE

D1 : CHECK CONTINUITY OF THE BLOCK HEATER POWER SUPPLY CABLE AND THE BLOCK HEATER

1. Measure the resistance between the live supply terminal and the negative terminal of the block heater power supply connector.

•Is the resistance less than 20 ohms?

-> **Yes**

Repair the mains power supply to the vehicle block heater cable. TEST the system for normal operation.

-> **No**

Goto <<D2>>

D2 : CHECK THE CONTINUITY OF THE BLOCK HEATER

1. Disconnect the block heater electrical connector from the block heater.

2. Measure the resistance between the live supply terminal and the negative terminal of the block heater.

•Is the resistance less than 20 ohms?

-> **Yes**

Goto <<D3>>

-> **No**

INSTALL a new block heater. For additional information, refer to <<Block Heater>>. TEST the system for normal operation.

D3 : CHECK THE BLOCK HEATER FOR A SHORT TO GROUND

1. Measure the resistance between the live supply terminal and the earth terminal of the block heater.

•Is the resistance less than 10,000 ohms?

-> **Yes**

Install a new block heater. For additional information, refer to <<Block Heater>>. TEST the system for normal operation.

-> **No**

Goto <<D4>>

D4 : CHECK THE CONTINUITY OF THE BLOCK HEATER POWER SUPPLY CABLE

1. Measure the resistance of the live supply wire of the block heater cable.
2. Measure the resistance of the neutral supply wire of the block heater cable.
3. Measure the resistance of the ground supply wire of the block heater cable.

•Is the resistance less than 5 ohms?

-> Yes

Goto <<D5>>

-> No

Install a new block heater power supply cable. TEST the system for normal operation.

D5 : CHECK THE BLOCK HEATER POWER SUPPLY CABLE FOR A SHORT CIRCUIT

1. Measure the resistance between the live supply wire and the neutral supply wire of the block heater cable.
2. Measure the resistance between the live supply wire and the ground wire of the block heater cable.

•Is the resistance less than 10,000 ohms?

-> Yes

Install a new block heater power supply cable. TEST the system for normal operation.

-> No

Repair the mains power supply to the vehicle block heater cable. TEST the system for normal operation.

Component Tests

Pressure Test



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1. Switch the engine OFF.
2. Open the hood and install protective fender covers.
3. Carefully remove the coolant pressure cap from the coolant expansion tank to relieve pressure from the cooling system. Add coolant to the coolant expansion tank as necessary.

4. Install the cooling system Pressure Tester adaptor tightly to the coolant expansion tank.
5. Attach the pressure pump and gauge to the adapter fitting and pressurize the cooling system to 100 kPa (14.5 psi).
6. Observe the gauge reading for approximately two minutes. The pressure should not drop during this time.
 - If system holds pressure, proceed to step 8.
 - If the pressure drops check for leaks in the cooling system. Correct any leaks found and recheck the system.
7. Release the system pressure by slowly loosening the cooling system Pressure Tester adaptor. Check the coolant level and replenish as necessary with the correct coolant solution.
8. Conduct the pressure cap Pressure Test in this section.

Coolant Expansion Tank Pressure Cap Pressure Test



WARNING:

NEVER REMOVE THE COOLANT EXPANSION TANK CAP UNDER ANY CIRCUMSTANCES WHILE THE ENGINE IS OPERATING. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN DAMAGE TO THE COOLING SYSTEM OR ENGINE AND/OR PERSONAL INJURY. TO AVOID HAVING SCALDING HOT COOLANT OR STEAM BLOW OUT OF THE COOLING SYSTEM, USE EXTREME CARE WHEN REMOVING THE COOLANT EXPANSION TANK CAP FROM A HOT COOLING SYSTEM. WAIT UNTIL THE ENGINE HAS COOLED, THEN WRAP A THICK CLOTH AROUND THE COOLANT EXPANSION TANK CAP AND TURN IT SLOWLY UNTIL THE PRESSURE BEGINS TO RELEASE, STEP BACK WHILE THE PRESSURE IS RELEASED FROM THE SYSTEM. WHEN CERTAIN THAT ALL PRESSURE HAS BEEN RELEASED, (STILL WITH A CLOTH) TURN AND REMOVE THE COOLANT EXPANSION TANK CAP. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN PERSONAL INJURY.

1. Remove the coolant pressure cap from the coolant expansion tank.
2. Install the coolant pressure cap to the coolant system Pressure Tester.
3. Operate the cooling system pressure tester. Pressurize the coolant pressure cap until the pressure relief valve in the coolant pressure cap opens and observe the gauge reading. **NOTE:**
If the plunger of the pump is operated too quickly, an erroneous pressure reading will result.

Compare the gauge reading with the maximum opening pressure of the coolant pressure cap: 100 KPa (14.5 psi).
4. Release the pressure. Repeat Step 3 at least twice to make sure that the pressure test reading is repeatable and within acceptable gauge reading limits of the expansion tank cap.
5. If the pressure test gauge readings are not within acceptable gauge reading limits, install a new coolant pressure cap.
6. Pressurize the coolant pressure cap until the pressure is just below the opening pressure of the coolant pressure cap.
7. Observe the reading of the pressure gauge for one minute. The pressure should not fall within this time.
8. If the pressure falls below 10 KPa (1.5 psi) of the recorded pressure, install a new coolant pressure cap.

Thermostat Test, Mechanical

NOTE:

Fully open means the thermostat valve lifts a distance of 9.0 mm (0.35 inch) or more off the valve seat.

1. Remove the thermostat. For additional information, refer to<<Thermostat>>.
2. Immerse the thermostat in water.
3. Increase the temperature of the water.
4. Observe the state of the thermostat and the temperature of the water.
5. The thermostat should begin to open at 82°C (179°F) and is fully open at 93°C (199°F).
6. If the thermostat fails to open within acceptable limits, install a new thermostat.

Radiator Leak Test, Removed From the Vehicle



CAUTION:

Do not leak test an aluminium radiator in the same water that is used to leak test copper/brass radiators. Flux and caustic cleaners may be present in the test water which will corrode aluminium.

Clean the radiator before leak testing to prevent contamination of the test tank. Leak test the radiator in clean water with 138 kPa (20 psi) air pressure.

A separate clean test tank is recommended for aluminium radiators. If a separate tank is not available for aluminium radiator testing, rinse the test tank each time before testing an aluminium radiator.