Component Procedures: Cooling System

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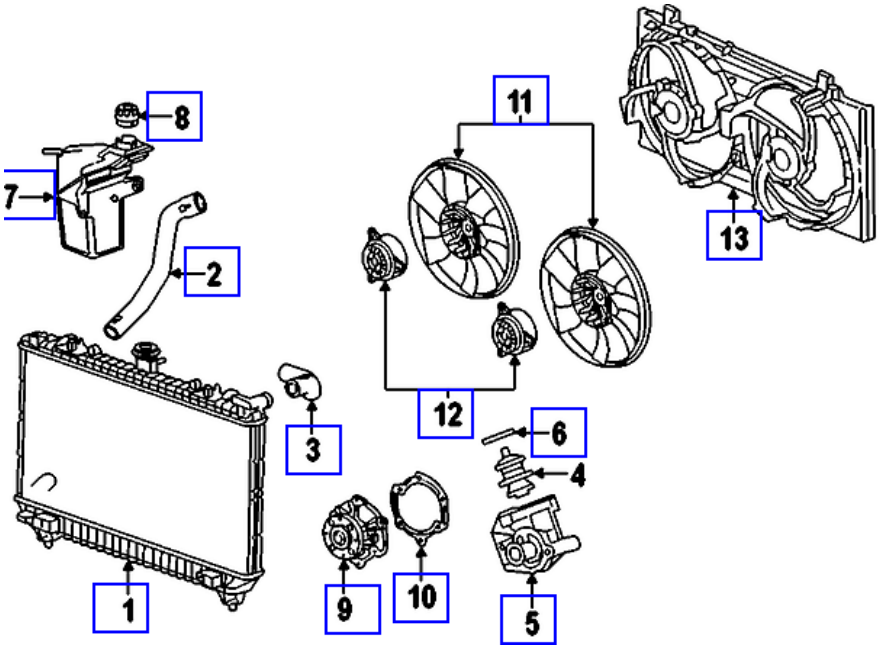
Exploded Parts Diagram (itype_83)



Parts and Labor (itype_189)

Labor

Operation	Qualifier Path	Skill	Std Hrs	Wty Hrs
Remove & Replace	Cooling Fan > Fan Blade, R&R > One	B	1.1	0.8
Remove & Replace	Cooling Fan > Fan Blade, R&R > Both	B	1.3	0.9
Remove & Replace	Cooling Fan > Fan Motor, R&R > One	B	1.1	0.8
Remove & Replace	Cooling Fan > Fan Motor, R&R > Both	B	1.3	0.9
Remove & Replace	Cooling Fan > Fan Relay, R&R	B	0.3	0.0
Remove & Replace	Cooling Fan > Fan Shroud, R&R	C	1.3	0.9
Remove & Replace	Cooling System > Block Heater, R&R	B	0.5	0.0
Remove & Replace	Cooling System > Expansion Plug, R&R > One	B	0.5	0.0
Remove & Replace	Cooling System > Expansion Plug, R&R > Each A?	B	0.4	0.0
Remove & Replace	Cooling System > Expansion Tank, R&R	C	0.6	0.5
Remove & Replace	Cooling System > Thermostat Gasket, R&R	B	1.8	0.0
Remove & Replace	Cooling System > Thermostat Housing, R&R	C	2.7	2.0
Remove & Replace	Cooling System > Thermostat, R&R	B	1.8	0.0
Remove & Replace	Radiator > Cap, R&R	C	0.2	0.2
Remove & Replace	Radiator > Lower Hose, R&R	C	1.4	0.7
Remove & Replace	Radiator > Radiator, R&R > Auto Trans	B	1.8	0.0
Remove & Replace	Radiator > Radiator, R&R > Manual Trans	B	1.7	1.0
Remove & Replace	Radiator > Upper Hose, R&R	C	1.4	0.7
Remove & Replace	Water Pump > Water Pump, R&R	B	1.8	1.2
Service	Periodical Maintenance > Cooling System, Serv?	B	1.5	1.0
Test	Cooling System > Cooling System Pressure, Test	B	0.3	0.0

Specifications Quick Reference (itype_439)

Quick Specifications
- item

Cooling System (Article 11807)

Cooling Fan Control – Variable Speed Single Fan System
LFX Engine
The engine cooling fan is a variable speed fan. The engine control module (ECM) controls the fan speed by

sending a pulse width modulated signal to the cooling fan control module. The cooling fan control module varies the voltage drop across the cooling fan motor in relation to the pulse width modulated signal.
Cooling fan speed is effected by many different conditions and can be adjusted from 10% to 100% duty cycle (PWM), 91% is considered high speed fan. When multiple cooling fan speed requests are received the ECM uses the highest cooling fan speed of all the requests. The ECM commands the cooling fan ON under the following conditions:
- Cooling fan duty cycle starts when engine coolant temperature reaches approximately 91°C (196°F) and reaches high speed at temperatures above 109°C (228°F).
- Cooling fan duty cycle starts when A/C pressure reaches approximately 725 kPa (105 psi) and reaches high speed at A/C pressures above 2100 kPa (305 psi).
- After the vehicle is shut OFF if the engine coolant temperature at key-off is greater than 113°C (235°F) or the A/C pressure is greater than 2300 kPa (334 psi) the cooling fan duty cycle is set to 55%, low speed. If the coolant temperature drops below 107°C (225°F) and the A/C pressure drops below 1800 kPa (261 psi) the fan will shut OFF. The fan will automatically shut OFF after 300 seconds, regardless of coolant temperature.
LS3/L99 Engine
Cooling fan speed is effected by many different conditions and can be adjusted from 20% to 99% duty cycle (PWM), 90% is considered high speed fan. When multiple cooling fan speed requests are received the ECM uses the highest cooling fan speed of all the requests. The ECM commands the cooling fan ON under the following conditions:
- Cooling fan duty cycle starts when engine coolant temperature reaches approximately 101°C (214°F) and reaches high speed at temperatures above 109°C (228°F).
- Cooling fan duty cycle starts when A/C pressure reaches approximately 975 kPa (141 psi) and reaches high speed at A/C pressures above 2100 kPa (305 psi).
- At transmission oil temperatures above approximately 112°C (234°F) the cooling fan duty cycle will be commanded to high speed.
Cooling System
The cooling system's function is to maintain an efficient engine operating temperature during all engine speeds and operating conditions. The cooling system is designed to remove approximately one-third of the heat produced by the burning of the air-fuel mixture. When the engine is cold, the system cools slowly or not at all. This allows the engine to warm quickly.
Cooling Cycle
Coolant is drawn from the radiator outlet and into the water pump inlet by the water pump. Some coolant will then be pumped from the water pump, to the heater core , then back to the water pump. This provides the passenger compartment with heat and defrost.
Coolant is also pumped through the water pump outlet and into the engine block . In the engine block, the coolant circulates through the water jackets surrounding the cylinders where it absorbs heat.
The coolant is then forced through the cylinder head gasket openings and into the cylinder head s. In the cylinder heads, the coolant flows through the water jackets surrounding the combustion chambers and valve seats, where it absorbs additional heat.
From the cylinder heads, the coolant is then forced to the thermostat . The flow of coolant will either be stopped at the thermostat until the engine is warmed, or it will flow through the thermostat and into the radiator where it is cooled and the coolant cycle is completed.
Operation of the cooling system requires proper functioning of all cooling system components. The cooling system consists of the following components:
Coolant
The engine coolant is a solution made up of a 50-50 mixture of DEX-COOL and clean drinkable water. The coolant solution carries excess heat away from the engine to the radiator, where the heat is dissipated to the atmosphere.
Radiator
The radiator is a heat exchanger . It consists of a core and two tanks. The aluminum core is a downflow tube and fin design. This is a brazed tube with convoluted louvered fin design. Separate tubes and fins are stacked together with a manifold at each end. The entire assembly is then brazed forming a homogeneous unified structure. The fins allow for efficient heat transfer from the coolant to the atmosphere. The inlet and outlet tanks are molded with a high temperature, glass reinforced nylon plastic. The tank and gasket is supplied as an assembly with silicone gasket attached to the tank. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core. The radiator also has a drain cock which is located in the bottom left of the lower tank. The drain cock includes the drain cock and drain cock seal.
The radiator removes heat from the coolant passing through it. The fins on the core absorb heat from the coolant passing through the tubes. As air passes between the fins, it absorbs heat and cools the coolant.
During vehicle use, the coolant heats and expands. The coolant that is displaced by this expansion flows into

the overflow tank. As the coolant circulates, air is allowed to exit. Coolant without bubbles absorbs heat much better than coolant with bubbles.

Pressure Cap

The pressure cap is a cap that seals and pressurizes the cooling system. It contains a blow off or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring and protects the radiator by relieving pressure if it exceeds 20 psi. The vacuum valve is held against its seat by a spring, which permits opening of the valve to relieve vacuum created in the cooling system as it cools off. The vacuum, if not relieved, could cause the radiator hose s to collapse.

The pressure cap allows pressure in the cooling system to build up. As the pressure builds, the boiling point of the coolant goes up as well. Therefore, the coolant can be safely run at a temperature higher than the boiling point of the coolant at atmospheric pressure. The hotter the coolant is, the faster the heat moves from the radiator to the cooler passing air. However, if the pressure exceeds the strength of the spring, the pressure valve rises so that the excess pressure can escape. When the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum causes the vacuum valve to open, allowing outside air into the cooling system. This equalizes the pressure in the cooling system with atmospheric pressure, thus preventing the radiator hoses from collapsing.

Coolant Recovery System

The coolant recovery system consists of a plastic coolant recovery reservoir and overflow tube. The recovery reservoir is also called a recovery tank or expansion tank . It is partially filled with coolant and is connected to the radiator fill neck with the overflow tube. Coolant can flow back and forth between the radiator and the reservoir.

In effect, a cooling system with a coolant recovery reservoir is a closed system. When the pressure in the cooling system gets too high, it will open the pressure valve in the pressure cap. This allows the coolant, which has expanded due to being heated, to flow through the overflow tube and into the recovery reservoir. As the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum opens the vacuum valve in the pressure cap, allowing some of the coolant in the reservoir to be siphoned back into the radiator. Under normal operating conditions, no coolant is lost. Although the coolant level in the recovery reservoir goes up and down, the radiator and cooling system are kept full. An advantage to using a coolant recovery reservoir is that it eliminates almost all air bubbles from the cooling system. Coolant without bubbles absorbs heat much better than coolant with bubbles.

Charge Air Cooling System (ZL1)

The charge air cooling systems function is to reduce the temperature of the air charge that is heated during the supercharging process which improves the efficiency and performance of the Powertrain. The charge air cooling system is an air-to-water system that uses a separate charge air cooling radiator located in front of the condenser and the radiator to cool the air charge. An electric pump is used to flow coolant from the charge air cooler, through the supercharger and charge air cooler reservoir, then back to the charge air cooler where the cycle repeats.

Air Baffles and Seals

The cooling system uses deflectors, air baffles and air seals to increase system cooling. Deflectors are installed under the vehicle to redirect airflow beneath the vehicle to flow through the radiator and increase cooling. Air baffles are also used to direct airflow into the radiator and increase cooling. Air seals prevent air from bypassing the radiator and A/C condenser. Air seals also prevent recirculation of the air for better hot weather cooling and A/C condenser performance.

Transmission Oil Cooler

The transmission oil cooler is a heat exchanger. It is located inside the lower tank of the radiator. The transmission fluid temperature is regulated by the temperature of the engine coolant that surrounds the oil cooler as the transmission fluid passes through the cooler.

The transmission oil pump , pumps the fluid through the transmission oil cooler feed line to the oil cooler. The fluid then flows through the cooler while the engine coolant absorbs heat from the fluid. The fluid is then pumped through the transmission oil cooler return line, to the transmission.

Transmission Oil Cooler (ZL1)

The transmission oil cooling system includes an integrated rear differential cooler. There are two transmission oil coolers in a series in the ZL1 transmission oil cooler system. The initial transmission oil cooler is a heat exchanger located in the lower end tank of the radiator. The transmission oil temperature is partially regulated by the temperature of the coolant leaving the radiator and passing over the heat exchanger.

Pipes/hoses from the transmission bring oil pumped at a high pressure through the rear differential, back to the radiator end tank cooler. The oil out of the radiator end tank cooler is plumbed to an air-to-oil cooler in front of the A/C condenser and radiator. This cooler helps provided additional cooling for performance driving conditions for the ZL1 transmission and rear differential. The transmission oil is then directed back

to the transmission.
Auxiliary Transmission Oil Cooler
The auxiliary transmission oil cooler is an oil-to-air heat exchanger located in front of the A/C condenser. The transmission oil temperature is regulated by the airflow passing over this heat exchanger. The oil out of the transmission is plumbed through the transmission oil cooler pipes/hoses to the cooler then directed back to the transmission. This cooler helps provided additional cooling for performance driving conditions.

Engine Heating/Cooling Schematics (Article 11911)

Figure 1: Cooling Fans
Figure 2: Charge Air Cooling Coolant Pump (LSA)

Cooling System Draining and Filling (GE 47716) (Article 11856)

Special Tools
- J 26568 - Coolant and Battery Fluid Tester
- J 42401 - Radiator Cap and Surge Tank Test Adapter
- GE-47716 - Vac-N-Fill Coolant Refill Tool

Draining Procedure
- Remove the coolant pressure cap.
- Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
- Place a drain pan under the drain cock.
- Remove the radiator drain cock . Refer to Radiator Drain Cock Replacement .
- Drain the cooling system.
- Lower the vehicle.
- Inspect the coolant.
- Follow the appropriate procedure based on the condition of the coolant.
- Normal in appearance—Follow the filling procedure.
- Discolored—Follow the flush procedure. Refer to Flushing .

Vac-N-Fill Procedure
- Install the J 42401 - Radiator Cap and Surge Tank Test Adapter onto the coolant surge tank.
- Attach the Vac-N-Fill cap to the J 42401 - Radiator Cap and Surge Tank Test Adapter (1) . Click for full-size image
- Attach the vacuum gauge assembly (1) to the Vac-N-Fill cap (2). Click for full-size image
- Attach the fill hose (1) to the barb fitting on the vacuum gauge assembly (2). Ensure that the valve is closed. Click for full-size image
- Pour the coolant mixture into the graduated reservoir (1). Click for full-size image
- Place the fill hose in the graduated reservoir (1).
- Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.
- Attach the venturi assembly (1) to the vacuum tank (2). Click for full-size image
- Attach a shop air hose to the venturi assembly (1). Ensure the valve (2) on the venturi assembly is closed. Click for full-size image
- Attach the vacuum hose (1) to the vacuum gauge assembly (2) and the vacuum tank (3). Click for full-size image
- Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present. Click for full-size image
- Continue to draw vacuum until the needle stops rising (1). This should be 610–660 mm Hg (24-26 in Hg). Cooling hoses may start to collapse. This is normal due to vacuum draw. Click for full-size image
- To aid in the fill process, position the graduated reservoir above the coolant fill port.
- Slowly open the valve (1) on the vacuum gauge assembly (2). When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose. Click for full-size image
- Close the valve on the venturi assembly.
- If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss. If vacuum loss is observed, refer to Loss of Coolant .
- Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.
- Once the vacuum gauge reaches zero (1), close the valve on the vacuum gauge assembly and repeat steps 11–17. Click for full-size image
- Detach the Vac-N-Fill cap from the J 42401 - Radiator Cap and Surge Tank Test Adapter .
- Remove the J 42401 - Radiator Cap and Surge Tank Test Adapter from the coolant surge tank.
- Add coolant to the system as necessary.

- Inspect the concentration of the coolant mixture using J 26568 - Coolant and Battery Fluid Tester .
- Detach the vacuum hose from the vacuum gauge assembly.
- Attach the extraction hose (1) to the vacuum hose (2). Click for full-size image
- Open the valve (1) on the venturi assembly (2) to start a vacuum draw. Click for full-size image
- Use the extraction hose (1) to draw out coolant to the proper level. Click for full-size image
- The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.
- Install the surge tank cap.

Cooling System Draining and Filling (LFX, Static Fill) (Article 11857)

Special Tools
J 26568 - Coolant and Battery Fluid Tester
Draining Procedure
- Remove the radiator fill cap from the radiator filler neck.
- Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
- Place a clean drain pan under the radiator drain cock .
- Remove the radiator drain cock (1). Click for full-size image
- Drain the cooling system.
- Lower the vehicle.
- Inspect the coolant.
- Follow the appropriate procedure based on the condition of the coolant.
- Normal in appearance—Follow the filling procedure.
- Discolored—Follow the flush procedure. Refer to Flushing .
- Install and tighten the radiator drain cock (1).
Filling Procedure
- Slowly fill the radiator with a 50/50 coolant mixture until the coolant level stabilizes at the top of the radiator filler neck. Refer to Approximate Fluid Capacities . Click for full-size image
- Install the radiator fill cap.
- Start the engine and allow to the engine to idle for 2 minutes in PARK or NEUTRAL with the parking brake engaged.
- Shut the engine OFF.
- Remove the radiator fill cap and slowly fill the coolant mixture until the level stabilizes just below the top of the radiator filler neck.
- Raise the engine RPM to 2500 rpm for 60 seconds.
- Repeat steps 5-8 until the coolant level has completely stabilized within the radiator fill neck.
- Start the engine and raise the engine RPM to 2500 rpm until the engine reaches normal operating temperature and the thermostat opens.
- Shut off the engine and allow the engine to cool.
- Remove the radiator fill cap.
- Inspect the concentration of the engine coolant using the J 26568 - Coolant and Battery Fluid Tester
- Inspect and if necessary, fill the coolant reservoir bottle as necessary.
- Rinse away any excess coolant from the engine and the engine compartment
- Inspect the cooling system for leaks.

Flushing (Article 11886)

- When the cooling system becomes contaminated, the cooling system should be flushed thoroughly to remove the contaminants before the engine is seriously damaged.
- This procedure is effective in removing contaminants caused by the use of improper coolants, coolant at the end of its life, or some liquid chemical flushing agents. This procedure is NOT effective for removing debris contamination caused by component failure, or the use of ‘stop leak’ additives. When the system is contaminated by this type of debris, use the system flow diagrams to identify components that may need replacement to restore proper system flow.
- Do not use chemical flush agents.
- Store used coolant in the proper manner, such as in a used engine coolant holding tank. Do not pour used coolant down a drain. Ethylene glycol antifreeze is a very toxic chemical. Do not dispose of coolant into the sewer system or ground water. This is illegal and ecologically unsound.
- Various methods and equipment can be used to flush the cooling system. If special equipment is used, such as a back flusher, follow the manufacturer's instruction. Always remove the thermostat before flushing the cooling system.

- Drain the cooling system. Cooling System Draining and Filling .
- Remove the coolant recovery reservoir . Coolant Recovery Reservoir Replacement .
- Clean and flush the coolant recovery reservoir with clean, drinkable water.
- Install the coolant recovery reservoir. Coolant Recovery Reservoir Replacement .
- Follow the drain and fill procedure using only clean, drinkable water. Cooling System Draining and Filling .
- Run the engine for 20 minutes.
- Stop the engine.
- Drain the cooling system. Cooling System Draining and Filling
- Repeat the procedure if necessary, until the fluid is nearly colorless.
- Fill the cooling system. Cooling System Draining and Filling .

Engine Cooling - Fastener Specifications (Article 11913)

Application Specification
Metric English
Charge Air Cooler Coolant Pump Bracket Fastener 9 Nm 80 lb in
Charge Air Cooler Drain Plug 9.6 Nm 85 lb in
Charge Air Cooler Radiator Fastener 10 Nm 89 lb in
Charge Air Cooler Vent Port Plug 9.6 Nm 85 lb in
Coolant Recovery Reservoir Bolt 17 Nm 13 lb in
Engine Coolant Fan Mounting Bolts 10 Nm 89 lb in
Engine Coolant Fan Nut 6 Nm 53 lb in
Engine Coolant Fan Shroud Bolt 8 Nm 70 lb in
Engine Coolant Thermostat Housing Bolts 10 Nm 89 lb in
Engine Oil Cooler Pipe Fastener (V8) 9 Nm 80 lb in
Engine Oil Cooler Inlet Hose Fitting Fastener (V8) 75 Nm 55 lb ft
Engine Oil Cooler Pipe Bolt 10 Nm 89 lb in
Engine Oil Cooler-to- Oil Pan M6 Bolts 10 Nm 89 lb in
Engine Oil Cooler-to-Oil Pan M8 Bolts 25 Nm 18 lb ft
Heater Inlet and Outlet Pipe Fastener (V6)
M6 10 Nm 89 lb in
- M6
M8 22 Nm 16 lb ft
- M8
Lower Thermostat Housing Bolts 10 Nm 89 lb in
Radiator Outlet Pipe (V6) 58 Nm 42 lb ft
Radiator Upper Bracket Bolt 9 Nm 80 lb in
Radiator Upper Support Bracket Bolt 9 Nm 80 lb in
Thermostat Housing Bolt (V8) 15 Nm 11 lb ft
Water Inlet Pipe Fastener (V8) 10 Nm 89 lb in
Water Outlet Fastener (V8) 10 Nm 89 lb in
Water Pump Bolt (V6)
First Pass 10 Nm 89 lb in (1)
- First Pass
Second Pass 10 Nm 89 lb in
- Second Pass
Final Pass 45 Degrees
- Final Pass
Water Pump Bolt (V8)
First Pass 15 Nm 11 lb ft
Final Pass 30 Nm 22 lb ft
Water Pump Inlet Bolt (V8) 30 Nm 22 lb ft
1. Use NEW fasteners.

All New Technical Service Bulletins (itype_432)

Tsbs
- Information on Flushing Oil Contamination from Cooling System (25-NA-052, 2026/03/16)

All Technical Service Bulletins (itype_100)

Tsbs

- Information on Overheating, Cooling System Contaminated with Engine Oil (22-NA-240, 2024/01/11)
- PIP5257D: Cooling System Contaminated With Engine Oil (PIP5257D, 2020/04/17)
- Information on Flushing Oil Contamination from Cooling System (25-NA-052, 2026/03/16)
- Information on Engine Overheating, Cooling System Contaminated with Engine Oil (21-NA-108, 2021/05/04)

Cooling System Leak Testing (Article 11814)

Special Tools
- J 24460-01 - Cooling System Pressure Tester
- J 42401-3 - Radiator Cap / Surge Tank Test Adapter

Cooling System Leak Testing
- Remove the pressure cap.
- Test the operation of the pressure cap. Refer to Pressure Cap Testing .
- Wash the pressure cap mating surface with water.
- Use the J 24460-01 - Cooling System Pressure Tester (1) with J 42401-3 - Radiator Cap / Surge Tank Test Adapter (2) in order to apply pressure to the cooling system. Do not exceed the pressure cap rating. Click for full-size image
- The cooling system should hold the rated pressure for at least 2 minutes. Observe the gauge for any pressure loss.
- Repair any leaks as required.

Symptoms - Engine Cooling (Article 11829)

Important Preliminary Inspections Before Starting

Before using the Symptom diagnosis, perform the following:
- Perform Diagnostic System Check - Vehicle and verify all of the following items:
- Engine control module (ECM) and malfunction indicator lamp (MIL) are operating correctly.
- There are no diagnostic trouble codes (DTCs) stored.
- Scan tool data is within a normal operating range.
- Verify the customer concern.
- Perform the Visual/Physical Inspection in this section. The visual/physical inspection is extremely important, and can lead to correcting a condition without additional testing. It may also help reveal the cause of an intermittent condition.
- Locate the correct symptom. Perform the tests and inspections associated with the symptom.

Review the entire cooling system operation in order to familiarize yourself with the system functions. Refer to Cooling Fan Description and Operation and Cooling System Description and Operation .

Visual/Physical Inspection
- The control module harness connectors
- The electrical center fuse/relay cavities
- The component terminals
- The component harness connector

Several of the symptom procedures call for a careful visual and physical inspection. This can lead to correcting a condition without further tests and can save time. This inspection should include the following:
- Ensure that the control module grounds are clean, tight, and correctly located.
- Inspect cooling system hoses and pipes for splits, kinks, and improper connections. Inspect thoroughly for any type of leak or restriction.
- Inspect for a dirty or restricted radiator or HVAC condenser.
- Inspect for aftermarket devices which could affect the operation of the cooling system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the coolant recovery reservoir for proper coolant level.

Identifying Intermittent Conditions

Many intermittent conditions occur with harness or connector movement due to engine torque, rough pavement, vibration or physical movement of a component. Refer to the following for a list to help isolate an intermittent condition:
- Water intrusion in connectors, terminals, or components
- Poor connector mating
- Terminal contact
- High circuit or component resistance—High resistance can include any resistance, regardless of the amount, which can interrupt the operation of the component.
- Harness' that are routed too tight, or chaffed circuits

- High or low ambient temperatures
- High or low engine coolant temperature s
- High underhood temperatures
- Heat build up in components or circuits due to circuit resistance, poor terminal contact, or high electrical load
- High or low system voltage
- High vehicle load conditions
- Rough road surface
- Electro-magnetic interference (EMI)/circuit interference from relays, solenoids or other electrical surge
- Incorrect installation of non-factory, aftermarket, or after factory add on accessories

If an intermittent fault is detected, refer to Testing for Intermittent Conditions and Poor Connections for specific strategies in diagnosing intermittent conditions.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:
- Engine Overheating
- Loss of Coolant
- Thermostat Diagnosis

Engine Overheating (Article 11825)

Step Action Yes No

DEFINITION: The engine temperature lamp comes on and stays on, or temperature gauge shows hot, or coolant overflows from the coolant recovery reservoir onto the ground while the engine is running. Special Tools J-26568 - Coolant and Battery Fluid Tester

Special Tools

J-26568 - Coolant and Battery Fluid Tester

1 Check the condenser, radiator , and auxiliary coolers for any obstructions or bent fins that would prevent air flow through the radiator. Is there any airflow obstruction or bent fins? Go to Step 2 Go to Step 3

2 Remove any debris that may cause an air flow obstruction. Remove or relocate aftermarket add-on components that block air flow to the radiator. Does the engine still overheat? Go to Step 3 System OK
- Remove any debris that may cause an air flow obstruction.
- Remove or relocate aftermarket add-on components that block air flow to the radiator.

3 Check for loose, missing, or damaged radiator air seals or deflectors. Are there any loose, missing, or damaged radiator air seals or deflectors? Go to Step 4 Go to Step 5

4 Repair or replace any loose, missing, or damaged radiator air seals or deflectors. Does the engine still overheat? Go to Step 5 System OK

5 Check for an inoperative cooling fan . Refer to Cooling Fan Inoperative . Is the cooling fan inoperative? Go to Step 6 Go to Step 7

6 Repair or replace the cooling fan(s) as necessary. Refer to Engine Coolant Fan Motor Replacement . Does the engine still overheat? Go to Step 7 System OK

7 Check for a loss of coolant. Refer to Loss of Coolant . Does the engine still overheat? Go to Step 8 System OK

8 Check for kinked or pinched cooling hoses. Does the engine still overheat? Go to Step 9 Go to Step 10

9 Relieve any kinks by rerouting the hoses. Replace the hoses, if necessary. Does the engine still overheat? Go to Step 10 System OK
- Relieve any kinks by rerouting the hoses.
- Replace the hoses, if necessary.

10 Using J-26568 - Coolant and Battery Fluid Tester , check the coolant concentration. Does the coolant concentration test correctly? Go to Step 12 Go to Step 11

11 Replace the coolant, if necessary. Refer to Cooling System Draining and Filling . Does the engine still overheat? Go to Step 12 System OK

12 Check for any blocked cooling system passages. Are there blocked cooling system passages? Go to Step 13 Go to Step 14

13 Remove any obstructions by flushing the cooling system. Refer to Flushing . Does the engine still overheat? Go to Step 14 Go to Step 19

14 Inspect the accessory drive belt tensioner . Refer to Drive Belt Tensioner Diagnosis for the 3.6L engine and Drive Belt Tensioner Diagnosis for the 6.2L engine. Does the engine still overheat? Go to Step 15 System OK

15 Check for a faulty thermostat . Refer to Thermostat Diagnosis . Does the engine still overheat? Go to Step 16 System OK

16 Replace the radiator. Refer to Radiator Replacement . Does the engine still overheat? Go to Step 17 System

OK
17 Check for a faulty water pump . The impeller blades may be eroded or broken. Is the water pump faulty? Go to Step 18 —
18 Replace the water pump. Refer to Water Pump Replacement . Does the engine still overheat? Go to Step 19 —
19 Operate the system to verify the repair. Did you correct the condition? System OK —

Loss of Coolant (LFX, L99/LS3) (Article 11826)

Step Action Yes No
DEFINITION: The cooling system is loosing coolant either internally or externally.
1 Were you sent here from Symptoms or another diagnostic table? Go to Step 2 Go to Symptoms - Engine Cooling
2 Repair any present DTCs. Refer to Diagnostic System Check - Vehicle . Is the action complete? Go to Step 3 —
3 Inspect the coolant level. Is the coolant at the proper level? Go to Step 5 Go to Step 4
4 Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling . Is the action complete? Go to Step 5 —
5 If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate? Go to Step 6 Go to Step 28
6 Engine overheating can cause a loss of coolant. Is the engine overheating? Go to Step 29 Go to Step 7
7 Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking? Go to Step 31 Go to Step 8
8 Idle the engine at normal operating temperature. Inspect for heavy white smoke coming out of the exhaust pipe . Is a heavy white smoke present from the exhaust pipe? Go to Step 9 Go to Step 10
- Idle the engine at normal operating temperature.
- Inspect for heavy white smoke coming out of the exhaust pipe .
9 Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor? Go to Step 30 Go to Step 10
10 Warning: Refer to Moving Parts and Hot Surfaces Warning . With the engine idling, inspect the coolant recovery system. Does the coolant recovery system discharge coolant while the engine is idling? Go to Step 15 Go to Step 11
11 Visually inspect the hoses, pipes and hose clamps at the following locations: Coolant overflow tank Water Pump Heater core Radiator Are any of the hoses, clamps or pipes leaking? Go to Step 22 Go to Step 12
- Coolant overflow tank
- Water Pump
- Heater core
- Radiator
12 Visually inspect the following components: Coolant pressure cap Block heater Core plug s Cylinder head gaskets Engine block Intake manifold Radiator Thermostat housing Water pump Are any of the listed components leaking? Go to Step 22 Go to Step 13
- Coolant pressure cap
- Block heater
- Core plug s
- Cylinder head gaskets
- Engine block
- Intake manifold
- Thermostat housing
- Water pump
13 Pressure test the cooling system. Refer to Cooling System Leak Testing . With the cooling system pressurized, visually inspect the components listed in steps 11 and 12. Are any leaks present? Go to Step 22 Go to Step 14
- Pressure test the cooling system. Refer to Cooling System Leak Testing .
- With the cooling system pressurized, visually inspect the components listed in steps 11 and 12.
14 Pressure test the coolant pressure cap. Refer to Pressure Cap Testing . Does the coolant pressure cap hold pressure? Go to Step 16 Go to Step 23
15 Pressure test the coolant pressure cap. Refer to Pressure Cap Testing . Does the coolant pressure cap hold pressure? Go to Step 32 Go to Step 23
16 Inspect for the following conditions: A coolant smell inside of the vehicle Coolant in the HVAC module drain tube Coolant on the vehicle floor covering near the HVAC module Is coolant present? Go to Step 24 Go to Step 17
- A coolant smell inside of the vehicle
- Coolant in the HVAC module drain tube

- Coolant on the vehicle floor covering near the HVAC module
17 Add 30 ml (1 oz) of GM P/N 89022219 (Canadian P/N 89022220) Canada Extended Life Coolant Leak Detection Dye to the cooling system for each 15 L (4 gal) of coolant. Refer to Approximate Fluid Capacities . Start the vehicle and allow the engine to reach normal operating temperature. Shut the engine off. Use the J 42220 - Universal 12V Leak Detection Lamp to visually inspect the components listed in steps 11 and 12. Are any leaks present? Go to Step 22 Go to Step 18
- Add 30 ml (1 oz) of GM P/N 89022219 (Canadian P/N 89022220) Canada Extended Life Coolant Leak Detection Dye to the cooling system for each 15 L (4 gal) of coolant. Refer to Approximate Fluid Capacities .
- Start the vehicle and allow the engine to reach normal operating temperature.
- Shut the engine off.
- Use the J 42220 - Universal 12V Leak Detection Lamp to visually inspect the components listed in steps 11 and 12.
18 Use the J 42220 - Universal 12V Leak Detection Lamp to inspect for the following conditions: Coolant dye in the HVAC module drain tube Coolant dye on the vehicle floor covering near the HVAC module Is coolant dye present? Go to Step 24 Go to Step 19
- Coolant dye in the HVAC module drain tube
- Coolant dye on the vehicle floor covering near the HVAC module
19 Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is a milky substance under the oil fill cap? Go to Step 20 Go to Step 21
20 Inspect the engine oil fluid level indicator for a gray/white milky substance. Is a milky substance on the engine oil fluid level indicator? Go to Step 30 Go to Step 21
21 Inspect the automatic transmission oil fluid level indicator, if equipped, for a gray/white milky substance. Is there a milky substance on the automatic transmission fluid level indicator? Go to Step 25 Go to Step 33
22 Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete? Go to Step 33 —
23 Replace the coolant pressure cap. Is the repair complete? Go to Step 33 —
24 Replace the heater core. Refer to Heater Core Replacement . Is the repair complete? Go to Step 33 —
25 Remove the transmission oil cooler line s from the radiator. Pressure test the cooling system. Refer to Cooling System Leak Testing . Inspect the transmission oil cooler for coolant. Is coolant present? Go to Step 26 Go to Step 27
- Remove the transmission oil cooler line s from the radiator.
- Inspect the transmission oil cooler for coolant.
26 Replace the radiator. Refer to Radiator Replacement . Service the automatic transmission. Refer to Engine Coolant/Water in Transmission . Is the repair complete? Go to Step 33 —
- Replace the radiator. Refer to Radiator Replacement .
- Service the automatic transmission. Refer to Engine Coolant/Water in Transmission .
27 Install the cooler lines to the radiator. Is the action complete? Go to Step 33 —
28 Repair the engine no crank condition. Refer to Engine Will Not Crank - Crankshaft Will Not Rotate for 3.6L or Engine Will Not Crank - Crankshaft Will Not Rotate for 6.2L engine. Is the repair complete? Go to Step 33 —
29 Repair the engine overheating condition. Refer to Engine Overheating . Is the repair complete? Go to Step 33 —
30 Repair the engine internal coolant leak. Refer to Coolant in Combustion Chamber for 3.6L or Coolant in Combustion Chamber for 6.2L engine. Is the repair complete? Go to Step 33 —
31 Repair the engine knock. Refer to Lower Engine Noise, Regardless of Engine Speed for 3.6L or Lower Engine Noise, Regardless of Engine Speed for 6.2L engine. Is the repair complete? Go to Step 33 —
32 Repair the combustion pressure in the cooling system problem. Refer to Coolant in Combustion Chamber for 3.6L or Coolant in Combustion Chamber for 6.2L engine. Is the repair complete? Go to Step 33 —
33 Operate the system in order to verify the repair. Did you find and correct the condition? System OK Go to Step 2

Coolant Heater Inoperative (Article 11811)

Diagnostic Instructions
- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description
The optional coolant heater operates using 110-volt AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather. There is an internal thermal switch in the power cord that prevents operation above −18°C (0°F). The coolant heater helps reduce fuel consumption when a

cold engine is warming up. The unit is equipped with a detachable AC power cord. A weather shield on the cord is provided to protect the plug when not in use.

Reference Information

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Circuit/System Testing

- Test the engine coolant heater for an open or short to ground.
- If open or shorted, replace the E19 coolant heater.
- If the heater tests normal, replace the coolant heater power cord.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Engine Coolant Heater Replacement
- Engine Coolant Heater Cord Replacement

Engine Fails to Reach Normal Operating Temperature (Article 11824)

Step Action Yes No

1 Did you review the Symptoms – Engine Cooling diagnostic information and perform the necessary inspections? Go to Step 2 Go to Symptoms - Engine Cooling

2 Verify that the engine does not reach normal operating temperature. Does the engine reach normal operating temperature? System OK Go to Step 3

3 Inspect the coolant level. Is the coolant level below the add mark? Go to Step 4 Go to Step 5

4 Add coolant as necessary. Perform a cooling system pressure test. Does the cooling system hold pressure? System OK Go to Step 5

- Add coolant as necessary.
- Perform a cooling system pressure test.

5 Inspect for a stuck open, missing, or incorrect thermostat . Refer to Thermostat Diagnosis . Is the thermostat operating properly? System OK Go to Step 6

6 Install the correct replacement thermostat. Refer to Engine Coolant Thermostat Replacement . Is the repair complete? Go to Step 7 —

7 Run the engine in order to verify the repair. Does the engine fail to reach normal operating temperature? — System OK

Engine Cooling - Special Tools (Article 11912)

Illustration Tool Number/ Description

Click for full-size image DT 47731 1/2 Inch Quick Connect Release Tool

Click for full-size image DT 41623-B J-41623-B 3/8 Inch Cooler Quick Connect Tool

Click for full-size image EN-24460-A J-24460-A Cooling System Pressure Tester

Click for full-size image GE 47716 Vac N Fill Coolant Refill Tool

Click for full-size image GE 47716-20 Cooling System Refill Adapter

Click for full-size image GE 50389 Coolant Pressure Test Quick Connector

Click for full-size image GE 24731 J 24731 Tempil Stick

Click for full-size image GE 26568 J 26568 Coolant and Battery Fluid Tester

Click for full-size image BO 38185 J 38185 Hose Clamp Pliers

Click for full-size image GE 39400-A J 39400-A Halogen Leak Detector

Click for full-size image GE 42220 J 42220 Universal 12V Leak Detection Lamp

Click for full-size image GE 42401 J 42401 Radiator Cap and Surge Tank Test Adapter

Out of specification (itype_158)

Tsbs

- PIP5257D: Cooling System Contaminated With Engine Oil (PIP5257D, 2020/04/17)
- Information on Engine Overheating, Cooling System Contaminated with Engine Oil (21-NA-108, 2021/05/04)

OEM Policies and Procedures (itype_120)

Tsbs

- Information on Flushing Oil Contamination from Cooling System (25-NA-052, 2026/03/16)