

2017 ENGINE**Engine Heating and Cooling - CT6****SPECIFICATIONS****FASTENER SPECIFICATIONS****Single Use Non-Threaded Fasteners/Components****NOTE:**

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application
Engine Coolant Air Bleed Pipe Seal
Engine Coolant Thermostat Housing Seal
Engine Oil Cooler Adapter Gasket
Engine Oil Cooler Seal
Heater Inlet and Outlet Pipe Gasket
Thermostat Bypass Pipe Gasket
Turbocharger Coolant Feed And Return Pipe Washer
Turbocharger Coolant Feed Pipe Copper Washer
Turbocharger Coolant Feed Pipe Gasket
Water Outlet Seal
Water Pump Gasket
Water Pump Inlet Pipe Seal
Water Pump Seal

Reusable Threaded Fastener Tightening Specifications**NOTE:**

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Air Bleeder Valve @ Charge Air Cooler (LGW)	12 N.m (106 lb in)
Auxiliary Radiator Bolt (LGW, LGX)	9 N.m (80 lb in)
Auxiliary Radiator Nut (LGW)	9 N.m (80 lb in)
Auxiliary Radiator Screw (LGW)	1.5 N.m (13 lb in)
Charge Air Cooler Coolant Hose Connector Bolt (LGW)	10 N.m (89 lb in)
Charge Air Cooler Coolant Pump Clamp Bolt (LGW)	9 N.m (80 lb in)
Charge Air Cooler Coolant Pump Nut (LGW)	9 N.m (80 lb in)
Charge Air Cooler Inlet Hose Fitting Nut (LGW)	9 N.m (80 lb in)
Coolant Heater	50 N.m (37 lb ft)
Engine Coolant Air Bleed Pipe Fastener (LGW, LGX, LTG)	10 N.m (89 lb in)
Engine Coolant Air Bleed Valve (LGW)	12 N.m (106 lb in)
Engine Coolant Fan Motor Bolt	6 N.m (53 lb in)
Engine Coolant Fan Bolt (LGW, LTG)	5.1 N.m (45 lb in)
Engine Coolant Fan Bolt (LGX)	7.25 N.m (64 lb in)
Engine Coolant Fan Shroud Bolt	5.1 N.m (45 lb in)
Engine Coolant Thermostat Housing Bolt	10 N.m (89 lb in)

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Engine Front Cover Bolt	25 N.m (18 lb ft)
Engine Oil Cooler Adapter Bolt	10 N.m (89 lb in)
Engine Oil Cooler Connector (LTG)	50 N.m (37 lb ft)
Engine Oil Cooler Coolant Inlet Hose Bracket Bolt	22 N.m (16 lb ft)
Engine Oil Cooler Inlet Pipe Bolt (LGW)	10 N.m (89 lb in)
Engine Oil Cooler Pipe Bolt (LGX)	10 N.m (89 lb in)
Engine Oil Cooler Pipe Fastener (LTG)	10 N.m (89 lb in)
Engine Oil Cooler Pipe Quick Connect Fitting (LGW)	35 N.m (26 lb ft)
Heater Inlet and Outlet Pipe Bolt (LGW, LGX)	9 N.m (80 lb in)
Heater Inlet and Outlet Pipe Bracket Bolt	9 N.m (80 lb in)
Heater Water Bypass Inlet Hose Bolt (LGW)	22 N.m (16 lb ft)
Heater Water Bypass Inlet Hose Bracket Bolt (LGX)	22 N.m (16 lb ft)
Radiator Air Side Baffle Bracket Bolt	9 N.m (80 lb in)
Radiator Air Upper Baffle Bolt (LGW LGX LTG - Left Side)	4 N.m (35 lb in)
Radiator Air Upper Baffle Bolt (LGX - Right Side)	9 N.m (80 lb in)
Radiator Air Upper Baffle Bolt (LGW, LTG - Right Side)	4 N.m (35 lb in)
Radiator Air Upper Baffle Bolt @ Radiator Air Side Upper Baffle	2.5 N.m (22 lb in)
Radiator Inlet Pipe Bolt (LTG)	9 N.m (80 lb in)
Radiator Lower Bracket Bolt	22 N.m (16 lb ft)
Radiator Surge Tank Bolt	9 N.m (80 lb in)
Radiator Upper Mount Bracket Bolt	9 N.m (80 lb in)
Thermostat Bypass Pipe Bolt (LTG)	10 N.m (89 lb in)
Turbocharger Coolant Feed and Return Pipe Bolt (LGW)	35 N.m (26 lb ft)
Turbocharger Coolant Feed Pipe Fasteners (LTG)	10 N.m (89 lb in)
Turbocharger Coolant Feed Pipe Hollow Screw (LTG)	35 N.m (26 lb ft)
Turbocharger Coolant Return Pipe Fasteners (LTG)	10 N.m (89 lb in)
Turbocharger Coolant Return Pipe Hollow Screw (LTG)	35 N.m (26 lb ft)
Water Outlet Bolt (LGW, LGX, LTG)	10 N.m (89 lb in)
Water Pump Bolt (LGW, LGX)	15 N.m (11 lb ft)
Water Pump Inlet Pipe Bolt (LGW, LGX)	9 N.m (80 lb in)
Water Pump Pulley Bolt (LGW, LGX)	10 N.m (89 lb in)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Cooling Systems		
2.0L (LTG) with CJ2	8.6 L	9.0 qt
2.0L (LTG) with C24	10.3 L	10.9 qt
2.0L (LTG) with HP9	9.8 L	10.4 qt
3.0L (LGW) with CJ2	10.6 L	11.2 qt
3.0L (LGW) with CJ2 with V03	11.5 L	12.2 qt
3.0L (LGW) with CJ2 without V03	10.6 L	11.2 qt
3.0L (LGW) with C24	12.3 L	13.0 qt
3.0L (LGW) with C24 with V03	13.2 L	13.9 qt

Application	Specification	
	Metric	US English
3.0L (LGW) with C24 without V03	12.3 L	13.0 qt
3.0L (LGW) Intercooler	3.2 L	3.4 qt
3.6L (LGX) with CJ2	9.8 L	10.3 qt
3.6L (LGX) with C24	11.4 L	12.0 qt

ADHESIVES, FLUIDS, LUBRICANTS AND SEALERS

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

SCHEMATIC WIRING DIAGRAMS

ENGINE HEATING/COOLING WIRING SCHEMATICS

Cooling Fan

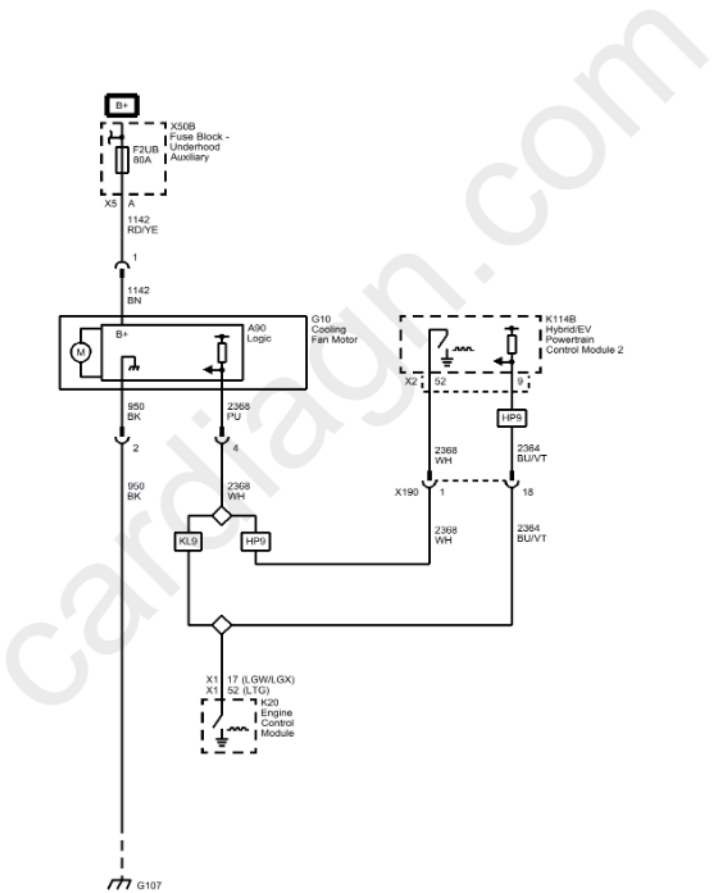


Fig. 1: Cooling Fan
Courtesy of GENERAL MOTORS COMPANY

Charge Air Cooler Pump (LGW)

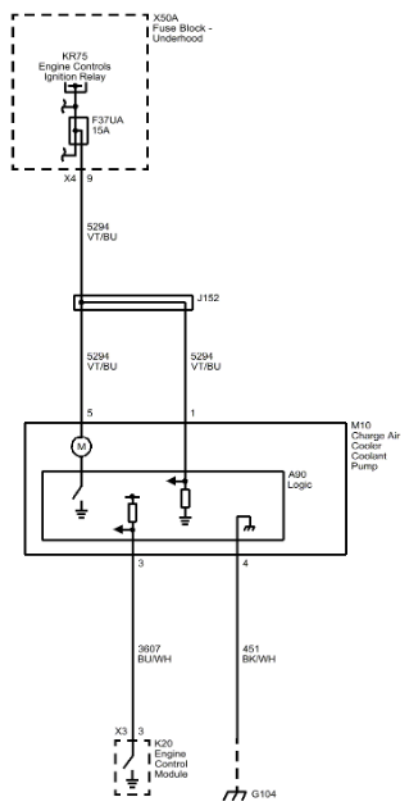


Fig. 2: Charge Air Cooler Pump (LGV)
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0480, P0691 OR P0692: COOLING FAN SPEED OUTPUT CIRCUIT (LTG)

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
Cooling Fan Control Module B+ Supply	P0480, P0691*	-	-	-
Cooling Fan Control Module Ground	-	-	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Cooling Fan Control Module Control	P0480, P0691	P0480, P0691	-	-
*Opens cooling fan fuse.				

Circuit/System Description

The engine cooling fan system is composed of one electric cooling fan and a cooling fan 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 motor in relation to the pulse width modulated signal, which enables cooling fan operation at variable speeds. The ECM will only operate the cooling fan at certain percentages to prevent undesirable noise and vibration. 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.

Conditions for Running the DTC

- The ignition voltage is greater than 11 volts.
- The DTCs 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.

Diagnostic Aids

- The cooling fan will not operate when the scan tool Cooling Fan Motor Command parameter displays less than 4%. This is a normal condition.
- 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.
- The cooling fan Control Function operates as described below when the ignition is ON and engine is OFF:
 - Command State 1 operates the cooling fan at approximately 18-21%
 - Command State 2 operates the cooling fan at approximately 54%
 - Command State 3 operates the cooling fan at approximately 67%
 - Command State 4 operates the cooling fan at approximately 85%
 - Command State 5 operates the cooling fan at approximately 90%
- During normal operating conditions the ECM may initially activate the cooling fan at 4 or 5% and then increase to the percentages indicated above, as needed, to satisfy powertrain cooling requirements. Generally, the ECM will operate the cooling fan at the specified percentages but, may scale the percentages either higher or lower in response to generator demand.
- When operating the cooling fan with a scan tool, the Commanded States 1-5 should be exercised in order, from OFF to High or High to OFF. The cooling fan control module may disable the cooling fan if a Commanded State is skipped.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

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

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify the G10 Cooling Fan Motor activates in each available speed when commanding the cooling fan ON with a scan tool. The cooling fan speed should increase with each command.

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

- **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 to verify the DTC does not reset. 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

1. Ignition OFF, disconnect the harness connector X1 at the G10 Cooling Fan Motor, ignition ON.
2. Verify that a test lamp illuminates between the B+ circuit terminal 1 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF and 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 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 and 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 B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, replace the G10 Cooling Fan Motor.
- **If the test lamp illuminates**
3. Connect a DMM, set on the diode setting, between the control circuit terminal X1-4 and ground.

NOTE: The cooling fan speed output circuit is pulled-up to a voltage within the ECM, 2-3 volts on the output circuit is normal.

4. 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 and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down.
 2. Disconnect the harness connector X1 at the K20 Engine Control Module.
 3. Test for infinite resistance between the G10 Cooling Fan Motor control circuit terminal X1-4 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.**
5. Command the cooling fan ON with a scan tool using Command State 5.
6. Verify the DMM reading is less than 1 V.
 - **If 1 V or greater**
 1. Ignition OFF.
 2. Disconnect the harness connector X1 at the K20 Engine Control Module, ignition ON.
 3. Test for less than 1 V between the G10 Cooling Fan Motor control circuit terminal X1-4 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
 4. Ignition OFF and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down.
 5. Test for less than 2 Ω in the circuit between the G10 Cooling Fan Motor terminal X1-4 and the K20 Engine Control Module terminal X1-52.
 - If 2 Ω or greater, repair the open in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 1 V**
7. Replace the G10 Cooling Fan Motor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Engine Coolant Fan Motor Replacement \(LGW LGX LTG\)](#)
- [Control Module References](#) for ECM replacement, setup and programming.

DTC P0480, P0691 OR P0692: COOLING FAN SPEED OUTPUT CIRCUIT (LGW OR LGX)

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
Cooling Fan Control Module B+ Supply	P0480, P0691*	-	-	-
Cooling Fan Control Module Ground	-	-	-	-
Cooling Fan Control Module Control	P0480, P0691	P0480, P0691	-	-
*Opens cooling fan fuse.				

Circuit/System Description

The engine cooling fan system is composed of one electric cooling fan and a cooling fan 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 motor in relation to the pulse width modulated signal, which enables cooling fan operation at variable speeds. The ECM will only operate the cooling fan at certain percentages to prevent undesirable noise and vibration. 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.

Conditions for Running the DTC

- The ignition voltage is greater than 11 volts.
- The DTCs 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.

Diagnostic Aids

- The cooling fan will not operate when the scan tool Cooling Fan Motor Command parameter displays less than 4%. This is a normal condition.
- 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.
- The cooling fan Control Function operates as described below when the ignition is ON and engine is OFF:
 - Command State 1 operates the cooling fan at approximately 18-21%

- Command State 2 operates the cooling fan at approximately 54%
- Command State 3 operates the cooling fan at approximately 67%
- Command State 4 operates the cooling fan at approximately 85%
- Command State 5 operates the cooling fan at approximately 90%
- During normal operating conditions the ECM may initially activate the cooling fan at 4 or 5% and then increase to the percentages indicated above, as needed, to satisfy powertrain cooling requirements. Generally, the ECM will operate the cooling fan at the specified percentages but, may scale the percentages either higher or lower in response to generator demand.
- When operating the cooling fan with a scan tool, the Commanded States 1-5 should be exercised in order, from OFF to High or High to OFF. The cooling fan control module may disable the cooling fan if a Commanded State is skipped.

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

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify the G10 Cooling Fan Motor activates in each available speed when commanding the cooling fan ON with a scan tool. The cooling fan speed should increase with each command.

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

- 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 to verify the DTC does not reset. 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

1. Ignition OFF, disconnect the harness connector X1 at the G10 Cooling Fan Motor, ignition ON.
2. Verify that a test lamp illuminates between the B+ circuit terminal 1 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF and 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 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 and 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 B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, replace the G10 Cooling Fan Motor.

- **If the test lamp illuminates**

3. Connect a DMM, set on the diode setting, between the control circuit terminal X1-4 and ground.

NOTE: The cooling fan speed output circuit is pulled-up to a voltage within the ECM, 2-3 volts on the output circuit is normal.

4. 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 and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connector X1 at the K20 Engine Control Module.
3. Test for infinite resistance between the G10 Cooling Fan Motor control circuit terminal X1-4 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.**

5. Command the cooling fan ON with a scan tool using Command State 5.

6. Verify the DMM reading is less than 1 V.

- **If 1 V or greater**

1. Ignition OFF.
2. Disconnect the harness connector X1 at the K20 Engine Control Module, ignition ON.
3. Test for less than 1 V between the G10 Cooling Fan Motor control circuit terminal X1-4 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
4. Ignition OFF and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 2 Ω in the circuit between the G10 Cooling Fan Motor terminal X1-4 and the K20 Engine Control Module terminal X1-17.
 - If 2 Ω or greater, repair the open in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If less than 1 V**

7. Replace the G10 Cooling Fan Motor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Engine Coolant Fan Motor Replacement \(LGW LGX LTG\)](#)
- [Control Module References](#) for ECM replacement, setup and programming.

DTC P1258: ENGINE COOLANT OVERTEMPERATURE - PROTECTION MODE

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 P1258

Engine Coolant Overtemperature - Protection Mode Active

Circuit/System Description

The engine control module (ECM) uses the engine coolant temperature sensor to monitor the engine for an over-temperature condition. This condition occurs when the coolant temperature is above a calibrated value. The ECM will alternately disable 2 groups of cylinders by turning OFF the fuel injectors. By switching between the 2 groups of cylinders, the ECM is able to reduce the temperature of the coolant.

Conditions for Running the DTC

- The engine is operating for greater than 30 seconds.
- DTC P1258 runs continuously once the conditions above have been met.

Conditions for Setting the DTC

The ECM detects that engine coolant temperature is warmer than 132 Å , $\text{Å}^{\circ}\text{C}$ (270 Å , $\text{Å}^{\circ}\text{F}$) for 2 seconds or greater.

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 IP will illuminate the coolant temperature indicator lamp and 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 remain active at the start of the next drive cycle until the ECT sensor DTC runs and passes.

Conditions for Clearing the MIL/DTC

DTC P1258 is a Type A DTC.

Reference Information

Schematic Reference

[Engine Controls Schematics \(LGW\)](#) [Engine Controls Schematics \(LGX\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Cooling Fan Description and Operation](#)
- [Instrument Cluster Description and Operation](#)
- [Indicator/Warning Message Description and Operation](#)

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

1. Ignition ON.
2. Verify DTC P0480, P0691 or P0692 is not set.

- **If a DTC is set**

Refer to [DTC P0480, P0691 or P0692 \(LTG\)](#) and/or [DTC P0480, P0691 or P0692 \(LGW or LGX\)](#).

- **If no DTCs is set**

3. Verify the cooling fan operates at each available speed as commanded with a scan tool.

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

- **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 that the customer experienced and verify the DTC does not set.

- **If the DTC sets**

Refer to [Symptoms - Engine Cooling](#).

- **If the DTC does not set**

6. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

DTC P1485-P1487: COOLING FAN OUTPUT CIRCUIT (HP9/WITHOUT HP9)

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 P1485

Cooling Fan Output Circuit

DTC P1486

Cooling Fan Output Circuit Low Voltage

DTC P1487

Cooling Fan Output Circuit High Voltage

For symptom byte in information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Cooling Fan Output Circuit	P1486	P1485	P1487	-
Fans operate at 90% with all malfunctions				

Circuit/System Description

The ECM controls the radiator cooling fans with a pulse width modulation (PWM) signal. The ECM modulates the output circuit to operate the engine radiator cooling fans in response to predetermined internal combustion engine (ICE) coolant temperatures. The ECM also uses requests from the HVAC cooling to determine the total percentage of cooling fan operation in a range of 0-100%. The ECM can determine if the output circuit is open, shorted to ground or shorted to a voltage by monitoring the feedback voltage.

Conditions for Running the DTC

- The battery voltage is greater than 11 V.
- The accessory circuit is active for greater than 5 s.
- DTCs P1485, P1486 and P1487 run continuously when the conditions above are met.

Conditions for Setting the DTC

DTC P1485

The ECM detects that the cooling fan output circuit is open.

DTC P1486

The ECM detects that the cooling fan output circuit is shorted to ground.

DTC P1487

The ECM detects that the cooling fan output circuit is shorted to voltage.

Action Taken When the DTC Sets

DTCs P1485, P1486 and P1487 are type B DTCs.

Conditions for Clearing the DTC

DTCs P1485, P1486 and P1487 are type B DTCs.

Reference Information

Schematic Reference

[Engine Heating/Cooling Schematics](#)

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

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify with a scan tool that no other DTCs are set.
 - **If any other DTCs are set**
 - Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
 - **If only no other DTCs are set**
3. Operate the vehicle within the conditions for running the DTC to verify the DTCs does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 - **If DTCs reset**

Refer to Circuit/System Testing.
 - **If DTCs does not reset**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the G10 Cooling Fan Motor. It may take up to 2 min for all vehicle systems to power down.
2. Connect a test lamp between the G10 Cooling Fan Motor harness connector control circuit terminal 1 and B+.
3. Verify the test lamp does not illuminate while the cooling fan is commanded OFF.
 - **If the test lamp illuminates**
 1. Ignition OFF.
 2. Test for infinite resistance between the control voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
4. Verify the test lamp flashes while the cooling fan is commanded ON.
 - **If the test lamp does not flash**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. 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
3. Ignition OFF.
 4. Test for less than 1 V in the control circuit end to end.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If the test lamp flashes**
 5. Replace the G10 Cooling Fan Motor

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Engine Coolant Fan Motor Replacement \(LGW LGX LTG\)](#)
- [Control Module References](#) for Engine Control Module replacement, programming and setup.

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](#). 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.
- 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:

- [Cooling Fan Always On](#)
- [Cooling Fan Inoperative](#)
- [Engine Overheating](#)
- [Loss of Coolant](#)
- [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 one electric cooling fan and a cooling fan 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 motor in relation to the pulse width modulated signal, which enables cooling fan operation at variable speeds. The ECM will only operate the cooling fan at certain percentages to

prevent undesirable noise and vibration. 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 fan will not operate when the scan tool Cooling Fan Motor Command parameter displays less than 4%. This is a normal condition.

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**

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 (LTG)** and/or **DTC P0480, P0691 or P0692 (LGW or LGX)**.
 - **If no DTC is set.**
3. Verify the scan tool Cooling Fan Motor Command parameter is less than 4%.
 - **If 4% or greater**

Refer to **Diagnostic Aids** and **Symptoms - Engine Cooling** for further diagnosis.
 - **If less than 4%**
4. Verify that the G10 Cooling Fan Motor is not operating.
 - **If the G10 Cooling Fan Motor is operating**

Test or replace the G10 Cooling Fan Motor.
 - **If the G10 Cooling Fan Motor is not operating**
5. All OK.

Repair Instructions

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

- **Engine Coolant Fan Shroud Replacement (LGW LGX LTG)** 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 one electric cooling fan and a cooling fan 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 motor in relation to the pulse width modulated signal, which enables cooling fan operation at variable speeds. The ECM will only operate the cooling fan at certain percentages to prevent undesirable noise and vibration. 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

- The cooling fan will not operate when the scan tool Cooling Fan Motor Command parameter displays less than 4%. This is a normal condition.
- 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.
- The cooling fan Control Function operates as described below when the ignition is ON and engine is OFF:
 - Command State 1 operates the cooling fan at approximately 18%
 - Command State 2 operates the cooling fan at approximately 54%
 - Command State 3 operates the cooling fan at approximately 67%
 - Command State 4 operates the cooling fan at approximately 85%
 - Command State 5 operates the cooling fan at approximately 90%
- During normal operating conditions the ECM may initially activate the cooling fan at 4 or 5% and then increase to the percentages indicated above, as needed, to satisfy powertrain cooling requirements. Generally, the ECM will operate the cooling fan at the specified percentages but, may scale the percentages either higher or lower in response to generator demand.
- When operating the cooling fan with a scan tool, the Commanded States 1-5 should be exercised in order, from OFF to High or High to OFF. The cooling fan control module may disable the cooling fan if a Commanded State is skipped.

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

- [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 \(LTG\)](#) and/or [DTC P0480, P0691 or P0692 \(LGW or LGX\)](#).

- **If no DTC is set.**

3. Verify the G10 Cooling Fan Motor activates and increases in speed with each command using a scan tool.

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

- **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.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector G10 Cooling Fan Motor.
2. Verify that a test lamp illuminates between the ground circuit terminal 4 and B+.
 - **If the test lamp does not illuminate**
 1. Ignition OFF and 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 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. Test or replace the G10 Cooling Fan Motor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Engine Coolant Fan Shroud Replacement \(LGW LGX LTG\)](#) 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.			

Step	Action	Yes	No
1	Check for a loss of coolant. Refer to Loss of Coolant Is there a loss of coolant?	Go to Step 2	Go to Step 3
2	Fill the system to the specified level. Refer to Cooling System Draining and Filling (Static without HP9) Cooling System Draining and Filling (GE 47716 without HP9) Cooling System Draining and Filling (Static LTG with HP9) Cooling System Draining and Filling (GE 47716 LTG with HP9) 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
8	Replace the coolant, if necessary. Refer to Cooling System Draining and Filling (Static without HP9) Cooling System Draining and Filling (GE 47716 without HP9) Cooling System Draining and Filling (Static LTG with HP9) Cooling System Draining and Filling (GE 47716 LTG with HP9) 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. 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. Engine Coolant Temperature Sensor Replacement or Engine Coolant Temperature Sensor Replacement Does the engine still overheat?	Go to Step 13	System OK

Step	Action	Yes	No
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. Refer to <u>Flushing (LGW LTG without HP9)</u> . 3. Refill the coolant. Refer to <u>Cooling System Draining and Filling (Static without HP9)</u> <u>Cooling System Draining and Filling (Static LTG with HP9)</u> <u>Cooling System Draining and Filling (GE 47716 LTG with HP9)</u> . 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
18	Replace the cooling fan shroud. Refer to <u>Engine Coolant Fan Shroud Replacement (LGW LGX LTG)</u> . 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 to <u>Engine Coolant Thermostat Housing Replacement (LGW, LGX)</u> and/or <u>Engine Coolant Thermostat Housing Replacement (LTG)</u> . 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 <u>Water Pump Replacement (LGW, LGX)</u> and/or <u>Water Pump Replacement (LTG)</u> . Does the engine still overheat?	-	System OK

LOSS OF COOLANT

Step	Action	Yes	No
DEFINITION: The cooling system is losing coolant either internally or externally.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to <u>Symptoms - Engine Cooling</u>

Step	Action	Yes	No
2	Repair any present DTCs. Refer to <u>Diagnostic System Check - Vehicle</u> . 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 <u>Cooling System Draining and Filling (Static without HP9)</u> , <u>Cooling System Draining and Filling (GE 47716 without HP9)</u> , <u>Cooling System Draining and Filling (Static LTG with HP9)</u> , <u>Cooling System Draining and Filling (GE 47716 LTG with HP9)</u> and <u>Charge Air Cooling System Draining and Filling (LGW)</u> for LF3. Is the action complete?	Go to Step 5	-
5	If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to Step 6	Go to Step 31
6	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 32	Go to Step 7
7	Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Go to Step 34	Go to Step 8
8	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 9	Go to Step 10
9	Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to Step 33	Go to Step 10
10	<u>WARNING:</u> <u>Refer to Moving Parts and Hot Surfaces Warning</u> . With the engine idling, inspect the coolant recovery system. Does the coolant recovery system discharge coolant while the engine is idling?	Go to Step 14	Go to Step 11

Step	Action	Yes	No
11	Visually inspect the hoses, pipes and hose clamps at the following locations: • Coolant Reservoir • Water Pump • Throttle Body • Heater core • Radiator Are any of the hoses, clamps or pipes leaking?	Go to Step 21	Go to Step 12
12	Visually inspect the following components: • Coolant pressure cap • Core plugs • Cylinder head gaskets • Engine block • Intake manifold • Radiator • Thermostat housing • Water pump Are any of the listed components leaking?	Go to Step 21	Go to Step 13
13	1. Pressure test the cooling system. Refer to Cooling System Leak Testing. 2. With the cooling system pressurized, visually inspect the components listed in steps 11 and 12. Are any leaks present?	Go to Step 21	Go to Step 14
14	Pressure test the coolant pressure cap. Refer to Pressure Cap Testing. Does the coolant pressure cap hold pressure?	Go to Step 15	Go to Step 22
15	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 23	Go to Step 16

Step	Action	Yes	No
16	1. Add 30 ml (1 oz) of Extended Life Coolant Leak Detection Dye to the cooling system for each 15 L (4 gal) of coolant. Refer to Adhesives, Fluids, Lubricants and Sealers and Approximate Fluid Capacities . 2. Start the vehicle and allow the engine to reach normal operating temperature. 3. Shut the engine off. 4. Use the J 42220 Universal 12V Leak Detection Lamp to visually inspect the components listed in steps 11 and 12. Are any leaks present?	Go to Step 21	Go to Step 17
17	Use the J 42220 Universal 12V Leak Detection Lamp to inspect for the following conditions: • Coolant dye in the HVAC module drain tube • Coolant dye on the vehicle floor covering near the HVAC module Is coolant dye present?	Go to Step 23	Go to Step 18
18	Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is a milky substance under the oil fill cap?	Go to Step 19	Go to Step 20
19	Inspect the engine oil fluid level indicator for a gray/white milky substance. Is a milky substance on the engine oil fluid level indicator?	Go to Step 33	Go to Step 20
20	Inspect the automatic transmission fluid for a gray/white milky substance. Is there a gray/white milky substance in the automatic transmission fluid?	Go to Step 24	Go to Step 26
21	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to Step 36	-
22	Replace the coolant pressure cap. Is the repair complete?	Go to Step 36	-
23	Replace the heater core. Refer to Heater Core Replacement . Is the repair complete?	Go to Step 36	-
24	1. Remove the transmission oil cooler lines from the radiator. 2. Pressure test the cooling system. Refer to Cooling System Leak Testing. 3. Inspect the transmission oil cooler for coolant. Is coolant present?	Go to Step 25	Go to Step 26

Step	Action	Yes	No
25	1. Replace the radiator. Refer to Radiator Replacement (LTG without HP9), Radiator Replacement (LGW), Radiator Replacement (LGX) and/or Radiator Replacement (LTG with HP9). 2. Service the automatic transmission. Refer to Engine Coolant/Water in Transmission. Is the repair complete?	Go to Step 36	-
26	Visually inspect the hoses, pipes and hose clamps at the following locations: • Charge Air Cooling Pump • Charge Air Cooler Radiator • Charge Air Cooler Pump Inlet and Outlet Hoses • Charge Air Cooler Reservoir Inlet and Outlet Hoses • Charge Air Cooler Reservoir • Supercharger Are any of the hoses, clamps or pipes leaking?	Go to Step 21	Go to Step 27
27	Visually inspect the following components: • Charge Air Cooling Pump • Charge Air Cooler Radiator • Charge Air Cooler Reservoir • Supercharger Are any of the listed components leaking?	Go to Step 21	Go to Step 28
28	1. Pressure test the cooling system. Refer to Charge Air Cooling System Leak Testing (LGW). 2. With the CAC cooling system pressurized, visually inspect the components listed in steps 26 and 27. Are any leaks present?	Go to Step 21	Go to Step 29

Step	Action	Yes	No
29	1. Add 30 ml (1 oz) Extended Life Coolant Leak Detection Dye to the cooling system for each 15 L (4 gal) of coolant. Refer to Adhesives, Fluids, Lubricants and Sealers and Approximate Fluid Capacities . 2. Activate the pump using the MDI to cycle the dye around the charge air cooling system. 3. Shut the engine off. 4. Use the J 42220 Universal 12V Leak Detection Lamp to visually inspect the components listed in steps 26 and 27. Are any leaks present?	Go to Step 21	Go to Step 36
30	Install the cooler lines to the radiator. Is the action complete?	Go to Step 36	-
31	Repair the engine no crank condition. Refer to Engine Will Not Crank - Crankshaft Will Not Rotate . Is the repair complete?	Go to Step 36	-
32	Repair the engine overheating condition. Refer to Engine Overheating. Is the repair complete?	Go to Step 36	-
33	Repair the engine internal coolant leak. Refer to: • Coolant in Engine Oil • Coolant in Combustion Chamber Is the repair complete?	Go to Step 36	-
34	Repair the engine knock. Refer to Lower Engine Noise, Regardless of Engine Speed . Is the repair complete?	Go to Step 36	-
35	Repair the combustion pressure in the cooling system problem. Refer to Cylinder Leakage Test . Is the repair complete?	Go to Step 36	-
36	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

THERMOSTAT DIAGNOSIS

Tools Required

- **J 24731** 188 Tempilstick
- **J 24731** 206 Tempilstick

The coolant thermostat can be tested using a temperature (tempil) stick. The temperature stick is a pencil-like device which has a wax material containing certain chemicals that melt at a given temperature. Temperature sticks can be used to determine a thermostat's operating range by rubbing 87Å, Å°C (188Å, Å°F) and 97Å, Å°C (206Å, Å°F) sticks on the outlet coolant pipe.

1. Use a tempilstick in order to find the opening and the closing temperatures of the thermostat.

- **J 24731** 188 tempilstick melts at 87Å,Å°C (188Å,Å°F). The thermostat should begin to open at 90Å,Å°C (194Å,Å°F).
- **J 24731** 206 tempilstick melts at 97Å,Å°C (206Å,Å°F). The thermostat should be fully open at 107Å,Å°C (225Å,Å°F).

2. Replace the thermostat if it does not operate properly between this temperature range.

COOLANT HEATER 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 coolant heater operates using 110 V AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather. The coolant heater also helps reduce fuel consumption when a cold engine is warming up. The unit is equipped with a detachable AC power cord. There is an internal thermal switch in the coolant heater cord that prevents operation above -18Å,Å°C (0Å,Å°F). A weather shield on the cord is provided to protect the plug when not in use.

Reference Information

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Circuit/System Testing

NOTE: The coolant heater cord will read Open due to an internal thermal switch if the ambient temperature is above -18Å,Å°C (0Å,Å°F).

1. Ignition OFF, disconnect the coolant heater cord from the E19 Coolant Heater.
2. Test for 30-40 Ω between the terminals of the E19 Coolant Heater.
 - **If not within 30-40 Ω**
Replace the E19 Coolant Heater.
 - **If within 30-40 Ω**
3. Test for infinite resistance between each terminal of the E19 Coolant Heater and ground.
 - **If less than infinite resistance**
Replace the E19 Coolant Heater.
 - **If infinite resistance**
4. Test for less than 2 Ω between the engine coolant heater cord plug and the engine coolant heater cord connector for each circuit.
 - **If greater than 2 Ω**
Replace the engine coolant heater cord.
 - **If less than 2 Ω**
All OK.

Repair Instructions

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
6	1. Replace the thermostat and housing. Refer to Engine Coolant Thermostat Housing Replacement (LGW, LGX) and/or Engine Coolant Thermostat Housing Replacement (LTG). 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

1. Remove the pressure cap.

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.

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



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.

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.
 - The pressure cap does not hold the rated pressure.

COOLING SYSTEM LEAK TESTING

Special Tools

- **EN-24460-A** Cooling System Pressure Tester
- **GE-42401-3** Radiator Cap / Surge Tank Test Adapter

For equivalent regional tools, Refer to [Special Tools](#)

Cooling System Leak Testing

1. Remove the pressure cap.

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.

2. Test the operation of the pressure cap. Refer to [Pressure Cap Testing](#).
3. Wash the pressure cap mating surface with water.
4. Use the **EN-24460-A** Cooling System Pressure Tester (1) with **GE-42401-3** Radiator Cap / Surge Tank Test Adapter in order to apply pressure to the cooling system (2).

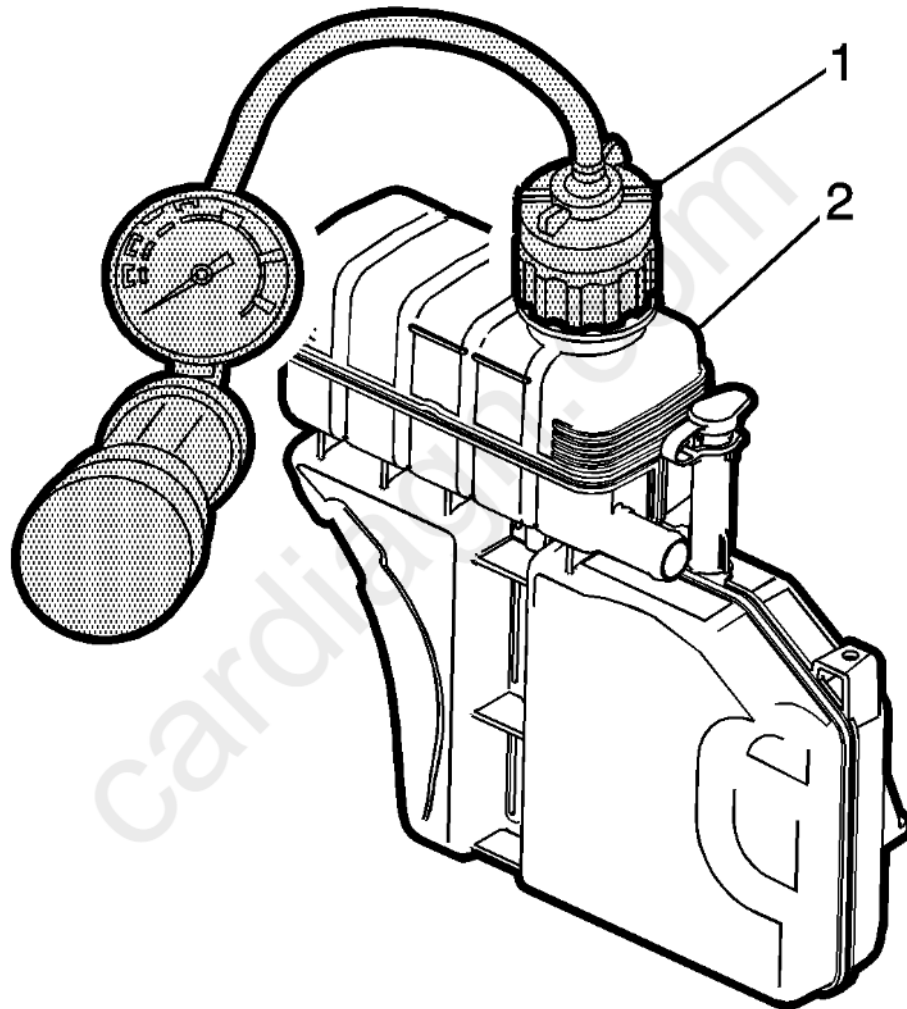


Fig. 4: Cooling System Pressure Tester
Courtesy of GENERAL MOTORS COMPANY

Do not exceed the pressure cap rating.

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.

CHARGE AIR COOLING SYSTEM LEAK TESTING (LGW)

Special Tools

- **EN-24460-A** Cooling System Pressure Tester
- **GE-50389** Cooling System Pressure Test Quick Connector
- **GE-47716-8** Vac-N-Fill Cap
- **GE-47716-30-A** Vac-N-Fill Adapter

For equivalent regional tools, refer to [Special Tools](#).

Cooling System Leak Testing

1. Remove the intake manifold cover. Refer to [Intake Manifold Cover Replacement \(LGW\)](#) .

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 anti-freeze, 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.

2. Remove the CAC quick connect vacuum fitting cap (1).

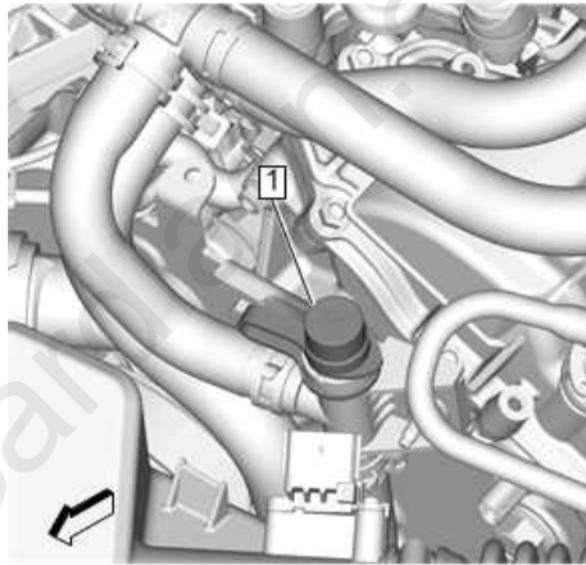


Fig. 5: CAC Quick Connect Vacuum Fitting Cap
 Courtesy of GENERAL MOTORS COMPANY

3. Install Cooling System Pressure Tester Cap Adapter (4) to **EN-24460-A** Cooling System Pressure Tester (5).

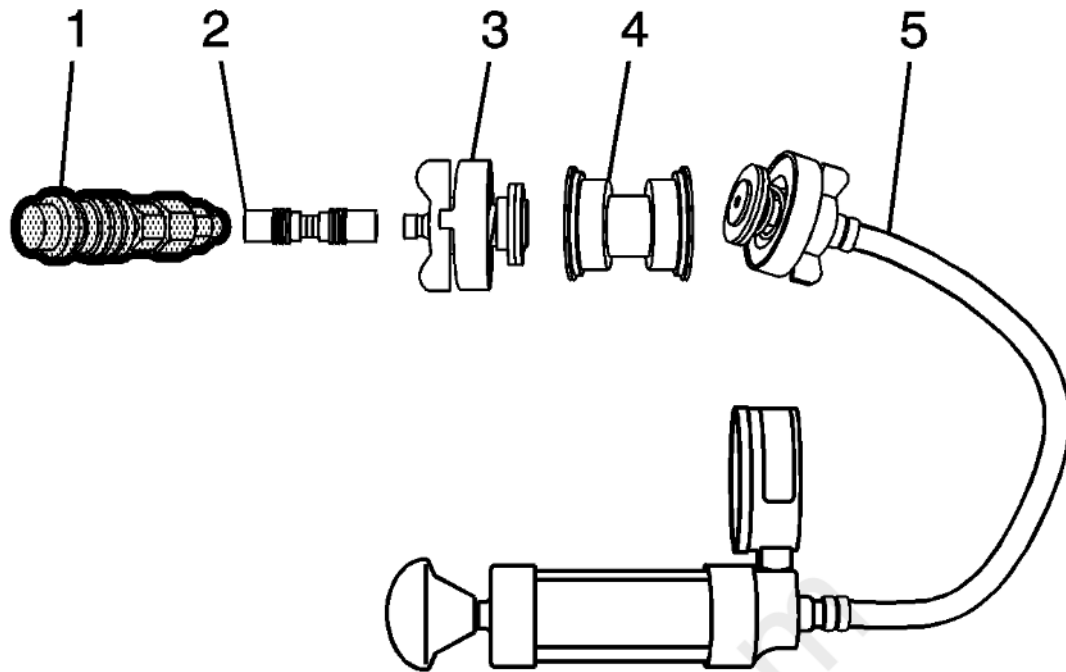


Fig. 6: Cooling System Pressure Tester Cap Adapter
 Courtesy of GENERAL MOTORS COMPANY

4. Install **GE-47716-8** Vac-N-Fill Cap (3) to Cooling System Pressure Tester Cap Adapter (4).
5. Install **GE-50389** Coolant Pressure Test Quick Connector (2) to **GE-47716-8** Vac-N-Fill Cap (3).
6. Install **GE-47716-30-A** Vac-N-Fill Adapter (1) to **GE-50389** Coolant Pressure Test Quick Connector (2).
7. Apply 5 psi pressure to the charge air cooler system for at least 2 minutes.
8. Observe the gauge for any pressure loss and 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

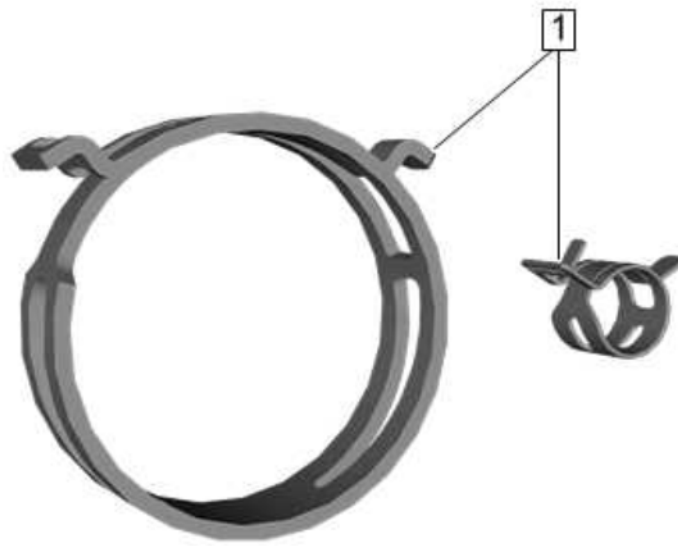


Fig. 7: Spring Type Hose Clamps

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

COOLING SYSTEM DRAINING AND FILLING (STATIC WITHOUT HP9)

Special Tools

J-26568 Coolant and Battery Fluid Tester

Draining Procedure

1. Place the vehicle on a level surface.

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.

2. Remove the coolant pressure cap (1) from the radiator surge tank.

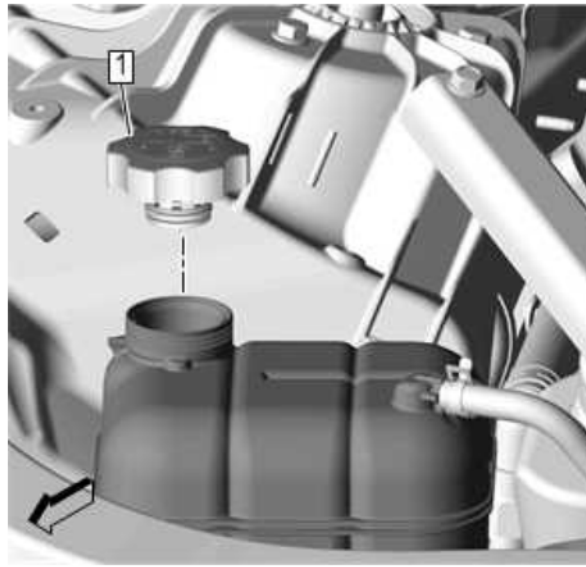


Fig. 8: Coolant Pressure Cap

Courtesy of GENERAL MOTORS COMPANY

3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
4. Remove the front bumper fascia lower stiffener. Refer to [Front Bumper Fascia Lower Stiffener Replacement](#)
5. Place a drain pan under the drain cock/plug.
6. Slowly loosen the drain cock/plug and drain the coolant into the drain pan. Do not completely remove the drain cock/plug.
7. Drain the cooling system.
8. Inspect the coolant.
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 \(LGW LTG without HP9\)](#)
10. Tighten the drain cock/plug.

CAUTION: Refer to [Component Fastener Tightening Caution](#) .

11. Install the front bumper fascia lower stiffener. Refer to [Front Bumper Fascia Lower Stiffener Replacement](#)
12. Lower the vehicle.

Filling Procedure

1. Slowly add a mixture of 50/50 DEX-COOL antifreeze and clean drinkable water to the cooling system through the radiator surge tank filler neck and through the top of the lower overflow reservoir as well. Refer to [Approximate Fluid Capacities](#)

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

2. Slowly fill the cooling system until the coolant level stabilizes at the FULL COLD marks on both the surge tank and overflow reservoir.
3. Start the engine and allow to the engine to idle in PARK or NEUTRAL with the parking brake engaged.
4. Slowly fill the coolant mixture until the coolant level stabilizes at the FULL COLD mark on the surge tank.
5. Install the surge tank cap and close the cap on the coolant overflow bottle.
6. Run the engine RPM to 2000-2500 rpm until the engine reaches normal operating temperature.

7. Allow the engine to idle for 3 minutes.
8. Shut the engine OFF.
9. Allow the engine to cool, remove the surge tank cap and open the overflow reservoir cap and repeat steps 1-8 until the coolant level has completely stabilized at the FULL COLD marks on both the surge tank and overflow reservoir.
10. Remove the surge tank cap.
11. Inspect the concentration of the engine coolant using the **J-26568** Coolant and Battery Fluid Tester.
12. Install the surge tank cap.
13. Inspect and if necessary, fill the surge tank and overflow reservoir as necessary.
14. Rinse away any excess coolant from the engine and the engine compartment
15. Inspect the cooling system for leaks.

COOLING SYSTEM DRAINING AND FILLING (GE 47716 WITHOUT HP9)

Special Tools

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

For equivalent regional tools. Refer to [Special Tools](#).

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 (1) from the radiator surge tank.

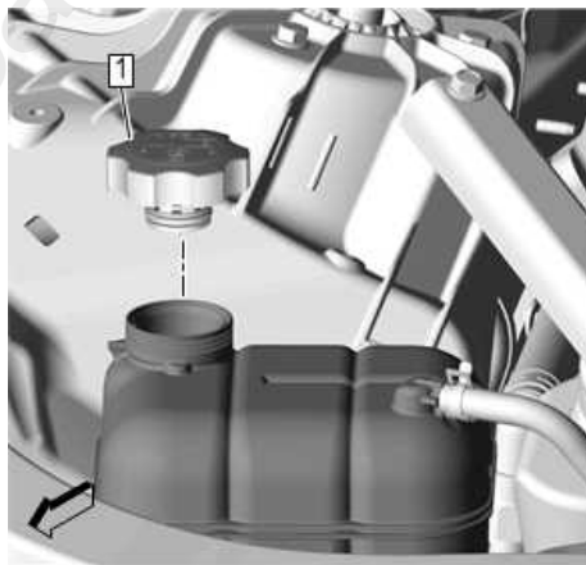


Fig. 9: Coolant Pressure Cap

Courtesy of GENERAL MOTORS COMPANY

3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
4. Remove the front bumper fascia lower stiffener. Refer to [Front Bumper Fascia Lower Stiffener Replacement](#)
5. Place a drain pan under the drain cock/plug.

6. Slowly loosen the drain cock/plug and drain the coolant into the drain pan. Do not completely remove the drain cock/plug.
7. Drain the cooling system.
8. Inspect the coolant.
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 \(LGW LTG without HP9\)](#)
10. Tighten the drain cock/plug.

CAUTION: Refer to [Component Fastener Tightening Caution](#) .

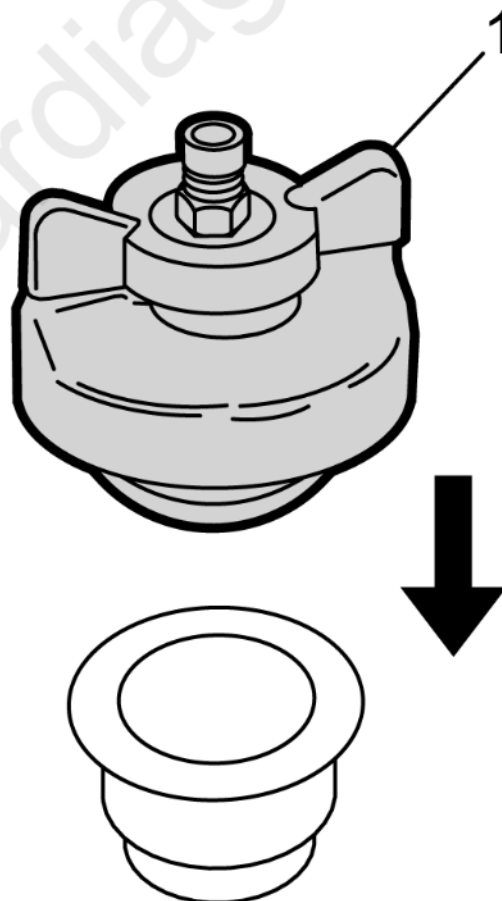
11. Install the front bumper fascia lower stiffener. Refer to [Front Bumper Fascia Lower Stiffener Replacement](#)
12. Lower the vehicle.

Vac-N-Fill Procedure

1. Install the **J-42401** Radiator Cap and Surge Tank Test Adapter to the coolant surge tank.

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

2. Attach the Vac N Fill cap to the **J-42401** Radiator Cap and Surge Tank Test Adapter (1) to the vehicles surge tank coolant fill port.



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.

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

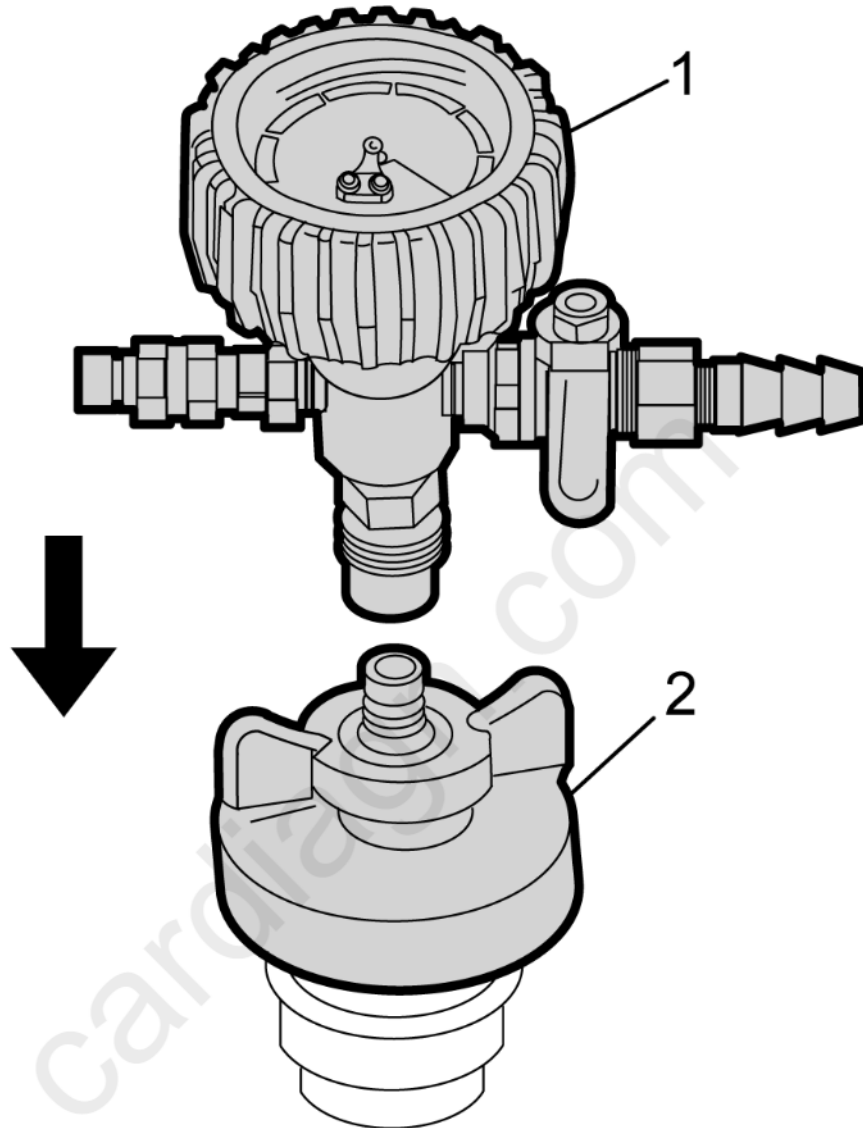


Fig. 11: Vacuum Gauge Assembly & Vac N Fill Cap
Courtesy of GENERAL MOTORS COMPANY

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

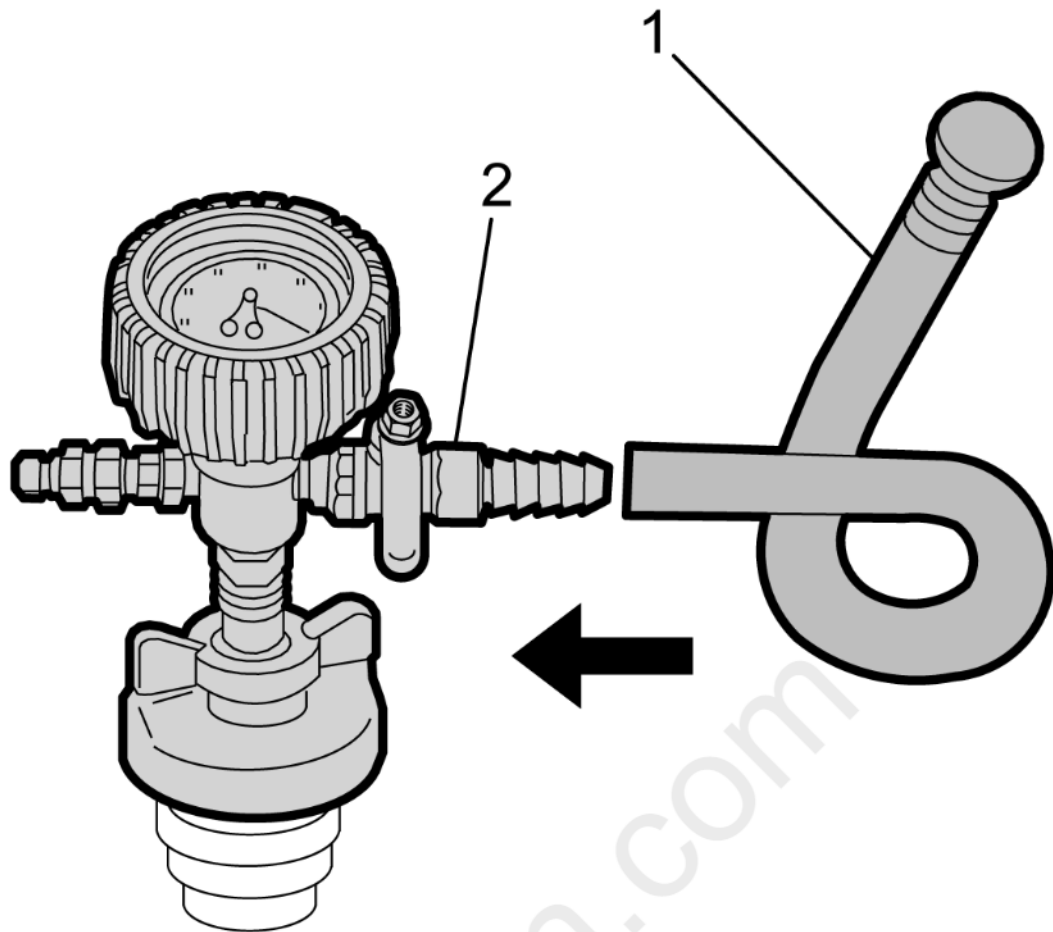


Fig. 12: Vacuum Gauge Assembly & Fill Hose
Courtesy of GENERAL MOTORS COMPANY

Ensure that the valve is closed.

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

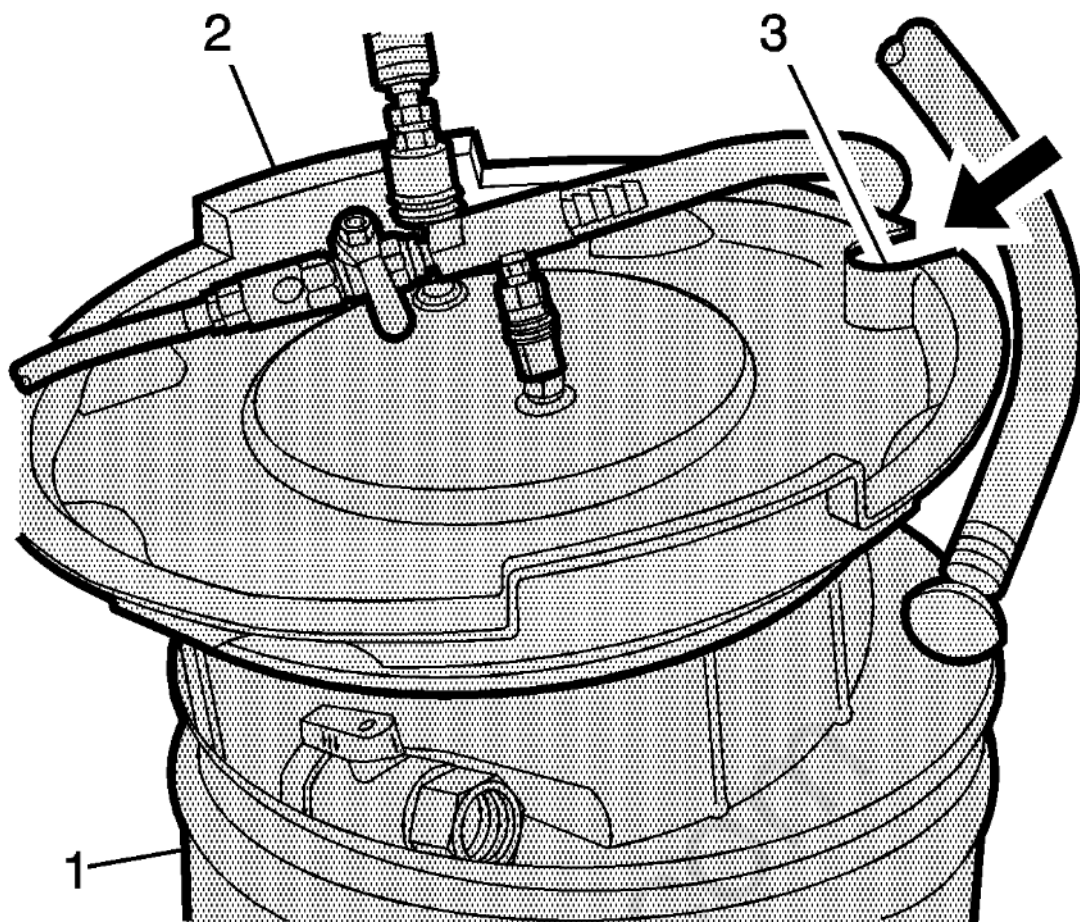


Fig. 13: Graduated Reservoir, Vacuum Tank & Cut-Out Area

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. Place the fill hose in the graduated reservoir (1).
7. Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.

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

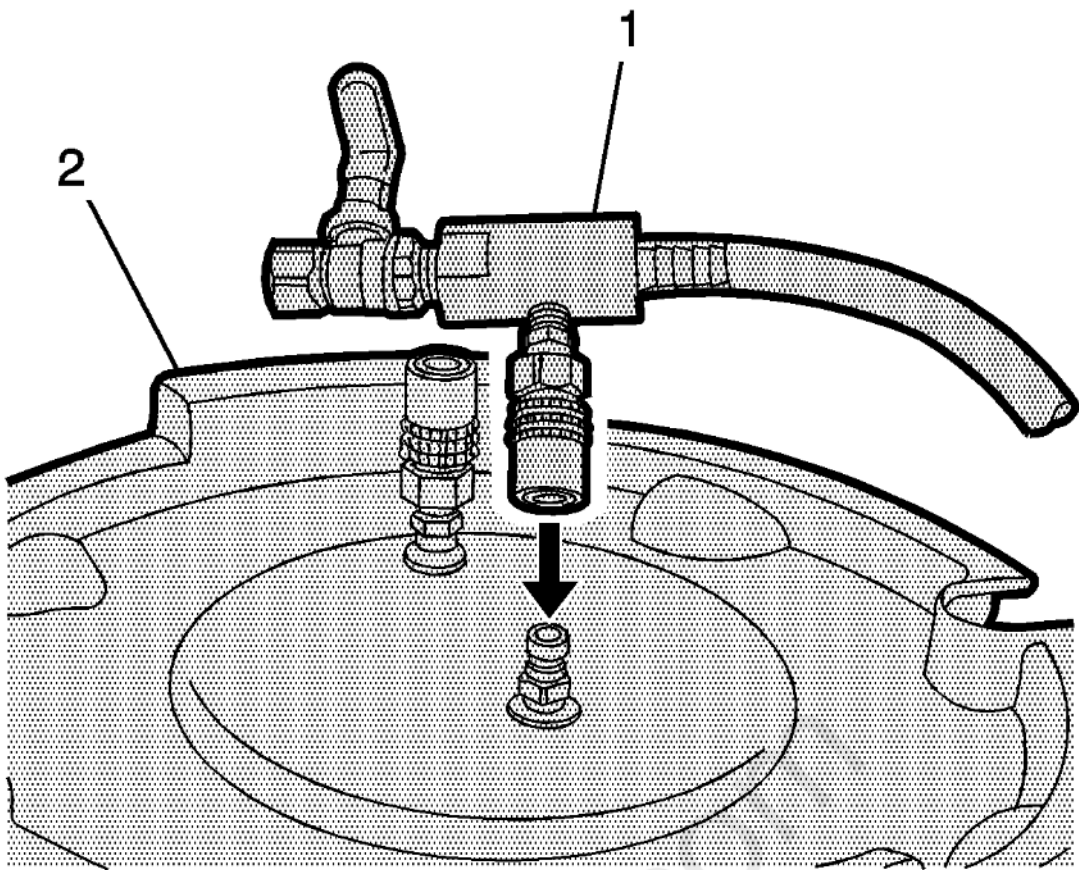


Fig. 14: Vacuum Tank & Venturi Assembly

Courtesy of GENERAL MOTORS COMPANY

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

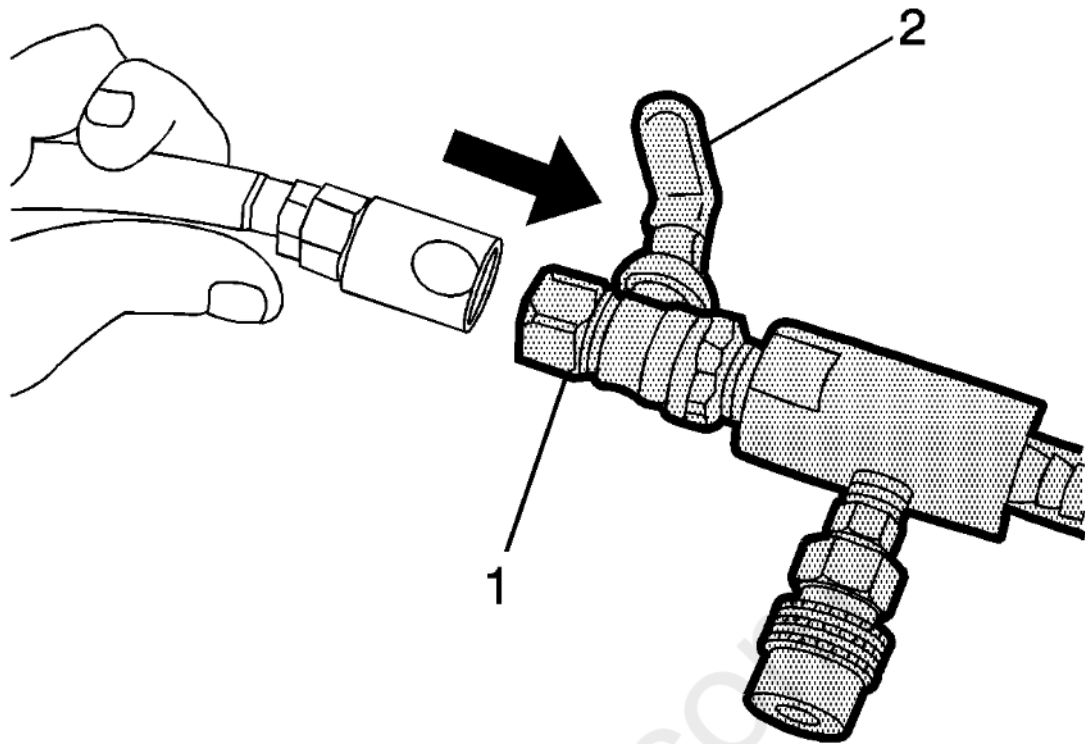


Fig. 15: Venturi Assembly & Valve

Courtesy of GENERAL MOTORS COMPANY

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

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

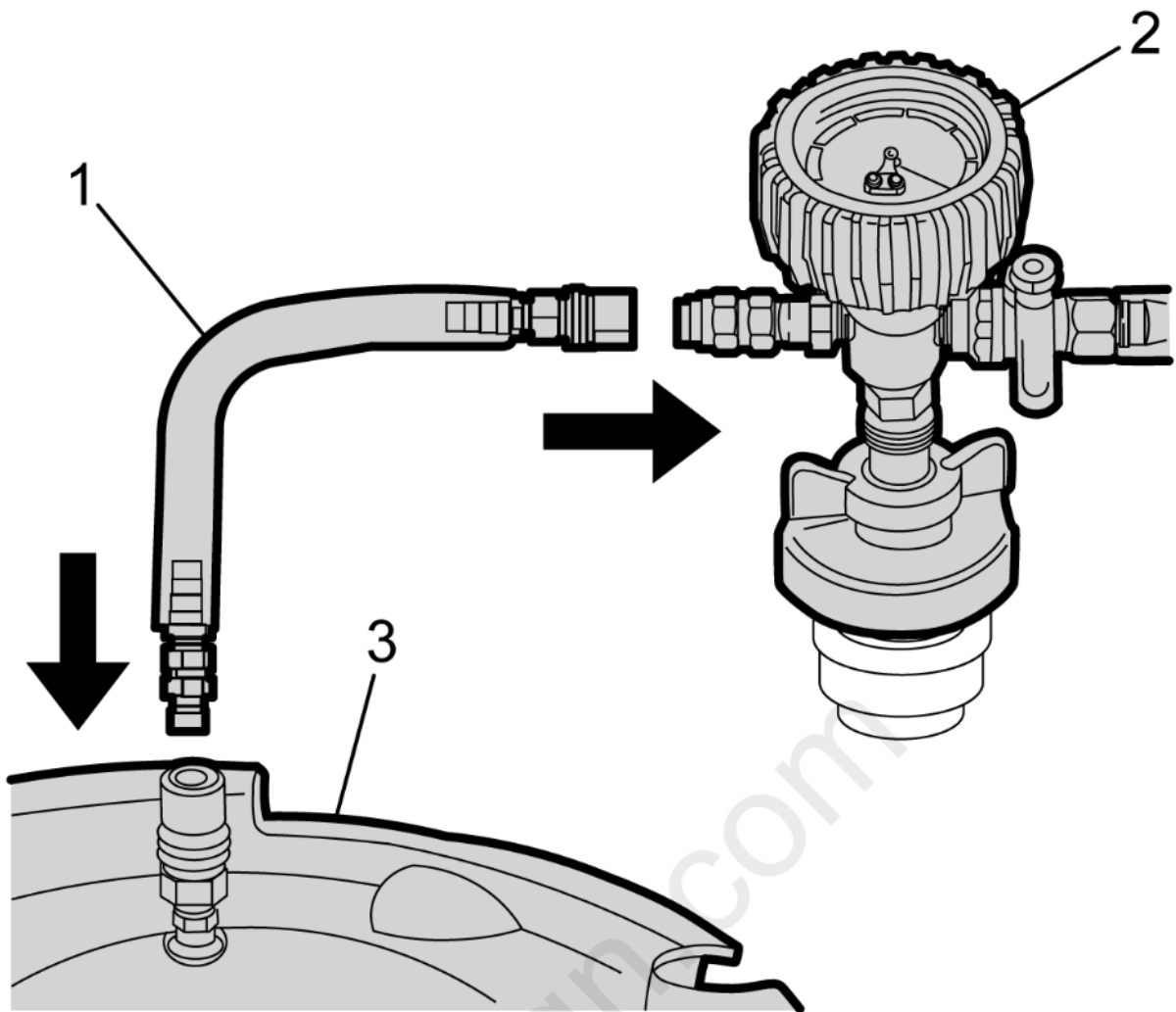


Fig. 16: Vacuum Hose, Gauge Assembly & Tank
Courtesy of GENERAL MOTORS COMPANY

11. Clamp off the overflow hose.
12. Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present.

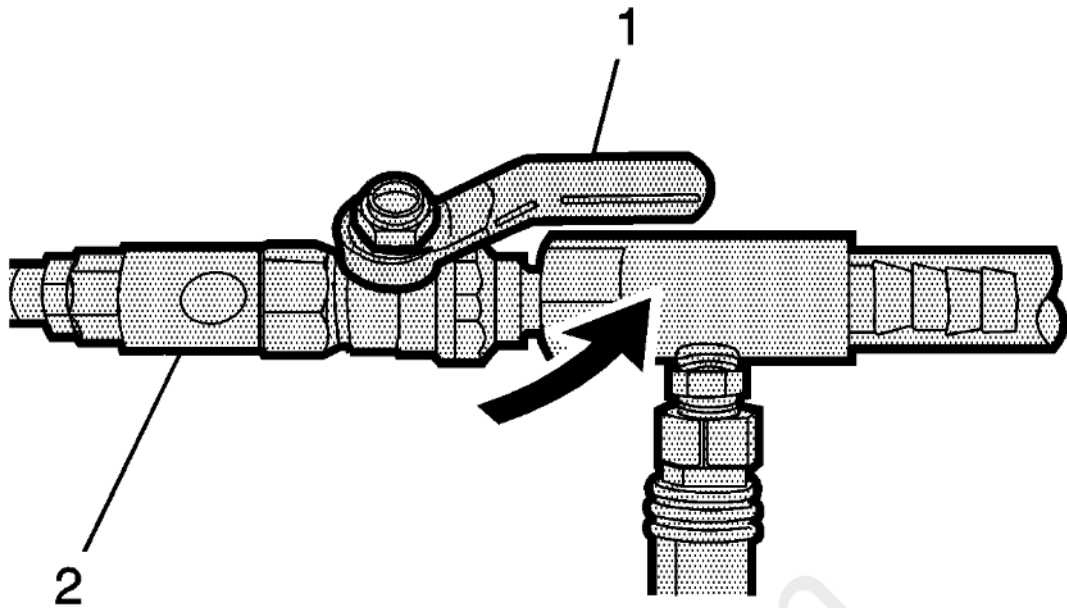


Fig. 17: Valve & Venturi Assembly

Courtesy of GENERAL MOTORS COMPANY

13. Continue to draw vacuum until the needle stops rising (1). This should be 610-660 mm Hg (24-26 in Hg).

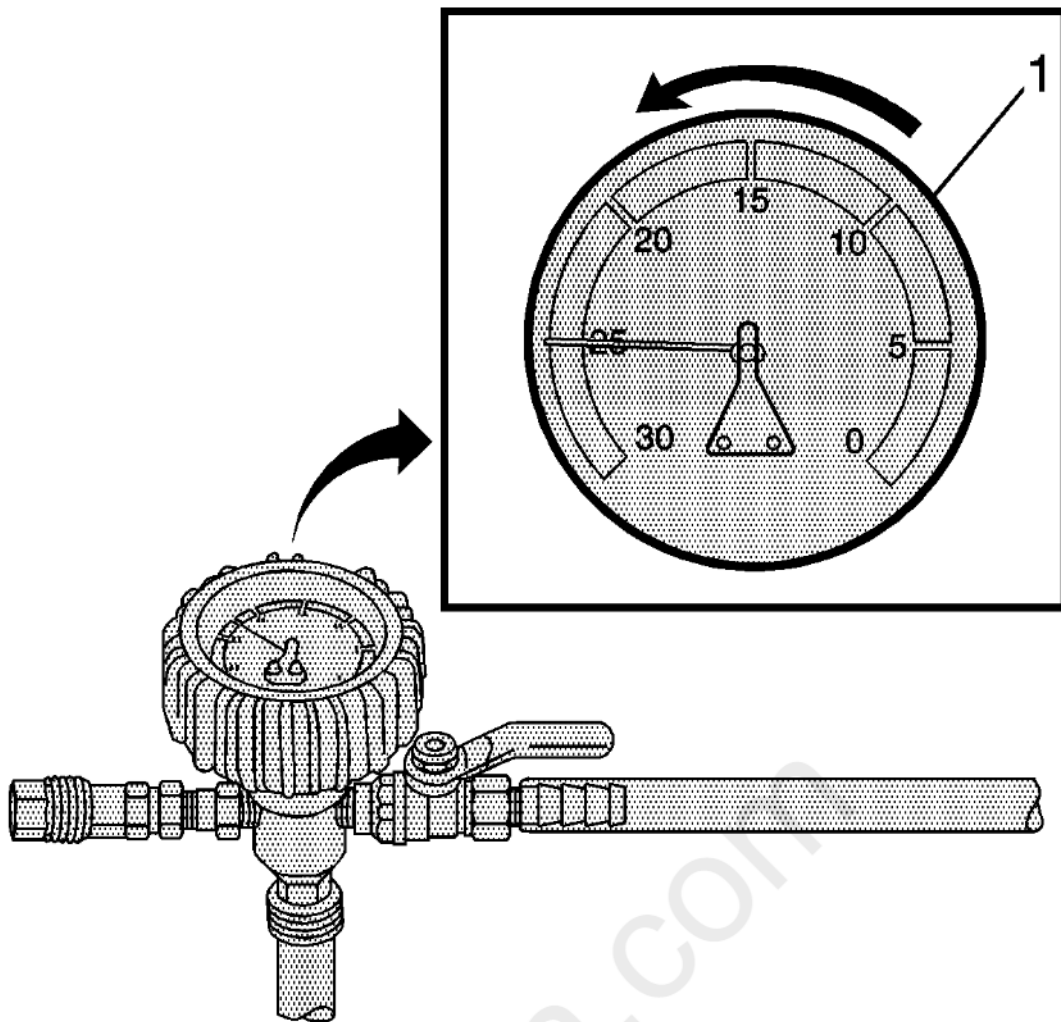


Fig. 18: Vacuum Gauge Needle

Courtesy of GENERAL MOTORS COMPANY

Cooling hoses may start to collapse. This is normal due to vacuum draw.

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

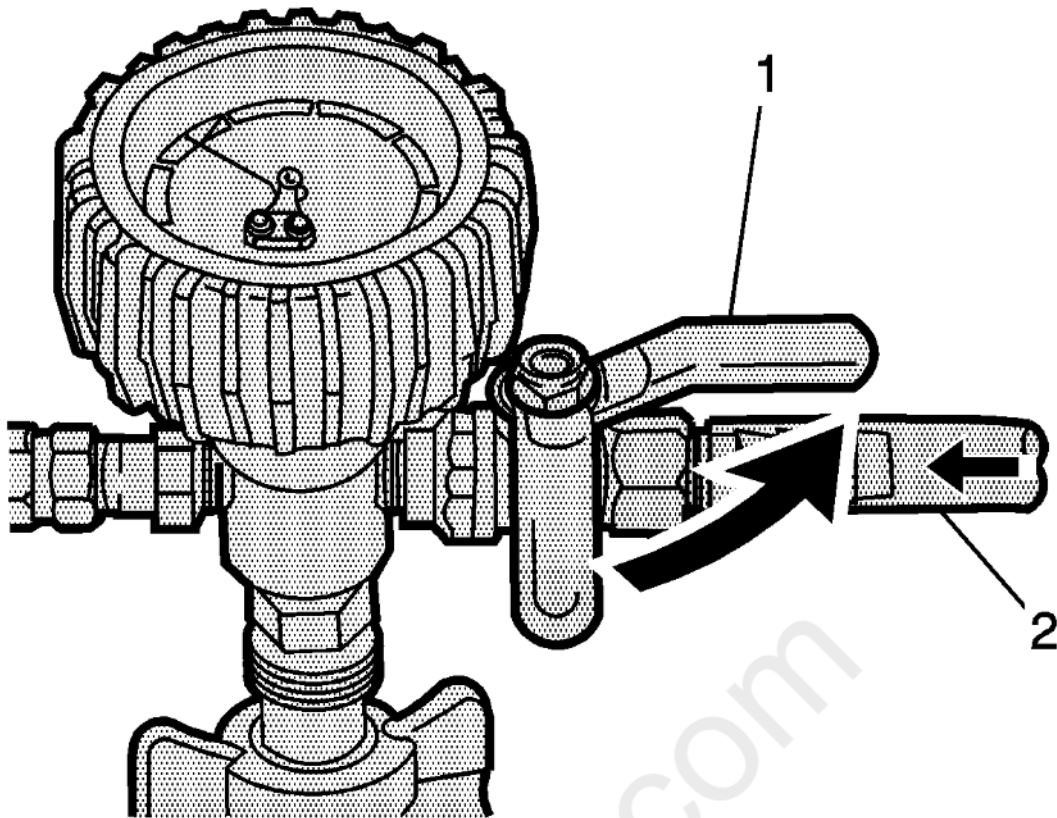


Fig. 19: Vacuum Gauge Assembly & Needle
Courtesy of GENERAL MOTORS COMPANY

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

If vacuum loss is observed, **Loss of Coolant**

18. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.
19. Once the vacuum gauge reaches zero (1), close the valve on the vacuum gauge assembly and repeat steps 11-17.

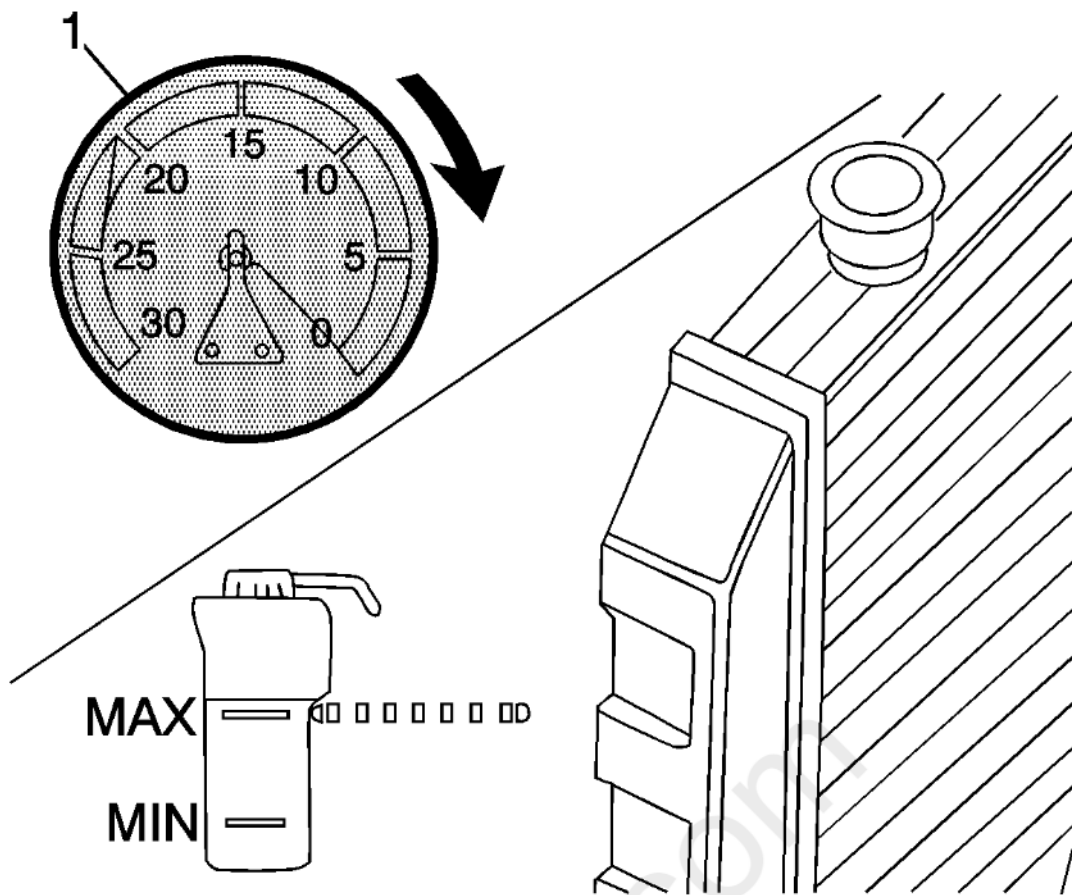


Fig. 20: Vacuum Gauge At Zero

Courtesy of GENERAL MOTORS COMPANY

20. Remove the **J-42401** Radiator Cap and Surge Tank Test Adapter.
21. Detach the **J-42401** Radiator Cap and Surge Tank Test Adapter from the vehicle fill port.
22. Add coolant to the system as necessary until the coolant reaches the FULL COLD fill lines on both the radiator surge tank and coolant overflow bottle.
23. Install the surge tank cap and close the cap on the overflow bottle.
24. Start the engine.
25. Run the engine at 2,000-2,500 RPM until the engine reaches normal operating temperature.
26. Allow the engine to idle for 3 minutes.
27. Shut the engine OFF.
28. Allow the engine to cool.
29. Add or remove coolant as necessary from the surge tank and overflow bottle until the levels are stabilized at the FULL COLD marks.
30. Inspect the cooling system for leaks.
31. Inspect the concentration of the engine coolant using the **J-26568** Coolant and Battery Fluid Tester.
32. Rinse away any excess coolant from the engine and the engine compartment.
33. 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 LTG WITH HP9)

Special Tools

J-26568 Coolant and Battery Fluid Tester

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Draining Procedure

1. Place the vehicle on a level surface.

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.

2. Disable the high voltage system. Refer to [High Voltage Disabling](#)
3. Remove the coolant pressure cap (1) from the radiator surge tank.

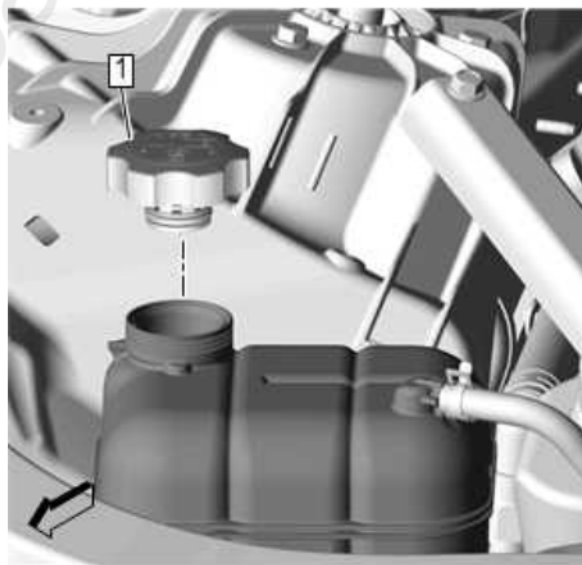


Fig. 21: Coolant Pressure Cap
Courtesy of GENERAL MOTORS COMPANY

4. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
5. Remove the front bumper fascia lower stiffener. Refer to [Front Bumper Fascia Lower Stiffener Replacement](#)

6. Place a drain pan under the drain cock.
7. Slowly loosen the drain cock and drain the coolant into the drain pan. Do not completely remove the drain cock.
8. Drain the cooling system.
9. Inspect the coolant.
10. 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 \(LGW LTG without HP9\)](#)
11. Tighten the drain cock.

CAUTION: Refer to [Component Fastener Tightening Caution](#) .

12. Install the front bumper fascia lower stiffener. Refer to [Front Bumper Fascia Lower Stiffener Replacement](#)
13. Lower the vehicle.

Filling Procedure

1. Slowly add a mixture of DEX-COOL[®] (Premix 50/50 with Deionized Water) to the cooling system through the radiator surge tank filler neck. Refer to [Approximate Fluid Capacities](#)

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

2. Slowly fill the cooling system until the coolant level reaches the FULL COLD marks on the radiator surge tank.
3. Enable the high voltage system. Refer to [High Voltage Enabling](#)
4. Connect the Global Diagnostic System 2 (GDS 2) to the vehicle.
5. Using the GDS 2, Enable the heater coolant pump.
6. While the pump is running, continue adding coolant to the system until coolant level stabilizes at the FULL COLD mark on the radiator surge tank.
7. Once the coolant level has stabilized, disable the heater coolant pump.
8. Install the radiator surge tank cap and close the hood.
9. With parking brake engaged, start the vehicle. With vehicle in PARK or NEUTRAL, press accelerator pedal until gas engine starts and allow gas engine to run until the hybrid battery takes over and the gas engine shuts off.
10. Reopen vehicle hood. Inspect radiator surge tank coolant level.
11. If coolant level is below the FULL COLD mark on the radiator surge tank, remove the radiator surge tank cap and slowly add coolant until the coolant level has reached and stabilized at the FULL COLD mark on the radiator surge tank.
12. Inspect the concentration of the engine coolant using the **J-26568** Coolant and Battery Fluid Tester.
13. Install the coolant pressure cap (1) to the radiator surge tank.

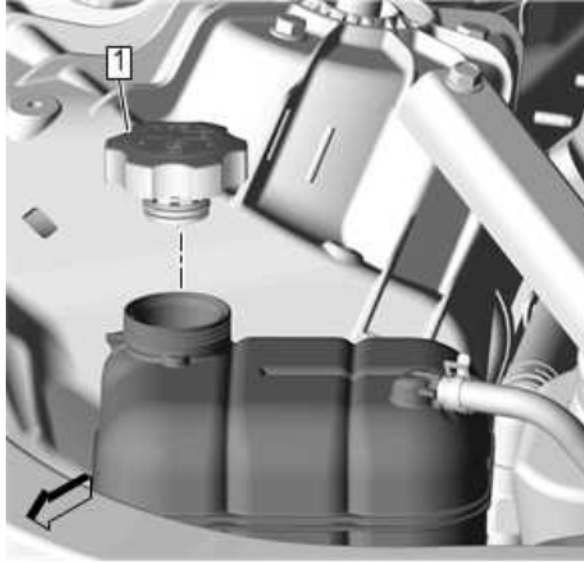


Fig. 22: Coolant Pressure Cap

Courtesy of GENERAL MOTORS COMPANY

14. Rinse away any excess coolant from the engine and the engine compartment.
15. Inspect the cooling system for leaks.

COOLING SYSTEM DRAINING AND FILLING (GE 47716 LTG WITH HP9)

Special Tools

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

For equivalent regional tools. [Special Tools](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

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. Disable the high voltage system. Refer to [High Voltage Disabling](#)
3. Remove the coolant pressure cap (1) from the radiator surge tank.

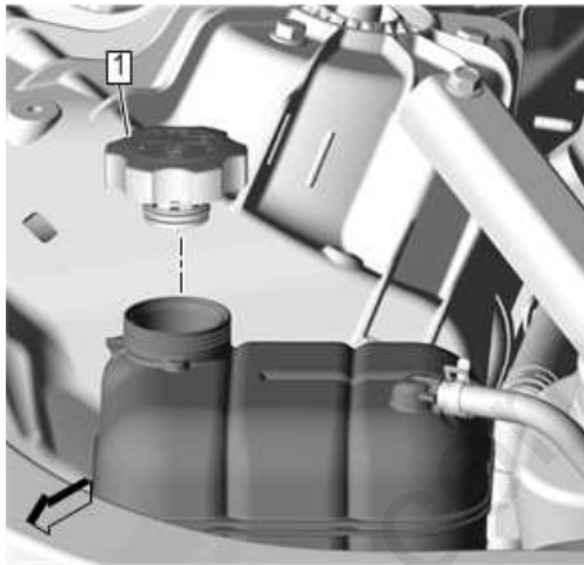


Fig. 23: Coolant Pressure Cap
Courtesy of GENERAL MOTORS COMPANY

4. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
5. Remove the front bumper fascia lower stiffener. Refer to [Front Bumper Fascia Lower Stiffener Replacement](#)
6. Place a drain pan under the drain cock/plug.
7. Slowly loosen the drain cock/plug and drain the coolant into the drain pan. Do not completely remove the drain cock/plug.
8. Drain the cooling system.
9. Inspect the coolant.
10. 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 \(LGW LTG without HP9\)](#)
11. Tighten the drain cock/plug.

CAUTION: Refer to [Component Fastener Tightening Caution](#) .

12. Install the front bumper fascia lower stiffener. Refer to [Front Bumper Fascia Lower Stiffener Replacement](#)
13. Lower the vehicle.

Vac-N-Fill Procedure

1. Install the **J-42401** Radiator Cap and Surge Tank Test Adapter to the coolant surge tank.

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

2. Attach the Vac N Fill cap to the J-42401 Radiator Cap and Surge Tank Test Adapter to the vehicles surge tank coolant fill port.

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.

3. Attach the vacuum gauge assembly to the Vac N Fill cap.
4. Attach the fill hose to the barb fitting on the vacuum gauge assembly.

Ensure that the valve is closed.

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

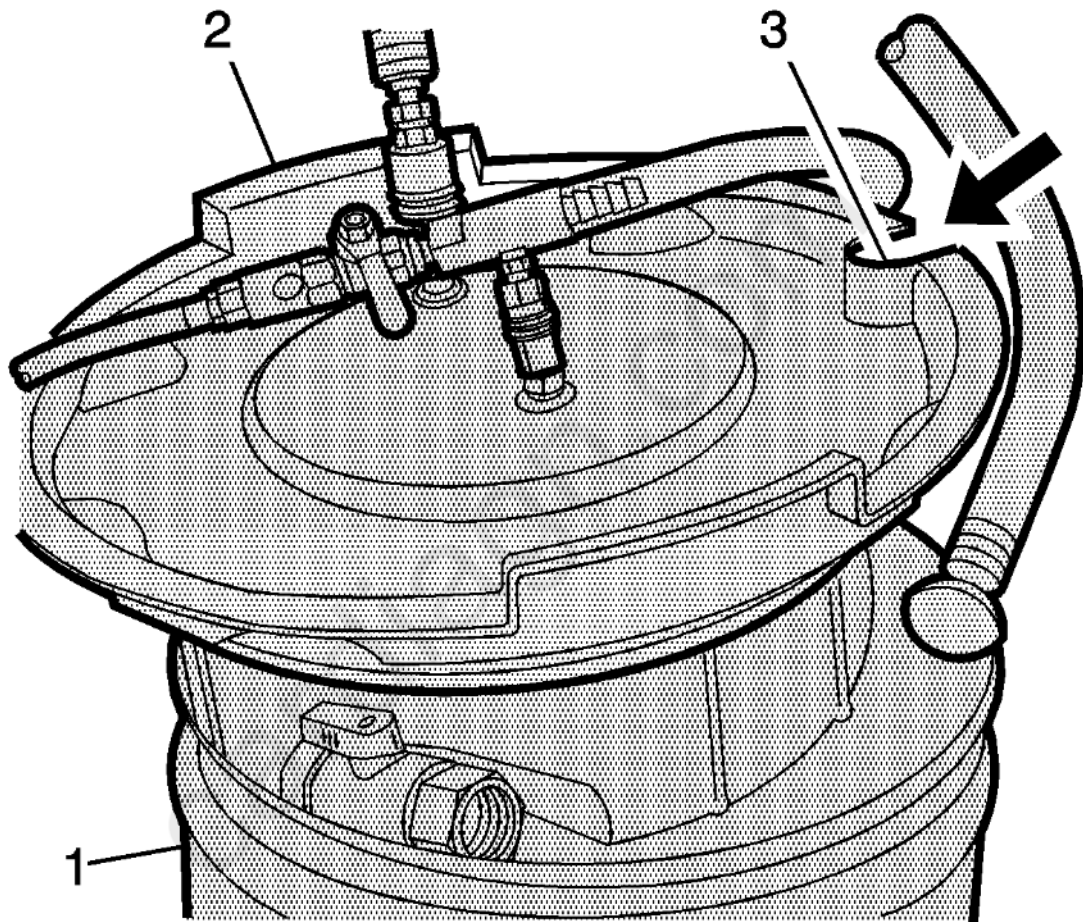


Fig. 24: Graduated Reservoir, Vacuum Tank & Cut-Out Area

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a Pre-mixed DEXCOOL[®] (50/50 mixture of DEXCOOL[®] and deionized water).

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

6. Place the fill hose in the graduated reservoir (1).
7. Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.

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

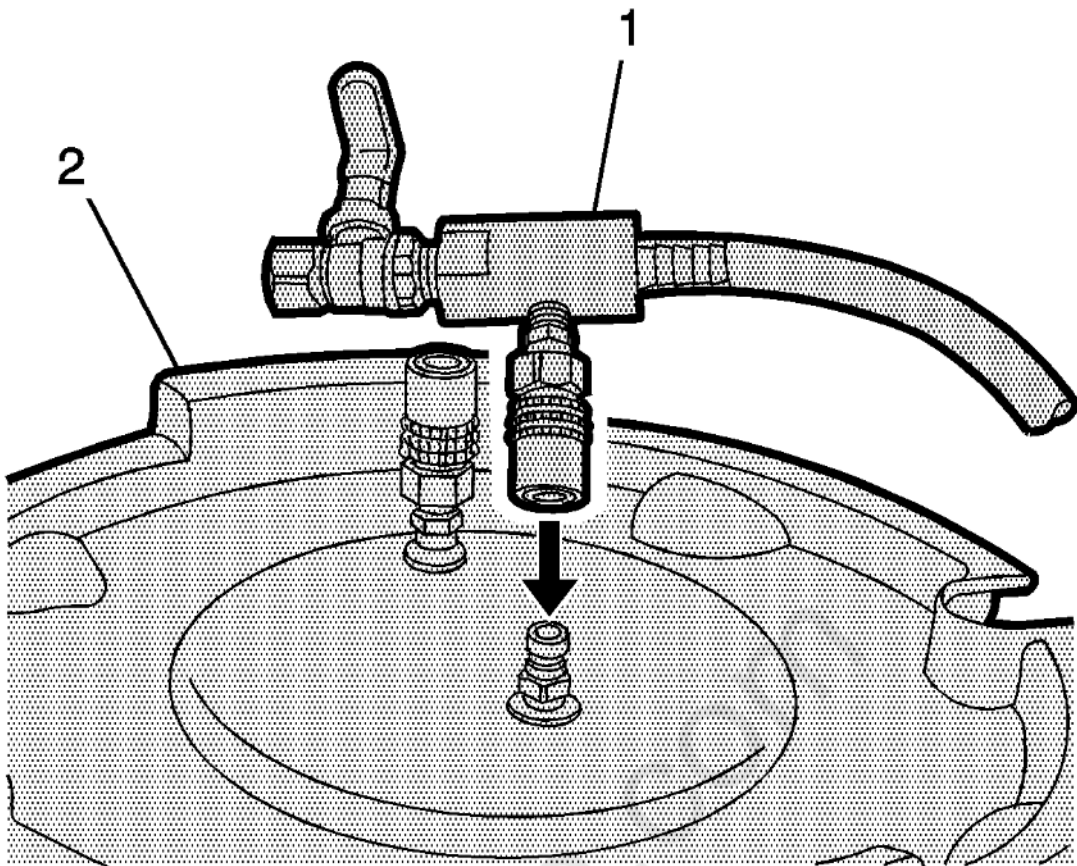


Fig. 25: Vacuum Tank & Venturi Assembly

Courtesy of GENERAL MOTORS COMPANY

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

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

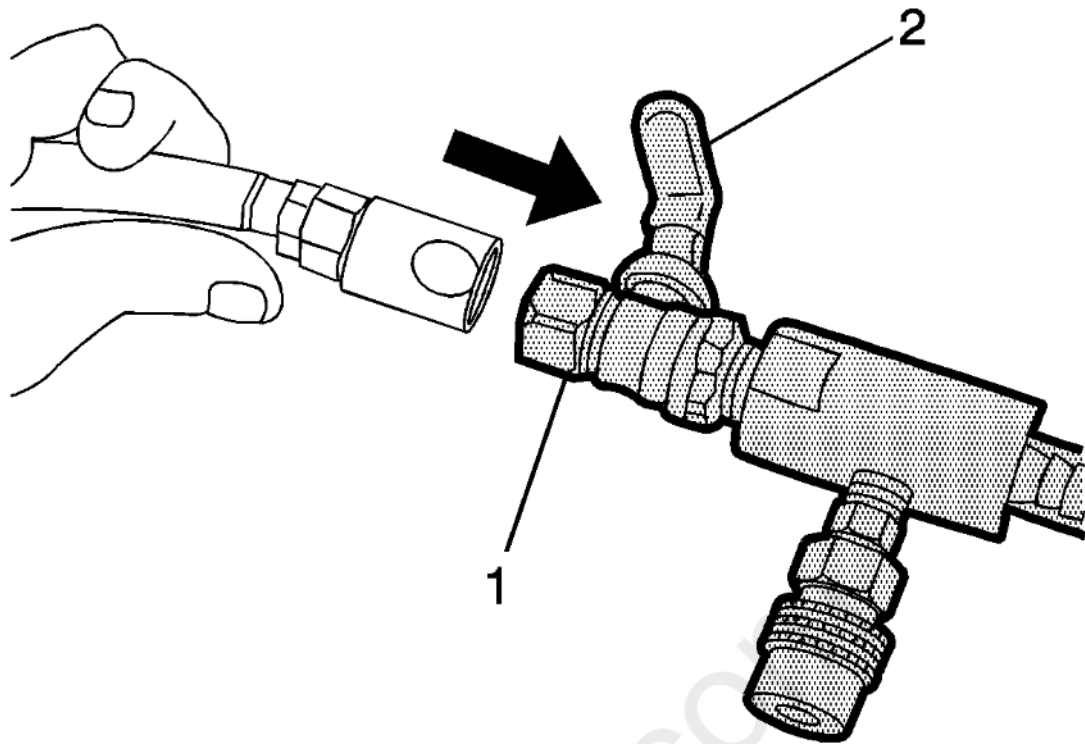


Fig. 26: Venturi Assembly & Valve

Courtesy of GENERAL MOTORS COMPANY

10. Attach the vacuum hose to the vacuum gauge assembly and the vacuum tank.
11. Clamp off the overflow hose.
12. Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present.

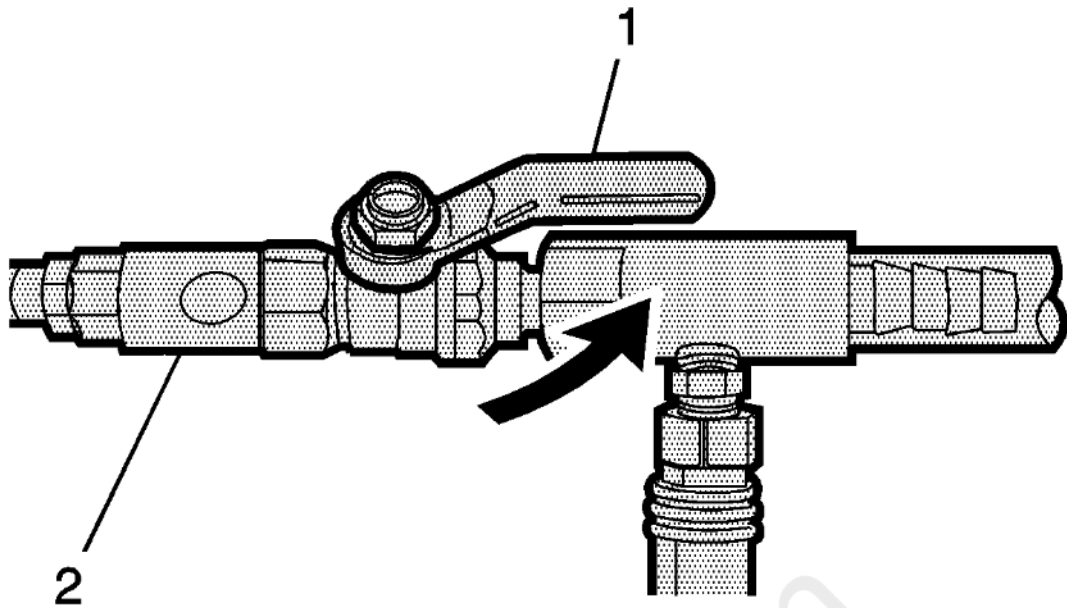


Fig. 27: Valve & Venturi Assembly

Courtesy of GENERAL MOTORS COMPANY

13. 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.

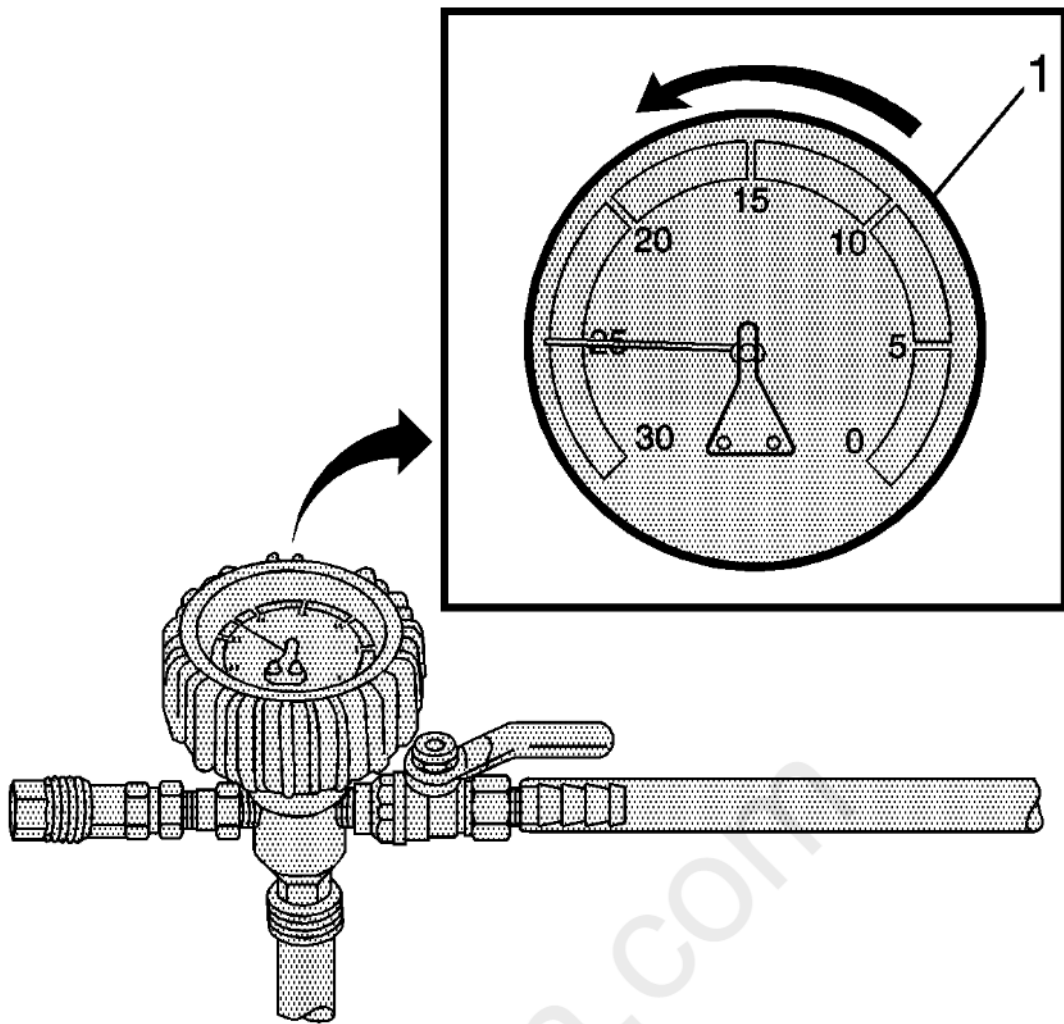


Fig. 28: Vacuum Gauge Needle

Courtesy of GENERAL MOTORS COMPANY

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

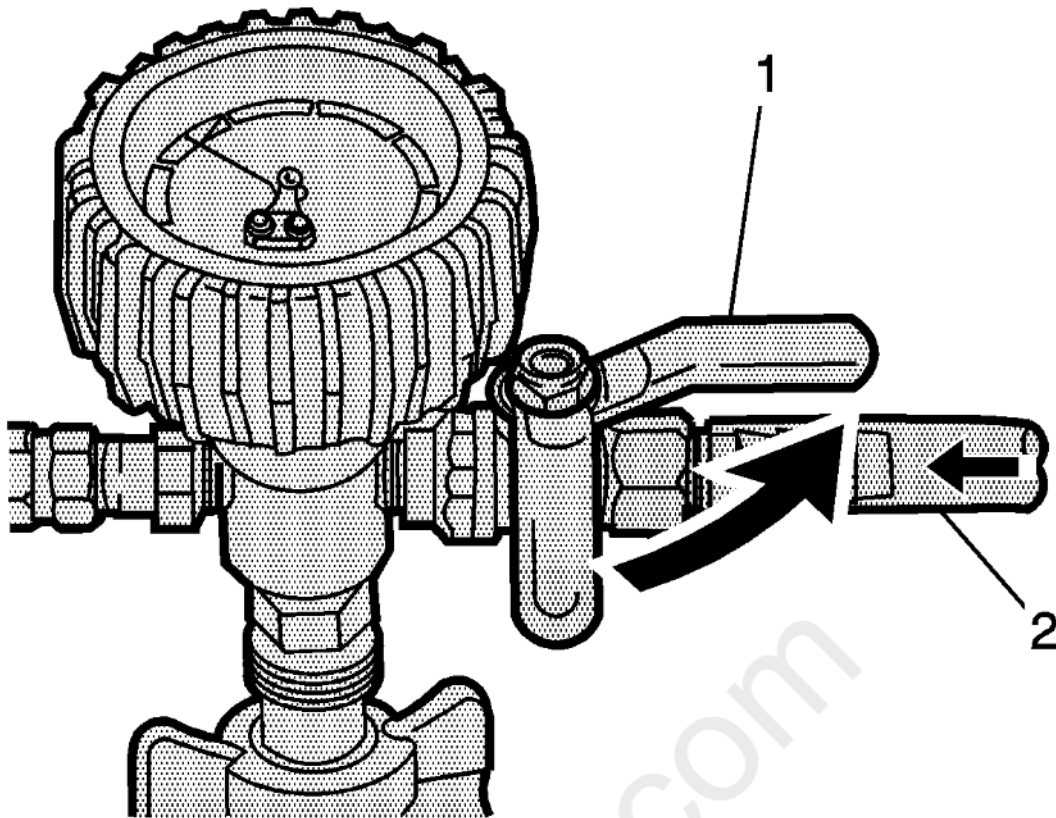


Fig. 29: Vacuum Gauge Assembly & Needle
Courtesy of GENERAL MOTORS COMPANY

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

If vacuum loss is observed, see [Loss of Coolant](#)

18. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.
19. Once the vacuum gauge reaches zero (1), close the valve on the vacuum gauge assembly and repeat steps 11-17.

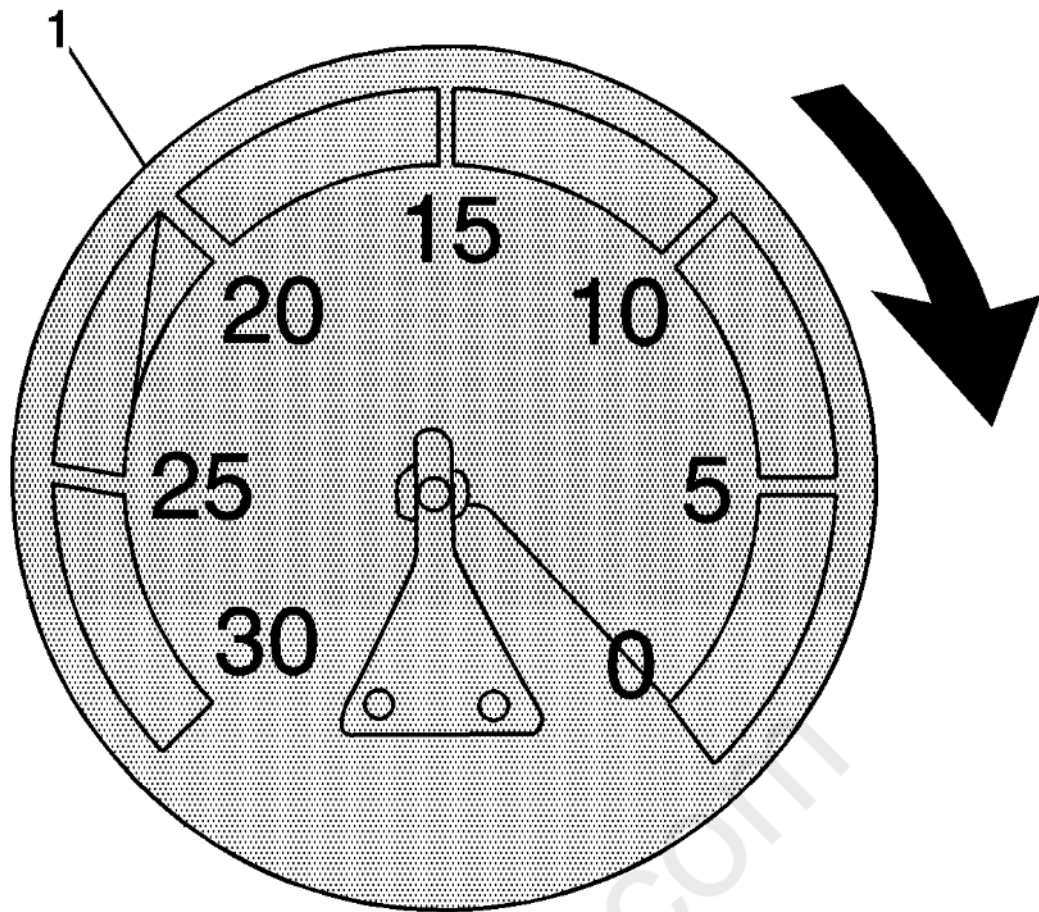


Fig. 30: Vacuum Gauge

Courtesy of GENERAL MOTORS COMPANY

20. Remove the **J-42401** Radiator Cap and Surge Tank Test Adapter.
21. Detach the **J-42401** Radiator Cap and Surge Tank Test Adapter from the vehicle fill port.
22. Add coolant to the system as necessary until the coolant reaches the FULL COLD fill lines on both the radiator surge tank and coolant overflow bottle.
23. Install the surge tank cap and close the cap on the overflow bottle.
24. Enable the high voltage system. Refer to [High Voltage Enabling](#)
25. Start the engine.
26. Run the engine at 2, 000-2, 500 RPM until the engine reaches normal operating temperature.
27. Allow the engine to idle for 3 minutes.
28. Shut the engine OFF.
29. Allow the engine to cool.
30. Add or remove coolant as necessary from the surge tank and overflow bottle until the levels are stabilized at the FULL COLD marks.
31. Inspect the cooling system for leaks.
32. Inspect the concentration of the engine coolant using the **J-26568** Coolant and Battery Fluid Tester.
33. Rinse away any excess coolant from the engine and the engine compartment.
34. 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.

CHARGE AIR COOLING SYSTEM DRAINING AND FILLING (LGW)

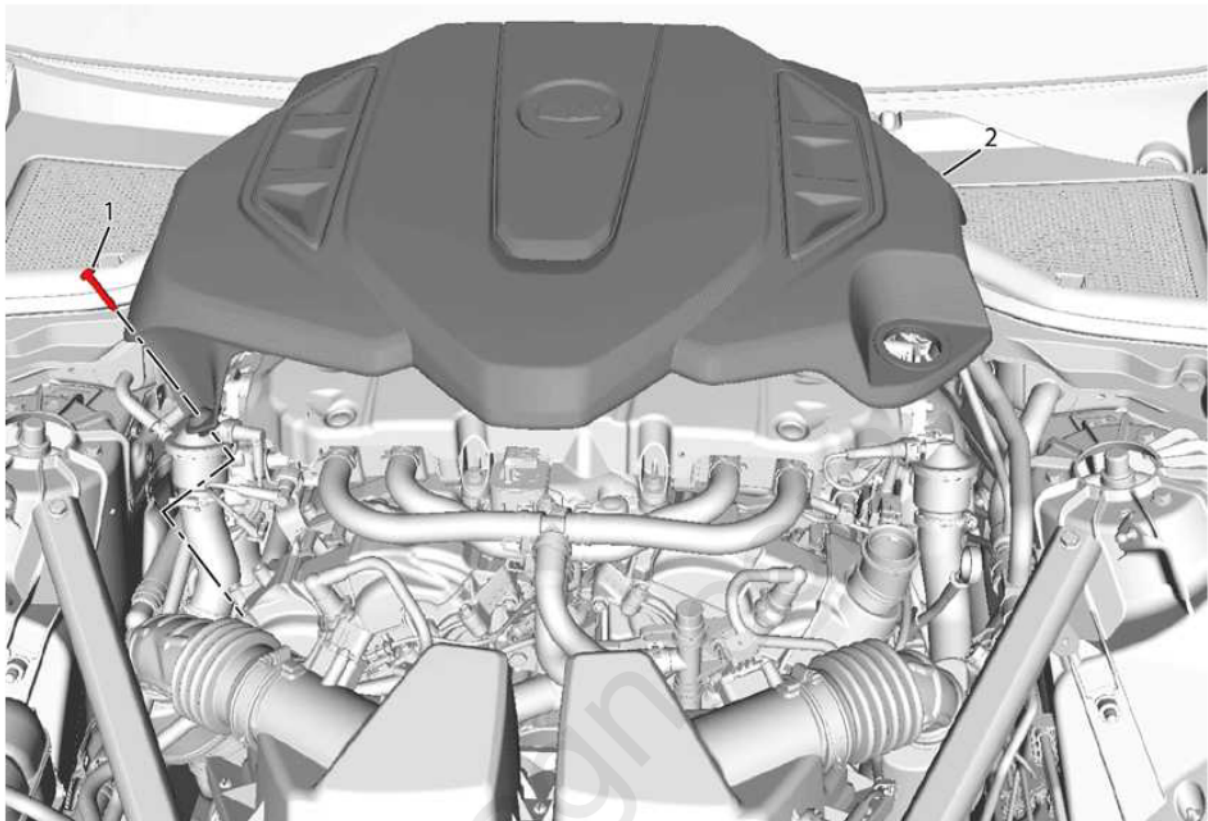
Special Tools

- GE-26568 Coolant and Battery Fluid tester
- GE-47716 Vac-N-Fill Coolant Refill Tool
- GE-47716-30-A Vac-N-Fill Adapter

For equivalent regional tools, refer to [Special Tools](#).

Draining Procedure

1. [Intake Manifold Cover Replacement \(LGW\)](#) (2)» Remove



[Fig. 31: Intake Manifold Cover \(LGW\)](#)

Courtesy of GENERAL MOTORS COMPANY

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.

NOTE: Make sure the intercooler system is cool and that the pump is not in the ON position.

2. Remove the turbocharger coolant feed pipe fitting cap (1).

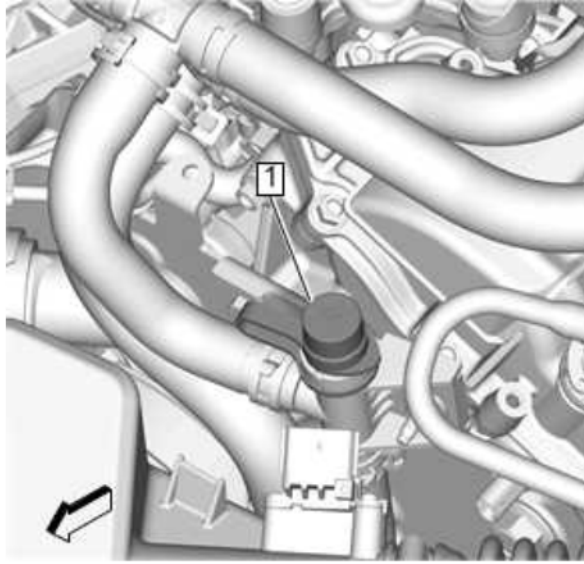


Fig. 32: CAC Quick Connect Vacuum Fitting Cap
Courtesy of GENERAL MOTORS COMPANY

3. Install absorbent rags under the charge air coolant bleeder valves (1) to absorb any coolant loss.

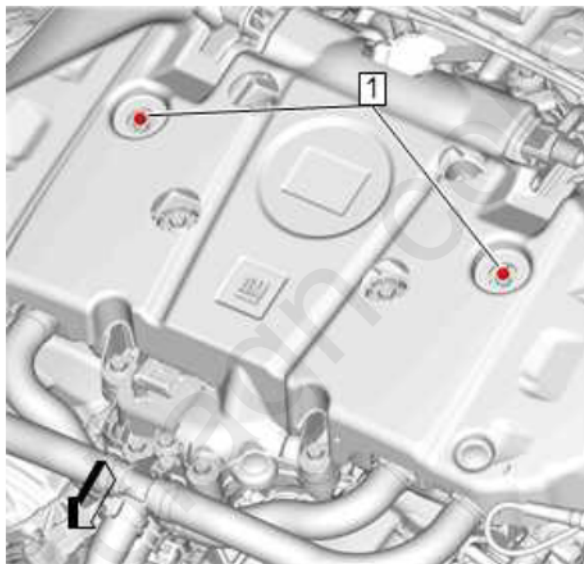


Fig. 33: Air Bleeder Valves
Courtesy of GENERAL MOTORS COMPANY

4. Open the two air bleeder valves (1) on the charge air cooler (CAC).
5. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
6. Remove the Underbody Front Air Deflector (3). Refer to [Underbody Front Air Deflector Replacement](#)

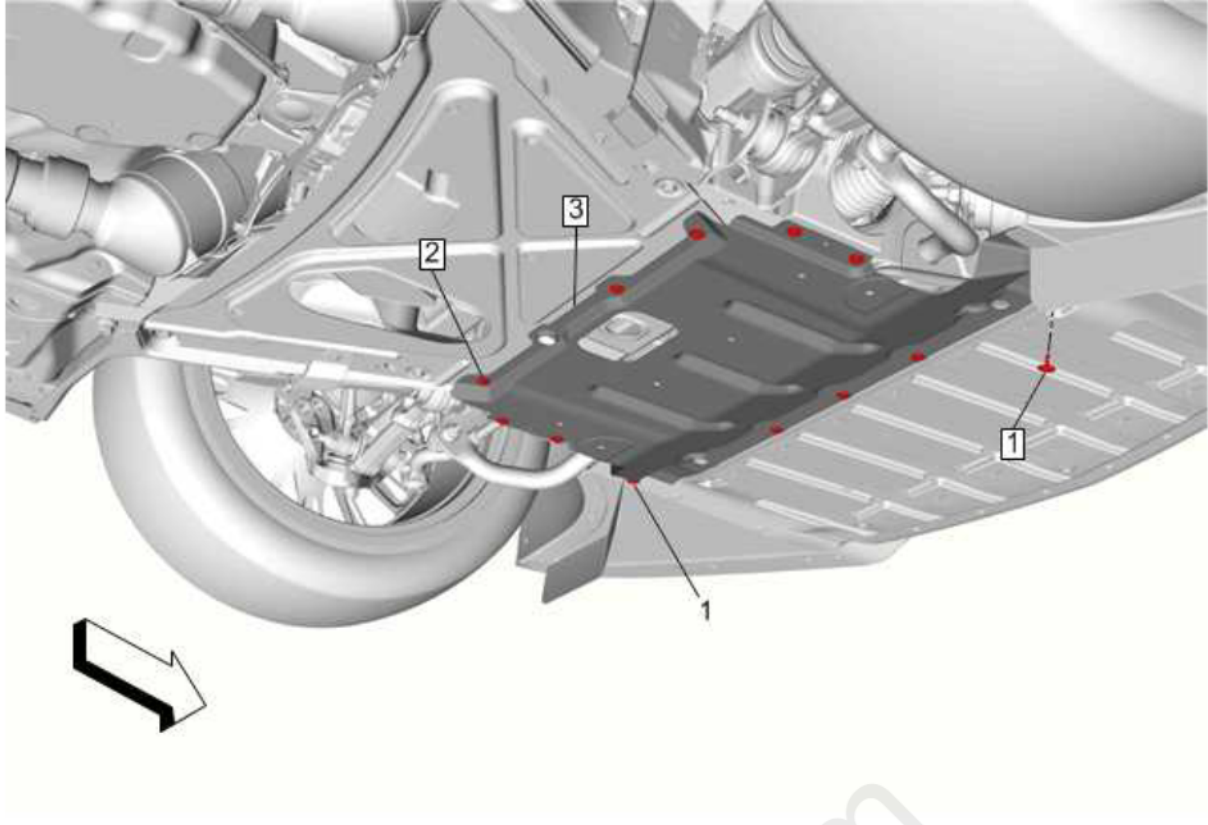


Fig. 34: Underbody Front Air Deflector

Courtesy of GENERAL MOTORS COMPANY

7. Lower the vehicle.
8. Remove the air cleaner assembly (1). Refer to [Air Cleaner Assembly Replacement \(LGW\)](#)

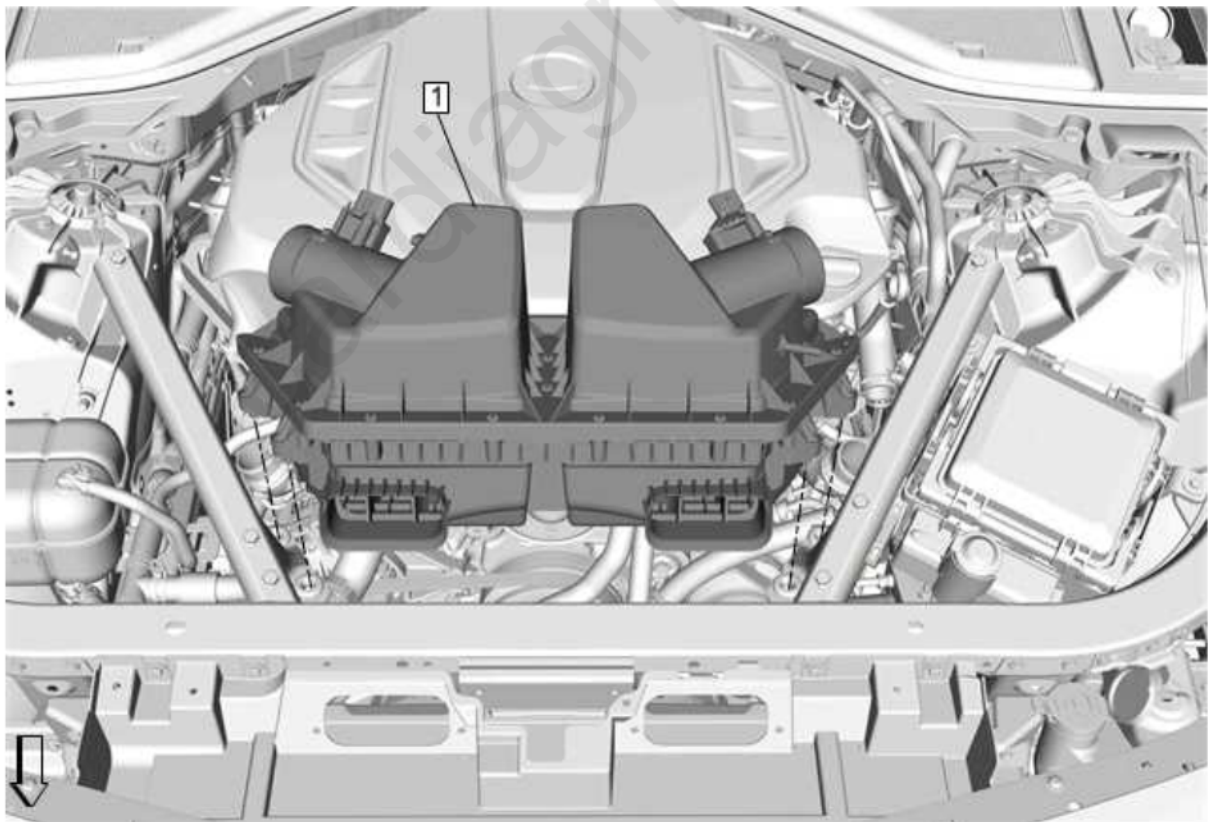


Fig. 35: Air Cleaner Assembly (LGW)

Courtesy of GENERAL MOTORS COMPANY

9. Remove the Charge Air Cooler Coolant Hose (2) at the Charge Air Coolant Pump. Refer to [Charge Air Cooler Coolant Pump Replacement \(LGW\)](#)

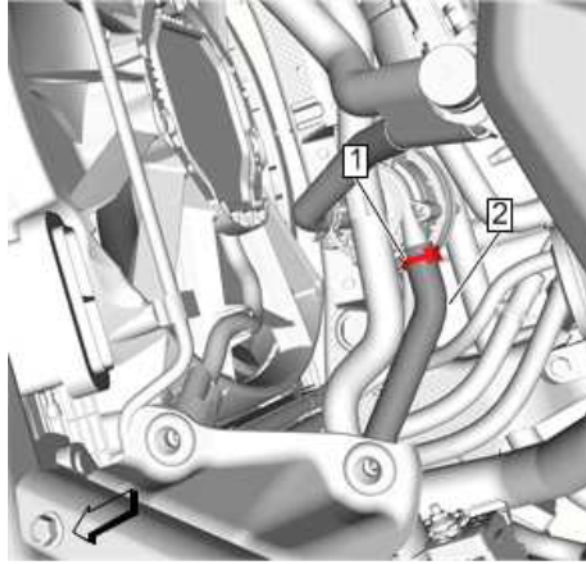


Fig. 36: Charge Air Cooler Coolant Hose
Courtesy of GENERAL MOTORS COMPANY

10. Allow the system to fully drain into a clean container.
11. Measure and record the amount of coolant drained.
12. Install the Charge Air Cooler Coolant Hose (2) to the Charge Air Coolant Pump. Refer to [**Charge Air Cooler Coolant Pump Replacement \(LGW\)**](#)

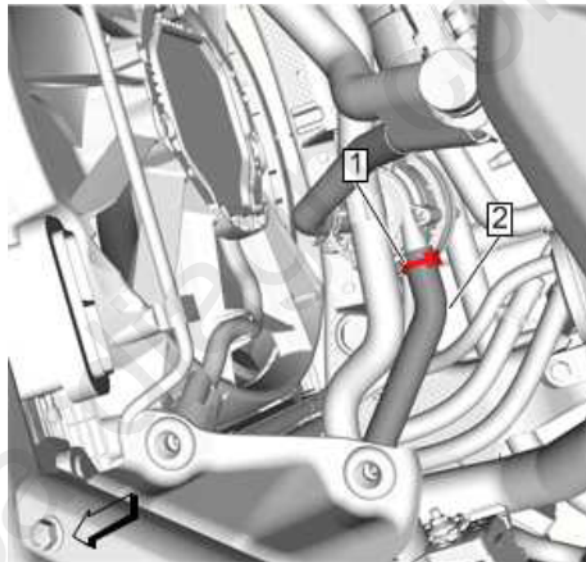


Fig. 37: Charge Air Cooler Coolant Hose
Courtesy of GENERAL MOTORS COMPANY

13. Install the air cleaner assembly (1). Refer to [**Air Cleaner Assembly Replacement \(LGW\)**](#)

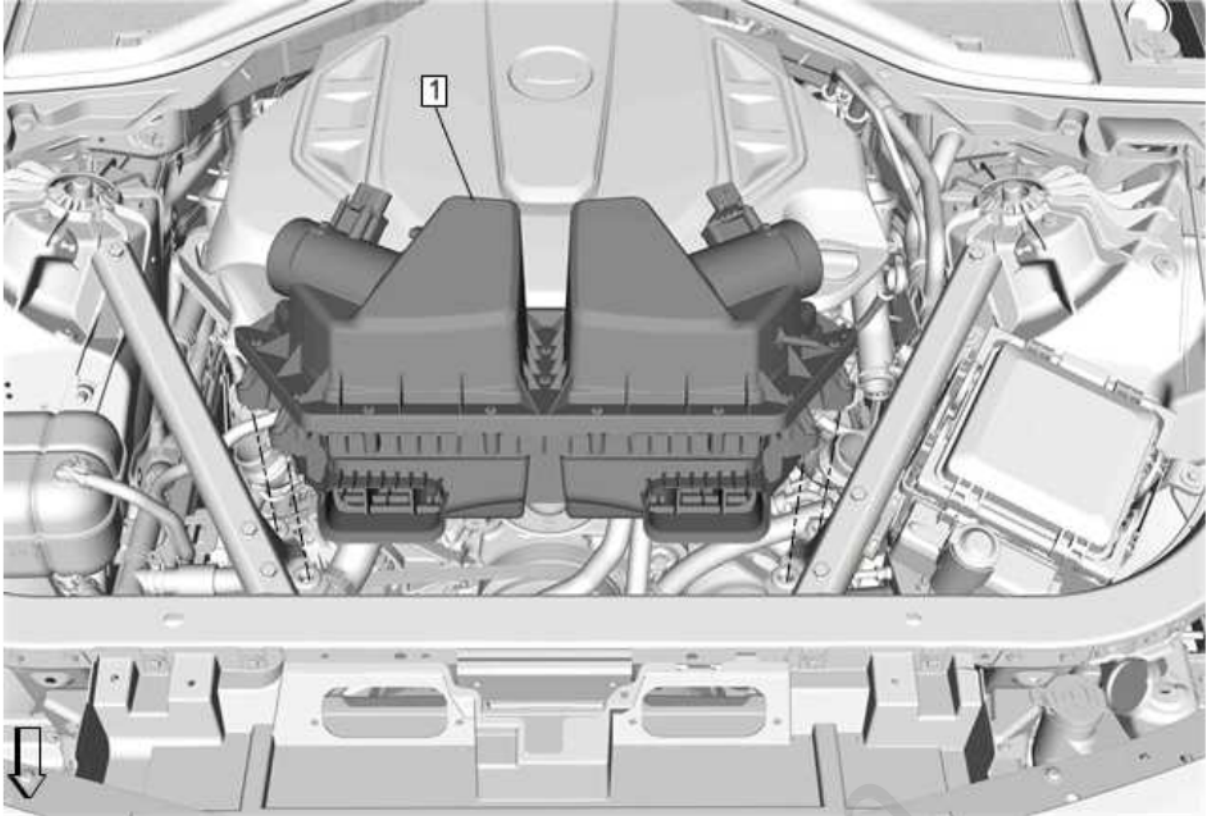


Fig. 38: Air Cleaner Assembly (LGW)

Courtesy of GENERAL MOTORS COMPANY

14. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
15. Install the Underbody Front Air Deflector (3). Refer to [Underbody Front Air Deflector Replacement](#)

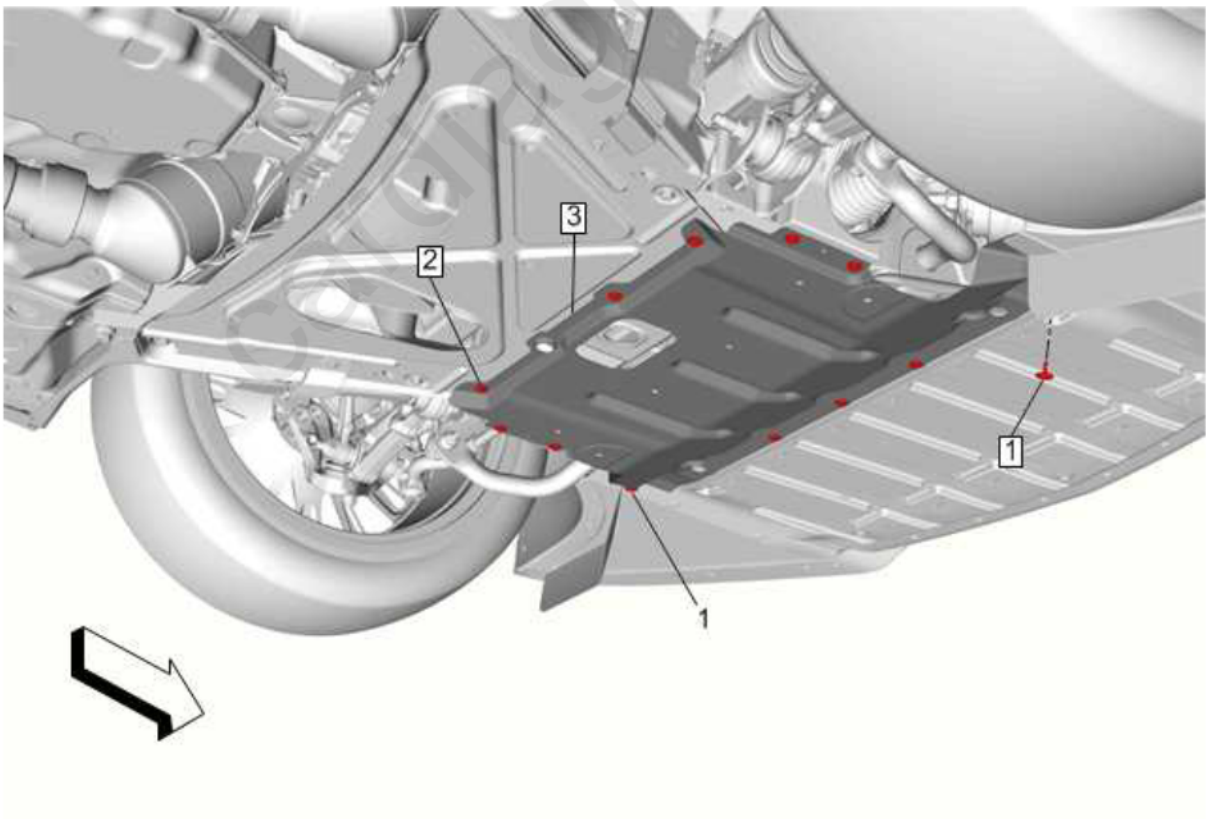


Fig. 39: Underbody Front Air Deflector

Courtesy of GENERAL MOTORS COMPANY

16. Lower the vehicle.

Vac-N-Fill Procedure

1. Close the two air bleeder valves (1) on the charge air cooler and tighten to 12 N.m (106 lb in).

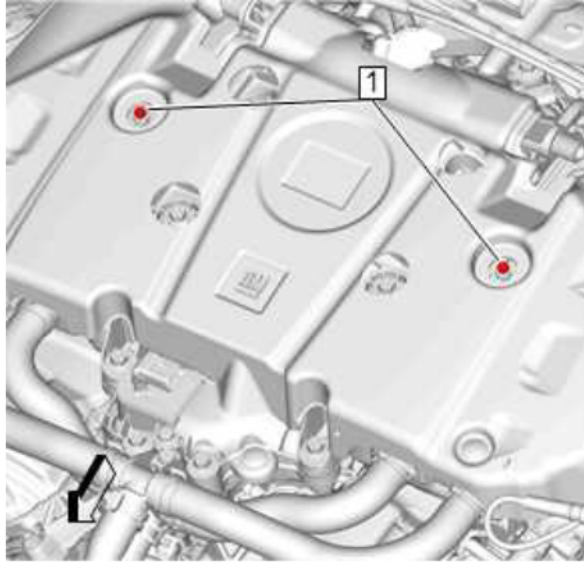


Fig. 40: Air Bleeder Valves

Courtesy of GENERAL MOTORS COMPANY

NOTE: It is critical that the system must be completely free of air to prevent CAC pump noise and loss of system performance.

2. Install absorbent rags under the turbocharger coolant feed pipe fitting to absorb any coolant loss.
3. Install the **GE-47716-30-A** Vac-N-Fill Adapter (1) to the turbocharger coolant feed pipe fitting.

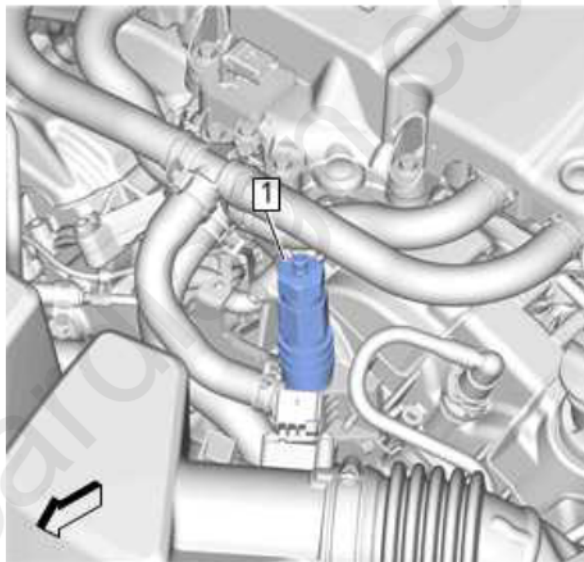


Fig. 41: GE-47716-30--A Vac-N-Fill Adapter

Courtesy of GENERAL MOTORS COMPANY

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

4. Attach the Vac-N-Fill gauge assembly to **GE-47716-30-A** Vac-N-Fill Adapter (1).

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.

5. Attach the vacuum gauge assembly to the Vac-N-Fill Adapter (1).
6. Attach the fill hose (1) to the barb fitting on the vacuum gauge assembly (2).

Ensure that the valve is closed.

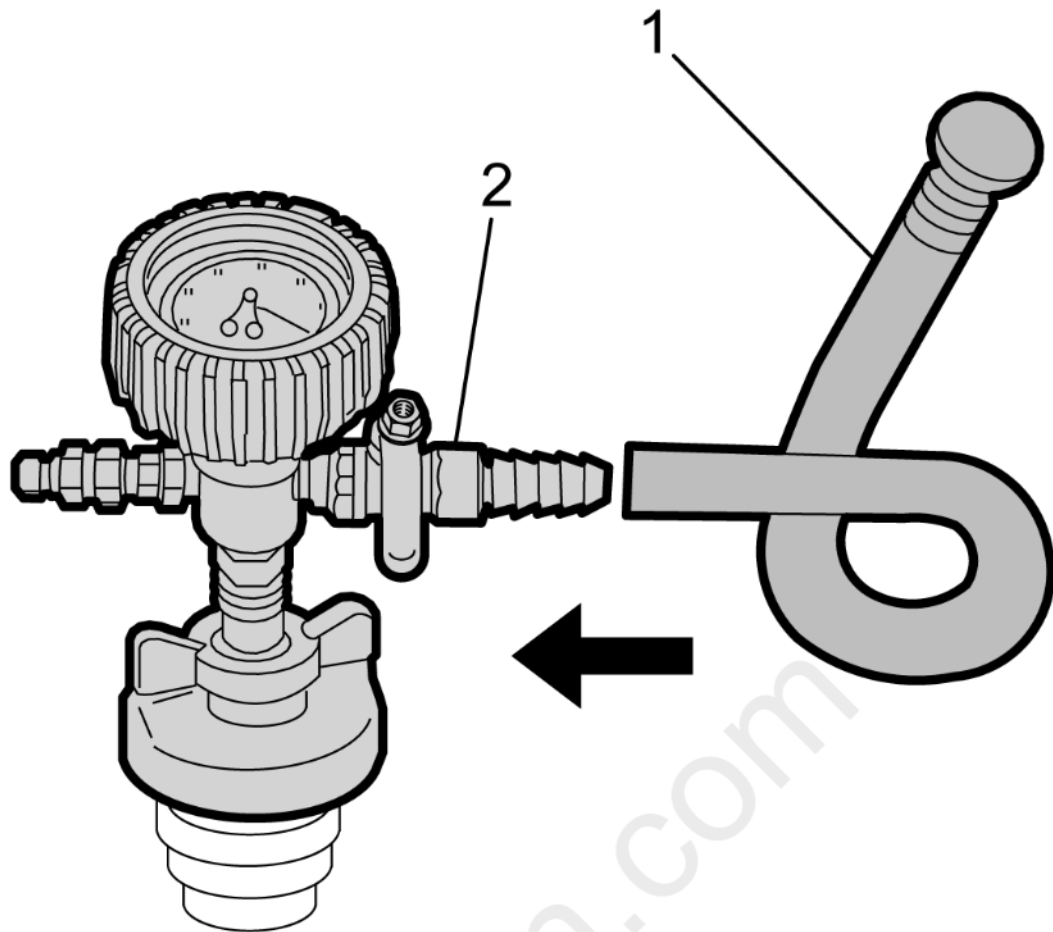


Fig. 42: Vacuum Gauge Assembly & Fill Hose
Courtesy of GENERAL MOTORS COMPANY

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

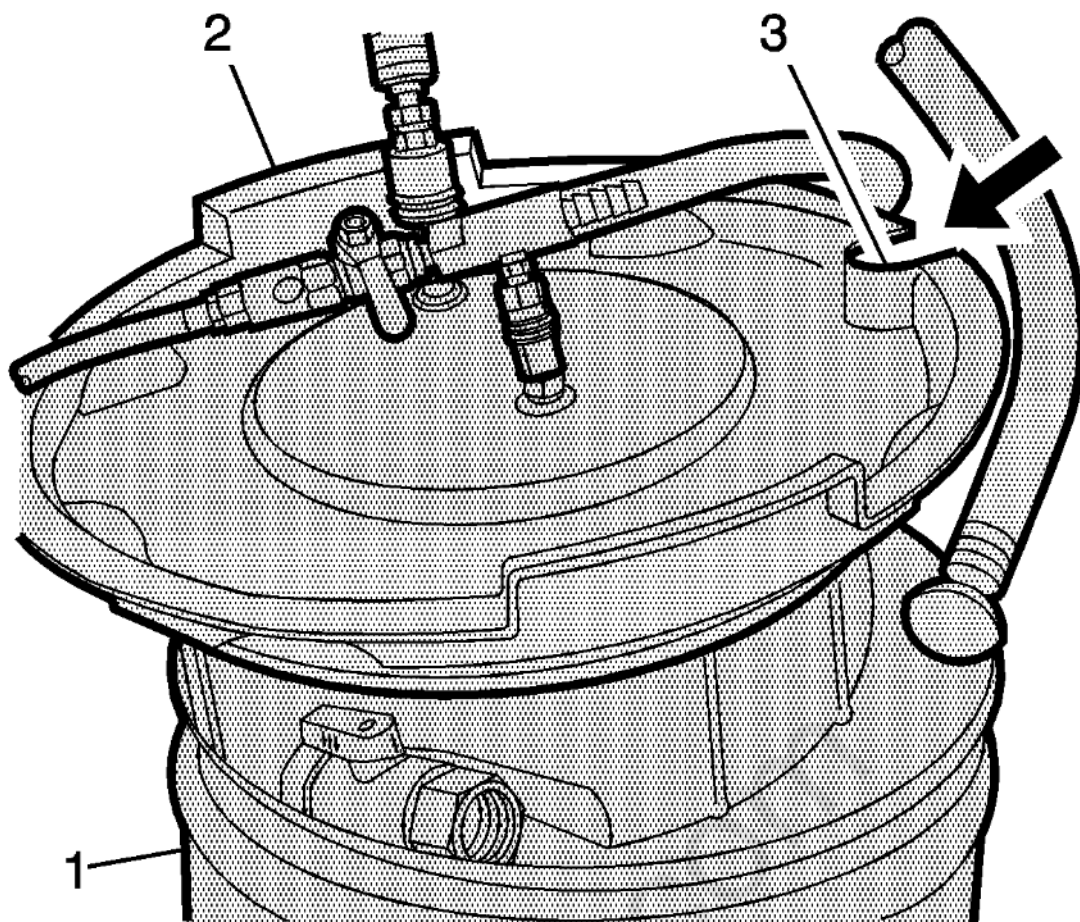


Fig. 43: Graduated Reservoir, Vacuum Tank & Cut-Out Area

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.

8. Place the fill hose in the graduated reservoir (1).
9. Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.

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.

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

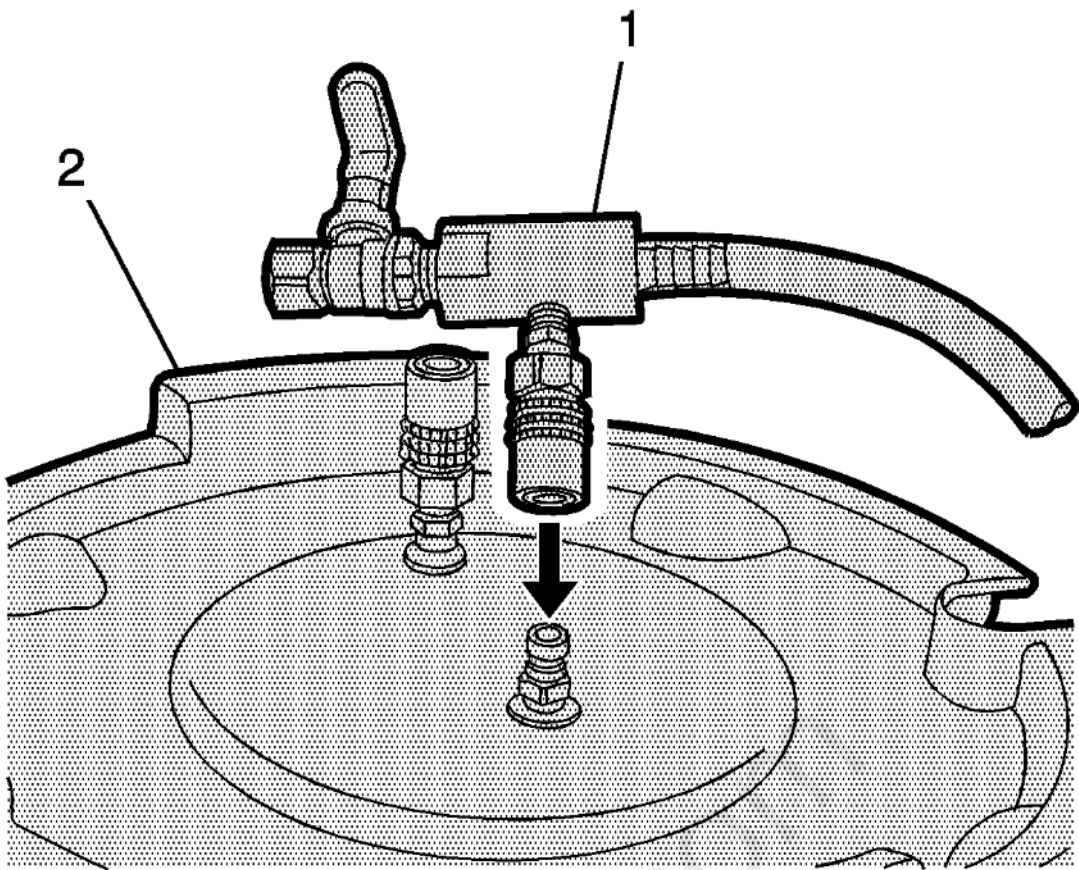


Fig. 44: Vacuum Tank & Venturi Assembly

Courtesy of GENERAL MOTORS COMPANY

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

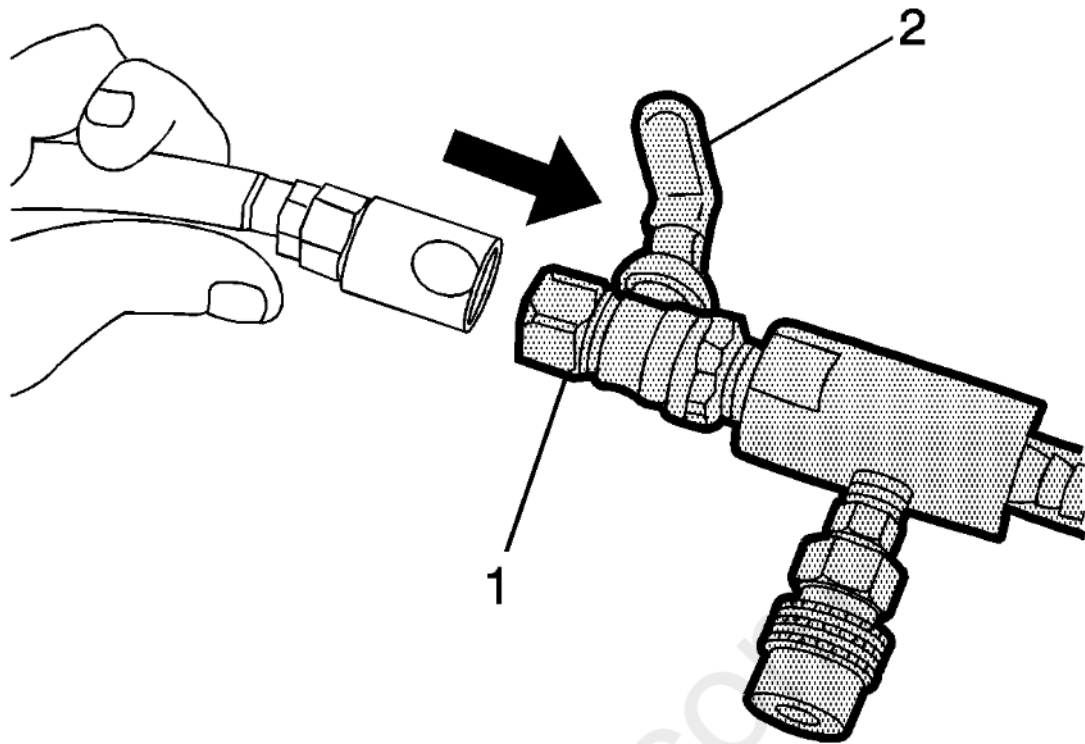


Fig. 45: Venturi Assembly & Valve

Courtesy of GENERAL MOTORS COMPANY

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

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

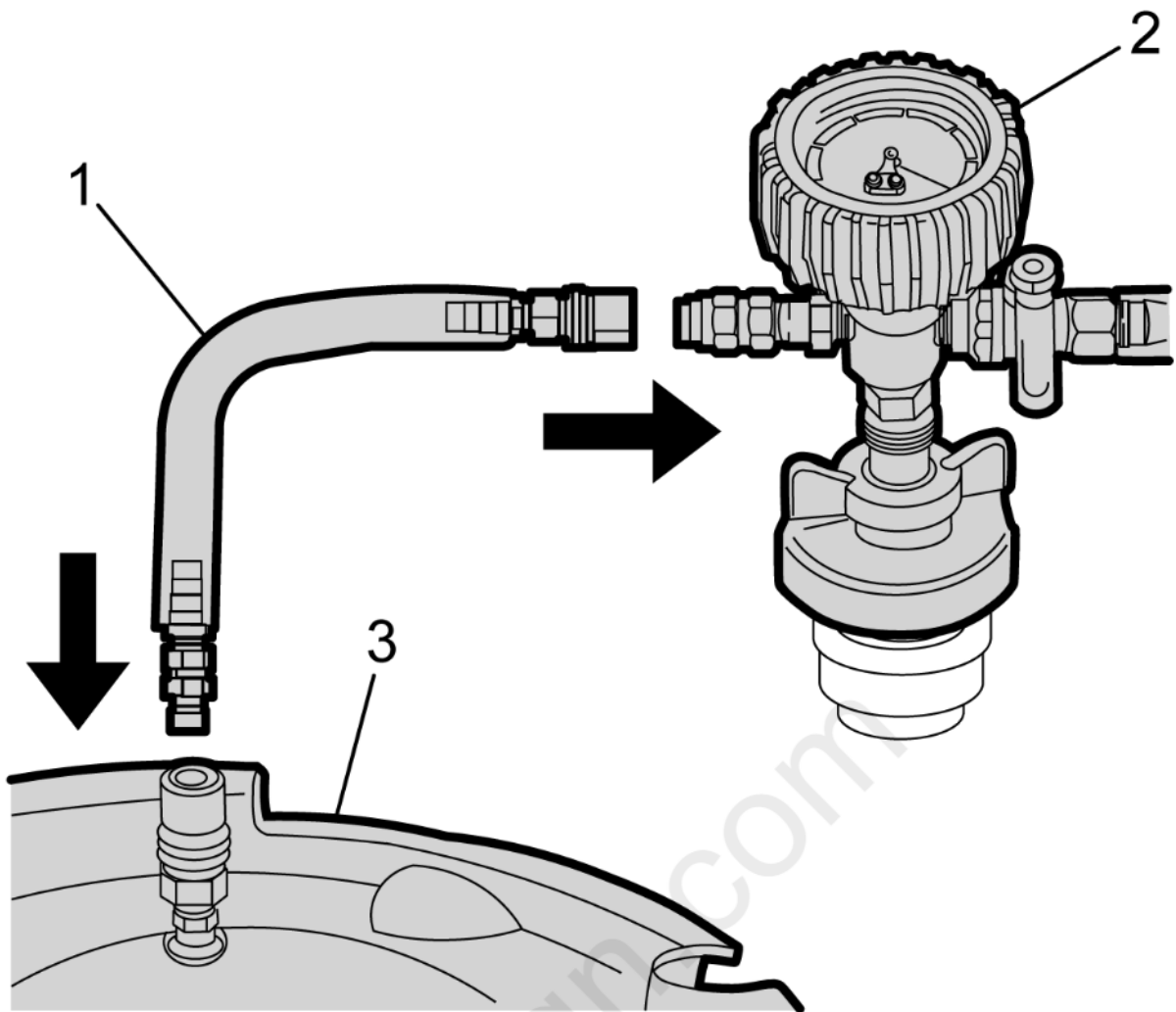


Fig. 46: Vacuum Hose, Gauge Assembly & Tank
Courtesy of GENERAL MOTORS COMPANY

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

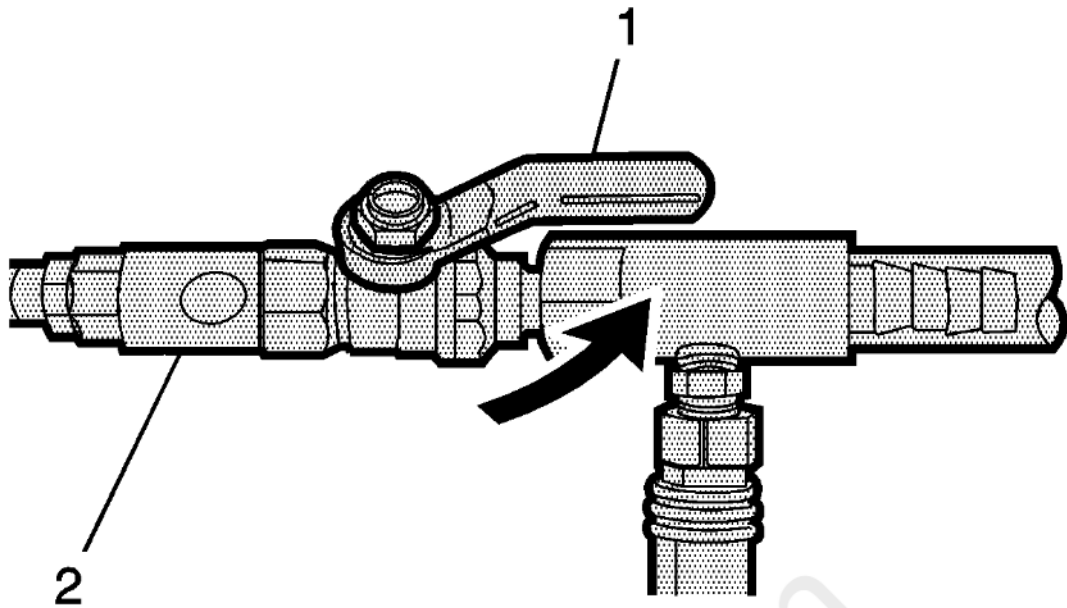


Fig. 47: Valve & Venturi Assembly

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).

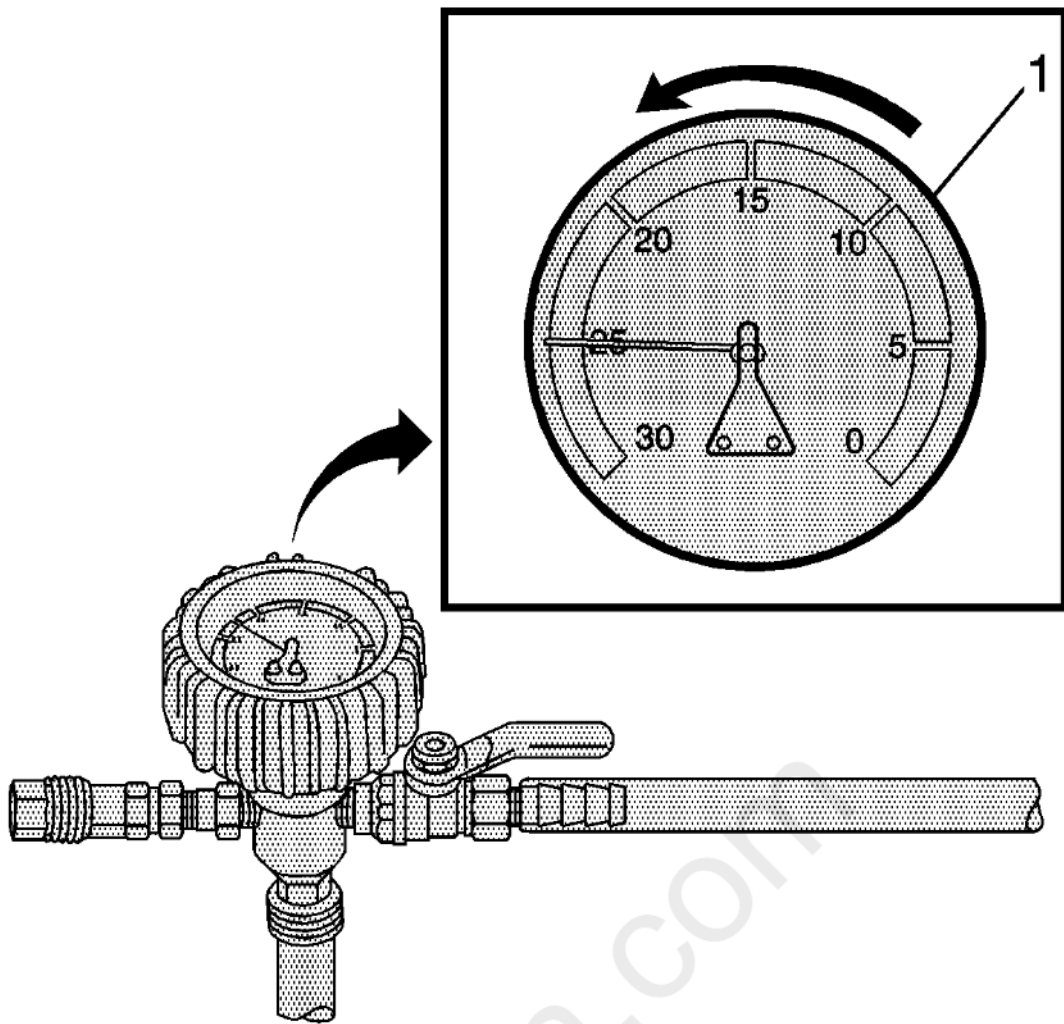


Fig. 48: Vacuum Gauge Needle

Courtesy of GENERAL MOTORS COMPANY

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.
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.

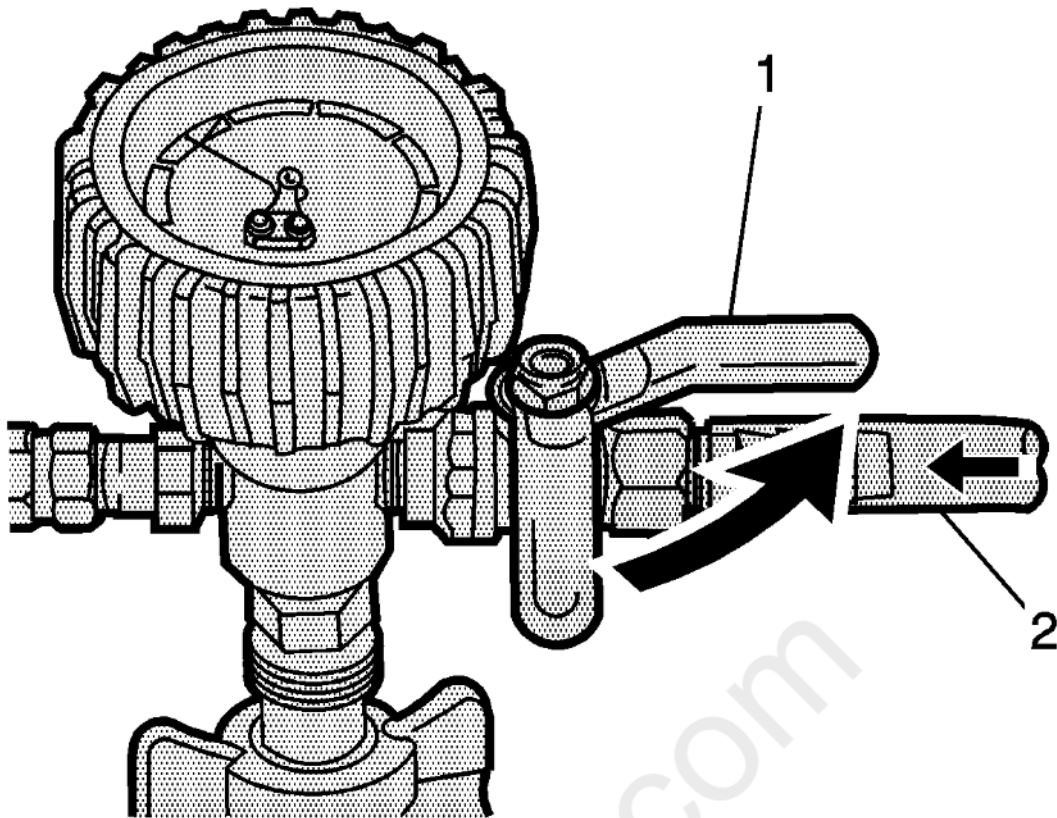


Fig. 49: Vacuum Gauge Assembly & Needle
Courtesy of GENERAL MOTORS COMPANY

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

If vacuum loss is observed, refer to **Loss of Coolant**.
19. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system
20. Once the vacuum gauge reaches zero, close the valve on the vacuum gauge assembly and repeat steps 12-19 until the return hose going back to Vac-N-Fill Bucket is filled solid with coolant and no air bubbles are visible.
21. Detach the Vac-N-Fill gauge assembly from the **GE-47716-30-A** Vac-N-Fill Adapter (1).

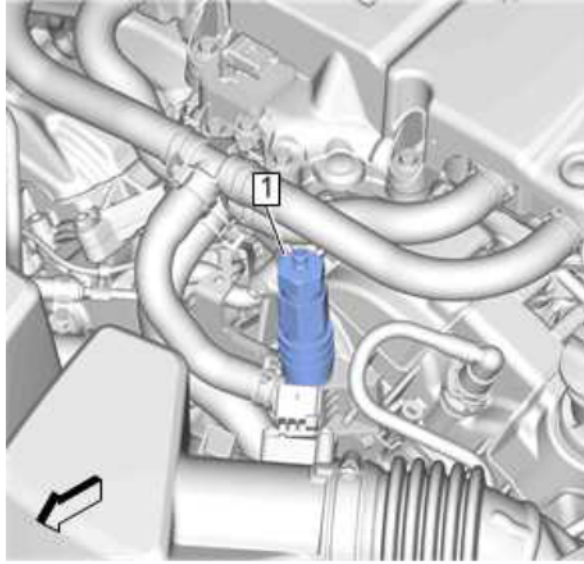


Fig. 50: GE-47716-30--A Vac-N-Fill Adapter
Courtesy of GENERAL MOTORS COMPANY

22. Remove the **GE-47716-30-A Vac-N-Fill Adapter (1)** from the turbocharger coolant feed pipe fitting.
23. Install the turbocharger coolant feed pipe fitting cap (1).

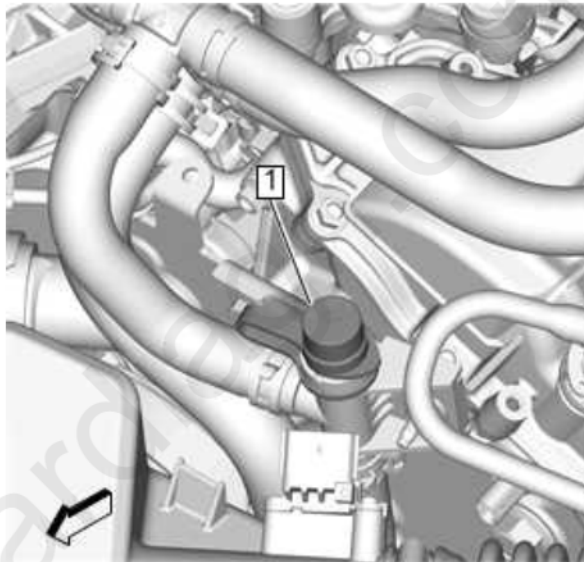


Fig. 51: CAC Quick Connect Vacuum Fitting Cap
Courtesy of GENERAL MOTORS COMPANY

24. Connect the Global Diagnostic System 2 (GDS 2) to the vehicle.
25. Enable the CAC Pump using the GDS 2. Run pump for one minute. Listen for any abnormal noises/cavitation inside the pump indicating excess air in the system. If pump shuts itself off during this process or there is excessive noise/cavitation at the pump, there is air still in the system. If this happens, the complete Drain & Fill Procedure will need to be repeated.
26. Remove the absorbent rags.
27. Rinse away any excess coolant from the engine and the engine compartment.
28. **Intake Manifold Cover Replacement (LGW)** (2)» Install

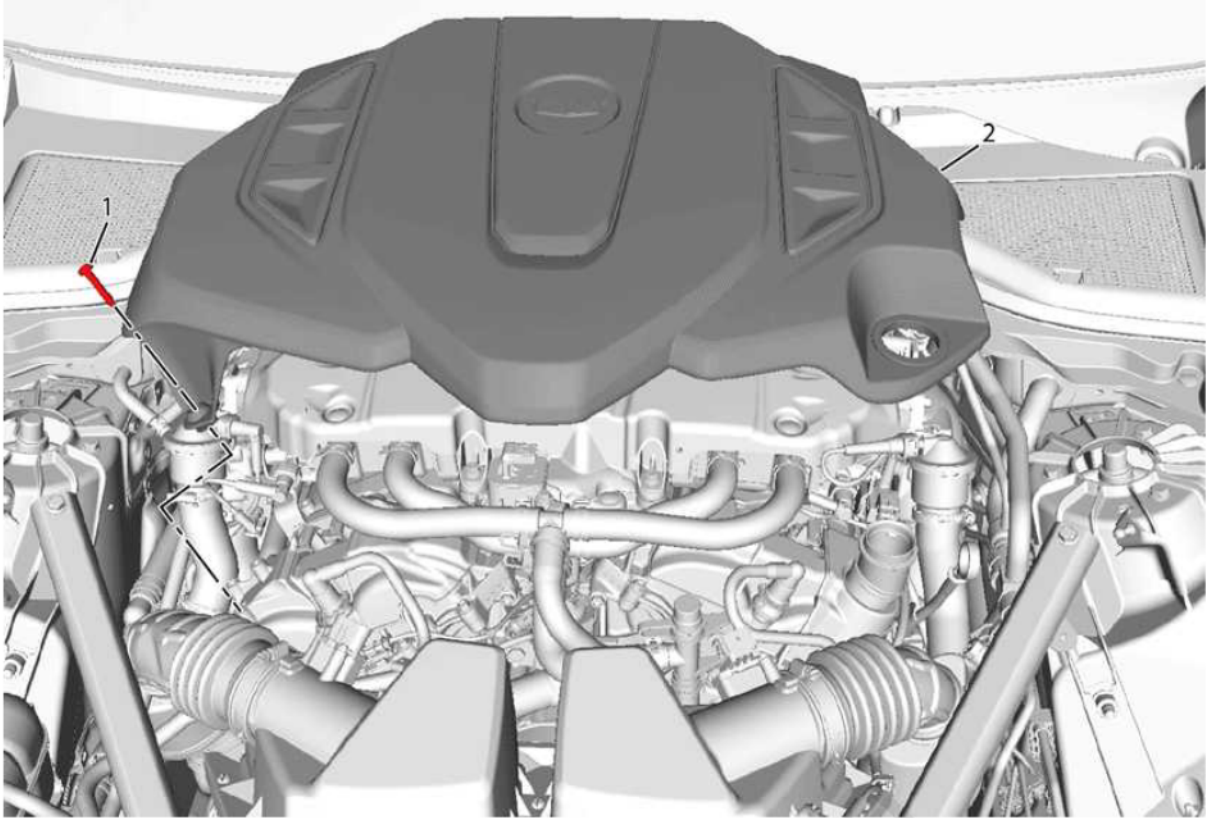


Fig. 52: Intake Manifold Cover (LGW)

Courtesy of GENERAL MOTORS COMPANY

FLUSHING (LGW LTG WITHOUT HP9)

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.
- 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. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#).
2. Remove the radiator surge tank. Refer to [Radiator Surge Tank Replacement \(LGW LTG without HP9\)](#).
3. Clean and flush the radiator surge tank with clean, drinkable water.
4. Install the radiator surge tank. Refer to [Radiator Surge Tank Replacement \(LGW LTG without HP9\)](#).

5. Follow the drain and fill procedure using only clean, drinkable water. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#).
6. Run the engine for 20 minutes.
7. Stop the engine.
8. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#).
9. Repeat the procedure if necessary, until the fluid is nearly colorless.
10. Fill the cooling system. [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#).

CHARGE AIR COOLING SYSTEM FLUSHING

NOTE: Do not use a chemical flush.

Store used coolant in the proper manner, such as in a used engine coolant holding tank. Do not pour used coolant down a drain. Ethylene glycol antifreeze is a very toxic chemical. Do not dispose of coolant into the sewer system or ground water. This is illegal and ecologically unsound.

Various methods and equipment can be used to flush the cooling system. If special equipment is used, such as a back flusher, follow the manufacturer's instruction.

When the charge air cooling (CAC) cooling system becomes contaminated, the CAC cooling system should be flushed thoroughly to remove the contaminants before the supercharger is seriously damaged.

1. Drain the CAC cooling system. Refer to [Charge Air Cooling System Draining and Filling \(LGW\)](#).
2. Follow the drain and fill procedure using only clean, drinkable water. Refer to [Charge Air Cooling System Draining and Filling \(LGW\)](#).
3. Command the CAC pump to the ON position using the Tech 2 or by starting the engine. Run the CAC pump for 5 minutes.
4. Drain the CAC cooling system. Refer to [Charge Air Cooling System Draining and Filling \(LGW\)](#).
5. Repeat the procedure if necessary, until the fluid is colorless.
6. Fill the CAC cooling system. Refer to [Charge Air Cooling System Draining and Filling \(LGW\)](#).

CHARGE AIR COOLING SYSTEM 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.

- Some conditions may require the use of warm water and a mild detergent.

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

- Clean the A/C condenser fins.
- Clean between the A/C condenser and charge air coolant radiator.
- Clean the charge air coolant radiator cooling fins.
- Straighten any damaged cooling fins.

RADIATOR CLEANING (LGW LTG WITHOUT HP9)

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.

- Some conditions may require the use of warm water and a mild detergent.

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

- Clean the A/C condenser fins.
- Clean between the A/C condenser and radiator.
- Clean the radiator cooling fins.
- Straighten any damaged cooling fins.

RADIATOR SURGE TANK REPLACEMENT (LGW LTG WITHOUT HP9)

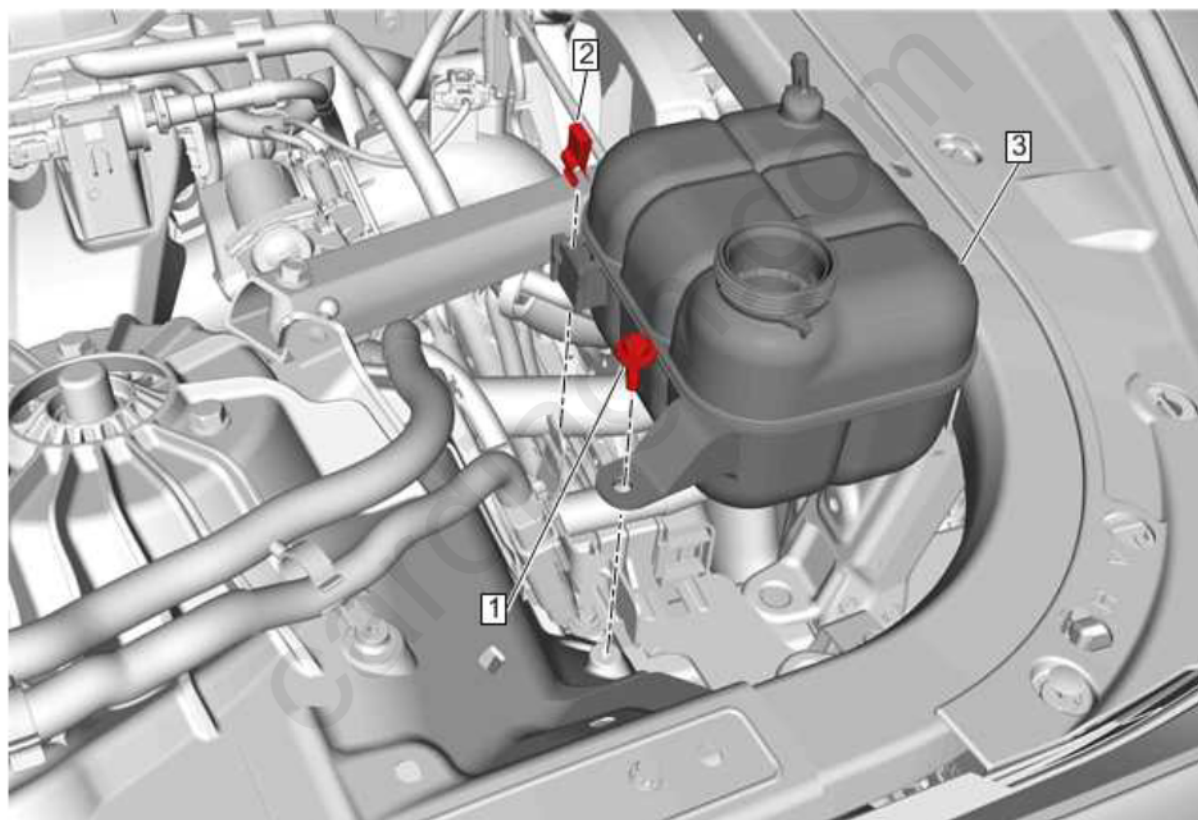


Fig. 53: Radiator Surge Tank (LGW LTG)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1.	Drain the cooling system. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9)
2.	Radiator Surge Tank Inlet Hose @ Radiator Surge Tank Remove - Radiator Surge Tank Inlet Hose Replacement (LTG without HP9) Radiator Surge Tank Inlet Hose Replacement (LGW)
3.	Engine Coolant Air Bleed Hose @ Radiator Surge Tank Remove - Engine Coolant Air Bleed Hose Replacement (Radiator Surge Tank to Engine Coolant Air Bleed Pipe - LTG without HP9) Engine Coolant Air Bleed Hose Replacement (LGW) Engine Coolant Air Bleed Hose Replacement (Radiator Surge Tank to Engine Coolant Air Bleed Pipe - LGW)

Callout	Component Name
1	Radiator Surge Tank Bolt CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Radiator Surge Tank Clip
2	Radiator Surge Tank Procedure 1. Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9) 2. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK REPLACEMENT (LGX)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. [Air Inlet Grille Panel Access Hole Cover Replacement](#) » Remove
3. Engine Coolant Air Bleed Hose Clamp (1) » Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

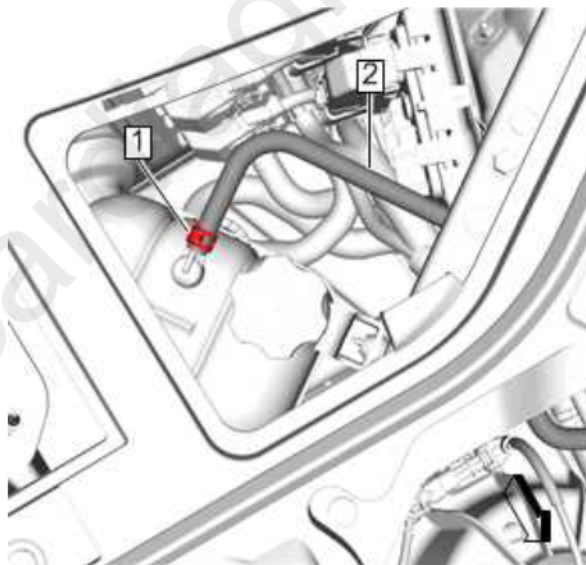


Fig. 54: Engine Coolant Air Bleed Hose
 Courtesy of GENERAL MOTORS COMPANY

4. Engine Coolant Air Bleed Hose (2) @ Radiator Surge Tank » Remove
5. Radiator Surge Tank Bolt (1) @ Radiator Surge Tank » Remove

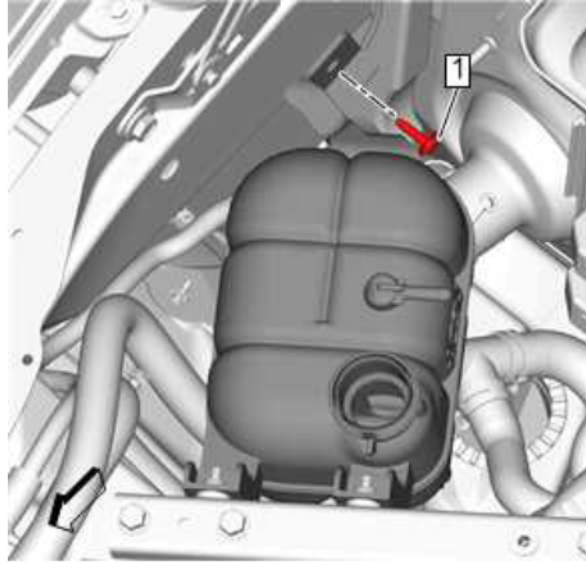


Fig. 55: Radiator Surge Tank Bolt
 Courtesy of GENERAL MOTORS COMPANY

6. Radiator Surge Tank (1) @ StudÃ,Ã» Remove

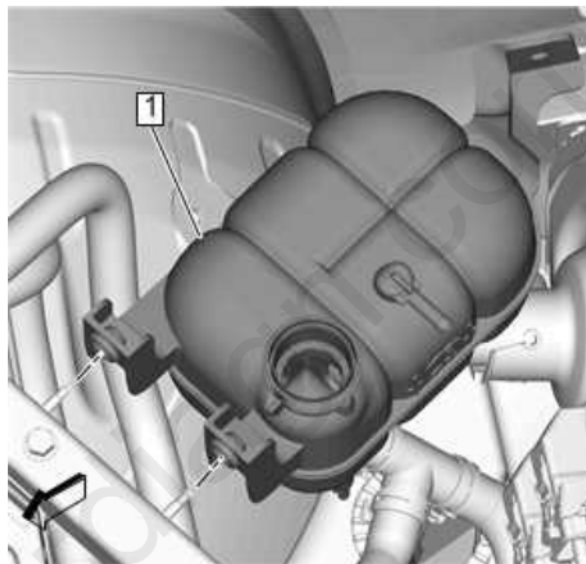


Fig. 56: Radiator Surge Tank
 Courtesy of GENERAL MOTORS COMPANY

7. Heater Outlet Hose Clamp (1) @ Radiator Surge Tank Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

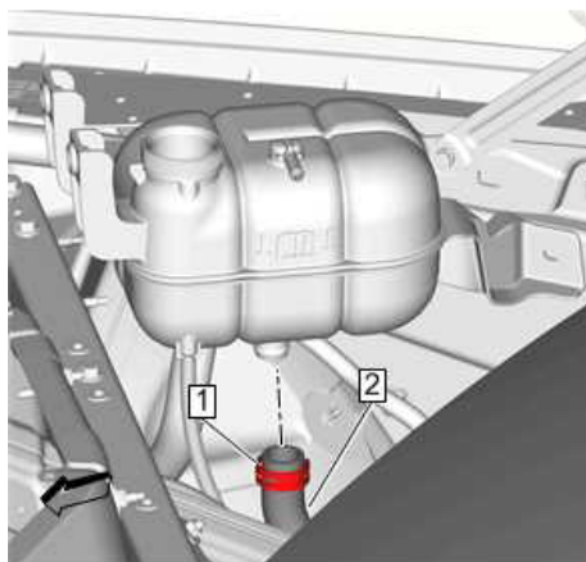


Fig. 57: Heater Outlet Hose
 Courtesy of GENERAL MOTORS COMPANY

8. Heater Outlet Hose (2) @ Radiator Surge Tank Remove

Installation Procedure

1. Heater Outlet Hose (2) @ Radiator Surge Tank Install

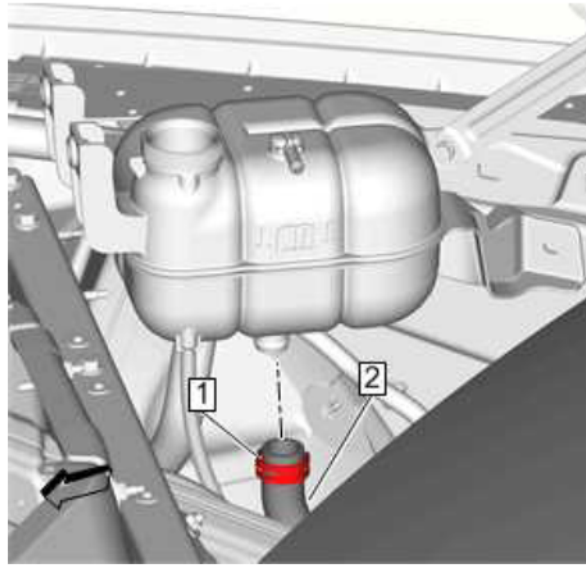


Fig. 58: Heater Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

2. Heater Outlet Hose Clamp (1) @ Radiator Surge Tank Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Radiator Surge Tank (1) @ Stud Install

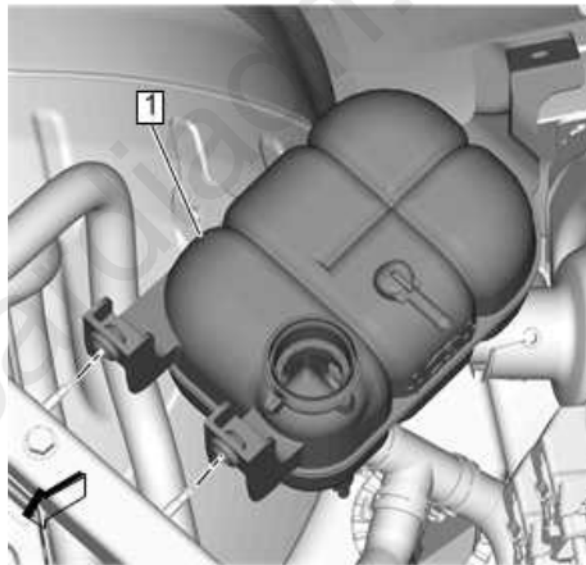


Fig. 59: Radiator Surge Tank

Courtesy of GENERAL MOTORS COMPANY

4. Radiator Surge Tank Bolt (1) @ Radiator Surge Tank Install and tighten 9 N.m (80 lb in)

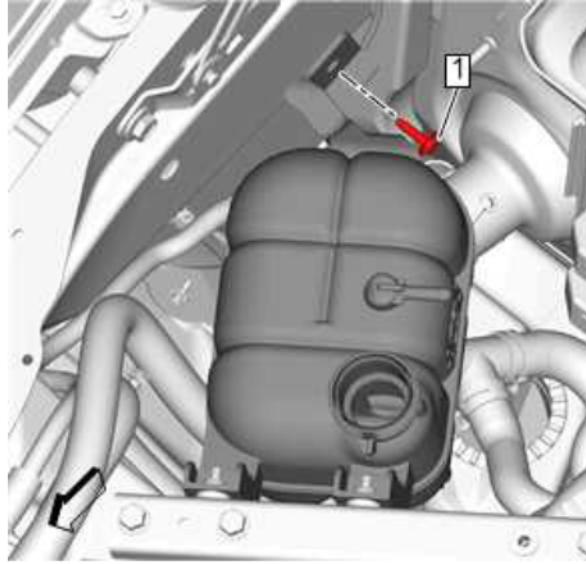


Fig. 60: Radiator Surge Tank Bolt

Courtesy of GENERAL MOTORS COMPANY

5. Engine Coolant Air Bleed Hose (2) @ Radiator Surge Tank, » Install

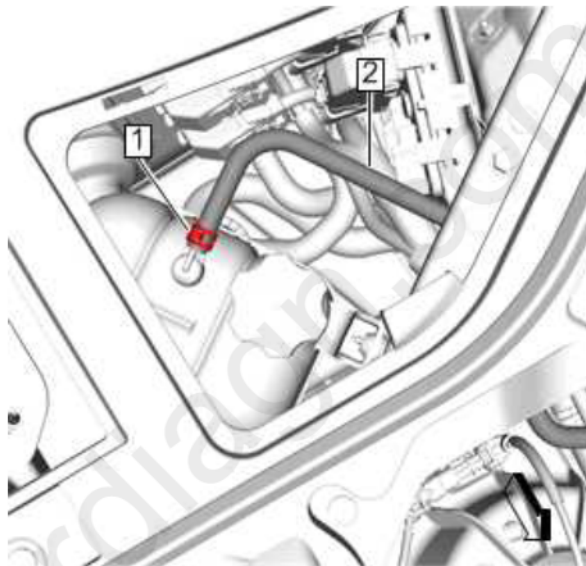


Fig. 61: Engine Coolant Air Bleed Hose

Courtesy of GENERAL MOTORS COMPANY

6. Engine Coolant Air Bleed Hose Clamp (1) » Engage - **Hose Clamp Replacement Guidelines - Spring Type**
7. **Air Inlet Grille Panel Access Hole Cover Replacement** » Install
8. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static without HP9)** and/or **Cooling System Draining and Filling (GE 47716 without HP9)**.
9. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK REPLACEMENT (LTG WITH HP9)

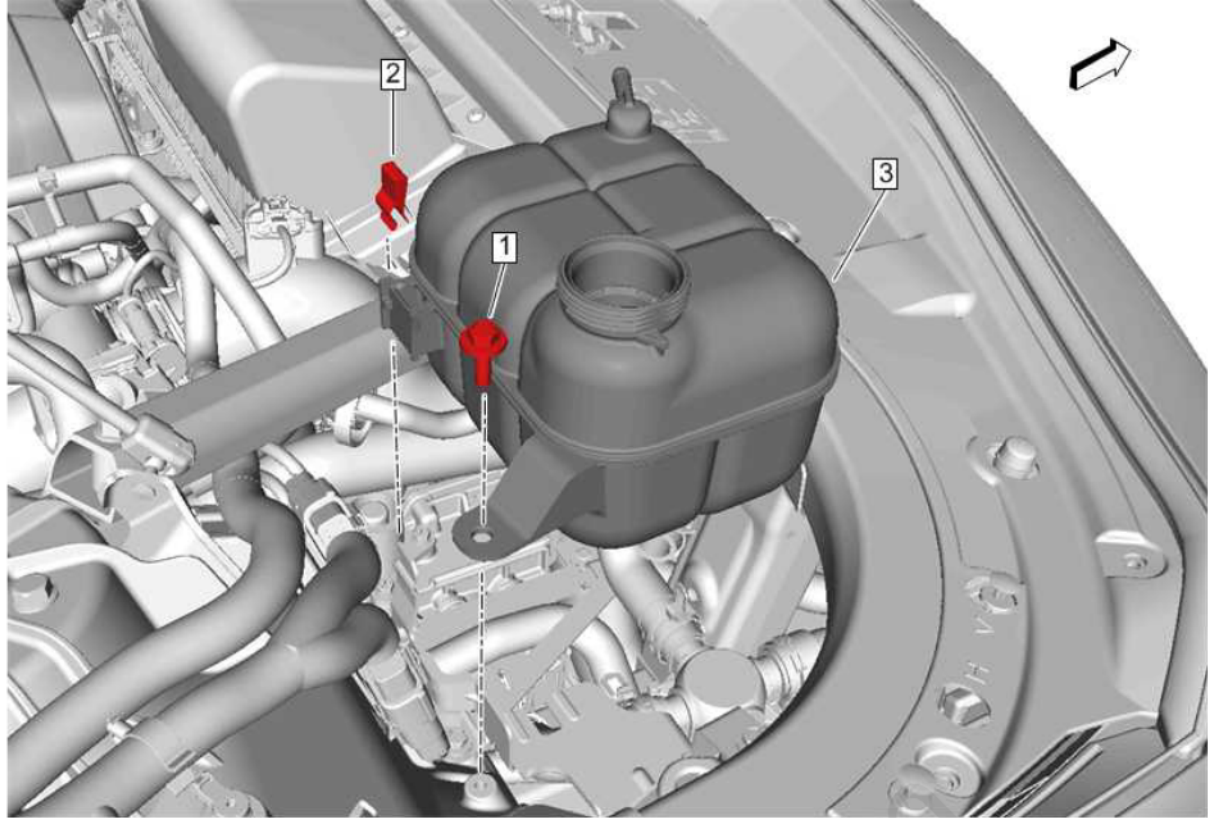


Fig. 62: Radiator Surge Tank (LTG with HP9)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Preliminary Procedures

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static LTG with HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 LTG with HP9\)](#)
3. Heater Water Auxiliary Pump Hose @ Radiator Surge Tank Remove - [Heater Water Auxiliary Pump Hose Replacement \(LTG with HP9 Surge Tank to Heater Coolant Pump to Radiator Inlet Pipe\) Heater Water Auxiliary Pump Hose Replacement \(LTG with HP9 Heater Coolant Heater to Heater Coolant Pump\)](#)
4. Engine Coolant Air Bleed Hose @ Radiator Surge Tank Remove - [Engine Coolant Air Bleed Hose Replacement \(Radiator Surge Tank to Engine Coolant Air Bleed Pipe - LTG with HP9\)](#)

1	Radiator Surge Tank Bolt CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Radiator Surge Tank Clip
3	Radiator Surge Tank Procedure 1. Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static LTG with HP9) and/or Cooling System Draining and Filling (GE 47716 LTG with HP9) 2. Enable the high voltage system. Refer to High Voltage Enabling 3. Start the engine and check for coolant leaks.

CHARGE AIR COOLER COOLANT HOSE REPLACEMENT (LGW)

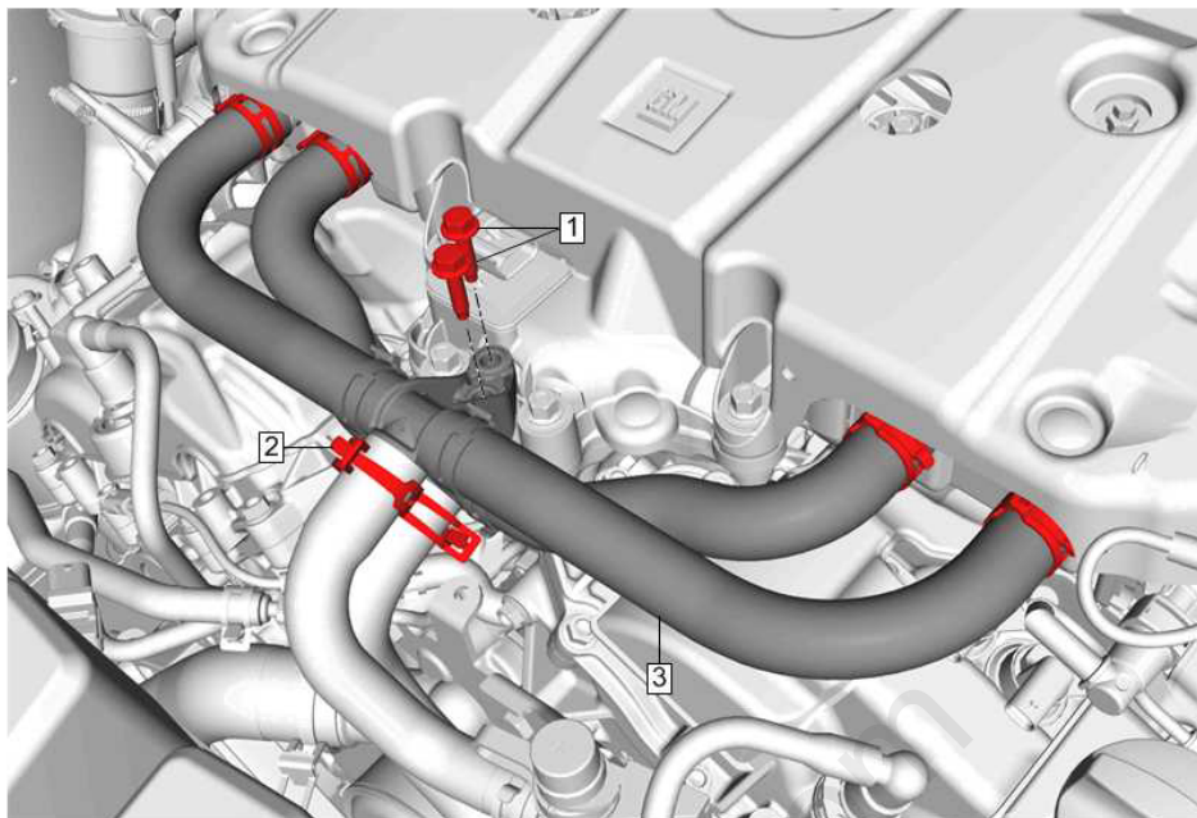


Fig. 63: Charge Air Cooler Coolant Hose (LGW)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Partially drain the charge air cooling system. Refer to Charge Air Cooling System Draining and Filling (LGW) 2. Intake Manifold Cover Replacement (LGW)	
1	Charge Air Cooler Coolant Hose Connector Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Charge Air Cooler Coolant Hose Clamp [6x] Procedure Hose Clamp Replacement Guidelines - Spring Type
3	Charge Air Cooler Coolant Hose Procedure 1. Fill the cooling system. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9) 2. Check the cooling system for leaks.

CHARGE AIR COOLER COOLANT HOSE REPLACEMENT - RADIATOR TO PUMP (LGW)

Removal Procedure

1. Drain the charge air cooling system. Refer to [Charge Air Cooling System Draining and Filling \(LGW\)](#)
2. Front Tire Front Air Deflector» Remove - [Front Tire Front Air Deflector Replacement](#)
3. Charge Air Cooler Coolant Hose Clamp (1) @ Charge Air Cooler Radiator» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

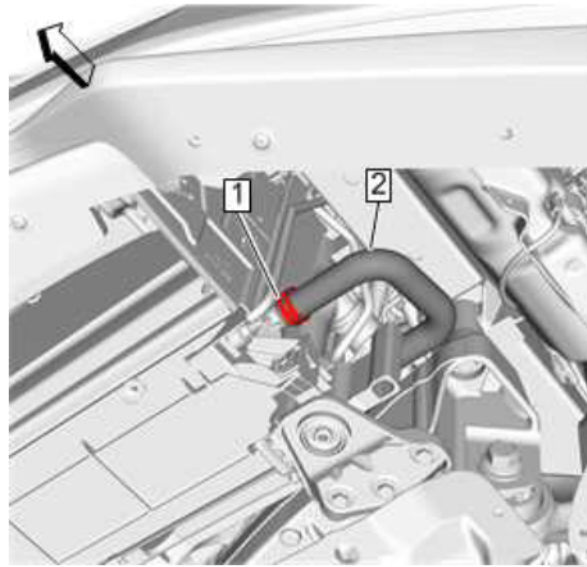


Fig. 64: Charge Air Cooler Coolant Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Charge Air Cooler Coolant Hose (2) @ Charge Air Cooler Radiator» Remove
5. Lower the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
6. Air Cleaner Assembly» Remove - [Air Cleaner Assembly Replacement \(LGW\)](#)
7. Charge Air Cooler Coolant Hose Clamp (1) @ Charge Air Cooler Coolant Pump» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

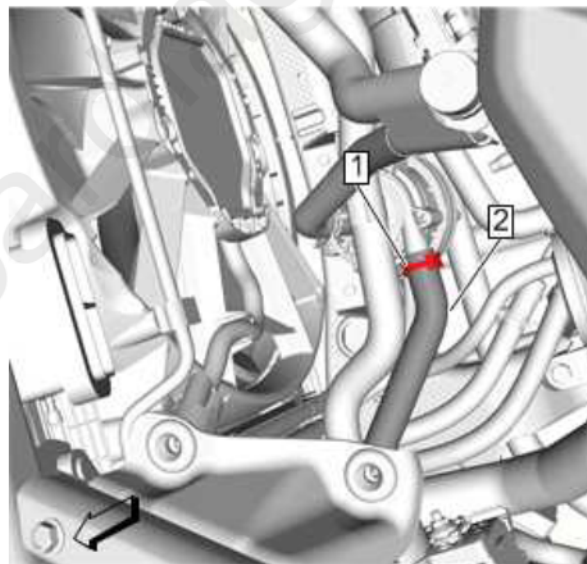


Fig. 65: Charge Air Cooler Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

8. Charge Air Cooler Coolant Hose (2) @ Charge Air Cooler Coolant Pump» Remove

Installation Procedure

1. Charge Air Cooler Coolant Hose (2) @ Charge Air Cooler Coolant Pump» Install

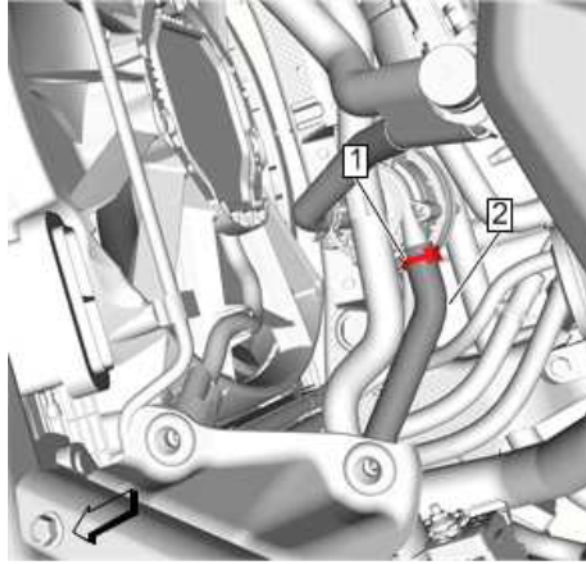


Fig. 66: Charge Air Cooler Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

2. Charge Air Cooler Coolant Hose Clamp (1) @ Charge Air Cooler Coolant Pump» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Air Cleaner Assembly» Install - **Air Cleaner Assembly Replacement (LGW)**
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
5. Charge Air Cooler Coolant Hose (2) @ Charge Air Cooler Radiator» Install

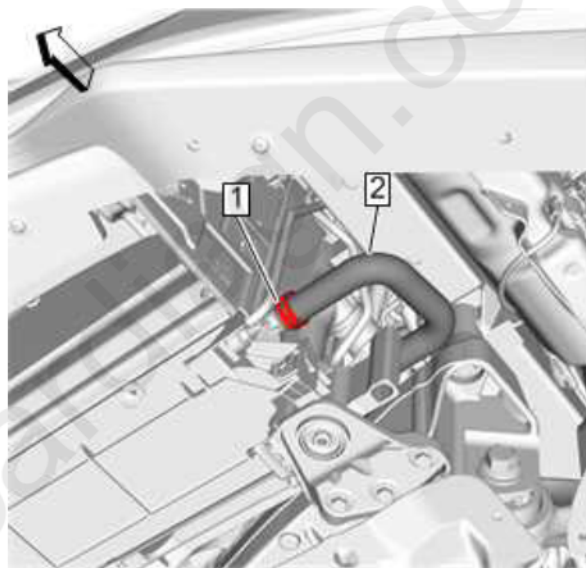


Fig. 67: Charge Air Cooler Coolant Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Charge Air Cooler Coolant Hose Clamp (1) @ Charge Air Cooler Radiator» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
7. Front Tire Front Air Deflector» Install - **Front Tire Front Air Deflector Replacement**
8. Fill the charge air cooling system to the proper level. Refer to **Charge Air Cooling System Draining and Filling (LGW)**
9. Check the charge air cooling system for leaks. Refer to **Charge Air Cooling System Leak Testing (LGW)**

CHARGE AIR COOLER COOLANT HOSE REPLACEMENT - INLET (LGW)

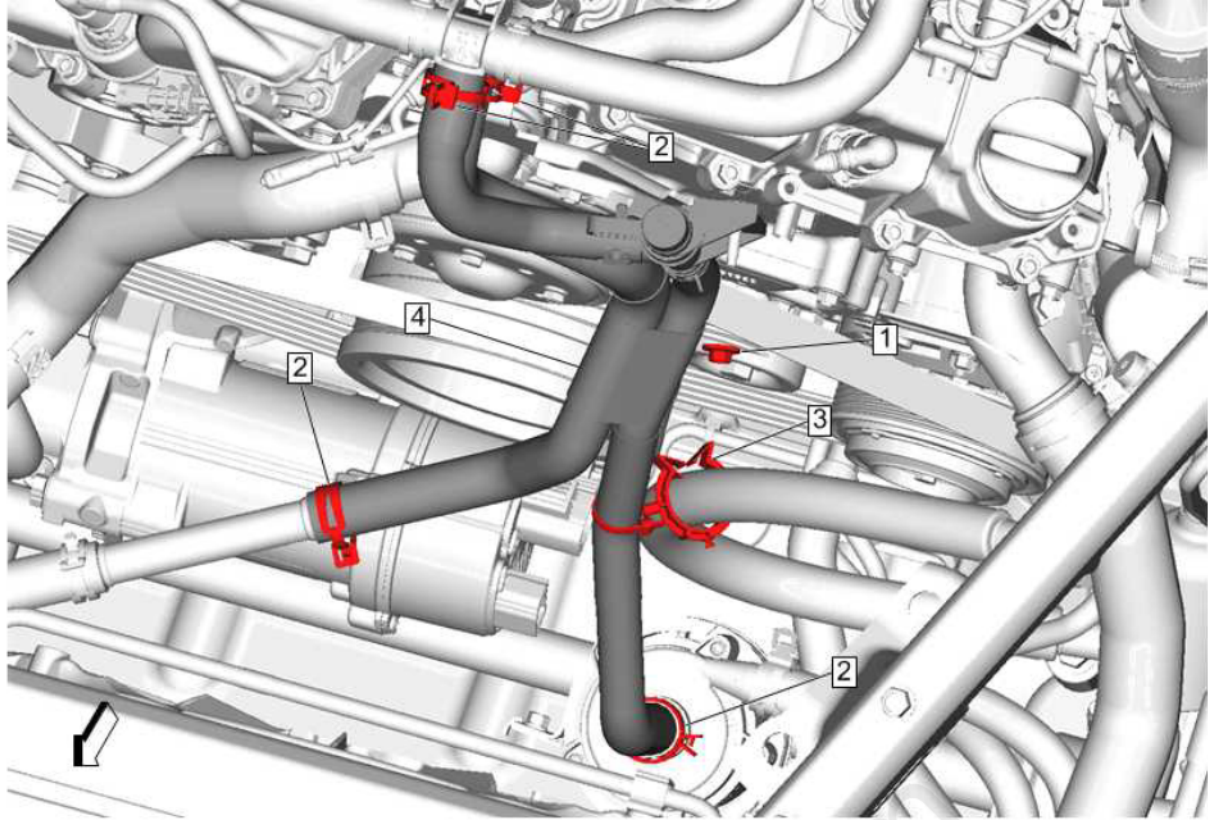


Fig. 68: Charge Air Cooler Coolant Hose
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Drain the charge air cooling system. Refer to Charge Air Cooling System Draining and Filling (LGW)	
1	Charge Air Cooler Inlet Hose Fitting Nut CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Charge Air Cooler Coolant Hose Clamp [4x] Procedure Hose Clamp Replacement Guidelines - Spring Type
3	C-Clip Strap Assembly
4	Charge Air Cooler Coolant Hose

RADIATOR SURGE TANK BRACKET REPLACEMENT (LGW LTG WITHOUT HP9)

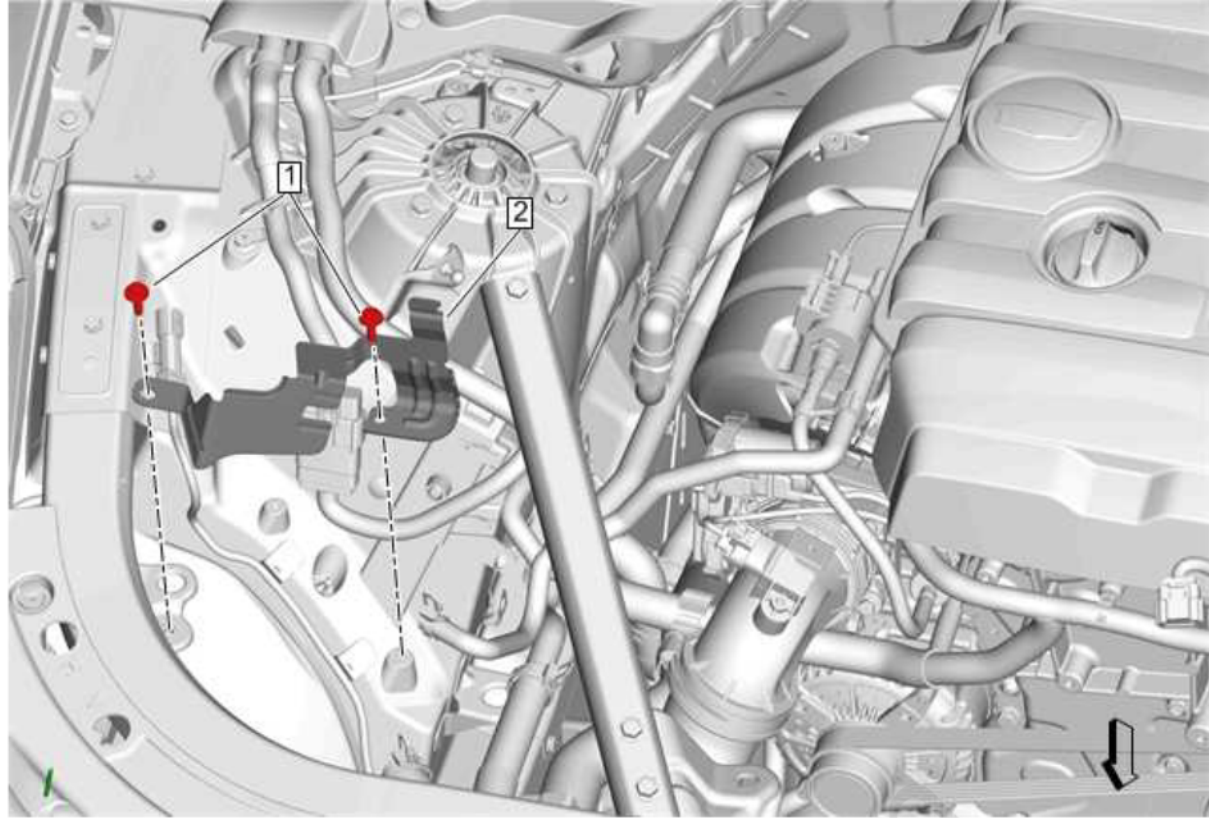


Fig. 69: Radiator Surge Tank Bracket (LGW LTG without HP9)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Radiator Surge Tank Replacement (LGW LTG without HP9)</u>	
1	Radiator Surge Tank Bolt [2x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Radiator Surge Tank Bracket Procedure 1. Fill the cooling system to the proper level. Refer to <u>Cooling System Draining and Filling (Static without HP9)</u> and/or <u>Cooling System Draining and Filling (GE 47716 without HP9)</u> 2. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK BRACKET REPLACEMENT (LTG WITH HP9)

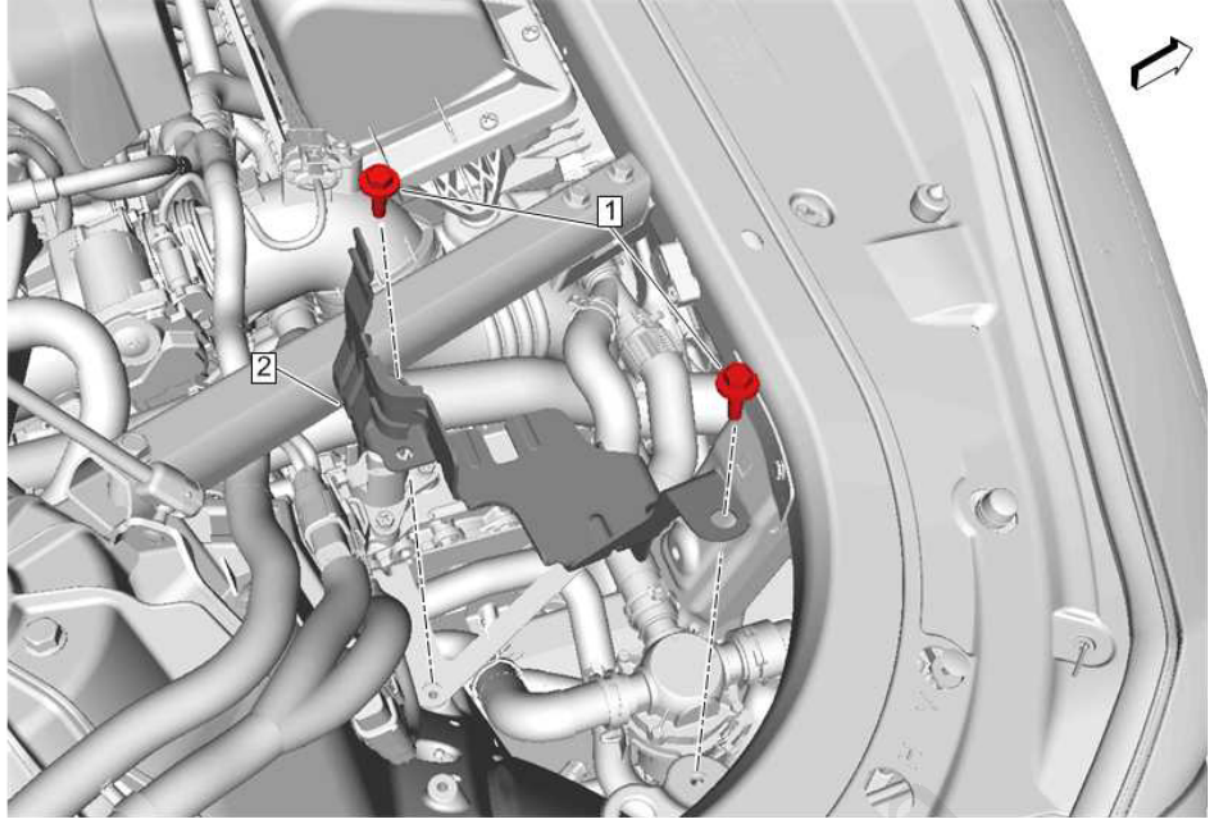


Fig. 70: Radiator Surge Tank Bracket (LTG with HP9)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: • Identify how to disable high voltage. • Identify how to test for the presence of high voltage. • Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. • Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. • Visually and functionally inspect the gloves before use. • Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. Preliminary Procedures 1. Disable the high voltage system. Refer to High Voltage Disabling 2. Radiator Surge Tank Replacement (LGW LTG without HP9)Radiator Surge Tank Replacement (LTG with HP9) 3. Heater Water Bypass Valve @ Radiator Surge Tank Bracket» Remove - Heater Water Bypass Valve Replacement (LTG with HP9)	
1	Radiator Surge Tank Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Radiator Surge Tank Bracket Procedure 1. Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static LTG with HP9) and/or Cooling System Draining and Filling (GE 47716 LTG with HP9) 2. Enable the high voltage system. Refer to High Voltage Enabling 3. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK INLET HOSE REPLACEMENT (LTG WITHOUT HP9)

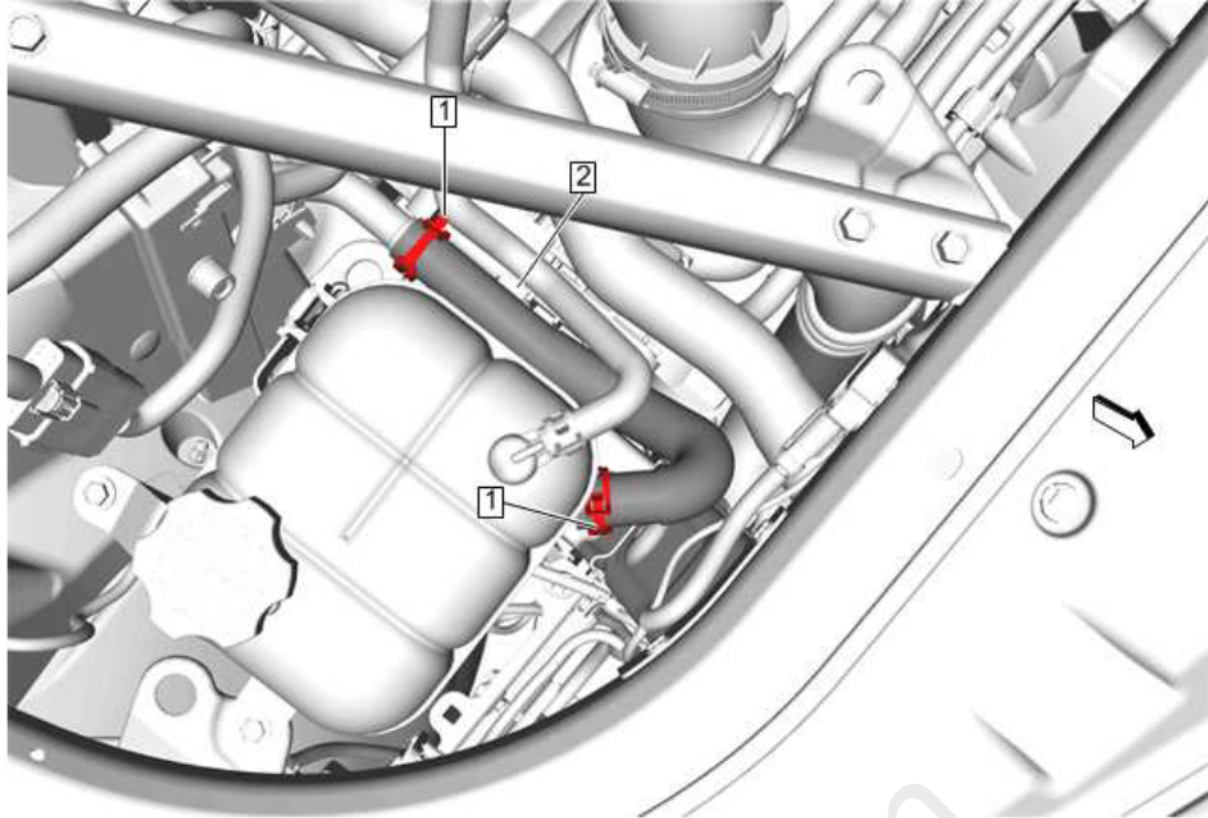


Fig. 71: Radiator Surge Tank Inlet Hose (LTG without HP9)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9)	
1	Radiator Surge Tank Inlet Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Radiator Surge Tank Inlet Hose Procedure 1. Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9) 2. Start the engine and check for coolant leaks.

RADIATOR SURGE TANK INLET HOSE REPLACEMENT (LGW)

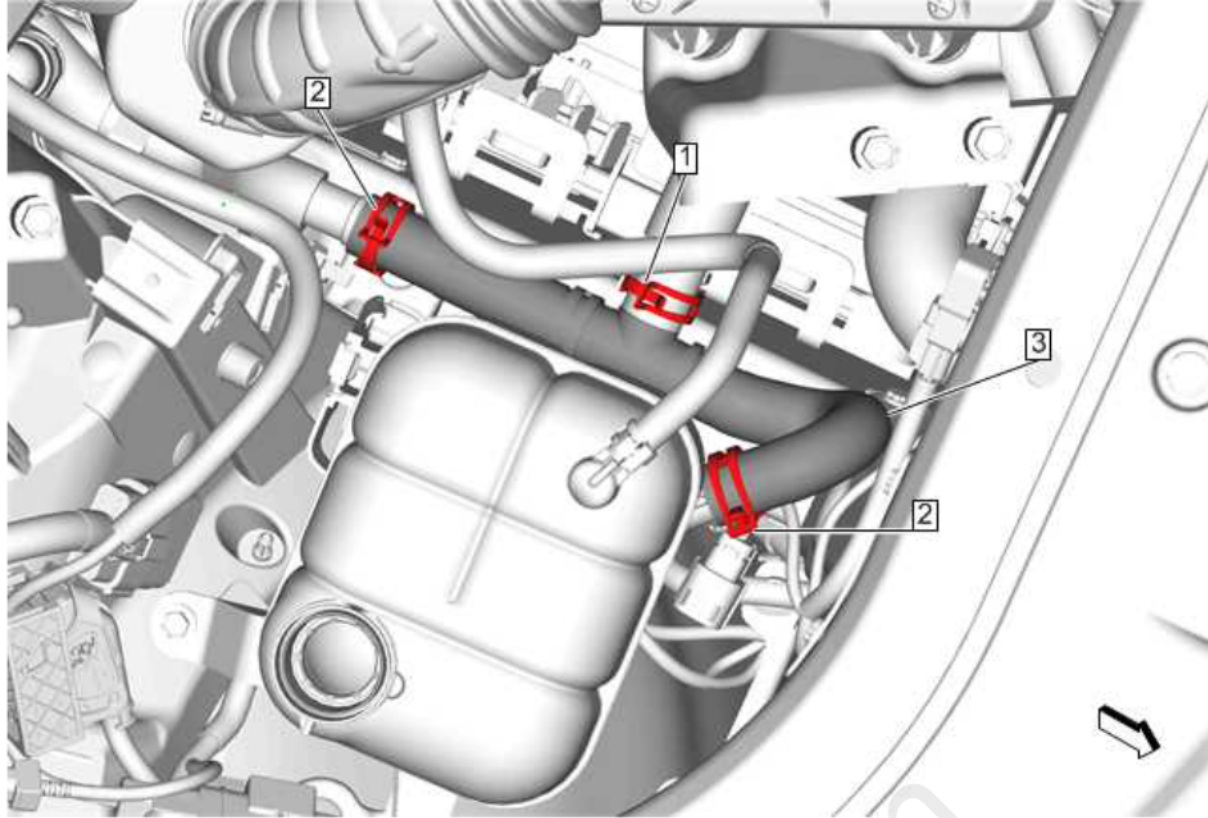


Fig. 72: Radiator Surge Tank Inlet Hose (LGW)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9)	
1	Auxiliary Heater Inlet Hose Clamp Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Radiator Surge Tank Inlet Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
3	Radiator Surge Tank Inlet Hose Procedure 1. Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9) 2. Start the engine and check for coolant leaks.

RADIATOR INLET PIPE REPLACEMENT (LTG)

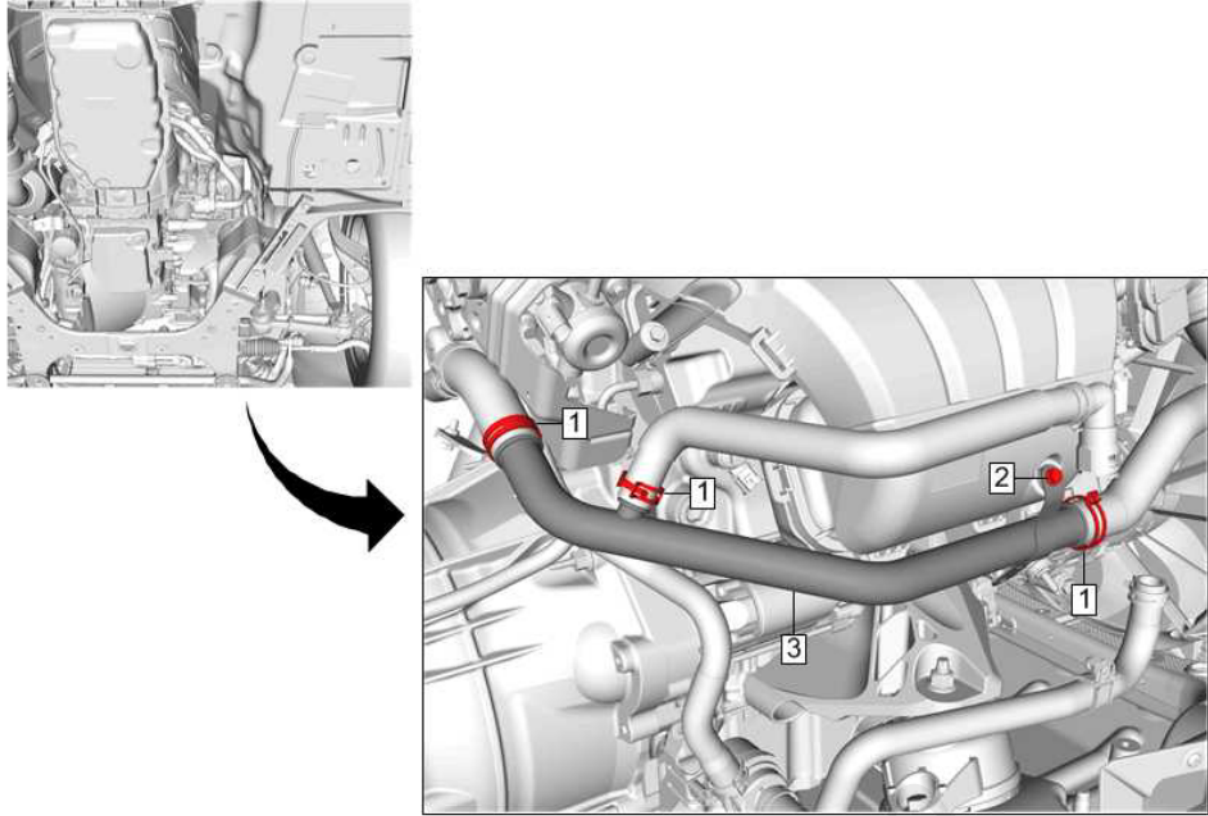


Fig. 73: Radiator Inlet Pipe (LTG)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static LTG with HP9) and/or Cooling System Draining and Filling (GE 47716 LTG with HP9) 2. Drivetrain and Front Suspension Cradle Plate Replacement	
1	Engine Coolant Hose Clamp [3x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Radiator Inlet Pipe Bolt CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
3	Radiator Inlet Pipe Procedure 1. Fill the cooling system. Refer to Cooling System Draining and Filling (Static LTG with HP9) and/or Cooling System Draining and Filling (GE 47716 LTG with HP9) 2. Check the cooling system for leaks.

RADIATOR INLET HOSE REPLACEMENT (LTG WITHOUT HP9)

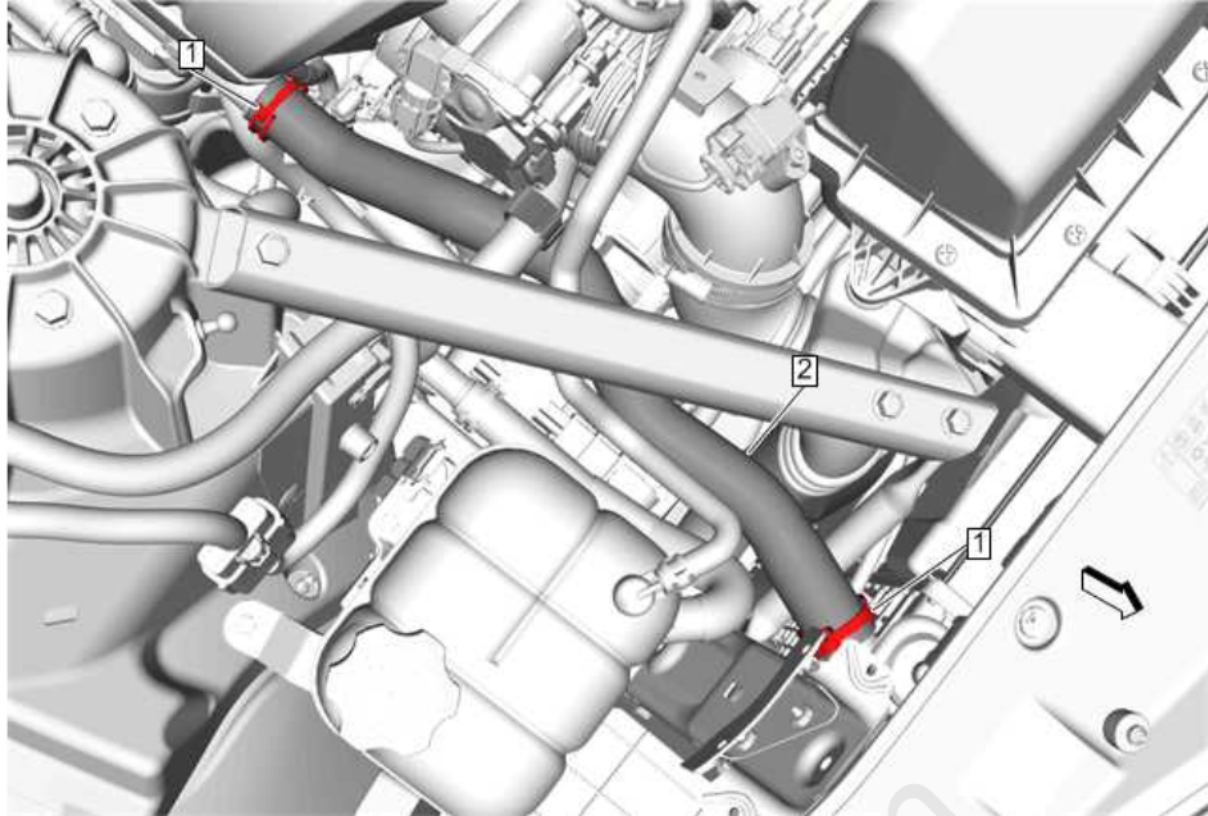


Fig. 74: Radiator Inlet Hose (LTG without HP9)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9)	
1	Radiator Inlet Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Radiator Inlet Hose Procedure 1. Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9) 2. Inspect for coolant leaks.

RADIATOR INLET HOSE REPLACEMENT (LGW)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. [Air Cleaner Assembly Replacement \(LGW\)](#) ã, ã» Remove
3. Auxiliary Heater Inlet Hose Clamp (1) @ Radiator Inlet Hose ã, ã» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

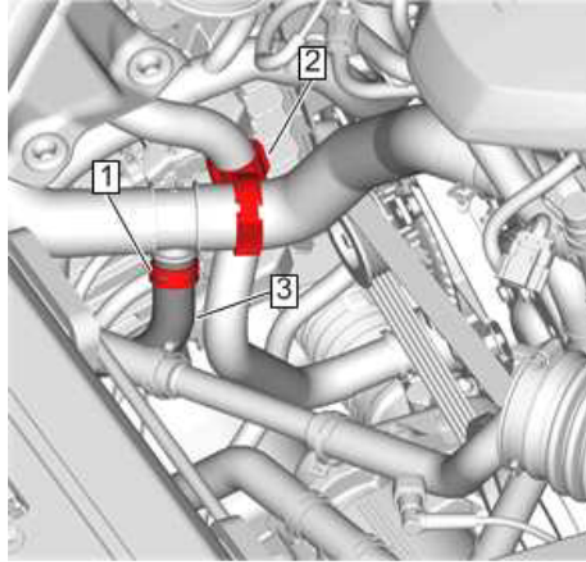


Fig. 75: Auxiliary Heater Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Auxiliary Heater Inlet Hose (3) @ Radiator Inlet Hose, » Remove
5. Disconnect the radiator inlet hose clip (2) from the heater water auxiliary pump inlet hose.
6. Radiator Inlet Hose Clamp (2) @ Water Outlet, » Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

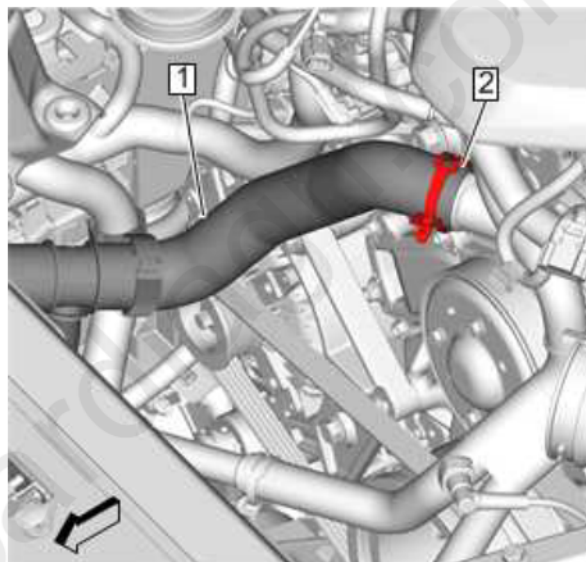


Fig. 76: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

7. Radiator Inlet Hose (1) @ Water Outlet, » Remove
8. Radiator Inlet Hose Clamp (1) @ Radiator, » Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

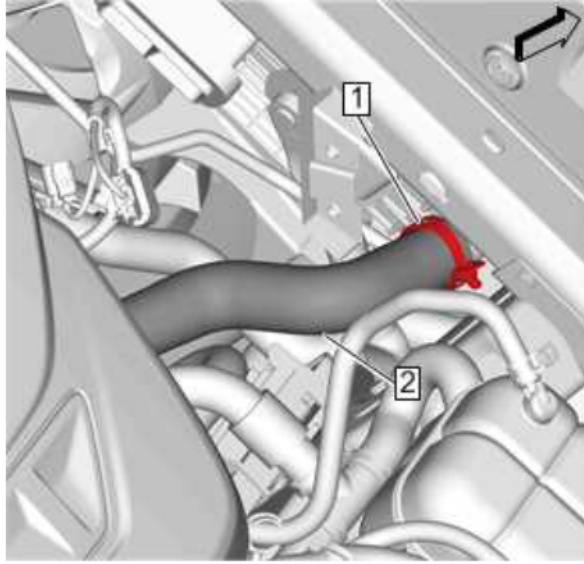


Fig. 77: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

9. Radiator Inlet Hose (2) @ Radiator» Remove

Installation Procedure

1. Radiator Inlet Hose (2) @ Radiator» Install

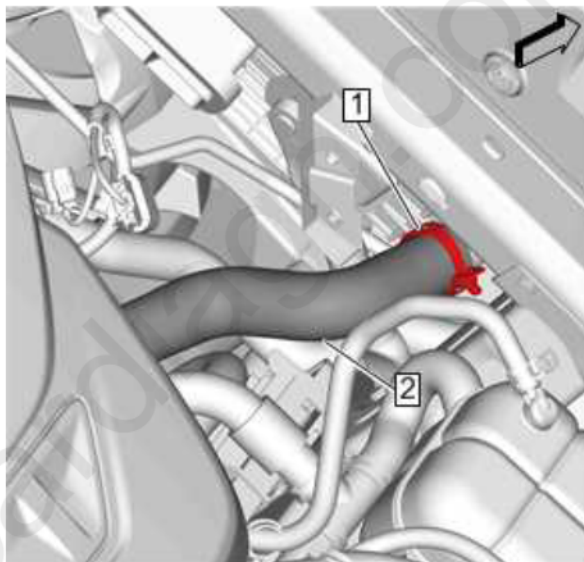


Fig. 78: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

2. Radiator Inlet Hose Clamp (1) @ Radiator» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Radiator Inlet Hose (1) @ Water Outlet» Install

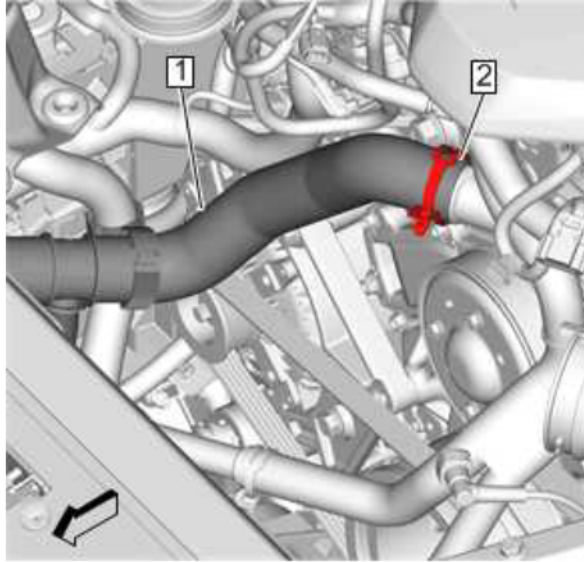


Fig. 79: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Radiator Inlet Hose Clamp (2) @ Water Outlet, & Engage - **Hose Clamp Replacement Guidelines - Spring Type**
5. Auxiliary Heater Inlet Hose (3) @ Radiator Inlet Hose, & Install

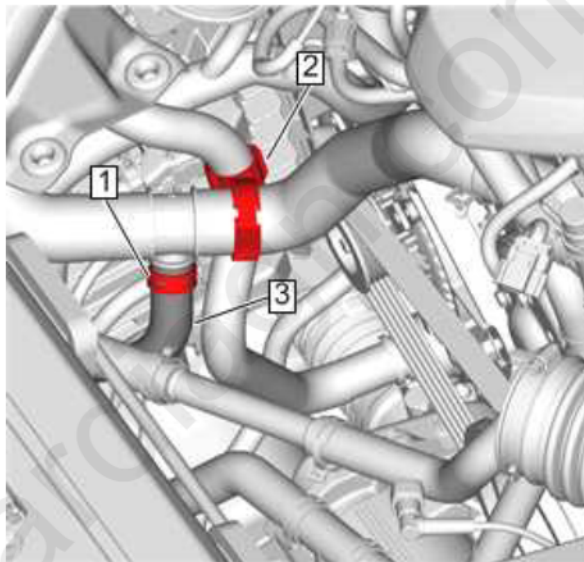


Fig. 80: Auxiliary Heater Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Auxiliary Heater Inlet Hose Clamp (1) @ Radiator Inlet Hose, & Engage - **Hose Clamp Replacement Guidelines - Spring Type**
7. Connect the radiator inlet hose clip (2) to the heater water auxiliary pump inlet hose.
8. **Air Cleaner Assembly Replacement (LGW)**, & Install
9. Fill the cooling system to the proper level. Refer to **Cooling System Draining and Filling (Static without HP9)** and/or **Cooling System Draining and Filling (GE 47716 without HP9)**.
10. Check the cooling system for leaks. Refer to **Cooling System Leak Testing**.

RADIATOR INLET HOSE REPLACEMENT (LGX)

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static without HP9)** and/or **Cooling System Draining and Filling (GE 47716 without HP9)**.
2. **Air Cleaner Assembly Replacement (LGX)**, & Remove
3. Radiator Inlet Hose Clamp (1) @ Water Outlet, & Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

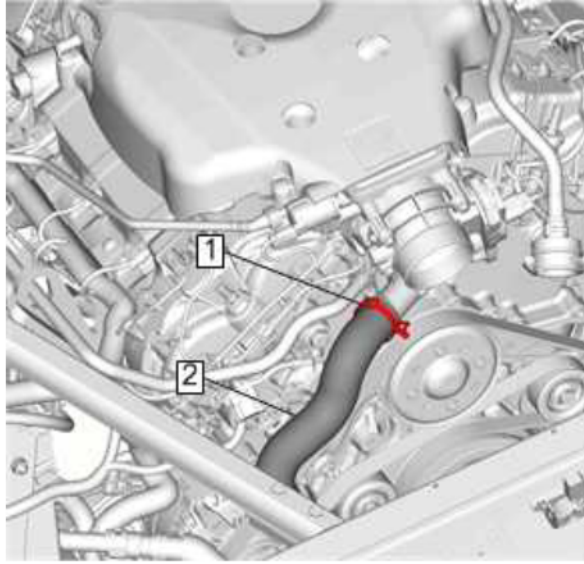


Fig. 81: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Radiator Inlet Hose (2) @ Water Outlet, &» Remove
5. Radiator Inlet Hose Clamp (1) @ Radiator, &» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

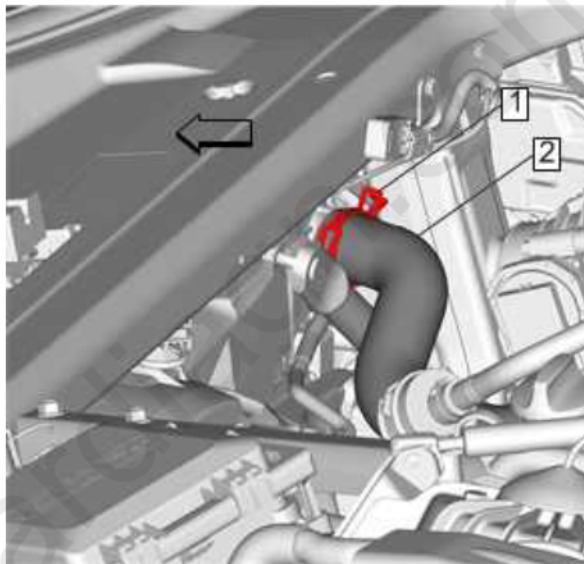


Fig. 82: Radiator Inlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Radiator Inlet Hose (2) @ Radiator, &» Remove

Installation Procedure

1. Radiator Inlet Hose (2) @ Radiator, &» Install

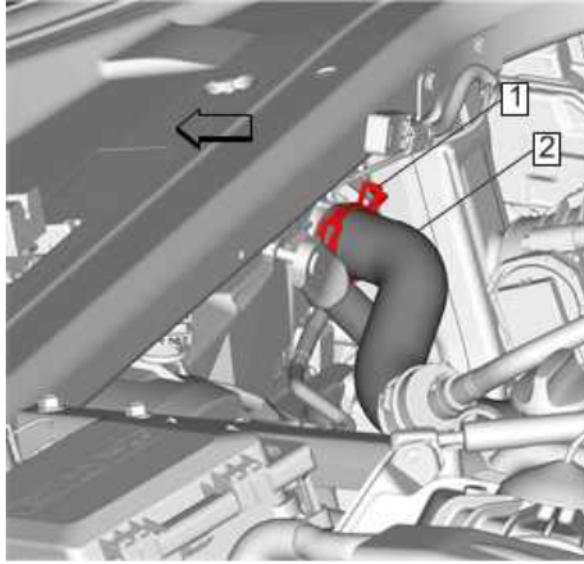


Fig. 83: Radiator Inlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

2. Radiator Inlet Hose Clamp (1) @ Radiator, » Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
3. Radiator Inlet Hose (2) @ Water Outlet, » Install

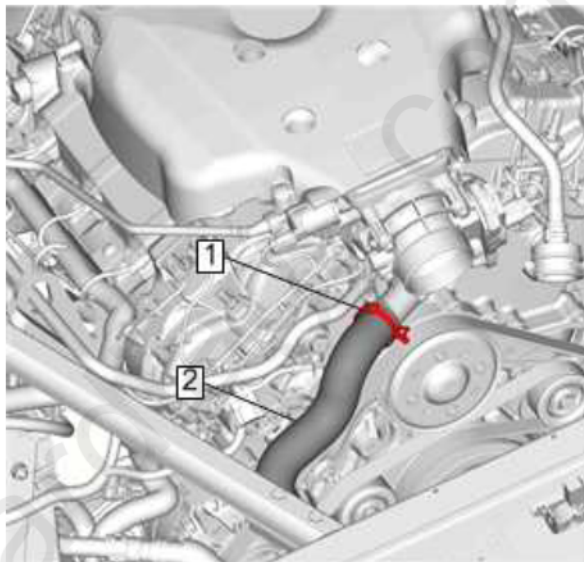


Fig. 84: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Radiator Inlet Hose Clamp (1) @ Water Outlet, » Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
5. [Air Cleaner Assembly Replacement \(LGX\)](#), » Install
6. Fill the cooling system to the proper level. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#).
7. Check the cooling system for leaks. Refer to [Cooling System Leak Testing](#).

RADIATOR INLET HOSE REPLACEMENT (LTG WITH HP9)

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.

- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static LTG with HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 LTG with HP9\)](#)
3. Radiator Inlet Hose Clip (1) @ Drive Motor Generator Control Module Coolant Pump Hose» Disengage

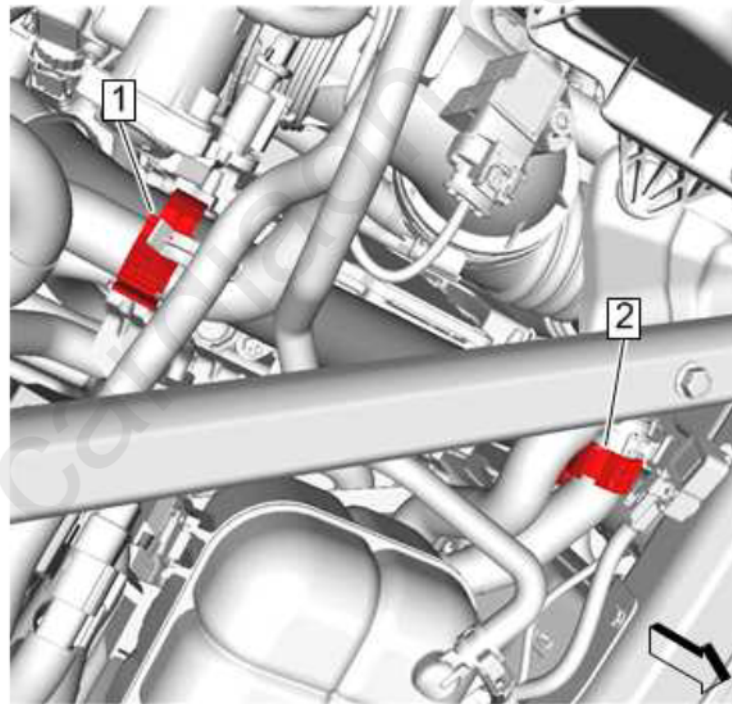


Fig. 85: Radiator Inlet Hose Clips

Courtesy of GENERAL MOTORS COMPANY

4. Radiator Inlet Hose Clip (2) @ Heater Water Auxiliary Pump Hose» Disengage
5. Radiator Inlet Hose Clamp (1)» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

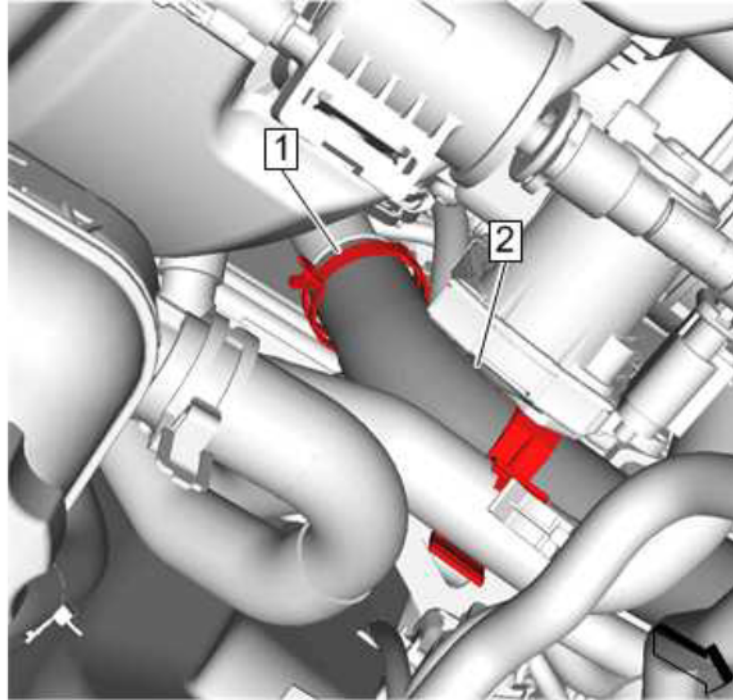


Fig. 86: Radiator Inlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Radiator Inlet Hose (2) @ Radiator Inlet Pipe» Remove
7. Radiator Inlet Hose Clamp (1)» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

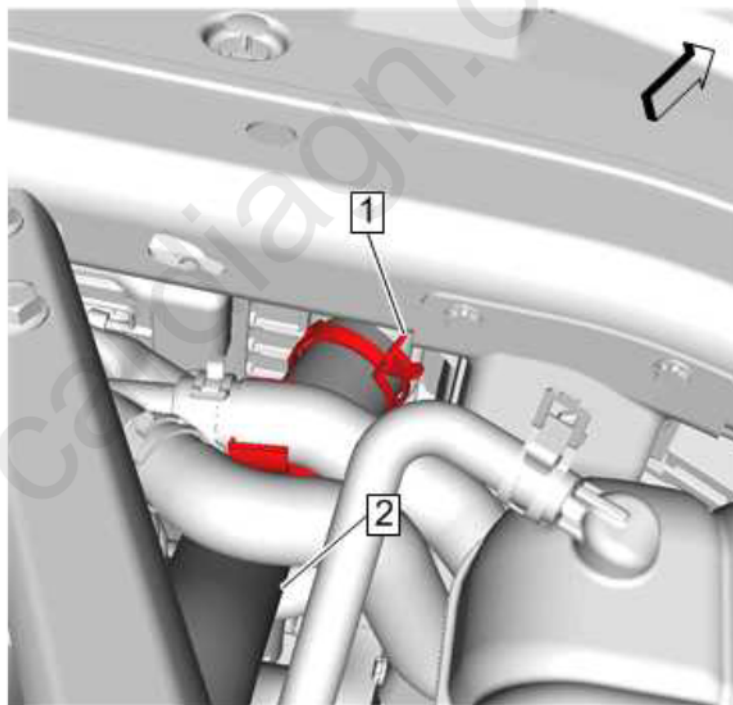


Fig. 87: Radiator Inlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

8. Radiator Inlet Hose (2) @ Radiator» Remove
9. Radiator Inlet Hose (2)» Remove
10. Transfer components as necessary.

Installation Procedure

1. Radiator Inlet Hose (2) @ Radiator» Install

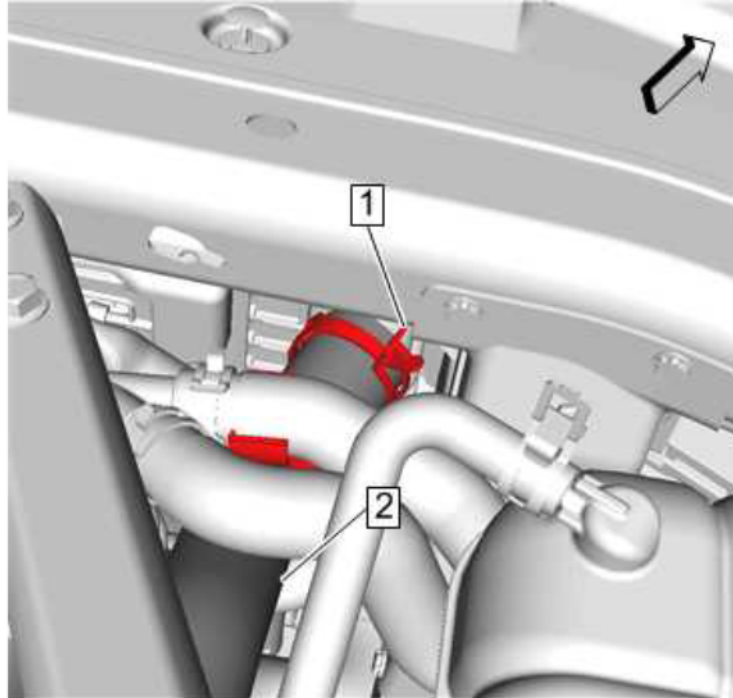


Fig. 88: Radiator Inlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

2. Radiator Inlet Hose Clamp (1) » Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
3. Radiator Inlet Hose (2) @ Radiator Inlet Pipe » Install

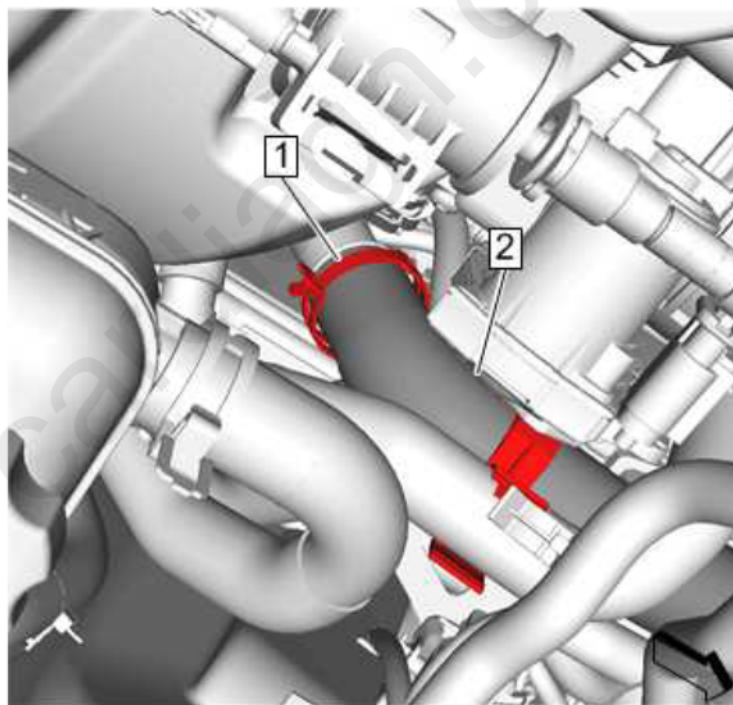


Fig. 89: Radiator Inlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Radiator Inlet Hose Clamp (1) » Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
5. Radiator Inlet Hose Clip (2) @ Heater Water Auxiliary Pump Hose » Engage

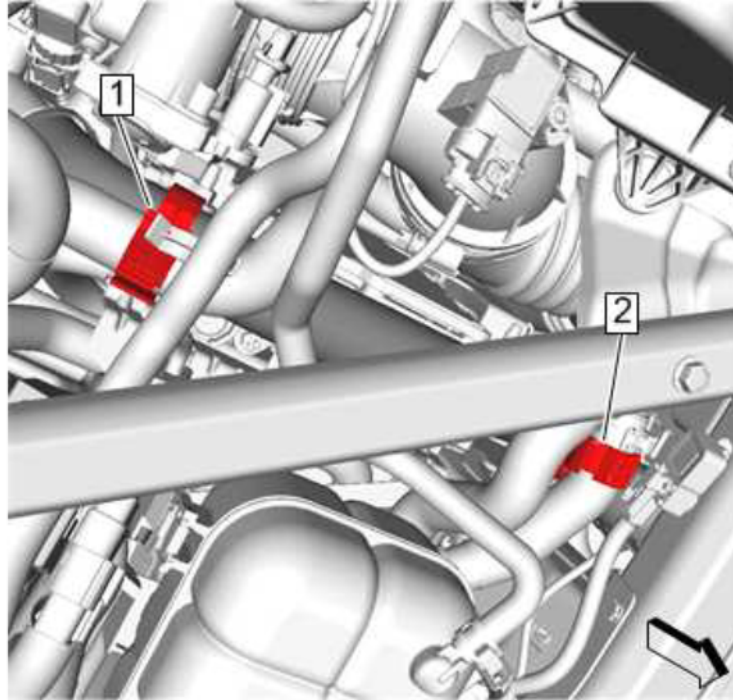


Fig. 90: Radiator Inlet Hose Clips

Courtesy of GENERAL MOTORS COMPANY

6. Radiator Inlet Hose Clip (1) @ Drive Motor Generator Control Module Coolant Pump Hose Engage
7. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static LTG with HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 LTG with HP9\)](#)
8. Enable the high voltage system. Refer to [High Voltage Enabling](#)
9. Start the engine and check for coolant leaks.

AUXILIARY RADIATOR INLET HOSE REPLACEMENT (LGW)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. Front Tire Front Air Deflector (2) Remove - [Front Tire Front Air Deflector Replacement](#)

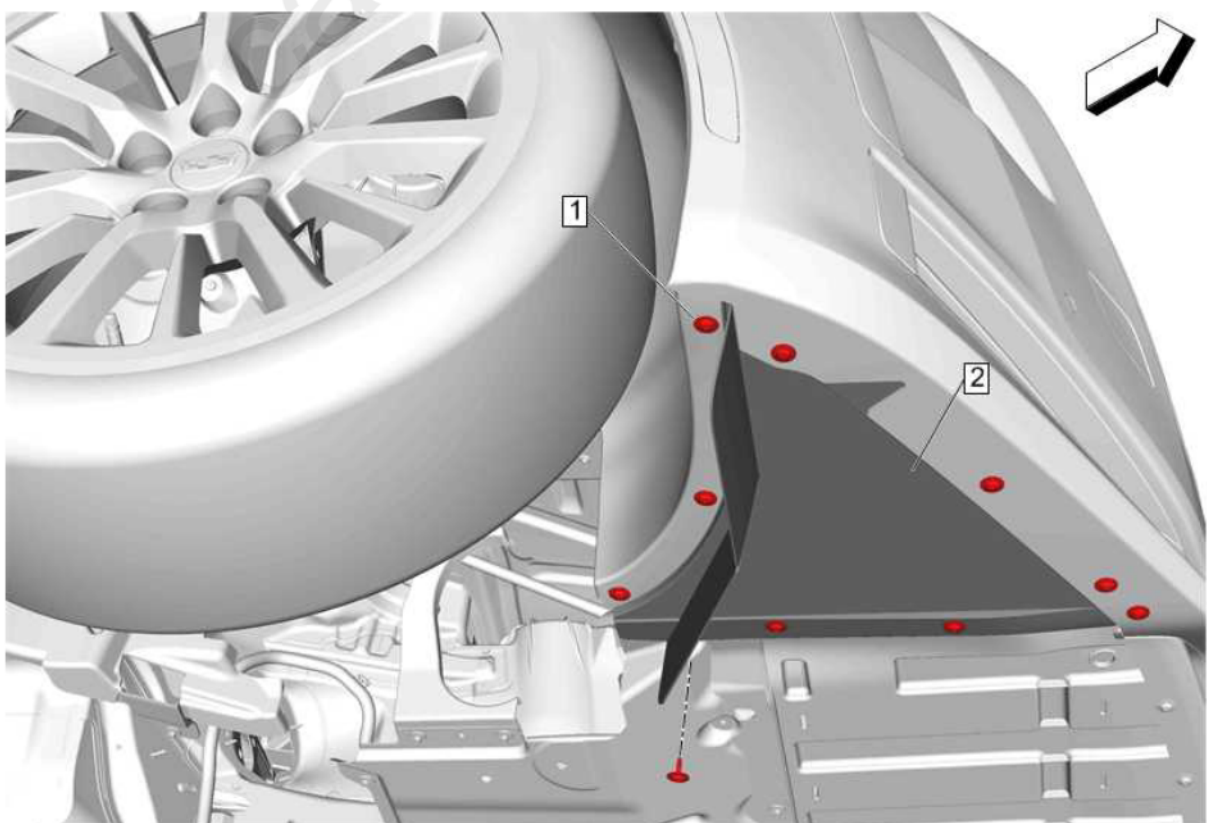


Fig. 91: Front Tire Front Air Deflector
Courtesy of GENERAL MOTORS COMPANY

3. Hose Clip (1) @ Auxiliary Radiator Inlet Hose» Remove

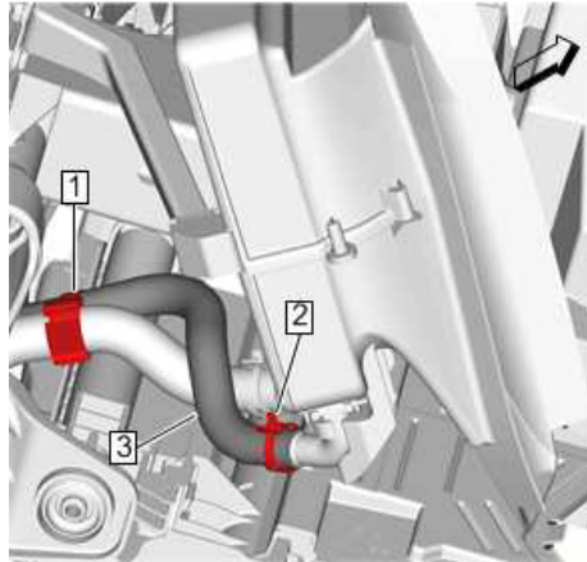


Fig. 92: Auxiliary Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

4. Auxiliary Radiator Inlet Hose Clamp (2) @ Auxiliary Radiator» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**
5. Auxiliary Radiator Inlet Hose (3) @ Auxiliary Radiator» Remove
6. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle**
7. Air Cleaner Assembly (1)» Remove - **Air Cleaner Assembly Replacement (LGW)**

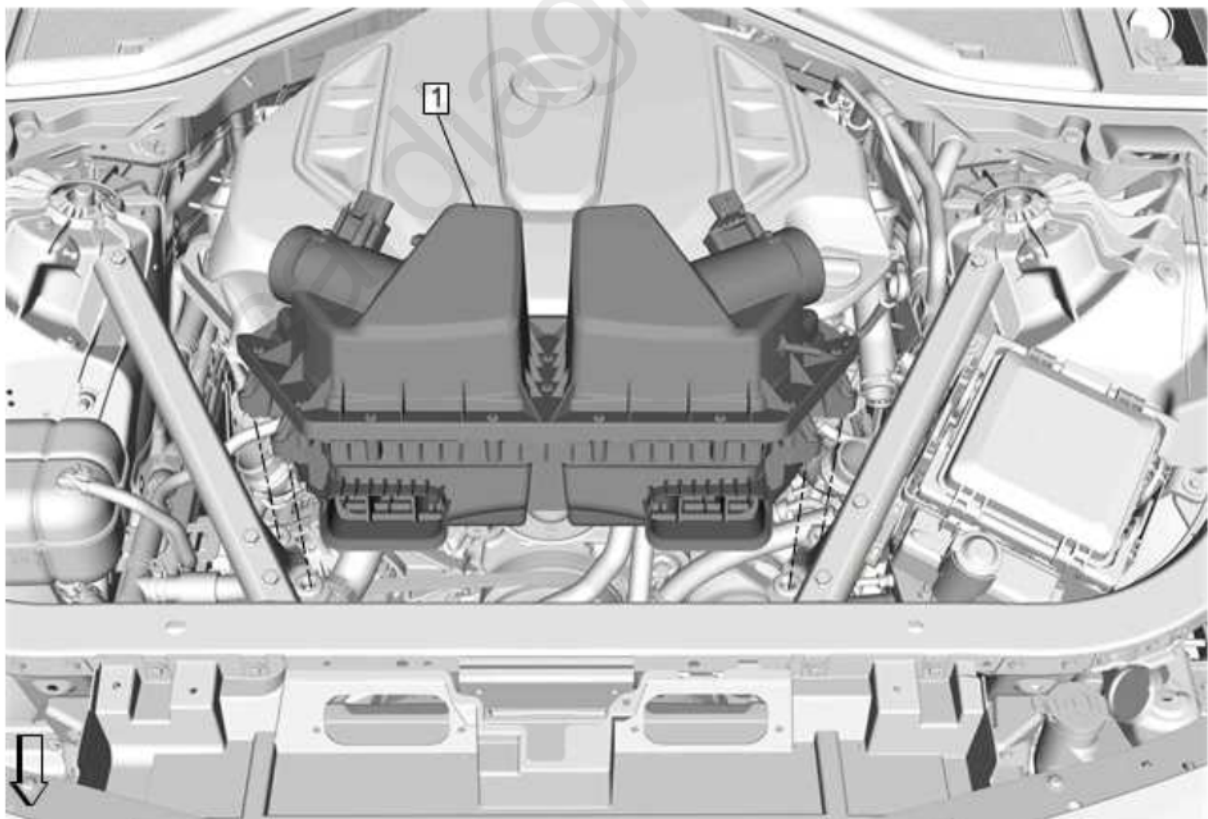


Fig. 93: Air Cleaner Assembly (LGW)
Courtesy of GENERAL MOTORS COMPANY

8. Auxiliary Radiator Inlet Hose Clamp (1) @ Radiator Inlet Hose» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

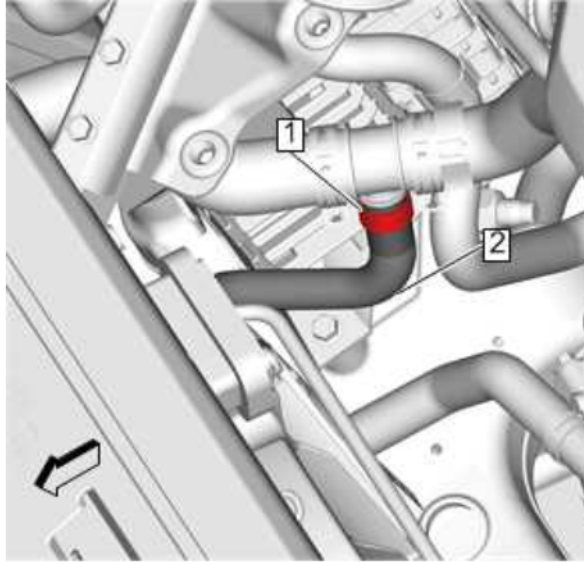


Fig. 94: Auxiliary Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

9. Auxiliary Radiator Inlet Hose (2) @ Radiator Inlet Hose» Remove

Installation Procedure

1. Auxiliary Radiator Inlet Hose (2) @ Radiator Inlet Hose» Install

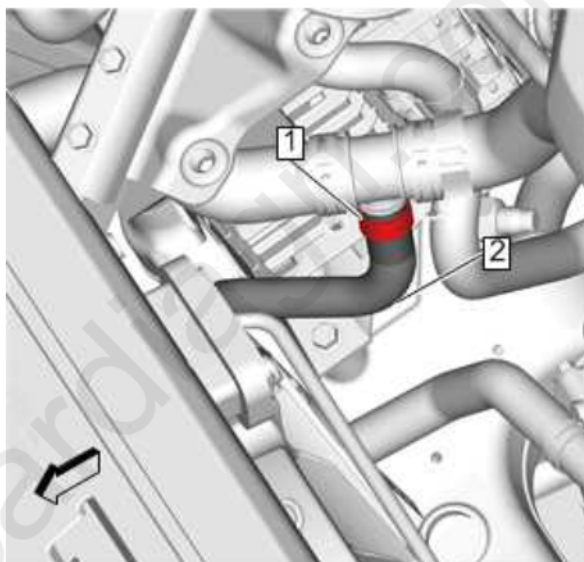


Fig. 95: Auxiliary Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

2. Auxiliary Radiator Inlet Hose Clamp (1) @ Radiator Inlet Hose» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Air Cleaner Assembly (1)» Install - **Air Cleaner Assembly Replacement (LGW)**

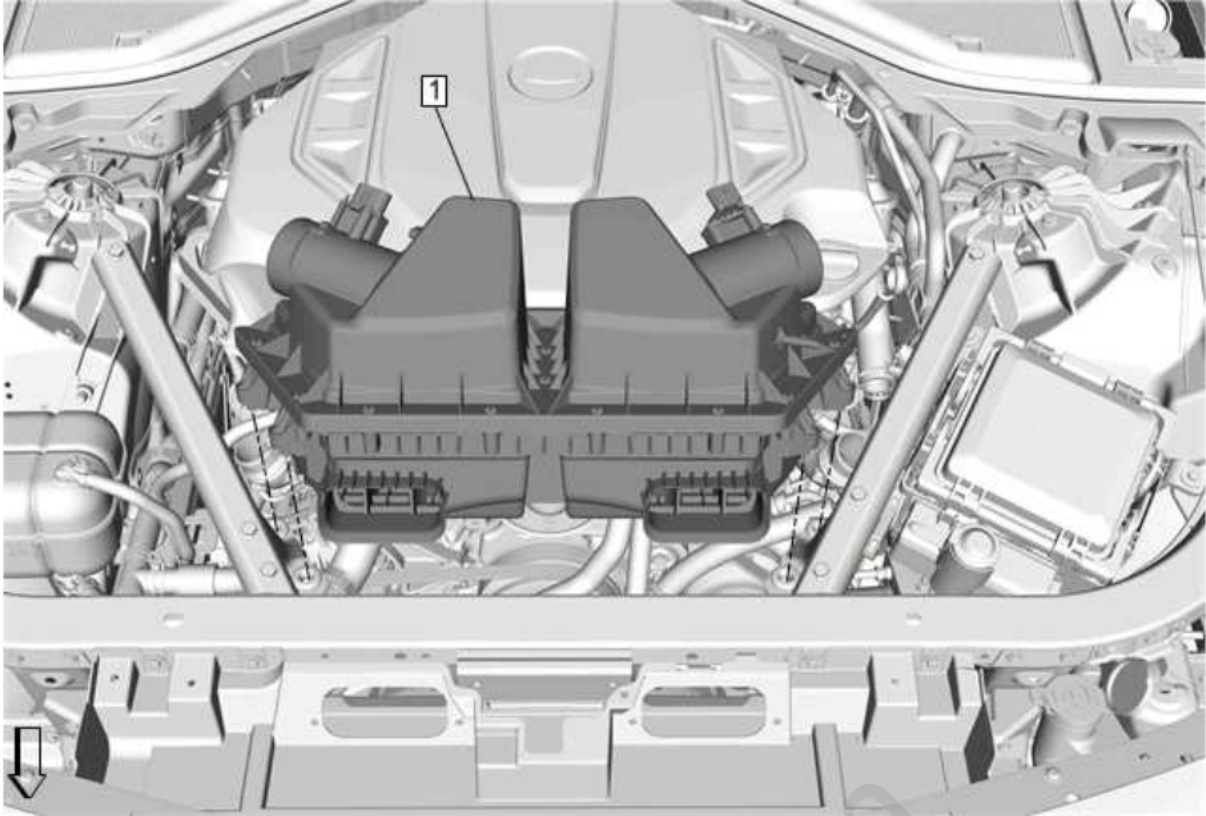


Fig. 96: Air Cleaner Assembly (LGW)

Courtesy of GENERAL MOTORS COMPANY

4. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
5. Auxiliary Radiator Inlet Hose (3) @ Auxiliary Radiator» Install

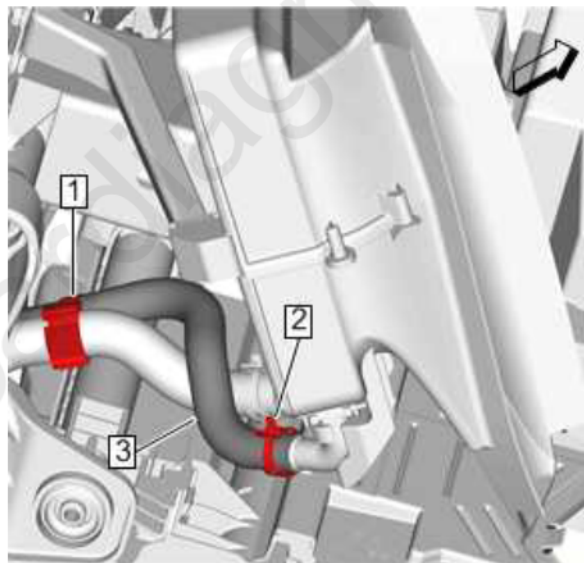


Fig. 97: Auxiliary Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Auxiliary Radiator Inlet Hose Clamp (2) @ Auxiliary Radiator» Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
7. Hose Clip (1) @ Auxiliary Radiator Inlet Hose» Install
8. Front Tire Front Air Deflector (2)» Install - [Front Tire Front Air Deflector Replacement](#)

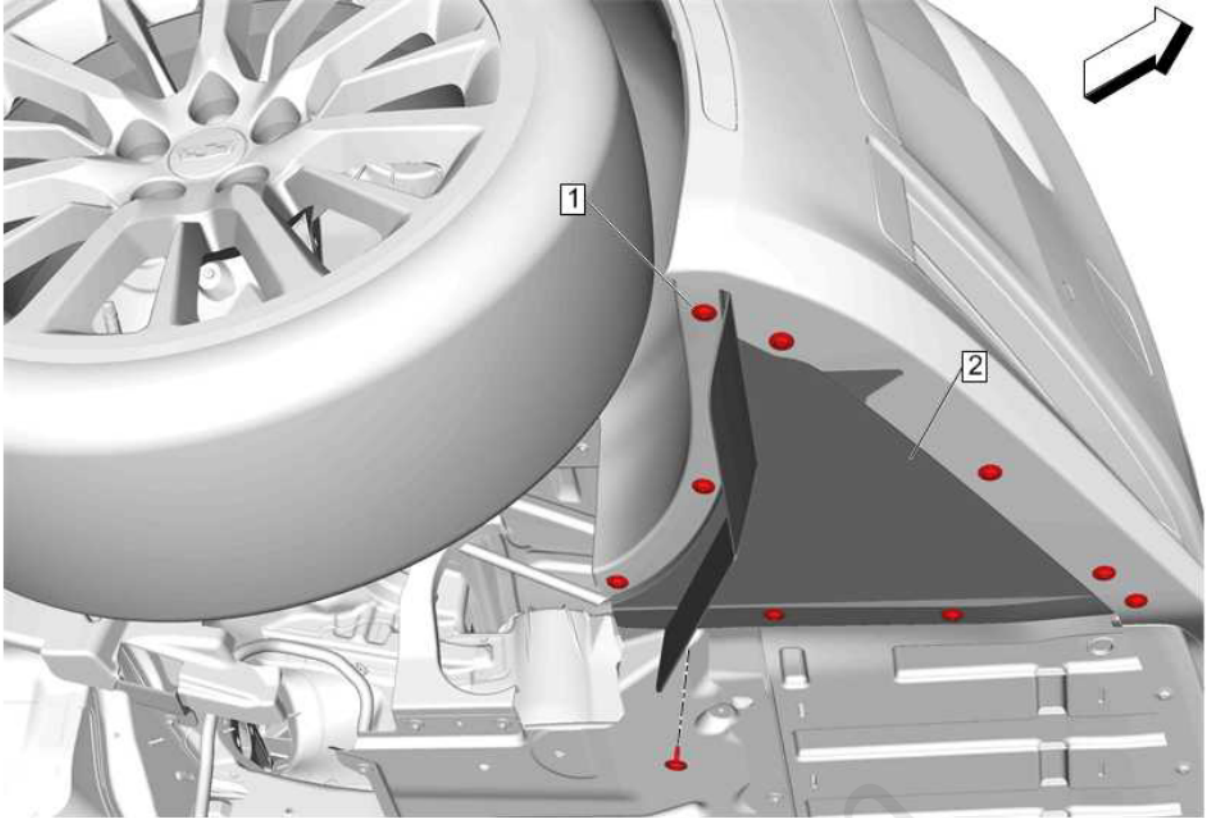


Fig. 98: Front Tire Front Air Deflector

Courtesy of GENERAL MOTORS COMPANY

9. Fill the cooling system to the proper level. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
10. Check the cooling system for leaks. Refer to [Cooling System Leak Testing](#).

RADIATOR OUTLET HOSE REPLACEMENT (LTG WITHOUT HP9)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. [Air Cleaner Outlet Duct Replacement](#) ã, ã» Remove
3. Hose Clamp (1) ã, ã» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

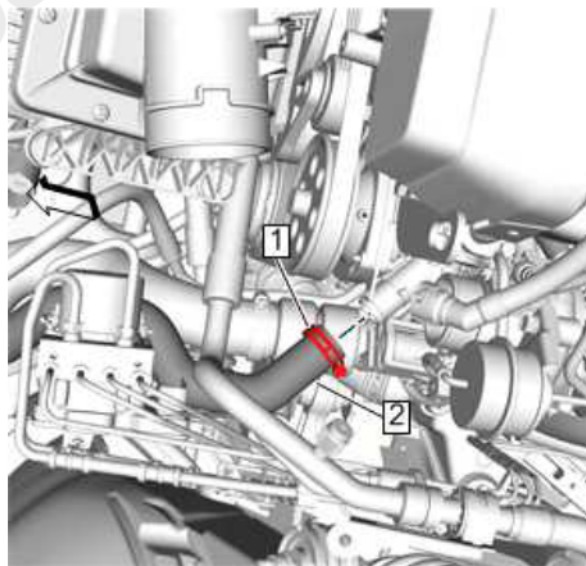


Fig. 99: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Radiator Outlet Hose (2) @ Engine Coolant Thermostat Housing ã, ã» Remove
5. Hose Clamp (1) ã, ã» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

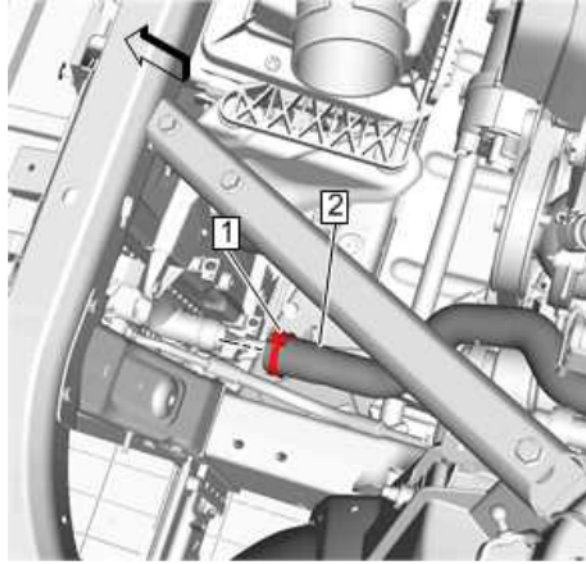


Fig. 100: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Radiator Outlet Hose (2) @ Radiator» Remove
7. Radiator Outlet Hose (2)» Remove

Installation Procedure

1. Radiator Outlet Hose (2)» Install

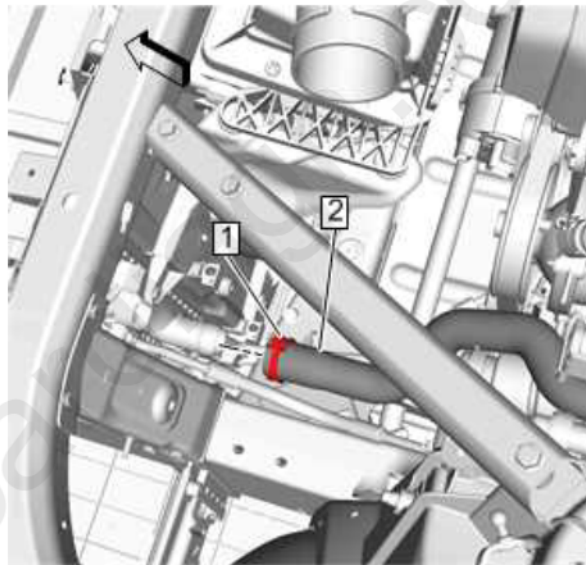


Fig. 101: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

2. Radiator Outlet Hose (2) @ Radiator» Install
3. Hose Clamp (1)» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
4. Radiator Outlet Hose (2) @ Engine Coolant Thermostat Housing» Install

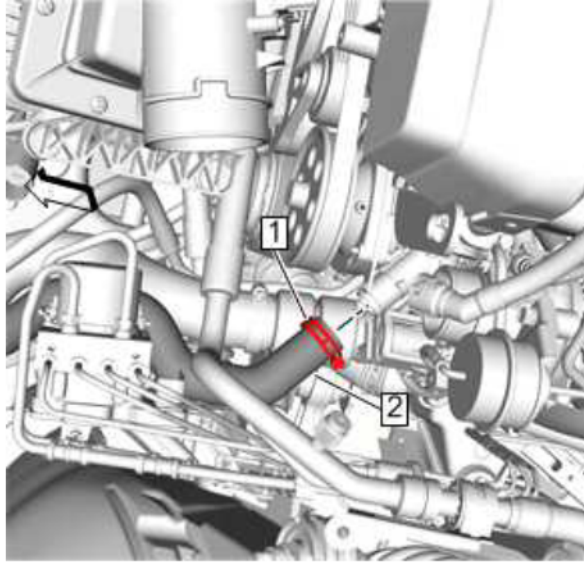


Fig. 102: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

5. Hose Clamp (1) » Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
6. [Air Cleaner Outlet Duct Replacement](#) Install
7. Fill the cooling system to the proper level. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#).
8. Check the cooling system for leaks. Refer to [Cooling System Leak Testing](#).

RADIATOR OUTLET HOSE REPLACEMENT (LGW)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#).
2. Lower the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. [Air Cleaner Assembly Replacement \(LGW\)](#) » Remove
4. Auxiliary Radiator Outlet Hose Clamp (1) @ Radiator Outlet Hose » Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

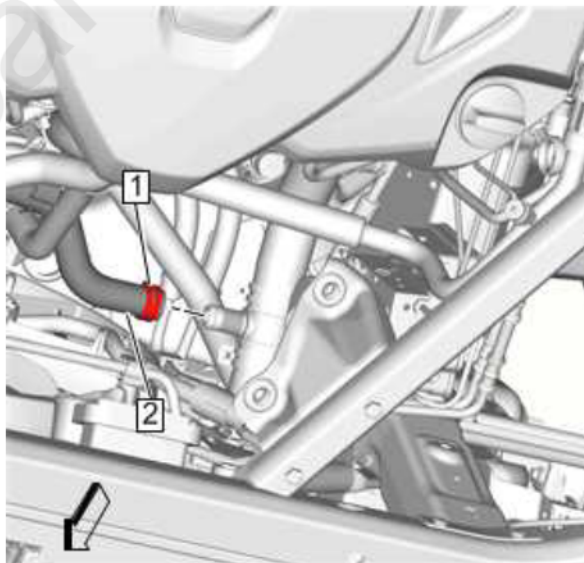


Fig. 103: Auxiliary Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

5. Auxiliary Radiator Outlet Hose (2) @ Radiator Outlet Hose » Remove
6. Radiator Outlet Hose Clamp (1) @ Water Pump Inlet Pipe » Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

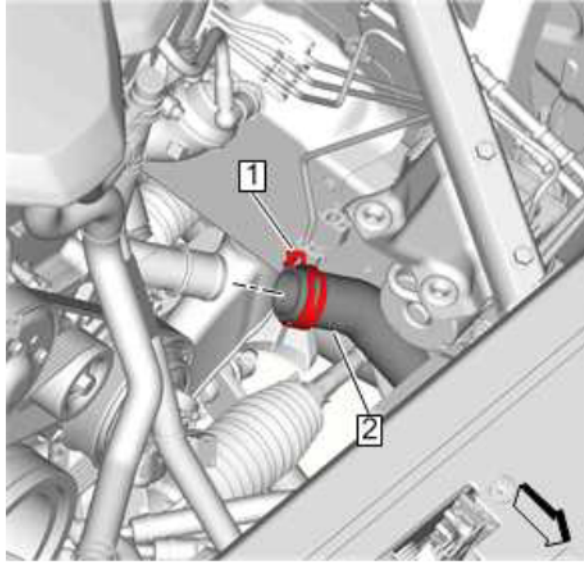


Fig. 104: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

7. Radiator Outlet Hose (2) @ Water Pump Inlet Pipe» Remove
8. Radiator Outlet Hose Clamp (1) @ Radiator» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

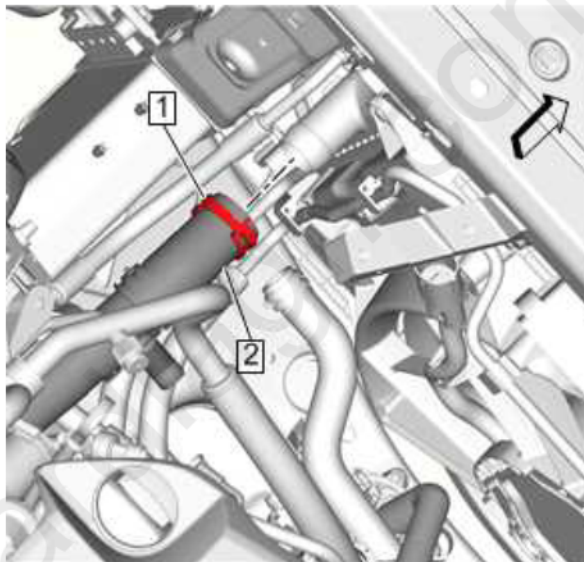


Fig. 105: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

9. Radiator Outlet Hose (2) @ Radiator» Remove

Installation Procedure

1. Radiator Outlet Hose (2) @ Radiator» Install

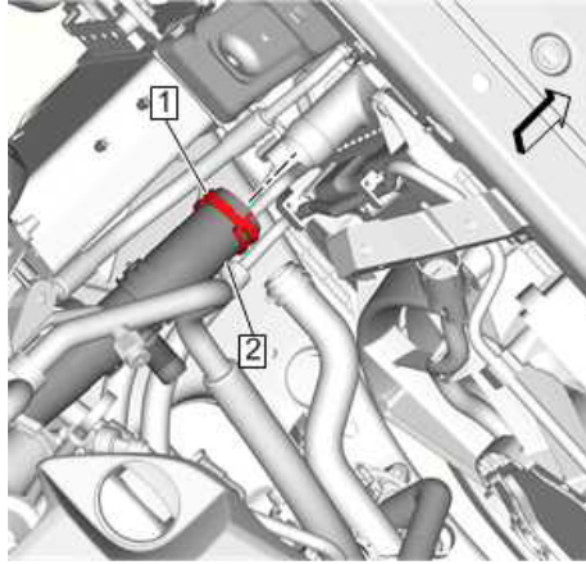


Fig. 106: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

2. Radiator Outlet Hose Clamp (1) @ Radiator Outlet Hose Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Radiator Outlet Hose (2) @ Water Pump Inlet Pipe Engage - **Hose Clamp Replacement Guidelines - Spring Type**

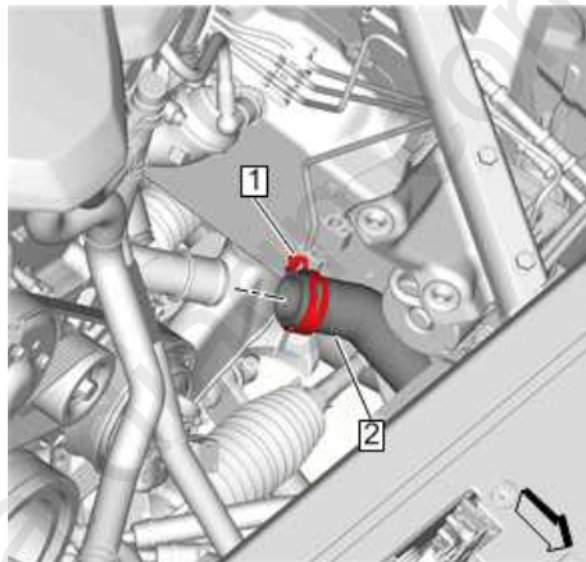


Fig. 107: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Radiator Outlet Hose Clamp (1) @ Water Pump Inlet Pipe Engage - **Hose Clamp Replacement Guidelines - Spring Type**
5. Auxiliary Radiator Outlet Hose (2) @ Radiator Outlet Hose Engage - **Hose Clamp Replacement Guidelines - Spring Type**

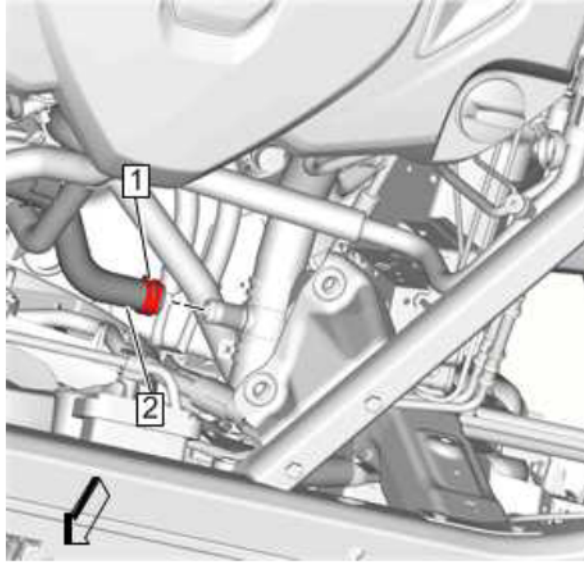


Fig. 108: Auxiliary Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Auxiliary Radiator Outlet Hose Clamp (1) @ Radiator Outlet Hose» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
7. **Air Cleaner Assembly Replacement (LGW)** » Install
8. Fill the cooling system to the proper level. Refer to **Cooling System Draining and Filling (Static without HP9)** and/or **Cooling System Draining and Filling (GE 47716 without HP9)**.
9. Check the cooling system for leaks. Refer to **Cooling System Leak Testing**.

RADIATOR OUTLET HOSE REPLACEMENT (LGX, WITH KC4)

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static without HP9)** and/or **Cooling System Draining and Filling (GE 47716 without HP9)**
2. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle**
3. **Air Cleaner Assembly Replacement (LGX)** » Remove
4. Engine Oil Cooler Coolant Inlet Hose Clamp (1) @ Radiator Outlet Hose» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

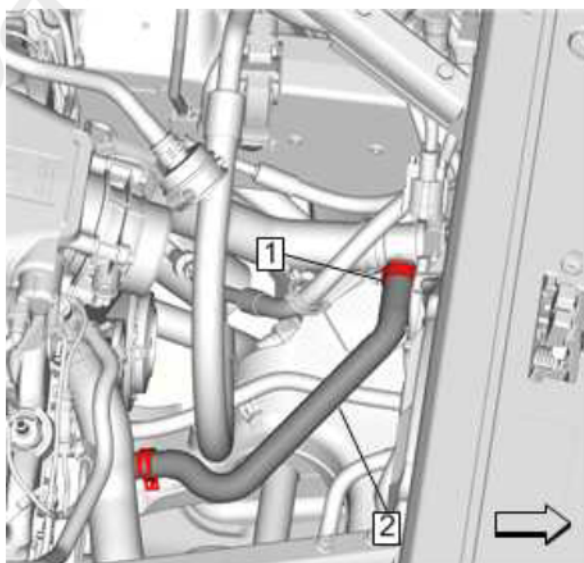


Fig. 109: Engine Oil Cooler Coolant Inlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

5. Engine Oil Cooler Coolant Inlet Hose (2) @ Radiator Outlet Hose» Remove
6. Radiator Outlet Hose Clamp (1) @ Water Pump Inlet Pipe» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

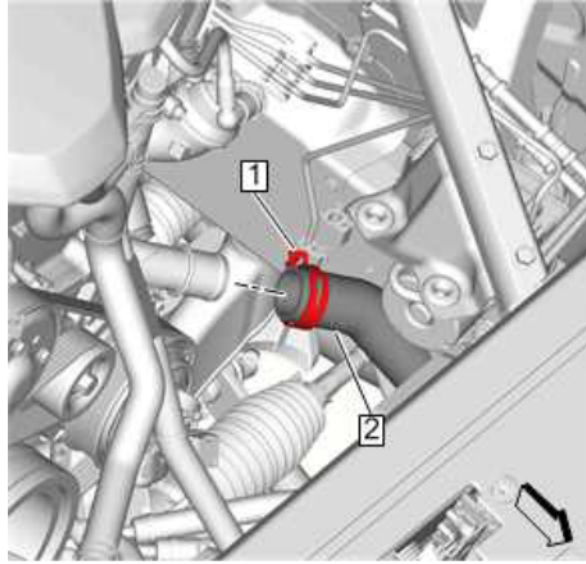


Fig. 110: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

7. Radiator Outlet Hose (2) @ Water Pump Inlet Pipe» Remove
8. Radiator Outlet Hose Clamp (1) @ Radiator» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

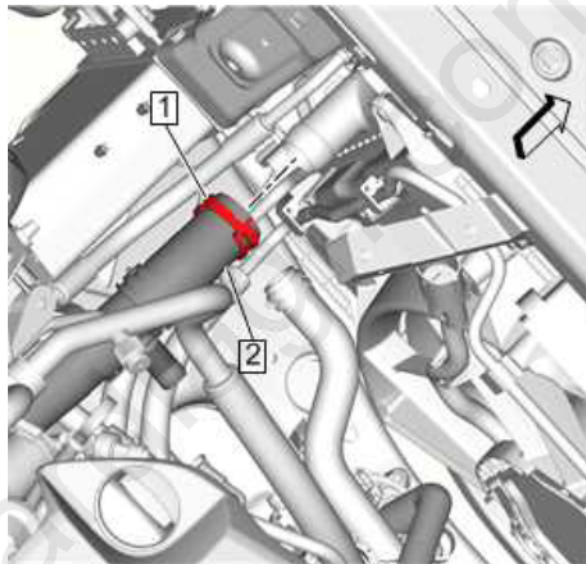


Fig. 111: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

9. Radiator Outlet Hose (2) @ Radiator» Remove

Installation Procedure

1. Radiator Outlet Hose (2) @ Radiator» Install

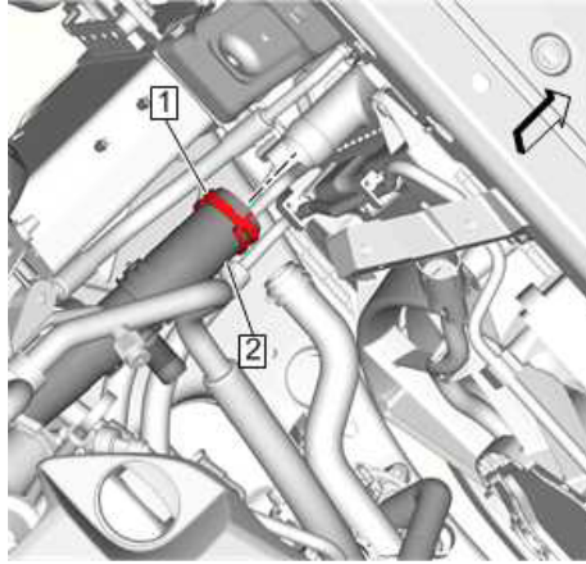


Fig. 112: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

2. Radiator Outlet Hose Clamp (1) @ Radiator Outlet Hose Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Radiator Outlet Hose (2) @ Water Pump Inlet Pipe Engage - Install

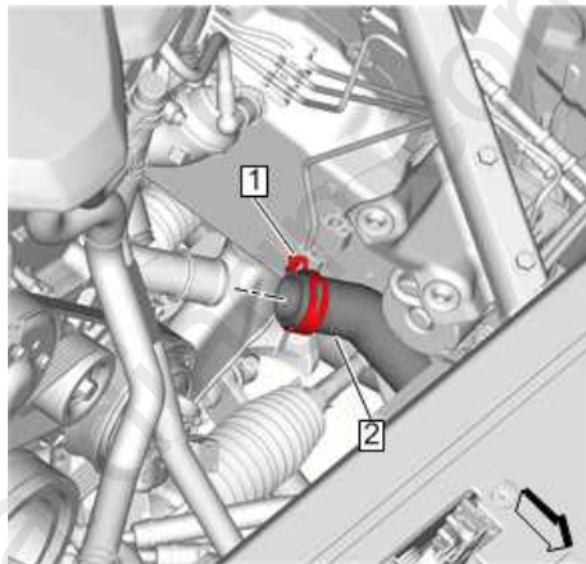


Fig. 113: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Radiator Outlet Hose Clamp (1) @ Water Pump Inlet Pipe Engage - **Hose Clamp Replacement Guidelines - Spring Type**
5. Engine Oil Cooler Coolant Inlet Hose (2) @ Radiator Outlet Hose Engage - Install

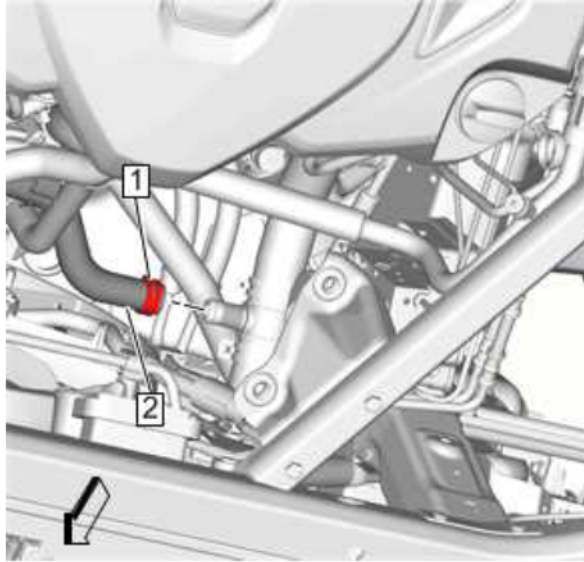


Fig. 114: Auxiliary Radiator Outlet Hose
 Courtesy of GENERAL MOTORS COMPANY

6. Engine Oil Cooler Coolant Inlet Hose Clamp (1) @ Radiator Outlet Hose» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
7. **Air Cleaner Assembly Replacement (LGX)** » Install
8. Fill the cooling system to the proper level. Refer to **Cooling System Draining and Filling (Static without HP9)** and/or **Cooling System Draining and Filling (GE 47716 without HP9)**.
9. Check the cooling system for leaks. Refer to **Cooling System Leak Testing**.

RADIATOR OUTLET HOSE REPLACEMENT (LGX WITHOUT KC4)

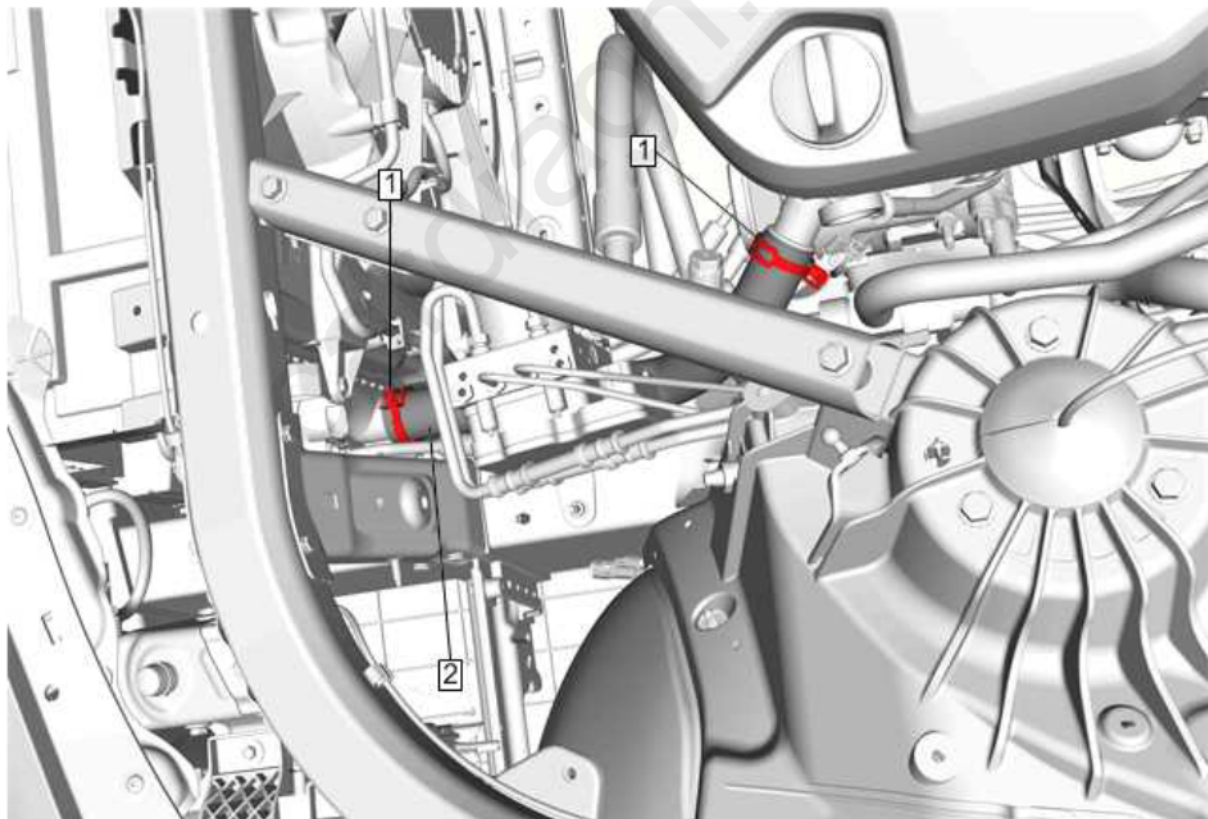


Fig. 115: Radiator Outlet Hose (LGX without KC4)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9) 2. Air Cleaner Outlet Duct Replacement (LGX)	
1	Radiator Outlet Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Radiator Outlet Hose Procedure 1. Fill the cooling system. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9) 2. Check the cooling system for leaks.

RADIATOR OUTLET HOSE REPLACEMENT (LTG WITH HP9)

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static LTG with HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 LTG with HP9\)](#)
3. Air Cleaner Outlet Duct (3)Ã,Â» Remove - [Air Cleaner Outlet Duct Replacement](#)

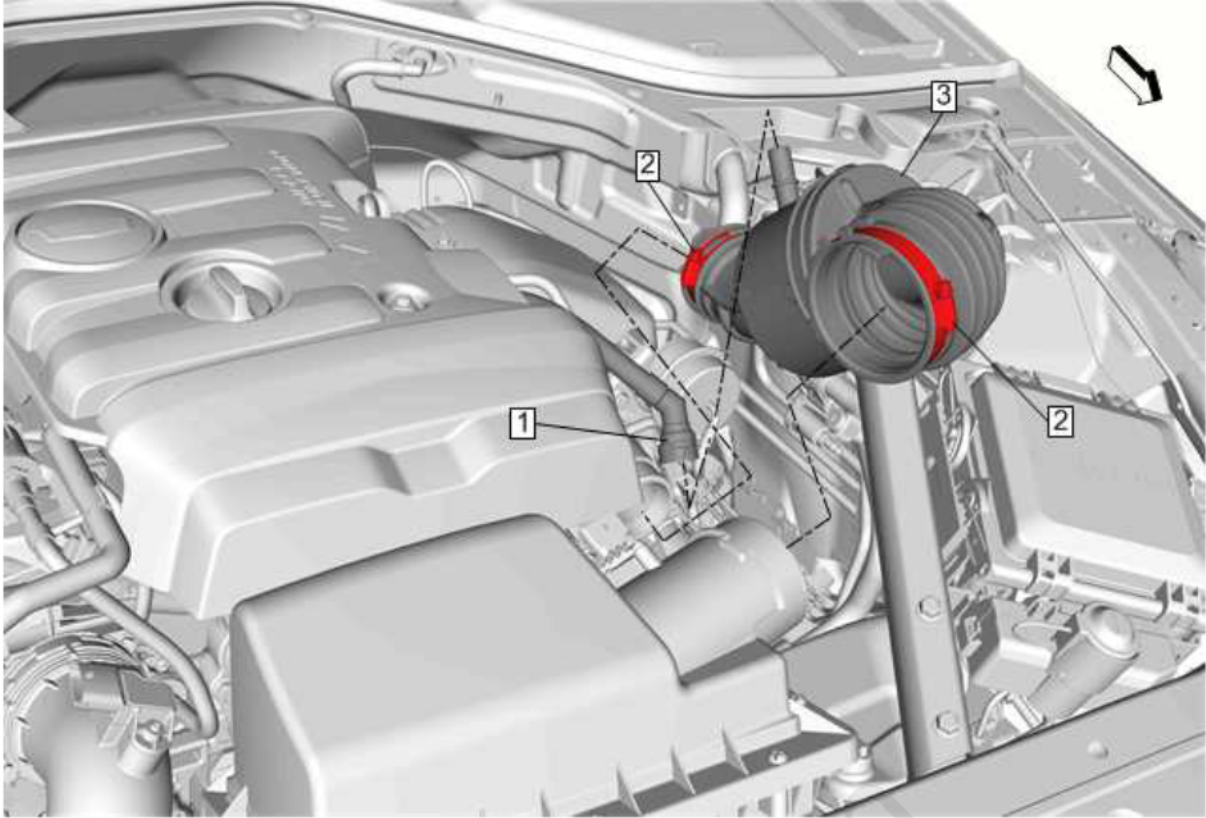


Fig. 116: Air Cleaner Outlet Duct

Courtesy of GENERAL MOTORS COMPANY

4. Radiator Outlet Hose Clamp (1) » Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

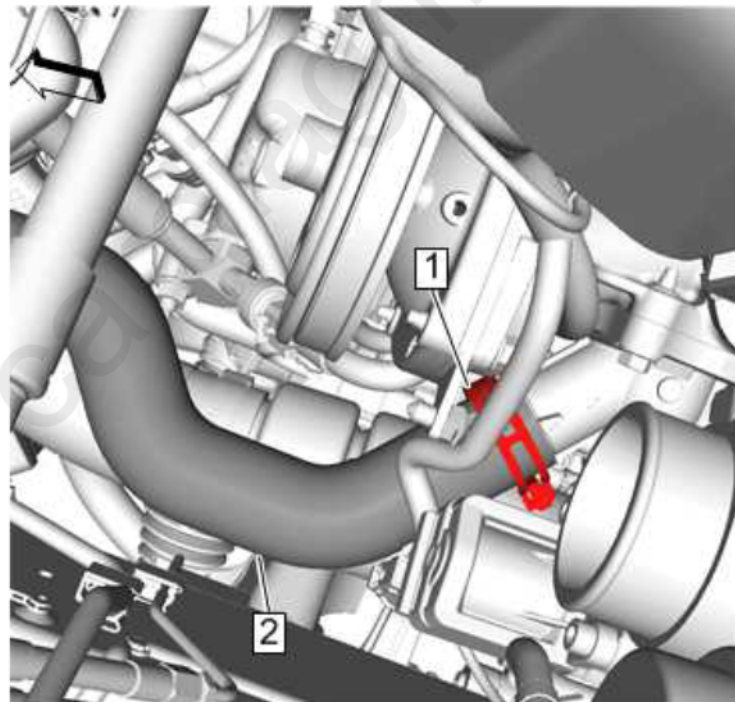


Fig. 117: Radiator Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

5. Radiator Outlet Hose (2) @ Engine Coolant Thermostat Housing » Remove
6. Charge Air Cooler Inlet Air Tube (2) @ Charge Air Cooler Radiator (3) » Remove - **Charge Air Cooler Inlet Air Tube Replacement**

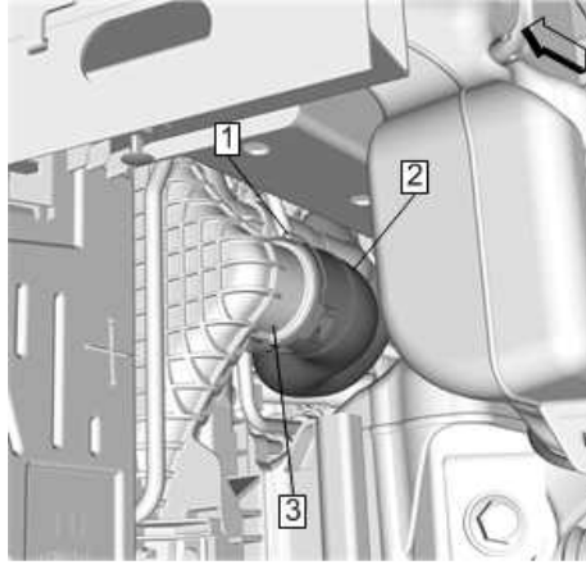


Fig. 118: Charge Air Cooler Inlet Air Tube And Charge Air Cooler Radiator
 Courtesy of GENERAL MOTORS COMPANY

7. Radiator Outlet Hose Clamp (1) » Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

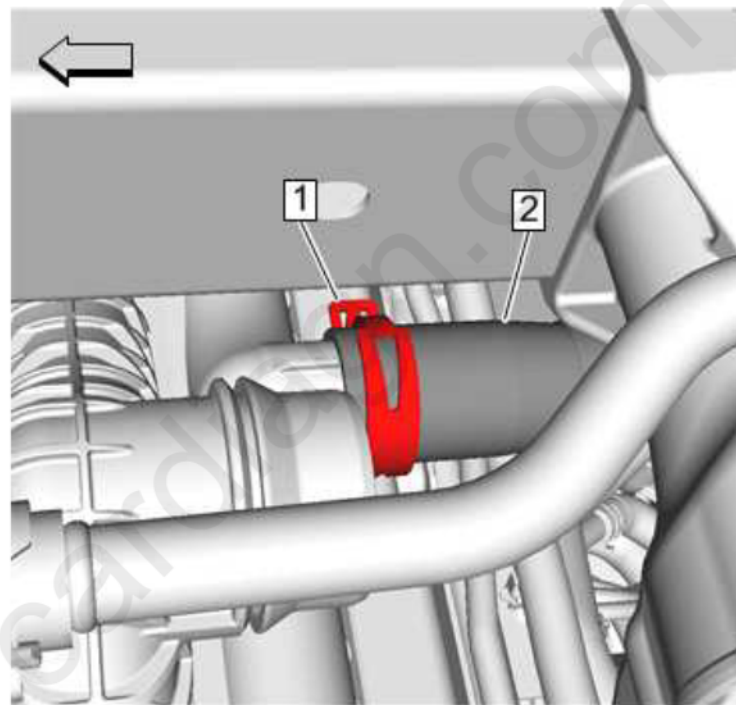


Fig. 119: Radiator Outlet Hose Clamp
 Courtesy of GENERAL MOTORS COMPANY

8. Radiator Outlet Hose (2) @ Radiator » Remove
9. Radiator Outlet Hose (2) » Remove

Installation Procedure

1. Radiator Outlet Hose (2) @ Radiator » Install

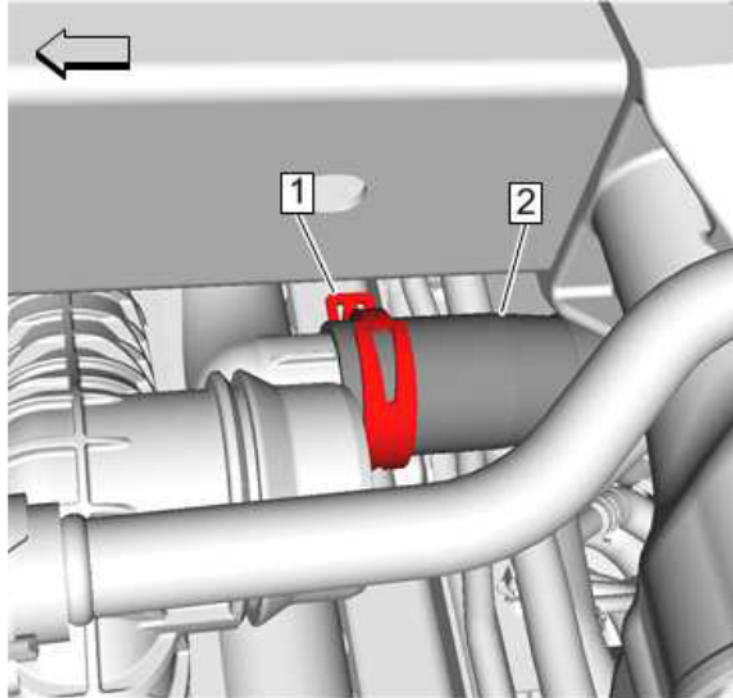


Fig. 120: Radiator Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

2. Radiator Outlet Hose Clamp (1) » Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Charge Air Cooler Inlet Air Tube (2) @ Charge Air Cooler Radiator (3) » Install - **Charge Air Cooler Inlet Air Tube Replacement**

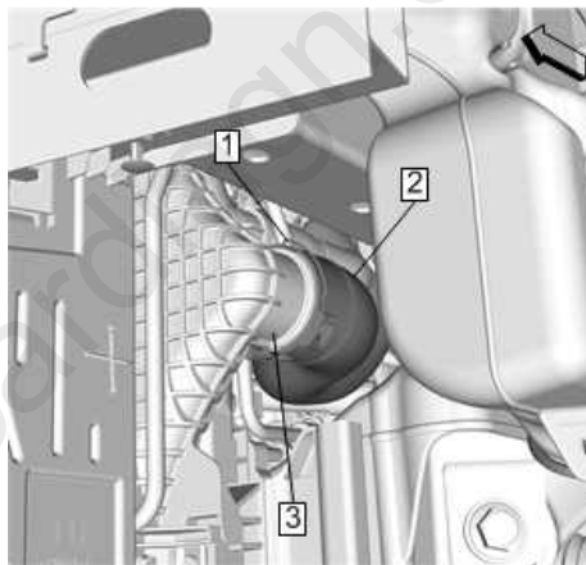


Fig. 121: Charge Air Cooler Inlet Air Tube And Charge Air Cooler Radiator

Courtesy of GENERAL MOTORS COMPANY

4. Radiator Outlet Hose (2) @ Engine Coolant Thermostat Housing » Install

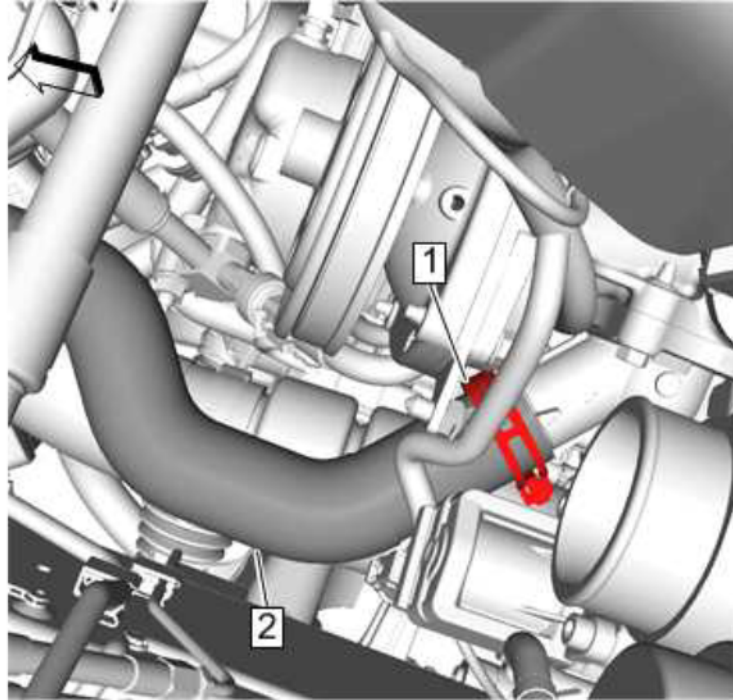


Fig. 122: Radiator Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

5. Radiator Outlet Hose Clamp (1) Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
6. Air Cleaner Outlet Duct (3) Install - [Air Cleaner Outlet Duct Replacement](#)

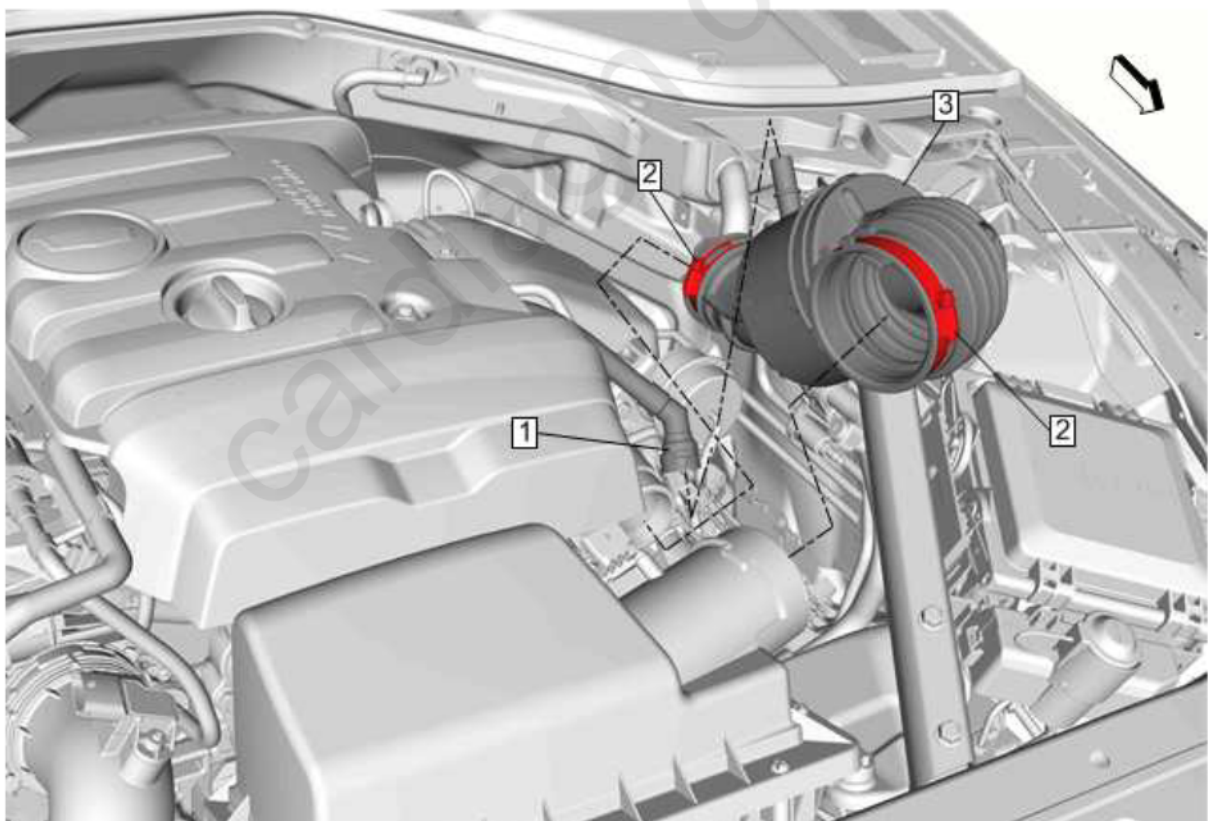


Fig. 123: Air Cleaner Outlet Duct

Courtesy of GENERAL MOTORS COMPANY

7. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static LTG with HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 LTG with HP9\)](#).
8. Enable the high voltage system. Refer to [High Voltage Enabling](#)
9. Start the engine and check for coolant leaks.

AUXILIARY RADIATOR OUTLET HOSE REPLACEMENT (LGW)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. Front Tire Front Air Deflector (2) » Remove - [Front Tire Front Air Deflector Replacement](#)

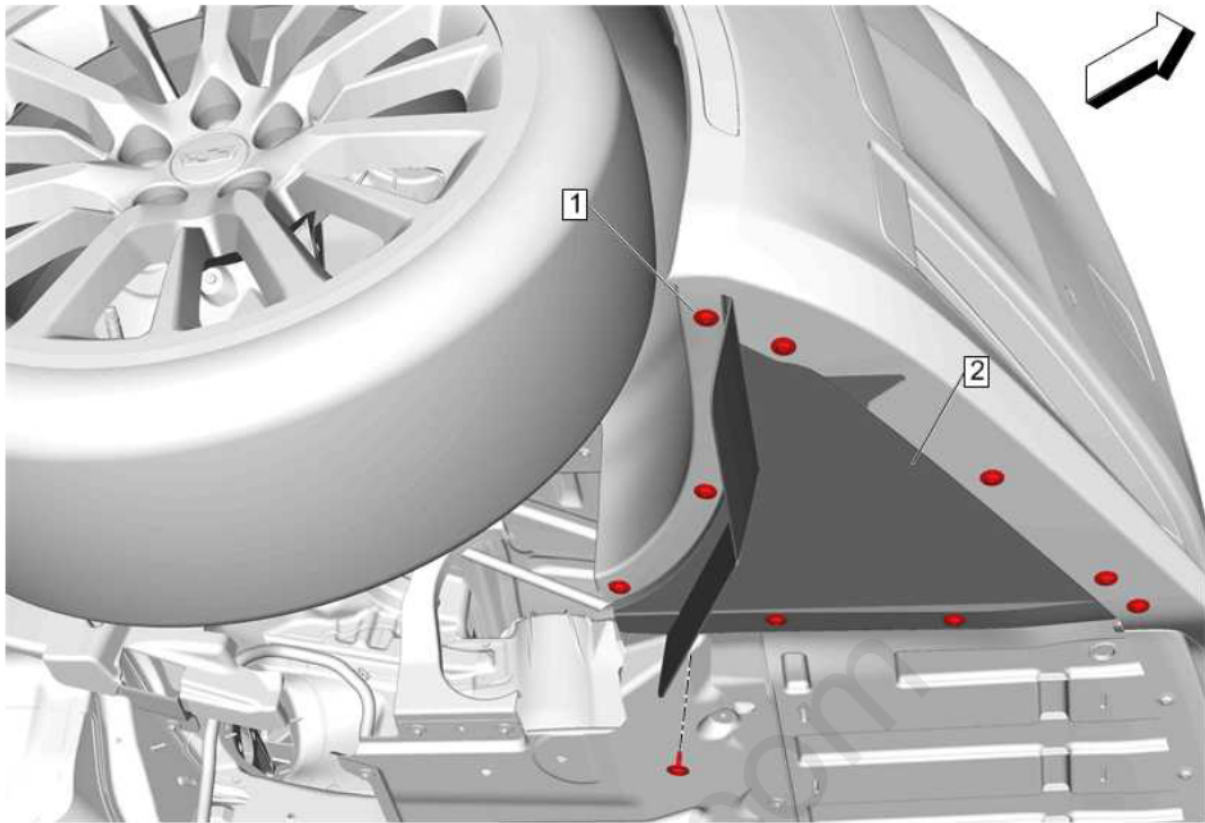


Fig. 124: Front Tire Front Air Deflector
Courtesy of GENERAL MOTORS COMPANY

3. Hose Clip (1) @ Auxiliary Radiator Inlet Hose » Remove

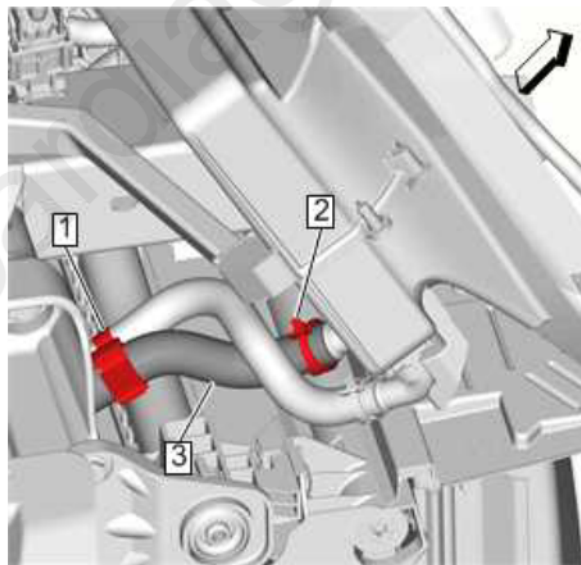


Fig. 125: Auxiliary Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

4. Auxiliary Radiator Outlet Hose Clamp (2) @ Auxiliary Radiator » Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)
5. Auxiliary Radiator Outlet Hose (3) @ Auxiliary Radiator » Remove
6. Hose Clip (1) @ Turbocharger Coolant Feed Hose » Remove

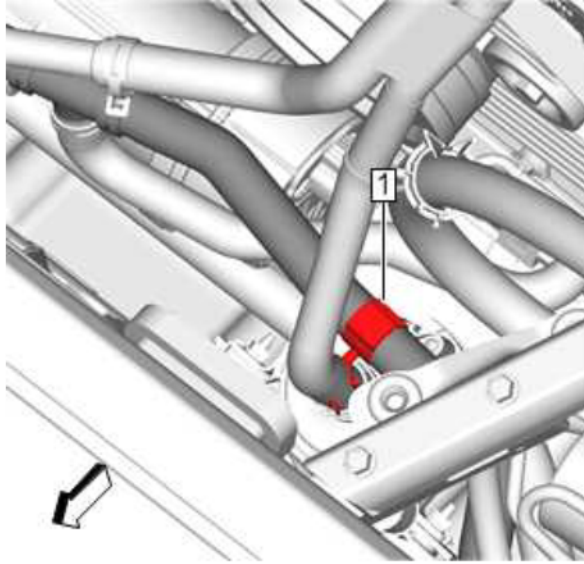


Fig. 126: Hose Clip

Courtesy of GENERAL MOTORS COMPANY

7. Auxiliary Radiator Outlet Hose Clamp (1) @ Radiator Outlet Hose» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

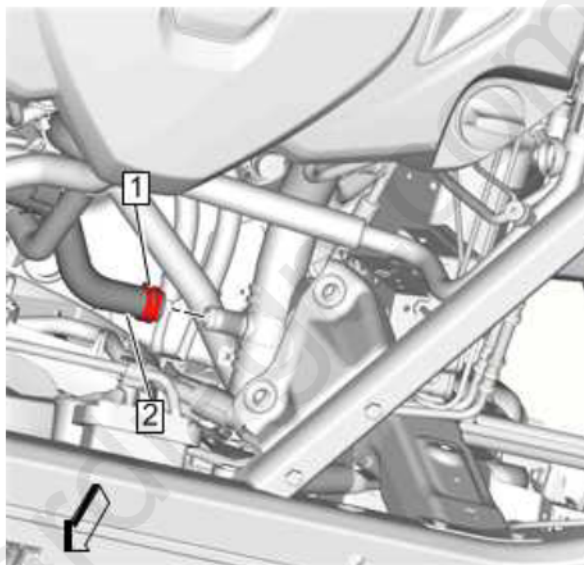


Fig. 127: Auxiliary Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

8. Auxiliary Radiator Outlet Hose (2) @ Radiator Outlet Hose» Remove
9. Engine Oil Cooler Coolant Inlet Hose Clamp (1) @ Auxiliary Radiator Outlet Hose» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

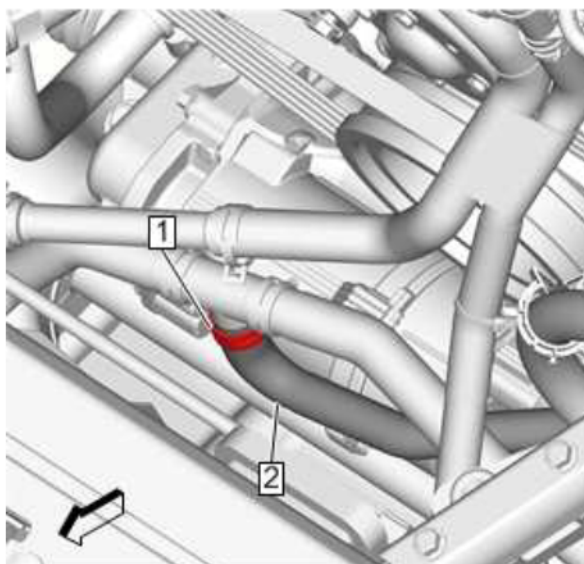


Fig. 128: Engine Oil Cooler Coolant Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

10. Engine Oil Cooler Coolant Inlet Hose (2) @ Auxiliary Radiator Outlet Hose» Remove
11. Hose Clip (1) @ Engine Coolant Fan Shroud» Remove

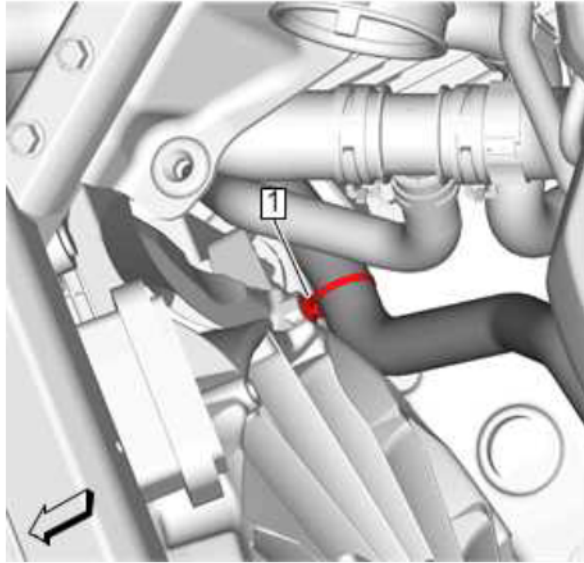


Fig. 129: Hose Clip
Courtesy of GENERAL MOTORS COMPANY

Installation Procedure

1. Hose Clip (1) @ Engine Coolant Fan Shroud» Install

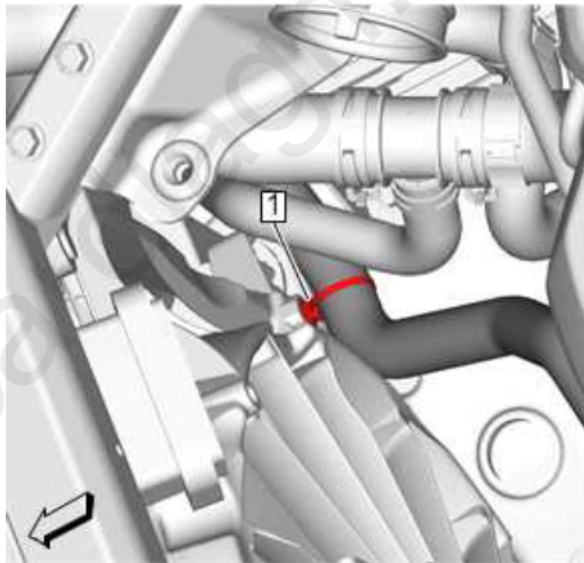


Fig. 130: Hose Clip
Courtesy of GENERAL MOTORS COMPANY

2. Engine Oil Cooler Coolant Inlet Hose (2) @ Auxiliary Radiator Outlet Hose» Install

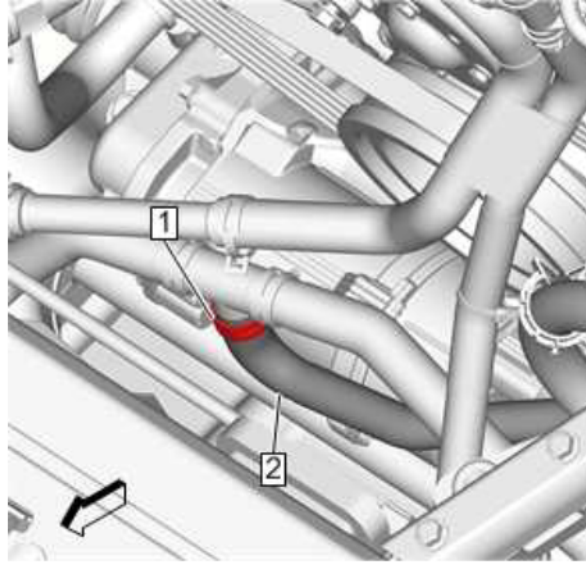


Fig. 131: Engine Oil Cooler Coolant Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

3. Engine Oil Cooler Coolant Inlet Hose Clamp (1) @ Auxiliary Radiator Outlet Hose» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
4. Auxiliary Radiator Outlet Hose (2) @ Radiator Outlet Hose» Install

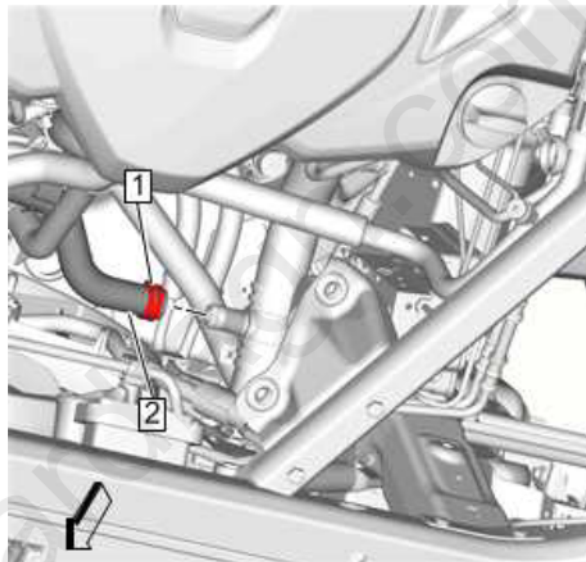


Fig. 132: Auxiliary Radiator Outlet Hose
 Courtesy of GENERAL MOTORS COMPANY

5. Auxiliary Radiator Outlet Hose Clamp (1) @ Radiator Outlet Hose» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
6. Hose Clip (1) @ Turbocharger Coolant Feed Hose» Install

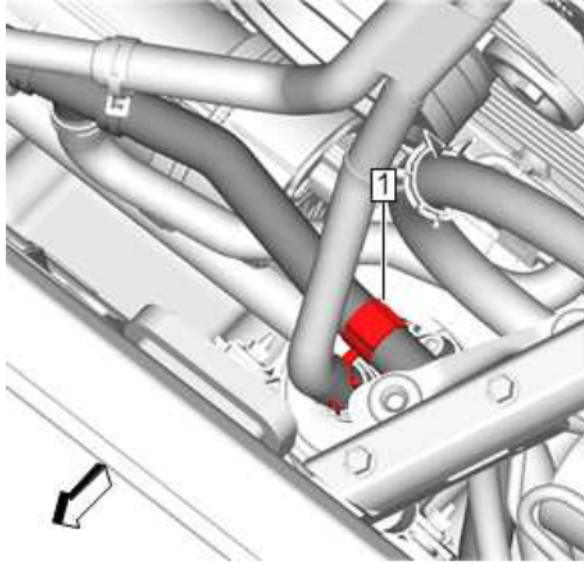


Fig. 133: Hose Clip

Courtesy of GENERAL MOTORS COMPANY

7. Auxiliary Radiator Outlet Hose (3) @ Auxiliary Radiator» Install

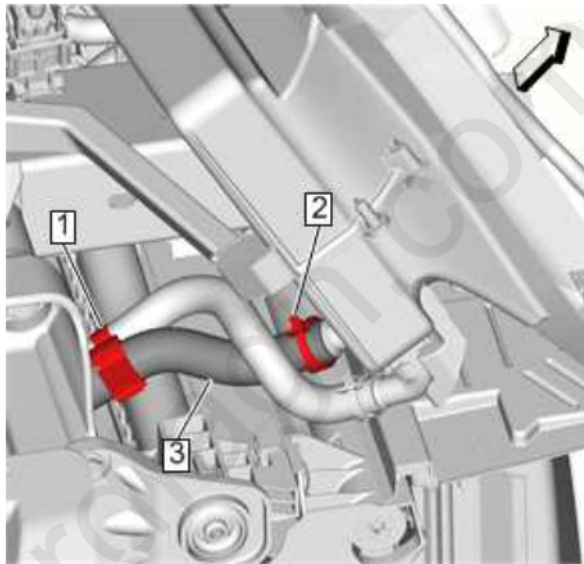


Fig. 134: Auxiliary Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

8. Auxiliary Radiator Outlet Hose Clamp (2) @ Auxiliary Radiator» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
9. Hose Clip (1) @ Auxiliary Radiator Inlet Hose» Install
10. Front Tire Front Air Deflector (2)» Install - **Front Tire Front Air Deflector Replacement**

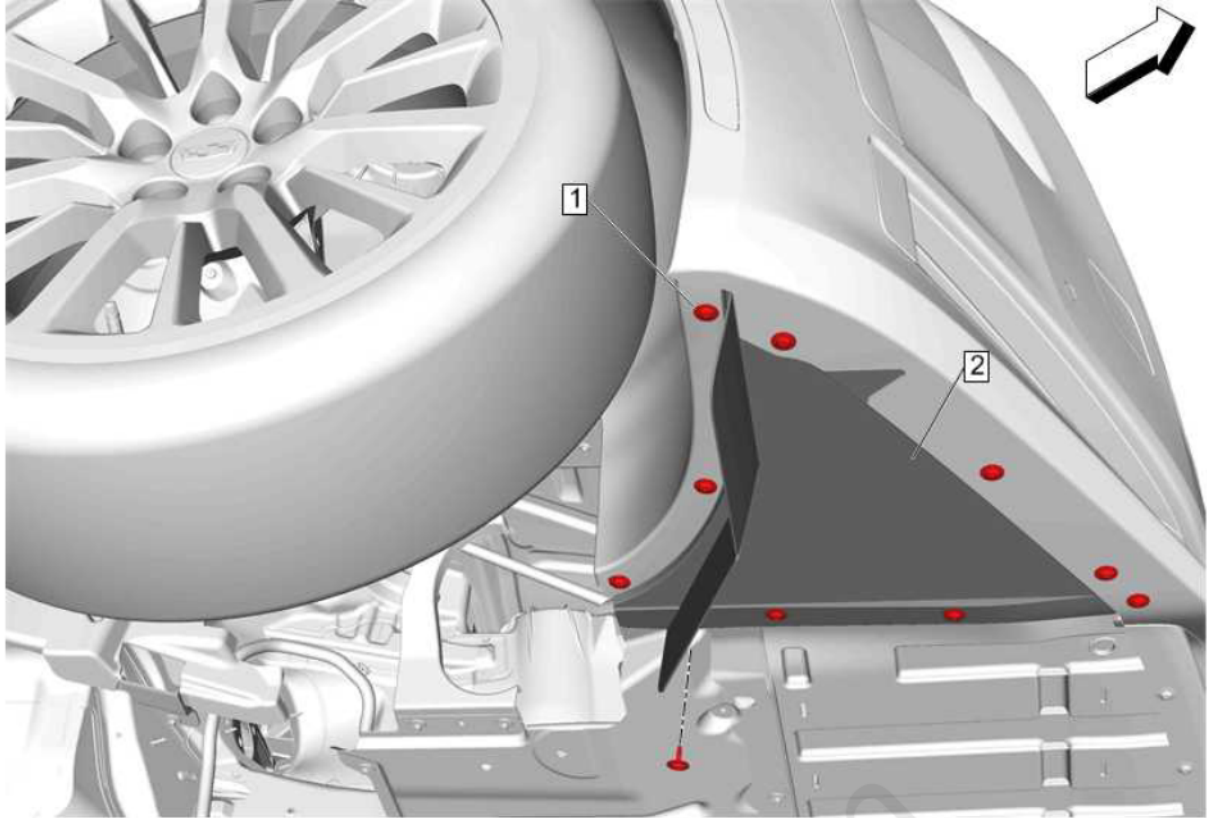


Fig. 135: Front Tire Front Air Deflector

Courtesy of GENERAL MOTORS COMPANY

11. Fill the cooling system to the proper level. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
12. Check the cooling system for leaks. Refer to [Cooling System Leak Testing](#).

CHARGE AIR COOLER REPLACEMENT (LGW)

Removal Procedure

1. Drain the charge air cooling system. Refer to [Charge Air Cooling System Draining and Filling \(LGW\)](#)
2. [Charge Air Cooler Cover Replacement](#) ã, ã» Remove

Installation Procedure

1. [Charge Air Cooler Cover Replacement](#) ã, ã» Install
2. Fill the charge air cooling system. Refer to [Charge Air Cooling System Draining and Filling \(LGW\)](#)
3. Start the engine and check for leaks.

RADIATOR UPPER BRACKET REPLACEMENT (LGW LGX LTG)

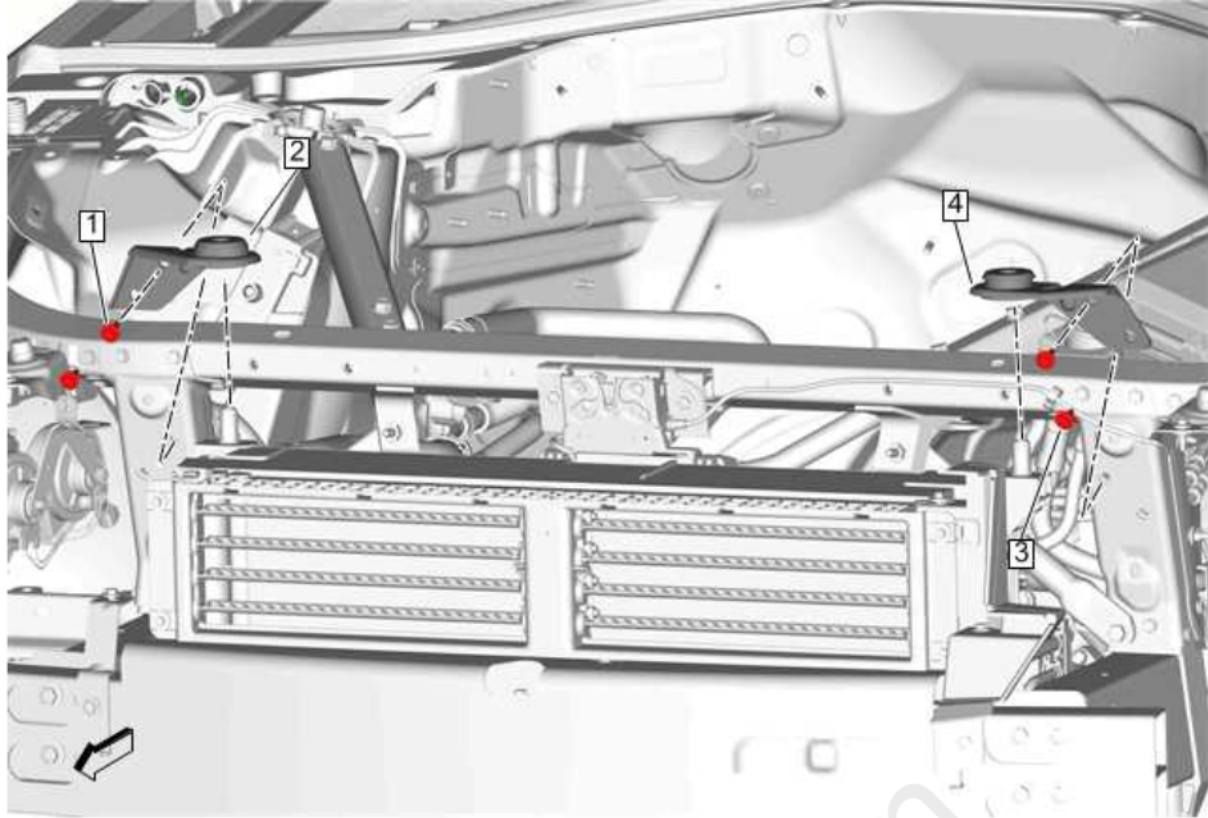


Fig. 136: Radiator Upper Bracket

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement (Without UV3) Front Bumper Fascia Replacement (With UV3)	
1	Radiator Upper Mount Bracket Bolt - Right Side [2x] CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Radiator Upper Bracket - Right Side
2	Radiator Upper Mount Bracket Bolt - Left Side [2x] CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
4	Radiator Upper Bracket - Left Side

ENGINE OIL COOLER REPLACEMENT (LTG)

Removal Procedure

1. Remove the engine oil filter. Refer to **Engine Oil and Oil Filter Replacement**
2. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static LTG with HP9)** and/or **Cooling System Draining and Filling (GE 47716 LTG with HP9)**
3. **Engine Mount Bracket Replacement - Left Side** » Remove
4. Remove the engine oil cooler pipe fastener. (1)

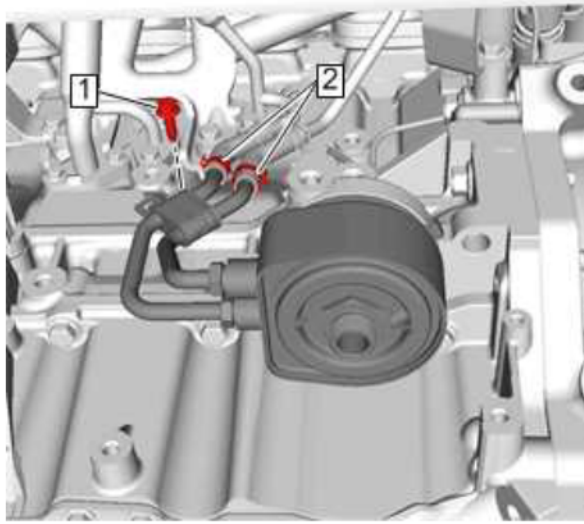


Fig. 137: Engine Oil Cooler Pipe Fastener
 Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the inlet and outlet hoses from the engine oil cooler. (2) **Hose Clamp Replacement Guidelines - Spring Type**
6. Remove the engine oil cooler connector (1).

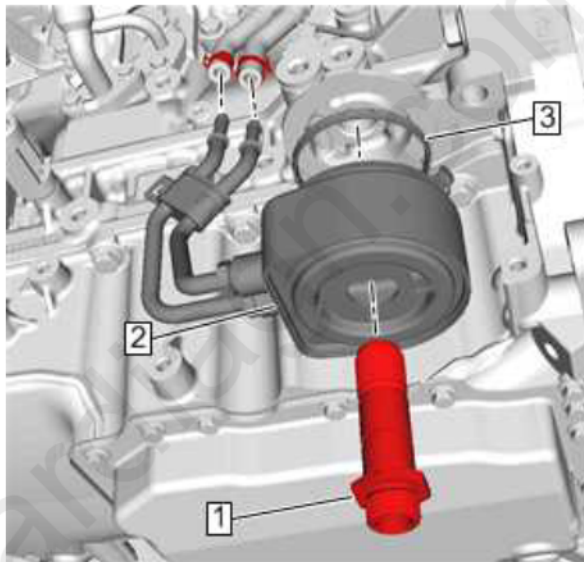


Fig. 138: Engine Oil Cooler Connector
 Courtesy of GENERAL MOTORS COMPANY

7. Remove the engine oil cooler. (2)
8. Remove and DISCARD the seal. (3)

Installation Procedure

1. When installing the engine oil cooler, position the engine oil cooler so that the tab (1) is against the engine block (2).

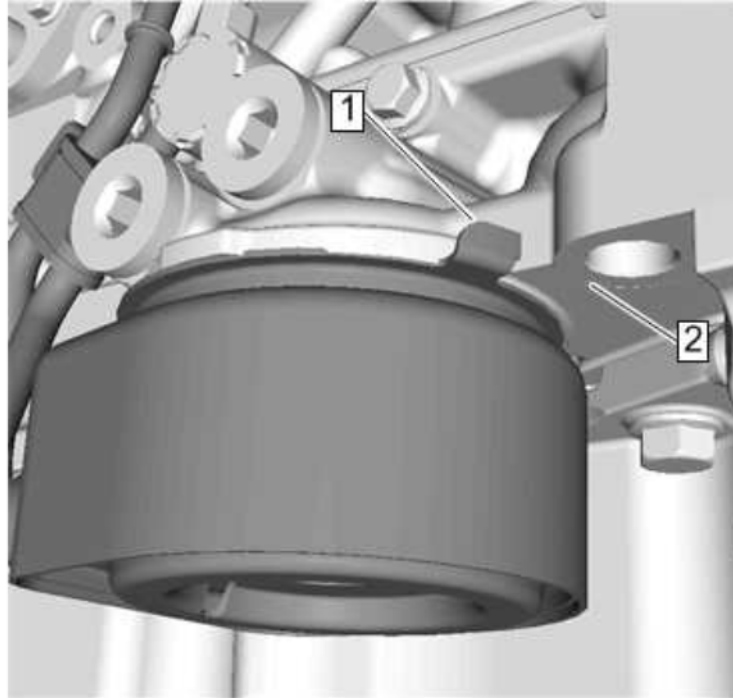


Fig. 139: Engine Block

Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW seal. (3)

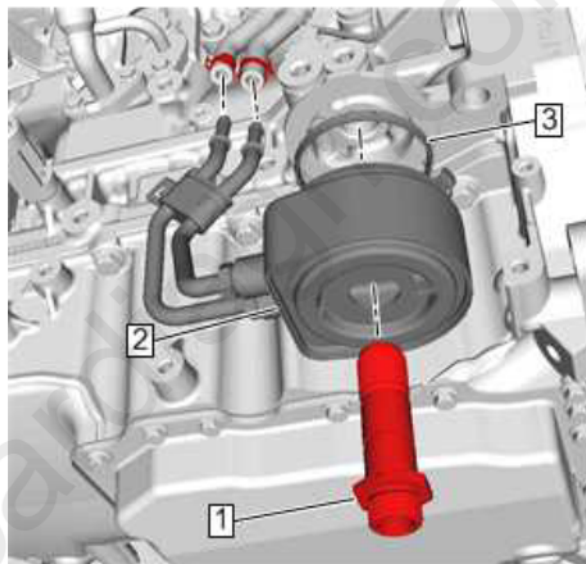


Fig. 140: Engine Oil Cooler Connector

Courtesy of GENERAL MOTORS COMPANY

3. Install the engine oil cooler. (2)
4. Install the engine oil cooler connector. (1) 50 N.m (37 lb ft)

CAUTION: Refer to **Component Fastener Tightening Caution** .

5. Install the oil cooler inlet and outlet hoses. (2) **Hose Clamp Replacement Guidelines - Spring Type**

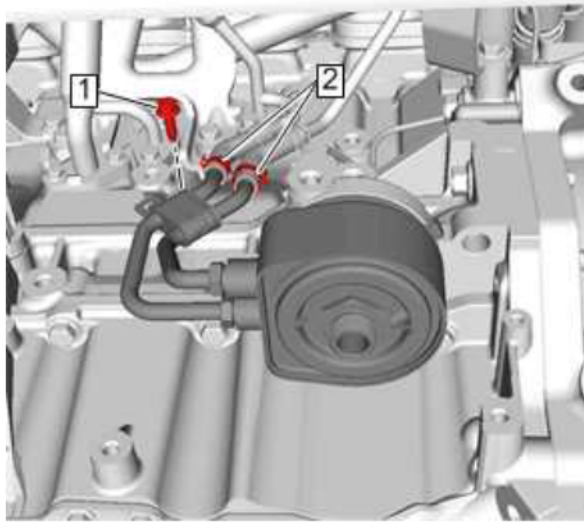


Fig. 141: Engine Oil Cooler Pipe Fastener
Courtesy of GENERAL MOTORS COMPANY

6. Install the engine oil cooler pipe fastener. 10 N.m (89 lb in)

CAUTION: Refer to [Fastener Caution](#) .

7. [Engine Mount Bracket Replacement - Left Side](#) ã, ã» Install
8. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static LTG with HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 LTG with HP9\)](#)
9. Change the engine oil and filter. Refer to [Engine Oil and Oil Filter Replacement](#)

ENGINE OIL COOLER ADAPTER REPLACEMENT (LGW)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. Drain the engine oil. Refer to [Engine Oil and Oil Filter Replacement](#)
3. [Engine Mount Bracket Replacement - Left Side \(LGW\)](#) ã, ã» Remove
4. Clamp (1) ã, ã» Disengage [3x] - [Hose Clamp Replacement Guidelines - Spring Type](#)

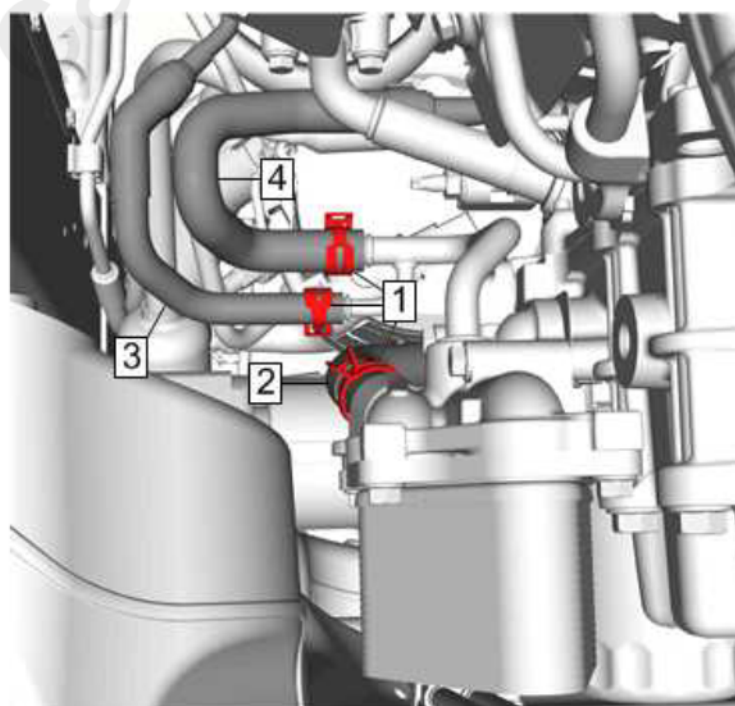


Fig. 142: Engine Oil Cooler Inlet Pipe
Courtesy of GENERAL MOTORS COMPANY

5. Engine Oil Cooler Inlet Hose (2)» Disengage
6. Turbocharger Coolant Feed and Return Pipe (3)» Disconnect
7. Engine Oil Cooler Inlet Pipe (4)» Disconnect
8. Engine Oil Cooler Adapter Bolt (1)» Remove [2x]

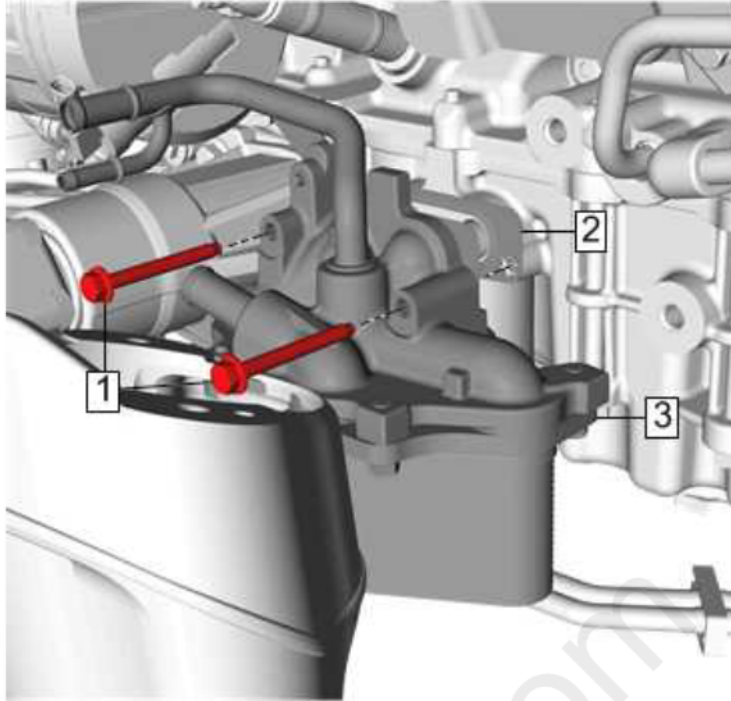


Fig. 143: Engine Oil Cooler Adapter Gasket
Courtesy of GENERAL MOTORS COMPANY

9. Engine Oil Cooler Adapter Gasket (2)» Remove and DISCARD
10. Engine Oil Cooler Adapter (3)» Remove

Installation Procedure

1. Clean the engine oil cooler housing to engine block sealing surfaces.
2. Engine Oil Cooler Adapter Gasket (2)» Install

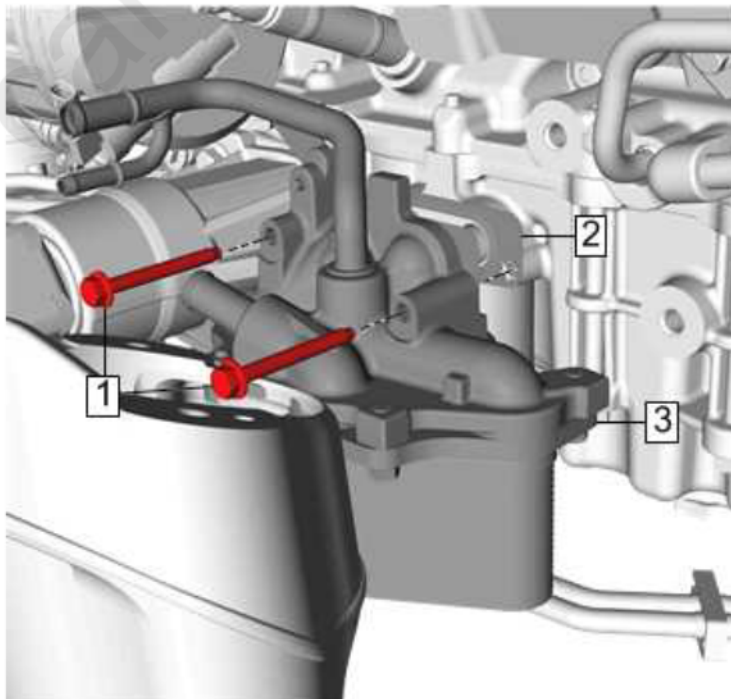


Fig. 144: Engine Oil Cooler Adapter Gasket
Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW engine oil cooler gasket.

3. Engine Oil Cooler Adapter (3)» Install
4. Engine Oil Cooler Adapter Bolt (1)» Install and tighten [2x] 10 N.m (89 lb in)

CAUTION: Refer to [Fastener Caution](#) .

5. Engine Oil Cooler Inlet Pipe (4)» Connect

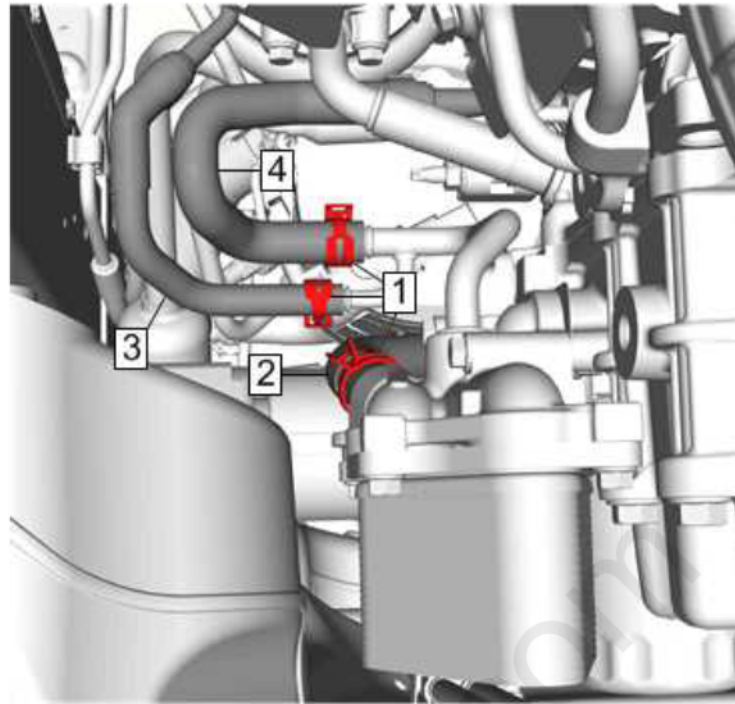


Fig. 145: Engine Oil Cooler Inlet Pipe
Courtesy of GENERAL MOTORS COMPANY

6. Turbocharger Coolant Feed and Return Pipe (3)» Connect
7. Engine Oil Cooler Inlet Hose (2)» Connect
8. Clamp (1)» Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
9. [Engine Mount Bracket Replacement - Left Side \(LGW\)](#) » Install
10. Check and correct the engine oil level. Refer to [Engine Oil and Oil Filter Replacement](#)
11. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
12. Start the engine and check for leaks.

ENGINE OIL COOLER ADAPTER REPLACEMENT (LGX WITH AWD)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. [Engine Mount Bracket Replacement - Left Side \(LGX\)](#) » Remove
3. Clamp (1)» Disengage [2x] - [Hose Clamp Replacement Guidelines - Spring Type](#)

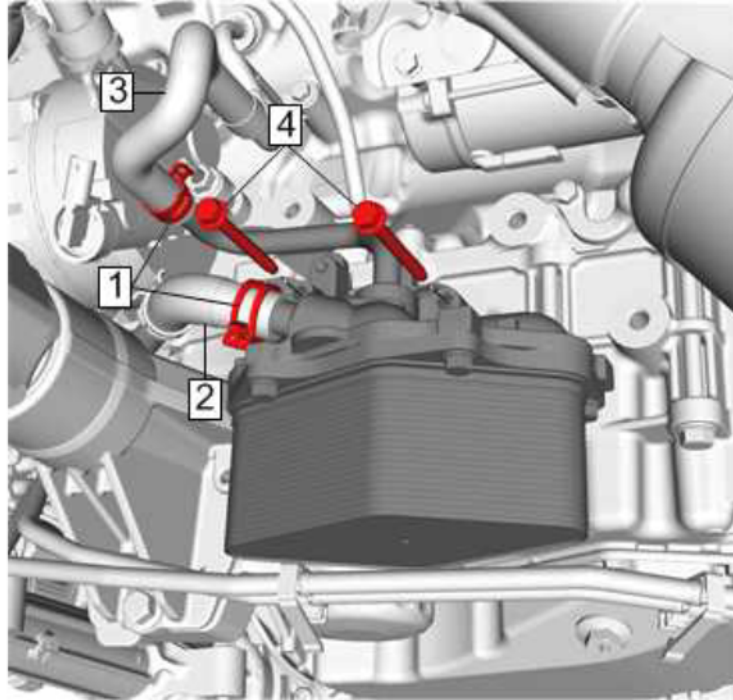


Fig. 146: Engine Oil Cooler Inlet Pipe And Hose
Courtesy of GENERAL MOTORS COMPANY

4. Engine Oil Cooler Inlet Hose (2) » Disconnect
5. Engine Oil Cooler Inlet Pipe (3) » Disconnect
6. Engine Oil Cooler Adapter Bolt (4) » Remove [2x]
7. Engine Oil Cooler Adapter (1) » Remove

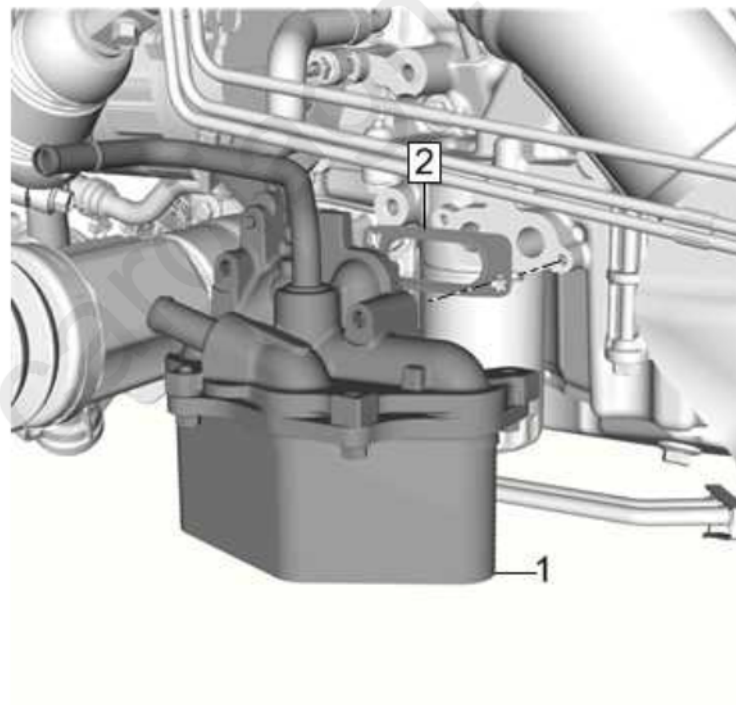


Fig. 147: Engine Oil Cooler Adapter Gasket
Courtesy of GENERAL MOTORS COMPANY

8. Engine Oil Cooler Adapter Gasket (2) » Remove and DISCARD

Installation Procedure

1. Clean the engine oil cooler housing to engine block sealing surfaces.
2. Engine Oil Cooler Adapter Gasket (2) » Install

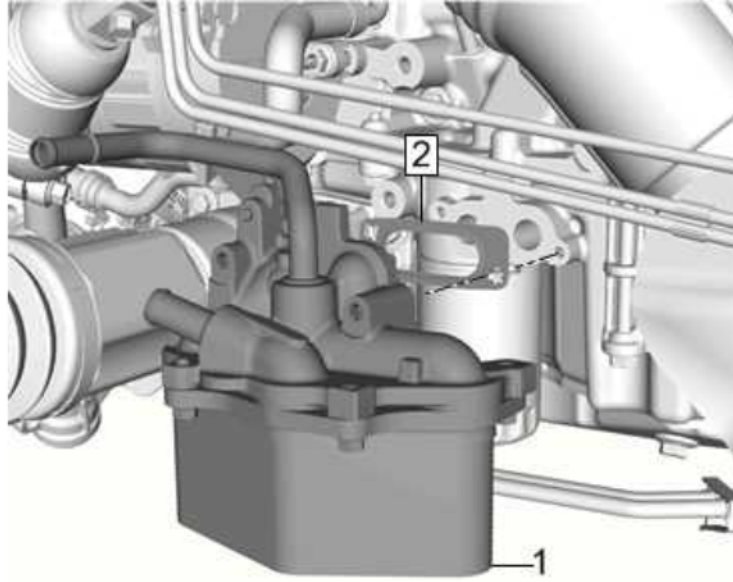


Fig. 148: Engine Oil Cooler Adapter Gasket
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a **NEW** engine oil cooler gasket.

3. Engine Oil Cooler Adapter (1) » Install
4. Engine Oil Cooler Adapter Bolt (4) » Install and tighten [2x] 10 N.m (89 lb in)

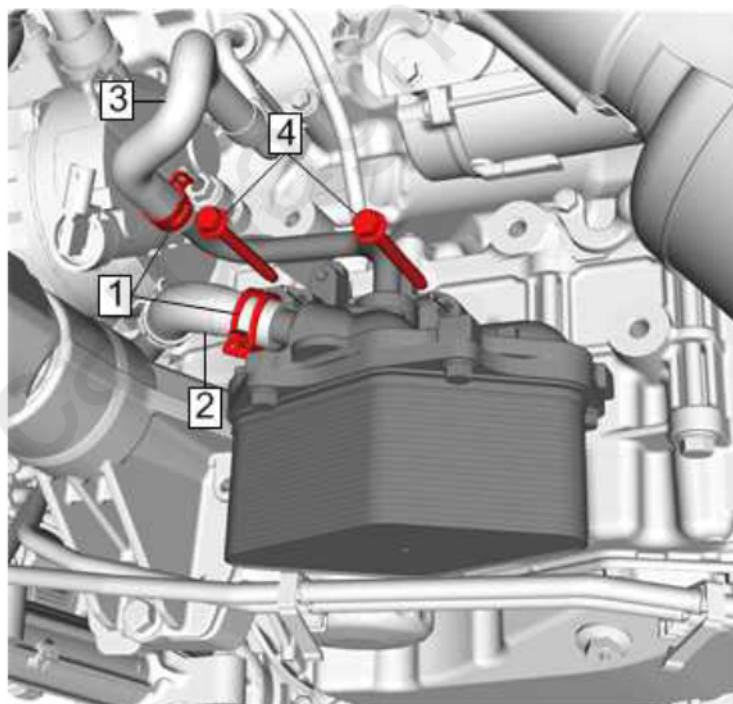


Fig. 149: Engine Oil Cooler Inlet Pipe And Hose
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

5. Engine Oil Cooler Inlet Pipe (3) » Connect
6. Engine Oil Cooler Inlet Hose (2) » Connect
7. Clamp (1) » Engage [2x] - **Hose Clamp Replacement Guidelines - Spring Type**
8. **Engine Mount Bracket Replacement - Left Side (LGX)** » Install
9. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static without HP9)****Cooling System Draining and Filling (GE 47716 without HP9)**

10. Check and correct the engine oil level. Refer to [Approximate Fluid Capacities \(LGX\)](#)

11. Start the engine and check for leaks.

ENGINE OIL COOLER PIPE/HOSE QUICK CONNECT FITTING REPLACEMENT (LGW)

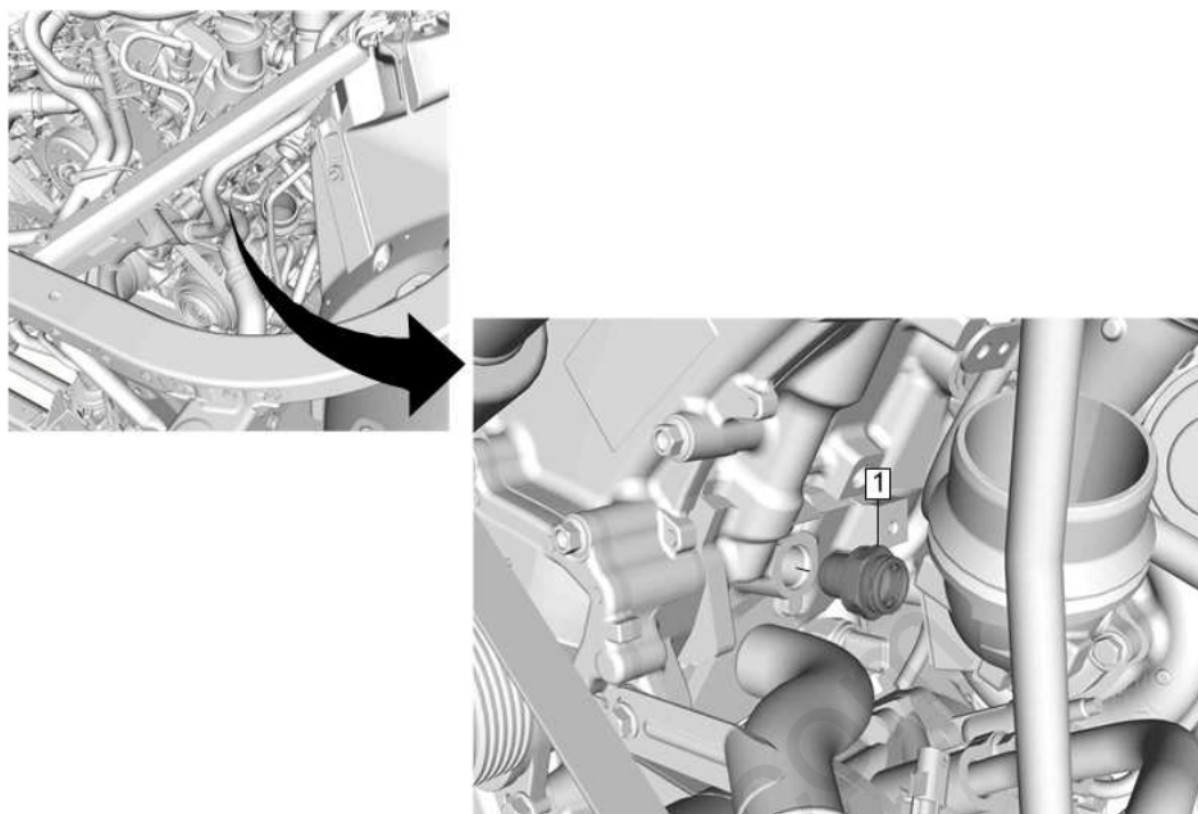


Fig. 150: Engine Oil Cooler Pipe/Hose Quick Connect Fitting (LGW)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Air Cleaner Outlet Front Duct Replacement (LGW) 2. Engine Oil Cooler Inlet Pipe Replacement (LGW)	
1	Engine Oil Cooler Pipe Quick Connect Fitting CAUTION: Refer to Component Fastener Tightening Caution . Tighten 35 N.m (26 lb ft)

ENGINE OIL COOLER COOLANT INLET HOSE REPLACEMENT (ENGINE OIL COOLER COOLANT INLET HOSE TO ENGINE OIL COOLER ADAPTER - LGW)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. Underbody Front Air Deflector (3) Remove - [Underbody Front Air Deflector Replacement](#)

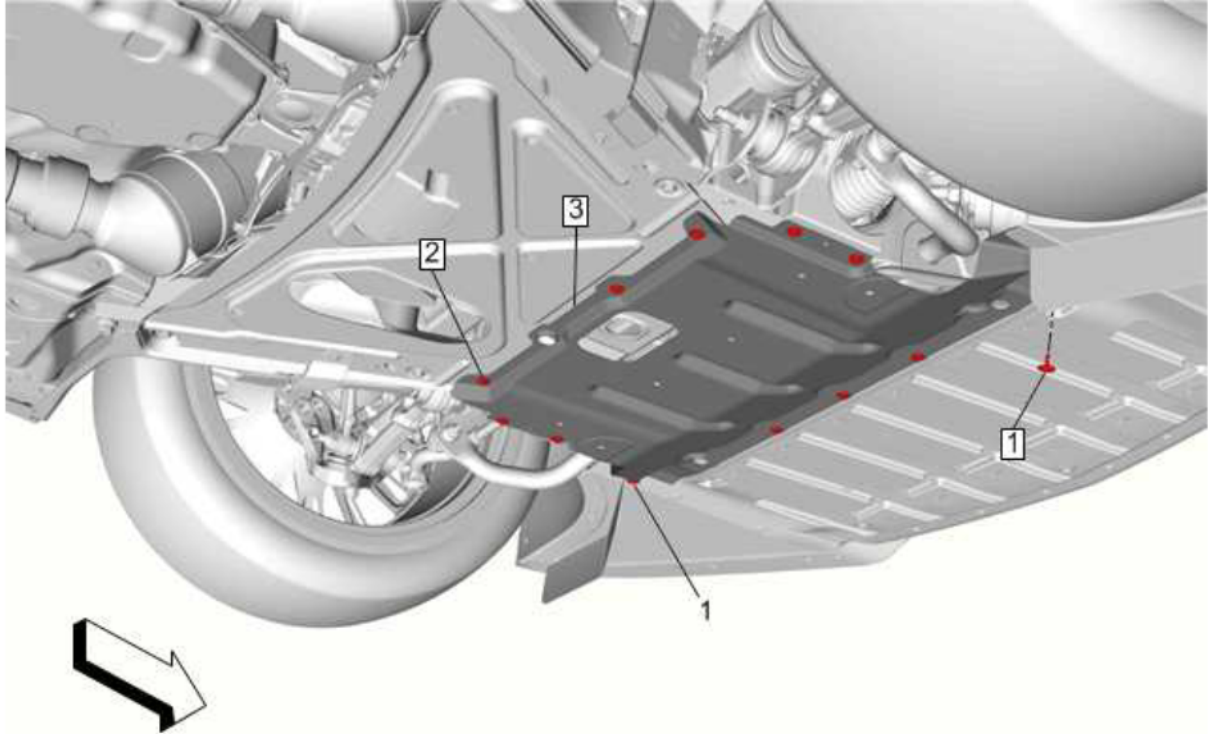


Fig. 151: Underbody Front Air Deflector

Courtesy of GENERAL MOTORS COMPANY

3. Drivetrain and Front Suspension Cradle Plate (3) » Remove - **Drivetrain and Front Suspension Cradle Plate Replacement**

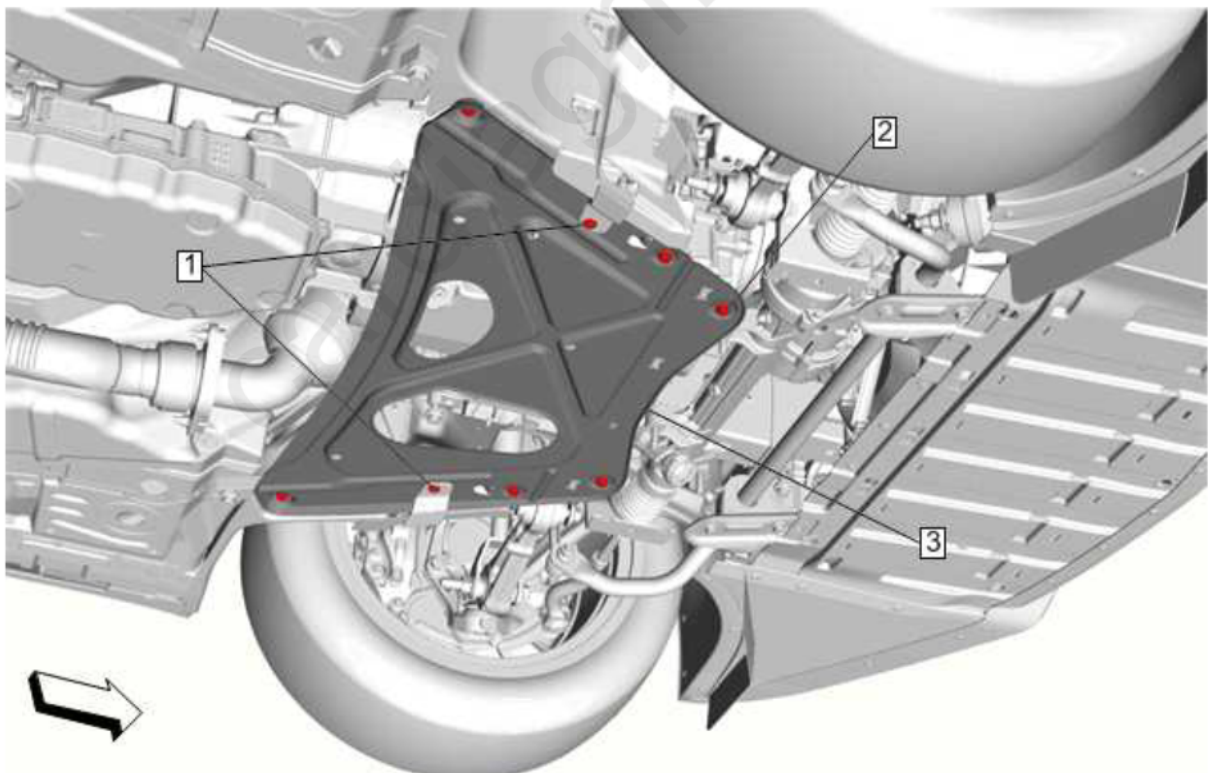


Fig. 152: Drivetrain and Front Suspension Cradle Plate

Courtesy of GENERAL MOTORS COMPANY

4. Engine Oil Cooler Coolant Inlet Hose (2) @ Engine Oil Cooler Coolant Inlet Hose » Remove - **Engine Oil Cooler Coolant Inlet Hose Replacement (Engine Oil Cooler Coolant Inlet Hose to Engine Oil Cooler Adapter - LGW)** and/or **Engine Oil Cooler Coolant Inlet Hose Replacement (Auxiliary Radiator Outlet Hose to Engine Oil Cooler Coolant Inlet Hose - LGW)**

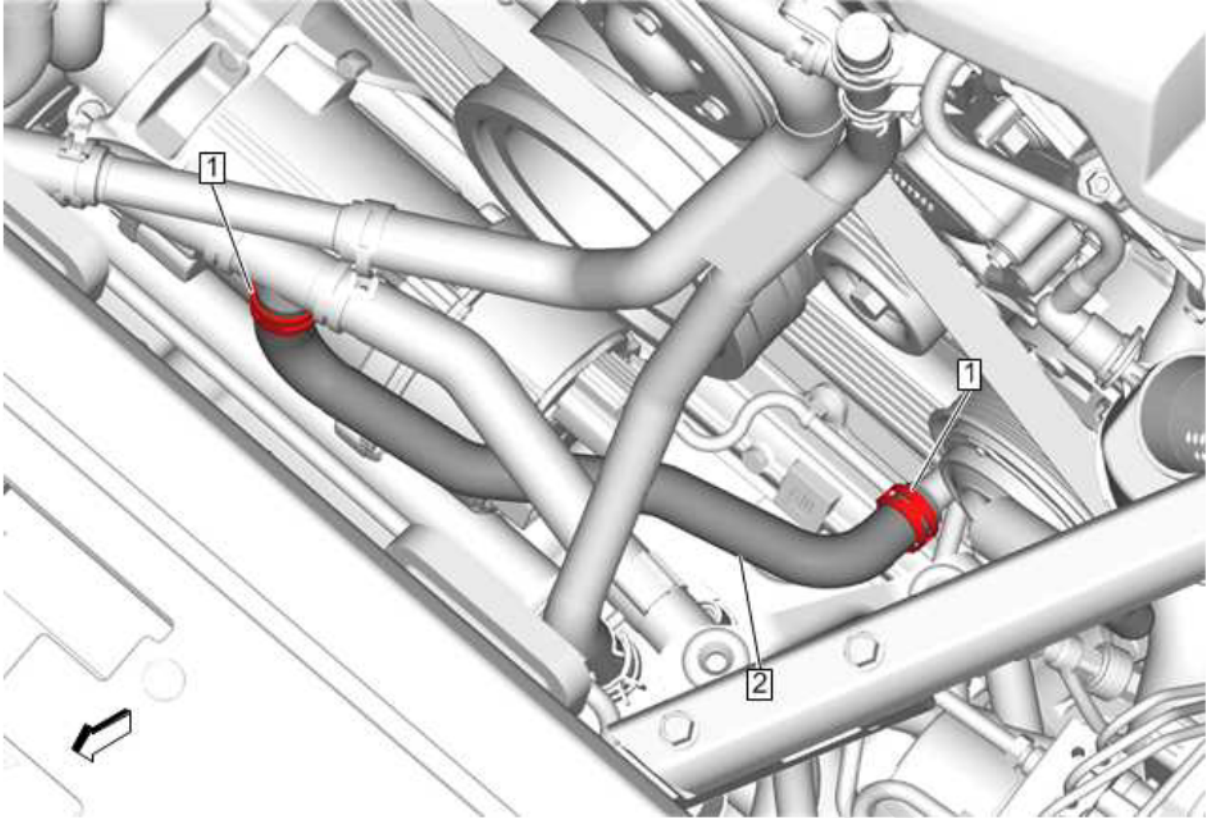


Fig. 153: Engine Oil Cooler Coolant Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

5. Wiring Harness (2) @ Transmission Fluid Cooler Pipe Bracket» Remove

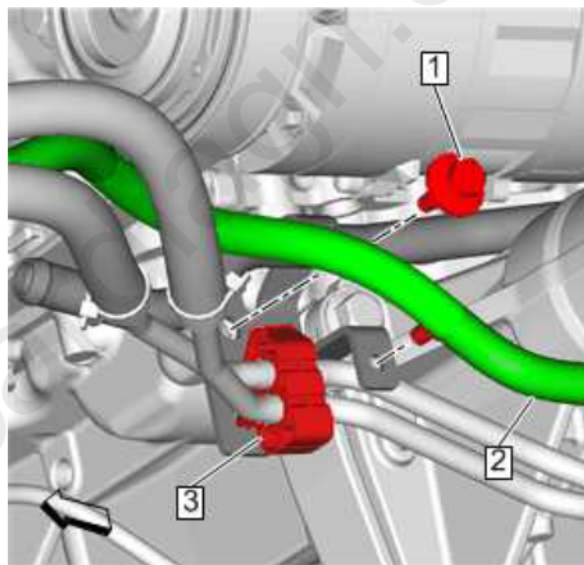


Fig. 154: Engine Oil Cooler Coolant Inlet Hose Bracket And Bolt
 Courtesy of GENERAL MOTORS COMPANY

6. Transmission Fluid Cooler Pipe Clip (3) @ Transmission Fluid Cooler Pipe Bracket» Remove
7. Engine Oil Cooler Coolant Inlet Hose Bracket Bolt (1) @ Transmission Fluid Cooler Pipe Bracket» Remove
8. Engine Oil Cooler Coolant Inlet Hose Clamp (1) @ Engine Oil Cooler Adapter» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

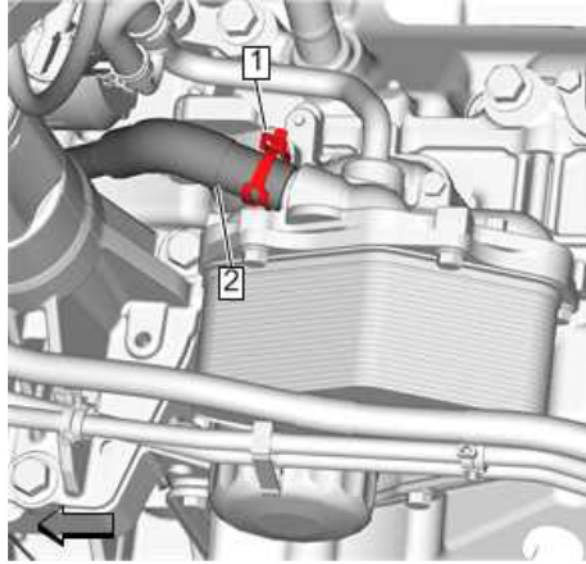


Fig. 155: Engine Oil Cooler Coolant Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

9. Engine Oil Cooler Coolant Inlet Hose (2) @ Engine Oil Cooler Adapter» Remove

Installation Procedure

1. Engine Oil Cooler Coolant Inlet Hose (2) @ Engine Oil Cooler Adapter» Install

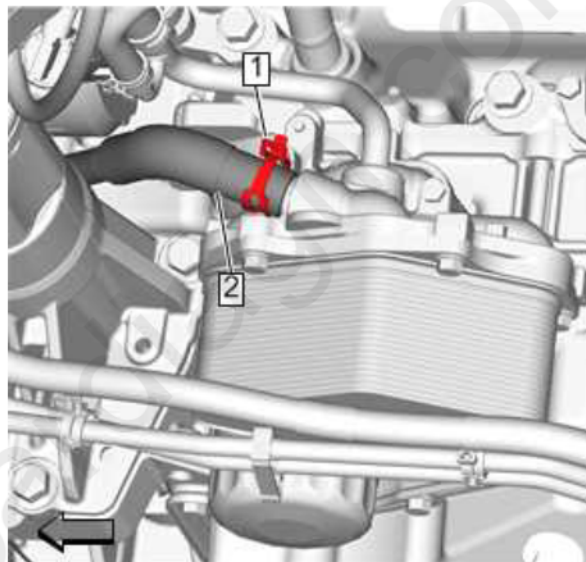


Fig. 156: Engine Oil Cooler Coolant Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

2. Engine Oil Cooler Coolant Inlet Hose Clamp (1) @ Engine Oil Cooler Adapter» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
3. Engine Oil Cooler Coolant Inlet Hose Bracket Bolt (1) @ Transmission Fluid Cooler Pipe Bracket» Install and tighten 22 N.m (16 lb ft)

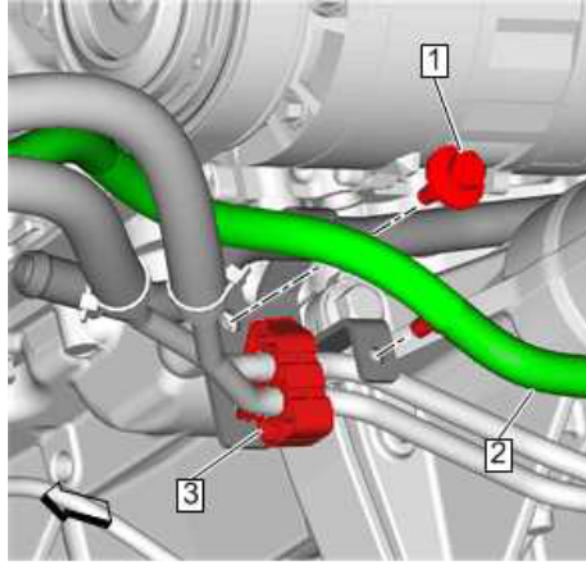


Fig. 157: Engine Oil Cooler Coolant Inlet Hose Bracket And Bolt
 Courtesy of GENERAL MOTORS COMPANY

4. Transmission Fluid Cooler Pipe Clip (3) @ Transmission Fluid Cooler Pipe Bracket» Install
5. Wiring Harness (2) @ Transmission Fluid Cooler Pipe Bracket» Install
6. Engine Oil Cooler Coolant Inlet Hose (2) @ Engine Oil Cooler Coolant Inlet Hose» Install - **Engine Oil Cooler Coolant Inlet Hose Replacement (Engine Oil Cooler Coolant Inlet Hose to Engine Oil Cooler Adapter - LGW)** and/or **Engine Oil Cooler Coolant Inlet Hose Replacement (Auxiliary Radiator Outlet Hose to Engine Oil Cooler Coolant Inlet Hose - LGW)**

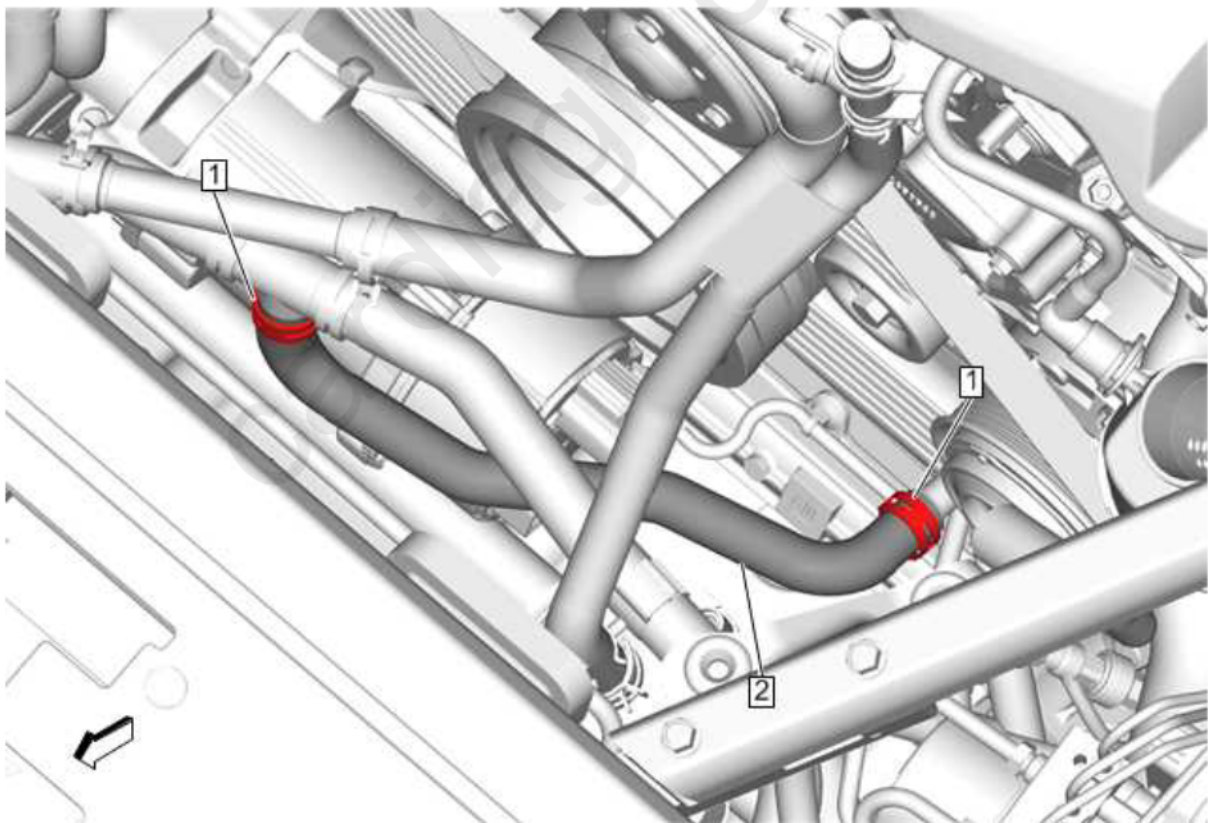


Fig. 158: Engine Oil Cooler Coolant Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

7. Drivetrain and Front Suspension Cradle Plate (3)» Install - **Drivetrain and Front Suspension Cradle Plate Replacement**

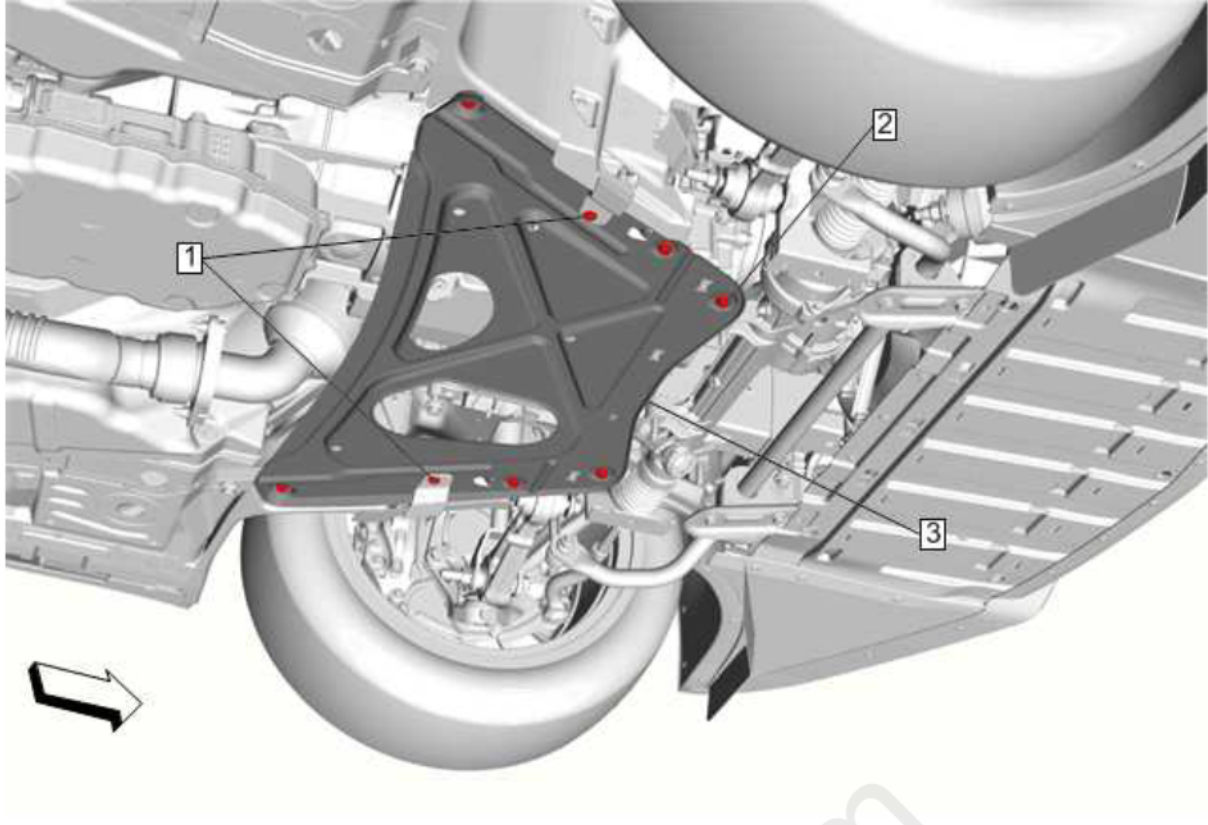


Fig. 159: Drivetrain and Front Suspension Cradle Plate
Courtesy of GENERAL MOTORS COMPANY

8. Underbody Front Air Deflector (3) » Install - [Underbody Front Air Deflector Replacement](#)

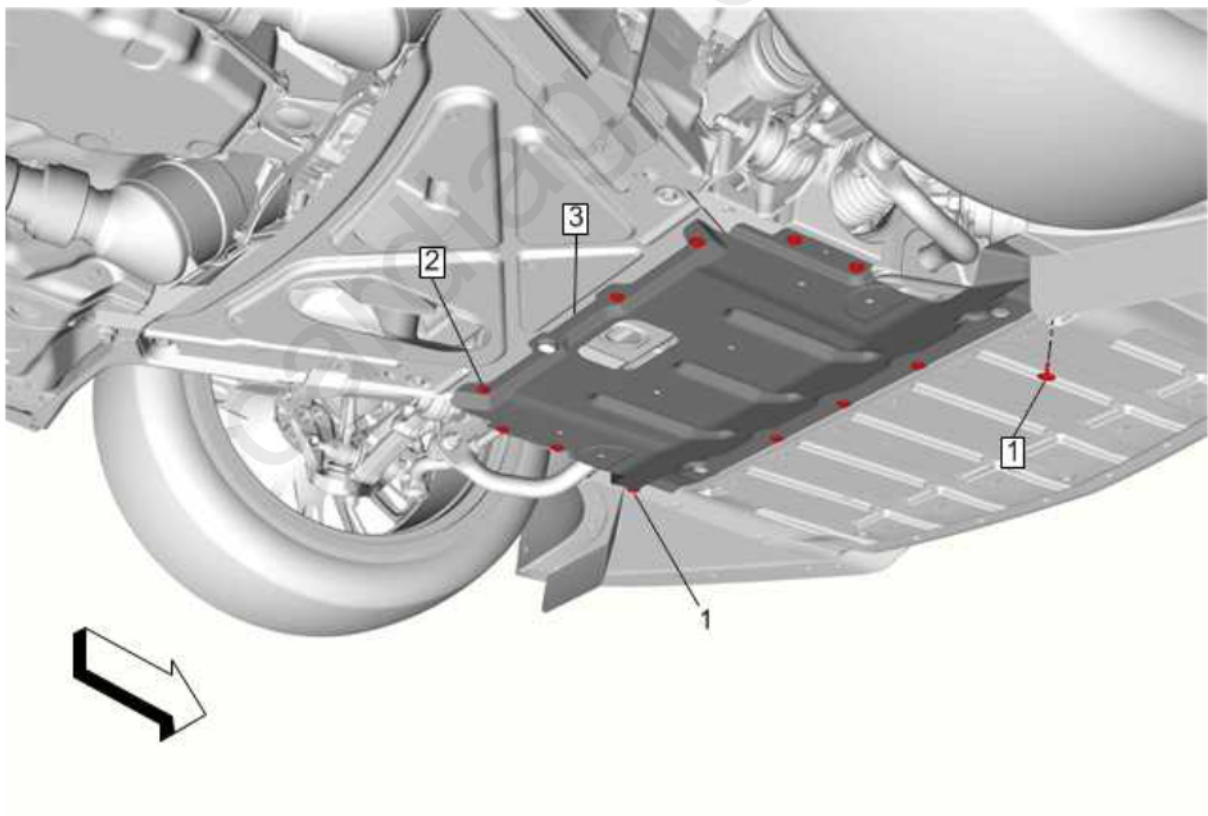


Fig. 160: Underbody Front Air Deflector
Courtesy of GENERAL MOTORS COMPANY

9. Fill the cooling system to the proper level. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#).
10. Check the cooling system for leaks. Refer to [Cooling System Leak Testing](#).

ENGINE OIL COOLER COOLANT INLET HOSE REPLACEMENT (AUXILIARY RADIATOR OUTLET HOSE TO ENGINE OIL COOLER COOLANT INLET HOSE - LGW)

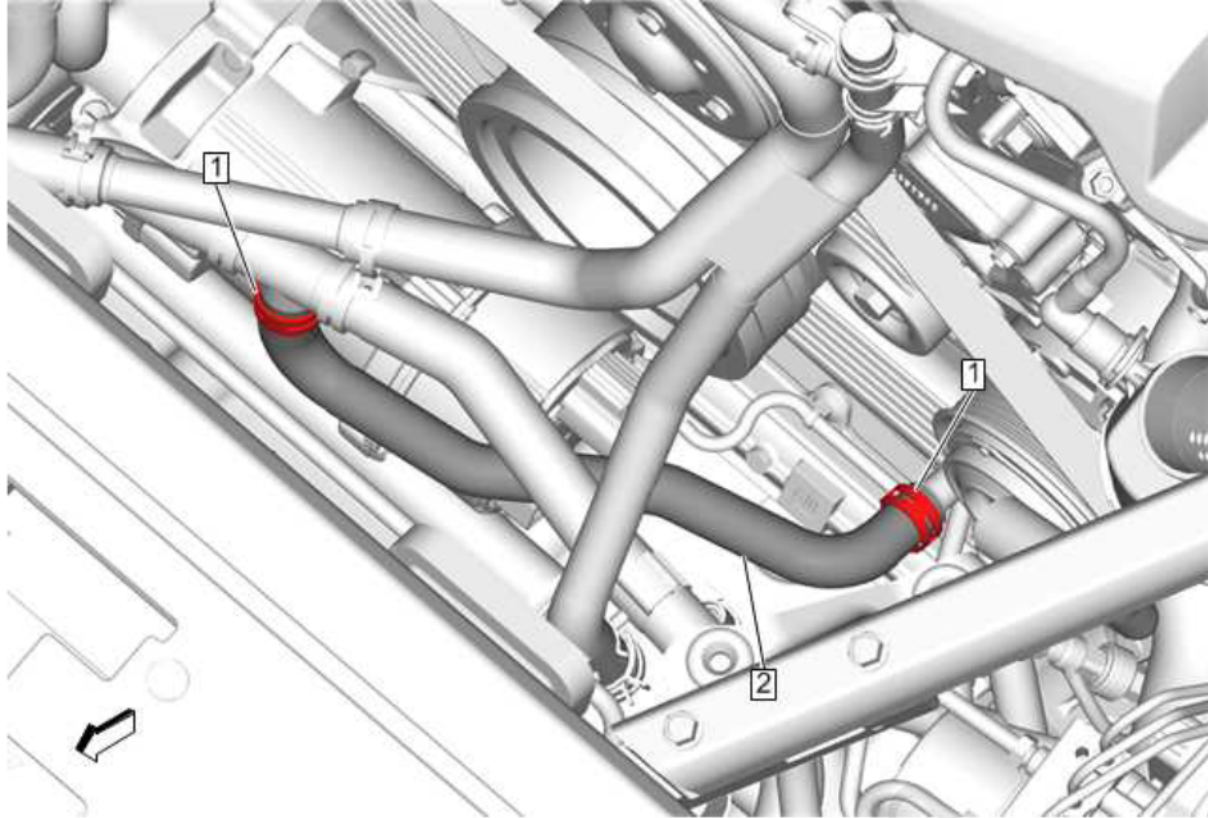


Fig. 161: Engine Oil Cooler Coolant Inlet Hose (Auxiliary Radiator Outlet Hose to Engine Oil Cooler Coolant Inlet Hose - LGW)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9) 2. Intake Manifold Cover Replacement 3. Air Cleaner Assembly Replacement (LGW)	
1	Engine Oil Cooler Coolant Inlet Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Engine Oil Cooler Coolant Inlet Hose Procedure 1. Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9) 2. Start the engine and check for coolant leaks.

ENGINE OIL COOLER COOLANT INLET HOSE REPLACEMENT (LGX)

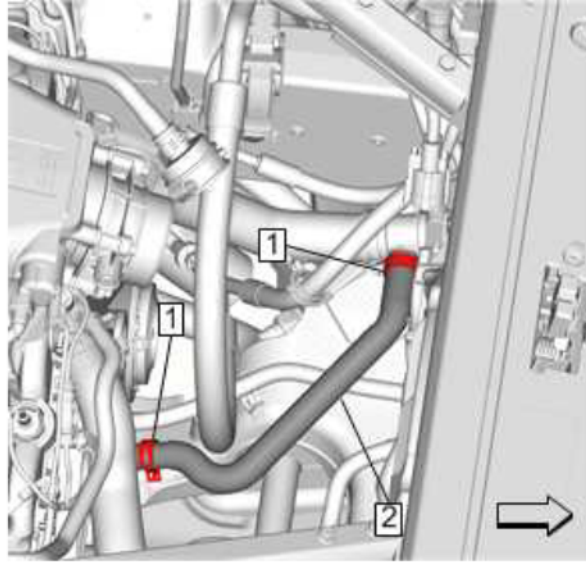


Fig. 162: Engine Oil Cooler Coolant Inlet Hose (LGX)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9) 2. Intake Manifold Cover Replacement 3. Air Cleaner Assembly Replacement (LGX)	
1	Engine Oil Cooler Coolant Inlet Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Engine Oil Cooler Coolant Inlet Hose Procedure 1. Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9) 2. Start the engine and check for coolant leaks.

ENGINE OIL COOLER INLET PIPE REPLACEMENT (LGW)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. [Turbocharger Replacement \(Right Side\)](#) [Turbocharger Replacement \(Left Side\)](#) ã, ã»
Remove
3. Hose Clamp (1) ã, ã» Disengage [2x] - [Hose Clamp Replacement Guidelines - Spring Type](#)

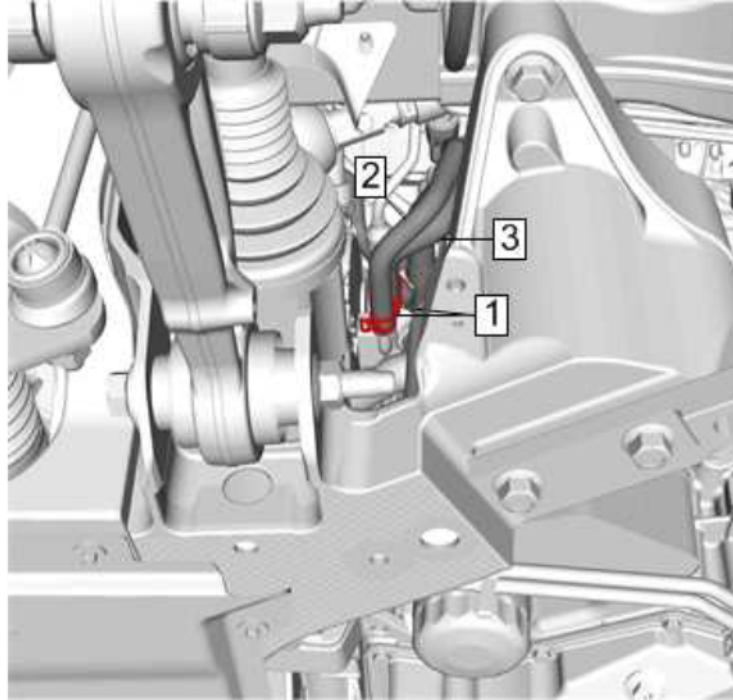


Fig. 163: Engine Oil Cooler Inlet Pipe

Courtesy of GENERAL MOTORS COMPANY

4. Turbocharger Coolant Feed and Return Pipe (2) » Disconnect
5. Engine Oil Cooler Inlet Pipe (3) » Disconnect
6. Engine Oil Cooler Inlet Pipe Bolt (1) » Remove

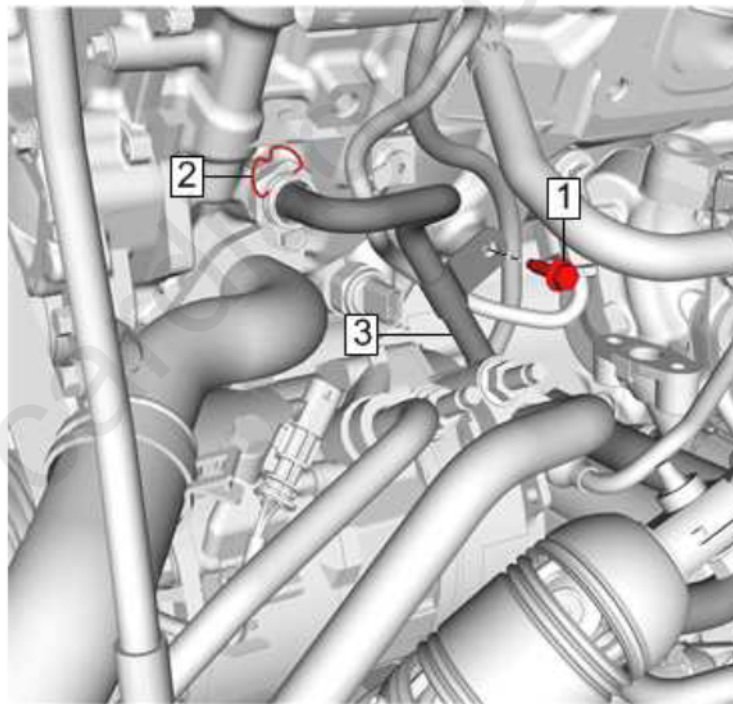


Fig. 164: Engine Oil Cooler Inlet Pipe

Courtesy of GENERAL MOTORS COMPANY

7. Remove the retainer from the quick connect fitting. (2)
8. Engine Oil Cooler Inlet Pipe (3) » Remove

Installation Procedure

1. Engine Oil Cooler Inlet Pipe (3) » Install

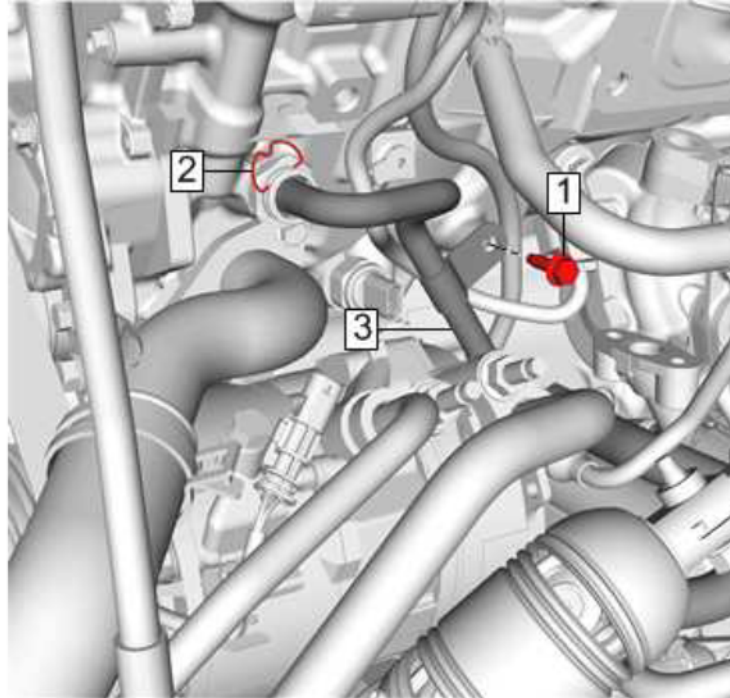


Fig. 165: Engine Oil Cooler Inlet Pipe

Courtesy of GENERAL MOTORS COMPANY

2. Install the retainer to the quick connect fitting. (2)
3. Engine Oil Cooler Inlet Pipe Bolt (1)» Install and tighten 10 N.m (89 lb in)

CAUTION: Refer to **Fastener Caution** .

4. Engine Oil Cooler Inlet Pipe (3)» Connect

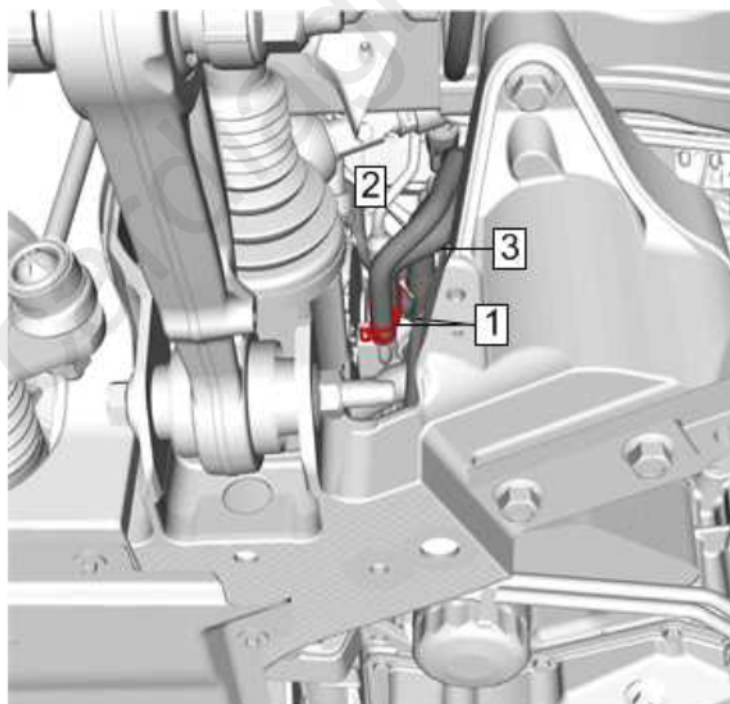


Fig. 166: Engine Oil Cooler Inlet Pipe

Courtesy of GENERAL MOTORS COMPANY

5. Turbocharger Coolant Feed and Return Pipe (2)» Connect
6. Hose Clamp (1)» Engage [2x] - **Hose Clamp Replacement Guidelines - Spring Type**
7. **Turbocharger Replacement (Right Side) Turbocharger Replacement (Left Side)** » Remove
8. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static without HP9)** and/or **Cooling System Draining and Filling (GE 47716 without HP9)**
9. Start the engine and check for leaks.

ENGINE OIL COOLER INLET PIPE REPLACEMENT (OIL COOLER TO RADIATOR, LGX WITH AWD)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. [Underbody Front Air Deflector Replacement](#) » Remove
3. [Drivetrain and Front Suspension Cradle Plate Replacement](#) » Remove
4. Clamp (1) » Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

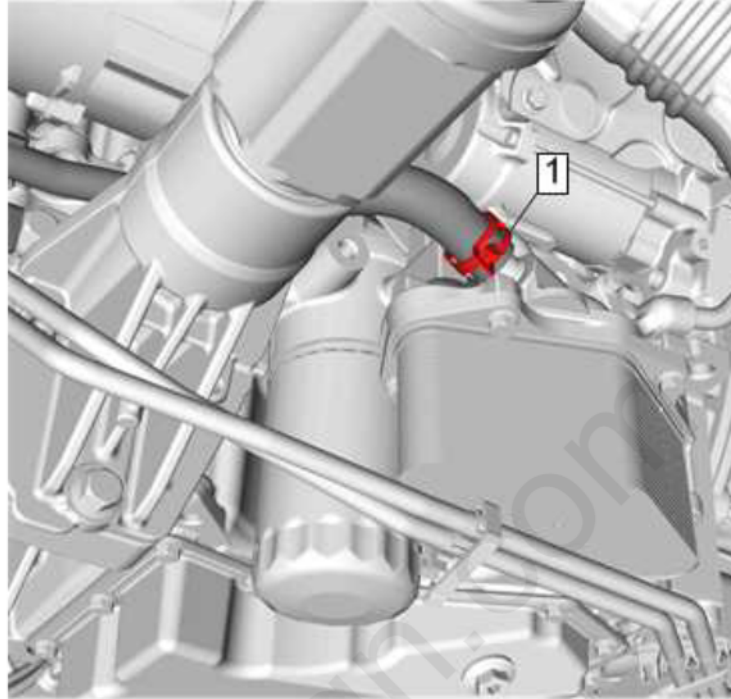


Fig. 167: Clamp

Courtesy of GENERAL MOTORS COMPANY

5. Clamp (1) » Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

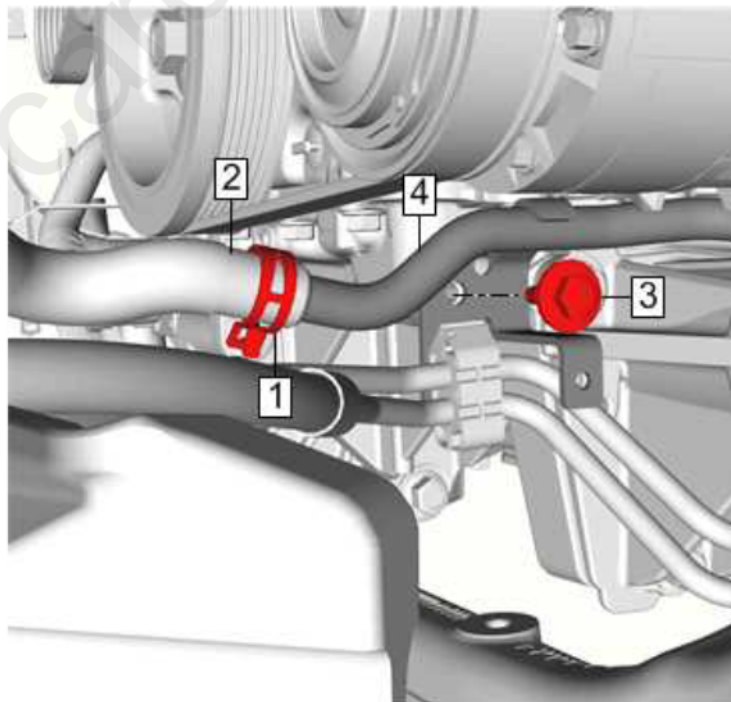


Fig. 168: Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Engine Oil Cooler Inlet Hose (2) » Disconnect
7. Engine Oil Cooler Pipe Bolt (3) » Remove

8. Engine Oil Cooler Inlet Pipe (4)» Remove

Installation Procedure

1. Engine Oil Cooler Inlet Pipe (4)» Install

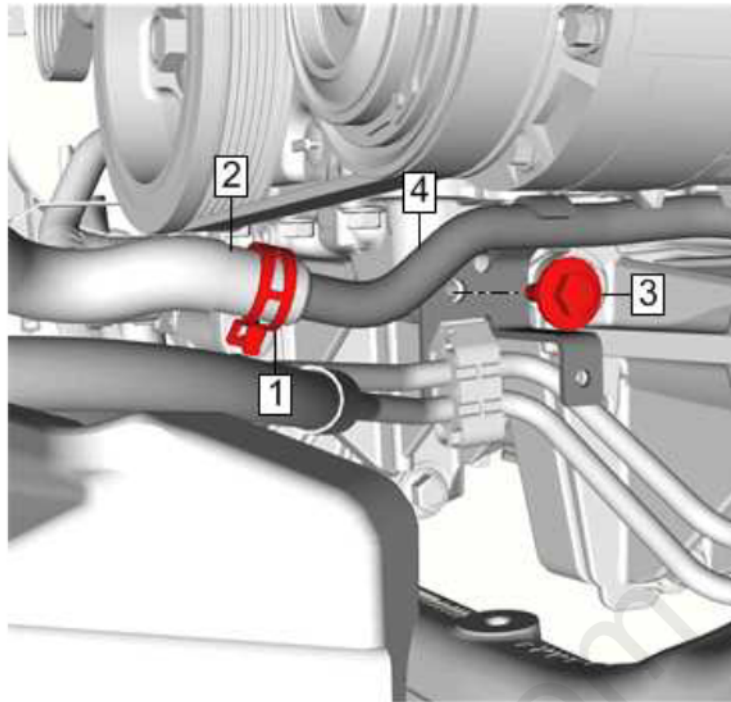


Fig. 169: Clamp

Courtesy of GENERAL MOTORS COMPANY

2. Engine Oil Cooler Pipe Bolt (3)» Install and tighten 10 N.m (89 lb in)

CAUTION: Refer to **Fastener Caution** .

3. Engine Oil Cooler Inlet Hose (2)» Connect

4. Clamp (1)» Engage - **Hose Clamp Replacement Guidelines - Spring Type**

5. Clamp (1)» Engage - **Hose Clamp Replacement Guidelines - Spring Type**

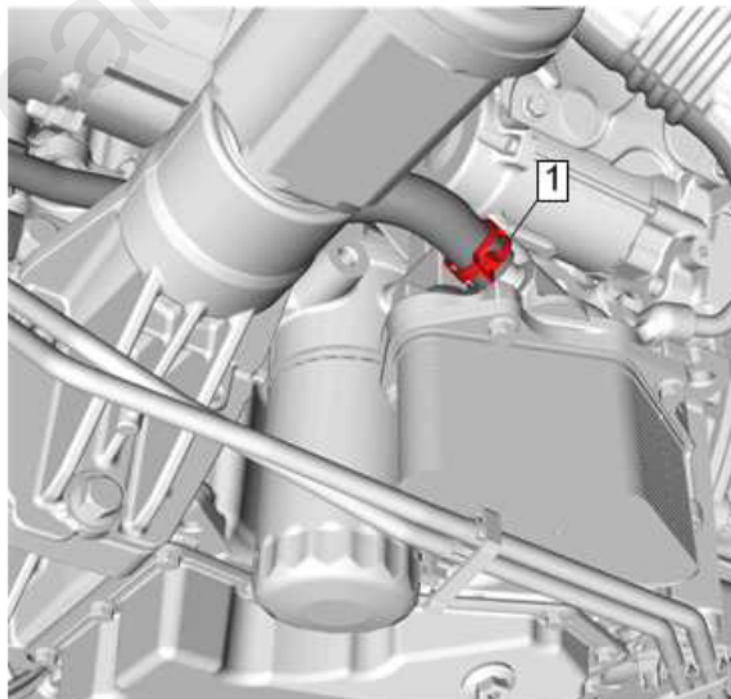


Fig. 170: Clamp

Courtesy of GENERAL MOTORS COMPANY

6. **Drivetrain and Front Suspension Cradle Plate Replacement** » Install

7. [Underbody Front Air Deflector Replacement A, A» Install](#)
8. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
9. Start the engine and check for leaks.

ENGINE OIL COOLER INLET PIPE REPLACEMENT (OIL COOLER TO ENGINE BLOCK, LGX WITH AWD)

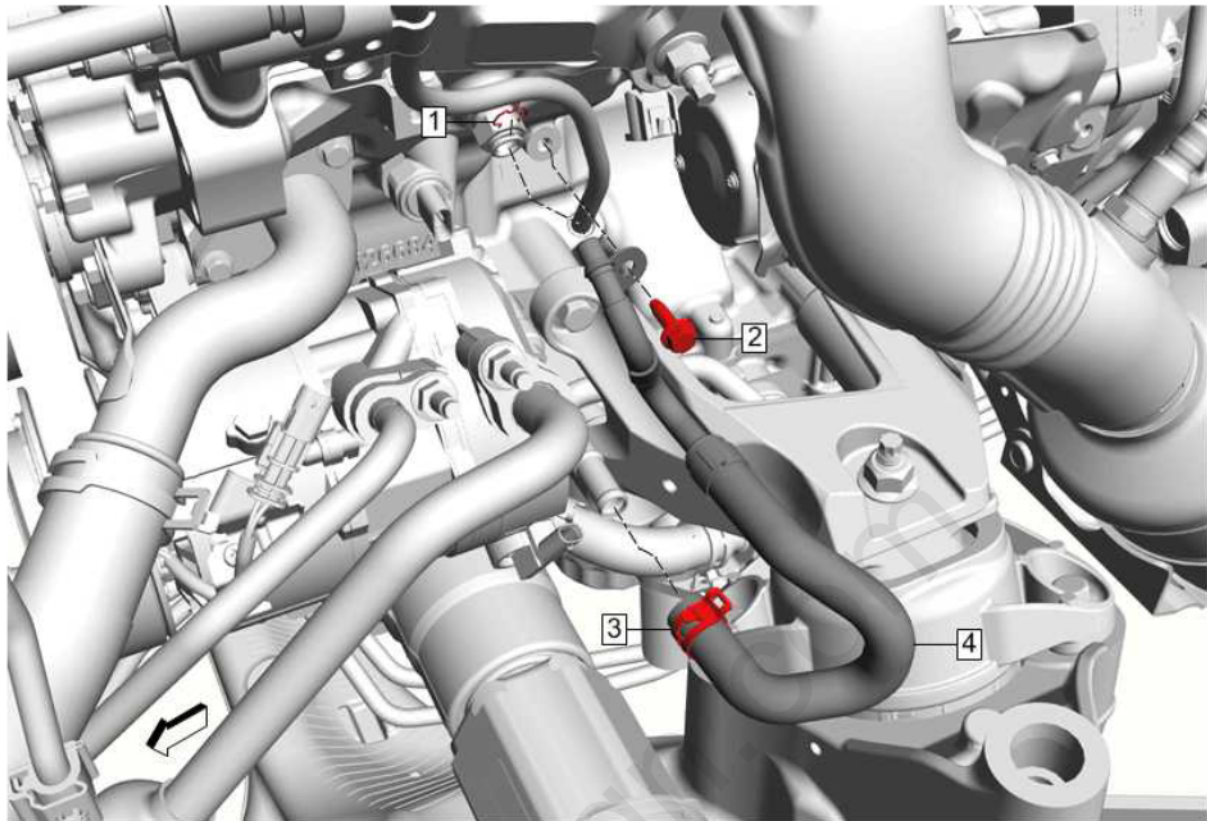


Fig. 171: Engine Oil Cooler Inlet Pipe (Oil Cooler to Engine Block, LGX with AWD)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Cooling System Draining and Filling (Static without HP9)Cooling System Draining and Filling (GE 47716 without HP9) Intake Manifold Cover Replacement (LGX)	
1	Retainer Procedure Disengage the engine oil cooler inlet pipe quick connect retainer.
2	Engine Oil Cooler Inlet Pipe Bolt CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
3	Clamp Procedure Hose Clamp Replacement Guidelines - Spring Type
4	Engine Oil Cooler Inlet Pipe

ENGINE COOLANT FAN MOTOR REPLACEMENT (LGW LGX LTG)

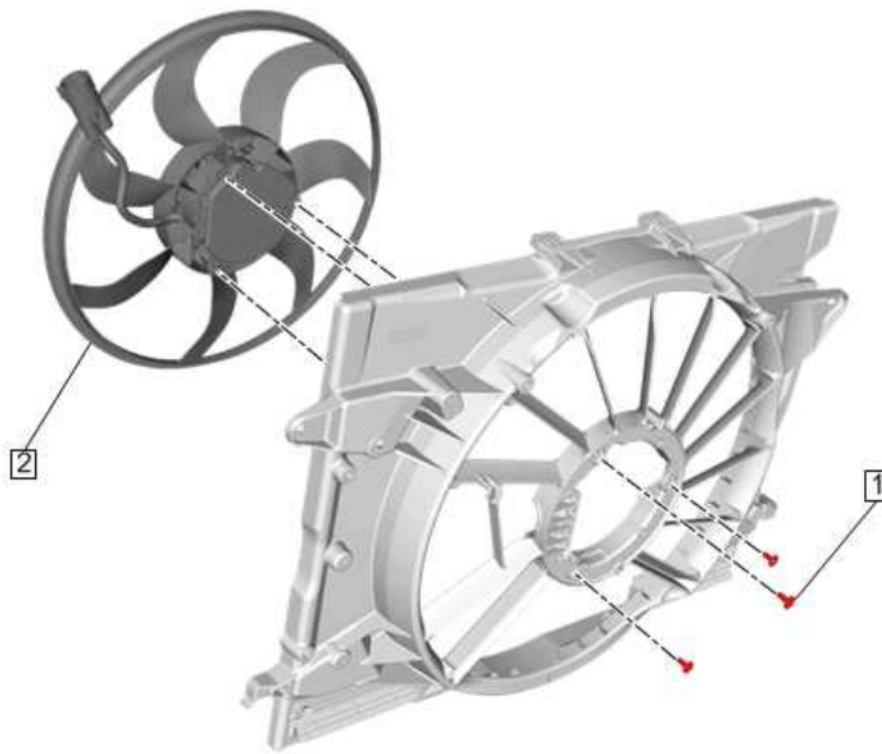


Fig. 172: Engine Coolant Fan Motor (LGW LGX LTG)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Engine Coolant Fan Shroud Replacement (LGW LGX LTG)</u>	
1	Engine Coolant Fan Motor Bolt [3x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 6.0 N.m (53 lb in)
2	Engine Coolant Fan Motor

TURBOCHARGER COOLANT FEED PIPE REPLACEMENT (LTG)

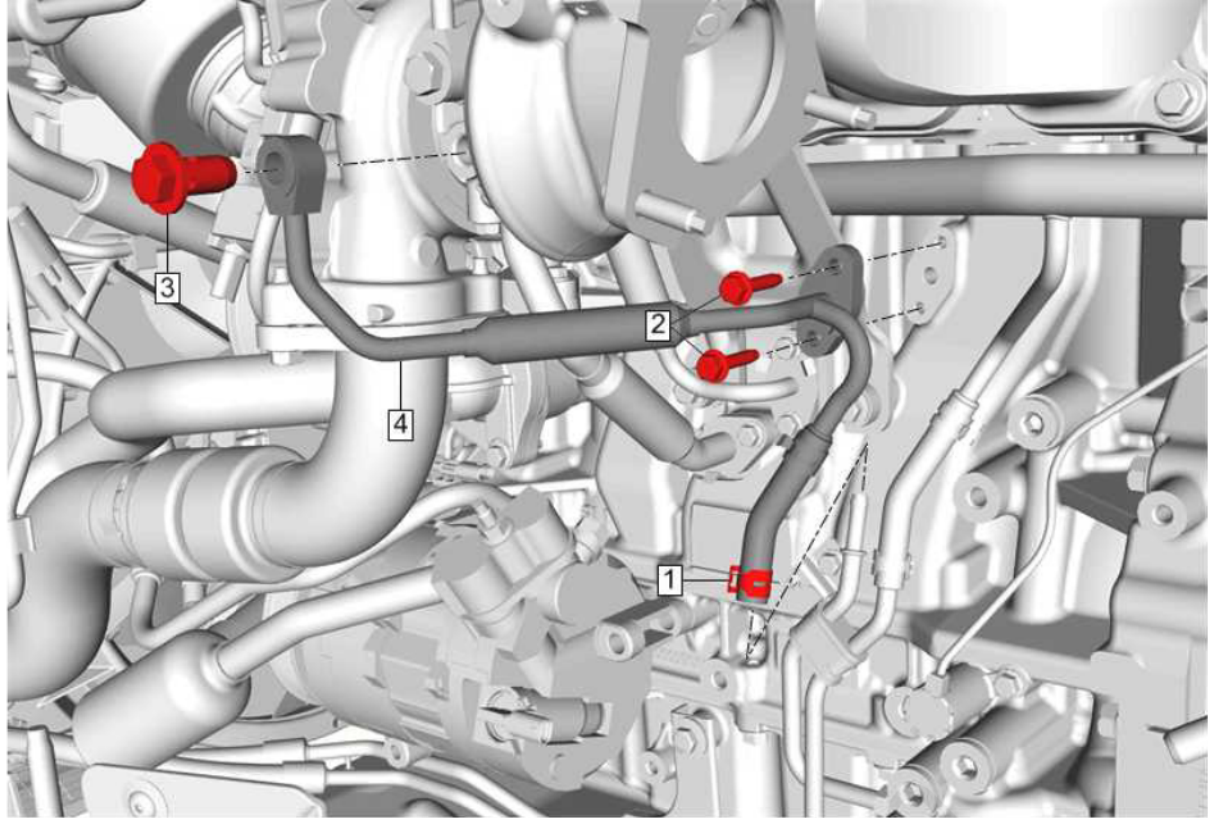


Fig. 173: Turbocharger Coolant Feed Pipe (LTG)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Wheelhouse Liner - Left SideÃ,Â» Remove - Front Wheelhouse Liner Replacement 2. Drain the cooling system. Refer to Cooling System Draining and Filling (Static LTG with HP9) and/or Cooling System Draining and Filling (GE 47716 LTG with HP9) 3. Warm Up Three-Way Catalytic Converter Replacement (LTG)	
1	Turbocharger Coolant Feed Hose Clamp Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Turbocharger Coolant Feed Pipe Fastener [2x] CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
3	Turbocharger Coolant Feed Pipe Hollow Screw Procedure Install NEW sealing washers. Tighten 35 N.m (26 lb ft)
4	Turbocharger Coolant Feed Pipe Procedure Install a NEW gasket.

TURBOCHARGER COOLANT RETURN PIPE REPLACEMENT (LTG)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static LTG with HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 LTG with HP9\)](#).
2. Intake Manifold Cover, Remove - [Intake Manifold Cover Replacement](#)
3. Turbocharger Heat Shield, Remove - [Turbocharger Heat Shield Replacement](#)
4. Positive Crankcase Ventilation Valve @ Turbocharger, Remove - [Positive Crankcase Ventilation Valve Replacement](#)
5. Turbocharger Coolant Return Pipe Hollow Screw (1), Remove

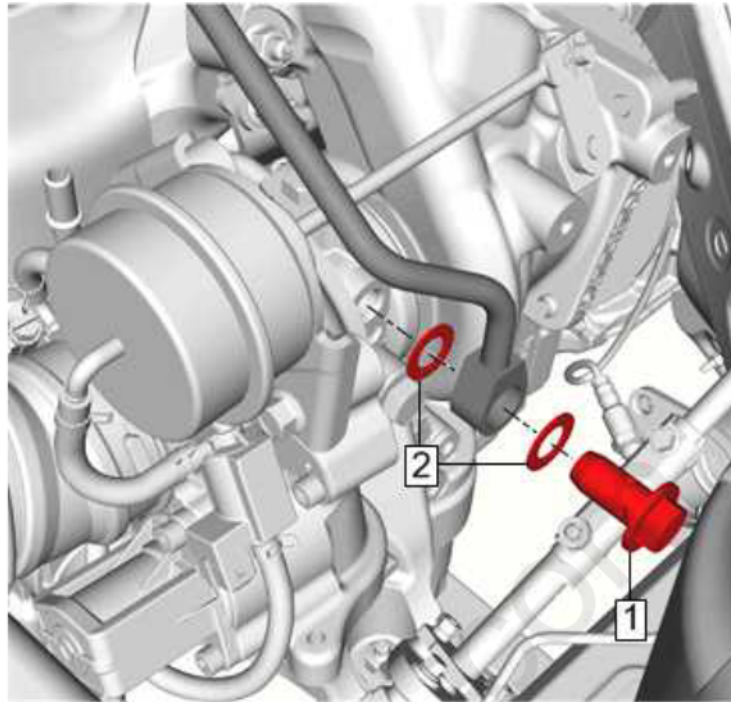


Fig. 174: Coolant Return Pipe, Bolt And Washer
Courtesy of GENERAL MOTORS COMPANY

6. Washer (2), Remove and DISCARD [2x]
7. Clamp (1), Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

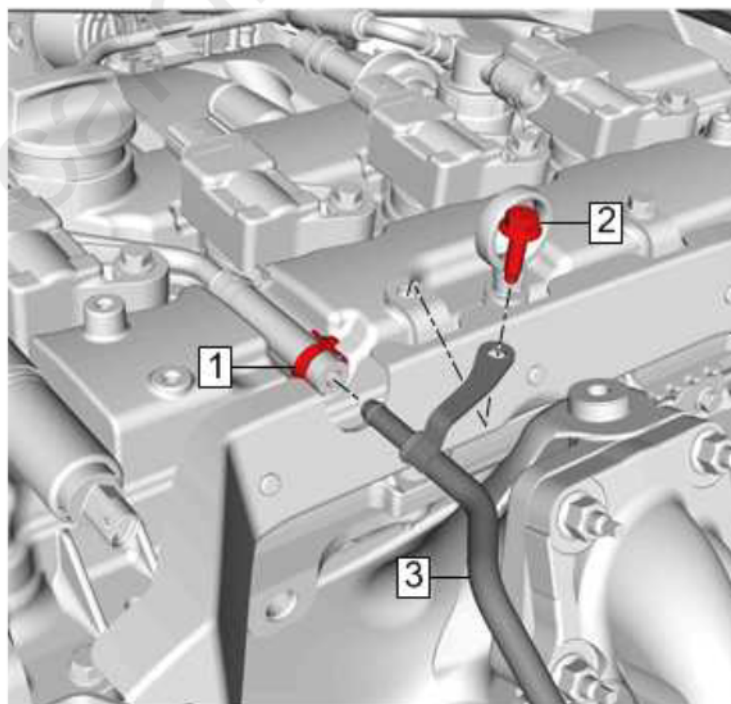


Fig. 175: Clamp, Bolt And Pipe
Courtesy of GENERAL MOTORS COMPANY

8. Turbocharger Coolant Return Pipe Fastener (2), Remove
9. Turbocharger Coolant Return Pipe (3), Remove

1. Turbocharger Coolant Return Pipe (3)» Install

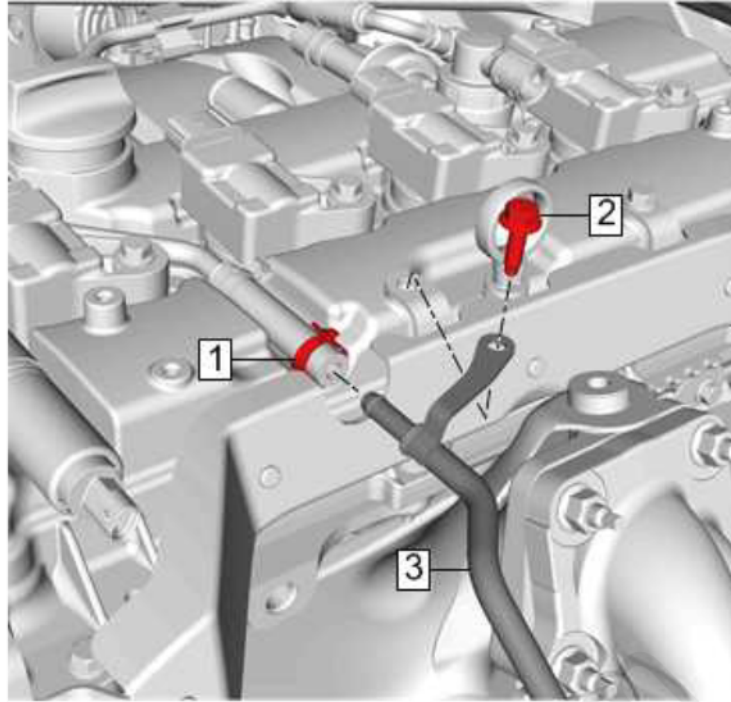


Fig. 176: Clamp, Bolt And Pipe
Courtesy of GENERAL MOTORS COMPANY

2. Turbocharger Coolant Return Pipe Fastener (2)» Install and tighten 10 N.m (89 lb in)

CAUTION: Refer to **Fastener Caution** .

3. Clamp (1)» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
4. Washer (2)» Install [2x]

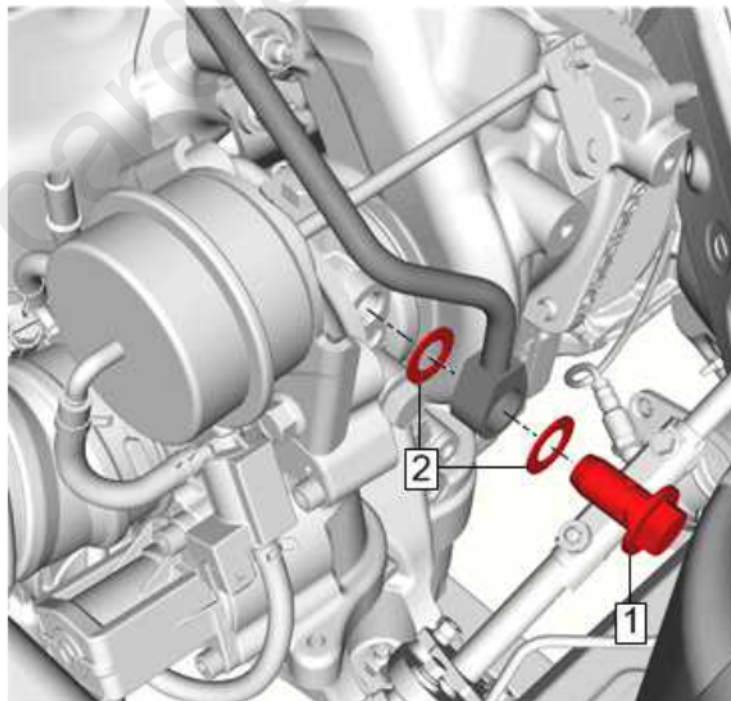


Fig. 177: Coolant Return Pipe, Bolt And Washer
Courtesy of GENERAL MOTORS COMPANY

NOTE: Install **NEW** washers.

5. Turbocharger Coolant Return Pipe Hollow Screw (1)» Install and tighten 35 N.m (26 lb ft)

6. Positive Crankcase Ventilation Valve @ Turbocharger» Install - [Positive Crankcase Ventilation Valve Replacement](#)
7. Turbocharger Heat Shield» Install - [Turbocharger Heat Shield Replacement](#)
8. Intake Manifold Cover» Install - [Intake Manifold Cover Replacement](#)
9. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static LTG with HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 LTG with HP9\)](#)
10. Start the engine and check for leaks.

TURBOCHARGER COOLANT FEED AND RETURN PIPE REPLACEMENT (LEFT, LGW)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. Charge Air Bypass Valve» Remove - [Charge Air Bypass Valve Replacement - Left Side](#)
3. Air Cleaner Outlet Front Duct» Remove - [Air Cleaner Outlet Front Duct Replacement \(LGW\)](#)
4. Engine Front Splash Shield» Remove - [Engine Front Splash Shield Replacement - Left Side \(Rear\)](#) [Engine Front Splash Shield Replacement - Left Side \(Front\)](#)
5. Hose Clamp (1)» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

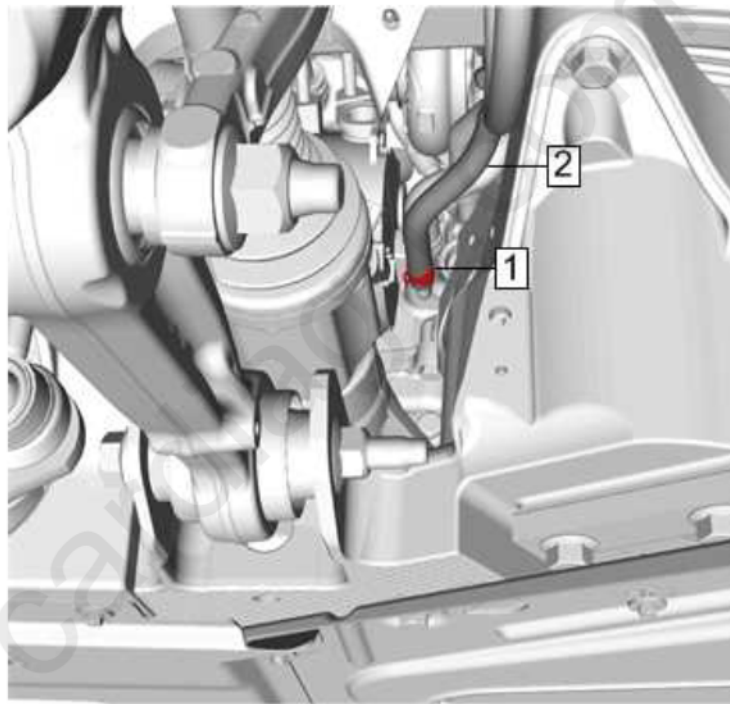


Fig. 178: Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Turbocharger Coolant Feed and Return Pipe (2)» Disconnect
7. Air Conditioning Refrigerant Heat Exchanger» Remove - [Air Conditioning Refrigerant Heat Exchanger Replacement \(LGW, LGX\)](#)
8. Remove the retainer from the quick connect fitting. (1)

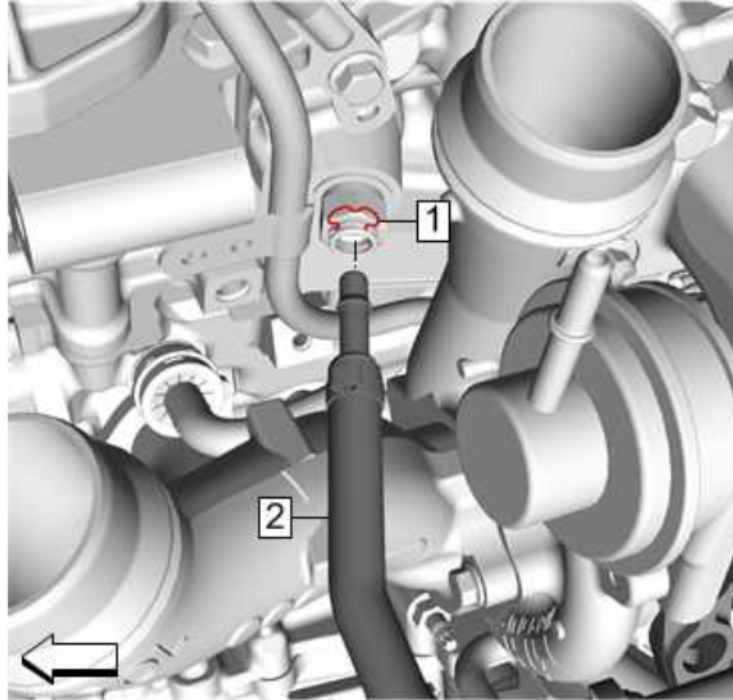


Fig. 179: Retainer And Quick Connect Fitting
 Courtesy of GENERAL MOTORS COMPANY

9. Turbocharger Coolant Feed and Return Pipe (2) » Disconnect
10. Turbocharger Coolant Feed and Return Pipe Bolt (1) » Remove [2x]

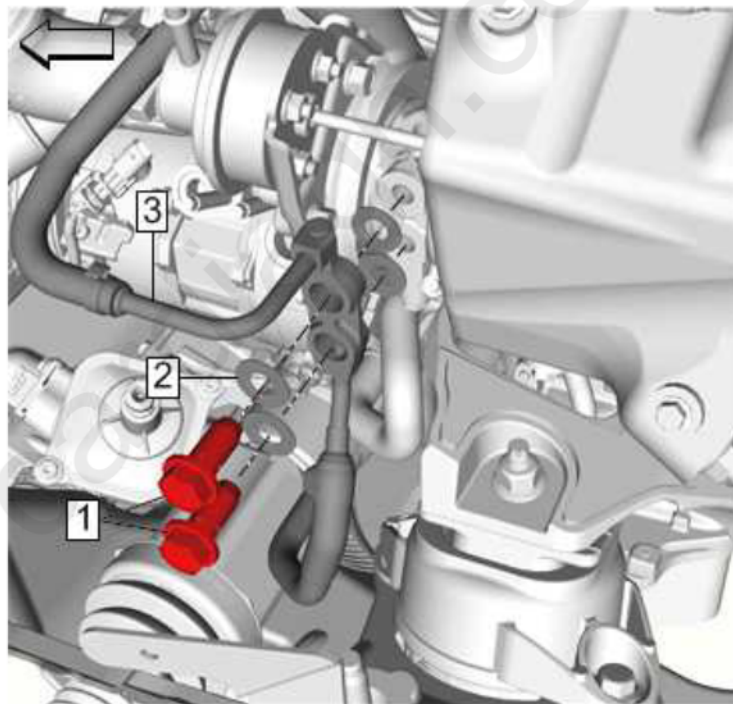


Fig. 180: Turbocharger Coolant Feed and Return Pipe
 Courtesy of GENERAL MOTORS COMPANY

11. Turbocharger Coolant Feed and Return Pipe Washer (2) » Remove and DISCARD [4x]
12. Turbocharger Coolant Feed and Return Pipe (3) » Remove

Installation Procedure

1. Turbocharger Coolant Feed and Return Pipe (3) » Install

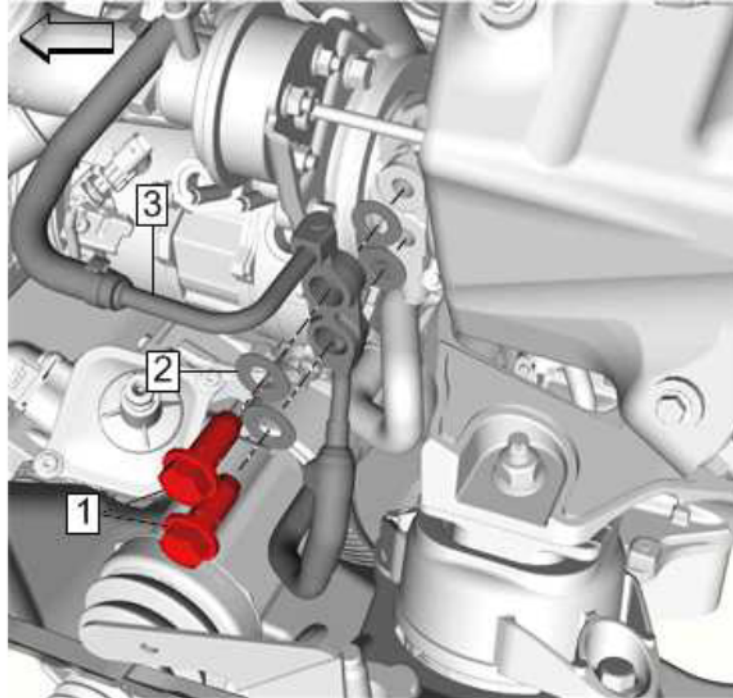


Fig. 181: Turbocharger Coolant Feed and Return Pipe
Courtesy of GENERAL MOTORS COMPANY

2. Turbocharger Coolant Feed and Return Pipe Washer (2)» Install [4x]

NOTE: Install **NEW** sealing washers.

3. Turbocharger Coolant Feed and Return Pipe Bolt (1)» Install and tighten [2x] 35 N.m (26 lb ft)

CAUTION: Refer to **Fastener Caution** .

4. Turbocharger Coolant Feed and Return Pipe (2)» Connect

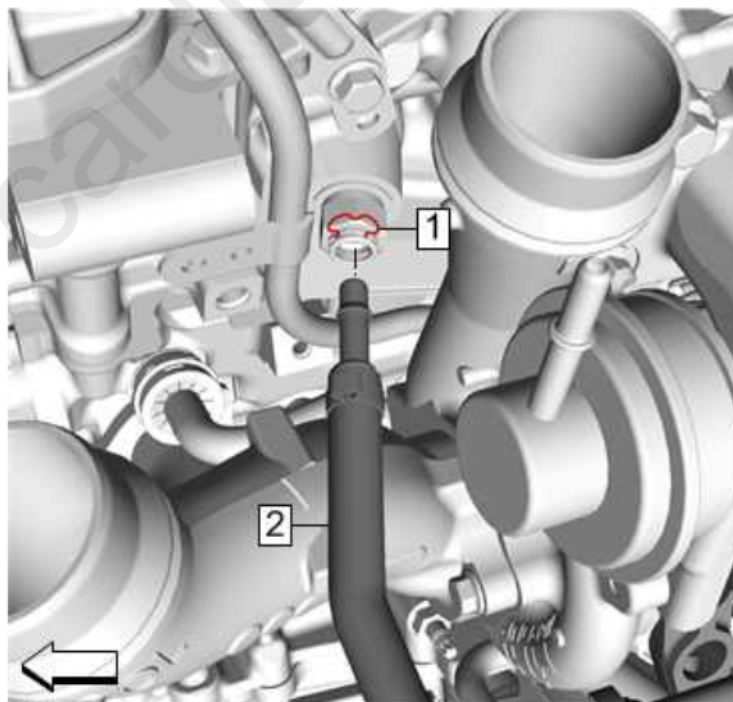


Fig. 182: Retainer And Quick Connect Fitting
Courtesy of GENERAL MOTORS COMPANY

5. Install the retainer to the quick connect fitting. (1)
6. Air Conditioning Refrigerant Heat Exchanger» Install - **Air Conditioning Refrigerant Heat Exchanger Replacement (LGW, LGX)**
7. Turbocharger Coolant Feed and Return Pipe (2)» Connect

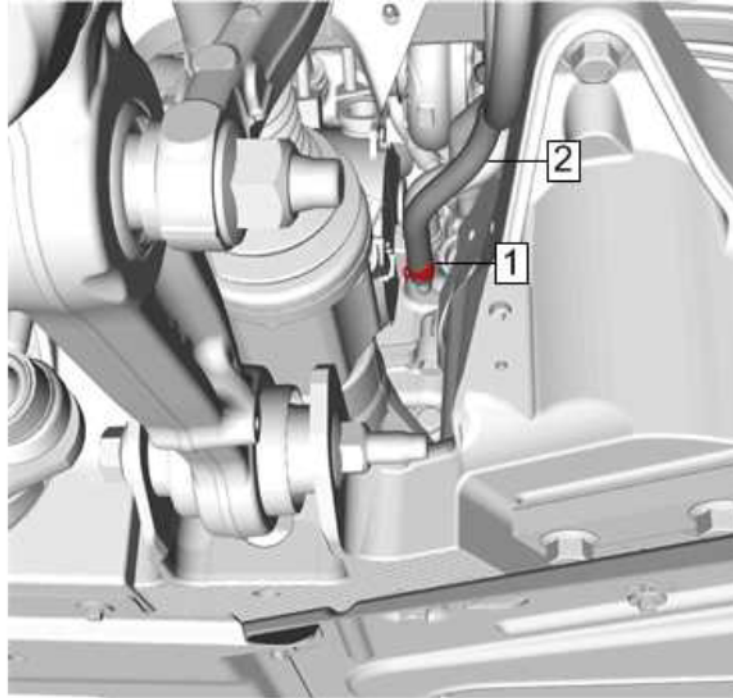


Fig. 183: Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

8. Hose Clamp (1) » Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
9. Engine Front Splash Shield » Install - [Engine Front Splash Shield Replacement - Left Side \(Rear\)](#) [Engine Front Splash Shield Replacement - Left Side \(Front\)](#)
10. Charge Air Bypass Valve » Install - [Charge Air Bypass Valve Replacement - Left Side](#)
11. Air Cleaner Outlet Front Duct » Install - [Air Cleaner Outlet Front Duct Replacement \(LGW\)](#)
12. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#).
13. Start the engine and check for leaks.

TURBOCHARGER COOLANT FEED AND RETURN PIPE REPLACEMENT (RIGHT, LGW)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. [Generator Replacement \(LGW\)](#) » Remove
3. [Charge Air Bypass Valve Replacement - Right Side](#) » Remove
4. Remove the retainer from the quick connect fitting. (1) [2x]

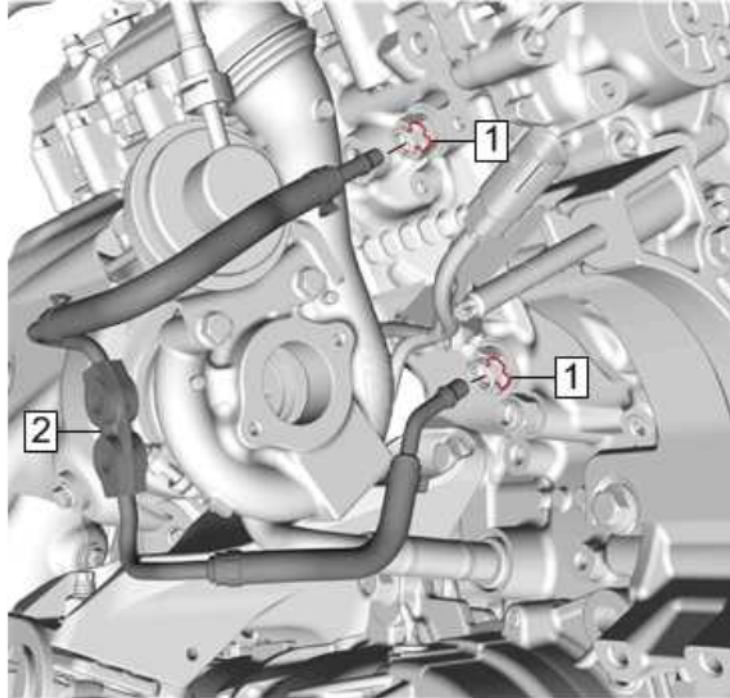


Fig. 184: Retainer And Quick Connect Fitting
 Courtesy of GENERAL MOTORS COMPANY

5. Turbocharger Coolant Feed and Return Pipe (2) » Disconnect
6. Turbocharger Coolant Feed and Return Pipe Bolt (1) » Remove [2x]

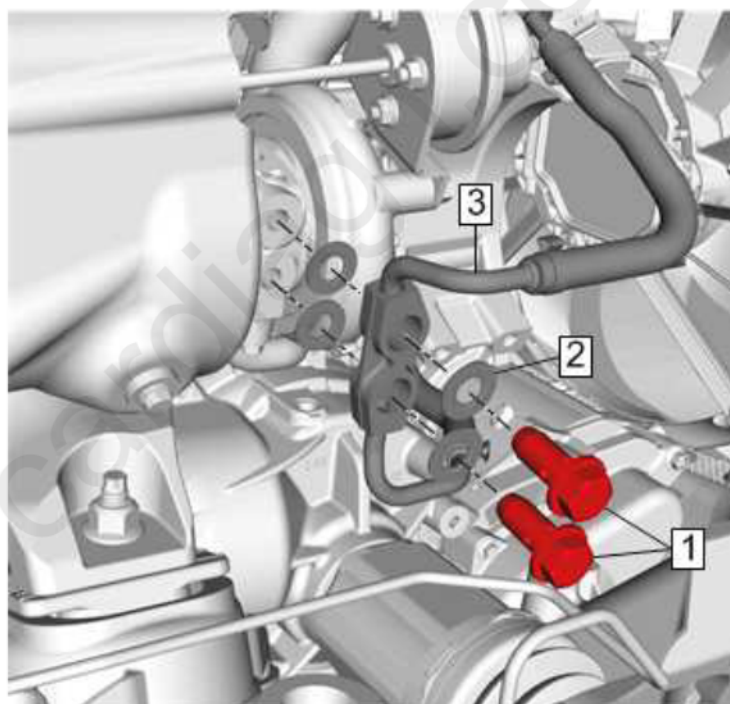


Fig. 185: Turbocharger Coolant Feed And Return Pipe
 Courtesy of GENERAL MOTORS COMPANY

7. Turbocharger Coolant Feed and Return Pipe Washer (2) » Remove and DISCARD [4x]
8. Turbocharger Coolant Feed and Return Pipe (3) » Remove

Installation Procedure

1. Turbocharger Coolant Feed and Return Pipe (3) » Install

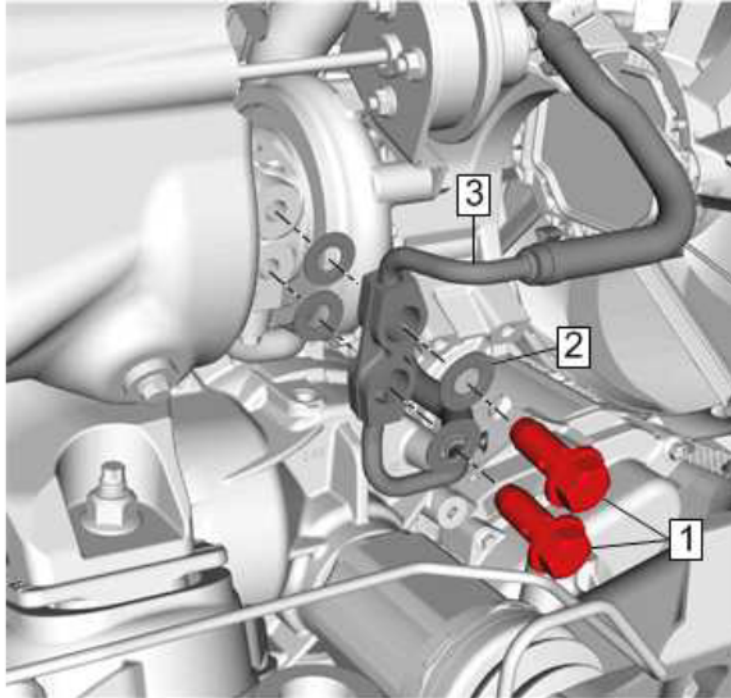


Fig. 186: Turbocharger Coolant Feed And Return Pipe

Courtesy of GENERAL MOTORS COMPANY

2. Turbocharger Coolant Feed and Return Pipe Washer (2)» Install [4x]

NOTE: Install **NEW** sealing washers.

3. Turbocharger Coolant Feed and Return Pipe Bolt (3)» Install and tighten [2x] 35 N.m (26 lb ft)

CAUTION: Refer to **Fastener Caution** .

4. Turbocharger Coolant Feed and Return Pipe (2)» Connect

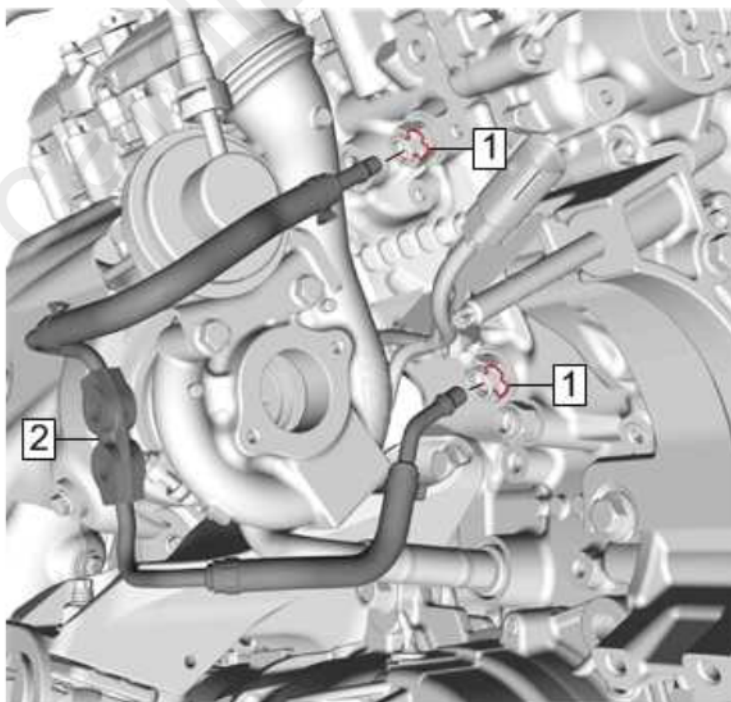


Fig. 187: Retainer And Quick Connect Fitting

Courtesy of GENERAL MOTORS COMPANY

5. Install the retainer to the quick connect fitting. (1) [2x]
6. **Charge Air Bypass Valve Replacement - Right Side** » Install
7. **Generator Replacement (LGW)** » Install

8. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)

9. Start the engine and check for leaks.

TURBOCHARGER COOLANT RETURN HOSE REPLACEMENT (LGW)

Removal Procedure

1. Drain the charge air cooling system. Refer to [Charge Air Cooling System Draining and Filling \(LGW\)](#)
2. [Air Cleaner Assembly Replacement \(LGW\)](#) » Remove
3. [Front Compartment Front Sight Shield Replacement](#) » Remove
4. Charge Air Cooler Coolant Hose Clamp (1) @ Charge Air Cooler Coolant Hose » Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

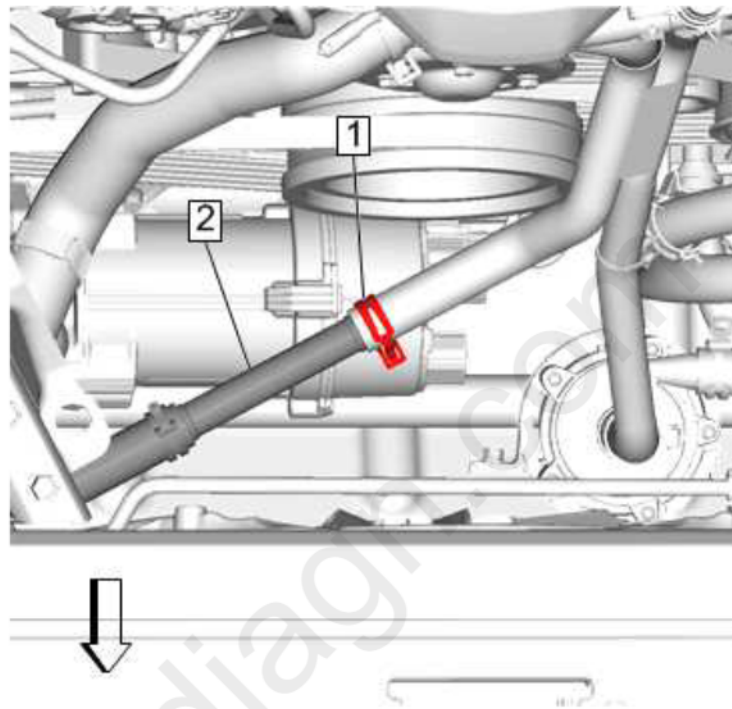


Fig. 188: Charge Air Cooler Coolant Hose Clamp And Hose
Courtesy of GENERAL MOTORS COMPANY

5. Turbocharger Coolant Return Hose (2) @ Charge Air Cooler Coolant Hose » Remove
6. Hose Clip (2) @ Engine Coolant Fan Shroud » Remove

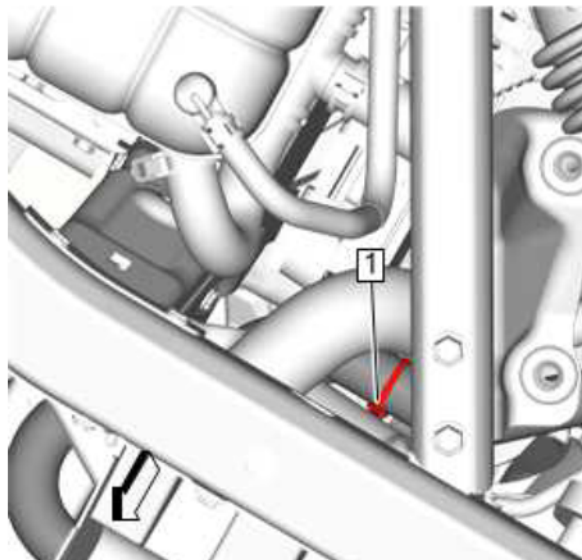


Fig. 189: Hose Clip
Courtesy of GENERAL MOTORS COMPANY

7. Turbocharger Coolant Return Hose Clamp (1)» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

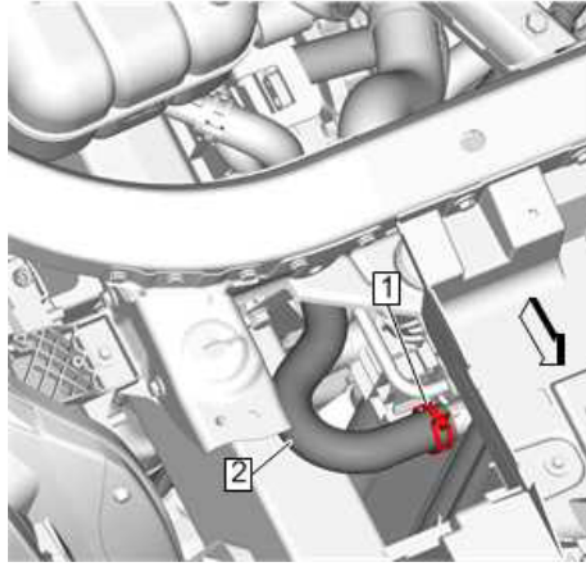


Fig. 190: Turbocharger Coolant Return Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

8. Turbocharger Coolant Return Hose (2) @ Charge Air Cooler Radiator» Remove

Installation Procedure

1. Turbocharger Coolant Return Hose (2) @ Charge Air Cooler Radiator» Install



Fig. 191: Turbocharger Coolant Return Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

2. Turbocharger Coolant Return Hose Clamp (1)» Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
3. Hose Clip (2) @ Engine Coolant Fan Shroud» Install

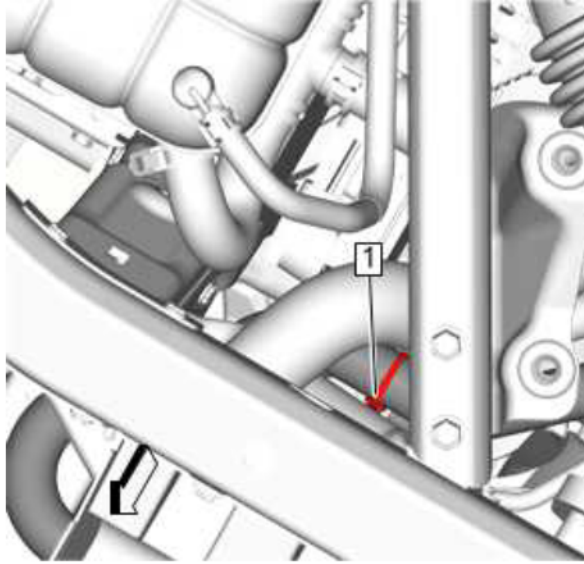


Fig. 192: Hose Clip

Courtesy of GENERAL MOTORS COMPANY

4. Turbocharger Coolant Return Hose (2) @ Charge Air Cooler Coolant Hose» Install

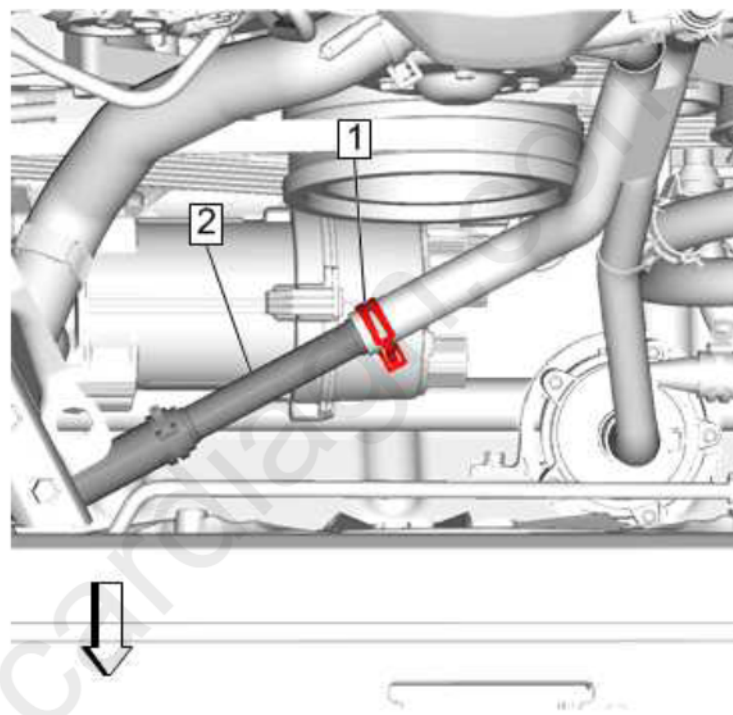


Fig. 193: Charge Air Cooler Coolant Hose Clamp And Hose

Courtesy of GENERAL MOTORS COMPANY

5. Charge Air Cooler Coolant Hose Clamp (1) @ Charge Air Cooler Coolant Hose» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
6. **Front Compartment Front Sight Shield Replacement** » Install
7. **Air Cleaner Assembly Replacement (LGW)** » Install
8. Fill the charge air cooling system. Refer to **Charge Air Cooling System Draining and Filling (LGW)**
9. Check the charge air cooling system for leaks. Refer to **Charge Air Cooling System Leak Testing (LGW)**.

WATER PUMP INLET PIPE REPLACEMENT (LGW)

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static without HP9)** and/or **Cooling System Draining and Filling (GE 47716 without HP9)**
2. **Air Cleaner Outlet Front Duct Replacement (LGW)** » Remove

3. Radiator Outlet Hose Clamp (1)A,Â» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

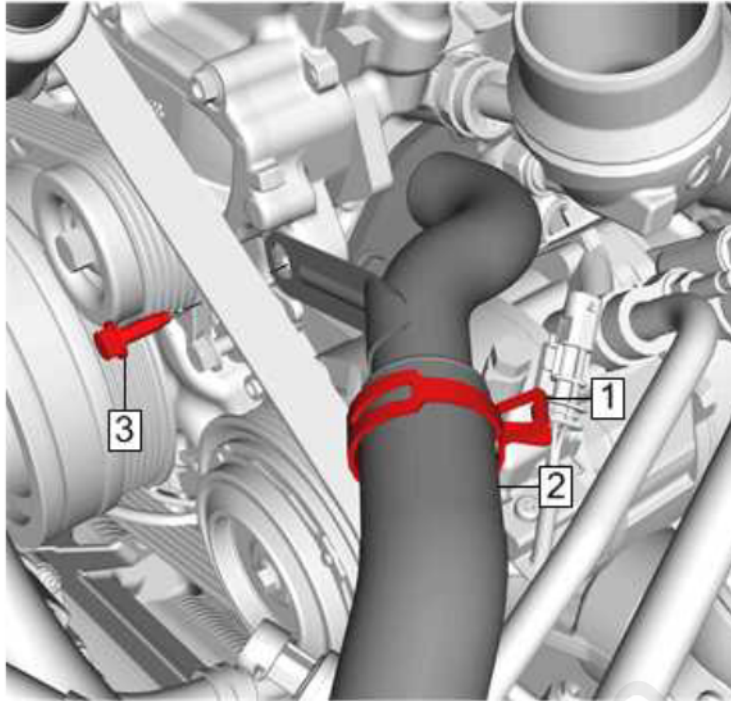


Fig. 194: Radiator Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Radiator Outlet Hose (2)A,Â» Disconnect
5. Water Pump Inlet Pipe Bolt (3)A,Â» Remove
6. Water Pump Inlet Pipe Bolt (1)A,Â» Remove [2x]

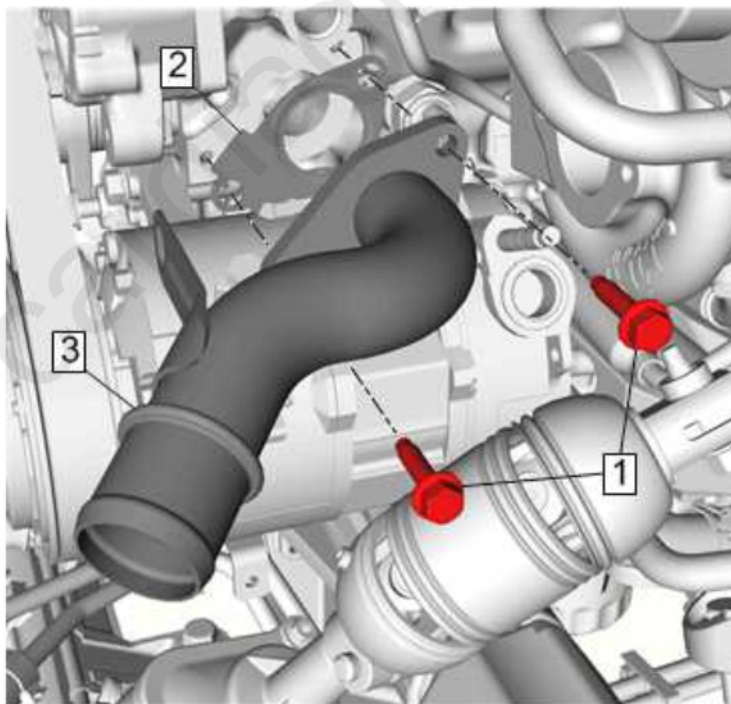


Fig. 195: Water Pump Inlet Pipe
Courtesy of GENERAL MOTORS COMPANY

7. Water Pump Inlet Pipe Seal (2)A,Â» Remove and DISCARD
8. Water Pump Inlet Pipe (3)A,Â» Remove

Installation Procedure

1. Water Pump Inlet Pipe (3)A,Â» Install

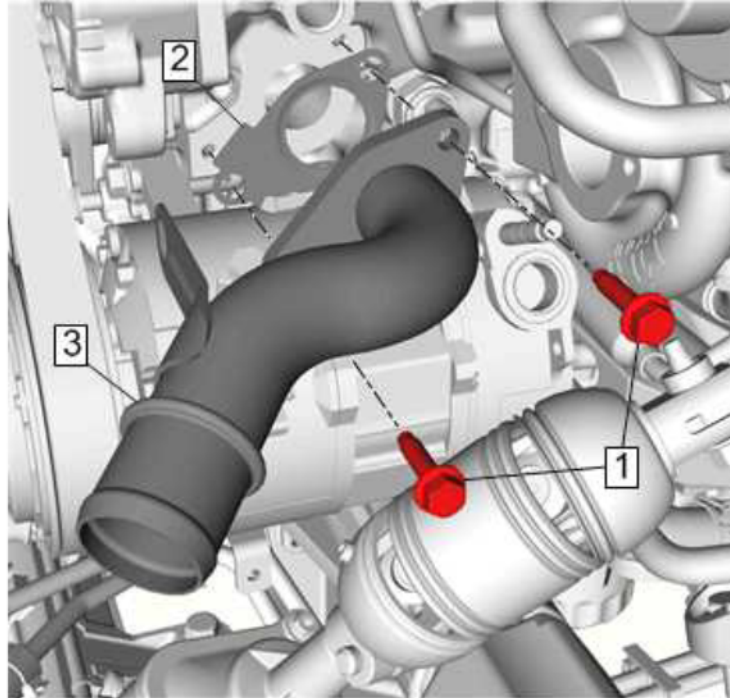


Fig. 196: Water Pump Inlet Pipe

Courtesy of GENERAL MOTORS COMPANY

2. Water Pump Inlet Pipe Seal (2)» Install

NOTE: Install a **NEW** water pump inlet seal.

3. Water Pump Inlet Pipe Bolt (1)» Install and tighten [2x] 9 N.m (80 lb in)

CAUTION: Refer to **Fastener Caution**.

4. Water Pump Inlet Pipe Bolt (3)» Install and tighten 9 N.m (80 lb in)

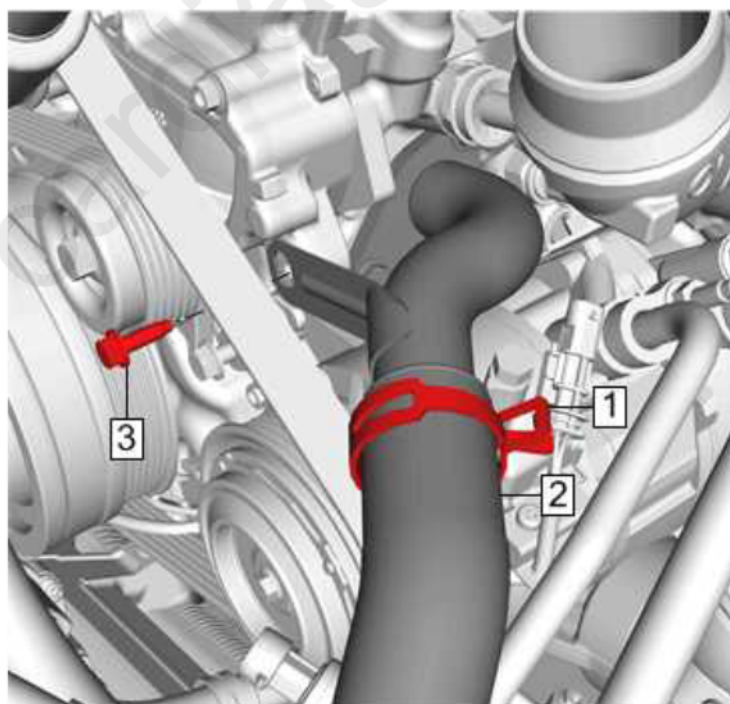


Fig. 197: Radiator Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

5. Radiator Outlet Hose (2)» Connect
6. Radiator Outlet Hose Clamp (1)» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
7. **Air Cleaner Outlet Front Duct Replacement (LGW)** » Install

8. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
9. Start the engine and check for leaks.

WATER PUMP INLET PIPE REPLACEMENT (LGX)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. Radiator Outlet Hose Clamp (1) » Reposition - [Hose Clamp Replacement Guidelines - Spring Type](#)

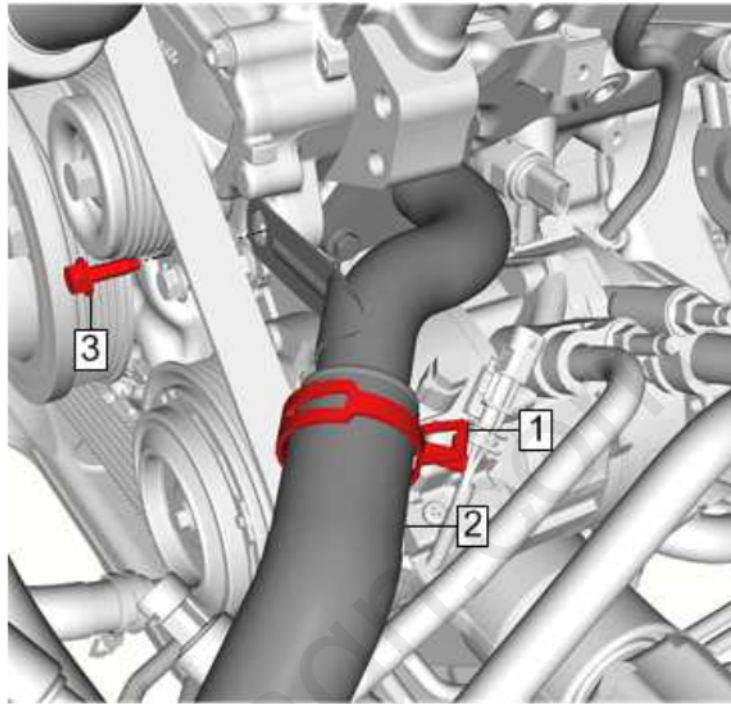


Fig. 198: Radiator Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Radiator Outlet Hose (2) » Disconnect
4. Water Pump Inlet Pipe Bolt (3) » Remove
5. Water Pump Inlet Pipe Bolt (1) » Remove [2x]

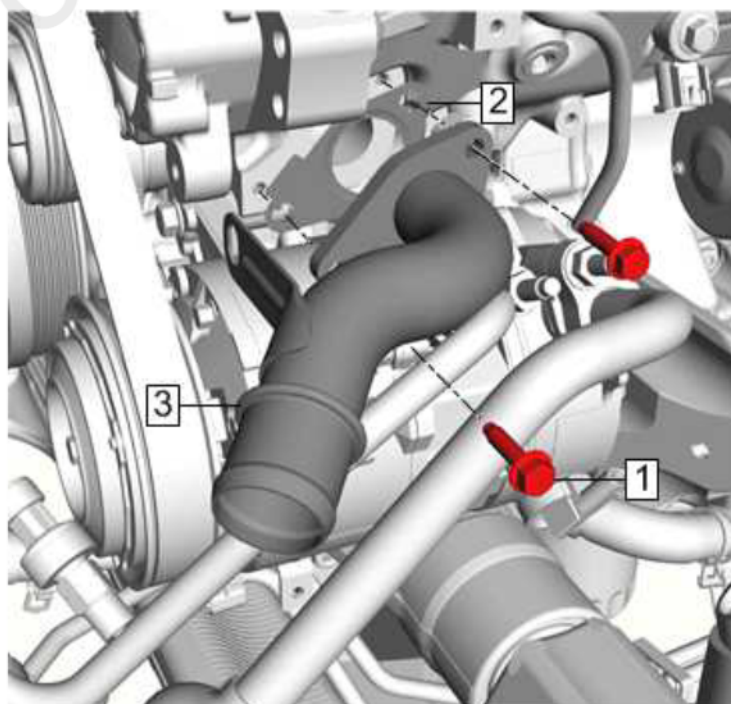


Fig. 199: Water Pump Inlet Pipe
Courtesy of GENERAL MOTORS COMPANY

6. Water Pump Inlet Pipe Seal (2)» Remove and DISCARD
7. Water Pump Inlet Pipe (3)» Remove

Installation Procedure

1. Water Pump Inlet Pipe (3)» Install

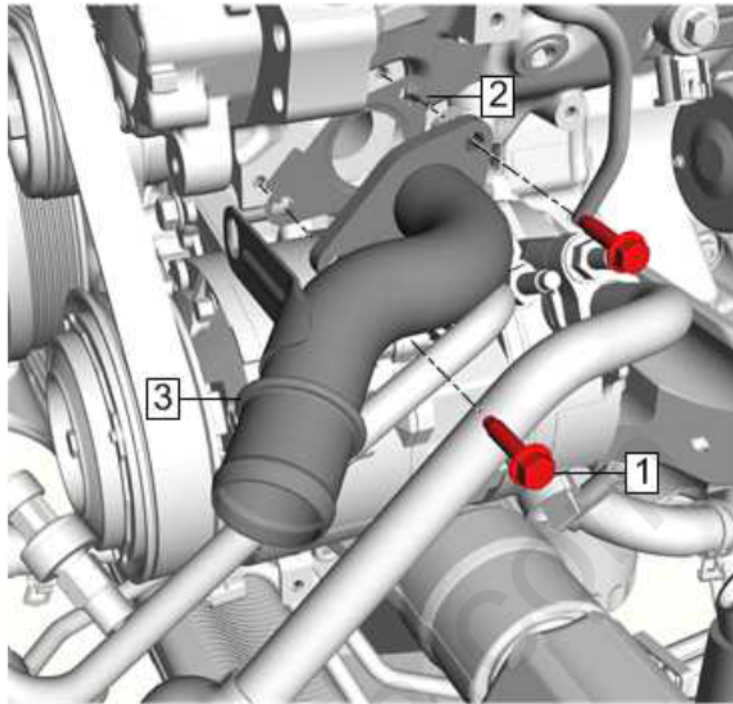


Fig. 200: Water Pump Inlet Pipe
Courtesy of GENERAL MOTORS COMPANY

2. Water Pump Inlet Pipe Seal (2)» Install

NOTE: Install a NEW water pump inlet seal.

3. Water Pump Inlet Pipe Bolt (1)» Install and tighten [2x] 9 N.m (80 lb in)

CAUTION: Refer to **Fastener Caution** .

4. Water Pump Inlet Pipe Bolt (3)» Install and tighten 9 N.m (80 lb in)

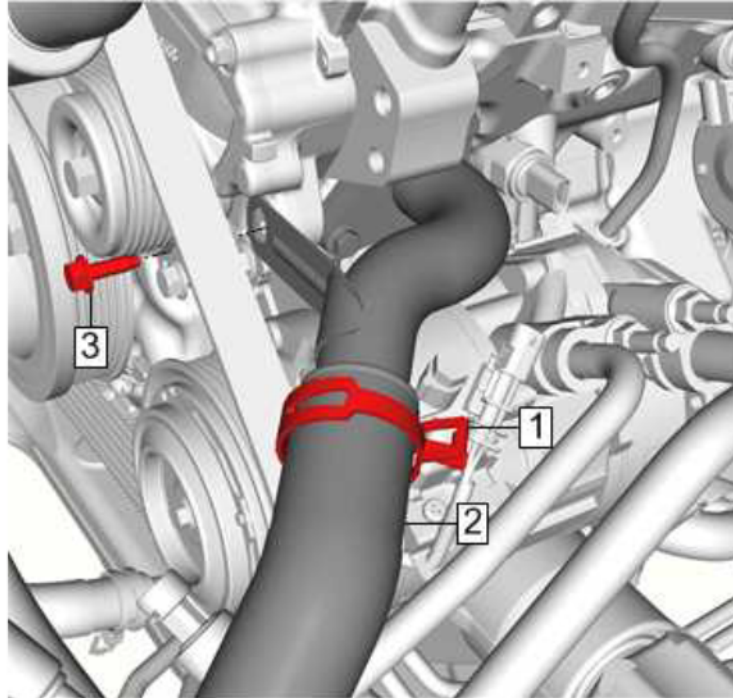


Fig. 201: Radiator Outlet Hose Clamp
 Courtesy of GENERAL MOTORS COMPANY

5. Radiator Outlet Hose (2)» Connect
6. Radiator Outlet Hose Clamp (1)» Install - [Hose Clamp Replacement Guidelines - Spring Type](#)
7. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
8. Start the engine and check for leaks.

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (LGW, LGX)

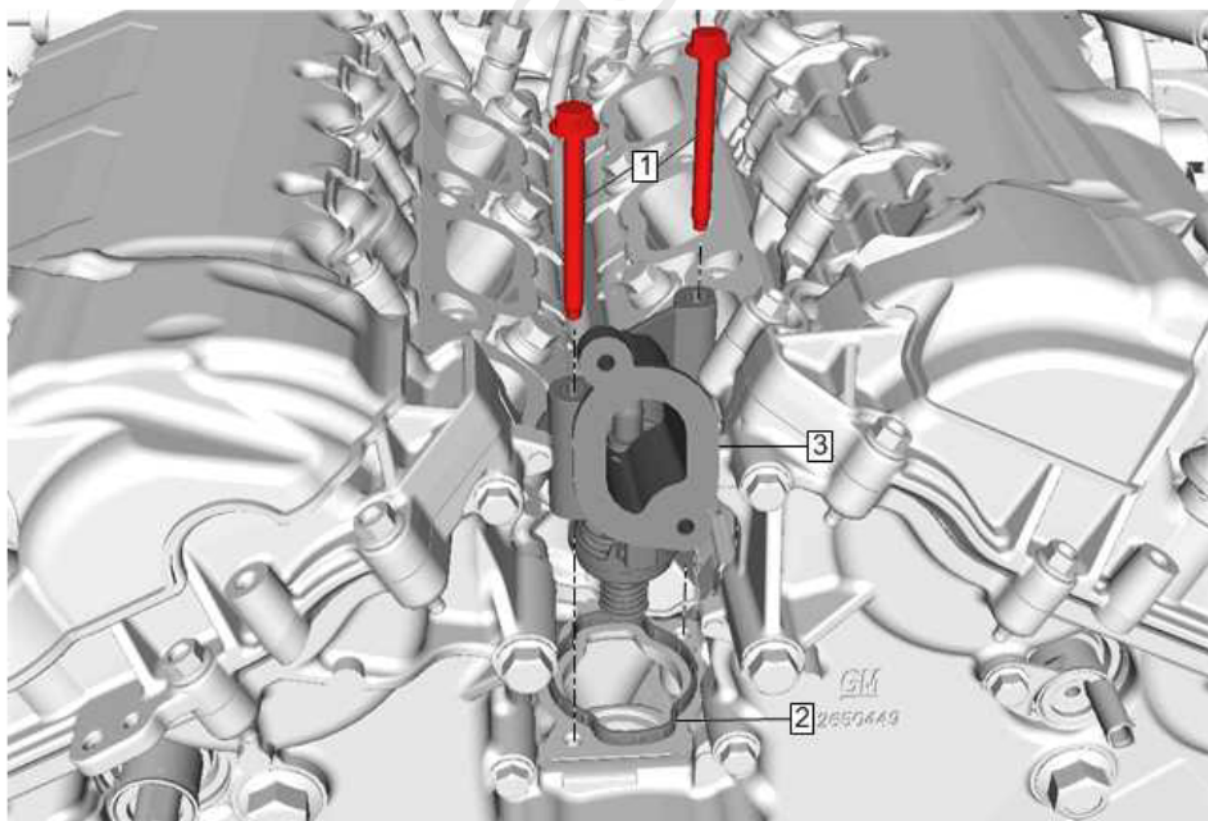


Fig. 202: Engine Coolant Thermostat Housing (LGW, LGX)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures 1. Engine Coolant Air Bleed Pipe Replacement (LGW, LGX) 2. Water Outlet Replacement (LGX)Water Outlet Replacement (LGW)	
1	Engine Coolant Thermostat Housing Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Engine Coolant Thermostat Housing Seal Procedure Install a NEW engine coolant thermostat housing seal.
3	Engine Coolant Thermostat Housing

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT (LTG)

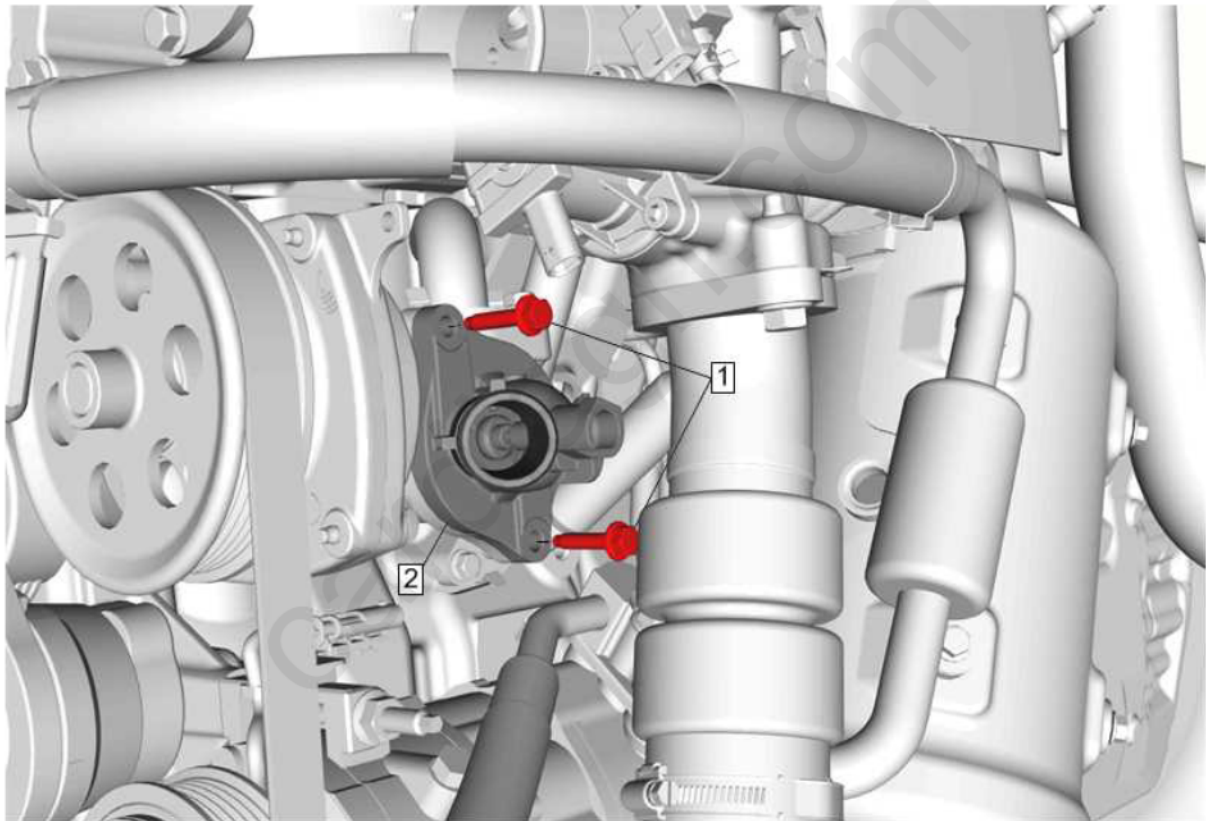


Fig. 203: Engine Coolant Thermostat Housing (LTG)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Air Cleaner Outlet Duct Replacement 2. Radiator Outlet Hose Replacement (LTG without HP9)Radiator Outlet Hose Replacement (LTG with HP9)	

Callout	Component Name
1	Engine Coolant Thermostat Housing Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Engine Coolant Thermostat Housing Procedure Install a NEW engine coolant thermostat housing seal.

ENGINE COOLANT AIR BLEED VALVE REPLACEMENT (LGW)

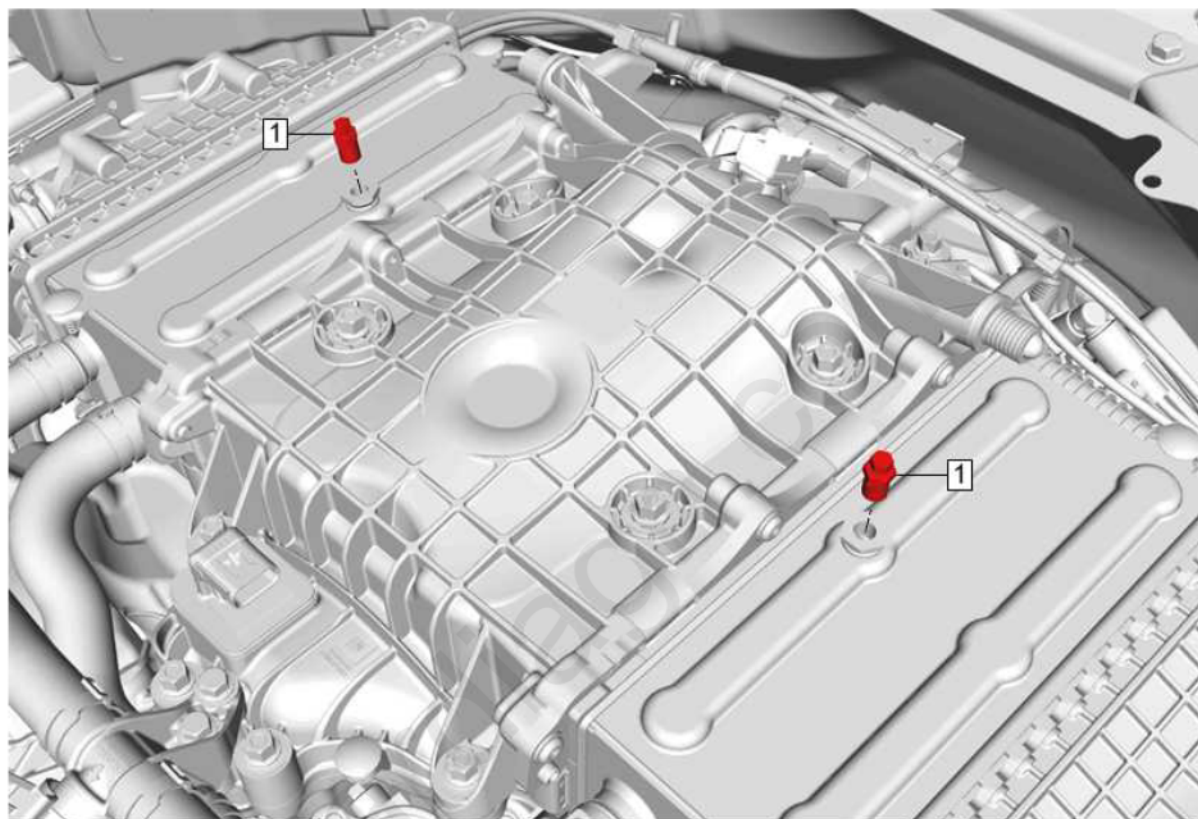


Fig. 204: Engine Coolant Air Bleed Valve (LGW)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Partially drain the charge air cooling system. Refer to Charge Air Cooling System Draining and Filling.(LGW) 2. Intake Manifold Cover Replacement (LGW)	
1	Engine Coolant Air Bleed Valve [2x] CAUTION: Refer to Component Fastener Tightening Caution . Tighten 12 N.m (106 lb in)

ENGINE COOLANT AIR BLEED PIPE REPLACEMENT (LTG)

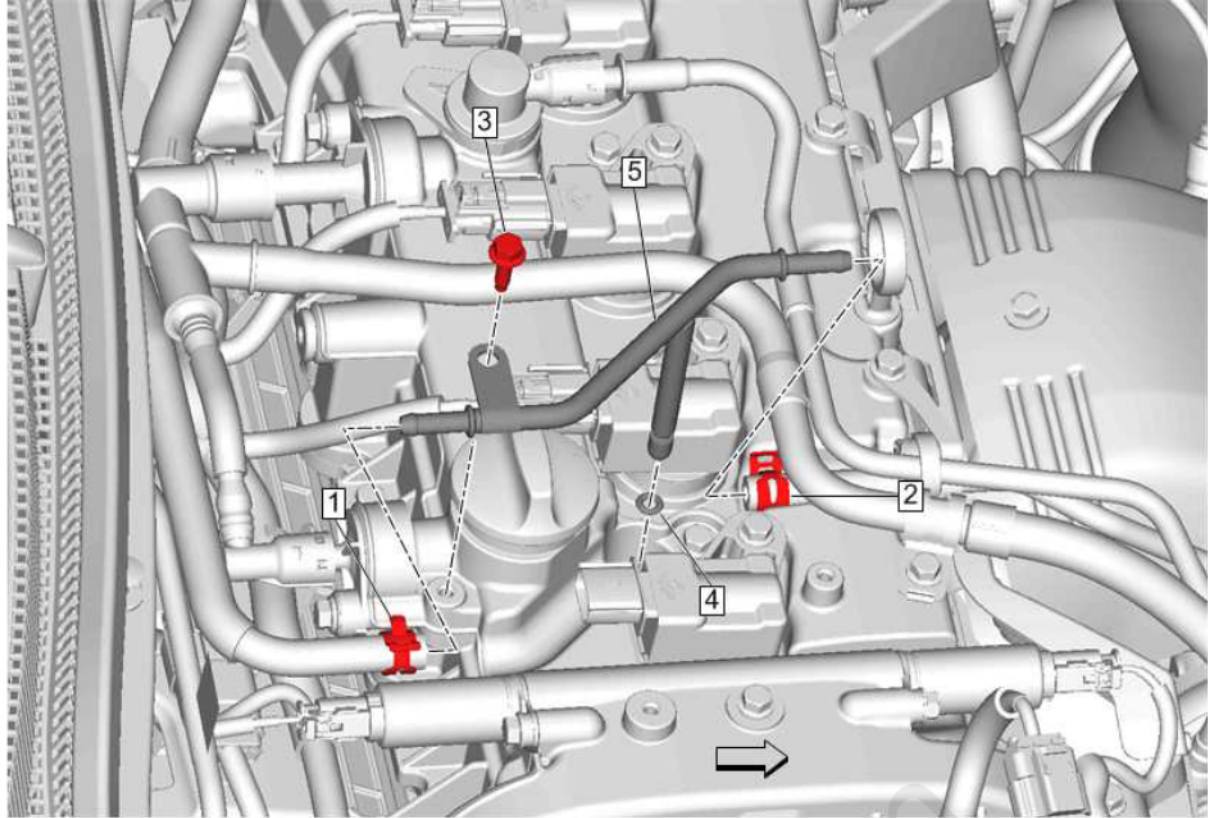


Fig. 205: Engine Coolant Air Bleed Pipe
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static LTG with HP9) and/or Cooling System Draining and Filling (GE 47716 LTG with HP9) 2. Turbocharger Coolant Return Pipe Replacement (LTG) 3. Positive Crankcase Ventilation Hose/Pipe/Tube Replacement	
1	Surge Tank Vent Hose Clamp
2	Turbocharger Coolant Return Pipe Clamp
3	Engine Coolant Air Bleed Pipe Fastener CAUTION: Refer to Fastener Caution . Tighten: 10 N.m (89 lb in)
4	Engine Coolant Air Bleed Pipe Seal Procedure Install a NEW seal
5	Engine Coolant Air Bleed Pipe Procedure Disconnect the electrical wiring harness connector from the ignition coil.

ENGINE COOLANT AIR BLEED PIPE REPLACEMENT (LGW, LGX)

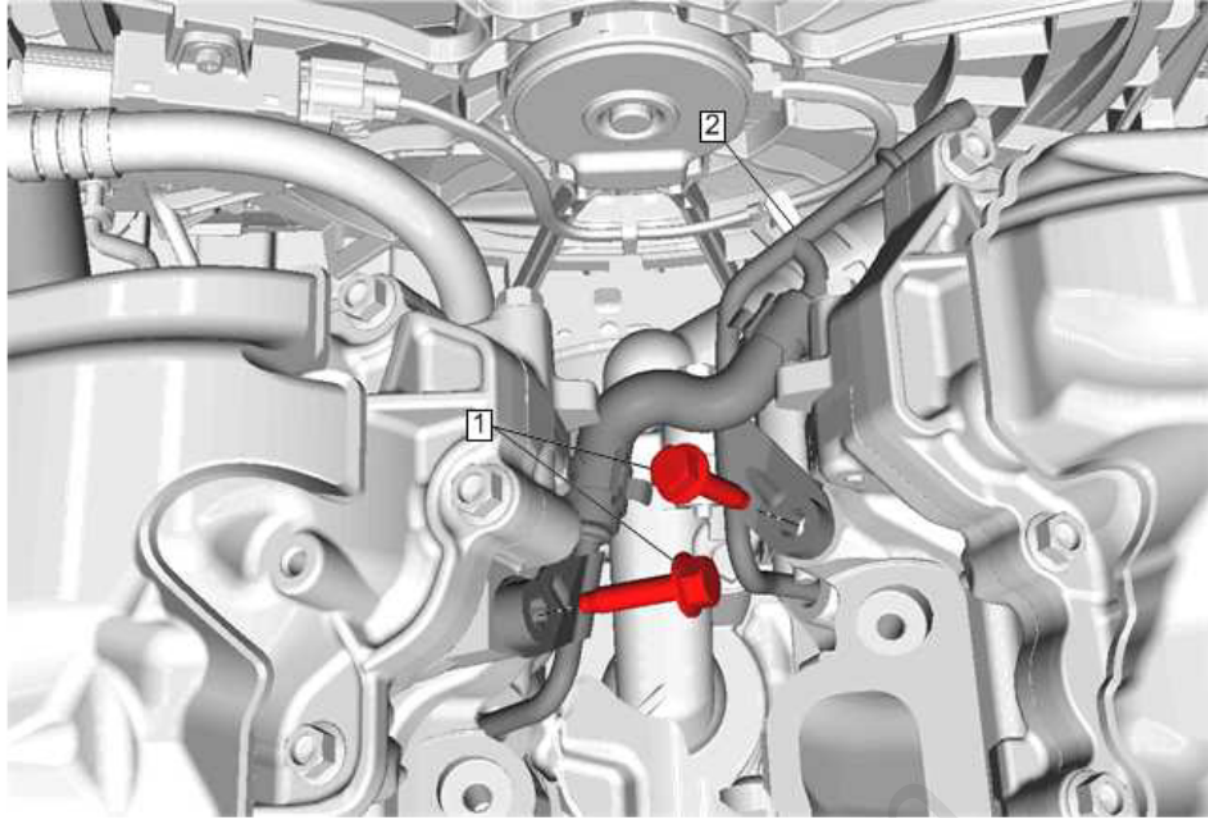


Fig. 206: Engine Coolant Air Bleed Pipe (LGW, LGX)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Cooling System Draining and Filling (Static without HP9)</u><u>Cooling System Draining and Filling (GE 47716 without HP9)</u> <u>Intake Manifold Replacement (LGW)</u> <u>Intake Manifold Replacement (LGX)</u> <u>Radiator Surge Tank Inlet Hose Replacement (LTG without HP9)</u><u>Radiator Surge Tank Inlet Hose Replacement (LGW)</u> @ Engine Coolant Air Bleed PipeÄ, Ä» Disconnect	
1	Engine Coolant Air Bleed Pipe Bolt [2x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Engine Coolant Air Bleed Pipe Procedure Install NEW seals.

ENGINE COOLANT AIR BLEED HOSE REPLACEMENT (LGX)

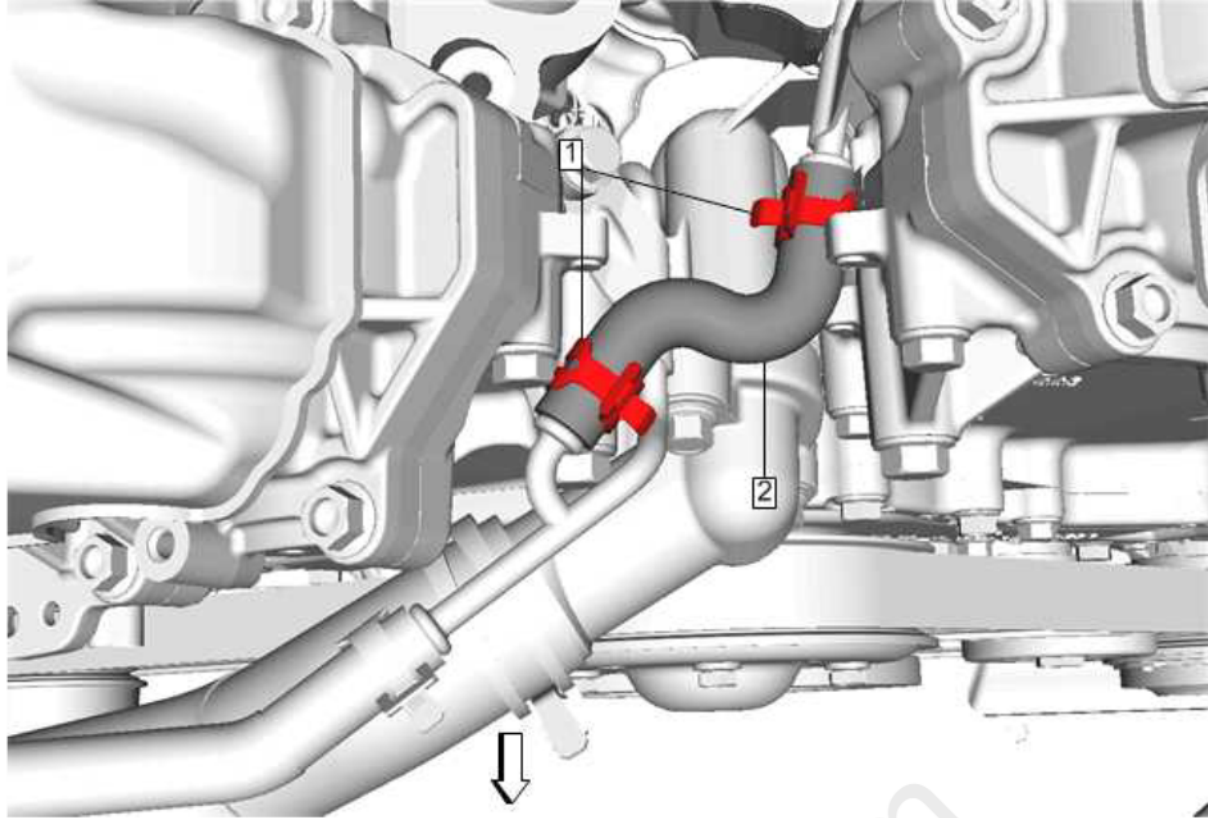


Fig. 207: Engine Coolant Air Bleed Hose (LGX)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Cooling System Draining and Filling (Static without HP9)Cooling System Draining and Filling (GE 47716 without HP9) 2. Intake Manifold Replacement (LGX)	
1	Engine Coolant Air Bleed Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Engine Coolant Air Bleed Hose

ENGINE COOLANT AIR BLEED HOSE REPLACEMENT (RADIATOR SURGE TANK TO ENGINE COOLANT AIR BLEED PIPE - LTG WITHOUT HP9)

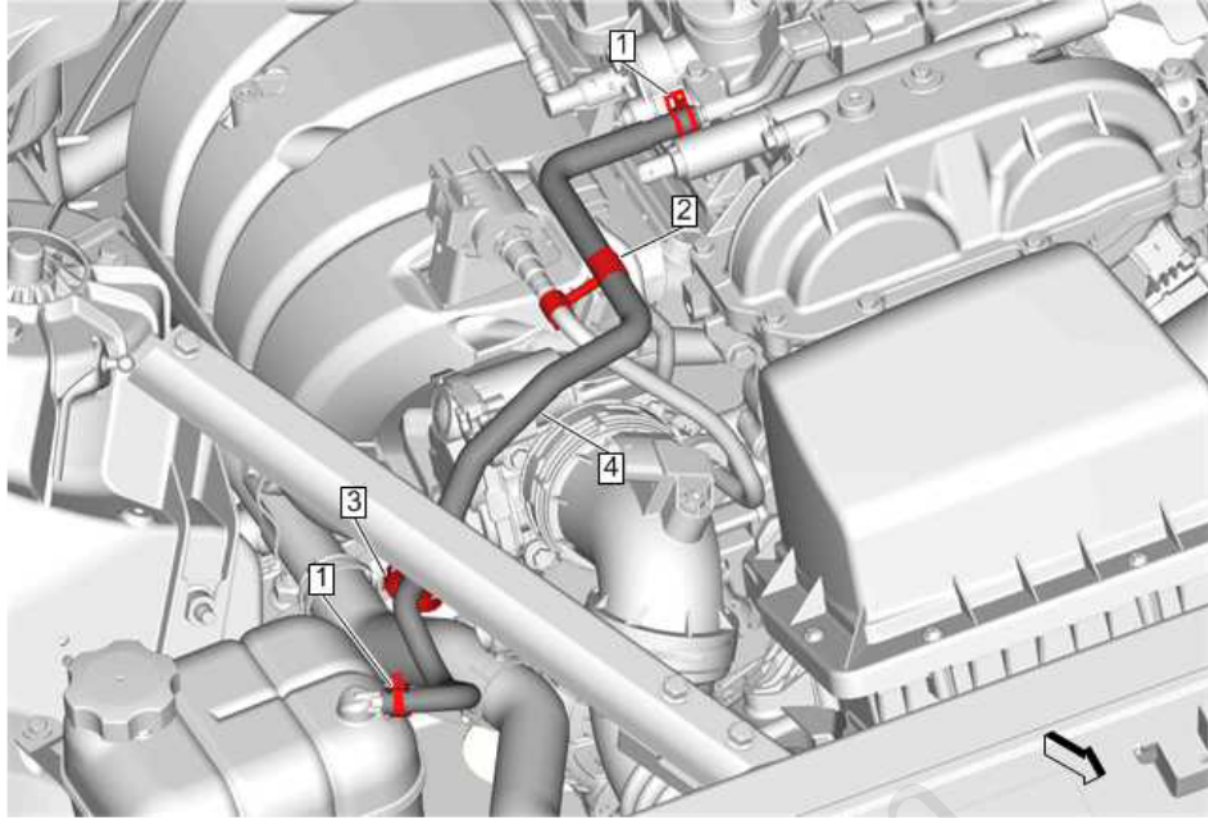


Fig. 208: Engine Coolant Air Bleed Hose (Radiator Surge Tank to Engine Coolant Air Bleed Pipe - LTG without HP9)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Intake Manifold Cover Replacement</u>	
1	Engine Coolant Air Bleed Hose Clamp [2x] Procedure <u>Hose Clamp Replacement Guidelines - Spring Type</u>
2	Engine Coolant Air Bleed Hose Clip
3	Engine Coolant Air Bleed Hose Clip
4	Engine Coolant Air Bleed Hose Procedure 1. Fill the cooling system to the proper level. Refer to <u>Cooling System Draining and Filling (Static without HP9)</u> and/or <u>Cooling System Draining and Filling (GE 47716 without HP9)</u> 2. Start the engine and check for coolant leaks.

ENGINE COOLANT AIR BLEED HOSE REPLACEMENT (LGW)

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static without HP9)** and/or **Cooling System Draining and Filling (GE 47716 without HP9)**
2. **Intake Manifold Cover Replacement (LGW)** ã, ã» Remove
3. Charge Air Cooler Inlet Hose Fitting Nut (1) ã, ã» Remove

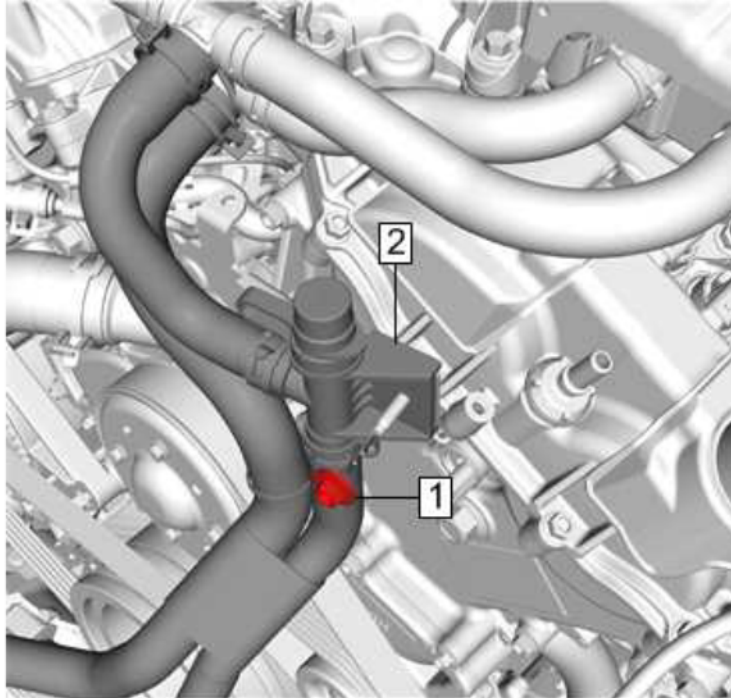


Fig. 209: Charge Air Cooler Inlet Hose Assembly

Courtesy of GENERAL MOTORS COMPANY

4. Charge Air Cooler Inlet Hose Assembly (2)» Reposition
5. Engine Front Cover Bolt (1)» Remove [2x]

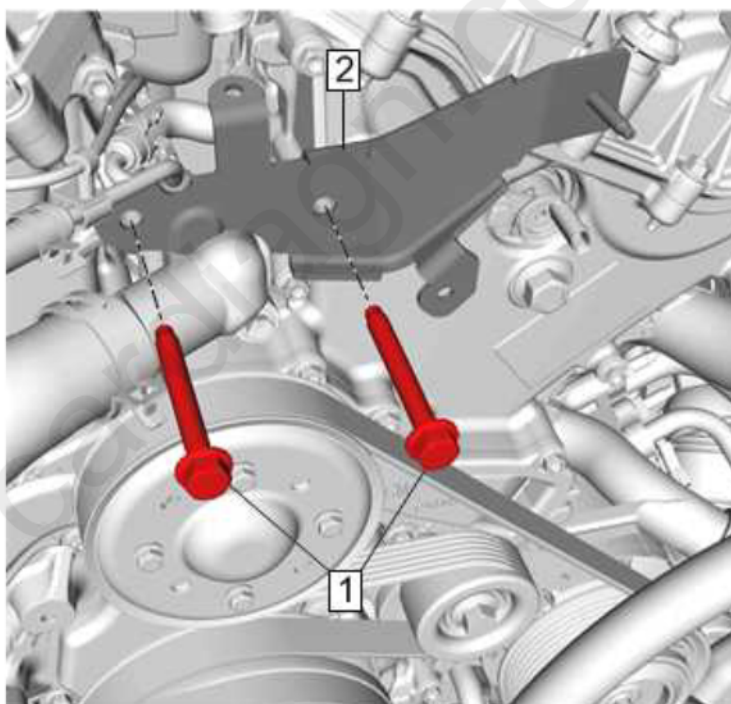


Fig. 210: Turbocharger Coolant Feed Pipe Bracket

Courtesy of GENERAL MOTORS COMPANY

6. Turbocharger Coolant Feed Pipe Bracket (2)» Reposition
7. Engine Coolant Air Bleed Hose Clamp (1)» Disengage [2x] - **Hose Clamp Replacement Guidelines - Spring Type**

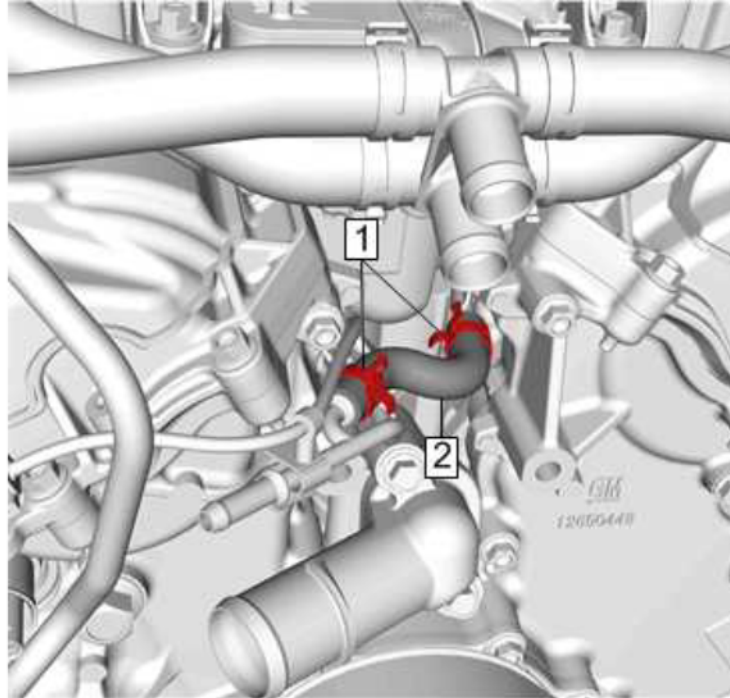


Fig. 211: Engine Coolant Air Bleed Hose
Courtesy of GENERAL MOTORS COMPANY

8. Engine Coolant Air Bleed Hose (2)» Remove

Installation Procedure

1. Engine Coolant Air Bleed Hose (2)» Install

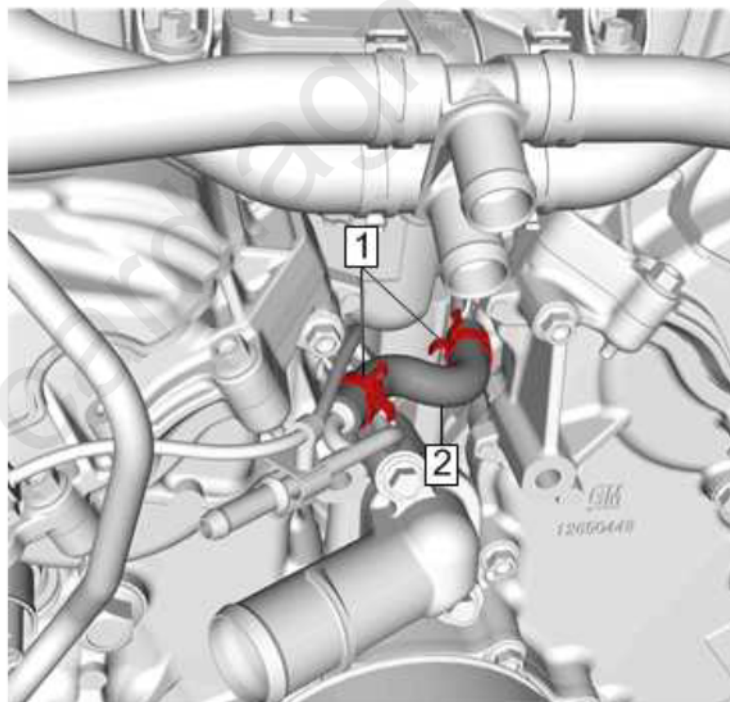


Fig. 212: Engine Coolant Air Bleed Hose
Courtesy of GENERAL MOTORS COMPANY

2. Engine Coolant Air Bleed Hose Clamp (1)» Engage [2x] - **Hose Clamp Replacement Guidelines - Spring Type**
3. Turbocharger Coolant Feed Pipe Bracket (2)» Install

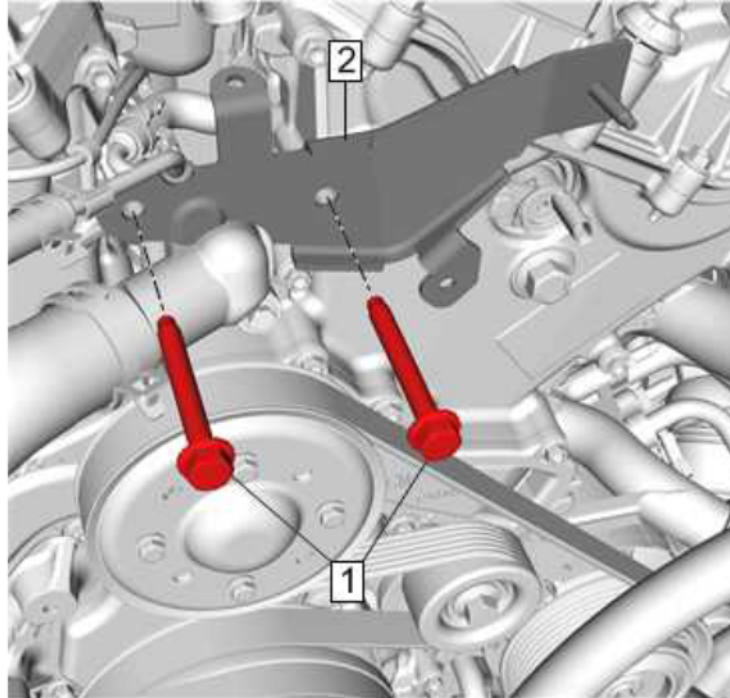


Fig. 213: Turbocharger Coolant Feed Pipe Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Engine Front Cover Bolt (1)» Install and tighten [2x] 25 N.m (18 lb ft)

CAUTION: Refer to **Fastener Caution** .

5. Charge Air Cooler Inlet Hose Assembly (2)» Install

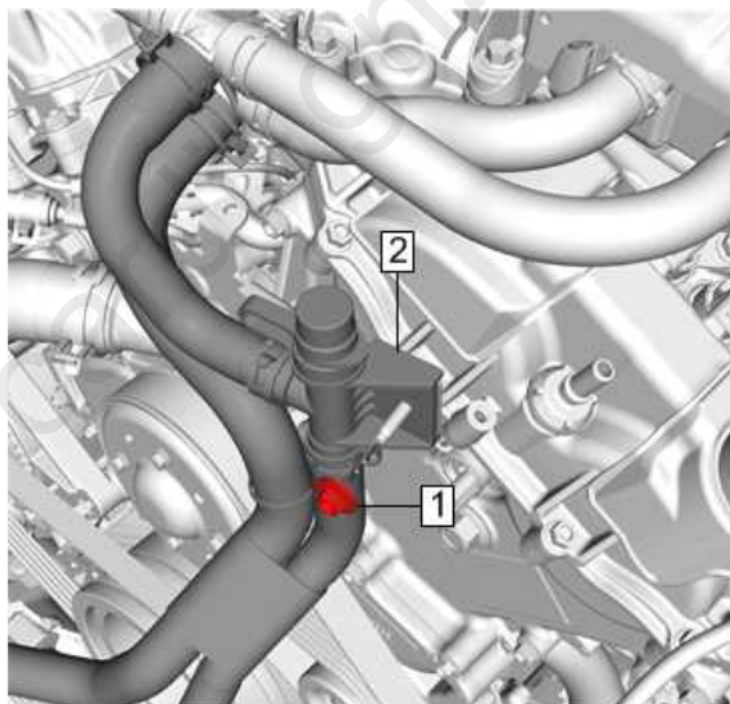


Fig. 214: Charge Air Cooler Inlet Hose Assembly
Courtesy of GENERAL MOTORS COMPANY

6. Charge Air Cooler Inlet Hose Fitting Nut (1)» Install and tighten 9 N.m (80 lb in)
7. **Intake Manifold Cover Replacement (LGW)** » Install
8. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static without HP9)** and/or **Cooling System Draining and Filling (GE 47716 without HP9)**
9. Start the engine and check for leaks.

ENGINE COOLANT AIR BLEED HOSE REPLACEMENT (RADIATOR SURGE TANK TO ENGINE COOLANT AIR BLEED PIPE - LGW)

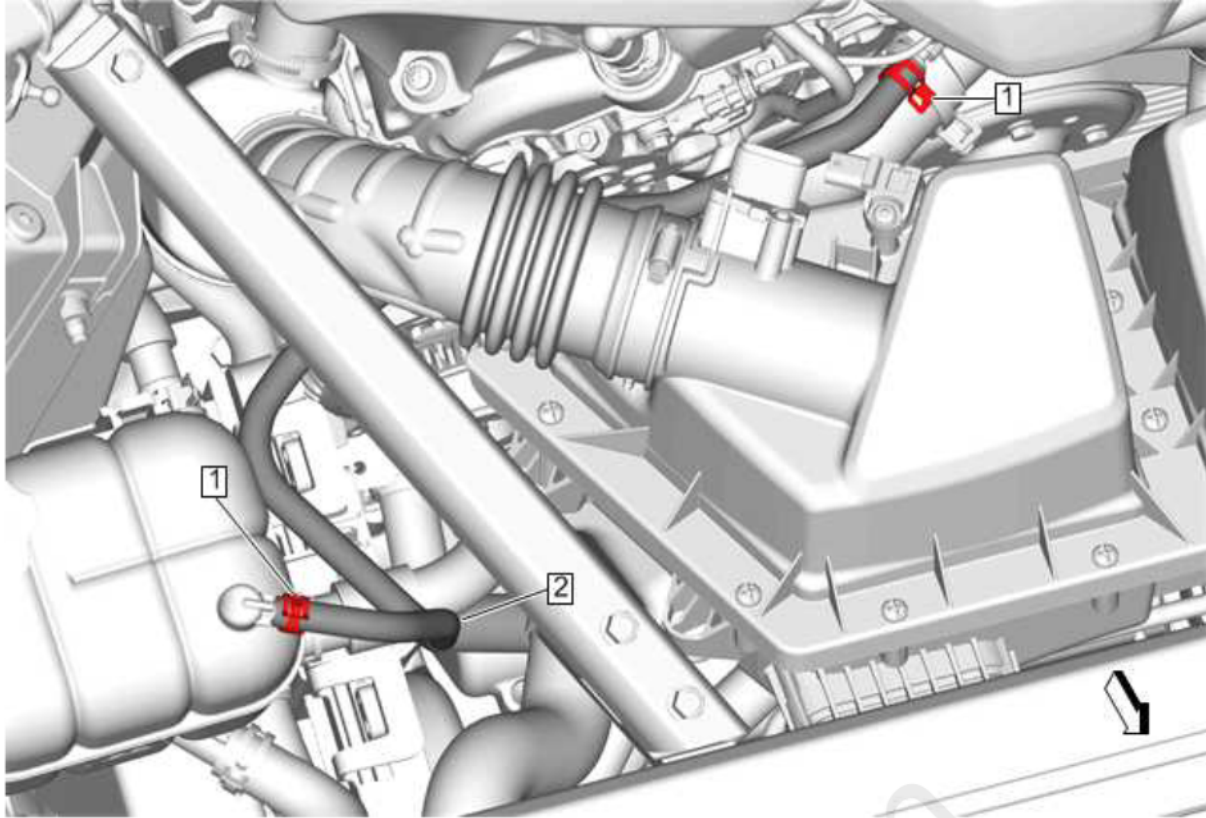


Fig. 215: Engine Coolant Air Bleed Hose (Radiator Surge Tank to Engine Coolant Air Bleed Pipe - LGW)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Engine Coolant Air Bleed Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Engine Coolant Air Bleed Hose Procedure 1. Fill the cooling system to the proper level. 2. Start the engine and check for coolant leaks.

ENGINE COOLANT AIR BLEED HOSE REPLACEMENT (RADIATOR SURGE TANK TO ENGINE COOLANT AIR BLEED PIPE - LGX)

Removal Procedure

1. Intake Manifold Cover (2) » Remove - [Intake Manifold Cover Replacement \(LGX\)](#)

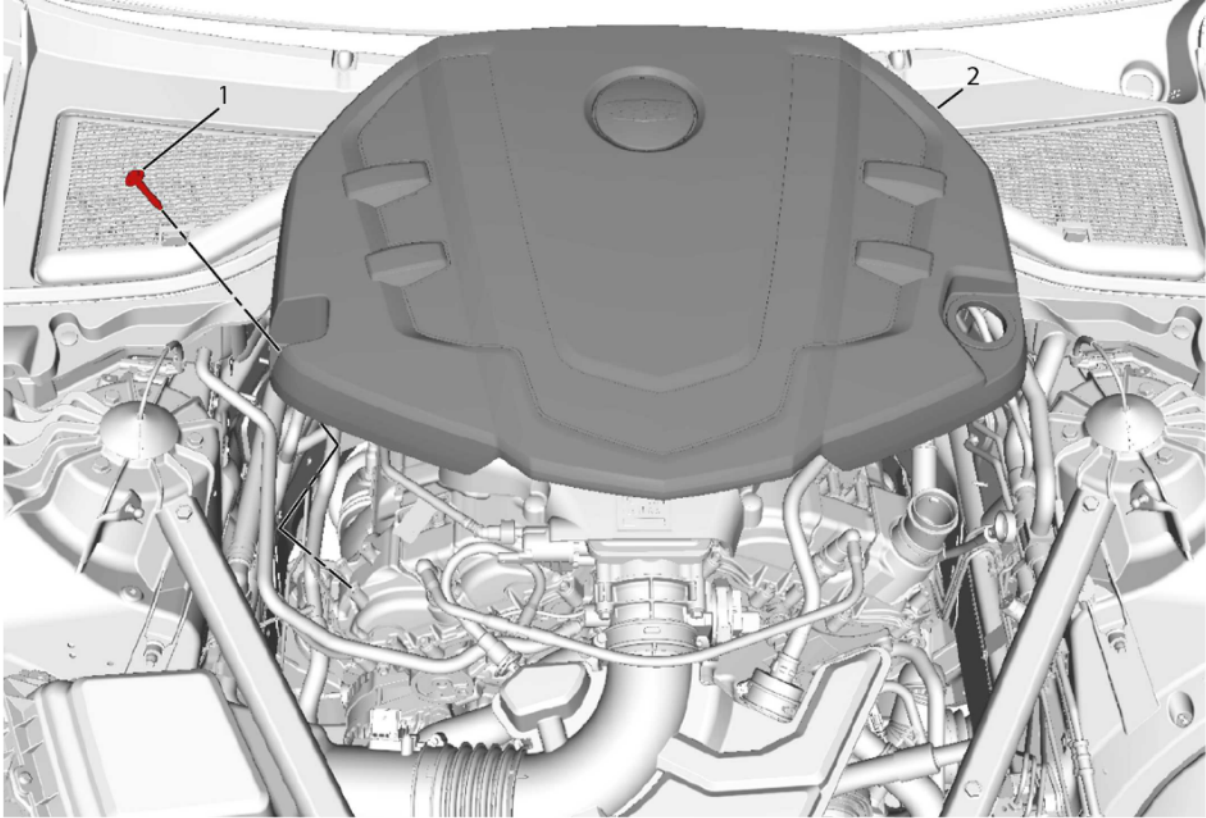


Fig. 216: Intake Manifold Cover (LGX)

Courtesy of GENERAL MOTORS COMPANY

2. Remove the air inlet grille panel (2). Refer to [Air Inlet Grille Panel Replacement](#)

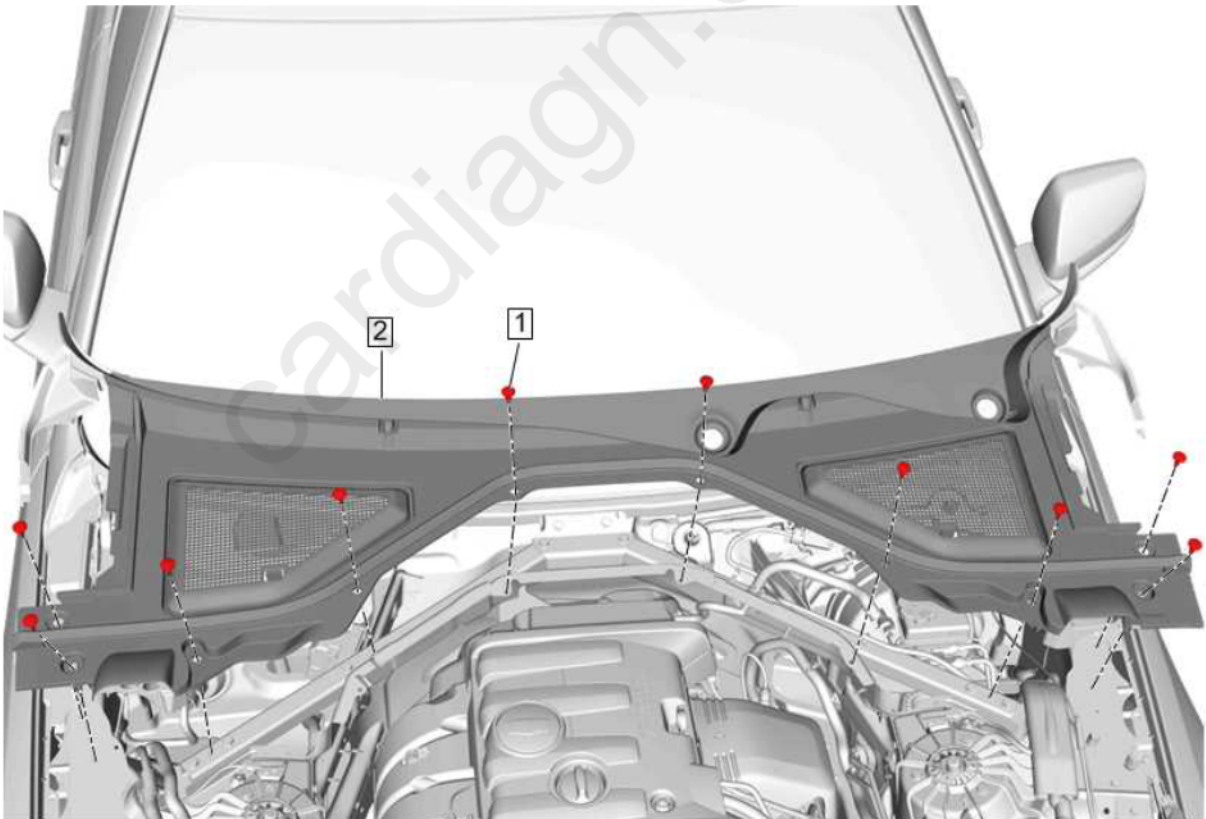


Fig. 217: Air Inlet Grille Panel

Courtesy of GENERAL MOTORS COMPANY

3. Engine Coolant Air Bleed Hose Clamp (1) Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

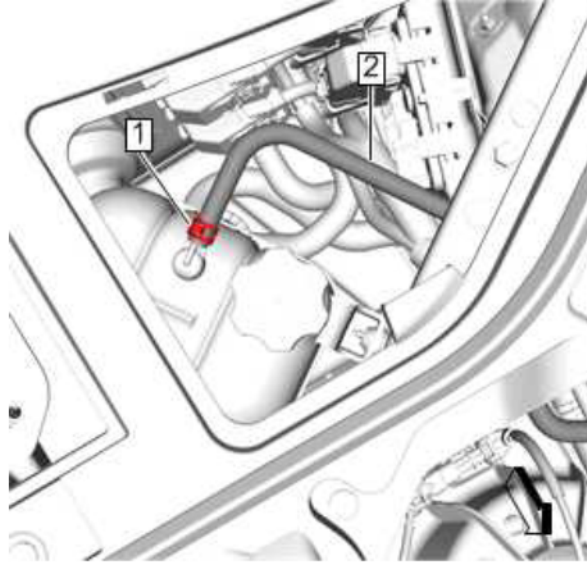


Fig. 218: Engine Coolant Air Bleed Hose

Courtesy of GENERAL MOTORS COMPANY

4. Engine Coolant Air Bleed Hose (2) @ Radiator Surge Tank» Remove
5. Engine Coolant Air Bleed Hose Clamp (1) Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

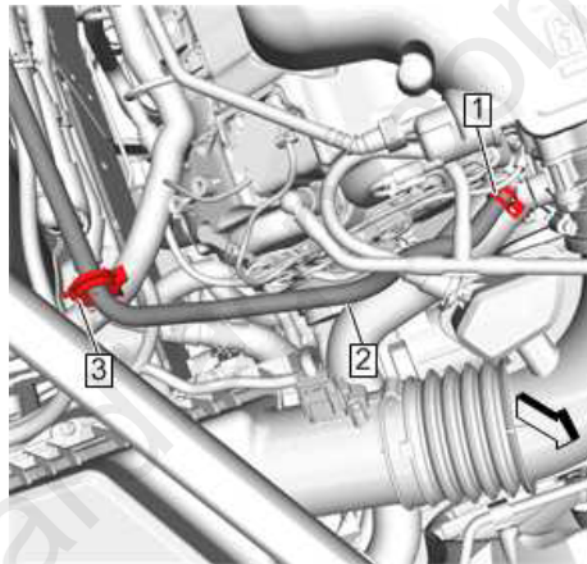


Fig. 219: Engine Coolant Air Bleed Hose

Courtesy of GENERAL MOTORS COMPANY

6. Engine Coolant Air Bleed Hose (2) @ Engine Coolant Air Bleed Pipe» Remove
7. Engine Coolant Air Bleed Hose (2) @ Wiring Harness Retainer (3)» Remove
8. Engine Coolant Air Bleed Hose (1) Remove

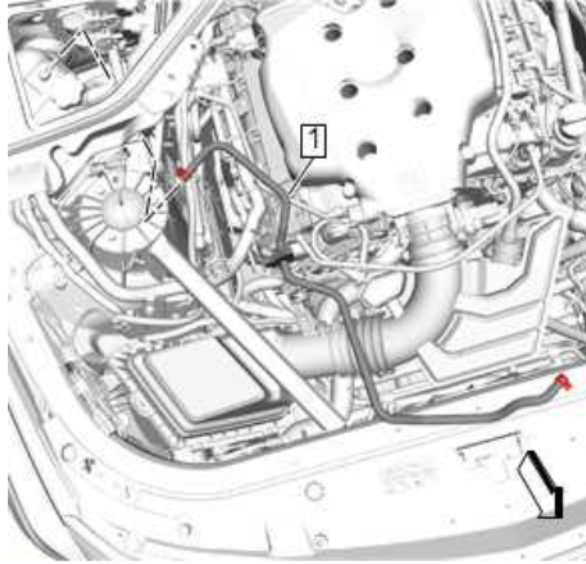


Fig. 220: Engine Coolant Air Bleed Hose
 Courtesy of GENERAL MOTORS COMPANY

9. Transfer components as necessary.

Installation Procedure

1. Engine Coolant Air Bleed Hose (1) Install

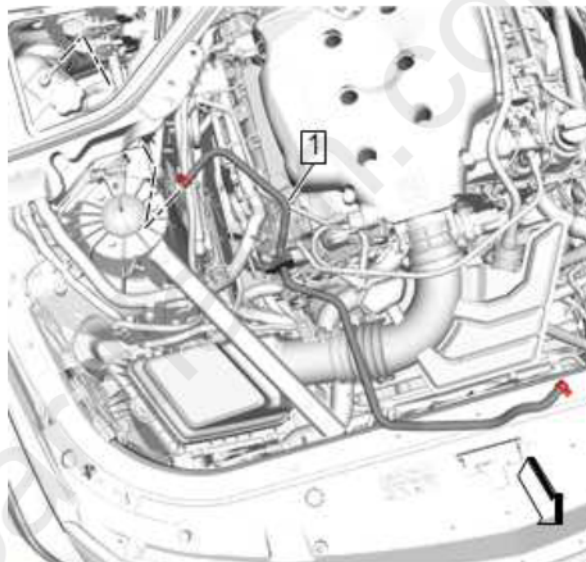


Fig. 221: Engine Coolant Air Bleed Hose
 Courtesy of GENERAL MOTORS COMPANY

2. Engine Coolant Air Bleed Hose (2) @ Wiring Harness Retainer (3) Install

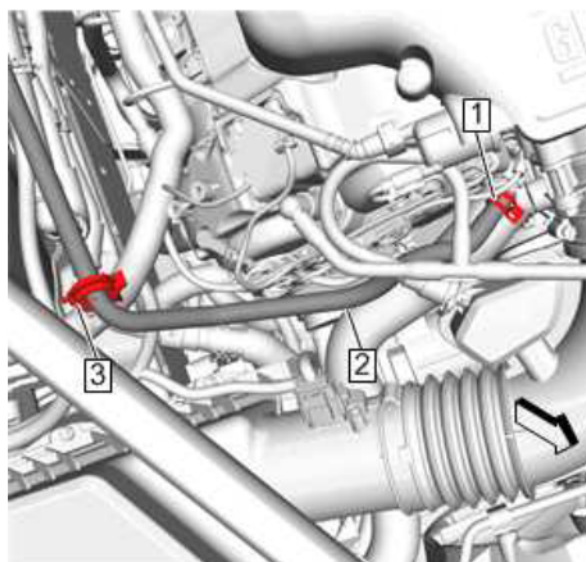


Fig. 222: Engine Coolant Air Bleed Hose
Courtesy of GENERAL MOTORS COMPANY

3. Engine Coolant Air Bleed Hose (2) @ Engine Coolant Air Bleed Pipe» Install
4. Engine Coolant Air Bleed Hose Clamp (1) Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
5. Engine Coolant Air Bleed Hose (2) @ Radiator Surge Tank» Install

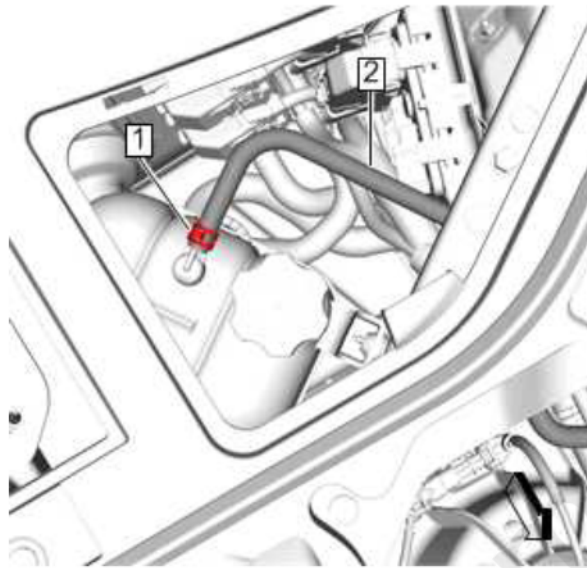


Fig. 223: Engine Coolant Air Bleed Hose
Courtesy of GENERAL MOTORS COMPANY

6. Engine Coolant Air Bleed Hose Clamp (1) Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
7. Install the air inlet grille panel (2). Refer to [Air Inlet Grille Panel Replacement](#)

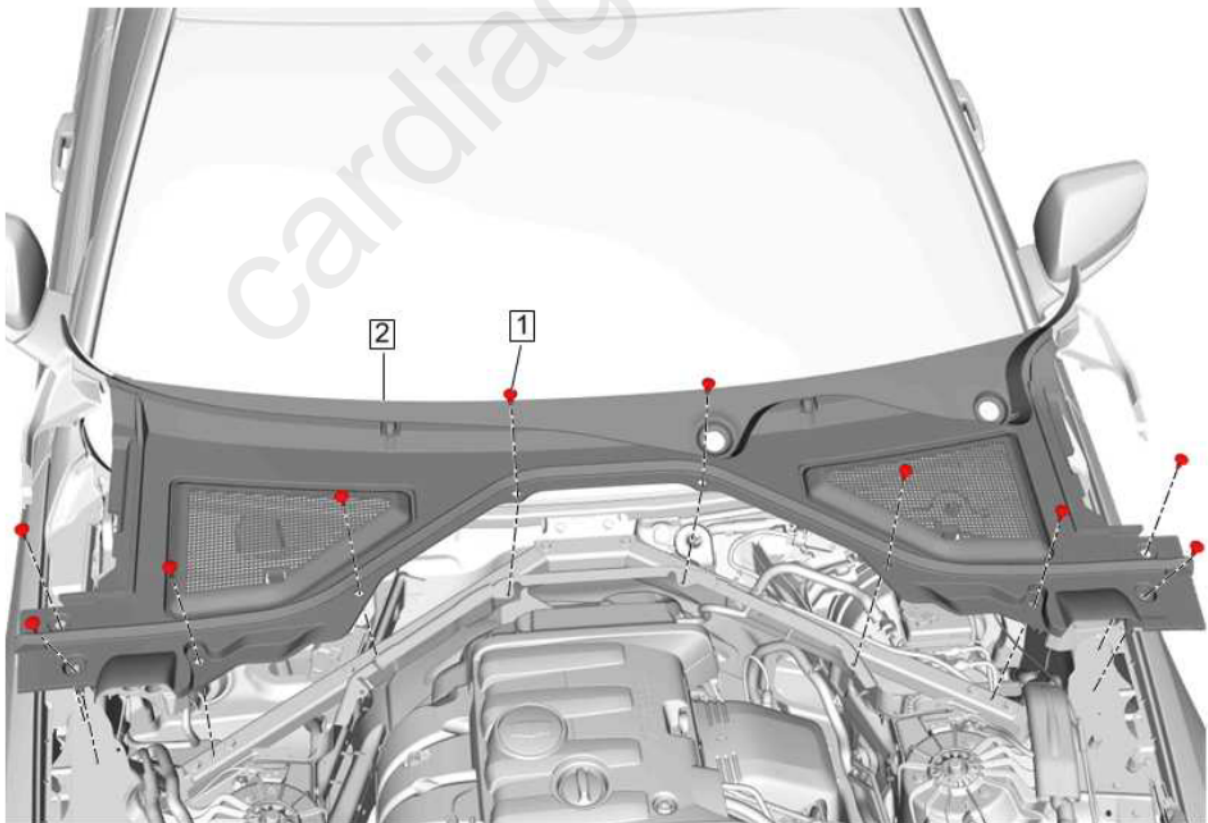


Fig. 224: Air Inlet Grille Panel
Courtesy of GENERAL MOTORS COMPANY

8. Intake Manifold Cover (2)» Install - [Intake Manifold Cover Replacement \(LGX\)](#)

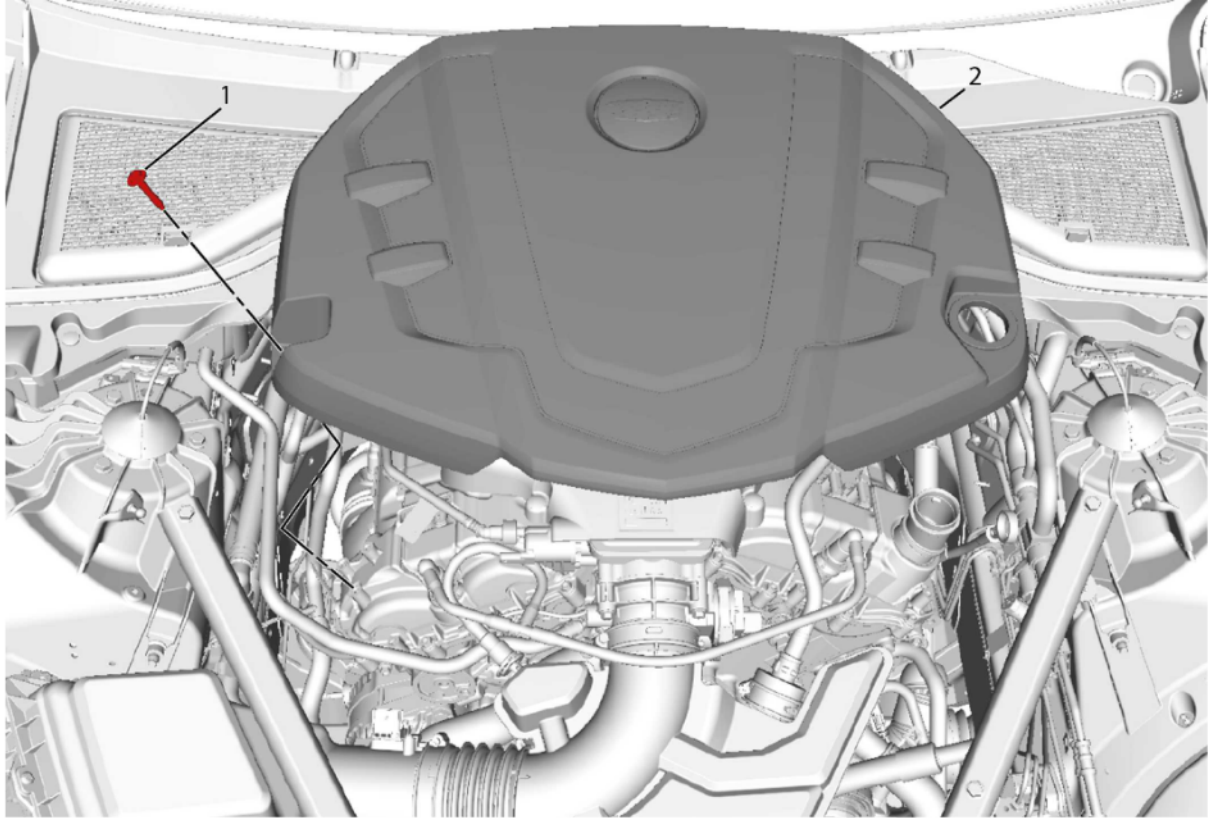


Fig. 225: Intake Manifold Cover (LGX)

Courtesy of GENERAL MOTORS COMPANY

9. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
10. Start the engine and check for coolant leaks.

ENGINE COOLANT AIR BLEED HOSE REPLACEMENT (RADIATOR SURGE TANK TO ENGINE COOLANT AIR BLEED PIPE - LTG WITH HP9)

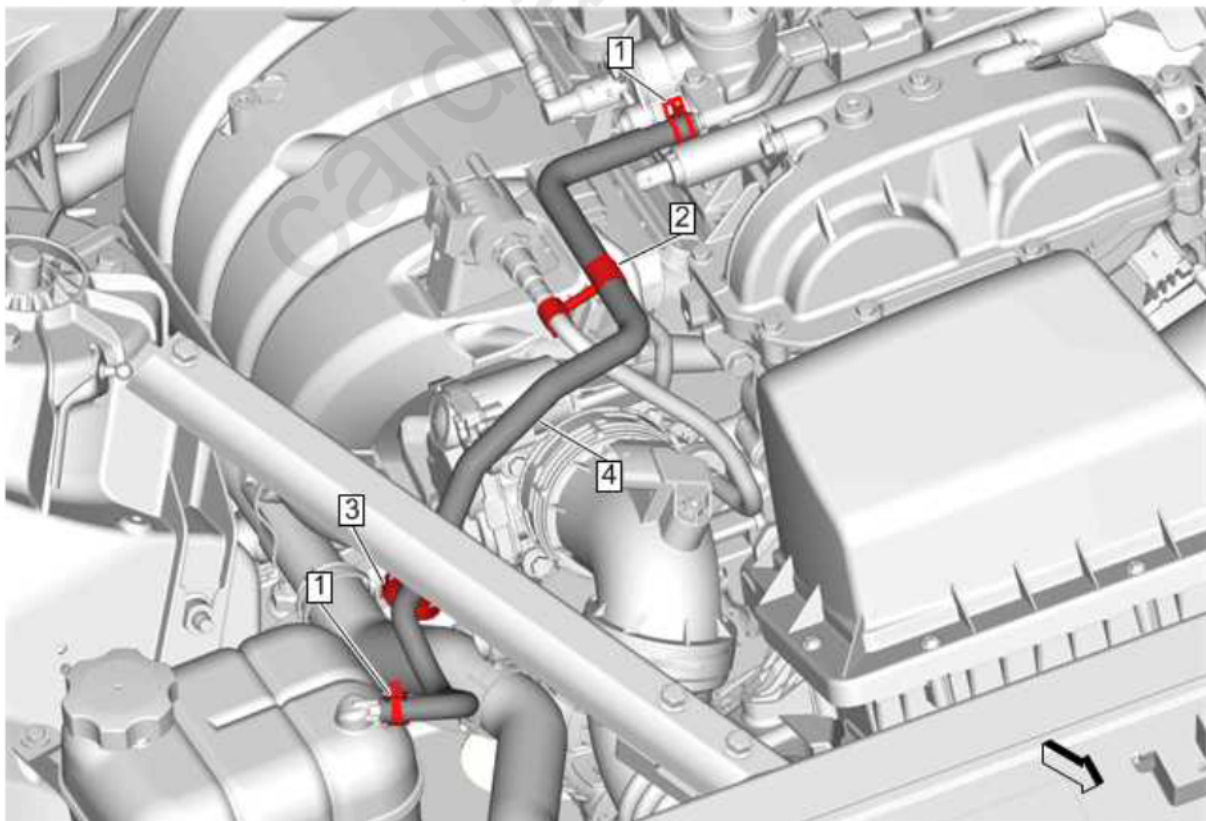


Fig. 226: Engine Coolant Air Bleed Hose (Radiator Surge Tank to Engine Coolant Air Bleed Pipe - LTG with HP9)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
---------	----------------

Callout	Component Name
WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: • Identify how to disable high voltage. • Identify how to test for the presence of high voltage. • Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. • Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors. • Visually and functionally inspect the gloves before use. • Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. Preliminary Procedures 1. Disable the high voltage system. Refer to High Voltage Disabling 2. Intake Manifold Cover Replacement	
1	Engine Coolant Air Bleed Hose Clamp [2x] Procedure Hose Clamp Replacement Guidelines - Spring Type
2	Engine Coolant Air Bleed Hose Clip
3	Engine Coolant Air Bleed Hose Clip
4	Engine Coolant Air Bleed Hose Procedure 1. Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling (Static LTG with HP9) and/or Cooling System Draining and Filling (GE 47716 LTG with HP9) 2. Enable the high voltage system. Refer to High Voltage Enabling 3. Start the engine and check for coolant leaks.

WATER OUTLET REPLACEMENT (LGX)

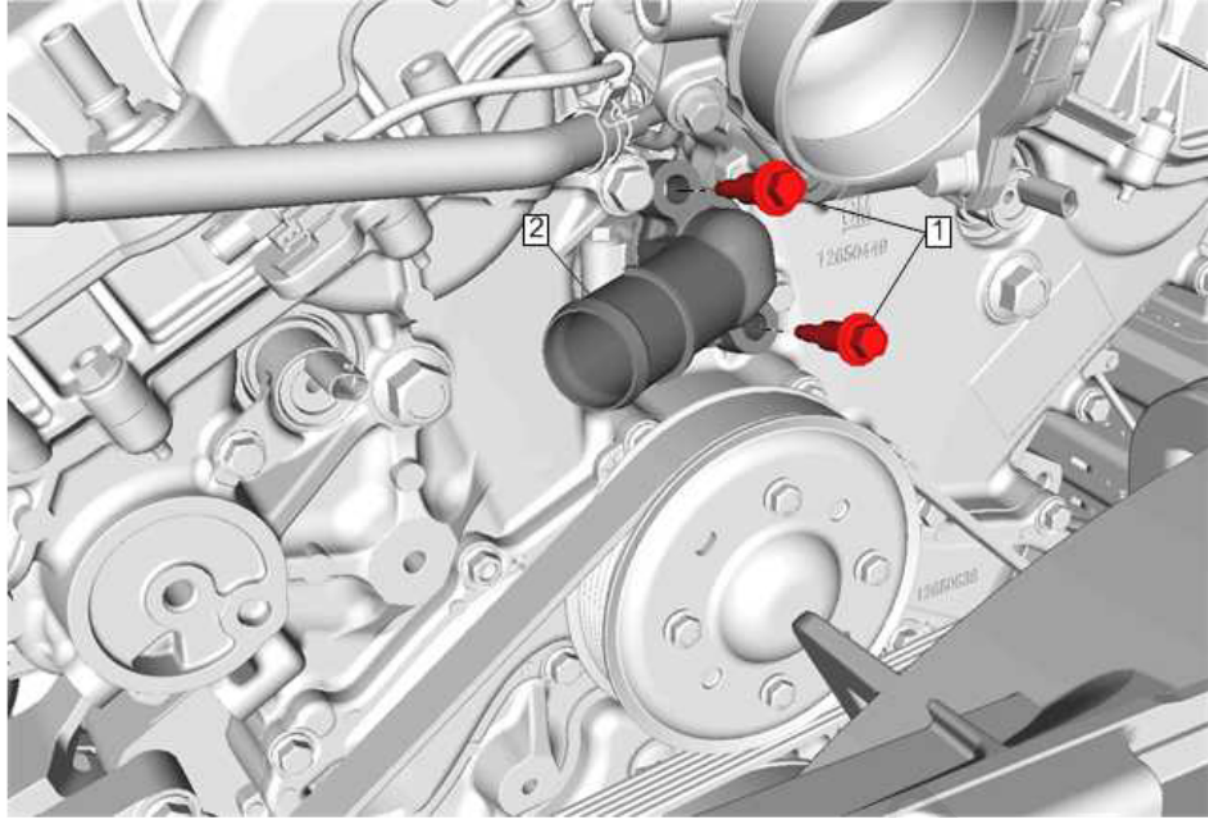


Fig. 227: Water Outlet (LGX)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Throttle Body Assembly Replacement (LGX) Radiator Inlet Hose Replacement (LGX) @ Water Pump Outlet Pipe, Disconnect - Relocate the engine wiring harness and routing channel.	
1	Water Outlet Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Water Outlet Procedure Install a NEW seal.

WATER OUTLET REPLACEMENT (LGW)

Removal Procedure

- Drain the cooling system. Refer to **Cooling System Draining and Filling (Static without HP9)** and/or **Cooling System Draining and Filling (GE 47716 without HP9)**
- Intake Manifold Cover Replacement (LGW)** , Remove
- Charge Air Cooler Inlet Hose Fitting Nut (1) , Remove

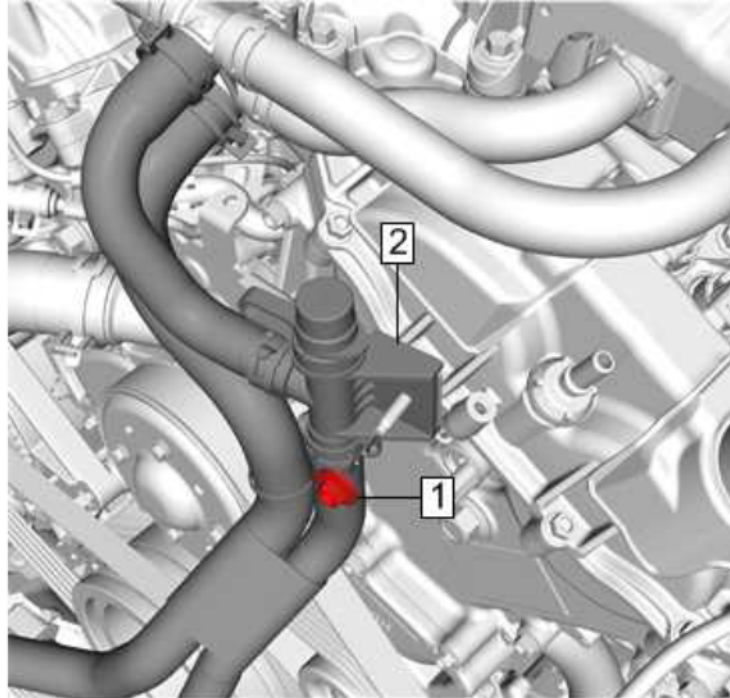


Fig. 228: Charge Air Cooler Inlet Hose Assembly
Courtesy of GENERAL MOTORS COMPANY

4. Charge Air Cooler Inlet Hose Assembly (2)» Reposition
5. Engine Front Cover Bolt (1)» Remove [2x]

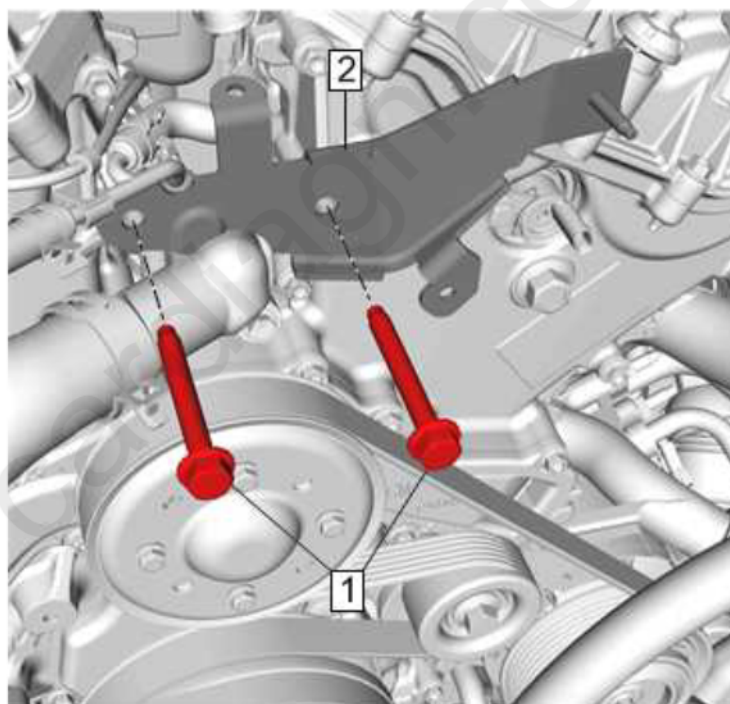


Fig. 229: Turbocharger Coolant Feed Pipe Bracket
Courtesy of GENERAL MOTORS COMPANY

6. Turbocharger Coolant Feed Pipe Bracket (2)» Reposition
7. Radiator Inlet Hose Clamp (1)» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**

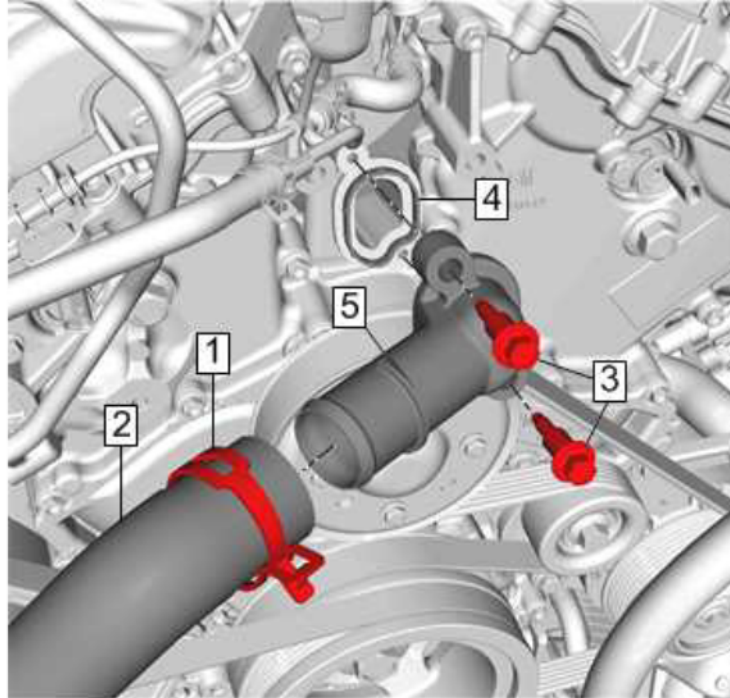


Fig. 230: Radiator Inlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

8. Radiator Inlet Hose (2) » Disconnect
9. Water Outlet Bolt (3) » Remove [2x]
10. Water Outlet (5) » Remove
11. Water Outlet Seal (4) » Remove and DISCARD

Installation Procedure

1. Water Outlet Seal (4) » Install

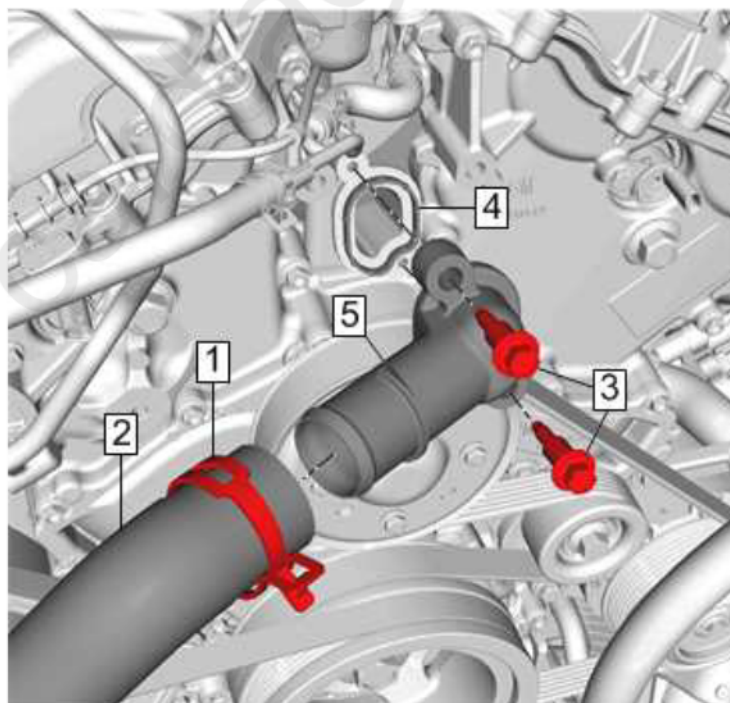


Fig. 231: Radiator Inlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW water outlet seal.

2. Water Outlet (5) » Install
3. Water Outlet Bolt (3) » Install and tighten [2x] 10 N.m (89 lb in)

CAUTION: Refer to [Fastener Caution](#) .

4. Radiator Inlet Hose (2)» Connect
5. Radiator Inlet Hose Clamp (1)» Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
6. Turbocharger Coolant Feed Pipe Bracket (6)» Install

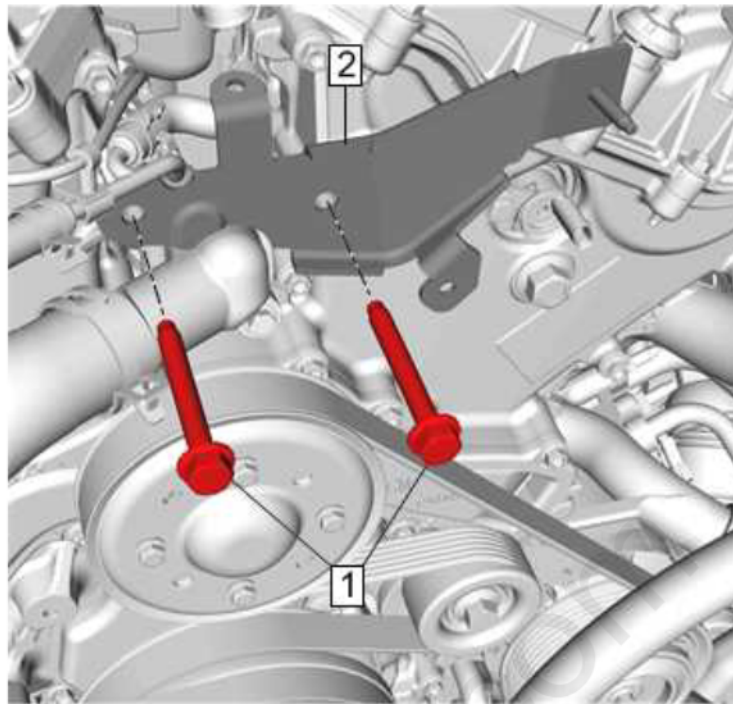


Fig. 232: Turbocharger Coolant Feed Pipe Bracket
Courtesy of GENERAL MOTORS COMPANY

7. Engine Front Cover Bolt (1)» Install and tighten [2x] 25 N.m (18 lb ft)
8. Charge Air Cooler Inlet Hose Assembly (2)» Install

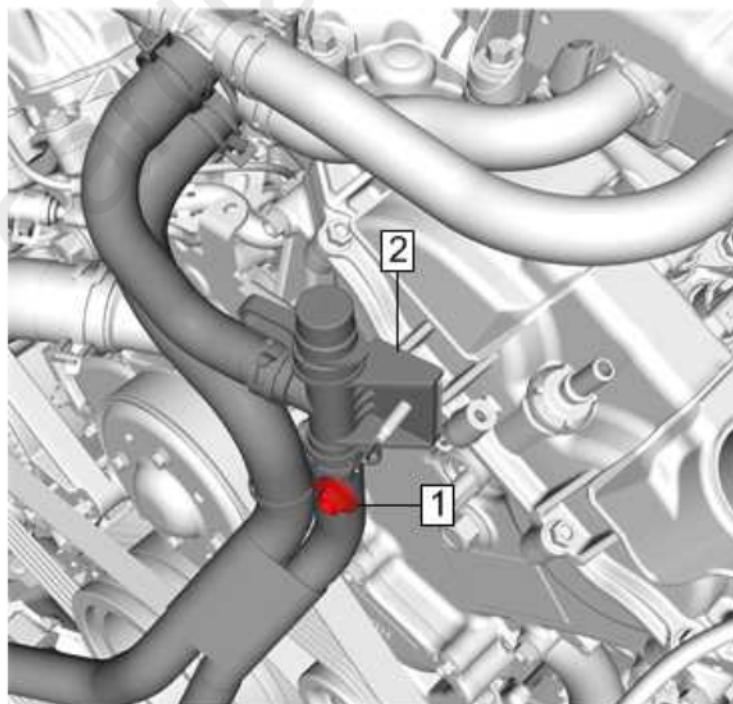


Fig. 233: Charge Air Cooler Inlet Hose Assembly
Courtesy of GENERAL MOTORS COMPANY

9. Charge Air Cooler Inlet Hose Fitting Nut (1)» Install and tighten 9 N.m (80 lb in)
10. [Intake Manifold Cover Replacement \(LGW\)](#) » Install
11. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)

12. Start the engine and check for leaks.

WATER OUTLET REPLACEMENT (LTG)

Removal Procedure

1. Fuel Pump Cover (2) Remove - [Fuel Pump Cover Replacement](#)

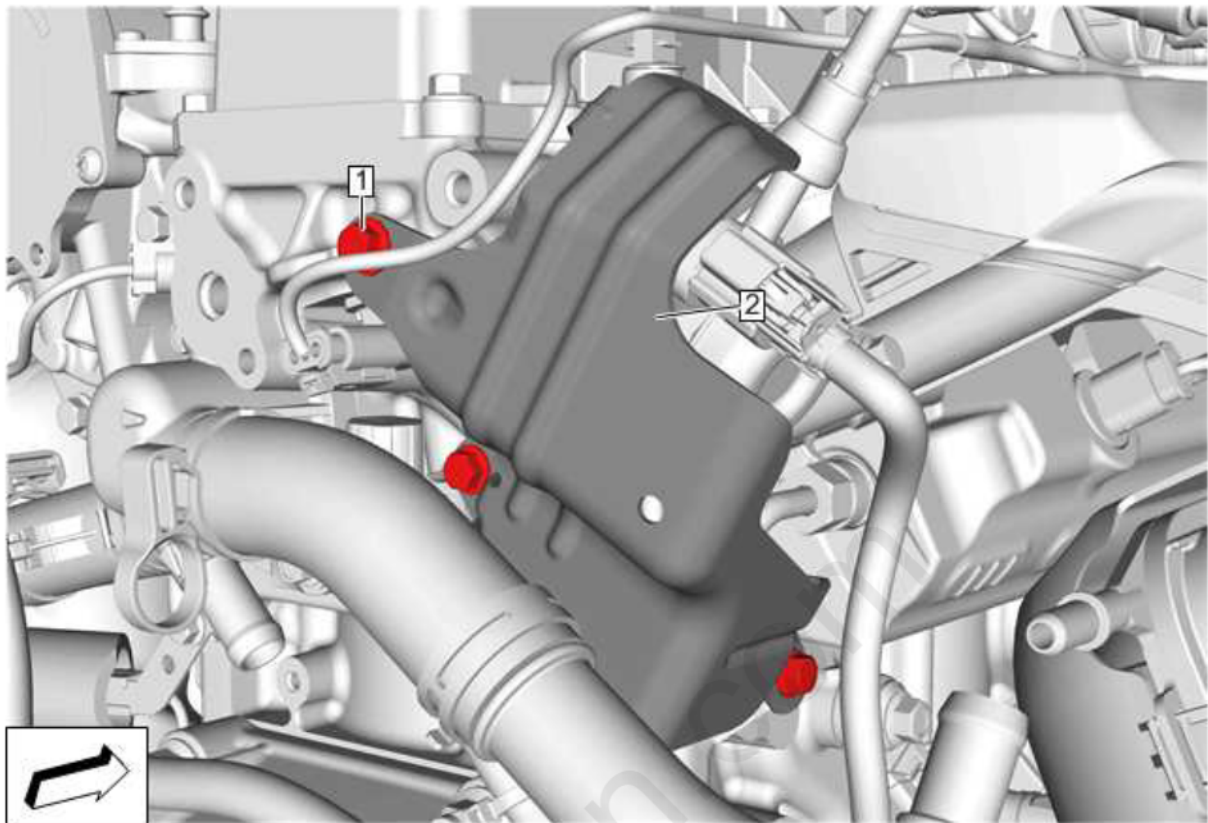


Fig. 234: Fuel Pump Cover

Courtesy of GENERAL MOTORS COMPANY

2. Vacuum Pump (2) Remove - [Vacuum Pump Replacement](#)

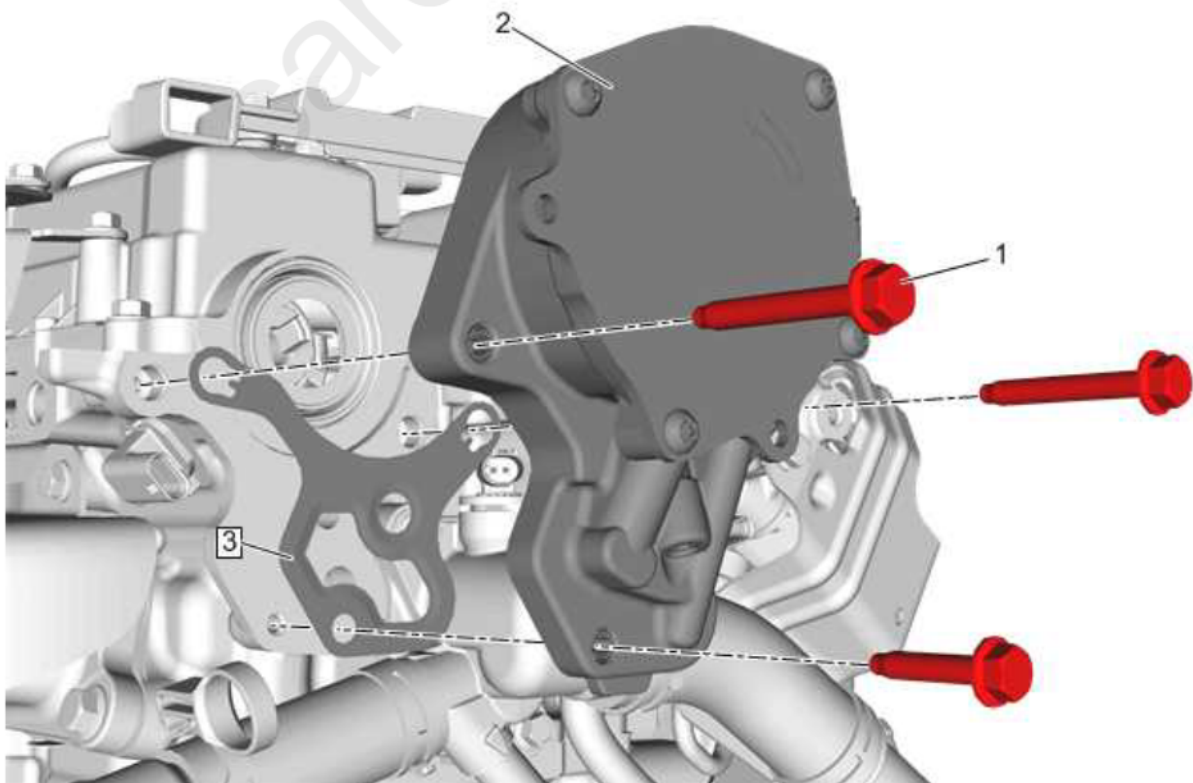


Fig. 235: Vacuum Pump

Courtesy of GENERAL MOTORS COMPANY

3. Engine Coolant Temperature Sensor Electrical Connector (1)» Disconnect

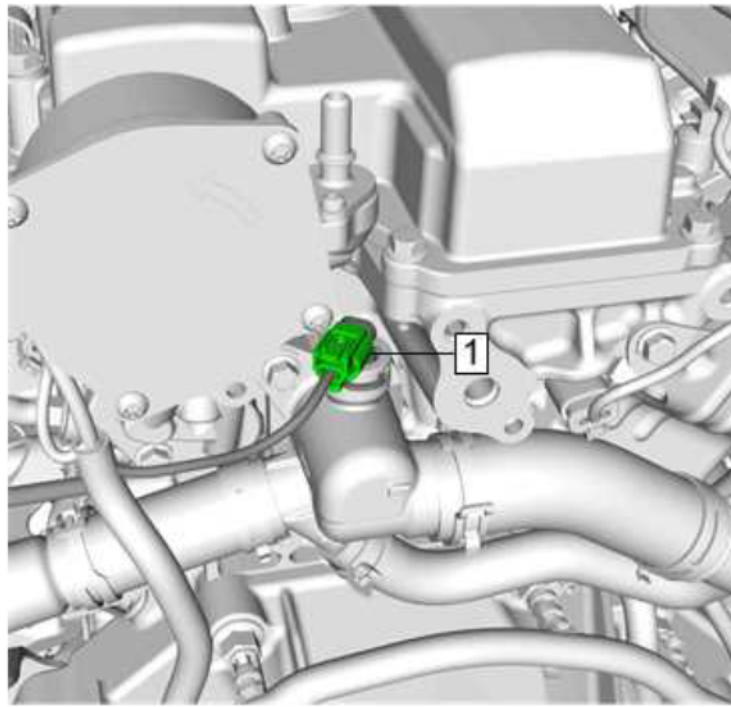


Fig. 236: Engine Coolant Temperature Sensor Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

4. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
5. Auxiliary Heater Outlet Hose Clamp (1) @ Heater Coolant Pump» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

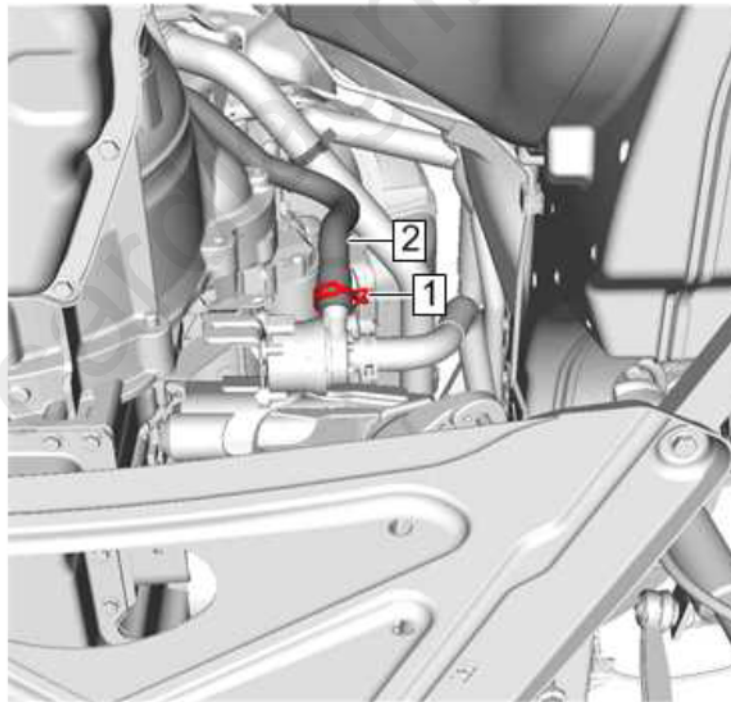


Fig. 237: Auxiliary Heater Outlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Auxiliary Heater Outlet Hose (2) @ Heater Coolant Pump» Remove
7. Thermostat Bypass Pipe (1)» Remove - [Thermostat Bypass Pipe Replacement \(LTG\)](#)

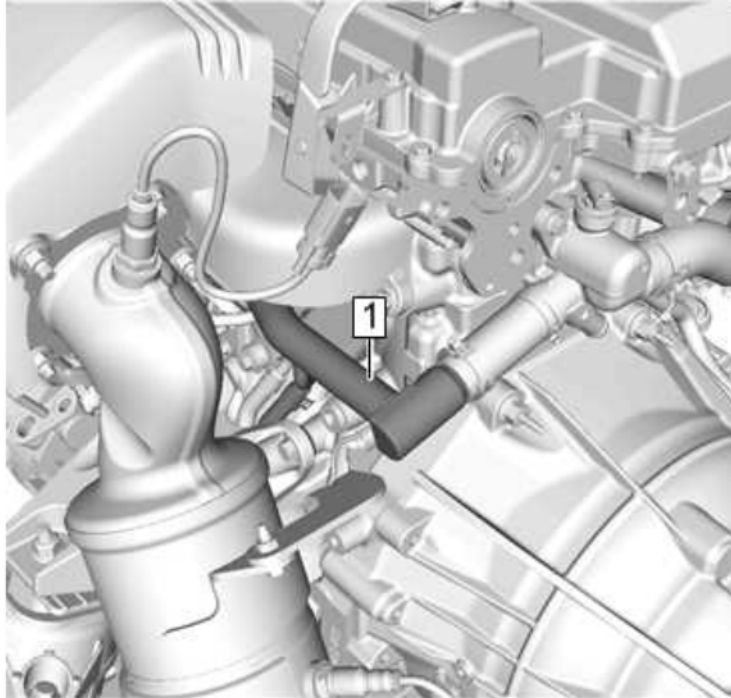


Fig. 238: Thermostat Bypass Pipe

Courtesy of GENERAL MOTORS COMPANY

8. Hose Clamp (1)» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

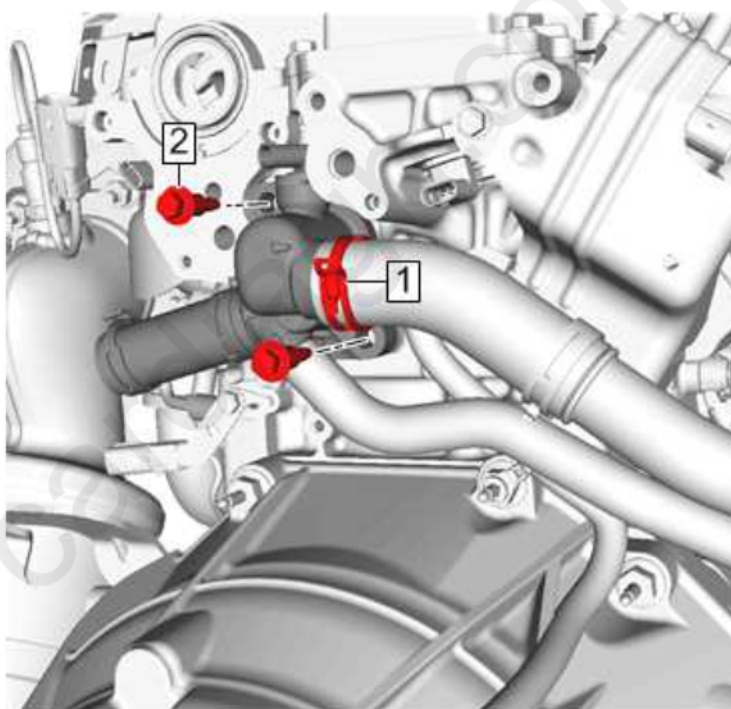


Fig. 239: Hose Clamp And Water Outlet Bolts

Courtesy of GENERAL MOTORS COMPANY

9. Water Outlet Bolt (2)» Remove [2x]
10. Water Outlet (1)» Remove

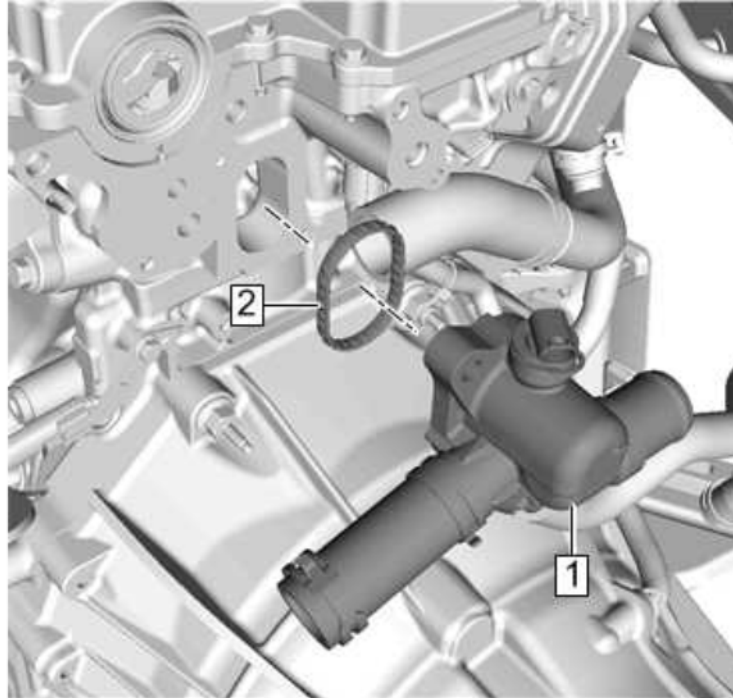


Fig. 240: Water Outlet And Seal

Courtesy of GENERAL MOTORS COMPANY

11. Water Outlet Seal (2)» Remove and DISCARD

Installation Procedure

1. Water Outlet Seal (2)» Install

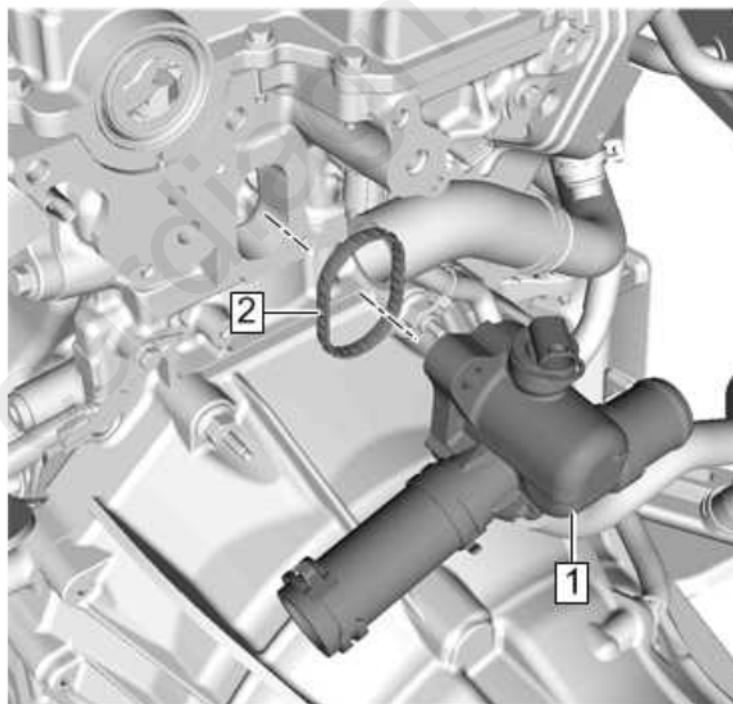


Fig. 241: Water Outlet And Seal

Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW seal.

2. Water Outlet (1)» Install
3. Water Outlet Bolt (2)» Install and tighten [2x] 10 N.m (89 lb in)

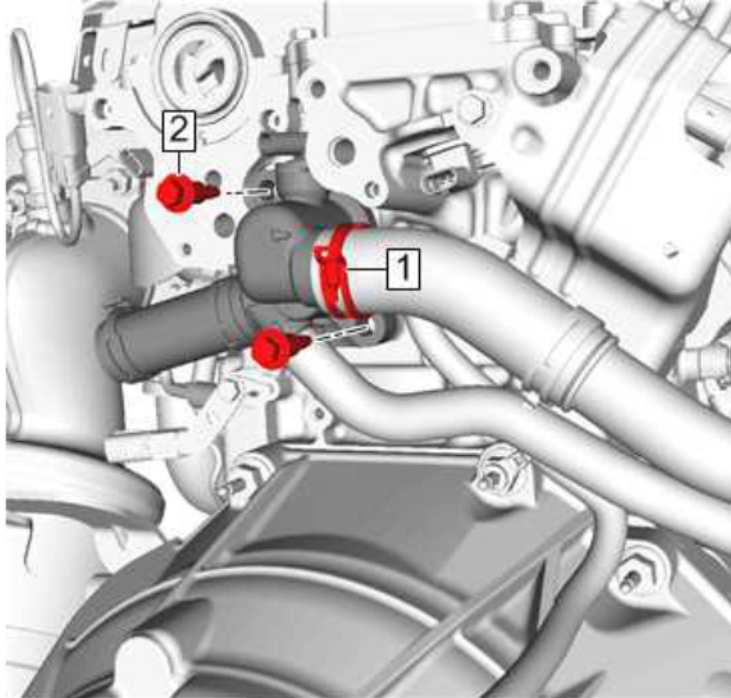


Fig. 242: Hose Clamp And Water Outlet Bolts
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

4. Hose Clamp (1) » Engage - **Hose Clamp Replacement Guidelines - Spring Type**
5. Thermostat Bypass Pipe (1) » Install - **Thermostat Bypass Pipe Replacement (LTG)**

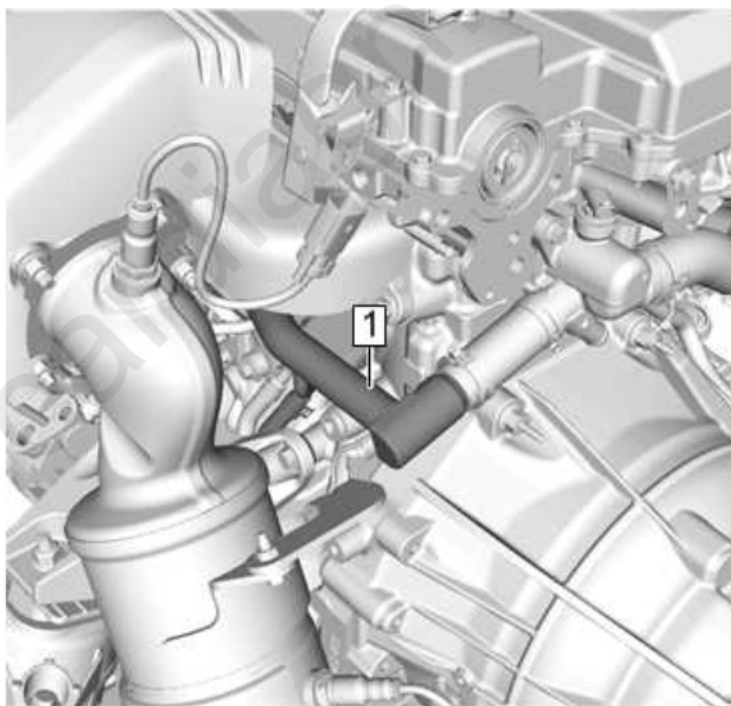


Fig. 243: Thermostat Bypass Pipe
 Courtesy of GENERAL MOTORS COMPANY

6. Auxiliary Heater Outlet Hose (2) @ Heater Coolant Pump » Install

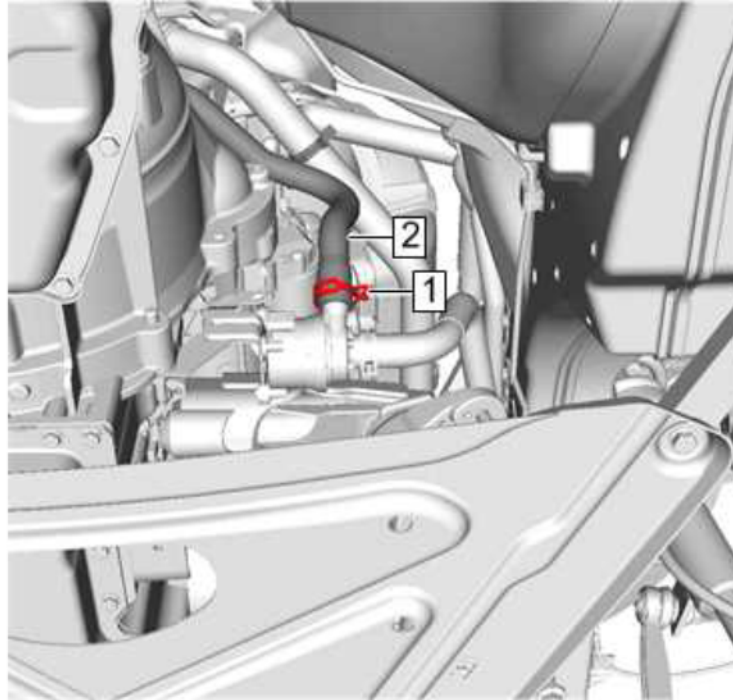


Fig. 244: Auxiliary Heater Outlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

7. Auxiliary Heater Outlet Hose Clamp (1) @ Heater Coolant Pump» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
8. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle**
9. Engine Coolant Temperature Sensor Electrical Connector (1)» Connect

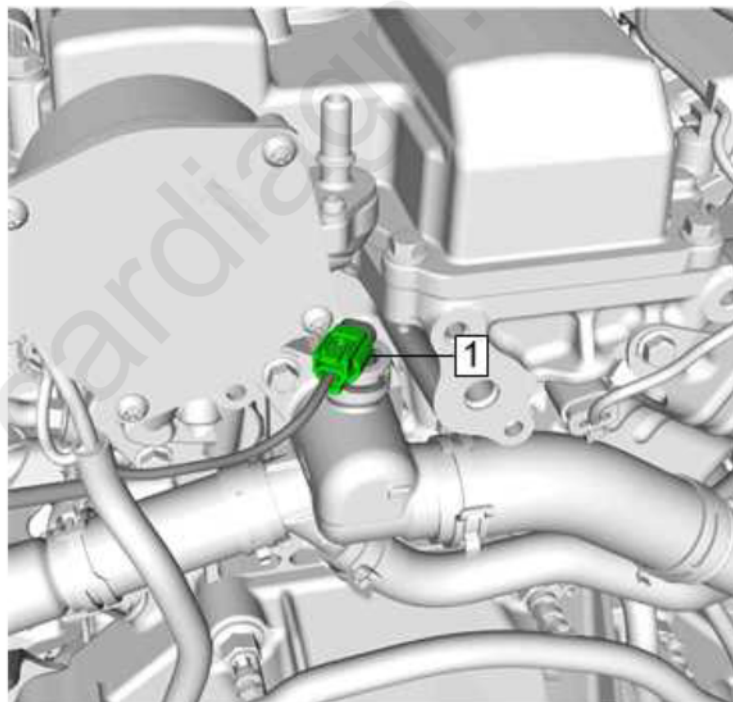


Fig. 245: Engine Coolant Temperature Sensor Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

10. Vacuum Pump (2)» Install - **Vacuum Pump Replacement**

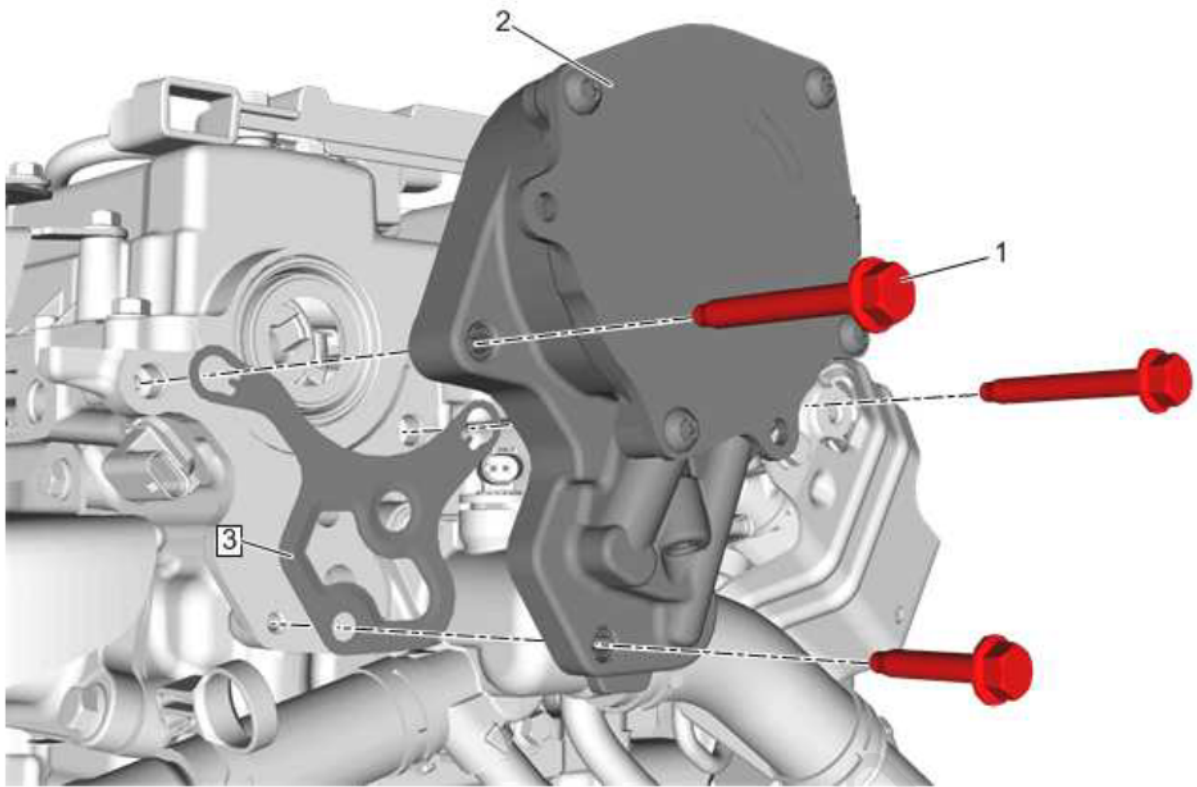


Fig. 246: Vacuum Pump

Courtesy of GENERAL MOTORS COMPANY

11. Fuel Pump Cover (2)» Install - **Fuel Pump Cover Replacement**

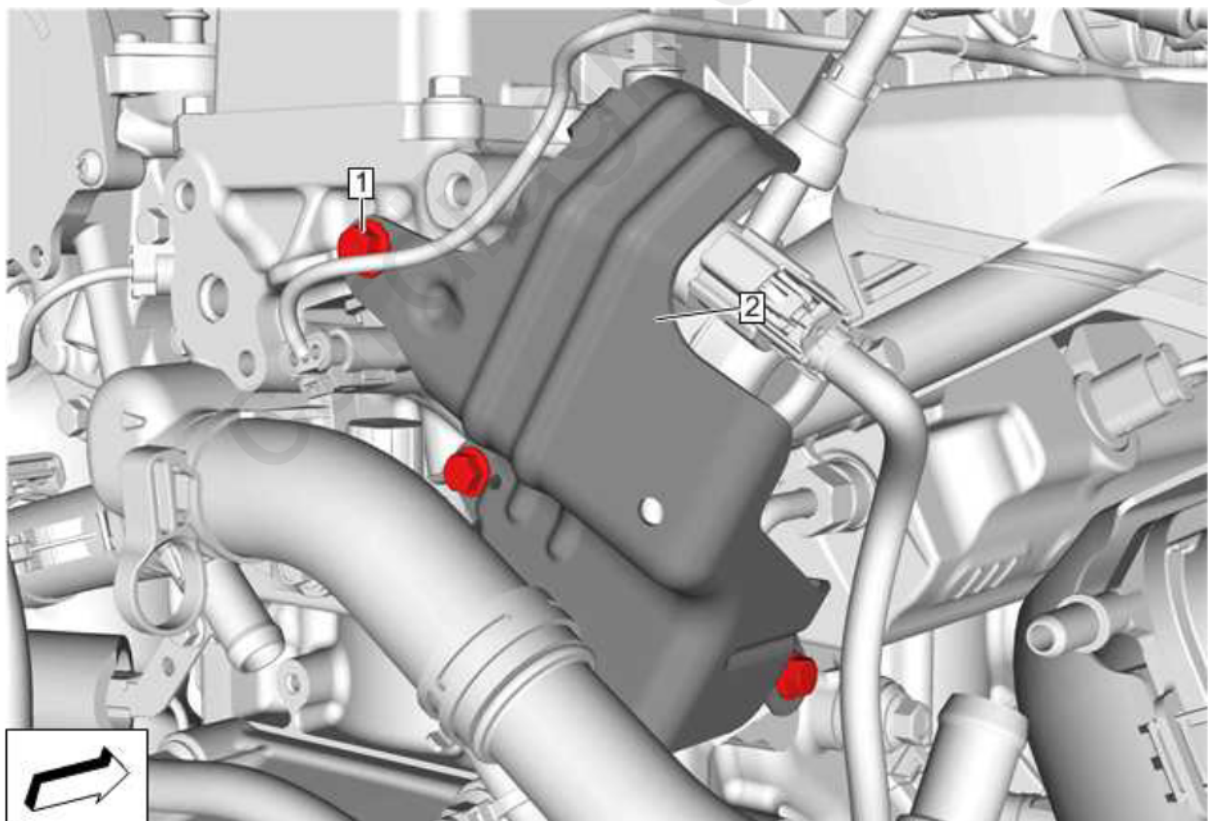


Fig. 247: Fuel Pump Cover

Courtesy of GENERAL MOTORS COMPANY

THERMOSTAT BYPASS PIPE REPLACEMENT (LTG)

Removal Procedure

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static LTG with HP9)** and/or **Cooling System Draining and Filling (GE 47716 LTG with HP9)**
2. Exhaust Manifold Brace» Remove - **Exhaust Manifold Brace Replacement (LTG)**

3. Engine Mount Bracket - Left Side» Remove - [Engine Mount Bracket Replacement - Left Side](#)

4. Thermostat Bypass Hose Clamp (1)» Disengage

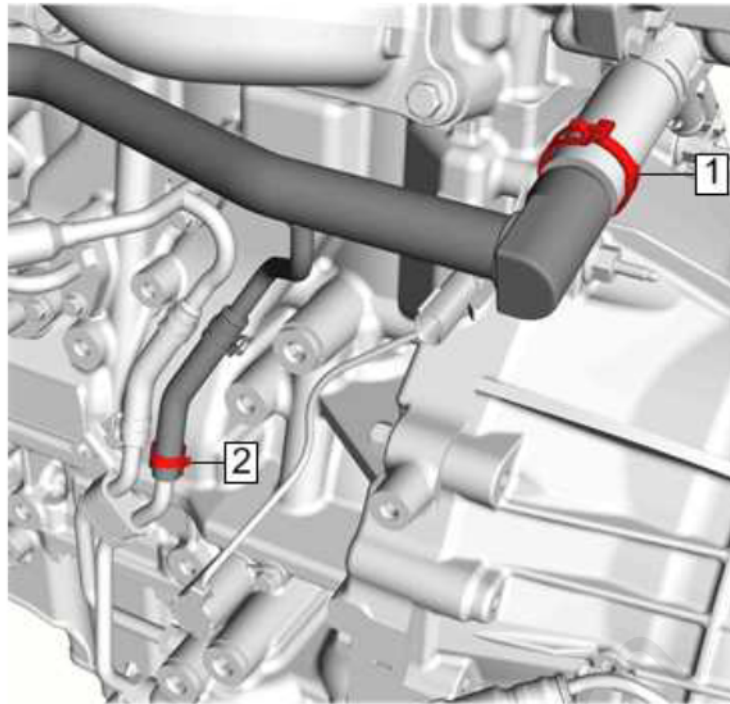


Fig. 248: Clamps

Courtesy of GENERAL MOTORS COMPANY

5. Engine Oil Cooler Inlet Hose Clamp (2)» Disengage

6. Thermostat Bypass Pipe Bolt (1)» Remove [2x]

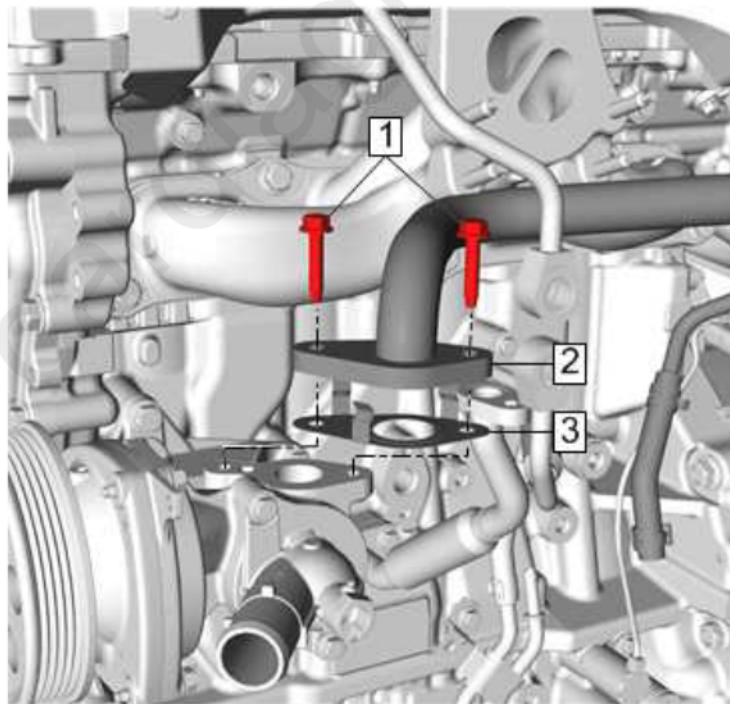


Fig. 249: Thermostat Bypass Pipe Gasket

Courtesy of GENERAL MOTORS COMPANY

7. Thermostat Bypass Pipe (2)» Remove

8. Thermostat Bypass Pipe Gasket (3)» Remove and DISCARD

Installation Procedure

1. Thermostat Bypass Pipe Gasket (3)» Install

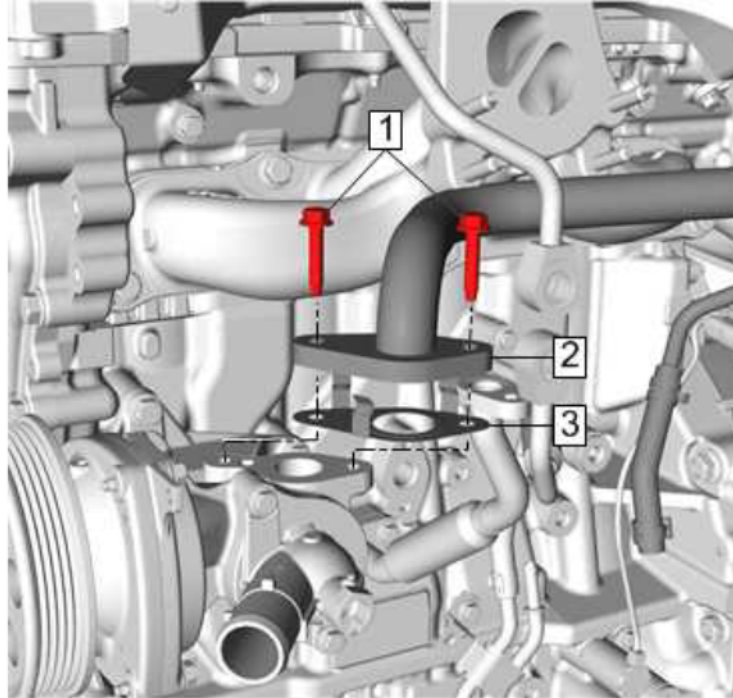


Fig. 250: Thermostat Bypass Pipe Gasket
Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW thermostat bypass pipe gasket.

2. Thermostat Bypass Pipe (2)» Install
3. Thermostat Bypass Pipe Bolt (1)» Install and tighten [2x] 10 N.m (89 lb in)

CAUTION: Refer to [Fastener Caution](#) .

4. Engine Oil Cooler Inlet Hose Clamp (2)» Engage

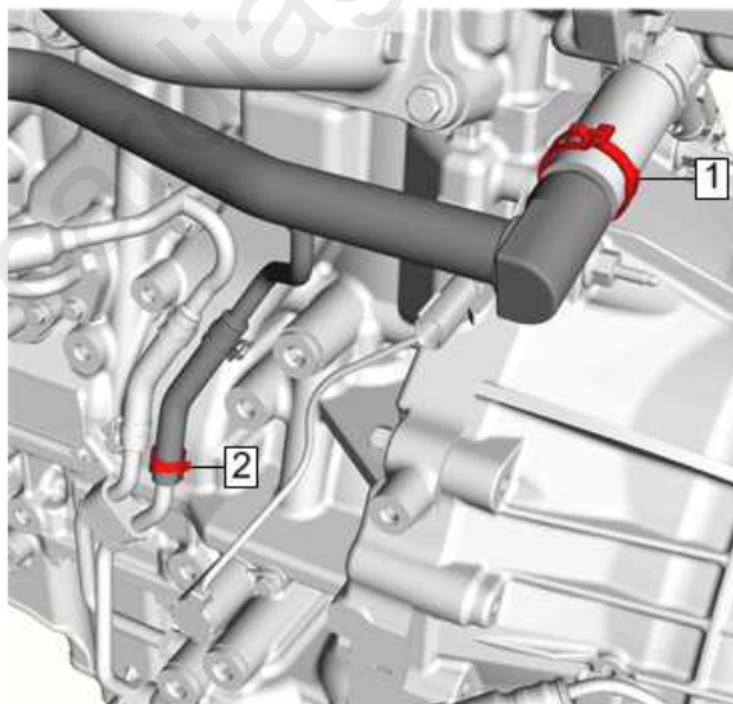


Fig. 251: Clamps
Courtesy of GENERAL MOTORS COMPANY

5. Thermostat Bypass Hose Clamp (1)» Engage
6. Engine Mount Bracket - Left Side» Install - [Engine Mount Bracket Replacement - Left Side](#)
7. Exhaust Manifold Brace» Install - [Exhaust Manifold Brace Replacement \(LTG\)](#)

8. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static LTG with HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 LTG with HP9\)](#).
9. Start the engine and check for leaks.

HEATER WATER BYPASS INLET HOSE REPLACEMENT (LGW)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#)[Cooling System Draining and Filling \(GE 47716 without HP9\)](#).
2. Front Axle Propeller Shaft, » Remove - [Front Axle Propeller Shaft Replacement \(LGX, LGW\)](#)
3. Turbocharger Heat Shield (2), » Remove

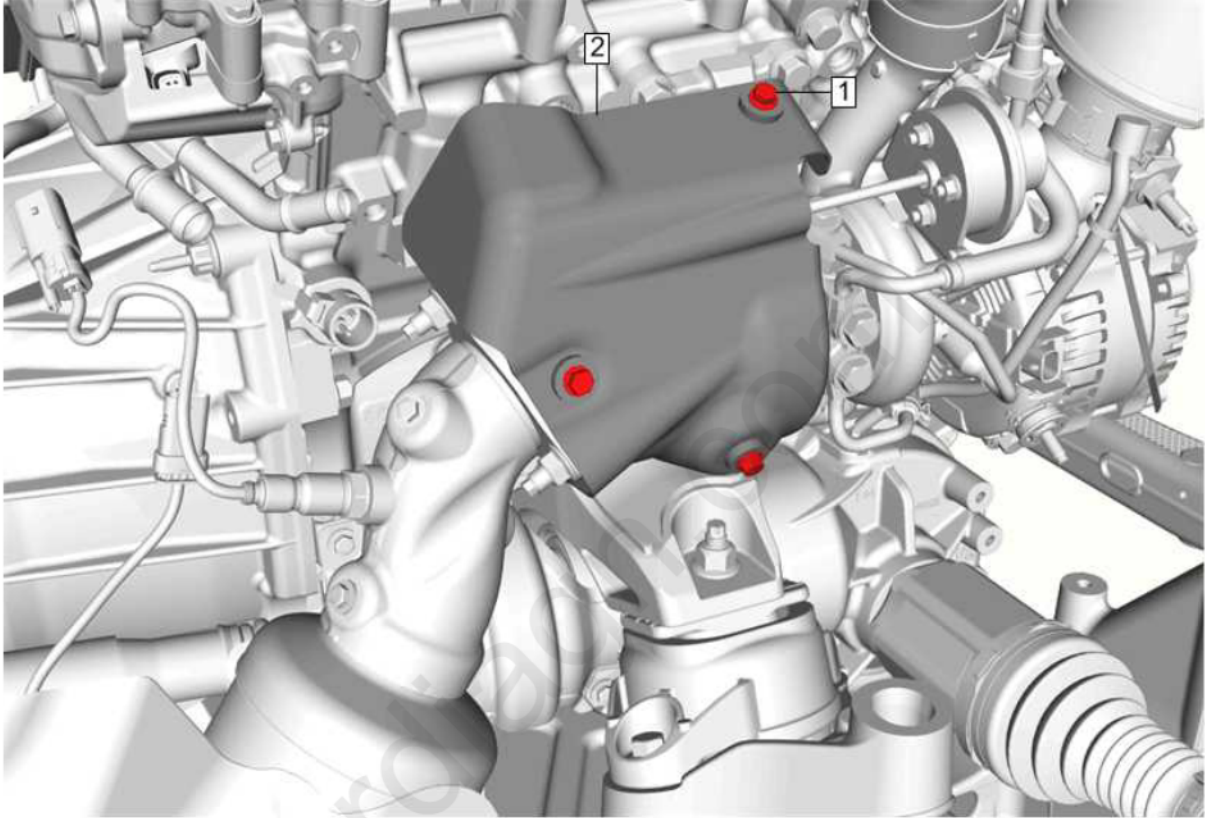


Fig. 252: Turbocharger Heat Shield (Right, LGW)
Courtesy of GENERAL MOTORS COMPANY

4. Bolt (1) @ Heater Water Bypass Inlet Hose, » Remove

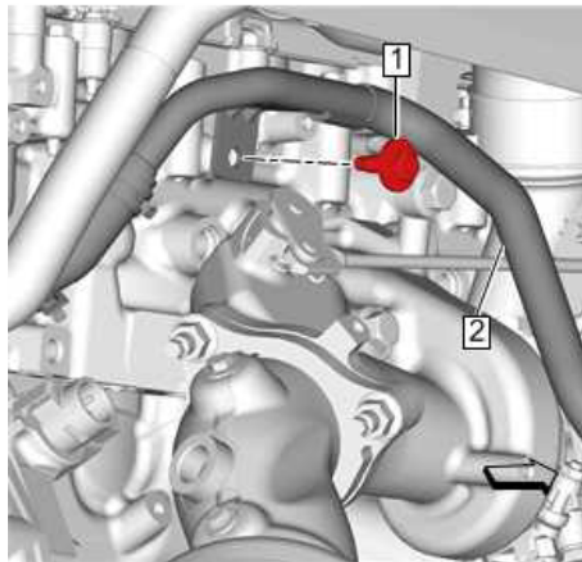


Fig. 253: Heater Water Bypass Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Heater Water Bypass Inlet Hose Clamp (1)» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

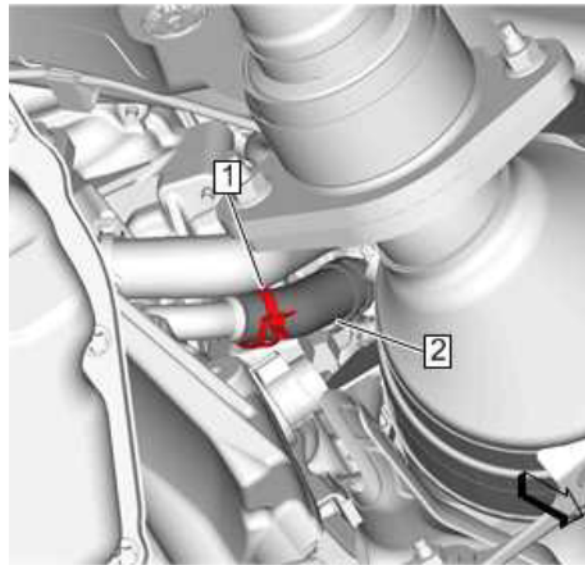


Fig. 254: Heater Water Bypass Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

6. Heater Water Bypass Inlet Hose (2) @ Heater Inlet and Outlet Pipe» Remove
7. Lower the vehicle. - [Lifting and Jacking the Vehicle](#)
8. Air Cleaner Assembly (1)» Remove - [Air Cleaner Assembly Replacement \(LGW\)](#)

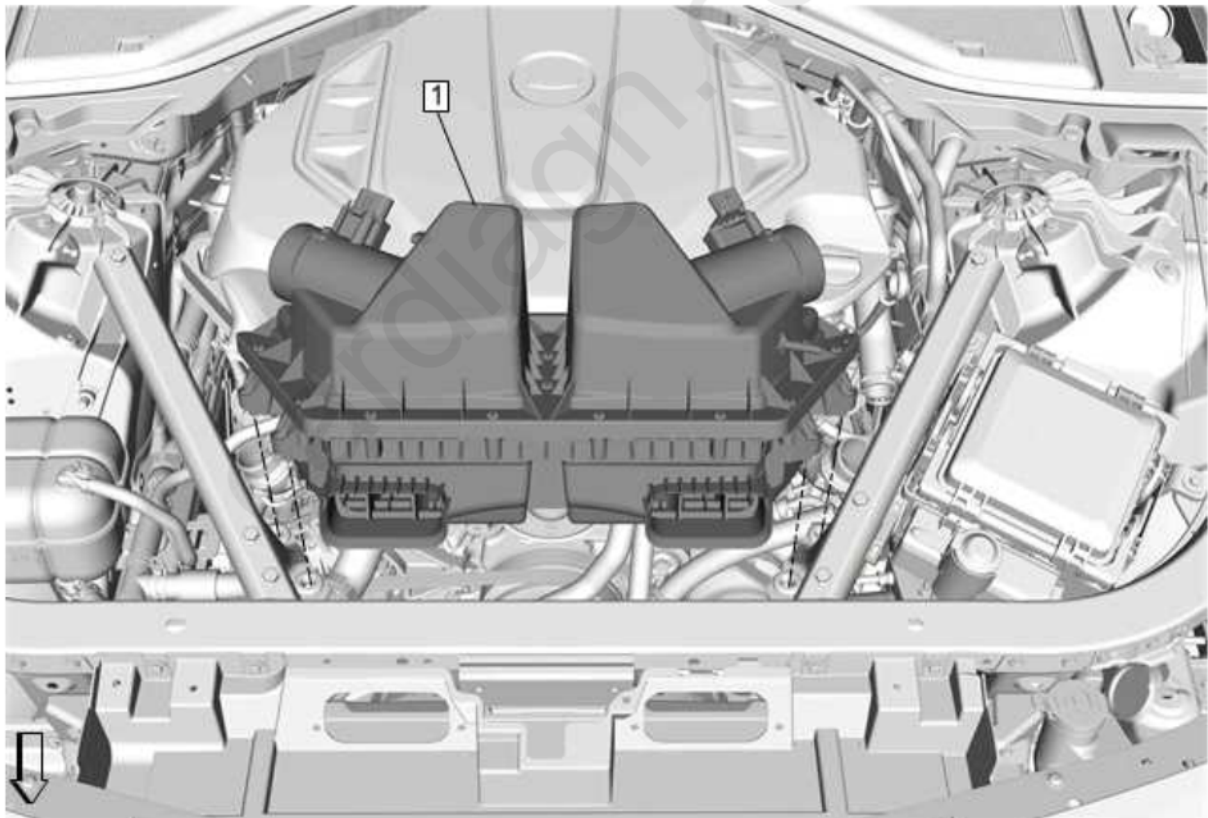


Fig. 255: Air Cleaner Assembly (LGW)
Courtesy of GENERAL MOTORS COMPANY

9. Air Cleaner Outlet Rear Duct» Remove - [Air Cleaner Outlet Rear Duct Replacement \(LGW\)](#)
10. Heater Water Bypass Inlet Hose Clamp (1) @ Heater Coolant Pump» Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

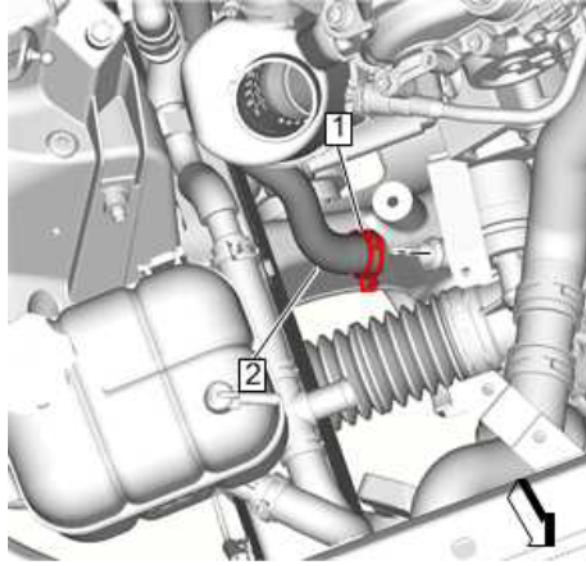


Fig. 256: Heater Water Bypass Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

11. Heater Water Bypass Inlet Hose (2) @ Heater Coolant PumpÃ,Â» Remove
12. Heater Water Bypass Inlet HoseÃ,Â» Remove

Installation Procedure

1. Heater Water Bypass Inlet HoseÃ,Â» Install
2. Heater Water Bypass Inlet Hose (2) @ Heater Coolant PumpÃ,Â» Install

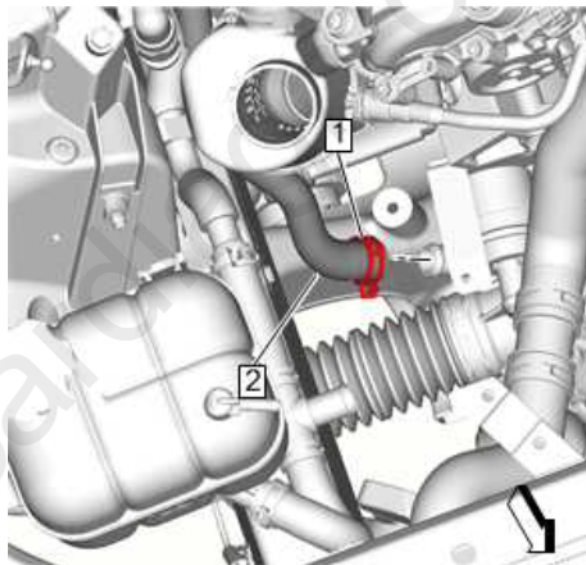


Fig. 257: Heater Water Bypass Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

3. Heater Water Bypass Inlet Hose Clamp (1) @ Heater Coolant PumpÃ,Â» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
4. Air Cleaner Outlet Rear DuctÃ,Â» Install - **Air Cleaner Outlet Rear Duct Replacement (LGW)**
5. Air Cleaner Assembly (1)Ã,Â» Install - **Air Cleaner Assembly Replacement (LGW)**

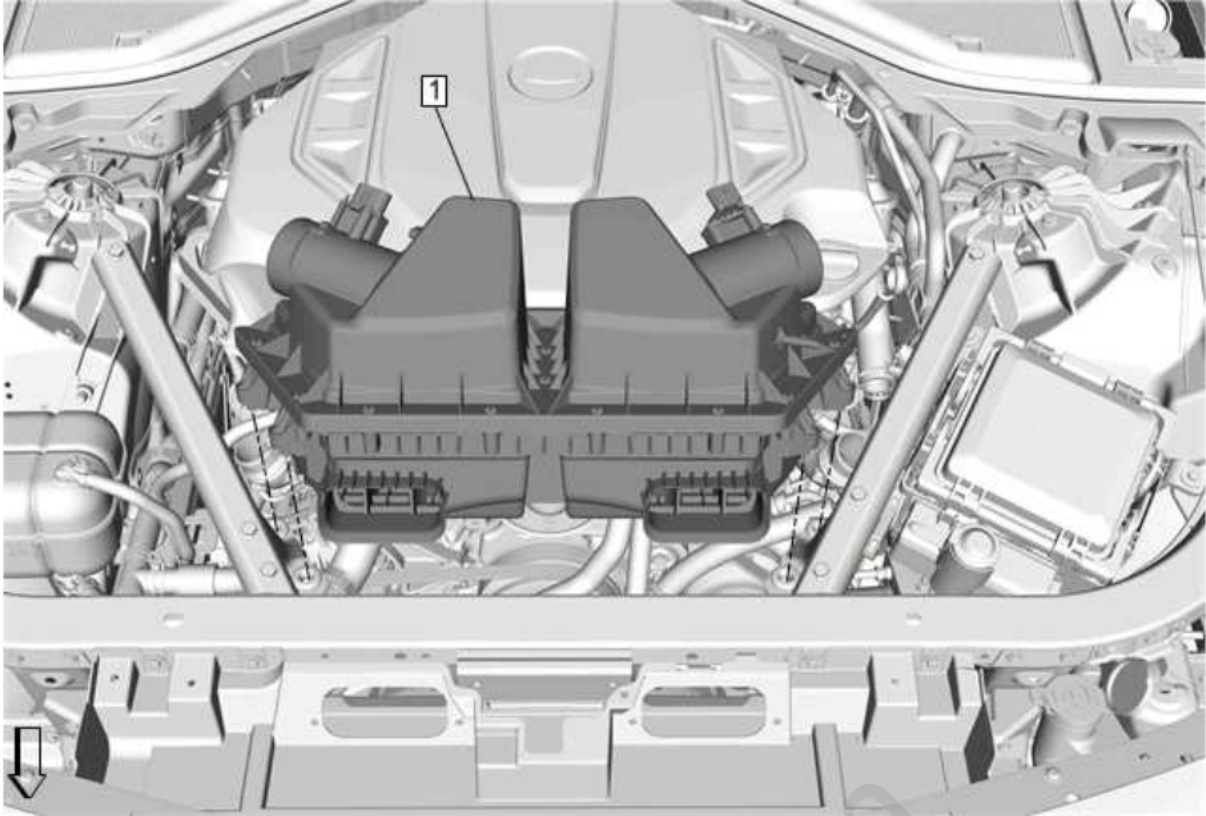


Fig. 258: Air Cleaner Assembly (LGW)

Courtesy of GENERAL MOTORS COMPANY

6. Raise the vehicle. - [Lifting and Jacking the Vehicle](#)
7. Heater Water Bypass Inlet Hose (2) @ Heater Inlet and Outlet Pipe» Install

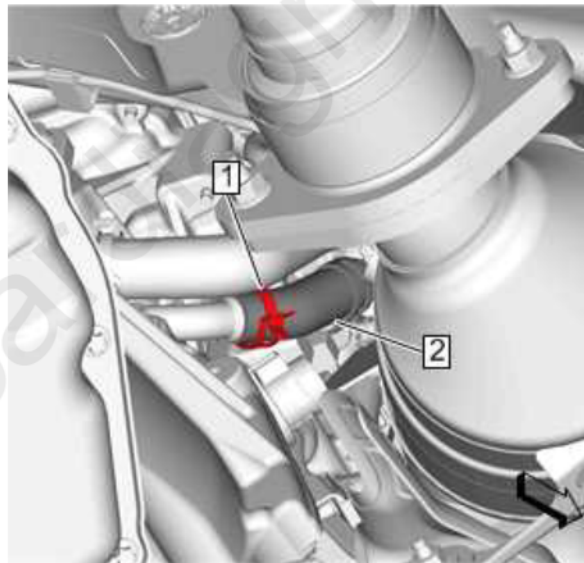


Fig. 259: Heater Water Bypass Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

8. Heater Water Bypass Inlet Hose Clamp (1)» Engage - [Hose Clamp Replacement Guidelines - Spring Type](#)
9. Bolt (1) @ Heater Water Bypass Inlet Hose» Install and tighten 22 N.m (16 lb ft)

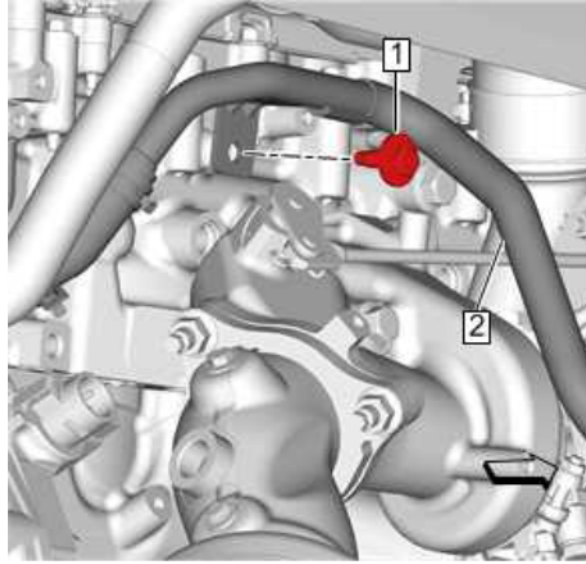


Fig. 260: Heater Water Bypass Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

10. Turbocharger Heat Shield (2)» Install

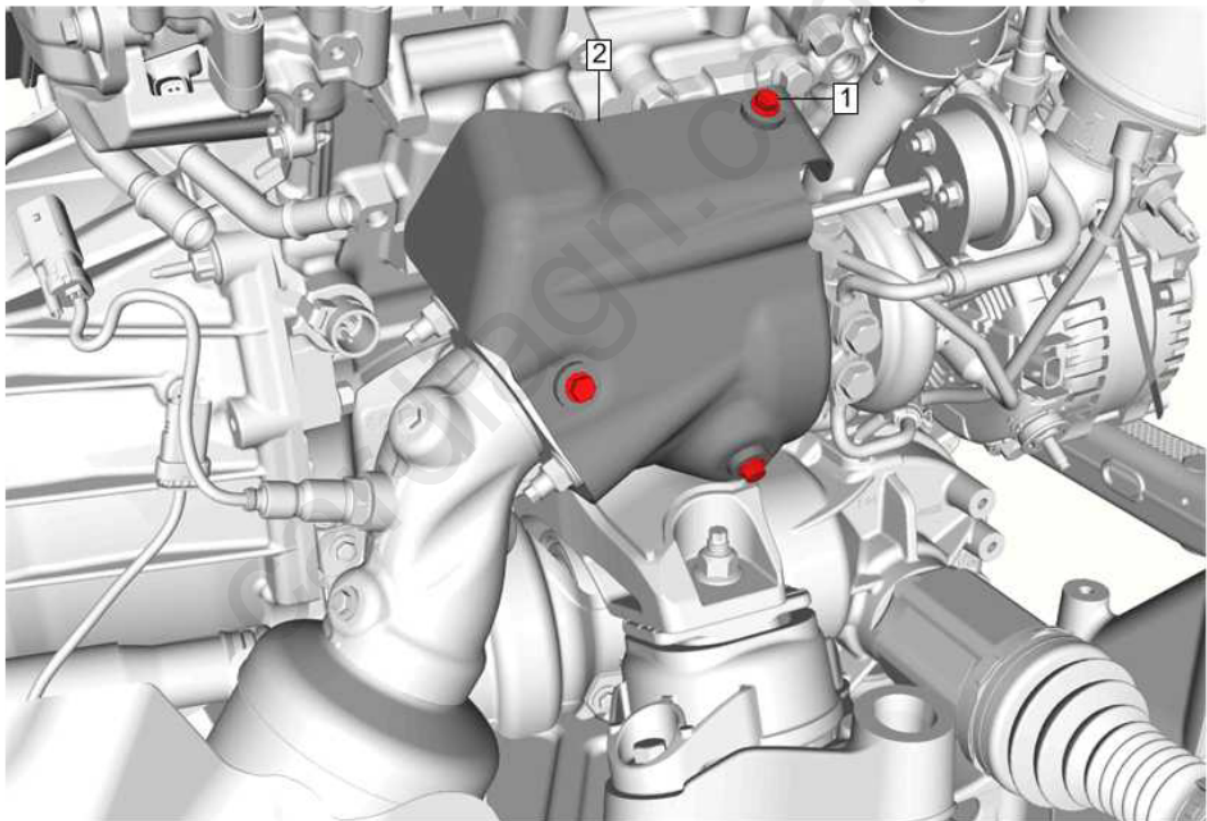


Fig. 261: Turbocharger Heat Shield (Right, LGW)
Courtesy of GENERAL MOTORS COMPANY

11. Front Axle Propeller Shaft» Install - [Front Axle Propeller Shaft Replacement \(LGX, LGW\)](#)
12. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
13. Start the engine and check for coolant leaks.

HEATER WATER BYPASS INLET HOSE REPLACEMENT (LGX)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)

2. Air Cleaner Assembly, Remove [Air Cleaner Assembly Replacement \(LGX\)](#)
3. Heater Water Bypass Inlet Hose Clamp (1) @ Heater Water Bypass Inlet Hose (2), Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

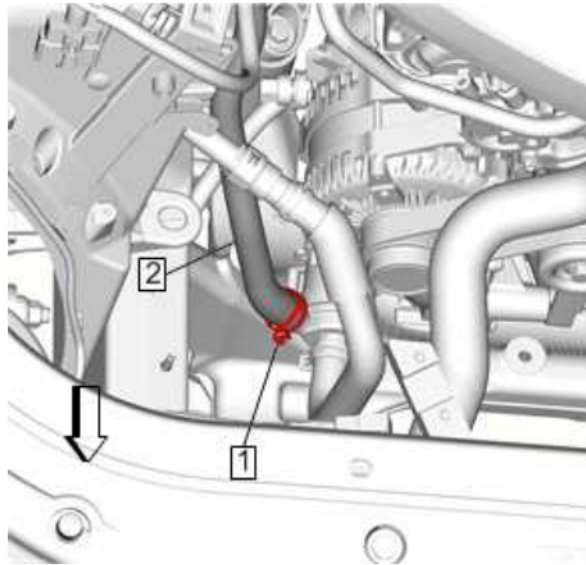


Fig. 262: Heater Water Bypass Inlet Hose Clamp
 Courtesy of GENERAL MOTORS COMPANY

4. Front Axle Propeller Shaft, Remove [Front Axle Propeller Shaft Replacement \(LGX, LGW\)](#)
5. Heater Water Bypass Inlet Hose Clamp (1) @ Heater Water Bypass Inlet Hose (2), Disengage - [Hose Clamp Replacement Guidelines - Spring Type](#)

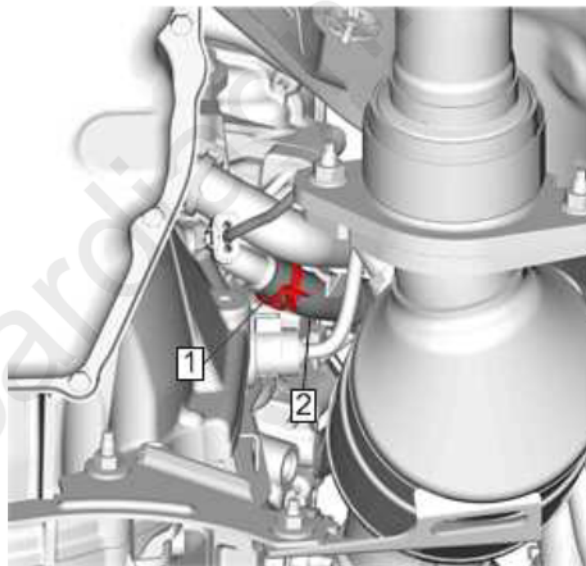


Fig. 263: Heater Water Bypass Inlet Hose Clamp
 Courtesy of GENERAL MOTORS COMPANY

6. Heater Water Bypass Inlet Hose Bracket Bolt (1), Remove

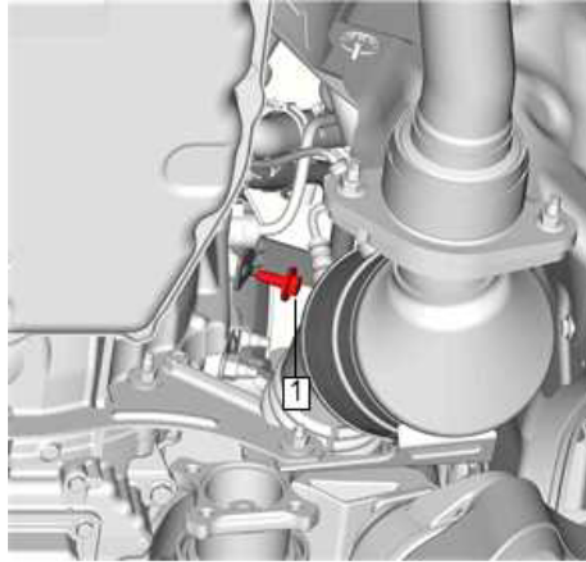


Fig. 264: Heater Water Bypass Inlet Hose Bracket Bolt
 Courtesy of GENERAL MOTORS COMPANY

7. Lower the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
8. Heater Water Bypass Inlet Hose (1)» Remove

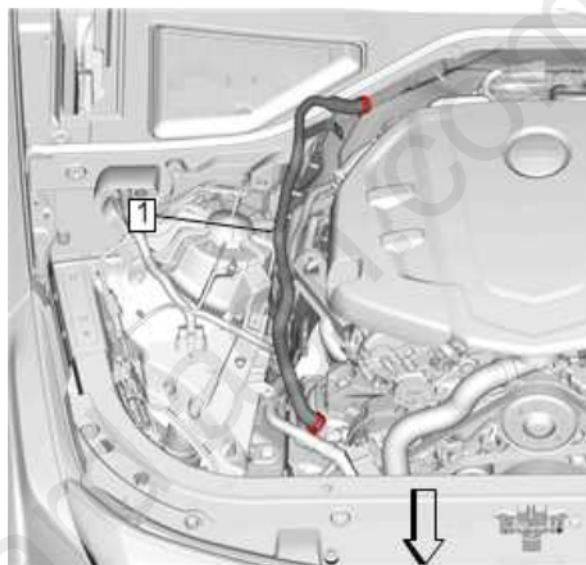


Fig. 265: Heater Water Bypass Inlet Hose Clamp
 Courtesy of GENERAL MOTORS COMPANY

Installation Procedure

1. Heater Water Bypass Inlet Hose (1)» Install

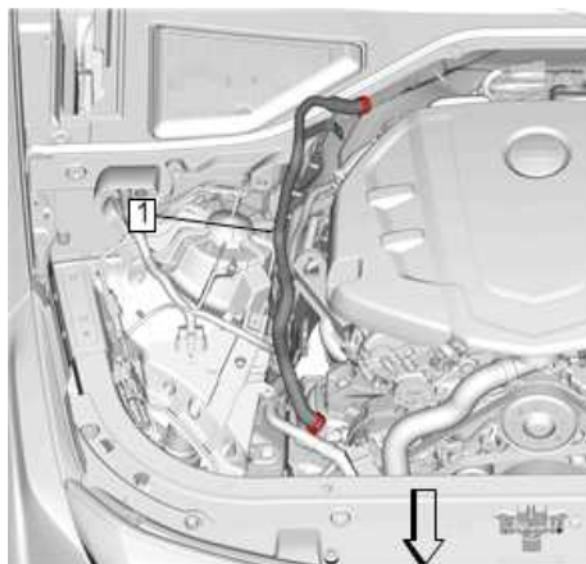


Fig. 266: Heater Water Bypass Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle**
3. Heater Water Bypass Inlet Hose Bracket Bolt (1)» Install and tighten 22 N.m (16 lb ft)

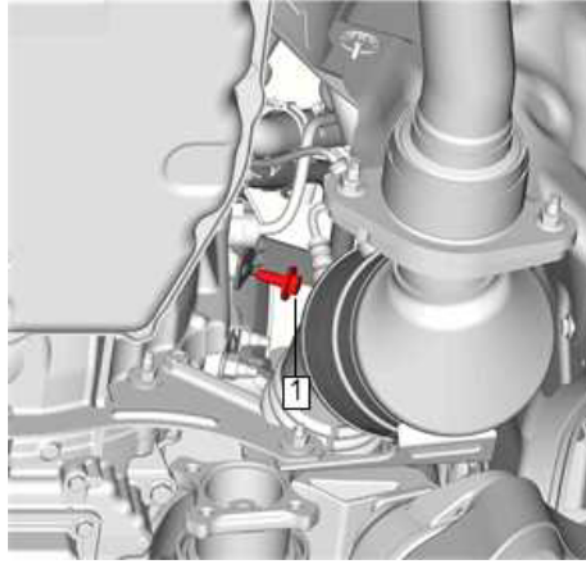


Fig. 267: Heater Water Bypass Inlet Hose Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Heater Water Bypass Inlet Hose Clamp (1) @ Heater Water Bypass Inlet Hose (2)» Engage - **Hose Clamp Replacement Guidelines - Spring Type**

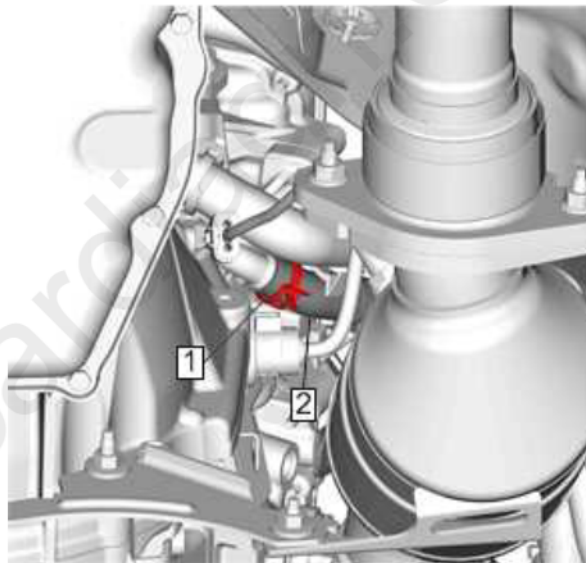


Fig. 268: Heater Water Bypass Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Front Axle Propeller Shaft» Install **Front Axle Propeller Shaft Replacement (LGX, LGW)**
6. Heater Water Bypass Inlet Hose Clamp (1) @ Heater Water Bypass Inlet Hose (2)» Engage - **Hose Clamp Replacement Guidelines - Spring Type**

Callout	Component Name
Preliminary Procedures <u>Fuel Pipe Shield Replacement (LGW) Fuel Pipe Shield Replacement (LGX)</u> - Auxiliary Heater Inlet Hose @ Heater Inlet and Outlet Pipe» Disconnect - <u>Auxiliary Heater Inlet Hose Replacement (LGW) Auxiliary Heater Inlet Hose Replacement (LGX)</u> - Heater Water Bypass Inlet Hose @ Heater Inlet and Outlet Pipe» Disconnect - <u>Heater Water Bypass Inlet Hose Replacement (LGW) Heater Water Bypass Inlet Hose Replacement (LGX)</u>	
1	Heater Inlet and Outlet Pipe Bracket Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Heater Inlet and Outlet Pipe Bolt [2x] Tighten 9 N.m (80 lb in)
3	Heater Inlet and Outlet Pipe Gasket Procedure Install a NEW gasket.
4	Heater Inlet and Outlet Pipe

WATER PUMP PULLEY REPLACEMENT (LGW, LGX)

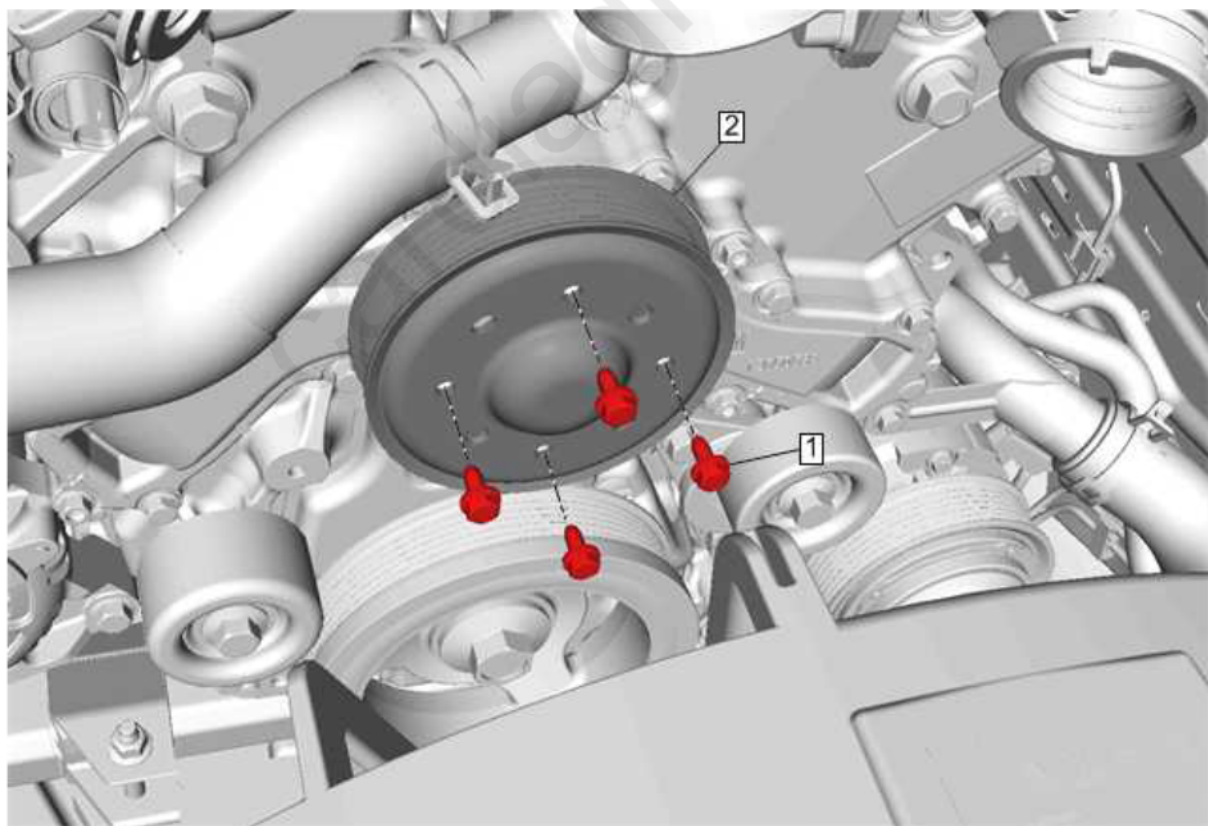


Fig. 271: Water Pump Pulley (LGW, LGX)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Drive Belt Replacement (LGX) Drive Belt Replacement (LGW)</u>	

Callout	Component Name
1	Water Pump Pulley Bolt [4x] CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Water Pump Pulley Procedure 1. Install the EN-46104 Water Pump Pulley Holding Tool onto the water pump pulley mounting holes. 2. Remove the water pump pulley bolts. 3. Remove the EN-46104 Water Pump Pulley Holding Tool from the water pump pulley. Special Tools EN-46104 Water Pump Pulley Holding Tool For equivalent regional tools, refer to Special Tools .

WATER PUMP REPLACEMENT (LGW, LGX)

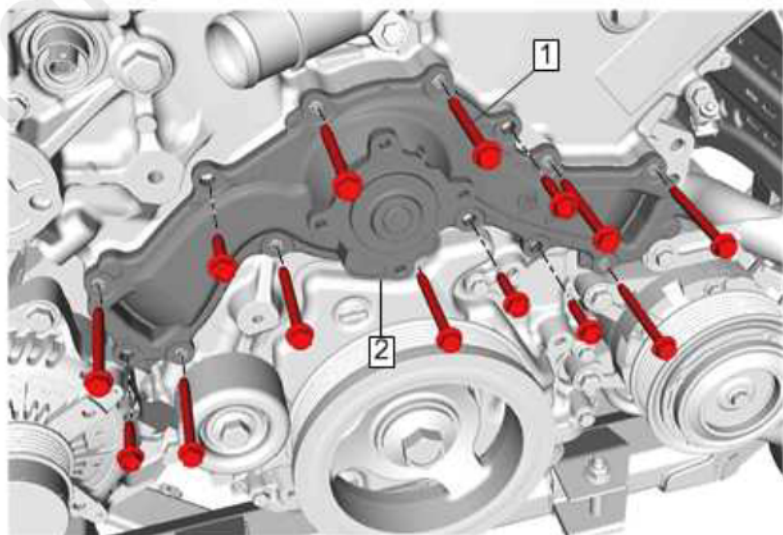
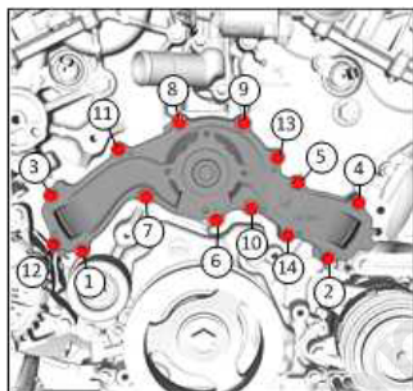


Fig. 272: Water Pump (LGX)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1.	Cooling System Draining and Filling (Static without HP9) Cooling System Draining and Filling (GE 47716 without HP9)
2.	Drive Belt Tensioner Replacement (LGX) Drive Belt Tensioner Replacement (LGW)
3.	Water Pump Pulley Replacement (LGW, LGX)

Callout	Component Name
1	Water Pump Bolt [14x] CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component. CAUTION: Refer to Fastener Caution . NOTE: • Install NEW bolts. • Take note that there are different bolt lengths. Tighten in sequence 15 N.m (11 lb ft)
2	Water Pump NOTE: Install a NEW gasket.

WATER PUMP REPLACEMENT (LTG)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static LTG with HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 LTG with HP9\)](#)
2. Intake Manifold Cover» Remove - [Intake Manifold Cover Replacement](#)
3. Drive Belt» Remove - [Drive Belt Replacement \(Except Hybrid\)](#) [Drive Belt Replacement \(Hybrid\)](#)
4. Charge Air Cooler Inlet Air Tube» Remove - [Charge Air Cooler Inlet Air Tube Replacement](#)
5. Engine Wiring Harness Retainer (1)» Disconnect

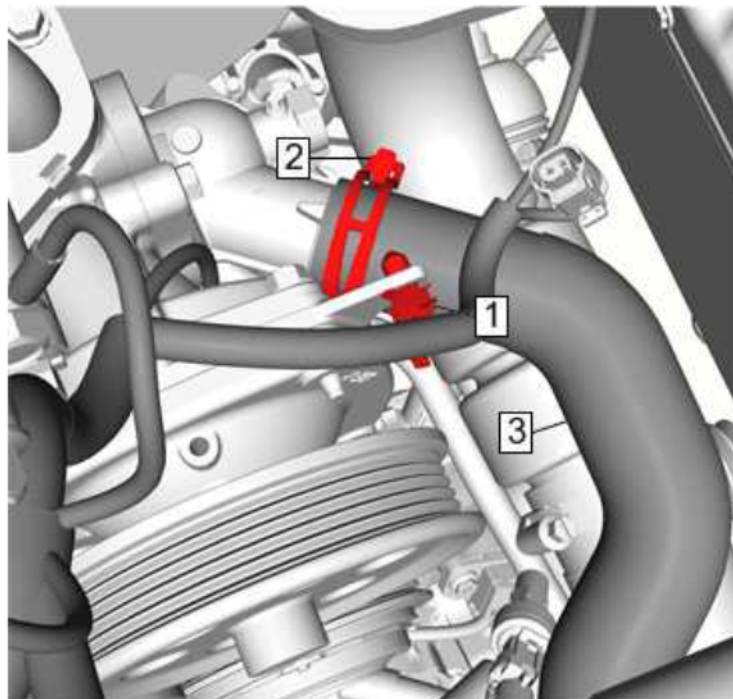


Fig. 273: Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

6. Radiator Outlet Hose Clamp (2)» Disengage - **Hose Clamp Replacement Guidelines - Spring Type**
7. Radiator Outlet Hose (3)» Disconnect
8. Thermostat Bypass Pipe Bolt (1)» Remove [2x]

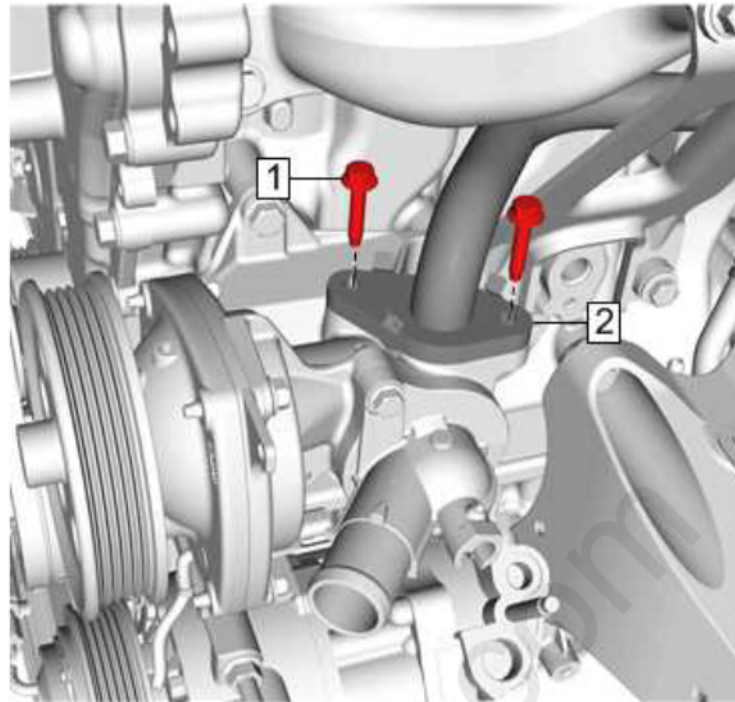


Fig. 274: Thermostat Bypass Pipe Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Thermostat Bypass Pipe Gasket (2)» Remove and DISCARD
10. Water Pump Bolt (1)» Remove [3x]

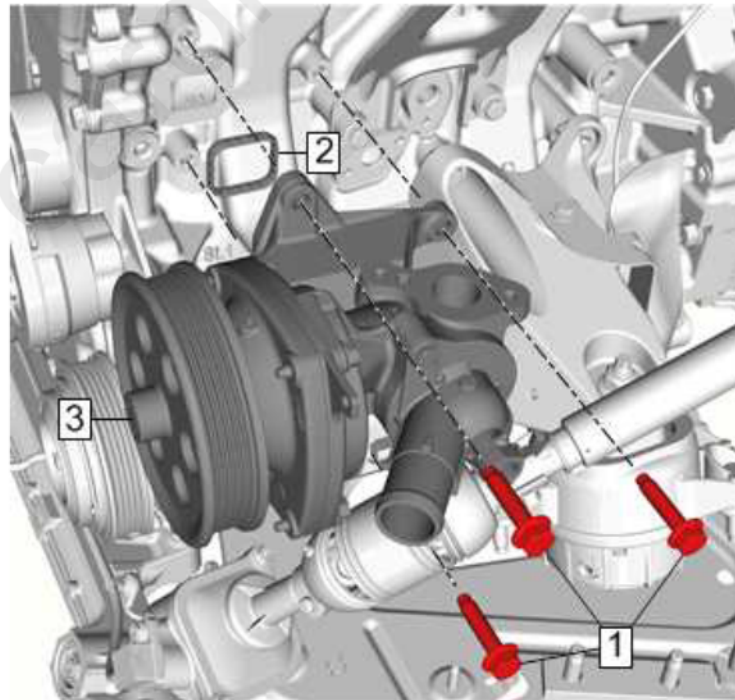


Fig. 275: Water Pump Seal
Courtesy of GENERAL MOTORS COMPANY

11. Water Pump (3)» Remove
12. Water Pump Seal (2)» Remove and DISCARD
13. Transfer components as necessary.

Installation Procedure

1. Carefully clean the water pump sealing surfaces.
2. Water Pump Seal (2)» Install

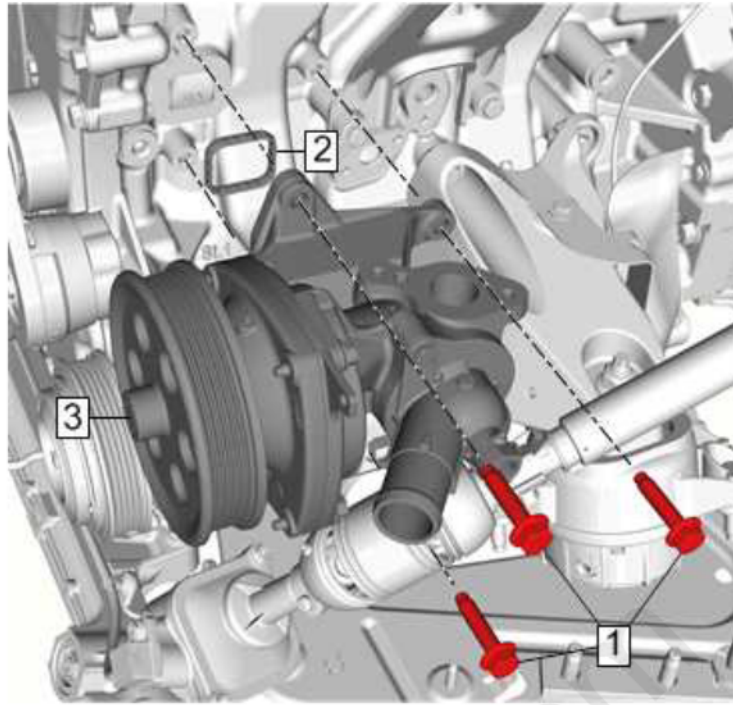


Fig. 276: Water Pump Seal

Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a **NEW** water pump seal.

3. Water Pump (3)» Install
4. Water Pump Bolt (1)» Hand tighten [3x]
5. Water Pump Bolt (1)» Tighten [3x] 25 N.m (18 lb ft)

CAUTION: Refer to **Fastener Caution** .

NOTE: Tighten the water pump bolts in a counter clockwise pattern beginning with the top most bolt to properly compress the water pump seal.

6. Thermostat Bypass Pipe Gasket (2)» Install

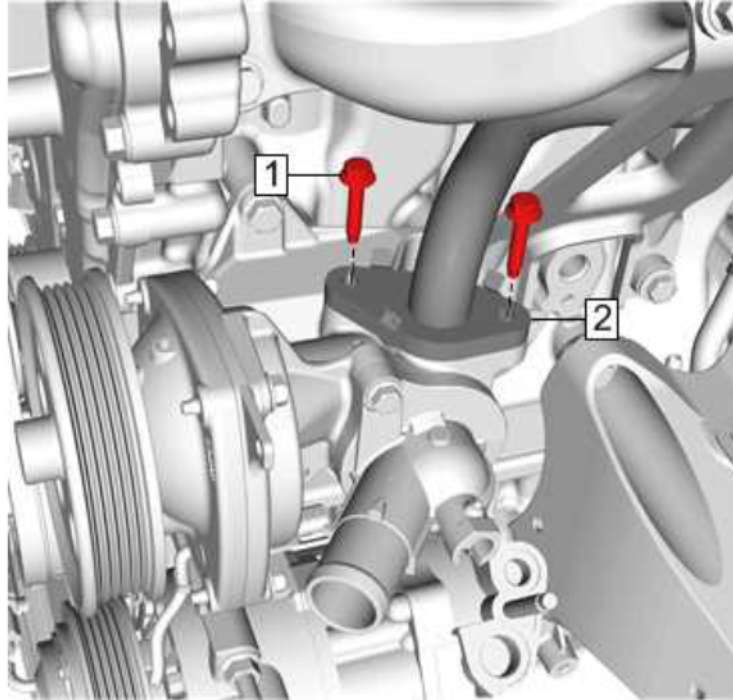


Fig. 277: Thermostat Bypass Pipe Bolt
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW gasket.

7. Thermostat Bypass Pipe Bolt (1)» Install and tighten [2x] 10 N.m (89 lb in)
8. Radiator Outlet Hose (3)» Connect

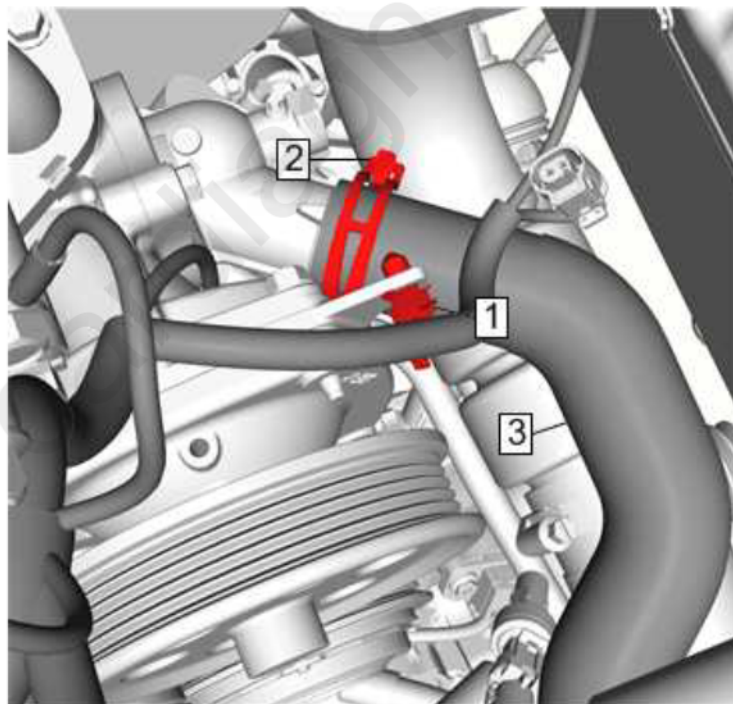


Fig. 278: Radiator Outlet Hose
 Courtesy of GENERAL MOTORS COMPANY

9. Radiator Outlet Hose Clamp (2)» Engage - **Hose Clamp Replacement Guidelines - Spring Type**
10. Engine Wiring Harness Retainer (1)» Connect
11. Charge Air Cooler Inlet Air Tube» Install - **Charge Air Cooler Inlet Air Tube Replacement**
12. Drive Belt» Install - **Drive Belt Replacement (Except Hybrid) Drive Belt Replacement (Hybrid)**
13. Intake Manifold Cover» Install - **Intake Manifold Cover Replacement**
14. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static LTG with HP9)** and/or **Cooling System Draining and Filling (GE 47716 LTG with HP9)**

15. Start the engine and check for coolant leaks.

CHARGE AIR COOLER COOLANT PUMP REPLACEMENT (LGW)

Removal Procedure

1. Drain the charge air cooling system. Refer to [Charge Air Cooling System Draining and Filling \(LGW\)](#)
2. Electrical Connector @ Charge Air Cooler Coolant Pump» Remove
3. Retainer Clip @ Charge Air Cooler Coolant Pump» Remove
4. Charge Air Cooler Coolant Hose (2) @ Charge Air Cooler Coolant Pump» Remove - [Charge Air Cooler Coolant Hose Replacement - Radiator to Pump \(LGW\)](#)

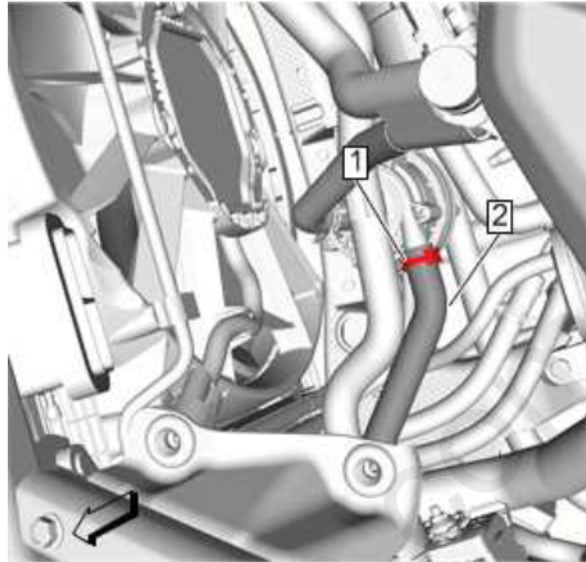


Fig. 279: Charge Air Cooler Coolant Hose
Courtesy of GENERAL MOTORS COMPANY

5. Charge Air Cooler Coolant Hose (3) @ Charge Air Cooler Coolant Pump» Remove - [Charge Air Cooler Coolant Hose Replacement - Inlet \(LGW\)](#)

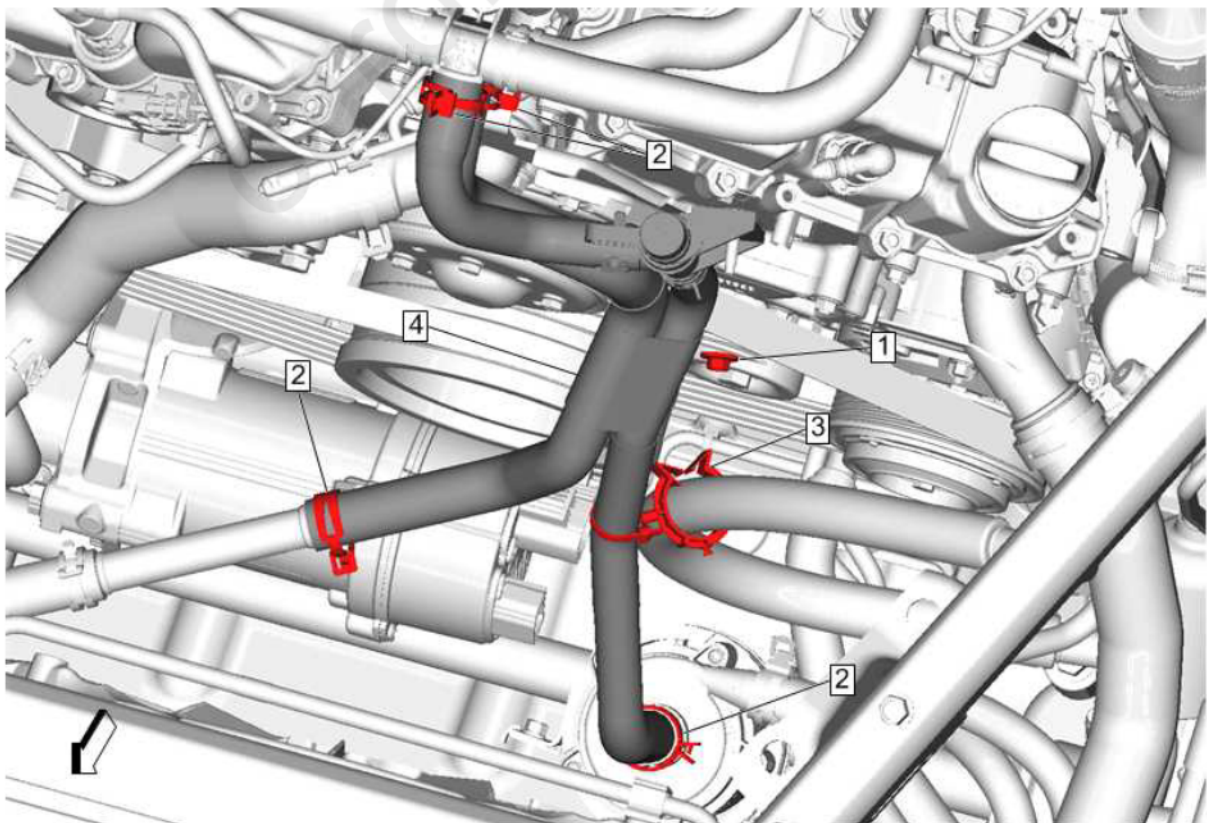


Fig. 280: Charge Air Cooler Coolant Hose
Courtesy of GENERAL MOTORS COMPANY

6. Charge Air Cooler Coolant Pump Clamp Bolt (1)» Remove [2x]

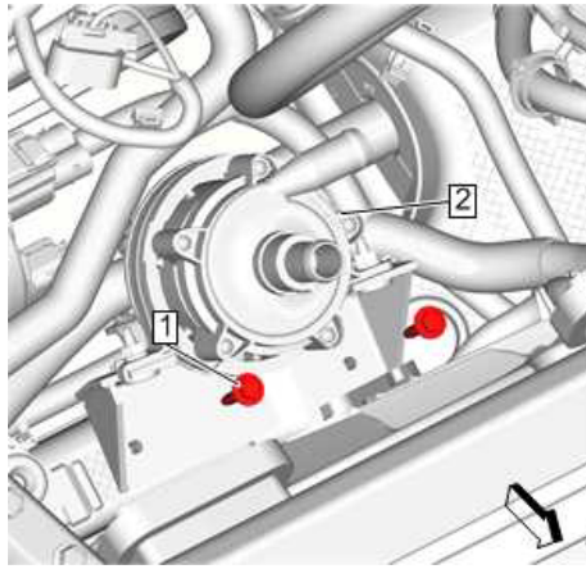


Fig. 281: Charge Air Cooler Coolant Pump And Clamp Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Charge Air Cooler Coolant Pump (2)» Remove

8. Charge Air Cooler Coolant Pump Nut (1)» Remove [2x]

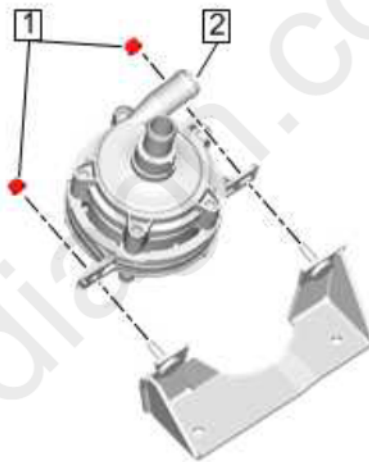


Fig. 282: Charge Air Cooler Coolant Pump
Courtesy of GENERAL MOTORS COMPANY

9. Charge Air Cooler Coolant Pump (2)» Remove

Installation Procedure

1. Charge Air Cooler Coolant Pump (2)» Install

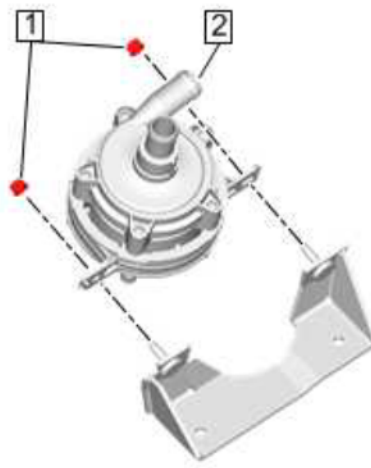


Fig. 283: Charge Air Cooler Coolant Pump

Courtesy of GENERAL MOTORS COMPANY

2. Charge Air Cooler Coolant Pump Nut (1)» Install and tighten [2x] 9 N.m (80 lb in)

CAUTION: Refer to [Fastener Caution](#) .

3. Charge Air Cooler Coolant Pump (2)» Install

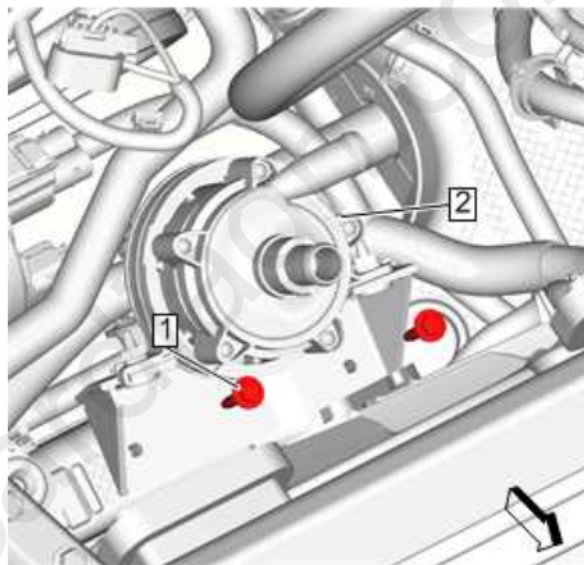


Fig. 284: Charge Air Cooler Coolant Pump And Clamp Bolt

Courtesy of GENERAL MOTORS COMPANY

4. Charge Air Cooler Coolant Pump Clamp Bolt (1)» Install and tighten [2x] 9 N.m (80 lb in)
5. Charge Air Cooler Coolant Hose (3) @ Charge Air Cooler Coolant Pump» Install - [Charge Air Cooler Coolant Hose Replacement - Inlet \(LGW\)](#)

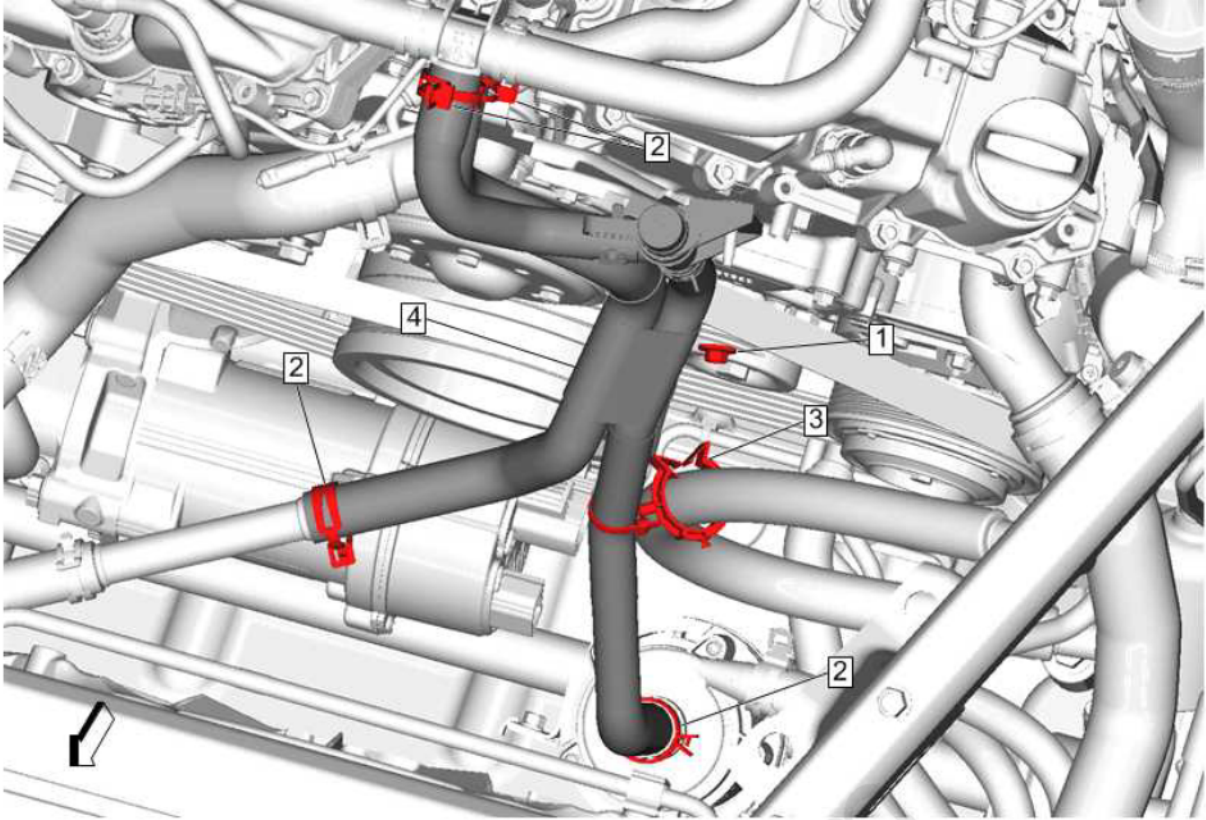


Fig. 285: Charge Air Cooler Coolant Hose
 Courtesy of GENERAL MOTORS COMPANY

6. Charge Air Cooler Coolant Hose (2) @ Charge Air Cooler Coolant PumpÃ,Â» Install - **Charge Air Cooler Coolant Hose Replacement - Radiator to Pump (LGW)**

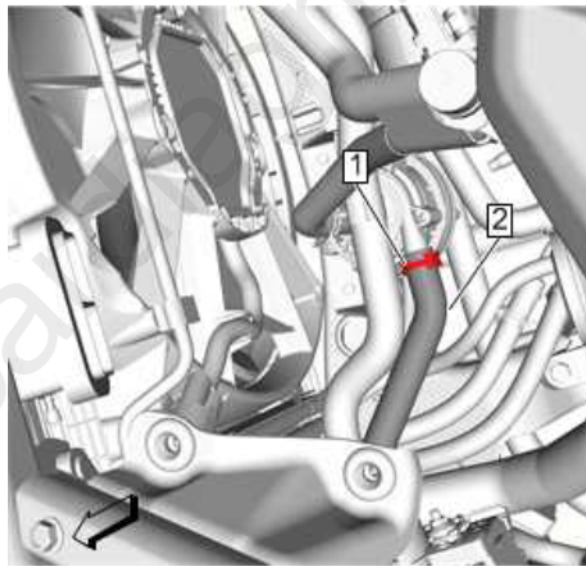


Fig. 286: Charge Air Cooler Coolant Hose
 Courtesy of GENERAL MOTORS COMPANY

7. Retainer Clip @ Charge Air Cooler Coolant PumpÃ,Â» Install
8. Electrical Connector @ Charge Air Cooler Coolant PumpÃ,Â» Install
9. Fill the charge air cooling system. Refer to **Charge Air Cooling System Draining and Filling (LGW)**
10. Check the charge air cooling system for leaks. Refer to **Charge Air Cooling System Leak Testing (LGW)**

ENGINE COOLANT FAN SHROUD REPLACEMENT (LGW LGX LTG)

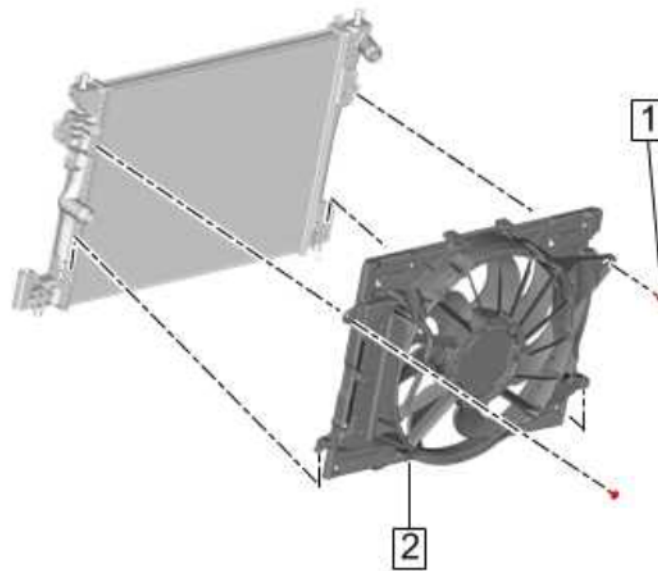


Fig. 287: Engine Coolant Fan Bolt (LGW LGX LTG)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Radiator Replacement (LTG without HP9)</u> <u>Radiator Replacement (LGW)</u> <u>Radiator Replacement (LGX)</u> <u>Radiator Replacement (LTG with HP9)</u>	
1	Engine Coolant Fan Shroud Bolt [2x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 5.1 N.m (45 lb in)
2	Engine Coolant Fan Shroud Procedure Transfer components as necessary.

RADIATOR REPLACEMENT (LTG WITHOUT HP9)

Removal Procedure

1. Drain the cooling system. Refer to Cooling System Draining and Filling (Static without HP9) and/or Cooling System Draining and Filling (GE 47716 without HP9).
2. Air Conditioning Condenser Bracket Replacement ã, ã» Remove
3. Radiator Upper Bracket (2, 4) ã, ã» Remove - Radiator Upper Bracket Replacement (LGW LGX LTG)

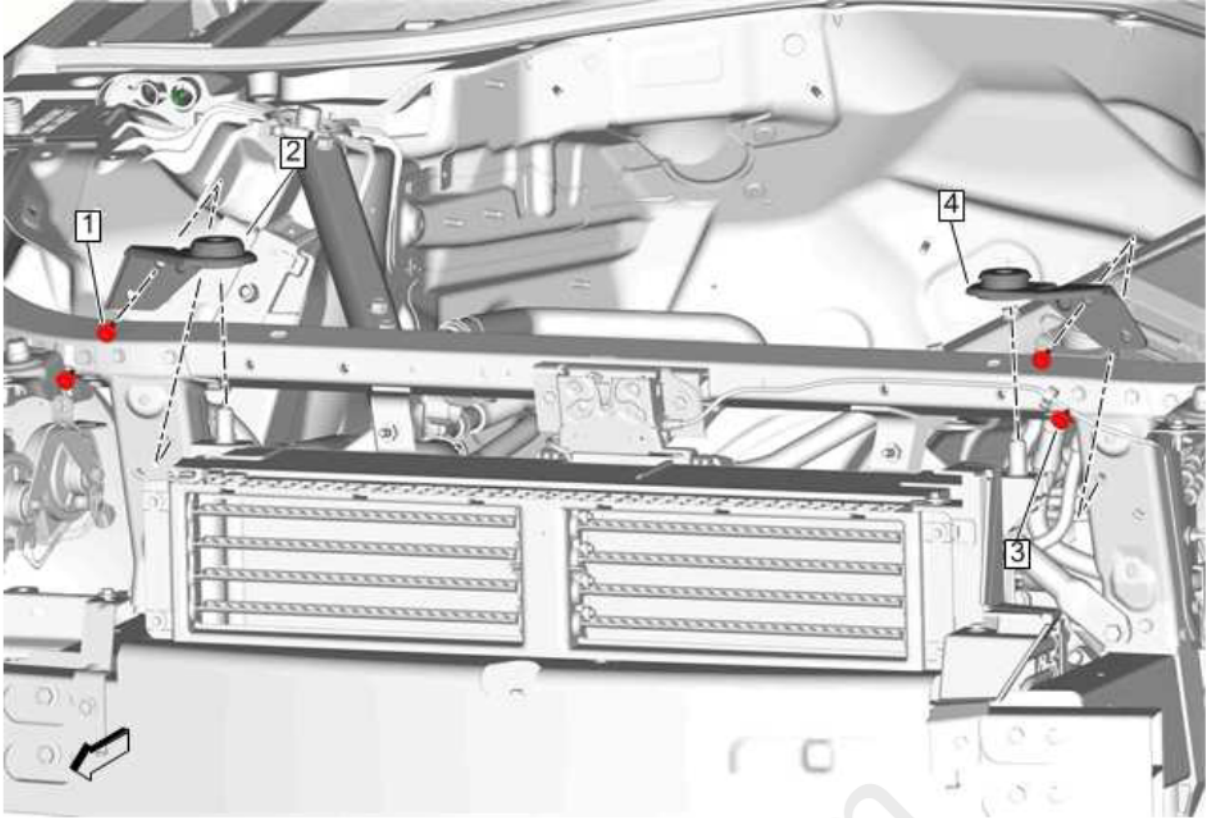


Fig. 288: Radiator Upper Bracket

Courtesy of GENERAL MOTORS COMPANY

4. Charge Air Cooler Radiator (1) » Remove - [Charge Air Cooler Radiator Replacement](#)

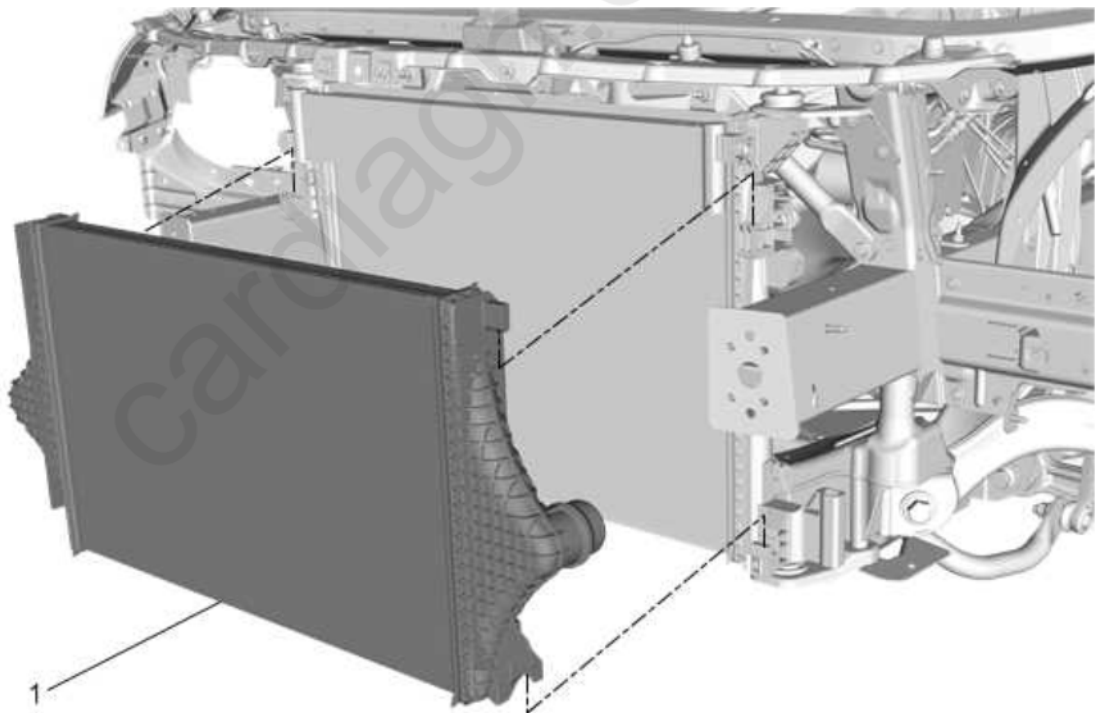


Fig. 289: Charge Air Cooler Radiator

Courtesy of GENERAL MOTORS COMPANY

5. Radiator Inlet Hose (2) @ Radiator Assembly » Remove - [Radiator Inlet Hose Replacement \(LTG with HP9\)](#)

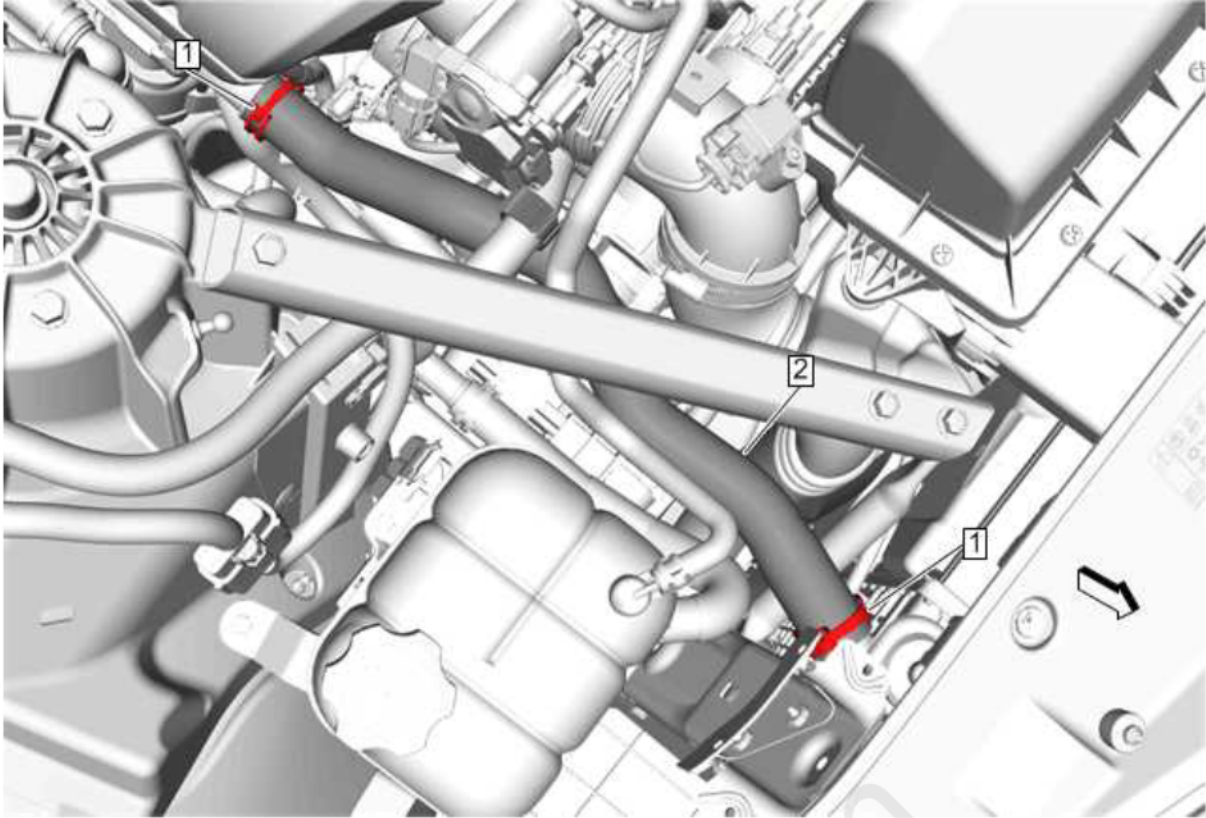


Fig. 290: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Radiator Outlet Hose (2) @ Radiator Assembly, Remove - **Radiator Outlet Hose Replacement (LTG with HP9)**

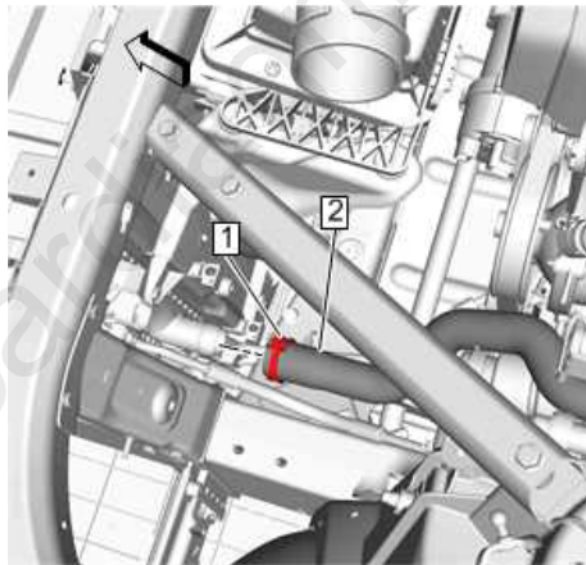


Fig. 291: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

7. Transmission Fluid Cooler Pipe Clip (1) @ Engine Coolant Fan Shroud, Remove - **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LTG)** [4x]

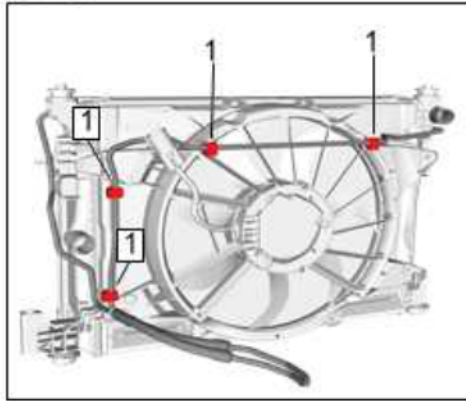


Fig. 292: Transmission Fluid Cooler Pipe Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

8. Electrical Connector @ Engine Coolant Fan Shroud» Disconnect
9. Remove the wiring harness retainers at the engine coolant fan shroud.
10. Engine Coolant Fan Module Radiator (1)» Remove

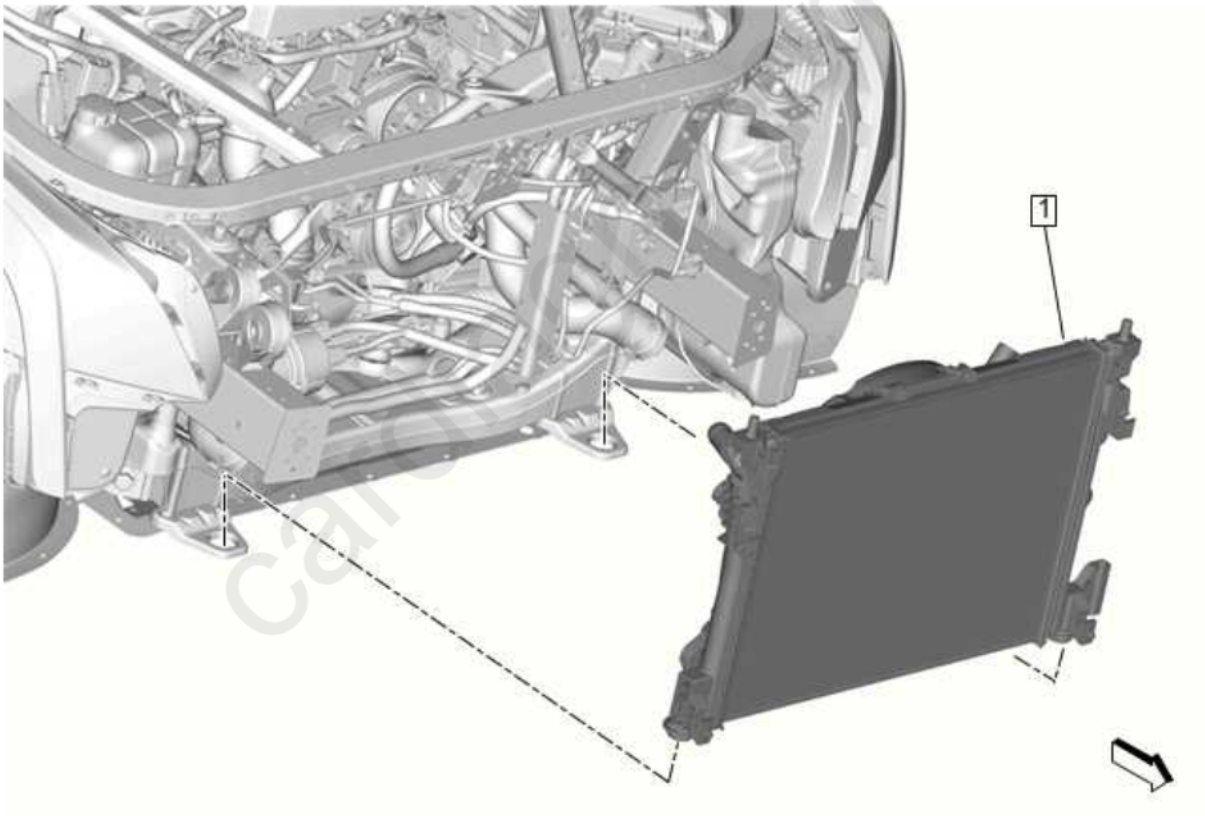


Fig. 293: Engine Coolant Fan Module Radiator
Courtesy of GENERAL MOTORS COMPANY

11. Engine Coolant Fan Bolt (1)» Remove [2x]

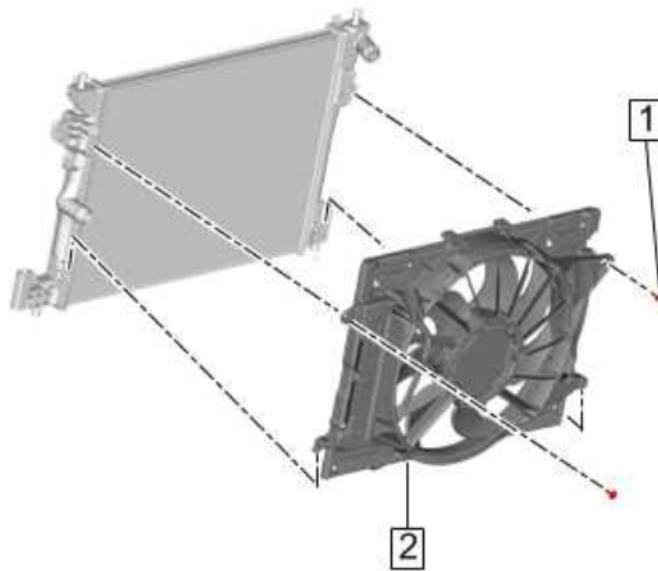


Fig. 294: Engine Coolant Fan Bolt

Courtesy of GENERAL MOTORS COMPANY

12. Engine Coolant Fan Shroud (2) @ Radiator Assembly» Remove

Installation Procedure

1. Engine Coolant Fan Shroud (2) @ Radiator Assembly» Install

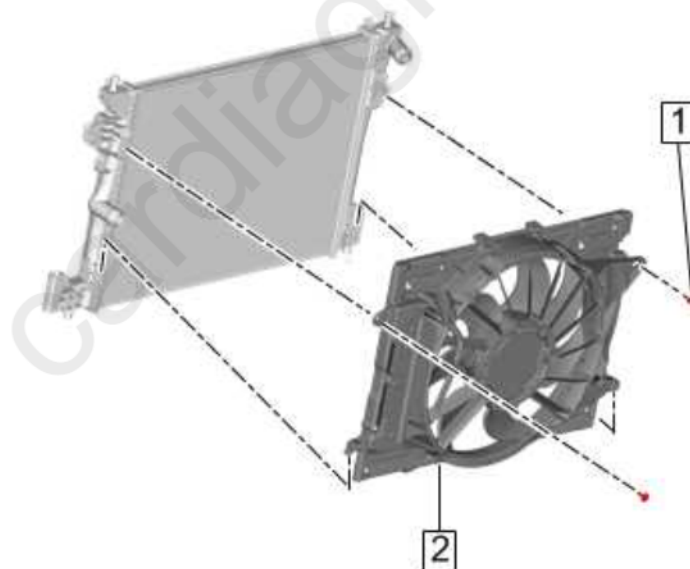


Fig. 295: Engine Coolant Fan Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Engine Coolant Fan Bolt (1)» Install and tighten [2x] 5.1 N.m (45 lb in)
3. Engine Coolant Fan Module Radiator (1)» Install

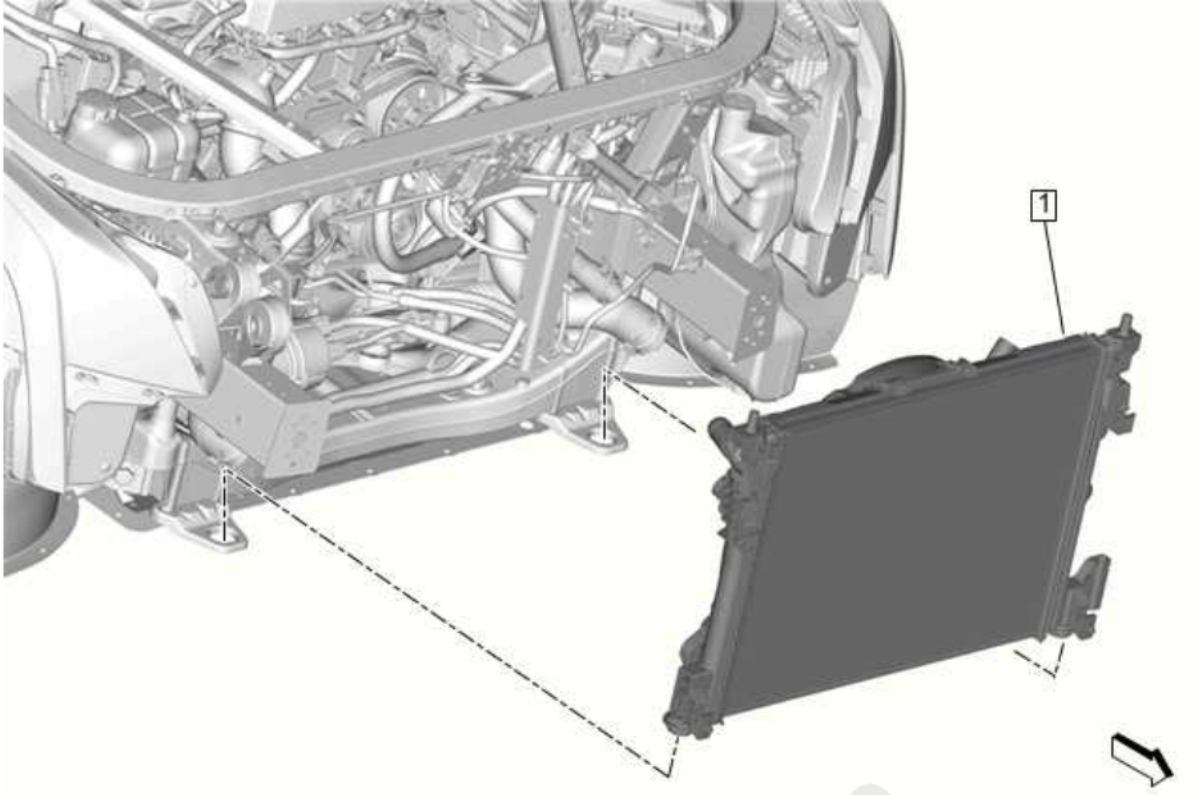


Fig. 296: Engine Coolant Fan Module Radiator

Courtesy of GENERAL MOTORS COMPANY

4. Install the wiring harness retainers at the engine coolant fan shroud.
5. Electrical Connector @ Engine Coolant Fan Shroud» Connect
6. Transmission Fluid Cooler Pipe Clip (1) @ Engine Coolant Fan Shroud» Install - **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LTG) [4x]**

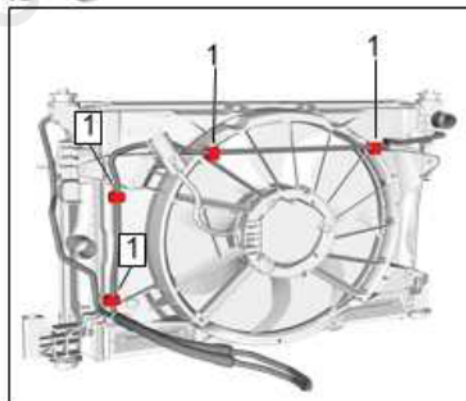


Fig. 297: Transmission Fluid Cooler Pipe Retaining Clip

Courtesy of GENERAL MOTORS COMPANY

7. Radiator Outlet Hose (2) @ Radiator Assembly» Install - **Radiator Outlet Hose Replacement (LTG without HP9)**

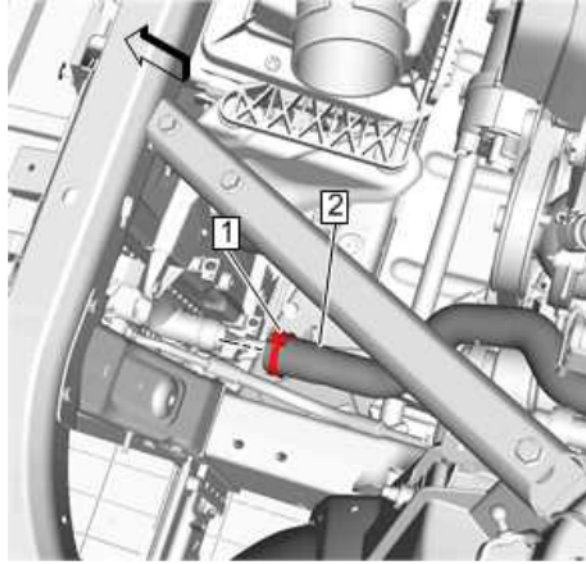


Fig. 298: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

8. Radiator Inlet Hose (2) @ Radiator AssemblyÃ,Â» Install - **Radiator Inlet Hose Replacement (LTG without HP9)**

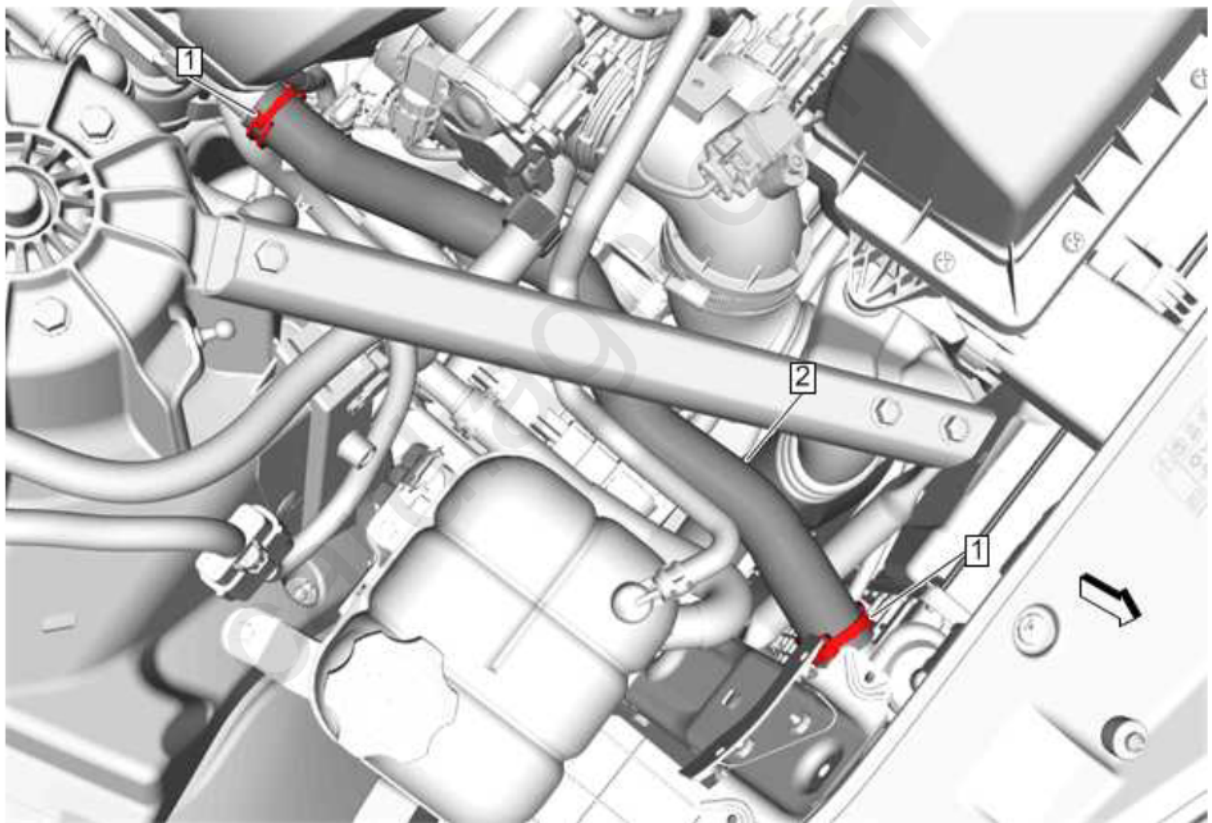


Fig. 299: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

9. Charge Air Cooler Radiator (1)Ã,Â» Install - **Charge Air Cooler Radiator Replacement**

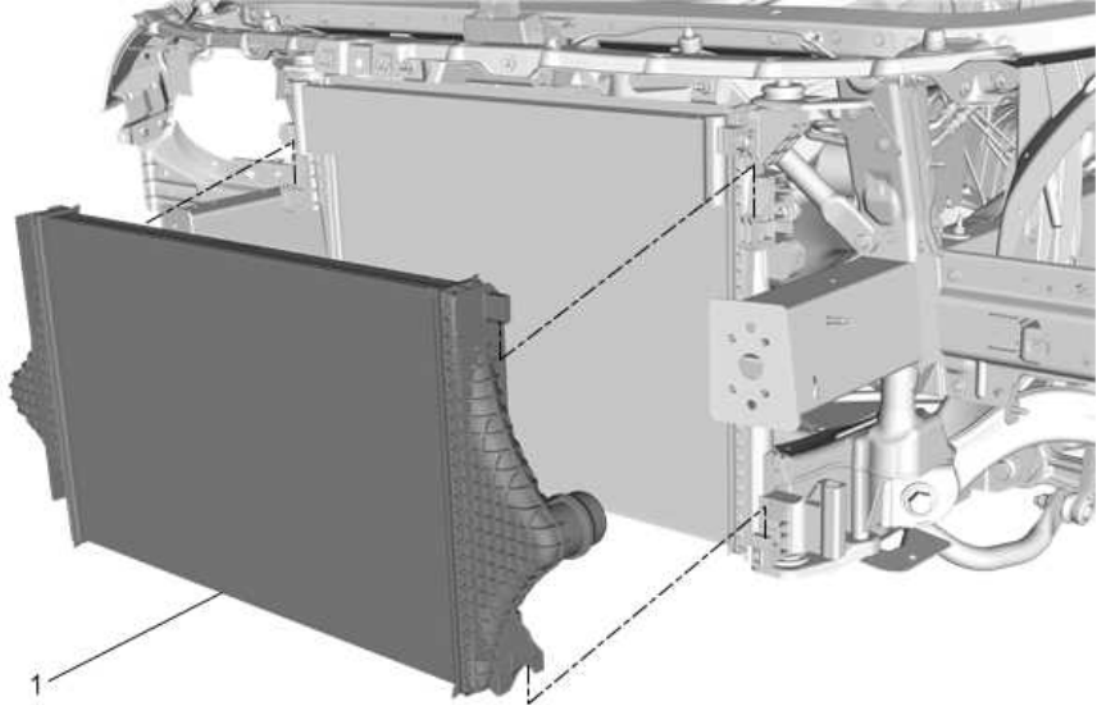


Fig. 300: Charge Air Cooler Radiator

Courtesy of GENERAL MOTORS COMPANY

10. Radiator Upper Bracket (2, 4) » Install - **Radiator Upper Bracket Replacement (LGW LGX LTG)**

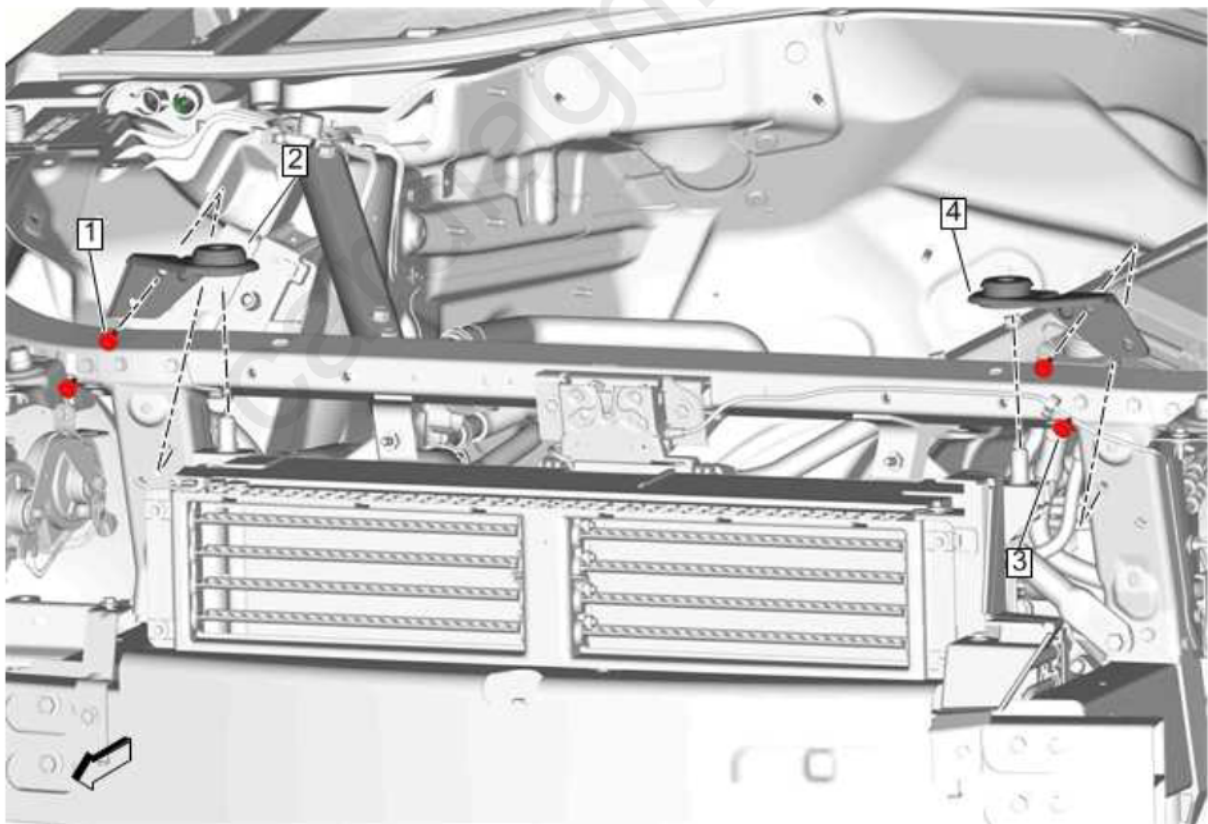


Fig. 301: Radiator Upper Bracket

Courtesy of GENERAL MOTORS COMPANY

11. **Air Conditioning Condenser Bracket Replacement** » Install
12. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static without HP9)** and/or **Cooling System Draining and Filling (GE 47716 without HP9)**
13. Start the engine and check for coolant leaks.

RADIATOR REPLACEMENT (LGW)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. Charge Air Cooler Radiator (1)» Remove - [Charge Air Cooler Radiator Replacement \(LGW\)](#)

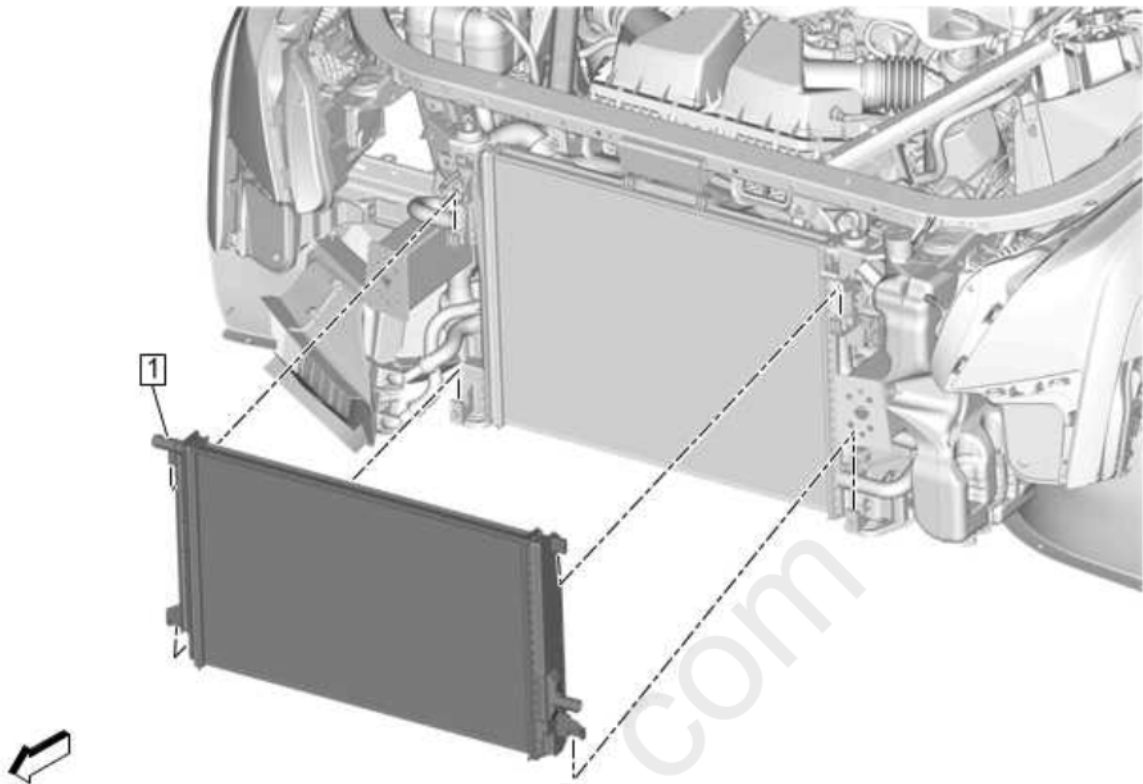


Fig. 302: Charge Air Cooler Radiator
Courtesy of GENERAL MOTORS COMPANY

3. Radiator Upper Bracket (2, 4)» Remove - [Radiator Upper Bracket Replacement \(LGW LGX LTG\)](#)

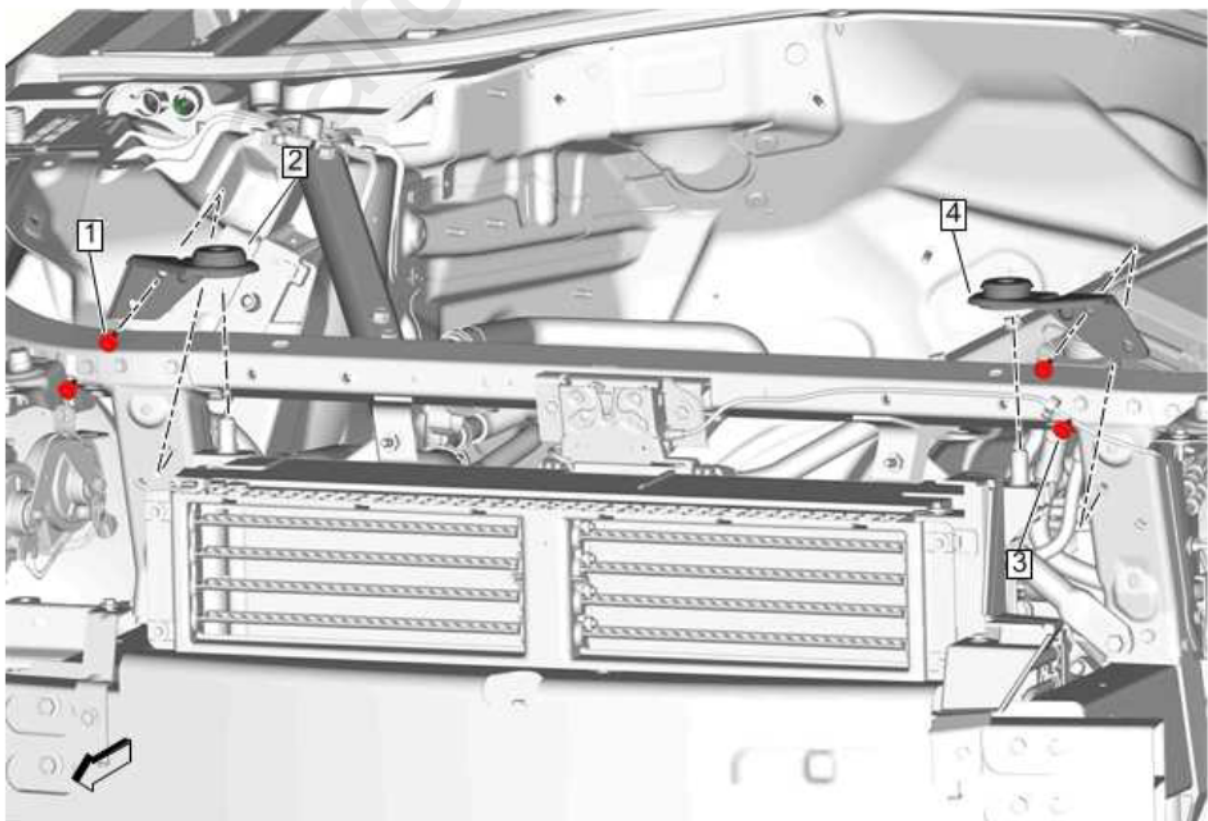


Fig. 303: Radiator Upper Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Radiator Inlet Hose (2) @ Radiator AssemblyA,Â» Remove - [Radiator Inlet Hose Replacement \(LGW\)](#)

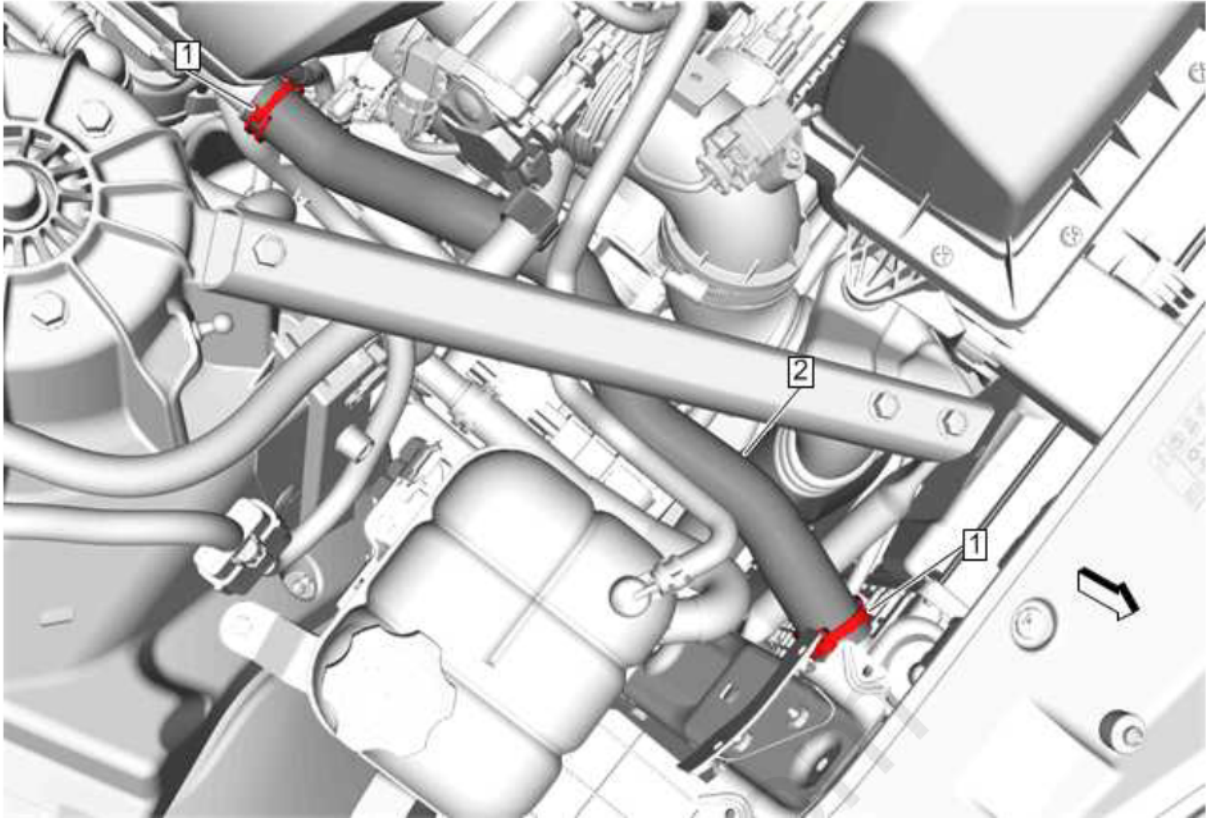


Fig. 304: Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

5. Radiator Outlet Hose (2) @ Radiator AssemblyÃ,Ä» Remove - [Radiator Outlet Hose Replacement \(LGW\)](#)

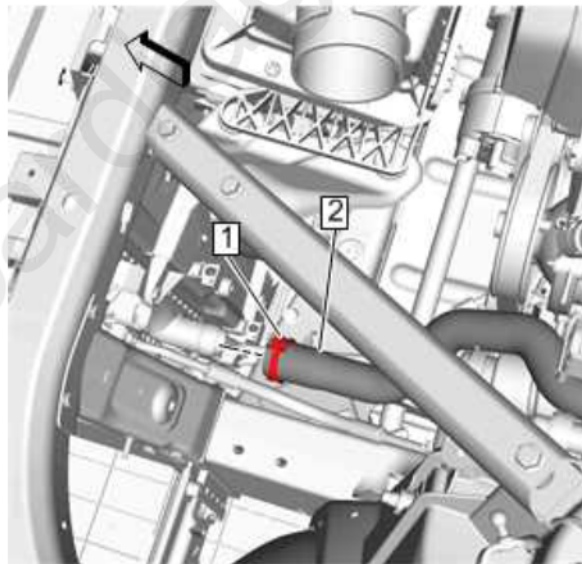


Fig. 305: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Transmission Fluid Cooler Pipe Clip (1) @ Engine Coolant Fan ShroudÃ,Ä» Remove [4x] - [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LGW\)](#)

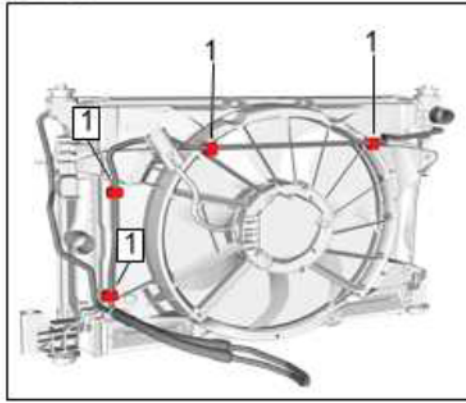


Fig. 306: Transmission Fluid Cooler Pipe Retaining Clip
 Courtesy of GENERAL MOTORS COMPANY

7. Hose Clip (1) @ Engine Coolant Fan Shroud» Remove

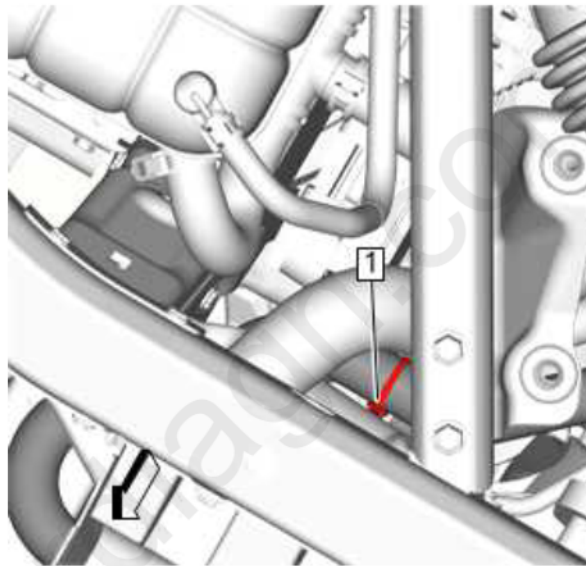


Fig. 307: Hose Clip
 Courtesy of GENERAL MOTORS COMPANY

8. Electrical Connector @ Engine Coolant Fan Shroud» Disconnect

9. Wiring Harnesses @ Engine Coolant Fan Shroud» Remove

NOTE: Note the location and routing of the wiring harness to ensure proper reinstallation.

10. Engine Coolant Fan Module Radiator (1)» Remove

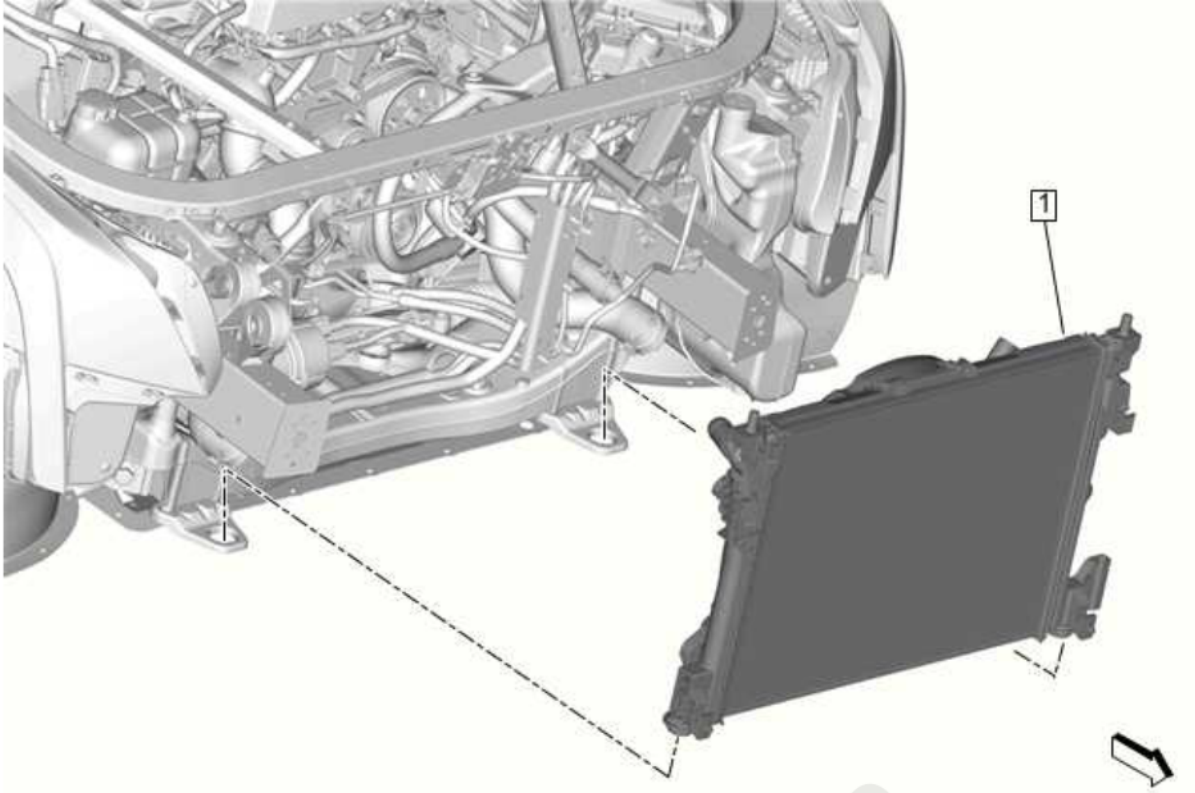


Fig. 308: Engine Coolant Fan Module Radiator
Courtesy of GENERAL MOTORS COMPANY

11. Engine Coolant Fan Bolt (1) » Remove [2x]

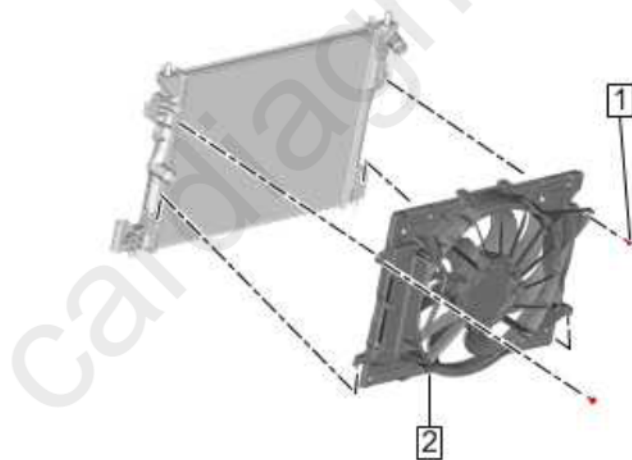


Fig. 309: Engine Coolant Fan Bolt
Courtesy of GENERAL MOTORS COMPANY

12. Engine Coolant Fan Shroud (2) @ Radiator Assembly » Remove

13. Transfer components as necessary.

Installation Procedure

1. Engine Coolant Fan Shroud (2) @ Radiator Assembly » Install

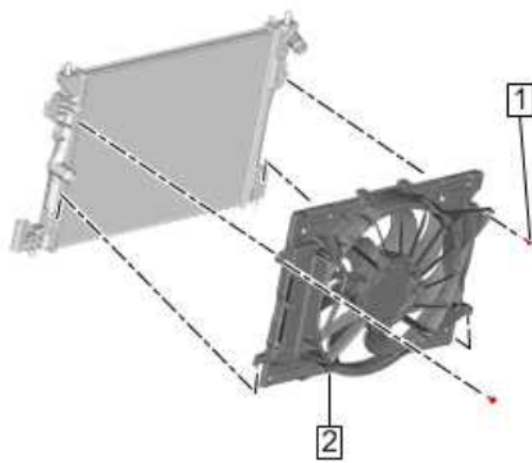


Fig. 310: Engine Coolant Fan Bolt
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Engine Coolant Fan Bolt (1)» Install and tighten [2x] 5.1 N.m (45 lb in)
3. Engine Coolant Fan Module Radiator (1)» Install

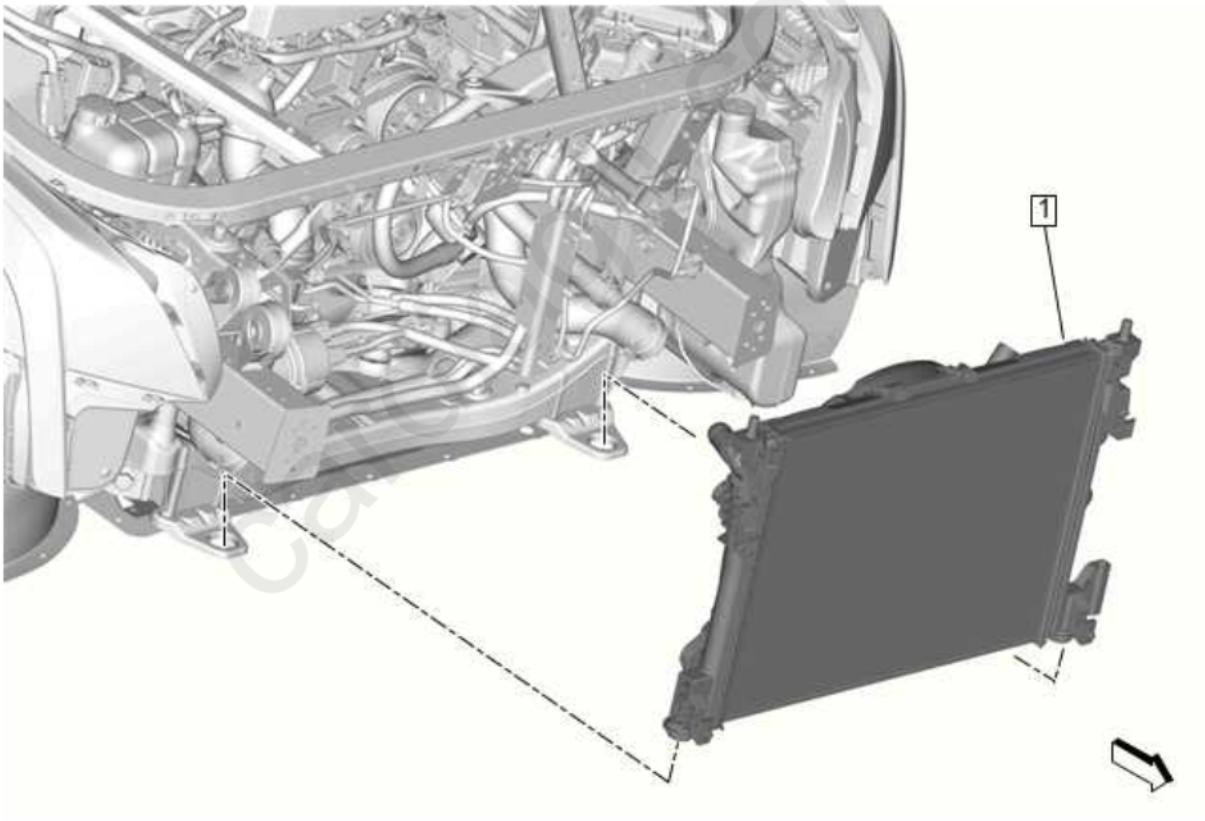


Fig. 311: Engine Coolant Fan Module Radiator
 Courtesy of GENERAL MOTORS COMPANY

4. Wiring Harnesses @ Engine Coolant Fan Shroud» Install
5. Electrical Connector @ Engine Coolant Fan Shroud» Connect
6. Hose Clip (1) @ Engine Coolant Fan Shroud» Install

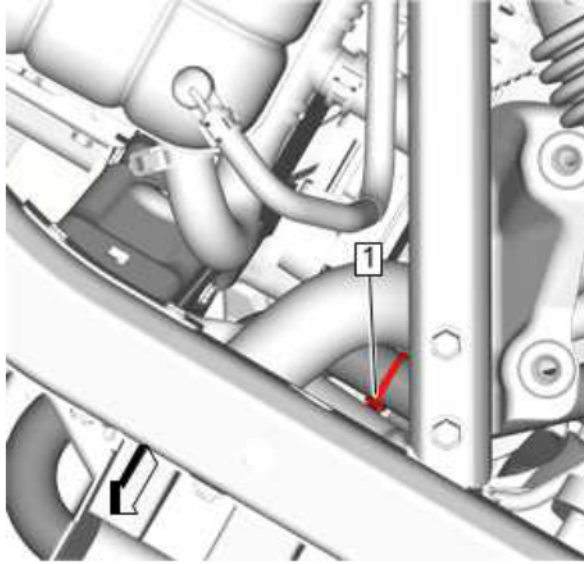


Fig. 312: Hose Clip

Courtesy of GENERAL MOTORS COMPANY

7. Transmission Fluid Cooler Pipe Clip (1) @ Engine Coolant Fan Shroud» Install [4x] - **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LGW)**

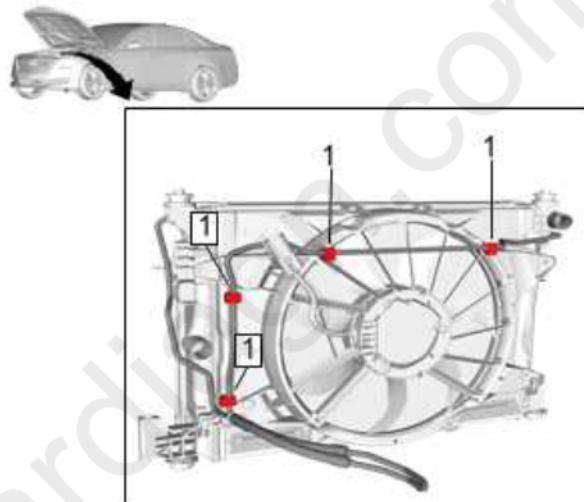


Fig. 313: Transmission Fluid Cooler Pipe Retaining Clip

Courtesy of GENERAL MOTORS COMPANY

8. Radiator Outlet Hose (2) @ Radiator Assembly» Install - **Radiator Outlet Hose Replacement (LGW)**

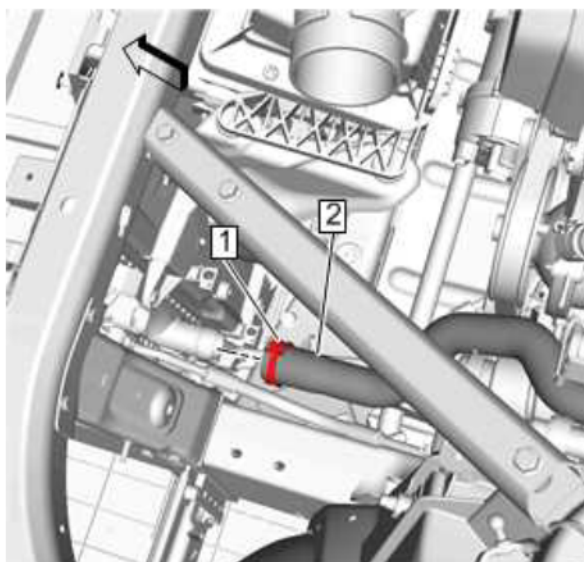


Fig. 314: Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

9. Radiator Inlet Hose (2) @ Radiator Assembly, » Install - **Radiator Inlet Hose Replacement (LGW)**

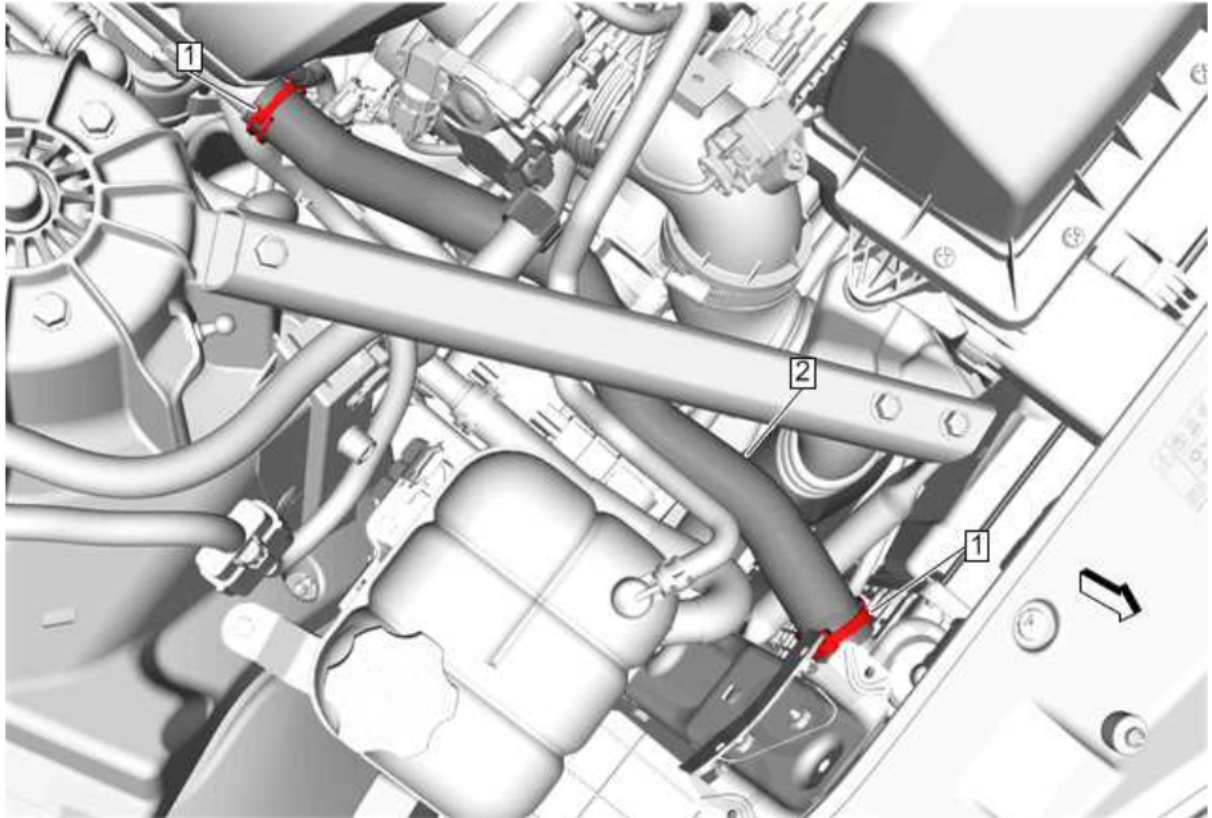


Fig. 315: Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

10. Radiator Upper Bracket (2, 4) » Install - **Radiator Upper Bracket Replacement (LGW LGX LGT)**

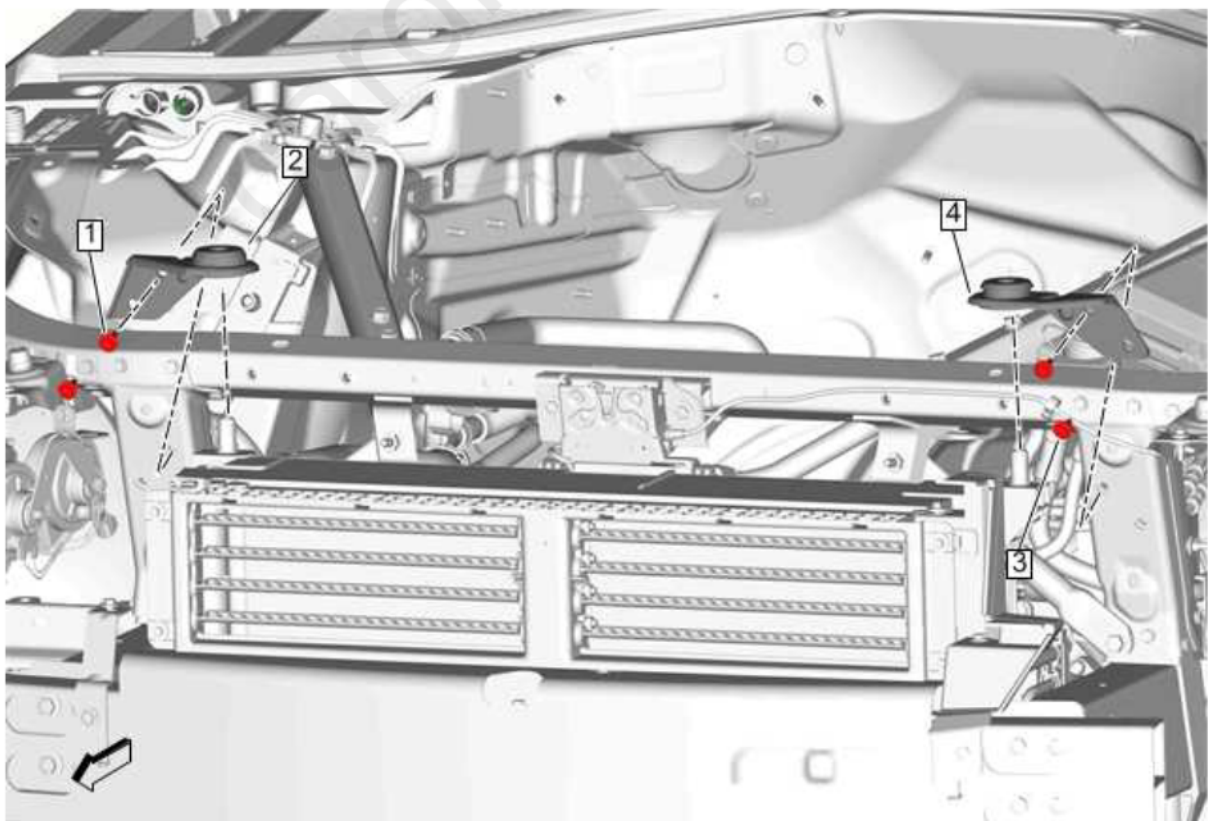


Fig. 316: Radiator Upper Bracket
Courtesy of GENERAL MOTORS COMPANY

11. Charge Air Cooler Radiator (1)A, A» Install - [Charge Air Cooler Radiator Replacement \(LGW\)](#)

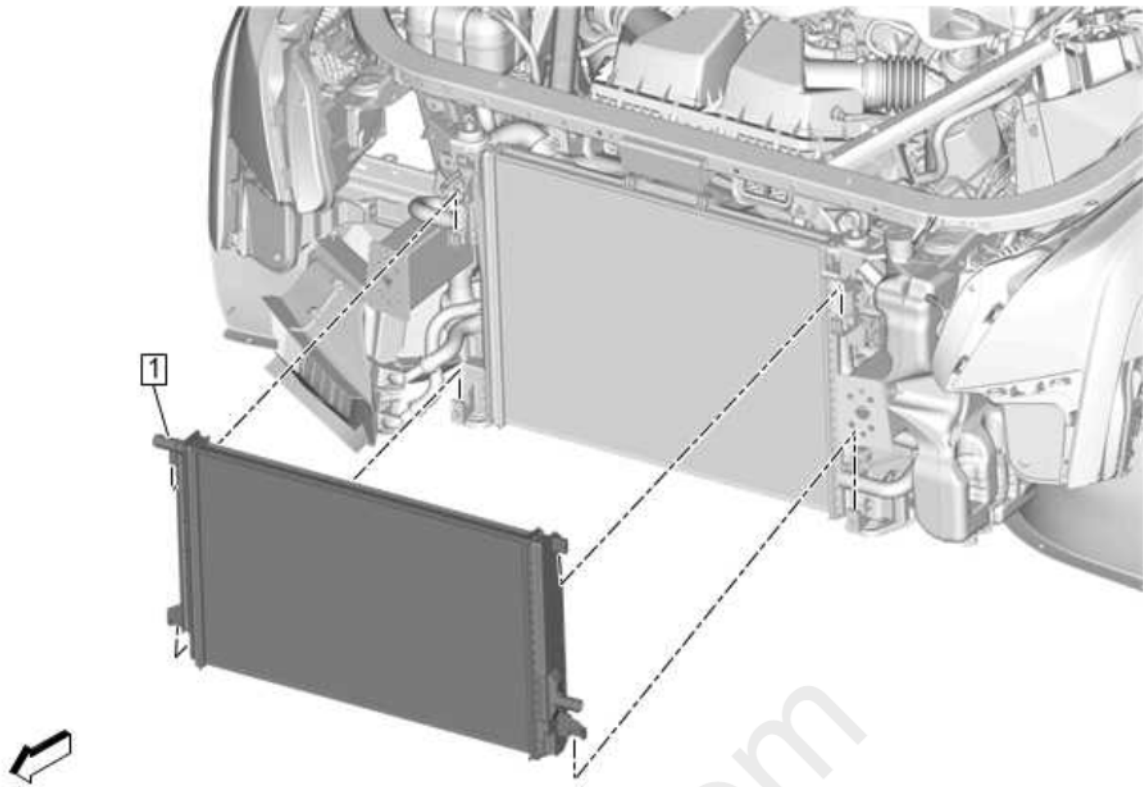


Fig. 317: Charge Air Cooler Radiator

Courtesy of GENERAL MOTORS COMPANY

12. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
13. Start the engine and check for coolant leaks.

RADIATOR REPLACEMENT (LGX)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
2. Air Conditioning Condenser Bracket (2)A, A» Remove - [Air Conditioning Condenser Bracket Replacement](#)

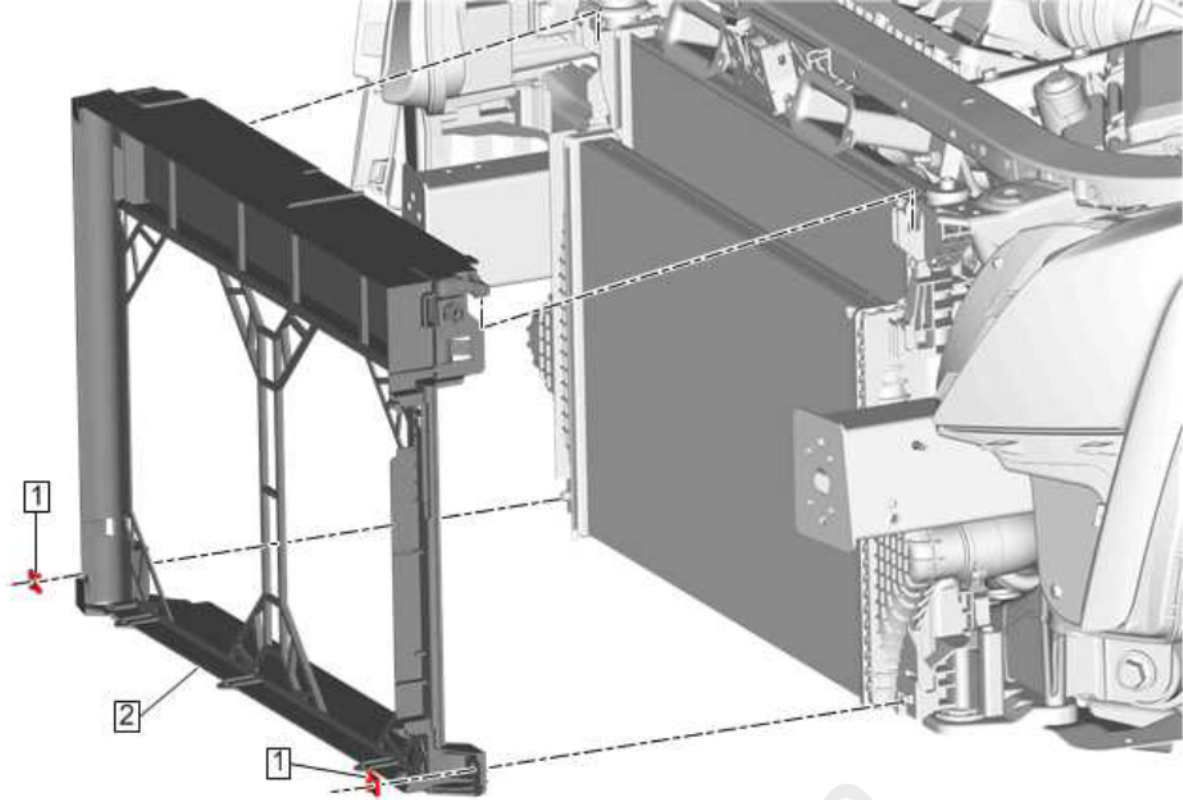


Fig. 318: Air Conditioning Condenser Bracket
 Courtesy of GENERAL MOTORS COMPANY

3. Radiator Upper Bracket (2, 4) » Remove - **Radiator Upper Bracket Replacement (LGW LGX LTG)**

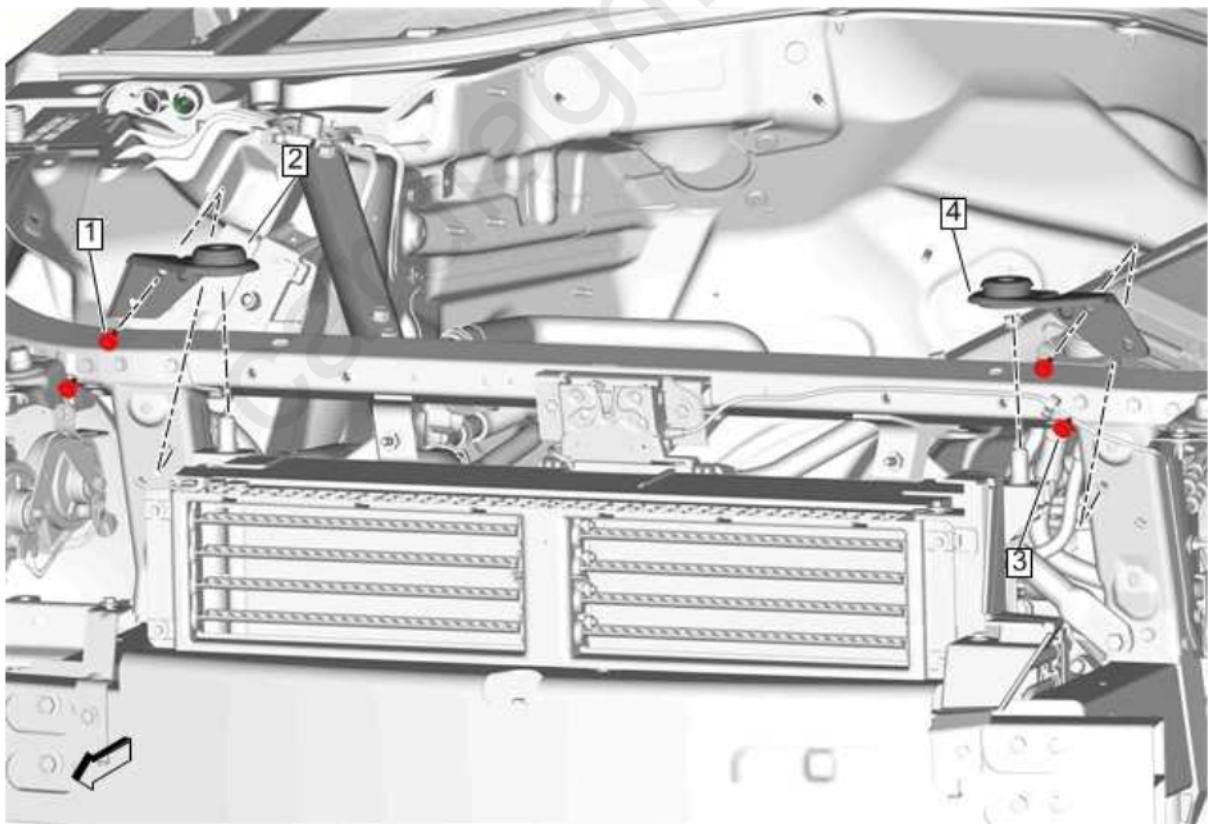


Fig. 319: Radiator Upper Bracket
 Courtesy of GENERAL MOTORS COMPANY

4. Radiator Inlet Hose (2) @ Radiator Assembly » Remove - **Radiator Inlet Hose Replacement (LGX)**

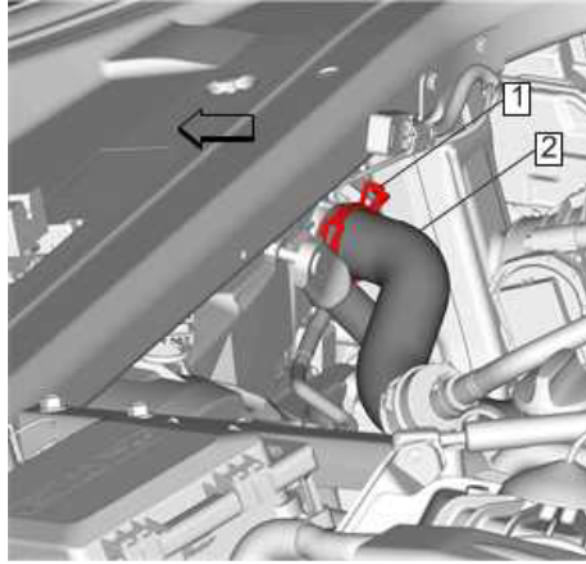


Fig. 320: Radiator Inlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

5. Radiator Outlet Hose (2) @ Radiator Assembly » Remove - **Radiator Outlet Hose Replacement (LGX, with KC4)** and/or **Radiator Outlet Hose Replacement (LGX without KC4)**

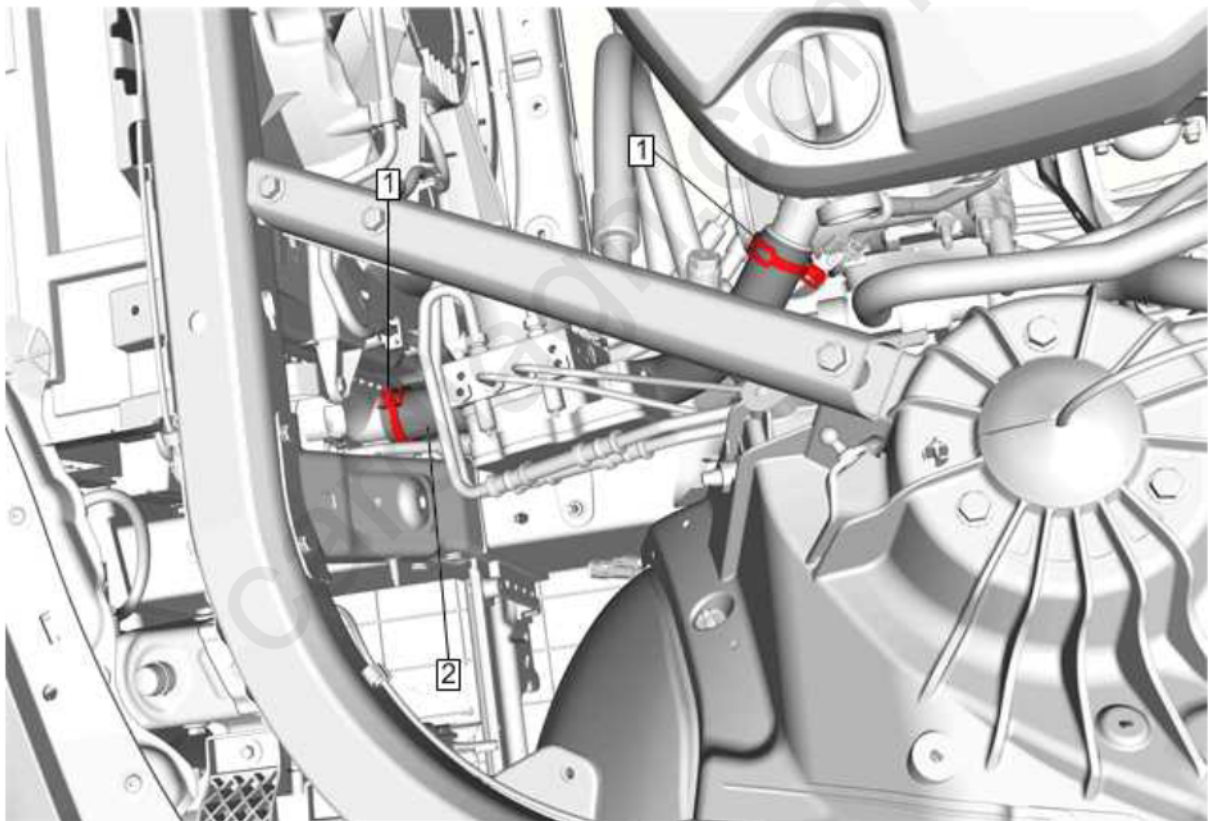


Fig. 321: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Transmission Fluid Cooler Pipe Clip (1) @ Engine Coolant Fan Shroud » Remove - **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LTG)** **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LTG With HP9)** **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LGW)** [4x]

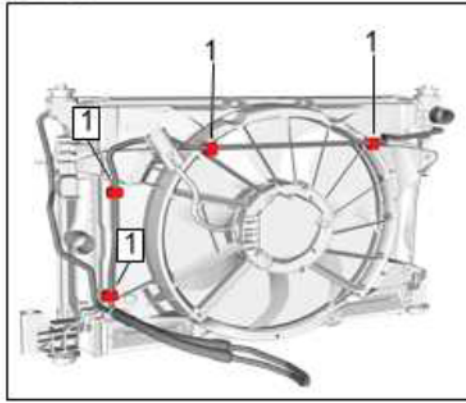


Fig. 322: Transmission Fluid Cooler Pipe Retaining Clip
 Courtesy of GENERAL MOTORS COMPANY

7. Electrical Connector @ Engine Coolant Fan Shroud» Disconnect
8. Engine Coolant Fan Module Radiator (1)» Remove

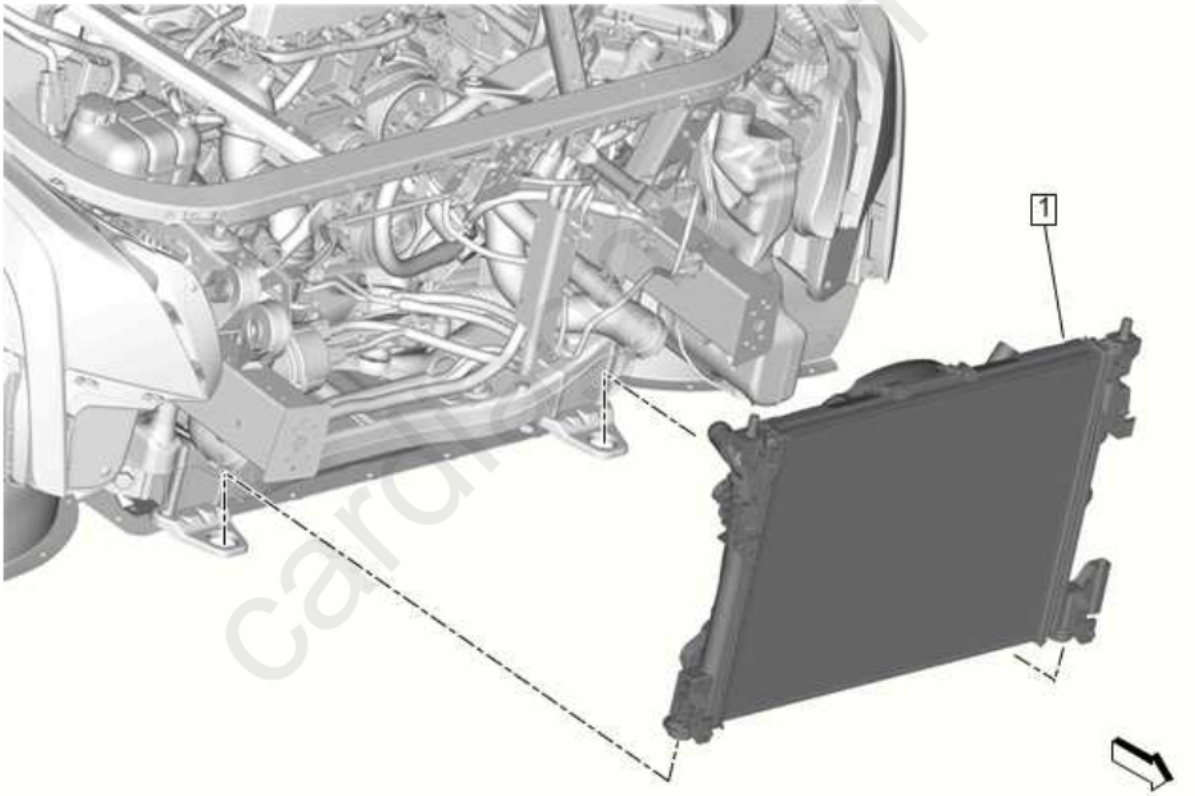


Fig. 323: Engine Coolant Fan Module Radiator
 Courtesy of GENERAL MOTORS COMPANY

9. Engine Coolant Fan Bolt (1)» Remove [2x]

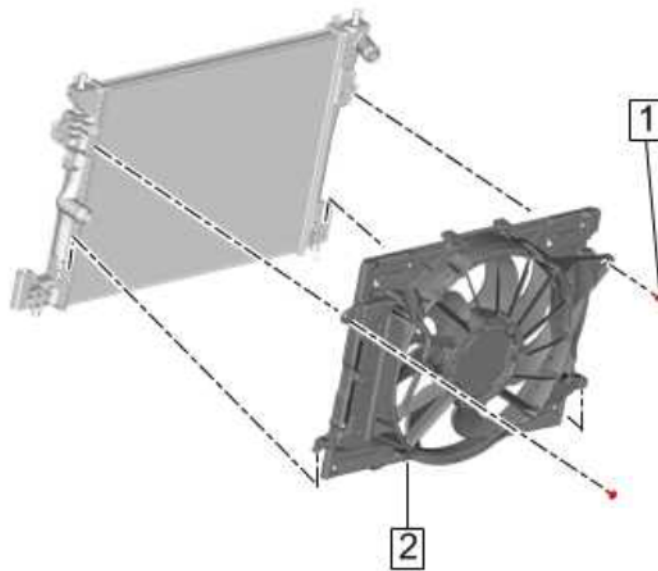


Fig. 324: Engine Coolant Fan Bolt

Courtesy of GENERAL MOTORS COMPANY

10. Engine Coolant Fan Shroud (2) @ Radiator AssemblyÃ,Â» Remove

Installation Procedure

1. Engine Coolant Fan Shroud (2) @ Radiator AssemblyÃ,Â» Install

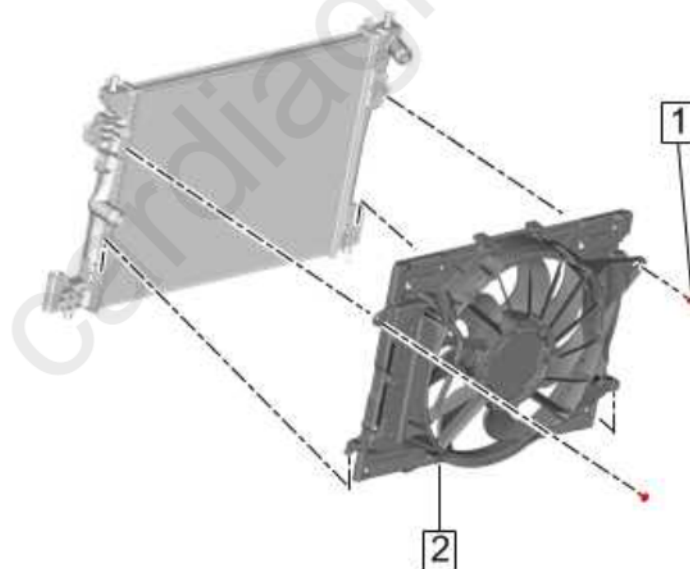


Fig. 325: Engine Coolant Fan Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Engine Coolant Fan Bolt (1)Ã,Â» Install and tighten [2x] 7.25 N.m (64 lb in)

3. Engine Coolant Fan Module Radiator (1)Ã,Â» Install

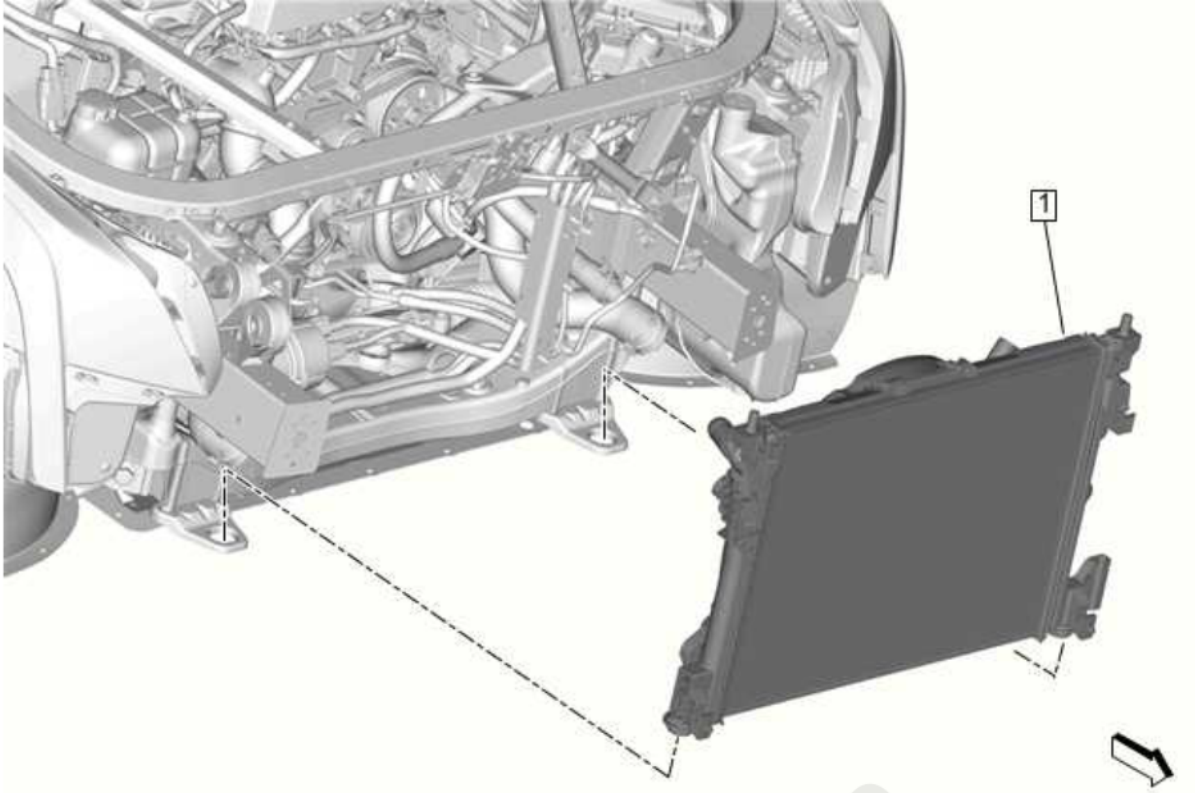


Fig. 326: Engine Coolant Fan Module Radiator
Courtesy of GENERAL MOTORS COMPANY

4. Electrical Connector @ Engine Coolant Fan Shroud, » Connect
5. Transmission Fluid Cooler Pipe Clip (1) @ Engine Coolant Fan Shroud, » Install - **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LTG)** **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LTG With HP9)** **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LGW)** [4x]

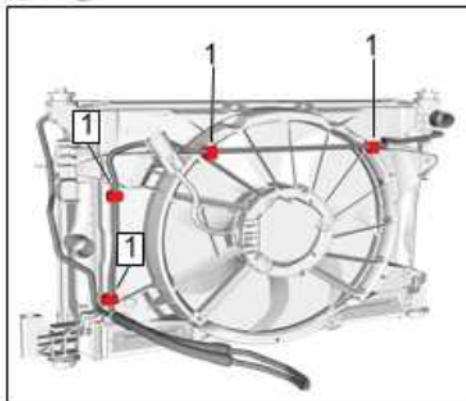


Fig. 327: Transmission Fluid Cooler Pipe Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

6. Radiator Outlet Hose (2) @ Radiator Assembly, » Install - **Radiator Outlet Hose Replacement (LGX, with KC4)** **Radiator Outlet Hose Replacement (LGX without KC4)**

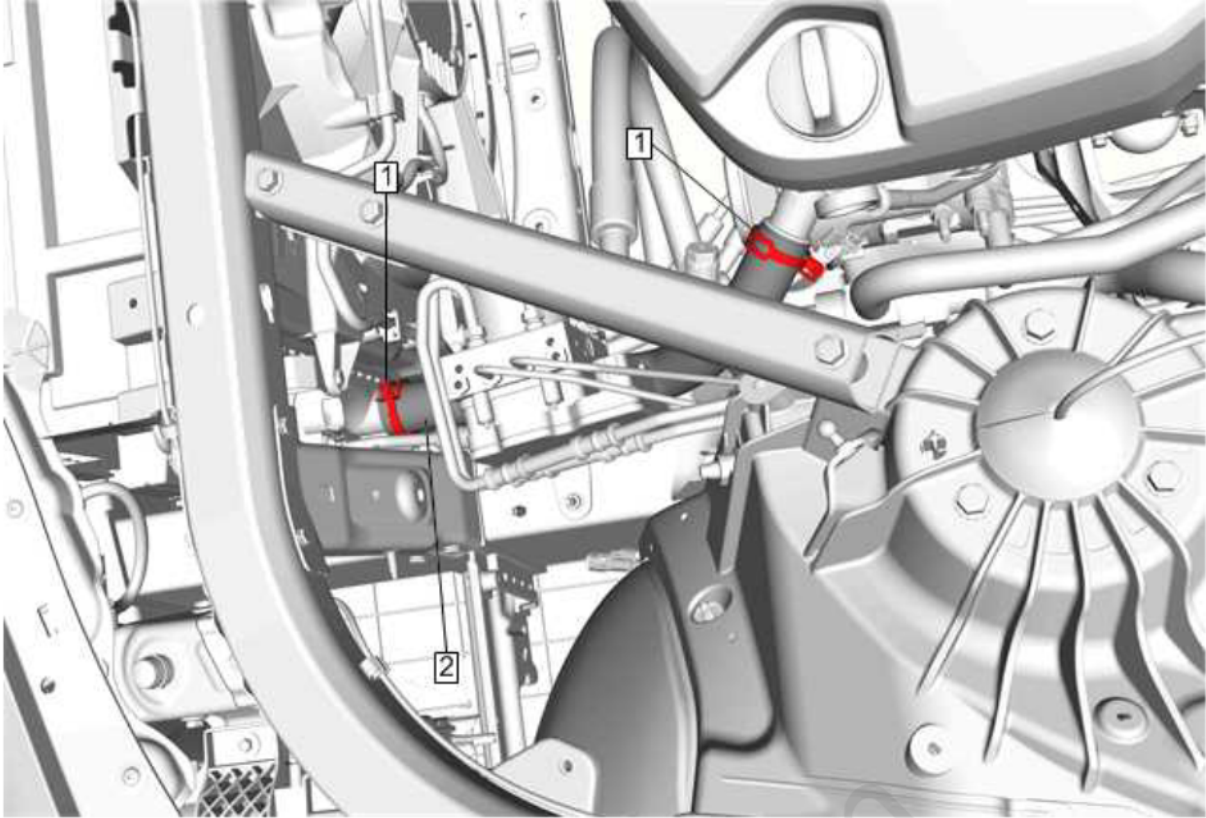


Fig. 328: Radiator Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

7. Radiator Inlet Hose (2) @ Radiator Assembly, Â» Install - **Radiator Inlet Hose Replacement (LGX)**

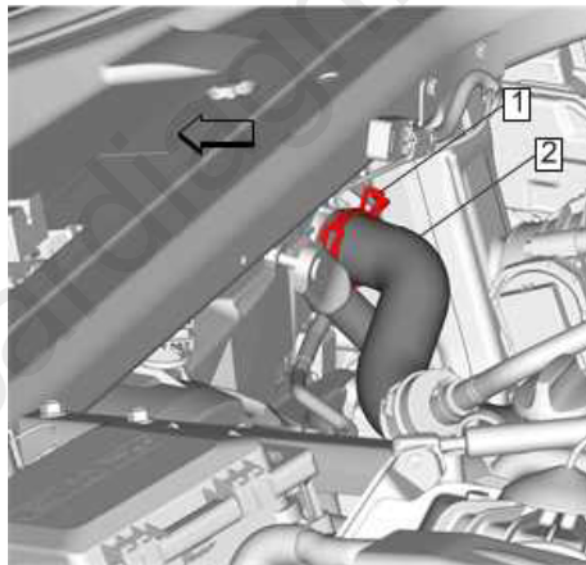


Fig. 329: Radiator Inlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

8. Radiator Upper Bracket (2, 4) Â» Install - **Radiator Upper Bracket Replacement (LGW LGX LTG)**

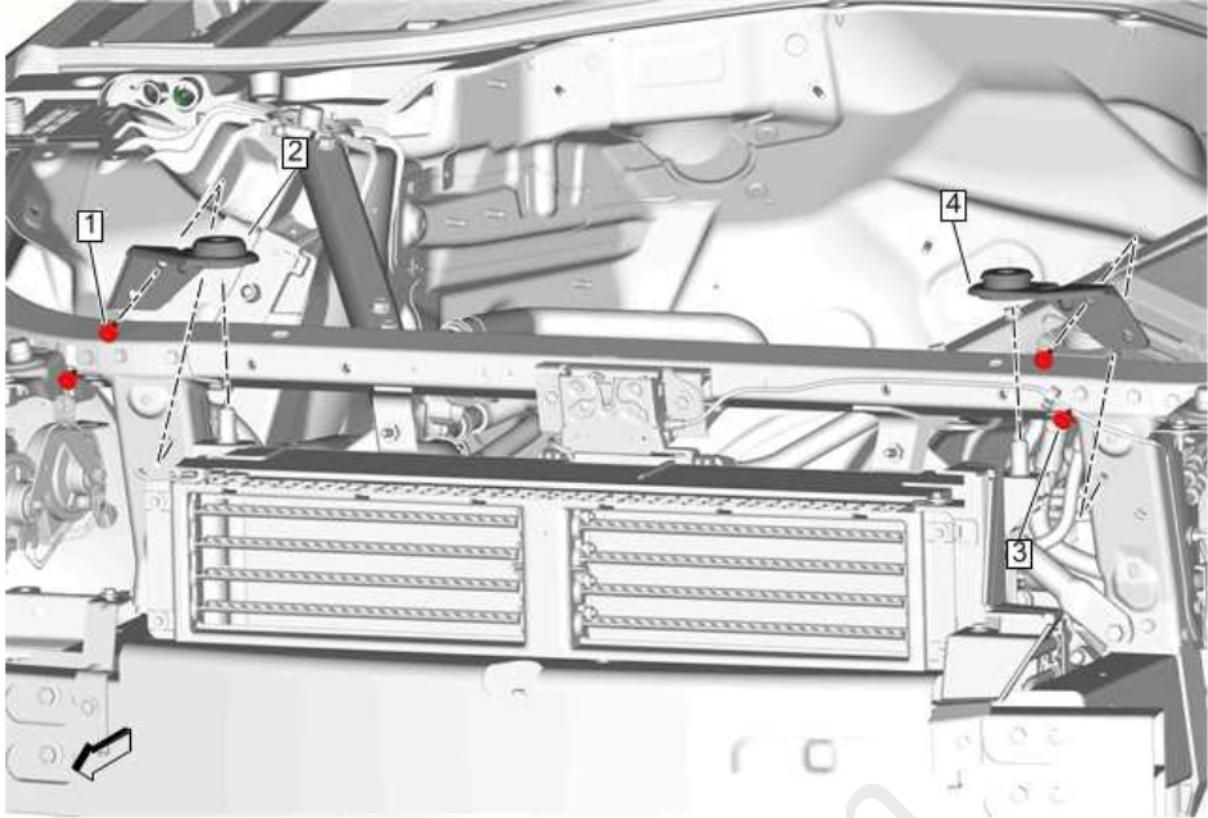


Fig. 330: Radiator Upper Bracket

Courtesy of GENERAL MOTORS COMPANY

9. Air Conditioning Condenser Bracket (2)» Install - **Air Conditioning Condenser Bracket Replacement**

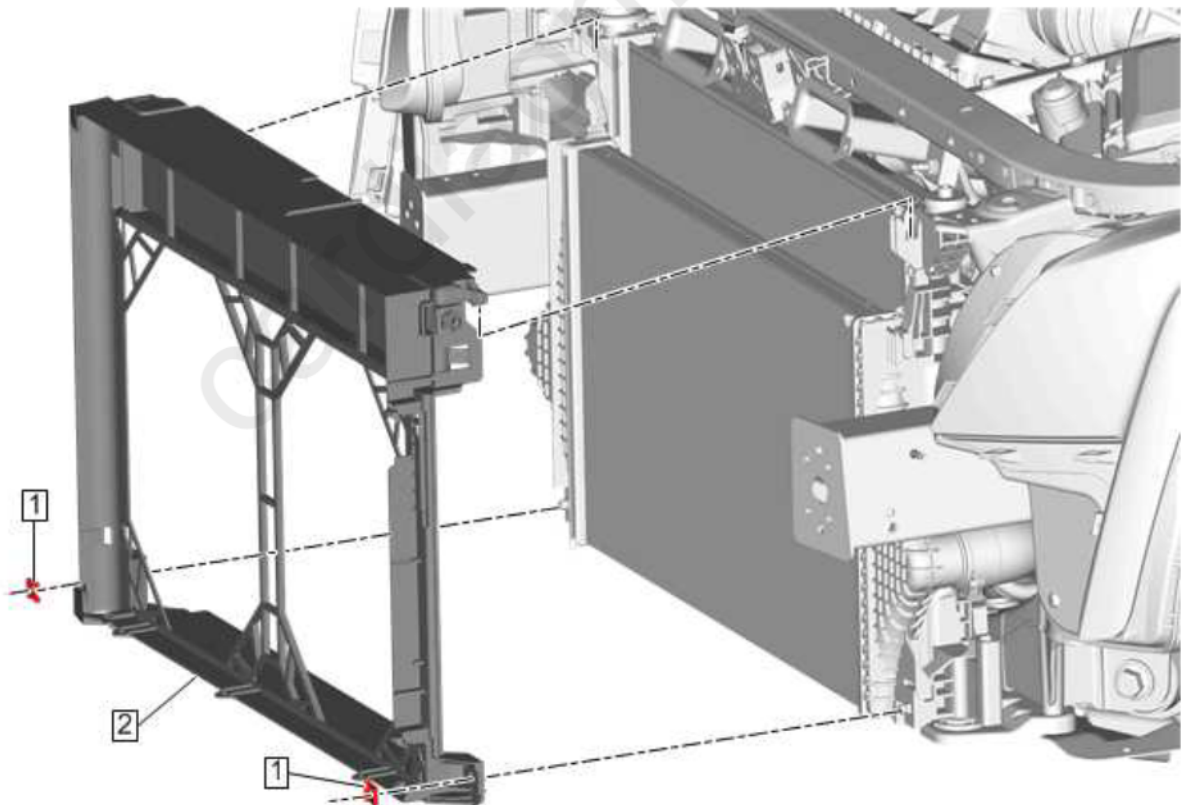


Fig. 331: Air Conditioning Condenser Bracket

Courtesy of GENERAL MOTORS COMPANY

10. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static without HP9)** and/or **Cooling System Draining and Filling (GE 47716 without HP9)**
11. Start the engine and check for coolant leaks.

RADIATOR REPLACEMENT (LTG WITH HP9)

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static LTG with HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 LTG with HP9\)](#)
3. Front Bumper Fascia (4) Remove - [Front Bumper Fascia Replacement \(Without UV3\)](#) [Front Bumper Fascia Replacement \(With UV3\)](#)

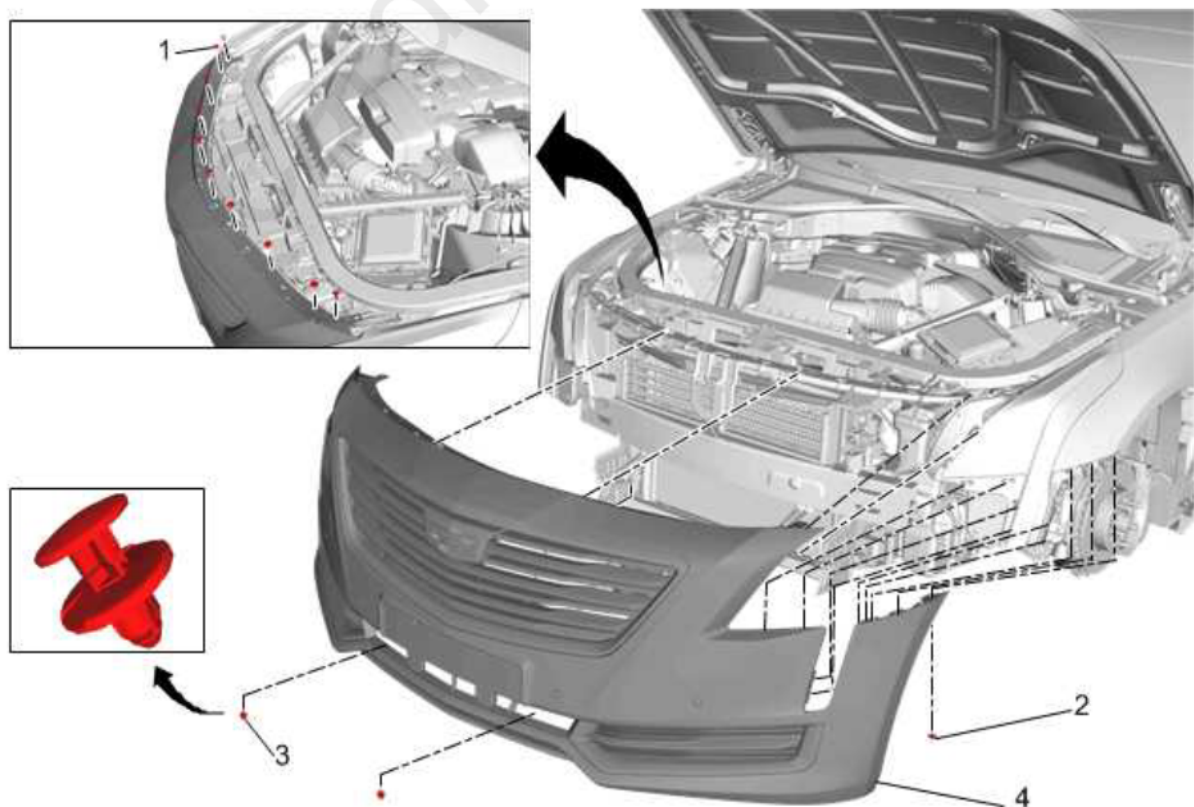


Fig. 332: Front Bumper Fascia

Courtesy of GENERAL MOTORS COMPANY

4. Air Conditioning Condenser Bracket (2)A, A» Remove - [Air Conditioning Condenser Bracket Replacement](#)

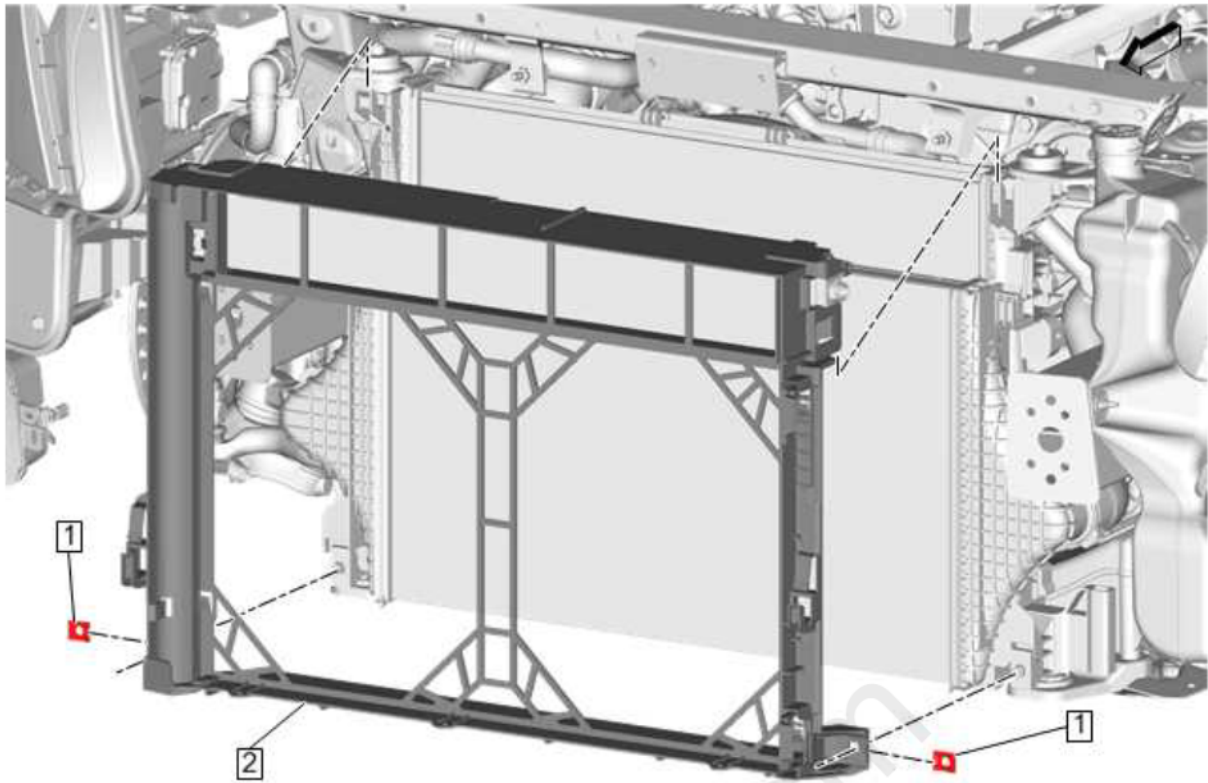


Fig. 333: Air Conditioning Condenser Bracket
Courtesy of GENERAL MOTORS COMPANY

5. Radiator Upper Bracket (2, 4)Ã, Â» Remove - [Radiator Upper Bracket Replacement \(LGW LGX LTG\)](#)

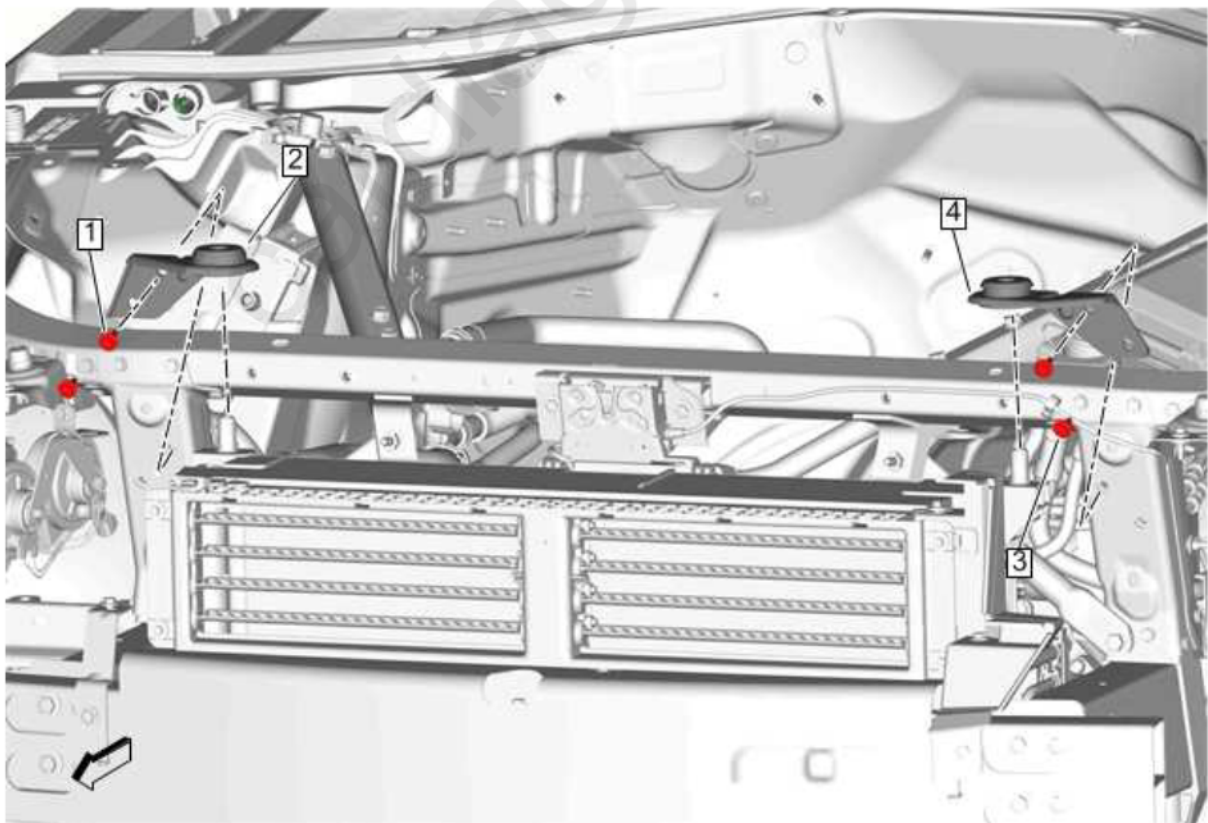


Fig. 334: Radiator Upper Bracket
Courtesy of GENERAL MOTORS COMPANY

6. Charge Air Cooler Radiator (1)Ã, Â» Remove - [Charge Air Cooler Radiator Replacement](#)

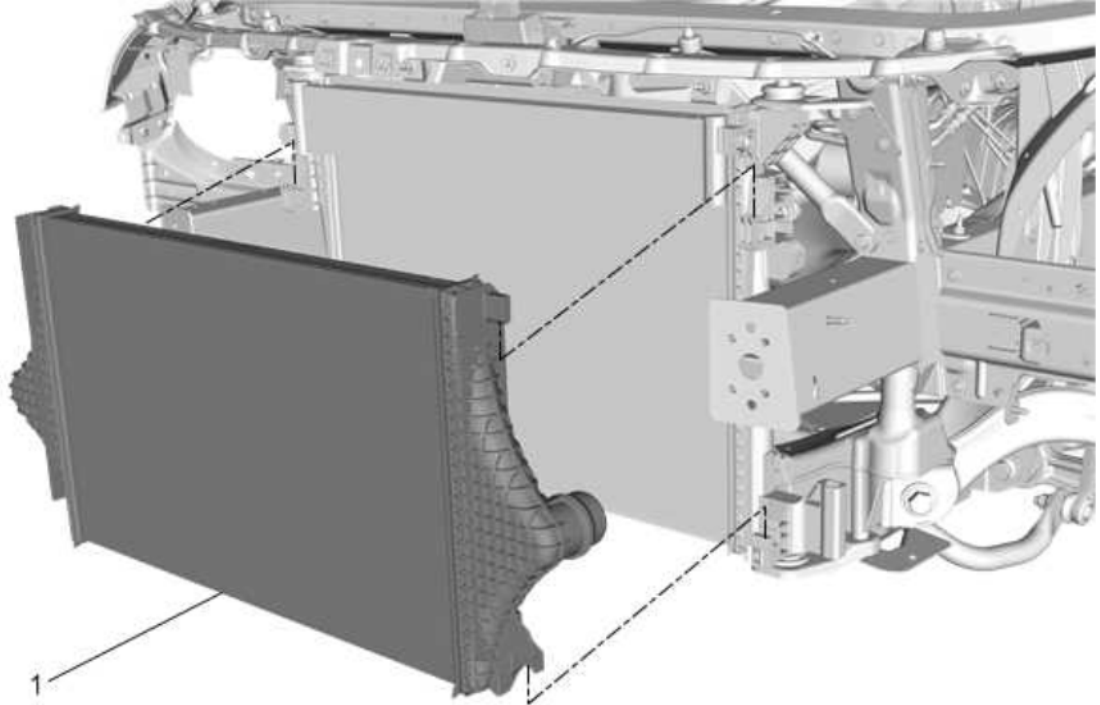


Fig. 335: Charge Air Cooler Radiator

Courtesy of GENERAL MOTORS COMPANY

7. Radiator Inlet Hose (2) @ Radiator AssemblyÃ,Â» Remove - **Radiator Inlet Hose Replacement (LTG with HP9)**

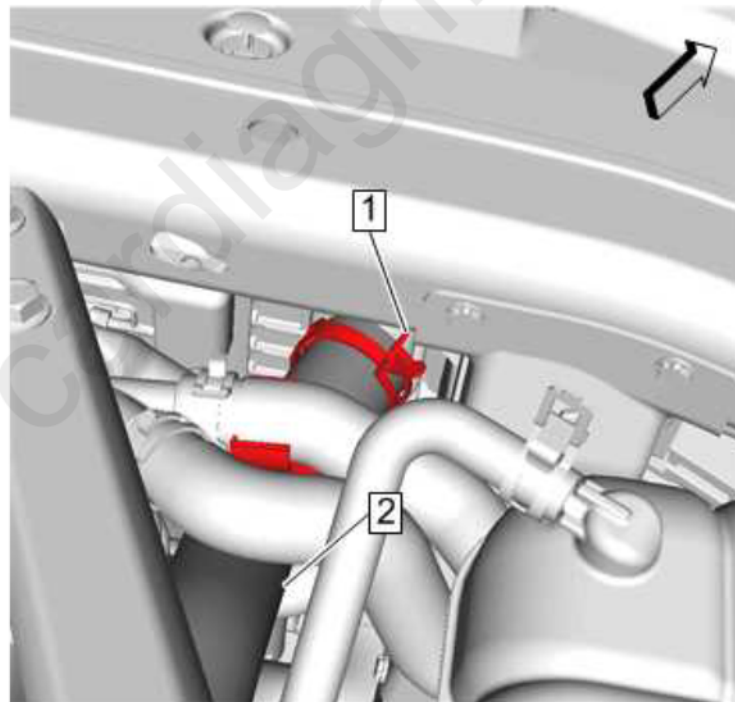


Fig. 336: Radiator Inlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

8. Radiator Outlet Hose (2) @ Radiator AssemblyÃ,Â» Remove - **Radiator Outlet Hose Replacement (LTG with HP9)**

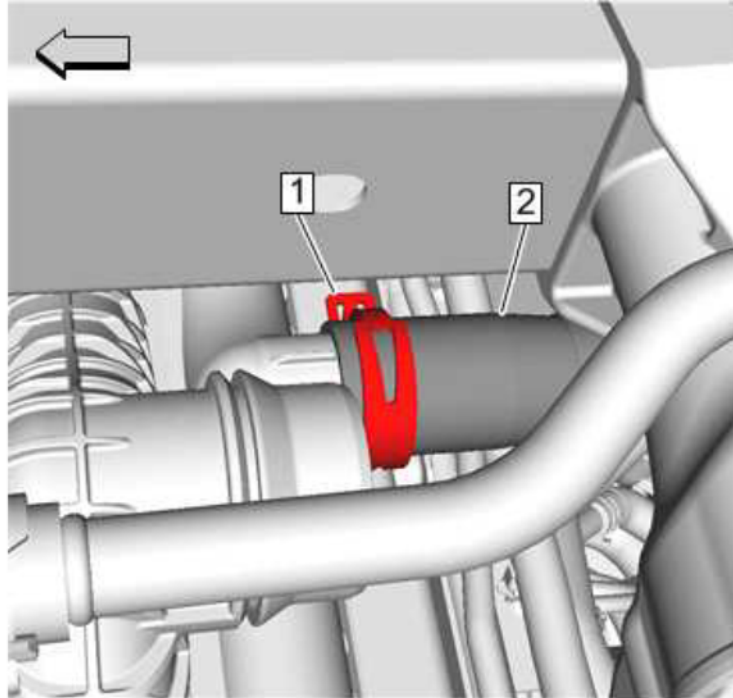


Fig. 337: Radiator Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

9. Transmission Fluid Cooler Pipe Clip (1) @ Engine Coolant Fan Shroud, & » Remove [4x] - **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LTG With HP9)**

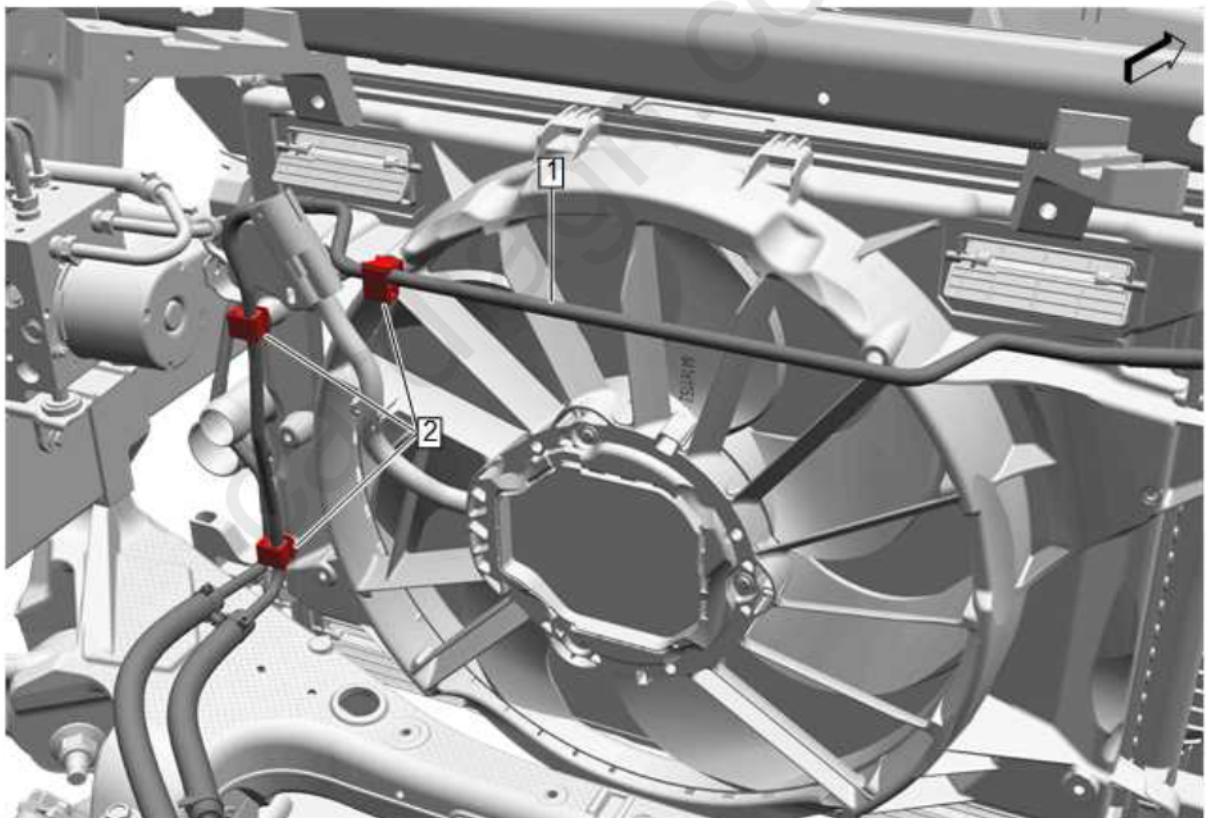


Fig. 338: Transmission Fluid Cooler Pipe Clips

Courtesy of GENERAL MOTORS COMPANY

10. Electrical Connector @ Engine Coolant Fan Shroud, & » Disconnect
11. Engine Coolant Fan Module Radiator (1), & » Remove

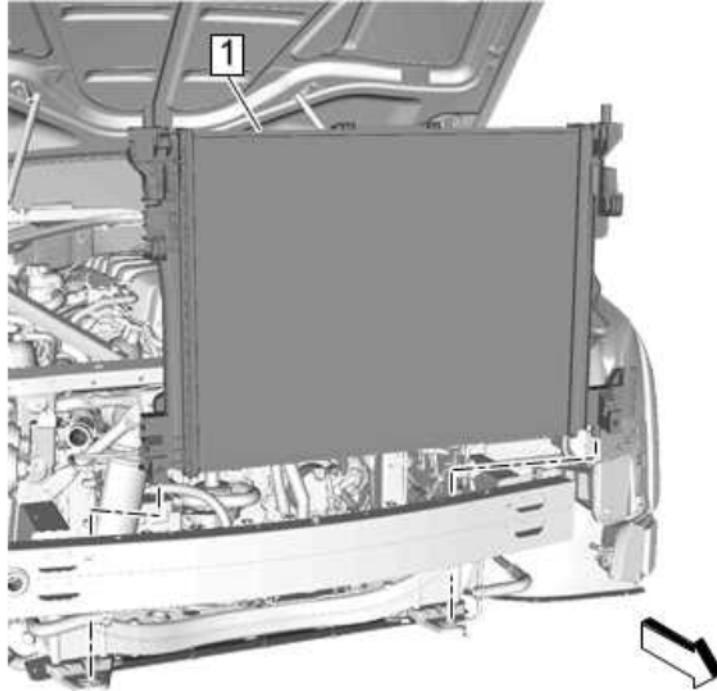


Fig. 339: Engine Coolant Fan Module Radiator
Courtesy of GENERAL MOTORS COMPANY

12. Engine Coolant Fan Bolt (1) » Remove [2x]

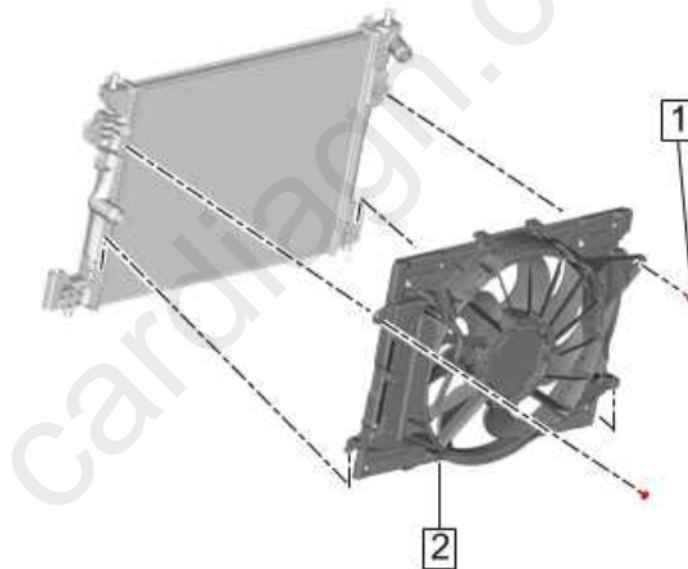


Fig. 340: Engine Coolant Fan Bolt
Courtesy of GENERAL MOTORS COMPANY

13. Engine Coolant Fan Shroud (2) @ Radiator Assembly (3) » Remove
 14. Transfer components as necessary.

Installation Procedure

1. Engine Coolant Fan Shroud (2) @ Radiator Assembly (3) » Install

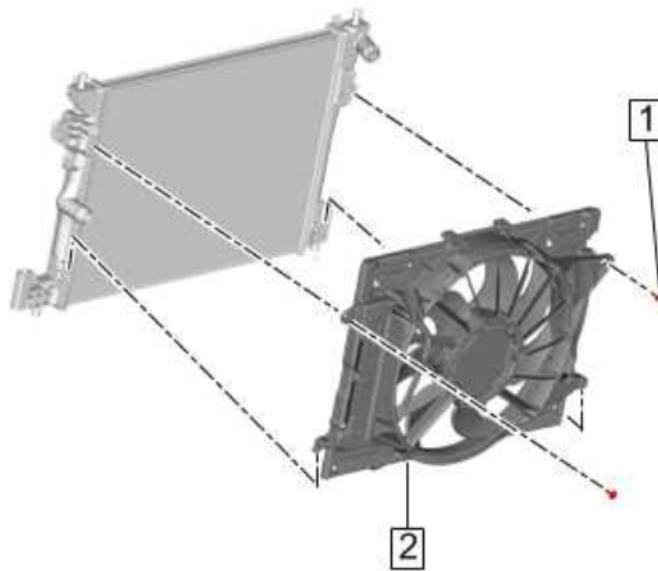


Fig. 341: Engine Coolant Fan Bolt
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Engine Coolant Fan Bolt (1)» Install and tighten [2x] 5.1 N.m (45 lb in)
3. Engine Coolant Fan Module Radiator (1)» Install

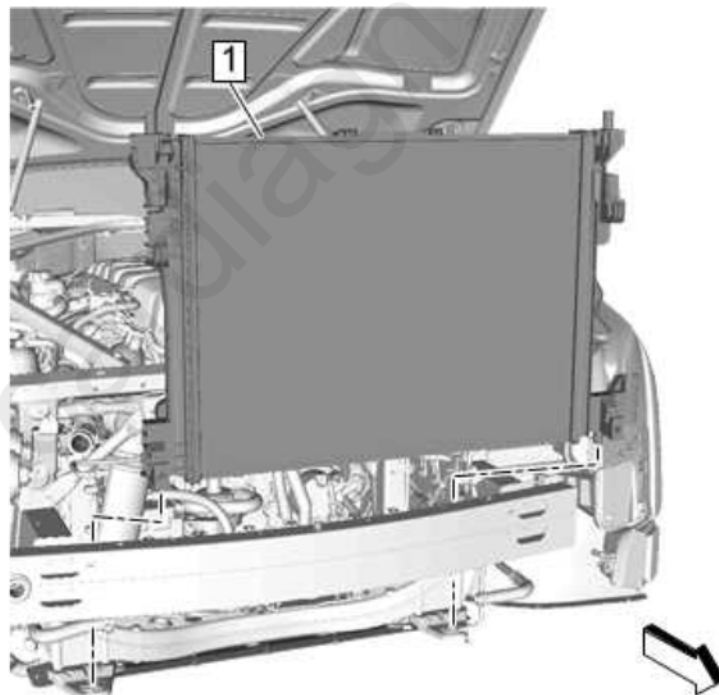


Fig. 342: Engine Coolant Fan Module Radiator
 Courtesy of GENERAL MOTORS COMPANY

4. Electrical Connector @ Engine Coolant Fan Shroud» Connect
5. Transmission Fluid Cooler Pipe Clip (1) @ Engine Coolant Fan Shroud» Install [4x] - **Transmission Fluid Cooler Inlet and Outlet Pipe Replacement (LTG With HP9)**

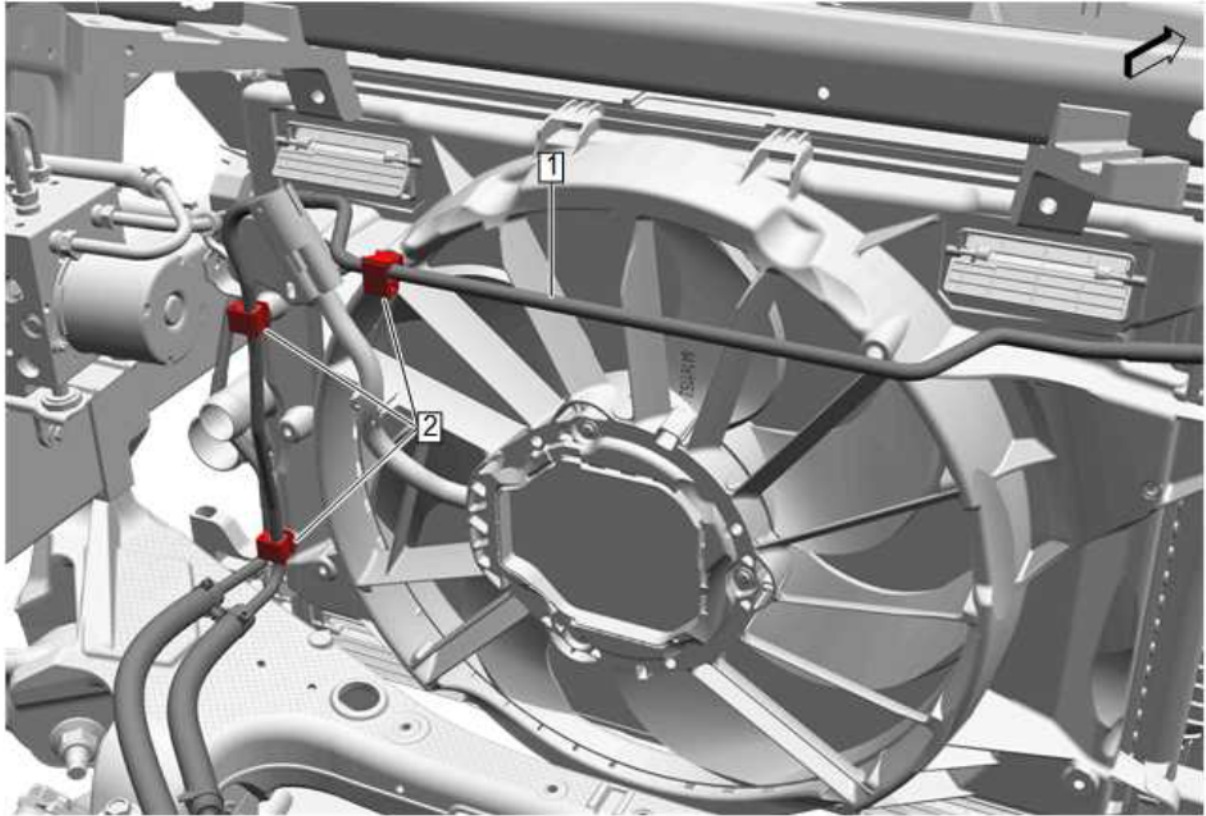


Fig. 343: Transmission Fluid Cooler Pipe Clips
 Courtesy of GENERAL MOTORS COMPANY

6. Radiator Outlet Hose (2) @ Radiator AssemblyÃ,Â» Install - **Radiator Outlet Hose Replacement (LTG with HP9)**

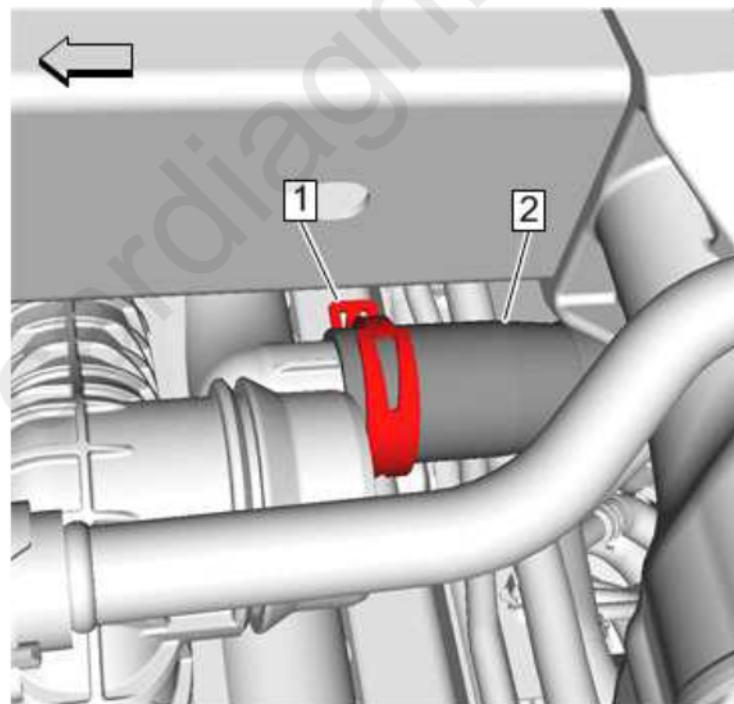


Fig. 344: Radiator Outlet Hose Clamp
 Courtesy of GENERAL MOTORS COMPANY

7. Radiator Inlet Hose (2) @ Radiator AssemblyÃ,Â» Install - **Radiator Inlet Hose Replacement (LTG with HP9)**

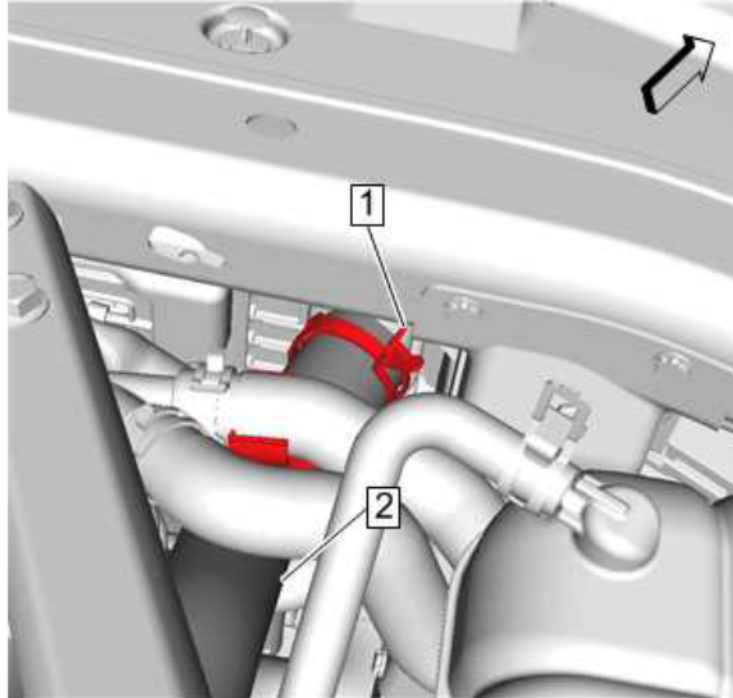


Fig. 345: Radiator Inlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

8. Charge Air Cooler Radiator (1) » Install - **Charge Air Cooler Radiator Replacement**

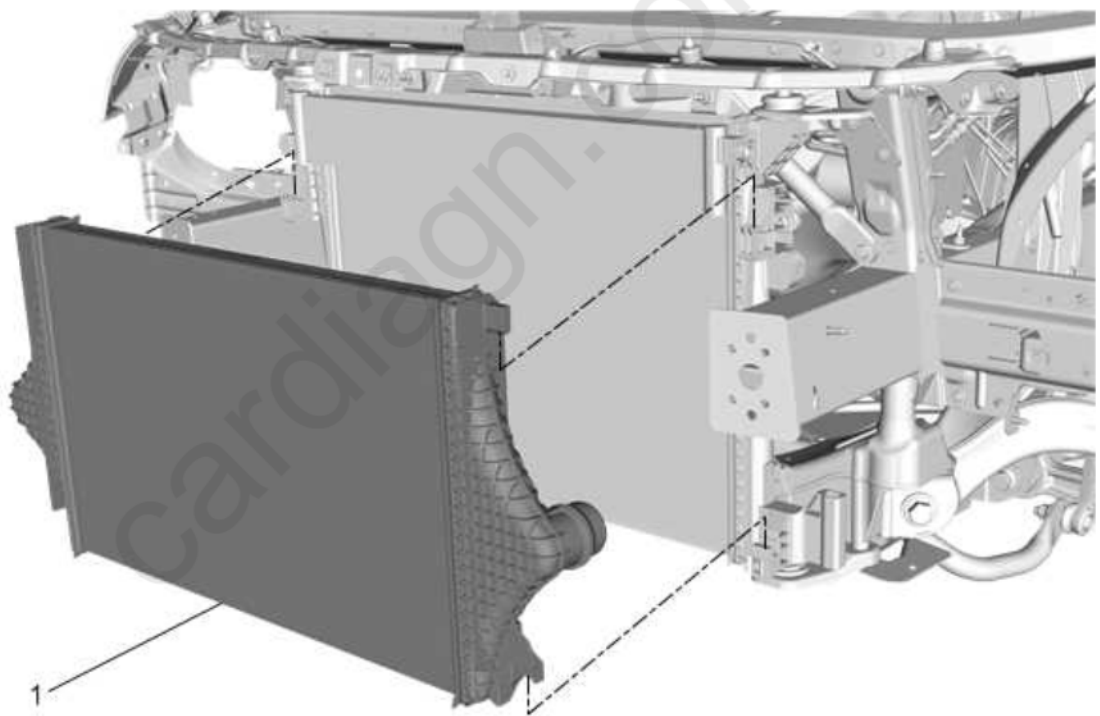


Fig. 346: Charge Air Cooler Radiator

Courtesy of GENERAL MOTORS COMPANY

9. Radiator Upper Bracket (2, 4) » Install - **Radiator Upper Bracket Replacement (LGW LGX LTG)**

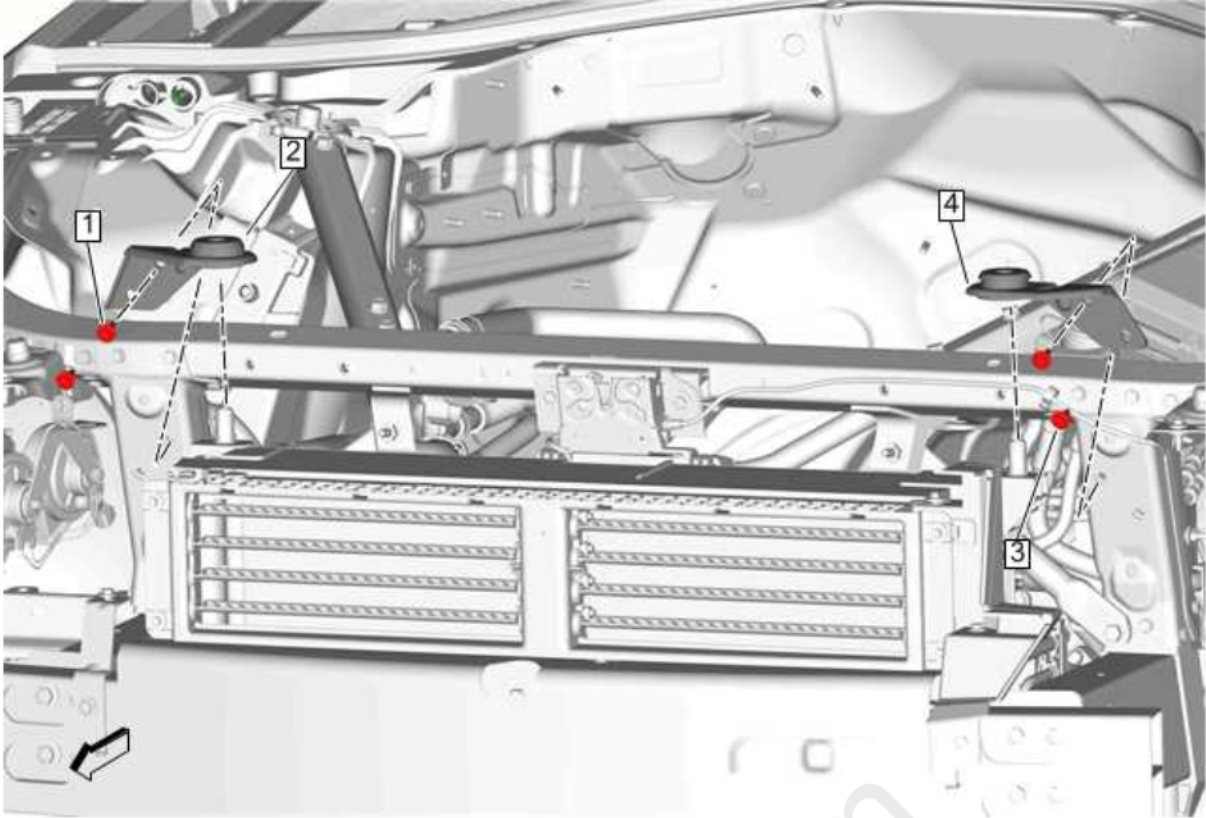


Fig. 347: Radiator Upper Bracket

Courtesy of GENERAL MOTORS COMPANY

10. Air Conditioning Condenser Bracket (2)» Install - **Air Conditioning Condenser Bracket Replacement**

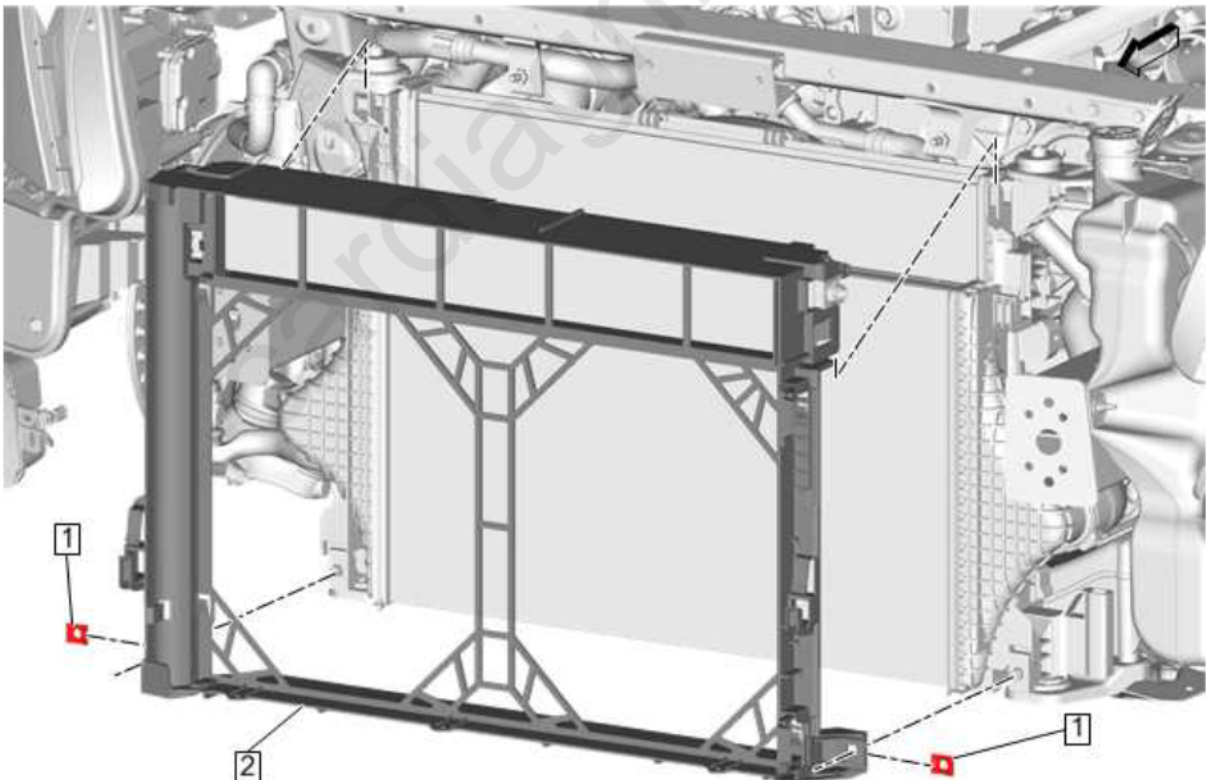


Fig. 348: Air Conditioning Condenser Bracket

Courtesy of GENERAL MOTORS COMPANY

11. Front Bumper Fascia (4)» Remove - **Front Bumper Fascia Replacement (Without UV3)**
Front Bumper Fascia Replacement (With UV3)

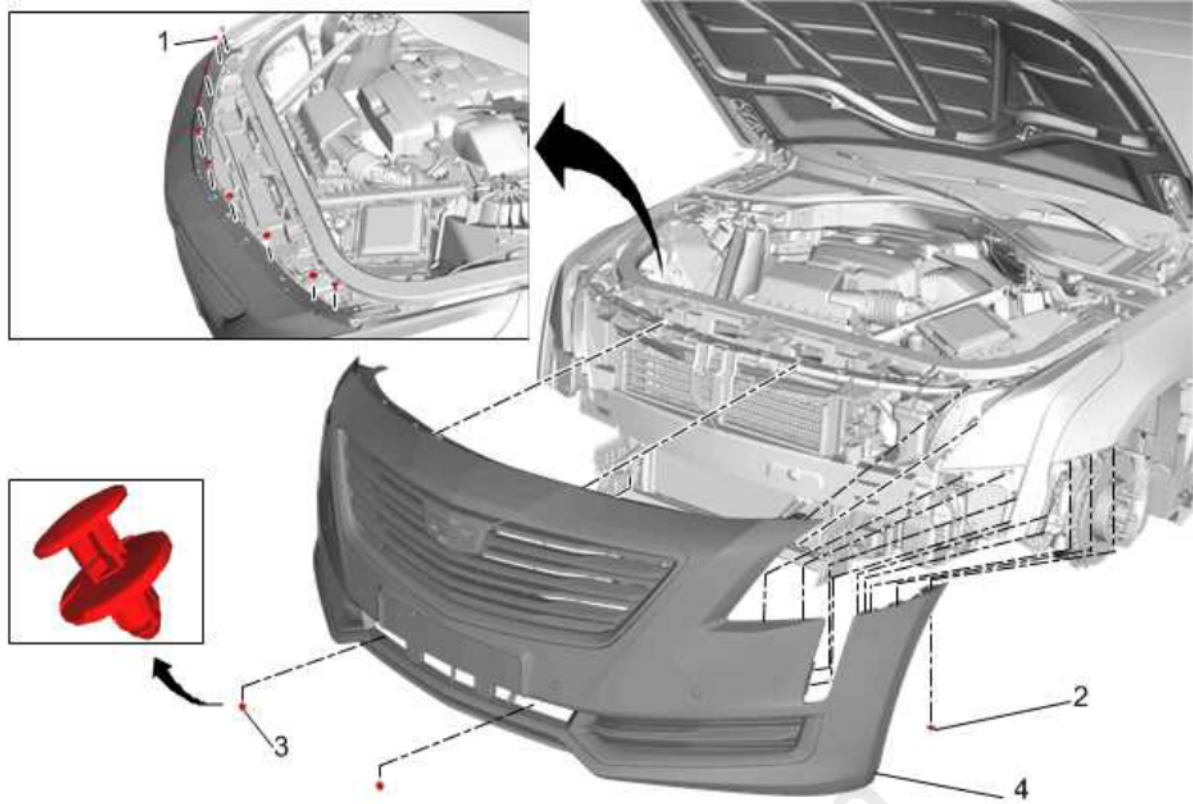


Fig. 349: Front Bumper Fascia

Courtesy of GENERAL MOTORS COMPANY

12. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static LTG with HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 LTG with HP9\)](#)
13. Enable the high voltage system. Refer to [High Voltage Enabling](#)
14. Start the engine and check for coolant leaks.

AUXILIARY RADIATOR REPLACEMENT (LGW)

Removal Procedure

1. Front Bumper Fascia, » Remove - [Front Bumper Fascia Replacement \(With out UV3\)](#) [Front Bumper Fascia Replacement \(With UV3\)](#)
2. Drain the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
3. Auxiliary Radiator Inlet Hose (3) @ Auxiliary Radiator, » Remove - [Auxiliary Radiator Inlet Hose Replacement \(LGW\)](#)

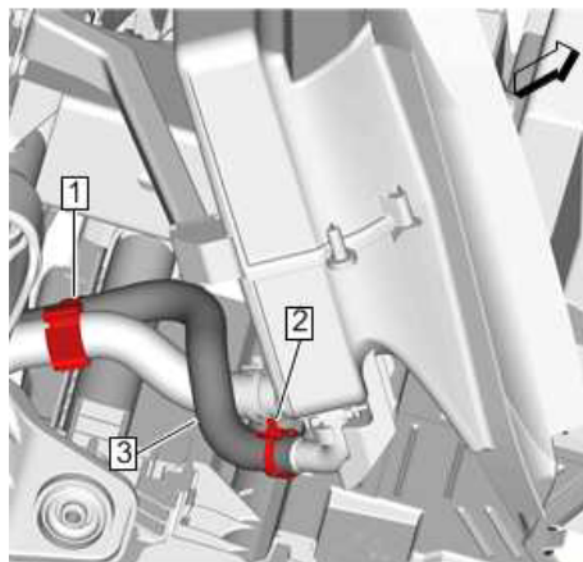


Fig. 350: Auxiliary Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Auxiliary Radiator Outlet Hose (3) @ Auxiliary Radiator A, A» Remove - [Auxiliary Radiator Outlet Hose Replacement \(LGW\)](#)

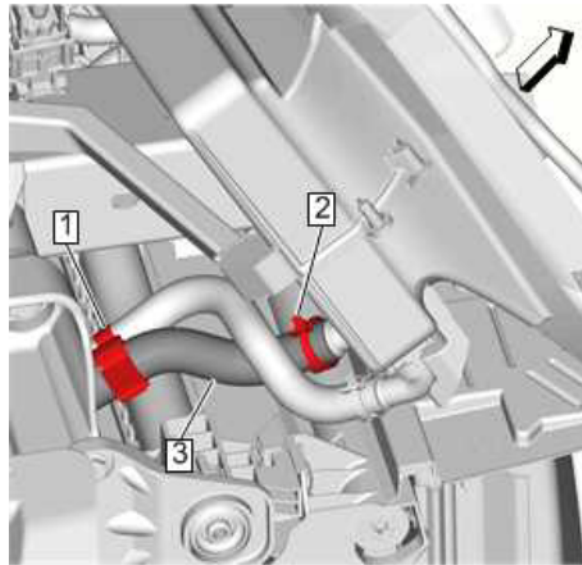


Fig. 351: Auxiliary Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Auxiliary Radiator Bracket (1) @ Auxiliary Radiator Bracket A, A» Remove - [Auxiliary Radiator Bracket Replacement \(LGW\)](#)

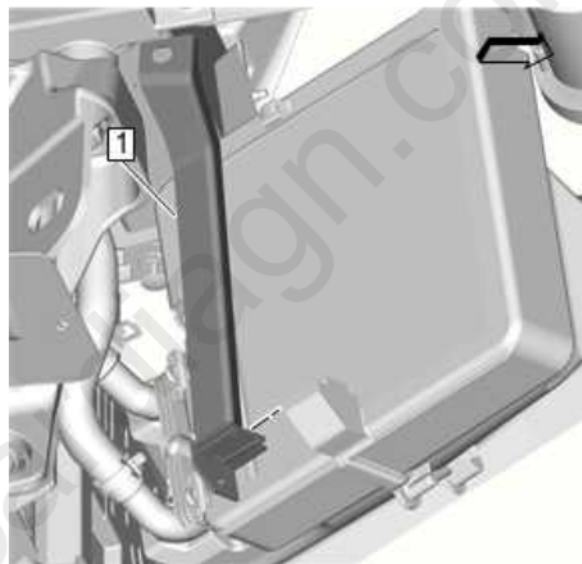


Fig. 352: Auxiliary Radiator Bracket
Courtesy of GENERAL MOTORS COMPANY

6. Auxiliary Radiator Bolt (1) @ Auxiliary Radiator Bracket A, A» Remove

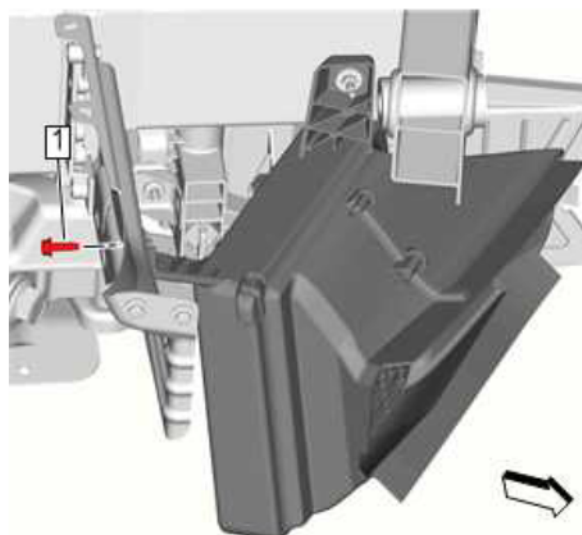


Fig. 353: Auxiliary Radiator Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Auxiliary Radiator Nut (1) @ Auxiliary Radiator Bracket» Remove

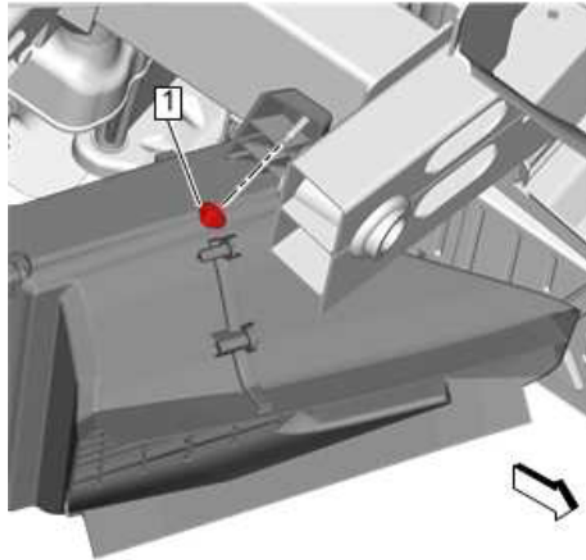


Fig. 354: Auxiliary Radiator Nut
Courtesy of GENERAL MOTORS COMPANY

8. Auxiliary Radiator (1)» Remove

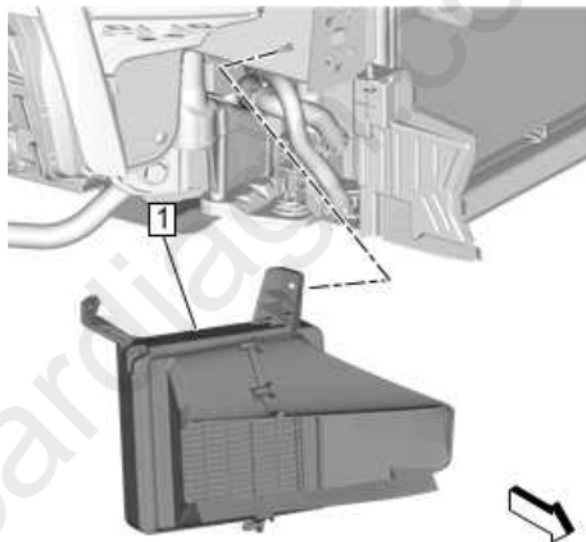


Fig. 355: Auxiliary Radiator
Courtesy of GENERAL MOTORS COMPANY

9. Auxiliary Radiator Screw (1) @ Auxiliary Radiator Bracket» Remove

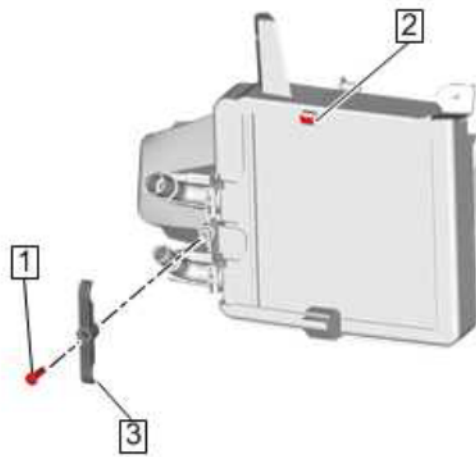


Fig. 356: Retainer And Radiator Bracket

Courtesy of GENERAL MOTORS COMPANY

10. Auxiliary Radiator Bracket (3) @ Auxiliary Radiator Bracket» Remove
11. Retainer (2) @ Auxiliary Radiator Bracket» Remove
12. Auxiliary Radiator Screw (4)» Remove [4x]

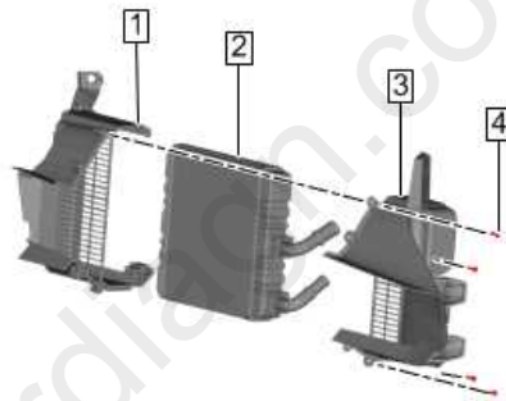


Fig. 357: Auxiliary Radiator

Courtesy of GENERAL MOTORS COMPANY

13. Auxiliary Radiator Bracket (1)» Remove
14. Auxiliary Radiator Bracket (3)» Remove
15. Auxiliary Radiator (2)» Remove

Installation Procedure

1. Auxiliary Radiator (2)» Install

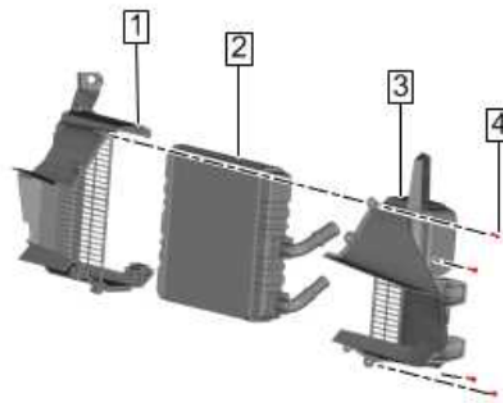


Fig. 358: Auxiliary Radiator

Courtesy of GENERAL MOTORS COMPANY

2. Auxiliary Radiator Bracket (3) » Install
3. Auxiliary Radiator Bracket (1) » Install
4. Auxiliary Radiator Screw (4) » Install and tighten [4x] 1.5 N.m (13 lb in)

CAUTION: Refer to **Fastener Caution** .

5. Retainer (2) @ Auxiliary Radiator Bracket » Install

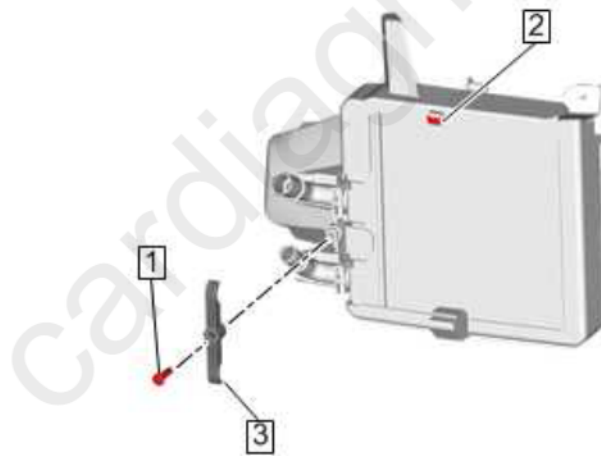


Fig. 359: Retainer And Radiator Bracket

Courtesy of GENERAL MOTORS COMPANY

6. Auxiliary Radiator Bracket (3) @ Auxiliary Radiator Bracket » Install
7. Auxiliary Radiator Screw (1) @ Auxiliary Radiator Bracket » Install and tighten 1.5 N.m (13 lb in)
8. Auxiliary Radiator Bracket (1) @ Auxiliary Radiator Bracket » Install - **Auxiliary Radiator Bracket Replacement (LGW)**

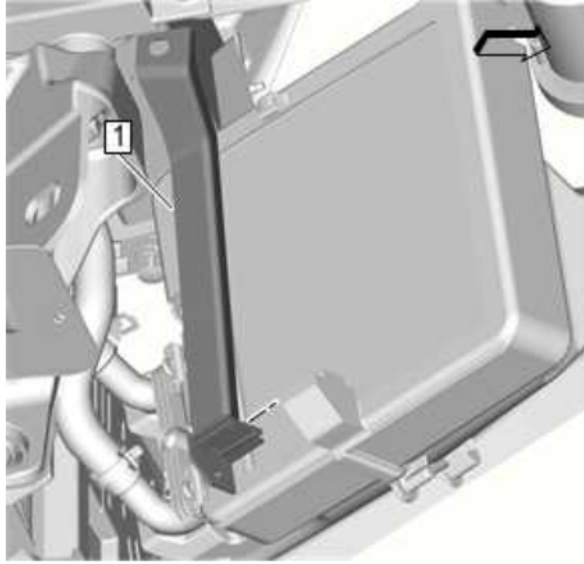


Fig. 360: Auxiliary Radiator Bracket

Courtesy of GENERAL MOTORS COMPANY

9. Auxiliary Radiator Nut (1) @ Auxiliary Radiator Bracket» Install and tighten 9 N.m (80 lb in)

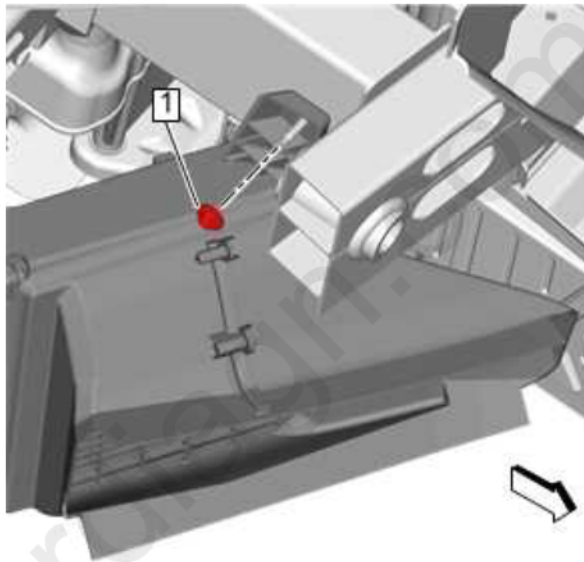


Fig. 361: Auxiliary Radiator Nut

Courtesy of GENERAL MOTORS COMPANY

10. Auxiliary Radiator Bolt (1) @ Auxiliary Radiator Bracket» Install and tighten 9 N.m (80 lb in)

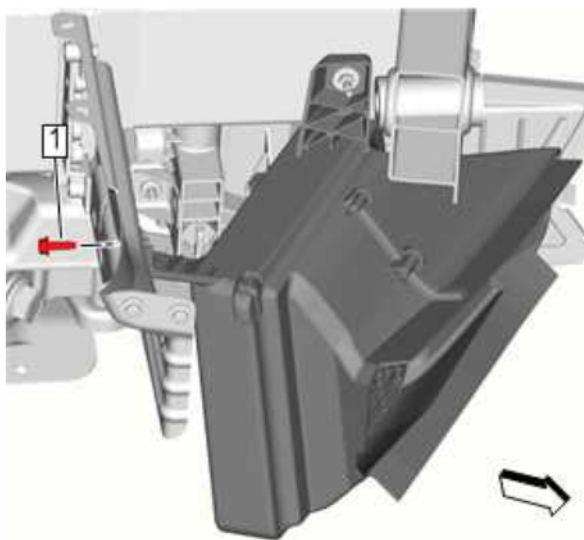


Fig. 362: Auxiliary Radiator Bolt

Courtesy of GENERAL MOTORS COMPANY

11. Auxiliary Radiator Outlet Hose (3) @ Auxiliary RadiatorÃ,Â» Install - [Auxiliary Radiator Outlet Hose Replacement \(LGW\)](#)

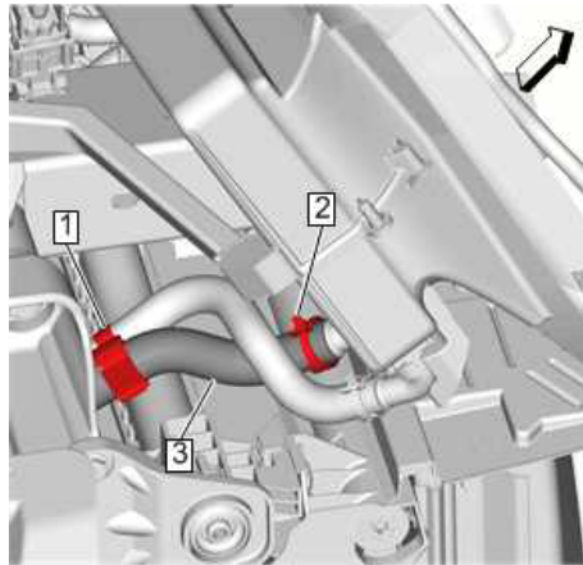


Fig. 363: Auxiliary Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

12. Auxiliary Radiator Inlet Hose (3) @ Auxiliary RadiatorÃ,Â» Install and tighten - [Auxiliary Radiator Inlet Hose Replacement \(LGW\)](#)

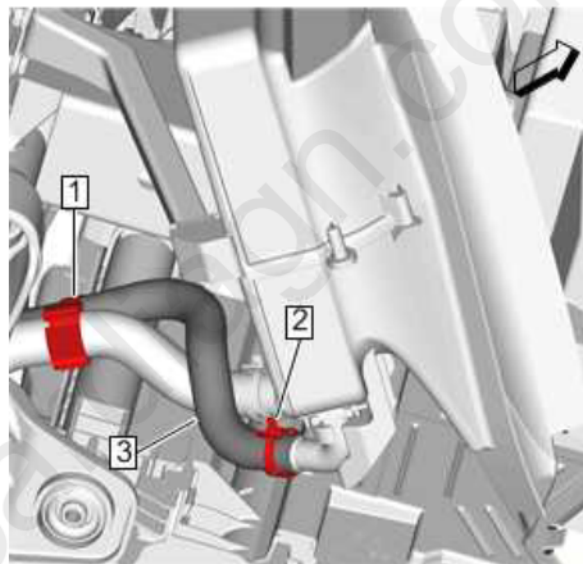


Fig. 364: Auxiliary Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

13. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static without HP9\)](#) and/or [Cooling System Draining and Filling \(GE 47716 without HP9\)](#)
14. Start the engine and check for coolant leaks.
15. Front Bumper FasciaÃ,Â» Install - [Front Bumper Fascia Replacement \(Without UV3\)](#) [Front Bumper Fascia Replacement \(With UV3\)](#)

AUXILIARY RADIATOR BRACKET REPLACEMENT (LGW)

Removal Procedure

1. Front Tire Front Air DeflectorÃ,Â» Remove - [Front Tire Front Air Deflector Replacement](#)
2. Auxiliary Radiator Bolt (1)Ã,Â» Remove

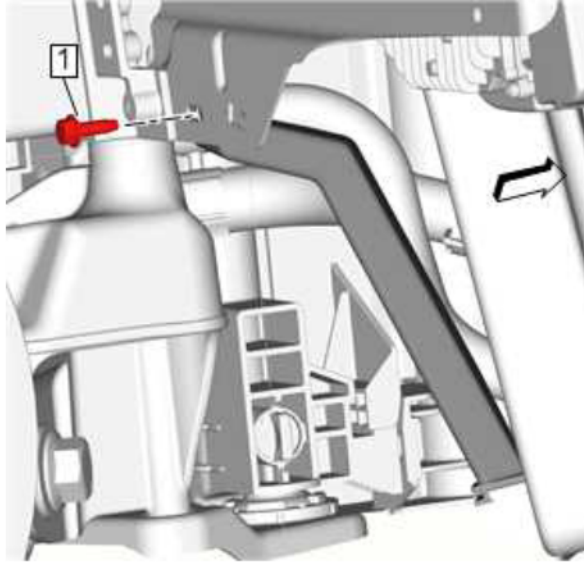


Fig. 365: Auxiliary Radiator Bolt
 Courtesy of GENERAL MOTORS COMPANY

3. Auxiliary Radiator Screw (1) » Remove

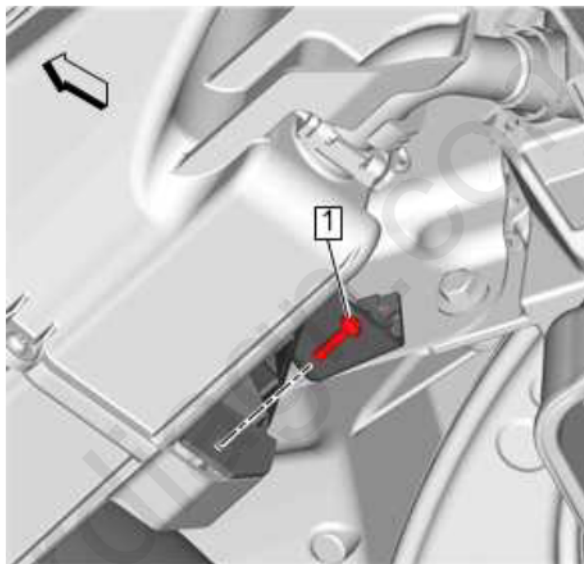


Fig. 366: Auxiliary Radiator Screw
 Courtesy of GENERAL MOTORS COMPANY

4. Auxiliary Radiator Bracket (1) » Remove

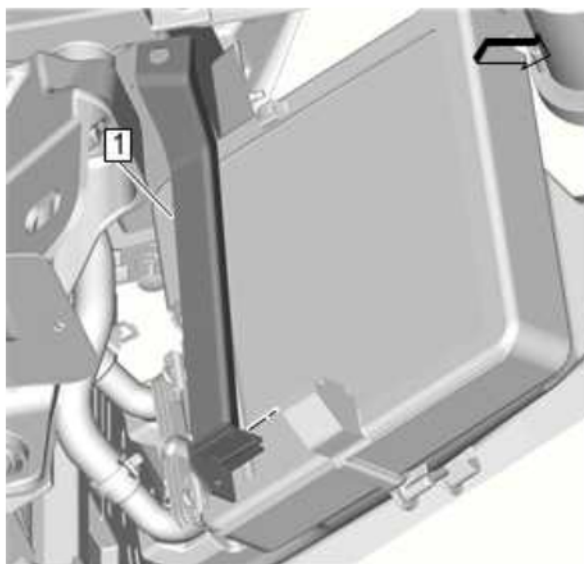


Fig. 367: Auxiliary Radiator Bracket
 Courtesy of GENERAL MOTORS COMPANY

1. Auxiliary Radiator Bracket (1) @ Auxiliary Radiator» Install

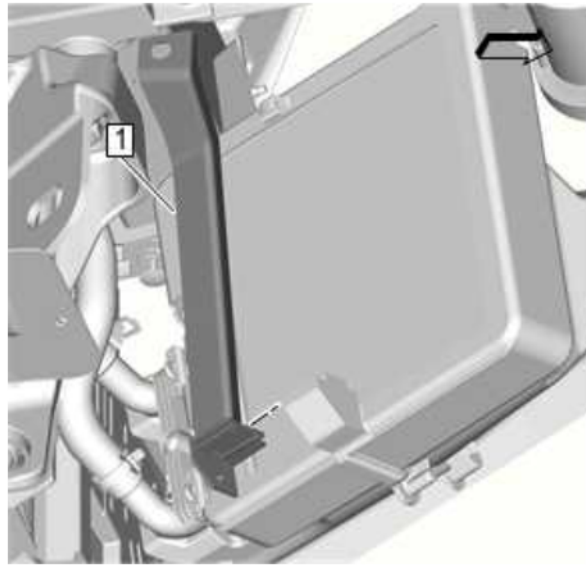


Fig. 368: Auxiliary Radiator Bracket

Courtesy of GENERAL MOTORS COMPANY

2. Auxiliary Radiator Screw (1)» Install and tighten 1.5 N.m (13 lb in)

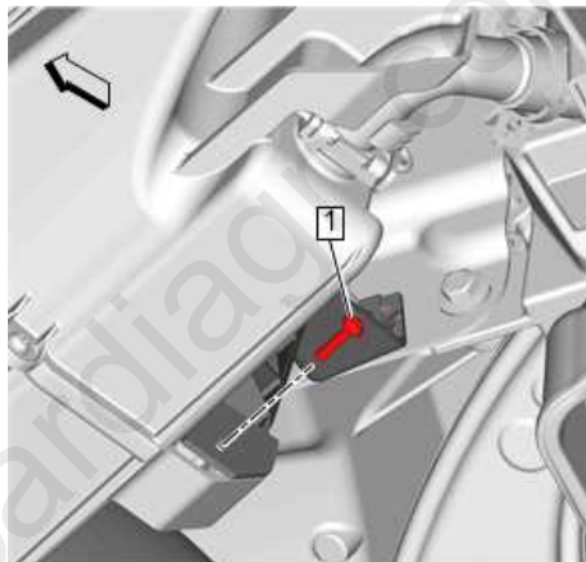


Fig. 369: Auxiliary Radiator Screw

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

3. Auxiliary Radiator Bolt (1)» Install and tighten 9 N.m (80 lb in)

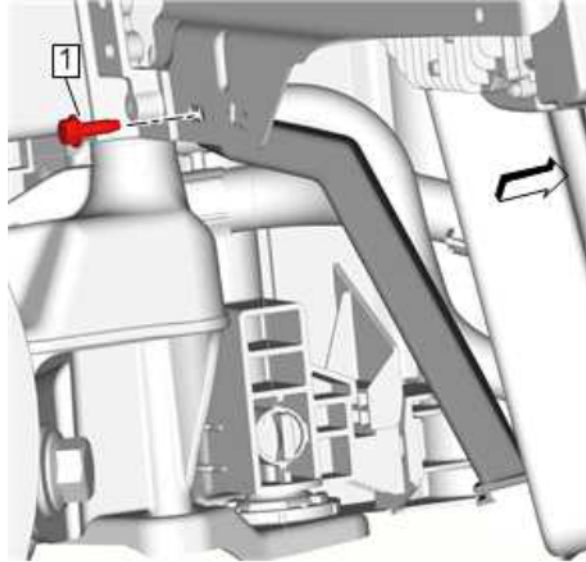


Fig. 370: Auxiliary Radiator Bolt

Courtesy of GENERAL MOTORS COMPANY

4. Front Tire Front Air Deflector» Install - **Front Tire Front Air Deflector Replacement**

RADIATOR LOWER INSULATOR REPLACEMENT (LGW LGX LTG - LEFT SIDE)

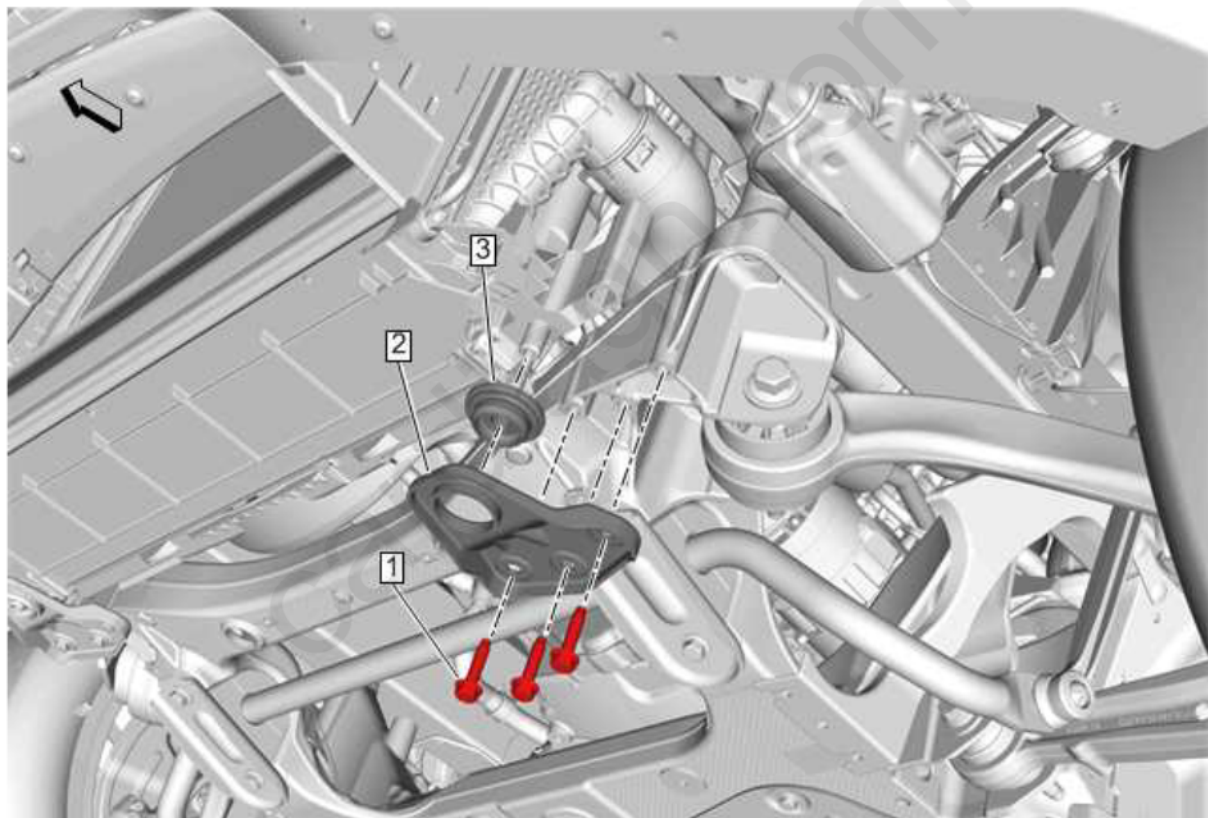


Fig. 371: Radiator Lower Insulator

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
<u>Front Bumper Fascia Lower Stiffener Replacement</u> - Support the radiator.	

Callout	Component Name
1	Radiator Lower Bracket Bolt - Left Side [3x] CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Radiator Lower Bracket - Left Side
3	Radiator Lower Insulator - Left Side

RADIATOR LOWER INSULATOR REPLACEMENT (LGW LGX LTG - RIGHT SIDE)

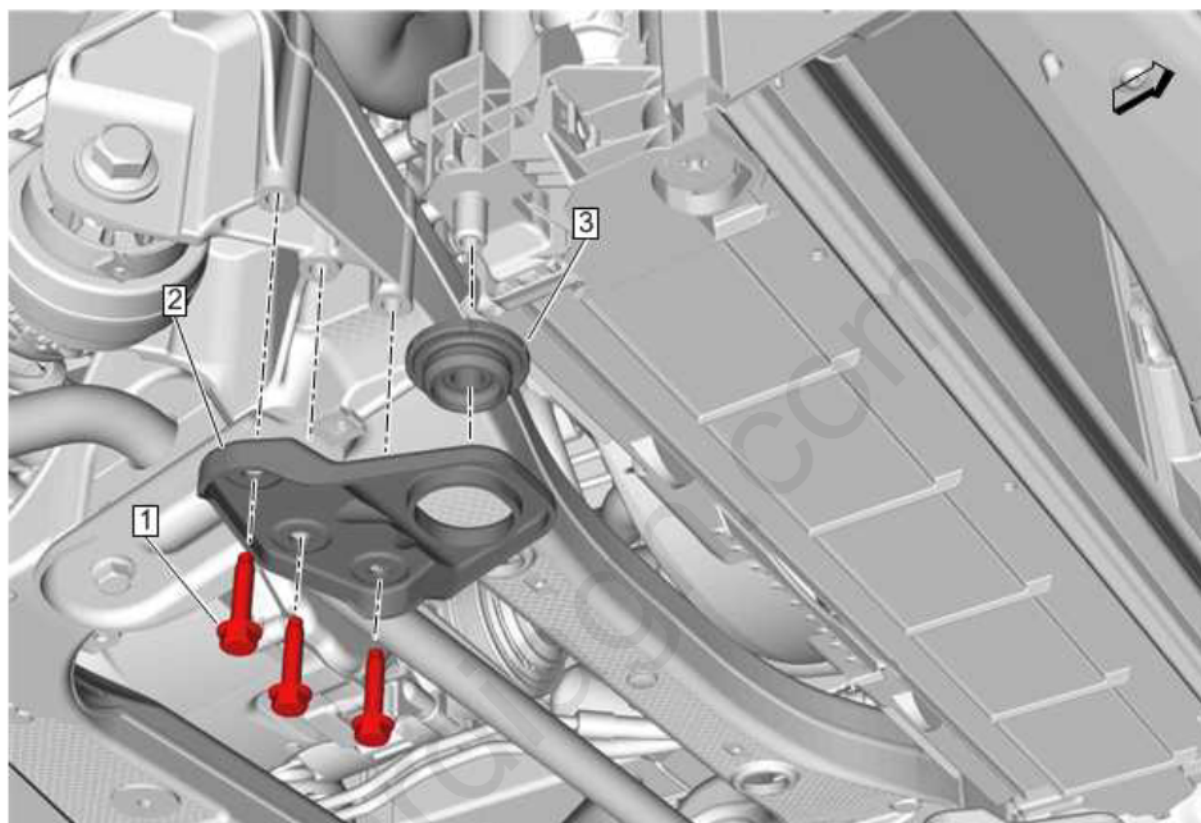


Fig. 372: Radiator Lower Insulator (LGW LGX LTG - Right Side)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Front Bumper Fascia Lower Stiffener Replacement - Support the radiator.	
1	Radiator Lower Bracket Bolt - Right Side [3x] CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Radiator Lower Bracket - Right Side
3	Radiator Lower Insulator - Right Side

CHARGE AIR COOLER RADIATOR REPLACEMENT (LGW)

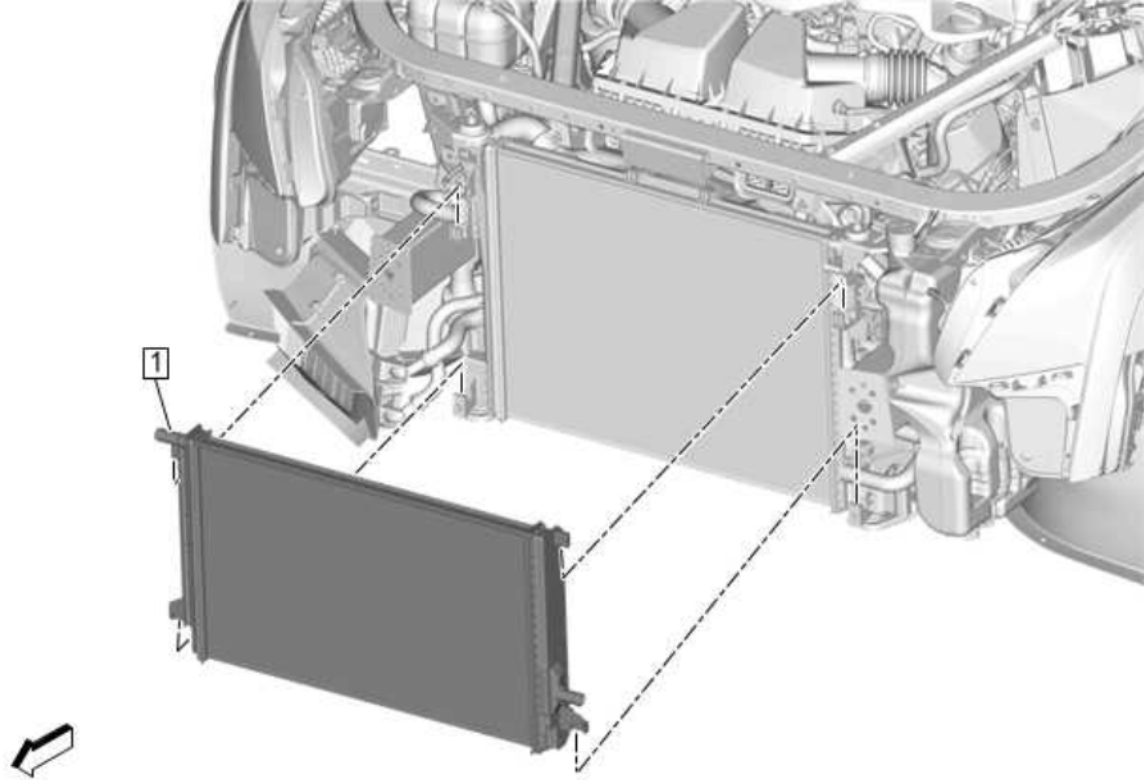


Fig. 373: Charge Air Cooler Radiator (LGW)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the charge air cooling system. Refer to Charge Air Cooling System Draining and Filling (LGW) 2. Air Conditioning Condenser Bracket Replacement 3. Charge Air Cooler Coolant Hose @ Charge Air Cooler RadiatorÃ,Â» Remove - Turbocharger Coolant Return Hose Replacement (LGW) 4. Turbocharger Coolant Return Hose @ Charge Air Cooler RadiatorÃ,Â» Remove - Charge Air Cooler Coolant Hose Replacement - Radiator to Pump (LGW)	
1	Charge Air Cooler Radiator Procedure 1. Fill the charge air cooling system. Refer to Charge Air Cooling System Draining and Filling (LGW) 2. Start the engine and check for coolant leaks.

RADIATOR AIR LOWER BAFFLE REPLACEMENT (LGW LXG LTG)

Removal Procedure

1. [Front Bumper Fascia Lower Stiffener Replacement](#) Ã,Â» Remove
2. Radiator Air Lower Baffle Retainer (1)Ã,Â» Remove [3x]

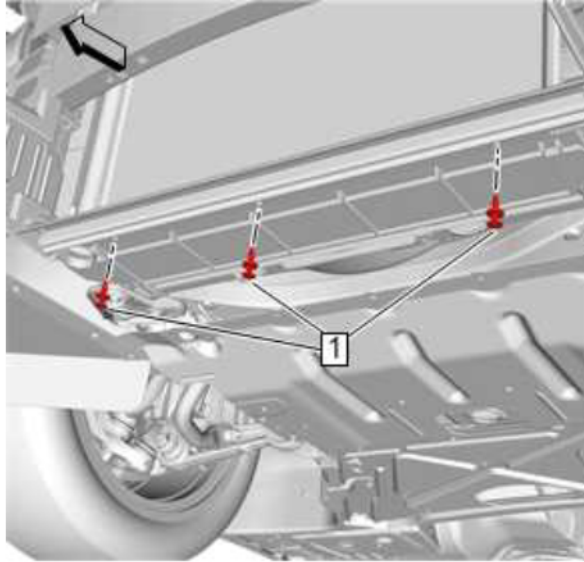


Fig. 374: Radiator Air Lower Baffle Retainer
 Courtesy of GENERAL MOTORS COMPANY

3. Radiator Air Side Baffle Retainer (1) » Remove [2x]

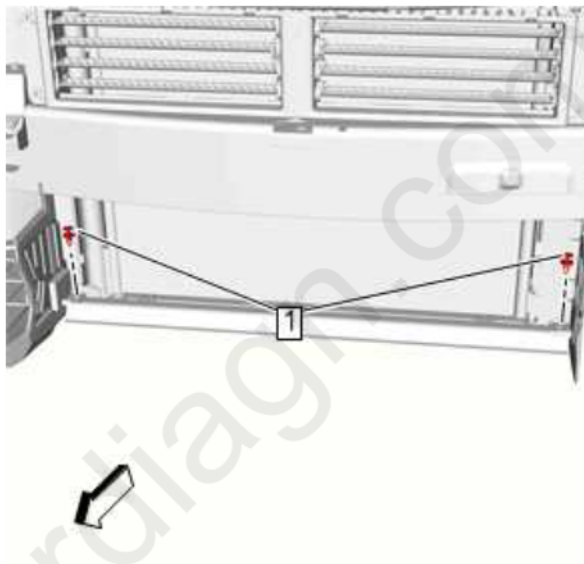


Fig. 375: Radiator Air Side Baffle Retainer
 Courtesy of GENERAL MOTORS COMPANY

4. Radiator Air Lower Baffle (1) » Remove

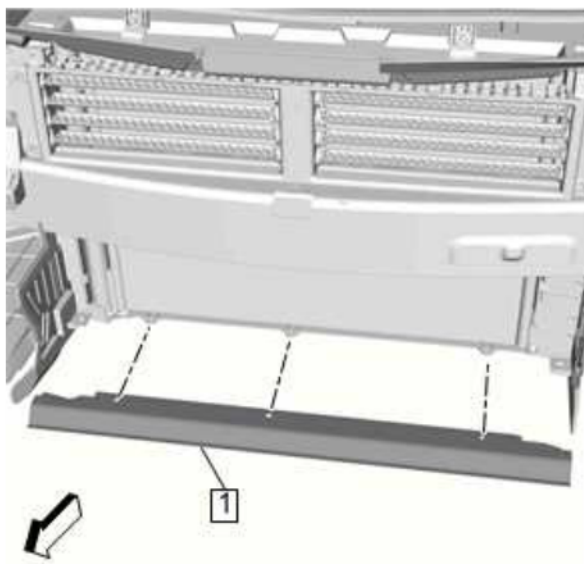


Fig. 376: Radiator Air Lower Baffle
 Courtesy of GENERAL MOTORS COMPANY

1. Radiator Air Lower Baffle (1)» Install

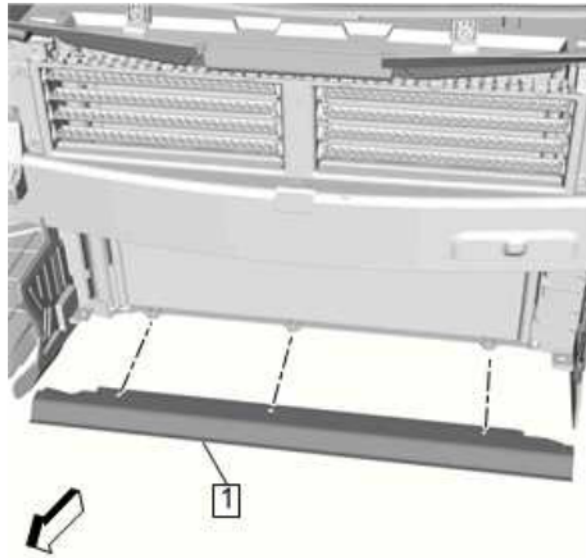


Fig. 377: Radiator Air Lower Baffle

Courtesy of GENERAL MOTORS COMPANY

2. Radiator Air Side Baffle Retainer (1)» Install [2x]

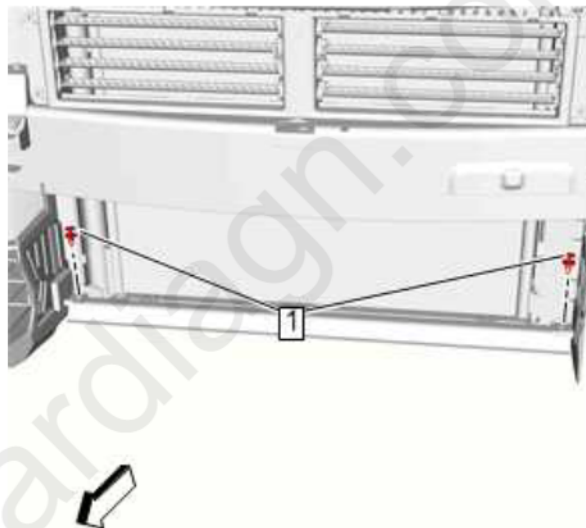
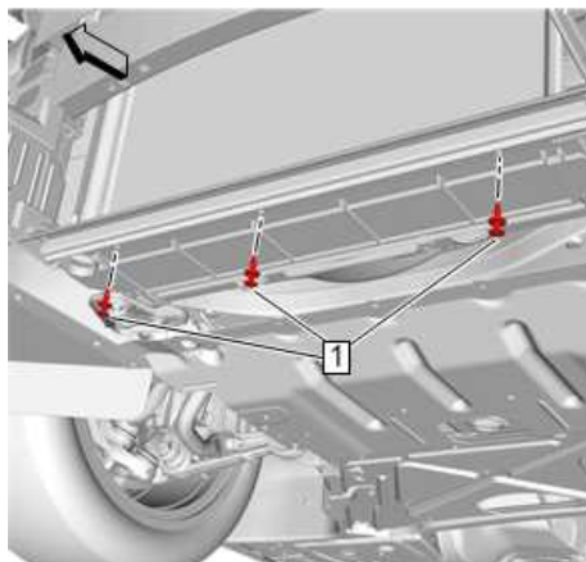


Fig. 378: Radiator Air Side Baffle Retainer

Courtesy of GENERAL MOTORS COMPANY

3. Radiator Air Lower Baffle Retainer (1)» Install [3x]



4. **Front Bumper Fascia Lower Stiffener Replacement** » Install

RADIATOR AIR SIDE UPPER BAFFLE REPLACEMENT (LGW LGX LTG - LEFT SIDE)

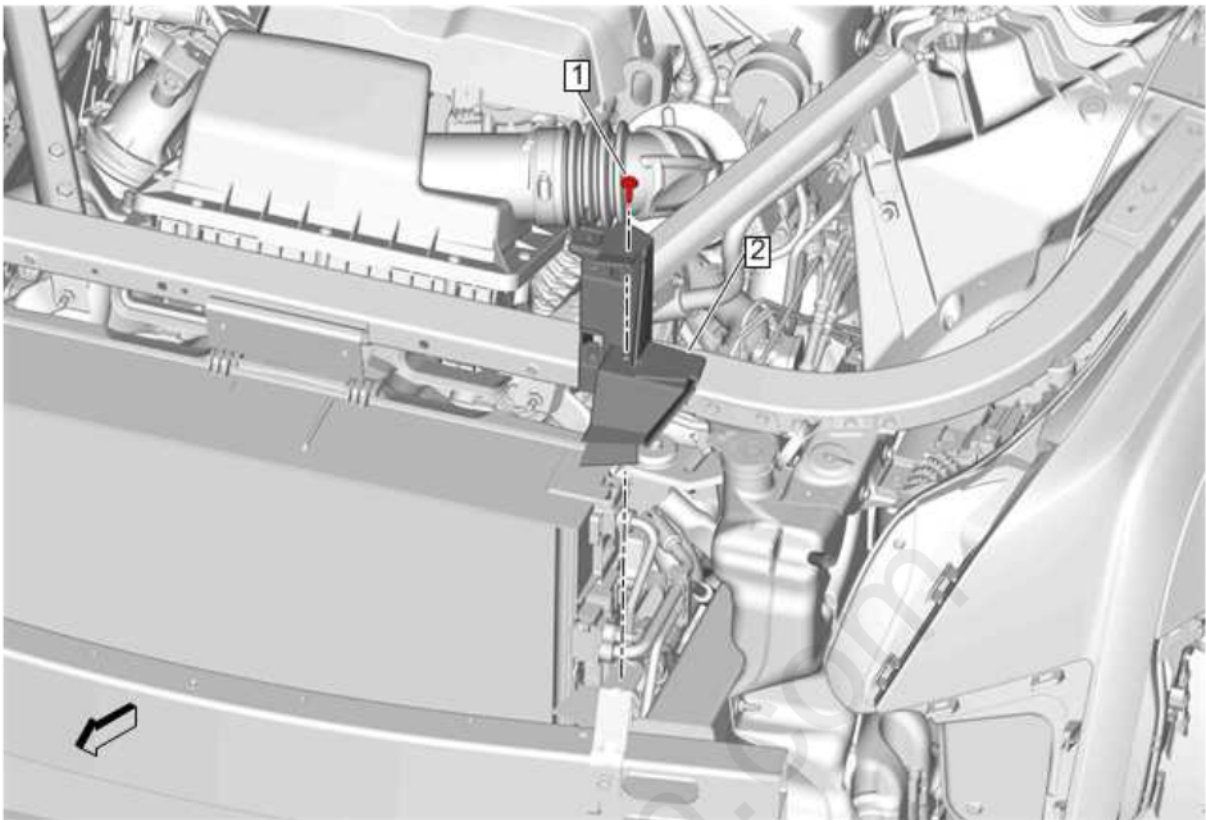


Fig. 380: Radiator Air Side Upper Baffle (LGW LGX LTG - Left Side)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Bumper Shutter Replacement 2. Front Bumper Fascia Support Replacement 3. Radiator Air Upper Baffle and Deflector Replacement (LGW LTG)Radiator Air Upper Baffle and Deflector Replacement (LGX)	
1	Radiator Air Upper Baffle Bolt CAUTION: Refer to Fastener Caution . Tighten 4 N.m (35 lb in)
2	Radiator Air Side Upper Baffle - Left Side

RADIATOR AIR SIDE UPPER BAFFLE REPLACEMENT (LGW LTG - RIGHT SIDE)

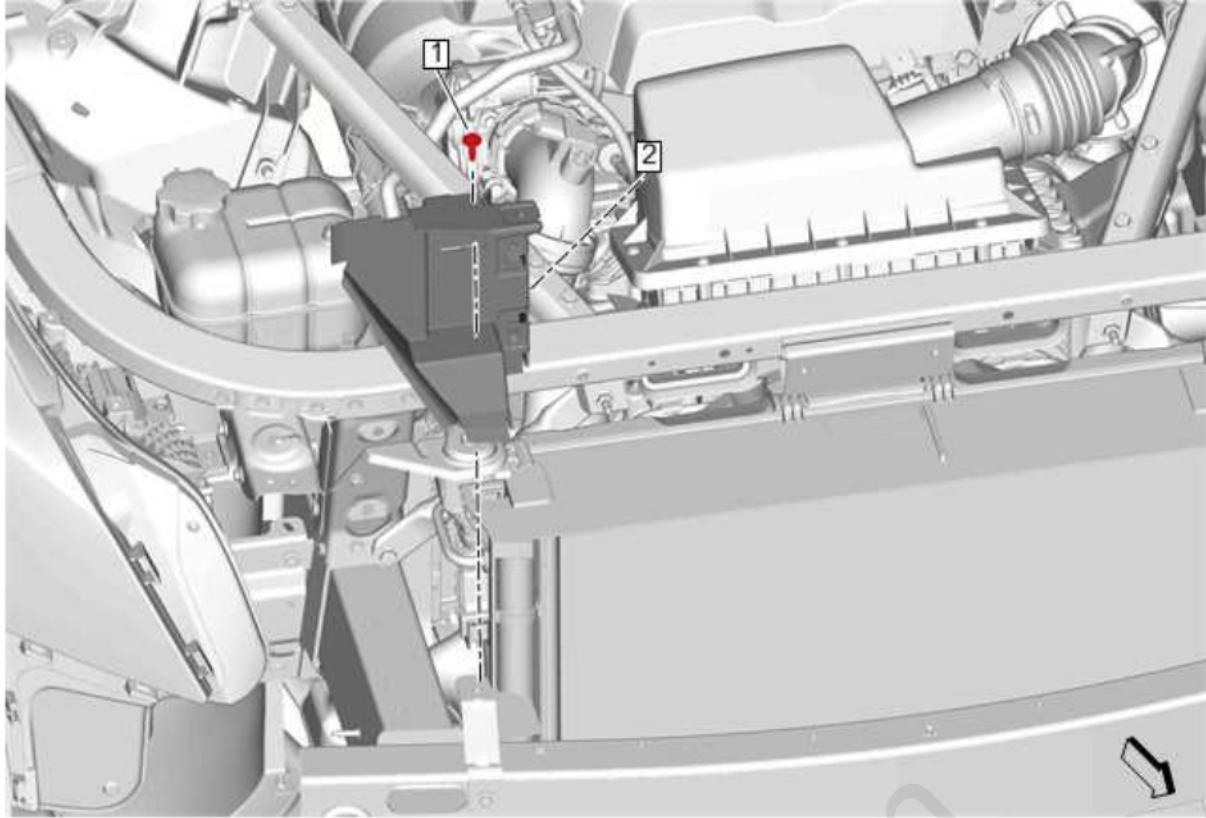


Fig. 381: Radiator Air Side Upper Baffle (LGW LTG - Right Side)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. <u>Front Bumper Shutter Replacement</u> 2. <u>Front Bumper Fascia Support Replacement</u> 3. <u>Radiator Air Upper Baffle and Deflector Replacement (LGW LTG)</u>	
1	Radiator Air Upper Baffle Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 4 N.m (35 lb in)
2	Radiator Air Side Upper Baffle - Right Side

RADIATOR AIR SIDE UPPER BAFFLE REPLACEMENT (LGX - RIGHT SIDE)

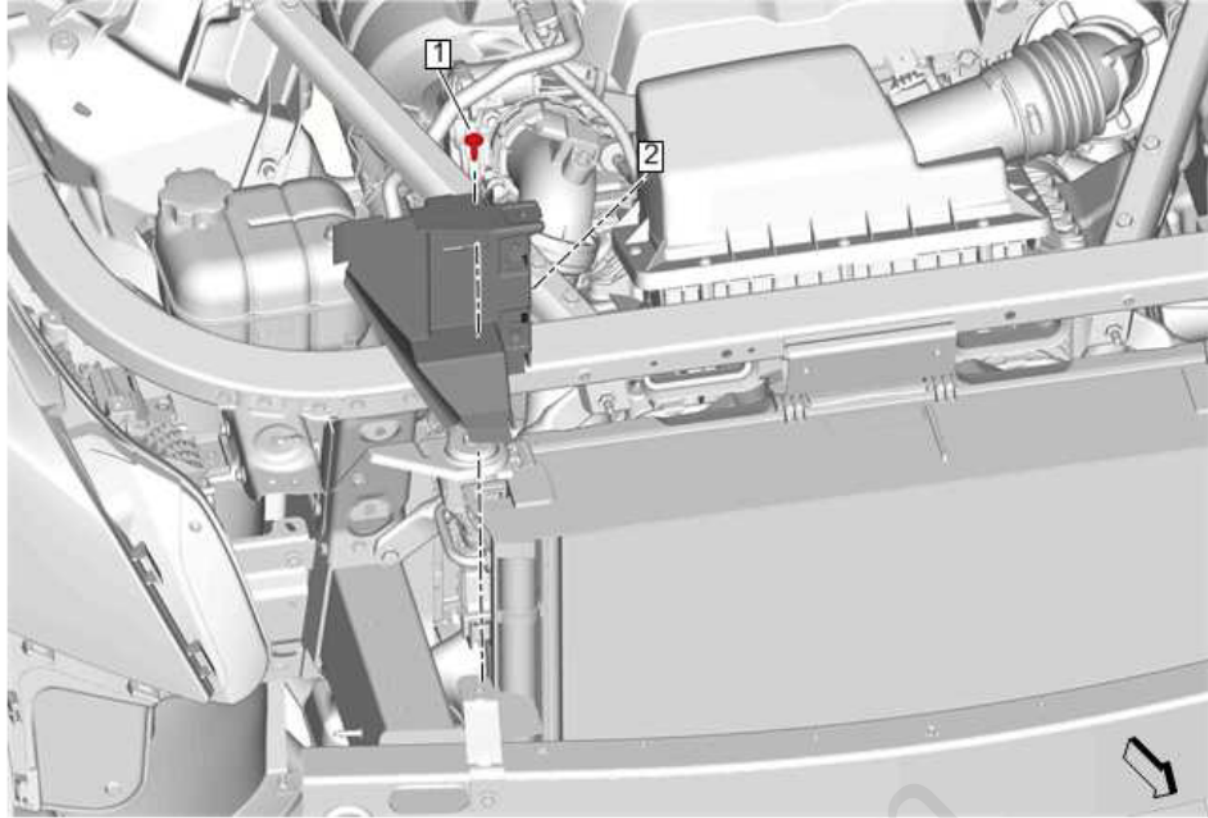


Fig. 382: Radiator Air Side Upper Baffle (LGX - Right Side)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Front Bumper Shutter Replacement</u> <u>Front Bumper Fascia Support Replacement</u> <u>Radiator Air Upper Baffle and Deflector Replacement (LGX)</u> <u>Intake Air Duct Replacement (LGX)</u>	
1	Radiator Air Upper Baffle Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Radiator Air Side Upper Baffle - Right Side

RADIATOR AIR SIDE LOWER BAFFLE REPLACEMENT (LGW LGX LTG - LEFT SIDE)

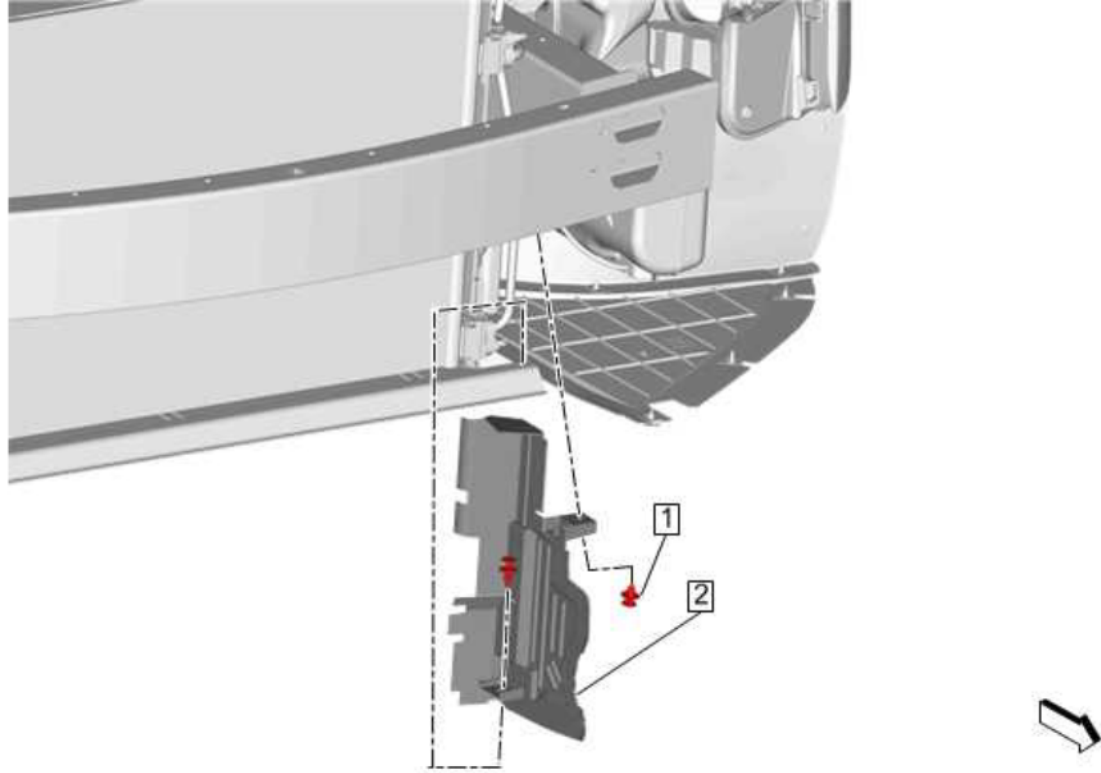


Fig. 383: Radiator Air Side Lower Baffle (LGW LGX LTG - Left Side)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Front Bumper Fascia Replacement (Without UV3) Front Bumper Fascia Replacement (With UV3)</u>	
1	Radiator Air Side Baffle Retainer [2x]
2	Radiator Air Side Lower Baffle - Left Side

RADIATOR AIR SIDE LOWER BAFFLE REPLACEMENT (LGW LGX LTG - RIGHT SIDE)

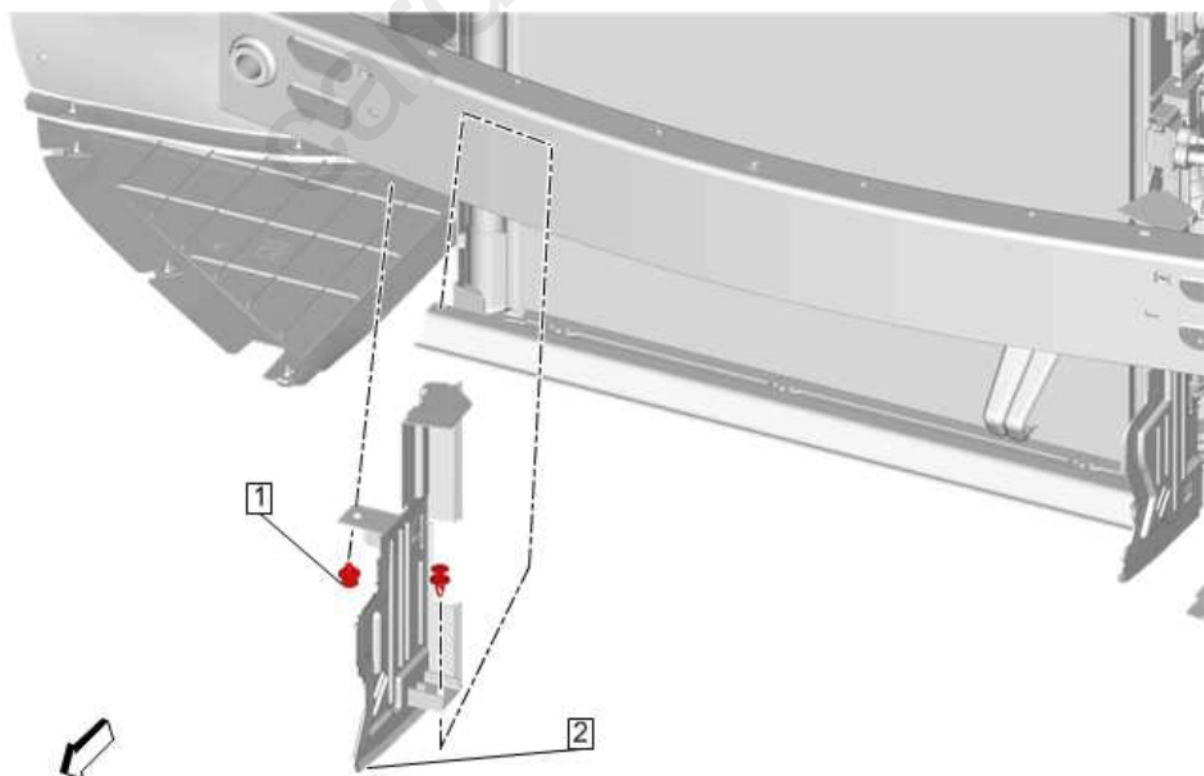


Fig. 384: Radiator Air Side Lower Baffle (LGW LGX LTG - Right Side)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement (Without UV3) Front Bumper Fascia Replacement (With UV3)	
1	Radiator Air Side Baffle Retainer [2x]
2	Radiator Air Side Lower Baffle - Right Side

RADIATOR AIR SIDE BAFFLE BRACKET REPLACEMENT (LGW LGX LTG)

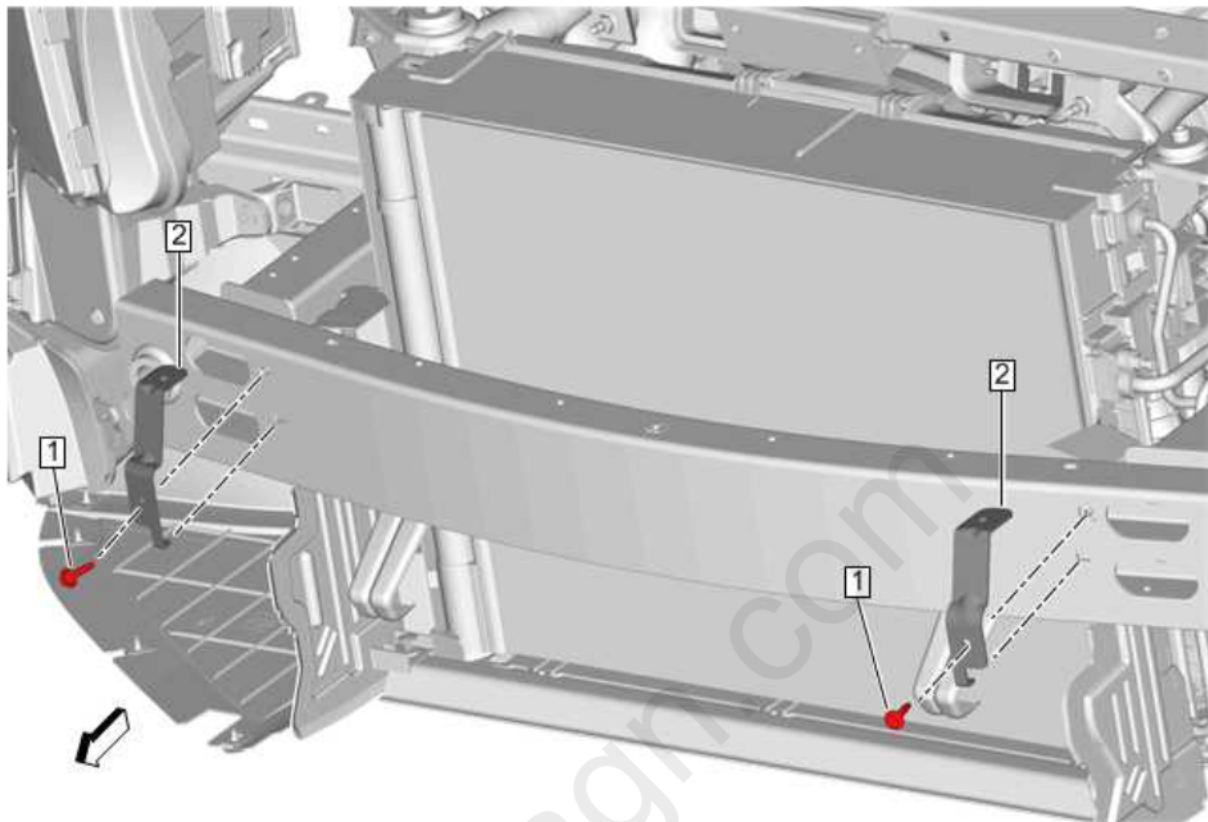


Fig. 385: Radiator Air Side Baffle Bracket (LGW LGX LTG)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Radiator Air Side Upper Baffle Replacement (LGW LGX LTG - Left Side) Radiator Air Side Upper Baffle Replacement (LGW LTG - Right Side) Radiator Air Side Upper Baffle Replacement (LGX - Right Side)	
1	Radiator Air Side Baffle Bracket Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Radiator Air Side Baffle Bracket [2x]

RADIATOR AIR UPPER BAFFLE AND DEFLECTOR REPLACEMENT (LGW LTG)

Removal Procedure

1. Front Bumper Fascia, & » Remove - **Front Bumper Fascia Replacement (Without UV3) Front Bumper Fascia Replacement (With UV3)**
2. Front Bumper Fascia Support Brace, & » Remove - **Front Bumper Fascia Support Replacement**
3. Intake Air Duct (2), & » Remove [2x] - **Intake Air Duct Replacement**

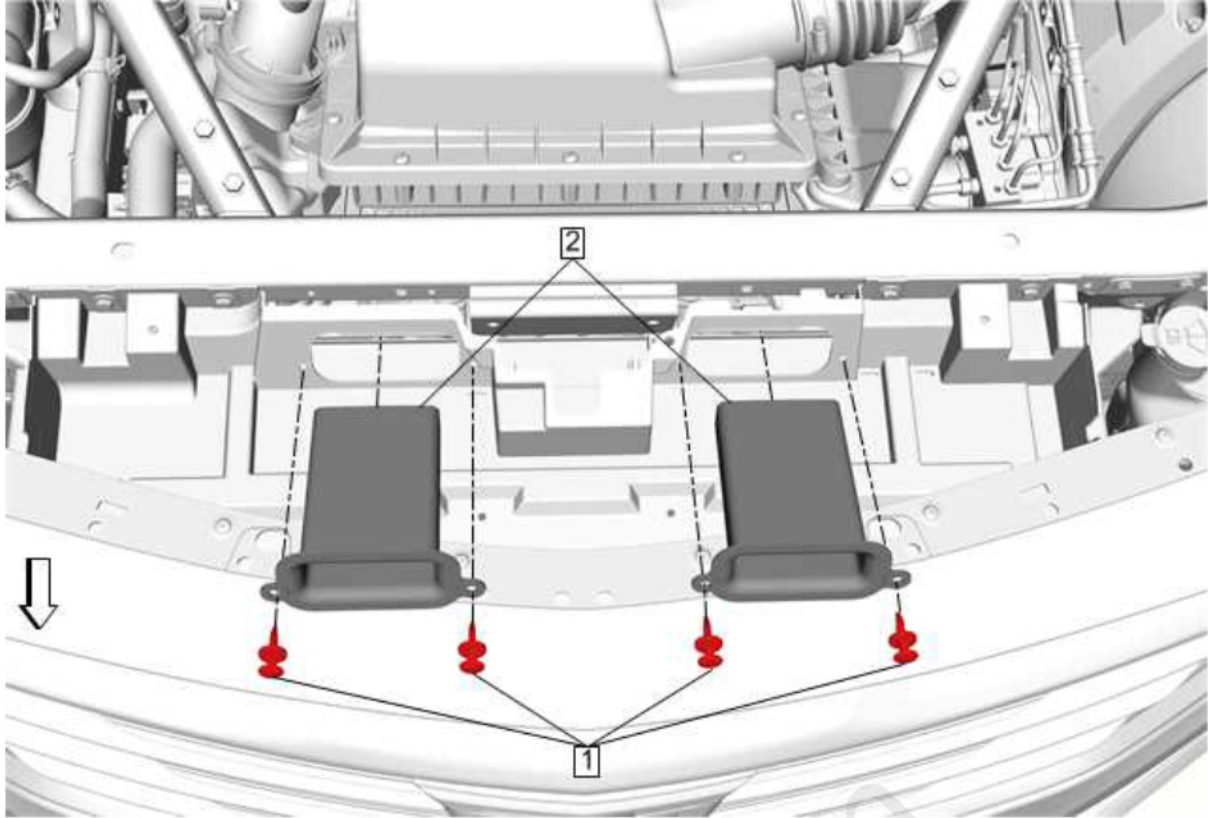


Fig. 386: Air Duct

Courtesy of GENERAL MOTORS COMPANY

4. Radiator Air Upper Baffle Bolt (1) @ Radiator Air Side Upper Baffle - Right Side» Remove

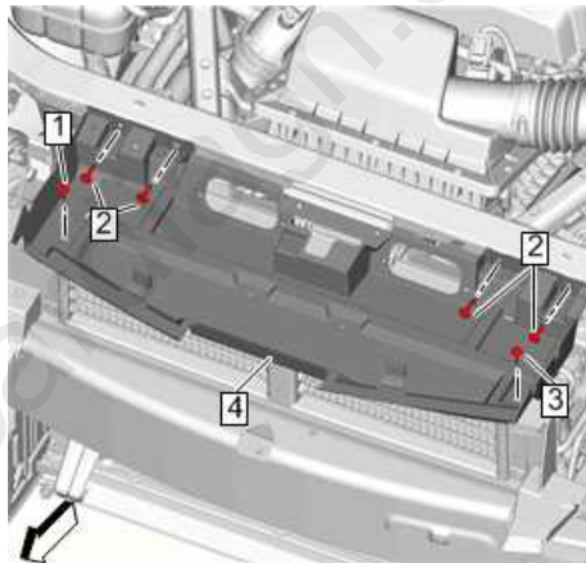


Fig. 387: Radiator Air Upper Baffle and Deflector

Courtesy of GENERAL MOTORS COMPANY

5. Radiator Air Upper Baffle Bolt (3) @ Radiator Air Side Upper Baffle - Left Side» Remove
6. Radiator Air Upper Baffle Bolt (2) @ Front End Upper Tie Bar» Remove [4x]
7. Radiator Air Upper Baffle and Deflector (4)» Remove

Installation Procedure

1. Radiator Air Upper Baffle and Deflector (4)» Install

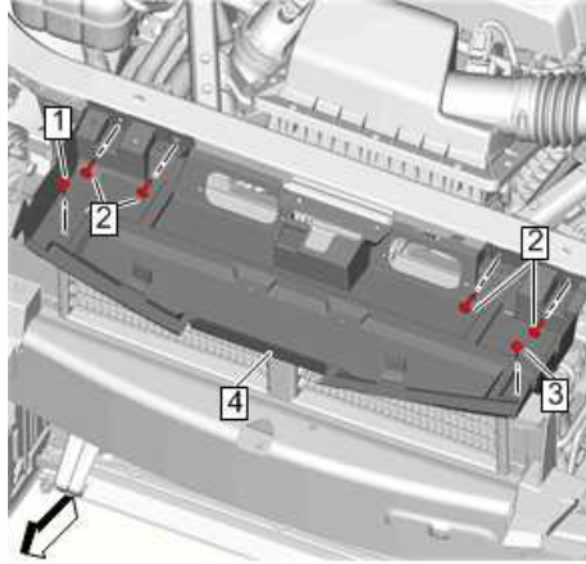


Fig. 388: Radiator Air Upper Baffle and Deflector
 Courtesy of GENERAL MOTORS COMPANY

2. Radiator Air Upper Baffle Bolt (2) @ Front End Upper Tie Bar» Install and tighten [4x] 4 N.m (35 lb in)

CAUTION: Refer to [Fastener Caution](#) .

3. Radiator Air Upper Baffle Bolt (3) @ Radiator Air Side Upper Baffle - Left Side» Install and tighten 2.5 N.m (22 lb in)
4. Radiator Air Upper Baffle Bolt (1) @ Radiator Air Side Upper Baffle - Right Side» Install and tighten 2.5 N.m (22 lb in)
5. Intake Air Duct (2)» Install [2x] - [Intake Air Duct Replacement](#)

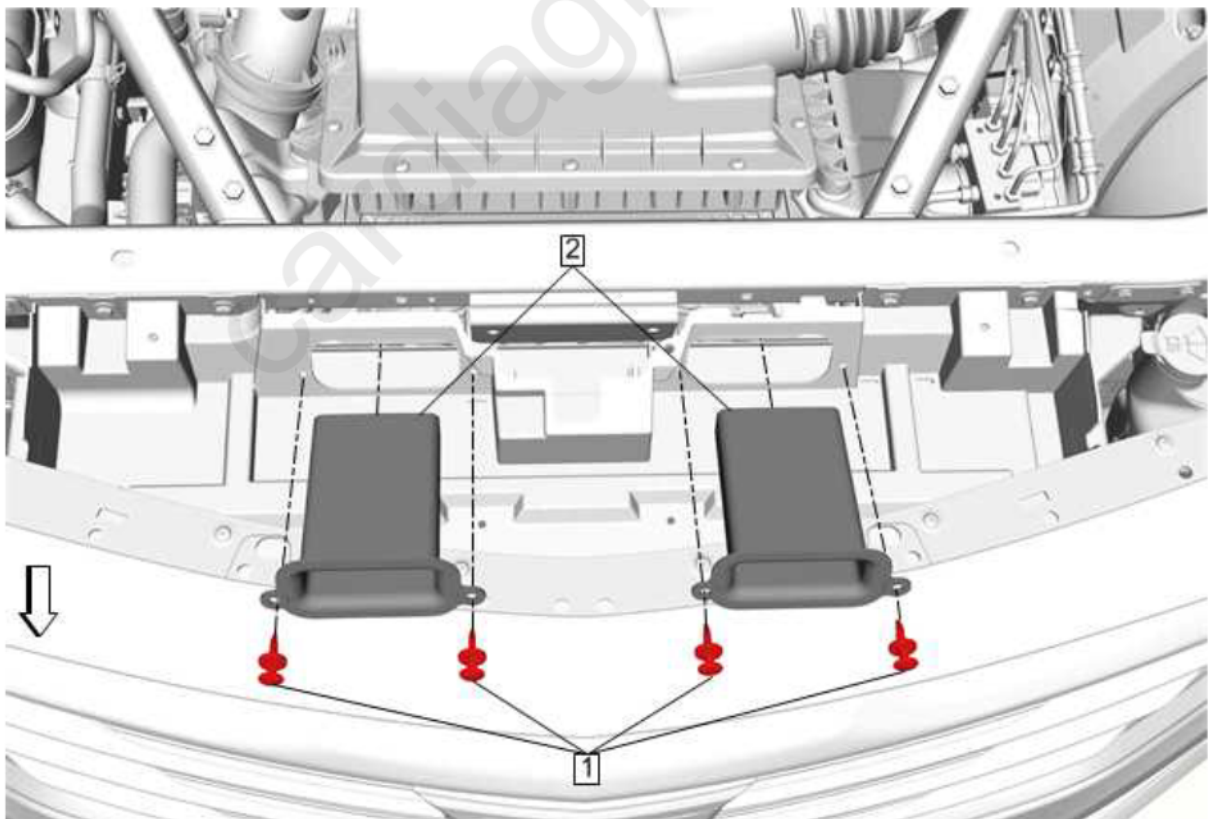
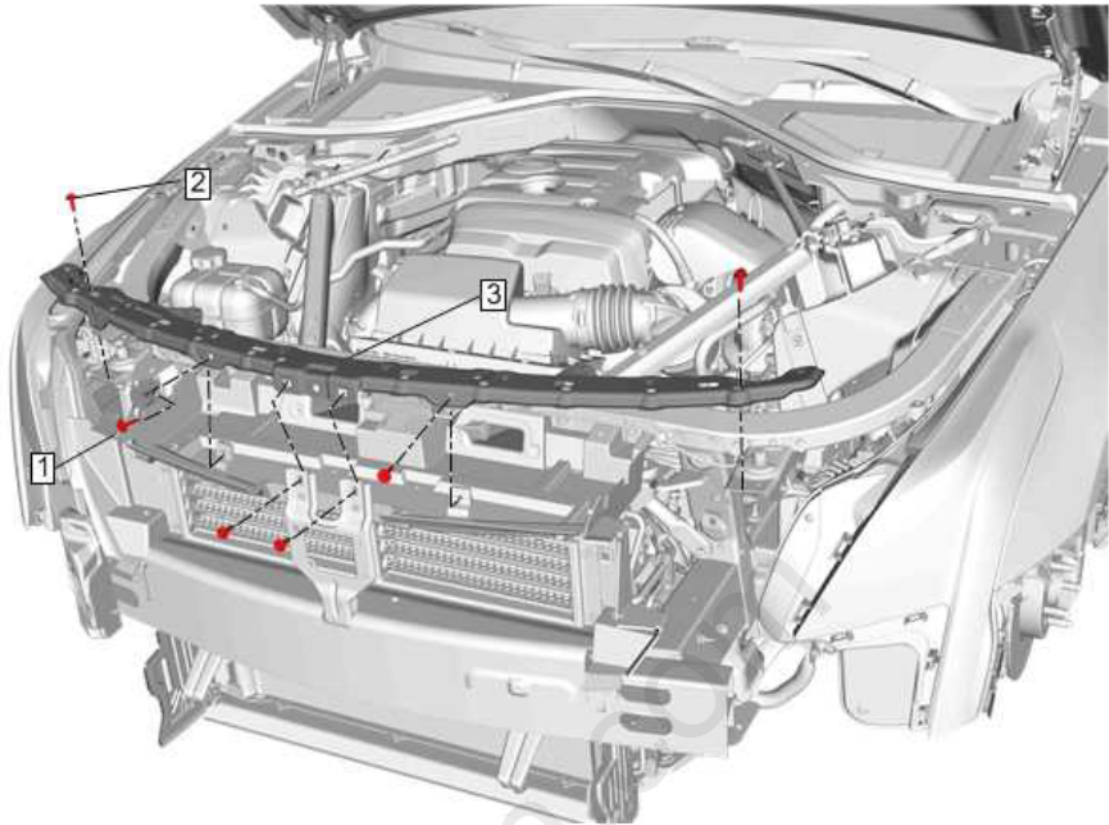


Fig. 389: Air Duct
 Courtesy of GENERAL MOTORS COMPANY

6. Front Bumper Fascia Support Brace» Install - [Front Bumper Fascia Support Replacement](#)
7. Front Bumper Fascia» Install - [Front Bumper Fascia Replacement \(Without UV3\)](#) [Front Bumper Fascia Replacement \(With UV3\)](#)

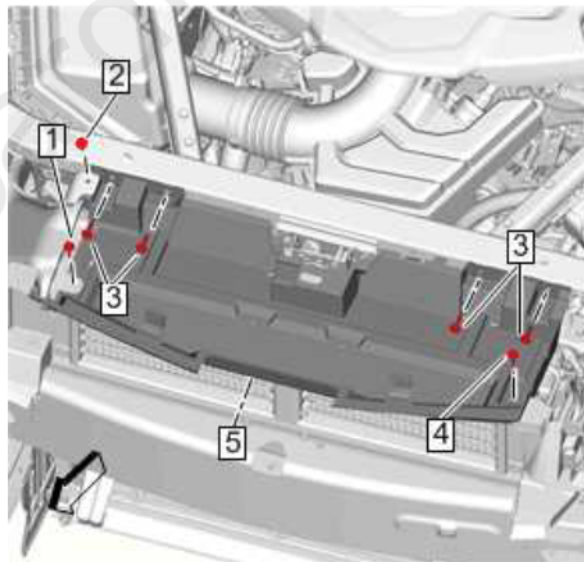
Removal Procedure

1. Front Bumper Fascia Support Brace (3) » Remove - [Front Bumper Fascia Support Replacement](#)



[Fig. 390: Front Bumper Fascia Support](#)
Courtesy of GENERAL MOTORS COMPANY

2. Air Inlet Grille Panel Retainer (2) » Remove



[Fig. 391: Air Inlet Grille Panel Retainer](#)
Courtesy of GENERAL MOTORS COMPANY

3. Radiator Air Upper Baffle Bolt (1) @ Radiator Air Side Upper Baffle - Right Side » Remove
4. Radiator Air Upper Baffle Bolt (4) @ Radiator Air Side Upper Baffle - Left Side » Remove
5. Radiator Air Upper Baffle Bolt (5) @ Front End Upper Tie Bar » Remove [4x]
6. Radiator Air Upper Baffle and Deflector (5) » Remove

Installation Procedure

1. Radiator Air Upper Baffle and Deflector (5)» Install

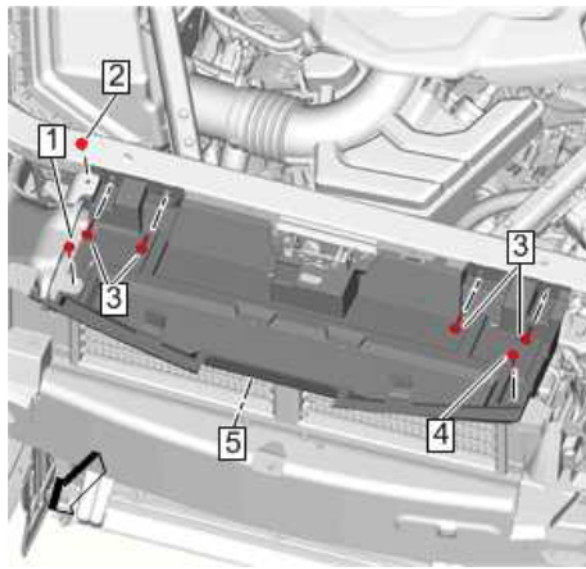


Fig. 392: Air Inlet Grille Panel Retainer

Courtesy of GENERAL MOTORS COMPANY

2. Radiator Air Upper Baffle Bolt (3) @ Front End Upper Tie Bar» Install and tighten [4x] 4.0 N.m (35 lb in)

CAUTION: Refer to **Fastener Caution** .

3. Radiator Air Upper Baffle Bolt (4) @ Radiator Air Side Upper Baffle - Left Side» Install and tighten 2.5 N.m (22 lb in)
4. Radiator Air Upper Baffle Bolt (1) @ Radiator Air Side Upper Baffle - Right Side» Install and tighten 2.5 N.m (22 lb in)
5. Air Inlet Grille Panel Retainer (2)» Install
6. Front Bumper Fascia Support Brace (3)» Install - **Front Bumper Fascia Support Replacement**

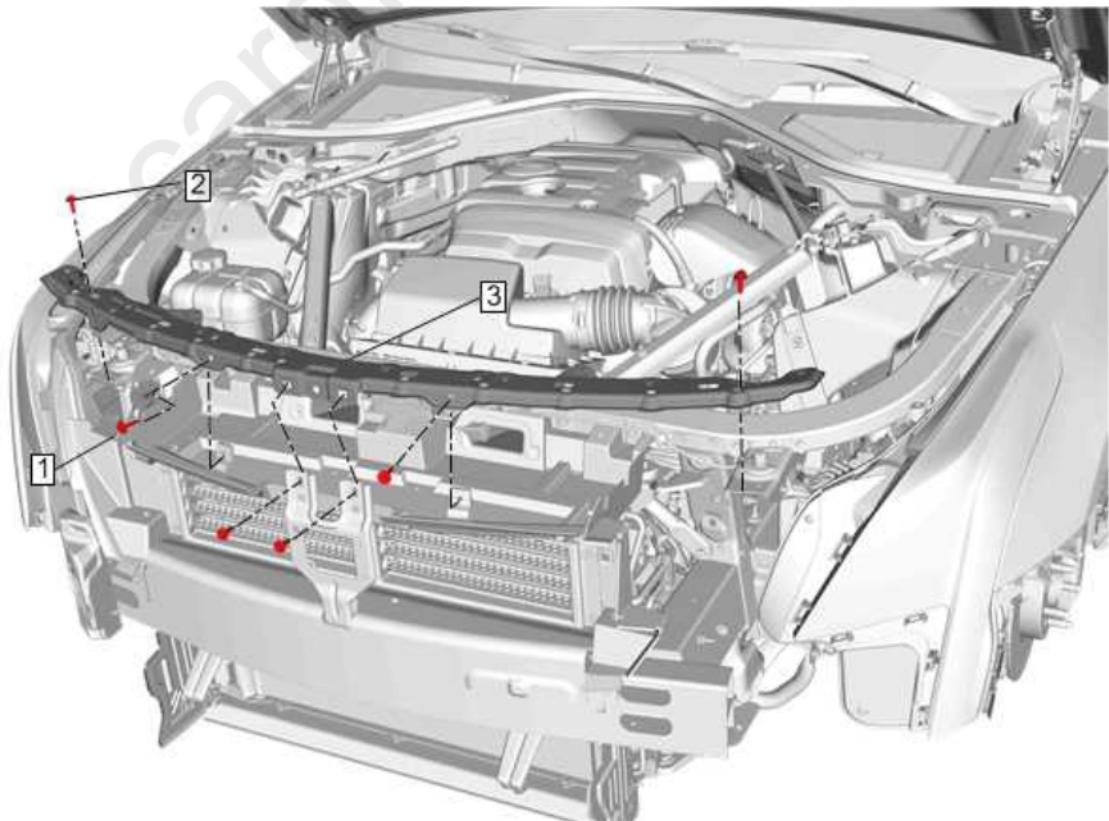


Fig. 393: Front Bumper Fascia Support

Courtesy of GENERAL MOTORS COMPANY

COOLANT HEATER REPLACEMENT (LGW)

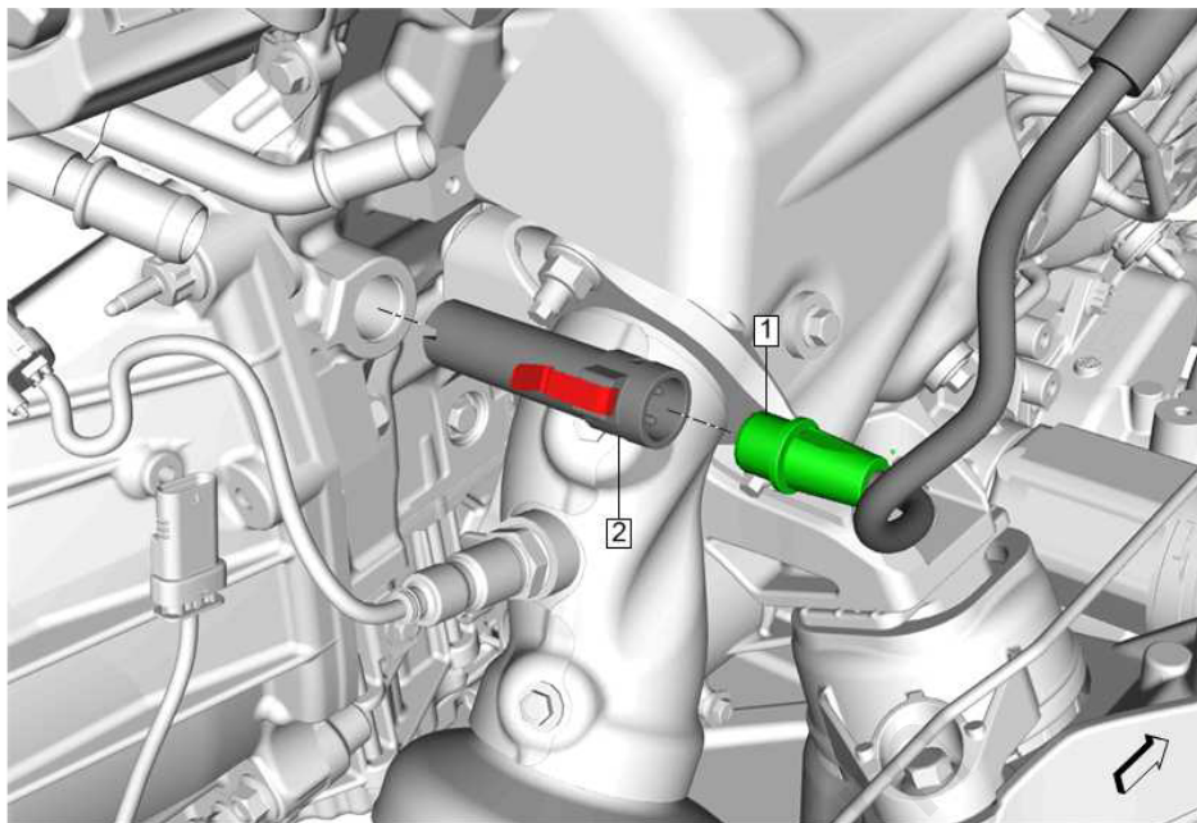


Fig. 394: Coolant Heater (LGW)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. <u>Cooling System Draining and Filling (Static without HP9)</u> <u>Cooling System Draining and Filling (GE 47716 without HP9)</u>	
2. <u>Front Axle Propeller Shaft Replacement (LGX, LGW)</u>	
1	Coolant Heater Cord Procedure Disconnect the electrical connector.
2	Coolant Heater Procedure Release the coolant heater retaining clip.

COOLANT HEATER REPLACEMENT (LTG)

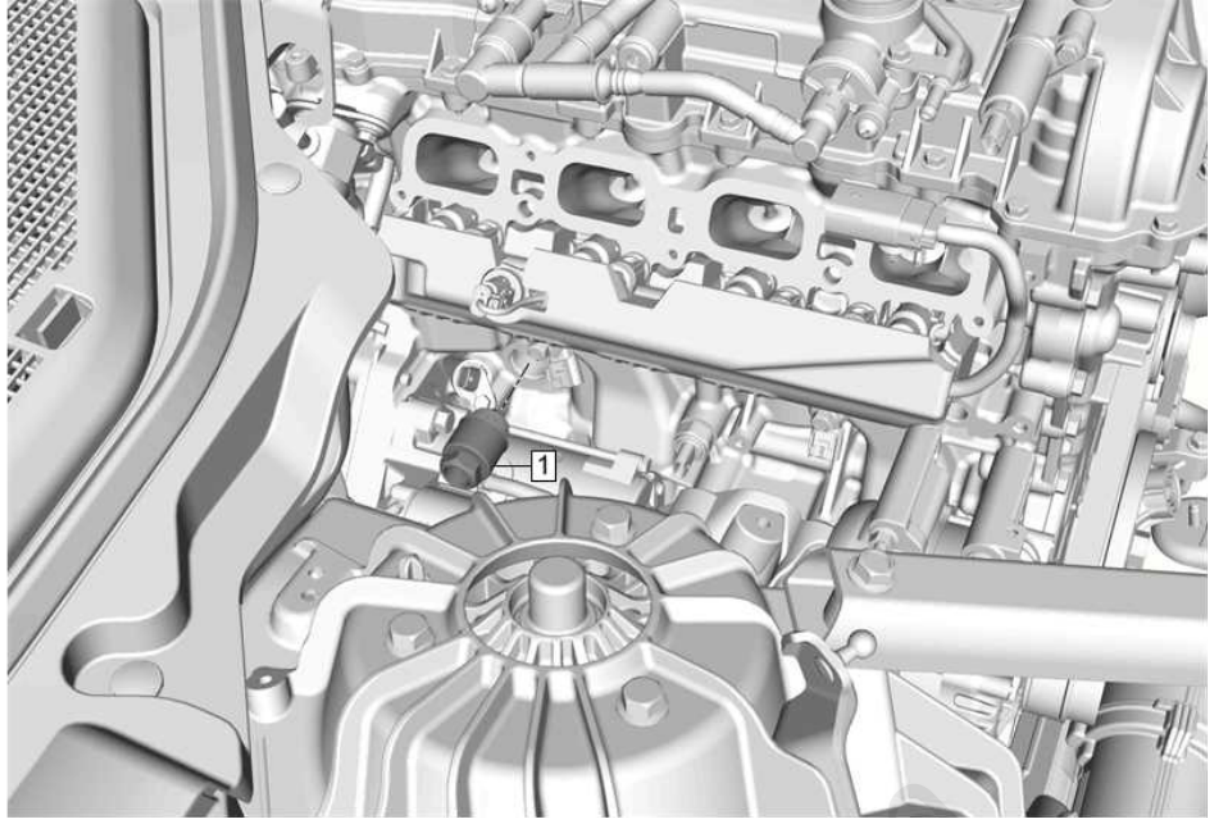


Fig. 395: Coolant Heater (LTG)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Intake Manifold Replacement (Except Hybrid) Intake Manifold Replacement (Hybrid)</u> - Coolant Heater Cord @ Coolant Heater» Disconnect - <u>Coolant Heater Cord Replacement (LTG)</u>	
1	Coolant Heater CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . Tighten 50 N.m (37 lb ft)

COOLANT HEATER CORD REPLACEMENT (LGW)

Removal Procedure

- Front Axle Propeller Shaft Replacement (LGX, LGW)** » Remove
- Coolant Heater Cord Clip (1)» Disengage

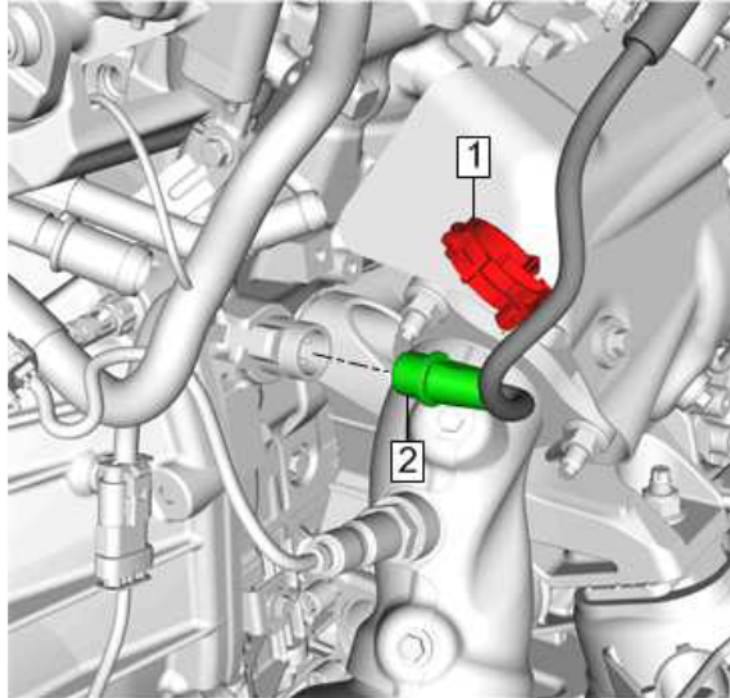


Fig. 396: Coolant Heater Cord Retaining Clip And Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

3. Coolant Heater Cord Electrical Connector (2) » Disconnect
4. Coolant Heater Cord Clip (1) » Disengage [5x]

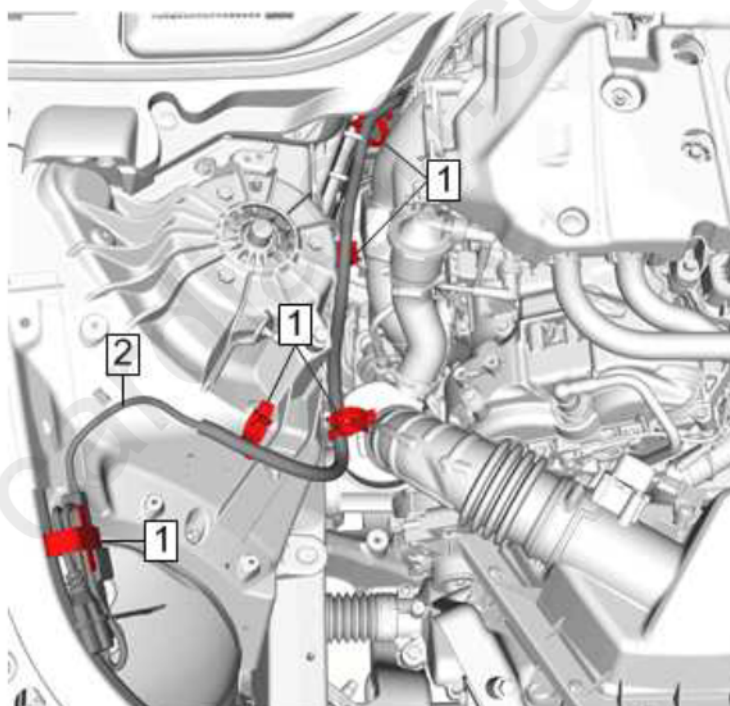


Fig. 397: Coolant Heater Cord And Retaining Clip
 Courtesy of GENERAL MOTORS COMPANY

5. Coolant Heater Cord (2) » Remove

Installation Procedure

1. Coolant Heater Cord (2) » Install

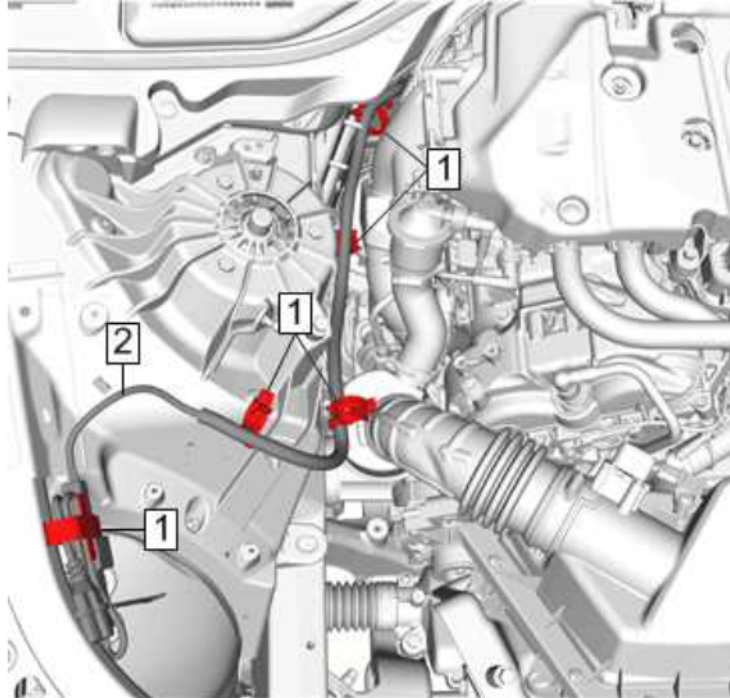


Fig. 398: Coolant Heater Cord And Retaining Clip
 Courtesy of GENERAL MOTORS COMPANY

2. Coolant Heater Cord Clip (1) » Engage [5x]
3. Coolant Heater Cord Electrical Connector (2) » Connect

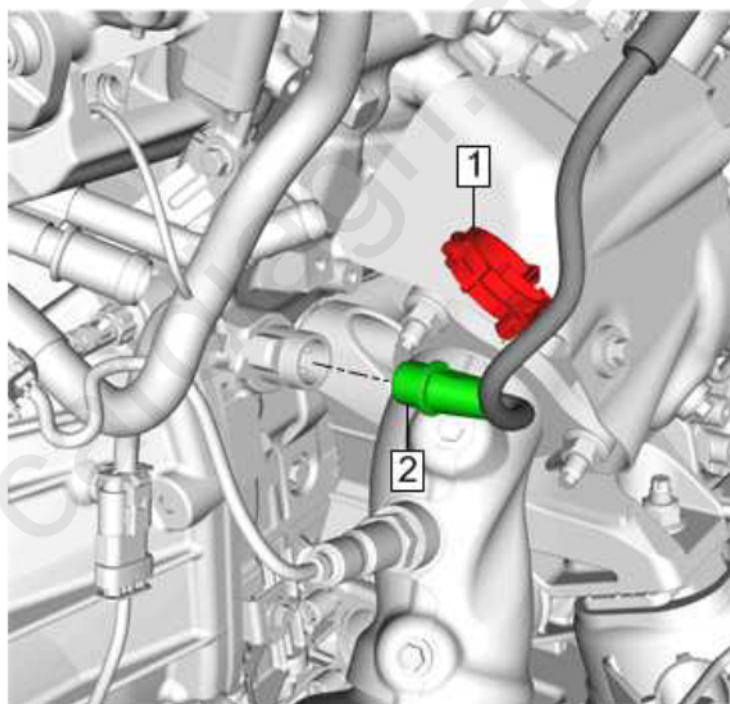


Fig. 399: Coolant Heater Cord Retaining Clip And Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

4. Coolant Heater Cord Clip (1) » Engage
5. **Front Axle Propeller Shaft Replacement (LGX, LGW)** » Install

COOLANT HEATER CORD REPLACEMENT (LTG)

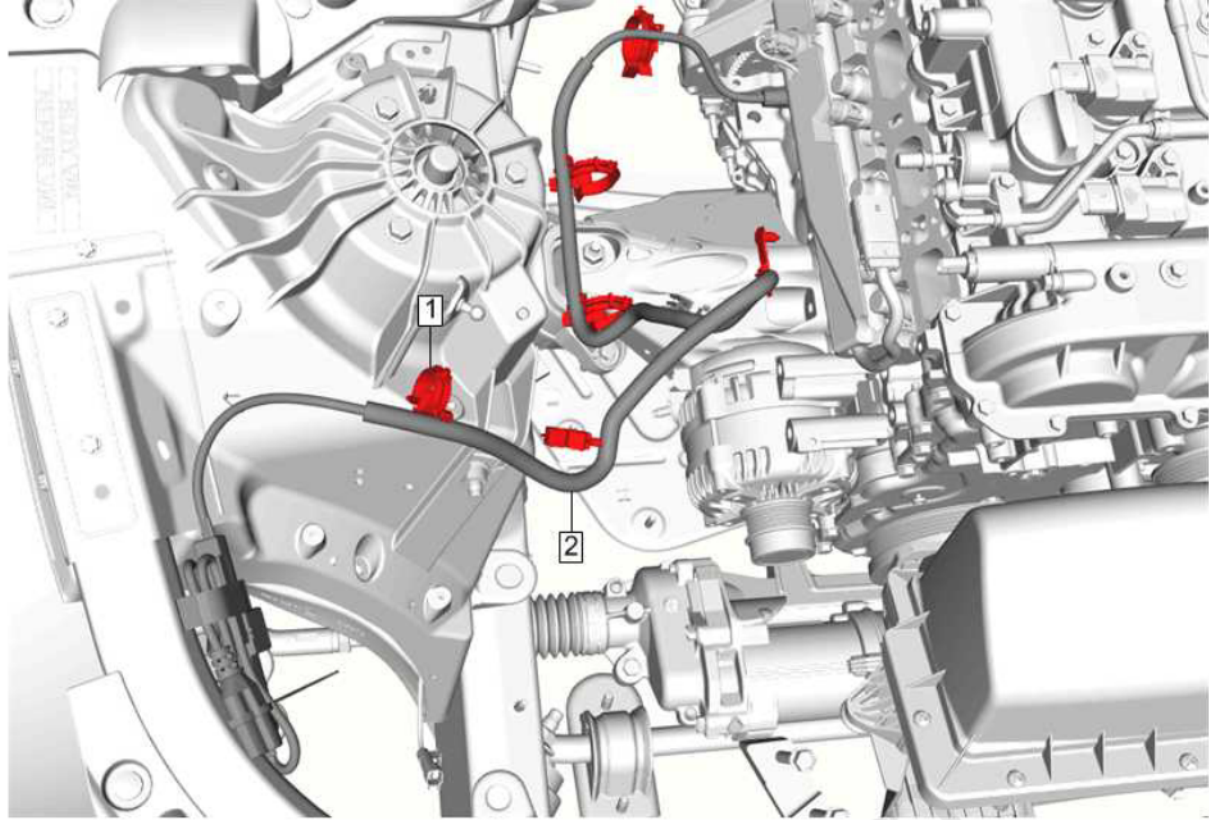


Fig. 400: Coolant Heater Cord (LTG)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Intake Manifold Replacement (Except Hybrid)</u> <u>Intake Manifold Replacement (Hybrid)</u>	
1	Coolant Heater Cord Clip [6x]
2	Coolant Heater Cord

DESCRIPTION AND OPERATION

COOLING FAN DESCRIPTION AND OPERATION

Cooling Fan Control

The engine cooling fan system is composed of one electric cooling fan and a cooling fan 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 motor in relation to the pulse width modulated signal, allowing the cooling fan to operate at variable speeds. The cooling fan speed is effected by many different operating conditions and the ECM will adjust the duty cycle based on cooling system requirements.

This system is unique in that the ECM will not operate the cooling fan at every speed within a 0-90 percent range. The cooling fan calibration is designed to operate the cooling fan at 5 specific percentages in order to avoid the speed regions that create undesirable noise and vibration. During normal operating conditions the ECM may initially activate the cooling fan at 4 or 5% and then increase to the desired percentages to satisfy powertrain cooling requirements. Generally, the ECM will operate the cooling fan at specific percentages but, may scale the percentages either higher or lower in response to generator demand. The percentages at which the cooling fan operates may vary between vehicle lines and engines.

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. The scan tool output control is only capable of operating the cooling fan in the speed percentages allowed by the ECM. When multiple cooling fan speed requests are received, the ECM operates the fan at the highest of the 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

- The instrument panel cluster (IPC) shows the engine temperature on the temperature gauge. The value is sent on the data communication line from engine control module (ECM). When the coolant temperature is more than 132 Å , $\text{Å}^{\circ}\text{C}$ (270 Å , $\text{Å}^{\circ}\text{F}$) IPC receives a discrete input from ECM requesting illumination.
- The IPC performs the display test at the start of each ignition cycle. The IPC illuminates the TEMP indicator.

Coolant Heater

The optional engine coolant heater operates using AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather. 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 flows from the radiator outlet and the auxiliary radiator (located on the right front corner of the vehicle) outlet into the water pump inlet. Some coolant flows from the water pump, to the heater core, then back to the water pump. This provides the passenger compartment with heat and defrost capability as the coolant warms up.

Coolant also flows from the water pump outlet and into the engine block. In the engine block, the coolant circulates through the water jackets surrounding the cylinders where the coolant absorbs heat.

The coolant then flows 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 the coolant absorbs additional heat.

Coolant is also directed to the throttle body. There the coolant circulates through passages in the casting. During initial start up, the coolant assists in warming the throttle body.

From the cylinder heads, the coolant flows to the thermostat. The flow of coolant will either be stopped at the thermostat until the engine reaches normal operating temperature or the coolant will flow through the thermostat and into the radiator where the coolant is cooled. At this point, the coolant flow cycle is completed.

Efficient operation of the cooling system requires proper functioning of all cooling system components. The cooling system consists of the following components.

Coolant

The engine coolant is a solution made up of a 50-50 mixture of DEX-COOL and clean drinkable water. The coolant solution carries excess heat away from the engine to the radiator, where the heat is dissipated to the atmosphere.

Charge Air Cooling System - LTG

The charge air cooling system's function is to reduce the temperature of the air charge that is heated during the turbocharging process, which improves the efficiency and performance of the Powertrain. The charge air cooling system is an air-to-air system that uses a separate charge air cooling radiator located between the condenser and the radiator to cool the air charge. Filtered air from the air induction system is compressed in the turbocharger, by an exhaust air driven turbine in the turbocharger. That compressed filtered air is then forced down the charge air cooler duct, through the charge air cooler radiator where it is cooled and then proceeds up to the engine intake manifold, for use by the engine.

Charge Air Cooling System - LGW

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

Radiator

The radiator is a heat exchanger consisting of a core and 2 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 located in the bottom of the right hand tank. The drain cock unit includes the drain cock and drain cock seal.

Heat is removed from the coolant as the coolant passes through the radiator. The fins on the core transfer heat from the coolant passing through the tubes. Air passing between the fins absorbs the heat and cools the coolant.

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 and releasing coolant to the overflow portion of the surge tank, which is at atmospheric 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 coolant from the overflow bottle to draw back into the upper surge tank. This equalizes the pressure in the cooling system with atmospheric pressure, preventing the radiator and coolant hoses from collapsing.

Surge Tank

This surge tank is actually two chambers connected together, a surge tank and an overflow bottle. The top chamber is the surge tank and is the highest point of the coolant system. It uses a threaded pressure cap, similar to the one used on a radiator or engine fill system. The bottom chamber is the overflow bottle. This is the air space in the cooling system where the coolant can expand into and contract from.

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. Under normal operating conditions, no coolant is lost. 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.

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 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.

Water Pump

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing with coolant inlet and outlet passages and an impeller. The impeller is a flat plate mounted on the pump shaft with a series of flat or curved blades or vanes. When the impeller rotates, the coolant between the vanes is thrown outward by centrifugal force. The impeller shaft is supported by one or more sealed bearings, which never need to be lubricated. With a sealed bearing, grease cannot leak out and dirt and water cannot get in.

The water pump circulates coolant throughout the cooling system. The pump is driven by the crankshaft from the drive belt.

Thermostat

The thermostat is a coolant flow control component, whose purpose is to regulate the operating temperature of the engine. The thermostat utilizes a temperature sensitive wax-pellet element, which connects to a valve through a piston. Heating is causing the element to expand and exert pressure against a rubber diaphragm. This pressure forces the valve to open. Cooling causes the element to contract. This contraction allows a spring to push the valve closed.

When the coolant temperature is below 91°Ã,°C (195°Ã,°F), the thermostat valve remains closed. This prevents circulation of the coolant to the radiator and allows the engine to warm up quickly. After the coolant temperature reaches 91°Ã,°C (195°Ã,°F), the thermostat valve will open. The switch point will differ a little depending on engine. The coolant is then allowed to circulate through the thermostat to the radiator where the engine heat is dissipated to the atmosphere. The thermostat also provides a restriction in the cooling system, even after opening. This restriction creates a pressure difference which prevents cavitation at the water pump and forces coolant to circulate through the engine block.

For some engines a solenoid thermostat controlled by the ECM will open and close the circulation.

Transmission Oil Cooler

The transmission uses an auxiliary transmission fluid oil cooler. Transmission fluid runs through the cooler where the fins of the cooler help to transfer heat to the atmosphere which aids in cooling the fluid. The transmission oil is then directed out of the external oil cooler and back to the transmission.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description

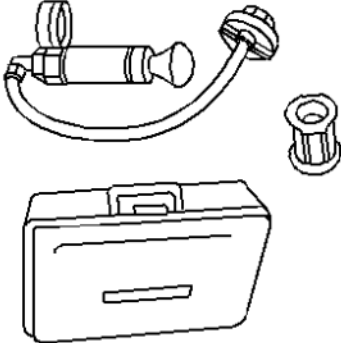
Illustration	Tool Number/ Description
	BO 38185 J 38185 Hose Clamp Pliers
	EL 35616-F J 35616-F Connector Test Adapter Kit
	EN 24460-A J 24460-01 Cooling System Pressure Tester
	EN 46104 J 46104 Water Pump Pulley Holding Tool
	GE 24731 J 24731 Tempilstick

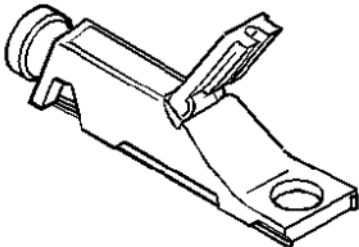
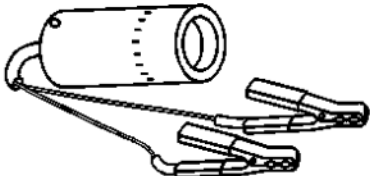
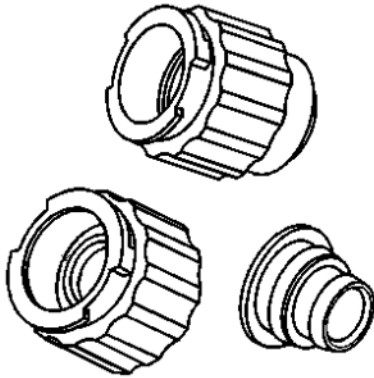
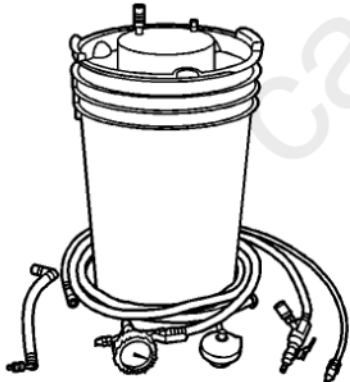
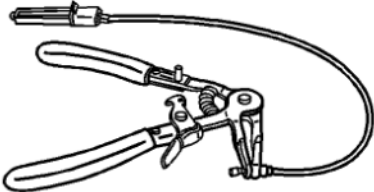
Illustration	Tool Number/ Description
	GE 26568 J 26568 Coolant and Battery Fluid Tester
	GE 42220 J 42220 Universal 12V Leak Detection Lamp
	GE 42401-A J 42401 Radiator Cap and Surge Tank Test Adapter
	GE 47716 Vac N Fill Coolant Refill Tool
	GE 47716-30-A Vac N Fill Coolant Adapter

Illustration	Tool Number/ Description
	GE 47622 Hose Clamp Pliers
	GE 50389 Coolant Pressure Test Quick Connector