ENGINE

Engine Heating and Cooling - Escalade, Suburban, Tahoe, Yukon

SPECIFICATIONS

FASTENER SPECIFICATIONS

Application	Specification	
	Metric	English
Coolant Heater (L83, L86)	50 N.m	37 lb ft
Engine Coolant Air Bleed Pipe Bolt (L96)	12 N.m	106 lb in
Engine Coolant Fan Rear Fan Shroud Bolt (L83, L86)	7 N.m	62 lb in
Engine Coolant Manifold Fastener (L83, L86)	25 N.m	18 lb ft
Engine Coolant Thermostat Housing Bolt (L96)	15 N.m	11 lb ft
Surge Tank Bolt (L83, L86)	10 N.m	89 lb in
Surge Tank Nut (L83, L86)	10 N.m	89 lb in
Thermostat Housing Bolt (L83, L86)	10 N.m	89 lb in
Water Pump Fastener (L83, L86)	10 N.m	89 lb in
Water Pump Fastener (L96)	Â	Â
• First Pass	15 N.m	11 lb ft
• Second Pass	30 N.m	22 lb ft

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Cooling System		
5.3L (L83)	15.73 L	16.62 qt
6.2L (L86)	15.73 L	16.62 qt

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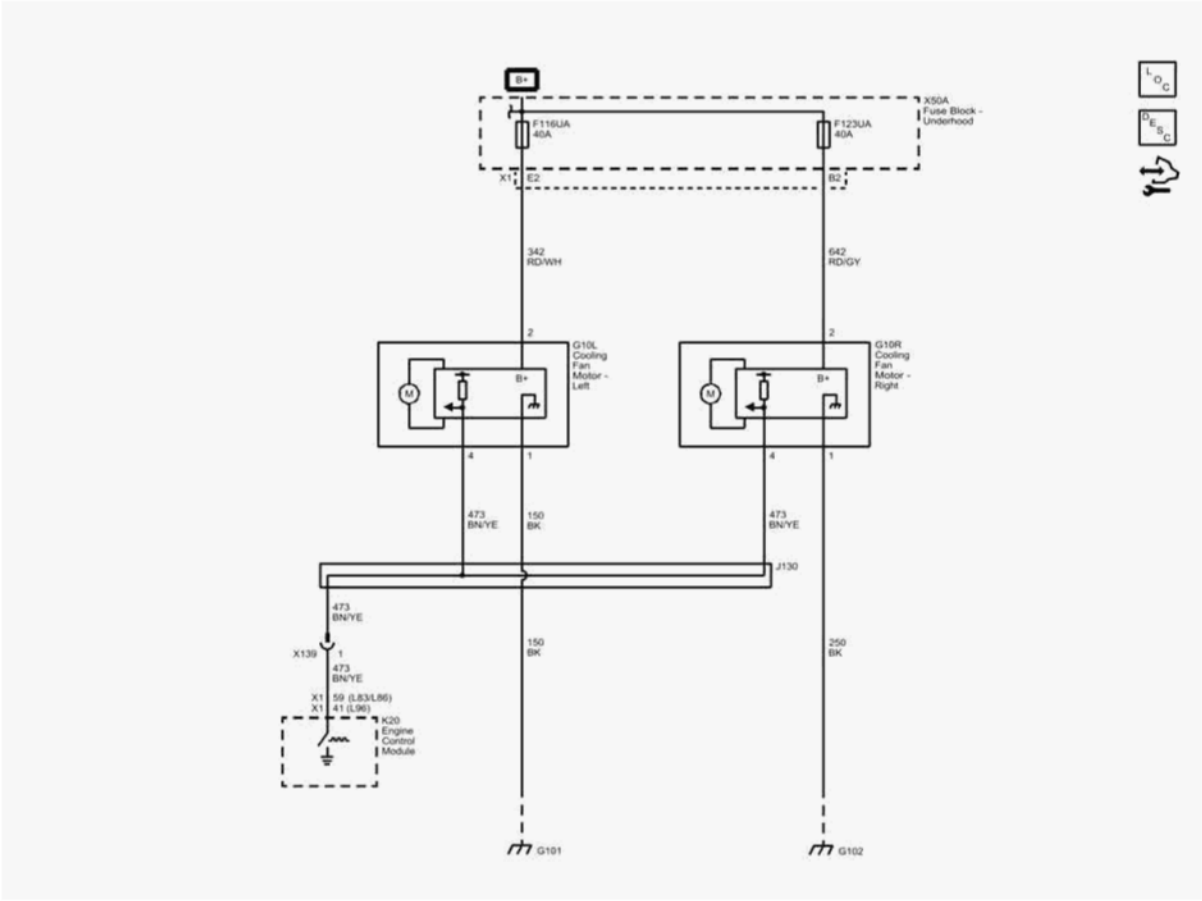
ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Extended Life Coolant Leak Detection Dye	Dye	89022219	89022220
DEX-COOLÂ®	Coolant	12346290	10953464

SCHEMATIC WIRING DIAGRAMS

ENGINE HEATING/COOLING WIRING SCHEMATICS

Engine Cooling Fans



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Fig. 1: Engine Cooling Fans
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0480, P0691, OR P0692: COOLING FAN SPEED

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.

DTC Descriptors

DTC P0480

Cooling Fan Speed Output Circuit

DTC P0691

Cooling Fan Speed Output Circuit Low Voltage

DTC P0692

Cooling Fan Speed Output Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
G10L Cooling Fan Motor - Left Ignition Voltage	1	2	-	-
G10L Cooling Fan Motor - Left Ground	-	-	-	-
G10L Cooling Fan Motor - Left Control	P0691 or 2	P0480 or 2	P0692 or 2	-
G10R Cooling Fan Motor - Right Ignition Voltage	3	4	-	-

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Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
G10R Cooling Fan Motor - Right Ground	-	-	-	-
G10R Cooling Fan Motor - Right Control	P0691 or 4	P0480 or 4	P0692 or 4	Â

1. Opens left cooling fan fuse without a DTC.
2. Left fan inoperative without a DTC.
3. Opens right cooling fan fuse without a DTC.
4. Right cooling fan inoperative without a DTC.

Circuit/System Description

The engine control module (ECM) commands the speed of the cooling fans based on cooling requirements. The ECM controls the cooling fan speed by commanding the cooling control module. The cooling fan control module supplies separate power and ground circuits for each cooling fan. The ECM sends a pulse width modulated (PWM) signal to the cooling fan control module. The cooling fan control module interprets the signal and operates the cooling fans at the commanded speeds.

Conditions for Running the DTC

- The ignition voltage is 11 volts or greater.
- The engine speed is 400 RPM or greater.
- The ECM driver transitions from ON to OFF or from OFF to ON.
- DTCs P0480, P0691, and P0692 run continuously once the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for greater than 5 seconds.

Action Taken When the DTC Sets

- DTCs P0480, P0691, and P0692 are Type B DTCs.

Conditions for Clearing the MIL/DTC

- DTCs P0480, P0691, and P0692 are Type B DTCs.

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Diagnostic Aids

- A delay or ramp up of approximately 12 seconds may occur before the cooling fan activates or changes speed when being commanded with a scan tool.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

K20 Engine Control Module: Scan Tool Information for scan tool information

Circuit/System Verification

NOTE: **There is a slight delay before the cooling fans activate.**

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1. Engine operating, command the Cooling Fans from 0 % to 90 % with a scan tool.
2. Verify the G10 Cooling Fan Motors activates in each available speed.
    - **The cooling fan does not activate or increase in speed as commanded**

      Refer to Circuit/System Testing

    - **The cooling fan activates and increases in speed as commanded**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
    - **If the DTC sets**

      Refer to Circuit/System Testing

    - **If the DTC does not set**
5. All OK.

Circuit/System Testing

NOTE: **Both cooling fan motors must be disconnected or incorrect diagnosis may result.**

1. Ignition OFF, disconnect the following G10 Cooling Fan Motors.
    - G10L Cooling Fan Motor Left.
    - G10R Cooling Fan Motor Right.
2. Ignition ON, verify that a test lamp illuminates between the following terminals and ground.
    - G10L Cooling Fan Motor Left - terminal 2
    - G10R Cooling Fan Motor Right - terminal 2
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp and turn all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
    2. Test for less than 2 Ω in the appropriate B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**

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1. Ignition OFF, remove the test lamp and turn all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for infinite resistance between the terminals listed below and ground.
    - G10L Cooling Fan Motor Left - terminal 2.
    - G10R Cooling Fan Motor Right - terminal 2
    - If less than infinite resistance, repair the short to ground in the circuit.
    - If infinite resistance, replace the appropriate G10 Cooling Fan Motor.

- **If the test lamp illuminates**

NOTE: **The cooling fan speed output circuit is pulled-up to a voltage within the ECM, 3-4 volts on the output circuit is normal.**

3. Ignition OFF, disconnect the following G10 Cooling Fan Motors.
    - G10L Cooling Fan Motor Left
    - G10R Cooling Fan Motor Right
4. Connect a DMM, set on the diode setting, between the following terminals and ground.
    - G10L Cooling Fan Motor Left - terminal 4
    - G10R Cooling Fan Motor Right - terminal 4
5. Ignition ON, verify the DMM reading is greater than 2.5 V or displays O.L. with the cooling fan commanded OFF.
    - **If 2.5 V or less**
    1. Ignition OFF, all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
    2. Disconnect the K20 Engine Control Module harness connector X1.
    3. Test for infinite resistance between the appropriate G10 Cooling Fan Motor control circuit terminal 4 and ground.
        - If less than infinite resistance, repair the short to ground in the circuit.
        - If infinite resistance, replace the K20 Engine Control Module.
    - **If greater than 2.5 V or displays O.L.**
6. Command the Cooling Fan ON to 90 % with a scan tool.
7. Verify the DMM reading is less than 1 V.
    - **If 1 V or greater**
    1. Ignition OFF, disconnect harness connector X1 at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the appropriate G10 Cooling Fan Motor control circuit terminal 4 and ground.

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- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V.

3. Ignition OFF, and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down.
4. Test for less than 2 Ω in the G10 Cooling Fan Motor control circuit terminal 4, end to end.
    - If 2 Ω or greater, repair the open/high resistance in the control circuit.
    - If less than 2 Ω, replace the K20 Engine Control Module.

- **If less than 1 V**

8. Test or replace the appropriate G10 Cooling Fan Motor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Fan Blade Replacement (L83 L86)** for G10 Cooling Fan Motor Replacement.
- **Control Module References** for ECM replacement, setup, and programming

DTC P1258: ENGINE COOLANT OVER TEMPERATURE - PROTECTION MODE ACTIVE

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.

DTC Descriptor

DTC P1258

Engine Coolant Over temperature - Protection Mode Active

Circuit/System Description

The engine control module (ECM) uses the engine coolant temperature (ECT) sensor to monitor the engine for an over-temperature condition. This condition occurs when the coolant temperature is above a calibrated value for a calibrated length of time. The ECM will disable half of the cylinders by turning OFF the fuel injectors. By disabling half of cylinders, the ECM is able to reduce the temperature of the coolant.

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Conditions for Running the DTC

The engine is operating.

Conditions for Setting the DTC

All V8

The coolant temperature is warmer than 129Â°C (264Â°F) for greater than 10 seconds.

Action Taken When the DTC Sets

- DTC P1258 is a Type A DTC.
- The engine will operate in the Overheated Engine Protection Operating Mode.
- The engine coolant temperature indicator lamp, if equipped, will illuminate.
- The driver information center (DIC), if equipped, may display a message.
- If the protection mode is active and an ECT sensor DTC sets, the protection mode will activate during the next drive cycle until the ECT sensor DTC runs and passes.

Conditions for Clearing the DTC

DTC P1258 is a Type A DTC.

Reference Information

Description and Operation

- **Cooling System Description and Operation**
- **Instrument Cluster Description and Operation**
- **Indicator/Warning Message Description and Operation**
- **Audible Warnings Description and Operation**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0480, P0691 or P0692 is not set.
   - **If a DTC is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If no DTCs is set**

   NOTE: A short delay occurs before the ECM changes the cooling fan speed.

3. Verify the cooling fan operates at each available speed as commanded with a scan tool.
   - **Cooling fan does not operate**

     Refer to **Cooling Fan Inoperative**.

   - **Cooling fan operates**
4. Verify that the engine does not overheat.
   - **Engine overheats**

     Refer to **Engine Overheating**.

   - **Engine does not overheat**
5. Operate the vehicle within the Conditions for Running the DTC.
   - **If the DTC sets**

     Refer to **Symptoms - Engine Cooling**.

   - **If the DTC does not set**
6. All OK

Repair Instructions

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Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

SYMPTOMS - ENGINE COOLING

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

CAUTION: Use the connector test adapter kit EL-35616-F for any test that requires probing the following items:

- **The control module harness connectors**
- **The electrical center fuse/relay cavities**
- **The component terminals**
- **The component harness connector**

Using this kit will prevent damage caused by the improper probing of connector terminals.

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.

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- 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 temperatures
- 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:

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- Cooling Fan Always On
- Cooling Fan Inoperative
- Engine Overheating
- Loss of Coolant (L86 L83)Loss of Coolant (L96)
- Thermostat Diagnosis
- Engine Fails To Reach Normal Operating Temperature

COOLING FAN ALWAYS ON

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 engine cooling fan system is composed of two electric cooling fans. The engine control module (ECM) controls the fan speed by sending a pulse width modulated (PWM) signal to the cooling fan control modules. The cooling fan control module varies the voltage drop across the cooling fan motor in relation to the pulse width modulated signal, which enables cooling fan operation at variable speeds. The cooling fan control module is thermally protected to prevent module damage in the case of a short circuit condition in the cooling fan motor.

Diagnostic Aids

- Certain resistance conditions with IAT or ECT sensors may cause unwarranted cooling fan activation. If the ECM is commanding the cooling fan ON for no apparent reason and without any component or system DTCs set, the IAT or ECT sensor may be skewed. If this condition is suspected, refer to the temperature versus resistance tables in the appropriate engine controls subsection.
- The cooling fans will not operate when the scan tool Cooling Fan Motor Command parameter displays 0 %. This is a normal condition.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

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COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P0480, P0691, or P0692, is not set.
   - **If a DTC is set**

     Refer to **DTC P0480, P0691, or P0692**.

   - **If no DTC is set.**
3. Verify the scan tool Cooling Fan Motor Command parameter is 0 %.
   - **If greater than 0 %**

     Refer to Diagnostic Aids and **Symptoms - Engine Cooling** for further diagnosis.

   - **If 0 %**
4. Verify that the G10 Cooling Fan Motors are not operating.
   - **If a G10 Cooling Fan Motor is operating**

     Test or replace the appropriate G10 Cooling Fan Motor.

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- **If the G10 Cooling Fan Motor is not operating**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Fan Blade Replacement (L83 L86)** for G10 Cooling Fan Motor Replacement.
- **Control Module References**

COOLING FAN INOPERATIVE

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 engine cooling fan system is composed of two electric cooling fans. The engine control module (ECM) controls the fan speed by sending a pulse width modulated (PWM) signal to the cooling fan control modules. The cooling fan control module varies the voltage drop across the cooling fan motor in relation to the pulse width modulated signal, which enables cooling fan operation at variable speeds. The cooling fan control module is thermally protected to prevent module damage in the case of a short circuit condition in the cooling fan motor.

Diagnostic Aids

A delay or ramp up of approximately 12 seconds may occur before the cooling fan activates or changes speed when being commanded with a scan tool.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

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COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P0480, P0691, or P0692, is not set.
   - **If a DTC is set**

     Refer to **DTC P0480, P0691, or P0692**.

   - **If no DTC is set.**

   NOTE: A slight delay may occur before the cooling fan activates.

3. Verify the G10 Cooling Fan Motor activates and increases in speed with each command using a scan tool.
   - **The cooling fan does not activate or increase in speed**

     Refer to Circuit/System Testing

   - **The cooling fan activates and increases in speed**
4. All OK.

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Circuit/System Testing

1. Ignition OFF, disconnect the appropriate G10 Cooling Fan Motor harness connector.
2. Ignition ON, verify that a test lamp illuminates between ground circuit terminal 1 and B+.
    - **If the test lamp does not illuminate**
    1. Ignition OFF, test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If the test lamp illuminates**
3. Verify that a test lamp illuminates between B+ circuit terminal 2 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, test for less than 2 Ω in the appropriate B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, test for infinite resistance between the appropriate B+ circuit terminal and ground.
        - If less than infinite resistance, repair the short to ground in the circuit.
        - If infinite resistance, replace the appropriate G10 Cooling Fan Motor.
    - **If the test lamp illuminates**

NOTE: **Both G 10 Cooling Fan Motors must be disconnected or incorrect diagnosis may result.**

4. Ignition OFF, disconnect the other G 10 Cooling Fan Motor harness connector.
5. Ignition ON, test appropriate G 10 Cooling Fan Motor for 3-4 volts on the control circuit terminal 4.
    - **If 3 V or less**
    1. Ignition OFF, all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
    2. Test for less than 2 Ω between the terminals listed below:
        - G10L Cooling Fan Motor Left - terminal 4
        - G10R Cooling Fan Motor Right - terminal 4
        - If 2 Ω or greater, repair the open/high resistance in the circuit.

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- **If 3-4 V**

6. Test or replace the appropriate G 10 Cooling Fan Motor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Fan Blade Replacement (L83 L86)** for G10 Cooling Fan Motor replacement.
- **Control Module References**

ENGINE OVERHEATING

Step	Action	Yes	No
DEFINITION: The engine temperature lamp comes on and stays on, or temperature gauge shows hot, or coolant overflows from the surge tank onto the ground while the engine is running.			
1	Check for a loss of coolant. Refer to **Loss of Coolant (L86 L83)Loss of Coolant (L96)**. Is there a loss of coolant?	Go to **Step 2**	Go to **Step 3**
2	Fill the system to the specified level. Does the engine still overheat?	Go to **Step 3**	System OK
3	Check for kinked or pinched surge tank hoses, especially at the radiator. Are any surge tank hoses kinked or pinched?	Go to **Step 4**	Go to **Step 5**
4	1. Relieve any kinks by rerouting the hoses. 2. Replace the hoses, if necessary. Does the engine still overheat?	Go to **Step 5**	System OK
5	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 6**	Go to **Step 7**
6	Repair or replace any loose, missing, or damaged radiator air seals or deflectors. Does the engine still overheat?	Go to **Step 7**	System OK
7	Check the coolant concentration. Does the coolant concentration test correctly?	Go to **Step 9**	Go to **Step 8**

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Step	Action	Yes	No
8	Replace the coolant, if necessary. Does the engine still overheat?	Go to **Step 9**	System OK
9	**NOTE:** **Use the correct pressure cap.** Check the system for loss of pressure. Refer to **Pressure Cap Testing**Is there a loss of pressure?	Go to **Step 10**	Go to **Step 11**
10	Repair any leaks, as necessary. Does the engine still overheat?	Go to **Step 11**	System OK
11	Check for a faulty engine coolant temperature sensor. Is the engine coolant temperature sensor faulty?	Go to **Step 12**	Go to **Step 13**
12	Replace the engine coolant temperature sensor. Refer to **Engine Coolant Temperature Sensor Replacement** Does the engine still overheat?	Go to **Step 13**	System OK
13	Check the radiator for any air flow obstructions or bent fins. Is there any airflow obstruction or bent fins?	Go to **Step 14**	Go to **Step 15**
14	1. Remove or relocate add-on parts that block air flow to the radiator. 2. Clean any debris from the radiator core. Does the engine still overheat?	Go to **Step 15**	System OK
15	Check for any blocked cooling system passages. Are there any blocked cooling system passages?	Go to **Step 16**	Go to **Step 17**
16	1. Remove any obstruction. 2. Flush the cooling system, as required. 3. Refill the coolant. Does the engine still overheat?	Go to **Step 17**	System OK
17	Check for an inoperative cooling fan. Is the cooling fan inoperative?	Go to **Step 18**	Go to **Step 19**

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Step	Action	Yes	No
18	Replace the cooling fan. Refer to **Fan Blade Replacement (L83 L86)**. Does the engine still overheat?	Go to **Step 19**	System OK
19	Check for a thermostat that is stuck closed. Is the thermostat stuck closed?	Go to **Step 20**	Go to **Step 21**
20	Replace the thermostat. Refer **Engine Coolant Thermostat Housing Replacement (L83, L86)Engine Coolant Thermostat Housing Replacement (L96)**. Does the engine still overheat?	Go to **Step 21**	System OK
21	Check for a faulty water pump. The impeller blades may be eroded or broken. Is the water pump faulty?	Go to **Step 22**	-
22	Replace the water pump. Refer to **Water Pump Replacement (L83, L86)Water Pump Replacement (L96)**. Does the engine still overheat?	-	System OK

LOSS OF COOLANT (L86 L83)

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 (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)Cooling System Draining and Filling (Vac N Fill L83 L86)Cooling System Draining and Filling (Static Fill L83 L86)**. Is the action complete?	Go to **Step 5**	-
5	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to **Step 19**	Go to **Step 6**

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Step	Action	Yes	No
6	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to **Step 7**	Go to **Step 8**
7	1. Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. 2. 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 20**	Go to **Step 8**
8	Visually inspect the hoses, pipes and hose clamps. Are any of the hoses, clamps or pipes leaking?	Go to **Step 21**	Go to **Step 9**
9	Visually inspect the following components: • Block heater • Coolant pressure cap • Core plugs • Throttle body • Engine block • Intake manifold • Radiator • Thermostat housing • Water pump Are any of the listed components leaking?	Go to **Step 21**	Go to **Step 10**
10	1. Pressure test the cooling system. Refer to **Cooling System Leak Testing (L96)Cooling System Leak Testing (L83, L86)**. 2. With the cooling system pressurized, visually inspect the components listed in steps 7 and 8.	Go to **Step 21**	Go to **Step 11**

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Step	Action	Yes	No
	Are any leaks present?		
11	Pressure test the coolant pressure cap. Refer to **Pressure Cap Testing**. Does the coolant pressure cap hold pressure?	Go to **Step 12**	Go to **Step 16**
12	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 21**	Go to **Step 13**
13	Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is there a milky substance under the oil fill cap?	Go to **Step 14**	Go to **Step 15**
14	Inspect the engine oil fluid level indicator for a gray/white milky substance. Is there a milky substance on the engine oil fluid level indicator?	Go to **Step 17**	Go to **Step 15**
15	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 18**	Go to **Step 22**
16	Replace the coolant pressure cap. Is the repair complete?	Go to **Step 22**	-
17	1. Replace the radiator. Refer to **Radiator Replacement (L83 L86)Radiator Replacement (L96)**. 2. Replace the oil and filter. Refer to **Engine Oil and Oil Filter Replacement** . Is the repair complete?	Go to **Step 22**	-
18	1. Replace the radiator. Refer to **Radiator Replacement (L83 L86)Radiator Replacement (L96)**. 2. Service the automatic transmission. Refer to the following: **Engine**	Go to **Step 22**	-

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Step	Action	Yes	No
	Coolant/Water in Transmission . Is the repair complete?		
19	Repair the engine overheating condition. Refer to Engine Overheating. Is the repair complete?	Go to **Step 22**	-
20	Repair the engine internal coolant leak. Refer to Coolant in Combustion Chamber , or, Coolant in Engine Oil . Is the repair complete?	Go to **Step 22**	-
21	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to **Step 22**	-
22	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

LOSS OF COOLANT (L96)

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 (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)Cooling System Draining and Filling (Vac N Fill L83 L86)Cooling System Draining and Filling (Static Fill L83 L86). Is the action complete?	Go to **Step 5**	-
5	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to **Step 19**	Go to **Step 6**
6	1. Idle the engine at normal operating temperature.	Go to **Step 7**	Go to **Step 8**

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Step	Action	Yes	No
	2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?		
7	1. Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. 2. 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 20**	Go to **Step 8**
8	Visually inspect the hoses, pipes and hose clamps. Are any of the hoses, clamps or pipes leaking?	Go to **Step 21**	Go to **Step 9**
9	Visually inspect the following components: • Block heater • Coolant pressure cap • Core plugs • Throttle body • Engine block • Intake manifold • Radiator • Thermostat housing • Water pump Are any of the listed components leaking?	Go to **Step 21**	Go to **Step 10**
10	1. Pressure test the cooling system. Refer to **Cooling System Leak Testing (L96)Cooling System Leak Testing (L83, L86)**. 2. With the cooling system pressurized, visually inspect the components listed in steps 7 and 8. Are any leaks present?	Go to **Step 21**	Go to **Step 11**

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Step	Action	Yes	No
11	Pressure test the coolant pressure cap. Refer to **Pressure Cap Testing**. Does the coolant pressure cap hold pressure?	Go to **Step 12**	Go to **Step 16**
12	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 21**	Go to **Step 13**
13	Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is there a milky substance under the oil fill cap?	Go to **Step 14**	Go to **Step 15**
14	Inspect the engine oil fluid level indicator for a gray/white milky substance. Is there a milky substance on the engine oil fluid level indicator?	Go to **Step 17**	Go to **Step 15**
15	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 18**	Go to **Step 22**
16	Replace the coolant pressure cap. Is the repair complete?	Go to **Step 22**	-
17	1. Replace the radiator. Refer to **Radiator Replacement (L83 L86)Radiator Replacement (L96)**. 2. Replace the oil and filter. Refer to **Engine Oil and Oil Filter Replacement** . Is the repair complete?	Go to **Step 22**	-

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Step	Action	Yes	No
18	1. Replace the radiator. Refer to **Radiator Replacement (L83 L86)Radiator Replacement (L96)**. 2. Service the automatic transmission. Refer to the following: **Engine Coolant/Water in Transmission** . Is the repair complete?	Go to **Step 22**	-
19	Repair the engine overheating condition. Refer to **Engine Overheating**. Is the repair complete?	Go to **Step 22**	-
20	Repair the engine internal coolant leak. Refer to **Coolant in Combustion Chamber** , or, **Coolant in Engine Oil** . Is the repair complete?	Go to **Step 22**	-
21	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to **Step 22**	-
22	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

THERMOSTAT DIAGNOSIS

Thermostat Test Procedure Using Glycol

Inspect the operation of the thermostat by hanging the thermostat on a hook in a 33 percent glycol solution.

In order to inspect if the thermostat valve is opening properly, perform the following test:

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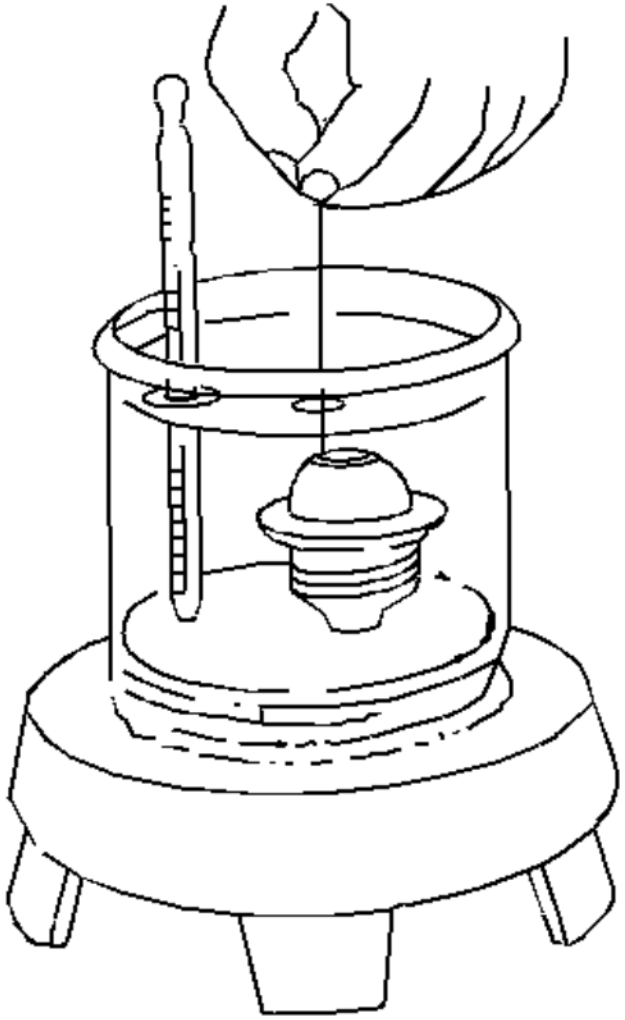


Fig. 2: View Of Thermostat Test Procedure Using Glycol
Courtesy of GENERAL MOTORS COMPANY

1. Completely submerge the thermostat in a glycol solution. The solution should be 11Â°C (22Â°F) above the temperature indicated on the thermostat valve.

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2. Thoroughly agitate the solution. Under these conditions, the thermostat valve should open.

In order to inspect if the thermostat valve is closing properly, perform the following test:

1. Completely submerge the thermostat in a glycol solution. The solution should be 6Â°C (10Â°F) below the temperature indicated on the thermostat valve.
2. Thoroughly agitate the solution. Under these conditions, the thermostat valve should close completely.

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

Step	Action	Yes	No
1	1. Ensure that the cooling system is full. 2. Allow the engine to cool. 3. Start the engine. 4. Turn the air conditioning system off. 5. Inspect the engine cooling fan(s). Is the electric cooling fan on?	Go to **Step 2**	Go to **Step 3**
2	1. Diagnose and repair the cooling fan system. Refer to **Cooling Fan Always On**. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to **Step 3**	System OK
3	Install the Scan Tool to the DLC. Compare the Scan Tool coolant temperature reading to the I/P cluster coolant temperature. Is the I/P cluster coolant temperature close to the reading on the Scan Tool?	Go to **Step 5**	Go to **Step 4**
4	1. Diagnose and repair the coolant temperature gauge system. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to **Step 5**	System OK
5	Inspect the thermostat for proper operation. Refer to **Thermostat Diagnosis**. Is the thermostat operating properly?	Go to **Step 1**	Go to **Step 6**

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Step	Action	Yes	No
6	1. Replace the thermostat. Refer to **Engine Coolant Thermostat Housing Replacement (L83, L86)Engine Coolant Thermostat Housing Replacement (L96)**. 2. Verify the customer complaint. Does the engine still fail to reach normal operating temperature?	Go to **Step 1**	System OK

PRESSURE CAP TESTING

Special Tools

- **EN-24460-A** Cooling System Pressure Tester
- **GE-42401-A** Radiator Cap / Surge Tank Test Adapter

For equivalent regional tools, Refer to **Special Tools**

Pressure Cap Testing

WARNING: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

1. Remove the pressure cap.
2. Wash the pressure cap sealing surface with water.

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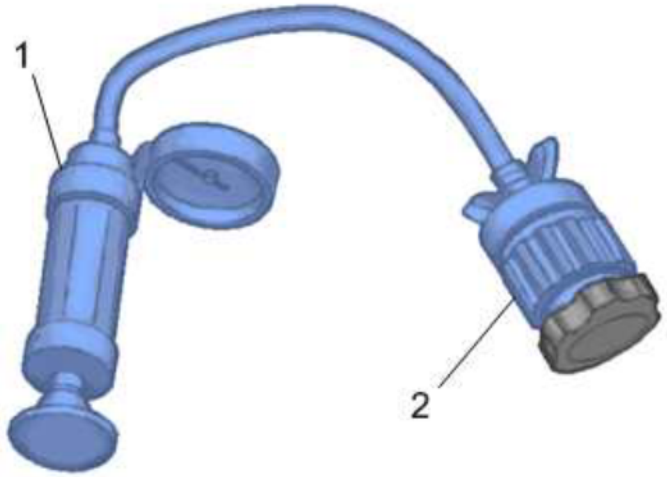


Fig. 3: Identifying Pressure Cap Tester
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Lubricate J-42401-1 and pressure cap o-rings with coolant and press cap to seat o-ring on J-42401-1 before turning to engage threads.**

3. Use the **EN-24460-A** Cooling System Pressure Tester (1) with **GE-42401-A** Radiator Cap / Surge Tank Test Adapter (2) in order to test the pressure cap.
4. Test the pressure cap for the following conditions:
   - Pressure release when the **EN-24460-A** Cooling System Pressure Tester exceeds the pressure rating of the pressure cap.
   - Maintain the rated pressure for at least 10 seconds.

     Note the rate of pressure loss.

5. Replace the pressure cap under the following conditions:
   - The pressure cap does not release pressure which exceeds the rated pressure of the cap.

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- The pressure cap does not hold the rated pressure.

COOLANT LEAK TESTING (L96)

Special Tools

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

For equivalent regional tools, refer to **Special Tools**.

WARNING: Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine, fenders, and the person removing the cap. Serious bodily injury may result. Flammable antifreeze, such as alcohol, is not recommended for use at any time. Flammable antifreeze could cause a serious fire.

WARNING: In order to help avoid being burned, do not remove the radiator cap while the engine and the radiator are hot. Scalding fluid and steam can be blown out under pressure if the cap is removed too soon.

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to **Pressure Cap Testing**.
3. Wash the pressure cap mating surface with water.

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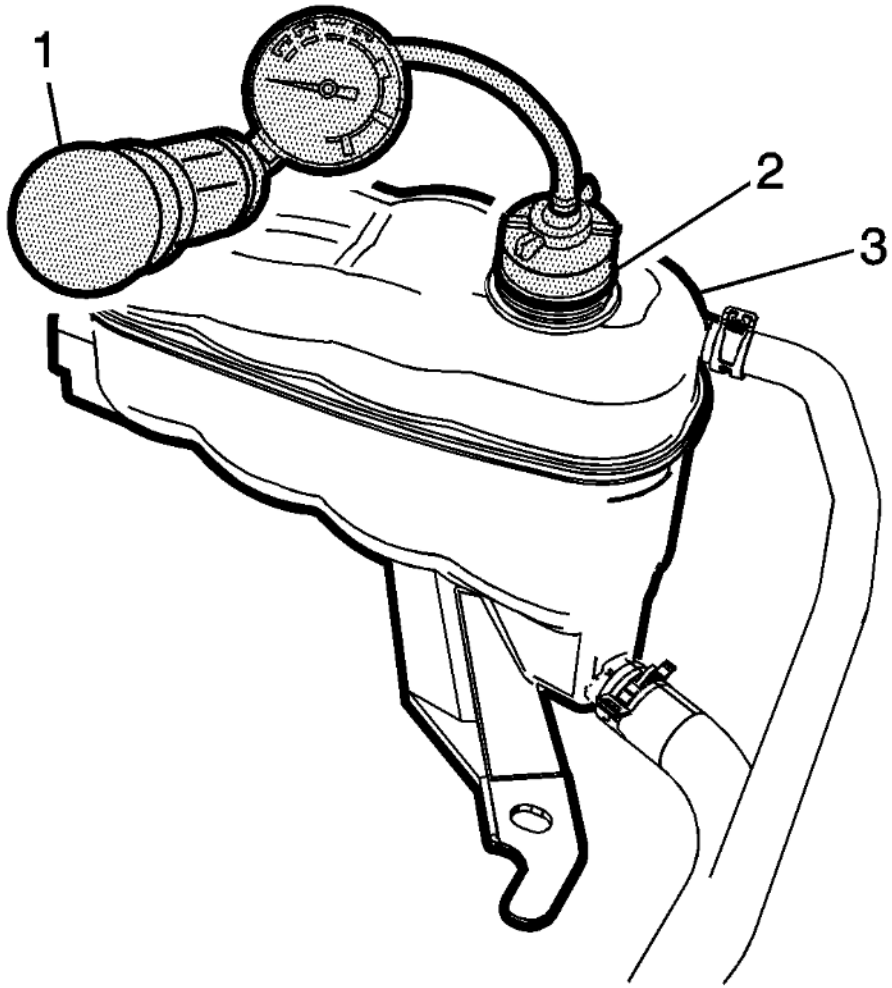


Fig. 4: Radiator Cap/Surge Tank Test Adapter
Courtesy of GENERAL MOTORS COMPANY

4. Use the **J-24460-01** cooling system pressure tester (1) with the **J-42401** radiator cap/surge tank test adapter (2) in order to apply pressure to the cooling system.

   Do not exceed the pressure cap rating.

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5. The cooling system should hold the rated pressure for at least 2 minutes.

   Observe the gauge for any pressure loss.

6. Repair any leaks as required.

COOLANT LEAK TESTING (L83, L86)

Special Tools

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

For equivalent regional tools, refer to **Special Tools**.

WARNING: Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine, fenders, and the person removing the cap. Serious bodily injury may result. Flammable antifreeze, such as alcohol, is not recommended for use at any time. Flammable antifreeze could cause a serious fire.

WARNING: In order to help avoid being burned, do not remove the radiator cap while the engine and the radiator are hot. Scalding fluid and steam can be blown out under pressure if the cap is removed too soon.

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to **Pressure Cap Testing**.
3. Wash the pressure cap mating surface with water.

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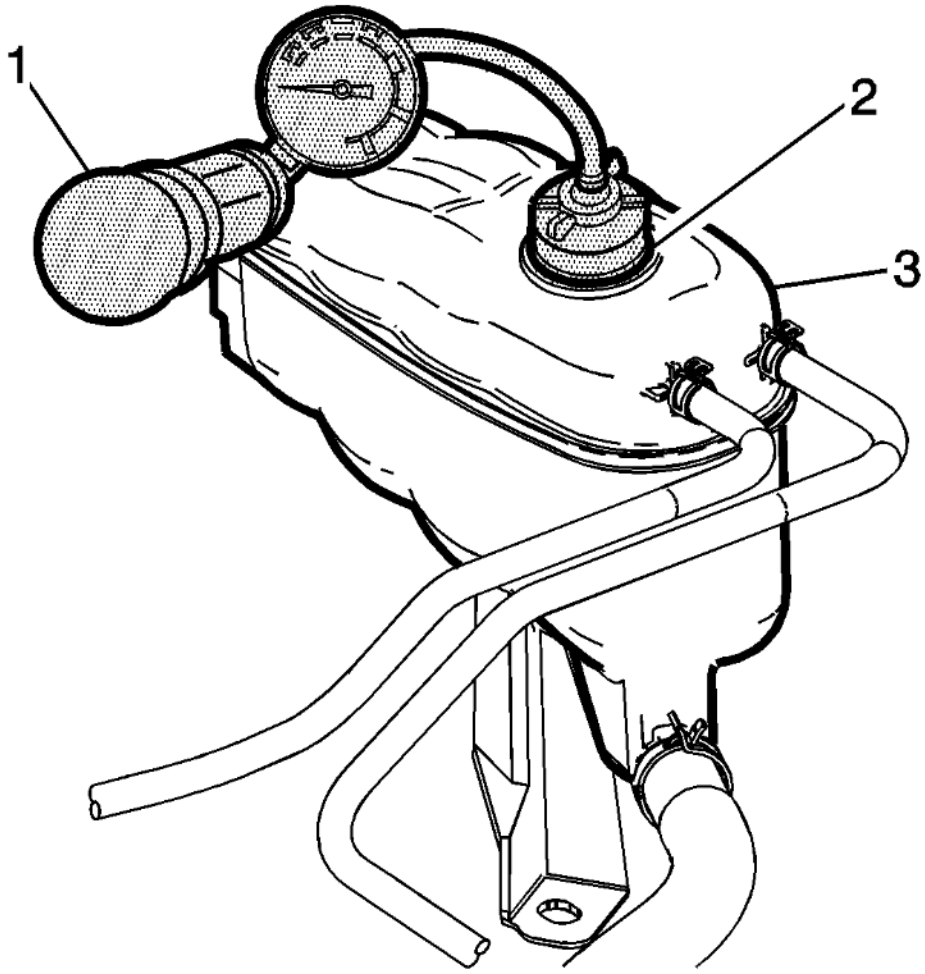


Fig. 5: Cooling System Pressure Tester
Courtesy of GENERAL MOTORS COMPANY

4. Use the **J-24460-01** cooling system pressure tester (1) with the **J-42401** radiator cap/surge tank test adapter (2) in order to apply pressure to the cooling system.

   Do not exceed the pressure cap rating.

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5. The cooling system should hold the rated pressure for at least 2 minutes.

   Observe the gauge for any pressure loss.

6. Repair any leaks as required.

REPAIR INSTRUCTIONS

HOSE CLAMP REPLACEMENT GUIDELINES - SPRING TYPE

Special Tools

- **BO-38185** Hose Clamp Pliers
- **GE-47622** Hose Clamp Pliers.

Equivalent regional tools:**Special Tools**

Spring Type Hose Clamp Replacement Guidelines



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Fig. 6: Spring Type Hose Clamps
Courtesy of GENERAL MOTORS COMPANY

Vehicles utilize spring type hose clamps (1) to secure joints in which fluids, gases, or engine vacuum can travel to various vehicle systems. Spring type hose clamps are engineered to provide the proper amount of tension to maintain a leak & maintenance free joint for the life of the vehicle.

Spring type hose clamps have a special coating applied to the exterior of the clamp that is engineered to resist rust/corrosion, improve durability and increase the life of the hose clamp. If the coating is damaged, rust/corrosion could form resulting in the need to replace the hose clamp.

Many spring type hose clamps within GM utilize a small amount of adhesive placed directly on the hose clamp to secure the clamp to the mating hose for manufacturing purposes. Over time the strength of the adhesive will deteriorate. It is extremely important when a technician is attempting to service a joint or remove the hose clamp, that the clamp is not rotated or repositioned so that is tears and/or damages the hose. In this case, the hose and clamp must both be replaced.

When repairing a vehicle it is very important to observe the condition of both the hose and the spring type hose clamp as well as the orientation of the clamp to the hose.

If the spring type hose clamp(s) have any of the following conditions on any area of the clamp, replace the clamp(s) immediately.

- Rust/Corrosion
- Cracks
- Physical damage
- Leakage attributed to the retention of the clamp

Removing The Spring Type Hose Clamp

While keeping the hose stationary, use BO-38185 Hose Clamp Pliers or GE-47622 Hose Clamp Pliers and release the spring type hose clamp tension while attempting to separate the hose clamp from the hose.

- If the spring type hose clamp will not easily separate from the hose and/or the clamp tears or damages the hose, both the hose and hose clamp must be replaced
- If the spring type hose clamp is easily removed from the hose, the clamp can be reused provided that the clamp does not have any of the conditions as noted above.

If The Spring Type Hose Clamp Is Being Reused

It is extremely important that the spring type hose clamp is orientated to the hose in the exact same position as it was installed during vehicle

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assembly so that the hose clamp is not damaged or the hose clamp does not contact or damage any adjacent components. Do not use any type of adhesive on the hose clamp prior to installation.

When Reusing The Spring Type Hose Clamp and Replacing The Hose

- The inside and outside hose diameter must be identical between the new hose and the existing hose to guarantee proper hose clamp tension and joint integrity.
- Always place the existing spring type hose clamp in the same orientation as it was positioned prior to separating the joint. The new hose might have a marking on the hose indicating the correct position of a hose clamp, which should re-confirm the correct hose clamp position. The hose clamp should not contact any adjacent components after installation.

When Reusing The Spring Type Hose Clamp with an Existing Hose

Always place the existing spring type hose clamp in the same orientation as it was positioned prior to separating the joint. The existing hose might have an indentation or compression mark on the hose from where the hose clamp was installed previously. The hose clamp should identically overlay this position. The existing hose might also have a marking on the hose indicating the correct position of the hose clamp, which should re-confirm the correct hose clamp position. The hose clamp should not contact any adjacent components after installation.

If The Spring Type Hose Clamp Is Being Replaced

If the hose clamp needs to be replaced, always replace the hose as part of the service repair. It is extremely important that a new spring type hose clamp is orientated to the hose in the exact same position as it was installed during vehicle assembly so that the hose clamp is not damaged or the hose clamp does not contact or damage any adjacent components. Do not use any type of adhesive on the hose clamp prior to installation.

When Replacing The Spring Type Hose Clamp and Replacing The Hose

- The inside and outside hose diameter must be identical between the new hose and the existing hose to guarantee proper hose clamp tension and joint integrity.
- Always place the new spring type hose clamp in the same orientation as it was positioned prior to separating the joint. The new hose might have a marking on the hose indicating the correct position of a hose clamp, which should re-confirm the correct hose clamp position. The hose clamp should not contact any adjacent components after installation.

When Replacing The Spring Type Hose Clamp with an Existing Hose

Always place the new spring type hose clamp in the same orientation as it was positioned prior to separating the joint. The existing hose might have an indentation or compression mark on the hose from where a hose clamp was installed previously. The hose clamp should identically overlay this position. The existing hose might also have a marking on the hose indicating the correct position of the hose clamp, which should re-confirm the

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correct hose clamp position. The hose clamp should not contact any adjacent components after installation.

COOLING SYSTEM DRAINING AND FILLING (STATIC FILL L96)

Special Tools

- **J-26568** Coolant and Battery Tester
- **J-38185** Hose Clamp Pliers

Draining Procedure

WARNING: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

1. Follow the steps below in order to remove the surge tank fill cap:
    1. Slowly rotate the cap counterclockwise.
    2. Stop rotating and allow the hissing to stop.
    3. After all the hissing stops, continue turning counterclockwise in order to remove the cap.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Place a drain pan under the lower radiator hose and/or drain cock.
4. Reposition the lower radiator hose and/or drain cock from the radiator.
5. Drain the cooling system.

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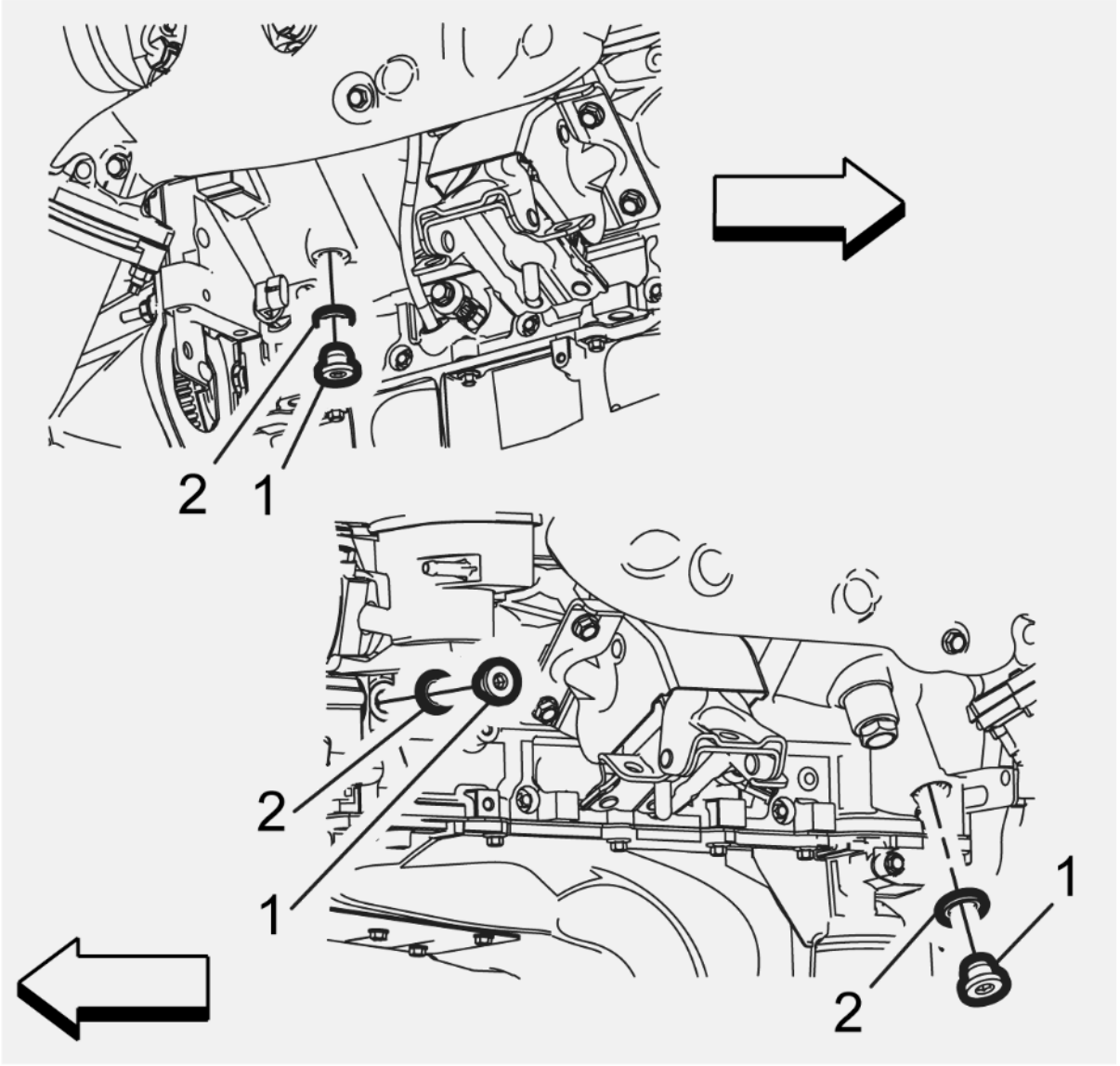


Fig. 7: Engine Block Coolant Drain Hole Plugs
Courtesy of GENERAL MOTORS COMPANY

6. If a complete engine block drain is required, remove the left and right engine block coolant drain hole plugs (1) and engine block coolant drain hole plug gaskets (2).
7. Inspect the coolant.

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8. 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**.

Filling Procedure

CAUTION: The procedure below must be followed. Improper coolant level could result in a low or high coolant level condition, causing engine damage.

1. Install the lower radiator hose and/or drain cock to the radiator.

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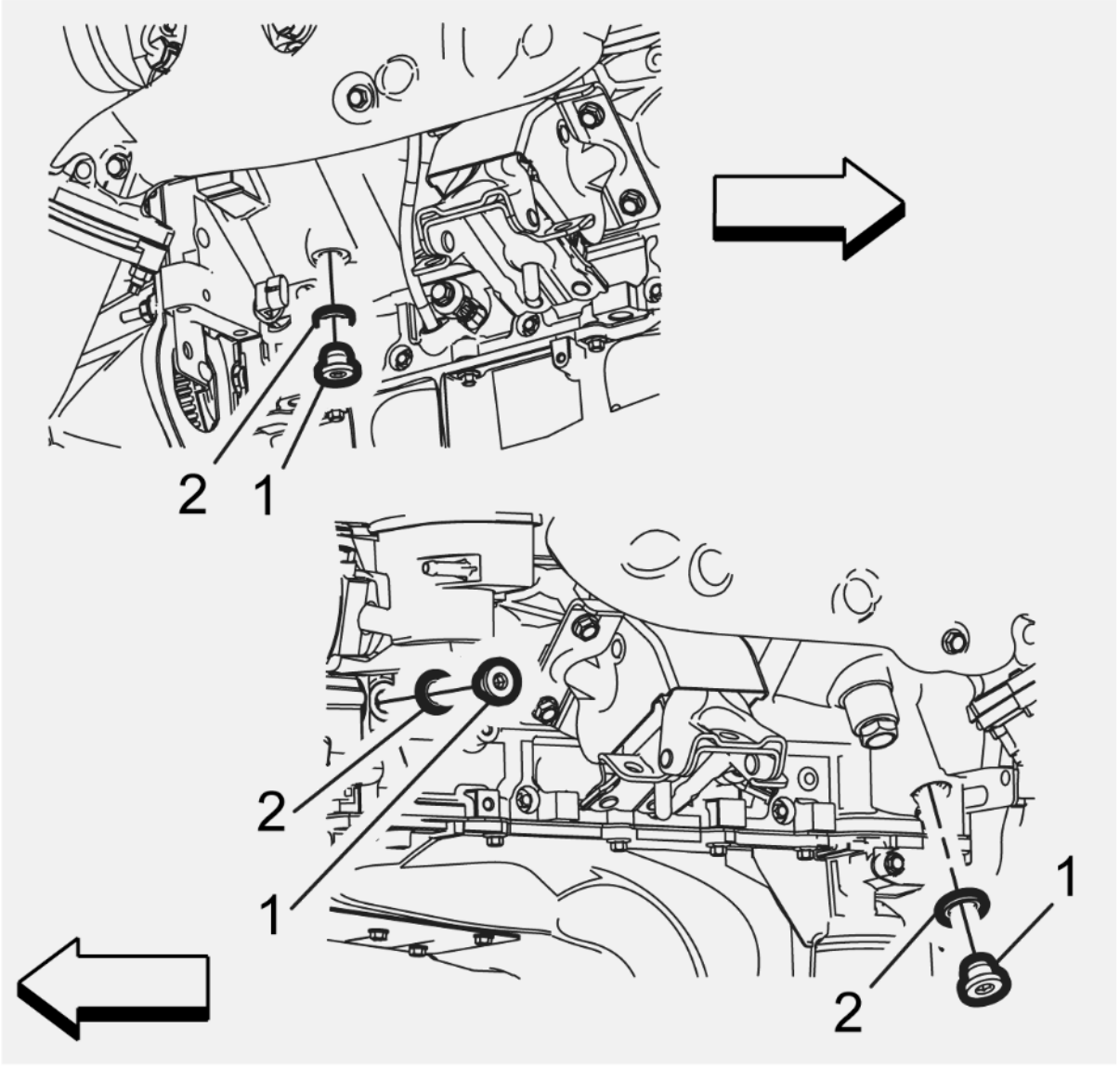


Fig. 8: Engine Block Coolant Drain Hole Plugs
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

2. If the left and right engine block coolant drain hole plugs (1) and engine block coolant drain hole plug gaskets (2) were removed, install the

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engine block coolant drain hole plugs (1) and engine block coolant drain hole plug gaskets (2). Refer to **Engine Block Plug Installation** .

3. Lower the vehicle.

NOTE: **Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water.**

4. Slowly fill the cooling system with a 50/50 coolant mixture. Refer to **Approximate Fluid Capacities**.
5. Install the coolant pressure cap.
6. Start the engine.
7. Run the engine at 2, 000-2, 500 RPM until the engine reaches normal operating temperature.

   Engine should reach an operating temperature of 90Â°C (194Â°F) and the upper radiator hose should be HOT.

8. Allow the engine to idle for 3 minutes.
9. Shut the engine OFF.
10. Allow the engine to cool.
11. Top off the coolant as necessary.
12. Inspect the concentration of the engine coolant using the **J-26568** coolant and battery tester.
13. Rinse away any excess coolant from the engine and the engine compartment.

COOLING SYSTEM DRAINING AND FILLING (VAC N FILL L96)

Special Tools

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

Draining Procedure

WARNING: **With a pressurized cooling system, the coolant temperature in the radiator can be considerably higher than the boiling point of the solution at atmospheric pressure. Removal of the surge tank cap, while the cooling system is hot and under high pressure, causes the solution to boil instantaneously with explosive force. This will cause the solution to spew out over the engine, the fenders, and the person removing the cap. Serious bodily injury may result.**

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1. Park the vehicle on a level surface.
2. Remove the coolant pressure cap.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Place a drain pan under the drain cock and/or lower radiator hose.
5. Reposition the radiator drain cock and/or lower radiator hose.
6. Drain the cooling system.

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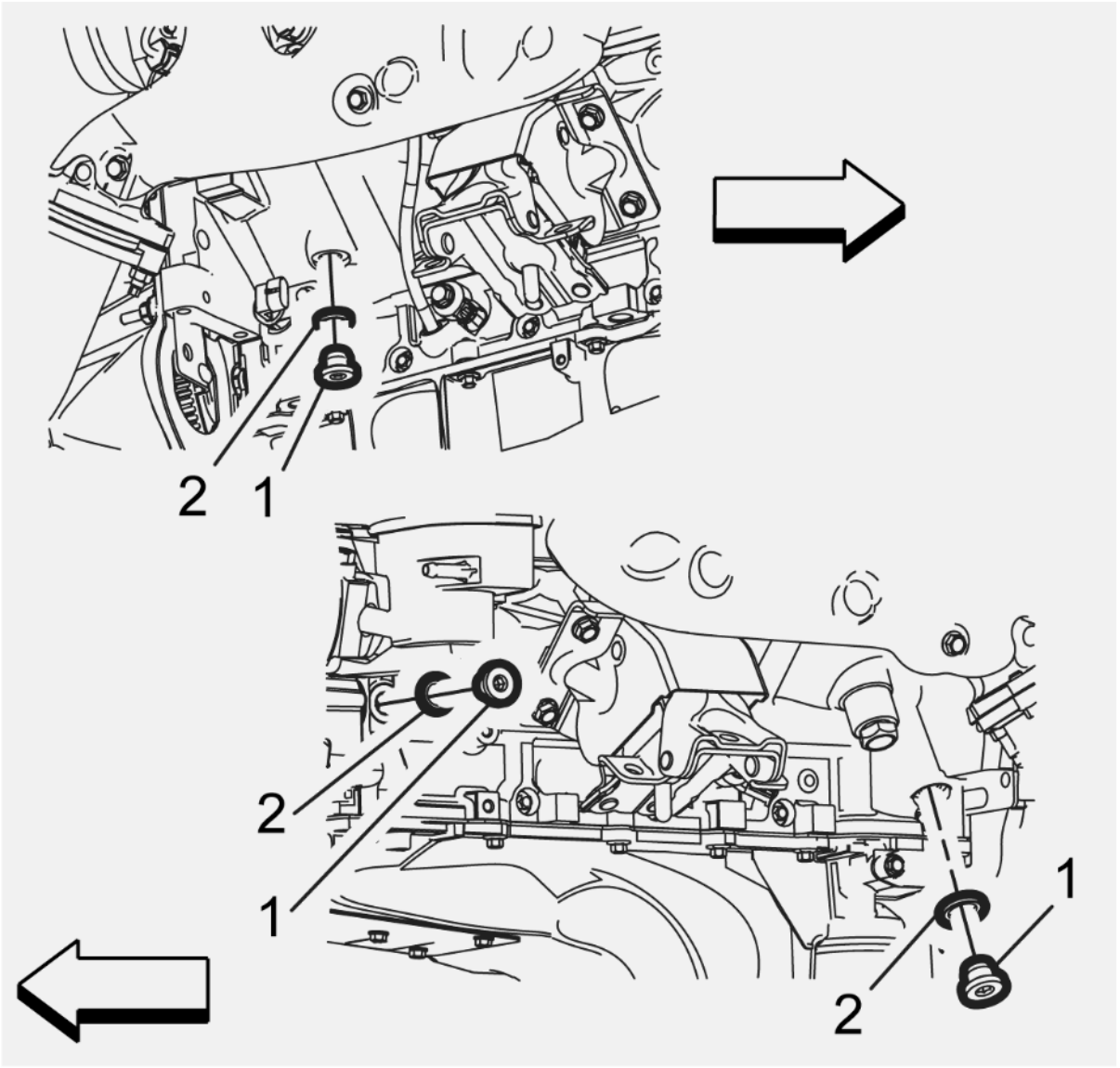


Fig. 9: Engine Block Coolant Drain Hole Plugs
Courtesy of GENERAL MOTORS COMPANY

7. If a complete engine block drain is required, remove the left and right engine block coolant drain hole plugs (1) and engine block coolant drain hole plug gaskets (2).
8. Inspect the coolant.

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9. 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

NOTE: **To prevent boiling of the coolant/water mixture in the vehicles cooling system, do not apply vacuum to a cooling system above 49Â°C (120Â°F). The tool will not operate properly when the coolant is boiling.**

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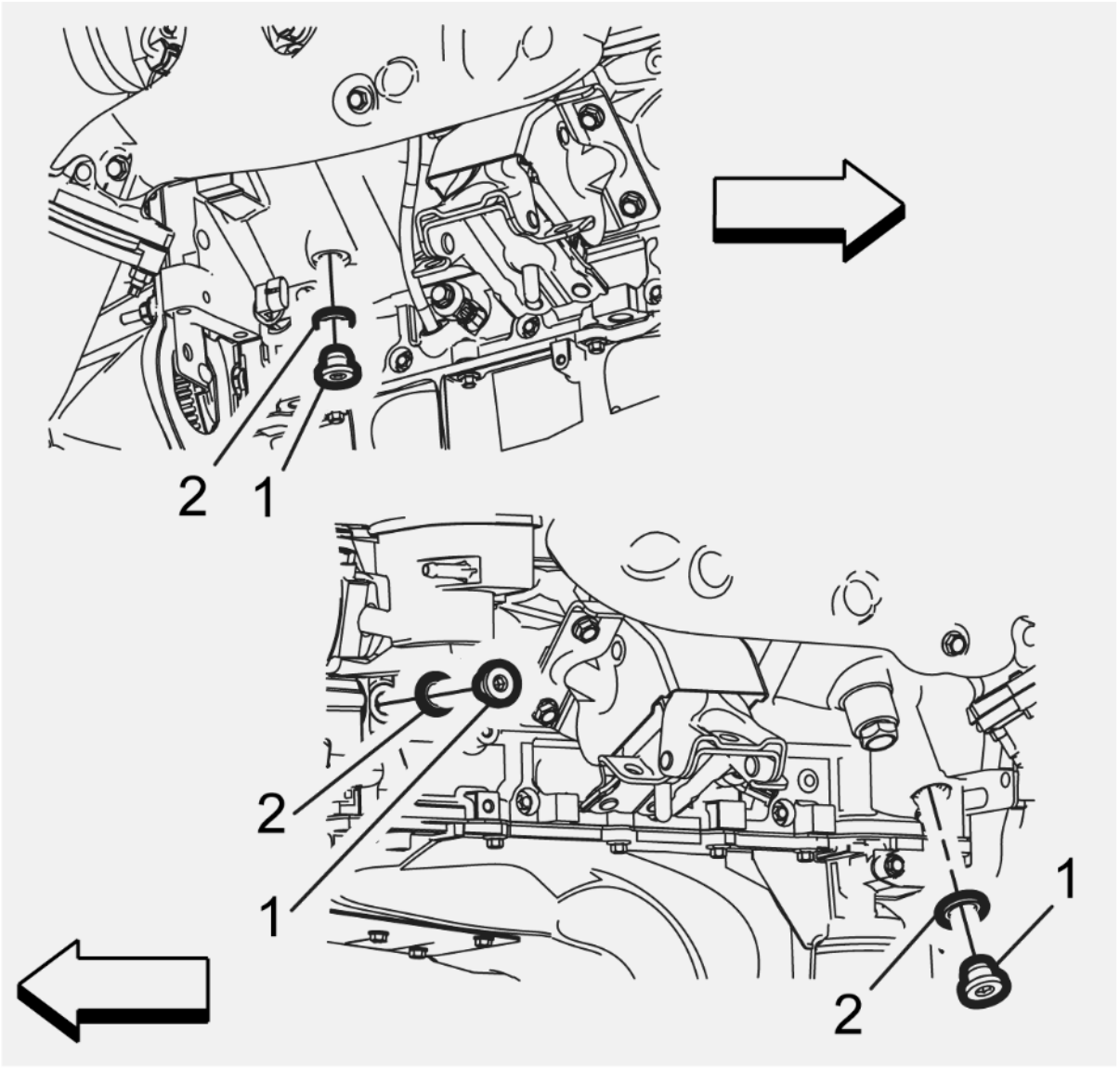


Fig. 10: Engine Block Coolant Drain Hole Plugs
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

1. If the left and right engine block coolant drain hole plugs (1) and engine block coolant drain hole plug gaskets (2) were removed, install the

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engine block coolant drain hole plugs (1) and engine block coolant drain hole plug gaskets (2). Refer to **Engine Block Plug Installation** .

2. Install the **J-42401** radiator cap and surge tank test adapter.

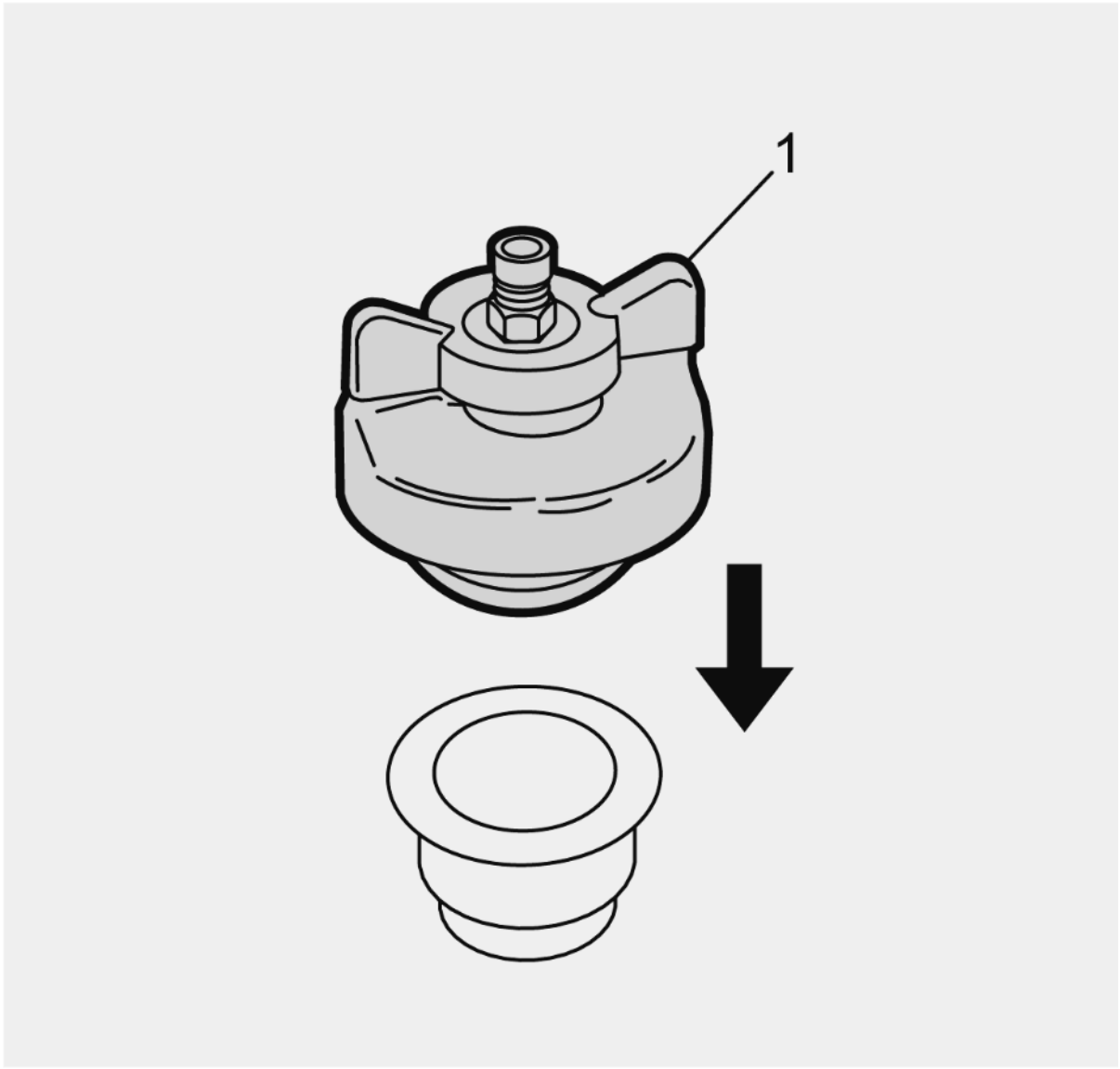


Fig. 11: Radiator Cap & Surge Tank Test Adapter
Courtesy of GENERAL MOTORS COMPANY

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3. Attach the Vac-N-Fill cap (1) to the vehicles coolant fill port.

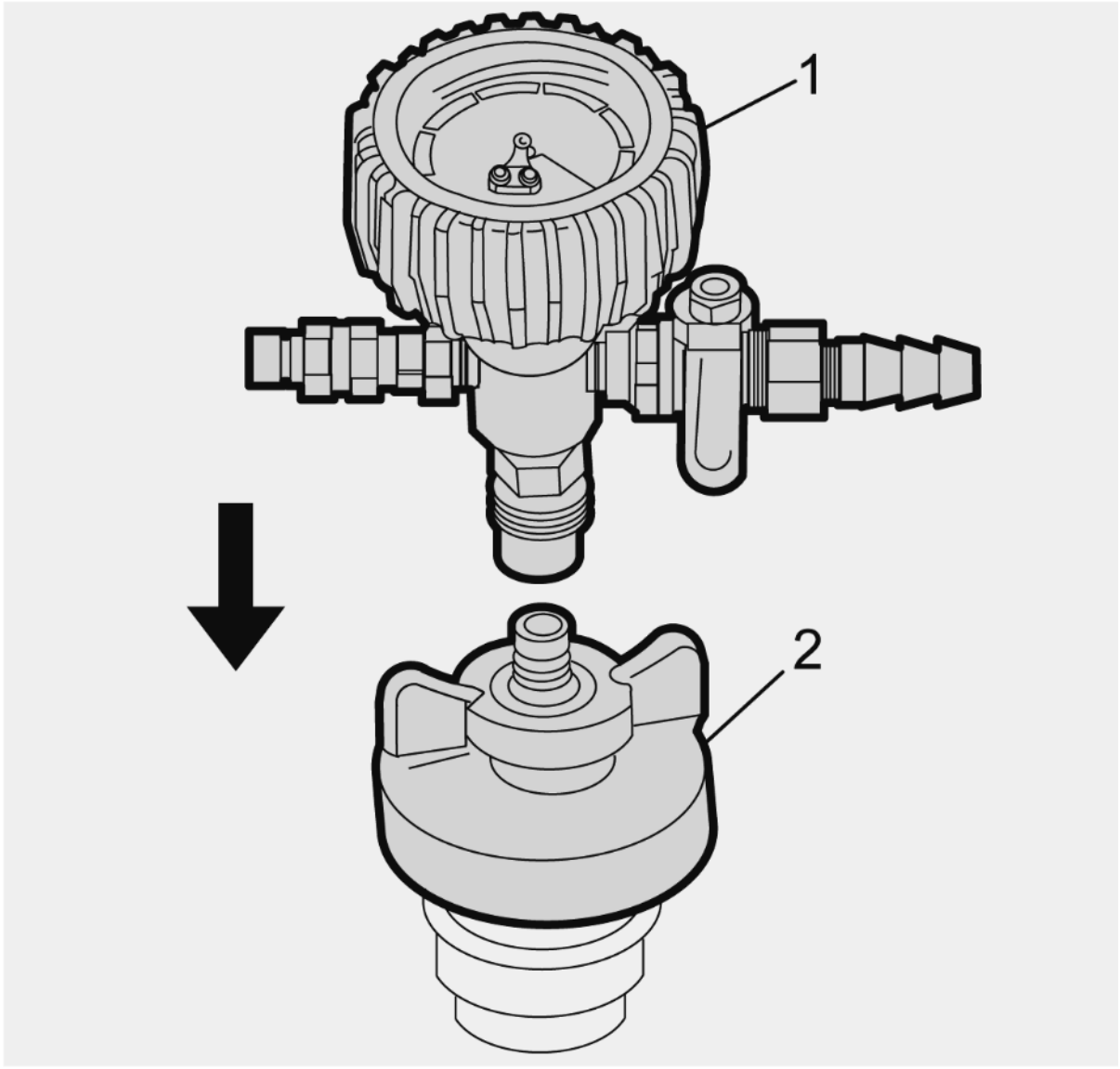


Fig. 12: Vacuum Gauge Assembly & Vac N Fill Cap
Courtesy of GENERAL MOTORS COMPANY

4. Attach the vacuum gauge assembly (1) to the Vac-N-Fill cap (2).

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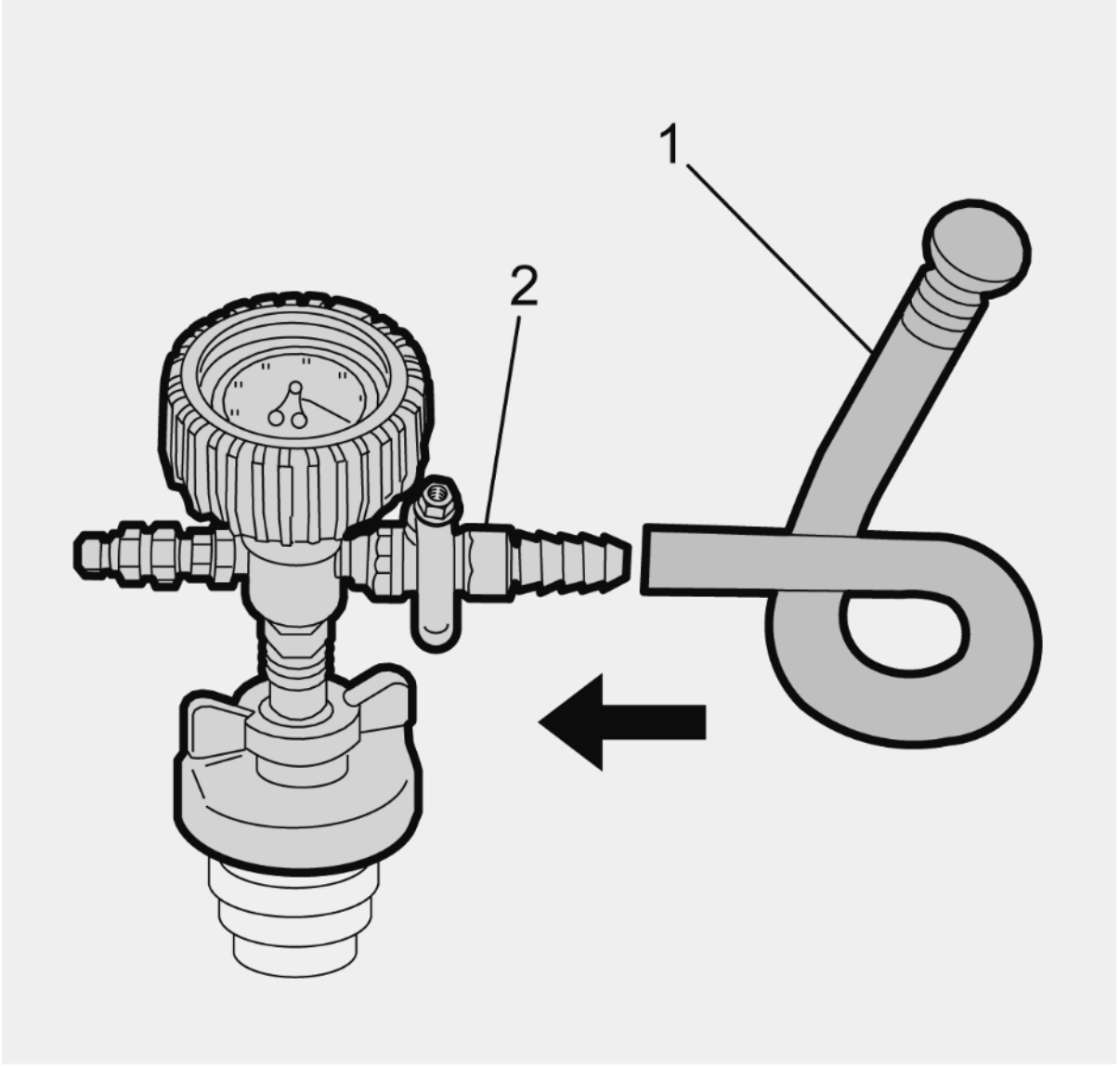


Fig. 13: Vacuum Gauge Assembly & Fill Hose
Courtesy of GENERAL MOTORS COMPANY

5. Attach the fill hose (1) to the barb fitting on the vacuum gauge assembly (2).

   Ensure that the valve is closed.

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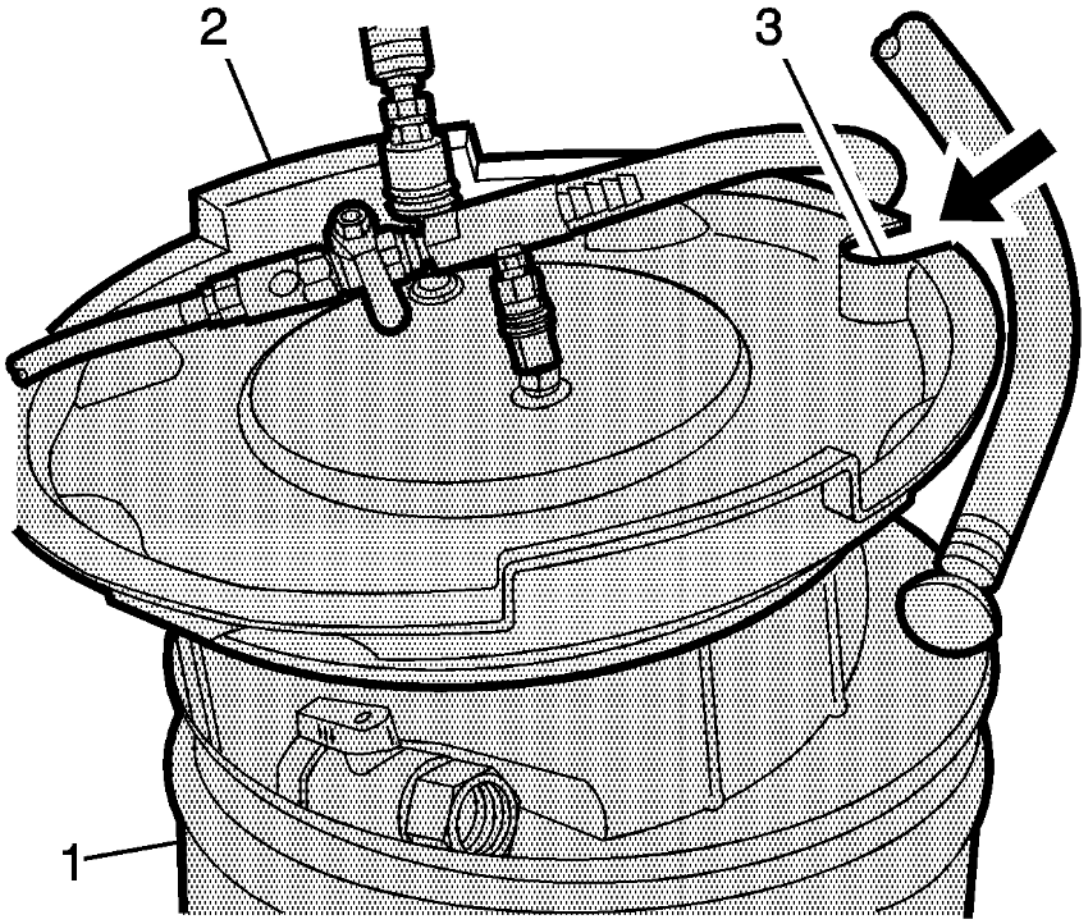


Fig. 14: Graduated Reservoir, Vacuum Tank & Cut-Out Area
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water.**

Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.

6. Pour the coolant mixture into the graduated reservoir (1).

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7. Place the fill hose in the graduated reservoir (1).

NOTE: **Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.**

8. Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.

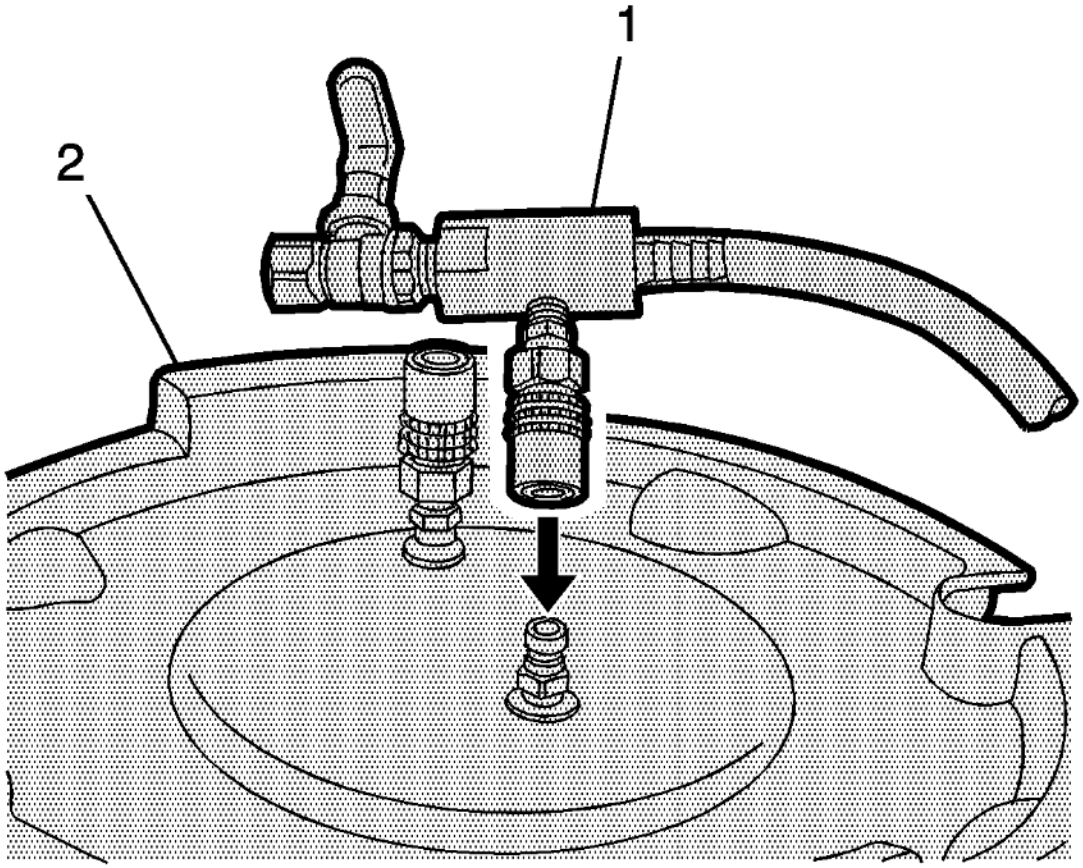


Fig. 15: Vacuum Tank & Venturi Assembly

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Courtesy of GENERAL MOTORS COMPANY

9. Attach the venturi assembly (1) to the vacuum tank (2).

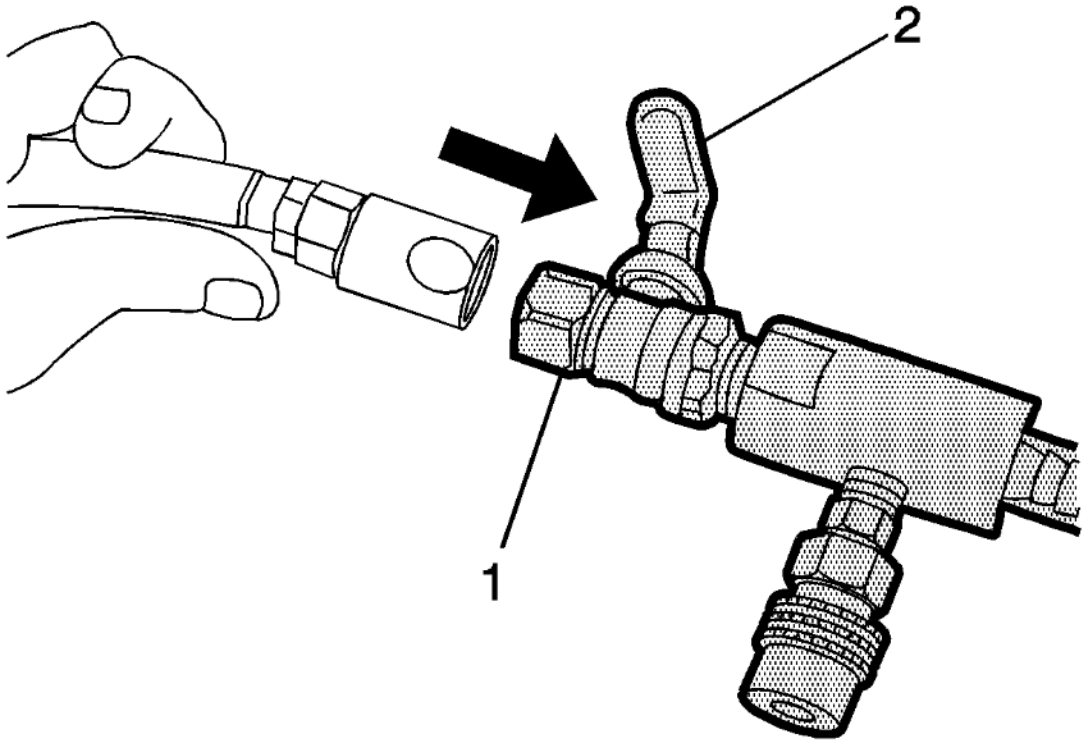


Fig. 16: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

10. Attach a shop air hose to the venturi assembly (1).

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Ensure the valve (2) on the venturi assembly is closed.

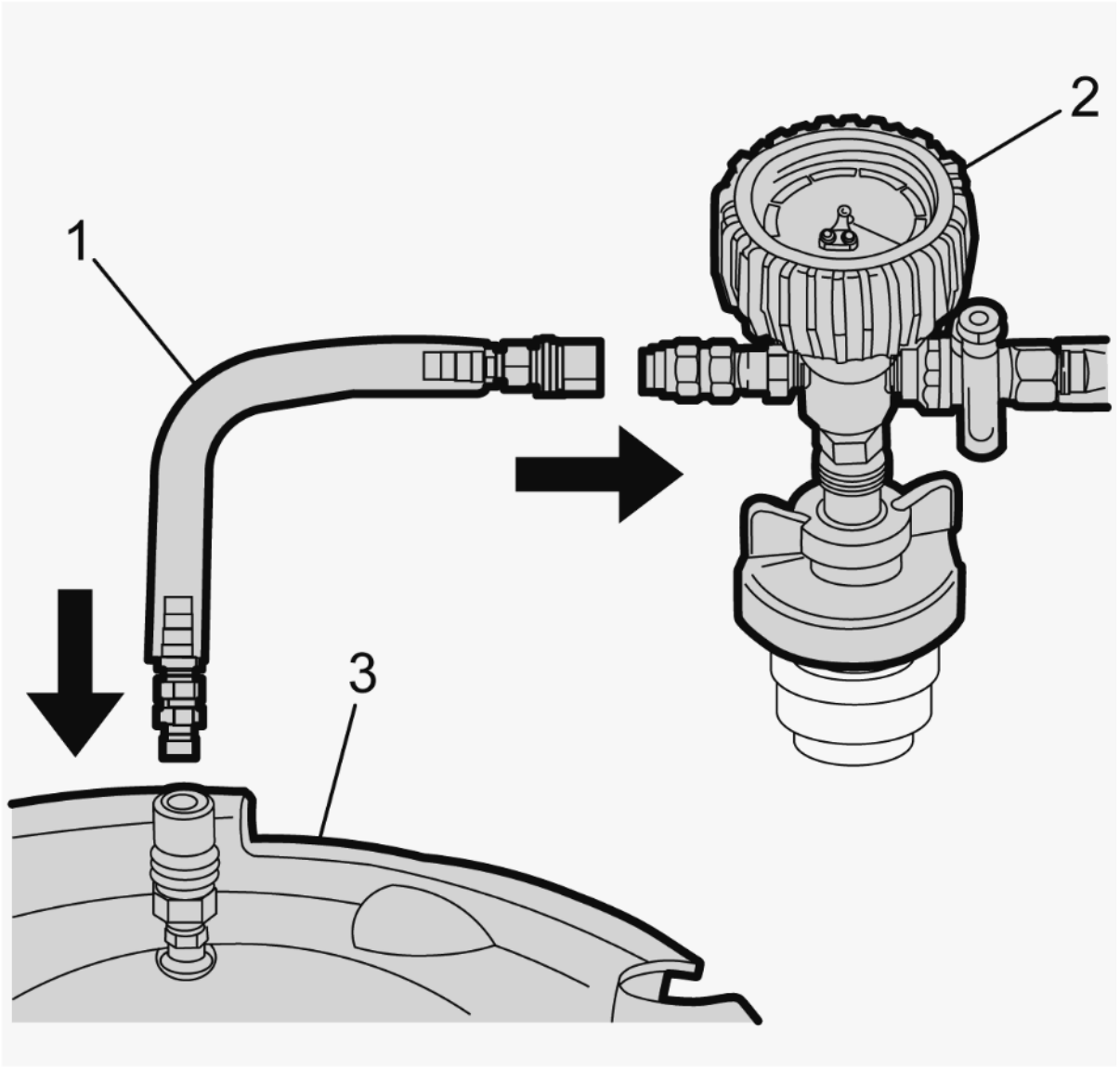


Fig. 17: Vacuum Hose, Gauge Assembly & Tank
Courtesy of GENERAL MOTORS COMPANY

11. Attach the vacuum hose (1) to the vacuum gauge assembly (2) and the vacuum tank (3).

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12. Clamp off the overflow hose.

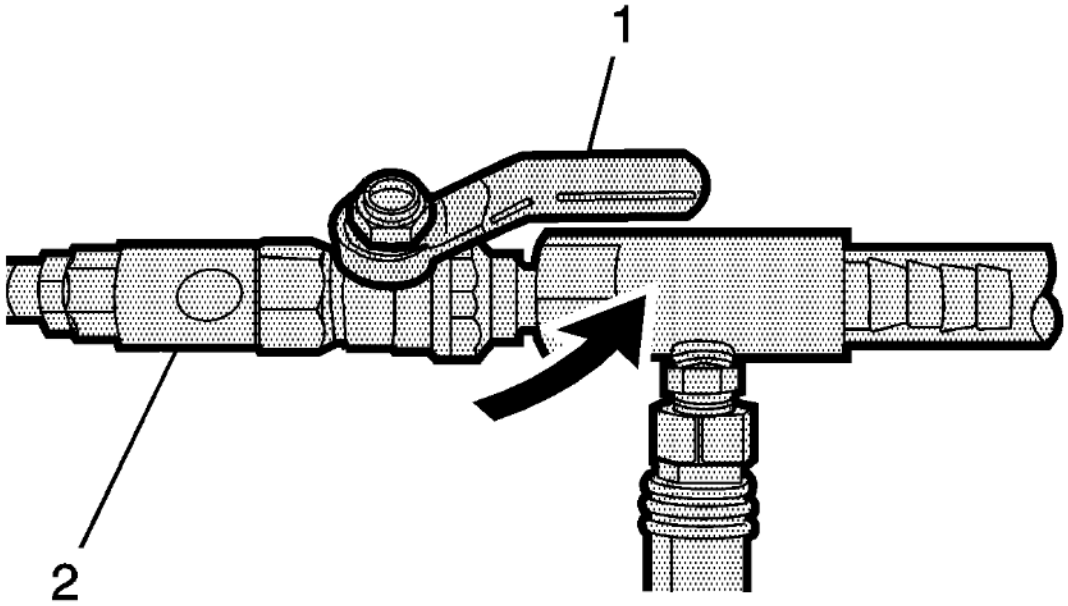


Fig. 18: Valve & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

13. Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present.

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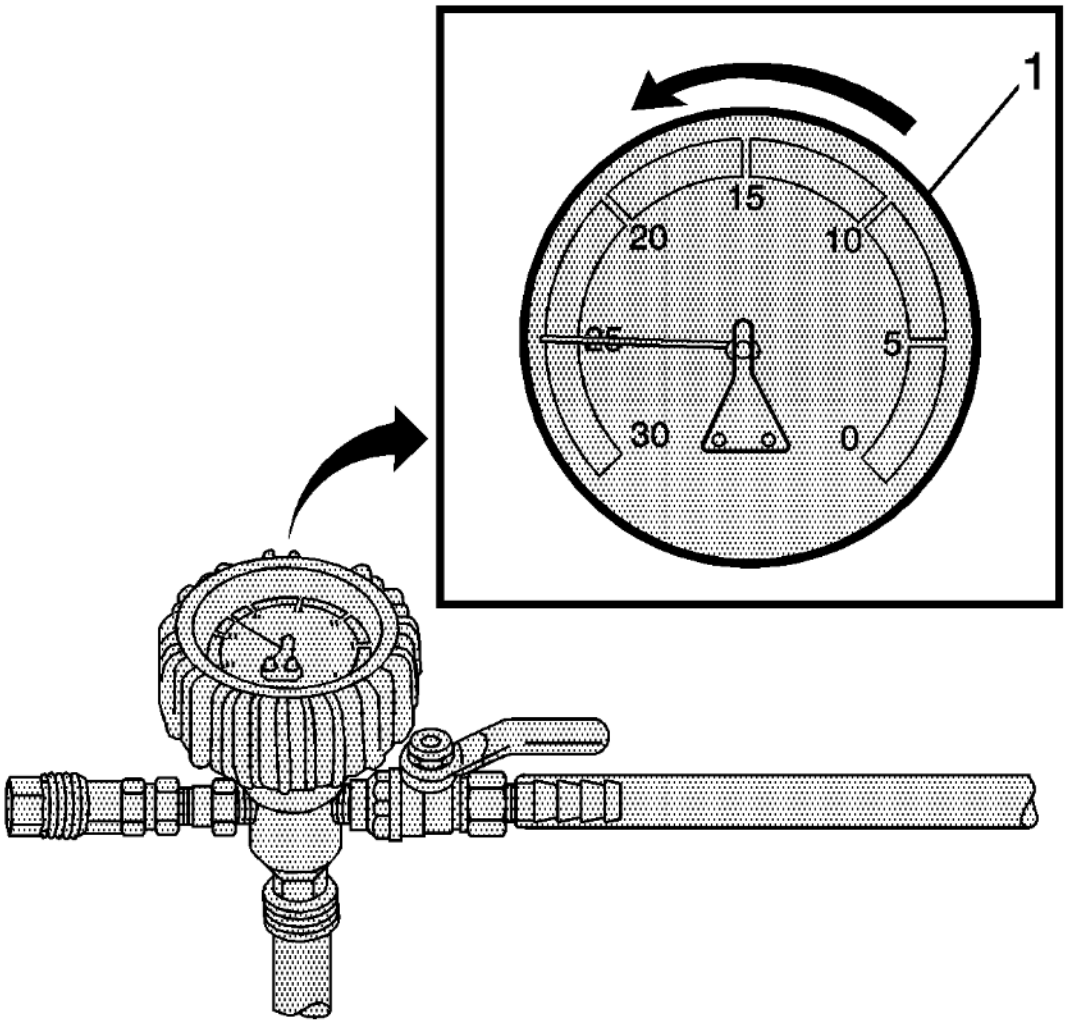


Fig. 19: Vacuum Gauge Needle
Courtesy of GENERAL MOTORS COMPANY

14. 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.

15. To aid in the fill process, position the graduated reservoir above the coolant fill port.

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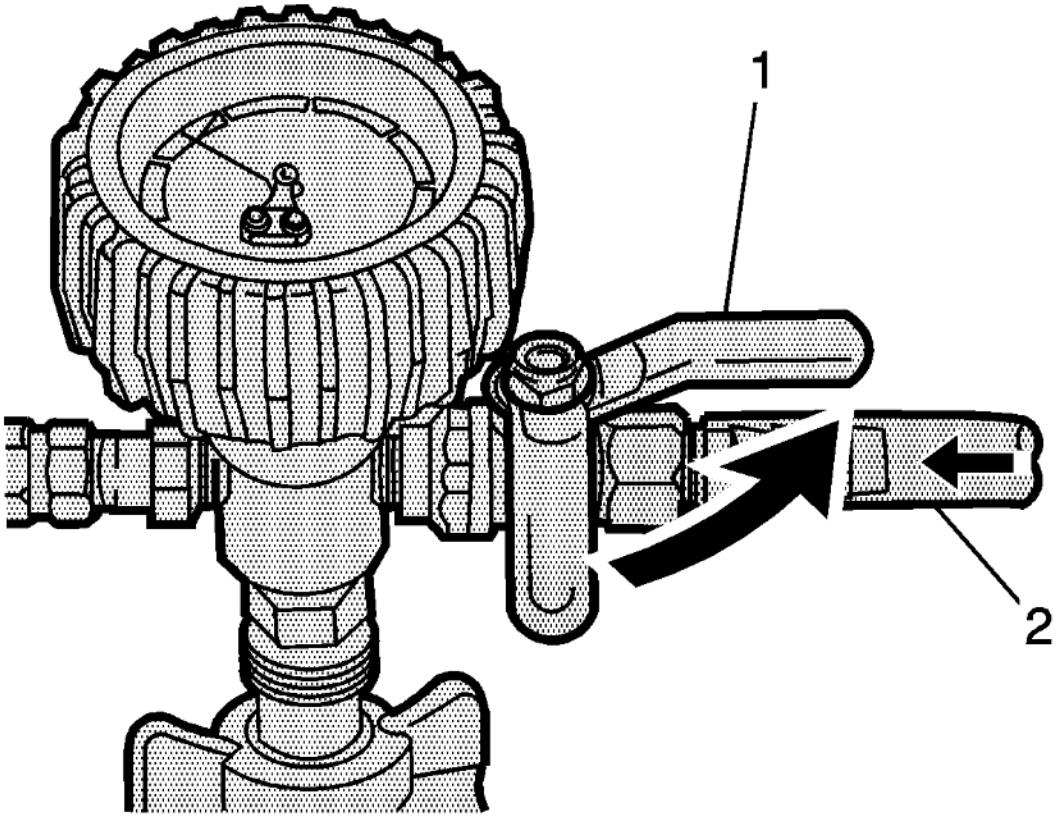


Fig. 20: Vacuum Gauge Assembly & Needle
Courtesy of GENERAL MOTORS COMPANY

16. 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.
17. Close the valve on the venture assembly.
18. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss.

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If vacuum loss is observed, refer to **Loss of Coolant (L86 L83)Loss of Coolant (L96)**.

19. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.

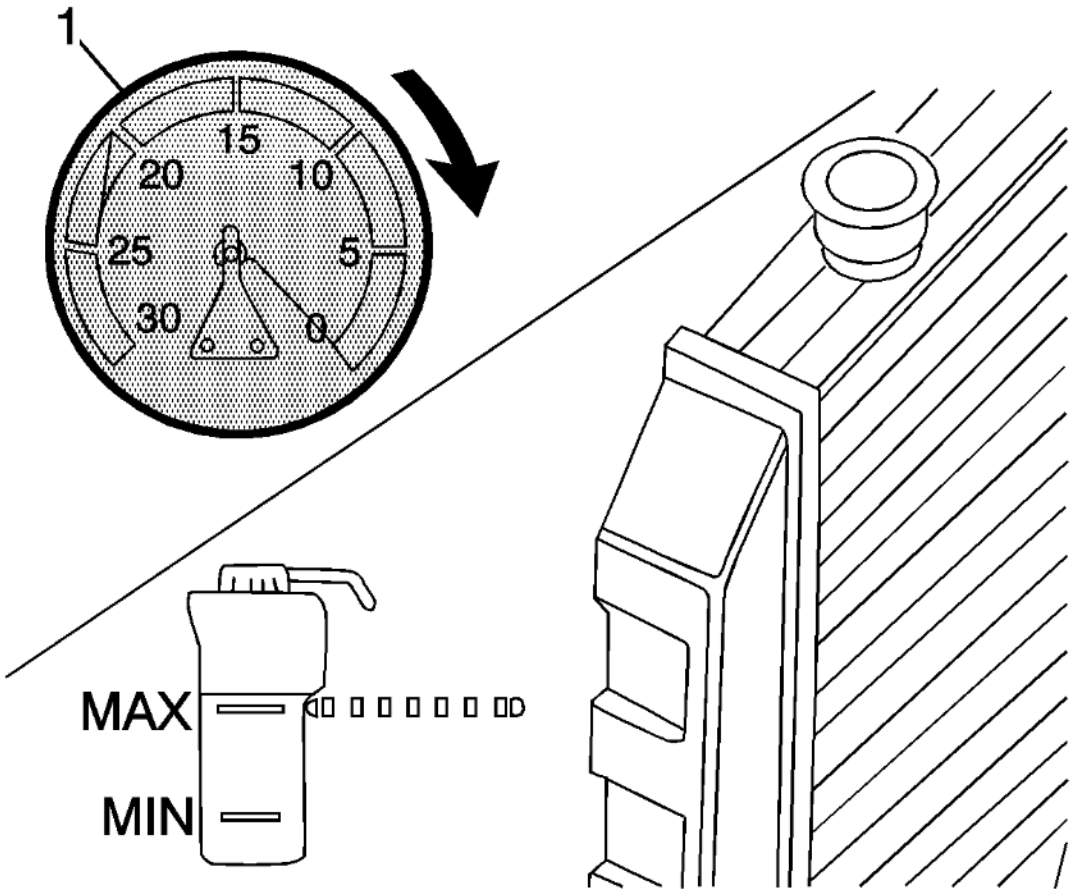


Fig. 21: Vacuum Gauge At Zero
Courtesy of GENERAL MOTORS COMPANY

20. Once the vacuum gauge reaches zero (1), close the valve on the vacuum gauge assembly and repeat steps 11-17.

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21. Remove the **J-42401** radiator cap and surge tank test adapter.
22. Detach the Vac-N-Fill cap from the vehicles coolant fill port.
23. Add coolant to the system as necessary.
24. Inspect the concentration of the coolant mixture using **J-26568** coolant and battery tester.

NOTE: **After filling the cooling system, the extraction hose can be used to remove excess coolant to achieve the proper coolant level.**

25. Detach the vacuum hose form the vacuum gauge assembly.

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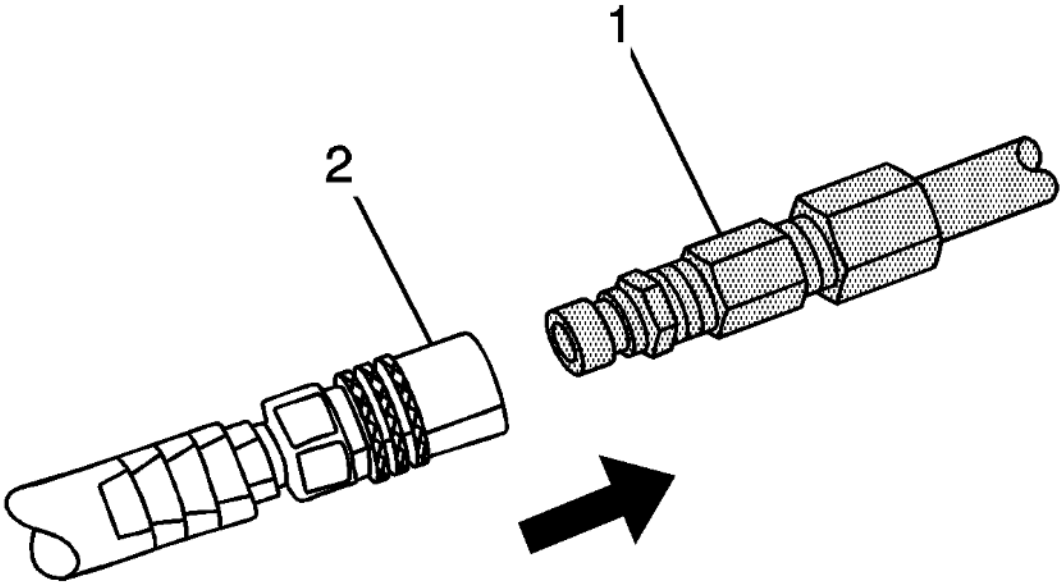


Fig. 22: Vacuum Hose & Extraction Hose
Courtesy of GENERAL MOTORS COMPANY

26. Attach the extraction hose (1) to the vacuum hose (2).

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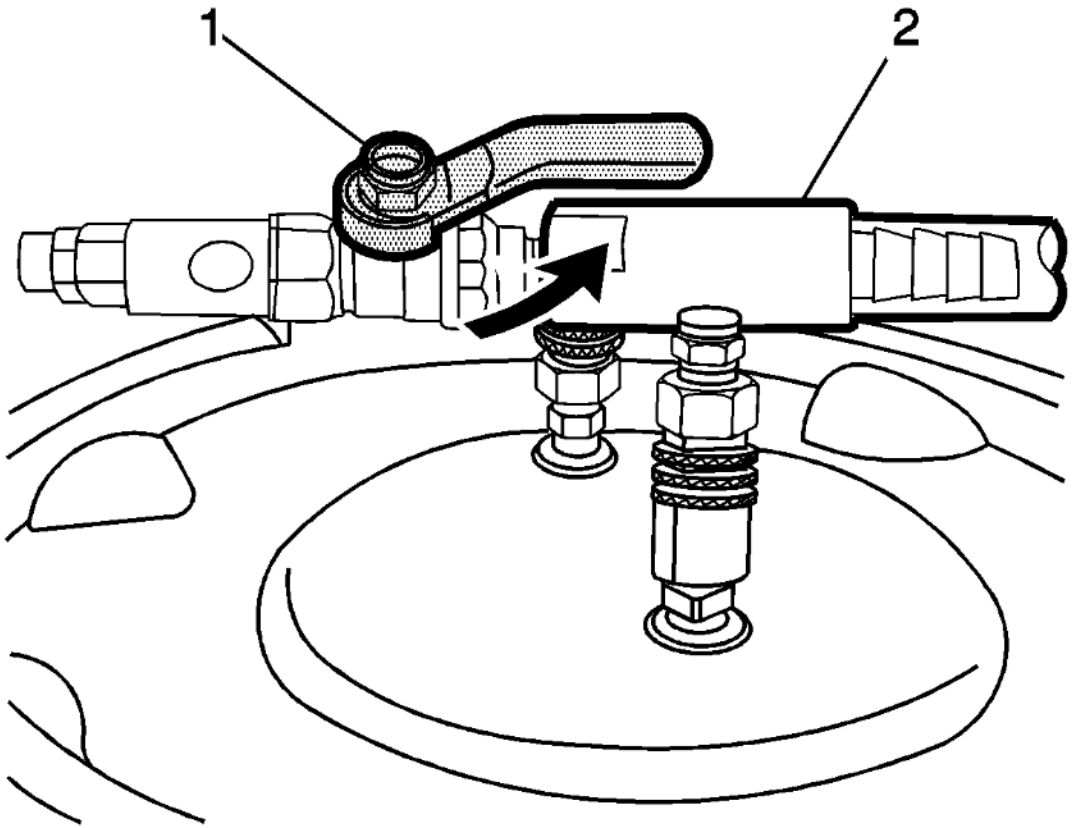


Fig. 23: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

27. Open the valve (1) on the venturi assembly (2) to start a vacuum draw.

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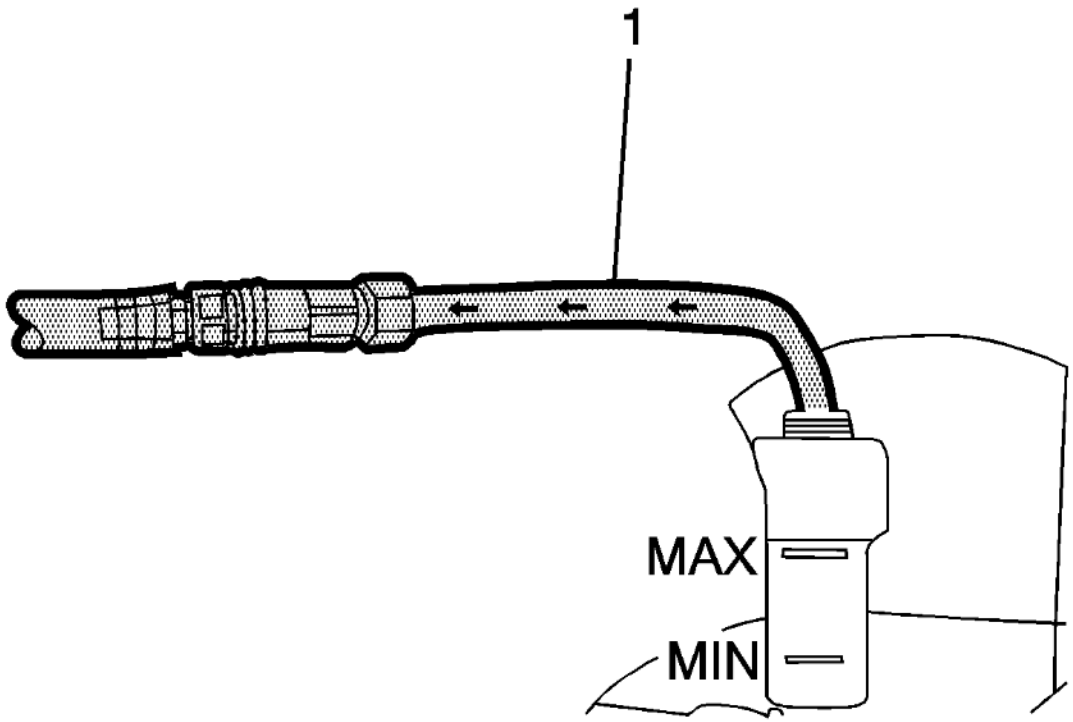


Fig. 24: Coolant Extraction Hose
Courtesy of GENERAL MOTORS COMPANY

28. Use the extraction hose (1) to draw out coolant to the proper level.
29. 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.

COOLING SYSTEM DRAINING AND FILLING (VAC N FILL L83 L86)

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Special Tools

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

Draining Procedure

WARNING: With a pressurized cooling system, the coolant temperature in the radiator can be considerably higher than the boiling point of the solution at atmospheric pressure. Removal of the surge tank cap, while the cooling system is hot and under high pressure, causes the solution to boil instantaneously with explosive force. This will cause the solution to spew out over the engine, the fenders, and the person removing the cap. Serious bodily injury may result.

1. Park the vehicle on a level surface.
2. Remove the coolant pressure cap.
3. Raise and support the vehicle. **Lifting and Jacking the Vehicle** .
4. Place a drain pan under the radiator drain cock.
5. Install a suitable length of hose to the radiator drain cock nipple and route the hose to allow free drain of coolant.
6. Open the radiator drain cock.
7. Drain the cooling system.

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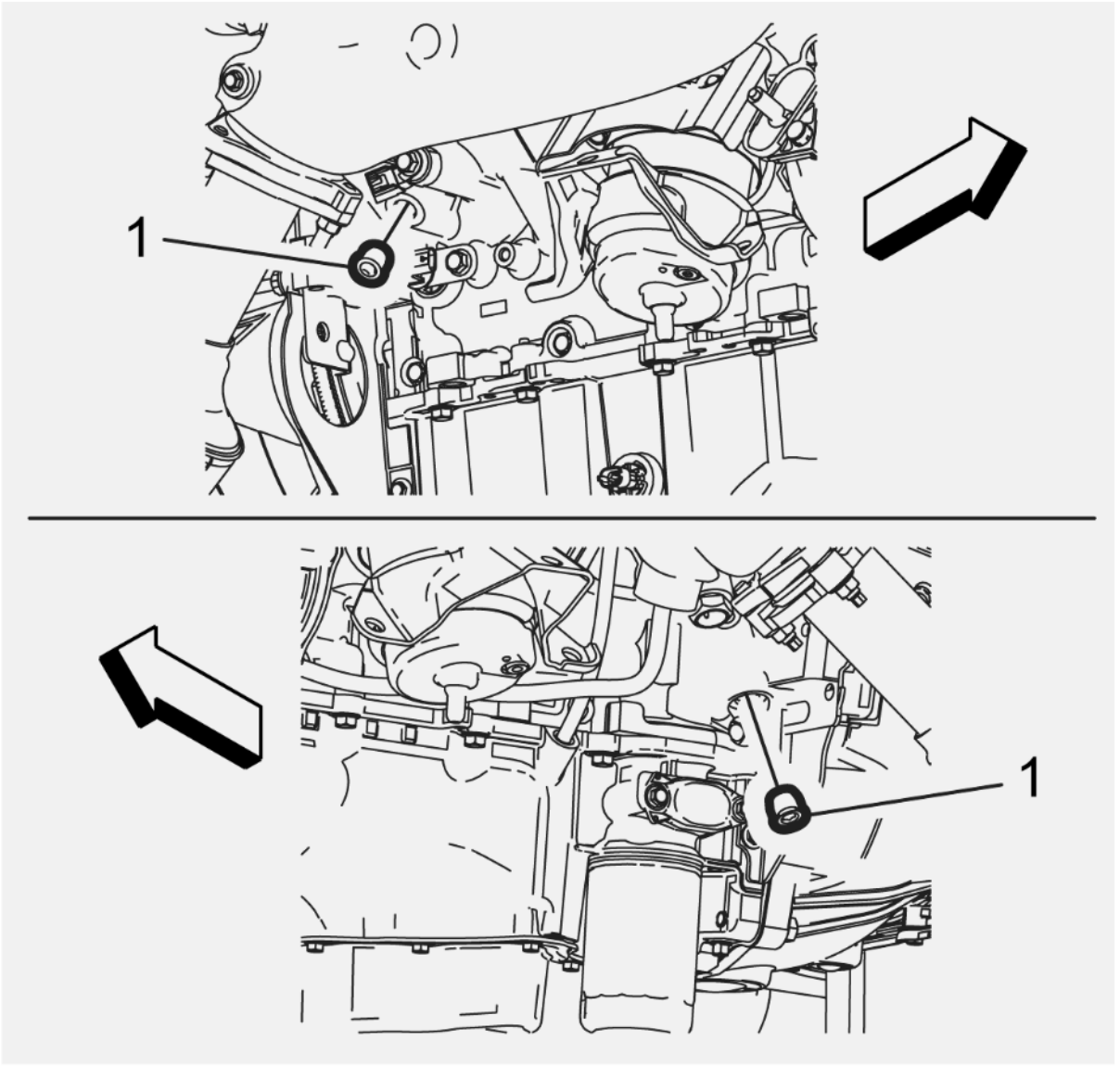


Fig. 25: Engine Block Coolant Drain Hole Plugs
Courtesy of GENERAL MOTORS COMPANY

8. If a complete engine block drain is required, remove the left and right engine block coolant drain hole plugs (1).
9. Inspect the coolant.
10. Follow the appropriate procedure based on the condition of the coolant.

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- Normal in appearance-Follow the filling procedure.
- Discolored-Follow the flush procedure. **Flushing**.

Vac-N-Fill Procedure

NOTE: **To prevent boiling of the coolant/water mixture in the vehicles cooling system, do not apply vacuum to a cooling system above 49Â°C (120Â°F). The tool will not operate properly when the coolant is boiling.**

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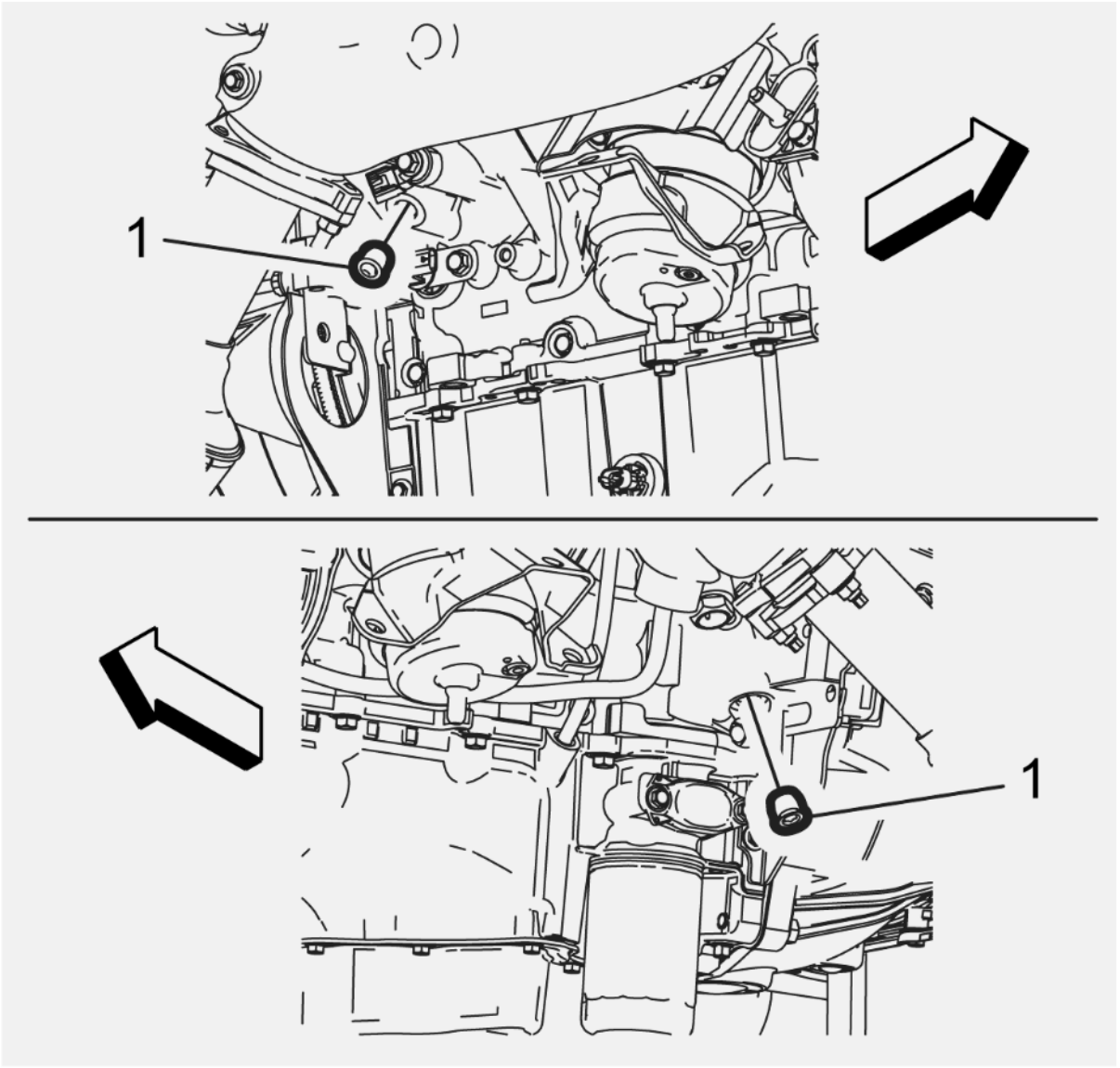


Fig. 26: Engine Block Coolant Drain Hole Plugs
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

1. If the left and right engine block coolant drain hole plugs (1) were removed, install the engine block coolant drain hole plugs (1). **Engine Block**

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Plug Installation .

2. Install the **J-42401** radiator cap and surge tank test adapter.

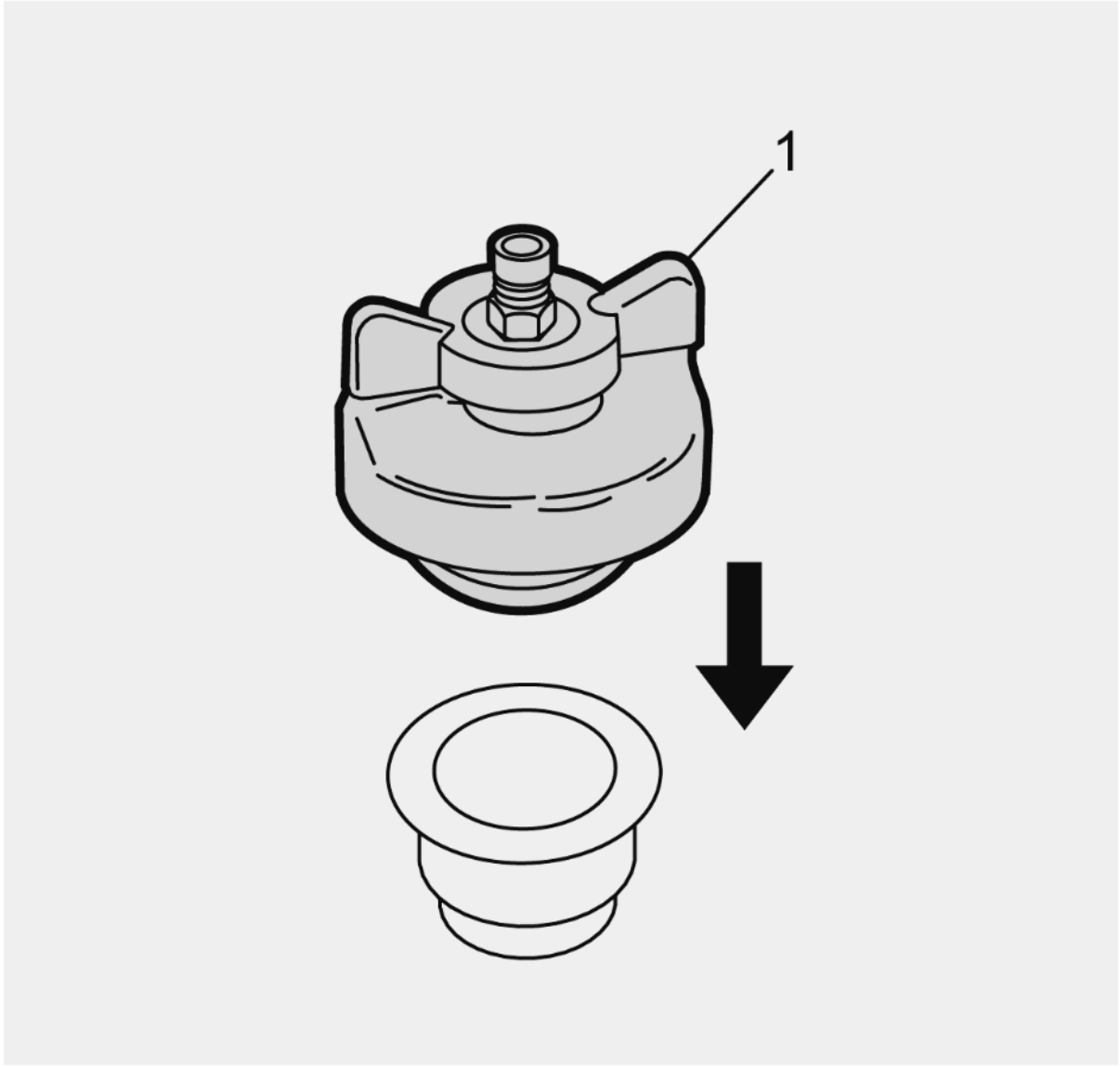


Fig. 27: Radiator Cap & Surge Tank Test Adapter
Courtesy of GENERAL MOTORS COMPANY

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3. Attach the Vac-N-Fill cap (1) to the vehicles coolant fill port.

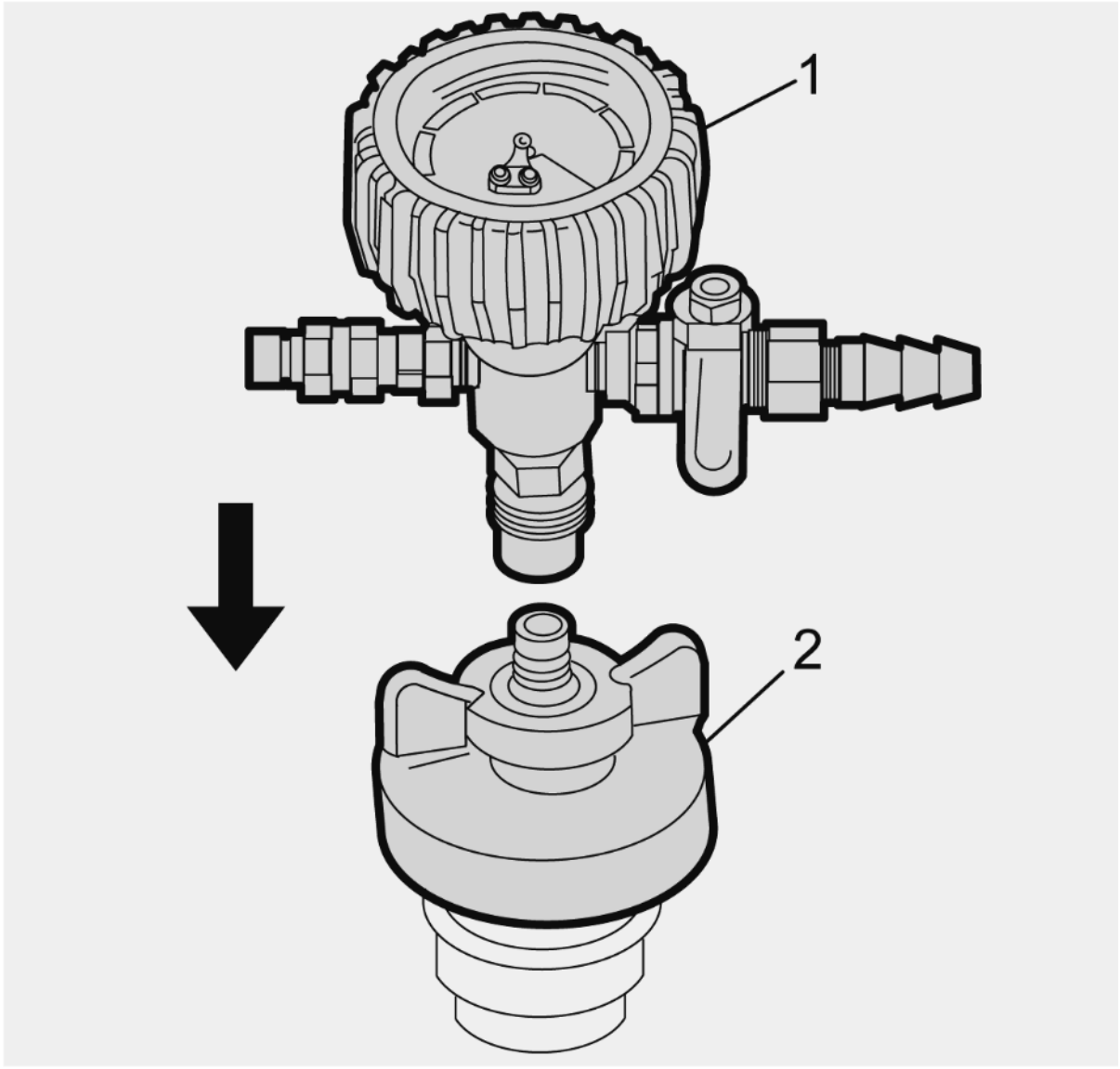


Fig. 28: Vacuum Gauge Assembly & Vac N Fill Cap
Courtesy of GENERAL MOTORS COMPANY

4. Attach the vacuum gauge assembly (1) to the Vac-N-Fill cap (2).

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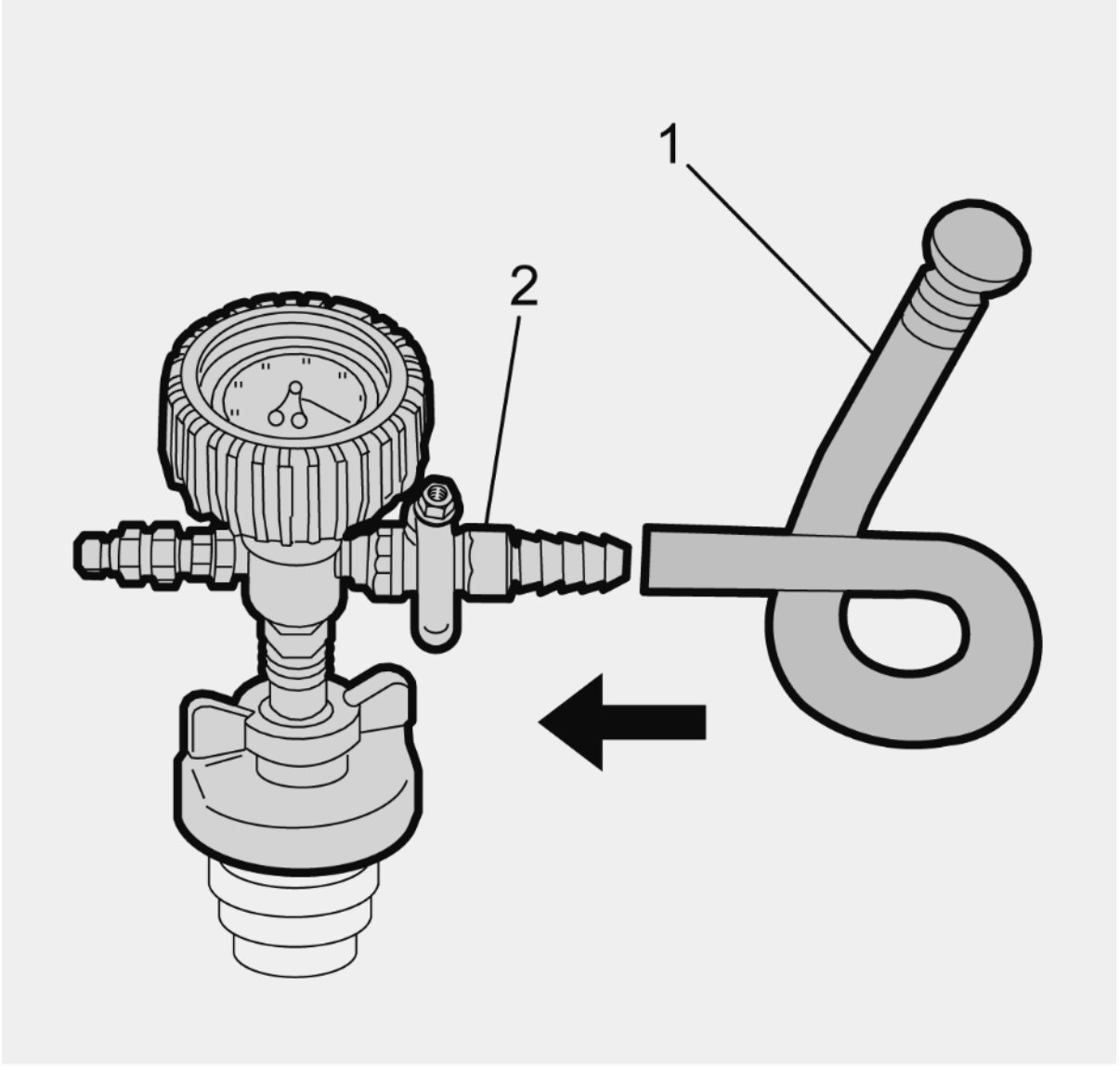


Fig. 29: Vacuum Gauge Assembly & Fill Hose
Courtesy of GENERAL MOTORS COMPANY

5. Attach the fill hose (1) to the barb fitting on the vacuum gauge assembly (2).

   Ensure that the valve is closed.

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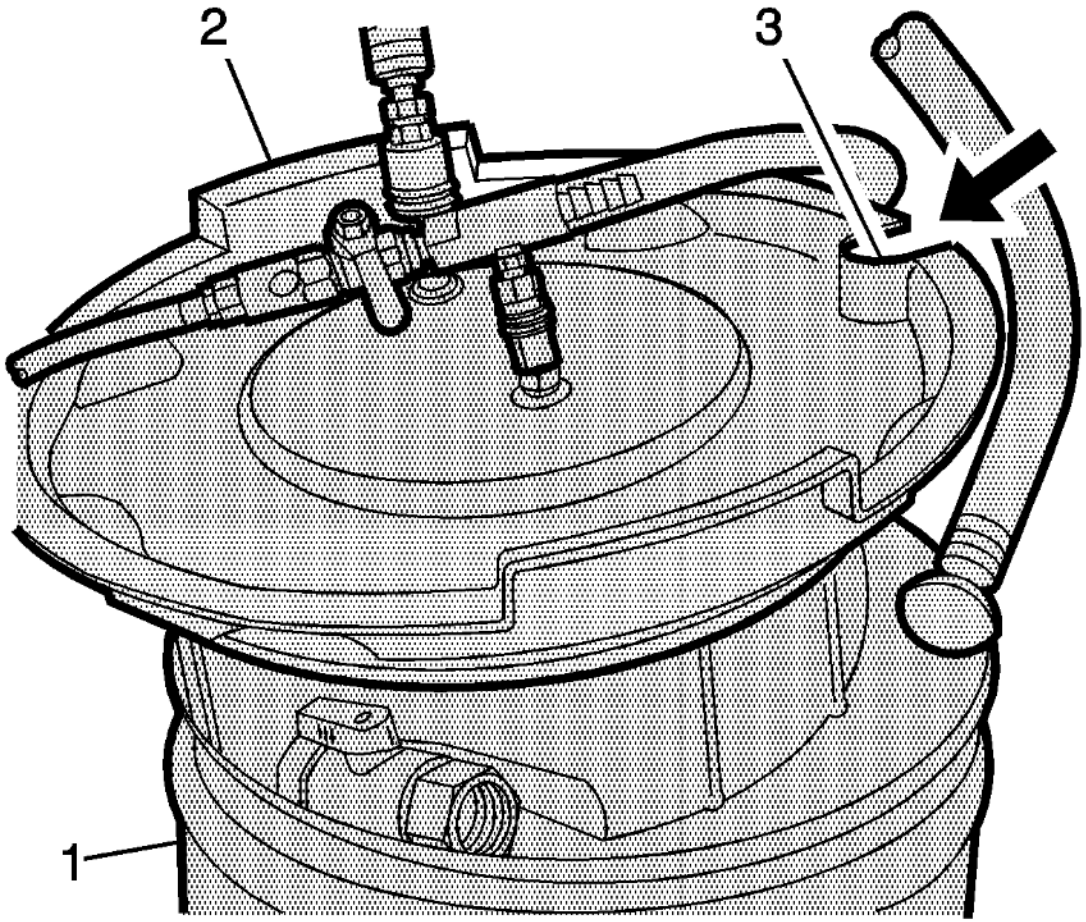


Fig. 30: Graduated Reservoir, Vacuum Tank & Cut-Out Area
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water.**

Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.

6. Pour the coolant mixture into the graduated reservoir (1).

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7. Place the fill hose in the graduated reservoir (1).

NOTE: **Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.**

8. Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.

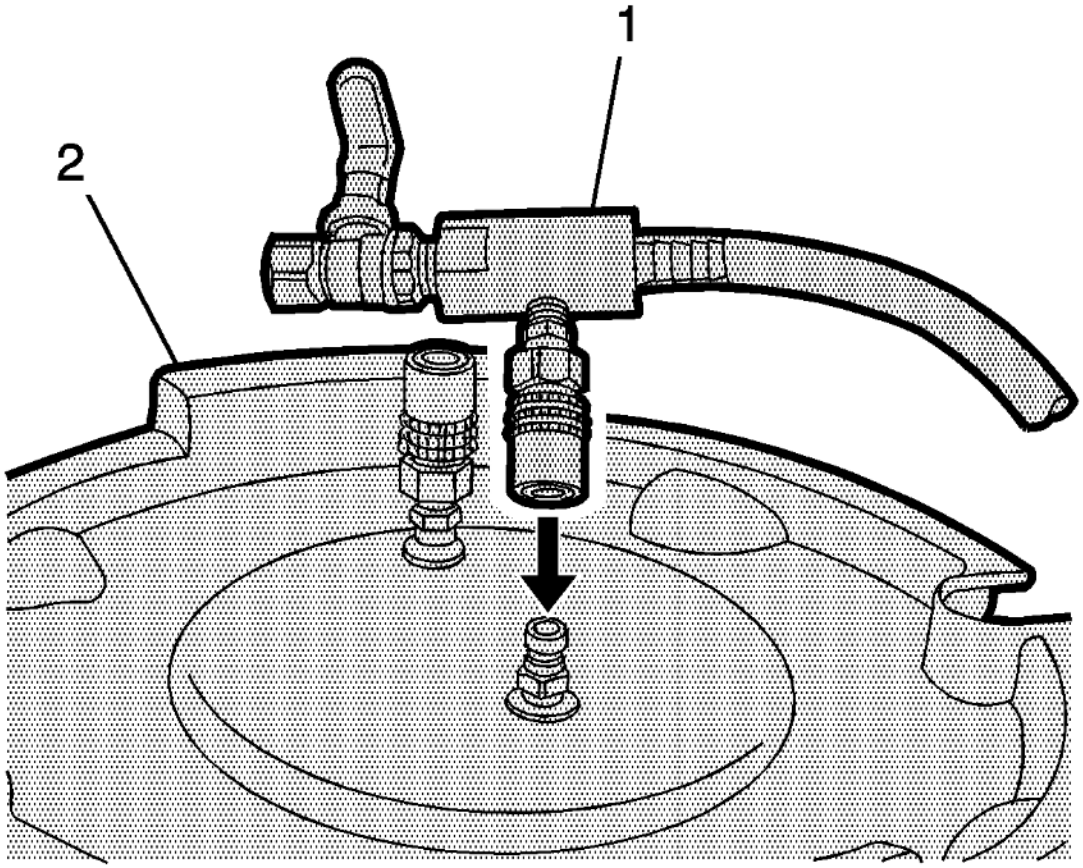


Fig. 31: Vacuum Tank & Venturi Assembly

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Courtesy of GENERAL MOTORS COMPANY

9. Attach the venturi assembly (1) to the vacuum tank (2).

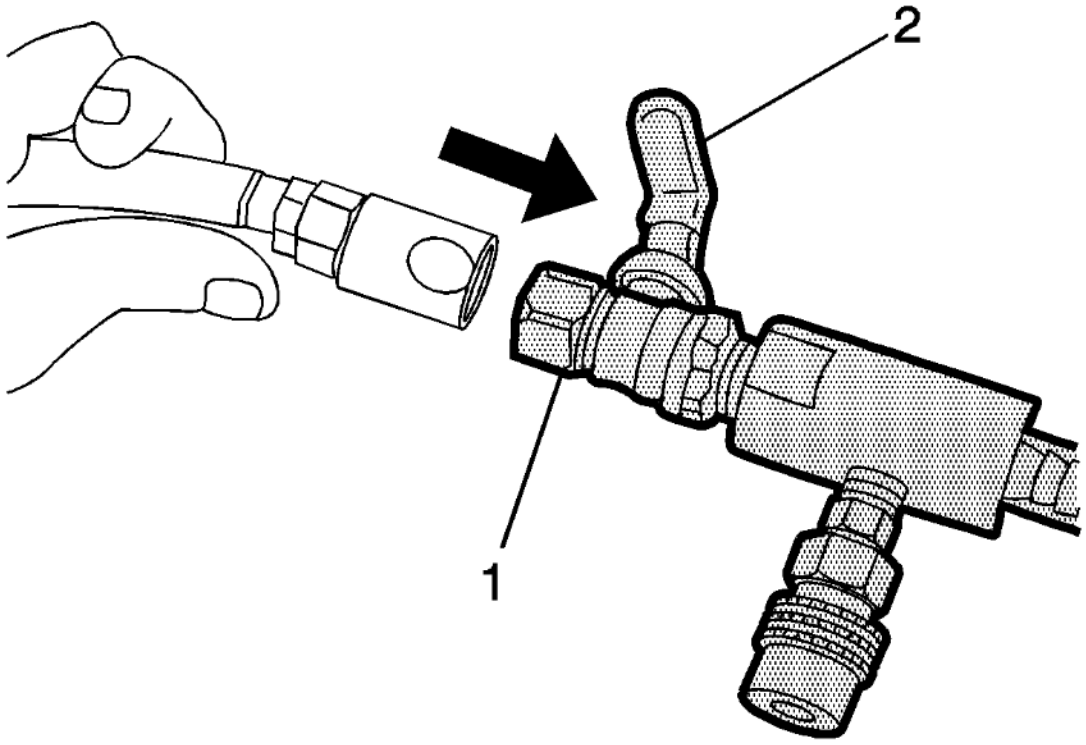


Fig. 32: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

10. Attach a shop air hose to the venturi assembly (1).

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Ensure the valve (2) on the venturi assembly is closed.

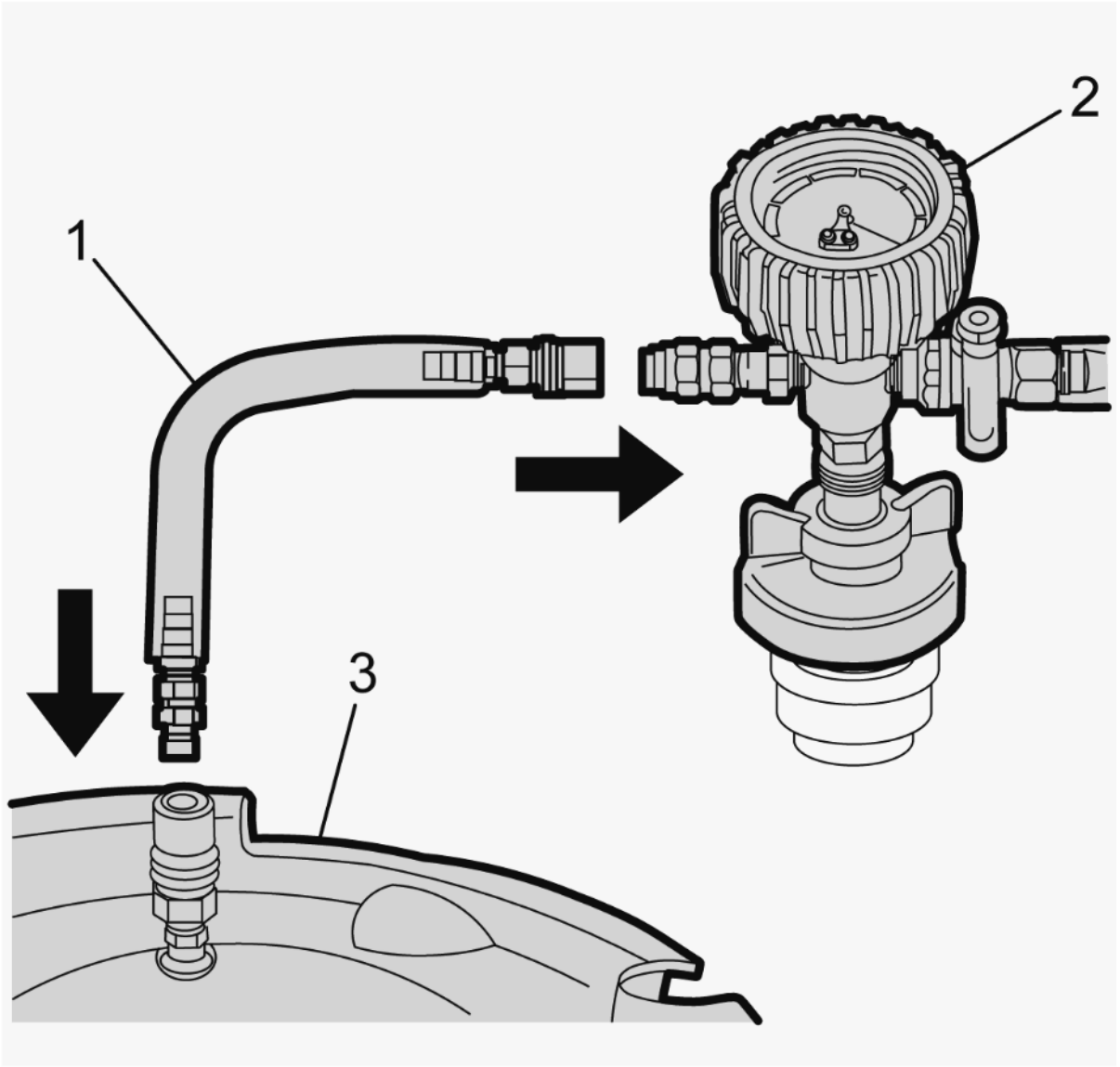


Fig. 33: Vacuum Hose, Gauge Assembly & Tank
Courtesy of GENERAL MOTORS COMPANY

11. Attach the vacuum hose (1) to the vacuum gauge assembly (2) and the vacuum tank (3).

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12. Clamp off the overflow hose.

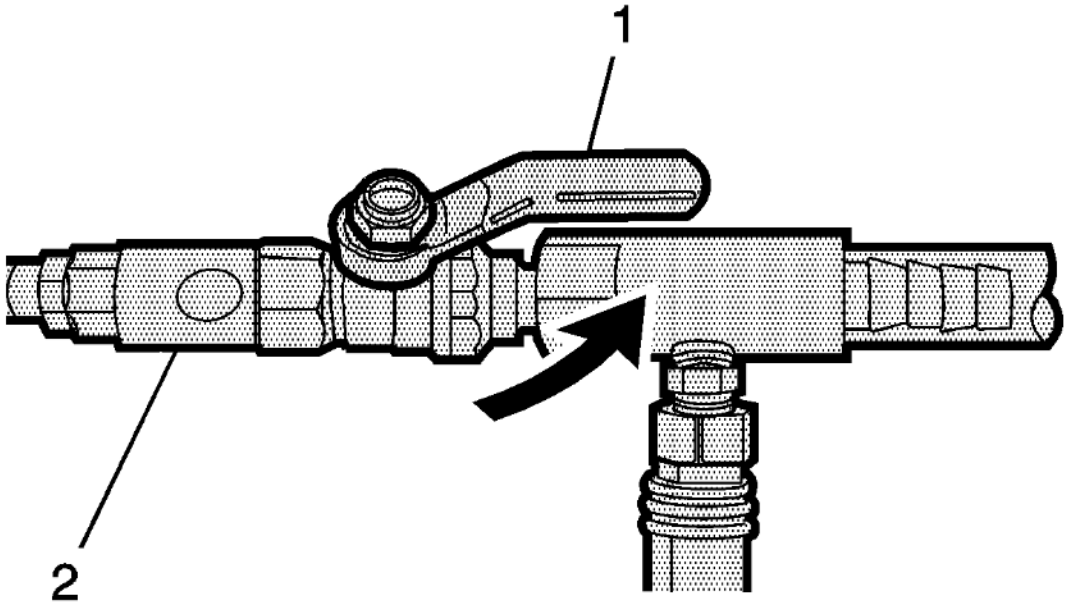


Fig. 34: Valve & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

13. Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present.

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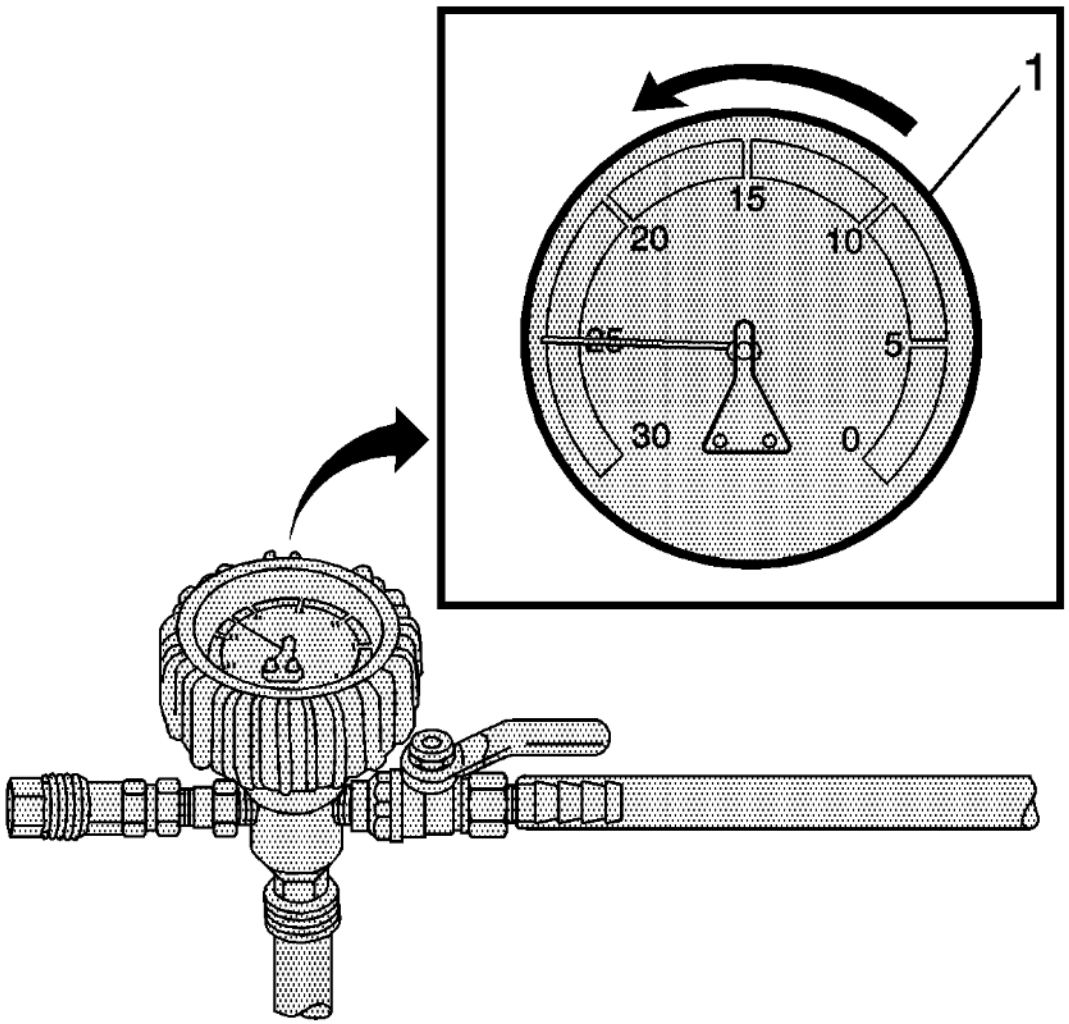


Fig. 35: Vacuum Gauge Needle
Courtesy of GENERAL MOTORS COMPANY

14. 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.

15. To aid in the fill process, position the graduated reservoir above the coolant fill port.

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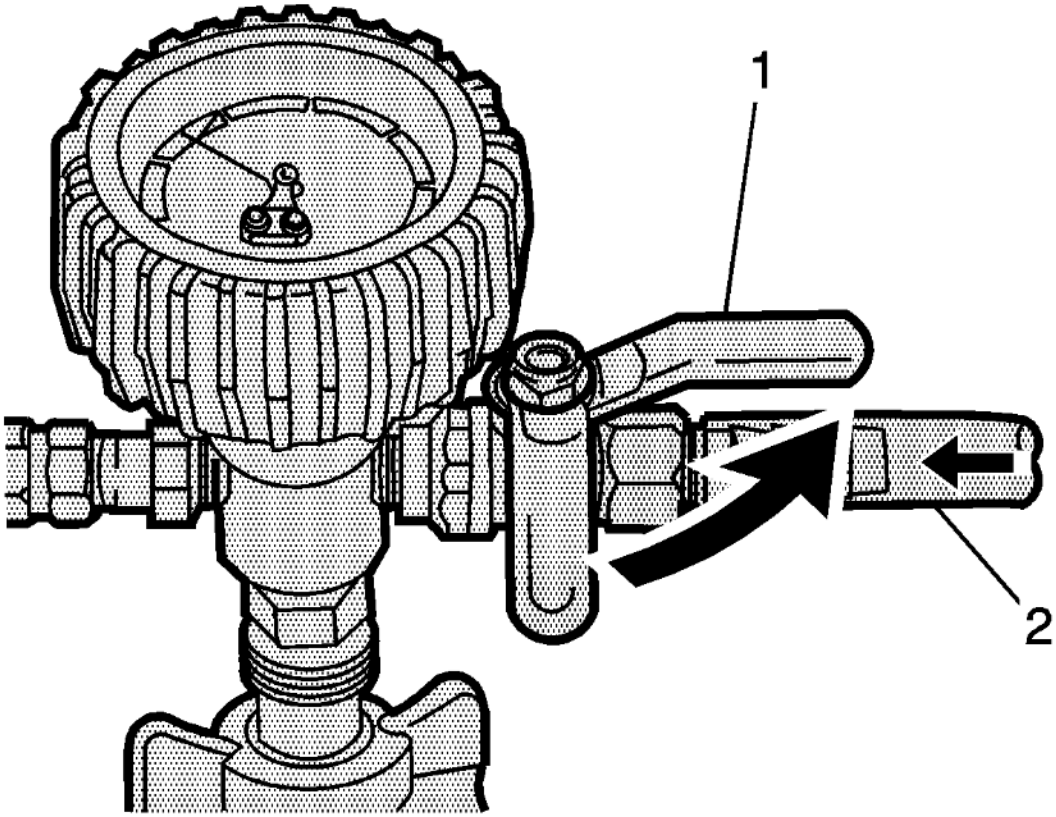


Fig. 36: Vacuum Gauge Assembly & Needle
Courtesy of GENERAL MOTORS COMPANY

16. 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.
17. Close the valve on the venture assembly.
18. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss.

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If vacuum loss is observed, refer to **Loss of Coolant (L86 L83)**.

19. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.

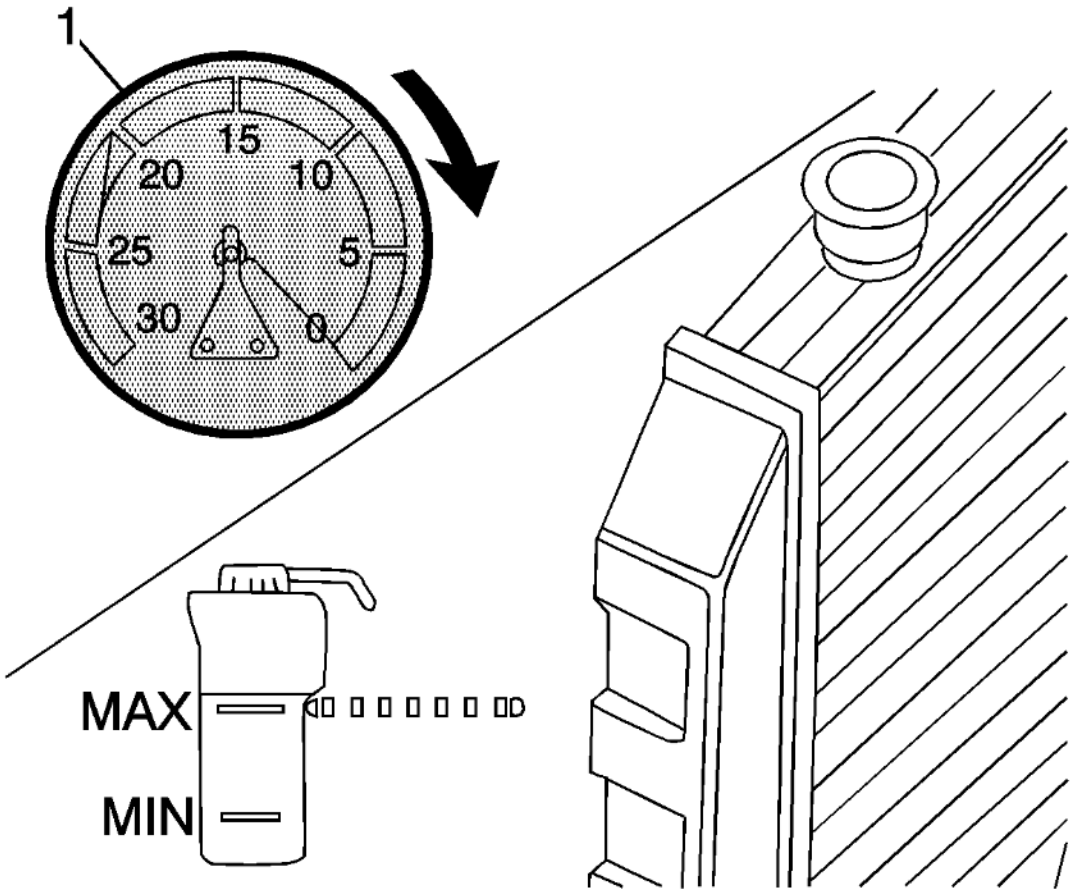


Fig. 37: Vacuum Gauge At Zero
Courtesy of GENERAL MOTORS COMPANY

20. Once the vacuum gauge reaches zero (1), close the valve on the vacuum gauge assembly and repeat steps 11-17.

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21. Remove the **J-42401** radiator cap and surge tank test adapter.
22. Detach the Vac-N-Fill cap from the vehicles coolant fill port.
23. Add coolant to the system as necessary.
24. Inspect the concentration of the coolant mixture using **J-26568** coolant and battery tester.

NOTE: **After filling the cooling system, the extraction hose can be used to remove excess coolant to achieve the proper coolant level.**

25. Detach the vacuum hose form the vacuum gauge assembly.

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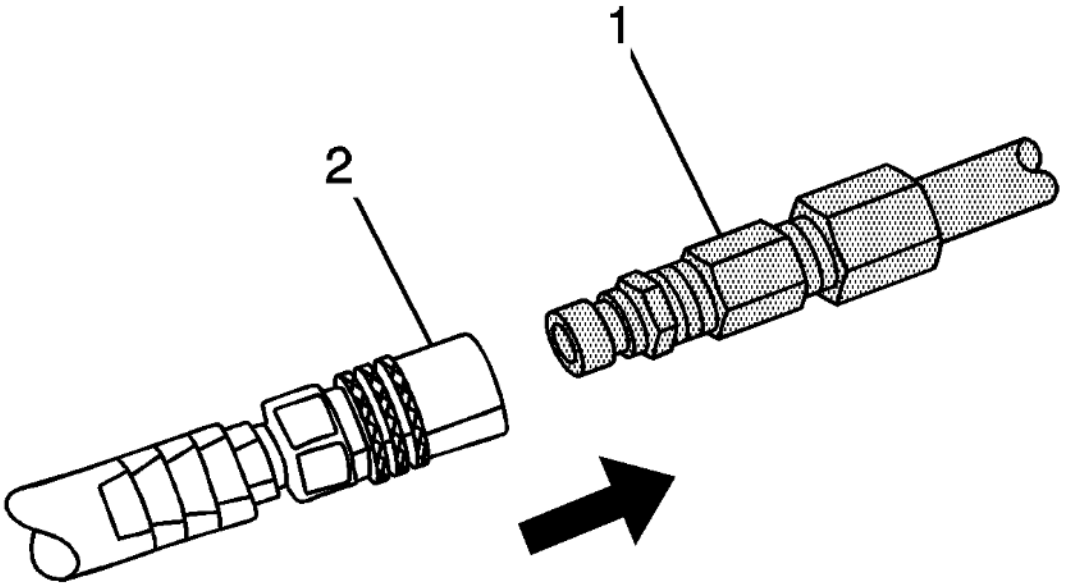


Fig. 38: Vacuum Hose & Extraction Hose
Courtesy of GENERAL MOTORS COMPANY

26. Attach the extraction hose (1) to the vacuum hose (2).

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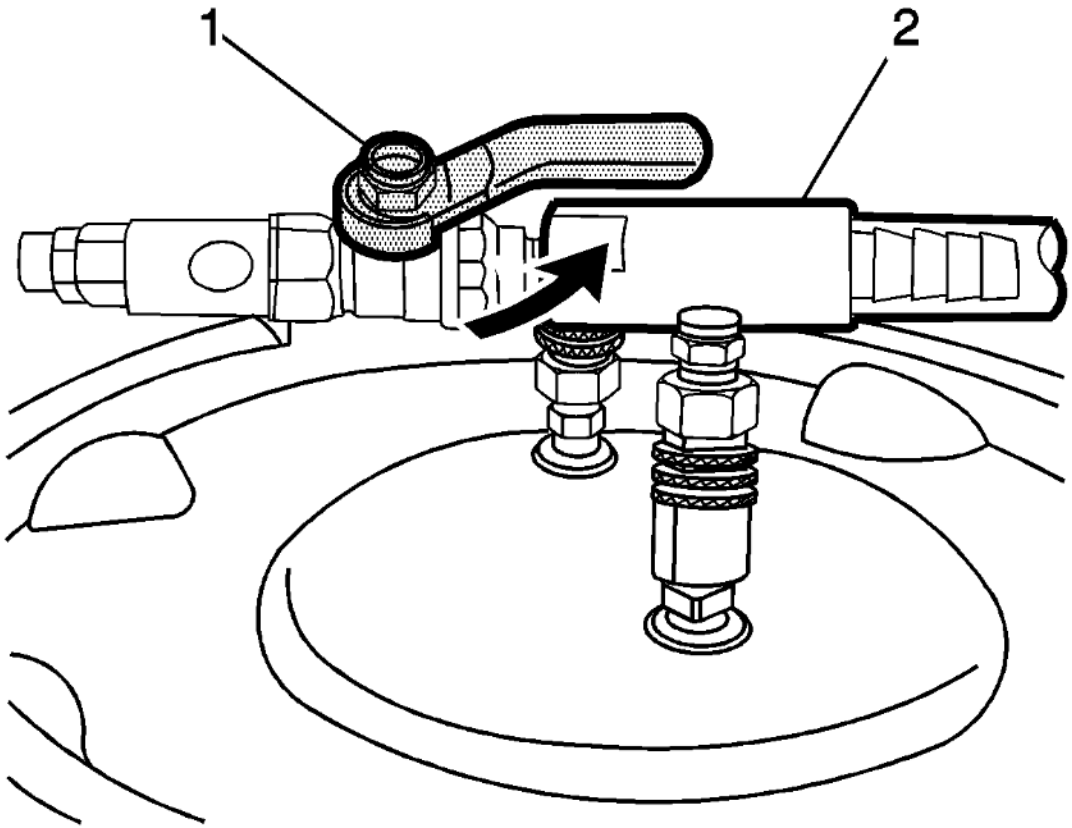


Fig. 39: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

27. Open the valve (1) on the venturi assembly (2) to start a vacuum draw.

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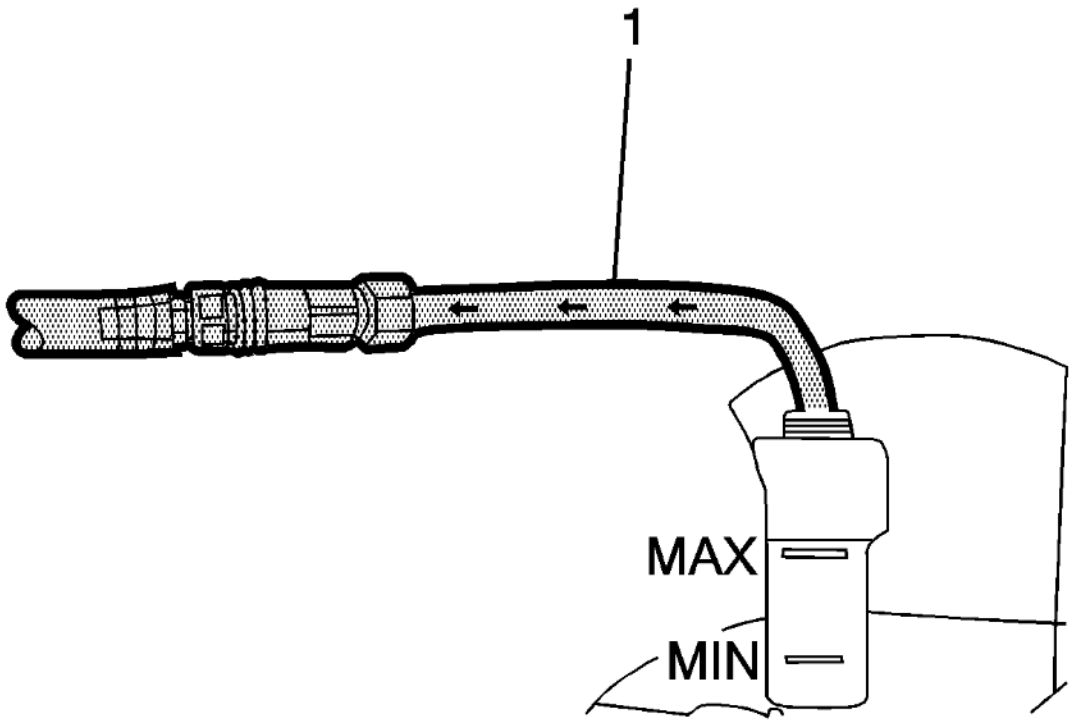


Fig. 40: Coolant Extraction Hose
Courtesy of GENERAL MOTORS COMPANY

28. Use the extraction hose (1) to draw out coolant to the proper level.
29. 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.

COOLING SYSTEM DRAINING AND FILLING (STATIC FILL L83 L86)

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Special Tool

J-26568 Coolant and Battery Tester

Draining Procedure

WARNING: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

1. Follow the steps below in order to remove the surge tank fill cap:
    1. Slowly rotate the cap counterclockwise.
    2. Stop rotating and allow the hissing to stop.
    3. After all the hissing stops, continue turning counterclockwise in order to remove the cap.
2. Raise and support the vehicle. **Lifting and Jacking the Vehicle** .
3. Place a drain pan under the radiator drain cock.
4. Install a suitable length of hose to the radiator drain cock nipple and route the hose to allow free drain of coolant.
5. Open the radiator drain cock.
6. Drain the cooling system.

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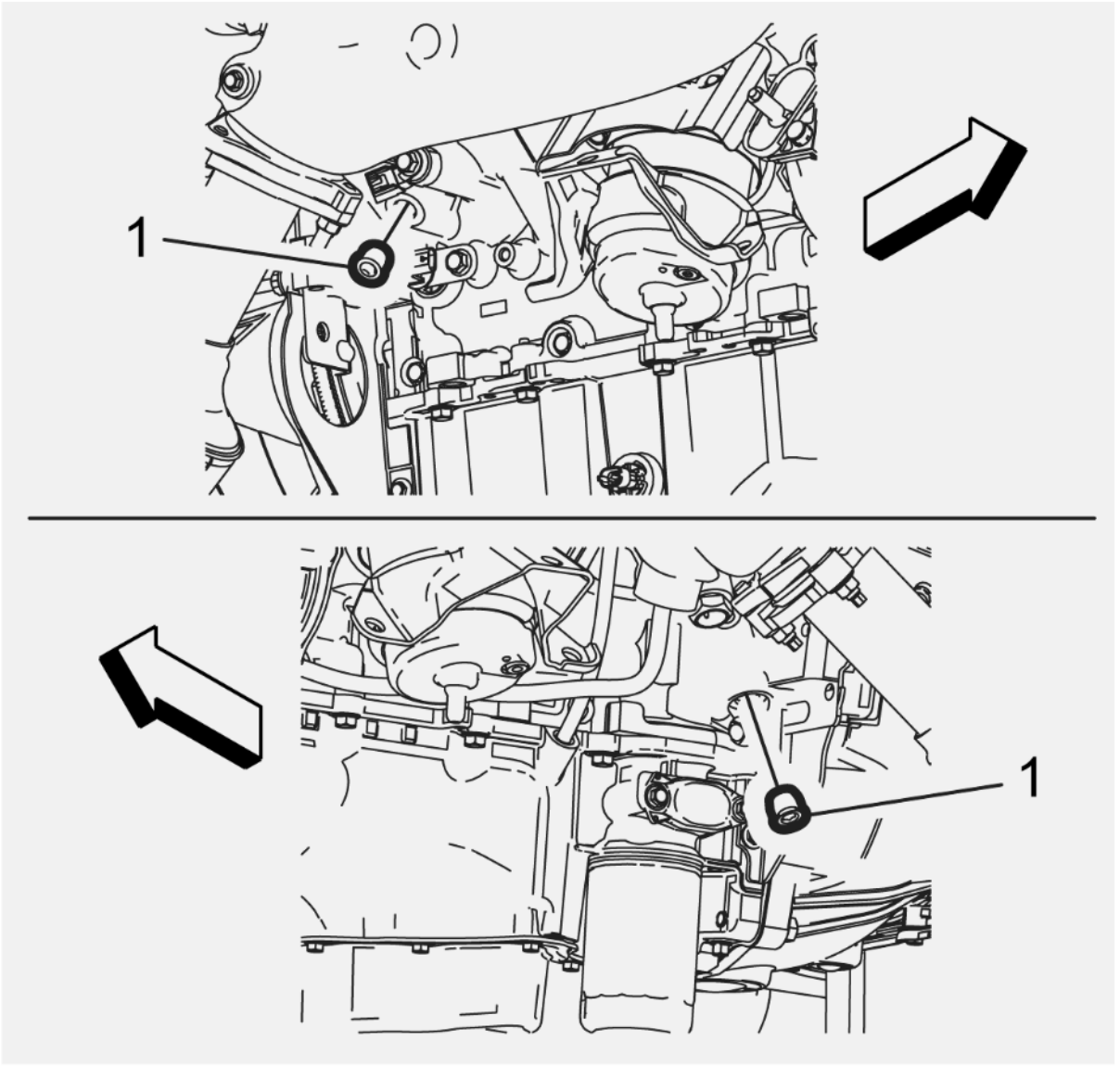


Fig. 41: Engine Block Coolant Drain Hole Plugs
Courtesy of GENERAL MOTORS COMPANY

7. If a complete engine block drain is required, remove the left and right engine block coolant drain hole plugs (1).
8. Remove the engine block coolant heater, if equipped. **Coolant Heater Replacement**.
9. Inspect the coolant.

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10. Follow the appropriate procedure based on the condition of the coolant:
    - Normal in appearance-Follow the filling procedure.
    - Discolored-Follow the flush procedure. **Flushing**.

Filling Procedure

CAUTION: The procedure below must be followed. Improper coolant level could result in a low or high coolant level condition, causing engine damage.

1. Close the radiator drain cock.
2. Remove the drain hose.

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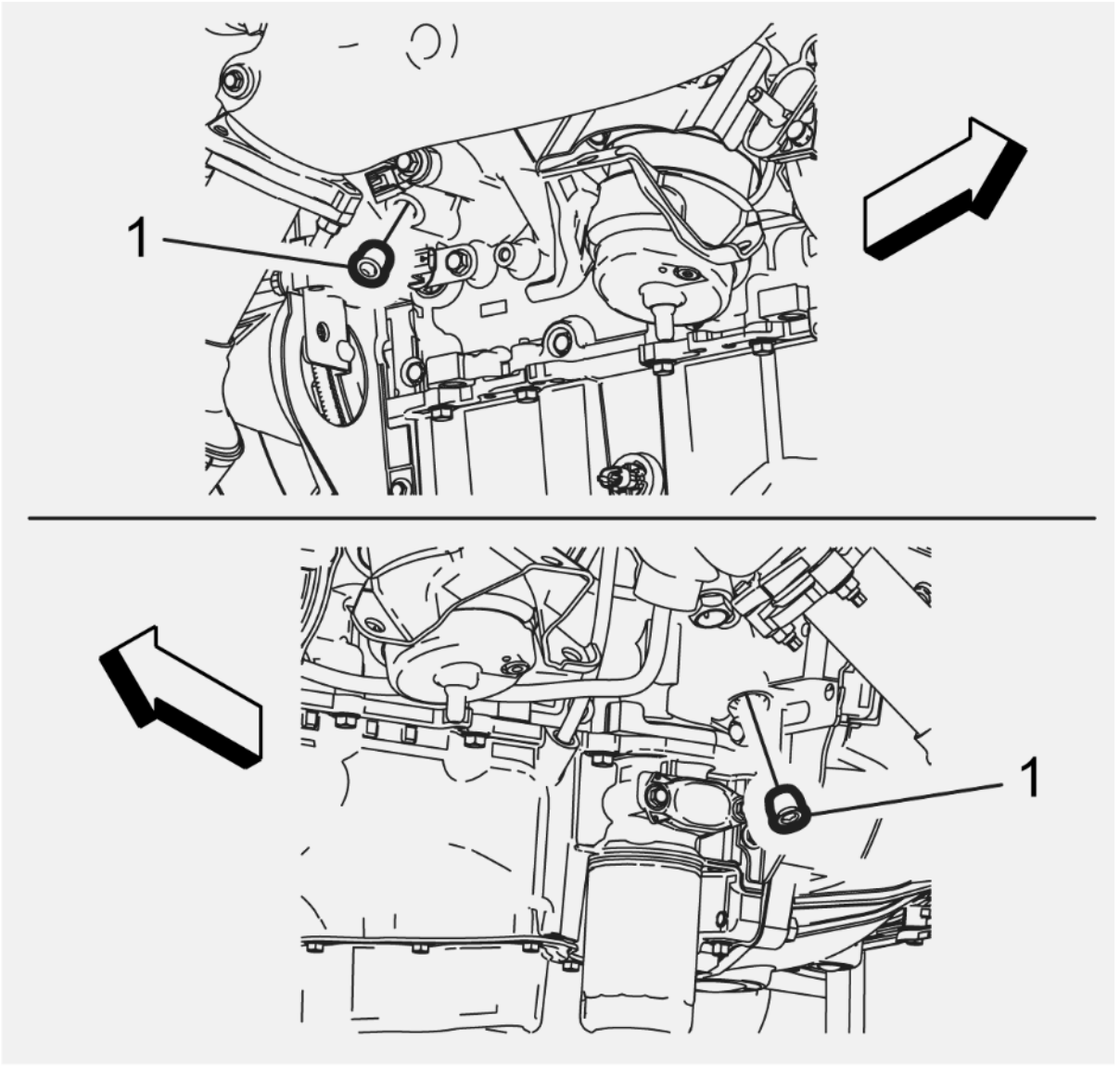


Fig. 42: Engine Block Coolant Drain Hole Plugs
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

3. If the left and right engine block coolant drain hole plugs (1) were removed, install the engine block coolant drain hole plugs (1). **Engine Block**

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Plug Installation .

4. Install the engine block coolant heater, if equipped. Coolant Heater Replacement.
5. Lower the vehicle.

NOTE: **Use a 50/50 mixture of DEX-COOL antifreeze and clean, drinkable water.**

6. Slowly fill the cooling system with a 50/50 coolant mixture. Approximate Fluid Capacities.
7. Install the coolant pressure cap.
8. Start the engine.
9. Run the engine at 2, 000-2, 500 RPM until the engine reaches normal operating temperature.

   Engine should reach an operating temperature of 90Â°C (194Â°F) and the upper radiator hose should be HOT.

10. Allow the engine to idle for 3 minutes.
11. Shut the engine OFF.
12. Allow the engine to cool.
13. Top off the coolant as necessary.
14. Inspect the concentration of the engine coolant using the **J-26568** coolant and battery tester.
15. Rinse away any excess coolant from the engine and the engine compartment.

FLUSHING

NOTE:

- **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.**

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- **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.**

1. Block the drive wheels.
2. Place the transmission in park (P) or neutral (N).
3. Engage the park brake.
4. Run the engine until the thermostat opens.
5. Stop the engine.
6. Follow the drain and fill procedure using only clean drinkable water. Repeat the procedure if necessary, until the fluid is nearly colorless. **Cooling System Draining and Filling (Static Fill L83 L86)**.
7. Fill the coolant reservoir to the FULL HOT mark.
8. Fill the cooling system. **Cooling System Draining and Filling (Static Fill L83 L86)**.

RADIATOR CLEANING

WARNING: NEVER spray water on a hot heat exchanger. The resulting steam could cause personal injury.

CAUTION: The heat exchanger fins are necessary for good heat transfer. Do not brush the fins. This may cause damage to the fins, reducing heat transfer.

NOTE: Remove bugs, leaves, dirt and other debris by blowing compressed air through the engine side of the radiator.

Keep compressed air stream perpendicular to the core face and allow adequate distance of the air nozzle to the core face so not to cause fin damage.

- Some conditions may require the use of warm water and a mild (non caustic) detergent.
- Clean the A/C condenser fins.
- Clean between the A/C condenser and radiator.
- Clean the charge air cooler fins, if equipped.
- Clean between the air cooler fins and radiator, if equipped.

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- Clean the radiator cooling fins.
- Straighten any damaged cooling fins.

RADIATOR SURGE TANK REPLACEMENT (L83 L86)

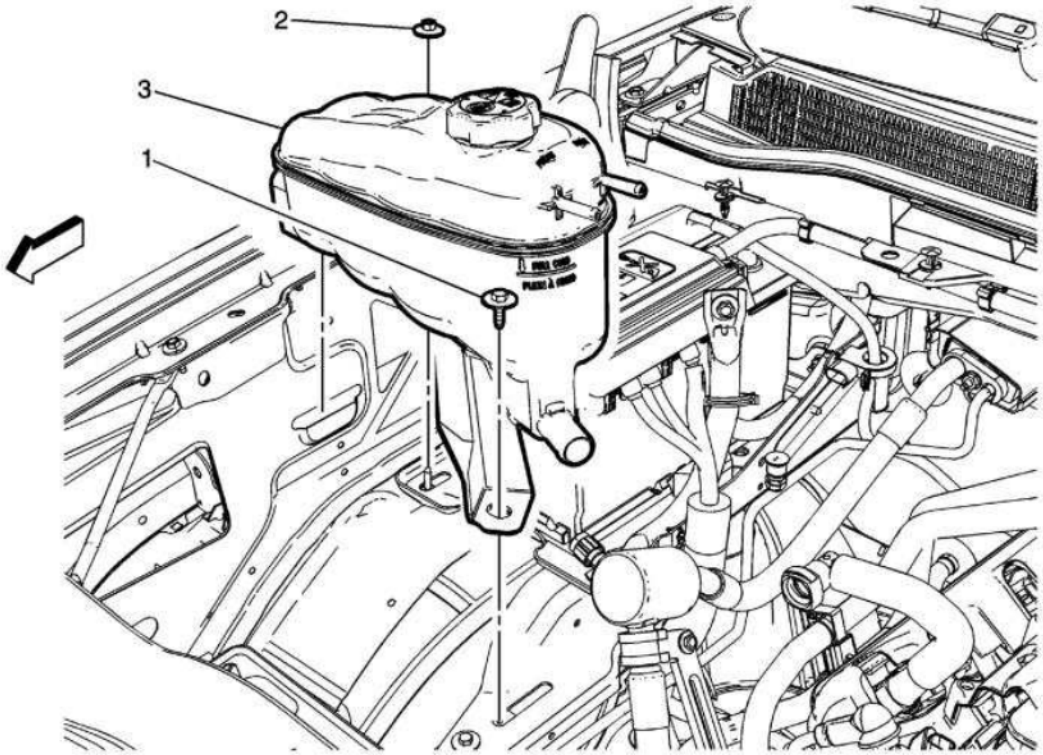


Fig. 43: Radiator Surge Tank (L83, L86)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac N Fill L83 L86)Cooling System Draining and Filling (Static Fill L83 L86)**.	
2. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .	

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Callout	Component Name
3. Remove the radiator surge tank inlet hoses from the radiator surge tank. Refer to **Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Radiator L83 L86)Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Water Outlet L83 L86)**. 4. Remove the radiator outlet hose from the radiator surge tank. Refer to **Radiator Outlet Hose Replacement (L83 L86)**.	
1	Surge Tank Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 10 N.m (89 lb in)
2	Surge Tank Nut **Tighten** 10 N.m (89 lb in)
3	Surge Tank **Procedures** 1. Fill the cooling system to the proper level. 2. Inspect the cooing system for leaks.

RADIATOR SURGE TANK REPLACEMENT (L96)

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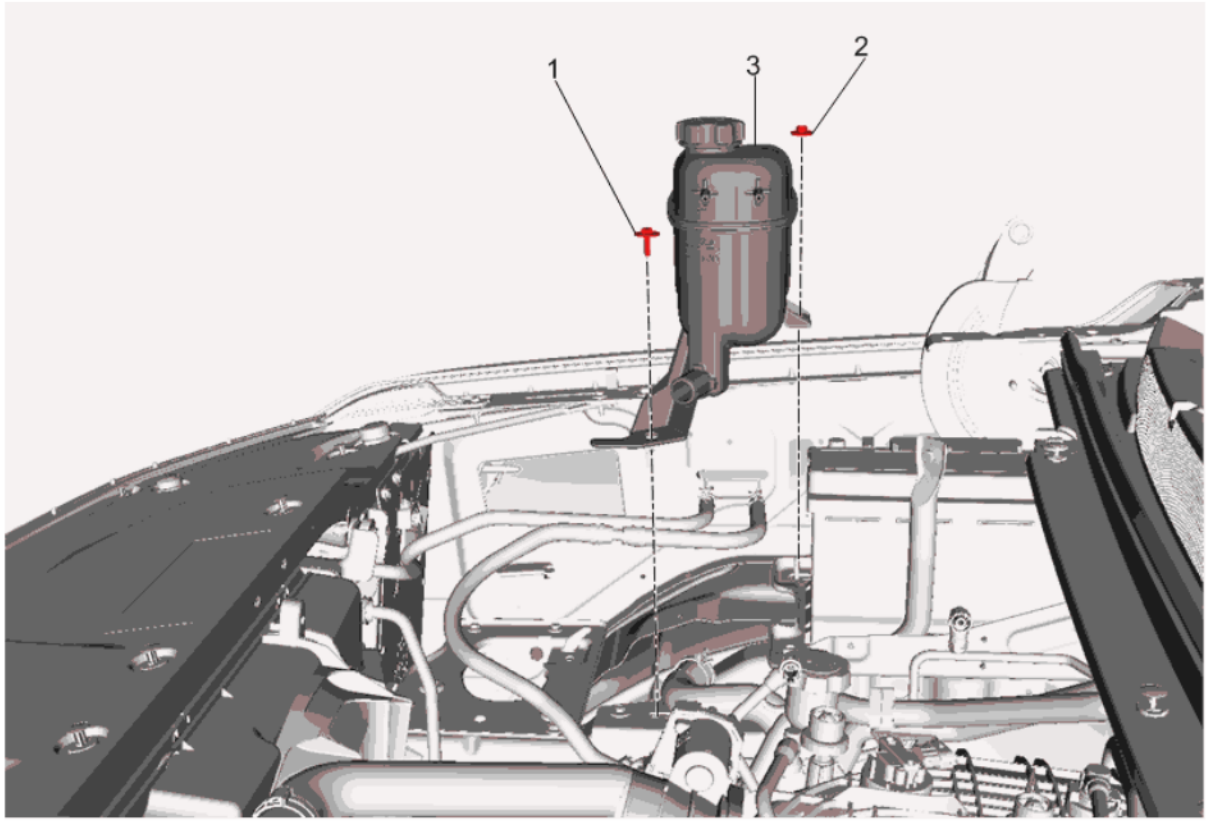


Fig. 44: Radiator Surge Tank
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Radiator Surge Tank Inlet Hose @ Radiator Surge Tank -**Radiator Surge Tank Inlet Hose Replacement (L96)** 2. Remove Radiator Surge Tank Overflow Hose @ Radiator Surge Tank -**Radiator Surge Tank Overflow Hose Replacement (L96)** 3. Remove Radiator Surge Tank Outlet Hose @ Radiator Surge Tank -**Radiator Surge Tank Outlet Hose Replacement (L96)**	
1	Surge Tank Bolt **CAUTION:**

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Callout	Component Name
	Refer to Fastener Caution . **Tighten** 10 N.m (89 lb in)
2	Surge Tank Nut **Tighten** 10 N.m (89 lb in)
3	Surge Tank **Procedures** 1. Fill the cooling system to the proper level. 2. Inspect the cooing system for leaks.

RADIATOR SURGE TANK INLET HOSE REPLACEMENT (SURGE TANK TO RADIATOR L83 L86)

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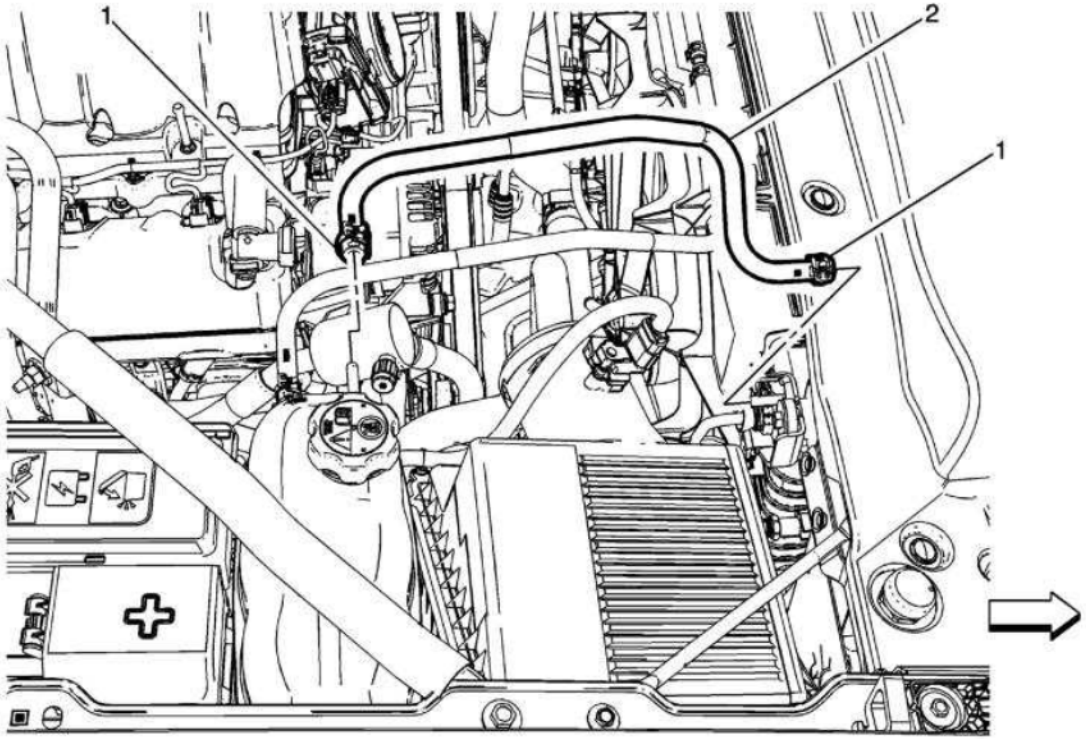


Fig. 45: Radiator Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac N Fill L83 L86)Cooling System Draining and Filling (Static Fill L83 L86)**.	
1	Radiator Surge Tank Inlet Hose Clamps (Qty: 2) **Procedure** Using **BO-38185** hose clamp pliers, reposition the radiator surge tank inlet hose clamps. **Special Tools** **BO-38185** Hose Clamp Pliers For equivalent regional tools, refer to **Special Tools**.

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Callout	Component Name
2	Radiator Surge Tank Inlet Hose **Procedures** 1. Fill the cooling system to the proper level. 2. Inspect the cooing system for leaks.

RADIATOR SURGE TANK INLET HOSE REPLACEMENT (SURGE TANK TO WATER OUTLET L83 L86)

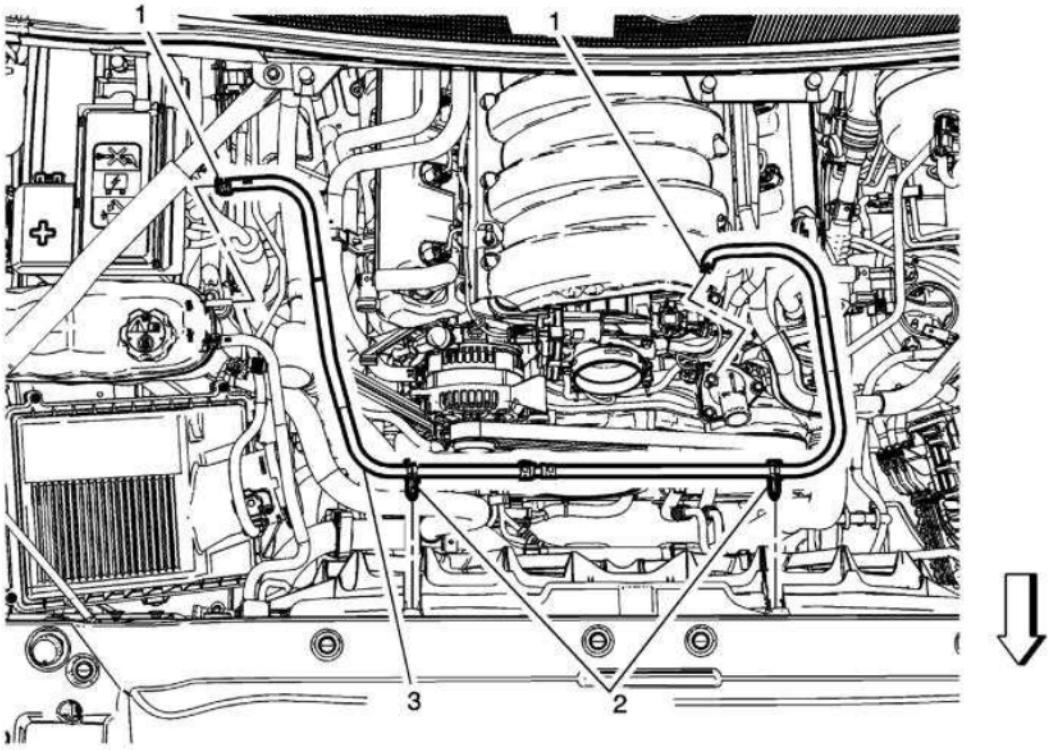


Fig. 46: Radiator Surge Tank Inlet Hose (Surge Tank To Water Outlet L83, L86)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

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Callout	Component Name
CAUTION: **Use caution when removing the hose from the thermostat housing. The plastic thermostat housing may break if excessive force is used.**	**Preliminary Procedure** 1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac N Fill L83 L86)** **Cooling System Draining and Filling (Static Fill L83 L86)**. 2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement (Chevrolet and GMC)** **Air Cleaner Outlet Duct Replacement (Cadillac)** .
1	Radiator Surge Tank Inlet Hose Clamps (Qty: 2) **Procedure** Using **BO-38185** hose clamp pliers, reposition the radiator surge tank inlet hose clamps. **Special Tools** **BO-38185** Hose Clamp Pliers For equivalent regional tools, refer to **Special Tools**.
2	Radiator Surge Tank Inlet Hose Retainers (Qty: 2) **Procedure** Remove radiator surge tank inlet hose from retainers.
3	Radiator Surge Tank Inlet Hose **Procedures** 1. Fill the cooling system to the proper level. 2. Inspect the cooing system for leaks.

RADIATOR SURGE TANK INLET HOSE REPLACEMENT (L96)

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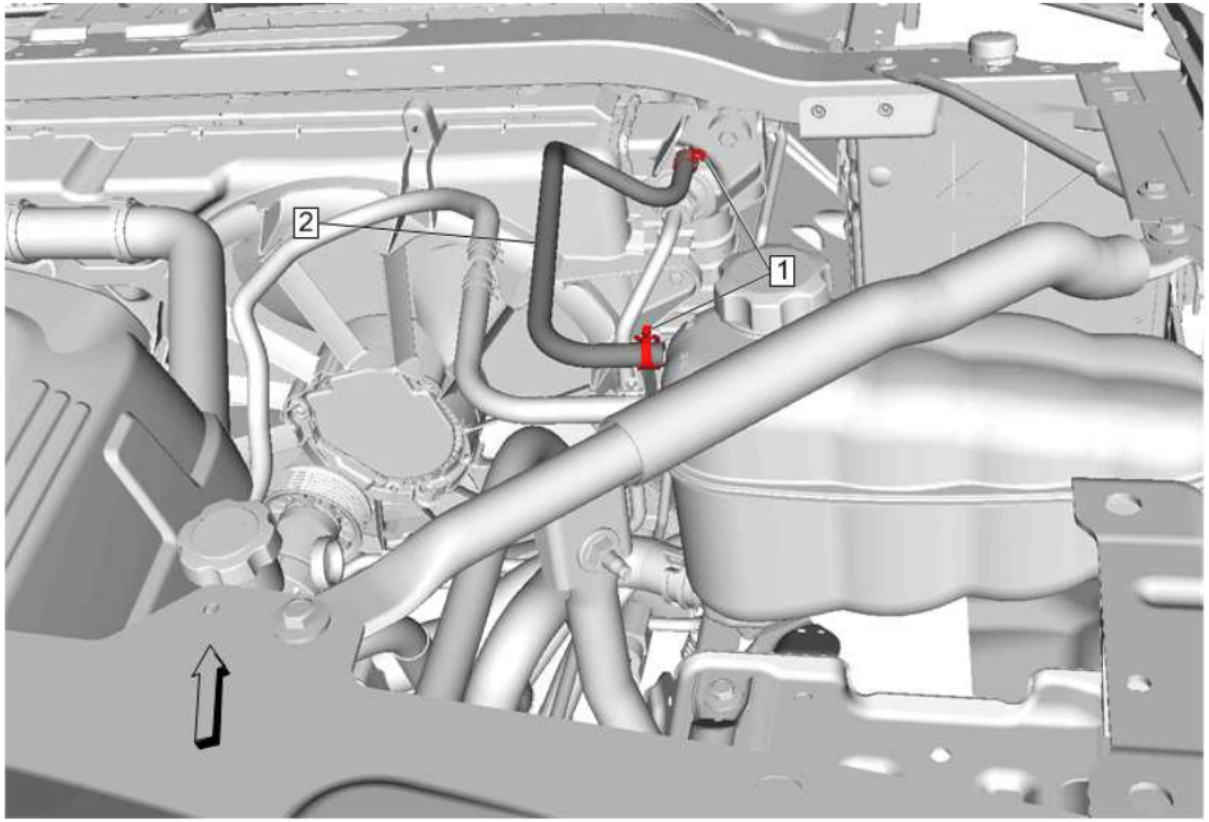


Fig. 47: Radiator Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Drain the cooling system. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)**	
1	Radiator Surge Tank Inlet Hose Clamp (Qty: 2) **Procedure** Disengage tension on the radiator surge tank inlet hose clamps using **BO-38185** hose clamp pliers and remove the radiator surge tank inlet hose and clamps. **Special Tools** **BO-38185** Hose Clamp Pliers For equivalent regional tools, refer to **Special Tools**.

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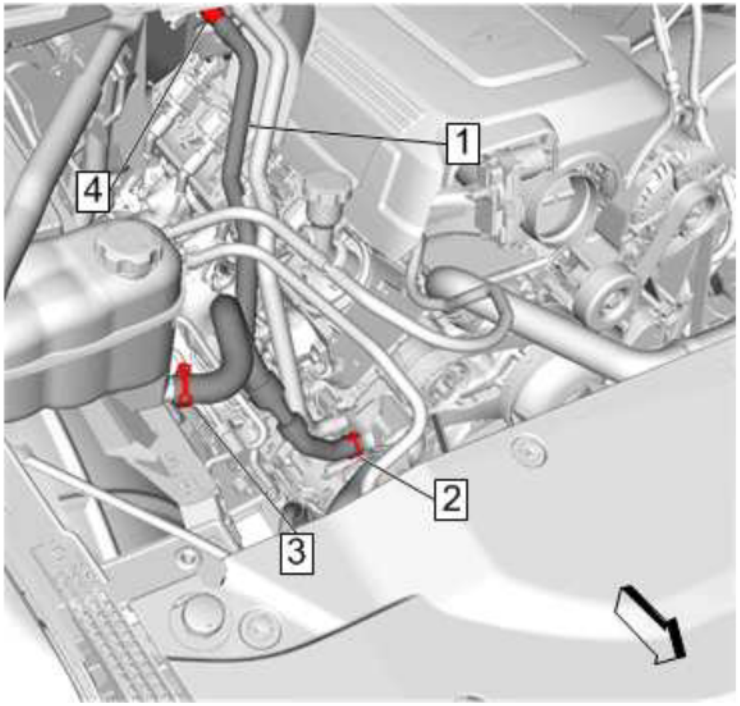
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Callout	Component Name
2	Radiator Surge Tank Inlet Hose **Procedures** 1. Fill the engine cooling system to the proper level. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)** 2. Inspect the cooling system for leaks. **Cooling System Leak Testing (L83, L86)** 3. Install the air cleaner assembly. **Air Cleaner Assembly Replacement**

RADIATOR SURGE TANK OUTLET HOSE REPLACEMENT (L96)

Removal Procedure

1. Drain the cooling system. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)**.
2. Remove the air cleaner assembly. **Air Cleaner Assembly Replacement** .



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Fig. 48: Radiator Surge Tank Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Disengage Radiator Surge Tank Outlet Hose Clamp@Radiator Surge Tank. **Hose Clamp Replacement Guidelines - Spring Type**
4. Remove Radiator Surge Tank Outlet Hose@Radiator Surge Tank.
5. Disengage Radiator Surge Tank Outlet Hose Clamp@Engine Coolant Thermostat Housing.**Hose Clamp Replacement Guidelines - Spring Type**
6. Remove Radiator Surge Tank Outlet Hose@ Engine Coolant Thermostat Housing.
7. Disconnect the quick connect at the heater core outlet pipe (4).
8. Remove the radiator surge tank outlet hose (1) from the vehicle.

Installation Procedure

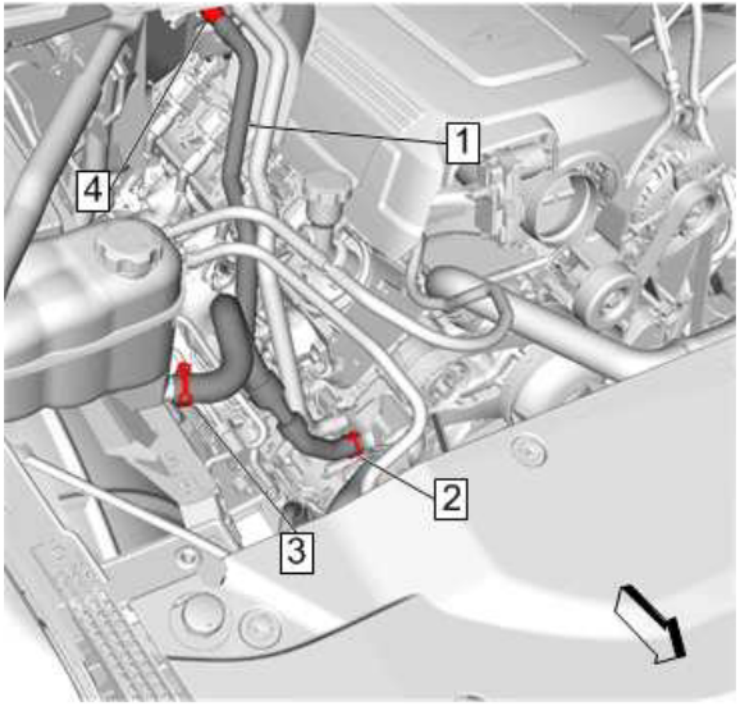


Fig. 49: Radiator Surge Tank Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

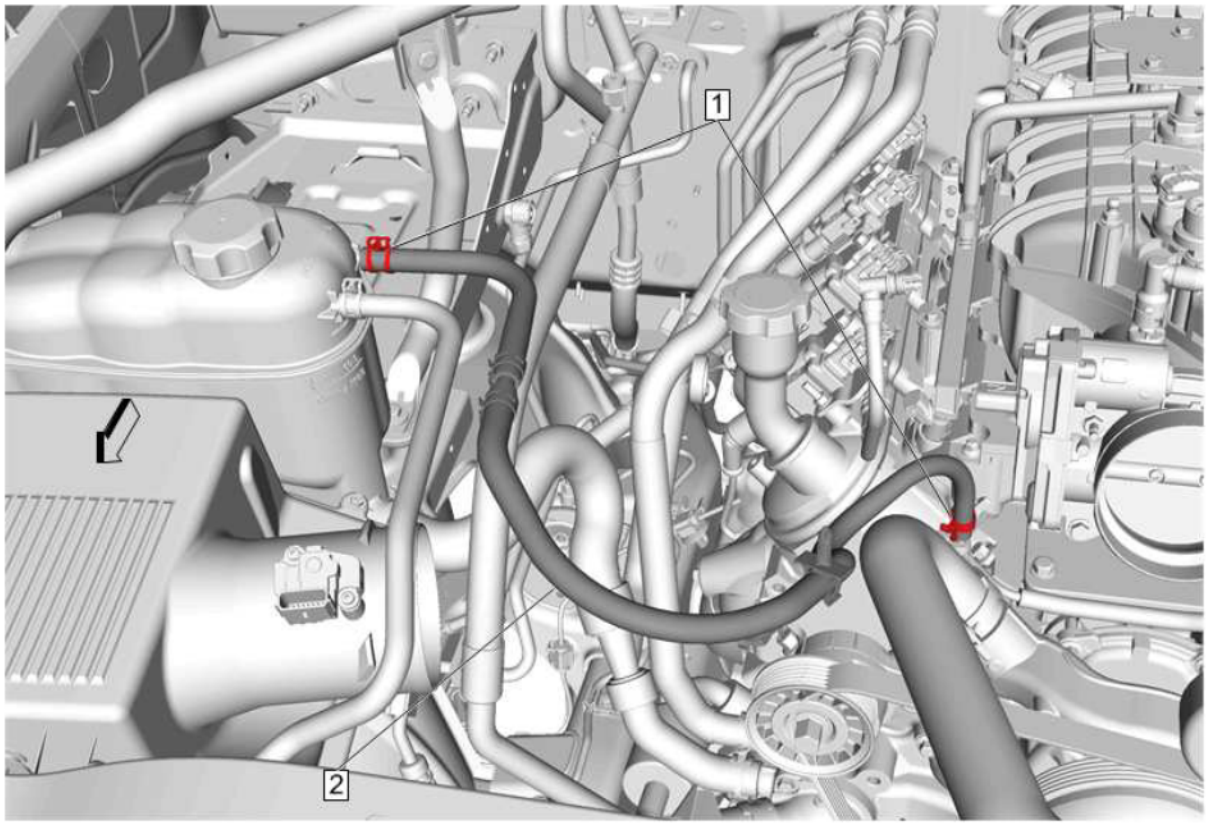
1. Install the radiator surge tank outlet hose (1).

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2. Connect the quick connect at the heater core outlet pipe (4).
3. Install Radiator Surge Tank Outlet Hose@Radiator Surge Tank(3).
4. Engage Radiator Surge Tank Outlet Hose Clamp@Radiator Surge Tank. **Hose Clamp Replacement Guidelines - Spring Type**
5. Install Radiator Surge Tank Outlet Hose@ Engine Coolant Thermostat Housing(2).
6. Engage Radiator Surge Tank Outlet Hose Clamp@Engine Coolant Thermostat Housing. **Hose Clamp Replacement Guidelines - Spring Type**
7. Install the air cleaner assembly. **Air Cleaner Assembly Replacement** .
8. Fill the engine cooling system to the proper level. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)**.
9. Inspect the cooling system for leaks. **Cooling System Leak Testing (L96)**.

RADIATOR SURGE TANK OVERFLOW HOSE REPLACEMENT (L96)



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Fig. 50: Radiator Surge Tank Overflow Hose
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)**. 2. **Intake Manifold Cover Replacement** 3. **Air Cleaner Resonator Outlet Duct Replacement**	
1	Radiator Surge Tank Overflow Hose Clamp (Qty: 2) **Procedure** **Hose Clamp Replacement Guidelines - Spring Type**
2	Radiator Surge Tank Overflow Hose **Procedures** 1. Fill the engine cooling system to the proper level. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)** 2. Inspect the cooling system for leaks. **Cooling System Leak Testing (L96)**

RADIATOR INLET HOSE REPLACEMENT (L83 L86)

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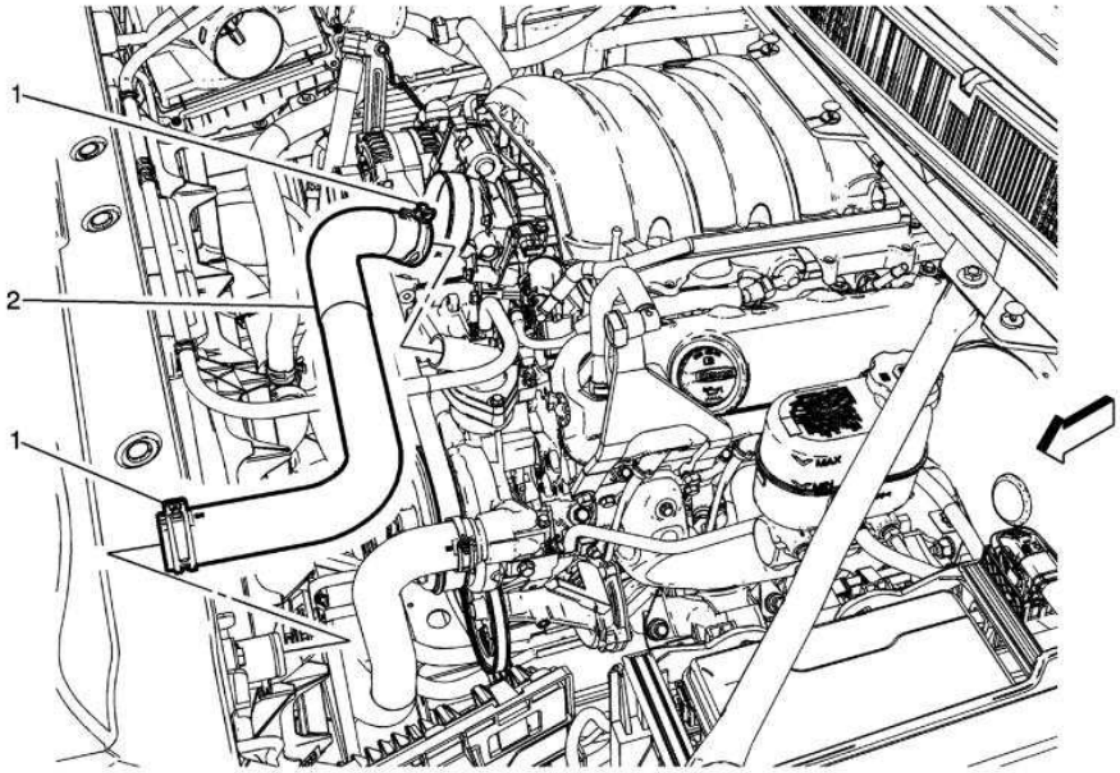


Fig. 51: Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac N Fill L83 L86)** **Cooling System Draining and Filling (Static Fill L83 L86)**. 2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement (Chevrolet and GMC)** **Air Cleaner Outlet Duct Replacement (Cadillac)** .	
1	Radiator Inlet Hose Clamps (Qty: 2) **Procedure** Using **BO-38185** hose clamp pliers, reposition the radiator inlet hose clamps.

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Callout	Component Name
	Special Tools **BO-38185** Hose Clamp Pliers For equivalent regional tools, refer to **Special Tools**.
2	Radiator Inlet Hose **Procedures** 1. Fill the cooling system to the proper level. 2. Inspect the cooing system for leaks.

RADIATOR INLET HOSE REPLACEMENT (L96)

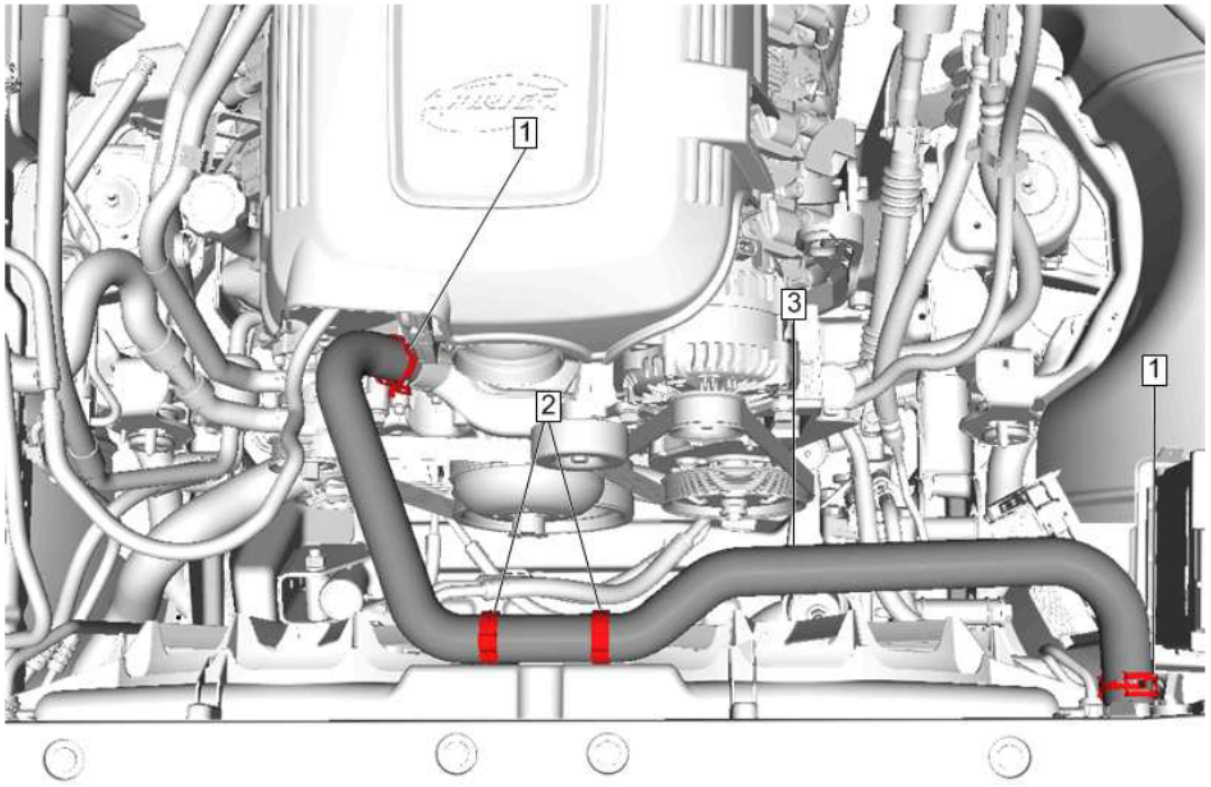


Fig. 52: Radiator Inlet Hose

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Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Drain the cooling system **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)** 2. Remove Air Cleaner Assembly -**Air Cleaner Assembly Replacement**	
1	Radiator Inlet Hose Clamp (Qty: 2) **Hose Clamp Replacement Guidelines - Spring Type**
2	Radiator Inlet Hose Retainer (Qty: 2)
3	Radiator Inlet Hose **Procedures** 1. Fill the cooling system to the proper level. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)** 2. Inspect the cooing system for leaks.

RADIATOR OUTLET HOSE REPLACEMENT (L83 L86)

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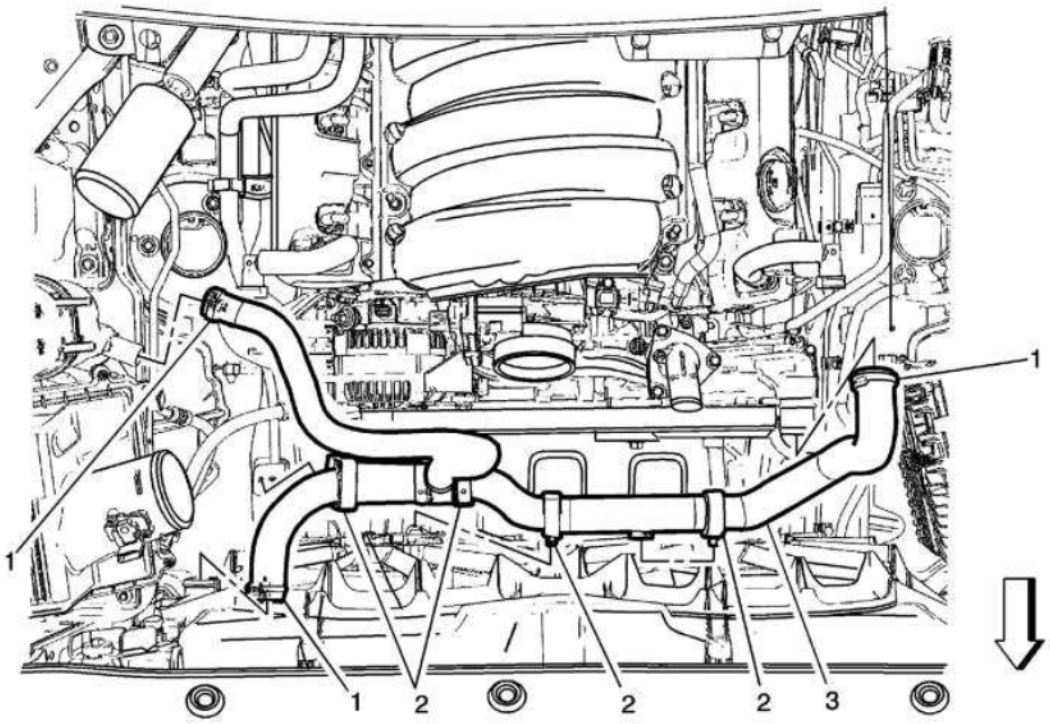


Fig. 53: Radiator Outlet Hose Retainers
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac N Fill L83 L86)** **Cooling System Draining and Filling (Static Fill L83 L86)**. 2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement (Chevrolet and GMC)** **Air Cleaner Outlet Duct Replacement (Cadillac)** .	
1	Radiator Outlet Hose Clamp (Qty: 3) **Procedure** Using **BO-38185** hose clamp pliers, reposition the radiator outlet hose clamps.

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Callout	Component Name
	Special Tools **BO-38185** Hose Clamp Pliers For equivalent regional tools, refer to **Special Tools**.
2	Radiator Outlet Hose Retainer (Qty: 3) **Procedure** Remove the radiator outlet hose retainers from the engine coolant fan rear shroud and the radiator outlet pipe bracket.
3	Radiator Outlet Hose **Procedure** 1. Fill the cooling system to the proper level. 2. Inspect the cooing system for leaks.

RADIATOR OUTLET HOSE REPLACEMENT (L96)

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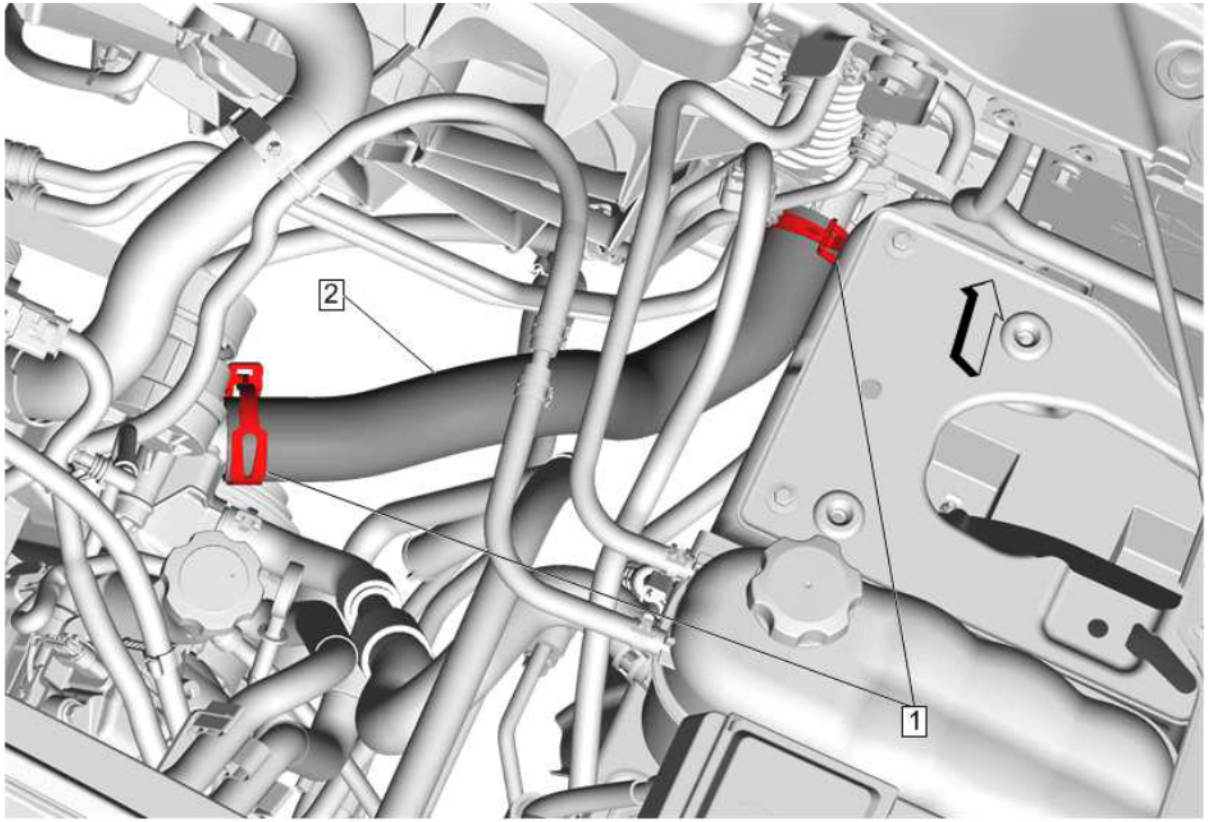


Fig. 54: Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)**. 2. Remove the air cleaner resonator outlet duct. **Air Cleaner Resonator Outlet Duct Replacement** . 3. Remove the air cleaner assembly. **Air Cleaner Assembly Replacement**	
1	Radiator Outlet Hose Clamp **Procedure** Disengage tension on the radiator outlet hose clamp using **BO-38185** hose clamp pliers. **Hose Clamp Replacement**

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Callout	Component Name
	Guidelines - Spring Type **Special Tools** **BO-38185** Hose Clamp Pliers For equivalent regional tools, refer to **Special Tools**.
2	Radiator Outlet Hose **Procedure** 1. Fill the engine cooling system to the proper level. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)**. 2. Inspect the cooling system for leaks. **Cooling System Leak Testing (L96)**.

FAN BLADE REPLACEMENT (L83 L86)

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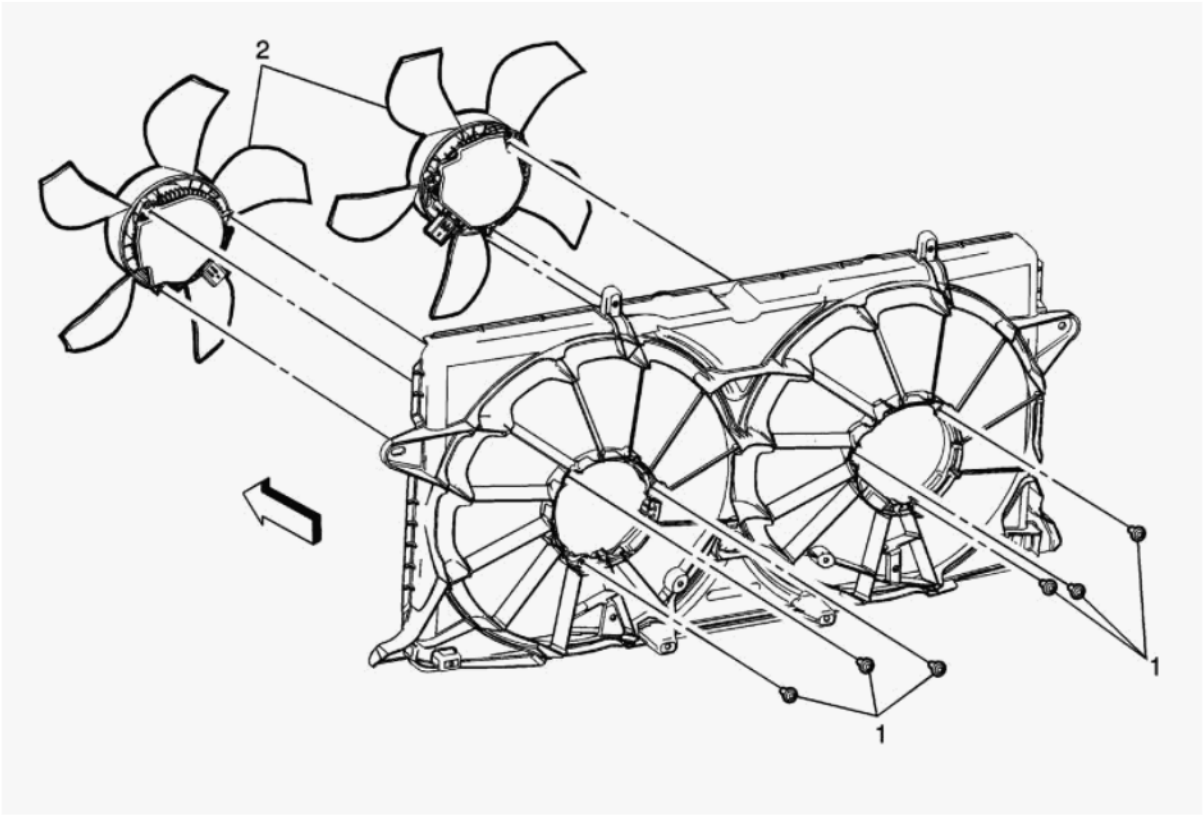


Fig. 55: Engine Coolant Fan
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove engine coolant fan rear shroud. Refer to **Engine Coolant Fan Rear Shroud Replacement (L96)**. **NOTE:** **The left and right side fan blades are different. Ensure you install the**	

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Callout	Component Name
left or right side fan blades on the proper side.	
1	Fan Blade Fastener (Qty: 6) Three Per Motor **CAUTION:** **Refer to Fastener Caution .**
2	Fan Blade (Qty: 2)

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (L83, L86)

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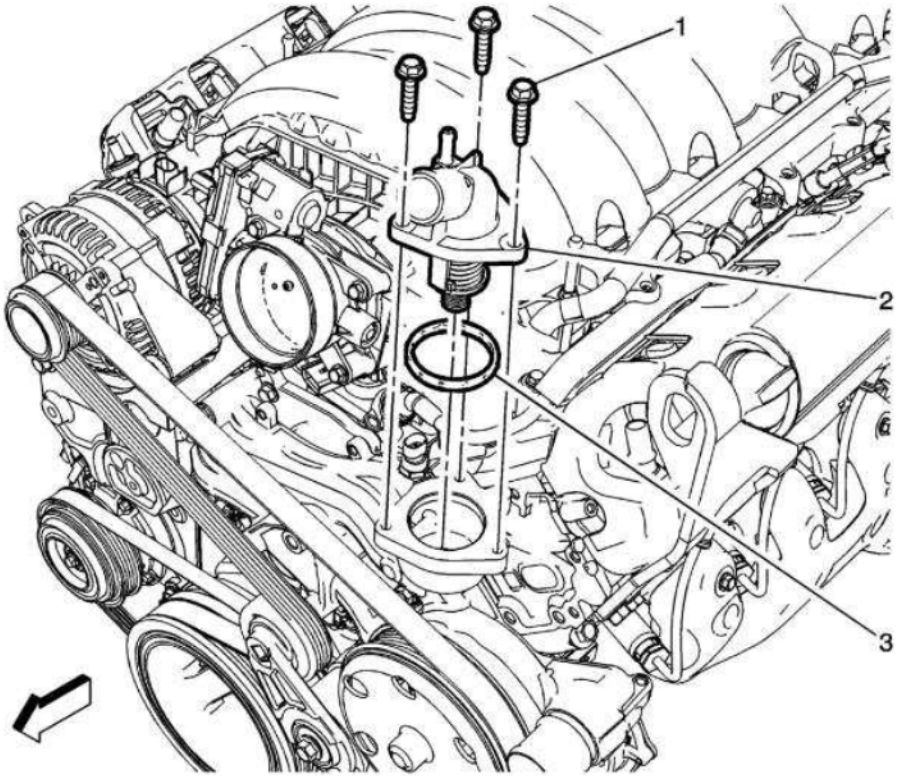


Fig. 56: Engine Coolant Thermostat Housing (L83 With Thermostat)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAUTION: Use caution when removing the hose from the thermostat housing. The plastic thermostat	

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Callout	Component Name
housing may break if excessive force is used. **Preliminary Procedures** 1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac N Fill L83 L86)Cooling System Draining and Filling (Static Fill L83 L86)**. 2. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement (Chevrolet and GMC) Air Cleaner Outlet Duct Replacement (Cadillac)** . 3. Disconnect the radiator inlet hose from the thermostat housing. Refer to **Radiator Inlet Hose Replacement (L83 L86)**. 4. Disconnect the radiator surge tank inlet hose from the thermostat housing. Refer to **Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Radiator L83 L86)Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Water Outlet L83 L86)**.	
1	Thermostat Housing Bolt (Qty: 3) **CAUTION:** **Refer to Fastener Caution .** **Procedure** Remove the thermostat housing bolts. **Tighten** 10 N.m (89 lb in)
2	Thermostat Housing
3	Thermostat Housing Gasket **Procedure** Install a new thermostat gasket.

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (L96)

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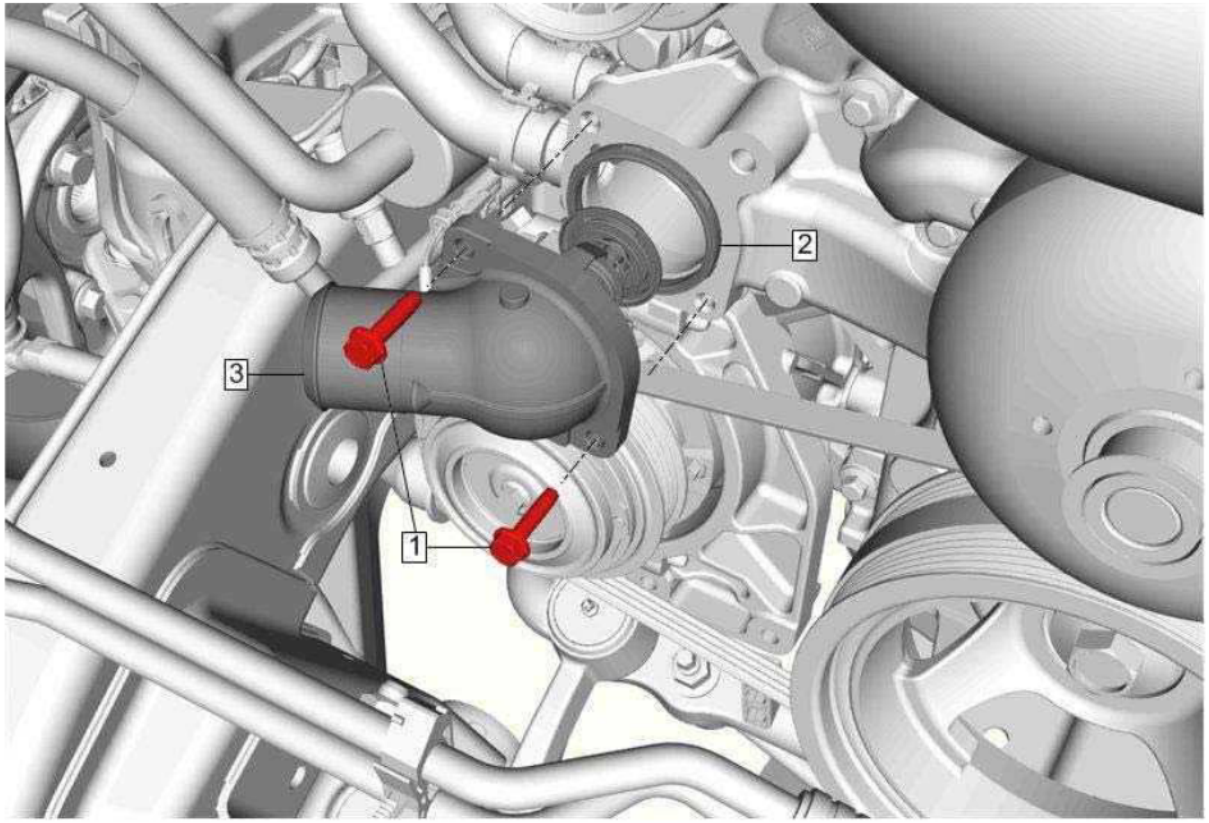


Fig. 57: Engine Coolant Thermostat Housing
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)** 2. **Air Cleaner Resonator Outlet Duct Replacement** 3. Disconnect Radiator Outlet Hose@Engine Coolant Thermostat Housing -**Radiator Outlet Hose Replacement (L96)**	
1	Engine Coolant Thermostat Housing Bolt (Qty: 2) **CAUTION:**

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Callout	Component Name
	Refer to **Fastener Caution** . **Tighten** 15 N.m (11 lb ft)
2	Engine Coolant Thermostat Housing Seal
3	Engine Coolant Thermostat Housing

ENGINE COOLANT THERMOSTAT REPLACEMENT (L96)

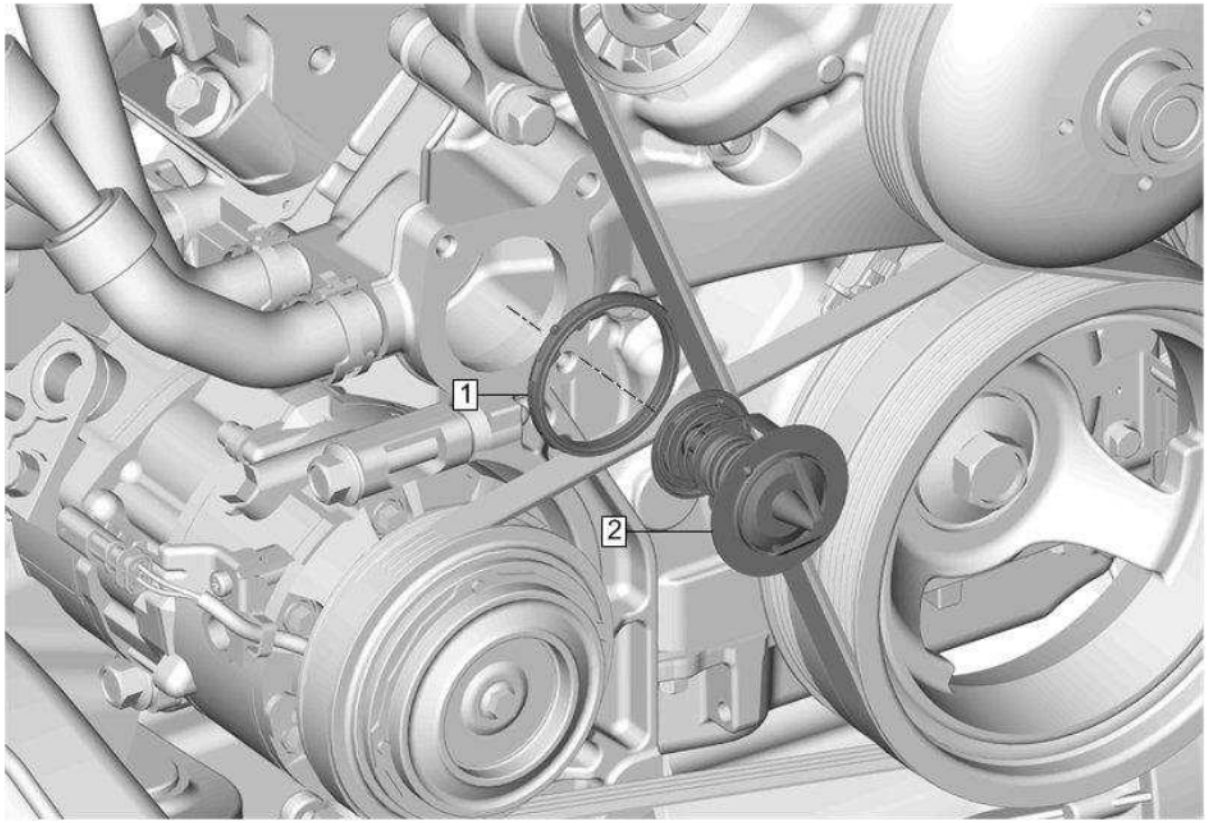


Fig. 58: Engine Coolant Thermostat

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Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Engine Coolant Thermostat Housing Replacement (L96)**	
1	**NOTE:** **Install a NEW engine coolant thermostat housing seal.** Engine Coolant Thermostat Housing Seal
2	Engine Coolant Thermostat

ENGINE COOLANT MANIFOLD REPLACEMENT (L83, L86)

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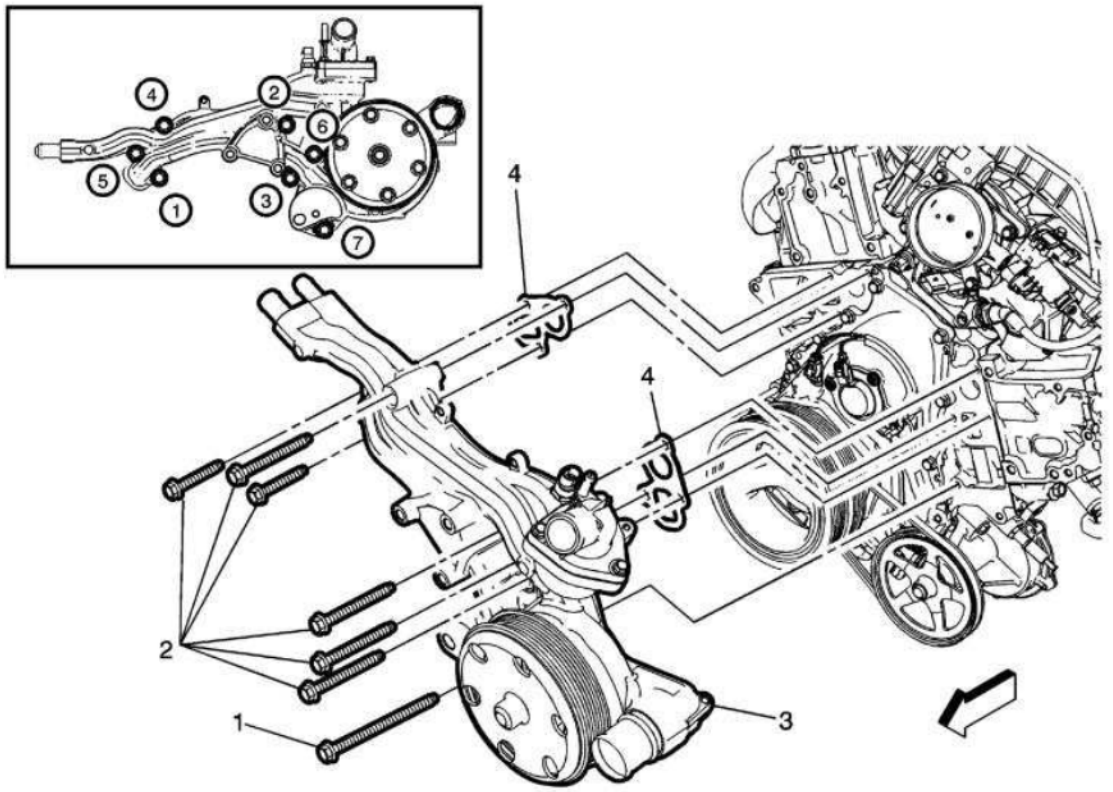


Fig. 59: Engine Coolant Manifold
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Preliminary Procedures

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac N Fill L83 L86)Cooling System Draining and Filling (Static Fill L83 L86)**.
2. Disconnect the engine coolant temperature sensor.
3. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement - Accessory** .
4. Remove the generator and drive belt tensioner bracket. Refer to **Generator Bracket Replacement** .
5. Disconnect the radiator surge tank inlet hose from the engine coolant manifold. Refer to **Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Radiator L83 L86)Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Water Outlet**

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Callout	Component Name
	L83 L86). 6. Disconnect the radiator inlet and outlet hoses from the engine coolant manifold. Refer to, and **Radiator Outlet Hose Replacement (L83 L86)**. 7. Disconnect the heater inlet and outlet hoses from the engine coolant manifold. Refer to **Heater Inlet Hose Replacement (L83 L86)** , and **Heater Outlet Hose Replacement (L83 L86)** . 8. Separate the engine electrical wiring harness from the engine coolant manifold and reposition the harness.
1	Engine Coolant Manifold Fastener (Qty: 7) **CAUTION:** **Refer to Fastener Caution .** **Procedure** Clean the fastener threads and apply thread locker. Refer to **Adhesives, Fluids, Lubricants, and Sealers**. **NOTE:** **Tighten the water pump bolts in the sequence shown.** **Tighten** 25 N.m (18 lb ft)
2	Engine Coolant Manifold Gaskets **Procedure** Install a new engine coolant manifold gaskets.
3	Engine Coolant Manifold **Procedure**

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Callout	Component Name
	If replacing the engine coolant manifold perform the following: 1. **Engine Coolant Manifold Disassemble** 2. **Engine Coolant Manifold Cleaning and Inspection** 3. **Engine Coolant Manifold Assemble**

ENGINE COOLANT AIR BLEED PIPE REPLACEMENT (L96)

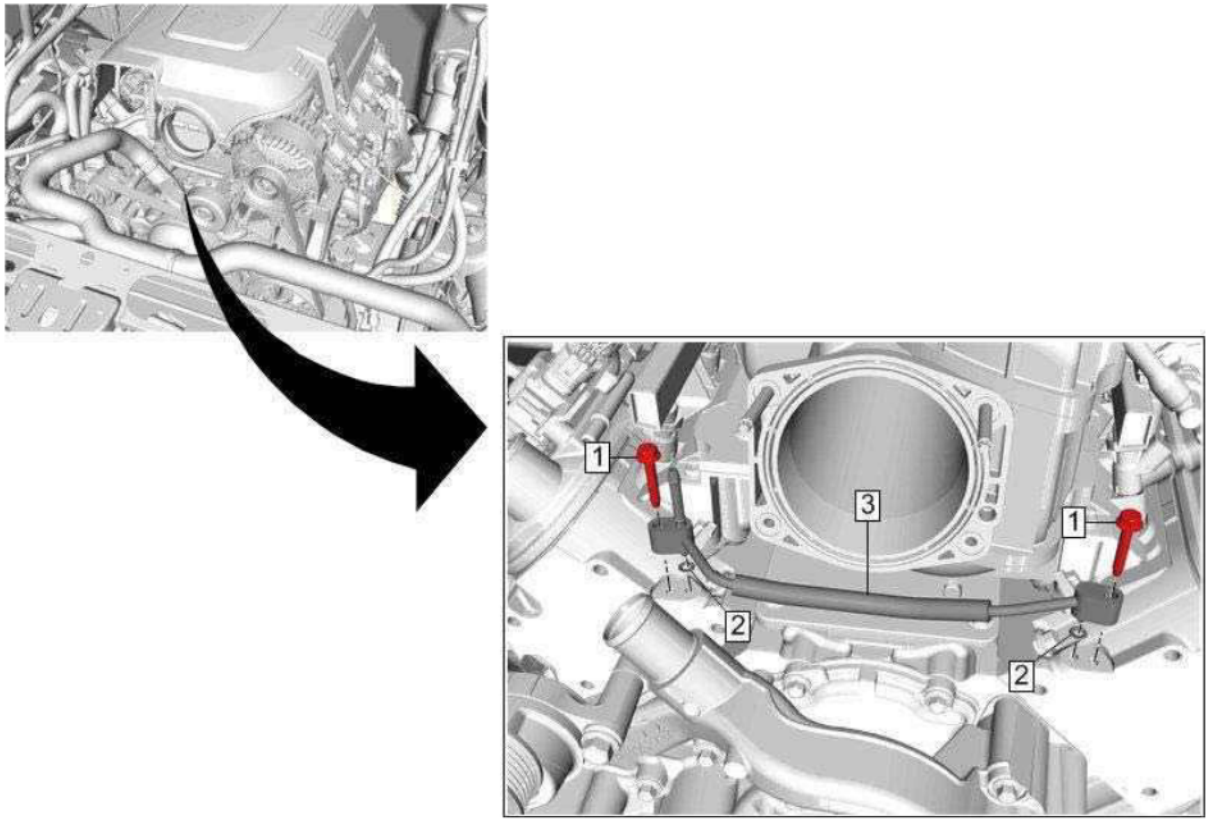


Fig. 60: Engine Coolant Air Bleed Pipe
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

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Callout	Component Name
Preliminary Procedure Disconnect Radiator Surge Tank Overflow Hose @Engine Coolant Air Bleed Pipe -**Radiator Surge Tank Overflow Hose Replacement (L96)**	
1	Engine Coolant Air Bleed Pipe Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 12 N.m (106 lb in)
2	Engine Coolant Air Bleed Pipe O-Ring (Qty: 2) **Procedure** Install a NEW O-ring seal.
3	Engine Coolant Air Bleed Pipe

WATER PUMP REPLACEMENT (L83, L86)

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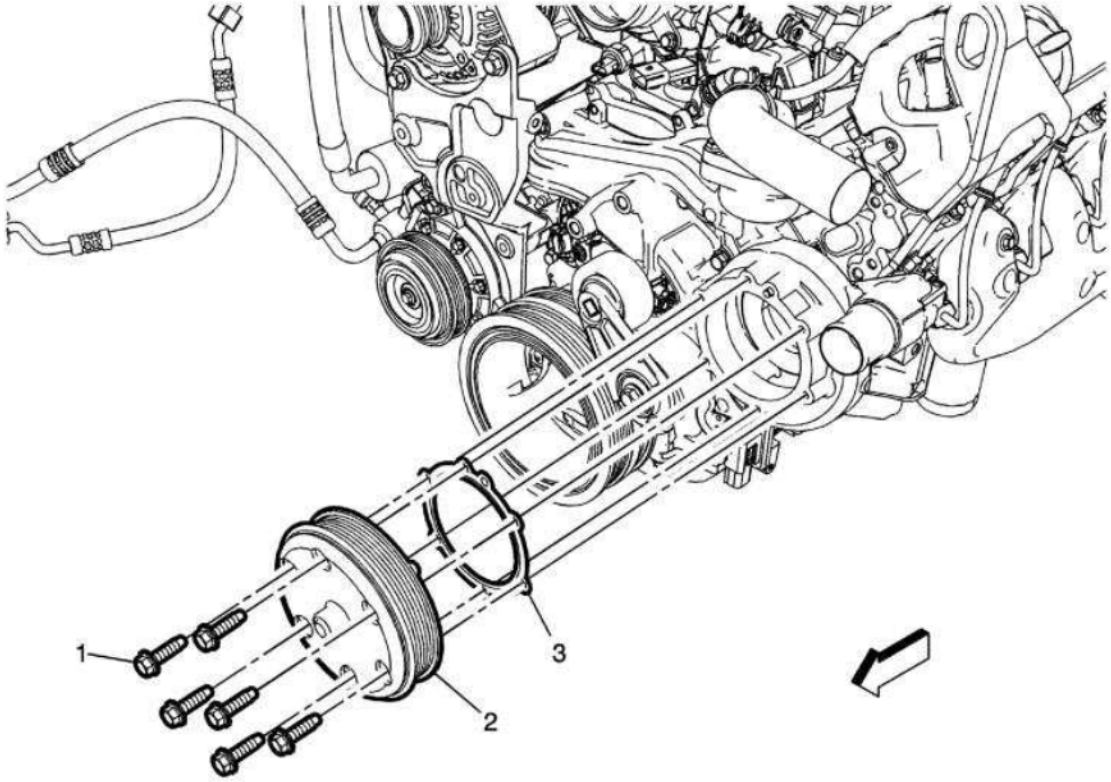


Fig. 61: Water Pump
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac N Fill L83 L86)Cooling System Draining and Filling (Static Fill L83 L86)**. 2. Remove the drive belt. Refer to **Drive Belt Replacement - Accessory** .	
1	Water Pump Bolt (Qty: 6) **CAUTION:**

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Callout	Component Name
	Refer to Fastener Caution . **Procedure** Remove the water pump bolts. **Tighten** 10 N.m (89 lb in)
2	Water Pump
3	Water Pump Gasket **Procedure** Install a new water pump gasket.

WATER PUMP REPLACEMENT (L96)

Removal Procedure

1. Drain the cooling system. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)**
2. Remove Air Cleaner Resonator Outlet Duct.**Air Cleaner Resonator Outlet Duct Replacement** .
3. Remove Drive Belt - Accessory. **Drive Belt Replacement - Accessory** .

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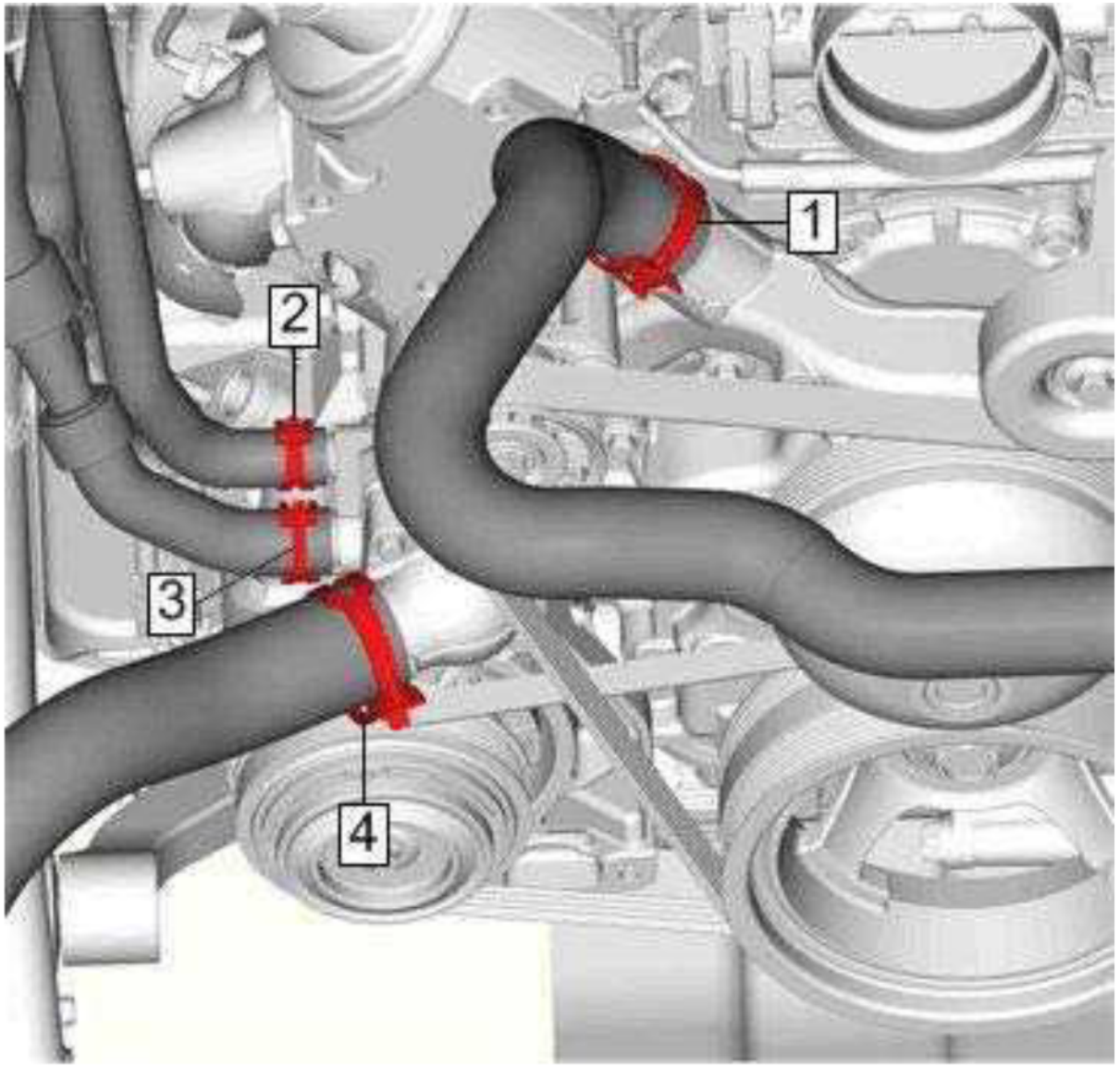


Fig. 62: Hoses
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Radiator Inlet Hose (1).
5. Disconnect Heater Inlet Hose (2).
6. Disconnect Radiator Surge Tank Inlet Hose (3).

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7. Disconnect Radiator Outlet Hose (4)

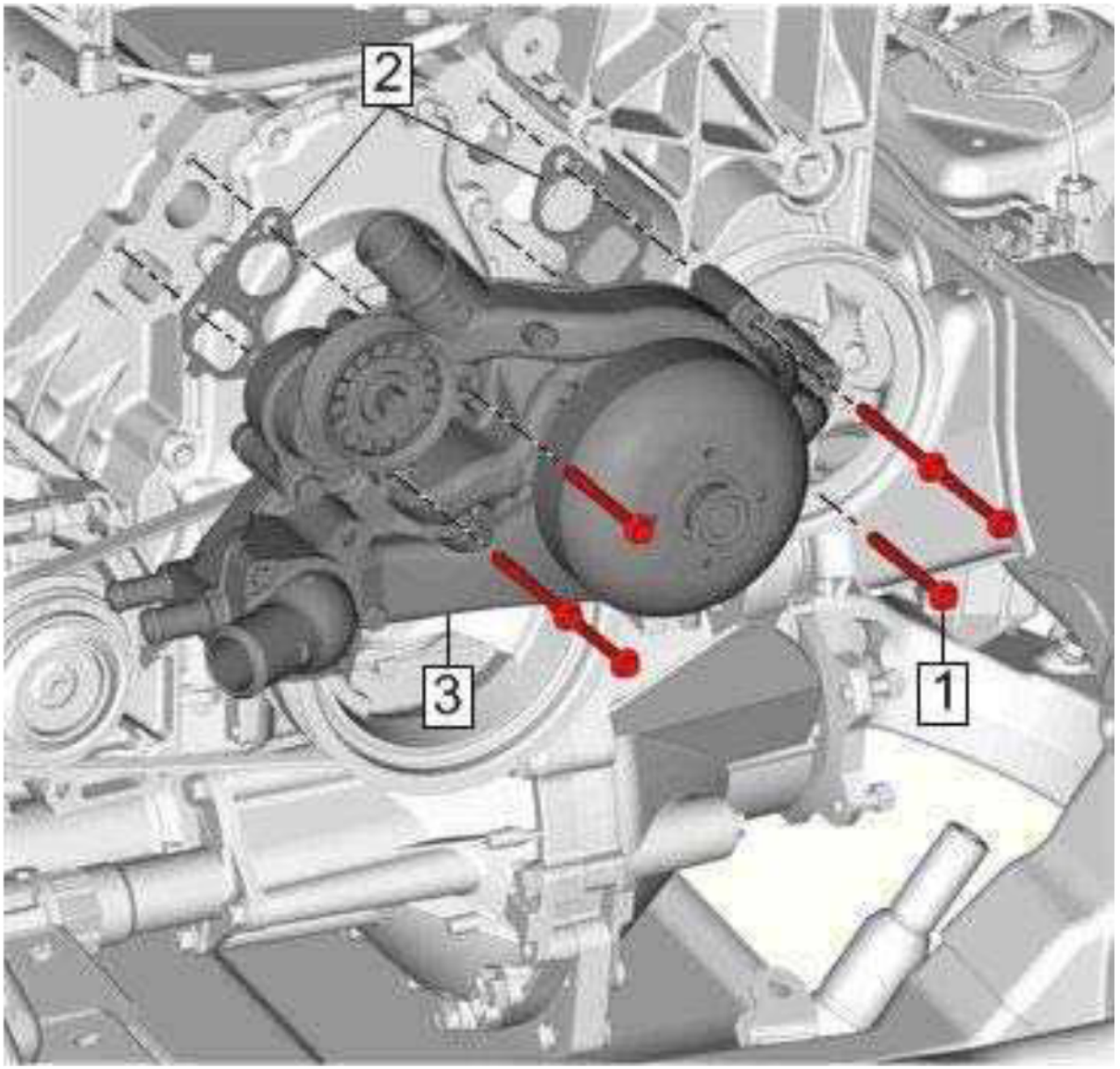


Fig. 63: Water Pump Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove Water Pump Bolt (1).

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9. Remove Water Pump (3).
10. Remove Water Pump Gasket (2) and DISCARD
11. Transfer components as necessary.

Installation Procedure

CAUTION: **DO NOT use cooling system seal tabs, or similar compounds, unless otherwise instructed. The use of cooling system seal tabs, or similar compounds, may restrict coolant flow through the passages of the cooling system or the engine components. Restricted coolant flow may cause engine overheating and/or damage to the cooling system or the engine components/assembly.**

NOTE: **All gaskets surfaces are to be free of oil or other foreign material during assembly.**

1. Carefully clean the water pump sealing surfaces.

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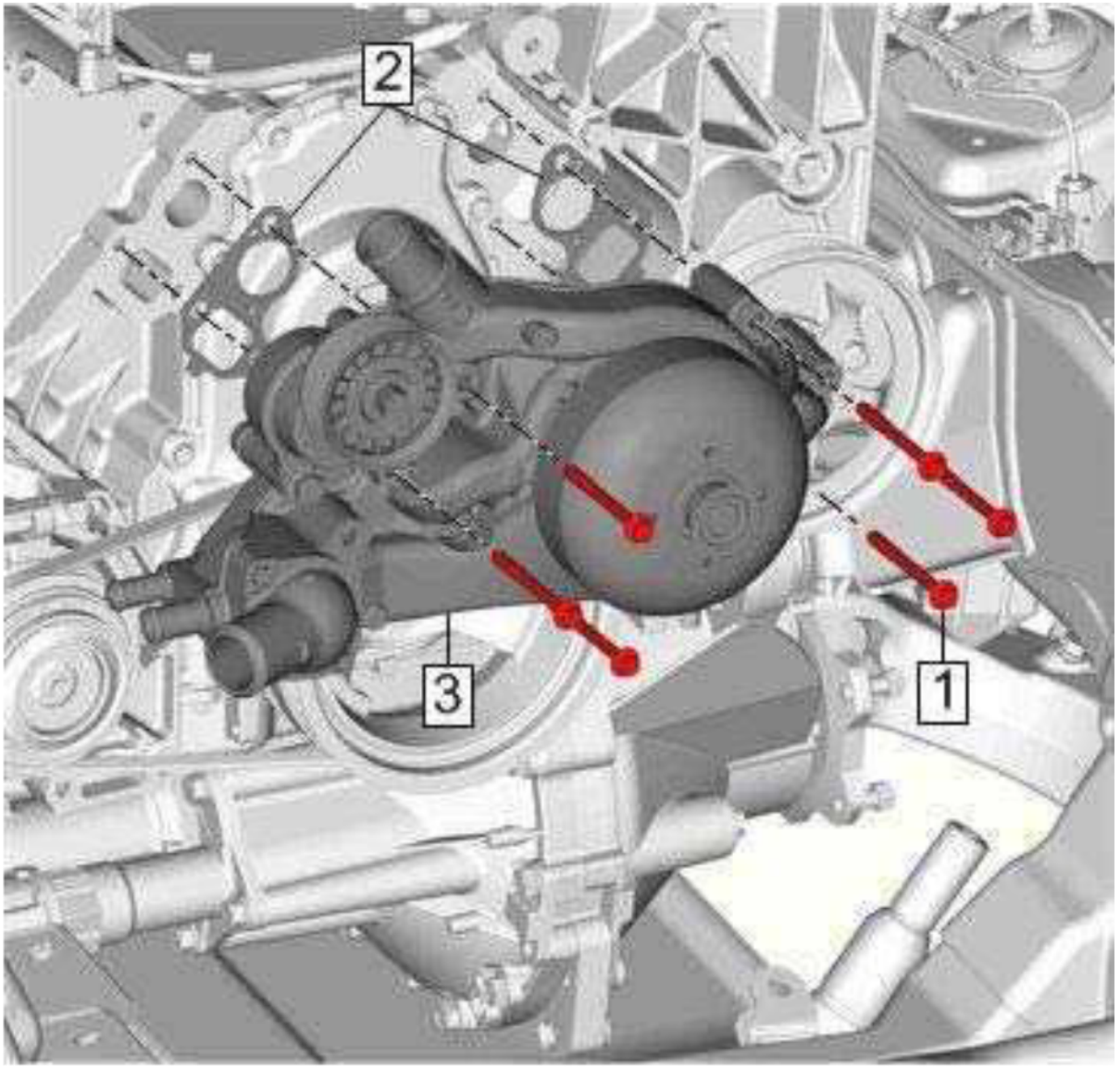


Fig. 64: Water Pump Bolt
Courtesy of GENERAL MOTORS COMPANY

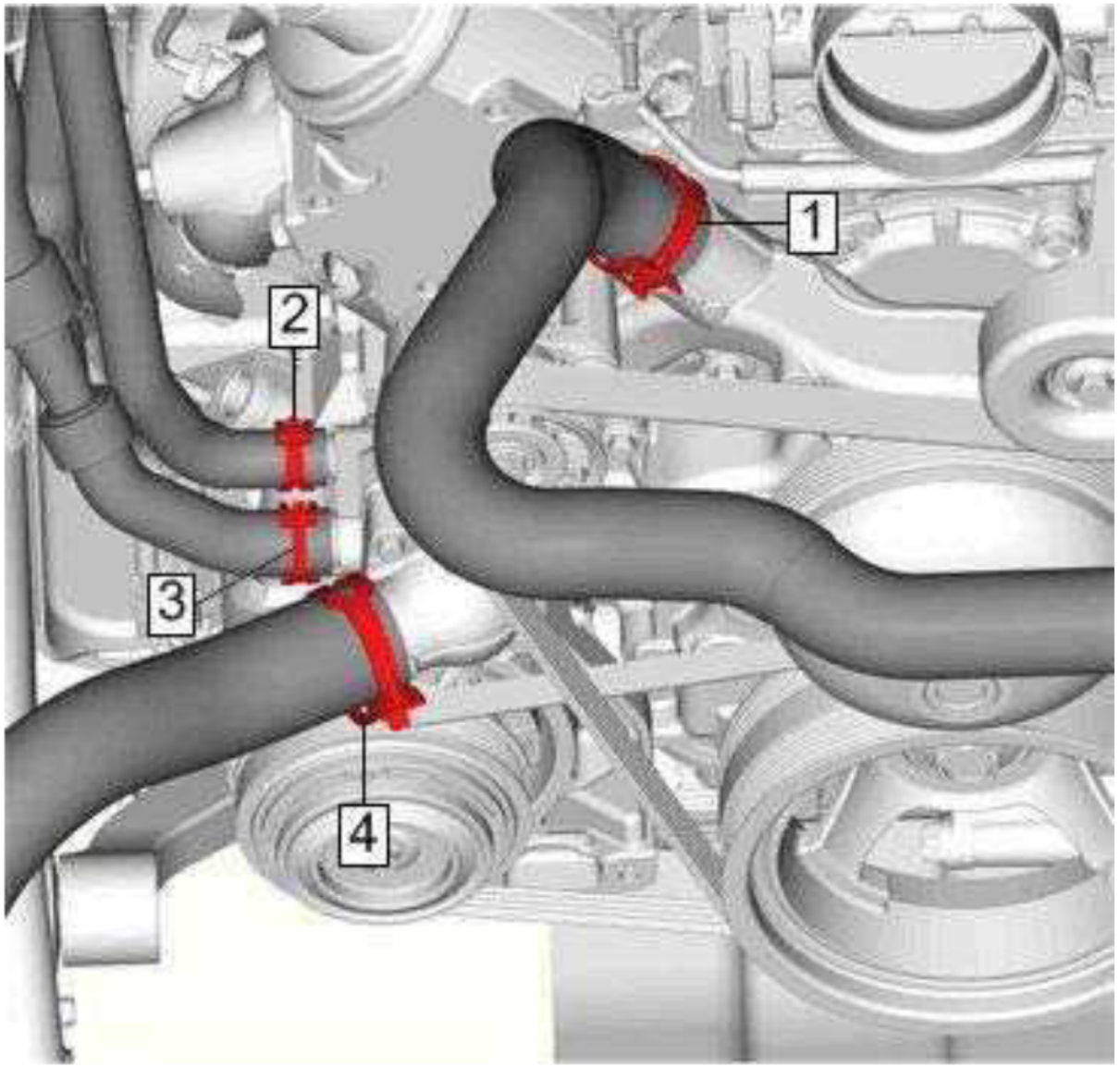
2. Install a NEW water pump gasket (2).
3. Install Water Pump (3).

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CAUTION: **Refer to Fastener Caution .**

4. Install Water Pump Bolt (1) and tighten
   - First Pass 15 N.m (11 lb ft)
   - Second Pass 30 N.m (22 lb ft)



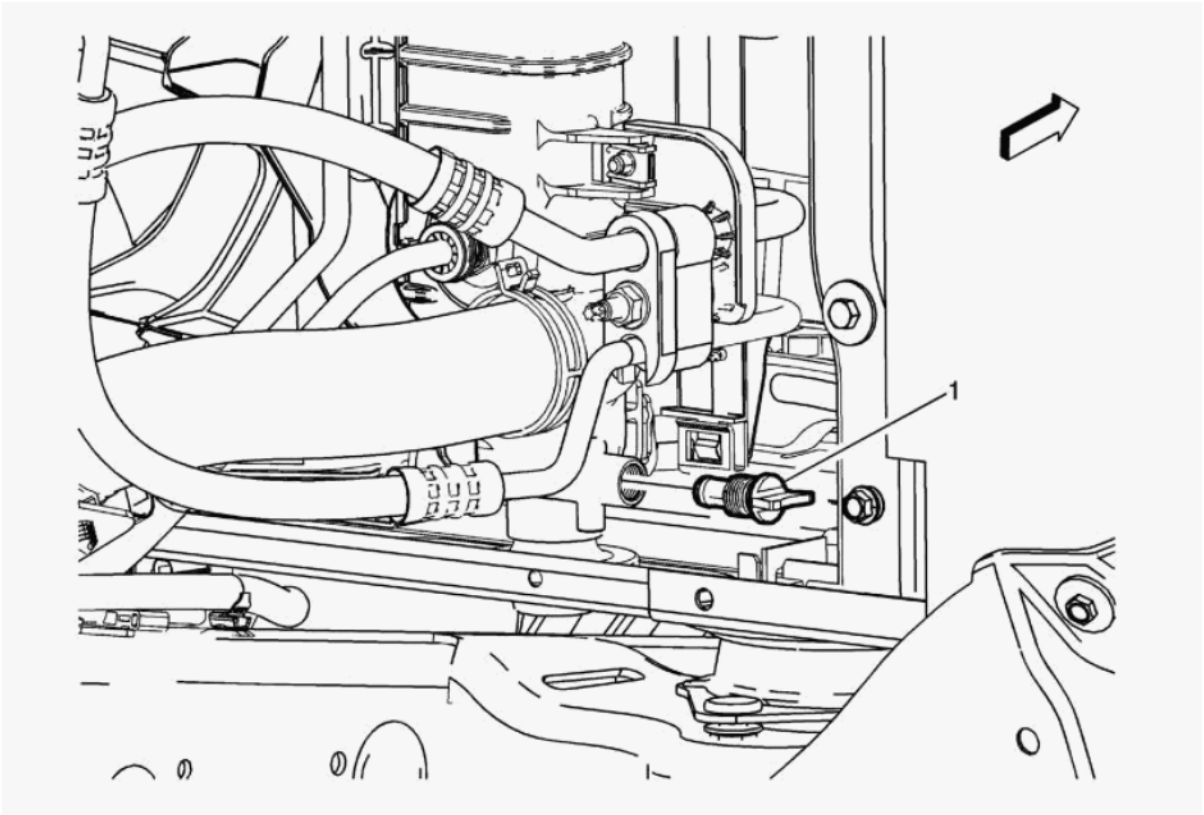
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Fig. 65: Hoses
Courtesy of GENERAL MOTORS COMPANY

5. Connect Radiator Outlet Hose (4)
6. Connect Radiator Surge Tank Inlet Hose (3)
7. Connect Heater Inlet Hose (2)
8. Connect Radiator Inlet Hose (1)
9. Install Drive Belt - Accessory. **Drive Belt Replacement - Accessory**
10. Install Air Cleaner Resonator Outlet Duct. **Air Cleaner Resonator Outlet Duct Replacement**
11. Fill the cooling system to the proper level. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)**

RADIATOR DRAIN COCK REPLACEMENT (L83 L86)



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Fig. 66: Radiator Drain Cock (L83 L86)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Place a drain pan under the radiator drain cock. 3. Remove the right side front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement - Right Side (Cadillac)** **Front Wheelhouse Liner Replacement - Right Side (Chevrolet)** **Front Wheelhouse Liner Replacement - Right Side (GMC)** . 4. Attach a rubber hose to the radiator drain port to guide the coolant into the drain pan 5. Drain the engine coolant. Refer to **Cooling System Draining and Filling (Vac N Fill L83 L86)** **Cooling System Draining and Filling (Static Fill L83 L86)**.	
1	Radiator Drain Cock **CAUTION:** **Refer to Fastener Caution .** **Procedures** 1. Fill the cooling system to the proper level. 2. Inspect the cooing system for leaks.

ENGINE COOLANT FAN REAR SHROUD REPLACEMENT (L83, L86)

Removal Procedure

1. Remove the air cleaner outlet duct. **Air Cleaner Outlet Duct Replacement (Chevrolet and GMC)** **Air Cleaner Outlet Duct Replacement (Cadillac)**
2. Remove the front compartment front sight shield. **Front Compartment Front Sight Shield Replacement (GMC)** **Front Compartment Front Sight Shield Replacement (Chevrolet)** **Front Compartment Front Sight Shield Replacement (Cadillac)**

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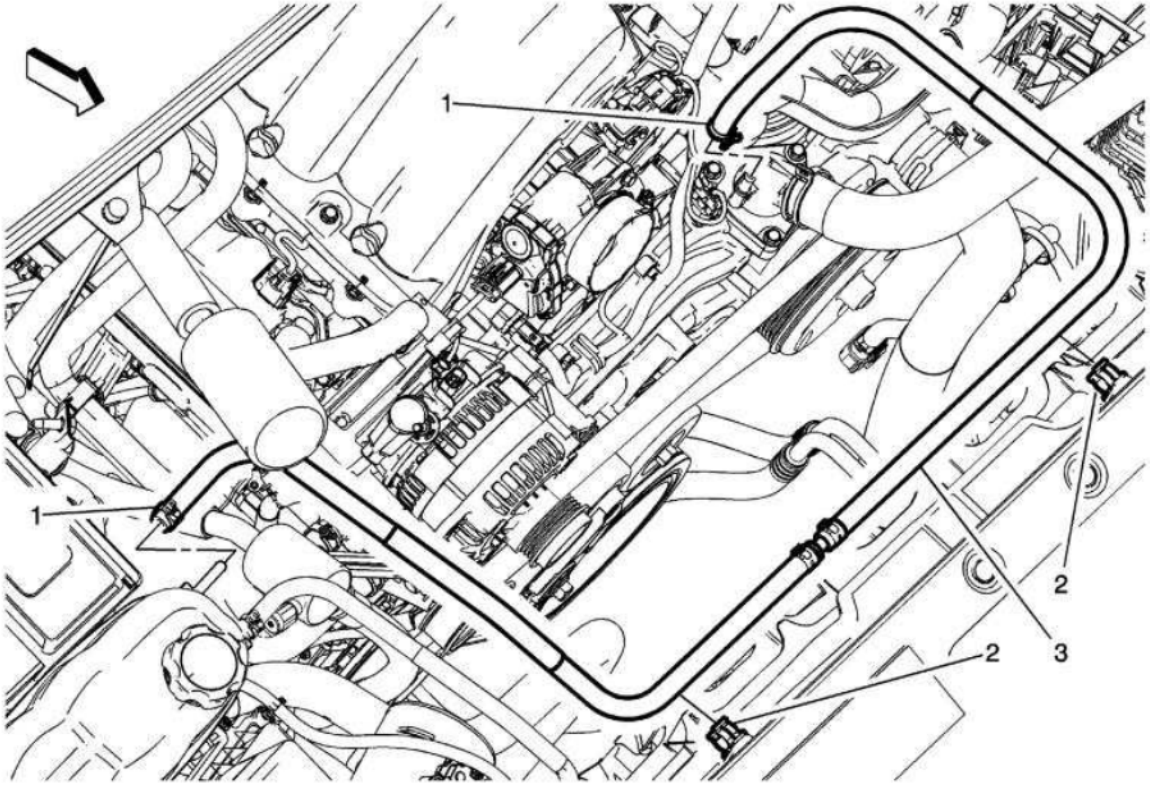


Fig. 67: Radiator Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

3. Unclip the radiator surge tank inlet hose (3) from the engine coolant fan rear shroud and reposition out of the way. **Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Radiator L83 L86)Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Water Outlet L83 L86)**
4. Unclip the electrical harness from the engine coolant fan rear shroud.
5. Disconnect the electrical connectors from the engine coolant fans and reposition out of the way.

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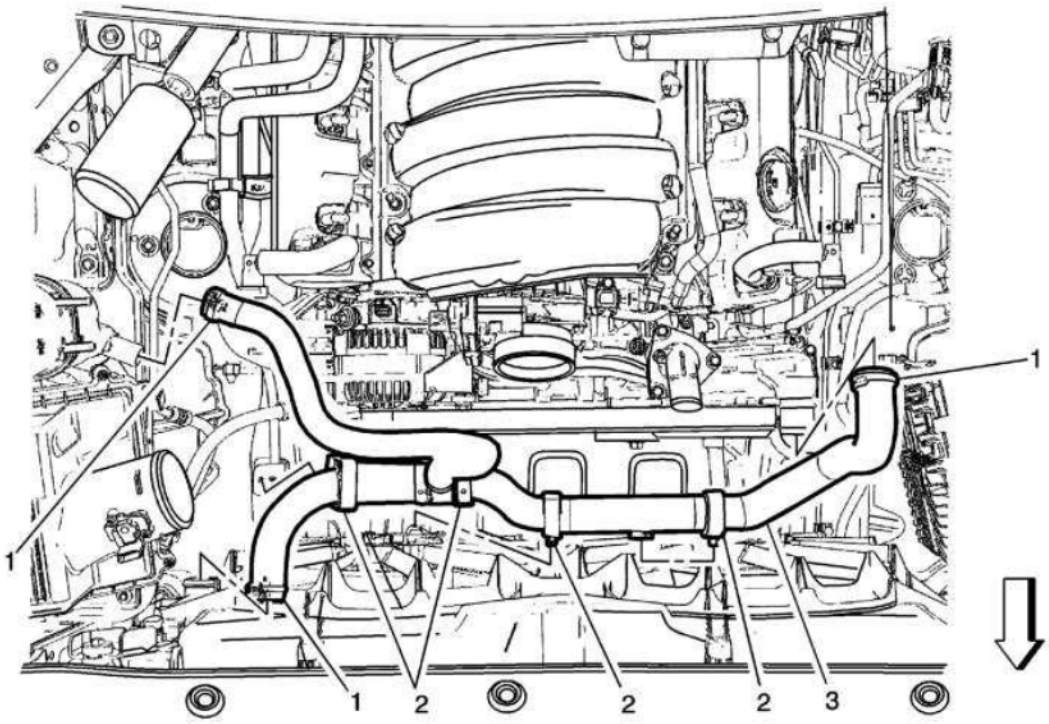


Fig. 68: Radiator Outlet Hose Retainers
Courtesy of GENERAL MOTORS COMPANY

6. Unclip the radiator outlet hose retainers (2) from the engine coolant fan rear shroud. **Radiator Outlet Hose Replacement (L83 L86)**
7. Remove the transmission fluid cooler inlet and outlet pipe from the radiator. **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (L83 MYC)** **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (L86 M5U)**
8. Unclip the transmission fluid cooler inlet and outlet pipe from the engine coolant fan rear shroud.
9. Remove the engine oil cooler hose from the radiator. **Engine Oil Cooler Hose Replacement**
10. Unclip the engine oil cooler hose from the engine coolant fan rear shroud.

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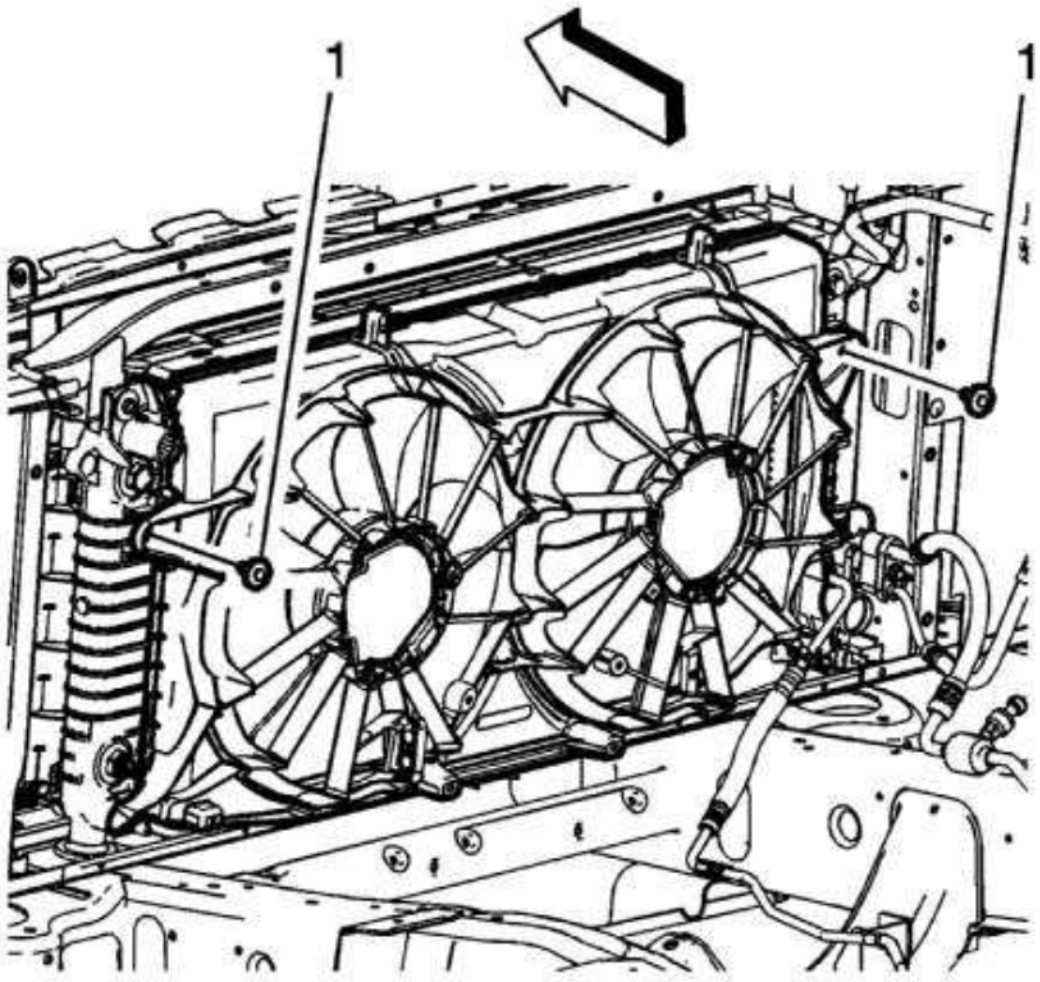


Fig. 69: Engine Coolant Fan Rear Shroud Bolts
Courtesy of GENERAL MOTORS COMPANY

11. Remove the engine coolant fan rear shroud bolts (1).

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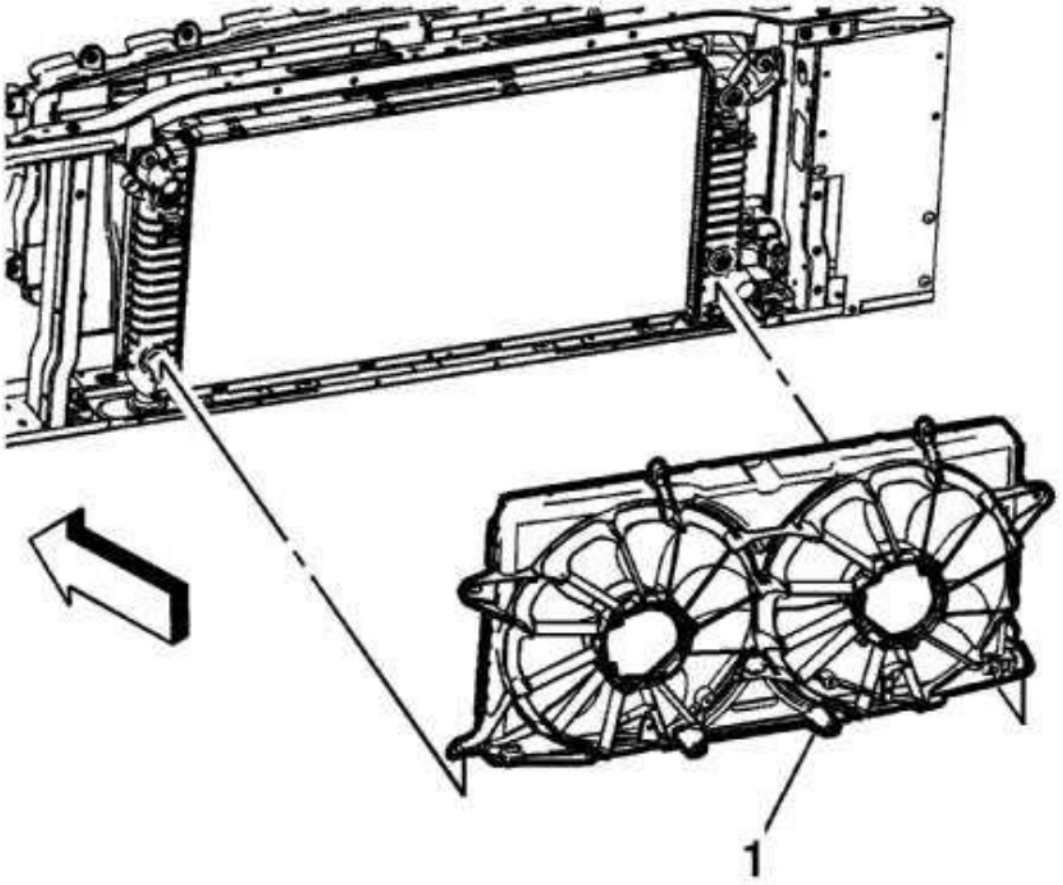


Fig. 70: Engine Coolant Fan Rear Shroud
Courtesy of GENERAL MOTORS COMPANY

12. Remove the engine coolant fan rear shroud (1) from the vehicle.

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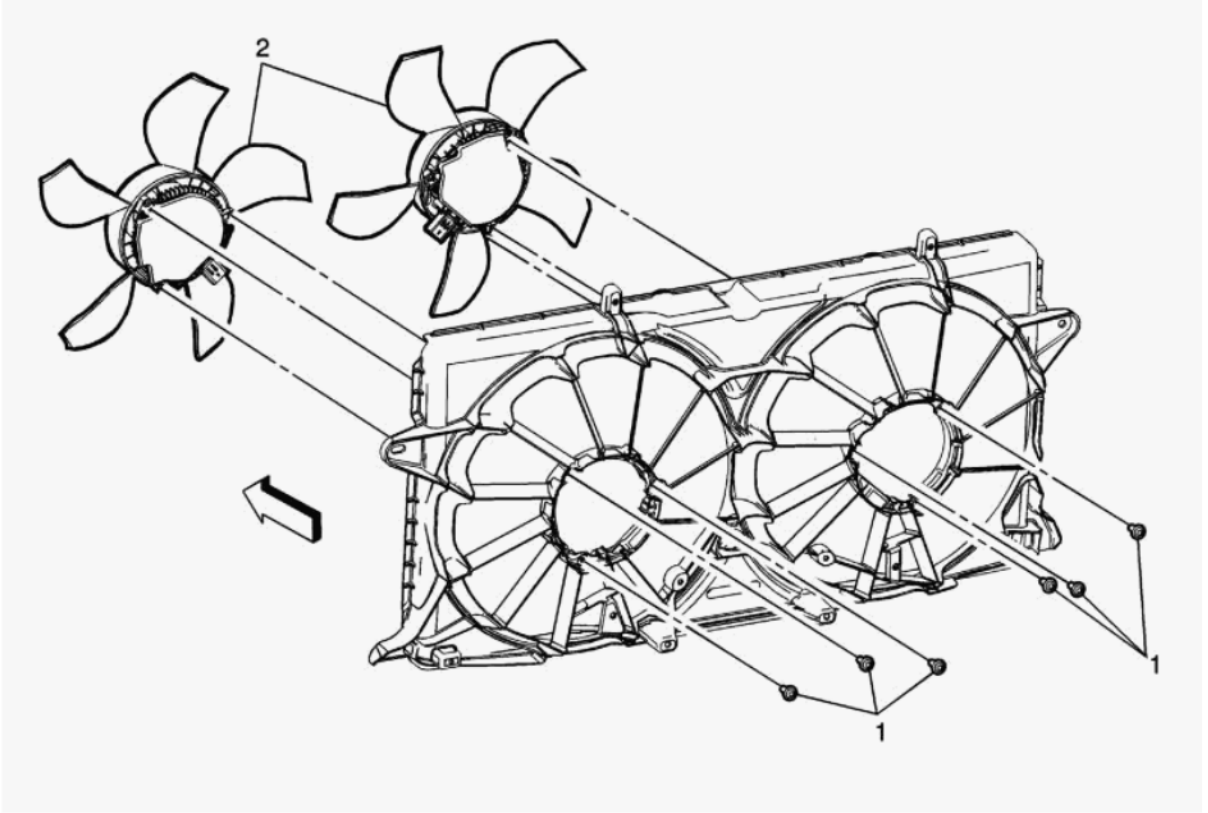


Fig. 71: Engine Coolant Fan
Courtesy of GENERAL MOTORS COMPANY

13. Remove the fan blade (2) from the engine coolant fan rear shroud. **Fan Blade Replacement (L83 L86)**

Installation Procedure

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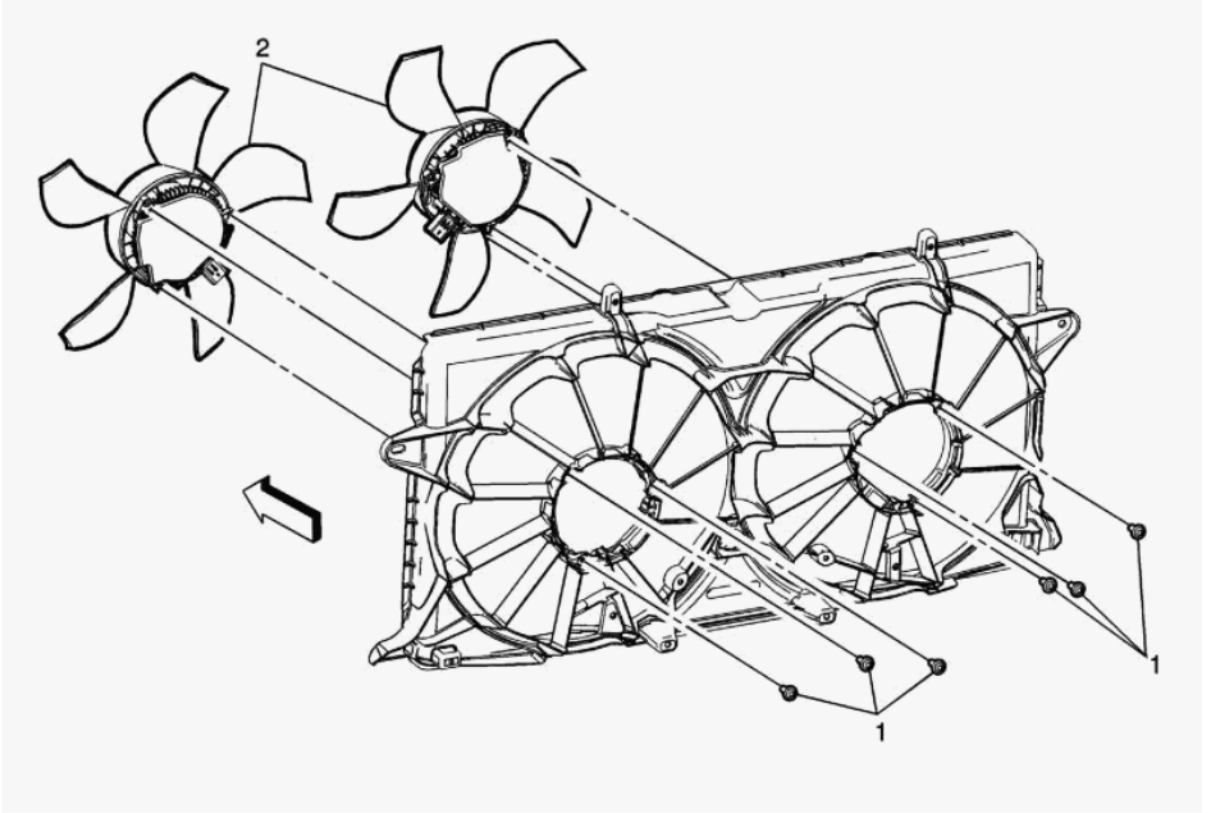


Fig. 72: Engine Coolant Fan
Courtesy of GENERAL MOTORS COMPANY

1. Install the fan blade (2) to the engine coolant fan rear shroud. **Fan Blade Replacement (L83 L86)**

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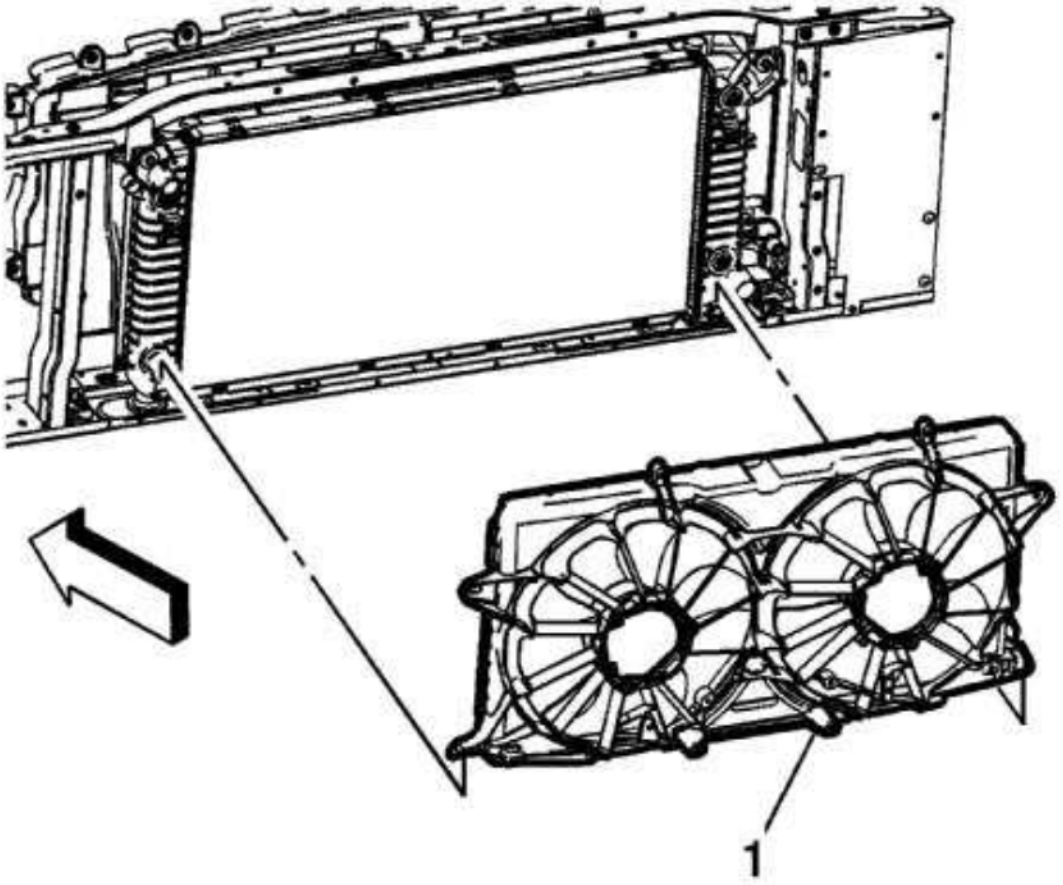


Fig. 73: Engine Coolant Fan Rear Shroud
Courtesy of GENERAL MOTORS COMPANY

2. Install the engine coolant fan rear shroud (1) to the radiator.

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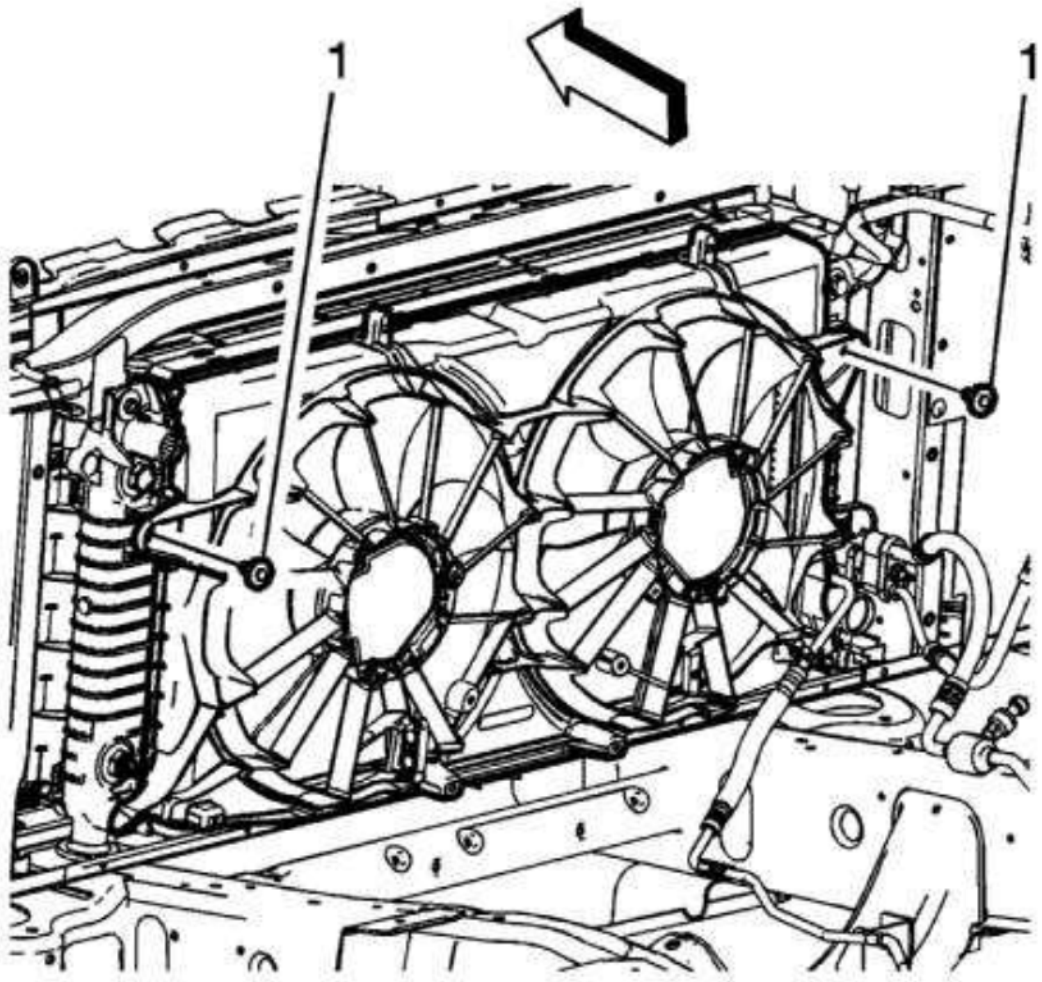


Fig. 74: Engine Coolant Fan Rear Shroud Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

3. Install the engine coolant fan rear fan shroud bolts (1) and tighten to 7 N.m (62 lb in).
4. Install the engine oil cooler hose to the radiator. **Engine Oil Cooler Hose Replacement**

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5. Install the engine oil cooler hose to the engine coolant fan rear shroud.
6. Install the transmission fluid cooler inlet and outlet pipe to the radiator. **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (L83 MYC)** **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (L86 M5U)**
7. Install the transmission fluid cooler inlet and outlet pipe to the engine coolant fan rear shroud.

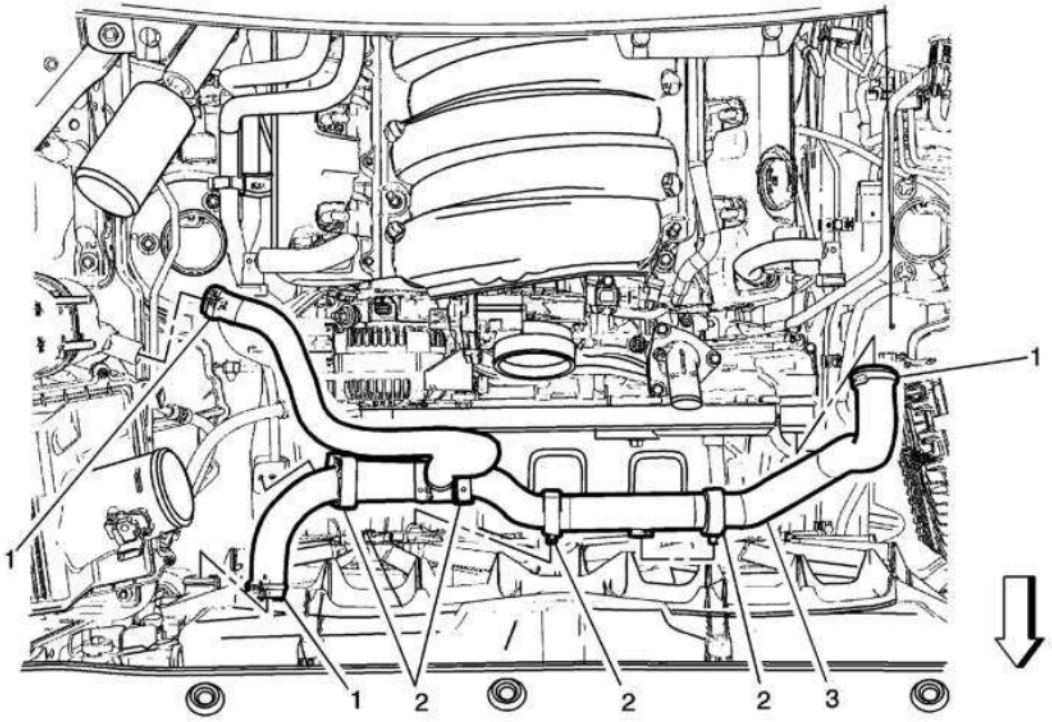


Fig. 75: Radiator Outlet Hose Retainers
Courtesy of GENERAL MOTORS COMPANY

8. Install the radiator outlet hose retainers (2) to the engine coolant fan rear shroud. **Radiator Outlet Hose Replacement (L83 L86)**
9. Connect the electrical connectors to the engine coolant fans.
10. Install the electrical harness to the engine coolant fan rear shroud.

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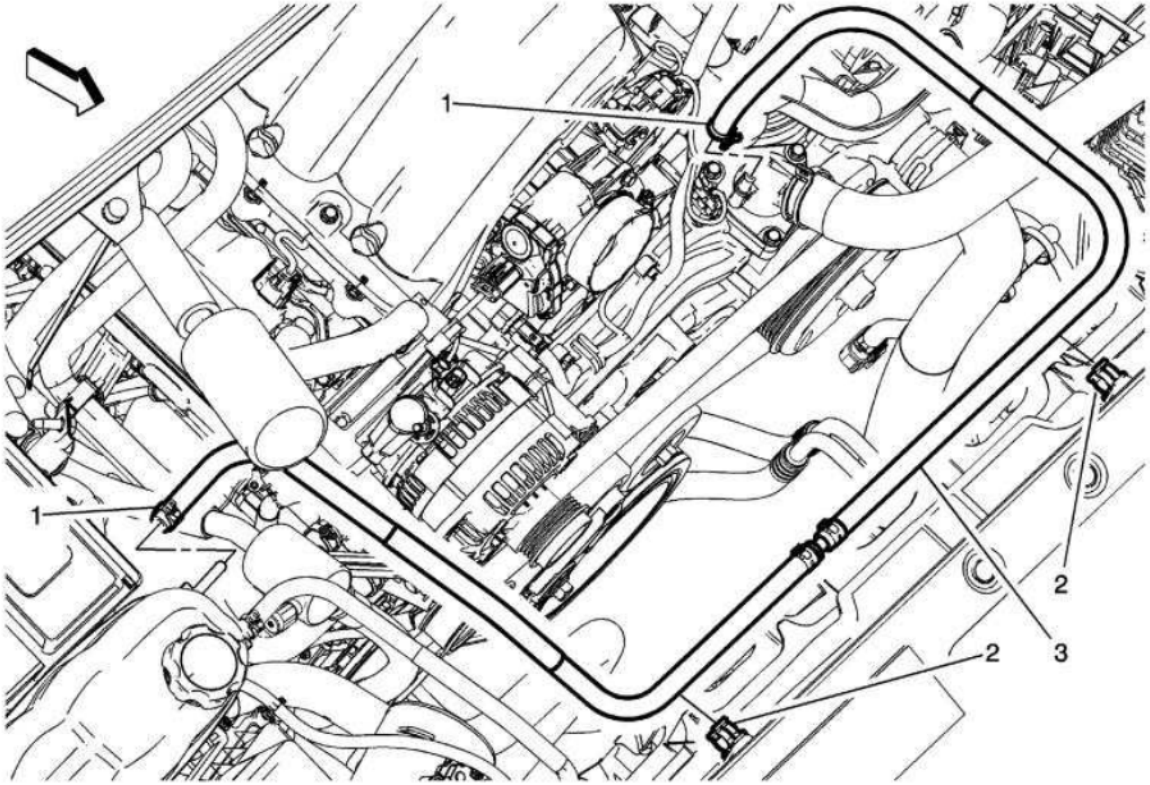


Fig. 76: Radiator Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

11. Install the radiator surge tank inlet hose (3) to the engine coolant fan rear shroud. **Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Radiator L83 L86)Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Water Outlet L83 L86)**
12. Install the front compartment front sight shield. **Front Compartment Front Sight Shield Replacement (GMC) Front Compartment Front Sight Shield Replacement (Chevrolet) Front Compartment Front Sight Shield Replacement (Cadillac)**
13. Install the air cleaner outlet duct. **Air Cleaner Outlet Duct Replacement (Chevrolet and GMC) Air Cleaner Outlet Duct Replacement (Cadillac)**

ENGINE COOLANT FAN REAR SHROUD REPLACEMENT (L96)

Removal Procedure

1. Remove Air Cleaner Resonator Outlet Duct -**Air Cleaner Resonator Outlet Duct Replacement**

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2. Remove Air Cleaner Assembly -**Air Cleaner Assembly Replacement**
3. Disconnect Engine Oil Cooler Hose@Engine Coolant Fan Rear Shroud -**Engine Oil Cooler Hose Replacement**

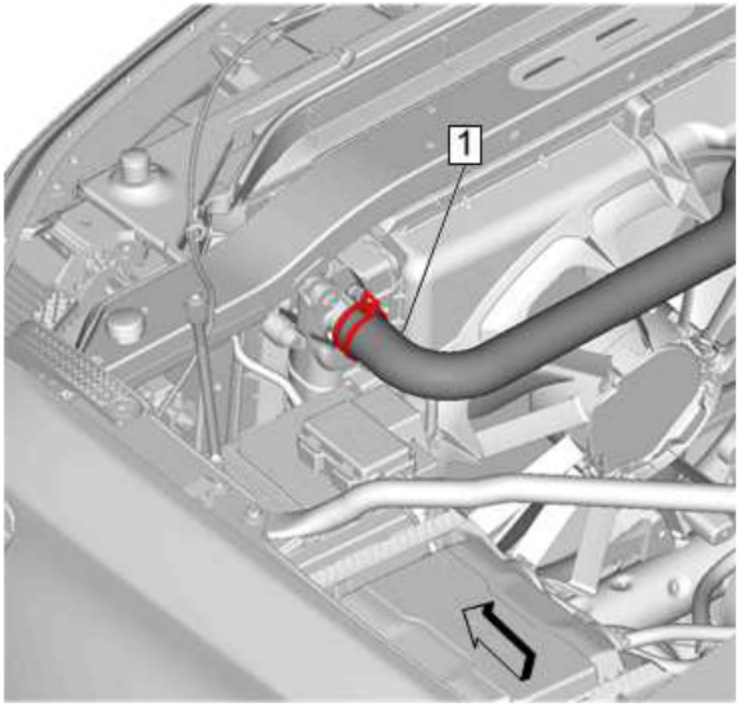


Fig. 77: Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Radiator Inlet Hose (1) @Radiator **Radiator Inlet Hose Replacement (L96)**

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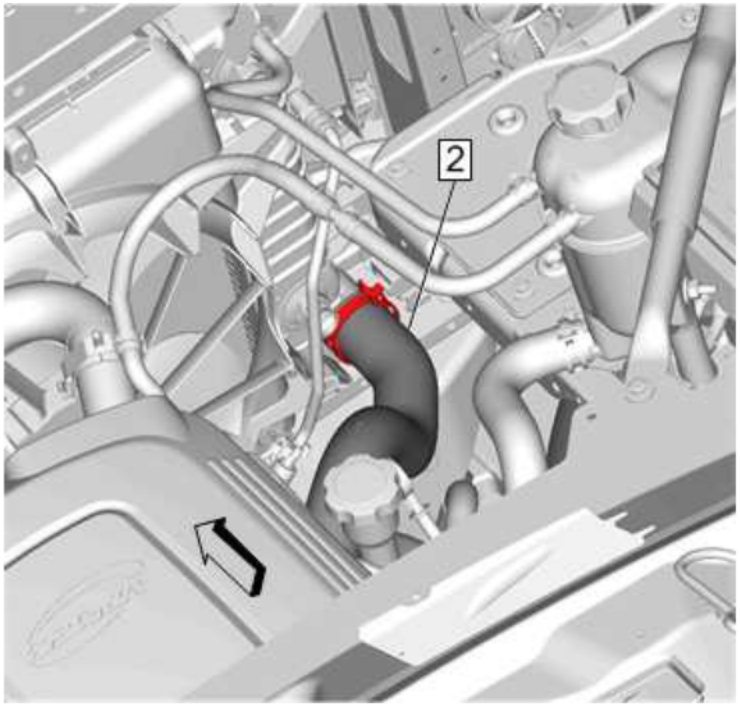


Fig. 78: Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Radiator Outlet Hose (1) @Radiator **Radiator Outlet Hose Replacement (L96)**
6. Without disconnecting the transmission fluid cooler lines at the radiator, unclip the retainers at the shroud and position the lines out of the way.

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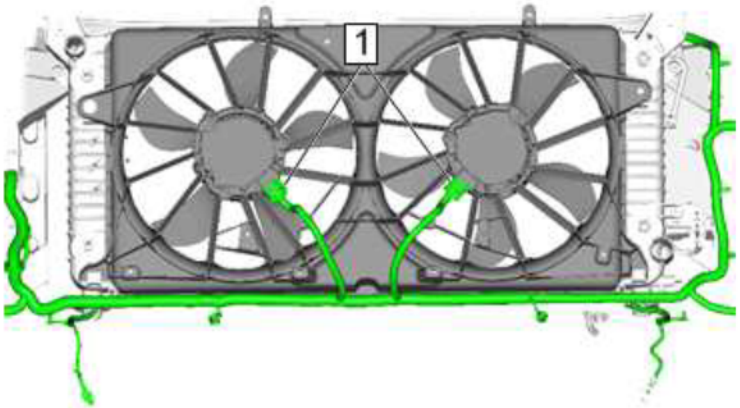


Fig. 79: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Electrical Connector (1) @Cooling Fan

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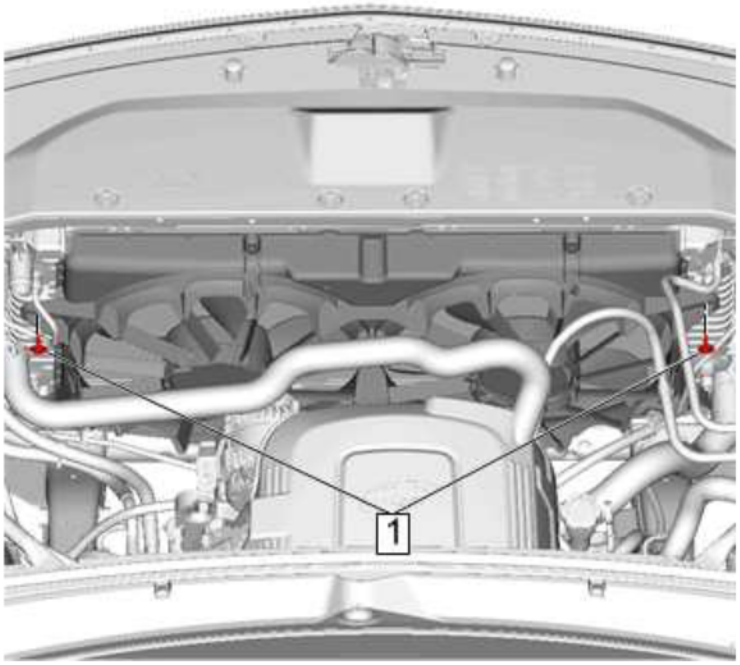


Fig. 80: Engine Coolant Fan Shroud Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove Engine Coolant Fan Shroud Bolt (1)

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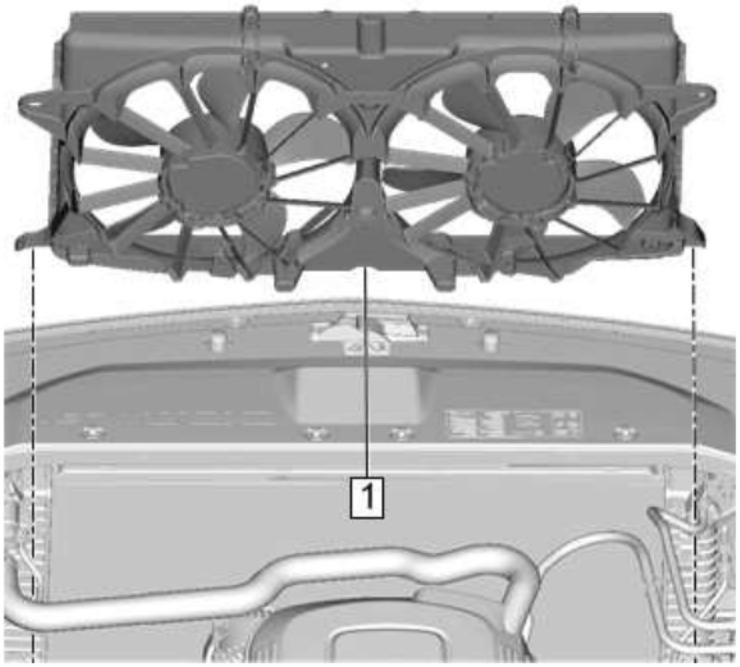


Fig. 81: Engine Coolant Fan Rear Shroud
Courtesy of GENERAL MOTORS COMPANY

9. Remove Engine Coolant Fan Rear Shroud (1)

Installation Procedure

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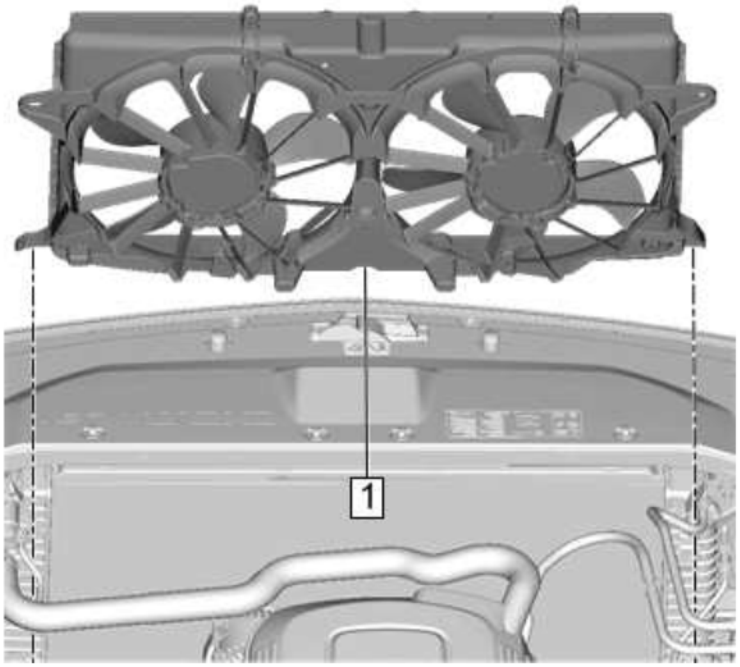


Fig. 82: Engine Coolant Fan Rear Shroud
Courtesy of GENERAL MOTORS COMPANY

1. Install Engine Coolant Fan Rear Shroud (1).

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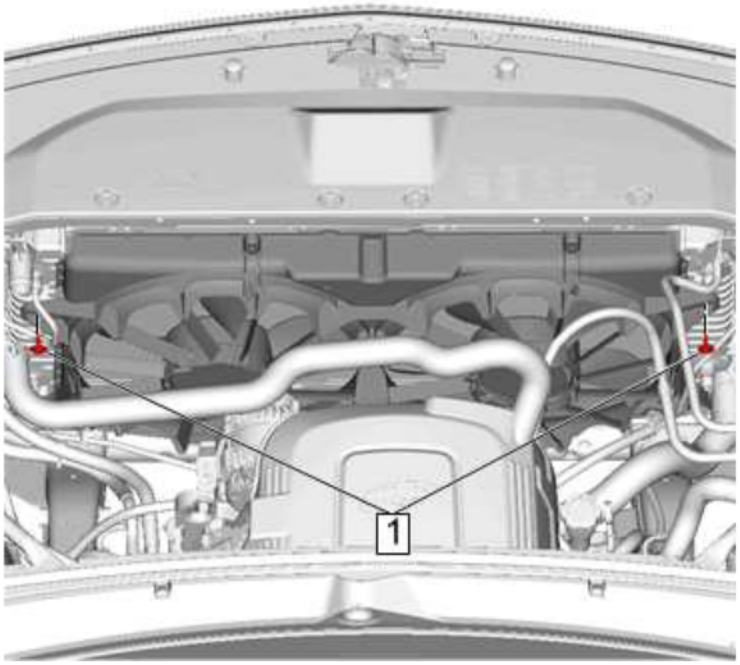


Fig. 83: Engine Coolant Fan Shroud Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

2. Install Engine Coolant Fan Shroud Bolt (1) and tighten 17 N.m (13 lb ft)

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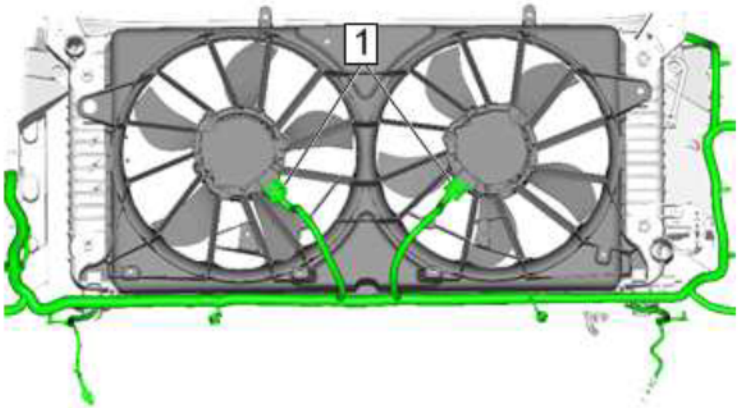


Fig. 84: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Connect Electrical Connector (1) @Cooling Fan
4. Reposition Transmission Fluid Cooler Lines @Radiator

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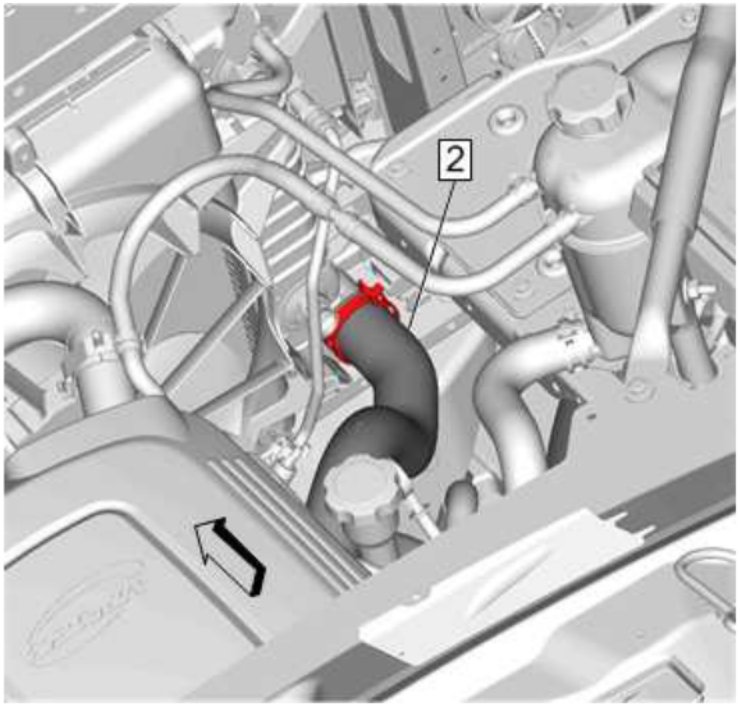


Fig. 85: Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Connect Radiator Outlet Hose (1) @Radiator **Radiator Outlet Hose Replacement (L96)**

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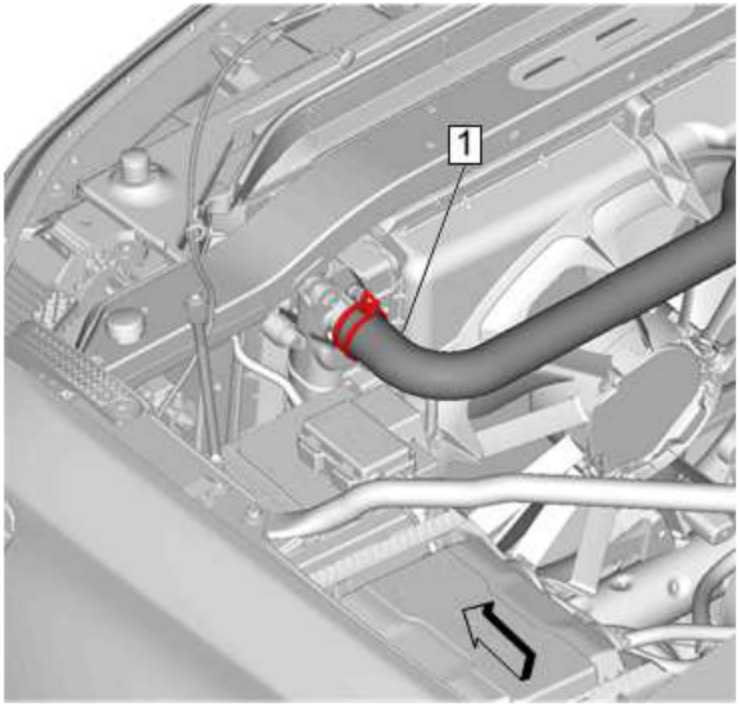


Fig. 86: Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

6. Connect Radiator Inlet Hose (1) @Radiator **Radiator Inlet Hose Replacement (L96)**
7. Connect Engine Oil Cooler Hose@Engine Coolant Fan Rear Shroud **Engine Oil Cooler Hose Replacement**
8. Install Air Cleaner Assembly **Air Cleaner Assembly Replacement**
9. Install Air Cleaner Resonator Outlet Duct **Air Cleaner Resonator Outlet Duct Replacement**

RADIATOR REPLACEMENT (L83 L86)

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Vac N Fill L83 L86)Cooling System Draining and Filling (Static Fill L83 L86)**.
2. Remove the engine coolant fan rear shroud. Refer to **Engine Coolant Fan Rear Shroud Replacement (L83, L86)**.

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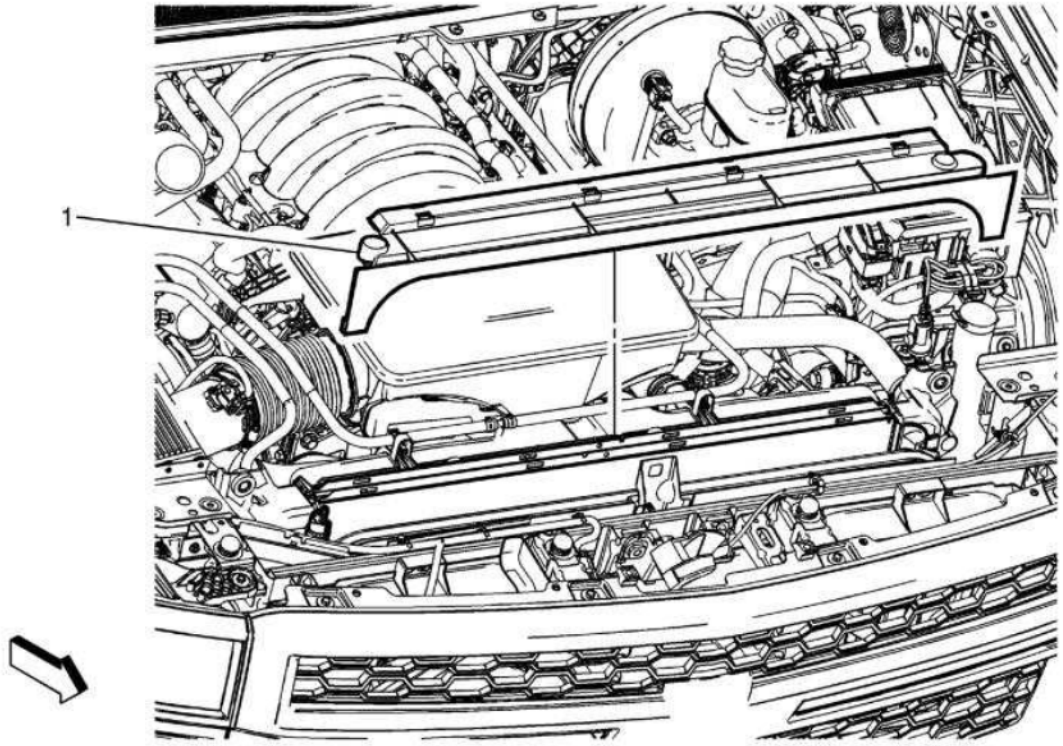


Fig. 87: Radiator Air Upper Baffle And Deflector
Courtesy of GENERAL MOTORS COMPANY

3. Remove the radiator air upper baffle and deflector (1). Refer to **Radiator Air Upper Baffle and Deflector Replacement (Top of Radiator L83 L86)Radiator Air Upper Baffle and Deflector Replacement (Right of Radiator L83 L86)**.

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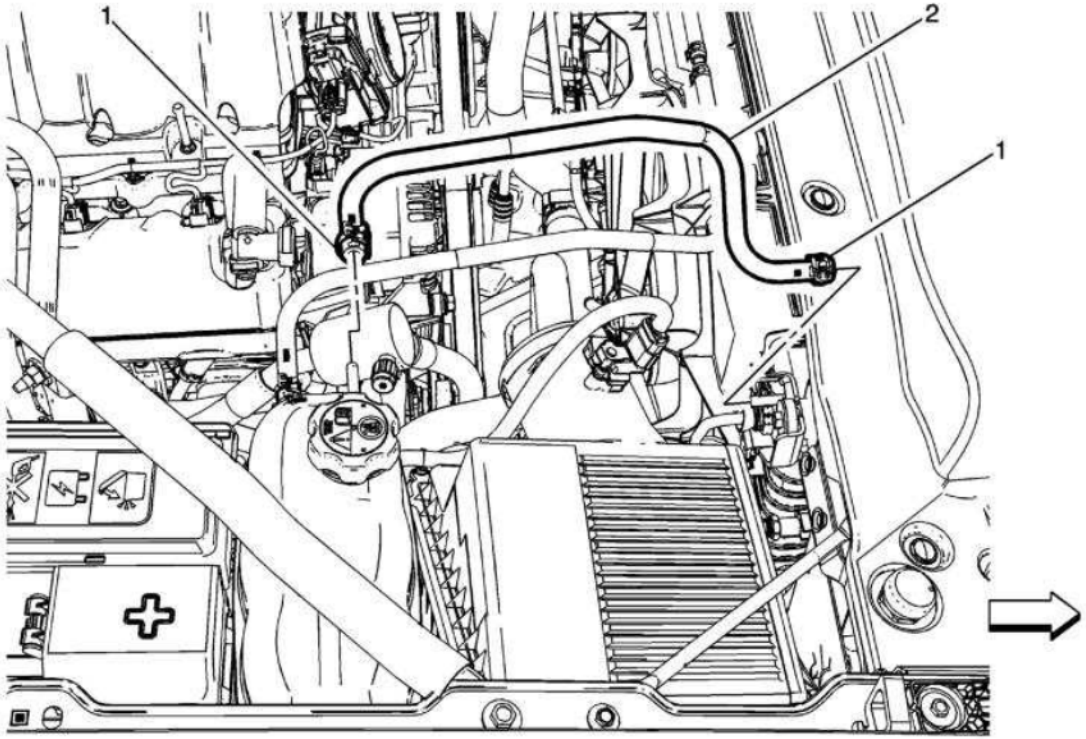


Fig. 88: Radiator Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

4. Remove the radiator surge tank inlet hose (2) from the radiator. Refer to **Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Radiator L83 L86)Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Water Outlet L83 L86)**.

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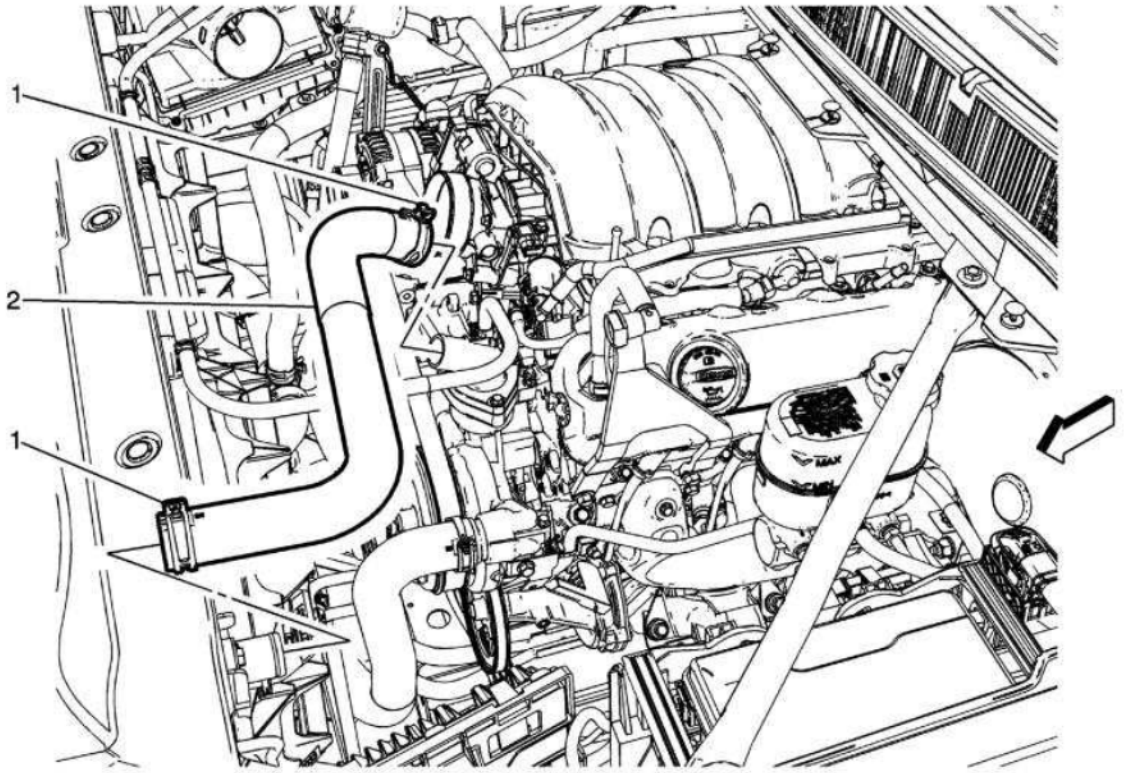


Fig. 89: Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Remove the radiator inlet hose (2) from the radiator. Refer to **Radiator Inlet Hose Replacement (L83 L86)**.

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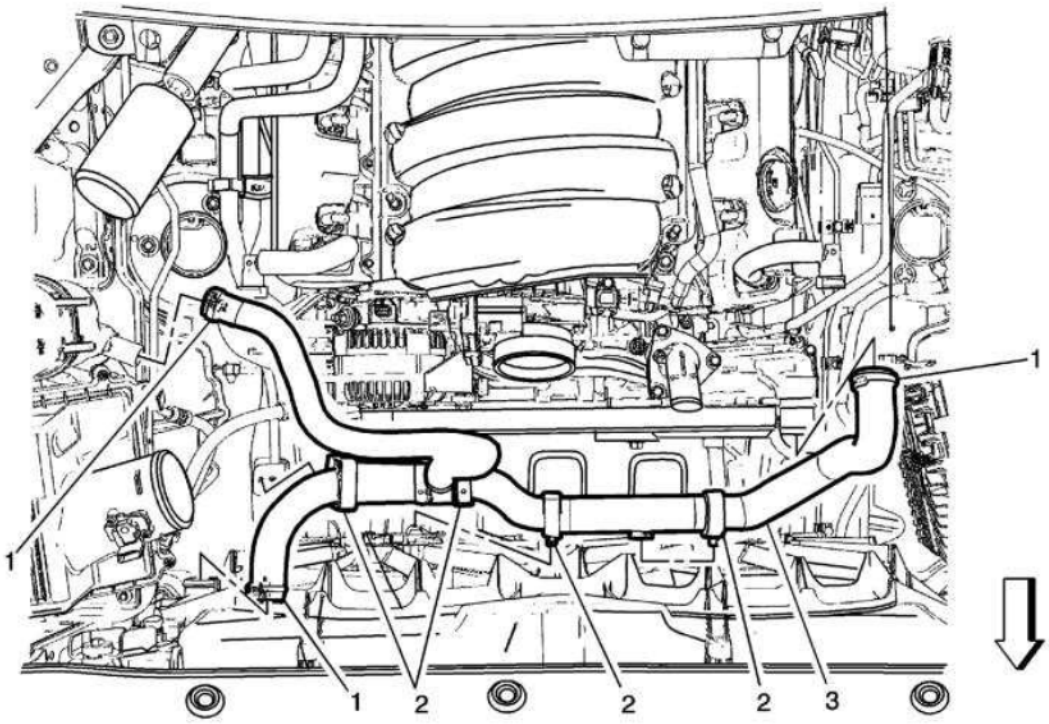


Fig. 90: Radiator Outlet Hose Retainers
Courtesy of GENERAL MOTORS COMPANY

6. Remove the radiator outlet hose (3) from the radiator. Refer to **Radiator Outlet Hose Replacement (L83 L86)**.
7. Remove the transmission fluid auxiliary cooler inlet pipe. Refer to **Transmission Fluid Auxiliary Cooler Inlet Pipe Replacement (L83 L86)** .
8. Remove the transmission fluid auxiliary cooler outlet pipe. Refer to **Transmission Fluid Auxiliary Cooler Outlet Pipe Replacement (L83 L86)** .

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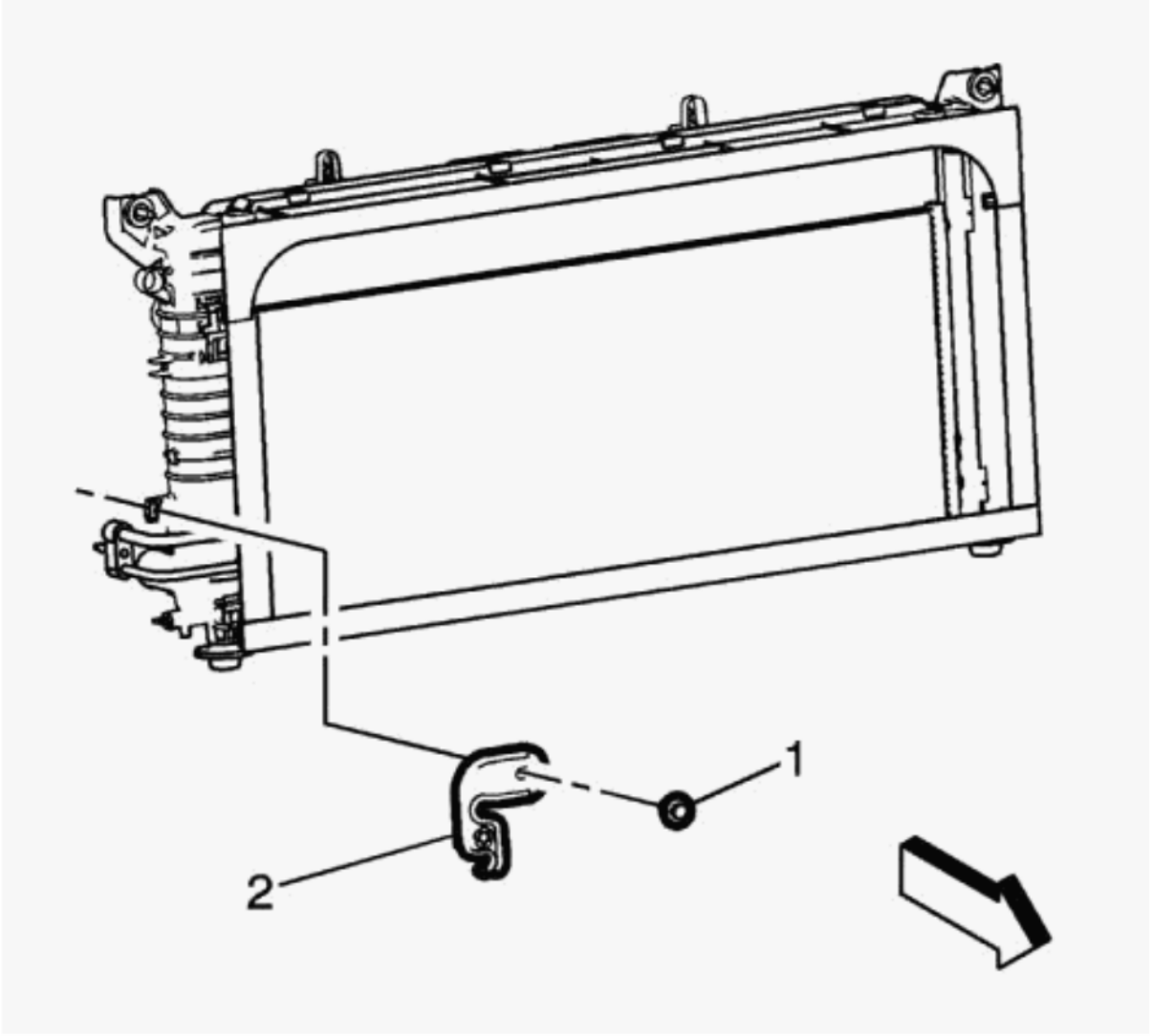


Fig. 91: Air Conditioning Condenser Bracket
Courtesy of GENERAL MOTORS COMPANY

9. Remove the air conditioning condenser bracket (2) from the radiator. Refer to **Air Conditioning Condenser Bracket Replacement** .
10. Without disconnecting the air conditioning compressor and condenser hoses, carefully lift the air conditioning condenser assembly off the radiator and position out of the way.

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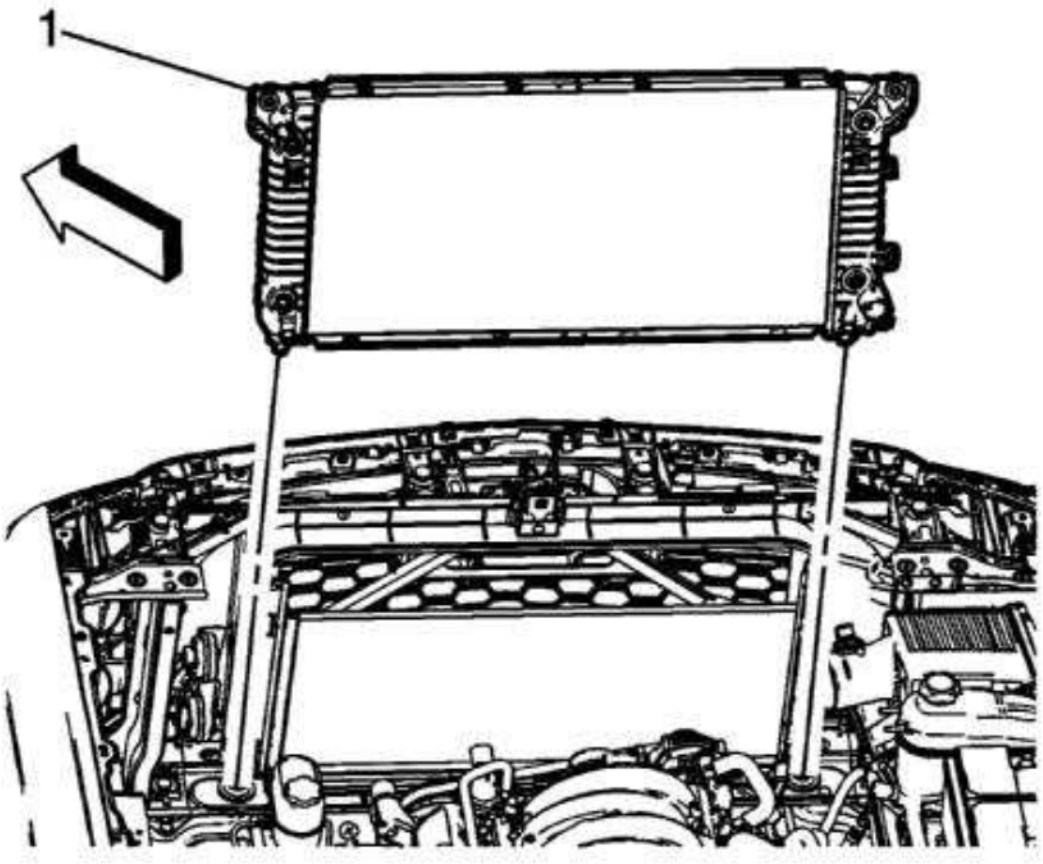


Fig. 92: Radiator
Courtesy of GENERAL MOTORS COMPANY

11. Tilt the radiator rearward and release the radiator air lower baffle retaining tabs from the radiator. Refer to **Radiator Air Lower Baffle Replacement (L83 L86)**.
12. Remove the radiator (1) from the vehicle.
13. If replacing the radiator transfer the components as necessary.

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Installation Procedure

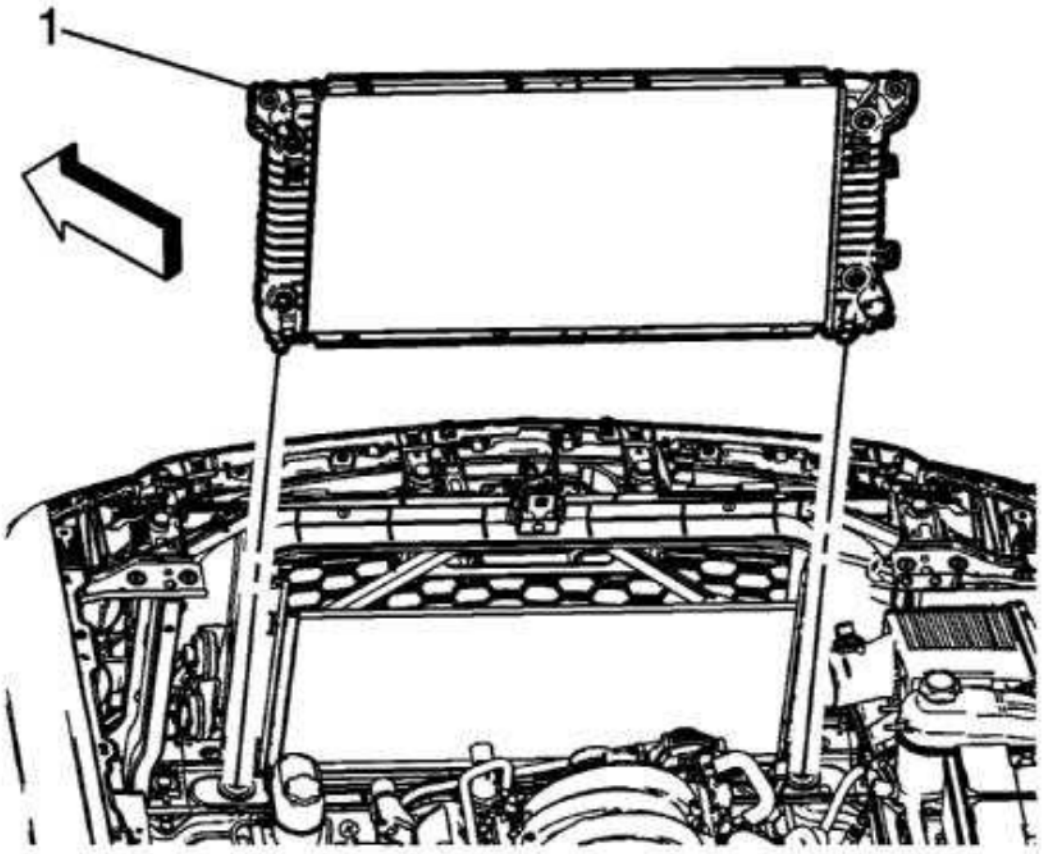


Fig. 93: Radiator
Courtesy of GENERAL MOTORS COMPANY

1. Install the radiator (1) to the vehicle.
2. Ensure the radiator air lower baffle retaining tabs are engaged to the radiator. Refer to **Radiator Air Lower Baffle Replacement (L83 L86)**.
3. Carefully install the air conditioning condenser assembly to the radiator.

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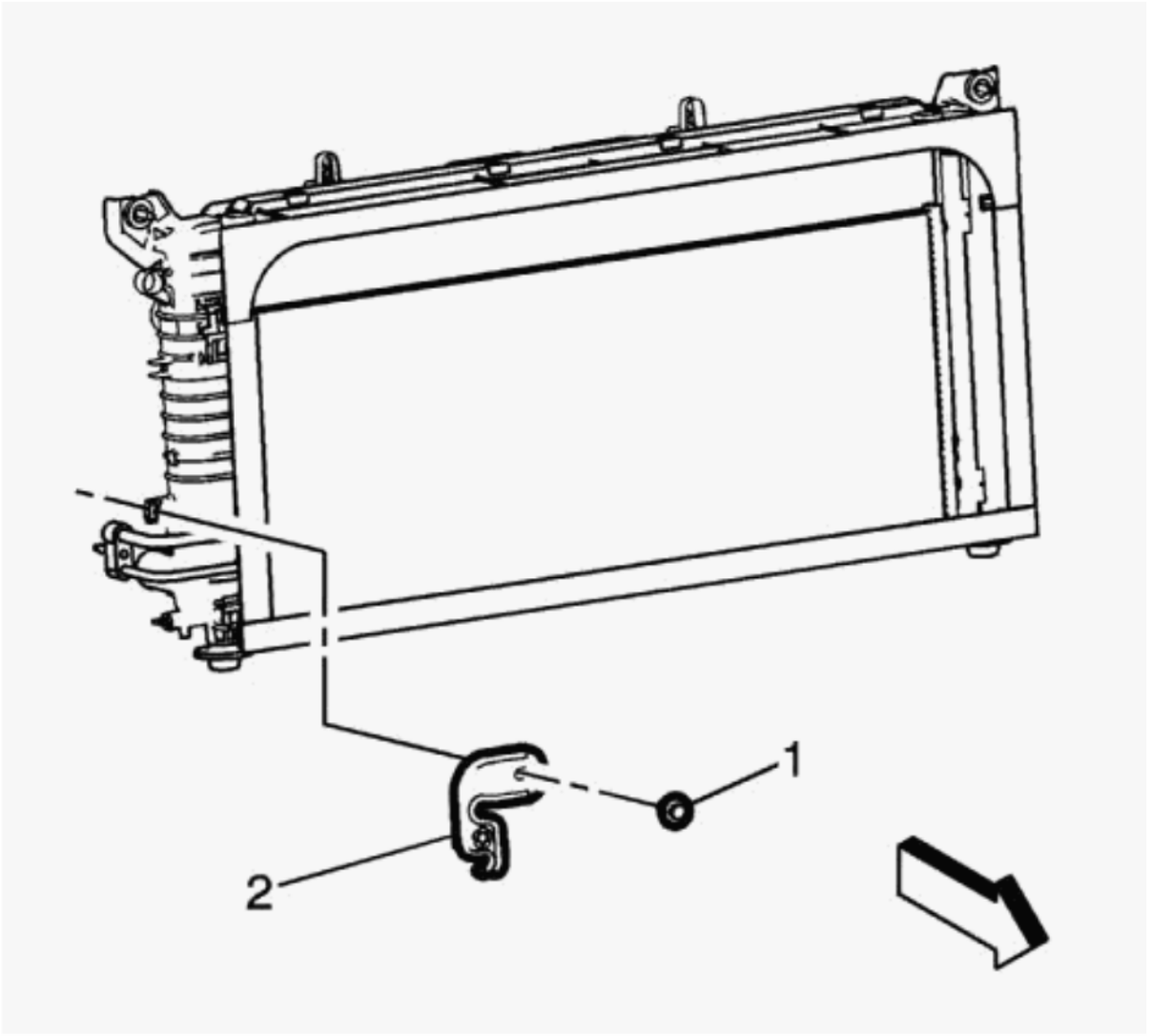


Fig. 94: Air Conditioning Condenser Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Install the air conditioning condenser bracket (2) to the radiator. Refer to **Air Conditioning Condenser Bracket Replacement** .
5. Install the transmission fluid auxiliary cooler outlet pipe. Refer to **Transmission Fluid Auxiliary Cooler Outlet Pipe Replacement (L83 L86)** .
6. Install the transmission fluid auxiliary cooler inlet pipe. Refer to **Transmission Fluid Auxiliary Cooler Inlet Pipe Replacement (L83 L86)** .

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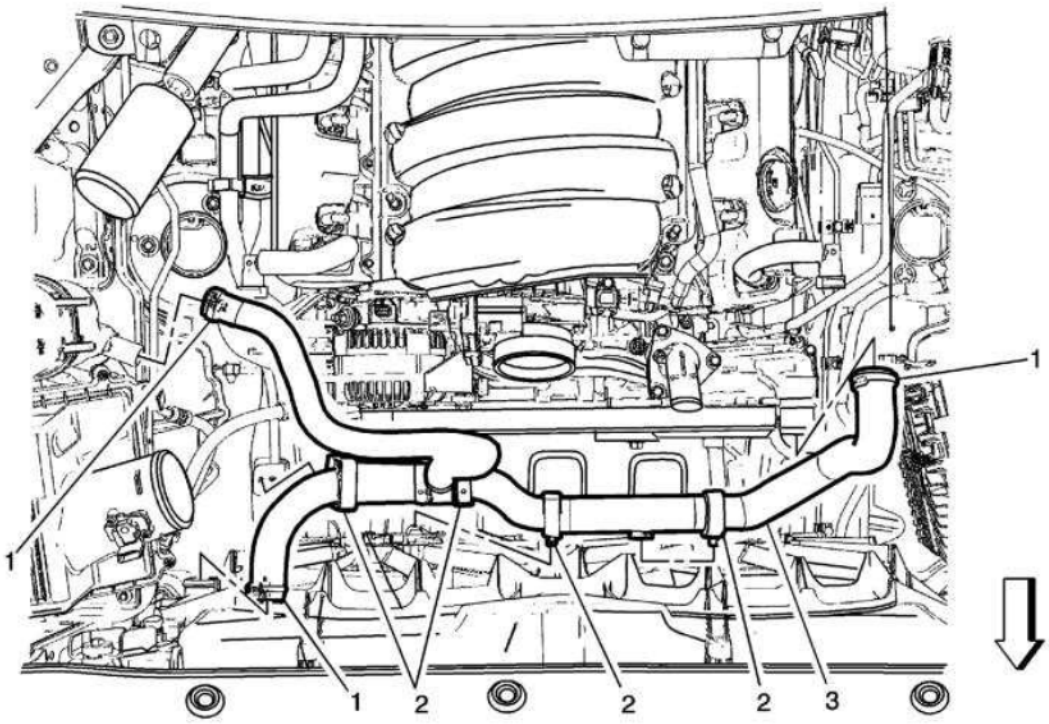


Fig. 95: Radiator Outlet Hose Retainers
Courtesy of GENERAL MOTORS COMPANY

7. Install the radiator outlet hose (3) to the radiator. Refer to **Radiator Outlet Hose Replacement (L83 L86)**.

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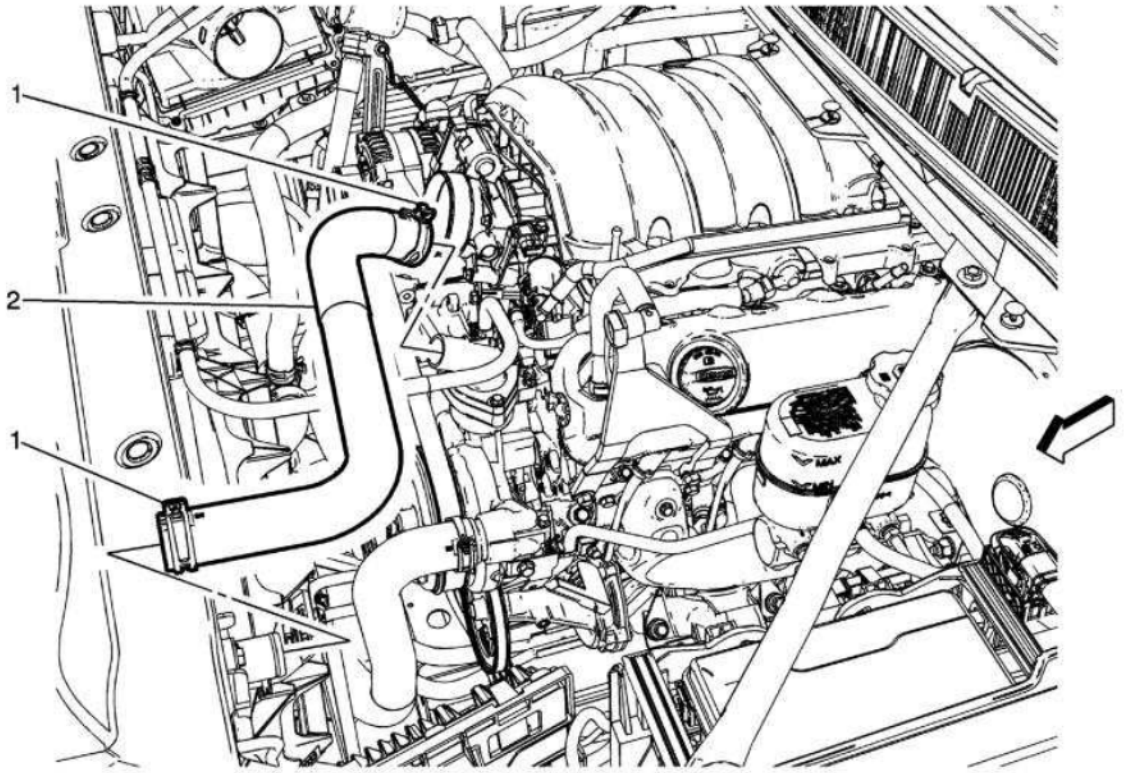


Fig. 96: Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

8. Install the radiator inlet hose (2) to the radiator. Refer to **Radiator Inlet Hose Replacement (L83 L86)**.

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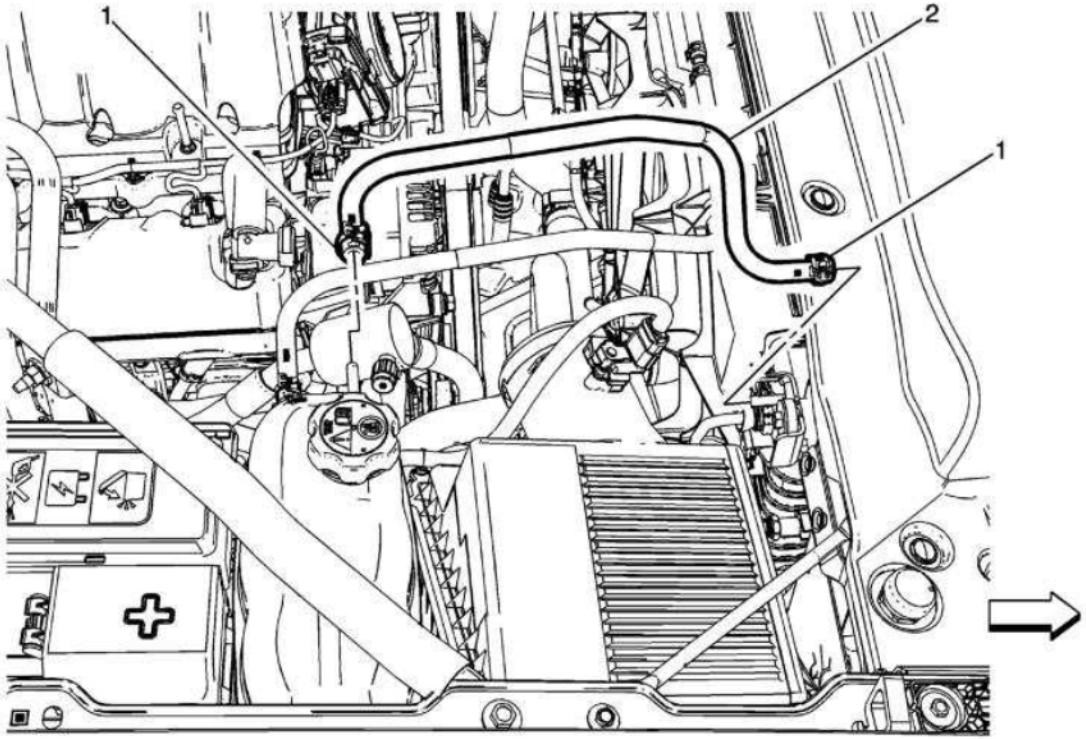


Fig. 97: Radiator Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

9. Install the radiator surge tank inlet hose (2) to the radiator. Refer to **Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Radiator L83 L86)Radiator Surge Tank Inlet Hose Replacement (Surge Tank To Water Outlet L83 L86)**.

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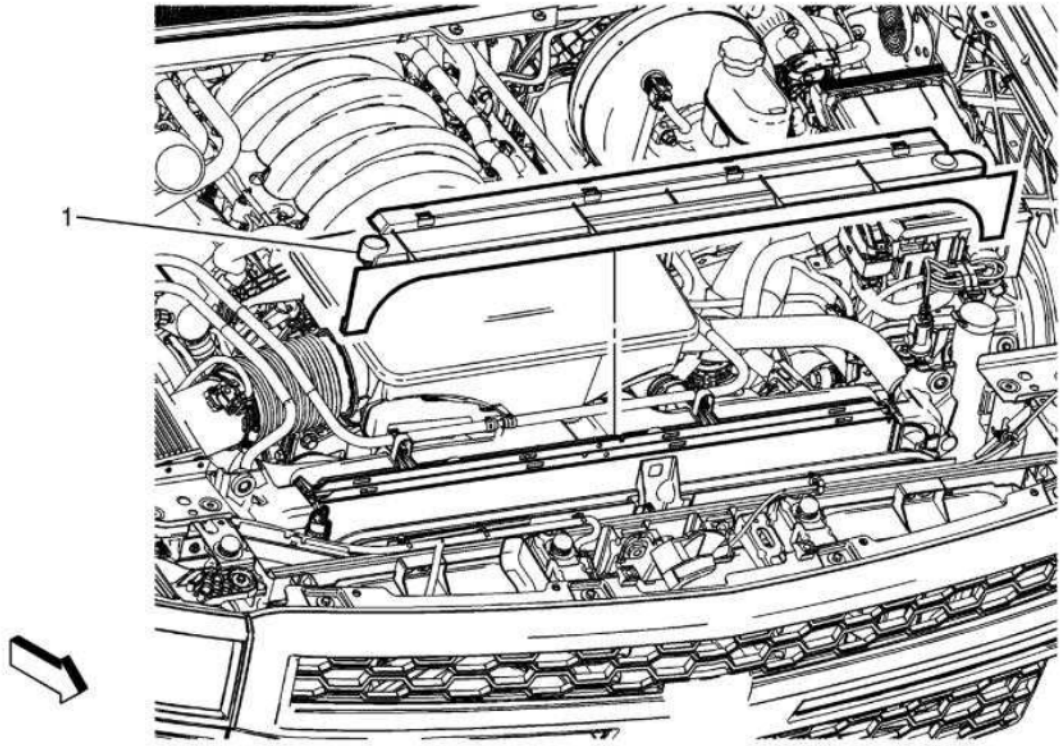


Fig. 98: Radiator Air Upper Baffle And Deflector
Courtesy of GENERAL MOTORS COMPANY

10. Install the radiator air upper baffle and deflector (1). Refer to **Radiator Air Upper Baffle and Deflector Replacement (Top of Radiator L83 L86)Radiator Air Upper Baffle and Deflector Replacement (Right of Radiator L83 L86)**.
11. Install the engine coolant fan rear shroud. Refer to **Engine Coolant Fan Rear Shroud Replacement (L83, L86)**.
12. Fill the cooling system to the proper level. Refer to **Cooling System Draining and Filling (Vac N Fill L83 L86)Cooling System Draining and Filling (Static Fill L83 L86)**.
13. Inspect the cooling system for leaks. Refer to **Cooling System Leak Testing (L83, L86)**.

RADIATOR REPLACEMENT (L96)

Removal Procedure

1. Drain the cooling system. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)**

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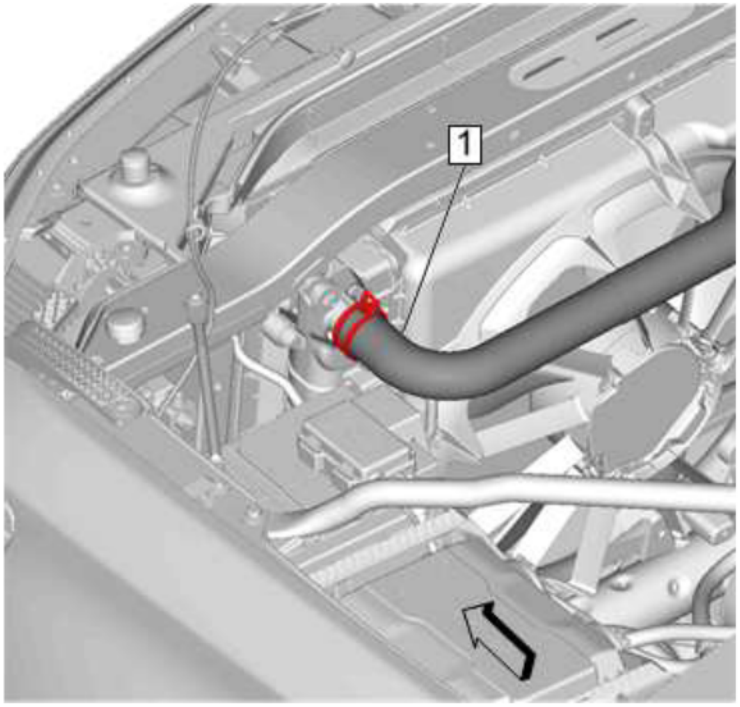


Fig. 99: Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Radiator Inlet Hose (1) @Radiator -**Radiator Inlet Hose Replacement (L96)**

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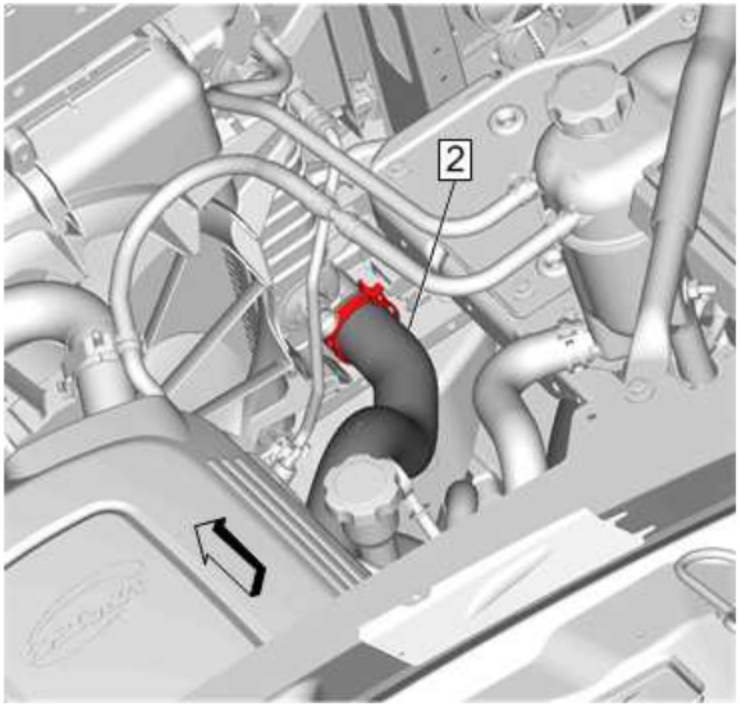


Fig. 100: Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Radiator Outlet Hose (1) @Radiator -**Radiator Outlet Hose Replacement (L96)**

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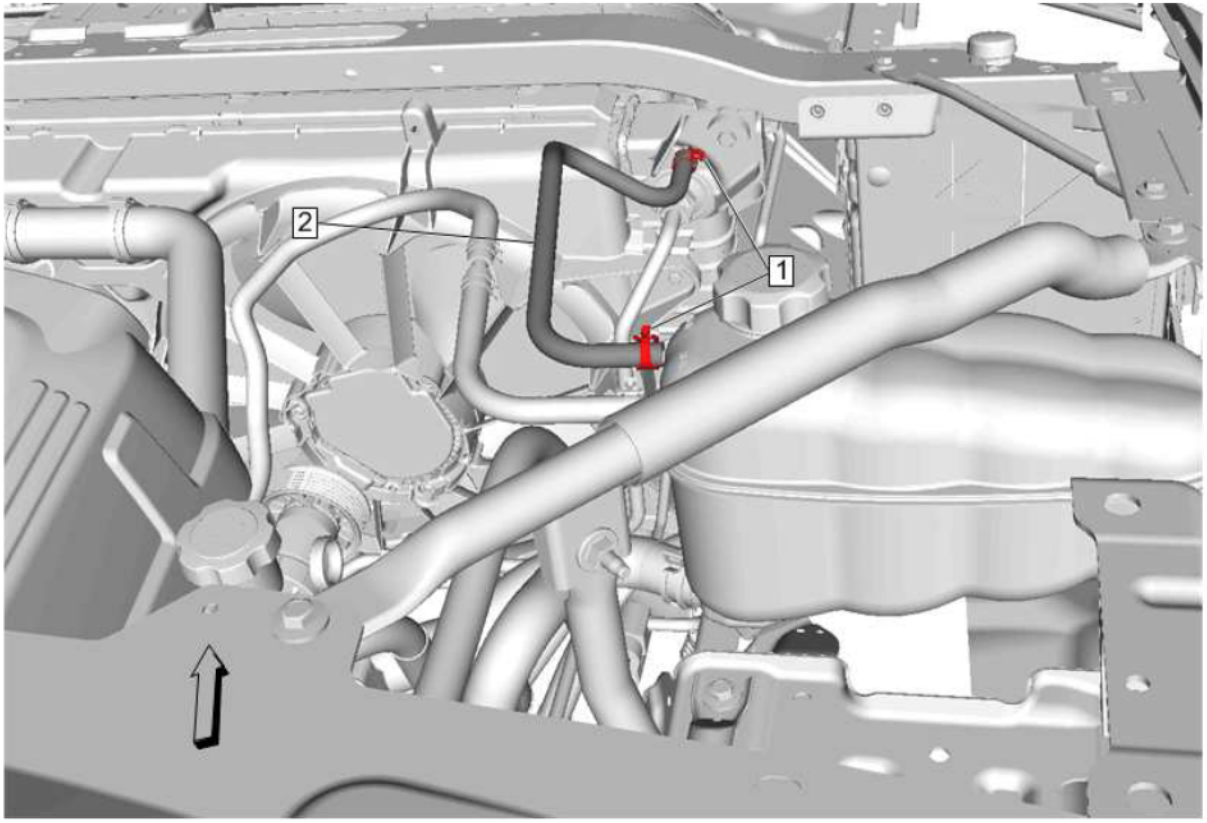


Fig. 101: Radiator Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Radiator Surge Tank Inlet Hose (2) @Radiator -**Radiator Surge Tank Inlet Hose Replacement (L96)**

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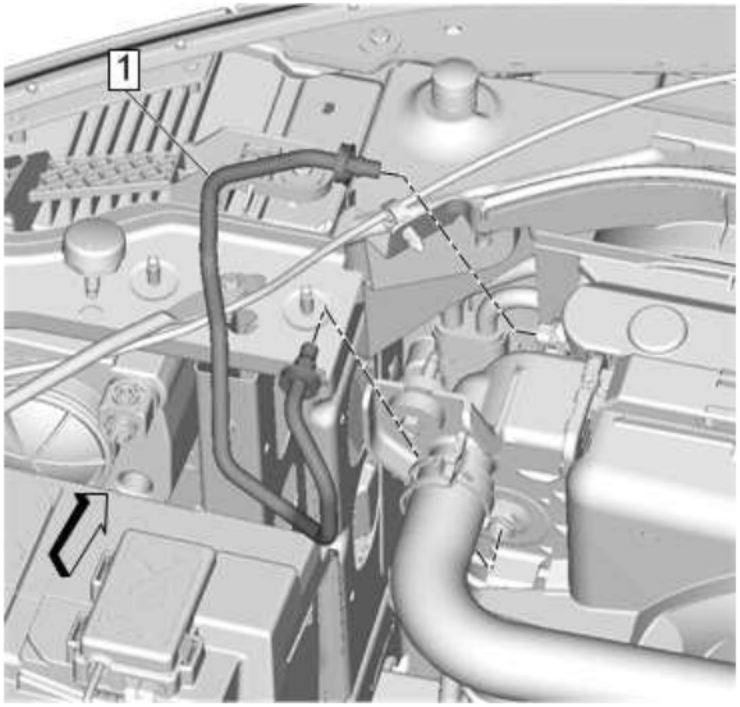


Fig. 102: Transmission Fluid Auxiliary Cooler Inlet Pipe
Courtesy of GENERAL MOTORS COMPANY

5. Remove Transmission Fluid Auxiliary Cooler Inlet Pipe (1).**Transmission Fluid Auxiliary Cooler Inlet Pipe Replacement (L83 L86)**
6. Remove Transmission Fluid Cooler Inlet and Outlet Pipe@Radiator -**Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (L83 MYC)** **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (L86 M5U)**
7. Remove Engine Oil Cooler Hose@Radiator -**Engine Oil Cooler Hose Replacement**

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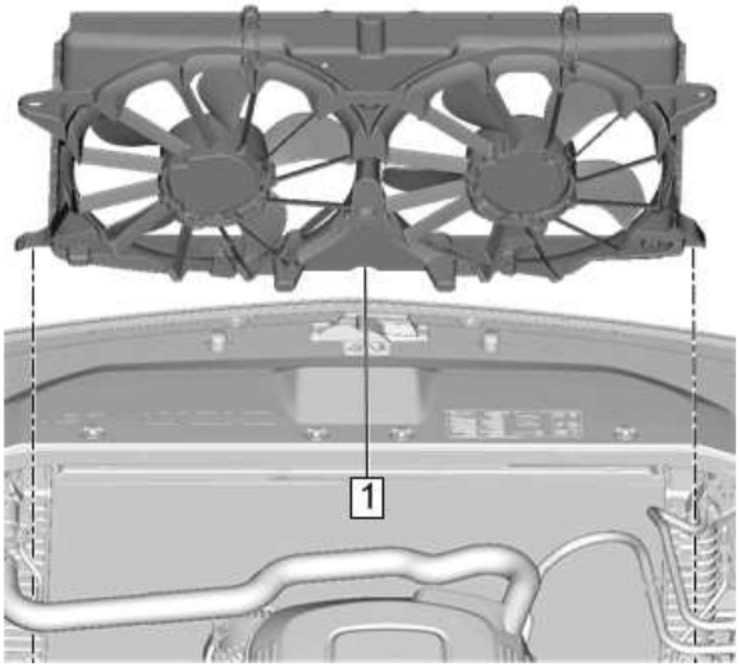


Fig. 103: Engine Coolant Fan Rear Shroud
Courtesy of GENERAL MOTORS COMPANY

8. Remove Engine Coolant Fan Rear Shroud (1).**Engine Coolant Fan Rear Shroud Replacement (L96)**
9. Remove Radiator Air Upper Baffle -**Radiator Air Upper Baffle and Deflector Replacement (Top of Radiator L83 L86)Radiator Air Upper Baffle and Deflector Replacement (Right of Radiator L83 L86)**
10. Disconnect Air Conditioning Evaporator Tube@Radiator -**Air Conditioning Evaporator Tube Replacement (L96)**
11. Disconnect Air Conditioning Condenser Hose@Radiator -**Air Conditioning Condenser Hose Replacement (L96)**
12. Remove Air Conditioning Condenser Bracket -**Air Conditioning Condenser Bracket Replacement**

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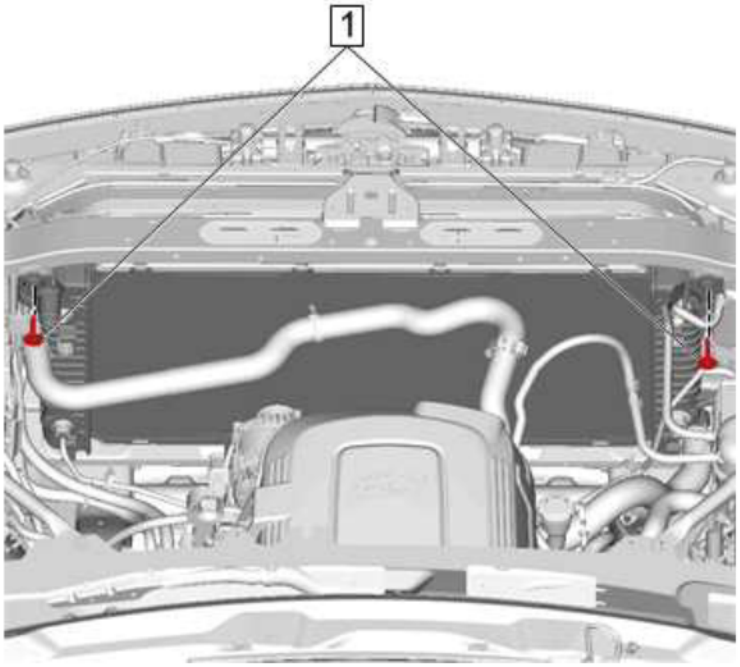


Fig. 104: Radiator Upper Mount Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

13. Remove Radiator Upper Mount Bracket Bolt (1)
14. Tilt the radiator rearward and release the condenser retaining tabs.
15. Lift the condenser off of the radiator and set aside.

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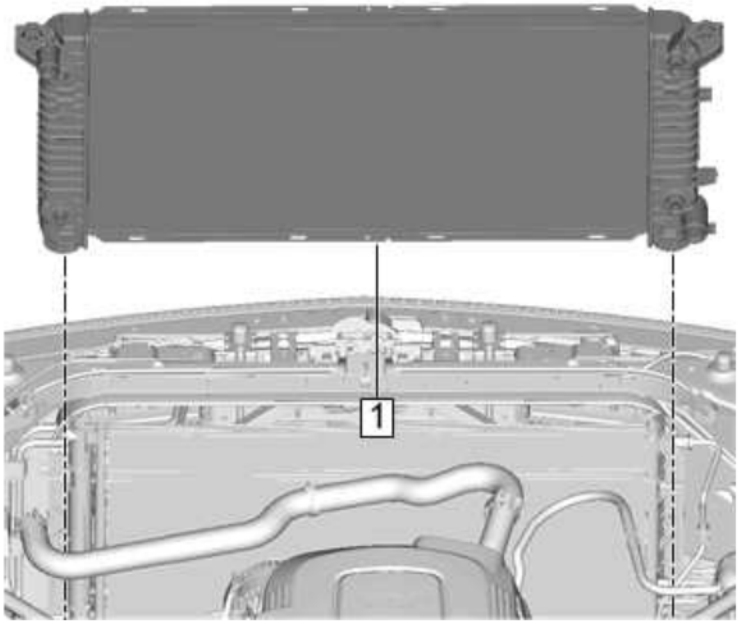


Fig. 105: Radiator
Courtesy of GENERAL MOTORS COMPANY

16. Remove Radiator (1).
17. If replacing the radiator transfer the components as necessary.

Installation Procedure

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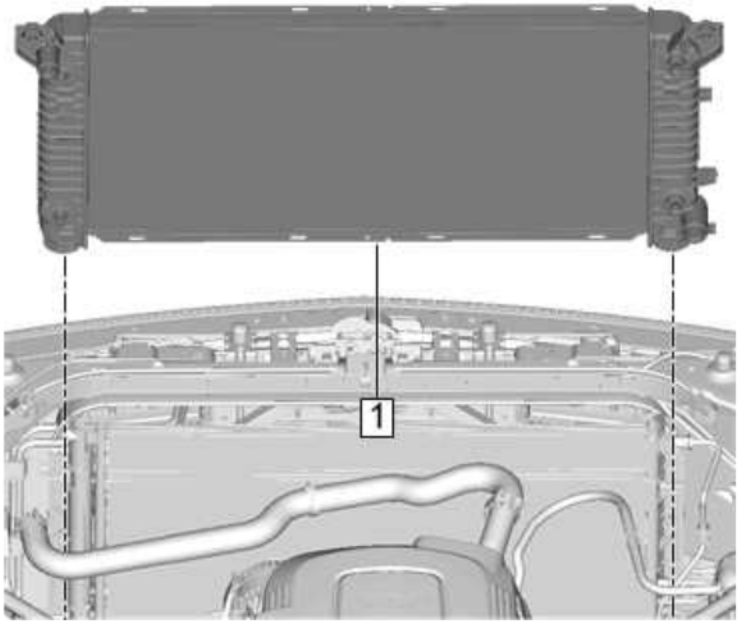


Fig. 106: Radiator
Courtesy of GENERAL MOTORS COMPANY

1. Radiator (1).
2. Connect the condenser to the radiator.

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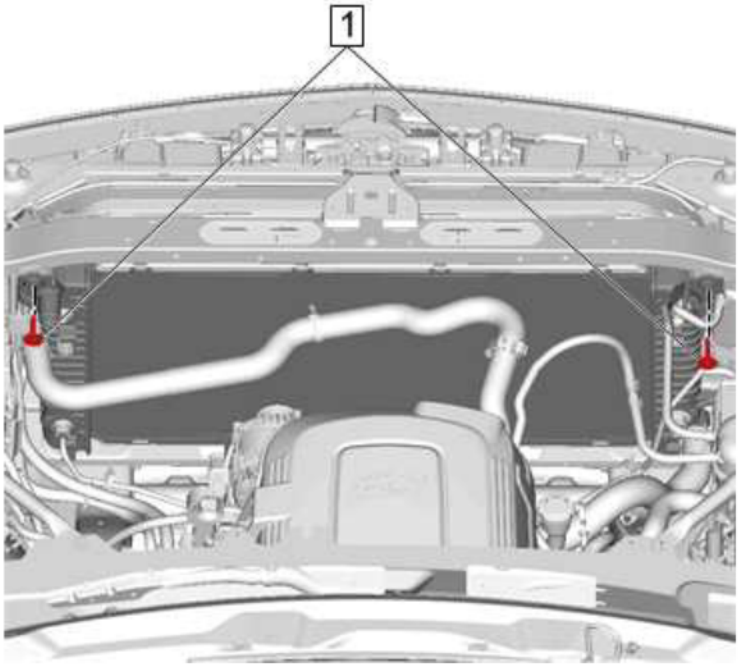


Fig. 107: Radiator Upper Mount Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Install Radiator Upper Mount Bracket Bolt (1) and tighten 25 N.m (18 lb ft)
4. Install Air Conditioning Condenser Bracket -**Air Conditioning Condenser Bracket Replacement**
5. Connect Air Conditioning Condenser Hose@Radiator -**Air Conditioning Condenser Hose Replacement (L96)**
6. Connect Air Conditioning Evaporator Tube@Radiator -**Air Conditioning Evaporator Tube Replacement (L96)**
7. Install Radiator Air Upper Baffle -**Radiator Air Upper Baffle and Deflector Replacement (Top of Radiator L83 L86)Radiator Air Upper Baffle and Deflector Replacement (Right of Radiator L83 L86)**

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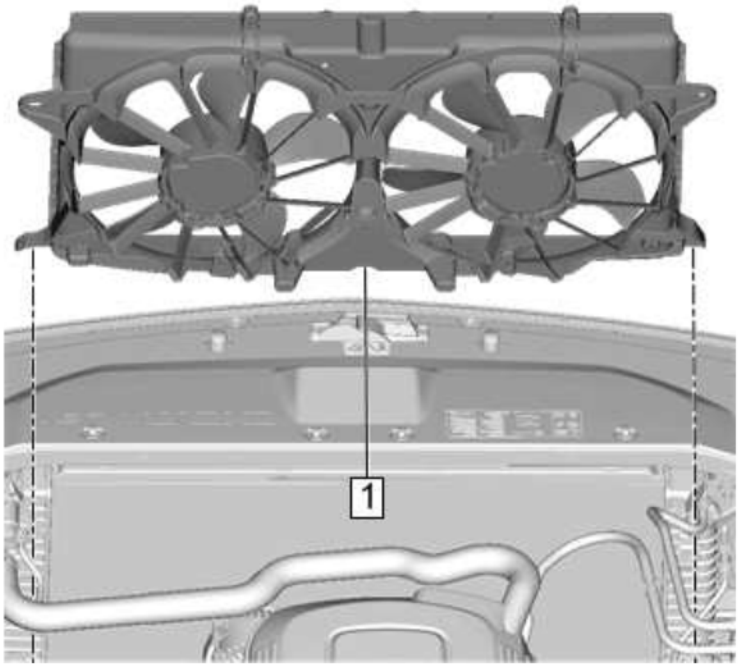


Fig. 108: Engine Coolant Fan Rear Shroud
Courtesy of GENERAL MOTORS COMPANY

8. Install Engine Coolant Fan Rear Shroud -**Engine Coolant Fan Rear Shroud Replacement (L96)**
9. Install Engine Oil Cooler Hose@Radiator -**Engine Oil Cooler Hose Replacement**
10. Install Transmission Fluid Cooler Inlet and Outlet Pipe@Radiator -**Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (L83 MYC)** **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (L86 M5U)**

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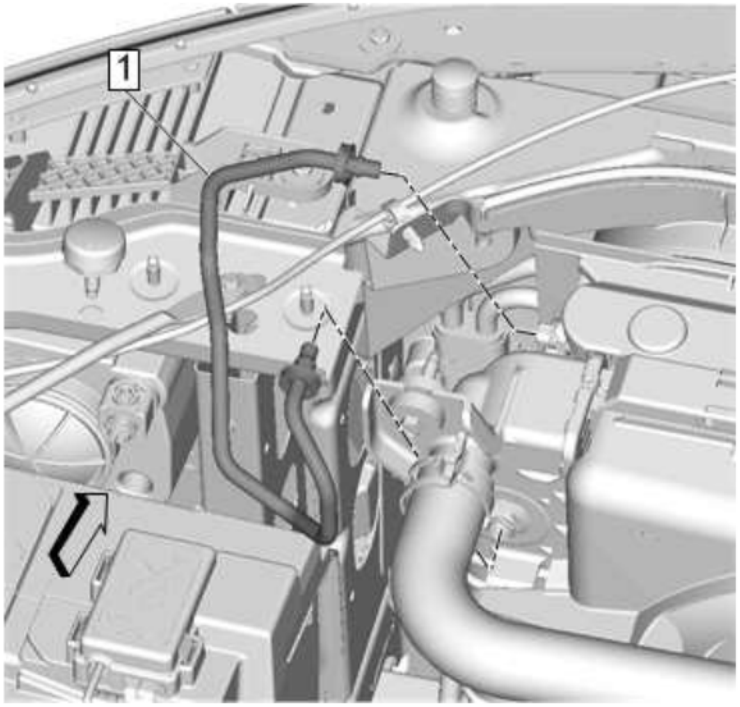


Fig. 109: Transmission Fluid Auxiliary Cooler Inlet Pipe
Courtesy of GENERAL MOTORS COMPANY

11. Install Transmission Fluid Auxiliary Cooler Inlet Pipe -**Transmission Fluid Auxiliary Cooler Inlet Pipe Replacement (L83 L86)**

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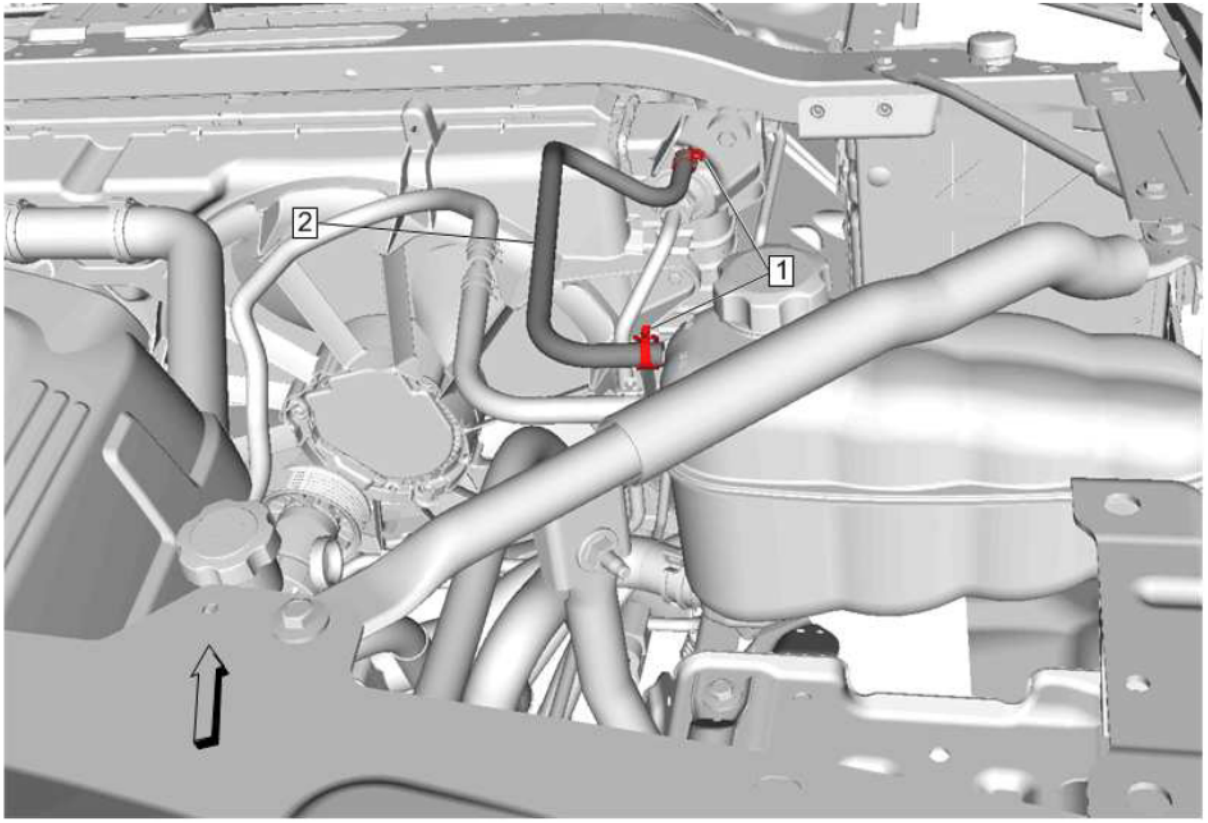


Fig. 110: Radiator Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

12. Connect Radiator Surge Tank Inlet Hose (2) @Radiator -**Radiator Surge Tank Inlet Hose Replacement (L96)**

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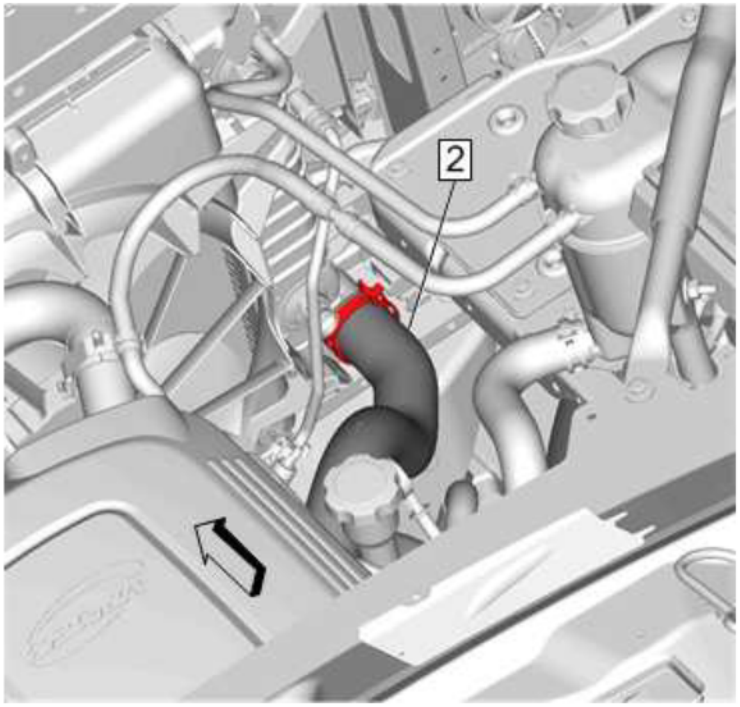


Fig. 111: Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

13. Connect Radiator Outlet Hose (1) @Radiator -**Radiator Outlet Hose Replacement (L96)**

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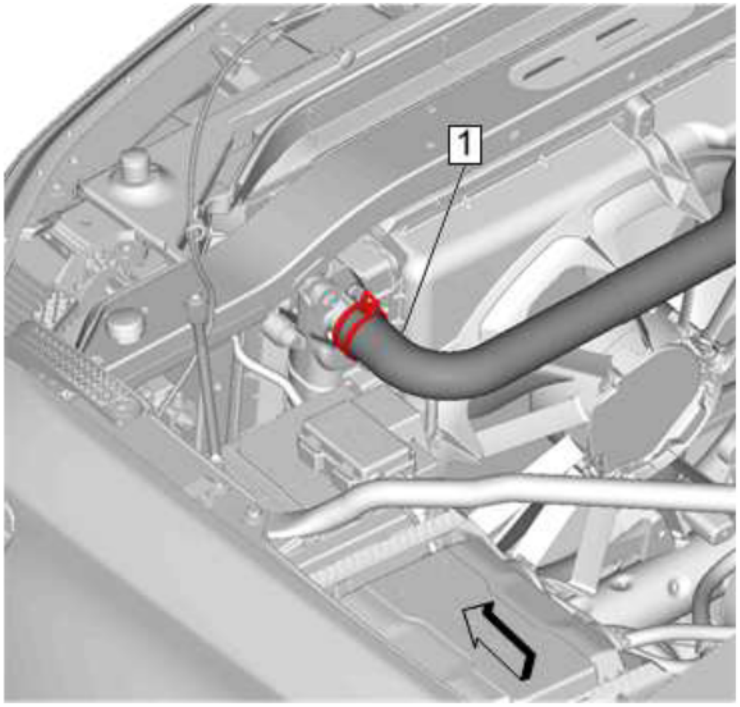


Fig. 112: Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

14. Connect Radiator Inlet Hose (1) @Radiator -**Radiator Inlet Hose Replacement (L96)**
15. Fill the cooling system to the proper level. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)**
16. Inspect the cooling system for leaks. **Cooling System Leak Testing (L96)**

RADIATOR UPPER INSULATOR REPLACEMENT (L96)

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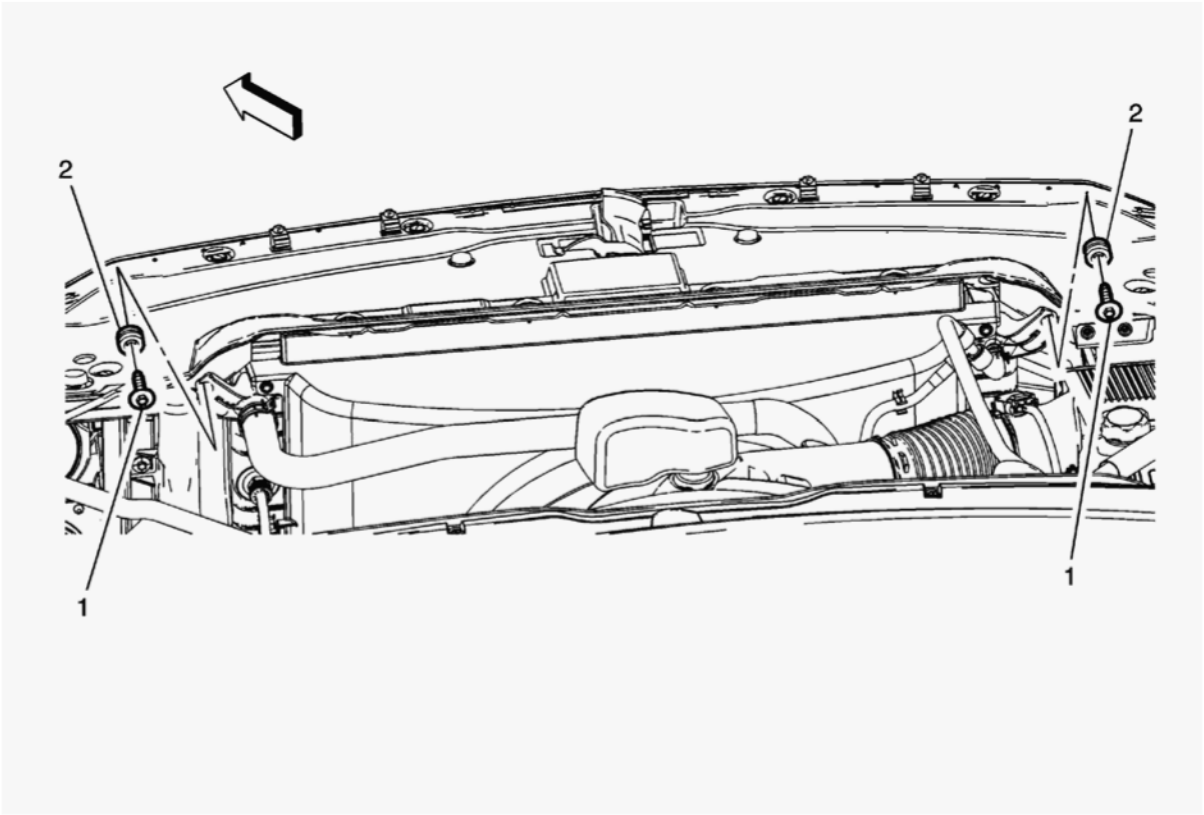


Fig. 113: Radiator Upper Insulator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front end upper tie bar support. Refer to **Front End Upper Tie Bar Support Replacement** .	
1	Radiator Upper Mount Bracket Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .**

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Callout	Component Name
	Tighten 25 N.m (18 lb ft)
2	Radiator Upper Insulator (Qty: 2) **Procedure** Carefully move the top of the radiator rearward to remove the radiator upper insulators.

RADIATOR UPPER INSULATOR REPLACEMENT (L83, L86)

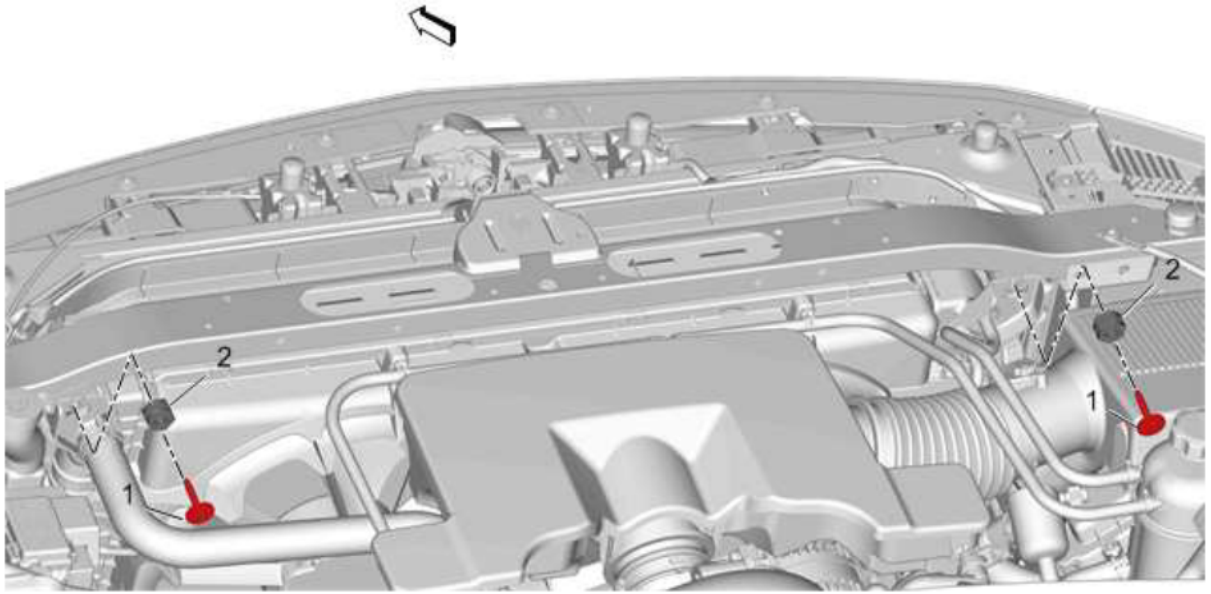


Fig. 114: Radiator Upper Insulator (L83, L86)
Courtesy of GENERAL MOTORS COMPANY

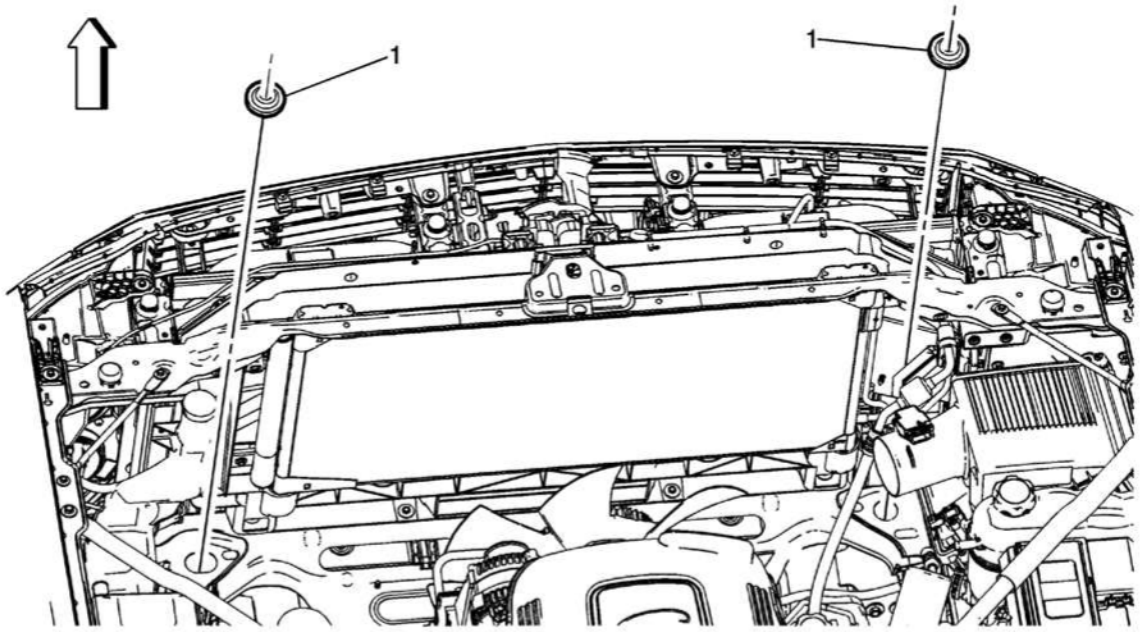
Callout	Component Name
1	Radiator Upper Mount Bracket Bolt (Qty: 2)

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Callout	Component Name
	CAUTION: **Refer to** **Fastener Caution .** **Tighten** 25 N.m (18 lb ft)
2	Radiator Upper Insulator <p01> **Procedure** Carefully move the top of the radiator rearward to remove the radiator upper insulators.

RADIATOR LOWER INSULATOR REPLACEMENT (L96)



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Fig. 115: Radiator Lower Insulator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the radiator. Refer to **Radiator Replacement (L96)**.	
1	Radiator Lower Insulator (Qty: 2)

RADIATOR LOWER INSULATOR REPLACEMENT (L83 L86)

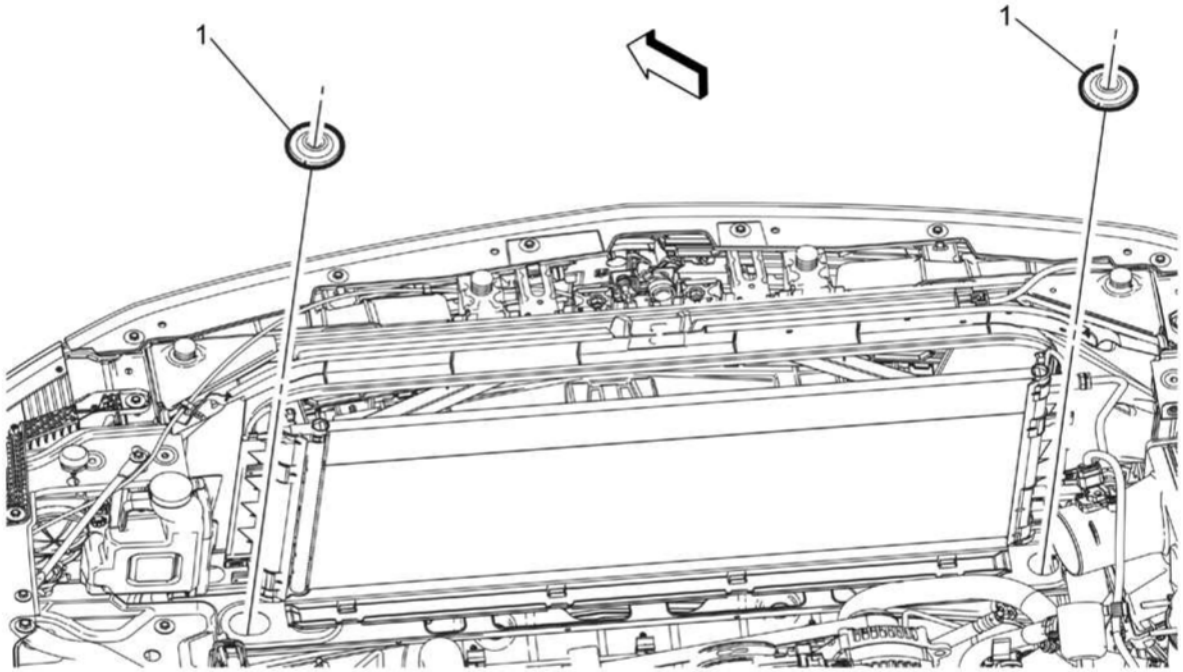


Fig. 116: Radiator Lower Insulator (L83 L86)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

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Callout	Component Name
Preliminary Procedure Reposition the radiator as necessary. Refer to **Radiator Replacement (L83 L86)**.	
1	Radiator Lower Insulator (Qty: 2)

RADIATOR SUPPORT BAFFLE REPLACEMENT (L96)

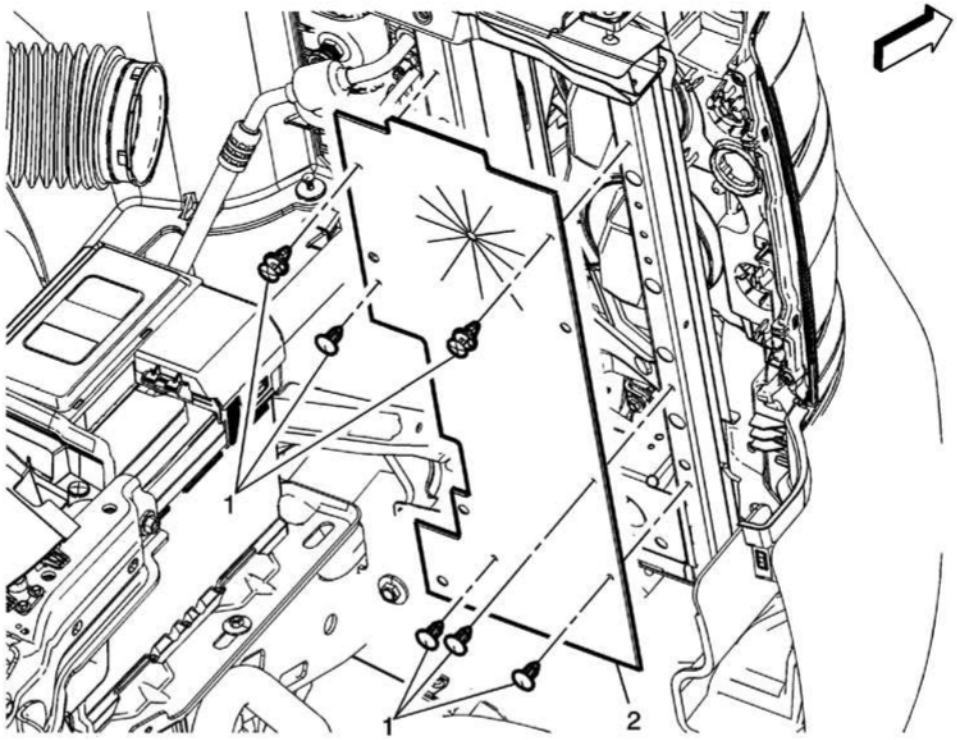


Fig. 117: Radiator Support Baffle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .	

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Callout	Component Name
2. Unclip the electrical harness retainer from the radiator support baffle and reposition out of the way.	
1	Radiator Support Baffle Retainer (Qty: 6)
2	Radiator Support Baffle

RADIATOR AIR BAFFLE REPLACEMENT - LEFT (L83 L86)

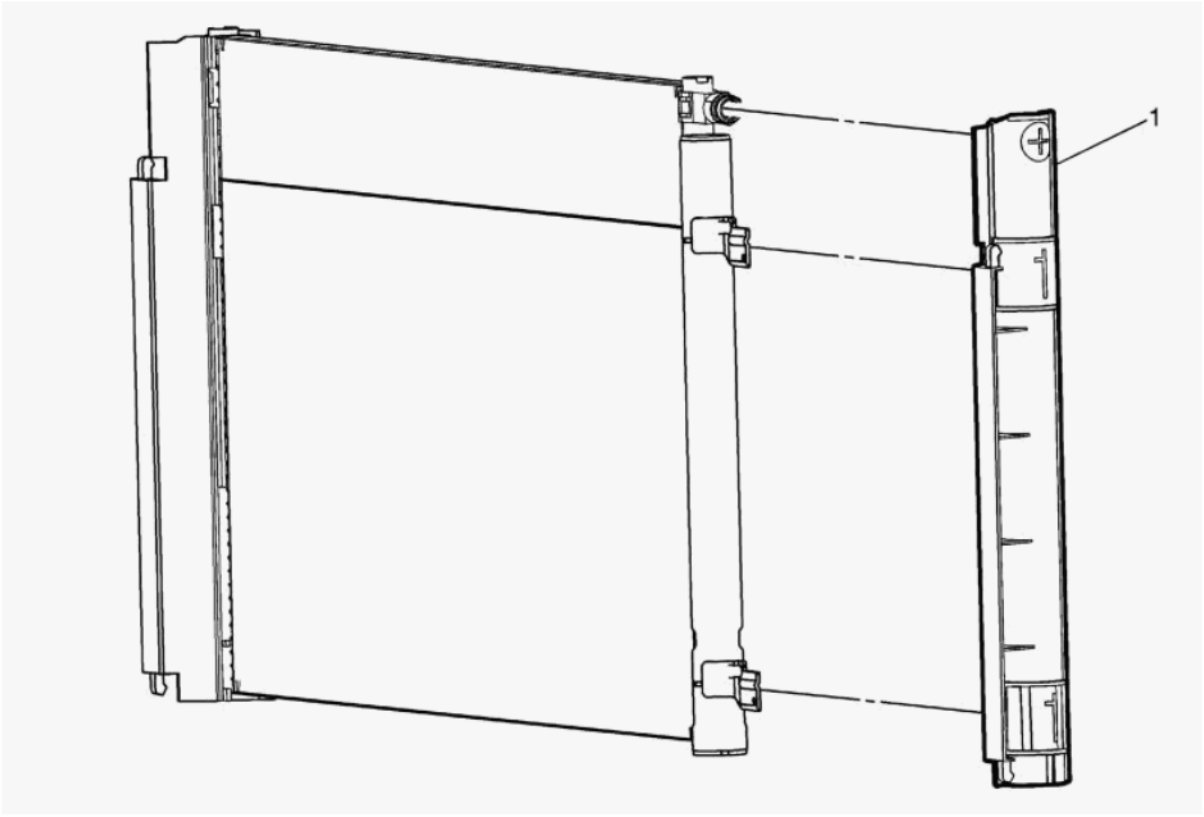


Fig. 118: Radiator Air Baffle - Left (L83, L86)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the air conditioning condenser from the vehicle. Refer to **Air Conditioning Condenser Replacement (L83 L86)** .	

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Callout	Component Name
1	Radiator Air Baffle Left **Procedure** Remove the radiator air baffle left from the radiator air lower baffle and remove from the condenser.

RADIATOR AIR BAFFLE REPLACEMENT - RIGHT (L83 L86)

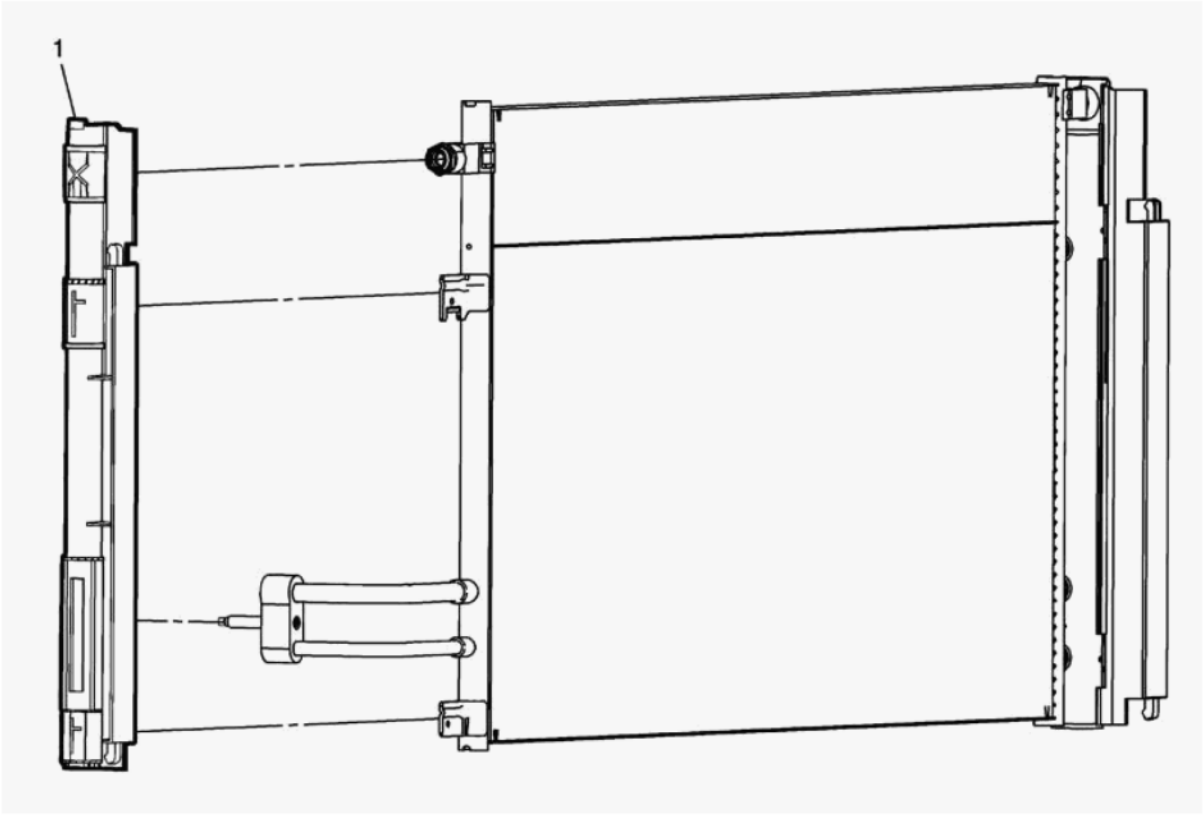


Fig. 119: Radiator Air Baffle - Right (L83, L86)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the air conditioning condenser from the vehicle. Refer to **Air Conditioning Condenser Replacement (L83 L86)** .	

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Callout	Component Name
1	Radiator Air Baffle Right **Procedure** Remove the radiator air baffle right from the radiator air lower baffle and remove from the condenser.

RADIATOR AIR LOWER BAFFLE REPLACEMENT (L83 L86)

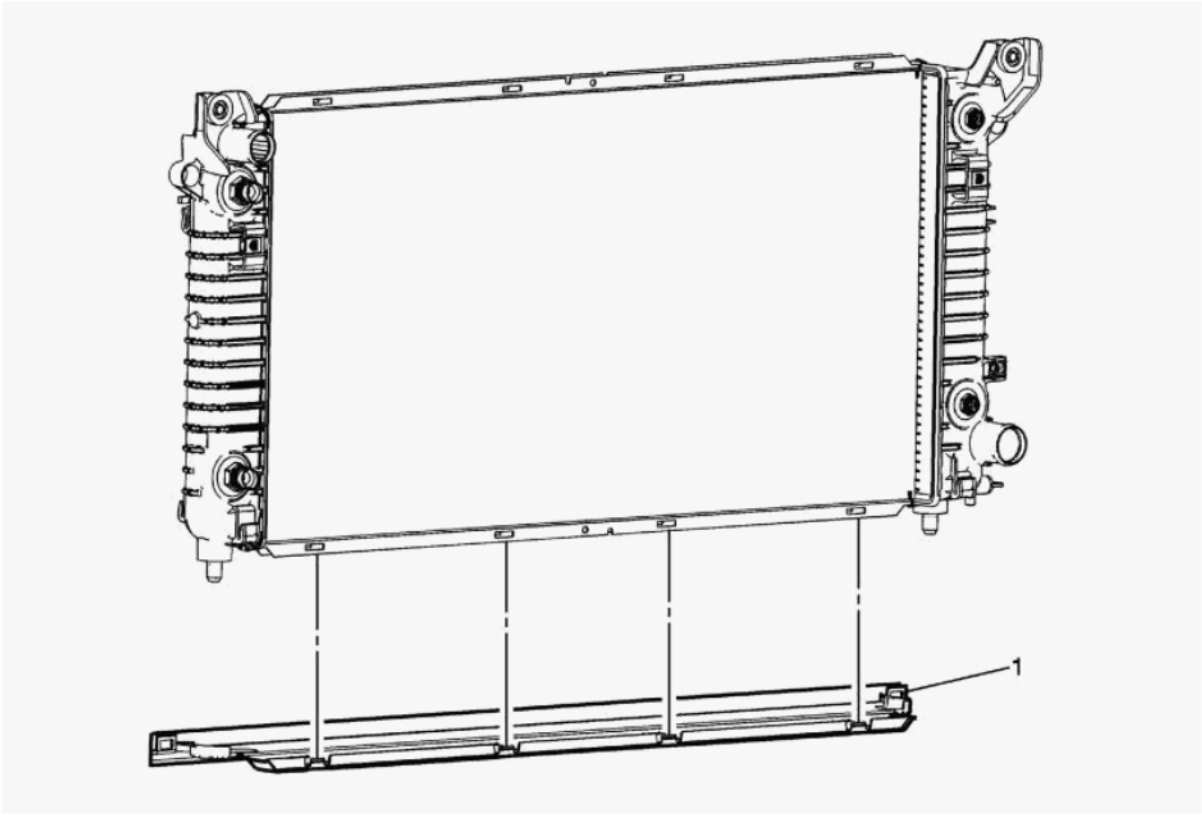


Fig. 120: Radiator Air Lower Baffle (L83, L86)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove the engine coolant fan rear shroud from the vehicle. Refer to **Engine Coolant Fan Rear Shroud Replacement (L83, L86)**.	

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Callout	Component Name
	2. Remove the front end upper tie bar support. Refer to **Front End Upper Tie Bar Support Replacement** . 3. Raise the condenser and radiator as and assembly (CRA) upward and support CRA above lower tie-bar. 4. Push downward on radiator air lower baffle to remove the left and right radiator air baffle retaining tabs from the radiator air lower baffle. Refer to **Radiator Air Baffle Replacement - Left (L83 L86)**, and **Radiator Air Baffle Replacement - Right (L83 L86)**. **NOTE:** **Some early builds have 1 or 2 tie straps holding the baffle to the radiator at the inner tabs. Cut tie strap before removing baffle.**
1	Radiator Air Lower Baffle **Procedure** Push each of the four radiator air lower baffle retaining tabs inward to disengage the radiator air lower baffle from the radiator.

RADIATOR AIR LOWER BAFFLE REPLACEMENT (L96)

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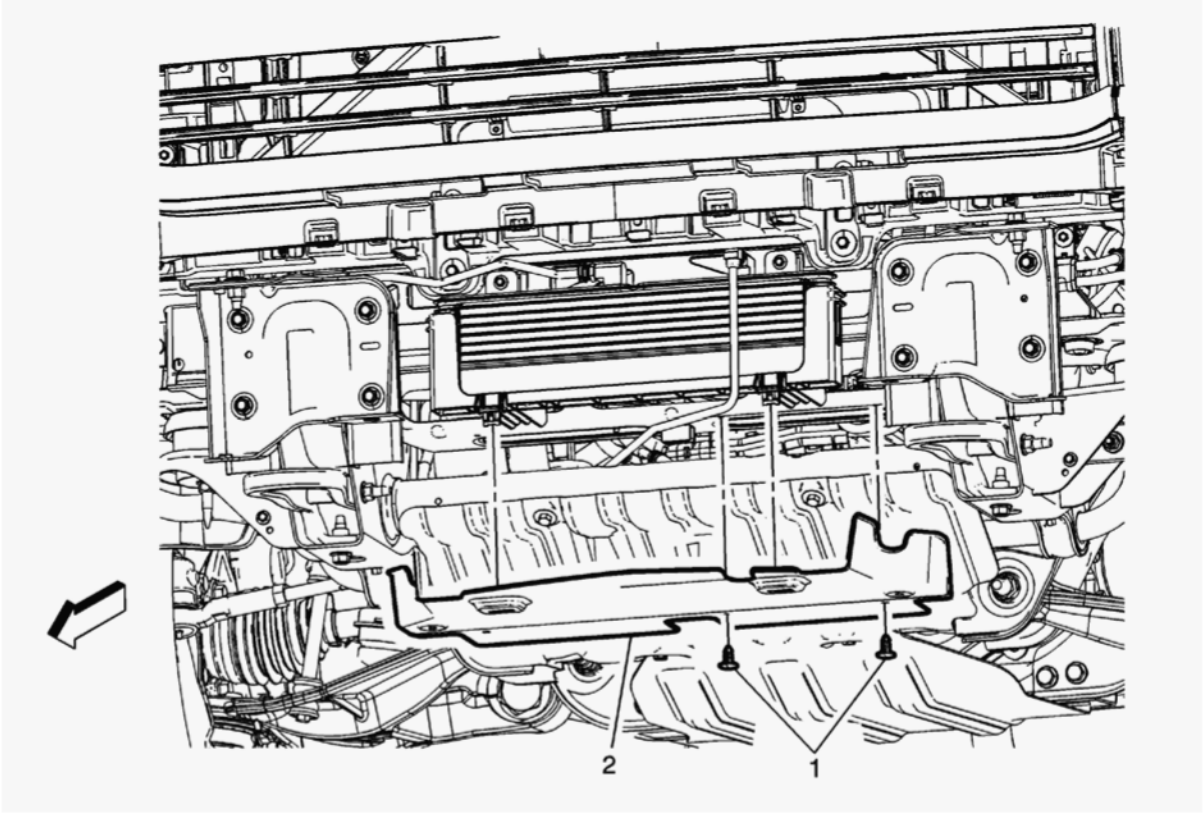


Fig. 121: Radiator Air Lower Baffle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove the Front Bumper Impact Bar. Refer to **Front Bumper Impact Bar Replacement (GMC)** **Front Bumper Impact Bar Replacement (Chevrolet)** **Front Bumper Impact Bar Replacement (Cadillac)** .	
1	Radiator Air Lower Baffle Retainer (Qty: 2)
2	Radiator Air Lower Baffle **Procedure** 1. Remove the electrical wiring harness retainer from the radiator air lower baffle and reposition out of the way.

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Callout	Component Name
	2. Unclip the transmission fluid auxiliary cooler from the radiator air lower baffle.

RADIATOR AIR UPPER BAFFLE AND DEFLECTOR REPLACEMENT (TOP OF RADIATOR L83 L86)

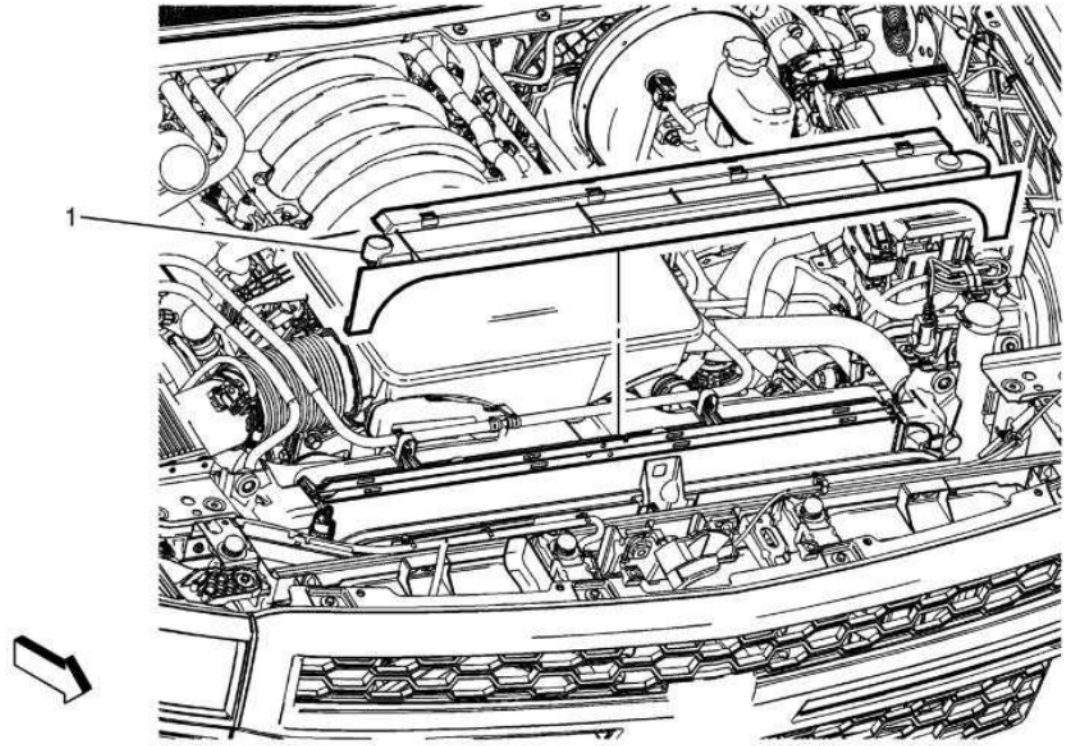


Fig. 122: Radiator Air Upper Baffle And Deflector
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
	1. Remove the front compartment front sight shield. Refer to **Front Compartment Front Sight Shield Replacement (GMC)** **Front Compartment Front Sight Shield Replacement (Chevrolet)** **Front Compartment Front Sight Shield Replacement (Cadillac)** .

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Callout	Component Name
2. Remove the front end upper tie bar support. Refer to **Front End Upper Tie Bar Support Replacement** .	
1	Radiator Air Upper Baffle and Deflector **Procedure** Unclip the radiator air upper baffle and deflector from the radiator and lift up to remove.

RADIATOR AIR UPPER BAFFLE AND DEFLECTOR REPLACEMENT (RIGHT OF RADIATOR L83 L86)

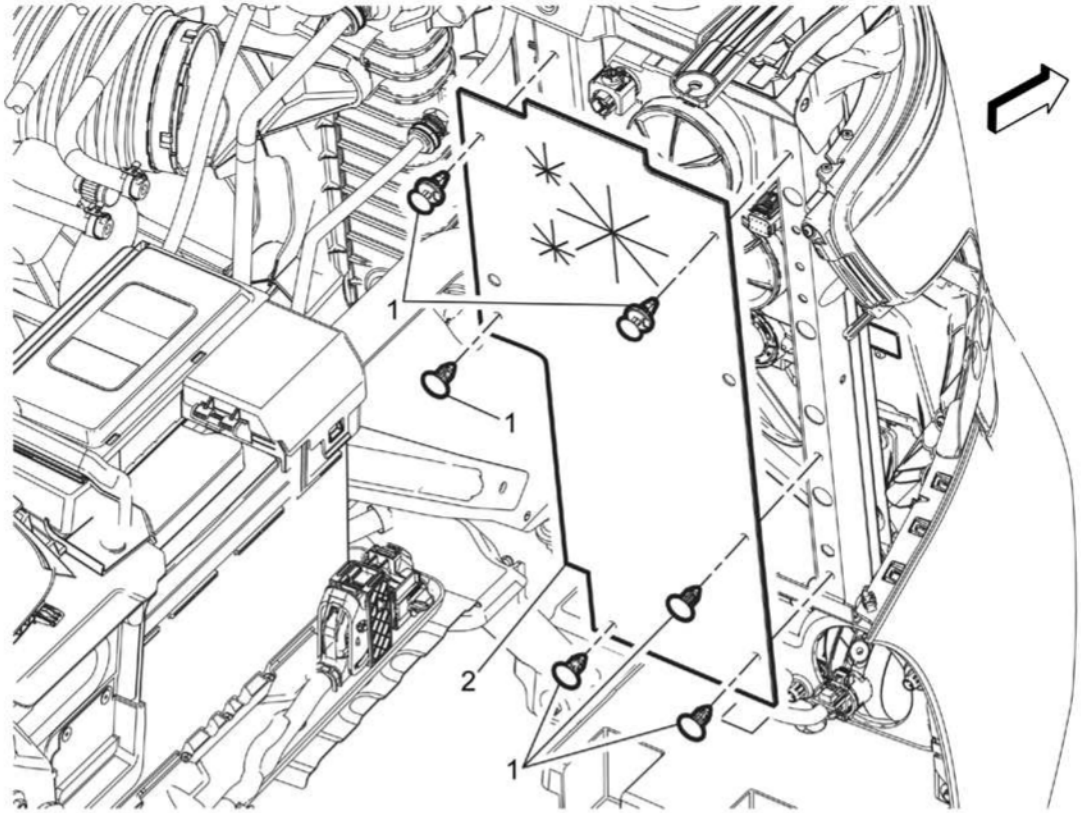


Fig. 123: Radiator Air Upper Baffle and Deflector (Right of Radiator L83 L86)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	

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Callout	Component Name
1. **Air Cleaner Bracket Replacement** 2. Unclip the electrical harness retainer from the radiator air upper baffle and deflector and reposition out of the way.	
1	Radiator Air Upper Baffle and Deflector Retainer (Qty: 6)
2	Radiator Air Upper Baffle and Deflector

RADIATOR AIR SEAL REPLACEMENT (L83 L86)

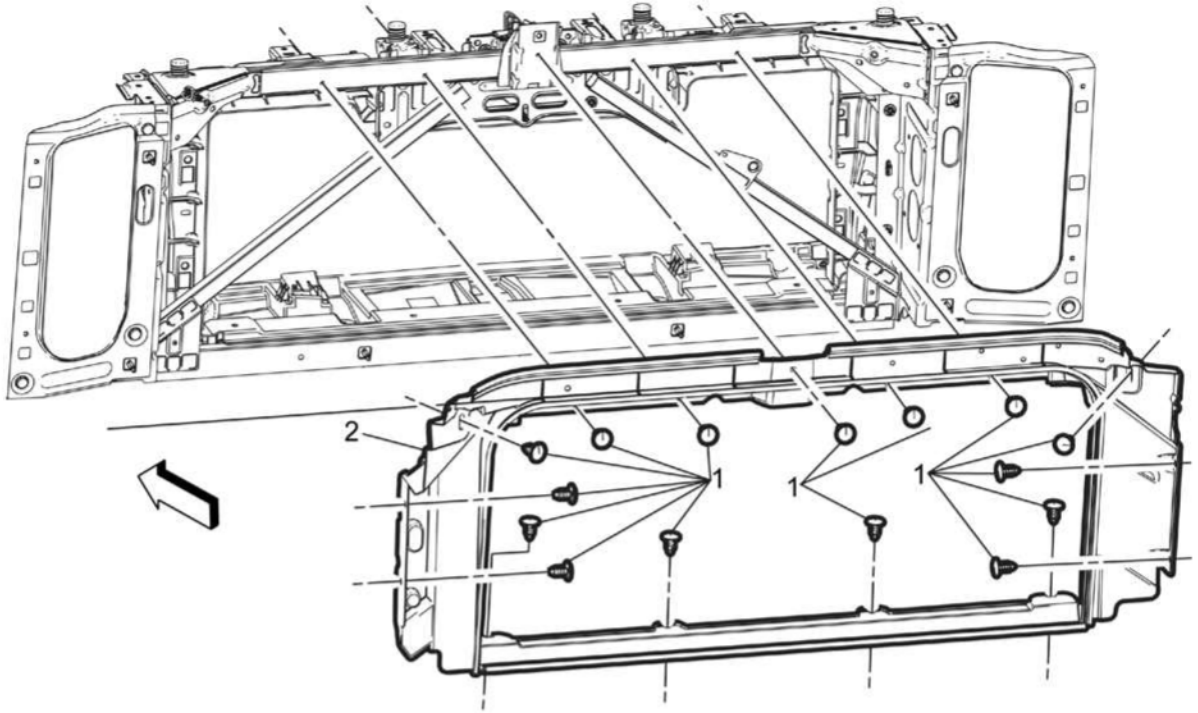


Fig. 124: Radiator Air Seal
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	

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Callout	Component Name
Remove the headlamp radiator grille mount panel from the vehicle. Refer to **Headlamp and Radiator Grille Mount Panel Replacement** .	
1	Radiator Air Seal Retainer (Qty: 15)
2	Radiator Air Seal

RADIATOR AIR SEAL REPLACEMENT (L96)

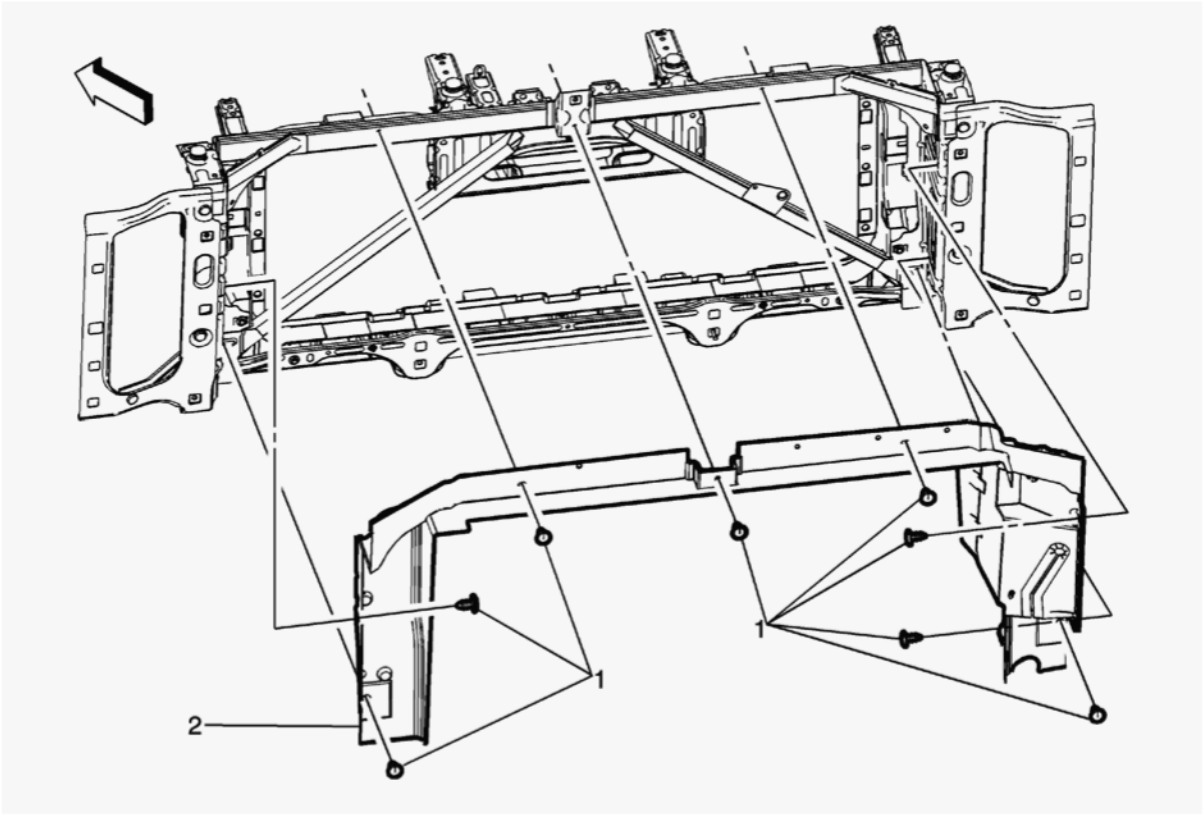


Fig. 125: Radiator Air Seal
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the headlamp and radiator grille mount panel. **Headlamp and Radiator Grille Mount Panel Replacement** .	
1	Radiator Air Seal Retainer (Qty: 8)

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Callout	Component Name
2	Radiator Air Seal

COOLANT HEATER REPLACEMENT

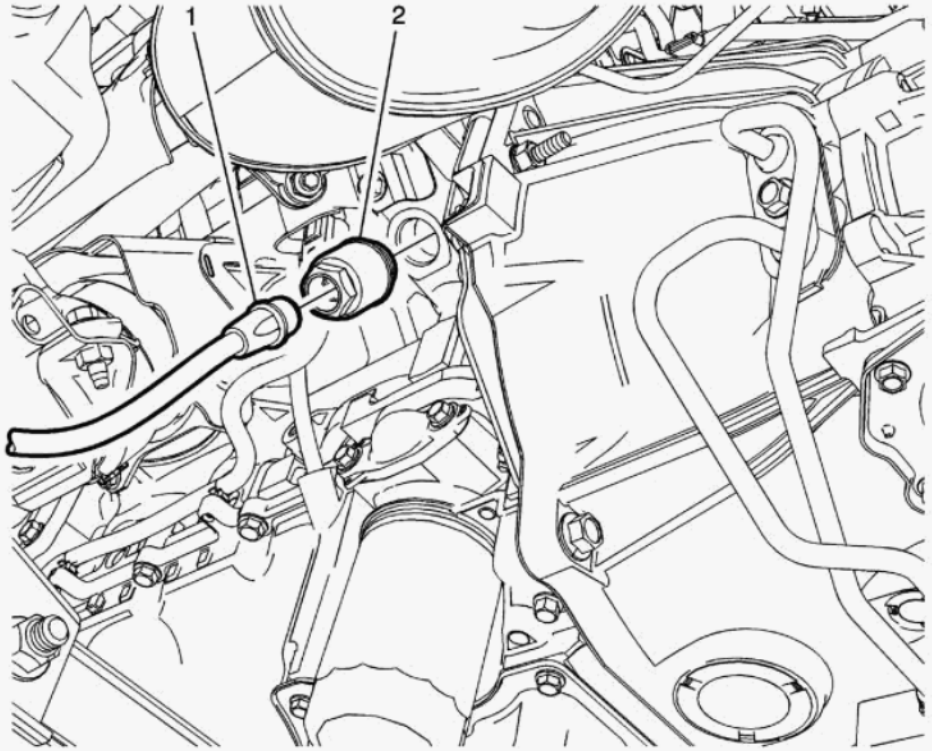


Fig. 126: Coolant Heater
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
1. Drain the cooling system. **Cooling System Draining and Filling (Static Fill L96)Cooling System Draining and Filling (Vac N Fill L96)Cooling System Draining and Filling (Vac N Fill L83 L86)Cooling System Draining and Filling (Static Fill L83 L86)**	
2. If equipped **Front Axle Propeller Shaft Replacement (NPO) Front Axle Propeller Shaft Replacement (NQH) Front Axle**	

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Callout	Component Name
Propeller Shaft Replacement (Heavy Duty)	
1	Coolant Heater Cord **Procedure** Remove Coolant Heater Cord Retaining Clip
2	Coolant Heater **CAUTION:** **Refer to Fastener Caution .** **Tighten** 50 N.m (37 lb ft)

COOLANT HEATER CORD REPLACEMENT

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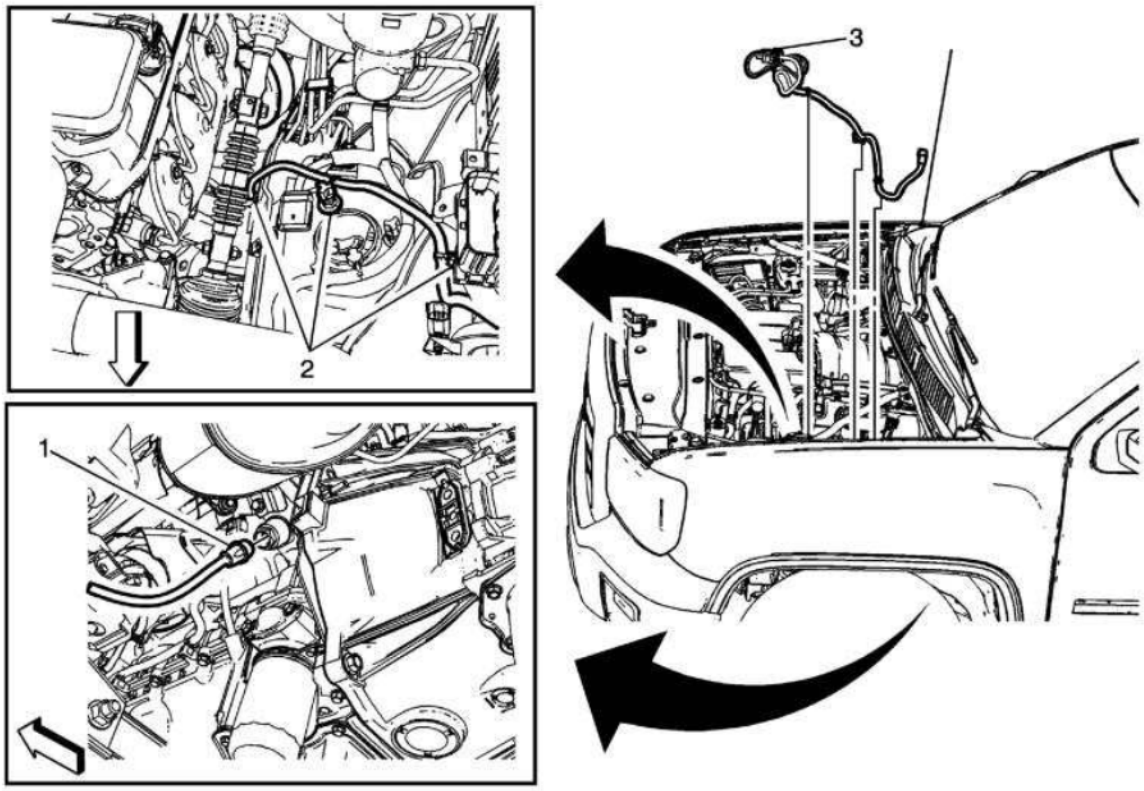


Fig. 127: Coolant Heater Cord
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .	
1	Coolant Heater Cord Connector
2	Coolant Heater Cord Retainers
3	Coolant Heater Cord **Procedure** Note the location and routing of the coolant heater cord prior to removal in order to ensure proper installation.

DESCRIPTION AND OPERATION

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COOLING FAN DESCRIPTION AND OPERATION

Cooling Fan Control

The engine cooling fan system is composed of 2 electric cooling fans, fan motors, and a control module. The engine control module (ECM) controls the fan speed by sending a pulse width modulated (PWM) signal to the cooling fan control module. The cooling fan control module varies the voltage drop across the cooling fan motors in relation to the pulse width modulated signal, which allows the cooling fans to operate at variable speeds.

The cooling fan speed is effected by many different conditions and the ECM will adjust the duty cycle from 0-100 percent based on cooling system requirements. The scan tool output control is only capable of operating the cooling fan increments, between 10-90 percent. 90 percent is considered high speed fan. When multiple cooling fan speed requests are received, the ECM operates the fan at the highest of speed requests. The ECM commands the fans ON under the following conditions:

- The engine coolant temperature is warmer than a predetermined temperature.
- The engine oil temperature is warmer than a predetermined temperature.
- The A/C pressure reaches a predetermined pressure.
- If the engine coolant temperature at key-off is warmer than a predetermined value, or the A/C pressure is greater than a predetermined value, the cooling fan will operate at a low speed. The fan will shut OFF if the temperature or pressure drops below the predetermined value, but will only operate for 2 minutes, regardless of the coolant temperature or A/C pressure.

COOLING SYSTEM DESCRIPTION AND OPERATION

Engine Coolant Indicators

ENGINE COOLANT HOT

The instrument panel cluster (IPC) displays ENGINE COOLANT HOT message when the IPC receives a message from the powertrain control module (PCM) requesting illumination of this driver warning.

ENGINE OVERHEATED

The IPC displays ENGINE OVERHEATED message when the IPC receives a message from the PCM requesting illumination of this driver warning.

REDUCED ENGINE POWER

The IPC displays REDUCED ENGINE POWER message when the IPC detects a reduced engine power condition from the PCM. The IPC receives a message from the PCM requesting illumination when the engine temperature exceeds a calibrated value.

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Coolant Heater (If Equipped)

The optional engine coolant heater (RPO K05) 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 -18Â°C (0Â°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.

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 coolant does not flow to the radiator until the thermostat opens. 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. Coolant will then be 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.

Some coolant is also pumped from the water pump to the heater core, then back to the water pump. This provides the passenger compartment with heat and defrost.

The coolant is then forced through the cylinder head gasket openings and into the cylinder heads. In the cylinder heads, the coolant flows through the water jackets surrounding the combustion chambers and valve seats, where it absorbs additional heat.

Coolant

The engine coolant is a solution made up of a 50-50 mixture of DEX-COOL and suitable drinking 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 tube and fin crossflow design that extends from the inlet tank to the outlet tank. Fins are placed around the outside of the tubes to improve heat transfer to the atmosphere.

The inlet and outlet tanks are a molded, high temperature, nylon reinforced plastic material. A high temperature rubber gasket seals the tank flange edge to the aluminum core. 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 (except HD), located in the bottom of the right hand tank. The drain cock unit includes the drain cock and drain cock seal.

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The radiator removes heat from the coolant passing through it. The fins on the core transfer heat from the coolant passing through the tubes. As air passes between the fins, it absorbs heat and cools the coolant.

Surge Tank

The surge tank is a plastic tank with a threaded pressure cap. The tank is mounted at a point higher than all other coolant passages. The surge tank provides an air space in the cooling system that allows the coolant to expand and contract. The surge tank provides a coolant fill point and a central air bleed location.

During vehicle use, the coolant heats and expands. The increased coolant volume flows into the surge tank. As the coolant circulates, any air is allowed to bubble out. Coolant without air bubbles absorbs heat much better than coolant with bubbles.

During vehicle use, the coolant heats and expands. The increased coolant volume can in some conditions push past the pressure cap and through a channel into the overflow bottle. As the coolant circulates, air is allowed to bubble out. This air is then transferred to the overflow bottle, through the surge tank cap, where it returns to the atmosphere. Coolant without air bubbles absorbs heat much better than coolant with bubbles. When the engine cools, the coolant, without air bubbles, contracts back into the surge tank from the bottom of the overflow bottle.

Pressure Cap

The pressure cap seals the cooling system. It contains a blow off or pressure relief valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring, which protects the radiator from excessive cooling system pressure. 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, might cause the radiator and/or coolant hoses to collapse.

The pressure cap allows cooling system pressure to build up as the temperature increases. As the pressure builds, the boiling point of the coolant increases. Engine coolant can be safely run at a temperature much higher than the boiling point of the coolant at atmospheric pressure. The hotter the coolant is, the faster the heat transfers from the radiator to the cooler, passing air.

The pressure in the cooling system can get too high. When the cooling system pressure exceeds the rating of the pressure cap, it raises the pressure valve, venting the excess pressure.

As 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 surge tank. This equalizes the pressure in the cooling system with atmospheric pressure, preventing the radiator and coolant hoses from collapsing.

Air Baffles and Seals

The cooling system uses deflectors, air baffles and air seals to increase cooling system capability. Deflectors are installed under the vehicle to redirect

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airflow beneath the vehicle and through the radiator to increase engine cooling. Air baffles are also used to direct airflow through the radiator and increase cooling capability. Air seals prevent air from bypassing the radiator and A/C condenser, and prevent recirculation of hot air for better hot weather cooling and A/C condenser performance.

Cooling Fan and Clutch

The engine cooling fan and clutch are driven by the crankshaft via the drive belt. The cooling fan draws air through the radiator to improve the transfer of heat from the coolant to the atmosphere. As the fan blades spin, they pull cool, outside air past the radiator core. The fan clutch drives the cooling fan. The fan clutch controls the amount of torque that is transmitted from the crankshaft to the fan blades. The clutch allows more torque to engage on the fan when the engine operating temperature increases and/or the vehicle speed is low. As the torque increases, the fan turns more quickly. The fan clutch decreases the torque applied to the cooling fan when the engine temperature decreases and/or the vehicle speed is high. As the torque decreases, the fan speed decreases.

Transmission Oil Cooler

The transmission oil cooler is a heat exchanger. It is located inside the right side (V6) or left side (V8), end 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.

Engine Oil Cooler

The engine oil cooler is a heat exchanger located inside the left side (V6) or right side (V8), end tank of the radiator. The engine oil temperature is controlled by the temperature of the engine coolant that surrounds the oil cooler in the radiator.

The engine oil pump, pumps the oil through the engine oil cooler line to the oil cooler. The oil then flows through the cooler where the engine coolant absorbs heat from the oil. The oil is then pumped through the oil cooler return line, to the engine block system.

Cooling Fan Control - Two Fan System

The engine cooling fan system consists of 2 electrical cooling fans, with a microcontroller that receives and allows the powertrain control module (PCM) to operate both fans together at several speeds. The cooling fans and fan PWM Signal receive battery positive voltage from the underhood fuse block.

During closed loop mode (PWM signal between 10% and 91%), both cooling fans will run at a controlled speed, depending on the percentage of PWM signal is being sent. At this closed loop mode, both fans will run at the speed it is being indicated according to the signal is being read by the

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microcontroller.

During open loop mode (PWM signal between 92% and 95%), both cooling fans will run at a non-controlled speed, this mode is when the fans will run at the maximum speed giving the maximum airflow, this mode is activated when conditions being mentioned later in this document activate it.

NOTE: **The right and left cooling fan connectors are interchangeable. When servicing the fans be sure that the connectors are plugged into the correct fan.**

The PCM commands the low speed cooling fans ON under the following conditions:

- Engine coolant temperature exceeds a calibrated value.
- A/C refrigerant pressure exceeds a calibrated value.
- After the vehicle is shut OFF if the engine coolant temperature at key-off is:
  - 107Â°C-112Â°C then enable low speed fans.
  - 105Â°C then disable low speed fans.
  - 112Â°C then enable high speed fan.
  - 105Â°C then disable high speed fans.
  - The fans (high and low speed) will turn off after a maximum 5 min.

The PCM commands the high speed fans ON under the following conditions:

- Engine coolant temperature exceeds a calibrated value.
- A/C refrigerant pressure exceeds a calibrated value.
- When certain DTCs set.

At idle and very low vehicle speeds the cooling fans are only allowed to increase in speed if required. This insures idle stability by preventing the fans from cycling between high and low speed.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description

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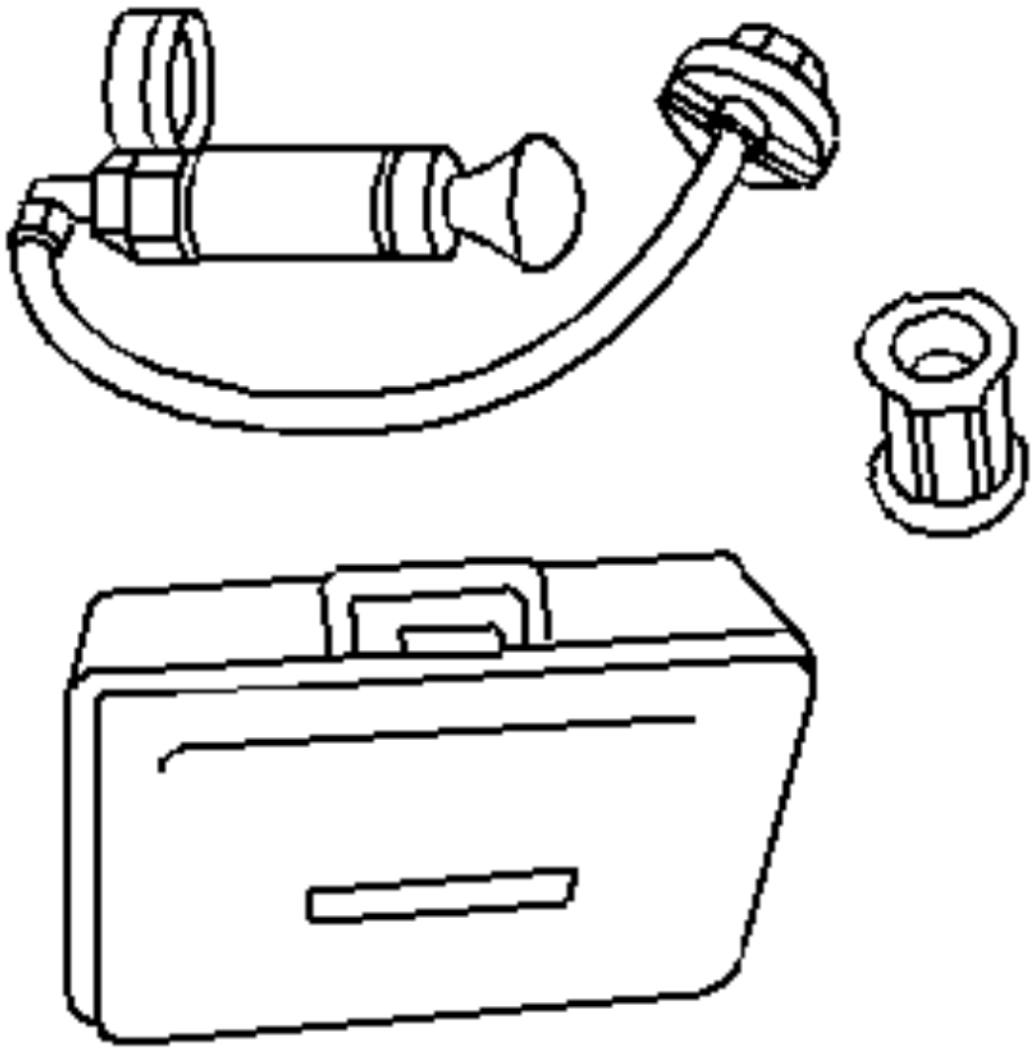
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Illustration	Tool Number/ Description
	BO 38185 J 38185 Hose Clamp Pliers

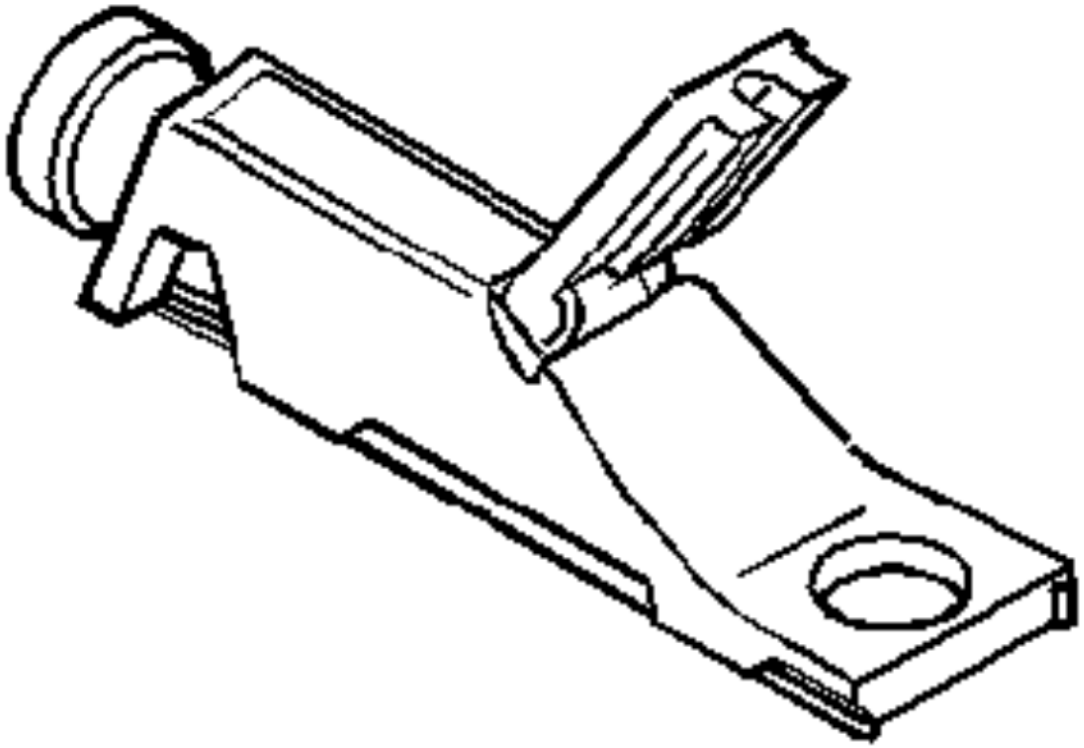
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Illustration	Tool Number/ Description
	EL 35616-F J 35616-F Connector Test Adapter Kit

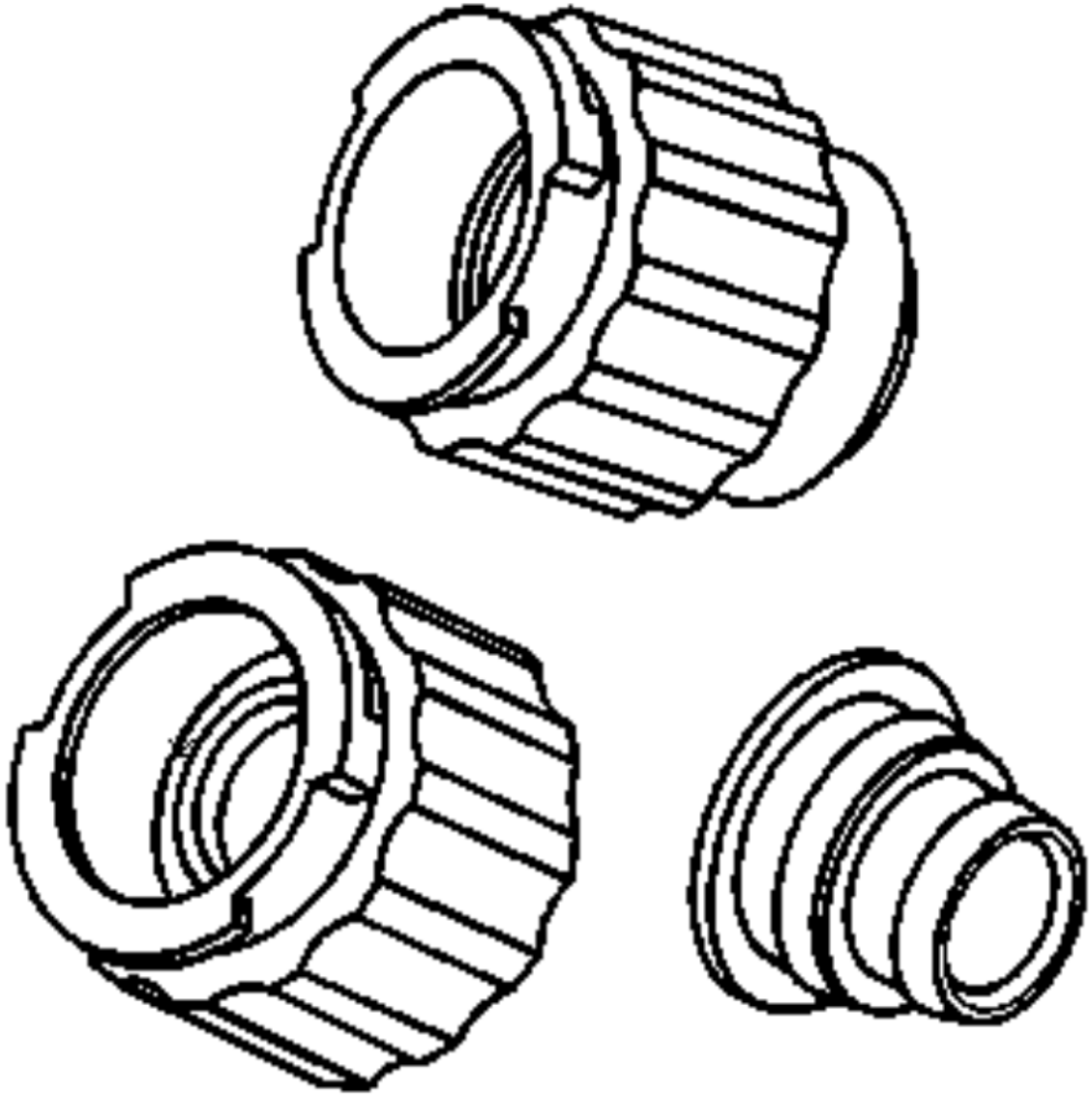
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Illustration	Tool Number/ Description
	EN 24460-A J 24460-01 Cooling System Pressure Tester

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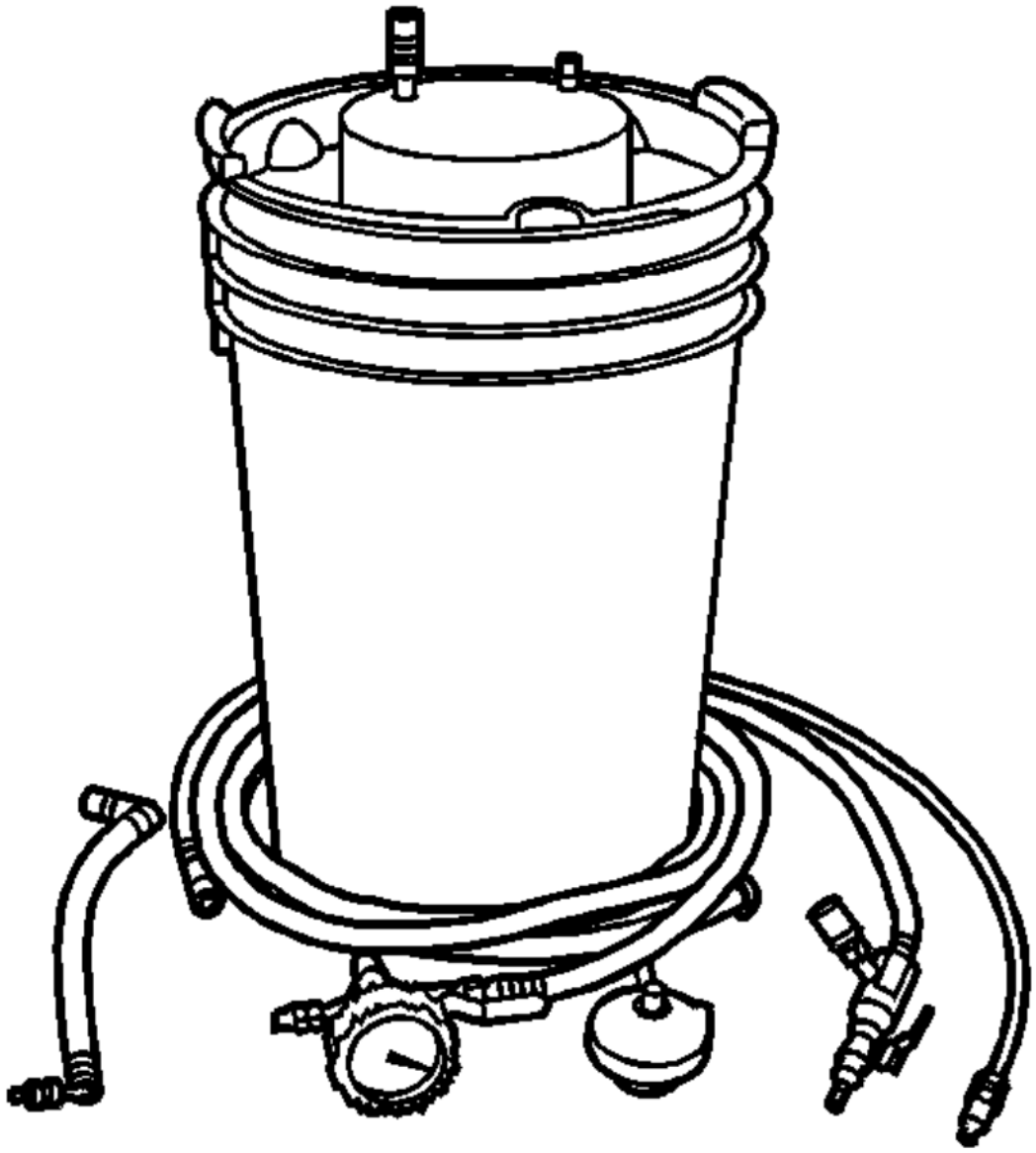
Illustration	Tool Number/ Description
	GE 26568 J 26568 Coolant and Battery Fluid Tester

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Illustration	Tool Number/ Description
	GE 42401-A J 42401 Radiator Cap and Surge Tank Test Adapter

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Illustration	Tool Number/ Description
	GE 47716 Vac N Fill Coolant Refill Tool

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